Agenda
Reliability Assessment and Study Updates

Isabella Nicosia
Stakeholder Engagement and Policy Specialist

2021-2022 Transmission Planning Process Stakeholder Meeting
September 27-28, 2021

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.
- To ask a question, press #2 on your telephone keypad. Please state your name and affiliation first.
- Calls are structured to stimulate an honest dialogue and engage different perspectives.
- Please keep comments friendly and respectful.

2021-2022 Transmission Planning Process Stakeholder Call – Agenda

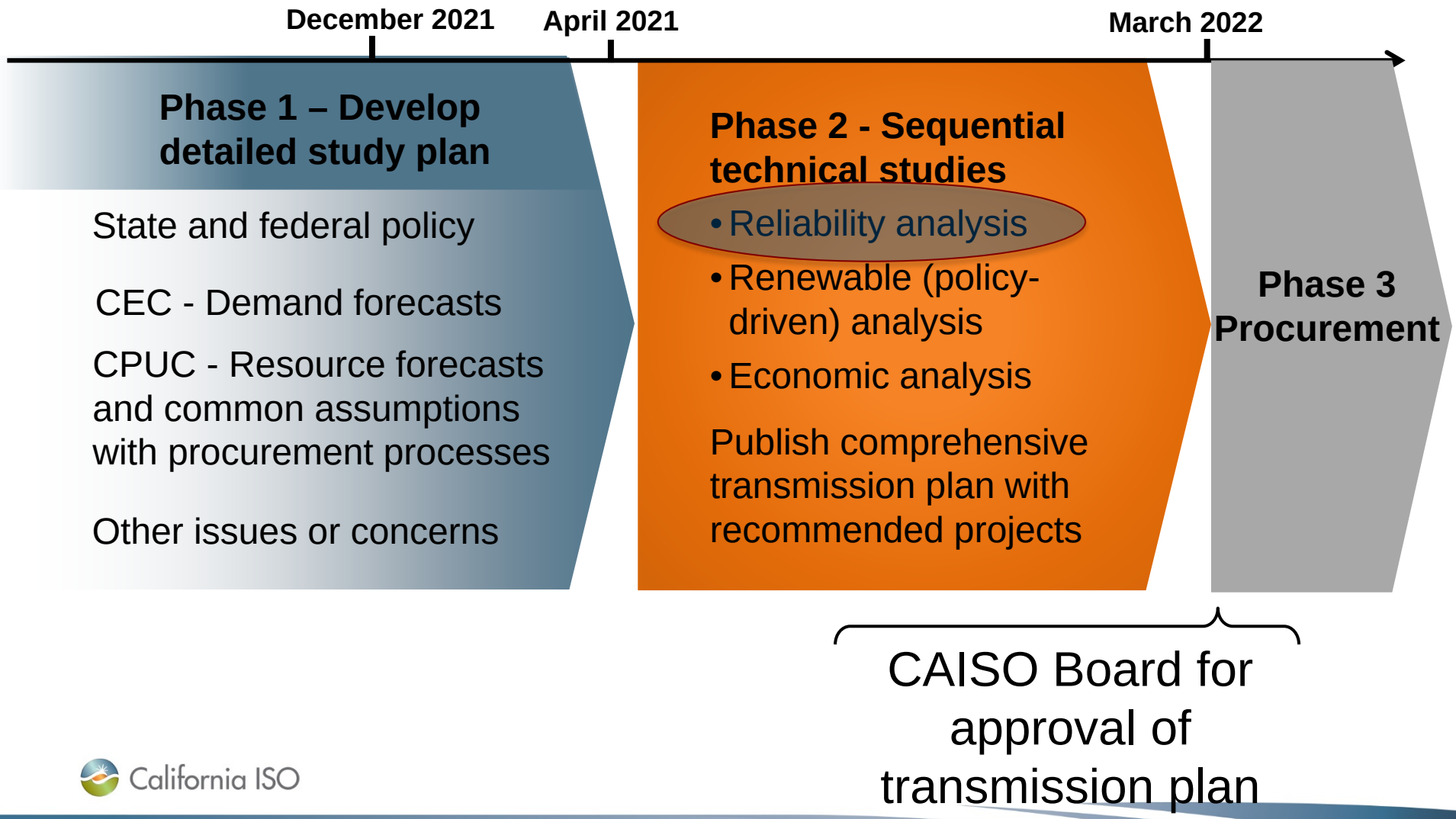
Topic	Presenter
Day 1 – September 27	
Overview & Key Issues	Jeff Billinton
Reliability Assessment - North	RTN - Engineers
Reliability Assessment - South	RTS - Engineers
Wildfire Assessment - Scenarios	David Le
20 Year Transmission Outlook - Update	Jeff Billinton
Day 2 – September 28	
PTO Proposed Reliability Solutions	PG&E, SCE, SDG&E, GLW
Economic Assessment - Update	Yi Zhang
Next Steps	Isabella Nicosia

Introduction and Overview
Preliminary Reliability Assessment Results

Jeff Billinton
Director, Transmission Infrastructure Planning

2021-2022 Transmission Planning Process Stakeholder Meeting
September 27-28, 2021

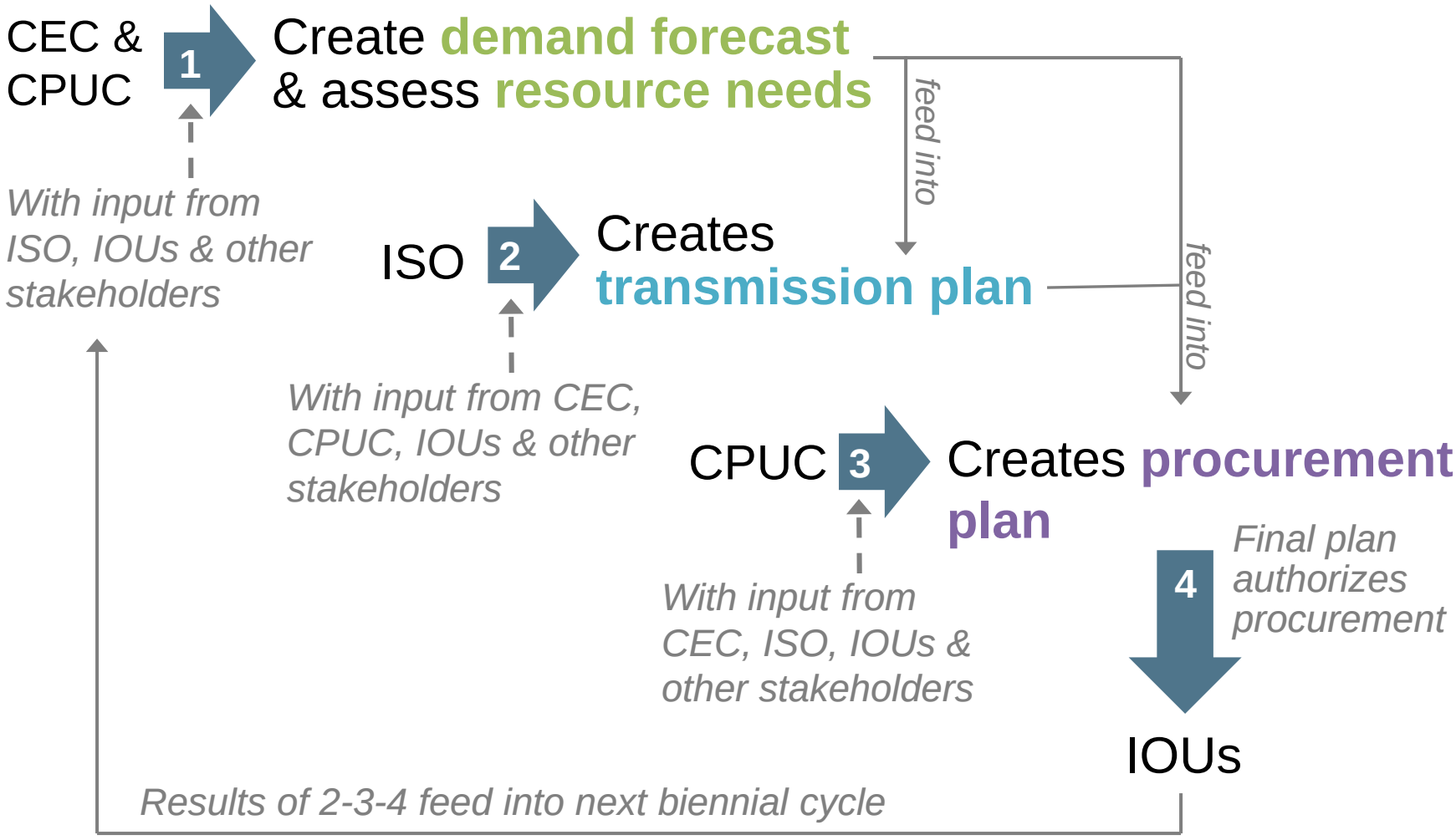
2021-2022 Transmission Planning Process



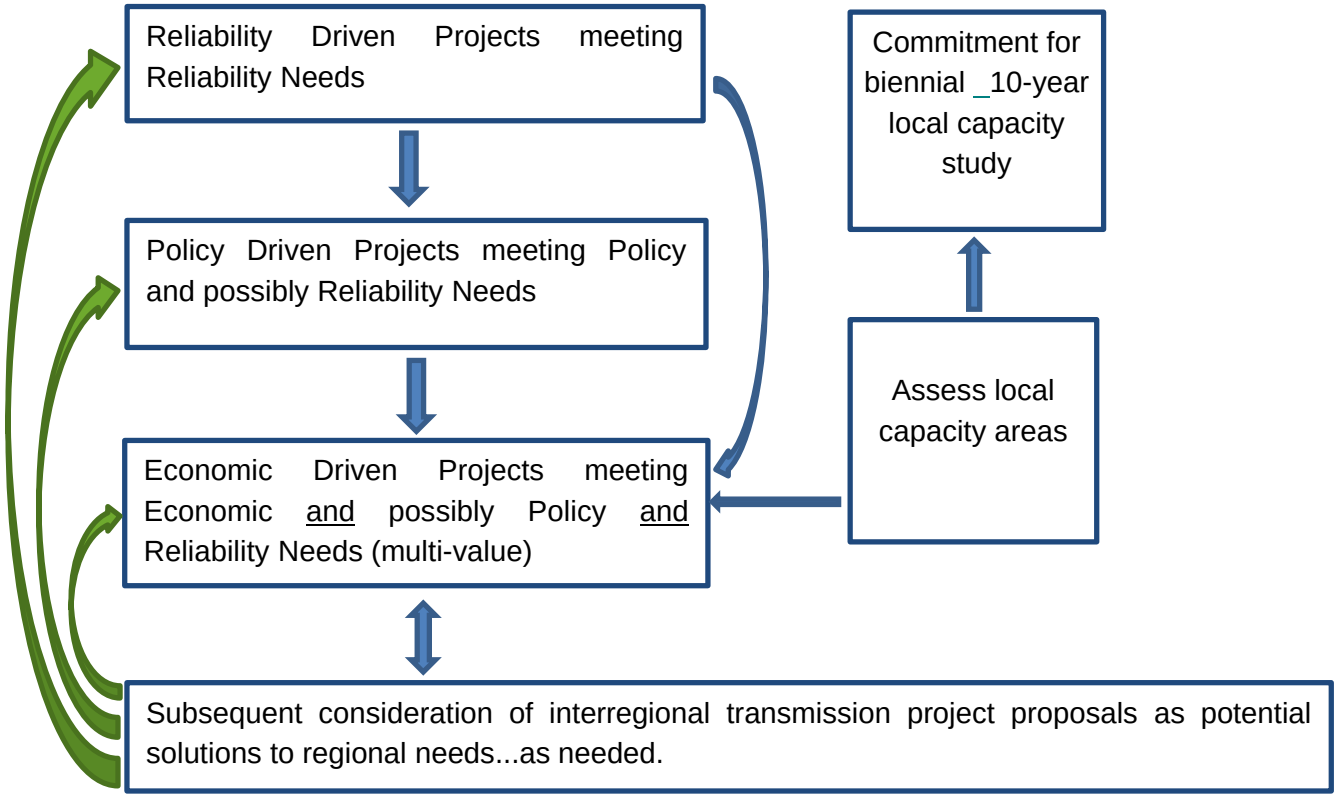
2021-2022 Transmission Plan Milestones

- Draft Study Plan posted on February 18
- Stakeholder meeting on Draft Study Plan on February 25
- Final Study Plan posted on March 31
- Stakeholder meeting May 14
- Stakeholder meeting July 27
- Preliminary reliability study results posted and open Request Window on August 13
- Stakeholder meeting on September 27 and 28
  - Comments to be submitted by October 12
- Request window closes October 15
- Preliminary policy and economic study results on November 18
- Comments to be submitted by December 6
- Draft transmission plan to be posted on January 31, 2022
- Stakeholder meeting in February
- Comments to be submitted within two weeks after stakeholder meeting
- Revised draft for approval at March Board of Governor meeting

Planning and procurement overview



Studies are coordinated as a part of the transmission planning process



The reliability assessment is a key component of the overall 2021-2022 Transmission Plan Study Plan

- Reliability Assessment to identify reliability-driven needs
  - CPUC IRP base portfolio used for reliability assessment
  - Load forecast based on California Energy Demand Revised Forecast 2020-2031 adopted by California Energy Commission (CEC) on January 25, 2021
- 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
    - Wildfire PSPS assessment, conducted as extreme event analysis

2021-2022 Ten Year Reliability Assessment To Date

- Preliminary study results were posted on August 13
  - Based on assumptions identified in 2021-2022 Study Plan
  - Satisfy requirements of:
    - NERC Reliability Standards
    - WECC Regional Criteria
    - ISO Planning Standards
- Transmission request window (reliability driven projects) opened on August 13
  - PTO proposed mitigations submitted to CAISO by September 15

2021-2022 Ten Year Reliability Assessment

- Comments on Stakeholder Meeting due October 12
- 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 plan to be issued for stakeholder comments by January 31, 2022
- Purpose of today's stakeholder meeting
  - Review the results of the reliability analysis, including wildfire PSPS assessment
  - 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 Issues

- Preparation for policy and economic assessment are underway with the preliminary analysis to be presented at the November 17 stakeholder meeting
- The CAISO will be updating the wildfire assessment for the North Coast North Bay area. Working with PG&E and CPUC on updated weather scenarios to present preliminary results at the November 17 stakeholder meeting
- Preparation for 20 year transmission underway are underway, based upon SB100 Starting Point scenario that will be presented today, with an update of the preliminary analysis to be presented at the November 17 stakeholder meeting

Key Issues
(continued)

- The transmission access forecast charge model from the 2020-2021 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 2021-2022 transmission planning process with the stakeholder comments submitted on this stakeholder call

Comments

- Comments due by end of day October 12, 2021

- Submit comments through the ISO's commenting tool, using the template provided on the process webpage:
- https://stakeholdercenter.caiso.com/RecurringStakeholderProcesses/2021-2022-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

Greater Bay Area
Preliminary Reliability Assessment Results

Binaya Shrestha
Manager - Regional Transmission North

2021-22 Transmission Planning Process Stakeholder Meeting
September 27-28, 2021

Greater Bay Area

- Service areas cover Alameda, Contra Costa, Santa Clara, San Mateo and San Francisco counties.
- Supply sources: Vaca Dixon, Tesla and Metcalf
- 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

Load and Load Modifier Assumptions - Greater Bay Area

S. No.	Study Case	Scenario Type	Description	Gross Load (MW)	AAEE (MW)	BTM-PV		Net Load (MW)	Demand	
						Installed (MW)	Output (MW)		Total (MW)	D2 (MW)
1	2023-SP	Baseline	2023 summer peak load conditions. Peak load time - hours ending 18:00.	9,081	40	1,931	155	8,886	61	30
2	2023-WP	Baseline	2023 winter peak load conditions. Peak load time - hours ending 19:00.	7,351	51	1,931	12	7,288	61	30
3	2023-SpOP	Baseline	2023 spring off-peak load conditions. Off-peak load time - hours ending 20:00.	6,245	104	1,931	0	6,141	61	30
4	2023-SP-HiRenew	Sensitivity	2023 summer peak load conditions with hi-renewable dispatch sensitivity	9,081	40	1,931	1,912	7,129	61	30
5	2023-OP-HiRenew	Baseline	2023 spring off-peak load conditions with hi-renewable dispatch sensitivity	6,245	104	1,931	1,944	4,197	61	30
6	2026-SP	Baseline	2026 summer peak load conditions. Peak load time - hours ending 19:00.	9,177	60	2,423	24	9,093	59	30
7	2026-WP	Baseline	2026 winter peak load conditions. Peak load time - hours ending 19:00.	7,874	81	2,423	0	7,793	59	30
8	2026-SpOP	Baseline	2026 spring off-peak load conditions. Off-peak load time - hours ending 13:00.	5,118	52	2,423	1,914	3,152	59	30
9	2026-SP-Hi-CEC	Sensitivity	2026 summer peak load conditions with high CEC load forecast sensitivity	9,177	0	2,423	24	9,153	59	30
10	2031-SP	Baseline	2031 summer peak load conditions. Peak load time - hours ending 19:00.	9,486	142	3,098	31	9,313	57	30
11	2031-WP	Baseline	2031 winter peak load conditions. Peak load time - hours ending 19:00.	8,389	142	3,098	0	8,247	57	30
12	2031-Hi-SouthBay	Sensitivity	2031 summer peak load conditions with high South Bay load sensitivity	9,937	142	3,098	31	9,764	57	30

Note: Includes PG&E load only. DR and storage are modeled offline in starting base cases.

Generation Assumptions - Greater Bay Area

S. No.	Study Case	Scenario Type	Description	Battery Storage (MW)	Solar		Wind		Hydro		Thermal	
					Installed (MW)	Dispatch (MW)	Installed (MW)	Dispatch (MW)	Installed (MW)	Dispatch (MW)	Installed (MW)	Dispatch (MW)
1	2023-SP	Baseline	2023 summer peak load conditions. Peak load time - hours ending 18:00.	45	48	25	227	98	0	0	5710	5150
2	2023-WP	Baseline	2023 winter peak load conditions. Peak load time - hours ending 19:00.	45	25	0	227	30	0	0	5710	3227
3	2023-SpOP	Baseline	2023 spring off-peak load conditions. Off-peak load time - hours ending 20:00.	45	25	0	227	53	0	0	5910	3091
4	2023-SP-HiRenew	Sensitivity	2023 summer peak load conditions with hi-renewable dispatch sensitivity	45	48	39	227	141	0	0	5710	3095
5	2023-OP-HiRenew	Baseline	2023 spring off-peak load conditions with hi-renewable dispatch sensitivity	45	25	25	227	167	0	0	5910	879
6	2026-SP	Baseline	2026 summer peak load conditions. Peak load time - hours ending 19:00.	401	48	24	227	81	0	0	5710	4947
7	2026-WP	Baseline	2026 winter peak load conditions. Peak load time - hours ending 19:00.	401	48	13	227	30	0	0	5710	4893
8	2026-SpOP	Baseline	2026 spring off-peak load conditions. Off-peak load time - hours ending 13:00.	401	48	45	227	44	0	0	5710	684
9	2026-SP-Hi-CEC	Sensitivity	2026 summer peak load conditions with high CEC load forecast sensitivity	401	48	24	227	81	0	0	5710	4903
10	2031-SP	Baseline	2031 summer peak load conditions. Peak load time - hours ending 19:00.	656	48	24	257	74	0	0	5710	4574
11	2031-WP	Baseline	2031 winter peak load conditions. Peak load time - hours ending 19:00.	656	48	0	257	32	0	0	5710	5126
12	2031-Hi-SouthBay	Sensitivity	2031 summer peak load conditions with high South Bay load sensitivity	656	48	0	257	80	0	0	5710	5032

Previously approved transmission projects modelled in base cases

Project Name	Division	In-service Year	First Year Modeled
Monta Vista 230 kV Bus Upgrade Project	De Anza	2023	2023
Los Esteros 230 kV Substation Shunt Reactor	San Jose	2021	2023
Martin 230 kV Bus Extension Project (Egbert Switching Station)	San Francisco	2024	2026
East Shore-Oakland J 115 kV Reconductoring Project	East Bay	2022	2023
Ravenswood – Cooley Landing 115 kV Reconductor	Peninsula	2022	2023
Oakland Clean Energy Initiative	East Bay	2022	2023
Moraga 230kV Bus Upgrade	East Bay	2026	2026
Northern Oakland Area Reinforcement Project (Maintenance)	East Bay	2027	2030
Jefferson 230 kV Bus Upgrade	Peninsula	2026	2026
South of San Mateo Capacity Increase (Ravenswood-San Mateo 115 kV Line)	Peninsula	2027	2030
Cooley Landing-Palo Alto and Ravenswood-Cooley Landing 115 kV Line Rerate	Peninsula	2022	2023
Metcalf – Piercy & Swift – Metcalf and Newark – Dixon Landing 115 kV Upgrade	San Jose	2029	2030
(Revised) Morgan Hill Area Reinforcement (FKA: Spring Substation)	San Jose	2026	2026
East Shore 230 kV Bus Terminals Reconfiguration	Mission	2026	2026
Newark 230/115 kV Transformer Bank #7 Circuit Breaker Addition	Mission	2026	2026
Christie-Sobrante 115 kV Line Reconductor	East Bay	2028	2030
Moraga-Sobrante 115 kV Line Reconductor	East Bay	On Hold	Not modeled
Ravenswood 230/115 kV transformer #1 Limiting Facility Upgrade	Peninsula	2024	2026
Newark-Milpitas No. 1 115 kV Line Limiting Facility Upgrade	San Jose	2022	2023
North Tower 115 kV Looping Project	East Bay	2030	2030
Moraga-Castro Valley 230 kV Line Capacity Increase Project	Diablo	2025	2026
Pittsburg 230/115 kV Transformer Capacity Increase	Diablo	2026	2026

Reliability assessment preliminary results summary

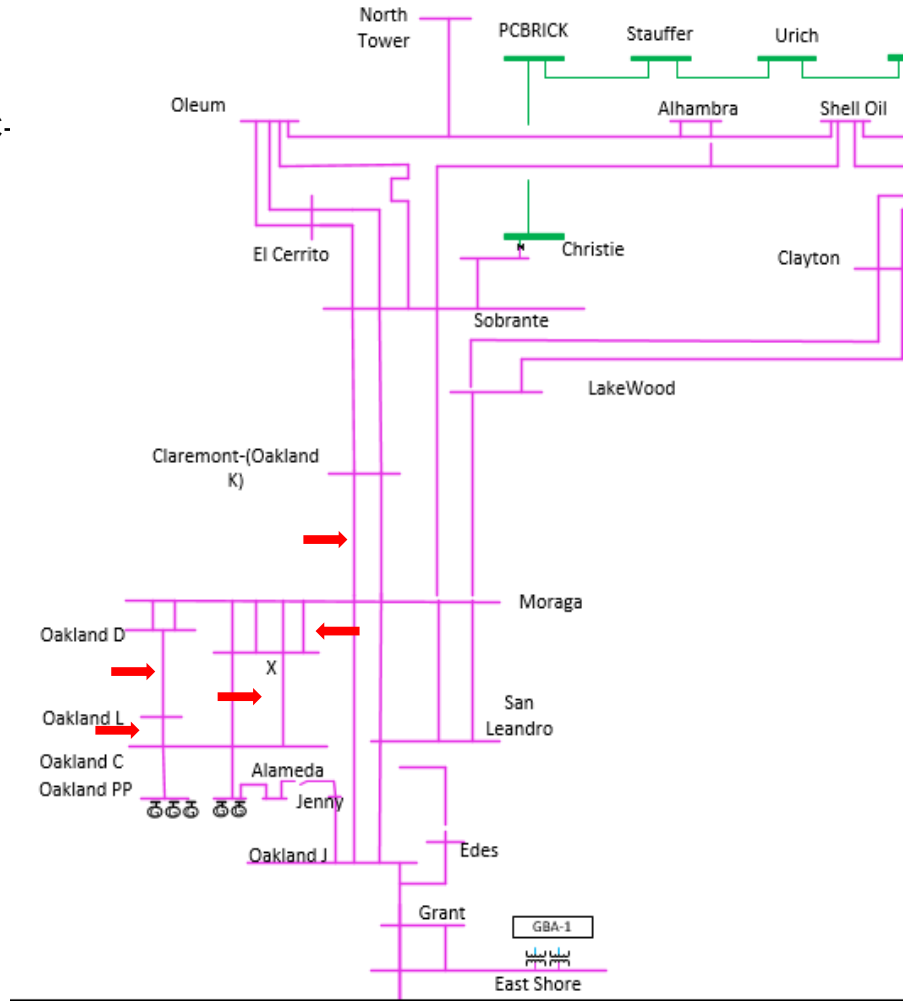
East Bay Division – Results Summary

Observations

- Northern Oakland Issues
  - P2,P6 contingencies driven overloads on Oakland C-X #2, #3 and D-L 115 kV cables in all scenarios.
  - P2,P6 contingencies driven Oakland C-L 115 kV overloads in long-term in Summer and mid-term in Winter Peak scenarios.
  - P2,P6 contingencies driven overloads on Moraga-X 115 kV lines in short-term Summer peak scenario.
  - P2 contingencies driven overloads on Moraga-Claremont 115 kV lines in short and mid-term Summer peak scenarios.

Approved and Potential Mitigations

- Oakland C-X #2, #3 and D-L cables overloads are mitigated by OCEI project.
- Moraga-Claremont and Moraga-Oakland X 115 kV lines overloads are mitigated by Northern Oakland Reinforcement project.
- Oakland C-L 115 kV cable overload will be continued to monitor in the future cycles.



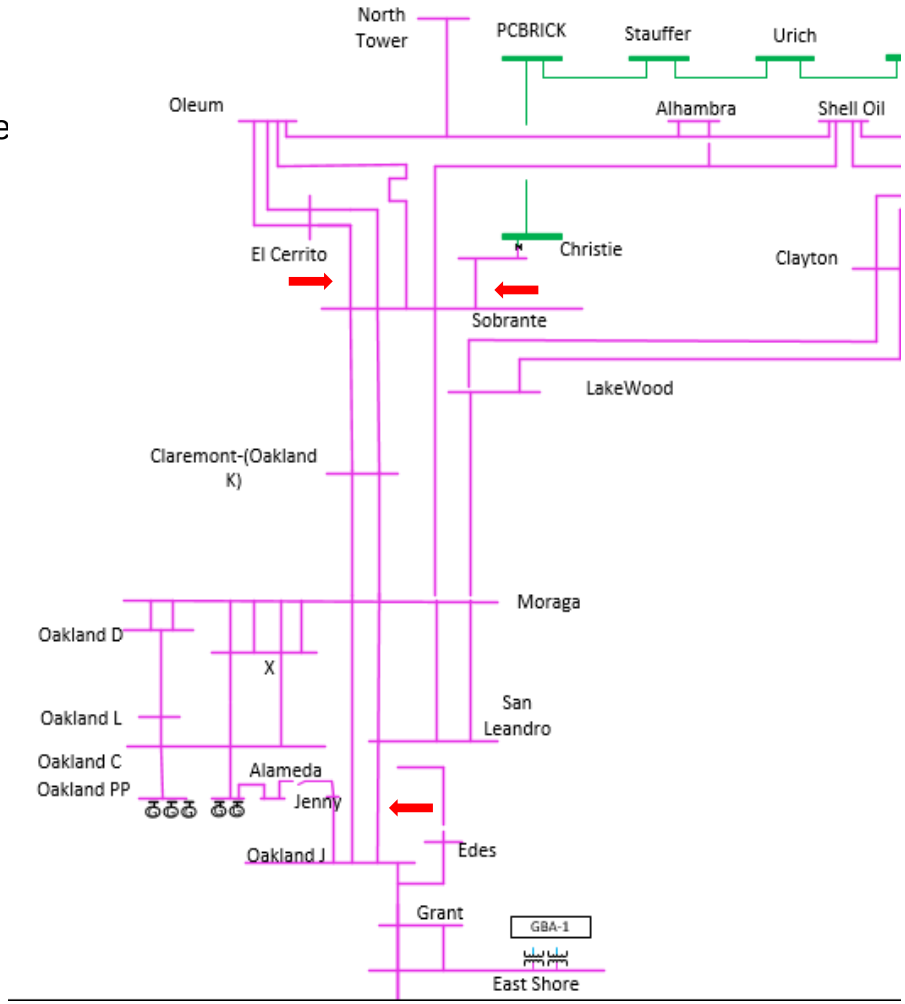
East Bay Division – Results Summary

Observations

- Other East Bay Issues
  - P7 contingency driven overload on Christie-Sobrante 115 kV line in short and mid-term Summer peak scenarios.
  - P2,P5 contingencies driven overloads on San Leandro-Oakland J 115 kV lines in near-term Summer peak scenario.
  - P2,P6 contingencies driven Oakland C-L 115 kV overloads in long-term in Summer and mid-term in Winter Peak scenarios.
  - P2 contingencies driven overloads on Sobrante-El Cerrito 115 kV lines in all Summer peak scenarios.

Approved and Potential Mitigations

- Christie-Sobrante overload is mitigated by reconductoring project.
- San Leandro-Oakland J overload is mitigated by East Shore bus reconfiguration project.
- P2 contingencies causing overloads on Sobrante-El Cerrito lines are under review.



Diablo Division – Results Summary

Observations

230 kV Issues

- P2, P5 overloads in Contra Costa area 230 kV lines some starting year 2 and some only in sensitivity cases.

Pittsburg 115 kV system overloads

- P3 overload on Pittsburg 230/115 kV bank in near-term Summer peak scenario.

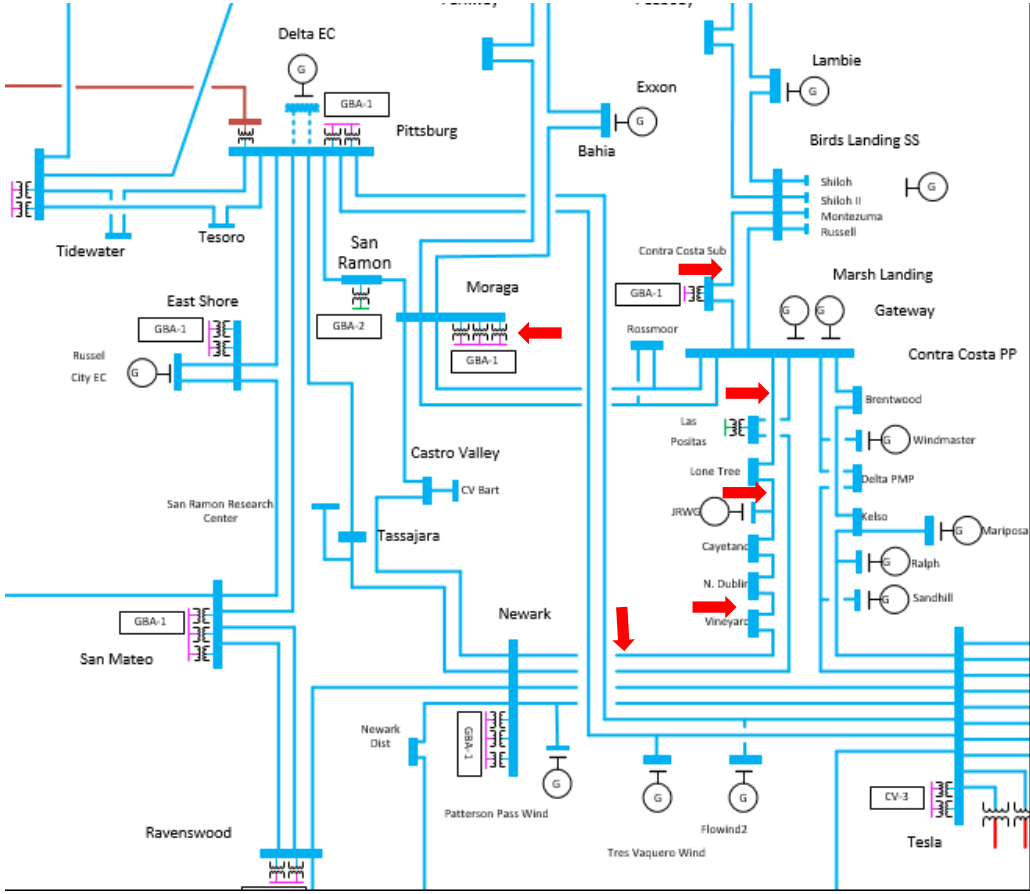
Approved and Potential Mitigations

230 kV

- Overloads driven by P2 contingencies at Moraga 230 kV are mitigated by Moraga 230 kV bus upgrade project.
- Overloads driven by P2 contingencies at Contra Costa 230 kV could potentially be mitigated by Contra Costa 230 kV bus upgrade/reconfiguration.

115 kV

- P3 overload on the Pittsburg bank is mitigated by the Pittsburg 230/115 kV transformer capacity increase project.



San Francisco Division – Results Summary

Observations

- Some P2, P6 overloads observed in long-term Summer peak scenario.

Potential Mitigations

- The overloads will be continued to be monitored in future cycles.

Peninsula Division – Results Summary

Observations

115 kV

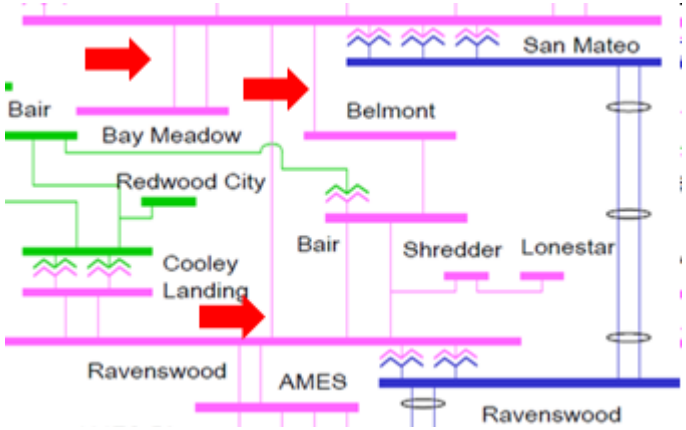
- P6 overload on Ravenswood 230/115 kV bank #1 in short-term Summer peak.
- P5 overloads on Ravenswood-Cooley Landing, Ravenswood-San Mateo #1 and San Mateo-Belmont 115 kV lines in all Summer peak scenarios.

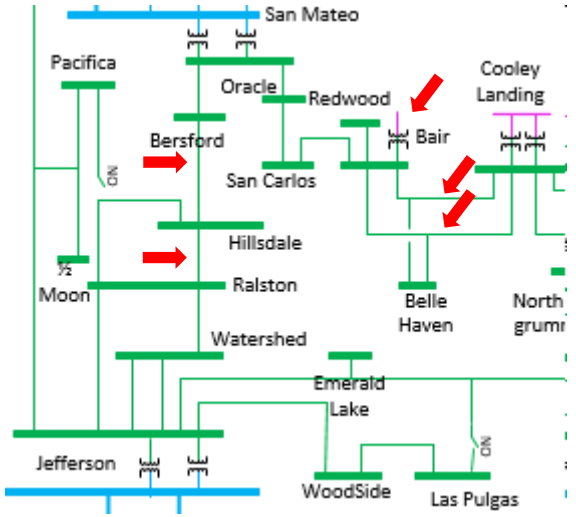
60 kV

- Multiple P5, P7 overloads on Peninsula 60 kV lines in all Summer peak scenarios.

Potential Mitigations

- Ravenswood bank overload is mitigated by the Ravenswood 230/115 kV transformer #1 Limiting Facility Upgrade project
- Recommended protection upgrade at Ravenswood 115 kV bus for P5 driven overloads.
- 60 kV lines overloads are mitigated by the Jefferson 230 kV Bus Upgrade project.





Mission Division – Results Summary

Observations

230/115 kV

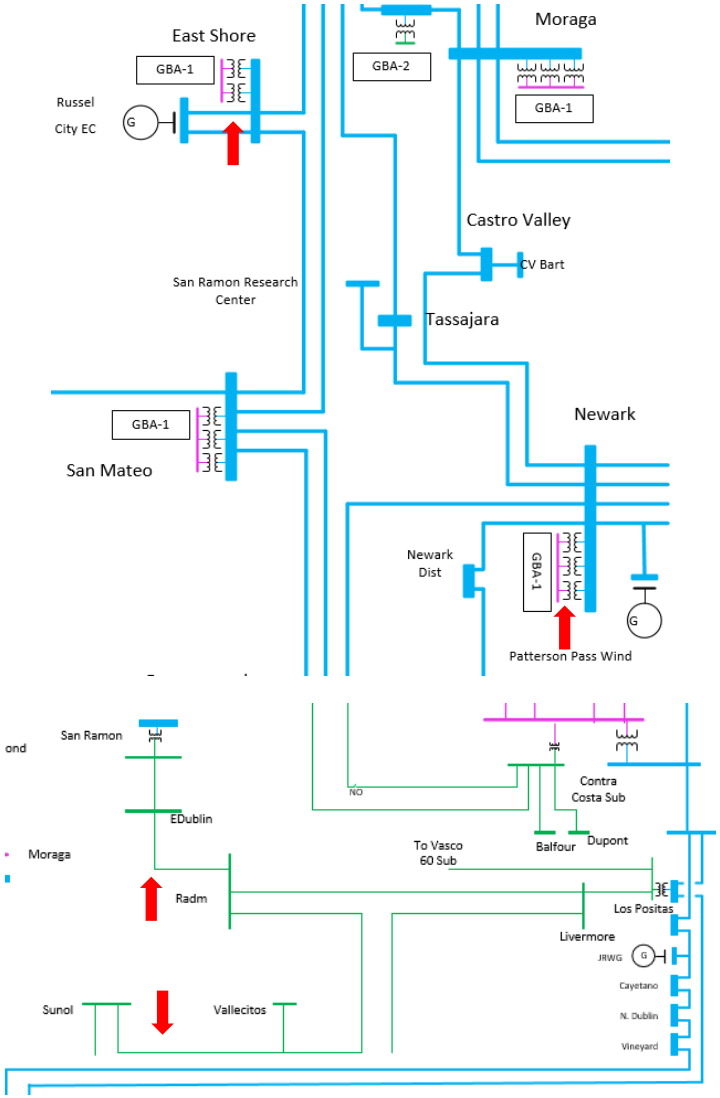
- P2 overload on East Shore 230/115 kV bank #1 in short-term Summer peak.
- P2, P6 overloads on Newark 230/115kV Banks #7 and #11 in all Summer peak scenarios.

60 kV

- P6 overloads on Newark-Vallecitos and San Ramon-Radum 60 kV lines in long-term Summer peak scenario.

Potential Mitigations

- East Shore bank overload is mitigated by the East Shore 230 kV Bus Terminals Reconfiguration project.
- Newark banks overloads are mitigated by the Newark 230/115 kV Transformer Bank #7 Circuit Breaker Addition project.
- 60 kV lines overloads will be continued to be monitored in future cycles.



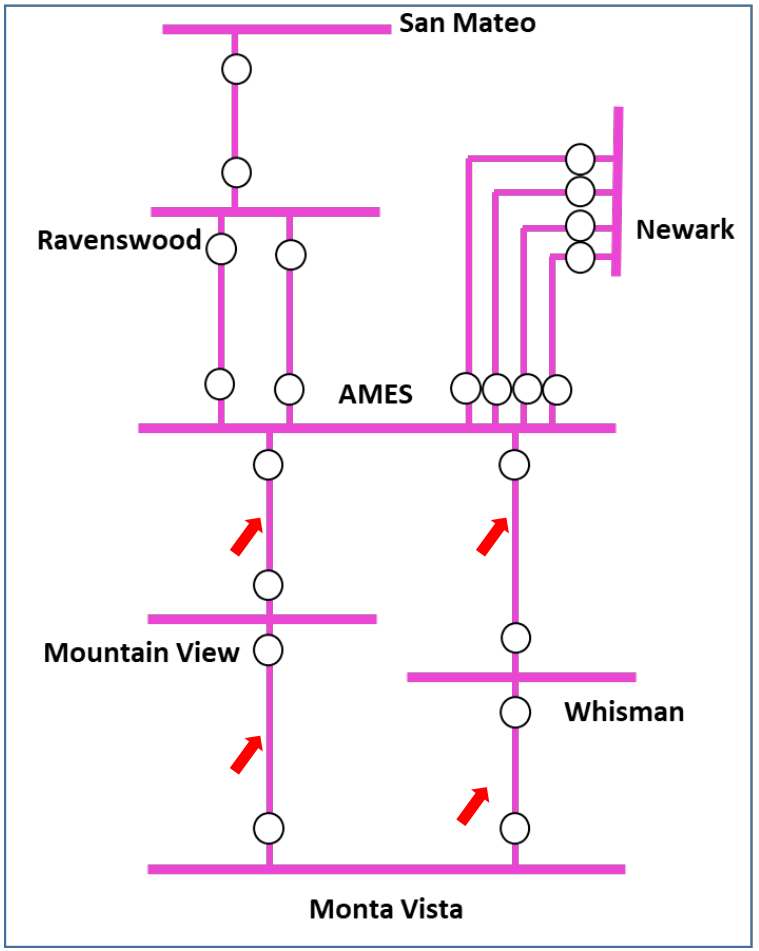
De Anza Division – Results Summary

Observations

- P5 overloads on Ames-Mountain View-Whisman 115 kV lines in all Summer peak scenarios.
- P2, P3, P5, P6 and P7 overloads on Britton-Monta Vista, Lawrence - Monta Vista, Mountain View-Monta Vista, Newark-Lawerence, Whisman-Monta Vista 115 kV lines and Monta Vista 230/115 kV Trans Nos. 2 and 3 in long-term Summer peak scenario.

Potential Mitigations

- Recommended protection upgrade at Monta Vista 115 kV bus for P5 driven overloads.
- Other overloads will be continued to be monitored in future cycles.



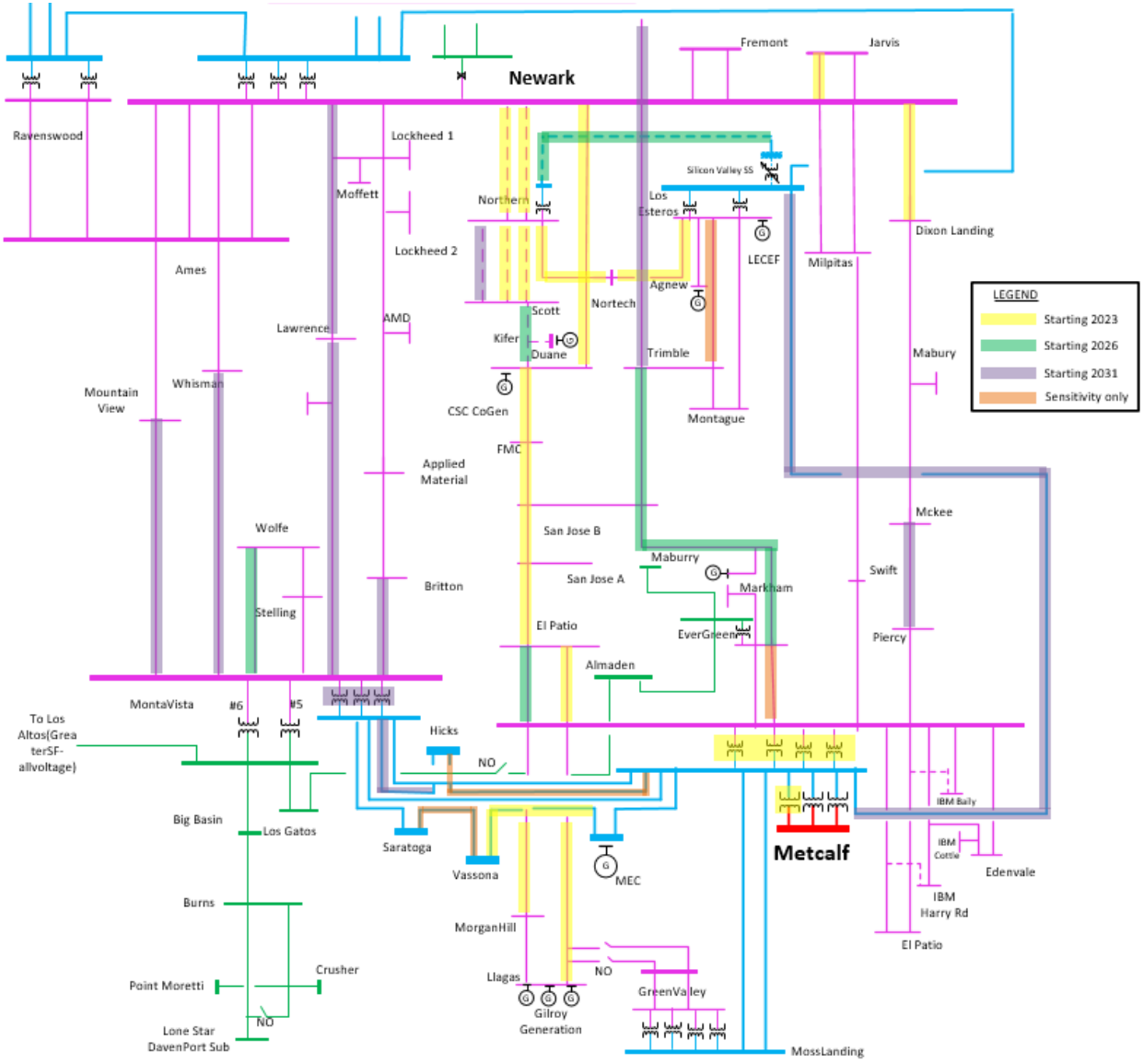
San Jose Division – Results Summary

Facility	2023					2026				2031					Sensitivity				
	P1	P2	P5	P6	P7	P1	P2	P5	P7	P0	P1	P2	P5	P7	P0	P1	P2	P5	P7
El Patio-San Jose Sta. 'A' 115 kV Line		X			X			X				X	X	X	X	X	X	X	X
Evergreen-Almaden 60 kV Line	X																		
FMC-San Jose 'B' 115 kV Line		X					X					X							
Kifer-Duane 115 kV Line							X		X							X			X
Kifer-FMC 115 kV Line		X										X							
Los Esteros-Metcalf 230 kV Line												X				X	X		
Los Esteros-Nortech 115 kV Line		X				X				X	X								
Los Esteros-Silicon Switching Station 230 kV Line						X										X			
Los Esteros-Trimble 115 kV Line																	X		
Mckee-Piercy 115 kV Line											X								
Metcalf 230/115 kV Trans No. 1		X																	
Metcalf 230/115 kV Trans No. 2		X																	
Metcalf 230/115 kV Trans No. 3		X																	
Metcalf 230/115 kV Trans No. 4		X															X		
Metcalf 500/230 kV Trans No. 13				X															
Metcalf-El Patio No. 1 115 kV Line							X					X	X	X		X	X	X	X
Metcalf-El Patio No. 2 115 kV Line		X											X	X		X		X	X
Metcalf-Evergreen No. 1 115 kV Line																		X	X
Metcalf-Hicks 230 kV Line																	X		X
Metcalf-Llagas 115 kV Line				X															
Metcalf-Morgan Hill 115 kV Line				X															
Monta Vista-Hicks 230 kV Line												X							X
Monta Vista-Wolfe 115 kV Line						X	X												
Newark-Dixon Landing 115kV Line	X	X			X														
Newark-Jarvis #1 115kV Line	X																		
Newark-Kifer 115kV Line		X		X	X		X	X	X		X		X	X		X			
Newark-Northern Receiving Station #1 115kV Line			X		X	X	X				X	X		X		X			X
Newark-Northern Receiving Station #2 115kV Line			X	X			X		X		X	X	X			X	X		
Newark-Trimble 115kV Line													X					X	X
Nortech-NRS 115 kV Line				X		X	X		X		X			X					
NRS-Scott No. 1 115 kV Line		X																	
NRS-Scott No. 2 115 kV Line		X																	
NRS-Scott No. 3 115 kV Line														X					
San Jose B bus tie							X						X					X	X
San Jose 'B'-Stone-Evergreen 115 kV Line									X				X	X		X	X	X	X
San Jose Sta 'A'-'B' 115 kV Line		X			X		X	X					X						X
Saratoga-Vasona 230 kV Line																			X
Scott-Duane 115 kV Line		X																	
Swift-Metcalf 115 kV Line																		X	
Trimble-San Jose 'B' 115 kV Line							X												
Vasona-Metcalf 230 kV Line		X			X						X	X			X				X

San Jose Division – Results Summary

Potential Mitigations

- New 230 or 500 kV source into the San Jose system



Greater Bay Area – Low Voltage Results Summary

Potential Mitigations

- Low voltage issue will be mitigated by solutions addressing thermal issues in the area.

Division	Type	2023 Summer Peak	2026 Summer Peak	2031 Summer Peak
SF	P6	>0.9	>0.9	0.88
Peninsula	P0	0.98	0.98	0.93
	P1	0.96	0.96	0.91
	P2	0.97	0.99	0.89
	P3	>0.9	>0.9	0.85
	P5	0.64	0.63	0.59
	P6	>0.9	>0.9	0.80
	P7	0.63	0.98	0.90
Mission	P2	0.96	0.95	0.90
	P3	>0.9	>0.9	0.80
	P5	0.97	0.96	0.85
	P6	>0.9	>0.9	0.80
De Anza	P1	0.97	1.02	0.85
	P2	0.97	1.02	0.85
	P3	>0.9	>0.9	0.80
	P5	0.99	1.00	0.84
	P6	>0.9	>0.9	0.79
	P7	1.00	1.01	0.91
San Jose	P0	>0.9	1.00	0.94
	P1	0.97	0.97	0.87
	P2	>0.9	0.84	0.78
	P3	>0.9	>0.9	0.75
	P5	1.00	1.01	0.86
	P6	>0.9	>0.9	0.70
	P7	0.96	0.97	0.82

Sensitivity issues

Overloaded Facility	Category	2026 SP High CEC Forecast	2023 SpOP Hi Renew & Min Gas Gen	2023 SP Hi Renew & Min Gas Gen	2031-Summer Peak-High SouthBay
Birds Landing - Contra Costa Sub 230 kV Line	P2				√
Britton-Monta Vista 115 kV Line	P1				√
Cayetano-Lone Tree (Lone Tree-USWP) 230kV Line	P0, P7				√
Cayetano-Lone Tree (USWP-Cayetano) 230kV Line	P7				√
El Patio-San Jose Sta. 'A' 115 kV Line	P0, P1, P2, P3, P5, P7				√
Jefferson-Stanford #1 60kV Line	P2				√
Kifer-Duane 115 kV Line	P1, P7				√
Las Positas-Newark 230kV Line	P7				√
Lawrence - Monta Vista 115 kV	P0, P1, P2				√
Lockheed #2 115 kV Tap	P1				√
Los Esteros 230/115 kV Trans No. 3	P3, P6				√
Los Esteros 230/115 kV Trans No. 4	P3, P6				√
Los Esteros-Metcalf 230 kV Line	P1, P2				√
Los Esteros-Montague 115 kV Line	P3, P6				√
Los Esteros-Silicon Switching Station 230 kV Line	P1				√
Los Esteros-Trimble 115 kV Line	P2, P6				√
Metcalf 230/115 kV Trans No. 1	P6				√
Metcalf 230/115 kV Trans No. 2	P6				√
Metcalf 230/115 kV Trans No. 3	P6				√
Metcalf 230/115 kV Trans No. 4	P2				√
Metcalf 230/115 kV Trans No. 4	P6				√
Metcalf-El Patio No. 1 115 kV Line	P1, P2, P5, P7				√
Metcalf-El Patio No. 2 115 kV Line	P1, P5, P7				√
Metcalf-Evergreen No. 1 115 kV Line	P2, P3, P5, P7				√
Metcalf-Evergreen No. 2 115 kV Line	P2, P3, P5, P7				√
Metcalf-Hicks 230 kV Line	P2, P7				√

Overloaded Facility	Category	2026 SP High CEC Forecast	2023 SpOP Hi Renew & Min Gas Gen	2023 SP Hi Renew & Min Gas Gen	2031-Summer Peak-High SouthBay
Monta Vista 230/115 kV Trans No. 2	P3				√
Monta Vista 230/115 kV Trans No. 4	P3				√
Monta Vista-Hicks 230 kV Line	P7				√
Moraga-Castro Valley 230kV Line	P2				√
Mountain View-Monta Vista 115 kV Line	P1, P7				√
Newark 230/115kV Transformer #11	P1, P2, P5, P7				√
Newark 230/115kV Transformer #7	P2, P3, P5				√
Newark-Ames Dist 115kV Line	P2				√
Newark-Kifer 115kV Line	P1				√
Newark-Lawerence 115kV Line	P1, P5, P6, P7				√
Newark-Milpitas #1 115kV Line	P6				√
Newark-Newark Dist 230kV section	P2				√
Newark-Northern Receiving Station #1 115kV Line	P1, P7				√
Newark-Northern Receiving Station #2 115kV Line	P1, P2				√
Newark-Trimble 115kV Line	P5, P7				√
North Dublin-Cayetano 230kV Cable	P7				√
North Dublin-Vineyard 230 kV Line	P2, P5				√
Oleum-Martinez 115kV Line	P2		√		
Piercy-Metcalf 115 kV Line	P6				√
San Jose B bus tie	P5				√
San Jose B bus tie	P7				√
San Jose 'B'-Stone-Evergreen 115 kV Line	P1, P2, P3, P5, P6, P7				√
San Jose Sta 'A'-'B' 115 kV Line	P7				√
Saratoga-Vasona 230 kV Line	P7				√
Sobrante-Moraga 115kV Line	P5				√
Swift-Metcalf 115 kV Line	P5				√
Tassajara-Newark 230kV Line	P2			√	
Vasona-Metcalf 230 kV Line	P0, P7				√
Whisman-Monta Vista 115 kV Line	P2, P3, P7				√

Summary of potential new upgrades

Division	Reliability Concern	Potential Upgrade
East Bay	P2, P6	• Oakland C-L overload mitigation • Sobrante P2 contingencies under review
Diablo	P2	• Contra Costa 230 kV bus upgrade/reconfiguration
San Francisco	NA	• None required at this time.
Penninsula	P2	• Ravenswood 115 kV protection upgrade
Mission	NA	• None required at this time.
De Anza	Multiple	• Monta Vista 115 kV protection upgrade
San Jose	Multiple	• Potentially new 230 or 500 kV source into the area.
Low voltage	NA	• Not required. Thermal solutions will address.

PG&E Bulk System
Preliminary Reliability Assessment Results

Irina Green
Senior Advisor, Regional Transmission North

2021-2022 Transmission Planning Process Stakeholder Meeting
September 27-28, 2021

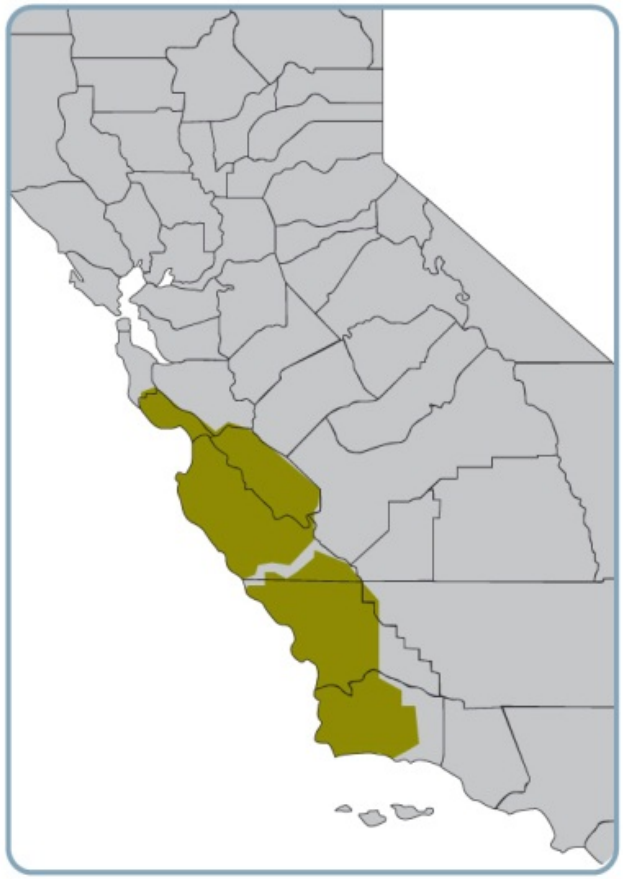
Presentation available on Market Participant Portal

Central Coast Los Padres Area
Preliminary Reliability Assessment Results

Lindsey Thomas
Senior Regional Transmission Engineer

2021-2022 Transmission Planning Process Stakeholder Meeting
September 27-28, 2021

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

S. No.	Study Case	Scenario Type	Description	Gross Load (MW)	AAEE (MW)	BTM-PV		Net Load (MW)	Demand Response	
						Installed (MW)	Output (MW)		Total (MW)	D2 (MW)
1	CCLP-2023-SP	Baseline	2023 summer peak load conditions. Peak load time - hours between 19:00 and 20:00.	1,269	13	488	5	1,252	23	21
2	CCLP-2025-SP	Baseline	2025 summer peak load conditions. Peak load time - hours between 19:00 and 20:00.	1,243	15	504	0	1,228	27	15
3	CCLP-2030-SP	Baseline	2030 summer peak load conditions. Peak load time -hours between 19:00 and 20:00.	1,324	26	631	0	1,297	27	15
4	CCLP-2023-SOP	Baseline	2023 spring off-peak load conditions. Off-peak load time - hours ending 20:00.	829	14	488	0	815	27	25
5	CCLP-2025-SOP	Baseline	2025 spring off-peak load conditions. Off-peak load time - hours ending 13:00.	710	0	504	403	307	27	15
6	CCLP-2023-WP	Baseline	2023 winter peak load conditions. Peak load time - hours ending 19:00.	1,053	15	488	2	1,036	0	0
7	CCLP-2025-WP	Baseline	2025 winter peak load conditions. Peak load time - hours ending 19:00.	1,054	16	504	0	1,038	27	15
8	CCLP-2030-WP	Baseline	2030 winter peak load conditions. Peak load time - hours ending 19:00.	1,122	28	631	0	1,094	27	15
9	CCLP-2025-SP-HiCEC	Sensitivity	2025 summer peak load conditions with hi-CEC load forecast sensitivity	1,243	0	504	0	1,243	27	15
10	CCLP-2025-SOP-HiRenew	Sensitivity	2025 spring off-peak load conditions with hi renewable dispatch sensitivity	710	0	504	499	211	27	15
11	CCLP-2023-SP-HiRenew	Sensitivity	2023 summer peak load conditions with hi-renewable dispatch sensitivity	1,189	9	488	429	751	27	15

Generation Assumptions - Central Coast/ Los Padres Area

S. No.	Study Case	Scenario Type	Description	Battery Storage (MW)	Solar		Wind		Hydro		Thermal	
					Installed (MW)	Dispatch (MW)	Installed (MW)	Dispatch (MW)	Installed (MW)	Dispatch (MW)	Installed (MW)	Dispatch (MW)
1	CCLP-2023-SP	Baseline	2023 summer peak load conditions. Peak load time - hours between 19:00 and 20:00.	0	812	18	0	0	0	0	2,676	1,161
2	CCLP-2025-SP	Baseline	2025 summer peak load conditions. Peak load time - hours between 19:00 and 20:00.	600	816	0	101	44	0	0	2,718	1,143
3	CCLP-2030-SP	Baseline	2030 summer peak load conditions. Peak load time -hours between 19:00 and 20:00.	650	816	0	101	44	0	0	2,718	1,143
4	CCLP-2023-SOP	Baseline	2023 spring off-peak load conditions. Off-peak load time - hours ending 20:00.	0	841	0	0	0	0	0	2,676	1,098
5	CCLP-2025-SOP	Baseline	2025 spring off-peak load conditions. Off-peak load time - hours ending 13:00.	600	816	773	101	20	0	0	2,718	163
6	CCLP-2023-WP	Baseline	2023 winter peak load conditions. Peak load time - hours ending 19:00.	0	826	0	0	0	0	0	2,676	681
7	CCLP-2025-WP	Baseline	2025 winter peak load conditions. Peak load time - hours ending 19:00.	600	816	0	101	13	0	0	2,718	1,098
8	CCLP-2030-WP	Baseline	2030 winter peak load conditions. Peak load time - hours ending 19:00.	650	816	0	101	13	0	0	2,718	1,098
9	CCLP-2025-SP-HiCEC	Sensitivity	2025 summer peak load conditions with hi-CEC load forecast sensitivity	600	816	0	101	44	0	0	2,718	1,143
10	CCLP-2025-SOP-HiRenew	Sensitivity	2025 spring off-peak load conditions with hi renewable dispatch sensitivity	600	816	766	101	65	0	0	2,718	451
11	CCLP-2023-SP-HiRenew	Sensitivity	2023 summer peak load conditions with hi-renewable dispatch sensitivity	0	812	972	0	0	0	0	2,676	0

Previously approved transmission projects modelled in base cases

Project Name	First Year Modeled
Estrella Substation Project	2026
South of Mesa Upgrade	2027
Salinas-Firestone #1 and #2 60kV lines	2026
Oil Fields 60 kV Area Voltage Support	2029
Morgan Hill Area Reinforcement (FKA: Spring Substation)	2026
North of Mesa Upgrade	On Hold

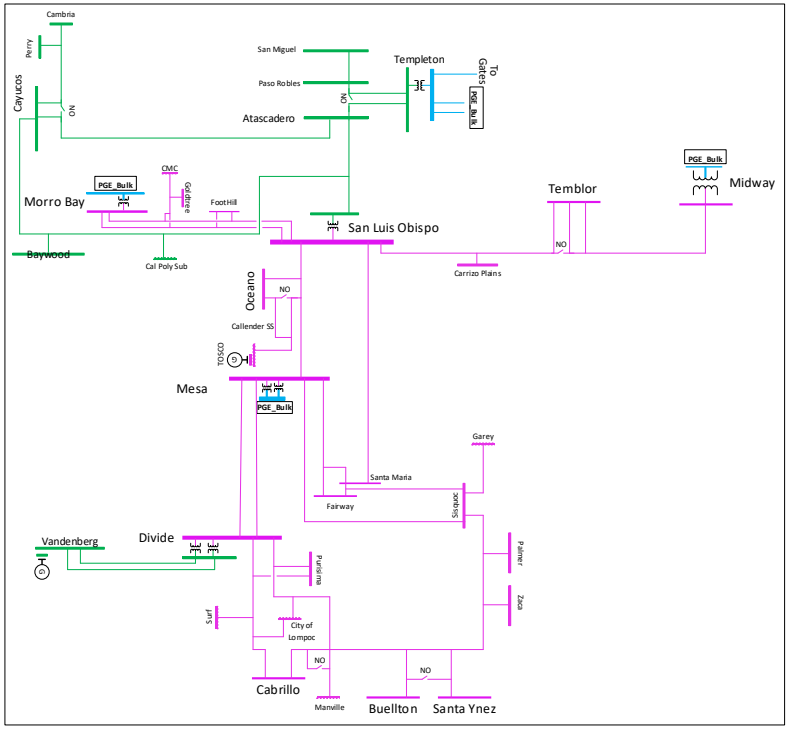
Central Coast/ Los Padres - Results Summary

Observations

- P5-5 Morro Bay overloads
- P2, P6, P7 overloads in the greater Mesa area
- P1,P2, P6, P7 overloads on Salinas- Firestone #1 and #2 Lines
- P1, P2, P6 overloads in Templeton 70kV area
- P6 and P7 overloads on Green Valley – Watsonville 60 kV line
- P2, P6, P7 overloads in the Santa Maria – Santa Ynez Corridor

Approved and Potential Mitigations

- Add redundant relay
- Modified RAS in area
- Salinas- Firestone #1 and #2 reconductor
- Estrella Substation Project
- Morgan Hill Area Reinforcement
- South of Mesa Upgrades



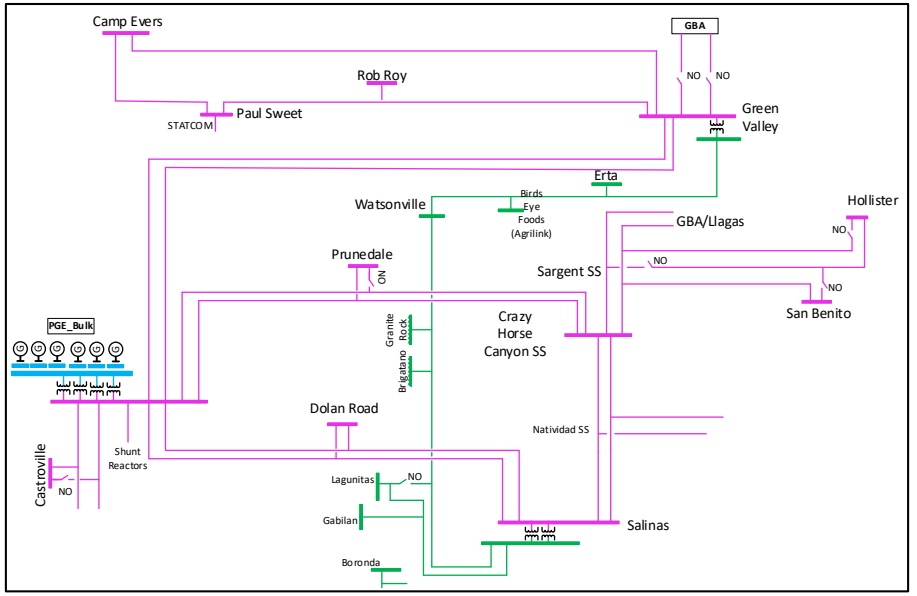
Central Coast/ Los Padres – Low Voltage Results Summary

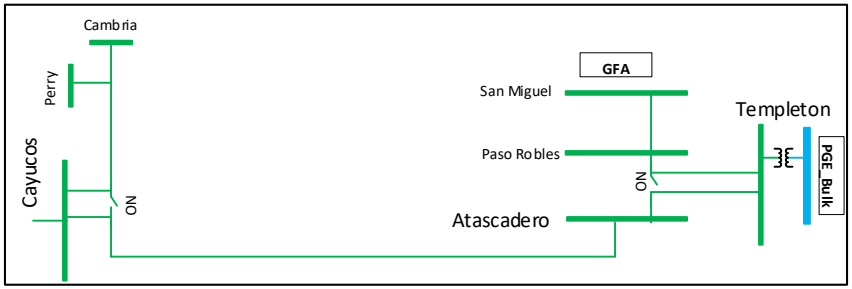
<u>Observations</u>

- P2 and P6 low voltage in Salinas 115kV Pocket
- P1 and P2 low voltage in San Miguel 70kV Pocket

<u>Approved and Potential Mitigations</u>

- Salinas – Firestone #1 and #2 reconductor Project
- Estrella Project





Sensitivity-only issues

Below is the list of facility overloads identified in sensitivity scenario(s) only

Overloaded Facility	Category	2023Summer Peak High Renew	2023 Off-Peak High Renew
San Miguel-Paso Robles 70 kV Line	P6		√

Summary of potential new upgrades

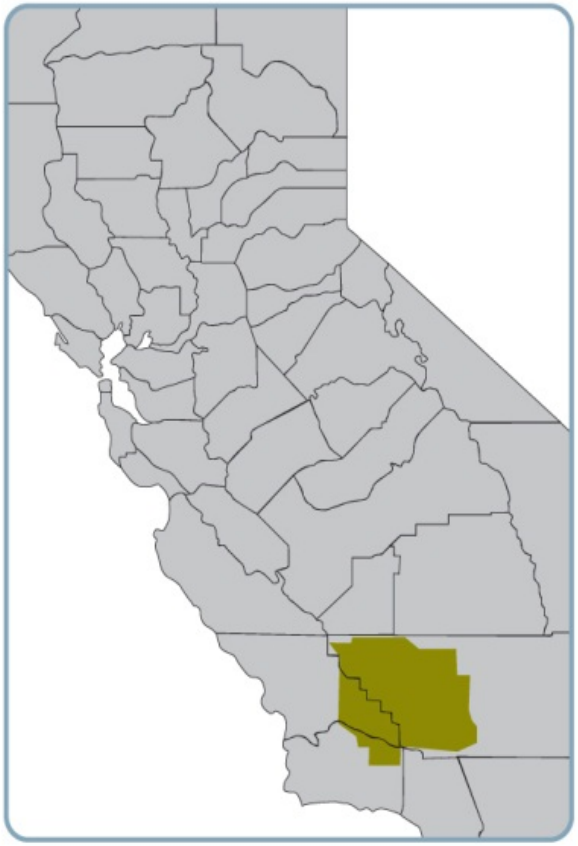
Division	Reliability Concern	Potential Upgrade
None		

Kern Area
Preliminary Reliability Assessment Results

Lindsey Thomas
Senior Regional Transmission Engineer

2021-2022 Transmission Planning Process Stakeholder Meeting
September 27-28, 2021

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 Area

	Study Case	Scenario Type	Description	Gross Load (MW)	AAEE (MW)	BTM-PV		Net Load (MW)	Demand Response	
						Installed (MW)	Output (MW)		Total (MW)	D2 (MW)
1	KERN-2023-SP	Baseline	2023 summer peak load conditions. Peak load time - hours ending 19:40.	1,910	12	565	0	1,897	66	60
2	KERN-2026-SP	Baseline	2026 summer peak load conditions. Peak load time - hours ending 19:40.	1,931	20	671	0	1,911	66	60
3	KERN-2031-SP	Baseline	2031 summer peak load conditions. Peak load time - hours ending 19:40.	1,977	46	825	0	1,931	65	60
4	KERN-2023-SOP	Baseline	2023 spring off-peak load conditions. Off-peak load time – hours ending 20:00.	1,315	21	565	0	1,294	66	57
5	KERN-2026-SOP	Baseline	2026 spring off-peak load conditions. Off-peak load time – hours ending 13:00.	1,073	15	671	530	529	0	0
6	KERN-2026-SP-HiCEC	Sensitivity	2026 summer peak load conditions with hi-CEC load forecast sensitivity	1,931	0	671	0	1,930	66	60
7	KERN-2023-SOP-HiRenew	Sensitivity	2023 spring off-peak load conditions with hi renewable dispatch sensitivity	1,910	12	565	560	1,338	66	60
8	KERN-2023-SP-HiRenew	Sensitivity	2023 summer peak load conditions with hi-renewable dispatch sensitivity	1,922	18	565	560	1,345	66	60

Generation Assumptions - Kern Area

	Study Case	Scenario Type	Description	Battery Storage (MW)	Solar		Wind		Hydro		Thermal	
					Installed (MW)	Dispatch (MW)	Installed (MW)	Dispatch (MW)	Installed (MW)	Dispatch (MW)	Installed (MW)	Dispatch (MW)
1	KERN-2023-SP	Baseline	2023 summer peak load conditions. Peak load time - hours ending 19:40.	0	510	38	0	0	18	11	2,348	2,175
2	KERN-2026-SP	Baseline	2026 summer peak load conditions. Peak load time - hours ending 19:40.	182	510	0	0	0	18	11	2,348	2,348
3	KERN-2031-SP	Baseline	2031 summer peak load conditions. Peak load time - hours ending 19:40.	277	1,316	860	0	0	18	18	2,348	2,156
4	KERN-2023-SOP	Baseline	2023 spring off-peak load conditions. Off-peak load time – hours ending 20:00.	0	510	0	0	0	18	18	2,348	2,227
5	KERN-2026-SOP	Baseline	2026 spring off-peak load conditions. Off-peak load time – hours ending 13:00.	182	510	524	0	0	18	17	2,348	527
6	KERN-2026-SP-HiCEC	Sensitivity	2026 summer peak load conditions with hi-CEC load forecast sensitivity	182	510	0	0	0	18	11	2,348	2,348
7	KERN-2023-SOP-HiRenew	Sensitivity	2023 spring off-peak load conditions with hi renewable dispatch sensitivity	0	510	515	0	0	18	18	2,348	549
8	KERN-2023-SP-HiRenew	Sensitivity	2023 summer peak load conditions with hi-renewable dispatch sensitivity	0	510	438	0	0	18	11	2,348	0

Previously approved transmission projects modelled in base cases

Project Name	First Year Modeled
Midway-Kern PP 230 kV Lines Nos. 1, 3, and 4 Capacity Increase Project	2021
Semitropic-Midway 115 kV Line Reconductor	2021
Kern PP 230 kV Area Reinforcement	2021
Wheeler Ridge Voltage Support	2021
Midway-Kern PP 230 kV #2 Line Project	2024
Midway-Temblor 115 kV Line Reconductor & Voltage Support	2027
Bakersfield Nos. 1 and 2 230kV Tap Lines Reconductoring	2027
Kern PP 115 kV Area Reinforcement	2027
Wheeler Ridge Junction Substation	On Hold

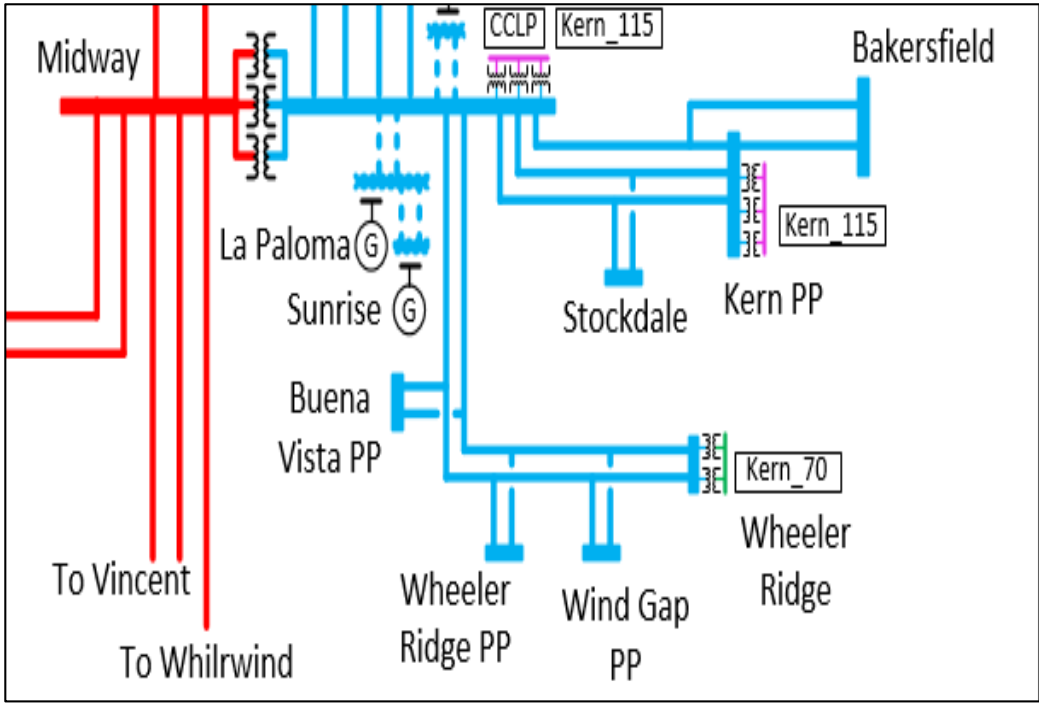
Kern 230 kV– Results Summary

Observations 230 kV

- New P2 Midway-Bakersfield 230 kV Overloads in 2026 Study Years
- P2, P6 and P7 OL's on the Midway – Kern Lines
- P2 OL's on Midway – Wheeler Ridge lines

Approved and Potential Mitigations

- Under review since OL is only seen in 2026 Study years
- Midway-Kern PP 230 kV #2 Line Project
- PGE maintenance bus conversion Project



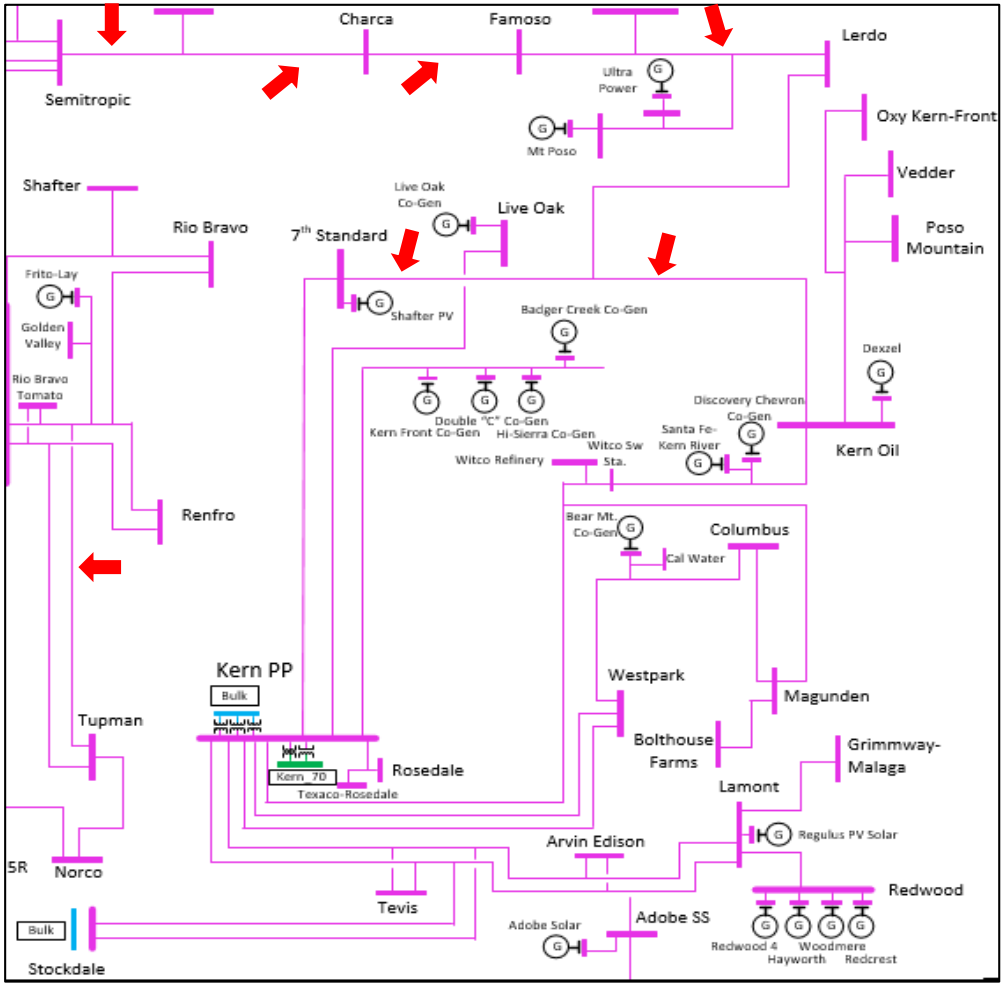
Kern 115 kV – Results Summary

Observations115 kV

- Several Overloads caused by P2s on the Midway 115 kV bus
- P1, P2, P6 and P7 OLs seen on Live Oak – Kern Oil 115 kV line

Approved and Potential Mitigations

- Short term issues will be mitigated by operating solutions/Action Plan/Summer Setup. Additional review is being performed to determine if a better long term solution is needed.
- Results under review



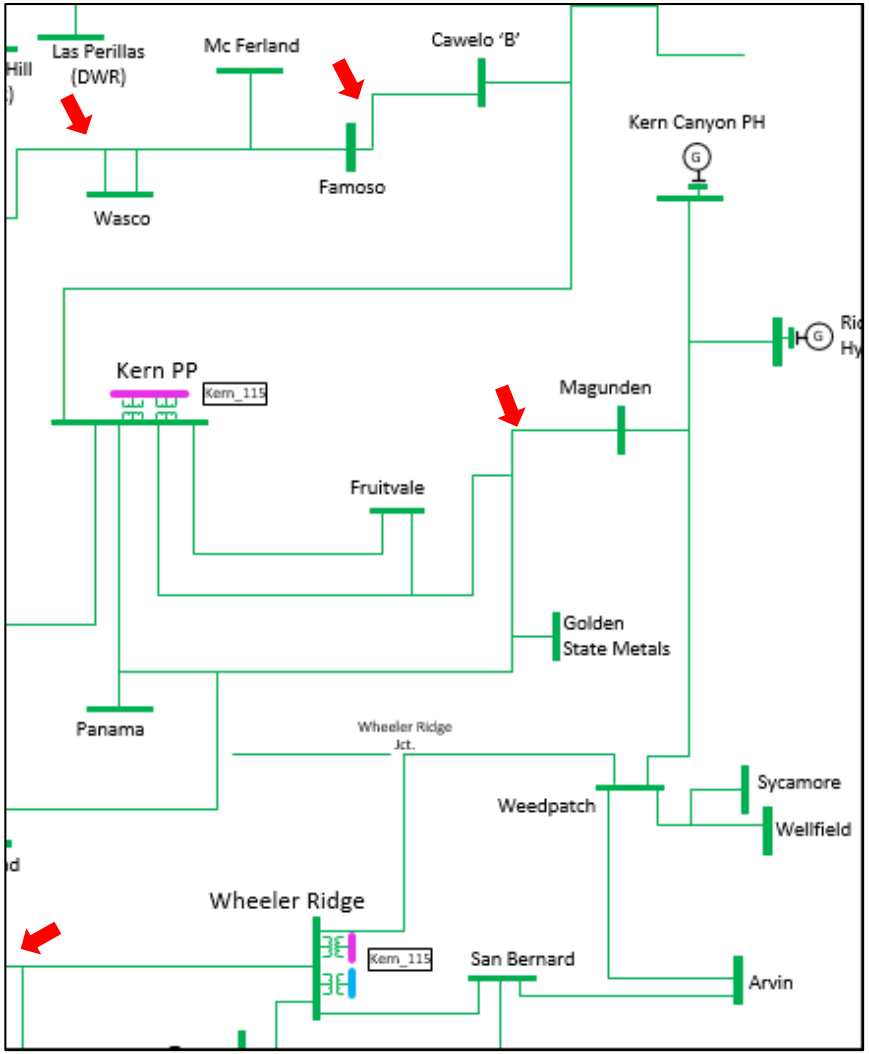
Kern 70 kV-Results Summary

Observations 70 kV

Multiple 70 kV P2 and P7 Overloads

Approved and Potential Mitigations

- Utilize operating solutions and/or Summer Setup.



Kern– Low Voltage Results Summary

Observations

- Summer set up related low voltage issues 2031 scenario

Approved and Potential Mitigations

- Mitigated by operating solutions/Action Plan/Summer Setup

Sensitivity issues

Below is the list of facility overloads identified in sensitivity scenario(s) only

Overloaded Facility	Category	2026 High CEC	2023Summer Peak High Renew	2023 Off-Peak High Renew
Fellows-Taft 115 kV Line	P2		√	√
Midsun-Midway 115 kV Line	P1, P2			√
Midway-Lapaloma #1 230 kV Line	P1, P2	√		
Smyrna-Semitropic-Midway 115 kV Line	P1			√
Taft-Cuyama #1 70 kV Line	P0		√	

Summary of potential new upgrades

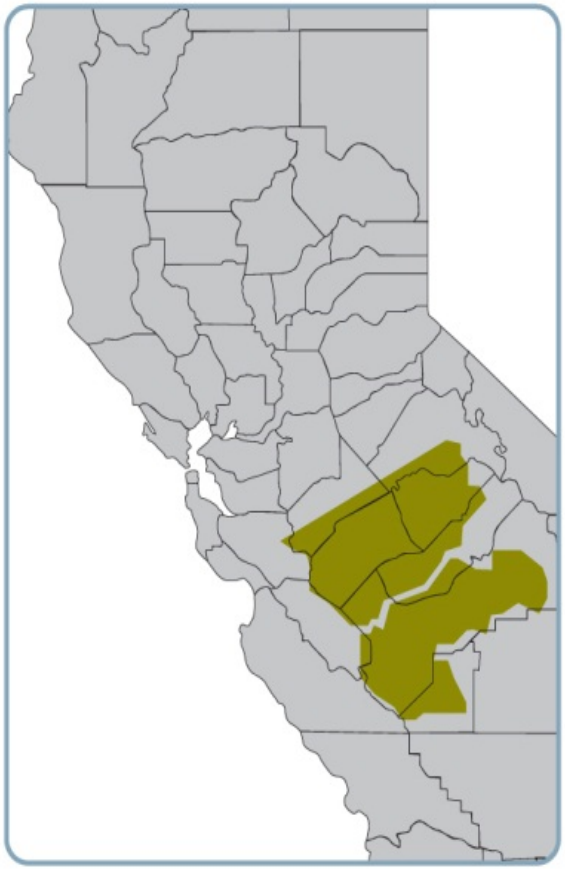
Division	Reliability Concern	Potential Upgrade
Kern 115 kV	P1, P2, P6 and P7 Thermal overloads seen on Live Oak – Kern Oil 115 kV line	Results under review

Fresno Area
Preliminary Reliability Assessment Results

Emily Hughes
Regional Transmission Engineer

2021-2022 Transmission Planning Process Stakeholder Meeting
September 27-28, 2021

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

S. No.	Study Case	Scenario Type	Description	Gross Load (MW)	AAEE (MW)	BTM-PV		Net Load (MW)	Demand Response	
						Installed (MW)	Output (MW)		Total (MW)	D2 (MW)
1	GFA-2023-SP	Baseline	2023 summer peak load conditions. Peak load time - hours ending 19:00.	3,208	22	1,610	16	3,170	33	19
2	GFA-2026-SP	Baseline	2026 summer peak load conditions. Peak load time - hours ending 19:00.	3,266	36	2,076	21	3,209	32	19
3	GFA-2031-SP	Baseline	2031 summer peak load conditions. Peak load time - hours ending 19:00.	3,369	84	2,744	27	3,257	31	19
4	GFA-2023-SOP	Baseline	2023 spring off-peak load conditions. Off-peak load time - hours ending 20:00.	2,312	41	1,811	0	2,271	51	22
5	GFA-2026-SOP	Baseline	2026 spring off-peak load conditions. Off-peak load time - hours ending 13:00.	1,001	27	2,076	1640	(666)	0	0
6	GFA-2023-SP-HiRenew	Sensitivity	2023 summer peak load conditions with hi-renewable dispatch sensitivity	3,208	22	1,610	1594	1,592	33	19
7	GFA-2023-SpOP-HiRenew	Sensitivity	2023 spring off-peak load conditions with hi-renewable dispatch sensitivity	2,312	41	1,811	1793	478	51	22
8	GFA-2026-SP-Hi-CEC	Sensitivity	2026 summer peak load conditions with hi-CEC load forecast sensitivity	3,266	0	2,076	21	3,245	32	19

Generation Assumptions - Greater Fresno Area

S. No.	Study Case	Scenario Type	Description	Battery Storage (MW)	Solar		Wind		Hydro		Thermal	
					Installed (MW)	Dispatch (MW)	Installed (MW)	Dispatch (MW)	Installed (MW)	Dispatch (MW)	Installed (MW)	Dispatch (MW)
1	GFA-2023-SP	Baseline	2023 summer peak load conditions. Peak load time - hours ending 19:00.	309	2758	329	13	9	1870	1784	1269	1165
2	GFA-2026-SP	Baseline	2026 summer peak load conditions. Peak load time - hours ending 19:00.	421	2440	763	13	9	1870	1807	1269	1192
3	GFA-2031-SP	Baseline	2031 summer peak load conditions. Peak load time - hours ending 19:00.	852	3484	48	186	126	1870	1768	1269	1181
4	GFA-2023-SOP	Baseline	2023 spring off-peak load conditions. Off-peak load time - hours ending 20:00.	309	2758	0	13	3	1870	-298	1269	791
5	GFA-2026-SOP	Baseline	2026 spring off-peak load conditions. Off-peak load time - hours ending 13:00.	421	2529	2172	13	3	1870	-330	1269	84
6	GFA-2023-SP-HiRenew	Sensitivity	2023 summer peak load conditions with hi-renewable dispatch sensitivity	309	2758	2495	13	8	1870	1817	1269	526
7	GFA-2023-SpOP-HiRenew	Sensitivity	2023 spring off-peak load conditions with hi-renewable dispatch sensitivity	309	2758	2097	13	8	1870	-298	1269	388
8	GFA-2026-SP-Hi-CEC	Sensitivity	2026 summer peak load conditions with hi-CEC load forecast sensitivity	421	2440	763	13	9	1870	1808	1269	1192

Previously approved transmission projects modelled in base cases

Project Name	Expected ISD
Northern Fresno 115 kV Area Reinforcement (Northern Fresno Reliability)	Completed
Wilson-Legrand 115 kV Reconductoring	Apr-21
Wilson Voltage Support (Wilson 115 kV STATCOM)	May-21
Kingsburg-Lemoore 70 kV Line Reconductoring	Mar-22
Herndon - Bullard 115 kV Reconductoring	Apr-24
Panoche-Oro Loma 115 kV Reconductoring	Jul-23
Wilson 115 kV Area Reinforcement	Dec-28
Oro Loma 70 kV Area Reinforcement	Apr-25
Giffen Line Reconductoring	Apr-24
Borden 230/70 kV Transformer Bank #1 Capacity Increase	Jan-21
Wilson-Oro Loma 115 kV Line Reconductoring	Jan-26
Bellota-Warnerville 230kV Reconductoring	Apr-24
Gregg-Herndon #2 230 kV Line Circuit Breaker Upgrade	Jan-20
Reedley 70 kV Reinforcement (Renamed to Reedley 70 kV Area Reinforcement Projects Include Battery at Dinuba)	May-23

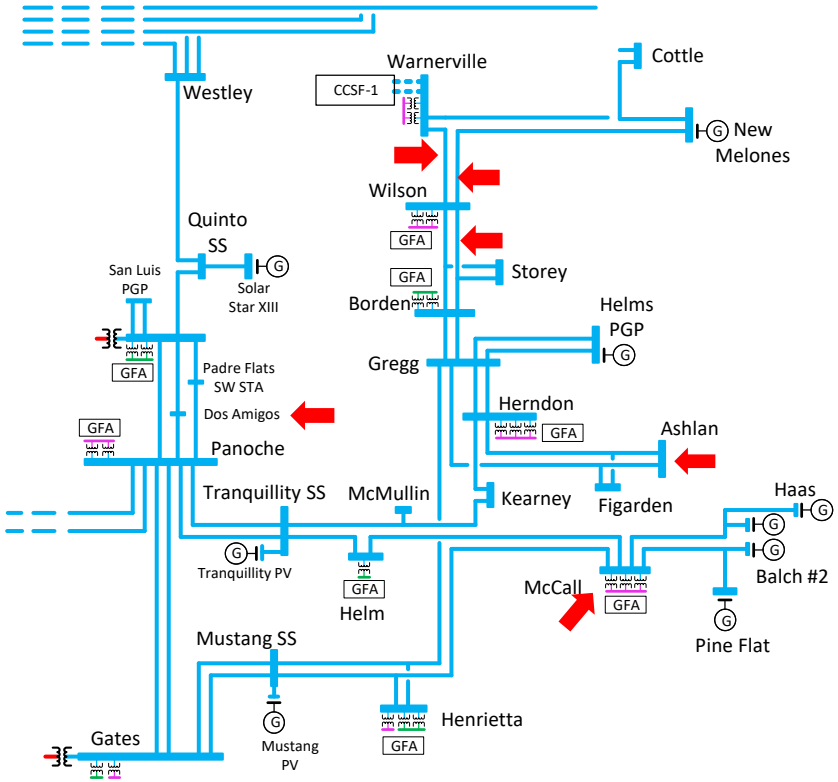
Fresno – 230kV Results Summary

Observations

1. P6 overloads in the 2026 off-peak case:
   - Gregg-Ashlan 230kV Line
   - Herndon-Ashlan 230kV Line
   - following the loss of Gregg-Herndon #1 and #2 230kV Lines
2. P5 overload on Los Banos-Dos Amigos 230kV Line following the loss of Gates section D & E bus
3. P2 overloads on McCall 230/115kV transformers #2 and #3 in the 2023 off-peak case
4. P7 overload on Warnerville-Wilson 230kV Line in the 2026 off-peak case
5. P2 overload on Wilson-Melones 230kV Line in the 2023 off-peak case
6. P2 and P6 overloads on Wilson-Storey #1 and #2 230kV Lines

Potential Mitigations

1. Generation re-dispatch
2. Install redundant relay project in progress
3. Generation re-dispatch
4. Generation re-dispatch
5. Generation re-dispatch
6. Project: Wilson 115kV Reinforcement



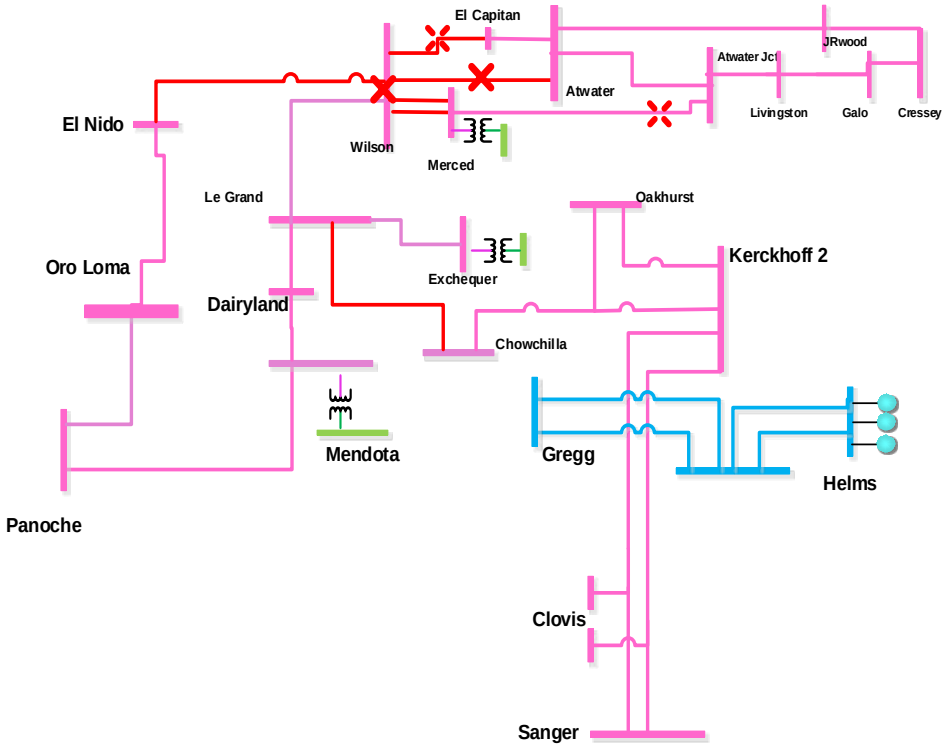
Fresno – Wilson Area 115kV Results Summary

Observations

1. P2 overloads:
   - Atwater-Merced 115kV Line
   - Chowchilla-Kerckhoff #2 115kV Line
   - Panoche-Mendota 115kV Line
2. P5 overload on Herndon-Woodward 115kV Line following the failure of non-redundant relay
3. P6 overloads:
   - El Capitan-Wilson 115kV Line
   - Exchequer-Le Grand 11kV Line
   - Wilson-Atwater #2 115kV Line
   - Wilson-Merced #2 115kV Line

Potential Mitigations

1. Project: Wilson 115kV Reinforcement
2. Install redundant relay project in process
3. Project: Wilson 115kV Reinforcement



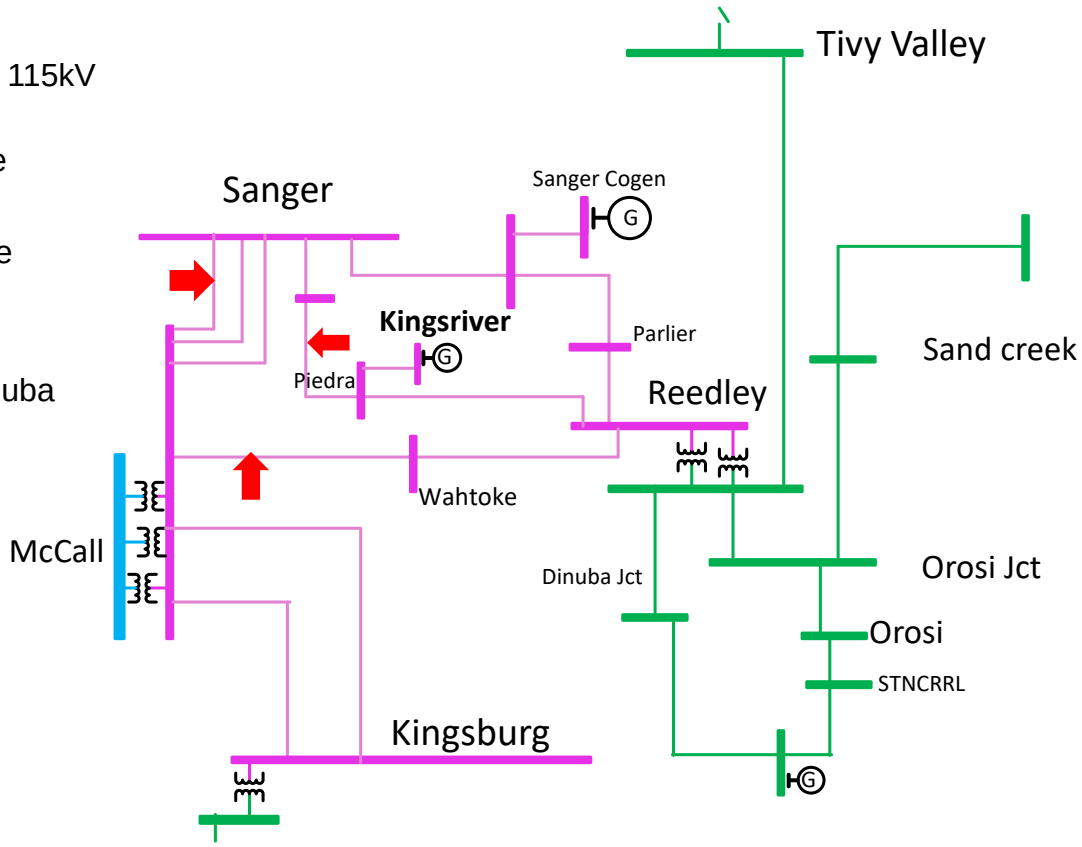
Fresno – Reedley Area 115kV Results Summary

Observations

1. P6 overload on Kingsriver-Sanger-Reedley 115kV Line
2. P6 overload on McCall-Reedley 115kV Line
3. P6 overload on McCall-Sanger #2 Line
4. P7 overload on Sanger-Reedley 115kV Line

Potential Mitigations

1. Project: Reedley 70 kV Reinforcement (Dinuba Battery Energy Storage)



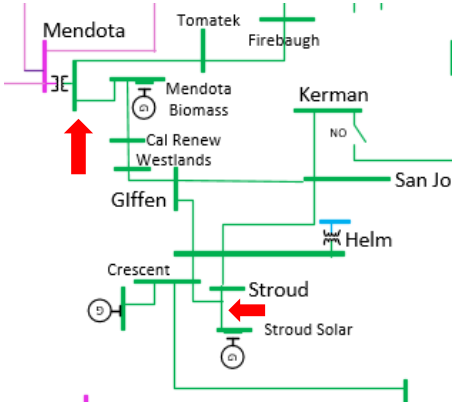
Fresno – 70kV Results Summary

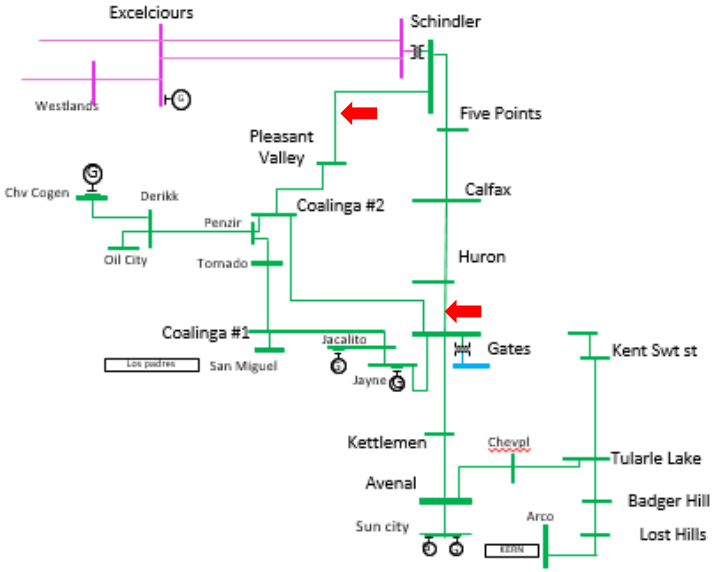
Observations

1. P7 overload on Mendota-San Joaquin-Helm 70kV Line in the 2026 off-peak case
2. P2 overloads on Merced 115/70kV transformer, Merced Falls-Exchequer 70kV Line, and Merced-Merced Falls 70kV Line following the loss of Wilson A Section 1D & Wilson B section 2D
3. P5 overloads on Schindler 115/70kV transformer and Schindler-Coalinga 70kV Line following the loss of non-redundant relay at Gates
4. P2 overload on Schindler-Huron-Gates 70kV Line
5. P1 overload on Stroud-Stroud Sw Station 70kV Line in the 2026 off-peak case

Potential Mitigations

1. Generation re-dispatch
2. Project: Wilson 115kV Reinforcement
3. Install redundant relay project in progress
4. Operating solution available
5. Generation re-dispatch





Fresno– Low Voltage Results Summary

Observations

1. P1 low voltages on Panoche-Mendota 115kV Line in all peak cases
2. P1 low voltages on Panoche-Oro Loma 115kV Line in 2031 peak case
3. Low voltages in Oro Loma 70kV in all peak cases
4. Multiple Low Voltage seen in the Coalinga 70kV area in all peak cases
5. Low voltages in the Reedley 70kV pocket in all peak cases

Approved and Potential Mitigations

1. Wilson 115kV Reinforcement Project
2. Panoche-Oro Loma 115kV Reconductoring project as well as monitor future forecast
3. Oro Loma 70kV area Reinforcement Project
4. Wilson 115kV Reinforcement Project
5. Reedley 70kV Reinforcement Project

Sensitivity only issues

Below is the list of facility overloads identified in sensitivity scenario(s) only

Overloaded Facility	Category	2026 High CEC	2023 SP - High Renewables	2023 OP - High Renewables
(New) Los Banos-C560SS 230 kV Line	P2, P5		√	
(New)Oro Loma-Mendota 115kV Line	P2			√
Bellota - Warnerville 230 kV Line	P5, P7		√	√
Chowchilla-Kerckhoff #2 115 kV Line	P5		√	
Dairyland-Mendota 115 kV Line	P1, P2		√	
Dos Amigos PP-Panoche #3 230 kV Line	P1, P2, P5, P7		√	
Exchequer-Le Grand 115 kV Line	P2, P5		√	
Gates-Gregg 230 kV Line	P2, P7		√	
GWF-Kingsburg 115 kV Line	P6			√
Henrietta 230/115 kV Transformer #3	P6			√
HW_TAP-RB_TAP8 115kV Line (CCSF)	P7		√	
Intake-MOC_TAP5 230kV Line (CCSF)	P6			√
Kerckhoff - Clovis - Sanger #1 115 kV Line	P6		√	
Wilson-Gregg 230 kV Line	P2, P5, P7		√	
Wilson-Le Grand 115 kV Line	P1, P2		√	

Sensitivity only issues - continued

Overloaded Facility	Category	2026 High CEC	2023 SP - High Renewables	2023 OP - High Renewables
Le Grand-Dairyland 115 kV Line	P1, P2, P6		√	
Los Banos-Panoche #2 230 kV Line	P1		√	
McCall-Kingsburg #1 115 kV Line	P6			√
McCall-Kingsburg #2 115 kV Line	P6			√
Merced 115/70 kV Transformer #2	P6		√	
Merced Falls-Exchequer 70 kV Line	P6		√	√
Merced-Merced Falls 70 kV Line	P6		√	
MOC_TAP5-Warnerville 230kV Line (CCSF)	P6			√
MOSSLNSW-LASAGUILASS #2 230KV	P2, P5		√	
NORTHSTAR-Mendota 115 kV Line	P1, P2, P7		√	
Panoche-Gates 230 kV Line #1	P2		√	
Panoche-Gates 230 kV Line #2	P2		√	
Panoche-Lasaguilass 230 kV Line #2	P2		√	
Wilson-Melones 230 kV Line	P5		√	
Wilson-Oro Loma 115 kV Line	P6			√

Sensitivity only issues - continued

Overloaded Facility	Category	2026 High CEC	2023 SP - High Renewables	2023 OP - High Renewables
Panoche-Mendota 115 kV Line	P1, P2, P5, P7		√	
Panoche-PADREFLATSSS 230 kV Line	P2, P5		√	
Panoche-Schindler #1 115 kV Line	P1, P2, P5, P6		√	√
Panoche-Schindler #2 115 kV Line	P2			√
RB_TAP8-Stanford 115kV Line (CCSF)	P7		√	
Reedley 115/70 kV Transformer #2	P2	√		
Schindler 115/70 kV Transformer #1	P7			√
Schindler-Coalinga #2 70 kV Line	P6, P7			√
Schindler-Huron-Gates 70 kV Line	P2, P6, P7		√	√
Stroud-Stroud Sw Station 70 kV Line	P2			√
Warnerville 230/115 kV Bank #3 (CCSF)	P6			√
Warnerville-HW_TAP 115kV Line (CCSF)	P7		√	
Warnerville-Stanford 115kV Line (CCSF)	P7		√	
Wilson-Storey 230 kV Line #1	P2, P5, P6, P7		√	
Wilson-Storey 230 kV Line #2	P2, P5		√	

Summary of Fresno results

- No new upgrades or projects
- Continue to need existing projects
  - Wilson 115kV Reinforcement Project
  - Herndon-Bullard 115 kV Reconductor
  - Reedley 70 kV Reinforcement (Dinuba Battery Energy Storage)
  - Wilson-Oro Loma Reconductoring

North Coast & North Bay Area
Preliminary Reliability Assessment Results

Bryan Fong
Senior Regional Transmission Engineer

2021-2022 Transmission Planning Process Stakeholder Meeting
September 27-28, 2021

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 - North Coast and North Bay Area

S. No.	Study Case	Scenario Type	Description	Gross Load (MW)	AAEE (MW)	BTM-PV		Net Load (MW)	Demand Response	
						Installed (MW)	Output (MW)		Total (MW)	D2 (MW)
1	NCNB-2023-SP	Baseline	2023 summer peak load conditions. Peak load time - hours ending 19:00.	1,474	24	658	0	1,451	6	3
2	NCNB-2026-SP	Baseline	2026 summer peak load conditions. Peak load time - hours ending 19:00.	1,473	15	528	0	1,459	6	3
3	NCNB-2031-SP	Baseline	2031 summer peak load conditions. Peak load time - hours ending 19:00.	1,537	57	847	0	1,479	6	3
4	NCNB-2023-SOP	Baseline	2023 spring off-peak load conditions. Off-peak load time - hours ending 20:00.	1,021	20	493	0	1,002	16	10
5	NCNB-2026-SOP	Baseline	2026 spring off-peak load conditions. Off-peak load time - hours ending 13:00.	702	21	658	520	161	0	0
6	NCNB-2023-WP	Baseline	2023 winter peak load conditions. Peak load time - hours ending 19:00.	1,369	20	528	0	1,349	0	0
7	NCNB-2026-WP	Baseline	2026 winter peak load conditions. Peak load time - hours ending 19:00.	1,442	32	658	0	1,410	6	3
8	NCNB-2031-WP	Baseline	2031 winter peak load conditions. Peak load time - hours ending 19:00.	1,557	58	847	0	1,499	6	3
9	NCNB-2026-SP-HiCEC	Sensitivity	2026 summer peak load conditions with hi-CEC load forecast sensitivity	1,474	0	658	0	1,474	6	3
10	NCNB-2023-SPOP-HiReMinGas	Sensitivity	2026 spring off-peak load conditions with hi renewable dispatch sensitivity	1,021	20	493	488	513	16	10
11	NCNB-2023-SP-HiRenew	Sensitivity	2023 summer peak load conditions with hi-renewable dispatch sensitivity	1,473	15	528	523	936	6	3

Generation Assumptions - North Coast and North Bay Area

S. No.	Study Case	Scenario Type	Description	Battery Storage (MW)	Solar		Wind		Hydro		Thermal	
					Installed (MW)	Dispatch (MW)	Installed (MW)	Dispatch (MW)	Installed (MW)	Dispatch (MW)	Installed (MW)	Dispatch (MW)
1	NCNB-2023-SP	Baseline	2023 summer peak load conditions. Peak load time - hours ending 19:00.	0	0	0	0	0	25	11	1,535	54
2	NCNB-2026-SP	Baseline	2026 summer peak load conditions. Peak load time - hours ending 19:00.	0	0	0	0	0	25	11	1,535	54
3	NCNB-2031-SP	Baseline	2031 summer peak load conditions. Peak load time - hours ending 19:00.	0	0	0	0	0	25	11	1,535	105
4	NCNB-2023-SOP	Baseline	2023 spring off-peak load conditions. Off-peak load time - hours ending 20:00.	0	0	0	0	0	25	3	1,535	732
5	NCNB-2026-SOP	Baseline	2026 spring off-peak load conditions. Off-peak load time - hours ending 13:00.	0	0	0	0	0	25	5	1,535	704
6	NCNB-2023-WP	Baseline	2023 winter peak load conditions. Peak load time - hours ending 19:00.	0	0	0	0	0	25	5	1,535	727
7	NCNB-2026-WP	Baseline	2026 winter peak load conditions. Peak load time - hours ending 19:00.	0	0	0	0	0	25	5	1,535	730
8	NCNB-2031-WP	Baseline	2031 winter peak load conditions. Peak load time - hours ending 19:00.	0	0	0	0	0	25	5	1,535	781
9	NCNB-2026-SP-HiCEC	Sensitivity	2026 summer peak load conditions with hi-CEC load forecast sensitivity	0	0	0	0	0	25	11	1,535	54
10	NCNB-2023-SPOP-HiReMinGas	Sensitivity	2026 spring off-peak load conditions with hi renewable dispatch sensitivity	0	0	0	0	0	25	3	1,535	732
11	NCNB-2023-SP-HiRenew	Sensitivity	2023 summer peak load conditions with hi-renewable dispatch sensitivity	0	0	0	0	0	25	0	1,535	54

Previously approved transmission projects modelled in base cases

Project Name	Expected year of in-service
Clear Lake 60 kV System Reinforcement	Dec-2027
Fulton-Hopland 60 kV Line Project	Dec-2021
Ignacio Area Upgrade	Dec-2029
Lakeville 60 kV Area Reinforcement	Dec-2027
Vaca Dixon-Lakeville 230 kV Corridor Series Compensation	Oct-2025
Tulucay-Napa #2 60 kV Line Capacity Increase	Dec-2026

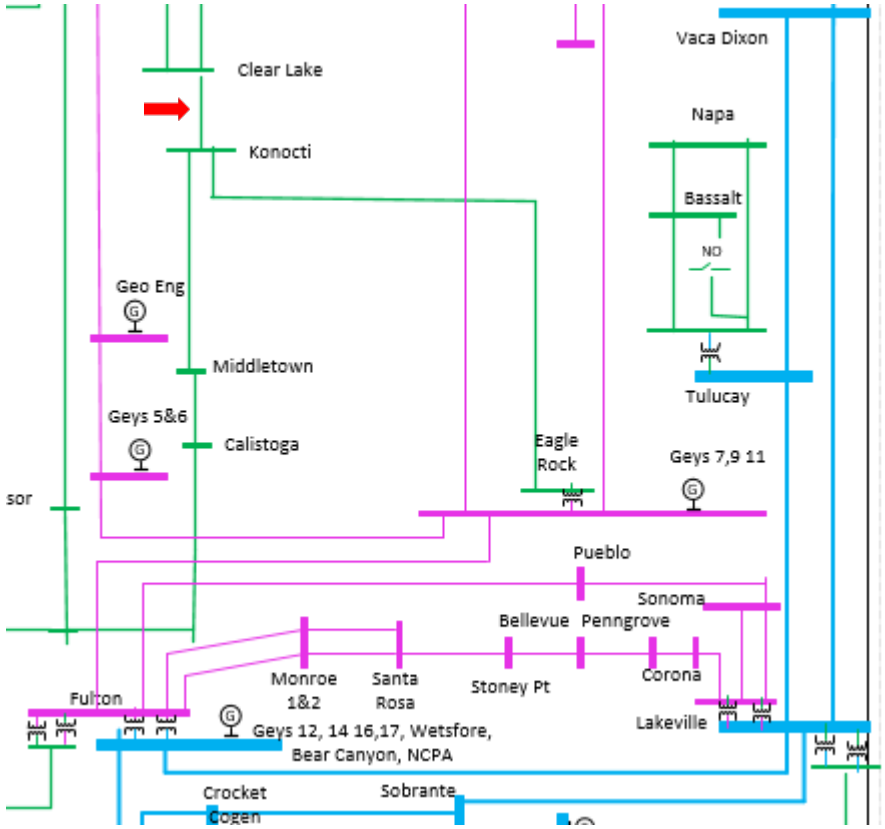
Reliability issues identified in 2021-2022 TPP

Observations
60 kV

- P2-4 Bus Tie Breaker Fault of Fulton 115KV - Section 2F & 1F or
- P5 Fulton Bus 1 & 2 Section D(Failure of non-redundant relay)
- causes overload of Clear Lake - Eagle Rock 60 kV Line in summer peak cases

Approved and Potential Mitigations

- Clear Lake 60 kV System Reinforcement – Dec 2027
- Interim operation solution



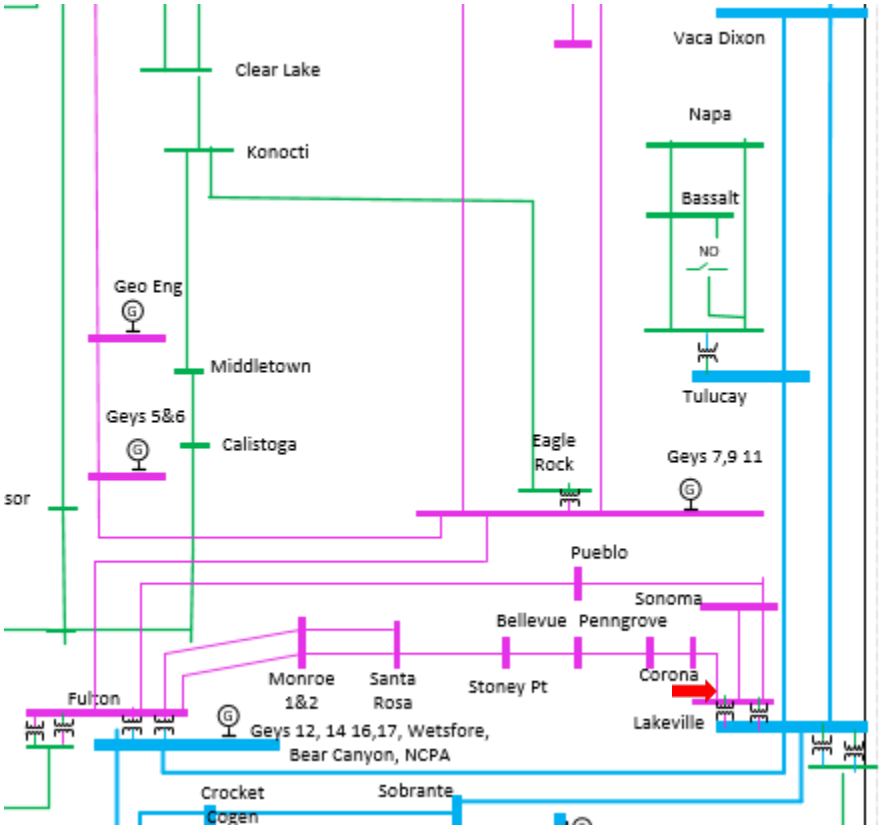
Reliability issues identified in 2021-2022 TPP

Observations
115 kV

- P2-4 Bus Tie Breaker Fault of Fulton 115KV - Section 2D & 1D or
- P5 Fulton 230 KV BAAH BUS #1 D (Failure of non-redundant relay) or
- P7 Fulton 230/115KV TB 4 & Fulton 230/115KV TB 9
- causes overload of Corona- Lakeville 115kV Line in summer peak cases

Approved and Potential Mitigations

- Fulton SPS and/ or system upgrade
- Interim operation solution

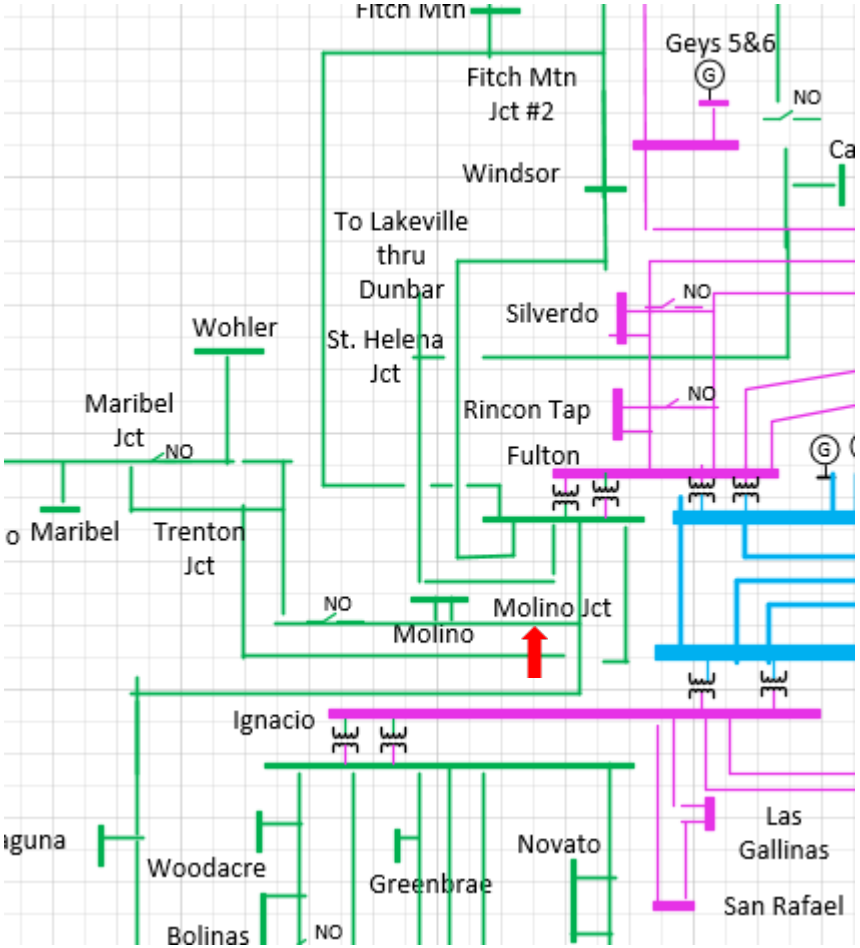


Reliability issues identified in 2021-2022 TPP

Observations
60 kV

- P2-4 Bus Tie Breaker Fault of Fulton 115KV - Section 2F & 1F or
- P5 Fulton Bus 1 & 2 Section E/F (Failure of non-redundant relay)
- causes overload of Fulton- Molino-Cotati 60 kV Line in summer peak cases

Approved and Potential Mitigations
- Fulton SPS and/ or system upgrade
- Interim operation solution



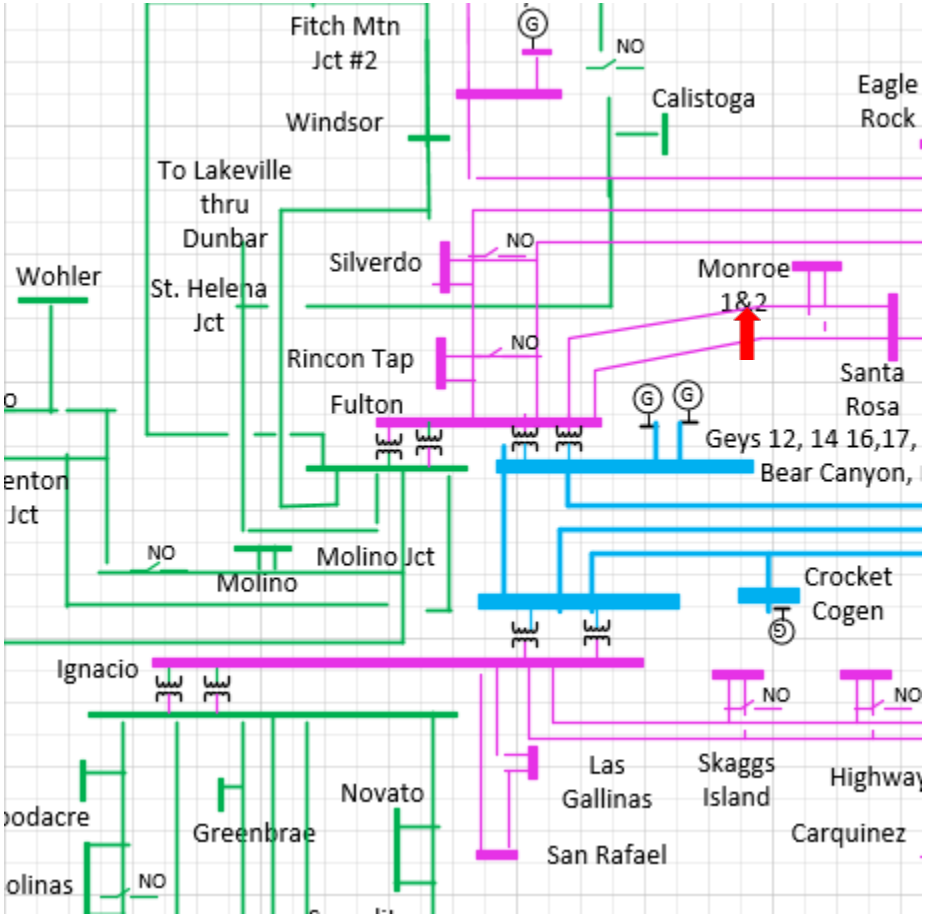
Reliability issues identified in 2021-2022 TPP

Observations
115kV

- P6 Fulton-Santa Rosa #2 115KV & Corona-Lakeville 115KV Line
- cause overload of Fulton- Santa Rosa No.1 115 kV Line in summer peak cases

Approved and Potential Mitigations

- Fulton SPS and/ or system upgrade
- Interim operation solution



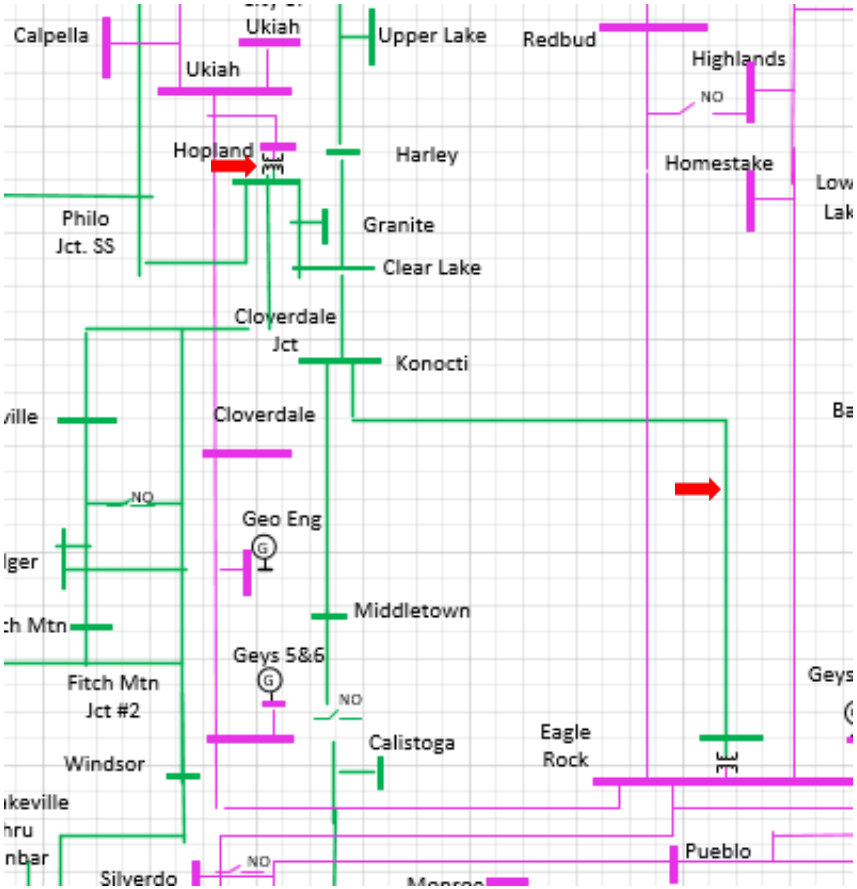
Reliability issues identified in 2021-2022 TPP

Observations
60 kV

- P2-4 Bus Tie Breaker Fault of Fulton 115KV - Section 2F & 1F or
- P5 Fulton Bus 1 & 2 Section D (Failure of non-redundant relay) or
- P6 Fulton 230/115KV TB 1 & Fulton 230/115KV TB 2
- causes overload of Konocti - Eagle Rock 60kV Line and Hopland 115/60 kV Bank No.2 in summer peak cases

Approved and Potential Mitigations

- Clear Lake 60 kV System Reinforcement – Dec 2027
- Maintenance project to increase capacity of Hopland Bank#2 by 2024
- Interim operation solution

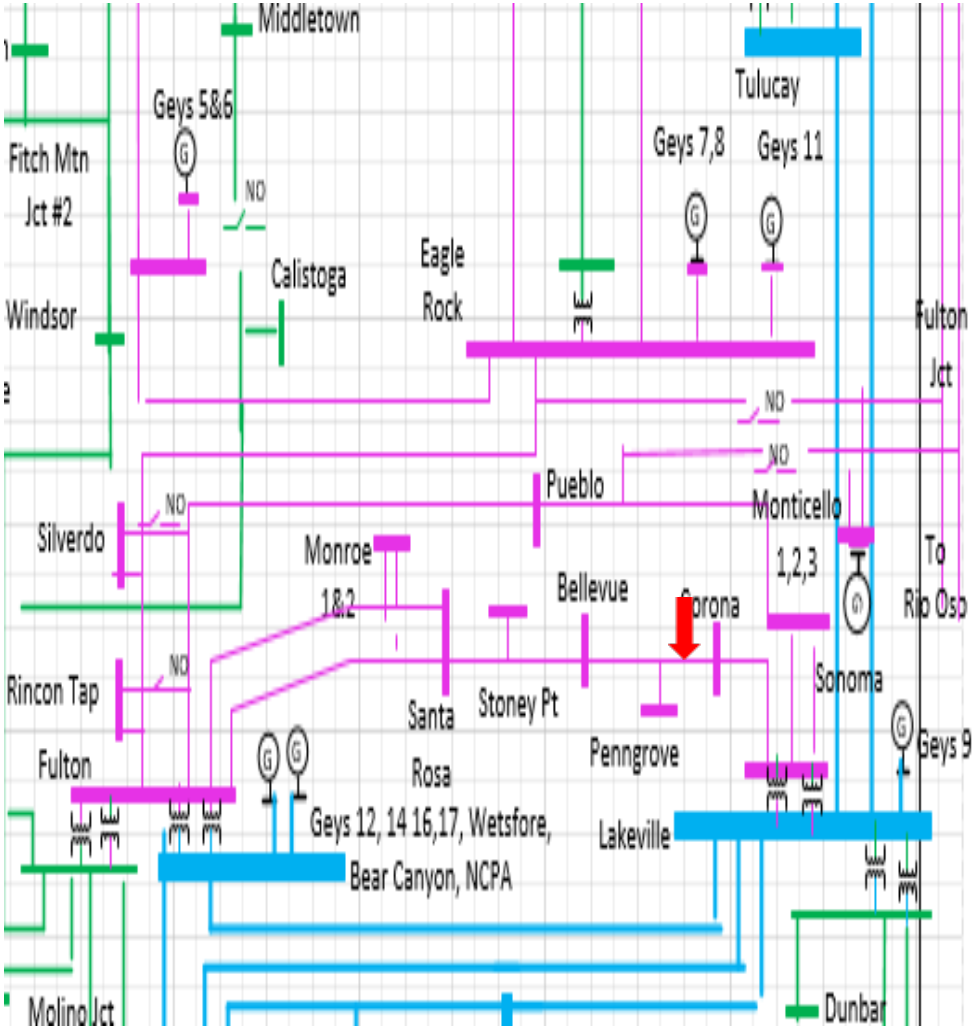


Reliability issues identified in 2021-2022 TPP

Observations
115 kV

- P2-4 Bus Tie Breaker Fault of Fulton 115KV - Section 2D & 1D or
- P5 Fulton 230 KV BAAH BUS #1 D (Failure of non-redundant relay) or
- P6 Fulton 230/115KV TB 4 & Fulton 230/115KV TB 9 or
- P7 DCTL Fulton-Santa Rosa #1 & #2 115kV Lines
- causes overload of Santa Rosa- Corona 115 kV Line in summer peak cases

Approved and Potential Mitigations
- Fulton SPS and/ or system upgrade
- Interim operation solution



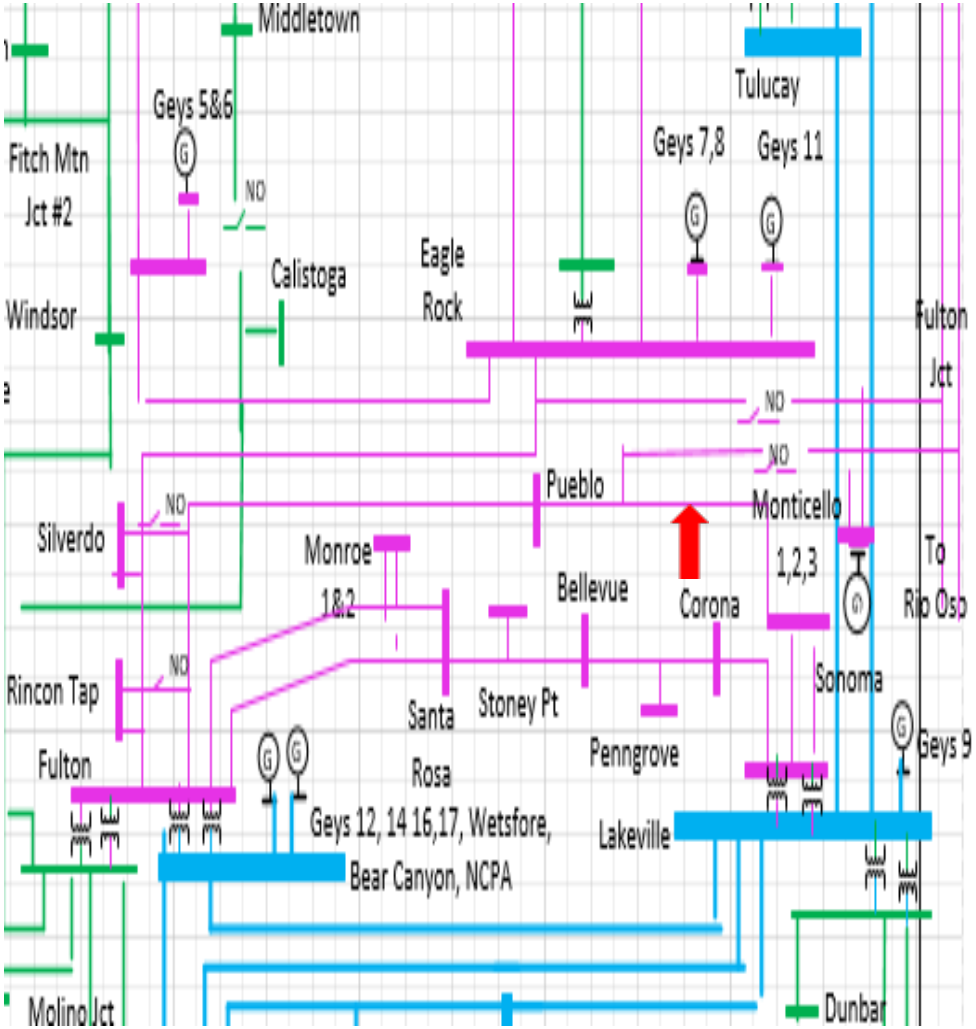
Reliability issues identified in 2021-2022 TPP

Observations
115 kV

- P5 Fulton 230 KV BAAH BUS #1 D (Failure of non-redundant relay) or
- P6 Fulton 230/115KV TB 4 & Fulton 230/115KV TB 9
- causes overload of Sonoma - Pueblo 115 kV Line in summer peak cases

Approved and Potential Mitigations

- Fulton SPS and/ or system upgrade
- Interim operation solution



Reliability issues identified in 2020-2021 TPP

Observations and Potential Mitigations

- Low voltages identified at Calistoga 60 kV Area in the summer peak cases.
  - Switch in Fulton SVD (230kV)

Sensitivity-only issues

Below is the list of facility overloads identified in sensitivity scenario(s) only

- None

Summary of Potential New Upgrades

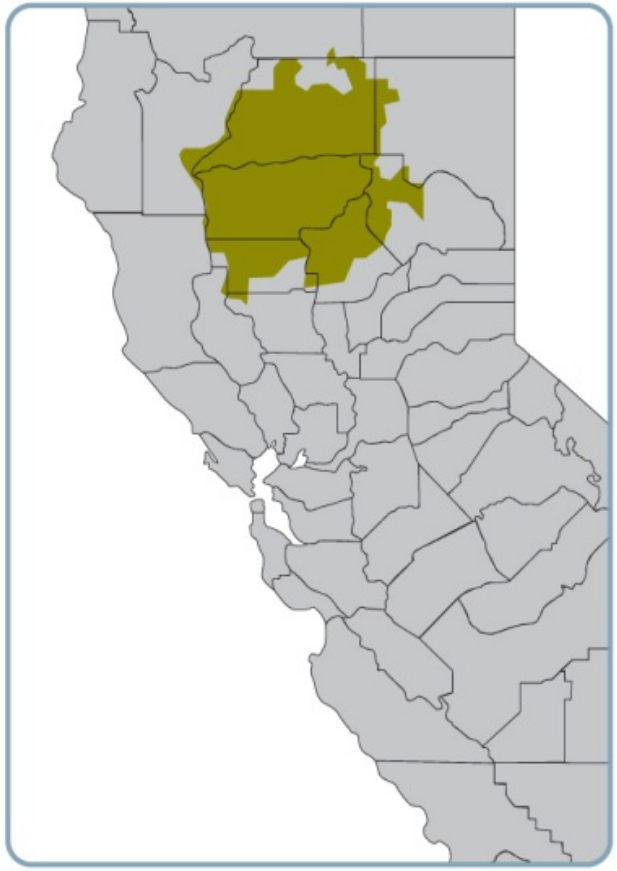
- Fulton SPS and/ or system upgrade

North Valley Area
Preliminary Reliability Assessment Results

Bryan Fong
Senior Regional Transmission Engineer

2021-2022 Transmission Planning Process Stakeholder Meeting
September 27-28, 2021

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

S. No.	Study Case	Scenario Type	Description	Gross Load (MW)	AAEE (MW)	BTM-PV		Net Load (MW)	Demand Response	
						Installed (MW)	Output (MW)		Total (MW)	D2 (MW)
1	NVLY-2023-SP	Baseline	2023 summer peak load conditions. Peak load time - hours ending 19:20.	893	10	355	7	876	15	13
2	NVLY-2026-SP	Baseline	2026 summer peak load conditions. Peak load time - hours ending 19:20.	903	17	423	8	878	15	13
3	NVLY-2031-SP	Baseline	2031 summer peak load conditions. Peak load time - hours ending 19:20.	935	42	503	10	883	14	13
4	NVLY-2023-SOP	Baseline	2023 spring off-peak load conditions. Off-peak load time – hours ending 20:00.	593	11	381	0	581	36	28
5	NVLY-2026-SOP	Baseline	2026 spring off-peak load conditions. Off-peak load time – hours ending 13:00.	309	15	423	334	-40	0	0
6	NVLY-2026-SP-HiCEC	Sensitivity	2026 summer peak load conditions with hi-CEC load forecast sensitivity	903	0	423	8	895	15	13
7	NVLY-2023-SPOP-HiReMinGas	Sensitivity	2023 spring off-peak load conditions with hi renewable dispatch sensitivity	593	11	381	377	205	36	28
8	NVLY-2023-SP-HighREMinGas	Sensitivity	2023 summer peak load conditions with hi-renewable dispatch sensitivity	879	10	355	352	517	15	13

Generation Assumptions – North Valley Area

S. No.	Study Case	Scenario Type	Description	Battery Storage (MW)	Solar		Wind		Hydro		Thermal	
					Installed (MW)	Dispatch (MW)	Installed (MW)	Dispatch (MW)	Installed (MW)	Dispatch (MW)	Installed (MW)	Dispatch (MW)
1	NVLY-2023-SP	Baseline	2023 summer peak load conditions. Peak load time - hours ending 19:20.	0	8	0	103	62	1,792	1,417	1,067	476
2	NVLY-2026-SP	Baseline	2026 summer peak load conditions. Peak load time - hours ending 19:20.	0	8	0	103	62	1,792	1,511	1,067	585
3	NVLY-2031-SP	Baseline	2031 summer peak load conditions. Peak load time - hours ending 19:20.	0	8	0	457	274	1,792	1,395	1,067	507
4	NVLY-2023-SOP	Baseline	2023 spring off-peak load conditions. Off-peak load time – hours ending 20:00.	0	8	0	103	21	1,792	941	1,067	431
5	NVLY-2026-SOP	Baseline	2026 spring off-peak load conditions. Off-peak load time – hours ending 13:00.	0	8	8	103	21	1,792	1,273	1,067	0
6	NVLY-2026-SP-HiCEC	Sensitivity	2026 summer peak load conditions with hi-CEC load forecast sensitivity	0	8	0	103	62	1,792	1,511	1,067	470
7	NVLY-2023-SPOP-HiReMinGas	Sensitivity	2023 spring off-peak load conditions with hi renewable dispatch sensitivity	0	8	0	103	66	1,792	943	1,067	416
8	NVLY-2023-SP-HighREMinGas	Sensitivity	2023 summer peak load conditions with hi-renewable dispatch sensitivity	0	8	8	103	86	1,792	1,388	1,067	397

Projects in North Valley Area

Projects	Expected ISD
Approved TPP Projects	
Glen 230/60 kV Transformer No. 1 Replacement	4/1/2022
Cottonwood 230/115 kV Transformer replacement	6/1/2023
Cascade 115/60 kV No. 2 Transformer Project	12/1/2025
Tyler 60 kV Shunt Capacitor	12/1/2026
Cottonwood 115 kV Bus Sectionalizing Breaker	12/1/2025
Red Bluff-Coleman 60 kV Line Upgrade	5/1/2025
Round Mountain Dynamic Reactive Support Project	Jun-2024
Palermo-Wyandotte 115kV Line Section Reconductoring	May-2023
Other Projects	
Cottonwood – Red Bluff 60 kV line reconductoring (PG&E Maintenance project MWC 93)	6/8/2021
Table Mountain 115 kV SPS	TBD
Grizzly PH Interconnection into Bucks Creek	June-2022

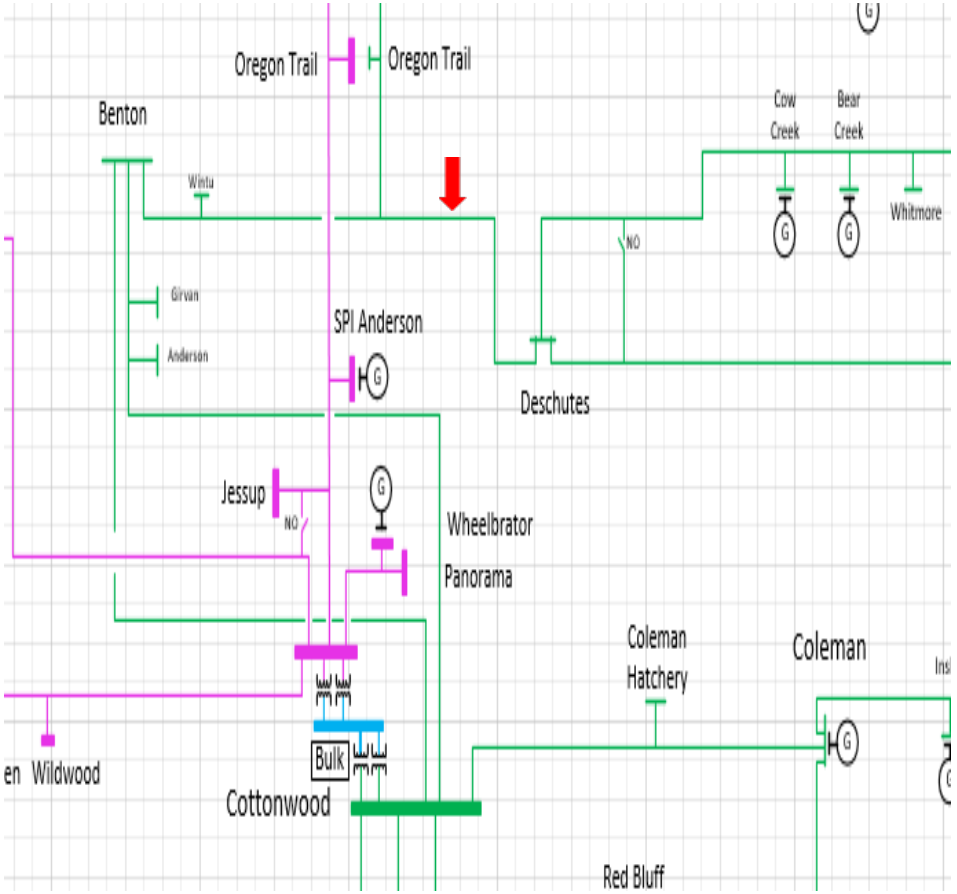
Reliability issues identified in 2021-2022 TPP

Observations
60 kV

- P5 Cottonwood 115KV Bus 1/Bus 2 (Failure of non-redundant relay) or
- P5 Cottonwood 230KV Bus Section E/G (Failure of non-redundant relay)
- causes overload of Benton-Deschutes 60 kV Line in summer peak cases

Approved and Potential Mitigations

- Protection upgrade



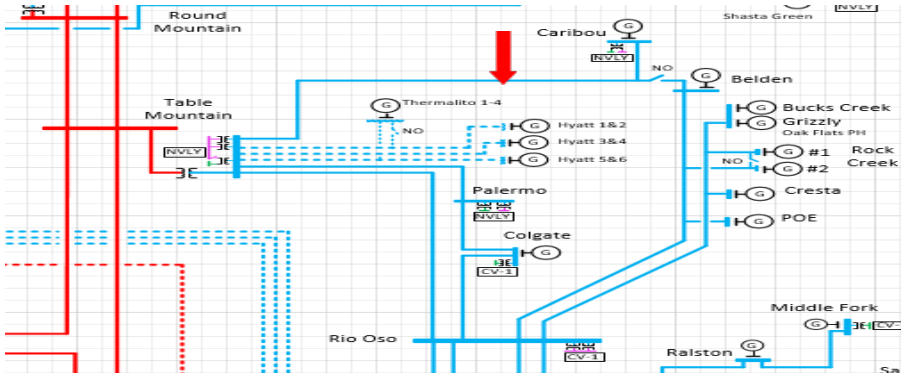
Reliability issues identified in 2021-2022 TPP

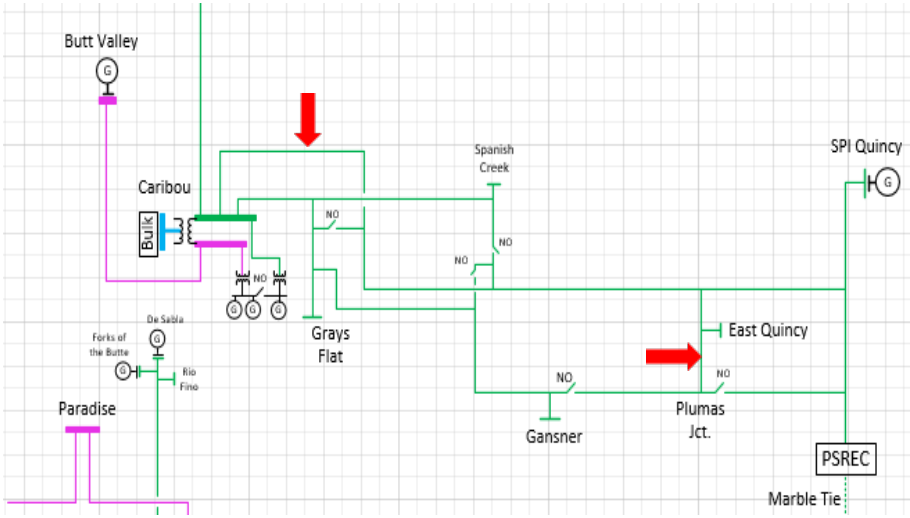
Observations
230 and 60kV

- P2-4 Bus Tie Breaker Fault TBL MT D 230KV - Section 1D & 2D or
- P2-1 Line Section w/o Fault Caribou-Table Mtn 230KV or
- P2-2 Bus Fault TBL MT D 230KV Section 1D or
- P2-4 Bus Tie Breaker Fault TBL MT D Section 1D & TBL MT E Section 1E 230KV
- causes overload of Caribou - Table Mountain 230kV and Caribou-Plumas Jct 60 kV Line in summer peak cases

Approved and Potential Mitigations

- Modify Caribou RAS





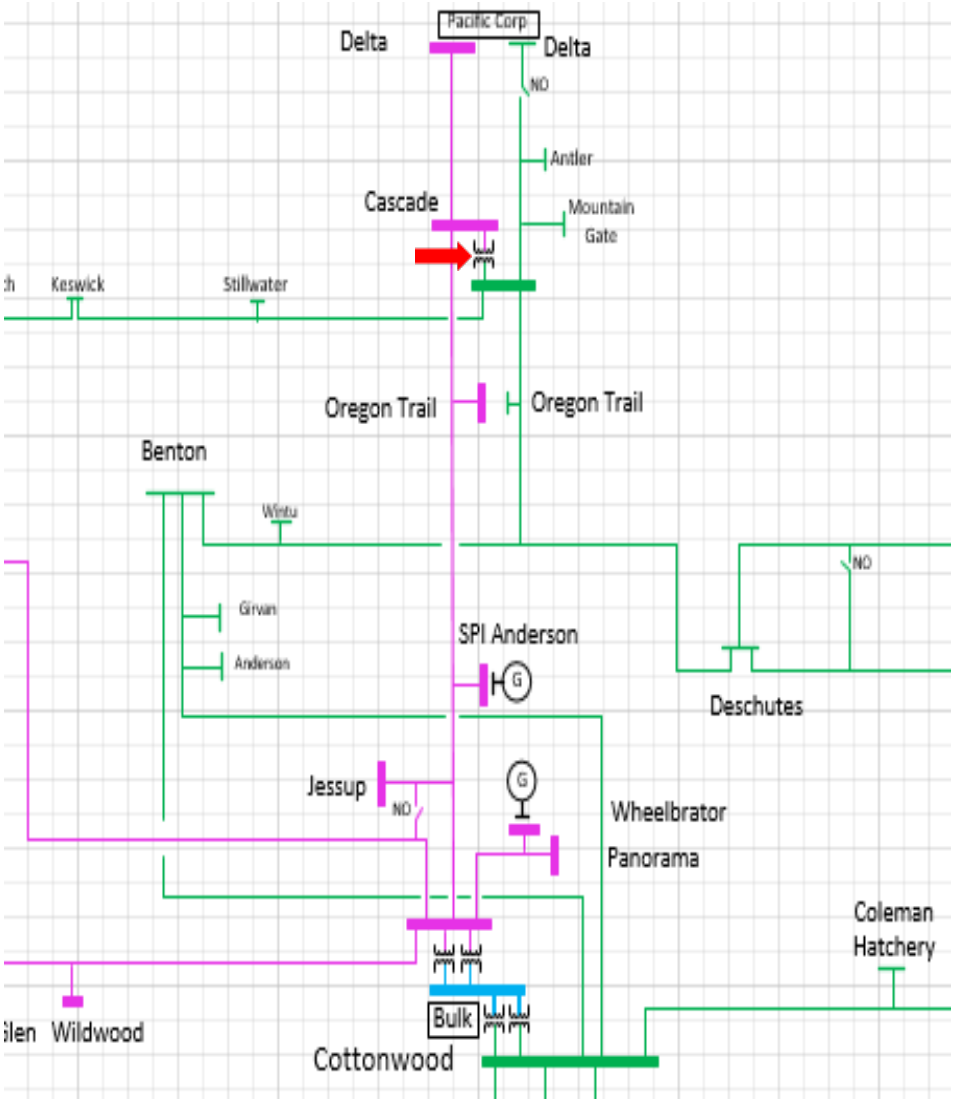
Reliability issues identified in 2021-2022 TPP

Observations
60 kV

- P5 Cottonwood 230KV Bus Section E/G (Failure of non-redundant relay)
- causes overload of Cascade No.1 115/60/13.8 kV Transformer in summer peak 2023 case only

Approved and Potential Mitigations

- Cascade 115/60 kV No. 2 Transformer Project - Dec 2025



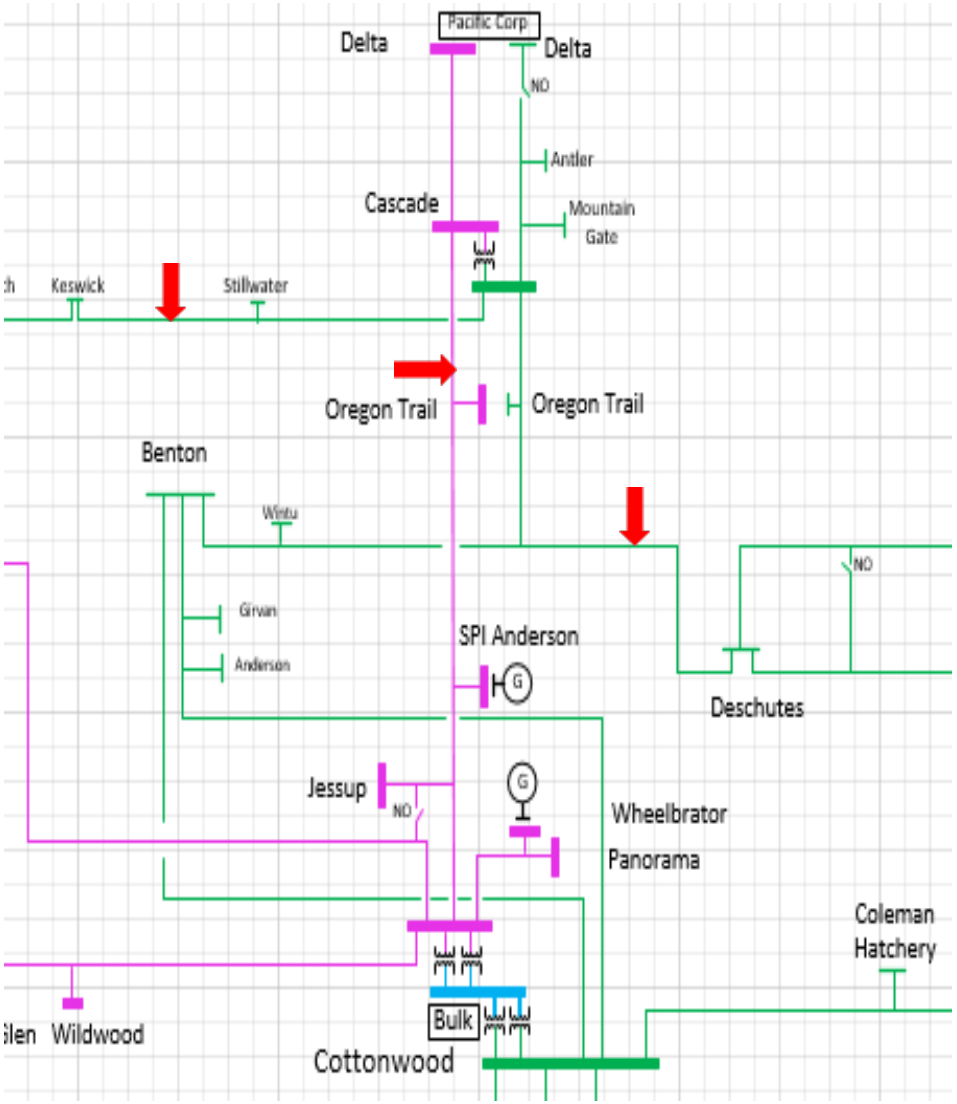
Reliability issues identified in 2021-2022 TPP

Observations
115 and 60kV

- P5 Cottonwood 230KV Bus Section E/G (Failure of non-redundant relay)
- causes overload of Cascade-Cottonwood 115 kV, Keswick-Cascade 60 kV and Cascade-Deschutes 60 kV Line in summer peak cases

Approved and Potential Mitigations

- Protection upgrade



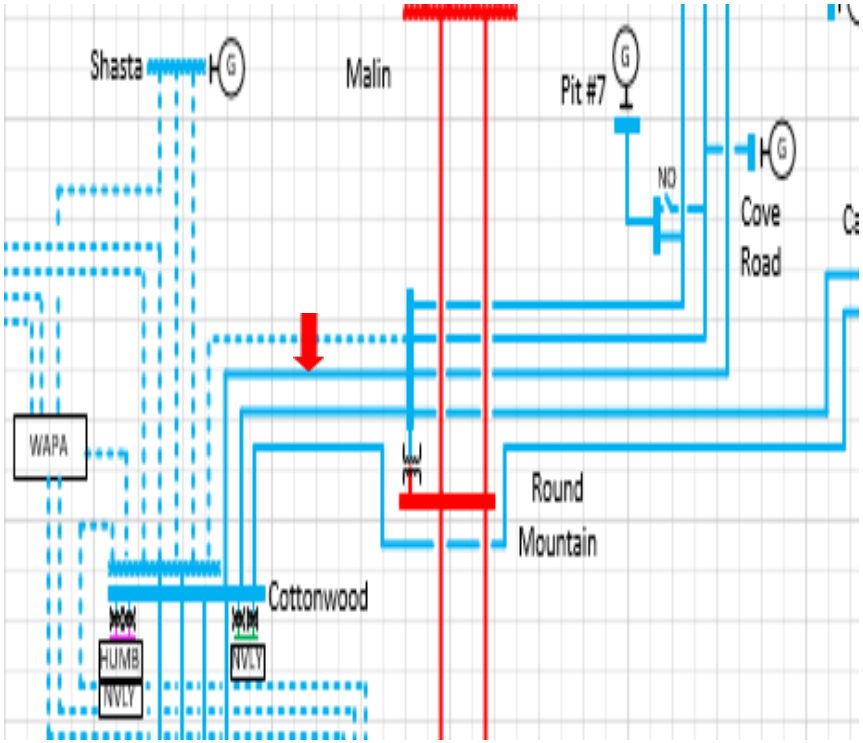
Reliability issues identified in 2021-2022 TPP

Observations
230 kV

- P5 Round Mountain 230KV Bus 1 & 2 Sec. E (Failure of non-redundant relay)
- causes overload of Round Mountain - Cottonwood #1 230kV in summer peak cases

Approved and Potential Mitigations

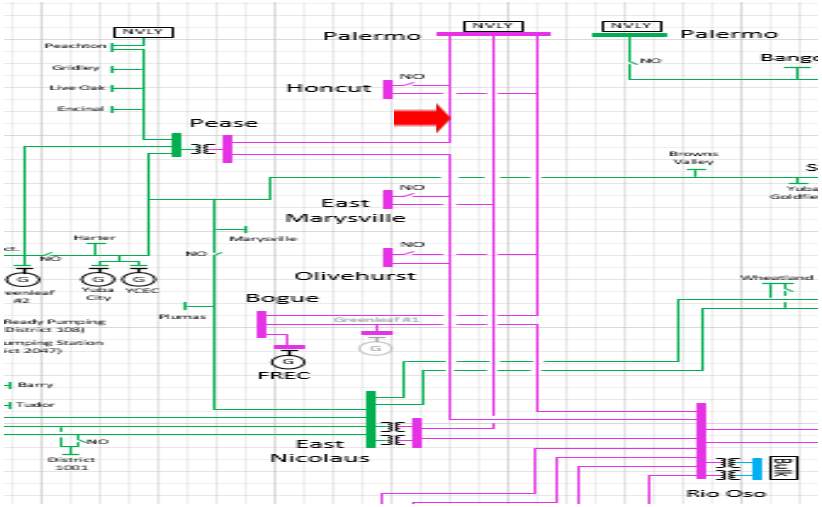
- Protection upgrade



Reliability issues identified in 2021-2022 TPP

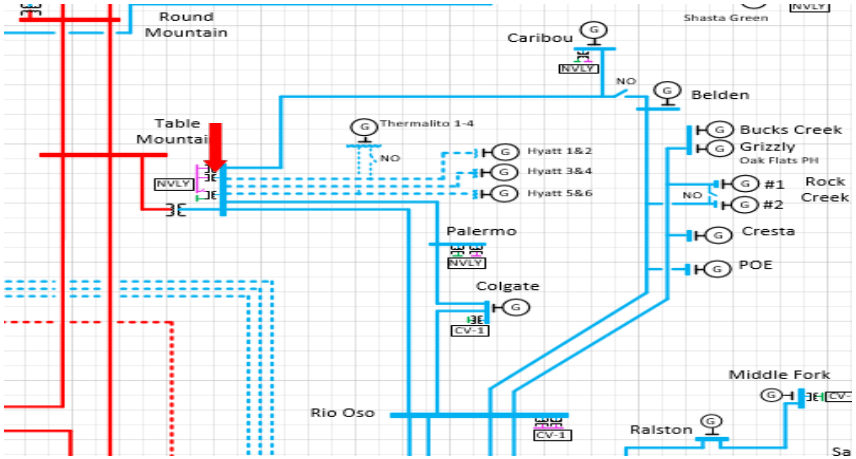
Observations
115 kV

- P2-3 Non-Bus Tie Breaker Fault TBL MT D - 1D 230KV & TBL MT D- TBL MT E 230KV
- causes overload of Palermo-Pease 115 kV Line and Table Mountain No.3 230/115 kV Transformer in summer peak cases



Approved and Potential Mitigations

- Modify Caribou RAS



Reliability issues identified in 2020-2021 TPP

Observations and Potential Mitigations

- P6 (N-1-1CASCADE 115/60KV TB 1 & CASCADE-BENTON-DESCHUTES 60KV) causes low voltage at 60 kV buses in Keswick and Cascade Area in the summer peak cases.
  - Mitigation under review

- P5 (Non-Redundant Relay) causes low voltage at 60 kV buses in Still Walter and Mtn Gate Area in the summer peak cases.
  - Protection Upgrade

Sensitivity-only issues continues

Below is the list of facility overloads identified in sensitivity scenario(s) only

Overloaded Facility	Category	2026 SP High CEC Forecast	2023 SP Heavy Renewable & Min Gas Gen	2023 OP Heavy Renewable & Min Gas Gen
Cascade-Deschutes 60 kV Line	P1			√

Summary of Potential New Upgrades

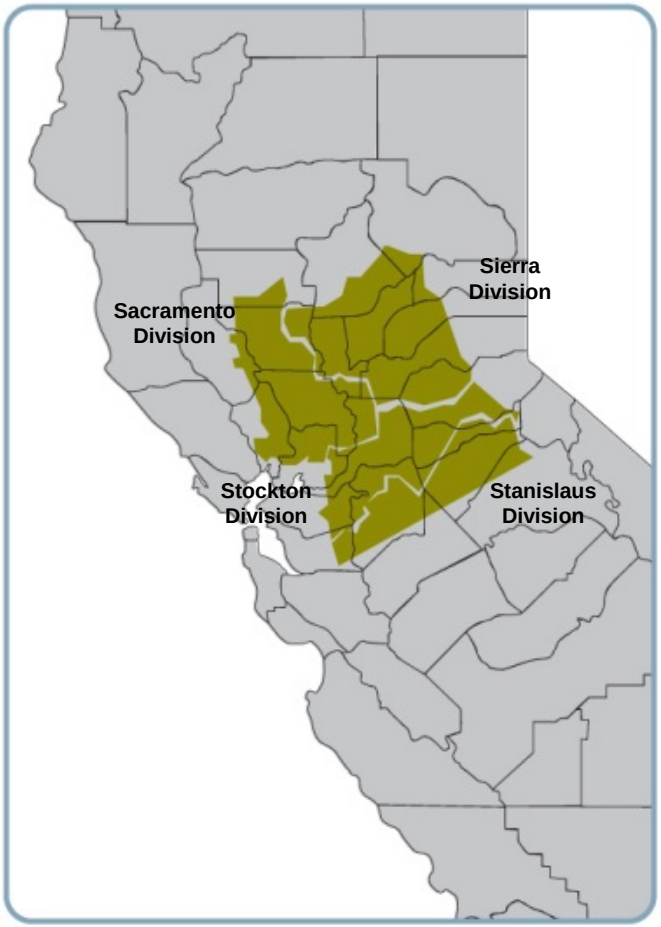
Potential New Upgrade Proposed in this TPP Cycle	Contingency
Protection upgrade to address P5-5 on Round Mountain 230 kV	P5-5
Protection upgrade to address P5-5 on Cottonwood 230 kV	P5-5
Protection upgrade to address P5-5 on Cottonwood 115 kV	P5-5
SPS upgrade to address P2-1 on Caribou – Table Mountain 230 kV line	P2-1

Central Valley Area
Preliminary Reliability Assessment Results

Ebrahim Rahimi
Senior Advisor - Regional Transmission North

2021-22 Transmission Planning Process Stakeholder Meeting
September 27-28, 2021

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

S. No.	Study Case	Scenario Type	Description	Gross Load (MW)	AAEE (MW)	BTM-PV		Net Load (MW)	Demand Response	
						Installed (MW)	Output (MW)		Total (MW)	D2 (MW)
1	CVLY-2023-SP	Baseline	2023 summer peak load conditions. Peak load time - hours ending 18:50.	4,062	31	1,667	17	4,014	103	88
2	CVLY-2026-SP	Baseline	2026 summer peak load conditions. Peak load time - hours ending 19:00.	4,138	49	2,100	21	4,068	101	88
3	CVLY-2031-SP	Baseline	2031 summer peak load conditions. Peak load time - hours ending 19:00.	4,269	122	2,688	27	4,121	99	88
4	CVLY-2023-SOP	Baseline	2023 spring off-peak load conditions. Off-peak load time - hours ending 20:00.	2,869	54	1,696	0	2,815	101	59
5	CVLY-2026-SOP	Baseline	2026 spring off-peak load conditions. Off-peak load time - hours ending 13:00.	1,425	44	2,100	1659	(278)	0	0
6	CVLY-2026-SP-Hi-CEC	Sensitivity	2026 summer peak load conditions with hi-CEC load forecast sensitivity	4,138	0	2,100	21	4,117	101	88
7	CVLY-2023-SOP-HiRenew	Sensitivity	2023 spring off-peak load conditions with hi renewable dispatch sensitivity	2,869	54	1,696	1679	1,136	101	59
8	CVLY-2023-SP-HiRenew	Sensitivity	2023 summer peak load conditions with hi-renewable dispatch sensitivity	4,062	31	1,667	1650	2,381	103	88

Note: Includes PG&E load only. DR and storage are modeled offline in starting base cases.

Includes PG&E load only.

DR and storage are modeled offline in starting base cases.

Generation Assumptions – Central Valley Area

S. No.	Study Case	Scenario Type	Description	Battery Storage (MW)	Solar		Wind		Hydro		Thermal	
					Installed (MW)	Dispatch (MW)	Installed (MW)	Dispatch (MW)	Installed (MW)	Dispatch (MW)	Installed (MW)	Dispatch (MW)
1	CVLY-2023-SP	Baseline	2023 summer peak load conditions. Peak load time - hours ending 18:50.	15	34	0	1021	552	1409	1342	1324	758
2	CVLY-2026-SP	Baseline	2026 summer peak load conditions. Peak load time - hours ending 19:00.	65	34	0	1021	552	1409	1371	1324	780
3	CVLY-2031-SP	Baseline	2031 summer peak load conditions. Peak load time - hours ending 19:00.	123	34	0	1245	745	1409	1222	1324	912
4	CVLY-2023-SOP	Baseline	2023 spring off-peak load conditions. Off-peak load time - hours ending 20:00.	15	34	1	1254	251	1409	1123	1324	599
5	CVLY-2026-SOP	Baseline	2026 spring off-peak load conditions. Off-peak load time - hours ending 13:00.	65	34	31	1256	244	1409	850	1324	223
6	CVLY-2026-SP-Hi-CEC	Sensitivity	2026 summer peak load conditions with hi-CEC load forecast sensitivity	65	34	0	1021	552	1409	1371	1324	762
7	CVLY-2023-SOP-HiRenew	Sensitivity	2023 spring off-peak load conditions with hi renewable dispatch sensitivity	15	34	34	1254	803	1409	1124	1324	605
8	CVLY-2023-SP-HiRenew	Sensitivity	2023 summer peak load conditions with hi-renewable dispatch sensitivity	15	34	20	1021	612	1409	842	1324	51

Note: Includes PG&E load only. DR and storage are modeled offline in starting base cases.

Includes PG&E load only.

DR and storage are modeled offline in starting base cases.

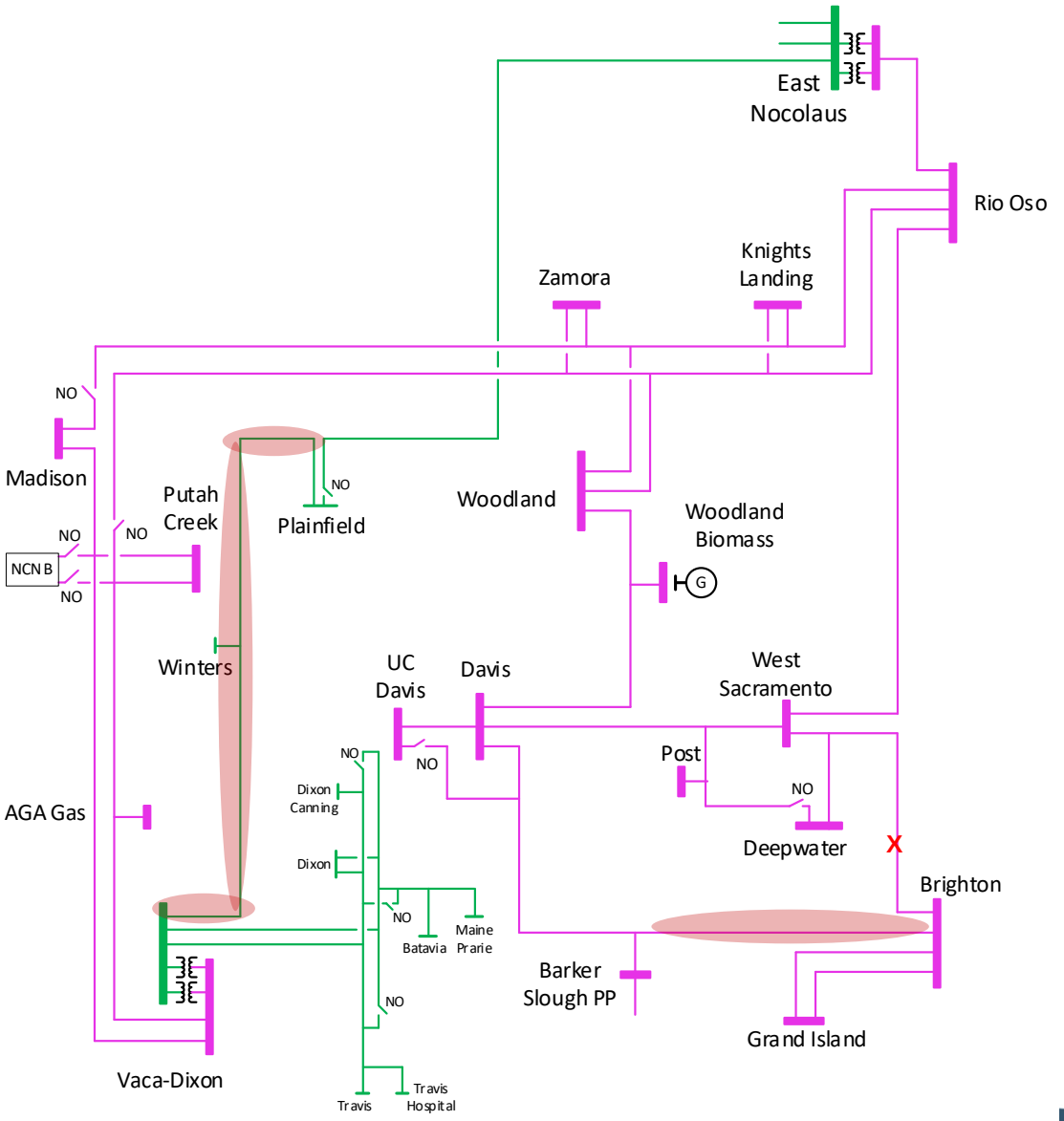
Sacramento Division

Projects in Sacramento Area

Projects	Expected ISD
Approved TPP Projects	
Vaca-Davis Area Reinforcement. The project scope is: ▪ Install 10 MVAR Shunt Capacitor at Plainfield 60 kV Substation, ▪ Replace Vaca - Dixon 115/60 kV Transformer Bank No. 5 ▪ Replace all the limiting elements of Dixon 60 kV sub	June-2025

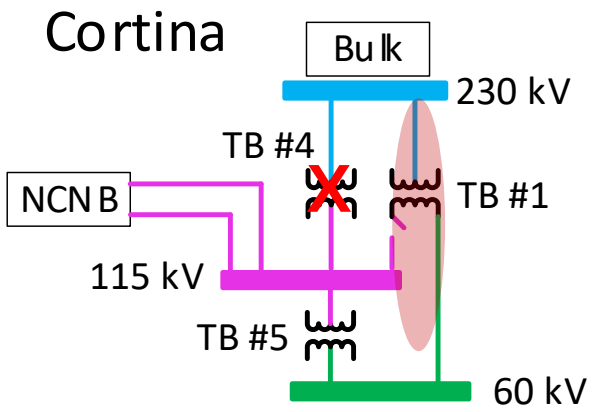
Sacramento Thermal Results Summary (1/2)

- P0 overload on Vaca – Plainfield 60 kV radial line starting 2023
  - Potential mitigation: Line reconductor, BESS,…
  - Short term solution: substation reconfiguration
- P1 overload on Brighton – Davis 115 kV line for West Sacramento – Brighton 115 kV line outage
  - The issue is only in 2023 and goes away with Rio Oso Transformer Upgrade and SVC projects
  - Short-term solution: Disable automatics



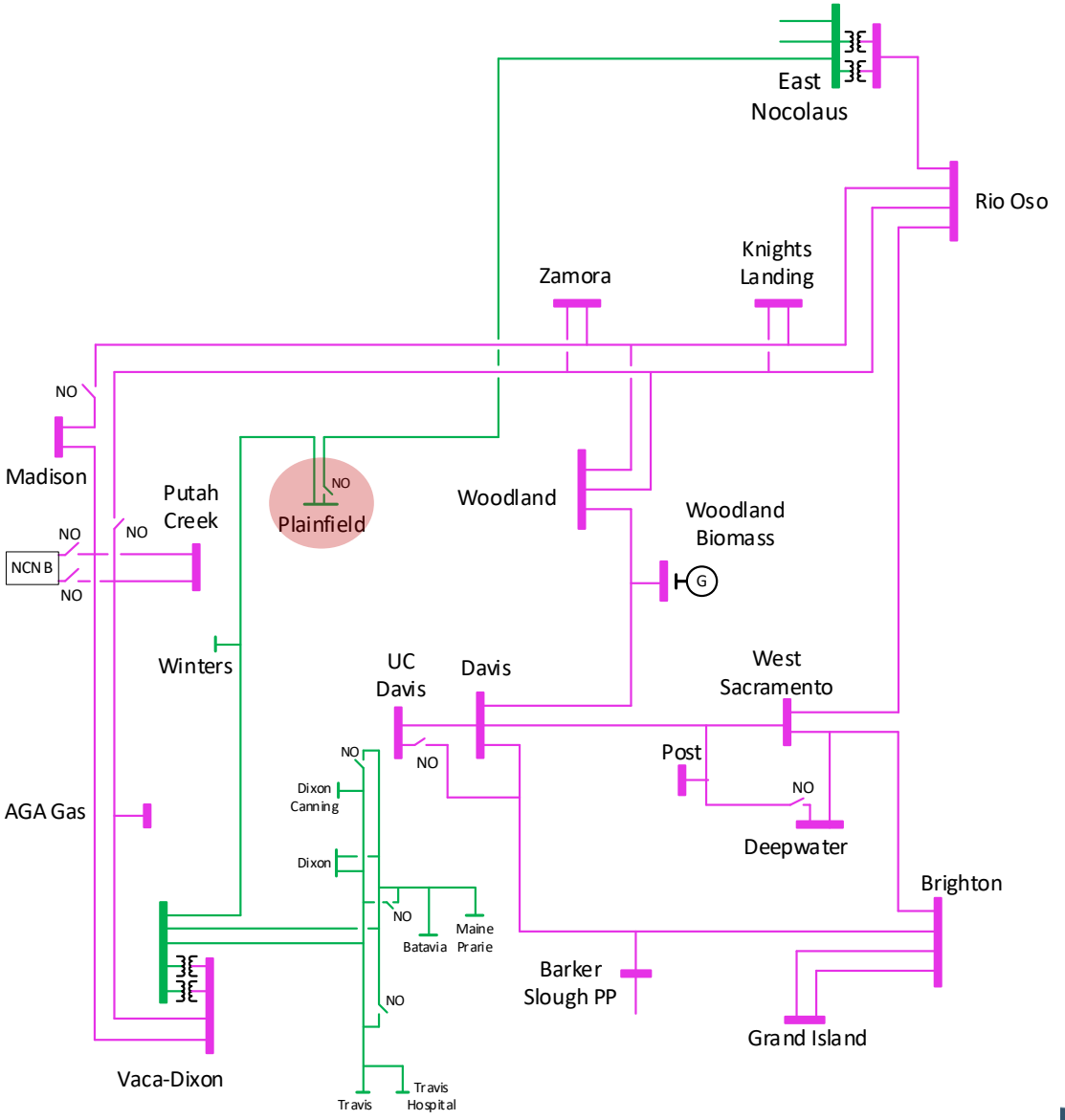
Sacramento Thermal Results Summary (2/2)

- P1 overload on Cortina 230/115/60 KV TB #1 for the contingency of the Cortina 230/115 kV TB #4 starting 2023
  - Potential mitigation: Upgrade TB #1
  - Short term solution: Operating procedure



Low Voltage Results Summary

- Low voltage at Plainfield 60 kV bus in the near term which is addressed by the capacitor banks added as part of the Vaca Davis area reinforcement project.
- Continue to monitor the long term issue.



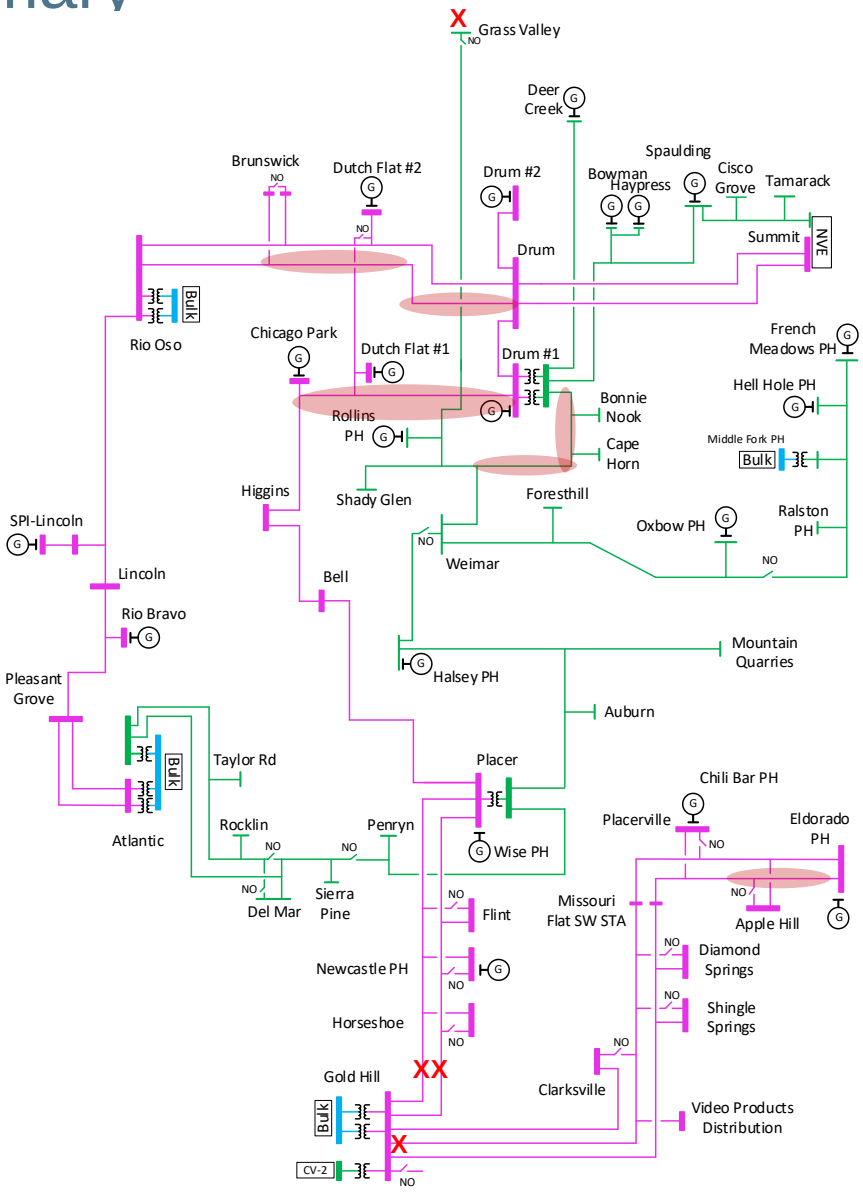
Sierra Division

Projects in Sierra Area

Projects	Expected ISD
Approved TPP Projects	
Pease 115/60 kV Transformer Addition	Nov-21
Rio Oso 230/115 kV Transformer Upgrades	Oct-23
Rio Oso Area 230 kV Voltage Support	Sep-24
East Marysville 115/60 kV	Nov-27
Gold Hill 230/115 kV Transformer Addition	Jun-28

Sierra Thermal Results Summary

- P7 of Placer – Gold Hill #1 and #2 overloads Drum – Higgins 115 kV line in the long term
  - Continue to monitor
- P3 of Colgate – Grass Valley 60 kV and Rollins Unit 1 gen, overloads Drum – Grass Valley – Weimar 60 kV.
  - Potential mitigation: Disable automatics.
- P6 of Rio Oso – Atlantic 230 kV and Gold Hill Atlantic 230 kV lines severely overload the underlying 115 kV lines
  - Potential mitigation: Operating procedure or SPS
- P6 of Drum – Rio Oso #2 115 kV and Drum – Higgins 115 kV overloads Drum – Rio Oso #1.
  - Potential mitigation: generation redispatch after the first contingency.
- P5-5 on Gold Hill 230 kV causes voltage collapse on all peak cases.
  - Potential mitigation: Protection upgrade
- P2-1 on Gold Hill - Missouri Flats 115 kV Line causes overload in the long term which we will continue to monitor



Low voltage issues

- There are low voltage issues in the near term in the Rio Oso – Davis – Brighton 115 kV area that will be addressed by the Rio Oso Transformer Upgrade and SVC projects.

- In the long term there are low voltage issues in the Gold Hill – El Dorado 115 kV and the Woodland 115 kV areas that will be monitored and if required will be addressed in future TPP cycles.

Stockton/Stanislaus (Tesla – Bellota) Divisions

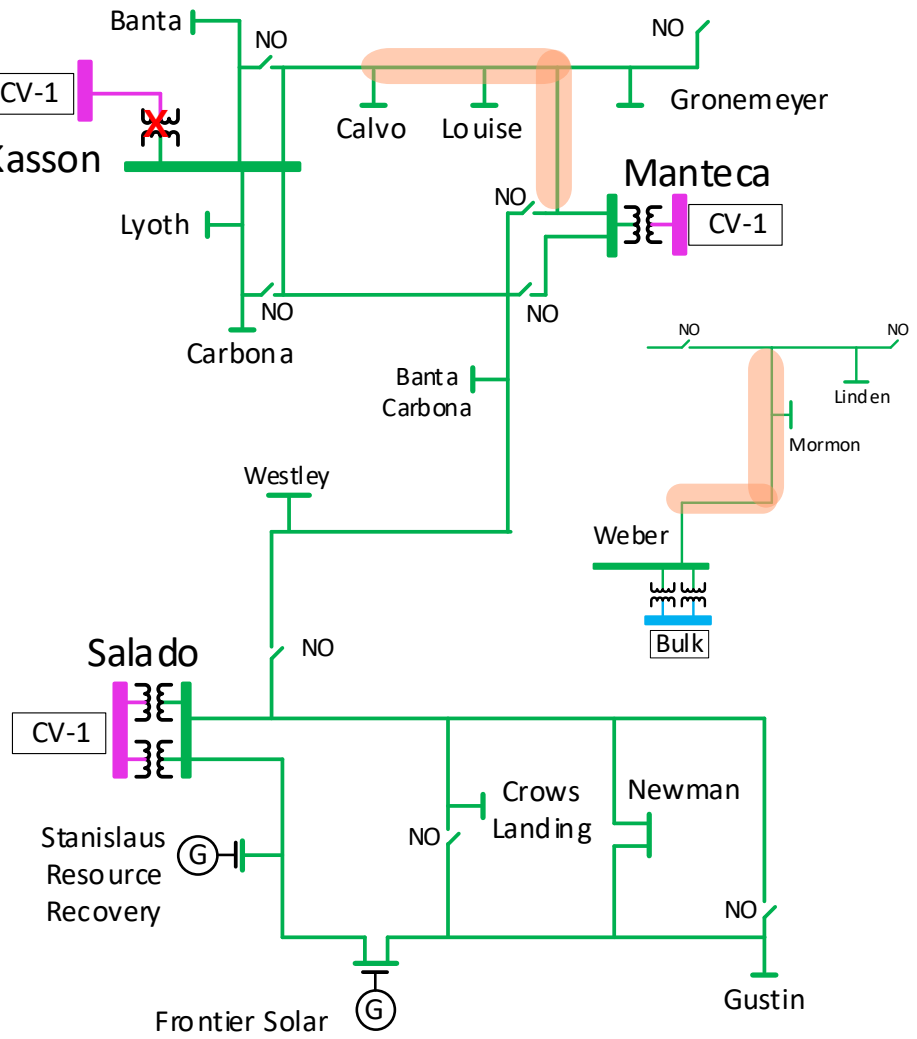
Projects in Stockton/Stanislaus Area

Projects	Expected ISD
Approved TPP Projects	
Mosher Transmission Project	Sep-25
Vierra 115 kV Looping Project	Dec-26
Tesla 230 kV Bus Series Reactor	May-23
Lockeford-Lodi Area 230 kV Development	Apr-26

Stockton/Stanislaus Thermal Results Summary (1/3)

- P0 overload on Weber – Mormon Jct. 60 kV radial line
  - Occurs in real time but was not identified in our cases due to lower load.
  - Potential mitigation: Line reconductor (one section, 6.5miles, BESS, …)

- P1 overload on Kasson- Manteca 60 kV line for Kasson 115/60 kV contingency
  - Potential mitigation: Add second transformer, …
  - Short term: Kasson SPS



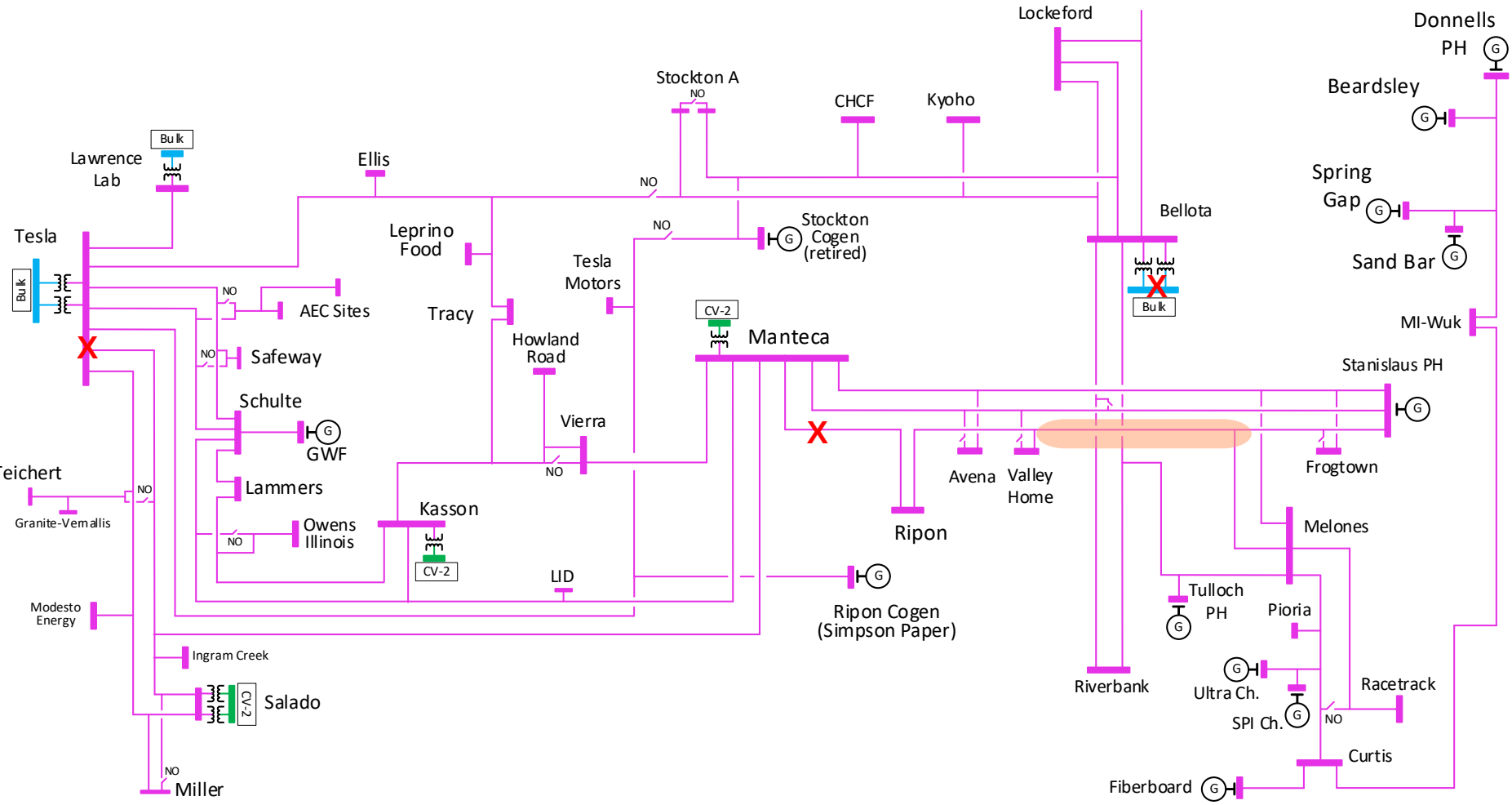
Stockton/Stanislaus Thermal Results Summary (2/3)

- P1 of Manteca – Ripon 115 kV line overloads Melones – Valley Home 115 kV line starting 2023
  - Potential mitigation: Line reconductor, …
  - Short tem: Operating measure

- P2-4 of Tesla 115 kV causes voltage issues and overload starting 2023
  - Potential mitigation: SPS, bus upgrade, …

- P5-5 on Bellota 230 kV causes overload starting 2023
  - Potential mitigation: Protection upgrade

Stockton/Stanislaus Thermal Results Summary (3/3)



Low Voltage Results Summary

- In the long term, there are low voltage issues in the Valley Home – Curtis 115 kV and Salado Newman 60 kV areas that will be monitored and if required addressed in future TPP cycles.

- P2-4 of Tesla 115 kV bus causes voltage issue across Tesla- Bellota 115 kV system

- P5-5 on Bellota 230 kV bus causes low voltage issue in Bellota – Manteca 115 kV system

Summary of Potential New Upgrades in Central Valley

Division	Potential New Upgrade in this TPP Cycle	Contingency
Sacramento	Address P0 overload on Vaca - Plainfield 60 kV line	P0
	Address P1 overload on Cortina TB #1	P1
Sierra	Protection upgrade at Gold Hill 230 kV to address P5-5	P5-5
	Operating procedure to address P6 at Atlantic 230 kV	P6
Stockton/ Stanislaus	Address P0 on Weber – Mormon Jct. 60 kV line	P0
	Address overload on sections of the Manteca - Melones 115 kV area	P1
	Protection upgrade to address P5-5 on Bellota 230 kV	P5-5

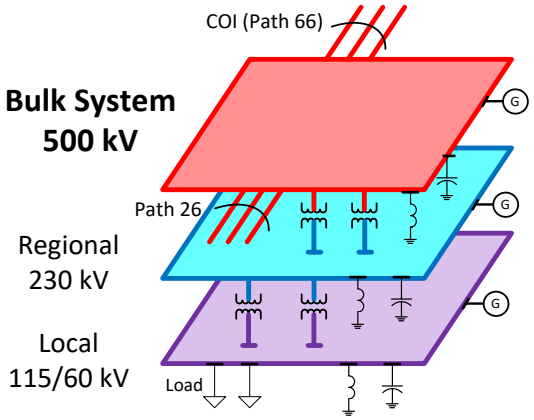
High Voltage Assessment in PG&E System
Status Update

Ebrahim Rahimi
Senior Advisor - Regional Transmission North

2021-22 Transmission Planning Process Stakeholder Meeting
September 27-28, 2021

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-2025
Maple Creek SVC	Jul-2028
Rio Oso SVC	Sep-2024
Tyler 60 kV Shunt Capacitor	Dec-2024
Number of transformer upgrade projects could help with voltage control through tap adjustments.	
In Operation:	
Delevan 230 kV Substation Shunt Reactor	
Los Esteros 230 kV Shunt Reactor	
Wilson 115 kV Voltage Support	
Wheeler Ridge Voltage Support	

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

Study Scenarios

- Initial Scenarios
  - 2023 Spring off Peak
    - 8pm, real time power factor, COI max N-S
  - 2026 Spring off Peak
    - 1pm, real time power factor, COI max S-N
  - 2031 Spring off Peak
    - 1pm, Tariff power factor, COI max S-N
  - 2031 Winter off Peak
    - 1pm, Tariff power factor, COI around 700 MW S-N
  - 2026 Spring off Peak with High Renewables (sensitivity)
- Other scenarios will be developed and studied in later stages

Review of Real Time Voltage Data

115 kV Bus Voltages > 126 kV - Number of Hours per month

	Brighton	Drum	East Nicolaus	Moss Landing	Pease	Placer	Rio Oso	Vierra	Chowchilla	Exchequer	El Capitan	Atwater	Mendota	Wilson	Le Grand	Corcoran	Bellota	Lockeford	Melones	Schulte	Manteca	Riverbank
Mar-19	0	0	4	0	0.02	0	0	0	1	1	27	2	0	1	1	0	0	0	1	0	0	0
Apr-19	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	11	0	0	0
May-19	0	0	16	0	0	0	0	0	5	93	29	16	0	3	2	0.1	0	0	1	0	0	0
Jun-19	0	0	0.1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Jul-19	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Aug-19	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Sep-19	0	0	0.02	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Oct-19	0	0.4	0	0	0	0	0.02	0	4	0.1	7	5	0	3	3	0	0	0	0	0	0	0
Nov-19	0	0	13	0	0.02	0	0.02	0	0	48	4	0.2	0	0	0	0	0	0	0	0	0	0
Dec-19	0	0	0.03	0	0	0	0	0	0.1	0	0	1	0	0	0	0	0	0	0	0	0	0
Jan-20	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Feb-20	0	0	3	0	0	0	0	0	0	0	0	0.03	0	0	0	0	0	0	0	0	0	0
Mar-20	0	0	3	0	0	0	0.02	0	0	0	3	0	0	0	0.02	0	0	0	0	0	0	0
Apr-20	0	0	14	0	0	0	0.1	0	2	29	0	9	0	2	2	0	0	0	3	0	0	0
May-20	0	0	22	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0.02	0
Jun-20	0	0	11	0	0	0	3	0	0	4	0	2	0	0	0	0	0	0	0	0	0	0
Jul-20	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Aug-20	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Sep-20	0	0.1	1	0	0	0	0	0	0	0.4	0	0	0	0	0	0	0	0	0	0	0	0
Oct-20	0	0	2	0	0	0	3	0	0	0.2	0	0	0	0	0	0	0	0	0	0	0	0
Nov-20	0	0	29	0	0	0	7	0	0	0.1	0	9	0	0	0	0	0	0	0	0	0	0
Dec-20	0	0	14	0	1	0	5	0	0	0	14	0	1	0	5	0	0	0	0	0	0	0
Jan-21	0	0	4	0	0	0	0	0	17	104	0	3	0	0	6	0	0	0	0	0	0	0
Feb-21	0	0	23	0	0	0	0.03	0	19	9	1	2	0	0	19	0	0	0	0	0	0	0
Mar-21	0	0	37	0	1	0	0.1	0	15	12	0	0.02	0	0	16	0	0	0	0	0	0	0
Apr-21	0	0	1	0	1	0	0.02	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
May-21	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Jun-21	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0
Jul-21	0	0	0	0	0.1	0	0	0	0	13	0	0	0	0	0	0	0	0	0	0	0	0

115 kV Bus Voltages > 121 kV - Number of Hours per month

	Brighton	Drum	East Nicolaus	Moss Landing	Pease	Placer	Rio Oso	Vierra	Chowchilla	Exchequer	El Capitan	Atwater	Mendota	Wilson	Le Grand	Corcoran	Bellota	Lockeford	Melones	Schulte	Manteca	Riverbank
Mar-19	743	705	743	132	626	137	743	616	738	741	743	743	454	743	735	411	13	313	743	625	565	23
Apr-19	720	648	720	129	564	94	720	378	523	645	642	595	239	571	439	256	26	376	720	506	316	24
May-19	744	740	744	245	476	371	744	479	603	744	670	655	278	625	456	421	4	360	740	652	418	65
Jun-19	719	686	713	211	284	142	708	267	296	495	520	438	91	423	209	272	3	253	649	410	219	3
Jul-19	744	596	727	323	183	34	725	149	83	724	440	317	35	297	43	320	4	104	561	374	91	0
Aug-19	744	659	713	338	126	22	706	224	174	744	464	393	36	412	129	420	4	42	586	421	209	0.02
Sep-19	720	638	708	371	425	288	720	456	441	710	564	550	79	538	337	554	2	89	669	546	441	8
Oct-19	744	586	740	547	557	207	744	656	681	726	739	743	311	743	683	635	3	398	633	673	636	0.2
Nov-19	721	682	717	573	629	44	721	578	643	706	629	720	393	717	661	521	3	329	553	592	548	0.5
Dec-19	744	601	744	625	508	64	744	257	742	738	651	744	550	743	743	80	21	503	702	303	214	6
Jan-20	739	488	744	273	243	25	744	411	730	701	415	743	494	735	736	1	29	416	723	428	406	18
Feb-20	645	460	696	112	40	45	696	624	464	453	105	683	252	661	438	0.3	3	308	612	664	620	7
Mar-20	743	606	708	61	93	63	743	726	743	606	708	61	93	63	743	726	0	0	0	0	0	0
Apr-20	714	593	716	49	56	84	715	641	508	611	285	668	316	650	537	39	2	229	720	662	634	13
May-20	733	702	733	113	527	263	735	318	190	650	82	472	58	413	142	0	3	281	705	469	261	198
Jun-20	720	570	695	114	314	232	701	348	157	388	161	490	17	494	94	7	3	223	584	442	337	121
Jul-20	744	607	702	132	147	93	719	163	31	164	32	252	3	255	11	0	2	150	360	290	140	17
Aug-20	744	594	698	139	142	30	713	133	744	594	698	139	142	30	713	133	0	0	0	0	0	0
Sep-20	720	588	711	176	294	192	718	465	155	234	222	438	5	426	146	1	2	165	625	602	504	62
Oct-20	744	637	744	215	374	112	744	443	338	393	569	650	121	627	365	30	2	235	589	561	466	38
Nov-20	721	633	698	164	350	89	721	614	462	494	601	721	436	712	635	11	3	292	641	633	655	91
Dec-20	685	616	736	181	637	363	744	626	685	616	736	181	637	363	744	626	0	0	0	0	0	0
Jan-21	744	629	744	317	634	414	744	657	547	493	676	743	323	740	532	1	2	381	648	661	592	89
Feb-21	672	584	672	142	203	410	672	487	423	337	665	672	281	670	417	0.2	1	408	638	411	535	180
Mar-21	743	619	743	92	740	404	743	541	281	275	740	704	149	717	279	0.2	2	385	669	493	605	159
Apr-21	720	684	720	112	676	81	720	330	160	202	612	561	69	438	137	1	4	314	666	354	378	107
May-21	744	735	725	245	672	196	647	493	29	55	216	197	16	170	27	2	4	125	621	564	426	137
Jun-21	720	667	712	106	665	39	714	303	7	39	380	332	7	341	0.02	0.02	4	87	267	438	255	51
Jul-21	744	663	732	64	718	0	732	156	0.1	35	373	370	0.1	351	0	1	2	61	168	333	169	6

230 kV Bus Voltages > 242 kV

	Bellota	Birds Landing	Brighton	Cortina	Cottonwood	Gold Hill	Palermo	Rio Oso	Valley Springs	McCall
Mar-19	0	0	0	0.4	0	0	0	0	0	0
Apr-19	0	0	0	0	0	0	0	0	0	0
May-19	0	0	0.2	0.4	0	0	0	0	0.1	0
Jun-19	0	0	0	0	0	0.03	0	0	0	0
Jul-19	0	0	0	0	0	0	0	0	0	0
Aug-19	0	0	0	0	0	0	0	0	0	0
Sep-19	0	0	0	0	0	0.2	0.4	0	0	0
Oct-19	0	0	4	0	0	0	0.2	0	0	0
Nov-19	0	0	1	0	0	0	0	0	0	0
Dec-19	0	0	0	0	0	0	0	0	0	0
Jan-20	0	0	0	0	0	0	0	0	0	0
Feb-20	0	0	0	0	0	0	0	0	0	0
Mar-20	0	0	0	0	0	5	0	0	0	0
Apr-20	0	0	0.1	0	0	0	1	0	0	0
May-20	0	0	0	0	0	0	0	0	0	0
Jun-20	0	0	8	0	0	56	0.3	0	0	0
Jul-20	0	0	0	0	0	5	0	0	0	0
Aug-20	0	0	0	0	0	0.03	0.3	0	0.3	0
Sep-20	0	0	0	0	0	0	2	0	0	0
Oct-20	0	0	0	0	0	12	0.02	0	0	0
Nov-20	0	0	3	0	0	15	5	0	0	7
Dec-20	0	0	4	0	0	0	0	0	0	0
Jan-21	0	0	3	0	0	0	2	0	0	0
Feb-21	0	0	15	0	0	0	1	0	0	0.1
Mar-21	0	0	9	0	0	0	10	0	0	0
Apr-21	0	0	27	0	0	0	0.3	0	0	0
May-21	0	0	0	0	0	0	0	0	0	0
Jun-21	0	0	0	0	0	0	0	0	0	0
Jul-21	0	0	0	0	0	0	0	0	0	0

230 kV Bus Voltages > 238 kV

	Bellota	Birds Landing	Brighton	Cortina	Cottonwood	Gold Hill	Palermo	Rio Oso	Valley Springs	McCall
Mar-19	51	46	133	239	41	0	23	0	241	1
Apr-19	23	59	61	112	4	0	41	0	123	0.2
May-19	42	65	107	187	53	0	164	0.3	124	11
Jun-19	7	41	58	70	36	144	334	0	40	1
Jul-19	0	9	25	54	37	251	382	0.03	0	1
Aug-19	17	9	86	65	47	244	275	1	46	5
Sep-19	23	11	264	109	22	404	320	17	72	0.5
Oct-19	17	2	408	38	1	0	534	56	86	0.02
Nov-19	5	8	447	0.5	0	0	386	45	74	76
Dec-19	0	0.02	275	0	0	0	302	2	48	150
Jan-20	0	3	127	72	2	0	254	0	41	119
Feb-20	0	8	36	102	16	0	314	4	36	61
Mar-20	0	5	486	61	14	58	541	36	541	36
Apr-20	4	60	415	37	7	0	482	30	92	82
May-20	0	49	328	132	18	0	274	26	83	0
Jun-20	9	37	178	54	6	425	228	39	91	26
Jul-20	0	4	89	3	5	383	161	2	4	4
Aug-20	0	1	86	5	0.2	8	205	4	205	4
Sep-20	33	8	206	45	3	0	251	4	101	30
Oct-20	0.1	9	262	22	25	231	378	21	50	99
Nov-20	0.2	0	356	0	0	400	243	33	216	171
Dec-20	9.6	0	415	3	4	3	221	32	221	32
Jan-21	7	0	444	0.02	22	36	166	89	196	75
Feb-21	30	0	507	1	6	50	270	123	349	26
Mar-21	2	0	529	10	29	52	421	116	115	23
Apr-21	0	0	417	0	19	33	447	87	99	18
May-21	0	20	262	2	5	0.1	250	72	43	30
Jun-21	15	6	231	1	3	0	239	14	152	9
Jul-21	7	2	163	0	0	0	174	1	75	5

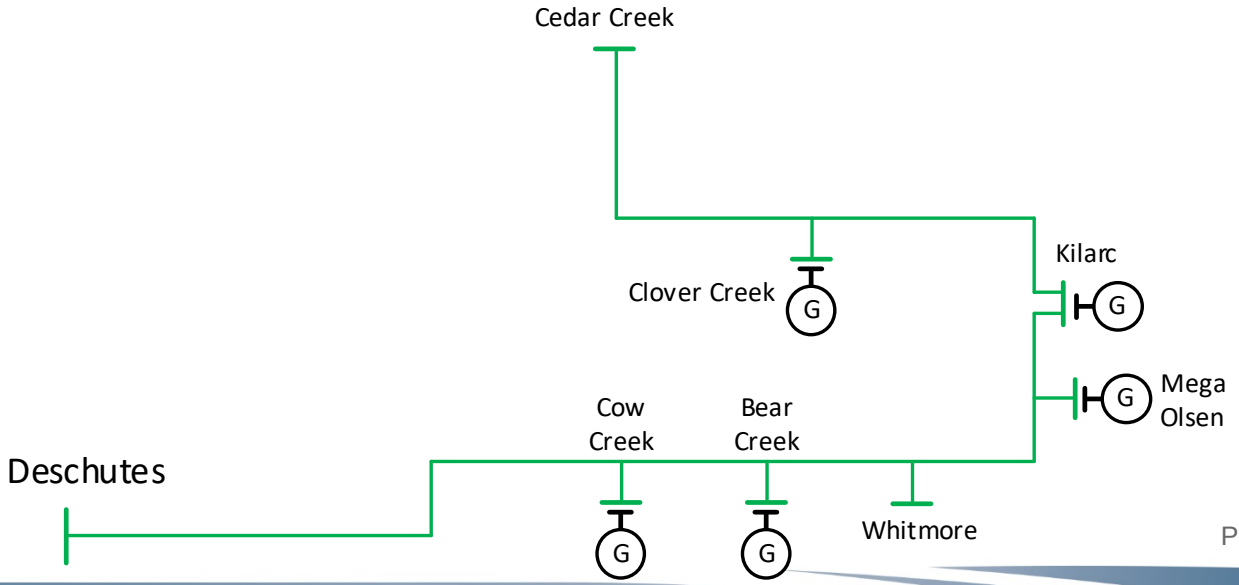
	> 551 kV				> 541 kV		
	Gates	Round Mtn	Table Mtn		Gates	Round Mtn	Table Mtn
Mar-19	0	0	0		223	6	209
Apr-19	0	0	0		26	0.1	38
May-19	0	0	0		59	0.1	28
Jun-19	0	0.02	0		25	68	50
Jul-19	0	0	0		28	69	94
Aug-19	0	0	0		72	9	56
Sep-19	0	0	0		151	2	125
Oct-19	0	0	0		303	0	99
Nov-19	0	0.3	0		463	0.3	7
Dec-19	0	0	0		187	7	40
Jan-20	0	0	0		34	1	5
Feb-20	0	0	0		23	8	56
Mar-20	0	0	0		25	0	100
Apr-20	0	0	0		11	0.02	4
May-20	0	0	0		0	0	33
Jun-20	0	0	0		0.1	2	33
Jul-20	0	0	0		0	0.1	17
Aug-20	0	0	0		1	1	16
Sep-20	0	0	0		1	0.1	74
Oct-20	0	0	0		54	5	101
Nov-20	0	0	0		90	8	15
Dec-20	0	0	0		7	0	0
Jan-21	0	0	0		0.1	2	2
Feb-21	0	0	0		0	7	88
Mar-21	0	0	0		0.4	0.2	67
Apr-21	0	0	0		0	0.4	55
May-21	0	0	1		0	1	253
Jun-21	0	0	0		0	0.4	161
Jul-21	0	0	0		2	77	119

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

North Valley

- High voltages were observed on the 115 kV system around Palermo and Table Mountain 115 kV systems. Both Palermo and Table Mountain 230/115 kV transformers have LTC. Models are under review to ensure the LTC actions and settings are correctly reflected.

- High voltages were observed on the radial 60 kV systems Deschutes to Cedar Creek radial 60 kV system (40-50 miles). Potential mitigation is to install shunt reactor in the area.



North Coast North Bay

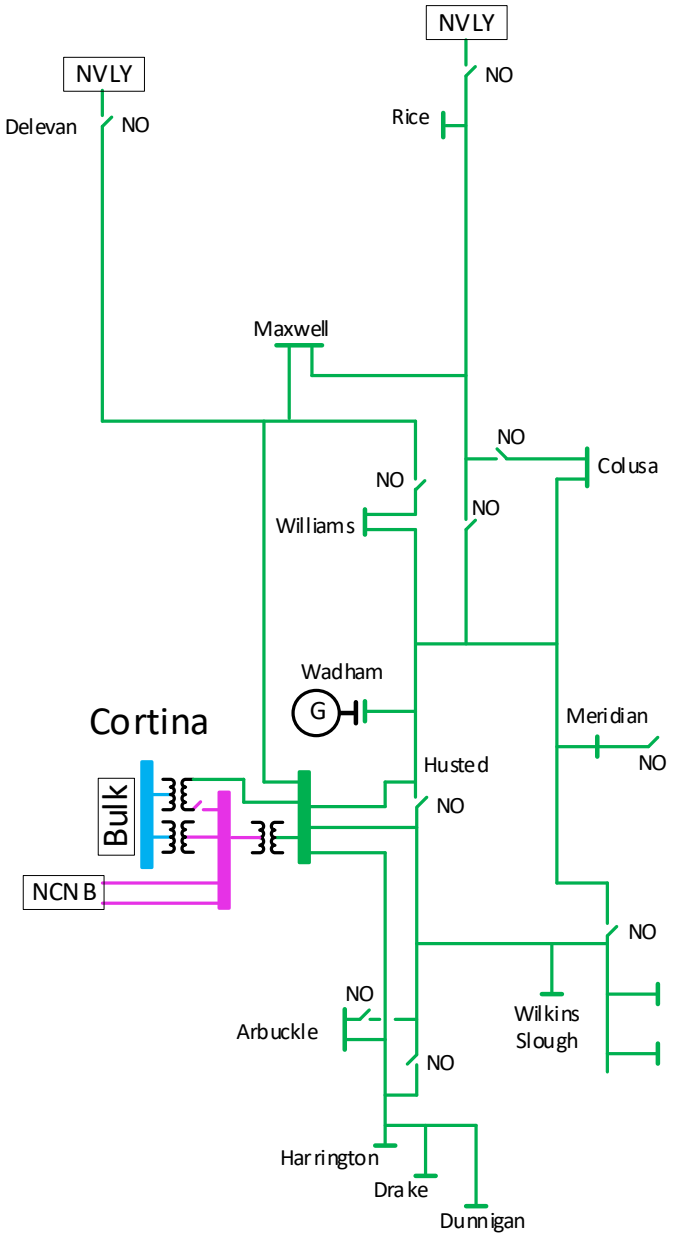
- High voltages were observed on the 115 kV system around Fulton and Mendocino 115 kV systems. While issues at Fulton 115 could potentially be addressed using the Fulton 230/115 kV transformer LTC, the potential mitigation for Mendocino area is to install shunt reactor or other voltage support upgrades in the area.

- High voltages were observed on the radial 60 kV systems from Fulton to Gualala and from Fulton to Cotati 60 kV. Potential mitigation is to install shunt reactor in the area.

Sacramento

- High voltages were observed in the 60 kV system supplied from Cortina substation. The LTC of Cortina 115/60 kV and 230/60 kV transformers should be able to control the voltage in the 60 kV area within acceptable range. Further review of the models and setting is required.

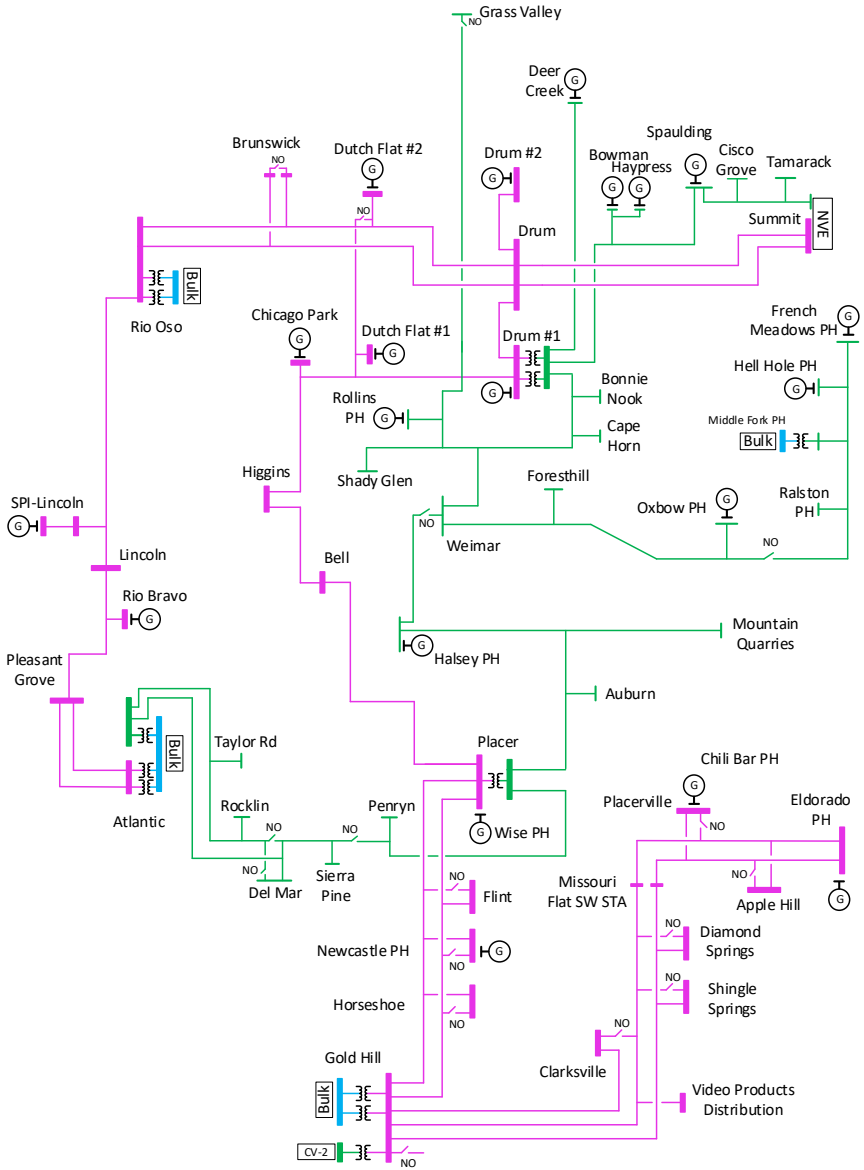
- High voltages were observed in the long term in the Rio Oso – Davis – Brighton 115 kV system which will be monitored and if required will be addressed in future TPP cycles.



Sierra (1/2)

- High voltages were observed in 115 kV network in the Sierra in areas that are at a distance from the 230 kV source substations at Rio Oso, Atlantic and Gold Hill.
  - Initial assessment has indicated that in the long term, utilizing the LTC of the source transformers and the SVC at Rio Oso would be sufficient to address slight high voltages in the area

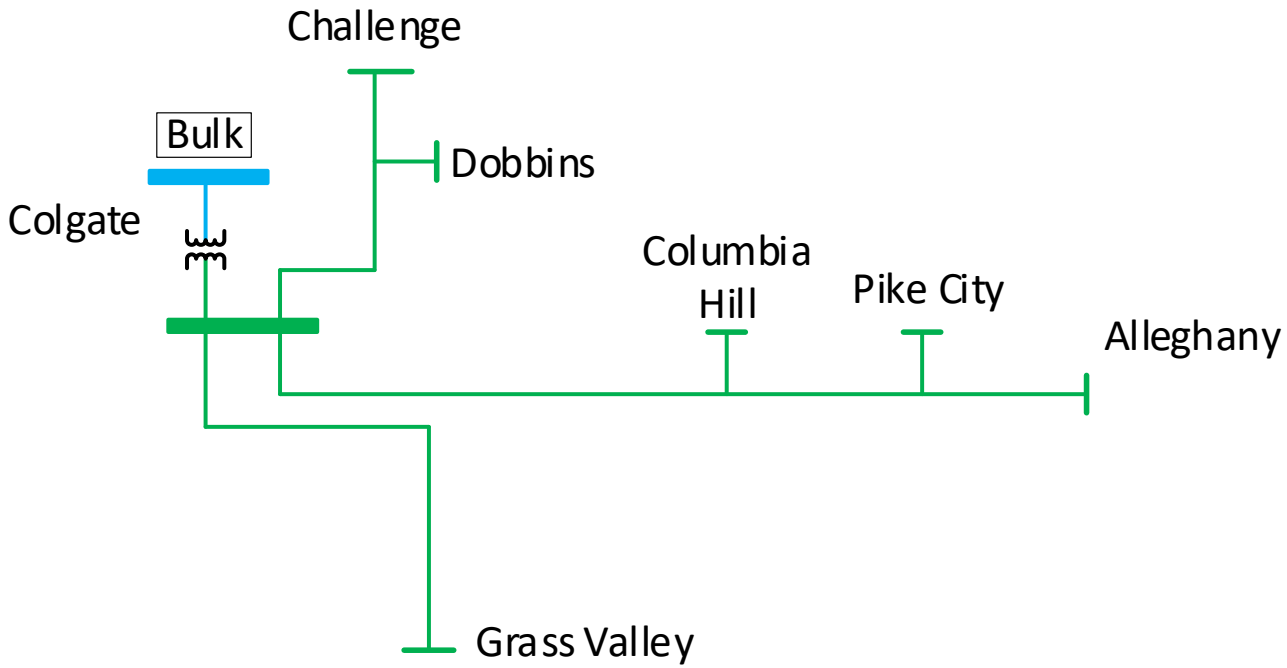
- High voltages were observed in 60 kV system supplied from Atlantic substation. The 230/60 kV transformer does not have LTC. Potential mitigation would be to add voltage regulator or upgrade the transformer to have LTC.



California ISO

Sierra (2/2)

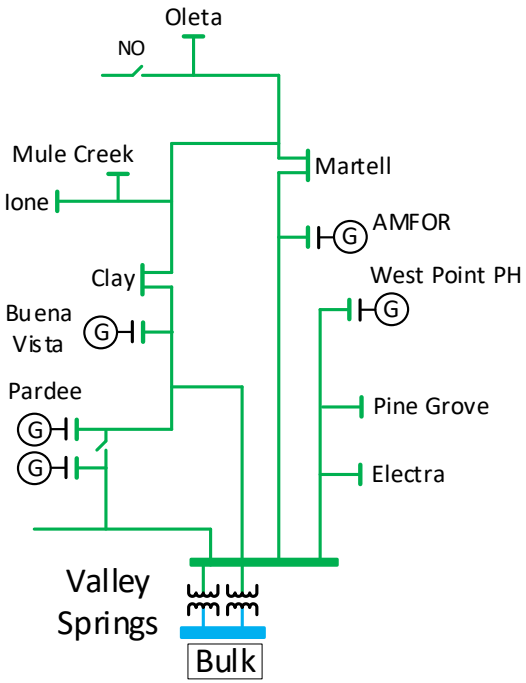
- High voltages were observed in 60 kV radial system supplied by Colgate substation. Potential mitigation would be to upgrade the transformer with one that has LTC.



Stockton/Stanislaus (1/2)

- There are high voltages in the 60 kV area supplied from Valley Springs 230/60 kV substation. It is being reviewed whether a combination of transformer LTC and the generator scheduled voltage would be sufficient to address the high voltage issues.

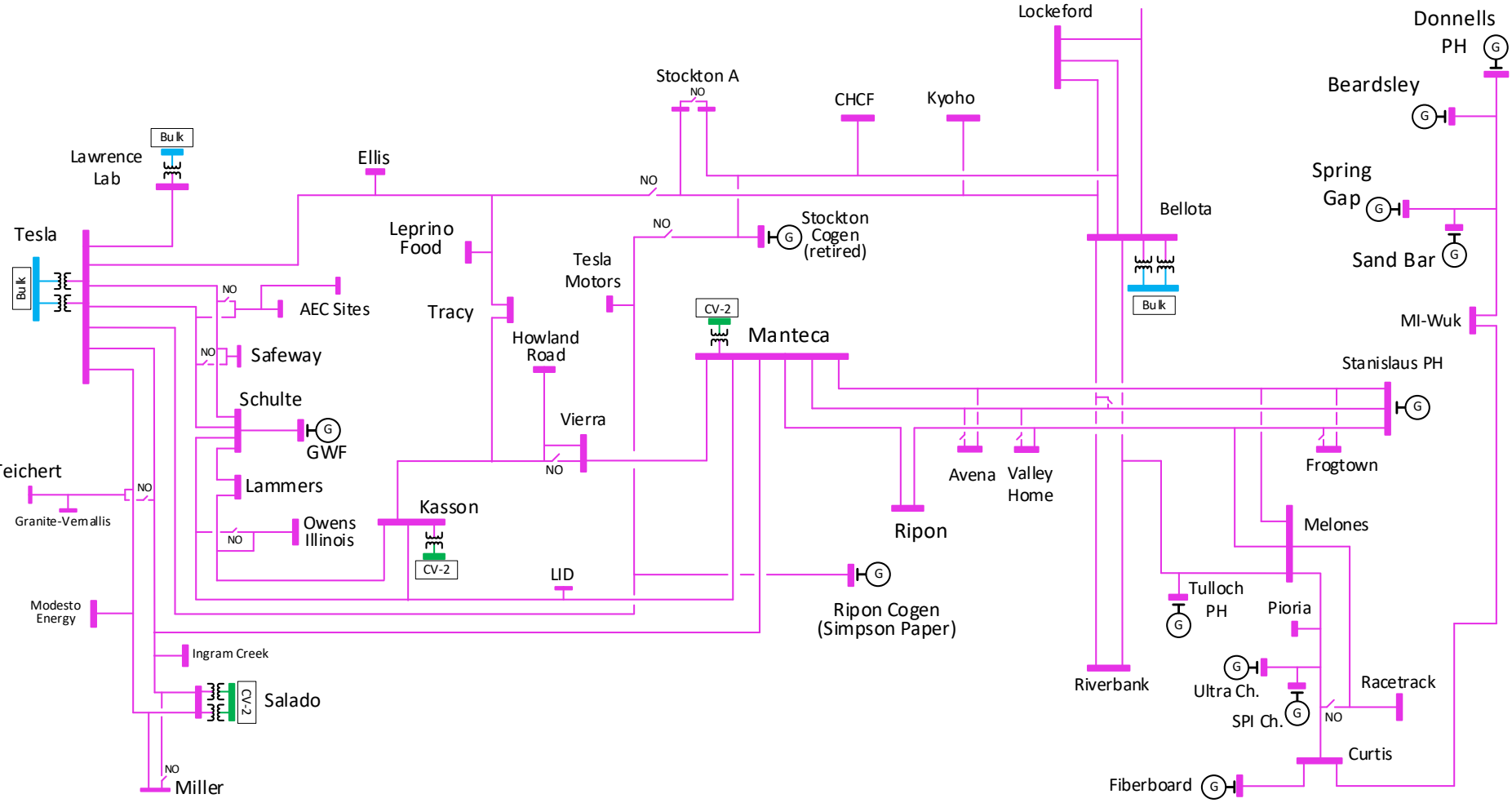
- There are also high voltages in the Salado – Newman 60 kV area which could potentially be addressed by the Salado 115/60 kV LTC.



- High voltages were observed in the Riverbank – Melones – Donnells PH 115 kV network especially under low hydro conditions. Potential mitigation would be shunt reactors at Melones or nearby substations.

- The 115 kV network supplied from Tesla 230/115 kV substation experiences high voltage as well. Potential mitigation would be to install shunt reactors or transformers with LTC.

Stockton/Stanislaus (2/2)



Greater Bay Area

- Review the feasibility of using LTC for the following substations is under review:
  - Pittsburg 230/115kV
  - Metcalf 230/115 kV
  - Las Positas 230/60 kV
  - Monta Vista 115/60kV
  - Evergreen 115/60kV

- Potential mitigation for high voltage in Monta Vista 230 kV is shunt reactor or other voltage support upgrades.

Greater Fresno Area

- Review the feasibility of using LTC for the following substations
  - Herndon 230/115kV
  - Panoche 230/115kV
  - Mc Call 230/115kV
  - Los Banos 230/70 kV
  - Borden 230/60kV
  - Oro Loma 115/70kV
  - Henrietta 230/70kV
  - Helm 230/70kV
  - Kearney 230/70kV
  - Corcoran 115/70kV
  - Kingsburg 115/70kV
  - Reedley 115/70kV

- Potential mitigation for high voltage Exchequer and Oakhurst 115 kV area is shunt reactor or other voltage support upgrades.

Kern

- Review the feasibility of using LTC for the following substations
  - Arco 230/70kV
  - Midway 230/115kV
  - Wheeler Ridge 230/70kV
  - Kern Power 115/70kV
  - Taft 115/70kV

Central Coast Los Padres

- Review the feasibility of using LTC for the following substations
  - Moss Landing 230/115 kV
  - Monta Vista 115/60 kV
  - Green Valley 115/60kV
  - Coburn 230/60kV
  - Mesa 230/115kV
  - Templeton 230/70kV
  - Divide 115/70kV

- Potential mitigation for high voltage at Mesa 230 kV area is shunt reactor or other voltage support upgrades.

High Level Summary of Results

- With implementation of Round Mountain and Gates STATCOM projects, there are no high voltage issues at the 500 kV system under normal 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:
  - Tesla 115 kV area
  - Melones 115 kV area
  - Mendocino 115 kV area
  - Atlantic 60 kV area
  - Colgate 60 kV area
  - Gualala 60 kV area
  - Cotati 60 kV area
  - Exchequer 115 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
  - 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.

SCE Main System
Preliminary Reliability Assessment Results

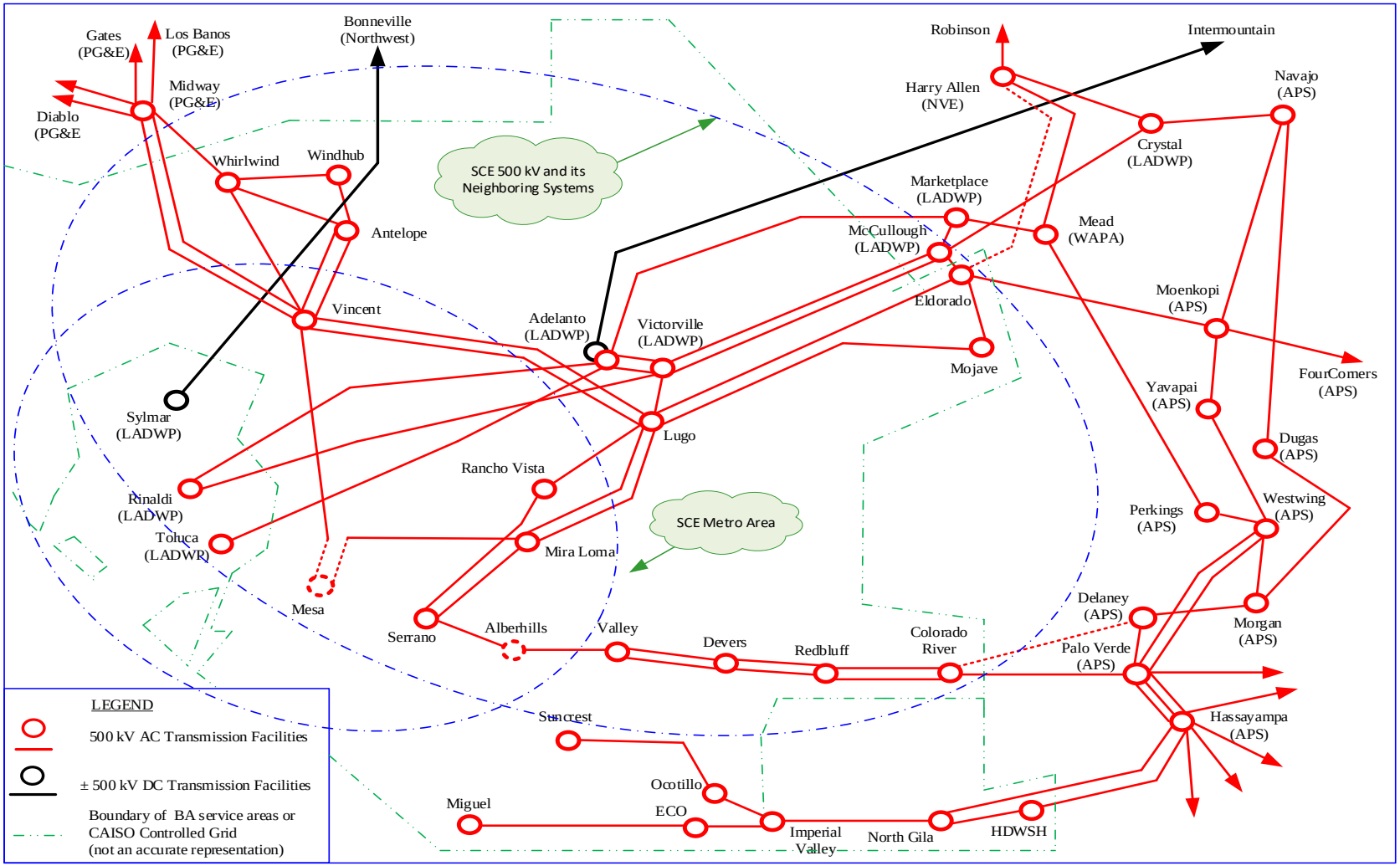
Frank Chen
Regional Transmission Engineer Lead

2021-2022 Transmission Planning Process Stakeholder Meeting
September 27-28, 2021

SCE Main System

- Covers SCE's 500 kV system and Metro area serving Los Angeles, Orange, Ventura, and Santa Barbara counties
- Comprised of 500 kV and 230 kV transmission facilities
- 1-in-10 summer peak net load of 25,586 MW including pump load in the SCE service territory in 2031
- Forecast load includes the impact of 8,420 MW of BTM PV and 459 MW of AAEE
- Renewable resources of solar, wind, and energy storage increase to 19,142 MW, 5,757 MW, and 12,151 MW by 2031
- Gas generation capacity maintains at 22,437 MW (net) by 2030 after scheduled OTC retirements

SCE Main System – SCE 500 kV System and Metro Area



SCE Main System Study Scenarios

- Base scenarios

No.	Study Case	Description
B1	B1-2023-SP	2023 summer peak load condition at HE16 PST, 9/5
B2	B2-2026-SP	2026 summer peak load condition at HE16 PST, 9/1
B3	B3-2031-SP	2031 summer peak load condition at HE19 PST, 9/3
B4	B4-2023-OP	2023 spring off-peak load condition at HE20 PST, 4/26
B5	B5-2026-LL	2026 spring off-peak/minimal load condition at HE13 PST, 4/5

- Sensitivity scenarios

No.	Study Case	Description
S1	S1-2026-SP-HLOAD	2026 summer peak load condition with high CEC load forecast
S2	S2-2023-SP-HRPS	2023 summer peak load condition with heavy renewable output
S3	S3-2023-OP-HRPS	2023 spring off-peak load condition with heavy renewable output

Demand Side Assumptions – SCE Main System

Study Case	Scenario	Gross Load (MW)	AAEE (MW)	BTM-PV (MW)		Net Load (MW)	Pump Load (MW)	Demand Response* (MW)	
				Installed Capacity	Output			D1 (fast)	D2 (slow)
B1-2023-SP	Baseline	26607	207	4929	2267	24340	493	410	373
B2-2026-SP	Baseline	27380	502	6390	2939	24441	493	410	373
B3-2031-SP	Baseline	25042	459	8420	0	25042	544	410	373
B4-2023-OP	Baseline	15821	134	4929	0	15821	1111	NA	NA
B5-2026-LL	Baseline	10670	115	6390	5048	5621	1079	NA	NA
S1-2026-SP-HLOAD	Sensitivity	29288	502	6390	2939	26349	493	410	373
S2-2023-SP-HRPS	Sensitivity	28825	207	4929	4485	24340	493	410	373
S3-2023-OP-HRPS	Sensitivity	20306	134	4929	4485	15821	1111	NA	NA

Note: DR and storage are modeled offline in starting base cases.

Supply Side Assumptions – SCE Main System

Study Case	Scenario	Thermal (MW)		Hydro (MW)		Pumped Storage (MW)		Solar (MW)		Wind (MW)		Energy Storage (MW)	
		Installed	Dispatch	Installed	Dispatch	Installed	Dispatch	Installed	Dispatch	Installed	Dispatch	Installed	Dispatch
B1-2023-SP	Baseline	22388	8401	1596	1068	237	200	12946	6605	4484	856	5603	104
B2-2026-SP	Baseline	22437	8326	1596	1071	237	200	13175	6712	4420	843	5787	0
B3-2031-SP	Baseline	22437	9832	1596	1327	550	512	19142	14	5757	2247	12151	2659
B4-2023-OP	Baseline	22388	6878	1596	1068	237	150	12946	0	4484	2054	5603	0
B5-2026-LL	Baseline	22437	143	1596	112	237	25	13159	12365	4420	1455	5667	-5516
S1-2026-SP-HLOAD	Sensitivity	22437	9384	1596	1071	237	200	13175	6702	4420	843	5787	0
S2-2023-SP-HRPS	Sensitivity	22388	4966	1596	1068	237	200	12950	12014	4484	2868	5603	104
S3-2023-OP-HRPS	Sensitivity	22388	124	1596	1068	237	150	12959	12627	4484	2839	5603	-3373

Previously approved transmission projects modelled in base cases

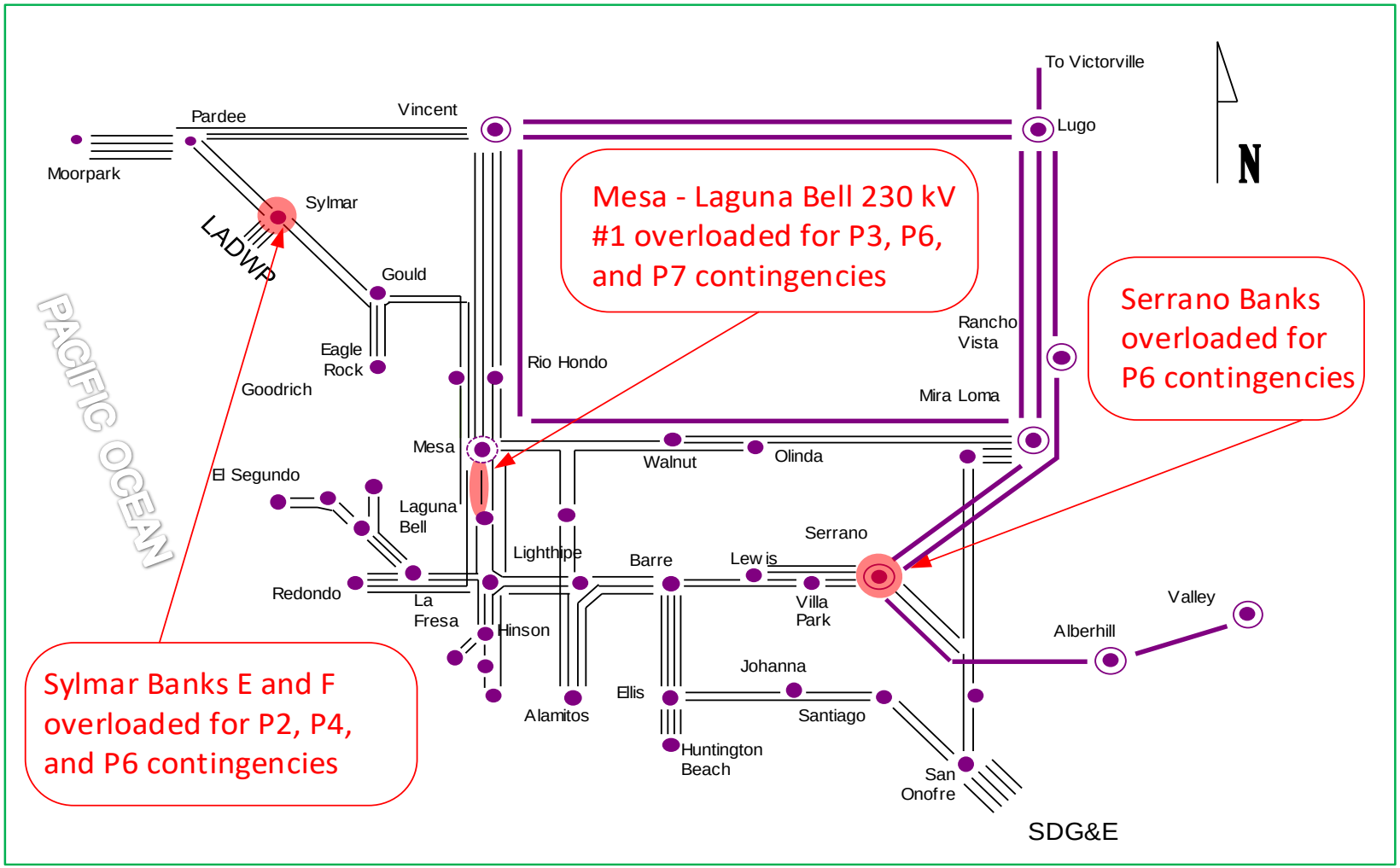
Project Name	Expected ISD	First Year Modeled
Mesa 500 kV Substation	March-22	2023
Laguna Bell Corridor Upgrade	December-20	2023
Moorpark–Pardee No. 4 230 kV Circuit	June-21	2023
Pardee-Sylmar No. 1 and No. 2 230 kV Lines Rating Increase	June-23	2023
Alberhill 500 kV Substation	October-25	2026
Delaney-Colorado River 500 kV Line (Ten West Link Project)	June-23	2023
Lugo Substation Install new 500 kV CBs for AA Banks	December-24	2026
Lugo – Victorville 500 kV Upgrade (SCE portion)	June-23	2023

Reliability Assessment Preliminary Results

Metro Area of SCE Main System

The results of SCE 500 kV system are not presented here as they are similar to these identified in the SOCAL Bulk System Studies that covers the SCE 500 kV and SDG&E bulk systems

Summary of Thermal Overload Concerns in SCE Metro



1. Serrano Banks 500/230 kV Thermal Overloads

Reliability Concern

Serrano 500/230 kV Transformers overloaded for the loss of any other two Serrano transformer banks (P6)

Overloaded Facility	Contingency (All and Worst P6)	Category	Loading % (Baseline Scenarios)			Loading % (Sensitivity Scenarios)		
			B1_2023 Summer Peak	B2_2026 Summer Peak	B3_2031 Summer Peak	S1_2026 SP High CEC Forecast	S2_2023 SP Heavy Renewable	S3_2023 OP Heavy Renewable
Serrano Transformer Banks 500/230 kV #1, #2 (worst), or #3	Loss of other two Serrano transformer banks #2/#3, #1/#3, or #1/#2	P6	104.4	106.86	106.03	104.19	115.37	117.4

Potential Mitigation Alternatives

- Dispatch available resources including energy storage and demand response (RDRR) after the first contingency along with Operation Procedure 7590
- Recommend to utilize the 30-minute emergency ratings of the banks that allow the market/operation to eliminate the overloads within 30 minutes after the 2nd contingency
- Add more resources or 4th Serrano bank if the available resources are not adequate

2. Mesa - Laguna Bell 230 kV #1 Thermal Overloads

Reliability Concern

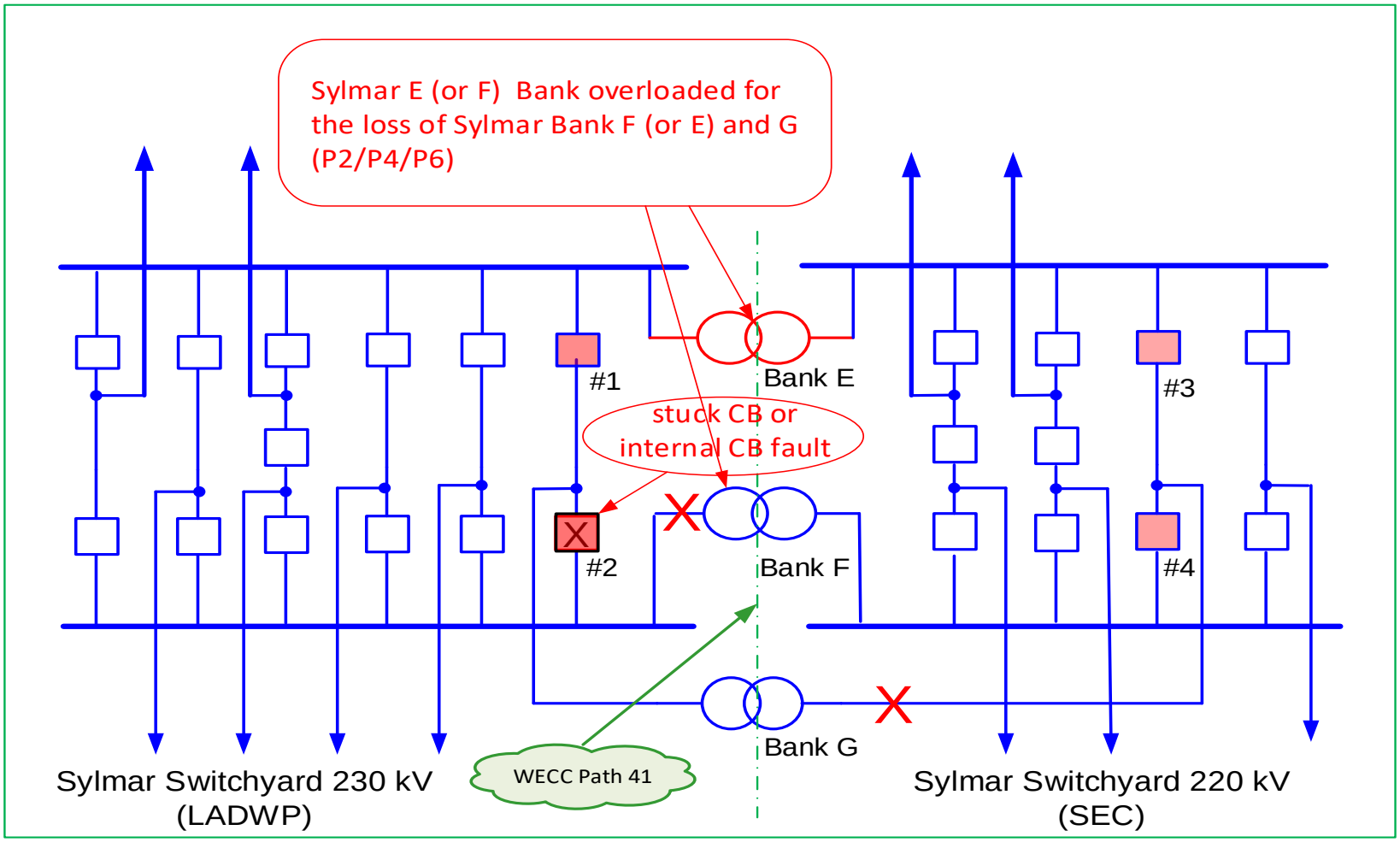
Mesa - Laguna Bell 230 kV #1 overloaded for various contingencies (P3, P6, and P7)

Overloaded Facility	Contingency (All and Worst P6)	Category	Loading % (Baseline Scenarios)			Loading % (Sensitivity Scenarios)		
			B1_2023 Summer Peak	B2_2026 Summer Peak	B3_2031 Summer Peak	S1_2026 SP High CEC Forecast	S2_2023 SP Heavy Renewable	S3_2023 OP Heavy Renewable
LAGUBELL - MESA CAL 230 kV Ckt #1	Alamitos Energy Power Plant out of service followed by the loss of LITEHIPE - MESA CAL 230.0 Ckt #1	P3	95.97	<90	103.11	100.87	101.73	<90
	Loss of Mesa Transformer 500/230 kV Bank #3 followed by the outage of Mesa Transformer 500/230 kV Bank #4	P6	103.48	102.46	109.82	110.16	109.22	97.38
	Loss of LITEHIPE - MESA CAL 230 kV line followed by the outage of MESA CAL - REDONDO 230 kV line	P6	113.39	109.19	120.56	118.98	120.25	106.38
	Loss of MESACALS - LAGUBELL 230 kv Ckt #2 AND LITEHIPE - MESA CAL 230 kV Ckt #1	P6/P7	105.72	101.49	109.58	109.49	113.64	105.96

Potential Mitigation Alternatives

- Dispatch available resources including energy storage and DR for the pre-P7 contingency and after the first contingency for P3 and P6 contingencies
- Re-conductor Laguna-Bell Mesa 230 kV Circuit #1 if cost-effective
- Add more resources if the available resources are not adequate

3. Sylmar Banks E and F Thermal Overload



3. Sylmar Banks E and F Thermal Overload (Cont'd)

Reliability Concern

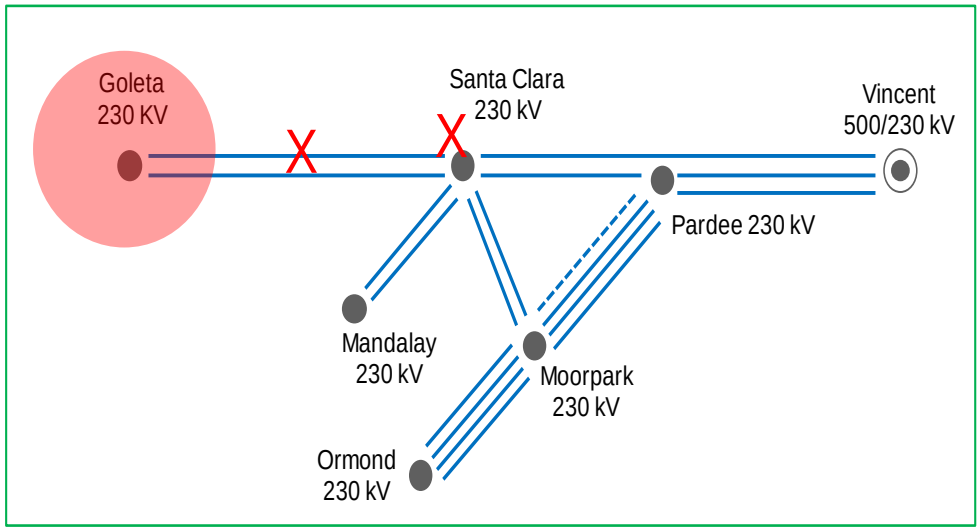
- Sylmar Bank E or F overloaded for the loss of Bank F or E and G by an internal breaker failure (P2) or a stuck breaker (P4), and for the loss of Bank F or E followed by the outage of Bank G (P6)

Overloaded Facility	Contingency (All and Worst P6)	Category	Loading % (Baseline Scenarios)			
			B1_2023 Summer Peak	B2_2026 Summer Peak	B3_2031 Summer Peak	B6_2031 Spring Off-Peak (SOCAL Bulk Study)
SYLMAR 230/220 kV Bank E or F	Loss of Sylmar Bank F (or E) and G by a Stuck Breaker (P4) or an Internal Breaker Fault (P2)	P2/P4	<90	<90	103.45	149.7
	Loss of Sylmar Bank F (or E) followed by the outage of Sylmar Bank G (P6)	P6	<90	<90	103.46	149.69

Potential Mitigation Alternative

- Develop operation procedure or short-term emergency ratings to manage power flow via the banks (Path 41) for pre- or post- contingency
- Re-configure the switchyard by adding one-and-half breaker schemes if possible
- Remove the three banks between LADWP and SCE along with other facility upgrade
- Upgrade the banks E and F

4. Goleta 230 kV Substation - Low Voltage



Reliability Concern

Goleta 230 kV bus voltage went as low as 0.89 pu of 220 nominal voltage for P6 contingencies

Potential Mitigation Alternative

Dispatch available resources that were previously proposed by ISO in the Goleta/S.Clara area after the first contingency

Substation	Contingency (All and Worst P6)	Category	Voltage PU (Baseline Scenarios)			Voltage PU (Sensitivity Scenarios)		
			B1_2023 Summer Peak	B2_2026 Summer Peak	B3_2031 Summer Peak	S1_2026 SP High CEC Forecast	S2_2023 SP Heavy Renewable	S3_2023 OP Heavy Renewable
GOLETA 230 kV Bus	Santa Clara–Goleta Ckt #1 or #2 230 kV AND Santa Clara 230 kV Shunt Capacitor	P6	no issue	no issue	no issue	no issue	0.86 pu of 230 kV	no issue

Summary of Potential New Upgrades

Concern	Potential Upgrade Alternative
Mesa-Laguna Bell 230 kV #1 overloaded for P3/P6/P7 contingencies	• Dispatch available resources including energy storage and demand response after the first contingency • Re-conductor Laguna-Bell Mesa 230 kV Circuit #1 if cost-effective • Recommend additional resources if the available resources are not adequate
Serrano 500/230 kV transformers overloaded for P6 contingencies	• Dispatch available resources including energy storage and demand response (RDRR) after the first contingency along with Operation Procedure 7590 • Recommend to utilize the 30-minute emergency ratings of the banks that allow the market/operation to eliminate the overloads within 30 minutes after the 2nd contingency • Recommend additional resources or 4th Serrano bank if the available resources are not adequate
Sylmar Banks E and F overloaded for P2/P4/P6 contingencies	▪ Develop operation procedure or short-term emergency ratings to manage power flow via the banks (Path 41) for pre- or post- contingency ▪ Re-configure the switchyard by adding one-and-half breaker schemes if possible ▪ Remove the three banks between LADWP and SCE along with other facility upgrade ▪ Upgrade the banks E and F

Southern California 500 kV Bulk System Preliminary Reliability Assessment Results

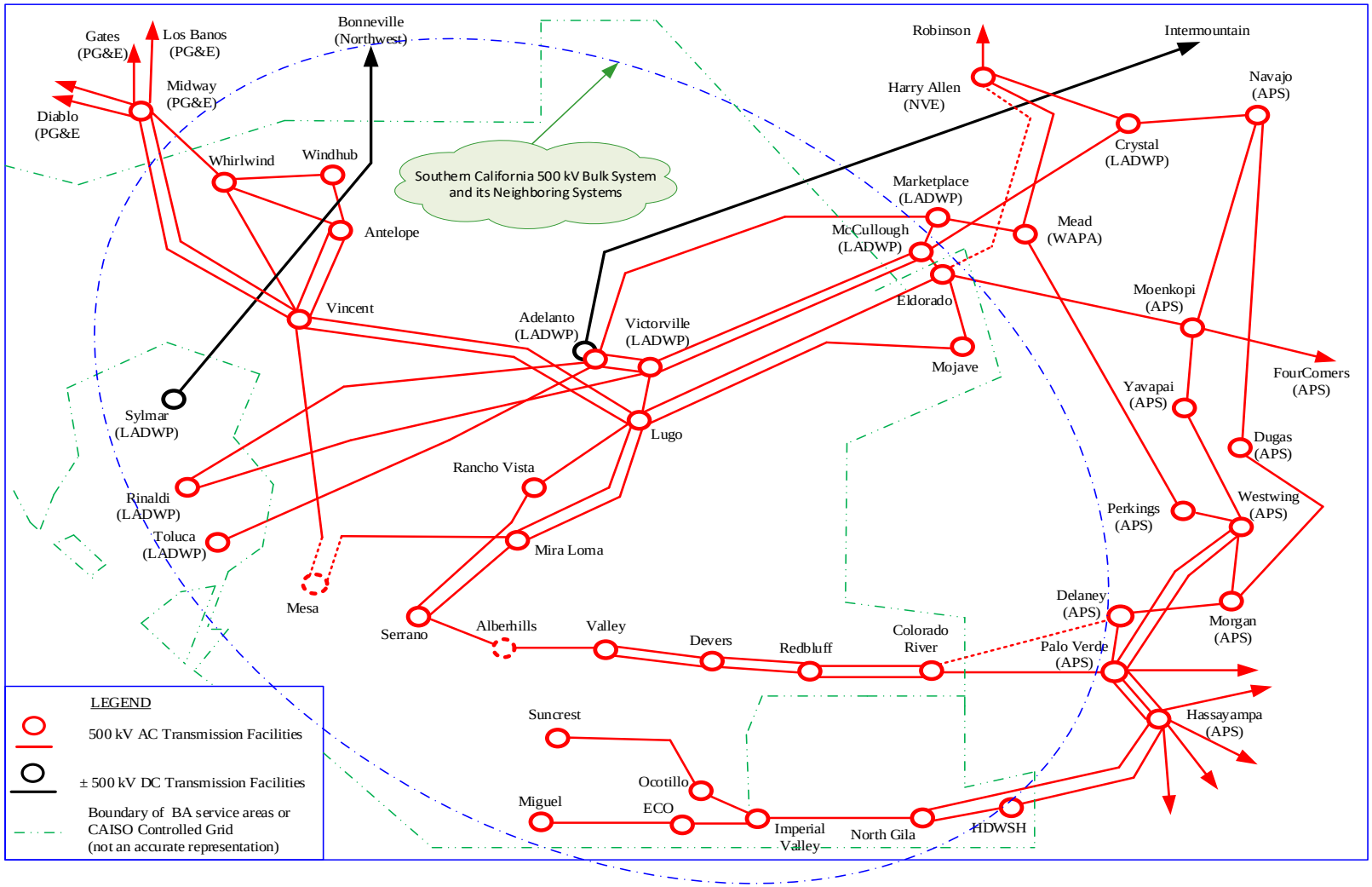
Frank Chen
Regional Transmission Engineer Lead

2021-2022 Transmission Planning Process Stakeholder Meeting
September 27-28, 2021

Southern California (SOCAL) Bulk System

- Covers SCE's 500 kV bulk and SDG&E's Main Import system
- Comprised of 500 kV and limited 230 kV transmission facilities
- 1-in-5 summer peak net load of 28,604 MW in the SCE and SDG&E service territories in 2031
- Forecast load includes the impact of 8,420 MW of BTM PV and 459 MW of AAEE
- Renewable resources of solar, wind, and energy storage increase to 19,142 MW, 5,757 MW, and 12,151 MW by 2031
- Gas generation capacity maintains at 22,437 MW (net) by 2031 after scheduled OTC retirements

Southern California 500 kV Bulk System



Southern California Bulk System Study Scenarios

- Base scenarios

No.	Study Case	Description
B1	B1-2023-SP	2023 summer peak load condition at HE16 PST, 9/5
B2	B2-2026-SP	2026 summer peak load condition at HE16 PST, 9/1
B3	B3-2031-SP	2031 summer peak load condition at HE19 PST, 9/3
B4	B4-2023-OP	2023 spring off-peak load condition at HE20 PST, 4/26
B5	B5-2026-LL	2026 spring off-peak/minimal load condition at HE13 PST, 4/5
B6	B6-2026-LL	2031 spring off-peak/minimal load condition at HE13:00 PST, 4/6

- Sensitivity scenarios

No.	Study Case	Description
S1	S1-2026-SP-HLOAD	2026 summer peak load condition with high CEC load forecast
S2	S2-2023-SP-HRPS	2023 summer peak load condition with heavy renewable output
S3	S3-2023-OP-HRPS	2023 spring off-peak load condition with heavy renewable output

Demand Side Assumptions – Southern California Bulk System

Study Case	Scenario	Gross Load (MW)	AAEE (MW)	BTM-PV (MW)		Net Load (MW)	Pump Load (MW)	Demand Response (MW)	
				Installed Capacity	Output			D1 (fast)	D2 (slow)
B1-2023-SP	Baseline	29666	338	6853	2493	27173	493	411	407
B2-2026-SP	Baseline	27310	836	8656	0	27310	493	411	407
B3-2031-SP	Baseline	28060	886	11087	0	28060	544	411	407
B4-2023-OP	Baseline	18799	220	6853	0	18799	1111	NA	NA
B5-2026-LL	Baseline	13194	192	8656	6997	6196	1079	NA	NA
B6-2026-LL	Baseline	13575	151	11087	9002	4573	0	NA	NA
S1-2026-SP-HLOAD	Sensitivity	30309	836	8656	0	30309	493	411	407
S2-2023-SP-HRPS	Sensitivity	29666	338	6853	2493	27173	493	411	407
S3-2023-OP-HRPS	Sensitivity	18799	220	6853	0	18799	1111	NA	NA

Supply Side Assumptions – Southern California Bulk System

Study Case	Scenario	Thermal (MW)		Hydro (MW)		Pumped Storage (MW)		Solar (MW)		Wind (MW)		Energy Storage (MW)	
		Installed	Dispatch	Installed	Dispatch	Installed	Dispatch	Installed	Dispatch	Installed	Dispatch	Installed	Dispatch
B1-2023-SP	Baseline	26100	8615	1596	1068	277	240	14572	7435	5212	1002	5987	0
B2-2026-SP	Baseline	26105	12813	1600	1059	277	240	14650	0	5195	1969	6181	3219
B3-2031-SP	Baseline	26108	11576	1614	1283	904	552	21166	0	7027	2707	13710	2143
B4-2023-OP	Baseline	26130	9562	1596	1068	277	150	14570	106	5107	2457	6004	40
B5-2026-LL	Baseline	26110	157	1596	112	277	25	14628	13664	4935	1610	6065	-5516
B6-2031-LL	Baseline	26385	488	1600	14	904	-577	21060	19034	6875	2072	13588	-11457
S1-2026-SP-HLOAD	Sensitivity	26105	13033	1600	1059	277	240	14650	0	5195	1951	6181	3820
S2-2023-SP-HRPS	Sensitivity	26100	4413	1596	1068	277	200	14586	13811	5212	3185	5987	104
S3-2023-OP-HRPS	Sensitivity	26100	426	1596	1068	277	150	14584	14148	5107	3185	6004	-3850

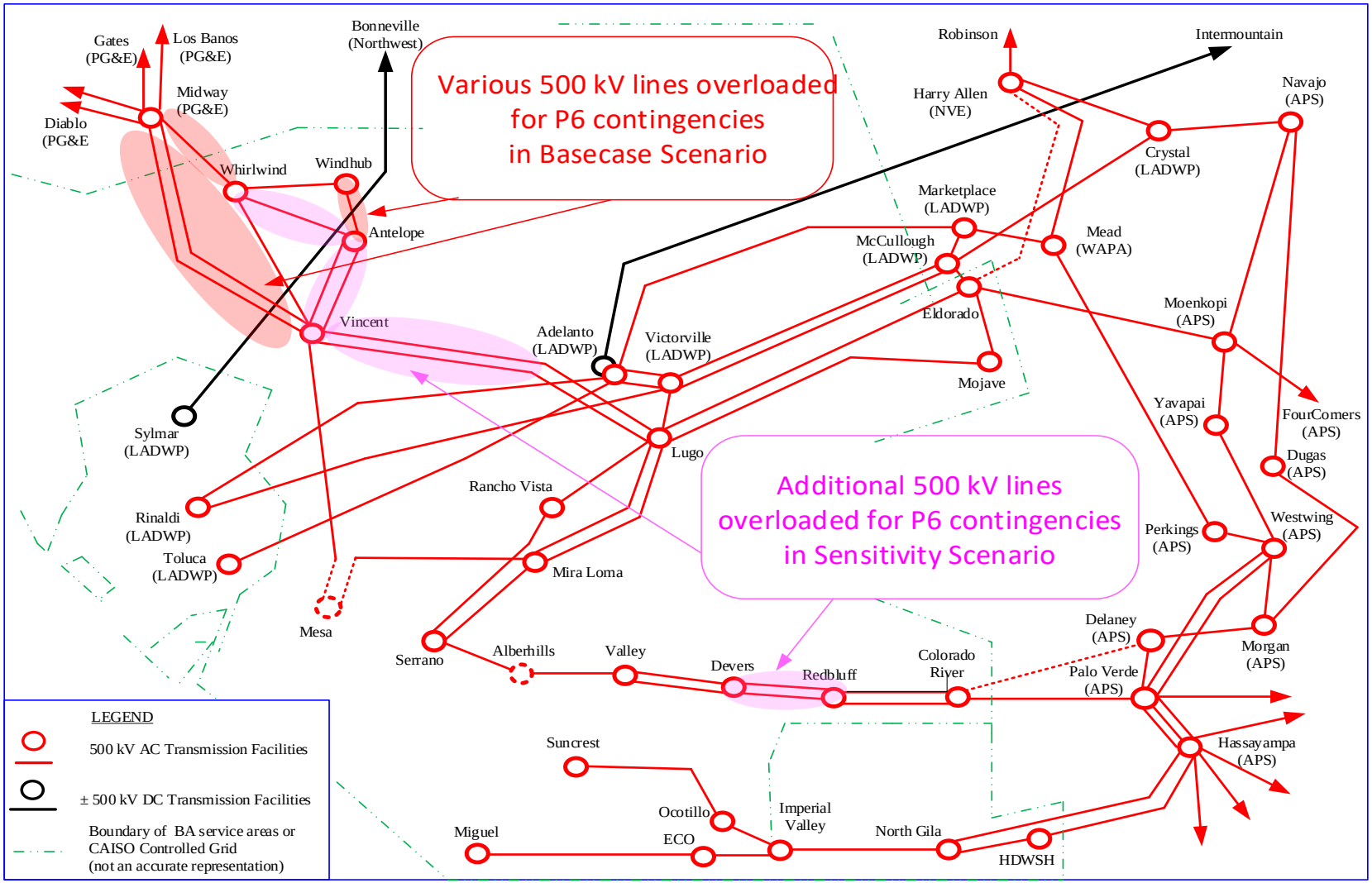
Previously approved transmission projects modelled in base cases

Project Name	Expected ISD	First Year Modeled
Mesa 500 kV Substation	March-22	2023
Laguna Bell Corridor Upgrade	December-20	2023
Moorpark–Pardee No. 4 230 kV Circuit	June-21	2023
Pardee-Sylmar No. 1 and No. 2 230 kV Lines Rating Increase	June-23	2023
Alberhill 500 kV Substation	October-25	2026
Delaney-Colorado River 500 kV Line (Ten West Link Project)	June-23	2023
Lugo Substation Install new 500 kV CBs for AA Banks	December-24	2026
Lugo – Victorville 500 kV Upgrade (SCE portion)	June-23	2023
Riverside Transmission Reliability Project	October-26	2030
Harry Allen - Eldorado 500 kV Line	August-21	2023
S-Line Upgrade	Summer -2023	2023

Reliability Assessment Preliminary Results

Southern California 500 kV Bulk System Under CAISO Control

Summary of Thermal Overload Concerns in SOCAL Bulk System



1. Midway–Vincent and Midway–Whirlwind 500 kV Lines Thermal Overloads

Reliability Concern

Midway–Vincent and Midway–Whirlwind 500 kV lines overloaded for P6 contingencies in Basecase and Sensitivity Scenarios

Overloaded Facility	Contingency (All and Worst P6)	Category	Loading % (Baseline Scenarios)				Loading % (Sensitivity Scenarios)		
			B1_2023 Summer Peak	B2_2026 Summer Peak	B3_2031 Summer Peak	B6_2031 Spring Off-Peak	S1_2026 SP High CEC Forecast	S2_2023 SP Heavy Renewable	S3_2023 OP Heavy Renewable
Midway - Whirlwind 500 kV Ckt 3	MIDWAY - VINCENT 500 kV Ckt 1 and Ckt 2	P6	161.82	91.21	<90	138.99	90.7	97.77	<90
Midway - Vincent 500 kV line Ckt #2 or Ckt #1	MIDWAY - VINCENT 500.0 Ckt 1 or Ckt2 -AND- MIDWAY - WHIRLWIND 500 kV Ckt 3	P6	122.83	<90	<90	107.33	<90	<90	<90
	PDCI1_CONVERTER MONOPOLE #1 or #2 -AND- MIDWAY - VINCENT 500 kV Ckt 1 or Ckt 2	P6	111.65	<90	<90	<90	<90	101.37	<90

Potential Mitigation Alternatives

- Re-dispatch generation and bypass series capacitors as system adjustment after the initial contingency, along with existing Path 26 and PDCI RASs curtailing generation

2. Whirlwind–Antelope and Antelope–Vincent 500 kV Lines Thermal Overloads

Reliability Concern

Whirlwind–Antelope and Antelope–Vincent 500 kV lines overloaded for P2/P4 and P6 contingencies

Overloaded Facility	Contingency (All and Worst P6)	Category	Loading % (Baseline Scenarios)				Loading % (Sensitivity Scenarios)		
			B1_2023 Summer Peak	B2_2026 Summer Peak	B3_2031 Summer Peak	B6_2031 Spring Off-Peak	S1_2026 SP High CEC Forecast	S2_2023 SP Heavy Renewable	S3_2023 OP Heavy Renewable
ANTELOPE - WHIRLWIND 500 kV	Midway-Whirlwind 500kV & Vincent-Whirlwind 500kV with series cap bypass	P2/P4	<90	<90	<90	<90	<90	113.47	<90
	VINCENT - WHIRLWIND 500 kV Ckt 3 -AND- ANTELOPE - WINDHUB 500 kV Ckt 1	P6	<90	<90	<90	101.54	<90	150.15	102.73
ANTELOPE - VINCENT 500 kV Ckt 1 or Ckt 2	VINCENT - WHIRLWIND 500 kV Ckt 3 -AND- ANTELOPE - VINCENT 500 kV Ckt 2 or Ckt 1	P6	<90	<90	<90	91.74	<90	129.81	<90

Potential Mitigation Alternatives

- Modify the planned Tehachapi cRAS to cover the P2/P4 contingencies
- Redispatch generation in the Whirlwind and Windhub areas after the first contingency as needed

3. Vincent – Lugo 500 kV Lines Thermal Overloads

Reliability Concern

Lugo - Vincent 500 kV lines overloaded for P6 contingencies in Sensitivity Scenario only

Overloaded Facility	Contingency (All and Worst P6)	Category	Loading % (Baseline Scenarios)				Loading % (Sensitivity Scenarios)		
			B1_2023 Summer Peak	B2_2026 Summer Peak	B3_2031 Summer Peak	B6_2031 Spring Off-Peak	S1_2026 SP High CEC Forecast	S2_2023 SP Heavy Renewable	S3_2023 OP Heavy Renewable
LUGO - VINCENT 500 kV Ckt 1 or Ckt 2	VINCENT - MESA CAL 500 kV Line -AND- LUGO - VINCENT 500 kV Ckt 2 o Ckt 1	P6	<90	<90	<90	96.75	<90	106.71	<90

Potential Mitigation Alternatives

- Re-dispatch generation and bypass series capacitors as system adjustment after the initial contingency

4. Devers – Redbluff 500 kV Lines Thermal Overloads

Reliability Concern

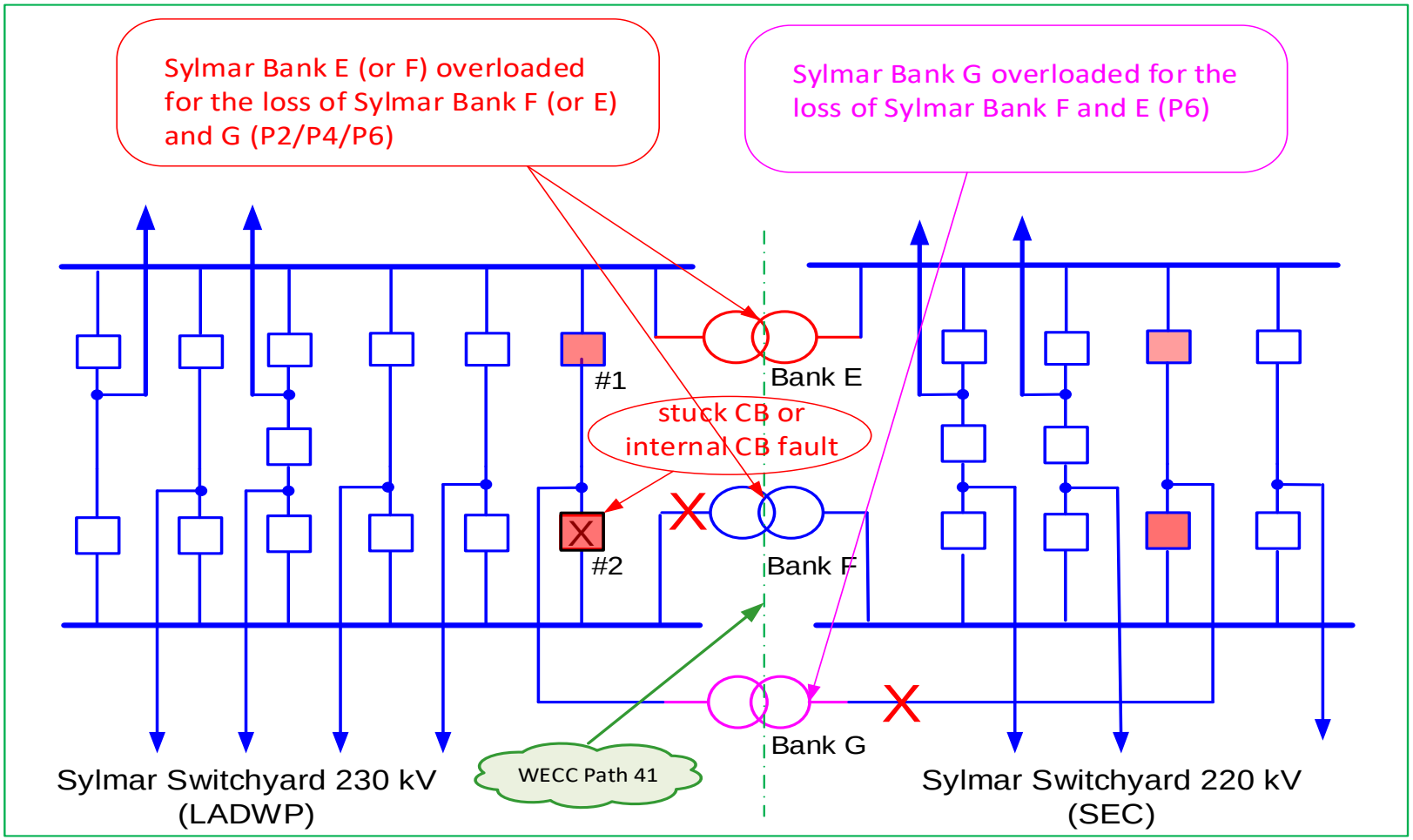
Devers - Redbluff 500 kV lines overloaded for P4 and P6 contingencies in Sensitivity Scenario only

Overloaded Facility	Contingency (All and Worst P6)	Category	Loading % (Baseline Scenarios)			Loading % (Sensitivity Scenarios)		
			B1_2023 Summer Peak	B2_2026 Summer Peak	B3_2031 Summer Peak	S1_2026 SP High CEC Forecast	S2_2023 SP Heavy Renewable	S3_2023 OP Heavy Renewable
Devers - Redbluff 500 kV Ckt 1 or 2	Alamitos Energy Power Plant -AND- DEVERS - REDBLUFF 500 kV Ckt 2 or 1	P3	<90	<90	<90	<90	105.7	<90
	PDCI CONVERTER MONOPOLE #1 or #2 -AND- DEVERS - REDBLUFF 500 kV Ckt 2 or 1	P6	<90	<90	<90	<90	105.58	<90
	NORTH GILA - IMPRLVLY 500 KV -AND- DEVERS - REDBLUFF 500 kV Ckt 2 or 1	P6	<90	<90	<90	<90	117.97	102.64

Potential Mitigation Alternatives

- Colorado River Corridor RAS to trip generating facilities connected to Colorado River and Red Bluff Substations along with system adjustment after the first contingency as needed

5. Sylmar Banks E and F Thermal Overload



5. Sylmar Banks E and F Thermal Overload (Cont'd)

Reliability Concern

- Sylmar Banks E, F, and G overloaded for P2/P4 and P6 contingencies

Overloaded Facility	Contingency (All and Worst P6)	Category	Loading % (Baseline Scenarios)				Loading % (Sensitivity Scenarios)		
			B1_2023 Summer Peak	B2_2026 Summer Peak	B3_2031 Summer Peak	B6_2031 Spring Off-Peak	S1_2026 SP High CEC Forecast	S2_2023 SP Heavy Renewable	S3_2023 OP Heavy Renewable
SYLMAR 230/220 kV Bank E or F	Loss of Sylmar Bank F (or E) and G	P2/P4	<90	<90	96.5	149.7	<90	<90	<90
	Loss of Sylmar Bank F (or E) and G	P6	<90	<90	96.5	149.69	<90	<90	<90
SYLMAR 230/220 kV Banks E and F	UGO - VICTORVL 500 kV line -AND- Sylmar Bank G	P6	<90	<90	96.38	105.16	<90	<90	<90
SYLMAR 230/220 kV Bank G	Loss of Sylmar Bank F and E	P6	<90	<90	<90	108.4	<90	<90	<90

Potential Mitigation Alternative

- Same as the mitigation alternatives in the SCE Main system study results

6. Series Capacitor Banks of Vincent-Midway 500 kV Lines - High Voltage

Reliability Concern

Series Capacitor Banks of Vincent - Midway 500 kV Ckt 1 and Ckt 2 went as high as 1.12 pu of the 525 nominal voltage

Substation	Contingency (All and Worst P6)	Category	Voltage PU (Baseline Scenarios)			
			B1_2023 Summer Peak	B2_2026 Summer Peak	B3_2031 Summer Peak	B6_2031 Spring Off-Peak
Series Capacitor Banks of Vincent - Midway 500 kV Ckt 1 or Ckt 2	MIDWAY - VINCENT Ckt 2 or Ckt 1 - AND- MIDWAY - WHIRLWIND 500.0 Ckt 3	P6	1.17 pu of 500 kV	no issue	no issue	1.13 pu of 500 kV

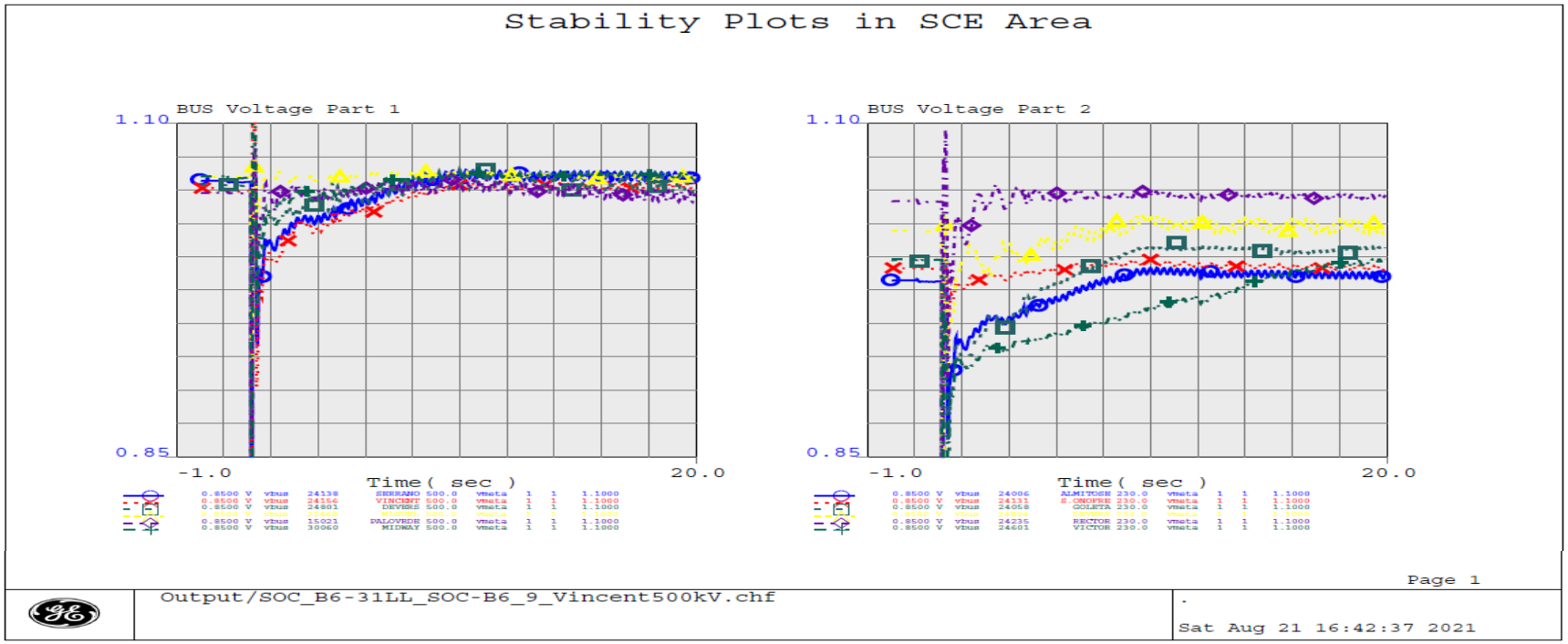
Potential Mitigation Alternative

- Bypass the series capacitors as system adjustment after the initial contingency

Transient Stability Results

Reliability Assessment

- No WECC criteria violations were identified on the southern California bulk system for a total of 83 selected disturbances including P1 though P7 contingencies.
- However, some small oscillation issues, shown below as an example, were observed for various disturbances because some dynamic models of future IBR resources (repc_a and repc_b) need to be tuned.



Summary of Potential New Upgrades

Concern	Potential Upgrade Alternative
Sylmar Banks E and F overloaded for P2/P4/P6 contingencies	Same as the mitigation alternatives discussed in the SCE Main system study results: ▪ Develop operation procedure or short-term emergency ratings to manage power flow via the banks (Path 41) for pre- or post- contingency ▪ Re-configure the switchyard by adding one-and-half breaker schemes if possible ▪ Remove the three banks between LADWP and SCE along with other facility upgrade ▪ Upgrade the banks E and F

SCE Eastern Area
Preliminary Reliability Assessment Results

Nikitas Zagoras
Regional Transmission Engineer

2021-2022 Transmission Planning Process Stakeholder Meeting
September 27-28, 2021

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 4,962 MW in 2023

SCE Eastern Area Study Scenarios

- Base scenarios

No.	Case	Description
B1	2023 Summer Peak	SCE Summer peak load time (9/5 HE 16 PPT)
B2	2026 Summer Peak	SCE Summer peak load time (9/1 HE 16 PPT)
B3	2031 Summer Peak	SCE Summer peak load time (9/3 HE 19 PPT)
B4	2023 Spring Off-Peak	Spring shoulder load time (4/26 HE 20 PPT)
B5	2026 Spring Light Load	Spring minimum net load time (4/5 HE 13 PPT)

- Sensitivity scenarios

No	Case	Change From Base Assumption
S1	2026 Summer Peak	High CEC forecasted load
S2	2023 Spring Off-Peak	Heavy renewable output and minimum gas generation commitment
S3	2023 Summer Peak	Heavy renewable output and minimum gas generation commitment

Demand Side Assumptions

S. No.	Base Case	Gross Load (MW)	AAEE (MW)	BTM-PV		Net Load (MW)	Demand Response	
				Installed (MW)	Output (MW)		Fast	Slow
B1	2023 Summer Peak	5507	58	1058	487	4962	57	18
B2	2026 Summer Peak	5700	117	1058	612	4971	57	18
B3	2031 Summer Peak	5197	114	1718	0	5083	57	18
B4	2023 Off Peak	3114	58	1058	0	3057	57	18
B5	2026 Off Peak	2218	117	1058	1051	1050	57	18
S1	2026 Peak High CEC Load	6136	117	1058	612	5407	57	18
S2	2023 Peak Heavy Renewable Output & Min. Gas Gen.	5494	58	1058	487	4949	57	18
S3	2023 Off Peak Heavy Renewable Output & Min. Gas Gen.	3408	58	1058	0	3351	57	18

Note: DR and storage are modeled offline in starting base cases.

Supply Side Assumptions

S. No.	Base Case	Battery Storage (MW)	Solar		Wind		Hydro		Thermal	
			Installed (MW)	Dispatch (MW)	Installed (MW)	Dispatch (MW)	Installed (MW)	Dispatch (MW)	Installed (MW)	Dispatch (MW)
B1	2023 Summer Peak	1161	3488	1779	880	176	311	201	3032	2801
B2	2026 Summer Peak	1161	3488	1779	880	176	311	201	3032	2871
B3	2031 Summer Peak	1262	3488	0	880	352	311	311	3032	2871
B4	2023 Off Peak	1161	3488	0	880	422	311	201	3032	2871
B5	2026 Off Peak	1161	3488	3278	880	299	311	201	3032	2871
S1	2026 Peak High CEC Load	1161	3488	1779	880	176	311	201	3032	2871
S2	2023 Peak Heavy Renewable Output & Min. Gas Gen.	1161	3488	3453	860	577	311	201	3032	2815
S3	2023 Off Peak Heavy Renewable Output & Min. Gas Gen.	1161	3488	3453	880	590	311	201	3032	2871
Note: DR and storage are modeled offline in starting base cases.										

Previously approved transmission projects modelled in base cases

Project Name	ISD	First Year Modeled
West of Devers Upgrade	05/14/2021	2023
Delaney-Colorado River 500 kV line	07/01/2023	2023
Riverside Transmission Reliability Project	10/01/2026	2026
Alberhill 500 kV Substation	10/20/2025	2026

Neighboring system transmission projects modelled in base cases

Project Name	ISD	First Year Modeled
Mirage-Ramon #2 230 kV line		2026

Reliability assessment preliminary results summary

Base Scenario Results – Thermal Loading

Overloaded Facility	Contingency (All and Worst P6)	Cat.	Loading % (Baseline Scenarios)					Potential Mitigation Solution
			2023 Summer Peak	2026 Summer Peak	2031 Summer Peak	2026 Spring Off-Peak	2023 Spring Off-Peak	
J.HINDS - MIRAGE 230 kV #1	PALO VRDE - COL. RIVER #1 500 kV	P1	<100	<100	<100	<100	103.4	Blythe RAS
	DELANEY - COL. RIVER 500 kV #1 and PALO VRDE - COL. RIVER 500 kV #1	P6	109.7	<100	<100	<100	124.8	Blythe RAS
	DEVERS - RED BLUFF 500 kV # 1 and DEVERS - RED BLUFF 500 kV #2	P6	136.4	<100	<100	<100	124.0	Col. River CRAS, Blythe RAS
	COL. RIVER - RED BLUFF 500 kV #1 and COL. RIVER - RED BLUFF 500 kV #2	P6	120.8	<100	<100	<100	124.1	Col. River CRAS, Blythe RAS
	C.V. - MIRAGE 230 kV #1 and RAMON - MIRAGE 230 kV #1	P7	107.2	<100	<100	<100	113.2	Path 42 RAS
	EAGLE MTN - J.HINDS CB, and J.HINDS SHUNT REACTOR, and EAGLE MTN SHUNT REACTOR (P2 ~ long lead time equipment loss)	P2	136.2	<100	133.4	<100	136.3	Blythe RAS

Base Scenario Results – Thermal Loading

Overloaded Facility	Contingency (All and Worst P6)	Cat.	Loading % (Baseline Scenarios)					Potential Mitigation Solution
			2023 Summer Peak	2026 Summer Peak	2031 Summer Peak	2026 Spring Off-Peak	2023 Spring Off-Peak	
DEVERS - RED BLUFF 500 kV #1	DEVERS - RED BLUFF 500 kV #2 and N.GILA - IMPRL VLY 500 kV #1	P6	112.8	<100	<100	<100	<100	Col. River CRAS
DEVERS - RED BLUFF 500 kV #2	DEVERS - RED BLUFF 500 kV #1 and N.GILA - IMPRL VLY 500 kV #1	P6	110.8	<100	<100	<100	<100	Col. River CRAS
J.HINDS - EAGLE MTN 230 kV #1	DEVERS - MIRAGE 230 kV #1 and DEVERS - MIRAGE 230 kV #2	P7	<100	<100	105.6	<100	101.4	Path 42 RAS
J.HIND MWD - J.HINDS 230 kV #1	DEVERS - MIRAGE 230 kV #1 and DEVERS - MIRAGE 230 kV #2	P7	109.9	<100	126.9	<100	101.5	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	
DEVERS - RED BLUFF 500 kV #1	DEVERS - RED BLUFF 500 kV #2	P1	<100	101.1	<100	Col. River CRAS
	DEVERS - RED BLUFF 500 kV #2 and N.GILA - IMPRL VLY 500 kV #1	P6	<100	119.8	111.7	Col. River CRAS
DEVERS - RED BLUFF 500 kV #2	DEVERS - RED BLUFF 500 kV #1 and N.GILA - IMPRL VLY 500 kV #1	P6	<100	117.6	108.5	Col. River CRAS
RED BLUFF 500/230/13.8 kV #1	RED BLUFF 500/230/13.8 kV #2	P1	<100	<100	123.0	Col. River CRAS
RED BLUFF 500/230/13.8 kV #2	RED BLUFF 500/230/13.8 kV #1	P1	<100	<100	125.1	Col. River CRAS
COL. RIVER 500/230/13.8 kV #1	COLRIVER 500/230/13.8 kV #2	P1	<100	102.2	<100	Col. River CRAS
COL. RIVER 500/230/13.8 kV #2	COLRIVER 500/230/13.8 kV #1	P1	<100	102.2	<100	Col. River CRAS
EAGLE MTN - IRON MTN 230 kV #1	DEVERS - RED BLUFF 500 kV # 1 and DEVERS - RED BLUFF 500 kV #2	P6	<100	104.1	<100	Col. River CRAS

High Voltage Results

Substation	Contingency (All and Worst P6)	Cat.	Voltage PU (Baseline Scenarios)					Potential Mitigation Solution
			2023 Summer Peak	2026 Summer Peak	2031 Summer Peak	2023 Spring Off-Peak	2026 Spring Off-Peak	
BLYTHE 161 kV	Open CB372-WALC. Line BLYTHE 161 kV Bus Tie (WALC - SCE), J. Hinds Shunt Reactor	P2/P4	<1.05	<1.05	<1.05	<1.05	1.11	Reactive device switching
	Open CB372-WALC. Line BLYTHE 161 kV Bus Tie (WALC - SCE), Eagle Shunt Reactor	P2/P4	<1.05	<1.05	<1.05	<1.05	1.11	Reactive device switching

Low Voltage Results

Substation	Contingency (All and Worst P6)	Cat.	Voltage PU (Sensitivity Scenarios)			Potential Mitigation Solution
			2026 SP High CEC Forecast	2023 SP Heavy Renewable & Min Gas Gen	2023 OP Heavy Renewable & Min Gas Gen	
EAGLE Mtn 161 kV	DEVERS - RED BLUFF 500 kV #1 and DEVERS - RED BLUFF 500 kV #2	P6	>0.9	0.88	>0.9	Reactive device switching

Stability Results

Contingency	Cat.	Transient Stability Performance					Potential Mitigation Solution
		Baseline Scenarios			Sensitivity Scenarios		
		2026 Summer Peak	2031 Summer Peak	2023 Spring Off-Peak	2026 SP High CEC Forecast	2023 OP Heavy Renewable & Min Gas Gen	
Julian Hinds-Mirage 230 kV	P1	No Issues	No Issues	WECC criteria not met	No Issues	Diverge	Blythe RAS
Mirage-J.Hinds 230 kV with stuck breaker followed by Mirage-Ramon 230 kV	P4.2	No Issues	No Issues	WECC criteria not met	No Issues	Diverge	Blythe RAS
Julian Hinds-Mirage 230 kV, non-redundant pilot relay fail	P5.2	No Issues	No Issues	WECC criteria not met	No Issues	Diverge	Blythe RAS
Devers-Mirage 230 kV #1 & #2	P7.1	No Issues	Unstable	No Issues	No Issues	No Issues	Path 42 RAS

Summary of Potential New Upgrades

Concern	Potential Upgrade
None identified	

SCE North of Lugo Area
Preliminary Reliability Assessment Results

Meng Zhang
Sr Regional Transmission Engineer

2021-2022 Transmission Planning Process Stakeholder Meeting
September 27-28, 2021

SCE North of Lugo (NOL) Area

- Comprised of 55, 115 and 230 kV transmission facilities
- Total installed generation capacity in the area is over 2100 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	2023 Summer Peak	Summer peak load time (9/5 HE 16 PST)
B2	2026 Summer Peak	Summer peak load time (9/1 HE 16 PST)
B3	2031 Summer Peak	Summer peak load time (9/3 HE 19 PST)
B4	2023 Spring Off-Peak	Spring minimum net load time (4/26 HE 20 PST)
B5	2026 Spring Off-Peak	Spring shoulder load time (4/5 HE 13 PST)
B6	2031 Spring Off-Peak	Spring shoulder load time (4/6 HE 13 PST)

- Sensitivity scenarios

No	Case	Change From Base Assumption
S1	2026 SP High Load	High CEC forecasted load
S2	2023 SP High Renewable	Heavy renewable output and minimum gas generation commitment
S3	2023 SOP High Renewable	Heavy renewable output and minimum gas generation commitment

Reliability Assessment
Preliminary Results Summary

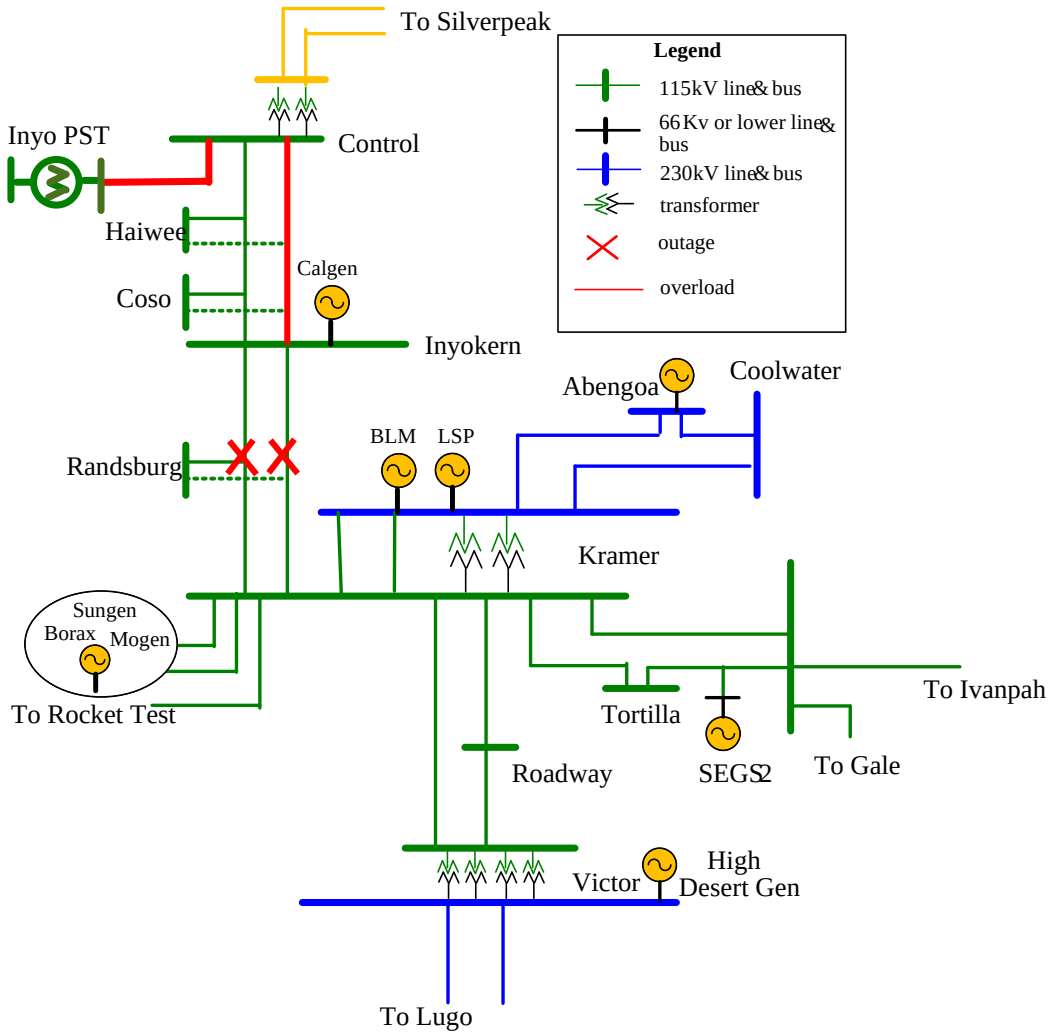
Base Scenario Results – Thermal Loading

Overloaded Facility	Contingency (All and Worst P6)	Category	Category Description	Loading % (Baseline Scenarios)						Project & Potential Mitigation Solutions
				2023 Summer Peak	2026 Summer Peak	2031 Summer Peak	2023 Spring Off-Peak	2026 Spring Off-Peak	2031 Spring Off-Peak	
Control - Inyo 115kV line	INYOKERN - KRAMER 115.0 ck 1 line KRAMER-INYOKERN-RANDSB 115 ck 1	P6	N-1-1	128.24	111.43	Diverge	Diverge	Diverge	117.14	Operating Procedure 7690 would redispatch generation as needed.
Remaining Victor 230/115kV transformer	Loss of the other two Victor 230/115kV transformers	P6	N-1-1	<100	<100	100.41	<100	<100	<100	Monitor load growth; utilize the existing spare transformer
Ivanpah - Mountain Pass 115kV line	KRAMER - COLWATER 115.0 ck 1 Line KRAMER - TORTILLA 115.0 ck 1	P6	N-1-1	<100	<100	Diverge	<100	<100	<100	Operating Procedure 127 would radialize the system at Mountain Pass after the first outage

Base Scenario Results – Low/High Voltage

Substation	Contingency (All and Worst P6)	Category	Category Description	Voltage PU (Baseline Scenarios)						Project & Potential Mitigation Solutions
				2023 Summer Peak	2026 Summer Peak	2031 Summer Peak	2023 Spring Off-Peak	2026 Spring Off-Peak	2031 Spring Off-Peak	
Baker, Coolwater, Tortilla 115kV	KRAMER - COLWATER 115.0 ck 1 Line KRAMER - TORTILLA 115.0 ck 1	P6	N-1-1	1.126	1.1338	Diverge	1.1045	1.1383	1.4992	Operating procedure 127 would radialize the system at Mountain Pass; reduce generation output after the first outage

Base Scenario Results – continued



Summary of Potential New Upgrades

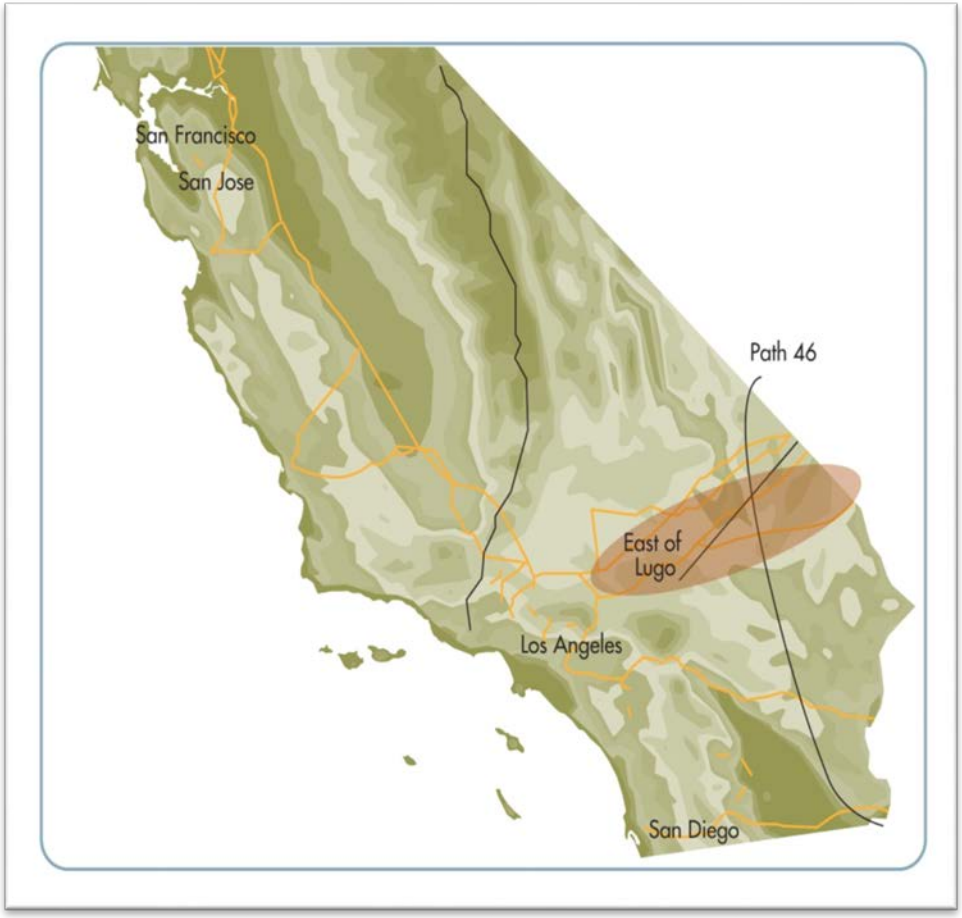
Concern	Potential Upgrade
None identified	

SCE East of Lugo Area
Preliminary Reliability Assessment Results

Meng Zhang
Sr Regional Transmission Engineer

2021-2022 Transmission Planning Process Stakeholder Meeting
September 27-28, 2021

East of Lugo (EOL) Area



- Comprised of 115, 230 & 500 kV transmission facilities.
- Includes Eldorado, Mohave, Merchant, Ivanpah, CIMA, Pisgah Mountain Pass, Dunn Siding and Baker substations
- Total installed generation capacity is about 1786 MW. And over 70% of the total capacity is solar generation.
- The load is mostly served from CIMA 66kV substation.

SCE EOL Area Study Scenarios

- Base scenarios

No.	Case	Description
B1	2023 Summer Peak	Summer peak load time (9/5 HE 16 PST)
B2	2026 Summer Peak	Summer peak load time (9/1 HE 16 PST)
B3	2031 Summer Peak	Summer peak load time (9/3 HE 19 PST)
B4	2023 Spring Off-Peak	Spring minimum net load time (4/26 HE 20 PST)
B5	2026 Spring Off-Peak	Spring shoulder load time (4/5 HE 13 PST)
B6	2031 Spring Off-Peak	Spring shoulder load time (4/6 HE 13 PST)

- Sensitivity scenarios

No	Case	Change From Base Assumption
S1	2026 SP High Load	High CEC forecasted load
S2	2023 SP High Renewable	Heavy renewable output and minimum gas generation commitment
S3	2023 SOP High Renewable	Heavy renewable output and minimum gas generation commitment

Demand Side Assumptions

Scenario No.	Case	Gross Load (MW)	AAEE (MW)	BTM-PV MW)		Net Load (MW)	Demand Response (Installed)	
				Installed	Output		Fast (MW)	Slow (MW)
B1	2023 Summer Peak	38	0	0	0	38	0	0
B2	2026 Summer Peak	27	0	2	1	26	0	0
B3	2031 Summer Peak	31	0	4	0	31	0	0
B4	2023 Spring Light Load	26	0	0	0	26	0	0
B5	2026 Spring Off-peak	2	0	2	1	1	0	0
B6	2031 Spring Off-peak	16	0	4	3	13	0	0
S1	2026SP High CEC Load	27	0	2	1	26	0	0
S2	2023 SP Heavy Renewable Output & Min. Gas Gen	38	0	0	0	38	0	0
S3	2023 SOP Heavy Renewable Output & Min. Gas Gen.	26	0	0	0	26	0	0

Supply Side Assumptions

Scenario No.	Case	Installed Battery Storage (MW)	Solar		Wind		Hydro		Thermal	
			Installed (MW)	Dispatch (MW)	Installed (MW)	Dispatch (MW)	Installed (MW)	Dispatch (MW)	Installed (MW)	Dispatch (MW)
B1	2023 Summer Peak	0	1261	643	0	0	0	0	525	419
B2	2026 Summer Peak	0	1461	745	0	0	0	0	525	419
B3	2031 Summer Peak	501	2434	0	1062	425	0	0	525	419
B4	2023 Spring Light Load	0	1261	0	0	0	0	0	525	419
B5	2026 Spring Off-peak	0	1461	1373	0	0	0	0	525	0
B6	2031 Spring Off-peak	501	2434	2288	1062	361	0	0	525	0
S1	2026SP High CEC Load	0	1461	745	0	0	0	0	525	419
S2	2023 SP Heavy Renewable Output & Min. Gas Gen	0	1261	1248	0	0	0	0	525	0
S3	2023 SOP Heavy Renewable Output & Min. Gas Gen.	0	1261	1248	0	0	0	0	525	0

Previously approved transmission projects modeled in base cases

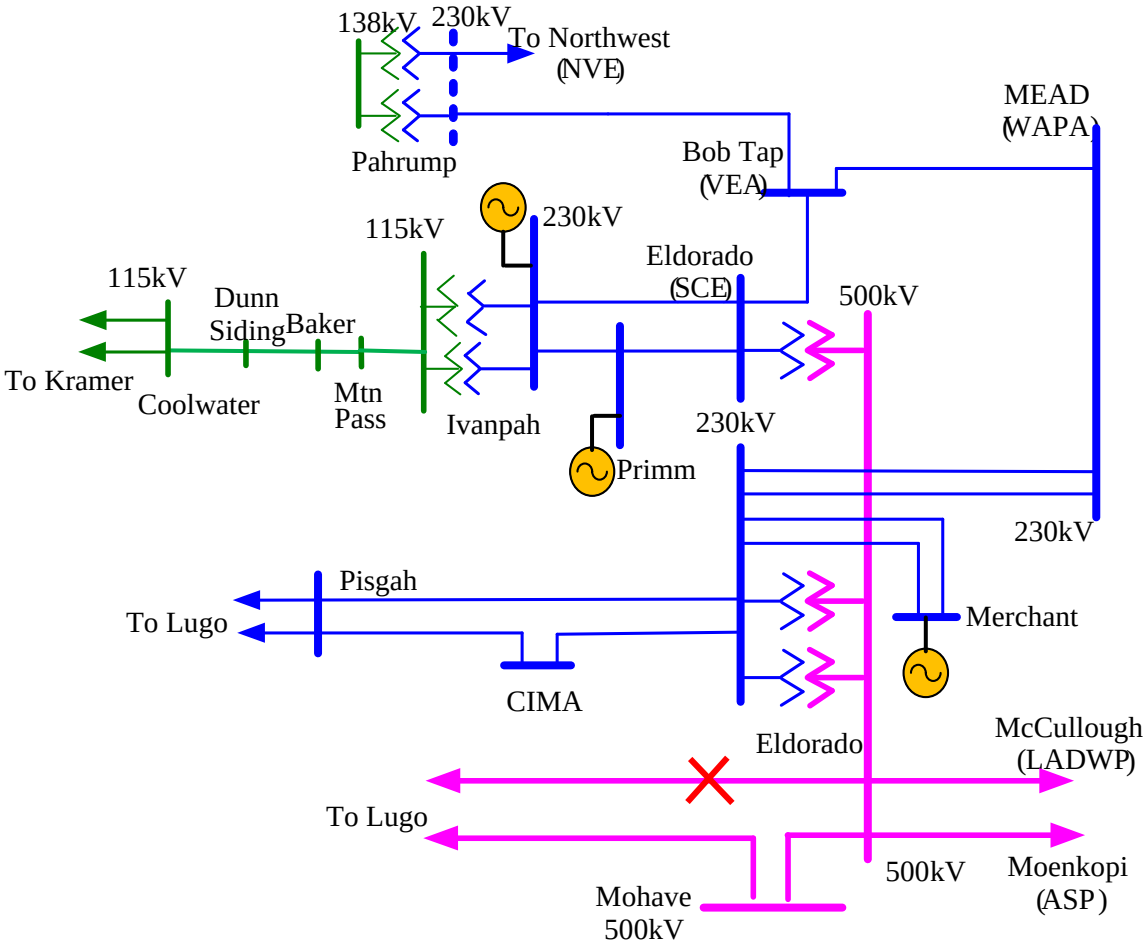
Project Name	First Year Modeled
Eldorado-Lugo Series Capacitor Upgrade	2023
Lugo-Mohave Series Capacitor Upgrade	2023
Calcite 230kV Substation	2023
Lugo-Victorville 500kV Line Upgrade	2023

Reliability assessment preliminary results summary

Base Scenario Results – Thermal Loading

Overloaded Facility	Contingency (All and Worst P6)	Category	Category Description	Loading % (Baseline Scenarios)						Loading % (Sensitivity Scenarios)			Project & Potential Mitigation Solutions
				2023 Summer Peak	2026 Summer Peak	2031 Summer Peak	2023 Spring Off-Peak	2026 Spring Off-Peak	2031 Spring Off-Peak	2026 SP High CEC Forecast	2023 SP Heavy Renewable & Min Gas Gen	2023 OP Heavy Renewable & Min Gas Gen	
Pisgah - Calcite 230kV	Calcite - Lugo 230kV and ES-CALCITE-S	P3	G-1/L-1	NA	NA	<100	NA	NA	109.58	NA	NA	NA	Generation redispatch following first contingency

Base Scenario Results – continued



Summary of Potential New Upgrades

Concern	Potential Upgrade
None identified	

Big Creek Corridor
Preliminary Reliability Assessment Results

Robert Sparks
Regional Transmission - South

2021-2022 Transmission Planning Process Stakeholder Meeting
September 27-28, 2021

SCE Big Creek Corridor

- Serves the SCE load area extending north from the Metro area and into Tulare County
- Comprised of 230 kV and 66 kV transmission facilities
- 1-in-10 summer peak net load of 2,328 MW in 2023
- Forecast load includes the impact of 686 MW of BTM PV and 32 MW of AAEE
- Approximately 4,700 MW of existing and committed resources comprised of solar, wind, gas-fired, hydro and battery storage

Study Scenarios

- Base scenarios

No.	Case	Description
B1	2023 Summer Peak	SCE Summer peak load time (9/5 HE 16 PPT)
B2	2026 Summer Peak	SCE Summer peak load time (9/1 HE 16 PPT)
B3	2031 Summer Peak	SCE Summer peak load time (9/3 HE 19 PPT)
B4	2023 Spring Off-Peak	Spring shoulder load time (4/26 HE 20 PPT)
B5	2026 Spring Off-Peak	Spring minimum net load time (4/5 HE 13 PPT)

- Sensitivity scenarios

No	Case	Change From Base Assumption
S1	2026 Summer Peak	High CEC forecasted load
S2	2023 Summer Peak	Heavy renewable output and minimum gas generation commitment
S3	2023 Spring Off-Peak	Heavy renewable output and minimum gas generation commitment

* Note: The off-peak sensitivity case with heavy renewable output and minimum gas generation commitment is based on the 2022 Spring Off-Peak Case rather than the 2025 Spring Off-Peak Case as indicated in the study plan.

Demand Side Assumptions

Scenario No.	Base Case	Gross Load (MW)	AAEE (MW)	BTM-PV		Net Load (MW)	Demand Response (installed)	
				Installed (MW)	Output (MW)		Fast (MW)	Slow (MW)
B1	2023 Summer Peak	2559	16	469	216	2328	59	13
B2	2026 Summer Peak	1102	32	185	98	972	59	13
B3	2031 Summer Peak	2245	32	686	0	2213	59	13
B4	2023 Off Peak	2120	16	469	0	2104	59	13
B5	2026 Off Peak	1650	32	469	448	1170	59	13
S1	2026 Peak High CEC Load	2802	32	469	261	2509	59	13
S2	2023 Peak Heavy Renewable Output & Min. Gas Gen.	2559	16	469	216	2328	59	13
S3	2023 Off Peak Heavy Renewable Output & Min. Gas Gen.	2120	16	469	0	2104	59	13

Note: DR and storage are modeled offline in starting base cases.

Supply Side Assumptions

Scenario No.	Base Case	Battery Storage (Installed) (MW)	Solar (Grid Connected)		Wind		Hydro		Thermal	
			Installed (MW)	Dispatch (MW)	Installed (MW)	Dispatch (MW)	Installed (MW)	Dispatch (MW)	Installed (MW)	Dispatch (MW)
B1	2023 Summer Peak	901	1247	636	0	0	962	773	1607	1452
B2	2026 Summer Peak	1021	1680	858	0	0	980	780	1614	1564
B3	2031 Summer Peak	1021	1668	0	0	0	980	913	1614	1564
B4	2023 Off Peak	901	1247	0	0	0	962	773	1607	1564
B5	2026 Off Peak	1021	1257	1177	0	0	962	773	1614	1534
S1	2026 Peak High CEC Load	1021	1680	858	0	0	980	780	1614	1564
S2	2023 Peak Heavy Renewable Output & Min. Gas Gen.	901	1682	1235	0	0	980	773	1607	1452
S3	2023 Off Peak Heavy Renewable Output & Min. Gas Gen.	901	1682	1666	0	0	980	782	1607	1564
Note: DR and storage are modeled offline in starting base cases.										

Previously approved transmission projects modelled in base cases

Project Name	ISD	First Year Modeled
Big Creek Corridor Rating Increase	In-service	2023

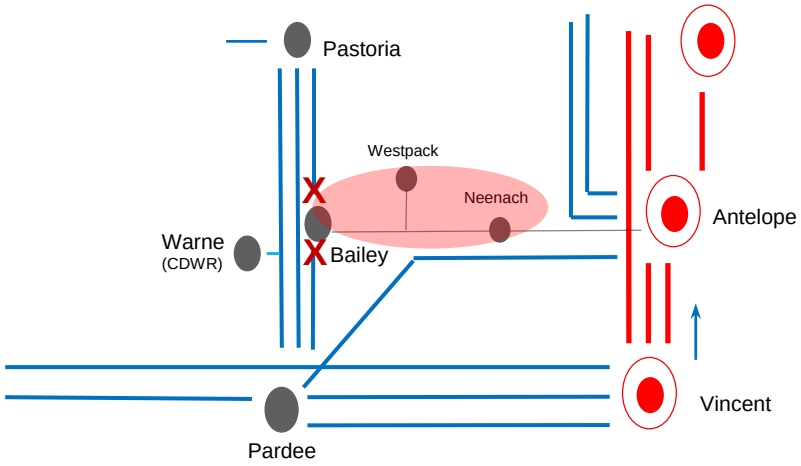
Reliability assessment preliminary results summary

Base Scenario Results – Thermal Loading

Overloaded Facility	Contingency (All and Worst P6)	Category	Category Description	Loading %					Project & Potential Mitigation Solutions
				2023 Summer Peak	2026 Summer Peak	2031 Summer Peak	2023 Spring Off-Peak	2026 Spring Off-Peak	
Windhub 500/230 kV Transformer No. 3 or No. 4	Remaining Windhub 500/230 kV Transformer No. 3 or No. 4	P1	T-1	<100%	<100%	117.1	<100%	<100%	Congestion management; Planned Windhub CRAS identified in GIP
Antelope 230 kV/66 kV transformers	Loss of two Antelope 230 kV/66 kV transformers	P6	T-1/T-1	123.3	123	179.7	115.8	<100%	Energize existing spare after initial contingency
Big Creek 2 – Big Creek 3 230 kV	Big Creek 1–Rector & Big Creek 8–Big Creek 3 230 kV lines	P6	L-1/L-1	126.6	126.0	132.7	114.37	<100%	Reduce Big Creek generation after initial contingency
	Big Creek 1–Rector & Big Creek 8–Big Creek 2 230 kV lines	P6	L-1/L-1	110.7	110.6	115.6	<100%	<100%	

Base Scenario Results – Low/High Voltage

Substation	Contingency (All and Worst P6)	Category	Category Description	Voltage (p.u.)					ISO Approved Projects & Potential Mitigation Solutions
				2023 Summer Peak	2026 Summer Peak	2031 Summer Peak	2023 Spring Off-Peak	2026 Spring Off-Peak	
Bailey – Antelope 66 kV system	Bailey–Pardee & Bailey–Pastoria 230 kV	P6	L-1/L-1	> 0.9	> 0.9	Diverged	Diverged	> 0.9	Split Antelope–Bailey 66 kV System per existing SCE operating procedure after initial contingency
Bailey 66 kV system	Bailey 230/66 kV #2 $ #3 Transformers	P6	T-1/T-1	> 0.9	> 0.9	Diverged	Diverged	> 0.9	



Base Scenario Results – Transient Stability

Contingency (All and Worst P6)	Category	Category Description	2023 Summer Peak	2026 Summer Peak	ISO Approved Projects & Potential Mitigation Solutions
Bailey–Pardee & Bailey–Pastoria 230 kV, 3-PH Fault @ Pardee, Normal Clearing	P6	L-1/L-1	WECC criteria not met	WECC criteria not met	Split Antelope–Bailey 66 kV System per existing SCE operating procedure after initial contingency

Sensitivity Assessment Results

- Facility overloads identified in sensitivity scenarios only

Overloaded Facility	Contingency (All and Worst P6)	Category	Loading %			Project & Potential Mitigation Solutions
			2026 SP High CEC Forecast	2023 SP Heavy Renewable & Min Gas Gen	2023 OP Heavy Renewable & Min Gas Gen	
Neenack — Bailey/Westpack Tap 66 kV	Bailey – Pardee & Baily – Pastoria 230 kV lines or Bailey 230/66 kV transformers	P6	103.4	<100%	103.8	Split Antelope–Bailey 66 kV System per existing SCE operating procedure after initial contingency

Summary of Potential New Upgrades

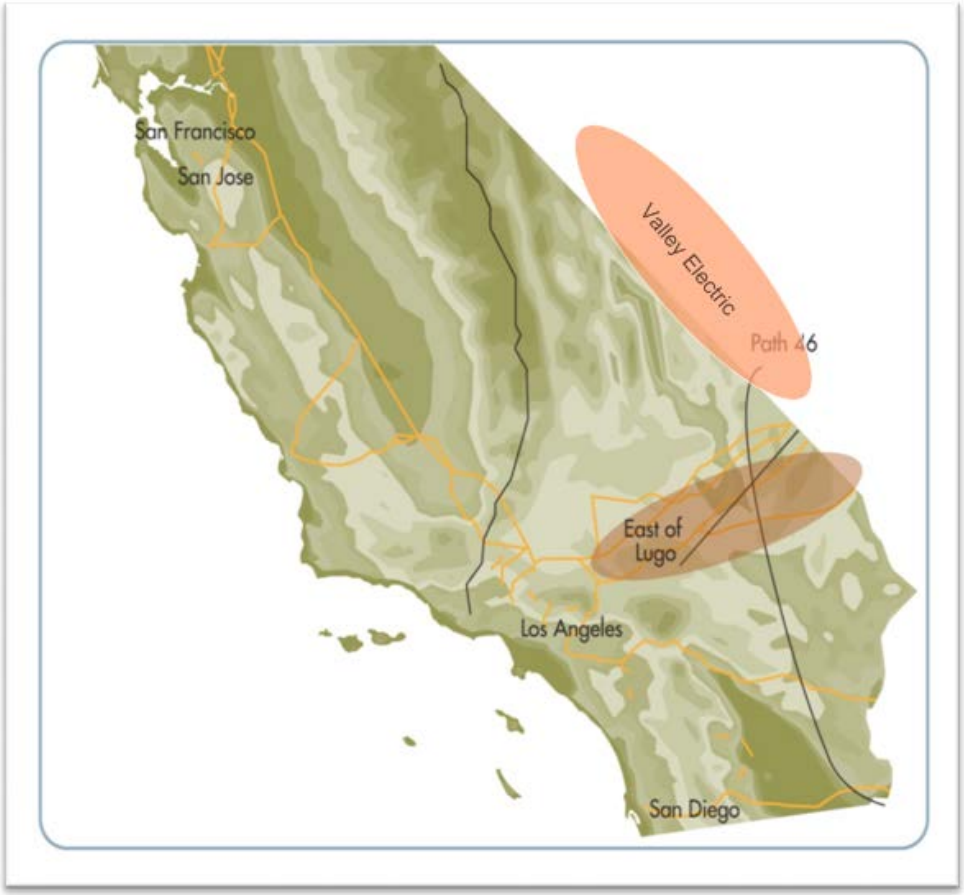
Concern	Potential Upgrade
None identified	

Valley Electric Association
Preliminary Reliability Assessment Results

Meng Zhang
Sr Regional Transmission Engineer

2021-2022 Transmission Planning Process Stakeholder Meeting
September 27-28, 2021

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 2023, 2026 and 2031 are 171 MW, 176 MW and 192 MW respectively.

VEA Study Scenarios

- Base scenarios

No.	Case	Description
B1	2023 Summer Peak	Summer peak load time (9/5 HE 16 PST)
B2	2026 Summer Peak	Summer peak load time (9/1 HE 16 PST)
B3	2031 Summer Peak	Summer peak load time (9/3 HE 19 PST)
B4	2023 Spring Off-Peak	Spring minimum net load time (4/26 HE 20 PST)
B5	2026 Spring Off-Peak	Spring shoulder load time (4/5 HE 13 PST)
B6	2031 Spring Off-Peak	Spring shoulder load time (4/6 HE 13 PST)

- Sensitivity scenarios

No	Case	Change From Base Assumption
S1	2023 Summer Peak with high forecasted load	Load increased to reflect future load service requests
S2	2026 Summer Peak with high forecasted load	Load increased to reflect future load service requests
S3	2026 Off-peak with heavy renewable output	Solar dispatch increased to 20% exceedance values

Demand Side Assumptions

Scenario No.	Case	Gross Load (MW)	AAEE (MW)	BTM-PV		Net Load (MW)	Demand Response	
				Installed (MW)	Output (MW)		Fast (MW)	Slow (MW)
B1	2023 Summer Peak	171	0	0	0	171	0	0
B2	2026 Summer Peak	176	0	0	0	176	0	0
B3	2031 Summer Peak	192	0	0	0	192	0	0
B4	2023 Spring Light Load	112	0	0	0	112	0	0
B5	2026 Spring Off-peak	32	0	0	0	32	0	0
B6	2031 Spring Off-peak	46	0	0	0	46	0	0
S1	2023 Summer Peak with high forecasted load	182	0	0	0	182	0	0
S2	2026 Summer Peak with high forecasted load	188	0	0	0	188	0	0
S3	2026 Off Peak with heavy renewable output	32	0	0	0	32	0	0

Supply Side Assumptions

Scenario No.	Case	Installed Storage (MW)	Solar		Wind		Hydro		Thermal	
			Installed (MW)	Dispatch (MW)	Installed (MW)	Dispatch (MW)	Installed (MW)	Dispatch (MW)	Installed (MW)	Dispatch (MW)
B1	2023 Summer Peak	0	375	60	0	0	0	0	0	0
B2	2026 Summer Peak	0	375	60	0	0	0	0	0	0
B3	2031 Summer Peak	0	2,647	0	0	0	0	0	0	0
B4	2023 Spring Light Load	0	375	0	0	0	0	0	0	0
B5	2026 Spring Off-peak	0	375	111	0	0	0	0	0	0
B6	2031 Spring Off-peak	0	2,647	1,195	0	0	0	0	0	0
S1	2023 Summer Peak with high forecasted load	0	375	60	0	0	0	0	0	0
S2	2026 Summer Peak with high forecasted load	0	375	60	0	0	0	0	0	0
S3	2026 Off Peak with heavy renewable output	0	375	360	0	0	0	0	0	0

Previously Approved Transmission Projects

No.	Transmission Projects	First Year Modeled	Description
1	Gamebird 230/138kV Transformer	2023	A new 230/138kV transformer at Gamebird 138kV substation and loop into Pahrump-Sloan Canyon 230kV line

Reliability Assessment
Preliminary Results Summary

Thermal Loading Results

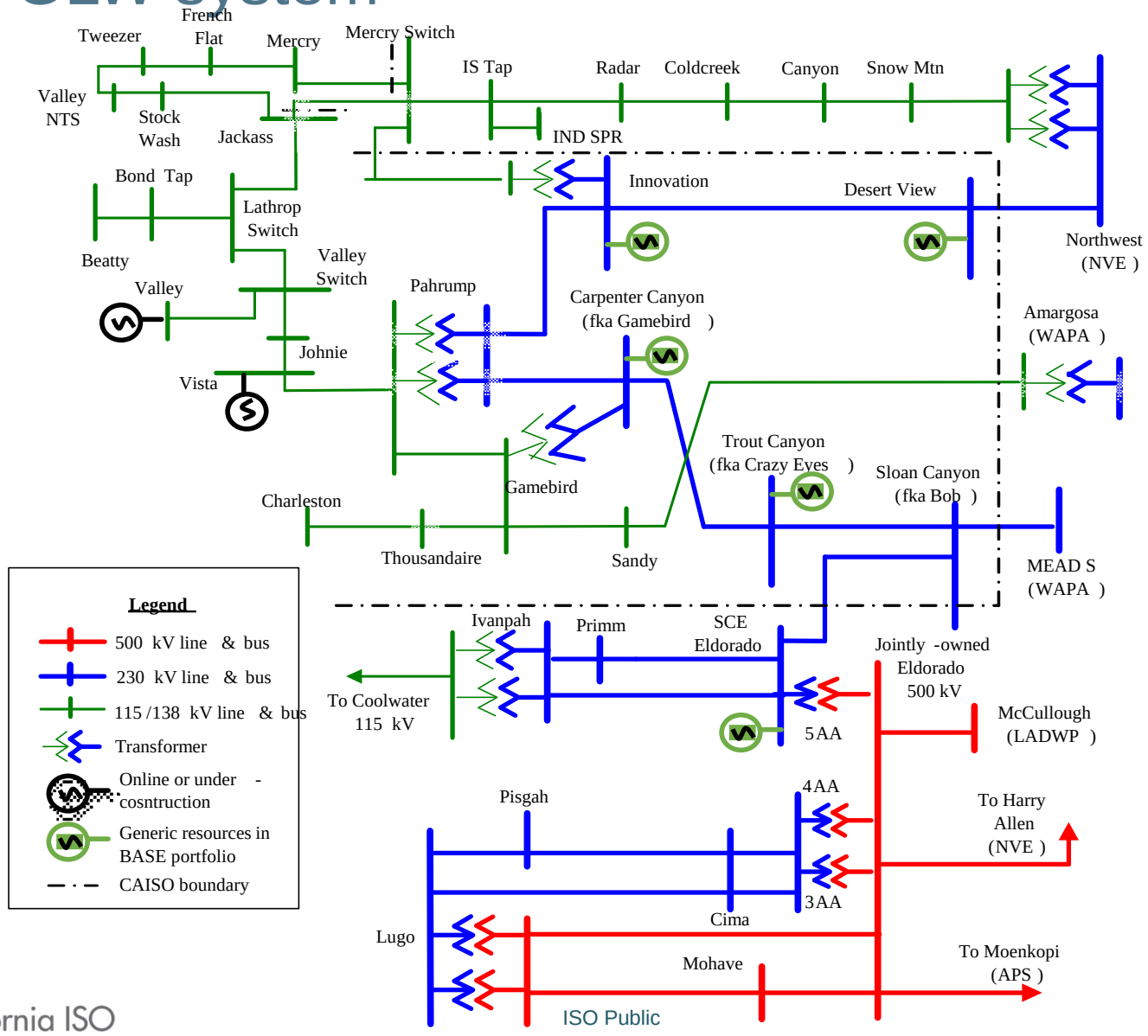
Overloaded Facility	Contingency (All and Worst P6)	Category	Category Description	Loading % (Baseline Scenarios)						Loading % (Sensitivity Scenarios)			Project & Potential Mitigation Solutions
				2023 Summer Peak	2026 Summer Peak	2031 Summer Peak	2023 Spring Off-Peak	2026 Spring Off-Peak	2031 Spring Off-Peak	2023 SP with Forecasted Load Addition	2026 SP with Forecasted Load Addition	2023 OP Heavy Renewable & Min Gas Gen	
Amargosa 230/138kV transformer	Base Case	P0	Base Case	<100	<100	<100	<100	<100	109.11	<100	<100	<100	Generation redispatch precontingency; RAS proposed in GIDAP process; will evaluate further in policy study for potential upgrade
	NWEST 230.0 to DESERT VIEW 230.0 Circuit 1	P1	N-1	<100	<100	<100	<100	<100	251.24	<100	<100	<100	
	SLOAN_CANYON230-kV BRKR	P4	Stuck Breaker	<100	<100	<100	<100	<100	164.31	<100	<100	<100	
Northwest - Desert View 230kV line	Base Case	P0	Base Case	<100	<100	<100	<100	<100	109.26	<100	<100	<100	
	TROUT CANYON 230.0 to SLOAN CANYON 230.0 Circuit 1	P1	N-1	<100	<100	<100	<100	<100	109.46	<100	<100	<100	
	SLOAN_CANYON230-kV BRKR	P4	Stuck Breaker	<100	<100	<100	<100	<100	109.42	<100	<100	<100	
Mercury SW - IS Tap 138kV line	Base Case	P0	Base Case	<100	<100	<100	<100	<100	135.37	<100	<100	<100	
	NWEST 230.0 to DESERT VIEW 230.0 Circuit 1	P1	N-1	<100	<100	<100	<100	<100	432.03	<100	<100	<100	
	TROUT CANYON 230.0 to SLOAN CANYON 230.0 Circuit 1	P1	N-1	<100	<100	<100	<100	<100	184.41	<100	<100	<100	
	SLOAN CANYON 230-kV Bus Fault	P4	Stuck Breaker	<100	<100	<100	<100	<100	184.36	<100	<100	<100	
Pahrump - Innovation 230kV line	NWEST 230.0 to DESERT VIEW 230.0 Circuit 1	P1	N-1	<100	<100	<100	<100	<100	104.32	<100	<100	<100	
Pahrump - Gamebird 230kV line	NWEST 230.0 to DESERT VIEW 230.0 Circuit 1	P1	N-1	<100	<100	<100	<100	<100	102.66	<100	<100	<100	
Amargosa - Sandy - Gamebird 138kV line	NWEST 230.0 to DESERT VIEW 230.0 Circuit 1	P1	N-1	<100	<100	<100	<100	<100	177.36	<100	<100	<100	
Innovation 230/138kV transformer	NWEST 230.0 to DESERT VIEW 230.0 Circuit 1	P1	N-1	<100	<100	<100	<100	<100	180.82	<100	<100	<100	
	INNOVATION 230.0 to DESERT VIEW 230.0 Circuit 1	P1	N-1	<100	<100	<100	<100	<100	119.43	<100	<100	<100	
Innovation - Desert View 230kV line	Base Case	P0	Base Case	<100	<100	<100	<100	<100	123.84	<100	<100	<100	
	IS TAP 138.0 to MERCRYSW 138.0 Circuit 1	P1	N-1	<100	<100	<100	<100	<100	100.31	<100	<100	<100	
	TROUT CANYON 230.0 to SLOAN CANYON 230.0 Circuit 1	P1	N-1	<100	<100	<100	<100	<100	124.68	<100	<100	<100	
	P4-2-10_SLOAN_CANYON230-kV BRKR	P4	Stuck Breaker	<100	<100	<100	<100	<100	124.53	<100	<100	<100	
Innovation - Mercury SW 138kV	line_1_Line NWEST 230.0 to DESERT VIEW 230.0 Circuit 1	P1	N-1	<100	<100	<100	<100	<100	115.18	<100	<100	<100	
Trout Canyon - Sloan Canyon 230kV	line_1_Line NWEST 230.0 to DESERT VIEW 230.0 Circuit 1	P1	N-1	<100	<100	<100	<100	<100	176.35	<100	<100	<100	
	line_18_Line INNOVATION 230.0 to DESERT VIEW 230.0 Circuit 1	P1	N-1	<100	<100	<100	<100	<100	128.7	<100	<100	<100	

Overloaded Facility	Contingency (All and Worst P6)	Category	Category Description	Loading % (Baseline Scenarios)						Loading % (Sensitivity Scenarios)			Project & Potential Mitigation Solutions
				2023 Summer Peak	2026 Summer Peak	2031 Summer Peak	2023 Spring Off-Peak	2026 Spring Off-Peak	2031 Spring Off-Peak	2023 SP with Forecasted Load Addition	2026 SP with Forecasted Load Addition	2023 OP Heavy Renewable & Min Gas Gen	
Amargosa - Sandy 138kV line	Trout Canyon - Sloan Canyon 230kV line and Northwest - Desert View 230kV line	P6	N-1-1	<100	<100	Diverge	<100	<100	<100	<100	<100	102.38	Monitor load growth in the area; 2nd Pahrump - Trout Canyon - Sloan Canyon 230kV; radialize system after the first contingency; for the overload in sensitivity case, rely on Sloan Canyon RAS
	Trout Canyon - Sloan Canyon 230kV line and Pahrump - Innovation 230kV line	P6	N-1-1	<100	<100	<100	<100	<100	<100	<100	<100	112.11	Sloan Canyon RAS
Amargosa 230/138kV transformer	Gamebird - Pahrump 138kV and Gamebird 230/138kV transformer	P6	N-1-1	107.36	110.95	167.54	<100	<100	<100	131.58	142.56	<100	Radialize system after the first contingency
Pahrump 230/138kV transformer No.1	Pahrump 230/138kV transformer No.2 and Gamebird 230/138kV transformer	P6	N-1-1	<100	<100	118.48	<100	<100	<100	<100	<100	<100	Monitor load growth in the area; utilize the short-term emergency rating of the transformer and perform manual load shedding
Pahrump 230/138kV transformer No.2	Pahrump 230/138kV transformer No.1 and Gamebird 230/138kV transformer	P6	N-1-1	<100	<100	116.9	<100	<100	<100	<100	<100	<100	
Gamebird 230/138kV transformer	Trout Canyon - Sloan Canyon 230kV line and Pahrump - Gamebird 230kV line	P6	N-1-1	<100	<100	<100	<100	<100	<100	<100	<100	125.72	Sloan Canyon RAS
Gamebird - Pahrump 138kV line	Trout Canyon - Sloan Canyon 230kV line and Pahrump - Gamebird 230kV line	P6	N-1-1	<100	<100	<100	<100	<100	<100	<100	<100	101.28	Sloan Canyon RAS
Jackass Flats - Mercury SW 138kV line	Pahrump - Vista 138kV line and Jackass Flats - Stockwash 138kV line	P6	N-1-1	<100	<100	<100	<100	107.8	<100	<100	<100	<100	Generation redispatch following first contingency
	Trout Canyon - Sloan Canyon 230kV line and Pahrump - Innovation 230kV line	P6	N-1-1	<100	<100	106.74	<100	<100	<100	<100	<100	129.4	Monitor load growth in the area; transmission reconfiguration; for the overload in sensitivity case, rely on Sloan Canyon RAS

Low/High Voltage Results

Substation	Contingency (All and Worst P6)	Category	Category Description	Voltage PU (Baseline Scenarios)						Voltage PU (Sensitivity Scenarios)			Project & Potential Mitigation Solutions
				2023 Summer Peak	2026 Summer Peak	2031 Summer Peak	2023 Spring Off-Peak	2026 Spring Off-Peak	2031 Spring Off-Peak	2023 SP with Forecasted Load Addition	2026 SP with Forecasted Load Addition	2023 OP Heavy Renewable & Min Gas Gen	
Gamebird, Pahrump, Innovation, Trout Canyon and Desert View 230kV	Trout Canyon - Sloan Canyon 230kV and Northwest - Desert View 230kV	P6	N-1-1	0.84	>0.9	Diverge	0.85	>0.9	>0.9	0.82	>0.9	>0.9	radialize system after the first contingency; 2nd Pahrump - Trout Canyon - Sloan Canyon 230kV
Charleston, Thousandaire, Pahrump 138kV	Pahrump - Innovation 230kV and Gamebird - Trout Canyon 230kV	P6	N-1-1	0.84	0.84	0.68	>0.9	>0.9	>0.9	0.79	0.77	>0.9	Existing UVLS
Charleston, Thousandaire, Sandy 138kV	Gamebird 230/138kV transformer and Gamebird - Pahrump 230kV line	P6	N-1-1	0.81	0.82	0.74	>0.9	>0.9	>0.9	0.73	0.72	>0.9	

VEA-GLW system



Summary of Potential New Upgrades

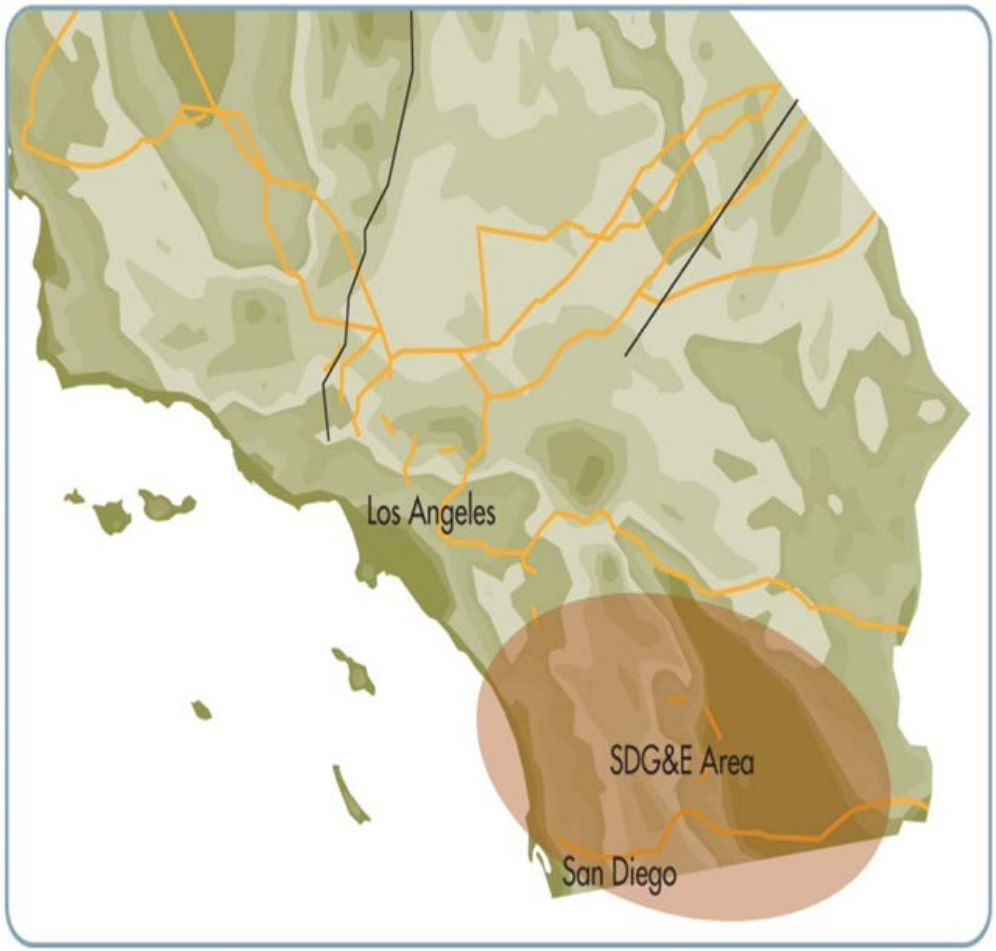
Concern	Potential Upgrade
System divergence following P6 outage of Trout Canyon – Sloan Canyon and Desert View – Northwest 230kV lines	2nd Pahrump – Trout Canyon – Sloan Canyon 230kV line
Multiple normal and P1 overloads in 2031 spring off-peak case	Will evaluate further in policy study for potential upgrade

San Diego Gas & Electric Area
Preliminary Reliability Assessment Results

Amanda Wong
Senior Regional Transmission Engineer

2021-2022 Transmission Planning Process Stakeholder Meeting
September 27-28, 2021

SDG&E Transmission System



- The SDG&E system is comprised of its 500/230 kV main and 138/69 kV sub-transmission systems
- The 500 kV system consists of Southwest Powerlink (SWPL) and Sunrise Powerlink (SRPL)
- Provides energy service to 3.6 million consumers in San Diego and Southern Orange counties

California ISO

SDG&E Area Study Scenarios

- Base scenarios

No.	Case	Description
B1	2023 Summer Peak	Summer peak load time (9/6 HE 19)
B2	2026 Summer Peak	Summer peak load time (9/2 HE 19)
B3	2031 Summer Peak	Summer peak load time (9/4 HE 19)
B4	2023 Spring Off-Peak	Spring off-peak time (5/23 HE 20)
B5	2026 Spring Off-Peak	Spring off-peak time (4/5 HE 13)

- Sensitivity scenarios

No	Case	Change From Base Assumption
S1	2023 Summer Peak	Heavy renewable output and minimum gas generation commitment
S2	2023 Spring Off-Peak	Heavy renewable output and minimum gas generation commitment
S3	2026 Summer Peak	High CEC forecasted load

Load and Load Reduction Assumptions

Study Case	Scenario	Gross Area Load (MW)	AAEE (MW)	BTM-PV (MW)		Net Load (MW)	Demand Response (MW)*	
				Installed Capacity	Output		D1	D2
B1-2023SP	Base	4600	43	492	0	4600	*Information is deemed confidential per SDG&E request*	
B2-2026SP	Base	4711	96	1949	0	4711		
B3-2031SP	Base	4847	176	2667	0	4847		
B4-2023OP	Base	3450	32	492	0	3450		
B5-2026OP	Base	2561	52	2266	1949	612		
S1-2023SP	Sensitivity	4600	43	492	473	4127		
S2-2023OP	Sensitivity	3450	32	492	473	2977		
S3-2026SP	Sensitivity	4711	96	1949	0	4711		

Generation Resource Assumptions

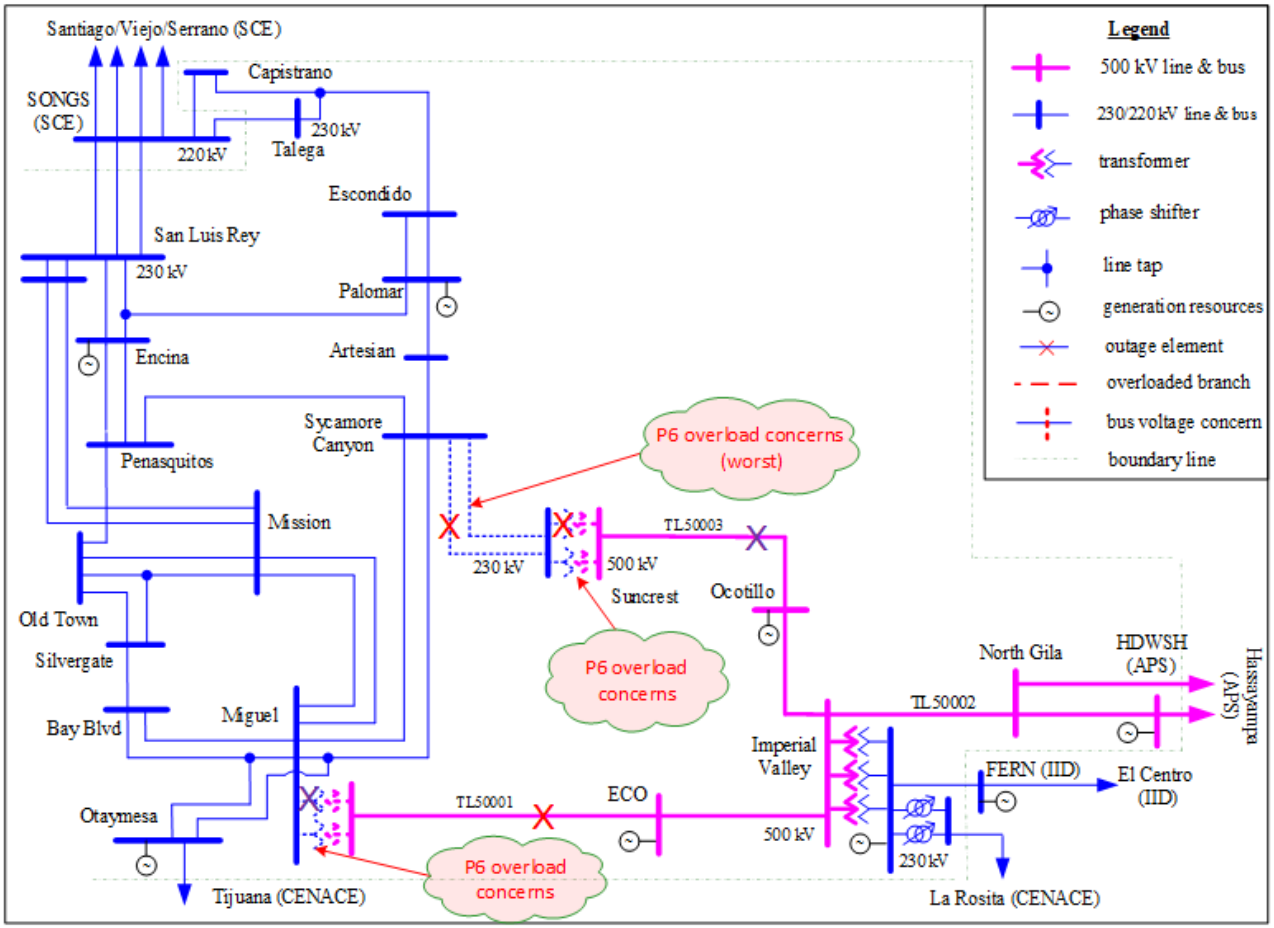
Study Case	Scenario	Energy Storage (MW)		Solar (MW)		Wind (MW)		Thermal (MW)		Pumped Storage Hydro (MW)		Biomass (MW)	
		Installed	Dispatch	Installed	Dispatch	Installed	Dispatch	Installed	Dispatch	Installed	Dispatch	Installed	Dispatch
B1-2023SP	Base	341	0	1479	0	778	257	3713	3343	40	40	0	0
B2-2026SP	Base	341	181	1483	0	778	257	3671	3453	40	40	0	0
B3-2031SP	Base	1515	0	2084	0	1273	425	3671	2449	354	40	0	0
B4-2023OP	Base	341	40	1624	105	623	424	3743	2664	40	0	0	0
B5-2026OP	Base	398	0	1469	814	515	155	3673	219	40	0	0	0
S1-2023SP	Sensitivity	384	0	1479	1561	778	371	3713	1306	40	40	0	0
S2-2023OP	Sensitivity	341	50	1624	1559	623	318	3743	1058	40	0	0	0
S3-2026SP	Sensitivity	341	181	1483	0	778	257	3671	3453	40	40	0	0

Transmission Projects Modeled in Base Cases

Project Name	ISD	First Year Modeled
TL674A Loop-in (Del Mar-North City West) & Removal of TL666D (Del Mar-Del Mar Tap)	Nov-21	2023
Reconductor TL692: Japanese Mesa - Las Pulgas	Dec-21	2023
TL13834 Trabuco-Capistrano 138 kV Line Upgrade	Complete	2023
TL644, South Bay-Sweetwater: Reconductor	Jun-22	2023
2nd Escondido-San Marcos 69 kV T/L	Sep-22	2023
Artesian 230 kV Sub & loop-in TL23051	Jun-22	2023
Rose Canyon-La Jolla 69 kV T/L	Nov-22	2023
TL695B Japanese Mesa-Talega Tap Reconductor	Jun-23	2023
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)	May-23	2023
IID S-Line Upgrade	2023	2023
TL632 Granite Loop-In and TL6914 Reconfiguration	Aug-23	2023
TL690E, Stuart Tap-Las Pulgas 69 kV Reconductor	Mar-27	2031
Reconductor TL 605 Silvergate – Urban	Jun-27	2031
Sweetwater Reliability Enhancement	Dec-27	2031

Reliability Assessment Preliminary Results Summary

SWPL and SRPL



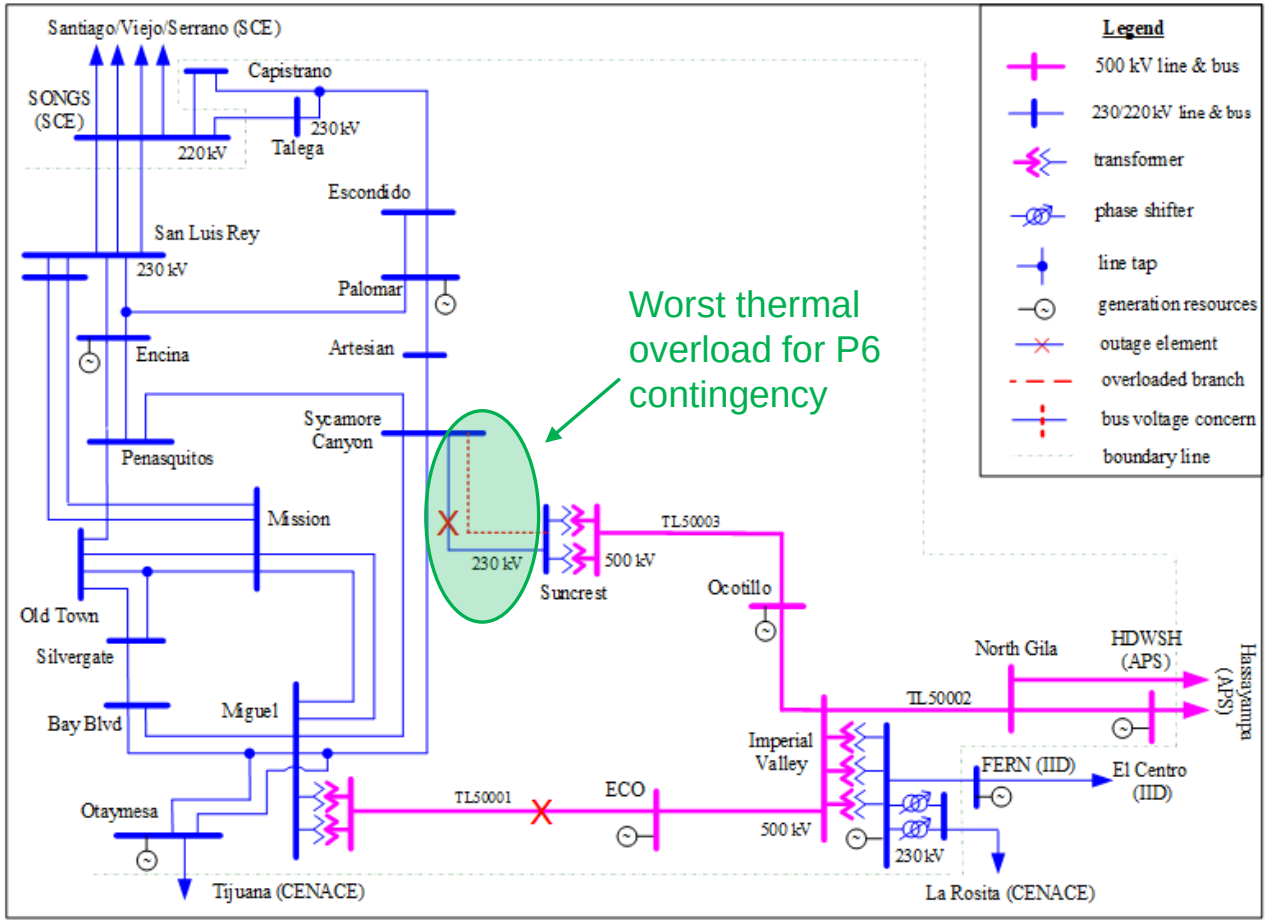
Reliability Concern

- P6 thermal overload concerns on the following SWPL and SRPL facilities:
  - Suncrest – Sycamore Canyon 230 kV lines
  - Suncrest Banks #80 & #81
  - Miguel Banks #80 & #81

Potential Mitigation

- Discussed in the following slides

Suncrest - Sycamore 230 kV lines



Reliability Concern

- Thermal overload as high as 135% to 227%* of normal rating

Potential Mitigation

- Use of the TL23054/23055 RAS
- Rely on system adjustments and operational actions, e.g.
  - Reducing gen output in the greater IV area
  - Dispatching conventional gas gen, preferred resources, energy storage, etc.
  - Curtailing ISO import
  - Adjusting IV PST
  - Bypassing series cap banks in Hassayampa – N. Gila 500 kV lines

*Considering both base and sensitivity scenarios

Thermal Loading Results – Base Scenarios (1)

Overloaded Facility	Contingency	Category	Loading %					Project & Potential Mitigation Solutions
			B1 2023 SP	B2 2026 SP	B3 2031 SP	B4 2023 OP	B5 2026 OP	

228320 SYCAMORE TP1 230 22832 SYCAMORE 230 1 1	PEC_ALL_Gen PEN_CT1/CT2/ST ID 1 AND TL50001_Line ECO-ML 500kV ck 1	P3	104.92	<100	103.74	<100	<100	▪ Use of the TL23054/23055 RAS
								▪ 30-min ratings allows for post-contingency operational mitigations
								▪ Rely on system adjustments and operational actions, e.g.
								  ▪ Reducing gen output in the greater IV area
								  ▪ Dispatching conventional gas gen, preferred resources, energy storage, etc. in the San Diego & SCE areas
								  ▪ Curtailing ISO import
								  ▪ Adjusting IV PST
								  ▪ Bypassing series cap banks in Hassayampa – N. Gila 500 kV lines

	TL50001+GEN_DROP_RAS_Line ECO-ML 500kV ck 1 + GEN DROP RAS AND PEC_ALL_Gen PEN_CT1/CT2/ST ID 1	P3	101.89	<100	<100	<100	<100	
	TL50001_Line ECO-ML 500kV ck 1 AND TL23055_Line SCR-SX 230kV ck 2	P6	176.18	144.8	166.93	134.89	<100	
	TL50001+GEN_DROP_RAS_Line ECO-ML 500kV ck 1 + GEN DROP RAS AND TL23055_Line SCR-SX 230kV ck 2	P6	157.39	115.54	139.58	112.29	<100	

Thermal Loading Results – Base Scenarios (2)

Overloaded Facility	Contingency	Category	Loading %					Project & Potential Mitigation Solutions
			B1 2023 SP	B2 2026 SP	B3 2031 SP	B4 2023 OP	B5 2026 OP	

22886 SUNCREST 230 228860 SUNCREST TP1 230 1 1	TL50001_Line ECO-ML 500kV ck 1 AND PEC_ALL_Gen PEN_CT1/CT2/ST ID 1	P3	113.41	<100	103.99	<100	<100	▪ Use of existing TL23040 IV 500 kV N-1 RAS along with system adjustment after G-1 event
								▪ 30-min short-term emergency ratings of 230 kV lines allows for post-contingency operational mitigations
								▪ Rely on system adjustments and operational actions, e.g.
								  ▪ Reducing gen output in the greater IV area
								  ▪ Dispatching conventional gas gen, preferred resources, energy storage, etc. in the San Diego area
								  ▪ Adjusting IV PST

	TL50001+GEN_DROP_RAS_Line ECO-ML 500kV ck 1 + GEN DROP RAS AND PEC_ALL_Gen PEN_CT1/CT2/ST ID 1	P3	102.1	<100	<100	<100	<100	
	TL50001_Line ECO-ML 500kV ck 1 AND OMEC_ALL_Gen OTAYMGT1/GT2/ST1 ID 1	P3	112.55	<100	<100	<100	<100	
	TL50001+GEN_DROP_RAS_Line ECO-ML 500kV ck 1 + GEN DROP RAS AND OMEC_ALL_Gen OTAYMGT1/GT2/ST1 ID 1	P3	101.25	<100	<100	<100	<100	
	ML8013_ML 8013 CB - BK 80&TL50001	P4	<100	104.55	<100	<100	<100	
	ML8023_ML 8023 CB - BK 81&TL50001	P4	<100	104.55	<100	<100	<100	
	TL50001_Line ECO-ML 500kV ck 1 AND TL23050_Line IV PST-ROA 230kV ck 1	P6	115.46	<100	106.51	<100	<100	
	TL23040_Line OM-TJI 230kV ck 1 AND TL50001_Line ECO-ML 500kV ck 1	P6	<100	<100	104.44	<100	<100	

Thermal Loading Results – Base Scenarios (3)

Overloaded Facility	Contingency	Category	Loading %					Project & Potential Mitigation Solutions
			B1 2023 SP	B2 2026 SP	B3 2031 SP	B4 2023 OP	B5 2026 OP	
22885 SUNCREST 500 22889 SNCRSMP2 500 1 1	TL50001_Line ECO-ML 500kV ck 1 AND SCR_BK80_Tran SCR 500/230kV ck 1	P6	132.27	109.16	126.28	103.26	<100	▪ 30-min short-term emergency ratings of Suncrest banks allows for post-contingency operational mitigations ▪ Rely on system adjustments and operational actions, e.g. ▪ Reducing gen output in the greater IV area ▪ Dispatching conventional gas gen, preferred resources, energy storage, etc. in the San Diego & SCE areas ▪ Curtailing ISO import ▪ Adjusting IV PST ▪ Bypassing series cap banks in Hassayampa – N. Gila 500 kV lines
	TL50001+GEN_DROP_RAS_Line ECO-ML 500kV ck 1 + GEN DROP RAS AND SCR_BK80_Tran SCR 500/230kV ck 1	P6	119.36	<100	106.18	<100	<100	
22885 SUNCREST 500 22888 SNCRSMP1 500 1 1	TL50001_Line ECO-ML 500kV ck 1 AND SCR_BK81_Tran SCR 500/230kV ck 2	P6	132.2	109.08	126.24	103.11	<100	
	TL50001+GEN_DROP_RAS_Line ECO-ML 500kV ck 1 + GEN DROP RAS AND SCR_BK81_Tran SCR 500/230kV ck 2	P6	119.3	<100	106.12	<100	<100	

Thermal Loading Results – Base Scenarios (4)

Overloaded Facility	Contingency	Category	Loading %					Project & Potential Mitigation Solutions
			B1 2023 SP	B2 2026 SP	B3 2031 SP	B4 2023 OP	B5 2026 OP	

22468 MIGUEL 500 22472 MIGUELMP 500 1 1 AND 22464 MIGUEL 230 22472 MIGUELMP 500 1 1	OMEC_ALL_Gen OTAYMGT1/GT2/ST1 ID 1 AND ML_BK81_Tran ML 500/230kV ck 2	P3	101.32	<100	<100	<100	<100	▪ 30-min short-term emergency ratings of Miguel banks allows for post-contingency operational mitigations
								▪ Use of existing Miguel BK 80/81 RAS
								▪ Rely on system adjustments and operational actions, e.g.
								  ▪ Reducing gen output in the greater IV area
								  ▪ Dispatching conventional gas gen, preferred resources, energy storage, etc. in the San Diego & SCE areas
								  ▪ Curtailing ISO import
								  ▪ Adjusting IV PST
								  ▪ Bypassing series cap banks in Hassayampa – N. Gila 500 kV lines

	PEC_ALL_Gen PEN_CT1/CT2/ST ID 1 AND ML_BK81_Tran ML 500/230kV ck 2	P3	<100	<100	101.79	<100	<100	
	TL50003_Line OCO-SCR 500kV ck 1 AND ML_BK81_Tran ML 500/230kV ck 2	P6	140.67	106.66	137.8	108.44	<100	
	TL50003+GEN_DROP_RAS_Line OCO-SCR 500kV ck 1 + GEN DROP RAS AND ML_BK81_Tran ML 500/230kV ck 2	P6	119.76	<100	115.86	<100	<100	
22464 MIGUEL 230 22468 MIGUEL 500 2 1	TL50003_Line OCO-SCR 500kV ck 1 AND ML_BK80_Tran ML 500/230kV ck 1	P6	134.49	104.89	135.51	105.64	<100	
	TL50003+GEN_DROP_RAS_Line OCO-SCR 500kV ck 1 + GEN DROP RAS AND ML_BK80_Tran ML 500/230kV ck 1	P6	117.75	<100	113.98	<100	<100	

Thermal Loading Results – Base Scenarios (5)

Overloaded Facility	Contingency	Category	Loading %					Project & Potential Mitigation Solutions
			B1 2023 SP	B2 2026 SP	B3 2031 SP	B4 2023 OP	B5 2026 OP	
22609 OTAYMESA 230 20149 TJI-230 230 1 2	TL23041_Line SX-OM-ML 230kV ck 1 AND TL23042_Line BB-OM-ML 230kV ck 1	P6	108.09	122.2	<100	<100	<100	▪ Use of existing 230kV Otay Mesa Gen Drop RAS ▪ Rely on system adjustments and operational actions, e.g. ▪ Reducing gen output in the greater IV area ▪ Dispatching conventional gas gen, preferred resources, energy storage, etc. in the San Diego area ▪ Adjusting IV PST
	TL50003_Line OCO-SCR 500kV ck 1 AND TL50001_Line ECO-ML 500kV ck 1	P6	<100	<100	114.8	<100	<100	

Thermal Loading Results – Base Scenarios (6)

Overloaded Facility	Contingency	Category	Loading %					Project & Potential Mitigation Solutions
			B1 2023 SP	B2 2026 SP	B3 2031 SP	B4 2023 OP	B5 2026 OP	
22430 SILVERGT 230 22596 OLD TOWN 230 1 1	TL23028_Line SG-MS-OT 230kV ck 1 AND TL23071_Line SX-PQ 230kV ck 1	P6	<100	109.82	<100	102.37	<100	▪ 2-hr short-term emergency ratings of TL23036, TL23028A, and TL23029 allows for post-contingency operational mitigations ▪ Rely on system adjustments and operational actions, e.g. ▪ Reducing gen output ▪ Charging energy storage in the Otay Mesa area ▪ Dispatching gen resources in northern San Diego area and/or the SCE LA Basin ▪ Curtailing import from CENACE
	TL23028_Line SG-MS-OT 230kV ck 1 AND TL50003_Line OCO-SCR 500kV ck 1	P6	<100	107.8	<100	100.51	<100	
22430 SILVERGT 230 22597 OLDTWNTP 230 1 1	TL23029_Line SG-OT 230kV ck 1 AND TL23071_Line SX-PQ 230kV ck 1	P6	<100	108.93	<100	101.56	<100	
	TL23029_Line SG-OT 230kV ck 1 AND TL50003_Line OCO-SCR 500kV ck 1	P6	<100	107.72	<100	100.46	<100	

Thermal Loading Results – Base Scenarios (7)

- Existing 500 kV gen drop RAS observed to contribute to overloads on 161 kV lines in the IID system

Overloaded Facility	Contingency	Category	Loading %					Project & Potential Mitigation Solutions
			B1 2023 SP	B2 2026 SP	B3 2031 SP	B4 2023 OP	B5 2026 OP	
21072 YUCCA161 161 21059 PILOTKNB 161 1 1	TL50002_Line NG-IV 500kV ck 1 AND TL50001+GEN_DROP_RAS_Line ECO-ML 500kV ck 1 + GEN DROP RAS	P6	120.58	133.99	100.14	<100	<100	Review RAS actions for existing 500kV TL 50001 Gen Drop RAS. Generation dropped by the RAS makes this loading worse.
21331 ELCENTSW 161 21059 PILOTKNB 161 1 1	TL50002_Line NG-IV 500kV ck 1 AND TL50003+GEN_DROP_RAS_Line OCO-SCR 500kV ck 1 + GEN DROP RAS	P6	144.53	125.06	122.3	<100	<100	Review RAS actions for existing 500kV TL 50003 Gen Drop RAS. Generation dropped by the RAS makes this loading worse.

Thermal Loading Results – Sensitivity Scenarios (1)

- Additional contingencies contribute to overloading the same facilities discussed in the previous slides
- Potential mitigation solutions are expected to be the same as those identified for the base scenario

Overloaded Facility	Contingency	Category	Loading %		
			S3 2026 SP	S1 2023 SP	S2 2023 OP
22886 SUNCREST 230 228860 SUNCREST TP1 230 1 1	TL50001_Line ECO-ML 500kV ck 1	P1	<100	115.47	101.94
	ML7013_ML 7013 CB - BK 80&81	P4	<100	115.23	102.46
	ECO-500-4T_CB EAST COUNTY 500KV 4T	P4	<100	111.7	<100
22885 SUNCREST 500 22889 SNCRSMP2 500 1 1	SCR_BK80_Tran SCR 500/230kV ck 1	P1	<100	102.13	<100
22885 SUNCREST 500 22888 SNCRSMP1 500 1 1	SCR_BK81_Tran SCR 500/230kV ck 2	P1	<100	102.13	<100
22468 MIGUEL 500 22472 MIGUELMP 500 1 1 AND 22464 MIGUEL 230 22472 MIGUELMP 500 1 1	ML_BK81_Tran ML 500/230kV ck 2	P1	<100	141.23	<100
	TL50003_Line OCO-SCR 500kV ck 1	P1	<100	119.09	<100
	OCO-500-2W_CB OCOTILLO 500KV 2W	P4	<100	117.86	<100
	ML-230-2T_CB MIGUEL 230KV 2T	P4	<100	140.89	<100
	ML-2T_MIGUEL 230 kV 2T CB	P4	<100	140.89	<100
22464 MIGUEL 230 22468 MIGUEL 500 2 1	ML_BK80_Tran ML 500/230kV ck 1	P1	<100	138.42	<100

Thermal Loading Results – Sensitivity Scenarios (2)

- Reliability concerns observed in the sensitivity scenarios, but not in the base scenarios

Overloaded Facility	Contingency	Category	Loading %			Project & Potential Mitigation Solutions
			S3 2026 SP	S1 2023 SP	S2 2023 OP	
22930 ECO 500 22468 MIGUEL 500 1 2	OCO-500-1E_CB OCOTILLO 500KV 1E	P4	<100	116.97	<100	▪ Use of existing TL23040 IV 500 kV N-1 RAS to eliminate P4 and P7 overload concerns ▪ Rely on system adjustments to eliminate P6 overload
	SCR-2T_SUNCREST 2T BK81 & TL50003	P4	<100	118.03	<100	
	SCR-500-2T_CB SUNCREST 500KV 2T	P4	<100	118.03	<100	
	TL23050_Line IV PST-ROA 230kV ck 1 AND TL50003_Line OCO-SCR 500kV ck 1	P6	<100	136.1	<100	
	TL23054+23055_Lines SCR-SX 230kV ck 1 + SCR-SX 230kV ck 2	P7	<100	117.38	<100	
22356 IMPRLVLY 230 22362 IV BK82 MP 500 1 1	IV_BK81_Tran IV 500/230kV ck 2 AND IV_BK80_Tran IV 500/230kV ck 1	P6	<100	128.19	107.62	Curtail generation delivered to the Imperial Valley 230 kV substation after 1st contingency as system adjustment

Voltage Concerns in Sensitivity Scenarios (1)

- Low voltages observed for the sensitivity scenarios with heavy renewables & minimum gas generation

Substation	Contingency	Category	Voltage PU		Project & Potential Mitigation Solutions
			S1 2023 SP	S2 2023 OP	
VALCNTR 69 kV	TL681_Line AS-VC-FE 69kV ck 1	P1	>0.9	0.87	System adjustments, such as increasing dispatch of existing gas generation.
	TL0681B_TL0681B ASH TP-VALCNTR ck 1	P2.1	>0.9	0.87	
	PEC_ALL_Gen PEN_CT1/CT2/ST ID 1 AND TL681_Line AS-VC-FE 69kV ck 1	P3	>0.9	0.87	
Q1191_HV 69 kV	TL681_Line AS-VC-FE 69kV ck 1	P1	>0.9	0.87	System adjustments, such as increasing dispatch of existing gas generation.
	TL0681B_TL0681B ASH TP-VALCNTR ck 1	P2.1	>0.9	0.87	
	PEC_ALL_Gen PEN_CT1/CT2/ST ID 1 AND TL681_Line AS-VC-FE 69kV ck 1	P3	>0.9	0.87	
RINCON 69 kV	PEC_ALL_Gen PEN_CT1/CT2/ST ID 1 AND TL681_Line AS-VC-FE 69kV ck 1	P3	>0.9	0.90	System adjustments, such as increasing dispatch of existing gas generation, after first contingency
SUNCREST TP1 230 kV	TL23050_Line IV PST-ROA 230kV ck 1 AND TL50004_Line IV-ECO 500kV ck 1	P6	0.86	>0.9	System adjustments, such as increasing dispatch of existing gas generation, after first contingency
SUNCREST TP2 230 kV	TL23050_Line IV PST-ROA 230kV ck 1 AND TL50004_Line IV-ECO 500kV ck 1	P6	0.86	>0.9	
SYCAMORE TP1 230 kV	TL23050_Line IV PST-ROA 230kV ck 1 AND TL50004_Line IV-ECO 500kV ck 1	P6	0.86	>0.9	
SYCAMORE TP2 230 kV	TL23050_Line IV PST-ROA 230kV ck 1 AND TL50004_Line IV-ECO 500kV ck 1	P6	0.86	>0.9	
SNCRS SVC HV 230 kV	TL23050_Line IV PST-ROA 230kV ck 1 AND TL50004_Line IV-ECO 500kV ck 1	P6	0.87	>0.9	

Voltage Concerns in Sensitivity Scenarios (2)

- Voltage deviation observed for the sensitivity scenarios with heavy renewables & minimum gas generation

Substation	Contingency	Category	Post Cont. Voltage Deviation %		Project & Potential Mitigation Solutions
			S1 2023 SP	S2 2023 OP	
VALCNTR 69 kV	TL681_Line AS-VC-FE 69kV ck 1	P1	<8	11.03	System adjustments, such as increasing dispatch of existing gas generation.
	TL0681B_TL0681B ASH TP-VALCNTR ck 1	P2.1	<8	11.03	
	PEC_ALL_Gen PEN_CT1/CT2/ST ID 1 AND TL681_Line AS-VC-FE 69kV ck 1	P3	<8	10.91	
Q1191_HV 69 kV	TL681_Line AS-VC-FE 69kV ck 1	P1	<8	11.01	System adjustments, such as increasing dispatch of existing gas generation.
	TL0681B_TL0681B ASH TP-VALCNTR ck 1	P2.1	<8	11.01	
	PEC_ALL_Gen PEN_CT1/CT2/ST ID 1 AND TL681_Line AS-VC-FE 69kV ck 1	P3	<8	10.89	
RINCON 69 kV	PEC_ALL_Gen PEN_CT1/CT2/ST ID 1 AND TL681_Line AS-VC-FE 69kV ck 1	P3	<8	8.57	System adjustments, such as increasing dispatch of existing gas generation, after first contingency
SUNCREST TP1 230 kV	TL23050_Line IV PST-ROA 230kV ck 1 AND TL50004_Line IV-ECO 500kV ck 1	P6	14.88	<8	System adjustments, such as increasing dispatch of existing gas generation, after first contingency
SUNCREST TP2 230 kV	TL23050_Line IV PST-ROA 230kV ck 1 AND TL50004_Line IV-ECO 500kV ck 1	P6	14.88	<8	
SYCAMORE TP1 230 kV	TL23050_Line IV PST-ROA 230kV ck 1 AND TL50004_Line IV-ECO 500kV ck 1	P6	14.65	<8	
SYCAMORE TP2 230 kV	TL23050_Line IV PST-ROA 230kV ck 1 AND TL50004_Line IV-ECO 500kV ck 1	P6	14.65	<8	
SNCRS SVC HV 230 kV	TL23050_Line IV PST-ROA 230kV ck 1 AND TL50004_Line IV-ECO 500kV ck 1	P6	15.01	<8	

Transient Stability Analysis

- Performed for B2, B3, B4, S2, S3 cases
- 49 credible contingencies evaluated
  - Includes P1, P2.2, P5.5, P7
- No WECC criteria violations were observed

2021-2022 TPP PSPS/Wildfire Impact Assessment Study Scope – Southern California

David Le
Senior Advisor Regional Transmission Engineer

Frank Chen
Lead Regional Transmission Engineer

2021-2022 Transmission Planning Process Stakeholder Meeting
September 27-28, 2021

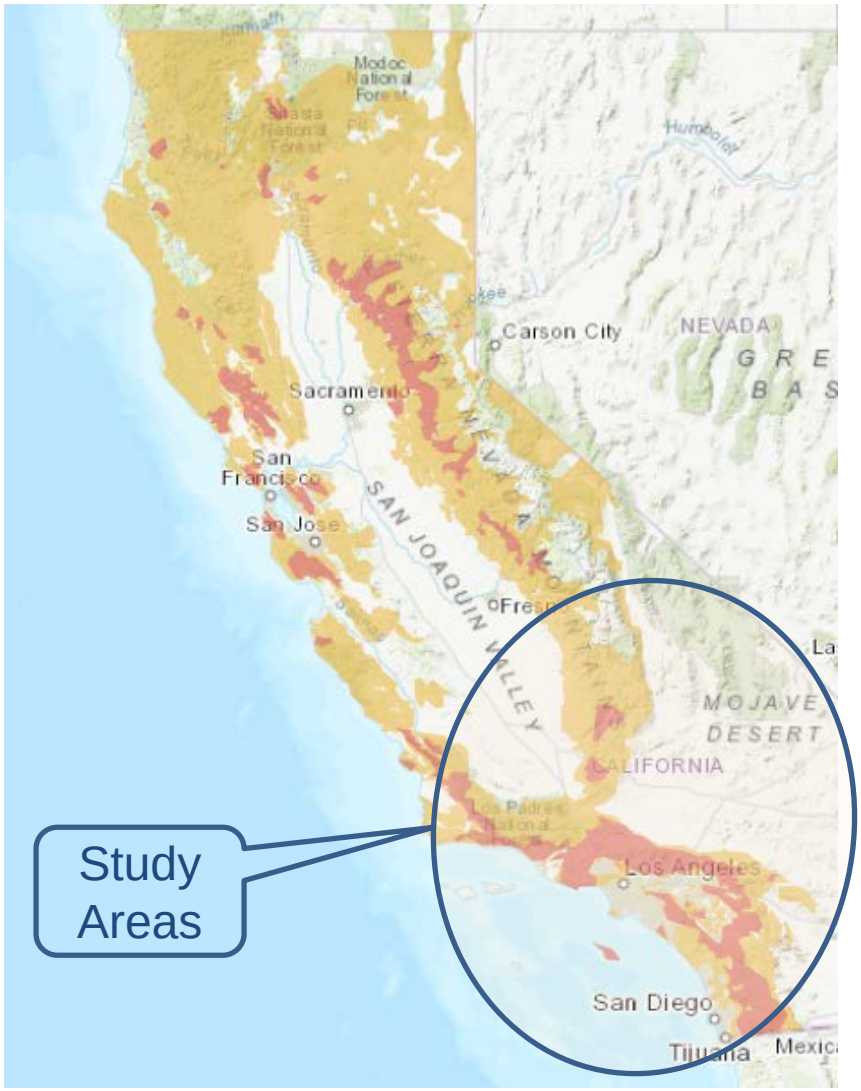
Study scope and objective

- The 2021-2022 TPP study scope includes assessment for SCE and SDG&E service territories only. The assessment includes the following:
  - gathering information regarding fire risk areas and facilities.
  - developing PSPS scenarios with different combinations of transmission lines de-energized.
  - assessing direct and indirect load impact for each scenario.
  - developing potential mitigation solution

- The objective of the assessment is to study different scenarios to provide insight into the potential range of load impacts if different combinations of transmission lines within fire threat zones are included in the scope of PSPS event.

Wildfire related information

- Transmission system overlaid with fire zones
  - Facilities in Tier 2 (elevated) and 3 (extreme) fire zones
- Major wildfires that have occurred
- PSPS or fire events in 2019 or 2020



Map source: https://ia.cpuc.ca.gov/firemap/

Scenario development

- Scenarios were developed by working with SCE and SDG&E and reviewing historical data
  - when PSPS events occurred or identified to be likely to occur and identifying facilities that were de-energized or flagged to be de-energized based on forecasted conditions
  - actual fire events and identifying facilities that were de-energized
- Tier-2 or tier-3 fire zone maps were also referenced
- Localized scenarios and wide-area scenarios were developed

Study Approach

Starting base case

- The study is performed area-by-area for SCE and SDG&E areas consistent with the studies performed within reliability assessment.
- The 2026 local area summer peak base case and off-peak case are used as a starting case, depending on the specific PSPS or wildfire scenario.

PSPS/Wildfire scenario

- Each scenario is applied to the starting case one at a time
- Specific facilities within the PSPS or Wildfire study scope is de-energized concurrently

Base case with PSPS/Wildfire

- Report load isolated due to application of PSPS/Wildfire event study scope (direct load impact)
- Check for any normal overloads or voltage issues
- Mitigate base case issues with generation re-dispatch, system reconfiguration via operational mitigations or load drop (indirect load impact)

Contingency analysis

- Perform N-1 contingency analysis on the clean PSPS/Wildfire event base case
- Report post contingency system performance
- Develop potential mitigations. If the mitigation involves load drop, report as indirect load impact

Potential mitigation development

- Identify critical facilities in each local areas for potential to reduce risk of fire impact
  - Coordinate with PTOs on existing wildfire mitigation plan
- Identify active CAISO approved projects that could potentially reduce risk of fire impact
  - Identify opportunities to expedite implementation of active projects that could help alleviate identified issues
  - Identify opportunities for minor scope change of active projects that could help alleviate identified issues
- Identify potential new upgrades that could help reduce risk of fire impact

Study Scenarios for SDG&E Service Territory

	Scenario Description	Wildfire Event?	PSPS Event?	500kV	230kV	138kV	69kV	Study Base Cases
1	SDG&E 2007 fire event	√		√	√	√	√	Summer 2026 partial peak (*October peak*)
2	Eastern 69kV PSPS event		√				√	Spring 2023 off-peak
3	Southeastern fire event	√		√	√		√	Summer 2026 peak
4	Northern and Southeastern localized PSPS event		√		√		√	Summer 2026 peak
5	Various Eastern 69kV lines PSPS event		√				√	Spring 2023 off-peak
6	Various Eastern 69kV lines PSPS event (different than event #5)		√				√	Spring 2023 off-peak
7A	Bond fire scenario #1 (joint SCE/SDG&E event)	√		√	√			Spring 2023 off-peak
7B	Bond fire scenario #2 (joint SCE/SDG&E event)	√		√	√			Spring 2023 off-peak

Study Scenarios for SCE Service Territory

Scenario ID	Scenario Description	Wildfire Event?	Potential PSPS Event?	500 kV	230 kV	Study Base Cases
1	Ventura PSPS Event		√		√	Spring 2023 off-peak
2	Ventura and Los Angeles PSPS Event		√		√	Spring 2023 off-peak
3	Kern Localized PSPS Event		√	√	√	Spring 2023 off-peak
4	San Bernardino & Orange PSPS Event		√	√	√	Summer 2026 peak
5	Los Angeles PSPS Event		√	√	√	Summer 2026 peak
6	San Bernardino PSPS Event		√		√	Summer 2026 peak
7	SCE Main System Wide PSPS Event		√	√	√	Spring 2023 off-peak
8	Big Creek Fire Scenario	√			√	Summer 2026 peak
9	Bond Fire Scenario (Joint SCE/SDG&E Event)	√	√	√	√	Spring 2023 off-peak

20 Year Transmission Outlook
SB100 Starting Point Scenario

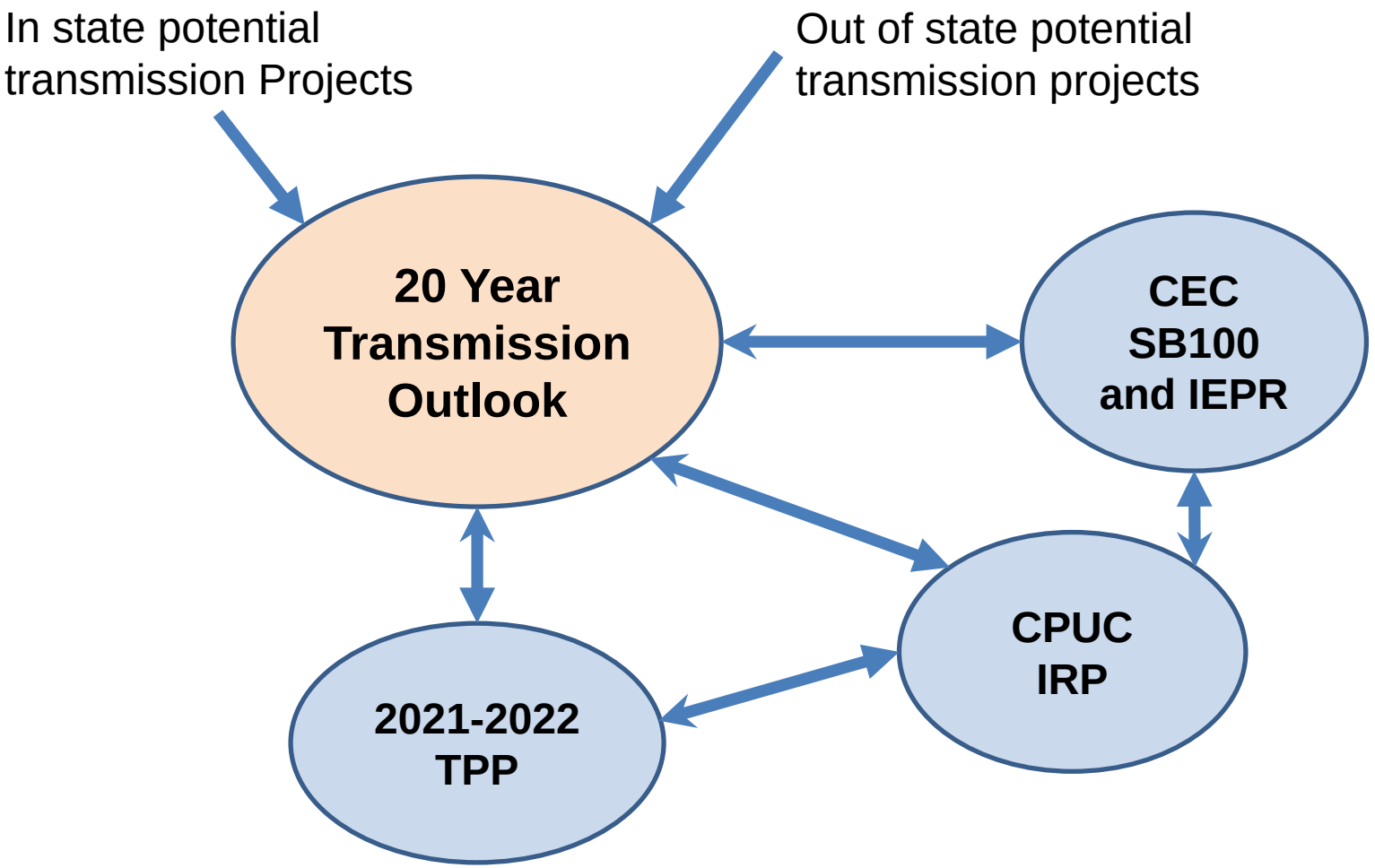
Jeff Billinton
Director, Transmission Infrastructure Planning

2021-2022 Transmission Planning Process Stakeholder Meeting
September 27-28, 2020

The 20-year transmission outlook initiative will be coordinated with 2021-2022 transmission planning process

- The Outlook will include higher level technical studies to test feasibility of alternatives, and not the detailed level of comprehensive analysis that underpins the 10-Year Transmission Plan
- Accordingly the Outlook will coordinate with currently scheduled 10-Year Transmission Plan stakeholder sessions to the extent possible, and hold separate stakeholder sessions as appropriate.
- Coordination with the California Energy Commission SB100 and California Public Utilities Commission IRP
- The process welcomes and will incorporate stakeholder input and consultation.

Primary Paths for Coordination with Other Initiatives



SB 100 Starting Point for the CAISO 20-year Transmission Outlook

- The Starting Point scenario, based on the SB 100 Report, is for CAISO's use as the basis for the 20-year outlook process.
- The Starting Point scenario is largely based on the 2021 SB 100 Report Core scenario (SB 100 Core) but draws from other scenarios in the 2021 SB 100 Report as well.
- Intended to provide an immediately useful starting point for the CAISO in its 20-year outlook.
- The use of the Starting Point scenario for the 20-year outlook is not a commitment to the resource and storage mix included in the scenario.
    - Instead, the energy agencies intend to continue to consider a range of scenarios in forthcoming reliability assessments and stakeholder work on resource build requirements.
- The Starting Point scenario is informational only and should not be used, in itself, to support approval of near-term infrastructure

https://efiling.energy.ca.gov/GetDocument.aspx?tn=239685&DocumentContentId=73101

Starting Point scenario portfolio of resources

- The following table compares the SB 100 Core scenario for 2040 with the Starting Point scenario to be used in the CAISO's 20 year transmission outlook

Table 2: Comparison of 2040 SB 100 Core and Starting Point Scenario

Resource Type	2040 SB 100 Core Scenario (MW)	2040 Starting Point Scenario (MW)
Natural gas fired power plants	(4,722)	(15,000)
Battery energy storage	32,093	37,000
Long duration energy storage	4,000	4,000
Utility-scale solar	53,212	53,212
In-state wind	2,237	2,237
Offshore wind	5,256	10,000
Out of state wind	10,315	12,000
Geothermal	135	2,332

Source: RESOLVE Model results viewer, SB 100 joint-agency model: https://www.energy.ca.gov/sb100

https://efiling.energy.ca.gov/GetDocument.aspx?tn=239685&DocumentContentId=73101

Natural gas fired power plant retirement

- The Starting Point scenario includes an assumption that 15,000 MW of natural gas power plant capacity would be retired by 2040

- The Starting Point scenario indicates the CAISO should assume:
  - that the oldest natural gas power plants retire first, with a priority on those that are in and adjacent to disadvantaged communities (DAC)
    - Disadvantaged communities are defined and identified by the California Office of Environmental Health Hazard Assessment and are available in the CalEnviroScreen 3.0 webtool at: https://oehha.ca.gov/calenviroscreen/report/calenviroscreen-30.
    - For purposes of this Starting Point scenario a DAC adjacent community is within a 2.5 mile radius of a natural gas power plant.
  - that at least 3,000 MW of the 15,000 MW of retirements are assigned to gas power plants that rely on the Aliso Canyon storage facility as provided by the agencies, with a priority on the oldest power plants and those that are in and adjacent to DACs.
    - The agencies have identified 3,000 MW which is between the range identified in the CPUC September 15, 2021: 2027 and 2035 Shortfall Memo.

Natural gas fired power plant retirement *(continued)*

- For the 20 year outlook, the CAISO will assess approximately 15,000 MW of gas-fired generation retired in the CAISO system

- There is approximately 2,000 MW of gas-fired generation connected to the CAISO system that rely on the Aliso Canyon storage facility as provided by the agencies

  – The agencies also identified approximately 2,000 MW of gas-fired generation connected outside of the CAISO system that rely on the Aliso Canyon storage facility

Natural gas fired power plant retirement *(continued)*

- Applying the age, DAC and DAC adjacent criteria with the 2000 MW of gas-fired generation in the CAISO system relying on Aliso Canyon, the following is retirement of gas-fired generation by local capacity area:

Local Capacity Area	Capacity (MW)
Greater Bay Area	4427
Sierra	153
Stockton	361
Fresno	669
Kern	407
LA Basin	3,632
Big Creek-Ventura	695
San Diego-IV	131
CAISO System	3,933
Total	**14,408**

Natural gas fired power plant retirement
Outside CAISO system as identified by the agencies

- There is approximately the following gas-fired generation outside CAISO identified in DAC and DAC 2.5 adjacent:
  - 3.8 GW within DAC
  - 0.6 GW within DAC 2.5 adjacent

- There is also approximately the following gas-fired generation outside CAISO identified as being Aliso Canyon dependent:
  - 2.0 GW
    - All are within DAC or DAC 2.5 adjacent

Battery energy storage

- The approach used for assigning battery energy storage to transmission zones for the 20-year outlook draws on the approach applied to battery energy storage in the CPUC's IRP process for the CAISO's 2021-2022 transmission planning process.

- The 37,000 MW of selected battery energy storage is allocated as follows:

  - 9,368 MW of battery storage already allocated in the IRP resource portfolio for the 2021-2022 TPP base case is carried over without any changes.
  - The remaining battery energy storage will be allocated by expanding upon the approach from the 2021-2022 TPP base case:
    - Co-locate in transmission zones where renewable resources are concentrated.
    - Allocate battery storage based on system needs identified in the study.

Long duration energy storage

- The 4,000 MW of long-duration energy storage in the SB 100 Core scenario will be allocated by building off the current 2021-2022 transmission planning process base case as well as current commercial interest.

- The 4,000 MW of LDES will be allocated by:
  - 627 MW of pumped hydroelectric already mapped in the IRP resource portfolio for the 2021-2022 TPP base case.
  - 2,400 MW of pumped hydroelectric as described in the current CAISO interconnection queue.
  - 1,600 MW of location unconstrained LDES that is unassigned should be assigned to transmission zones based on a combination of geologic and technological factors and system needs.

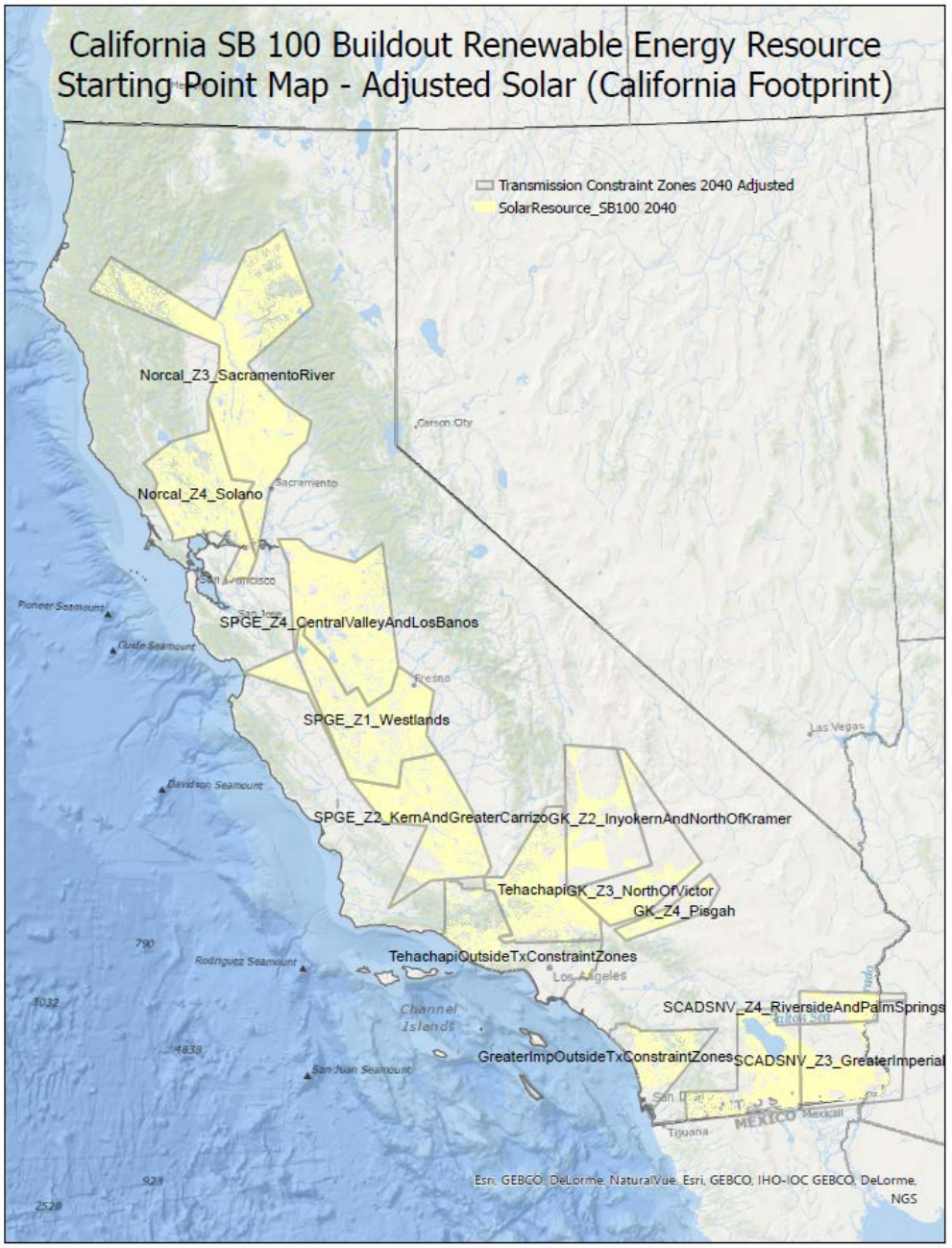
Utility-scale solar

- The Starting Point scenario utilizes known commercial interest to allocate solar development to transmission zones rather than carrying forward the allocations made by the RESOLVE model

- The CEC utilized a high-level environmental screen to assess whether the commercial interest allocation had resulted in a clearly disproportionate assignment of solar build out to any of the transmission zones relative to the availability of “lower implication” land in each zone

SB100 Starting Point Solar in Transmission Zones

- Figures shows the in-state transmission zones as a starting point for where solar might be developed based on the re-allocation of solar based on commercial interest.



Utility-scale solar

The SB100 Starting Point scenario identified 53,212 MW of solar capacity in the following transmission zones.

Resource	Transmission Zone	Capacity (MW)
Greater_Imperial_Solar	SCADSNV_Z3_GreaterImperial	6,407
Inyokern_North_Kramer_Solar	GK_Z2_InyokernAndNorthOfKramer	2,162
Kern_Greater_Carrizo_Solar	SPGE_Z2_KernAndGreaterCarrizo	6,154
North_Victor_Solar	GK_Z3_NorthOfVictor	674
Sacramento_River_Solar	Norcal_Z3_SacramentoRiver	998
Solano_Solar	Norcal_Z4_Solano	169
Tehachapi_Solar	Tehachapi	9,544
Westlands_Solar	SPGE_Z1_Westlands	12,655
Pisgah_Solar	GK_Z4_Pisgah	674
RiversideAndPalmSprings Solar	RiversideAndPalmSprings	4,922
CentralValleyAndLos Banos Solar	CentralValleyAndLosBanosSolar	1,079
Tehachapi Outside of Constraint Zones	Tehachapi Outside of Constraint Zones	2,066
Greater ImpOutside Constraint Zones		995
Mountain_Pass_El_Dorado_Solar	Mountain_Pass_El_Dorado	248
Southern_Nevada_Solar	SCADSNV-GLW_VEA	2,024
Arizona_Solar	SCADSNV-Riverside_Palm_Springs	2,352

In-state wind

- In the SB 100 Core scenario, the RESOLVE model selects all of the available in-state wind resource potential.

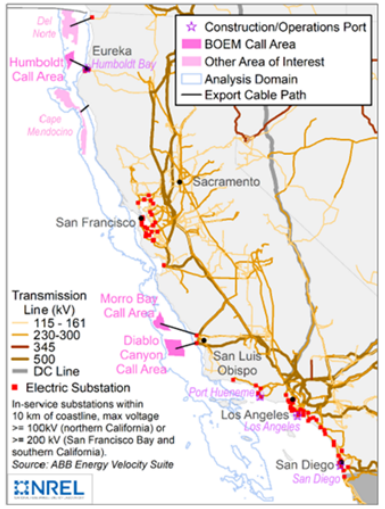
- As indicated in the Starting Point on, RESOLVE selects 2,237 MW, which is similar to the 1,981 MW included in the CPUC IRP portfolios being studied in the 2021-2022 TPP base case.

Offshore wind

- In the Starting Point scenario 10,000 MW of offshore wind energy identified which is consistent with other SB 100 scenarios.
- Within the 2021-2022 TPP the CAISO is studying offshore wind energy as a sensitivity and in an outlook study.
- As presented in CAISO July 27 stakeholder call.

Coordination with 2021-2022 TPP Policy Sensitivity 2 on Offshore Wind Portfolio

- Sensitivity 2 includes the following OSW resources:
  - Humboldt: 1.6 GW
  - Diablo Canyon: 4.3 GW
  - Morro Bay: 2.4 GW
- Detailed studies will be performed to identify the transmission needs for the above 8.3 GW
- In addition, an outlook assessment will be performed to accommodate an additional 12.8 GW of offshore wind (totaling 21.1 GW)
  - Del Norte: 6.6 GW
  - Cape Mendocino: 6.2 GW



Source: The Cost of Floating Offshore Wind Energy in California Between 2019 and 2032 (nrel.gov) (Page 39)

California ISO

Page 10

California ISO Public

Out of state wind

- Starting Point scenario has 12,000 MW
  - On new transmission
    - Wyoming 4,685 MW
    - New Mexico 5,215 MW
  - On existing transmission
    - Northwest 1,500 MW
    - Baja California 600 Mw

- At the July 22, 2021 CEC SB100 workshop a number of projects were identified that could bring out of state wind power to CAISO system
  https://efiling.energy.ca.gov/GetDocument.aspx?tn=238965&DocumentContentId=72387
  - The identified transmission development projects could provide for a portion of the transmission required to access 12,000 MW of out of state wind resources
  - Additional transmission either to the border of the CAISO system or to interconnection points within the CAISO will likely be required

Geothermal

- The Starting Point scenario the CAISO identified 2,332 MW of geothermal resources in 2040

- As a starting point for the 20-year outlook, and to more fully understand the ability for geothermal to scale in and around the Salton Sea region the agencies allocated most (2,012 MW), but not all, of the geothermal capacity to the Imperial transmission zone

  – With the remainder of the geothermal capacity (320 MW) identified in the southern Nevada area

Next Steps

- The CAISO will start developing study case to conduct high level assessment based upon the SB100 Starting Point scenario

- Assigning resources identified in the SB100 Starting Point scenarios as identified in transmission zones to locations of the CAISO bulk transmission system for assessment

20 Year Transmission Outlook Milestones

- Stakeholder call initiating Outlook on May 14
  - Comments to be submitted by May 28
- Coordination with CEC workshops on SB100
  - SB 100 Workshop on June 2
  - SB100 Workshop – Transmission Projects on July 22
  - SB100 Workshop – Land use / Resource Mapping in August
- Stakeholder call – Transmission Planning Update on July 27
  - Comments to be submitted by August 10
- Update at 2021-2022 TPP Stakeholder call on September 27 and 28
  - Comments to be submitted by October 12
- Update at 2021-2022 TPP Stakeholder call on November 18
  - Comments to be submitted by December 6
- Draft 20 Year Transmission Outlook as standalone document together with draft 2021-2022 Transmission Plan to be posted on January 31, 2022
- Stakeholder meeting in February

Agenda
Reliability Assessment and Study Updates

Isabella Nicosia
Stakeholder Engagement and Policy Specialist

2021-2022 Transmission Planning Process Stakeholder Meeting
September 27-28, 2021

2021-2022 Transmission Planning Process Stakeholder Call – Agenda

Topic	Presenter
Day 1 – September 27	
Overview & Key Issues	Jeff Billinton
Reliability Assessment - North	RTN - Engineers
Reliability Assessment - South	RTS - Engineers
Wildfire Assessment - Scenarios	David Le
20 Year Transmission Outlook - Update	Jeff Billinton
Day 2 – September 28	
PTO Proposed Reliability Solutions	PG&E, SCE, SDG&E, GLW
Economic Assessment - Update	Yi Zhang
Next Steps	Isabella Nicosia