Agenda
Reliability Assessment and Study Updates

Isabella Nicosia
Senior Stakeholder Engagement and Policy Specialist

2023-2024 Transmission Planning Process Stakeholder Meeting
September 26-27, 2023

Reminders

- Stakeholder calls and meetings related to Transmission Planning are not recorded.
  - Given the expectation that documentation from these calls will be referred to in subsequent regulatory proceedings, we address written questions through written comments, and enable more informal dialogue at the call itself.
  - Minutes are not generated from these calls, however, written responses are provided to all submitted comments.
- Calls are structured to stimulate an honest dialogue and engage different perspectives.
- Please keep comments professional and respectful.

Instructions for raising your hand to ask a question

- If you are connected to audio through your computer or used the “call me” option, select the raise hand icon located on the bottom of your screen.
  Note: #2 only works if you dialed into the meeting.
  - Please remember to state your name and affiliation before making your comment.

2023-2024 Transmission Planning Process Stakeholder Call – Agenda

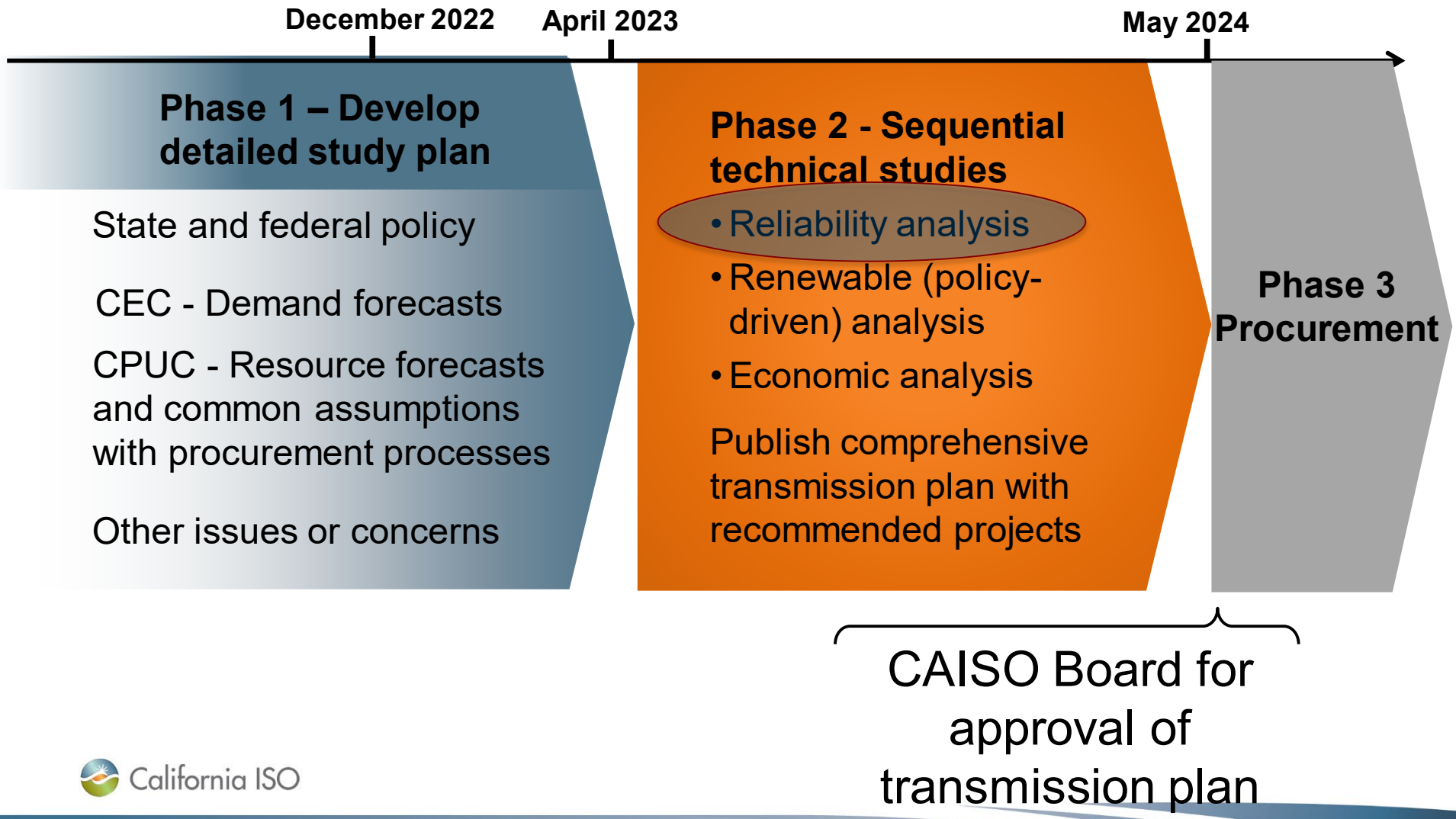
Topic	Presenter
Day 1 – September 26	
Overview & Key Issues	Binaya Shrestha
Reliability Assessment – North	RTN - Engineers
Reliability Assessment - South	RTS - Engineers
Day 2 – September 27	
PTO Proposed Reliability Solutions	SDG&E, PG&E, SCE, GLW
High Voltage TAC Update	Binaya Shrestha
Policy Assessment - Update	Lindsey Thomas
Economic Assessment - Update	Yi Zhang
20-Year Transmission Outlook - Update	Ebrahim Rahimi

Introduction and Overview
Preliminary Reliability Assessment Results

Binaya Shrestha
Manager - Regional Transmission North

2023-2024 Transmission Planning Process Stakeholder Meeting
September 26-27, 2023

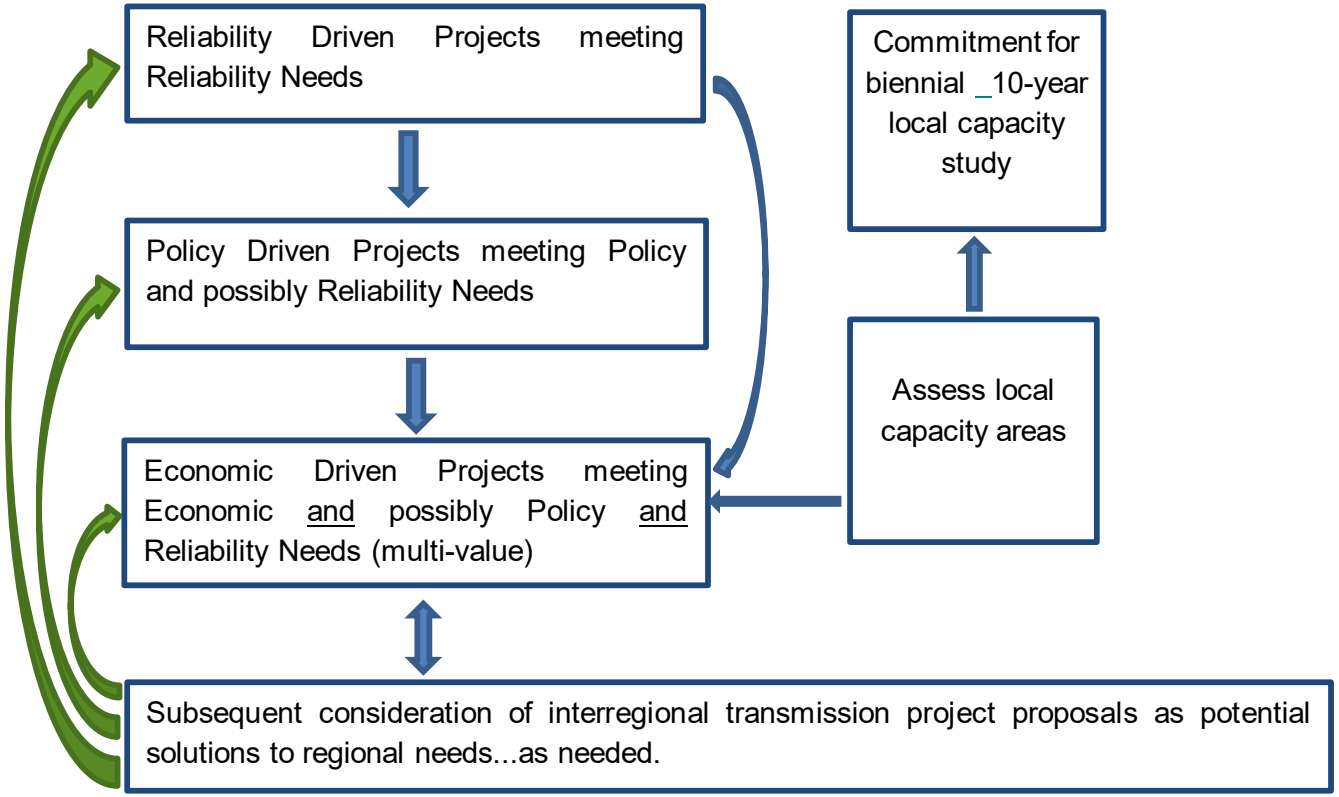
2023-2024 Transmission Planning Process



2023-2024 Transmission Plan Milestones

- Draft Study Plan posted on February 21
- Stakeholder meeting on Draft Study Plan on February 28
  - Comments to be submitted by March 14
- Final Study Plan to be posted on March 31
- Preliminary reliability study results to be posted on August 15
- Stakeholder meeting on September 26 and 27
  - Comments to be submitted by October 11
- Request window closes October 15
- Preliminary policy and economic study results on November 16
  - Comments to be submitted by December 4
- Draft transmission plan to be posted on March 31, 2024
- Stakeholder meeting in April
  - Comments to be submitted within two weeks after stakeholder meeting
- Revised draft for approval at May Board of Governor meeting

Studies are coordinated as a part of the transmission planning process



The reliability assessment is a key component of the overall 2023-2024 Transmission Planning Process

- Reliability Assessment to identify reliability-driven needs
  - 2022 California Energy Demand Update (CEDU) Forecast 2022-2035 adopted by the California Energy Commission (CEC) on January 25, 2023

    https://www.energy.ca.gov/data-reports/reports/integrated-energy-policy-report/2022-integrated-energy-policy-report-update-2
  - Base portfolio included in CPUC Decision 23-02-040 for use in CAISO 2023-2024 transmission planning process

    https://docs.cpuc.ca.gov/PublishedDocs/Published/G000/M502/K956/502956567.PDF
- This is also foundational to other aspects of the plan, which continues to evolve in each cycle:
  - Policy Assessment
  - Economic Assessment
  - Other Studies
    - Long-term Congestion Revenue Rights
    - Frequency Response

2023-2035 Twelve Year Reliability Assessment

- Preliminary study results were posted on August 15
  - Based on assumptions identified in 2023-2024 TPP Study Plan
  - Satisfy requirements of:
    - NERC Reliability Standards
    - WECC Regional Criteria
    - ISO Planning Standards
- Transmission request window (reliability driven projects) opened on August 15
  - PTO proposed mitigations submitted to CAISO by September 15

2023-2035 Twelve Year Reliability Assessment

- Comments on Stakeholder Meeting due October 11
- Request Window closes October 15
  - Request Window is for alternatives to reliability assessment
- ISO recommended projects:
  - For management approval of reliability projects less than $50 million will be presented at November stakeholder session
  - For Board of Governor approval of reliability projects over $50 will be included in draft transmission plan
- Purpose of today's stakeholder meeting
  - Review the results of the reliability analysis
  - Set stage for stakeholder feedback on potential mitigations

Critical Energy Infrastructure Information

- The ISO is constantly re-evaluating its CEII practices to ensure they remain sufficient going forward.
- Continuing with steps established in previous years:
  - Continuing to not post extreme event contingency discussions in general - only shared on an exception basis where mitigations are being considered:
    - Details on secure web site
    - Summaries on public site
  - Continuing to migrate previous planning cycles material to the secure website.
- Bulk System Assessment presentation has been posted on the secure site.

Key Updates

- Updated transportation electrification demand forecast included the latest CEC forecast.
- Preparation for policy and economic assessment are underway with the preliminary analysis to be presented at the November 16th stakeholder meeting
- The transmission access forecast charge model from the 2022-2023 transmission planning process has been posted to the transmission planning process webpage.
  - http://www.caiso.com/planning/Pages/TransmissionPlanning/Default.aspx
  - The CAISO will accept comments that could provide enhancements to the model for use in the 2023-2024 transmission planning process with the stakeholder comments submitted on this stakeholder call

Comments

- Comments due by end of day October 11, 2023

- Submit comments through the ISO's commenting tool, using the template provided on the process webpage:
- https://stakeholdercenter.caiso.com/RecurringStakeholderProcesses/2023-2024-Transmission-planning-process

Request Window Submissions for Reliability Assessment

- Request Window closes October 15
  - Request Window is for alternatives in the reliability assessment
  - Stakeholders requested to submit comments to: requestwindow@caiso.com
  - ISO will post Request Window submission on the market participant portal

California ISO Public

Greater Bay Area
Preliminary Reliability Assessment Results

Uriel Rangel
Regional Transmission North

2023-24 Transmission Planning Process Stakeholder Meeting
September 26-27, 2023

Greater Bay Area

- Service areas cover Alameda, Contra Costa, Santa Clara, San Mateo and San Francisco counties.
- Supply sources: Vaca Dixon, Tesla, Metcalf, and Collinsvile*.
- Comprised of 60, 115 & 230 & 500 kV transmission facilities.
- For ease of conducting the performance evaluation, the Greater Bay Area is divided into Seven sub-areas:
  - San Francisco
  - San Jose
  - Peninsula
  - Mission
  - East Bay
  - Diablo
  - De Anza

California ISO

* ISD 2028

California ISO Public

Load and Load Modifier Assumptions - Greater Bay Area

Study Case	Description	Gross Load (MW)	BTM-PV		AAEE (MW)	AAFS (MW)	AATE (MW)	Net Load (MW)	DR (MW)
			Output (MW)	Installed (MW)					
2025-SPOP	2025 Spring off-Peak load condition. Off-Peak load time - hours ending 19:00	7964	0	2635	-101	21	126	7862	-180
2025-WP	2025 Winter Peak load condition. Winter Peak load time - hours ending 19:00	8937	0	2635	-83	21	126	8854	-196
2028-SPOP	2028 Spring Off-Peak load condition. Off-Peak load time - hours ending 13:00	8204	2642	3345	-122	43	316	5440	-179
2028-WP	2028 Winter Peak load condition. Winter Peak load time - hours ending 19:00	9639	3	3345	-144	43	316	9492	-179
2035-WP	2035 Winter Peak load condition. Winter Peak load time - hours ending 19:00	11654	11	4781	-266	99	1069	11376	-196
GBA-2025-SP	2025 Summer Peak load condition. Peak load time - hours ending 17:30	10039	1012	2663	-72	22	126	8955	-180
GBA-2028-SP	2028 Summer Peak load condition. Peak load time - hours ending 17:30	10366	1143	3391	-117	115	316	9106	-179
GBA-2035-SP	2035 Summer Peak load condition. Peak load time - hours ending 19:00	13171	1	4810	-201	566	1070	12968	-196
GBA-2025-SP_HiRE	2025 Summer peak Load conditions with Hi-Renewable dispatch (Sensitivity)	10099	2617	2663	-72	22	126	7409	-180
2025-SPOP-Hire	2025 Spring off-peak load conditions and high renewables (Sensitivity)	7964	0	2635	-101	21	126	7862	-180
GBA-2028-SP-HiCEC	2028 Summer Peak load condition with Hi-CEC load forecast (Sensitivity)	10367	1137	3391	0	116	316	9231	-179

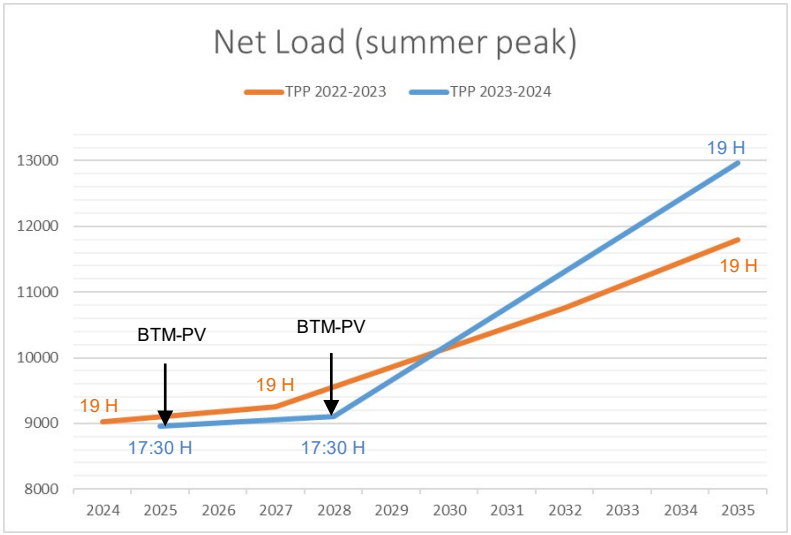
Generation Assumptions - Greater Bay Area

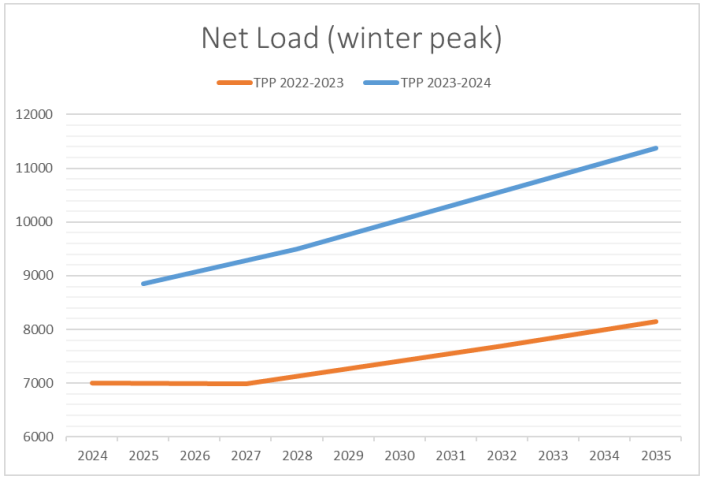
Study Case	Description	Battery		Solar		Wind		Hydro		Thermal	
		Installed (MW)	Dispatch (MW)	Installed (MW)	Dispatch (MW)	Installed (MW)	Dispatch (MW)	Installed (MW)	Dispatch (MW)	Installed (MW)	Dispatch (MW)
2025-SPOP	2025 Spring off-Peak load condition. Off-Peak load time - hours ending 19:00	467	-419	211	0	264	97	0	0	5575	4711
2025-WP	2025 Winter Peak load condition. Winter Peak load time - hours ending 19:00	467	0	211	0	264	57	0	0	5575	4184
2028-SPOP	2028 Spring Off-Peak load condition. Off-Peak load time - hours ending 13:00	467	-279	211	180	264	54	0	0	5575	697
2028-WP	2028 Winter Peak load condition. Winter Peak load time - hours ending 19:00	467	0	211	0	264	57	0	0	5575	4895
2035-WP	2035 Winter Peak load condition. Winter Peak load time - hours ending 19:00	1156	0	221	0	264	57	0	0	5342	4712
GBA-2025-SP	2025 Summer Peak load condition. Peak load time - hours ending 17:30	467	-349	211	82	264	107	0	0	5575	4770
GBA-2028-SP	2028 Summer Peak load condition. Peak load time - hours ending 17:30	467	4	211	72	264	122	0	0	5575	5054
GBA-2035-SP	2035 Summer Peak load condition. Peak load time - hours ending 19:00	1156	812	221	10	264	86	0	0	5342	4721
GBA-2025-SP_HiRE	2025 Summer peak Load conditions with Hi-Renewable dispatch (Sensitivity)	467	-164	211	210	264	213	0	0	5575	2553
2025-SPOP-Hire	2025 Spring off-peak load conditions and high renewables (Sensitivity)	467	-419	211	6	264	107	0	0	5575	4711
GBA-2028-SP-HiCEC	2028 Summer Peak load condition with Hi-CEC load forecast (Sensitivity)	467	5	211	72	264	122	0	0	5575	4891

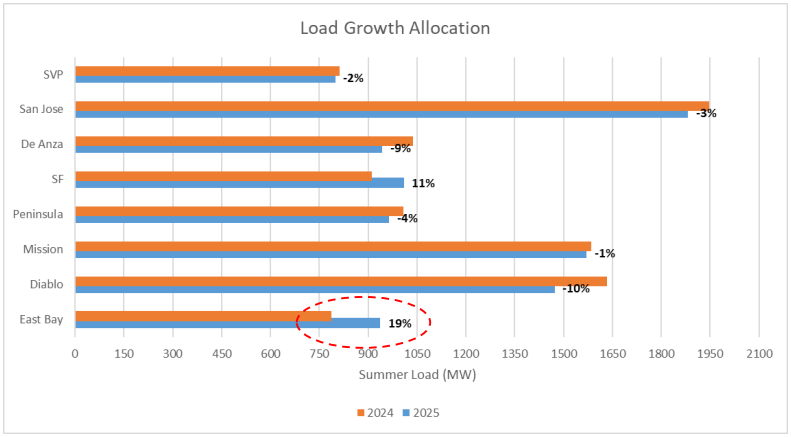
Previously approved transmission projects modelled in base cases

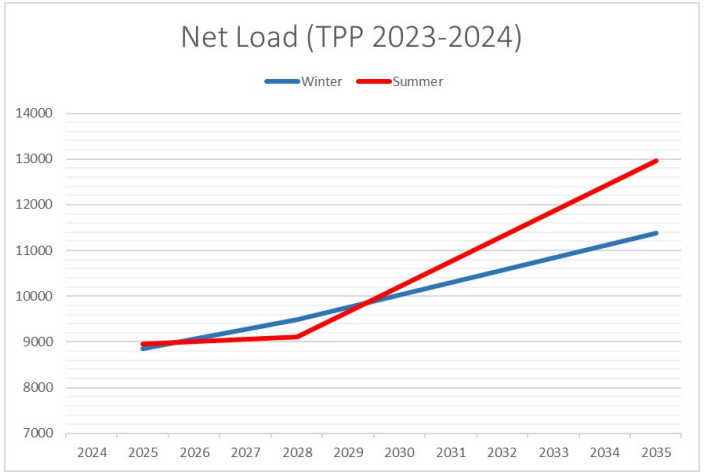
Project Name	Division	In Service Date
Contra Costa PP 230 kV Line Terminals Reconfiguration Project	Diablo	May-2025
Moraga-Castro Valley 230 kV Line Capacity Increase Project	Diablo	Oct-2024
Pittsburg 230/115 kV Transformer Capacity Increase	Diablo	Jun-2026
Lone Tree – Cayetano – Newark corridor Series Compensation	Diablo	Dec-2027
New Collinsville 500 kV substation	Diablo	Dec-2027
East Shore-Oakland J 115 kV Reconductoring Project	East Bay	Dec-2023
Oakland Clean Energy Initiative	East Bay	Jun-2022 Apr-2025
Christie-Sobrante 115 kV Line Reconductor	East Bay	May-2028
Moraga 230 kV Bus Upgrade	East Bay	Dec-2028
Moraga-Sobrante 115 kV Line Reconductor	East Bay	on hold
East Shore 230 kV Bus Terminals Reconfiguration	Mission	Dec-2025
Newark 230/115 kV Transformer Bank #7 Circuit Breaker Addition	Mission	Dec-2026
North Tower 115 kV Looping Project	Mission	Jan-2030
Cooley Landing Substation Circuit Breaker No #62 Upgrade	Peninsula	Dec-2026
Cooley Landing-Palo Alto and Ravenswood-Cooley Landing 115 kV Lines Rerate	Peninsula	Dec-2022
Ravenswood 230/115 kV transformer #1 Limiting Facility Upgrade	Peninsula	Dec-2025
Jefferson 230 kV Bus Upgrade	Peninsula	Dec-2026
South of San Mateo Capacity Increase	Peninsula	Jun-2027
Redwood City Area 115 kV System Reinforcement	Peninsula	Dec-2030
Martin 230 kV Bus Extension	San Francisco	Apr-2026
Series Compensation on Los Esteros-Nortech 115 kV Line	San Jose	Dec-2024
Newark-Milpitas #1 115 kV Line Limiting Facility Upgrade	San Jose	Dec-2024
Vasona-Metcalf 230 kV Line Limiting Elements Removal Project	San Jose	May-2025
Metcalf 230 kV Substation Circuit Breaker #No 292 Upgrade	San Jose	Sep-2025
Metcalf-Piercy & Swift and Newark-Dixon Landing 115 kV Upgrade	San Jose	Dec-2027
Morgan Hill Area Reinforcement (formerly Spring 230/115 kV substation)	San Jose	Sep-2027
San Jose Area HVDC Line (Metcalf – San Jose)	San Jose	Apr-2028
San Jose Area HVDC Line (Newark - NRS)	San Jose	Dec-2027
Monta Vista 230 kV Bus Upgrade	De Anza	Aug-2025

Load insights

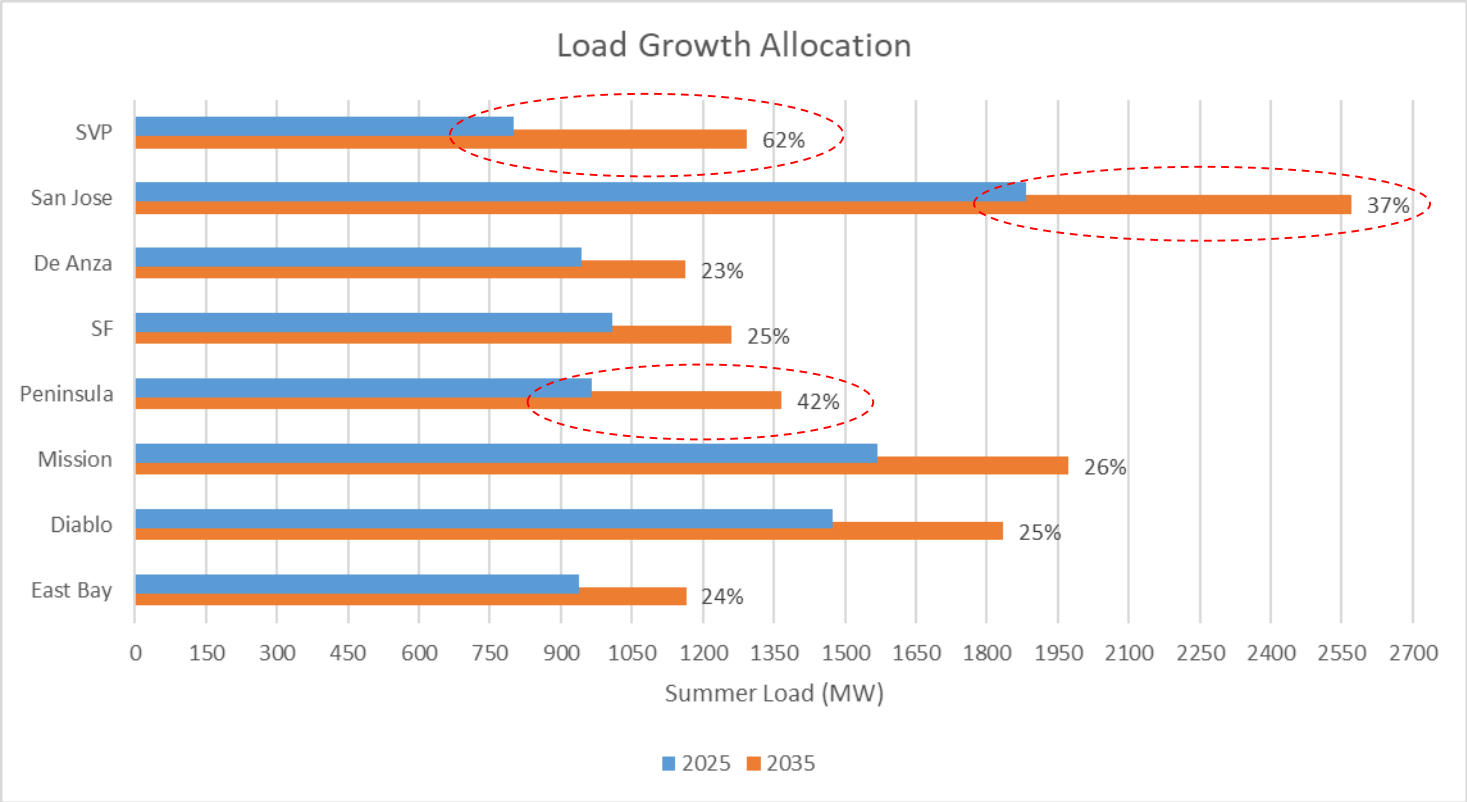








Load insights



Reliability assessment preliminary results summary

Reliability Issues with Previously Approved Reliability Projects

East Bay

- Oakland Clean Energy Initiative
  - P2,P6 contingencies (losing both circuits Claremont – D) driven overloads on Moraga - X 115 kV cables in the 2025 and 2028 scenarios. And on the C – X #2 circuit in all scenarios.

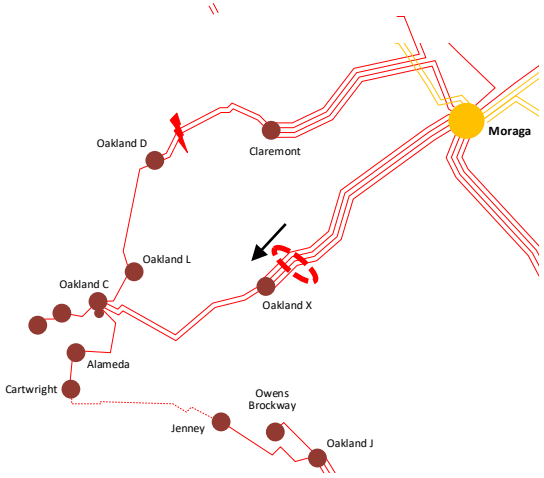
- East Shore-Oakland J 115 kV Reconductoring Project
  - P1 – P7 contingencies driven overloads on the Southern Oakland 115 kV system in the long-term scenarios.

- Other Oakland issues
  - P2,P6 contingencies driven overloads on Oakland C – L #1 in the near and long-term scenarios (D and L radial from C).
  - P6 contingency driven overload on the Claremont – D #2 or #3 circuits in the long term-scenario (D and L radial in one circuit from Claremont).
  - P6 contingency driven overload on L – D in the long-term scenario.

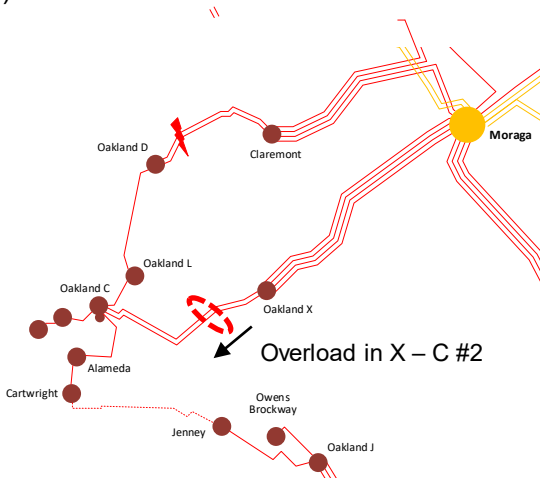
Potential Mitigations

- The Moraga – X 115 kV lines rebuild project will address the overload on those lines as from 2030. However, the overload on the C-X #2 115 kV cable will still remain. The load forecast and allocation in the Oakland pocket is under review as there is a significant variation with last year's study cases.
- For near and long-term issues in this pocket, potential projects proposals will be developed after the load investigation.

P2, P6 (Claremont – D #2 and #3)

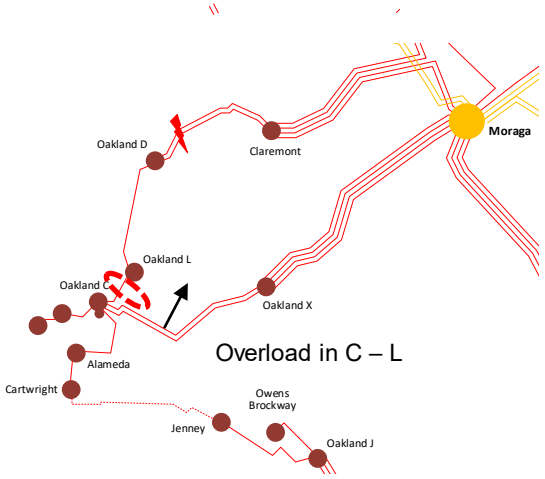


Overload in Moraga – X (2025 and 2028 only)
By 2030 the Moraga – X rebuild project will mitigate this overload

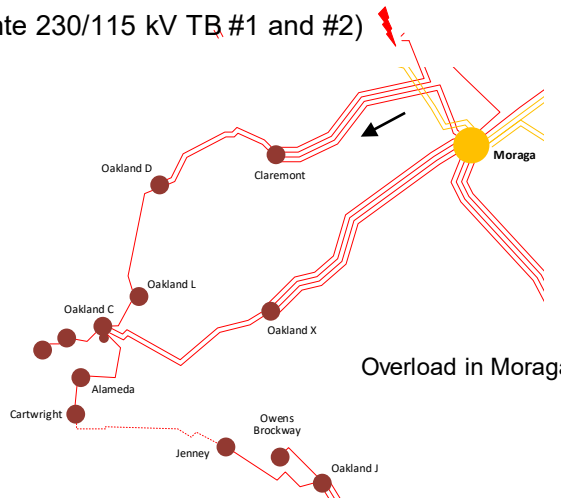


Oakland X – C #2 (157 MVA Rate)
Oakland X – C #3 (240 MVA Rate)

Near-term issues

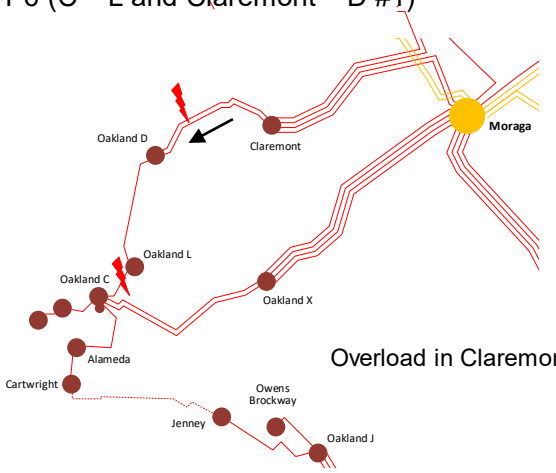


P6 (Sobrante 230/115 kV TB #1 and #2)



Overload in Moraga – Claremont #1 and #2

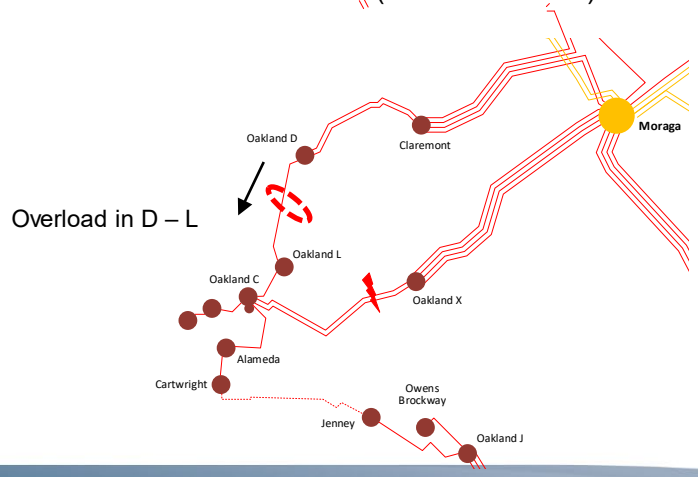
P6 (C – L and Claremont – D #1)



Overload in Claremont – D #2

Long-term issues

P6 (C – X #2 and #3)



Overload in D – L

Reliability Issues with Previously Approved Reliability Projects

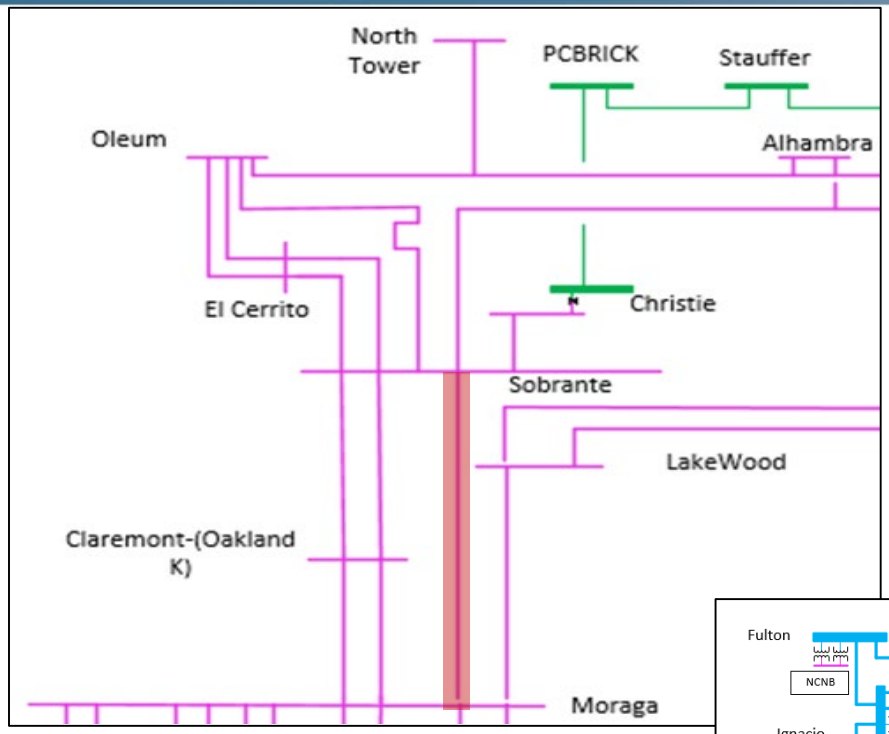
- Moraga-Sobrante 115 kV Line Reconductor (currently on-hold)
  - P2,P5 contingencies driven overloads on the Moraga-Sobrante #1,115 kV line

- New Collinsville 500 kV substation
  - P2, P6 contingencies driven overloads on the Pittsburg-Collinsville #1 230 kV line.
  - P1, P2, P3 contingencies driven overloads on the 500/230 kV TB in Collinsville.
  - P2, P7 contingencies driven overloads on the Pittsburg-San Mateo and East Shore-San Mateo 230 kV lines

Potential Mitigations

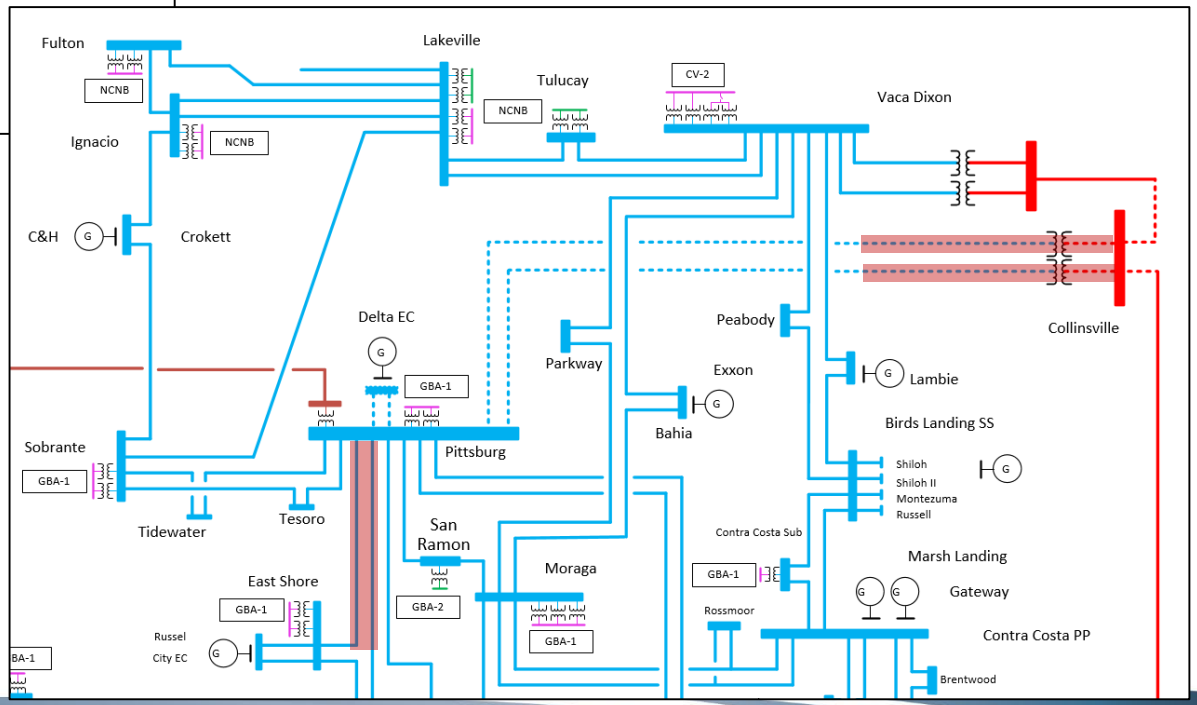
- Reactivate the Moraga-Sobrante line re-conducturing project in this planning cycle.
- Series compensation rearrangement to reduce/control flow on Table – Vaca – Collinsville - Tesla 500 kV path (interim operating solution). Series reactor on Collinsville – Pittsburg 230 kV lines as part of the ultimate Collinsville project.

Diablo



Moraga-Sobrante 115 kV Line

Collinsville 500/230 kV TB
Collinsville – Pittsburg 230 kV lines



Pittsburg – San Mateo 230 kV line
Pittsburg – East Shore 230 kV line

California ISO

Reliability Issues with Previously Approved Reliability Projects

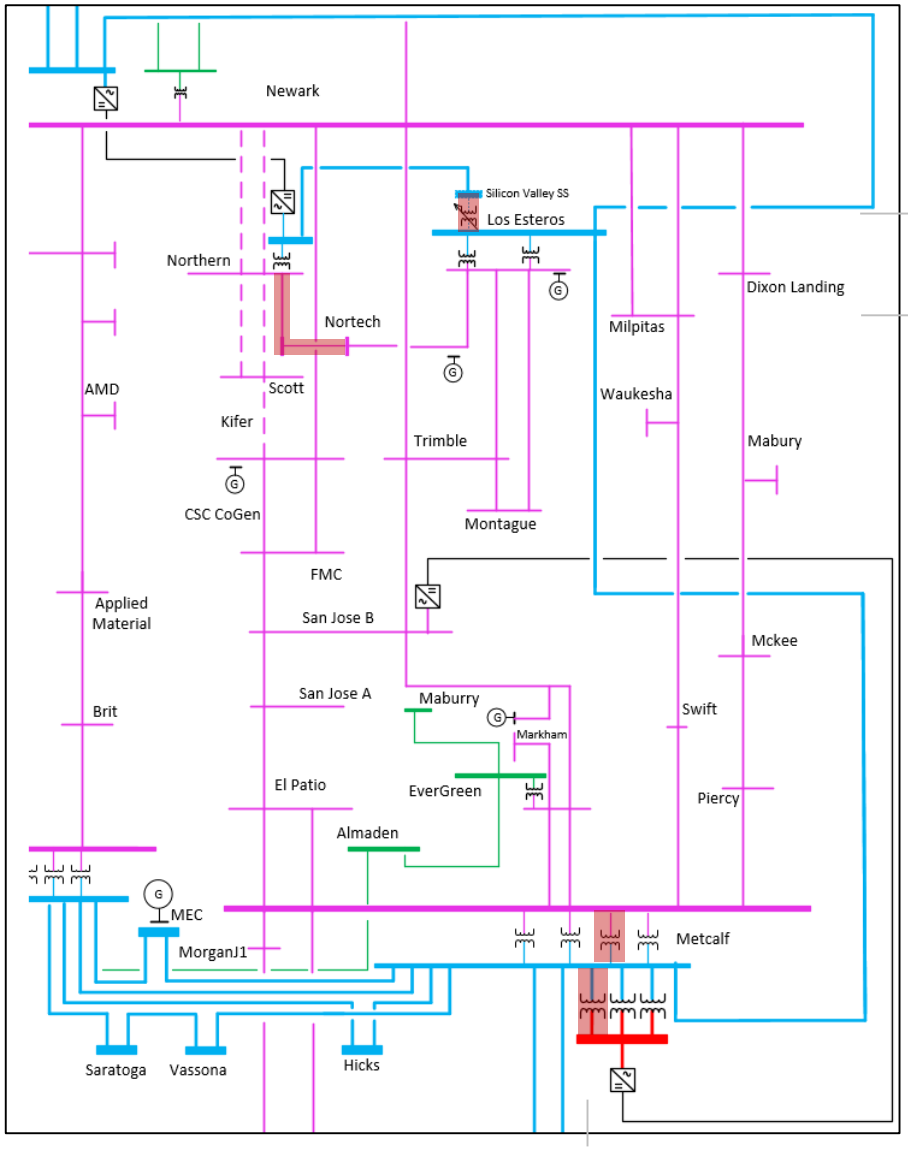
- San Jose Area HVDC Lines: Newark – NRS and Metcalf – San Jose
  - P1,P6 contingencies driven overloads on the Nortech-NRS #1 115 kV line and Los Esteros PST in the Near-term scenarios.
  - P6 contingencies driven overloads on the Metcalf 500/230 and 230/115 kV TB in the long-term scenarios.

- Metcalf-Piercy & Swift and Newark-Dixon Landing 115 kV Upgrade
  - P2, P6, P7 contingencies driven overloads on the 115 kV lines: Metcalf-Swift #1, Metcalf-Piercy #1, and Newark-Dixon Landing #1. Long-term only issue.

- Morgan Hill Area Reinforcement (formerly Spring 230/115 kV substation)
  - P6 contingencies driven overloads on the Llagas-Morgan J2 #1 115 kV line. Long-term only issue.

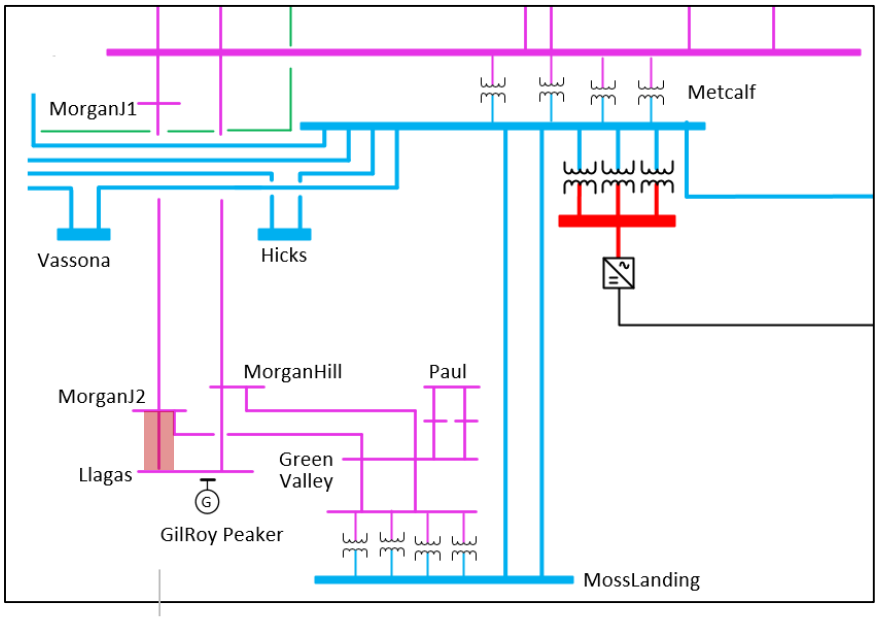
Potential Mitigations

- Operational coordination between the PST, San Jose Area HVDC lines and the Series Compensation in Los Esteros – Nortech is under review to avoid this overloads in the near-term. For long-term overloads in the San Jose area the load forecast and allocation is under review.
- For the other two, a re-scope of the projects is under review.



Los Esteros – SSS 230 kV PST

Nortech – NRS 115 kV line



Llagas – Morgan J2 115 kV line

Metcalf 500/230 TB #1, #2, or #3
Metcalf 230/115 TB #1, #2, #3, or #4

California ISO Public

Potential project needs

– San Mateo-Beresford-Hillsdale 60 kV line — SF - Peninsula
  - P2, P7 contingencies driven overloads on the San Mateo to Beresford and Beresford to Hillsdale 60 kV lines.

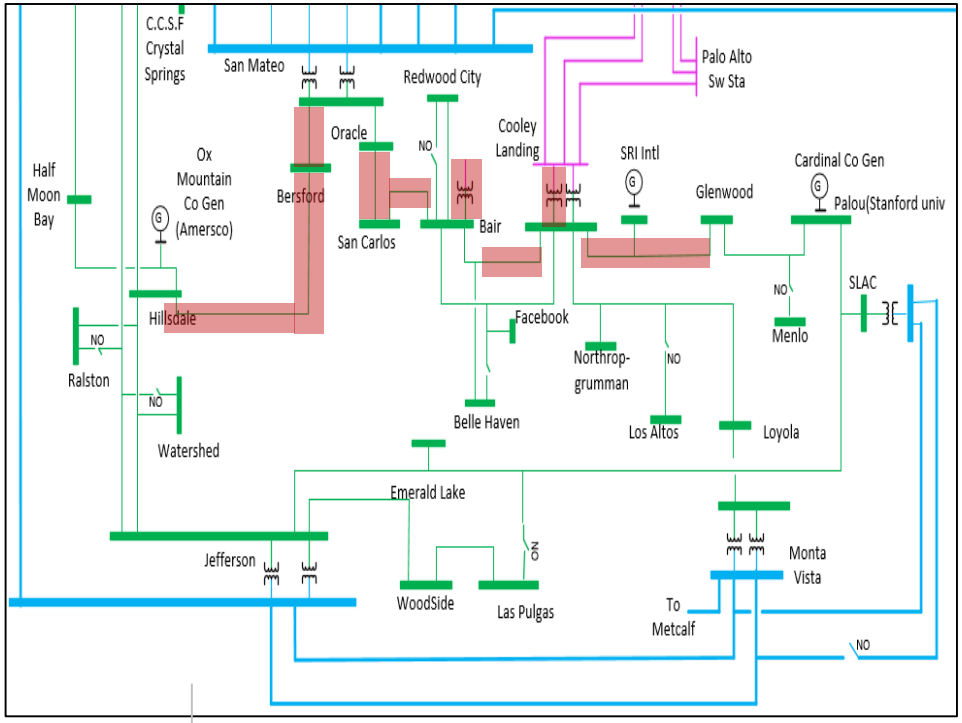
– Cooley Landing 60 kV system — SF - Peninsula
  - P6 contingencies (most of them related with the Cooley Landing 115/60 kV transformer banks) driven overloads in the 60 kV system of this area in the near-term and long-term.
  - P1, P2, and P7 contingencies driven overloads in the long-term.

– Martin-Millbrae 60 kV system — SF - Peninsula
  - P1,P2, P6 contingencies driven overloads on the 60 kV grid connecting Martin and Millbrae.

– Newark-Metcalf 115 kV lines — San Jose
  - P6 contingencies driven overloads on the Newark-Ringwood #1 115 kV lines, and low voltage issues.
  - P1, P2, P7 contingencies driven overloads on the McKee-Piercy 115 kV line (section 1).

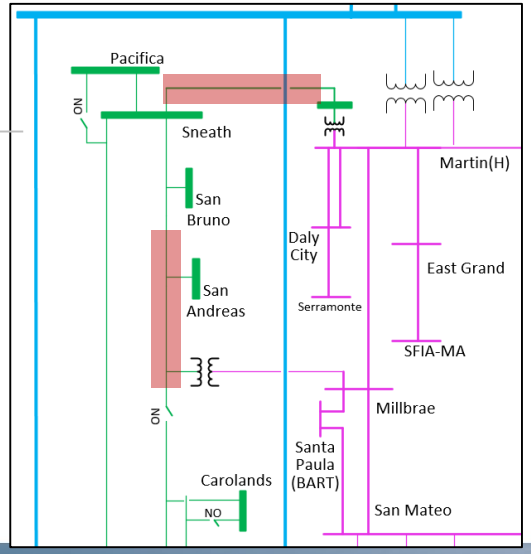
Potential Mitigations

- The San Mateo – Beresford – Hillsdale 60 kV line and Cooley Landing 60 kV system issues can be addressed with operating solutions.
- The mitigation for Martin-Millbrae 60 kV and Newark-Metcalf 115 kV is under development.

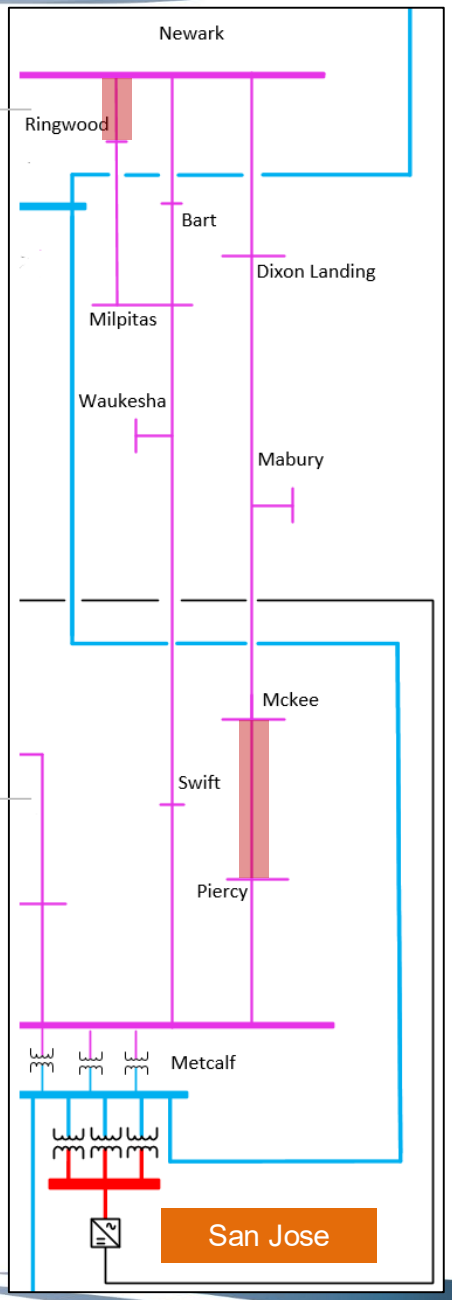


Multiple facilities in the San Francisco and Peninsula 60 kV system

SF - Peninsula



Newark – Ringwood 115 kV line



Mckee – Piercy 115 kV line

Potential project needs

– Pittsburg-Sobrante 115 kV lines

- P2 contingencies driven overloads on the Alhambra – Oleum #1 115 kV line.

Diablo

– Montavista 230/115 kV TB

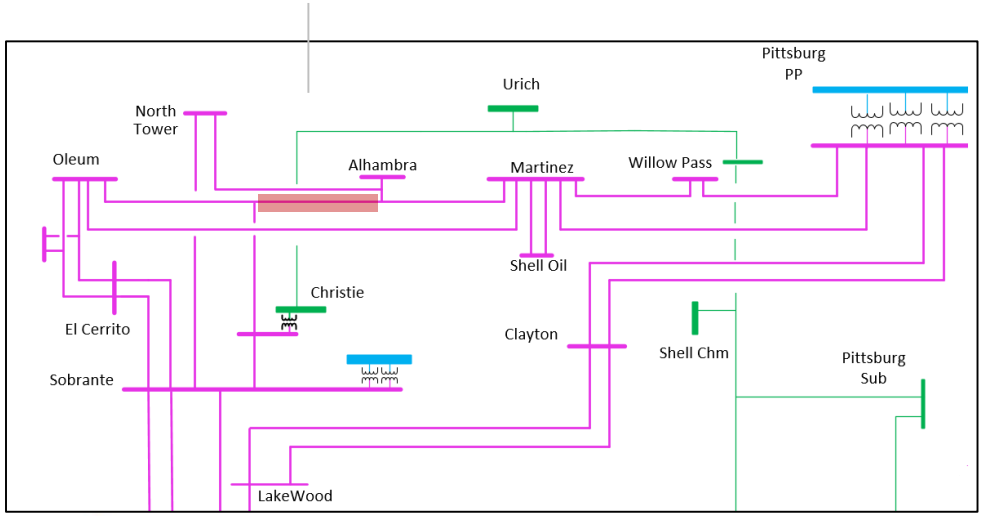
- P6 contingencies (losing 2 TB in Montavista) driven overloads on the Montavista 230/115 kV TB #2, #3 or #4 in long-term scenarios.

De Anza

Potential Mitigations

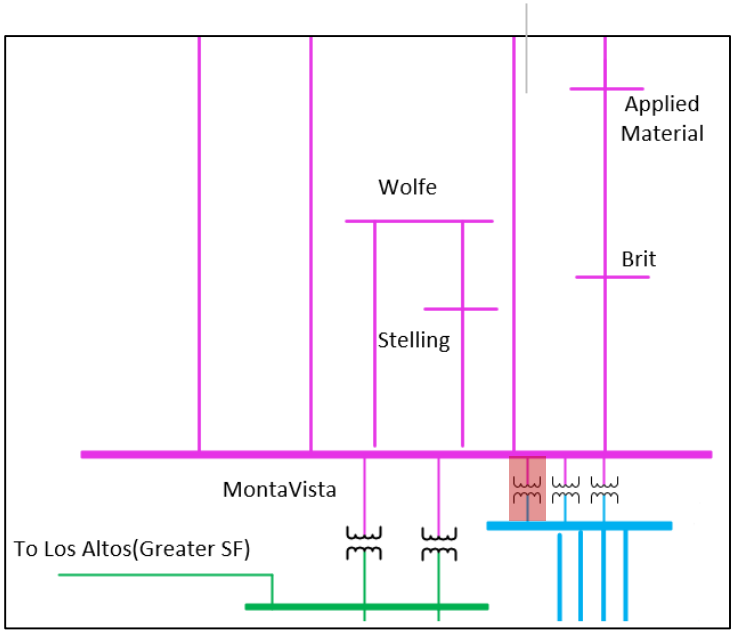
- The mitigation is under development for both issues.

Alhambra – Christie/Oleum 115 kV line



Diablo

Montavista 230/115 kV TB #1, #2 or #3



De Anza

California ISO Public

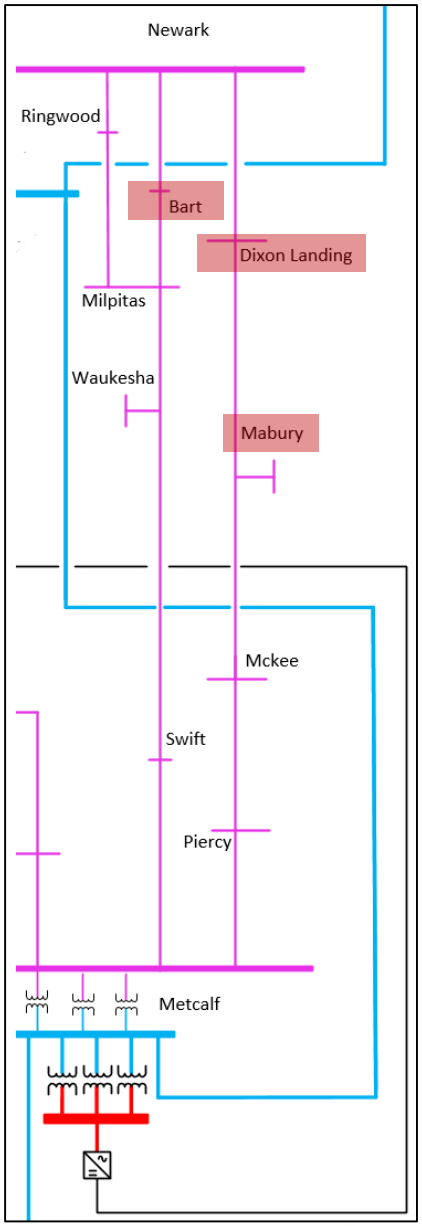
Low Voltage issues

San Jose

- Newark-Metcalf 115 kV loop
  - P1 – P7 contingencies driven low voltages in DIXON LD, MABURY, and BARTLP115 kV substations.

Potential Mitigations

- Mitigation under development.



P5 concerns observed for:

Contingency	Mitigation
SOBRANTE 230-115KV BATT(FAILURE OF NON-REDUNDANT BATT)	Install redundant battery supply
CONTRA COSTA PP 230KV BATT(FAILURE OF NON-REDUNDANT BATT)	Sensitivity only
MORAGA 230-115KV BATT(FAILURE OF NON-REDUNDANT BATT)	Install redundant battery supply
LAS POSITAS 230-60KV BATT(FAILURE OF NON-REDUNDANT BATT)	Project: Lone Tree – Cayetano – Newark Corridor Series Compensation
PITTSBURG PP 230-115KV BATT(FAILURE OF NON-REDUNDANT BATT)	Install redundant battery supply
EASTSHORE 115KV BATT(FAILURE OF NON-REDUNDANT BATT)	Install redundant battery supply
Single Control Circuitry Failure at SRS 115kV bus	Project: SRS rebuild project
NEWARK 230KV BATT(FAILURE OF NON-REDUNDANT BATT)	Install redundent battery supply
NEWARK D 115 & 60KV BATT(FAILURE OF NON-REDUNDANT BATT)	Project: San Jose area HVDC
NEWARK E&F 115KV BATT(FAILURE OF NON-REDUNDANT BATT)	Project: San Jose area HVDC
Singele DC Supply Failure at NRS300 115kV bus	Project: San Jose area HVDC
CLAYTON 115KV BATT(FAILURE OF NON-REDUNDANT BATT)	Install redundant battery supply
EASTSHORE 230KV BATT(FAILURE OF NON-REDUNDANT BATT)	Continue to monitor
CLAREMONT (OAKLAND K) 115KV BATT(FAILURE OF NON-REDUNDANT BATT)	Review project: Moraga - Oakland X Rebuild
OAKLAND X 115KV BATT(FAILURE OF NON-REDUNDANT BATT)	Install redundant battery supply
Single DC Supply Failure at NRS400 115kV bus	Install redundant battery supply

Summary of potential new upgrades

Division	Reliability Concern	Potential Upgrade
East Bay	P2, P6	• Load forecast and allocation under investigation.
Diablo	P2, P6	• Reactivate the Moraga – Sobrante 115 kV line reconducturing project. • Series compensation rearrangement on Table – Vaca – Collinsville - Tesla 500 kV path. • Series reactor on Collinsville – Pittsburg 230 kV lines as part of the ultimate Collinsville project.
SF - Peninsula	Multiple	• Operating solution for San Mateo – Beresford – Hillsdale and Cooley Landing 60 kV issues. • The mitigation for Martin-Millbrae 60 kV is under development.
De Anza	P6	• Potential Monta Vista 230/115 kV TB upgrade. • Potential Martinez-Alhambra capacity increase.
San Jose	Multiple	• Load forecast and allocation under investigation. • Review the operational coordination between the PST, San Jose Area HVDC lines and the Series Compensation in Los Esteros – Nortech. • Review scope of the Metcalf-Piercy & Swift and Newark-Dixon Landing 115 kV Upgrade and Morgan Hill Area Reinforcement projects. • Potential project to reinforce the Newark-Metcalf 115 kV loop (increase transmission capacity and voltage support)

California ISO Public

Humboldt
Preliminary Reliability Assessment Results

Preethi Rondla
Senior Regional Transmission Engineer-North

2023-24 Transmission Planning Process Stakeholder Meeting
September 26-27, 2023

Humboldt Area

- 3000 sq. mile area located NW corner of PG&E service area
- Cities include
  - Eureka
  - Arcata
  - Garberville
- Transmission facilities: 115 kV from Cottonwood and 60 kV – from Mendocino

Load and load modifier assumptions – Humboldt

Scenario	Study Case	Description	Gross Load (MW)	AAEE (MW)	AAFS (MW)	AATE (MW)	BTM-PV (MW)		Net Load (MW)	Demand Response Installed
							Installed	Output		
Base	2025-SPOP.epc	2025 Spring off-Peak load condition. Off-Peak load time - hours ending 19:00	136	-1	0	2	41	0	135	1
	2025-WP.epc	2025 Winter Peak load condition. Winter Peak load time - hours ending 19:00	189	-1	0	2	41	0	188	1
	2028-SPOP.epc	2028 Spring Off-Peak load condition. Off-Peak load time - hours ending 13:00	134	-2	1	5	56	45	88	1
	2028-WP.epc	2028 Winter Peak load condition. Winter Peak load time - hours ending 19:00	208	-2	1	5	56	0	206	1
	2035-WP-r1.epc	2035 Winter Peak load condition. Winter Peak load time - hours ending 19:00	282	-4	1	17	93	0	278	1
	HUMB-2025HS.epc	2025 Summer Peak load condition. Peak load time - hours ending 21:00	161	-1	0	2	41	5	155	1
	HUMB-2028HS.epc	2028 Summer Peak load condition. Peak load time - hours ending 21:00	167	-2	2	5	57	7	158	1
	HUMB-2035HS.epc	2035 Summer Peak load condition. Peak load time - hours ending 21:00	237	-3	8	18	94	0	234	1
Sensitivity	HUMB-2025HS-Hire.epc	2025 Summer peak Load conditions with Hi-Renewable dispatch Sensitivity	161	-1	0	2	41	41	119	1
	2025-SPOP-Hire.epc	2025 Spring off-peak load conditions and high renewables	136	-1	0	2	41	0	135	1
	HUMB-2028-Hicec.epc	2028 Summer Peak load condition with Hi-CEC load forecast sensitivity.	167	0	2	5	57	7	160	1

Generation assumptions - Humboldt

Scenario	Study Case	Description	Battery		Solar		Wind		Hydro		Thermal	
			Installed	Dispatch	Installed	Dispatch	Installed	Dispatch	Installed	Dispatch	Installed	Dispatch
Base	2025-SPOP.epc	2025 Spring off-Peak load condition. Off-Peak load time - hours ending 19:00	0	0	2	0	0	0	5	0	257	59
	2025-WP.epc	2025 Winter Peak load condition. Winter Peak load time - hours ending 19:00	0	0	2	0	0	0	5	0	257	56
	2028-SPOP.epc	2028 Spring Off-Peak load condition. Off-Peak load time - hours ending 13:00	0	2	2	2	0	0	5	0	257	23
	2028-WP.epc	2028 Winter Peak load condition. Winter Peak load time - hours ending 19:00	0	0	2	0	0	0	5	0	257	56
	2035-WP-r1.epc	2035 Winter Peak load condition. Winter Peak load time - hours ending 19:00	0	0	2	0	0	0	5	0	257	157
	HUMB-2025HS.epc	2025 Summer Peak load condition. Peak load time - hours ending 21:00	0	0	2	0	0	0	5	0	257	89
	HUMB-2028HS.epc	2028 Summer Peak load condition. Peak load time - hours ending 21:00	0	0	2	0	0	0	5	0	257	89
	HUMB-2035HS.epc	2035 Summer Peak load condition. Peak load time - hours ending 21:00	5	3	2	0	161	21	5	0	259	244
Sensitivity	HUMB-2025HS-Hire.epc	2025 Summer peak Load conditions with Hi-Renewable dispatch Sensitivity	0	0	2	2	0	0	5	0	257	170
	2025-SPOP-Hire.epc	2025 Spring off-peak load conditions and high renewables	0	0	2	0	0	0	5	0	257	58
	HUMB-2028-Hicec.epc	2028 Summer Peak load condition with Hi-CEC load forecast sensitivity.	0	0	2	0	0	0	5	0	257	92

Previously approved transmission projects modelled in base cases

Project	Expected ISD
Willow Creek Reactive Support (Formerly Maple Creek)	Dec-27
Garberville Area Reinforcement	Dec-32

Reliability assessment preliminary results summary

Humboldt – Results summary

Near-term and mid-term

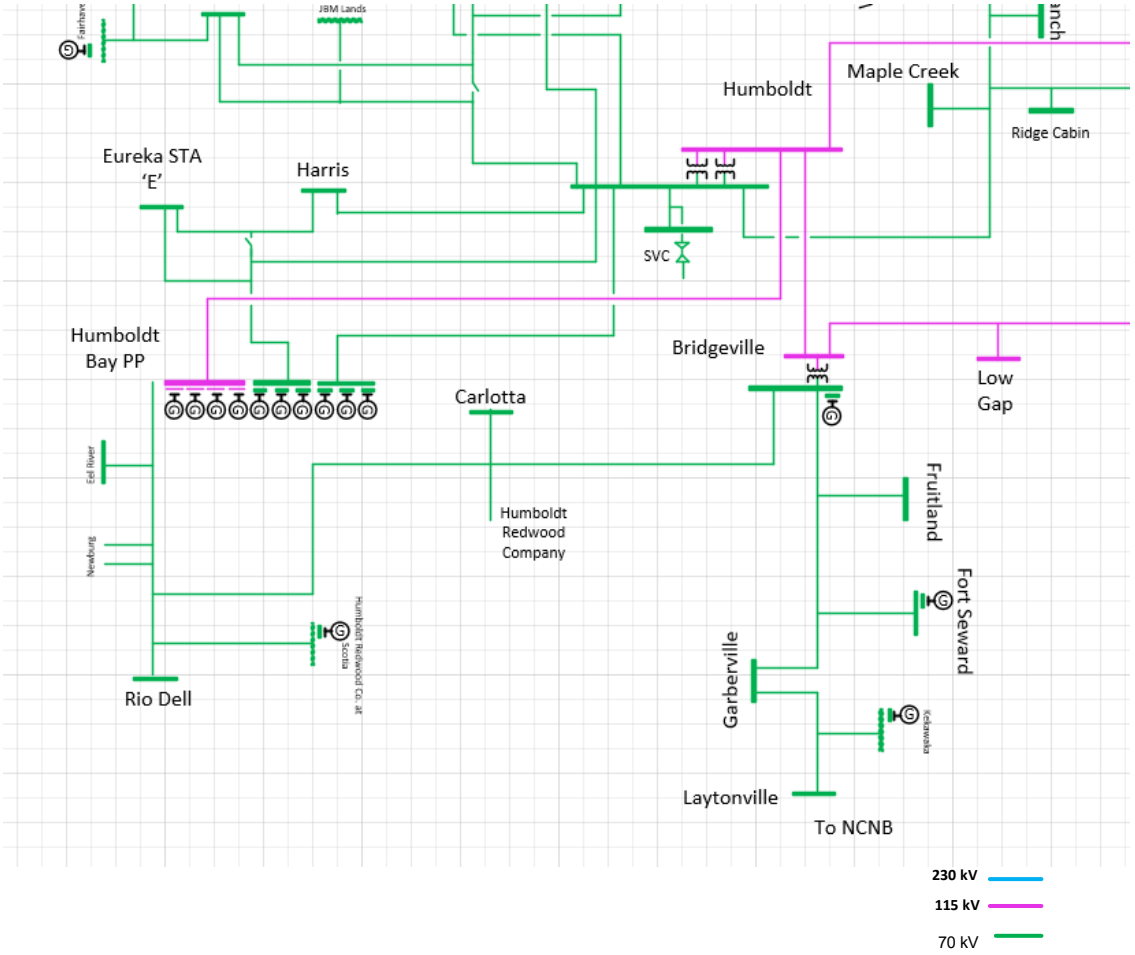
- P1, P2 and P3 overloads on multiple 60 kV lines and line sections, in near and mid-term and P1, P2 low voltages, mostly in Garberville area that are resolved in long term.

Long-term only issues

- P0 overloads on Humboldt Bay-Rio Dell jct 60 kV

Approved and Potential Mitigations

- Garberville reinforcement project approved in TPP 22-23.
- The long-term overloads related to high loads in newburg, riodell area will be monitored in future cycles.



P5 results summary

Contingency	Mitigation
BRIDGEVILLE 115-60KV BATT(FAILURE OF NON-REDUNDENT BATT)	INSTALL REDUNDANT BATTERY SUPPLY
HUMBOLDT 115 KV BUS (FAILURE OF NON-REDUNDENT RELAY)	INSTALL REDUNDANT BATTERY SUPPLY
HUMBOLDT 115KV BATT(FAILURE OF NON-REDUNDENT BATT)	INSTALL REDUNDANT RELAY

Summary of potential new upgrades

- None, continue to monitor load forecast

California ISO Public

Fresno Area
Preliminary Reliability Assessment Results

Preethi Rondla
Sr Regional Transmission Engineer

2023-2024 Transmission Planning Process Stakeholder Meeting
September 26-27, 2023

Greater Fresno Area

- Service areas cover Fresno, Kings, Tulare and Madera counties
- Supply Sources: Gates, Los Banos and Wilson
- Comprised of 70,115, 230 & 500 kV transmission facilities

Load and Load Modifier Assumptions - Greater Fresno Area

Scenario	Study Case	Description	Gross Load (MW)	AAEE (MW)	AAFS (MW)	AATE (MW)	BTM-PV (MW)		Net Load (MW)	Demand Response Installed
							Installed	Output		
Base	2025-SPOP.epc	2025 Spring off-Peak load condition. Off-Peak load time - hours ending 19:00	2974	-49	11	11	1820	2	2945	108
	2028-SOP.epc	2028 Summer off-peak condition. Peak load time-hours ending 15:00	2609	-67	24	31	2144	1286	1311	0
	2028-SPOP.epc	2028 Spring Off-Peak load condition. Off-Peak load time - hours ending 13:00	1760	-65	24	31	2144	1693	57	116
	GFA-2025-SP.epc	2025 Summer Peak load condition. Peak load time - hours ending 19:00	4078	-32	12	11	1799	154	3915	108
	GFA-2028-SP.epc	2028 Summer Peak load condition. Peak load time - hours ending 19:00	4051	-52	54	31	2123	183	3901	116
	GFA-2035-SP.epc	2035 Summer Peak load condition. Peak load time - hours ending 19:00	4794	-90	263	117	2953	0	5084	124
Sensitivity	GFA-2025-SPHire.epc	2025 Summer peak Load conditions with Hi-Renewable dispatch Sensitivity	4078	-32	12	11	1799	1756	2313	108
	2025-SPOP-Hire.epc	2025 Spring off-peak load conditions and high renewables	2974	-49	11	11	1820	2	2945	108
	GFA-2028-SPHicec.epc	2028 Summer Peak load condition with Hi-CEC load forecast sensitivity.	4051	0	54	31	2123	183	3953	116

Generation Assumptions - Greater Fresno Area

Scenario	Study Case	Description	Battery		Solar		Wind		Hydro		Thermal	
			Installed	Dispatch	Installed	Dispatch	Installed	Dispatch	Installed	Dispatch	Installed	Dispatch
Base	2025-SPOP.epc	2025 Spring off-Peak load condition. Off-Peak load time - hours ending 19:00	1744	1512	4386	0	99	46	1898	996	1414	1301
	2028-SOP.epc	2028 Summer off-peak condition. Peak load time-hours ending 15:00	1744	0	4386	3055	99	34	1898	300	1414	424
	2028-SPOP.epc	2028 Spring Off-Peak load condition. Off-Peak load time - hours ending 13:00	1744	-1008	4386	2698	99	24	1898	-420	1414	373
	GFA-2025-SP.epc	2025 Summer Peak load condition. Peak load time - hours ending 19:00	1744	436	4386	385	99	53	1898	1819	1414	1255
	GFA-2028-SP.epc	2028 Summer Peak load condition. Peak load time - hours ending 19:00	1744	610	4386	392	99	53	1898	1820	1414	1294
	GFA-2035-SP.epc	2035 Summer Peak load condition. Peak load time - hours ending 19:00	2902	2118	8621	717	172	111	1898	1702	1417	1182
Sensitivity	GFA-2025-SPHire.epc	2025 Summer peak Load conditions with Hi-Renewable dispatch Sensitivity	1744	-785	4386	4179	99	61	1898	583	1414	1259
	2025-SPOP-Hire.epc	2025 Spring off-peak load conditions and high renewables	1744	-1512	4386	758	99	46	1898	-186	1414	1168
	GFA-2028-SPHicec.epc	2028 Summer Peak load condition with Hi-CEC load forecast sensitivity.	1744	785	4386	392	99	53	1898	1820	1414	1292

Previously approved transmission projects modelled in base cases

Project	Expected ISD
Borden 230/70 kV Transformer Bank #1 Capacity Increase	Dec-27
Coppermine 70 kV Reinforcement Project	Dec-27
Giffen Line Reconductoring Project	Dec-23
Herndon-Bullard 115 kV Reconductoring Project	Dec-26
Moss Landing – Las Aguilas 230 kV Series Reactor Project	Dec-26
Oro Loma 70 kV Area Reinforcement	Jan-27
Panoche – Ora Loma 115 kV Line Reconductoring	Mar-24
Reedley 70 kV Reinforcement (Renamed to Reedley 70 kV Area Reinforcement Projects)	Oct-25
Warnerville-Bellota 230 kV line reconductoring	Apr-24
Wilson 115 kV Area Reinforcement	Jan-28
Wilson-Le Grand 115 kV line reconductoring	Nov-23
Wilson-Oro Loma 115kV Line Reconductoring	Dec-28
Equipment Upgrade at CCSF Owned Warnerville 230 kV Substation	Dec-24
Los Banos 70 kV Area Reinforcement	Dec-29
Borden-Storey 230 kV 1 and 2 Line Reconductoring	Dec-32
Henrietta 230/115 kV Bank 3 Replacement	Dec-32
Los Banos 230 kV Circuit Breakers Replacement	Dec-32
Panoche 115 kV Circuit Breaker Replacement and 230 kV Bus Upgrade project	Dec-32

Fresno – 230 kV Results Summary

Observations

1. P1 overloads in 2025 and 2035 peak case:
   - Gregg-Ashlan 230 kV line
   - For loss of Herndon-Figarden-Ashlan 230 kV
2. P2 overloads in all three years
   - Mc Call 230/115 kV Bank 2
   - For loss of Mccall 230 kV section 1D and 2D
3. P1 overloads in 2025 and 2035 peak only
   - Borden 230/70 kV Bank 1
   - For loss of Borden 230/70 kV Bank 4

Potential Mitigations

1. Monitoring load growth in Ashlan
2. Under review
3. Existing Borden 230/70 kV bank 1 capacity increase project insufficient for long term

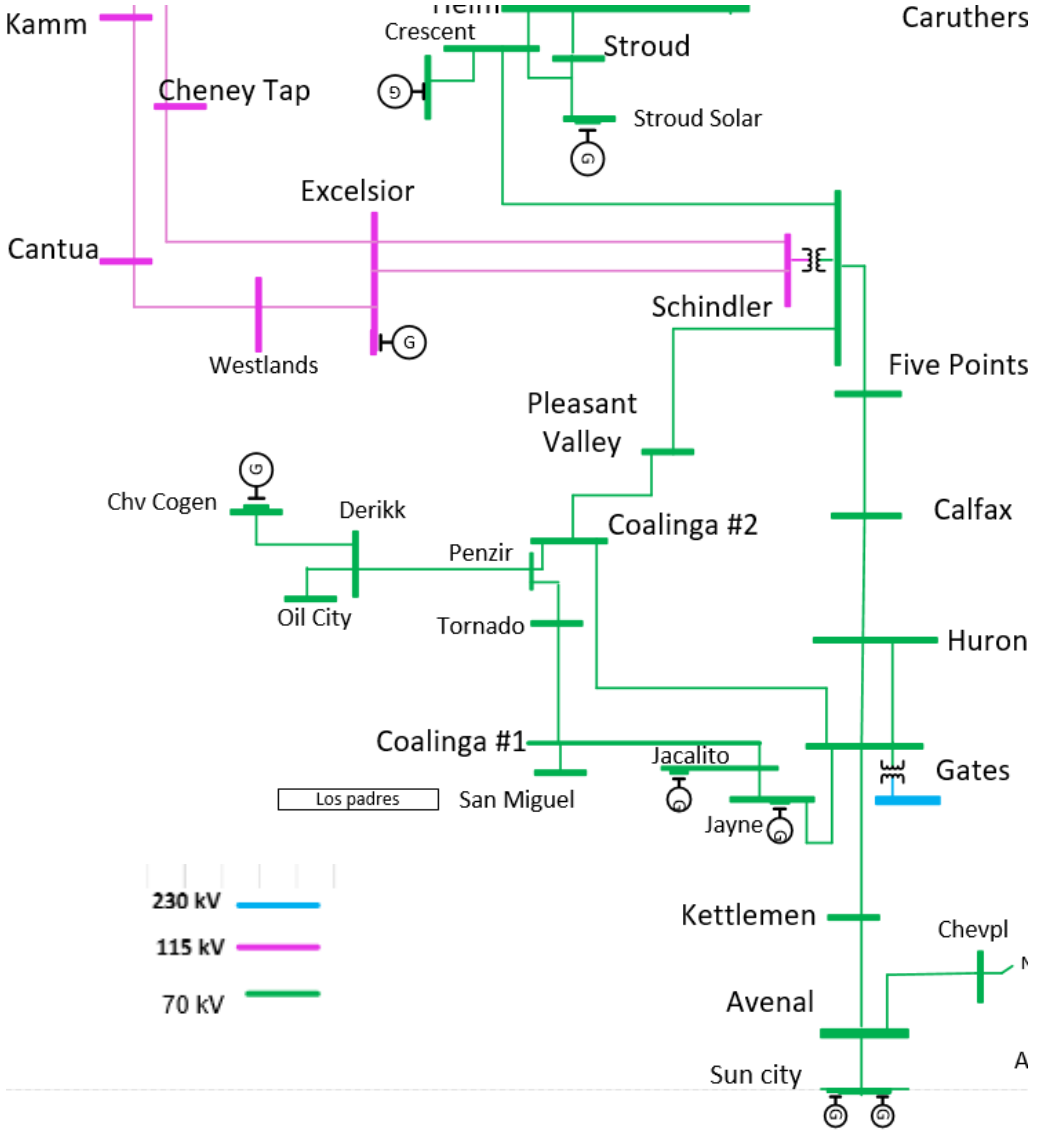
Fresno 115/70 kV Results Summary

Observations

1. P1 overloads:
   - Schindler 115/70 kV bank 1
   - For loss of Gates 230/70 kV bank 5
2. P2 overloads:
   - Schindler 115/70 kV bank 1
   - For loss of Gates 230 kV section 2D
3. P6 overloads:
   - Excelsior-Schindler #1 and #2 115 kV lines for loss of Gates 230/70 kV bank and Excelsior-Schindler 115 kV line
   - Panoche-Schindler #1 115 kV line for loss of Gates 230/70 kV bank and Panoche-Excelsior #2 115 kV line
4. P1 overloads:
   - Schindler-Huron-Gates 70 kV line and Five points-Huron-Gates 70 kV line.
   - For loss of Gates 230/70 kV bank 5

Potential Mitigations

1. Project: Additional Gates 230/70 kV bank will address these issues



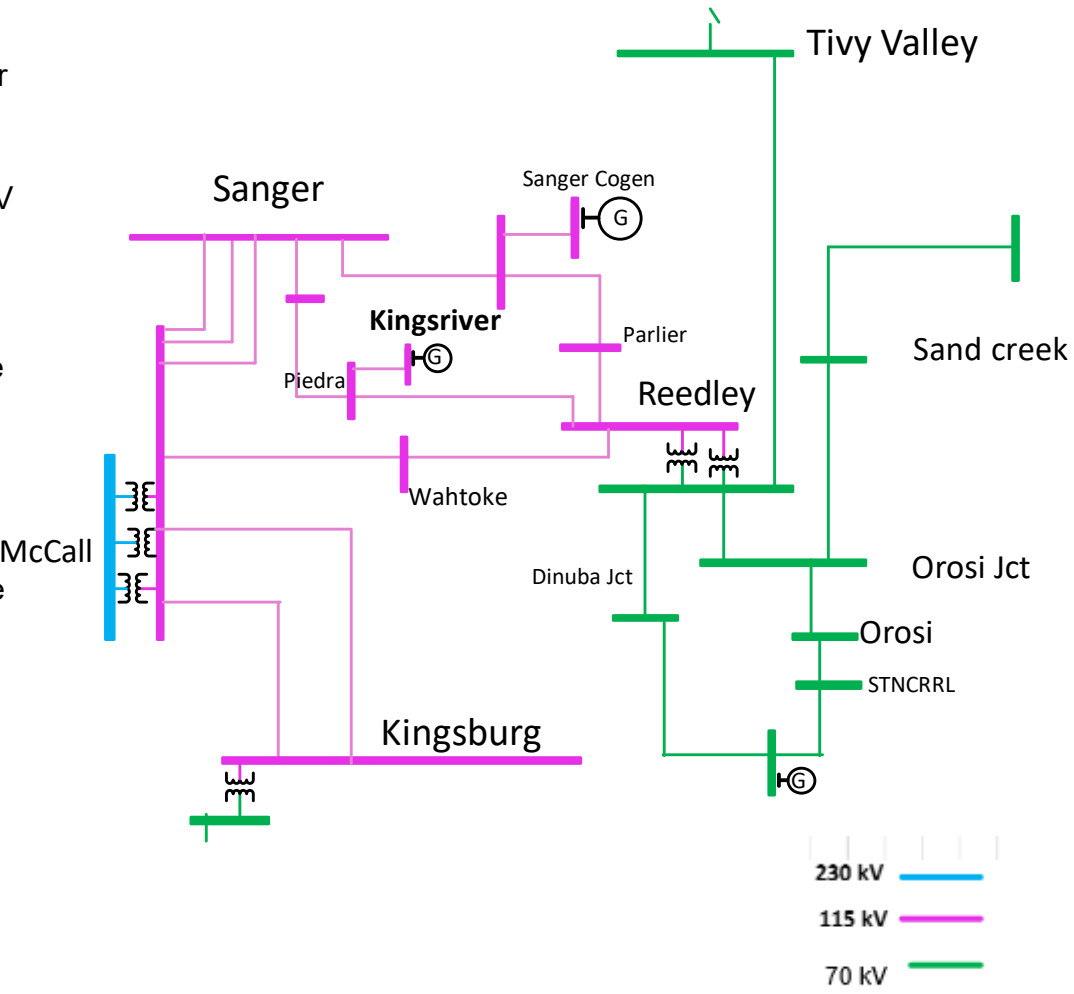
Fresno – Reedley Area 115kV/70 kV Results Summary

Observations

1. P1 overload on Dinuba- Orosi 70 kV Line for loss of Reedley-Dinuba #1 70 kV line
2. P1 overload on Reedley 115/70 kV transformer #4 for loss of Reedley 115/70 kV transformer #2
3. P6 overload on Kingsriver-Sanger-Reedley 115 kV Line
4. P6 overload on McCall-Reedley 115 kV Line
5. P6 overload on McCall-Sanger #2 Line

Potential Mitigations

1. Project: Reedley 70 kV Reinforcement (Dinuba Battery Energy Storage) need to be re-scoped to address all issues observed



Fresno– Low Voltage Results Summary

Observations

1. P0-P7 low voltages on Camden 70 kV
2. P1-P6 low voltages on California Ave 115 kV, Chowchilla 115 kV area, Oro loma 115 kV
3. Multiple Low Voltages seen in the Coalinga 70 kV area
4. Low voltages in the Reedley 70 kV pocket in all peak cases

Approved and Potential Mitigations

1. Voltage support needed for this radial area
2. Voltage support needed and review Oro Loma 70 kV area Reinforcement Project
3. Additional Gates bank can help mitigate
4. Reedley 70 kV Reinforcement/re-scope Project

Fresno- P5 Results Summary

Contigency	Mitigation
Los Banos 500-230-70kV Batt(FAILURE OF NON-REDUNDENT BATT)	INSTALL REDUNDENT BATTERY SUPPLY
WILSON 115 KV #1 & #2 BUS (FAILURE OF NON-REDUNDENT RELAY)	INSTALL REDUNDANT RELAY
Wilson 230-115kV Batt(FAILURE OF NON-REDUNDENT BATT)	INSTALL REDUNDENT BATTERY SUPPLY
Mccall 230-115kV Batt(FAILURE OF NON-REDUNDENT BATT)	INSTALL REDUNDENT BATTERY SUPPLY
HERNDON #1 115KV BUS (FAILURE OF NON-REDUNDENT RELAY)	INSTALL REDUNDANT RELAY
Sanger 115kV Batt(FAILURE OF NON-REDUNDENT BATT)	INSTALL REDUNDENT BATTERY SUPPLY
Gregg 230kV Batt(FAILURE OF NON-REDUNDENT BATT)	INSTALL REDUNDENT BATTERY SUPPLY
Herndon 230-115kV Batt(FAILURE OF NON-REDUNDENT BATT)	INSTALL REDUNDENT BATTERY SUPPLY
GATES SECTION D & E 230 KV BUS (FAILURE OF NON-REDUNDENT RELAY)	INSTALL REDUNDANT RELAY
Gates 500kV Batt(FAILURE OF NON-REDUNDENT BATT)	INSTALL REDUNDENT BATTERY SUPPLY
Panoche 230-115kV Batt(FAILURE OF NON-REDUNDENT BATT)	INSTALL REDUNDENT BATTERY SUPPLY
Figarden 230kV Batt #1(FAILURE OF NON-REDUNDENT BATT)	INSTALL REDUNDENT BATTERY SUPPLY
Figarden 230kV Batt #2(FAILURE OF NON-REDUNDENT BATT)	INSTALL REDUNDENT BATTERY SUPPLY
Gates 230-70kV Batt(FAILURE OF NON-REDUNDENT BATT)	INSTALL REDUNDENT BATTERY SUPPLY
Hammonds 115kV Batt(FAILURE OF NON-REDUNDENT BATT)	INSTALL REDUNDENT BATTERY SUPPLY
Oro Loma 115-70kV Batt(FAILURE OF NON-REDUNDENT BATT)	INSTALL REDUNDENT BATTERY SUPPLY
Borden 230-70kV Batt(FAILURE OF NON-REDUNDENT BATT)	INSTALL REDUNDENT BATTERY SUPPLY
Mustang SW STA 230kV Batt(FAILURE OF NON-REDUNDENT BATT)	INSTALL REDUNDENT BATTERY SUPPLY
Excelsior SW STA 115kV Batt(FAILURE OF NON-REDUNDENT BATT)	INSTALL REDUNDENT BATTERY SUPPLY
Hammonds 115kV Batt(FAILURE OF NON-REDUNDENT BATT)	INSTALL REDUNDENT BATTERY SUPPLY

Summary of potential new upgrades

- New project expected for Gates 230/70 kV area
- Below projects may need re-scope
  - Reedley 70 kV reinforcement project

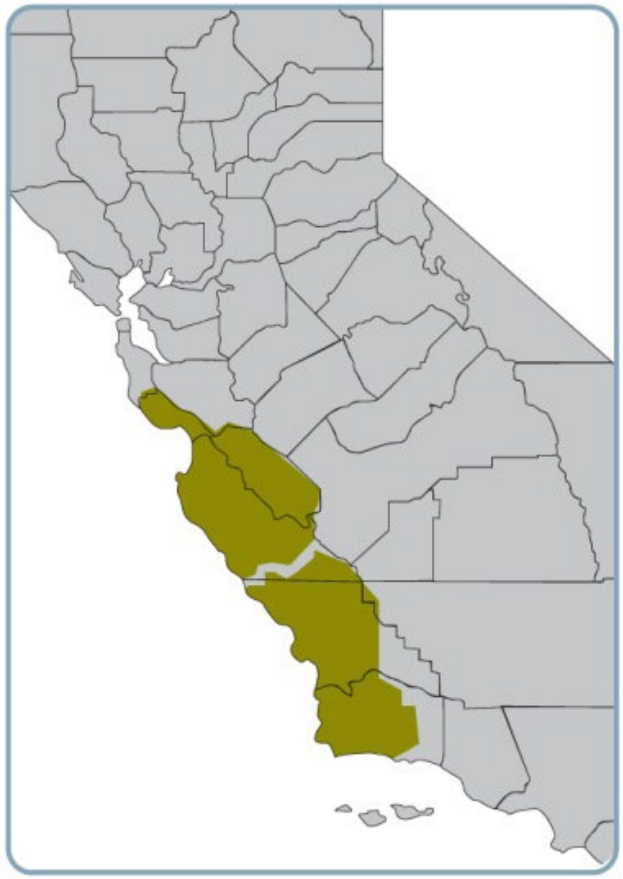
California ISO Public

Central Coast and Los Padres Area Preliminary Reliability Assessment Results

Rujuta Barve
Regional Transmission Engineer

2023-2024 Transmission Planning Process Stakeholder Meeting
September 26-27, 2023

Central Coast/ Los Padres Area



- Central Coast is located south of the Greater Bay Area, it extends along the central coast from Santa Cruz to King City
- Major substations in Central Coast: Moss Landing, Green Valley, Paul Sweet, Salinas, Watsonville, Monterey, Soledad and Hollister
- Central Coast supply sources: Moss Landing, Panoche, King City and Monta Vista
- Central Coast transmission system includes 60, 115, 230 and 500 kV facilities

- Los Padres is located south of the Central Coast Division
- Major substations in Los Padres : Paso Robles, Atascadero, Morro Bay, San Luis Obispo, Mesa, Divide, Santa Maria and Sisquoc
- Key supply sources in Los Padres include Gates, Midway and Morro Bay
- Diablo Canyon nuclear power plant (2400 MW) is located in Los Padres but does not serve the area
- Los Padres transmission system includes 70, 115, 230 and 500 kV facilities

Load and Load Modifier Assumptions – Central Coast/ Los Padres Area

Scenario	Study case	Description	Gross Load (MW)	BTM-PV Output (MW)	BTM-PV Installed Capacity (MW)	AAEE Load (MW)	AAFS Load (MW)	AATE Load (MW)	Net Load (MW)	Total DR (MW)
Base	2025-SPOP.epc	2025 Spring off-Peak load condition. Off-Peak load time - hours ending 19:00	1091	1	637	-16	3	15	1074	-80
	2025-WP.epc	2025 Winter Peak load condition. Winter Peak load time - hours ending 19:00	1312	1	637	-13	3	15	1299	-93
	2028-SPOP.epc	2028 Spring Off-Peak load condition. Off-Peak load time - hours ending 13:00	1042	583	738	-20	5	41	438	-83
	2028-WP.epc	2028 Winter Peak load condition. Winter Peak load time - hours ending 19:00	1429	1	738	-21	5	41	1407	-83
	2035-WP-r1.epc	2035 Winter Peak load condition. Winter Peak load time - hours ending 19:00	1848	1	1003	-40	11	160	1807	-93
	CCLP-2025HS.epc	2025 Summer Peak load condition. Peak load time - hours ending 19:00	1426	0	644	-11	3	15	1414	-80
	CCLP-2028HS.epc	2028 Summer Peak load condition. Peak load time - hours ending 19:00	1504	0	745	-18	14	41	1485	-83
	CCLP-2035HS.epc	2035 Summer Peak load condition. Peak load time - hours ending 19:00	2044	0	1009	-33	69	160	2012	-93
Sensitivity	CCLP-2025HS-Hire.epc	2025 Summer peak Load conditions with Hi-Renewable dispatch Sensitivity	1426	617	644	-11	3	15	798	-80
	2025-SPOP-Hire.epc	2025 Spring off-peak load conditions and high renewables sensitivity	1091	1	637	-16	3	15	1074	-80
	CCLP-2028HS-Hicec.epc	2028 Summer Peak load condition with Hi-CEC load forecast sensitivity.	1504	0	745	0	14	41	1503	-83

Generation Assumptions - Central Coast/ Los Padres

Scenario	Study Case	Description	Battery		Solar		Wind		Hydro		Thermal	
			Installed	Dispatch	Installed	Dispatch	Installed	Dispatch	Installed	Dispatch	Installed	Dispatch
Base	2025-SPOP.epc	2025 Spring off-Peak load condition. Off-Peak load time - hours ending 19:00	302	-272	856	0	101	47	0	0	1325	1242
	2025-WP.epc	2025 Winter Peak load condition. Winter Peak load time - hours ending 19:00	302	0	856	0	101	25	0	0	1325	1247
	2028-SPOP.epc	2028 Spring Off-Peak load condition. Off-Peak load time - hours ending 13:00	302	-181	856	728	101	24	0	0	1325	75
	2028-WP.epc	2028 Winter Peak load condition. Winter Peak load time - hours ending 19:00	302	0	856	0	101	25	0	0	1325	1266
	2035-WP-r1.epc	2035 Winter Peak load condition. Winter Peak load time - hours ending 19:00	352	0	1086	0	356	89	300	300	11	11
	CCLP-2025HS.epc	2025 Summer Peak load condition. Peak load time - hours ending 19:00	302	75	856	0	101	55	0	0	1325	1278
	CCLP-2028HS.epc	2028 Summer Peak load condition. Peak load time - hours ending 19:00	302	72	856	9	101	55	0	0	1325	1278
	CCLP-2035HS.epc	2035 Summer Peak load condition. Peak load time - hours ending 19:00	402	197	1086	0	356	68	300	37	11	11
Sensitivity	CCLP-2025HS-Hire.epc	2025 Summer peak Load conditions with Hi-Renewable dispatch Sensitivity	302	-272	856	847	101	63	0	0	1325	1193
	2025-SPOP-Hire.epc	2025 Spring off-peak load conditions and high renewables sensitivity	302	-272	856	0	101	47	0	0	1325	1189
	CCLP-2028HS-Hicec.epc	2028 Summer Peak load condition with Hi-CEC load forecast sensitivity.	302	106	856	9	101	55	0	0	1325	1278

Previously approved transmission projects modelled in base cases

Project Name	Expected In-service Date
Coburn-Oil Fields 60 kV system Project	Jun 2029
Estrella Substation Project	Jul 2029*
Salinas-Firestone #1 and #2 60kV Lines	Dec 2026
South of Mesa Upgrade	Apr 2027
Mesa 230/115 kV Spare Transformer	May 2029**
Morgan Hill Area Reinforcement (formerly Spring 230/115 kV Substation)	Sep 2027
Moss Landing – Las Aguilas 230 kV Series Reactor Project	Dec 2026

*Expected ISD changed after TPP cases were finalized. The project is modeled in cases starting 2028.

** Not modeled in 2035 TPP cases.

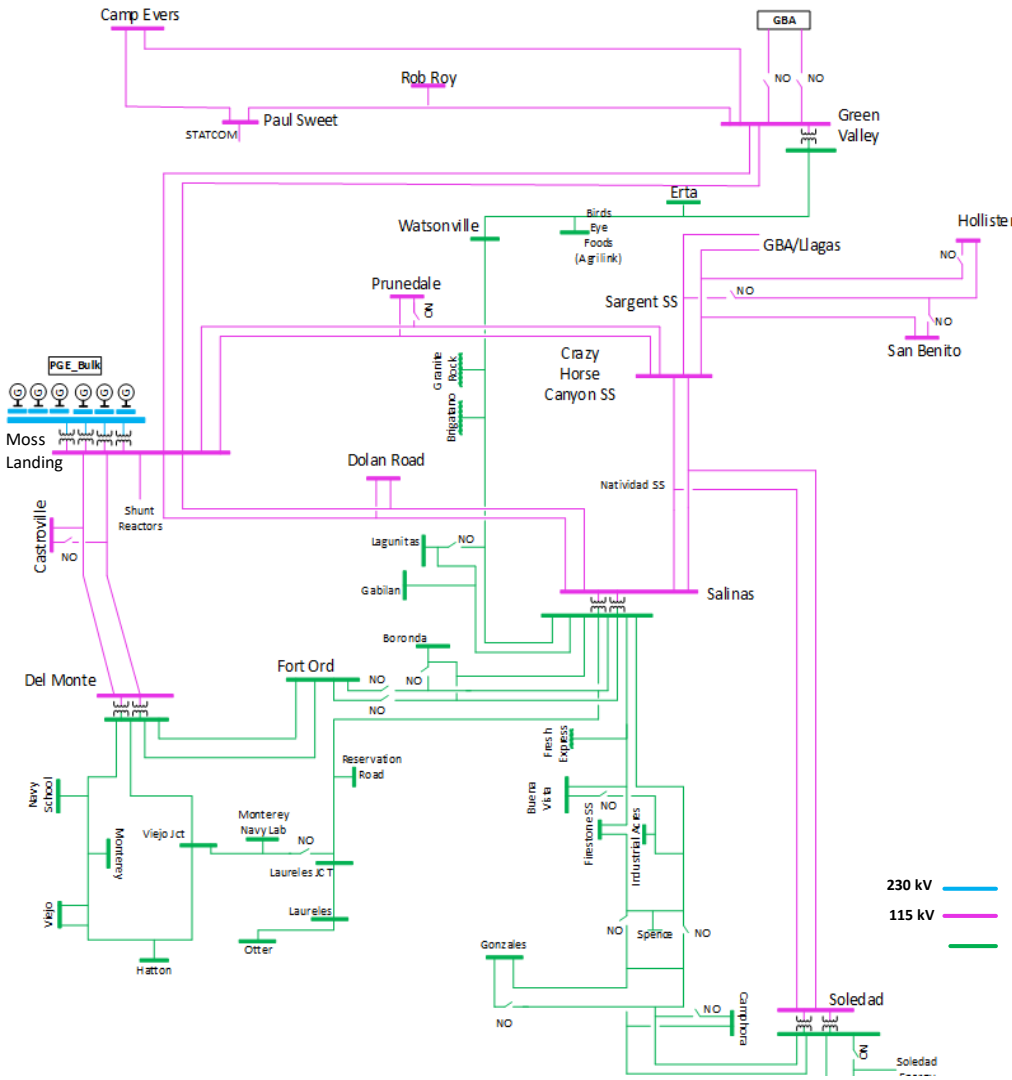
Central Coast - Results Summary

Observations

- Green Valley-Watsonville-Salinas 60 kV
  - P6 and P7 overloads on Watsonville-Salinas 60kV line and Salinas-Lagunitas
  - P7 overloads on Green Valley 115/60 kV transformer bank and Green Valley-Watsonville 60 kV line
- Salinas-Firestone 60 kV #1 & #2
  - NERC Category P0, P1, P2, and P7 overloads are identified on Salinas-Firestone 60 kV Line #1 & #2

Approved and Potential Mitigations

- Morgan Hill Area Reinforcement
  - Expected to be in-service Q3 of 2027
- Salinas-Firestone 60 kV line #1 & line #2 Re-conductor
  - Expected to be in-service Q4 of 2026



California ISO Public

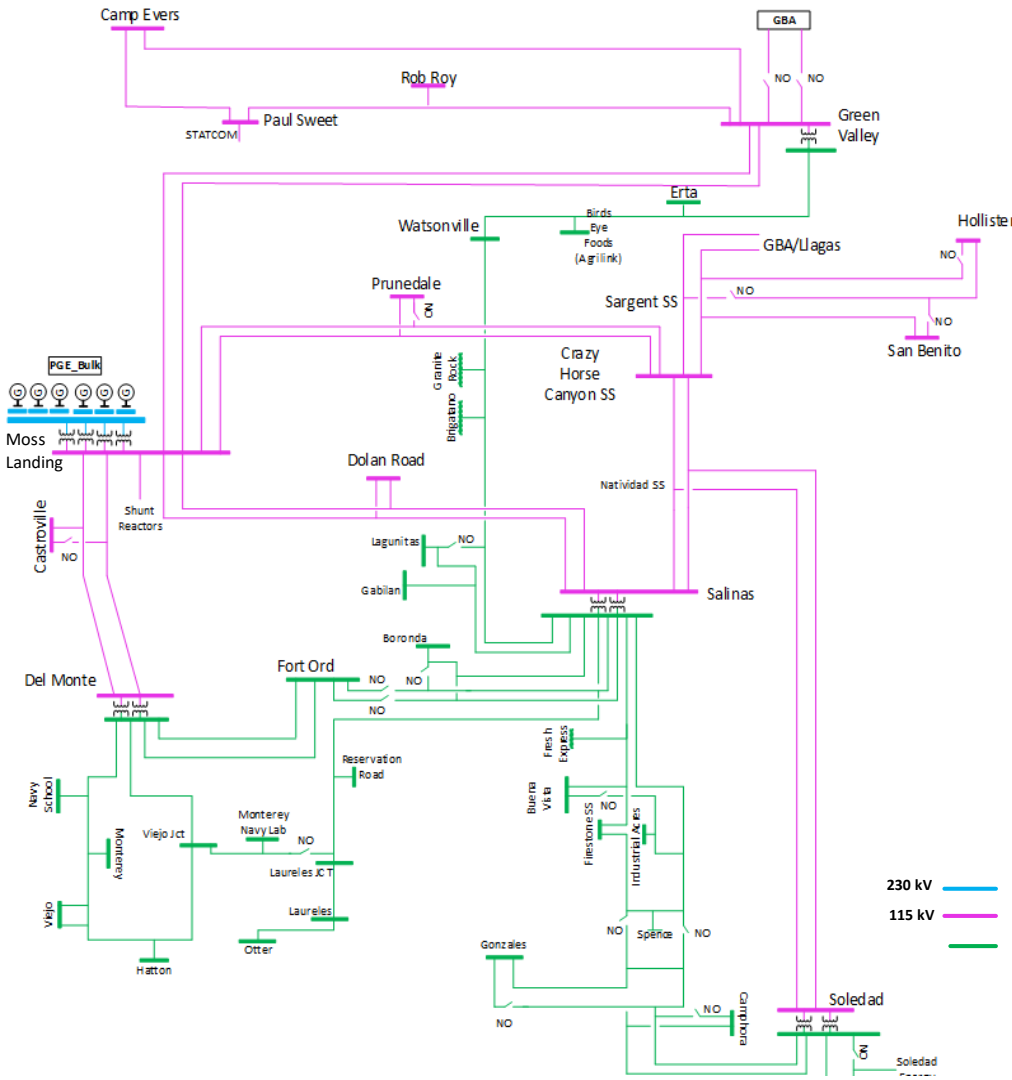
Central Coast - Results Summary

Observations

- Crazy Horse Canyon-Moss Landing-Salinas-Soledad-Natividad 115 kV
  - NERC Category P6 and P7 overloads observed on:
    - Crazy Horse Canyon-Natividad #1 115 kV line
    - Crazy Horse Canyon-Soledad 115 kV line
    - Crazy Horse Canyon-Moss Landing #2 115 kV line
    - Moss Landing-Salinas #1 115 kV line
  - Low voltages observed at multiple 115 kV substations including San Benito, Hollister, Salinas, and Soledad for NERC Category P2, P6, and P7 contingencies

Approved and Potential Mitigations

- Previously recommended RAS in 2018-2019 TPP
- Potential area reinforcement project



California ISO Public

Los Padres - Results Summary

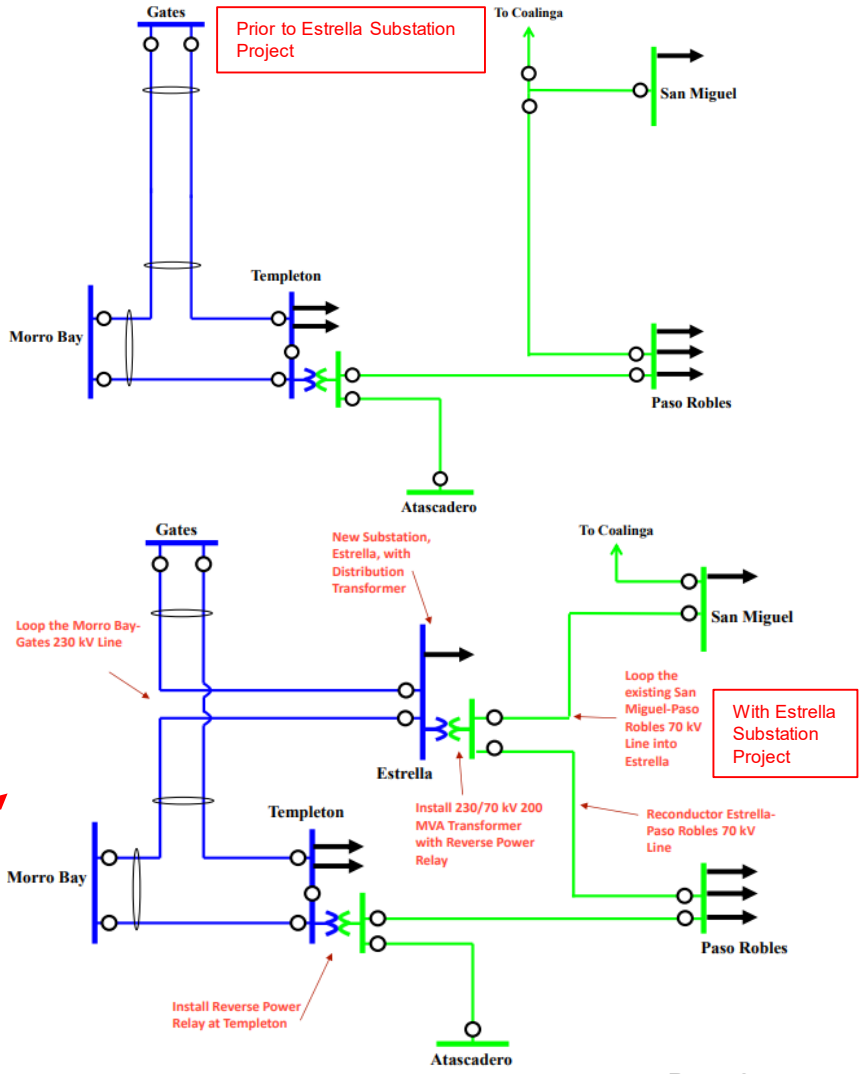
Observations

- San Miguel-Paso Robles-Templeton 70 kV
  - NERC Category P1 and P7 contingencies result in overloads on the Coalinga #1-San Miguel 70 kV line and San Miguel-Paso Robles 70 kV line.
  - NERC Category P6 contingencies result in overloads on Atascadero-San Luis Obispo 70 kV line and Baywood-San Luis Obispo 70 kV line.
  - Near term voltage issues are identified at multiple 70 kV substations including San Miguel, Paso Robles, Atascadero, Baywood, Cayucos, and Perry and 230 kV Templeton substation for NERC Category P0, P1, P3, P5, P6 and P7 contingencies.

Approved and Potential Mitigations

- Estrella Substation Project
  - Expected to be in-service Q3 of 2029

Scope of Estrella Substation Project is documented in red.



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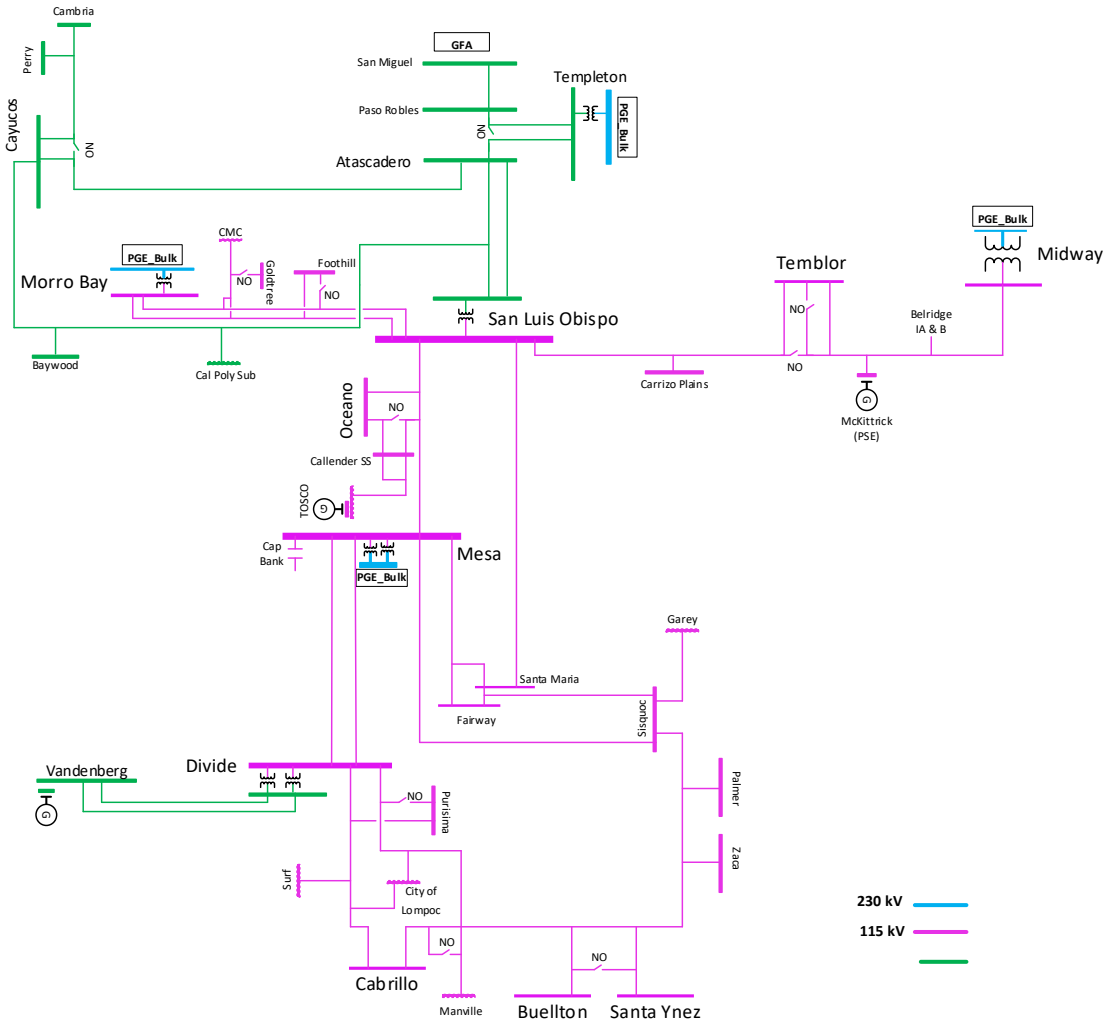
Los Padres - Results Summary

Observations

- P2, P6, P7 overloads on:
  - Callender Switching Station-Mesa 115 kV line
  - Divide-Cabrillo 115 kV line
  - Morro Bay 230/115 kV transformer bank
  - Morro Bay-San Luis Obispo 115 kV line
  - Oceano-Callender Switching Station 115 kV line
  - San Luis Obispo-Oceano 115 kV line
  - San Luis Obispo-Santa Maria 115 kV line
  - Santa Maria-Sisquoc 115 kV line
  - Sisquoc-Santa Ynez Switching Station 115 kV line
  - Temblor-San Luis Obispo 115 kV line

Approved and Potential Mitigations

- Existing UVLS at Morro Bay & Mesa
- South of Mesa Upgrades
  - Expected to be in-service Q2 of 2027



California ISO Public

Central Coast/ Los Padres – P5 Results Summary

Observations

- P5 concerns observed for:

NERC Category	Contingency	Mitigation
P5	HOLLISTER 115KV BATT(FAILURE OF NON-REDUNDENT BATT)	Install redundant battery supply
P5	HOLLISTR 115KV BUS D (FAILURE OF NON-REDUNDENT RELAY)	Install redundant relay
P5	MESA 230 KV BAAH BUS #1 OR #2 (FAILURE OF NON-REDUNDENT RELAY)	Redundant relay installation recommended in 2022-2023 TPP
P5	MESA 230-115KV BATT(FAILURE OF NON-REDUNDENT BATT)	Redundant battery supply installation recommended in 2022-2023 TPP
P5	MORRO BAY 230KV BUS (FAILURE OF NON-REDUNDENT RELAY)	Redundant relay installation recommended in 2020-2021 TPP
P5	MORRO BAY SW 230-115KV BATT(FAILURE OF NON-REDUNDENT BATT)	Redundant battery supply installation recommended in 2022-2023 TPP
P5	MOSS LANDING 230-115KV BATT(FAILURE OF NON-REDUNDENT BATT)	Redundant battery supply installation recommended in 2022-2023 TPP
P5	SALINAS 115KV BAAH BUS #1 OR #2 (FAILURE OF NON-REDUNDENT RELAY)	Redundant relay installation recommended in 2018-2019 TPP
P5	SOLAR SW STA 230KV BATT(FAILURE OF NON-REDUNDENT BATT)	Redundant battery supply installation recommended in 2022-2023 TPP
P5	TEMPLETON 230-70KV BATT(FAILURE OF NON-REDUNDENT BATT)	Project: Estrella Substation Project
P5	CALIENTE 230KV BATT(FAILURE OF NON-REDUNDENT BATT)	Continue to monitor
P5	DOLAN ROAD 115KV BATT(FAILURE OF NON-REDUNDENT BATT)	Continue to monitor

Summary of potential new upgrades

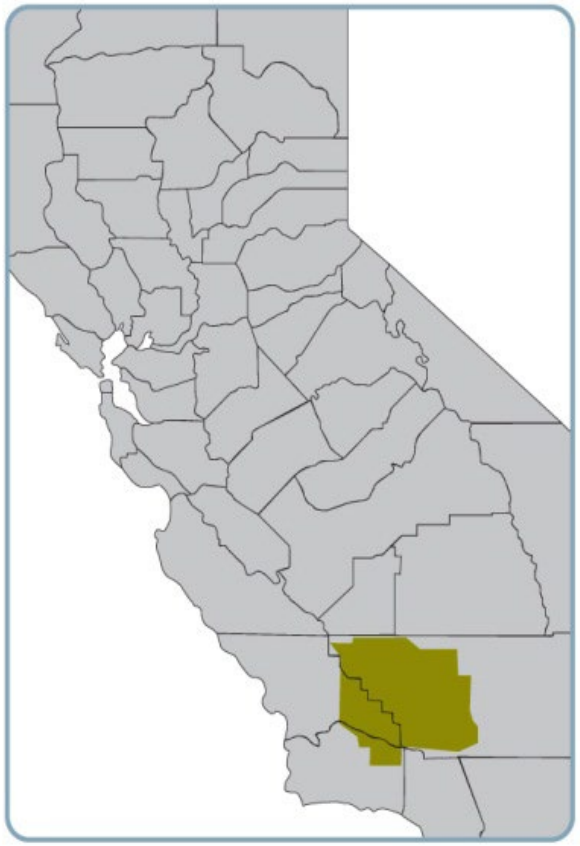
Area	Reliability Concern	Potential Upgrade
Central Coast	Salinas – Firestone 60 kV corridor thermal and voltage concerns	1. Review scope of Salinas-Firestone 60 kV line #1 & #2 re-conductor 2. Add voltage support in the area
Central Coast	Crazy Horse Canyon-Moss Landing-Salinas-Soledad-Natividad 115 kV corridor thermal and voltage concerns	1. Review scope of previously recommended RAS 2. Add voltage support in the area

Kern
Preliminary Reliability Assessment Results

Yara Khalaf
Senior Regional Transmission Engineer

2023-24 Transmission Planning Process Stakeholder Meeting
September 26-27, 2023

Kern Area



- Located south of the Yosemite-Fresno area and includes southern portion of the PG&E San Joaquin Division
- Major stations include Midway and Kern Power Plant
- Transmission system includes 60, 115 and 230 kV facilities.

Load and Load Modifier Assumptions - Kern

Scenario	Study Case	Description	Gross Load (MW)	AAEE (MW)	AAFS (MW)	AATE (MW)	BTM-PV (MW)		Net Load (MW)	Demand Response Installed (MW)
							Installed	Output		
Base	2025-SPOP.epc	2025 Spring off-Peak load condition. Off-Peak load time - hours ending 19:00	1487	-25	6	3	852	1	1461	368
	2028-SOP.epc	2028 Summer off-peak condition. Peak load time-hours ending 15:00	1570	-33	12	10	1011	606	930	0
	2028-SPOP.epc	2028 Spring Off-Peak load condition. Off-Peak load time - hours ending 13:00	1158	-32	12	10	1011	798	327	407
	Kern-2025-SP.epc	2025 Summer Peak load condition. Peak load time - hours ending 19:00	1973	-17	6	3	803	0	1955	368
	Kern-2028-SP.epc	2028 Summer Peak load condition. Peak load time - hours ending 19:00	2152	-27	24	10	962	0	2125	407
	Kern-2035-SP.epc	2035 Summer Peak load condition. Peak load time - hours ending 19:00	2323	-46	110	37	1347	0	2276	443
Sensitivity	Kern-2025-SP-Hire.epc	2025 Summer peak Load conditions with Hi-Renewable dispatch Sensitivity	1973	-17	6	3	803	792	1163	368
	2025-SPOP-Hire.epc	2025 Spring off-peak load conditions and high renewables	1487	-25	6	3	852	1	1461	368
	Kern-2028-SP-Hicec.epc	2028 Summer Peak load condition with Hi-CEC load forecast sensitivity.	2152	0	24	10	962	0	2152	407

Generation Assumptions - Kern

Scenario	Study Case	Description	Battery		Solar		Wind		Hydro		Thermal	
			Installed	Dispatch	Installed	Dispatch	Installed	Dispatch	Installed	Dispatch	Installed	Dispatch
Base	2025-SPOP.epc	2025 Spring off-Peak load condition. Off-Peak load time - hours ending 19:00	251	-228	1368	0	0	0	29	18	3203	2229
	2028-SOP.epc	2028 Summer off-peak condition. Peak load time-hours ending 15:00	251	0	1368	1049	0	0	29	14	3203	2990
	2028-SPOP.epc	2028 Spring Off-Peak load condition. Off-Peak load time - hours ending 13:00	251	-152	1368	1157	0	0	29	14	3203	561
	Kern-2025-SP.epc	2025 Summer Peak load condition. Peak load time - hours ending 19:00	251	88	1368	0	0	0	29	24	3203	2687
	Kern-2028-SP.epc	2028 Summer Peak load condition. Peak load time - hours ending 19:00	251	113	1368	14	0	0	29	24	3203	2704
	Kern-2035-SP.epc	2035 Summer Peak load condition. Peak load time - hours ending 19:00	700	385	2748	184	0	0	29	14	3203	3156
Sensitivity	Kern-2025-SP-Hire.epc	2025 Summer peak Load conditions with Hi-Renewable dispatch Sensitivity	251	-172	1368	1332	0	0	29	14	3203	2971
	2025-SPOP-Hire.epc	2025 Spring off-peak load conditions and high renewables	251	-228	1368	184	0	0	29	14	3203	2097
	Kern-2028-SP-Hicec.epc	2028 Summer Peak load condition with Hi-CEC load forecast sensitivity.	251	138	1368	14	0	0	29	24	3203	2703

Previously approved transmission projects modelled in base cases

Project	Expected ISD
Midway-Kern PP Nos. 1,3 and 4 230 kV Lines Capacity Increase (Kern PP 230 kV Area Reinforcement Project)	Mar-21
Kern PP 115 kV Area Reinforcement	Aug-27
Midway – Kern PP #2 230 kV Line	Apr-27
Midway-Kern PP Nos. 1,3 and 4 230 kV Lines Capacity Increase (Midway 230kV Bus Section D Upgrade Project)	Aug-25
Midway-Temblor 115 kV Line Reconductor and Voltage Support	Apr-29
Wheeler Ridge Junction Substation	Mar-34
Midway – Kern PP #2 230 kV Line (Bakersfield-Kern Reconductor)	Aug-28
North East Kern 115 kV Line Reconductoring	Dec-32

Reliability assessment preliminary results summary

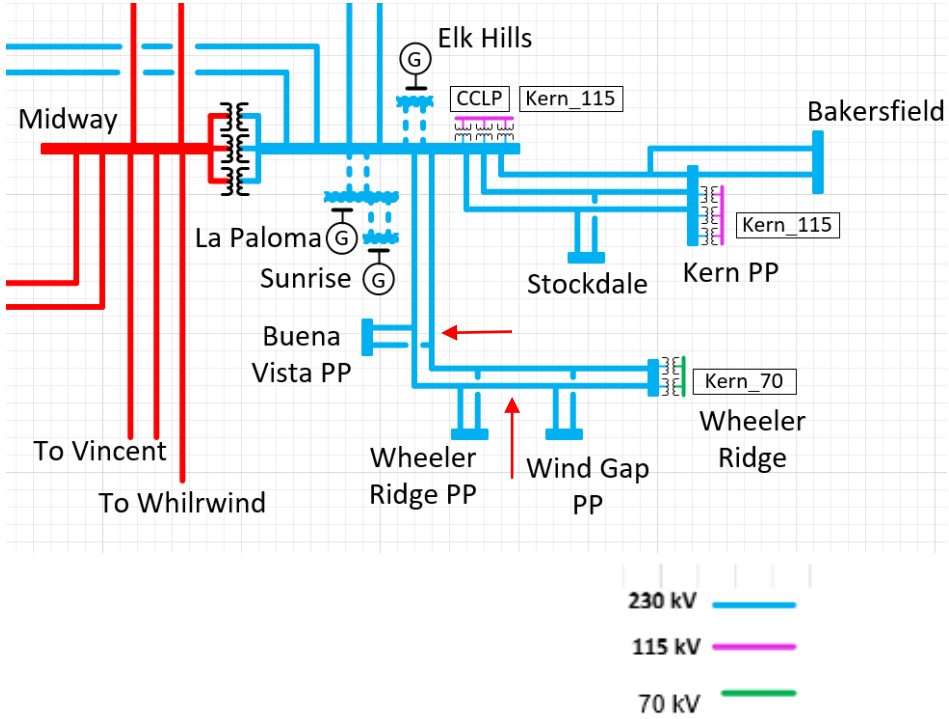
Kern 230 kV – Results summary

Observations

- P1 through P6 overloads on Midway – Wheeler Ridge 230 kV #1 and #2 lines

Approved and Potential Mitigations

- Wheeler ridge 230 kV project

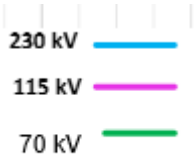


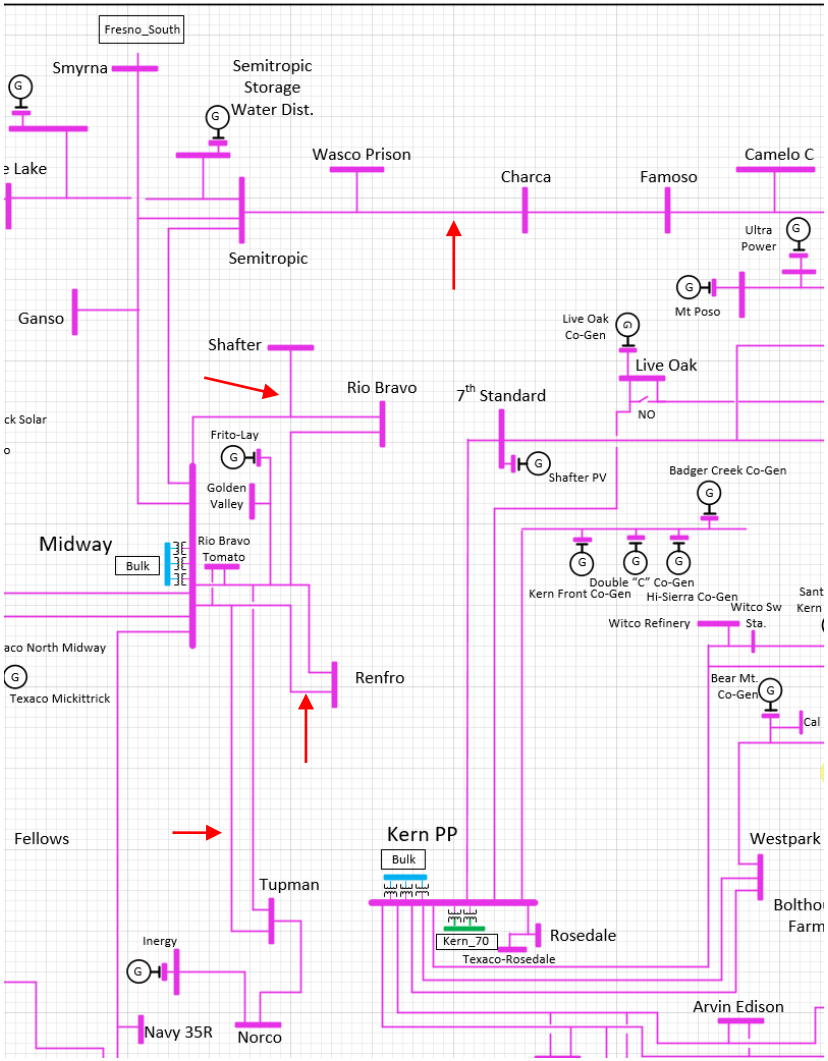
California ISO Public

Kern 115 kV – Results summary

Observations

1. Most of the overloads are mitigated in 2035 due to North East Kern 115 kV reconductoring project
2. Midway-Tupman-Rio Bravo-Renfro 115 kV Line P1, P2 overloads in all 3 years. Mitigation under development.
3. P2: Kern PP-Seventh Standard 115 kV Line overloads in 2035 only





California ISO Public

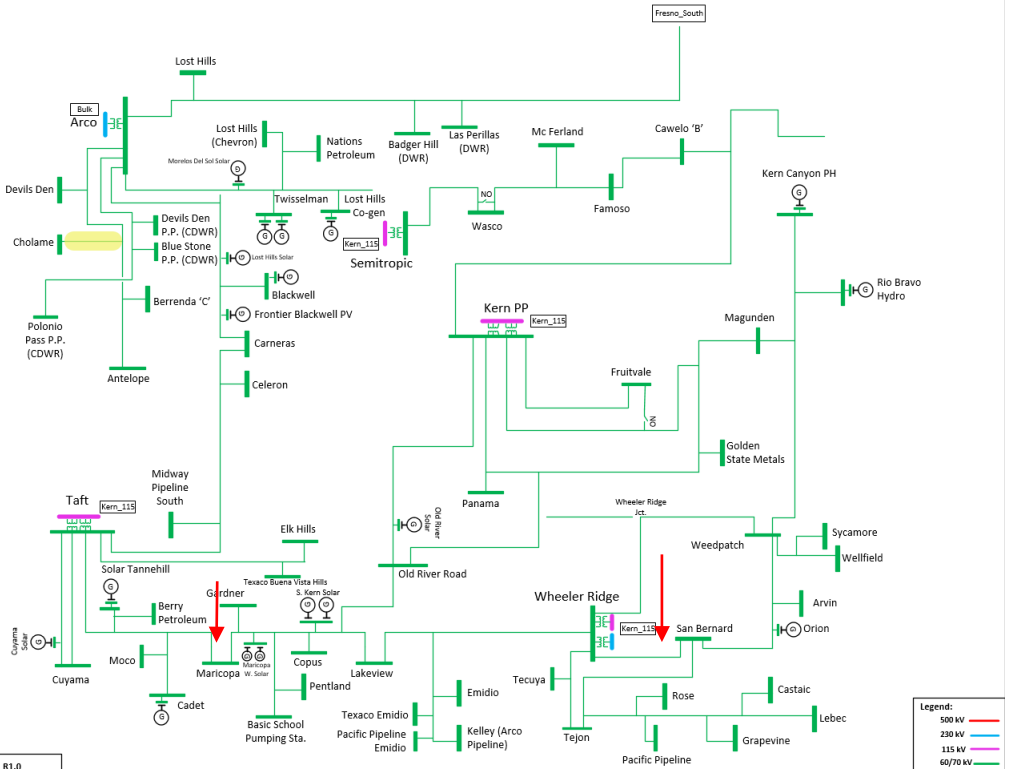
Kern 70 kV – Results summary

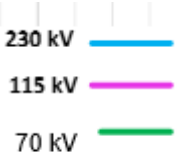
Observations

- P1 Wheeler Ridge-San Bernard 70 kV Line and Wheeler Ridge-Tejon 70 kV Line
- P2: Taft-Maricopa 70 kV, Copus-Old River 70 kV Line and Maricopa-Copus 70 kV Line in long term only

Approved and Potential Mitigations

- Summer setup.





California ISO Public

P5 Results summary

Contingency	Mitigation
MIDWAY 500KV BATT(FAILURE OF NON-REDUNDENT BATT)	INSTALL REDUNDANT BATTERY SUPPLY
MIDWAY 230-115KV BATT(FAILURE OF NON-REDUNDENT BATT)	INSTALL REDUNDANT BATTERY SUPPLY
TUPMAN 115KV BUS 1D (FAILURE OF NON-REDUNDENT RELAY)	INSTALL REDUNDANT RELAY
RENFRO 115KV (FAILURE OF NON-REDUNDENT RELAY)	INSTALL REDUNDANT RELAY
KERN 230KV BATT(FAILURE OF NON-REDUNDENT BATT)	INSTALL REDUNDANT BATTERY SUPPLY
KERN 115KV BATT(FAILURE OF NON-REDUNDENT BATT)	INSTALL REDUNDANT BATTERY SUPPLY
KERN 230KV BATT(FAILURE OF NON-REDUNDENT BATT)	INSTALL REDUNDANT BATTERY SUPPLY
MIDWAY 500KV BATT(FAILURE OF NON-REDUNDENT BATT)	INSTALL REDUNDANT BATTERY SUPPLY
KERN 230KV BATT(FAILURE OF NON-REDUNDENT BATT)	INSTALL REDUNDANT BATTERY SUPPLY
MIDWAY 230-115KV BATT(FAILURE OF NON-REDUNDENT BATT)	INSTALL REDUNDANT BATTERY SUPPLY

Summary of potential new upgrades

- Below projects need re-scope
  - Potential mitigation for Midway-Tupman-Rio Bravo-Renfro 115 kV line overloads.

North Coast and North Bay Areas
Preliminary Reliability Assessment Results

Bryan Fong
Senior Regional Transmission Engineer

2023-2024 Transmission Planning Process Stakeholder Meeting
September 26-27, 2023

North Coast and North Bay Areas

- 10,000 sq. mile area located north of the Bay Area and south of Humboldt
- Counties include:
  - Sonoma, Mendocino, Lake, Marin and part of Napa and Sonoma counties – 10,000 sq. miles
- Cities include:
  - Laytonville, Petaluma, San Rafael, Novato, Benicia, Vallejo
- Transmission facilities: 60kV, 115kV and 230 kV

Load and Load Modifier Assumptions - NCNB Area

Scenario	Study Case	Description	Battery		Solar		Wind		Hydro		Thermal	
			Installed	Dispatch	Installed	Dispatch	Installed	Dispatch	Installed	Dispatch	Installed	Dispatch
Base	2025-SPOP.epc	2025 Spring off-Peak load condition. Off-Peak load time - hours ending 19:00	103	-93	18	0	0	0	25	11	994	858
	2025-WP.epc	2025 Winter Peak load condition. Winter Peak load time - hours ending 19:00	103	0	18	0	0	0	25	11	994	830
	2028-SPOP.epc	2028 Spring Off-Peak load condition. Off-Peak load time - hours ending 13:00	103	-62	18	16	0	0	25	11	994	776
	2028-WP.epc	2028 Winter Peak load condition. Winter Peak load time - hours ending 19:00	103	0	18	0	0	0	25	11	994	830
	2035-WP-r1.epc	2035 Winter Peak load condition. Winter Peak load time - hours ending 19:00	128	0	18	3	0	0	25	19	1137	973
	NCNB-2025-SP.epc	2025 Summer Peak load condition. Peak load time - hours ending 19:00	103	-2	18	2	0	0	25	19	994	887
	NCNB-2028-SP.epc	2028 Summer Peak load condition. Peak load time - hours ending 19:00	103	46	18	0	0	0	25	19	994	869
	NCNB-2035-SP.epc	2035 Summer Peak load condition. Peak load time - hours ending 19:00	103	77	18	0	0	0	25	11	994	858
Sensitivity	NCNB-2025-SP-Hire.epc	2025 Summer peak Load conditions with Hi-Renewable dispatch Sensitivity	128	-93	18	0	0	0	25	14	1137	973
	2025-SPOP-Hire.epc	2025 Spring off-peak load conditions and high renewables	103	-93	18	0	0	0	25	11	994	858
	NCNB-2028-SP-Hicec.epc	2028 Summer Peak load condition with Hi-CEC load forecast sensitivity.	103	56	18	0	0	0	25	19	994	869

Generation Assumptions - NCNB Area

Scenario	Study Case	Description	Battery		Solar		Wind		Hydro		Thermal	
			Installed	Dispatch	Installed	Dispatch	Installed	Dispatch	Installed	Dispatch	Installed	Dispatch
Base	2025-SPOP.epc	2025 Spring off-Peak load condition. Off-Peak load time - hours ending 19:00	103	-93	18	0	0	0	25	11	994	858
	2025-WP.epc	2025 Winter Peak load condition. Winter Peak load time - hours ending 19:00	103	0	18	0	0	0	25	11	994	830
	2028-SPOP.epc	2028 Spring Off-Peak load condition. Off-Peak load time - hours ending 13:00	103	-62	18	16	0	0	25	11	994	776
	2028-WP.epc	2028 Winter Peak load condition. Winter Peak load time - hours ending 19:00	103	0	18	0	0	0	25	11	994	830
	2035-WP-r1.epc	2035 Winter Peak load condition. Winter Peak load time - hours ending 19:00	128	0	18	3	0	0	25	19	1137	973
	NCNB-2025-SP.epc	2025 Summer Peak load condition. Peak load time - hours ending 19:00	103	-2	18	2	0	0	25	19	994	887
	NCNB-2028-SP.epc	2028 Summer Peak load condition. Peak load time - hours ending 19:00	103	46	18	0	0	0	25	19	994	869
	NCNB-2035-SP.epc	2035 Summer Peak load condition. Peak load time - hours ending 19:00	103	77	18	0	0	0	25	11	994	858
Sensitivity	NCNB-2025-SP-Hire.epc	2025 Summer peak Load conditions with Hi-Renewable dispatch Sensitivity	128	-93	18	0	0	0	25	14	1137	973
	2025-SPOP-Hire.epc	2025 Spring off-peak load conditions and high renewables	103	-93	18	0	0	0	25	11	994	858
	NCNB-2028-SP-Hicec.epc	2028 Summer Peak load condition with Hi-CEC load forecast sensitivity.	103	56	18	0	0	0	25	19	994	869

Previously approved transmission projects modelled in base cases

Project Name	Expected ISD
Clear Lake 60 kV System Reinforcement	Dec-2028
Ignacio Area Upgrade	Dec-2028
Lakeville 60 kV Area Reinforcement	Dec-2028
Tulucay-Napa #2 60 kV Line Capacity Increase	Dec-2025
Vaca Dixon-Lakeville 230 kV Corridor Series Compensation	Oct-2025
Tulucay-Napa #2 60 kV line Reconductoring project	Dec-2028
Santa Rosa 115 kV lines Reconductoring project	Dec-2028

Reliability assessment preliminary results summary

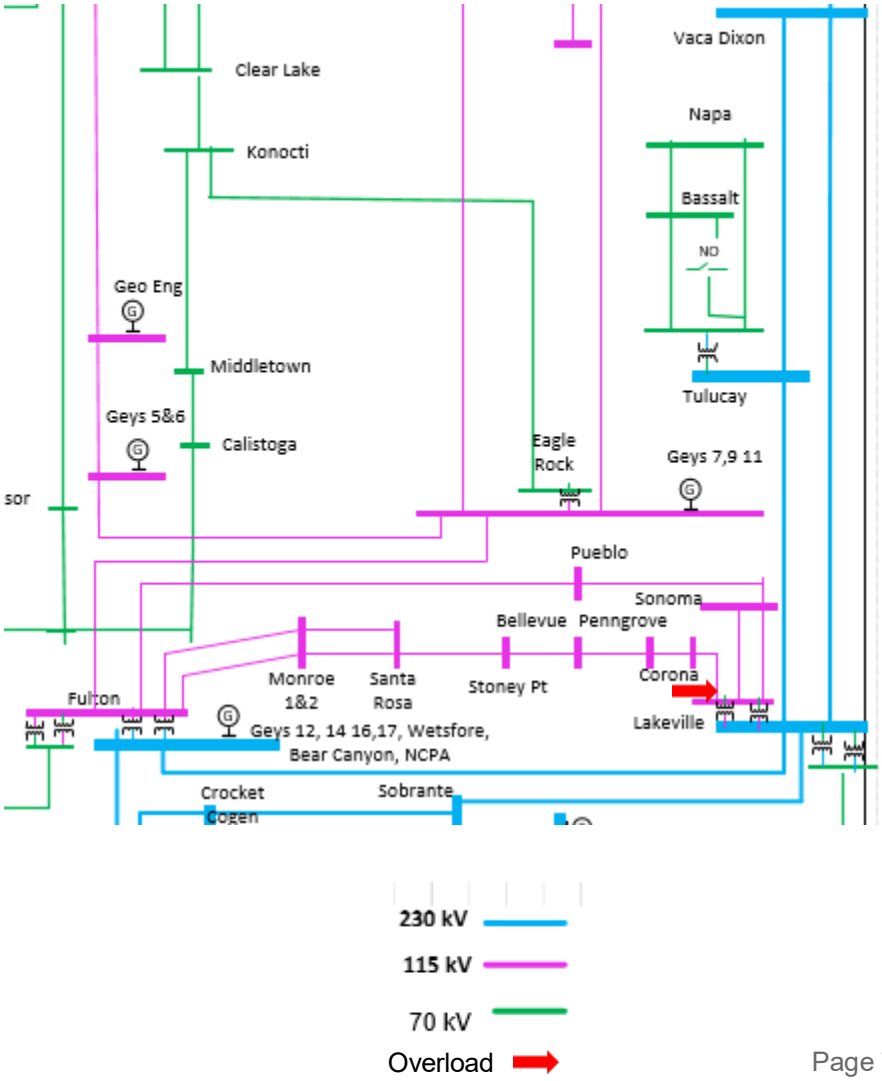
NCNB– Results Summary

Observations

- P2 Fulton 115 kV Bus Tie breaker causes overload of Corona- Lakeville 115 kV Line in 2025 summer peak cases only because of Santa Rosa 115 kV lines Reconductoring project

Potential Mitigations

- Operation solution for 2025



California ISO Public

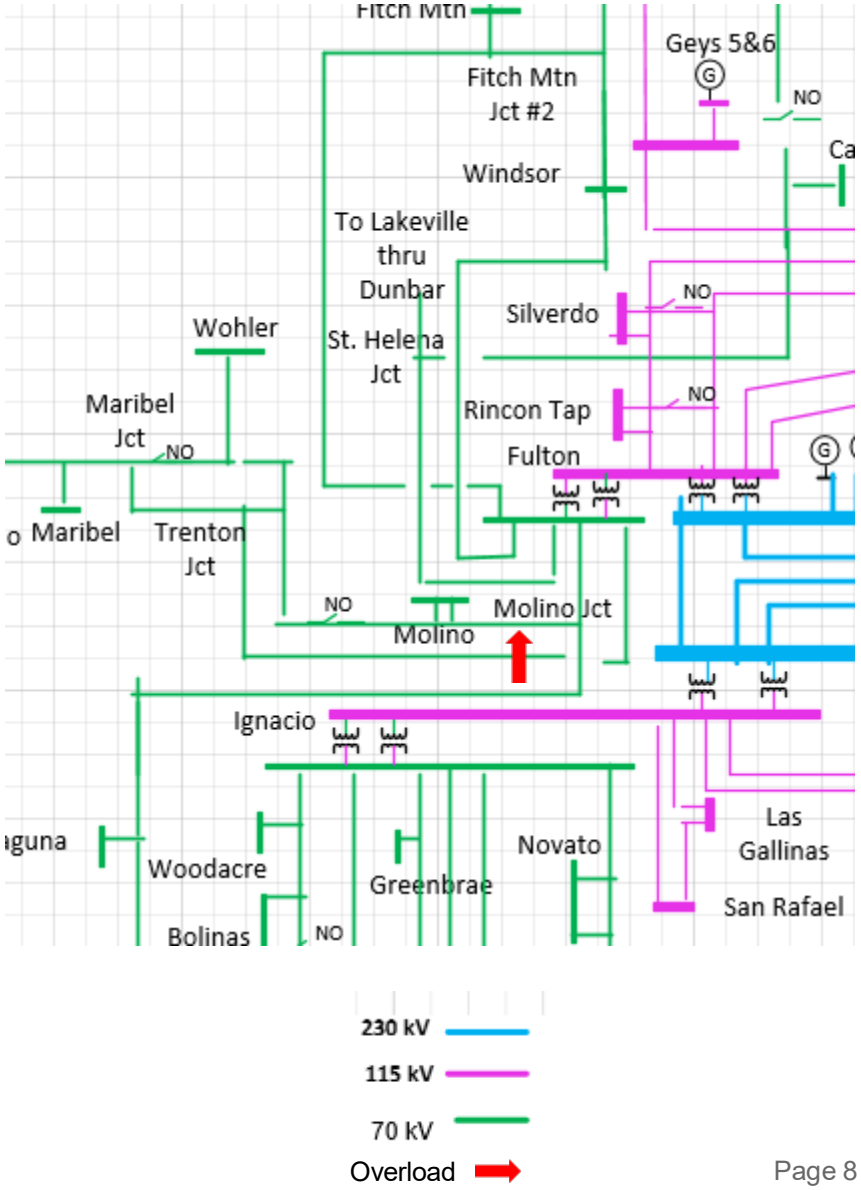
NCNB– Results Summary

Observations

- P1 Lakeville #2 60 kV Line cause overload of Fulton- Molino- Cotati 60 kV Line in 2035 summer peak cases

Potential Mitigations

- Continue to monitor



California ISO Public

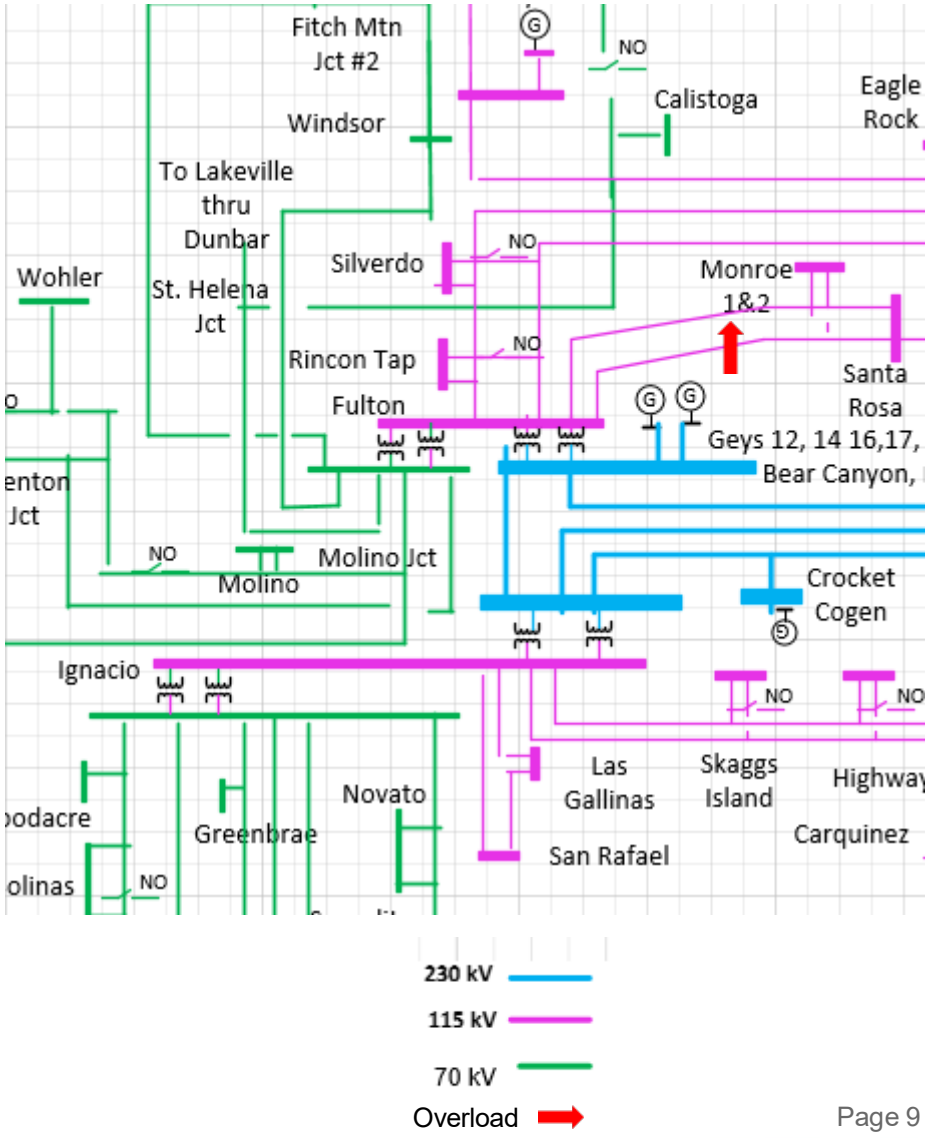
NCNB– Results Summary

Observations

- P6 Fulton-Santa Rosa #2 115 kV & Corona-Lakeville 115 kV Line cause overload of Fulton- Santa Rosa No.1 115 kV Line in 2025 summer peak cases only because of Santa Rosa 115 kV lines Reconductoring project

Potential Mitigations

- Operation solution for 2025



California ISO Public

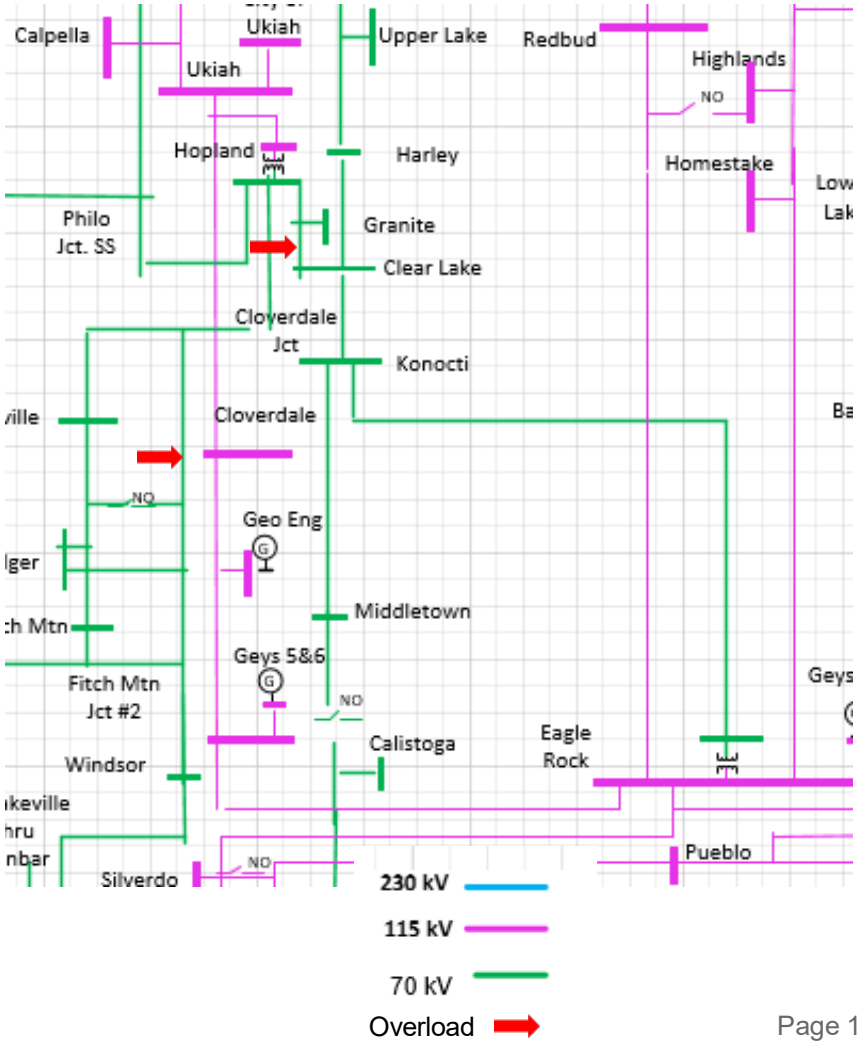
NCNB– Results Summary

Observations

- P1 Konocti- Eagle Rock 60 kV Line
- P1 Eagle Rock 115/60 KV Bank 1
- P7 Geysers #17- Fulton & Eagle Rock-Fulton –Silverado 115 kV Lines
- P7 Geysers #9-Lakeville & Eagle Rock-Fulton – Silverado 115 kV Lines causes overload of both Clear Lake- Hopland 60 kV Line & Fulton - Hopland 60 kV Line in summer peak cases.

Potential Mitigations

- Review Clear Lake 60 kV System Reinforcement project
- Review Clear Lake 60 kV System Reinforcement project
- Review Clear Lake 60 kV System Reinforcement project
- Review Clear Lake 60 kV System Reinforcement project



California ISO Public

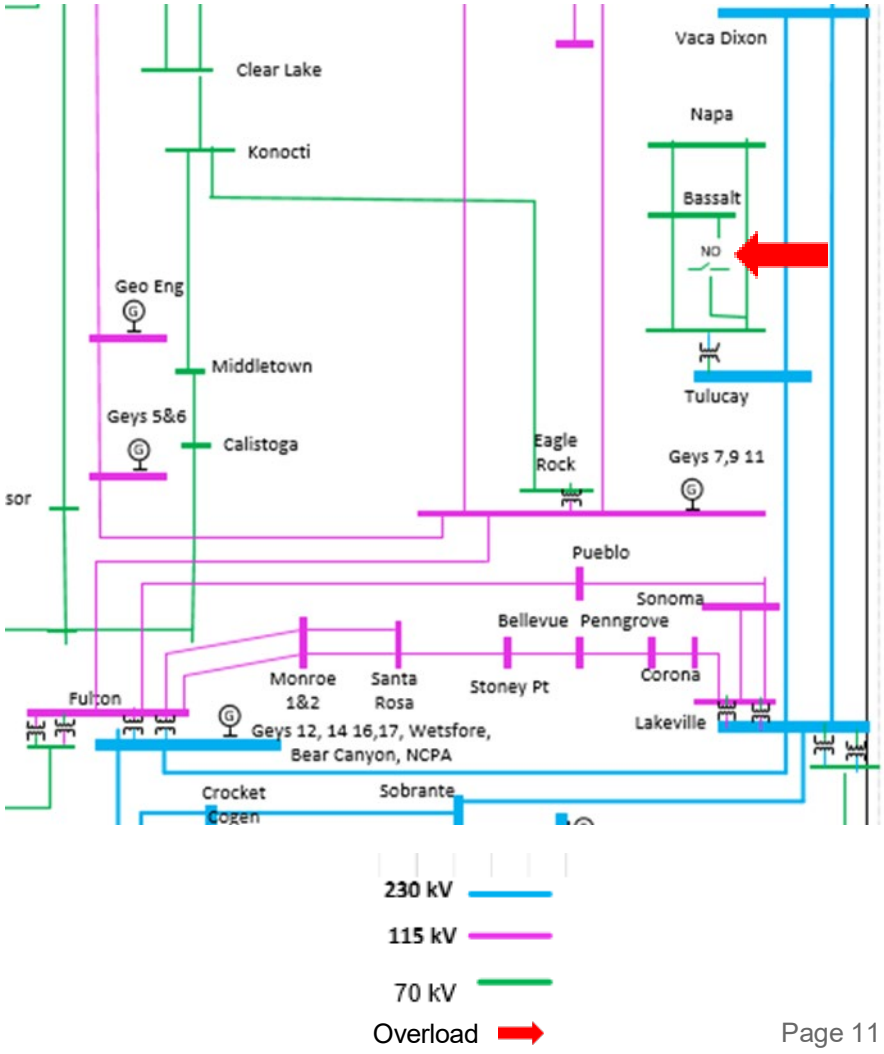
NCNB– Results Summary

Observations

- P0 Tulucay-Napa #2 60kV Line experiences base case overload in 2025 summer peak cases only because of Tulucay - Napa #2 60 kV Capacity Increase

Potential Mitigations

- Interim operation solution



California ISO Public

P5 results summary

Contingency	Mitigation
FULTON 230 KV BAAH BUS #1 (Non-Redundant Relay)	Install Redundant Relay
FULTON BUS 115 kV 1 & 2 SECTION D (Non-Redundant Relay)	Install Redundant Relay
MENDOCINO 115 KV BUS 1&2 (Non-Redundant Relay)	Install Redundant Relay
LAKEVILLE 230 kV BUS 1&2 SECTION E (Non-Redundant Relay)	Install Redundant Relay
CLOVERDALE 115 KV (Non-Redundant Relay)	Install Redundant Relay
FULTON 115 kV (Non-Redundant battery supply)	Install Redundant Battery Supply
MENDOCINO 115 KV (Non-Redundant battery supply)	Install Redundant Battery Supply
LAKEVILLE 230 kV (Non-Redundant battery supply)	Install Redundant Battery Supply

Low Voltage Results Summary

Potential Mitigations

- Most of the low voltage issue will be mitigated by solutions addressing thermal issues in the area.

Cont. Type	Area	2025 Summer Peak	2028 Summer Peak	2035 Summer Peak
P1	Laytonville and Covelo 60 kV	0.71 PU	0.83 PU	0.67 PU
P2	Sonoma and Santa Rosa 115 kV	0.74 PU	0.74 PU	0.74 PU
P3	Laytonville and Covelo 60 kV	0.89 PU	0.87 PU	0.70 PU
P5	Fulton and Monroe 115 kV	Diverge	Diverge	Diverge
P6	Laytonville and Covelo 60 kV	0.75 PU	0.74 PU	Diverge
P7	Sonoma and Bellevue 115 kV	0.75 PU	0.76 PU	0.76 PU

Summary of potential new upgrades

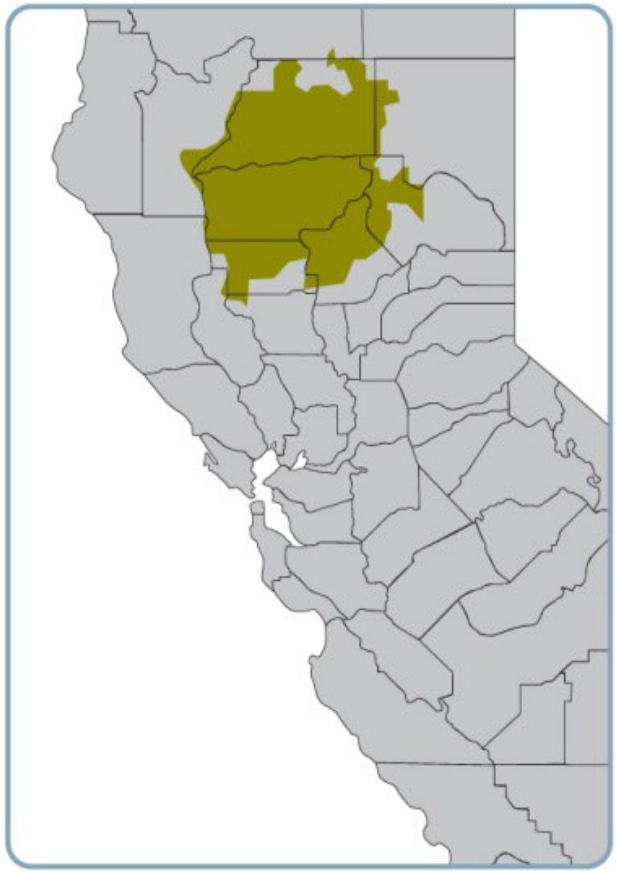
Reliability Concern	Potential Upgrade
Laytonville and Covelo 60 kV low voltages	New reactive device
Calistoga 60 kV low voltage	New reactive device

North Valley Area
Preliminary Reliability Assessment Results

Bryan Fong
Senior Regional Transmission Engineer

2023-2024 Transmission Planning Process Stakeholder Meeting
September 26-27, 2023

North Valley Area



- North Valley Area located in the NE corner of PG&E system
- Major cities: Chico, Redding, Red Bluff, Paradise
- Comprised of 60, 115 & 230 & 500 kV transmission facilities.
- Supply sources include Table Mountain, Cottonwood, and Palermo

Load and Load Modifier Assumptions - North Valley Area

Scenario	Study Case	Description	Gross Load (MW)	AAEE (MW)	AAFS (MW)	AATE (MW)	BTM-PV (MW)		Net Load (MW)	Demand Response Installed (MW)
							Installed	Output		
Base	2025-SPOP.epc	2025 Spring off-Peak load condition. Off-Peak load time - hours ending 19:00	682	-9	3	3	431	1	672	46
	2028-SOP.epc	2028 Summer off-peak condition. Peak load time-hours ending 15:00	590	-16	6	9	514	308	266	0
	2028-SPOP.epc	2028 Spring Off-Peak load condition. Off-Peak load time - hours ending 13:00	475	-12	6	9	514	406	57	48
	NVLY-2025-SP.epc	2025 Summer Peak load condition. Peak load time - hours ending 20:00	937	-7	3	3	435	38	892	46
	NVLY-2028-SP.epc	2028 Summer Peak load condition. Peak load time - hours ending 20:00	944	-12	14	9	518	1	932	48
	NVLY-2035-SP.epc	2035 Summer Peak load condition. Peak load time - hours ending 20:00	1132	-20	69	33	727	0	1111	51
Sensitivity	NVLY-2025-SP-Hire.epc	2025 Summer peak Load conditions with Hi-Renewable dispatch Sensitivity	924	-7	3	3	435	431	485	-46
	2025-SPOP-Hire.epc	2025 Spring off-peak load conditions and high renewables	682	-9	3	3	431	1	672	-46
	NVLY-2028-SP-Hicec.epc	2028 Summer Peak load condition with Hi-CEC load forecast sensitivity.	944	0	14	9	518	1	943	-48

Generation Assumptions - North Valley Area

Scenario	Study Case	Description	Battery		Solar		Wind		Hydro		Thermal	
			Installed	Dispatch	Installed	Dispatch	Installed	Dispatch	Installed	Dispatch	Installed	Dispatch
Base	2025-SPOP.epc	2025 Spring off-Peak load condition. Off-Peak load time - hours ending 19:00	0	0	11	0	103	49	1801	1444	981	811
	2028-SOP.epc	2028 Summer off-peak condition. Peak load time-hours ending 15:00	0	0	11	9	103	36	1801	256	981	650
	2028-SPOP.epc	2028 Spring Off-Peak load condition. Off-Peak load time - hours ending 13:00	0	0	11	10	103	25	1801	1445	981	633
	NVLY-2025-SP.epc	2025 Summer Peak load condition. Peak load time - hours ending 20:00	0	0	11	1	103	56	1801	1751	981	877
	NVLY-2028-SP.epc	2028 Summer Peak load condition. Peak load time - hours ending 20:00	0	0	11	0	103	56	1801	1685	981	792
	NVLY-2035-SP.epc	2035 Summer Peak load condition. Peak load time - hours ending 20:00	80	39	546	0	442	168	1801	1587	1023	996
Sensitivity	NVLY-2025-SP-Hire.epc	2025 Summer peak Load conditions with Hi-Renewable dispatch Sensitivity	0	0	11	11	103	64	1801	1591	981	583
	2025-SPOP-Hire.epc	2025 Spring off-peak load conditions and high renewables	0	0	11	0	103	49	1801	1444	981	812
	NVLY-2028-SP-Hicec.epc	2028 Summer Peak load condition with Hi-CEC load forecast sensitivity.	0	0	11	0	103	56	1801	1591	981	647

Previously approved transmission projects modelled in base cases

Project Name	Expected ISD
Palermo – Wyandotte 115 kV Line Section Reconductoring Project	Jul-2021
Cascade 115/60 kV No.2 Transformer Project	Dec-2024
Cortina 230/115/60 kV Transformer Bank No. 1 Replacement Project	May-2027
Cottonwood 115 kV Bus Sectionalizing Breaker	Feb-2026
Cottonwood 230/115 kV Transformers 1 and 4 Replacement Project	Dec-2026
Glenn 230/60 kV Transformer No. 1 Replacement	Oct-2023
Reconductor Delevan-Cortina 230kV line	Dec-2028
Red Bluff-Coleman 60 kV Reinforcement	Nov-2031

Reliability assessment preliminary results summary

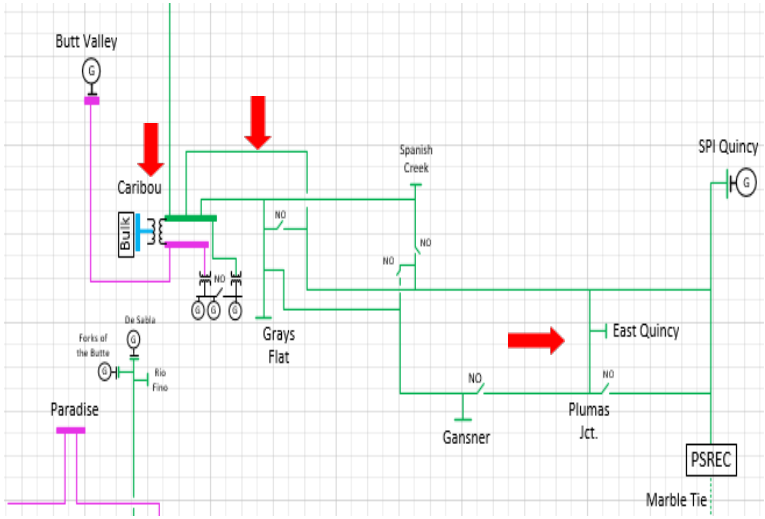
NVLY – Results Summary

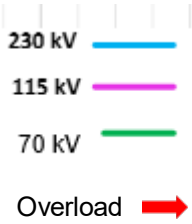
Observations

- P2 Table Mountain 230 kV Bus causes overload of both Caribou-Plumas Jct 60 kV Line and Caribou No.11 230/115/60 kV Transformer in summer peak cases

Potential Mitigations

- Review Caribou RAS





California ISO Public

P5 results summary

Contingency	Mitigation
Round Mountain 500 and 230 kV (Non-Redundant battery supply)	Install Redundant Battery Supply
Table Mountain 500 and 230 kV (Non-Redundant battery supply)	Install Redundant Battery Supply
Cottonwood 115kV and 230 kV (Non-Redundant battery supply)	Install Redundant Battery Supply
Cottonwood 230KV (Non-Redundant Relay)	Install Redundant Relay
Logan Creek 230KV (Non-Redundant Relay)	Install Redundant Relay

Low Voltage Results Summary

Potential Mitigations

- Low voltage issue will be mitigated by installing Table Mountain 115 kV RAS and reviewing Caribou RAS

Cont. Type	Area	2025 Summer Peak	2028 Summer Peak	2035 Summer Peak
P1	Caribou 230 and 115 kV	Diverge	Diverge	Diverge
P2	Caribou 230 and 115 kV	Diverge	Diverge	Diverge
P3	Caribou 230 and 115 kV	Diverge	Diverge	Diverge
P5	Caribou 230 and 115 kV	Diverge	Diverge	Diverge
P6	None	NA	NA	NA
P7	Caribou 230 and 115 kV	Diverge	Diverge	Diverge

Summary of potential new upgrades

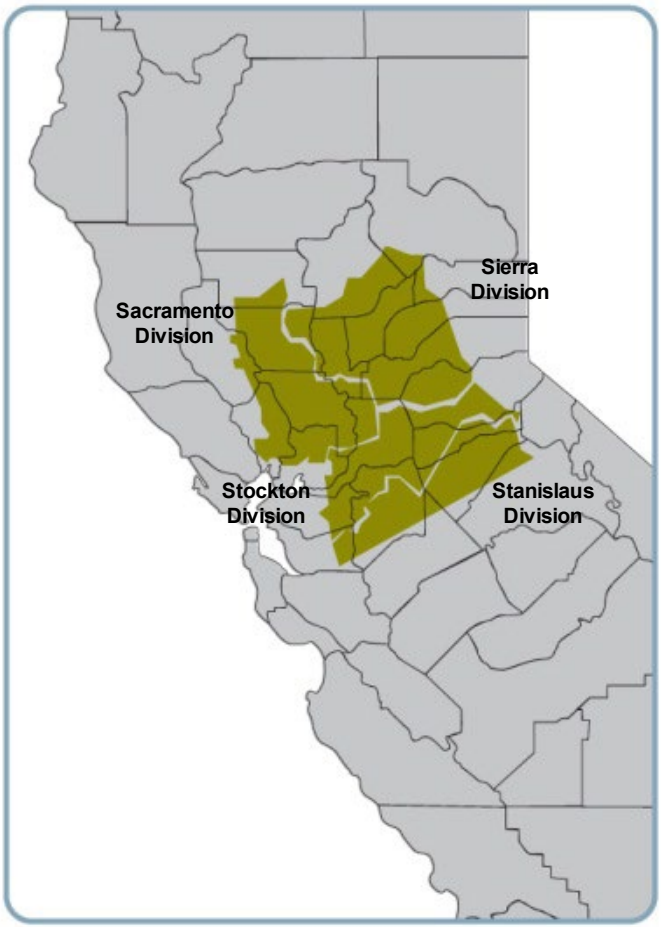
Reliability Concern	Potential Upgrade
Multiple location - Low voltage and voltage deviation	Review Caribou RAS
P2, P6 & P7 causing 115 kV lines overload and low voltage	Install Table Mountain 115 kV RAS

Central Valley Area
Preliminary Reliability Assessment Results

Subrina Sultana Noureen
Regional Transmission Engineer-North

2023-24 Transmission Planning Process Stakeholder Meeting
September 26th -27th , 2023

Central Valley Area



- The Central Valley Area covers the central part of the Sacramento Valley.
- The area is divided into four divisions:
  - Sacramento
  - Sierra
  - Stockton
  - Stanislaus
- Comprised of 60, 115 & 230 & 500 kV transmission facilities.
- Supply sources include Vaca Dixon, Rio Oso, Gold Hill, Atlantic, Brighton, Lockeford, Bellota

Load and Load Modifier Assumptions – Central Valley Area

Scenario	Study Case	Description	Gross Load (MW)	AAEE (MW)	AAFS (MW)	AATE (MW)	BTM-PV (MW)		Net Load (MW)	Demand Response Installed (MW)
							Installed	Output		
Base	2025-SPOP.epc	2025 Spring off-Peak load condition. Off-Peak load time - hours ending 19:00	2844	-56	16	23	1953	1	2787	-170
	2028-SOP.epc	2028 Summer off-peak condition. Peak load time-hours ending 15:00	2701	-85	33	62	2349	1410	1207	0
	2028-SPOP.epc	2028 Spring Off-Peak load condition. Off-Peak load time - hours ending 13:00	2293	-68	33	62	2349	1856	369	-178
	CVLY-2025-SP.epc	2025 Summer Peak load condition. Peak load time - hours ending 19:00	4325	-38	17	23	1974	670	3617	-170
	CVLY-2028-SP.epc	2028 Summer Peak load condition. Peak load time - hours ending 19:00	4301	-62	76	62	2370	1	4239	-178
	CVLY-2035-SP.epc	2035 Summer Peak load condition. Peak load time - hours ending 19:00	4982	-106	368	225	3287	0	4876	-194
Sensitivity	2025-SPOP-Hire.epc	2025 Spring off-peak load conditions and high renewables	2844	-56	16	23	1953	1	2787	-170
	CVLY-2025-SP-Hire.epc	2025 Summer peak Load conditions with Hi-Renewable dispatch Sensitivity	4321	-38	17	23	1974	1943	2340	-170
	CVLY-2028-SP-Hicec.epc	2028 Summer Peak load condition with Hi-CEC load forecast sensitivity.	4301	0	76	62	2370	1	4301	-178

Generation Assumptions – Central Valley Area

Scenario	Study Case	Description	Battery		Solar		Wind		Hydro		Thermal	
			Dispatch	Installed	Dispatch	Installed	Dispatch	Installed	Dispatch	Installed	Dispatch	Installed
Base	2025-SPOP.epc	2025 Spring off-Peak load condition. Off-Peak load time - hours ending 19:00	-480	537	0	122	559	1212	1186	1425	1197	1317
	2028-SOP.epc	2028 Summer off-peak condition. Peak load time-hours ending 15:00	0	1024	157	204	416	1212	943	1453	1227	1317
	2028-SPOP.epc	2028 Spring Off-Peak load condition. Off-Peak load time - hours ending 13:00	-612	1024	174	204	286	1212	1120	1425	321	1317
	CVLY-2025-SP.epc	2025 Summer Peak load condition. Peak load time - hours ending 19:00	-376	537	41	122	642	1212	1414	1425	1126	1317
	CVLY-2028-SP.epc	2028 Summer Peak load condition. Peak load time - hours ending 19:00	666	1024	2	204	642	1212	1125	1425	1227	1317
Sensitivity	CVLY-2035-SP.epc	2035 Summer Peak load condition. Peak load time - hours ending 19:00	1089	1492	0	859	555	1843	1124	1425	1333	1357
	2025-SPOP-Hire.epc	2025 Spring off-peak load conditions and high renewables	-480	537	0	122	559	1212	1186	1425	1197	1317
	CVLY-2025-SP-Hire.epc	2025 Summer peak Load conditions with Hi-Renewable dispatch Sensitivity	-215	537	117	122	999	1212	1151	1425	1079	1317

California ISO Public

Reliability assessment preliminary results summary

Sacramento Division

Projects in Sacramento Area

Approved TPP Projects	Expected ISD
Vaca-Davis Area Reinforcement.	2026
Cortina 230/115/60 kV Transformer Bank No. 1 Replacement Project	2027
Reconductor Delevan-Cortina 230kV line	2028

Sacramento Thermal Results Summary

❑ **Observation**

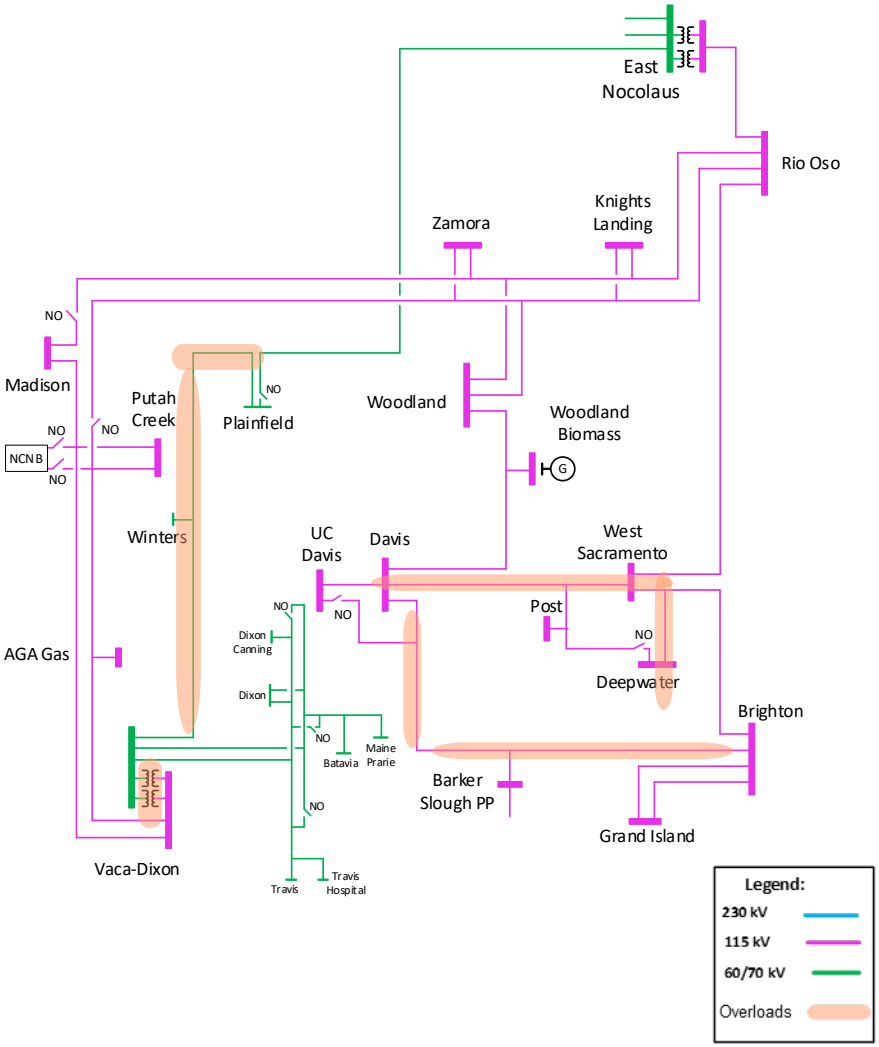
- P0 overloads on Vaca-Plainfield 60 kV line
- P1, P2, P6 and P7 overloads on Brighton - Howard JCT3 115 kV Line
- P2, P6 and P7 overloads on Brighton - Davis 115 kV Line
- P2, P5, and P6 Overloads on Woodland - Davis 115 kV Line
- P6 overloads on Deepwater TP - Davis 115 kV – Davis 115 kV Line

❑ **Approved and Potential Mitigations**

- Vaca Davis Area Reinforcement Project.

  Expected ISD: Dec. 2025

  Short term: Action Plan
- SPS recommended in 2017-2018 TPP



Sierra Division

Projects in Sierra Area

Approved TPP Projects	Expected ISD
Rio Oso 230/115 kV Transformer Upgrades	2024
Rio Oso Area 230 kV Voltage Support	2024
East Marysville 115/60 kV	2027
Gold Hill 230/115 kV Transformer Addition	2028
Reconductor Rio Oso–SPI Jct–Lincoln 115kV line	2028
Atlantic 230/60 kV transformer voltage regulator	2026

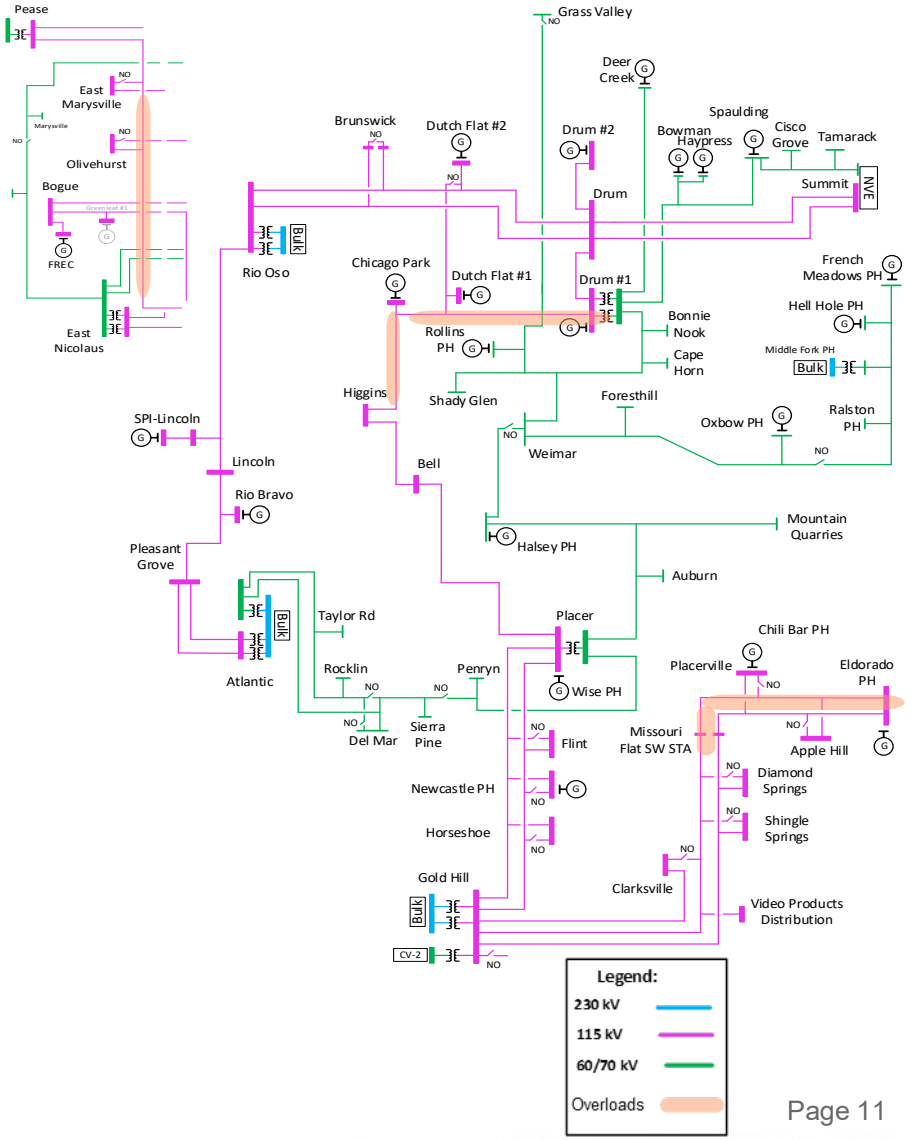
Sierra Thermal Results Summary

- **Observation**

  - P1, P3, P5 overloads on Nicolaus - Marysville 60 kV Line (Plumas-East Nicolaus)
  - P2 overloads on El Dorado-Missouri Flat #1 and #2
  - P2, P5, and P7 Overloads on Drum - Higgins 115 kV Line

- **Approved and Potential Mitigations**

  - Pease Sub-Area LCR Mitigation Project
  - Generation Dispatch
  - Continue to monitor future forecast
  - SPS or system upgrade as needed



Stockton/Stanislaus (Tesla – Bellota) Divisions

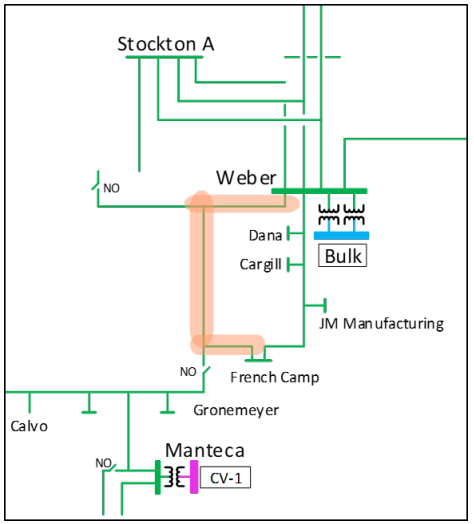
Projects in Stockton/Stanislaus Area

Approved TPP Projects	Expected ISD
Mosher Transmission Project	2027
Vierra 115 kV Looping Project	2025
Tesla 230 kV Bus Series Reactor	2023
Lockeford-Lodi Area 230 kV Development	2027
Kasson – Kasson Junction 1 115 kV Line Section Reconductoring Project	2027
Manteca #1 60 kV Line Section Reconductoring Project	2027
Manteca-Ripon-Riverbank-Melones Area 115 kV Line Reconductoring Project	2028
Weber-Mormon Jct Line Section Reconductoring Project	2027
Tesla 115 kV Bus Reconfiguration Project	2030
Banta 60 kV Bus Voltage Conversion project	2024

Stockton/Stanislaus Thermal Results Summary

❑ **Observation**

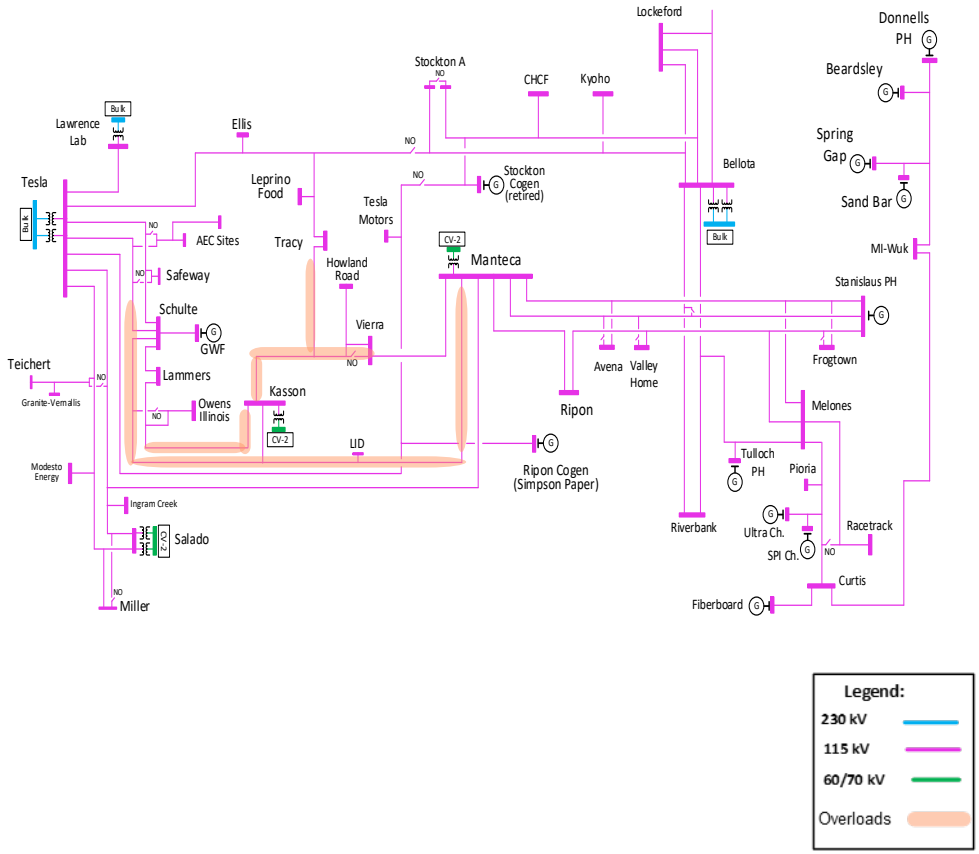
- P1 overloads on Weber 60 kV Line No. 2 (Weber - French Camp)
- P1 Overloads on Manteca - Louise 60 kV Line
- P1, P2, P5, P6 and P7 overloads on Manteca - Vierra 115 kV Line
- P1 and P7 overloads on Valley Springs - Martell 60 kV Line No. 1
- P1 and P6 overloads on New BANTA-TRACY 115 kV Line
- P2, P3 and P6 overloads on Schulte - Kasson - Manteca 115 kV Line
- P2, P5, P6 and P7 overloads on Lockeford No. 1 60 kV Line
- P2 overloads on Tesla 115 kV Line
- P3, P5 and P7 overloads on Tesla - Tracy 115 kV Line



California ISO Public

Stockton/Stanislaus Thermal Results Summary

- **Approved and Potential Mitigations**
  - Tesla 115 kV Bus Reconfiguration Project
  - Project: Lockeford-Lodi Project
  - Existing operating procedure
  - Vierra Looping project
  - Existing operating procedure
  - Continue to monitor future forecast
  - SPS or system upgrade as needed
  - Banta 60 kV Bus Voltage Conversion project



P5 Results Summary

Contingency	Mitigation
TESLA 115KV BUS (FAILURE OF NON-REDUNDENT RELAY)	INSTALL REDUNDANT RELAY
TESLA 230-115KV BATT (FAILURE OF NON-REDUNDENT BATT)	INSTALL REDUNDANT BATTERY SUPPLY
MANTECA 115-60KV BATT (FAILURE OF NON-REDUNDENT BATT)	INSTALL REDUNDANT BATTERY SUPPLY
RIO OSO 230-115KV BATT (FAILURE OF NON-REDUNDENT BATT)	INSTALL REDUNDANT BATTERY SUPPLY
TESLA 500KV BATT (FAILURE OF NON-REDUNDENT BATT)	INSTALL REDUNDANT BATTERY SUPPLY
KASSON 115KV BUS (FAILURE OF NON-REDUNDENT RELAY)	INSTALL REDUNDANT RELAY
RIO OSO 230 KV BUS (FAILURE OF NON-REDUNDENT RELAY)	INSTALL REDUNDANT RELAY
GOLD HILL 230 KV BUS (FAILURE OF NON-REDUNDENT RELAY)	INSTALL REDUNDANT RELAY
STAGG 230KV BUS (FAILURE OF NON-REDUNDENT RELAY)	INSTALL REDUNDANT RELAY
GOLD HILL 115 KV BUS (FAILURE OF NON-REDUNDENT RELAY)	INSTALL REDUNDANT RELAY
RIO OSO 115 KV BUS (FAILURE OF NON-REDUNDENT RELAY)	INSTALL REDUNDANT RELAY
TESLA 230KV BUS C&D&E (FAILURE OF NON-REDUNDENT RELAY)	INSTALL REDUNDANT RELAY
STAGG 230-60KV BATT (FAILURE OF NON-REDUNDENT BATT)	INSTALL REDUNDANT BATTERY SUPPLY
SCHULTE SW STA 115KV BATT (FAILURE OF NON-REDUNDENT BATT)	INSTALL REDUNDANT BATTERY SUPPLY
KASSON 115-60KV BATT (FAILURE OF NON-REDUNDENT BATT)	INSTALL REDUNDANT BATTERY SUPPLY
PEASE 115-60KV BATT (FAILURE OF NON-REDUNDENT BATT)	INSTALL REDUNDANT BATTERY SUPPLY
BRIGHTON 230KV BUS (FAILURE OF NON-REDUNDENT RELAY)	INSTALL REDUNDANT RELAY
PEASE 115 KV BUS (FAILURE OF NON-REDUNDENT RELAY)	INSTALL REDUNDANT RELAY

Central Valley Low Voltage Results Summary

- **Observation**

- P1, P6 low voltages at Carbona 60 kV Area
- P1 low voltages at Lockeford 115kV, 230 kV Area
- P2 low voltages at Bellota 115 kV Area
- P2 low voltages at Camanche 115 kV Area
- P2 low voltage at Davis 115 kV area
- P2, P7 low voltage at Deepwater 115 kV area
- P2, P7 low voltage at Post 115 kV area
- P2 low voltage at W. Sacramento 115 kV area
- P6 low voltage at Banta 115 kV Area
- P6 low voltage at Manteca 115 kV Area
- P6 low voltage at Ripon 115 kV Area
- P6 low voltage at Vierra 115 kV Area

- Approved and Potential Mitigations

- Atlantic 230/60 kV transformer voltage regulator
- Rio Oso Area 230 kV Voltage Support
- Lockeford-Lodi Area 230 kV Development
- Vaca Davis Area Reinforcement Project
- Tesla 115 kV Bus Reconfiguration Project

California ISO

PG&E Bulk System
Preliminary Reliability Assessment Results

Chris Fuchs
Regional Transmission North

2023-2024 Meeting to Discuss Preliminary Results
Sept 26, 2023

Confidential – Subject to Transmission Planning NDA

PG&E Bulk Transmission System

- Service area from CA-OR border in the north to Vincent 500 kV Sub in the south
- PG&E system is comprised of 60, 115, 230 & 500 kV transmission facilities.
- Studied 7 base cases and 3 sensitivity cases for governor power flow
- Studied 4 base case and 2 sensitivity cases for dynamic stability
- Years: 2025, 2028 & 2035
- 1-in-5 heat wave load for peak cases
- Major 500/230 kV substations: Olinda, Round Mountain, Table Mountain, Vaca Dixon, Tesla, Tracy, Metcalf, Moss Landing, Los Banos, Gates, Midway
- Major WECC Paths: COI (Path 66), PDCI (Path 65) and Path 26

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Generation Assumptions - Bulk

Scenario Type	Description	Solar, incl. hydrid		Wind		Hydro		Thermal		Battery Storage	
		Installed (MW)	Dispatch (MW)	Installed (MW)	Dispatch (MW)	Installed (MW)	Dispatch (MW)	Installed (MW)	Dispatch (MW)	Installed (MW)	Dispatch (MW)
Baseline	2025 Summer Peak load condition. Peak load time - hours ending 19:00	7632	1396	1797	983	7850	6460	17369	15121	4282	803
Baseline	2028 Summer Peak load condition. Peak load time - hours ending 19:00	7714	1222	1797	972	7850	5946	17369	15823	4770	1938
Baseline	2035 Summer Peak load condition. Peak load time - hours ending 19:00	15658	240	7873	3062	7850	5873	17369	15171	8601	2198
Baseline	2028 Spring Off Peak load condition. Peak load time - hours ending 20:00	7632	446	1797	860	7850	6007	17369	15026	4282	-3649
Baseline	2028 Spring Off Peak load condition. Peak load time - hours ending 13:00	7714	6331	1797	482	7850	4903	17369	4627	4770	-2214
Baseline	2035 Spring Off Peak load condition. Peak load time - hours ending 13:00	15658	6953	7873	1084	7850	4908	17369	2874	8601	-8023
Baseline	2035 Winter Peak load condition. Peak load time - hours ending 19:00	15658	256	7873	2017	7850	5310	17369	15720	8601	0
Sensitivity	2025 Summer Peak load condition with high renewable output	7632	7494	1797	1113	7850	6454	17369	15020	4282	-2457
Sensitivity	2025 Spring Shoulder Peak with high renewable output	7632	446	1797	857	7850	6007	17369	15009	4282	-3649
Sensitivity	2028 Summer Peak load condition with High CEC load	7714	1222	1797	972	7850	5946	17369	15944	4770	2237

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Load Assumptions - Bulk

Study Case	Description	Non-Conforming Load	Total Gross Load	BTM-PV Output	BTM-PV Installed Capacity	AAEE Load	AAFS Load	AATE Load	Total Net(Managed) Load	Total DR	DR2
2025HS	2025 Summer Peak load condition. Peak load time - hours ending 19:00	2552	22007	364	9103	-296	65	202	21347	-986	-738
2028HS	2028 Summer Peak load condition. Peak load time - hours ending 19:00	2665	23768	443	11086	-510	134	525	22815	-1046	-798
2035_SumPk	2035 Summer Peak load condition. Peak load time - hours ending 19:00	2775	29382	1	15598	-839	402	1873	28542	-1139	-891
2025SPOP	2028 Spring Off Peak load condition. Peak load time - hours ending 20:00	2551	18461	6	9103	-276	65	202	18179	-986	-738
2028SPOP	2028 Spring Off Peak load condition. Peak load time - hours ending 13:00	2661	16355	8744	11069	-343	134	525	7268	-1046	-798
2035_SprOffPk	2035 Spring Off Peak load condition. Peak load time - hours ending 13:00	2775	14946	11179	15526	-571	197	1247	3196	-1139	-891
2035HW	2035 Winter Peak load condition. Peak load time - hours ending 19:00	2774	23533	22	15526	-741	296	1860	22770	-1139	-891
2025HS_HighRE	2025 Summer Peak load condition with high renewable output	2552	21971	9012	9103	-296	65	202	12663	-986	-738
2025SPOP_HighRE	2025 Spring Shoulder Peak with high renewable output	2551	18461	6	9103	-276	65	202	18179	-986	-738
2028HS_HighCEC	2028 Summer Peak load condition with High CEC load	2665	23769	554	11086	0	134	525	23214	-1046	-798

Confidential – Subject to Transmission Planning NDA

Previously Approved Transmission Projects in the PG&E Bulk System Modeled in Base Cases

Project Name	Year Modeled
Round Mtn 500 kV Dynamic Reactive Support	2025
Gates 500 kV Dynamic Reactive Support	2025
Collinsville 500 kV Substation	2028
Manning 500 kV Substation	2028

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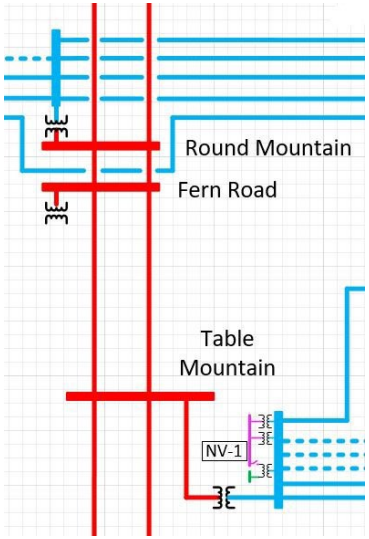
Round Mtn – Fern Rd – Table Mtn 500 kV



- Outage of a single Round Mountain – Fern Road – Table Mountain 500 kV line (P1) will overload the parallel line
- Additional P6 contingencies will overload for 2035 Winter Peak case
- 500 kV equipment derates causing higher SOP overloads from last year.
- Alleviate overload by increasing equipment ratings & using RAS to bypass series capacitor

Overloaded Facility	Contingency Description	Ctg Code	Category Type	Loading % (Baseline Scenarios)							Loading % (Sensitivity Scenarios)			Project & Potential Mitigation Solutions
				2025 Summer Peak	2028 Summer Peak	2035 Summer Peak	2025 Spring Off Peak	2028 Spring Off-Peak	2035 Spring Off-Peak	2035 Winter Peak	2025 SP Heavy Renewable	2025 SOP Heavy Renewable & Min Gas Gen	2028 SP High CEC Forecast	
ROUND MT 500.0 - RM_TM_21 500.0 - 1 & 2 (series capacitors)	ROUND MT-RM_DRS #1 500KV LINE	P1_2-0	L-1	129.91%	126.77%	131.86%	<95%	<95%	<95%	<95%	125.98%	<95%	127.57%	Parallel line outage overloads remaining line. Bypass SC and System redispatch
	TABLE MTN-RM_DRS #1 500KV LINE & TABLE MTN #5 500/230K	P6_1_2-6	L-1/T-1	<95%	<95%	<95%	<95%	<95%	<95%	104.86%	<95%	<95%	<95%	
	TABLE MTN-RM_DRS #1 500KV LINE	P1_2-19	L-1	<95%	<95%	<95%	<95%	<95%	<95%	107.01%	<95%	<95%	<95%	

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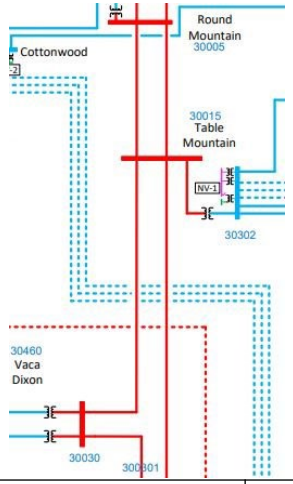
Table Mountain – Vaca Dixon 500kV

- Marginal overloads in the short-term
- Moderate in the long term and in sensitivity cases in short term
- Reinstate ratings
- Series compensation rearrangement to reduce/control flow on Table Mtn – Vaca Dixon – Collinsville - Tesla 500 kV path (interim operating solution).



Overloaded Facility	Contingency Description	Ctg Code	Category Type	Loading % (Baseline Scenarios)							Loading % (Sensitivity Scenarios)			Project & Potential Mitigation Solutions
				2025 Summer Peak	2028 Summer Peak	2035 Summer Peak	2025 Spring Off Peak	2028 Spring Off-Peak	2035 Spring Off-Peak	2035 Winter Peak	2025 SP Heavy Renewable	2025 SOP Heavy Renewable & Min Gas Gen	2028 SP High CEC Forecast	
TABLE MTN 500.0 - TM_VD_11 500.0 - 1 & VACA-DIX 500.0 - TM_VD_12 500.0 - 1	OLINDA-CAPTJACK #1 500KV LINE	P1_2-19	L-1	96.98%	<95%	112.17%	<95%	<95%	<95%	<95%	105.22 %	<95%	<95%	SC bypasss and System redispatch as required.
	OLINDA-TRACY #1 500KV LINE	P1_2-4	L-1	100.6%	95.87 %	115.26%	<95%	<95%	<95%	<95%	107.86 %	<95%	95.86%	
	OLINDA-TRACY #1 500KV LINE & OLINDA-CAPTJACK #1 500KV	P6_1_1-72	L-1/L-1	104.11%	99.37 %	118.74%	<95%	<95%	<95%	<95%	112.11 %	<95%	99.28%	
	TABLE MTN-TESLA #1 500KV LINE & TRACY-TESLA #1 500KV L	P6_1_1-13	L-1/L-1	<95%	<95%	108.79%	<95%	<95%	<95%	<95%	104.82 %	<95%	<95%	
	DIABLOCNYNSS GENERATOR & OLINDA-CAPTJACK #1 500KV LINE	P3_2-19	G-1/L-1	<95%	<95%	112.17%	<95%	<95%	<95%	<95%	<95%	<95%	103.43%	
	DIABLOCNYNSS GENERATOR & OLINDA-TRACY #1 500KV LINE	P3_2-4	G-1/L-1	<95%	<95%	115.26%	<95%	<95%	<95%	<95%	<95%	<95%	<95%	

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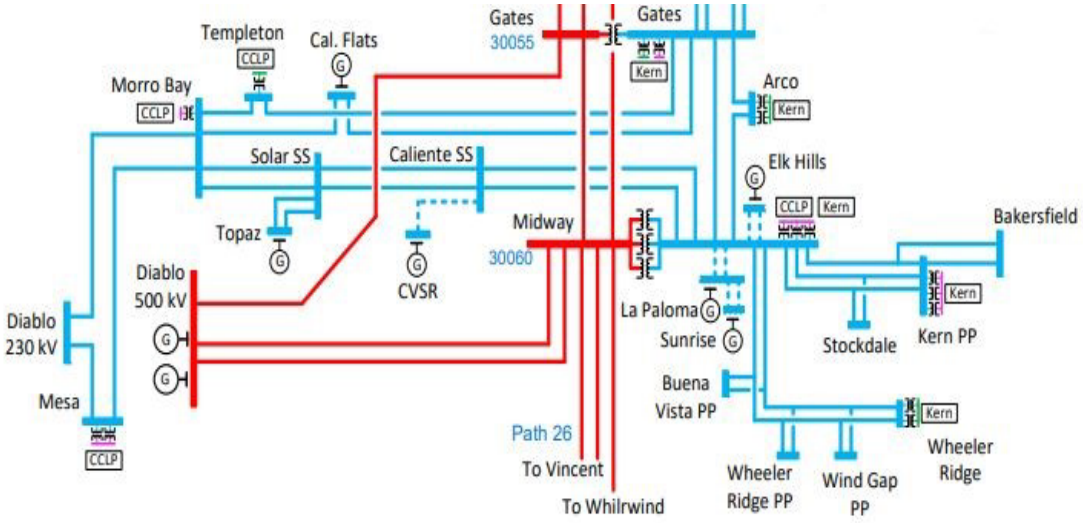
Gates – Midway 500kV

- 500kV overload due to derated equipment; increase rating
- 230kV overloads; redispatch



Overloaded Facility	Contingency Description	Contingency Code	Category Description	Loading % (Baseline Scenarios)							Loading % (Sensitivity Scenarios)			Project & Potential Mitigation Solutions
				2025 Summer Peak	2028 Summer Peak	2035 Summer Peak	2025 Spring Off Peak	2028 Spring Off-Peak	2035 Spring Off-Peak	2035 Winter Peak	2025 SP Heavy Renewable	2025 SOP Heavy Renewable & Min Gas Gen	2028 SP High CEC Forecast	
GATES 500.0 - GT_MW_11 500.0 - 1	LOSBANOS-MIDWAY #1 500KV LINE	P1_2-14	L-1	<95%	<95%	<95%	130.58%	<95%	<95%	<95%	<95%	130.56%	<95%	This is a series capacitor branch. Mitigate violation by closing the bypass switch. Remaining overload handled by system redispatch.
GATES F 230.0 - MIDWAY-F 230.0 - 1	GATES #11 & #12 500/230KV BANK	P6_2_2-3	L-1/L-1	<95%	<95%	<95%	146.36%	<95%	<95%	<95%	100.45%	146.44%	<95%	
GATES F 230.0 - MIDWAY-F 230.0 - 1	GATES-DIABLOCNYNSS #1 500KV LINE & GATES-MIDWAY #1 500	P6_1_1-47	L-1/L-1	<95%	<95%	<95%	165.22%	121.48%	<95%	<95%	<95%	165.28%	<95%	
ARCO 230.0 - MIDWAY-E 230.0 - 1	GATES-MIDWAY #1 500KV LINE	P1_2-16	L-1	<95%	<95%	<95%	109.64%	<95%	<95%	<95%	<95%	109.66%	<95%	Open 230kV loop.
	LOSBANOS-MIDWAY #1 500KV LINE & GATES-MIDWAY #1 500KV	P6_1_1-48	L-1/L-1	<95%	<95%	<95%	126.11%	<95%	<95%	<95%	<95%	126.1%	<95%	
	GATES #11 & #12 500/230KV BANK	P6_2_2-3	L-1/L-1	<95%	<95%	<95%	142.27%	<95%	<95%	<95%	99.51%	142.34%	<95%	
	GATES-DIABLOCNYNSS #1 500KV LINE & GATES-MIDWAY #1 500	P6_1_1-47	L-1/L-1	<95%	<95%	<95%	157.56%	<95%	<95%	<95%	<95%	157.61%	<95%	

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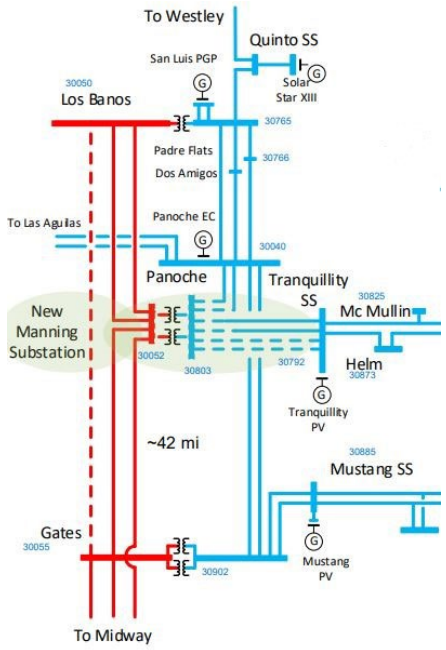
Los Banos - Manning – Midway 500kV

- SOP overloads noted
- System redispatch



Overloaded Facility	Contingency Description	Contingency Code	Category Description	Loading % (Baseline Scenarios)							Loading % (Sensitivity Scenarios)			
				2025 Summer Peak	2028 Summer Peak	2035 Summer Peak	2025 Spring Off Peak	2028 Spring Off-Peak	2035 Spring Off-Peak	2035 Winter Peak	2025 SP Heavy Renewable	2025 SOP Heavy Renewable & Min Gas Gen	2028 SP High CEC Forecast	2035-SP-HalfSC
MANNING 500.0 - LB_MN_21 500.0 - 1	LOSBANOS-GATES #3 500KV LINE & LOSBANOS-MANNING #1 500	P6_1_1-41	L-1/L-1	<95%	<95%	<95%	<95%	<95%	110.9%	<95%	<95%	<95%	<95%	<95%
MANNING 500.0 - LB_MN_11 500.0 - 1	LOSBANOS-GATES #3 500KV LINE & LOSBANOS-MANNING #2 500	P6_1_1-42	L-1/L-1	<95%	<95%	<95%	<95%	<95%	110.9%	<95%	<95%	<95%	<95%	<95%
LOSBANOS 500.0 - LB_MN_21 500.0 - 2	LOSBANOS-GATES #3 500KV LINE & LOSBANOS-MANNING #1 500	P6_1_1-41	L-1/L-1	<95%	<95%	<95%	<95%	<95%	124.85%	95.46%	<95%	<95%	<95%	<95%
MN_MW_21 500.0 - MANNING 500.0 - 2	GATES-DIABLOCNYNSS #1 500KV LINE & GATES-MIDWAY #1 500	P6_1_1-56	L-1/L-1	<95%	<95%	<95%	<95%	114.7%	100.07%	<95%	<95%	<95%	<95%	<95%

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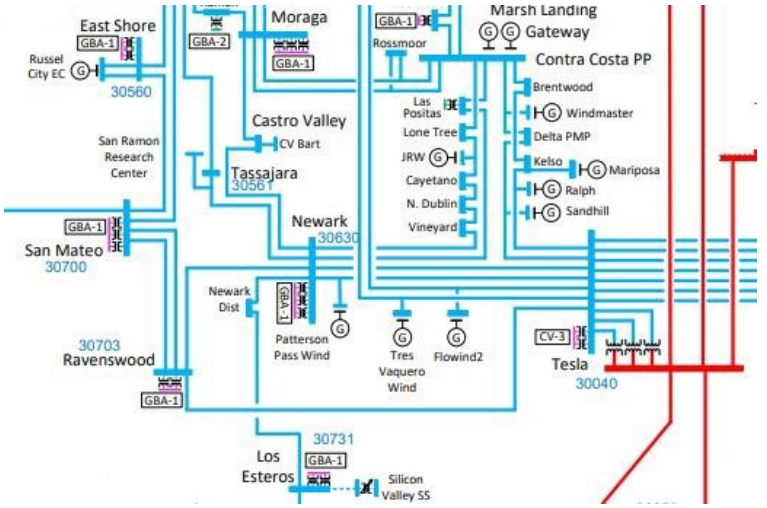
Newark 230kV

- Marginal overloads in the near term
- Moderate overloading in longer term
- Re-dispatch to alleviate overloads and continue to monitor



Overloaded Facility	Contingency Description	Contingency Code	Category Description	Loading % (Baseline Scenarios)							Loading % (Sensitivity Scenarios)			Project & Potential Mitigation Solutions
				2025 Summer Peak	2028 Summer Peak	2035 Summer Peak	2025 Spring Off Peak	2028 Spring Off-Peak	2035 Spring Off-Peak	2035 Winter Peak	2025 SP Heavy Renewable	2025 SOP Heavy Renewable & Min Gas Gen	2028 SP High CEC Forecast	
LS PSTAS 230.0 - NEWARK D 230.0 - 1	VACA-DIX-TESLA #1 500KV LINE & TESLA-METCALF #1 500KV	P6_1_1-17	L-1/L-1	97.8%	99.28%	109.51%	<95%	<95%	<95%	<95%	<95%	<95%	99.99%	Eliminate excessive 230kV loop flow by opening up Los Costas - Los Positas 230kV line
	TESLA-METCALF #1 500KV LINE & METCALF-MOSSLAND #1 500K	P6_1_1-23	L-1/L-1	101.08%	101.44%	110.82%	<95%	<95%	<95%	96.37%	<95%	<95%	102.45%	
	TESLA-METCALF & MOSSLAND-LOSBANOS #1 500KV LINES	P6_1_1-100	L-1/L-1	102.0%	99.92%	119.91%	101.9%	<95%	<95%	106.26%	<95%	101.83%	100.47%	
NEWARK E 230.0 - NWK DIST 230.0 - 1	TESLA-METCALF & MOSSLAND-LOSBANOS #1 500KV LINES	P6_1_1-100	L-1/L-1	96.69%	<95%	126.75%	109.25%	<95%	<95%	99.58%	<95%	109.03%	<95%	Open line section and redispatch San Jose generation
	TESLA-METCALF #1 500KV LINE & METCALF-MOSSLAND #1 500K	P6_1_1-23	L-1/L-1	<95%	95.06%	108.48%	<95%	<95%	<95%	<95%	<95%	<95%	96.42%	
NWK DIST 230.0 - LS ESTRS 230.0 - 1	TESLA-METCALF #1 500KV LINE & METCALF-MOSSLAND #1 500K	P6_1_1-23	L-1/L-1	96.1%	96.1%	111.59%	<95%	<95%	<95%	<95%	<95%	<95%	97.63%	Open line section and redispatch San Jose generatrion
	TESLA-METCALF & MOSSLAND-LOSBANOS #1 500KV LINES	P6_1_1-100	L-1/L-1	98.16%	<95%	132.83%	114.88%	<95%	102.49%	99.18%	<95%	114.63%	<95%	
TASSAJAR 230.0 - SRRC JCT 230.0 - NEWARK E 230.0 - 1	TESLA-METCALF #1 500KV LINE & METCALF-MOSSLAND #1 500K	P6_1_1-23	L-1/L-1	<95%	<95%	112.04%	<95%	<95%	<95%	<95%	<95%	<95%	<95%	Under investigation
	TESLA-METCALF & MOSSLAND-LOSBANOS #1 500KV LINES	P6_1_1-100	L-1/L-1	<95%	<95%	122.04%	<95%	<95%	<95%	<95%	<95%	<95%	<95%	Under investigation

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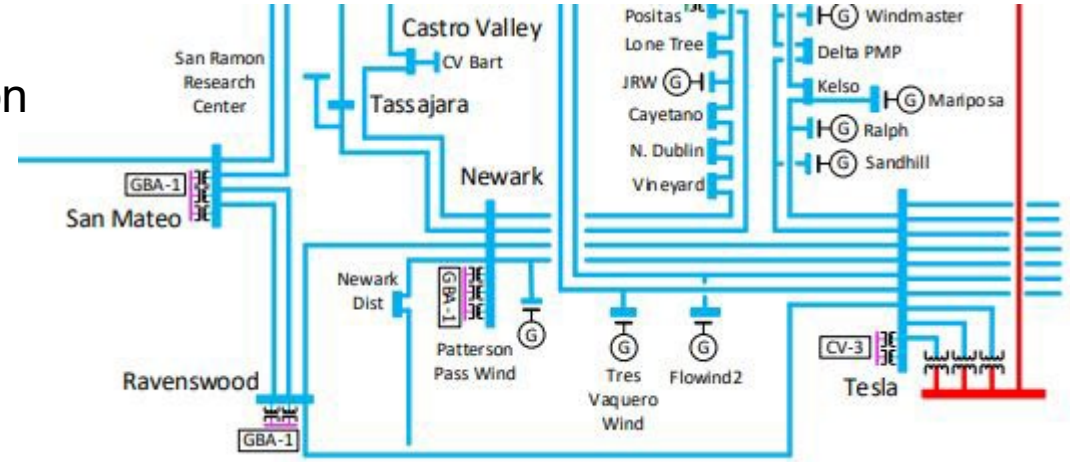
Newark 230kV cont'd

- Longer term thermal violation
- Possible candidate for reconductoring. Continue to monitor.



Overloaded Facility	Contingency Description	Contingency Code	Category Description	Loading % (Baseline Scenarios)							Loading % (Sensitivity Scenarios)			Project & Potential Mitigation Solutions
				2025 Summer Peak	2028 Summer Peak	2035 Summer Peak	2025 Spring Off Peak	2028 Spring Off-Peak	2035 Spring Off-Peak	2035 Winter Peak	2025 SP Heavy Renewable	2025 SOP Heavy Renewable & Min Gas Gen	2028 SP High CEC Forecast	
NEWARK E 230.0 - PPASSJCT 230.0 - 2	TESLA-METCALF #1 500KV LINE & TESLA #2 500/230KV BANK	P6_1_2-11	L-1/T-1	<95%	<95%	107.04%	<95%	<95%	<95%	<95%	<95%	<95%	<95%	Curtail generation
	TESLA-METCALF #1 500KV LINE & METCALF-MOSSLAND #1 500K	P6_1_1-23	L-1/L-1	<95%	<95%	118.4%	<95%	<95%	<95%	96.14%	<95%	<95%	<95%	
	TESLA-METCALF & MOSSLAND-LOSBANOS #1 500KV LINES	P6_1_1-100	L-1/L-1	<95%	<95%	127.92%	<95%	<95%	<95%	106.42%	<95%	<95%	<95%	

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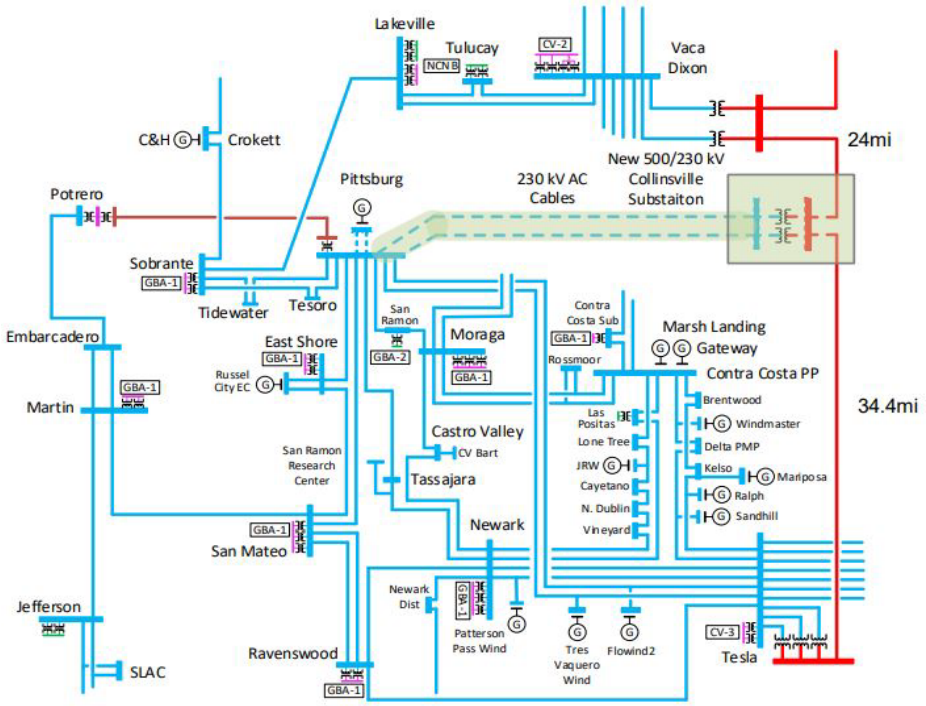
Collinsville 230kV

- P6 contingencies will overload for 2035 Winter Peak case.
- This is applicable to a # of 230kV Collinsville lines (San Mateo, E. Shore, etc)
- Series compensation rearrangement to reduce/control flow on Table Mtn – Vaca Dixon – Collinsville - Tesla 500 kV path (interim operating solution).
- Series reactor on Collinsville – Pittsburg 230 kV lines as part of the ultimate Collinsville project.



Overloaded Facility	Contingency Description	Contingency Code	Category Description	Loading % (Baseline Scenarios)							Loading % (Sensitivity Scenarios)			Project & Potential Mitigation Solutions
				2025 Summer Peak	2028 Summer Peak	2035 Summer Peak	2025 Spring Off Peak	2028 Spring Off-Peak	2035 Spring Off-Peak	2035 Winter Peak	2025 SP Heavy Renewable	2025 SOP Heavy Renewable & Min Gas Gen	2028 SP High CEC Forecast	
COLLINSVILLE 230.0 - PITTSBURG-E 230.0 - E. SHORE 230.0 - 1	TESLA-METCALF #1 500KV LINE & TESLA #2 500/230KV BANK	P6_1_2-11	L-1/T-1	<95%	<95%	107.51%	<95%	<95%	<95%	<95%	<95%	<95%	<95%	2035SP P0 overload on Pittsburgh - E Shore 2035 SumPk requires investigation.
	TESLA-METCALF #1 500KV LINE & METCALF-MOSSLAND #1 500K	P6_1_1-23	L-1/L-1	<95%	<95%	117.79%	<95%	<95%	<95%	<95%	<95%	<95%	<95%	
	TESLA-METCALF & MOSSLAND-LOSBANOS #1 500KV LINES	P6_1_1-100	L-1/L-1	<95%	<95%	125.93%	<95%	<95%	<95%	97.38%	<95%	<95%	<95%	

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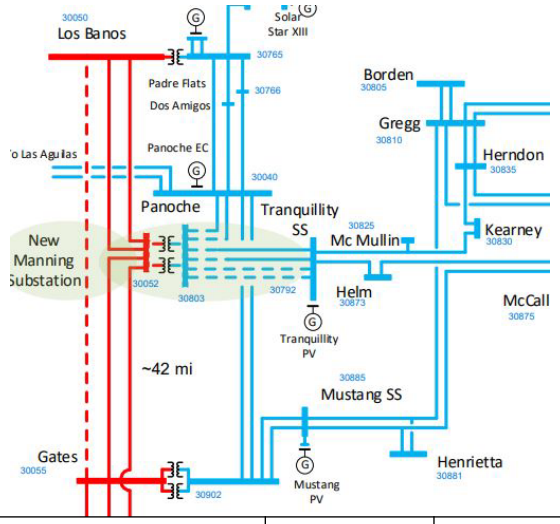
Panoche – Gates 230kV 1&2

- P6 contingencies will overload for 2035 SOP
- System redispatch



Overloaded Facility	Contingency Description	Contingency Code	Category Description	Loading % (Baseline Scenarios)							Loading % (Sensitivity Scenarios)			Project & Potential Mitigation Solutions
				2025 Summer Peak	2028 Summer Peak	2035 Summer Peak	2025 Spring Off Peak	2028 Spring Off-Peak	2035 Spring Off-Peak	2035 Winter Peak	2025 SP Heavy Renewable	2025 SOP Heavy Renewable & Min Gas Gen	2028 SP High CEC Forecast	
PANOCHE 230.0 - GATES E 230.0 - 1 & 2	TESLA-LOSBANOS #1 500KV LINE & LOSBANOS #1 500/230KV B	P6_1_2-21	L-1/T-1	<95%	<95%	<95%	104.44%	110.46%	<95%	<95%	<95%	104.17%	<95%	Both Panoche230-Gate230 lines can be opened to prevent loop flow. Redispatch 500kV flow as required.
	LOSBANOS-GATES #3 500KV LINE & LOSBANOS-GATES #1 500KV	P6_1_1-39	L-1/L-1	<95%	<95%	<95%	120.76%	106.09%	<95%	<95%	<95%	120.64%	<95%	
	LOSBANOS-GATES #3 500KV LINE	P1_2-12	L-1	<95%	<95%	<95%	<95%	106.09%	<95%	<95%	<95%	<95%	<95%	
	TESLA-LOSBANOS #1 500KV LINE & LOSBANOS-GATES #3 500KV	P6_1_1-42	L-1/L-1	<95%	<95%	<95%	<95%	116.05%	<95%	<95%	<95%	<95%	<95%	
	MOSSLAND-LOSBANOS #1 500KV LINE & LOSBANOS-GATES #3 50	P6_1_1-45	L-1/L-1	<95%	<95%	<95%	<95%	119.89%	<95%	<95%	<95%	<95%	<95%	

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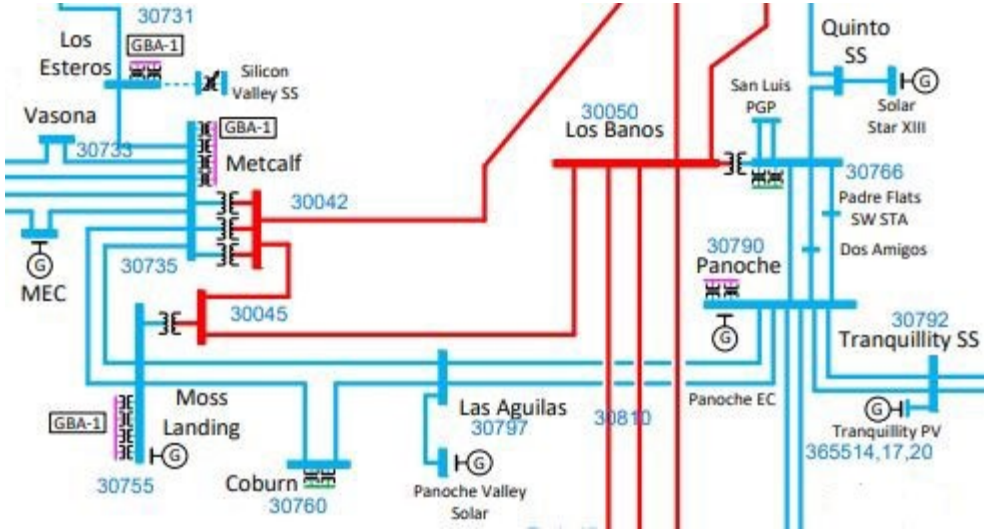
Moss Landing – Las Aquilas 230kV

- 2028/2035 SOP thermal violations
- Use of series reactor at Las Aguilas



Overloaded Facility	Contingency Description	Contingency Code	Category Description	Loading % (Baseline Scenarios)							Loading % (Sensitivity Scenarios)			Project & Potential Mitigation Solutions
				2025 Summer Peak	2028 Summer Peak	2035 Summer Peak	2025 Spring Off Peak	2028 Spring Off-Peak	2035 Spring Off-Peak	2035 Winter Peak	2025 SP Heavy Renewable	2025 SOP Heavy Renewable & Min Gas Gen	2028 SP High CEC Forecast	
MOSSLNSW 230.0 - LASAGLSRCTR 230.0 - 1	MOSSLAND-LOSBANOS #1 500KV LINE	P1_2-11	L-1	<95%	<95%	<95%	<95%	159.66%	110.76%	<95%	<95%	<95%	<95%	Redispatch San Jose generation after first contingency
	DIABLOCNYNSS GENERATOR & MOSSLAND-LOSBANOS #1 500KV LINE	P3_2-11	G-1/L-1	<95%	<95%	<95%	<95%	<95%	110.76%	<95%	<95%	<95%	<95%	
	MOSSLAND-LOSBANOS #1 500KV LINE & LOSBANOS-MANNING #1	P6_1_1-39	L-1/L-1	<95%	<95%	<95%	<95%	<95%	115.82%	<95%	<95%	<95%	<95%	
	TRACY-LOSBANOS #1 500KV LINE & MOSSLAND-LOSBANOS #1 50	P6_1_1-30	L-1/L-1	<95%	<95%	<95%	<95%	<95%	134.77%	100.58%	<95%	<95%	<95%	
	TESLA-LOSBANOS #1 500KV LINE & MOSSLAND-LOSBANOS #1 50	P6_1_1-34	L-1/L-1	<95%	<95%	<95%	<95%	<95%	144.43%	107.83%	<95%	<95%	<95%	
PANOCHE 230.0 - LASAGUILASS 230.0 - 1 & 2	TESLA-METCALF & MOSSLAND-LOSBANOS #1 500KV LINES	P6_1_1-100	L-1/L-1	<95%	<95%	95.79%	<95%	<95%	106.6%	<95%	<95%	<95%	<95%	2035SOP line overload mitigated by opening line to prevent loop flow.
	MOSSLAND-LOSBANOS #1 500KV LINE & LOSBANOS-GATES #3 50	P6_1_1-45	L-1/L-1	<95%	<95%	<95%	<95%	100.91%	<95%	<95%	<95%	<95%	<95%	2035SOP line overload mitigated by opening line to prevent loop flow.
	METCALF-MOSSLAND #1 500KV LINE & MOSSLAND-LOSBANOS #1	P6_1_1-33	L-1/L-1	<95%	<95%	<95%	<95%	103.29%	<95%	<95%	<95%	<95%	<95%	2035SOP line overload mitigated by opening line to prevent loop flow.

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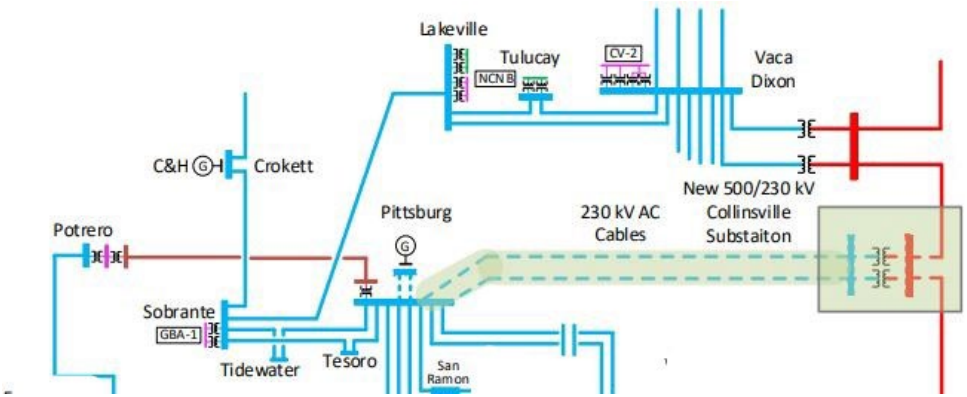
Vaca Dixon 230kV

- Vaca-Dixon 230 kV overload in 2035.
- Continue to monitor.

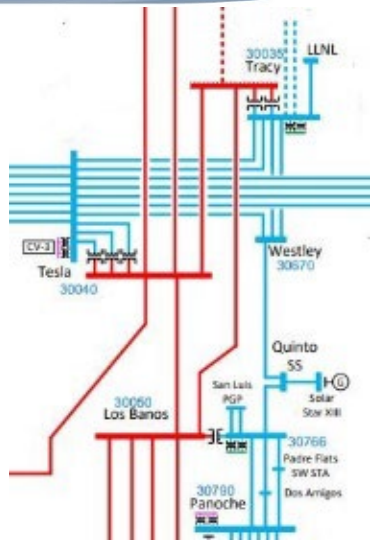


Overloaded Facility	Contingency Description	Contingency Code	Category Description	Loading % (Baseline Scenarios)							Loading % (Sensitivity Scenarios)			Project & Potential Mitigation Solutions
				2025 Summer Peak	2028 Summer Peak	2035 Summer Peak	2025 Spring Off Peak	2028 Spring Off-Peak	2035 Spring Off-Peak	2035 Winter Peak	2025 SP Heavy Renewable	2025 SOP Heavy Renewable & Min Gas Gen	2028 SP High CEC Forecast	
TULUCAY 230.0 - VACA-DIX 230.0 - 1	VACA-DIX-TESLA #1 500KV LINE	P1_2-5	L-1	<95%	<95%	103.98%	<95%	<95%	<95%	95.32%	<95%	<95%	<95%	P6 contingencies that include VacaDix - Collinsville - Tesla & Telsa - Metcalf contingency under consideration of being dropped from P6 designation.
	VACA-DIX-TESLA #1 500KV LINE & TESLA-METCALF #1 500KV	P6_1_1-17	L-1/L-1	<95%	<95%	108.67%	<95%	<95%	<95%	98.18%	<95%	<95%	<95%	

Confidential – Subject to Transmission Planning NDA

Westley/Quinto 230kV

- Overloading in 2028 SOP case
- Reduce/re-dispatch local generation



Overloaded Facility	Contingency Description	Contingency Code	Category Description	Loading % (Baseline Scenarios)							Loading % (Sensitivity Scenarios)			Project & Potential Mitigation Solutions
				2025 Summer Peak	2028 Summer Peak	2035 Summer Peak	2025 Spring Off Peak	2028 Spring Off-Peak	2035 Spring Off-Peak	2035 Winter Peak	2025 SP Heavy Renewable	2025 SOP Heavy Renewable & Min Gas Gen	2028 SP High CEC Forecast	
WESTLEY 230.0 - FINKSWSTA 230.0 - 1	MOSSLAND-LOSBANOS #1 500KV LINE	P1_2-11	L-1	<95%	<95%	<95%	<95%	105.11%	<95%	<95%	<95%	<95%	<95%	
	TRACY-LOSBANOS #1 500KV LINE	P1_2-7	L-1	<95%	<95%	<95%	<95%	110.75%	<95%	<95%	<95%	<95%	<95%	
	TESLA-LOSBANOS #1 500KV LINE	P1_2-9	L-1	<95%	<95%	<95%	<95%	115.73%	<95%	<95%	<95%	<95%	<95%	
QUINTO_SS 230.0 - LOSBANOS 230.0 - 1	TRACY-LOSBANOS #1 500KV LINE	P1_2-7	L-1	<95%	<95%	<95%	<95%	104.07%	<95%	<95%	<95%	<95%	<95%	
	TESLA-LOSBANOS #1 500KV LINE	P1_2-9	L-1	<95%	<95%	<95%	<95%	109.03%	<95%	<95%	<95%	<95%	<95%	Under investigation
	TRACY-TESLA #1 500KV LINE & TESLA-LOSBANOS #1 500KV LI	P6_1_1-29	L-1/L-1	<95%	<95%	<95%	<95%	114.59%	<95%	<95%	<95%	<95%	<95%	
QUINTO_SS 230.0 - FINKSWSTA 230.0 - 1	MOSSLAND-LOSBANOS #1 500KV LINE	P1_2-11	L-1	<95%	<95%	<95%	<95%	105.87%	<95%	<95%	<95%	<95%	<95%	
	TRACY-LOSBANOS #1 500KV LINE	P1_2-7	L-1	<95%	<95%	<95%	<95%	111.84%	<95%	<95%	<95%	<95%	<95%	
	TRACY-TESLA #1 500KV LINE & TESLA-LOSBANOS #1 500KV LI	P6_1_1-29	L-1/L-1	<95%	<95%	<95%	<95%	122.63%	<95%	<95%	<95%	<95%	<95%	

Confidential – Subject to Transmission Planning NDA

Conclusion

- For northern 500 kV overloads, increase ratings
- Install RAS on Round Mtn – Table Mtn 500 kV path to bypass series capacitor
- Adjust series compensation on Table Mtn – Vaca Dixon – Collinsville – Tesla 500 kV path as a short term solution
- Preliminary 2025 and 2028 transient results show no criteria violation or instability. The dynamic simulations results are under review.
- 2035 policy cases to be evaluated once off-shore wind interconnection point and equipment has been finalized

Confidential – Subject to Transmission Planning NDA

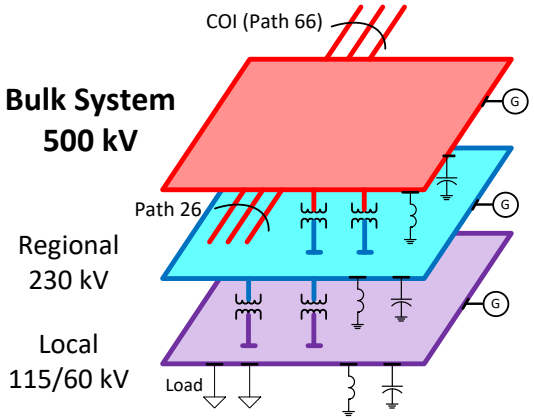
High Voltage Assessment in PG&E System
Status Update

Subrina Sultana Noureen, Uriel Rangel Diaz
Regional Transmission North

2023-24 Transmission Planning Process Stakeholder Meeting
September 26-27, 2023

Background and Objective

- System wide voltage studies for PG&E system was performed in 2017-2018 TPP with following recommendations:
  - Proceed with number of approved voltage support projects
    - Rio Oso SVC, Wilson SVC, Bellota Reactor, Ignacio Reactor, …
  - Mitigate issues at 500 kV system with voltage support potentially at Round Mountain and Gates 500 kV areas
  - Review and address load power factor issues
  - Re-assess the voltage mitigation needs with above measures in place



Approved Voltage Support Projects in PG&E System

Projects	Expected ISD
Round Mountain Dynamic Reactive Support Project	Jun-2024
Gates Dynamic Reactive Support Project	Jun-2024
Plainfield Shunt Capacitor	Jun-2026
Maple Creek SVC	Jul-2026
Rio Oso SVC	Oct-2024
Tyler 60 kV Shunt Capacitor	Dec-2026
Atlantic 230/60 kV transformer voltage regulator	Dec-2026
Table Mountain second 500/230 kV transformer	Dec-2027
Some of the transformer upgrade projects could help with voltage control through tap adjustments.	

Study Objective and Methodology

- Objective
  - Identify potential mitigation measures to address high voltage issues across PG&E system in the planning horizon

- Methodology
  - Table 3 in the ISO planning standards was used as voltage criteria
  - If possible, system adjustments such as transformer taps and generator scheduled voltage was used to address the high voltage issue.
  - If system adjustments were not sufficient, shunt reactors were added to the system as a potential mitigation measure

Voltage Criteria

Table 3: System Voltage Limits in PG&E Area

Facility	Nominal Voltage	Steady State Pre-Contingency		Steady State Post-Contingency	
		High (kV/p.u.)	Low (kV/p.u.)	High (kV/p.u.)	Low (kV/p.u.)
DCPP bus	500 kV	545/1.090	512/1.024	550/1.100	512/1.024
All other buses	500 kV	550/1.100	518/1.036	550/1.100	473/0.946
DCPP bus	230 kV	242/1.052	218/0.948	242/1.052	207/0.900
All other buses	230 kV	242/1.052	219/0.952	242/1.052	207/0.900
All buses	115 kV	121/1.052[2]	109/0.948	121/1.052[1]	104/0.904
All buses	70 kV	72.5/1.036	66.5/0.950	72.5/1.036	63.0/0.900
All buses	60 kV	63.0/1.050	57.0/0.950	66.0/1.100	54.0/0.900

Review of Real Time Voltage Data

	115 kV Bus Voltage > 121 kV - Number of Hours Per Month																				
	Brighton 115 kV	Drum 115 kV	East Nicolaus 115 kV	Moss Landing 115 kV	Pease 115 kV	Placer 115 kV	Rio Oso 115 kV	Vierra 115 kV	Chowchilla 115 KV	Exchequer 115 KV	El Capitan 115 KV	Atwater 115 KV	Mendota 115 KV	Wilson 115 KV	Le Grand 115 KV	Corcoran 115 KV	Bellota 115 KV	Lockeford 115 KV	Melones 115 KV	Schulte 115 KV	Manteca 115 KV	Riverbank 115 KV
Aug-22	649	629	674	111	245	13	670	349	37	263	409	339	6	320	38	0.02	2	154	479	523	370	33
Sep-22	676	657	699	172	567	243	699	414	69	117	281	245	62	240	49	38	6	119	534	533	426	24
Oct-22	744	715	740	145	555	125	740	600	102	221	275	225	65	80	50	62	3	193	560	665	598	64
Nov-22	720	556	712	135	680	24	720	720	447	103	418	368	260	149	309	114	5	292	670	720	720	107
Dec-22	744	514	744	140	738	13	744	702	358	184	241	245	235	70	223	82	2	325	638	732	692	93
Jan-23	744	642	744	55	744	63	744	698	488	226	403	323	285	92	313	408	2	524	733	731	719	188
Feb-23	672	572	672	68	672	75	672	656	503	473	509	458	275	65	405	405	1	413	671	649	654	208
Mar-23	743	640	743	93	743	115	739	729	504	739	263	219	368	129	252	279	1	588	739	726	714	360
Apr-23	720	623	649	76	582	175	701	629	463	564	221	209	328	42	289	192	4	521	720	551	627	323
May-23	672	675	672	173	586	162	671	560	259	486	426	373	215	267	234	48	2	482	744	701	598	308
Jun-23	713	620	703	156	551	174	704	431	107	375	396	260	126	166	92	39	1	348	711	506	384	221
Jul-23	735	622	721	140	456	64	720	158	26	183	484	392	26	369	35	9	3	259	681	267	147	113
Aug-23	737	644	728	136	514	74	706	166	48	732	534	454	28	418	35	4	1	179	672	362	157	42

	115 kV Bus Voltage > 126 kV - Number of Hours Per Month																				
	Brighton 115 kV	Drum 115 kV	East Nicolaus 115 kV	Moss Landing 115 kV	Pease 115 kV	Placer 115 kV	Rio Oso 115 kV	Vierra 115 kV	Chowchilla 115 KV	Exchequer 115 KV	El Capitan 115 KV	Atwater 115 KV	Mendota 115 KV	Wilson 115 KV	Le Grand 115 KV	Corcoran 115 KV	Bellota 115 KV	Lockeford 115 KV	Melones 115 KV	Schulte 115 KV	Manteca 115 KV	Riverbank 115 KV
Aug-22	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Sep-22	0	0	14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Oct-22	0	0	20	0	0	0	0	0	0	0.1	0	0	0	0	0	0	0	0	0	0	0	0
Nov-22	0	0	33	0	0	0	0	0.2	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Dec-22	0	0	4	0	0.1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
Jan-23	0	0	5	0	0	0	0	0.02	0	1	1	0	0	0	0	0	0	0	0	0	0	0
Feb-23	0	0	131	0	104	0	9	0	0	0	0	0	0	0	0	33	0	0	0	0	0	0
Mar-23	0	0	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0
Apr-23	0	0.1	13	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
May-23	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0
Jun-23	0	0	0	0	0	0	0	0	0	0.2	0	0.2	0	0	0	0	0	0	0	0	0	0
Jul-23	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Aug-23	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

	230 kV Bus Voltage >238 kV - Number of Hours Per Month										
	Bellota 230 kV	Birds Landing 230 kV	Brighton 230 kV	Cortina 230 kV	Cottonwood 230 kV	Gold Hill 230 kV	Palermo 230 kV	Rio Oso 230 kV	Table Mtn 230 kV	Valley Springs 230 kV	McCall 230 kV
Aug-22	55	9	83	2	0	0	67	0	91	145	7
Sep-22	18	33	224	30	11	0	219	16	112	77	57
Oct-22	40	9	380	0.5	14	3	376	81	200	197	97
Nov-22	18	52	435	16	36	0.2	510	65	230	183	121
Dec-22	10	14	378	20	32	0	339	61	180	116	228
Jan-23	5	12	163	28	18	0	113	8	22	18	415
Feb-23	0.2	7	275	10	73	0	41	9	20	23	283
Mar-23	0	29	28	24	55	0	105	1	12	0.02	1
Apr-23	0	23	167	5	72	0	291	0	5	15	5
May-23	0	181	65	17	3	0	241	111	17	17	62
Jun-23	0	61	47	0	24	0	258	0	2	20	27
Jul-23	16	8	97	2	11	0	200	1	58	65	8
Aug-23	7	44	87	38	5	0	112	4	124	19	7

	230 kV Bus Voltage > 242 kV - Number of Hours Per Month										
	Bellota 230 kV	Birds Landing 230 kV	Brighton 230 kV	Cortina 230 kV	Cottonwood 230 kV	Gold Hill 230 kV	Palermo 230 kV	Rio Oso 230 kV	Table Mtn 230 kV	Valley Springs 230 kV	McCall 230 kV
Aug-22	0	0	0	0	0	0	0	0	0	0	0
Sep-22	0	0	0	0	0	0	0	0	0	0	0
Oct-22	0	0	4	0	0	0	0	0	0	0	0
Nov-22	0	0	1	0	0	0	0	0	0	0	1
Dec-22	0	0	0.4	0	0	0	2	0	0	0	4
Jan-23	0	0	0	0	0	0	0	0	0	0	14
Feb-23	0	0	0	0	0	0	0	0	0	0	4
Mar-23	0	0	0	0	0	0	4	0	0	0	0
Apr-23	0	0	0	0	0	0	0	0	0	0	0
May-23	0	1	0	0	0	0	0.1	30	0	0	0
Jun-23	0	0	0	0	0	0	0	0	0	0	0
Jul-23	0	0	0	0	0	0	0	0	0	0	0
Aug-23	0	0	0	0	0	0	0	0	0	0	0

	500 kV Bus Voltage > 541 kV - Number of Hours Per Month		
	Gates 500 KV	Round Mtn 500 kV	Table Mtn 500 kV
Aug-22	45	7	30
Sep-22	34	17	102
Oct-22	15	23	175
Nov-22	3	6	217
Dec-22	2	6	200
Jan-23	138	34	211
Feb-23	27	30	105
Mar-23	42	160	136
Apr-23	27	225	219
May-23	8	47	98
Jun-23	5	92	86
Jul-23	2	395	260
Aug-23	62	303	272

	500 kV Bus Voltage > 551 kV - Number of Hours Per Month		
	Gates 500 KV	Round Mtn 500 kV	Table Mtn 500 kV
Aug-22	0	0	0
Sep-22	0	0	0
Oct-22	0	0	0
Nov-22	0	0	0
Dec-22	0	0	0
Jan-23	0	0	0
Feb-23	0	0	0
Mar-23	0	0	0
Apr-23	0	0	0
May-23	0	0	0
Jun-23	0	0	0
Jul-23	0	0	0
Aug-23	0	0	0

Preliminary Study Results for Base Case (P0) and Potential Mitigation Measures

High Voltage Summary in TPP Studies

- Central Coast/Los Padres
  - GREENVALLEY 60 kV
  - ERTA 60 kV
- Central Valley
  - BRIGHTON 115 kV
  - Grand IS 115 kV
  - CORDELLT 115 kV
  - DAVIS 115 kV
  - DEEPWATER 115 kV
  - GRAND IS 115 kV
  - HIGGINS 115 kV
  - MOBILCHE 115 kV
  - POST 115 kV
  - Q653F 115 kV
  - W.SECRAMENTO 115 kV
  - WOODLAND 115 kV
- Greater Bay Area
  - CYTE PMP 115 kV
  - DYERWND 60 kV
  - EDENVALE 115 kV
  - IBM-BALY 115 kV
  - IBM-HRRS 115 kV
  - MTCALF D 115 kV
  - MTCALF E 115 kV
  - SAN RAMN 60 kV
  - ST TRESA 115 kV
- Greater Fresno Area
  - AIRPROD 115 kV
  - ANGIOLA 70 kV
  - AUBERRY 70 kV
  - BOSWELL 70 kV
  - CAL AVE 115 kV
  - CLOVIS-1 115 kV
  - CORCORAN 70, 115 kV
  - CORCORANPV_P 115 kV
  - CORSGOLD 115 kV
  - DANISHCM 115 kV
  - FRSHWTR 115 kV
  - KERCKHF1 115 kV
  - KNGSRVR1 115 kV
  - LIVNGSTN 70 kV
  - MALAGA 115 kV
  - MC CALL 115 kV
  - NRTHFORK 70 kV
  - OAKHURST 115 kV
  - PARLIER 115 kV
  - PIEDRA #1 and #2 115 kV
  - PPG 115 kV
  - RAINBW 115 kV
  - RANCHRS 115 kV
  - REEDLEY 115 kV
  - RIOBRVOFSNO 115 kV
  - SANGER 115 kV
  - SANGERCGN 115 kV
  - WAHTOKE 115 kV
  - WAUKENA_SS 115 kV
  - WST FRSO 115 kV

California ISO Public

High Voltage Summary in TPP Studies

- North Coast/North Bay
  - CARQUINZ 115 kV
  - HIGHWAY 115 kV
  - IGNACIO 115 kV
  - LS GLLNS 115 kV
  - MNTCLOPH 115 kV
  - MONTCLLO 115 kV
  - NTWR ALT 115 kV
  - SAN RAFL 115 kV
  - SKAGGS 115 kV
- North Valley
  - CHALLNGE 60 kV
  - ELKCREEK 60 kV

High Level Summary of Results

- With implementation of Round Mountain and Gates STATCOM projects, there will be no high voltage issues at the 500 kV system under normal or contingency conditions.

- Based on the initial review of the feasibility of adjustments to the existing system to address high voltage issues, the following areas may require voltage support upgrades and are further reviewed to identify optimum size and type of voltage support:
  - Melones 115 kV area
  - Exchequer 115 KV Area
  - Grand IS 115 kV Area
  - Palermo 230 kV Area
  - Livingstone 70 kV Area

Next Steps

- Further analysis of the areas with potential need for voltage support upgrade
  - Analysis of more sensitivity scenario
  - Review of historical data
  - Detailed review of power factor assumptions in high priority areas
  - Determine the optimum size and technology
  - Implementation feasibility assessment

- Continue system adjustment feasibility assessment and model validation for the rest of the PG&E system
  - Update the mitigation measures if system adjustments are not feasible and propose projects if all the required analysis are complete.

Southern California Bulk
Preliminary Reliability Assessment Results

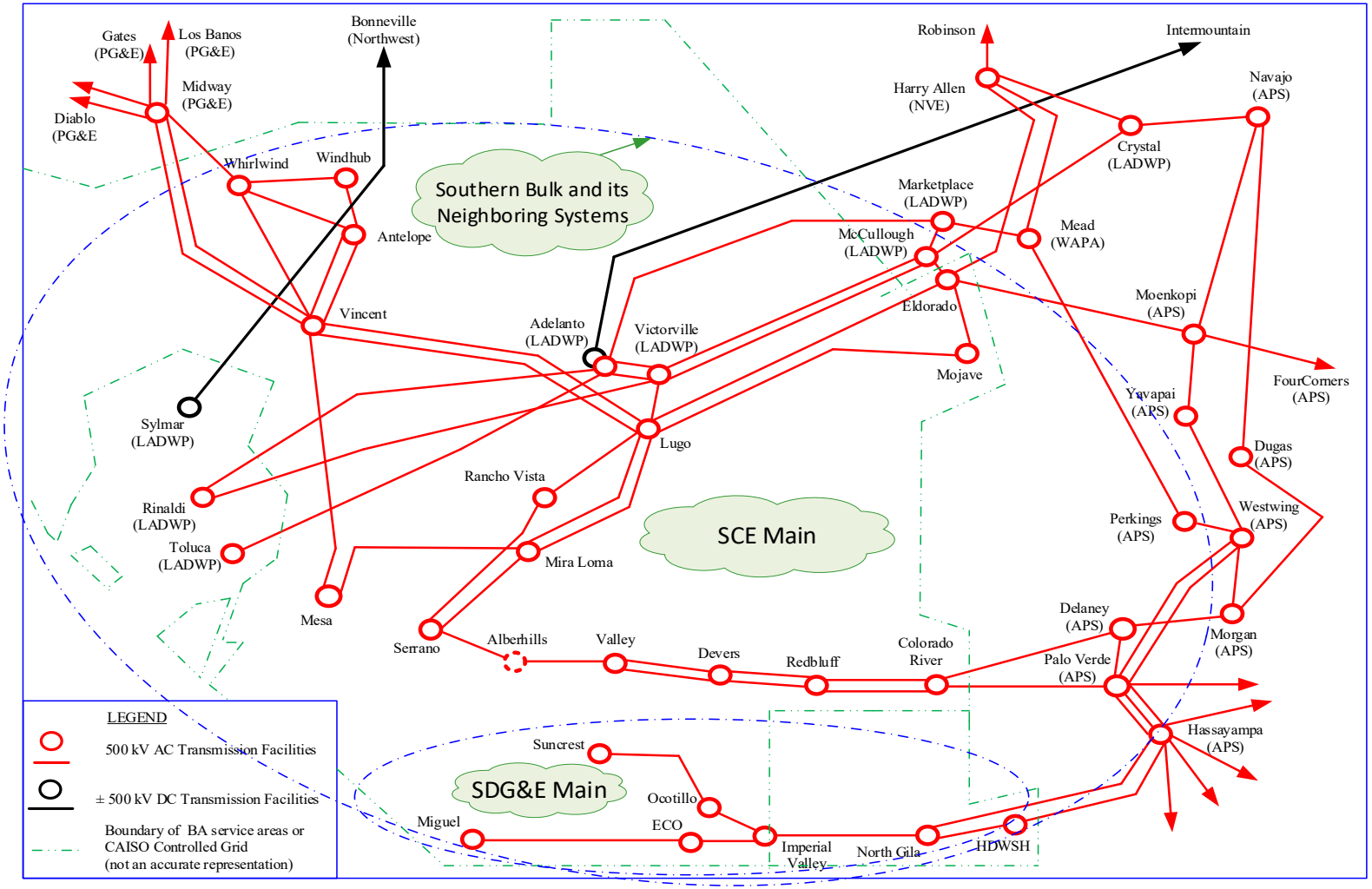
Frank Chen
Regional Transmission Engineer Lead

2023-24 Transmission Planning Process Stakeholder Meeting
September 26-27, 2023

Southern California Bulk System

- Covers the SCE Main and SDG&E Main Systems
- Serves Los Angeles, San Bernardino, Ventura, Santa Barbara, Orange, and San Diego counties, along with the greater Imperial Valley area
- Comprised of 500 kV, 230 kV transmission facilities

Southern California Bulk System - 2025



Southern California Bulk System Study Scenarios

Baseline Scenarios

Study Case Name	Scenario	Description
B1-25SP	Baseline	2025 summer peak load at HE16 PST, 9/2
B2-28SP	Baseline	2028 summer peak load at HE17 PST, 9/5
B3-35SP	Baseline	2035 summer peak load at HE19 PST, 9/4
B4-28SumOP	Baseline	2028 summer Off-Peak Load Case at HE15 PST, 9/5
B6-25OP	Baseline	2025 spring off-peak load at HE20 PST, 4/23
B7-28OP	Baseline	2028 spring off-peak load at HE12 PST, 4/2
B8-35OP	Baseline	2035 spring off-peak load at HE13 PST, 4/1

Sensitivity Scenarios, including Additional Transportation Electrification

Study Case Name	Scenario	Description
S1-28SP-HLOAD	Sensitivity	2028 summer peak with high CEC load forecast
S2-25SP-HiRenew	Sensitivity	2025 summer peak with heavy renewable output
S3-25OP-BCharging	Sensitivity	2025 spring off-peak with BES charging in load pocket

Load Demand Assumptions – Southern California Bulk

Study Case	Scenario	Gross Load (MW)	AAEE	AAFS	ATE	BTM-PV		Net Load (MW)	Including		Demand Response*	
						Installed Capacity	Impact		Pump	Loss	D1 (PDR)	D2 (fast RDRR)
B1-25SP	Baseline	32797	-499	49	205	7584	4022	28530	451	480	-436	-357
B2-28SP		32697	-864	98	533	9186	2828	29636	452	498	-436	-357
B3-35SP		31134	-1280	260	2195	13420	0	32309	497	556	-436	-357
B4-28SumOP		35143	-868	96	612	9186	6569	28415	452	694	-436	-357
B5-35WP		793	0	0	0	9906	793	0	497	0	-436	-357
B6-25OP		20516	-234	49	192	7584	0	20523	451	491	-436	-357
B7-28OP		15508	-181	125	251	9186	8304	7399	452	156	-436	-357
B8-35OP		16889	-302	318	882	13420	10666	7121	497	835	-436	-357
S1-28SP-HLOAD	Sensitivity	33138	-864	100	543	9186	2828	30089	452	518	-436	-357
S2-25SP-HiRenew		32797	-499	49	205	7584	4022	28530	451	480	-436	-357
S3-25OP-BCharging		20516	-234	49	192	7584	0	20523	451	491	-436	-357

Note: DR are modeled offline in starting cases.

Generation Assumptions – Southern California Bulk

Study Case	Scenario	Thermal (MW)		Hydro (MW)		Pumped Storage (MW)		Geothermal (MW)		Biomass (MW)		Solar (MW)		Wind (MW)		Energy Storage (MW)	
		Installed	Dispatch	Installed	Dispatch	Installed	Dispatch	Installed	Dispatch	Installed	Dispatch	Installed	Dispatch	Installed	Dispatch	Installed	Dispatch
B1-25SP	Baseline	15,054	7,171	1,433	1,071	270	90	368	341	134	18	17,566	12,959	4,873	1,170	14,230	0
B2-28SP		15,054	3,740	1,432	1,085	270	236	368	336	134	54	17,563	9,077	4,873	1,409	14,698	7,535
B3-35SP		15,054	8,232	1,433	889	1,969	538	1,197	991	141	40	34,450	0	10,894	4,319	21,561	13,257
B4-28SumOP		15,054	2,880	1,432	275	270	38	368	195	134	54	17,566	13,476	4,873	1,137	14,698	6,862
B6-25OP		15,054	9,923	1,432	912	270	198	368	132	134	50	17,443	0	4,886	2,647	14,230	0
B7-28OP		15,054	7,240	1,432	1,053	270	199	368	312	134	54	17,563	14,351	4,873	1,270	14,698	-14,508
B8-35OP		15,055	349	1,433	926	1,969	-500	1,197	251	141	128	34,346	30,446	10,894	2,672	21,650	-20,060
S1-28SP-HLOAD	Sensitivity	15,054	3,640	1,432	1,085	270	236	368	336	134	54	17,563	9,077	4,873	1,409	14,698	7,535
S2-25SP-HiRenew		15,054	5,092	1,433	1,081	270	90	368	258	134	18	17,566	17,320	4,873	3,141	14,230	-274
S3-25OP-BCharging		15,054	10,638	1,432	921	270	198	368	132	134	50	17,443	0	4,886	2,648	14,230	-557

Generation Retirement – Southern California Bulk

Already Retired			To Be Retired	Aged Unit Retirement
Thermal (MW)	Hydro (MW)	Biomass (MW)	Thermal (MW)	Thermal (MW)
7573	154	260	2150	501

Previously approved transmission projects modelled in base cases

Project Name	Transmission Plan Approved	Expected ISD	First Year Modeled
Alberhill 500 kV Substation	2009	April-27	2027
Delaney-Colorado River 500 kV Line (Ten West Link Project)	2013-2014	April-24	2024
Lugo Substation Install new 500 kV CBs for AA Banks	2008	Dec-24	2028
Lugo – Victorville 500 kV Upgrade (SCE portion)	2017	Jan-25	2028
Laguna Bell - Mesa No. 1 230 kV Line Rating Increase Project	2021-2022	Dec-23	2025
Barre 230kV Switchrack Conversion to Breaker-and-a-Half	2022-2023	June, 2026	2028
Serrano 4AA 500/230 kV Transformer Bank Addition	2022-2023	Dec-27	2028
Sylmar Transformer Replace *	2022-2023	2026	2028
Antelope-Whirlwind 500 kV Line Upgrade Project	2022-2023	Jun-26	2028
Devers-Red Bluff 500 kV 1 and 2 Line Upgrade	2022-2023	May-28	2028
Colorado River-Red Bluff 500 kV 1 Line Upgrade	2022-2023	May-28	2028
Devers-Valley 500 kV 1 Line Upgrade	2022-2023	May-28	2028
Serrano-Alberhill-Valley 500 kV 1 Line Upgrade	2022-2023	May-28	2028
San Bernardino-Etiwanda 230 kV 1 Line Upgrade	2022-2023	2031	3035
Mira Loma-Mesa 500 kV Underground Third Cable	2022-2023	2026	2028
Imperial Valley–North of SONGS 500 kV Line and Substation	2022-2023	2034	2035
North of SONGS–Serrano 500 kV line	2022-2023	2034	2035
Serrano–Del Amo–Mesa 500 kV Transmission Reinforcement	2022-2023	2033	2035
North Gila–Imperial Valley 500 kV line	2022-2023	2032	2035

* Joint SCE/LADWP project. Date indicated only includes SCE scope

Major Path Flows in Southern California Bulk

Study Case	Scenario	Southern California Bulk System Cases				
		Path 26 (MW)	Path 45 (MW)	Path 46 (MW)	Path 49 (MW)	Path 65 (MW)
B1-25SP	Baseline	3982	-500	4366	-2079	3000
B2-28SP		1048	0	5633	1906	3100
B3-35SP		-1992	-592	9799	3370	3090
B4-28SumOP		69	0	4938	-69	3100
B6-25OP		351	0	4789	2961	1400
B7-28OP		-1861	0	2642	-2796	-931
B8-35OP		-2950	-400	2925	-3857	-919
S1-28SP-HLOAD	Sensitivity	2147	-593	6030	2099	3100
S2-25SP-HiRenew		2168	-500	2620	-3920	3000
S3-25OP-BCharging		38	0	5652	3497	2711

Reliability Assessment Results Summary

Southern California Bulk

Summary of Overloaded Facilities – Southern California Bulk

Overload Facility	Worst Loading % in Baseline Scenario		Worst Loading % in Sensitivity Scenario				
	B1, B2, B3, B4, B6, B7, B8		S1, S2, S3				
	P6	P7	P2/P4	P3	P5	P6	P7
	Overlapping singles	common structure	Stuck Breaker/ Internal Fault		Non-Redundant Relay	Overlapping singles	common structure
ELDORDO - MCCULLGH 500kV 1 1	145%						
LUGO - VINCENT 500 kV #1 or #2						118%	
VINCENT - MESA CAL 500kV #1 and #2						109%	
VINCENT - WIRLWIND 500kV 3 1						118%	
MIDWAY - VINCNT 500kV Ckt #1, #2	130%						
ANTELOPE - WINDHUB 500kV 1 1						110%	
MIDWAY - WHIRLWIND 500kV Ckt #3	173% (N2S) 132% (S2N)	173% (N2S)* 132% (S2N)*					
ANTELOPE - WIRLWIND 500kV 1 1	122%		122%	110%	122%	163%	
ANTELOPE - VINCENT 500kV #1, #2	115%		103%		103%	149%	
DEVERS - DVRS_RED BLUFF_11 500kV #1 or #2						120%	

Note : The simultaneous loss of the Midway - Vincent 500 kV Ckt #1 and #2 is treated as a credible common corridor N-2 event

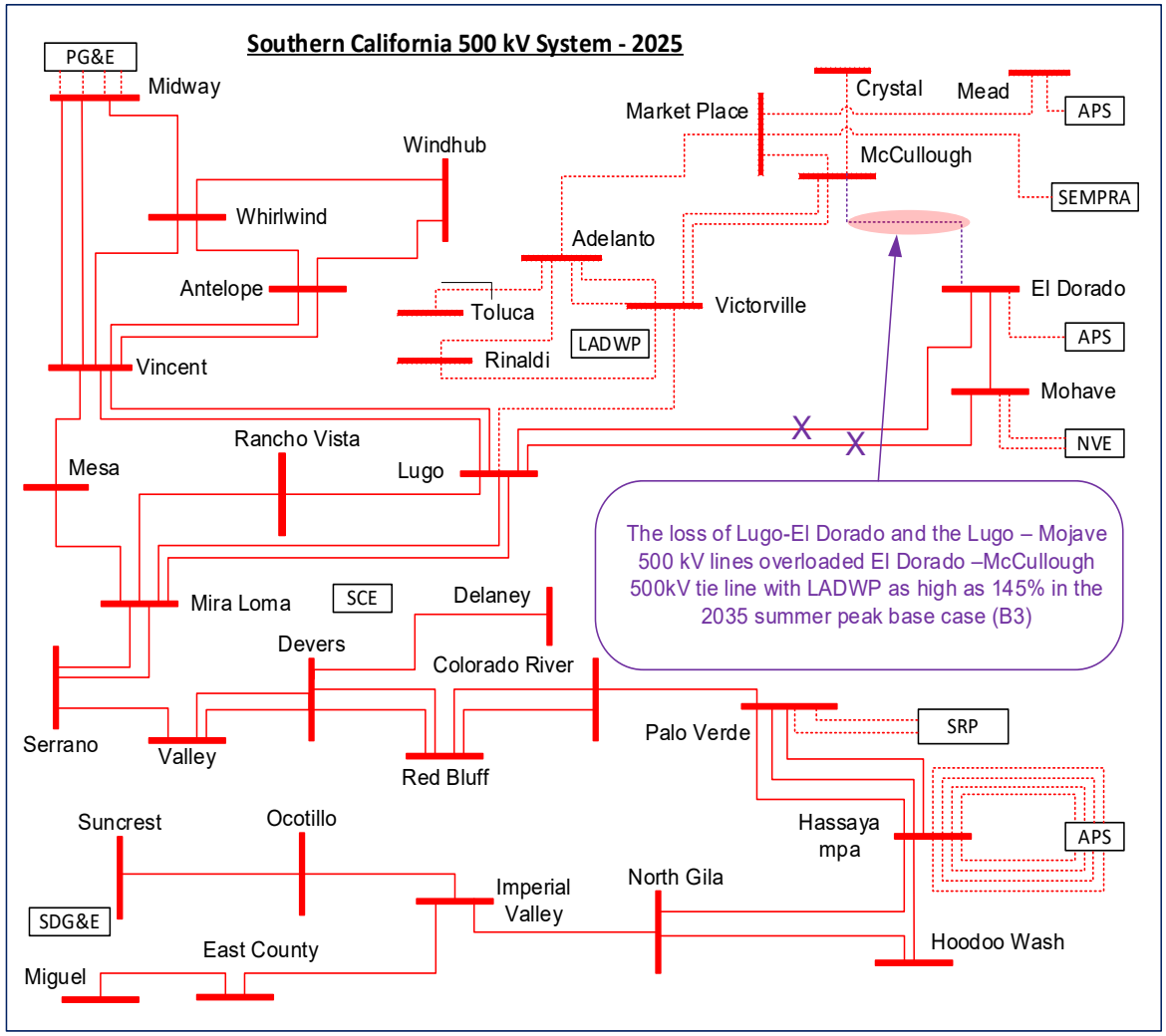
P6 Thermal Overload in El Dorado–McCullough 500 kV line

Observations

1. The El Dorado –McCullough 500kV tie line with LADWP overloaded for various P6 contingencies in the 2035 summer peak base case (B3)
2. A total of 2500 MW out-of-state wind is assumed to be imported through the Harry Allen-El Dorado intertie-line based on the CPUC base portfolio

Potential Mitigations

1. Operation mitigation actions including curtailing generation in the El Dorado area and reducing the import via Harry Allen-Eldorado and Path 46 after the 1st contingency of P6 event
2. Modify the existing Lugo – Victorville RAS to cover the P6 events



California ISO

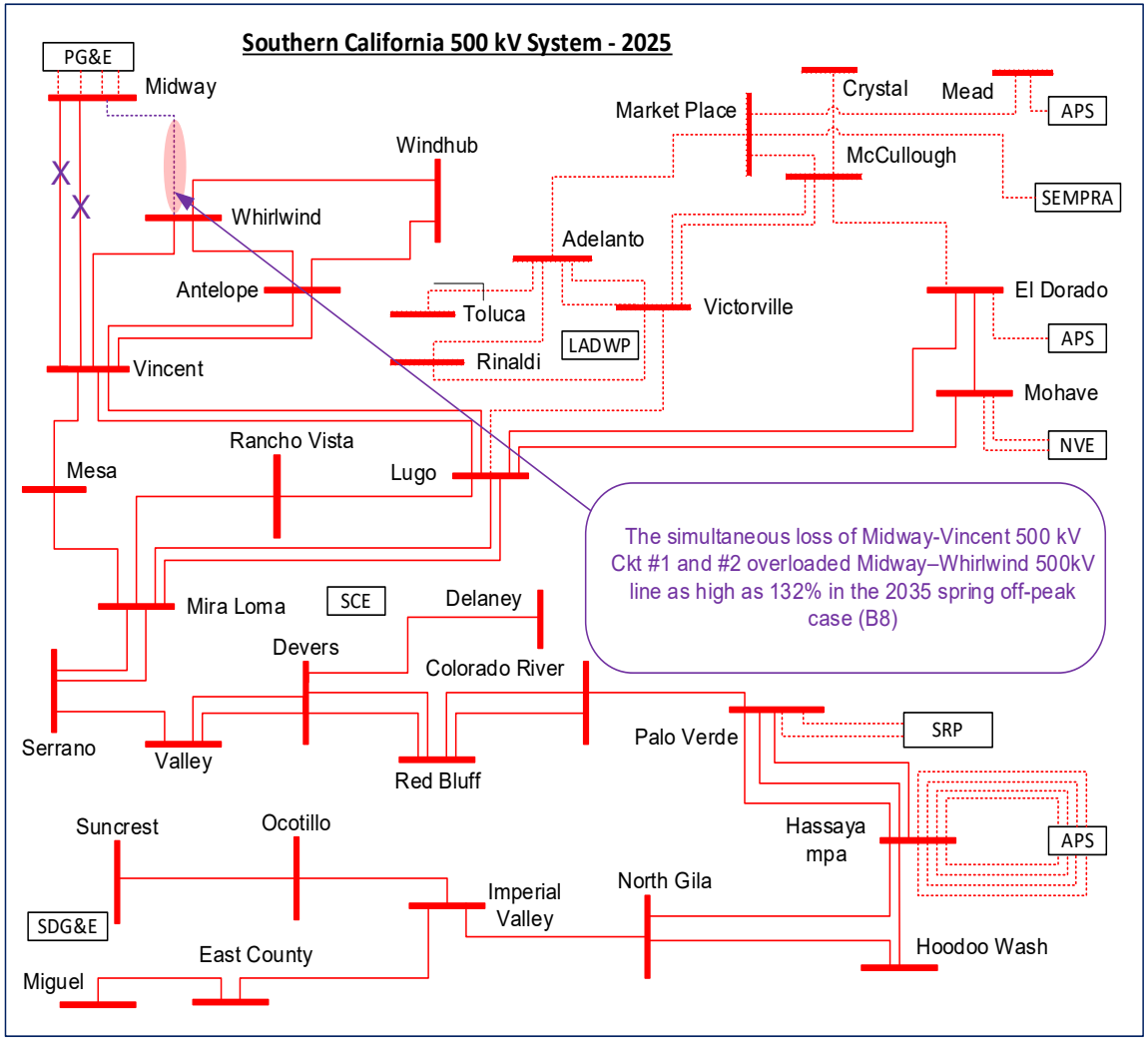
N-2 Overload in Midway-Whirlwind 500 kV Line of Path 26

Observations

1. The simultaneous loss of the Midway - Vincent 500 kV Ckt #1 and #2 is treated as a credible common corridor N-2 event
2. Midway–Whirlwind 500kV line overloaded for the N-2 event in operating condition with heavy northbound flow via Path 26 and heavy renewable output

Potential Mitigations

1. Collaboration with potential policy-driven mitigation is necessary to address the N-2 overload concern with high northbound flow and high Tehachapi area generation
2. Modify the existing Path 26 RAS to cover the operating scenario
3. Congestion management



California ISO

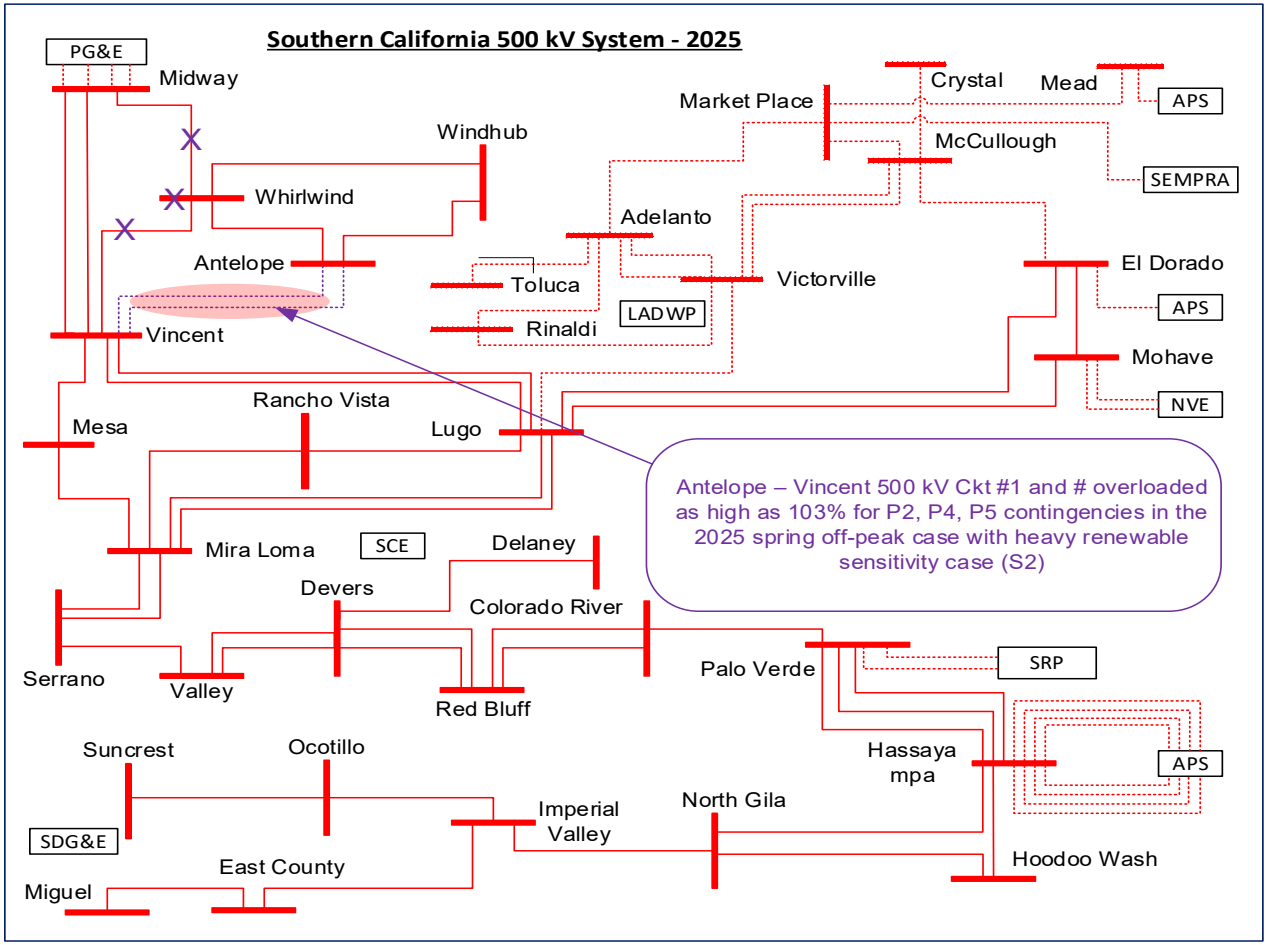
P2/P4/P5 Overloads in Antelope–Vincent 500 kV lines

Observations

1. Antelope – Vincent 500 kV Ckt #1 and #2 overloaded for P2, P4, and P5 contingencies in the S2-2025SP-HiRenew sensitivity case

Potential Mitigations

1. Eliminate the P2 and P4 contingencies by modifying Whirlwind 500 kV bus configuration
2. Eliminate the P5 contingency by monitoring or upgrading Whirlwind CB# 8012 with redundant trip coil



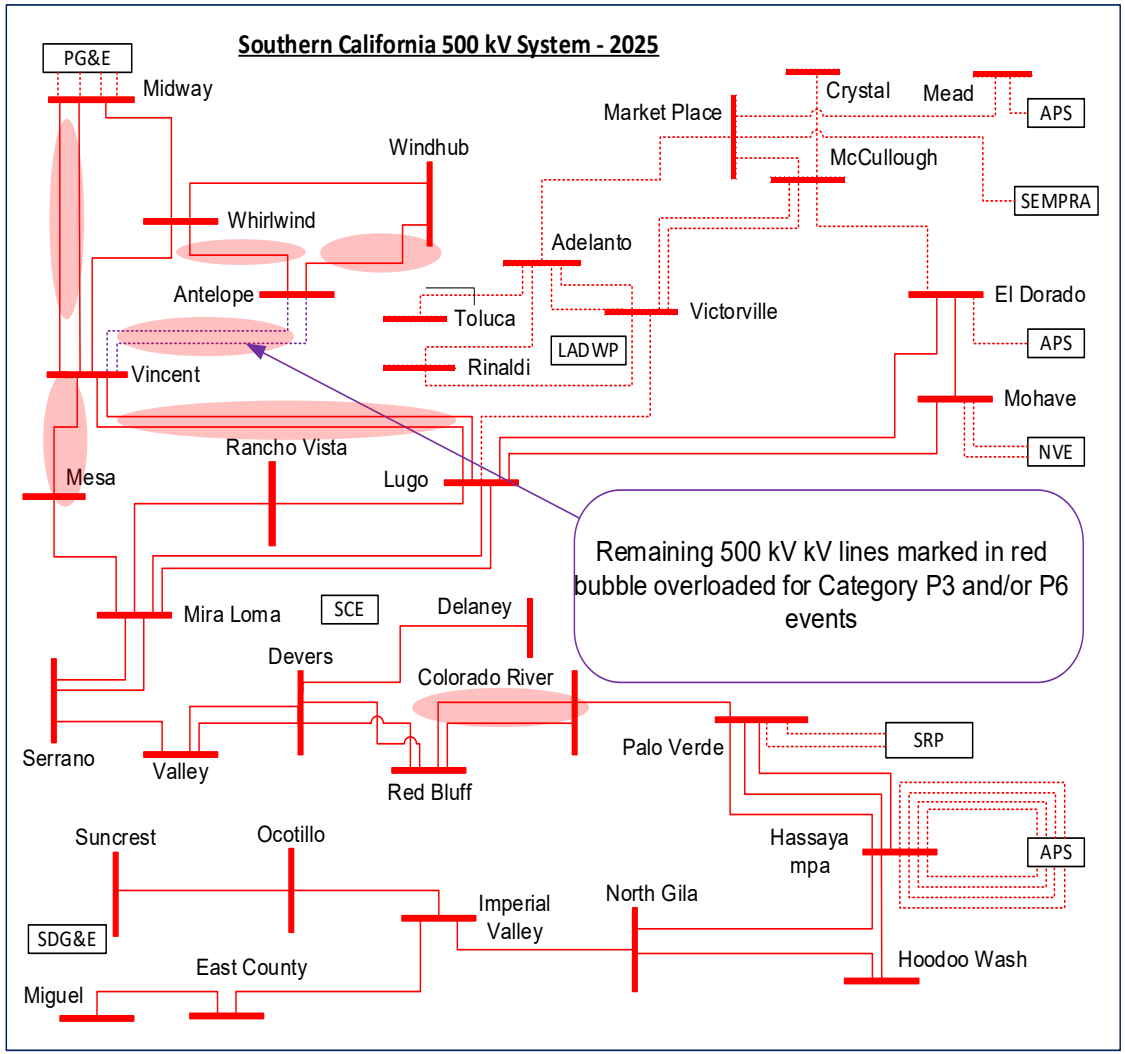
Remaining P6 Thermal Overloads

Observations

1. The following 500 kV lines overloaded for Category P6 and/or P3 events:
   - LUGO-VINCENT 500 kV 1, 2
   - VINCENT-MESA CAL 500kV 1,2
   - VINCENT- WIRLWIND 500kV 3
   - MIDWAY-VINCNT 500kV 1, 2
   - ANTELOPE-WINDHUB 500kV 1 1
   - ANTELOPE-WIRLWIND 500kV 1
   - ANTELOPE-VINCENT 500kV 1, 2
   - DEVERS-REDBLUFF 500kV 1, 2

Potential Mitigations

1. The P3 and P6 overloads could be mitigated by operational mitigations including curtailing generation, reducing import or export, and/or bypassing series cap banks after the first contingency of the P3/P6 events
2. The Antelope-Whirlwind 500 kV line overload will be mitigated by the previously approved Antelope-Whirlwind 500 kV line upgrade project



California ISO

Potential Mitigations on Southern California Bulk System

- Revise the current Path 26 Remedial Action Scheme (RAS) to address the N-2 overload concern on the Midway – Whirlwind 500 kV line during high northbound flows and high Tehachapi area generation.

- Mitigate the P2/P4/P5 Antelope – Vincent 500 kV lines overloads by modifying Whirlwind 500 kV bus configuration and monitoring or upgrading Whirlwind CB# 8012 with redundant trip coil

SCE Main System
Preliminary Reliability Assessment Results

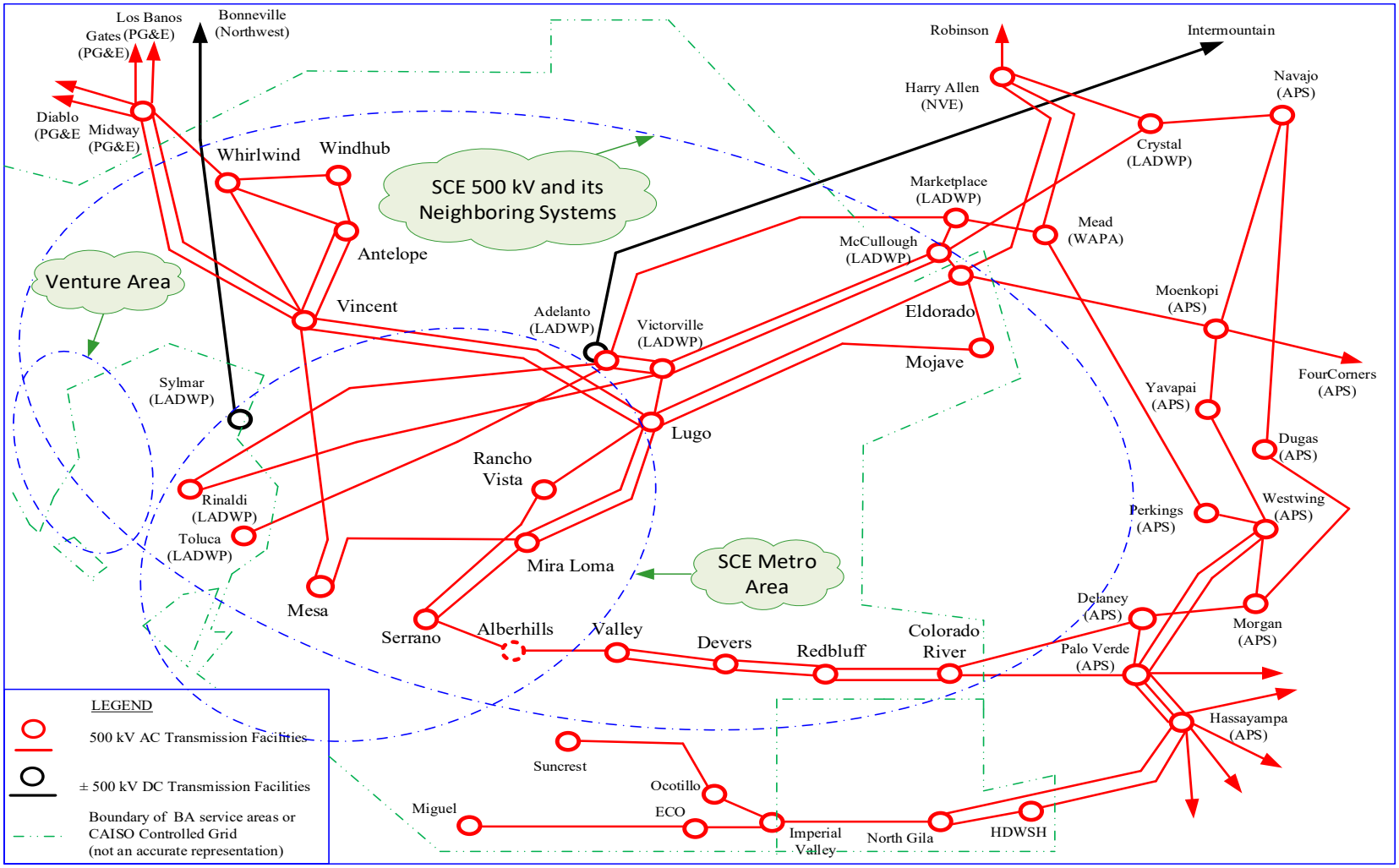
Frank Chen
Regional Transmission Engineer Lead

2023-24 Transmission Planning Process Stakeholder Meeting
September 26-27, 2023

SCE Main System

- Covers SCE's 500 kV system, Metro, East of Lugo, and Ventura areas
- Serves Los Angeles, San Bernardino, Northern Orange, Ventura, and Santa Barbara counties
- Comprised of 500 kV, 230 kV transmission facilities

SCE Main System



SCE Main System Study Scenarios

Baseline Scenarios

Study Case Name	Scenario	Description
B1-25SP	Baseline	2025 summer peak load at HE16 PST, 9/2
B2-28SP	Baseline	2028 summer peak load at HE17 PST, 9/5
B3-35SP	Baseline	2035 summer peak load at HE19 PST, 9/4
B4-28SumOP	Baseline	2028 summer Off-Peak Load Case at HE15 PST, 9/5
B5-35WP	Baseline	2035 winter Peak Load Case at HE08 PST, 2/7
B6-25OP	Baseline	2025 spring off-peak load at HE20 PST, 4/23
B7-28OP	Baseline	2028 spring off-peak load at HE12 PST, 4/2
B8-35OP	Baseline	2035 spring off-peak load at HE13 PST, 4/1

Sensitivity Scenarios

Study Case Name	Scenario	Description
S1-28SP-HLOAD	Sensitivity	2028 summer peak with high CEC load forecast
S2-25SP-HiRenew	Sensitivity	2025 summer peak with heavy renewable output
S3-25OP-BCharging	Sensitivity	2025 spring off-peak with BES charging in load pocket

Load Demand Assumptions – SCE Main

Study Case	Scenario	Gross Load (MW)	AAEE	AAFS	AATE	BTM-PV		Net Load (MW)	Including		Demand Response*	
						Installed Capacity	Impact		Pump	Loss	D1 (PDR)	D2 (fast RDRR)
B1-25SP	Baseline	28541	-302	53	169	5455	3000	25461	451	381	-436	-357
B2-28SP		28193	-520	319	453	6642	2192	26253	452	393	-436	-357
B3-35SP		27074	-746	1527	1844	9906	0	29700	497	445	-436	-357
B4-28SumOP		30638	-510	312	444	6642	4915	25969	452	617	-436	-357
B5-35WP		22126	-582	1191	1438	9906	793	23382	497	449	-436	-357
B6-25OP		17082	-200	35	112	5455	0	17030	451	325	NA	NA
B7-28OP		12878	-125	77	109	6642	6244	6695	452	122	NA	NA
B8-35OP		14206	-142	290	350	9906	7925	6780	497	819	NA	NA
S1-28SP-HLOAD	Sensitivity	28655	-520	324	461	6642	2192	26728	452	405	-436	-357
S2-25SP-HiRenew		28541	-302	53	169	5455	3000	25461	451	381	-436	-357
S3-25OP-BCharging		17082	-200	35	112	5455	0	17030	451	325	NA	NA

Note: DR are modeled offline in starting cases.

Generation Assumptions – SCE Main

Study Case	Scenario	Thermal (MW)		Hydro (MW)		Pumped Storage (MW)		Geothermal (MW)		Biomass (MW)		Solar (MW)		Wind (MW)		Energy Storage (MW)	
		Installed	Dispatch	Installed	Dispatch	Installed	Dispatch	Installed	Dispatch	Installed	Dispatch	Installed	Dispatch	Installed	Dispatch	Installed	Dispatch
B1-25SP	Baseline	11332	7041	1429	1069	230	50	368	341	134	18	15584	11690	4097	984	12413	0
B2-28SP		11332	3053	1428	1083	230	198	368	336	134	54	15581	8258	4097	1068	12881	7535
B3-35SP		11332	5058	1429	884	1429	500	1197	991	141	40	30438	0	9624	2990	18609	13258
B4-28SumOP		11332	1373	1428	273	230	0	368	195	134	54	15584	12056	4097	942	12881	6069
B5-35WP		11332	4088	1429	1027	1429	250	1197	1111	141	106	30438	8433	9624	3753	18609	0
B6-25OP		11332	5309	1429	912	230	198	368	132	134	50	15461	0	4111	2252	12413	2327
B7-28OP		11332	7364	1428	1053	230	199	368	312	134	54	15581	12635	4097	983	12881	-12694
B8-35OP		11332	118	1429	926	1429	0	1197	251	141	128	30334	26963	9624	2353	18698	-17467
S1-28SP-HLOAD	Sensitivity	11332	3053	1428	1083	230	198	368	336	134	54	15581	8258	4097	1068	12881	7191
S2-25SP-HiRenew		11332	4248	1429	1079	230	50	368	341	134	18	15584	13781	4097	2649	12413	-1496
S3-25OP-BCharging		11332	6669	1429	912	230	198	368	132	134	50	15461	0	4111	2252	12413	657

Generation Retirement – SCE Main

Already Retired			To Be Retired	Aged Unit Retirement Plan
Thermal (MW)	Hydro (MW)	Biomass (MW)	Thermal (MW)	Thermal (MW)
7567	154	260	2150	501

Previously approved transmission projects modelled in base cases

Project Name	Transmission Plan Approved	Expected ISD	First Year Modeled
Alberhill 500 kV Substation	2009	April-27	2027
Delaney-Colorado River 500 kV Line (Ten West Link Project)	2013-2014	April-24	2024
Lugo Substation Install new 500 kV CBs for AA Banks	2008	Dec-24	2028
Lugo – Victorville 500 kV Upgrade (SCE portion)	2017	Jan-25	2028
Laguna Bell - Mesa No. 1 230 kV Line Rating Increase Project	2021-2022	Dec-23	2025
Barre 230kV Switchrack Conversion to Breaker-and-a-Half	2022-2023	June, 2026	2028
Serrano 4AA 500/230 kV Transformer Bank Addition	2022-2023	Dec-27	2028
Sylmar Transformer Replace *	2022-2023	2026	2028
Antelope-Whirlwind 500 kV Line Upgrade Project	2022-2023	Jun-26	2028
Devers-Red Bluff 500 kV 1 and 2 Line Upgrade	2022-2023	May-28	2028
Colorado River-Red Bluff 500 kV 1 Line Upgrade	2022-2023	May-28	2028
Devers-Valley 500 kV 1 Line Upgrade	2022-2023	May-28	2028
Serrano-Alberhill-Valley 500 kV 1 Line Upgrade	2022-2023	May-28	2028
San Bernardino-Etiwanda 230 kV 1 Line Upgrade	2022-2023	2031	3035
Mira Loma-Mesa 500 kV Underground Third Cable	2022-2023	2026	2028
Imperial Valley–North of SONGS 500 kV Line and Substation	2022-2023	2034	2035
North of SONGS–Serrano 500 kV line	2022-2023	2034	2035
Serrano–Del Amo–Mesa 500 kV Transmission Reinforcement	2022-2023	2033	2035

* Joint SCE/LADWP project. Date indicated only includes SCE scope

Major Path flows in SCE Main System Study

Study Case	Scenario	SCE Main System Cases					
		Path 26 (MW)	Path 41 (MW)	Path 42 (MW)	Path 46 (MW)	Path 49 (MW)	Path 65 (MW)
B1-25SP	Baseline	3969	-459	683	4198	-2248	3000
B2-28SP		1048	3	658	5618	1900	3100
B3-35SP		1899	840	1265	8921	3530	3090
B4-28SumOP		1366	286	872	5549	656	3100
B5-35WP		-442	968	1323	8953	2361	1474
B6-25OP		326	542	294	4274	1948	2711
B7-28OP		-1962	-249	910	2608	-2678	-931
B8-35OP		-2991	-559	1682	3272	-3362	-918
S1-28SP-HLOAD	Sensitivity	1080	75	678	5904	2240	3100
S2-25SP-HiRenew		3979	-503	756	4398	-2114	3000
S3-25OP-BCharging		322	563	307	4525	2280	2711

Reliability Assessment Results Summary

SCE Main System

Summary of Overloaded Facilities – SCE Main

Overload Facility	Worst Loading % in Baseline Scenario			Worst Loading % in Sensitivity Scenario		
	B1, B2, B3, B4, B5, B6, B7, B8			S1, S2, S3		
	P5	P6	P7	P5	P6	P7
	Non-Redundant Relay	Overlapping singles	common structure	Non-Redundant Relay	Overlapping singles	common structure
SERRANO 500/230 kV Banks		143%			131%	
VINCENT 500/230 kV Banks		116%			121%	
Mesa 500/230 kV Banks		111%			114%	
BARRE - ELLIS 230 kV Ckt #1, #2, #3, #4		117%	117%			
BARRE - VILLA PK 230 kV 1 1		105%				
BARRE-W - ELLIS 230 kV #1 and #2		125%			103%	
ELLIS - SANTIAGO 230 kV 1 1		112%			110%	
LCIENEGA - LA FRESA 230 kV 1 1		124%	124%			
LITEHIPE - MESA CAL 230 kV 1 1		107%	107%		107%	107%
SERRANO - VILLA PK 230kV Ckt #1 and #2		113%				
CHINO - MIRALOME 230 #3		108%	108%			
DELAMO - BARRE 230 kV 1 1	107%					
CENTER - MESACALS 230 kV 1 1	112%	110%	101%	104%	105%	
S.ONOFRE - SERRANO 230 kV 1 1	103%					

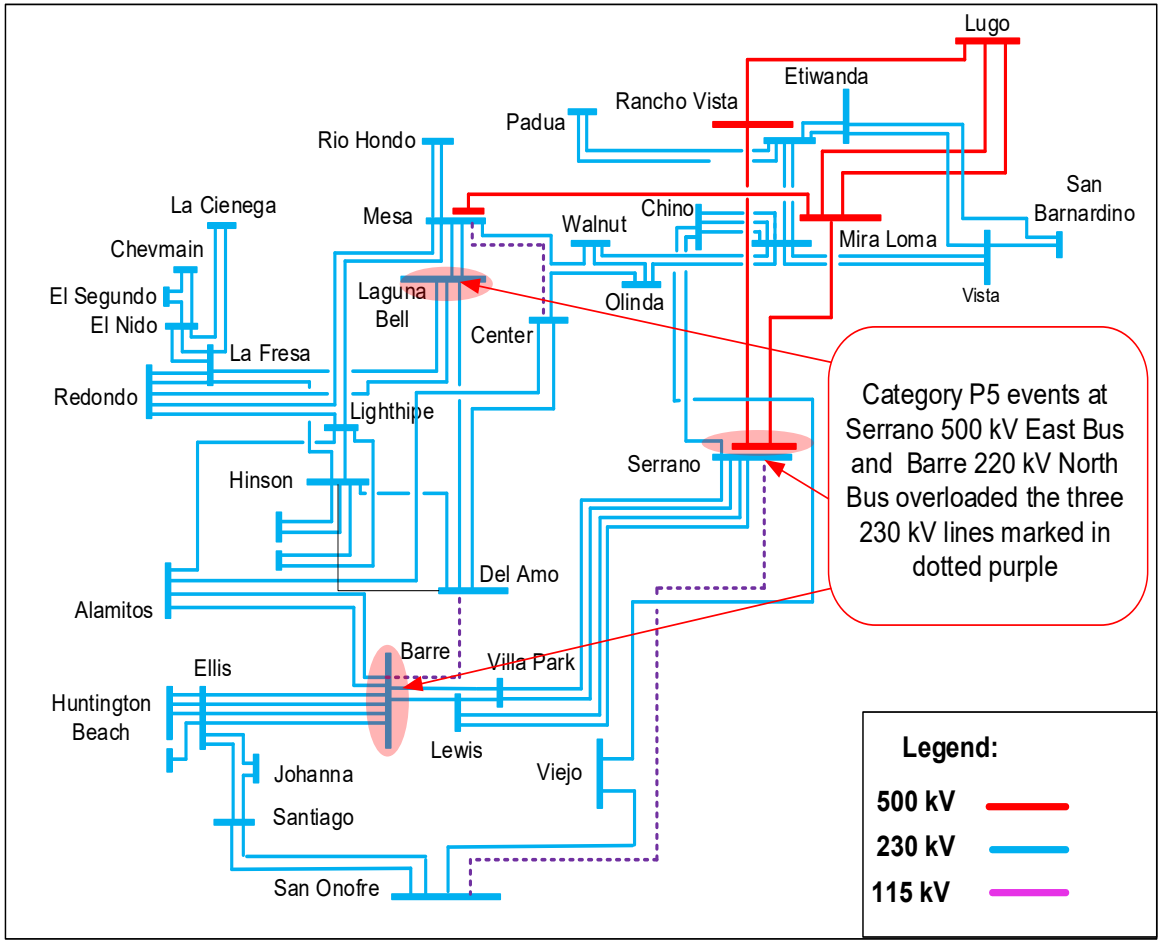
P5 Thermal Overloads

Observations

1. Del Amo–Barre, Center–Mesa, and Serrano–San Onofre 230 kV lines overloaded for the P5 contingencies in the 2025 summer peak case

Potential Mitigations

- Further investigate the non-redundant bus differential relays at Serrano 500 kV and Barre 220 kV buses, and upgrade the bus differential relays as needed



P6 and P7 Thermal Overloads

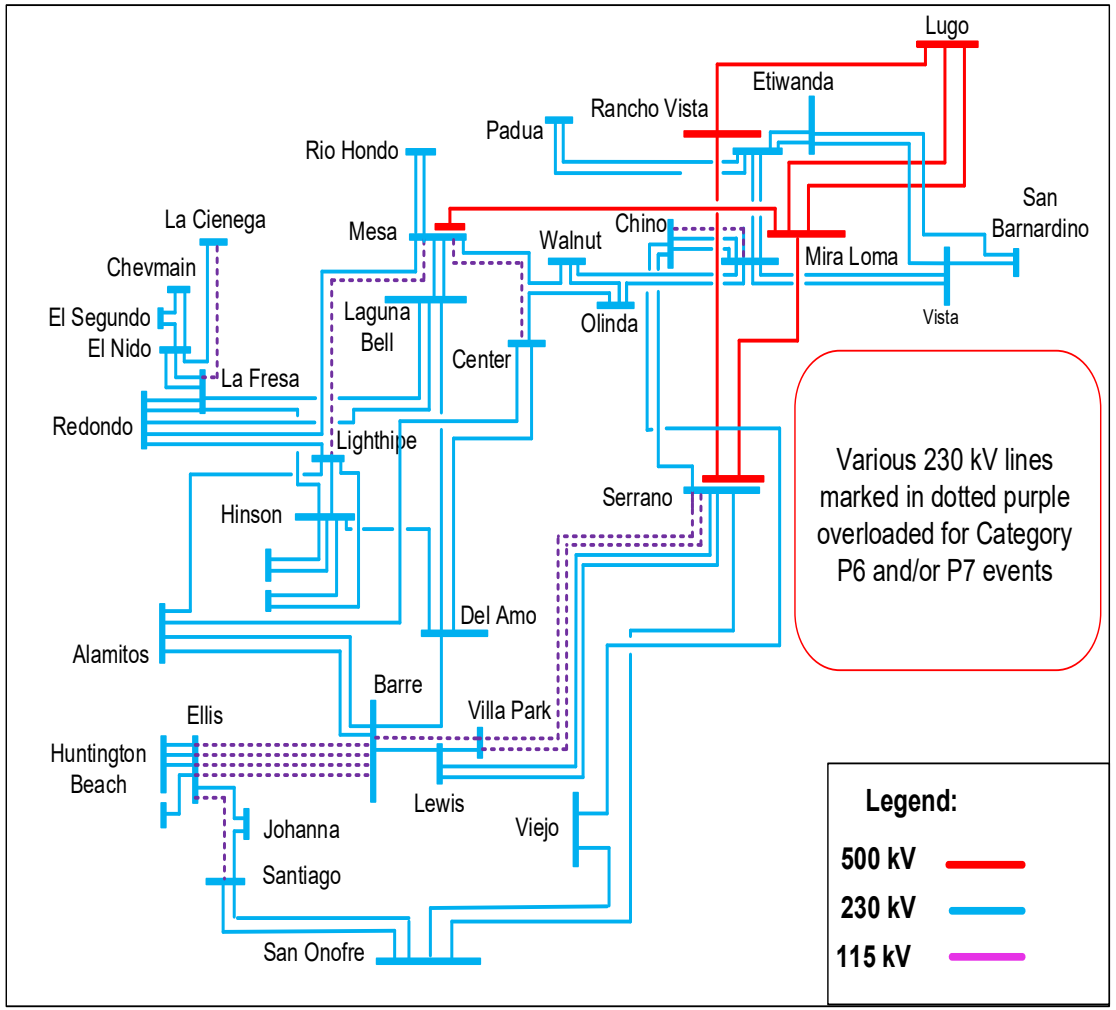
Observations

The following 500/230 kV AA banks and 230 kV lines overloaded for Category P6 and/or P7 events in the near-term summer peak case:

- Serrano AA banks
- Vincent AA banks
- Mesa AA banks
- Barre-Ellis Ckt 1, 2, 3, 4
- Barre-Villa Park Ckt 1
- Barre-W-Ellis Ckt 1, 2 (2028SP)
- Ellis-Santiago Ckt 1
- La Cienega-La Fresa Ckt 1
- Lighthipe-Mesa Ckt 1
- Serrano-Villa Park Ckt 1, 2
- Chino-Miraloma Ckt 3
- Center-Mesa Ckt 1

Potential Mitigations

- Operational mitigations eliminate the overloads in the short-term
- Previously approved projects mitigate the overloads in the long-term



California ISO Public

Recommendation on SCE Main System

- Recommend SCE protection engineer to investigate the non-redundant bus differential relays at Serrano 500 kV and Barre 220 kV buses, and upgrade the bus differential relays as needed

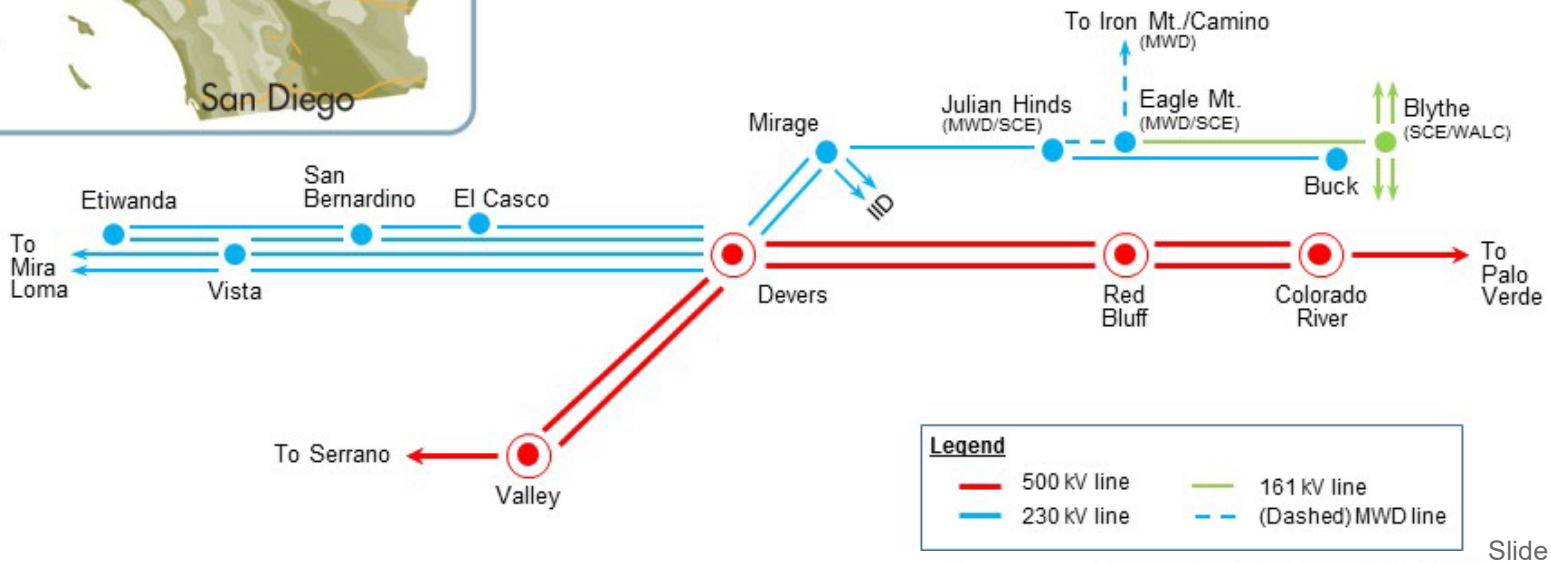
SCE Eastern Area
Preliminary Reliability Assessment Results

Nikitas Zagoras
Sr. Regional Transmission Engineer

2023-2024 Transmission Planning Process Stakeholder Meeting
September 26-27, 2023

SCE Eastern Area

- Includes the SCE owned transmission system in the Riverside County around and east of the Devers Substation
- Comprised of 500, 230 and 161 kV transmission facilities
- Summer Peak Net Load of 5,144 MW in 2025



SCE Eastern Area Study Scenarios

- Base scenarios

No.	Case	Description
B1	2025 Summer Peak	Summer peak load time (09/02 HE 16 PPT)
B2	2028 Summer Peak	Summer peak load time (09/05 HE 17 PPT)
B3	2035 Summer Peak	Summer peak load time (09/04 HE 19 PPT)
B6	2025 Spring Off-Peak	Spring off-peak time (04/23 HE 20 PPT)
B7	2028 Spring Off-Peak	Spring off-peak time (04/02 HE 12 PPT)

- Sensitivity scenarios

No.	Case	Change From Base Assumption
S1	2028 Summer Peak	High CEC forecasted load
S2	2025 Summer Peak	Heavy renewable output and minimum gas generation commitment
S3	2025 Spring Shoulder-Peak	Heavy renewable output and minimum gas generation commitment

Demand Assumptions

Scenario	Study Case	Description	Gross Load (MW)	AAEE (MW)	AAFS (MW)	ATE (MW)	BTM-PV (MW)		Net Load (MW)	Demand Response Installed (MW)		Pump Load
							Installed	Output		Fast	Slow	
Base	2025 SP	2025 Summer Peak	5990	-63	14	35	1538	846	5144	-59	-14	282
	2028 SP	2028 Summer Peak	5686	-107	73	93	1800	594	5092	-59	-14	282
	2035 SP	2035 Summer Peak	4724	-151	346	382	2478	0	4724	-59	-14	282
	2025 SprOP	2025 Spring Off-Peak	3209	-42	9	23	1538	0	3209	-59	-14	0
	2028 SprOP	2028 Spring Off-Peak	2846	-26	18	22	1800	1692	1155	-59	-14	0
Sensitivity	2028 SP	2028 Summer Peak with forecasted load addition	5777	-107	74	95	1800	594	5183	-59	-14	282
	2025 SP	2025 Summer Peak with heavy renewable output and min. gas generation	5990	-63	14	35	1538	846	5144	-59	-14	282
	2025 SprP	2025 Spring Shoulder-Peak with heavy renewable output	3209	-42	9	23	1538	0	3209	-59	-14	0

Supply Assumptions

Scenario	Study Case	Description	Energy Storage*		Solar		Wind		Hydro		Thermal	
			Installed	Dispatch	Installed	Dispatch	Installed	Dispatch	Installed	Dispatch	Installed	Dispatch
Base	2025 SP	2025 Summer Peak	4332	30	5105	3880	731	175	465	208	3859	2693
	2028 SP	2028 Summer Peak	4800	1636	5105	2706	731	190	465	217	3859	15
	2035 SP	2035 Summer Peak	5693	4132	8179	0	731	321	465	82	3859	1407
	2025 SprOP	2025 Spring Off-Peak	4332	1428	5105	0	731	402	465	121	3859	2449
	2028 SprOP	2028 Spring Off-Peak	4800	-4700	5105	4161	731	175	465	192	3859	2059
Sensitivity	2028 SP	2028 Summer Peak with forecasted load addition	4800	1636	5105	2706	731	190	465	217	3859	15
	2025 SP	2025 Summer Peak with heavy renewable output and min. gas generation	4332	-484	5105	5055	731	490	465	208	3859	1885
	2025 SprP	2025 Spring shoulder-peak with heavy renewable output	4332	1185	5105	0	731	402	465	121	3859	1959

*Battery storage and Pumped Hydro

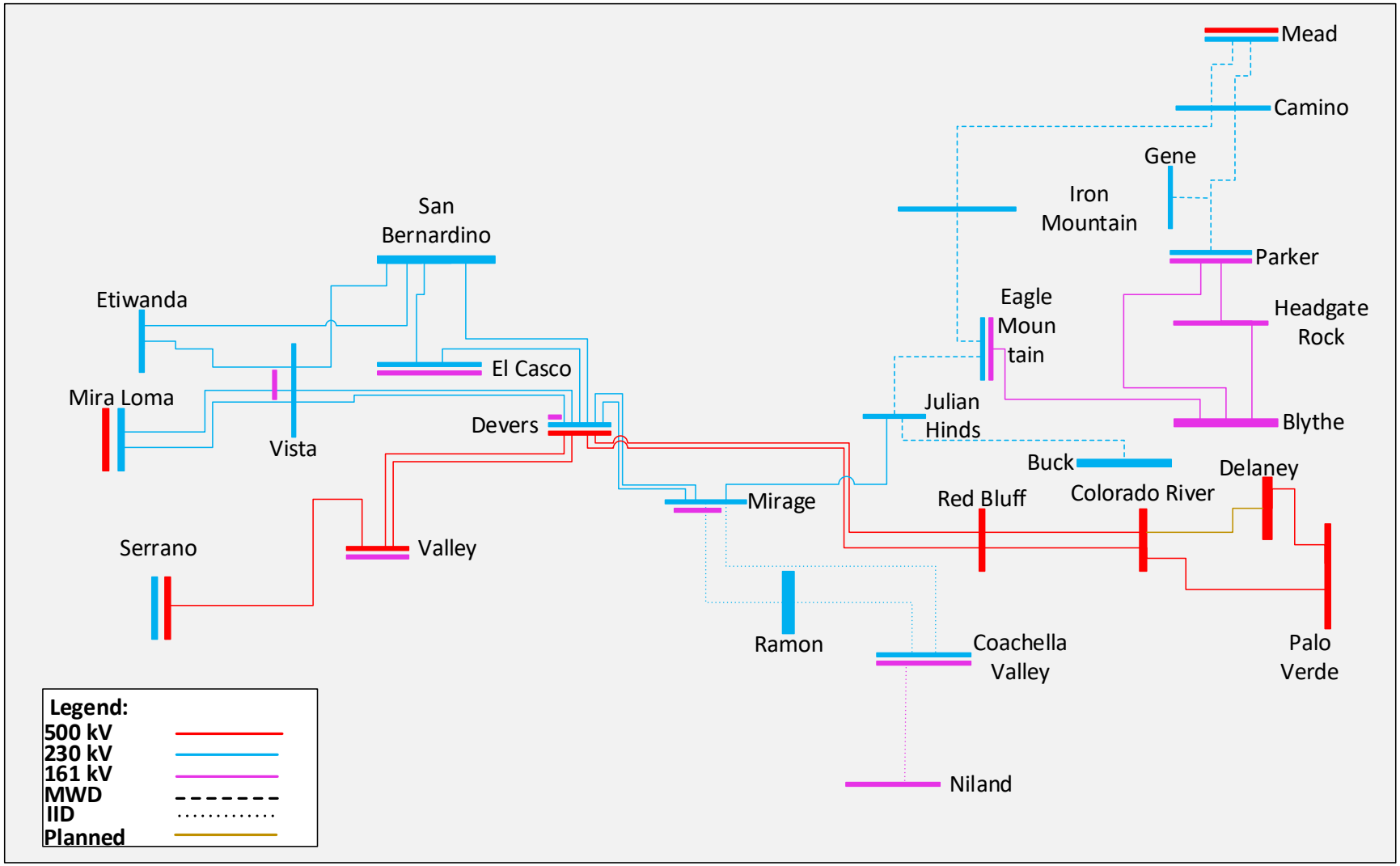
Previously approved transmission projects modelled in base cases

Project Name	ISD	First Year Modeled
Devers - Red Bluff 500 kV 1 and 2 Line Rating Upgrade	12/2028	2028
Colorado River - Red Bluff 500 kV 1 Line Rating Upgrade	12/2028	2028
Devers - Valley 500 kV 1 Line Rating Upgrade	12/2028	2028
Serrano - Alberhill - Valley 500 kV 1 Line Rating Upgrade	12/2028	2028
San Bernardino - Etiwanda 230 kV 1 Line Rating Upgrade	12/2031	2035
San Bernardino - Vista 230 kV 1 Line Rating Upgrade	12/2026	2028
Vista - Etiwanda 230 kV 1 Line Rating Upgrade	12/2031	2035

Neighboring system transmission projects modelled in base cases

Project Name	ISD	First Year Modeled
Mirage-Ramon #2 230 kV line	01/2025	2025

Reliability assessment preliminary results summary



Base Scenario Results – Thermal Loading

Overloaded Facility	Contingency (All and Worst P6)	Cat.	Loading % (Baseline Scenarios)					Potential Mitigation Solution
			2025 Summer Peak	2028 Summer Peak	2035 Summer Peak	2025 Spring Off-Peak	2028 Spring Off-Peak	
J.HINDS - MIRAGE 230 kV #1	CAMINO - GENE - IRON MTN - MEAD 230 KV (4 terminal line)	P1	<100	Diverge	<100	<100	114	Blythe RAS*
	JHINDMWD - EAGLEMTN 230 kV	P1	141	<100	138	<100	<100	
	EAGLE MTN - IRON MTN 230 kV #1	P1	<100	<100	<100	<100	115	
	Various P4 contingencies i.e. Loss of multiple elements caused by a stuck CB along with long lead time equipment loss, in the MWD-SCE area	P4	135	<100	136	140	<100	
	DEVERS – RED BLUFF #1 500 kV DEVERS - RED BLUFF #2 5000 kV	P6	108	<100	108	<100	119	
	DEVERS - MIRAGE #1 230 kV DEVERS - MIRAGE #2 230 kV	P7	<100	<100	<100	<100	115	Path 42 RAS*, Blythe RAS*

*Existing RAS

Base Scenario Results – Thermal Loading

Overloaded Facility	Contingency (All and Worst P6)	Cat.	Loading % (Baseline Scenarios)					Potential Mitigation Solution
			2025 Summer Peak	2028 Summer Peak	2035 Summer Peak	2025 Spring Off-Peak	2028 Spring Off-Peak	
J.HINDS MWD - EAGLE MTN 230 kV #1	J.HINDS - MIRAGE 230 kV BLYTHESC – EAGLE MTN 161kV	P6	160	<100	152	Diverge	<100	Blythe RAS (arming point update needed, from 900A to 730A)
	DEVERS - MIRAGE 230 kV #1 DEVERS - MIRAGE 230 kV #2	P7	142	<100	<100	112	141.0	
	J.HINDS - MIRAGE 230 kV	P1	149	<100	144	185	<100	
The above contingencies overload also the J.HINDS MWD - J.HINDS 230kV, EAGLE MTN - IRON MTN 230 kV #1 and IRON MTN - CAMINO 230kV lines but with less severe effect. The above proposed mitigations are applicable for those lines too.								
RAMON - MIRAGE # 1 230 kV	RAMON - MIRAGE 230kV CV - MIRAGE 230kV	P6	<100	<100	117.2	<100	112.3	Planned Path 42 RAS

Sensitivity Scenario Results – Thermal Loading

Overloaded Facility	Contingency (All and Worst P6)	Cat.	Loading % (Sensitivity Scenarios)			Potential Mitigation Solution
			2026 SP with Forecasted Load Addition	2023 SP Heavy Renewable & Min Gas Gen	2023 OP Heavy Renewable & Min Gas Gen	
RED BLUFF 500/230/13.8 kV #1	RED BLUFF 500/230/13.8 kV #2	P1	<100	166	<100	WOCR CRAS*
RED BLUFF 500/230/13.8 kV #2	RED BLUFF 500/230/13.8 kV #1	P1	<100	166	<100	
COL. RIVER 500/230/13.8 kV #1	COLRIVER 500/230/13.8 kV #2	P1	<100	133	<100	
COL. RIVER 500/230/13.8 kV #2	COLRIVER 500/230/13.8 kV #1	P1	<100	133	<100	

*Existing RAS

Stability Results

Contingency	Cat.	Baseline Scenarios & Sensitivity Scenarios	Potential Mitigation Solution
Eagle Mtn. 230 kV Bus, non-Redundant DC Supply fail	P5.3.13c	WECC criteria not met	Add redundant DC supply
Julian Hinds 230 kV Bus, non-Redundant DC Supply fail	P5.3.13c	WECC criteria not met	Add redundant DC supply
Blythe SCE 161 kV Bus, non-Redundant DC Supply fail	P5.3.13c	WECC criteria not met	Add redundant DC supply
Mirage 230 kV Bus, non-Redundant DC Supply fail	P5.3.13c	WECC criteria not met	Add redundant DC supply
Devers 500 kV Bus, non-Redundant DC Supply fail	P5.3.13c	WECC criteria not met	Add redundant DC supply
El Casco 230 kV Bus, non-Redundant DC Supply fail	P5.3.13c	WECC criteria not met	Add redundant DC supply
San Bernardino 230 kV Bus, non-Redundant DC Supply fail	P5.3.13c	WECC criteria not met	Add redundant DC supply
Vista 230 kV Bus, non-Redundant DC Supply fail	P5.3.13c	WECC criteria not met	Add redundant DC supply
Etiwanda 230 kV Bus, non-Redundant DC Supply fail	P5.3.13c	WECC criteria not met	Add redundant DC supply
Valley 500 kV Bus, non-Redundant DC Supply fail	P5.3.13c	WECC criteria not met	Add redundant DC supply

Stability Results

Contingency	Cat.	Baseline		Sensitivity	Potential Mitigation Solution
		2028 SP	2035 SP	2028 SP High CEC	
Julian Hinds-Mirage & Eagle Mtn.-Iron Mtn. 230 kV	P6.1	Diverge	Diverge	Diverge	ISO7720 (OP) with system adjustments after the first contingency
Julian Hinds-Mirage & Eagle Mtn.-Iron Mtn. 230 kV & ISO7720 (OP)	P6.1	Diverge	No Issues	Diverge	ISO7720 (OP) with system adjustments after the first contingency
Mirage-Ramon & Coachella Valley-Mirage 230 kV	P6.1	No Issues	Diverge	No Issues	Planned Path 42 RAS, Blythe RAS
Coachella Valley-Ramon & Coachella Valley-Mirage 230 kV	P7.1	Undamped Oscillations	Undamped Oscillations	Undamped Oscillations	Planned Path 42 RAS
Coachella Valley-Ramon & Coachella Valley-Mirage 230 kV with RAS	P7.1	Undamped Oscillations	Undamped Oscillations	Undamped Oscillations	Planned Path 42 RAS

Summary of Potential New Upgrades

Concern	Potential Upgrade
Existing Blythe RAS will not detect an overload at J.HINDS MWD - EAGLE MTN 230 kV #1	Blythe RAS (arming point update needed, from 900A to 730A)*
Multiple, non-redundant DC supply failure contingencies (P5.3.13c), caused WECC stability criteria violations, for all the cases studied. The DC supply failures, studied, were located at: ➢ Eagle Mtn. 230 kV Bus ➢ Julian Hinds 230 kV Bus ➢ Blythe SCE 161 kV Bus ➢ Mirage 230 kV Bus ➢ Devers 500 kV Bus ➢ El Casco 230 kV Bus ➢ San Bernardino 230 kV Bus ➢ Vista 230 kV Bus ➢ Etiwanda 230 kV Bus ➢ Valley 500 kV Bus	Add a redundant DC supply

Big Creek Corridor
Preliminary Reliability Assessment Results

Anuj Hiray
Regional Transmission - South

2023-24 Transmission Planning Process Stakeholder Meeting
September 26-27, 2023

SCE Big Creek Corridor

- Serves the SCE area extending north from the Metro area.
- Comprised of 500 kV, 230 kV and 66 kV transmission facilities
- 1-in-10 summer peak net load of 2,221 MW in 2035
- The forecast load includes the impact of 1053 MW of BTM PV and 63 MW of AAEE
- Approximately 12,000 MW of existing and committed resources comprised of solar, wind, gas-fired, hydro and storage battery

Load and Load Modifier Assumptions – Big Creek Corridor

Scenario	Study Case	Description	Gross Load (MW)	AAEE (MW)	AAFS (MW)	ATE (MW)	BTM-PV (MW)		Net Load (MW)	Demand Response Installed (MW)	
							Installed	Output		Fast	Slow
Base	2025SP	Summer Peak for 2025	2842	-21	5	14	617	340	2285	-68	-11
	2028SP	Summer Peak for 2028	2788	-37	24	37	742	245	2227	-68	-11
	2035SP	Summer Peak for 2035	2803	-63	126	147	1053	0	2221	-68	-11
	2028SmrOP	Summer Off-Peak for 2028	3053	-36	24	36	742	549	2491	-68	-11
	2025OP	Spring Off-Peak for 2025	1841	-14	3	9	617	0	1284	-68	-11
	2028OP	Spring Off-Peak for 2028	1744	-9	6	9	742	698	1182	-68	-11
Sensitivity	2028SP HiLoad	High CEC Load for 2028 summer peak	2835	-37	24	37	742	245	2273	-68	-11
	2025SP HiRen	High renewable output and minimum gas generation in 2025 suumer peak	2842	-21	5	14	617	611	2285	-68	-11
	2025OP BESS Charging	Battery in charging mode in 2025 spring off-peak	1844	-14	3	9	617	0	1284	-68	-11

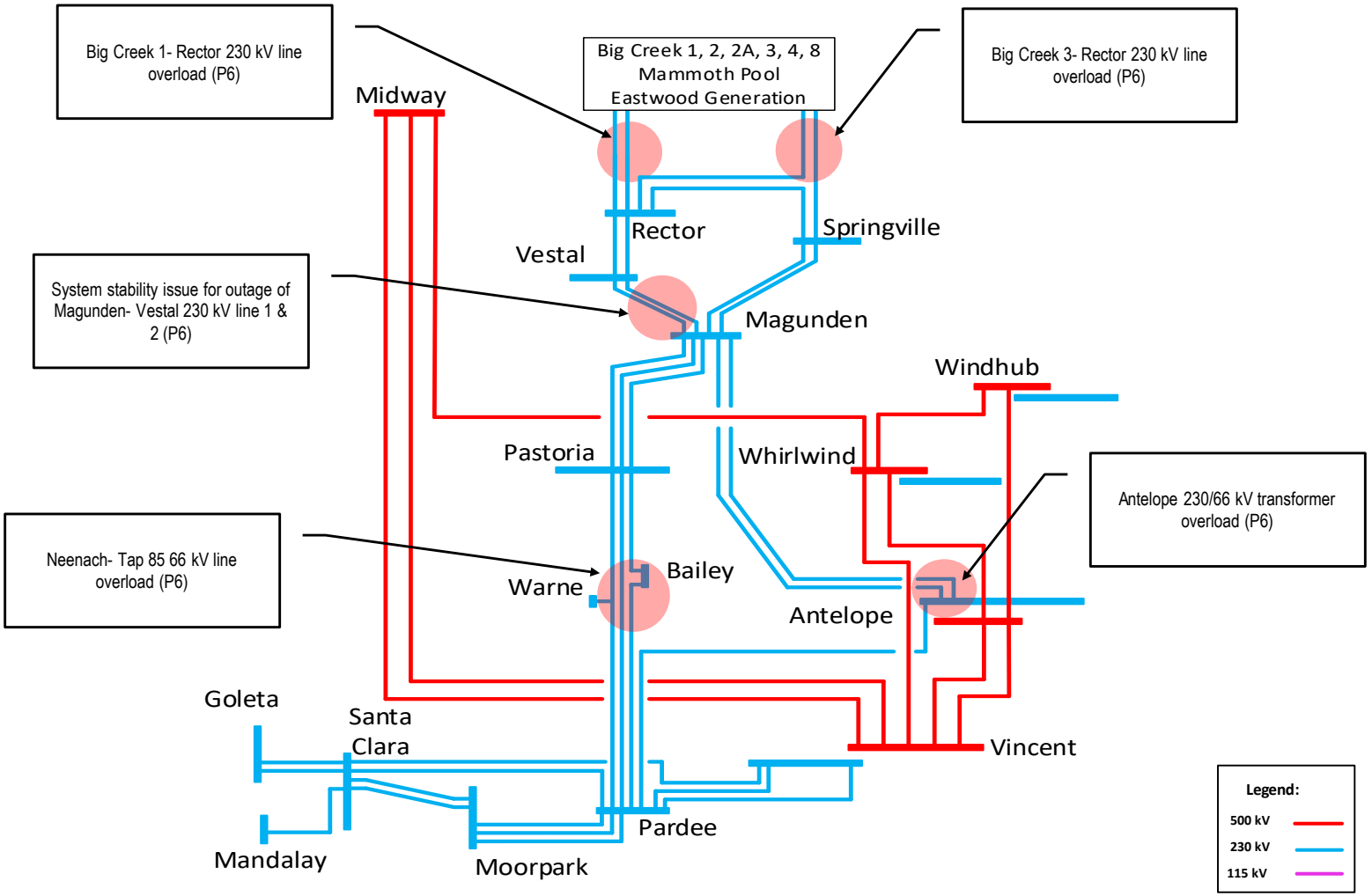
Generation Assumptions – Big Creek Corridor

Scenario	Study Case	Description	Battery		Solar		Wind		Hydro		Thermal	
			Installed	Dispatch	Installed	Dispatch	Installed	Dispatch	Installed	Dispatch	Installed	Dispatch
Base	2025SP	Summer Peak for 2025	4719	0	6526	4939	3349	804	1018	794	3445	1304
	2028SP	Summer Peak for 2028	4719	3539	6523	3449	3349	873	1018	826	3445	1781
	2035SP	Summer Peak for 2035	6322	6037	12476	0	3473	1528	1018	806	3445	303
	2028SmrOP	Summer Off-Peak for 2028	4719	2597	6526	5176	3349	770	1018	736	3445	777
	2025OP	Spring Off-Peak for 2025	4719	680	6506	0	3363	1840	1017	775	3445	1070
	2028OP	Spring Off-Peak for 2028	4719	-4536	6523	5361	3349	804	1018	795	3445	1376
Sensitivity	2028SP HiLoad	High CEC Load for 2028 summer peak	4719	3539	6523	3449	3349	873	1018	795	3445	714
	2025SP HiRen	High renewable output and minimum gas generation in 2025 suumer peak	4719	0	6526	6461	3349	2244	1018	794	3445	1304
	2025OP BESS Charging	Battery in charging mode in 2025 spring off-peak	4719	-4574	6506	0	3363	1840	1017	775	3445	1070

Previously approved transmission projects modelled in base cases

Project Name	In-service Year	First Year Modeled
Pardee-Sylmar No. 1 and No. 2 230 kV Lines Rating Increase	2024	2025

Reliability assessment preliminary results summary


Big Creek 1- Rector 230 kV line overload (P6)
Big Creek 1, 2, 2A, 3, 4, 8 Mammoth Pool Eastwood Generation
Big Creek 3- Rector 230 kV line overload (P6)
Midway
Rector
Springville
Vestal
System stability issue for outage of Magunden- Vestal 230 kV line 1 & 2 (P6)
Magunden
Windhub
Pastoria
Whirlwind
Antelope 230/66 kV transformer overload (P6)
Neenach- Tap 85 66 kV line overload (P6)
Bailey
Warne
Antelope
Goleta
Santa Clara
Vincent
Pardee
Mandalay
Moorpark
Legend:
500 kV
230 kV
115 kV

Thermal Loading – Big Creek Corridor

Overloaded Facility	Contingency (All and Worst P6)	Category	Category Description	Loading % (Baseline Scenarios)						Loading % (Sensitivity Scenarios)			Project & Potential Mitigation Solutions
				2025 Summer Peak	2028 Summer Peak	2035 Summer Peak	2028 Summer-Off Peak	2025 Spring-Off Peak	2028 Spring-Off Peak	2028 SP High CEC Forecast	2025 SP Heavy Renewable & Min Gas Gen	2025 OP Sensitivity	
24402 ANTELOPE 66.0 24401 ANTELOPE 230 1 1	tran_P6_207154_Tran ANTELOPE 66.00 to ANTELOPE 230.00 Circuit 2 0.00 Tran ANTELOPE 66.00 to ANTELOPE	P6	N-1-1	106.0	125.3	195.1	< 100	106.7	< 100	129.1	< 100	107.6	Energizing existing hot spare transformer after initial contingency
24402 ANTELOPE 66.0 24401 ANTELOPE 230 1 1	tran_P6_207128_Tran ANTELOPE 66.00 to ANTELOPE 230.00 Circuit 1 0.00 Tran ANTELOPE 66.00 to ANTELOPE	P6	N-1-1	106.3	125.6	195.9	< 100	107.1	< 100	129.5	< 100	107.9	Energizing existing hot spare transformer after initial contingency
24301 BIG CRK1 230 24235 RECTOR 230 1 1	line_P6_201309_Line BIG CRK2 230.0 to BIG CRK3 230.0 Circuit 1 Line BIG CRK8 230.0 to BIG CRK3 230.0 Circuit 1	P6	N-1-1	< 100	124.1	< 100	< 100	124.7	124.3	124.2	< 100	125.1	Existing Big Creek/San Joaquin Valley RAS
24303 BIG CRK3 230 24235 RECTOR 230 1 1	line_P6_201073_Line BIG CRK1 230.0 to RECTOR 230.0 Circuit 1 Line RECTOR 230.0 to BIG CRK3 230.0 Circuit 2	P6	N-1-1	116.8	143.5	111.6	114.7	140.6	126.0	144.3	113.7	141.5	Existing Big Creek/San Joaquin Valley RAS
24305 BIG CRK8 230 24303 BIG CRK3 230 1 1	line_P6_201065_Line BIG CRK1 230.0 to RECTOR 230.0 Circuit 1 Line BIG CRK2 230.0 to BIG CRK3 230.0 Circuit 1	P6	N-1-1	< 100	127.8	< 100	< 100	129.3	129.2	127.8	< 100	130.2	Existing Big Creek/San Joaquin Valley RAS

Low/High Voltage – Big Creek Corridor

Overloaded Facility	Contingency (All and Worst P6)	Category	Category Description	Voltage PU (Baseline Scenarios)						Voltage PU (Sensitivity Scenarios)			Project & Potential Mitigation Solutions
				2025 Summer Peak	2028 Summer Peak	2035 Summer Peak	2028 Summer -Off Peak	2025 Spring-Off Peak	2028 Spring-Off Peak	2028 SP High CEC Forecast	2025 SP Heavy Renewable & Min Gas Gen	2025 OP Sensitivity	
ALAMO SC 66 kV	line_P6_202257_Line PARDEE 230.0 to BAILEY 230.0 Circuit 1 Line BAILEY 230.0 to PASTORIA 230.0 Circuit 1	P6	N-1-1	0.9 < V < 1.1	0.9 < V < 1.1	0.75	0.9 < V < 1.1	0.9 < V < 1.1	1.11	0.9 < V < 1.1	0.9 < V < 1.1	0.9 < V < 1.1	system adjustments after first contingency mitigates the issue
	tran_P6_207228_Tran BAILEY 66.00 to BAILEY 230.00 Circuit 2 0.00 Tran BAILEY 66.00 to BAILEY	P6	N-1-1	0.9 < V < 1.1	0.9 < V < 1.1	0.76	0.9 < V < 1.1	1.11	1.13	0.9 < V < 1.1	0.9 < V < 1.1	0.9 < V < 1.1	system adjustments after first contingency mitigates the issue
ALPINE 66 kV	line_P6_202257_Line PARDEE 230.0 to BAILEY 230.0 Circuit 1 Line BAILEY 230.0 to PASTORIA 230.0 Circuit 1	P6	N-1-1	0.9 < V < 1.1	0.9 < V < 1.1	0.76	0.9 < V < 1.1	1.10	1.13	0.9 < V < 1.1	0.9 < V < 1.1	0.9 < V < 1.1	system adjustments after first contingency mitigates the issue
	tran_P6_207228_Tran BAILEY 66.00 to BAILEY 230.00 Circuit 2 0.00 Tran BAILEY 66.00 to BAILEY	P6	N-1-1	0.9 < V < 1.1	0.9 < V < 1.1	0.76	0.9 < V < 1.1	1.13	1.15	0.9 < V < 1.1	0.9 < V < 1.1	1.11	system adjustments after first contingency mitigates the issue
BAILEY 66 kV	line_P6_202257_Line PARDEE 230.0 to BAILEY 230.0 Circuit 1 Line BAILEY 230.0 to PASTORIA 230.0 Circuit 1	P6	N-1-1	0.9 < V < 1.1	0.9 < V < 1.1	0.76	0.9 < V < 1.1	1.12	1.15	0.9 < V < 1.1	0.9 < V < 1.1	1.11	system adjustments after first contingency mitigates the issue
	tran_P6_207228_Tran BAILEY 66.00 to BAILEY 230.00 Circuit 2 0.00 Tran BAILEY 66.00 to BAILEY	P6	N-1-1	0.9 < V < 1.1	0.9 < V < 1.1	0.76	0.9 < V < 1.1	1.11	1.13	0.9 < V < 1.1	0.9 < V < 1.1	0.9 < V < 1.1	system adjustments after first contingency mitigates the issue

Transient Stability – Big Creek Corridor

Contingency (All and Worst P6)	Category	Category Description	Loading % (Baseline Scenarios)						Loading % (Sensitivity Scenarios)			Project & Potential Mitigation Solutions
			2025 Summer Peak	2028 Summer Peak	2035 Summer Peak	2028 Summer-Off Peak	2025 Spring-Off Peak	2028 Spring-Off Peak	2028 SP High CEC Forecast	2025 SP Heavy Renewable & Min Gas Gen	2025 OP Sensitivity	
Big Creek 1	P5	Non-Redundant Relay	WECC criteria not met	WECC criteria not met	No issues	WECC criteria not met	No issues	No issues	WECC criteria not met	WECC criteria not met	No issues	investigate options to address non redundant DC supply
Big Creek 2	P5	Non-Redundant Relay	WECC criteria not met	WECC criteria not met	WECC criteria not met	WECC criteria not met	WECC criteria not met	WECC criteria not met	WECC criteria not met	WECC criteria not met	WECC criteria not met	investigate options to address non redundant DC supply
Big Creek 3	P5	Non-Redundant Relay	WECC criteria not met	WECC criteria not met	WECC criteria not met	WECC criteria not met	WECC criteria not met	WECC criteria not met	WECC criteria not met	WECC criteria not met	WECC criteria not met	investigate options to address non redundant DC supply
Big Creek 4	P5	Non-Redundant Relay	No issues	No issues	No issues	WECC criteria not met	No issues	WECC criteria not met	No issues	No issues	No issues	investigate options to address non redundant DC supply
Big Creek 8	P5	Non-Redundant Relay	No issues	WECC criteria not met	WECC criteria not met	No issues	WECC criteria not met	WECC criteria not met	WECC criteria not met	No issues	WECC criteria not met	investigate options to address non redundant DC supply
Neenach 66 kV	P5	Non-Redundant Relay	No issues	No issues	No issues	WECC criteria not met	No issues	No issues	No issues	No issues	No issues	investigate options to address non redundant DC supply
Pardee 230 kV	P5	Non-Redundant Relay	No issues	No issues	WECC criteria not met	No issues	No issues	No issues	No issues	No issues	No issues	investigate options to address non redundant DC supply
Pastoria 230 kV	P5	Non-Redundant Relay	WECC criteria not met	WECC criteria not met	WECC criteria not met	WECC criteria not met	No issues	No issues	WECC criteria not met	WECC criteria not met	No issues	investigate options to address non redundant DC supply
Rector 230 kV	P5	Non-Redundant Relay	WECC criteria not met	WECC criteria not met	WECC criteria not met	WECC criteria not met	WECC criteria not met	WECC criteria not met	WECC criteria not met	WECC criteria not met	WECC criteria not met	investigate options to address non redundant DC supply
Springville 230 kV	P5	Non-Redundant Relay	No issues	WECC criteria not met	No issues	No issues	No issues	No issues	WECC criteria not met	No issues	No issues	investigate options to address non redundant DC supply
Vestal 230 kV	P5	Non-Redundant Relay	No issues	WECC criteria not met	No issues	No issues	No issues	No issues	WECC criteria not met	No issues	No issues	investigate options to address non redundant DC supply
Magunden-Vestal No. 1 & 2	P6	N-1-1	Unstable	Unstable	No issues	Unstable	No issues	No issues	Unstable	Unstable	No issues	Existing Big Creek/San Joaquin Valley RAS
Big Creek 4-Springville & Big Creek 1-Rector 230kV	P6	N-1-1	Unstable	Unstable	No issues	No issues	No issues	No issues	Unstable	Unstable	No issues	Existing Big Creek/San Joaquin Valley RAS
Big Creek 3 - Rector No.1 and Big Creek 1 - Rector 230 kV	P7	DCTL	No issues	Unstable	No issues	No issues	No issues	No issues	Unstable	No issues	No issues	Existing Big Creek/San Joaquin Valley RAS

Summary of potential new upgrades

Concern	Potential Upgrade
None identified	

SCE North of Lugo Area
Preliminary Reliability Assessment Results

Meng Zhang
Regional Transmission Engineer Lead

2023-24 Transmission Planning Process Stakeholder Meeting
September 26-27, 2023

SCE North of Lugo (NOL) Area

- Comprised of 55, 115 and 230 kV transmission facilities
- Total installed generation capacity in the area is over 3500 MW.
- The loads are mainly served from Control, Kramer and Victor substations. The area can be divided into following subareas:
  - North of Control
  - Kramer/North of Kramer/Cool Water
  - Victor

SCE NOL Area Study Scenarios

- Base scenarios

No.	Case	Description
B1	2025 Summer Peak	Summer peak load time (9/2 HE 16 PST)
B2	2028 Summer Peak	Summer peak load time (9/5 HE 17 PST)
B3	2035 Summer Peak	Summer peak load time (9/4 HE 19 PST)
B4	2028 Summer Off-Peak	Summer shoulder load time (9/5 HE 15 PST)
B5	2035 Winter Peak	Winter peak load time (2/7 HE 08 PST)
B6	2025 Spring Off-Peak	Spring minimum net load time (4/23 HE 20 PST)
B7	2028 Spring Off-Peak	Spring shoulder load time (4/2 HE 12 PST)
B8	2035 Spring Off-Peak	Spring shoulder load time (4/1 HE 13 PST)

- Sensitivity scenarios

No	Case	Change From Base Assumption
S1	2028 SP High CEC Load	2028 summer peak load condition with high CEC load forecast
S2	2025 SP High Renewable	2025 summer peak condition with heavy renewable output and minimum gas generation commitment
S3	2025 SOP BESS Charging	2025 spring off-peak condition with battery storage in charging mode

California ISO Public

Load and Load Modifier Assumptions – North of Lugo Area

Scenario	Study Case	Description	Gross Load (MW)	AAEE (MW)	AAFS (MW)	ATE (MW)	BTM-PV (MW)		Net Load (MW)	Demand Response Installed (MW)	
							Installed	Output		Fast	Slow
Base	2025SP	2025 Summer Peak	1111	-20	3	4	337	186	912	81	34
	2028SP	2028 Summer Peak	1083	-33	20	11	411	136	945	81	34
	2035SP	2035 Summer Peak	968	-51	107	43	627	0	1067	81	34
	2028SmrOP	2028 Summer Off Peak	1232	-33	20	11	411	304	926	81	34
	2035WP	2035 Winter Peak	805	-40	83	34	627	50	832	81	34
	2025OP	2025 Spring Off Peak	611	-13	2	3	337	0	602	81	34
	2028OP	2028 Spring Off Peak	614	-8	5	3	411	387	227	81	34
	2035OP	2035 Spring Off Peak	686	-10	20	8	627	502	203	81	34
Sensitivity	2028SP HiLoad	2028SP High CEC Load	1776	-33	33	17	411	136	1658	81	34
	2025SP HiRen	2025 SP Heavy Renewable Output & Min. Gas Gen	1111	-20	3	4	337	186	912	81	34
	2025OP BESS Charging	2025 OP BESS Charging	611	-13	2	3	337	0	602	81	34

Generation Assumptions – North of Lugo Area

Scenario	Study Case	Description	Battery		Solar		Wind		Hydro		Thermal	
			Installed	Dispatch	Installed	Dispatch	Installed	Dispatch	Installed	Dispatch	Installed	Dispatch
Base	2025SP	2025 Summer Peak	1412	0	2227	1429	17	4	57	53	1637	716
	2028SP	2028 Summer Peak	1412	352	2227	1180	17	4	57	43	1637	503
	2035SP	2035 Summer Peak	1741	1190	2864	0	17	8	57	43	1637	359
	2028SmrOP	2028 Summer Off Peak	1412	237	2227	1431	17	4	57	40	1637	221
	2035WP	2035 Winter Peak	1741	0	2864	888	17	7	57	53	1637	144
	2025OP	2025 Spring Off Peak	1412	190	2227	0	17	10	57	23	1637	670
	2028OP	2028 Spring Off Peak	1412	-1406	2227	1745	17	4	57	54	1637	894
	2035OP	2035 Spring Off Peak	1741	-1735	2864	2549	17	6	57	24	1637	373
Sensitivity	2028SP HiLoad	2028SP High CEC Load	1412	352	2227	1180	17	4	57	43	1637	503
	2025SP HiRen	2025 SP Heavy Renewable Output & Min. Gas Gen	1412	0	2227	1861	17	4	57	53	1637	300
	2025OP BESS Charging	2025 OP BESS Charging	1412	-503	2227	0	17	10	57	23	1637	828

Note*: A negative number indicates battery charging

Previously approved transmission projects modeled in base cases

Project Name	In-service Year	First Year Modeled
New Coolwater 230/115kV Transformer Bank	2026	2028
New Control 115kV Shunt Reactor	2026	2028
3rd Lugo 500/230kV Transformer	2028	2028
Lugo-Victor 230kV Nos. 1,2,3&4 Lines Reconductor	2028	2028
Kramer-Victor 115kV Lines 230kV Conversion	2033	2035

Reliability Assessment Preliminary Results Summary

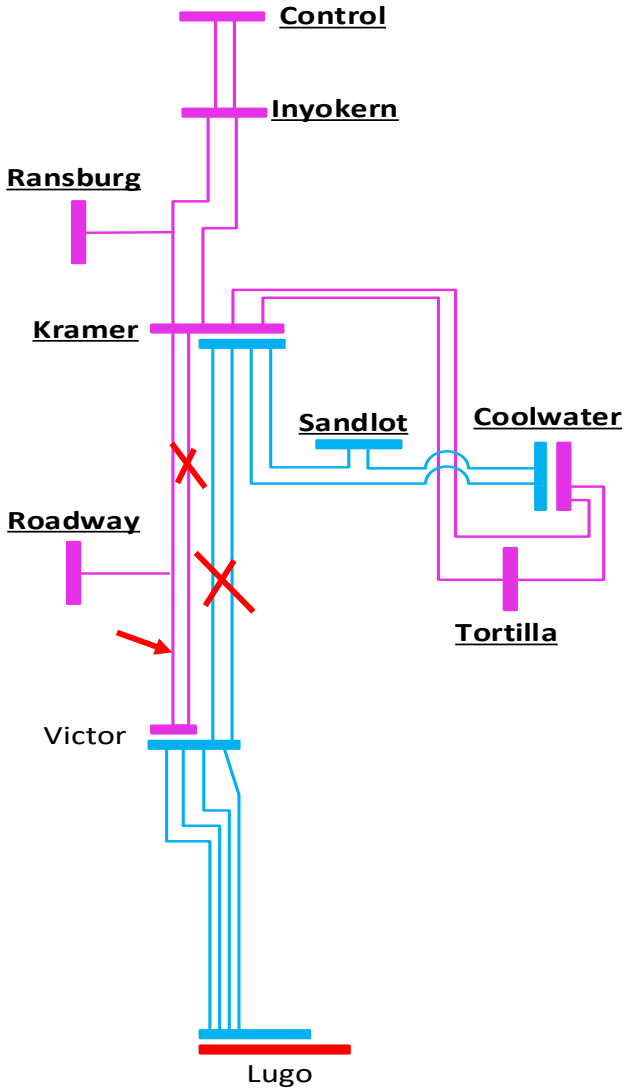
Victor – Roadway 115kV line

Observations

- Victor – Roadway 115kV line could be overloaded or diverged following Category P7 contingency of loss of Kramer-Victor 230kV Nos.1&2 lines or Category P6 contingency of Loss of Victor – Kramer 115kV and one of Kramer – Victor 230kV lines would overload Victor – Roadway 115kV line in multiple near term base and sensitivity scenarios

Potential Mitigations

- Rely on the existing Mojave Desert RAS or generation redispatch after the first contingency as short term solution
- The previously TPP approved Victor – Kramer 230kV conversion project would provide a long term solution to the issue



California ISO Public

Kramer – Coolwater 230kV line

Observations

- Category P6 contingency of loss of Sandlot – Kramer 230kV line and Coolwater 230/115kV transformer would overload Kramer – Coolwater 230kV line in 2028 spring off-peak base scenario

Potential Mitigations

- Rely on generation redispatch after the first contingency

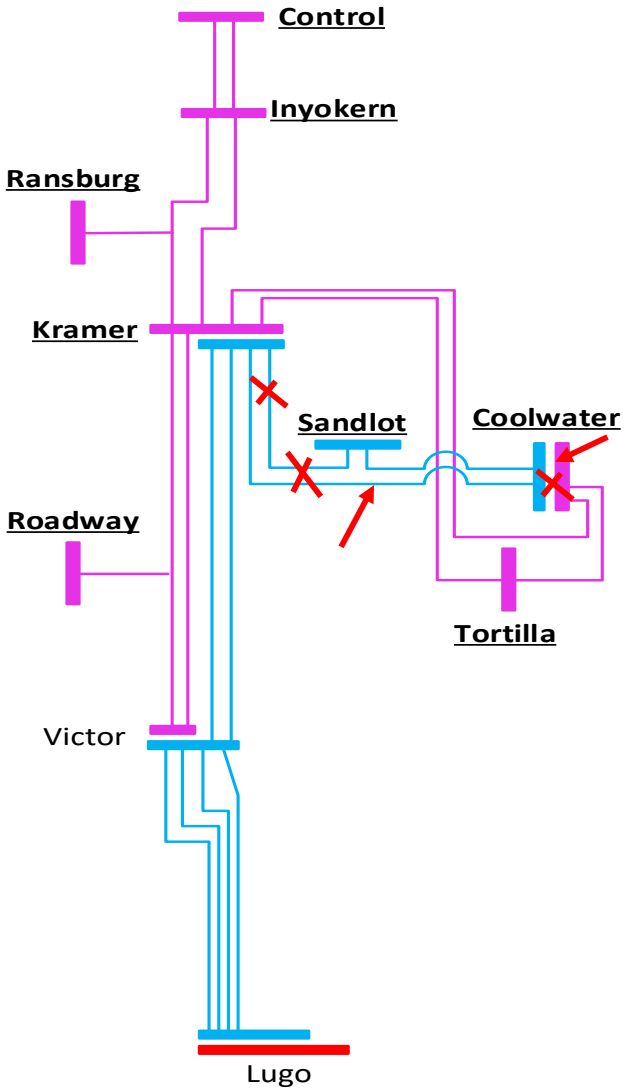
Coolwater 230/115kV transformer

Observations

- Category P7 contingency of loss of Sandlot – Kramer and Kramer – Coolwater 230kV lines would overload Coolwater 230/115kV transformer in 2028 spring off-peak base scenario

Potential Mitigations

- Add the contingency and monitored facility to planned Kramer CRAS



California ISO Public

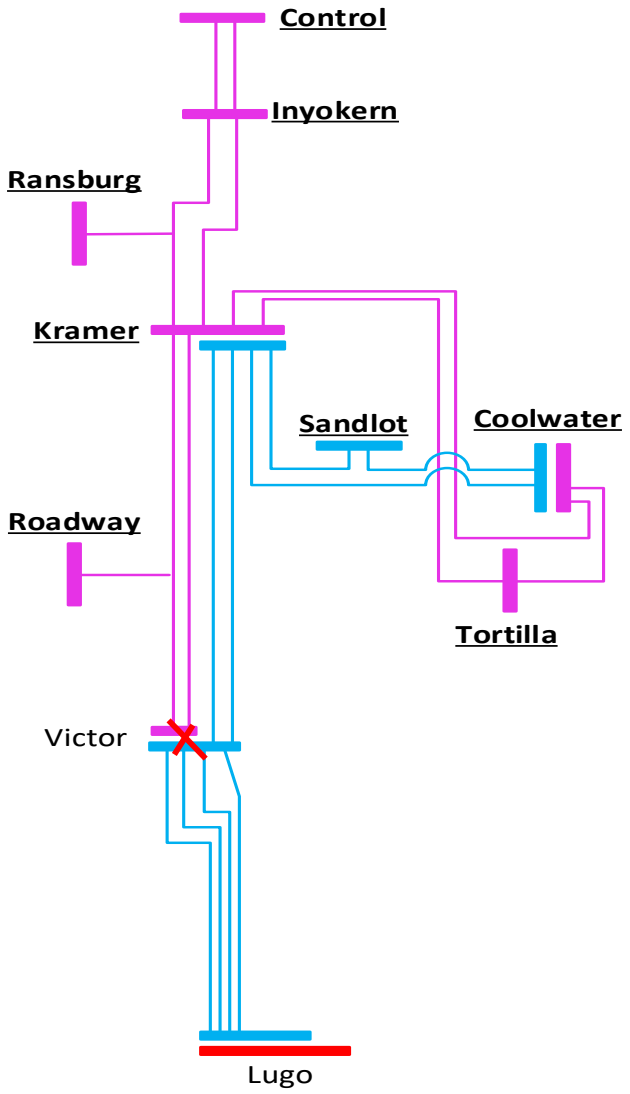
Victor 230/115kV Transformers

Observations

- Loss of two Victor 230/115kV transformers would overload the remaining Victor transformer in 2035 basecases and 2028 summer peak with high CEC forecast sensitivity scenario

Potential Mitigations

- Utilize existing 230/115kV spare transformer at Victor



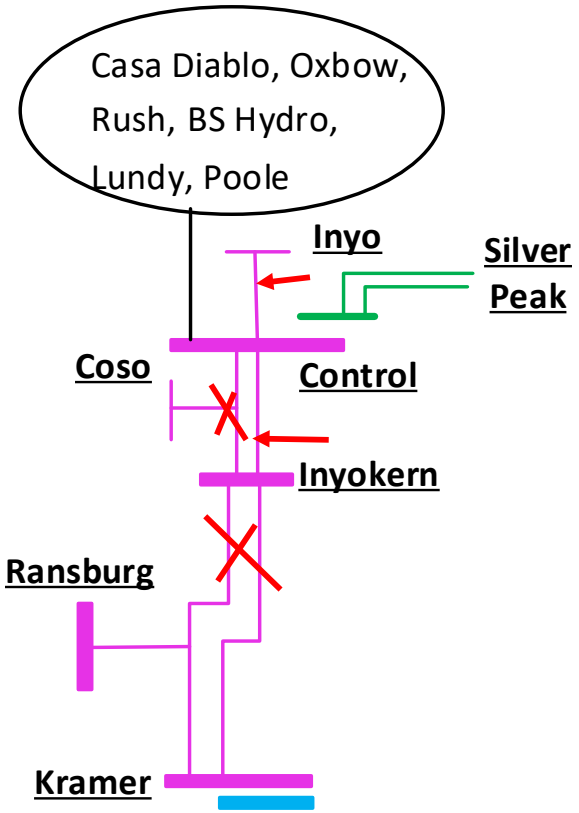
Control-Inyokern 115kV Systems

Observations

- Category P1 contingency of Control – Coso – Inyokern 115kV line and Category P2 contingency of Control 115kV east bus could overload Control – Inyokern 115kV line in various base and sensitivity scenarios
- Category P7 contingency of Control – Coso – Inyokern and Control – Inyokern 115kV lines could result in Inyo 115kV PST divergence
- Category P6 contingency of Inyokern – Kramer – Ransburg and Inyokern – Kramer 115kV lines and Category P5 contingency of Kramer 115kV east bus could overload the Control – Inyo 115kV line or result in divergence in base and sensitivity scenarios

Potential Mitigations

- Operating procedure 7690 would reduce pre-selected generation output to mitigate Category P1 and P6 contingencies overload
- Existing Bishop RAS would prevent Category P7 contingency divergence
- Install redundant bus differential relay at Kramer 115kV east bus



Low/High Voltage Issues

Substation	Contingency (All and Worst P6)	Category	Voltage PU (Baseline Scenarios)								Project & Potential Mitigation Solutions
			2025 Summer Peak	2028 Summer Peak	2035 Summer Peak	2028 Summer Off Peak	2035 Winter Peak	2025 Spring Off-Peak	2028 Spring Off-Peak	2035 Spring Off-Peak	
Randsburg, Inyokern, Downs, Searles 115kV	Inyokern-Kramer 115kV line	P1	0.9<P.U.<1.06	0.9<P.U.<1.06	0.9<P.U.<1.06	0.80	0.9<P.U.<1.06	0.9<P.U.<1.06	0.9<P.U.<1.06	0.9<P.U.<1.06	Install shunt capacitor at Inyokern
Inyo 115kV	Control 115kV E/W bus section fault	P5	1.14	1.10	1.0<P.U.<1.05	1.06	0.97	1.11	1.10	1.0<P.U.<1.05	Install shunt reactor at Inyo
Control, Inyo, 115kV	Control-Inyokern and Control-Coso-Inyokern 115kV lines	P7	0.93	0.95	1.0<P.U.<1.05	1.0<P.U.<1.05	0.87	1.0<P.U.<1.05	0.94	0.90	Bishop RAS
	Kramer 115kV East Bus	P5	0.91	0.92	1.0<P.U.<1.05	1.0<P.U.<1.05	0.89	1.0<P.U.<1.05	0.92	1.0<P.U.<1.05	Install redundant relay
Control 115kV	Inyokern-Kramer and Inyokern-Kramer-Randsburg 115kV lines	P6	0.91	0.93	0.94	1.0<P.U.<1.05	0.90	1.0<P.U.<1.05	0.93	1.0<P.U.<1.05	Operating procedure 7690
Coolwater, Baker, Dunn Siding, Tortilla, Tiefort 115kV	Kramer 115kV East Bus	P5	0.79	0.9<P.U.<1.05	0.9<P.U.<1.05	0.9<P.U.<1.05	0.9<P.U.<1.05	0.70	0.9<P.U.<1.05	0.9<P.U.<1.05	Previously approved new Coolwater 230/115kV transformer
Coolwater 115kV	Kramer-Coolwater and Coolwater-Tortilla 115kV lines	P6	0.77	0.9<P.U.<1.05	0.9<P.U.<1.05	0.9<P.U.<1.05	0.9<P.U.<1.05	0.9<P.U.<1.05	0.9<P.U.<1.05	0.9<P.U.<1.05	Previously approved new Coolwater 230/115kV transformer

Sensitivity Study Assessment

- There were no facility overloads or voltage violations identified in sensitivity scenarios only

Transient Stability Analysis

- Performed on B2, B3, B6, S1, and S3 cases
- 96 credible contingencies evaluated
  - Includes P4.2, P5, P6 and P7
- Two Category P4.2 contingencies could result in bus voltage recovery not meeting WECC criteria. Installing shunt capacitor is recommended.
- Two Category P6 and two Category P7 contingencies could result in system being unstable or diverged. Existing RAS and operating procedures could mitigate the issues. The previously approved transmission plan projects would provide a long term solution.
- Potential system divergence following non-redundant DC supply failure. Install redundant DC supply is recommended.

Summary of Potential New Upgrades

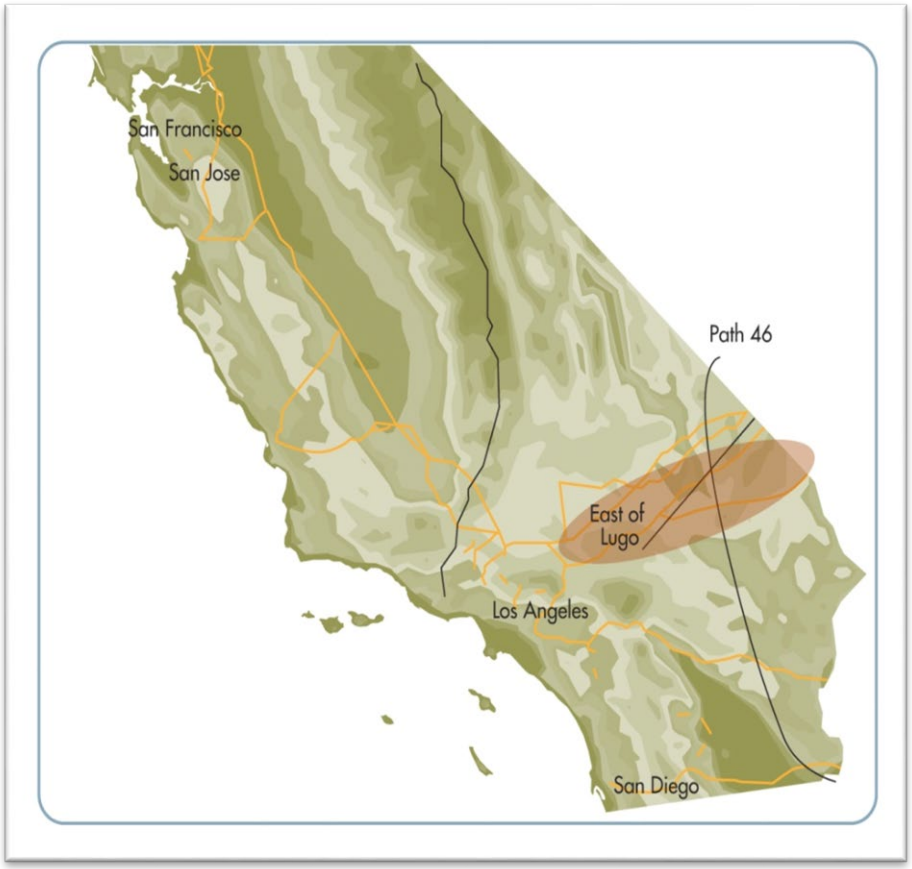
Facilities	Reliability Concern	Potential Upgrade
Randsburg, Inyokern, Downs and Searles 115kV buses	Low Voltage	• Install shunt capacitor at load bus

SCE East of Lugo Area
Preliminary Reliability Assessment Results

Meng Zhang
Regional Transmission Engineer Lead

2023-2024 Transmission Planning Process Stakeholder Meeting
September 26-27, 2023

East of Lugo (EOL) Area



- Consists of the transmission system between the Lugo and Eldorado substations.
- A major transmission corridor connecting California with Nevada and Arizona; a part of Path 46 and integrated heavily with LADWP and other neighboring transmission system.
- The existing EOL bulk system consists of:
  - 500kV lines from Lugo to Eldorado and Mohave substations
  - 230kV lines from Lugo to Pisgah to Eldorado
  - 115kV lines from Ivanpah to Cool Water
  - 500kV and 230kV tie lines with neighboring systems including the Harry Allen – Eldorado 500kV line
- The load is mostly served from CIMA 66kV substation.

SCE EOL Area Study Scenarios

- Base scenarios

No.	Case	Description
B1	2025 Summer Peak	Summer peak load time (9/2 HE 16 PST)
B2	2028 Summer Peak	Summer peak load time (9/5 HE 17 PST)
B3	2035 Summer Peak	Summer peak load time (9/4 HE 19 PST)
B4	2028 Summer Off-Peak	Summer shoulder load time (9/5 HE 15 PST)
B5	2035 Winter Peak	Winter peak load time (2/7 HE 08 PST)
B6	2025 Spring Off-Peak	Spring minimum net load time (4/23 HE 20 PST)
B7	2028 Spring Off-Peak	Spring shoulder load time (4/2 HE 12 PST)
B8	2035 Spring Off-Peak	Spring shoulder load time (4/1 HE 13 PST)

- Sensitivity scenarios

No	Case	Change From Base Assumption
S1	2028 SP High CEC Load	2028 summer peak load condition with high CEC load forecast
S2	2025 SP High Renewable	2025 summer peak condition with heavy renewable output and minimum gas generation commitment
S3	2025 SOP BESS Charging	2025 spring off-peak condition with battery storage in charging mode

Load and Load Modifier Assumptions – East of Lugo Area

Scenario	Study Case	Description	Gross Load (MW)	AAEE (MW)	AAFS (MW)	ATE (MW)	BTM-PV (MW)		Net Load (MW)	Demand Response Installed (MW)	
							Installed	Output		Fast	Slow
Base	2025SP	2025 Summer Peak	2.38	-0.02	0.04	0.08	3.62	1.7	0.78	0	0
	2028SP	2028 Summer Peak	1.64	-0.04	0.09	0.22	4.62	1.2	0.68	0	0
	2035SP	2035 Summer Peak	-0.3	-0.04	0.17	0.93	7.76	0	0.76	0	0
	2028SmrOP	2028 Summer Off Peak	3.16	-0.04	0.08	0.22	4.62	2.76	0.66	0	0
	2035WP	2035 Winter Peak	0.22	-0.03	0.13	0.73	7.67	0.46	0.59	0	0
	2025OP	2025 Spring Off Peak	0.45	-0.01	0.03	0.05	3.62	0	0.52	0	0
	2028OP	2028 Spring Off Peak	3.6	-0.01	0.02	0.05	4.62	3.5	0.16	0	0
	2035OP	2035 Spring Off Peak	4.54	-0.01	0.03	0.18	7.76	4.6	0.14	0	0
Sensitivity	2028SP HiLoad	2028SP High CEC Load	1.67	-0.04	0.09	0.23	4.62	1.23	0.72	0	0
	2025SP HiRen	2025 SP Heavy Renewable Output & Min. Gas Gen	2.38	-0.02	0.04	0.08	3.62	1.7	0.78	0	0
	2025OP BESS Charging	2025 OP BESS Charging	0.45	-0.01	0.03	0.05	3.62	0	0.52	0	0

Generation Assumptions – East of Lugo Area

Scenario	Study Case	Description	Battery		Solar		Wind		Hydro		Thermal	
			Installed	Dispatch	Installed	Dispatch	Installed	Dispatch	Installed	Dispatch	Installed	Dispatch
Base	2025SP	2025 Summer Peak	312	0	1204	915	0	0	0	0	832	688
	2028SP	2028 Summer Peak	312	134	1204	638	0	0	0	0	832	507
	2035SP	2035 Summer Peak	1566	1566	3234	0	5000	975	0	0	1161	329
	2028SmrOP	2028 Summer Off Peak	312	134	1204	963	0	0	0	0	832	507
	2035WP	2035 Winter Peak	1566	0	3234	1002	5000	975	0	0	1161	748
	2025OP	2025 Spring Off Peak	312	0	1204	0	0	0	0	0	832	603
	2028OP	2028 Spring Off Peak	312	-312	1204	1011	0	0	0	0	832	702
	2035OP	2035 Spring Off Peak	1566	-1566	3234	2878	5000	825	0	0	1161	26
Sensitivity	2028SP HiLoad	2028SP High CEC Load	312	134	1204	638	0	0	0	0	832	507
	2025SP HiRen	2025 SP Heavy Renewable Output & Min. Gas Gen	312	0	1204	1191	0	0	0	0	832	688
	2025OP BESS Charging	2025 OP BESS Charging	312	-279	1204	0	0	0	0	0	832	603

[1] Include 2,500 MW out-of-state wind in 2035 cases
[2] Include 329 MW geothermal in 2035 cases

Previously approved transmission projects modeled in base cases

Project Name	First Year Modeled
Eldorado – Lugo Series Capacitor Upgrade	2025
Lugo – Mohave Series Capacitor Upgrade	2025
Calcite 230kV Substation	2025
Lugo – Victorville 500kV Line Upgrade	2028

Reliability Assessment Preliminary Results Summary

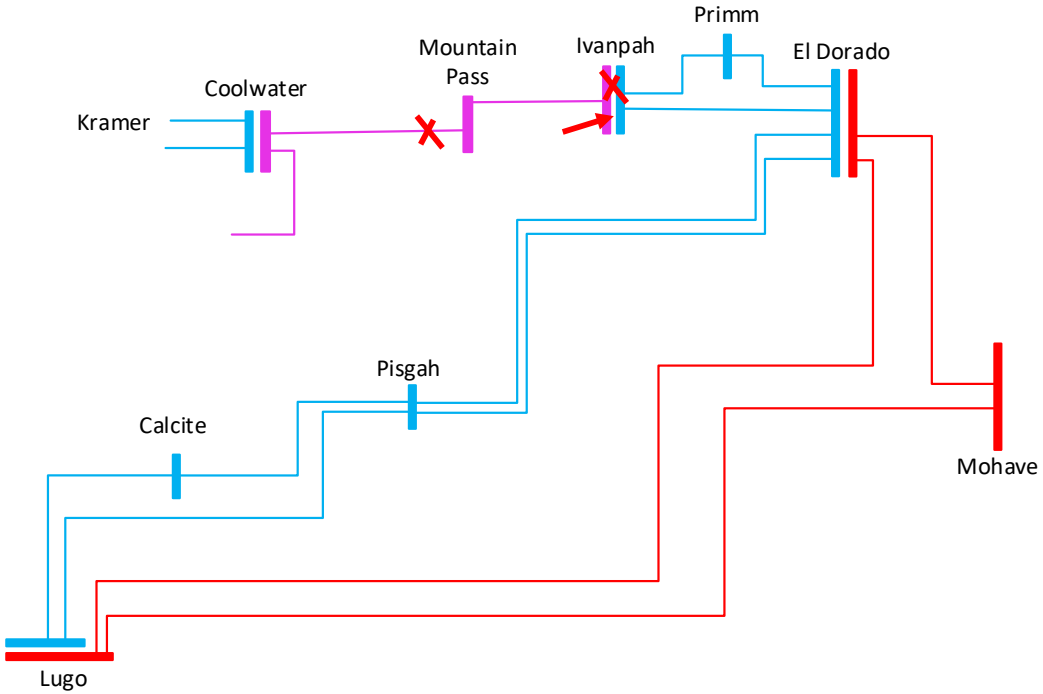
Ivanpah 230/115kV Transformer

Observations

- The remaining Ivanpah 230/115kV transformer could be overloaded following loss of the other Ivanpah transformer (P1) in 2035 spring off-peak case
- It could also be overloaded following Category P6 contingency of loss of the other Ivanpah transformer and Ivapah – Mountain Pass – Baker – Dunn Siding – Coolwater 115kV line in 2035 spring off-peak base case and 2025 summer peak with heavy renewable generation and minimum gas output sensitivity case

Potential Mitigations

- Existing Ivanpah RAS



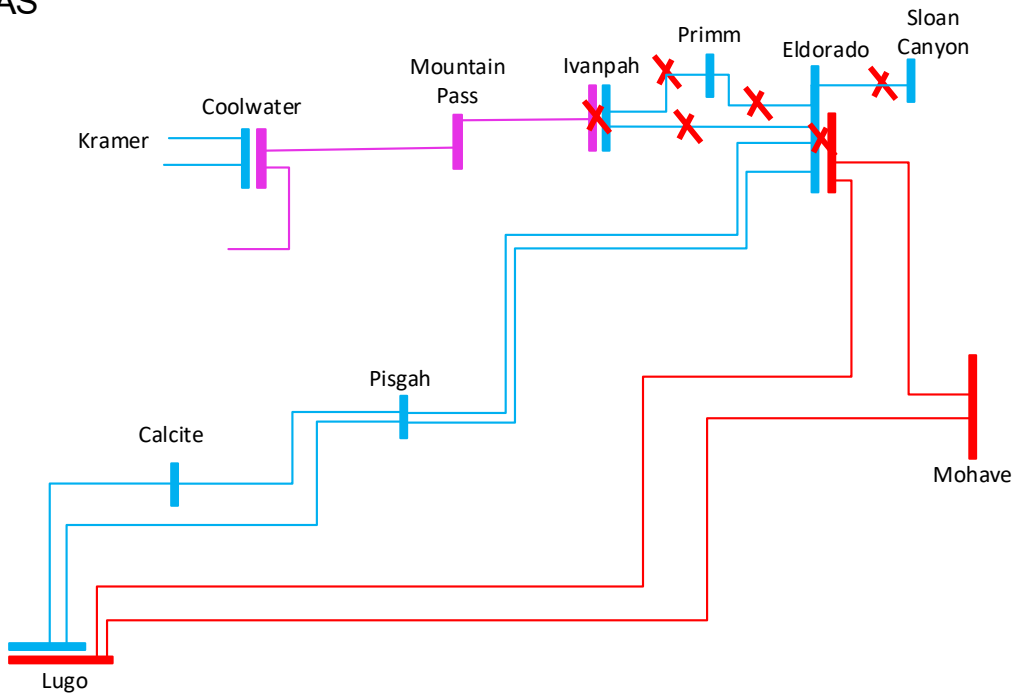
Ivapah – Mountain Pass – Baker – Dunn Siding – Coolwater 115kV line

Observations

- System divergence following Category P6 contingency of loss of both Ivanpah transformers or loss of Eldorado 5AA bank and Eldorado – Sloan Canyon 230kV line in multiple base and sensitivity cases
- System divergence following Category P7 contingencies of Eldorado – Ivapah and Eldorado – Primm 230kV liens or Eldorado – Ivanpah and Ivanpah – Primm 230kV lines in multiple base and sensitivity cases

Potential Mitigations

- Existing Ivanpah RAS



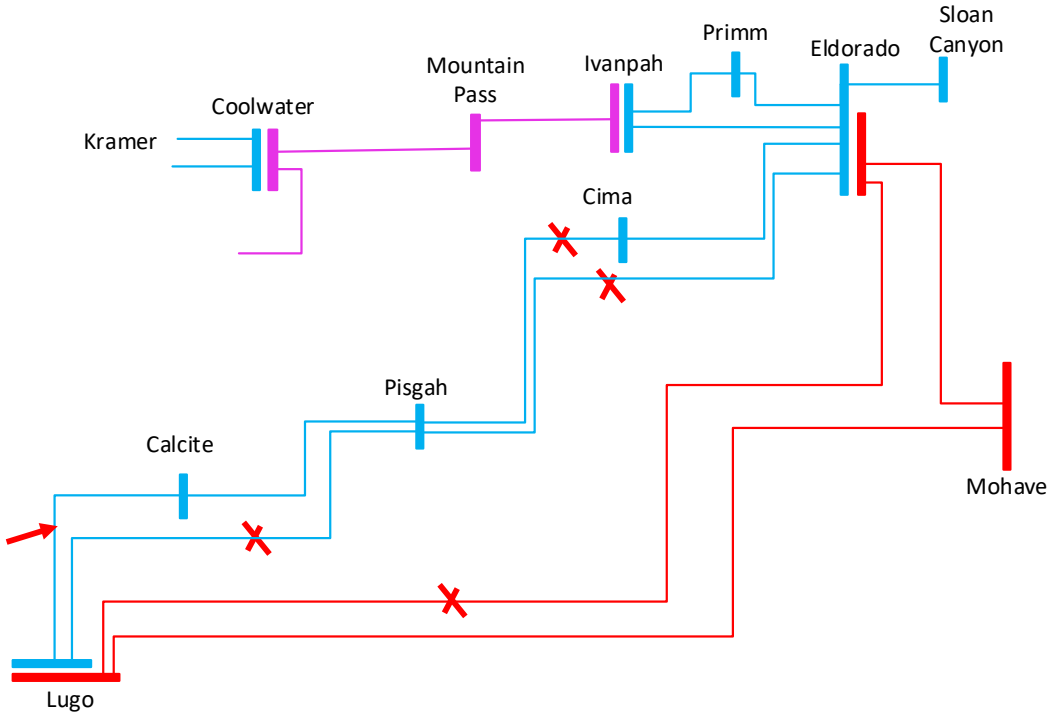
Lugo – Calcite 230kV No.1 Line

Observations

- Category P4 contingency of Eldorado – Cima – Pisgah #2 stuck circuit breaker followed by loss of Lugo – Pisgah No.2 230kV line and multiple Category P6 contingencies involving loss of Lugo – Pisgah 230kV line could overload the line in 2035 base scenarios

Potential Mitigations

- Future Calcite CRAS
- Congestion management



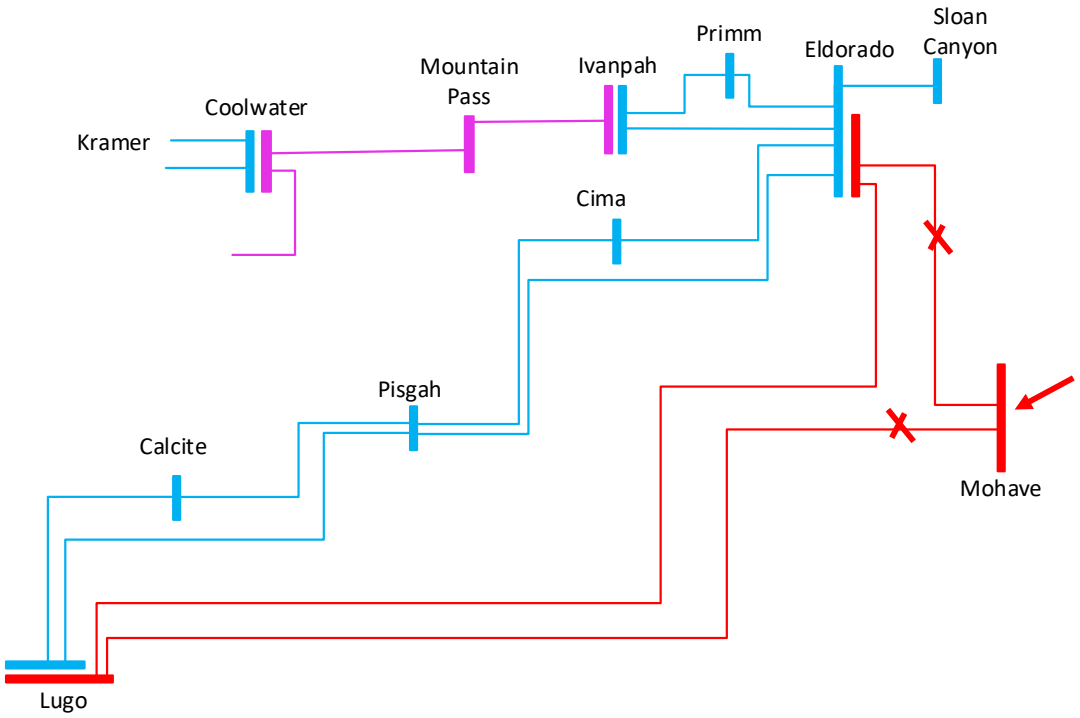
Mohave 500kV Bus

Observations

- Category P6 contingency of Lugo – Mohave and Eldorado – Mohave 500kV lines could cause low voltages and potentially system divergence at Mohave 500kV bus in all base and sensitivity scenarios.

Potential Mitigations

- NVE Operating Procedure
- Lugo – Victorville RAS to trip generation and isolate Mohave from NVE system



Sensitivity Study Assessment

- There were no facility overloads or voltage violations identified in sensitivity scenarios only

Transient Stability Analysis

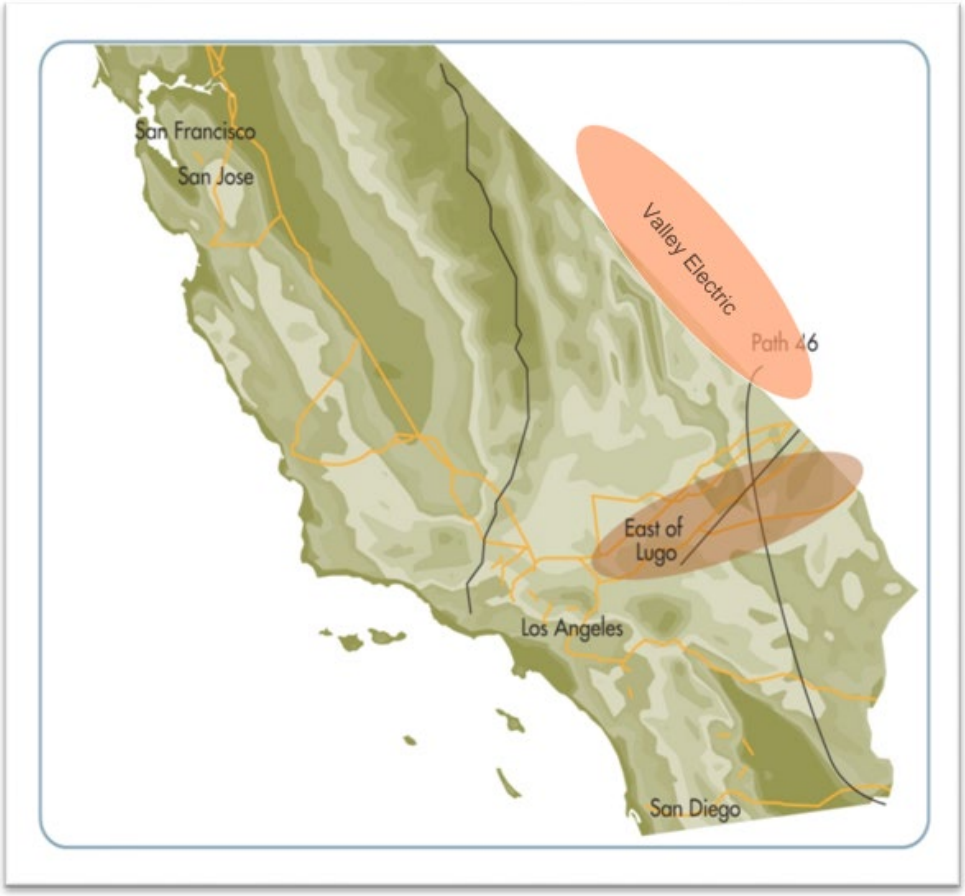
- Performed for B2, B3, B6, S1, and S3 cases
- 39 credible contingencies evaluated
  - Includes P1, P4, P6 and P7
- No transient stability issues identified

Valley Electric Association
Preliminary Reliability Assessment Results

Meng Zhang
Regional Transmission Engineer Lead

2023-24 Transmission Planning Process Stakeholder Meeting
September 26-27, 2023

Valley Electric Association (VEA) Area



- VEA system is comprised of 138 and 230 KV transmission facilities under ISO control
- Gridliance West (GLW) is the Transmission Owner for the 230 kV facilities in the VEA area
- Connects to SCE's Eldorado 230kV substation, WAPA's Mead 230kV substation, WAPA's Amargosa 138kV substation, NV Energy's Northwest 230kV substation and shares buses at Jackass 138kV and Mercury 138kV stations
- 115MW of existing generation.
- Forecasted 1-in-10 summer peak loads for 2025, 2028 and 2035 are 169 MW, 177 MW and 196 MW respectively.

VEA Area Study Scenarios

- Base scenarios

No.	Case	Description
B1	2025 Summer Peak	Summer peak load time (6/27 HE 16 PST)
B2	2028 Summer Peak	Summer peak load time (6/23 HE 17 PST)
B3	2035 Summer Peak	Summer peak load time (7/3 HE 18 PST)
B4	2035 Winter Peak	Winter peak load time (12/31 HE 08 PST)
B5	2025 Spring Off-Peak	Spring minimum load time (4/23 HE 20 PST)
B6	2028 Spring Off-Peak	Spring shoulder load time (4/2 HE 12 PST)
B7	2035 Spring Off-Peak	Spring shoulder load time (4/1 HE 13 PST)

- Sensitivity scenarios

No	Case	Change From Base Assumption
S1	2025 SP with forecasted load addition	Load increased to reflect future load service requests
S2	2028 SP with forecasted load addition	Load increased to reflect future load service requests
S3	2025 SOP BESS charging	2025 spring off-peak condition with battery storage in charging mode

Load and Load Modifier Assumptions – VEA Area

Scenario	Study Case	Description	Gross Load (MW)	AAEE (MW)	AAFS (MW)	ATE (MW)	BTM-PV (MW)		Net Load (MW)	Demand Response Installed (MW)	
							Installed	Output		Fast	Slow
Base	2025SP	2025 Summer Peak	169	0	0	0	0	0	169	0	0
	2028SP	2028 Summer Peak	177	0	0	0	0	0	177	0	0
	2035SP	2035 Summer Peak	196	0	0	0	0	0	196	0	0
	2035WP	2035 Winter Peak	151	0	0	0	0	0	151	0	0
	2025OP	2025 Spring Off Peak	82	0	0	0	0	0	82	0	0
	2028OP	2028 Spring Off Peak	64	0	0	0	0	0	64	0	0
	2035OP	2035 Spring Off Peak	37	0	0	0	0	0	37	0	0
Sensitivity	2025SP HiLoad	2025SP with forecasted load addition	180	0	0	0	0	0	180	0	0
	2028SP HiRen	2028SP with forecasted load addition	196	0	0	0	0	0	196	0	0
	2025OP BESS Charging	2025 OP BESS Charging	82	0	0	0	0	0	82	0	0

Generation Assumptions – VEA Area

Scenario	Study Case	Description	Battery[1]		Solar		Wind		Hydro		Thermal[2]	
			Installed	Dispatch	Installed	Dispatch	Installed	Dispatch	Installed	Dispatch	Installed	Dispatch
Base	2025SP	2025 Summer Peak	137	9	378	363	0	0	0	0	0	0
	2028SP	2028 Summer Peak	137	8	378	333	0	0	0	0	0	0
	2035SP	2035 Summer Peak	1469	0	3541	1487	403	81	0	0	500	490
	2035WP	2035 Winter Peak	1469	6	3541	496	403	97	0	0	500	500
	2025OP	2025 Spring Off Peak	137	127	378	0	0	0	0	0	0	0
	2028OP	2028 Spring Off Peak	137	8	378	344	0	0	0	0	0	0
	2035OP	2035 Spring Off Peak	1469	-369	3541	3151	403	133	0	0	500	0
Sensitivity	2025SP HiLoad	2025SP with forecasted load addition	137	9	378	363	0	0	0	0	0	0
	2028SP HiRen	2028SP with forecasted load addition	137	8	378	333	0	0	0	0	0	0
	2025OP BESS Charging	2025 OP BESS Charging	137	-127	378	0	0	0	0	0	0	0

[1] Includes battery and other storage in the VEA/GLW area
[2] Includes geothermal

Previously approved transmission projects modeled in base cases

Project Name	In-service Year	First Year Modeled
New Gamebird 230/138kV Transformer	2022	2025
GLW Core Upgrade Project	2027	2028
Beatty 230kV Project	2027	2028

Reliability Assessment Preliminary Results Summary

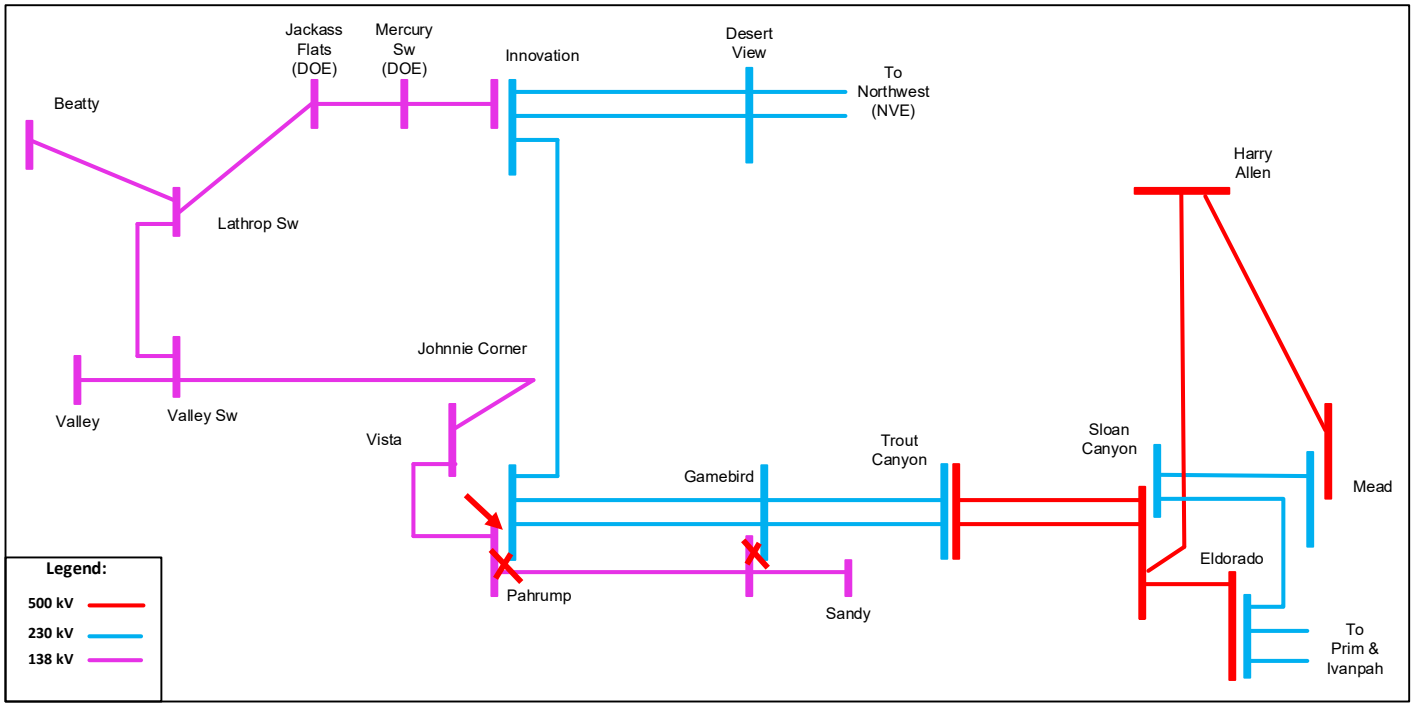
Pahrump 230/115kV Transformer

Observations

- The remaining Pahrump 230/138kV transformer is observed overloaded following loss of Gamebird 230/138kV transformer and the other Pahrump 230/138kV transformer in 2035 summer peak case driven by VEA area load growth

Approved and Potential Mitigations

- Utilize existing UVLS scheme



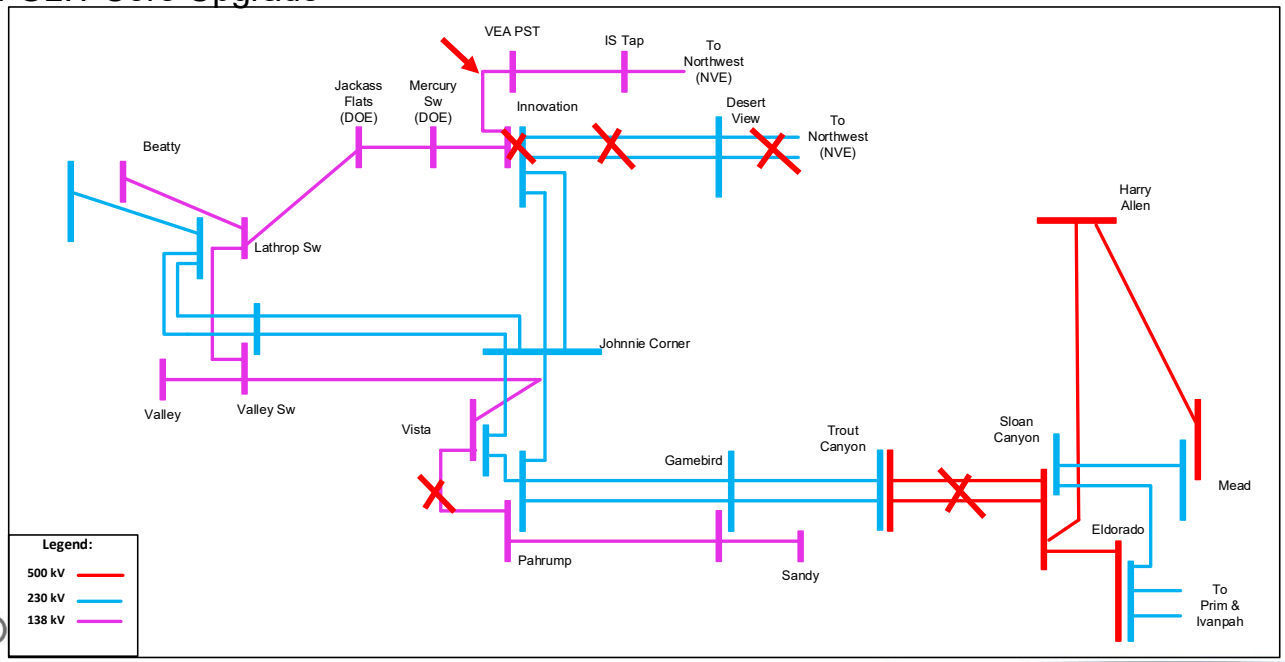
VEA PST-IS Tap-Northwest 138kV Line

Observations

- Category P7 contingency overloads following loss of Northwest – Desert View 230kV, Innovation – Desert View 230kV or Trout Canyon – Sloan Canyon 500kV DCTL lines in 2035 base case scenarios
- Category P6 contingency overload following loss of Pahrump – Vista 138kV line and Innovation 230/138kV transformer in 2035 summer off-peak base case scenario
- Category P6 contingency overload following loss of Innovation – Desert View 230kV and Trout Canyon – Sloan Canyon 230kV lines in 2025 base case scenarios

Approved and Potential Mitigations

- Planned Innovation RAS and Trout Canyon RAS
- Generation redispatch would mitigate Category P6 contingency overloads
- The approved GLW Core Upgrade



California ISO Public

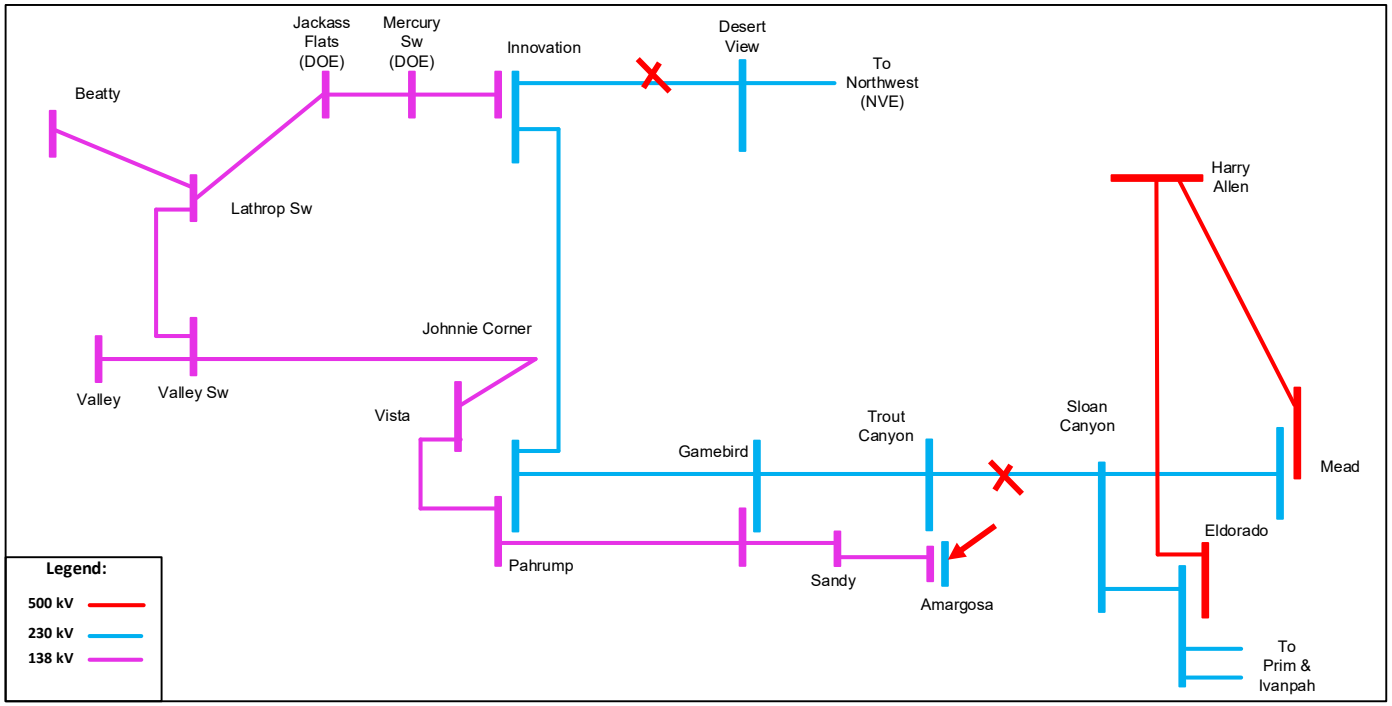
Amargosa 230/138kV Transformer

Observations

- Category P6 contingency overload following loss of Innovation – Desert View and Trout Canyon – Sloan Canyon 230kV lines in 2025 base scenarios

Approved and Potential Mitigations

- Rely on generation redispatch as a short term solution
- Previously approved GLW Core Upgrade will provide a long term mitigation



California ISO Public

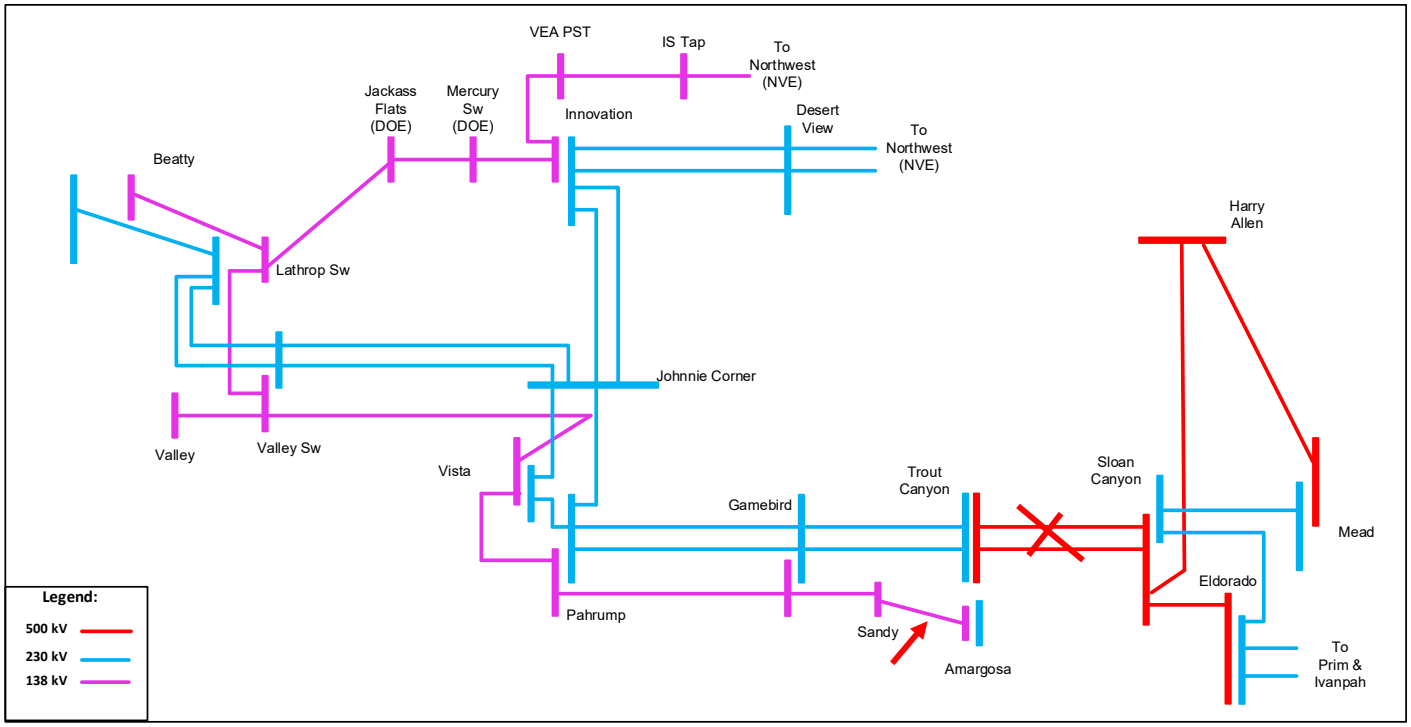
Amargosa – Sandy 138kV Line

Observations

- Category P7 contingency overload following loss of Trout Canyon – Sloan Canyon 500kV DCTL lines in 2035 base scenarios

Approved and Potential Mitigations

- Planned Trout Canyon RAS



California ISO Public

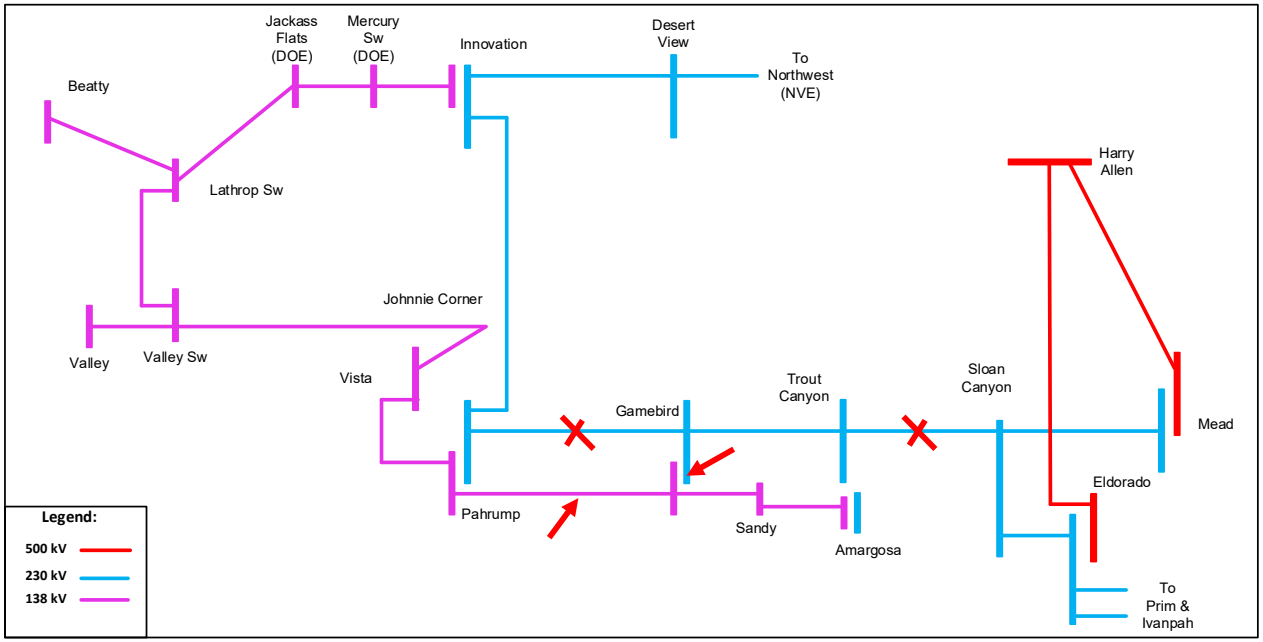
Gamebird 230/138kV Transformer and Gamebird – Pahrump 138kV Line

Observations

- Category P6 contingency overload following loss of Pahrump – Gamebird and Trout Canyon – Sloan Canyon 230kV lines in 2025 base scenarios

Approved and Potential Mitigations

- Rely on generation redispatch as a short term solution
- Previously approved GLW Core Upgrade will provide a long term mitigation



California ISO Public

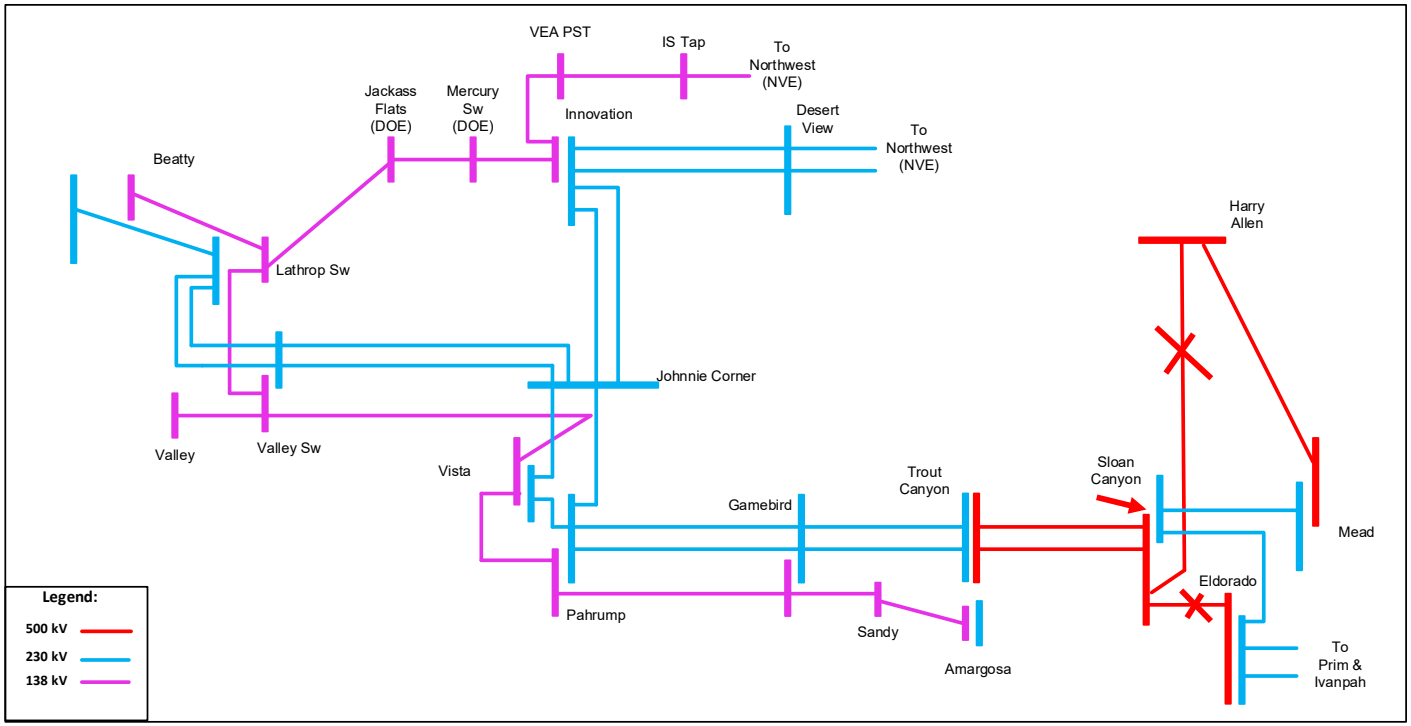
Sloan Canyon 500/230kV Transformer

Observations

- Category P6 contingency overload following loss of Sloan Canyon – Harry Allen and Sloan Canyon – Eldorado 500kV lines in 2035 spring off-peak base scenario

Approved and Potential Mitigations

- Generation redispatch after the first contingency



California ISO Public

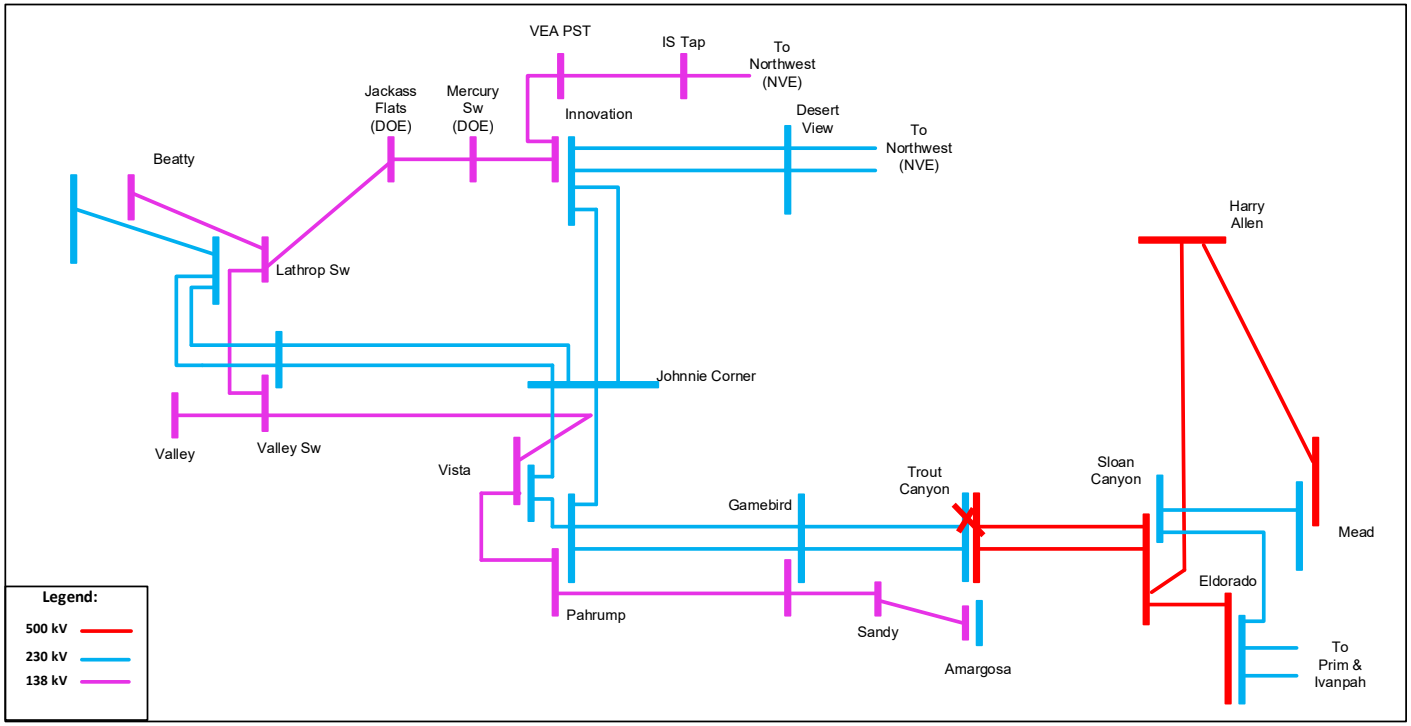
Trout Canyon 500/230kV Transformer

Observations

- The remaining Trout Canyon 500/230kV transformer could be overloaded following Category P6 contingency of loss of the other two Trout Canyon 500/230kV transformers in 2035 spring off-peak base scenario

Approved and Potential Mitigations

- Generation redispatch after the first contingency



California ISO Public

Transient Stability Analysis

- Performed for B2, B3, B5, S2, and S3 cases

- 45 credible contingencies evaluated
  - Includes P1, P4.2, P5, P6 and P7

- There were three Category P1 contingencies that could potentially result in unstable transient stability performance in 2035 summer peak case. Those contingencies are under review with the PTO

Summary of Potential New Upgrades

- Majority of the thermal and voltage issues identified in reliability assessment could be mitigated by existing UVLS scheme, generation redispatch and the TPP approved GLW Core Upgrade and Beatty 230kV Project.

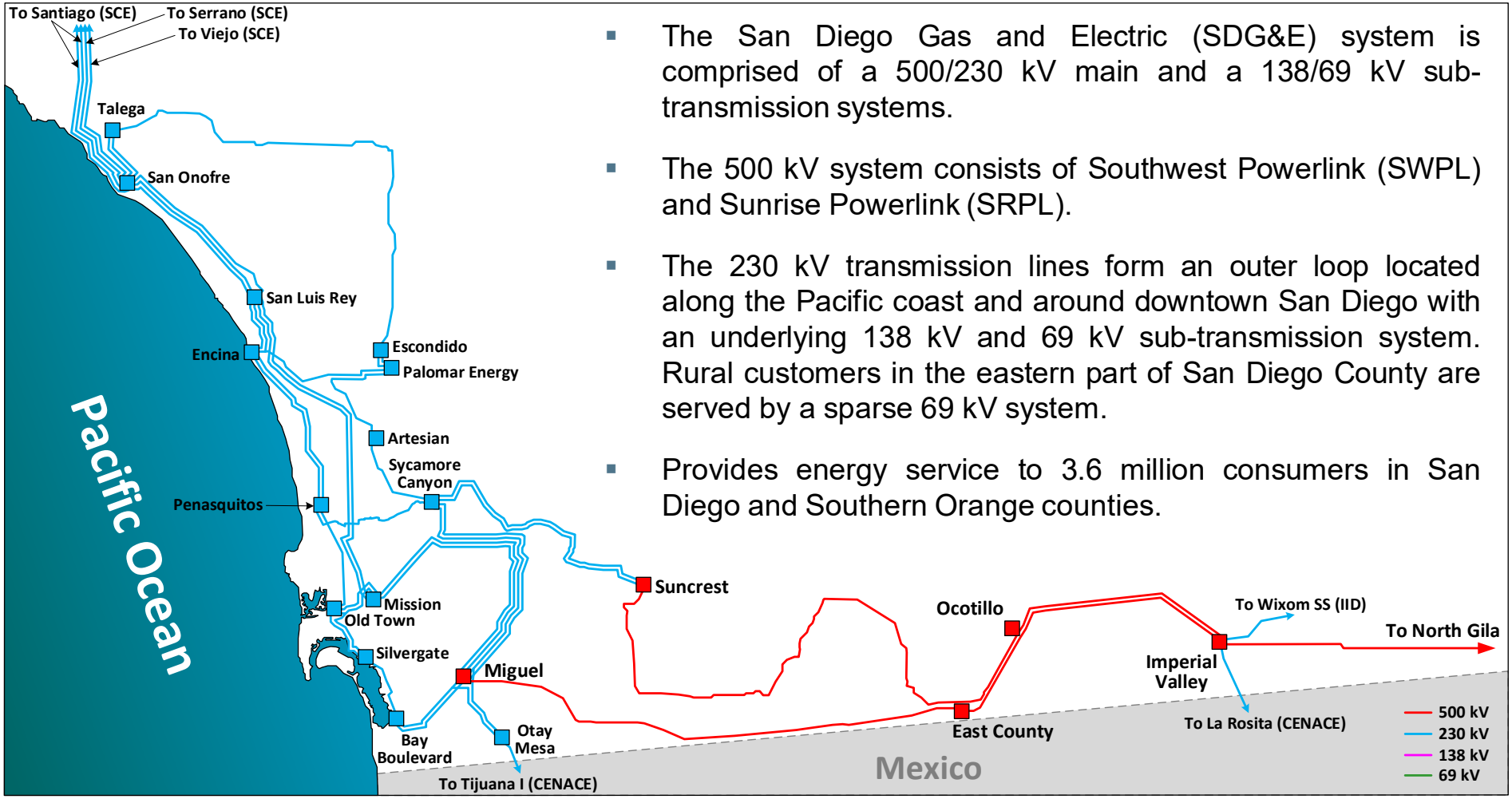
- Thermal issues identified in 2035 base case scenarios could be mitigated by future RAS and generation redispatch

San Diego Gas & Electric Area
Preliminary Reliability Assessment Results

Rene Romo de Santos
Senior Regional Transmission Engineer

2023-2024 Transmission Planning Process Stakeholder Meeting
September 26-27, 2023

SDG&E Transmission System



- The San Diego Gas and Electric (SDG&E) system is comprised of a 500/230 kV main and a 138/69 kV sub-transmission systems.
- The 500 kV system consists of Southwest Powerlink (SWPL) and Sunrise Powerlink (SRPL).
- The 230 kV transmission lines form an outer loop located along the Pacific coast and around downtown San Diego with an underlying 138 kV and 69 kV sub-transmission system. Rural customers in the eastern part of San Diego County are served by a sparse 69 kV system.
- Provides energy service to 3.6 million consumers in San Diego and Southern Orange counties.

Study Scenarios, Load and Generation Assumptions, and Approved Projects Modeled Summary

SDG&E Area Study Scenarios

- Base scenarios

No.	Case	Description
B1	2025 Summer Peak	Summer peak load time (9/3 HE 19)
B2	2028 Summer Peak	Summer peak load time (9/6 HE 19)
B3	2035 Summer Peak	Summer peak load time (9/5 HE 19)
B4	2028 Summer Off-Peak	Summer off-peak time (9/6 HE 15)
B5	2035 Winter Peak	Winter peak load time (12/10 HE 19)
B6	2025 Spring Off-Peak	Spring off-peak time (5/27 HE 20)
B7	2028 Spring Off-Peak	Spring off-peak time (5/14 HE 13)
B8	2035 Spring Off-Peak	Spring off-peak time (4/1 HE 13)

- Sensitivity scenarios

No.	Case	Change From Base Assumption
S1	2025 Summer Peak	Heavy renewable output and minimum gas generation commitment
S2	2025 Spring Off-Peak	Storage charging in load pockets
S3	2028 Summer Peak	1-in-20 load forecast

Load Forecast and Load Modifier Assumptions

Study Case	Scenario	Gross Load (MW)	AAEE (MW)	AAFS (MW)	TE (MW)	BTM-PV (MW)		Net Load (MW)
						Installed Capacity	Output	
B1-2025SP	Base	4971	50	13	42	2129	0	4976
B2-2028SP	Base	5127	86	75	101	2544	0	5217
B3-2035SP	Base	5504	169	341	346	3514	0	6022
B4-2028OP	Base	5840	151	75	168	2544	1654	4278
B5-2035WP	Base	4302	107	328	652	3514	0	5175
B6-2025OP	Base	3668	35	13	82	2129	0	3728
B7-2028OP	Base	2764	58	43	150	2544	2162	736
B8-2035OP	Base	2674	106	182	533	3514	2741	542
S1-2025SP	Sensitivity	4985	50	13	42	2129	2044	2946
S2-2025OP	Sensitivity	3751	35	13	82	2129	0	3810
S3-2028SP	Sensitivity	5175	86	75	101	2544	0	5266

AAEE → Additional Achievable Energy Efficiency (Value is subtracted to calculate the Net Load)
AAFS → Additional Achievable Fuel Substitution
TE → Transportation Electrification (Includes Baseline and Additional Achievable Transport Electrification)
BTM-PV → Behind-the-meter Solar Photovoltaic Generation (Value is subtracted to calculate the Net Load)

Generation Resource Assumptions

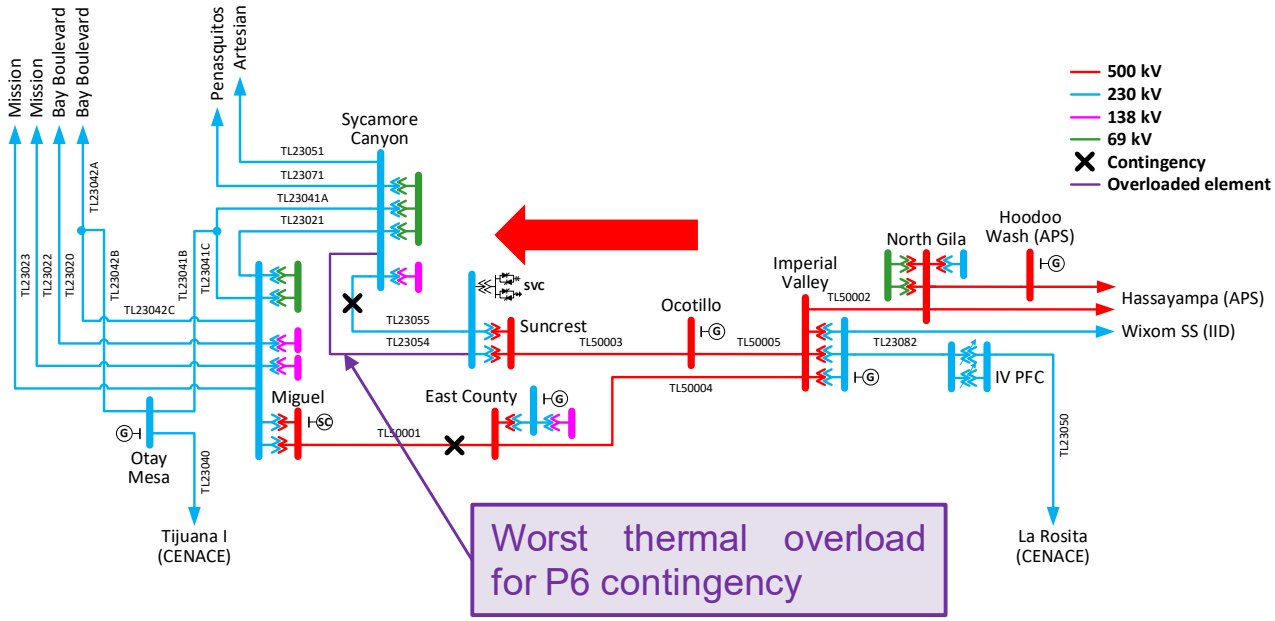
Study Case	Battery Energy Storage (MW)		Solar (MW)		Wind (MW)		Thermal (MW)		Pumped Storage Hydro (MW)		Hydro (MW)		Long Duration Energy Storage (MW)	
	Installed	Dispatch	Installed	Dispatch	Installed	Dispatch	Installed	Dispatch	Installed	Dispatch	Installed	Dispatch	Installed	Dispatch
B1-2025SP	1928	0	2072	0	775	140	3728	3519	40	40	4	2	0	0
B2-2028SP	1928	0	2072	0	775	140	3728	3519	40	38	4	2	0	0
B3-2035SP	3063	0	4102	0	1270	229	3728	3519	40	38	4	2	500	0
B4-2028OP	1928	0	2072	1447	775	195	3728	2549	40	38	4	2	0	0
B5-2035WP	3063	0	4102	0	1270	127	3728	3021	40	30	4	2	500	0
B6-2025OP	1928	0	2072	0	775	381	3728	1978	40	0	4	0	0	0
B7-2028OP	1928	-1925	2072	1828	775	226	3728	30	40	0	4	0	0	0
B8-2035OP	3063	-3060	4102	3562	1270	484	3728	50	40	0	4	0	500	-500
S1-2025SP	1928	0	2072	1967	775	395	3728	1387	40	40	4	2	0	0
S2-2025OP	1928	-1884	2072	0	775	381	3728	3171	40	0	4	0	0	0
S3-2028SP	1928	0	2072	0	775	140	3728	3519	40	38	4	2	0	0

Approved Transmission Projects Modeled in Base Cases

Project Name	In-service Date	First Year Modeled
2nd Escondido - San Marcos 69 kV T/L	Feb-23	2025
IID S-Line Upgrade	2023	2025
Southern Orange County Reliability Upgrade Project – Alternative 3 (Rebuild Capistrano Substation, construct a new SONGS - Capistrano 230 kV line and a new 230 kV tap line to Capistrano)	Feb-24	2025
Reconductor TL 605 Silvergate - Urban	Jun-24	2025
TL649D Reconductor (San Ysidro - Otay Lake Tap)	Aug-24	2025
SG and OT Redundant Bus Differential Relay	Q3-2024	2025
TL695B Japanese Mesa - Talega Tap Reconductor	Aug-26	2028
TL632 Granite Loop-In and TL6914 Reconfiguration	Aug-26	2028
Sweetwater Reliability Enhancement	Oct-27	2028
TL690E, Stuart Tap - Las Pulgas 69 kV Reconductor	Mar-28	2028
TL623C Reconductor (San Ysidro - Otay Tap)	Sep-29	2035
Miguel-Sycamore Canyon (TL23021) 230 kV line Loop-in to Suncrest	2032	2035
Rearrange TL23013 PQ-OT and TL6959 PQ-Mira Sorrento	2032	2035
Reconductor TL680C San Marcos -Melrose Tap	2032	2035
3 Ohm Series Reactor on Sycamore-Penasquitos 230 kV line	2032	2035
Upgrade TL13820 Sycamore-Chicarita 138 kV	2032	2035
Upgrade series capacitors on HW-NG and HA-NG to 2739 MVA	2032	2035
North Gila–Imperial Valley 500 kV line	2032	2035
Imperial Valley–North of SONGS 500 kV Line and Substation	2034	2035
North of SONGS–Serrano 500 kV line	2034	2035

Reliability Assessment Preliminary Results Summary

230 kV TL23054/TL23055 Suncrest – Sycamore Canyon



Reliability Concern

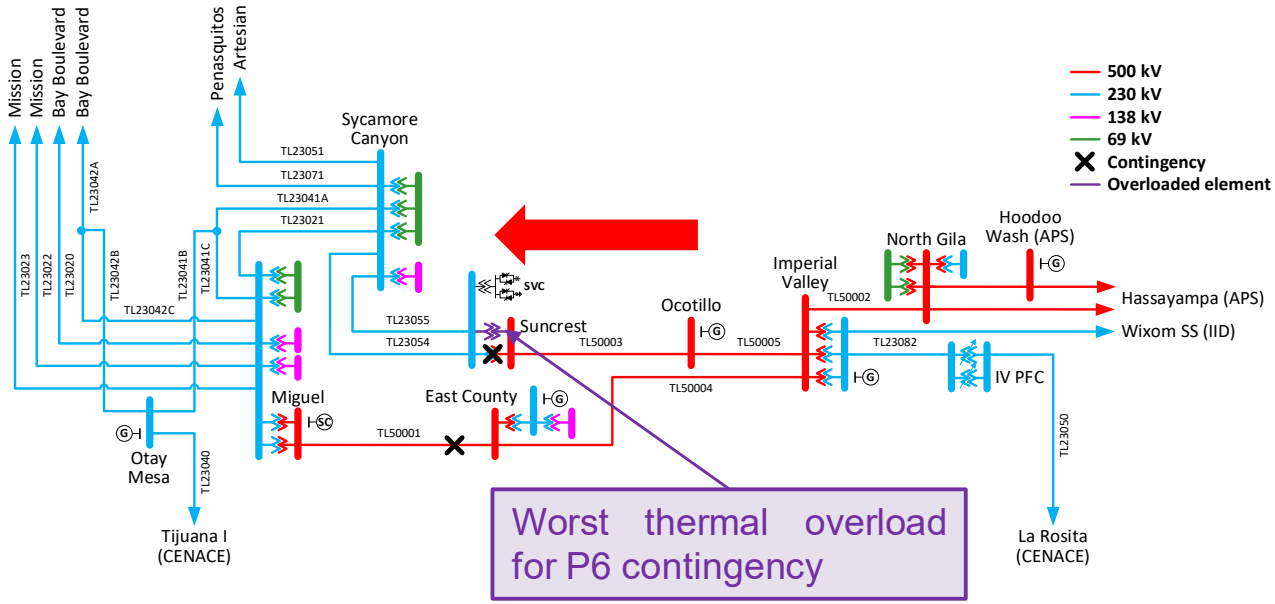
- P6 thermal overload: 115% → 146%* of normal rating

Potential Mitigation

- Existing TL23054/23055 RAS
- 30-min emergency rating
- System adjustments and operational actions
  - Reducing gen output in the greater IV area
  - Dispatching conventional gas gen, and BESS in San Diego metro area
  - Adjusting IV PST
  - Bypassing series capacitors Hassayampa/Hoodoo Wash – North Gila 500 kV transmission lines
- Miguel-Sycamore Canyon 230 kV line Loop-in to Suncrest (ISD 2032)

*Considering both base and sensitivity scenarios

Suncrest 500/230 kV Banks 80 and 81



Reliability Concern

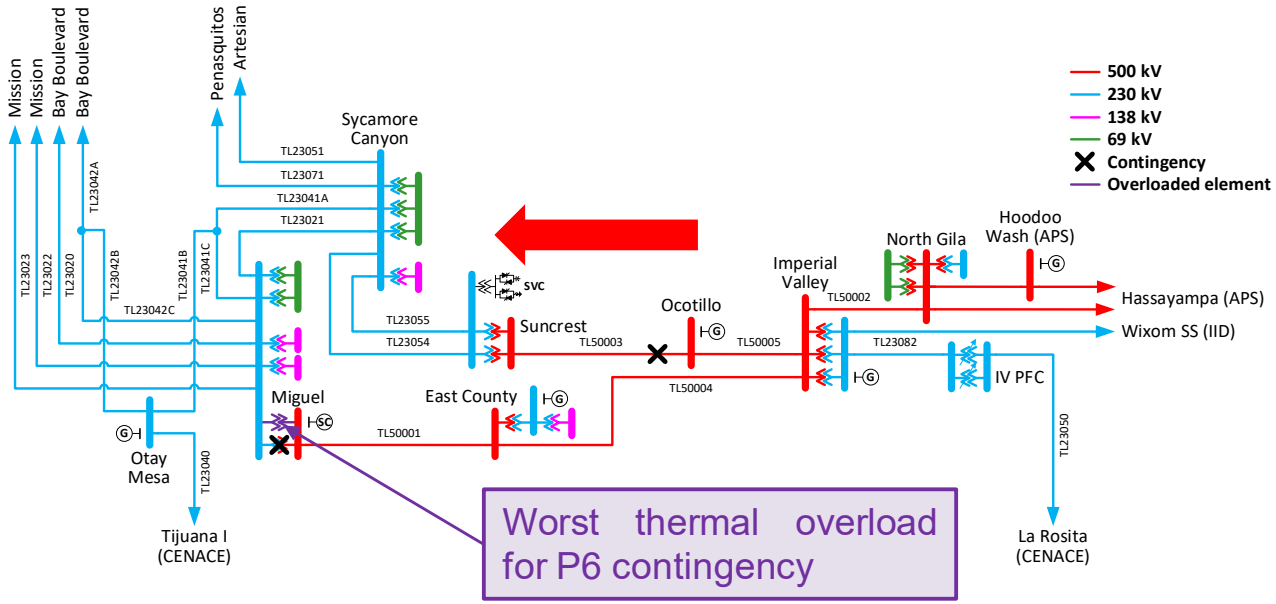
- P6 thermal overload: 110% of 24-hr rating in B4 case

Potential Mitigation

- 30-min emergency rating
- System adjustments and operational actions
  - Reducing gen output in the greater IV area
  - Dispatching conventional gas gen, and BESS in San Diego metro area
  - Adjusting IV PST
  - Bypassing series capacitors Hassayampa/Hoodoo Wash – North Gila 500 kV transmission lines
- Miguel-Sycamore Canyon 230 kV line Loop-in to Suncrest (Third Suncrest 500/230 kV bank) (ISD 2032)

B4 → 2028 Summer Off-Peak

Miguel 500/230 kV Banks 80 and 81



Reliability Concern

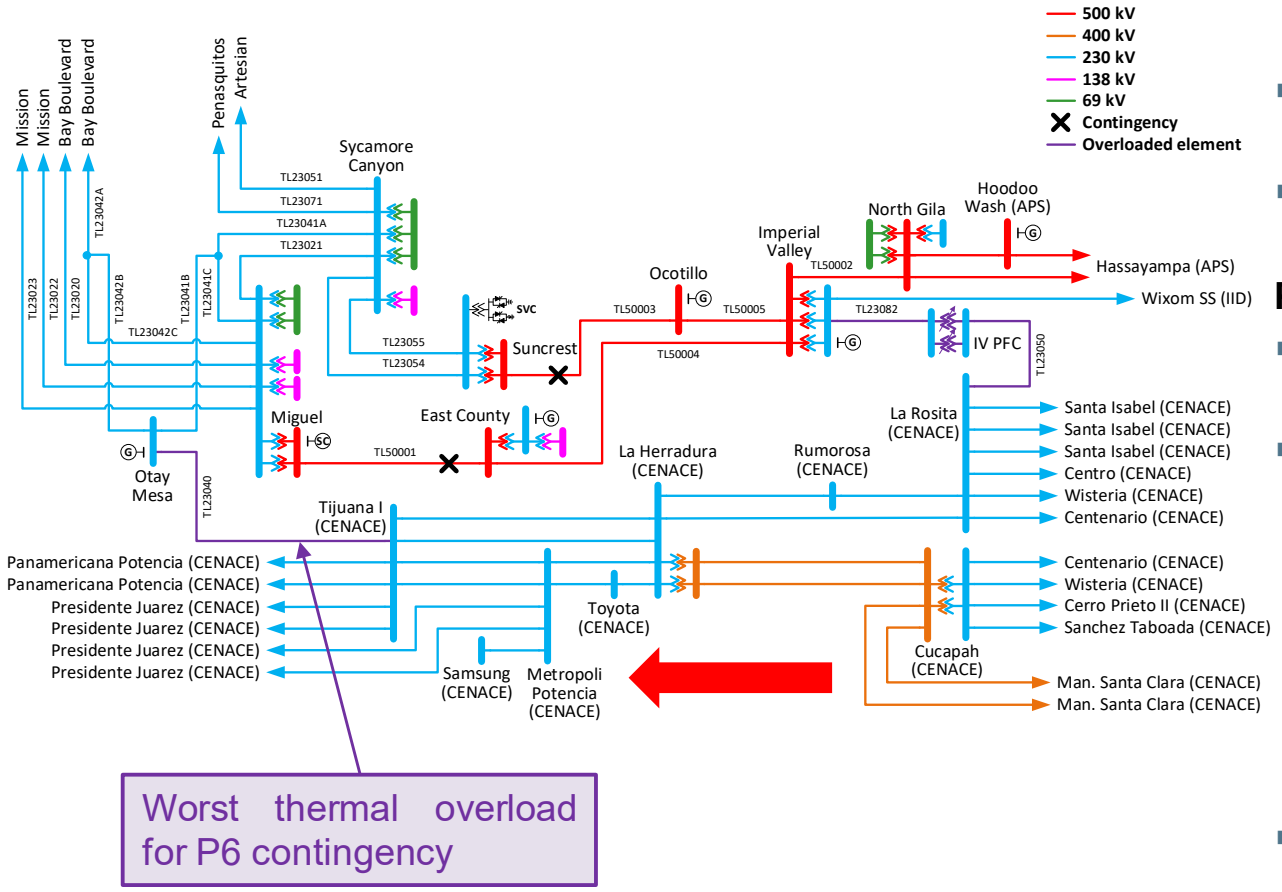
- P6 thermal overload: 101% → 129%* of 24-hr rating

Potential Mitigation

- Existing Miguel BK 80/81 RAS
- 30-min emergency rating
- System adjustments and operational actions
  - Reducing gen output in the greater IV area
  - Dispatching conventional gas gen, and BESS in San Diego metro area
  - Adjusting IV PST
  - Bypassing series capacitors Hassayampa/Hoodoo Wash – North Gila 500 kV transmission lines
- Miguel-Sycamore Canyon 230 kV line Loop-in to Suncrest (Third Miguel 500/230 kV bank) (ISD 2032)

*Considering both base and sensitivity scenarios

Path 45 facilities thermal overloads (1/2)



Reliability Concern

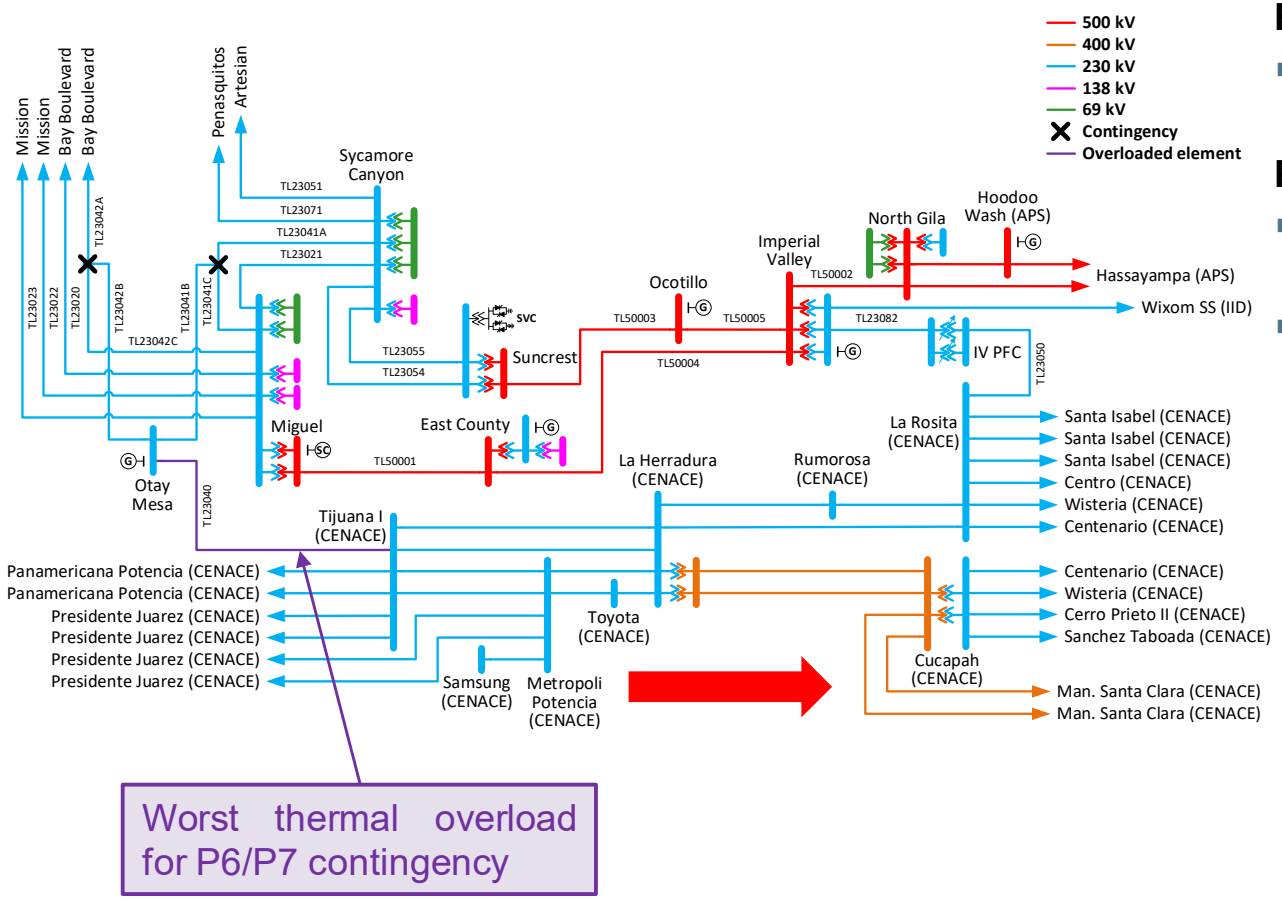
- P6 thermal overload: 100% → 118%* of normal rating for IV-ROA
- P6 thermal overload: 126% → 149%* of 4-hr rating for OM-TJI
- P6 thermal overload: 112% → 136%* of 24-hr rating for IV PST

Potential Mitigation

- Existing TL50001 Gen Drop RAS or TL50003 Gen Drop RAS
- System adjustments and operational actions
  - Reducing gen output in the greater IV area
  - Dispatching conventional gas gen, and BESS in San Diego metro area
  - Adjusting IV PST
  - Bypassing series capacitors Hassayampa/Hoodoo Wash – North Gila 500 kV transmission lines
- Imperial Valley–North of SONGS 500 kV Line and Substation (ISD 2034)

*Considering both base and sensitivity scenarios

Path 45 facilities thermal overloads (2/2)



Reliability Concern

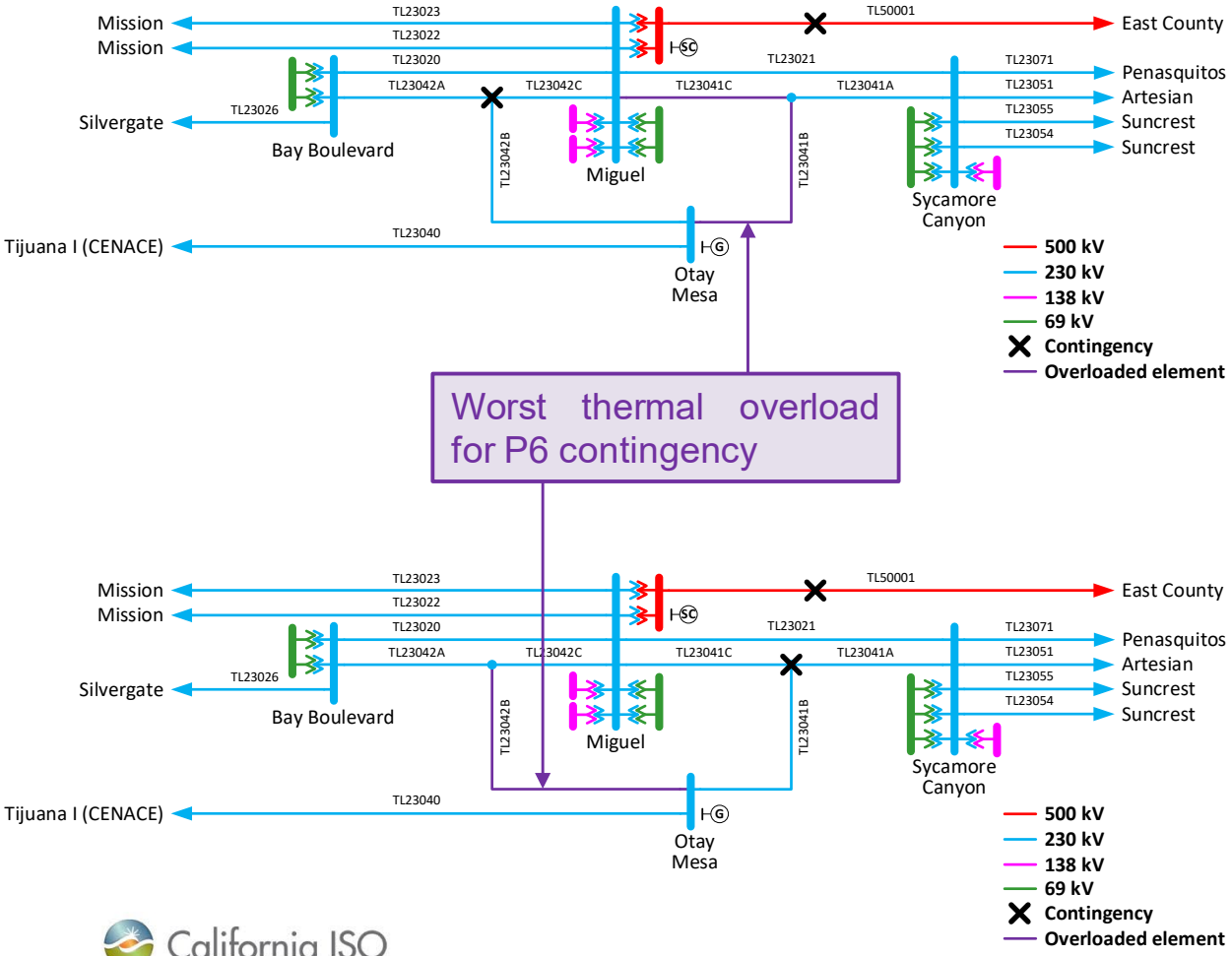
- P6 and P7 thermal overload: 104%* of 4-hr rating for OM-TJI

Potential Mitigation

- Existing 230 kV Otay Mesa Gen Drop RAS
- System adjustments and operational actions
  - Reducing generation output at Otay Mesa

*Considering both base and sensitivity scenarios

230 kV TL23041 Sycamore Canyon – Otay Mesa – Miguel and TL23042 Bay Boulevard – Otay Mesa – Miguel



Reliability Concern

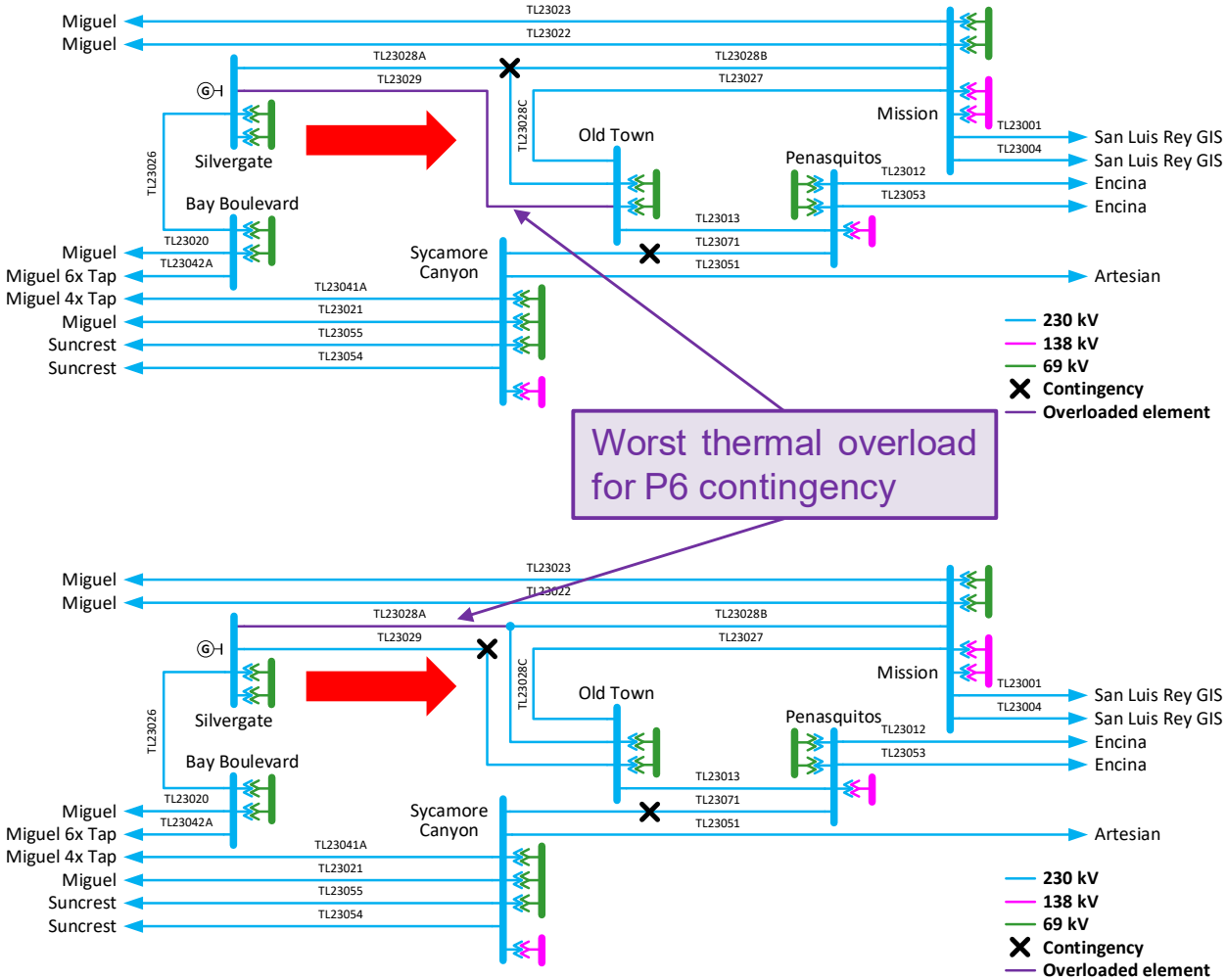
- P6 thermal overload: 101% → 124%* of normal rating

Potential Mitigation

- Existing TL23041/TL23042 RAS
- 30-min emergency rating
- System adjustments and operational actions
  - Reducing generation output at Otay Mesa

*Considering both base and sensitivity scenarios

230 kV TL23028 Silvergate – Old Town – Mission and TL23029 Silvergate – Old Town



Reliability Concern

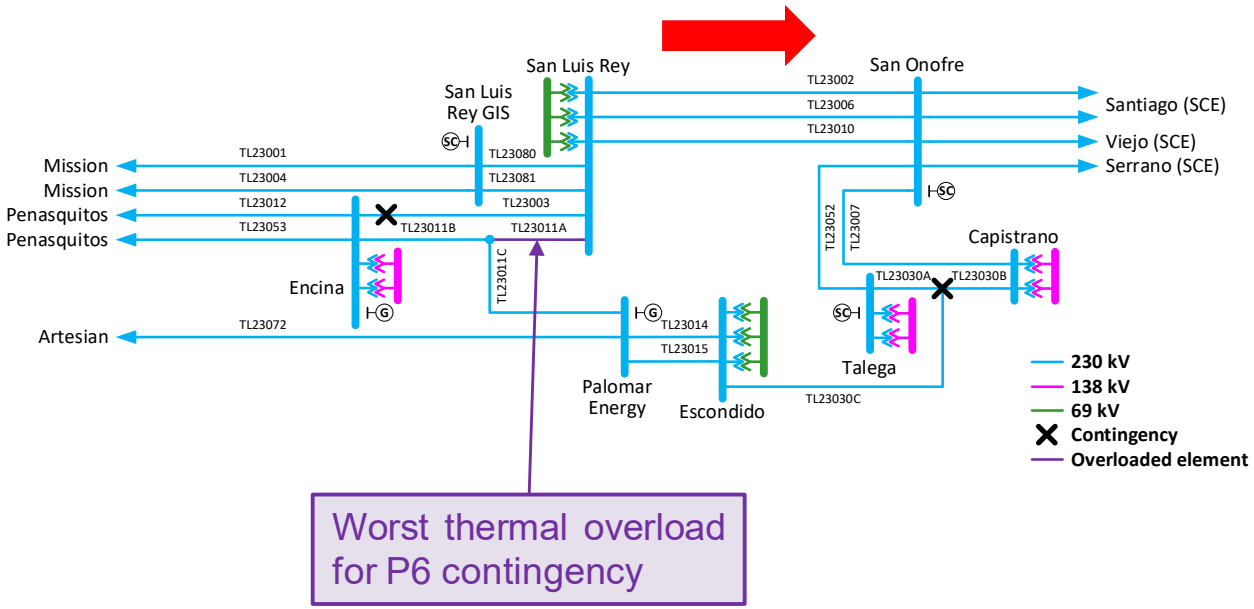
- P6 thermal overload: 100% → 105%* of normal rating for TL23028A
- P6 thermal overload: 102% → 106%* of normal rating for TL23029

Potential Mitigation

- 2-hr emergency rating
- System adjustments and operational actions
  - Reducing generation output at Otay Mesa, Otay, and/or Border substations
- Imperial Valley–North of SONGS 500 kV Line and Substation reduces flow in this path

*Considering both base and sensitivity scenarios

230 kV TL23011 San Luis Rey – Encina – Palomar Energy Center



Reliability Concern

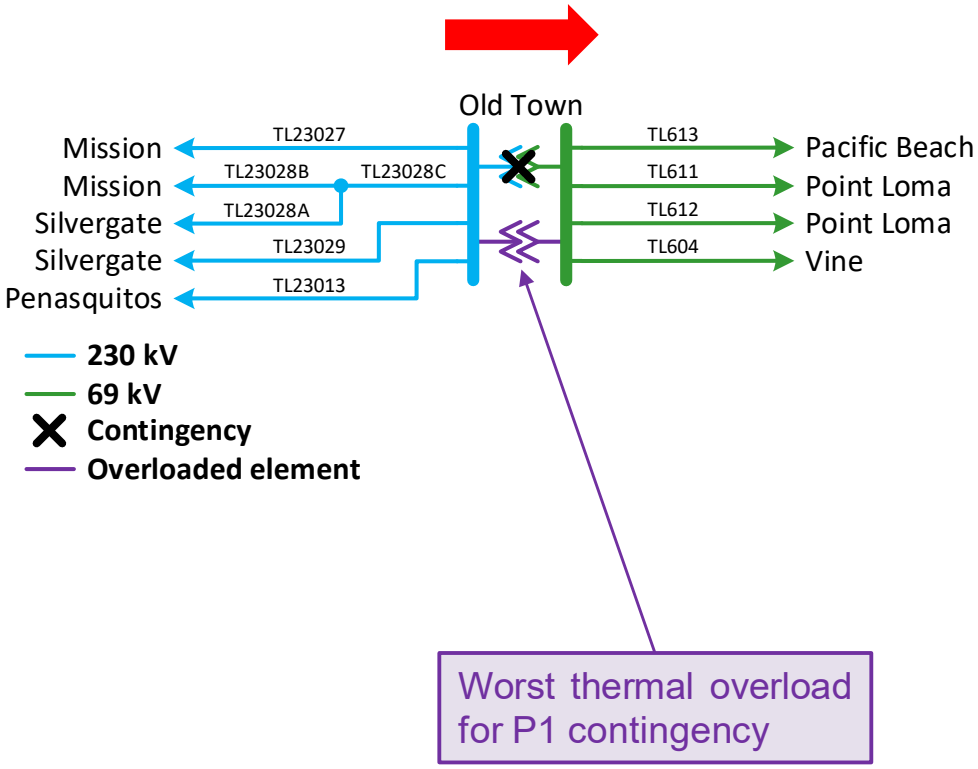
- P6 thermal overload: 108% of normal rating for TL23011A in S1 case

Potential Mitigation

- System adjustments and operational actions
  - Reducing generation output at Palomar Energy Center

S1 → 2025 Summer Peak with heavy renewable output and minimum gas generation commitment

Old Town 230/69 kV Banks 70 and 71



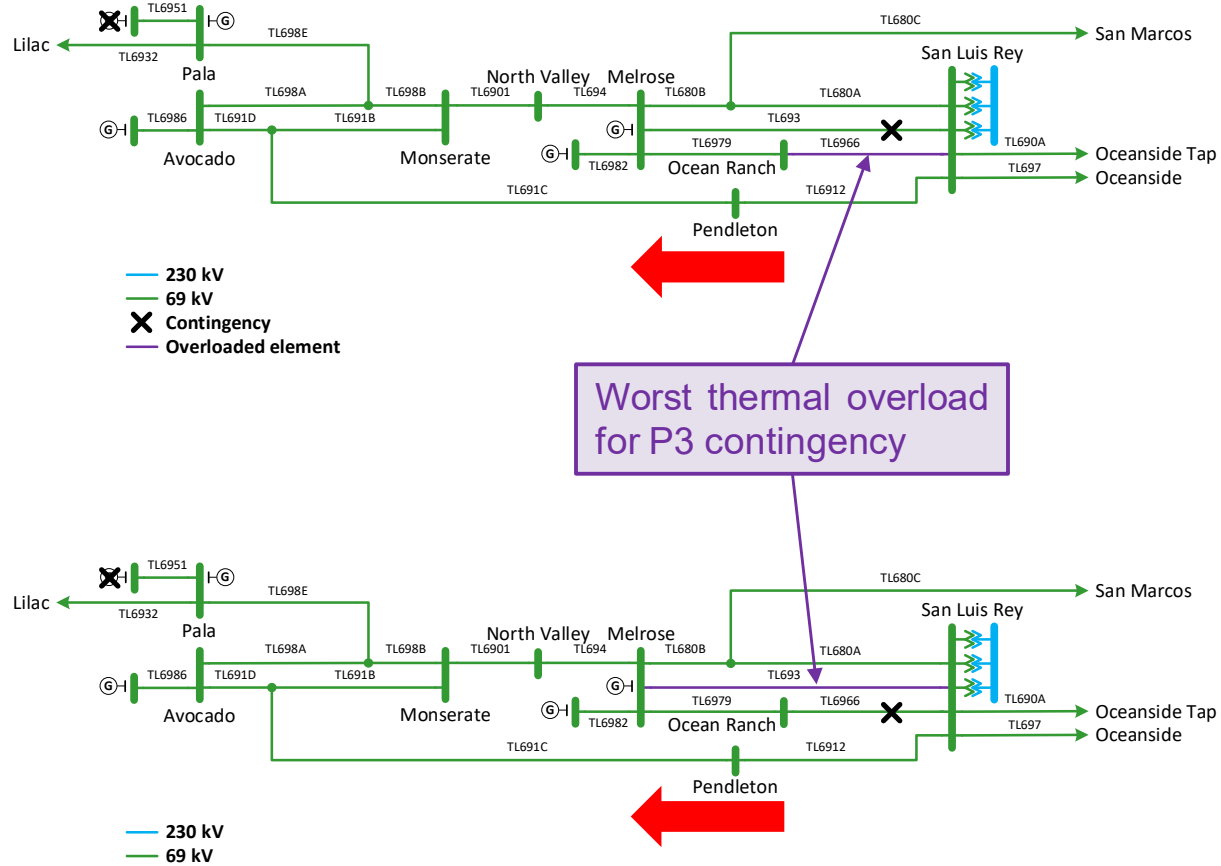
Reliability Concern

- P1 and P4 thermal overloads: 108% of 24-hr rating for Old Town BK70 or BK71 in B3 case

Potential Mitigation

- Add a third 230/69 kV transformer in Old Town substation
- Install battery energy storage in the 69 kV load pocket area if there is space available

69 kV TL693 San Luis Rey – Melrose and TL6966 San Luis Rey – Ocean Ranch



Worst thermal overload for P3 contingency

Reliability Concern

- P3 thermal overloads: 103% of normal rating for TL693 in S2 case
- P1, P3 and P5 thermal overloads: 100% → 123%* of normal rating for TL6966

Potential Mitigation

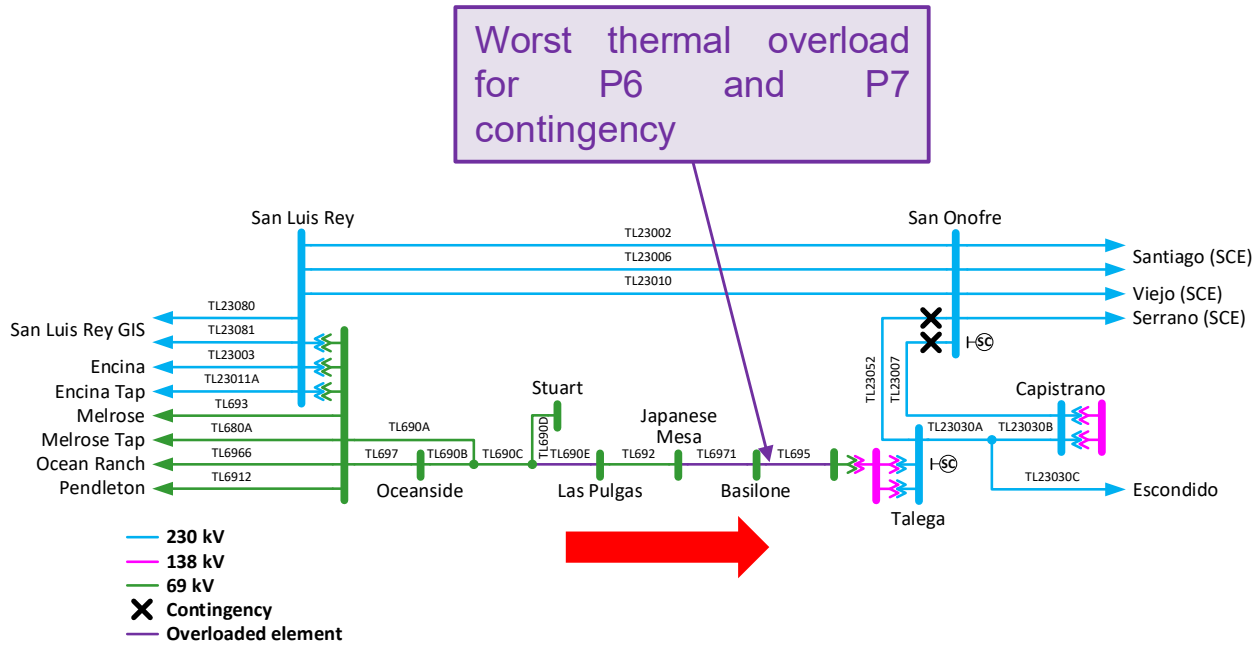
- Dispatch Melrose BESS in B3 and B5 cases
- Limit the charging of Melrose BESS in S2 case
- Continue to monitor the P5 concern in the S2 case
- Potential need for transmission upgrades in the long term

B3 → 2035 Summer Peak
B5 → 2035 Winter Peak
S2 → 2025 Spring Off-Peak with storage charging in load pockets

*Considering both base and sensitivity scenarios

California ISO Public

69 kV TL695 Talega – Basilone, TL6971 Basilone – Japanese Mesa and TL690E Stuart Tap – Las Pulgas



Reliability Concern

- P6 and P7 thermal overloads: 131% of normal rating for TL6971 in B1 case
- P3, P4, P6 and P7 thermal overloads: 117% → 165%* of normal rating for TL695
- P6 and P7 thermal overloads: 108% → 148%* of normal rating for TL690E

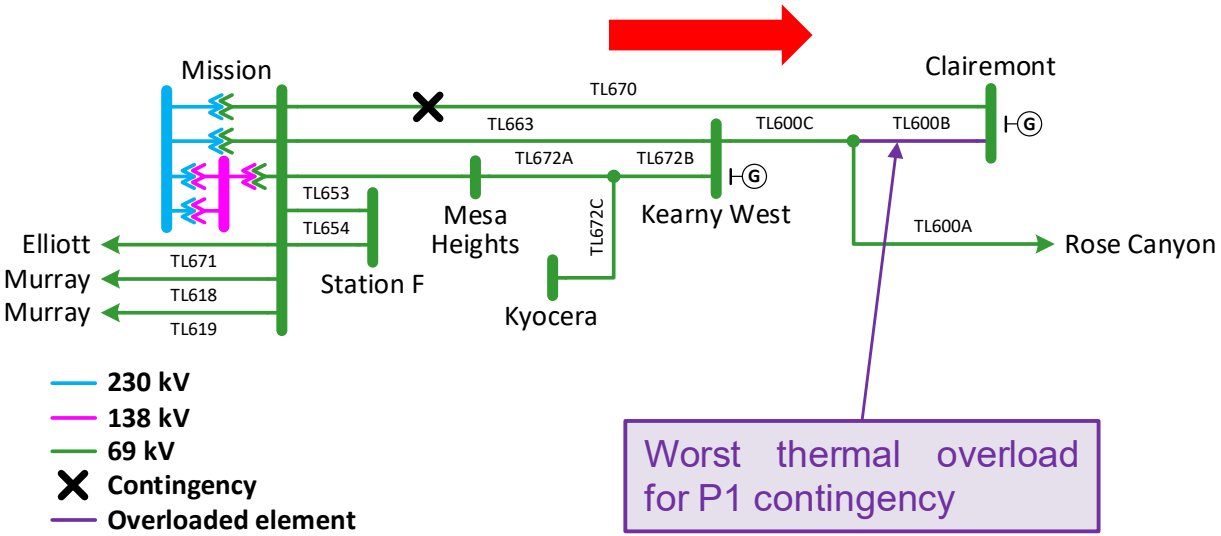
Potential Mitigation

- Existing TL695 at TA overload scheme in the short-term
- TL695B Japanese Mesa-Talega Tap Reconductor project (ISD August 2026)
- TL690E, Stuart Tap-Las Pulgas 69 kV Reconductor project (ISD March 2028)

B1 → 2025 Summer Peak

*Considering both base and sensitivity scenarios

69 kV TL600B Clairemont – Clairemont Tap



Reliability Concern

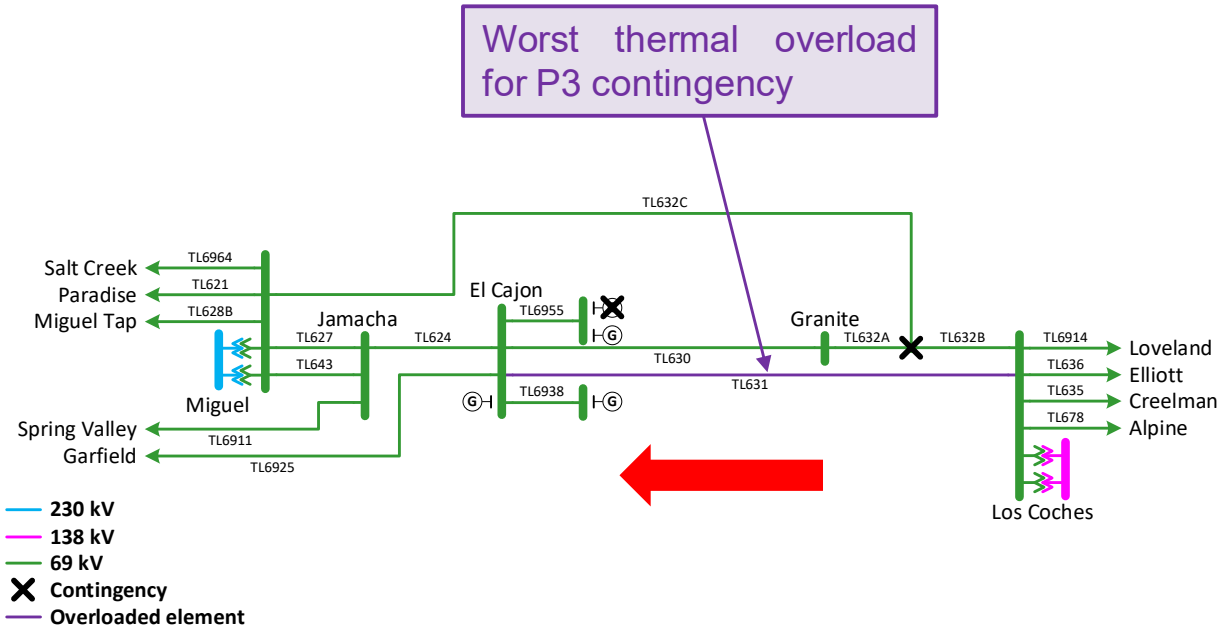
- P1 thermal overload: 106% of normal rating for TL600B in B3 case

Potential Mitigation

- Discuss potential upgrade alternatives with the PTO or install additional battery energy storage at Clairemont substation

B3 → 2035 Summer Peak

El Cajon LCR Subarea – 69 kV TL631 El Cajon – Los Coches



Reliability Concern

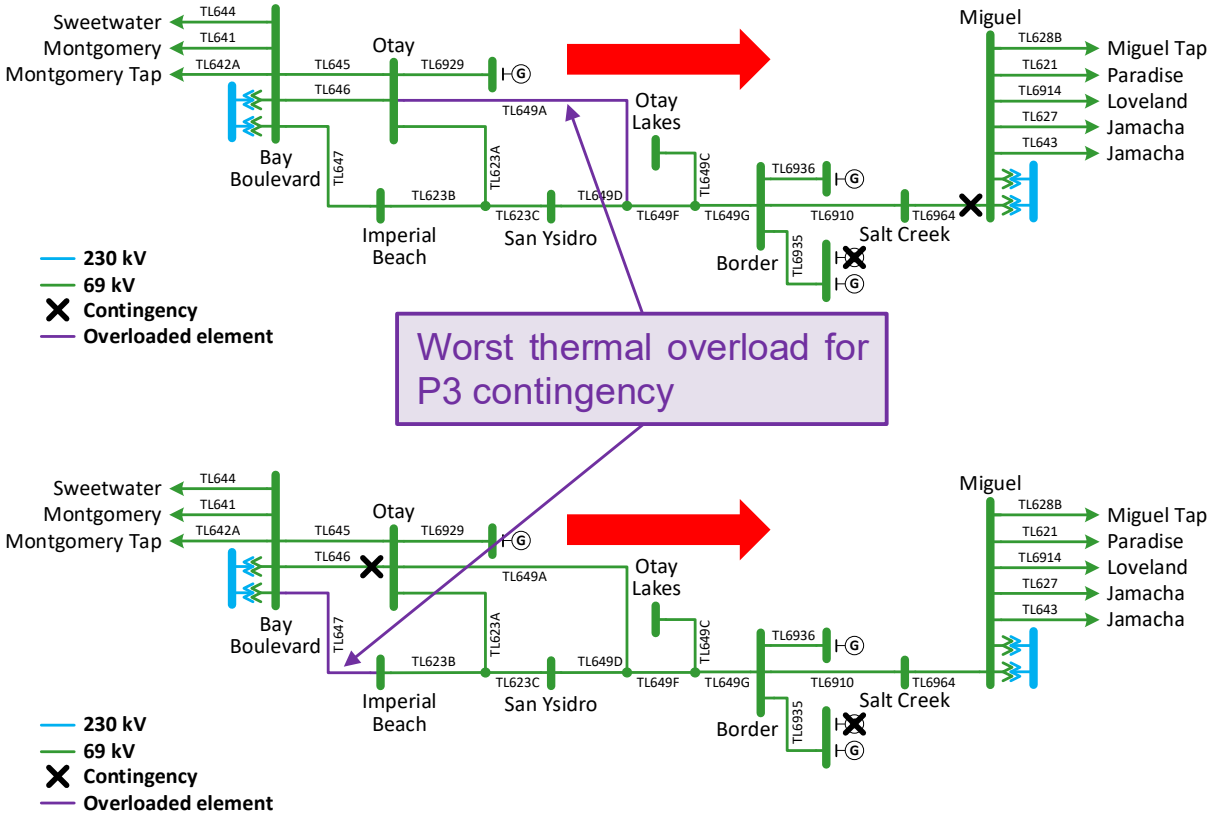
- P1 and P3 thermal overloads: 103% →111% of normal rating in S1 case
- P3 thermal overloads: 100% → 105% of normal rating in B1 and B6 cases

Potential Mitigation

- Dispatch El Cajon gas fired unit in S1 case
- Dispatch El Cajon, Paradise, Kearny, and/or Clairemont BESS in B1 and B6 cases
- TL632 Granite Loop-In and TL6914 Reconfiguration project (ISD August 2026)

B1 → 2025 Summer Peak
B6 → 2025 Spring Off-Peak
S1 → 2025 Summer Peak with heavy renewable output and minimum gas generation commitment

Border LCR Subarea – 69 kV TL649A Otay – Otay Lakes Tap and TL647 Bay Boulevard – Imperial Beach



Reliability Concern

- P1 thermal overload: 116% of normal rating for TL649A in S1 case
- P1 high voltage deviation: 8.33% at Salt Creek substation in S1 case
- P3 thermal overloads: 102% → 173%* of normal rating for TL649A
- P3 thermal overload: 104% of normal rating for TL647 in B5 case

Potential Mitigation

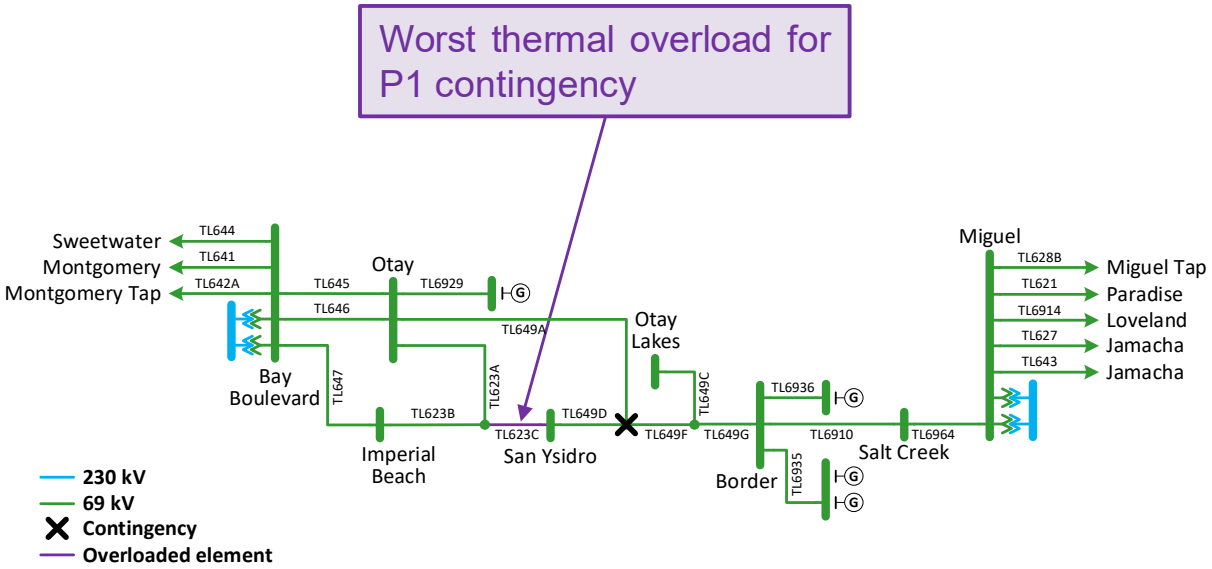
- Dispatch a Border gas fired unit in S1 case
- Dispatch additional Border gas fired generation after the first contingency for P3 events

*Considering both base and sensitivity scenarios

B5 → 2035 Winter Peak
S1 → 2025 Summer Peak with heavy renewable output and minimum gas generation commitment

California ISO Public

69 kV TL623C San Ysidro – Otay Tap



Reliability Concern

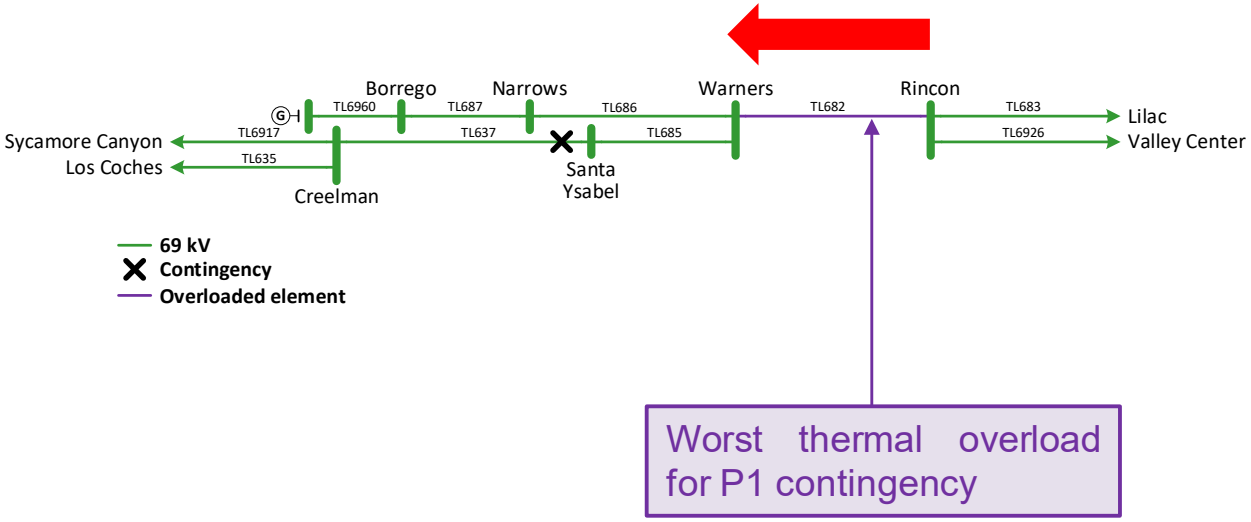
- P1 thermal overloads: 102% → 104%* of normal rating

Potential Mitigation

- TL623C Reconductor San Ysidro - Otay Tap (ISD September 2029)

*Considering both base and sensitivity scenarios

69 kV TL682 Warners – Rincon



Reliability Concern

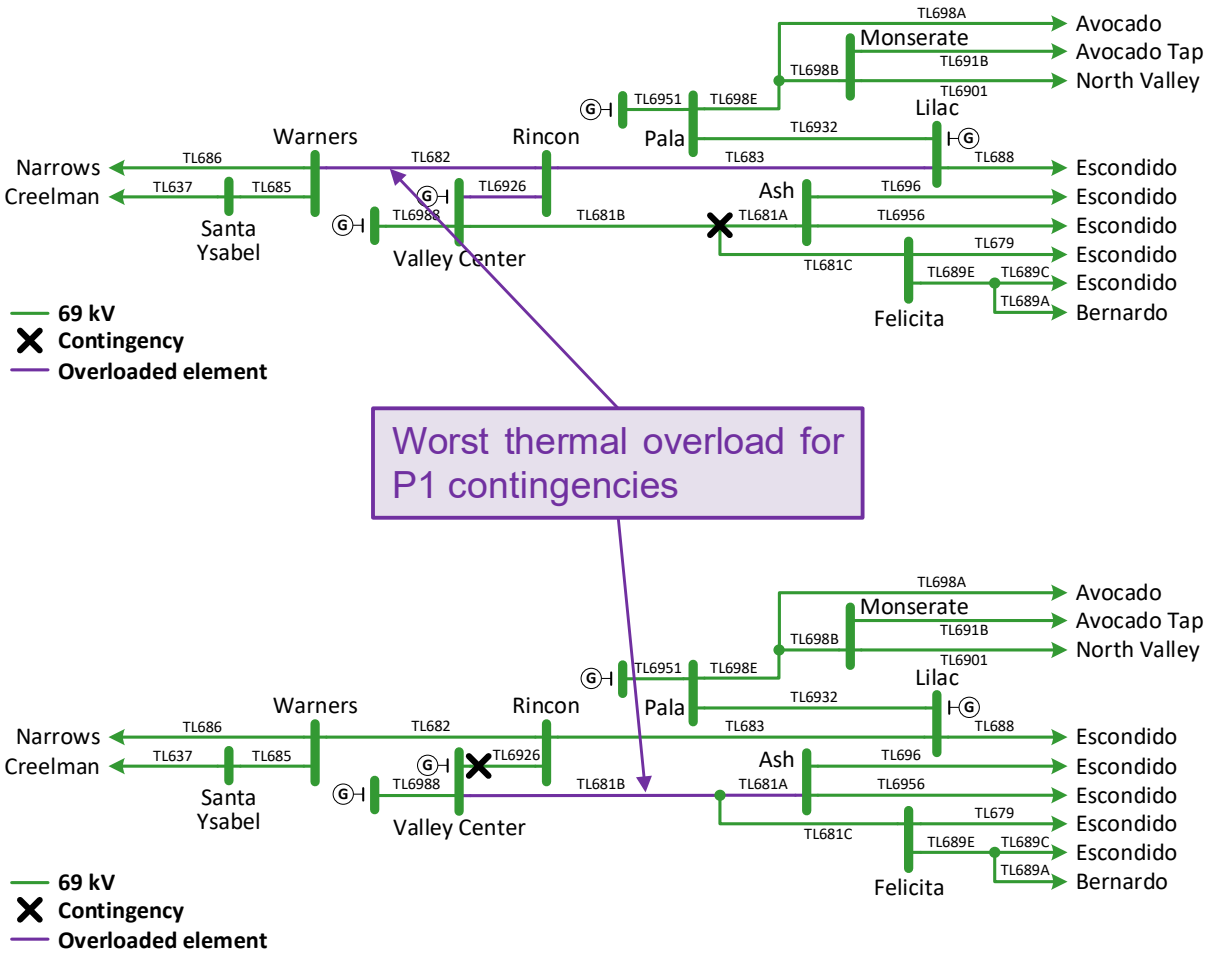
- P1 thermal overload: 102% of normal rating for TL682 in B3 case

Potential Mitigation

- Change Current Transformer at Warners substation

B3 → 2035 Summer Peak

Valley Center BESS charging – 69 kV thermal overloads



Reliability Concern

- P1 and P3 thermal overloads: 135% → 144% of normal rating for TL682 in B7 and B8 cases
- P1 and P3 thermal overloads: 109% → 119% of normal rating for TL683 in B7, B8 and S2 cases
- P1 and P3 thermal overloads: 104% → 139% of normal rating for TL6926 in B7, B8 and S2 cases
- P1, P3 and P6 thermal overloads: 101% → 148% of 9-hr rating for TL681B in B7, B8 and S2 cases
- P1, P3 and P6 thermal overloads: 101% → 110% of 9-hr rating for TL681A in B7, B8 and S2 cases

Potential Mitigation

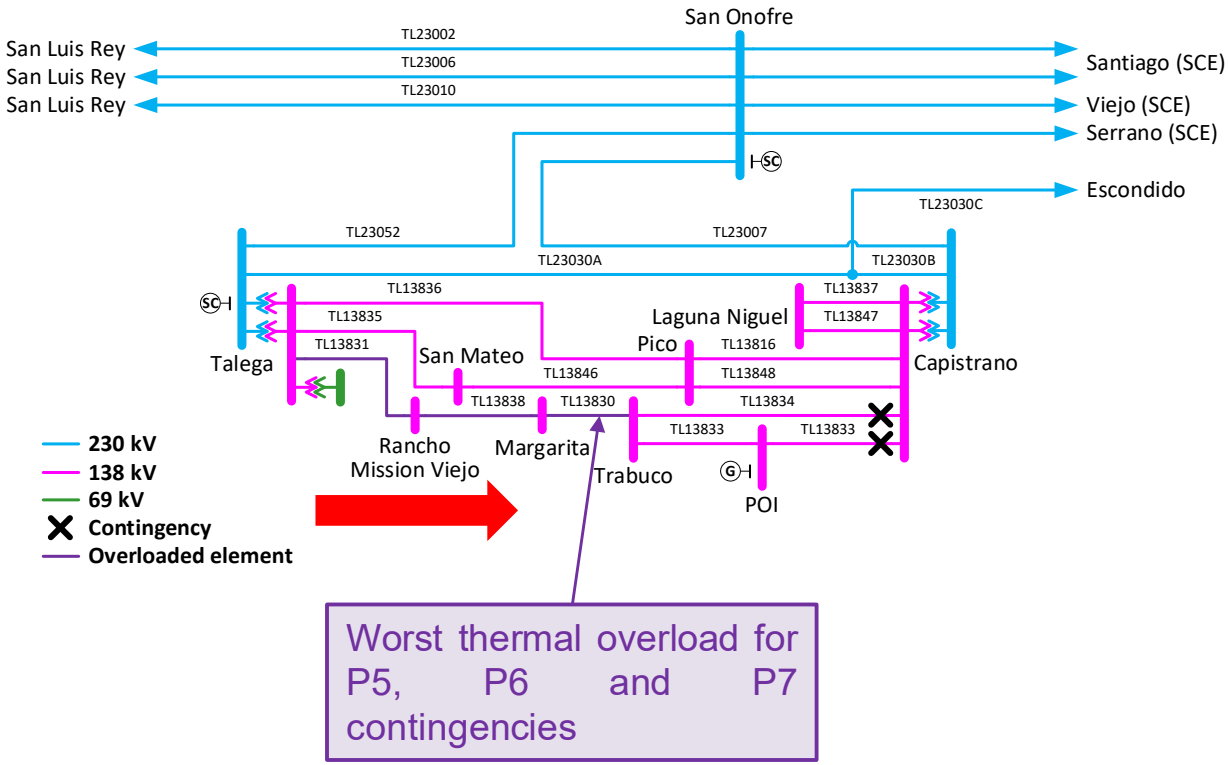
- Limit the charging of BESS to protect against the overloading of TL681A, TL682 and TL683, which currently are not monitored by the RAS
- Existing Valley Center RAS to trip the battery energy storage (under charging mode) at Valley Center
- Discuss potential upgrade alternatives with the PTO

California ISO

B7 → 2028 Spring Off-Peak
B8 → 2035 Spring Off-Peak
S2 → 2025 Spring Off-Peak with storage charging in load pockets

California ISO Public

Trabuco – Capistrano BESS charging – 138 kV thermal overloads (1/2)



Reliability Concern

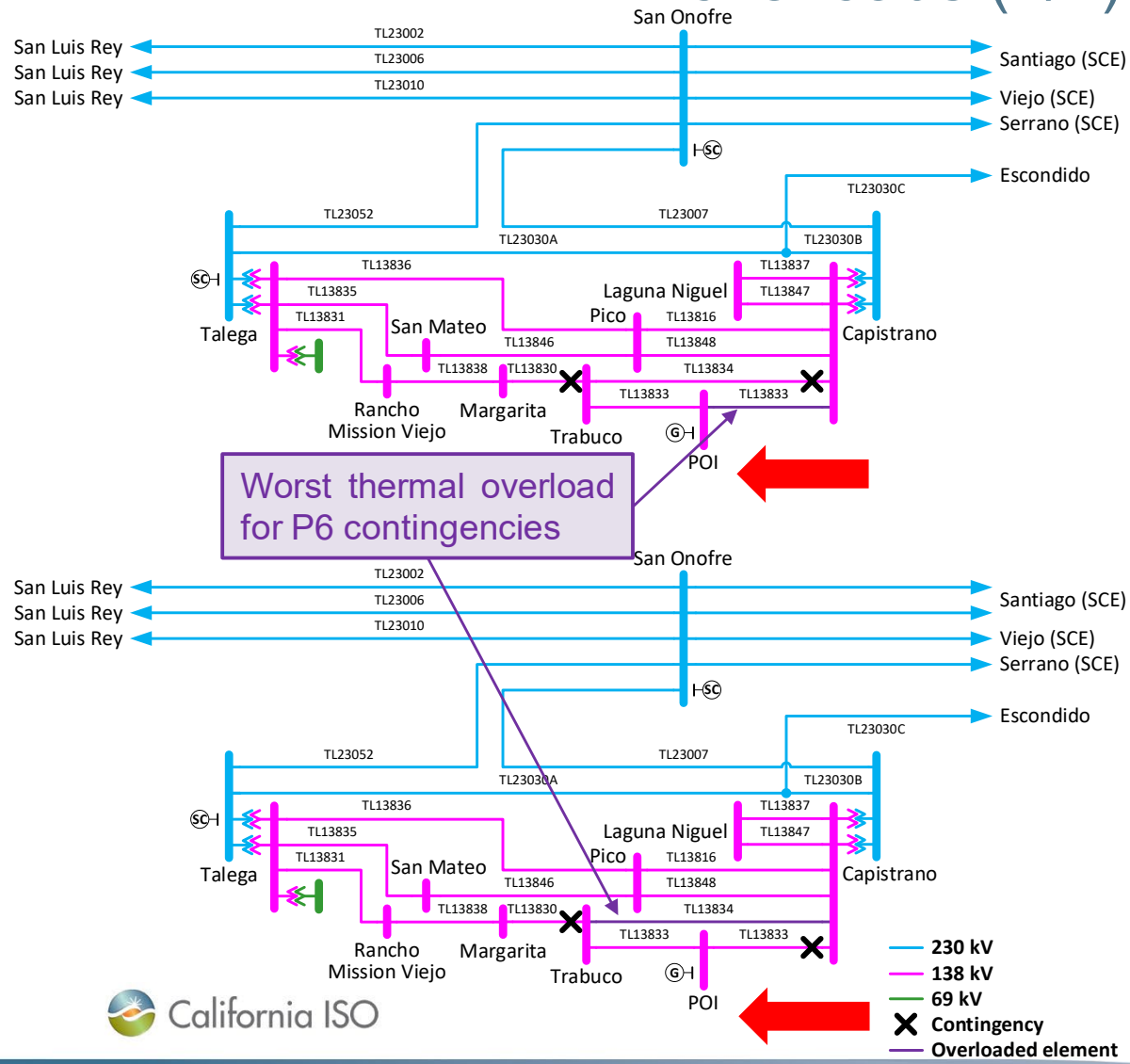
- P5, P6 and P7 thermal overloads: 105 → 107% of normal rating for TL13830, TL13831 and TL13838 in B8 case

Potential Mitigation

- Continue to monitor the 138 kV thermal overload concerns identified in the B8 case and discuss with the PTO the potential for cost effective upgrade solutions for P5 and P7 contingencies

B8 → 2035 Spring Off-Peak

Trabuco – Capistrano BESS charging – 138 kV thermal overloads (2/2)



Reliability Concern

- P2 and P6 thermal overloads: 104% of normal rating for TL13833 in B8 case
- P6 thermal overload: 105% of normal rating for TL13834 in B8 case

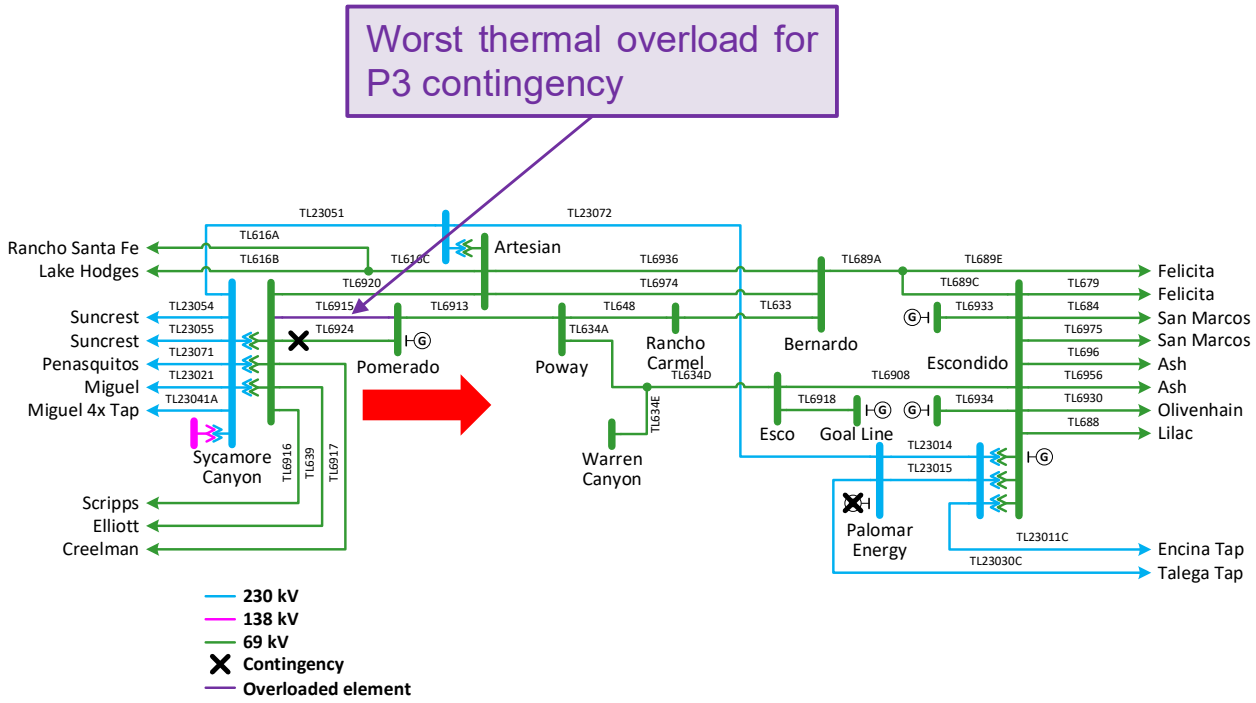
Potential Mitigation

- Continue to monitor the 138 kV thermal overload concerns identified in the B8 case and discuss with the PTO the potential for cost effective upgrade solutions for P2 contingency

B8 → 2035 Spring Off-Peak

California ISO Public

Pomerado BESS charging – 69 kV TL6915/TL6924 Sycamore Canyon – Pomerado



Reliability Concern

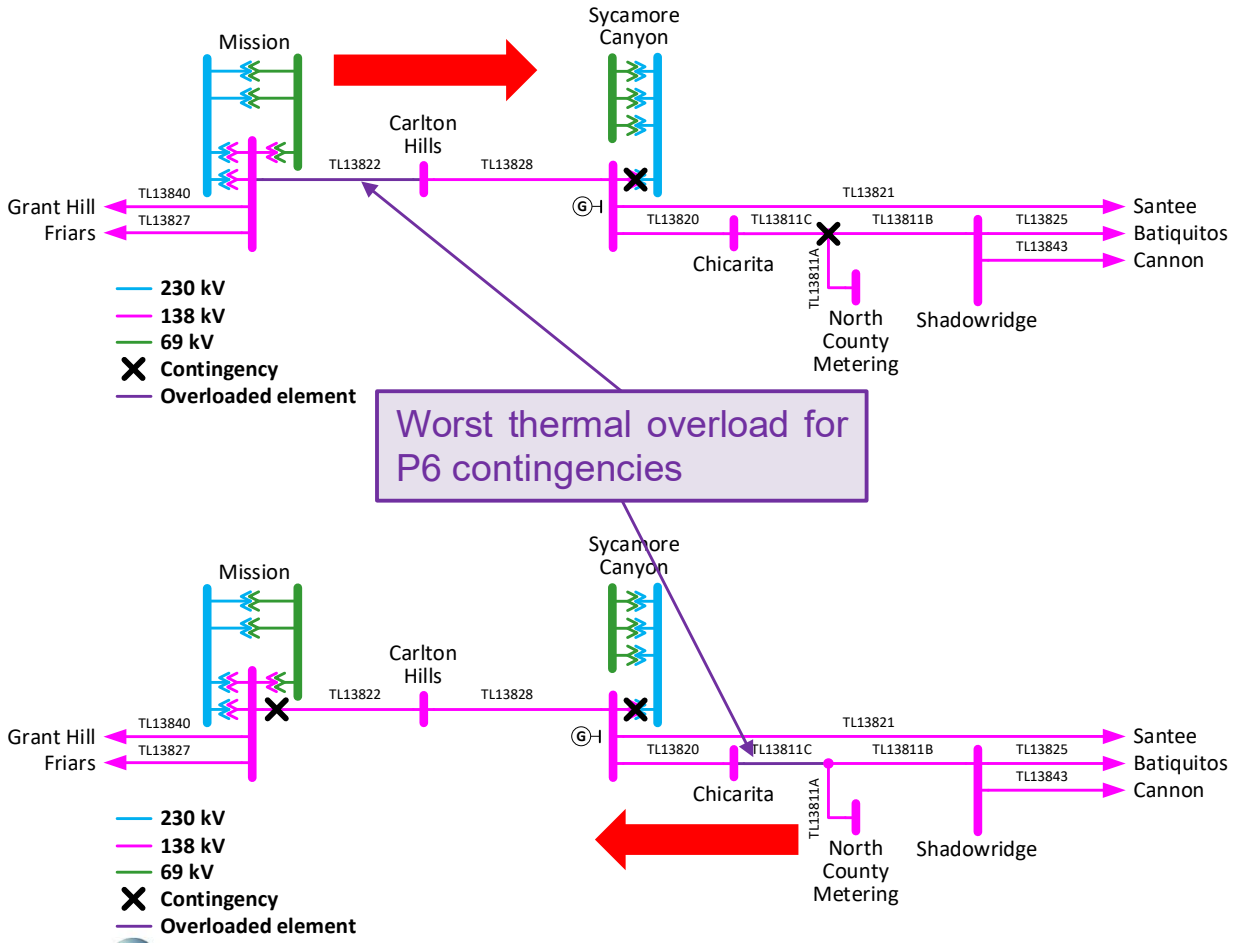
- P3 thermal overloads: 103% of 5-hr rating for TL6915 and TL6924 in S2 case

Potential Mitigation

- Battery energy storage charging curtailment after the first contingency for the P3 events

S2 → 2025 Spring Off-Peak with storage charging in load pockets

Sycamore Canyon BESS charging – 138 kV TL13822 Mission – Carlton Hills and TL13811C Chicarita – North County Metering Tap



Reliability Concern

- P6 thermal overload: 108% of normal rating for TL13811C in S2 case
- P6 thermal overload: 102% of normal rating for TL13822 in S2 case

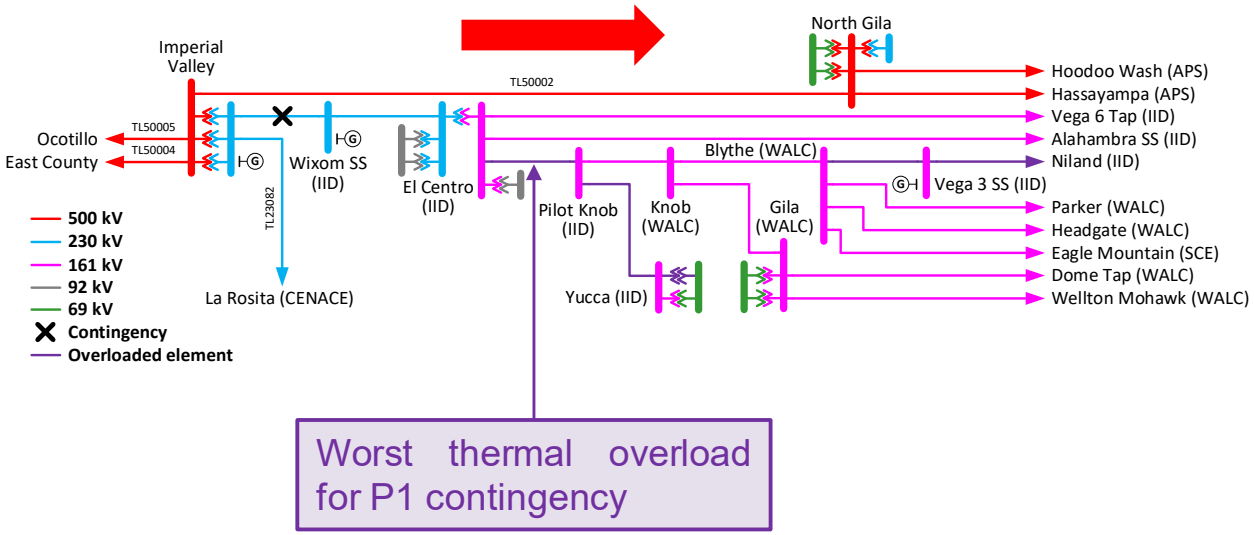
Potential Mitigation

- Battery energy storage charging curtailment after the first contingency for the P6 events

S2 → 2025 Spring Off-Peak with storage charging in load pockets

California ISO Public

IID thermal overloads due to high export



High export from IID area to SDG&E and SCE Eastern areas in B5, B7 and B8 cases

B5 → 2035 Winter Peak
B7 → 2028 Spring Off-Peak
B8 → 2035 Spring Off-Peak

Reliability Concern

- P1 thermal overloads: 102% → 152% of normal rating
- P3 thermal overloads: 104% → 157% of normal rating
- P4 thermal overloads: 102% → 158% of normal rating

Potential Mitigation

- IID would need to rely on pre-contingency congestion management to protect against the P1 outage of the S-Line
- Additional system adjustments in IID area would be needed for some of the P3 and P6 events
- Blythe RAS would operate for the contingencies that include the outage of J. Hinds - Mirage 230 kV transmission line

Transient Stability Analysis

- Performed for B2, B3, B6, S2, and S3 cases
- 52 credible contingencies evaluated for all cases and 5 additional contingencies in the B3 case due to the addition of the Imperial Valley – North of SONGS – Serrano 500 kV transmission lines and 230 kV transmission lines loop-in into North of SONGS substation
  - Includes P1, P5.5 and P7
- No WECC criteria violations were observed

Agenda
Reliability Assessment and Study Updates

Isabella Nicosia
Senior Stakeholder Engagement and Policy Specialist

2023-2024 Transmission Planning Process Stakeholder Meeting
September 26-27, 2023

2023-2024 Transmission Planning Process Stakeholder Call – Agenda

Topic	Presenter
Day 1 – September 26	
Overview & Key Issues	Binaya Shrestha
Reliability Assessment – North	RTN - Engineers
Reliability Assessment - South	RTS - Engineers
Day 2 – September 27	
PTO Proposed Reliability Solutions	SDG&E, PG&E, SCE, GLW
High Voltage TAC Update	Binaya Shrestha
Policy Assessment - Update	Lindsey Thomas
Economic Assessment - Update	Yi Zhang
20-Year Transmission Outlook - Update	Ebrahim Rahimi