

Study Area: SCE North of Lugo

Thermal Overloads



ID	Overloaded Facility	Worst Contingency	Category	Category Description	Loading (%)								Potential Mitigation Solutions
					2018 Summer Peak	2018 Summer Off-Peak	2021 Summer Peak	2021 Summer Light Load	2026 Summer Peak	N/A	N/A	N/A	
NOL-T-1	Inyo 115kV Phase Shifter	Control-Inyokern 115kV line	P1	N-1	<100	100.00	<100	109.00	<100				Congestion management
NOL-T-1	Lugo 500/230kV Transformer No. 1	Lugo 500/230kV Transformer No. 2	P1	T-1	<100	111.00	<100	116.00	<100				Utilize High Desert Power Plant (HDPP) RAS to curtail generation
NOL-T-2	Lugo 500/230kV Transformer No. 2	Lugo 500/230kV Transformer No. 1	P1	T-1	<100	111.00	<100	116.00	<100				
NOL-T-3	Lugo-Victor No. 1, 2, 3, or 4 230kV line	Any two of Lugo-Victor No. 1, 2, 3, or 4 230kV lines	P6/P7	N-1-1/N-2	<100	111.00	<100	119.00	<100				
NOL-T-4	Kramer 230/115kV Transformers No.1 or 2	Kramer-Victor No. 1 and 2 230kV lines	P7	N-2	101.00	Divergent	102.00	109.00	100.00				Utilize existing Mohave Desert RAS to curtail generation
NOL-T-5	Kramer-Roadway 115kV line	Kramer-Victor No. 1 and 2 230kV lines	P7	N-2	131.00	163.00	132.00	159.00	129.00				Utilize existing Mohave RAS to curtail generation
NOL-T-6	Kramer-Victor 115kV line	Kramer-Victor No. 1 and 2 230kV lines	P7	N-2	129.00	162.00	130.00	158.00	127.00				
NOL-T-7	Roadway-Victor 115kV line	Kramer-Victor No. 1 and 2 230kV lines	P7	N-2	105.00	136.00	105.00	135.00	103.00				
NOL-T-8	Inyo 115kV Phase Shifter	Kramer-Victor No. 1 and 2 230kV lines	P7	N-2	<100	151.00	<100	168.00	<100				
NOL-T-9	Control-Inyo 115kV line	Kramer-Victor No. 1 and 2 230kV lines	P7	N-2	<100	113.00	<100	130.00	<100				
NOL-T-10	Case divergence	Lugo No. 1 and No. 2 500/230kV transformer banks	P6	T-1-1	Divergent	Divergent	Divergent	Divergent	Divergent				Utilize existing HDPP and Mohave Desert RAS
NOL-T-11	Inyo 115kV Phase Shifter	Lugo No. 1 and No. 2 500/230kV transformer banks	P6	T-1-1	<100	117.00	<100	131.00	<100				
NOL-T-12	Case divergence	Kramer-Cool Water 115kV and Kramer-Tortilla 115kV lines	P6	N-1-1	Divergent	Convergent	Divergent	Convergent	Divergent				Utilize SCE's Operating Procedure 127, separating Kramer 115kV system from the Cool Water 115kV system.
NOL-T-13	Case divergence	Inyokern-Kramer No. 1 115kV and Inyokern-Tap 701 115kV lines	P6	N-1-1	Divergent	Divergent	Divergent	Divergent	Divergent				New operating procedure to curtail generation as part of system adjustment between contingencies
NOL-T-14	Case divergence	Inyokern-Kramer No. 1 115kV and Kramer-Inyokern-Randsburg No. 3 115kV lines	P6	N-1-1	Divergent	Divergent	Divergent	Divergent	Divergent				
NOL-T-15	Case divergence under off-peak or light load conditions	Control-Coso-Inyokern115kV and Control-Inyokern 115kV lines	P6	N-1-1	<100	Divergent	<100	Divergent	<100				Utilize existing Bishop RAS to curtail generation in the Bishop area
NOL-T-16	Case divergence	Kramer 115kV North or South Bus Section Bus Fault Delayed Fault Clearing - this removes 9 line segments and two Kramer 230/115kV banks	P5.5	Delayed bus fault clearing	Divergent	Divergent	Divergent	Divergent	Divergent				This is to be investigated further with SCE Planning and System Protection to validate the delayed clearing time,

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					2018 Summer Peak	2018 Summer Off-Peak	2021 Summer Peak	2021 Summer Light Load	2026 Summer Peak	N/A	N/A	N/A	
X-T-17	Case divergence	Lugo 230kV East or West Bus Delayed Fault Clearing - this removes five lines and two 500/230kV transformers	P5.5	Delayed bus fault clearing	Divergent	Divergent	Divergent	Divergent	Divergent				as well as potential impacted line and transformer trippings. Investigate installation of back-up relays.

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Voltage Deviations



ID	Substation	Worst Contingency	Category	Category Description	Post Cont. Voltage Deviation %								Potential Mitigation Solutions
					2018 Summer Peak	2018 Summer Off-Peak	2021 Summer Peak	2021 Summer Light Load	2026 Summer Peak	Select..	Select..	Select..	
NOL-VD-1	Various buses between Control and Silver Peak 55kV	35-CYCLE 1-Phase Fault at Control 115 kV Bus, Bus Differential Relay Failure : Control 115 kV North East Bus	P5.5	Delayed clearing fault, Multiple contingency	<10%	10.2 - 13.9		11.4 - 19.1	Divergent				This is to be investigated further with SCE Planning and System Protection to validate the delayed clearing time, as well as potential impacted line and transformer trippings. Investigate installation of backup relays.
NOL-VD-2	Various buses between Control and Silver Peak 55kV	35-CYCLE 1-Phase Fault at Control 115 kV Bus, Bus Differential Relay Failure : Control 115 kV North West Bus	P5.5	Multiple contingency	Cool Water 115kV: 10.8	5.6 - 13.9		11.4 - 19.1	Divergent				
NOL-VD-3	Various buses between Control and Silver Peak 55kV	35-CYCLE 1-Phase Fault at Control 115 kV Bus, Bus Differential Relay Failure : Control 115 kV Southeast or Southwest Bus	P5.5	Multiple contingency				11.4 - 19.1	Divergent				
NOL-VD-4	Case divergent	SLG fault with delayed 30-cycle delayed clearing at Kramer 115kV North (or South) bus with bus differential relay failure	P5.5	Multiple contingency	Divergent	Divergent	Divergent	Divergent	Divergent				
NOL-VD-5	Case divergent	Kramer-Randsburg-Inyokern 115kV, followed by Kramer-Inyokern 115kV line, without RAS	P6.1.1	N-1-1		Divergent		Divergent					New operating procedure to curtail generation as part of system adjustment between contingencies
NOL-VD-6	Case divergent	Lugo 500/230kV transformer No. 1, followed by N-1 of transformer No. 2 (or vice versa)	P6.2.2	T-1-1	Divergent	Divergent	Divergent	Divergent	Divergent				Safety Net using High Desert Power Plant (HDPP) RAS and Mohave Desert RAS to curtail generation
NOL-VD-7	Case divergent	Cool Water - Kramer 115kV, followed by Kramer - Tortilla 115kV line	P6.1.1	N-1-1	Divergent		Divergent	Seven buses > 10.0	Divergent				Utilize SCE's Operating Procedure 127, separating Kramer 115kV system from the Cool Water 115kV system between contingencies

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High/Low Voltage



ID	Substation	Worst Contingency	Category	Category Description	Voltage (PU)								Potential Mitigation Solutions
					Select..	Select..	Select..	Select..	Select..	Select..	Select..	Select..	
X-V-1													
X-V-2													
X-V-3													
X-V-4													
X-V-5													
X-V-6													
X-V-7													
X-V-8													
X-V-9													
X-V-10													
X-V-11													
X-V-12													
X-V-13													
X-V-14													
X-V-15													
X-V-16													
X-V-17													
X-V-18													
X-V-19													

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Transient Stability



ID	Contingency	Category	Category Description	Transient Stability Performance							Potential Mitigation Solutions
				2018 Summer Peak	2018 Summer Off-Peak	2021 Summer Peak	2021 Summer Light Load	2026 Summer Peak	Select..	Select..	
X-TS-1	Control-Casa Diablo 115 kV (Fault 20% from Control)	P4.2	Stuck Breaker	Undamping voltage oscillations at and north of Randsburg 115kV bus.	Undamping voltage oscillations at and north of Randsburg 115kV bus.	Undamping voltage oscillations at and north of Randsburg 115kV bus.	Undamping voltage oscillations at and north of Randsburg 115kV bus.	Undamping voltage oscillations at and north of Randsburg 115kV bus.			Work with SCE Planning and Protection Engineering to consider local breaker failure backup (LBFB) protection scheme.
X-TS-2	Kramer-Cool Water 115 kV (Fault 20% from Kramer)	P4.2	Stuck Breaker	No voltage recovery to 80% for two buses near persistent fault (Coolwater and Tortilla 115kV)	No voltage recovery to 80% for two buses near persistent fault (Coolwater and Tortilla 115kV)	No voltage recovery to 80% for two buses near persistent fault (Coolwater and Tortilla 115kV)	No voltage recovery to 80% for two buses near persistent fault (Coolwater and Tortilla 115kV)	No voltage recovery to 80% for two buses near persistent fault (Coolwater and Tortilla 115kV)			
X-TS-3	Cool Water-SEGS-Tortilla 115 kV (Fault 20% from Tortilla)	P4.2	Stuck Breaker	Undamping voltage oscillations north of Lugo area	Undamping voltage oscillations north of Lugo area	Undamping voltage oscillations north of Lugo area	Undamping voltage oscillations north of Lugo area	Undamping voltage oscillations north of Lugo area			
X-TS-4	Cool Water-SEGS-Tortilla 115 kV (Fault 20% from Cool Water)	P4.2	Stuck Breaker	Undamping voltage oscillations north of Lugo area	Undamping voltage oscillations north of Lugo area	Undamping voltage oscillations north of Lugo area	Undamping voltage oscillations north of Lugo area	Undamping voltage oscillations north of Lugo area			
X-TS-5	Kramer-Inyokern-Randsburg No. 1 115 kV (Fault 20% from Kramer)	P4.2	Stuck Breaker	No Voltage Recovery to acceptable limit for some buses (i.e., Downs 115kV 37% voltage dip)	No Voltage Recovery to acceptable limit for some buses in the Inyokern area	No Voltage Recovery to acceptable limit for some buses in the Inyokern area	No Voltage Recovery to acceptable limit for some buses in the Inyokern area	No Voltage Recovery to acceptable limit for some buses in the Inyokern area			
X-TS-6	Kramer-Tortilla 115 kV (Fault 20% from Kramer)	P4.2	Stuck Breaker	No Voltage Recovery to acceptable limit for some buses locally	No Voltage Recovery to acceptable limit for some buses locally	No Voltage Recovery to acceptable limit for some buses locally	No Voltage Recovery to acceptable limit for some buses locally	No Voltage Recovery to acceptable limit for some buses locally			
X-TS-7	Lugo 230 kV E Bus	P5.5	Delayed Fault Clearing	Unstable north of Lugo area	Unstable north of Lugo area	Unstable north of Lugo area	Unstable north of Lugo area	Unstable north of Lugo area			Work with SCE Planning and Protection Engineering to consider back-up relay protection.
X-TS-8	Lugo 230 kV W Bus	P5.5	Delayed Fault Clearing	Unstable north of Lugo area	Unstable north of Lugo area	Unstable north of Lugo area	Unstable north of Lugo area	Unstable north of Lugo area			
X-TS-9	Kramer-Inyokern-Randsburg No. 1 & 3 115 kV_noRAS	P6.1.1	Normal Clearing	Angular oscillations (negative damping) north of Kramer area	Angular oscillations (negative damping) north of Kramer area	Angular oscillations (negative damping) north of Kramer area	Angular oscillations (negative damping) north of Kramer area	Angular oscillations (negative damping) north of Kramer area			New operating procedure to curtail generation as part of system adjustment between contingencies
X-TS-10	Lugo-500/230 kV Transformer Banks no RAS	P6.2.2	Normal Clearing	Undamping local area voltage oscillations	Undamping local area voltage oscillations	Undamping local area voltage oscillations	Undamping local area voltage oscillations	Undamping local area voltage oscillations			Utilize RAS to curtail local generation (see results below)
X-TS-11	Lugo-500/230 kV Transformer Banks with RAS	P6.2.2	Normal Clearing	Positive damping, stable	Positive damping, stable	Positive damping, stable	Positive damping, stable	Positive damping, stable			

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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..	
X-SLD-1												

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

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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..	
X-SS-1										

No single source substation with more than 100 MW Load