Agenda
Reliability Assessment and Study Updates

Isabella Nicosia
Stakeholder Engagement and Policy Specialist

2020-2021 Transmission Planning Process Stakeholder Meeting
September 23-24, 2020

2020-2021 Transmission Planning Process Stakeholder Call – Agenda

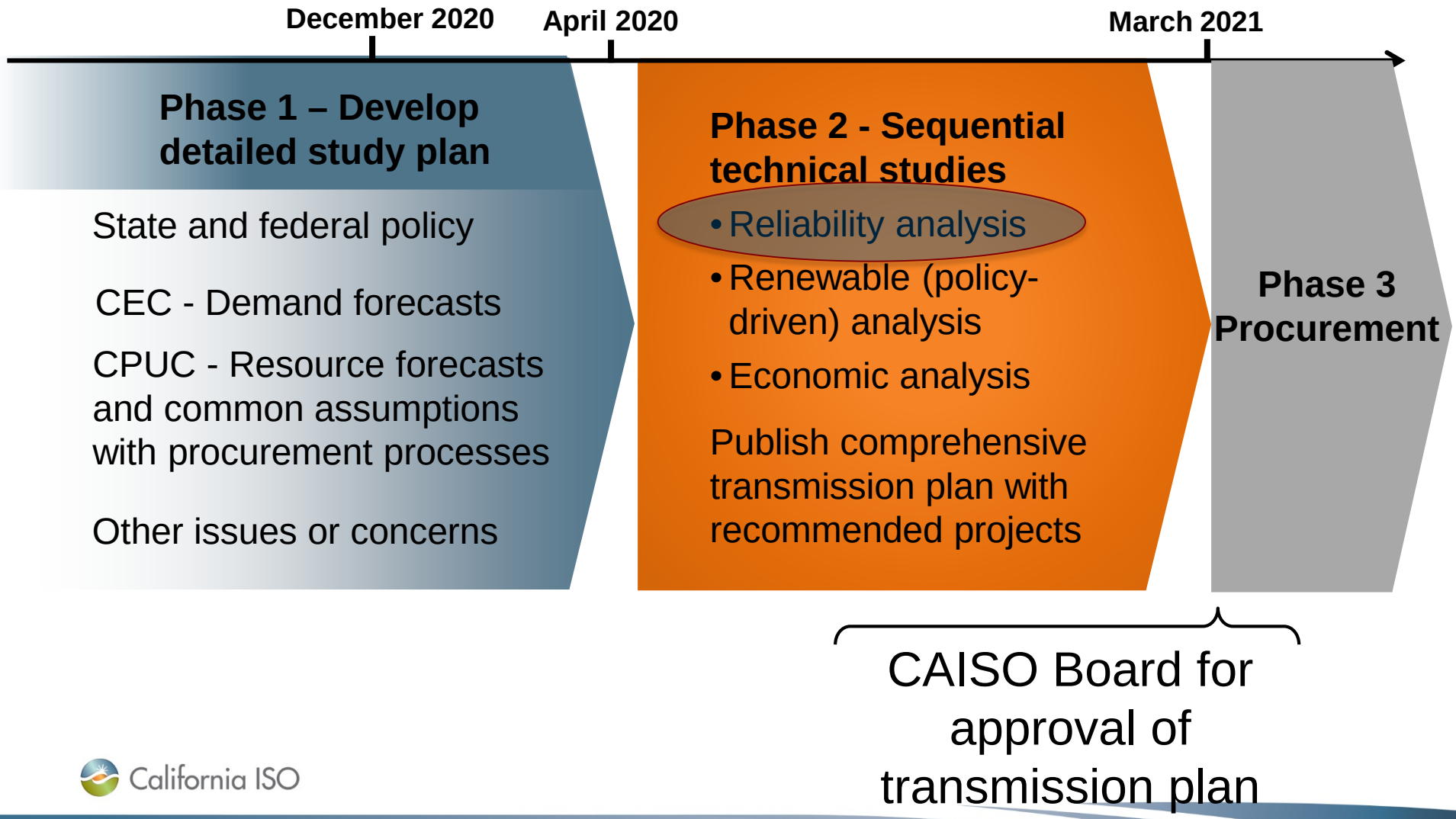
Topic	Presenter
Day 1 – September 23	
Overview & Key Issues	Jeff Billinton
Reliability Assessment - North	RTN - Engineers
Reliability Assessment - South	RTS - Engineers
SDG&E Proposed Reliability Solutions	SDG&E
PG&E Proposed Reliability Solutions	PG&E
Day 2 – September 24	
10-year Local Capacity Technical Study	RT - Engineers
Wildfire Impact Assessment – PG&E Area	RTN - Engineers
Next Steps	Isabella Nicosia

Introduction and Overview
Preliminary Reliability Assessment Results

Jeff Billinton
Director, Transmission Infrastructure Planning

2020-2021 Transmission Planning Process Stakeholder Meeting
September 23-24, 2020

2020-2021 Transmission Planning Process



California ISO

2020-2021 Transmission Plan Milestones

- Draft Study Plan posted on February 21
- Stakeholder meeting on Draft Study Plan on February 28
- Comments to be submitted by March 13
- Final Study Plan to be posted on March 31
- Stakeholder call – update June 3
- Comments to be submitted by June 17
- Preliminary reliability study results to be posted on August 14
- Stakeholder meeting on September 23 and 24
- Comments to be submitted by October 8
- Request window closes October 15
- Preliminary policy and economic study results on November 17
- Comments to be submitted by December 1
- Draft transmission plan to be posted on January 31, 2019
- Stakeholder meeting in February
- Comments to be submitted within two weeks after stakeholder meeting
- Revised draft for approval at March Board of Governor meeting

The reliability assessment is a key component of the overall 2020-2021 Transmission Plan Study Plan

- Reliability Assessment to identify reliability-driven needs
  - CPUC IRP base portfolio used for reliability assessment
  - Load forecast based on California Energy Demand Revised Forecast 2019-2030 adopted by California Energy Commission (CEC) on January 9, 2019
- This is also foundational to other aspects of the plan, which continues to evolve in each cycle:
  - Policy Assessment
  - Economic Planning Study to identify economically-driven elements
  - Interregional Transmission Planning Process
  - Other Studies
    - Local Capacity Requirements (near term, mid term, long term)
    - Long-term Congestion Revenue Rights
    - Frequency Response
    - Wildfire PSPS assessment, conducted as extreme event analysis

2019-2020 Ten Year Reliability Assessment To Date

- Preliminary study results were posted on August 14
  - Based on assumptions identified in 2020-2021 Study Plan
  - Satisfy requirements of:
    - NERC Reliability Standards
    - WECC Regional Criteria
    - ISO Planning Standards
- Transmission request window (reliability driven projects) opened on August 14
  - PTO proposed mitigations submitted to CAISO by September 15

2019-2020 Ten Year Reliability Assessment

conducted every 2 years

- **Comments on Stakeholder** Meeting due October 8
  - Alternatives related to local capacity technical studies are to be submitted with stakeholder comments
- Request Window closes October 15
  - Request Window is for alternatives to reliability assessment
- ISO recommended projects:
  - For management approval of reliability projects less than $50 million will be presented at November stakeholder session
  - For Board of Governor approval of reliability projects over $50 will be included in draft plan to be issued for stakeholder comments by January 31, 2020
- Purpose of today's stakeholder meeting
  - Review the results of the reliability analysis, including wildfire PSPS assessment
  - Review the results of the 10-year local capacity technical study
  - 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 and Wildfire Impact Assessment presentations have also been posted on the secure site.

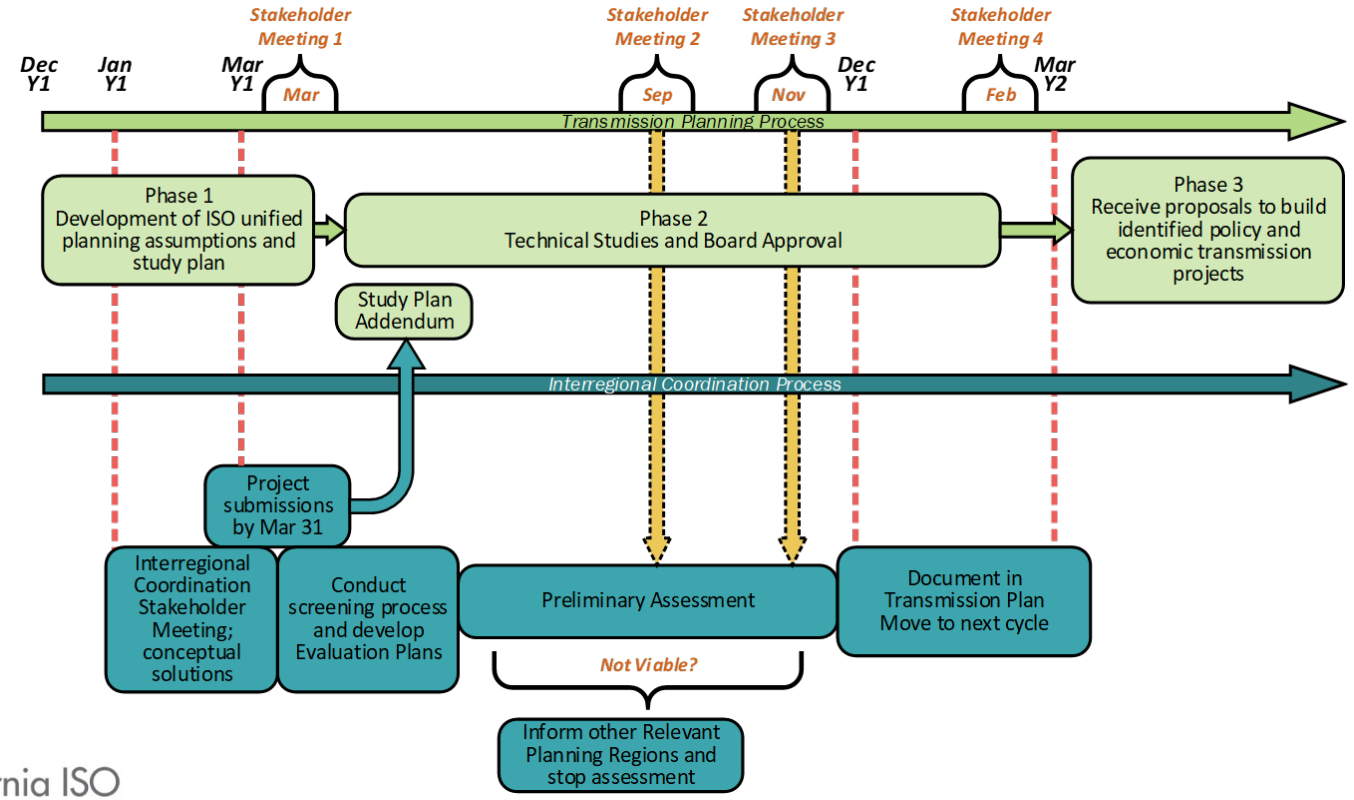
Key Issues (continued)

- Preparation for policy and economic assessment are underway with the preliminary analysis to be presented at the November 17 stakeholder meeting

- 10-year local capacity technical study:
  - Identify 2030 local capacity requirements
  - Update storage capability (MW/MWh requirements and charging limitations)
  - Identify transmission options that combined with storage could eliminate or materially reduce gas-fired generation in targeted areas and sub-areas.

Key Issues (continued)

- Interregional transmission planning process
  - Interregional projects submitted into the two year process this year are being addressed as per tariff-defined processes



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

Stakeholder Comments

- Stakeholder comments to be submitted by October 8
  - Stakeholder comments are to include potential alternatives for economic LCR assessment for
  - Stakeholders requested to submit comments to: regionaltransmission@caiso.com
  - Stakeholder comments are to be submitted within two weeks after stakeholder meetings
  - ISO will post comments and responses on website

PG&E Bulk System
Preliminary Reliability Assessment Results

Irina Green
Senior Advisor, Regional Transmission North

2020-2021 Transmission Planning Process Stakeholder Meeting
September 23-24, 2020

Presentation available on Market Participant Portal

Humboldt

Preliminary Reliability Assessment Results

Lindsey Thomas
Regional Transmission Engineer

2020-2021 Transmission Planning Process Stakeholder Meeting
September 23-24, 2020

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

Previously approved transmission projects modelled in base cases

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

Use of past study scope

Past studies from 2019-2020 TPP were used for Humboldt area based on the use of Past Study Methodology presented at June 3, 2020 stakeholder meeting.

- For steady state analysis, past studies were used for all three years with the additional studies undertaken:
  - Additional P2 and P5 contingencies
  - Sensitivity study of summer peak without facility rerates

- For transient analysis, new studies were performed for all three years.

*http://www.caiso.com/Documents/AppendixC-BoardApprovedt2019-2020TransmissionPlan.pdf

Reliability issues identified in 2019-2020 TPP

None

Reliability issues identified in 2020-2021 TPP

Observations

- For 2022 and 2030, P1-2 Low voltage violations were observed
  - contingency definition for modeling the Garberville SVCs was updated in this planning cycle

Potential Mitigations

- Garberville SVC setting change or additional reactive support

New sensitivity-only issues

Below is the list of overloads that get worse or are new overloads in the no-rerate sensitivity

Overloaded Facility	Category
None	

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

Overloaded Facility	Category	2025 High CEC	2022Summer Peak High Renew	2025 Off-Peak High Renew	2030 QF Retirement
None					

Summary of potential new upgrades

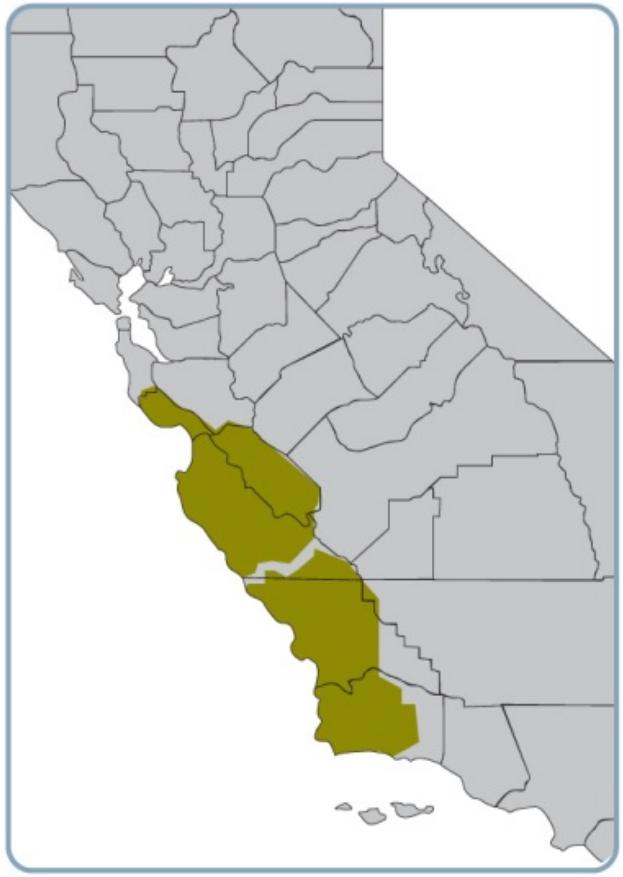
Division	Reliability Concern	Potential Upgrade
Humboldt	P1-2 Low voltage	Garberville SVC setting change or additional reactive support

Central Coast Los Padres Area
Preliminary Reliability Assessment Results

Lindsey Thomas
Regional Transmission Engineer

2020-2021 Transmission Planning Process Stakeholder Meeting
September 23-24, 2020

Central Coast/ Los Padres Area



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

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

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

S. No.	Study Case	Scenario Type	Description	Gross Load (MW)	AAEE (MW)	BTM-PV		Net Load (MW)	Demand Response	
						Installed (MW)	Output (MW)		Total (MW)	D2 (MW)
1	CCLP-2022-SP	Baseline	2022 summer peak load conditions. Peak load time - hours between 19:00 and 20:00.	1,189	9	434	0	1,180	27	15
2	CCLP-2025-SP	Baseline	2025 summer peak load conditions. Peak load time - hours between 19:00 and 20:00.	1,243	15	504	0	1,228	27	15
3	CCLP-2030-SP	Baseline	2030 summer peak load conditions. Peak load time -hours between 19:00 and 20:00.	1,324	26	631	0	1,297	27	15
4	CCLP-2022-SOP	Baseline	2022 spring off-peak load conditions. Off-peak load time - hours ending 20:00.	911	7	434	0	904	27	15
5	CCLP-2025-SOP	Baseline	2025 spring off-peak load conditions. Off-peak load time - hours ending 13:00.	710	0	504	403	307	27	15
6	CCLP-2022-WP	Baseline	2022 winter peak load conditions. Peak load time - hours ending 19:00.	1,006	9	434	0	997	27	15
7	CCLP-2025-WP	Baseline	2025 winter peak load conditions. Peak load time - hours ending 19:00.	1,054	16	504	0	1,038	27	15
8	CCLP-2030-WP	Baseline	2030 winter peak load conditions. Peak load time - hours ending 19:00.	1,122	28	631	0	1,094	27	15
9	CCLP-2025-SP-HiCEC	Sensitivity	2025 summer peak load conditions with hi-CEC load forecast sensitivity	1,243	0	504	0	1,243	27	15
10	CCLP-2025-SOP-HiRenew	Sensitivity	2025 spring off-peak load conditions with hi renewable dispatch sensitivity	710	0	504	499	211	27	15
11	CCLP-2022-SP-HiRenew	Sensitivity	2022 summer peak load conditions with hi-renewable dispatch sensitivity	1,189	9	434	429	751	27	15
12	CCLP-2030-SP-xRerates	Sensitivity	2030 summer peak load conditions with no rerates	1,324	26	631	0	1,297	27	15

Generation Assumptions - Central Coast/ Los Padres Area

S. No.	Study Case	Scenario Type	Description	Battery Storage (MW)	Solar		Wind		Hydro		Thermal	
					Installed (MW)	Dispatch (MW)	Installed (MW)	Dispatch (MW)	Installed (MW)	Dispatch (MW)	Installed (MW)	Dispatch (MW)
1	CCLP-2022-SP	Baseline	2022 summer peak load conditions. Peak load time - hours between 19:00 and 20:00.	598	841	0	101	44	0	0	2718	1098
2	CCLP-2025-SP	Baseline	2025 summer peak load conditions. Peak load time - hours between 19:00 and 20:00.	598	816	0	101	44	0	0	2718	1143
3	CCLP-2030-SP	Baseline	2030 summer peak load conditions. Peak load time -hours between 19:00 and 20:00.	598	816	0	101	44	0	0	2718	1143
4	CCLP-2022-SOP	Baseline	2022 spring off-peak load conditions. Off-peak load time - hours ending 20:00.	598	841	0	101	56	0	0	2718	274
5	CCLP-2025-SOP	Baseline	2025 spring off-peak load conditions. Off-peak load time - hours ending 13:00.	598	816	773	101	20	0	0	2718	163
6	CCLP-2022-WP	Baseline	2022 winter peak load conditions. Peak load time - hours ending 19:00.	598	841	0	101	13	0	0	2718	1098
7	CCLP-2025-WP	Baseline	2025 winter peak load conditions. Peak load time - hours ending 19:00.	598	816	0	101	13	0	0	2718	1098
8	CCLP-2030-WP	Baseline	2030 winter peak load conditions. Peak load time - hours ending 19:00.	598	816	0	101	13	0	0	2718	1098
9	CCLP-2025-SP-HiCEC	Sensitivity	2025 summer peak load conditions with hi-CEC load forecast sensitivity	598	816	0	101	44	0	0	2718	1143
10	CCLP-2025-SOP-HiRenew	Sensitivity	2025 spring off-peak load conditions with hi renewable dispatch sensitivity	598	816	766	101	65	0	0	2718	451
11	CCLP-2022-SP-HiRenew	Sensitivity	2022 summer peak load conditions with hi-renewable dispatch sensitivity	598	841	681	101	63	0	0	2718	163
12	CCLP-2030-SP-xRerates	Sensitivity	2030 summer peak load conditions with no rerates	598	816	0	101	44	0	0	2718	1143

Previously approved transmission projects modelled in base cases

Project Name	First Year Modeled
Estrella Substation Project	2023
Coburn-Oil Fields 60 kV system project	2022
South of Mesa Upgrade	2023
North of Mesa Upgrade (formerly Midway-Andrew 230 kV Project)	ON HOLD
Salinas-Firestone #1 and #2 60 kV Lines	2024

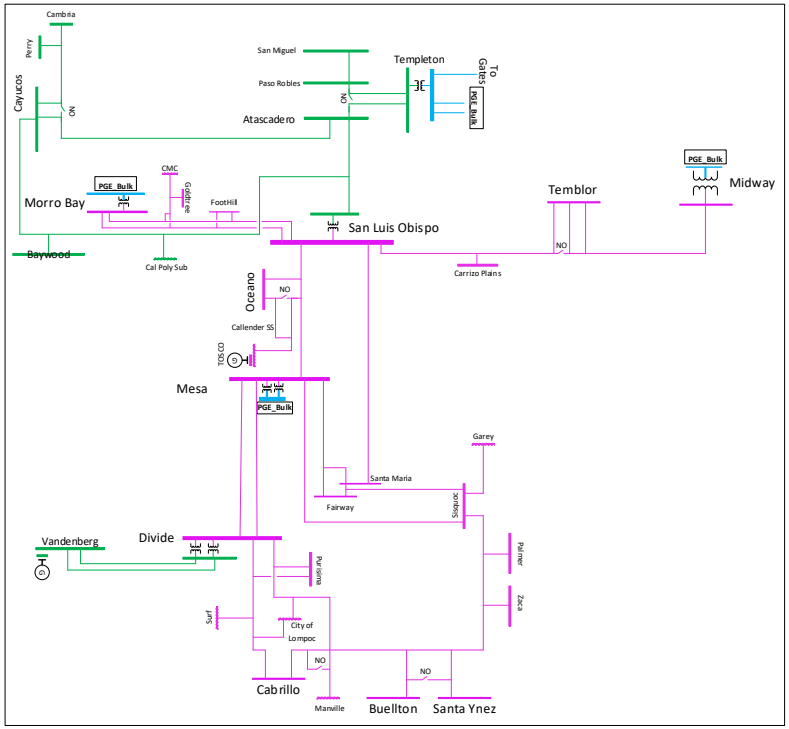
Central Coast/ Los Padres - Results Summary

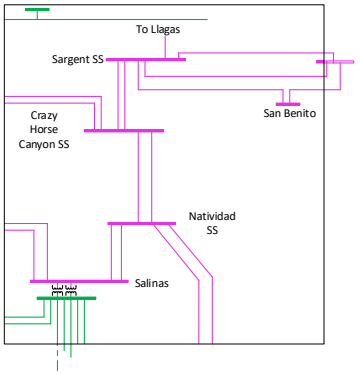
Observations

- New P5-5 Morro Bay overloads
- Known P2, P6, P7 overloads in the greater Mesa area
- Known P2, P6, P7 overloads on Crazy Horse – Salinas #1 and #2 Lines
- Known P1, P2, P6 overloads in Templeton 70kV area

Approved and Potential Mitigations

- Add redundant relay
- North of Mesa upgrades
- RAS Proposed in 2018-2019 Cycle
- Estrella Substation Project





Central Coast/ Los Padres – Low Voltage Results Summary

Observations

- P1,P3,P6,P7 low voltage on Crazy horse – Salinas 115kV
- For the Loss of GREENVALLEY 115/60kV TB 1 seeing large(>8%) Delta V
- P1 for loss of SAN MIGL-UNIONPGAE #1 70kV in 2030 only
- P3, P6 for the loss of Coburn – Oil Fields #1 60kV line

Approved and Potential Mitigations

- Crazy Horse-Salinas 115kV
  - For P1 only in 2025 – Power Factor correction
  - For P3, P6, P6, P7 – RAS previously recommended
- Adjust the Green valley 115/60kV bank Tap Setting
- Continue to Monitor
- Coburn – Oil Fields
  - Status Quo/ Continue to monitor
  - Upgrade currently approved project in the area

Sensitivity-only issues

Below is the list of overloads that get worse or are new overloads in the no-rerate sensitivity

Overloaded Facility	Category
None	

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

Overloaded Facility	Category	2025 High CEC	2022Summer Peak High Renew	2025 Off-Peak High Renew	2030 QF Retirement
None					

Summary of potential new upgrades

Division	Reliability Concern	Potential Upgrade
Los Padres	P5 at Morro Bay	Add Redundant relay

North Coast & North Bay Area
Preliminary Reliability Assessment Results

Bryan Fong
Senior Regional Transmission Engineer

2020-2021 Transmission Planning Process Stakeholder Meeting
September 23-24, 2020

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

Previously approved transmission projects modelled in base cases

Project Name	Expected year of in-service
Fulton-Fitch Mountain 60kV Line Reconductor (Fulton-Hopland 60kv Line) Project	2020
Clear Lake 60kV System Reinforcement	2022
Ignacio Area Upgrade	2024
Napa – Tulucay #2 60kV Line	2023
Lakeville 60kV Area Reinforcement	2022
Vaca-Lakeville 230kV Corridor Series Compensation	2021

Use of past study scope

Past studies from 2019-2020 TPP were used for North Coast North Bay area based on the use of Past Study Methodology presented at June 3, 2020 stakeholder meeting.

- For steady state past study were used for all three years.
  - Additional P2 and P5 contingencies and rerate sensitivity were studied in this cycle.

- For transient analysis no new studies were performed for all three years.

*http://www.caiso.com/Documents/AppendixC-BoardApprovedt2019-2020TransmissionPlan.pdf

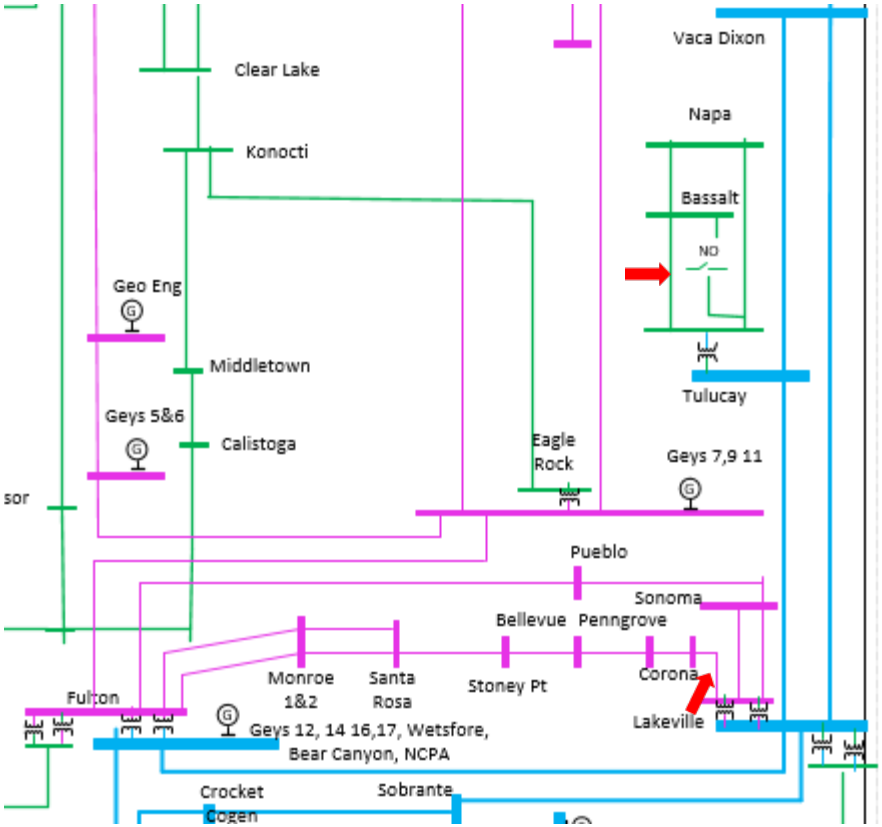
Reliability issues identified in 2019-2020 TPP

Observations
115 kV

- For P0, 8% overload on Tulucay - Napa #2 60 kV (Tulucay 60 kV to Basalt 60 kV) in 2022 SP case
- P2-4 Fulton 115KV Sub - Section 2D & 1D causes overload of Corona – Lakeville 115kV Line in summer peak cases

Approved and Potential Mitigations

- Approved Napa – Tulucay #2 60kV Line Upgrade (2023)
  - Interim operation solution before 2023.
- Fulton 115 SPS recommended in 2017-18 TPP.



Reliability issues identified in 2020-2021 TPP

Observations and Potential Mitigations

- Low voltages identified at North Bay 60 kV (Cotati and Petaluma) Area in the summer peak cases.
  - continue to monitor. (no mitigation needed as the contingency is non-BES)

- Low voltages identified at Ignacio 115 kV (North Tower & Highway) Area in the 2030 summer peak case.
  - continue to monitor. (mitigation is needed for 2030 as the contingency is BES element)

New sensitivity-only issues

Below is the list of overloads that get worse or are new overloads in the no-rerated sensitivity

Overloaded Facility	Category
Tulucay - Napa #2 60 kV (Tulucay 60 kV to Basalt 60 kV)	P-0
Corona-Lakeville 115 kV Line	P2-4, 5-5, 7-1
Sonoma - Pueblo 115 kV	P5-5

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

Overloaded Facility	Category	2025 High CEC	2022Summer Peak High Renew
Fulton-Hopland 60 kV Line	P2-4	√	√
Bellevue-Corona 115 kV Line	P2-4, 5-5, 7-1	√	
Corona-Lakeville 115 kV Line	P2-4, 5-5, 7-1	√	
Sonoma - Pueblo 115 kV	P5-5	√	
Mendocino -Clearlake 60 kV	P2-2, 2-3	√	
Fulton- Molino- Cotati 60 kV	P2-4	√	√
LAKEVILLE #2 60 kV	P2-4, 5-5	√	√

Summary of Potential New Upgrades

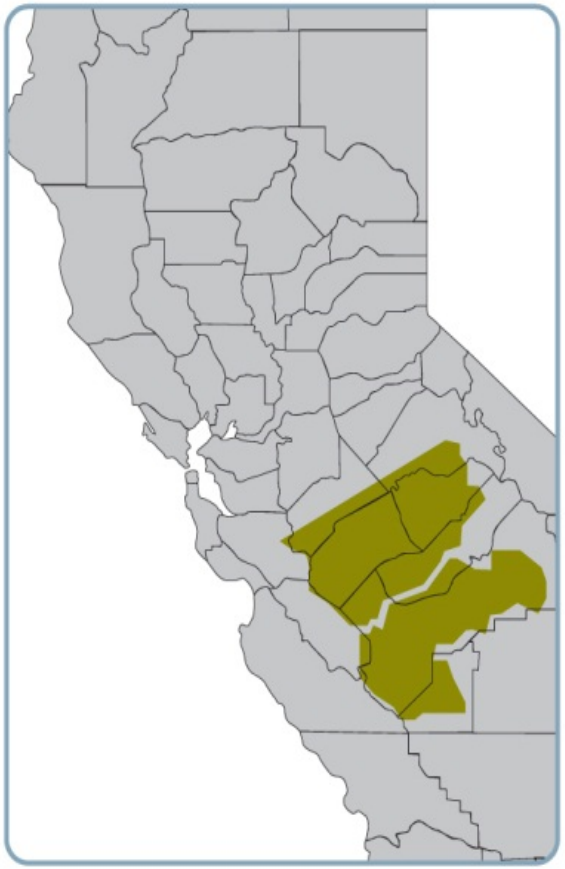
- None

Fresno Area
Preliminary Reliability Assessment Results

Vera Hart
Senior Regional Transmission Engineer

2020-2021 Transmission Planning Process Stakeholder Meeting
September 23-24, 2020

Greater Fresno Area



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

Load and Load Modifier Assumptions - Greater Fresno Area

S. No.	Study Case	Scenario Type	Description	Gross Load (MW)	AAEE (MW)	BTM-PV		Net Load (MW)	Demand Response	
						Installed (MW)	Output (MW)		Total (MW)	D2 (MW)
1	GFA-2022-SP	Baseline	2022 summer peak load conditions. Peak load time - hours ending 19:00.	3,848	33	1,556	0	3,815	51	22
2	GFA-2022-SpOP	Baseline	2022 spring off-peak load conditions. Off-peak load time - hours ending 20:00.	1,349	21	1,686	0	1,328	51	22
3	GFA-2022-SP-HiRenew	Sensitivity	2022 summer peak load conditions with hi-renewable dispatch sensitivity	3,221	27	1,686	1669	1,525	51	22
4	GFA-2025-SP	Baseline	2025 summer peak load conditions. Peak load time - hours ending 19:00.	3,389	44	2,042	0	3,345	51	22
5	GFA-2025-SpOP	Baseline	2025 spring off-peak load conditions. Off-peak load time - hours ending 13:00.	1,038	0	2,042	1633	(595)	51	22
6	GFA-2025-SP-Hi-CEC	Sensitivity	2025 summer peak load conditions with hi-CEC load forecast sensitivity	3,389	0	2,042	0	3,389	51	22
7	GFA-2025-SpOP-HiRenew	Sensitivity	2025 spring off-peak load conditions with hi renewable dispatch sensitivity	1,038	0	2,042	2021	(983)	51	22
8	GFA-2030-SP	Baseline	2030 summer peak load conditions. Peak load time - hours ending 19:00.	3,606	78	2,782	0	3,528	51	22
9	GFA-2030-SP-xReRates	Sensitivity	2030 summer peak load conditions with no rerate	3,606	78	2,782	0	3,528	51	22

Generation Assumptions - Greater Fresno Area

S. No.	Study Case	Scenario Type	Description	Battery Storage (MW)	Solar		Wind		Hydro		Thermal	
					Installed (MW)	Dispatch (MW)	Installed (MW)	Dispatch (MW)	Installed (MW)	Dispatch (MW)	Installed (MW)	Dispatch (MW)
1	GFA-2022-SP	Baseline	2022 summer peak load conditions. Peak load time - hours ending 19:00.	313	2980	30	13	7	1880	1799	1,386	1,170
2	GFA-2022-SpOP	Baseline	2022 spring off-peak load conditions. Off-peak load time - hours ending 20:00.	313	2980	0	13	7	1880	-344	1,386	567
3	GFA-2022-SP-HiRenew	Sensitivity	2022 summer peak load conditions with hi-renewable dispatch sensitivity	313	2980	2726	13	8	1880	1234	1,386	136
4	GFA-2025-SP	Baseline	2025 summer peak load conditions. Peak load time - hours ending 19:00.	313	2980	30	13	7	1880	1735	1,386	1,139
5	GFA-2025-SpOP	Baseline	2025 spring off-peak load conditions. Off-peak load time - hours ending 13:00.	313	2980	2173	13	3	1880	-397	1,386	390
6	GFA-2025-SP-Hi-CEC	Sensitivity	2025 summer peak load conditions with hi-CEC load forecast sensitivity	313	2980	30	13	7	1880	1672	1,386	1,104
7	GFA-2025-SpOP-HiRenew	Sensitivity	2025 spring off-peak load conditions with hi renewable dispatch sensitivity	313	2980	1721	13	9	1880	-401	1,386	117
8	GFA-2030-SP	Baseline	2030 summer peak load conditions. Peak load time - hours ending 19:00.	313	2980	27	13	7	1880	1772	1,386	1,174
9	GFA-2030-SP-xReRates	Sensitivity	2030 summer peak load conditions with no rerate	313	2980	30	13	7	1880	1788	1,386	1,193

Previously approved transmission projects modelled in base cases

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

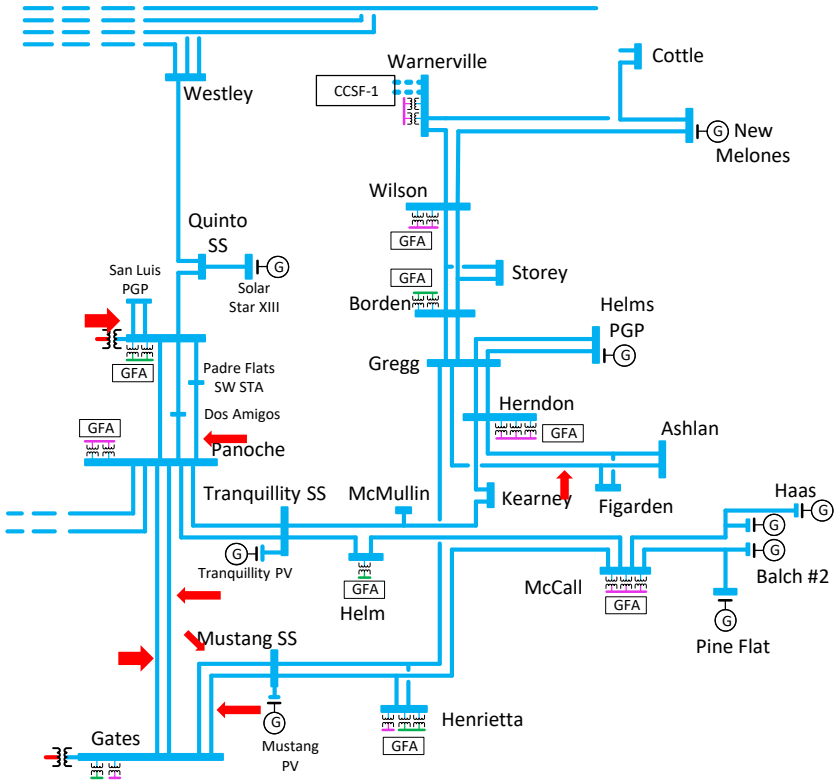
Fresno Area – 230kV Results Summary

Observations

1. P5.5(failure of non redundant Protection) on Gates 230kV bus overloading Mosslanding-Las Aguillas, Los Banos-Panoche, Los Banos Dos Amigos 230kV lines in the 2025 Spring off-peak case
2. P3 and P6 on the Gates-Mustang #1 and #2 230kV Lines in the 2025 Spring off-peak case
3. P6 overloads on the Gregg-Ashland 230kV line in 2025 Spring-off peak
4. P6 overloads on the Los Banos-San Luis PGP #1 & #2 230 kV Lines in 2030 Peak
5. P6 overloads on the Panoche-Gates # 1 and #2 230 kV Lines and Gates-Arco, Gates-Midway 230kV Lines in 2022 spring off peak

Potential Mitigations

1. Protection Upgrade at Gates 230kV
2. Reduce Solar gen at Mustang
3. Generation re-dispatch
4. Continue to monitor future load forecast
5. Generation re-dispatch



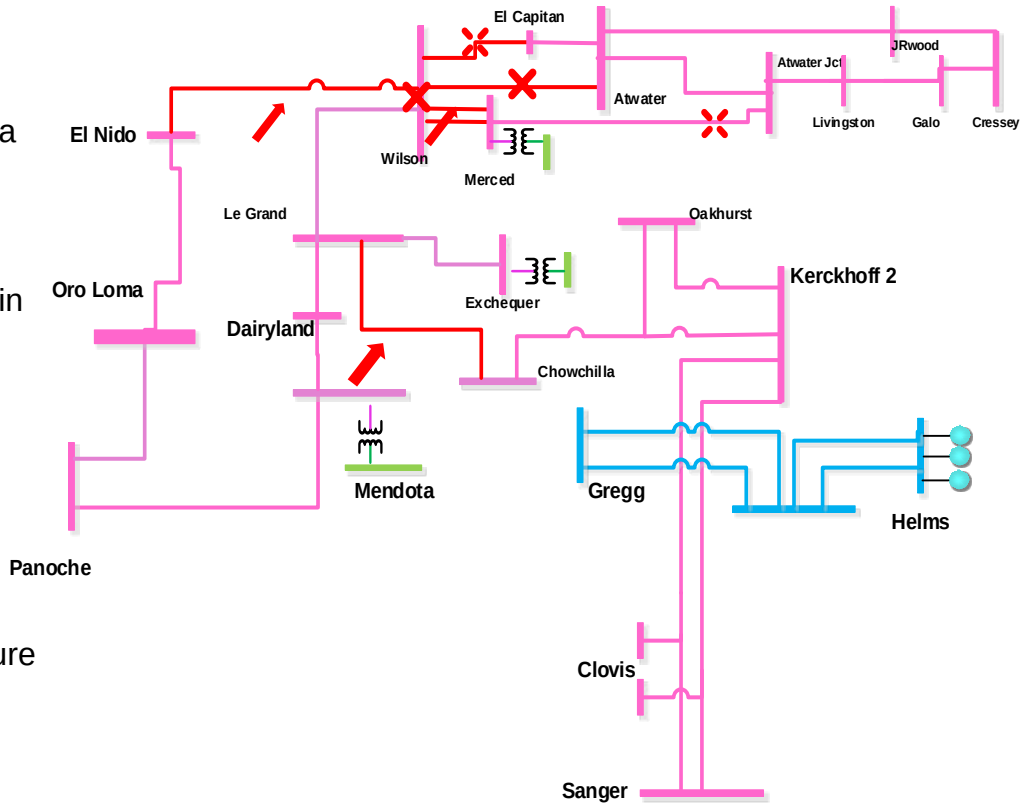
Wilson 115kV Area– Results Summary

Observations

1. P6 Overloads observed in the Wilson/Atwater 115kV Area for all peak years
2. P2, P5.5,P6 Overloads in the Wilson 115kV Area in year 2022
3. P2, P2-1 overloads on the Wilson-Oro Loma 115kV line in near term years.
4. Chowchilla-Legrand 115kV line overload for P2 in Off-peak cases
5. 115kV overloads near Panoche for P6 contingencies in the later years

Potential Mitigations

1. Expand Atwater SPS
   - To drop load post first contingency
   - Switching post first contingency
2. Wilson 115kV Reinforcement Project solves future years
3. Wilson-Oro Loma 115kV line Reconductoring Project
4. Redispatch Generation
5. Monitor future forecast



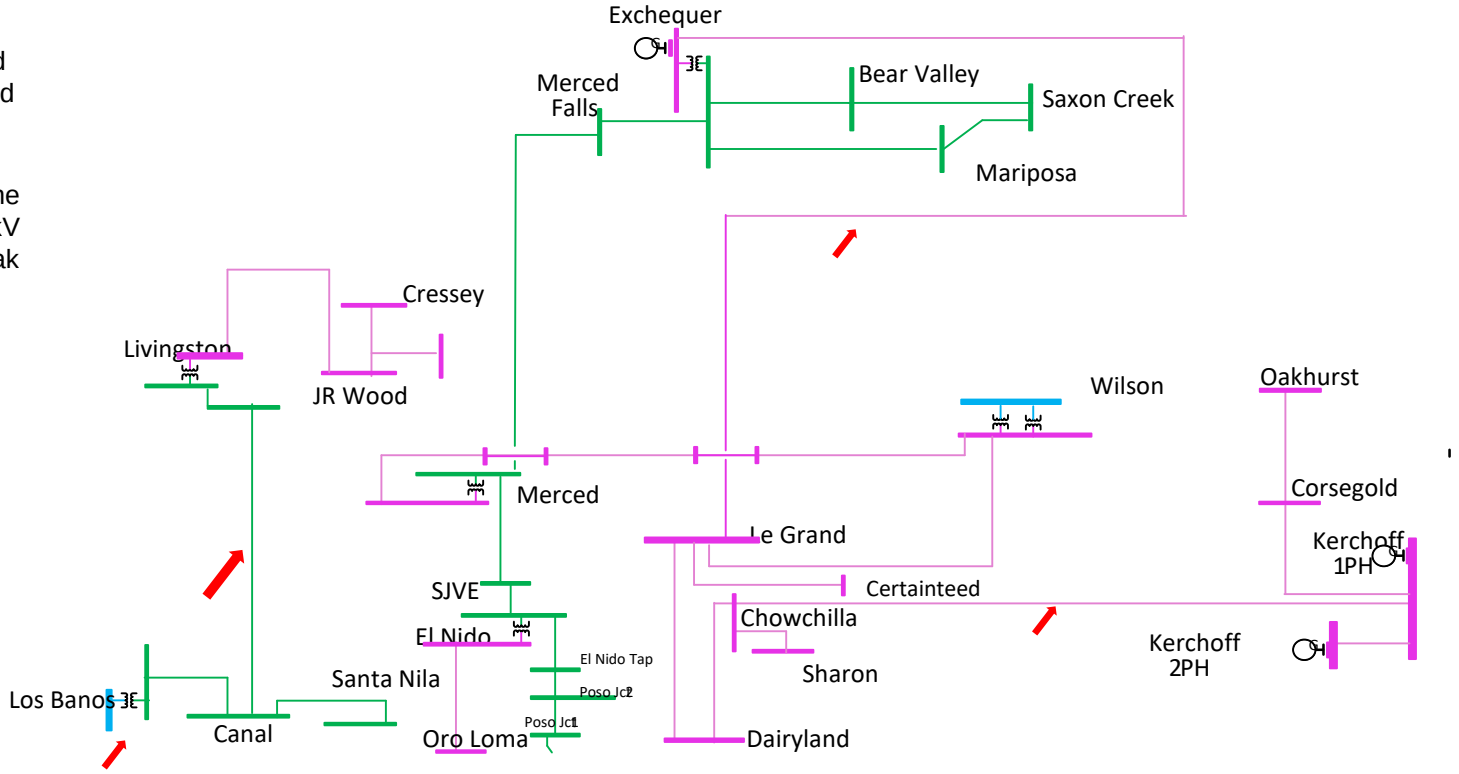
Yosemite115/70kV Area– Results Summary

Observations

1. P1-P7 Overloads observed on the Exchequer-Le Grand 115kV for peak years and 2025 Spring off-peak
2. P6 and P7 Overloads on the Chowchilla-Kerchkoff 115kV Line in 2025 Spring off-peak
3. Overload on Los Banos 230/70kV TB and Los Banos 70kV area in 2030

Potential Mitigations

1. Exchequer SPS to trip Exchequer gen
2. Generation Re-dispatch
3. Continue to monitor future forecast



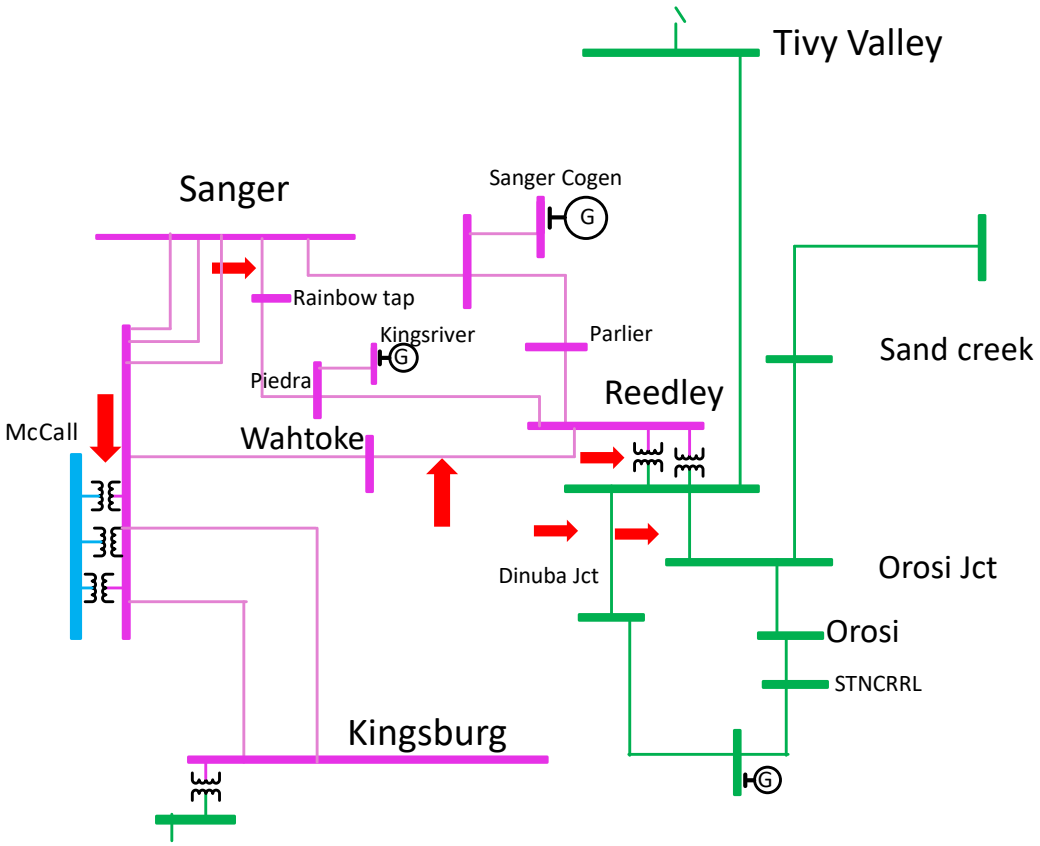
Fresno Area –Reedley Area Results Summary

Observations

1. Multiple 70kV overloads in the Reedley/Dinuba area for P1, P2, P3, P6 contingencies in all peak years
2. P1-P6 overloads on the Reedley 115/70kV TB #2 in peak years
3. Overloads and Low voltages in the Reedley 115kV area due to Wahtoke Load not being dropped for P6 Contingencies in peak years
4. P6 Overloads on the McCall 230/115kV TBs in the long term years

Approved and Potential Mitigations

1. Dinuba BESS project mitigates near term issues.
   - Current Dinuba Battery is not sufficient for 2025 and 2030 P1-P7 overloads. Project is under review
2. Reedley TB #2 replacement Maintenance project
3. SPS to drop load at Wahtoke
4. Continue to monitor future load forecast



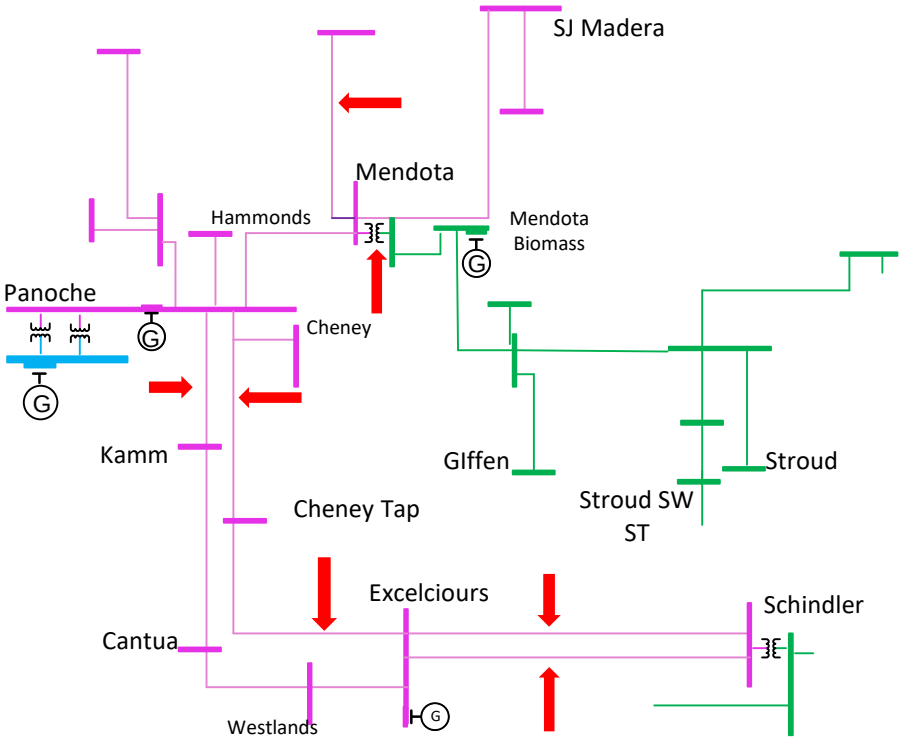
Fresno Area – Panoche Area Results Summary

Observations

1. Panoche-Schindler 115kV corridor overloads for P6 contingencies in all peak years and 2025 Spring off-peak
2. P6 Overloads on Oro Loma-Mendota 115kV line and Mendota 115/70kV TB in 2025 Spring off-peak case

Approved and Potential Mitigations

1. Under Review for system reconfiguration post first contingency
2. Gen redispatch



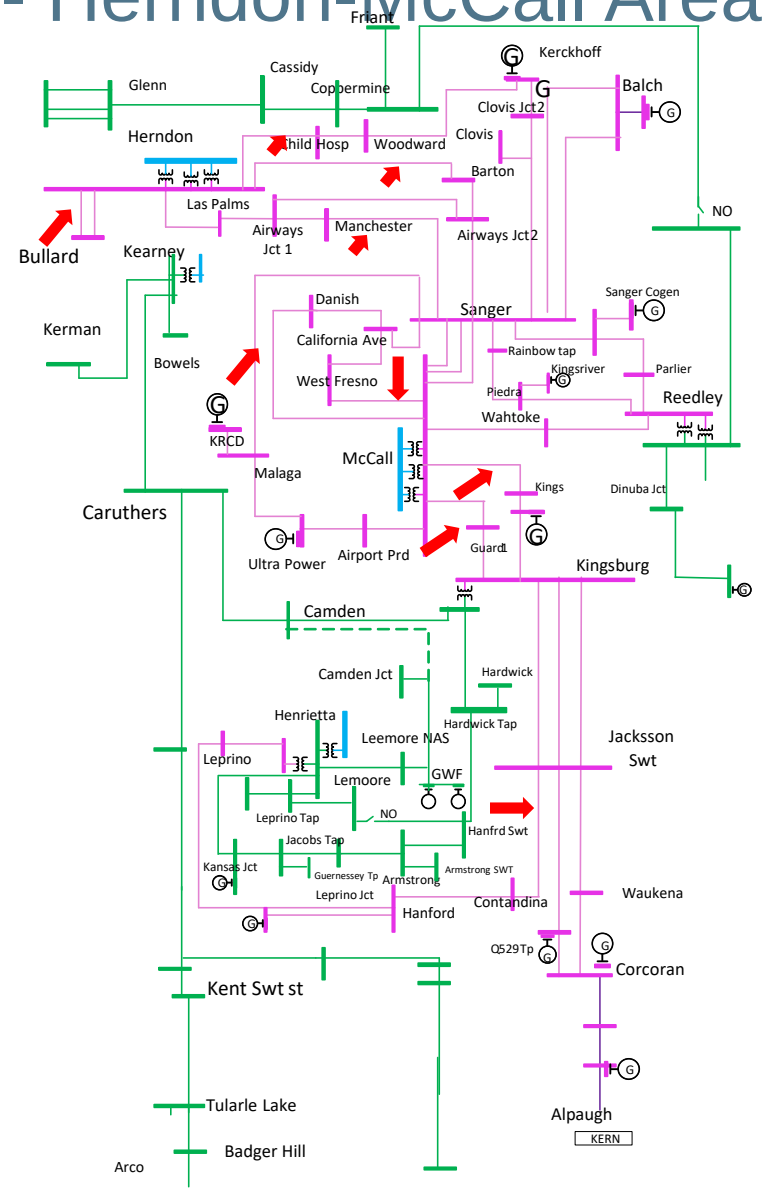
Fresno Area – Results- Herndon-McCall Area

<u>Observations</u>

1. P6 and P7 overloads on the McCall-California Ave115kV Line, McCall-West Fresno 115kV Line in 2030
2. P6 overloads on the McCall-Kingsburg #1 & #2 115kV lines in 2025 and 2030
3. P6 Overload on Herndon-Bullard 115kV line in 2030
4. P2 and P6 Overloads on the Herndon-Barton, Herndon-Woodward, Herndon-Manchester, Manchester-Airways-Sanger 115kV lines in the 2025 Spring-off-peak case

<u>Potential Mitigations</u>

1. Continue to monitor future load forecast
2. Continue to monitor future load forecast
3. Continue to monitor future load forecast
4. Generation re-dispatch



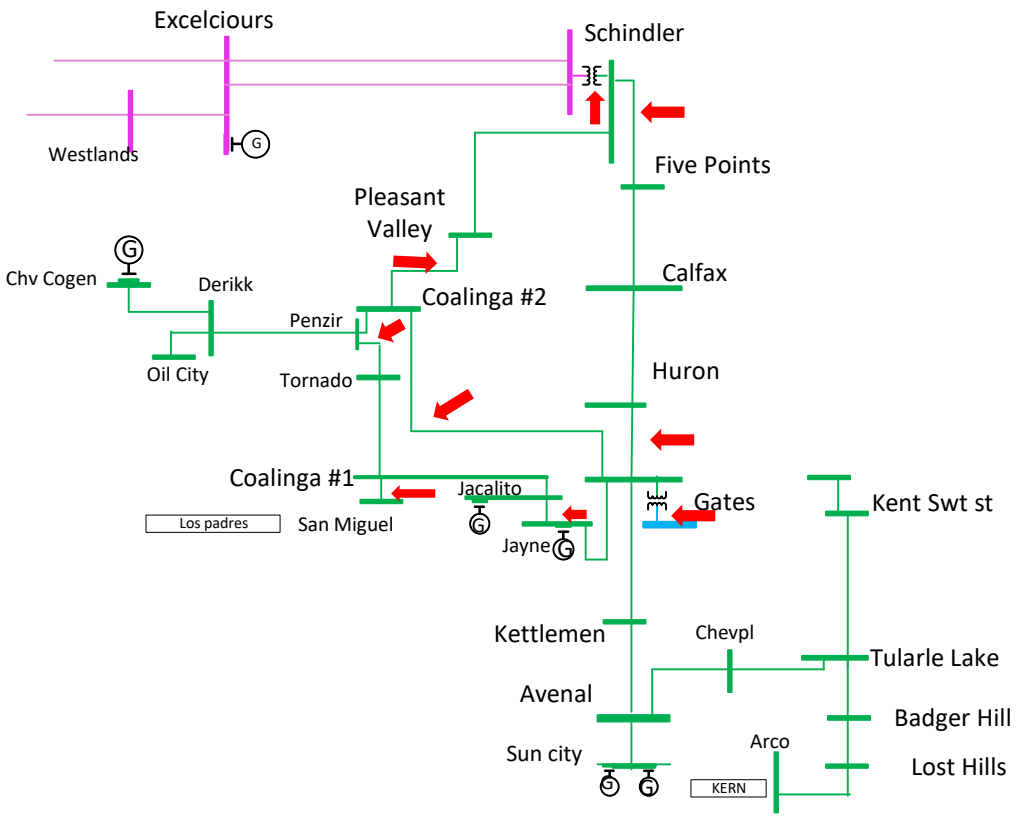
Fresno Area – Results- Coalinga Area

Observations

1. P1,P3 overloads on the Five Points-Huron-Gates 70 kV Line in 2030 and 2025 Spring off-peak
2. P6 overloads in the Coalinga 70kV Pocket in All peak years
3. P5.5(failure of non redundant Protection) on Gates 230kV bus overloading Schindler TB115/70kV,Schindler-Coalinga 70kV,Schindler-Five Points 70kV lines in peak years
4. Gates 230/70kV Tb #5 Overload for P6 in 2025 Spring-off-peak case

Potential Mitigations

1. Continue to monitor future load forecast
2. System Reconfiguration under review
3. Protection Upgrade at Gates 230kV
4. Generation redispatch



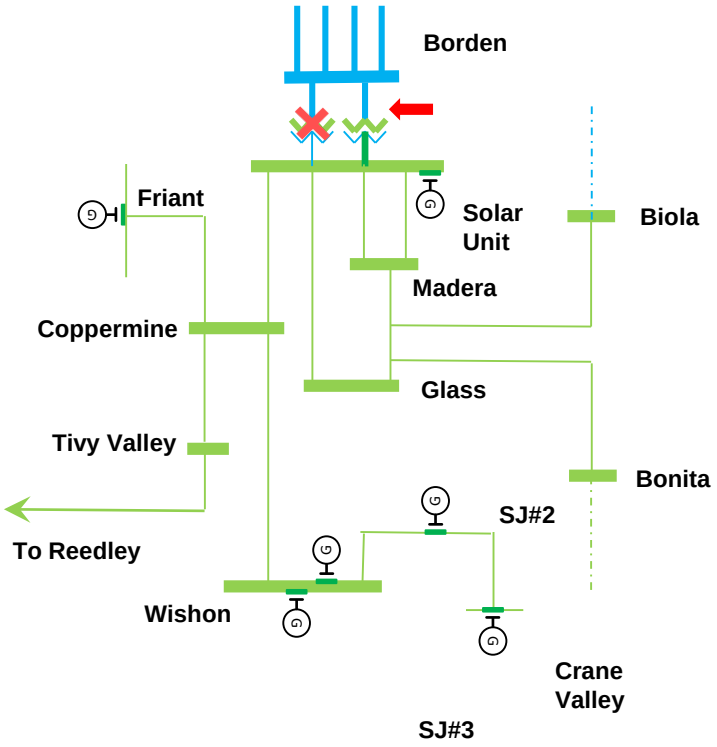
Fresno Area – Results- Borden Area

Observations

1. P3 and P6 overloads on the Borden 230/70kV TB #1 in the Summer peak 2022

Approved/Potential Mitigations

1. Borden Capacity increase project resolves future years



Fresno– Low Voltage Results Summary

Observations

- Yosemite 70kV Area low voltage issues observed for P0
- P1 Low voltages in Oro Loma in 2025 and 2030 peak years
- P2,P3,P6 Low voltages in Oro Loma 115kV and 70kV in All peak years
- Summer set up related low voltage issues in non-summer peak scenario
- Multiple Low Voltage seen in the Coalinga 70kV area in peak 2025 and 2030.
- P1,P2,P6 Low voltages in the Reedley 70kV pocket in peak 2025 and 2030

Approved and Potential Mitigations

- Under Review
- Monitor future forecast
- Short term Action plan summer setup, long term solution under review
- Potential need for Summer Setup at Oro Loma
- Continue to monitor future forecast
- Continue to monitor future forecast

Sensitivity-only issues

Below is the list of overloads that get worse or are new overloads in the no-rerate sensitivity

Overloaded Facility	Category
Wilson-Merced #1 and #2 115 kV Line	P3, P7
Kingsriver-Sanger-Reedley 115 kV Line (Sanger-Rainbow Tap)	P3

Sensitivity-only issues

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

Overloaded Facility	Category	2025 High CEC	2022Summer Peak High Renew	2025 Off-Peak High Renew
Bellota-Warnerville 230 kV Line	P7		√	
Warnerville - Wilson 230 kV Line	P2		√	
Helms-Gregg #1& #2 230kV lines	P3,P6	√		
Balch-McCall 230 kV Line (Balch-Pine Flats)	P6	√		
Gates-Gregg 230 kV Line (Henrietta Tap 1-Henrietta)	P6			√
Mustang-Gregg 230kV line	P6,P7			√
Mustang-McCall 230kV line	P1-P7			√
Wilson-Merced #2 115 kV Line	P1,P2,P6,P7	√		√
Dairyland-Le Grand 115 kV Line (Newhall-Dairyland)	P6			√
Chowchilla-Dairyland 115kv Line	P6			√
Oro Loma-Mendota 70 kV Line (Oro Loma-Poso Jct 1)	P1,P2	√		
Borden-Coppermine 70 kV Line	P2,P5			√
Oro Loma-Mendota 70 kV Line	P6			√

Sensitivity-only issues continues

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

Overloaded Facility	Category	2025 High CEC	2022Summer Peak High Renew	2025 Off-Peak High Renew
Mendota 115/70 kV Transformer Bank 1	P6			√
Mendota-San Juaquin-Helm 70kV Line	P1,P2,P3			√
Barton-Airways-Sanger 115 kV Line	P6			√
Kingsburg-Corcoran #2 115 kV Line	P6			√
Henrietta 230/115 kV Transformer Bank 3	P1,P2,P3,P7			√
Henrietta-GWF 115 kV Line	P1,P2,P3,P7			√
Kingsburg-Corcoran #1 115 kV Line	P6		√	
GWF-Kingsburg 115kV Line	P6			√
Mendota-San Joaquin-Helm 70 kV Line	P1,P2,P3			√
Helm-Kerman 70 kV Line	P6			√
Five Points-Huron-Gates 70 kV Line				

Summary of potential new upgrades

Division/Area	Reliability Concern	Potential Upgrade
Gates 230kV	P5.5	Install redundant Protection at Gates 230kV Bus
Wilson 115kV	P6	Expand Atwater SPS
Reedley 115kV	P6	SPS to drop Wahtoke load

Greater Bay Area
Preliminary Reliability Assessment Results

Abhishek Singh
Regional Transmission Engineer Lead

2020-21 Transmission Planning Process Stakeholder Meeting
September 23-24, 2020

Greater Bay Area

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

Load and Load Modifier Assumptions - Greater Bay Area

S. No.	Study Case	Scenario Type	Description	Gross Load (MW)	AAEE (MW)	BTM-PV		Net Load (MW)	Demand	
						Installed (MW)	Output (MW)		Total (MW)	D2 (MW)
1	2022-SP	Baseline	2022 summer peak load conditions. Peak load time - hours ending 18:00.	8,825	66	1,781	257	8,502	182	95
2	2022-WP	Baseline	2022 winter peak load conditions. Peak load time - hours ending 19:00.	7,246	67	1,781	0	7,179	182	95
3	2022-SpOP	Baseline	2022 spring off-peak load conditions. Off-peak load time - hours ending 20:00.	7,100	53	1,781	0	7,047	182	95
4	2022-SP-HiRenew	Sensitivity	2022 summer peak load conditions with hi-renewable dispatch sensitivity	8,825	66	1,781	1763	6,996	182	95
5	2025-SP	Baseline	2025 summer peak load conditions. Peak load time - hours ending 18:00.	9,071	102	2,289	229	8,740	182	95
6	2025-WP	Baseline	2025 winter peak load conditions. Peak load time - hours ending 19:00.	7,450	117	2,289	0	7,333	182	95
7	2025-SpOP	Baseline	2025 spring off-peak load conditions. Off-peak load time - hours ending 13:00.	5,531	0	2,289	1831	3,700	182	95
8	2025-SP-Hi-CEC	Sensitivity	2025 summer peak load conditions with hi-CEC load forecast sensitivity	9,071	0	2,289	229	8,842	182	95
9	2025-SpOP-HiRenew	Sensitivity	2025 spring off-peak load conditions with hi renewable dispatch sensitivity	5,531	0	2,289	2266	3,265	182	95
10	2030-SP	Baseline	2030 summer peak load conditions. Peak load time - hours ending 19:00.	9,347	173	2,955	0	9,174	182	95
11	2030-WP	Baseline	2030 winter peak load conditions. Peak load time - hours ending 19:00.	7,659	203	2,955	0	7,456	182	95
12	2030-SP-Non-Rerate	Sensitivity	2030 summer peak load conditions. Peak load time - hours ending 19:00.	9,347	173	2,995	0	9,174	182	95
13	2030-SVP	Sensitivity	2030 summer peak load conditions with high SVP load sensitivity	9,347	173	2,955	0	9,174	182	95

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

Generation Assumptions - Greater Bay Area

S. No.	Study Case	Scenario Type	Description	Battery Storage (MW)	Solar		Wind		Hydro		Thermal	
					Installed (MW)	Dispatch (MW)	Installed (MW)	Dispatch (MW)	Installed (MW)	Dispatch (MW)	Installed (MW)	Dispatch (MW)
1	2022-SP	Baseline	2022 summer peak load conditions. Peak load time - hours ending 18:00.	80	25	2	264	124	0	0	7321	5491
2	2022-WP	Baseline	2022 winter peak load conditions. Peak load time - hours ending 19:00.	80	25	0	264	28	0	0	7321	4799
3	2022-SpOP	Baseline	2022 spring off-peak load conditions. Off-peak load time - hours ending 20:00.	80	25	0	264	120	0	0	7321	1176
4	2022-SP-HiRenew	Sensitivity	2022 summer peak load conditions with hi-renewable dispatch sensitivity	80	25	24	264	135	0	0	7321	929
5	2025-SP	Baseline	2025 summer peak load conditions. Peak load time - hours ending 18:00.	116	25	2	264	118	0	0	7321	5419
6	2025-WP	Baseline	2025 winter peak load conditions. Peak load time - hours ending 19:00.	116	25	0	264	28	0	0	7321	4591
7	2025-SpOP	Baseline	2025 spring off-peak load conditions. Off-peak load time - hours ending 13:00.	116	25	23	264	44	0	0	7321	1233
8	2025-SP-Hi-CEC	Sensitivity	2025 summer peak load conditions with hi-CEC load forecast sensitivity	116	25	2	264	90	0	0	7321	5492
9	2025-SpOP-HiRenew	Sensitivity	2025 spring off-peak load conditions with hi renewable dispatch sensitivity	116	25	22	264	137	0	0	7321	1178
10	2030-SP	Baseline	2030 summer peak load conditions. Peak load time - hours ending 19:00.	116	25	2	264	97	0	0	7321	5054
11	2030-WP	Baseline	2030 winter peak load conditions. Peak load time - hours ending 19:00.	116	25	0	264	28	0	0	7321	5265
12	2030-SP-Non-Rerate	Sensitivity	2030 summer peak load conditions. Peak load time - hours ending 19:00.	116	25	2	264	98	0	0	7321	5053
13	2030-SVP	Sensitivity	2030 summer peak load conditions with high SVP load sensitivity	116	25	2	264	79	0	0	7321	5076

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

Previously approved transmission projects modelled in base cases

Project Name	Division	First Year Modeled
East Shore-Oakland J 115 kV Reconductoring Project	East Bay	2025
North Tower 115 kV Looping Project	East Bay	2022
Oakland Clean Energy Initiative Project	East Bay	2025
Christie-Sobrante 115 kV Line Reconductor	East Bay	2025
Moraga-Sobrante 115 kV Line Reconductor	East Bay	On Hold(TPP19-20)
Pittsburg 230/115 kV Transformer Capacity Increase	Diablo	2022
Martin 230 kV Bus Extension	San Francisco	2025
South of San Mateo Capacity Increase (revised scope)	Peninsula	2030
Ravenswood – Cooley Landing 115 kV Line Reconductor	Peninsula	2022
Cooley Landing-Palo Alto and Ravenswood-Cooley Landing 115 kV Rerate	Peninsula	2022
Jefferson 230 kV Bus Upgrade	Peninsula	2025
Ravenswood 230/115 kV Transformer #1 Limiting Facility Upgrade	Peninsula	2022
Moraga-Castro Valley 230 kV Line Capacity Increase Project	Mission	2022
Monta Vista 230 kV Bus Upgrade	De Anza	2022
Los Esteros 230 kV Substation Shunt Reactor	San Jose	2022
Newark-Milipitas #1 115 kV Line Upgrade	San Jose	2022
Trimble-San Jose B 115 kV Line Upgrade	San Jose	2022
San Jose-Trimble 115 kV Series Reactor	San Jose	2022
Morgan Hill Area Reinforcement (revised scope)	San Jose	2025
Metcalf-Piercy & Swift and Newark-Dixon Landing 115 kV Upgrade	San Jose	2025

Reliability assessment preliminary results summary

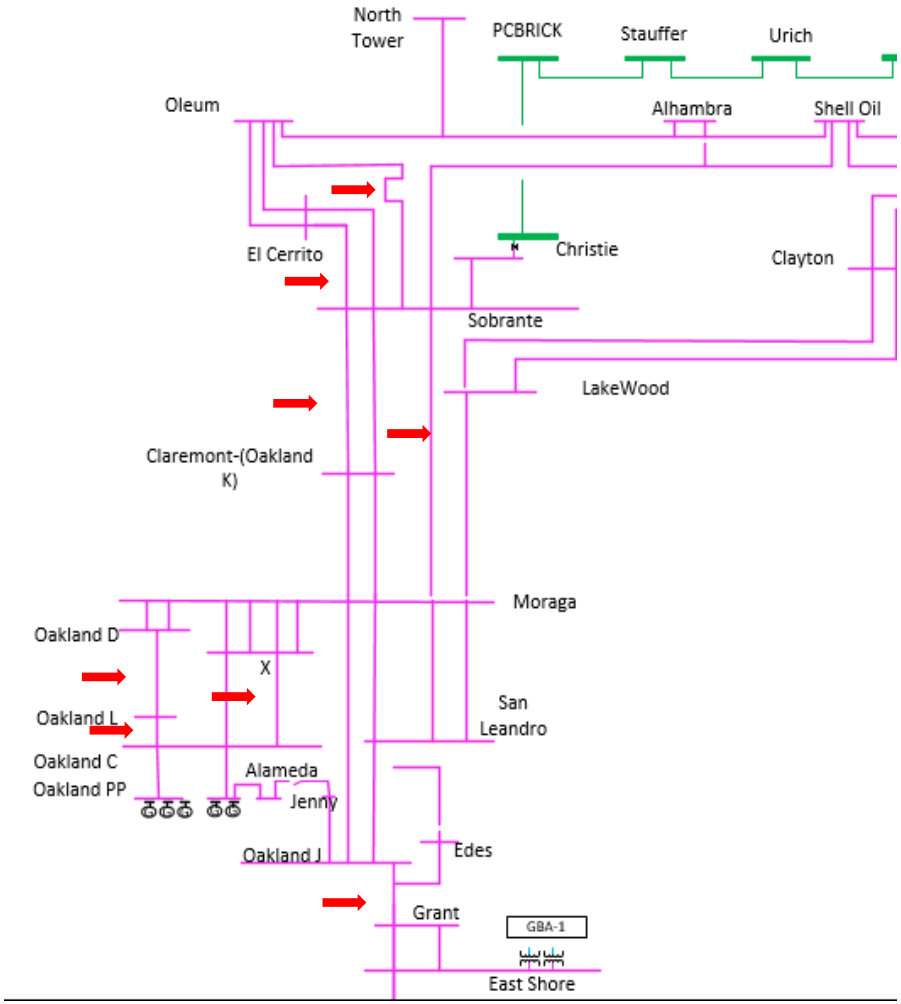
East Bay Division – Results Summary

Observations

- Northern Oakland Issues
  - P2,P6 contingency driven Oakland C-L 115 kV overloads seen in short and long term Summer and Winter Peak scenarios
  - P2,P6 driven overloads on C-X #2(Long term Summer and Winter 2025 & 30)
  - P2,P6 driven overloads on D-L cables overload(Long term Summer and Winter 2025 & 30)
- Grant-Oakland J –Moraga 115 kV OL seen in 2025 and 30 for a Moraga 115 kV P2 contingency and P6 respectively
- Multiple P2 driven Overloads in Sobrante 115 kV area

Approved and Potential Mitigations

- North Oakland Overloads will get mitigated by OCEI project. Long term winter peak overloads under review
- Southern Oakland Overloads get mitigated by East shore-Oakland J and SPS in the long term. P2 issue is under review for potential modeling issue
- Sobrante area overloads are P2 driven and under review for modeling issues



Diablo Division – Results Summary

Observations

230 kV Issues

- P2 Overloads in Contra Costa area 230 kV lines some starting year 2 and some only in sensitivity cases.
- P2 Overloads on Moraga bank seen only in the 10 year cases

Pittsburg 115 kV system overloads

- Multiple overloads identified in Pittsburg 115 kV system some starting year 2.

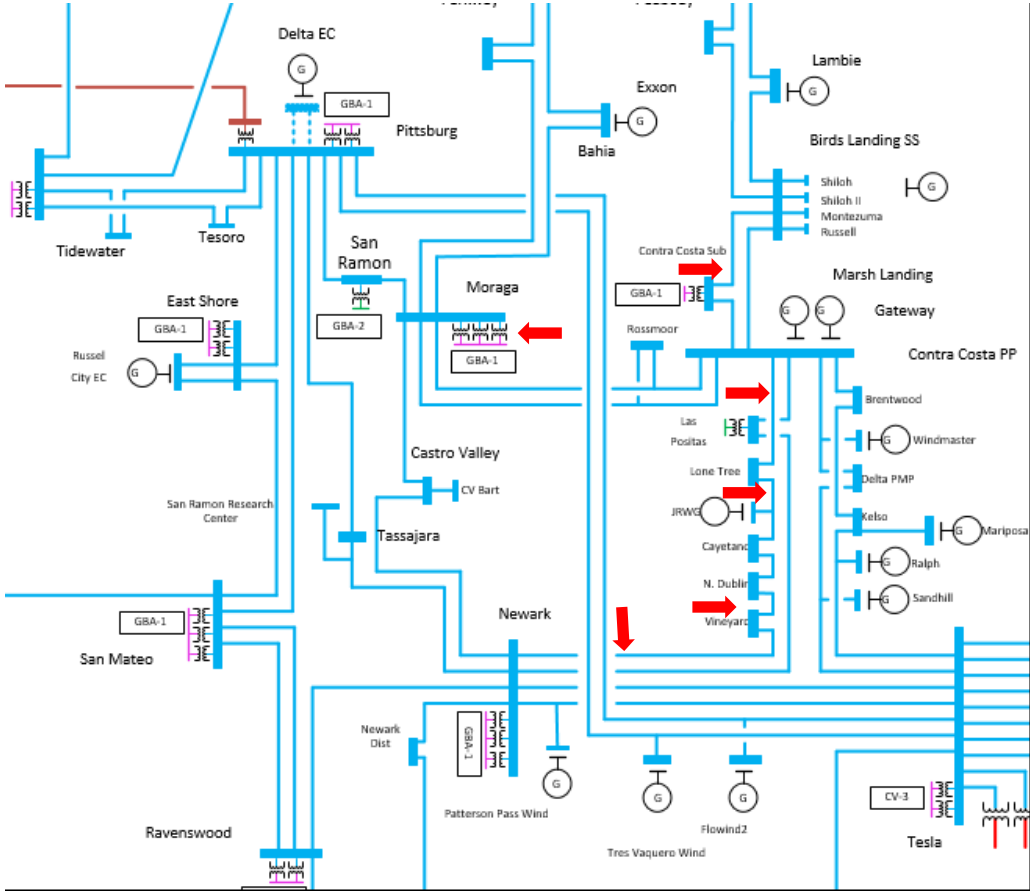
Approved and Potential Mitigations

230 kV

- Short term: Operating solutions including generation redispatch. Monitor sensitivity & long term only overloads
- Long term: Potential Contra Costa 230 kV bus upgrade

115 kV

- Modeling Issues that can be mitigated by existing RAS in the area



San Francisco Division – Results Summary

Observations

- No overloads observed.

Potential Mitigations

- No new upgrade expected.

Peninsula Division – Results Summary

Observations

115 kV

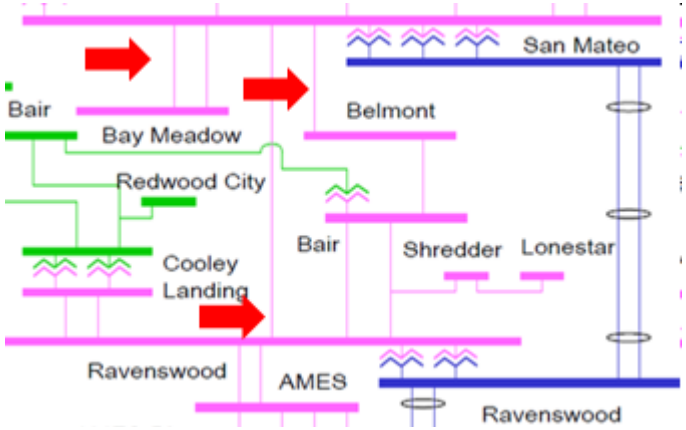
- Short term P2,P5 & Sensitivity P6 Overloads on Ravenswood-Cooley Landing and San Mateo-Belmont 115 kV lines

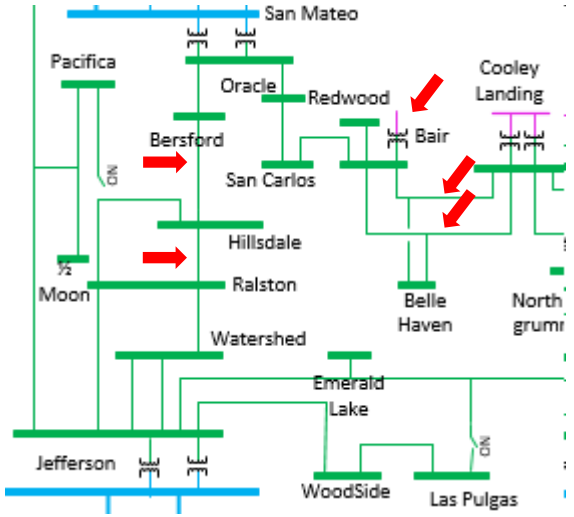
60 kV

- Short term P5,P6 &P7 Overloads Multiple 60 kV lines and 115/60 kV Transformers

Potential Mitigations

- Rely on operating solutions for P6 overloads.
- Short term operating solution for P7 overloads, Jefferson bus upgrade mitigates long term issues.
- Potential Protection/Bus upgrades for P2,P5 issues at Ravenswood and Jefferson 115 substations





Mission Division – Results Summary

Observations

230 kV

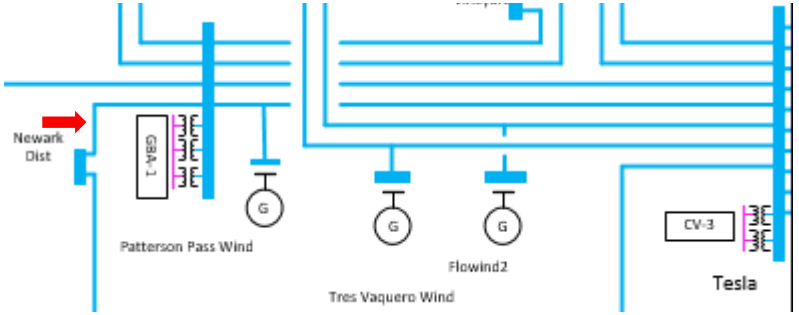
- Tesla-Newark 230 kV line overloads in Rerate sensitivity case only.

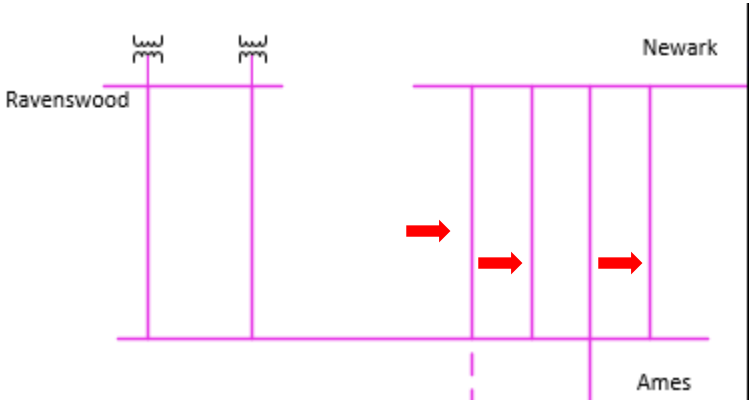
115 kV

- Newark-Ames 115 kV lines overload in Rerate sensitivity case only.

Potential Mitigations

- Monitor overloads as only in the rerate sensitivity case





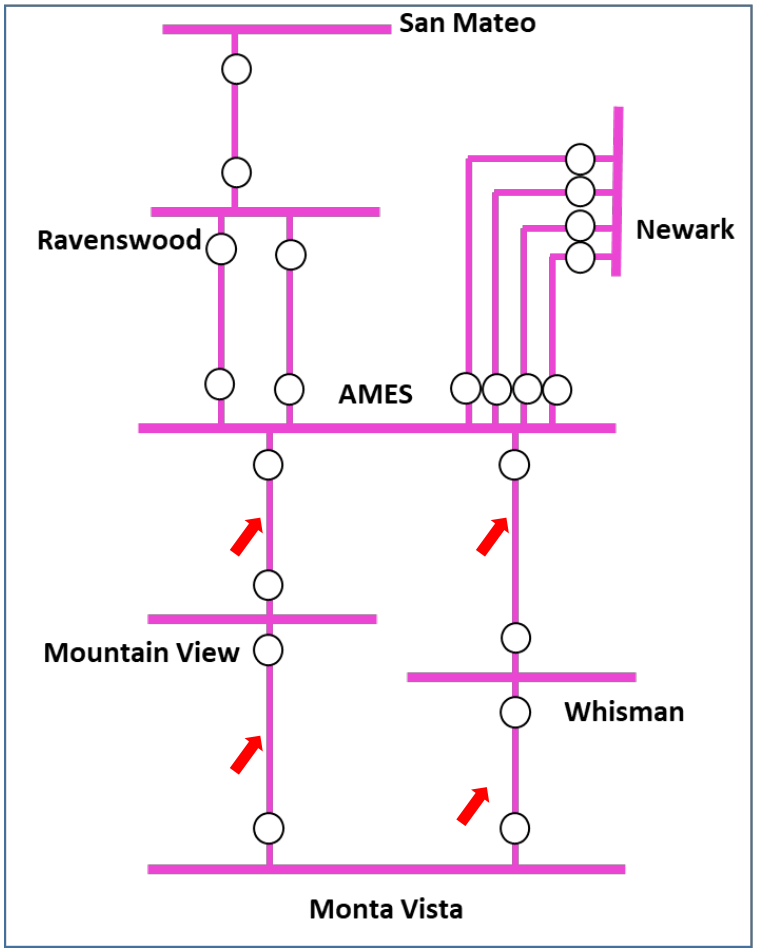
De Anza Division – Results Summary

Observations

- Short term: Ames-Mountain View-Whisman 115 kV line overload for P2/P5 contingency at Monta Vista 115 kV.
- Long-term P1 overload on Monta Vista-Wolfe 115 kV Line.
- Long-term P6/P7 overloads on Mountain View-Monta Vista and Newark-Lawrence 115kV lines.

Potential Mitigations

- P2 issues mitigated by approved Monta Vista Bus upgrade project.
- Potential modeling issue with the P5 contingency driven overloads.
- Continue to monitor future load forecast for P6/P7 driven long-term overloads.



San Jose Division – Results Summary

Observations

230 kV

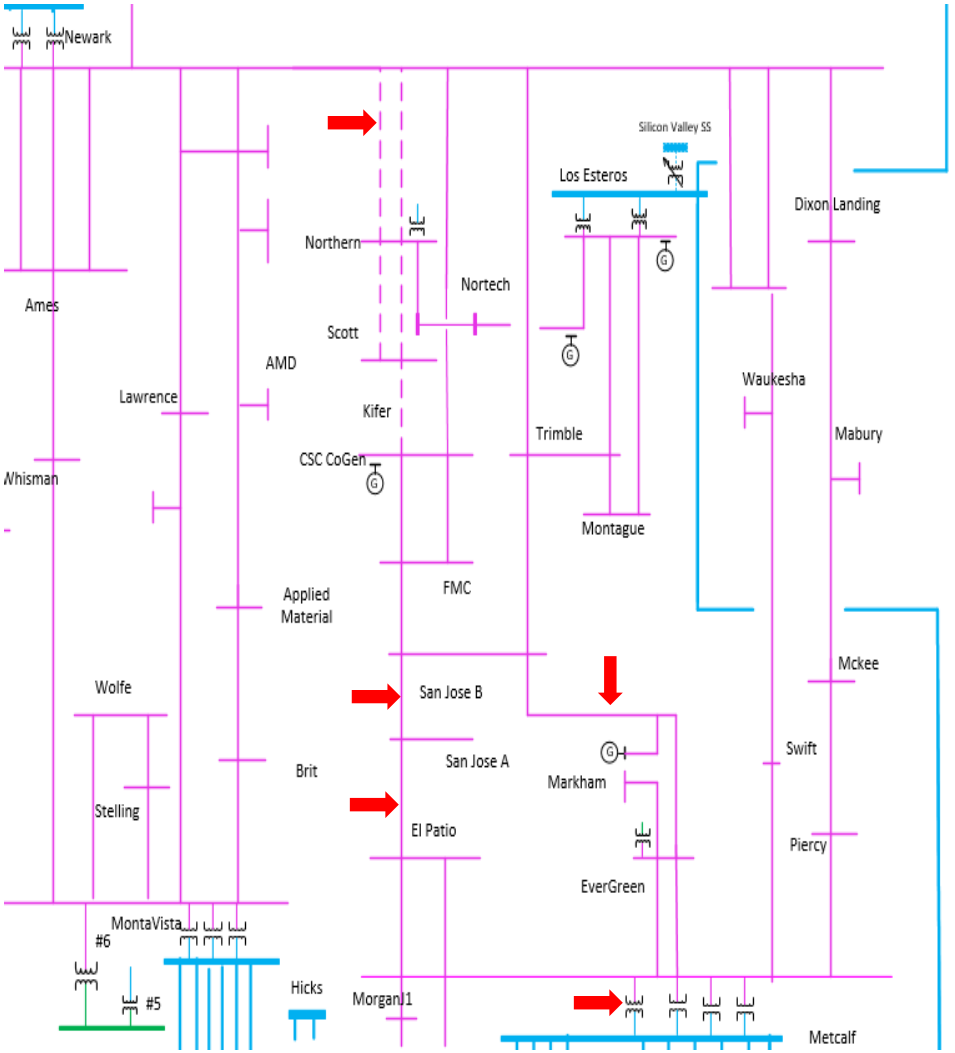
- Short term: Overloads identified on the Metcalf 230/115 kV banks for P2 contingencies at Metcalf 230 kV starting in year 2.
- P5 Los Esteros-Silicon Sw Station 230 kV
- 115kV
- Long Term: Overloads identified on the El Patio-San Jose Sta. 'A', San Jose 'B'-Stone-Evergreen, San Jose Sta 'A'-'B' and Newark-Northern Receiving Station #1 115 kV lines for P2, P5 and P7 contingencies starting in year 10.

60 kV

- Short Term: Overloads identified on the Evergreen-Almaden 60 kV line for P1 contingency starting in year 2.

Potential Mitigations

- Disable automatic load transfer for 60 kV, Operating solution and Potential Metcalf 230 kV bus upgrade for short term overloads
- Monitor Long term overloads.



Greater Bay Area – Low Voltage Results Summary

- East Bay
  - No low voltage issues identified
- Diablo
  - Low voltages identified at Moraga and Tassajara 230 kV in the summer peak high renewable sensitivity case.
    - Sensitivity only, continue to monitor.
- San Francisco
  - Marginal low voltage at Larkin 115 kV identified for Potrero 115 kV P5 contingency in year 10.
    - Continue to monitor.
- Peninsula
  - Low voltages identified in Peninsula 60 kV system for loss of 230 kV source at Jefferson due to either Jefferson 230 kV P5 or Monta Vista-Jefferson Nos. 1 & 2 230 kV lines P7 contingencies starting in year 2.
  - Jefferson 230 kV bus upgrade project would address these low voltage issues.

Greater Bay Area – Low Voltage Results Summary

- Peninsula (Continued)
  - Low voltage identified at Cooley Landing 115 kV for P5 contingency in year 10.
    - Continue to monitor.
- Mission
  - Low voltages identified at San Ramon 230 kV in the summer peak high renewable sensitivity case.
    - Sensitivity only, continue to monitor.
  - Low voltage identified at E. Shore 230 kV for P5 contingency at E. Shore 230 kV starting in year 5.
    - East Shore 230 kV Bus Terminals Reconfiguration project addresses this.
- De Anza
  - No Issues.
- San Jose
  - Low voltages identified at Almaden 60 kV and some 115 kV buses for P1, P2 and P7 in the year 10 summer peak case.
    - Continue to monitor as long term issue

Sensitivity issues – No-rerate sensitivity

Facility overloads seen in non-rerate case	Contingency Category
Bair-Cooley Landing #2 60kV Line	P2
Cayetano-Lone Tree (Lone Tree-USWP) 230kV Line	P0, P1, P5, P7
Cayetano-Lone Tree (USWP-Cayetano) 230kV Line	P0, P1, P5, P7
Christie-Sobrante (Oleum-Sobrante) 115kV Line	P7
Evergreen-Almaden 60 kV Line	P0
Grant-Eastshore #1 115kV Line	P1
Loyola-Monta Vista 60 kV Line	P0
Moraga-Claremont #1 115kV Line	P2
Moraga-Claremont #2 115kV Line	P2
Moraga-Oakland J 115kV Line	P2, P5
Moraga-San Leandro #1 115kV Line	P2, P5
Moraga-San Leandro #2 115kV Line	P2, P5
Mountain View-Monta Vista 115 kV Line	P3, P6
Newark-Ames #1 115kV Line	P5, P6
Newark-Ames #3 115kV Line	P2, P5, P6, P7
Newark-Ames Dist 115kV Line	P2, P5, P6, P7
Newark-Dixon Landing 115kV Line	P1, P2, P3, P6, P7
Newark-Northern Receiving Station #1 115kV Line	P5, P7
Newark-Northern Receiving Station #2 115kV Line	P5
Newark-Trimble 115kV Line	P5
North Dublin-Vineyard 230 kV Line	P1, P2, P5, P7
Piercy-Metcalf 115 kV Line	P1
Ravenswood-Bair #1 115kV Line	P6
Ravenswood-Cooley Landing #1 115kV Line	P2
Ravenswood-San Mateo #1 115kV Line	P2, P5, P6, P7
San Mateo-Bair 60kV Line	P2
San Mateo-Bay Meadows #1 115kV Line	P1
San Mateo-Bay Meadows #2 115kV Line	P1
San Mateo-Belmont 115kV Line	P6
San Mateo-Hillsdale JCT 60kV Line	P2, P7
Swift-Metcalf 115 kV Line	P2
Tesla - Newark 230 kV Line No. 2	P3, P6, P7
Whisman-Monta Vista 115 kV Line	P2, P3, P5, P7

Sensitivity issues - other

Overloaded Facility	Category	2025 SP High CEC Forecast	2025 SpOP Hi Renew & Min Gas Gen	2022 SP Heavy Renewable & Min Gas Gen	2030-Summer Peak-High SVP
Birds Landing - Contra Costa PP 230 kV Line	P1			√	
Birds Landing - Contra Costa Sub 230 kV Line	P2				√
Contra Costa-Contra Costa Sub 230kV Line	P1,P2			√	
Eastshore-San Mateo 230kV Line	P5			√	√
El Patio-San Jose Sta. 'A' 115 kV Line	P7				√
Kifer-FMC 115 kV Line	P7				√
Los Esteros-Nortech 115 kV Line	P7				√
Los Esteros-Silicon Switching Station 230 kV Line					
Metcalf-El Patio No. 1 115 kV Line	P2				√
Metcalf-El Patio No. 2 115 kV Line	P2				√
Moraga-Lakewood 115kV Line (Lakewood Reactors)	P2			√	√
Newark-Kifer 115kV Line	P5				√
Newark-Northern Receiving Station #2 115kV Line	P5				√
Nortech-NRS 115 kV Line	P1				√
Birds Landing - Contra Costa PP 230 kV Line	P1			√	
Birds Landing - Contra Costa Sub 230 kV Line	P2				√
Contra Costa-Contra Costa Sub 230kV Line	P1,P2			√	
Eastshore-San Mateo 230kV Line	P5			√	√
El Patio-San Jose Sta. 'A' 115 kV Line	P7				√

Summary of potential new upgrades

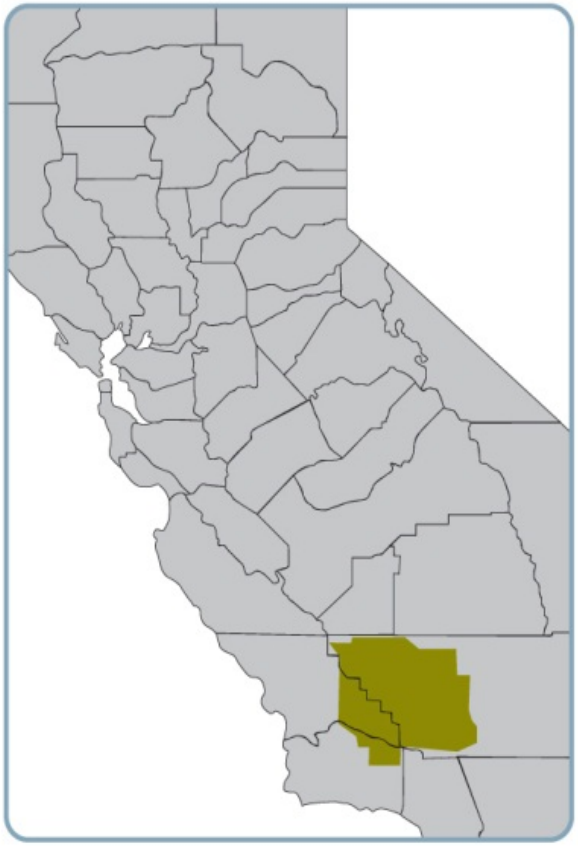
Division	Reliability Concern	Potential Upgrade
East Bay	NA	None required at this time.
Diablo	P2	Contra Costa 230 kV bus upgrade or operational solution (flow gate)
San Francisco	NA	None required at this time.
Penninsula	P5	Ravenswood & Jefferson 115 kV Protection Upgrade
Mission	NA	None
De Anza	P7	None/Long term overload(Newark-Lawrence) will be monitored for future
San Jose	NA	None required at this time.
Voltage Mitigation	Multiple	These will be evaluated together with high voltage mitigation issues

Kern Area
Preliminary Reliability Assessment Results

Abhishek Singh
Regional Transmission Engineer Lead

2020-2021 Transmission Planning Process Stakeholder Meeting
September 23-24, 2020

Kern Area



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

Load and Load Modifier Assumptions - Kern Area

Study Case	Scenario Type	Description	Gross Load (MW)	AAEE (MW)	BTM-PV		Net Load (MW)	mand Respor	
					Installed (MW)	Output (MW)		Total (MW)	D2 (MW)
KERN-2022-SP	Baseline	2022 summer peak load conditions. Peak load time - hours ending 20:00.	1,769	14	614	0	1,755	75	57
KERN-2025-SP	Baseline	2025 summer peak load conditions. Peak load time - hours ending 20:00.	1,855	23	705	0	1,832	75	57
KERN-2030-SP	Baseline	2030 summer peak load conditions. Peak load time - hours ending 20:00.	2,001	40	884	0	1,961	75	57
KERN-2022-SOP	Baseline	2022 spring off-peak load conditions. Off-peak load time – hours ending 20:00.	1,071	11	614	0	1,060	75	57
KERN-2025-SOP	Baseline	2025 spring off-peak load conditions. Off-peak load time – hours ending 13:00.	846	0	705	564	282	75	57
KERN-2025-SP-HiCEC	Sensitivity	2025 summer peak load conditions with hi-CEC load forecast sensitivity	1,855	0	705	0	1,855	75	57
KERN-2025-SOP-HiRen	Sensitivity	2025 spring off-peak load conditions with hi renewable dispatch sensitivity	846	0	705	698	148	75	57
KERN-2022-SP-HiRene	Sensitivity	2022 summer peak load conditions with hi-renewable dispatch sensitivity	1,769	14	614	607	1,148	75	57
KERN-2030-SP-xRerate	Sensitivity	2030 summer peak load conditions with no rerates	2,001	40	884	0	1,961	75	57
KERN-2030-SP-QF	Sensitivity	2030 summer peak load conditions with QF retirement sensitivity	2,001	40	884	0	1,961	75	57

Generation Assumptions - Kern Area

Study Case	Scenario Type	Description	Battery Storage (MW)	Solar		Wind		Hydro		Thermal	
				Installed (MW)	Dispatch (MW)	Installed (MW)	Dispatch (MW)	Installed (MW)	Dispatch (MW)	Installed (MW)	Dispatch (MW)
KERN-2022-SP	Baseline	2022 summer peak load conditions. Peak load time - hours ending 20:00.	2	614	6	0	0	29	25	3,447	2,765
KERN-2025-SP	Baseline	2025 summer peak load conditions. Peak load time - hours ending 20:00.	0	614	6	0	0	29	18	3,447	2,689
KERN-2030-SP	Baseline	2030 summer peak load conditions. Peak load time - hours ending 20:00.	0	614	6	0	0	29	18	3,447	2,797
KERN-2022-SOP	Baseline	2022 spring off-peak load conditions. Off-peak load time – hours ending 20:00.	2	614	0	0	0	29	25	3,447	1,568
KERN-2025-SOP	Baseline	2025 spring off-peak load conditions. Off-peak load time – hours ending 13:00.	0	614	517	0	0	29	18	3,447	460
KERN-2025-SP-HiCEC	Sensitivity	2025 summer peak load conditions with hi-CEC load forecast sensitivity	0	614	0	0	0	29	18	3,447	2,823
KERN-2025-SOP-HiRen	Sensitivity	2025 spring off-peak load conditions with hi renewable dispatch sensitivity	0	614	488	0	0	29	18	3,447	460
KERN-2022-SP-HiRene	Sensitivity	2022 summer peak load conditions with hi-renewable dispatch sensitivity	2	614	593	0	0	29	18	3,447	543
KERN-2030-SP-xRerate	Sensitivity	2030 summer peak load conditions with no rerates	0	614	6	0	0	29	18	3,447	2,797
KERN-2030-SP-QF	Sensitivity	2030 summer peak load conditions with QF retirement sensitivity	0	614	6	0	0	29	18	3,447	1,971

Previously approved transmission projects modelled in base cases

Project Name	First Year Modeled
Wheeler Ridge Voltage Support	2022
Midway-Kern PP 230 kV #2 Line Project	2025
Kern PP 115 kV Area Reinforcement	2025
Wheeler Ridge Junction Substation	On Hold (2019-20 TPP)
Bakersfield Nos. 1 and 2 230kV Tap Lines Reconductoring	2025
Midway-Temblor 115 kV Line Reconductor and Voltage	2025
Midway-Kern PP 230 kV Line Nos. 1, 3 and 4 Capacity Increase Project	2025

Kern 230 kV– Results Summary

Observations

230 kV

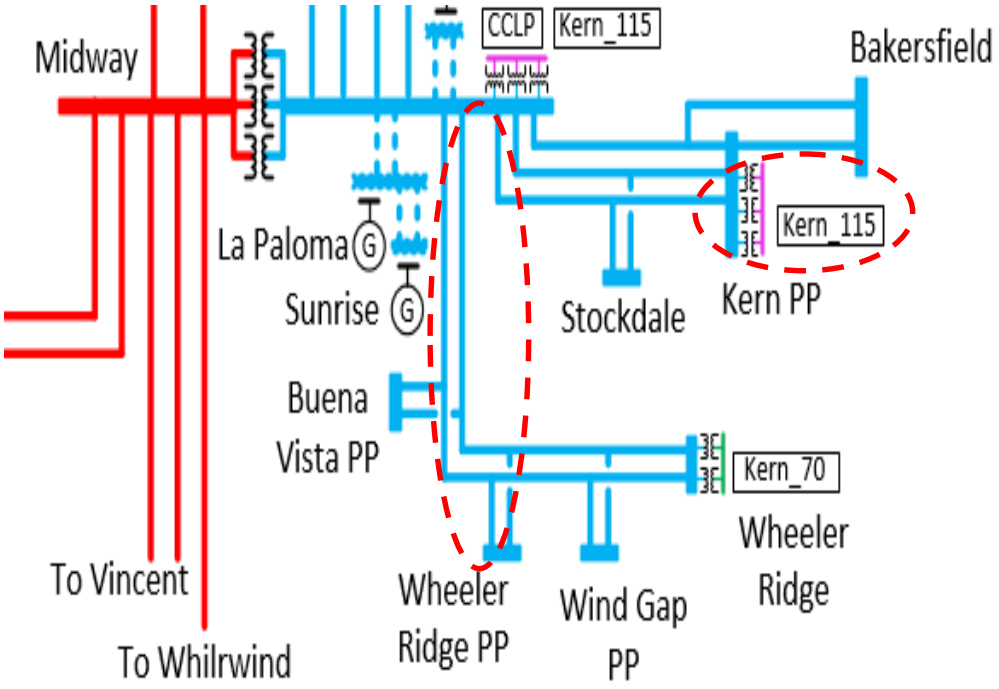
Midway-Wheeler ridge 230 kV Overloads starting 2022(Multiple sections-P2 only)

- Midway-Buena Vista J1/J2 (All Peak years)
- Buena Vista J1/J2-WheelrJ1/J2 (2030 Peak only)

Kern 230/115 kV banks –Starting 2030(P6 only)

Approved and Potential Mitigations

- Short term issues will be mitigated by operating solutions/Action Plan
- Long Term-Wheeler Ridge Junction or some other suitable alternative



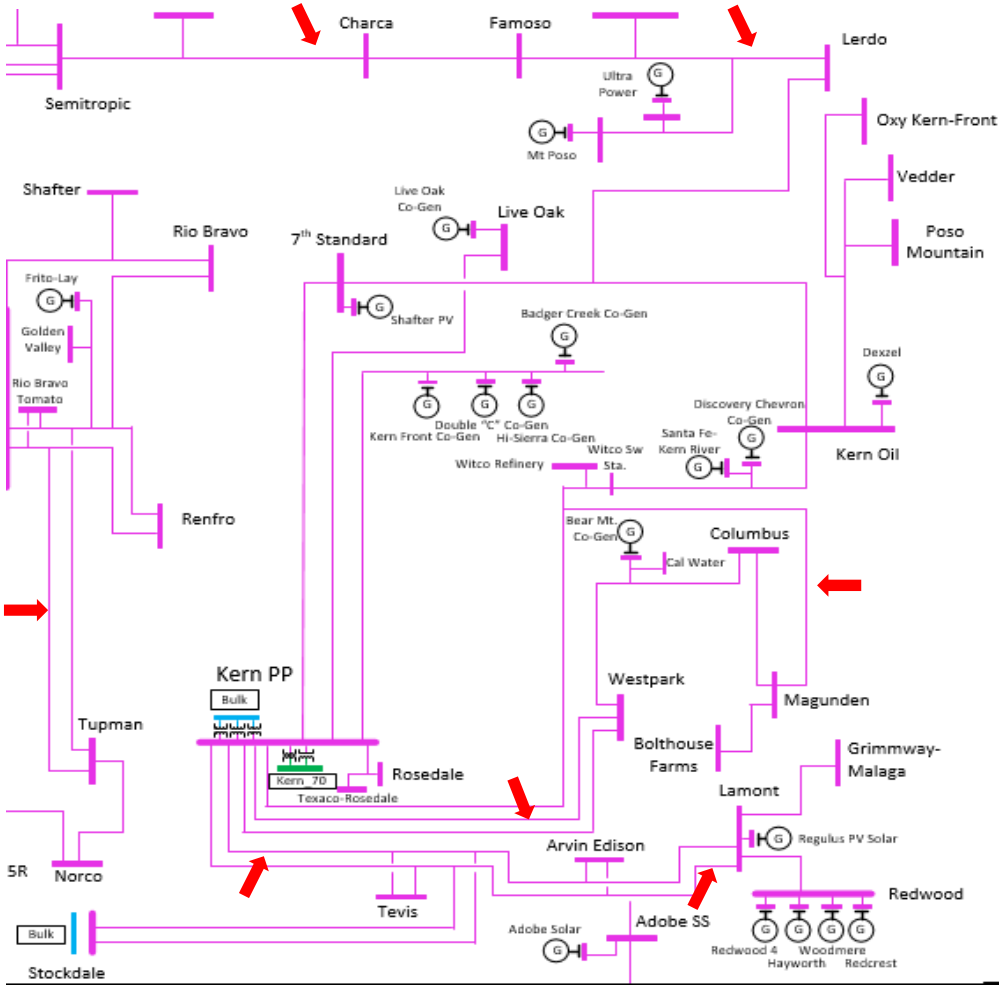
Kern 115 kV – Results Summary

Observations
115 kV

- Kern-Magunden-Witco 115 kV Line (Kern Oil Jct-Magunden,Kern Oil Jct – Kern Water)-Starting 2025-P6,7
- Kern Power-Tevis # 1 & # 2 Issues
  - P1,P2-1 & other P2 Issues(P1-22,P2-1:22, Other P2-25)
- Kern Power-West Park-2025(P6 only)
- Midway-Tupman line overloads (P2-All Years)

Approved and Potential Mitigations

- Short term issues will be mitigated by operating solutions/Action Plan/Summer Setup
- Long Term-Wheeler Ridge Junction or some other suitable alternative



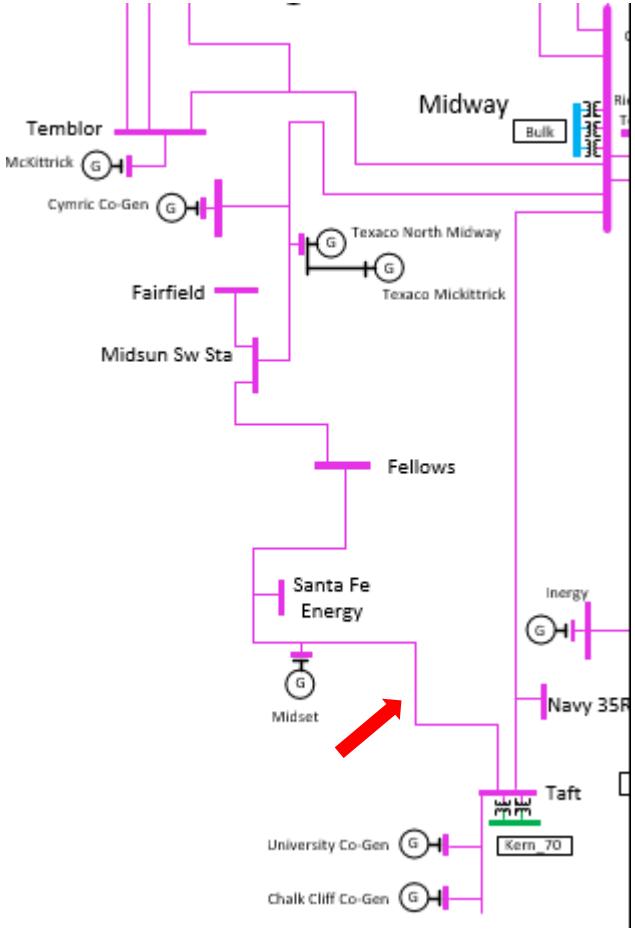
Kern 115 kV – Results Summary

Observations
115 kV-Continued

- Midway-Taft 115 kV overloads (Fellows-Taft and Avery)-2025 OPK & OPKHRE (P2 only overloads)

Approved and Potential Mitigations

- Short term issues will be mitigated by operating solutions/Action Plan
- Long Term-Monitor the overloads



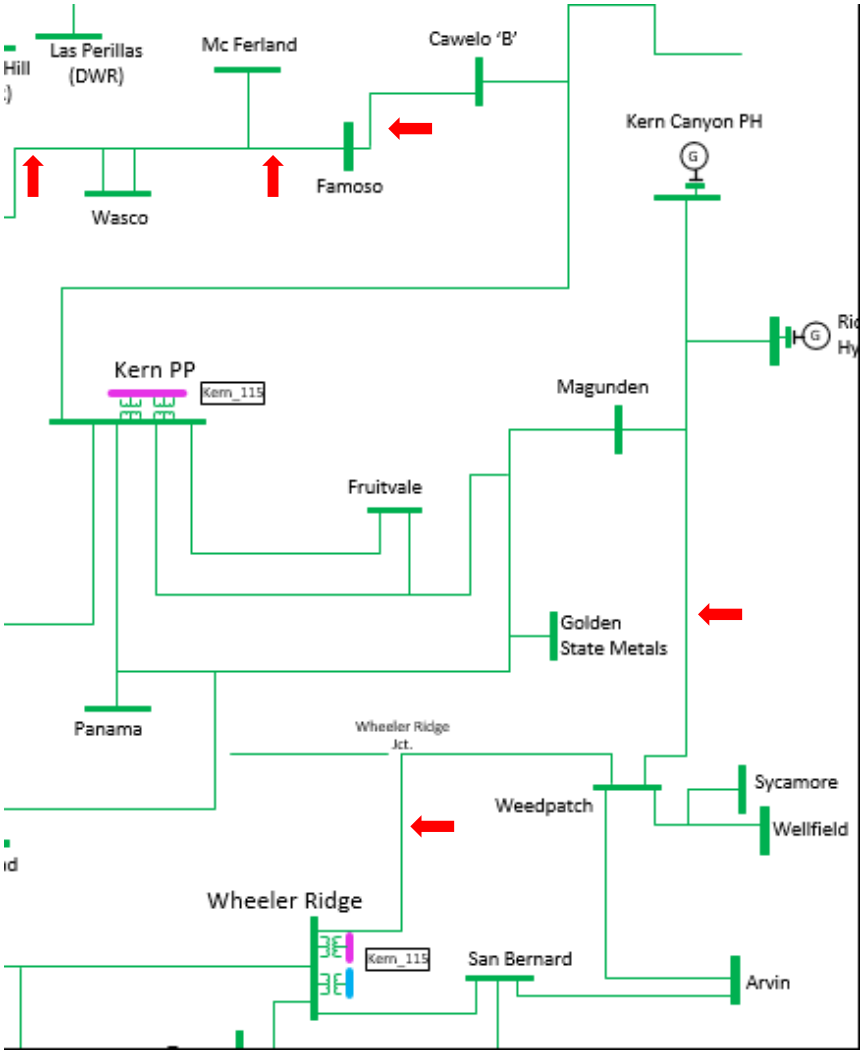
Kern 70 kV-Results Summary

Observations
70 kV

Multiple 70 kV P2,P6 Overloads seen in the Off-Peak Studies

Approved and Potential Mitigations

- Utilize Summer Setup for summer and non-summer months
- Monitor some long term overloads in future TPP cycles



Kern– Low Voltage Results Summary

Observations

- Midway-Wheeler ridge 230 kV lines (P7) & Wheeler Ridge 230/70 kV T/F (P6) cause low voltage issues on multiple voltage levels in 2022-OPK only. (Summer set up not modeled in Opk Case)
- Summer set up related low voltage issues in non-summer peak scenarios
- Multiple Low Voltage seen in the QF retirement scenario.

Approved and Potential Mitigations

- Short term issues will be mitigated by operating solutions/Action Plan/Summer Setup
- Long Term-Wheeler Ridge Junction or some other suitable alternative in conjunction with the high voltage studies

Sensitivity issues

Below is the list of overloads that get worse or are new overloads in the no-rerate sensitivity

Overloaded Facility	Category
Kern-Magunden-Witco 115 kV Line (Kern Oil Jct-Kern Water)	P7
Westpark-Magunden 115 kV Line (Magunden-Magunden Jct)	P7
Midway-Semitropic 115 kV Line (Semitropic_E - Midway 115 kV)	P2-1
Kern PP-Westpark #2 & #1 115 kV Line	P7
Kern-Magunden-Witco 115 kV Line (Kern Oil Jct-Magunden)	P6

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

Overloaded Facility	Category	2025 High CEC	2022Summer Peak High Renew	2025 Off-Peak High Renew	2030 QF Retirement
Taft-Q356Jn-Taft A 70 kV	P0, P2		√	√	
Blackwell-LostHill 70 kV	P0		√		
Lamont-Arvin Junction 115 kV	P6		√		

Summary of potential new upgrades

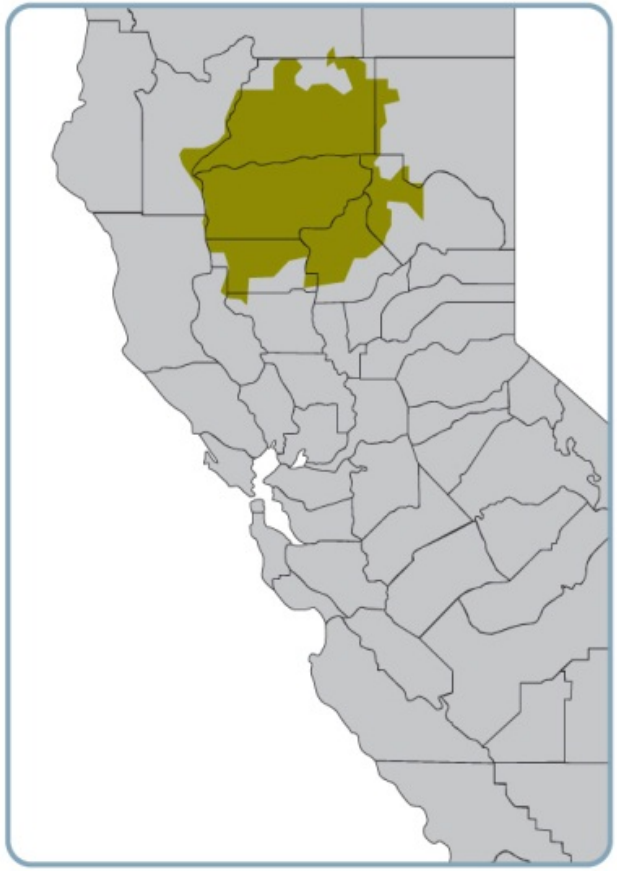
Division	Reliability Concern	Potential Upgrade
Kern- 230 kV (Midway-Wheeler Ridge Area)	Thermal overload on Multiple 230 and 115 kV lines under P1, P2-1, P2-4, P6 and P7 conditions	Wheeler Ridge Junction or some other suitable alternative
Kern-115 kV –Lamont and Kern PP 115 kV area		

North Valley Area
Preliminary Reliability Assessment Results

Ebrahim Rahimi
Regional Transmission Engineer Lead

2020-21 Transmission Planning Process Stakeholder Meeting
September 23-24, 2020

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

Study Case	Scenario Type	Description	Gross Load (MW)	AAEE (MW)	BTM-PV		Net Load (MW)	Demand Response	
					Installed (MW)	Output (MW)		Total (MW)	D2 (MW)
NVLY-2022-SP	Baseline	2022 summer peak load conditions. Peak load time - hours between 18:00 and 19:00.	869	7	353	0	862	36	28
NVLY-2025-SP	Baseline	2025 summer peak load conditions. Peak load time - hours between 18:00 and 19:00.	898	11	434	0	887	36	28
NVLY-2030-SP	Baseline	2030 summer peak load conditions. Peak load time - hours between 18:00 and 19:00.	937	19	563	0	918	36	28
NVLY-2022-SOP	Baseline	2022 spring off-peak load conditions. Off-peak load time – hours ending 20:00.	405	6	353	0	399	36	28
NVLY-2025-SOP	Baseline	2025 spring off-peak load conditions. Off-peak load time – hours ending 13:00.	312	0	434	347	-35	36	28
NVLY-2025-SP-HiCEC	Sensitivity	2025 summer peak load conditions with hi-CEC load forecast sensitivity	898	0	434	0	898	36	28
NVLY-2025-SOP-HiRenew	Sensitivity	2025 spring off-peak load conditions with hi renewable dispatch sensitivity	312	0	434	429	-117	36	28
NVLY-2022-SP-HiRenew	Sensitivity	2022 summer peak load conditions with hi-renewable dispatch sensitivity	869	7	353	349	513	36	28
NVLY-2030-SP-xReRates	Sensitivity	2030 summer peak load conditions with no rerates	937	19	563	0	918	36	28
Note:									
DR and storage are modeled offline in sarting base cases.									

Generation Assumptions – North Valley Area

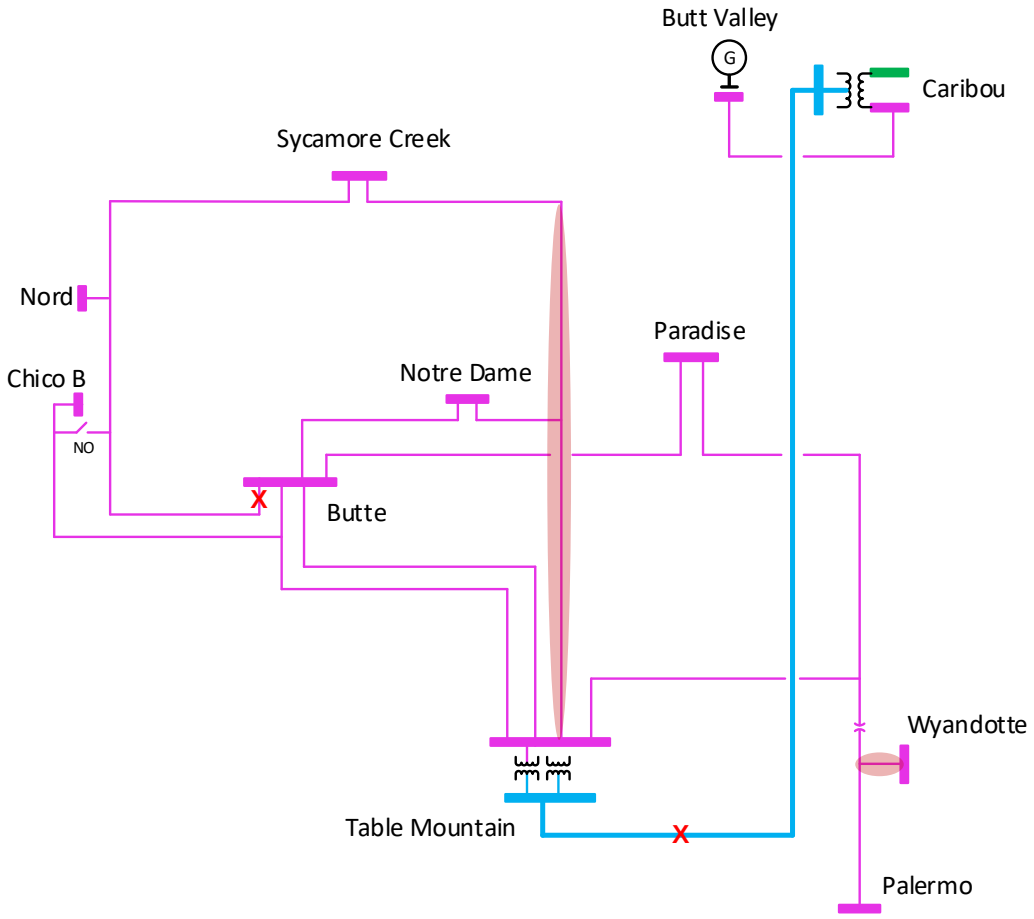
Study Case	Scenario Type	Description	Battery Storage (MW)	Solar		Wind		Hydro		Thermal	
				Installed (MW)	Dispatch (MW)	Installed (MW)	Dispatch (MW)	Installed (MW)	Dispatch (MW)	Installed (MW)	Dispatch (MW)
NVLY-2022-SP	Baseline	2022 summer peak load conditions. Peak load time - hours between 18:00 and 19:00.	0	0	0	103	68	1,768	1,622	1,067	718
NVLY-2025-SP	Baseline	2025 summer peak load conditions. Peak load time - hours between 18:00 and 19:00.	0	0	0	103	68	1,792	1,566	1,067	734
NVLY-2030-SP	Baseline	2030 summer peak load conditions. Peak load time - hours between 18:00 and 19:00.	0	0	0	103	68	1,752	1,597	1,067	658
NVLY-2022-SOP	Baseline	2022 spring off-peak load conditions. Off-peak load time – hours ending 20:00.	0	0	0	103	57	1,768	1,268	1,067	414
NVLY-2025-SOP	Baseline	2025 spring off-peak load conditions. Off-peak load time – hours ending 13:00.	0	0	0	103	21	1,792	888	1,067	97
NVLY-2025-SP-HiCEC	Sensitivity	2025 summer peak load conditions with hi-CEC load forecast sensitivity	0	0	0	103	68	1,792	1,566	1,067	752
NVLY-2025-SOP-HiRenew	Sensitivity	2025 spring off-peak load conditions with hi renewable dispatch sensitivity	0	0	0	103	64	1,768	1,646	1,067	405
NVLY-2022-SP-HiRenew	Sensitivity	2022 summer peak load conditions with hi-renewable dispatch sensitivity	0	0	0	103	64	1,768	1,646	1,067	405
NVLY-2030-SP-xReRates	Sensitivity	2030 summer peak load conditions with no rerates	0	0	0	103	68	1,752	1,597	1,067	658

Projects in North Valley Area

Projects	Expected ISD
Approved TPP Projects	
Glen 230/60 kV Transformer No. 1 Replacement	Mar-2021
Delevan 230 kV Substation Shunt Reactor	Jan-2021
Cottonwood 230/115 kV Transformer replacement	Nov-2021
Cascade 115/60 kV No. 2 Transformer Project	Jan-2022
Tyler 60 kV Shunt Capacitor	Dec-2022
Cottonwood 115 kV Bus Sectionalizing Breaker	Dec-2022
Red Bluff-Coleman 60 kV Line Upgrade	Jul-2023
Round Mountain Dynamic Reactive Support Project	Jun-2024
Other Projects	
Cottonwood – Red Bluff 60 kV line reconductoring (PG&E Maintenance project MWC 93)	May-2021
Grizzly PH Interconnection into Bucks Creek	Jun-2021

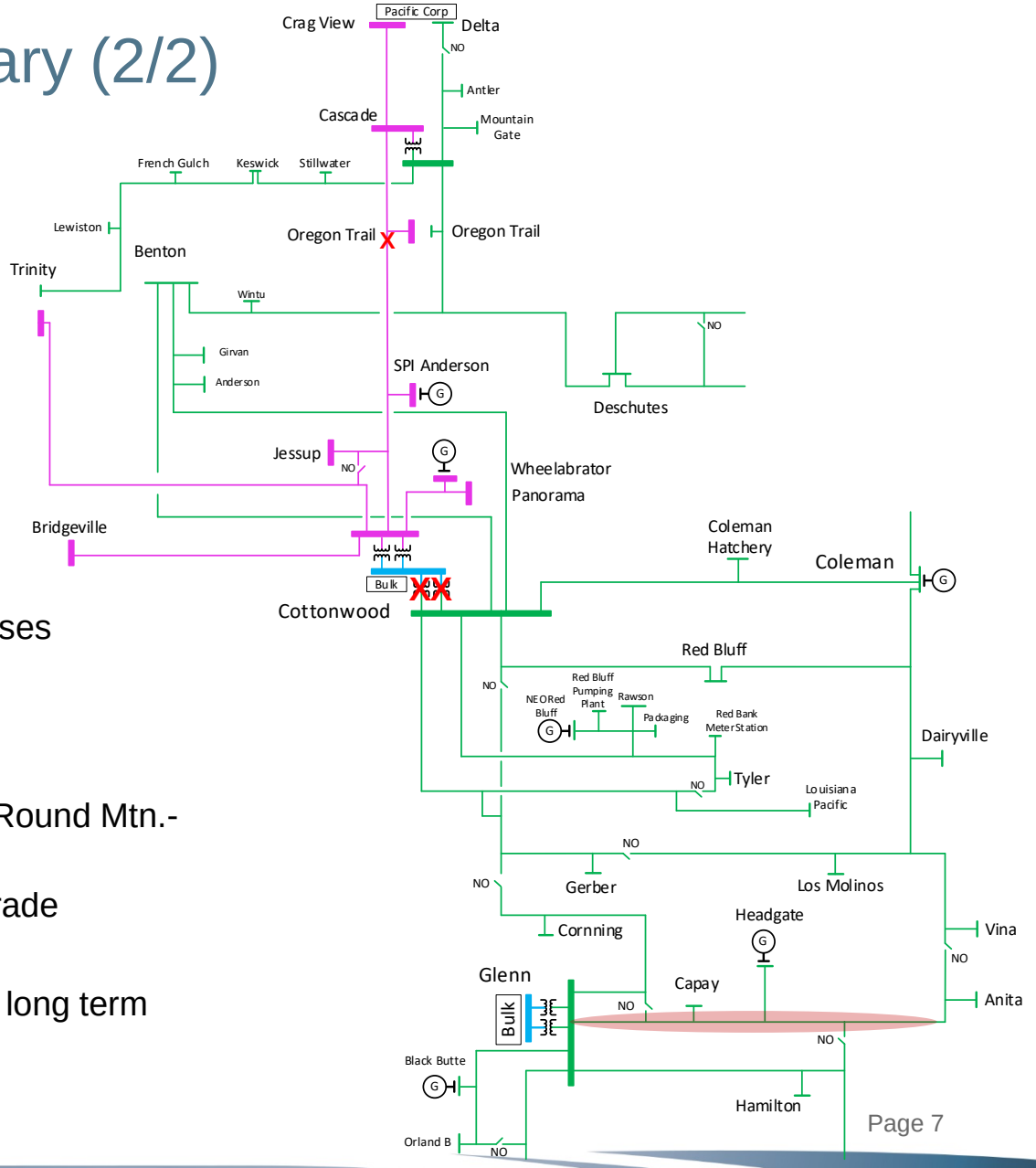
Thermal Results Summary (1/2)

- P0 overload of Palermo – Wyandotte 115 kV radial line
  - Upgrade the jumper/terminal equipment
- P2-1 of Caribou - Table Mtn. 230 kV causes voltage issue
  - Upgrade the Caribou SPS and/or Plumas-Sierra separation scheme
- P2-1 of Butte – Sycamore 115 kV overloading Table Mountain – Sycamore 115 kV line, starting 2022
  - Mitigation under review



Thermal Results Summary (2/2)

- P5-5 on Cottonwood 230 kV overloads the underlying 115 kV and 60 kV network starting 2022
  - Protection upgrade
- P6 of Cottonwood 230/60 kV transformers overload Cascade-Benton-Deschutes 60 kV line starting 2022
  - Potential mitigation: SPS
- P2-1 of Oregon trail – SPI-Anderson causes voltage issues starting 2022
  - Potential mitigation under review
- P5-5 Round Mountain 230kV overloads Round Mtn.-Cottonwood 230 kV line starting 2022
  - Potential mitigation: Protection upgrade
- P0 overload on Glen #3 60 kV line in the long term
  - Continue to monitor



Low Voltage Results Summary

- Cascade 115 kV
  - Any contingency (P1, P2, P6) resulting in the trip of both Cascade – Cottonwood 115 kV and Cascade – Craigview 115 kV lines, starting 2022

- Oregontrail 115 kV
  - P2-1 causes voltage below the limit in 2022 and close to limit in other years

- P3 of the proposed Tyler 60 kV capacitor bank causes low voltage at Tyler
- Palermo 230,
- 60 kV buses in Keswick and Cascade areas

Summary of Potential New Upgrades

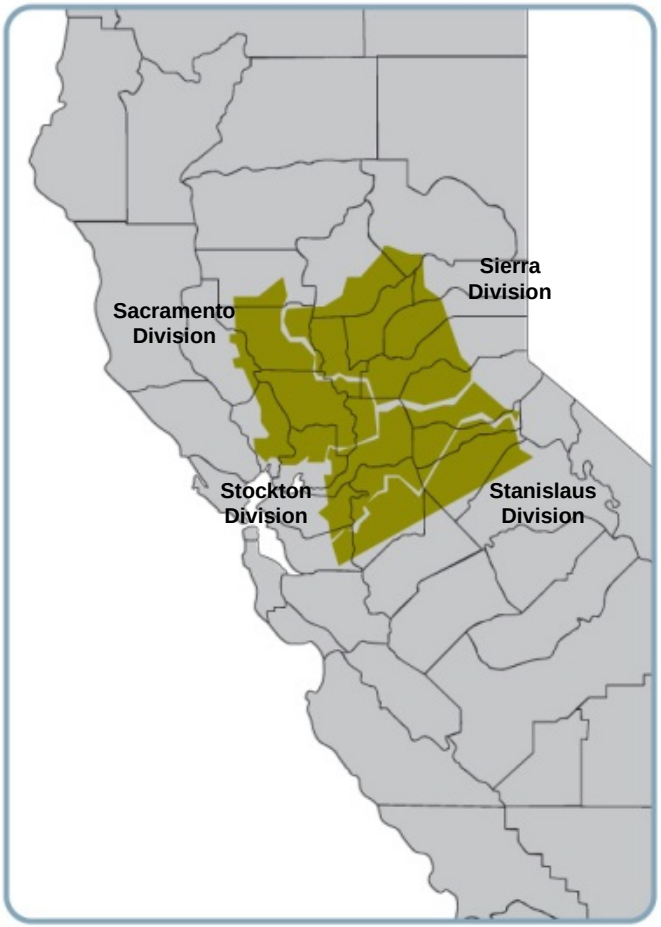
Potential New Upgrade Proposed in this TPP Cycle	Contingency
Jumper/terminal equipment upgradeissue to address P0 on Palermo – Wyandotte 115 kV line	P0
Protection upgrade to address P5-5 on Round Mountain 230 kV	P5-5
Protection upgrade to address P5-5 on Cottonwood 230 kV	P5-5
SPS upgrade to address P2-1 on Caribou – Table Mountain 230 kV line	P2-1

Central Valley Area
Preliminary Reliability Assessment Results

Ebrahim Rahimi
Regional Transmission Engineer Lead

2020-21 Transmission Planning Process Stakeholder Meeting
September 23-24, 2020

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

Study Case	Scenario Type	Description	Gross Load (MW)	AAEE (MW)	BTM-PV		Net Load (MW)	Demand Response	
					Installed (MW)	Output (MW)		Total (MW)	D2 (MW)
CVLY-2022-SP	Baseline	2022 summer peak load conditions. Peak load time - hours ending 19:00.	4,054	33	1,556	0	4,021	101	59
CVLY-2025-SP	Baseline	2025 summer peak load conditions. Peak load time - hours ending 19:00.	4,150	53	1,917	0	4,097	101	59
CVLY-2030-SP	Baseline	2030 summer peak load conditions. Peak load time - hours ending 19:00.	4,381	93	2,459	0	4,287	101	59
CVLY-2022-SpOP	Baseline	2022 spring off-peak load conditions. Off-peak load time - hours ending 20:00.	2,044	28	1,556	0	2,016	101	59
CVLY-2025-SpOP	Baseline	2025 spring off-peak load conditions. Off-peak load time - hours ending 13:00.	1,572	0	1,917	1533	39	101	59
CVLY-2025-SP-Hi-CEC	Sensitivity	2025 summer peak load conditions with hi-CEC load forecast sensitivity	3,904	0	1,917	58	3,846	101	59
CVLY-2025-SpOP-HiRenew	Sensitivity	2025 spring off-peak load conditions with hi renewable dispatch sensitivity	1,572	0	1,917	1898	(326)	101	59
CVLY-2022-SP-HiRenew	Sensitivity	2022 summer peak load conditions with hi-renewable dispatch sensitivity	3,897	47	1,556	1540	2,310	101	59

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

Generation Assumptions – Central Valley Area

Study Case	Scenario Type	Description	Battery Storage (MW)	Solar		Wind		Hydro		Thermal	
				Installed (MW)	Dispatch (MW)	Installed (MW)	Dispatch (MW)	Installed (MW)	Dispatch (MW)	Installed (MW)	Dispatch (MW)
CVLY-2022-SP	Baseline	2022 summer peak load conditions. Peak load time - hours ending 19:00.	12	38	1	1125	611	1401	1136	1,408	1,104
CVLY-2025-SP	Baseline	2025 summer peak load conditions. Peak load time - hours ending 19:00.	12	38	1	1021	553	1427	1140	1,408	1,058
CVLY-2030-SP	Baseline	2030 summer peak load conditions. Peak load time - hours ending 19:00.	12	38	1	1019	552	1379	954	1,402	1,025
CVLY-2022-SpOP	Baseline	2022 spring off-peak load conditions. Off-peak load time - hours ending 20:00.	12	38	1	1125	600	1401	1086	1,408	253
CVLY-2025-SpOP	Baseline	2025 spring off-peak load conditions. Off-peak load time - hours ending 13:00.	12	38	19	1021	197	1427	779	1,408	223
CVLY-2025-SP-Hi-CEC	Sensitivity	2025 summer peak load conditions with hi-CEC load forecast sensitivity	12	38	1	1021	553	1427	1140	1,408	1,049
CVLY-2025-SpOP-HiRenew	Sensitivity	2025 spring off-peak load conditions with hi renewable dispatch sensitivity	12	38	35	1125	676	1401	1267	1,408	270
CVLY-2022-SP-HiRenew	Sensitivity	2022 summer peak load conditions with hi-renewable dispatch sensitivity	12	38	35	1125	676	1401	1364	1,408	420

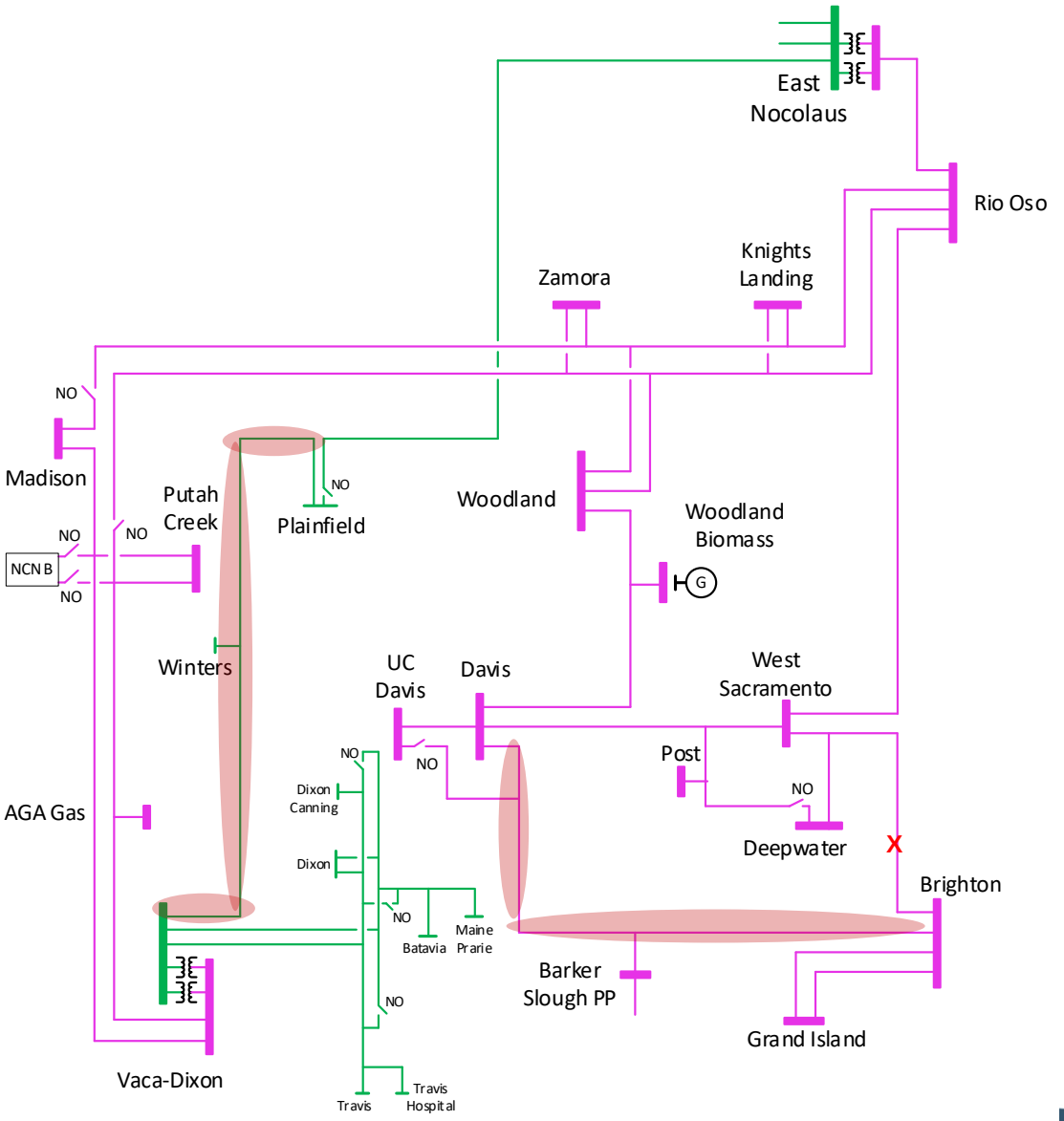
Sacramento Division

Projects in Sacramento Area

Projects	Expected ISD
Approved TPP Projects	
Vaca-Davis Area Reinforcement. The project scope is: ▪ Install 10 MVAR Shunt Capacitor at Plainfield 60 kV Substation, ▪ Replace Vaca - Dixon 115/60 kV Transformer Bank No. 5 ▪ Replace all the limiting elements of Dixon 60 kV sub	Feb-2022

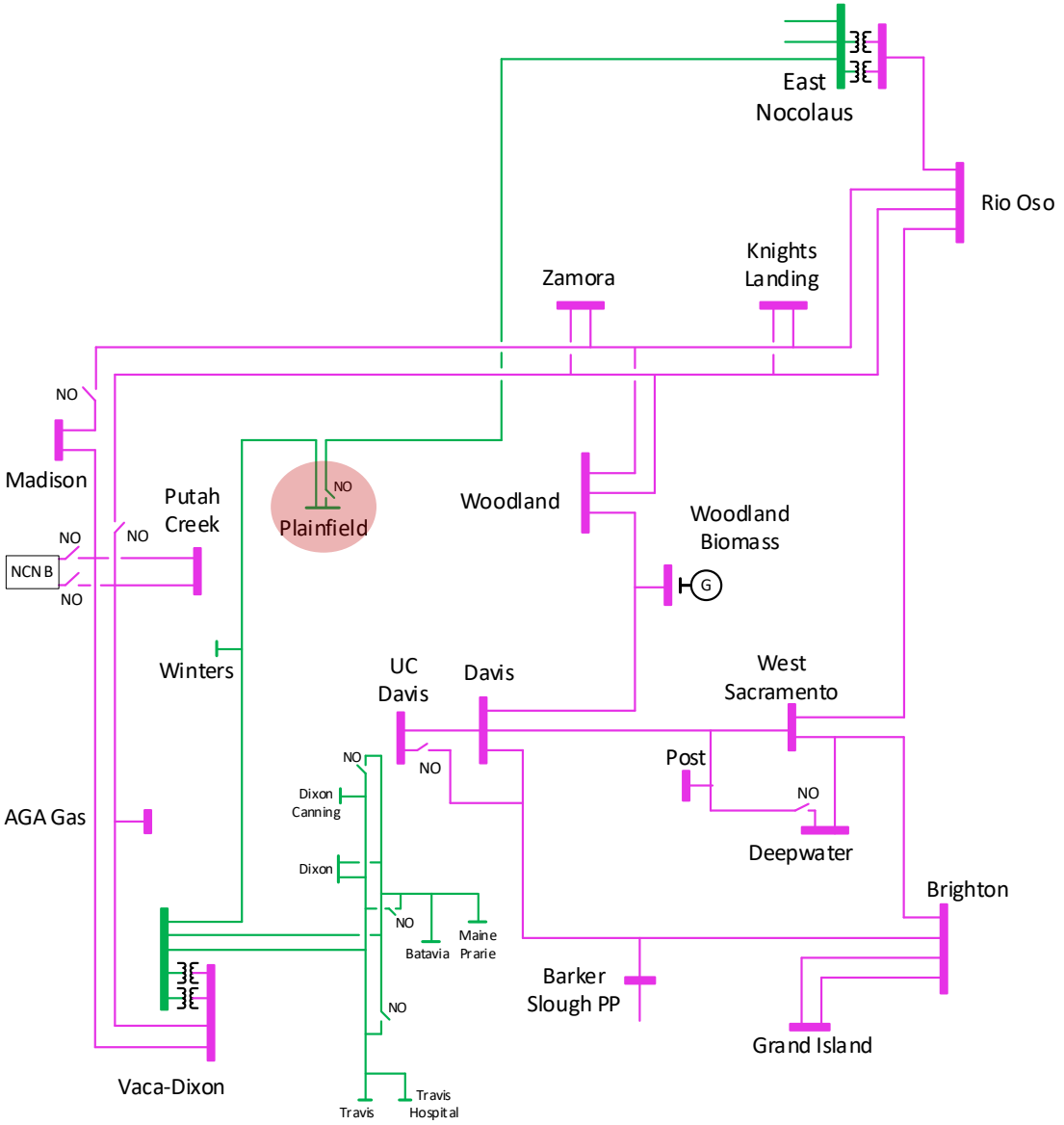
Sacramento Thermal Results Summary

- P0 overload on Vaca – Plainfield 60 kV radial line starting 2022
  - Potential mitigation: Line reconductor, …
  - Short term solution: substation reconfiguration
- P1 overload on Brighton – Davis 115 kV line for West Sacramento – Brighton 115 kV line outage starting 2022
  - Potential mitigation: Line reconductor, …



Low Voltage Results Summary

- Low voltage at Plainfield 60 kV bus



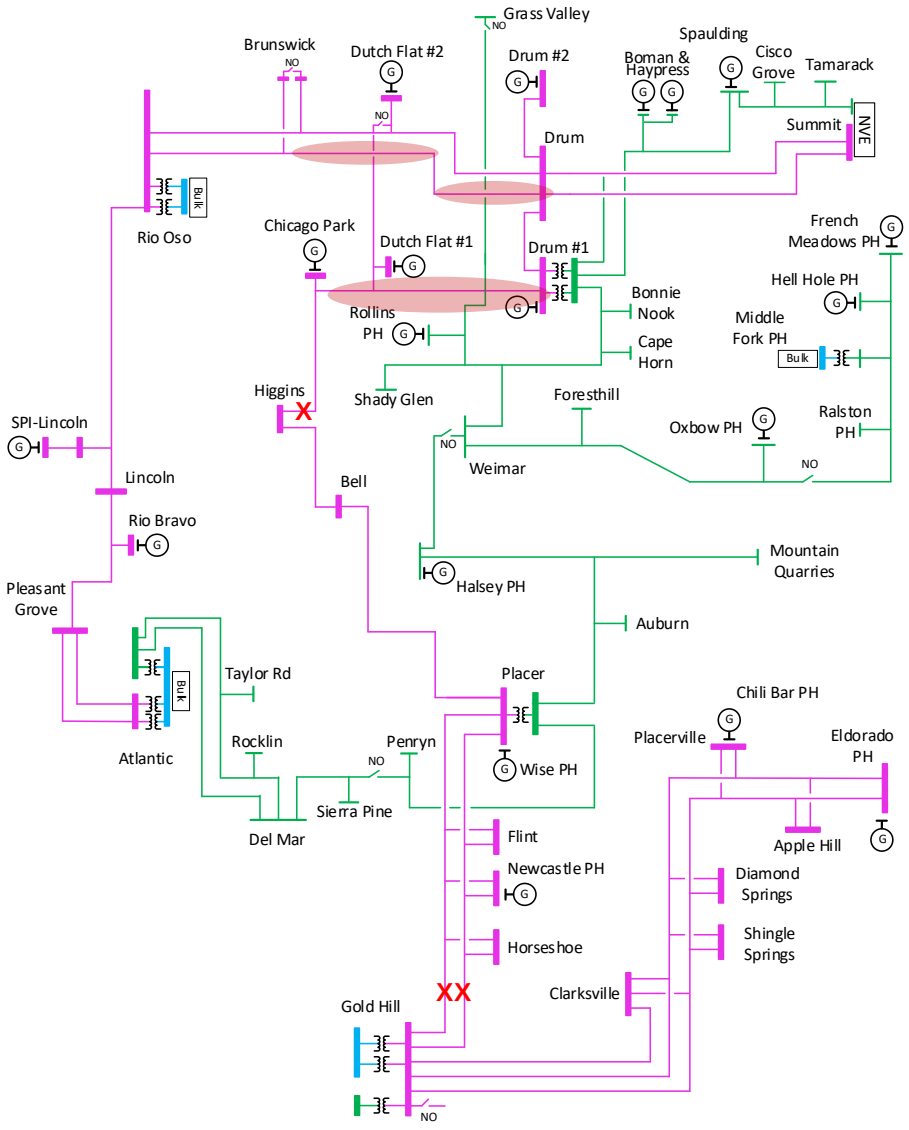
Sierra Division

Projects in Sierra Area

Projects	Expected ISD
Approved TPP Projects	
Pease 115/60 kV Transformer Addition	Nov-20
Rio Oso 230/115 kV Transformer Upgrades	Jun-22
Rio Oso Area 230 kV Voltage Support	Sep-22
South of Palermo 115 kV Reinforcement Project	Nov-22
East Marysville 115/60 kV	Dec-22
Gold Hill 230/115 kV Transformer Addition	Dec-24
Other projects	
Drum – Rio Oso 115 kV Reconductor	Mar-22
Gold Hill 115/60 kV Bank No. 5 Replacement	Jun-22
Pease 115/60 kV Bank No. 2 Replacement	Mar-21
Rio Oso 115 kV BAAH Bus Upgrade	Dec-22
Rio Oso 230 kV BAAH Bus Upgrade	Dec-22

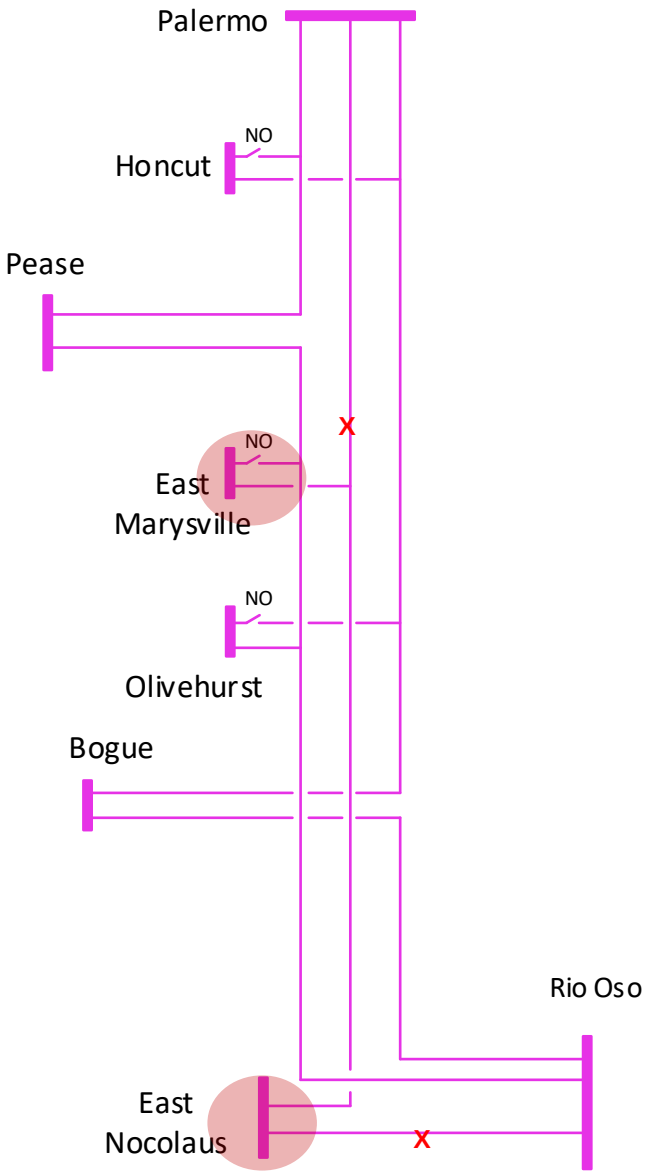
Sierra Thermal Results Summary

- P7 of Placer – Gold Hill #1 and #2 overloads Drum – Higgins 115 kV line in the long term
  - Continue to monitor
- P2-1 of Drum – Higgins 115 kV line overloads Drum – Rio Oso #2 115 kV line due to high generation
  - Potential mitigation: Trip Chicago Park generator post contingency.
- P6 of Rio Oso – Atlantic 230 kV and Gold Hill Atlantic 230 kV lines severely overload the underlying 115 kV lines
  - Potential mitigation: Operating procedure or SPS
- P5-5 on Gold Hill 230 kV causes voltage collapse on all peak cases.
  - Potential mitigation: Protection upgrade



Low voltage issues

- P6 contingency of Rio Oso – Nicolaus 115 kV and Palermo E. Marysville 115 kV lines causes low voltage at East Marysville and E. Nicolaus substations.
  - Potential mitigation: Operating measure after the first contingency



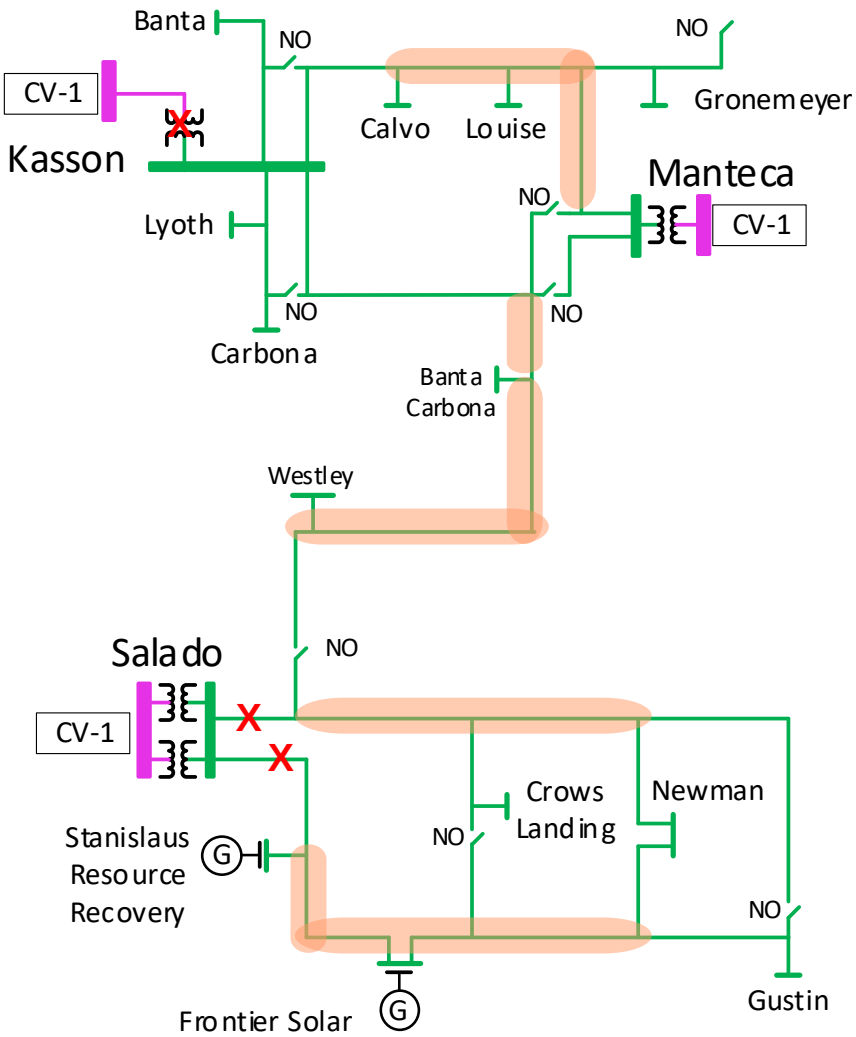
Stockton/Stanislaus (Tesla – Bellota) Divisions

Projects in Stockton/Stanislaus Area

Projects	Expected ISD
Approved TPP Projects	
Mosher Transmission Project	Mar-21
Vierra 115 kV Looping Project	Jan-23
Tesla 230 kV Bus Series Reactor	Dec-23
Lockeford-Lodi Area 230 kV Development	Jul-25

Stockton/Stanislaus Thermal Results Summary (1/3)

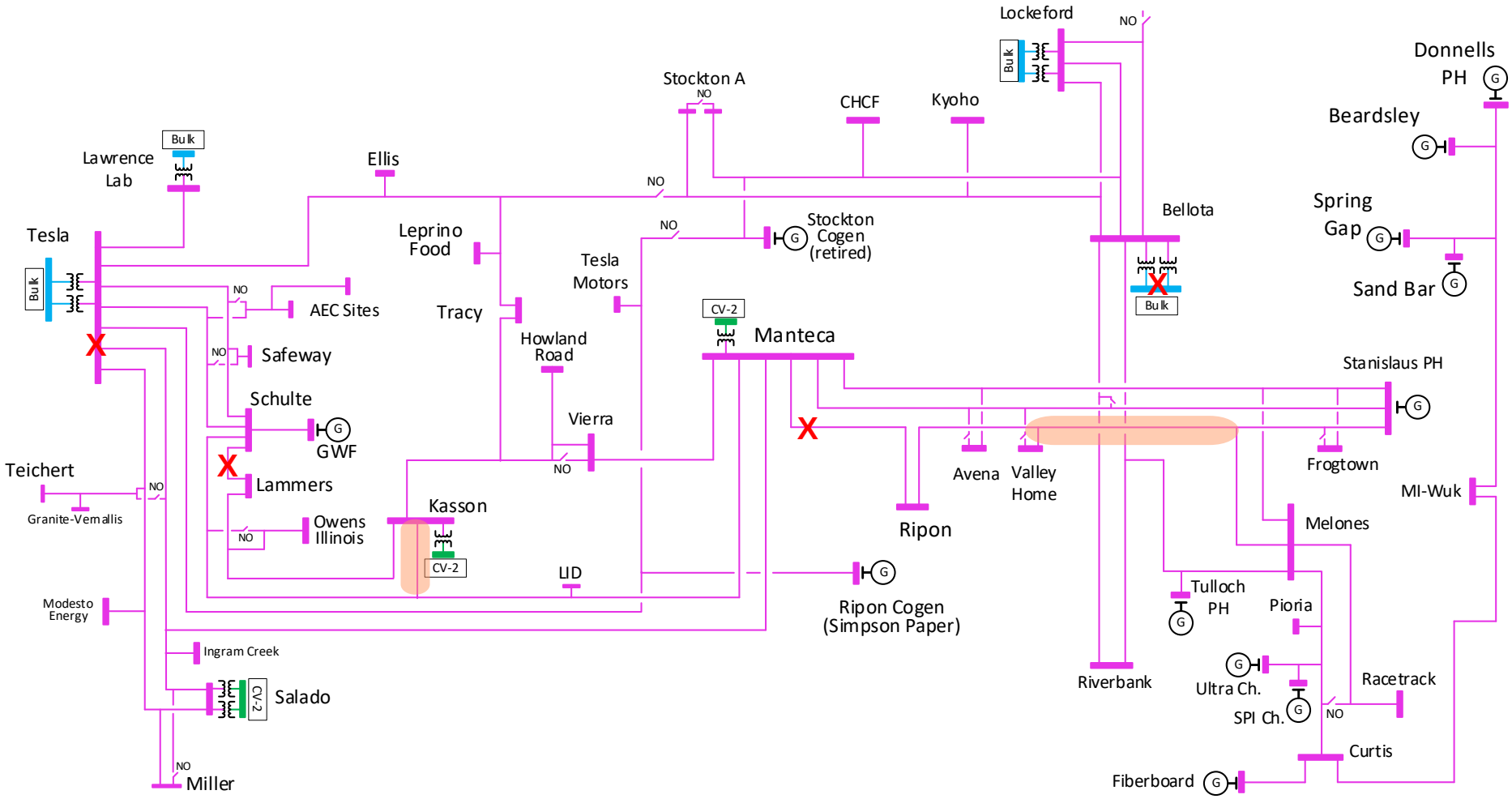
- P0 overload on two sections of Manteca #1 60 kV Line starting 2022
  - Potential mitigation: Reconductor a section and evaluate options to address the other section.
- P1 overload in Salado – Newman 60 kV area starting in 2022
  - Potential mitigation: 60 kV Line reconductor
  - Short term: operating procedure
- P1 overload on Kasson- Manteca 60 kV line for Kasson 115/60 kV contingency
  - Potential mitigation: Add second transformer, …
  - Short term: Kasson SPS



Stockton/Stanislaus Thermal Results Summary (2/3)

- P1 of Schulte – Lammers contingency overloads Schulte – Kasson – Manteca 115 kV.
  - Potential mitigation: Reconductor a short section of the line
- P1 of Manteca – Ripon 115 kV line overloads Melones – Valley Home 115 kV line starting 2025
  - Potential mitigation: Line reconductor, …
  - Short tem: Operating measure
- P2-4 of Tesla 115 kV causes voltage issues and overload
  - Potential mitigation: SPS, bus upgrade, …
- P5-5 on Bellota 230 kV causes overload starting 2022
  - Potential mitigation: Protection upgrade

Stockton/Stanislaus Thermal Results Summary (3/3)



Low Voltage Results Summary

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

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

Summary of Potential New Upgrades in Central Valley

Division	Potential New Upgrade in this TPP Cycle	Contingency
Sacramento	Address P0 overload on Vaca - Plainfield 60 kV line	P0
	Address P1 overload on Brighton - Davis 115 kV line	P1
Sierra	Protection upgrade at Gold Hill 230 kV to address P5-5	P5-5
	SPS at Drum/Higgins to trip generation for P2-1	P2-1
	Operating procedure to address P6 at Atlantic 230 kV	P6
Stockton/ Stanislaus	Reconductor a section to address P0 on Manteca #1 60 kV line	P0
	Reconductor a section to address P1 overload on Schulte – Kasson – Manteca 115 kV.	P1
	Protection upgrade to address P5-5 on Bellota 230 kV	P5-5

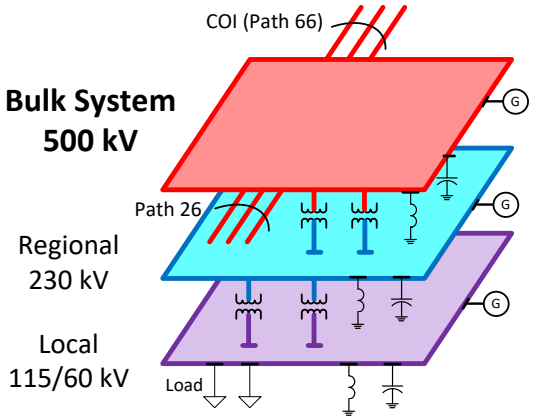
High Voltage Assessment in PG&E System
Preliminary Reliability Assessment Results

Ebrahim Rahimi
Regional Transmission Engineer Lead

2020-21 Transmission Planning Process Stakeholder Meeting
September 23-24, 2020

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
Delevan 230 kV Substation Shunt Reactor	Jan-2021
Los Esteros 230 kV Shunt Reactor	Apr-2021
Wilson Voltage Support	May-2021
Wheeler Ridge Voltage Support	Aug-2021
Plainfield Shunt Capacitor	Feb-2022
Maple Creek SVC	Jul-2022
Rio Oso SVC	Sep-2022
Tyler 60 kV Shunt Capacitor	Dec-2022
Number of 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

- Initial Scenarios
  - 2022 Spring off Peak
    - 8pm, real time power factor, COI max S-N
  - 2025 Spring off Peak
    - 1pm, real time power factor, COI max S-N
  - 2030 Spring off Peak
    - 1pm, Tariff power factor, COI max S-N
  - 2025 Spring off Peak with High Renewables
- Other scenarios will be developed and studied in later stages

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

North Valley

Adjustment/Project	Number of buses that their high voltage could be addressed with each action			
	2022 SOP	2025 SOP	2025 SOP HRE	2030 SOP
Palermo 230/115kV	0	4	4	15
Glenn 230/60kV	0	12	12	10
Cottonwood 230/60kV	0	5	10	0
Colgate 230/60kV	0	3	9	0
Palermo 230/60kV	0	9	9	0
Table Mountain 230/115kV	0	2	6	0
Dairyville new 60kV shunt reactor	0	7	7	0
Whitmore new 60kV shunt reactor	5	0	7	7
Cottonwood 230/115kV	0	2	2	0
Butte 115/60kV	1	1	1	0

North Coast North Bay

Adjustment/Project	Number of buses that their high voltage could be addressed with each action			
	2022 SOP	2025 SOP	2025 SOP HRE	2030 SOP
Fulton 230/115kV	4	14	14	0
Silverado new 115kV shunt reactor	3	0	1	0
Moraga 230/115kV	0	0	1	0
Mendocino 115kV shunt adjustment	0	5	7	0

Sacramento

Adjustment/Project	Number of buses that their high voltage could be addressed with each action			
	2022 SOP	2025 SOP	2025 SOP HRE	2030 SOP
Action plan until Rio Oso Tx and SVC project	2	2	2	1
Cortina 230/115/60kV	4	17	21	0
Vaca Dixon 230/115kV	1	1	1	1
Colusa new 60kV shunt reactor	0	3	3	0
Colusa new 60kV shunt reactor	0	1	1	0

Sierra

Adjustment/Project	Number of buses that their high voltage could be addressed with each action			
	2022 SOP	2025 SOP	2025 SOP HRE	2030 SOP
Gold Hill 230/115kV and shunt adjustment	5	29	18	0
Rio Oso 230/115kV and SVC	0	10	13	2
POE, Cresta Vsch change	0	4	10	0
Atlantic 230/60kV	5	4	5	0
Forest Hill new 60kV shunt reactor	0	3	0	0
Rio Oso, Palermo, Brighton 230/115kV	0	2	2	2

Stockton/Stanislaus

Adjustment/Project	Number of buses that their high voltage could be addressed with each action			
	2022 SOP	2025 SOP	2025 SOP HRE	2030 SOP
Tesla 230/115kV	0	21	38	0
Melones new 115kV shunt reactor	1	32	32	23
Lockeford 230/60kV	0	9	9	0
Weber 230/60kV	0	0	0	0
Bellota 230/115kV	0	0	25	2
Valley Springs 230/60kV	0	19	22	15
Stagg 230/60kV	0	0	0	0
Salado 115/60kV	0	0	0	0
Linden new 60kV shunt reactor	0	3	3	0
Manteca 115/60kV	0	0	0	0
Valley Springs 230/60kV, Bellota 230/115kV	2	2	2	2

Greater Bay Area

Adjustment/Project	Number of buses that their high voltage could be addressed with each action			
	2022 SOP	2025 SOP	2025 SOP HRE	2030 SOP
Pittsburg 230/115kV	7	0	16	0
San Ramon 230/60kV	20	0	0	0
Monta Vista new 230kV shunt reactor	0	4	14	0
Monta Vista 115/60kV	1	13	16	14
Herdlyn 60/60kV	0	12	13	0
Contra Costa Sub 115/60kV	0	4	4	0
Metcalf new 230kV shunt reactor	0	1	3	0
Sobrante 230/115kV	0	0	2	0
Martinez 115kV shunt adjustment	0	0	1	0

Greater Fresno Area

Adjustment/Project	Number of buses that their high voltage could be addressed with each action			
	2022 SOP	2025 SOP	2025 SOP HRE	2030 SOP
Herndon 230/115kV	0	12	7	0
Panoche 230/115kV	4	13	12	9
Mc Call 230/115kV	10	12	12	0
Exchequer new 115 kV shunt reactor	1	13	16	1
Oro Loma 115/70kV	19	22	24	2
Borden 230/60kV	13	23	23	23
Henrietta 230/70kV	22	22	22	18
HAAS 70/13.8kV and the HAAS Vsch	1	1	1	0
Helm 230/70kV	10	11	11	10
Mendota 115/70kV	0	10	10	0
Kearney 230/70kV	0	7	7	7
Corcoran 115/70kV	5	5	5	5
Kingsburg 115/70kV	0	1	1	0
Reedley 115/70kV	3	3	3	0

Kern

Adjustment/Project	Number of buses that their high voltage could be addressed with each action			
	2022 SOP	2025 SOP	2025 SOP HRE	2030 SOP
Kern 230/115kV and 115/70kV	10	24	23	16
Arco 230/70kV	38	31	31	23
Midway 230/115kV	0	3	2	2
Wheeler 230/70kV	16	22	17	20
Taft 115/70kV	4	2	3	0

Central Coast Los Padres

Adjustment/Project	Number of buses that their high voltage could be addressed with each action			
	2022 SOP	2025 SOP	2025 SOP HRE	2030 SOP
Coburn 230/60kV	0	0	1	0
Green Valley 115/60kV	6	3	3	3
Mesa new 230kV shunt and 230/115kV	3	6	6	0
Templeton 230/70kV	0	3	3	0
Divide 115/70kV	2	2	2	2

Bulk System

Adjustment/Project	Number of buses that their high voltage could be addressed with each action			
	2022 SOP	2025 SOP	2025 SOP HRE	2030 SOP
Action plan until STATCOMs	1	0	0	0

Humboldt

- No high voltage issues were identified in the study scenarios in Humboldt area

High Level Summary of Results

- With implementation of Round Mountain and Gates STATCOM projects, there are no high voltage issues at the 500 kV system under normal conditions.
- Most high voltage issues occur in off peak cases representing middle of the day with power factor based on historical data (2025)
- While there are high voltage issues in most areas, issues in Grater Fresno and Kern areas occur in more scenarios which is in line with operators experience in real time.
- If feasible, most of the high voltage issues could be addressed by adjusting the existing system.
- Shunt reactors are required in certain areas to address high voltage issues.

Next Steps

- Consider additional sensitivity scenarios and identify high voltage mitigation measures for new sensitivity scenarios:
  - 2030 Spring off Peak with Real Time Power Factors
  - 2030 Spring off Peak with Real Time Power Factors and with COI ~ 0
  - System snapshots in Real Time

- Test the P0 potential mitigation measures under P1-P7 contingencies on spring off peak cases.
  - Modify/add mitigation measures to address all the high voltage issue under normal and contingency conditions

- Feasibility assessment and model validation
  - Work with PG&E to check the validity of the detail model in power flow cases and the feasibility of the proposed mitigation measures, especially on system adjustments (Transformer taps, generator scheduled voltage, ...)

- Update the mitigation measures if system adjustments are not feasible and propose projects if all the required analysis are complete.

SCE Metro Area
Preliminary Reliability Assessment Results

Nebiyu Yimer
Regional Transmission Engineer Lead

2020-2021 Transmission Planning Process Stakeholder Meeting
September 23-24, 2020

SCE Metro Area

- Covers SCE's system serving Los Angeles, Orange, Ventura and Santa Barbara counties
- Comprised of 500 kV and 230 kV transmission facilities
- 1-in-10 summer peak net load of 18,319 MW in 2030
- Forecast load includes the impact of 4,673 MW of BTM PV and 460 MW of AAEE
- Thermal generation capacity decreases by approximately 4,153 MW (net) by 2030 due to scheduled retirements.

SCE Metro Area Study Scenarios

- Base scenarios

No.	Case	Description
B1	2022 Summer Peak	SCE Summer peak load time (9/6 HE 17 PPT)
B2	2025 Summer Peak	SCE Summer peak load time (9/2 HE 18 PPT)
B3	2030 Summer Peak	SCE Summer peak load time (9/3 HE 20 PPT)
B4	2022 Spring Off-Peak	Spring shoulder load time (4/27 HE 21 PPT)
B5	2025 Spring Light Load	Spring minimum net load time (4/6 HE 13 PPT)

- Sensitivity scenarios

No	Case	Change From Base Assumption
S1	2025 Summer Peak	High CEC forecasted load
S2	2022 Spring Off-Peak*	Heavy renewable output and minimum gas generation commitment
S3	2022 Summer Peak	Heavy renewable output and minimum gas generation commitment

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

Demand Side Assumptions

Scenario No.	Base Case	Gross Load (MW)	AAEE (MW)	BTM-PV		Net Load (MW)	Demand Response (installed)	
				Installed (MW)	Output (MW)		Fast (MW)	Slow (MW)
B1	2022 Summer Peak	19,298	216	2,715	1,195	17,887	237	375
B2	2025 Summer Peak	19,076	370	3,600	828	17,878	237	375
B3	2030 Summer Peak	18,779	460	4,673	0	18,319	237	375
B4	2022 Spring Off-Peak	11,460	143	2,715	0	11,317	N/A	N/A
B5	2025 Spring Light Load	7,989	104	3,600	2,916	4,969	N/A	N/A
S1	2025 SP High CEC Load	20,028	370	3,600	828	18,830	237	375
S2	2022 SOP Heavy Renewable Output & Min. Gas Gen.	7,989	143	2,715	2,471	11,317	N/A	N/A
S3	2022 SP Heavy Renewable Output & Min. Gas Gen.	19,101	216	2,715	2,471	17,888	237	375

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

Supply Side Assumptions

No.	Base Case	Battery Storage (Installed) (MW)	Solar (Grid Connected)		Wind		Hydro		Thermal	
			Installed (MW)	Dispatch (MW)	Installed (MW)	Dispatch (MW)	Installed (MW)	Dispatch (MW)	Installed (MW)	Dispatch (MW)
B1	2022 Summer Peak	455	106	54	0	0	43	18	7,748	3,602
B2	2025 Summer Peak	455	106	22	0	0	43	2	4,884	3,493
B3	2030 Summer Peak	455	375	0	0	0	34	20	4,875	3,535
B4	2022 Spring Off-Peak	455	106	0	0	0	43	12	7,748	2,671
B5	2025 Spring Light Load	455	106	99	0	0	43	6	4,884	252
S1	2025 SP High CEC Load	455	106	22	0	0	43	2	4,884	3,680
S2	2022 SOP Heavy Renewable Output & Min. Gas Gen.	455	106	105	0	0	43	12	7,748	1,222
S3	2022 SP Heavy Renewable Output & Min. Gas Gen.	455	106	104	0	0	43	18	7,748	2,652

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

Previously approved transmission projects modelled in base cases

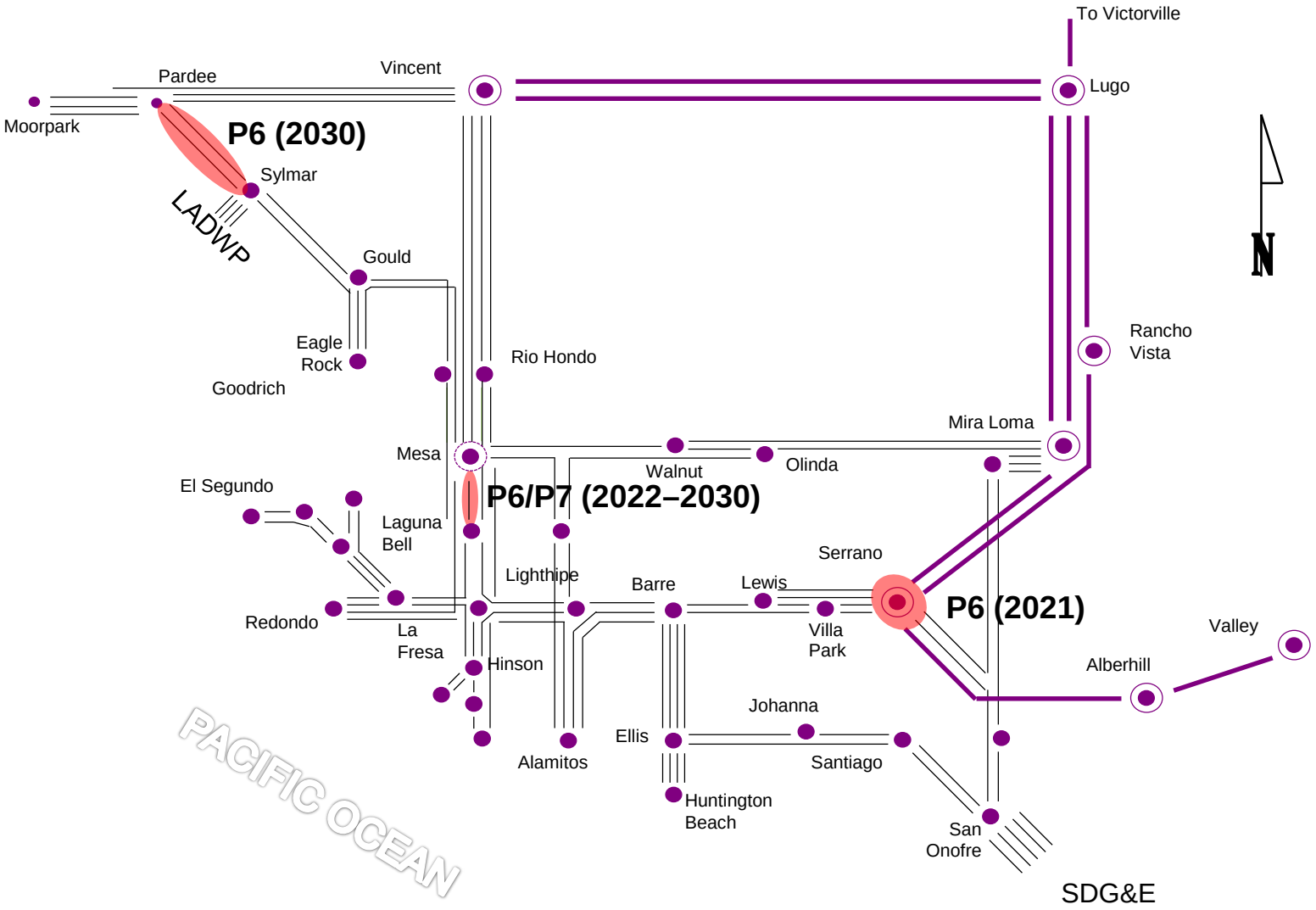
Project Name	ISD	First Year Modeled
Mesa 500 kV Substation	3/1/2022	2022
Laguna Bell Corridor Upgrade	12/31/2020	2022
Moorpark–Pardee No. 4 230 kV Circuit	6/1/2021	2022
Pardee-Sylmar No. 1 and No. 2 230 kV Lines Rating Increase	5/31/2023	2025
Riverside Transmission Reliability Project	10/1/2026	2030
Alberhill 500 kV Substation	TBD	2030

Reliability assessment preliminary results summary

Base Scenario Results – Thermal Loading

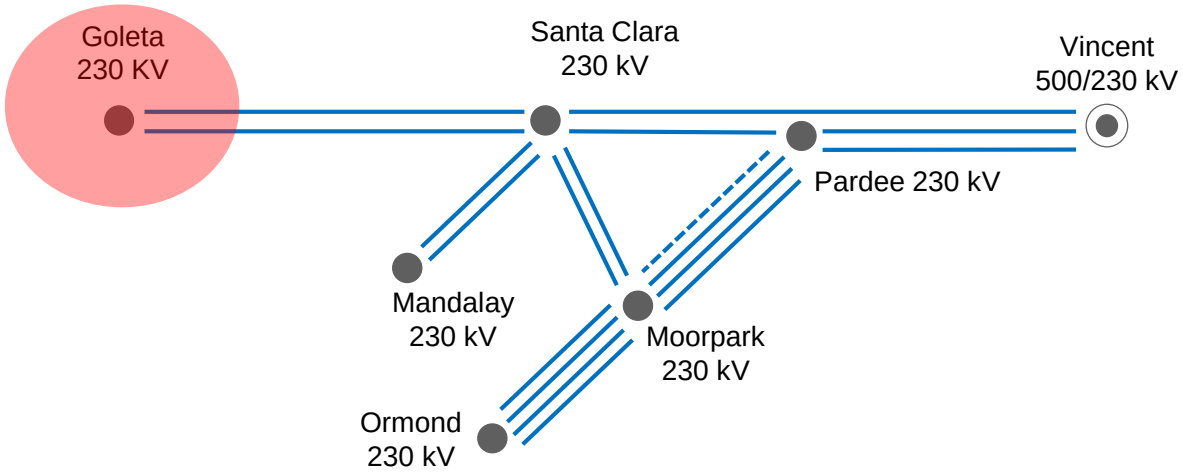
Overloaded Facility	Worst Contingency	Category	Category Description	Loading % (Baseline Scenarios)			Potential Mitigation Solutions
				2022 Summer Peak	2025 Summer Peak	2030 Summer Peak	
Pardee - Sylmar 230 kV #1 or #2	Remaining Pardee - Sylmar 230 kV line & Victorville - Lugo 500 kV line	P6	L-1/L-1	<100	<100	110	Re-dispatch resources after initial contingency
Mesa - Laguna Bell 230 kV #1	Mesa - Lighthipe & Mesa - Redondo 230 kV lines	P6	L-1/L-1	104	100	110	Re-dispatch resources; monitor LCR and economic impact
	Mesa - Lighthipe & Mesa - Laguna Bell #2 230 kV lines	P7	L-2	100	<100	102	
Serrano 500/230 kV Transformers (Worst case T2)	Two Serrano 500/230 kV Transformers	P6	T-1/T-1	<100	<100	100	OP 7590

Base Scenario Results – Thermal Loading (Cont'd)



Base Scenario Results – Low/High Voltage

Substation	Contingency (All and Worst P6)	Category	Category Description	Voltage PU 2030 Summer Peak	Potential Mitigation Solutions
Goleta	Santa Clara–Goleta #1 or #2 230 kV & Santa Clara 230 kV Shunt Capacitor	P6	N-1/L-1	0.90	CPUC-approved energy storage LCR resources



Sensitivity Assessment Results

- Facility overloads identified in sensitivity scenarios only

Overloaded Facility	Category	2025 SP High CEC Load	2022 SOP Heavy Ren. Output & Min Gas Gen. Commitment	2022 SP Heavy Ren. Output & Min Gas Gen. Commitment
Mesa 500/230 kV Transformers	P6			√
Vincent 500/230 kV Transformers	P6			√

- The overloads can be mitigated by re-dispatching generation after initial contingency

Summary of Potential New Upgrades

Concern	Potential Upgrade
None identified	

Big Creek Corridor and Tehachapi Area Preliminary Reliability Assessment Results

Nebiyu Yimer
Regional Transmission Engineer Lead

2020-2021 Transmission Planning Process Stakeholder Meeting
September 23-24, 2020

SCE Big Creek Corridor and Tehachapi Area

- Serves the large area extending north from the Metro area
- Comprised of 500 kV, 230 kV and 66 kV transmission facilities
- 1-in-10 summer peak net load of 2,437 MW in 2030
- Forecast load includes the impact of 760 MW of BTM PV and 48 MW of AAEE
- Approximately 12,000 MW of existing and committed resources comprised of solar, wind, gas-fired, hydro and storage battery

Study Scenarios

- Base scenarios

No.	Case	Description
B1	2022 Summer Peak	SCE Summer peak load time (9/6 HE 17 PPT)
B2	2025 Summer Peak	SCE Summer peak load time (9/2 HE 18 PPT)
B3	2030 Summer Peak	SCE Summer peak load time (9/3 HE 20 PPT)
B4	2022 Spring Off-Peak	Spring shoulder load time (4/27 HE 21 PPT)
B5	2025 Spring Light Load	Spring minimum net load time (4/6 HE 13 PPT)

- Sensitivity scenarios

No	Case	Change From Base Assumption
S1	2025 Summer Peak	High CEC forecasted load
S2	2022 Spring Off-Peak*	Heavy renewable output and minimum gas generation commitment
S3	2022 Summer Peak	Heavy renewable output and minimum gas generation commitment

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

Demand Side Assumptions

Scenario No.	Base Case	Gross Load (MW)	AAEE (MW)	BTM-PV		Net Load (MW)	Demand Response (installed)	
				Installed (MW)	Output (MW)		Fast (MW)	Slow (MW)
B1	2022 Summer Peak	2,607	20	482	212	2,375	67	21
B2	2025 Summer Peak	2,536	35	570	131	2,370	67	21
B3	2030 Summer Peak	2,485	48	760	0	2,437	67	21
B4	2022 Spring Off-Peak	1,627	12	482	0	1,615	N/A	N/A
B5	2025 Spring Light Load	1,045	10	570	462	574	N/A	N/A
S1	2025 SP High CEC Load	2,661	35	570	131	2,495	67	21
S2	2022 SOP Heavy Renewable Output & Min. Gas Gen.	2,065	12	482	439	1,615	N/A	N/A
S3	2022 SP Heavy Renewable Output & Min. Gas Gen.	2,833	20	482	439	2,375	67	21

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

Supply Side Assumptions

No.	Base Case	Battery Storage (Installed) (MW)	Solar (Grid Connected)		Wind		Hydro		Thermal	
			Installed (MW)	Dispatch (MW)	Installed (MW)	Dispatch (MW)	Installed (MW)	Dispatch (MW)	Installed (MW)	Dispatch (MW)
B1	2022 Summer Peak	643	5080	2591	3529	706	1227	637	1,517	559
B2	2025 Summer Peak	643	5080	1040	3529	871	1227	1021	1,517	1,367
B3	2030 Summer Peak	663	6194	0	3523	1412	1233	1018	1,517	765
B4	2022 Spring Off-Peak	643	5080	0	3529	1376	1227	798	1,517	602
B5	2025 Spring Light Load	643	5080	4751	3529	1200	1227	422	1,517	-
S1	2025 SP High CEC Load	643	5080	1040	3529	871	1227	1021	1,517	1,416
S2	2022 SOP Heavy Renewable Output & Min. Gas Gen.	643	5080	5029	3529	2365	1227	847	1,517	-
S3	2022 SP Heavy Renewable Output & Min. Gas Gen.	643	5080	5029	3529	0	1227	637	1,517	-

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

Previously approved transmission projects modelled in base cases

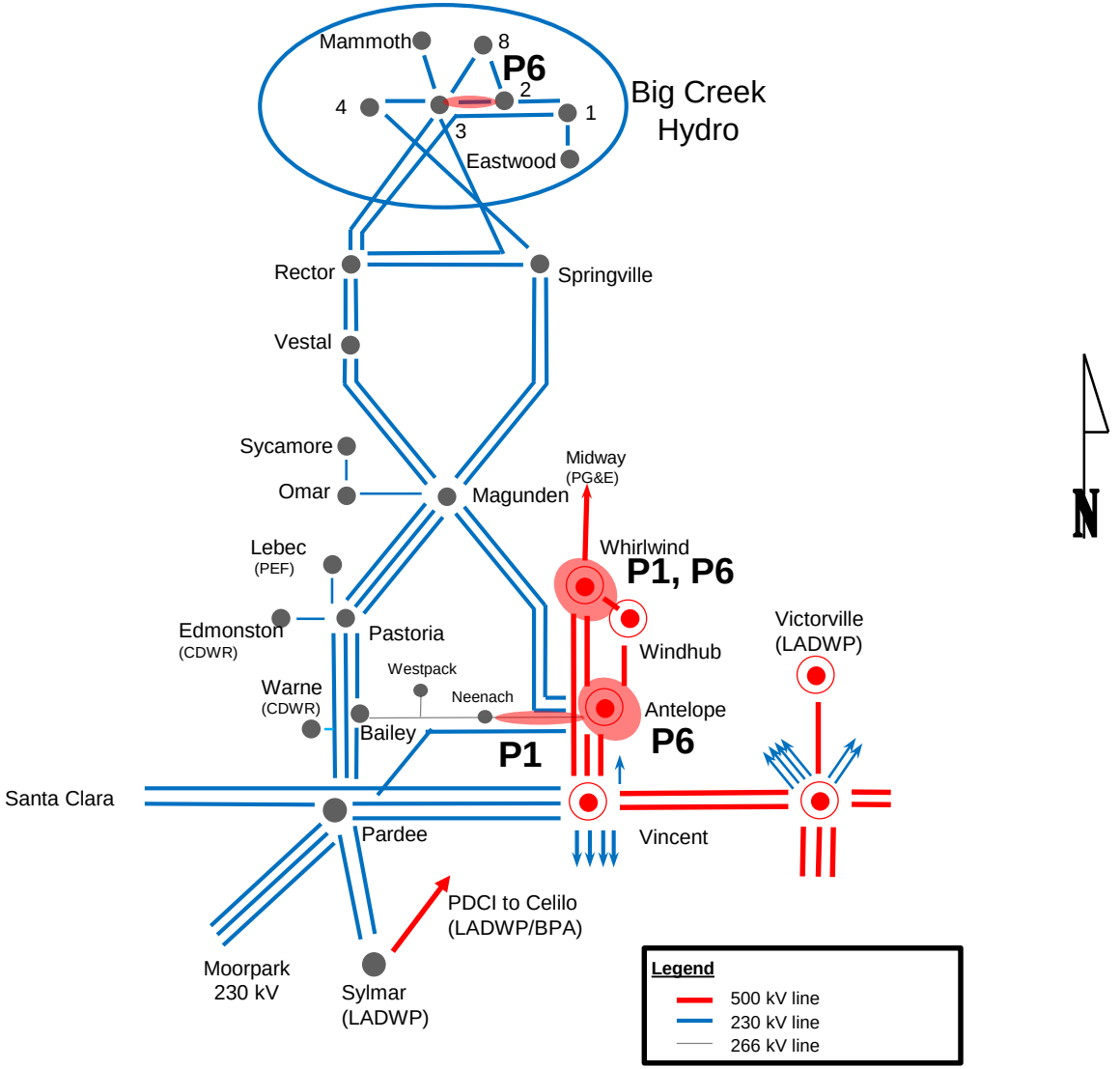
Project Name	ISD	First Year Modeled
Big Creek Corridor Rating Increase	In-service	2022

Reliability assessment preliminary results summary

Base Scenario Results – Thermal Loading

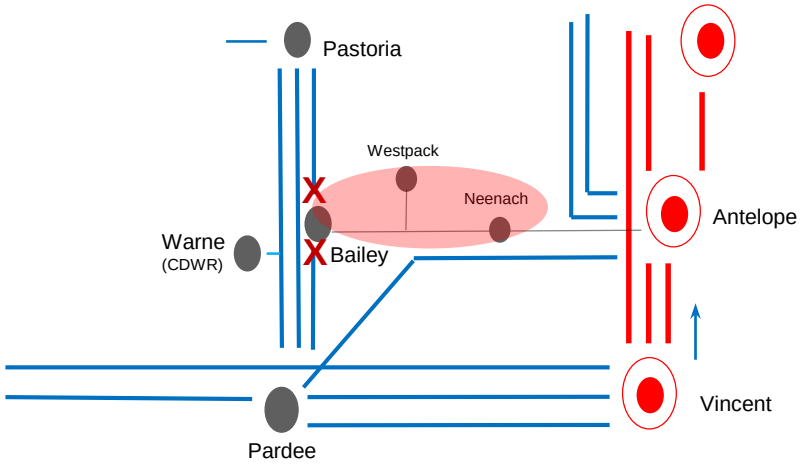
Overloaded Facility	Contingency (All and Worst P6)	Category	Category Description	Loading %					Potential Mitigation Solutions
				2022 Summer Peak	2025 Summer Peak	2030 Summer Peak	2022 Spring Off-Peak	2025 Spring Off-Peak	
Whirlwind 500/230 kV Transformers	One Whilwind 500/230 kV Transformer	P1	N-0	<100	<100	<100	<100	116	Whirlwind RAS
	Two Whirlwind 500/230 kV Transformers	P6	T-1/T-1	127	<100	<100	<100	241	
Antelope–Neenach 66 kV	Neenack — Bailey/Westpack 66 kV	P1/P2.1	L-1	<100	<100	<100	<100	101	Congestion management
Big Creek 2–Big Creek 3 230 kV	Big Creek 1–Rector & Big Creek 8–Big Creek 3 230 kV lines	P6	L-1/L-1	<100	130	130	136	<100	Reduce Big Creek generation after initial contingency
	Big Creek 1–Rector & Big Creek 8–Big Creek 2 230 kV lines	P6	L-1/L-1	<100	114	114	120	<100	
Antelope 230/66 kV Transformers	Two Antelope 230/66 kV Transformers	P6	T-1/T-1	<100	124	157	<100	<100	Energize spare after initial contingency

Base Scenario Results – Thermal Loading (Cont'd)



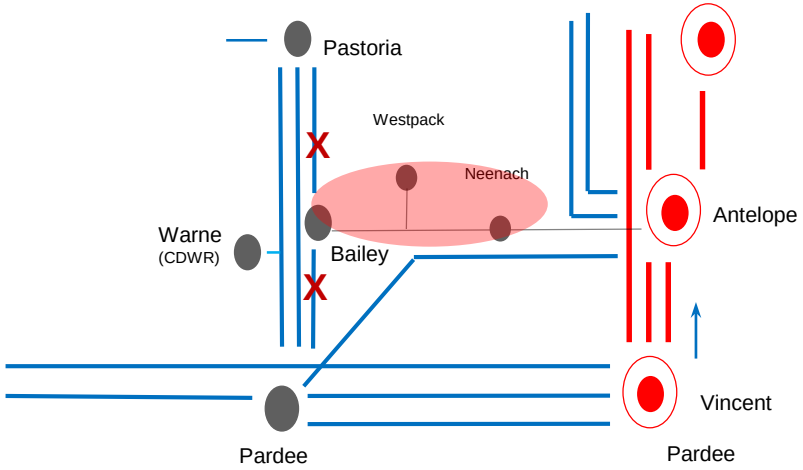
Base Scenario Results – Low/High Voltage

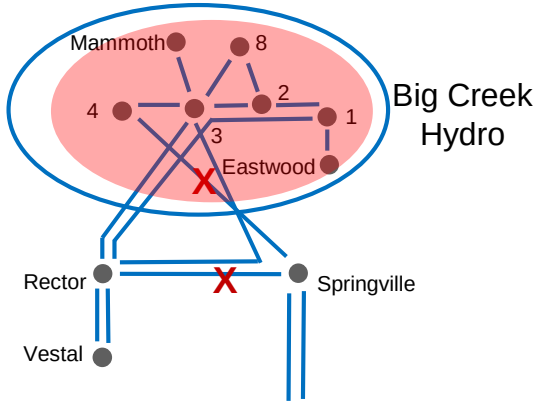
Substation	Contingency (All and Worst P6)	Category	Category Description	Voltage (p.u.)				ISO Approved Projects & Potential Mitigation Solutions
				2022 Summer Peak	2025 Summer Peak	2030 Summer Peak	2022 Spring Off-Peak	
Bailey 66 kV sytem	Bailey–Pardee & Bailey–Pastoria 230 kV	P6	L-1/L-1	Diverged	Diverged	Diverged	Diverged	Split Antelope–Bailey 66 kV System per existing SCE operating procedure after initial contingency
Bailey 66 kV sytem	Bailey 230/66 kV #2 $ #3 Transformers	P6	T-1/T-1	Diverged	Diverged	Diverged	Diverged	



Base Scenario Results – Transient Stability

Contingency (All and Worst P6)	Category	Category Description	2030 Summer Peak	ISO Approved Projects & Potential Mitigation Solutions
Bailey–Pardee & Bailey–Pastoria 230 kV, 3-PH Fault @ Pardee, Normal Clearing	P6	L-1/L-1	Local 66 kV instability	Split Antelope–Bailey 66 kV System per existing SCE operating procedure after initial contingency
Big Creek 4-Springville & Rector-Springville, 3-PH Fault @ Big Creek 4, Normal Clearing	P6	T-1/T-1	Local instability	Big Creek RAS





Sensitivity Assessment Results

- Facility overloads identified in sensitivity scenarios only

Overloaded Facility	Category	2025 SP High CEC Load	2022 SOP Heavy Ren. Output & Min Gas Gen. Commitment	2022 SP Heavy Ren. Output & Min Gas Gen. Commitment
Whirlwind 500/230 kV Transformers	P0		√	
Neenach – Bailey/Westpack Tap 66 kV	P0			√

- The overloads can be mitigated using congestion management

Summary of Potential New Upgrades

Concern	Potential Upgrade
None identified	

SCE Eastern Area
Preliminary Reliability Assessment Results

Charles Cheung
Senior Regional Transmission Engineer

2020-2021 Transmission Planning Process Stakeholder Meeting
September 23-24, 2020

SCE Eastern Area

- Includes the SCE owned transmission system in the Riverside County around and east of the Devers Substation
- Comprised of 500, 230 and 161 kV transmission facilities.
- Summer Peak net load of 4,758 MW in 2022

SCE Eastern Area Study Scenarios

- Base scenarios

No.	Case	Description
B1	2022 Summer Peak	Summer peak load time (9/6 Hour 16)
B2	2025 Summer Peak	Summer peak load time (9/2 Hour 17)
B3	2030 Summer Peak	Summer peak load time (9/3 Hour 19)
B4	2022 Spring Off-Peak	Spring shoulder load time (4/27 Hour 20)
B5	2025 Spring Light Load	Spring minimum net load time (4/6 Hour 13)

- Sensitivity scenarios

No	Case	Change From Base Assumption
S1	2025 Summer Peak	High CEC forecasted load
S2	2022 Spring Off-Peak*	Heavy renewable output and minimum gas generation commitment
S3	2022 Summer Peak	Heavy renewable output and minimum gas generation commitment

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

Demand Side Assumptions

S. No.	Base Case	Gross Load (MW)	AAEE (MW)	BTM-PV		Net Load (MW)	Demand Response	
				Installed (MW)	Output (MW)		Fast	Slow
B1	2022 Summer Peak	5212	65	885	389	4758	53	5
B2	2025 Summer Peak	5183	131	1088	250	4802	53	5
B3	2030 Summer Peak	5143	177	1384	0	4966	53	5
B4	2022 Off Peak	3063	65	885	0	2997	53	5
B5	2025 Off Peak	2356	131	1088	881	1345	53	5
S1	2025 Peak High CEC Load	5436	131	1088	250	5055	53	5
S2	2022 Off Peak Heavy Renewable Output & Min. Gas Gen.	3868	65	885	805	2997	53	5
S3	2022 Peak Heavy Renewable Output & Min. Gas Gen.	5628	65	885	805	4758	53	5

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

Supply Side Assumptions

S. No.	Base Case	Battery Storage (MW)	Solar		Wind		Hydro		Thermal	
			Installed (MW)	Dispatch (MW)	Installed (MW)	Dispatch (MW)	Installed (MW)	Dispatch (MW)	Installed (MW)	Dispatch (MW)
B1	2022 Summer Peak	0	2892	1473	637	127	315	0	4022	2064
B2	2025 Summer Peak	0	2892	607	637	141	315	119	4022	1338
B3	2030 Summer Peak	0	5742	0	679	271	315	119	4022	2871
B4	2022 Off Peak	0	2892	2	637	248	315	51	4022	1356
B5	2025 Off Peak	0	2892	2718	637	216	315	0	4022	0
S1	2025 Peak High CEC Load	0	2892	607	637	141	315	119	4022	2345
S2	2022 Off Peak Heavy Renewable Output & Min. Gas Gen.	0	2892	2863	637	427	315	51	4022	701
S3	2022 Peak Heavy Renewable Output & Min. Gas Gen.	0	2892	2863	637	0	315	0	4022	222

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

Previously approved transmission projects modelled in base cases

Project Name	ISD	First Year Modeled
West of Devers Upgrade	Dec. 2021	2022
Delaney-Colorado River 500 kV line	Dec. 2021	2022
Riverside Transmission Reliability Project	10/1/2026	2030
Alberhill 500 kV Substation	TBD	2030

Neighboring system transmission projects modelled in base cases

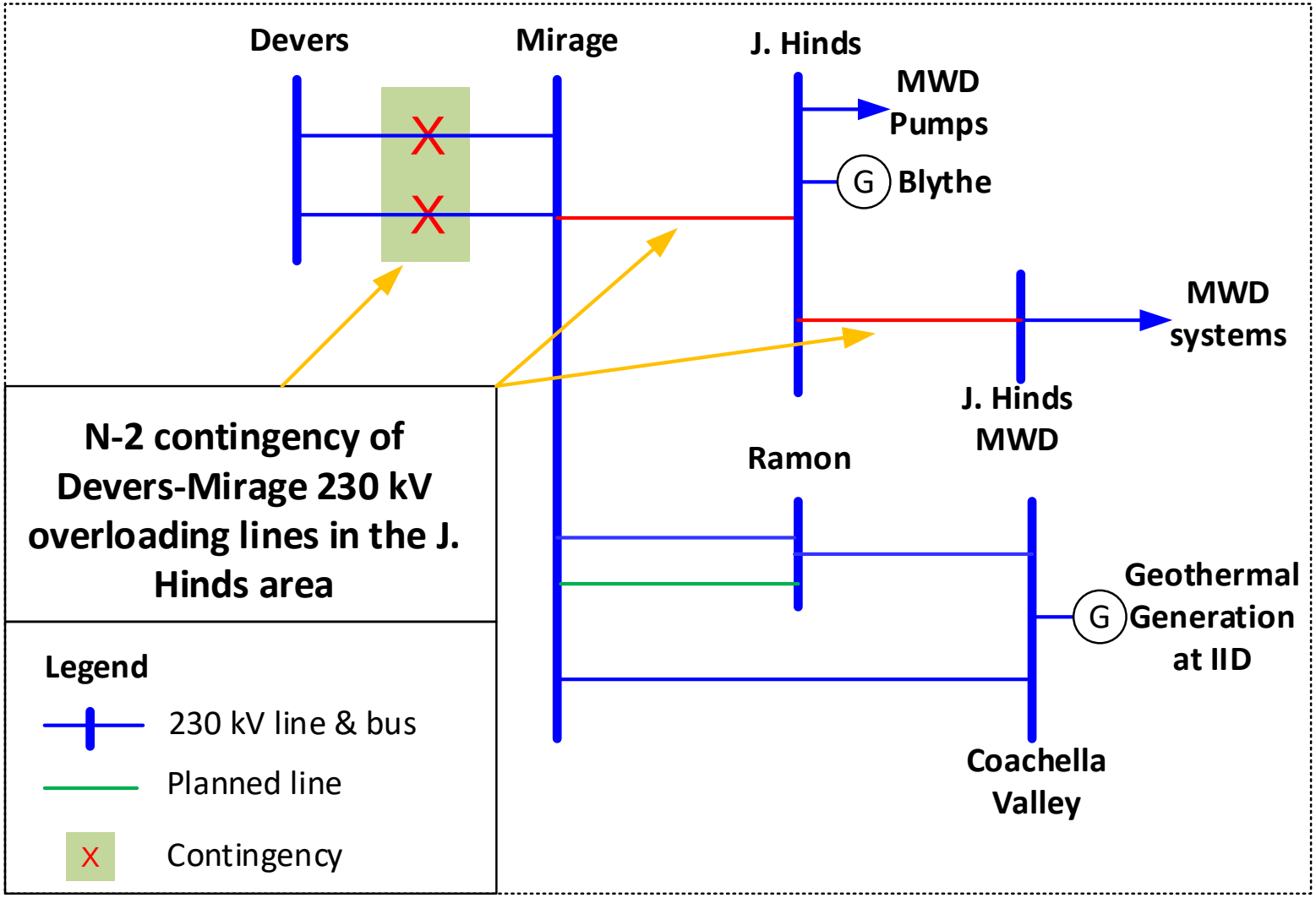
Project Name	ISD	First Year Modeled
2nd Mirage-Ramon 230 kV line	TBD	2025

Reliability assessment preliminary results summary

Base Scenario Results – Thermal Loading

Overloaded Facility	Worst Contingency	Category	Loading % (Baseline Scenarios)					Potential Mitigation Solutions
			2022 Summer Peak	2025 Summer Peak	2030 Summer Peak	2022 Spring Off-Peak	2025 Spring Off-Peak	
Julian Hinds MWD-Julian Hinds 230 kV #1	Devers-Mirage 230 kV #1 and 2	P7	93.69	<90	Non-converge	138.6	<90	Existing RAS to trip generation in Blythe and IID. Planned RAS to trip additional generation and capacitor banks in IID

Base Scenario Results – Thermal Loading (Cont'd)



Stability Results

Contingency	Category	Loading % (Baseline Scenarios)					Potential Mitigation Solutions
		2025 Summer Peak	2030 Summer Peak	2022 Spring Off-Peak	2025 Peak High CEC Forecast	2022 Spring Off-Peak High Renewable	
SLG Fault at Devers 230 kV, tripping Devers - Mirage 230 kV #1 & #2	P7	Stable	Unstable	Stable	Stable	Stable	Existing RAS to trip generation in Blythe and IID. Planned RAS to trip additional generation and capacitor banks in IID

Summary of Potential New Upgrades

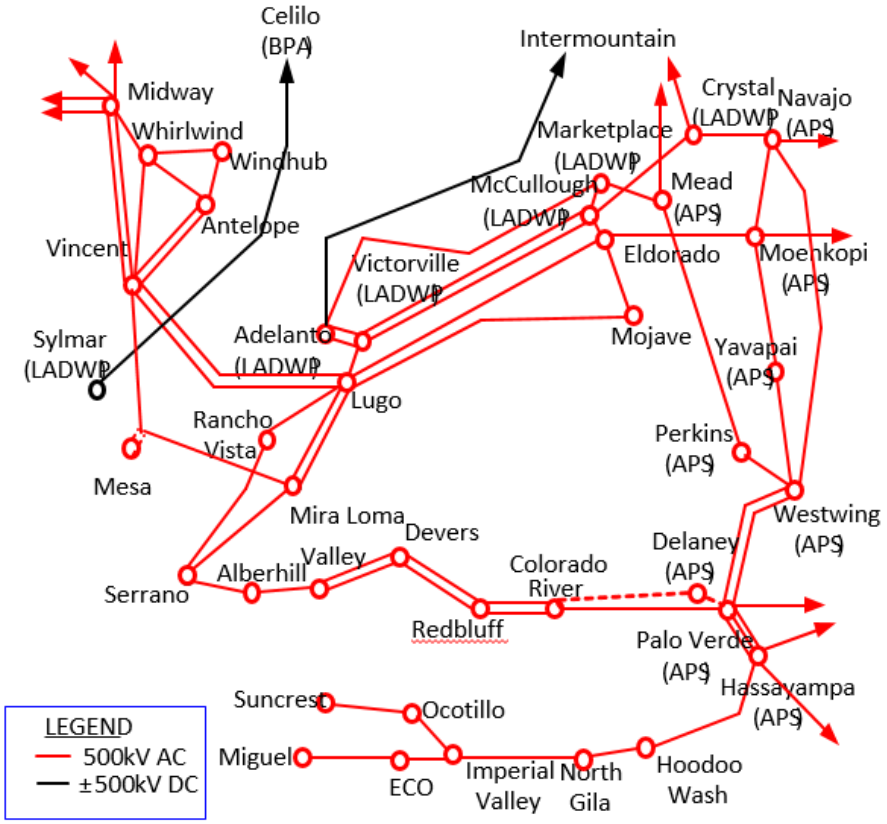
Concern	Potential Upgrade
None identified	

SCE Bulk
Preliminary Reliability Assessment Results

Meng Zhang
Sr Regional Transmission Engineer

2020-2021 Transmission Planning Process Stakeholder Meeting
September 23-24, 2020

SCE Bulk System



- SCE 500 kV system including interconnections with neighboring systems
- 1-in-5 summer peak net load of 22,628 MW in 2030
- Forecast 7,698 MW of BTM PV and 746 MW of AAEE by 2030
- 31,585 MW of existing generation

SCE Bulk Area Study Scenarios

- Base scenarios

No.	Case	Description
B1	2022 Summer Peak	1-in 5 summer peak load (9/6 HE 16 PPT)
B2	2025 Summer Peak	Consolidated CAISO summer peak (9/2 HE 18 PPT)
B3	2030 Summer Peak	Consolidated CAISO summer peak (9/3 HE 19 PPT)
B4	2022 Spring Off-Peak	Spring shoulder load time (4/27 HE20 PPT)
B5	2025 Spring Light Load	CAISO spring minimum net load time (4/6 HE 13 PPT)
B6	2030 Spring Light Load	CAISO spring minimum net load time (4/7 HE 13 PPT)

- Sensitivity scenarios

No	Case	Change From Base Assumption
S1	2025 Summer Peak	High CEC forecasted load
S2	2022 Spring Off-Peak*	Heavy renewable output and minimum gas generation commitment
S3	2022 Summer Peak	Heavy renewable output and minimum gas generation commitment

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

Load and Load Modifier Assumptions – SCE Bulk

Scenario No.	Case	Gross Load (MW)	AAEE (MW)	BTM-PV MW)		Net Load (MW)	Demand Response (Installed)	
				Installed	Output		Fast (MW)	Slow (MW)
B1	2022 Summer Peak	25400	282	4540	1998	23120	397	448
B2	2025 Summer Peak	23506	583	5899	295	22628	397	448
B3	2030 Summer Peak	23260	746	7698	0	22628	397	448
B4	2022 Spring Off-peak	15098	178	4540	0	14920	N/A	N/A
B5	2025 Spring Light Load	11574	163	5899	4778	6633	N/A	N/A
B6	2030 Summer Light	11983	172	7698	6235	5576	N/A	N/A
S1	2025 SP High CEC Load	26789	583	5899	1357	24849	397	448
S2	2022 SOP Heavy Renewable Output & Min. Gas Gen	19229	178	4540	0	19051	N/A	N/A
S3	2022 SP Heavy Renewable Output & Min. Gas Gen.	28103	282	4540	4131	23690	N/A	N/A

Generation Assumptions – SCE Bulk System

Scenario No.	Case	Installed Battery Storage (MW)	Solar		Wind		Hydro		Thermal	
			Installed (MW)	Dispatch (MW)	Installed (MW)	Dispatch (MW)	Installed (MW)	Dispatch (MW)	Installed (MW)	Dispatch (MW)
B1	2022 Summer Peak	1208	10291	5248	4166	833	1688	445	14231	6017
B2	2025 Summer Peak	1208	10291	206	4166	1295	1688	913	11367	8975
B3	2030 Summer Peak	1229	16315	0	4201	1683	1685	933	11321	7771
B4	2022 Spring Off Peak	1208	10291	2	4166	1625	1688	692	14231	5383
B5	2025 Spring Off Peak	1208	10291	9650	4166	1416	1688	428	11414	512
B6	2030 Spring Off Peak	1229	16082	10636	4208	1431	1688	-517	11484	536
S1	2025 SP High CEC Load	1208	10291	2133	4166	1012	1688	913	11367	9401
S2	2022 SOP Heavy Renewable Output & Min. Gas Gen	1208	10291	10189	4166	2791	1688	692	14231	1810
S3	2022 SP Heavy Renewable Output & Min. Gas Gen.	1208	10291	10189	4166	0	1688	445	14231	3570

Previously Approved Transmission Projects

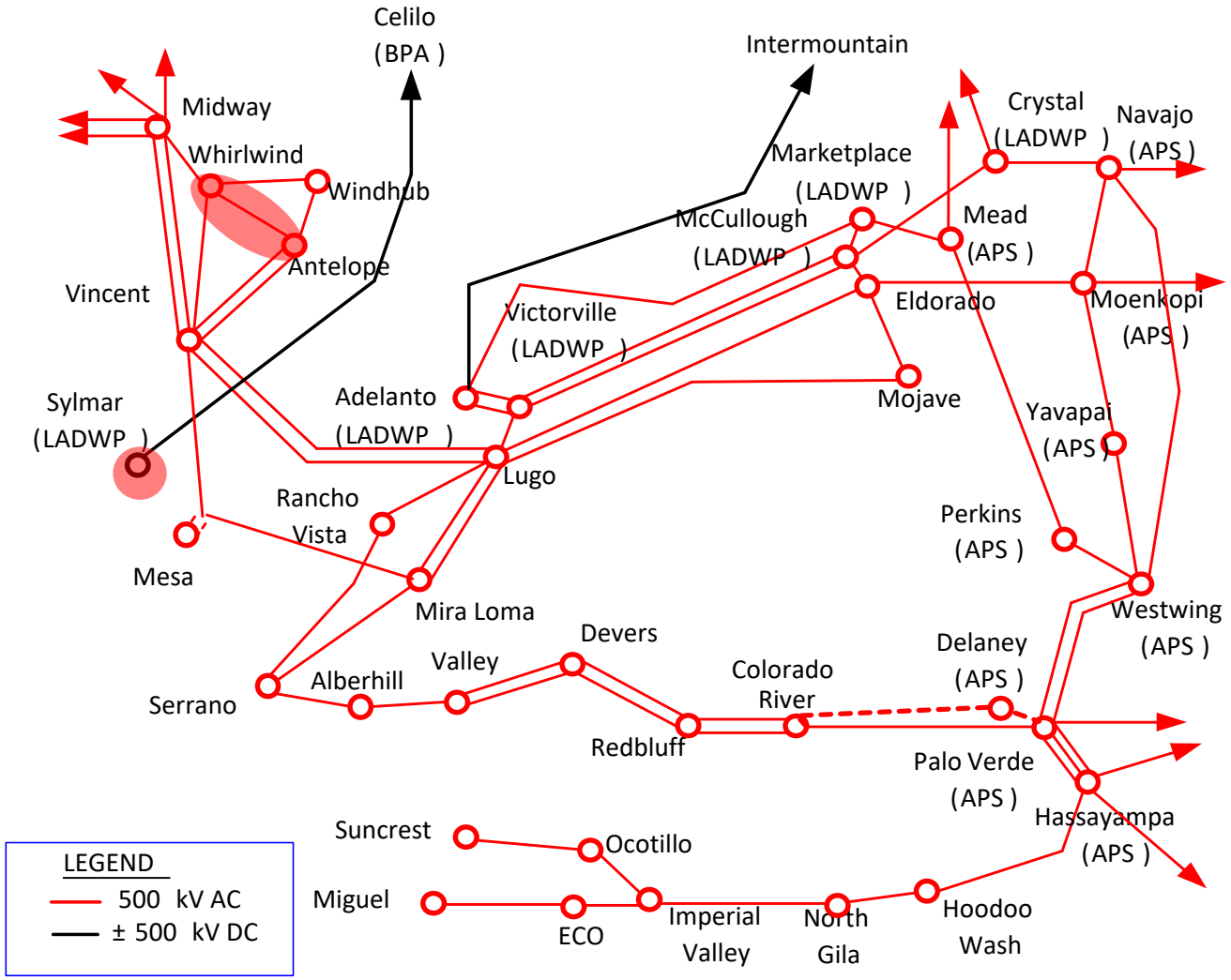
Project Name	ISD	First Year Modeled
Lugo – Victorville 500 kV Upgrade	Dec. 2021	2022
Delaney – Colorado River 500 kV Line	Dec. 2021	2022
Mesa 500 kV Substation	Mar. 2022	2022
Alberhill 500 kV Substation	TBD	2030

Reliability assessment preliminary results summary

Base Scenario Results – Thermal Loading

Overloaded Facility	Contingency (All and Worst P6)	Category	Category Description	Loading % (Baseline Scenarios)						Project & Potential Mitigation Solutions
				2022 Summer Peak	2025 Summer Peak	2030 Summer Peak	2022 Spring Off-Peak	2025 Spring Off-Peak	2030 Spring Off-Peak	
ANTELOPE-WIRLWIND 500kV	ANTELOPE 500.0 to WINDHUB 500.0 Circuit 1 & VINCENT 500.0 to WIRLWIND 500.0 Circuit 3	P6	N-1-1	<100	<100	<100	<100	108.54	<100	Generation redispatch, reduce gen at Whirlwind 230kV
The remaining two Sylmar banks	Lugo-Victorville 500kV & one Sylmar bank	P6	N-1-1	<100	<100	142.56	<100	<100	<100	Reduce PDCI and generation redispatch following the first outage

SCE Bulk Thermal Overloads



Base Scenario Results – Low/High Voltage

- There is no low/high voltage issues identified in the SCE bulk system assessment

Sensitivity Study Assessment

- Facility overloads identified in sensitivity scenarios only

Overloaded Facility	Contingency (All and Worst P6)	Category	Loading % (Sensitivity Scenarios)		
			2025 SP High CEC Forecast	2022 SpOP Hi Renew & Min Gas Gen	2022 SP Heavy Renewable & Min Gas Gen
Serrano 500/230kV transformers	Loss of two Serrano 500/230kV transformers	P6	✓	✓	
Vincent 500/230kV transformer No. 2 or 3	Vincent-Mesa 500kV & Vincent 500/230kV transformer No.3 or 2	P6			✓
Vincent 500/230kV transformer No. 1 or 4	Vincent-Mesa 500kV & Vincent 500/230kV transformer No.4 or 1	P6			✓

- Mitigation includes operating procedures and re-dispatch of resources 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

2020-2021 Transmission Planning Process Stakeholder Meeting
September 23-24, 2020

SCE North of Lugo (NOL) Area

- Comprised of 55, 115 and 230 kV transmission facilities
- Total installed generation capacity in the area is over 2400 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	2022 Summer Peak	SCE Summer peak load time
B2	2025 Summer Peak	SCE Summer peak load time
B3	2030 Summer Peak	SCE Summer peak load time
B4	2022 Spring Off-Peak	Spring shoulder load time
B5	2024 Spring Light Load	Spring minimum net load time

- Sensitivity scenarios

No	Case	Change From Base Assumption
S1	2025 Summer Peak	High CEC forecasted load
S2	2022 Spring Off-Peak*	Heavy renewable output and minimum gas generation commitment
S3	2022 Summer Peak	Heavy renewable output and minimum gas generation commitment

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

Demand Side Assumptions

Scenario No.	Case	Installed Battery Storage (MW)	Solar		Wind		Hydro		Thermal	
			Installed (MW)	Dispatch (MW)	Installed (MW)	Dispatch (MW)	Installed (MW)	Dispatch (MW)	Installed (MW)	Dispatch (MW)
B1	2022 Summer Peak	110	1003	893	0	0	74	54	1381	425
B2	2025 Summer Peak	110	1003	893	0	0	74	54	1381	1255
B3	2030 Summer Peak	110	1366	1256	0	0	74	54	1381	1255
B4	2022 Spring Off Peak	110	1003	893	0	0	74	54	1381	425
B5	2025 Spring Off Peak	110	1003	893	0	0	74	54	1381	1255
S1	2025 SP High CEC Load	110	1003	211	0	0	74	0	1381	1065
S2	2022 SOP Heavy Renewable Output & Min. Gas Gen	110	1003	993	0	0	74	22	1381	376
S3	2022 SP Heavy Renewable Output & Min. Gas Gen.	110	1003	993	0	0	74	21	1381	695

Supply Side Assumptions

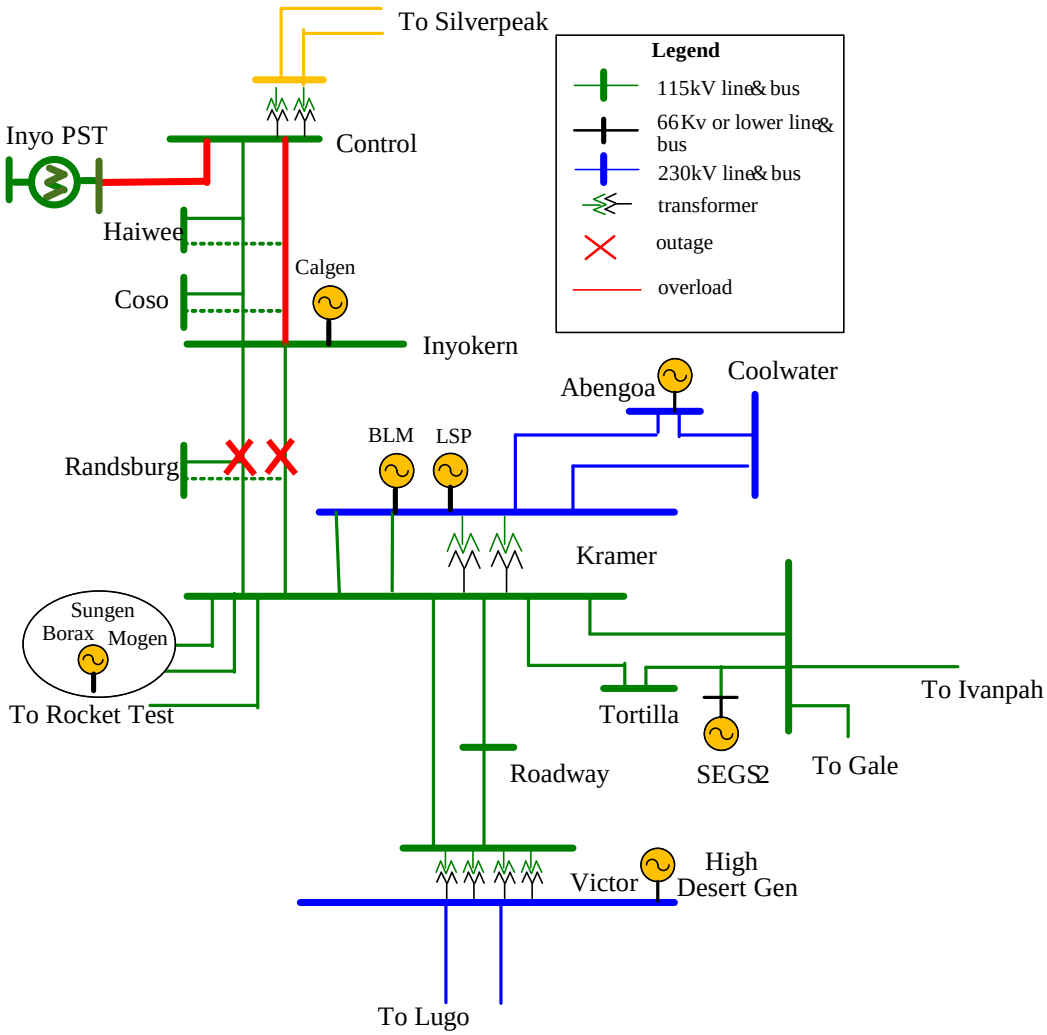
Scenario No.	Case	Gross Load (MW)	AAEE (MW)	BTM-PV MW)		Net Load (MW)	Demand Response (Installed)	
				Installed	Output		Fast (MW)	Slow (MW)
B1	2022 Summer Peak	1176	6	856	377	793	66	33
B2	2025 Summer Peak	1071	11	1113	256	804	66	33
B3	2030 Summer Peak	842	14	1453	0	828	66	33
B4	2022 Spring Off Peak	504	4	856	0	500	N/A	N/A
B5	2025 Spring Off Peak	1130	3	1113	902	225	N/A	N/A
S1	2025 SP High CEC Load	1113	11	1113	256	846	66	33
S2	2022 SOP Heavy Renewable Output & Min. Gas Gen	1282	4	856	779	499	N/A	N/A
S3	2022 SP Heavy Renewable Output & Min. Gas Gen.	1578	6	856	779	793	N/A	N/A

Reliability Assessment
Preliminary Results Summary

Base Scenario Results – Thermal Loading

Overloaded Facility	Contingency (All and Worst P6)	Category	Category Description	Loading % (Baseline Scenarios)					Project & Potential Mitigation Solutions
				2022 Summer Peak	2025 Summer Peak	2030 Summer Peak	2022 Spring Off-Peak	2025 Spring Off-Peak	
Control-Inyo 115kV Line	INYOKERN - KRAMER 115.0 ck 1 and KRAMER-INYOKERN-RANDSB 115 ck 1	P6	N-1-1	138.38	139.44	153.41	Nonconv	Nonconv	Operating Procedure 7690

Base Scenario Results – continued



Base Scenario Results – Low/High Voltage

Substation	ontingency (All and Worst P	Category	Category Description	Voltage PU (Baseline Scenarios)					Project & Potential Mitigation Solutions
				2022 Summer Peak	2025 Summer Peak	2030 Summer Peak	2022 Spring Off-Peak	2025 Spring Off-Peak	
Coolwater 115kV	KRAMER - COLWATER 115.0 ck 1 & COLWATER-SEG2-TORTILLA 115 ck 1	P6	N-1-1	0.80	0.82	0.76	>0.9	>0.9	Operating Procedure 127
Inyo 115kV	CONTROL - INYO 115.0 ck 1	P1	N-1	1.17	1.20	<1.1	1.16	1.13	Future shunt reactor at Inyo 230kV bus
Control 115kV	INYOKERN - KRAMER 115.0 ck 1 and KRAMER-INYOKERN-RANDSB 115 ck 1	P6	N-1-1	>0.9	>0.9	0.85	>0.9	>0.9	Operating Procedure 7690

Summary of Potential New Upgrades

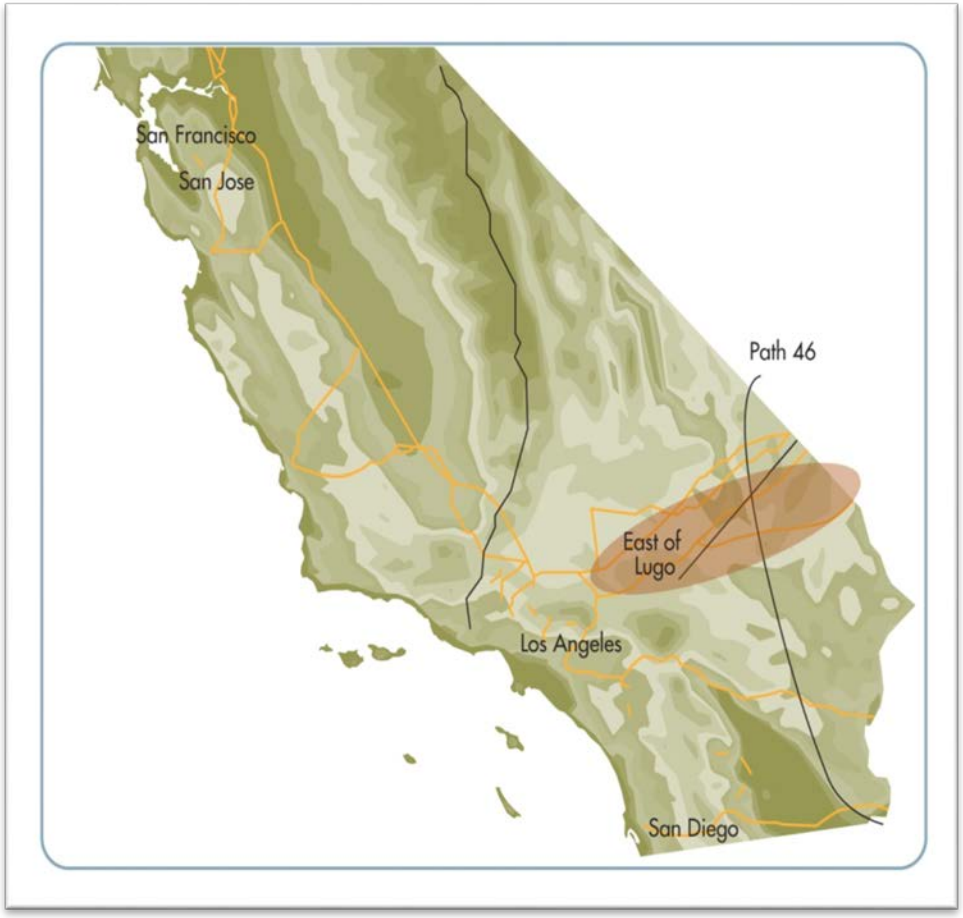
Concern	Potential Upgrade
- High voltage at Inyo 115kV bus following P1 contingency	- Shunt reactor at Inyo 230kV bus

SCE East of Lugo Area
Preliminary Reliability Assessment Results

Meng Zhang
Sr Regional Transmission Engineer

2020-2021 Transmission Planning Process Stakeholder Meeting
September 23-24, 2020

East of Lugo (EOL) Area



- Comprised of 115, 230 & 500 kV transmission facilities.
- Includes Eldorado, Mohave, Merchant, Ivanpah, CIMA, Pisgah Mountain Pass, Dunn Siding and Baker substations
- Total installed generation capacity is about 1779 MW. And over 70% of the total capacity is solar generation.
- The load is mostly served from CIMA 66kV substation.

SCE EOL Area Study Scenarios

- Base scenarios

No.	Case	Description
B1	2022 Summer Peak	SCE Summer peak load time (9/6 HE 17 PPT)
B2	2025 Summer Peak	SCE Summer peak load time (9/2 HE 18 PPT)
B3	2030 Summer Peak	SCE Summer peak load time (9/3 HE 20 PPT)
B4	2022 Spring Off-Peak	Spring shoulder load time (4/27 HE 21 PPT)
B5	2024 Spring Light Load	Spring minimum net load time (4/6 HE 13 PPT)

- Sensitivity scenarios

No	Case	Change From Base Assumption
S1	2025 Summer Peak	High CEC forecasted load
S2	2022 Spring Off-Peak*	Heavy renewable output and minimum gas generation commitment
S3	2022 Summer Peak	Heavy renewable output and minimum gas generation commitment

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

Demand Side Assumptions

Scenario No.	Case	Gross Load (MW)	AAEE (MW)	BTM-PV MW)		Net Load (MW)	Demand Response (Installed)	
				Installed	Output		Fast (MW)	Slow (MW)
B1	2022 Summer Peak	2.18	0	0.19	0.08	2.1	0	0
B2	2025 Summer Peak	2.02	0	0.57	0.13	1.89	0	0
B3	2030 Summer Peak	1.7	0	1.16	0	1.71	0	0
B4	2022 Spring Off Peak	1.32	0	0.19	0	1.32	0	0
B5	2025 Spring Off Peak	0.99	0	0.57	0.46	0.53	0	0
S1	2025 SP High CEC Load	2.12	0	0.57	0.13	1.99	0	0
S2	2022 SOP Heavy Renewable Output & Min. Gas Gen	1.49	0	0.19	0.17	1.32	0	0
S3	2022 SP Heavy Renewable Output & Min. Gas Gen.	2.27	0	0.19	0.17	2.1	0	0

Supply Side Assumptions

Scenario No.	Case	Installed Battery Storage (MW)	Solar		Wind		Hydro		Thermal	
			Installed (MW)	Dispatch (MW)	Installed (MW)	Dispatch (MW)	Installed (MW)	Dispatch (MW)	Installed (MW)	Dispatch (MW)
B1	2022 Summer Peak	0	1254	639	0	0	0	0	525	0
B2	2025 Summer Peak	0	1254	263	0	0	0	0	525	449
B3	2030 Summer Peak	0	1254	0	0	0	0	0	525	419
B4	2022 Spring Off Peak	0	1254	0	0	0	0	0	525	419
B5	2025 Spring Off Peak	0	1254	1179	0	0	0	0	525	0
S1	2025 SP High CEC Load	0	1254	263	0	0	0	0	525	449
S2	2022 SOP Heavy Renewable Output & Min. Gas Gen	0	1254	1241	0	0	0	0	525	0
S3	2022 SP Heavy Renewable Output & Min. Gas Gen.	0	1254	1241	0	0	0	0	525	0

Previously Approved Transmission Projects

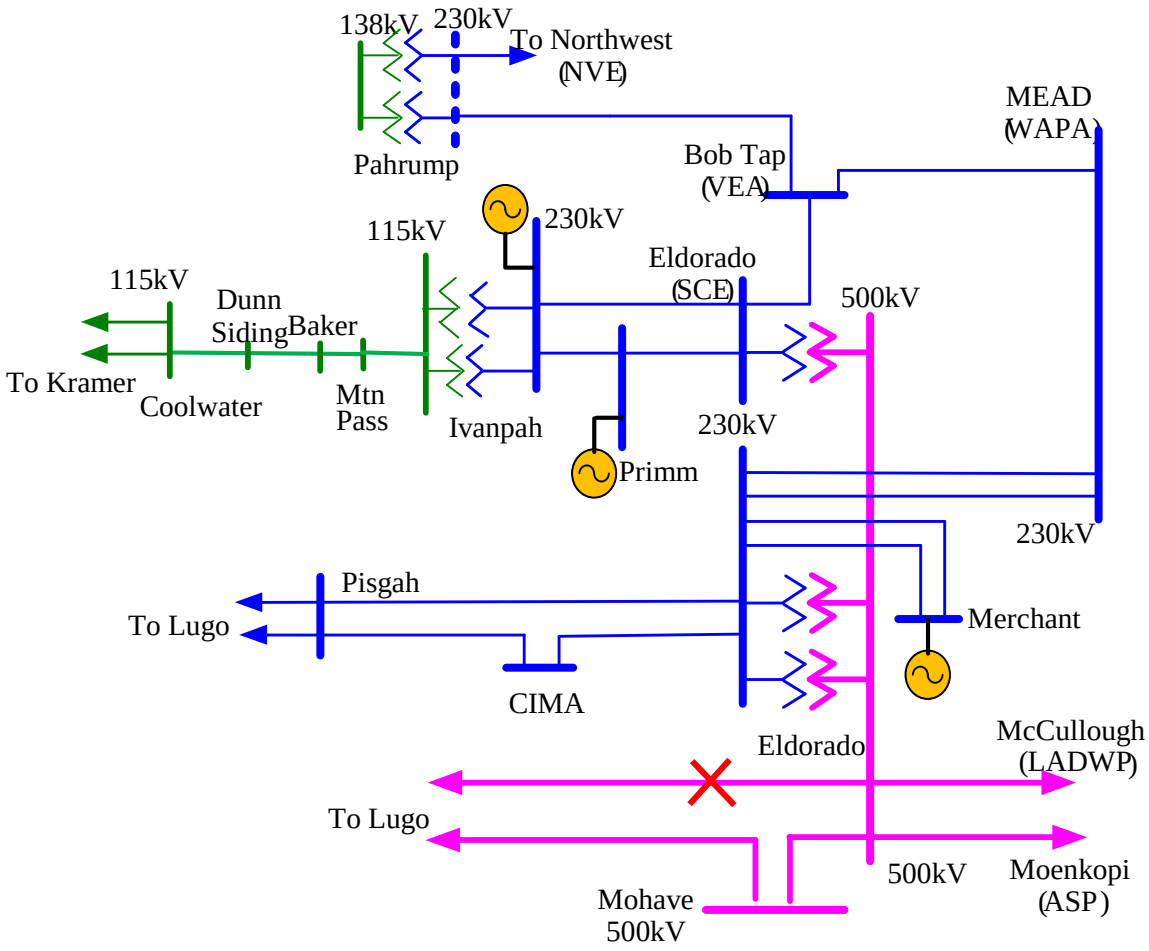
Project Name	ISD	First Year Modeled
Eldorado-Lugo Series Capacitor Upgrade	June 2021	2022
Lugo-Mohave Series Capacitor Upgrade	June 2021	2022
Calcite 230kV Substation	June 2021	2022
Lugo-Victorville 500kV Line Upgrade	June 2021	2022

Reliability assessment preliminary results summary

Base Scenario Results – Thermal Loading

Overloaded Facility	Contingency (All and Worst P6)	Category	Category Description	Loading % (Baseline Scenarios)					Project & Potential Mitigation Solutions
				2022 Summer Peak	2025 Summer Peak	2030 Summer Peak	2022 Spring Off-Peak	2025 Spring Off-Peak	
J.HINDS-MIRAGE 230kV	ELDORDO-LUGO 500kV line	P1	N-1	<100	103.95	<100	<100	<100	Blythe Energy RAS

Base Scenario Results – continued



Summary of Potential New Upgrades

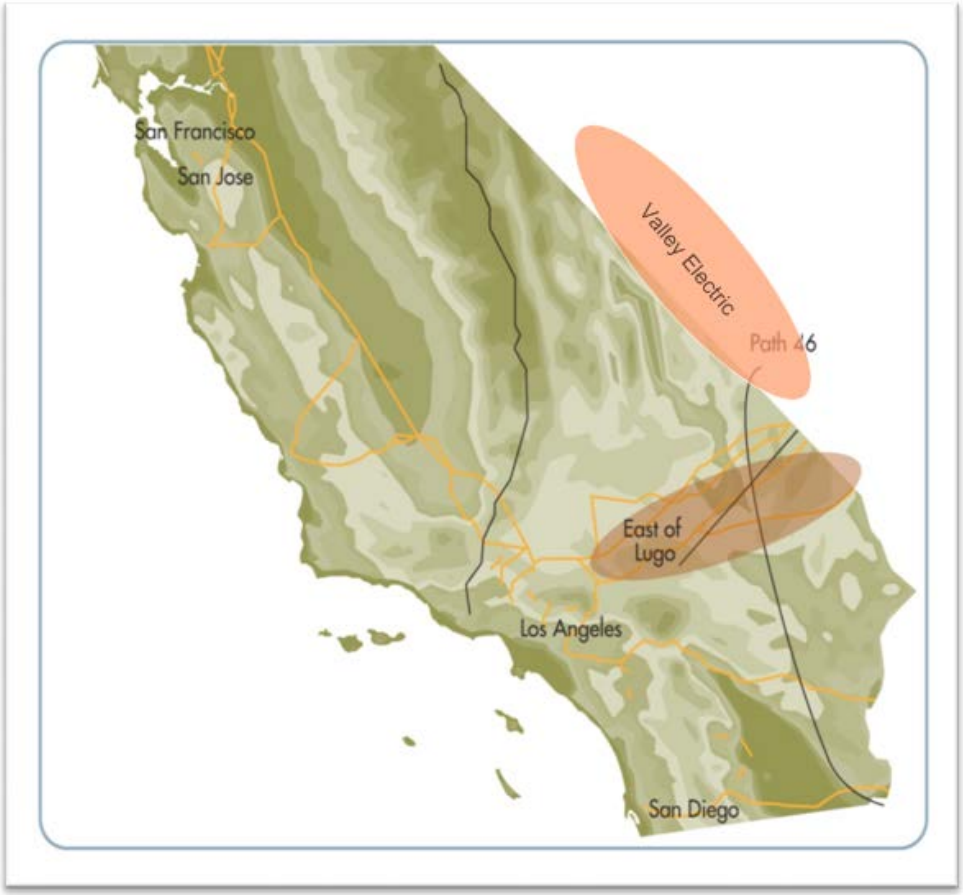
Concern	Potential Upgrade
None identified	

Valley Electric Association
Preliminary Reliability Assessment Results

Meng Zhang
Sr Regional Transmission Engineer

2020-2021 Transmission Planning Process Stakeholder Meeting
September 23-24, 2020

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 2022, 2025 and 2030 are 169 MW, 177 MW and 191 MW respectively.

VEA Study Scenarios

- Base scenarios

No.	Case	Description
B1	2022 Summer Peak	Summer peak load time (9/6 HE 16 PST)
B2	2025 Summer Peak	Summer peak load time (9/2 HE 17 PST)
B3	2030 Summer Peak	Summer peak load time (9/3 HE 19 PST)
B4	2022 Spring Off-Peak	Spring minimum net load time (4/27 HE 20 PST)
B5	2025 Spring Off-Peak	Spring shoulder load time (4/6 HE 13 PST)

- Sensitivity scenarios

No	Case	Change From Base Assumption
S1	2022 Summer Peak with high forecasted load	Load increase to reflect future load service requests
S2	2025 Summer Peak with high forecasted load	Load increase to reflect future load service requests
S3	2025 Off-peak with heavy renewable output	Model portfolio projects expected to be in-service by 2025

Demand Side Assumptions

Scenario No.	Case	Gross Load (MW)	AAEE (MW)	BTM-PV		Net Load (MW)	Demand Response	
				Installed (MW)	Output (MW)		Fast (MW)	Slow (MW)
B1	2022 Summer Peak	169	0	0	0	169	0	0
B2	2025 Summer Peak	177	0	0	0	177	0	0
B3	2030 Summer Peak	191	0	0	0	191	0	0
B4	2022 Spring Off Peak	109	0	0	0	109	0	0
B5	2025 Spring Off Peak	61	0	0	0	61	0	0
S1	2022 Summer Peak with high forecasted load	180	0	0	0	180	0	0
S2	2025 Summer Peak with high forecasted load	207	0	0	0	207	0	0
S3	2025 Off Peak with heavy renewable output	61	0	0	0	61	0	0

Supply Side Assumptions

Scenario No.	Case	Installed Storage (MW)	Solar		Wind		Hydro		Thermal	
			Installed (MW)	Dispatch (MW)	Installed (MW)	Dispatch (MW)	Installed (MW)	Dispatch (MW)	Installed (MW)	Dispatch (MW)
B1	2022 Summer Peak	0	115	59	0	0	0	0	0	0
B2	2025 Summer Peak	0	115	25	0	0	0	0	0	0
B3	2030 Summer Peak	0	820	0	0	0	0	0	0	0
B4	2022 Spring Off Peak	0	115	0	0	0	0	0	0	0
B5	2025 Spring Off Peak	0	115	111	0	0	0	0	0	0
S1	2022 Summer Peak with high forecasted load	0	115	59	0	0	0	0	0	0
S2	2025 Summer Peak with high forecasted load	0	115	25	0	0	0	0	0	0
S3	2025 Off Peak with heavy renewable output	0	820	786	0	0	0	0	0	0

Previously Approved Transmission Projects

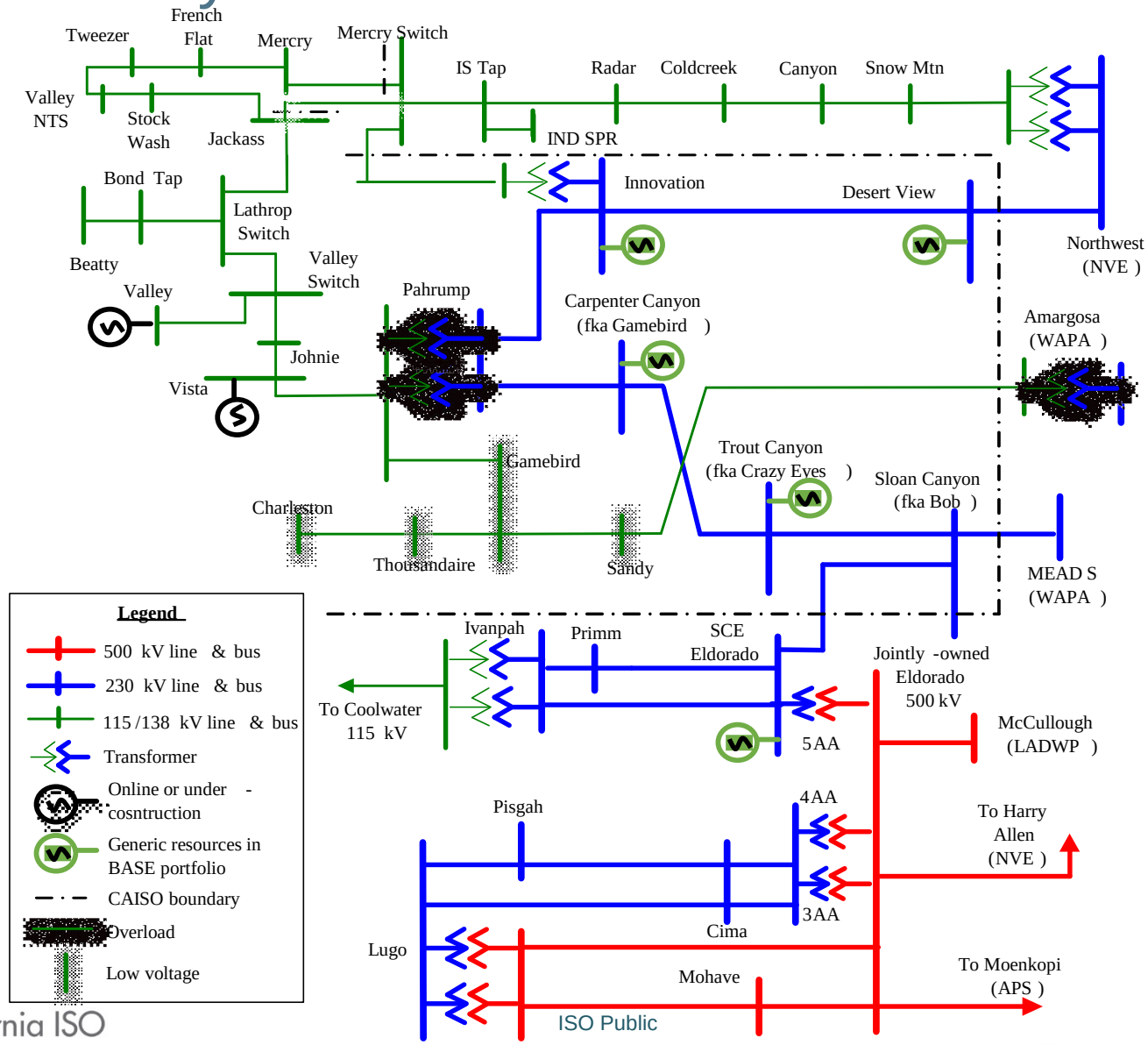
No.	Transmission Projects	First Year Modeled	Description
1	Gamebird 230/138kV Transformer	2022	A new 230/138kV transformer at Gamebird 138kV substation and loop into Pahrump-Sloan Canyon 230kV line

Reliability Assessment
Preliminary Results Summary

Thermal Loading Results

Overloaded Facility	Contingency (All and Worst P6)	Category	Category Description	Loading % (Baseline Scenarios)					Project & Potential Mitigation Solutions
				2022 Summer Peak	2025 Summer Peak	2030 Summer Peak	2022 Spring Off-Peak	2025 Spring Off-Peak	
Amargosa 230/138kV transformer	Innovation-Desert View 230kV & Gamebird-Sloan Cyn/Trout Cyn 230kV lines	P6	N-1-1	107.24	146.35	166.46	<100	<100	New operating procedure to radialize system after the first contingency
	Pahrump-Gamebird 138kV & Gamebird 230/138kV	P6	N-1-1	108.69	110.55	125.25	<100	<100	
Remaining Pahrump 230/138kV transformer	Pahrump 230/138kV transformer & Gamebird 230/138kV transformer	P6	N-1-1	<100	<100	107.51	<100	<100	Existing UVLS, load shedding

VEA-GLW system



Low/High Voltage Results

Substation	Contingency (All and Worst P6)	Category	Category Description	Voltage PU (Baseline Scenarios)					Project & Potential Mitigation Solutions
				2022 Summer Peak	2025 Summer Peak	2030 Summer Peak	2022 Spring Off-Peak	2025 Spring Off-Peak	
Charleston-Thousandaire-Gamebird, Vista-Jackass138kV buses	Innovation-Desert View 230kV & Gamebird-Sloan Canyon/Trout Canyon 230kV	P6	N-1-1	0.8634	0.7984	0.681	>0.9	0.8829	Existing UVLS
	Pahrump-Gamebird 138kV line & Gamebird 230/138kV transformer	P6	N-1-1	0.8191	0.8157	0.7913	>0.9	>0.9	

Sensitivity Assessment Results

- Below is the list of facility overloads identified only in the sensitivity scenarios

Overloaded Facility	Contingency (All and Worst P6)	Category	2022 SP Forecast Load Addition	2025 SP Forecast Load Addition	2025 OP Heavy Renewable
Amargosa-Sandy 138kV line	Nwest-Desert View 230kV	P1			✓
	Innovation-Desert View 230kV & MercurySW-IS Tap 138kV lines	P6			✓
Gamebird-Trout Canyon 230kV line	Trout Canyon-Sloan Canyon 230kV line	P1			✓
Trout Canyon-Sloan Canyon 230kV line	Gamebird-Trout Canyon 230kV line	P1			✓

- Mitigation includes RAS schemes identified in the GIDAP process

Summary of Potential New Upgrades

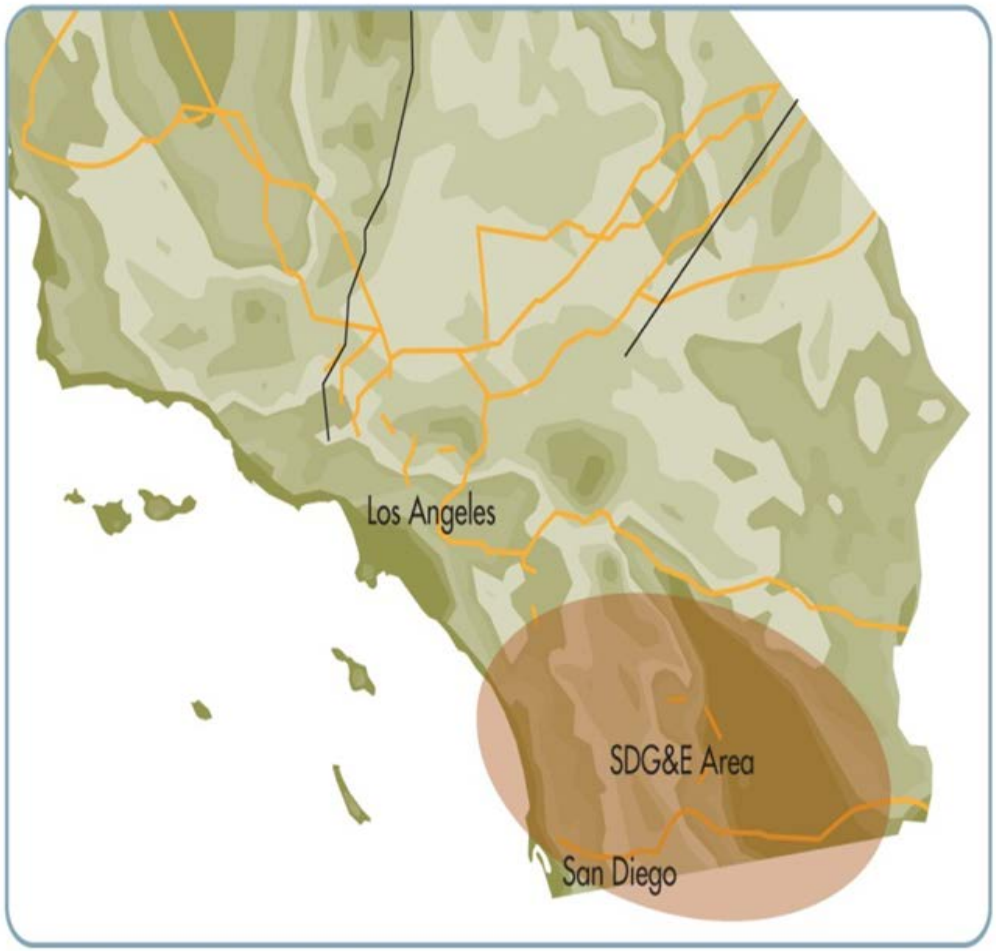
Concern	Potential Upgrade
None identified	

SDG&E Main System
Preliminary Reliability Assessment Results

Frank Chen
Regional Transmission Engineer Lead

2020-2021 Transmission Planning Process Stakeholder Meeting
September 23-24, 2020

SDG&E Main Transmission System



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

California ISO

Load and Load Reduction Assumptions

Study Case	Scenario	Description	Gross Load (MW)	AAEE (MW)	BTM-PV (MW)		Net Load (MW)	Demand Response (MW)	
					Installed Capacity	Output		Total	D2
B1-2022-SP	Baseline	2022 summer peak load condition at Hour Ending 19:00 PST, 9/7	4587	37	1768	0	4587	40	38
B2-2025-SP	Baseline	2025 summer peak load condition at hour ending 19:00 PST, 9/3	4710	66	2104	0	4710	40	38
B3-2030-SP	Baseline	2030 summer peak load condition at Hour Ending 19:00 PST, 9/4	4872	112	2436	0	4872	40	38
B4-2022-OP	Baseline	2022 spring off-peak load condition at hour ending 20:00 PST, 4/27	2982	24	1768	0	2982	40	38
B5-2025-LL	Baseline	2022 spring off-peak/minimal load condition at hour ending 13:00 PST, 4/6	2531	12	2104	1683	848	40	38
S1-2025-SP-HLOAD	Sensitivity	2025 summer peak load condition with high CEC load forecast	4789	66	2104	0	4789	40	38
S2-2022-OP-HRPS	Sensitivity	2022 spring off-peak load condition with heavy renewable output	5001	24	2104	2020	2982	40	38
S3-2025-SP-HRPS	Sensitivity	2025 summer peak load condition with heavy renewable output	6284	37	1768	1697	4587	40	38

Compared to last year results

- Variation in load forecast

Study Year	TPP 2019-2020			TPP 2020-2021		
	2021	2024	2029	2022	2025	2030
Peak Load Fortecast	4671	4835	4923	4587	4710	4872
Peak Load Fluctuation compared to TPP 2019-2020				-84	-125	-51

Generation Resources Base Portfolio

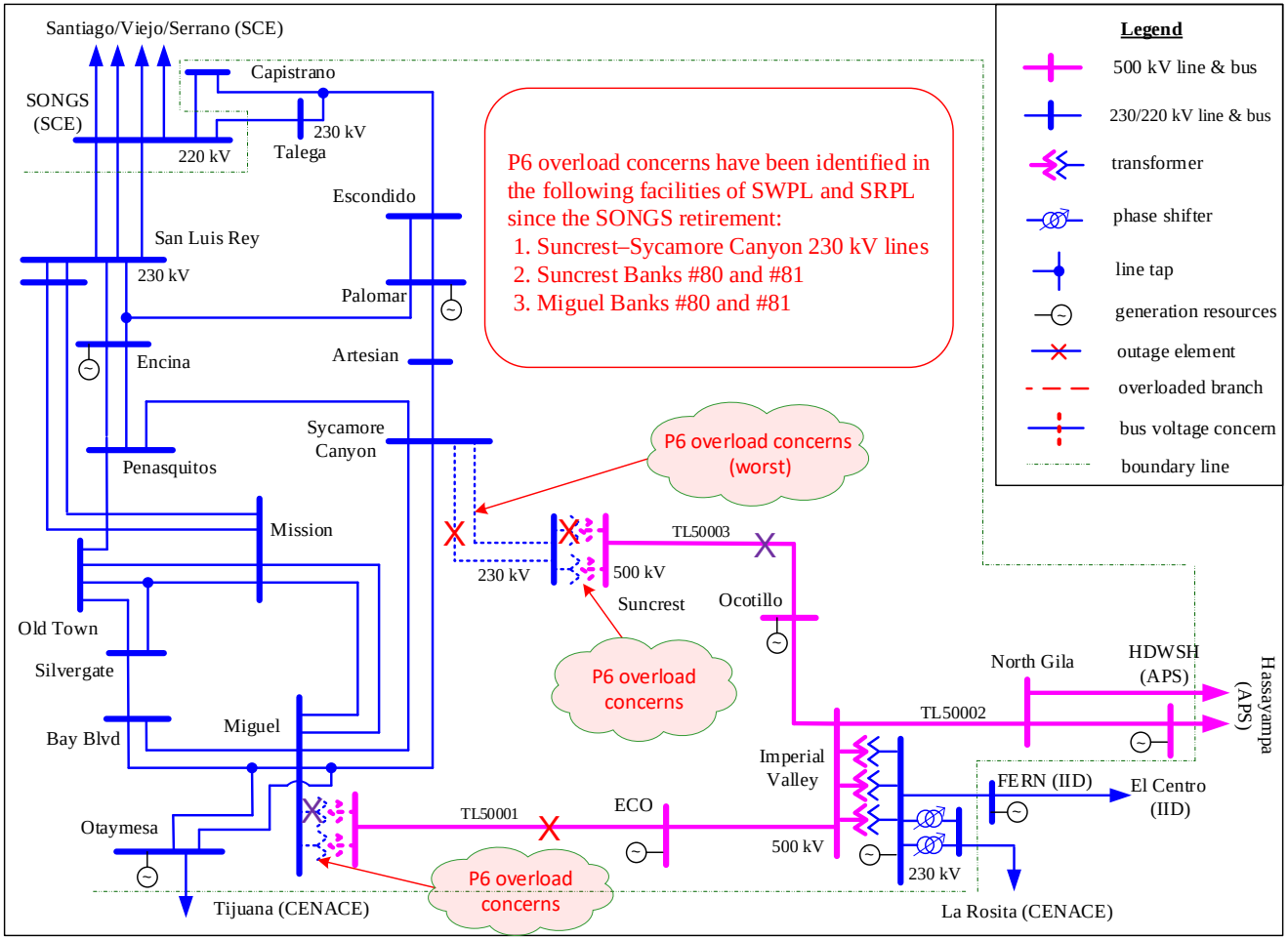
Study Case	Scenario	Description	Energy Storage (MW)		Solar (MW)		Wind (MW)		Thermal (MW)		Biomass (MW)	
			Installed	Dispatch	Installed	Dispatch	Installed	Dispatch	Installed	Dispatch	Installed	Dispatch
B1-2022-SP	Baseline	2022 summer peak load condition at Hour Ending 19:00 PST, 9/7	429	40	1587	0	709	234	3554	3550	9	9
B2-2025-SP	Baseline	2025 summer peak load condition at hour ending 19:00 PST, 9/3	429	40	1589	0	778	257	3517	2696	9	9
B3-2030-SP	Baseline	2030 summer peak load condition at Hour Ending 19:00 PST, 9/4	429	40	1812	0	778	257	3517	3506	9	9
B4-2022-OP	Baseline	2022 spring off-peak load condition at hour ending 20:00 PST, 4/27	429	-389	1587	0	709	568	3554	0	9	9
B5-2025-LL	Baseline	2022 spring off-peak/minimal load condition at hour ending 13:00 PST, 4/6	429	-389	1589	1510	778	234	3517	0	9	9
S1-2025-SP-HLOAD	Sensitivity	2025 summer peak load condition with high CEC load forecast	429	40	1589	0	709	234	3517	2760	9	9
S2-2022-OP-HRPS	Sensitivity	2022 spring off-peak load condition with heavy renewable output	429	-389	1587	1523	778	397	3554	1976	9	9
S3-2022-SP-HRPS	Sensitivity	2022 summer peak load condition with heavy renewable output	429	40	1587	1523	709	362	3554	1799	9	9

Transmission projects modelled in base cases

Project Name	ISD	First Year Modeled
Reconductor Mission – Mesa Heights, TL676	June-19	2022
Reconductor Bernardo – Rancho Carmel (TL633)	November-19	2022
Interconnect 300 MVArs of Dynamic VAR Support at Suncrest 230 kV	February-20	2022
Reconductor Kearny – Mission, TL663	March-20	2022
Path 45 Uprated from 408 MW to 600 MW North-to-South	June-20	2022
Penasquitos – Miramar (TL6906) Loop into Mesa Rim	August-20	2022
Reconductor Japanese Mesa – Las Pulgas, TL692	January-22	2022
TL6975 2nd San Marcos - Escondido 69 kV Circuit	January-22	2022
Artesian East 230 kV Expansion with 69 kV upgrades	April-22	2022
Otay 69 kV Reconfiguration	June-22	2022
South Orange County Reliability Enhancement	5/3/2022 (Multiple phases)	2022
IID's S-Line Upgrade	by summer of 2022	2022
Reconductor Sweetwater – South Bay (Bay Blvd), TL644	October-22	2025
Reconductor TL695B/TL6971	October-22	2025
TL691 - Avocado Tap-Pendleton reconductor (CPEN)	November-22	2025
TL6983 2nd Pomerado – Poway 69 kV Circuit	April-26	not modeled (under re-evaluation)
TL690E Stuart Tap - Las Pulgas 69kV reconductor	May-26	
Kearny – Clairemont Tap (TL600) Reconductor and Loop into Mesa Heights	July-26	
TL632 Granite loop-in and TL6914 reconfiguration	October-26	
Reconductor TL605 Silvergate – Urban	June-27	
Open Sweetwater Tap (TL603) and Loop into Sweetwater	December-27	

Identified Reliability Concerns and Potential Mitigation Solutions

P6 Overload Concerns in SWPL and SRPL



Reliability Concern

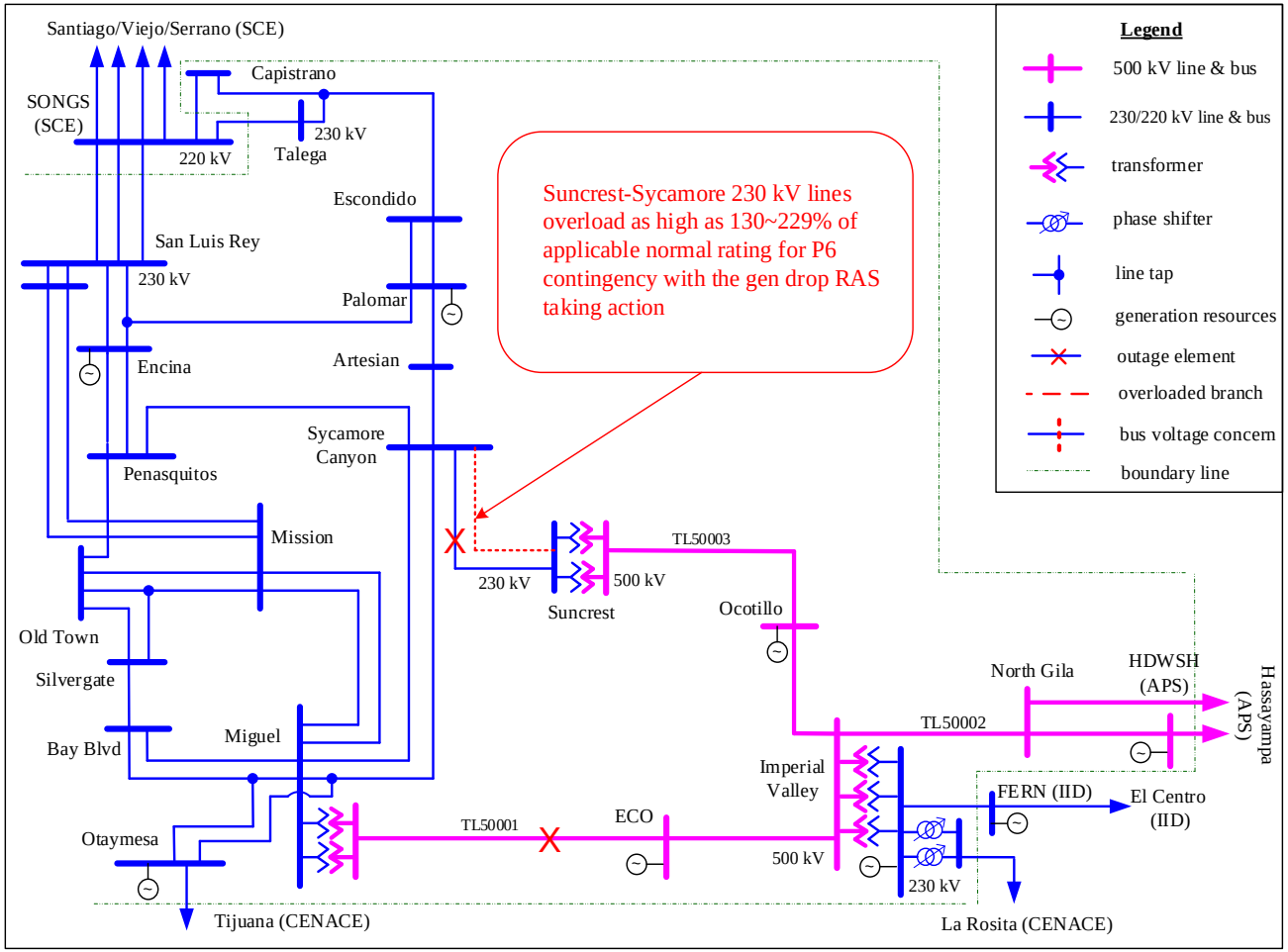
- Thermal overloads for P6 contingencies

Potential Mitigation

- Rely on similar system adjustment and operational action to eliminate the P6 overload concerns.

Please refer to the next slide for detail on the system adjustment and operational action to eliminate the P6 overload concerns

Suncrest-Sycamore 230 kV lines (worst)



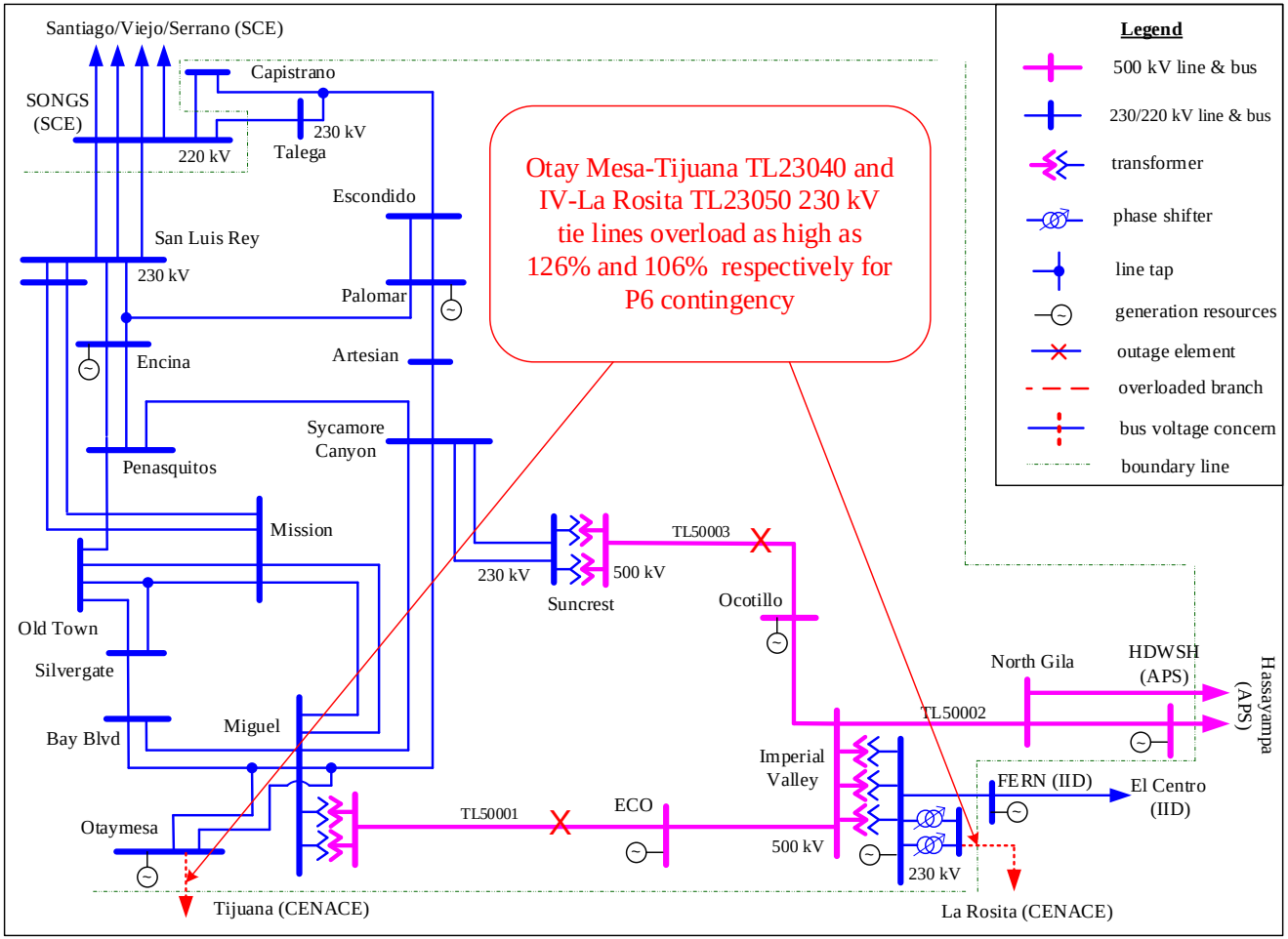
Reliability Concern

- The worst thermal overloads for the P6 contingencies

Potential Mitigation

Rely on system adjustments and operational actions, such as reducing gen in the greater IV area, dispatching gas and preferred resources, energy storage, and DR in San Diego and LA Basin, curtailing import, adjusting IV PST, and bypassing series cap banks in Hassayampa – N. Gila 500 kV lines as needed, along with the TL23054/23055 RAS.

SDG&E 230 kV ties with CENACE



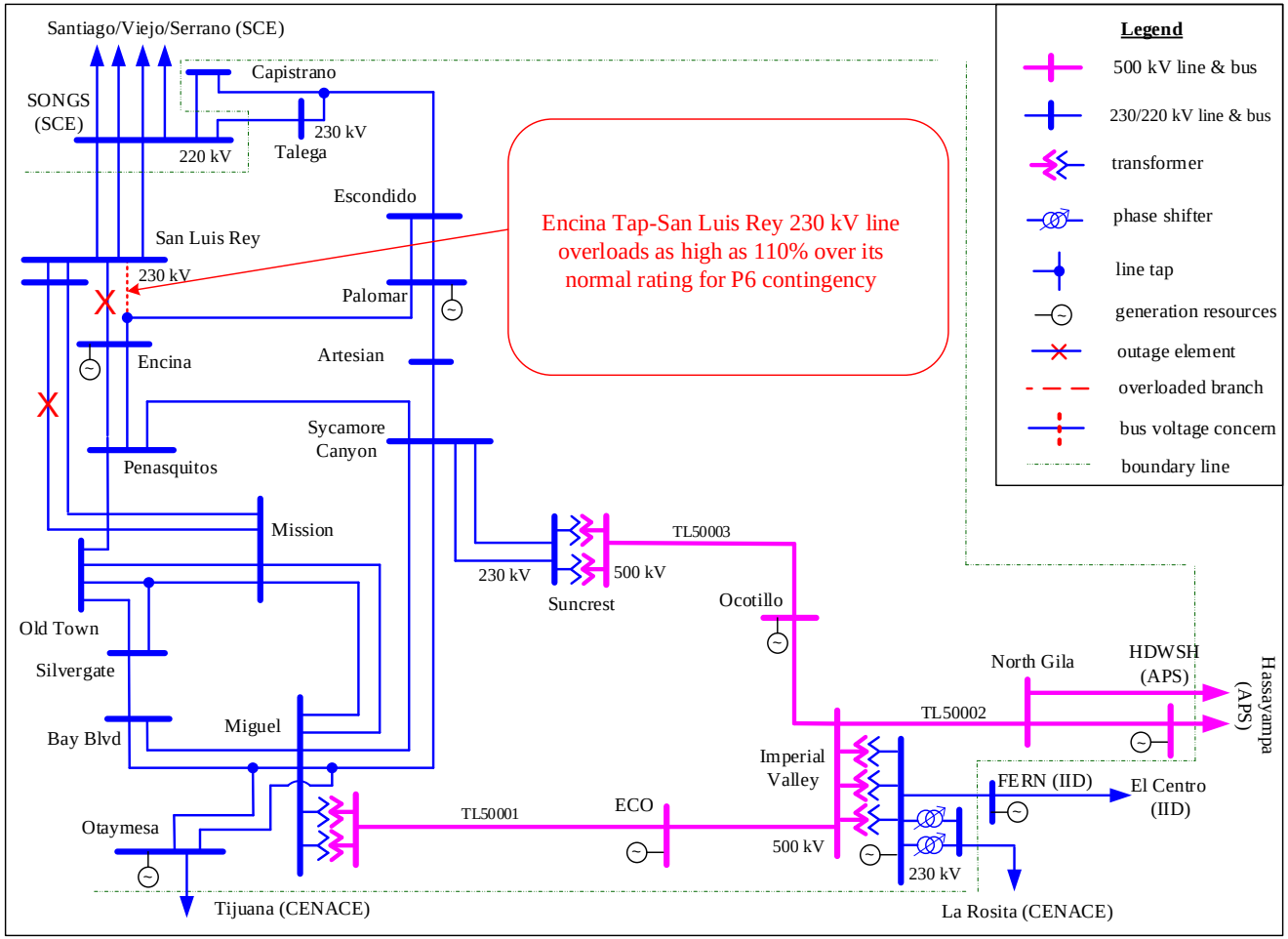
Reliability Concern

- Thermal overloads for P6 event

Potential Mitigation

- Rely on system adjustment and operation procedure to reduce generation in the greater IV area while increasing energy resources output in the San Diego area, along with IV PST adjustment as needed

Encina-San Luis Rey 230 kV path



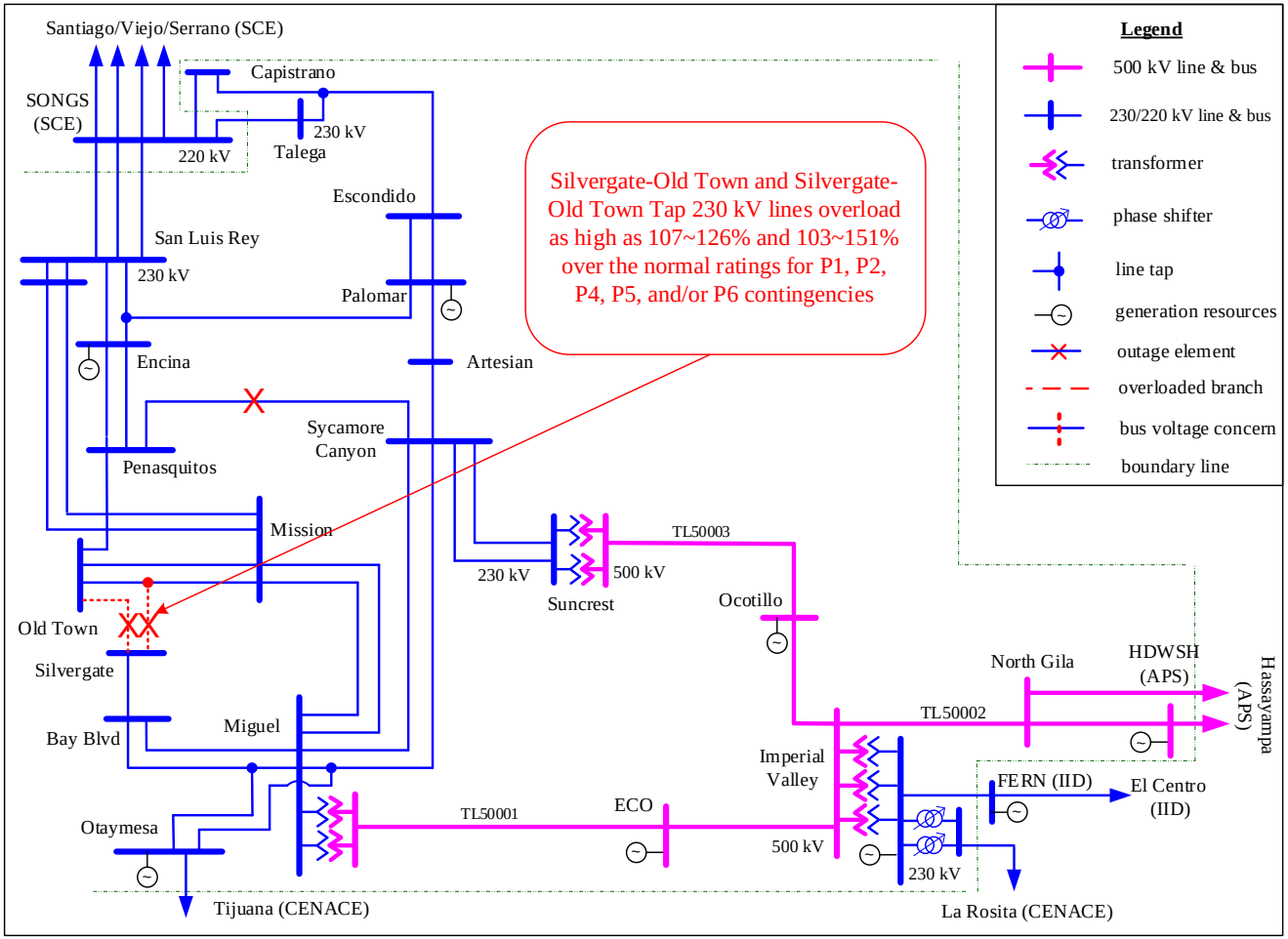
Reliability Concern

- Thermal overloads under the spring off-peak scenario with heavy northbound flow from San Diego to LA Basin

Potential Mitigation

- Rely on operation procedure to reduce the northbound flow after the 1st contingency as system adjustment

Silvergate-Old Town 230 kV path



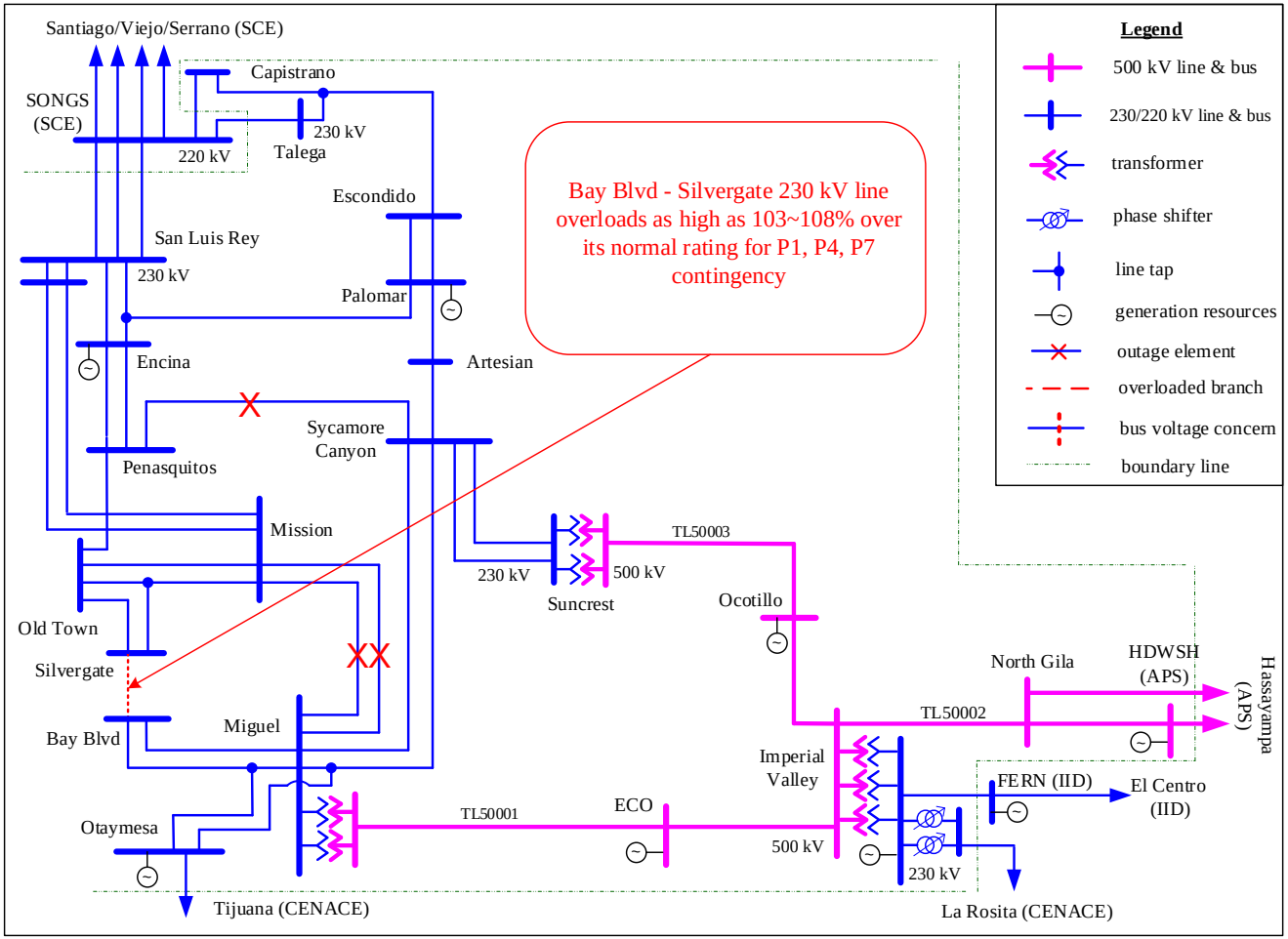
Reliability Concern

- Thermal overloads for P1/P2/P4/P5/P6 events

Potential Mitigation

- Rely on the 2-hour short term emergency ratings and system adjustment for the market and operators to eliminate the overloads
- The system adjustment includes operational action to reduce generation in the Otay Mesa area after contingency

Bay Blvd - Silvergate 230 kV line



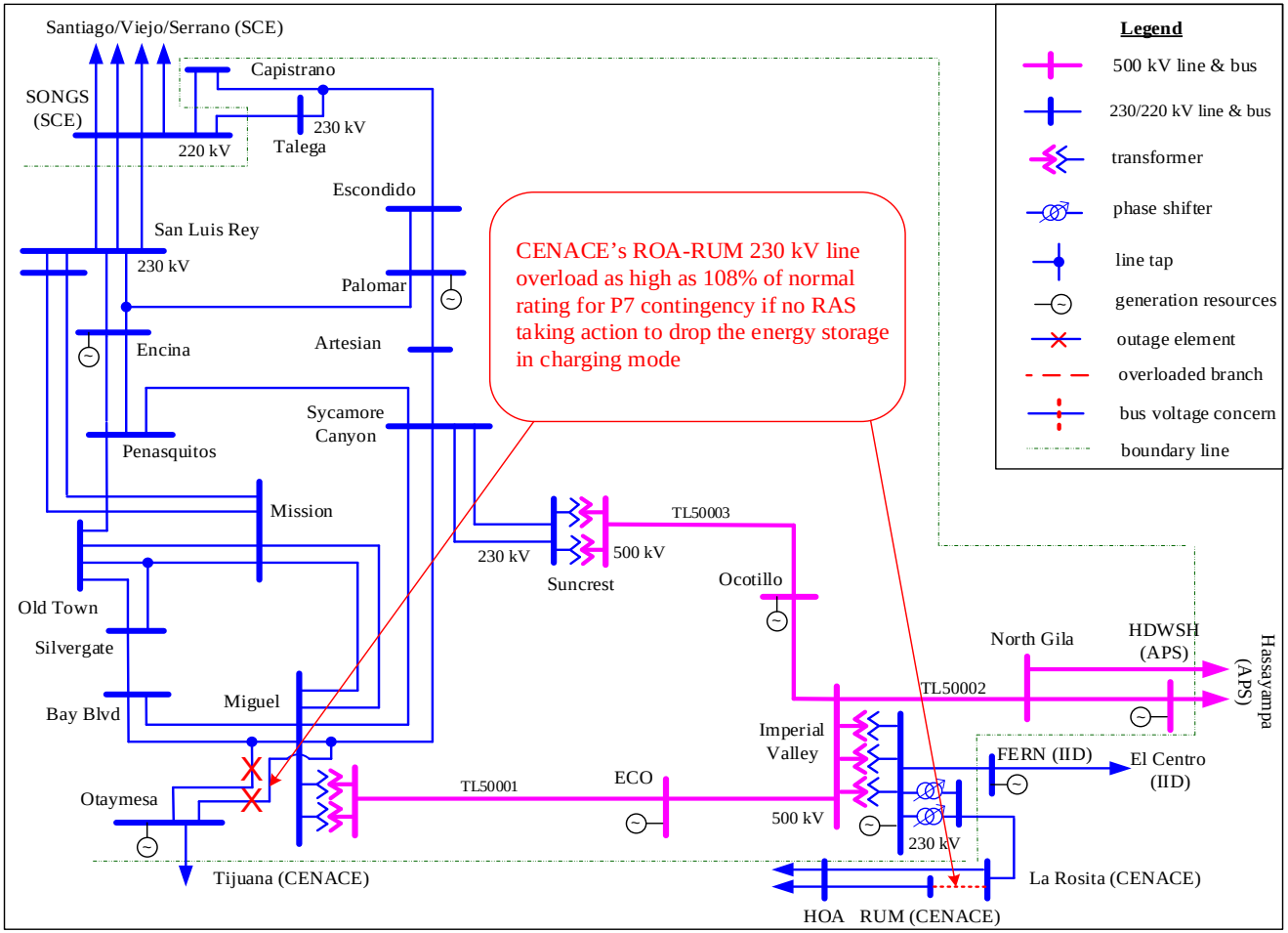
Reliability Concern

- Thermal overloads for P1/P4/P7 contingencies

Potential Mitigation

- Rely on the 2-hour short term emergency ratings and operation procedure that allow the market and operators to eliminate the overloads by reducing generation output in the Otay Mesa area

CENACE Valley – Coast 230 kV path



Reliability Concern

Thermal overloads in the CENACE Valley – Coast 230 kV system for P7 contingency, which may result in system separation between SDG&E and CENACE

Potential Mitigation

- Modify the 230kV Otay Mesa gen drop RAS to drop Gateway Battery Storage project in both charging and discharging modes, or
- Rely on pre-contingency congestion management to manage Gateway Battery Storage charging mode

Reliability Concerns in Sensitivity Scenario

The earlier slides include both the base and sensitivity study results. Below is the list of overloads that are new or get worse in the sensitivity scenario

Reliability Concern		Type of Concern	Category
ID	Facility		
1	Suncrest-Sycamore 230 kV path	Thermal	P3/P6
2	Suncrest BK80 and BK81	Thermal	P6
3	Miguel BK80 and BK81	Thermal	P3/P6
4	SDG&E 230 kV ties with CENACE	Thermal	P6
5	Encina-San Luis Rey 230 kV path	Thermal	P6
6	Silvergate-OldTown 230 kV path	Thermal	P1/P2/P4/P5/P6
7	Bay Blvd - Silvergate 230 kV line	Thermal	P1/P4/P7

Summary of Potential System Improvement

Division	Reliability Concern	Potential Upgrade
CENACE Valley – Coast 230 kV system	Thermal overloads in the CENACE Valley – Coast 230 kV system for the loss of Otay Mesa - Miguel 230 kV lines (P7 contingency), which may result in system separation between SDG&E and CENACE	Modify the 230kV Otay Mesa gen drop RAS to drop Gateway Battery Storage project in both charging and discharging modes, or rely on pre-contingency congestion management to manage Gateway Battery Storage charging mode

San Diego Gas & Electric Area Sub-Transmission
Preliminary Reliability Assessment Results

Charles Cheung
Senior Regional Transmission Engineer

2020-2021 Transmission Planning Process Stakeholder Meeting
September 23-24, 2020

SDGE Area Sub-Transmission Study Scenarios

- Base scenarios

No.	Case	Description
B1	2022 Summer Peak	Summer peak load time (9/7 Hour 19)
B2	2025 Summer Peak	Summer peak load time (9/3 Hour 19)
B3	2030 Summer Peak	Summer peak load time (9/4 Hour 19)
B4	2022 Spring Off-Peak	Spring shoulder load time (4/27 Hour 20)
B5	2025 Spring Light Load	Spring minimum net load time (4/6 Hour 13)

- Sensitivity scenarios

No	Case	Change From Base Assumption
S1	2025 Summer Peak	High CEC forecasted load
S2	2022 Spring Off-Peak*	Heavy renewable output and minimum gas generation commitment
S3	2022 Summer Peak	Heavy renewable output and minimum gas generation commitment

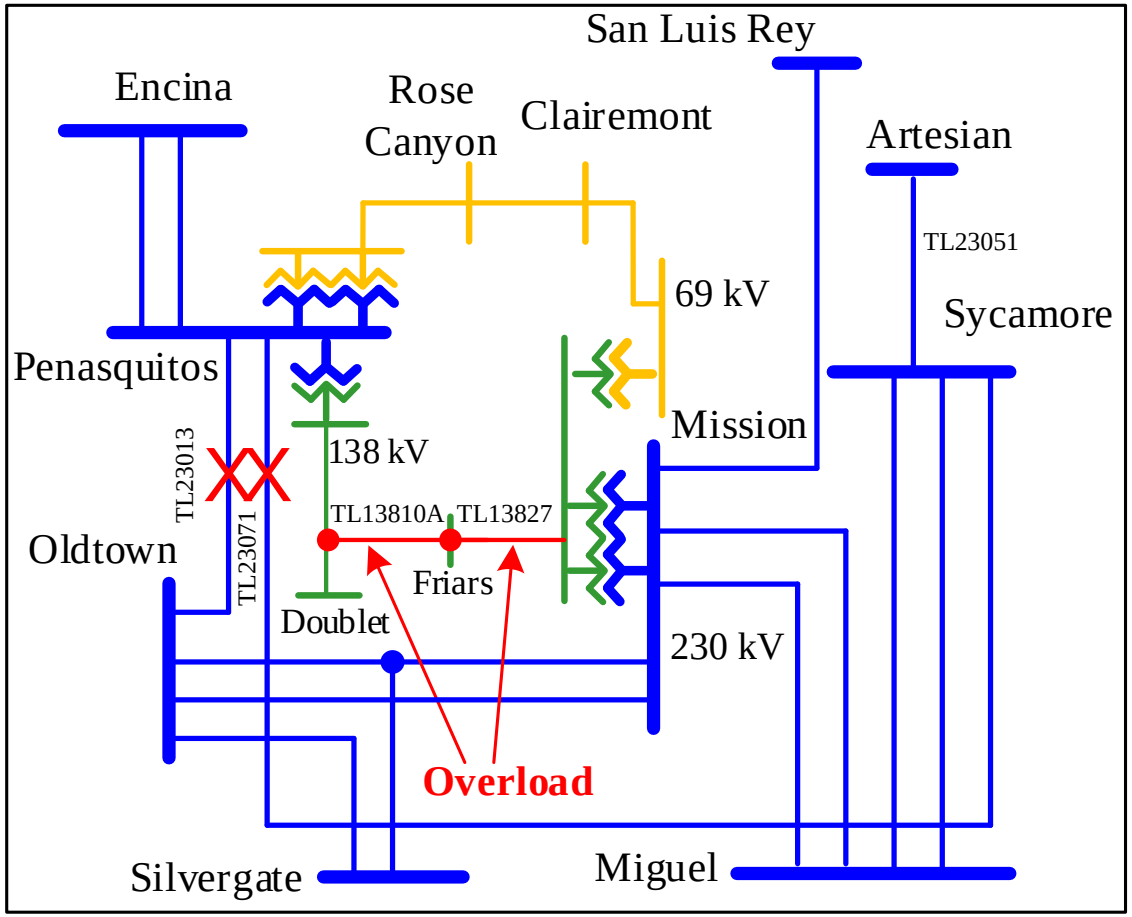
* Note: The off-peak sensitivity case with heavy renewable output and minimum gas generation commitment is based on the 2022 Spring Off-Peak Case rather than the 2025 Spring Off-Peak Case as indicated in the study plan.

Reliability assessment preliminary results summary

Thermal loading Results (1)

Overloaded Facility	Contingencies	Category	Loading (%)				Potential Mitigation Solutions
			B1 2022 SP	B2 2025 SP	B3 2030 SP	S2 2022 OP High RE	
Doublet Tap-Friars 138 kV	Sycamore-Penasquitos 230 kV AND Artesian-Sycamore 230 kV	P6	<90	<90	<90	**110**	• Generation Re-dispatch • Potential RAS to trip generation • Upgrade Relay or adjust relay settings
	Penasquitos-Old Town 230 kV AND Sycamore-Penasquitos 230 kV	P7	<90	**106**	**111**	**170**	
Friars-Mission 138 kV	Penasquitos-Old Town 230 kV AND Sycamore-Penasquitos 230 kV	P7	<90	**103**	**108**	**142**	

Friars Area P7 Contingency Thermal Overload



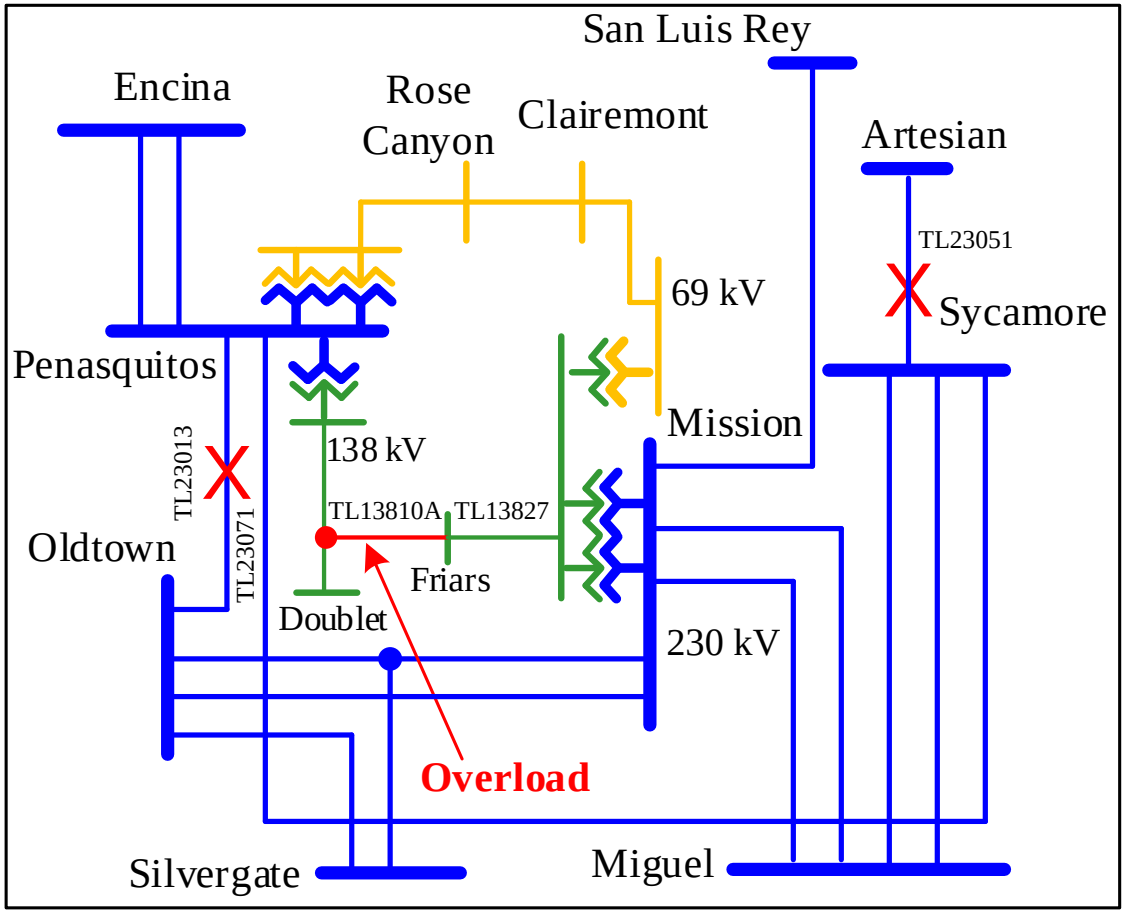
Thermal Overload:

- In the 2025 Peak, 2030 Peak, and 2022 Spring Off-Peak sensitivity cases, N-2 thermal overload on TL13810A (115 MVA) and TL13827 (153 MVA) after losing TL23013 and TL23071

Mitigation:

- Generation Re-dispatch
- Potential RAS to trip generation
- Upgrade Relay or adjust relay settings

Friars Area P6 Contingency Thermal Overload



Thermal Overload:

- In the 2022 Spring Off-Peak sensitivity case, N-1-1 thermal overload on TL13810A (115 MVA) after losing TL23013 and TL23051

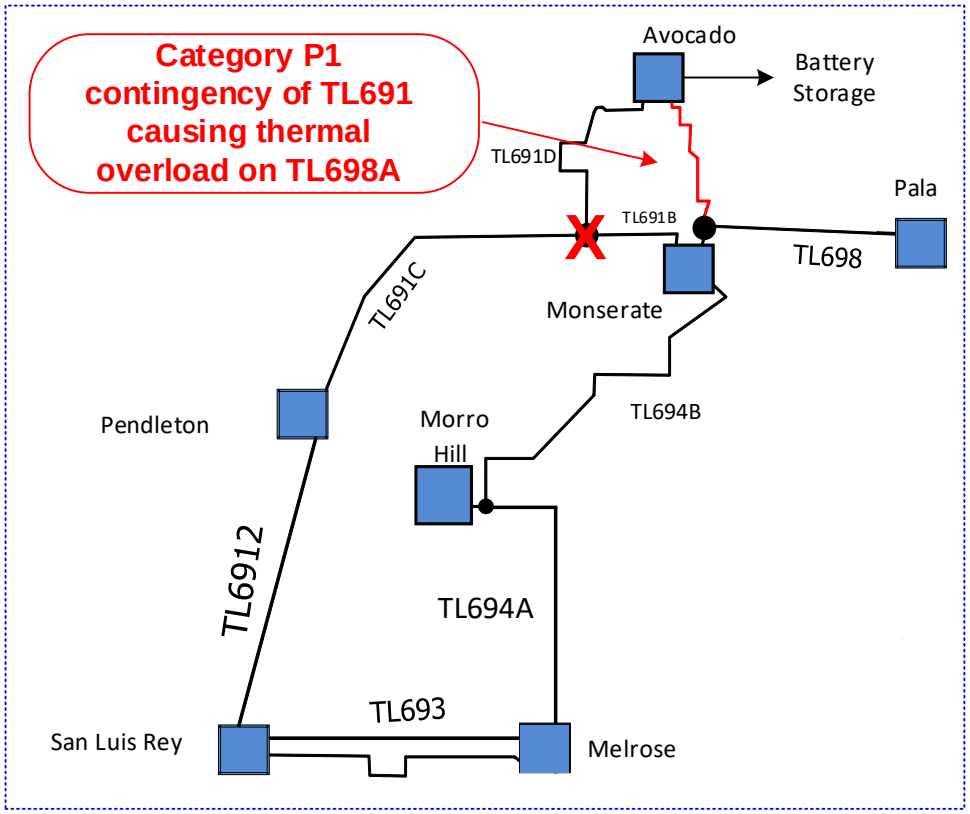
Mitigation:

- Generation Re-dispatch
- Potential RAS to trip generation
- Upgrade Relay or adjust relay settings

Thermal loading Results (2)

Overloaded Facility	Contingencies	Category	Loading (%)			Potential Mitigation Solutions
			B4 2022 OP	B5 2025 OP	S2 2022 OP High RE	
Avocado-Avocado Tap 69 kV	Avocado-Monstrate-Pala 69 kV	P1	**101**	<100	**101**	Curtail charging or Potential RAS to trip battery charging at Avocado
Avocado-Monstrate Tap 69 kV	Avocado-Monstrate-Pendleton 69 kV	P1	**101**	<100	**101**	

Avocado Area P1/P2.1 Contingency Thermal Overload (1)



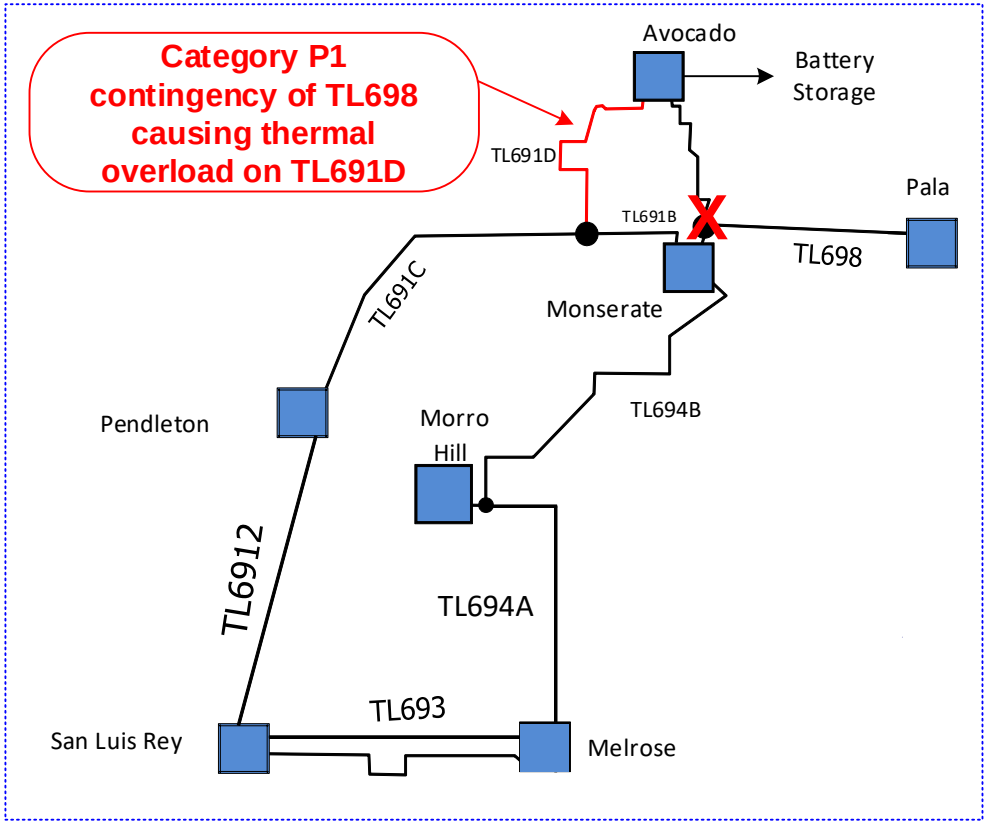
Thermal Overload:

- In the 2022 Off-Peak case, N-1 thermal overload on TL698A (52 MVA) after losing TL691 or TL691D
- 35 MW of Battery at Avocado was in charging mode

Mitigation:

- Curtail charging
- Potential RAS to trip battery charging

Avocado Area P1/P2.1 Contingency Thermal Overload (2)



Thermal Overload:

- In the 2022 Off-Peak case, N-1 thermal overload on TL691D (52 MVA) after losing TL698 or TL698A
- 35 MW of Battery at Avocado in charging mode

Mitigation:

- Curtail charging
- Potential RAS to trip battery charging

Summary of Potential New Upgrades

Concern	Potential Upgrade
None identified	

SDG&E Sub-transmission Projects Re-evaluation

No.	Project	In-service Date	Category	Year Approved
1	TL6983 2nd Pomerado – Poway 69 kV Circuit	4/2/2026	P3	2014-2015
2	TL690E Stuart Tap - Las Pulgas 69kV Reconductor	5/1/2026	P1/P7	2013-2014
3	TL600 Kearny – Clairemont Tap Reconductor and Loop into Mesa Heights	7/28/2026	P6	2015-2016
4	Loop Granite – Granite Tap, TL632A, into Granite and Cancel Los Coches – El Cajon Reconductor, TL631	10/22/2026	P0	2014-2015
5	TL605 Silvergate – Urban Reconductor	6/25/2027	P6	2015-2016
6	Open Sweetwater Tap (TL603) and Loop into Sweetwater	12/20/2027	P3	2012-2013

SDG&E Sub-transmission Projects Re-evaluation Results

No.	Project	Reliability Need found?	Deliverability Need found?
1	TL6983 2nd Pomerado – Poway 69 kV Circuit	No	No
2	TL690E Stuart Tap - Las Pulgas 69kV Reconductor	Yes	N/A
3	TL600 Kearny – Clairemont Tap Reconductor and Loop into Mesa Heights	No	No
4	Loop Granite – Granite Tap, TL632A, into Granite and Cancel Los Coches – El Cajon Reconductor, TL631	Yes	N/A
5	TL605 Silvergate – Urban Reconductor	Yes	N/A
6	Open Sweetwater Tap (TL603) and Loop into Sweetwater	Yes	N/A

SDG&E Sub-transmission Projects Re-evaluation Results

No.	Overloaded Facility	Contingencies	Category	Loading (%)		
				B1 2022 SP	B2 2025 SP	B3 2030 SP
2	Stuart Tap-Las Pulgas 69 kV	Talega-S.Onofre 230 kV ck 2 and Capistrano-S.Onofre 230 kV ck 1	P6	N/A	**135**	**123**
		Talega-S.Onofre 230 kV ck 1 and 2	P7	**135**	N/A	N/A
4	El Cajon-Los Coches 69 kV	El Cajon Generator 2 and Granite-Los Coches-Miguel 69 kV ck 1	P3	**101**	**102**	**103**
		El Cajon Generator 1 and Granite-Los Coches-Miguel 69 kV ck 1	P3	<100	**101**	**102**
5	Silvergate-Urban 69 kV	Old Town-Vine Sub 69 kV	P1	<90	<90	**120**
		Old Town 230/69 kV Transformer 1 or 2	P1	<90	<90	**105**
6	Naval Station Meter-Sweetwater Tap 69 kV	Non-redundant Rely Failure Silvergate 230 kV	P5	<100	**103**	**112**
	Sweetwater-Sweetwater Tap 69 kV	Non-redundant Rely Failure Silvergate 230 kV	P5	100	**108**	**118**
		Silvergate-Bay Blvd 230 kV and Sycamore-Penasquitos 230 kV	P6	<90	<100	**102**

SDG&E Sub-transmission Projects Re-evaluation next step

- Evaluate the policy and economic need of these two projects

No.	Project
1	TL6983 2nd Pomerado – Poway 69 kV Circuit
3	TL600 Kearny – Clairemont Tap Reconductor and Loop into Mesa Heights

Agenda
Reliability Assessment and Study Updates

Isabella Nicosia
Stakeholder Engagement and Policy Specialist

2020-2021 Transmission Planning Process Stakeholder Meeting
September 23-24, 2020

2020-2021 Transmission Planning Process Stakeholder Call – Agenda

Topic	Presenter
Day 1 – September 23	
Overview & Key Issues	Jeff Billinton
Reliability Assessment - North	RTN - Engineers
Reliability Assessment - South	RTS - Engineers
SDG&E Proposed Reliability Solutions	SDG&E
PG&E Proposed Reliability Solutions	PG&E
Day 2 – September 24	
10-year Local Capacity Technical Study	RTN & RTS - Engineers
Wildfire Impact Assessment – PG&E Area	RTN - Engineers
Next Steps	Isabella Nicosia