Agenda
Reliability Assessment and Study Updates

Brenda Corona
Stakeholder Engagement and Policy Specialist

2022-2023 Transmission Planning Process Stakeholder Meeting
September 27-28, 2022

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.

2022-2023 Transmission Planning Process Stakeholder Call – Agenda

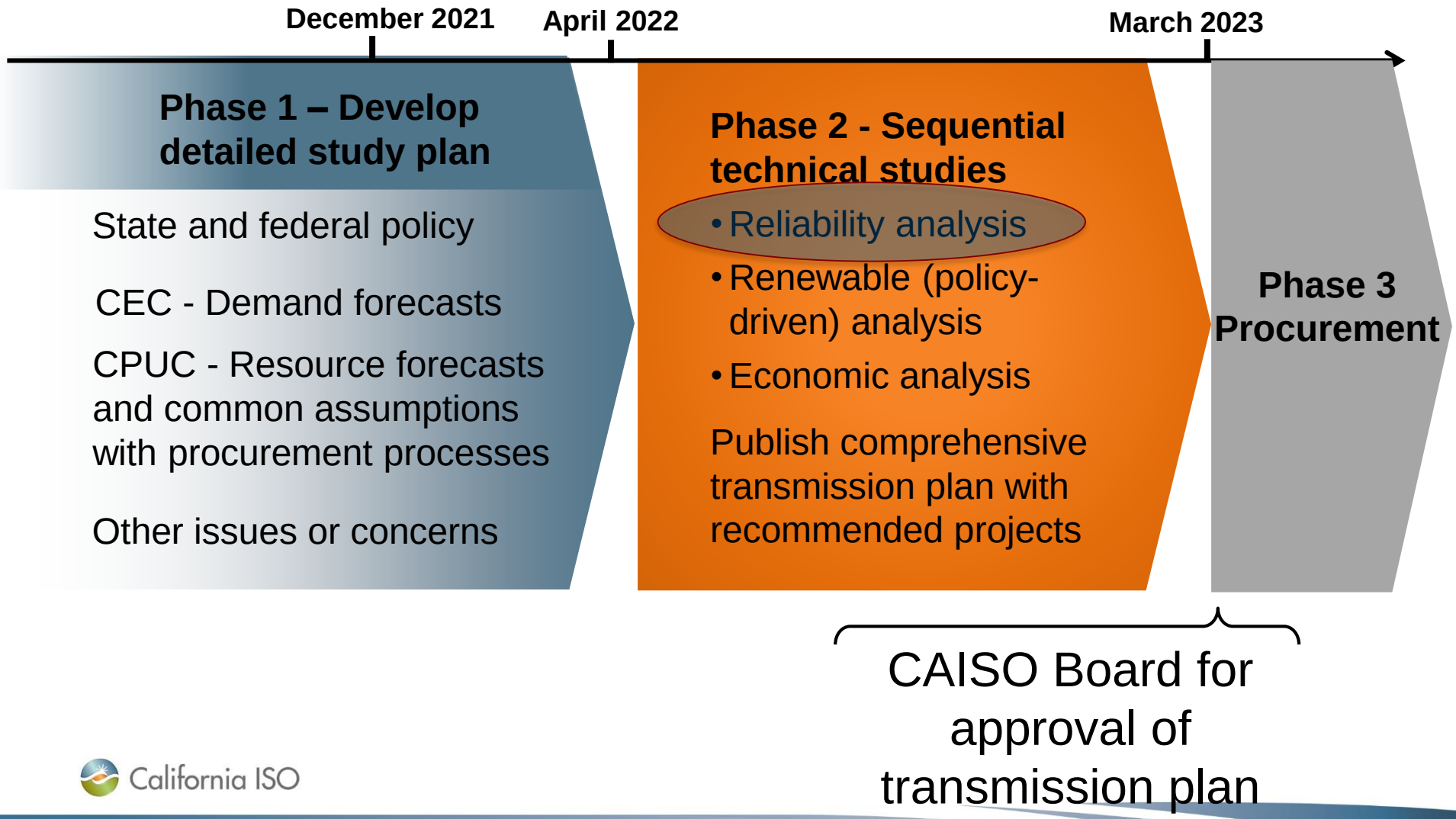
Topic	Presenter
Day 1 – September 27	
Overview & Key Issues	Binaya Shrestha
Reliability Assessment - North	RTN - Engineers
Reliability Assessment - South	RTS - Engineers
Day 2 – September 28	
PTO Proposed Reliability Solutions	PG&E, SCE, SDG&E, GLW
High Voltage TAC Update	Binaya Shrestha
Policy Assessment - Update	Nebiyu Yimer
Economic Assessment - Update	Yi Zhang
Next Steps	Brenda Corona

Introduction and Overview
Preliminary Reliability Assessment Results

Binaya Shrestha
Manager - Regional Transmission North

2022-2023 Transmission Planning Process Stakeholder Meeting
September 27-28, 2022

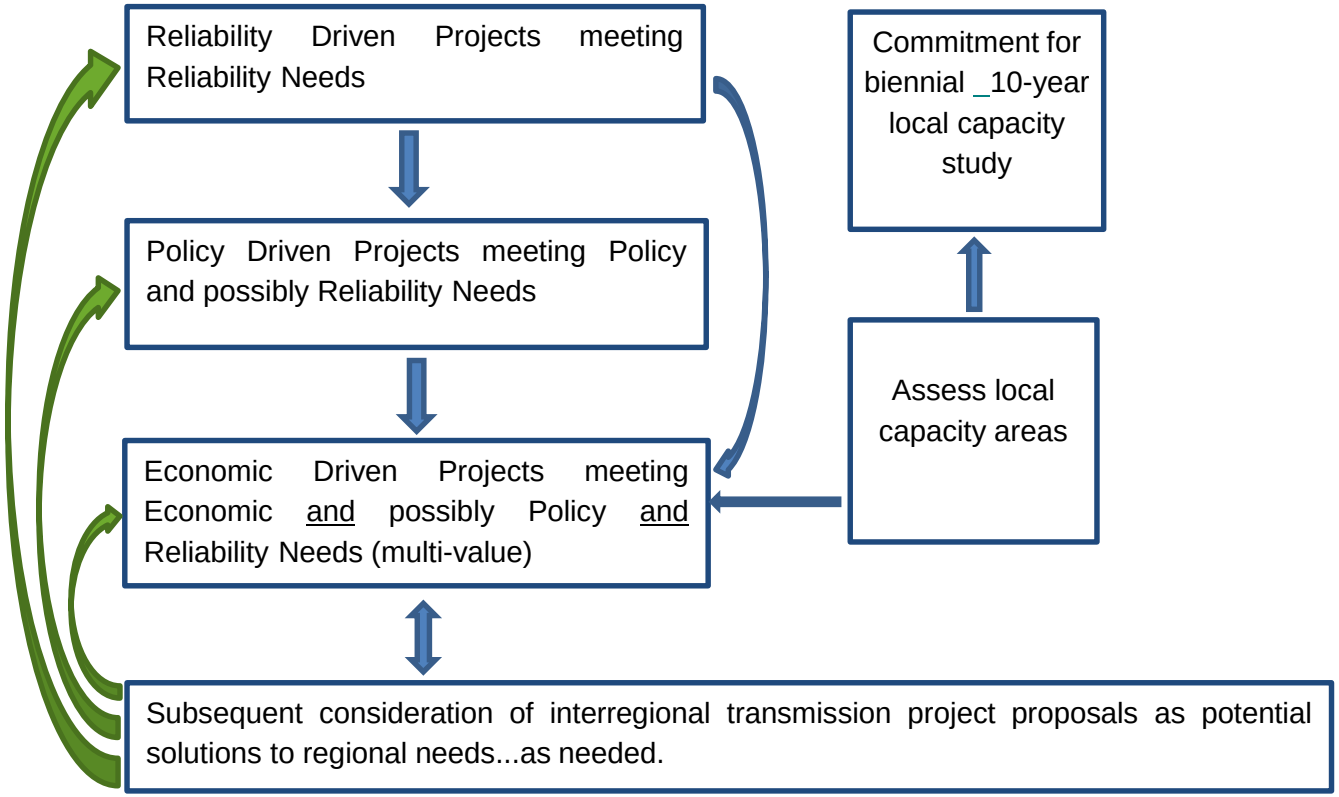
2022-2023 Transmission Planning Process



2022-2023 Transmission Plan Milestones

- Draft Study Plan posted on February 18
- Stakeholder meeting on Draft Study Plan on February 28
- Final Study Plan posted on March 31
- Stakeholder meeting July 6
- Preliminary reliability study results posted and open Request Window on August 15
- 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 17
- Comments to be submitted by December 5
- Draft transmission plan to be posted on January 31, 2023
- Stakeholder meeting in February
- Comments to be submitted within two weeks after stakeholder meeting
- Revised draft for approval at March Board of Governor meeting

Studies are coordinated as a part of the transmission planning process



The reliability assessment is a key component of the overall 2022-2023 Transmission Plan Study Plan

- Reliability Assessment to identify reliability-driven needs
  - Base portfolio included in CPUC Decision 22-02-004 for use in CAISO 2022-2023 transmission planning process

    https://docs.cpuc.ca.gov/SearchRes.aspx?docformat=ALL&docid=451412947
  - 2021 Integrated Energy Policy Report (IEPR) Additional Transportation Electrification demand scenario adopted by the CEC on May 24, 2022

    https://efiling.energy.ca.gov/GetDocument.aspx?tn=243354
- 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

2022-2023 Ten Year Reliability Assessment To Date

- Preliminary study results were posted on August 15
  - Based on assumptions identified in 2022-2023 Study Plan
  - Satisfy requirements of:
    - NERC Reliability Standards
    - WECC Regional Criteria
    - ISO Planning Standards
- Transmission request window (reliability driven projects) opened on August 15
  - PTO proposed mitigations submitted to CAISO by September 15

2022-2023 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 transmission plan
- Purpose of today's stakeholder meeting
  - Review the results of the reliability analysis
  - Set stage for stakeholder feedback on potential mitigations

Critical Energy Infrastructure Information

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

Key Issues

- Additional Transportation Electrification demand forecast were included in the 2032 baseline scenario and 2035 High Electrification Sensitivity scenario.
- Preparation for policy and economic assessment are underway with the preliminary analysis to be presented at the November 17 stakeholder meeting
- Special studies
  - 2035 High Electrification
    - Reliability analysis will be presented at this stakeholder call
    - Preliminary Policy and economic results to be presented at November 17 stakeholder meeting
  - Reduced Reliance on Aliso Canyon Gas Storage
    - Will be presented at November 17 stakeholder meeting

Key Issues
(continued)

- The transmission access forecast charge model from the 2021-2022 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 2022-2023 transmission planning process with the stakeholder comments submitted on this stakeholder call

Comments

- Comments due by end of day October 12, 2022

- Submit comments through the ISO's commenting tool, using the template provided on the process webpage:
- https://stakeholdercenter.caiso.com/RecurringStakeholderProcesses/2022-2023-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

2022-23 Transmission Planning Process Stakeholder Meeting
September 27-28, 2022

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	Description	Scenario Type	Gross Load (MW)	BTM-PV		AAEE (MW)	Net Load (MW)
					Output (MW)	Installed (MW)		
1	GBA-2024-SP	2024 Summer Peak load condition. Peak load time - hours ending 19:00	Baseline	9090	0	2316	62	9028
2	GBA-2024-SP-HiRenew	2024 Summer peak Load conditions with Hi-Renewable dispatch Sensitivity	Sensitivity	9080	2293	2316	62	6725
3	GBA-2027-SP	2027 Summer Peak load condition. Peak load time - hours ending 19:00	Baseline	9356	0	2929	96	9259
4	GBA-2027-SP-HiCEC	2027 Summer peak load conditions with Hi-CEC load forecast sensitivity.	Sensitivity	9340	0	2929	0	9340
5	GBA-2032-SP	2032 Summer Peak load condition. Peak load time - hours ending 19:00	Baseline	10889	0	3960	135	10754
6	2024-WPK	2024 Winter Peak load condition. Winter Peak load time - hours ending 19:00	Baseline	7079	0	2340	73	7006
7	2024-SPOP	2024 Spring off-Peak load condition. Off-Peak load time - hours ending 20:00	Baseline	6688	0	2316	58	6631
8	2024-SPOP-COI	2024 Spring off-peak load conditions and COI Import.	Sensitivity	6688	0	2316	58	6631
9	2027-WPK	2027 Winter Peak load condition. Winter Peak load time - hours ending 19:00	Baseline	7122	0	2940	127	6995
10	2027-SPOP	2027 Spring Off-Peak load condition. Off-Peak load time - hours ending 13:00	Baseline	8337	2354	2943	75	5908
11	2032-WPK	2032 Winter Peak load condition. Winter Peak load time - hours ending 19:00	Baseline	7896	0	3959	199	7697
12	GBA-2035-SP-ATE	2035 Summer Peak load condition with ATE. Peak load time - hours ending 19:00	Sensitivity	11963	0	3948	162	11801

Generation Assumptions - Greater Bay Area

S. No.	Study Case	Scenario Type	Description	Battery		Solar		Wind		Hydro		Thermal	
				Installed (MW)	Dispatch (MW)	Installed (MW)	Dispatch (MW)	Installed (MW)	Dispatch (MW)	Installed (MW)	Dispatch (MW)	Installed (MW)	Dispatch (MW)
1	2024-SPOP-COI	Sensitivity	2024 Spring off-peak load conditions and COI Import sensitivity	367	0	46	0	208	32	0	0	5554	1369
2	2024-SPOP	Baseline	2024 Spring off-Peak load condition. Off-Peak load time - hours ending 20:00	367	0	46	0	208	32	0	0	5554	1409
3	2024-WPK	Baseline	2024 Winter Peak load condition. Winter Peak load time - hours ending 19:00	367	0	46	0	208	24	0	0	5554	2549
4	GBA-2024-SP-HiRenew	Sensitivity	2024 Summer peak Load conditions with Hi-Renewable dispatch Sensitivity	367	0	46	46	208	106	0	0	5554	321
5	GBA-2024-SP	Baseline	2024 Summer Peak load condition. Peak load time - hours ending	367	0	46	0	208	53	0	0	5554	4593
6	2027-SPOP	Baseline	2027 Spring Off-Peak load condition. Off-Peak load time - hours ending 13:00	367	0	46	42	208	38	0	0	5554	783
7	2027-WPK	Baseline	2027 Winter Peak load condition. Winter Peak load time - hours ending 19:00	367	0	46	0	208	21	0	0	5579	2511
8	GBA-2027-SP-HiCEC	Sensitivity	2027 Summer peak load conditions with Hi-CEC load forecast sensitivity.	367	0	46	0	208	47	0	0	5554	4339
9	GBA-2027-SP	Baseline	2027 Summer Peak load condition. Peak load time - hours ending	367	0	46	0	208	48	0	0	5554	4468
10	2032-WPK	Baseline	2032 Winter Peak load condition. Winter Peak load time - hours ending 19:00	547	0	46	0	208	53	0	0	5579	3423
11	GBA-2032-SP	Baseline	2032 Summer Peak load condition. Peak load time - hours ending 19:00	547	0	46	0	208	48	0	0	5554	4994

Previously approved transmission projects modelled in base cases

Project Name	Division	In-service Year	First Year Modeled
Christie-Sobrante 115 kV Line Reconductor	East Bay	2028	2032
Cooley Landing-Palo Alto and Ravenswood-Cooley Landing 115 kV Lines Rerate	San Jose	2022	2024
East Shore 230 kV Bus Terminals Reconfiguration	Mission	2026	2027
East Shore-Oakland J 115 kV Reconductoring Project (name changed from East Shore-Oakland J 115 kV Reconductoring Project & Pittsburg-San Mateo 230 kV Looping Project since only the 115 kV part was approved)	East Bay	2022	2024
Jefferson 230 kV Bus Upgrade	Peninsula	2026	2027
Metcalf-Piercy & Swift and Newark-Dixon Landing 115 kV Upgrade	San Jose	2029	2032
Monta Vista 230 kV Bus Upgrade	De Anza	2024	2024
Moraga 230 kV Bus Upgrade	East Bay	2027	2027
Moraga-Castro Valley 230 kV Line Capacity Increase Project	Diablo	2025	2027
Moraga-Sobrante 115 kV Line Reconductor	East Bay	on hold	on hold
Morgan Hill Area Reinforcement (formerly Spring 230/115 kV substation)	San Jose	2026	2027
Newark 230/115 kV Transformer Bank #7 Circuit Breaker Addition	Mission	2026	2027
Newark-Milpitas #1 115 kV Line Limiting Facility Upgrade	San Jose	2022	2024
North Tower 115 kV Looping Project	Mission	2030	2032
Oakland Clean Energy Initiative	East Bay	2023	2024
Pittsburg 230/115 kV Transformer Capacity Increase	Diablo	2025	2027
Ravenswood – Cooley Landing 115 kV Line Reconductor	Peninsula	2023	2024
Ravenswood 230/115 kV transformer #1 Limiting Facility Upgrade	Peninsula	2024	2024
South of San Mateo Capacity Increase	Peninsula	2027	2027
Martin 230 kV Bus Extension	San Francisco	2024	2024
Contra Costa PP 230 kV Line Terminals Reconfiguration Project	Diablo	2025	2027
Vasona-Metcalf 230 kV Line Limiting Elements Removal Project	San Jose	2025	2027
San Jose Area HVDC Line (Newark - NRS)	San Jose	2028	2032
San Jose Area HVDC Line (Metcalf – San Jose)	San Jose	2028	2032
Series Compensation on Los Esteros-Nortech 115 kV Line	San Jose	2023	2024
Metcalf 230 kV Substation Circuit Breaker #No 292 Upgrade	San Jose	2025	2027
Cooley Landing Substation Circuit Breaker No #62 Upgrade	Peninsula	2026	2027
New Collinsville 500 kV substation	Bulk/Diablo	2028	2032

Reliability assessment preliminary results summary

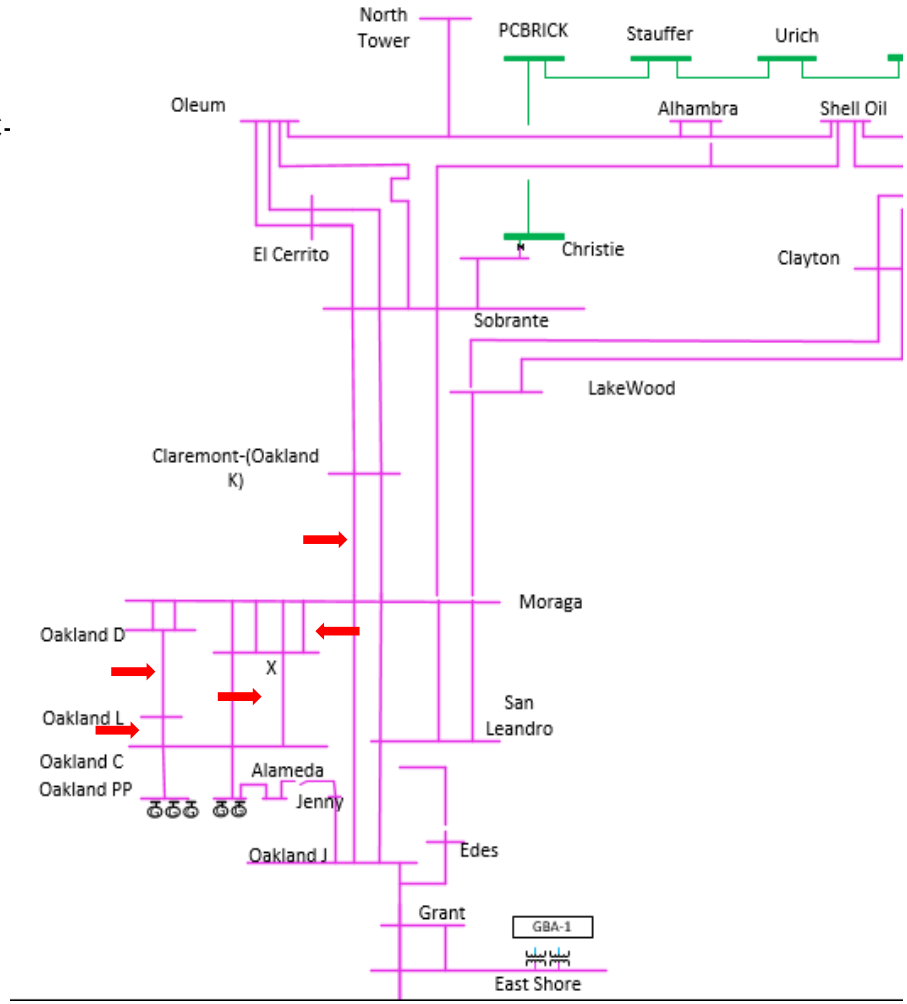
East Bay Division – Results Summary (2023 – 2032)

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 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.



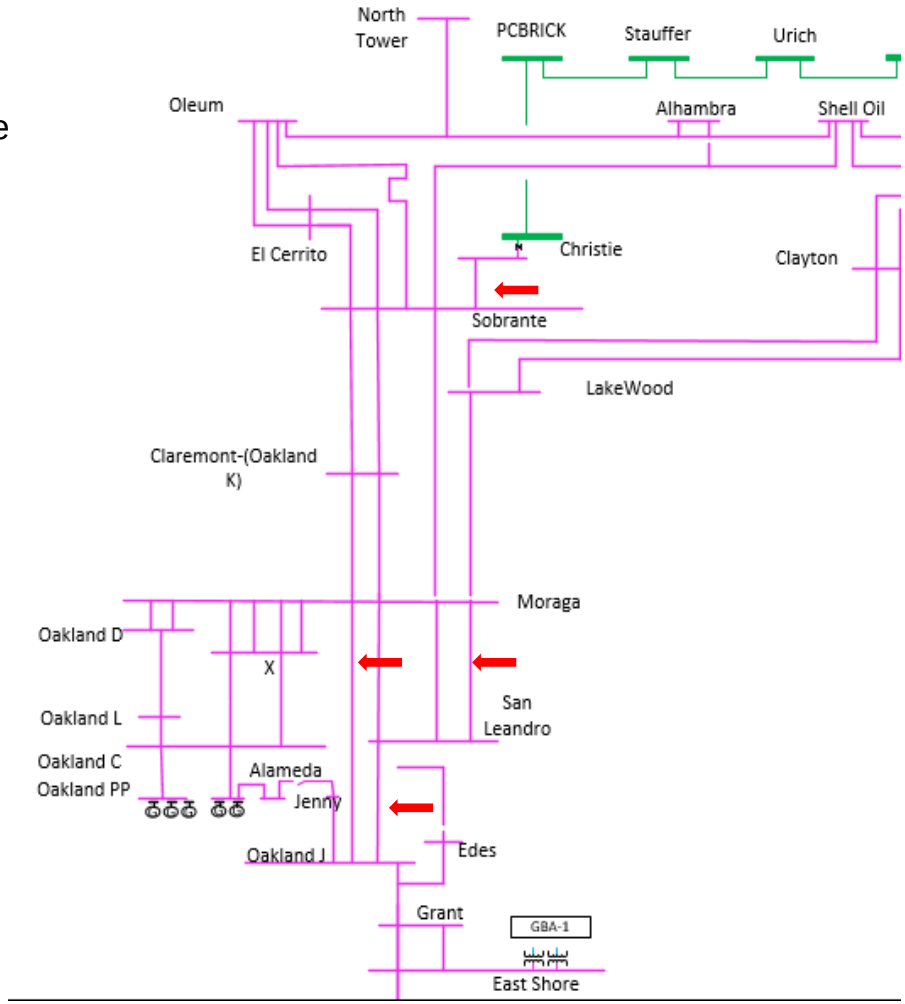
East Bay Division – Results Summary (2023 – 2032)

Observations

- Other East Bay Issues
  - P7 contingency driven overload on Christie-Sobrante 115 kV line in short and mid-term Summer peak scenarios.
  - P2,P3,P6 & P7 contingencies driven overloads on San Leandro-Oakland J, Moraga-Oakland J and Moraga-San Leandro 115 kV lines in near, mid and long-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.

Approved and Potential Mitigations

- Christie-Sobrante overload is mitigated by reconductoring project.
- San Leandro-Oakland J, Moraga-Oakland J and Moraga-San Leandro 115 kV lines overload will be mitigated by Oakland J RAS and San Leandro RAS.



East Bay Division – Results Summary (2035 ATE Sensitivity)

Incremental issues identified in 2035 ATE sensitivity

Facility	Cont Type / Worst Loading %				Facility overloaded in baseline scenario?
	P1	P2	P5	P7	
Martinez-Sobrante 115kV Line		109	110		Yes
Moraga 230/115kV Transformer #3		112			Yes
MORAGA.E-SN LNDRO 115 kV		110	113		Yes
Moraga-Oakland J 115kV Line		102	112	112	Yes
Moraga-San Leandro #1 115kV Line	111	107	109	109	Yes
Moraga-San Leandro #2 115kV Line	108		110	110	Yes
Oakland C - Oakland L #1 115kV Cable		123	114		Yes
Oakland C - Oakland X #2 115kV Cable		118	118		Yes
Oakland D - Oakland L 115kV Cable		107	125	106	Yes
Oleum - North Tower-Christie 115 kV (North tower sub to North Tower Jt2)		103			No
Oleum-El Cerrito STA G #1 115kV Line			102	118	No
San Leandro - Oakland J #1 115kV Line	101	103	110	110	Yes
SN LNDRO-EDESJCT1 115 kV	101	103	110	110	Yes
Sobrante 230/115kV Transformer #2		101			No
Sobrante-El Cerrito STA G #2 115kV Line		112			No
Sobrante-Grizzly-Claremont #1 115kV Line (Hillside-Grizzly JCT)		103	103		Yes
Sobrante-Grizzly-Claremont #2 115kV Line (Hillside-Grizzly JCT)		105			Yes
Sobrante-Moraga 115kV Line		100		105	Yes
Sobrante-Richmond STA R #1 115kV Line	111	111			No
Sobrante-Richmond STA R #2 115kV Line	111	111			No

Diablo Division – Results Summary (2023 – 2032)

Observations

Contra Costa area 230 kV Issues

- P2,P3,P7 overloads in Contra Costa area 230 kV lines near to long-term.

Long-term only issues

- P3 overloads on Collinsville-Pittsburg and Pittsburg-East Shore 230 kV lines. P6,P7 overloads on Pittsburg-San Mateo 230 kV line.

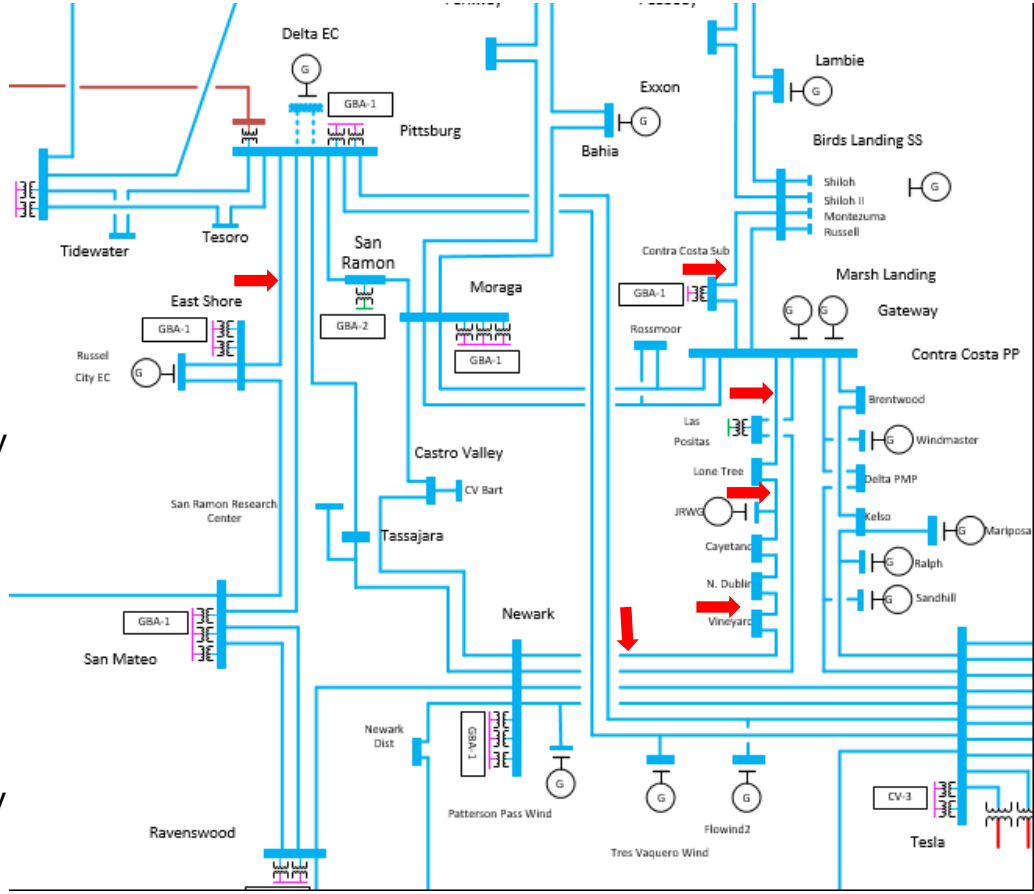
Approved and Potential Mitigations

Contra Costa area 230 kV Issues

- Most of the P2 driven overloads are mitigated by Moraga 230 kV bus upgrade and Contra Costa 230 kV bus reconfiguration projects.
- For remaining issues, line capacity increase will be needed. Contra Costa area generation redispatch can be used in the interim.

Long-term only issues

- Overloads on the Collinsville-Pittsburg lines can be mitigated by operating solution. New capacity increase project may be needed for overloads on the Pittsburg-San Mateo line.



Diablo Division – Results Summary (2035 ATE Sensitivity)

Incremental issues identified in 2035 ATE sensitivity

Facility	Cont Type / Worst Loading %				Facility overloaded in baseline scenario?
	P1	P2	P5	P7	
Cayetano-Lone Tree (Lone Tree-USWP) 230kV Line				101	Yes
COLLNSVL-PITSBG E 230 kV	117	106			No
COLLNSVL-PITSBG F 230 kV	117				No
Lakewood-Meadow Lane-Clayton 115kV Line	106				No
Las Positas-Newark 230kV Line		101		100	Yes
Moraga-Lakewood 115kV Line (Lakewood Reactors)		118			Yes
North Dublin-Cayetano 230kV Cable	107	110	104	109	Yes
North Dublin-Vineyard 230 kV Line		101	101		No
PITSBG F-PITSBG E 230 kV	110				No
Pittsburg-Eastshore 230kV Line		101			Yes
Pittsburg-San Mateo 230kV Line		106	107		Yes
San Ramon-Radum 60kV Line	105	108	101	108	No

San Francisco Division – Results Summary (2023 – 2032)

Observations

- A long-term P6 overload observed on the Potrero-Mission (AX) 115kV Cable in the Summer peak scenario.

Potential Mitigations

- The overloads will be continued to be monitored in future cycles. New capacity increase project may be needed.

San Francisco Division – Results Summary (2035 ATE Sensitivity)

Incremental issues identified in 2035 ATE sensitivity

Facility	Cont Type / Worst Loading %		Facility overloaded in baseline scenario?
	P2	P5	
Martin-Larkin (HY-1) 115kV Cable		112	No
Potrero-Larkin #2 (AY-2) 115kV Cable	100		No
Potrero-Mission (AX) 115kV Cable	104	105	Yes
Potrero-TBC 115kV section	100		No

Peninsula Division – Results Summary (2023 – 2032)

Observations

115 kV

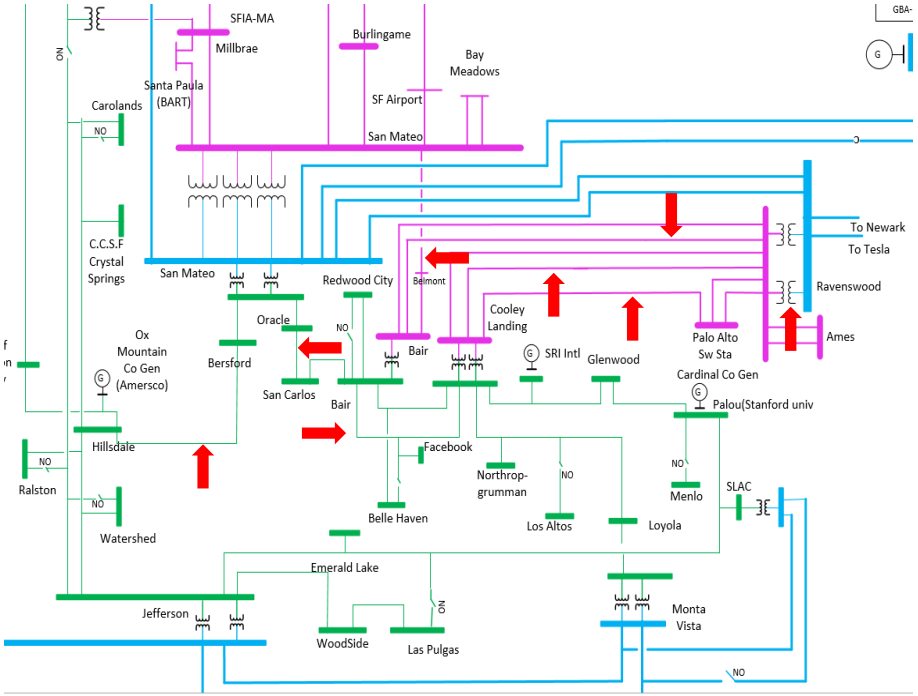
- P1, P2, P6 overload on Ravenswood 230/115 kV bank #1 in short-term Summer peak. P6 overload on Ravenswood 230/115 kV bank #2 in long-term.
- P2, P6, P7 overloads on Cooley Landing-Palo Alto, Ravenswood-Bair #1, Ravenswood-Cooley Landing #2 and San Mateo-Belmont 115 kV lines in all Summer peak scenarios.

60 kV

- Multiple P2, P6, P7 overloads on Peninsula 60 kV lines in all Summer peak scenarios.

Approved and Potential Mitigations

- Ravenswood bank #1 overload is mitigated by the Ravenswood 230/115 kV transformer #1 Limiting Facility Upgrade project.
- New capacity increase project for overloads on other 115 kV lines in the area.
- Overloads on Bair-Cooley Landing #2 and San Mateo-Bair 60 kV lines are mitigated by operating solution. Remaining long-term issues will be continued to be monitored in future cycles. New capacity increase project may be needed.



Peninsula Division – Results Summary (2035 ATE Sensitivity)

Incremental issues identified in 2035 ATE sensitivity

Facility	Cont Type / Worst Loading %					Facility overloaded in baseline scenario?
	P0	P1	P2	P5	P7	
Bair-Cooley Landing #2 60kV Line	101		101	101	102	Yes
Cooley Landing 115/60kV Transformer #1		105	103			No
Cooley Landing 115/60kV Transformer #2		105	103			No
Cooley Landing-Stanford 60kV Line (Cooley Landing-SRI)	116		104	105		No
Jefferson-Las Pulgas 60kV Line (Jefferson-Woodside)				116		No
Jefferson-Stanford #1 60kV Line				101		No
Martin-Daly City #1 115kV Line		114	115			No
Martin-Daly City #2 115kV Line		114	116			No
Martin-Sneath Lane 60kV Line		108	109	108		No
Millbrae-Sneath Lane 60kV Line		114	108	112		No
Ravenswood 230/115kV Transformer #1		103				Yes
Ravenswood-Ames #1 115 kV Line						No
Ravenswood-Ames #2 115kV Line						No
Ravenswood-Bair #1 115kV Line		106	112	106		Yes
Ravenswood-Cooley Landing #1 115kV Line			111			No
Ravenswood-Cooley Landing #2 115kV Line			102			Yes
Ravenswood-Palo Alto #1 115kV Line					104	No
Ravenswood-Palo Alto #2 115kV Line					103	No
San Mateo 115/60kV Transformer #8				103		Yes
San Mateo 230/115kV Transformer #7				101		No
San Mateo-Hillsdale JCT 60kV Line (Hillsdale-Hillsdale JCT)				115	113	Yes

Mission Division – Results Summary (2023 – 2032)

Observations

230/115 kV

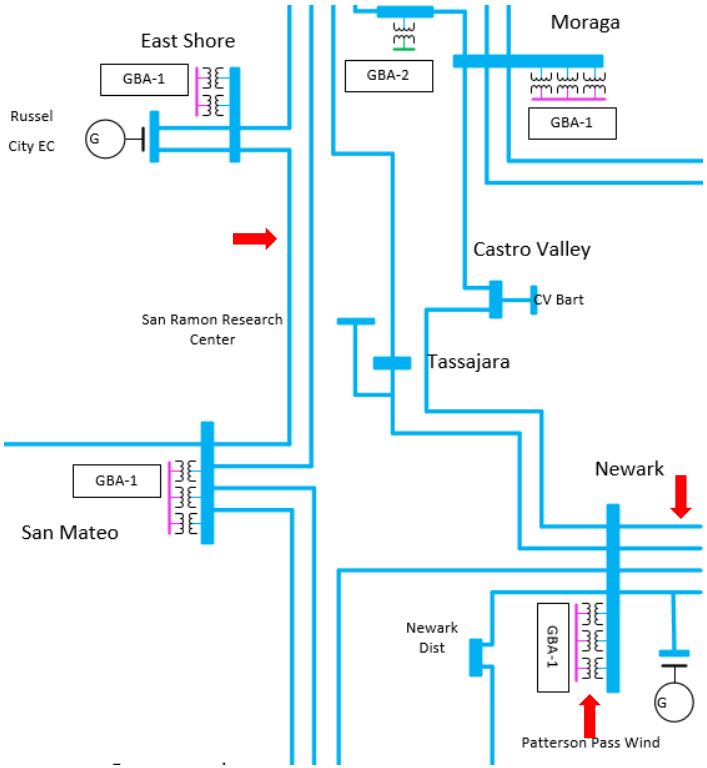
- P6 overload on NEWARK F-RINGWOODSWST 115kV line in all Summer peak scenarios.
- P2, P6 overloads on Newark 230/115kV Banks #7 and #11 in mid and long-term Summer peak scenarios.

Long-term only issues

- P7 overloads on Eastshore-San Mateo 230kV line.
- P6 overloads on Tesla - Newark 230 kV Line No. 2 line.

Potential Mitigations

- NEWARK F-RINGWOODSWST 115 kV line capacity increase.
- Newark banks overloads are mitigated by the Newark 230/115 kV Transformer Bank #7 Circuit Breaker Addition project.
- Remaining long-term issues will be continued to be monitored in future cycles. New capacity increase project may be needed.



Mission Division – Results Summary (2035 ATE Sensitivity)

Incremental issues identified in 2035 ATE sensitivity

Facility	Cont Type / Worst Loading %			Facility overloaded in baseline scenario?
	P1	P2	P5	
Eastshore 230/115kV Transformer #1	100	100		No
Eastshore 230/115kV Transformer #2		101		Yes
Eastshore-San Mateo 230kV Line				Yes
Grant-Eastshore #1 115kV Line		109		No
Grant-Eastshore #2 115kV Line		110		No
Newark 230/115kV Transformer #11			105	Yes
Tesla - Newark 230 kV Line No. 2		104		Yes

De Anza Division – Results Summary (2023 – 2032)

Observations

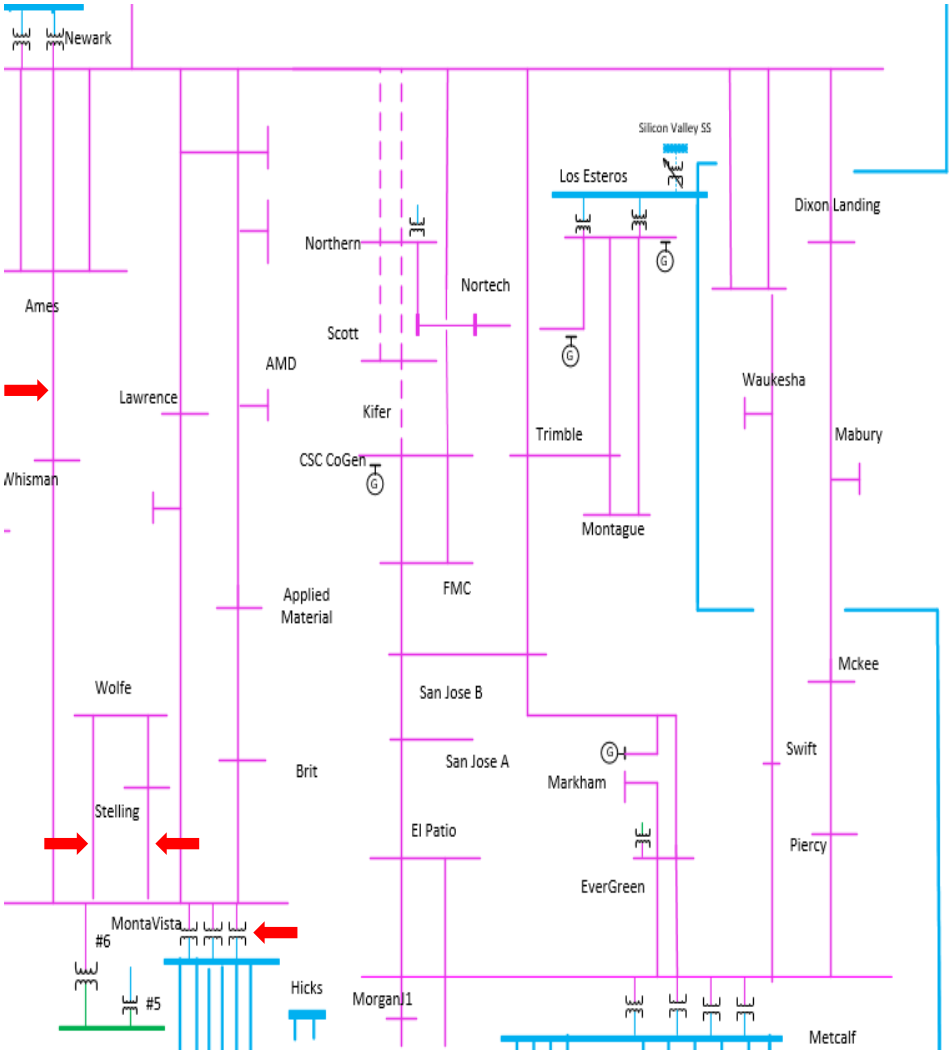
- P2, P6 overloads on Monta Vista 230/115 kV Trans Nos. 2, 3 & 4 from mid to long-term Summer peak scenario.
- P1, P2 overloads on Monta Vista-Wolfe 115 kV line in all Summer peak scenarios.

Long-term only issues

- P6 overloads on AMES-Whisman 115 kV line.
- P2, P3 overloads on Stelling-Monta Vista 115 kV line.

Potential Mitigations

- Monta Vista 230/115 kV Trans capacity increase.
- Monta Vista-Wolfe 115 kV line capacity increase.
- The long-term overloads will be continued to be monitored in future cycles. New capacity increase project may be needed.



De Anza Division – Results Summary (2035 ATE Sensitivity)

Incremental issues identified in 2035 ATE sensitivity

Facility	Cont Type / Worst Loading %				Facility overloaded in baseline scenario?
	P1	P2	P5	P7	
Metcalf-Hicks 230 kV Line				105	Yes
Monta Vista-Hicks 230 kV Line				101	No
Mountain View-Monta Vista 115 kV Line		104	104	101	No
Newark-Applied Materials 115kV Line	101	101	106	101	No
Newark-Lawerence 115kV Line				101	Yes
Saratoga-Vasona 230 kV Line				104	No

San Jose Division – Results Summary (2023 – 2032)

Observations

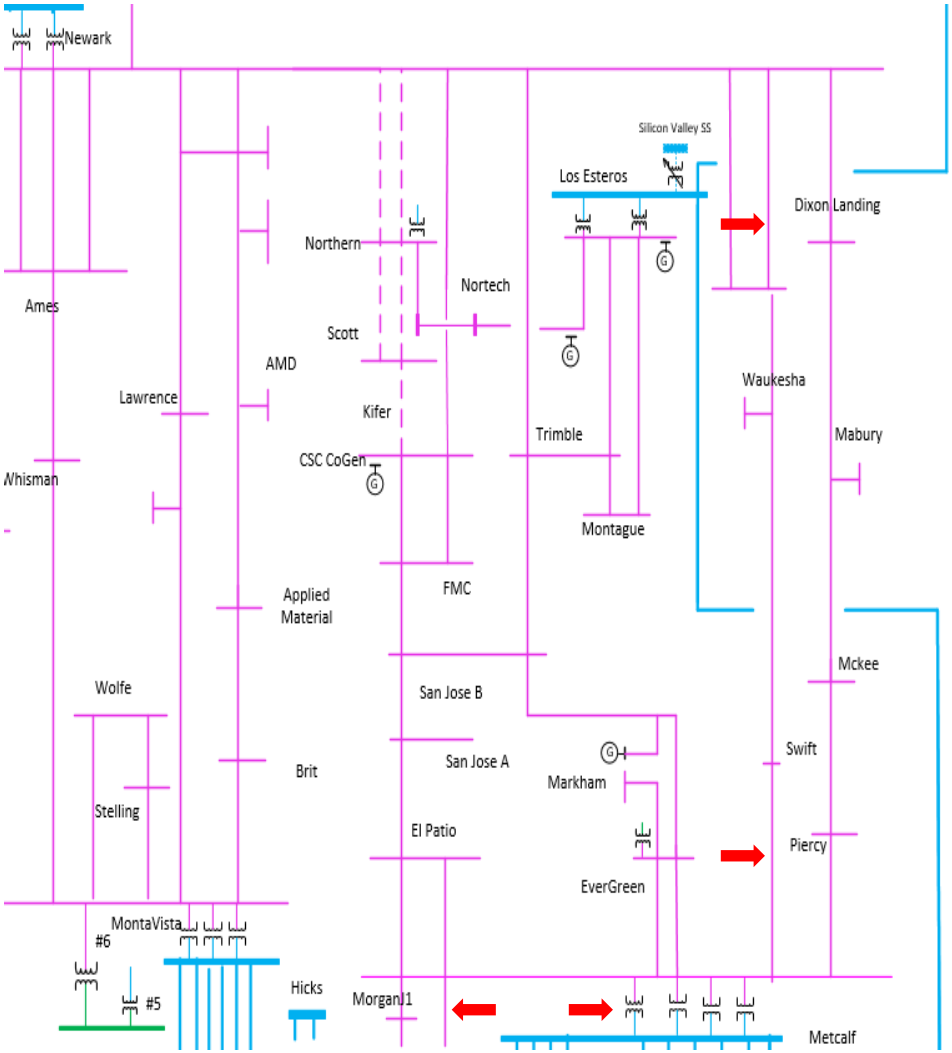
- P6 overload on Newark-Milpitas #1 115kV line in all Summer peak scenarios.
- P2, P6 overloads on Metcalf 230/115 kV Trans Nos. 1, 2, 3 & 4 from near to long-term Summer peak scenario.
- P2, P6 overloads on Swift-Metcalf 115 kV line in all Summer peak scenarios.
- P6 overload on Metcalf-Morgan Hill 115 kV line in all Summer peak scenarios.

Long-term only issues

- P1, P2 overloads on Mckee-Piercy 115 kV line.
- P2 overloads on Milpitas-Swift 115 kV line.
- P1 overload on Newark-Jarvis #1 115 kV line.
- P7 overload on San Jose 'B'-Stone-Evergreen 115 kV line.

Potential Mitigations

- Newark-Milpitas #1 115kV line capacity increase.
- Metcalf 230/115 kV Transformers CB addition.
- Review project: Metcalf-Dixon Landing reconductor
- Review project: Morgan Hill-Green Valley project
- The long-term overloads will be continued to be monitored in future cycles. New capacity increase project may be needed.



San Jose Division – Results Summary (2035 ATE Sensitivity)

Incremental issues identified in 2035 ATE sensitivity

Facility	Cont Type / Worst Loading %				Facility overloaded in baseline scenario?
	P1	P2	P5	P7	
Dixon Landing-McKee 115 kV Line	114	115			Yes
GREENVALLEY-MOSSLNSW 115 kV				111	No
GREENVALLEY-MRGN HIL 115 kV				102	Yes
Los Esteros-Metcalf 230 kV Line		102			Yes
LS ESTRS-LSESTRSRCTR 115 kV		114			Yes
LSESTRSRCTR-NORTECH 115 kV		114			Yes
Mckee-Piercy 115 kV Line		102			Yes
Metcalf 230/115 kV Trans No. 1		106			Yes
Metcalf 230/115 kV Trans No. 2		108			Yes
Metcalf 230/115 kV Trans No. 3		105			Yes
Metcalf-Edenvale No. 1 115 kV Line	100	100			No
Metcalf-Edenvale No. 2 115 kV Line		100			No
Metcalf-El Patio No. 1 115 kV Line	106	106	117	107	Yes
Metcalf-Hicks 230 kV Line		101			Yes
MRGN HIL-AWSGILROYSS 115 kV				113	Yes
Newark-Kifer 115kV Line		106			Yes
Newark-Northern Receiving Station #1 115kV Line		139			Yes
Newark-Northern Receiving Station #2 115kV Line		130	101		Yes
Piercy-Metcalf 115 kV Line	113	113	103	114	Yes
San Jose Sta 'A'-'B' 115 kV Line				103	Yes
Swift-Metcalf 115 kV Line			102		Yes

List of substation with P5 contingency driven issues

Division	Substation	P5 Contingency Description
De Anza	MONTA VISTA 115KV BAAH	Non-Redundent Relay
De Anza	MONTA VISTA 230-115KV	Non-Redundent battery supply
Diablo	C.COSTAPP 230KV BUS 1&2	Non-Redundent Relay
Diablo	CONTRA COSTA PP 230KV	Non-Redundent battery supply
Diablo	PITTSBURG PP 230-115KV	Non-Redundent battery supply
Diablo	PITTSBURG PP 230KV	Non-Redundent Relay
East Bay	CLAREMONT 115kV	Non-Redundent battery supply
East Bay	MORAGA 230-115KV	Non-Redundent battery supply
East Bay	MORAGA 230KV BUS #1 &2	Non-Redundent Relay
East Bay	OAKLAND X 115KV	Non-Redundent battery supply
East Bay	SAN LEANDRO 115kV	Non-Redundent battery supply
East Bay	SOBRANTE 230-115KV	Non-Redundent battery supply
Mission	EAST SHORE 230 KV BAAH	Non-Redundent Relay
Mission	EASTSHORE 115KV	Non-Redundent battery supply
Mission	EASTSHORE 230KV	Non-Redundent battery supply
Mission	NEWARK 230KV	Non-Redundent battery supply
Mission	NEWARK D 115 & 60KV	Non-Redundent battery supply
Mission	NEWARK E&F 115KV	Non-Redundent battery supply
Peninsula	JEFFERSON 230 KV BAAH BUS	Non-Redundent Relay
Peninsula	RAVENSWOOD 115	Non-Redundent Relay
Peninsula	RAVENSWOOD 230 KV BAAH BUS	Non-Redundent Relay
Peninsula	RAVENSWOOD 230-115KV	Non-Redundent battery supply
Peninsula	SAN MATEO 230-115-60KV	Non-Redundent battery supply
San Fransisco	HUNTERS POINT 115	Non-Redundent battery supply
San Fransisco	MARTIN 230kV	Non-Redundent battery supply
San Jose	LOS ESTEROS 115KV BAAH BUS	Non-Redundent Relay
San Jose	LOS ESTEROS 230 KV BAAH BUS #1&2	Non-Redundent Relay
San Jose	LOS ESTEROS 230-115KV	Non-Redundent battery supply
San Jose	METCALF 115KV	Non-Redundent battery supply
San Jose	METCALF 500-230KV	Non-Redundent battery supply
San Jose	NORTECH 115KV	Non-Redundent battery supply
San Jose	SAN JOSE B 115KV	Non-Redundent battery supply
San Jose	TRIMBLE 115KV	Non-Redundent battery supply

Low Voltage Results Summary

Potential Mitigations

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

Division	Cont. Type	2024 Summer Peak	2027 Summer Peak	2032 Summer Peak
Diablo	P5	0.77 PU	0.71 PU	Diverge
Peninsula	P5	Diverge	Diverge	Diverge
Mission	P5	0.94 PU	0.89 PU	0.87 PU
De Anza	P1	0.89 PU	0.88 PU	0.84 PU
	P5	Diverge	Diverge	Diverge
San Jose	P1	0.91 PU	0.90 PU	0.88 PU
	P2	0.93 PU	0.90 PU	0.83 PU
	P5	0.88 PU	0.50 PU	0.83 PU
	P6	0.88 PU	0.80 PU	Diverge

Summary of potential new upgrades

Division	Reliability Concern	Potential Upgrade
East Bay	P2, P6	• Oakland J RAS, San Leandro RAS • Oakland C-L 115 kV cable overload will be continued to monitor
Diablo	Multiple	• Cayetano-Lone Tree 230 kV line capacity increase. • Pittsburg-San Mateo 230 kV line overload will be continued to monitor
San Francisco	NA	• None required at this time.
Penninsula	Multiple	• New capacity increase for overloads on 115 kV lines in the area • Ravenswood 230/115 kV bank #2 overload will be continued to monitor
Mission	Multiple	• New capacity increase NEWARK F-RINGWOODSWST 115 kV line. • Eastshore-San Mateo and Tesla-Newark 230 kV lines overload will be continued to monitor
De Anza	Multiple	• Monta Vista 230/115 kV Trans capacity increase. • Monta Vista-Wolfe 115 kV line capacity increase. • AMES-Whisman and Stelling-Monta Vista 115 kV lines overload will be continued to monitor
San Jose	Multiple	• New capacity increase Newark-Milpitas #1 115 kV line. • Metcalf 230/115 kV Transformers CB addition • Mckee-Piercy, Milpitas-Swift, Newark-Jarvis #1 and San Jose 'B'-Stone-Evergreen 115 kV lines overload will be continued to monitor

Humboldt

Preliminary Reliability Assessment Results

Binaya Shrestha
Manager - Regional Transmission North

2022-23 Transmission Planning Process Stakeholder Meeting
September 27-28, 2022

Humboldt Area

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

Load and Load Modifier Assumptions – Humboldt

S. No.	Study Case	Description	Scenario Type	Gross Load (MW)	BTM-PV		AAEE (MW)	Net Load (MW)
					Output (MW)	Installed (MW)		
1	HUMB-2024-SP-HiRenew	2024 Summer peak Load conditions with Hi-Renewable dispatch Sensitivity	Sensitivity	123	23	23	1	99
2	HUMB-2024-SP	2024 Summer Peak load condition. Peak load time - hours ending 21:00	Baseline	123	0	23	1	122
3	HUMB-2027-SP	2027 Summer Peak load condition. Peak load time - hours ending 21:00	Baseline	128	0	26	1	127
4	HUMB-2027-SP-HiCEC	2027 Summer peak load conditions with Hi-CEC load forecast sensitivity.	Sensitivity	128	0	26	0	128
5	HUMB-2032-SP	2032 Summer Peak load condition. Peak load time - hours ending 21:00	Baseline	163	0	32	2	161
6	2024-WPK	2024 Winter Peak load condition. Winter Peak load time - hours ending 19:00	Baseline	108	0	23	1	107
7	2024-SPOP	2024 Spring off-Peak load condition. Off-Peak load time - hours ending 20:00	Baseline	107	0	23	1	106
8	2024-SPOP-COI	2024 Spring off-peak load conditions and COI Import.	Sensitivity	107	0	23	1	106
9	2027-WPK	2027 Winter Peak load condition. Winter Peak load time - hours ending 19:00	Baseline	111	0	27	2	109
10	2027-SPOP	2027 Spring Off-Peak load condition. Off-Peak load time - hours ending 13:00	Baseline	117	21	26	1	95
11	2032-WPK	2032 Winter Peak load condition. Winter Peak load time - hours ending 19:00	Baseline	125	0	33	3	122
12	HUMB-2035-SP-ATE	2035 Summer Peak load condition with ATE. Peak load time - hours ending 21:00	Sensitivity	184	0	32	3	181

Generation Assumptions - Humboldt

S. No.	Study Case	Scenario Type	Description	Battery		Solar		Wind		Hydro		Thermal	
				Installed(MW)	Dispatch(MW)	Installed (MW)	Dispatch (MW)	Installed (MW)	Dispatch(MW)	Installed (MW)	Dispatch(MW)	Installed (MW)	Dispatch(MW)
1	2024-SPOP-COI	Sensitivity	2024 Spring off-peak load conditions and COI Import sensitivity	0	0	0	0	0	0	5	0	257	95
2	2024-SPOP	Baseline	2024 Spring off-Peak load condition. Off-Peak load time - hours ending 20:00	0	0	0	0	0	0	5	0	257	75
3	2024-WPK	Baseline	2024 Winter Peak load condition. Winter Peak load time - hours ending 19:00	0	0	0	0	0	0	5	0	257	179
4	HUMB-2024-SP-HiRenew	Sensitivity	2024 Summer peak Load conditions with Hi-Renewable dispatch Sensitivity	0	0	0	0	0	0	5	0	257	126
5	HUMB-2024-SP	Baseline	2024 Summer Peak load condition. Peak load time - hours ending 21:00	0	0	0	0	0	0	5	0	257	87
6	2027-SPOP	Baseline	2027 Spring Off-Peak load condition. Off-Peak load time - hours ending 13:00	0	0	0	0	0	0	5	0	257	144
7	2027-WPK	Baseline	2027 Winter Peak load condition. Winter Peak load time - hours ending 19:00	0	0	0	0	0	0	5	0	257	166
8	HUMB-2027-SP-HiCEC	Sensitivity	2027 Summer peak load conditions with Hi-CEC load forecast sensitivity.	0	0	0	0	0	0	5	0	257	89
9	HUMB-2027-SP	Baseline	2027 Summer Peak load condition. Peak load time - hours ending 21:00	0	0	0	0	0	0	5	0	257	93
10	2032-WPK	Baseline	2032 Winter Peak load condition. Winter Peak load time - hours ending 19:00	15	0	0	0	0	0	5	0	257	190
11	HUMB-2032-SP	Baseline	2032 Summer Peak load condition. Peak load time - hours ending 21:00	15	0	0	0	0	0	5	0	257	95

Previously approved transmission projects modelled in base cases

Project Name	First Year Modeled
Willow Creek Reactive Support (formerly Maple Creek)	2024

Reliability assessment preliminary results summary

Humboldt – Results Summary (2023 – 2032)

Observations

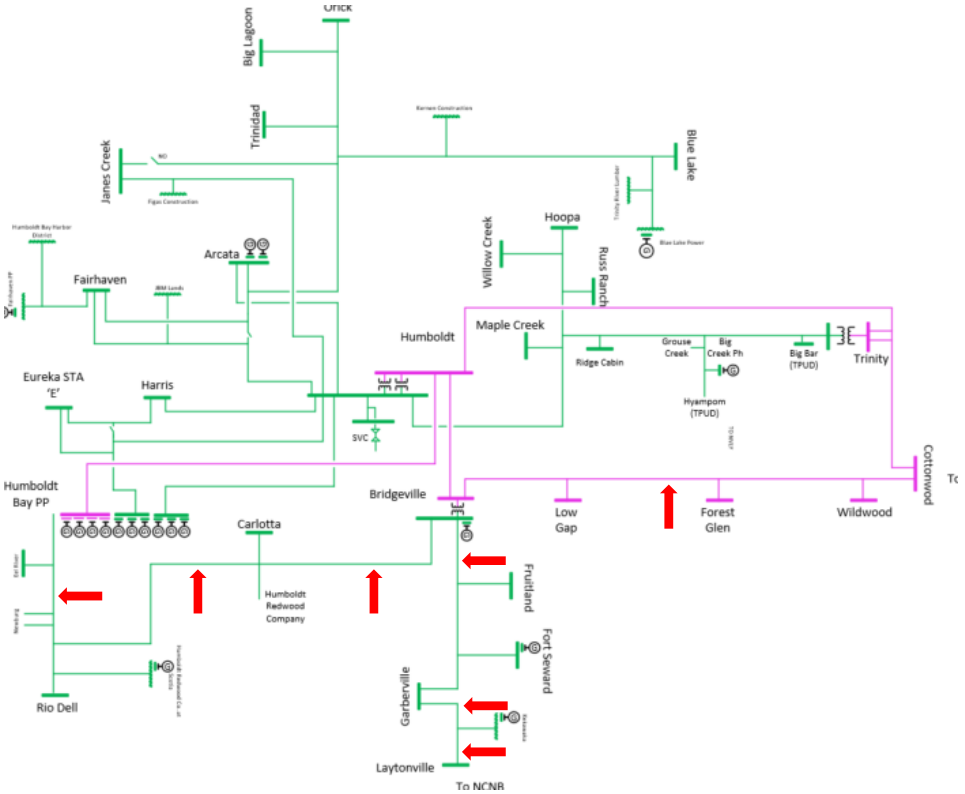
- 60 kV
  - P1, P2, P3 and P6 overloads on multiple 60 kV lines and line sections, some in near and mid-term and mostly in long-term.
  - P1, P2 low voltages, mostly in Garberville area.

Long-term only issues

- P3, P6 overloads on Bridgeville-Cottonwood 115 kV line.

Approved and Potential Mitigations

- 60 kV system line capacity increase.
- Mitigation for thermal issues could address the low voltage issues as well. If not, add reactive support in Garberville 60 kV area.
- The long-term overloads will be continued to be monitored in future cycles. New capacity increase project may be needed.



List of substation with P5 contingency driven issues

Substation	P5 Contingency Description
BRIDGEVILLE 115-60KV	Non-Redundent battery supply
HUMBOLDT 115 KV	Non-Redundent Relay
HUMBOLDT 115KV	Non-Redundent battery supply

Humboldt– Results Summary (2035 ATE Sensitivity)

Incremental issues identified in 2035 ATE sensitivity

Facility	Cont Type / Worst Loading %				Facility overloaded in baseline scenario?
	P1	P2	P5	P7	
31116 GRBRVLLE 60.0 31117 KEKAWAKAJCT 60.0 1 1	106		106		Yes
31117 KEKAWAKAJCT 60.0 31308 LYTNVLLE 60.0 1 1	106		106		Yes
Bridgeville - Garberville 60 kV Line (BRDGVLLE-FRUTLDJT)	145				Yes
Humboldt - Eureka 60 kV Line (HUMBOLDT-HARRIS)				114	No
Humboldt Bay - Humboldt No.1 60 kV Line (HUMBOLDT-HMBLT JT)				106	No
Humboldt Bay - Rio Dell Jct 60 kV Line	125	127			Yes
Humboldt-Trinity 115 kV Line	92	94		102	Yes
Newburg-Rio Dell Tap 60 kV Line		129	129		Yes
Rio Dell Jct - Bridgeville 60 kV Line (CARLOTTA-PCLUMBER)		132	132		Yes
Trinity-Maple Creek 60 kV Line		105	105		Yes

Summary of potential new upgrades

Reliability Concern	Potential Upgrade
P1, P2, P3 and P6 overloads	60 kV system line capacity increase.
P1, P2 low voltages, mostly in Garberville area	Mitigation for thermal issues could address the low voltage issues as well. If not, add reactive support in Garberville 60 kV area.

Fresno Area
Preliminary Reliability Assessment Results

Preethi Rondla
Sr Regional Transmission Engineer

2022-2023 Transmission Planning Process Stakeholder Meeting
September 27-28, 2022

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	Description	Scenario Type	Gross Load (MW)	BTM-PV		AAEE (MW)	Net Load (MW)
					Output (MW)	Installed (MW		
1	GFA-2024-SP	2024 Summer Peak load condition. Peak load time - hours ending 19:00	Baseline	3492	0	1612	24	3468
2	GFA-2024-SP-HiRenew	2024 Summer peak Load conditions with Hi-Renewable dispatch Sensitivity	Sensitivity	3492	1596	1612	24	1872
3	GFA-2027-SP	2027 Summer Peak load condition. Peak load time - hours ending 19:00	Baseline	3597	0	1955	31	3566
4	GFA-2027-SP-HiCEC	2027 Summer peak load conditions with Hi-CEC load forecast sensitivity.	Sensitivity	3597	0	1955	0	3597
5	GFA-2032-SP	2032 Summer Peak load condition. Peak load time - hours ending 19:00	Baseline	3905	0	2518	36	3869
6	2024-SPOP	2024 Spring off-Peak load condition. Off-Peak load time - hours ending 20:00	Baseline	2224	0	1612	26	2198
7	2024-SPOP-COI	2024 Spring off-peak load conditions and COI Import.	Sensitivity	2224	0	1612	26	2198
8	2027-SPOP	2027 Spring Off-Peak load condition. Off-Peak load time - hours ending 13:00	Baseline	3521	1594	1992	32	1895
9	GFA-2035-SP-ATE	2035 Summer Peak load condition with additional ATE. Peak load time - hours ending 19:00	Sensitivity	4013	0	2518	71	3942

Generation Assumptions - Greater Fresno Area

S. No.	Study Case	Scenario Type	Description	Battery		Solar		Wind		Hydro		Thermal	
				Installed (MW)	Dispatch (MW)	Installed (MW)	Dispatch (MW)	Installed (MW)	Dispatch (MW)	Installed (MW)	Dispatch (MW)	Installed (MW)	Dispatch (MW)
1	2024-SPOP-COI	Sensitivity	2024 Spring off-peak load conditions and COI Import sensitivity	1084	0	2185	0	13	3	686	523	1420	977
2	2024-SPOP	Baseline	2024 Spring off-Peak load condition. Off-Peak load time - hours ending 20:00	1084	0	2185	0	13	3	686	523	1420	1112
3	GFA-2024-SP-HiRenew	Sensitivity	2024 Summer peak Load conditions with Hi-Renewable dispatch Sensitivity	1084	0	2185	1960	13	8	1898	1713	1438	337
4	GFA-2024-SP	Baseline	2024 Summer Peak load condition. Peak load time - hours ending 19:00	1084	0	2336	45	13	8	1898	1723	1438	595
5	2027-SPOP	Baseline	2027 Spring Off-Peak load condition. Off-Peak load time - hours ending 13:00	1096	0	2336	1873	13	3	686	-496	1420	418
6	GFA-2027-SP-HiCEC	Sensitivity	2027 Summer peak load conditions with Hi-CEC load forecast sensitivity.	1096	0	2336	47	13	8	1898	1727	1438	1213
7	GFA-2027-SP	Baseline	2027 Summer Peak load condition. Peak load time - hours ending 19:00	1096	0	2336	47	13	8	1898	1727	1438	1224
8	GFA-2032-SP	Baseline	2032 Summer Peak load condition. Peak load time - hours ending 19:00	1889	0	2336	46	13	8	1898	1728	1438	1269

Previously approved transmission projects modelled in base cases

Project Name	Expected ISD
Wilson-Legrand 115 kV Reconductoring	Complete
Wilson Voltage Support (Wilson 115 kV STATCOM)	Complete
Kingsburg-Lemoore 70 kV Line Reconductoring	Mar-25
Herndon - Bullard 115 kV Reconductoring	Dec-26
Panoche-Oro Loma 115 kV Reconductoring	Jun-23
Wilson 115 kV Area Reinforcement	Dec-28
Oro Loma 70 kV Area Reinforcement	Dec-26
Giffen Line Reconductoring	Dec-24
Borden 230/70 kV Transformer Bank #1 Capacity Increase	Jan-25
Coppermine 70kV Reinforcement project	May-27
Wilson-Oro Loma 115 kV Line Reconductoring	May-28
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)	Sep-23

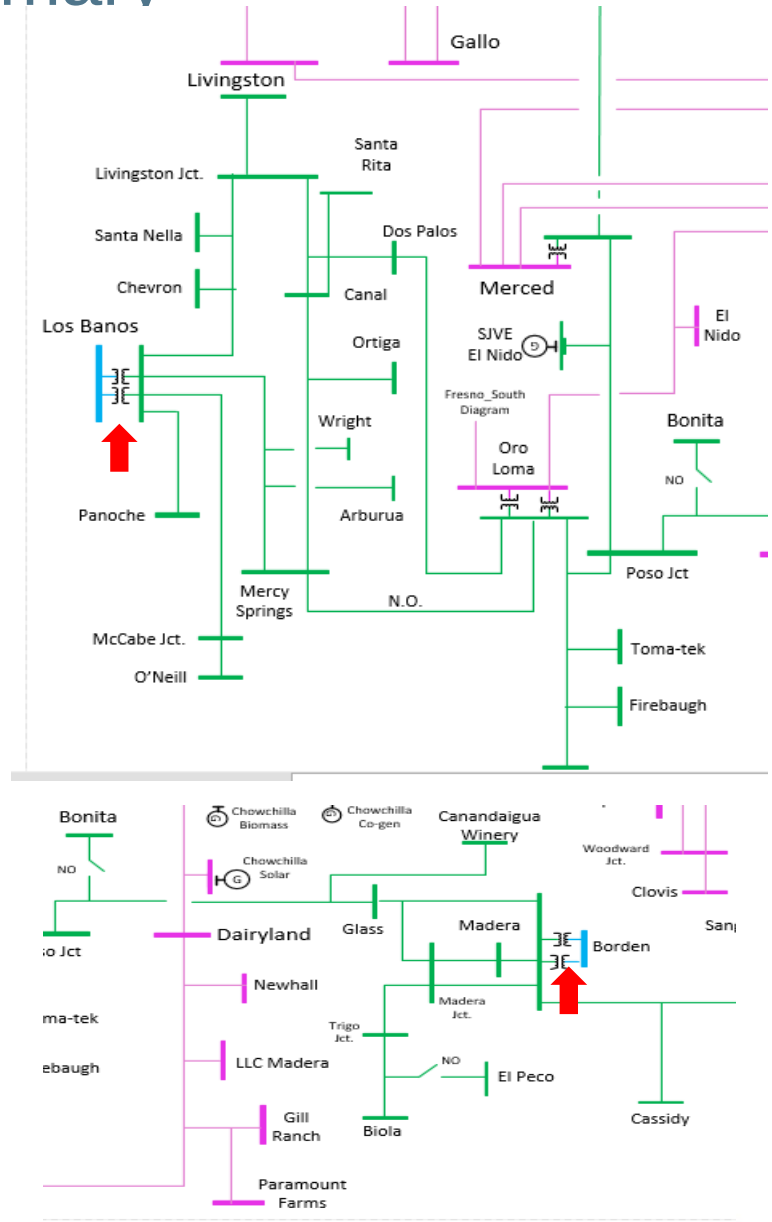
Fresno – 230kV Results Summary

Observations

1. P1 overloads in the 2027 and 2032 peak case:
   - Los Banos 230/70kV Bank No 3
   - For loss of Los Banos 230/70kV Bank No 4
2. P1 overloads in 2024 peak only
   - Borden 230/70kV Bank 1
   - For loss of Borden 230/70 kV Bank 4
3. P5 overloads on Moss Landing-Las Aguilas and Panoche-Las Aguilas 230kV line 1 and 2 in the 2024 peak case.
   - For loss of Los Banos 500-230-70kV Batt(FAILURE OF NON-REDUNDENT BATT)

Potential Mitigations

1. Bank capacity increase
2. Existing Borden 230/70 bank 1 capacity increase project
3. Install redundant battery



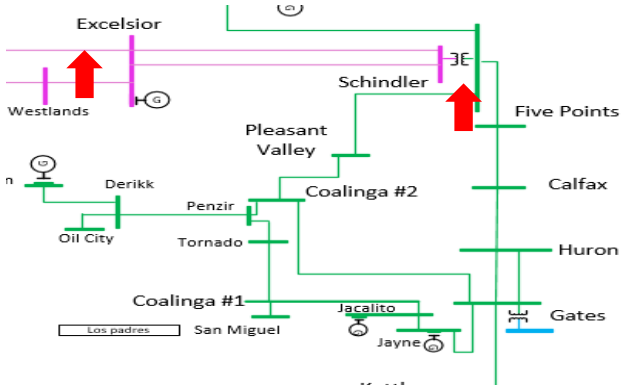
Fresno – Wilson Area 115kV Results Summary

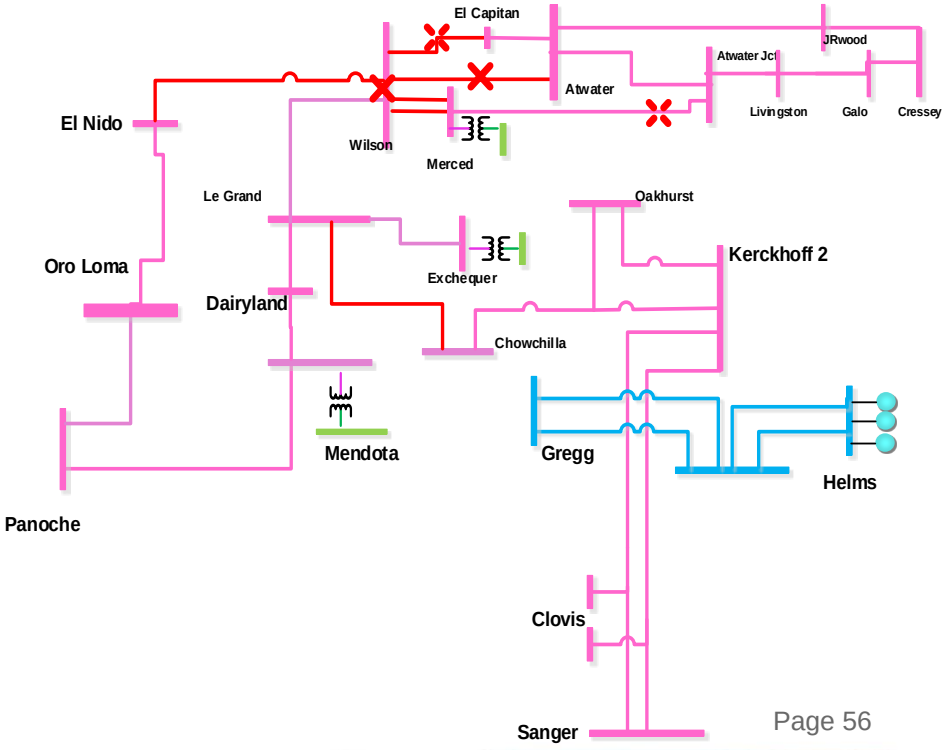
Observations

1. P1 overloads:
   - Panoche-Schindler 115kV Line
   - Schindler 115/70kV Bank 1
   - For loss of Gates 230/70kV Bank 5
2. P2 overloads:
   - Oro Loma- Mendota 115kV lines
3. P5 overload on Mccall-Reedley 115kV Line following the failure of non-redundant Battery at Sanger 115kV
4. P6 overloads:
   - El Capitan-Wilson 115kV Line
   - Exchequer-Le Grand 11kV Line
   - Wilson-Atwater #1 and #2 115kV Line
   - Wilson-Merced #2 115kV Line

Potential Mitigations

1. Project: Rely on generic resource solar+bess project on Gates 70kV.
2. Review existing Wilson-Oro Loma 115kV reconductoring
3. Install redundant battery
4. Project: Wilson 115kV Reinforcement





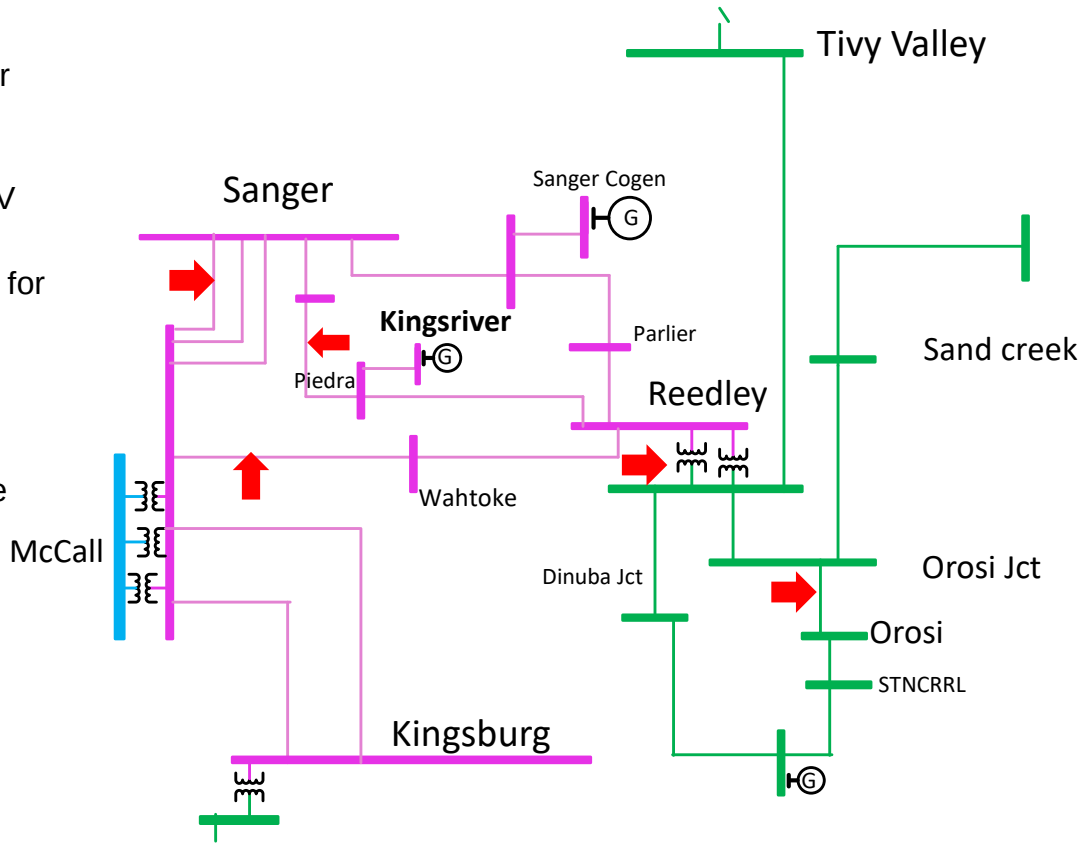
Fresno – Reedley Area 115kV/70kV Results Summary

Observations

1. P1 overload on Dinuba- Orosi 70kV Line for loss of Reedley-Dinuba #1 70kV line
2. P1 overload on Reedley 115/70kV transformer #4 for loss of Reedley 115/70kV transformer #2
3. P5 overload on Mccall- Reedley 115kV line for loss of Sanger 115kV Batt(FAILURE OF NON-REDUNDENT BATT)
4. P6 overload on Kingsriver-Sanger-Reedley 115kV Line
5. P6 overload on McCall-Reedley 115kV Line
6. P6 overload on McCall-Sanger #2 Line

Potential Mitigations

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



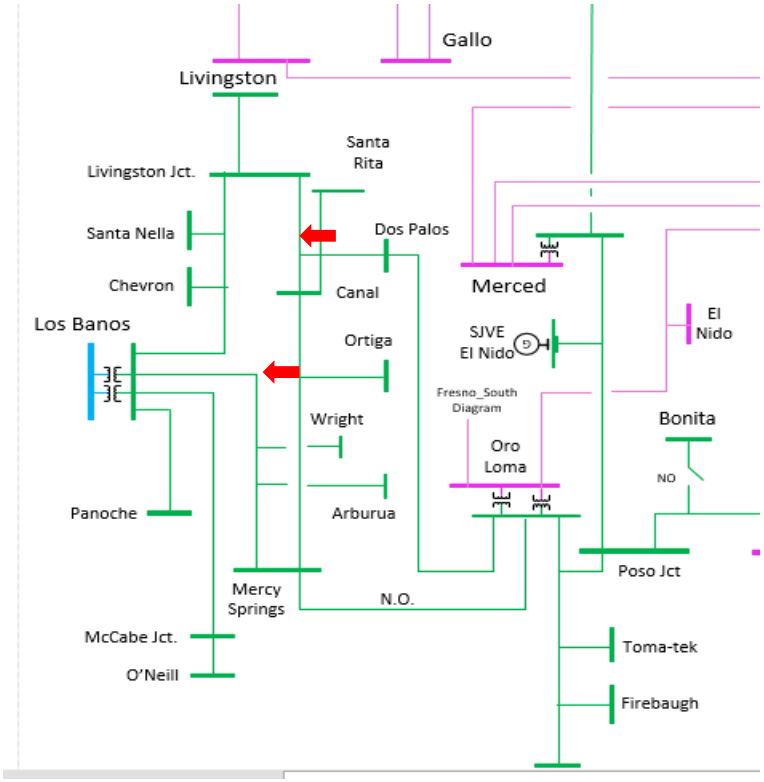
Fresno – 70kV Results Summary

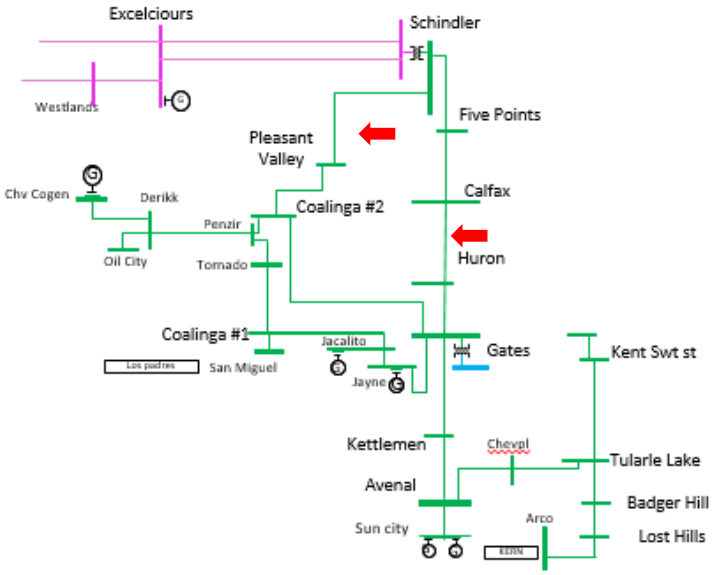
Observations

1. P1 overload on Los Banos-Canal-Oro Loma 70kV line for loss of Los banos-Livingston Jct- Canal 70kV
2. P1 overload on Schindler-Coalinga #2 70kV line and Schindler-Huron-Gates 70kV line for loss of Gates 230/70kV bank 5

Potential Mitigations

1. Review and upgrade existing Oro Loma 70kV area reinforcement
2. Project: Rely on generic resource sol





Fresno– Low Voltage Results Summary

Observations

1. P0 low voltages in Coppermine 70kV area
2. P0-P7 low voltages in Oro Loma 70kV area
3. P1 and P2 low voltages on Panoche-Mendota 115kV Line in all peak cases
4. P1 and P2 low voltages on Panoche-Oro Loma 115kV Line in 2032 peak cases
5. Multiple Low Voltage seen in the Coalinga 70kV area
6. Low voltages in the Reedley 70kV pocket in all peak cases

Approved and Potential Mitigations

1. Coppermine area re-inforcement project
2. Oro Loma 70kV area Reinforcement Project
3. Wilson 115kV Reinforcement Project
4. Panoche-Oro Loma 115kV Reconductoring project
5. Wilson 115kV Reinforcement Project.
6. Reedley 70kV Reinforcement Project

GFA Results Summary (2035 ATE Sensitivity)

Monitored Facility	P1	P2	P7	Facility overloaded in baseline scenario?
(New)Mercy Springs-Canal 70 kV Line #1	111.8			Yes
34370 MC CALL 115 30877 MCCALL2M 115 2 1		100.48		Yes
EXCELSIORSS-SCHINDLR #1 115kV Line		105.32		Yes
EXCELSIORSS-SCHINDLR #2 115kV Line		105.32		Yes
Five Points Sw Sta-Huron-Gates 70kV Line(Five Points Sw Sta-Calflax section)		121.76		Yes
GWF-Kingsburg 115 kV Line		102.38	101.42	Yes
Jackson Sw Sta-Contadina 115kV Line		104.56		Yes
Schindler 115/70 kV Transformer #1		122.46		Yes
Schindler-Coalinga #2 70 kV Line		104.2		Yes
Schindler-Coalinga #2 70 kV Line (Schindler-Paige section)		109.12		Yes
Schindler-Huron-Gates 70 kV Line	100.24	123.66		Yes

Sensitivity only issues

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

Overloaded Facility	Category	2024 SP Heavy Renewable & Min Gas Gen	2024 OP Sensitivity	2027 SP High CEC Forecast
Chowchilla-Kerckhoff #2 115 kV Line	P6	✓		
Dos Amigos PP-Panoche #3 230 kV Line	P6	✓		
Five Points Sw Sta-Huron-Gates 70kV Line(	P2, P7	✓		
GWF-Kingsburg 115 kV Line	P6	✓		
Kingsburg E-Kingsburg D 115kV section	P6	✓		
Legrand-Chowchilla 115kV	P2	✓		
Legrand-Dairyland 115kV(Legrand-chowchi	P2	✓		
McCall-Kingsburg #1 115 kV Line	P6	✓		
Merced Falls-Exchequer 70 kV Line	P6	✓		
Merced-Merced Falls 70 kV Line	P6	✓		

Sensitivity only issues - continued

Overloaded Facility	Category	2024 SP Heavy Renewable & Min Gas Gen	2024 OP Sensitivity	2027 SP High CEC Forecast
MustangSS-Gates 230KV Line No 1	P1, P6	✓		
MustangSS-Gates 230KV Line No 1	P3		✓	
MustangSS-Gates 230KV Line No 2	P1, P2, P6	✓		
MustangSS-Gates 230KV Line No 2	P3		✓	
Panoche-Schindler #2 115 kV Line	P2	✓		
Reedley 115/70 kV Transformer #4	P1, P2, P6			✓
Schindler 115/70 kV Transformer #1	P2, P6	✓		
Schindler-Coalinga #2 70 kV Line	P2, P6	✓		
Schindler-Huron-Gates 70 kV Line	P2	✓		
Warnerville - Wilson 230 kV Line	P1, P2, P6, P7		✓	
Wilson 230kV reactor	P7		✓	

Summary of Fresno results

- New project expected for Losbanos 70kV area
- Continue to need existing/rescope projects
  - Wilson 115kV Reinforcement Project
  - Herndon-Bullard 115 kV Reconductor
  - Reedley 70 kV Reinforcement (Dinuba Battery Energy Storage)
  - Wilson-Oro Loma Reconductoring

Bellota-Warnerville 230kV Line limiting equipment replacement

Vera Hart
Transmission Planning Engineer Lead
Regional Transmission North

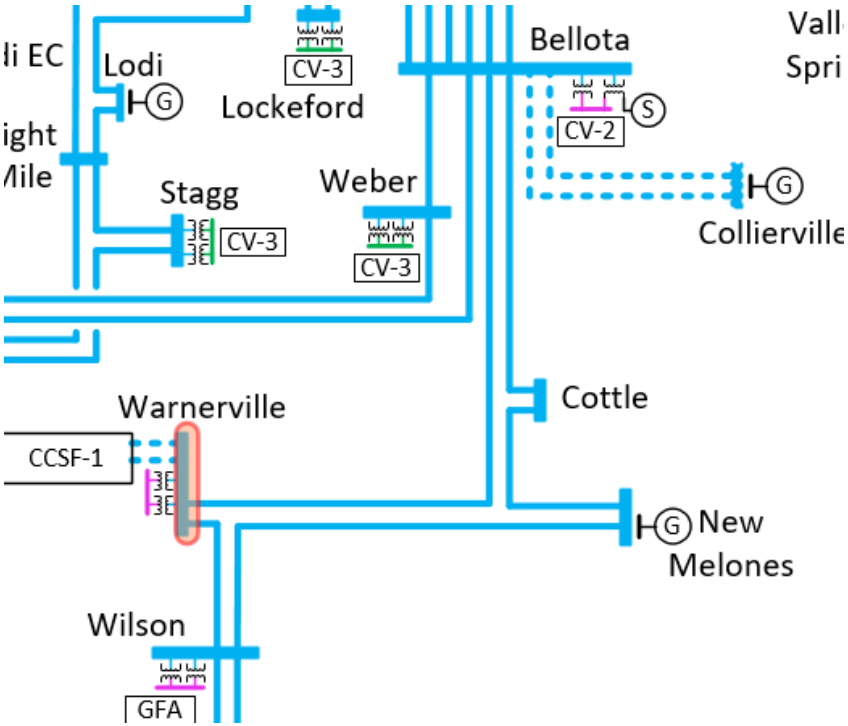
2022-23 Transmission Planning Process Stakeholder Meeting
September 27-28, 2022

Introduction

- Bellota-Warnerville 230kV reconductoring Project was Approved in the 2012-2013 TPP cycle as a Policy Project.
- In the 2021-2022 TPP cycle updated information was shared with CAISO that neighboring system equipment upgrades (owned by CCSF) at Warnerville 230kV Substation, are triggered by this CAISO previously approved reconductoring project
- The CAISO voluntarily agrees to bear the cost of the limiting equipment upgrades on the CCSF system – funded through participating transmission owner
- The ISO's tariff calls for stakeholders to be informed and provided an opportunity to provide comments (section 24.10)
- This presentation is to inform stakeholders of the scope and cost of upgrading the limiting equipment at Warnerville

Scope and Cost of upgrades at Warnerville 230kV substation

- Project Scope
  - Reconductor Bellota-Warnerville 230kV Line (Previously Approved Policy Project) and upgrade limiting equipment at Warnerville 230kV-Install new jumpers, switches and new relays at the Warnerville 230kV Sub
- Estimated Project Cost
  - $100-$150M-Line Reconductoring (Previously Approved)
  - + $1.6M Limiting equipment at Warnerville (Recommended for approval)
- Estimated In-service Date
  - 2024

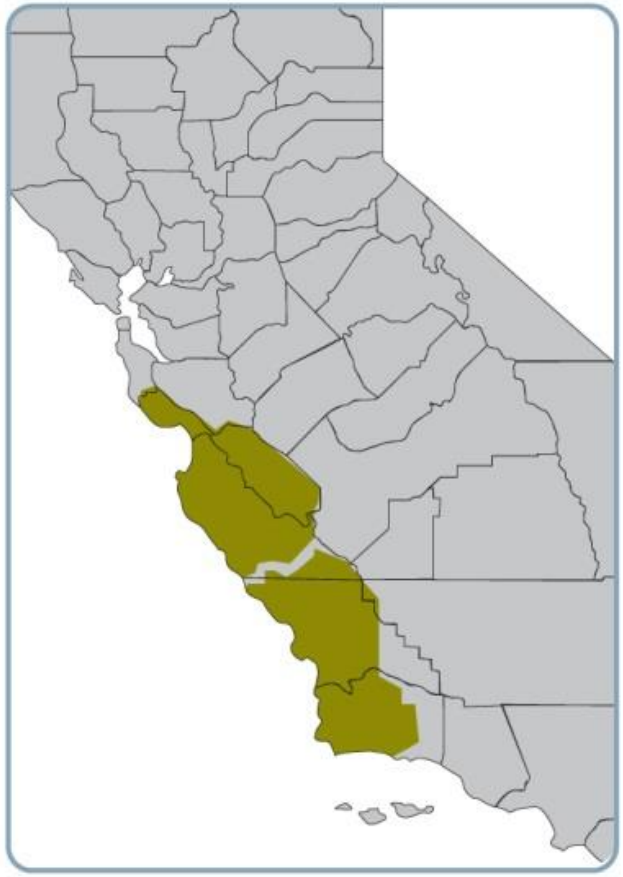


Central Coast and Los Padres Area
Preliminary Reliability Assessment Results

Preethi Rondla
Senior Regional Transmission Engineer

2022-2023 Transmission Planning Process Stakeholder Meeting
September 27-28, 2022

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	Description	Scenario Type	Gross Load (MW)	BTM-PV		AAEE (MW)	Net Load (MW)
					Output (MW)	Installed (MW)		
1	CCLP-2024-SP	2024 Summer Peak load condition. Peak load time - hours ending 19:00	Baseline	1109	0	602	14	1095
2	CCLP-2024-SP-HiRenew	2024 Summer peak Load conditions with Hi-Renewable dispatch Sensitivity	Sensitivity	1392	596	601	15	782
3	CCLP-2027-SP	2027 Summer Peak load condition. Peak load time - hours ending 19:00	Baseline	1436	0	796	24	1412
4	CCLP-2027-SP-HiCEC	2027 Summer peak load conditions with Hi-CEC load forecast sensitivity.	Sensitivity	1436	0	796	0	1435
5	CCLP-2032-SP	2032 Summer Peak load condition. Peak load time - hours ending 19:00	Baseline	1678	0	1162	37	1640
6	2024-WPK	2024 Winter Peak load condition. Winter Peak load time - hours ending 19:00	Baseline	980	0	610	14	966
7	2024-SPOP	2024 Spring off-Peak load condition. Off-Peak load time - hours ending 20:00	Baseline	987	0	602	11	976
8	2024-SPOP-COI	2024 Spring off-peak load conditions and COI Import.	Sensitivity	987	0	602	11	976
9	2027-WPK	2027 Winter Peak load condition. Winter Peak load time - hours ending 19:00	Baseline	987	0	806	24	962
10	2027-SPOP	2027 Spring Off-Peak load condition. Off-Peak load time - hours ending 13:00	Baseline	1291	644	805	14	633
11	2032-WPK	2032 Winter Peak load condition. Winter Peak load time - hours ending 19:00	Baseline	1102	0	1178	39	1064
12	CCLP-2035-SP-ATE	2035 Summer Peak load condition with ATE. Peak load time - hours ending 19:00	Sensitivity	1817	0	1162	35	1782

Generation Assumptions - Central Coast/ Los Padres Area

S. No.	Study Case	Scenario Type	Description	Battery		Solar		Wind		Hydro		Thermal	
				Installed (MW)	Dispatch (MW)	Installed (MW)	Dispatch (MW)	Installed (MW)	Dispatch (MW)	Installed (MW)	Dispatch (MW)	Installed (MW)	Dispatch (MW)
1	2024-SPOP-COI	Sensitivity	2024 Spring off-peak load conditions and COI Import sensitivity	656	0	812	0	0	0	0	0	2711	1088
2	2024-SPOP	Baseline	2024 Spring off-Peak load condition. Off-Peak load time - hours ending 20:00	656	0	812	0	0	0	0	0	2711	1088
3	2024-WPK	Baseline	2024 Winter Peak load condition. Winter Peak load time - hours ending 19:00	656	0	802	0	0	0	0	0	2711	1088
4	CCLP-2024-SP-HiRenew	Sensitivity	2024 Summer peak Load conditions with Hi-Renewable dispatch Sensitivity	656	0	812	804	0	0	0	0	2711	34
5	CCLP-2024-SP	Baseline	2024 Summer Peak load condition. Peak load time - hours ending 19:00	656	0	812	0	0	0	0	0	2711	1148
6	2027-SPOP	Baseline	2027 Spring Off-Peak load condition. Off-Peak load time - hours ending 13:00	656	0	812	747	0	0	0	0	2711	153
7	2027-WPK	Baseline	2027 Winter Peak load condition. Winter Peak load time - hours ending 19:00	656	0	802	0	0	0	0	0	2711	1088
8	CCLP-2027-SP-HiCEC	Sensitivity	2027 Summer peak load conditions with Hi-CEC load forecast sensitivity.	656	0	812	8	0	0	0	0	2711	1175
9	CCLP-2027-SP	Baseline	2027 Summer Peak load condition. Peak load time - hours ending 19:00	656	0	812	8	0	0	0	0	2711	1175
10	2032-WPK	Baseline	2032 Winter Peak load condition. Winter Peak load time - hours ending 19:00	707	0	802	0	0	0	0	0	2711	1088
11	CCLP-2032-SP	Baseline	2032 Summer Peak load condition. Peak load time - hours ending 19:00	707	0	812	8	0	0	0	0	2711	1189

Previously approved transmission projects modelled in base cases

Project Name	First Year Modeled
Estrella Substation Project	May 2026
South of Mesa Upgrade	Sep 2026
Salinas-Firestone #1 and #2 60kV lines	2025
Oil Fields 60 kV Area Voltage Support	Jun 2029
Morgan Hill Area Reinforcement (FKA: Spring Substation)	2026
Installing 10-ohm Reactors on Mosslanding-Las Aguilas 230kV line	May 2026
North of Mesa Upgrade	2026 (on hold)

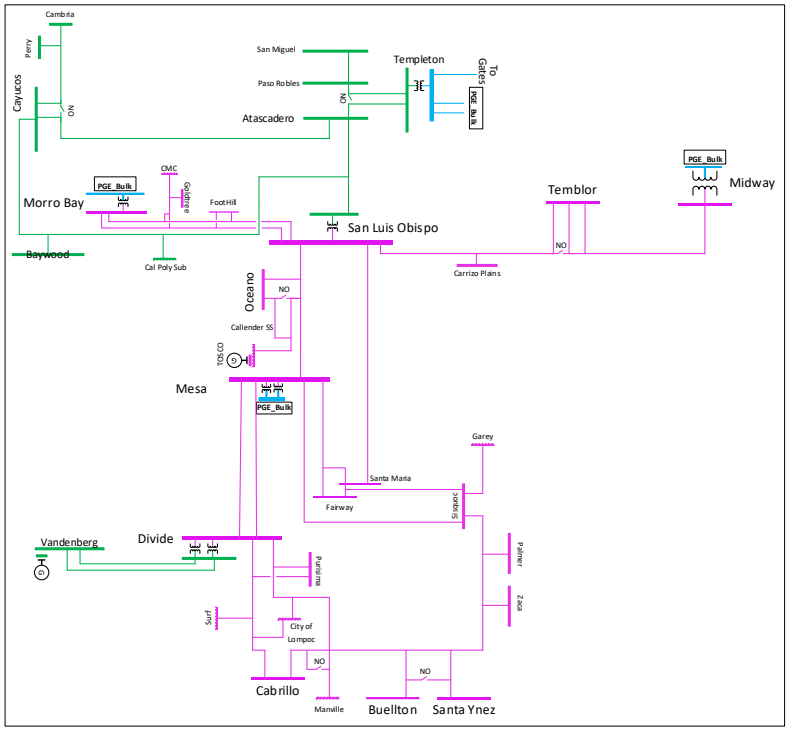
Central Coast/ Los Padres - Results Summary

Observations

- P5 overloads for loss of
  - _MESA 230-115KV BATT(FAILURE OF NON-REDUNDENT BATT)
  - _MORRO BAY SW 230-115KV BATT(FAILURE OF NON-REDUNDENT BATT)
  - _MOSS LANDING 230-115KV BATT(FAILURE OF NON-REDUNDENT BATT)
  - _SOLAR SW STA 230KV BATT(FAILURE OF NON-REDUNDENT BATT)
  - _CALIENTE 230KV BATT(FAILURE OF NON-REDUNDENT BATT)
- P2, P6, P7 overloads in the greater Mesa area
- P1,P2, P6, P7 overloads on Salinas- Firestone #1 and #2 Lines

Approved and Potential Mitigations

- Add redundant battery
- Existing UVLS/ Mesa BESS
- Salinas- Firestone #1 and #2 reconductor



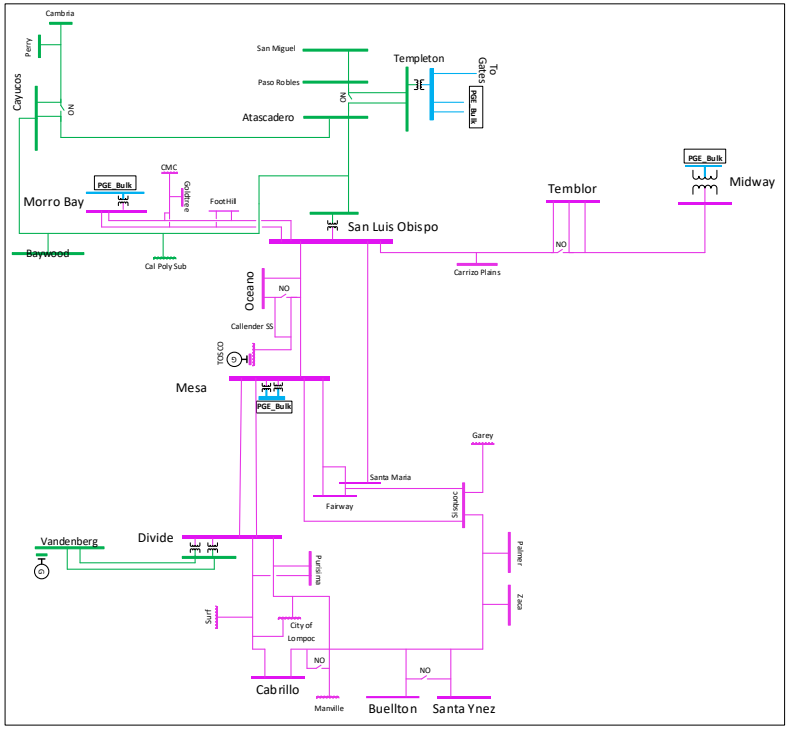
Central Coast/ Los Padres - Results Summary

Observations

- 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

- Estrella Substation Project
- Morgan Hill Area Reinforcement
- South of Mesa Upgrades



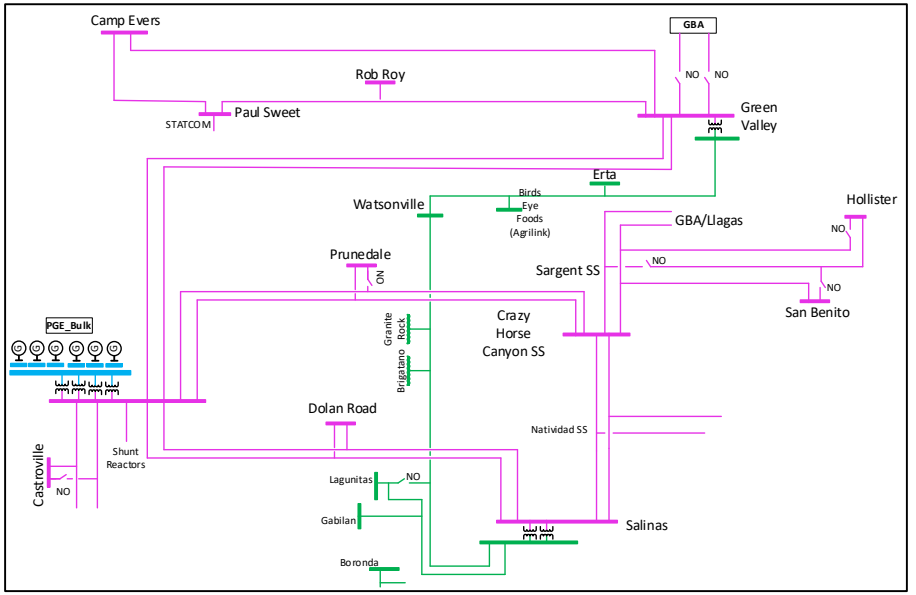
Central Coast/ Los Padres – Low Voltage Results Summary

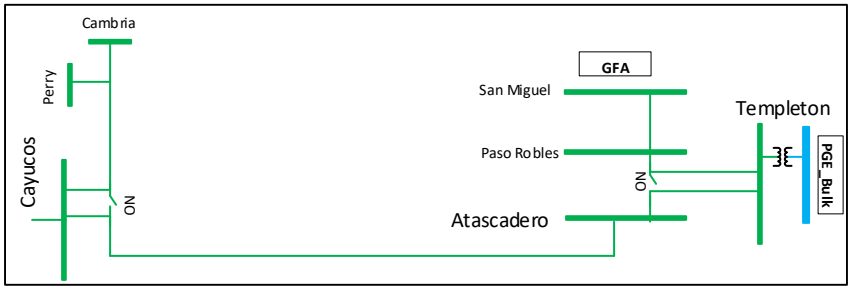
<u>Observations</u>

- 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

- None

CCLP Results Summary (2035 ATE Sensitivity)

Montored Facility	P1	P2	P5	P7	Facility overloaded in Baseline Scenario
Atascadero-Cayucos 70 kV Line		103.84			Yes
Callender Sw. Sta-Mesa 115 kV Line			0		Yes
Crazy Horse-Moss Landing #1 115 kV Line				109.26	Yes
Crazy Horse-Moss Landing #2 115 kV Line				106.43	Yes
Crazy Horse-Natividad #1 115 kV Line		101.57		111.82	Yes
Crazy Horse-Soledad 115 kV Line		101.57		111.82	Yes
Green Valley 115/60 Transformer #1				107.02	Yes
Mesa-Santa Maria 115 kV Line	108.31	109.87			Yes
Mesa-Sisquoc 115 kV Line				110.71	No
Morro Bay 230/115 Transformer No. 6			72.31		Yes
Morro Bay-Mesa 230 kV Line		106.04			Yes
Moss Landing-Del Monte #2 115 kV Line		106.46			No
S.M.ASSO-Sisquoc 115 kV Line				110.81	No
Salinas 115/60 kV Bank #2	104.29	104.29			No
San Luis Obispo-Oceano 115 kV Line			47.65		Yes
San Luis Obispo-Santa Maria 115 kV Line		106.58	0		Yes
Temblor-San Luis Obispo 115 kV Line		127.79		103.87	Yes

Summary of potential new upgrades

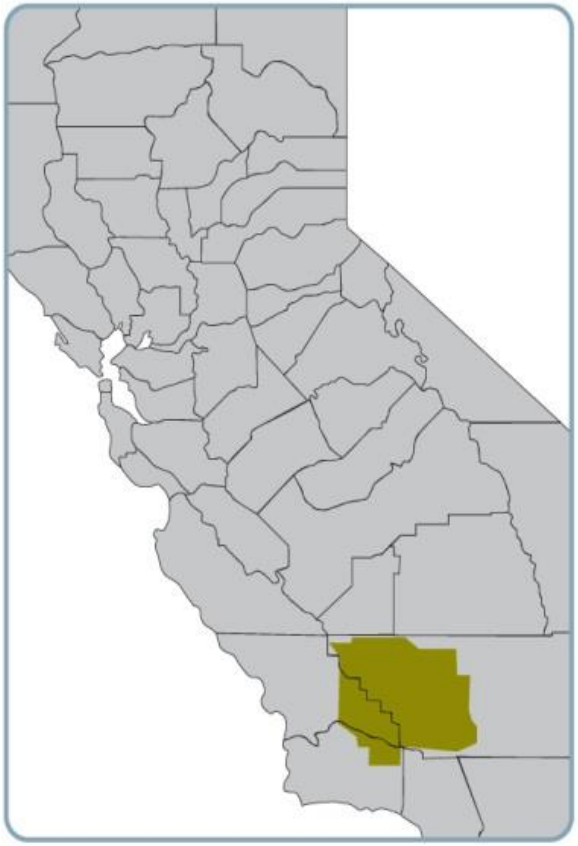
Division	Reliability Concern	Potential Upgrade
None		

Kern
Preliminary Reliability Assessment Results

Lindsey Thomas
Senior Regional Transmission Engineer

2022-23 Transmission Planning Process Stakeholder Meeting
September 27-28, 2022

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

S. No.	Study Case	Description	Scenario Type	Gross Load (MW)	BTM-PV		AAEE (MW)	Net Load (MW)
					Output (MW)	Installed (MW		
1	KERN-2024-SP	2024 Summer Peak load condition. Peak load time - hours ending 19:00	Baseline	2121	0	762	15	2106
2	KERN-2024-SP-HiRenew	2024 Summer peak Load conditions with Hi-Renewable dispatch Sensitivity	Sensitivity	2121	754	762	15	1352
3	KERN-2027-SP	2027 Summer Peak load condition. Peak load time - hours ending 19:00	Baseline	2175	0	906	22	2152
4	KERN-2027-SP-HiCEC	2027 Summer peak load conditions with Hi-CEC load forecast sensitivity.	Sensitivity	2175	0	906	0	2175
5	KERN-2032-SP	2032 Summer Peak load condition. Peak load time - hours ending 19:00	Baseline	2283	0	1170	31	2252
6	2024-SPOP	2024 Spring off-Peak load condition. Off-Peak load time - hours ending 20:00	Baseline	1484	0	762	14	1470
7	2024-SPOP-COI	2024 Spring off-peak load conditions and COI Import.	Sensitivity	1484	0	762	14	1470
8	2027-SPOP	2027 Spring Off-Peak load condition. Off-Peak load time - hours ending 13:00	Baseline	1862	708	885	17	1138
9	KERN-2035-SP-ATE	2035 Summer Peak load condition with ATE. Peak load time - hours ending 19:00	Sensitivity	2377	0	1170	37	2339

Generation Assumptions - Kern

S. No.	Study Case	Scenario Type	Description	Battery		Solar		Wind		Hydro		Thermal	
				Installed (MW)	Dispatch (MW)	Installed (MW)	Dispatch (MW)	Installed (MW)	Dispatch (MW)	Installed (MW)	Dispatch (MW)	Installed (MW)	Dispatch (MW)
1	2024-SPOP-COI	Sensitivity	2024 Spring off-peak load conditions and COI Import sensitivity	245	0	480	0	0	0	29	9	3304	1522
2	2024-SPOP	Baseline	2024 Spring off-Peak load condition. Off-Peak load time - hours ending 20:00	245	0	480	0	0	0	29	9	3304	2327
3	KERN-2024-SP-HiRenew	Sensitivity	2024 Summer peak Load conditions with Hi-Renewable dispatch Sensitivity	245	0	500	443	0	0	29	16	3283	565
4	KERN-2024-SP	Baseline	2024 Summer Peak load condition. Peak load time - hours ending 19:00	245	0	500	0	0	0	29	8	3283	2579
5	2027-SPOP	Baseline	2027 Spring Off-Peak load condition. Off-Peak load time - hours ending 13:00	245	0	510	456	0	0	29	9	3283	1948
6	KERN-2027-SP-HiCEC	Sensitivity	2027 Summer peak load conditions with Hi-CEC load forecast sensitivity.	245	0	500	0	0	0	29	22	3283	2679
7	KERN-2027-SP	Baseline	2027 Summer Peak load condition. Peak load time - hours ending 19:00	245	0	500	0	0	0	29	10	3283	2676
8	KERN-2032-SP	Baseline	2032 Summer Peak load condition. Peak load time - hours ending 19:00	499	0	500	0	0	0	29	11	3283	1485

Previously approved transmission projects modelled in base cases

Project Name	In-service Year	First Year Modeled
Wheeler Ridge Junction project	On HOLD	N/A
Bakersfield-Kern Taps 1&2 230kV Recon	9/29/2026	2027
Midway-Kern Nos. 1 and 2 230kV Line	6/2/2025	2027
Midway-Temblor 115kV Recon & Voltage Sup	2/16/2028	2032
Kern PP 115 kV Area Reinforcement	11/5/2026	2027

Reliability assessment preliminary results summary

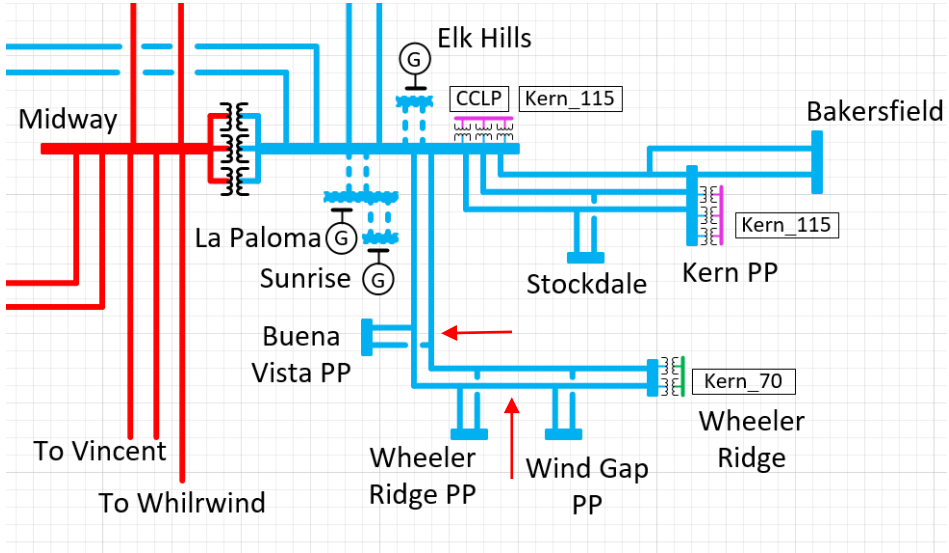
Kern 230 kV – Results Summary (2023 – 2032)

Observations

- P1, P2, P6 overloads on Midway – Wheeler Ridge 230kV #1 and #2 lines

Approved and Potential Mitigations

- Re-evaluation of on Hold Wheeler ridge substation project



Kern 115kV – Results Summary (2023 – 2032)

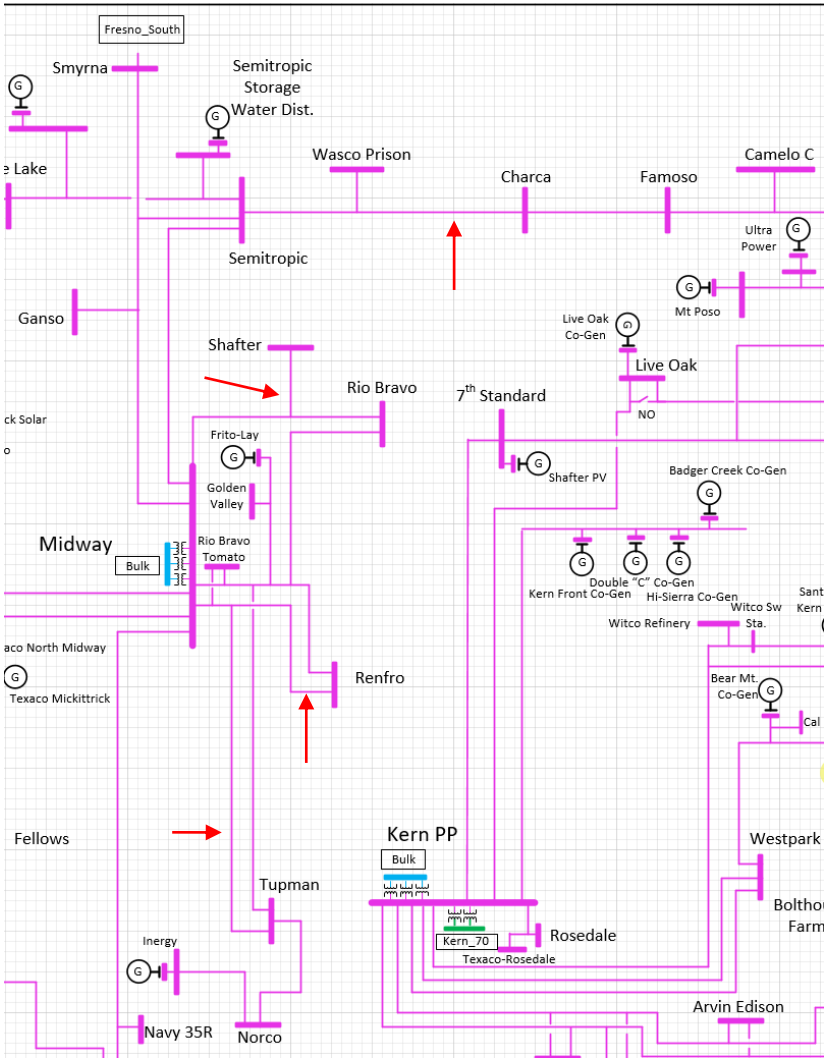
Observations

- Midway – Shafter 115 kV line P1, P2, P3, P5, P6, P7 overloads
- Midway-Tupman-Rio Bravo-Renfro 115 kV Line P1, P2, P3, P5, P6 overloads
- Semitropic – Famoso 115 kV line P1, P2, P3, P5, P6, P7 overloads
- Lerdo-Kern Oil-7th Standard 115 kV Line P3 overloads

- Long Term P2 Kern-Lamont 115 kV Line and Kern-Stockdale 115 kV Line overloads

Approved and Potential Mitigations

- New Kern 115 Area reconductoring
- Lamont BESS – Under Review



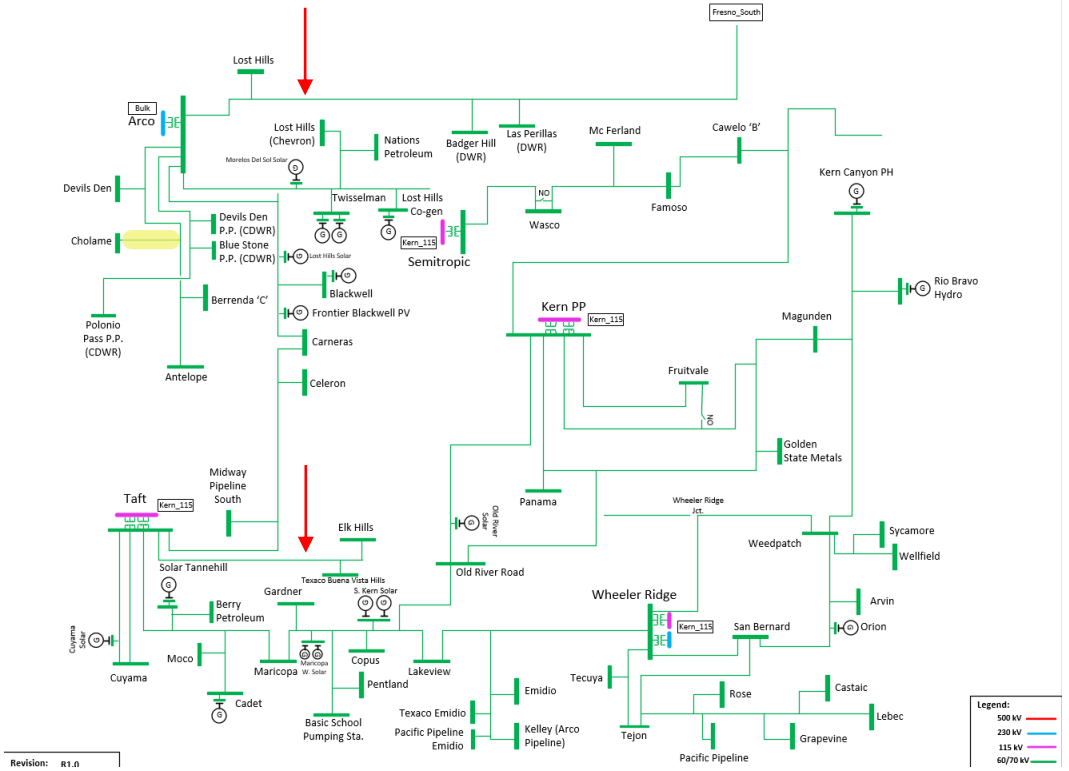
Kern 70kV – Results Summary (2023 – 2032)

Observations

- P0 overload on Arco-Tulare Lake 70 kV lines
- P1 Wheeler Ridge-San Bernard 70 kV Line and Wheeler Ridge-Tejon 70 kV Line

Approved and Potential Mitigations

- Operational solution



Kern – Results Summary (2035 ATE Sensitivity)

Incremental issues identified in 2035 ATE sensitivity

Monitored Facility	Cont. Type / Worst Loading %				Facility overloaded in baseline scenario?
	P1	P2	P5	P7	
Kern-Kern Oil-Famoso 70 kV Line	105.62	105.94	105.67		yes
Kern-Lamont 115 kV Line		102.92			yes
Kern-Stockdale 115 kV Line	102.94	104.07	102.94		yes
Lerdo-Famoso 115 kV Line			116.2		yes
Lerdo-Kern Oil-7th Standard 115 kV Line	103.22		103.1		yes
Live Oak-Kern Oil 115 kV Line			102.36		yes
Midway 230/115 kV Transformer #3		104.7			yes
Midway-Wheeler Ridge #2 230kV Line		102.65			yes
Semitropic-Midway #1 115kV Line		104.13			yes
Semitropic-Wasco 70 kV Line		104.69			yes
Taft-Elk Hills 70 kV Line	101.22	104.61	101.62	101.33	yes
Taft-Maricopa 70 kV Line	102.2	100.84			yes
Wasco-Famoso 70 kV Line		110.29	107.06		yes
Wasco-Famoso 70kV Line		109.42			yes
Wheeler Ridge-Tejon 70 kV Line	103.97				yes

Summary of potential new upgrades

Reliability Concern	Potential Upgrade
P1-P7	• New Kern 115 Area reconductoring

North Coast and North Bay Areas
Preliminary Reliability Assessment Results

Bryan Fong
Senior Regional Transmission Engineer

2022-23 Transmission Planning Process Stakeholder Meeting
September 27-28, 2022

North Coast and North Bay Areas

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

Load and Load Modifier Assumptions - NCNB Area

S. No.	Study Case	Description	Scenario Type	Gross Load (MW)	BTM-PV		AAEE (MW)	Net Load (MW)
					Output (MW)	Installed (MW)		
1	NCNB-2024-SP	2024 Summer Peak load condition. Peak load time - hours ending 19:00	Baseline	1490	26	596	9	1455
2	NCNB-2027-SP	2027 Summer Peak load condition. Peak load time - hours ending 19:00	Baseline	1523	0	730	12	1511
3	NCNB-2032-SP	2032 Summer Peak load condition. Peak load time - hours ending 19:00	Baseline	1830	0	948	13	1817
4	2024-WPK	2024 Winter Peak load condition. Winter Peak load time - hours ending 19:00	Baseline	1134	0	607	12	1122
5	2027-WPK	2027 Winter Peak load condition. Winter Peak load time - hours ending 19:00	Baseline	1134	0	745	21	1112
6	2032-WPK	2032 Winter Peak load condition. Winter Peak load time - hours ending 19:00	Baseline	1258	0	971	32	1225
7	2024-SPOP	2024 Spring off-Peak load condition. Off-Peak load time - hours ending 20:00	Baseline	1059	0	596	10	1049
8	2027-SPOP	2027 Spring Off-Peak load condition. Off-Peak load time - hours ending 13:00	Baseline	1123	584	730	13	527
9	NCNB-2024-SP-HiRe	2024 Summer peak Load conditions with Hi-Renewable dispatch Sensitivity	Sensitivity	1490	590	596	9	891
10	2024-SPOP-COI	2024 Spring off-peak load conditions and COI Import.	Sensitivity	1059	0	596	10	1049
11	NCNB-2027-SP-HiCEC	2027 Summer peak load conditions with Hi-CEC load forecast sensitivity.	Sensitivity	1523	0	730	0	1523
12	NCNB-2035-SP-ATE	2035 Summer Peak load condition with ATE. Peak load time - hours ending 19:00	Sensitivity	2034	0	948	29	2005

Generation Assumptions - NCNB Area

S. No.	Study Case	Scenario Type	Description	Battery		Solar		Wind		Hydro		Thermal	
				Installed (MW)	Dispatch (MW)	Installed (MW)	Dispatch (MW)	Installed (MW)	Dispatch (MW)	Installed (MW)	Dispatch (MW)	Installed (MW)	Dispatch (MW)
1	NCNB-2024-SP	Baseline	2024 Summer Peak load condition. Peak load time - hours ending 19:00	0	0	0	0	0	0	25	14	1535	823
2	NCNB-2027-SP	Baseline	2027 Summer Peak load condition. Peak load time - hours ending 19:00	0	0	0	0	0	0	25	4	1535	849
3	NCNB-2032-SP	Baseline	2032 Summer Peak load condition. Peak load time - hours ending 19:00	5	0	0	0	0	0	25	14	1535	931
4	2024-WPK	Baseline	2024 Winter Peak load condition. Winter Peak load time - hours ending 19:00	0	0	0	0	0	0	25	14	1535	764
5	2027-WPK	Baseline	2027 Winter Peak load condition. Winter Peak load time - hours ending 19:00	0	0	0	0	0	0	25	6	1535	764
6	2032-WPK	Baseline	2032 Winter Peak load condition. Winter Peak load time - hours ending 19:00	5	0	0	0	0	0	25	6	1535	764
7	2024-SPOP	Baseline	2024 Spring off-Peak load condition. Off-Peak load time - hours ending 20:00	0	0	0	0	0	0	25	6	1535	764
8	2027-SPOP	Baseline	2027 Spring Off-Peak load condition. Off-Peak load time - hours ending 13:00	0	0	0	0	0	0	25	6	1535	764
9	NCNB-2024-SP-HiRe	Sensitivity	2024 Summer peak Load conditions with Hi-Renewable dispatch Sensitivity	0	0	0	0	0	0	25	4	1535	823
10	2024-SPOP-COI	Sensitivity	2024 Spring off-peak load conditions and COI Import sensitivity	0	0	0	0	0	0	25	4	1535	790
11	NCNB-2027-SP-HiCEC	Sensitivity	2027 Summer peak load conditions with Hi-CEC load forecast sensitivity.	0	0	0	0	0	0	25	4	1535	849

Previously approved transmission projects modelled in base cases

Project Name	In-service Year	First Year Modeled
Clear Lake 60 kV System Reinforcement	2027	2027
Fulton-Hopland 60 kV Line Project	2021	2024
Ignacio Area Upgrade	2029	2032
Lakeville 60 kV Area Reinforcement	2027	2027
Vaca Dixon-Lakeville 230 kV Corridor Series Compensation	2025	2027
Tulucay-Napa #2 60 kV Line Capacity Increase	2026	2027

Reliability assessment preliminary results summary

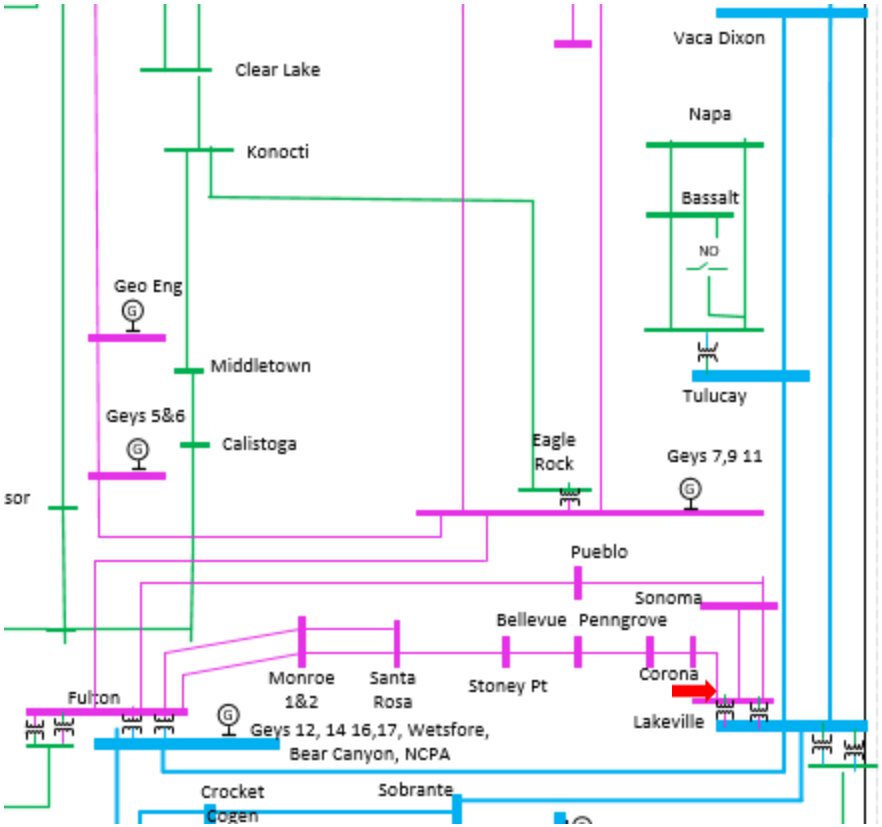
NCNB– Results Summary (2023 – 2032)

Observations
115 kV

- P2 & P5 Fulton 115KV Bus, P7 Fulton 230/115KV TB 4 & TB 9 causes overload of Corona- Lakeville 115kV Line in summer peak cases.

Potential Mitigations

- Santa Rosa SPS, BESS or reconductor
- Operation solution

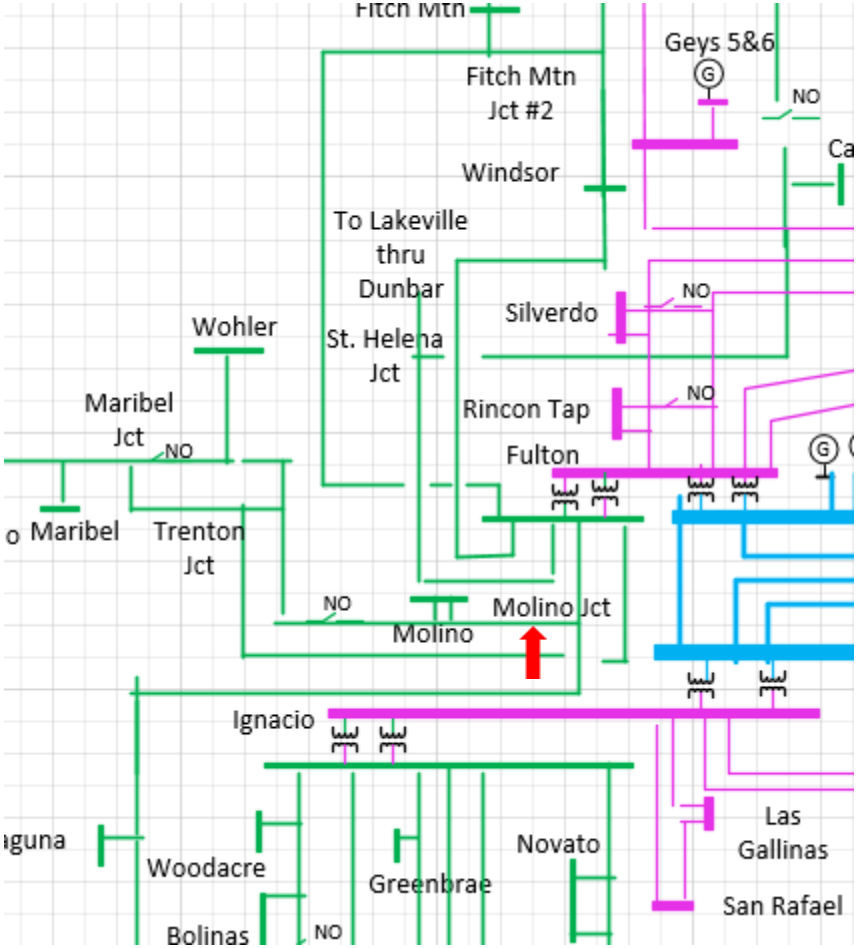


NCNB– Results Summary (2023 – 2032)

Observations
60 kV

- P2 and P5 Fulton 115KV Bus cause overload of Fulton- Molino- Cotati 60 kV Line in summer peak cases

Potential Mitigations
- Install Redundant Relay
- Operation solution

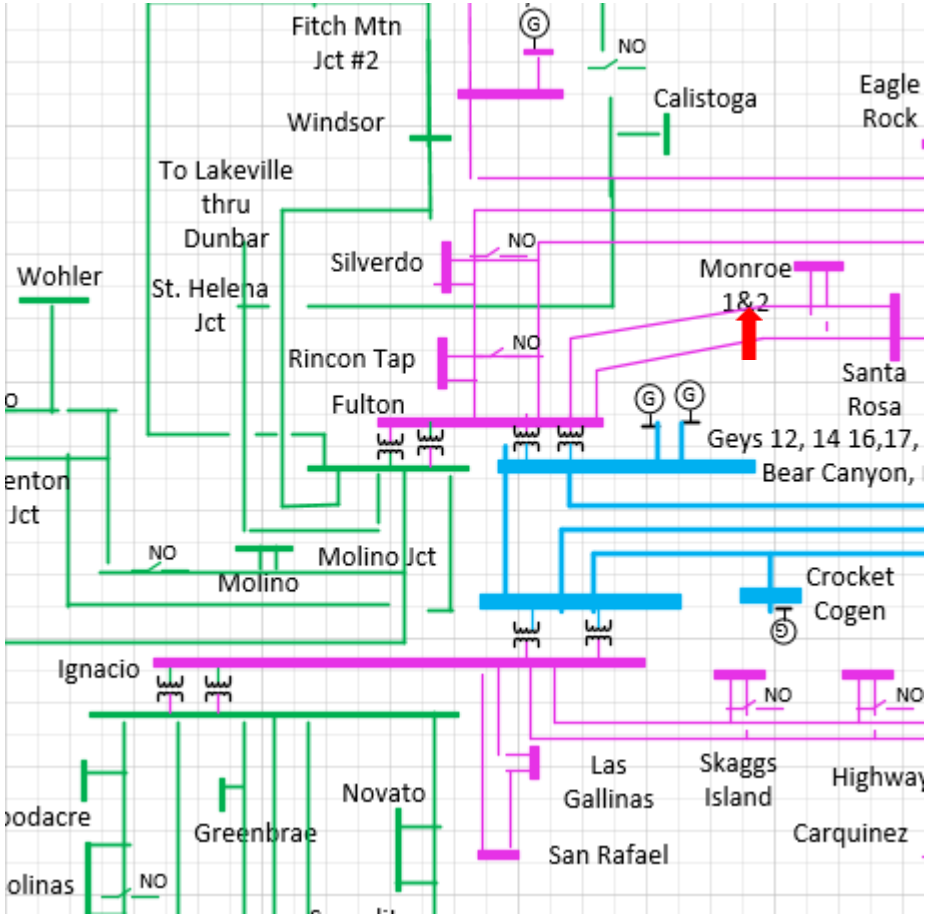


NCNB– Results Summary (2023 – 2032)

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

Potential Mitigations
- Santa Rosa SPS, BESS or reconductor
- Operation solution

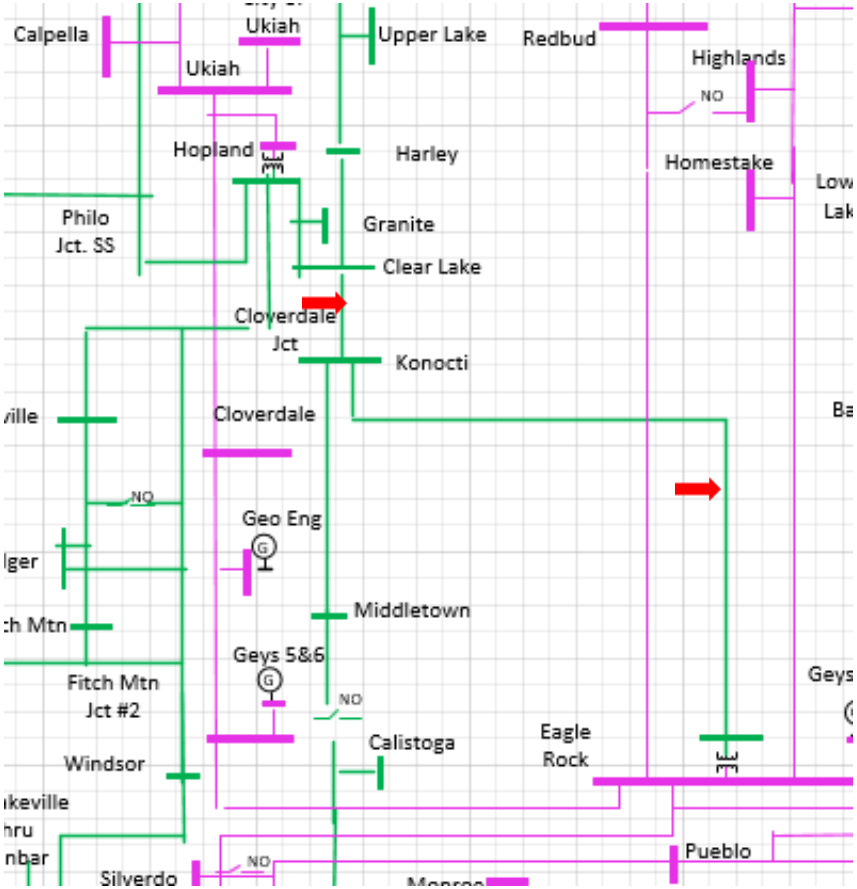


NCNB– Results Summary (2023 – 2032)

Observations
60 kV

- P2 Mendocino 115kV Bus, P5 Fulton 115KV Bus, P6 Eagle Rock-Redbud 115KV & Geysers #3-Cloverdale 115KV causes overload of both Clear Lake - Eagle Rock 60 kV Line & Konocti - Eagle Rock 60kV Line in summer peak cases.

Approved Mitigations
- Review Clear Lake 60 kV System Reinforcement project
- Interim operation solution



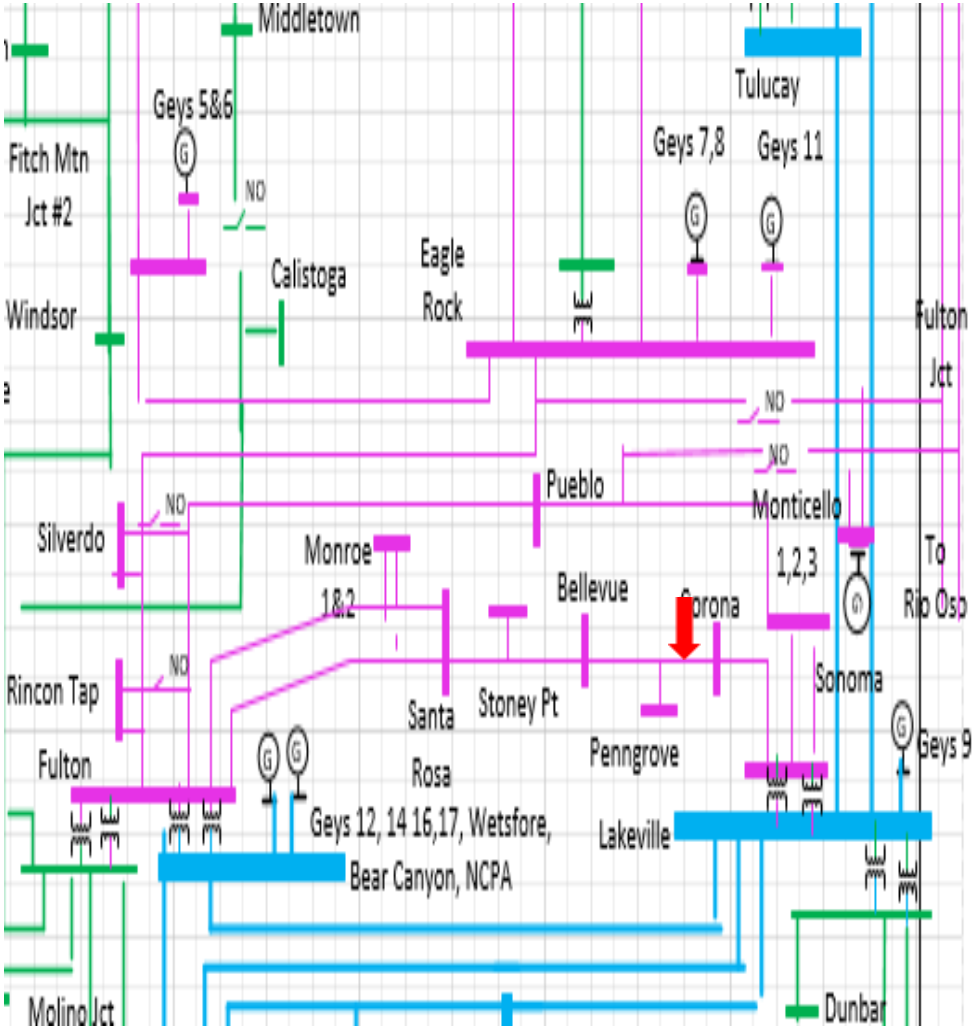
NCNB– Results Summary (2023 – 2032) SIMPLIFY

Observations
115 kV

- P5 Fulton 230 KV BAAH Bus or P6 Fulton-Santa Rosa #2 115KV & Corona-Lakeville 115KV causes overload of Santa Rosa- Corona 115 kV Line in summer peak cases.

Approved and Potential Mitigations

- Santa Rosa SPS, BESS or reconductor
- Interim operation solution

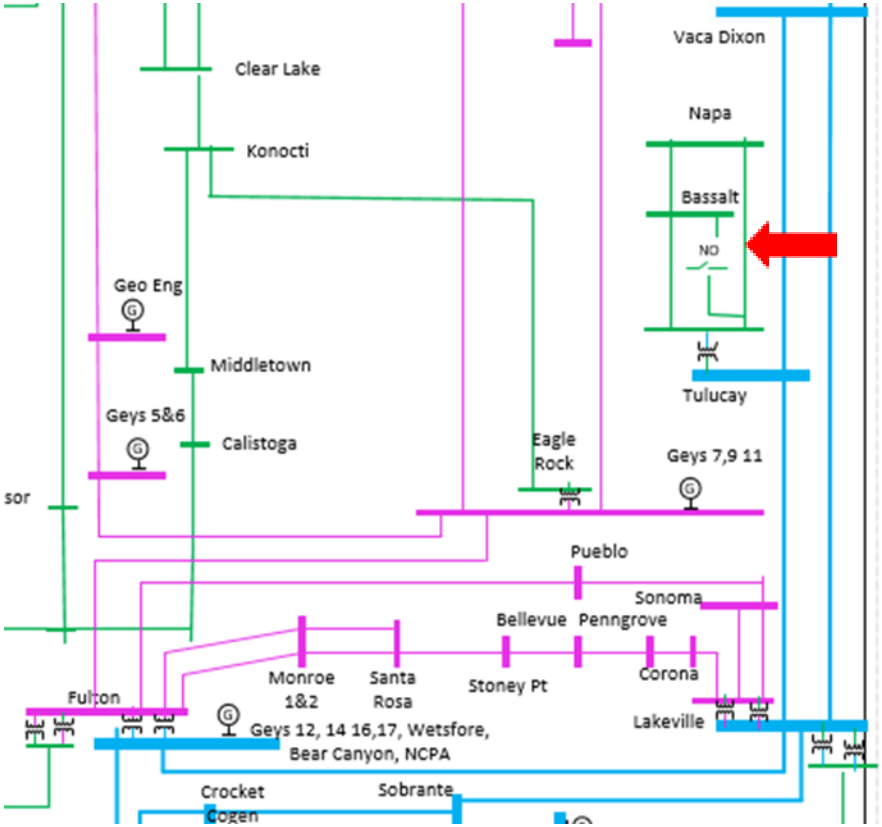


NCNB– Results Summary (2023 – 2032)

Observations
115 kV

- P1 Tulucay-Napa #1 60KV Line causes overload of Tulucay - Napa #2 60 kV (Tulucay 60 kV to Basalt 60 kV) Line in summer peak cases

Approved Mitigations
- Review project: Tulucay - Napa #2 60 kV Capacity Increase
- Interim operation solution



NCNB– Results Summary (2035 ATE Sensitivity)

Incremental issues identified in 2035 ATE sensitivity

Facility	Cont Type/ Worst loading %					Facility overloaded in baseline scenario?
	P0	P1	P2	P5	P7	
30440 TULUCAY 230 30458 TLCYVACARCTR 230 1 1					110	No
32568 IGNACIO 115 32574 SAN RAFL 115 1 1		112				No
Clear Lake - Eagle Rock 60 kV (Clear Lake 60 kV sub to Konocti Sub 60 kV)			NConv	NConv		Yes
Cordelia # 2 60 kV (Tulucay Jct 60 kV to Cordelia Pumps 60 kV)		103			103	No
Cortina - Mendocino 115 kV Line			NConv	NConv	101	No
Eagle Rock - Cortina 115 kV (Highland to Highland Jct2)				111		No
EAGLE ROCK 115/60 KV BANK NO.1		102	109	108	106	Yes
Eagle Rock- Fulton- Silverado 115 kv (Eagle rock sub to Silverado Jct2 115 kV)				104		No
Fulton -Calistoga 60 kV (Fulton Sub 60 kV to St. Helena Jct 60 kV)	115	124	110	115	120	Yes
Fulton- Molino- Cotati 60 kV(Molino sub 60 kV to Molino Jct 60 kV)		109		119		Yes
Geyser # 12 - Fulton 230 kV (Fulton - Geyser#14 Jct)	104					No
GEYSER # 3 - CLOVERDALE 115K (CLOVERDALE 115KV to MPE TAP115KV)			102		102	Yes
Hartley - Clear Lake 60kV			125	125	108	No
HOPLAND BANK 115/60.00 BANK NO.2		102	103	102	108	Yes
IGNACIO 230/115.00 BANK # 4		110				No
Ignacio - Mare Island No.2 (Ignacio sub to Hamilton Wetlands sub)	115	109	114	115	117	Yes
Konocti - Eagle Rock 60kV	104	102	128	NConv		Yes
Lakeville - Ignacio #2 230kV					118	No
LAKEVILLE #2 60 kV (Petaluma Jct 60 kV to Petaluma A)		107	113	128	119	Yes
LAKEVILLE 230/60 kV Bank # 3		107	112	NConv		No
Mendocino - Philo Jct - Hopland 60 kV(Mendocino Sub 60kV to UKIAH JT 60kV)			151	152	107	Yes
Mendocino -Clearlake 60 kV (Mendocino Sub 60 kV to Upper Lake Sub 60 Kv)			NConv	NConv		Yes
Monte Rio- Fulton 60 KV(Wohler Jct 60 Kv to Monte Rio Sub 60 KV)		110		110		No
Sonoma - Pueblo 115 kV				131		No
Tulucay - Napa #2 60 kV (Tulucay 60 kV to Basalt 60 kV)	100	104	107	109	109	Yes
Ukiah-Hopland-Cloverdale 115 kV (Ukiah sub 115kv to Hopland Jct 115kv)					128	No

List of substation with P5 contingency driven issues

Substation	P5 Contingency Description
FULTON 230 KV BAAH BUS #1	Non-Redundent Relay
FULTON BUS 115 kV 1 & 2 SECTION D	Non-Redundent Relay
MENDOCINO 115 KV BUS 1&2	Non-Redundent Relay
LAKEVILLE 230 kV BUS 1&2 SECTION E	Non-Redundent Relay
FULTON 115 kV	Non-Redundent battery supply
MENDOCINO 115 KV	Non-Redundent battery supply
LAKEVILLE 230 kV	Non-Redundent battery supply

Low Voltage Results Summary

Potential Mitigations

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

Cont. Type	2024 Summer Peak	2027 Summer Peak	2032 Summer Peak
P1	0.82 PU	0.78 PU	0.89 PU
P2	0.82 PU	0.79 PU	0.86 PU
P3	0.80 PU	0.77 PU	0.85 PU
P5	Diverge	Diverge	Diverge
P6	0.63 PU	0.59 PU	0.68 PU
P7	0.82 PU	0.78 PU	0.90 PU

Summary of potential new upgrades

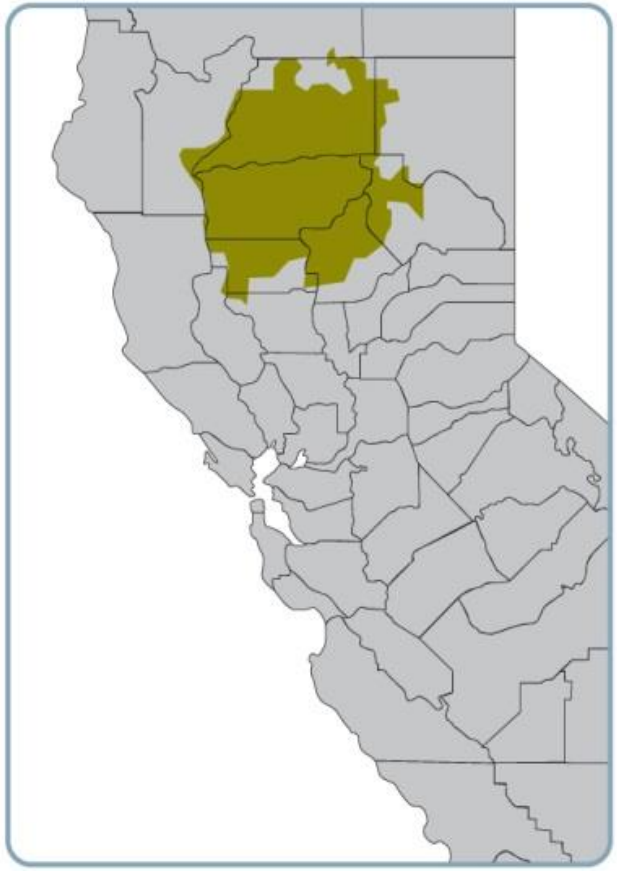
Reliability Concern	Potential Upgrade
Multiple	• Santa Rosa SPS, BESS or reconductor
Tulucay - Napa #2 60 kV	• Review project: Tulucay - Napa #2 60 kV Capacity Increase
Clear Lake - Eagle Rock 60 kV Line & Konocti - Eagle Rock 60kV Line	• Reviewproject: Clear Lake 60 kV System Reinforcement

North Valley Area
Preliminary Reliability Assessment Results

Bryan Fong
Senior Regional Transmission Engineer

2022-23 Transmission Planning Process Stakeholder Meeting
September 27-28, 2022

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	Description	Scenario Type	Gross Load (MW)	BTM-PV		AAEE (MW)	Net Load (MW)
					Output (MW)	Installed (MW)		
1	NVLY-2024-SP	2024 Summer Peak load condition. Peak load time - hours ending 20:00	Baseline	885	0	381	5	880
2	NVLY-2027-SP	2027 Summer Peak load condition. Peak load time - hours ending 20:00	Baseline	913	1	438	6	905
3	NVLY-2032-SP	2032 Summer Peak load condition. Peak load time - hours ending 20:00	Baseline	992	1	514	6	984
4	2024-SPOP	2024 Spring off-Peak load condition. Off-Peak load time - hours ending 20:00	Baseline	584	0	381	6	578
5	2027-SPOP	2027 Spring Off-Peak load condition. Off-Peak load time - hours ending 13:00	Baseline	447	351	438	7	89
6	NVLY-2024-SP-HiRe-v2	2024 Summer peak Load conditions with Hi-Renewable dispatch Sensitivity	Sensitivity	871	377	381	5	489
7	2024-SPOP-COI	2024 Spring off-peak load conditions and COI Import.	Sensitivity	584	0	381	6	578
8	NVLY-2027-SP-HiCEC	2027 Summer peak load conditions with Hi-CEC load forecast sensitivity.	Sensitivity	913	1	438	0	912
9	NVLY-2035-SP-ATE	2035 Summer Peak load condition with ATE. Peak load time - hours ending 20:00	Sensitivity	1044	1	514	16	1027

Generation Assumptions - North Valley Area

S. No.	Study Case	Scenario Type	Description	Battery		Solar		Wind		Hydro		Thermal	
				Installed (MW)	Dispatch (MW)	Installed (MW)	Dispatch (MW)	Installed (MW)	Dispatch (MW)	Installed (MW)	Dispatch (MW)	Installed (MW)	Dispatch (MW)
1	NVLY-2024-SP	Baseline	2024 Summer Peak load condition. Peak load time - hours ending 20:00	0	0	8	0	103	70	1786	1650	997	545
2	NVLY-2027-SP	Baseline	2027 Summer Peak load condition. Peak load time - hours ending 20:00	0	0	8	0	103	70	1786	1538	997	726
3	NVLY-2032-SP	Baseline	2032 Summer Peak load condition. Peak load time - hours ending 20:00	0	0	8	0	103	70	1786	1542	997	772
4	2024-SPOP	Baseline	2024 Spring off-Peak load condition. Off-Peak load time - hours ending 20:00	0	0	8	0	103	21	1786	1577	997	714
5	2027-SPOP	Baseline	2027 Spring Off-Peak load condition. Off-Peak load time - hours ending 13:00	0	0	8	8	103	23	1797	829	997	712
6	NVLY-2024-SP-HiRe-v2	Sensitivity	2024 Summer peak Load conditions with Hi-Renewable dispatch	0	0	8	8	103	64	1786	1622	997	353
7	2024-SPOP-COI	Sensitivity	2024 Spring off-peak load conditions and COI Import sensitivity	0	0	8	0	103	21	1786	1539	997	590
8	NVLY-2027-SP-HiCEC	Sensitivity	2027 Summer peak load conditions with Hi-CEC load forecast sensitivity.	0	0	8	0	103	70	1786	1603	997	632

Previously approved transmission projects modelled in base cases

Project Name	In-service Year	First Year Modeled
Glen 230/60 kV Transformer No. 1 Replacement	2022	2024
Cottonwood 230/115 kV Transformer replacement	2023	2024
Cascade 115/60 kV No. 2 Transformer Project	2025	2027
Tyler 60 kV Shunt Capacitor	2026	2027
Cottonwood 115 kV Bus Sectionalizing Breaker	2025	2027
Red Bluff-Coleman 60 kV Line Upgrade	2025	2027
Round Mountain Dynamic Reactive Support Project	2024	2027
Palermo-Wyandotte 115kV Line Section Reconductoring	2023	2024
Other Projects		
Cottonwood – Red Bluff 60 kV line reconductoring (PG&E Maintenance project MWC 93)	2021	2024
Table Mountain 115 kV SPS	TBD	
Grizzly PH Interconnection into Bucks Creek	2022	2024

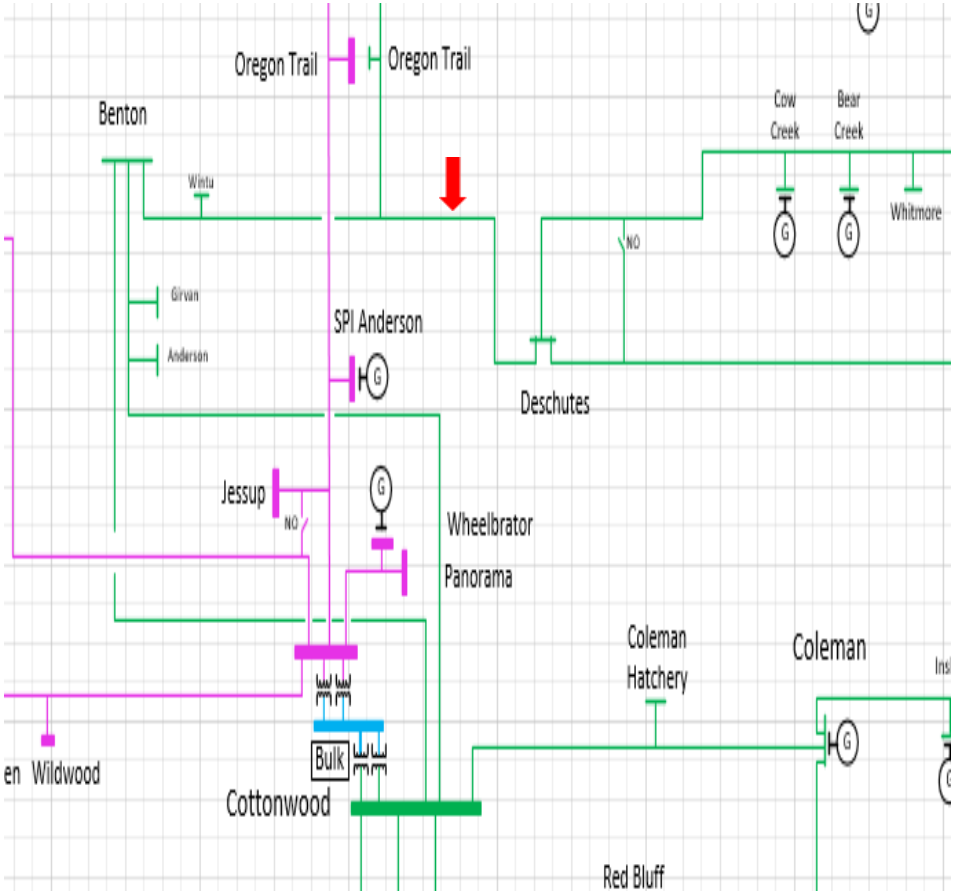
Reliability assessment preliminary results summary

NVLY – Results Summary (2023 – 2032)

Observations
60 kV

- P5 Cottonwood 115KV or 230kV causes overload of Benton-Deschutes 60 kV Line in summer peak cases

Potential Mitigations
- Protection upgrade

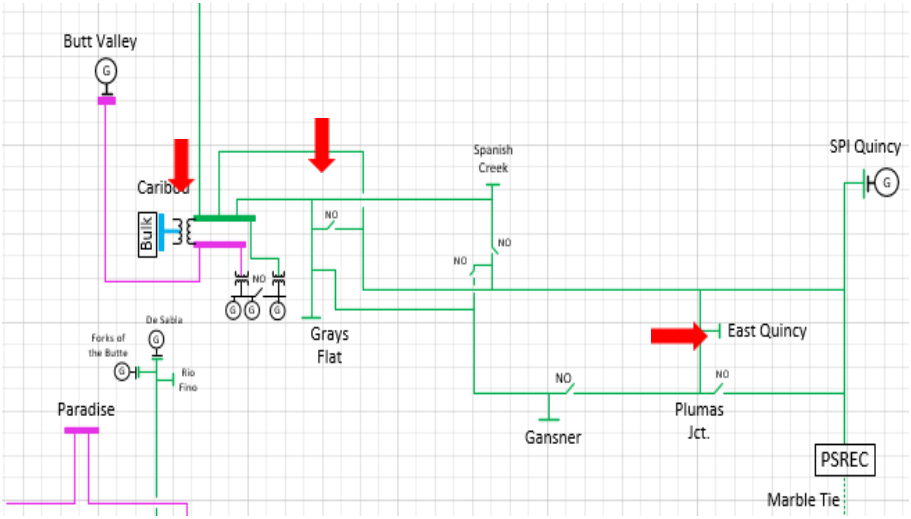


NVLY – Results Summary (2023 – 2032)

<u>Observations</u>
<u>230 and 60kV</u>

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

<u>Potential Mitigations</u>
- Review Caribou RAS
- Operation Solutions

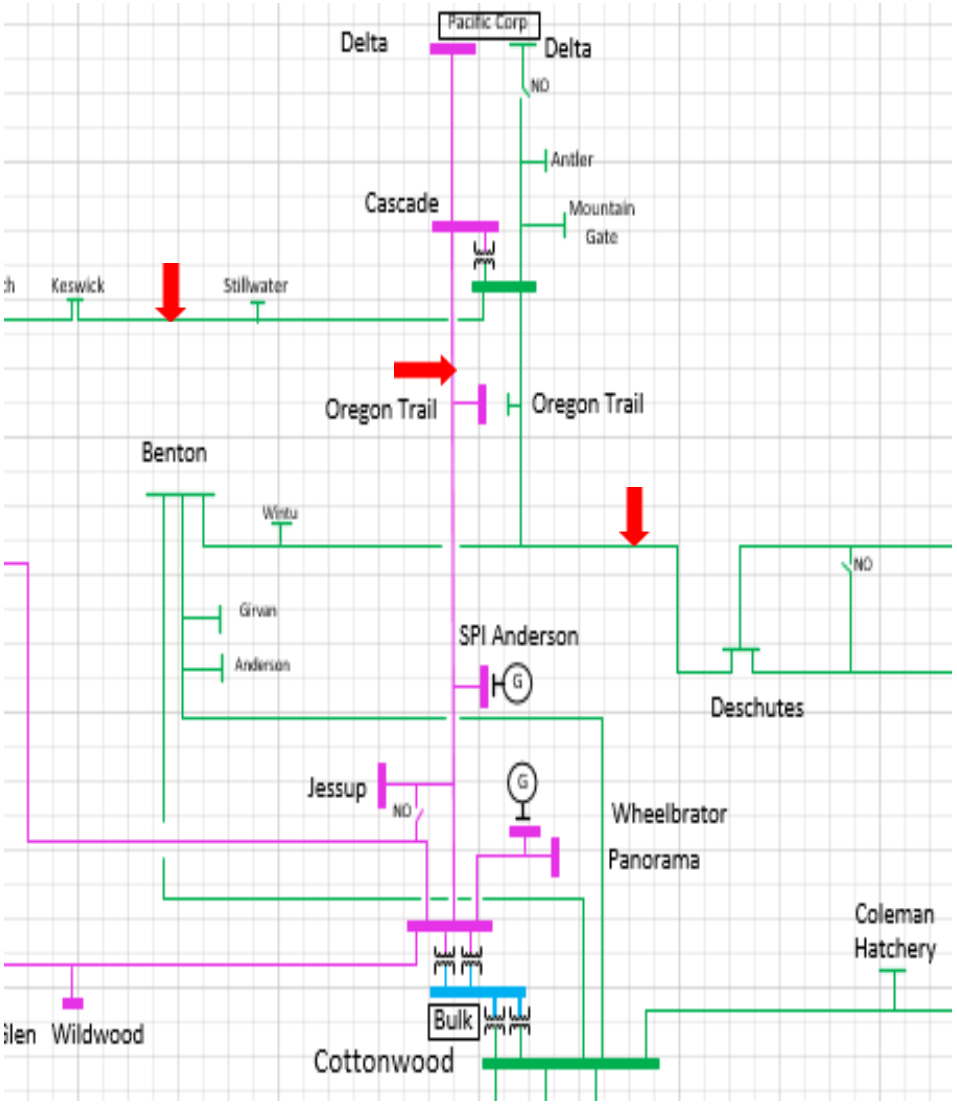


NVLY – Results Summary (2023 – 2032)

Observations
115 and 60kV

- P5 Cottonwood 230KV Bus causes overload of Cascade-Cottonwood 115 kV, Keswick-Cascade 60 kV and Cascade-Deschutes 60 kV Line in summer peak cases

Potential Mitigations
- Protection upgrade
- Operation Solutions

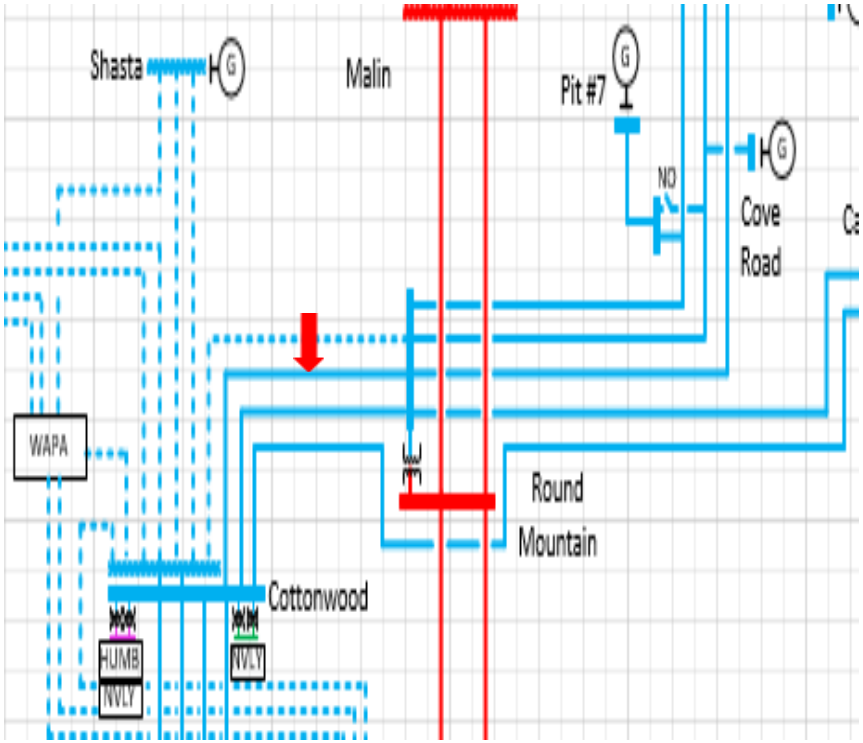


NVLY – Results Summary (2023 – 2032)

Observations
230 kV

- P5-5 Round Mountain 230KV DC Station
- causes overload of Round Mountain - Cottonwood #1 230kV in summer peak cases

Potential Mitigations
- Non-Redundant Battery Supply
- Operation Solutions

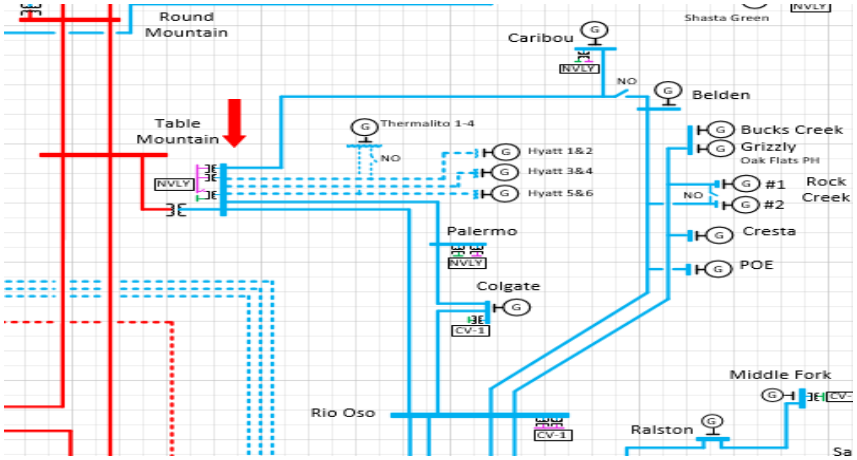


NVLY – Results Summary (2023 – 2032)

Observations
115 kV

- P2 Table Mountain 230kV Bus
- causes overload of Table Mountain No.3 230/115 kV Transformer in summer peak cases

Potential Mitigations
- Review Caribou RAS



NVLY– Results Summary (2035 ATE Sensitivity)

Incremental issues identified in 2035 ATE sensitivity

Facility	Cont Type/ Worst loading % P2	Facility overloaded in baseline scenario?
Sycamore Creek-Notre Dame-Table Mountain 115 kV Line	101	No
Table Mountain-Butte No.1 115 kV Line	104	No
Cottonwood-Benton No.1 60 kV Line	104	No

List of substation with P5 contingency driven issues

Substation	P5 Contingency Description
Round Mountain 500 and230 kV	Install station back-up battery
Cortina 230 kV	Install station back-up battery
Cottonwood 230 kV	Install station back-up battery
COTTONWOOD 230KV BUS SECTION	Install Redundant Relay

Low Voltage Results Summary

Potential Mitigations

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

Cont. Type	2024 Summer Peak	2027 Summer Peak	2032 Summer Peak
P1	0.84 PU	Diverge	Diverge
P2	0.89 PU	Diverge	Diverge
P3	0.89 PU	0.89 PU	0.89 PU
P5	Diverge	Diverge	Diverge
P6	0.85 PU	0.90 PU	0.55 PU
P7	0.83 PU	0.89 PU	0.88 PU

Summary of potential new upgrades

Reliability Concern	Potential Upgrade
P5-5	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
P2-1	Review Caribou RAS

PG&E Bulk System
Preliminary Reliability Assessment Results

Chris Fuchs
Regional Transmission North

2022-2023 Meeting to Discuss Preliminary Results
Sept 27, 2022

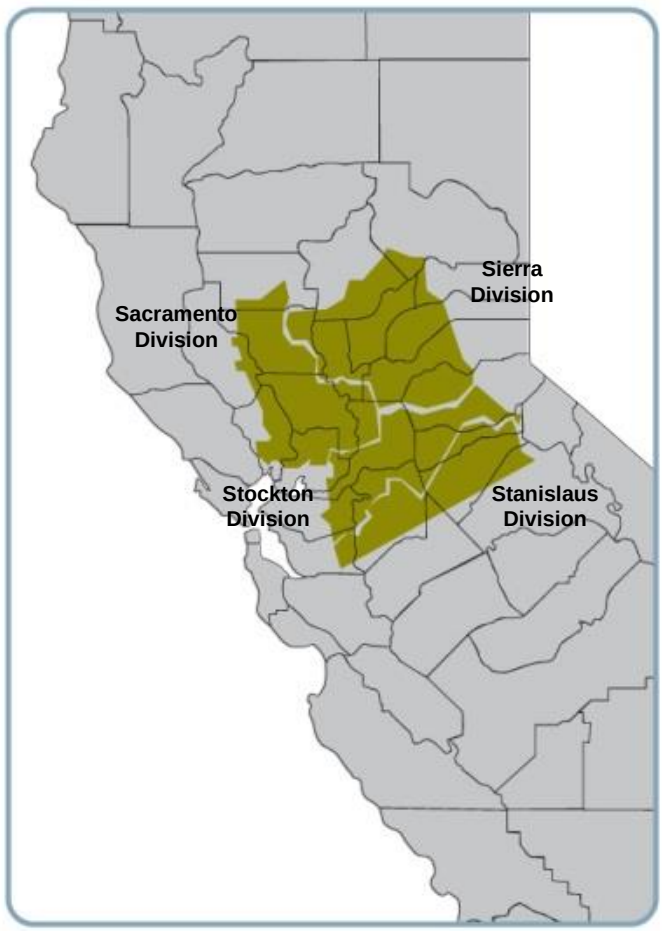
Presentation available on Market Participant Portal

Central Valley Area
Preliminary Reliability Assessment Results

Subrina Sultana Noureen
Regional Transmission Engineer-North

2022-23 Transmission Planning Process Stakeholder Meeting
September 27-28, 2022

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	Description	Scenario Type	Gross Load (MW)	BTM-PV		AAEE (MW)	Net Load (MW)
					Output (MW)	Installed (MW)		
1	CVLY-2024-SP	2024 Summer Peak load condition. Peak load time - hours ending 19:00	Baseline	3880	0	1875	25	3855
2	CVLY-2024-SP-HiRenew	2024 Summer peak Load conditions with Hi-Renewable dispatch Sensitivity	Sensitivity	3878	1856	1875	25	1998
3	CVLY-2027-SP	2027 Summer Peak load condition. Peak load time - hours ending 19:00	Baseline	4009	0	2293	30	3979
4	CVLY-2027-SP-HiCEC	2027 Summer peak load conditions with Hi-CEC load forecast sensitivity.	Sensitivity	4007	87	2293	0	3920
5	CVLY-2032-SP	2032 Summer Peak load condition. Peak load time - hours ending 19:00	Baseline	4586	0	3013	32	4554
6	2024-SPOP	2024 Spring off-Peak load condition. Off-Peak load time - hours ending 20:00	Baseline	2355	0	1875	28	2327
7	2024-SPOP-COI	2024 Spring off-peak load conditions and COI Import.	Sensitivity	2355	0	1875	28	2327
8	2027-SPOP	2027 Spring Off-Peak load condition. Off-Peak load time - hours ending 13:00	Baseline	2516	1838	2298	35	643
9	CVLY-2035-SP-ATE	2035 Summer Peak load condition with ATE. Peak load time - hours ending 19:00	Sensitivity	4961	0	3013	73	4888

Generation Assumptions – Central Valley Area

S. No.	Study Case	Scenario Type	Description	Battery		Solar		Wind		Hydro		Thermal	
				Installed(MW)	Dispatch(MW)	Installed (MW)	Dispatch (MW)	Installed (MW)	Dispatch (MW)	Installed(MW)	Dispatch (MW)	Installed(MW)	Dispatch (MW)
1	2024-SPOP-COI	Sensitivity	2024 Spring off-peak load conditions and COI Import sensitivity	65	0	34	0	872	138	1422	1217	1293	999
2	2024-SPOP	Baseline	2024 Spring off-Peak load condition. Off-Peak load time - hours ending 20:00	65	0	34	0	872	137	1422	1217	1293	805
3	CVLY-2024-SP-HiRenew	Sensitivity	2024 Summer peak Load conditions with Hi-Renewable dispatch Sensitivity	65	0	34	34	872	527	1422	1071	1293	380
4	CVLY-2024-SP	Baseline	2024 Summer Peak load condition. Peak load time - hours ending 19:00	65	0	34	0	872	476	1422	1163	1293	1186
5	2027-SPOP	Baseline	2027 Spring Off-Peak load condition. Off-Peak load time - hours ending 13:00	65	0	34	31	872	187	1448	1026	1293	736
6	CVLY-2027-SP-HiCEC	Sensitivity	2027 Summer peak load conditions with Hi-CEC load forecast sensitivity.	65	0	34	0	872	509	1422	1306	1293	1234
7	CVLY-2027-SP	Baseline	2027 Summer Peak load condition. Peak load time - hours ending 19:00	65	0	34	0	872	476	1422	1140	1293	1237
8	CVLY-2032-SP	Baseline	2032 Summer Peak load condition. Peak load time - hours ending 19:00	65	0	34	0	872	476	1422	1185	1293	1174

Reliability assessment preliminary results summary

Sacramento Division

Projects in Sacramento Area

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

Sacramento Thermal Results Summary

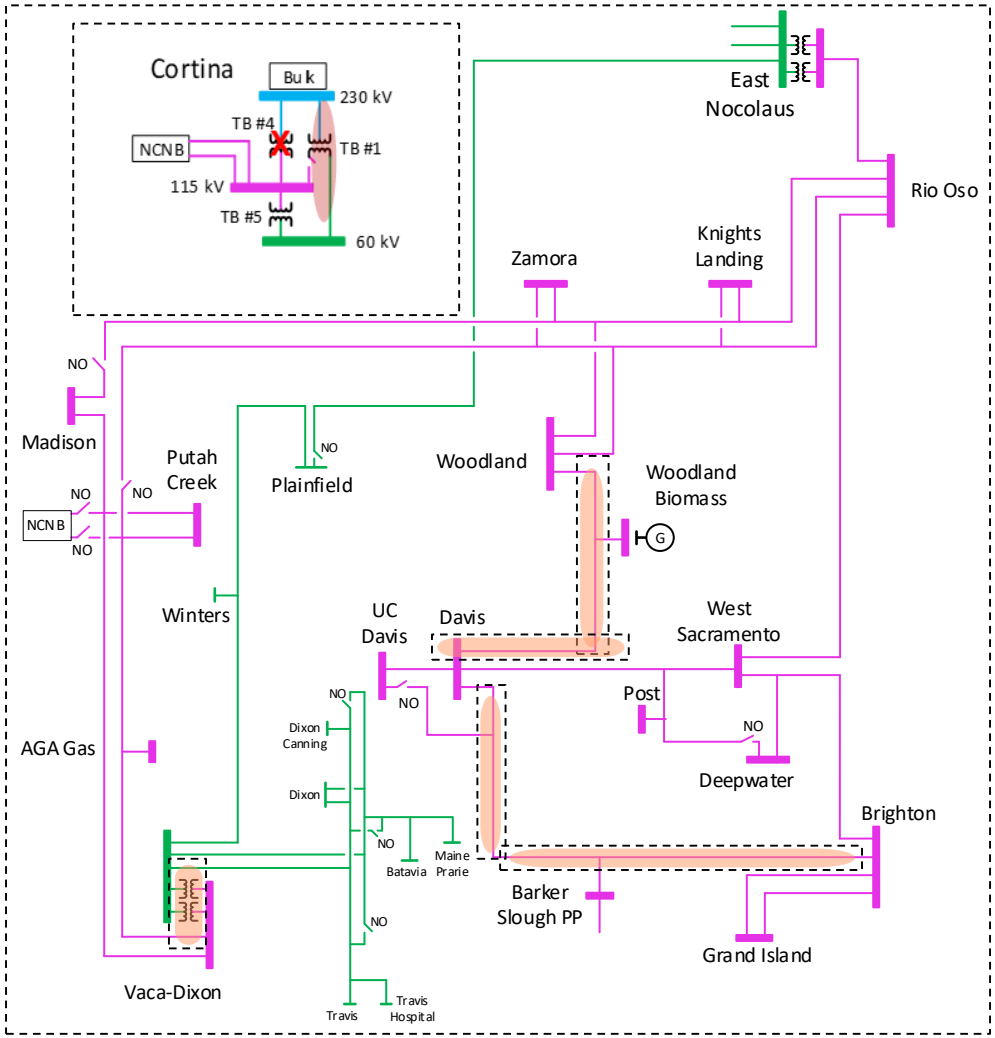
- P1 overloads on Dixon-Vaca #1 and #2 60 kV Line
- P1 overloads on Cortina 230/115/60 kV Transformer No. 1
- P2, P6 and P7 overloads on Brighton - Davis 115 kV Line
- P2 Overloads on Woodland - Davis 115 kV Line
- **Approved and Potential Mitigations**

  - Vaca Davis Area Reinforcement Project.

    Expected ISD: Dec. 2025

    Short term: Action Plan
  - Cortina 230/115/60 kV Transformer Bank No. 1 Replacement Project

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



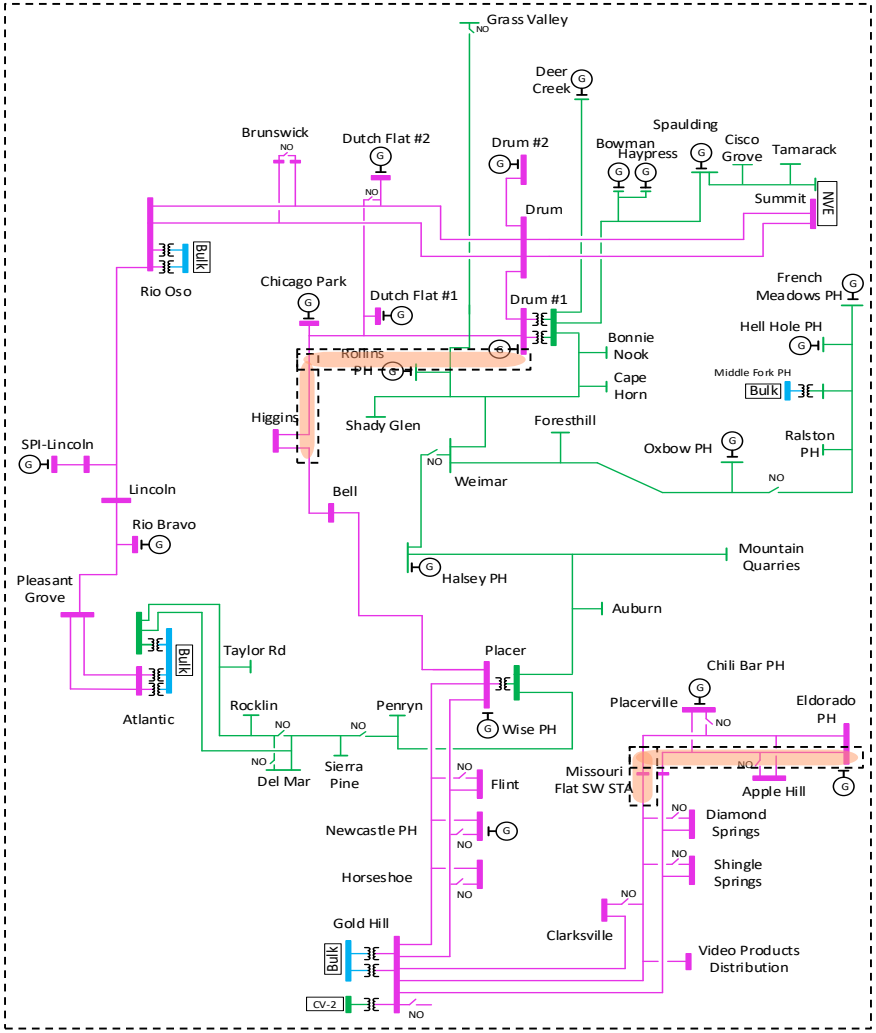
Sierra Division

Projects in Sierra Area

Approved TPP Projects	Expected ISD
Rio Oso 230/115 kV Transformer Upgrades	Apr-24
Rio Oso Area 230 kV Voltage Support	Oct-24
East Marysville 115/60 kV	Nov-27
Gold Hill 230/115 kV Transformer Addition	Jun-28
Reconductor Rio Oso–SPI Jct–Lincoln 115kV line	2028
Atlantic 230/60 kV transformer voltage regulator	2026

Sierra Thermal Results Summary

- P1 overloads on Nicolaus-Marysville 60kV line
- P2 overloads on El Dorado-Missouri Flat #1 and #2
- P7 Overloads on Drum - Higgins 115 kV Line
- **Approved and Potential Mitigations**
  - Pease Sub-Area LCR Mitigation Project
  - Continue to monitor future forecast
  - SPS or system upgrade as needed



Stockton/Stanislaus (Tesla – Bellota) Divisions

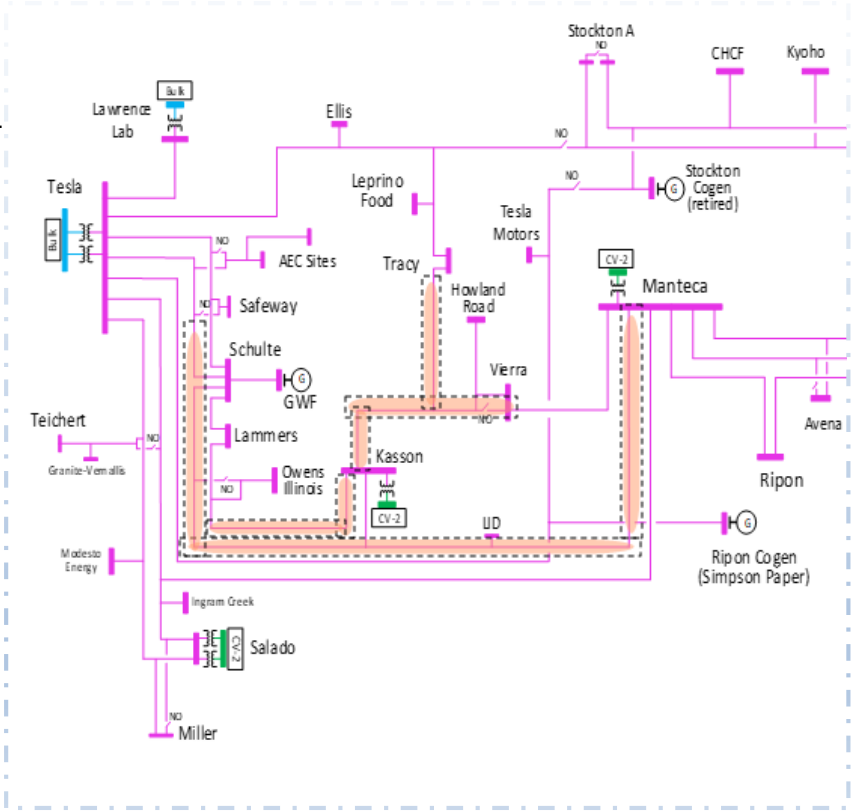
Projects in Stockton/Stanislaus Area

Approved TPP Projects	Expected ISD
Mosher Transmission Project	Dec-27
Vierra 115 kV Looping Project	Jun-25
Tesla 230 kV Bus Series Reactor	Aug-23
Lockeford-Lodi Area 230 kV Development	Jul-27
Kasson – Kasson Junction 1 115 kV Line Section Reconductoring Project	Jun-27
Manteca #1 60 kV Line Section Reconductoring Project	Jun-27
Manteca-Ripon-Riverbank-Melones Area 115 kV Line Reconductoring Project	2028
Weber-Mormon Jct Line Section Reconductoring Project	2027

Stockton/Stanislaus Thermal Results Summary

- P0 overload Salado-STNSLSRP 60kV Line
- P1 overloads on Schulte - Kasson - Manteca 115 kV Line
- P1 and P2 overloads on Vierra-Tracy-Kasson 115kV
- P1 overloads on Valley Springs - Martell 60 kV Line No. 1
- P1 overloads on Salado – Newman 60 kV Line
- P1, P5 and P7 overloads on Lockeford No. 1 60 kV Line
- P2 overloads on Tesla 115 kv Line
- P3 overloads on Lockeford - Industrial 60 kV

- **<u>Approved and Potential Mitigations</u>**
  - Existing operating procedure
  - Vierra Looping project
  - Tesla 115 kV Bus Upgrade
  - Project: Lockeford-Lodi Project
  - SPS or system upgrade as needed



CVLY – Results Summary (2035 ATE Sensitivity)

Incremental issues identified in 2035 ATE sensitivity

Monitor Facility	Cont Type/ Worst Loading %						Facility Overloaded in Baseline Scenario?
	P1	P2	P3	P5	P6	P7	
BRIGHTN- HOWARDJCT3 115 kV Line		110.82					Yes
Brighton - Davis 115 kV Line		100.49		106.89	116.76		Yes
Colgate - Smartville 60 kV Line No. 2			101.08				No
Cortina 60 kV Line No. 2	103.11	103.11				103.11	Yes
CRWS LDJ - GUSTN JT 60kV Line	101.93						Yes
Davis- Woodland Biomas Junction 115 kV Line				122.78	123.39	100.43	Yes
Dixon-Vaca #1 60 kV			146.36				Yes
Drum - Higgins 115 kV Line					217.11		Yes
Drum - Rio Oso 115 kV No. 1 Line				102.72		102.02	Yes
Drum - Rio Oso 115 kV No. 2 Line				112.31		111.52	Yes
Eldorado - Missouri Flat 115 kV No. 2 Line		101.77					Yes
Gold Hill 230/115 kV Transformer No. 1		108.24					No
Gustin JT - CRWS LDS 60kV Line			103.54				Yes
GUSTN JT-NEWMAN 60 kV	101.93		103.54				Yes
Higgins - Bell 115 kV Line					146.52		Yes
HOWARDJCT3- BRKRJCT 115 kV Line		110.82					Yes
Madison - Vaca 115 kV Lin		104.01					No
Manteca 60 kV Line No. 1			153.1				Yes
Missouri Flat - Gold Hill 115 kV No. 2 Line		103.24					No

CVLY – Results Summary (2035 ATE Sensitivity)

Incremental issues identified in 2035 ATE sensitivity

Monitor Facility	Cont Type/ Worst Loading %						Facility Overloaded in Baseline Scenario?
	P1	P2	P3	P5	P6	P7	
Nicolaus - Catlett 60 kV Line	142.47	142.47		130.06		142.47	No
Palermo-Nicolaus 115 kV Line				101.46			No
PATTERSN-CRWS LDJ 60 kV	111.51		113.25				Yes
PEASE TP- E.Marysville 60kV Line	105.79	105.79					Yes
Placer - Bell 115 kV Line					132.34		Yes
Placer - Gold Hill 115 kV Line No. 1					136.17		No
Rio Oso - Brighton 230 kV Line				102.33			No
Rio Oso - West Sacramento 115 kV Line		116.41		115.75	116.29		Yes
Rio Oso - Woodland 115 kV No. 1				108.05	104.58		No
Rio Oso - Woodland 115 kV No. 2				112.23	108.72		No
SALADO- PATTERSN 60kV Line	107.53		108.71				Yes
Tesla - Salado - Manteca 115 kV Line					119.08		Yes
Vaca-Plainfield 60 kV line	105.58						Yes
Weimar No. 1 60 kV Line	104.22		119.63				No
West Sacramento - Brighton 115 kV Line				106.14			Yes
Woodland - Davis 115 kV Line				110.94	110.89		Yes

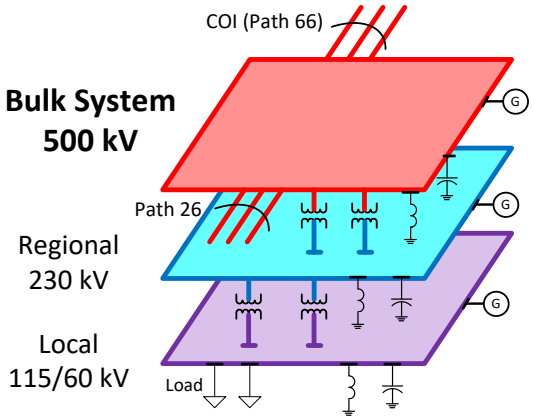
High Voltage Assessment in PG&E System
Status Update

Ebrahim Rahimi
Senior Advisor - Regional Transmission North

2022-23 Transmission Planning Process Stakeholder Meeting
September 27-28, 2022

Background and Objective

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



Approved Voltage Support Projects in PG&E System

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

Study Objective and Methodology

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

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

Voltage Criteria

Table 3: System Voltage Limits in PG&E Area

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

Study Scenarios

- Off-peak Scenarios studied
  - 2024 Spring off Peak
    - 8pm, real time power factor
  - 2027 Spring off Peak
    - 1pm, real time power factor
  - 2024 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-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
Aug-21	0	0	7	0	2	0	3	0	0	0.4	0	0	0	0	0	0	0	0	0	0	0	0
Sep-21	0	0	55	0	2	0	6	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
Oct-21	0	0	85	0	4	0	7	0	1	63	0	0	0	0	1	0	0	0	8	0	0	0
Nov-21	0	0	12	0	0.1	0	0	0	6	0	0	0	0	0	7	0	0	0	4	0	0	0
Dec-21	0	0	0.1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Jan-22	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Feb-22	0	0	8	0	16	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Mar-22	0	0	6	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0
Apr-22	0	0	10	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	2	0	0	0
May-22	0	0	0.3	0	0	0	0	0	0	0.02	0	0	0	0	0	0	0	0	6	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-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
Aug-21	744	686	743	87	703	2	743	120	26	581	540	519	2	484	14	0.1	32	104	173	254	116	22
Sep-21	720	674	718	116	682	175	718	446	21	687	413	308	22	260	31	18.9	4	94	469	554	392	87
Oct-21	744	744	744	124	731	127	744	626	269	724	385	380	178	112	221	77	6	187	698	725	702	138
Nov-21	721	713	721	226	713	82	721	700	265	350	513	453	453	3	284	48	3	209	716	712	651	104
Dec-21	744	639	744	228	708	49	744	614	416	612	360	340	244	50	269	82	3	300	713	646	672	62
Jan-22	744	692	744	195	739	28	744	721	528	694	437	413	319	71	422	38	6	368	744	712	649	165
Feb-22	602	532	672	149	646	137	667	622	454	530	505	507	116	196	288	3	6	276	655	644	613	153
Mar-22	743	642	743	176	702	112	743	691	326	419	419	284	195	52	215	19	8	287	740	718	682	142
Apr-22	720	629	720	174	653	116	720	682	197	713	366	293	169	49	164	62	4	300	709	709	489	123
May-22	744	714	721	150	559	212	723	652	81	522	149	128	65	52	34	10	1	191	738	712	634	109

230 kV Bus Voltages > 242 kV

	Bellota	Birds Landing	Brighton	Cortina	Cottonwood	Gold Hill	Palermo	Rio Oso	Valley Springs	McCall
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
Aug-21	0	0	6	0	0	0	0.2	0	0	0
Sep-21	0	0	0.4	0	0	0	0.3	0	0	0
Oct-21	0	0	13	0	0	0	31	0	0	0
Nov-21	0	0	1	0	0	0	21	0	0	0.02
Dec-21	0	0	0	0	0	0	0.1	0	0	6
Jan-22	0	0	0	0	0	0	0	0	0	0.4
Feb-22	0	0	0	0	0	0	2	0	0	0.02
Mar-22	0	0	0	0	0	0	0	0	0	0
Apr-22	0	0	5	0	0	0	5	0	0	6
May-22	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-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
Aug-21	25	6	190	1	0	0	426	32	105	15
Sep-21	43	0	348	1	2	0	269	35	105	10
Oct-21	27	17	452	10	10	8	634	108	40	117
Nov-21	0	13	299	5	4	0	471	63	0	151
Dec-21	0	0	176	0.2	0	0	264	11	0.03	251
Jan-22	0	4	187	0.1	10	0	297	10	0	187
Feb-22	0	41	256	2	7	4	224	35	0	51
Mar-22	1	38	282	9	4	0	209	13	17	72
Apr-22	18	67	382	9	10	1	475	32	108	140
May-22	5	55	229	11	15	0.5	172	10	40	62

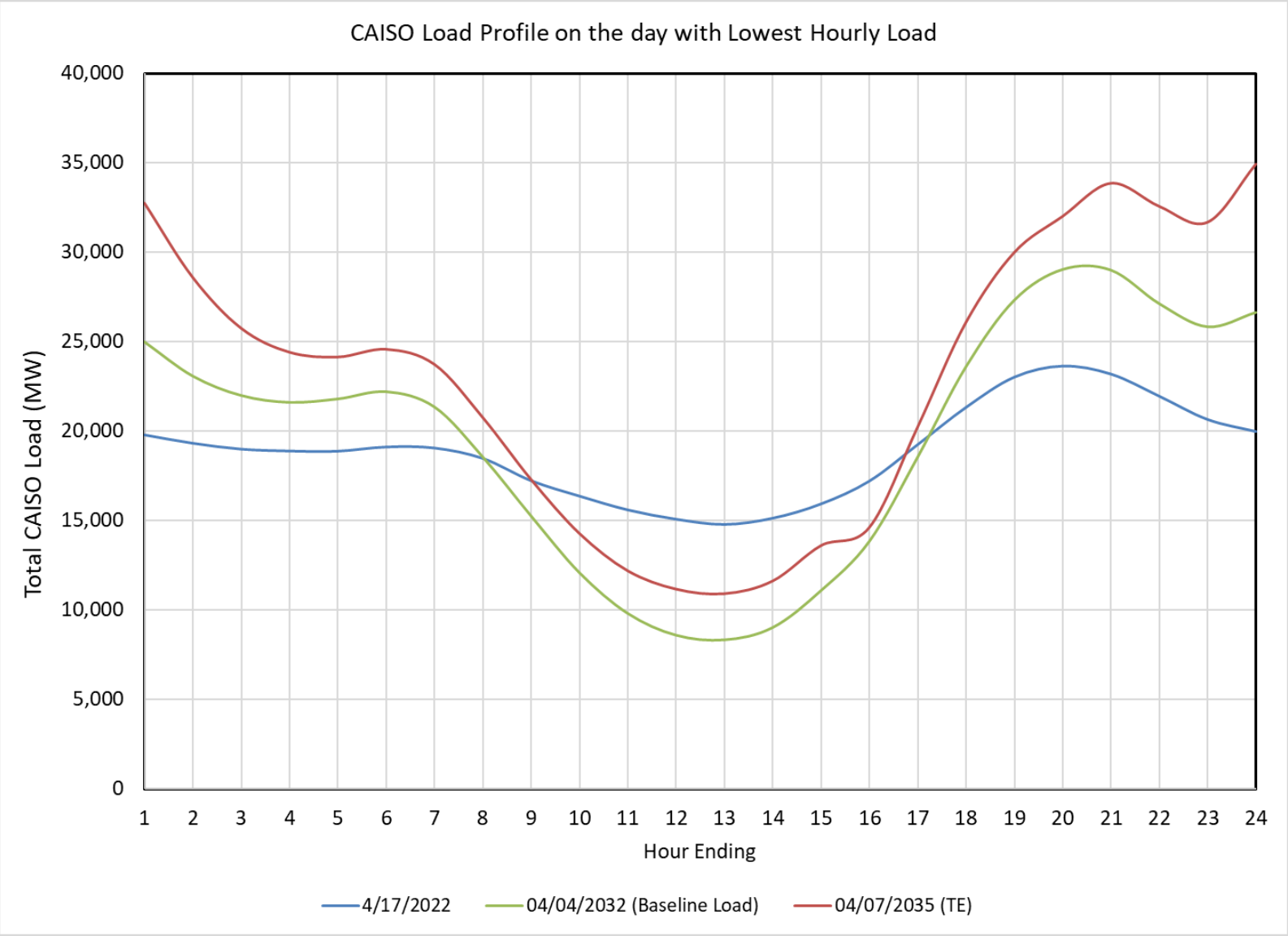
	> 551 kV				> 541 kV		
	Gates	Round Mtn	Table Mtn		Gates	Round Mtn	Table Mtn
Mar-20	0	0	0		25	0	100
Apr-20	0	0	0		11	0.02	4
May-20	0	0	0		0	0	33
Jun-20	0	0	0		0.1	2	33
Jul-20	0	0	0		0	0.1	17
Aug-20	0	0	0		1	1	16
Sep-20	0	0	0		1	0.1	74
Oct-20	0	0	0		54	5	101
Nov-20	0	0	0		90	8	15
Dec-20	0	0	0		7	0	0
Jan-21	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
Aug-21	0	0	0		0	0.02	0.1
Sep-21	0	0	0		0	0	0.02
Oct-21	0	0	0		0	158	3
Nov-21	0	0	0		0	56	45
Dec-21	0	0	0		0	5	1
Jan-22	0	0	0		0	1	0
Feb-22	0	0	0		0	0	0.03
Mar-22	0	0	0		0	13	0.1
Apr-22	0	0	0		0	84	4
May-22	0	0	0		0	12	0

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

High Voltage Summary in TPP Studies

- North Valley
  - Palermo and Table Mountain 115 kV
  - Deschutes and Glenn 60 kV
- North Coast North Bay
  - Mendocino 115 kV
  - Fulton 60 kV
- Central Valley
  - Rio Oso – Davis – Brighton 115 kV
  - Rio Oso, Atlantic and Gold Hill 115 kV
  - Melones – Donnells PH 115 kV
  - Colgate and Valley Springs 60 kV
- Greater Bay Area
  - Pittsburg 115kV, Metcalf 115 kV, Las Positas 60 kV, Monta Vista 230,115,60 kV, San Ramon 60 kV, Evergreen 60kV
- Central Coast Los Padres
  - Mesa 230, 115 kV
  - Moss Landing 115 kV
  - Green Valley 60 kV
  - Coburn 60 kV
  - Templeton 70 kV
  - Divide 70 kV
- Kern
  - Midway 115 kV
  - Kern Power 70 kV
  - Wheeler 70 kV
  - Arco 70 kV
- Greater Fresno Area
  - Exchequer 115 kV
  - Le Grand 115 kV
  - Panoche 115 kV
  - Herndon 115 kV
  - Mc Call 115 kV
  - Borden 70 kV
  - Oro Loma 70 kV
  - Henrietta 70 kV
  - Helm 70 kV
  - Kearney 70 kV
  - Corcoran 70 kV
  - Kingsburg 70 kV
  - Reedley 70 kV
- Humboldt
  - Humboldt 115 kV and 60 kV only under sensitivity scenario

Historical and Forecast Load Profile



High Level Summary of Results

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

- Preliminary review of the load profile under the sensitivity scenario of 2035 high electrification, it is that spring off peak load will continue to drop due to integration of BTM-PV on the distribution side

- 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:
  - Exchequer 115 kV area
  - Melones 115 kV area
  - Mendocino 115 kV area
  - Colgate 60 kV area

Next Steps

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

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

SCE Main System
Preliminary Reliability Assessment Results

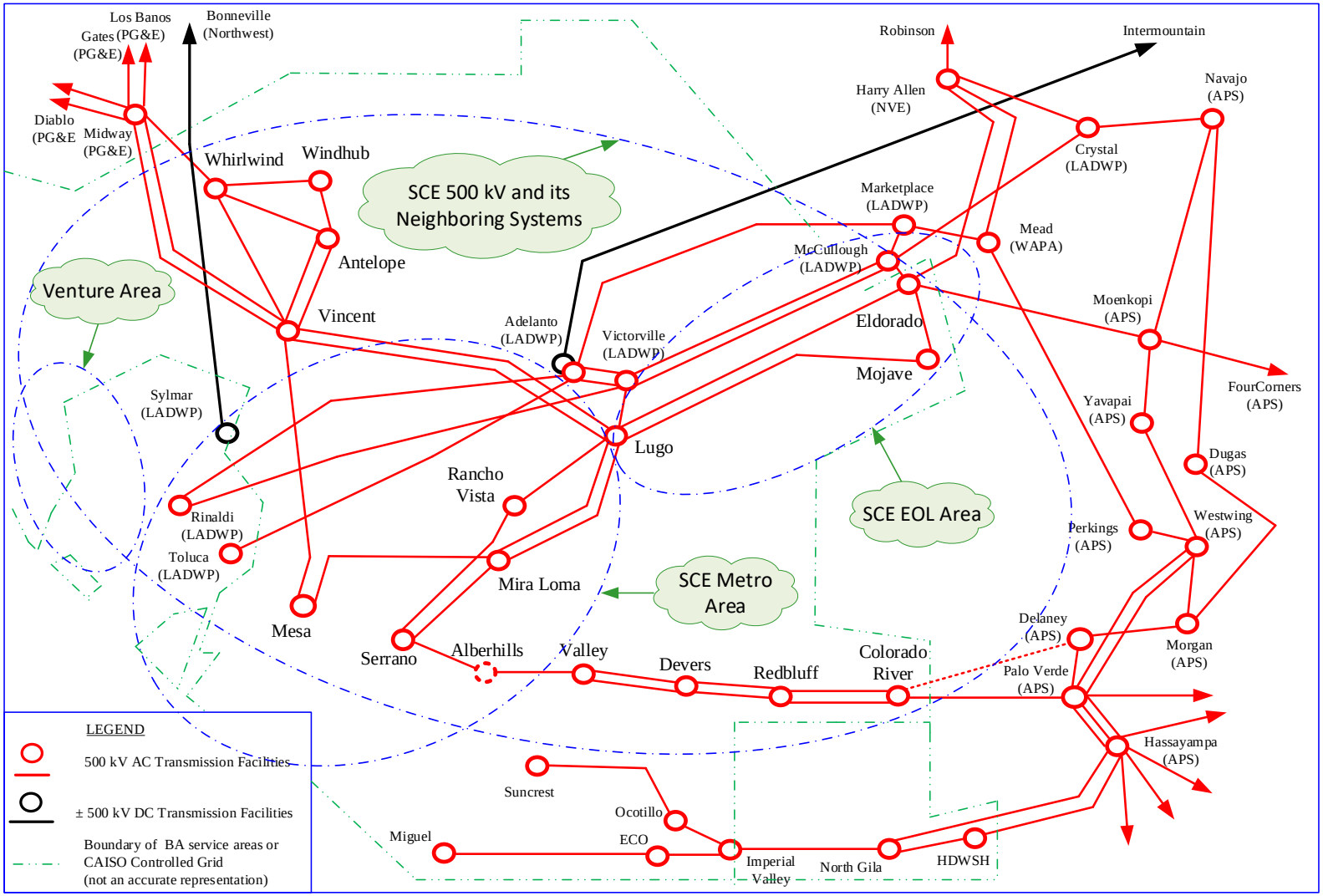
Frank Chen
Regional Transmission Engineer Lead

2022-2023 Transmission Planning Process Stakeholder Meeting
September 27-28, 2022

SCE Main System

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

SCE Main System



SCE Main System Study Scenarios

Baseline Scenarios

Case ID	Study Case Name	Description
B1	B1-2024SP	2024 summer peak load condition at HE16 PST, 9/3
B2	B2-2027SP	2027 summer peak load condition at HE17 PST, 9/7
B3	B3-2032SP	2032 summer peak load condition at HE19 PST, 9/7
B4	B4-2024OP	2024 spring off-peak load condition at HE20 PST, 4/24
B5	B5-2027OP	2027 spring off-peak load condition at HE13 PST, 4/4

Sensitivity Scenarios, including Additional Transportation Electrification

Case ID	Study Case Name	Description
S1	S1-2027SP-HLOAD	2027 summer peak condition with high CEC load forecast
S2	S2-2024SP-HiRenew	2024 summer peak condition with heavy renewable output
S3	S3-2024OP-HiRenew	2024 spring off-peak condition with heavy renewable output
S4	S4-2035SP-ATE	2035 summer peak load with non-coincident ATE load at HE19 PST, 9/7

Load Demand Assumptions – SCE Main

Study Case	Scenario	Gross Load (MW)	AAEE (MW)	AAFS (MW)	BTM-PV (MW)		Net Load (MW)	Pump Load (MW)	ATE (MW)	Demand Response* (MW)	
					Installed Capacity	Output				PDR/Fast RDRR	Slow RDRR
B1-2024-SP	Baseline	26949	-228	15	4893	2300	24436	473	0	-440	-336
B2-2027-SP	Baseline	26631	-401	68	6255	1501	24797	474	0	-440	-336
B3-2032-SP	Baseline	26672	-548	204	8101	0	25685	521	642	-440	-336
B4-2024-OP	Baseline	16269	-150	10	4893	0	16128	468	0	NA	NA
B5-2027-LL	Baseline	11726	-108	18	6255	4941	6695	474	0	NA	NA
S1-2027-SP-HLOAD	Sensitivity	28229	-401	73	6255	1501	26399	474	0	-440	-336
S2-2024-SP-HiRenew	Sensitivity	26949	-228	15	4893	2300	24436	473	0	-440	-336
S3-2024-OP-HiRenew	Sensitivity	16269	-150	10	4893	0	16128	468	0	NA	NA
S4-2035-SP-ATE	Sensitivity	27697	-518	227	9499	0	26218	521	1188	-440	-336

Note: DR are modeled offline in starting cases.

Generation Assumptions – SCE Main

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
B1-2024-SP	Baseline	10862	8937	1421	1077	230	200	12734	6436	4301	630	6814	4387
B2-2027-SP	Baseline	10862	7222	1423	1121	230	200	12734	2655	4301	810	6814	3953
B3-2032-SP	Baseline	10242	9104	1423	1107	730	280	19180	0	5894	2358	10944	9971
B4-2024-OP	Baseline	10862	9740	1423	974	230	200	12734	0	4301	1960	6814	3848
B5-2027-LL	Baseline	10862	7578	1423	868	230	50	12734	11883	4301	1313	6814	-6839
S1-2027-SP-HLOAD	Sensitivity	10862	8326	1423	1121	230	200	12734	2655	4301	810	6814	3953
S2-2024-SP-HiRenew	Sensitivity	10862	5536	1421	1077	230	200	12734	12223	4301	2812	6814	0
S3-2024-OP-HiRenew	Sensitivity	10862	6838	1423	974	230	200	12734	12607	4301	2855	6814	-6842
S4-2035-SP-ATE	Sensitivity	10242	9094	1423	1107	1430	280	27751	0	6433	2519	15650	10602

Generation Retirement – SCE Main

Already Retired			To Be Retired	Aged Unit Retirement Plan
Thermal (MW)	Hydro (MW)	Biomass (MW)	Thermal (MW)	Thermal (MW)
4708	154	310	4326	546

- Most of reliability concerns identified in the SCE Main system can be attributed to the generation retirements

Previously approved transmission projects modelled in base cases

Project Name	Transmission Plan Approved	Expected ISD	First Year Modeled
Moorpark–Pardee No. 4 230 kV Circuit	2018	In-Service	2024
Mesa 500 kV Substation	2014	In-Service	2024
Laguna Bell Corridor Upgrade	2015	In-Service	2024
Harry Allen-Eldorado 500 kV transmission project	2015-2016	In-Service	2024
Lugo-Mohave series capacitor upgrade	2013	June-23	2024
Lugo – Eldorado series cap and terminal equipment upgrade	2013	June-23	2024
Pardee-Sylmar No. 1 and No. 2 230 kV Lines Rating Increase	2020	June-24	2024
Alberhill 500 kV Substation	2009	April-27	2027
Delaney-Colorado River 500 kV Line (Ten West Link Project)	2013-2014	April-24	2024
Lugo Substation Install new 500 kV CBs for AA Banks	2008	December-24	2027
Lugo – Victorville 500 kV Upgrade (SCE portion*)	2017	January-25	2027
Laguna Bell - Mesa No. 1 230 kV Line Rating Increase Project	2021-2022	December-23	2024

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

Major Path flows in SCE Main System Study

Study Case	Scenario	SCE Main System Cases			
		Path 26 (MW)	Path 46 (MW)	Path 49 (MW)	Path 65 (MW)
B1-2024-SP	Baseline	3720	590	-3630	3200
B2-2027-SP	Baseline	3227	4450	1380	3131
B3-2032-SP	Baseline	425	5342	1933	3210
B4-2024-OP	Baseline	-1176	5225	1722	-945
B5-2027-LL	Baseline	-2832	-555	-3870	-973
S1-2027-SP-HLOAD	Sensitivity	3268	5140	1900	3131
S2-2024-SP-HiRenew	Sensitivity	3678	1173	-3730	3200
S3-2024-OP-HiRenew	Sensitivity	-1165	6429	1827	-945
S4-2035-SP-ATE	Sensitivity	425	5342	1933	3210

Reliability Assessment Results Summary

Summary of Overloaded Facilities – SCE Main

Overload Facility	Baseline Scenario				Sensitivity Scenario			
	B1, B2, B3, B4, or B5				S1, S2, or S3			
	P2/P4	P5	P6	P7	P2/P4	P5	P6	P7
	Stuck Breaker/ Internal Fault	Non-Redundant Relay	Overlapping singles	common structure	Stuck Breaker/ Internal Fault	Non-Redundant Relay	Overlapping singles	common structure
MIDWAY - VINCNT 500 kV Ckt #1			116.5				122.8	
MIDWAY - VINCNT 500 kV Ckt #2			118.8				124.1	
MIDWAY - WHIRLWIND 500 kV Ckt #3			155.4				155.9	
ANTELOPE - VINCENT 500 kV Ckt #1 and #2							139.7	
ANTELOPE - WHIRLWIND 500 kV Ckt #1					101.1	101.1	145.6	
VINCENT - WHIRLWIND 500 kV Ckt #3							105.1	
VINCENT - MESA CAL 500 kV Ckt #1							117.6	
LUGO - VINCENT 500 Ckt #1 and #2							135.9	
VINCENT 500/230 kV AA Banks #1, #2, #3, #4							119.4	
MESA CAL 500/230 kV Banks #3 and #4							106.7	
SERRANO 500/230 kV AA Banks #1, #2, #3			107				108.1	
CENTER - MESA 230 kC Ckt #1							109.2	
LA CIENEGA - LA FRESA 230 kV Ckt #1							128.9	128.2
EL NIDO - LA CIENEGA 230 kV Ckt #1								
LITEHIPE - MESA 230 kV Ckt #1							110	109.8
MESACALS - LAGUBELL 230 kV Ckt # 2							112.2	105.6
MESA - REDONDO 230 kV Ckt #1							104.2	
SYLMAR 230 kV Banks E and F	127.0		127		112.5		112.5	

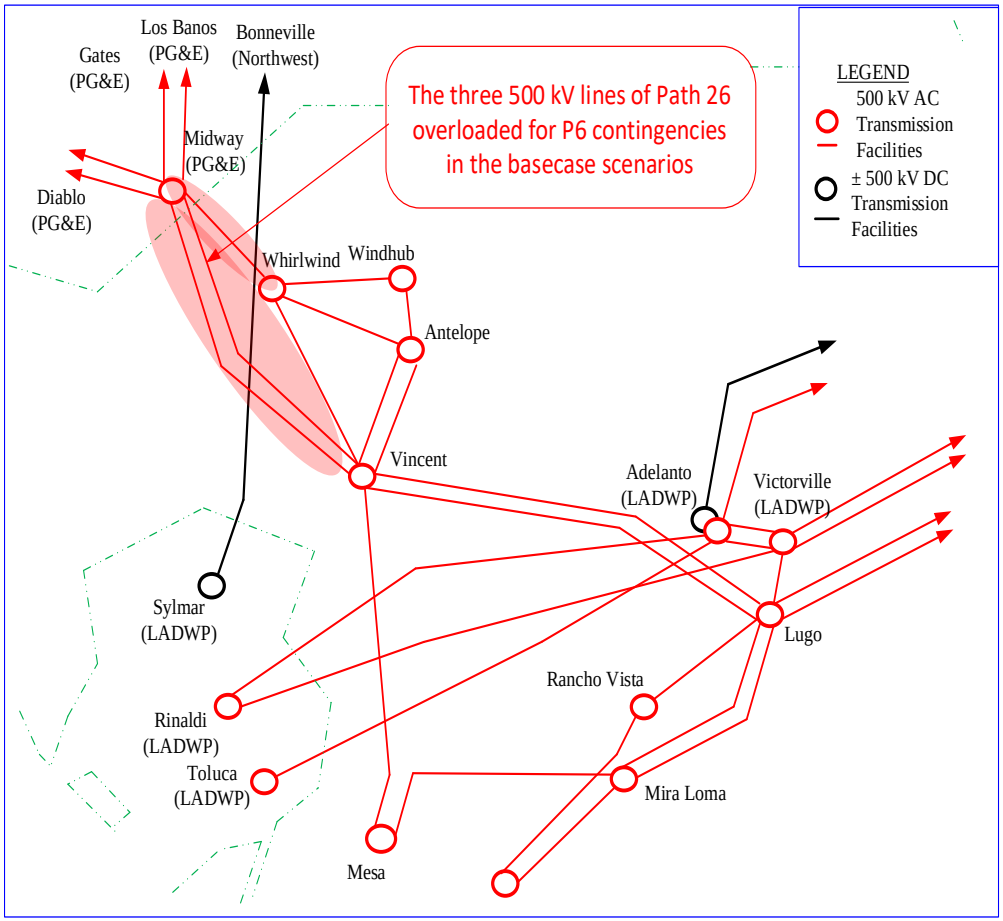
Thermal Overloads on Path 26

Observations

1. P6 overloads on the three 500 kV lines of Path 26 were identified in the B1-2024SP, B2-2027SP, B5-2027OP base cases, and the S1-2027SP-HLoad and the S2-2024SP-HiRenew sensitivity cases

Potential Mitigations

1. Reduce import via Path 26 by re-dispatching generation and bypassing the series capacitors as system adjustment after the initial contingency, along with existing Path 26 and PDCI RASs curtailing generation as needed.



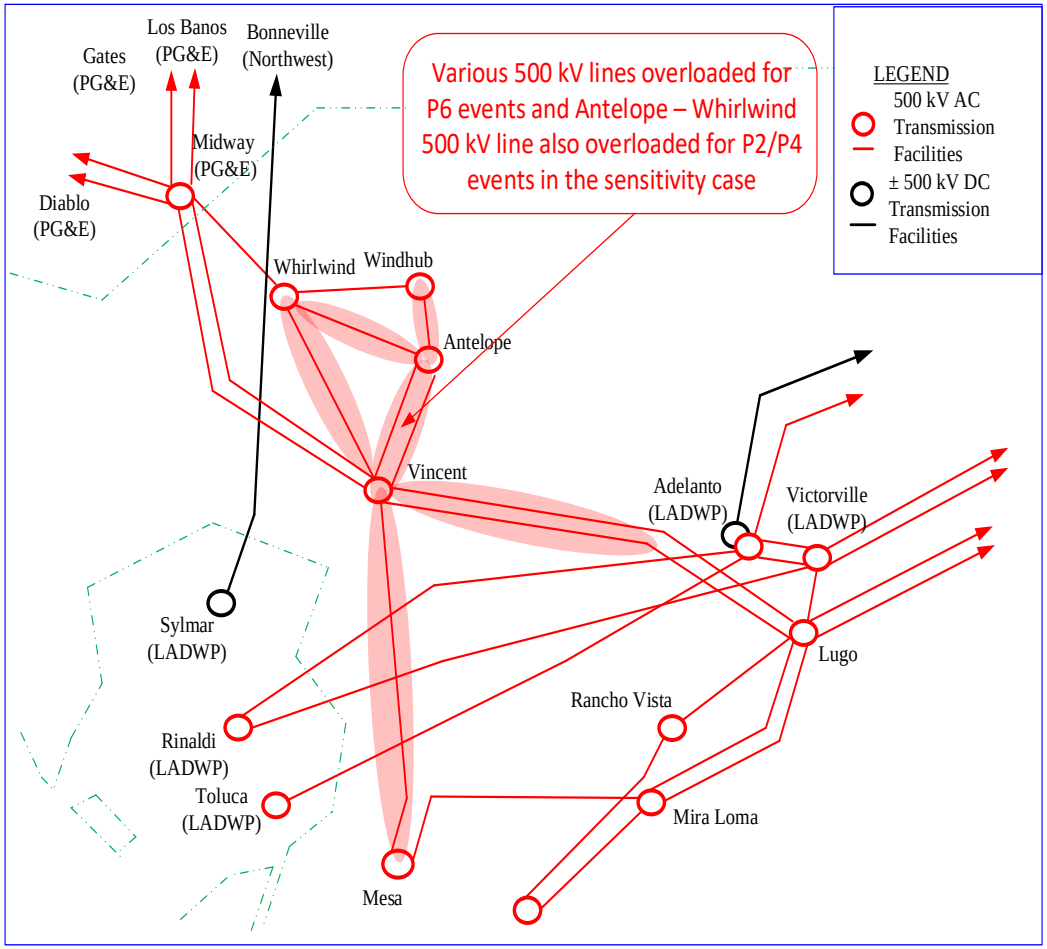
Thermal Overload in the SCE northern 500 kV lines

Observations

1. Various 500 kV lines overloaded for P6 contingencies in the S2-2024SP-HiRenew sensitivity cases, and
2. Antelope – Whirlwind 500 kV line overloaded also for P2/P4/P5 contingencies in the S2-2024SP-HiRenew sensitivity case

Potential Mitigations

1. Curtail up to about 1600 MW of generation in the Whirlwind/Windhub area after the first contingency
2. Modify Tehachapi CRAS to cover the P2/P5/P6 contingencies, or
3. Modify Whirlwind 500 kV bus configuration and have CB #8012 trip coil monitored and reported if possible



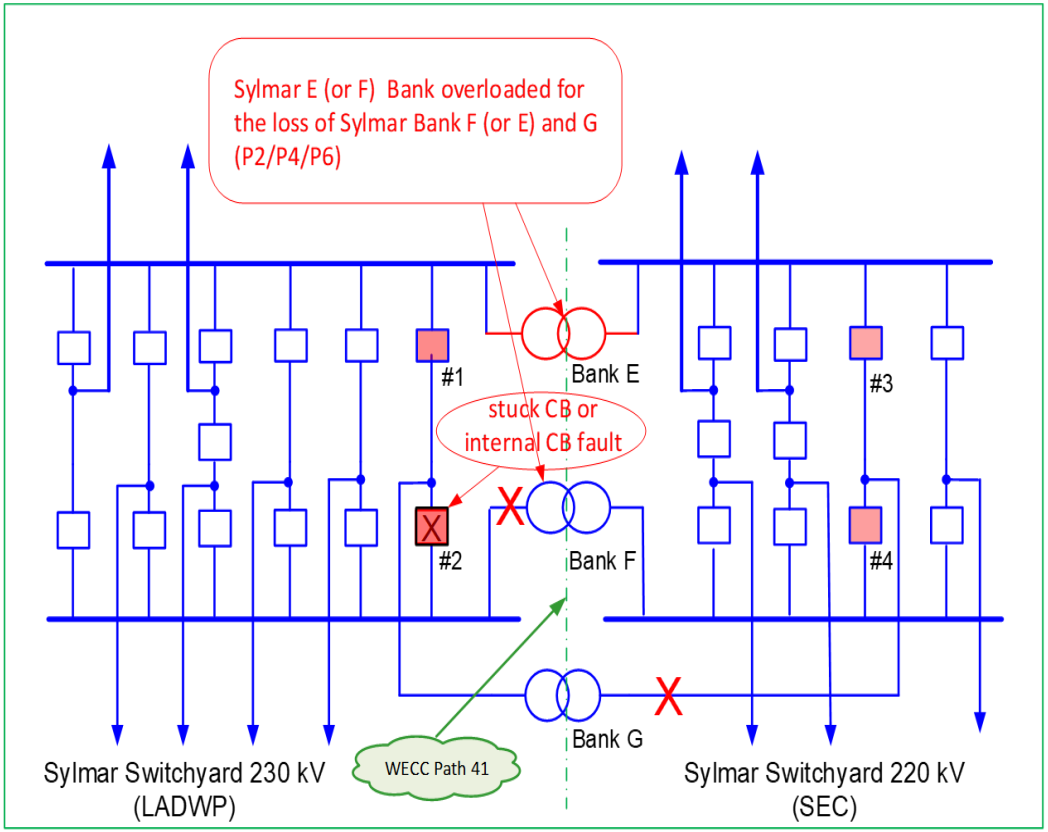
Sylmar Banks 500/230 kV Thermal Overloads

Observations

1. 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) in the B1-2024SP, B2-2027SP, B5-2027OP base cases and the S1-2027SP-Hload, S2-2024SP-HiRenew sensitivity cases

Potential Mitigations

- Sylmar banks E and F need to be upgraded by LADWP and SCE
- Develop an operation procedure to manage power flow via Sylmar banks (Path 41) in both directions for normal operation conditions as an interim mitigation before completion of the banks upgrade



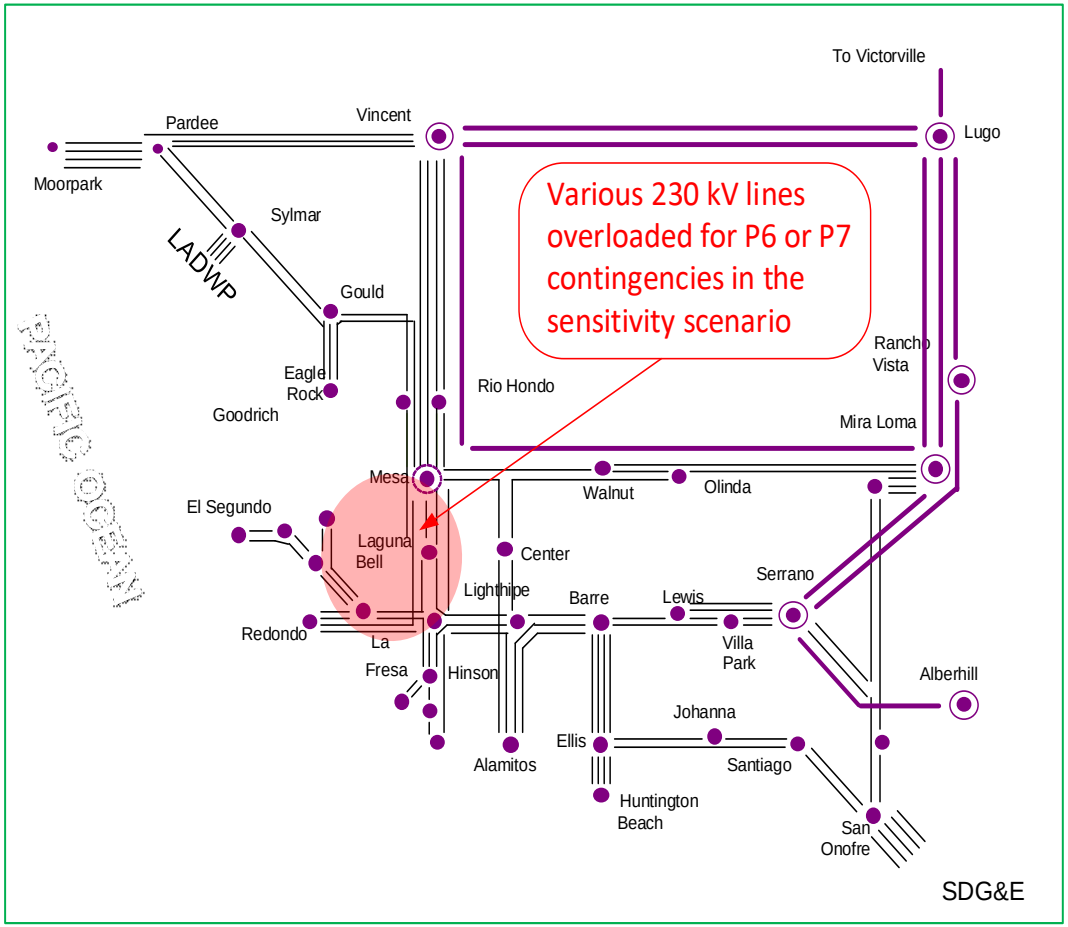
SCE Metro 230 kV Thermal Overloads

Observations

1. La Cienega – La Fresa, Litehipe – Mesa, Mesa – Lagula Bell #2, and Mesa – Redondo 230 kV lines overloaded for P6 or P7 contingencies in the S2-2024SP-HiRenew sensitivity cases

Potential Mitigations

- Dispatch available resources including energy storage and demand response in Western LA Basin



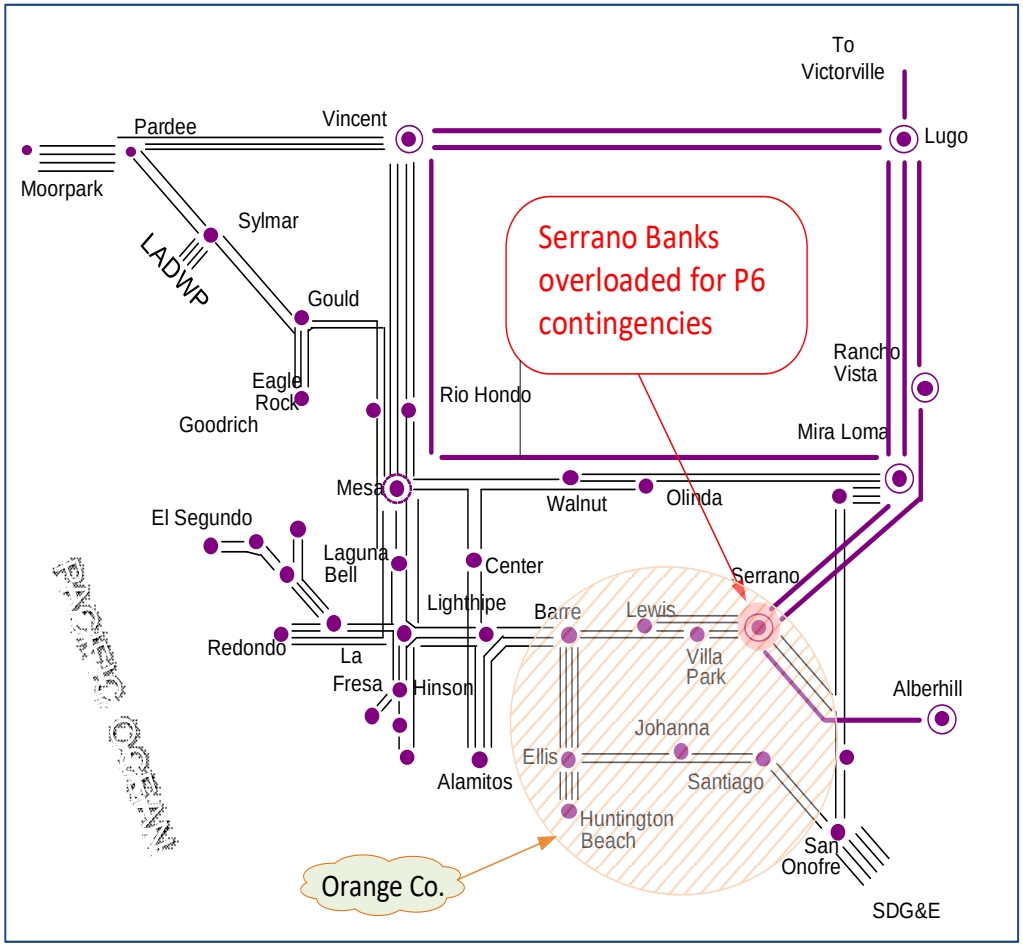
Serrano Banks 500/230 kV Thermal Overloads

Observations

1. Serrano 500/230 kV Transformers overloaded for the loss of any other two Serrano transformer banks (P6) in the B3-2032SP base case, and the S1-2027SP-HLoad and S2-2024SP-HiRenew sensitivity cases

Potential Mitigations

1. Dispatch available resources including energy storage and demand response in Western LA basin and the SDG&E area after the first contingency along with OP7590 as needed
2. Keep watch on the load growth, retirement of gas-fueled units, and implementation of the portfolio energy storage resources in Western LA Basin and the SDG&E, which play a big role in eliminating the Serrano banks overloads



2035 Summer Peak With ATE Sensitivity Study Result

Observations

1. With 1188 MW of ATE load forecast in the SCE area, no additional reliability concern was identified beyond the 10-year planning horizon

Potential Mitigations

No additional mitigation is needed

Overload Facility	Baseline Scenario		Sensitivity Scenario		2035 ATE Sensitivity Scenario	
	B1, B2, B3, B4, or B5		S1, S2, or S3		S4	
	P6	P7	P6	P7	P6	P7
	Overlapping singles	common structure	Overlapping singles	common structure	Overlapping singles	common structure
SERRANO 500/230 kV AA Banks #1, #2, #3	**107.0**		**108.1**		**105.0**	

Recommendation on SCE Main System

- Upgrade Sylmar banks E and F. As an interim mitigation, develop an operation procedure managing power flow via the Sylmar banks (Path 41) for pre-contingency

- Keep watch on the load growth, additional retirement of gas-fueled units, and implementation of the portfolio energy storage resources in Western LA Basin and the SDG&E area, which plays a big role in eliminating the Serrano banks overloads

- Modifying the Whirlwind 500 kV bus configuration and have the CB #8012 trip coils monitored and reported if possible

Southern California Bulk
Preliminary Reliability Assessment Results

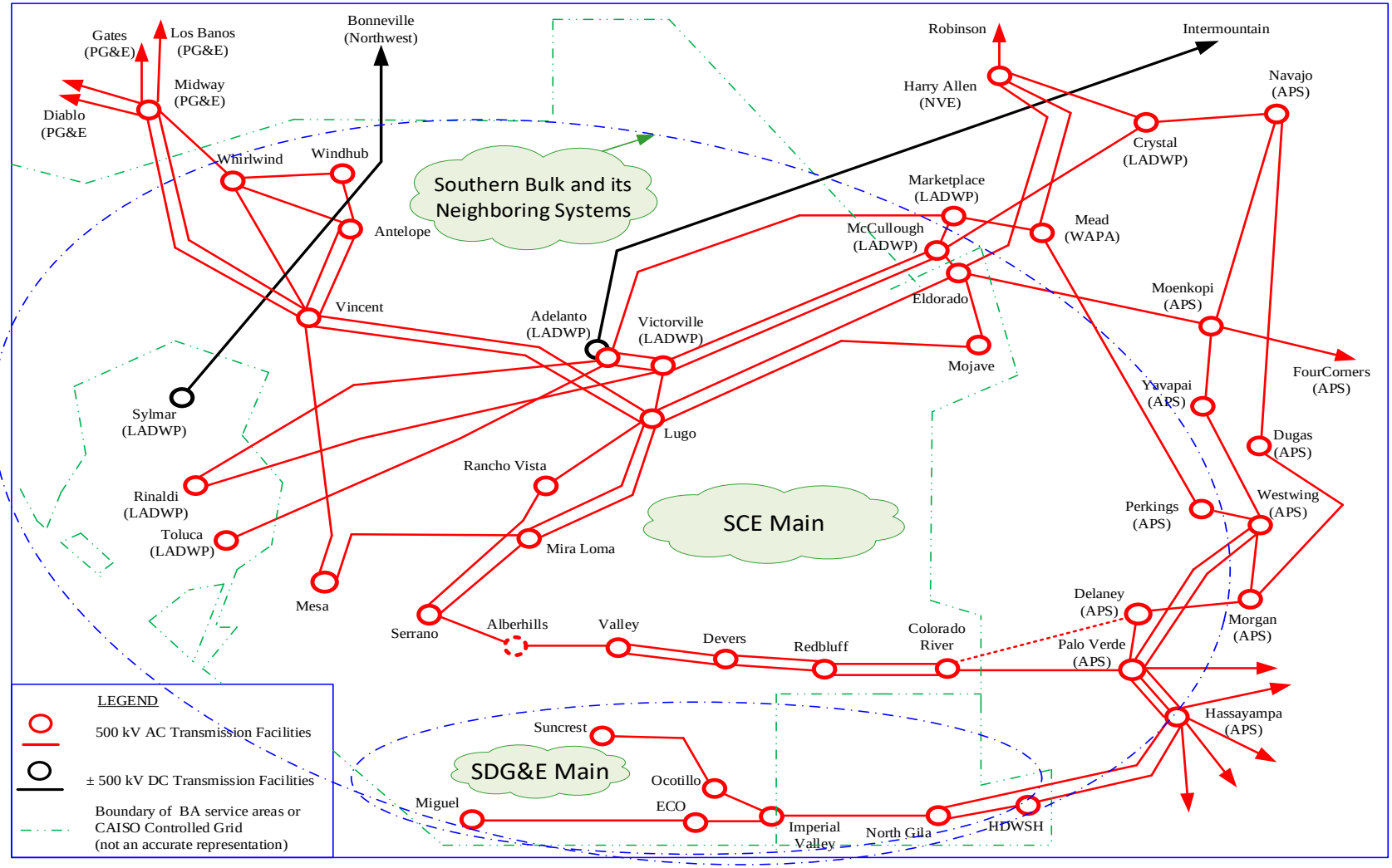
Frank Chen
Regional Transmission Engineer Lead

2022-2023 Transmission Planning Process Stakeholder Meeting
September 27-28, 2022

Southern California Bulk System

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

Southern California Bulk System



Southern California Bulk System Study Scenarios

Baseline Scenarios

Case ID	Study Case Name	Description
B1	B1-2024SP	2024 summer peak load condition at HE16 PST, 9/3
B2	B2-2027SP	2027 summer peak load condition at HE19 PST, 9/7
B3	B3-2032SP	2032 summer peak load condition at HE19 PST, 9/7
B4	B4-2024OP	2024 spring off-peak load condition at HE20 PST, 4/24
B5	B5-2027OP	2027 spring off-peak load condition at HE13 PST, 4/4
B6	B6-2032OP	2032 spring off-peak load condition at HE13 PST, 4/4

Sensitivity Scenarios, including Additional Transportation Electrification

Case ID	Study Case Name	Description
S1	S1-2027SP-HLOAD	2027 summer peak condition with high CEC load forecast
S2	S2-2024SP-HiRenew	2024 summer peak condition with heavy renewable output
S3	S3-2024OP-HiRenew	2024 spring off-peak condition with heavy renewable output
S4	S4-2035SP-ATE	2035 summer peak load with coincident ATE load at HE21 PST, 9/7

Load Demand Assumptions – Southern California Bulk

Study Case	Gross Load (MW)	AAEE (MW)	AAFS (MW)	BTM-PV (MW)		Net Load (MW)	Pump Load (MW)	ATE (MW)	Demand Response* (MW)	
				Installed Capacity	Output				PDR/Fast RDRR	Slow RDRR
B1-2024SP	30282	-277	17	6936	3260	26763	473	0	-466	-336
B2-2027SP	28934	-477	81	8722	0	28538	474	0	-466	-336
B3-2032SP	30654	-673	237	11311	0	29423	521	795	-466	-336
B4-2024OP	19466	-187	12	6936	0	19291	468	0	NA	NA
B5-2027OP	14364	-150	26	8722	7063	7176	474	0	NA	NA
B6-2032OP	16112	-189	65	11171	9210	5652	512	1126	NA	NA
S1-2027SP-HLOAD	30658	-477	86	8722	0	30267	474	0	-466	-336
S2-2024SP-HiRenew	30274	-277	17	6936	3260	26754	473	0	-466	-336
S3-2024OP-HiRenew	19466	-187	12	6936	0	19291	468	0	NA	NA
S4-2035SP-ATE	35181	-629	272	13029	0	30764	521	4060	-466	-336

Note: DR are modeled offline in starting cases.

Generation Assumptions – Southern California Bulk

Study Case	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
B1-2024-SP	13790	11936	1425	1079	270	240	14859	7504	5079	746	8004	4964
B2-2027-SP	13800	12151	1427	1125	270	240	14835	0	5079	1899	8004	4658
B3-2032-SP	13253	11997	1427	1102	1270	320	22101	0	7272	2103	12661	9941
B4-2024-OP	13849	12172	1427	974	270	200	14859	0	5079	2318	8004	4076
B5-2027-LL	13800	7757	1427	868	270	50	14619	13599	5079	1531	8244	-7616
B6-2031-LL	13253	5001	1427	218	1270	50	22007	19731	7272	2211	12751	-10193
S1-2027-SP-HLOAD	13800	12311	1427	1125	270	240	14835	0	5079	1899	8004	6163
S2-2024-SP-HiRenew	13790	7967	1425	1079	270	240	14859	14464	5079	3209	8004	-150
S3-2024-OP-HiRenew	13849	9445	1427	974	270	200	14859	14646	5079	3252	8004	-7669
S4-2035-SP-ATE	13253	12099	1427	1112	1970	820	31026	0	7811	2265	18138	12993

Generation Retirement – Southern California Bulk

Already Retired			To Be Retired	Aged Unit Retirement Plan
Thermal (MW)	Hydro (MW)	Biomass (MW)	Thermal (MW)	Thermal (MW)
4708	154	310	4326	546

- Most of reliability concerns that have been identified in the southern bulk system can be attributed to the generation retirements

Previously approved transmission projects modelled in base cases

Project Name	Transmission Plan Approved	Expected ISD	First Year Modeled
Moorpark–Pardee No. 4 230 kV Circuit	2018	In-Service	2024
Mesa 500 kV Substation	2014	In-Service	2024
Laguna Bell Corridor Upgrade	2015	In-Service	2024
Harry Allen-Eldorado 500 kV transmission project	2015-2016	In-Service	2024
Lugo-Mohave series capacitor upgrade	2013	June-23	2024
Lugo – Eldorado series cap and terminal equipment upgrade	2013	June-23	2024
Pardee-Sylmar No. 1 and No. 2 230 kV Lines Rating Increase	2020	June-24	2024
Alberhill 500 kV Substation	2009	April-27	2027
Delaney-Colorado River 500 kV Line (Ten West Link Project)	2013-2014	April-24	2024
Lugo Substation Install new 500 kV CBs for AA Banks	2008	December-24	2027
Lugo – Victorville 500 kV Upgrade (SCE portion)	2017	January-25	2027
Laguna Bell - Mesa No. 1 230 kV Line Rating Increase Project	2021-2022	December-23	2024
Lugo – Victorville 500 kV Upgrade (SCE portion)	2017	January-25	2027
IID S-Line Upgrade	2017-2018	July-05	2024

Major Path Flows in Southern California Bulk

Study Case	Scenario	Southern California Bulk System Cases			
		Path 26 (MW)	Path 46 (MW)	Path 49 (MW)	Path 65 (MW)
B1-2024-SP	Baseline	3690	420	-3895	3200
B2-2027-SP	Baseline	1107	5816	2375	3131
B3-2032-SP	Baseline	-100	4990	1908	3210
B4-2024-OP	Baseline	-1195	4832	1615	-945
B5-2027-LL	Baseline	-3122	26	-3110	-973
B6-2032-LL	Baseline	-2408	-1560	-6668	-940
S1-2027-SP-HLOAD	Sensitivity	485	6456	2918	3131
S2-2024-SP-HiRenew	Sensitivity	3614	870	-4090	3200
S3-2024-OP-HiRenew	Sensitivity	-1133	6703	1772	-945
S4-2035-SP-ATE	Sensitivity	-100	4988	1908	3210

Summary of Overloaded Facilities – Southern California Bulk

Overload Facility	Baseline Scenario				Sensitivity Scenario				2035 ATE Sensitivity Scenario				
	B1, B2, B3, B4, B5, or B6				S1, S2, or S3				S4				
	P2/P4	P5	P6	P7	P2/P4	P5	P6	P7	P1/P3	P2/P4	P5	P6	P7
	Stuck Breaker/ Internal Fault	Non-Redundant Relay	Overlapping singles	common structure	Stuck Breaker/ Internal Fault	Non-Redundant Relay	Overlapping singles	common structure	Single Outage	Stuck Breaker/ Internal Fault	Non-Redundant Relay	Overlapping singles	common structure
MIDWAY - VINCNT 500 kV Ckt #1			115				122.7						
MIDWAY - VINCNT 500 kV Ckt #2			117.3				126.1						
MIDWAY - WHIRLWIND 500 kV Ckt #3			153.4				152.3						
ANTELOPE - VINCENT 500 kV Ckt #1 and #2							141						
ANTELOPE - WHIRLWIND 500 kV Ckt #1			102.5		100.8	100.8	144.1						
VINCENT - WHIRLWIND 500 kV Ckt #3							104.2						
VINCENT - MESA CAL 500 kV Ckt #1							117.8						
LUGO - VINCENT 500 Ckt #1 and #2							137.5						
VINCENT 500/230 kV AA Banks #1, #2, #3, #4							117.9						
MESA CAL 500/230 kV Banks #3 and #4							106.5						
SERRANO 500/230 kV AA Banks #1, #2, and #3			101.5				120.4					111.8	
CENTER - MESA 230 kC Ckt #1						104.8	112.3	101.0					
LA CIENEGA - LA FRESA 230 kV Ckt #1							124.5	123.9	102.0	103.0	103.0	106	
EL NIDO - LA CIENEGA 230 kV Ckt #1									101.0	101.0	101.0		
LITEHIPE - MESA 230 kV Ckt #1							111.5	110.6					
MESACALS - LAGUBELL 230 kV Ckt # 2							113.1	106.3					
MESA - REDONDO 230 kV Ckt #1							104.2						
SYLMAR 230 kV Banks E and F	144.0		144		138.0		138						

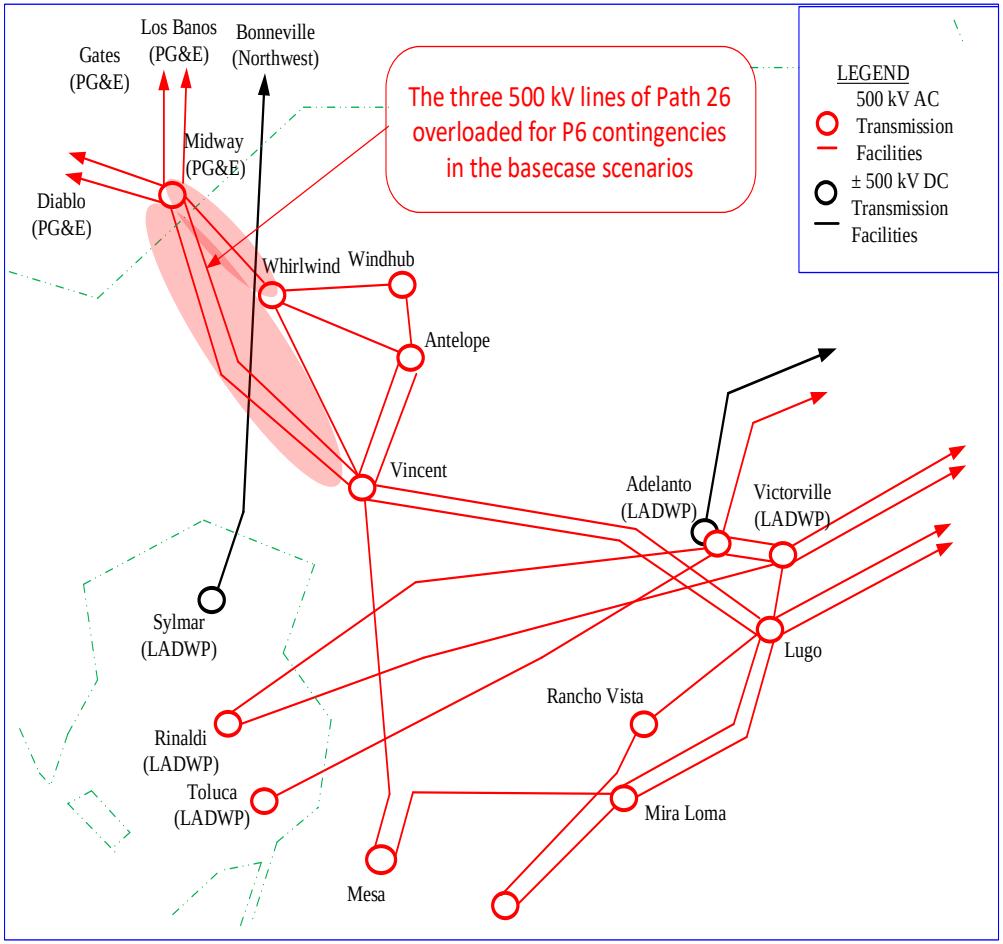
Thermal Overloads on Path 26

Observations

1. P6 overloads on the three 500 kV lines of Path 26 were identified in the B1-2024SP, B5-2027OP, and B6-2032OP base cases, and the S2-2024SP-HiRenew sensitivity cases

Potential Mitigations

1. Reduce import via Path 26 by re-dispatching generation and bypassing the series capacitors as system adjustment after the initial contingency, along with existing Path 26 and PDCI RASs curtailing generation as needed.



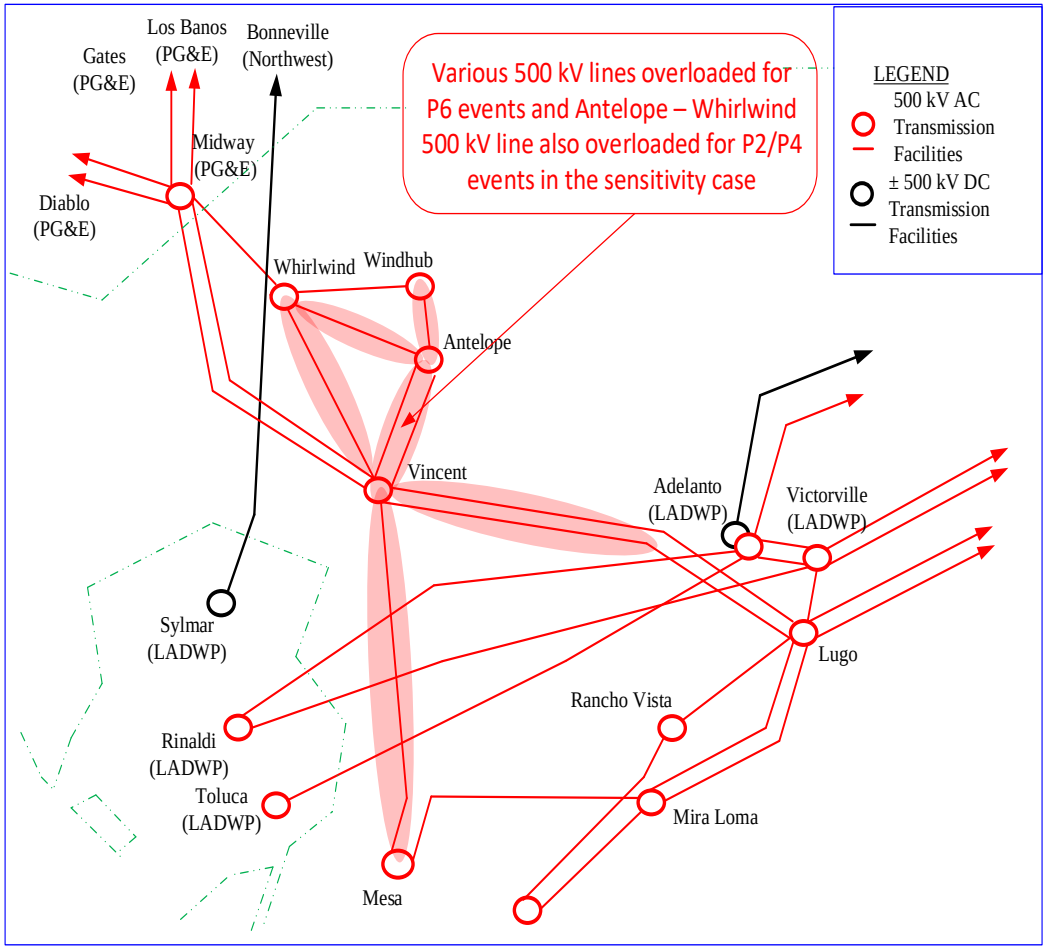
Thermal Overload in the SCE northern 500 kV lines

Observations

1. Various 500 kV lines overloaded for P6 contingencies in the B1-2024SP base case, and the S2-2024SP-HiRenew sensitivity case, and
2. Antelope – Whirlwind 500 kV line overloaded also for P2/P4/P5 contingencies in the S2-2024SP-HiRenew sensitivity case

Potential Mitigations

1. Curtail up to about 1600 MW of generation in the Whirlwind/Windhub area after the first contingency
2. Modify Tehachapi CRAS to cover the P2/P5/P6 contingencies
3. Eliminate the P2/P4 and P5 contingences by modifying Whirlwind 500 kV bus configuration and have CB #8012 trip coil monitored and reported if possible



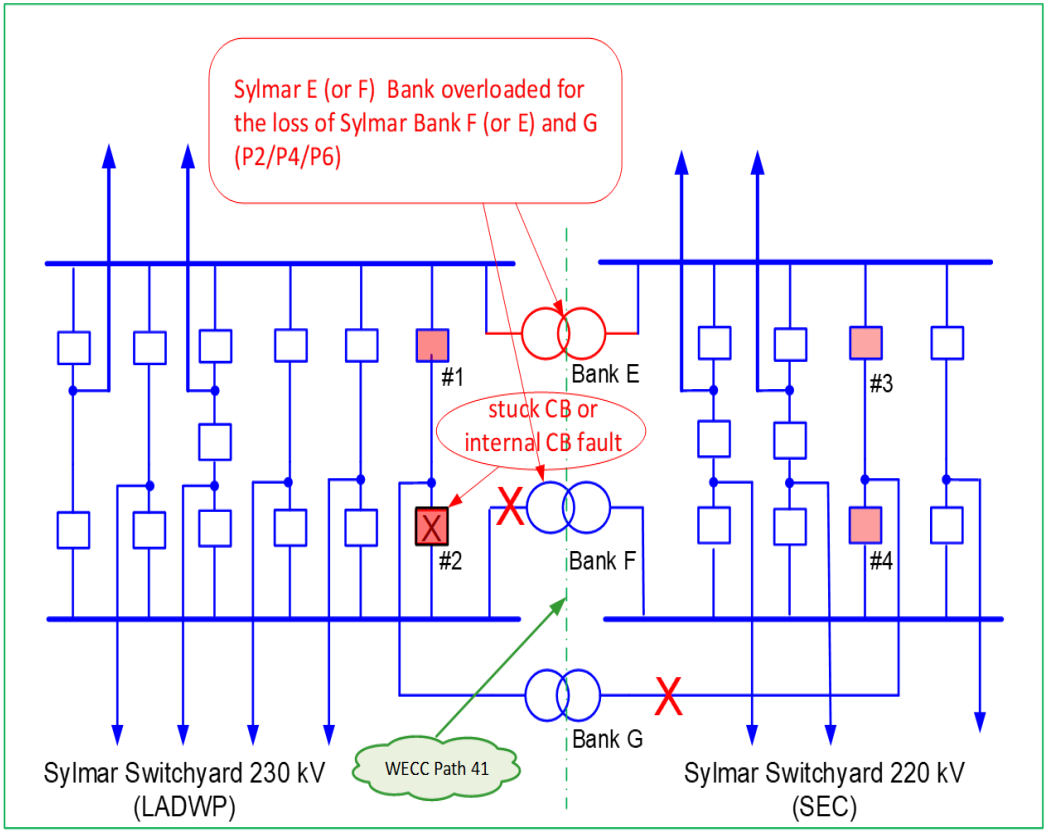
Sylmar Banks 500/230 kV Thermal Overloads

Observations

1. 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) in the B1-2024SP, B6-2032OP base cases and the S2-2024OP-HiRenew, S3-2024OP-HiRenew sensitivity cases

Potential Mitigations

- Sylmar banks E and F need to be upgraded by LADWP and SCE
- Develop an operation procedure to manage power flow via Sylmar banks (Path 41) in both directions for normal operation conditions as an interim mitigation before completion of the banks upgrade



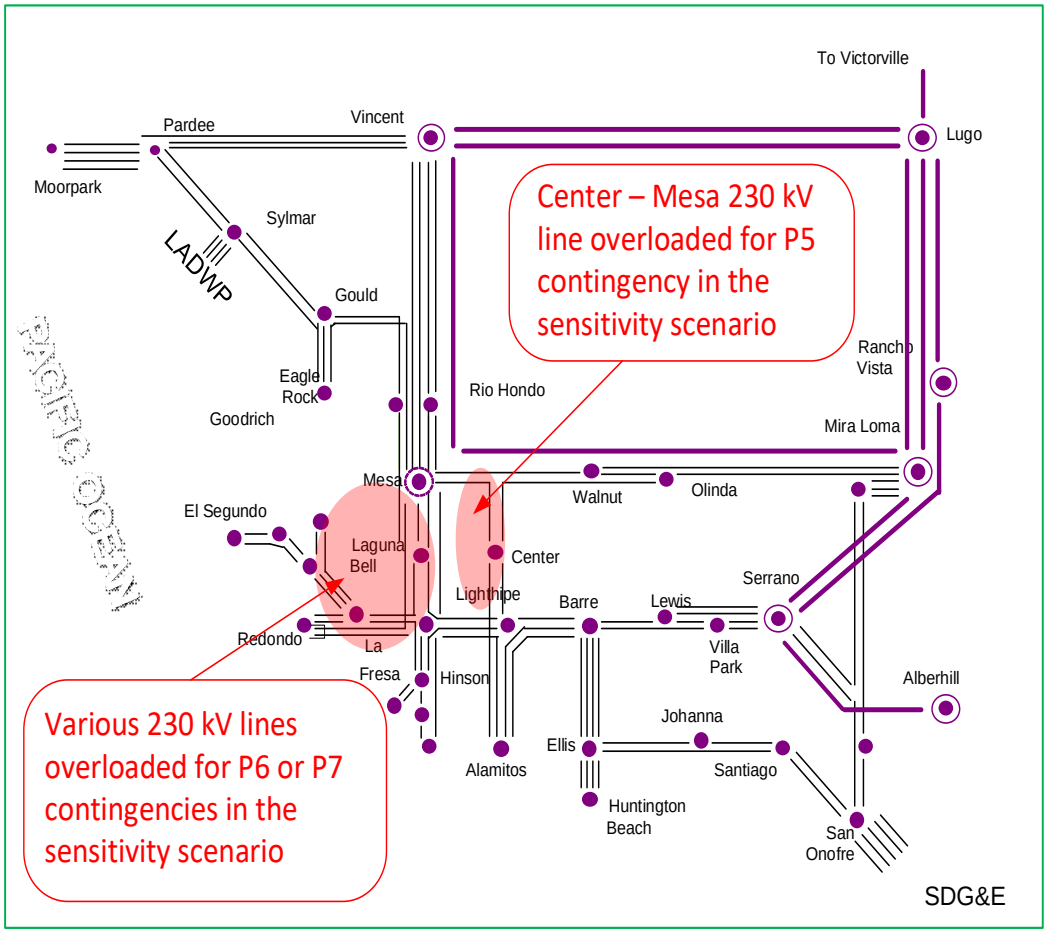
SCE Metro 230 kV Thermal Overloads

Observations

1. La Cienega–La Fresa, Litehipe–Mesa, Mesa–Lagula Bell #2, and Mesa–Redondo 230 kV lines overloaded for P6 or P7 contingencies in the S2-2024SP-HiRenew case
2. Center - Mesa 230 kV line overloaded also for a P5 contingency at Serrano East 500 kV bus in the S2-2024SP-HiRenew case

Potential Mitigations

- Dispatch available resources in Western LA Basin and the SDGE area
- Eliminate the P5 contingency by adding redundant relay at Serrano East 500 kV bus



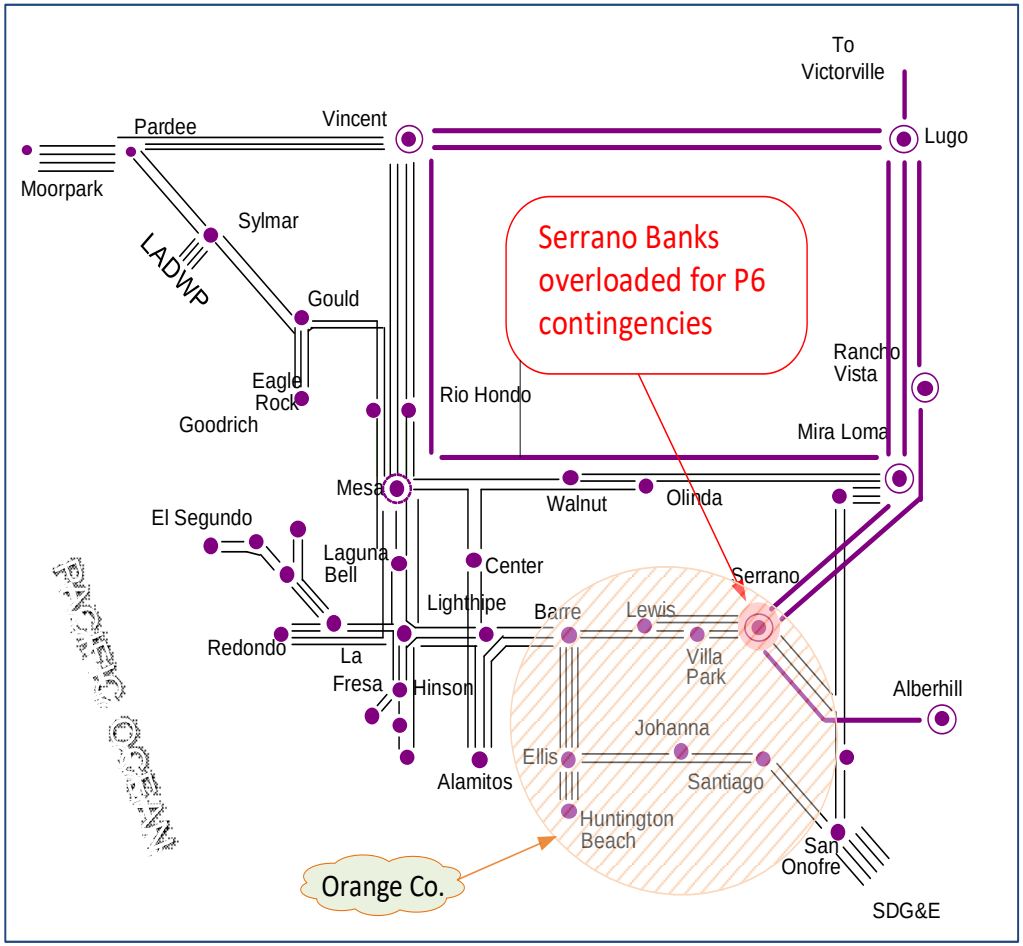
Serrano Banks 500/230 kV Thermal Overloads

Observations

1. Serrano 500/230 kV Transformers overloaded for the loss of any other two Serrano transformer banks (P6) in the B3-2032SP base case, and the S1-2027SP-HLoad and S2-2024SP-HiRenew sensitivity cases

Potential Mitigations

1. Dispatch available resources including energy storage and demand response in Western LA basin and the SDG&E area after the first contingency, along with OP7590 as needed
2. Keep watch on the load growth, retirement of gas-fueled units and implementation of the portfolio energy storage resources in Western LA Basin and the SDG&E area, which plays a big role in eliminating the Serrano banks overloads



2035 Summer Peak With ATE Sensitivity Study

Observations

1. With addition of the 2180 MW of ATE load in Western LA Basin, the P6 Serrano banks overload issue could not be mitigated by operational mitigation dispatching resources in Western LA Basin and the SDG&E area. The energy storage mitigation assumption is discussed in the following slides
2. La Cienega – La Fresa and El Nido – La Cienega 230 kV lines overloaded for P1~P7 and P1~ P5 contingencies

Potential Mitigations

1. Reliability-driven transmission mitigation for the Serrano banks overloads needs to coordinate with the policy and economic transmission needs in the area
2. The overloads on La Cienega–La Fresa and El Nido–La Cienega 230 kV lines are local reliability concerns due to ATE load addition and need to be watched

Overload Facility	Baseline Scenario		Sensitivity Scenario		2035 ATE Sensitivity Scenario				
	B1, B2, B3, B4, B5, or B6		S1, S2, or S3		S4				
	P6	P7	P6	P7	P1/P3	P2/P4	P5	P6	P7
	Overlapping singles	common structure	Overlapping singles	common structure	Single Outage	Stuck Breaker/ Internal Fault	Non-Redundant Relay	Overlapping singles	common structure
SERRANO 500/230 kV Banks #1, #2, #3	**101.5**		**120.4**					**111.8**	
LA CIENEGA - LA FRESA 230 kV Ckt #1			**124.5**	**123.9**	**102.0**	**103.0**	**103.0**	**106**	**106**
EL NIDO - LA CIENEGA 230 kV Ckt #1					**101.0**	**101.0**	**101.0**		

Energy Storage Mitigation for Serrano Bank Issue

- Energy storage can be utilized as an alternative transmission mitigation up to the portfolio amount or the long duration BESS charging capability, whichever is less
- Any amount of storage mitigation that need to be utilized beyond the CPUC/CEC Resource Adequacy (RA) MWh or 4-hour capability should consider the cost of adding additional MWh capability above the portfolio energy storage capability
- The portfolio long duration energy storage or pumped storage are assumed to have 8 hours discharging capability. And the portfolio Li-ion battery are assumed to have 4 hours discharging capability
- It is assumed that long duration BESS needs to have 8-hour generating capability to meet peak load that lasts 8 hours in Western LA Basin

Energy Storage Mitigation For Serrano Bank Issue
based on the Portfolio and the BESS Charging Limit

BESS Assumption		B3-2032SP Base Case						S4-2035SP ATE Sensitivity Case					
		Western LA Basin			SDGE Metro and Greater IV			Western LA Basin			SDGE Metro and Greater IV		
		MW	MWh	Duration (H)	MW	MWh	Duration (H)	MW	MWh	Duration (H)	MW	MWh	Duration (H)
2027 LCR Study	Long duration BESS charging capability	1820	14911	8.2	1634 MW/8076 MWh charging limit in SDGE Metro, No charging limit for the 339 MW in Greater IV Area			1820	14911	8.2	1634 MW/8076 MWh charging limit in SDGE Metro, No charging limit for the 539 MW in Greater IV Area		
	in which: 4-Hour BESS Charging Capability	570	2280	4.0	1000	4000	4.0	570	2280	4.0	1000	4000	4.0
	Long Duration Energy Charging Capability	1250	12631	10.1	634	4076	6.4	1250	12631	10.1	634	4076	6.4
CPUC Portfolio	Total Energy Storage for Resource Adequcy (RA)	1153	4672	4.1	2115	10620	5.0	1350	5400	4.0	2885	13240	4.6
	in which: 4-Hour Duration BESS	1153	4672	4.0	1575	6300	4.0	1350	5400	4.0	2345	8920	4.0
	LDES/PSH	0	0	NA	540	4320	8.0	0	0	NA	540	4320	8.0
	BESS MW capability reduced due to Long Duration Energy Charging Limitation*	0	0	0.0	-142	NA	NA	0	0	0.0	-712	NA	NA
Assumption A: Maximum Energy Storage for Serrano Banks Issue based on Portfolio and Long Duration Charging Limit		1153	NA	NA	1973	NA	NA	1350	NA	NA	2173	NA	NA
Assumption B: Minimum Energy Storage for Serrano Banks Issue based on 4-Hour Charging Limit and LDES/PSH		570	NA	NA	1540	NA	NA	570	NA	NA	1540	NA	NA

- The portfolio BESS amount in Western LA Basin can be fully used for the Serrano bank issue. But the portfolio energy storage including PSH in the SDG&E Metro area could not be fully used as it is beyond the 1634 MW of charging limit.

Capital Cost of the Energy Storage Mitigation
Addressing the Serrano Bank Issue

Storage Assumption	Storage Cost Rate	B3-2032SP Base Case								S4-2035SP ATE Sensitivity Case							
		Western LA Basin			SDGE Metro and Greater IV			Capital Cost	Is it adequate to mitigate Serrano Banks Issue?	Western LA Basin			SDGE Metro and Greater IV			Total Capital Cost of Additional Battery	Is it adequate to mitigate Serrano Bank Issue?
		BESS Dispatched	Additional Battery	Capital Cost	BESS Dispatched	Additional Battery	Capital Cost			BESS Dispatched	Additional Battery	Capital Cost	BESS Dispatched	Additional Battery	Capital Cost		
	$/kwh	MW	MWh	(k$)	MW	(k$)	(k$)	(k$)	Yes or No	MW	MWh	(k$)	MW	(k$)	(k$)	(k$)	Yes or No
Assumption A: Additional 4-hour battery needed to transform the remaining 4-hour BESS to LDES	150	1153	2332	$349,800	1973	1732	$259,800	$609,600	Yes	1350	3120	$468,000	2173	2532	$379,800	$847,800	No
Assumption B: Operate BESS within the 4-Hour Capability only		570	0	$0	1540	0	$0	$0	Marginal	570	0	$0	1540	0	$0	$0	No

- The 4-hour energy storage for system-wide resource adequacy can be used for local reliability purpose up to the 4-hour charging limit for free
- However, it is costly to use the 4-hour energy storage above the 4-hour charging limit as mitigate for the Serrano bank issue, as additional storage MWh needs to be added for achieving LDES capability, comparing with its transmission mitigation

Recommendation on Southern California Bulk System

- Upgrade Sylmar banks E and F. As an interim mitigation, develop an operation procedure managing power flow via Path 41 for pre-contingency

- Under the 2035 ATE sensitivity scenario, a reliability-driven transmission mitigation is needed for the Serrano bank issue, which will coordinate with the policy and economic transmission needs in the area

- Eliminate the P2/P4/P5 Antelope – Whirlwind 500 kV line overloads by modifying Whirlwind 500 kV bus configuration and have CB #8012 trip coil monitored and reported if possible

- Eliminate the P5 Center – Mesa 230 kV overload by adding redundant relay at Serrano East 500 kV bus

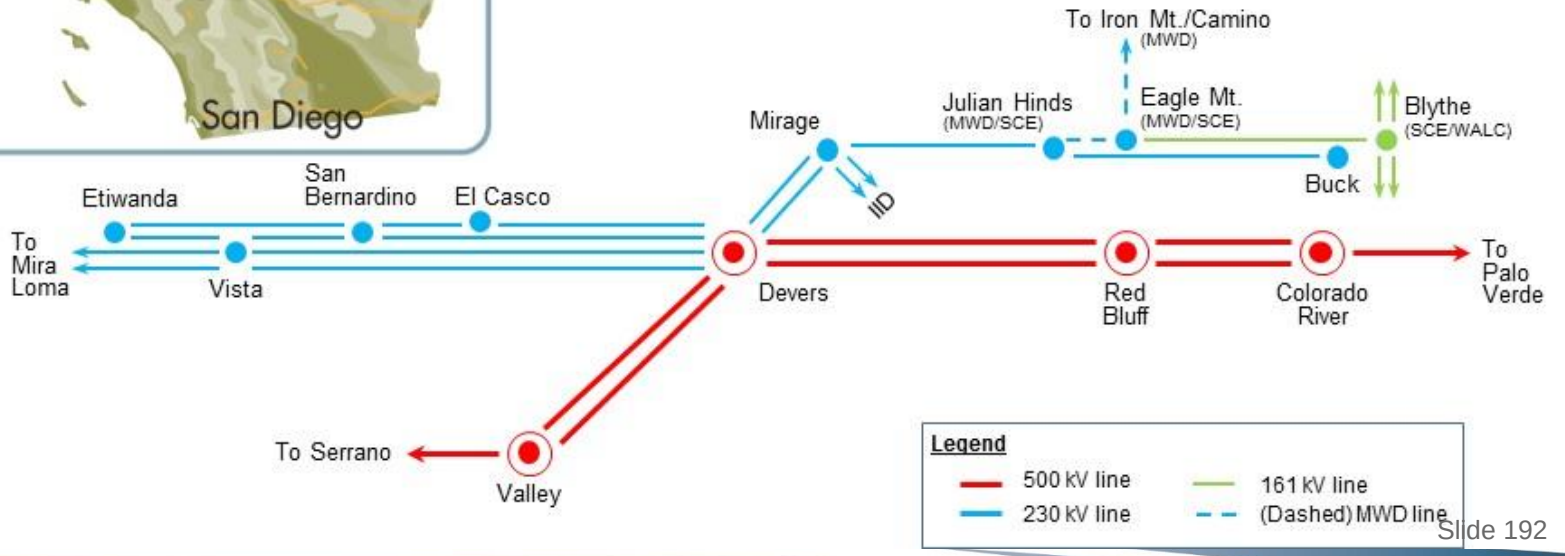
SCE Eastern Area
Preliminary Reliability Assessment Results

Nikitas Zagoras
Sr. Regional Transmission Engineer

2022-2023 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 5,095 MW in 2024



SCE Eastern Area Study Scenarios

- Base scenarios

No.	Case	Description
B1	2024 Summer Peak	Summer peak load time (9/3 HE 16 PPT)
B2	2027 Summer Peak	Summer peak load time (9/7 HE 17 PPT)
B3	2032 Summer Peak	Summer peak load time (9/7 HE 19 PPT)
B4	2024 Spring Off-Peak	Spring off-peak time (4/24 HE 20 PPT)
B5	2027 Spring Off-Peak	Spring off-peak time (4/24 HE 20 PPT)

- Sensitivity scenarios

No	Case	Change From Base Assumption
S1	2027 Summer Peak	High CEC forecasted load
S2	2024 Summer Peak	Heavy renewable output and minimum gas generation commitment
S3	2024 Spring Off-Peak	Heavy renewable output and minimum gas generation commitment
S4	2035 Summer Peak	2035 CEC forecasted load with Additional Transportation Electrification

Demand Assumptions

ID	Base Case	Gross Load (MW)	AAEE (MW)	AAFS (MW)	ATE (MW)	BTM-PV		Net Load (MW)	Demand Response	
						Installed (MW)	Output (MW)		Fast	Slow
B1	2024 Summer Peak	5752	43	2	0	1398	657	5095	61	15
B2	2027 Summer Peak	5554	76	14	0	1657	398	5157	61	15
B3	2032 Summer Peak	5465	104	41	82	2132	0	5465	61	15
B4	2024 Off Peak	3177	28	2	0	1398	0	3177	61	15
B5	2027 Off Peak	2625	21	4	0	1657	1309	1316	61	15
S1	2027 SP High CEC Load	5875	76	15	0	1657	398	5477	61	15
S2	2024 SP Heavy Renewable Output & Min. Gas Gen.	5752	43	2	0	1398	657	5095	61	15
S3	2024 OP Heavy Renewable Output & Min. Gas Gen.	3494	29	2	0	1398	0	3494	61	15
S4	2035 CEC forecasted load with ATE	5642	98	46	152	2500	0	5642	61	15

Supply Assumptions

ID	Base Case	Energy Storage (MW)		Solar		Wind		Hydro		Thermal	
		Installed (MW)	Dispatch (MW)	Installed (MW)	Dispatch (MW)	Installed (MW)	Dispatch (MW)	Installed (MW)	Dispatch (MW)	Installed (MW)	Dispatch (MW)
B1	2024 Summer Peak	2617	1547	3922	1943	787	106	463	208	3842	2272
B2	2027 Summer Peak	2617	2239	3922	800	787	142	463	210	3842	2435
B3	2032 Summer Peak	3107	2936	4932	0	1225	490	463	217	3845	2928
B4	2024 Off Peak	2617	1298	3922	0	787	344	463	193	3842	2862
B5	2027 Off Peak	2617	-2398	3922	3580	787	230	463	17	3842	1985
S1	2027 SP High CEC Load	2617	2239	3922	800	787	142	463	210	3842	2435
S2	2024 SP Heavy Renewable Output & Min. Gas Gen.	2617	30	3922	3882	787	472	463	208	3842	672
S3	2024 OP Heavy Renewable Output & Min. Gas Gen.	2617	-2401	3922	3882	787	501	463	193	3842	1609
S4	2035 CEC Forecasted load with ATE	4540	3636	8376	0	1226	490	463	217	3845	2928

Energy storage: Battery storage, Pumped Hydro / LDES

Previously approved transmission projects modelled in base cases

Project Name	ISD	First Year Modeled
Delaney-Colorado River 500 kV line	07/2023	2024
Riverside Transmission Reliability Project	10/2026	2026
Alberhill 500 kV Substation	10/2025	2027
Alberhill 500 kV Method of Service	04/2027	2027
Devers 230 kV Reconfiguration Project	TBD	2027

Neighboring system transmission projects modelled in base cases

Project Name	ISD	First Year Modeled
Mirage-Ramon #2 230 kV line	12/2025	2027

Reliability assessment preliminary results summary

Base Scenario Results – Thermal Loading

Overloaded Facility	Contingency (All and Worst P6)	Cat.	Loading % (Baseline Scenarios)					Potential Mitigation Solution
			2024 Summer Peak	2027 Summer Peak	2032 Summer Peak	2027 Spring Off-Peak	2024 Spring Off-Peak	
J.HINDS - MIRAGE 230 kV #1	CAMINO - GENE - IRON MTN - MEAD 230 KV (4 terminal line)	P1	<100	<100	<100	107	<100	Blythe RAS*
	JHINDMWD - EAGLEMTN 230 kV	P1	135	<100	136	140	<100	Blythe RAS*
	CBs-J.HindsMWD | J.HindMWD portion & EagleMTN-J.Hinds Jh & Eagle Shunt Reactor (P2 with long lead time equipment loss)	P2	135	<100	136	140	<100	Blythe RAS*
	CB405 EagleMTN | loss EagleMTN sub and J.Hind MWD portion Jh & Eagle Shunt Reactor (P2 with long lead time equipment loss)	P2	135	<100	136	140	<100	Blythe RAS*

*Existing 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	
J.HINDS MWD - EAGLE MTN 230 kV #1	J.HINDS - MIRAGE 230 kV BLYTHESC - EAGLEMTN 161 kV	P6	122	<100	120	<100	<100	Curtail Blythe area generation after the first contingency
	DEVERS - MIRAGE 230 kV #1 DEVERS - MIRAGE 230 kV #2	P7	111	<100	180	153	126	Path 42 RAS*
	J.HINDS - MIRAGE 230 kV	P1	116	<100	115	148	<100	Blythe RAS*

The above contingencies overload also the *EAGLE MTN - IRON MTN 230 kV #1* and *IRON MTN - CAMINO 230kV* lines but with less severe effect. The above proposed mitigations are applicable for those lines too.

*Existing 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	
J.HINDS MWD - EAGLE MTN #1 230 kV	J.HINDS - MIRAGE 230 kV BLYTHESC - EAGLEMTN 161 kV †	P6	122	<100	120	<100	<100	Curtail Blythe area generation after the first contingency
	DEVERS - MIRAGE #1 230 kV DEVERS - MIRAGE #2 230 kV †	P7	111	<100	180	153	126	Path 42 RAS*
	J.HINDS - MIRAGE 230 kV †	P1	116	<100	115	148	<100	Blythe RAS*
VEGA_3_SS - NILAND 161kV	RAMON - MIRAGE #1 230kV CVSUB - MIRAGE #1 230kV	P6	106	<100	<100	<100	<100	Path 42 RAS*
RAMON - MIRAGE # 2 230 kV	RAMON - MIRAGE 230kV CVSUB - RAMON 230kV	P6	<100	<100	131	<100	117	Curtail IID area generation after the first contingency

†This contingency overloads also the *EAGLE MTN - IRON MTN 230 kV #1* and *IRON MTN - CAMINO 230kV* lines, but with less severe effect. The above proposed mitigations are applicable for those lines too.

*Existing RAS

Sensitivity Scenario Results – Thermal Loading

Overloaded Facility	Contingency (All and Worst P6)	Cat.	Loading % (Sensitivity Scenarios)			Potential Mitigation Solution
			2026 SP with Forecasted Load Addition	2023 SP Heavy Renewable & Min Gas Gen	2023 OP Heavy Renewable & Min Gas Gen	
RED BLUFF 500/230/13.8 kV #1	RED BLUFF 500/230/13.8 kV #2	P1	<100	133	<100	Col. River CRAS*
RED BLUFF 500/230/13.8 kV #2	RED BLUFF 500/230/13.8 kV #1	P1	<100	134	<100	Col. River CRAS*
COL. RIVER 500/230/13.8 kV #1	COLRIVER 500/230/13.8 kV #2	P1	117	143	<100	Col. River CRAS*
COL. RIVER 500/230/13.8 kV #2	COLRIVER 500/230/13.8 kV #1	P1	117	143	<100	Col. River CRAS*
VEGA 3 - NILAND 161kV	RAMON - MIRAGE #1 230kV CVSUB - MIRAGE #1 230kV	P6	<100	110	<100	Path 42 RAS*

*Existing RAS

Voltage PU (Baseline Scenarios)

Substation	Contingency (All and Worst P6)	Cat.	Voltage PU (Baseline Scenarios)					Potential Mitigation Solution
			2024 Summer Peak	2027 Summer Peak	2032 Summer Peak	2024 Spring Off-Peak	2027 Spring Off-Peak	
EAGLEMTN	J.HINDS - MIRAGE 230 kV and BLYTHESC - EAGLEMTN 161 kV	P6	0.87	>0.90	0.89	>0.90	>0.90	Curtail Blythe area generation after the first contingency
MIRAGE	DEVERS - MIRAGE 230 kV #1 and DEVERS - MIRAGE 230 kV #2	P6	<1.10	1.12	<1.10	<1.10	<1.10	Path 42 RAS* (further investigation)
EAGLEMTN			>0.90	>0.90	0.83	>0.90	0.86	Path 42 RAS* (further investigation)
RAMON	RAMON - MIRAGE 230kV and CVSUB - RAMON 230kV	P6	1.16	<1.10	<1.10	1.43	<1.10	Curtail IID area generation after the first contingency

*Existing RAS

Voltage PU (Sensitivity Scenarios)

Substation	Contingency (All and Worst P6)	Cat.	Voltage PU (Sensitivity Scenarios)			Potential Mitigation Solution
			2027 SP with Forecasted Load Addition	2024 SP Heavy Renewable & Min Gas Gen	2024 OP Heavy Renewable & Min Gas Gen	
EAGLEMTN	J.HINDS - MIRAGE 230 kV and BLYTHESC - EAGLEMTN 161 kV	P6	>0.90	0.88	>0.90	Curtail Blythe area generation after the first contingency
MIRAGE	DEVERS - MIRAGE 230 kV #1 and DEVERS - MIRAGE 230 kV #2	P6	1.12	<1.10	1.12	Path 42 RAS*
EAGLEMTN			>0.90	>0.90	>0.90	Path 42 RAS*
RAMON	RAMON - MIRAGE 230kV and CVSUB - RAMON 230kV	P6	<1.10	1.15	1.43	Curtail IID area generation after the first contingency
EAGLEMTN	J.HINDS - MIRAGE 230 kV and EAGLEMTN-IRON MTN 230 kV	P6	<1.10	<1.10	1.22	Curtail Blythe area generation after the first contingency

*Existing RAS

Stability Results

Contingency	Cat.	Baseline Scenarios 2023 Spring Off-Peak	Potential Mitigation Solution
BlytheSCE-EagleMTN 161 kV, non-redundant pilot relay fail (20% EagleMTN)	P5.2	Diverge	Add redundant pilot relay
EagleMTN-IronMTN 230 kV, non-redundant pilot relay fail (20% EagleMTN)	P5.2	Diverge	Add redundant pilot relay
Julian Hinds-EagleMTN 230 kV, non-redundant pilot relay fail (20% EagleMTN)	P5.2	Diverge	Add redundant pilot relay
Julian Hinds-EagleMTN 230 kV & Blythe 1CT trip (RAS), non-redundant pilot relay fail	P5.2	Diverge	Add redundant pilot relay
Julian Hinds-EagleMTN 230 kV & Blythe 1CT trip (RAS), non-redundant pilot relay fail	P5.2	Diverge	Add redundant pilot relay
Julian Hinds-Mirage 230 kV, non-redundant pilot relay fail (20% Julian Hinds)	P5.2	Unstable	Add redundant pilot relay
Julian Hinds-Mirage 230 kV & Blythe 1CT trip (RAS), non-redundant pilot relay fail	P5.2	Diverge	Add redundant pilot relay
Julian Hinds-Mirage 230 kV, non-redundant pilot relay fail (20% Mirage)	P5.2	Diverge	Add redundant pilot relay
Julian Hinds-Mirage 230 kV & Blythe 1CT trip (RAS), non-redundant pilot relay fail	P5.2	Diverge	Add redundant pilot relay

2035 Summer Peak with ATE

Overloaded Facility	Contingency (All and Worst P6)	Cat.	2032 Summer Peak	2035 SP with ATE	Potential Mitigation Solutions
J.HINDS - MIRAGE #1 230 kV	CBs-J.HindsMWD | J.HindMWD portion & EagleMTN-J.Hinds, Jh & Eagle Shunt Reactor (P2 with long lead time equipment loss)	P2	136	138	Blythe RAS*
	CBs-EagleMTN | loss EagleMTN sub., Jh & Eagle Shunt Reactor (P2 with long lead time equipment loss)	P2	114	115	Blythe RAS*
	CB405 EagleMTN | loss EagleMTN sub and J.Hind MWD portion, Jh & Eagle Shunt Reactor (P2 with long lead time equipment loss)	P2	136	137	Blythe RAS*
	CB407 EagleMTN | loss EagleMTN sub and EagleMT-IronMTN, Jh & Eagle Shunt Reactor (P2 with long lead time equipment loss)	P2	114	115	Blythe RAS*
	CB405-EagleMT | Line JHINDMWD - EAGLEMTN 230 kV, Jh Shunt Reactor (P2 with long lead time equipment loss)	P2	114	115	Blythe RAS*
	CB405-EagleMT| Line JHINDMWD - EAGLEMTN 230 kV, Eagle Shunt Reactor (P2 with long lead time equipment loss)	P2	114	115	Blythe RAS*

*Existing RAS

2035 Summer Peak with ATE

Overloaded Facility	Contingency (All and Worst P6)	Cat.	2032 Summer Peak	2035 SP with ATE	Potential Mitigation Solutions
J.HINDS MWD – EAGLE MTN 230 kV #1	J.HINDS - MIRAGE 230 kV and BLYTHESC - EAGLEMTN 161 kV	P6	120	120	Curtail Blythe area generation after the first contingency
	J.HINDS - MIRAGE 230 kV	P1	115	115	Blythe RAS*
J.HIND MWD – J.HINDS 230 kV #1	DEVERS - MIRAGE 230 kV #1 and DEVERS - MIRAGE 230 kV #2	P7	205	104	Path 42 RAS*
	J.HINDS - MIRAGE 230 kV	P1	137	137	Blythe RAS*
EAGLE MTN – IRON MTN 230 kV #1	J.HINDS - MIRAGE 230 kV and BLYTHESC - EAGLEMTN 161 kV	P6	138	138	Curtail Blythe area generation after the first contingency
IRON MTN – CAMINO 230kV	J.HINDS - MIRAGE 230 kV and BLYTHESC - EAGLEMTN 161 kV	P6	104	104	Curtail Blythe area generation after the first contingency
RAMON – MIRAGE 230 kV # 2	RAMON - MIRAGE #1 230kV	P1	<100	102	Congestion management
	RAMON - MIRAGE 230kV and CVSUB - RAMON 230kV	P6	131	163	Curtail IID area generation after the first contingency

*Existing RAS

Summary of Potential New Upgrades

Concern	Potential Upgrade
None identified	

Big Creek Corridor
Preliminary Reliability Assessment Results

Anuj Hiray
Regional Transmission - South

2022-23 Transmission Planning Process Stakeholder Meeting
September 27-28, 2022

SCE Big Creek Corridor

- Serves the SCE area extending north from the Metro area.
- Comprised of 500 kV, 230 kV and 66 kV transmission facilities
- 1-in-10 summer peak net load of 1,913 MW in 2032
- The forecast load includes the impact of 1100 MW of BTM PV and -42 MW of AAEE
- Approximately 12,000 MW of existing and committed resources comprised of solar, wind, gas-fired, hydro and storage battery

Load and Load Modifier Assumptions – Big Creek Corridor

Scenario No.	Base Case	Gross Load (MW)	AAEE (MW)	ATE(MW)	AAFS (MW)	BTM-PV		Net Load (MW)	Net Pump Load (MW)	Demand Response		
						Installed (MW)	Output (MW)			D1	Fast (MW) D2	Slow (MW) D3
B1	2024 Summer Peak	2873	-17	0	1	780	366	2274	271	-1	-52	-11
B2	2027 Summer Peak	2701	-29	0	6	910	219	2102	272	-1	-52	-11
B3	2032 Summer Peak	2539	-42	50	19	1100	0	1913	298	-1	-52	-11
B4	2024 Off Peak	1858	-11	0	1	780	0	1259	271	-1	-52	-11
B5	2027 Off Peak	1827	-8	0	2	910	719	1228	272	-1	-52	-11
S1	2027 Peak High CEC Load	2806	-31	0	7	910	219	2207	272	-1	-52	-11
S2	2024 Peak Heavy Renewable Output & Min. Gas Gen.	2873	-17	0	1	780	710	2274	271	-1	-52	-11
S3	2024 Off Peak Heavy Renewable Output & Min. Gas Gen.	1858	-11	0	1	780	710	1259	271	-1	-52	-11
S4	2035 SP with Additional Transportation Electrification	2669	-40	92	22	0	0	2044	298	-1	-52	-11

Note: DR are modeled offline in starting base cases.

Generation Assumptions – Big Creek Corridor

Scenario No.	Base Case	Battery Storage		Solar (Grid Connected)		Wind		Hydro		Thermal	
		Installed (MW)	Dispatch (MW)	Installed (MW)	Dispatch (MW)	Installed (MW)	Dispatch (MW)	Installed (MW)	Dispatch (MW)	Installed (MW)	Dispatch (MW)
B1	2024 Summer Peak	2781	2502.3	5220.3	2675.9	3496.4	521.3	1020.9	811.6	3439.8	1653
B2	2027 Summer Peak	2760	449.3	5175.3	1088	3496.4	664.3	1014.6	810.8	3439.3	1608.6
B3	2032 Summer Peak	6487	6487	10722.3	0	3589.4	1435.8	1014.6	806.8	3439.3	1495.6
B4	2024 Off Peak	2760	2348.4	5175.3	0	3496.4	1608.3	1014.6	797.8	3436.3	1560.8
B5	2027 Off Peak	2781	-2722.2	5220.3	4915.4	3496.4	1077.2	1023.4	817.6	3480.8	1650
S1	2027 Peak High CEC Load	2760	449.3	5175.3	5123.6	3496.4	2342.6	1014.6	810.8	3439.3	1608.6
S2	2024 Peak Heavy Renewable Output & Min. Gas Gen.	2781	2134.5	5220.3	5168.1	3496.4	2342.6	1020.9	811.6	3439.8	878
S3	2024 Off Peak Heavy Renewable Output & Min. Gas Gen.	2760	2044	5175.3	5123.6	3496.4	2342.6	1014.6	797.8	3436.3	1560.8
S4	2035 SP with Additional Transportation Electrification	6405	5736	13080	0	3589	1436	1015	812	0	0

Note: DR are modeled offline in starting base cases.

Previously approved transmission projects modelled in base cases

Project Name	In-service Year	First Year Modeled
Pardee-Sylmar No. 1 and No. 2 230 kV Lines Rating Increase	2024	2023
Moorpark-Pardee Circuit Install	2022	2020

Reliability assessment preliminary results summary

Thermal Loading – Big Creek Corridor

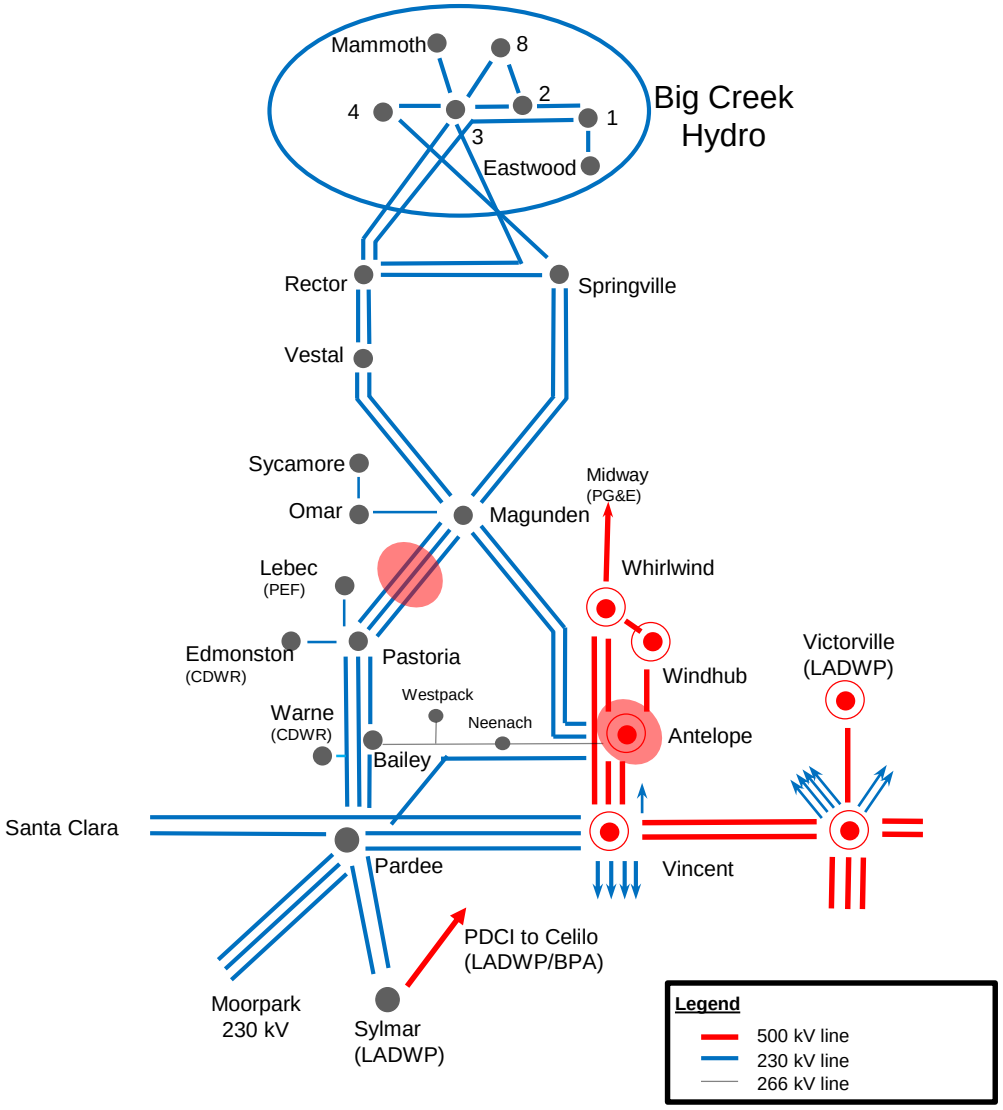
Overloaded Facility	Contingency (All and Worst P6)	Category	Category Description	Loading % (Baseline Scenarios)					Loading % (Sensitivity Scenarios)				Project & Potential Mitigation Solutions
				2024 Summer Peak	2027 Summer Peak	2032 Summer Peak	2024 Spring Off-Peak	2027 Spring Off-Peak	2027 SP High CEC Forecast	2024 SP Heavy Renewable & Min Gas Gen	2024 OP Sensitivity	2035 SP with Additional Transportation Electrification	
24087 MAGUNDEN 230 24115 PASTORIA 230 1 1	line_P6_200164_Line MAGUNDEN 230.0 to PASTORIA 230.0 Circuit 2 Line MAGUNDEN 230.0 to PASTORIA 230.0 Circuit 3	P6	N-1-1	119.4	< 100	< 100	137.2	Diverge	140.6	174.7	193.6	< 100	Curtail Generation North of Magunden after First Contingency as per BC/SJV RAS
24087 MAGUNDEN 230 24115 PASTORIA 230 2 1	line_P6_200084_Line MAGUNDEN 230.0 to PASTORIA 230.0 Circuit 1 Line MAGUNDEN 230.0 to PASTORIA 230.0 Circuit 3	P6	N-1-1	119.9	< 100	< 100	137.8	Diverge	141.1	175.3	194.3	< 100	Curtail Generation North of Magunden after First Contingency as per BC/SJV RAS
24402 ANTELOPE 66.0 24401 ANTELOPE 230 2 1	tran_P6_205979_Tran ANTELOPE 66.00 to ANTELOPE 230.00 Circuit 1 0.00 Tran ANTELOPE 66.00 to ANTELOPE	P6	N-1-1	114.8	141.6	170.1	110.7	< 100	< 100	< 100	< 100	Diverge	Energize existing spare after intial contingency
24302 BIG CRK2 230 24303 BIG CRK3 230 1 1	line_P6_200925_Line BIG CRK1 230.0 to RECTOR 230.0 Circuit 1 Line BIG CRK8 230.0 to BIG CRK3 230.0 Circuit 1	P6	N-1-1	125.7	127.1	114.1	129.4	Diverge	127.4	< 100	< 100	Diverge	Reduce Big Creek generation after initial contingency
24235 RECTOR 230 24303 BIG CRK3 230 2 1	line_BC_P7_03_Line BIG CRK1 230.0 to RECTOR 230.0 Circuit 1 Line RECTOR 230.0 to BIG CRK3 230.0 Circuit 1	P7	DCTL	116.3	116.2	114.7	Diverge	Diverge	115.0	< 100	< 100	Diverge	Existing Big Creek/San Joaquin Valley RAS

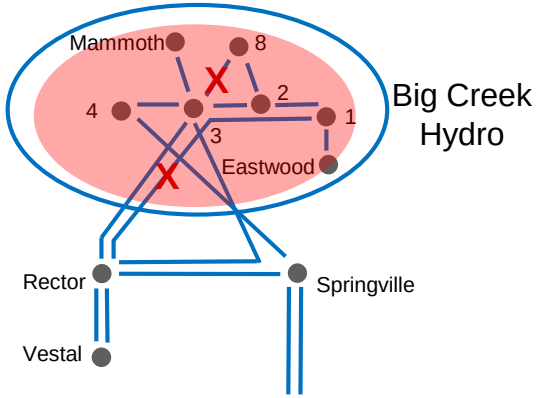
Low/High Voltage – Big Creek Corridor

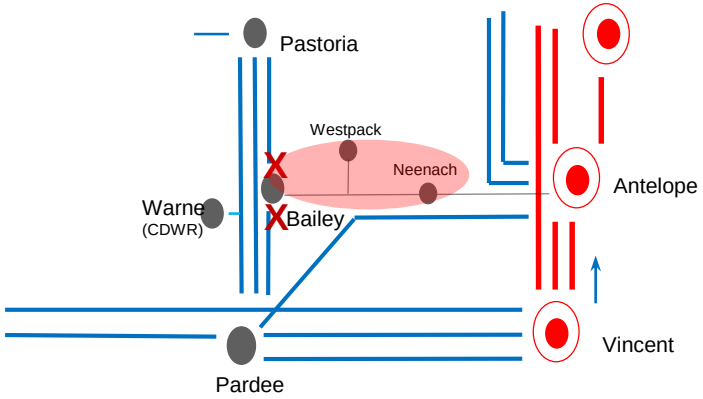
Substation	Contingency (All and Worst P6)	Category	Category Description	High/Low Voltage	Voltage PU (Baseline Scenarios)					Voltage PU (Sensitivity Scenarios)				Project & Potential Mitigation Solutions
					2024 Summer Peak	2027 Summer Peak	2032 Summer Peak	2024 Spring Off-Peak	2027 Spring Off-Peak	2027 SP High CEC Forecast	2024 SP Heavy Renewable & Min Gas Gen	2024 OP Sensitivity	2035 SP with Additional Transportation Electrification	
BAILEY 66 kV	line_P6_201921_Line PARDEE 230.0 to BAILEY 230.0 Circuit 1 Line BAILEY 230.0 to PASTORIA 230.0 Circuit 1	P6	N-1-1	Low	0.9 < V < 1.1	0.87	0.69	0.82	0.9 < V < 1.1	0.9 < V < 1.1	0.9 < V < 1.1	0.9 < V < 1.1	0.9 < V < 1.1	system adjustments after first contingency mitigates the issue
	tran_P6_206091_Tran BAILEY 66.00 to BAILEY 230.00 Circuit 2 0.00 Tran BAILEY 66.00 to BAILEY	P6	N-1-1	Low	0.9 < V < 1.1	0.88	0.69	0.84	0.9 < V < 1.1	0.9 < V < 1.1	0.9 < V < 1.1	0.9 < V < 1.1	0.9 < V < 1.1	system adjustments after first contingency mitigates the issue
BAILEY 230 kV	line_P6_201921_Line PARDEE 230.0 to BAILEY 230.0 Circuit 1 Line BAILEY 230.0 to PASTORIA 230.0 Circuit 1	P6	N-1-1	Low	0.9 < V < 1.1	0.84	0.66	0.80	0.9 < V < 1.1	0.9 < V < 1.1	0.9 < V < 1.1	0.9 < V < 1.1	0.9 < V < 1.1	system adjustments after first contingency mitigates the issue
WESTPAC 66 kV	line_P6_201921_Line PARDEE 230.0 to BAILEY 230.0 Circuit 1 Line BAILEY 230.0 to PASTORIA 230.0 Circuit 1	P6	N-1-1	Low	0.9 < V < 1.1	0.86	0.69	0.81	0.9 < V < 1.1	0.9 < V < 1.1	0.9 < V < 1.1	0.9 < V < 1.1	0.9 < V < 1.1	system adjustments after first contingency mitigates the issue
	tran_P6_206091_Tran BAILEY 66.00 to BAILEY 230.00 Circuit 2 0.00 Tran BAILEY 66.00 to BAILEY	P6	N-1-1	Low	0.9 < V < 1.1	0.87	0.69	0.83	0.9 < V < 1.1	0.9 < V < 1.1	0.9 < V < 1.1	0.9 < V < 1.1	0.9 < V < 1.1	system adjustments after first contingency mitigates the issue

Transient Stability – Big Creek Corridor

Contingency (All and Worst P6)	Category	Category Description	2024 Summer Peak	2027 Summer Peak	2032 Summer Peak	2024 Spring Off-Peak	2027 Spring Off-Peak	ISO Approved Projects & Potential Mitigation Solutions
line_P6_200632_Line SPRINGVL 230.0 to BIG CRK4 230.0 Circuit 1 Line BIG CRK1 230.0 to RECTOR 230.0 Circuit 1	P6	N-1-1	WECC criteria not met	WECC criteria not met	WECC criteria not met	WECC criteria not met	WECC criteria not met	Existing Big Creek/San Joaquin Valley RAS


Mammoth
8
4
2
1
3
Eastwood
Big Creek Hydro
Rector
Springville
Vestal
Sycamore
Omar
Magunden
Midway (PG&E)
Lebec (PEF)
Whirlwind
Edmonston (CDWR)
Pastoria
Windhub
Victorville (LADWP)
Westpack
Neenach
Warne (CDWR)
Bailey
Antelope
Santa Clara
Pardee
Vincent
PDCI to Celilo (LADWP/BPA)
Moorpark 230 kV
Sylmar (LADWP)
Legend
500 kV line
230 kV line
266 kV line


Mammoth
8
4
2
1
3
Eastwood
Big Creek Hydro
Rector
Springville
Vestal


Pastoria
Westpack
Neenach
Antelope
Warne (CDWR)
Bailey
Vincent
Pardee

Big Creek Corridor – Summary (2035 ATE Sensitivity)

New Incremental issues identified in 2035 ATE sensitivity

Overloaded Facility	Contingency (All and Worst P6)	Category	Category Description	Loading % (Baseline Scenarios)					Loading % (Sensitivity Scenarios)				Project & Potential Mitigation Solutions
				2024 Summer Peak	2027 Summer Peak	2032 Summer Peak	2024 Spring Off-Peak	2027 Spring Off-Peak	2027 SP High CEC Forecast	2024 SP Heavy Renewable & Min Gas Gen	2024 OP Sensitivity	2035 SP with Additional Transportation Electrification	
24402 ANTELOPE 66.0 24420 NEENACH 66.0 1 1	line_P6_201921_Line PARDEE 230.0 to BAILEY 230.0 Circuit 1 Line BAILEY 230.0 to PASTORIA 230.0 Circuit 1	P6	N-1-1	< 100	109.8	< 100	< 100	< 100	< 100	< 100	< 100	Diverge	Split Antelope–Bailey 66 kV System per existing SCE operating procedure after initial contingency

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

2022-23 Transmission Planning Process Stakeholder Meeting
September 27-28, 2022

SCE North of Lugo (NOL) Area

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

SCE NOL Area Study Scenarios

- Base scenarios

No.	Case	Description
B1	2024 Summer Peak	Summer peak load time (9/3 HE 16 PST)
B2	2027 Summer Peak	Summer peak load time (9/7 HE 17 PST)
B3	2032 Summer Peak	Summer peak load time (9/7 HE 19 PST)
B4	2024 Spring Off-Peak	Spring minimum net load time (4/24 HE 20 PST)
B5	2027 Spring Off-Peak	Spring shoulder load time (4/4 HE 13 PST)
B6	2032 Spring Off-Peak	Spring shoulder load time (4/4 HE 13 PST)

- Sensitivity scenarios

No	Case	Change From Base Assumption
S1	2027 SP High CEC Load	2027 summer peak load condition with high CEC load forecast
S2	2024 SP High Renewable	2024 summer peak condition with heavy renewable output and minimum gas generation commitment
S3	2024 SOP High Renewable	2024 spring off-peak condition with heavy renewable output
S4	2035 ATE Load	2032 summer peak load condition with 2035 CEC forecasted Additional Transportation Electrification load sensitivity

Load and Load Modifier Assumptions – North of Lugo Area

Scenario No.	Case	Gross Load (MW)	AAEE (MW)	AAFS (MW)	ATE (MW)	BTM-PV MW)		Net Load (MW)	Demand Response (Installed)	
						Installed	Output		Fast (MW)	Slow (MW)
B1	2024 Summer Peak	1176	-12	1	N/A	304	143	981	66	27
B2	2027 Summer Peak	1084	-21	4	N/A	356	85	981	66	27
B3	2032 Summer Peak	1042	-29	11	17	454	0	1024	66	27
B4	2024 Spring Light Load	640	-8	1	N/A	304	0	633	66	27
B5	2027 Spring Off-peak	540	-6	1	N/A	356	281	254	66	27
B6	2032 Spring Off-peak	576	-6	2	26	454	364	234	66	27
S1	2027SP High CEC Load	1145	-23	4	N/A	356	85	1041	66	27
S2	2024 SP Heavy Renewable Output & Min. Gas Gen	1135	-12	1	N/A	304	277	847	66	27
S3	2024 SOP Heavy Renewable Output & Min. Gas Gen.	640	-8	1	N/A	304	277	356	66	27
S4	2035 ATE Load	1043	-27	12	31	533	0	1059	66	27

Generation Assumptions – North of Lugo Area

Scenario No.	Case	Battery		Solar		Wind		Hydro		Thermal	
		Installed (MW)	Dispatch (MW)	Installed (MW)	Dispatch (MW)	Installed (MW)	Dispatch (MW)	Installed (MW)	Dispatch (MW)	Installed (MW)	Dispatch (MW)
B1	2024 Summer Peak	1023	369	2011	1072	17	3	57	46	1637	845
B2	2027 Summer Peak	1023	862	2011	438	17	3	57	51	1637	598
B3	2032 Summer Peak	1173	422	2390	0	17	7	57	52	1637	919
B4	2024 Spring Light Load	1023	-1015*	2011	0	17	8	57	56	1637	845
B5	2027 Spring Off-peak	1023	-1014	2011	1969	17	5	57	36	1637	606
B6	2032 Spring Off-peak	1173	-1166	2390	2318	17	5	57	17	1637	845
S1	2027SP High CEC Load	1023	862	2011	438	17	3	57	51	1637	598
S2	2024 SP Heavy Renewable Output & Min. Gas Gen	1023	0	2011	1998	17	12	57	46	1637	845
S3	2024 SOP Heavy Renewable Output & Min. Gas Gen.	1023	-1015	2011	1902	17	12	57	56	1637	845
S4	2035 ATE Load	1654	954	3198	0	17	7	57	52	1637	592

Note*: A negative number indicates battery charging

Reliability Assessment Preliminary Results Summary

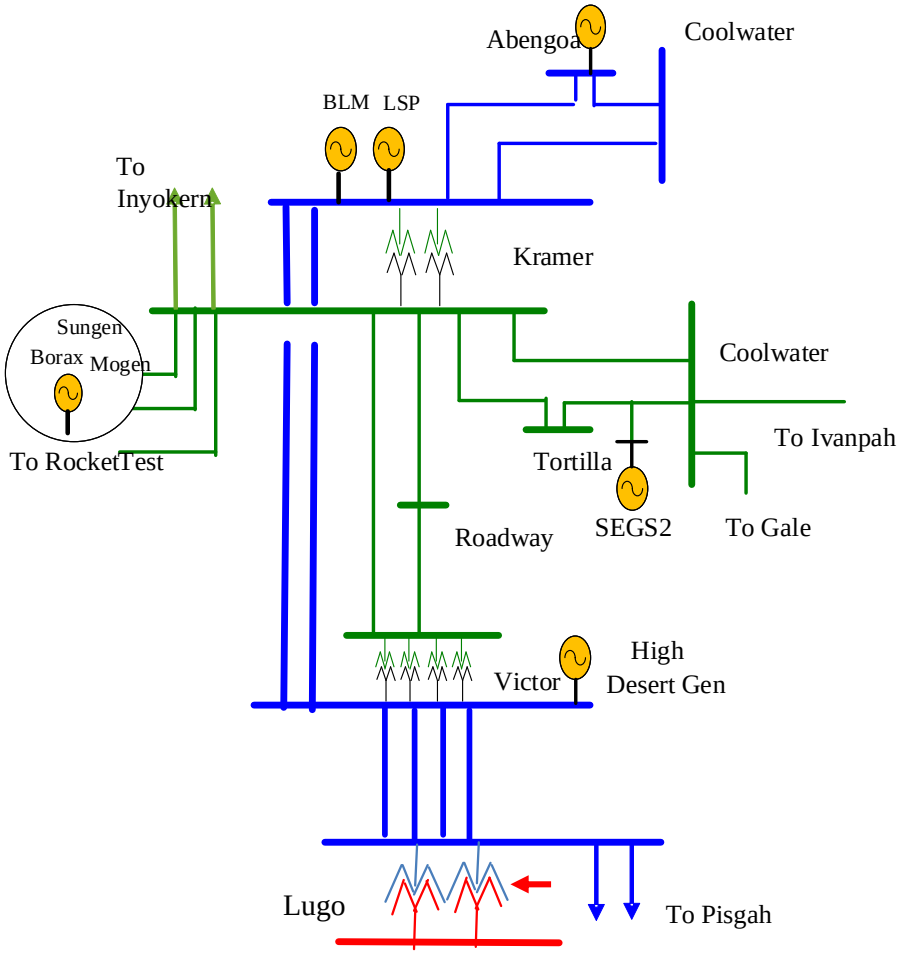
Lugo 500/230kV Transformers No.1 and 2

Observations

- Both Lugo 500/230kV transformers are observed normal overload (P0) in 2024 summer peak with heavy renewable output sensitivity scenario
- Loss of one Lugo 500/230kV transformer (P1) would overload the remaining transformer in multiple basecase scenarios
- Loss of two Lugo 500/230kV transformers (P6) would result in potential system divergence and voltage instability in multiple basecase scenarios

Potential Mitigations

- Long-term: New Lugo 500/230kV Transformer No.3
- Short-term: Existing HDPP RAS and Mojave Desert RAS



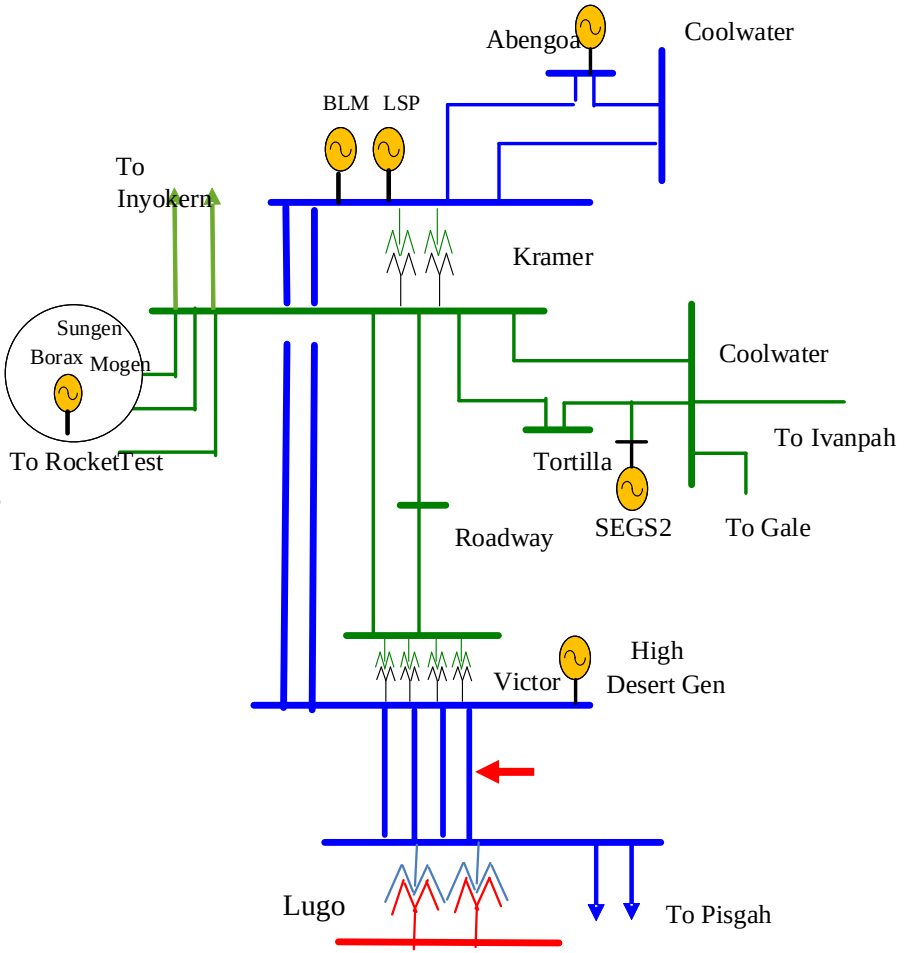
Lugo-Victor 230kV Transmission Lines

Observations

- All four Lugo – Victor 230kV transmission lines are observed normal overload (P0) in 2032 spring off-peak basecase scenario and 2024 summer peak with high renewable sensitivity scenario
- Loss of any one of the four 230kV lines (P1) would overload the remaining three 230kV lines in 2032 spring off-peak basecase scenario and 2024 summer peak with high renewable sensitivity scenario
- Loss of any two of the four 230kV lines (P6 and P7) would overload the remaining two 230kV lines in multiple basecase and sensitivity scenarios

Potential Mitigations

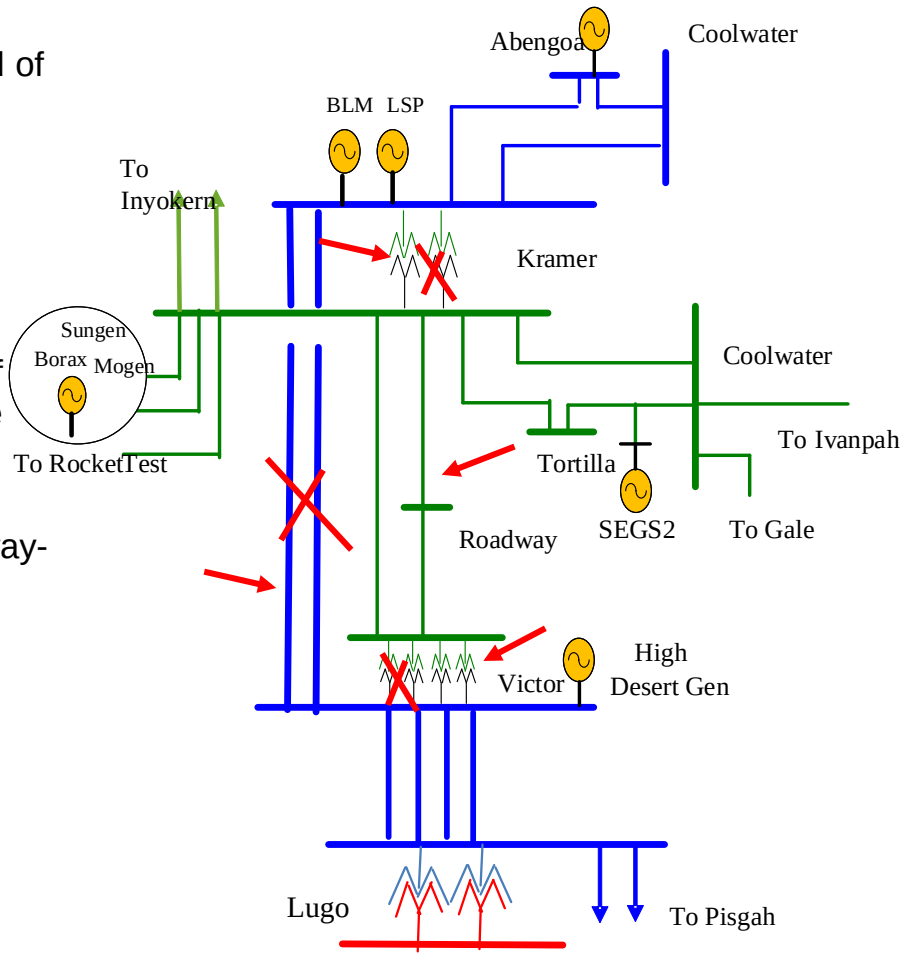
- Long-term: Lugo – Victor 230kV transmission lines reconductoring
- Short-term: Existing HDPP RAS and congestion management



Kramer-Victor 230kV and 115kV Systems

Observations

- Loss of Kramer-Victor 230kV Nos.1&2 lines (P7) could result in potential system divergence, thermal overload of Kramer 230/115kV transformers and Victor-Kramer 115kV lines in multiple basecase and sensitivity scenarios.
- Loss of two Victor 230/115kV transformers would overload the remaining Victor transformer in multiple basecase and sensitivity scenarios
- Loss of one Kramer 230/115kV transformer and one of the Kramer-Victor 230kV lines (P6) would overload the remaining Kramer transformer
- Multiple category P6 overload of Kramer-Victor 230kV lines and Kramer-Victor, Kramer-Roadway and Roadway-Kramer 115kV lines
- Overload in the area could be caused by either generation output in the area or battery charging when the renewable generation output is low



Potential Mitigations

- Existing Mojave Desert RAS
- Limit battery charging in the area when the generation output is low
- Utilize existing 230/115kV spare transformer at Victor
- Congestion management and generation redispatch to mitigate category P6 overloads

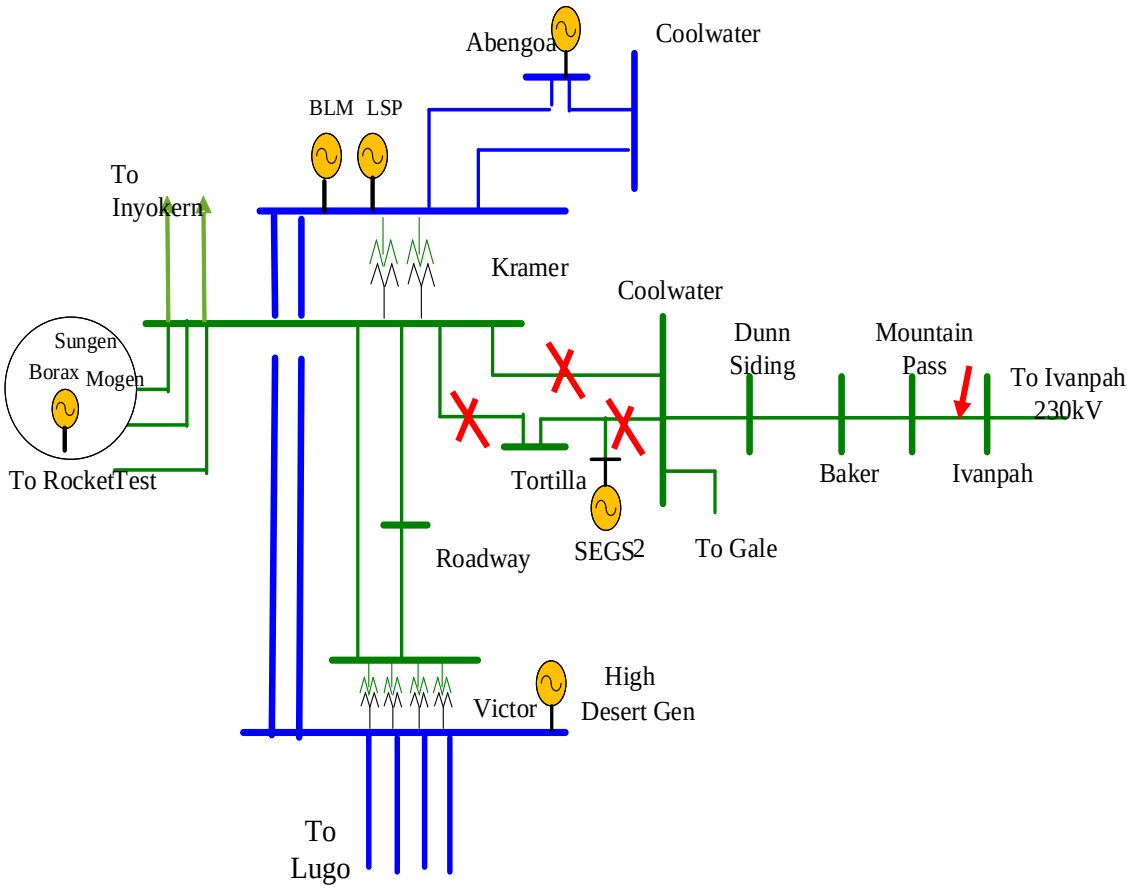
Kramer-Coolwater-Ivanpah 115kV System

Observations

- Potential voltage collapse following P6 contingencies of Kramer-Tortilla, Kramer-Coolwater and Tortilla-Coolwater 115kV lines in multiple basecase and sensitivity scenarios

Potential Mitigations

- Long-term: New 230/115kV transformer at Coolwater substation
- Short-term: OP-127 radialize system at Ivanpah following the first contingency



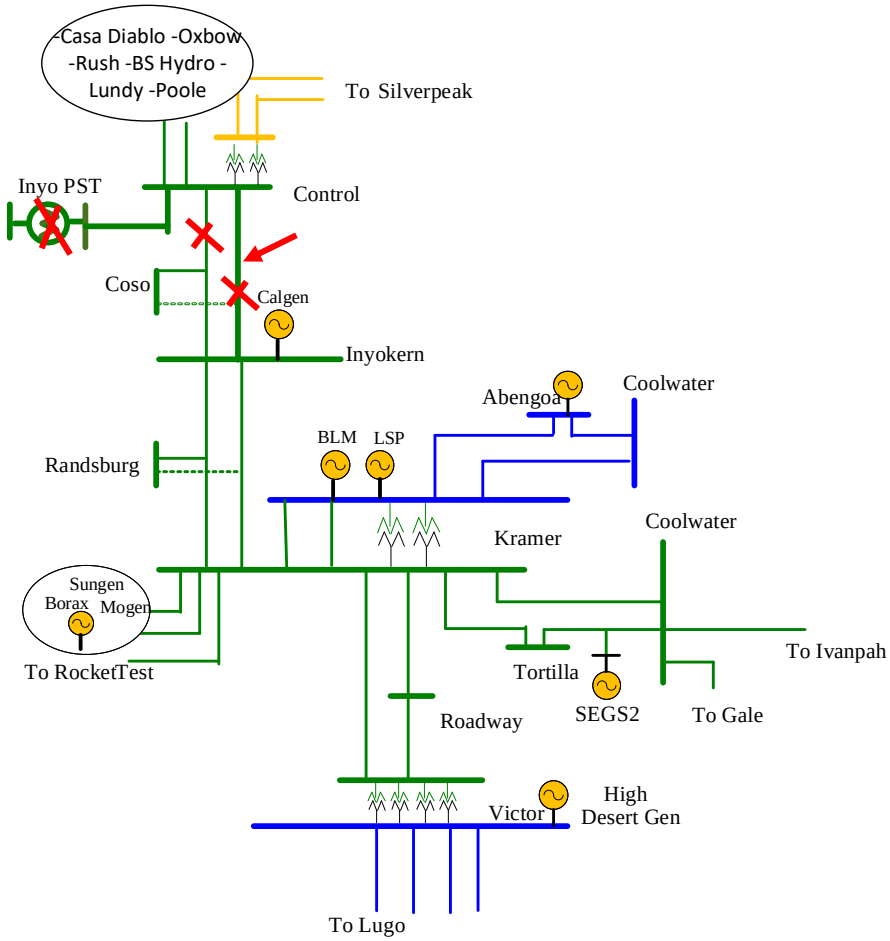
Control-Inyokern 115kV Systems

Observations

- Category P6 overload of Control-Coso-Inyokern line following loss of Conotrol-Inyokern and Inyo PST
- Category P2 and P6 contingencies involve loss of Control-Coso-Inyokern and Inyo PST would overload Contro-Inyokern line

Potential Mitigations

- Operating procedure 7650
- Existing Bishop RAS
- Generation redispatch



Sensitivity Study Assessment

- Facility overloads identified in sensitivity scenarios only

Overloaded Facility	Category	2024 SP High Renewable	2024 SOP High Renewable	2027 SP High CEC Load
Lugo 500/230kV Transformer Nos.1&2	P0	√		
Victor-Roadway 115kV Line	P0	√		
Kramer-Victor 230kV Nos. 1&2	P0	√		
The remaining Kramer-Victor 230kV Lines	P1	√		
Sandlot-Kramer 230kV Line	P2, P6	√		

Transient Stability Analysis

- Performed for B2, B3, B4, S2, and S3 cases
- 96 credible contingencies evaluated
  - Includes P4.2, P5, P6 and P7
- One potential Category P5 and P6 system divergence that would be mitigated by existing operating procedure
- Potential system divergence following non-redundant DC supply failure. Install redundant DC supply is recommended.

2035 Additional Transportation Electrification Scenario

Thermal Overloads Exacerbated in 2035 ATE Scenario

Overloaded Facility	Contingency	Category	2032 SP Worst Loading (%)	2035 ATE Worst Loading (%)
Victor 230/115kV Transformer No. 2	Victor 230/115kV Transformers Nos. 3&4	P6	105	114
Victor 230/115kV Transformer No. 3	Victor 230/115kV Transformers Nos. 1&4	P6	105	114
	Victor 115kV North Bus SecAB	P5	105	114
Victor 230/115kV Transformer No. 4	Victor 230/115kV Transformers Nos. 1&3	P6	1-5	114

Additional Thermal Overloads in 2035 ATE Scenario

- None identified

Additional Low Voltage Issues in 2035 ATE Scenario

Substation	TPL-001-5 Contingency category/ Post-contingency Voltage (P.U.)							
	P0	P1	P2	P3	P4	P5	P6	P7
Inyokern, Downs, Searles, Coso 115kV	0.91			0.8				

Summary of Potential New Upgrades

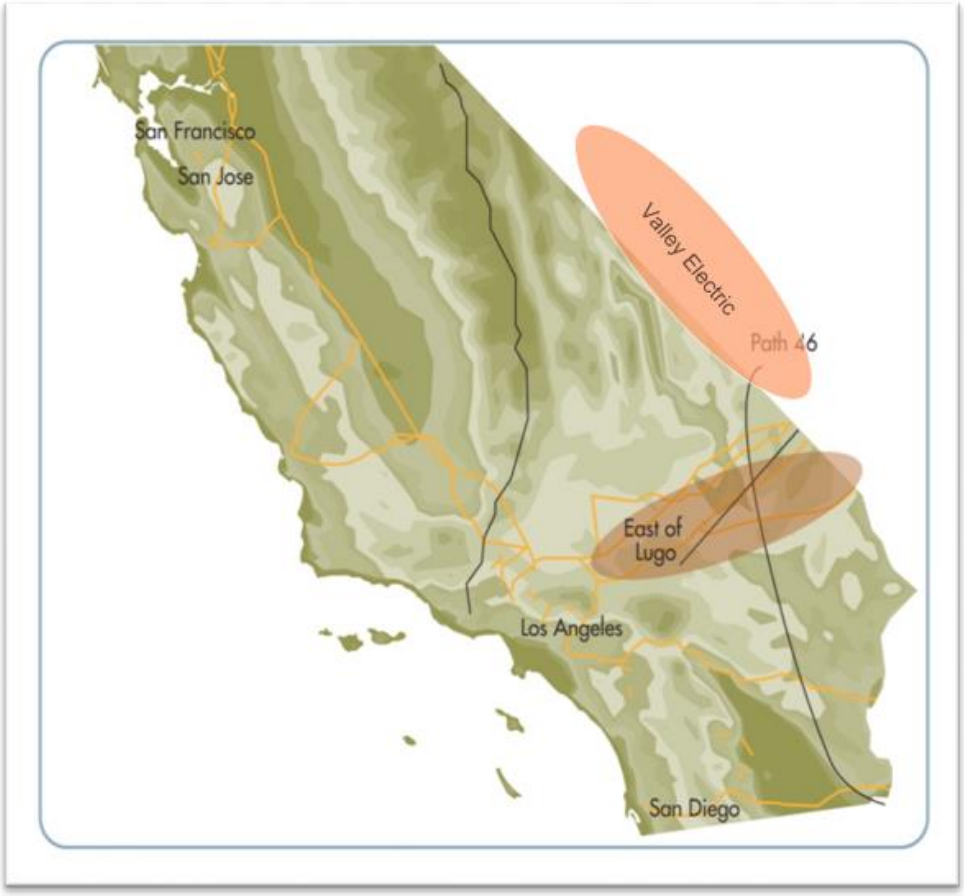
Facilities	Reliability Concern	Potential Upgrade
Lugo 500/230kV Transformers	Thermal overload	• New Lugo 500/230kV transformer
Lugo-Victor 230kV lines	Thermal overload	• Lugo-Victor 230kV line reconductoring
Coolwater 115kV system	Voltage collapse	• New Coolwater 230/115kV transformer

Valley Electric Association
Preliminary Reliability Assessment Results

Meng Zhang
Sr. Regional Transmission Engineer

2022-23 Transmission Planning Process Stakeholder Meeting
September 27-28, 2022

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 2024, 2027 and 2032 are 167 MW, 174 MW and 188 MW respectively.

VEA Area Study Scenarios

- Base scenarios

No.	Case	Description
B1	2024 Summer Peak	Summer peak load time (9/3 HE 16 PST)
B2	2027 Summer Peak	Summer peak load time (9/7 HE 17 PST)
B3	2032 Summer Peak	Summer peak load time (9/7 HE 19 PST)
B4	2024 Spring Off-Peak	Spring minimum net load time (4/24 HE 20 PST)
B5	2027 Spring Off-Peak	Spring shoulder load time (4/4 HE 13 PST)
B6	2032 Spring Off-Peak	Spring shoulder load time (4/4 HE 13 PST)

- Sensitivity scenarios

No	Case	Change From Base Assumption
S1	2024 SP with forecasted load addition	Load increased to reflect future load service requests
S2	2027 SP with forecasted load addition	Load increased to reflect future load service requests
S3	2027 SOP with heavy renewable output	2027 spring off-peak condition with heavy renewable output

Load and Load Modifier Assumptions – VEA Area

Scenario No.	Case	Gross Load (MW)	AAEE (MW)	AAFS (MW)	ATE (MW)	BTM-PV MW)		Net Load (MW)	Demand Response (Installed)	
						Installed	Output		Fast (MW)	Slow (MW)
B1	2024 Summer Peak	167	0	0	N/A	0	0	167	0	0
B2	2027 Summer Peak	174	0	0	N/A	0	0	174	0	0
B3	2032 Summer Peak	188	0	0	0	0	0	188	0	0
B4	2024 Spring Light Load	115	0	0	N/A	0	0	115	0	0
B5	2027 Spring Off-peak	120	0	0	N/A	0	0	120	0	0
B6	2032 Spring Off-peak	52	0	0	0	0	0	52	0	0
S1	2024SP Load Addition	178	0	0	N/A	0	0	178	0	0
S2	2027SP Load Addition	193	0	0	N/A	0	0	193	0	0
S3	2027OP High Renewable	120	0	0	N/A	0	0	120	0	0

Generation Assumptions – VEA Area

Scenario No.	Case	Battery		Solar		Wind		Geothermal	
		Installed (MW)	Dispatch (MW)	Installed (MW)	Dispatch (MW)	Installed (MW)	Dispatch (MW)	Installed (MW)	Dispatch (MW)
B1	2024 Summer Peak	128	0	378	140	0	0	0	0
B2	2027 Summer Peak	128	0	378	53	0	0	0	0
B3	2032 Summer Peak	763	0	2101	0	442	133	440	125
B4	2024 Spring Light Load	128	-127*	378	246	0	0	0	0
B5	2027 Spring Off-peak	128	0	378	355	0	0	0	0
B6	2032 Spring Off-peak	763	-635	2101	1993	442	137	440	440
S1	2024SP Load Addition	128	0	378	140	0	0	0	0
S2	2027SP Load Addition	128	0	378	53	0	0	0	0
S3	2027OP High Renewable	128	0	378	363	0	0	0	0

Note*: A negative number indicates battery charging

Previously approved transmission projects modeled in base cases

Project Name	In-service Year	First Year Modeled
New Gamebird 230/138kV Transformer	2022	2024
GLW Upgrade Project	TBD	2032

Reliability Assessment Preliminary Results Summary

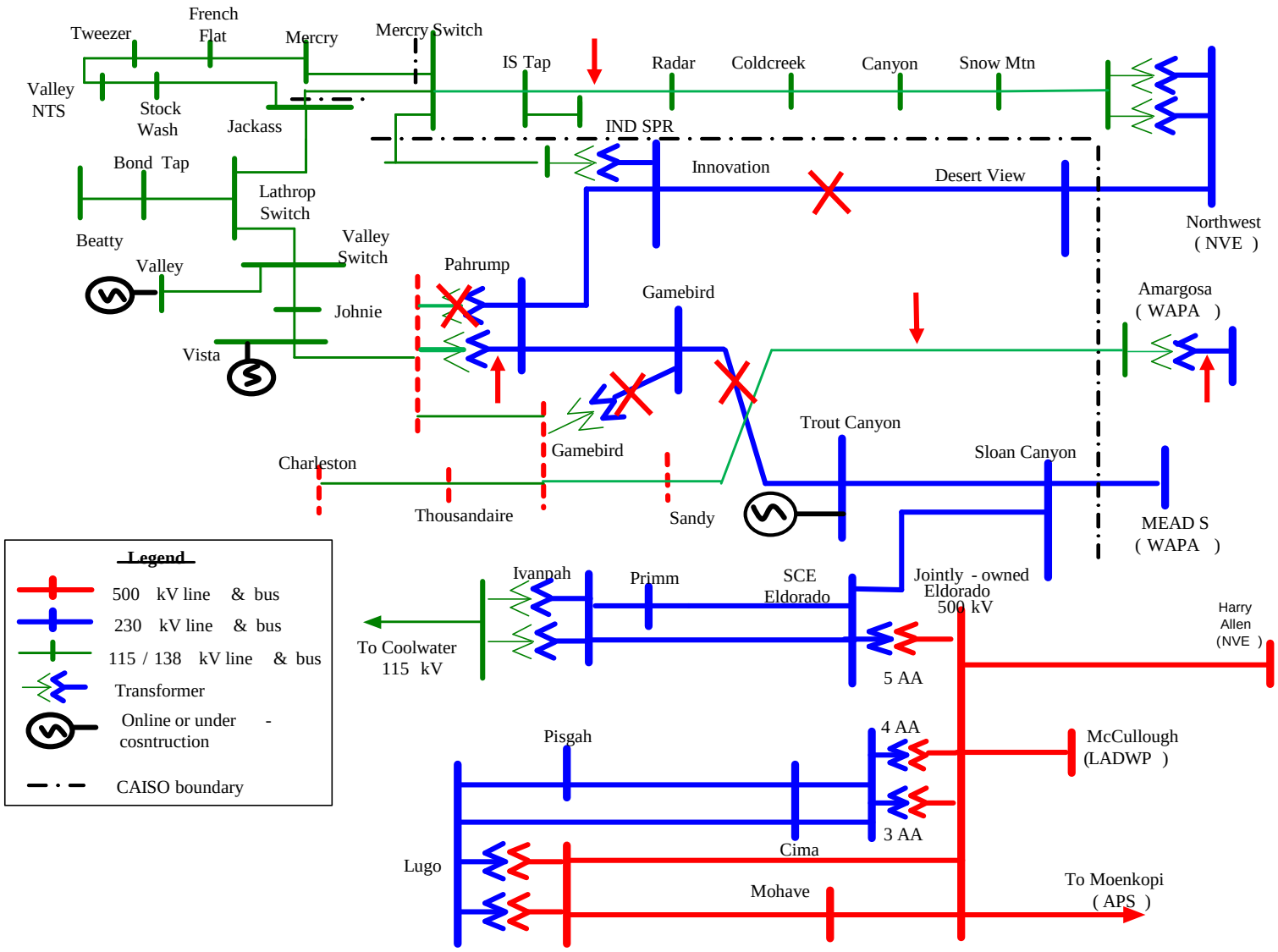
VEA 138kV System Load Driven Issues

Observations

- The remaining Pahrump 230/138kV transformer is observed overloaded following loss of Gamebird 230/138kV transformer and the other Pahrump 230/138kV transformer in multiple basecase and sensitivity scenarios
- Overload on Mercury SW-Northwest 138kV tie line and Amargosa 230/138kV transformer and Amargosa-Sandy 138kV lines following Category P6 contingency of Innovation-Desert View and Gamebird-Trout Canyon 230kV lines
- Low voltages at VEA 138kV and Pahrump, Gamebird, Innovation 230kV buses following P6 contingencies following Category P6 contingency of Innovation-Desert View and Gamebird-Trout Canyon 230kV lines

Approved and Potential Mitigations

- Utilize existing UVLS scheme
- The future GLW Upgrade project would mitigate the 230kV lines category P6 contingency violations


Tweezer
French Flat
Mercry
Mercry Switch
IS Tap
Radar
Coldcreek
Canyon
Snow Mtn
Valley NTS
Stock Wash
Jackass
IND SPR
Bond Tap
Innovation
Desert View
Lathrop Switch
Northwest (NVE)
Beatty
Valley Switch
Valley
Pahrump
Gamebird
Amargosa (WAPA)
Johnie
Vista
Gamebird
Trout Canyon
Sloan Canyon
Charleston
Thousandaire
Sandy
MEAD S (WAPA)
Legend
500 kV line & bus
230 kV line & bus
115 / 138 kV line & bus
Transformer
Online or under - cosntruction
CAISO boundary
Ivanpah
Primm
SCE Eldorado
Jointly - owned Eldorado 500 kV
Harry Allen (NVE)
To Coolwater 115 kV
5 AA
Pisgah
4 AA
McCullough (LADWP)
3 AA
Cima
Lugo
Mohave
To Moenkopi (APS)

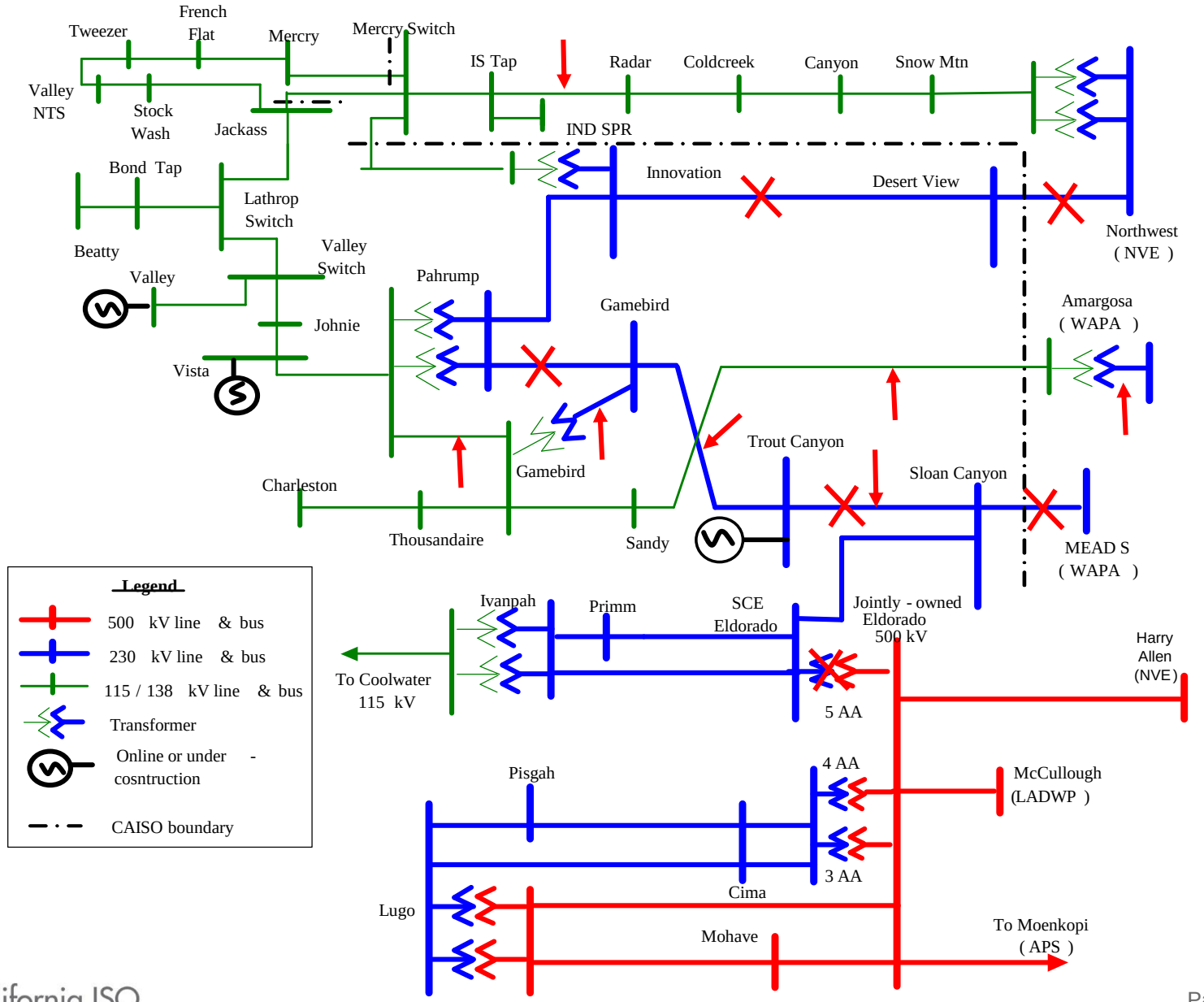
VEA-GLW System Generation Driven Issues

Observations

- Overload on Amargosa 230/138kV transformer, Sandy-Amargosa 138kV line, Mercury SW-Northwest 138KV tie line following Category P6 contingency of Innovation-Desert View or Desert View-Northwest 230kV line and Trout Canyon-Sloan Canyon 230kV line.
- Overload on Gamebird 230/138kV transformer and Gamebird-Pahrump 138kV line following Category P6 contingency of Trout Canyon-Sloan Canyon and Pahrump-Gamebird 230kV lines
- Overload and potential system divergence on Gamebird-Trout Canyon-Sloan Canyon 230kV lines following Category P6 contingency of Eldorado 5AA transformer and Sloan Canyon-Mead 230kV line.

Approved and Potential Mitigations

- Short-term solution: Sloan Canyon RAS and congestion management
- Long-term solution: approved GLW Upgrade project


Tweezer
French Flat
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500 kV line & bus
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Transformer
Online or under - cosntruction
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To Coolwater 115 kV
5 AA
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3 AA
Cima
Lugo
Mohave
To Moenkopi (APS)

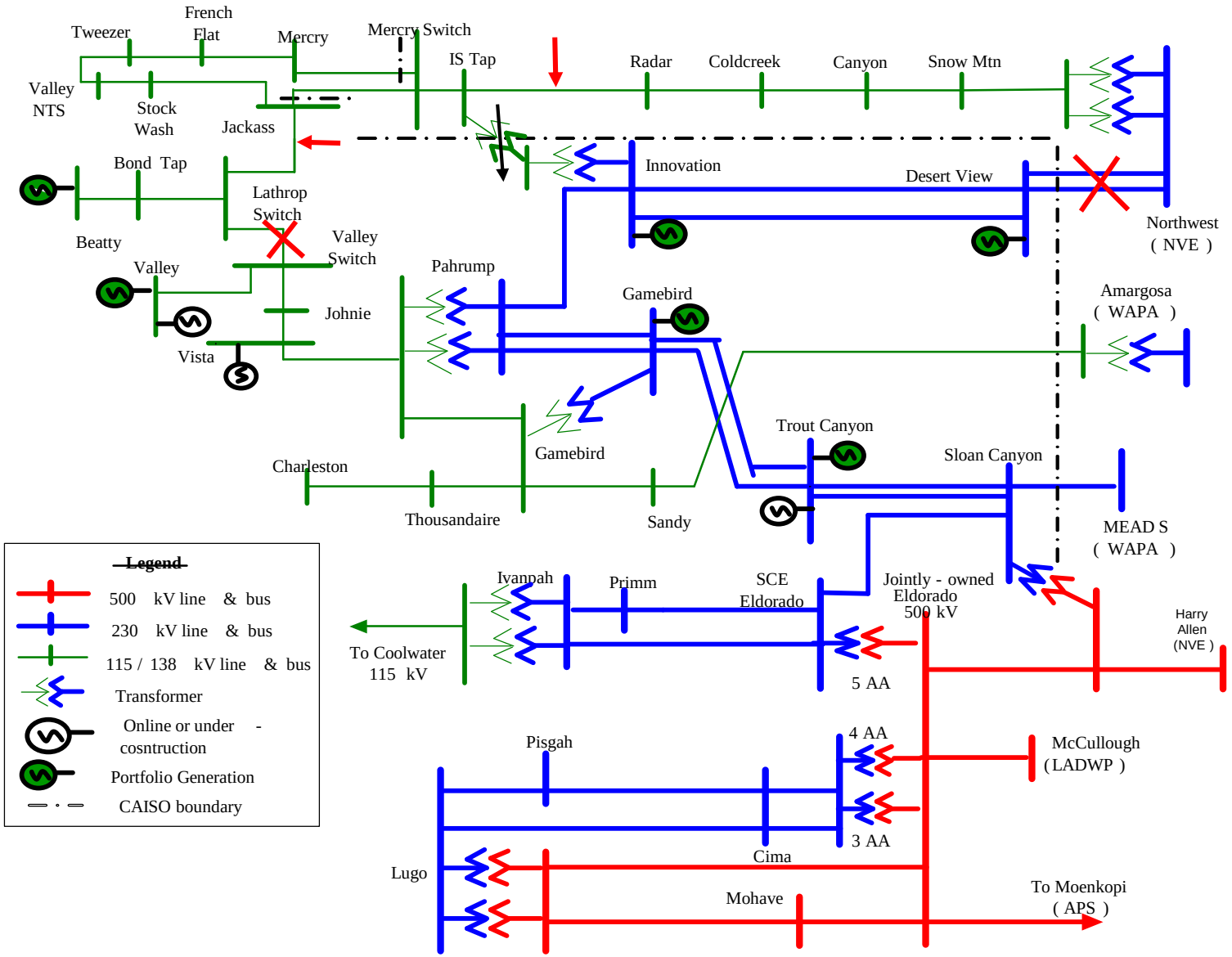
VEA-GLW System Portfolio Resources Driven Issues

Observations

- Overload on IS Tap-Northwest 138kV tie line following Category P7 contingency of Northwest-Desert View 230kV Nos. 1&2 lines
- Overload on Jackass Flat-Mercury SW 138kV line following multiple P1, P4, P5 and P6 contingencies

Approved and Potential Mitigations

- Future RAS under development
- New RAS to trip Beatty generation
- Potential transmission upgrade will be further evaluated in Policy Study


Tweezer
French Flat
Mercry
Mercry Switch
IS Tap
Radar
Coldcreek
Canyon
Snow Mtn
Valley NTS
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Bond Tap
Lathrop Switch
Beatty
Valley Switch
Valley
Vista
Johnie
Pahrump
Gamebird
Innovation
Desert View
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SCE Eldorado
Jointly - owned Eldorado 500 kV
Harry Allen (NVE)
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Lugo
Mohave
To Moenkopi (APS)
Legend
500 kV line & bus
230 kV line & bus
115 / 138 kV line & bus
Transformer
Online or under - cosntruction
Portfolio Generation
CAISO boundary

Transient Stability Analysis

- Performed for B2, B3, B4, S2, and S3 cases
- 45 credible contingencies evaluated
  - Includes P1, P4.2, P5, P6 and P7
- No WECC criteria violations were observed

Summary of Potential New Upgrades

- Majority of the thermal and voltage issues identified in reliability assessment could be mitigated by existing UVLS scheme, future RAS in the area and the TPP approved GLW Upgrade project.

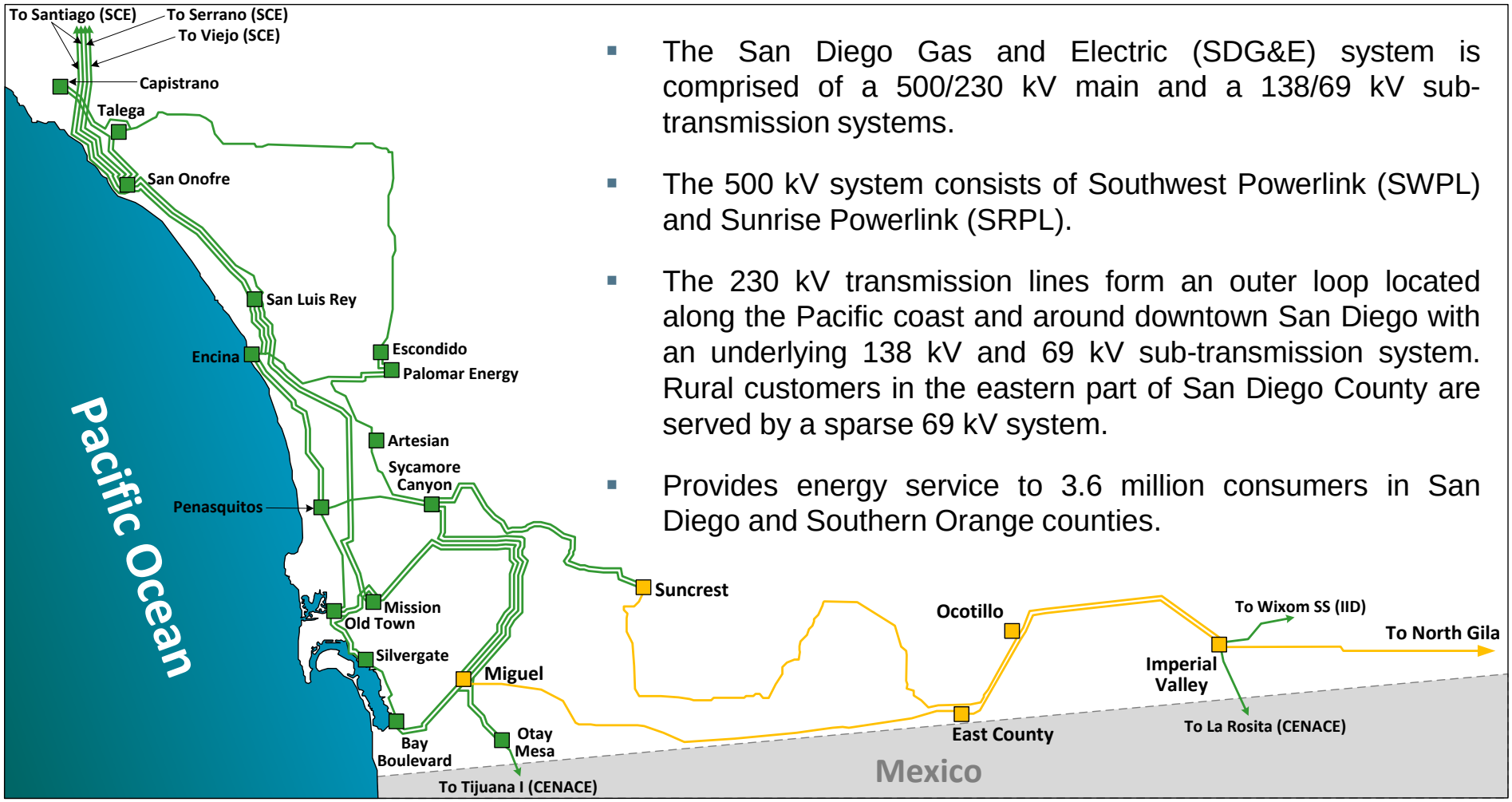
- Thermal issues identified in 2032 summer peak and off-peak scenarios related to the CPUC portfolio resources will be further evaluated in Policy Study

San Diego Gas & Electric Area
Preliminary Reliability Assessment Results

Rene Romo de Santos
Senior Regional Transmission Engineer

2022-2023 Transmission Planning Process Stakeholder Meeting
September 27-28, 2022

SDG&E Transmission System



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

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

SDG&E Area Study Scenarios

- Base scenarios

No.	Case	Description
B1	2024 Summer Peak	Summer peak load time (9/4 HE 19)
B2	2027 Summer Peak	Summer peak load time (9/2 HE 19)
B3	2032 Summer Peak	Summer peak load time (9/4 HE 19)
B4	2024 Spring Off-Peak	Spring off-peak time (5/28 HE 20)
B5	2027 Spring Off-Peak	Spring off-peak time (4/4 HE 13)
B6	2032 Spring Off-Peak	Spring off-peak time (4/4 HE 13)

- Sensitivity scenarios

No.	Case	Change From Base Assumption
S1	2024 Summer Peak	Heavy renewable output and minimum gas generation commitment
S2	2024 Spring Off-Peak	Storage charging in load pockets
S3	2027 Summer Peak	High CEC forecasted load
S4	2035 Summer Peak	2035 CEC forecasted load with Additional Transportation Electrification load sensitivity

Load Forecast and Load Modifier Assumptions

Study Case	Scenario	Gross Load (MW)	AAEE (MW)	AAFS (MW)	ATE (MW)	BTM-PV (MW)		Net Load (MW)
						Installed Capacity	Output	
B1-2024SP	Base	4867	49	3	0	2043	0	4821
B2-2027SP	Base	5048	76	14	0	2468	0	4985
B3-2032SP	Base	5393	125	37	154	3210	0	5459
B4-2024OP	Base	3602	36	2	0	2043	0	3568
B5-2027OP	Base	2752	42	8	0	2468	2122	596
B6-2032OP	Base	2928	69	20	213	3210	2728	364
S1-2024SP	Sensitivity	4861	49	3	0	2043	1961	2854
S2-2024OP	Sensitivity	3649	36	2	0	2043	0	3615
S3-2027SP	Sensitivity	5231	74	15	0	2468	0	5172
S4-2035SP	Sensitivity	5574	112	45	833	3642	0	6340

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

Generation Resource Assumptions

Study Case	Battery Energy Storage (MW)		Solar (MW)		Wind (MW)		Thermal (MW)		Pumped Storage Hydro (MW)		Hydro (MW)	
	Installed	Dispatch	Installed	Dispatch	Installed	Dispatch	Installed	Dispatch	Installed	Dispatch	Installed	Dispatch
B1-2024SP	1430	0	2125	21	778	195	3696	3528	40	40	4	2
B2-2027SP	1430	0	2102	0	778	257	3706	3374	40	40	4	4
B3-2032SP	1539	0	2051	0	1378	455	3706	3513	540	40	4	4
B4-2024OP	1430	0	2125	0	778	475	3709	2954	40	0	4	0
B5-2027OP	1430	-1427	2125	1998	778	218	3709	108	40	0	4	0
B6-2032OP	1539	-1536	2046	1919	1378	376	3707	50	540	0	4	0
S1-2024SP	1430	0	2125	2010	778	397	3696	1733	40	40	4	2
S2-2024OP	1430	-1310	2125	0	778	529	3709	2954	40	0	4	0
S3-2027SP	1430	0	2101	0	778	257	3706	3480	40	40	4	4
S4-2035SP	2578	0	3275	0	1378	455	3706	3513	540	215	4	4

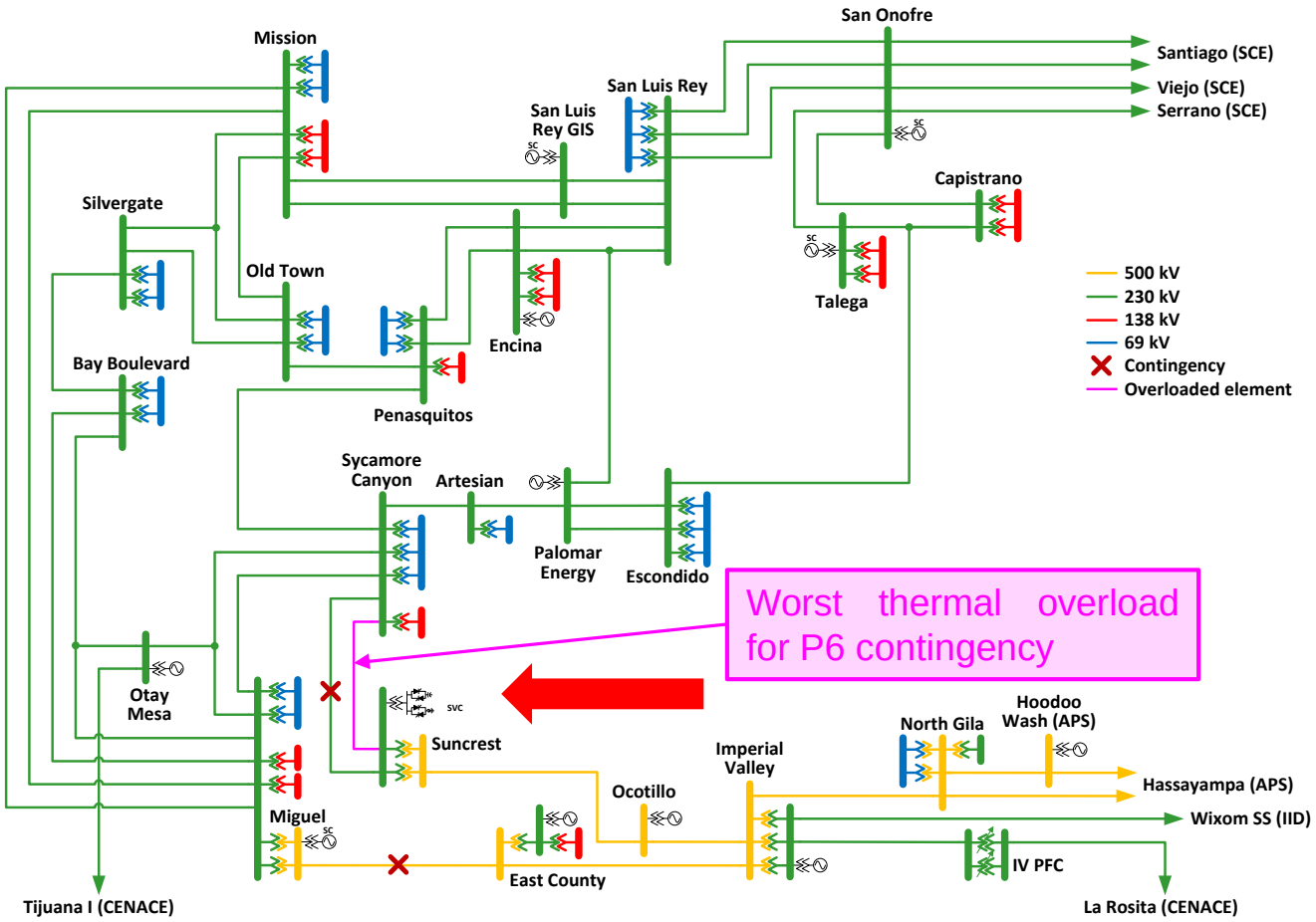
Approved Transmission Projects Modeled in Base Cases

Project Name	In-service Date	First Year Modeled
Reconductor TL692: Japanese Mesa - Las Pulgas	Oct-21	2024
TL644, South Bay - Sweetwater: Reconductor	May-22	2024
TL674A Loop-in (Del Mar - North City West) & Removal of TL666D (Del Mar - Del Mar Tap)	Dec-22	2024
2nd Escondido - San Marcos 69 kV T/L	Dec-22	2024
Artesian 230 kV Sub & loop-in TL23051	Dec-22	2024
IID S-Line Upgrade	2023	2024
Rose Canyon - La Jolla 69 kV T/L	Oct-23	2024
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-24	2024
Reconductor TL 605 Silvergate - Urban	Dec-24	2027
TL695B Japanese Mesa - Talega Tap Reconductor	Oct-25	2027
TL632 Granite Loop-In and TL6914 Reconfiguration*	May-26	2032
TL690E, Stuart Tap - Las Pulgas 69 kV Reconductor	Nov-26	2027
Sweetwater Reliability Enhancement	Dec-27	2032

* The ISD of this project was Nov-28 in Approved project list used to elaborate the base cases

Reliability Assessment Preliminary Results Summary

230 kV TL23054/TL23055 Suncrest - Sycamore Canyon



Additional resources dispatched to mitigate the 2032 Summer Peak thermal overloads can vary from 270 MW to 975 MW depending on other system adjustments

Reliability Concern

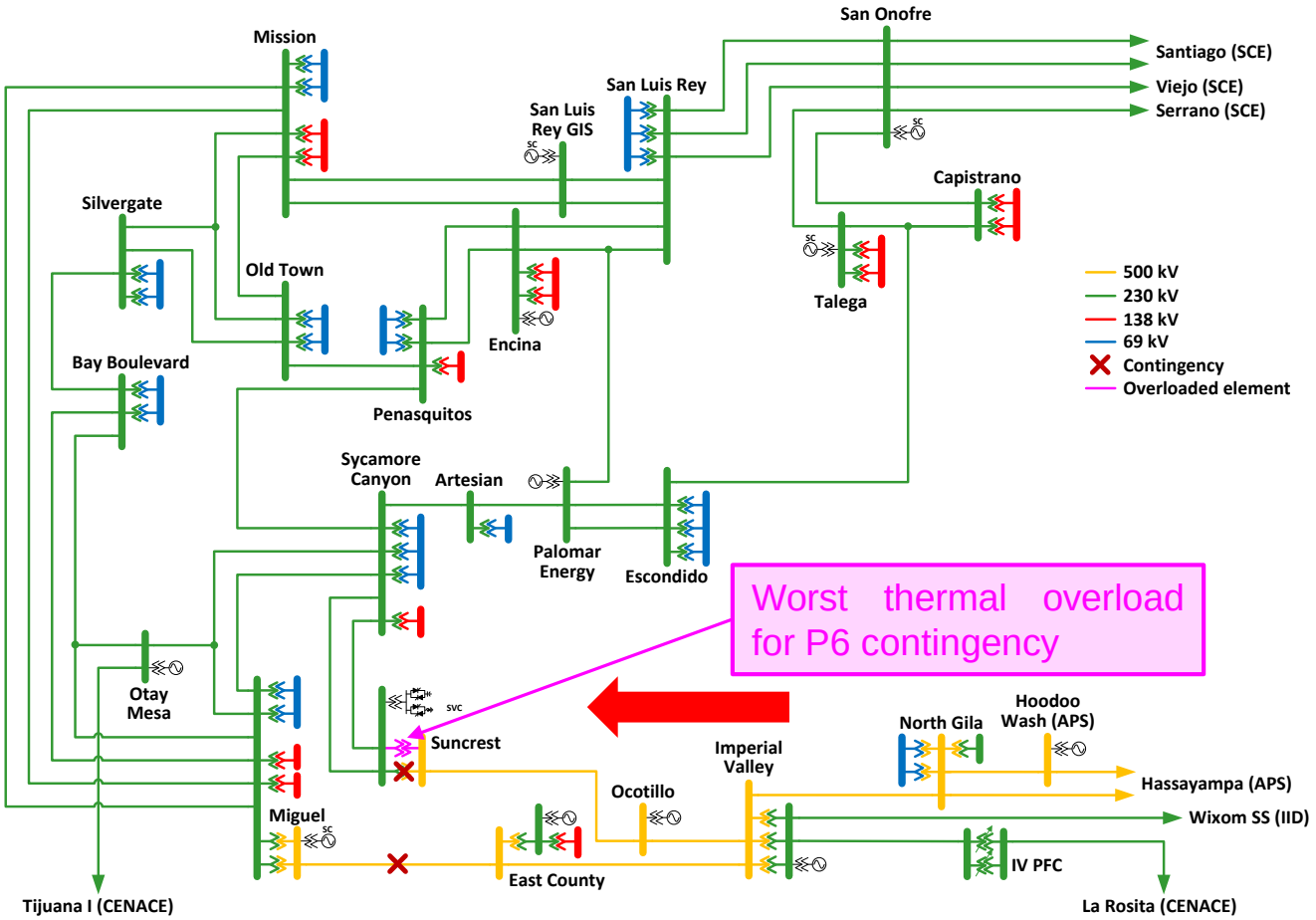
- P3 thermal overload: 100%* of normal rating
- P6 thermal overload: 119% → 176%* of normal rating

Potential Mitigation

- Use of the TL23054/23055 RAS or TL50001 Gen Drop RAS
- Rely on 30-min emergency rating
- Rely on system adjustments and operational actions, e.g.
  - Reducing gen output in the greater IV area
  - Dispatching conventional gas gen, BESS, and pumped hydro in San Diego metro area
  - Adjusting IV PST

*Considering both base and sensitivity scenarios

Suncrest 500/230 kV Banks 80 and 81



Reliability Concern

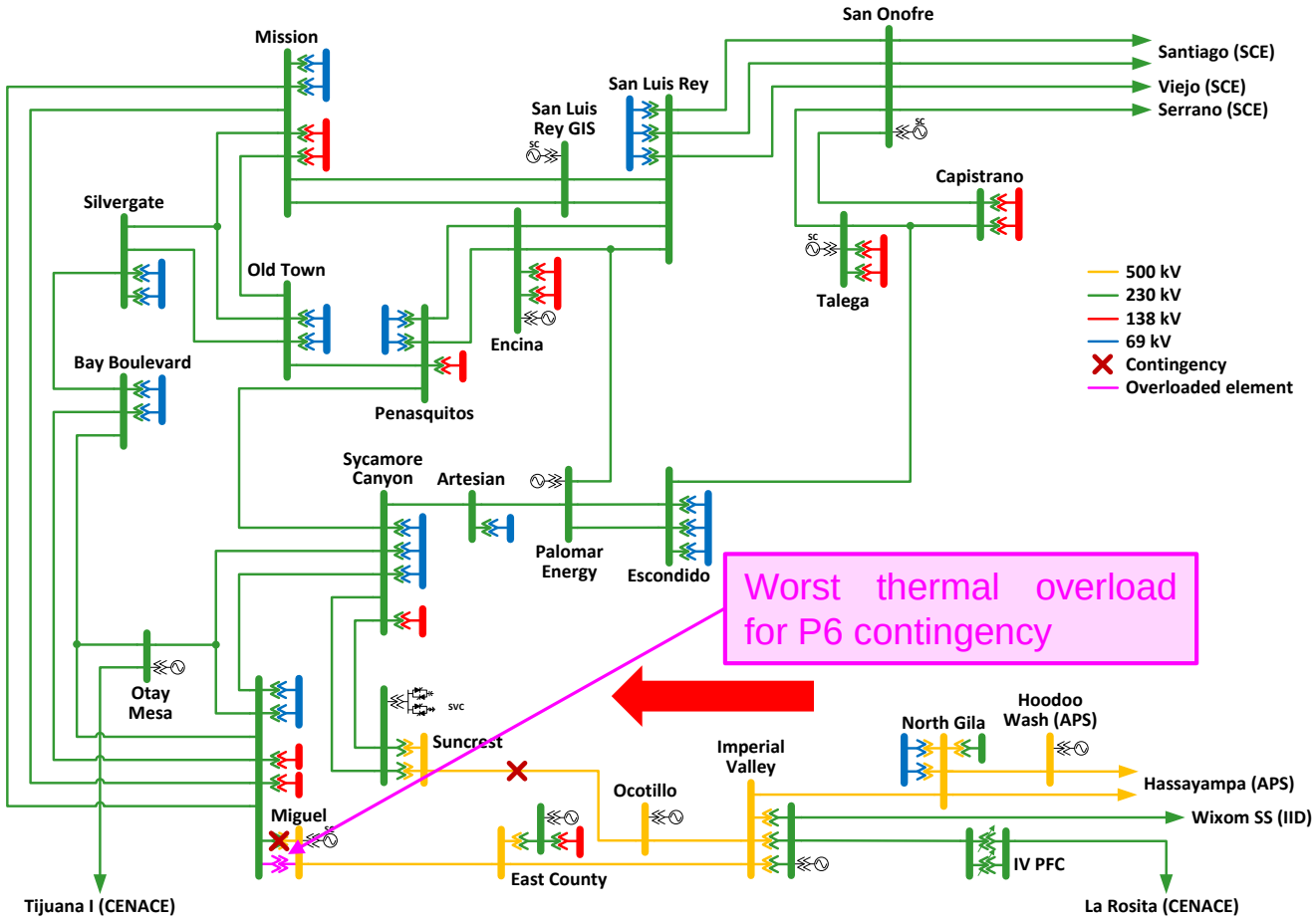
- P6 thermal overload: 101% → 132%* of 24-hr rating

Potential Mitigation

- Use of the TL50001 Gen Drop RAS
- Rely on 30-min emergency rating
- Rely on system adjustments and operational actions, e.g.
  - Reducing gen output in the greater IV area
  - Dispatching conventional gas gen, BESS, and pumped hydro in San Diego Metro area
  - Adjusting IV PST

*Considering both base and sensitivity scenarios

Miguel 500/230 kV Banks 80 and 81



Additional resources dispatched to mitigate the 2032 Summer Peak thermal overloads can vary from 0 MW to 456 MW depending on other system adjustments

Reliability Concern

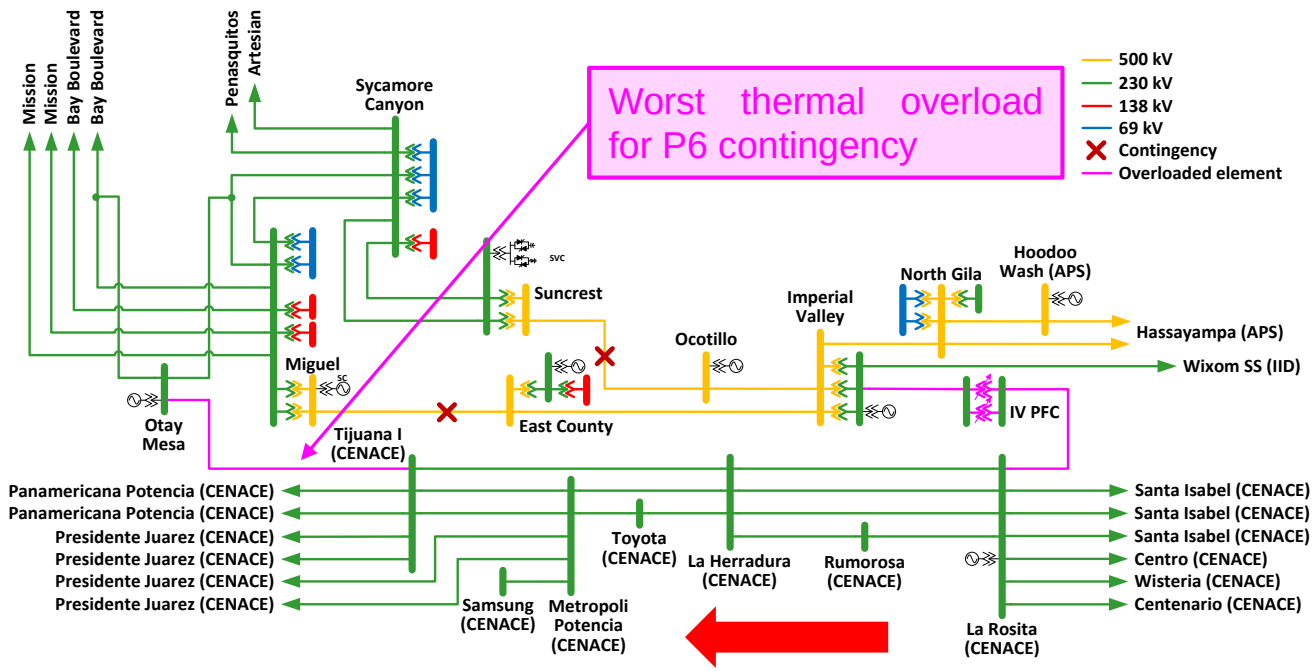
- P3 thermal overload: 102% → 104%* of 24-hr rating
- P6 thermal overload: 107% → 143%* of 24-hr rating

Potential Mitigation

- Use of the Miguel BK 80/81 RAS or TL50003 Gen Drop RAS
- Rely on 30-min emergency rating
- Rely on system adjustments and operational actions, e.g.
  - Reducing gen output in the greater IV area
  - Dispatching conventional gas gen, BESS, and pumped hydro in San Diego Metro area
  - Adjusting IV PST

*Considering both base and sensitivity scenarios

Path 45 facilities thermal overloads



Additional resources dispatched to mitigate the 2032 Summer Peak thermal overloads can vary from 0 MW to 1223 MW depending on other system adjustments

Reliability Concern

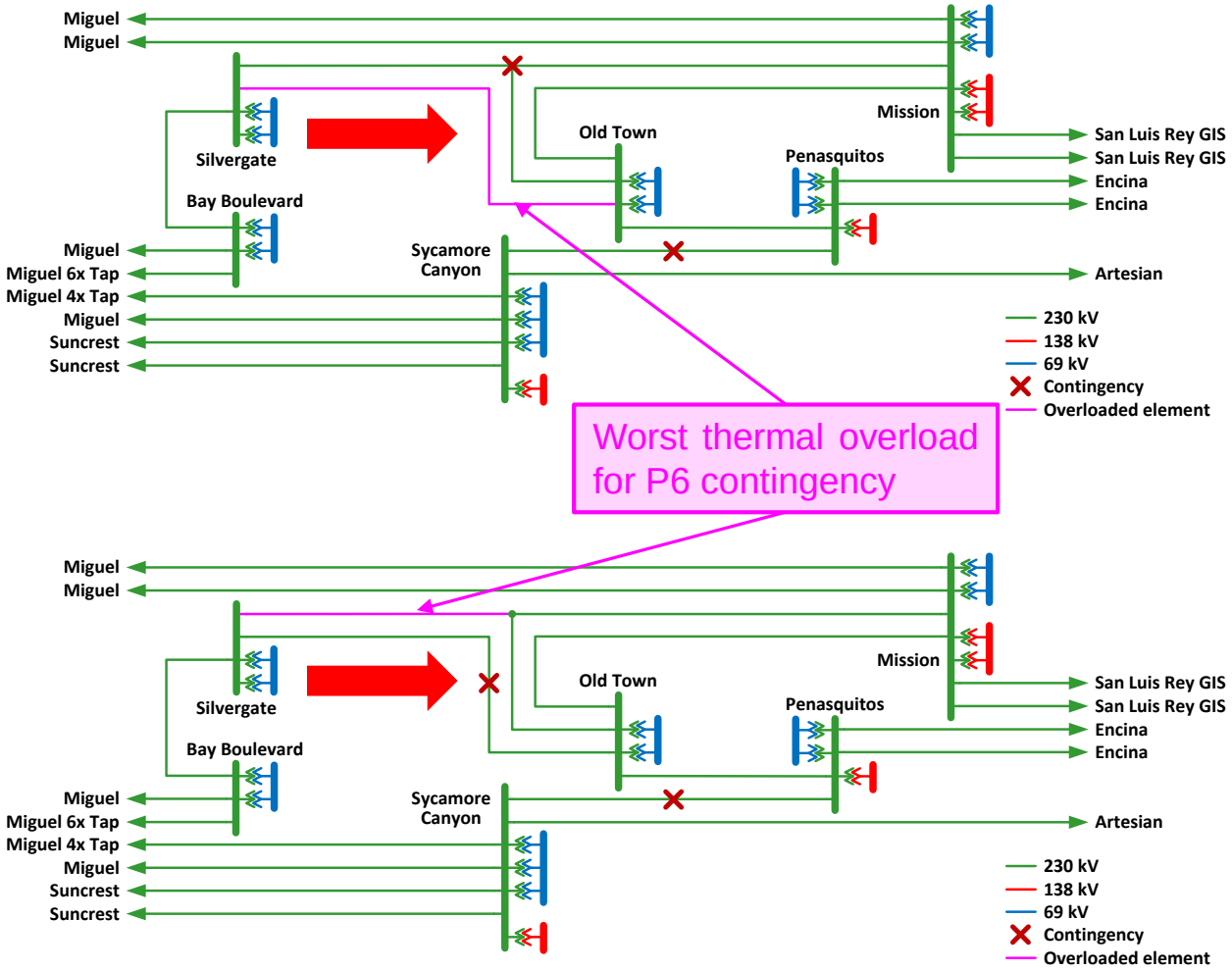
- P6 thermal overload: 103% → 145%* of 4-hr rating for OM-TJI
- P6 thermal overload: 101% → 125%* of 24-hr rating for IV PST

Potential Mitigation

- Use of TL50001 Gen Drop RAS or TL50003 Gen Drop RAS
- Rely on system adjustments and operational actions, e.g.
  - Reducing gen output in the greater IV area
  - Dispatching conventional gas gen, BESS, and pumped hydro in San Diego metro area
  - Adjusting IV PST

*Considering both base and sensitivity scenarios

230 kV TL23028A Silvergate – Old Town – Mission and TL23029 Silvergate – Old Town



Reliability Concern

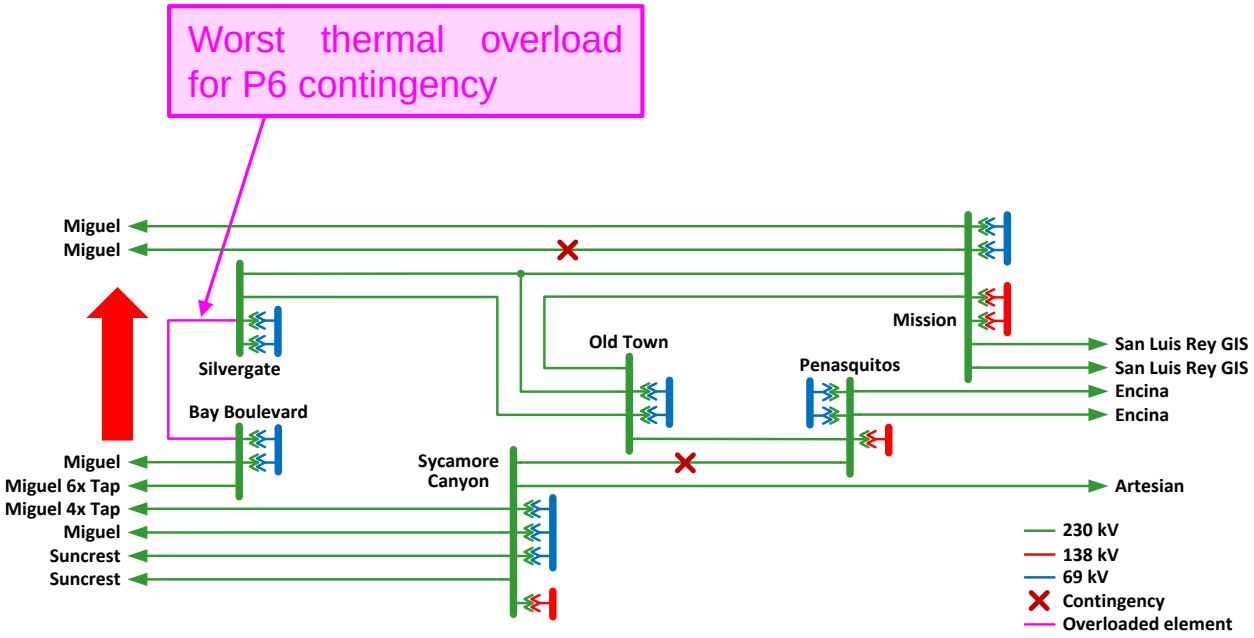
- P4 thermal overload: 101% of normal rating for TL23028A
- P6 thermal overload: 108% → 119%* of normal rating for TL23028A
- P6 thermal overload: 101% → 120%* of normal rating for TL23029

Potential Mitigation

- Rely on 2-hr emergency rating
- Rely on system adjustments and operational actions, e.g.
  - Reducing generation output at Otay Mesa
  - Dispatch battery energy storage in San Diego area connected north of Old Town substation

*Considering both base and sensitivity scenarios

230 kV TL23026 Silvergate – Bay Boulevard



Reliability Concern

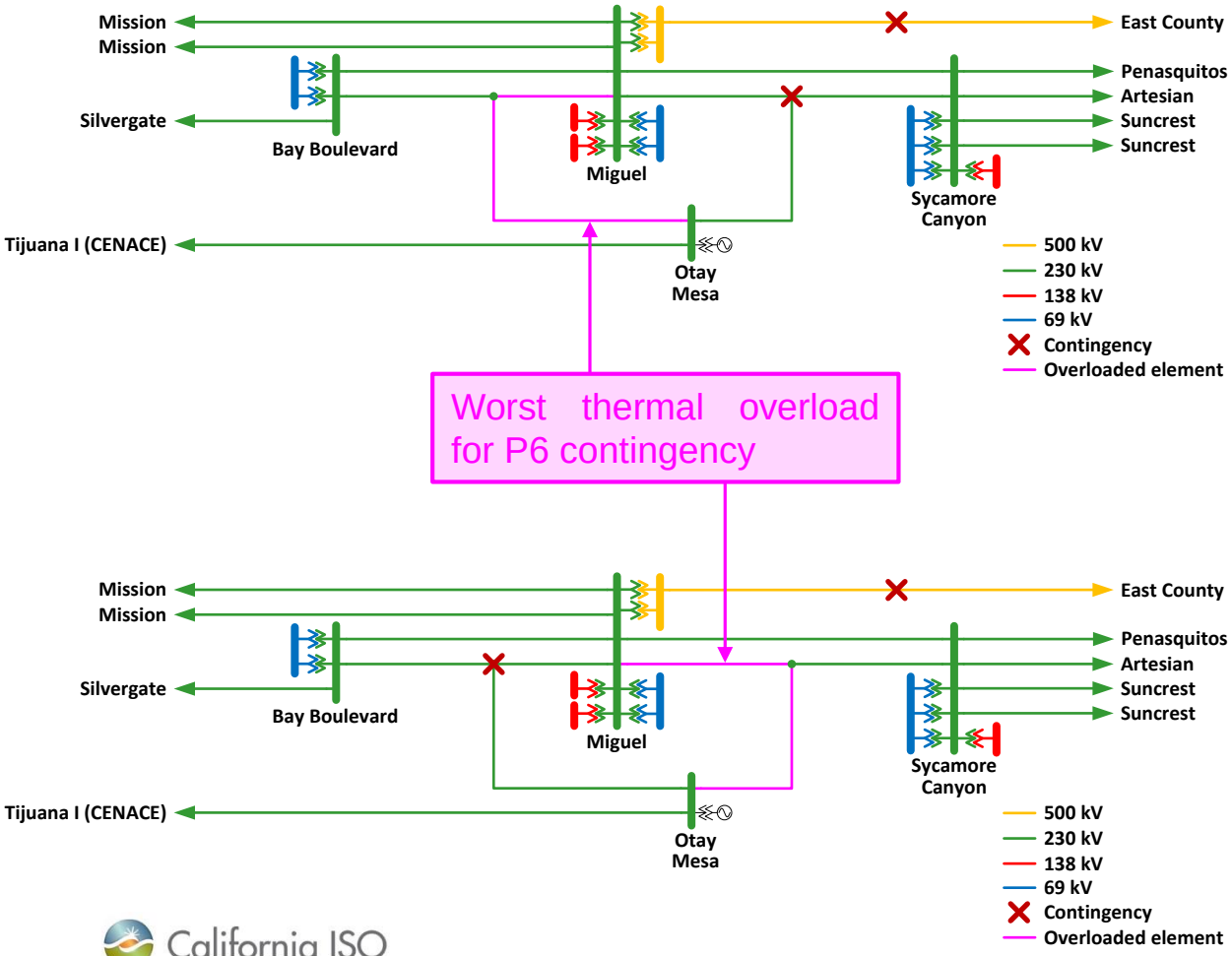
- P3 thermal overload: 100% → 104%* of normal rating
- P4 and P7 thermal overload: 101% → 108%* of normal rating
- P6 thermal overload: 102% → 112%* of normal rating

Potential Mitigation

- Rely on 2-hr emergency rating
- Rely on system adjustments and operational actions, e.g.
  - Reducing generation output at Otay Mesa
  - Dispatch battery energy storage in San Diego area connected north of Bay Boulevard substation

*Considering both base and sensitivity scenarios

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



Reliability Concern

- P2.1 thermal overload: 100% of normal rating
- P3 thermal overload: 101%* of normal rating
- P6 thermal overload: 102% → 135%* of normal rating

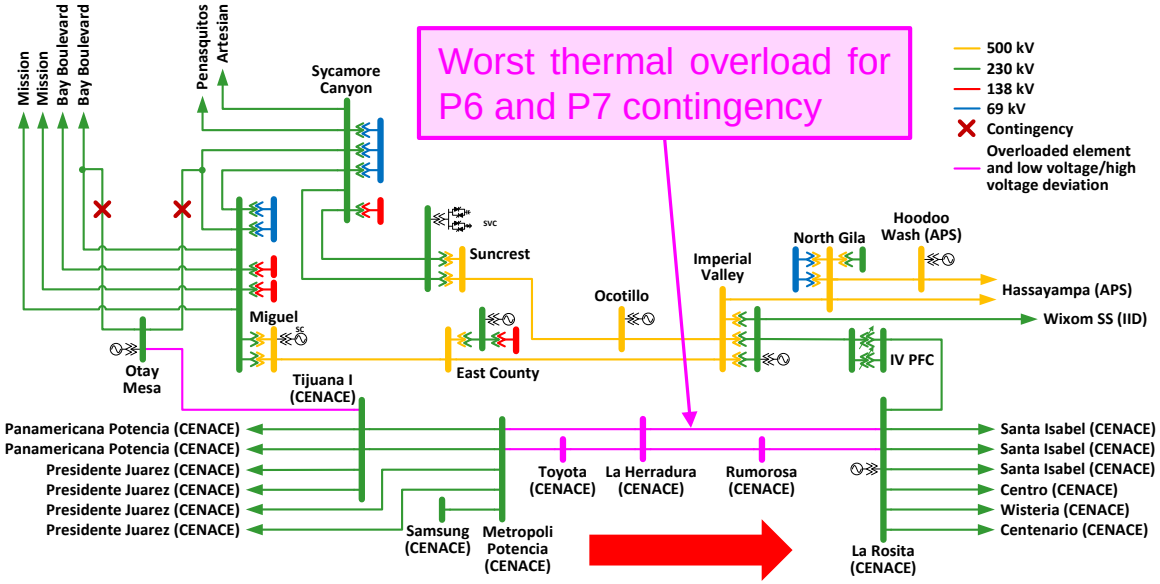
Potential Mitigation

- Use of TL23041/TL23042 RAS
- Rely on 30-min emergency rating
- Rely on system adjustments and operational actions, e.g.
  - Reducing generation output at Otay Mesa

*Considering both base and sensitivity scenarios

California ISO

230 kV CENACE thermal overloads and voltage issues



CENACE's grid model has several future reinforcements in WECC seed cases, thus contingencies in near-term base cases are more severe than in long-term bases cases.

Reliability Concern

- P6 and P7 thermal overload: 123% → 158%* of normal rating**
- P6 and P7 low voltage (0.88 pu*) and high voltage deviation (9% - 11.4%*)

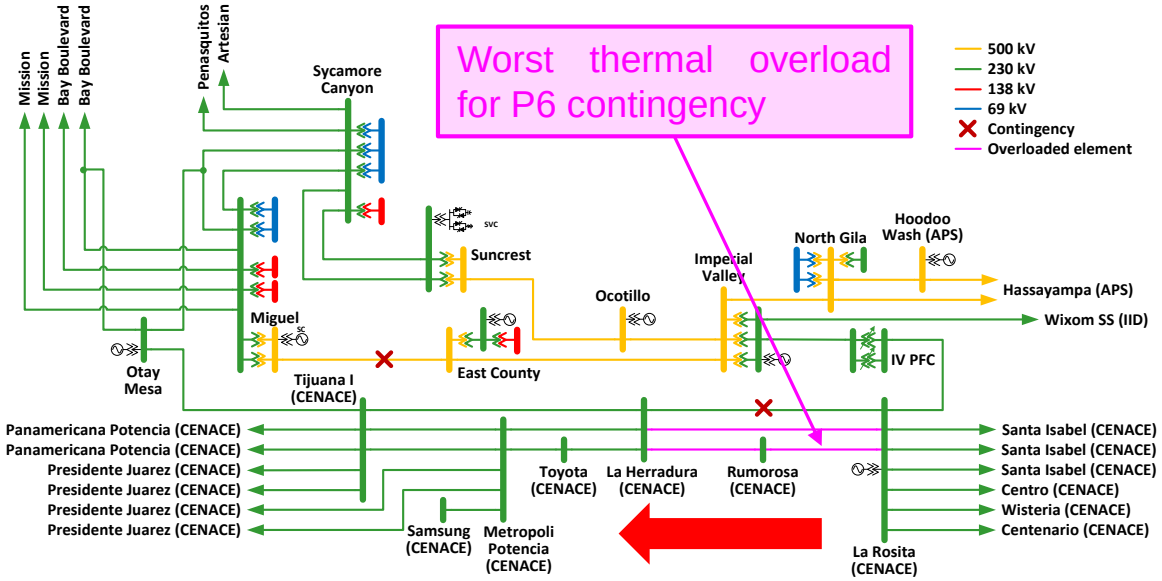
Potential Mitigation

- Use of Otay Mesa Gen Drop RAS

*Considering both base and sensitivity scenarios

**Divergence in 2024 Spring Off-Peak

230 kV CENACE thermal overloads and voltage issues



CENACE's grid model has several future reinforcements in WECC seed cases, thus contingencies in near-term base cases are more severe than in long-term bases cases.

Reliability Concern

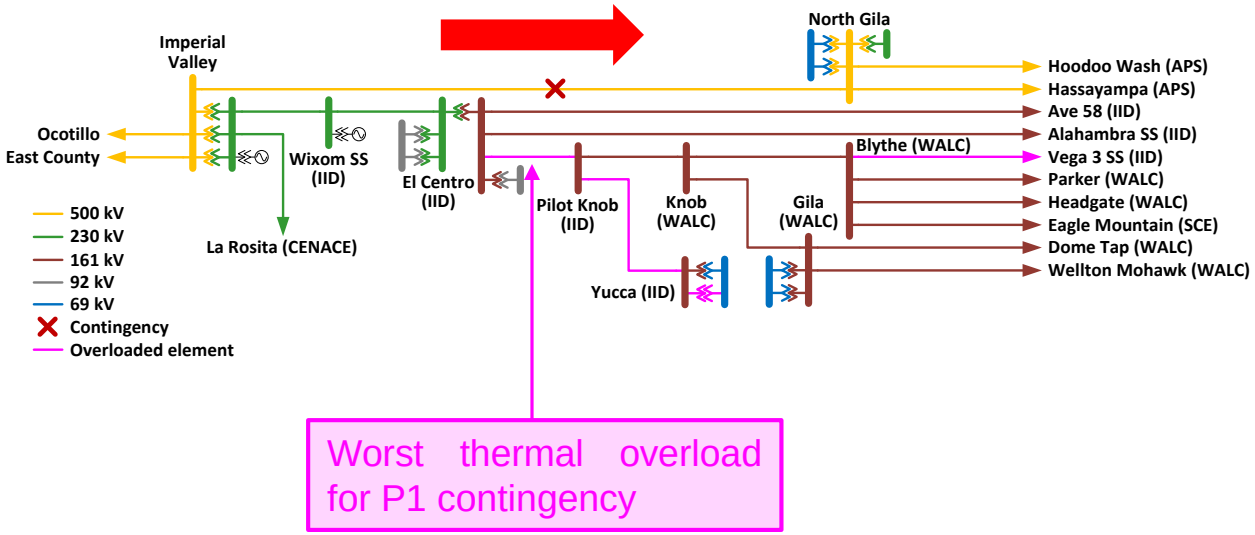
- P6 (TL50001 and ROA-TJI ck2) thermal overload: 110% → 112%* of normal rating

Potential Mitigation

- Rely on system adjustments and operational actions, e.g.
  - Reducing gen output in the greater IV area
  - Dispatching conventional gas gen, BESS, and pumped hydro in San Diego metro area
  - Adjusting IV PST

*Considering both base and sensitivity scenarios

161 kV IID thermal overloads



Reliability Concern

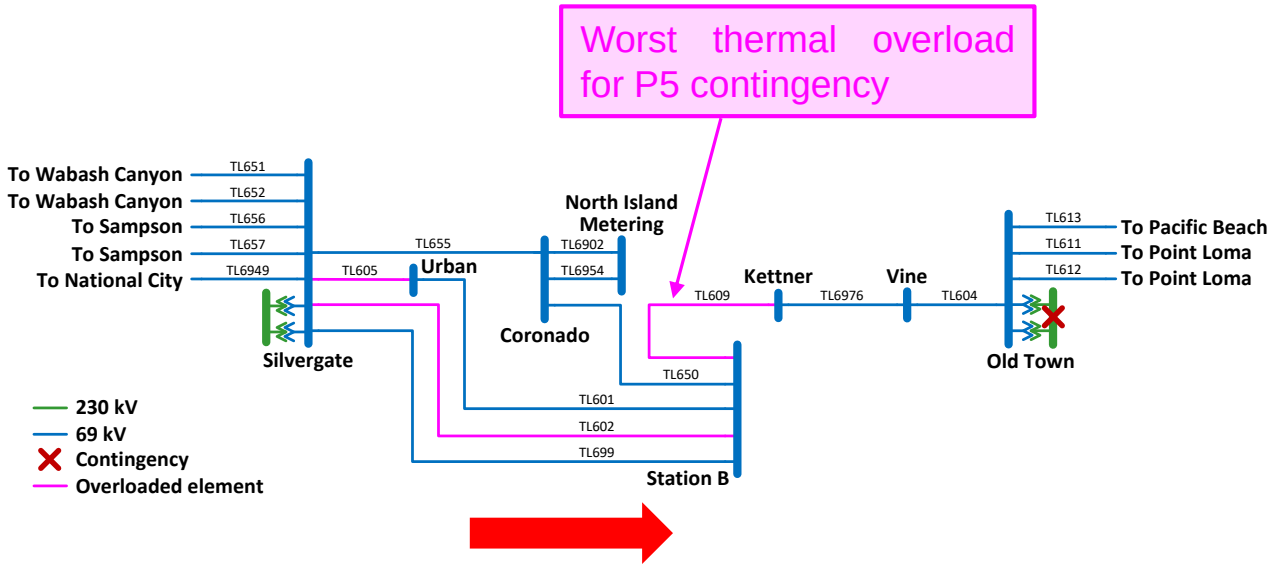
- P1 thermal overloads: 102% → 126% of normal rating
- P3 thermal overloads: 101% → 134% of normal rating
- P4 thermal overloads: 103% → 128% of normal rating

Potential Mitigation

- Congestion management by curtailing renewable generation at Imperial Valley substation

Overloads are only present in 2032 Spring-Off Peak Base Case since there is a high power flow from Imperial Valley to North Gila

69 kV thermal overloads for Old Town 230 kV N+S Bus P5 contingency



Reliability Concern

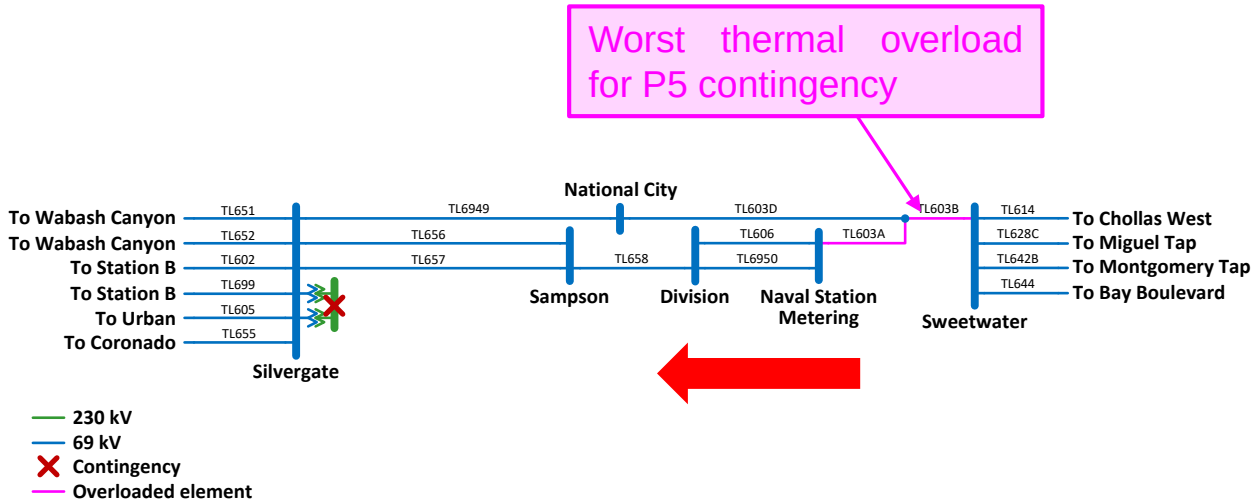
- P5 thermal overloads: 101% → 132%* of normal rating (4-hr rating for TL602)

Potential Mitigation

- Add redundancy to protection systems

*Considering both base and sensitivity scenarios

69 kV thermal overloads for Silvergate 230 kV E+W Bus P5 contingency



Reliability Concern

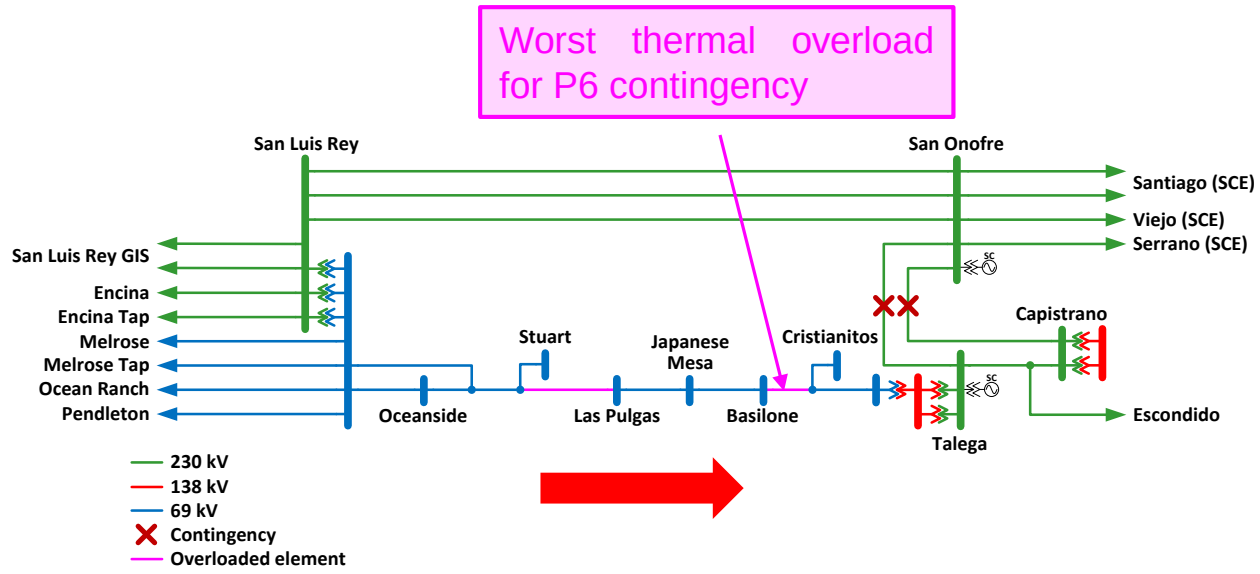
- P5 thermal overloads: 101% → 112%* of normal rating (24-hr rating for TL603A)

Potential Mitigation

- Add redundancy to protection systems
- Sweetwater Reliability Enhancement project (ISD December 2027) would also help mitigate these overloads, but would reappear in the long term

*Considering both base and sensitivity scenarios

69 kV thermal overloads for 230 kV TL23007 San Onofre – Capistrano and TL23052 San Onofre – Talega P6 contingency



Reliability Concern

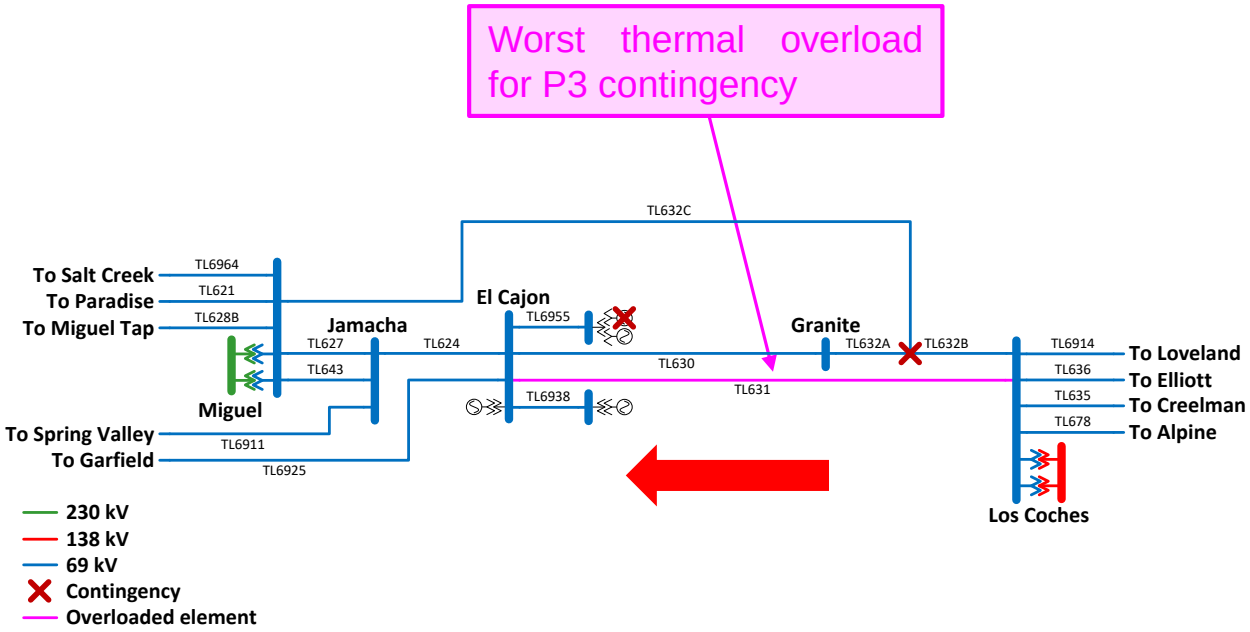
- P6 thermal overloads: 103% → 194%* of normal rating

Potential Mitigation

- Opening any segment of the 69 kV transmission lines from Oceanside Tap to Talega after the first contingency for the P6 event mitigates the overload in the short-term
- TL695B Japanese Mesa-Talega Tap Reconductor project (ISD October 2025)
- TL690E, Stuart Tap-Las Pulgas 69 kV Reconductor project (ISD November 2026)

*Considering both base and sensitivity scenarios

El Cajon LCR Subarea - Thermal overload of 69 kV TL631 El Cajon – Los Coches



Reliability Concern

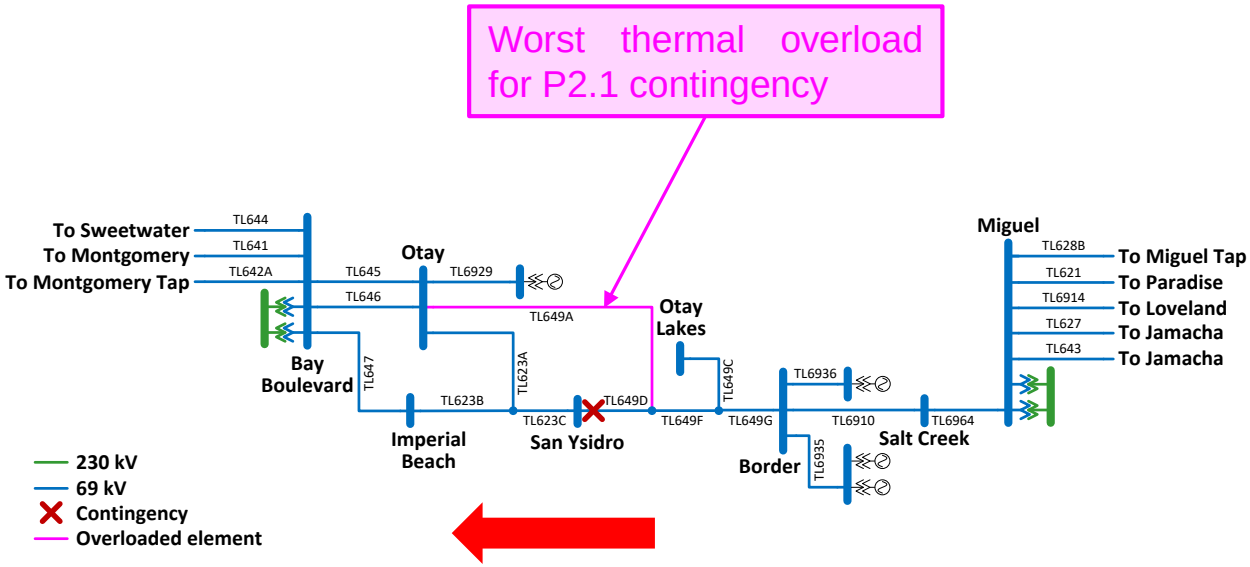
- P1 thermal overload: 115% of normal rating in 2024 SP sensitivity scenario with no gas generation
- P3 thermal overloads: 106% → 114%* of normal rating

Potential Mitigation

- System adjustments after the first contingency for the P3 events by dispatching El Cajon battery energy storage mitigates the overload in the short-term
- TL632 Granite Loop-In and TL6914 Reconfiguration project (ISD May 2026) mitigates the overloads in the long-term

*Considering both base and sensitivity scenarios

Border LCR Subarea - Thermal overload of 69 kV TL649A Otay – Otay Lakes Tap



Reliability Concern

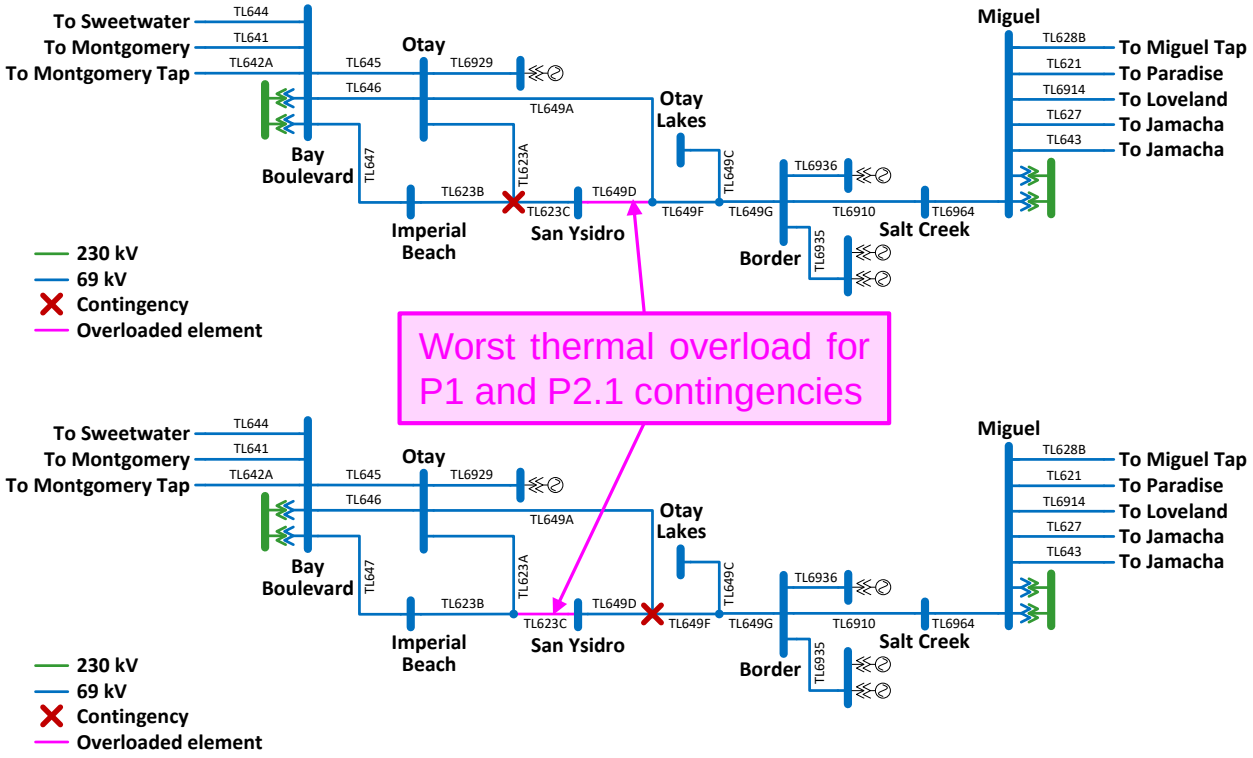
- P2.1 thermal overload: 102% of normal rating in 2024 SP base case with maximum gas generation

Potential Mitigation

- Rely on existing TL649 RAS to curtail Border gas generation unit 3

The overload in 2027 and 2032 Summer Peak base cases disappears as the load in Border subarea increases, thus reducing the power flow through TL649A

Border LCR Subarea - Thermal overload of 69 kV TL649D San Ysidro – Otay Lakes Tap and TL623C San Ysidro – Otay Tap



Reliability Concern

- P1 and P2.1 thermal overloads: 101% → 112%* of normal rating

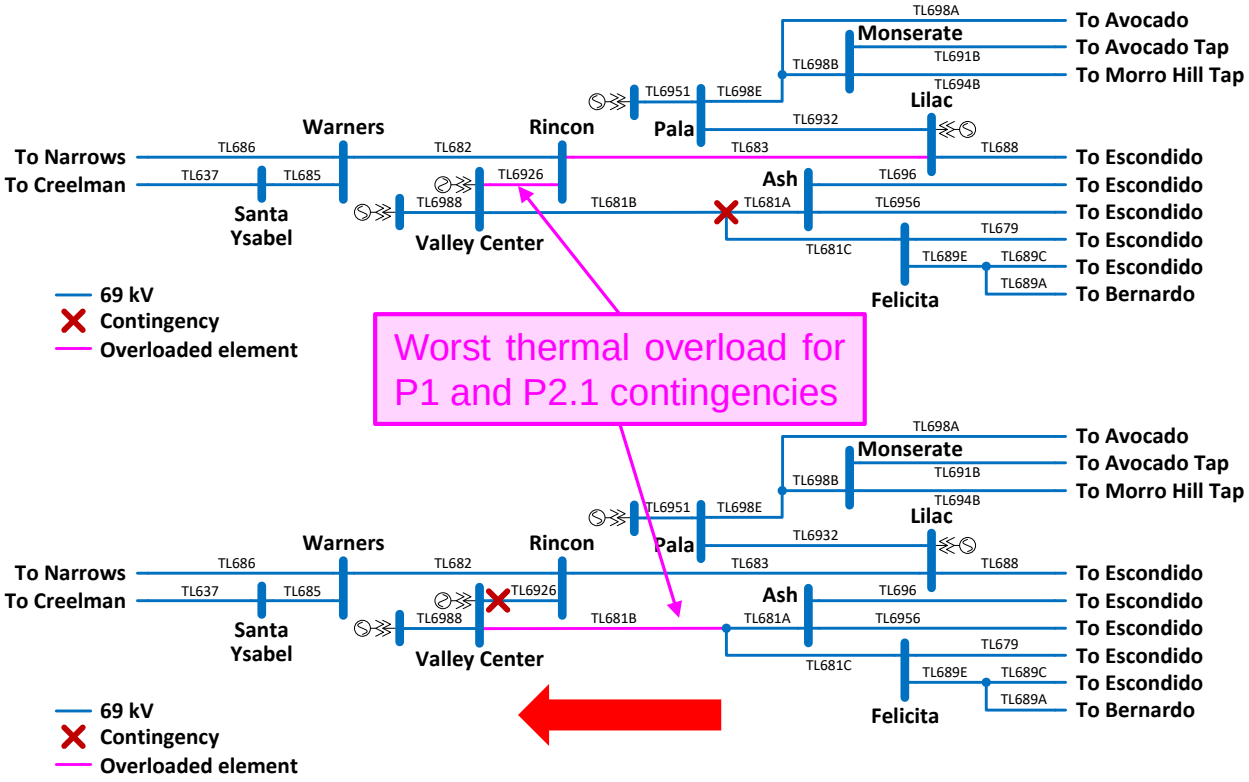
Potential Mitigation

- Model the ISO approved "Reconductor TL649D and TL623C (San Ysidro - Otay Lake Tap - Otay)" project (ISD August 2024)

"Reconductor TL649D and TL623C (San Ysidro - Otay Lake Tap - Otay)" project was approved in the 2017-2018 TPP but was not considered in the approved project list before the start of 2022-2023 TPP

*Considering both base and sensitivity scenarios

Valley Center BESS charging – Thermal overloads



These overloads are only present on 2024 Spring-Off Peak storage charging in load pockets sensitivity scenario

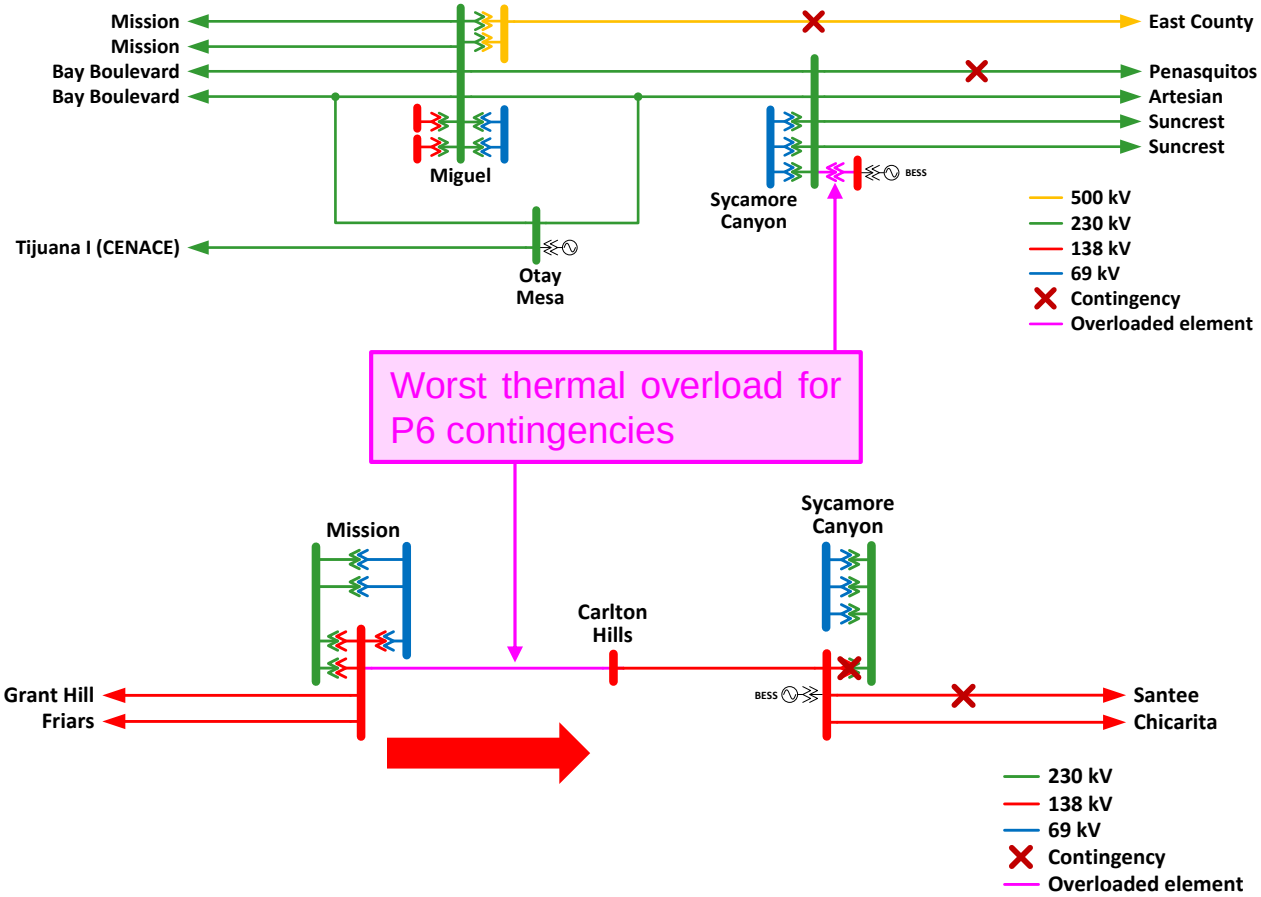
Reliability Concern

- P1 and P2.1 thermal overloads: 104% → 120% of normal rating
- P3 thermal overloads: 101% → 110% of normal rating

Potential Mitigation

- Use Valley Center RAS to trip the battery energy storage (under charging mode) at Valley Center
- Congestion management to protect against the overloading of TL683 Rincon - Lilac which currently is not monitored by the RAS

Sycamore Canyon BESS charging – Thermal overloads



These overloads are only present on 2024 Spring-Off Peak storage charging in load pockets sensitivity scenario

Reliability Concern

- P6 thermal overloads: 104% of 24-normal rating (230/138 kV Sycamore Canyon BK 60)
- P6 thermal overloads: 104% of normal rating (TL13822)

Potential Mitigation

- Battery energy storage charging curtailment after P1 contingency
- Implement a RAS to trip the battery energy storage (under charging mode) at Sycamore Canyon

Transient Stability Analysis

- Performed for B2, B3, B4, B6, S2, and S3 cases
- 49 credible contingencies evaluated
  - Includes P1, P2.2, P5.5, and P7
- No WECC criteria violations were observed

2035 Additional Transportation Electrification Scenario

Thermal Overloads Exacerbated in 2035 ATE Scenario

Overloaded Facility	Worst Thermal Overload (%)	TPL-001-5 Contingency category/ Thermal Overload (%)							
	2032	P0	P1	P2	P3	P4	P5	P6	P7
TL23054/TL23055 Suncrest - Sycamore Canyon	167				105			187	
500/230 kV Suncrest BK 80 & 81	125							137	
500/230 kV Miguel BK 80 & 81	134				112			151	
TL23040 Otay Mesa - Tijuana I	145							158	105
TL23050/TL23082 Imperial Valley - La Rosita	110							120	
Imperial Valley Phase Shift Transformers	125							138	
TL23028A Silvergate - Old Town Tap	119					101		122	
TL23029 Silvergate - Old Town	120							124	
TL23026 Silvergate - Bay Boulevard	112		105		111	114		120	114
TL23041 Sycamore Canyon - Otay Mesa - Miguel	134		101	102	102	101		141	101
TL23042 Bay Boulevard - Otay Mesa - Miguel	135		101	102	103	102		142	101
TL602 Silvergate - Station B	118						135		
TL609 Station B - Kettner	132						151		
TL605 Silvergate - Urban	114						130		
TL649D San Ysidro - Otay Lakes Tap	111		128	128	100			103	
TL623C San Ysidro - Otay Tap	112		129	129					

Additional Thermal Overloads in 2035 ATE Scenario

Overloaded Facility	TPL-001-5 Contingency category/ Thermal Overload (%)							
	P0	P1	P2	P3	P4	P5	P6	P7
TL23056 Suncrest - Suncrest SVC							102	
TL23052 San Onofre - Talega				101			106	
230/69 kV Old Town BK 70 & 71		113			113			
230/138 kV Sycamore Canyon BK 60							101	
230/69 kV Escondido BK 71					109			
TL699 Silvergate - Station B						112		
TL6976 Kettner - Vine						105		
TL604 Vine - Old Town						110		
TL603A Sweetwater - Naval Station Metering						104		
TL13826 Proctor Valley - Miguel							100	
TL636 Los Coches - Elliott							105	
TL6966 San Luis Rey - Ocean Ranch		104		112				
TL697 San Luis Rey - Oceanside							103	
TL690C Oceanside Tap - Stuart Tap							103	
TL13836 Talega - Pico							120	
TL13835 Talega - San Mateo					104		104	
TL628B Miguel - Miguel Tap				100				

Additional Thermal Overloads in 2035 ATE Scenario

Overloaded Facility	TPL-001-5 Contingency category/ Thermal Overload (%)							
	P0	P1	P2	P3	P4	P5	P6	P7
TL649A Otay - Otay Lakes Tap				103				
TL649C Otay Lakes - Border Tap	106							
TL647 Bay Boulevard - Imperial Beach			103					
TL641 Bay Boulevard - Montgomery			111					
TL6916 Sycamore Canyon - Scripps				101			109	101
TL682 Warners - Rincon		105						
161 kV TL El Centro - Pilot Knob							104	
161 kV TL Pilot Knob - Yucca							105	
161/69 kV Yucca BK 1							105	
92 kV TL Niland - Prison							112	
92 kV TL Prison - CSF Tap - CALIPAT							110	

Additional Voltage Deviation Issues in 2035 ATE Scenario

Substation	TPL-001-5 Contingency category/ Post-contingency Voltage Deviation (%)							
	P0	P1	P2	P3	P4	P5	P6	P7
Barrett 69 kV				8.1				

Resources needed to mitigate thermal overloads for SWPL and SRPL contingencies

Base Case	Overloaded facility	P6 Contingency	Total Generation curtailed in greater Imperial Valley area (MW)	Additional Resources dispatched in San Diego Metro area (MW)	Imperial Valley Phase Shift Transformer Adjustment
B3-2032SP	TL 23054 or 23055 Suncrest - Sycamore Canyon	TL 50001 East County - Miguel & TL 23054 or 23055 Suncrest - Sycamore Canyon	1168	975	No
			1401	270	Yes
S4-2035SP			1168	1905*	No
			1401	1000*	Yes
B3-2032SP	Suncrest Bank 80 or 81	TL 50001 East County - Miguel & Suncrest Bank 80 or 81	1168	0	No
			1401	0	Yes
S4-2035SP			1168	620	No
			1401	230	Yes
B3-2032SP	Miguel Bank 80 or 81	TL 50003 Ocotillo - Suncrest & Miguel Bank 80 or 81	1168	456	No
			1401	0	Yes
S4-2035SP			1168	1856*	No
			1401	390	Yes
B3-2032SP	TL 23040 Otay Mesa - Tijuana I	TL 50003 Ocotillo - Suncrest & TL 50001 East County - Miguel	1168	1223*	No
			1401	0	Yes
S4-2035SP			1168	1599*	No
			1401	856	Yes

* Based on the 2027 LCR Study, the approximate energy storage that can be added from the charging restriction perspective is 1634 MW and 8076 MWh, with a 4-hr maximum energy storage capacity of 991.5 MW. 2032 LCR Study will update these energy storage charging restrictions.

Agenda
Reliability Assessment and Study Updates

Brenda Corona
Stakeholder Engagement and Policy Specialist

2022-2023 Transmission Planning Process Stakeholder Meeting
September 27-28, 2022

2022-2023 Transmission Planning Process Stakeholder Call – Agenda

Topic	Presenter
Day 1 – September 27	
Overview & Key Issues	Binaya Shrestha
Reliability Assessment - North	RTN - Engineers
Reliability Assessment - South	RTS - Engineers
Day 2 – September 28	
PTO Proposed Reliability Solutions	PG&E, SCE, SDG&E, GLW
High Voltage TAC Update	Binaya Shrestha
Policy Assessment - Update	Nebiyu Yimer
Economic Assessment - Update	Yi Zhang
Next Steps	Brenda Corona