



VLRAG Update
1 in 10 and 1 in 20 Loads
Battery Placement

July 23, 2021

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1 in 10 and 1 in 20 Load Build Methodology

- Used the 2030 CEC forecast which includes 1in2, 1in5, 1in10, and 1in20 peak values for the year
- For each California area, calculated percentage to increase load for each area between 1in2 and 1in10, 1in2 and 1in20
- For the rest of the interconnection, used the overall California weighted average
- Used the multiplier for two weeks around the system peak of August 29, 2030; August 22 to September 5

Load Multipliers

Area	2030 CEC Peak			2030 Multiplier	
	1 in 2	1 in 10	1 in 20	1 in 10	1 in 20
CIPB	9,698	10,322	10,487	6.44%	8.13%
CIPV	14,120	15,014	15,249	6.33%	7.99%
CISC	26,676	28,369	28,839	6.35%	8.11%
CISD	4,871	5,310	5,358	9.00%	10.00%
LDWP	7,045	7,731	7,909	9.74%	12.26%
IID	1,202	1,258	1,264	4.63%	5.09%
TIDC	708	772	800	8.97%	12.92%
BANC	4,936	5,379	5,574	8.97%	12.92%
VEA	176	192	194	9.00%	10.00%
CA Avg. Other Areas:				7.08%	8.99%

Peak Load by Area (MW)

Area	2030 ADS	1in10	1in20	Area	2030 ADS	1in10	1in20
AESO	12,289	13,159	13,393	NEVP	6,392	6,844	6,966
AVA	2,141	2,293	2,333	NWMT	1,934	2,071	2,108
AZPS	8,439	9,036	9,197	PACW	3,592	3,846	3,915
BANC	4,684	5,104	5,289	PAID	1,143	1,224	1,246
BCHA	9,048	9,688	9,861	PAUT	7,863	8,419	8,570
BPAT	9,607	10,287	10,470	PAWY	1,336	1,431	1,456
CFE	4,232	4,531	4,612	PGE	3,529	3,779	3,846
CHPD	266	285	290	PNM	2,740	2,934	2,986
CIPB	8,390	8,930	9,073	PSCO	9,322	9,982	10,160
CIPV	13,284	14,125	14,346	PSEI	3,747	4,012	4,084
CISC	25,868	27,509	27,964	SCL	1,187	1,271	1,294
CISD	5,021	5,473	5,523	SPPC	2,097	2,245	2,285
DOPD	312	334	340	SRP	8,870	9,498	9,667
EPE	2,233	2,391	2,434	TEPC	3,384	3,623	3,688
GCPD	1,481	1,586	1,614	TIDC	636	693	718
IID	1,248	1,306	1,312	TPWR	583	624	635
IPFE	601	644	655	VEA	170	185	187
IPMV	1,154	1,236	1,258	WACM	4,117	4,408	4,487
IPTV	2,425	2,597	2,643	WALC	1,791	1,918	1,952
LDWP	7,801	8,560	8,758	WAUW	152	163	166

Unserved Load (MWh)

Area	Hours		Unserved Load		Area	Hours		Unserved Load	
	1in10	1in20	1in10	1in20		1in10	1in20	1in10	1in20
AVA	6	9	87	119	NWMT	4	6	168	338
AZPS	6	13	433	917	PAUT	1	4	193	705
BANC	6	8	1,105	1,772	PAWY	2	5	8	28
BPAT	6	8	2,130	5,850	PGE	6	8	2,539	4,902
CFE	14	14	6,644	7,770	PNM	5	7	921	1,953
CIPB	6	10	5,229	7,682	PSCO	5	8	119	755
CIPV	6	12	5,179	7,866	PSEI	4	7	14	537
CISC	6	9	2,050	3,072	SCL	0	4	0	276
CISD	6	10	1,563	2,215	SPPC	5	7	672	1,333
EPE	0	1	0	55	SRP	2	5	572	2,663
GCPD	6	7	293	1,485	TEPC	6	15	2,072	4,522
IID	6	9	485	668	TIDC	6	8	678	839
IPFE	2	3	91	146	TPWR	0	3	0	257
IPMV	3	5	27	48	WACM	4	9	69	1,039
IPTV	3	5	298	466	WALC	0	1	0	22
NEVP	4	6	96	267					

Battery Sizing

- All Batteries have 4-hour storage except CFE, 6-hour for 1in10 and 8-hour for 1in20.
- Path 45 SDG&E to CFE rating was increased from 408 MW to 600 MW.

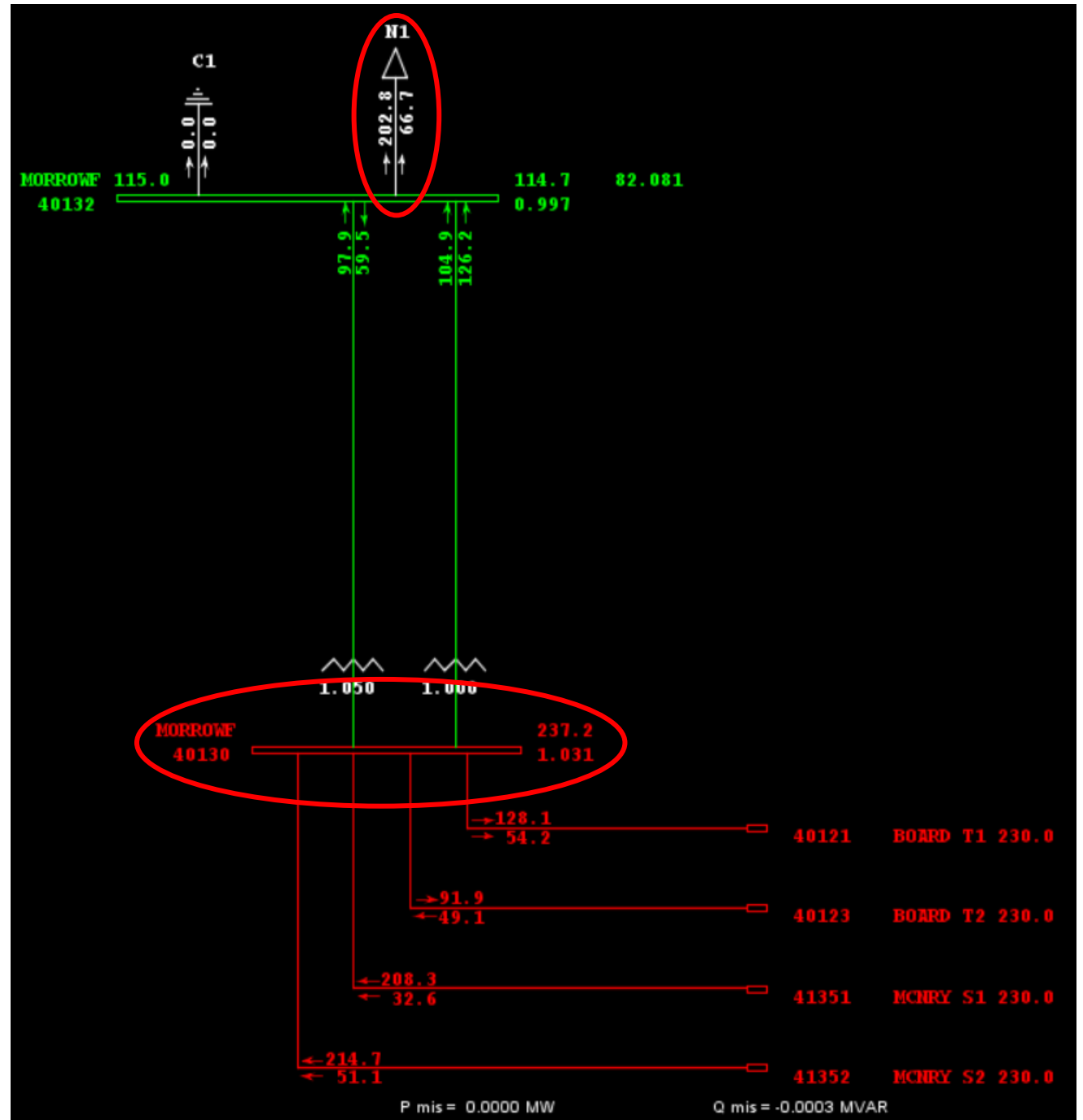
Area	1 in 10 Peak Unserved Load	1 in 20 Peak Unserved Load	BESS Pmax	# of Buses	Area	1 in 10 Peak Unserved Load	1 in 20 Peak Unserved Load	BESS Pmax	# of Buses
AVA	14.5	14.5	15	1	NWMT	63.8	83.2	84	1
AZPS	73.2	88.8	89	1	PAUT	192.8	245.0	245	1
BANC	251.6	261.8	262	1	PAWY	4.0	12.5	13	1
BPAT	668.9	1,348.9	1,349	5	PGE	768.6	769.2	770	3
CFE	1,109.8	1,188.5	1,189	4	PNM	393.8	421.8	422	2
CIPB	982.4	1,215.1	1,216	4	PSCO	46.7	304.8	305	2
CIPV	1,147.6	1,263.2	1,264	5	PSEI	3.5	172.2	173	3
CISC	343.6	343.6	344	2	SCL	0.0	69.1	70	1
CISD	305.5	305.5	306	2	SPPC	302.2	385.5	386	3
EPE	0.0	55.3	56	1	SRP	486.4	563.6	564	3
GCPD	198.4	384.8	385	2	TEPC	366.7	730.7	731	4
IID	89.0	91.5	92	2	TIDC	125.9	125.9	126	3
IPFE	50.5	52.4	53	1	TPWR	0.0	130.4	131	3
IPMV	9.5	9.5	10	1	WACM	25.3	307.5	308	2
IPTV	99.4	99.4	100	1	WALC	0.0	22.0	22	1
NEVP	46.0	54.6	55	1					

Battery Placement Methodology

- Limit size to 300 MW or less for each bus
- Determine number of buses
- Go to highest load buses for each area (load centers)
- Place battery on nearby well-connected high voltage bus

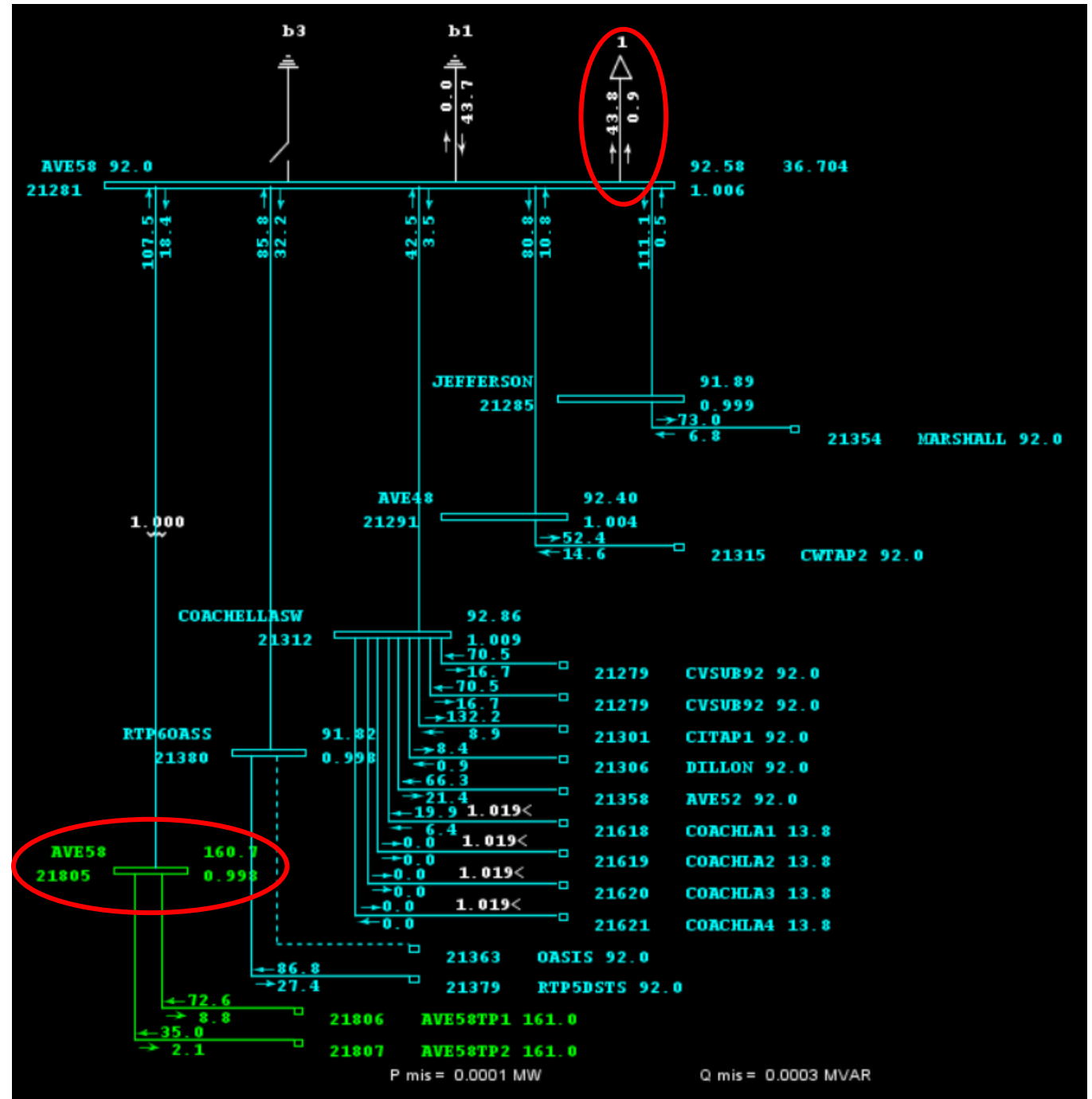
BPAT Battery: 1,349 MW

BPAT Bus ID	Load (MW)	BESS Bus	BESS size (20%) (MW)
40132	202.8	40130	269.8
40127	174.1	41141	269.8
40717	161.9	40422	269.8
41047	158.7	41353	269.8
402170	128.2	42100	269.8



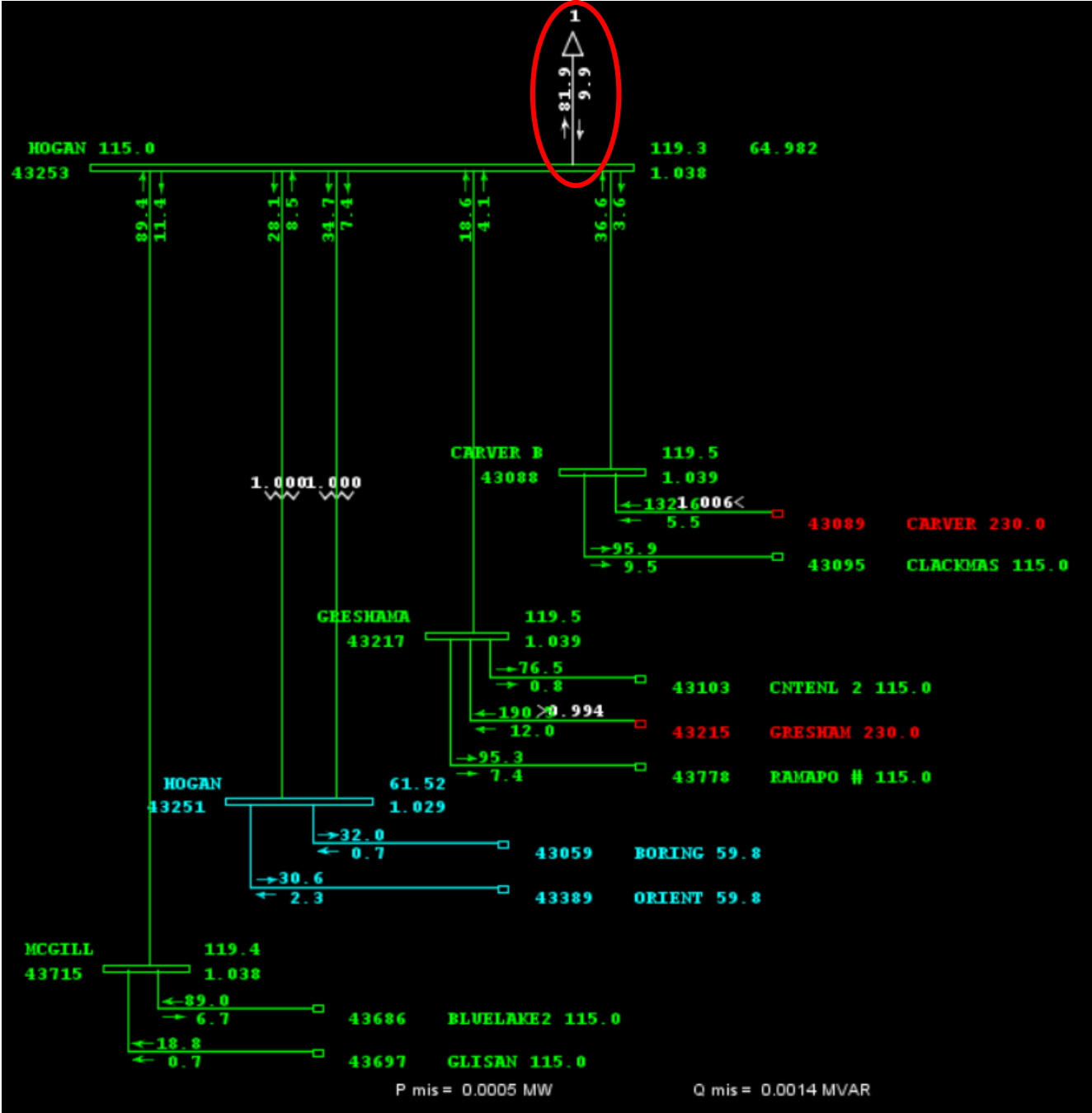
IID Battery: 92 MW

IID Bus ID	Load (MW)	BESS Bus	BESS Dist (50%) (MW)
21354	48.55	21309	46
21281	43.80	21805	46



PGE Battery: 770 MW

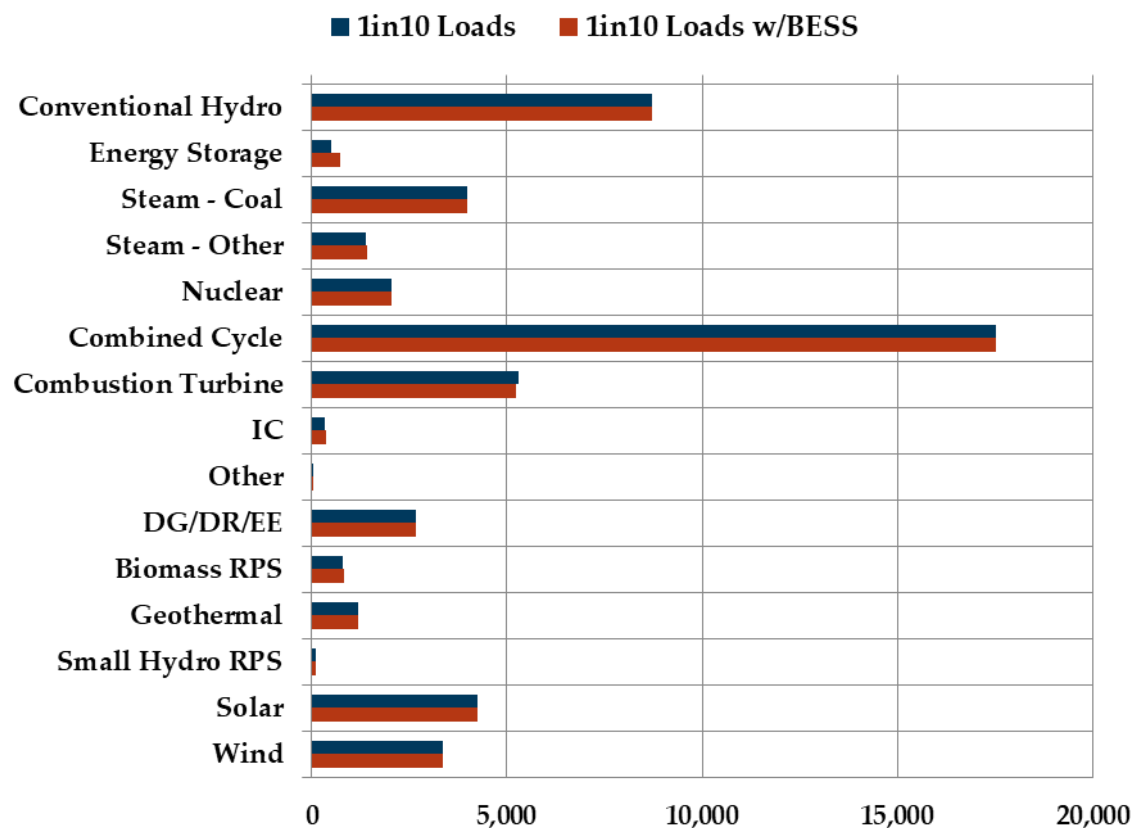
PSE Bus ID	Load (MW)	BESS Bus	BESS Dist (33.33%) (MW)
43157	87.52	43157	256.67
43253	81.89	43253	256.67
43739	77.84	43739	256.67



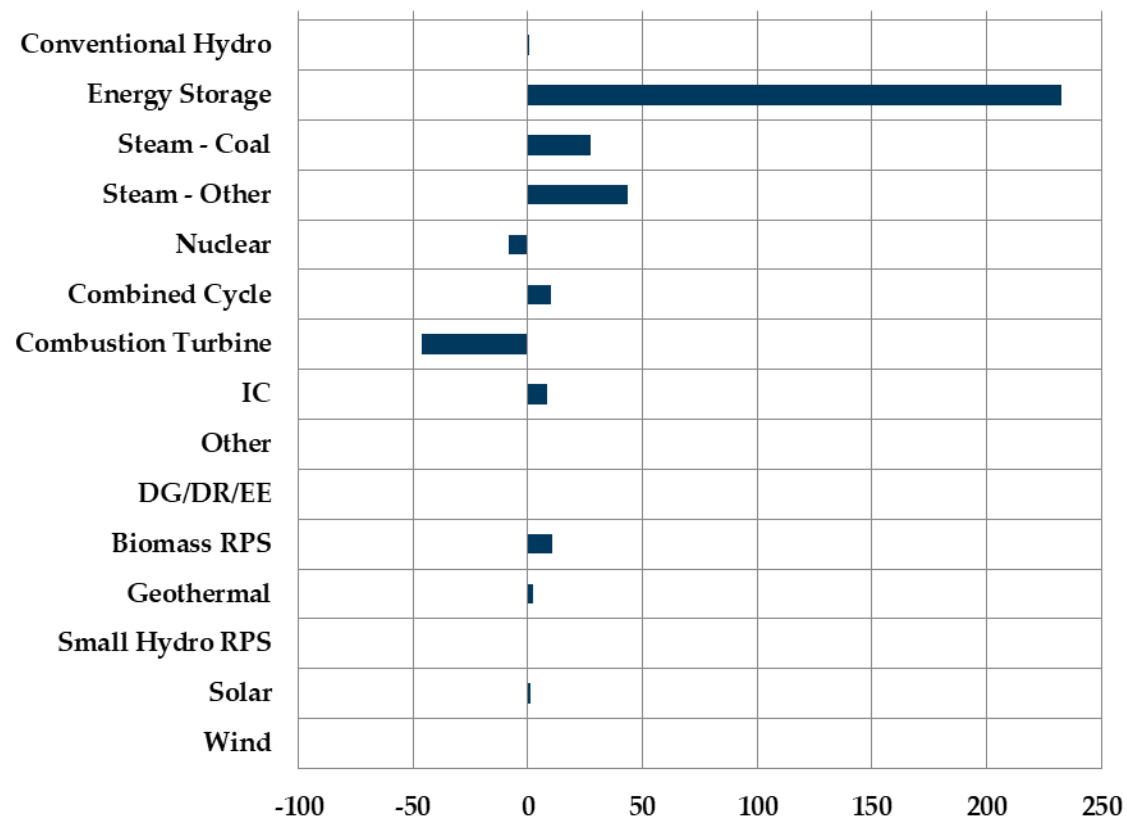
Results 1 in 10 Loads

Generation Dispatch

Annual Generation by Category (GWh)



Annual Energy Difference (GWh): 1in10 Loads vs 1in10 Loads w/BESS



Transmission Congestion

BranchName	Branch	From Area	To Area	1in10 Loads			1in10 Loads w/BESS		
				U75	U90	U99	U75	U90	U99
SHERIDAN_YELLOWTLP_1	66335_66750_1	PAWY	PAWY	3%	0%	0%	46%	29%	16%
J.HINDS_MIRAGE_1	25406_24806_1	CISC	CISC	58%	22%	0%	54%	24%	0%
OTAYMESA_TJI-230_1	22609_20149_1	CISD	CFE	37%	18%	0%	44%	23%	0%
MARKETPL_ADELANTO_1	26044_26003_1	LDWP	LDWP	38%	22%	0%	43%	21%	0%
MCCULLGH_VICTORVL_1	26048_26105_1	LDWP	LDWP	38%	21%	0%	43%	20%	0%
MCCULLGH_VICTORVL_2	26048_26105_2	LDWP	LDWP	38%	21%	0%	42%	20%	0%
SUNDANC4_1045L TAP_45	54135_57783_45	AESO	AESO	40%	20%	17%	37%	18%	14%
NINEMILE_WALLULA_1	47572_45331_1	PACW	PACW	23%	17%	0%	23%	17%	0%
SILVERGT_BAY BLVD_1	22430_22771_1	CISD	CISD	49%	6%	0%	46%	16%	0%
N.GILA_IMPRLVLY_1	22536_22360_1	CISD	CISD	33%	14%	0%	33%	14%	0%
CROSSOVER_PHSHFT XOVER_PS	630040_630041_PS	WAUW	WAUW	15%	5%	0%	41%	13%	0%
DODGEFLAT_DGEFLT MPT1_1	641120_641121_1	SPPC	SPPC	21%	11%	0%	21%	11%	0%
FISHSPRNG_FSHSP-TER1_1	640916_640917_1	SPPC	SPPC	21%	10%	0%	21%	10%	0%

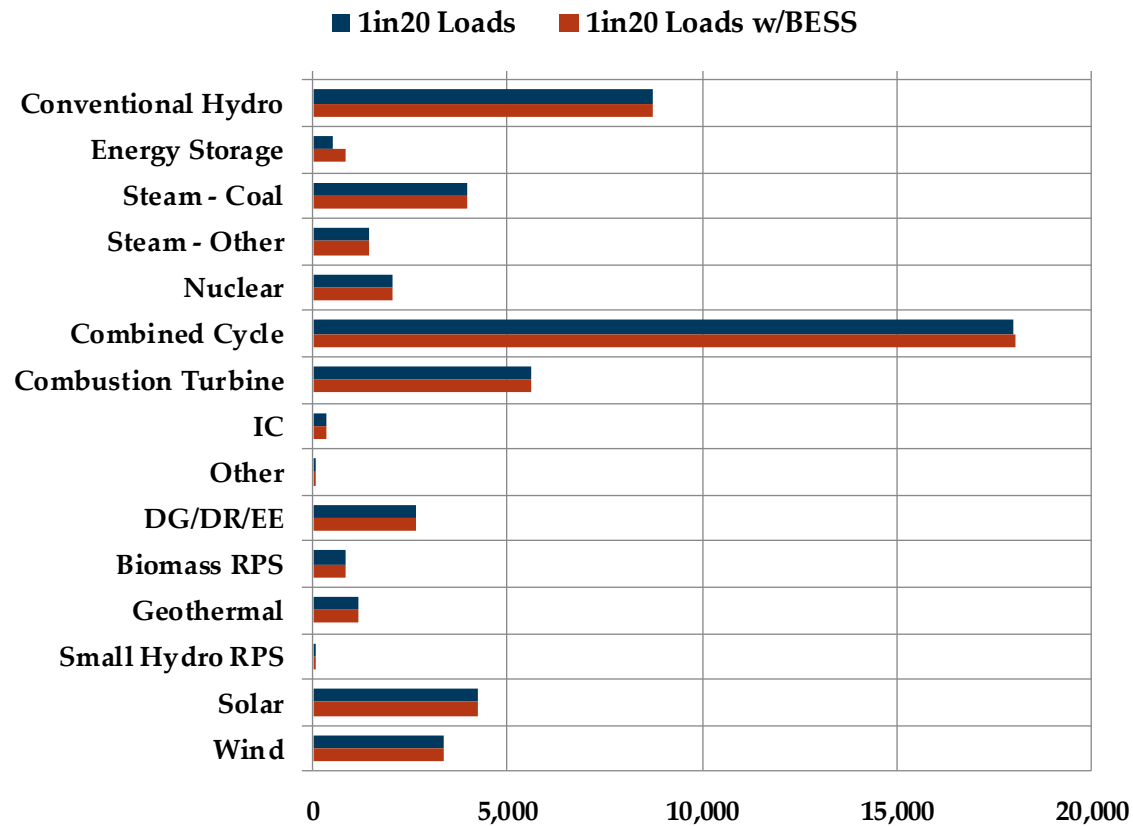
Avg LMP Before and After BESS (\$/MWh)

Area	1in10 Loads	1in10 Loads w/BESS	Area	1in10 Loads	1in10 Loads w/BESS
AESO	49.17	43.44	NEVP	92.92	41.54
AVA	89.26	41.60	NWMT	91.90	44.38
AZPS	90.04	39.87	PACW	93.35	43.14
BANC	125.52	75.33	PAID	93.06	41.82
BCHA	39.95	37.00	PAUT	90.50	40.66
BPAT	92.69	42.74	PAWY	88.38	39.53
CFE	167.48	36.39	PGE	93.83	43.24
CHPD	90.12	41.59	PNM	83.67	33.18
CIPB	121.72	71.55	PSCO	83.60	34.90
CIPV	121.67	71.49	PSEI	91.74	42.25
CISC	124.17	71.88	SCL	92.73	42.75
CISD	121.61	70.51	SPPC	82.82	36.19
DOPD	90.46	41.81	SRP	87.78	37.57
EPE	82.44	33.19	TEPC	91.22	40.31
GCPD	92.95	43.08	TIDC	125.72	76.00
IID	113.87	64.40	TPWR	91.92	42.36
IPFE	93.17	42.18	VEA	109.45	60.21
IPMV	95.12	43.55	WACM	85.52	36.93
IPTV	94.89	43.74	WALC	86.64	37.29
LDWP	124.97	72.04	WAUW	84.28	41.95

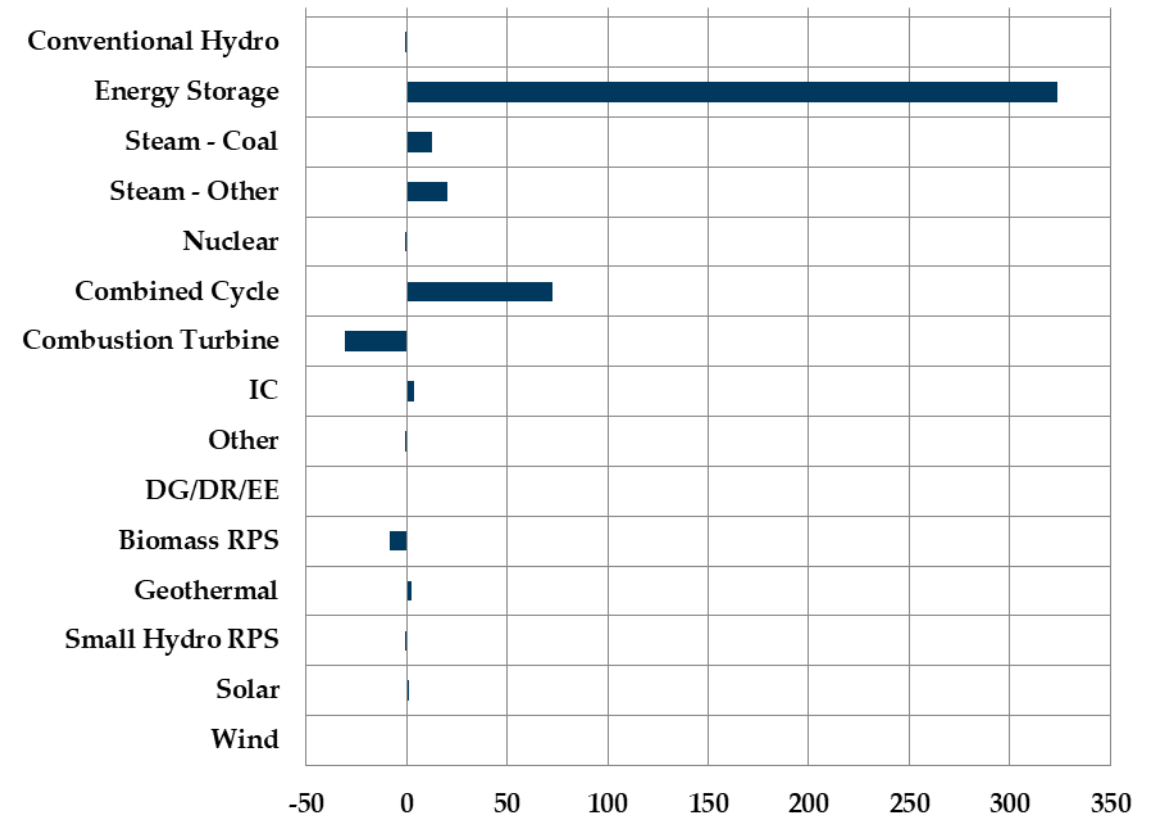
Results 1 in 20 Loads

Generation Dispatch

Annual Generation by Category (GWh)



Annual Energy Difference (GWh): 1in20 Loads vs 1in20 Loads w/BESS



Transmission Congestion

BranchName	Branch	From Area	To Area	1in20 Loads			1in20 Loads w/BESS		
				U75	U90	U99	U75	U90	U99
SHERIDAN_YELLOWTLP_1	66335_66750_1	PAWY	PAWY	5%	1%	0%	46%	28%	18%
J.HINDS_MIRAGE_1	25406_24806_1	CISC	CISC	59%	22%	0%	55%	20%	0%
SUNDANC4_1045L TAP_45	54135_57783_45	AESO	AESO	37%	18%	14%	37%	19%	13%
MARKETPL_ADELANTO_1	26044_26003_1	LDWP	LDWP	40%	21%	0%	37%	18%	0%
MCCULLGH_VICTORVL_1	26048_26105_1	LDWP	LDWP	40%	21%	0%	38%	18%	0%
SILVERGT_BAYBLVD_1	22430_22771_1	CISD	CISD	53%	6%	0%	51%	17%	0%
MCCULLGH_VICTORVL_2	26048_26105_2	LDWP	LDWP	39%	20%	0%	36%	17%	0%
NINEMILE_WALLULA_1	47572_45331_1	PACW	PACW	23%	17%	0%	23%	17%	0%
OTAYMESA_TJI-230_1	22609_20149_1	CISD	CFE	34%	17%	0%	29%	14%	0%
CROSSOVER_PHSFTXOVER_PS	630040_630041_PS	WAUW	WAUW	14%	3%	0%	37%	13%	0%
MEADOWBK_SUNYSLOP_1	14218_14227_1	AZPS	AZPS	36%	11%	0%	47%	12%	0%
DODGEFLAT_DGEFLT MPT1_1	641120_641121_1	SPPC	SPPC	21%	11%	0%	21%	11%	0%
N.GILA_IMPRLVLY_1	22536_22360_1	CISD	CISD	30%	13%	0%	27%	11%	0%
FISHSPRNG_FSHSP-TER1_1	640916_640917_1	SPPC	SPPC	21%	10%	0%	21%	10%	0%

Avg LMP Before and After BESS (\$/MWh)

Area	1in20 Loads	1in20 Loads w/BESS	Area	1in20 Loads	1in20 Loads w/BESS
AESO	59.09	46.26	NEVP	151.26	46.69
AVA	145.83	47.80	NWMT	148.43	50.55
AZPS	147.76	45.18	PACW	152.07	49.63
BANC	184.49	81.00	PAID	151.84	48.17
BCHA	46.48	38.36	PAUT	147.96	46.58
BPAT	151.24	49.17	PAWY	143.88	45.51
CFE	229.06	39.90	PGE	152.91	49.74
CHPD	147.36	47.88	PNM	141.17	38.89
CIPB	178.59	75.71	PSCO	134.82	41.01
CIPV	178.86	75.68	PSEI	149.96	48.60
CISC	184.38	76.64	SCL	151.52	49.17
CISD	180.30	75.04	SPPC	136.65	41.05
DOPD	147.89	48.11	SRP	144.88	42.67
EPE	138.31	38.96	TEPC	149.40	45.93
GCPD	151.66	49.53	TIDC	184.01	81.48
IID	170.88	68.91	TPWR	150.20	48.74
IPFE	152.04	48.53	VEA	166.09	64.88
IPMV	155.08	50.06	WACM	138.84	42.87
IPTV	154.83	50.31	WALC	142.92	42.45
LDWP	186.13	77.10	WAUW	135.12	47.78

Conclusions

- The 1in10 and 1in20 loads caused unserved load in many areas
- After adding BESS, the unserved load was able to be alleviated
 - 4-hour storage is sufficient everywhere except,
 - CFE needed
 - Path 45 SDG&E to CFE rating was increased from 408 MW to 600 MW
 - 6-hour storage with 1in10 loads
 - 8-hour storage with 1in20 loads



WECC

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