

2017-2018 ISO Reliability Assessment - Study Results

Study Area: **PG&E Bulk**



Overloaded Facility	Worst Contingency	Category	Category Description	Loading (%)										Potential Mitigation Solutions
				2019 Summer Peak	2022 Summer Peak	2027 Summer Peak	2027 Summer Partial Peak	2019 Light Spring	2022 Spring Off-peak	2027 Spring Off-peak	2022 Summer Peak, High renew	2027 Summer Peak shift	2022 Spring Off-peak, max PV	
500 kV LINES	NORTHERN CALIFORNIA													
ROUND MTN –TABLE MTN #1 or #2 500 kV	Rnd Mtn –Table Mtn #2 or # 1 500 kV	P1	L-1	106.5%	102.4%	102.5%	101.5%	<95%	<95%	<95%	103.9%	101.3%	<95%	Reduce COI flow according to seasonal nomogram or bypass ser caps on the remaining Round Mtn-Table Mtn 500 kV line or Tbl Mtn-Vaca Dix
ROUND MTN-TABLE MTN # 1 500 kV	Round Mtn-Table Mtn # 2 and Table Mtn 500/230 kV	P2	BRK	107.0%	104.2%	104.1%	102.4%	<95%	<95%	<95%	105.7%	102.9%	<95%	
ROUND MTN-TABLE MTN # 2 500 kV	Round Mtn-Table Mtn # 1 and Round Mtn 500/230 kV	P2	BRK	<95%	99.1%	<95%	98.6%	<95%	<95%	<95%	99.7%	95.1%	<95%	
ROUND MTN-TABLE MTN # 1 or # 2 500 kV	ROUND MTN-TABLE MTN # 2 or # 1 500 kV and Diablo unit	P3	G-1/L-1	118.2%	115.7%	N/A	N/A	<95%	<95%	N/A	116.1%	N/A	<95%	
ROUND MTN –TABLE MTN #1 or #2 500 kV	Table Mtn 500/230 kV x-former & Round Mtn-Table Mtn #2 or # 1	P6	T-1/L-1	107.0%	104.2%	104.3%	102.7%	<95%	<95%	<95%	106.3%	103.1%	<95%	Reduce COI flow according to seasonal nomogram or bypass ser caps on the remaining Round Mtn-Table Mtn 500 kV line or Tbl Mtn-Vaca Dix
	Round Mtn-Table Mtn #2 or # 1 500 kV and Table Mtn-Thermalito 230 kV	P6	L-1/L-1	117.6%	116.1%	117.4%	114.8%	<95%	<95%	<95%	117.2%	109.1%	<95%	
CAPTAIN JACK-OLINDA 500 kV	Round Mtn-Table Mtn # 2 & Round Mtn-Malin # 2 500 kV	P6	L-1/L-1	105.1%	105.6%	108.8%	107.8%	<95%	<95%	<95%	109.1%	105.4%	<95%	Operate within seasonal COI nomogram
CAPTAIN JACK-OLINDA 500 kV	Malin- Round Mtn #1 and #2 500 kV	P7	L-2	103.9%	105.1%	106.1%	106.0%	<95%	<95%	<95%	107.8%	104.1%	<95%	
	Round Mtn-Table Mtn # 1 & # 2 500 kV	P7	L-2	103.4%	106.6%	107.2%	105.6%	<95%	<95%	<95%	110.0%	106.6%	<95%	
OLINDA-MAXWELL 500 kV	Round Mtn-Table Mtn # 2 & Round Mtn-Malin # 2 500 kV	P6	L-1/L-1	100.8%	96.2%	100.3%	96.6%	<95%	<95%	<95%	100.8%	97.1%	<95%	Operate within seasonal COI nomogram
OLINDA-MAXWELL 500 kV	Round Mtn-Table Mtn # 1 & # 2 500 kV	P7	L-2	99.1%	96.6%	98.8%	96.6%	<95%	<95%	<95%	102.4%	97.9%	<95%	
MAXWELL-TRACY 500 kV	Round Mtn-Table Mtn # 1 & # 2 500 kV	P7	L-2	96.3%	<95%	96.8%	<95%	<95%	<95%	<95%	100.4%	96.0%	<95%	
MAXWELL - TRACY 500 kV	Round Mtn-Table Mtn # 2 & Round Mtn-Malin # 2 500 kV	P6	L-1/L-1	98.2%	95.9%	98.5%	<95%	<95%	<95%	<95%	98.9%	95.3%	<95%	
500 kV LINES	CENTRAL CALIFORNIA													
TESLA-LOS BANOS 500 kV	Tracy-Los Banos and Moss Landing-Los Banos 500kV	P6	L-1/L-1	<95%	<95%	<95%	<95%	<95%	116.1%	<95%	<95%	<95%	<95%	Reduce Path 15 flow under normal conditions
TRACY-LOS BANOS 500 kV	Tesla-Los Banos and Moss Landing-Los Banos 500kV	P6	L-1/L-1	<95%	<95%	<95%	<95%	<95%	110.2%	<95%	<95%	<95%	<95%	
LOS BANOS - GATES # 1 500 kV	normal conditions	P0	normal	<95%	<95%	<95%	<95%	<95%	98.7%	<95%	<95%	<95%	<95%	Not a violation. Reduce Path 15 flow under normal conditions
500/230 kV TRANSFORMERS														

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ROUND MTN 500/230 kV x-former	Olinda-Tracy 500 kV & Capt Jack-Olinda 500 kV	P6	L-1/L-1	<95%	<95%	<95%	<95%	<95%	95.9%	<95%	<95%	<95%	<95%	reduce some Pit River generation after first contingency
	Olinda-Tracy 500 kV & Olinda 500/230 kV	P6	L-1/T-1	<95%	<95%	<95%	<95%	<95%	100.5%	100.3%	<95%	<95%	<95%	
	Capt Jack-Olinda 500 kV and Table Mtn 500/230 kV x-former	P6	T-1/L-1	<95%	<95%	<95%	<95%	<95%	99.7%	<95%	<95%	<95%	<95%	
ROUND MTN 500/230 kV x-former	Round Mtn-Table Mtn # 1 and # 2 500 kV	P7	L-2	<95%	<95%	<95%	<95%	<95%	100.7%	99.9%	<95%	<95%	<95%	reduce Pit River generation
TABLE MTN 500/230 kV x-former	Table Mtn -Tesla and Vaca Dix-Tesla 500 kV	P6	L-1/L-1	<95%	<95%	<95%	<95%	<95%	<95%	98.6%	<95%	<95%	<95%	not a violation, monitor
TABLE MTN 500/230 kV x-former	Table Mtn -Tesla and Table Mtn -Vaca Dix-Tesla 500 kV	P7	L-2	<95%	<95%	<95%	<95%	<95%	<95%	99.3%	<95%	<95%	<95%	not a violation, monitor
OLINDA 500/230 kV x-former	Round Mtn 500/230 kV x-former & Olinda-Tracy 500 kV kV	P6	T-1/L-1	<95%	<95%	<95%	<95%	<95%	126.1%	128.0%	<95%	<95%	<95%	Colusa is off in off-peak cases, thus Colusa SPS is not applicable. Reduce Shasta generation after first contingency
	Malin-Round Mnt 500 kV #1 and Round Mtn 500/230 kV	P6	T-1/L-1	<95%	<95%	<95%	<95%	<95%	100.7%	96.0%	<95%	<95%	<95%	
	Malin-Round Mnt 500 kV #1 and Table Mtn 500/230 kV	P6	T-1/L-1	<95%	<95%	<95%	<95%	<95%	<95%	96.0%	<95%	<95%	<95%	
OLINDA 500/230 kV x-former	Malin-Round Mtn # 1 and # 2 500 kV	P7	L-2	<95%	<95%	<95%	<95%	<95%	107.3%	<95%	<95%	<95%	<95%	reduce Shasta generation
TRACY 500 /230 kV x-former #1 or # 2	Tesla-Tracy 500 kV Line and Tracy 500/230 kV x-former # 2 or # 1	P6	L-1/T-1	<95%	<95%	<95%	107.7%	<95%	<95%	<95%	98.6%	101.1%	<95%	open Tracy-Tesla 230 kV lines if overload, trip Tracy pumps if it persists
METCALF 500/230 kV x-former #11, 12 or 13	Metcalf 500/230 kV Transformers #11 & #12 or #13	P6	T-1/T-1	<95%	100.5%	96.8%	111.9%	<95%	103.9%	95.9%	118.5%	114.0%	<95%	dispatch Ls Esteros peakers after 1st contingency, trip load in San Jose if overload persists
GATES 500/230 kV x-former	Los Banos 500/230 kV	P1	T-1	<95%	<95%	<95%	102.8%	<95%	<95%	<95%	<95%	<95%	<95%	install 2-nd Gates 500/230 kV transformer, approved project
	Los Banos-Gates 500 kV # 1	P1	L-1	<95%	<95%	<95%	96.0%	<95%	<95%	<95%	<95%	<95%	<95%	
	MossLandg-Ls Banos 500 kV	P1	L-1	<95%	<95%	<95%	95.5%	<95%	<95%	<95%	<95%	<95%	<95%	
GATES 500/230 kV x-former	Los Banos-Midway 500 kV and Los Banos 500/230 kV	P2	BRK	<95%	<95%	<95%	103.0%	<95%	<95%	<95%	<95%	<95%	<95%	install 2-nd Gates 500/230 kV transformer, approved project
	Tracy-Los Banos and Los Banos-Gates # 1 500 kV	P2	BRK	<95%	<95%	<95%	96.3%	<95%	<95%	<95%	<95%	<95%	<95%	
	Gates-Midway and Diablo-Midway 500 kV	P2	BRK	<95%	<95%	<95%	<95%	<95%	<95%	96.9%	<95%	<95%	<95%	
	Los Banos-Moss Landing 500 kV and Los Banos 500/230 kV	P6	L-1/T-1	<95%	<95%	<95%	110.4%	<95%	<95%	<95%	<95%	<95%	<95%	
	Los Banos 500/230 kV and Midway 500/230 kV # 11,12 or 13	P6	T-1/T-1	<95%	<95%	<95%	106.0%	<95%	<95%	<95%	<95%	<95%	<95%	
	Los Banos-Gates # 1 500 kV and Los Banos 500/230 kV	P6	L-1/T-1	<95%	<95%	<95%	105.9%	<95%	<95%	<95%	<95%	<95%	<95%	

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GATES 500/230 kV x-former	Moss Landing-Los Banos and Tesla-Metcalf 500 kV	P6	L-1/L-1	<95%	<95%	<95%	105.8%	<95%	<95%	<95%	<95%	<95%	<95%	install 2-nd Gates 500/230 kV transformer, approved project
	Tesla 500/230 kV and Los Banos 500/230 kV	P6	T-1/T-1	<95%	<95%	<95%	105.8%	<95%	<95%	<95%	<95%	<95%	<95%	
	Los Banos-Tesla 500 kV and Los Banos 500/230 kV	P6	L-1/T-1	<95%	<95%	<95%	104.9%	<95%	<95%	<95%	<95%	<95%	<95%	
	Moss Landing 500/230 kV and Los Banos 500/230 kV	P6	T-1/T-1	<95%	<95%	<95%	104.2%	<95%	<95%	<95%	<95%	<95%	<95%	
	Tracy 500/230 kV and Los Banos 500/230 kV	P6	T-1/T-1	<95%	<95%	<95%	104.1%	<95%	<95%	<95%	<95%	<95%	<95%	
	Los Banos-Tracy 500 kV and Los Banos 500/230 kV	P6	L-1/T-1	<95%	<95%	<95%	104.0%	<95%	<95%	<95%	<95%	<95%	<95%	
	Los Banos-Gates # 3 500 kV and Los Banos 500/230 kV	P6	L-1/T-1	<95%	<95%	<95%	103.9%	<95%	<95%	<95%	<95%	<95%	<95%	
	Los Banos-Gates #1 and #3 500 kV	P6	L-1/L-1	<95%	<95%	<95%	103.8%	<95%	<95%	<95%	<95%	<95%	<95%	
	Midway 500/230 # 11 (or 13) and # 12 (or 13)	P6	T-1/T-1	<95%	<95%	<95%	101.0%	<95%	<95%	105.5%	<95%	<95%	<95%	
	Moss Landing-Los Banos and Los Banos-Gates # 1 500 kV	P6	L-1/L-1	<95%	<95%	<95%	99.8%	<95%	<95%	<95%	<95%	<95%	<95%	
	Gates-Midway 500 kV and Midway 500/230 kV # 11,12 or 13	P6	L-1/T-1	<95%	<95%	<95%	<95%	<95%	<95%	101.4%	<95%	<95%	<95%	
	Gates-Midway and Gates-Diablo 500 kV	P6	L-1/L-1	<95%	<95%	<95%	<95%	<95%	<95%	109.8%	<95%	<95%	<95%	
	Gates-Midway and Diablo-Midway 500 kV	P6	L-1/L-1	<95%	<95%	<95%	<95%	<95%	<95%	97.1%	<95%	<95%	<95%	
GATES 500/230 kV x-former	Los Banos-Gates #1 and Los Banos-Midway 500 kV	P7	L-2	<95%	<95%	<95%	106.1%	<95%	<95%	<95%	<95%	<95%	<95%	install 2-nd Gates 500/230 kV transformer, approved project
MIDWAY 500/230 kV x-former #11, 12 or 13	MIDWAY 500/230 kV x-former #11&12 or 12&13 or 11&13	P6	T-1/T-1	<95%	<95%	<95%	<95%	<95%	136.4%	148.5%	<95%	<95%	<95%	reduce generation at Midway 230 kV after first contingency
	MIDWAY 500/230 kV x-former #11, 12 or 13 and Gates 500/230 kV	P6	T-1/T-1	<95%	<95%	<95%	<95%	<95%	<95%	109.1%	<95%	<95%	<95%	
230 kV LINES	NORTHERN CALIFORNIA													
COTTONWD E-ROUND MTN 230kV #2	Tbl Mtn-Vaca Dix 500 kV & Cottonwood-Round Mtn #1 or #3 230 kV	P6	L-1/L-1	<95%	108.7%	111.3%	111.1%	<95%	<95%	<95%	99.1%	95.0%	<95%	limit COI import within nomogram or upgrade the line
COTTONWD E-ROUND MTN 230kV #2	Tbl Mtn-Tesla and Tbl Mtn-Vaca Dix 500 kV	P7	L-2	<95%	100.5%	102.8%	102.2%	<95%	<95%	<95%	109.6%	103.7%	<95%	
COTTONWD E-ROUND MTN 230kV #3	Tbl Mtn-Vaca Dix 500 kV and Cottonwood-Round Mtn # 1 or #2 230 kV	P6	L-1/L-1	110.5%	121.0%	124.1%	123.6%	<95%	<95%	<95%	110.4%	105.5%	<95%	limit COI import within nomogram or upgrade the line
COTTONWD E-ROUND MTN 230kV #3	Tbl Mtn-Tesla and Tbl Mtn-Vaca Dix 500 kV	P7	L-2	99.7%	110.7%	113.2%	112.3%	<95%	<95%	<95%	120.7%	113.9%	<95%	
TARLE MTN-RIO OSC 230 kV	Tbl Mtn-Tesla 500 kV and Tbl Mtn-Palermo 230 kV	P6	L-1/L-1	117.0%	<95%	<95%	<95%	<95%	<95%	<95%	<95%	<95%	<95%	

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TABLE MTN-RIO OSO 230 kV	Tbl Mtn-Vaca Dix 500 kV and Table Mtn-Palermo 230 kV	P6	L-1/L-1	125.4%	<95%	<95%	<95%	<95%	<95%	<95%	<95%	<95%	<95%	Upgrade terminal equipment on this line. Modeled upgraded starting from 2022
TABLE MTN-RIO OSO 230 kV	Tbl Mtn-Tesla and Tbl Mtn-Vaca Dix 500 kV	P7	L-2	100.3%	<95%	<95%	<95%	<95%	<95%	<95%	<95%	<95%	<95%	
LONE TREE-CAYETANO 230 kV	Tesla-Metcalf 500 kV & Moss Landing-Los Banos 500 kV	P6	L-1/L-1	<95%	<95%	<95%	101.6%	<95%	<95%	<95%	<95%	<95%	<95%	reduce generation at Contra Costa after first contingency
LS ESTEROS - NWK DIST 230 kV	Tesla-Metcalf 500 kV & Moss Landing-Los Banos 500 kV	P6	L-1/L-1	<95%	<95%	<95%	98.6%	<95%	106.5%	<95%	106.2%	<95%	<95%	dispatch Metcalf generation after 1st contingency
	Tesla-Metcalf 500 kV & Metcalf-Moss Landing 500 kV	P6	L-1/L-1	<95%	<95%	<95%	<95%	<95%	<95%	<95%	100.6%	98.0%	<95%	
NEWARK E - NWK DIST 230 kV	Tesla-Metcalf 500 kV & Moss Landing-Los Banos 500 kV	P6	L-1/L-1	<95%	<95%	<95%	98.3%	<95%	105.2%	<95%	105.1%	98.3%	<95%	
	Tesla-Metcalf 500kV & Metcalf-Moss Landing 500kV	P6	L-1/L-1	<95%	<95%	<95%	98.3%	<95%	105.2%	<95%	100.0%	<95%	<95%	
DELEVAN-CORTINA 230 kV	Malin-Round Mtn #2 500 kV & Round Mtn-Table Mtn #2 500 kV	P6	L-1/L-1	104.8%	<95%	<95%	<95%	<95%	<95%	<95%	<95%	<95%	<95%	reduce Colusa generation after first contingency, if overload
	Olinda-Tracy 500 kV & Tracy-Tesla 500 kV	P6	L-1/L-1	95.3%	<95%	<95%	<95%	<95%	<95%	<95%	<95%	<95%	<95%	
	Table Mtn-Vaca Dix 500 kV & Delevan-Vaca-Dixon 230 kV	P6	L-1/L-1	113.7%	105.8%	102.8%	110.4%	<95%	<95%	<95%	<95%	<95%	<95%	
	Table Mtn-Tesla 500 kV & Delevan-Vaca-Dixon 230 kV	P6	L-1/L-1	105.2%	<95%	<95%	101.8%	<95%	<95%	<95%	<95%	<95%	<95%	
	Olinda-Tracy 500 kV & Delevan-Vaca-Dixon 230 kV	P6	L-1/L-1	109.8%	102.1%	<95%	104.9%	<95%	<95%	<95%	<95%	<95%	<95%	
DELEVAN-CORTINA 230 kV	Tbl Mtn-Tesla and Tbl Mtn-Vaca Dix 500 kV	P7	L-2	103.8%	98.1%	<95%	103.6%	<95%	<95%	<95%	<95%	<95%	<95%	Depends on Colusa generation, reduce generation or re-rate the line
	Round Mtn-Table Mtn # 1 and # 2 500 kV	P7	L-2	<95%	<95%	<95%	97.5%	<95%	<95%	<95%	<95%	<95%	<95%	
BELLOTA-WARNERVILLE 230 kV	Los Banos-Moss Landing and Los Banos-Tesla 500 kV	P6	L-1/L-1	<95%	<95%	<95%	<95%	<95%	100.1%	<95%	<95%	<95%	<95%	Insert series reactor on Warnerville-Wilson if overload
BELLOTA-WARNERVILLE 230 kV	Los Banos-Tracy and Los Banos-Tesla 500 kV	P7	L-2	<95%	<95%	<95%	<95%	<95%	114.8%	<95%	<95%	<95%	<95%	
WARNERVILLE-WILSON 230 kV	Tesla-Metcalf 500 kV	P1	L-1	<95%	<95%	<95%	95.4%	<95%	<95%	<95%	<95%	<95%	<95%	insert series reactor if overload
WARNERVILLE-WILSON 230 kV	Los Banos 500/230 kV and Gates 500/230 kV	P6	T-1/T-1	<95%	<95%	<95%	131.8%	<95%	<95%	<95%	<95%	<95%	<95%	insert series reactor if overload
	Gates 500/230 kV and Midway # 11,12,or 13 500/230 kV	P6	T-1/T-1	<95%	<95%	<95%	121.2%	<95%	<95%	<95%	<95%	<95%	<95%	
	Gates-Diablo 500 kV and Gates 500/230 kV	P6	L-1/T-1	<95%	<95%	<95%	118.5%	<95%	<95%	<95%	<95%	<95%	<95%	

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WARNERVILLE-WILSON 230 kV	Los Banos-Gates #3 500 kV and Gates 500/230 kV	P6	L-1/T-1	<95%	<95%	<95%	118.3%	<95%	<95%	<95%	<95%	<95%	<95%	Insert series reactor if overload
	Los Banos-Gates #1 500 kV and Gates 500/230 kV	P6	L-1/T-1	<95%	<95%	<95%	117.1%	<95%	<95%	<95%	<95%	<95%	<95%	
	Gates-Midway 500 kV and Gates 500/230 kV	P6	L-1/T-1	<95%	<95%	<95%	116.4%	<95%	<95%	<95%	<95%	<95%	<95%	
WARNERVILLE-WILSON 230 kV	PDCI Bi-pole	P7	Bi-pole DC	<95%	<95%	<95%	106.1%	N/A	N/A	N/A	<95%	<95%	N/A	Insert series reactor
	Los Banos-Tracy and Los Banos-Tesla 500 kV	P7	L-2	<95%	<95%	<95%	<95%	<95%	100.1%	111.8%	<95%	<95%	<95%	
230 kV LINES	CENTRAL CALIFORNIA													
EIGHT MILE-LODI 230 kV	normal conditions	P0	normal	<95%	<95%	<95%	<95%	104.4%	<95%	<95%	<95%	<95%	<95%	reconductoring in December 2019, reduce Lodi generation under norm
EIGHT MILE-LODI 230 kV	Table Mtn 500/230 kV	P1	T-1	<95%	<95%	<95%	<95%	99.4%	<95%	<95%	<95%	<95%	<95%	
EIGHT MILE-LODI 230 kV	Table Mtn-Vaca Dix (or Tesla) 500 kV and Gold Hill-8 Mile 230 kV	P6	L-1/L-1	<95%	<95%	<95%	<95%	105.3%	<95%	<95%	<95%	<95%	<95%	
LOS BANOS - QUINTO_SS 230 kV	normal conditions	P0	normal	<95%	<95%	<95%	<95%	<95%	105.1%	101.5%	<95%	<95%	<95%	Reduce Path 15 flow under normal conditions. Reduce generation from the project connected to the Panoche-Los Banos 230 kV line. Or consider line upgrade
LOS BANOS - QUINTO_SS 230 kV	Los Banos-Tesla 500 kV	P1	L-1	<95%	<95%	<95%	<95%	<95%	128.4%	119.9%	<95%	<95%	<95%	Reduce Path 15 flow under normal conditions. Reduce generation from the project connected to the Panoche-Los Banos 230 kV line, use short-term rating if still overload
	Los Banos-Tracy 500 kV	P1	L-1	<95%	<95%	<95%	<95%	<95%	122.9%	115.5%	<95%	<95%	<95%	
	Moss Landing -Los Banos 500 kV	P1	L-1	<95%	<95%	<95%	<95%	<95%	110.6%	104.4%	<95%	<95%	<95%	
	Moss Landing -Metcalf 500 kV	P1	L-1	<95%	<95%	<95%	<95%	<95%	105.9%	101.3%	<95%	<95%	<95%	
	Los Banos-Gates # 1 500 kV	P1	L-1	<95%	<95%	<95%	<95%	<95%	97.1%	<95%	<95%	<95%	<95%	
	Gates 500/230 kV	P1	L-1	<95%	<95%	<95%	<95%	<95%	96.3%	96.5%	<95%	<95%	<95%	
LOS BANOS - QUINTO_SS 230 kV	Tesla-Los Banos and Los Banos-Gates #3 500 kV	P2	BRK	<95%	<95%	<95%	<95%	<95%	130.8%	121.9%	<95%	<95%	<95%	Reduce Path 15 flow under normal conditions. Reduce generation from the project connected to the Panoche-Los Banos 230 kV line, use short-term rating if still overload
	Tesla-Los Banos and Tesla-Vaca Dix 500 kV	P2	BRK	<95%	<95%	<95%	<95%	<95%	129.4%	120.6%	<95%	<95%	<95%	
	Tracy-Los Banos and Los Banos-Gates #1 500 kV	P2	BRK	<95%	<95%	<95%	<95%	<95%	128.1%	119.4%	<95%	<95%	<95%	
	Moss Landing-Los Banos 500 kV and Moss Landing 500/230 kV	P2	BRK	<95%	<95%	<95%	<95%	<95%	111.8%	105.9%	<95%	<95%	<95%	

Study Area: PG&E Bulk



Overloaded Facility	Worst Contingency	Category	Category Description	Loading (%)										Potential Mitigation Solutions
				2019 Summer Peak	2022 Summer Peak	2027 Summer Peak	2027 Summer Partial Peak	2019 Light Spring	2022 Spring Off-peak	2027 Spring Off-peak	2022 Summer Peak, High renew	2027 Summer Peak shift	2022 Spring Off-peak, max PV	
	Los Banos-Midway 500 kV and Los Banos 500/230 kV	P2	BRK	<95%	<95%	<95%	<95%	<95%	97.2%	105.7%	<95%	<95%	<95%	
LOS BANOS - QUINTO_SS 230 kV	Moss Langing-Los Banos 500 kV & Tesla-Los Banos 500 kV	P6	L-1/L-1	<95%	<95%	<95%	<95%	<95%	174.4%	156.8%	<95%	<95%	96.8%	Reduce Path 15 flow under normal conditions. Reduce generation from the project connected to the Panoche-Los Banos 230 kV line, use short-term rating if still overload
	Moss Landing-Los Banos 500 kV & Tracy-Los Banos 500 kV	P6	L-1/L-1	<95%	<95%	<95%	<95%	<95%	161.4%	147.9%	<95%	<95%	<95%	
	Tesla-Los Banos 500 kV & Metcalf-Moss Landing 500 kV	P6	L-1/L-1	<95%	<95%	<95%	<95%	<95%	155.9%	146.6%	<95%	<95%	<95%	
	Tracy-Tesla and Tesla-Los Banos 500 kV	P6	L-1/L-1	<95%	<95%	<95%	<95%	<95%	134.0%	124.3%	<95%	<95%	<95%	
	Tesla-Los Banos and Los Banos-Gates # 1 500 kV	P6	L-1/L-1	<95%	<95%	<95%	<95%	<95%	133.0%	123.6%	<95%	<95%	<95%	
	Tesla-Los Banos and Los Banos-Midway 500 kV	P6	L-1/L-1	<95%	<95%	<95%	<95%	<95%	132.1%	122.1%	<95%	<95%	<95%	
	Tracy-Tesla and Tracy-Los Banos 500 kV	P6	L-1/L-1	<95%	<95%	<95%	<95%	<95%	129.8%	122.1%	<95%	<95%	<95%	
	Tesla-Los Banos and Tesla-Vaca Dix 500 kV	P6	L-1/L-1	<95%	<95%	<95%	<95%	<95%	129.4%	120.6%	<95%	<95%	<95%	
	Tesla-Los Banos and Table Mtn-Tesla 500 kV	P6	L-1/L-1	<95%	<95%	<95%	<95%	<95%	129.1%	120.3%	<95%	<95%	<95%	
	Tesla-Metcalf and Tesla-Los Banos 500 kV	P6	L-1/L-1	<95%	<95%	<95%	<95%	<95%	127.4%	121.6%	<95%	<95%	<95%	
	Los Banos-Midway and Los Banos-Tracy 500 kV	P6	L-1/L-1	<95%	<95%	<95%	<95%	<95%	126.5%	117.9%	<95%	<95%	<95%	
	Tracy-Los Banos and Los Banos-Gates #3 500 kV	P6	L-1/L-1	<95%	<95%	<95%	<95%	<95%	125.3%	117.5%	<95%	<95%	<95%	
	Moss Landing-Los Banos and Los Banos-Gates # 1 500 kV	P6	L-1/L-1	<95%	<95%	<95%	<95%	<95%	115.4%	108.1%	<95%	<95%	<95%	
	Los Banos-Midway 500 kV & Mosslanding-Los Banos 500 kV	P6	L-1/L-1	<95%	<95%	<95%	<95%	<95%	113.7%	106.7%	<95%	<95%	<95%	
	Moss Landing-Los Banos & Los Banos-Gates #3 500 kV	P6	L-1/L-1	<95%	<95%	<95%	<95%	<95%	112.8%	106.2%	<95%	<95%	<95%	
	Metcalf-Moss Landing 500 kV and Moss Landing 500/230 kV	P6	L-1/T-1	<95%	<95%	<95%	<95%	<95%	111.6%	105.7%	<95%	<95%	<95%	
	Moss Landing-Metcalf and Moss Landing-Los Banos 500 kV	P6	L-1/L-1	<95%	<95%	<95%	<95%	<95%	110.5%	105.5%	<95%	<95%	<95%	
	Moss Landing-Los Banos and Moss Landing 500/230 kV	P6	L-1/T-1	<95%	<95%	<95%	<95%	<95%	110.5%	105.9%	<95%	<95%	<95%	

Study Area: **PG&E Bulk**



Overloaded Facility	Worst Contingency	Category	Category Description	Loading (%)										Potential Mitigation Solutions
				2019 Summer Peak	2022 Summer Peak	2027 Summer Peak	2027 Summer Partial Peak	2019 Light Spring	2022 Spring Off-peak	2027 Spring Off-peak	2022 Summer Peak, High renew	2027 Summer Peak shift	2022 Spring Off-peak, max PV	
	Los Banos-Gates # 1 and # 3 230 kV	P6	L-1/L-1	<95%	<95%	<95%	<95%	<95%	103.4%	101.1%	<95%	<95%	<95%	
	Gates 500/230 kV and Los Banos 500/230 kV	P6	T-1/T-1	<95%	<95%	<95%	<95%	<95%	101.6%	121.4%	<95%	<95%	<95%	
	Los Banos-Gates #1 500 kV and Los Banos 500/230 kV	P6	L-1/T-1	<95%	<95%	<95%	<95%	<95%	101.3%	109.2%	<95%	<95%	<95%	
	Los Banos-Gates # 3 and Los Banos-Midway 500 kV	P6	L-1/L-1	<95%	<95%	<95%	<95%	<95%	100.5%	95.6%	<95%	<95%	<95%	
	Gates 500/230 kV and Midway 500/230 kV	P6	T-1/T-1	<95%	<95%	<95%	<95%	<95%	98.4%	99.1%	<95%	<95%	<95%	
	Los Banos-Midway 500 kV and Los Banos 500/230 kV	P6	L-1/T-1	<95%	<95%	<95%	<95%	<95%	96.5%	105.7%	<95%	<95%	<95%	
	Los Banos-Gates #3 500 kV and Los Banos 500/230 kV	P6	L-1/T-1	<95%	<95%	<95%	<95%	<95%	<95%	100.8%	<95%	<95%	<95%	
	Moss Landing-Los Banos 500 kV & 230 kV line	P6	L-1/L-1	<95%	<95%	<95%	<95%	<95%	123.0%	116.2%	<95%	<95%	<95%	
	Tesla-Los Banos 500 kV & a 230 kV line	P6	L-1/L-1	<95%	<95%	<95%	<95%	<95%	136.4%	128.1%	<95%	<95%	<95%	
	Tracy-Los Banos 500 kV & a 230 kV line	P6	L-1/L-1	<95%	<95%	<95%	<95%	<95%	131.2%	124.2%	<95%	<95%	<95%	
LOS BANOS - QUINTO_SS 230 kV	Los Banos-Tesla & Los Banos-Tracy 500 kV with RAS off peak	P7	L-2	<95%	<95%	<95%	<95%	<95%	207.6%	183.3%	<95%	<95%	121.7%	Reduce Path 15 flow under normal conditions, reduce generation from the project connected to the Panoche-Los Banos 230 kV line, use short-term rating if still overload
WESTLEY - QUINTO_SS 230 kV	Moss Landing-Los Banos & Tesla-Los Banos 500kV	P6	L-1/L-1	<95%	<95%	<95%	<95%	<95%	108.0%	97.9%	<95%	<95%	<95%	Reduce Path 15 flow under normal conditions. Reduce generation from thje project conneted to Panoche-Los Banos 230 kV
	Moss Landing-Los Banos 500 kV & Tracy-Los Banos 500 kV	P6	L-1/L-1	<95%	<95%	<95%	<95%	<95%	100.6%	<95%	<95%	<95%	<95%	
WESTLEY-QUINTO_SS 230 kV	Los Banos-Tracy and Los Banos-Tesla 500 kV with RAS off peak	P7	L-2	<95%	<95%	<95%	<95%	<95%	126.9%	112.9%	<95%	<95%	<95%	
MOSSLANDING-LAS AGUILAS 230 kV	normal conditions	P0	normal	<95%	<95%	<95%	<95%	<95%	114.7%	116.8%	<95%	<95%	<95%	congestion management if overload: reduce output of the project connected to Las Aguilas, increase generation from Moss Landing
	Moss Landing -Los Banos 500 kV	P1	L-1	<95%	<95%	<95%	<95%	<95%	151.3%	146.7%	<95%	<95%	<95%	
	Moss Landing 500/230 kV x-former	P1	T-1	<95%	<95%	<95%	<95%	<95%	121.4%	117.2%	<95%	<95%	<95%	
	Los Banos-Gates 500 kV # 1	P1	L-1	<95%	<95%	<95%	<95%	<95%	120.7%	119.9%	<95%	<95%	<95%	
	Los Banos-Tesla 500 kV	P1	L-1	<95%	<95%	<95%	<95%	<95%	118.3%	118.2%	<95%	<95%	<95%	
	Gates 500/230 kV	P1	T-1	<95%	<95%	<95%	<95%	<95%	118.0%	127.9%	<95%	<95%	<95%	
	Los Banos-Midway 500 kV	P1	L-1	<95%	<95%	<95%	<95%	<95%	117.0%	117.2%	<95%	<95%	<95%	

Study Area: PG&E Bulk



Overloaded Facility	Worst Contingency	Category	Category Description	Loading (%)										Potential Mitigation Solutions
				2019 Summer Peak	2022 Summer Peak	2027 Summer Peak	2027 Summer Partial Peak	2019 Light Spring	2022 Spring Off-peak	2027 Spring Off-peak	2022 Summer Peak, High renew	2027 Summer Peak shift	2022 Spring Off-peak, max PV	
MOSSLANDING-LAS AGUILAS 230 kV	Los Banos-Tracy 500 kV	P1	L-1	<95%	<95%	<95%	<95%	<95%	115.3%	115.8%	<95%	<95%	<95%	reduce output of the project connected to Las Aguilas, increase generation from Moss Landing. Use short-term rating
	Metcalf-Tesla 500 kV	P1	L-1	<95%	<95%	<95%	<95%	<95%	114.7%	114.9%	<95%	<95%	<95%	
	Los Banos-Gates 500 kV # 3	P1	L-1	<95%	<95%	<95%	<95%	<95%	111.7%	112.7%	<95%	<95%	<95%	
	Table Mtn 500/230 kV	P1	T-1	<95%	<95%	<95%	<95%	<95%	109.4%	111.7%	<95%	<95%	<95%	
	Midway 500/230 kV # 11, 12 or 13	P1	T-1	<95%	<95%	<95%	<95%	<95%	108.1%	110.2%	<95%	<95%	<95%	
	Tracy-Tesla 500 kV	P1	L-1	<95%	<95%	<95%	<95%	<95%	108.0%	109.6%	<95%	<95%	<95%	
	Metcalf 500/230 kV	P1	T-1	<95%	<95%	<95%	<95%	<95%	107.5%	109.3%	<95%	<95%	<95%	
	Los Banos 500/230 kV transformer	P1	T-1	<95%	<95%	<95%	<95%	<95%	104.1%	111.1%	<95%	<95%	<95%	
MOSSLANDING-LAS AGUILAS 230 kV	Moss Landing-Los Banos 500 kV & Moss Landing 500/230 kV	P2	BRK	<95%	<95%	<95%	<95%	<95%	145.3%	138.1%	<95%	<95%	<95%	reduce output of the project connected to Las Aguilas, increase generation from Moss Landing. Use short-term rating
	Tracy-Los Banos and Los Banos-Gates #1 500 kV	P2	BRK	<95%	<95%	<95%	<95%	<95%	129.4%	127.0%	<95%	<95%	<95%	
	Tesla-Los Banos and Los Banos-Gates #3 500 kV	P2	BRK	<95%	<95%	<95%	<95%	<95%	123.6%	122.5%	<95%	<95%	<95%	
	Round Mtn-Table Mtn # 2 500 kV and Table Mtn 500/230 kV	P2	BRK	<95%	<95%	<95%	<95%	<95%	118.0%	111.7%	<95%	<95%	<95%	
	Los Banos-Midway 500 kV and Los Banos 500/230 kV	P2	BRK	<95%	<95%	<95%	<95%	<95%	117.6%	122.5%	<95%	<95%	<95%	
	Mosslanding-Los Banos 500 kV & Tesla-Metcalf 500 kV	P6	L-1/L-1	<95%	<95%	<95%	<95%	<95%	216.6%	202.0%	131.5%	<95%	<95%	
	Tesla-Los Banos & Mosslanding-Los Banos 500kV	P6	L-1/L-1	<95%	<95%	<95%	<95%	<95%	194.2%	182.8%	<95%	<95%	<95%	
	Tracy-Los Banos & Mosslanding-Los Banos 500 kV	P6	L-1/L-1	<95%	<95%	<95%	<95%	<95%	182.1%	172.9%	<95%	<95%	<95%	
	Moss Landing-Los Banos & Los Banos-Gates #1 500 kV	P6	L-1/L-1	<95%	<95%	<95%	<95%	<95%	163.4%	156.2%	<95%	<95%	<95%	
	Los Banos-Midway 500 kV & Mosslanding-Los Banos 500 kV	P6	L-1/L-1	<95%	<95%	<95%	<95%	<95%	160.1%	153.8%	<95%	<95%	<95%	
	Moss Landing-Los Banos and Los Banos-Gates # 3 500 kV	P6	L-1/L-1	<95%	<95%	<95%	<95%	<95%	156.0%	150.5%	<95%	<95%	<95%	
	Moss Landing 500/230 kV x-former & Metcalf-Moss Landing 500 kV	P6	T-1/L-1	<95%	<95%	<95%	<95%	<95%	145.2%	137.9%	<95%	<95%	<95%	
	Los Banos-Gates # 1 and # 3 500 kV	P6	L-1/L-1	<95%	<95%	<95%	<95%	<95%	143.0%	138.9%	<95%	<95%	<95%	

Study Area: PG&E Bulk



Overloaded Facility	Worst Contingency	Category	Category Description	Loading (%)										Potential Mitigation Solutions
				2019 Summer Peak	2022 Summer Peak	2027 Summer Peak	2027 Summer Partial Peak	2019 Light Spring	2022 Spring Off-peak	2027 Spring Off-peak	2022 Summer Peak, High renew	2027 Summer Peak shift	2022 Spring Off-peak, max PV	
MOSSLANDING-LAS AGUILAS 230 kV	Tesla-Los Banos and Los Banos-Gates #1 500 kV	P6	L-1/L-1	<95%	<95%	<95%	<95%	<95%	131.9%	129.2%	<95%	<95%	<95%	reduce output of the project connected to Las Aguilas, increase generation from Moss Landing. Use short-term rating
	Tesla-Los Banos and Los Banos-Midway 500 kV	P6	L-1/L-1	<95%	<95%	<95%	<95%	<95%	129.0%	126.8%	<95%	<95%	<95%	
	Los Banos-Gates # 3 and Los Banos-Midway 500 kV	P6	L-1/L-1	<95%	<95%	<95%	<95%	<95%	128.6%	126.3%	<95%	<95%	<95%	
	Los Banos-Midway and Los Banos-Tracy 500 kV	P6	L-1/L-1	<95%	<95%	<95%	<95%	<95%	126.0%	124.4%	<95%	<95%	<95%	
	Moss Landing 500/230 kV and Metcalf 500/230 kV	P6	T-1/T-1	<95%	<95%	<95%	<95%	<95%	125.5%	120.8%	<95%	<95%	<95%	
	Los Banos-Gates # 1 500 kV 500 kV and Gates 500/230 kV	P6	L-1/T-1	<95%	<95%	<95%	<95%	<95%	124.9%	133.0%	<95%	<95%	<95%	
	Gates-Midway 500 kV and Gates 500/230 kV	P6	L-1/T-1	<95%	<95%	<95%	<95%	<95%	124.8%	135.0%	<95%	<95%	<95%	
	Tracy-Tesla and Tesla-Los Banos 500 kV	P6	L-1/L-1	<95%	<95%	<95%	<95%	<95%	124.6%	123.3%	<95%	<95%	<95%	
	Gates 500/230 kV and Midway 500/230 kV	P6	T-1/T-1	<95%	<95%	<95%	<95%	<95%	123.1%	134.0%	<95%	<95%	<95%	
	Los Banos-Gates # 1 500 kV and Los Banos 500/230kV	P6	L-1/T-1	<95%	<95%	<95%	<95%	<95%	122.4%	126.1%	<95%	<95%	<95%	
	Los Banos-Gates # 3 500 kV 500 kV and Gates 500/230 kV	P6	L-1/T-1	<95%	<95%	<95%	<95%	<95%	120.7%	130.0%	<95%	<95%	<95%	
	Tracy-Los Banos and Los Banos-Gates #3 500 kV	P6	L-1/L-1	<95%	<95%	<95%	<95%	<95%	120.6%	120.1%	<95%	<95%	<95%	
	Gates 500/230 kV and Los Banos 500/230 kV	P6	T-1/T-1	<95%	<95%	<95%	<95%	<95%	119.2%	139.4%	<95%	<95%	<95%	
	Moss Landing 500/230 kV and Los Banos 500/230 kV	P6	T-1/T-1	<95%	<95%	<95%	<95%	<95%	119.1%	118.8%	<95%	<95%	<95%	
	Los Banos-Midway #1 500 kV & Midway 500/230 kV # 11, 12 or 13	P6	L-1/T-1	<95%	<95%	<95%	<95%	<95%	118.3%	118.7%	<95%	<95%	<95%	
	Los Banos-Midway 500 kV & Los Banos 500/230 kV	P6	L-1/T-1	<95%	<95%	<95%	<95%	<95%	117.6%	122.5%	<95%	<95%	<95%	
	Tesla-Vaca Dix and Tesla-Metcalf 500 kV	P6	L-1/L-1	<95%	<95%	<95%	<95%	<95%	115.7%	115.7%	<95%	<95%	<95%	
	Tracy-Tesla and Tesla-Metcalf 500 kV	P6	L-1/L-1	<95%	<95%	<95%	<95%	<95%	115.1%	115.3%	<95%	<95%	<95%	
	Two Midway 500/230 kV x-formers	P6	T-1/T-1	<95%	<95%	<95%	<95%	<95%	111.9%	114.5%	<95%	<95%	<95%	
	Table Mtn 500/230 kV and Round Mtn 500/230 kV, or two Metcalf 500/230 kV	P6	T-1/T-1	<95%	<95%	<95%	<95%	<95%	110.1%	112.3%	<95%	<95%	<95%	
	two Metcalf 500/230 kV transformers	P6	T-1/T-1	<95%	<95%	<95%	<95%	<95%	109.8%	111.2%	<95%	<95%	<95%	

2017-2018 ISO Reliability Assessment - Study Results

Study Area: **PG&E Bulk**



Overloaded Facility	Worst Contingency	Category	Category Description	Loading (%)										Potential Mitigation Solutions
				2019 Summer Peak	2022 Summer Peak	2027 Summer Peak	2027 Summer Partial Peak	2019 Light Spring	2022 Spring Off-peak	2027 Spring Off-peak	2022 Summer Peak, High renew	2027 Summer Peak shift	2022 Spring Off-peak, max PV	
	Table Mtn 500/230 kV and Tesla or Vaca Dix 500/230 kV	P6	T-1/T-1	<95%	<95%	<95%	<95%	<95%	109.4%	111.7%	<95%	<95%	<95%	
	Los Banos 500/230 and Midway 500/230 # 11,12 or 13	P6	T-1/T-1	<95%	<95%	<95%	<95%	<95%	106.2%	113.5%	<95%	<95%	<95%	
	Midway 500/230 kV and Moss Landing-Coburn 230 kV	P6	T-1/L-1	<95%	<95%	<95%	<95%	<95%	115.8%	119.2%	<95%	<95%	<95%	
	Tesla - Los Banos 500 kV & Moss Landing-Coburn 230 kV	P6	L-1/L-1	<95%	<95%	<95%	<95%	<95%	139.7%	139.2%	<95%	<95%	<95%	
	Tesla -Metcalf 500 kV & Moss Landing-Coburn 230 kV	P6	L-1/L-1	<95%	<95%	<95%	<95%	<95%	136.4%	137.6%	<95%	<95%	<95%	
	Mosslanding-Coburn 230 kV & 500 kV line from Los Banos	P6	L-1/L-1	<95%	<95%	<95%	<95%	<95%	138.2%	137.9%	<95%	<95%	<95%	
	Moss Landing-Los Banos 500 kV & Moss Landing-Coburn 230 kV	P6	L-1/L-1	<95%	<95%	<95%	<95%	<95%	179.9%	174.7%	<95%	<95%	<95%	
	Moss Landing-Los Banos 500 kV & Westley-Quinto 230 kV	P6	L-1/L-1	<95%	<95%	<95%	<95%	<95%	173.5%	167.2%	<95%	<95%	<95%	
	Moss Landing-Los Banos 500 kV & other 230 kV lines	P6	L-1/L-1	<95%	<95%	<95%	<95%	<95%	170.4%	164.4%	<95%	<95%	<95%	
	other 500 kV lines & Westley-Quinto 230 kV	P6	L-1/L-1	<95%	<95%	<95%	<95%	<95%	136.1%	128.4%	<95%	<95%	<95%	
MOSSLANDING-LAS AGUILAS 230 kV	Los Banos-Gates #1 and Los Banos-Midway 500 kV	P7	L-2	<95%	<95%	<95%	<95%	<95%	120.7%	118.1%	<95%	<95%	<95%	reduce output of the project connected to Las Aguilas, increase generation from Moss Landing. Use short-term rating or trip 3rd Helms pump
	Los Banos-Tracy and Los Banos-Tesla 500 kV w/RAS off -peak	P7	L-2	<95%	<95%	<95%	<95%	<95%	132.4%	128.9%	<95%	<95%	<95%	
MOSS LANDING-COBURN 230 kV	Metcalf-Tesla & Mosslandg-Los Banos 500kV	P6	L-1/L-1	<95%	<95%	<95%	<95%	<95%	107.5%	101.5%	<95%	<95%	<95%	Dispatch Moss Landing generation after first contingency
	Moss Landing - Las Aguilas 230 kV & Mosslanding-Los Banos 500 kV	P6	L-1/L-1	<95%	<95%	<95%	<95%	<95%	108.7%	106.6%	<95%	<95%	<95%	
LAS AGUILASS-PANOCH 230kV #1 or #2	Tesla-Metcalf 500 kV & Moss Landing-Los Banos 500 kV	P6	L-1/L-1	<95%	<95%	<95%	<95%	<95%	103.9%	<95%	<95%	<95%	<95%	Dispatch Moss Landing generation after first contingency
PANOCH-DOS AMIGOS 230 kV	Gates 500/230 kV transformer	P1	T-1	<95%	<95%	<95%	<95%	<95%	<95%	96.6%	<95%	<95%	<95%	istall 2-nd Gates transformer
PANOCH-DOS AMIGOS 230 kV	Los Banos-Gates # 1 and # 3 500 kV	P6	L-1/L-1	<95%	<95%	<95%	<95%	<95%	109.9%	109.2%	<95%	<95%	<95%	Follow Operational Procedure for Path 15 after first contingency
	Gates-Midway 500 kV and Gates 500/230 kV	P6	L-1/T-1	<95%	<95%	<95%	<95%	<95%	<95%	105.5%	<95%	<95%	<95%	
	Gates 500/230 kV and Midway 500/230 kV	P6	T-1/T-1	<95%	<95%	<95%	<95%	<95%	<95%	104.4%	<95%	<95%	<95%	

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Study Area: **PG&E Bulk**



Overloaded Facility	Worst Contingency	Category	Category Description	Loading (%)										Potential Mitigation Solutions
				2019 Summer Peak	2022 Summer Peak	2027 Summer Peak	2027 Summer Partial Peak	2019 Light Spring	2022 Spring Off-peak	2027 Spring Off-peak	2022 Summer Peak, High renew	2027 Summer Peak shift	2022 Spring Off-peak, max PV	
	Los Banos-Gates # 1 500 kV and Gates 500/230 kV	P6	L-1/T-1	<95%	<95%	<95%	<95%	<95%	<95%	102.6%	<95%	<95%	<95%	
PANOCHÉ-GATES # 1 and 2 230 kV	Los Banos-Gates #1 and #3 500 kV	P6	L-1/L-1	<95%	<95%	<95%	<95%	<95%	130.4%	101.0%	<95%	<95%	<95%	Reduce Path 15 flow under normal conditions, follow Operational Procedure after first contingency
	Los Banos-Gates # 3 and Los Banos-Midway 500 kV	P6	L-1/L-1	<95%	<95%	<95%	<95%	<95%	101.6%	<95%	<95%	<95%	<95%	
	Moss Landing-Los Banos and Los Banos-Gates # 1 500 kV	P6	L-1/L-1	<95%	<95%	<95%	<95%	<95%	99.0%	<95%	<95%	<95%	<95%	
PANOCHÉ_GATES # 1 and # 2 230 kV	Los Banos-Gates #1 and Los Banos-Midway 500 kV	P7	L-2	<95%	<95%	<95%	<95%	<95%	99.9%	<95%	<95%	<95%	<95%	Reduce Path 15 flow under normal conditions
MORROBAY- SOLARSS 230 kV # 1 or # 2	Gates-Midway 500 kV & Morro Bay-Solar SS 230 kV # 2 or # 1	P6	L-1/L-1	<95%	<95%	<95%	<95%	<95%	112.0%	100.3%	<95%	<95%	<95%	reduce generation from Topaz Solar after first contingency
	Midway 500/230 kV x-former # 11,12 or 13 & Morro Bay-Solar SS 230 kV #2 or #1	P6	L-1/L-1	<95%	<95%	<95%	<95%	<95%	107.1%	<95%	<95%	<95%	<95%	
	Gates-Diablo 500 kV & Morro Bay-Solar SS 230 kV # 2 or # 1	P6	L-1/L-1	<95%	<95%	<95%	<95%	<95%	101.0%	<95%	<95%	<95%	<95%	
	Los Banos-Midway 500 kV & Morro Bay-Solar SS 230 kV # 2 or # 1	P6	L-1/L-1	<95%	<95%	<95%	<95%	<95%	106.8%	<95%	<95%	<95%	<95%	
GATES -CALFLATSSS 230 kV	Gates-Midway and Gates-Diablo 500 kV	P6	L-1/L-1	<95%	<95%	<95%	<95%	<95%	98.7%	<95%	<95%	<95%	<95%	reduce generation from renewable project connected to Estrella-Gates 230 kV line
GATES-MIDWAY 230 kV	Gates-Midway and Gates-Diablo 500 kV	P6	L-1/L-1	<95%	<95%	<95%	<95%	<95%	107.0%	<95%	<95%	<95%	<95%	Short-term emergency rating used. Reduce Path 15 flow under normal conditions
115 kV LINES														
DRUM-BRUNSW-RIO OSO 115 kV	Round Mtn-Table Mtn #1 & 2 500 kV	P7	L-2	104.9%	100.3%	<95%	101.4%	<95%	<95%	<95%	111.8%	102.6%	<95%	reduce Drum generation
PEASE-E.MRSVLE-OLIVH 115 kV	Tbl Mtn-Tesla 500 kV and Tbl Mtn-Rio Oso 230 kV	P6	L-1/L-1	107.4%	<95%	<95%	<95%	<95%	<95%	<95%	<95%	<95%	<95%	South of Palermo Project. Prior to the project: limit COI import within nomogram
	Tbl Mtn-Vaca Dix 500 kV and Table Mtn-Rio Oso 230 kV	P6	L-1/L-1	113.9%	<95%	<95%	<95%	<95%	<95%	<95%	<95%	<95%	<95%	
RIO OSO-GREENLEAF TAP 115 kV	Tbl Mtn-Tesla 500 kV and Colgate-Rio Oso 230 kV	P6	L-1/L-1	109.9%	<95%	<95%	<95%	<95%	<95%	<95%	<95%	<95%	<95%	South of Palermo Project. Prior to the project: limit COI import within nomogram
	Tbl Mtn-Vaca Dix 500 kV and Colgate-Rio Oso 230 kV	P6	L-1/L-1	113.9%	<95%	<95%	<95%	<95%	<95%	<95%	<95%	<95%	<95%	
RIO OSO-GREENLEAF TAP 115 kV	Tbl Mtn-Tesla & Tbl Mtn-Vaca Dix 500 kV	P7	L-2	98.3%	<95%	<95%	<95%	<95%	<95%	<95%	<95%	<95%	<95%	

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Study Area: PG&E Bulk



Overloaded Facility	Worst Contingency	Category	Category Description	Loading (%)										Potential Mitigation Solutions
				2019 Summer Peak	2022 Summer Peak	2027 Summer Peak	2027 Summer Partial Peak	2019 Light Spring	2022 Spring Off-peak	2027 Spring Off-peak	2022 Summer Peak, High renew	2027 Summer Peak shift	2022 Spring Off-peak, max PV	
NEWARK F - LCKHD J1 115kV	Tesla-Metcalf 500 kV & Moss Landing-Los Banos 500 kV	P6	L-1/L-1	<95%	99.2%	<95%	105.7%	<95%	99.9%	<95%	<95%	100.3%	<95%	dispatch Metcalf generation after 1st contingency
TRIMBLE - SAN JOSE B DG 115 kV	Tesla-Metcalf 500 kV	P1	L-1	<95%	100.8%	102.4%	<95%	<95%	<95%	<95%	<95%	101.9%	<95%	reduce generation from Los Esteros or increase generation from Metcalf, or upgrade the line. See mitigation in the local area studies
TRIMBLE - SAN JOSE B DG 115 kV	Tesla-Metcalf 500 kV & Metcalf 500/230 kV	P2	BRK	<95%	102.5%	104.0%	<95%	<95%	<95%	<95%	<95%	103.9%	<95%	
TRIMBLE - SAN JOSE B DG 115 kV	Tesla-Metcalf 500 kV & Moss Landing-Los Banos 500 kV	P6	L-1/L-1	109.9%	140.3%	139.9%	147.1%	<95%	102.0%	<95%	109.0%	153.8%	<95%	reduce generation from Los Esteros or increase generation from Metcalf, or upgrade the line. See mitigation in the local area studies
	Tesla-Metcalf 500 kV & Moss Landing-Metcalf 500 kV	P6	L-1/L-1	108.0%	132.9%	133.3%	125.2%	<95%	<95%	<95%	103.1%	140.1%	<95%	
	Tesla-Metcalf 500 kV & SSS 230 - NRSraser 230	P6	L-1/L-1	<95%	114.3%	116.0%	102.5%	<95%	<95%	<95%	<95%	115.7%	<95%	
	Tesla-Metcalf 500 kV & Tesla-Los Banos 500 kV	P6	L-1/L-1	<95%	110.1%	111.6%	<95%	<95%	<95%	<95%	<95%	106.9%	<95%	
	Tesla-Metcalf 500 kV & Tesla-Vaca Dlx 500 kV	P6	L-1/L-1	<95%	103.3%	104.9%	<95%	<95%	<95%	<95%	<95%	104.0%	<95%	
MIDWAY-BELRIDGE JCT (MIDWAY-TEMBLOR) 115 kV	normal conditions	P0	L-1	<95%	<95%	<95%	102.2%	<95%	<95%	<95%	<95%	<95%	<95%	decrease generation at Midway or dispatch generation at Pump Jack
MIDWAY-BELRIDGE JCT (MIDWAY-TEMBLOR) 115 kV	Gates-Midway 500 kV	P1	L-1	<95%	<95%	<95%	97.0%	<95%	<95%	<95%	<95%	<95%	<95%	install 2-nd Gates 500/230 kV transformer and decrease generation at Midway or dispatch generation at Pump Jack after first contingency if overload expected
	Gates 500/230 kV	P1	T-1	<95%	<95%	<95%	109.8%	<95%	<95%	<95%	<95%	<95%	<95%	
MIDWAY-BELRIDGE JCT (MIDWAY-TEMBLOR) 115 kV	Los Banos-Gates # 1 and Gates-Midway 500 kV	P2	BRK	<95%	<95%	<95%	97.7%	<95%	<95%	<95%	<95%	<95%	<95%	
	Gates-Midway and Diablo-Midway # 2 500kV	P2	BRK	<95%	<95%	<95%	98.3%	<95%	<95%	<95%	<95%	<95%	<95%	
MIDWAY-BELRIDGE JCT (MIDWAY-TEMBLOR) 115 kV	Los Banos 500/230 kV and Gates 500/230kV	P6	T-1/T-1	<95%	<95%	<95%	118.2%	<95%	<95%	<95%	<95%	<95%	<95%	install 2-nd Gates 500/230 kV transformer and decrease generation at Midway or dispatch generation at Pump Jack after first contingency if overload expected
	Gates-Midway 500 kV and Gates 500/230kV	P6	L-1/T-1	<95%	<95%	<95%	113.7%	<95%	<95%	<95%	<95%	<95%	<95%	
	Los Banos-Gates # 1 500 kV and Gates 500/230kV	P6	L-1/T-1	<95%	<95%	<95%	112.6%	<95%	<95%	<95%	<95%	<95%	<95%	
	Los Banos-Gates # 3 500 kV and Gates 500/230kV	P6	L-1/T-1	<95%	<95%	<95%	111.0%	<95%	<95%	<95%	<95%	<95%	<95%	
	Gates- Diablo 500 kV and Gates 500/230kV	P6	L-1/T-1	<95%	<95%	<95%	110.2%	<95%	<95%	<95%	<95%	<95%	<95%	
	Gates-Midway 500 kV and Diablo-Gates 500 kV	P6	L-1/L-1	<95%	<95%	<95%	104.6%	<95%	<95%	<95%	<95%	<95%	<95%	
LOWER VOLTAGE FACILITIES	ONLY NORMAL CONDITIONS OVERLOADS SHOWN													
GFFNJCT-GIFFEN 70 kV (Westlands-Helm 70 kV)	normal conditions	P0	normal	<95%	<95%	<95%	<95%	<95%	123.5%	129.0%	96.1%	<95%	108.3%	reduce output for solar PV at Giffen, if overload, mitigation in local area studies

Study Area: PG&E Bulk



Overloaded Facility	Worst Contingency	Category	Category Description	Loading (%)										Potential Mitigation Solutions
				2019 Summer Peak	2022 Summer Peak	2027 Summer Peak	2027 Summer Partial Peak	2019 Light Spring	2022 Spring Off-peak	2027 Spring Off-peak	2022 Summer Peak, High renew	2027 Summer Peak shift	2022 Spring Off-peak, max PV	
AVENAL T - KETTLEMAN T 70 kV	normal conditions	P0	normal	<95%	<95%	<95%	<95%	<95%	103.5%	104.0%	<95%	<95%	<95%	reduce output from Sun City and/or Sandrag, mitigation in local area studies
HELM-STROUD 70 kV	normal conditions	P0	normal	<95%	<95%	<95%	<95%	<95%	<95%	101.0%	<95%	<95%	<95%	reduce output of solar PV connected to Helm 70 kV, mitigation in local area studies
MENDOTA-BIOMASS -ADAMS70 kV	normal conditions	P0	normal	<95%	<95%	<95%	<95%	<95%	<95%	166.3%	<95%	<95%	<95%	reduce output from Adams E, mitigation in local area studies
WHEELR 115/70 kV	normal conditions	P0	normal	<95%	<95%	<95%	<95%	<95%	<95%	127.7%	<95%	<95%	<95%	reduce output of solar PV connected to Wheeler, mitigation in local area studies
HELM 230/70 kV	normal conditions	P0	normal	<95%	<95%	<95%	<95%	<95%	114.7%	<95%	95.4%	<95%	<95%	reduce output of solar PV connected to Helm 70 kV, mitigation in local area studies
KETTLEMAN T -GATES 70 kV	normal conditions	P0	normal	<95%	<95%	<95%	<95%	<95%	151.8%	154.6%	126.6%	<95%	140.7%	reduce output from Sun City and/or Sandrag, mitigation in local area studies
AFFECTED SYSTEMS														
Ponderosa B -Captain Jack 500kV (Fort Rock series caps)	PDCI bi-pole	P7	PDCI	101.2%	126.0%	109.4%	108.4%	<95%	<95%	<95%	125.0%	108.62	<95%	overload due to insertion of Fort Rock series capacitors. Case diverges if they are not inserted, 2700 MW NW was tripped by RAS in 2022 and 2027, 2400 MW in 2019. Discuss with BPA as affected system
Grizzly-Malin 500kV (Fort Rock series caps)	PDCI bi-pole	P7	PDCI	100.7%	107.8%	<95%	<95%	<95%	<95%	<95%	107.1%	<95%	<95%	

Study Area: PG&E Bulk

Voltage Deviations



ID	Substation	Worst Contingency	Category	Category Description	Post Cont. Voltage Deviation %										Potential Mitigation Solutions
					2019 Summer Peak	2022 Summer Peak	2027 Summer Peak	2027 Summer Partial Peak	2019 Light Spring	2022 Spring Off-peak	2027 Spring Off-peak	2022 Summer Peak, High renew	2027 Summer Peak shift	2022 Spring Off-peak, max PV	
	NONE														
	OLINDA 500 kV	Round Mtn-Table Mtn # 1 and #2 500 kV	p7	L-2	<8%	<8%	<8%	<8%	<8%	<8%	<8%	10.9%	<8%	<8%	
	reactive margin	Paloverde units # 1 and 2	extreme	G-2	sufficient	sufficient	sufficient	sufficient	sufficient	sufficient	sufficient	insufficient	sufficient	sufficient	consider installing dynamic reactive device at Round Mtn
	reactive margin	Diablo units # 1 and 2	extreme	G-2	sufficient	sufficient	sufficient	sufficient	sufficient	sufficient	sufficient	insufficient	sufficient	sufficient	
	reactive margin	PDCI bi-pole	P7	DC	sufficient	sufficient	sufficient	sufficient	sufficient	sufficient	sufficient	insufficient	sufficient	sufficient	insert series capacitors at Ponderosa-Summer Lake 500 kV

Study Area: PG&E Bulk
High/Low Voltage



Substation	Worst Contingency	Category	Category Description	Voltage (kV)										Potential Mitigation Solutions
				2019 Summer Peak	2022 Summer Peak	2027 Summer Peak	2027 Summer Partial Peak	2019 Light Spring	2022 Spring Off-peak	2027 Spring Off-peak	2022 Summer Peak, High renew	2027 Summer Peak shift	2022 Spring Off-peak, max PV	
Diablo 500kV	normal conditions and all contingencies	P0-P7	normal & outages			>=549 kV - 552.2 (LB 500/230)	540					>=550 KV		consider installing shunt reactor or dynamic reactive device on Diablo or Gates 500 kV after Diablo Canyon plant retires and opening one of the Diablo-Midway 500kV lines
Diablo 500kV	normal conditions and all contingencies	P0-P7	normal & outages			553 (LB 500/230&Gates 500/230 or Moss 500/230)		up to 558 kV w/ Diablo1&2 out	>=543 kV norm 552 kV conting	>=544				
Midway 500 kV	normal conditions and all contingencies	P0-P7	normal & outages			>=540 kV						>=540 KV		
Gates 500 kV	normal conditions and all contingencies	P0-P7	normal & outages			>=545 kV		>=545				>=545 KV		
Gates 500 kV	contingencies	P0-P7	normal & outages					up to 553 kV				up to 552 kV		
Tracy 500 kV	normal conditions and all contingencies	P0-P7	normal & outages					>=544						
Tesla 500 kV	normal conditions and all contingencies	P0-P7	normal & outages					>=543						
Los Banos 500 kV	normal conditions and all contingencies	P0-P7	normal & outages					>=544						
Maxwell 500 kV	normal conditions and all contingencies	P0-P7	normal & outages					>=544					>=546	consider installing shunt reactor or dynamic reactive device on 500 kV in North PG&E
Maxwell 500 kV	Loss of one Diablo unit	P3	G-1			N/A	N/A	up to 555 kV	552 kV	N/A			up to 557 Kv	
Maxwell 500 kV	Loss of one Diablo unit & line or x-former	P3	G-1/L-1, or T-1			N/A	N/A	up to 557 kV	up to 555 kV	N/A			up to 557 KV	
Vaca Dixon 500 kV	normal conditions and all contingencies	P0-P7	normal & outages					>=543						
Table Mtn 500 kV	normal conditions and all contingencies	P0-P7	normal & outages					>=542						
Round Mtn 500 kV	normal conditions and all contingencies	P0-P7	normal & outages					>=541						
Alameda 115 kV	normal conditions	P0	normal & outages			up to 128.6 kV		up to 146.3 kV					up to 132.2 kV	mitigation in area studies
Cortina 115 kV system	normal conditions	P0	normal & outages			up to 123.5 kV		up to 124.6 kV						mitigation in area studies
Plain field 60 kV (Winters area)	normal conditions	P0	normal & outages			53.8 kV								mitigation in area studies, requires moving some load to other substations
500 kV buses in NW	normal conditions and all contingencies	P0-P7	normal & outages					up to 552 kV	up to 549 kV norm, 555 kV conting				up to 556 kV	reduce or turn off PDCI to increase COI North to South flow in part peak, turn on all available reactors in off peak
230, 115 and 60-70 kV in PG&E	normal conditions and all contingencies	P0-P7	normal & outages					up to 1.277 p.u					up to 1.095 p.u.	mitigation in area studies

Generator/Load	Contingency	Category	Category Description	Transient Stability Performance										Potential Mitigation Solutions
				2019 Summer Peak	2022 Summer Peak	2027 Summer Peak	2027 Summer Partial Peak	2019 Light Spring	2022 Spring Off-peak	2027 Spring Off-peak	2022 Summer Peak, High renew	2027 Summer Peak shift	2022 Spring Off-peak, max PV	
No violations if stalling of single phase air conditioners is disabled														need to develop more accurate load models
Delayed voltage recovery on the buses close to three phase faults with stalling of single phase air conditioners enabled														need to clarify criteria for transient voltage recovery
Voltages on all BES buses recovered to 80% of initial voltage for all buses and all contingencies														
32510 CHILI BAR, hydro	Tracy-Tesla and Tracy-Los Banos 500 kV	P7	L-2	tripped for under-excitation after 11 sec, 5.5 MW	not tripped, 5.5 MW	not tripped, 5.5 MW	not tripped, 5.5 MW	not tripped, 5.5 MW	not tripped, 7 MW	not tripped, 7 MW	not tripped, 5.5 MW	not tripped, 7 MW	not tripped, 3.3 kV	where tripped, high voltage in the base case, absorbs reactive power, went out-of-step
	Tesla-Metcalf 500 kV	P1	L-1											
	Tesla-Los Banos 500 kV	P1	L-1											
	Tracy-Los Banos 500 kV	P1	L-1											
	Tracy-Tesla 500 kV	P1	L-1											
	Tracy 500/230 kV	P1	T-1											
	Tesla 500/230 kV	P1	T-1											
	3phase faults on Tesla or Tracy	P6	L-1/L-1											
PV on bus 365554 on Midway-Wheelridge 230 kV	3phase fault on Midway 500 kV	P1-P7	any	tripped w/fault for high voltage, 25.1 MW	tripped w/fault for high voltage, 25.1 MW	tripped w/fault for high voltage, 25.1 MW	modeled off-line	modeled off-line	tripped w/fault for high voltage, 25.1 MW	tripped w/fault for high voltage, 25.1 MW	tripped w/fault for high voltage, 25.1 MW	tripped w/fault for high voltage, 25.1 MW	tripped w/fault for high voltage, 25.1 MW	possibly numerical issue,
PV on bus 365534 connected to Gates 230 kV	3phase fault on Midway 500 kV	P1-P7	any	modeled off-line	tripped w/fault for high voltage, 37.6 MW	tripped w/fault for high voltage, 37.6 MW	modeled off-line	modeled off-line	tripped w/fault for high voltage, 37.6 MW	tripped w/fault for high voltage, 37.6 MW	tripped w/fault for high voltage, 37.6 MW	tripped w/fault for high voltage, 37.6 MW	tripped w/fault for high voltage, 37.6 MW	possibly numerical issue,
	3phase fault on Los Banos, Gates or Tesla 500 kV	P1-7	any											
PV bus 365539 on Gardner-Maricopa 70 kV	3phase fault at Midway 500 kV	P1-P7	any	tripped w/fault for high voltage, 5 MW	tripped w/fault for high voltage, 5.1 MW	tripped w/fault for high voltage, 5.1 MW	modeled off-line	modeled off-line	tripped w/fault for high voltage, 5.1 MW	tripped w/fault for high voltage, 5.1 MW	tripped w/fault for high voltage, 5.1 MW	tripped w/fault for high voltage, 5.1 MW	tripped w/fault for high voltage, 5.1 MW	numerical issue, high voltags in the base case
33102 COLUMBIA , solar PV	Tesla-Los Banos 500 kV	P1	L-1	tripped for high volt, 4.8 MW	not tripped, 4.8 MW	not tripped, 4.8 MW	not tripped, 4.8 MW	modeled off-line	not tripped, 19.2MW	not tripped, 19.2MW	not tripped, 19.2MW	not tripped, 1.3MW	not tripped, 17 MW	high voltages in the base case, need to turn off shunt capacitor
	Tracy-Los Banos 500 kV	P1	L-1											
	Tracy-Tesla 500 kV	P1	L-1											
	Tracy 500/230 kV	P1	T-1											
	Tesla 500/230 kV	P1	T-1											
	Vaca Dix 500/230kV	P1	T-1											
	3phase faults on Vaca Dix	P1	T-1											
32700 Monticello, hydro	Tesla-Los Banos 500 kV	P1	L-1	tripped for under-excitation, 1.5 MW	tripped for under-excitation, 1.5 MW	tripped for under-excitation, 1.5 MW	tripped for under-excitation, 1.5 MW	not tripped, 1.5 MW	not tripped, 1.5 MW	not tripped, 1.5 MW	not tripped, 1.5 MW	not tripped, 1.5 MW	not tripped , 3.4 MW	small units, possible modeling error
	Tesla 500/230 kV	P1	T-1											
	Tracy 500/230 kV	P1	T-1											
	Tesla-Metcalf 500 kV	P1	L-1											
	Tracy-Tesla 500 kV	P1	L-1											
	Vaca Dix 500/230kV	P1	T-1											
	3phase faults on Tesla or Vaca Dix	P6	L-1/L-1											
365502 Solar PV at HELM 70 kV	3phase fault on LOSBANOS 500 kV	P1-P7	any	not tripped, 5MW	not tripped, 5MW	not tripped, 5MW	modeled off-line	modeled off-line	not tripped, 20 MW	not tripped, 20 MW	not tripped, 20 MW	not tripped, 1.4 MW	tripped for high voltage with fault, 9 MW	possibly numerical issue,
Generator/Load	Contingency	Category	Category Description	Transient Stability Performance										Potential Mitigation Solutions
				2019 Summer Peak	2022 Summer Peak	2027 Summer Peak	2027 Summer Partial Peak	2019 Light Spring	2022 Spring Off-peak	2027 Spring Off-peak	2022 Summer Peak, High renew	2027 Summer Peak shift	2022 Spring Off-peak, max PV	

Study Area: **PG&E Bulk**

Single Contingency Load Drop



ID	Worst Contingency	Category	Category Description	Amount of Load Drop (MW)								Potential Mitigation Solutions
				Select..	Select..	Select..	Select..	Select..	Select..	Select..	Select..	

No single contingency resulted in total load drop of more than 250 MW.

Study Area: **PG&E Bulk**



Single Source Substation with more than 100 MW Load

ID	Substation	Load Served (MW)								Potential Mitigation Solutions
		Select..	Select..	Select..	Select..	Select..	Select..	Select..	Select..	

No single source substation with more than 100 MW Load