

# 2014-2015 ISO Reliability Assessment - Preliminary Study Results

Study Area: **PG&E Bulk - Summer Peak**

High/Low Voltage



ID	Substation	Contingency	Category	Category Description	Voltage (PU)				Potential Mitigation Solutions
					2016 Summer Peak	2019 Summer Peak	2019 Spring Peak	2024 Summer Peak	
BULK-PK-V-1	voltages below 0.95 p.u. on multiple buses in all cases	normal conditions	A						mitigation in area studies
BULK-PK-V-2	voltages above 1.05 p.u. on multiple buses in all cases	normal conditions	A						mitigation in area studies
BULK-PK-V-3	500 kV buses in Northwest	PDCI bi-pole	C	Bi-pole DC	up to 1.14	up to 1.13	up to 1.12	up to 1.14	trip Celilo capacitors, turn off capacitors at Ostrander 500 kV
BULK-PK-V-4	Robinson 345 kV, Sierra area	PDCI bi-pole	C	Bi-pole DC	0.89	>0.9	>0.9	>0.9	turn on shunt capacitor on Robinson 345kV
BULK-PK-V-5	500 kV buses in Northwest	Table Mtn-Tesla and Table Mtn-Vaca Dix 500 kV	C	L-2	up to 1.10	up to 1.10	<1.1	up to 1.10	turn on shunt reactor at Grizzly or turn off shunt capacitors at Ostrander and Celilo
BULK-PK-V-6	500 kV buses in Northwest	Table Mtn-Tesla and Tesla-Vaca Dix 500 kV	C	L-2	up to 1.11	up to 1.11	up to 1.11	up to 1.11	turn on shunt reactor at Grizzly or turn off shunt capacitors at Ostrander and Celilo

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Study Area: **PG&E Bulk - Summer Off-Peak & Summer Light Load**

**High/Low Voltage**



ID	Substation	Contingency	Category	Category Description	Voltage (PU)			Potential Mitigation Solutions
					2016 Summer Off-Peak	2019 Summer Light Load	2024 Summer Off-Peak	
BULK-NP-V-1	500kV buses in Northwest	Diablo unit # 2	B	G-1	up to 1.11	<1.1	<1.1	turn off shunt capacitors at Ostrander and Monroe
BULK-NP-V-2	Diablo 500 kV	Diablo unit # 2	B	G-1	<1.1	1.1	<1.1	open Diablo-Midway 500 kV line if hi vlt on Diablo
BULK-NP-V-3	500kV buses in Northwest	Diablo-Midway # 1 and 2 500 kV	C	L-2	up to 1.11	up to 1.11	<1.1	turn off shunt capacitors at Ostrander and Monroe
BULK-NP-V-4	500kV buses in Northwest	Tesla-Los Banos and Tracy-Los Banos 500 kV	C	L-2	up to 1.11	<1.1	<1.1	turn off shunt capacitors at Ostrander and Monroe
BULK-NP-V-5	500kV buses in Northwest	Los Banos-Gates # 1 and Los Banos-Midway 500 kV	C	L-2	up to 1.11	<1.1	<1.1	turn off shunt capacitors at Ostrander and Monroe
BULK-NP-V-6	500kV buses in Northwest	Midway-Gates and Los Banos-Midway 500 kV	C	L-2	up to 1.11	<1.1	<1.1	turn off shunt capacitors at Ostrander and Monroe

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Study Area: **PG&E Bulk - Summer Peak**



## Transient Stability

ID	Contingency	Category	Category Description	Transient Stability Performance				Potential Mitigation Solutions
				2016 Summer Peak	2019 Summer Peak	2019 Spring Peak	2024 Summer Peak	
BULK-SP-TS-1	3-phase fault Table Mtn 500 kV Table Mtn 500/230 kV x-former	B	T-1	no violations	no violations	frq below 59.6 Hz for up to 11.6 cyc on buses 60 kV system off Table Mtn	no violations	Possible modeling error, or consider tripping small units: WIN&MADE, JELD-WN, and HONEYLK
BULK-SP-TS-2	3phase fault Gates 230 kV, Gates-Midway 230 kV	B	L-1	no violations	no violations	no violations	Q650AB tripped for hi frq with fault	consider changing protection settings
BULK-SP-TS-3	3phase fault Midway 230 kV, Gates-Midway 230 kV	B	L-1	Q622B, Q621A tripped for under-vlt, Q557 for under-frq, Wheeler Rdg, Windgap and Buenavst pumps tripped for under-freq, Smyrna and Charka Id tripped for under-frq, vlt dev up to 41.1% and slow frq recovery in Wheeler Rdg area	Q622B, Q621A tripped for under-vlt, Q557 for under-frq, Wheeler Rdg, Windgap and Buenavst pumps tripped for under-freq, Smyrna and Charka Id tripped for under-frq, vlt dev up to 40.5% and slow frq recovery in Wheeler Rdg area	Wheeler Rdg, Windgap and Buenavst pumps tripped for under-freq, vlt dev up to 37.0% and slow frq recovery in Wheeler Rdg area	Windgap vlt dev up to 29.3%, and slow frq recovery in Wheelr Ridge area, Q622B, Q621A tripped for under-vlt, Q557 for under-frq, Smyrna and Charka Id tripped for under-frq	consider changing protection settings on renewable generators tripped with fault. Midway pumps need to have fast protection to be tripped with 3-phase faults
BULK-SP-TS-4	3 phase 230 kV C.Costa, CCosta-LasPositas 230 kV	B	L-1	3 wind gen tripped for undervlt (32171, 32176, 32177)	3 wind gen tripped for undervlt (32171, 32176, 32177)	3 wind gen tripped for undervlt (32171, 32176, 32177)	3 wind gen tripped for undervlt (32171, 32176, 32177)	these are old units, don't have Under-Voltage Ride Through
BULK-SP-TS-5	3phase fault Gates 230 kV, Gates-Arco and Gates-Midway 230 kV	C	L-2	no violations	no violations	no violations	Q650AB tripped for hi frq with fault	consider changing protection settings
BULK-SP-TS-6	3phase fault Gates 230 kV, Gates-Gregg and Gates-Mc Call230 kV	C	L-2	no violations	no violations	no violations	Q650AB tripped for hi frq with fault	consider changing protection settings

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## Transient Stability



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				2016 Summer Peak	2019 Summer Peak	2019 Spring Peak	2024 Summer Peak	
BULK-SP-TS-7	3phase fault Midway 230 kV, Midway-Kern 230 kV #1 and 2 230 kV	C	L-2	Q622B, Q621A tripped for under-vlt, Q557 for under-frq, Wheeler Rdg, Windgap and Buenavst pumps tripped for under-frq, Smyrna and Charka Id tripped for under-frq, vlt dev up to 40.8% and slow frq recovery in Wheeler Rdg area	Q622B, Q621A tripped for under-vlt, Q557 for under-frq, Wheeler Rdg, Windgap and Buenavst pumps tripped for under-frq, Smyrna and Charka Id tripped for under-frq, vlt dev up to 40.3% and slow frq recovery in Wheeler Rdg area	Wheeler Rdg, Windgap and Buenavst pumps tripped for under-frq, vlt dev up to 36.8% slow frq recovery in Wheeler Rdg area	slow frq recovery in Wheel Rdg area. Q622B, Q621A tripped for under-vlt, Q557 for under-frq, Smyrna and Charka Id tripped for under-frq	consider changing protection settings on renewable generators tripped with fault. Midway pumps need to have fast protection to be tripped with 3-phase faults
BULK-SP-TS-8	3 phase 230 kV C.Costa, C.Costa-LasPositas, Ccos-Lonetree 230 kV	C	L-2	3 wind gen tripped for undervlt (32171, 32176, 32177)	3 wind gen tripped for undervlt (32171, 32176, 32177)	3 wind gen tripped for undervlt (32171, 32176, 32177)	3 wind gen tripped for undervlt (32171, 32176, 32177)	these are old units, don't have Under-Voltage Ride Through
BULK-SP-TS-9	3 phase 230 kV C.Costa, C.Costa-Brentwd, Ccos-Delta 230 kV	C	L-2	3 wind gen tripped for undervlt (32171, 32176, 32177)	3 wind gen tripped for undervlt (32171, 32176, 32177)	3 wind gen tripped for undervlt (32171, 32176, 32177)	3 wind gen tripped for undervlt (32171, 32176, 32177)	these are old units, don't have Under-Voltage Ride Through

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Study Area: **PG&E Bulk - Summer Off-Peak & Summer Light Load**

## Transient Stability



ID	Contingency	Category	Category Description	Transient Stability Performance			Potential Mitigation Solutions
				2016 Summer Off-Peak	2019 Summer Light Load	2024 Summer Off-Peak	
BULK-NP-TS-1	3phase 500 kV Midway, Midway-Diablo 500 kV	B	L-1	Q621A tripped for low vlt, Q559 and Q622B tripped for hi frq	no violations, these units are off in the base case	Q621A and Q622B tripped for low vlt	consider changing protection settings
BULK-NP-TS-2	3phase 500 kV Midway, Midway-Gates 500 kV	B	L-1	Q621A tripped for low vlt, Q559 and Q622B tripped for hi frq	no violations, these units are off in the base case	Q621A and Q622B tripped for low vlt	consider changing protection settings
BULK-NP-TS-3	3phase 500 kV Midway, Midway-Los Banos 500 kV	B	L-1	Q621A tripped for low vlt, Q559 and Q622B tripped for hi frq	no violations, these units are off in the base case	Q621A and Q622B tripped for low vlt	consider changing protection settings
BULK-NP-TS-4	3phase 500 kV Midway, Midway-Vincent #1, 2 or 3 500 kV	B	L-1	Q621A tripped for low vlt, Q559 and Q622B tripped for hi frq	no violations, these units are off in the base case	Q621A and Q622B tripped for low vlt	consider changing protection settings
BULK-NP-TS-5	3phase 500 kV Midway, Midway 500/230 kV x-former	B	T-1	Q621A tripped for low vlt, Q559 and Q622B tripped for hi frq	no violations, these units are off in the base case	Q621A and Q622B tripped for low vlt	consider changing protection settings
BULK-NP-TS-6	3phase fault Gates 230 kV, Midway-Gates 230 kV	B	L-1	Q650AB and Q636 tripped for low vlt	no violations, these units are off in the base case	Q650AB and Q636 tripped for low vlt	consider changing protection settings
BULK-NP-TS-7	3phase fault Midway 230 kV, Midway-Gates 230 kV	B	L-1	Windgap, Wheelr Rdg and Buenavsta pumps tripped for under-frequency, Q621A and Q622B tripped for low vlt, Q559 for hi frq, Q557 for low frq; slow frq recovery in Wheel Rdg area	Windgap, Wheel Rdg and Buenavs pumps tripped for under-frq	Q621A and Q622B tripped for low vlt, Q557 tripped for low frq, slow frq recovery in Wheelr Rdg area, Buenavst 1, Smyrna and Charka tripped for under-frq. Vlt dip Windgap2 29.9%	consider changing protection settings on renewable generators tripped with fault. Midway pumps need to have fast protection to be tripped with 3-phase faults

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Study Area: **PG&E Bulk - Summer Off-Peak & Summer Light Load**
**Transient Stability**


ID	Contingency	Category	Category Description	Transient Stability Performance			Potential Mitigation Solutions
				2016 Summer Off-Peak	2019 Summer Light Load	2024 Summer Off-Peak	
BULK-NP-TS-8	3 phase fault Round Mtn, Round Mtn 500/230 kV x-former	B	T-1	frq dip Round Mtn 230 kV bus	Kilarc gen out-of-step	no violations	possible modeling error
BULK-NP-TS-9	3 phase fault 230 kV Newark, Newark-Ravenswood 230 kV	B	L-1	2 wind gen tripped for undervlt (32176, 32177)	no violations	no violations	these are old units, don't have Under-Voltage Ride Through
BULK-NP-TS-10	3 phase fault 230 kV Tesla, Newark-Tesla 230 kV	B	L-1	2 wind gen tripped for undervlt (32176, 32177)	no violations	no violations	these are old units, don't have Under-Voltage Ride Through
BULK-NP-TS-11	3 phase fault 230 kV C.Costa, C.Costa-LasPositas 230 kV	B	L-1	3 wind gen tripped for undervlt (32171, 32176, 32177)	3 wind gen tripped for undervlt (32171, 32176, 32177)	3 wind gen tripped for undervlt (32171, 32176, 32177)	these are old units, don't have Under-Voltage Ride Through
BULK-NP-TS-12	3phase fault Olinda 500 kV, Olinda 500/230 kV	B	T-1	no violations	Kilarc gen out-of-step	no violations	possible modeling error
BULK-NP-TS-13	3phase fault Cottonwd 230 kV, Cottonwd-Olinda 230 kV	B	L-1	no violations	Kilarc gen out-of-step	no violations	possible modeling error
BULK-NP-TS-14	3 phase fault Midway 500 kV, Midway-Vincent # 1 and #2 500 kV	C	L-2	Q621A tripped for low vlt, Q559 and Q622B for hi frq	no violations, these units are off in the base case	Q621A and Q622B tripped for low vlt	consider changing protection settings
BULK-NP-TS-15	3 phase fault Midway 500 kV, Midway-Gates and Midway-Los Banos 500 kV	C	L-2	Q621A tripped for low vlt, Q559 and Q622B for hi frq	no violations, these units are off in the base case	Q621A and Q622B tripped for low vlt	consider changing protection settings
BULK-NP-TS-16	3phase fault Midway 230 kV, Midway-Kern #1 and 2 230kV	C	L-2	Windgap, Wheel Rdg and Buenavs pumps tripped for under-frq, slow frq recovery in Wheel Rdg area, Q621A and Q622B tripped for low vlt, Q559 for hi frq, Q557 for low frq;	Windgap, Wheel Rdg and Buenavs pumps tripped for under-frq	Q621A and Q622B tripped for low vlt, Q557 tripped for low frq, slow frq recovery in Wheel Rdg area, Buenavst 1, Smyrna and Charka tripped for under-frq. WIndgap2 vlt dip 30.4%	consider changing protection settings on renewable generators tripped with fault. Midway pumps need to have fast protection to be tripped with 3-phase faults

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Study Area: **PG&E Bulk - Summer Off-Peak & Summer Light Load**

### Transient Stability



ID	Contingency	Category	Category Description	Transient Stability Performance			Potential Mitigation Solutions
				2016 Summer Off-Peak	2019 Summer Light Load	2024 Summer Off-Peak	
BULK-NP-TS-17	3phase fault Gates 230 kV, Gates-Arco and Gates-Midway 230 kV	C	L-2	Q650AB and Q636 tripped for low vlt	no violations, these units are off in the base case	Q650AB and Q636 tripped for low vlt	consider changing protection settings
BULK-NP-TS-18	3 phase 230 kV C.Costa, CCosta-LasPositas, Ccos-Lonetree 230 kV	C	L-2	3 wind gen tripped for undervlt (32171, 32176, 32177)	3 wind gen tripped for undervlt (32171, 32176, 32177)	3 wind gen tripped for undervlt (32171, 32176, 32177)	these are old units, don't have Under-Voltage Ride Through
BULK-NP-TS-19	3 phase 230 kV C.Costa, CCosta-Brentwd, Ccos-Delta230 kV	C	L-2	3 wind gen tripped for undervlt (32171, 32176, 32177)	3 wind gen tripped for undervlt (32171, 32176, 32177)	3 wind gen tripped for undervlt (32171, 32176, 32177)	these are old units, don't have Under-Voltage Ride Through
BULK-NP-TS-20	3phase fault Gates 230 kV, Gates-Gregg and Gates-Mc Call230 kV	C	L-2	Q650AB and Q636 tripped for low vlt	no violations, these units are off in the base case	Q650AB and Q636 tripped for low vlt	consider changing protection settings

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Study Area: **PG&E Bulk - Summer Peak**

**Post-Transient Thermal Overloads**



ID	Overloaded Facility	Contingency	Category	Category Description	Loading (%)				Potential Mitigation Solutions
					2016 Summer Peak	2019 Summer Peak	2019 Spring Peak	2024 Summer Peak	
BULK-PK-PTT-1	Table Mtn-Vaca Dixon 500 kV	normal conditions	A	normal	<95%	<95%	98.7%	<95%	operate within seasonal COI nomogram
BULK-PK-PTT-2	Eight Mile-Lodi 230 kV	normal conditions	A	normal	<95%	<95%	113.4%	<95%	reduce Lodi and Stig generation or install series reactor on this line, or upgrade the line
BULK-PK-PTT-3	Oro Loma 115/70 # 2	normal conditions	A	Normal	107.5%	<95%	<95%	<95%	mitigation in the area studies
BULK-PK-PTT-4	Rnd Mtn –Table Mtn #1 or #2 500 kV	Rnd Mtn –Table Mtn #2 or #1 500 kV	B	L-1	101.7%	102.3%	106.0%	100.8%	bypass ser caps on the remaining Round Mtn-Table Mtn 500 kV line or reduce COI flow according to seasonal nomogram
BULK-PK-PTT-5	Eight Mile-Lodi 230 kV	Captain Jack-Olinda 500 kV	B	L-1	<95%	<95%	99.4%	<95%	reduce Lodi and Stig generation or install series reactor on this line, or upgrade the line
BULK-PK-PTT-6	Eight Mile-Lodi 230 kV	Olinda-Tracy 500 kV	B	L-1	<95%	<95%	104.2%	<95%	reduce Lodi and Stig generation or install series reactor on this line, or upgrade the line
BULK-PK-PTT-7	Eight Mile-Lodi 230 kV	Table Mtn-Tesla 500 kV	B	L-1	<95%	<95%	110.7%	<95%	reduce Lodi and Stig generation or install series reactor on this line, or upgrade the line
BULK-PK-PTT-8	Eight Mile-Lodi 230 kV	Table Mtn 500/230 kV x-former	B	L-1	<95%	<95%	116.5%	<95%	reduce Lodi and Stig generation or install series reactor on this line, or upgrade the line
BULK-PK-PTT-9	Eight Mile-Lodi 230 kV	Table Mtn-Vaca Dixon 500 kV	B	L-1	<95%	<95%	115.8%	<95%	reduce Lodi and Stig generation or install series reactor on this line, or upgrade the line
BULK-PK-PTT-10	Eight Mile-Lodi 230 kV	Tesla 500/230 kV x-former	B	L-1	<95%	<95%	98.9%	<95%	reduce Lodi and Stig generation or install series reactor on this line, or upgrade the line
BULK-PK-PTT-11	Eight Mile-Lodi 230 kV	Vaca Dixon-Tesla 500 kV	B	L-1	<95%	<95%	100.4%	<95%	reduce Lodi and Stig generation or install series reactor on this line, or upgrade the line



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**Post-Transient Thermal Overloads**



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					2016 Summer Peak	2019 Summer Peak	2019 Spring Peak	2024 Summer Peak	
BULK-PK-PTT-12	Eight Mile-Lodi 230 kV	PDCI mono-pole	B	PDCI	<95%	<95%	100.6%	<95%	reduce Lodi and Stig generation or install series reactor on this line, or upgrade the line
BULK-PK-PTT-13	Eight Mile-Lodi 230 kV	Diablo unit 2	B	G-1	<95%	<95%	100.6%	<95%	reduce Lodi and Stig generation or install series reactor on this line, or upgrade the line
BULK-PK-PTT-14	Captain Jack-Olinda 500 kV	Malin- Round Mtn #1 and #2 500 kV	C	L-2	100.4%	105.3%	104.1%	100.1%	operate within seasonal COI nomogram
BULK-PK-PTT-15	Captain Jack-Olinda 500 kV	Round Mtn-Table Mtn # 1 and # 2 500 kV	C	L-2	101.2%	104.9%	105.9%	100.6%	operate within seasonal COI nomogram
BULK-PK-PTT-16	Olinda-Tracy 500 kV	Round Mtn-Table Mtn # 1 and 2 500 kV	C	L-2	<95%	<95%	105.1%	<95%	operate within seasonal COI nomogram
BULK-PK-PTT-17	Olinda-Tracy 500 kV	Table Mtn-Tesla and Table Mtn-Vaca Dix 500 kV	C	L-2	<95%	<95%	101.9%	<95%	operate within seasonal COI nomogram
BULK-PK-PTT-18	Table Mtn-Vaca Dixon 500 kV	Tesla 500 kV stuck breaker	C	BRK	<95%	<95%	98.6%	<95%	not a violation
BULK-PK-PTT-19	Round Mtn 500/230 kV x-former	Malin-Round Mtn # 1 and 2 500 kV	C	L-2	<95%	<95%	101.0%	<95%	operate within COI nomogram
BULK-PK-PTT-20	Delta-Cascade 115 kV	Malin- Round Mtn #1 and #2 500 kV	C	L-2	100.7%	102.3%	102.2%	99.7%	adjust Weed phase shifter
BULK-PK-PTT-21	Delevan-Cortina 230 kV	Round Mtn-Table Mtn # 1 and # 2 500 kV	C	L-2	102.8%	104.1%	97.0%	101.7%	assess the use of COI nomogram and determine if additional mitigation is required
BULK-PK-PTT-22	Delevan-Cortina 230 kV	Tbl Mtn-Tesla and Tbl Mtn-Vaca Dix 500 kV	C	L-2	106.0%	106.5%	104.8%	103.7%	assess the use of COI nomogram and determine if additional mitigation is required
BULK-PK-PTT-23	Cottonwood E-Round Mtn 230kV #3	Tbl Mtn-Tesla and Tbl Mtn-Vaca Dix 500 kV	C	L-2	105.0%	106.1%	117.0%	104.8%	upgrade the line, or limit COI import within nomogram
BULK-PK-PTT-24	Cottonwood-Round Mtn # 2 230 kV	Table Mtn-Tesla and Table Mtn-Vaca Dix 500 kV	C	L-2	<95%	<95%	106.1%	<95%	upgrade the line, or limit COI import within nomogram
BULK-PK-PTT-25	Pease-E.Marysville 115 kV	Tbl Mtn-Tesla and Tbl Mtn-Vaca Dix 500 kV	C	L-2	96.3%	<95%	<95%	<95%	South of Palermo Project. Prior to the project: limit COI import within nomogram

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BULK-PK-PTT-26	Table Mtn-Rio Oso 230 kV	Tbl Mtn-Tesla and Tbl Mtn-Vaca Dix 500 kV	C	L-2	102.1%	107.2%	103.4%	107.8%	Upgrade terminal equipment on this line (approved project)
BULK-PK-PTT-27	Eight Mile-Lodi 230 kV	Tbl Mtn-Tesla and Tbl Mtn-Vaca Dix 500 kV	C	L-2	99.9%	97.5%	136.0%	103.0%	reduce Lodi and Stig generation or install series reactor on this line, or upgrade the line
BULK-PK-PTT-28	Eight Mile-Lodi 230 kV	PDCI bi-pole	C	PDCI	<95%	<95%	104.9%	<95%	reduce Lodi and Stig generation or install series reactor on this line, or upgrade the line
BULK-PK-PTT-29	Eight Mile-Lodi 230 kV	Diablo-Midway #1 and 2 500 kV	C	L-2	<95%	<95%	100.7%	<95%	reduce Lodi and Stig generation or install series reactor on this line, or upgrade the line
BULK-PK-PTT-30	Eight Mile-Lodi 230 kV	Tesla-Vaca Dix& Tesla-Table Mtn 500 kV	C	L-2	<95%	<95%	115.6%	<95%	reduce Lodi and Stig generation or install series reactor on this line, or upgrade the line
BULK-PK-PTT-31	Eight Mile-Lodi 230 kV	Round Mtn 500 kV stuck breaker	C	BRK	<95%	<95%	104.4%	<95%	reduce Lodi and Stig generation or install series reactor on this line, or upgrade the line
BULK-PK-PTT-32	Eight Mile-Lodi 230 kV	Table Mtn 500 kV stuck breaker	C	BRK	<95%	<95%	106.1%	<95%	reduce Lodi and Stig generation or install series reactor on this line, or upgrade the line
BULK-PK-PTT-33	Eight Mile-Lodi 230 kV	Tesla 500 kV stuck breaker	C	BRK	<95%	<95%	104.0%	<95%	reduce Lodi and Stig generation or install series reactor on this line, or upgrade the line
BULK-PK-PTT-34	Eight Mile-Lodi 230 kV	Vac Dixon 500 kV stuck breaker	C	BRK	<95%	<95%	106.8%	<95%	reduce Lodi and Stig generation or install series reactor on this line, or upgrade the line
BULK-PK-PTT-35	Bellota-Weber 230 kV	Table Mtn-Tesla and Table Mtn-Vaca Dix 500 kV	C	L-2	<95%	<95%	101.9%	<95%	reduce Collierville generation
BULK-PK-PTT-36	Vaca Dix-Parkway 230 kV	Tesla-Vaca Dix and Tesla-Table Mtn 500 kV	C	L-2	<95%	<95%	100.7%	<95%	operate COI within seasonal nomogram
BULK-PK-PTT-37	Drum-Brunswick # 2 115 kV	Round Mtn-Table Mtn # 1 and 2 500 kV	C	L-2	<95%	<95%	104.9%	<95%	reduce Drum generation

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**Post-Transient Thermal Overloads**



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					2016 Summer Peak	2019 Summer Peak	2019 Spring Peak	2024 Summer Peak	
BULK-PK-PTT-38	Dutch Fl-Brunsw tap # 1 115 kV	Round Mtn-Table Mtn # 1 and 2 500 kV	C	L-2	<95%	<95%	98.1%	<95%	reduce Drum generation
BULK-PK-PTT-39	Rio Oso-Gleaf Tp 115 kV	Tbl Mtn-Tesla and Tbl Mtn-Vaca Dix 500 kV	C	L-2	96.8%	<95%	<95%	<95%	South of Palermo Project. Prior to the project: limit COI import within nomogram
BULK-PK-PTT-40	E. Marysvl-Olivenhn 115 kV	Tbl Mtn-Tesla and Tbl Mtn-Vaca Dix 500 kV	C	L-2	100.8%	<95%	<95%	<95%	South of Palermo Project. Prior to the project: limit COI import within nomogram
BULK-PK-PTT-41	C. Costa-Moraga # 2 230 kV (Rosstap-Moraga)	C.Costa-La Positas and C. Costa-Lone Tree 230 kV	C	L-2	102.9%	<95%	<95%	<95%	upgrade modeled starting from 2019 case, existing SPS to trip Mossing prior to upgrade
BULK-PK-PTT-42	Midway-Kern #1 230 kV	Midway-Kern 230 kV # 2 and 3	C	L-2	103.9%	<95%	<95%	<95%	trip Bakersfield load prior to upgrade
BULK-PK-PTT-43	Gregg-Ashlan 230 kV	Gregg-Herndon 230 kV # 1 and 2	C	L-2	155.4%	<95%	<95%	<95%	Ashlan upgrade project, SPS prior to upgrade

ID	Overloaded Facility	Contingency	Category	Category Description	Loading (%)			Potential Mitigation Solutions
					2016 Summer Off-Peak	2019 Summer Light Load	2024 Summer Off-Peak	
BULK-NP-PTT-1	Gates-Midway 500 kV	normal conditions	A	normal	95.5%	<95%	99.5%	if overload, reduce Path 15 flow
BULK-NP-PTT-2	Los Banos -Q577 SS 230 kV	Los Banos-Tesla and Los Banos-Tracy 500 kV	C	L-2	105.0%	<95%	117.2%	reconductor the line or congestion management
BULK-NP-PTT-3	Panoche-Gates 230 kV # 1 & 2	Los Banos-Gates #1 and Los Banos-Midway 500 kV	C	L-2	<95%	<95%	98.4%	no overload with appropriate RAS
BULK-NP-PTT-4	Gates-Midway 230 kV	Midway-Gates and Midway-Los Banos 500 kV	C	L-2	<95%	<95%	96.3%	may need to limit Path 15 if overload

Study Area: **PG&E Bulk - Summer Peak****Post-Transient Voltage Deviations**

ID	Substation	Contingency	Category	Category Description	Post Cont. Voltage Deviation %				Potential Mitigation Solutions
					2016 Summer Peak	2019 Summer Peak	2019 Spring Peak	2024 Summer Peak	
BULK-PK-PTVD-1	HOLLISTR 115.0	Moss Landing 500/230 kV x-former	B	T-1	<5%	<5%	<5%	5.30%	adjust svds and transformer taps, or add a breaker to Moss Landing 500 kV bus
BULK-PK-PTVD-2	NTVD SW2 115.0	Moss Landing 500/230 kV x-former	B	T-1	<5%	<5%	<5%	5.30%	adjust svds and transformer taps, or add a breaker to Moss Landing 500 kV bus
BULK-PK-PTVD-3	NTVD SW1 115.0	Moss Landing 500/230 kV x-former	B	T-1	<5%	<5%	<5%	5.30%	adjust svds and transformer taps, or add a breaker to Moss Landing 500 kV bus
BULK-PK-PTVD-4	PRUNEDLE 115.0	Moss Landing 500/230 kV x-former	B	T-1	<5%	<5%	<5%	5.10%	adjust svds and transformer taps, or add a breaker to Moss Landing 500 kV bus
BULK-PK-PTVD-5	SOLEDAD 115.0	Moss Landing 500/230 kV x-former	B	T-1	<5%	<5%	<5%	5.60%	adjust svds and transformer taps, or add a breaker to Moss Landing 500 kV bus
BULK-PK-PTVD-6	SALINAS 115.0	Moss Landing 500/230 kV x-former	B	T-1	<5%	<5%	<5%	5.30%	adjust svds and transformer taps, or add a breaker to Moss Landing 500 kV bus
BULK-PK-PTVD-7	CSTRVLE 115.0	Moss Landing 500/230 kV x-former	B	T-1	<5%	<5%	<5%	5.00%	adjust svds and transformer taps, or add a breaker to Moss Landing 500 kV bus
BULK-PK-PTVD-8	DEL MNTE 115.0	Moss Landing 500/230 kV x-former	B	T-1	<5%	<5%	<5%	5.30%	adjust svds and transformer taps, or add a breaker to Moss Landing 500 kV bus
BULK-PK-PTVD-9	HOLST D 115.0	Moss Landing 500/230 kV x-former	B	T-1	<5%	<5%	<5%	5.30%	adjust svds and transformer taps, or add a breaker to Moss Landing 500 kV bus
BULK-PK-PTVD-10	SNBENITO 115.0	Moss Landing 500/230 kV x-former	B	T-1	<5%	<5%	<5%	5.30%	adjust svds and transformer taps, or add a breaker to Moss Landing 500 kV bus
BULK-PK-PTVD-11	WTSNVLE 115.0	Moss Landing 500/230 kV x-former	B	T-1	<5%	<5%	<5%	5.00%	adjust svds and transformer taps, or add a breaker to Moss Landing 500 kV bus
BULK-PK-PTVD-12	GRANT RK 115.0	Moss Landing 500/230 kV x-former	B	T-1	<5%	<5%	<5%	5.10%	adjust svds and transformer taps, or add a breaker to Moss Landing 500 kV bus
BULK-PK-PTVD-13	BRIGTANO 115.0	Moss Landing 500/230 kV x-former	B	T-1	<5%	<5%	<5%	5.10%	adjust svds and transformer taps, or add a breaker to Moss Landing 500 kV bus
BULK-PK-PTVD-14	LGNTS J1 60.0	Moss Landing 500/230 kV x-former	B	T-1	<5%	<5%	<5%	5.50%	adjust svds and transformer taps, or add a breaker to Moss Landing 500 kV bus
BULK-PK-PTVD-15	GABILAN 60.0	Moss Landing 500/230 kV x-former	B	T-1	<5%	<5%	<5%	5.50%	adjust svds and transformer taps, or add a breaker to Moss Landing 500 kV bus
BULK-PK-PTVD-16	SALINAS2 60.0	Moss Landing 500/230 kV x-former	B	T-1	<5%	<5%	<5%	5.40%	adjust svds and transformer taps, or add a breaker to Moss Landing 500 kV bus

Study Area: **PG&E Bulk - Summer Peak****Post-Transient Voltage Deviations**

ID	Substation	Contingency	Category	Category Description	Post Cont. Voltage Deviation %				Potential Mitigation Solutions
					2016 Summer Peak	2019 Summer Peak	2019 Spring Peak	2024 Summer Peak	
BULK-PK-PTVD-17	SALINAS1 60.0	Moss Landing 500/230 kV x-former	B	T-1	<5%	<5%	<5%	5.40%	adjust svds and transformer taps, or add a breaker to Moss Landing 500 kV bus
BULK-PK-PTVD-18	BORONDA 60.0	Moss Landing 500/230 kV x-former	B	T-1	<5%	<5%	<5%	5.40%	adjust svds and transformer taps, or add a breaker to Moss Landing 500 kV bus
BULK-PK-PTVD-19	FORT ORD 60.0	Moss Landing 500/230 kV x-former	B	T-1	<5%	<5%	<5%	5.30%	adjust svds and transformer taps, or add a breaker to Moss Landing 500 kV bus
BULK-PK-PTVD-20	DEL MNTE 60.0	Moss Landing 500/230 kV x-former	B	T-1	<5%	<5%	<5%	5.30%	adjust svds and transformer taps, or add a breaker to Moss Landing 500 kV bus
BULK-PK-PTVD-21	MONTEREY 60.0	Moss Landing 500/230 kV x-former	B	T-1	<5%	<5%	<5%	5.30%	adjust svds and transformer taps, or add a breaker to Moss Landing 500 kV bus
BULK-PK-PTVD-22	NAVY SCHL 60.0	Moss Landing 500/230 kV x-former	B	T-1	<5%	<5%	<5%	5.30%	adjust svds and transformer taps, or add a breaker to Moss Landing 500 kV bus
BULK-PK-PTVD-23	VIEJO 60.0	Moss Landing 500/230 kV x-former	B	T-1	<5%	<5%	<5%	5.40%	adjust svds and transformer taps, or add a breaker to Moss Landing 500 kV bus
BULK-PK-PTVD-24	HATTON 60.0	Moss Landing 500/230 kV x-former	B	T-1	<5%	<5%	<5%	5.40%	adjust svds and transformer taps, or add a breaker to Moss Landing 500 kV bus
BULK-PK-PTVD-25	NAVY LAB 60.0	Moss Landing 500/230 kV x-former	B	T-1	<5%	<5%	<5%	5.30%	adjust svds and transformer taps, or add a breaker to Moss Landing 500 kV bus
BULK-PK-PTVD-26	RSVTN RD 60.0	Moss Landing 500/230 kV x-former	B	T-1	<5%	<5%	<5%	5.60%	adjust svds and transformer taps, or add a breaker to Moss Landing 500 kV bus
BULK-PK-PTVD-27	LAURELES 60.0	Moss Landing 500/230 kV x-former	B	T-1	<5%	<5%	<5%	5.80%	adjust svds and transformer taps, or add a breaker to Moss Landing 500 kV bus
BULK-PK-PTVD-28	OTTER 60.0	Moss Landing 500/230 kV x-former	B	T-1	<5%	<5%	<5%	5.90%	adjust svds and transformer taps, or add a breaker to Moss Landing 500 kV bus
BULK-PK-PTVD-29	FRSHXPRS 60.0	Moss Landing 500/230 kV x-former	B	T-1	<5%	<5%	<5%	5.50%	adjust svds and transformer taps, or add a breaker to Moss Landing 500 kV bus
BULK-PK-PTVD-30	BNA VSTA 60.0	Moss Landing 500/230 kV x-former	B	T-1	<5%	<5%	<5%	5.60%	adjust svds and transformer taps, or add a breaker to Moss Landing 500 kV bus
BULK-PK-PTVD-31	FIRESTNE 60.0	Moss Landing 500/230 kV x-former	B	T-1	<5%	<5%	<5%	5.60%	adjust svds and transformer taps, or add a breaker to Moss Landing 500 kV bus
BULK-PK-PTVD-32	SPENCE 60.0	Moss Landing 500/230 kV x-former	B	T-1	<5%	<5%	<5%	5.60%	adjust svds and transformer taps, or add a breaker to Moss Landing 500 kV bus

Study Area: **PG&E Bulk - Summer Peak****Post-Transient Voltage Deviations**

ID	Substation	Contingency	Category	Category Description	Post Cont. Voltage Deviation %				Potential Mitigation Solutions
					2016 Summer Peak	2019 Summer Peak	2019 Spring Peak	2024 Summer Peak	
BULK-PK-PTVD-33	SNBRN JT 60.0	Moss Landing 500/230 kV x-former	B	T-1	<5%	<5%	<5%	5.40%	adjust svds and transformer taps, or add a breaker to Moss Landing 500 kV bus
BULK-PK-PTVD-34	IND.ACRE 60.0	Moss Landing 500/230 kV x-former	B	T-1	<5%	<5%	<5%	5.40%	adjust svds and transformer taps, or add a breaker to Moss Landing 500 kV bus
BULK-PK-PTVD-35	9 ST JCT 60.0	Moss Landing 500/230 kV x-former	B	T-1	<5%	<5%	<5%	5.80%	adjust svds and transformer taps, or add a breaker to Moss Landing 500 kV bus
BULK-PK-PTVD-36	CMPHR J2 60.0	Moss Landing 500/230 kV x-former	B	T-1	<5%	<5%	<5%	5.70%	adjust svds and transformer taps, or add a breaker to Moss Landing 500 kV bus
BULK-PK-PTVD-37	GONZALES 60.0	Moss Landing 500/230 kV x-former	B	T-1	<5%	<5%	<5%	5.80%	adjust svds and transformer taps, or add a breaker to Moss Landing 500 kV bus
BULK-PK-PTVD-38	CAMPORA 60.0	Moss Landing 500/230 kV x-former	B	T-1	<5%	<5%	<5%	5.70%	adjust svds and transformer taps, or add a breaker to Moss Landing 500 kV bus
BULK-PK-PTVD-39	SOLEDAD 60.0	Moss Landing 500/230 kV x-former	B	T-1	<5%	<5%	<5%	5.60%	adjust svds and transformer taps, or add a breaker to Moss Landing 500 kV bus
BULK-PK-PTVD-40	SLD ENRG 12.5	Moss Landing 500/230 kV x-former	B	T-1	<5%	<5%	<5%	5.60%	adjust svds and transformer taps, or add a breaker to Moss Landing 500 kV bus
BULK-PK-PTVD-41	CRZY_HRS 115.0	Moss Landing 500/230 kV x-former	B	T-1	<5%	<5%	<5%	5.20%	adjust svds and transformer taps, or add a breaker to Moss Landing 500 kV bus
BULK-PK-PTVD-42	NATIVDAD 115.0	Moss Landing 500/230 kV x-former	B	T-1	<5%	<5%	<5%	5.30%	adjust svds and transformer taps, or add a breaker to Moss Landing 500 kV bus
BULK-PK-PTVD-43	MAXWELL 500 kV	Captain Jack-Olinda 500kV	B	L-1	-5.60%	-5.50%	<5%	-5.40%	turn off shunt capacitor at Olinda or request exemption
BULK-PK-PTVD-44	MAXWELL 500 kV	Olinda-Tracy 500 kV	B	L-1	<5%	<5%	-5.20%	<5%	turn off shunt capacitor at Olinda or request exemption
BULK-PK-PTVD-45	buses in NW 115 kV and below	PDCI mono-pole outage	B	PDCI	54 buses up to 6.7%	63 buses up to 6.6%	85 buses up to 6.3%	<5%	need to turn on shunt caps in Northwest
BULK-PK-PTVD-46	Round Mtn 500 kV	PDCI mono-pole outage	B	PDCI	<5%	<5%	5.10%	<5%	turn on shunt capacitors at Malin
BULK-PK-PTVD-47	Malin 500 kV	PDCI mono-pole outage	B	PDCI	<5%	<5%	5.30%	<5%	turn on shunt capacitors at Malin
BULK-PK-PTVD-48	Malin 230 kV	PDCI mono-pole outage	B	PDCI	<5%	<5%	5.20%	<5%	turn on shunt capacitors at Malin

Study Area: **PG&E Bulk - Summer Peak****Post-Transient Voltage Deviations**

ID	Substation	Contingency	Category	Category Description	Post Cont. Voltage Deviation %				Potential Mitigation Solutions
					2016 Summer Peak	2019 Summer Peak	2019 Spring Peak	2024 Summer Peak	
BULK-PK-PTVD-49	Capt Jack 500 kV	PDCI mono-pole outage	B	PDCI	<5%	<5%	5.20%	<5%	turn on shunt capacitors at Malin
BULK-PK-PTVD-50	Burns 500 kV	PDCI mono-pole outage	B	PDCI	<5%	<5%	5.20%	<5%	turn on shunt capacitors at Malin
BULK-PK-PTVD-51	Rusel City 230 kV	East Shore-San Mateo 230 kV	B	L-1	<5%	<5%	5.30%	<5%	due to Russel City generation being off, further review with PTO
BULK-PK-PTVD-52	East Shore 230	East Shore-San Mateo 230 kV	B	L-1	<5%	<5%	5.30%	<5%	due to Russel City generation being off, further review with PTO
BULK-PK-PTVD-53	Rusel City 15 kV# 1 and 2	East Shore-San Mateo 230 kV	B	L-1	<5%	<5%	5.30%	<5%	due to Russel City generation being off, further review with PTO
BULK-PK-PTVD-54	Rusel City 18 kV	East Shore-San Mateo 230 kV	B	L-1	<5%	<5%	5.30%	<5%	due to Russel City generation being off, further review with PTO





*Post-Transient Voltage Deviations*

ID	Substation	Contingency	Category	Category Description	Post Cont. Voltage Deviation %			Potential Mitigation Solutions
					Select..	Select..	Select..	

No post-transient voltage deviations identified.