



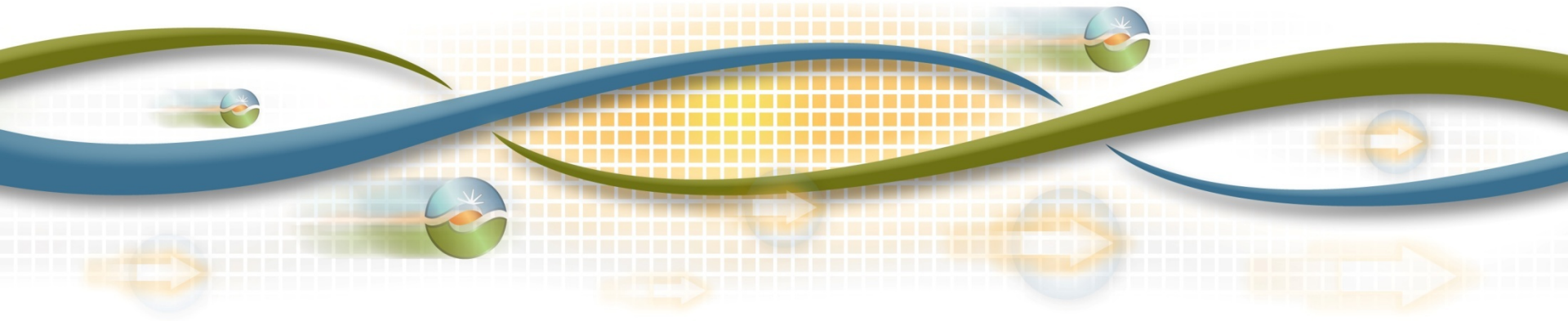
# Agenda – Day 1 & 2

## Preliminary Reliability Assessment Results

*Kim Perez*

*Stakeholder Engagement and Policy Specialist*

*2016-2017 Transmission Planning Process Stakeholder Meeting*  
*September 21-22, 2016*



# 2016-2017 Transmission Planning Process Stakeholder Meeting - Agenda – Day 1

Topic	Presenter
Introduction	Kim Perez
Overview	Chris Mensah-Bonsu
Key Issues	Neil Millar
Preliminary Reliability Results - North	ISO Regional Transmission Engineers
Review of Previously Approved North Projects	Jeff Billinton
Preliminary Reliability Results – South	ISO Regional Transmission Engineers
<i>If time permits, the Economic Study Assumptions presentation may be advanced</i>	<i>Yi Zhang</i>
Wrap-up & Next Steps	Kim Perez

# 2016-2017 Transmission Planning Process Stakeholder Meeting – Agenda – Day 2

Topic	Presenter
Introduction	Kim Perez
Special Studies updates	Planning Engineers
SDG&E Proposed Reliability Solutions	
SCE Proposed Reliability Solutions	
PG&E Proposed Reliability Solutions	
Economic Study Assumptions	Yi Zhang
Next Steps	Kim Perez

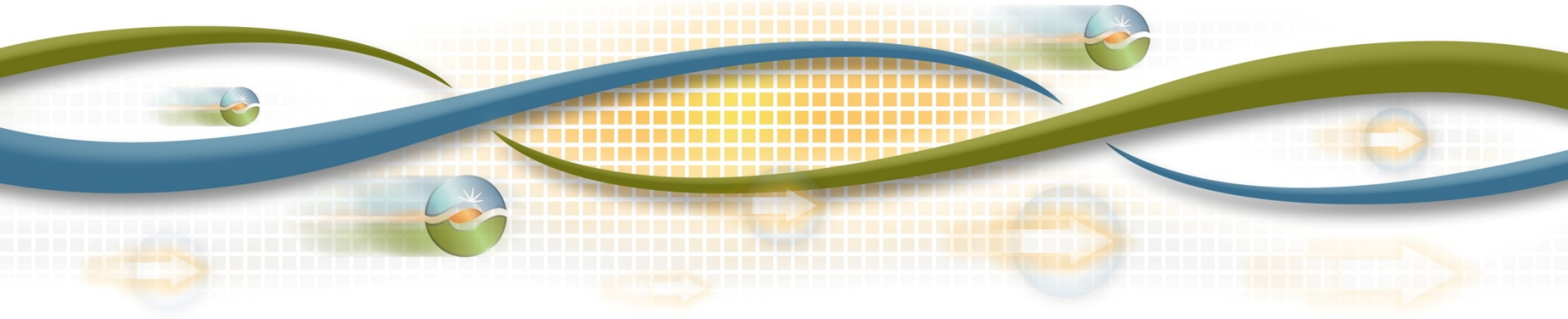


# Introduction and Overview

## Preliminary Reliability Assessment Results

*Chris Mensah-Bonsu*  
*Lead Regional Transmission Engineer*

*2016-2017 Transmission Planning Process Stakeholder Meeting*  
*September 21-22, 2016*



# Overview

- Transmission Planning Process
- Critical Energy Infrastructure Information
- Renewable Generation and Preferred Resources
- Conceptual statewide plan
- Transmission Access Charge

# 2016-2017 Transmission Planning Process

January 2016

April 2016

March 2017

## Phase 1 – Develop detailed study plan

State and federal policy

CEC - Demand forecasts

CPUC - Resource forecasts and common assumptions with procurement processes

Other issues or concerns

## Phase 2 - Sequential technical studies

- Reliability analysis
- Renewable (policy-driven) analysis
- Economic analysis

Publish comprehensive transmission plan with recommended projects

## Phase 3 Procurement

ISO Board for approval of transmission plan

# 2016-2017 Ten Year Reliability Assessment To Date

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

# 2016-2017 Ten Year Reliability Assessment going forward

- Comments due October 6
  - (slow response resource special study extended to October 10)
- Request window closes October 15
- 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 million will be included in draft plan to be issued for stakeholder comments by January 31, 2015
- Purpose of today's stakeholder meeting
  - Review the results of the reliability analysis
  - Set stage for stakeholder feedback on potential mitigations



# Critical Energy Infrastructure Information

- The ISO is constantly re-evaluating its CEII practices to ensure they remain sufficient going forward.
- Continuing with steps established in previous years:
  - Continuing to not post category D 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 migrating planning material over 1 year old to the secure website.
- One “bulk system” presentation has also been posted on the secure site.

# Renewable generation and other preferred resources play a major role in today's issues and presentations

- Renewable generation implications require new solutions to new emerging challenges – changing load patterns and voltage profiles in reliability analysis
- Planning efforts continue to focus on maximizing use of other preferred resources in mitigating reliability issues
- Special studies address or advance understanding of direct or indirect emerging issues directly or indirectly associated with higher renewable generation – *updates being provided in this session*

## Draft Conceptual Statewide Plan has been posted for stakeholder review and comment

- Previous years have primarily relied upon CTPG annual report
  - CTPG activities currently on hold with FERC Order 1000
- This year's draft plan is based on previous CTPG report updated with publicly available information – as was done last year
- Comment period to October 20<sup>th</sup>, with comments to be submitted to [regionaltransmission@caiso.com](mailto:regionaltransmission@caiso.com)
- We intend to review the value this provides, in light of the FERC Order 1000 regional and interregional planning requirements.

# High Voltage Transmission Access Charge Estimating Model

- The 2015-2016 TPP model and underlying estimated project data was posted and a stakeholder call held on May 23, 2016
- Comments have been received for possible future refinements, and are being considered
- The model will be updated in late 2016 and January 2017 for the stakeholder session 4 in February 2017.



# Key Issues influencing the 2016-2017 Study Plan *Transmission Planning Process*

*Neil Millar*

*Executive Director, Infrastructure Development*

*2016-2017 Transmission Planning Process Stakeholder Meeting  
September 21-22, 2016*

# Coordination of input assumptions with California Energy Commission and Public Utilities Commission

- CEC 2015 Integrated Energy Policy Report
  - California Energy Demand 2016-2026, Revised Electricity Forecast
- Continued coordination of study assumptions between Transmission Planning Process and CPUC's LTPP still underway, and in particular,
  - The existing 33% RPS scenarios will continue to be used until direction is available on 50% RPS goals; in 2017-2018 or possibly 2018-2019
- The ISO is continuing to heavily support RETI 2.0 to facilitate future renewable generation portfolio development efforts

## Key drivers of new issues in the transmission planning process requiring additional focus:

- State policies for renewable energy focusing on achieving a 33% renewables portfolio standard by 2020 *and now 50% by 2030*
- Advancement of behind the meter solar PV generation
- State policies on eliminating use of coastal waters for once-through cooling at thermal generation
- Aging assets and addressing emerging reliability needs
- Possible implications from greenhouse gas reduction goals
- Possible implications from federal Clean Power Plan

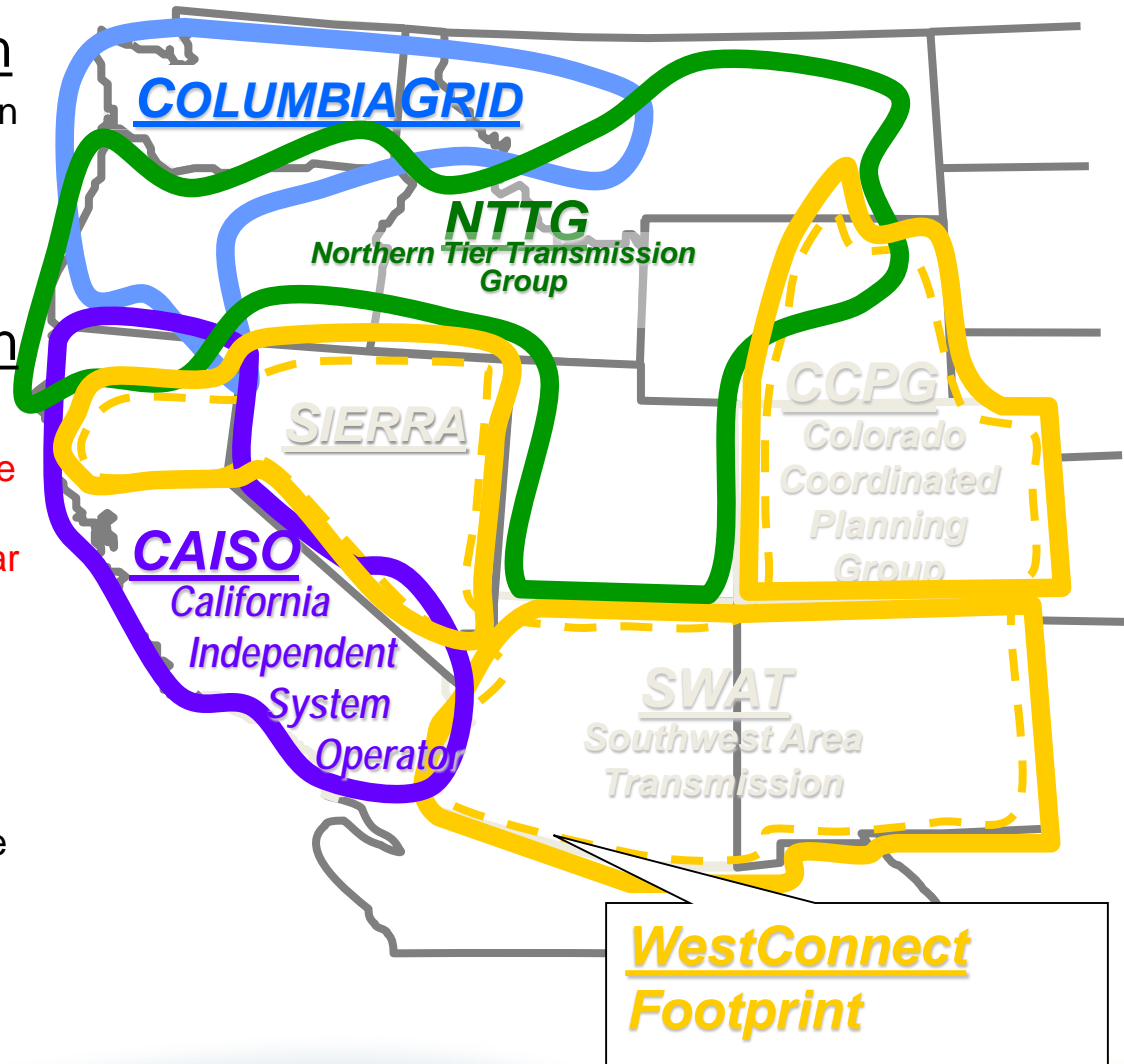
## Renewable Generation and other Preferred Resources are profoundly affecting transmission planning issues:

- Six special studies are in progress, advancing issues associated directly or indirectly with renewable generation and other preferred resources:
  - 50% Renewable Generation
  - Continuation of frequency response efforts through improved modeling
  - Large scale storage benefits
  - Slow response resources in local capacity areas \*
  - Gas/electric reliability coordination \*
  - Risks of early economic retirement of gas fleet
- Continued review of previously-approved projects in PG&E territory



# The ISO's interregional coordination framework was initiated on a pilot basis in the 50% RPS special studies:

- Interregional coordination
  - Annual exchange of information
  - Annual public interregional coordination meeting
- Joint evaluation of interregional transmission projects
  - Biennial cycle; **projects must be submitted no later than March 31<sup>st</sup> of any even-numbered year**
- Interregional cost allocation
  - Each region determines (1) if project meets any regional needs and (2) if project is more cost effective or efficient than regional solution(s)
  - Costs shared in proportion to each region's share of total benefits



## The special study plans are very ambitious:

- Draft results will be shared in the February stakeholder session but may not be in the January draft plan for all special studies
- Detailed results will be provided in the final draft plan presented to the ISO Board of Governors in March.



# PG&E Bulk Transmission System Preliminary Reliability Assessment Results

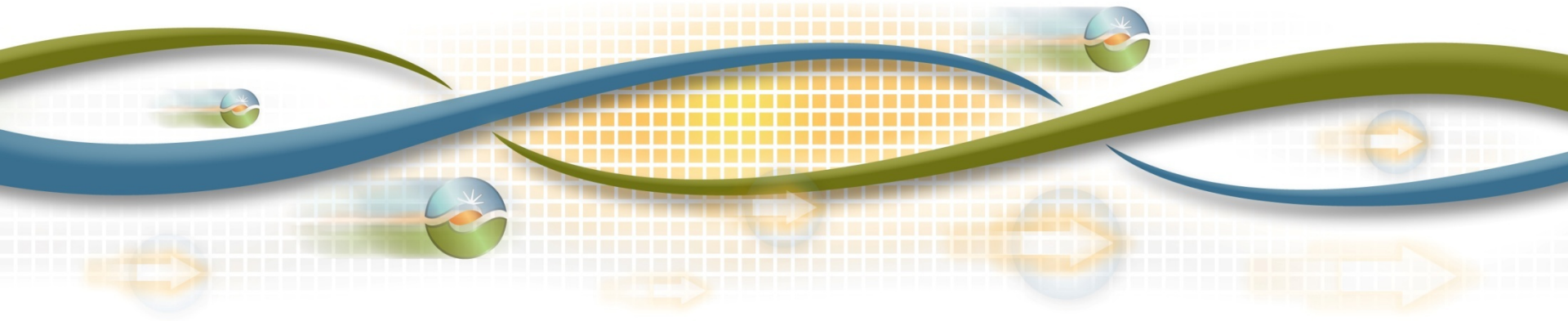
*Confidential – Subject to Transmission Planning NDA*

Irina Green

Senior Advisor Regional Transmission Engineer

2016-2017 Transmission Planning Process Stakeholder Meeting

September 21-22, 2016

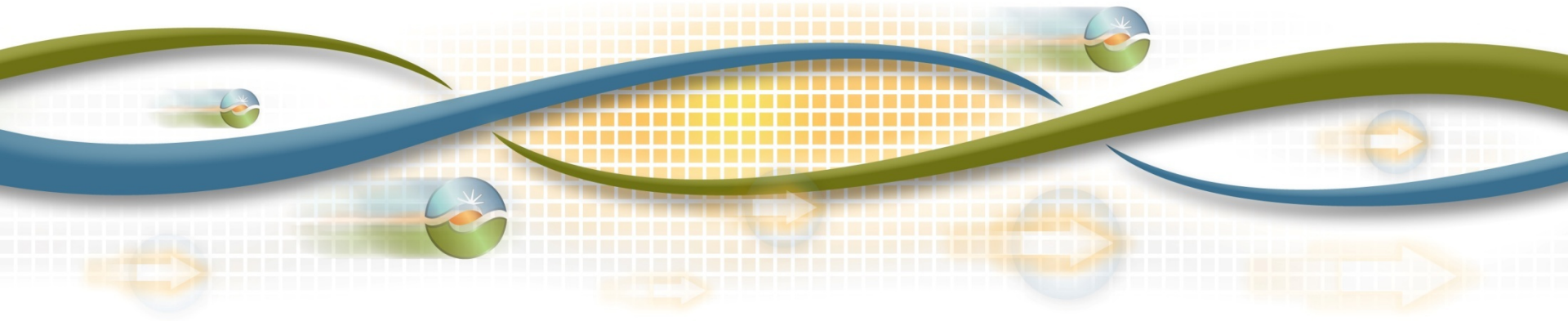




# Humboldt, North Coast & North Bay Areas Preliminary Reliability Assessment Results

Chris Mensah-Bonsu, PhD  
Lead Regional Transmission Engineer

2016-2017 Transmission Planning Process Stakeholder Meeting  
September 21-22, 2016



# 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
- Generation – 247 MW installed capacity
  - 172 MW Humboldt Bay Power Plant
  - 75 MW QFs
- Load in 2026:
  - 135 MW summer peak
    - AAEE: 17 MW
    - BTM-PV: 9.6 MW
  - 135 MW winter peak

# Study Scenarios for Humboldt Area

Load and Generation Scenarios	Study Year		
	2018	2021	2026
<b>Baseline Scenarios</b>			
Summer Peak	✓	✓	✓
Winter Peak	✓	✓	✓
Spring Off-Peak	✓		
Spring Light Load		✓	
Summer Partial Peak			
Winter peak - (SF & Peninsula)			
Winter peak - (SF Only)			
<b>Sensitivity Scenarios</b>			
Summer Peak with high CEC forecast load (No AAEE)		✓	
Summer peak with no BTM PV	✓		✓
Summer Peak with heavy renewable output and minimum gas generation commitment		✓	
Retirement of QF Generations			✓

# Transmission Projects in Humboldt Area

<b>Transmission Projects in Central Valley Area</b>	<b>Expected ISD</b>
<b>Less than \$50M</b>	
Maple Creek Reactive Support	May-17
<b>\$50M or More</b>	
New Bridgeville – Garberville No. 2 115 kV Line	Jan-24
<b>Projects found to be needed in the 2015-2016 Planning Cycle</b>	

# Humboldt Area Assessment Summary

- The assessment identified the followings:

Assessment	Number of issues for each category							
	P0	P1	P2	P3	P4	P5	P6	P7
Thermal overload	0	5	5	2	0	0	5	1
Low voltage	0	0	1	0	0	0	1	0
High voltage	0	1	0	1	0	0	3	0
Voltage deviation	n/a	0	2	0	0	0	0	0
Stability issues	n/a	12	15	0	14	5	0	2

- Compared to last year results:
  - New violations identified for contingency categories P1, P3, P7
  - Sensitivity studies for the Humboldt area identified new violations
    - 2021 Light load and 2026 no BTM conditions
  - Transient stability issues are under PTO review
  - Overall, the number of criteria violations are less than last year due to lower forecasted load.



# Humboldt Area - Results (Category P0 & P1)

## ■ Thermal Overloads

1. Humboldt-Bridgeville 115 kV Line (Cat P1 & P2, 2026)
2. Humboldt-Humboldt Jct 60 kV Line (P1 & P2, 2026)
3. Humboldt Bay - Rio Dell 60kV Line (Cat P1 & P2, 2026)
4. Rio Dell Jct - Bridgeville 60 kV Line (Cat P1 & P2, 2026)
5. Bridgeville-Garberville 60 kV Line (Cat P1 & P2, 2021)

## ■ Potential Mitigations

- Operating procedure to re-dispatch Humboldt generation
- Potentially reconductor the lines or upgrade to 115 kV system

## ■ Thermal Overloads (Sensitivity) – In addition to the overloads in the baseline scenarios:

1. Thermal violations were observed predominantly for the 2026 under the no BTM solar PV sensitivity study scenario

## ■ Potential Mitigations

- Interim action plans with load transfer, or redispatch Humboldt generation.

Thermal issues resulting from other contingency categories will be discussed in the area diagram

# Humboldt Area - Results (Category P0 & P1)

- **Low Voltage**

1. Bridgeville 115 kV (Category P2)
2. Fort Seward & Fruitland 60 kV (Category P2, 2021 Light load)

- **Potential Mitigation**

- Corrective Action Plan: Increase Bridgeville and Mendocino 60 kV regulator taps by SCADA

- **Voltage Deviation**

1. Garberville 60 kV (Cat P2)

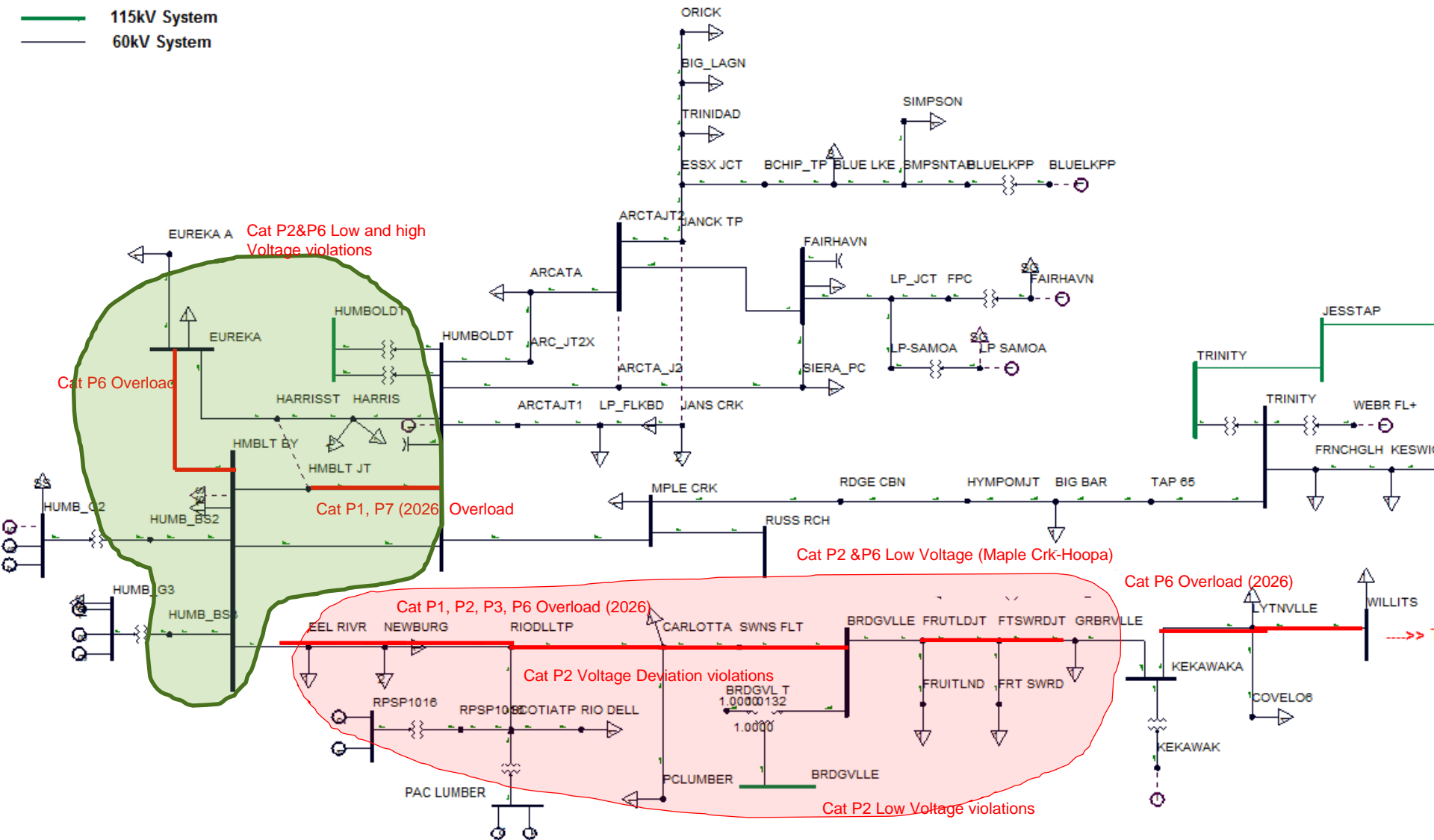
- **Potential Mitigation**

- Potential Mitigation: Action Plan

Thermal issues resulting from other contingency categories will be discussed in the area diagram

# Humboldt Area – Results (cont'd)

— 115kV System  
— 60kV System



# Summary and Conclusions

- Humboldt, Bridgeville and Garberville pockets have high voltage violations. Potential mitigation is “Under review with the PTO”
- Low voltage observed at Bridgeville 115 kV station for a ring bus breaker outage
  - Most of the issues will be addressed by projects that have been already approved by the ISO
  - Few marginal overloads that occur in the longer term or under sensitivity conditions are identified in this planning studies. The ISO will address those through preferred resources or by transmission development, and taking into account the time of issue occurrence.

# 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
- Generation- 1539 MW installed capacity
  - North Coast: 1473 MW
  - North Bay: 66 MW
- Load in 2026:
  - 1509 MW summer peak
    - AAEE: 93 MW
    - BTM-PV: 170
  - 1417 MW Winter peak

# Study Scenarios for North Coast / North Bay Area

Load and Generation Scenarios	Study Year		
	2018	2021	2026
<b>Baseline Scenarios</b>			
Summer Peak	✓	✓	✓
Winter Peak	✓	✓	✓
Spring Off-Peak	✓		
Spring Light Load		✓	
Summer Partial Peak			
Winter peak - (SF & Peninsula)			
Winter peak - (SF Only)			
<b>Sensitivity Scenarios</b>			
Summer Peak with high CEC forecast load (No AAEE)		✓	
Summer peak with no BTM PV	✓		✓
Summer Peak with heavy renewable output and minimum gas generation commitment		✓	
Retirement of QF Generations			✓

# Transmission Projects in North Coast & North Bay

Transmission Projects in Central Valley Area	Expected ISD
<b>Less than \$50M</b>	
Clear Lake 60 kV System Reinforcement	Feb-23
Fulton 230/115 kV Transformer	May-22
Fulton-Fitch Mountain 60 kV Line Reconductor	Aug-18
Ignacio – Alto 60 kV Line Voltage Conversion	Mar-23
Napa – Tulucay No. 1 60 kV Line Upgrades	Jul-20
Vaca Dixon – Lakeville 230 kV Reconductoring	Mar-19
<b>\$50M or More</b>	
<b>Projects found to be needed in the 2015-2016 Planning Cycle</b>	
Ignacio 230 kV Reactor	Dec-20

# North Coast / North Bay Assessment Summary

- The assessment identified the followings:

Assessment	Number of issues for each category							
	P0	P1	P2	P3	P4	P5	P6	P7
Thermal overload	0	4	15	2	0	8	42	10
Low voltage	0	0	4	0	0	0	2	1
High voltage	1	0	0	0	0	0	4	0
Voltage deviation	n/a	0	6	0	0	0	0	3
Stability issues	n/a	10	15	0	25	0	0	0

- Compared to last year results:
  - New violations identified for contingency categories P1, P3, P7
  - Sensitivity studies for the area identified new violations under:
    - 2021 Light load and 2026 no BTM sensitivity study conditions
  - Transient stability and high voltage issues are under PTO review
  - Overall, the number of criteria violations are less than last year due to lower forecasted load.



# North Coast / North Bay Area - Results (Category P0 & P1)

## ■ Thermal Overloads

1. Clear Lake-Hopland (Granite-Hopland) 60 kV Line (Cat P1, P2, 2018SP)
  - Potential mitigation: Redispatch Geysers units/Clear Lake 60 kV reinforcement project
2. Molino-Trenton Jct 60 kV Line (Cat P1, P2 2026 no BTM)
  - Potential Mitigation – Monitor loading
3. Petaluma A-Lakeville Jct 60 kV Line (Cat P1 winter & sensitivity)
  - Mitigation – Reconductor limiting equipment/Clear Lake 60kV system reinforcement project
4. Lakeville #2 60 kV Line (Lakeville-Lakeville Jct) (Cat P1, 2026 no BTM)
  - Mitigation – Monitor loading
5. Ignacio-Bolinas #1 60 kV Line (Olema-Bolinas) (Cat P2, diverge)
  - Reconductor Ignacio-Bolinas #1 60 kV Line/Upgrade to 115 kV voltage. Interim: Action Plan
6. Tulucay – Napa 60kV line #1 (Cat P2, 2018)
  - Mitigation – Tulucay-Napa reconductor project
7. Garberville-Laytonville 60 kV (Willits-Laytonville-Kekawaka) (Cat P2, diverge)
  - Add new line. Interim: Open Garberville-Laytonville 60 kV line at Willits or Bridgeville and source from Humboldt.
8. Corona-Lakeville 115 kV Line (Penngrove-Corona-Lakeville) (Cat P2, winter)
  - Mitigation - Reconductor Corona-Lakeville 115 kV Line

Thermal issues resulting from other contingency categories will be discussed in the area diagram

# North Coast / North Bay Area - Results (Category P0 & P1)

- **Thermal Overloads (Sensitivity)** – In addition to the overloads in the baseline scenarios:
  1. Thermal violations were observed predominantly for the 2026 under the no BTM solar PV sensitivity study scenario
- **Potential Mitigations**
  - Interim action plans with load transfer, or redispatch generation.

Thermal issues resulting from other contingency categories will be discussed in the area diagram

# North Coast / North Bay Area - Results (Category P0 & P1)

## ■ Low Voltage

1. Generally observed in the 60 kV system including Lower Lake, Eagle Rock, Konocti, Clear Lake, Big River (Cat P1, P2, P3, P6, P7)
  - Potential Mitigation – Clear Lake 60kV system reinforcement project
2. Covelo, Tocaloma, Lower Lake, Sausalito 60kV (Cat P2)
  - Potential Mitigation – Ignacio – Alto voltage conversion project
3. Bolinas, Stafford, Novato, Olema 60kV (Cat P2)
  - Potential Mitigation – Reconductor Olema – Bolinas 60kV line

## ■ Voltage Deviation

1. Lower Lake, Willits, Woodacre (Cat P1, P2)
  - Potential Mitigation – Open line at Willits/Clear Lake 60kV system reinforcement project
2. Stafford, Novato, Santa Rosa, Eagle Rock 60kV (Cat P2)
  - Potential Mitigation – Action Plan

## ■ Low Voltage (Sensitivity)

In addition to the overloads in the baseline scenarios, low voltage violations were identified under the sensitivity study scenarios:

- Potential Mitigations: Interim action plans with load transfer.

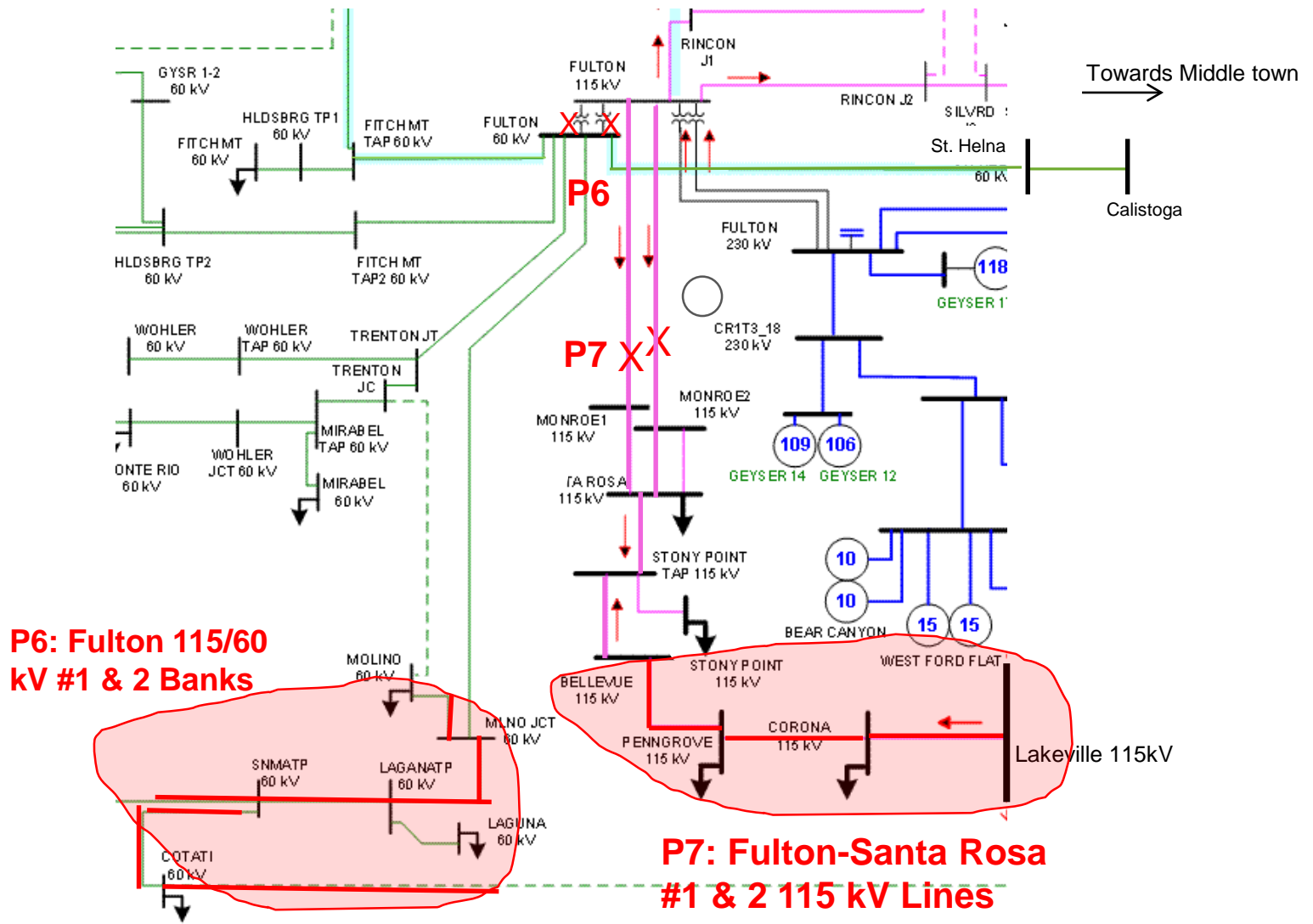
Thermal issues resulting from other contingency categories will be discussed in the area diagram

# North Coast / North Bay Area - Results (Category P6 & P7)

## Thermal Overloads

- **Category P6:** Fulton 115/60 kV #1 & #2 contingency causes overloads in the Fulton-Molino-Cotati 60 kV, Lakeville #2 60 kV (Cotati-Petaluma C-Petaluma A-Lakeville), and Cloverdale Jct-Geyser Jct 60 kV line sections
  - Potential Mitigation: Action Plan/SPS. Add Fulton 115/60 kV Bank.
- **Category P7:** Fulton Santa Rosa #1 & #2 115 kV Lines causes the Lakeville-Corona-Penngrove-Bellevue 115 kV line sections. Same for P2 – Fulton 115 kV Sub Bus tie outage.
  - Potential Mitigation: SPS/Action Plan. Reconductor Lakeville-Corona-Penngrove-Bellevue 115 kV line sections.

# Fulton/Molino area issues



# Summary and Conclusions

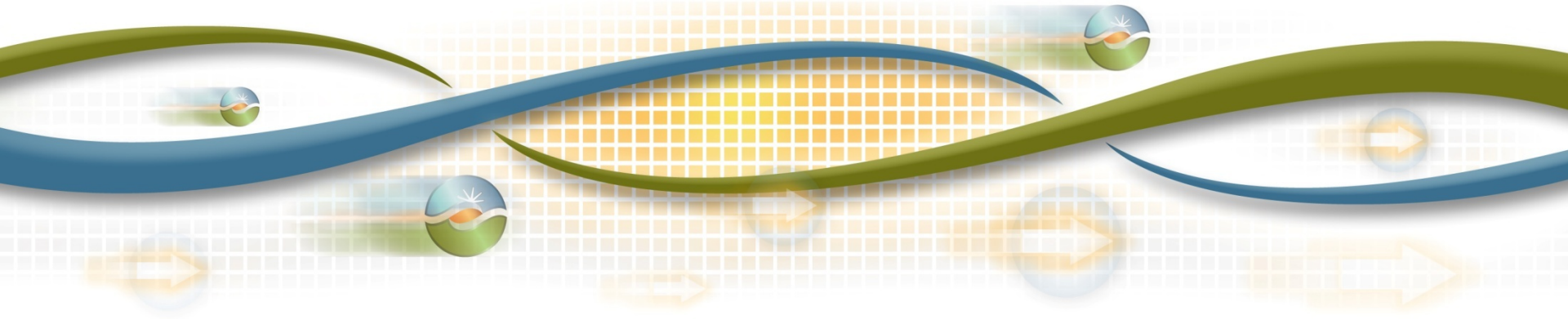
- No Cat P0 overload identified
- Cat P1-2 overload observed on Petaluma A-Lakeville Jct under both winter and no-BTM sensitivity conditions.
- Willits-Laytonville-Kekawaka 60 kV line sections experience diverge condition for Cat P2-3 (CB) contingency condition
- Most of the observed issues conditions are resolved in later years, addressed with SPS action, by Action Plans or projects that have been already approved by the ISO
- Few marginal overloads that occur in the longer term or under sensitivity conditions are identified in this planning studies. The ISO will address those through preferred resources or by transmission development, and taking into account the time of the issue occurrence.



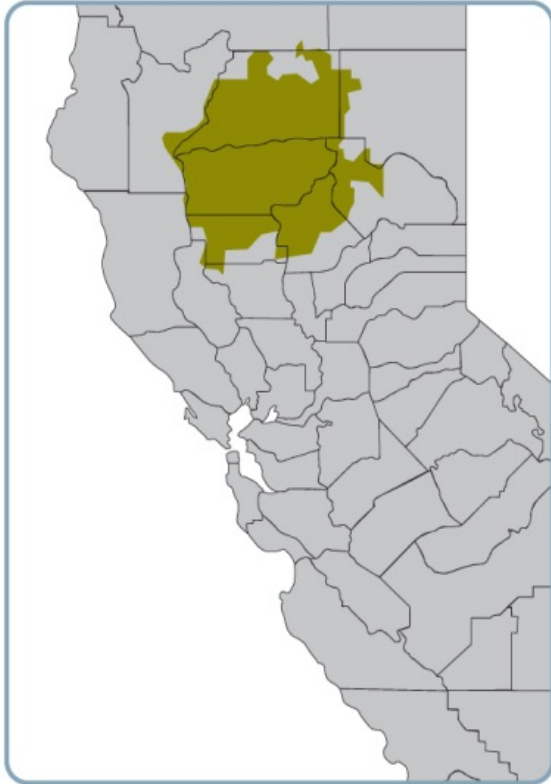
# North Valley Area Preliminary Reliability Assessment Results

Bryan Fong  
Sr. Regional Transmission Engineer

2015-2016 Transmission Planning Process Stakeholder Meeting  
September 21-22, 2015



# North Valley Area



- 15,000 sq. miles NE corner of PG&E
- Cities: Chico, Redding, Red Bluff, Paradise
- Generation: Over 2,000 MW of hydro. Colusa is the largest generation facility (717 MW).
- Comprised of 60, 115, 230 & 500 kV transmission facilities.
- generation)Load:
  - 2026 Summer Peak load forecast:
    - Load: 932 MW
    - AAEE: 38 MW
    - BTM-PV: 79 MW
    - **Net peak load in 2026: 894 MW**



# Study Scenarios

Load and Generation Scenarios	Study Year		
	2018	2021	2026
<b>Baseline Scenarios</b>			
Summer Peak	✓	✓	✓
Winter Peak			
Spring Off-Peak	✓		
Spring Light Load		✓	
Summer Partial Peak			
Winter peak - (SF & Peninsula)			
Winter peak - (SF Only)			
<b>Sensitivity Scenarios</b>			
Summer Peak with high CEC forecast load (No AAEE)		✓	
Summer peak with no BTM PV	✓		✓
Summer Peak with heavy renewable output and minimum gas generation commitment		✓	
Retirement of QF Generations			✓

# Transmission Projects in North Valley Area

Transmission Projects in Central Valley Area	Expected ISD
<b>Less than \$50M</b>	
Cascade 115/60 kV No.2 Transformer Project and Cascade – Benton 60 kV Line Project	May 19 and Nov-22
Glenn #1 60 kV Reconductoring	Apr-21
Glenn 230/60 kV Transformer No. 1 Replacement	Apr-21
Table Mountain – Sycamore 115 kV Line	May-22
<b>\$50M or More</b>	
Cottonwood-Red Bluff No. 2 60 kV Line Project and Red Bluff Area 230/60 kV Substation Project	Jun-23
<b>Projects found to be needed in the 2015-2016 Planning Cycle</b>	
Cottonwood 115 kV Substation Shunt Reactor	Dec-19
Delevan 230 kV Substation Shunt Reactor	Dec-20

# North Valley Area Assessment Summary

- The assessment identified the followings:

Assessment	Number of issues for each category							
	P0	P1	P2	P3	P4	P5	P6	P7
Thermal overload	3	3	7	6	0	0	23	2
Low voltage	0	5	6	2	0	0	11	3
High voltage	0	2	2	0	0	0	1	1
Voltage deviation	n/a	4	19	0	0	0	0	0
Stability issues	n/a	1	6	0	0	0	0	1

- Overall, the number of criteria violations are less than last year due to lower forecast load.
- Thermal overloads are identified under Cat P0 conditions and are under review with PTO
- Transient stability issues are under review with PTO

# North Valley Area – Results (Category P0 & P1)

- Thermal Overloads

1. Glenn #3 60 kV Line (Cat P0 – Summer 2018)
2. Coleman–Red Bluff 60kV Line (Cat P1 – Summer 2018)

- Potential Mitigations

- Interim action plans for overloads with long-term projects in place.

- Thermal Overloads (Sensitivity)

1. Cottonwood-Red Bluff 60 kV line (Cat P1 – Summer 2018 No BTM-PV and Summer 2021 No AAEE )
2. Coleman-Red Bluff 60 kV line (Cat P1 – Summer 2021 Heavy Renewable & Min Gas Gen)

- Potential Mitigations

- Interim action plans for overloads with long-term projects in place.
- Load transfer

Thermal issues resulting from other contingency categories will be discussed in the area diagram

# North Valley Area – Results (Category P0 & P1)

## ■ Voltage Results

- Hat Creek and Pit 60 kV high voltage (Cat P1 – 2018 Spring Off Peak)
- Red Bluff and Vina 60 kV low voltage (Cat P1 – 2018 & 2021 Summer Peak)

## ■ Potential Mitigations

- Interim action plans for overloads such as load transfer and may need additional reactive support
- Mitigation under investigation for the high voltage issues

## ■ Voltage Results (Sensitivity)

- No Cat P0 nor Cat P1 voltage deviation issues

## ■ Potential Mitigations

- N/A

Voltage issues resulting from other contingency categories will be discussed in the area diagram

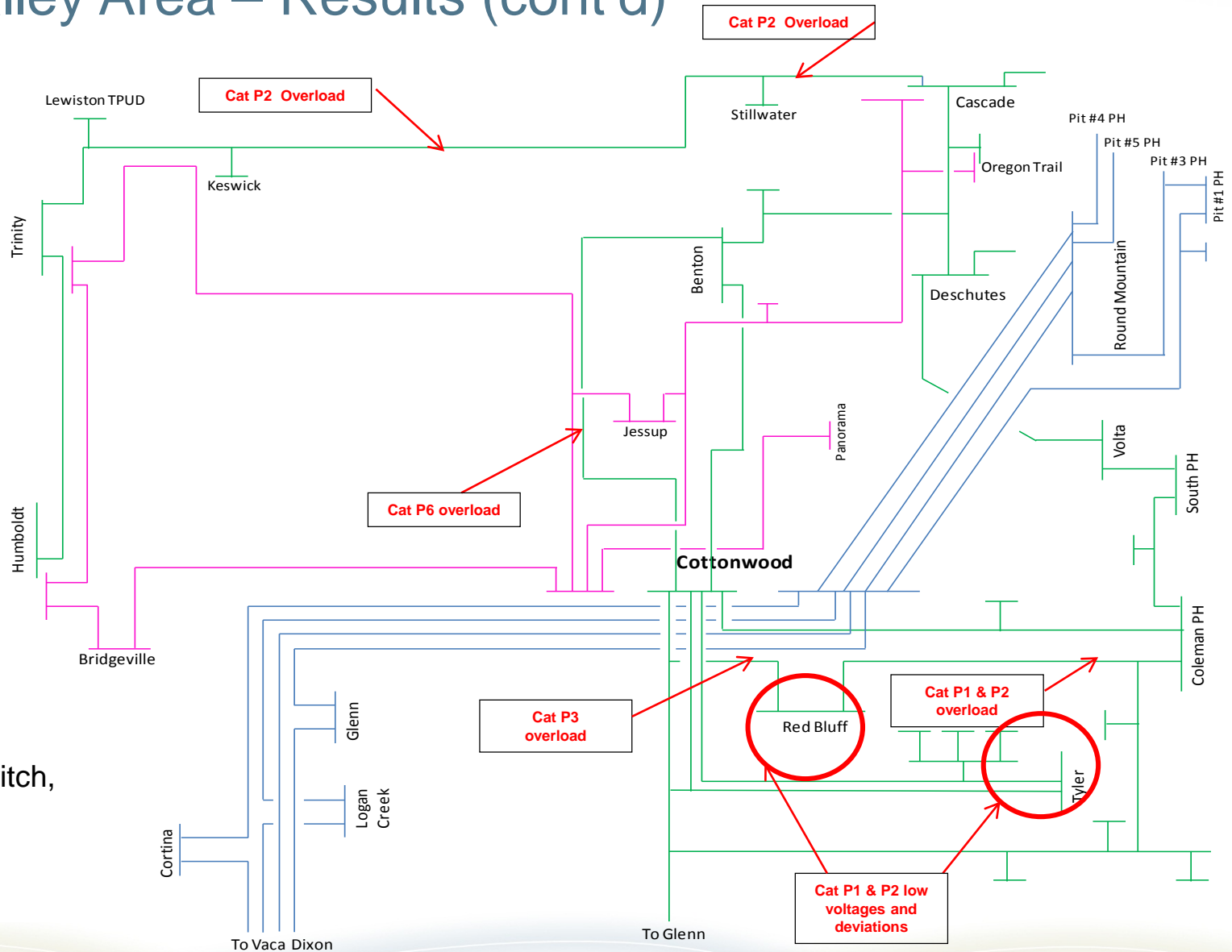
# North Valley Area – Results (cont'd)

## Legend

- 230 kV
- 115 kV
- 60 kV

## Mitigation

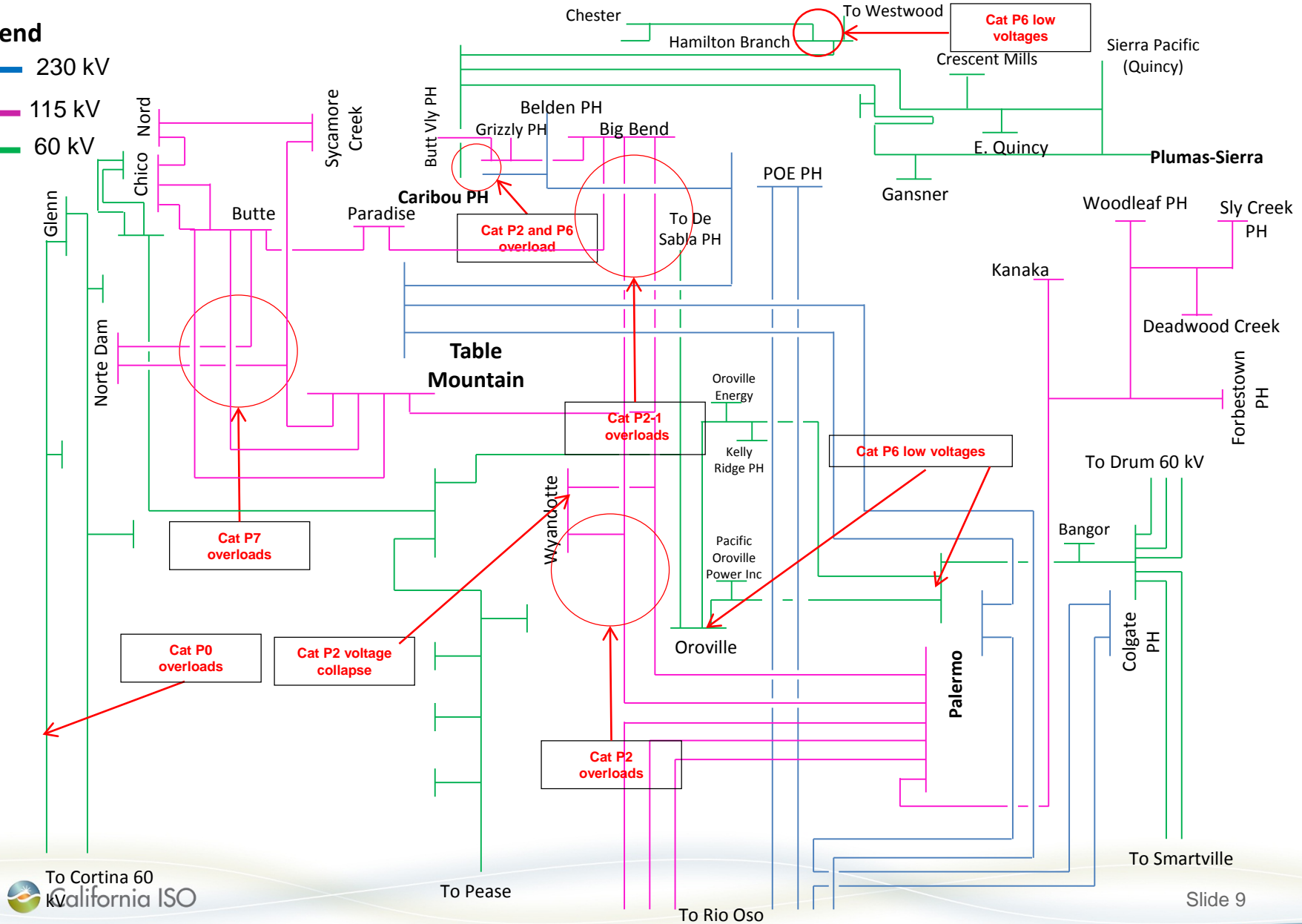
SPS, Load Switch,  
Load Drop,  
Reconductor



# North Valley Area – Results (cont'd)

## Legend

- 230 kV
- 115 kV
- 60 kV



# North Valley Area – Results

- **Sensitivity Studies**

- Category P6 thermal overloads were observed with increased occurrence under sensitivity criteria
- Category P2 voltage/ voltage deviation issues were observed with increased occurrence under sensitivity criteria



# Conclusion

## Reliability issues needing new mitigation

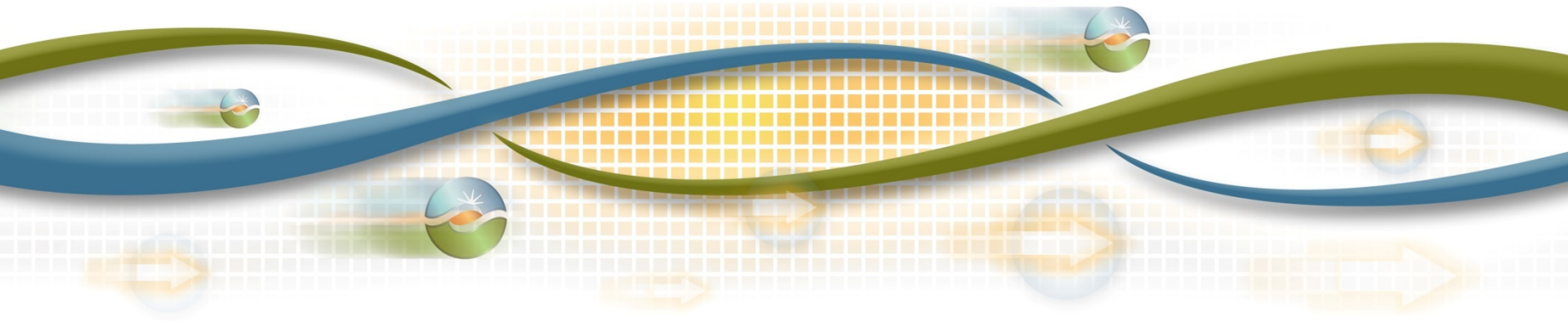
Area	Facility	Contingency Category	Potential Mitigation
North Valley 60 kV Area	Keswick-Stillwater 60kV Line	P2	Short Term: NVLY Action Plan Long Term: Cascade - Benton 60 kV Line Project
	Cascade-Stillwater 60kV Line	P2	
North Valley 60 kV Area	Low voltage issues in summer peak conditions	P1	Voltage support or storage
	High voltage issues in spring off- peak conditions	P1	Install reactive device
	High voltage issues in light load and off-peak conditions	P1	
North Valley 60 kV Area	High voltage issues in spring off- peak and sensitivity conditions	P6	Install reactive device
North Valley 60 kV Area	Keswick-Stillwater 60kV Line	P6	Short Term: NVLY Action Plan Long Term: Cascade - Benton 60 kV Line Project
North Valley 60 kV Area	Cascade-Stillwater 60kV Line	P6	Short Term: NVLY Action Plan Long Term: Cascade - Benton 60 kV Line Project



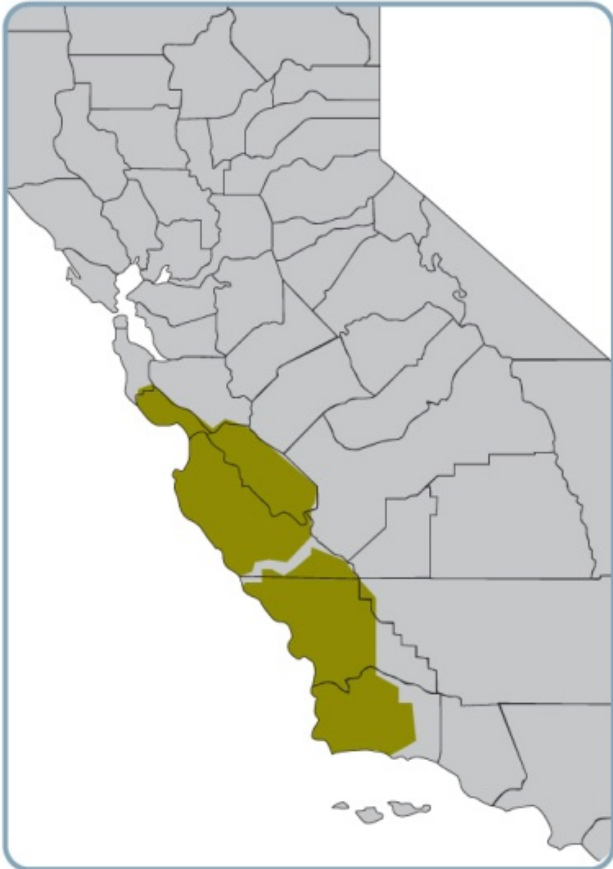
# Central Coast and Los Padres Areas Preliminary Reliability Assessment Results

Bryan Fong  
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2016-2017 Transmission Planning Process Stakeholder Meeting  
September 21-22, 2016

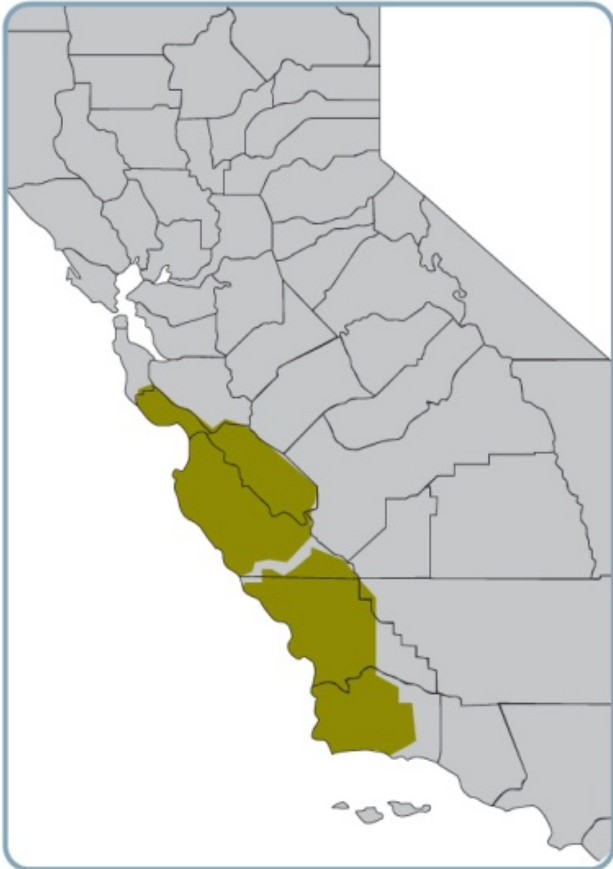


# Central Coast Area



- Located south of the Greater Bay Area, it extends along the central coast from Santa Cruz to King City
- Major substations: Moss Landing, Green Valley, Paul Sweet, Salinas, Watsonville, Monterey, Soledad and Hollister
- Supply sources: Moss Landing, Panoche, King City and Monta Vista
- Generation: Approximately 300 MW.
- Transmission system includes 60, 115, 230 and 500 kV facilities

# Central Coast Area



- **Load:**
  - 2026 Summer Peak load forecast:
    - Load: 723 MW
    - AAEE: 52 MW
    - BTM-PV: 82 MW
    - **Net peak load in 2026: 671 MW**
  
- **Load:**
  - 2026 Winter Peak load forecast:
    - Load: 682 MW
    - AAEE: 49 MW
    - BTM-PV: 0 MW
    - **Net peak load in 2026: 633 MW**

# Study Scenarios

Load and Generation Scenarios	Study Year		
	2018	2021	2026
<b>Baseline Scenarios</b>			
Summer Peak	✓	✓	✓
Winter Peak	✓	✓	✓
Spring Off-Peak	✓		
Spring Light Load		✓	
Summer Partial Peak			
Winter peak - (SF & Peninsula)			
Winter peak - (SF Only)			
<b>Sensitivity Scenarios</b>			
Summer Peak with high CEC forecast load (No AAEE)		✓	
Summer peak with no BTM PV	✓		✓
Summer Peak with heavy renewable output and minimum gas generation commitment		✓	
Retirement of QF Generations			✓

# Transmission Projects in Central Coast Area

<b>Transmission Projects in Central Valley Area</b>	<b>Expected ISD</b>
<b>Less than \$50M</b>	
Navidad Substation Interconnection	May-23
Soledad 115/60 kV Transformer Capacity	Apr-22
Watsonville Voltage Conversion	Apr-20
<b>\$50M or More</b>	
<b>Projects found to be needed in the 2015-2016 Planning Cycle</b>	

# Central Coast Area Assessment Summary

- The assessment identified the followings:

Assessment	Number of issues for each category							
	P0	P1	P2	P3	P4	P5	P6	P7
Thermal overload	0	1	8	0	0	0	1	0
Low voltage	0	0	4	0	0	0	0	0
High voltage	0	0	0	0	0	0	2	0
Voltage deviation	n/a	4	7	0	0	0	0	0
Stability issues	n/a	0	0	0	0	1	0	3

- Overall, the number of criteria violations are less than last year due to lower forecast load.
- No new thermal overloads due to Category P0 & P1
- Transient stability issues are under review with PTO

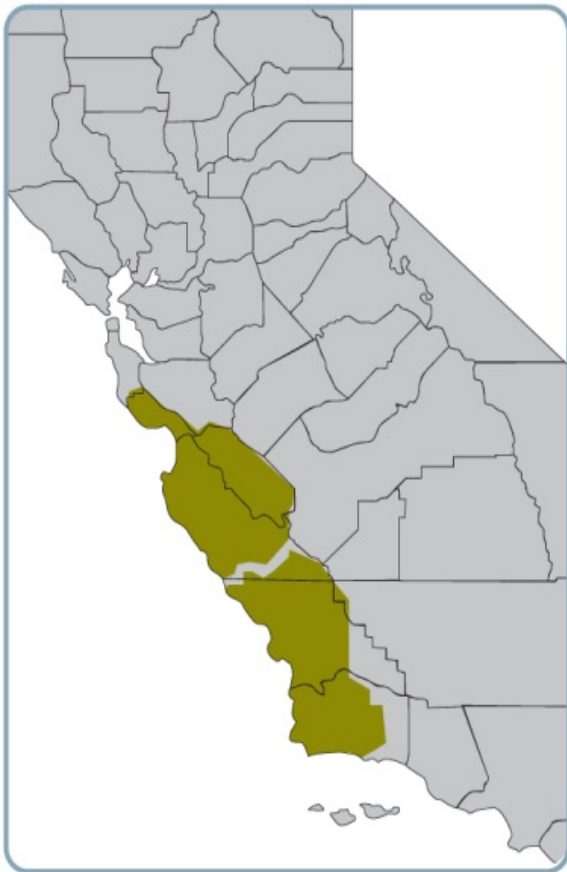
# Central Coast Area – Results

- **Sensitivity**

- Category P2-1 (new requirement) and P6 thermal overloads were observed with increased occurrence under sensitivity criteria
- No voltage/ voltage deviation issues with increased occurrence were observed under sensitivity criteria
- Potential mitigation: Mitigated under review

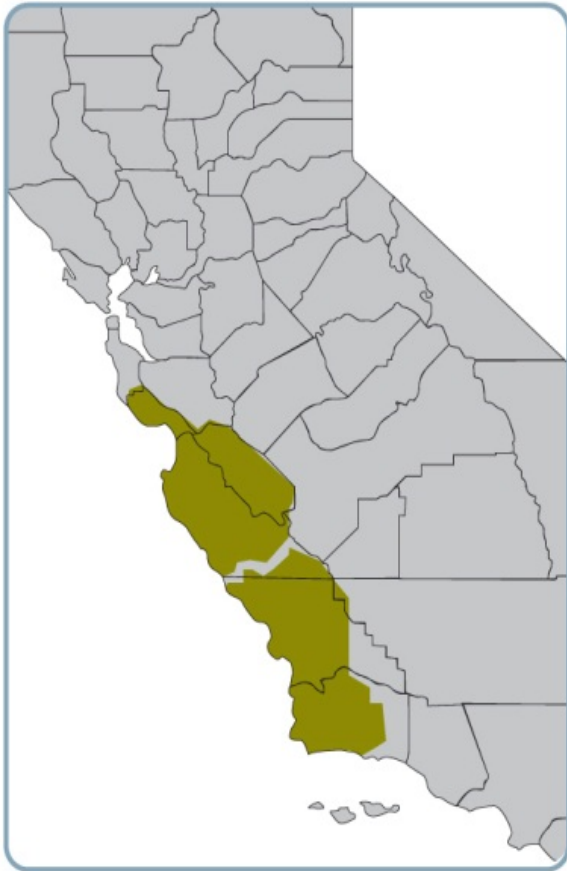


# Los Padres Area



- Located south of the Central Coast Division
- Major substations : Paso Robles, Atascadero, Morro Bay, San Luis Obispo, Mesa, Divide, Santa Maria and Sisquoc
- Key supply sources include Gates, Midway and Morro Bay
- Generation: Approximately 950 MW
- Diablo Canyon nuclear power plant (2400 MW) is located in Los Padres but does not serve the area
- Transmission system includes 70, 115, 230 and 500 kV facilities

# Los Padres Area



- **Load:**
  - 2026 Summer Peak load forecast:
    - Load: 610 MW
    - AEE: 37 MW
    - BTM-PV: 58 MW
    - **Net peak load in 2026: 573 MW**
  
- **Load:**
  - 2026 Winter Peak load forecast:
    - Load: 612 MW
    - AEE: 35 MW
    - BTM-PV: 0 MW
    - **Net peak load in 2026: 577 MW**

# Study Scenarios

Load and Generation Scenarios	Study Year		
	2018	2021	2026
<b>Baseline Scenarios</b>			
Summer Peak	✓	✓	✓
Winter Peak	✓	✓	✓
Spring Off-Peak	✓		
Spring Light Load		✓	
Summer Partial Peak			
Winter peak - (SF & Peninsula)			
Winter peak - (SF Only)			
<b>Sensitivity Scenarios</b>			
Summer Peak with high CEC forecast load (No AAEE)		✓	
Summer peak with no BTM PV	✓		✓
Summer Peak with heavy renewable output and minimum gas generation commitment		✓	
Retirement of QF Generations			✓

# Transmission Projects in Los Padres Area

Transmission Projects in Central Valley Area	Expected ISD
<b>Less than \$50M</b>	
Cayucos 70 kV Shunt Capacitor	May-21
Estrella Substation Project	May-19
Diablo Canyon Voltage Support Project	Feb-19
Mesa-Sisquoc 115 kV Line Reconductoring	Apr-17
Morro Bay 230/115 kV Transformer Addition Project	May-18
<b>\$50M or More</b>	
Midway-Andrew 230 kV Project	May-25
<b>Projects found to be needed in the 2015-2016 Planning Cycle</b>	

# Los Padres Area Assessment Summary

- The assessment identified the followings:

Assessment	Number of issues for each category							
	P0	P1	P2	P3	P4	P5	P6	P7
Thermal overload	0	3	8	1	0	0	17	0
Low voltage	0	0	21	0	0	0	0	18
High voltage	0	0	0	0	0	0	2	0
Voltage deviation	n/a	6	18	0	0	0	1	12
Stability issues	n/a	0	0	0	0	2	0	2

- Overall, the number of criteria violations are less than last year due to lower forecast load.
- No new thermal overloads due to Category P0 or P1 contingency conditions
- Transient stability issues are under review with PTO

# Los Padres Area – Results

- **Sensitivity**

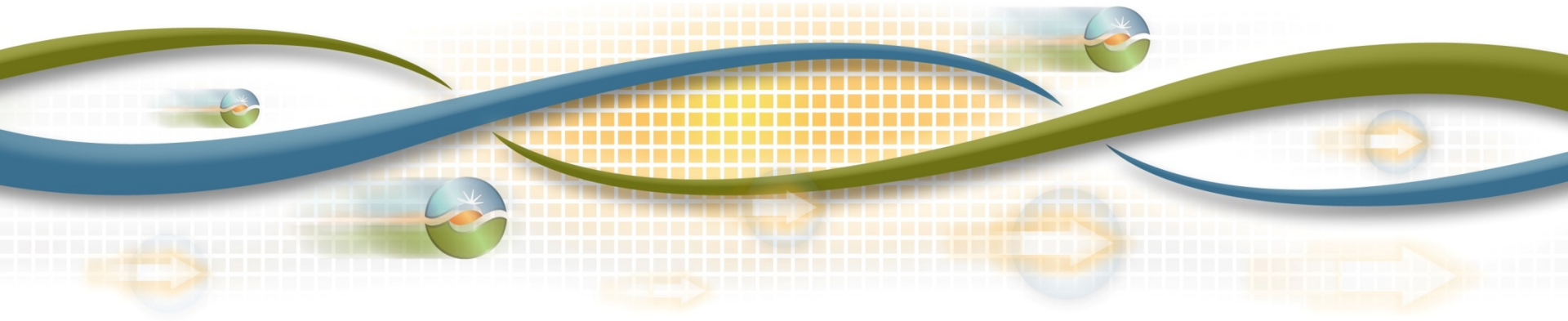
- Category P2 and P6 thermal overloads were observed with increased occurrence under sensitivity criteria
- No voltage/ voltage deviation issues with increased occurrence were observed under sensitivity criteria
- Potential mitigation: Mitigated by already approved projects Estrella 230 kV Substation, Midway-Andrew 230 kV Project, Morro Bay 230/115 kV Bank Addition Project (to be confirmed)



# Central Valley Area Preliminary Reliability Assessment Results

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Lead Regional Transmission Engineer

2016-2017 Transmission Planning Process Stakeholder Meeting  
September 21-22, 2016



# Central Valley Area



- Includes the following divisions:
  - Sacramento
  - Sierra
  - Stockton
  - Stanislaus
- Transmission facilities: 60, 115, 230 and 500 kV.
- Generation: 3,960 MW installed capacity
- Load:
  - 2026 Summer Peak load forecast:
    - Load: 4,512 MW
    - AAEE: 258 MW
    - BTM-PV: 360 MW
    - **Net peak load in 2026: 3,894 MW**



# Study Scenarios for Central Valley Area

Load and Generation Scenarios	Study Year		
	2018	2021	2026
<b>Baseline Scenarios</b>			
Summer Peak	✓	✓	✓
Winter Peak			
Spring Off-Peak	✓		
Spring Light Load		✓	
Summer Partial Peak			
Winter peak - (SF & Peninsula)			
Winter peak - (SF Only)			
<b>Sensitivity Scenarios</b>			
Summer Peak with high CEC forecast load (No AAEE)		✓	
Summer peak with no BTM PV	✓		✓
Summer Peak with heavy renewable output and minimum gas generation commitment		✓	
Retirement of QF Generations			✓

# Transmission Projects in Central Valley Area

Transmission Projects in Central Valley Area	Expected ISD
<b>Less than \$50M</b>	
Cortina No.3 60 kV Line Reconductoring Project	Dec-18
Lodi – Eight Mile 230 kV Line	May-22
Missouri Flat – Gold Hill 115 kV Line	Dec-18
Mosher Transmission Project	Aug-18
Pease 115/60 kV Transformer Addition and Bus Upgrade	Aug-19
Pease – Marysville #2 60 kV Line	Jun-22
Rio Oso – Atlantic 230 kV Line Project	Apr-24
Rio Oso 230/115 kV Transformer Upgrades	Jan-20
Rio Oso Area 230 kV Voltage Support	Dec- 20
Ripon 115 kV Line	Mar-19
Stagg – Hammer 60 kV Line	May-19
Stockton 'A' – Weber 60 kV Line Nos. 1 and 2 Reconductor	Dec-18
Tesla 115 kV Capacity Increase	Jun-16
Vierra 115 kV Looping Project	Apr-21
Weber 230/60 kV Transformer Nos. 2 and 2A Replacement	Jun-16
Weber – French Camp 60 kV Line Reconfiguration	Mar-16
West Point – Valley Springs 60 kV Line	Jun-19
<b>\$50M or More</b>	
Atlantic – Placer 115 kV Line	Apr-24
Lockeford – Lodi Area 230 kV Development	Dec-24
South of Palermo 115 kV Reinforcement Project	Apr-22
Vaca – Davis Voltage Conversion Project	Feb-21
<b>Projects found to be needed in the 2015-2016 Planning Cycle</b>	
Bellota 230 kV Substation Shunt Reactor	Dec-20
Delevan 230 kV Substation Shunt Reactor	Dec-20

# Central Valley Area Assessment Summary

- The assessment identified the followings:

Assessment	Number of issues for each category							
	P0	P1	P2	P3	P4	P5	P6	P7
Thermal overload	2	10	24	11	0	4	40	10
Low voltage	12	7	48	11	0	5	26	8
High voltage	33	0	26	0	0	4	0	0
Voltage deviation	n/a	30	47	0	0	5	0	13
Stability issues	n/a	4	3	4	6	5	3	1

- Overall, the number of criteria violations are less than last year due to lower forecast load.
- High and low voltages are identified under Cat P0 conditions and are under review with PTO
- Transient stability issues are under review with PTO

# Sacramento Division (Category P0 & P1)

## ■ Thermal Overloads (Baseline)

1. Vaca – Plainfield 60 kV line (Cat P0 – Summer 2018)
2. Vaca Dixon 115/60 kV Transformer Bank #5 (Cat P1 – Summer 2018)
3. Cortina 230/115/60 kV Transformer No. 1 (Cat P1 – all 3 study years)

## ■ Potential Mitigations

- Interim action plans until *Vaca - Davis Voltage Conversion Project* is in service
- Existing operating procedures will be used to address Cortina transformer issue

## ■ Thermal Overloads (Sensitivity) – In addition to the overloads in the baseline scenarios:

1. Marginal overload on Cortina 60 kV Line No. 2 (Cortina to Arbuckle 60 kV line) (Cat P1 – Summer 2018 No BTM-PV)

## ■ Potential Mitigations

- Interim action plans

Thermal issues resulting from other contingency categories will be discussed in the area diagram

# Sacramento Division (Category P0 & P1)

## ■ Voltage Results (Baseline)

- High voltage issues occur at Cortina 115 kV under both light load and peak load scenarios (Cat P0 - all study years)
- Low voltage issues occur on 60 kV system around Cortina from Colusa to Dunnigan (Cat P0 - 2018)
- There are voltage issues on 115 and 60 kV busses around Vaca

## ■ Potential Mitigations

- Interim action plans until *Vaca - Davis Voltage Conversion Project* is in service
- Further review is required with PTO regarding voltage issues around Cortina to recommend proper transmission development

## ■ Voltage Results (Sensitivity)

- No new voltage issues occur under sensitivity scenarios

## ■ Potential Mitigations

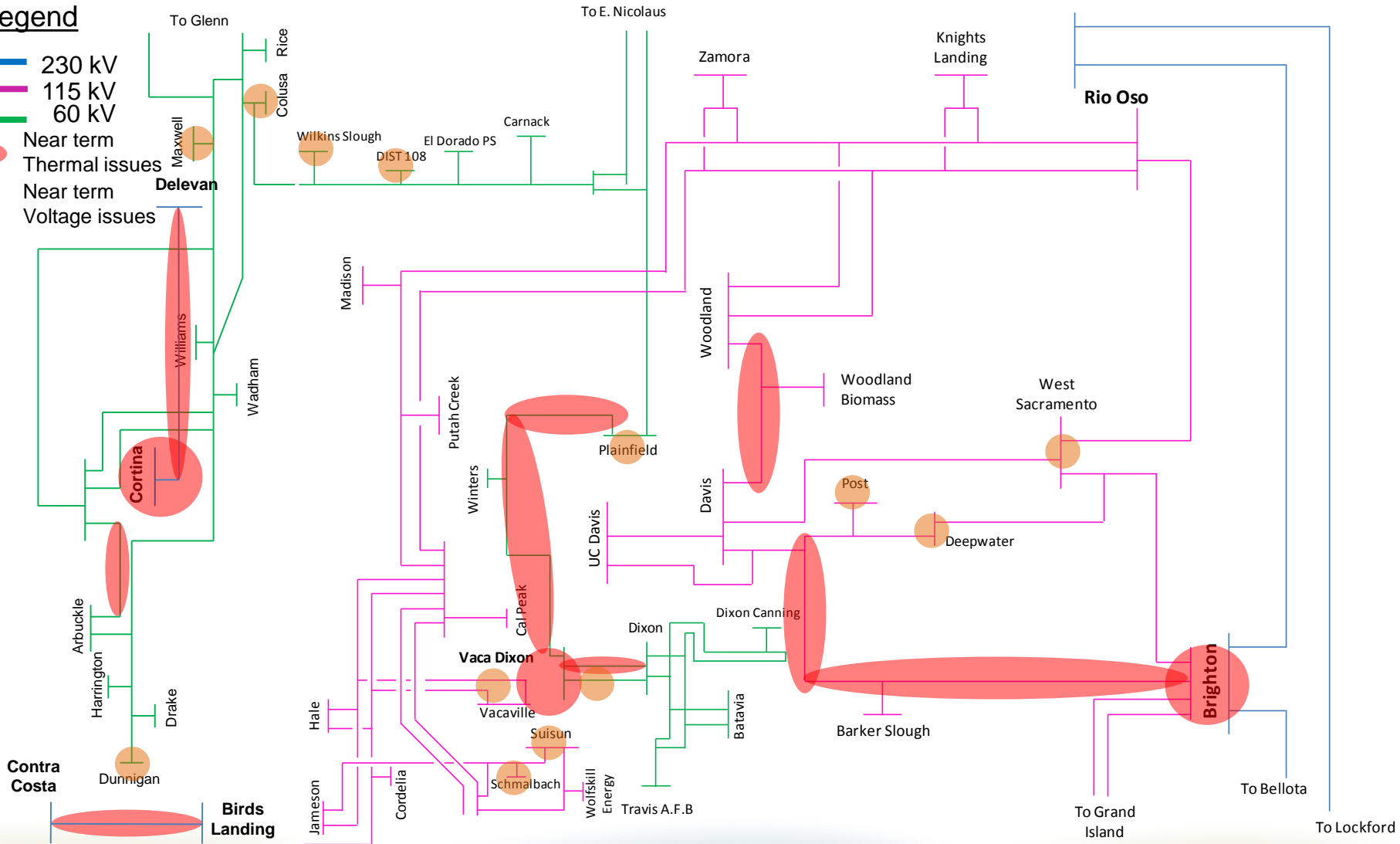
- Same mitigation measures used in base scenarios will address these issues.

Voltage issues resulting from other contingency categories will be discussed in the area diagram

# Sacramento Area – Near term

## Legend

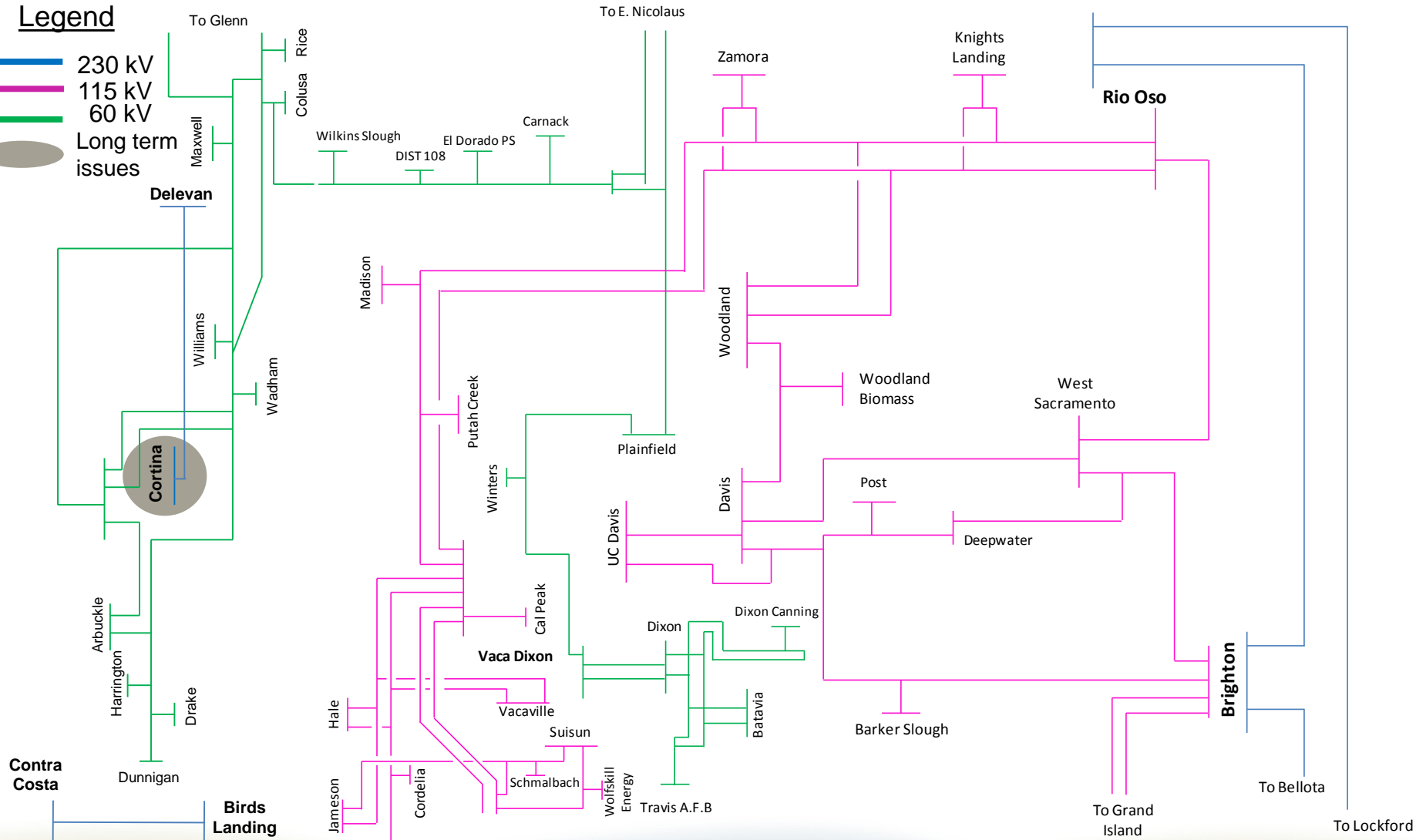
- 230 kV
- 115 kV
- 60 kV
- Near term Thermal issues
- Near term Voltage issues



# Sacramento Area – Long term

## Legend

- 230 kV
- 115 kV
- 60 kV
- Long term issues



# Sierra Division (Category P0 & P1)

- **Thermal Overloads (Baseline)**

1. Nicolaus - Marysville 60 kV Line (Cat P0 – Summer 2026)

- **Potential Mitigations**

- Reconductor the line – Continue to monitor the issue

- **Thermal Overloads (Sensitivity) – In addition to the overloads in the baseline scenarios:**

1. East Nicolaus 115/60 kV Banks 2 and 3 (Cat P1 – Only in Summer 2026 peak load with no BTM-PV)
2. Placer - Del Mar 60 kV Line (Cat P1 – peak load with no BTM-PV in 2018 and 2026)

- **Potential Mitigations**

- Interim action plans for near term issues. Continue to monitor the longer term issues and address them with transmission development or Preferred Resources.

Thermal issues resulting from other contingency categories will be discussed in the area diagram



# Sierra Division (Category P0 & P1)

## ■ Voltage Results (Baseline)

- High voltage issues occur at 115 kV busses between Drum and Rio Oso as well as around Gold Hills under light load conditions (Cat P0 - all study years)
- 60 kV busses between E. Nicolaus and Pease 60 kV (Cat P1 – 2021 and 2026)
- Penryn 60 kV (Cat P1 – only in 2018)

## ■ Potential Mitigations

- Interim action plans until and *Rio Oso Area 230 kV Voltage Support* project is in service. Further review is required with PTO regarding voltage issues around Gold Hills and Nicolaus to recommend proper transmission development

## ■ Voltage Results (Sensitivity)

- Similar issues as baseline scenarios other than no high voltage were identified around Drum, Rio Oso, and Gold Hills

## ■ Potential Mitigations

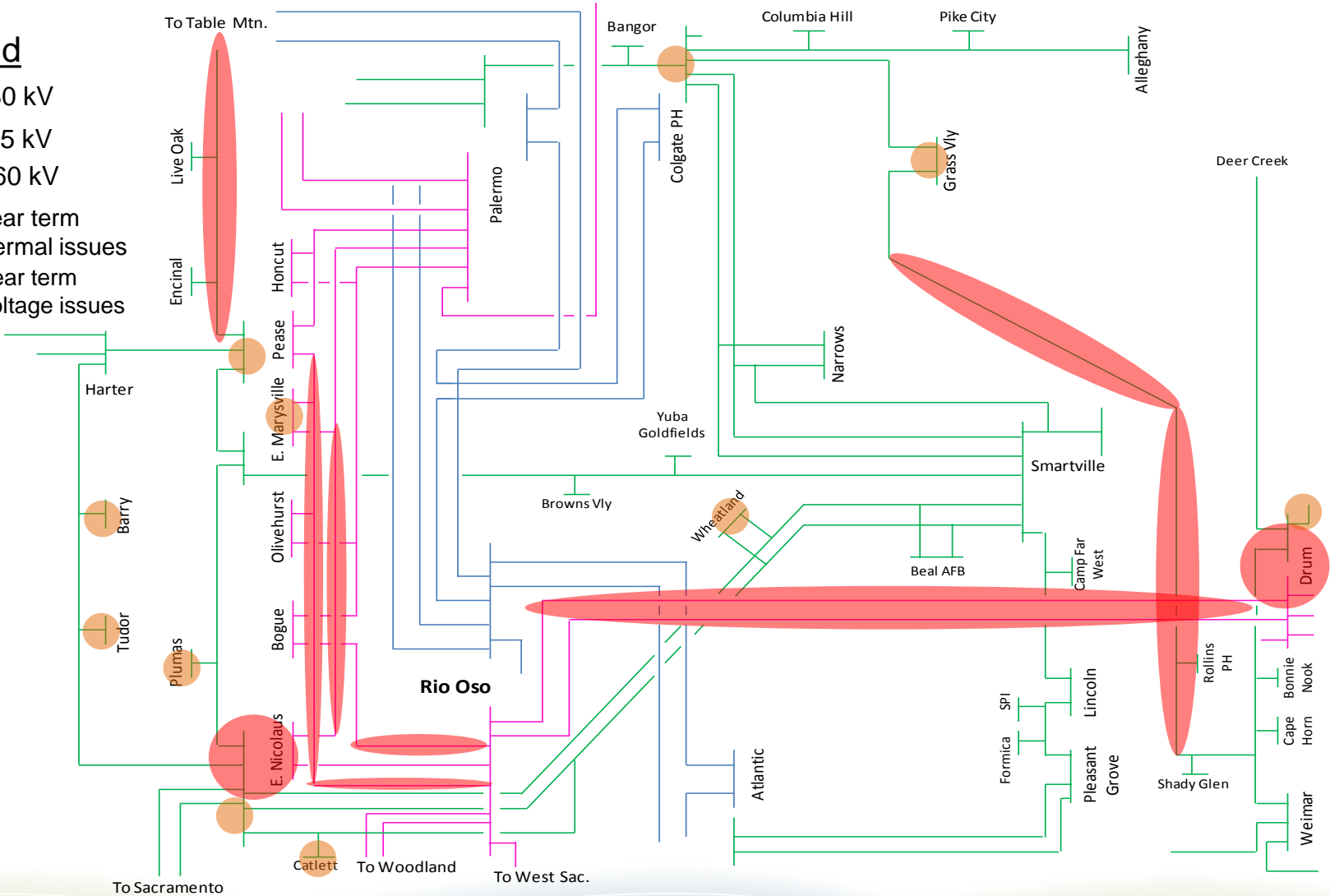
- Similar to baseline scenarios

Voltage issues resulting from other contingency categories will be discussed in the area diagram

# Sierra Area – Near term (1/2)

## Legend

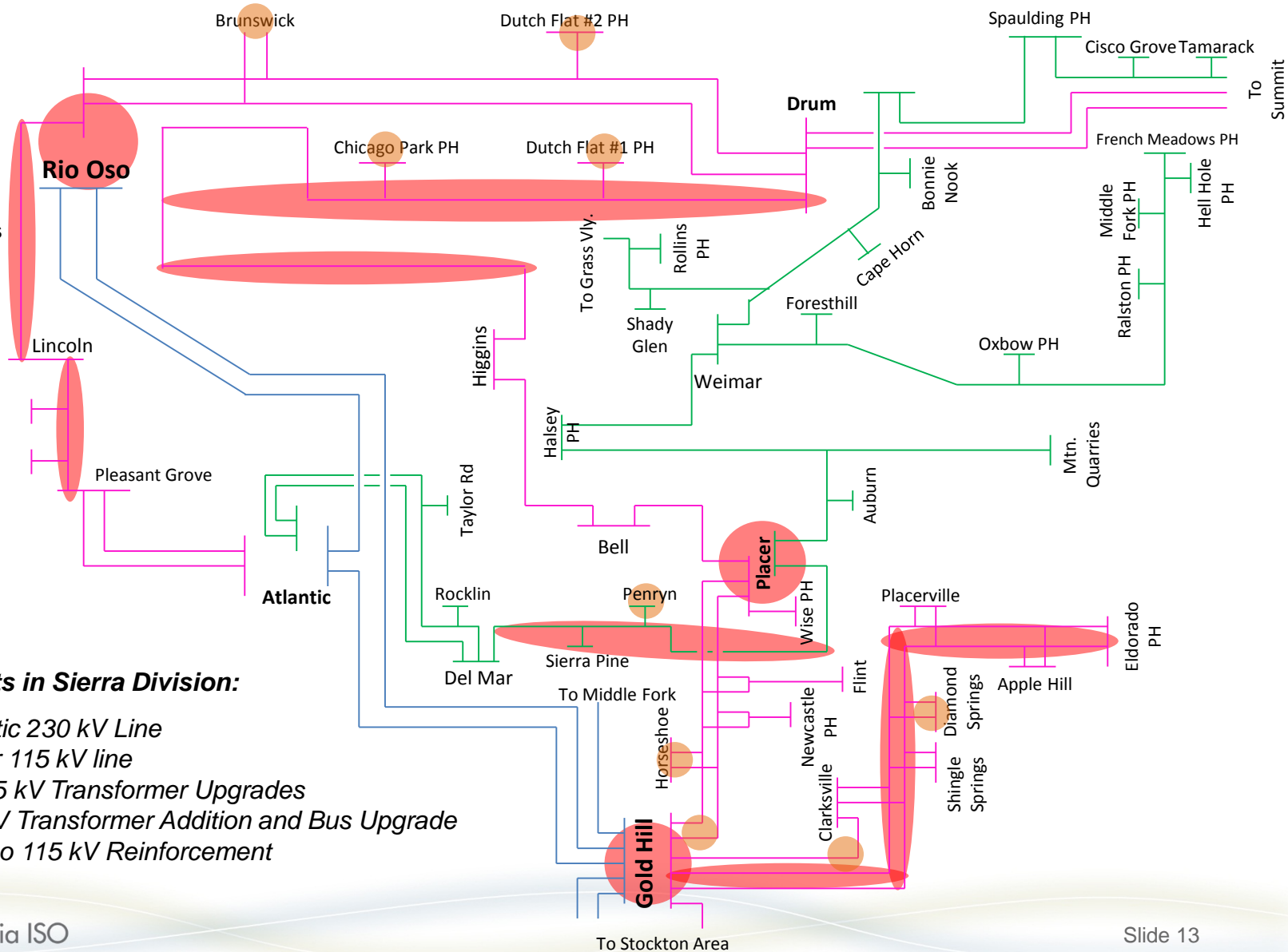
- 230 kV
- 115 kV
- 60 kV
- Near term thermal issues
- Near term Voltage issues



# Sierra Area – Near term (2/2)

## Legend

- 230 kV
- 115 kV
- 60 kV
- Near term thermal issues
- Near term Voltage issues



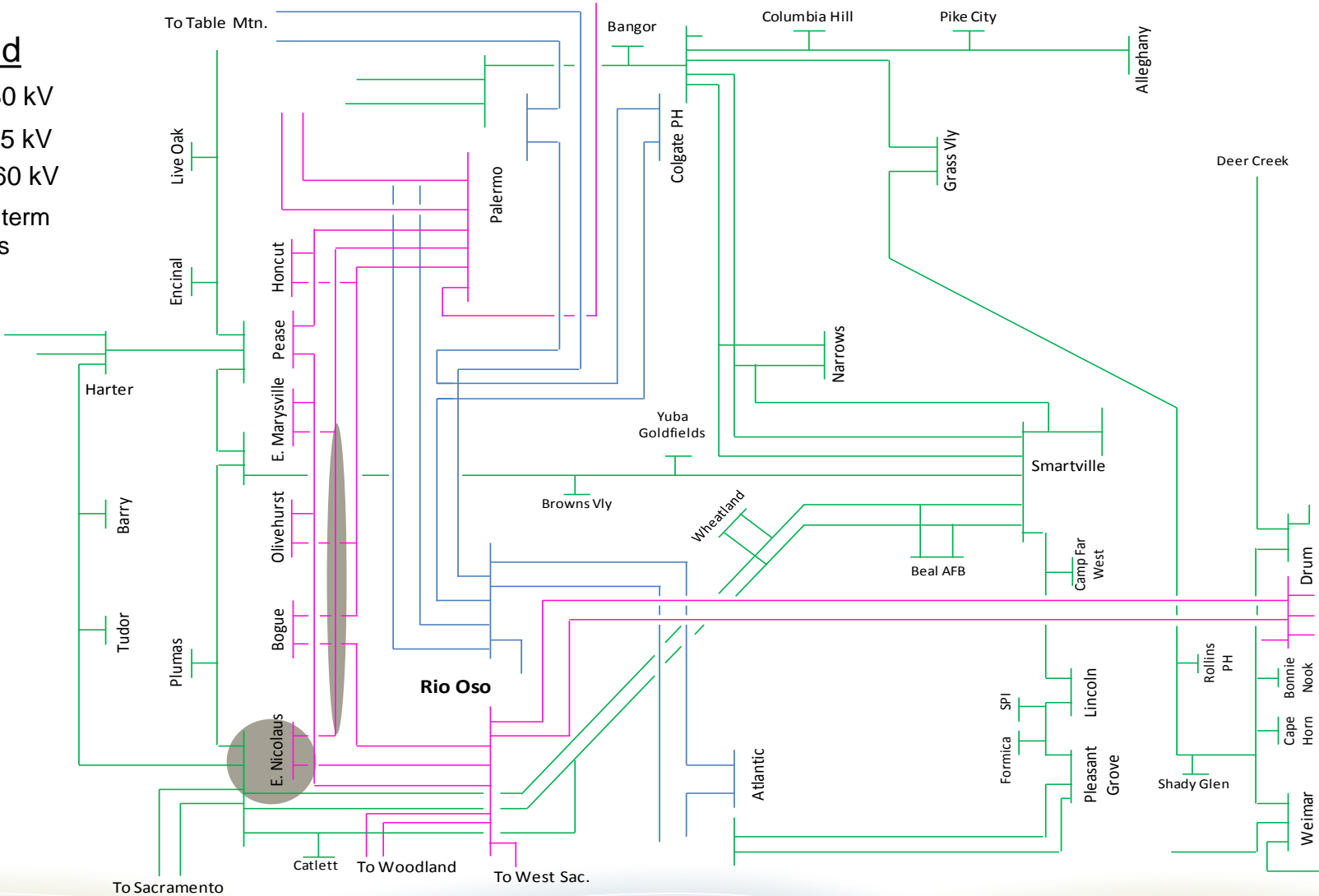
### Approved Projects in Sierra Division:

- Rio Oso – Atlantic 230 kV Line
- Atlantic – Placer 115 kV line
- Rio Oso 230/115 kV Transformer Upgrades
- Pease 115/60 kV Transformer Addition and Bus Upgrade
- South of Palermo 115 kV Reinforcement

# Sierra Area – Long term (1/2)





## Legend

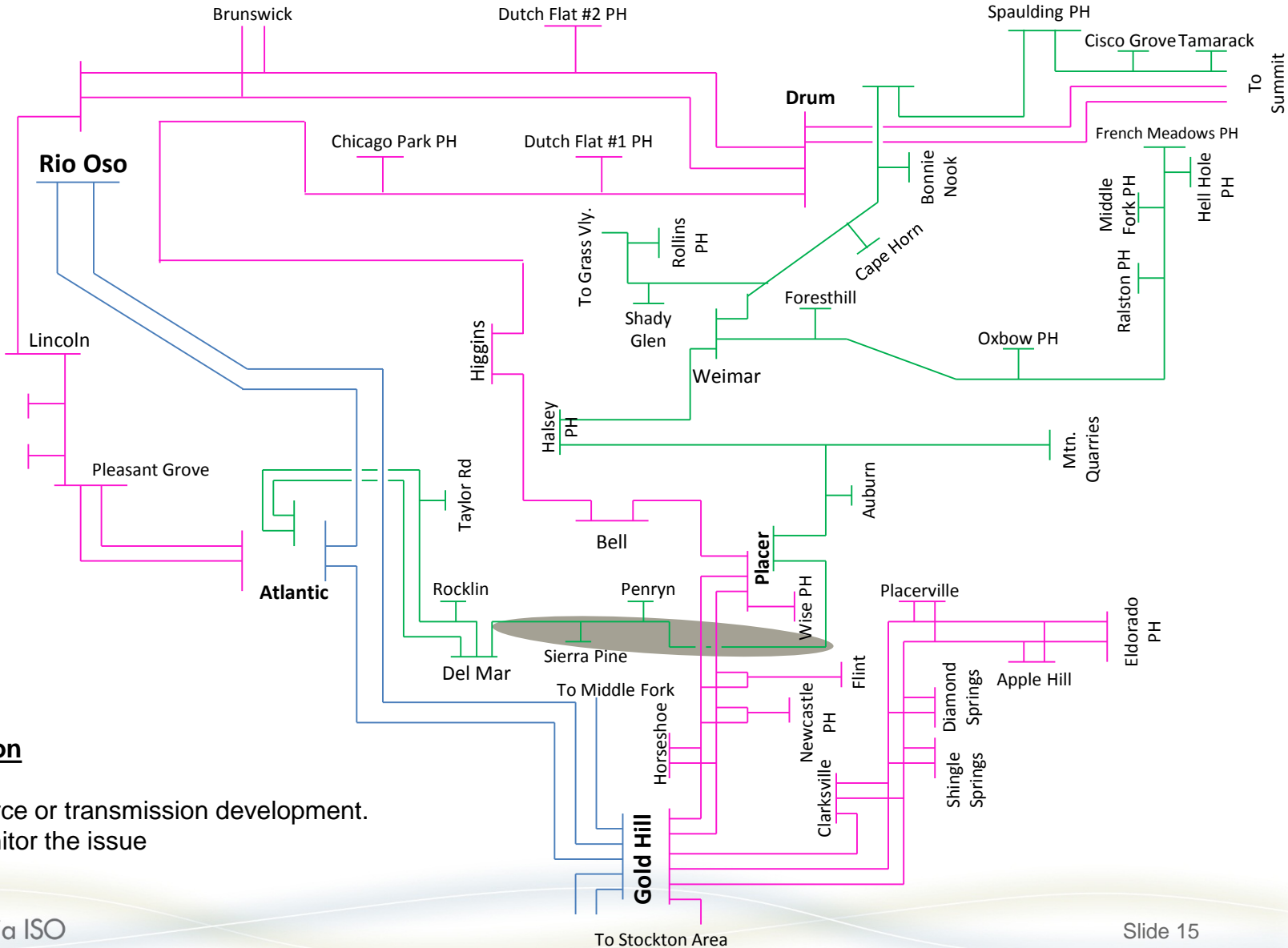
- 230 kV
- 115 kV
- 60 kV
- Long term issues



# Sierra Area – Long term (2/2)

## Legend

-  230 kV
-  115 kV
-  60 kV
-  Long term issues



## Potential Mitigation

- Preferred resource or transmission development.
- Continue to monitor the issue

# Stockton/Stanislaus Divisions (Category P0 & P1)

## ■ Thermal Overloads

1. Kasson - Louise 60 kV Line (Cat P1 – Summer 2026)
2. Manteca - Louise 60 kV Line (Cat P1 – All study years)
3. Manteca 115/60 kV Transformer No. 3 (Cat P1 – All study years)
4. Valley Springs No. 1 60 kV Line (Cat P1 – All study years)

## ■ Potential Mitigations

- Interim action plans for near term issues until a mitigation is finalized and implemented. Continue to monitor the long term issues.

## ■ Thermal Overloads (Sensitivity)

1. Same issues as the baseline scenarios. No new Cat P0 or Cat P1 issues were identified under sensitivity scenarios

## ■ Potential Mitigations

- Same mitigations as baseline scenarios

Thermal issues resulting from other contingency categories will be discussed in the area diagram

# Stockton/Stanislaus Divisions (Category P0 & P1)

## ■ Voltage Results

- 60 kV busses between Lockeford, Lodi and New Hope (Cat P0- 2018)
- 60 kV busses around Valley Springs substation (Cat P1 – only 2018)
- 60 kV busses around Kasson substation (Cat P1 – all study years)

## ■ Potential Mitigations

- Interim action plans until *Lockeford-Lodi Area 230 kV Development, West Point – Valley Springs 60 kV line projects* are in service. Mitigation measures to be developed to address voltage issues around Kasson 60 kV bus

## ■ Voltage Results (Sensitivity)

- Similar issues as baseline scenarios. No new voltage issues occur under sensitivity scenarios

## ■ Potential Mitigations

- Same mitigation measures used in base scenarios will address these issues.

Voltage issues resulting from other contingency categories will be discussed in the area diagram

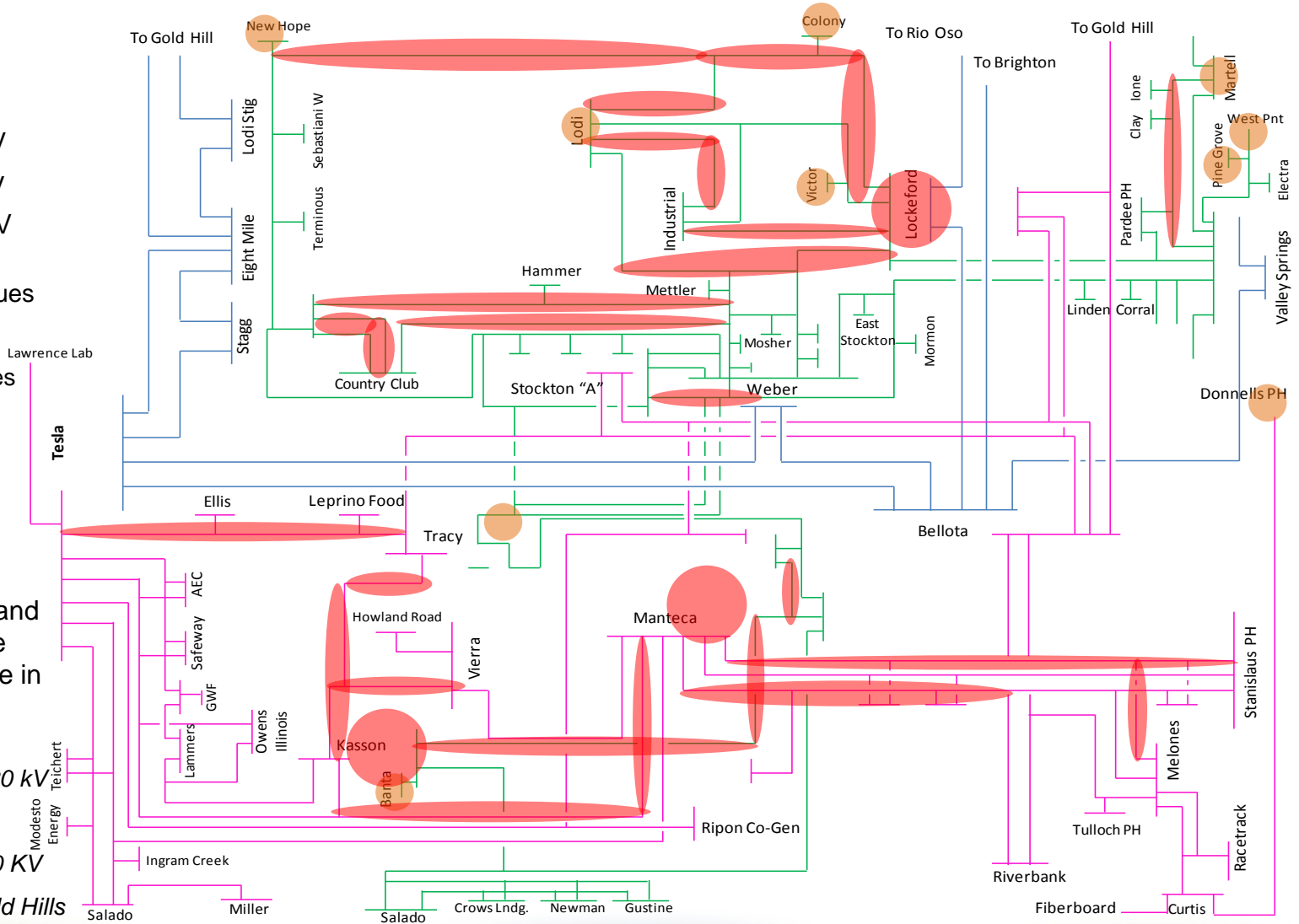
# Stockton/Stanslaus Area – Near term

## Legend

- 230 kV
- 115 kV
- 60 kV

● Near term thermal issues

● Near term Voltage issues



## Mitigation

Operating solution and action plans until the following projects are in service:

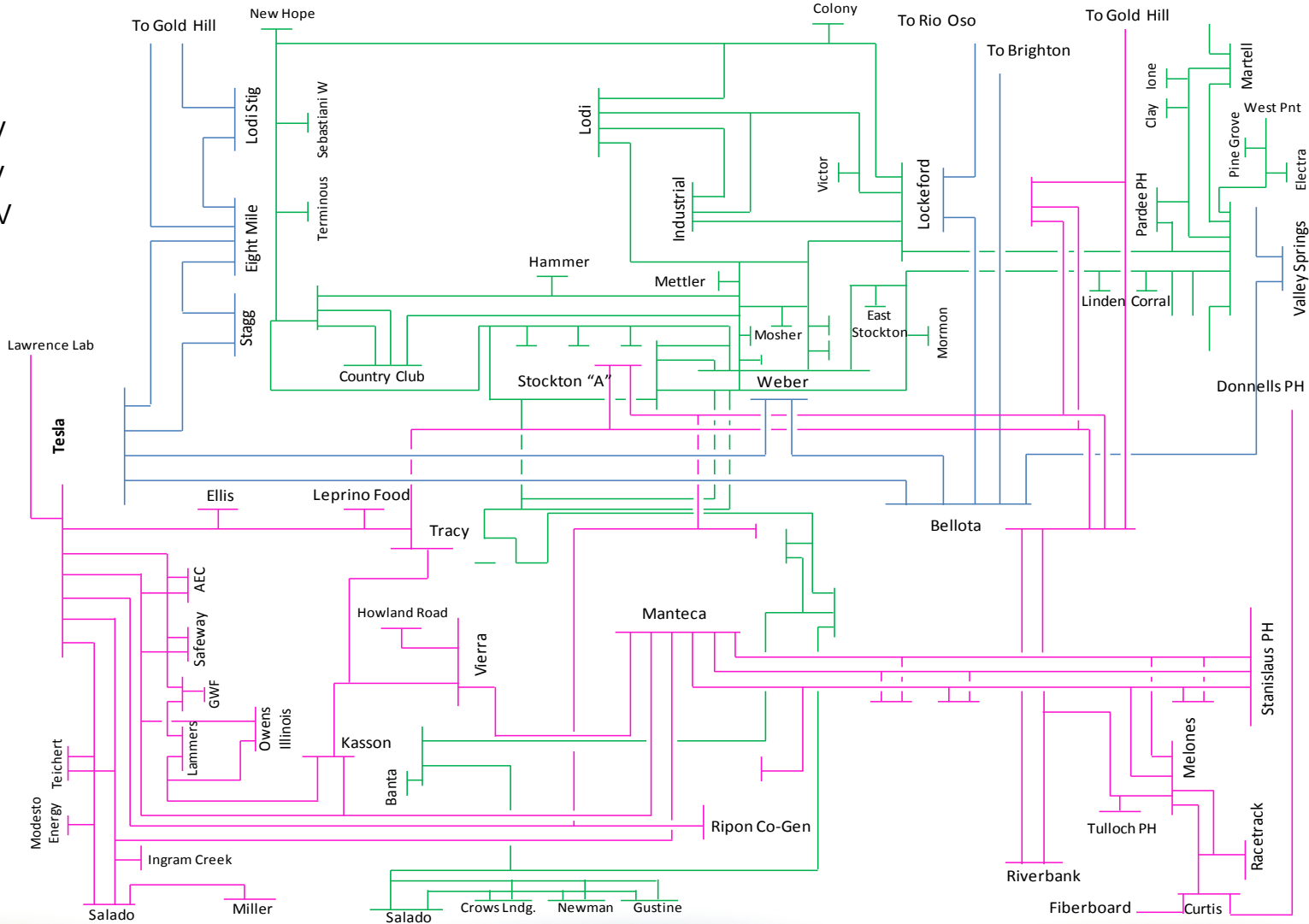
- *Lockeford – Lodi 230 kV*
- *Vierra 115 kV*
- *Stagg – Hammer 60 KV*
- *Missouri Flats – Gold Hills*
- *Stockton A – Weber 60 kV*



# Stockton/Stanislaus Area – Long Term

**Legend**

- 230 kV
- 115 kV
- 60 kV
- Long term issues



# New Potential Mitigation Measures

Division	Facility	Contingency Category	Potential Mitigation
Sierra	Drum - Rio Oso 115 kV No. 2 Line	P2-1	Drum operating procedure
	Eldorado - Missouri Flat 115 kV No. 1 and No. 2 Lines	P2-1	Transfer trip to open other end
	Nicolaus - Marysville 60 kV Line (Plumas-East Nicolaus)	P0	Transmission development or preferred resources. Continue to monitor the issue
Sacramento	Cortina 230/115/60 kV Transformer No. 1	P1	Existing operating procedure
Stockton/Stanislaus	Kasson - Louise 60 kV Line	P1	To be determined in discussions with PTO
	Manteca - Louise 60 kV Line	P1	To be determined in discussions with PTO
	Manteca 115/60 kV Transformer No. 3	P1	To be determined in discussions with PTO
	Valley Springs - Martell 60 kV Line No. 1	P1	Disable automatics
Central Valley Area	High/low voltage issues	P0	To be determined in discussions with PTO

# Summary and Conclusions

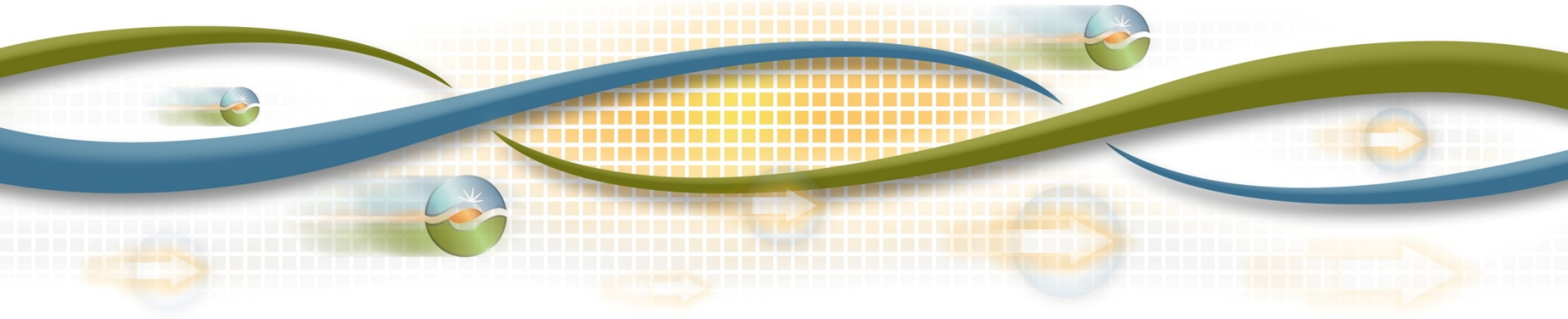
- The Central Valley area consist of Sacramento, Sierra, Stockton, and Stanislaus divisions.
- Approximately 15% of the PG&E load is located in the Central Valley area
- Under peak load conditions power is transferred to the Central Valley area from neighboring areas to serve the load
- There are number of reliability issues in the Central Valley area under different contingency conditions in the near term
- Most of the issues will be addressed by projects that have been already approved by the ISO
- Few marginal overloads that occur in the longer term or under sensitivity conditions are identified in this planning studies. The ISO will address those through preferred resources or by transmission development.



# Greater Bay Area Preliminary Reliability Assessment Results

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2016-2017 Transmission Planning Process Stakeholder Meeting  
September 21-22, 2016



# Greater Bay Area



- Service areas cover Alameda, Contra Costa, Santa Clara, San Mateo and San Francisco counties
- 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

# Greater Bay Area



- Major substations: Vaca Dixon, Tesla and Metcalf
- Supply sources: Vaca Dixon, Tesla and Metcalf
- Generation: Approximately 7,000 MW of generation capacity.
- Comprised of 60, 115 & 230 & 500 kV transmission facilities.
- Load:
  - 2026 Summer Peak load forecast:
    - Load: 9,398 MW
    - AAEE: 669 MW
    - BTM-PV: 669 MW
    - **Net peak load in 2026: 8,060 MW**

# Study Scenarios for Greater Bay Area

Load and Generation Scenarios	Study Year		
	2018	2021	2026
<b>Baseline Scenarios</b>			
Summer Peak	✓	✓	✓
Winter Peak			
Spring Off-Peak	✓		
Spring Light Load		✓	
Summer Partial Peak			
Winter peak - (SF & Peninsula)	✓	✓	✓
<b>Sensitivity Scenarios</b>			
Summer Peak with high CEC forecast load (No AAEE)		✓	
Summer peak with no BTM PV	✓		✓
Summer Peak with heavy renewable output and minimum gas generation commitment		✓	
Retirement of QF Generations			✓

# Transmission Projects in Greater Bay Area

Transmission Projects in Greater Bay Area	Expected ISD
<b>Less than \$50M</b>	
Contra Costa – Moraga 230 kV Line Reconductoring	16-Jan
Contra Costa Sub 230 kV Switch Replacement	17-Dec
Cooley Landing 115/60 kV Transformer Capacity Upgrade	17-Dec
East Shore-Oakland J 115 kV Reconductoring Project	19-Jan
Evergreen-Mabury Conversion to 115 kV	21-Nov
Lockheed No.1 115 kV Tap Reconductor	21-May
Los Esteros-Montague 115 kV Substation Equipment Upgrade	21-Mar
Menlo Area 60 kV System Upgrade	16-May
Metcalf-Evergreen 115 kV Line Reconductoring	19-May
Metcalf-Piercy & Swift and Newark-Dixon Landing 115 kV Upgrade	22-Apr
Monta Vista – Los Gatos – Evergreen 60 kV Project	22-May
Monte Vista 230 kV Bus Upgrade	19-Dec
Moraga Transformers Capacity Increase	16-Feb
Moraga-Castro Valley 230 kV Line Capacity Increase Project	21-Mar
Moraga-Oakland “J” SPS Project	19-Jan
Mountain View/Whisman-Monta Vista 115 kV Reconductoring	22-May
North Tower 115 kV Looping Project	21-Dec
NRS-Scott No. 1 115 kV Line Reconductor	17-Dec
Pittsburg 230/115 kV Transformer Capacity Increase	22-May
Pittsburg-Lakewood SPS Project	16-Mar
Ravenswood – Cooley Landing 115 kV Line Reconductor	19-May
San Mateo – Bair 60 kV Line Reconductor	22-May
South of San Mateo Capacity Increase	29-Feb
Spring 230/115 kV substation near Morgan Hill	21-May
Stone 115 kV Back-tie Reconductor	20-Oct
Tesla-Newark 230 kV Path Upgrade	19-Feb

Transmission Projects in Greater Bay Area	Expected ISD
<b>More than \$50M</b>	
Embarcadero-Potrero 230 kV Transmission Project	16-Jul
Martin 230 kV Bus Extension	21-Dec
<b>Projects found to be needed in the 2015-2016 Planning Cycle</b>	
Los Esteros 230 kV Substation Shunt Reactor	Dec-20



# Greater Bay Area Assessment Summary

- The assessment identified the followings:

Assessment	Number of issues for each category							
	P0	P1	P2	P3	P4	P5	P6	P7
Thermal overload	0	4	44	7	0	12	49	17
Low voltage	0	0	2*	0	0	2*	2*	2*
High voltage	7**	0	1**	0	0	0	0	0
Voltage deviation	n/a	0	2*	0	0	2*	2*	2*
Stability issues	n/a	1	4	1	4	7	1	1

- Overall, the number of criteria violations are less than last year due to lower forecast load.
- High voltages are identified in 115 and 60 kV systems under category P0 conditions and are under review with PTO
- Transient stability issues are under review with PTO

Note: \* Number of 115/60 kV areas with low voltages and voltage

\*\* Number of 115/60 kV areas with high voltages

# Greater Bay Area – Results (Category P0 & P1)

## ■ Thermal Overloads

1. Oleum-Christie 115 kV line (category P1 – Summer 2018 & 2021)
2. Newark-Dixon Landing 115 kV line (category P1 – Summer 2018 & 2021)
3. Piercy-Metcalf 115 kV line (category P1 – Summer 2018)
4. Evergreen-Almaden 60 kV line (category P1 – Summer and winter 2018 & 2021)

## ■ Potential Mitigations

- Interim action plans for overloads with long-term projects in place.

## ■ Thermal Overloads (Sensitivity)

1. Monta Vista-Wolfe 115 kV line (category P1 – Summer 2026 no BTM-PV)
2. Evergreen 115/60 kV transformer # 1 (category P1 – Summer 2018 no BTM-PV)

## ■ Potential Mitigations

- Preferred resource (DER)
- Interim action plans for overloads with long-term projects in place.

Thermal issues resulting from other contingency categories will be discussed in the area diagram

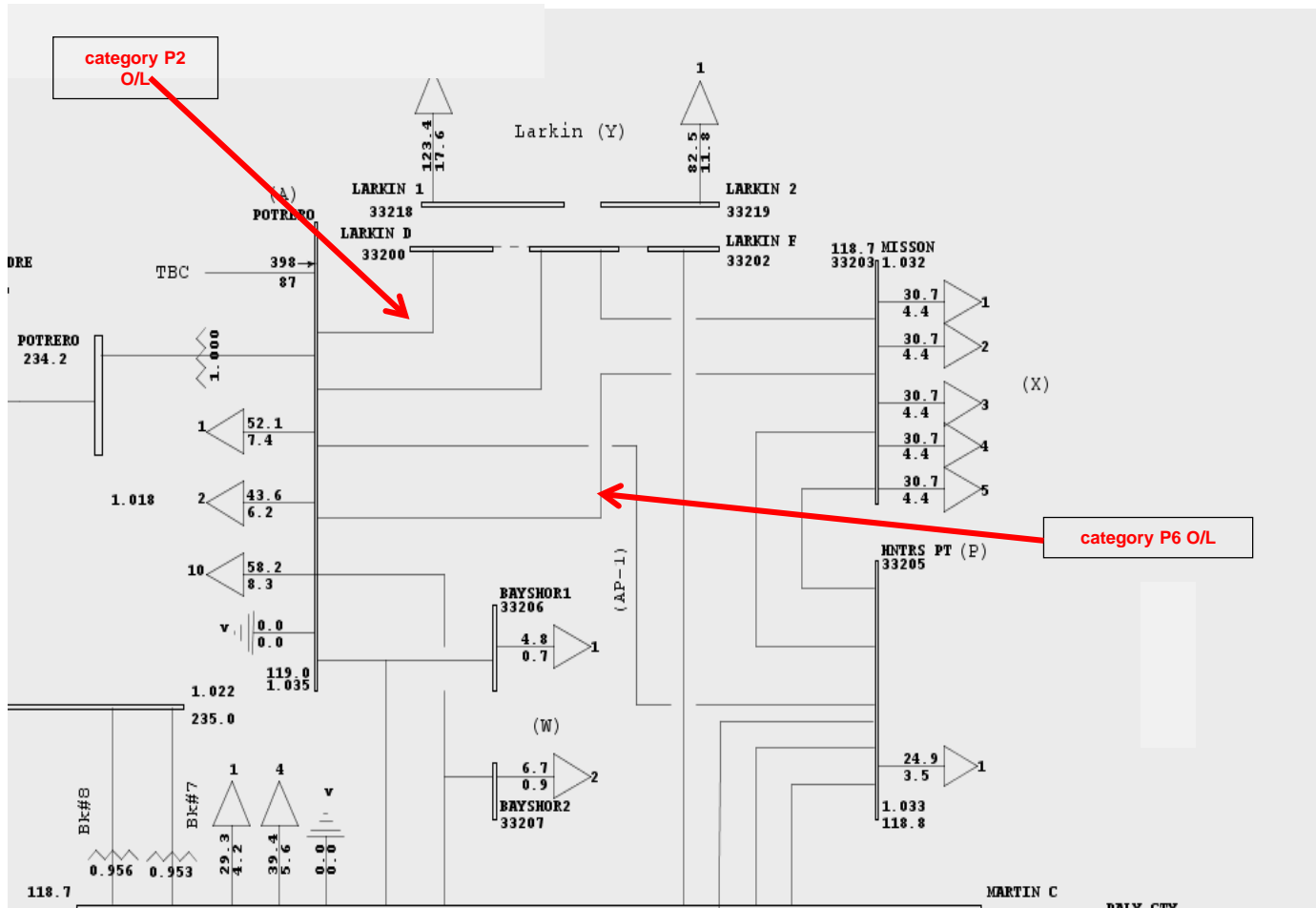
# Greater Bay Area – Results (Category P0 & P1)

- Voltage Results
  - High voltages in 115 and 60 kV systems under normal condition (category P0 – 2021 light-load)
- Potential Mitigations
  - Mitigation under investigation for the high voltage issues

- Voltage Results (Sensitivity)
  - No additional voltage issues identified

Voltage issues resulting from other contingency categories will be discussed in the area diagram

# San Francisco 115 kV system



## Approved Projects

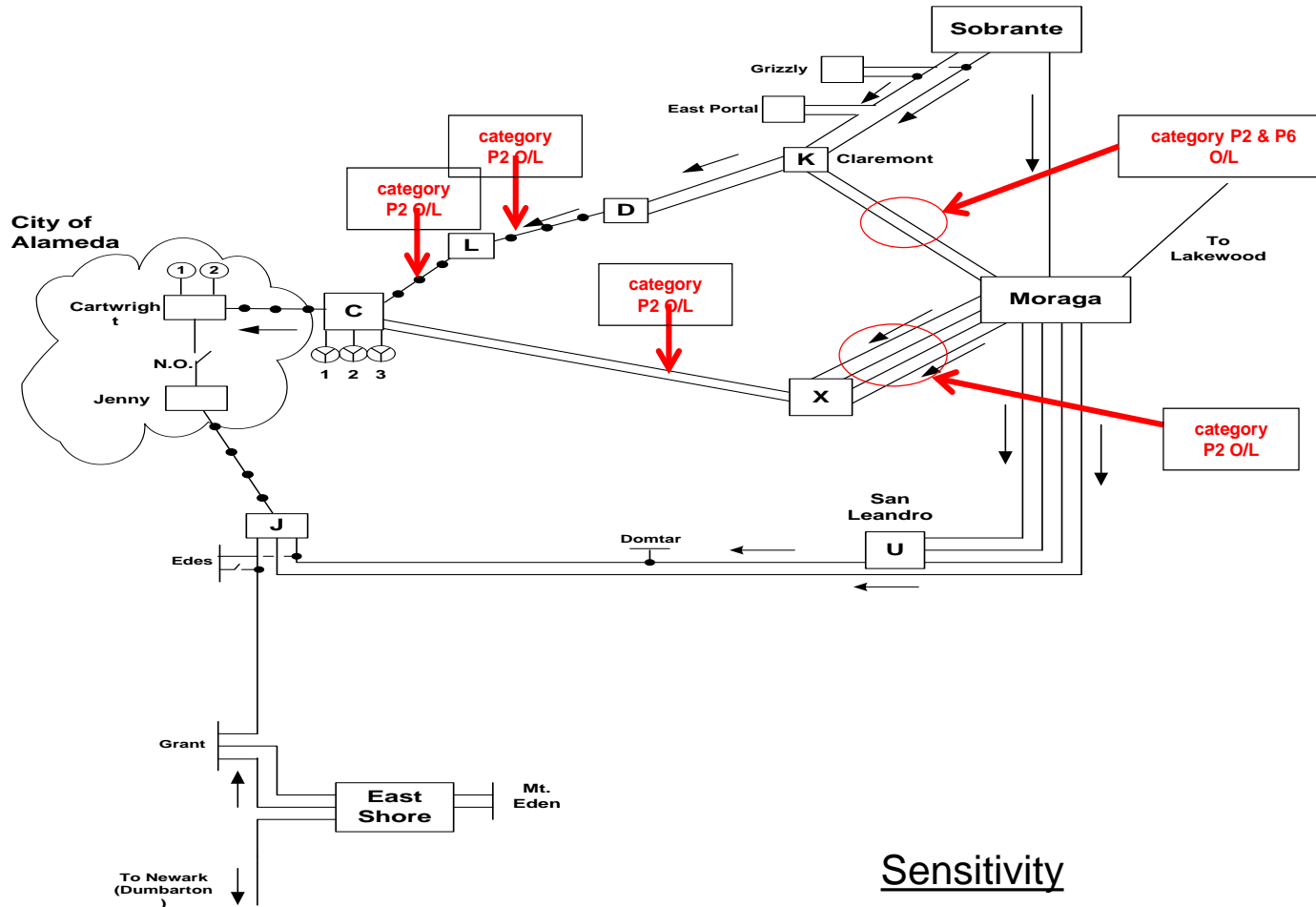
- TBC runback scheme modification & cable rerate

## Sensitivity

- No significant impact

# Oakland 115 kV system (Northern)

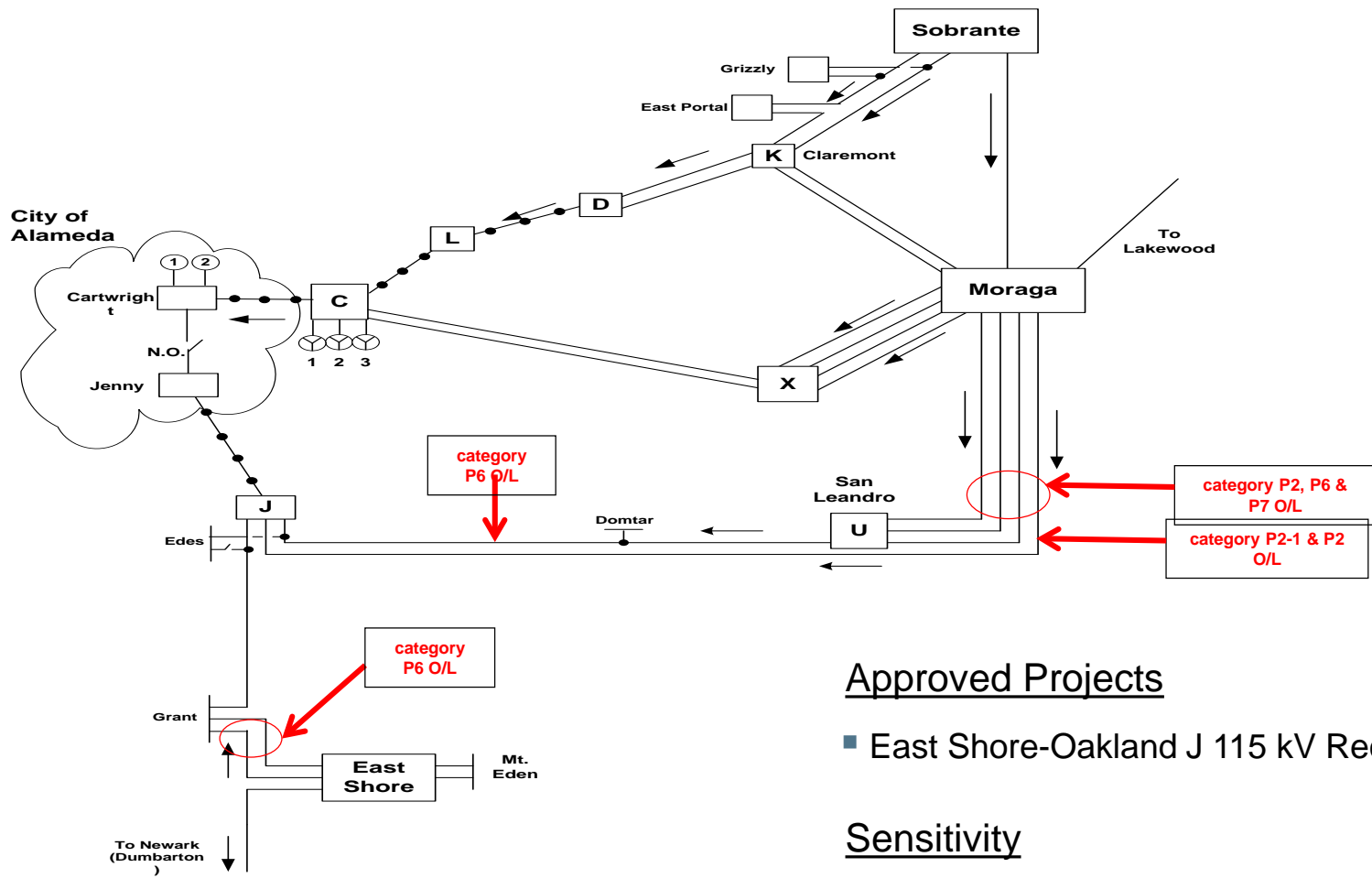
No local generation dispatched



## Sensitivity

- Thermal loadings worsen in “No BTM-PV and No AAEE”

# Oakland 115 kV system (Southern)



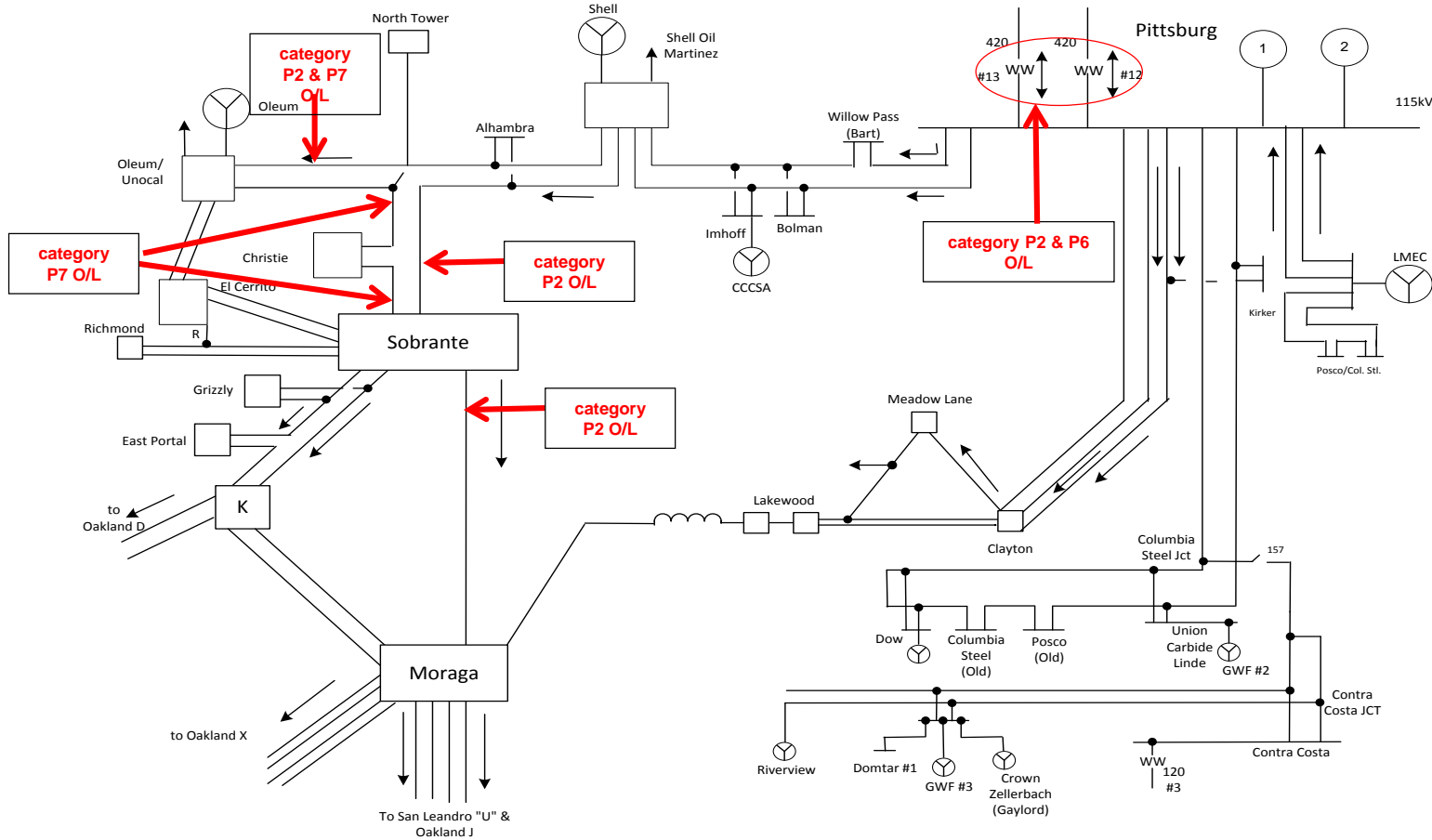
## Approved Projects

- East Shore-Oakland J 115 kV Reconductoring

## Sensitivity

- No significant impact

# Pittsburg-Moraga 115 kV system

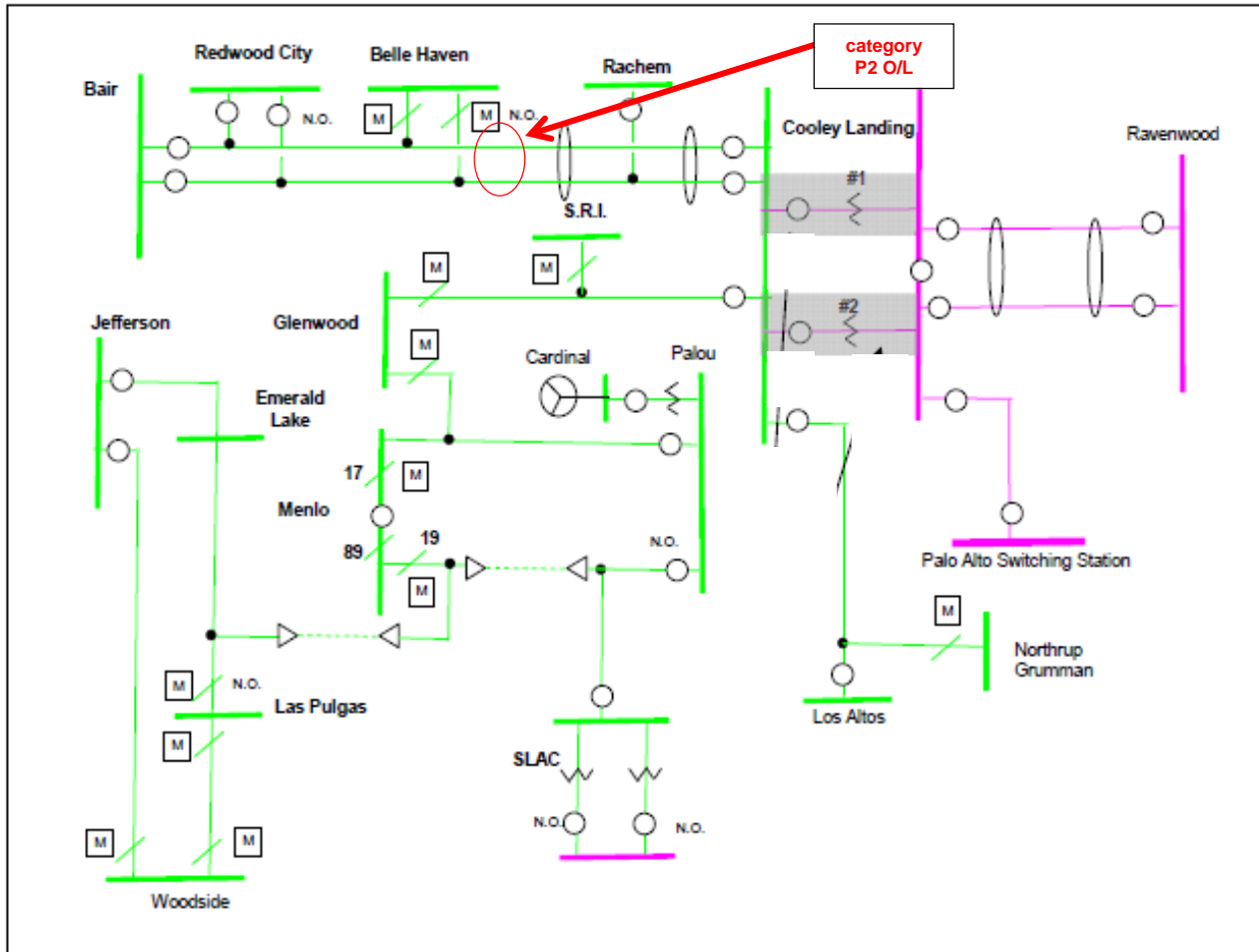


- North Tower 115 kV Looping
- Pittsburg 230/115 kV Transformer Addition

## Sensitivity

- Thermal loadings worsen in “No BTM-PV, No AAEE and No QF”

# Peninsula 60 kV system



## Approved Projects

- Jefferson-Stanford #2 60 kV line

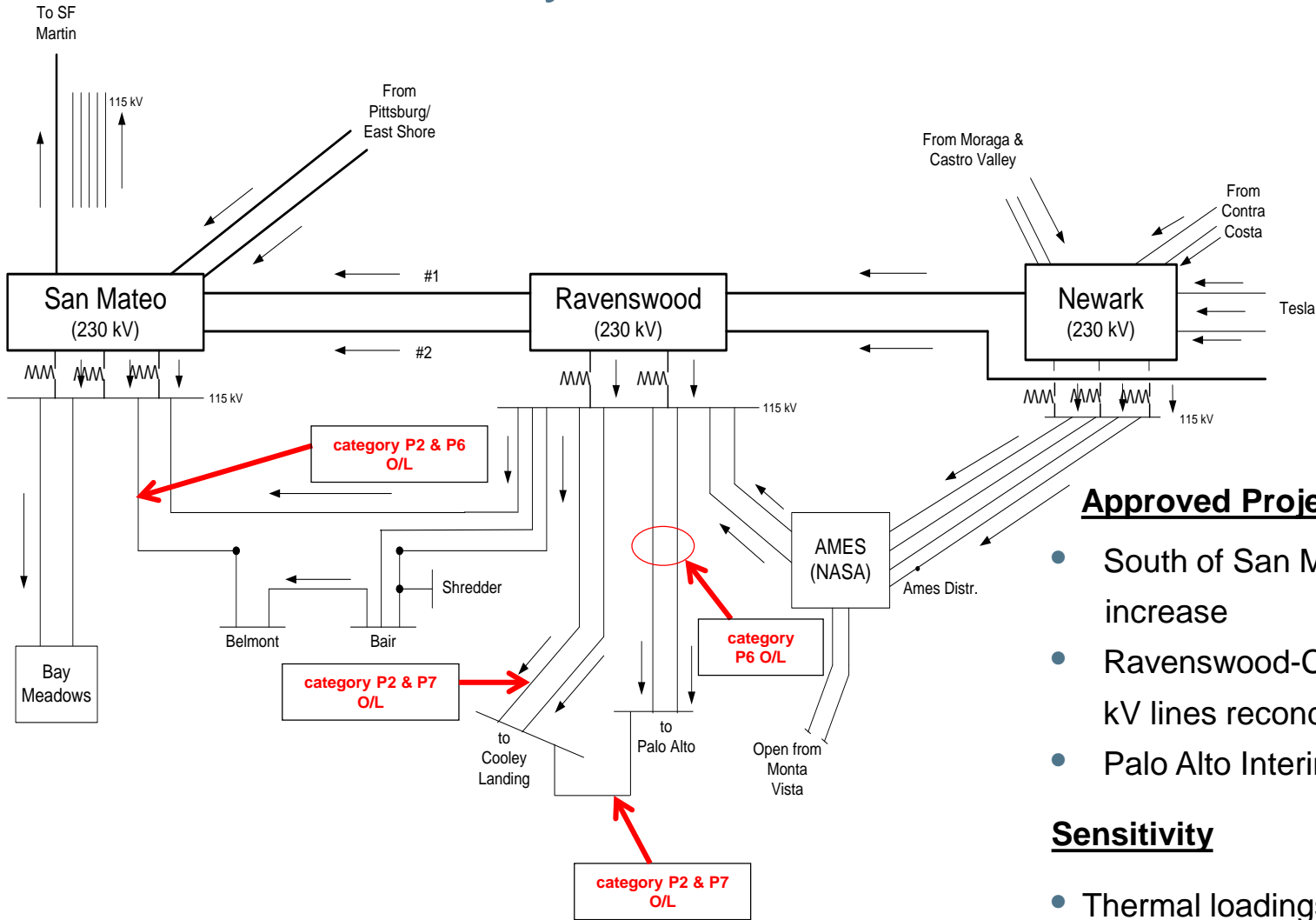
## Sensitivity

- Thermal loadings worsen in “No BTM-PV and No AAEE”





# Peninsula 115 kV system



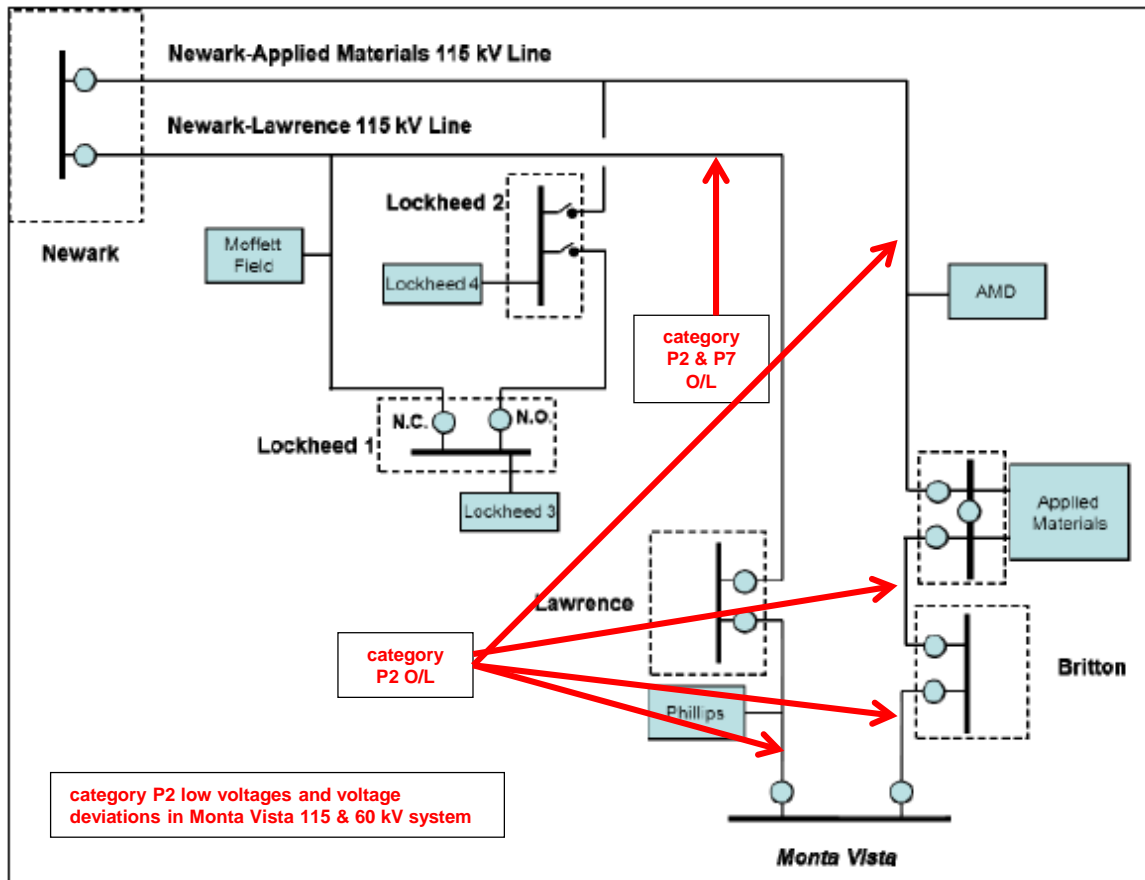
## Approved Projects

- South of San Mateo capacity increase
- Ravenswood-Cooley Landing 115 kV lines reconductor
- Palo Alto Interim SPS

## Sensitivity

- Thermal loadings slightly worsen in “No BTM-PV and No AAEE”

# Newark-Monta Vista 115 kV system



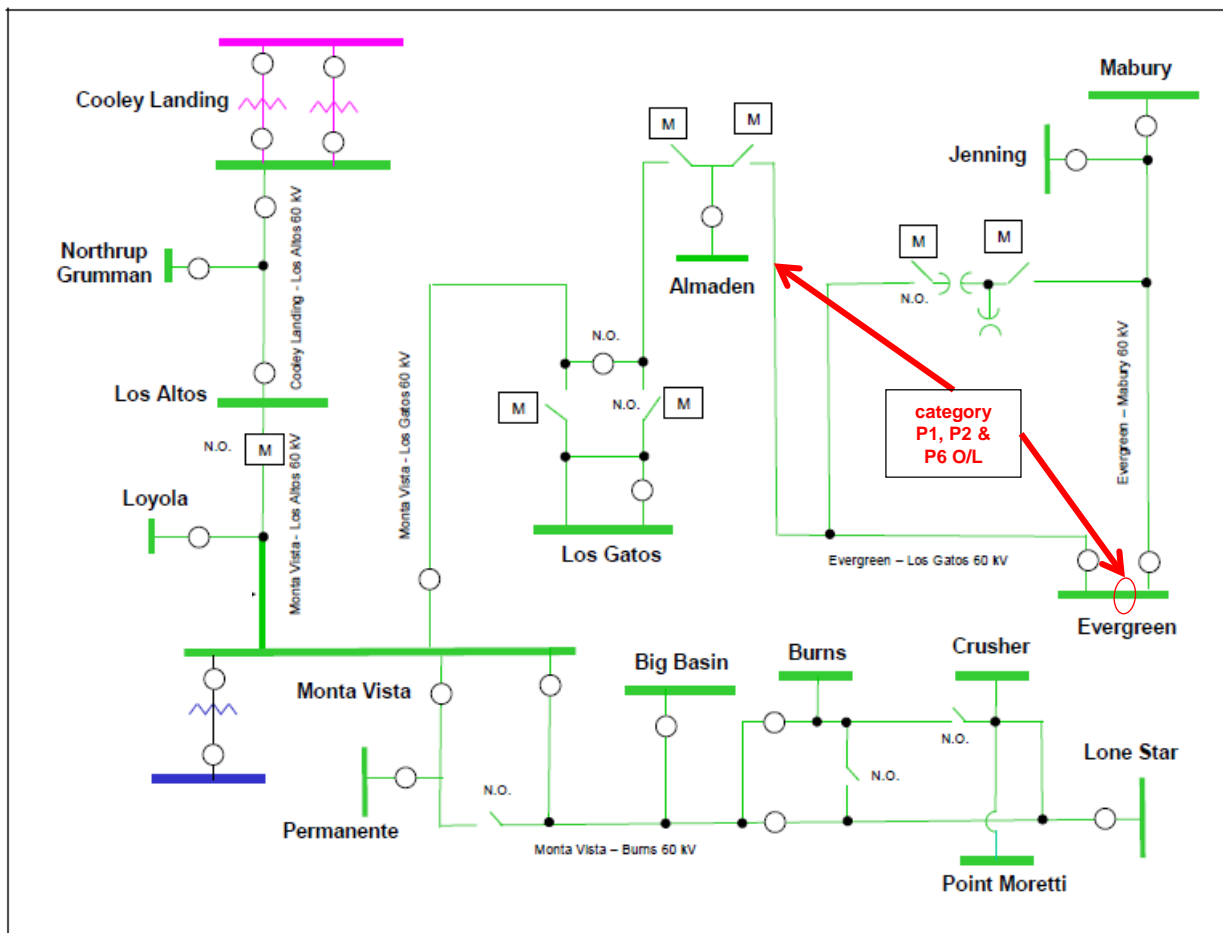
## Approved Projects

- Monta Vista 230 kV bus upgrade project

## Sensitivity

- One new overload in “No BTM-PV”
- Thermal loadings worsen in “No AAE”

# San Jose 60 kV system



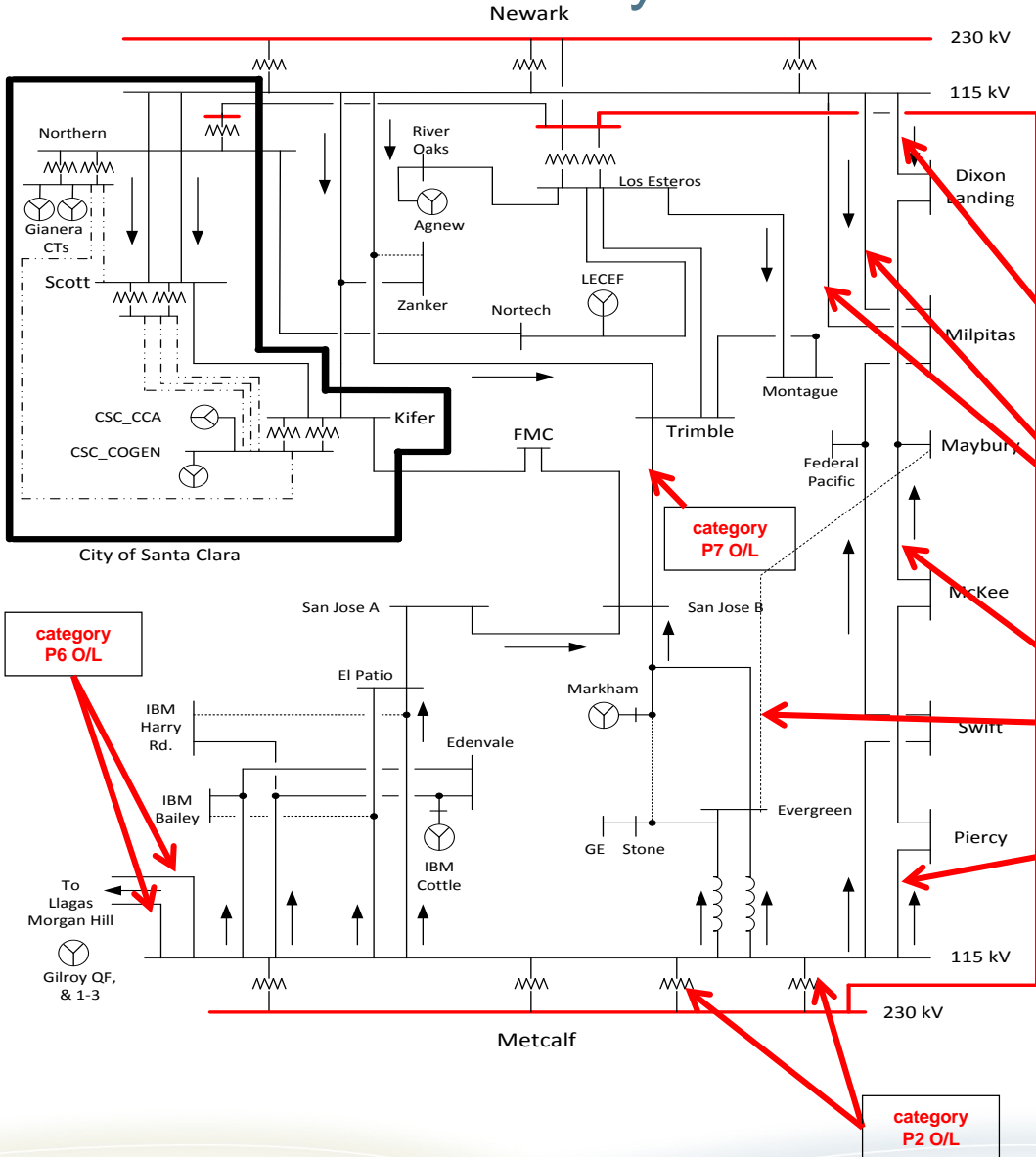
## Approved Projects

- Monta Vista - Los Gatos - Evergreen 60 kV Project
- Monta Vista 230 kV bus upgrade project

## Sensitivity

- Four new contingency overloads in “No BTM-PV”
- Thermal loadings worsen in “No AAEE”

# San Jose 115 kV system



## Approved Projects

- Metcalf-Piercy, Swift-Metcalf and Newark-Dixon Landing 115 kV upgrade
- Evergreen-Mabury 60 to 115 kV Conversion
- Morgan Hill Reinforcement Project

category P1, P2, P6 & P7 O/L

category P6 O/L

category P6 O/L

category P1, P2, & P7 O/L

## Sensitivity

- Seven new contingency overloads in “No BTM-PV”
- Six new contingency overloads in “No AAE”

category P2 O/L

# Conclusion

## Reliability issues needing new mitigation

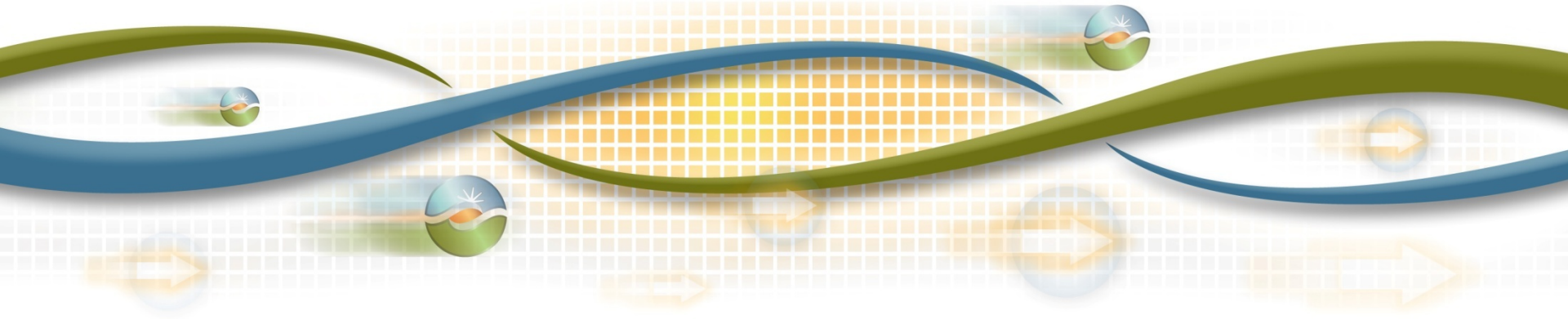
Area	Facility	Contingency Category	Potential Mitigation
Oleum-Christie 115 kV Area	Oleum-Martinez 115kV Line	P2	System upgrade or preferred resource
	Christie-Sobrante (Oleum-Sobrante) 115kV Line	P6	
	Oleum-Christie 115kV Line	P7	
Metcalf 115 kV Area	Newark-Dixon Landing 115kV Line	P2 & P6	Approved project scope change if feasible
	Newark-Milpitas #1 115kV Line	P6	System upgrade or preferred resource
	Newark-Milpitas #2 115kV Line	P6	
	Dixon Landing-McKee 115 kV Line	P6	
	Mabury-Jennings J. 115 kV Line	P6	
Peninsula 115 kV	San Mateo-Belmont 115kV Line	P6	Approved project scope change if feasible
Greater Bay Area	115 kV & 60 kV high voltage issues in light load conditions	P0	Voltage support or storage



# East Bay Area Sensitivity Study Preliminary Reliability Assessment Results

Binaya Shrestha  
Regional Transmission Engineer Lead

2016-2017 Transmission Planning Process Stakeholder Meeting  
September 21-22, 2016



# Objective

To identify the order of magnitude long-term reliability needs and assess reliance on existing SPS in East Bay area without the local generation being available.

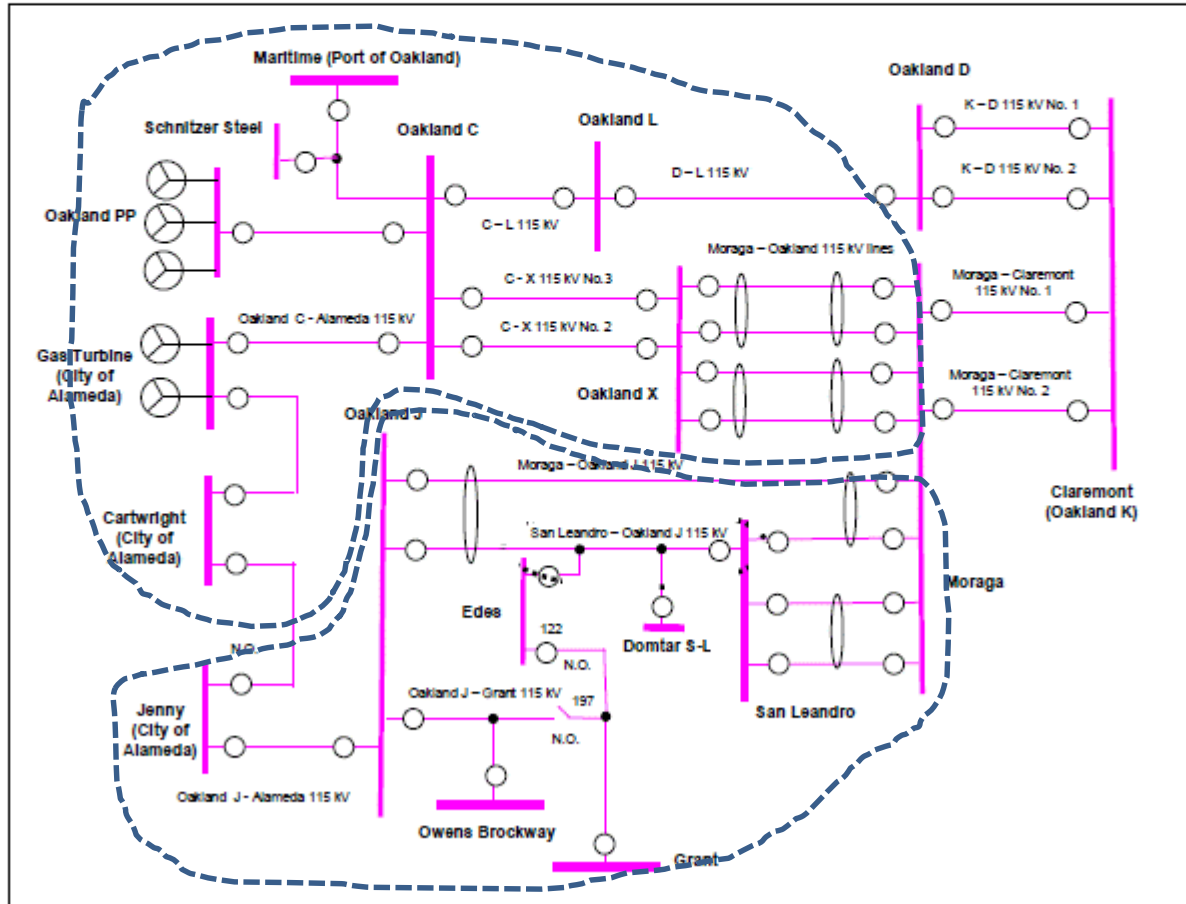


# Drivers for the long-term need

- Potential retirement of Oakland area generation due to age.
- Eliminate reliance on SPS per new ISO planning standard.

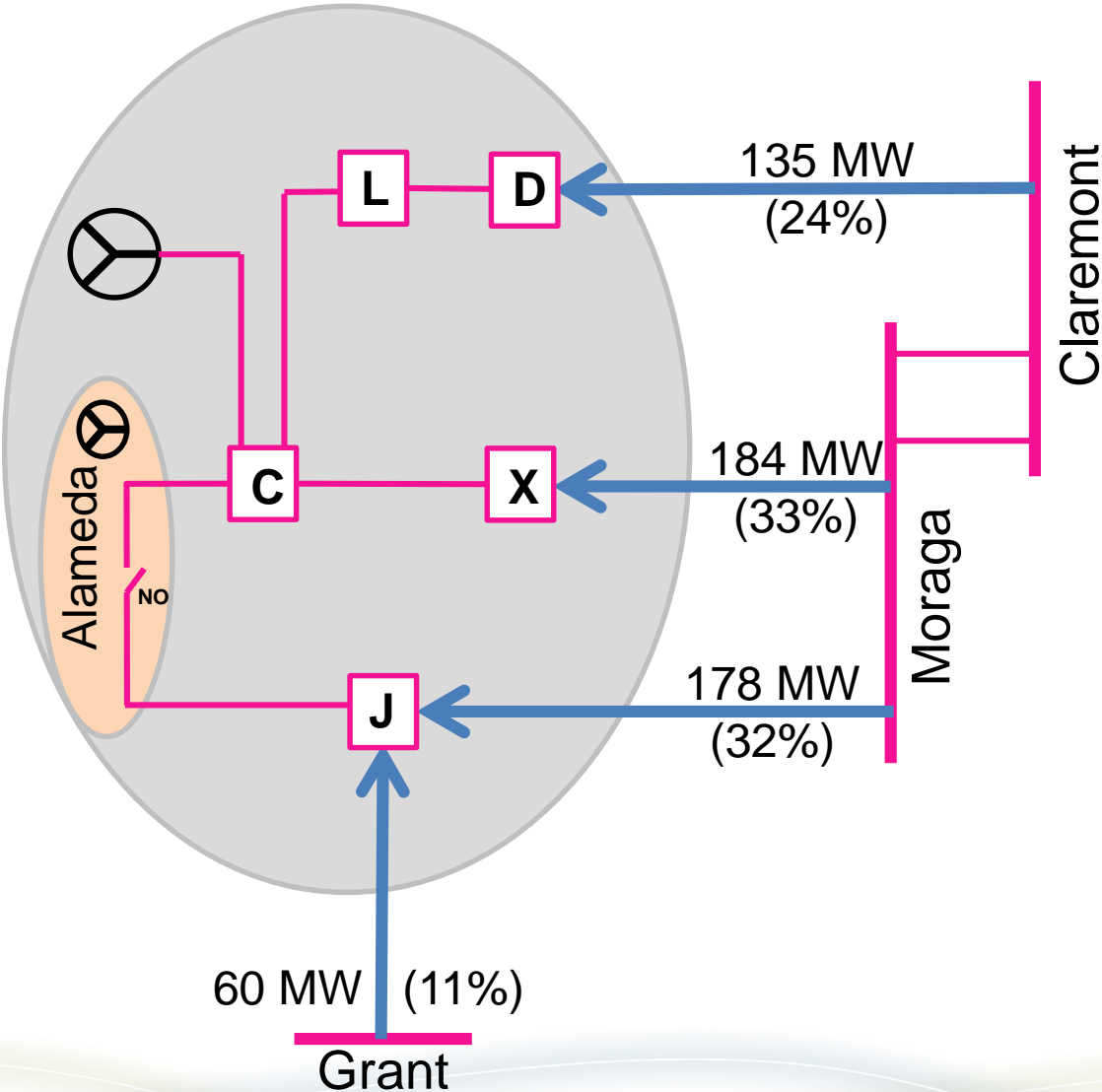


# One-line Diagram – Oakland area transmission system



# 2026 Oakland Area Supply

(N-0, Zero local Generation)



# Existing SPS in Oakland Area

SPS Name	Description
<b><i>Moraga – Oakland J 115 kV Line Overload RAS</i></b>	Prevents overloading of 115 kV lines from Moraga serving San Leandro and Oakland J. Opens circuit breakers at Oakland J to drop load.
<b><i>Grant 115 kV Overload SPS</i></b>	Prevents overloading of the Eastshore - Grant # 1 or # 2 115 kV lines. Trips distribution feeders at Grant.
<b><i>Oakland 115 kV C-X cable Overload RAS</i></b>	Prevents overloading of Oakland C – X #2 115 kV cable. Opens circuit breakers at Oakland C.
<b><i>Oakland 115 kV D-L cable Overload RAS</i></b>	Prevents overloading of Oakland D – L 115 kV cable. Opens circuit breakers at Oakland C.

# Study Scenarios

## ■ 15 Scenarios

- 2018 Summer Peak all local generation OFF
- 2021 Summer Peak all local generation OFF
- 2026 Summer Peak all local generation OFF
- 2021 Summer Peak all local generation OFF + No AAEE
- 2026 Summer Peak all local generation OFF + No BTM-PV
- 2018 Summer Peak Oakland ON Alameda OFF
- 2021 Summer Peak Oakland ON Alameda OFF
- 2026 Summer Peak Oakland ON Alameda OFF
- 2021 Summer Peak Oakland ON Alameda OFF + No AAEE
- 2026 Summer Peak Oakland ON Alameda OFF + No BTM-PV
- 2018 Summer Peak all local generation ON
- 2021 Summer Peak all local generation ON
- 2026 Summer Peak all local generation ON
- 2021 Summer Peak all local generation ON + No AAEE
- 2026 Summer Peak all local generation ON + No BTM-PV

# Thermal Overloads

Area	Contingency Category	Generation Scenarios					
		All Local Generation OFF		Oakland Generation ON		All Generation ON	
		Number of Facilities O/L	Worst O/L	Number of Facilities O/L	Worst O/L	Number of Facilities O/L	Worst O/L
Northern Oakland	P2	9	151%	0	NA	0	NA
	P6	11	117%	1	121%	1	125%
Southern Oakland	P2	2	106%	2	106%	2	106%

- The worst overload in northern area under all generation off scenario is on the Moraga-Oakland No. 3 & 4 115 kV lines for a bus-tie breaker failure at Moraga 115 kV.
- One facility that overloads in northern area in “only Oakland generation ON” or “all generation ON” scenarios is the Moraga-C Claremont No. 1 or 2 115 kV line for an overlapping outage of the parallel line and C-L 115 kV cable. Reducing local generation following the first contingency mitigates the overload.
- The worst overload in southern area is on the Grant-Oakland J 115 kV line for a bus-tie breaker failure at Moraga 115 kV.

# SPS Summary (Oakland C-X SPS)

Study Scenarios	Oakland C-X SPS					
	P1		P2		P6	
	Number of contingencies triggering SPS	Number of instances of overload mitigated	Number of contingencies triggering SPS	Number of instances of overload mitigated	Number of contingencies triggering SPS	Number of instances of overload mitigated
2018 SP All Local Gen OFF	-	-	3	0	1	0
2021 SP All Local Gen OFF	-	-	3	3	1	0
2026 SP All Local Gen OFF	-	-	3	3	1	0
2021 SP All Local Gen OFF, No AAEE	-	-	3	0	1	0
2026 SP All Local Gen OFF, No BTM-PV	-	-	3	0	1	0
2018 SP Oakland Gen ON, Alameda Gen OFF	-	-	-	-	-	-
2021 SP Oakland Gen ON, Alameda Gen OFF	-	-	-	-	-	-
2026 SP Oakland Gen ON, Alameda Gen OFF	-	-	-	-	-	-
2021 SP Oakland Gen ON, Alameda Gen OFF, No AAEE	-	-	-	-	-	-
2026 SP Oakland Gen ON, Alameda Gen OFF, No BTM-PV	-	-	-	-	-	-
2018 SP All Local Gen ON	-	-	-	-	-	-
2021 SP All Local Gen ON	-	-	-	-	-	-
2026 SP All Local Gen ON	-	-	-	-	-	-
2021 SP All Local Gen ON, No AAEE	-	-	-	-	-	-
2026 SP All Local Gen ON, No BTM-PV	-	-	-	-	-	-

- The C-X SPS is triggered only in “all local generation OFF” scenarios.
- For some P2 and all P6 contingencies the SPS is insufficient.



# SPS Summary (Oakland D-L SPS)

Study Scenarios	Oakland D-L SPS					
	P1		P2		P6	
	Number of contingencies triggering SPS	Number of instances of overload mitigated	Number of contingencies triggering SPS	Number of instances of overload mitigated	Number of contingencies triggering SPS	Number of instances of overload mitigated
2018 SP All Local Gen OFF	-	-	2	0	2	0
2021 SP All Local Gen OFF	-	-	1	0	2	0
2026 SP All Local Gen OFF	-	-	1	0	2	0
2021 SP All Local Gen OFF, No AAEE	-	-	1	0	2	0
2026 SP All Local Gen OFF, No BTM-PV	-	-	1	0	2	0
2018 SP Oakland Gen ON, Alameda Gen OFF	-	-	-	-	-	-
2021 SP Oakland Gen ON, Alameda Gen OFF	-	-	-	-	-	-
2026 SP Oakland Gen ON, Alameda Gen OFF	-	-	-	-	-	-
2021 SP Oakland Gen ON, Alameda Gen OFF, No AAEE	-	-	-	-	-	-
2026 SP Oakland Gen ON, Alameda Gen OFF, No BTM-PV	-	-	-	-	-	-
2018 SP All Local Gen ON	-	-	-	-	-	-
2021 SP All Local Gen ON	-	-	-	-	-	-
2026 SP All Local Gen ON	-	-	-	-	-	-
2021 SP All Local Gen ON, No AAEE	-	-	-	-	-	-
2026 SP All Local Gen ON, No BTM-PV	-	-	-	-	-	-

- The D-L SPS is triggered only in “all local generation OFF” scenarios.
- The SPS is insufficient to mitigate overloads.

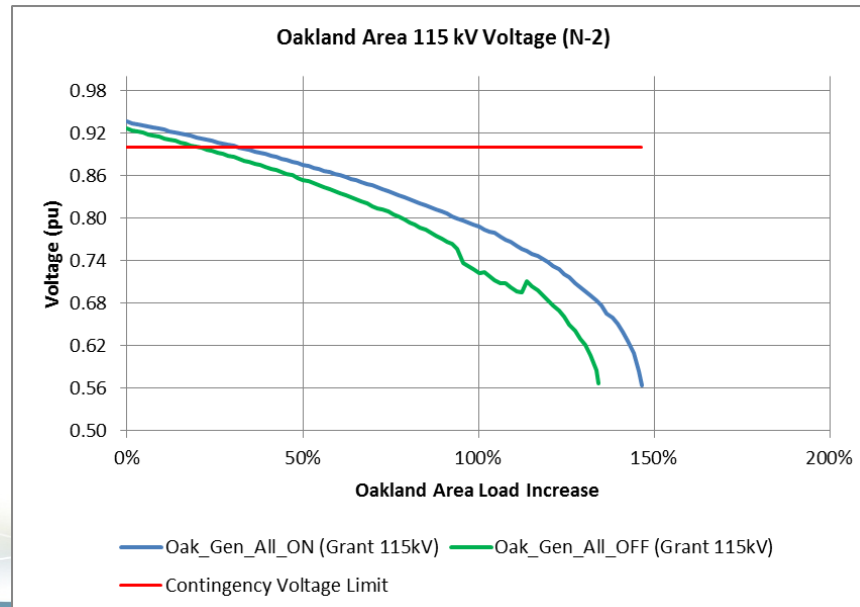
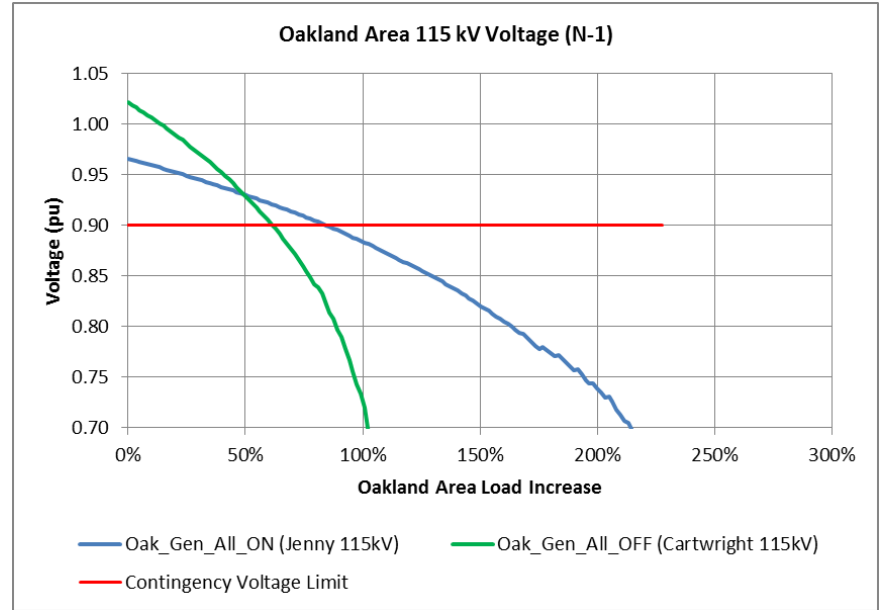
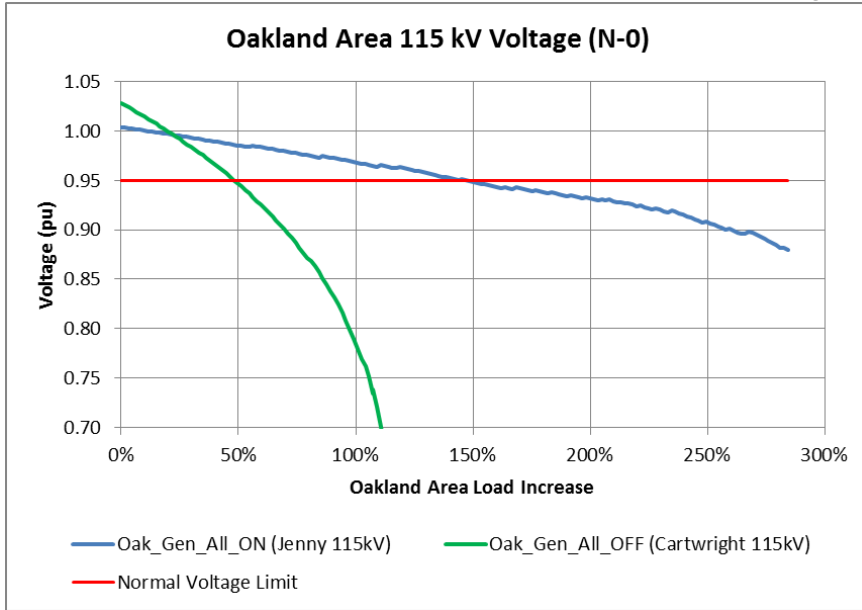
# SPS Summary (Moraga-Oakland J SPS)

Study Scenarios	Moraga-Oakland J SPS					
	P1		P2		P6	
	Number of contingencies triggering SPS	Number of instances of overload mitigated	Number of contingencies triggering SPS	Number of instances of overload mitigated	Number of contingencies triggering SPS	Number of instances of overload mitigated
2018 SP All Local Gen OFF	1	1	6	2	11	11
2021 SP All Local Gen OFF	-	-	-	-	-	-
2026 SP All Local Gen OFF	-	-	-	-	-	-
2021 SP All Local Gen OFF, No AAEE	-	-	-	-	-	-
2026 SP All Local Gen OFF, No BTM-PV	-	-	-	-	-	-
2018 SP Oakland Gen ON, Alameda Gen OFF	1	1	6	6	11	11
2021 SP Oakland Gen ON, Alameda Gen OFF	-	-	-	-	-	-
2026 SP Oakland Gen ON, Alameda Gen OFF	-	-	-	-	-	-
2021 SP Oakland Gen ON, Alameda Gen OFF, No AAEE	-	-	-	-	-	-
2026 SP Oakland Gen ON, Alameda Gen OFF, No BTM-PV	-	-	-	-	-	-
2018 SP All Local Gen ON	1	1	6	6	11	11
2021 SP All Local Gen ON	-	-	-	-	-	-
2026 SP All Local Gen ON	-	-	-	-	-	-
2021 SP All Local Gen ON, No AAEE	-	-	-	-	-	-
2026 SP All Local Gen ON, No BTM-PV	-	-	-	-	-	-

- The Moraga-Oakland J SPS is triggered only in 2018 scenarios.
- The SPS is sufficient to mitigate all overloads.

# Oakland Area PV Plots

(Starting load level – 2025)

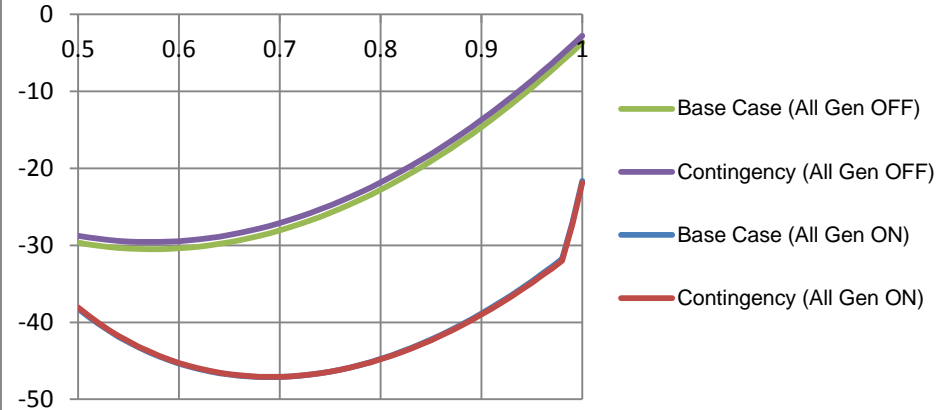


# Oakland Area QV Plots

Qgen vs. Reg. Volt

Bus: 38022 CARTWRT 115

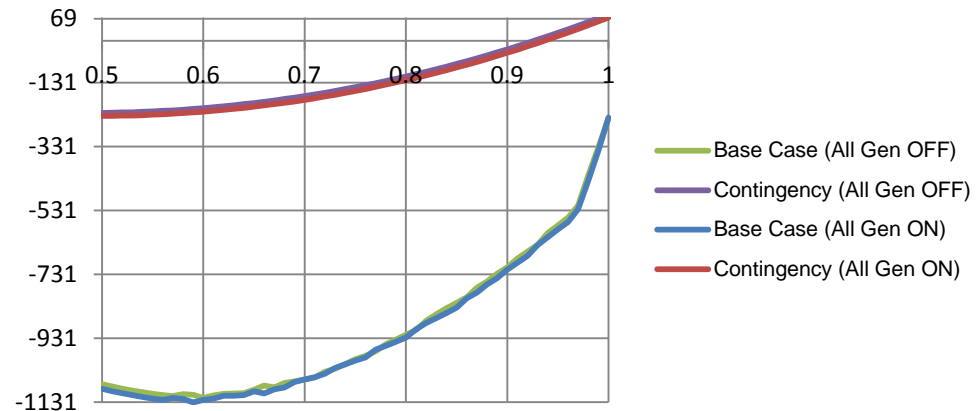
Contingency: Oakland D - Oakland L 115kV Cable



Qgen vs. Reg. Volt

Bus: 35104 GRANT 115

Contingency: Grant-Eastshore Nos. 1 & 2 115 kV lines



# Summary

- No voltage issues even with no local generation being available.
- No thermal issues with all or only Oakland generation available.
- Existing SPS in northern part not triggered with all or only Oakland generation available.
- Existing SPS in southern part not triggered following implementation of the E. shore-Oakland J project.
- Nine 115 kV facilities overloads for various categories P2 & P6 contingencies in northern part with no local generation available. Worst overload being 151%.
- Two 115 kV facilities overloads for various categories P2 contingencies in southern part. Worst overload being 106%.

# Conclusion

- Load forecast in East Bay area decreased by about 4% from last year's 2025 to this year's 2026 case due to increased behind-the-meter DG and AAEE. As such the extend of reliability issues in East Bay area reduced slightly compared to last year's assessment without the local generation being available.
- With the reliance on aging generation in the area, the ISO is continuing to assess the transmission needs in the Oakland area without the generation being available.
- The ISO will be considering transmission, generation or non-transmission solutions as we assess the needs of the area.
- In the near-term the area relies on SPS with a relatively small amount of load shedding as per the ISO Planning Standards; however the ISO will consider alternatives for the long-term horizon.

Questions?

# Reference Slides



# Overloads in northern part of Oakland 115 kV system

ID	Overloaded Facility	Worst Contingency	Category	Category Description	Loading (%)															
					2018 SP All Local Gen OFF	2021 SP All Local Gen OFF	2026 SP All Local Gen OFF	2021 SP All Local Gen OFF, No AAEE	2026 SP All Local Gen OFF, No BTM-PV	2018 SP Oakland Gen ON, Alameda Gen OFF	2021 SP Oakland Gen ON, Alameda Gen OFF	2026 SP Oakland Gen ON, Alameda Gen OFF	2021 SP Oakland Gen ON, Alameda Gen OFF, No AAEE	2026 SP Oakland Gen ON, Alameda Gen OFF, No BTM-PV	2018 SP All Local Gen ON	2021 SP All Local Gen ON	2026 SP All Local Gen ON	2021 SP All Local Gen ON, No AAEE	2026 SP All Local Gen ON, No BTM-PV	
GBA-EBS-T-1	Oakland D - Oakland L 115kV Cable	STATIN X 115kV - Section 2D & 1D	P2	Bus-tie breaker	113	107	104	117	110	29	24	22	31	27	20	21	23	17	21	
GBA-EBS-T-2	Oakland C - Oakland L #1 115kV Cable	CLARMNT 115kV Section 1D	P2	Bus	100	92	91	99	98	98	90	89	96	96	97	90	95	96	99	
GBA-EBS-T-3	Oakland C - Oakland X #2 115kV Cable	CLARMNT - 1D 115kV & SOBRANTE-GRIZZLY-CLAREMONT #2 line	P2	Non-bus-tie breaker	101	95	93	102	100	48	42	41	49	48	30	24	23	31	29	
GBA-EBS-T-5	Moraga-Claremont #1 115kV Line	STATIN X 115kV - Section 2D & 1D	P2	Bus-tie breaker	114	104	109	116	117	71	59	64	71	73	56	44	50	57	58	
GBA-EBS-T-6	Moraga-Claremont #2 115kV Line	STATIN X 115kV - Section 2D & 1D	P2	Bus-tie breaker	114	104	109	117	118	71	59	64	72	73	56	45	50	57	58	
GBA-EBS-T-7	Moraga-Oakland X #1 115kV Line	CLARMNT 115kV - Section 1D & 2D	P2	Bus-tie breaker	103	95	95	103	103	57	50	50	57	57	41	34	34	41	41	
GBA-EBS-T-8	Moraga-Oakland X #2 115kV Line	MORAGA 115kV - Section 1D & 1E	P2	Bus-tie breaker	109	101	105	112	114	63	54	57	64	66	48	39	43	49	51	
GBA-EBS-T-9	Moraga-Oakland X #3 115kV Line	MORAGA 115kV - Section 1D & 2D	P2	Bus-tie breaker	133	129	138	147	151	85	76	84	92	96	69	60	69	76	80	
GBA-EBS-T-10	Moraga-Oakland X #4 115kV Line	MORAGA 115kV - Section 1D & 2D	P2	Bus-tie breaker	133	129	138	147	151	85	76	84	92	96	69	60	69	76	80	
GBA-EBS-T-12	Oakland D - Oakland L 115kV Cable	C-X #2 115kV [9962] & C-X #3 115kV [9925]	P6	N-1/N-1	114	107	104	117	110	<95	<95	<95	<95	<95	<95	<95	<95	<95	<95	
GBA-EBS-T-13	Oakland C - Oakland L #1 115kV Cable	K-D #1 115kV [9966] & PITTSBURG-LOS MEDANOS #2 115kV [9993]	P6	N-1/N-1	100	0	0	99	98	98	<95	<95	97	96	98	<95	<95	96	96	
GBA-EBS-T-14	Oakland C - Oakland X #2 115kV Cable	C-X #3 115kV [9925] & D-L #1 115kV [9963]	P6	N-1/N-1	114	107	104	117	110	<95	<95	<95	<95	<95	<95	<95	<95	<95	<95	
GBA-EBS-T-15	Moraga-Claremont #1 115kV Line	C-X #2 115kV [9962] & C-X #3 115kV [9925]	P6	N-1/N-1	111	101	106	113	112	<95	<95	<95	<95	<95	<95	<95	<95	<95	<95	
GBA-EBS-T-16	Moraga-Claremont #1 115kV Line	MORAGA-CLAREMONT #2 115kV [2710] & C-L #1 115kV [9961]	P6	N-1/N-1	98	<95	99	100	101	106	103	112	112	121	110	107	116	116	125	
GBA-EBS-T-17	Moraga-Claremont #2 115kV Line	C-X #2 115kV [9962] & C-X #3 115kV [9925]	P6	N-1/N-1	111	101	106	114	112	<95	<95	<95	<95	<95	<95	<95	<95	<95	<95	
GBA-EBS-T-18	Moraga-Claremont #2 115kV Line	MORAGA-CLAREMONT #1 115kV [2700] & C-L #1 115kV [9961]	P6	N-1/N-1	98	<95	99	100	101	106	104	112	112	121	110	107	116	116	125	
GBA-EBS-T-19	Moraga-Oakland X #1 115kV Line	D-L #1 115kV [9963] & MORAGA-OAKLAND #2 115kV [2730]	P6	N-1/N-1	106	100	99	107	106	<95	<95	<95	<95	<95	<95	<95	<95	<95	<95	
GBA-EBS-T-20	Moraga-Oakland X #2 115kV Line	D-L #1 115kV [9963] & MORAGA-OAKLAND #1 115kV [2720]	P6	N-1/N-1	106	100	99	107	106	<95	<95	<95	<95	<95	<95	<95	<95	<95	<95	
GBA-EBS-T-21	Moraga-Oakland X #3 115kV Line	D-L #1 115kV [9963] & MORAGA-OAKLAND #1 115kV [2720]	P6	N-1/N-1	106	100	99	107	106	<95	<95	<95	<95	<95	<95	<95	<95	<95	<95	
GBA-EBS-T-22	Moraga-Oakland X #4 115kV Line	D-L #1 115kV [9963] & MORAGA-OAKLAND #1 115kV [2720]	P6	N-1/N-1	106	100	99	107	106	<95	<95	<95	<95	<95	<95	<95	<95	<95	<95	

# Overloads in southern part of Oakland 115 kV system

ID	Overloaded Facility	Worst Contingency	Category	Category Description	Loading (%)															
					2018 SP All Local Gen OFF	2021 SP All Local Gen OFF	2026 SP All Local Gen OFF	2021 SP All Local Gen OFF, No AAEE	2026 SP All Local Gen OFF, No BTM-PV	2018 SP Oakland Gen ON, Alameda Gen OFF	2021 SP Oakland Gen ON, Alameda Gen OFF	2026 SP Oakland Gen ON, Alameda Gen OFF	2021 SP Oakland Gen ON, Alameda Gen OFF, No AAEE	2026 SP Oakland Gen ON, Alameda Gen OFF, No BTM-PV	2018 SP All Local Gen ON	2021 SP All Local Gen ON	2026 SP All Local Gen ON	2021 SP All Local Gen ON, No AAEE	2026 SP All Local Gen ON, No BTM-PV	
GBA-EBS-T-4	Grant-Oakland J 115 kV Line	MORAGA 115kV - Section 1E & 2E	P2	Bus-tie breaker	NA	98	98	106	106	NA	98	98	106	106	NA	98	98	106	106	
GBA-EBS-T-11	Moraga-Oakland J 115kV Line	SN LNDRO 115kV - Section 1E & 2E	P2	Bus-tie breaker	101	78	78	85	82	100	84	84	91	88	100	86	86	92	90	



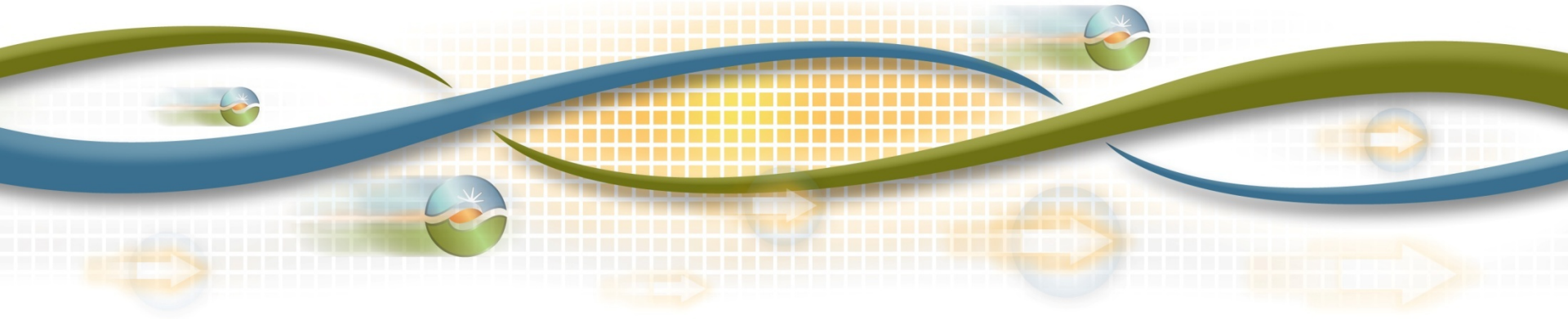
# Fresno Area Preliminary Reliability Assessment Results

Vera Hart

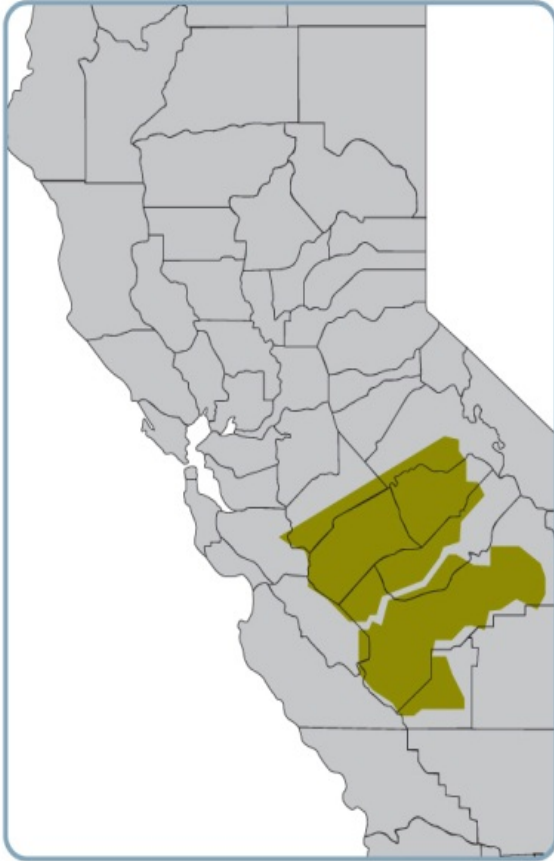
Sr. Regional Transmission Engineer

2016-2017 Transmission Planning Process Stakeholder Meeting

September 21-22, 2016



# Greater Fresno Area



- Includes the San Joaquin Division
- Comprised of 70, 115, 230 & 500 kV transmission facilities.
- Generation: Over 5,948 MW of installed capacity in 2026 case
- Load:
  - 2026 Summer Peak load forecast:
    - Load: 3,906 MW
    - AAEE: 171 MW
    - BTM-PV: 283 MW
    - **Net peak load in 2026: 3,452 MW**

# Study Scenarios

Load and Generation Scenarios	Study Year		
	2018	2021	2026
<b>Baseline Scenarios</b>			
Summer Peak	✓	✓	✓
Winter Peak			
Spring Off-Peak	✓		
Spring Light Load		✓	
Summer Partial Peak			
Winter peak - (SF & Peninsula)			
Winter peak - (SF Only)			
<b>Sensitivity Scenarios</b>			
Summer Peak with high CEC forecast load (No AAEE)		✓	
Summer peak with no BTM PV	✓		✓
Summer Peak with heavy renewable output and minimum gas generation commitment		✓	
Retirement of QF Generations			✓

# Approved Transmission Projects in Fresno Area

Project	Expected In-Service Date
Ashlan-Gregg and Ashlan-Herndon 230 kV Line Reconductor	18-May
Borden 230 kV Voltage Support	19-May
Caruthers – Kingsburg 70 kV Line Reconductor	17-May
Gregg-Herndon #2 230 kV Line Circuit Breaker Upgrade	17-May
Helm-Kerman 70 kV Line Reconductor	17-May
Kearney-Caruthers 70 kV Line Reconductor	17-May
Kearney – Hearndon 230 kV Line Reconductoring	17-Dec
Kearney-Kerman 70 kV Line Reconductor	21-May
Lemoore 70 kV Disconnect Switches Replacement	16-May
Los Banos-Livingston Jct-Canal 70 kV Switch Replacement	17-May
McCall-Reedley #2 115 kV Line	22-Apr
Oakhurst/Coarsegold UVLS	17-May
Oro Loma – Mendota 115 kV Conversion Project	18-May
Oro Loma 70 kV Area Reinforcement	20-May
Reedley 70 kV Reinforcement	18-May
Reedley 115/70 kV Transformer Capacity Increase	21-May
Reedley-Dinuba 70 kV Line Reconductor	17-May
Reedley-Orosi 70 kV Line Reconductor	17-May
Series Reactor on Warnerville-Wilson 230 kV Line	18-Dec
Warnerville-Bellota 230 kV line reconductoring	17-May
Wilson 115 kV Area Reinforcement	19-May
Wilson-Le Grand 115 kV line reconductoring	20-Dec
Fresno Reliability Transmission Projects	16-Mar
Gates #2 500/230 kV Transformer Addition	18-May
Gates-Gregg 230 kV Line[1]	20-Apr
Northern Fresno 115 kV Area Reinforcement	20-Sep
Wheeler Ridge Junction Substation	20-May
Panoche-Oro Loma 115kV Reconductoring Project	20-May

# Fresno Area Assessment Summary

- The 2016-2017 Baseline assessment identified:

Assessment	Number of issues for each category							
	P0	P1	P2	P3	P4	P5	P6	P7
Thermal overload	0	2	37	0	0	2	34	7
Low voltage	0	0	11	3	0	0	20	0
High voltage	22	1	4	0	0	0	0	0
Voltage deviation	n/a	8	10	0	0	0	0	0
Stability issues	n/a	3	86	0	175	0	25	8

- Compared to last year results:
  - One new Category P0 overload for Sensitivity Case
  - Several new High Voltage areas for P0
  - Two new P1 overloads in Baseline
  - No new Category P2-1 overloads in Baseline

# Thermal Results(Category P0, P1 & P2-1)

## ■ Thermal Overloads

1. Gregg- Helms #1 and #2 230kV Lines (P1-2018 Spring Case)
2. Herndon-Bullard #1 (Prundale Jct-Bullard)115kV (P2-1: 2018, 2021, 2026 Peak)

## ■ Potential Mitigations

1. Drop Additional Helms Pump
2. Mitigation Under Review
3. Short term Under review; Long term- Oro Loma 70kV Area Reinforcement project mitigates

## ■ Thermal Overloads (Sensitivity) – In addition to the overloads in the baseline scenarios:

1. Q272-Henrietta 70kV line section ( P0 overload for 2021 Heavy Renewable case)
2. Helms – E1 #1 and #2 230kV Lines(P1-2021 No AAEE Case)
3. Coalinga1-Coalinga2 70kV line (Coalinga 1-Tornado Tap Section)(P2-1: 2018 No BTM Peak Sensitivity Case)
4. Mercy Springs-Canal-Oro Loma 70kV line( Canal-Ortiga-Mercy Springs sections) (P2-1: 2018 BTM PV Sensitivity)

## ■ Potential Mitigations

1. Under Review
2. Under Review
3. Estrella mitigates future years
4. Oro Loma 70kV Reinforcement mitigates future years



# Voltage Results (Category P0, P1, P2-1)

## ■ Voltage Results

### 1. High voltage issues occur for Category P0 at:

- a) Gates 115kV and 70kV area (all years)
- b) Corcoran 70kV area (2021 Spring Light Load)
- c) McCall 70kV area (2021 Spring Light Load)

### 2. Low voltage issues for P2-1 and P3:

- a) Canal 70kV Area (2018 years)
- b) Chowchilla 115kV Area ( 2018, 2026)

## ■ Voltage Deviations for P2-1

- a) Livingston 70kV area (2018 Peak)

## ■ Potential Mitigations

- 1. Check Available Transformer Tap Changer
- 2. Under Review
- 3. Oro Loma 70kV Project mitigates future years

## ■ Voltage Results (Sensitivity)

- No new voltage issues occur under sensitivity scenarios

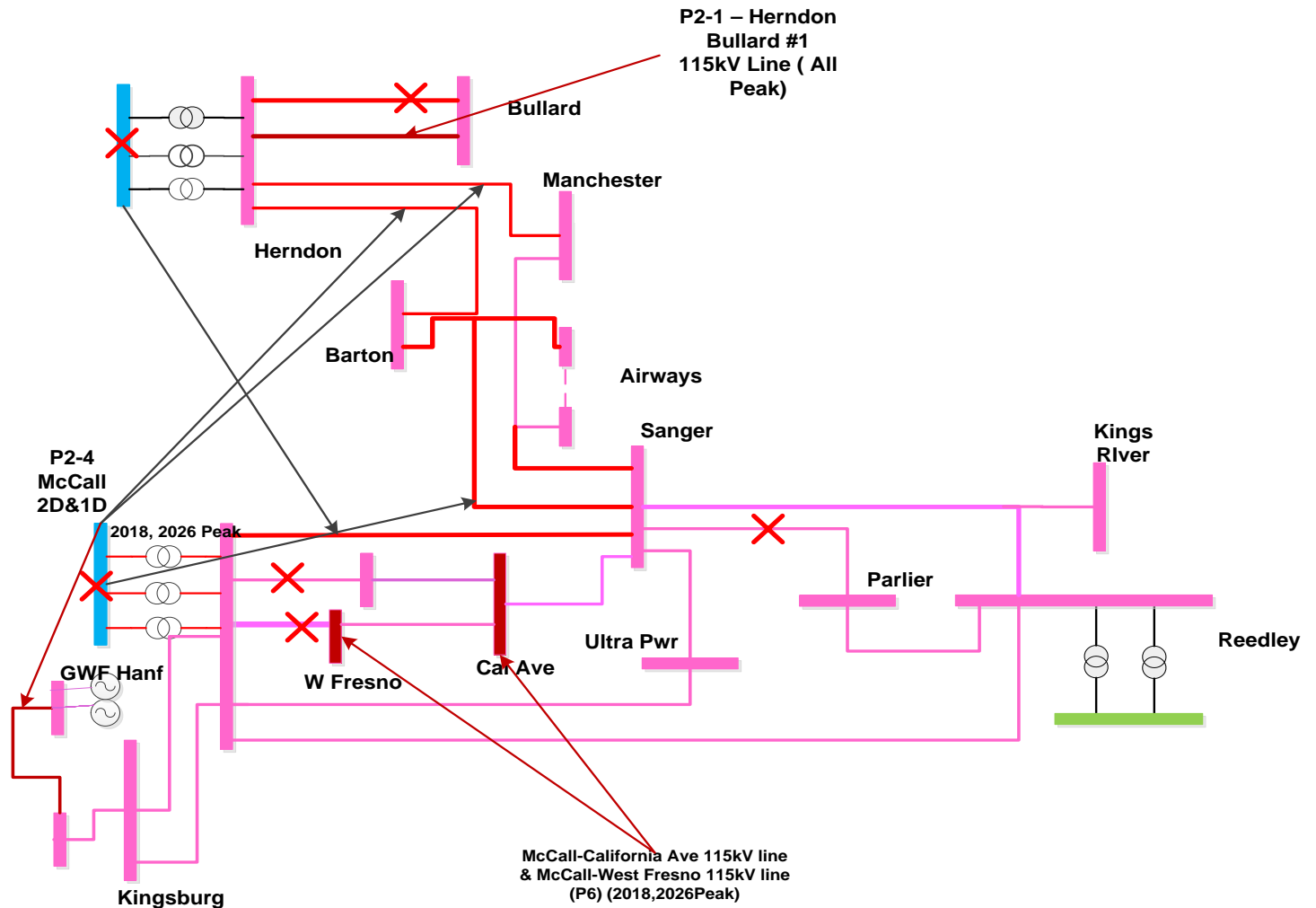
# Fresno Area – Results- Herndon-McCall Area

## Approved Projects

- Northern Fresno Reinforcement Project
- McCall-Reedley #2 line project

## Sensitivities:

- Thermal loadings worsen in “No BTM” and “No QF”
- Thermal loading lessens in High Renewables case





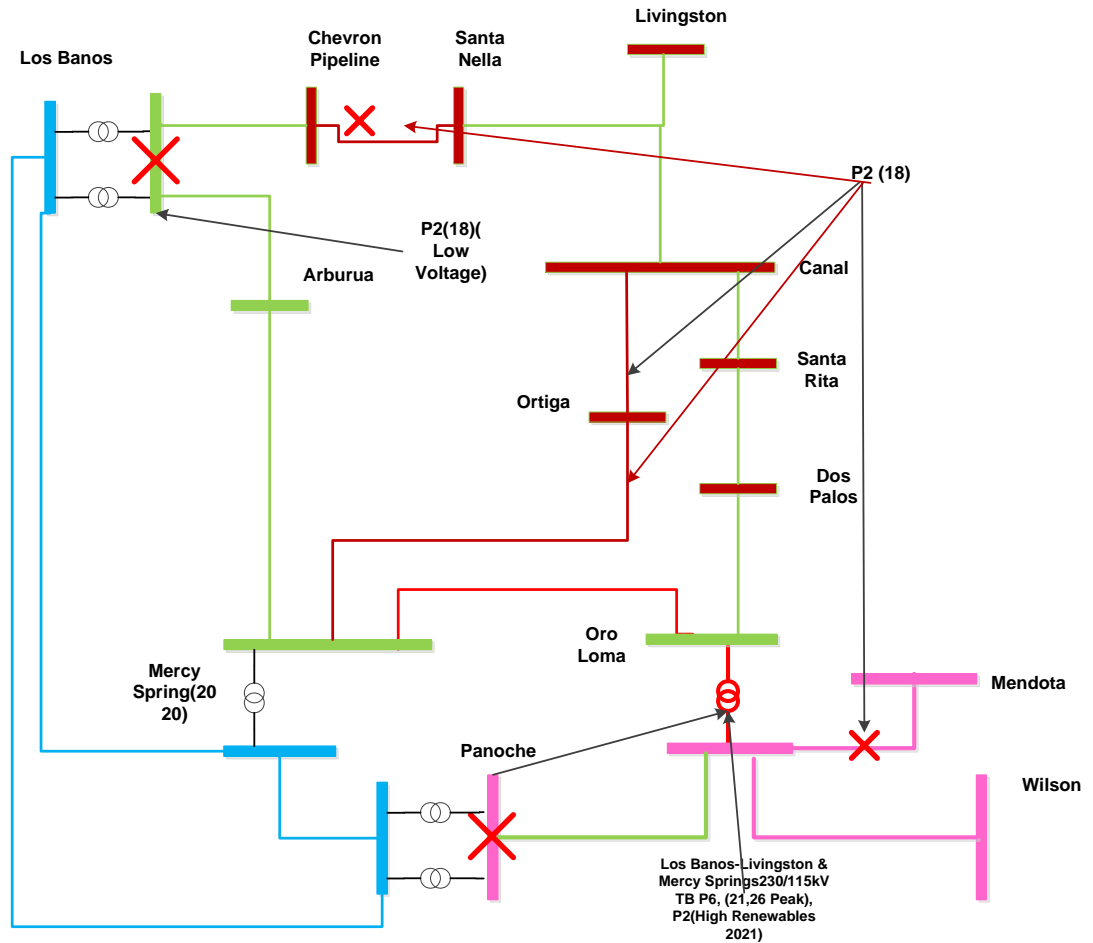
# Fresno Area – Oro Loma- Los Banos 70kV

## Approved Projects

- Oro Loma 70kV reinforcement project (Mercy Springs 230/70kV bank)

## Sensitivities

- Thermal loadings worsen in “No BTM”
- New Overloads in the BTM cases, High Renewable Case



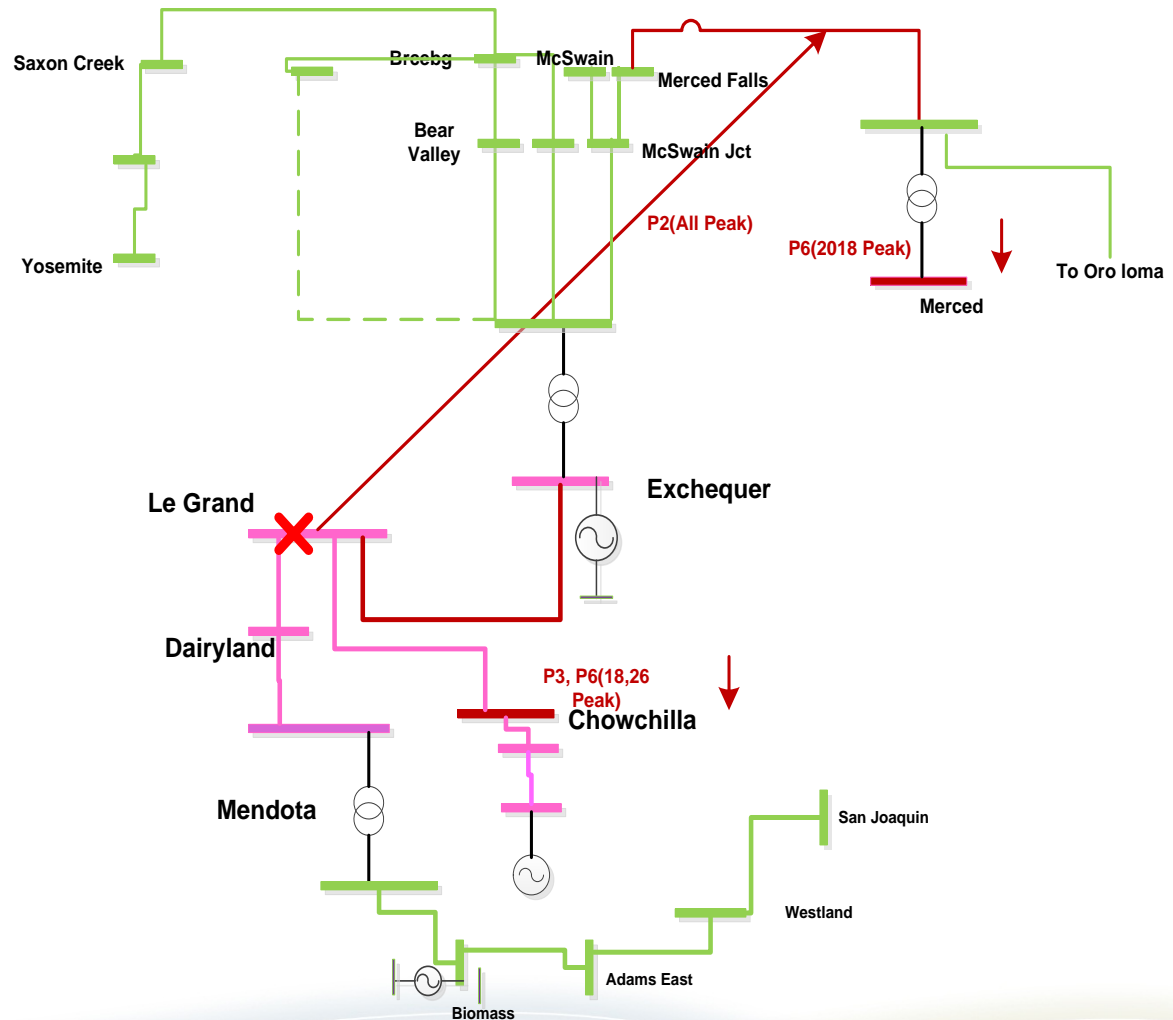
# Fresno Area – Exchequer

- Approved Projects

- None

- Sensitivities

- Thermal loadings and voltage worsen in “No BTM”, “No AAEE” and “No QF” cases
- New overload in the 2018 “No BTM” case



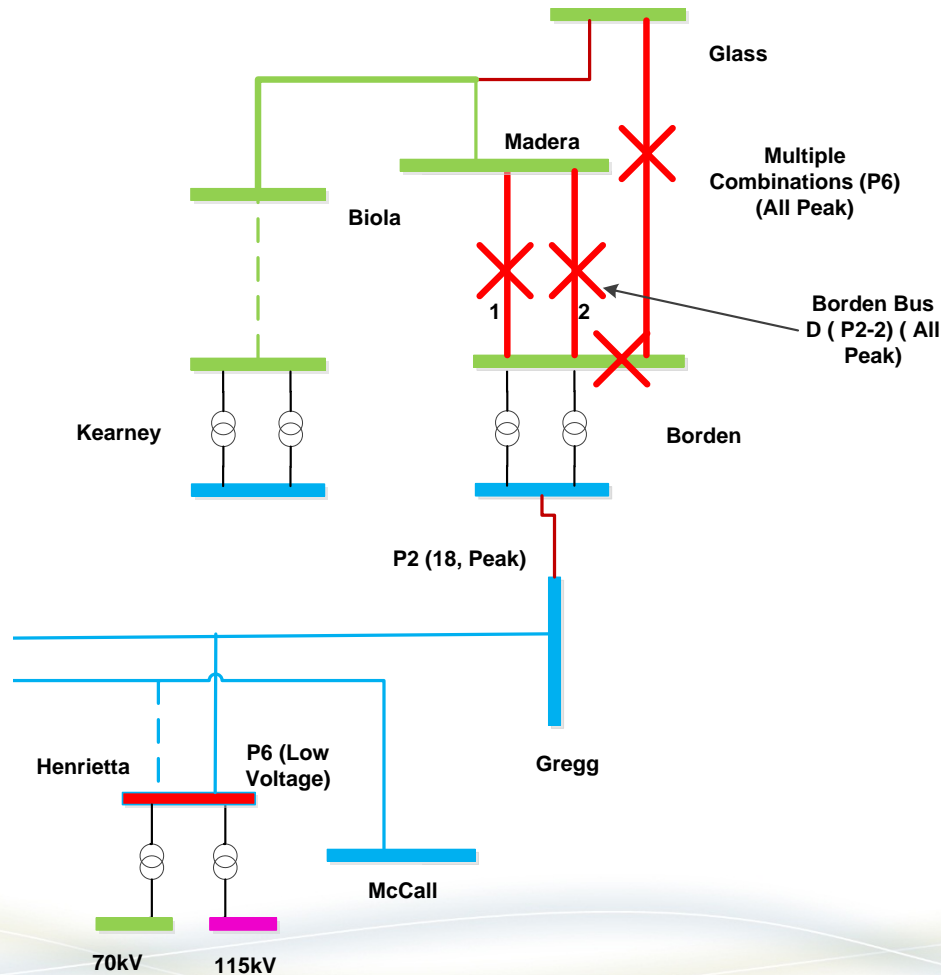
# Fresno Area -Borden-Madera 70kV-Results

- Approved Projects

- Borden 230 kV Voltage Support

- Sensitivities

- Thermal loadings worsen in all cases



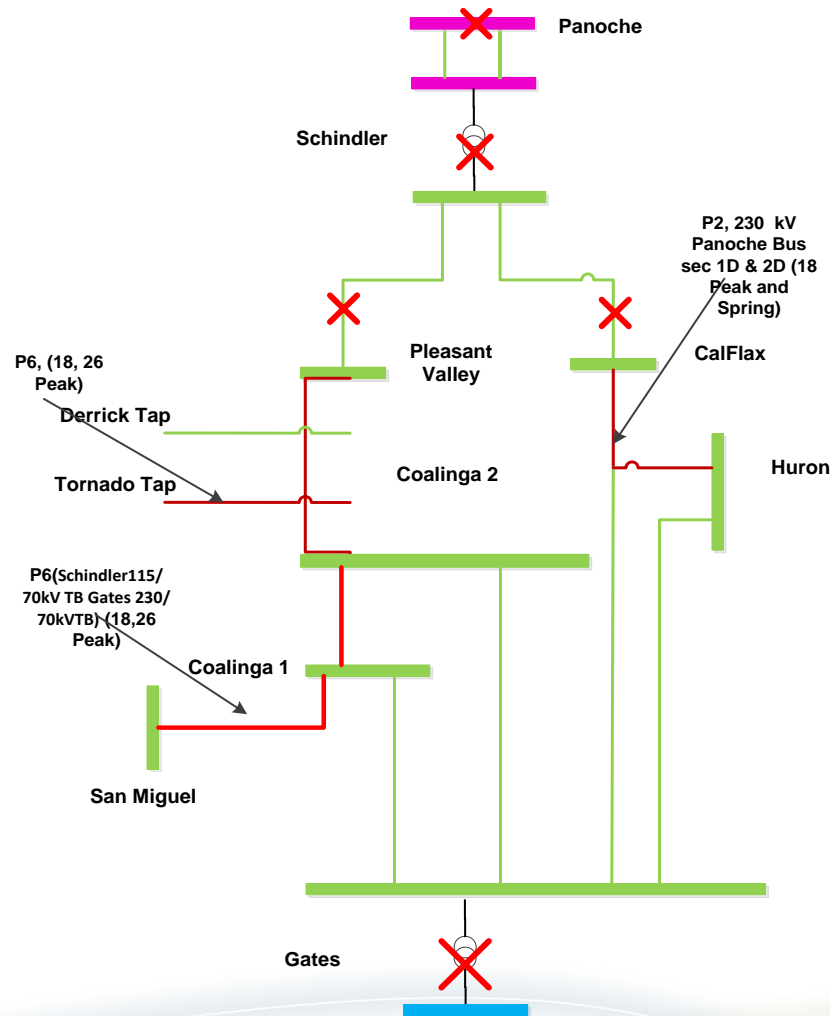
# Fresno Area –Coalinga 70kV Results

- Approved Projects

- Estrella Substation

- Sensitivities

- Thermal loadings worsen in “No BTM” case



# Conclusion

- Reliability Concerns in need of mitigation solution

<u>Area</u>	<u>Facility</u>	<u>Contingency Category</u>	<u>Cases Overloaded</u>	<u>Potential Mitigation</u>
Exchequer Area	Sharon-Oakhurst 115kV Line	P7	All Peak and No AAEE Sensitivity Case	SPS/Reconductor Line
	Merced Falls-Exchequer 70kV line	P2-3, P2-2	2021, 2026 Peak	Short Term rating/Upgrade/expand SPS
Oro Loma 70kV Area	Oro Loma 115/70kV TB	P6	2021,2026 Peak	Replace Limiting Equipment, Upgrade the T/F/ Explore possible SPS Options.
Borden 70kV	Borden-Madera-Glass 70kV lines	P6	All Peak	Expand Madera SPS
McCall 115kV and Herndon 115kV Area	McCall 230/115kV TBs	P6	2018 Peak, 2018, 2026 no BTM Case	SPS/Replace Banks
	Herndon-Bullard #2 115kV line	P2-1	All Peak, & Sensitivity Cases	Reconductor/Remove limiting elemets, if any.
Coalinga 70kV Area	San Miguel-Coalinga 70kV line	P6	2018, 2026 Peak and Sensitivity Cases	SPS/Reconductor Line
	Coalinga-Tornado 70kV area line	P6	2018,2026 Peak	Explore Reactive support options



# Conclusion- Continues

- Reliability Concerns in need of mitigation solution

<u>Area</u>	<u>Voltage</u>	<u>Contingency Category</u>	<u>Cases Overloaded</u>	<u>Potential Mitigation</u>
Gates 115kV Area	>1.05	P0, P1	All Cases	Under Review with PTO/ Check T/F Taps
McCall 70kV, Corcoran 70kV Area	>1.05	P0	All Cases	Under Review with PTO/Check T/F Taps
Chowchilla 115kV	< 0.9	P3, P6	2018, 2026 Peak	Modify Exchequer SPS
Hermietta 230kV	< 0.9	P6	All Peak	Operating solution/ interim SPS
West Fresno 115 kV pocket	< 0.9	P6	2018, 2026 Peak	Provide additional reactive support (Herndon/Mccall 115 kV pocket)

# Questions?

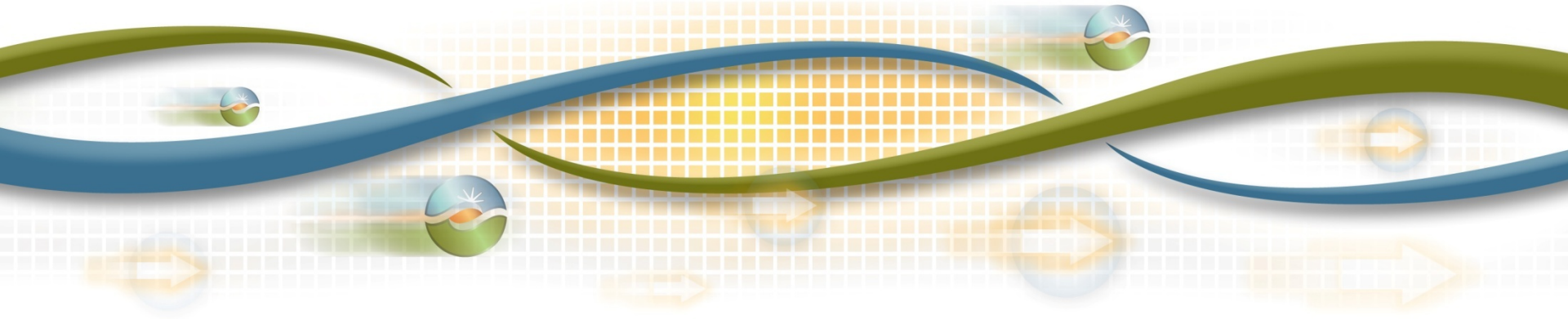


# Kern Area Preliminary Reliability Assessment Results

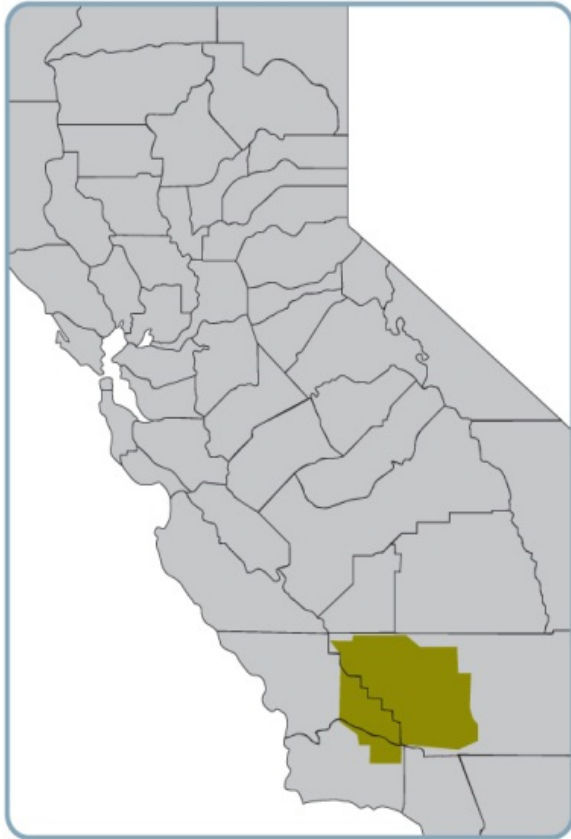
Vera Hart

Sr. Regional Transmission Engineer

2016-2017 Transmission Planning Process Stakeholder Meeting  
September 21-22, 2016



# 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
- Generation: 4014 MW of installed capacity in 2026.
- Transmission system includes 60, 115 and 230 kV facilities.
- Load:
  - 2026 Summer Peak load forecast:
    - Load: 2,236 MW
    - AAEE: 87 MW
    - BTM-PV: 108 MW
    - **Net peak load in 2026: 2,041 MW**

# Study Scenarios

Load and Generation Scenarios	Study Year		
	2018	2021	2026
<b>Baseline Scenarios</b>			
Summer Peak	✓	✓	✓
Winter Peak			
Spring Off-Peak	✓		
Spring Light Load		✓	
Summer Partial Peak			
Winter peak - (SF & Peninsula)			
Winter peak - (SF Only)			
<b>Sensitivity Scenarios</b>			
Summer Peak with high CEC forecast load (No AAEE)		✓	
Summer peak with no BTM PV	✓		✓
Summer Peak with heavy renewable output and minimum gas generation commitment		✓	
Retirement of QF Generations			✓

# Approved Transmission Projects in Kern Area

<b>Project</b>	<b>Expected In-Service Date</b>
Kern – Old River 70 kV Line Reconductor Project	16-Dec
Kern PP 230 kV Area Reinforcement	23-Apr
Midway-Kern PP Nos. 1,3 and 4 230 kV Lines Capacity Increase	19-Jan
Midway-Temblor 115 kV Line Reconductor and Voltage Support	18-May
San Bernard – Tejon 70 kV Line Reconductor	18-May
Semitropic – Midway 115 kV Line Reconductor	18-Dec
Taft-Maricopa 70 kV Line Reconductor	21-May
Wheeler Ridge Voltage Support	20-May
Wheeler Ridge-Weedpatch 70 kV Line Reconductor	18-May
Kern PP 115 kV Area Reinforcement	20-Dec
Midway – Kern PP #2 230 kV Line	21-Jun

# Kern Area Assessment Summary

- The 2016-2017 Baseline assessment identified:

Assessment	Number of issues for each category							
	P0	P1	P2	P3	P4	P5	P6	P7
Thermal overload	0	0	57	10	0	0	4	3
Low voltage	0	0	8	0	0	0	0	0
High voltage	41	0	0	0	0	0	0	0
Voltage deviation	n/a	0	15	0	0	0	0	0
Stability issues	n/a	13	11	80	0	0	25	8

- Compared to last year results:
  - 1 new Category P1 thermal overloads
  - 1 new Category P2-1 thermal overloads
  - New High Voltage Concerns for P0

# Thermal Results(Category P0 & P1)

## ■ Thermal Overloads

- Semitropic D-E 115kV line(P1- 99% 2026 Peak case)
- Semitropic D-E 115kV line(P2-1, 2026 Peak case)

## ■ Potential Mitigations

- Monitor facility loading levels due to long lead time, Revise North East Kern 115 kV Voltage Conversion

## ■ Thermal Overloads (Sensitivity) – In addition to the overloads in the baseline scenarios:

1. Marginal overload on Taft-TX Buena vista Tap 70kV Line section( Taft-Elk Hills 70kV Line) (Cat P0 – Summer 2021 No AAEE & Summer 2026 No BTM-PV)
2. Marginal overload Semitropic-Ganso 115kV Line(Cat P1 – Summer 2026 QF Retirement)

## ■ Potential Mitigations

- Monitor facility loading levels due to long lead time

Thermal issues resulting from other contingency categories will be discussed in the area diagram



# Voltage Results (Category P0 & P1)

## ■ Voltage Results

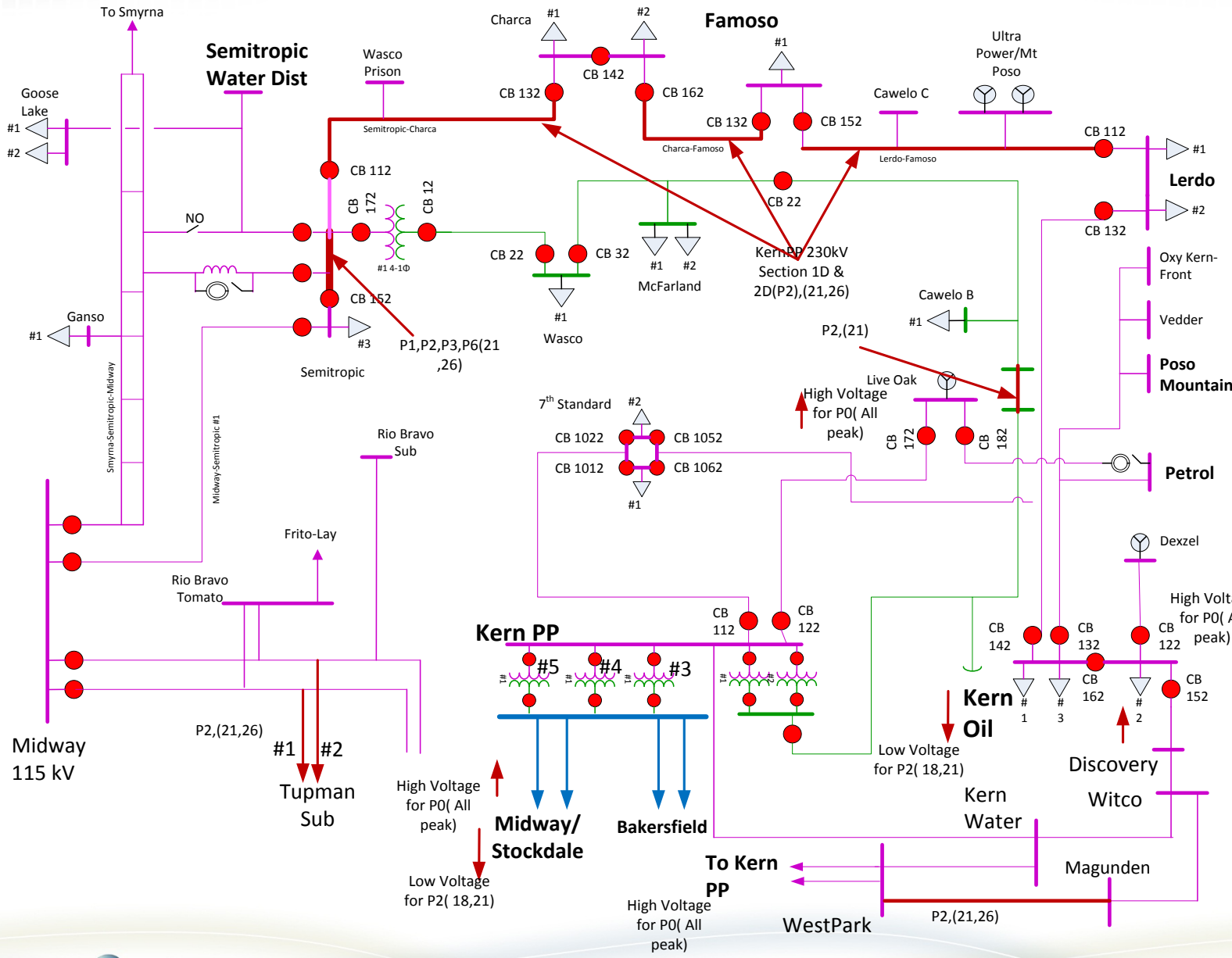
- High voltage issues occur at Kern Oil, Live Oak, Kern Front, Kernwater, Westpark, Tevis 115kV areas have High Voltages just above 1.05 pu ( Mainly Spring 2018 case and Summer 2026 Peak case)
- Low voltage issues - None
- Voltage Deviations- None
- Potential Mitigations
  - Check Available Transformer Tap Changer

## ■ Voltage Results (Sensitivity)

- No new voltage issues occur under sensitivity scenarios

Voltage issues resulting from other contingency categories will be discussed in the area diagram

# Kern Area – Results (Other Contingency Category)



- North East Kern 115 kV Voltage Conversion
- Wheeler Ridge Voltage Support Project
- Kern PP 115 kV Area Reinforcement Project
- Midway-Kern PP #1, #3 & #4 230 kV Line Capacity Increase Project
- Midway-Temblor 115 kV Line Reconductor
  - Semitropic-Midway Reconductoring

## Sensitivity

- Loadings worsen in No BTM cases and QF Retirement cases
- Potential mitigation: Mitigation under review

# Conclusion

- Thermal Reliability Concerns in need of mitigation solution  
Based on Baseline scenarios

Area	Facility	Contingency Category	Cases Overloaded	Potential Mitigation
Semitropic 115kV Area	Semitropic D-Semitropic E 115 kV #1 Line	P1, P2-1,P2,P3, P6	2021,2026 Peak	Monitor facility loading levels due to long lead time, Revise North East Kern 115 kV Voltage Conversion
	Chakra-Famoso115kV line	P2	2021,2026 Peak	
	Semitropic-Charka 115kV Line	P2	2021, 2026 Peak	
	Semitropic-Ganso 115kV Line	P3	2021, 2026 Peak	
	Lerdo-Famoso 115kV Line	P2	2021, 2026 Peak	
Wheeler Ridge 115kV Area	Wheeler- Wheeler Ridge 115kV line	P2	2021, 2026 Peak	Monitor facility loading levels due to long lead time, Revise North East Kern 115 kV Voltage Conversion
	Magunden- Wheeler Ridge 115kV line	P2-4	2021, 2026 Peak	
Midway 230kV Area	Midway-La Paloma #1 & #2 230kV Lines	P2, P3	2021, 2026 Peak	Generation redispatch
	Midway-Ganso 115kV Line	P2	2021, 2026 Peak	Monitor facility loading levels due to long lead time, Revise North East Kern 115 kV Voltage Conversion
	Midway-La Paloma #1 & #2 230kV Lines	P2	2021, 2026 Peak	Monitor facility loading levels, Generation Redispatch
	Midway-Buena Vista #1 & #2 lines	P2	2021, 2026 Peak	Monitor facility loading levels due to long lead time, Revise North East Kern 115 kV Voltage Conversion
Kern PP 115kV, 70kV Area	Tupman #1 & #2 115kV line	P2	2018,2026 Peak	Replace Limiting Switches at Tupman
	Kern Power -Old River #1 & #2 70kV Line	P6	2021 Peak	Kern 230kV Area Reinforcemnt Project
	Lerdo-Kern Oil- 7th Standard 115kV line	P2	2026 Peak	Monitor facility loading levels due to long lead time, Revise North East Kern 115 kV Voltage Conversion
Taft 70kV Area	Taft 115/70kV TB	P3	2026 Peak	Replace Transformer Bank

# Conclusion

- Voltage Concerns in need of mitigation solution

<u>Area</u>	<u>Voltage</u>	<u>Contingency Category</u>	<u>Cases Overloaded</u>	<u>Potential Mitigation</u>
Kern PP 115kV and Midway 115kV Area	>1.05	P0	All Cases	Under Review with PTO/ Check T/F Taps

# Questions?



## Review of Approved Projects –North Area

*Jeff Billinton*

*Manager - Regional Transmission -North*

*September 21-22, 2016*

*2016-2017 Transmission Planning Process Stakeholder Meeting*

# Approach to Project Review

- ISO will be conducting review of the currently approved transmission projects in the 2016-2017 transmission planning process
- Base Cases
  - Local planning cases base case using the load and assumptions for 2026 with the 2016 transmission topology
    - Sensitivity for the peak shift (PV off)
    - Sensitivity with peak shift and no AAEE

# Approach to Project Review

*(continued)*

- The assessment will include review of need for:
  - Reliability
  - Deliverability for generators
  - Local capacity requirement
  - Operational issues
- If there is still a need to be mitigated, the project will be reviewed if it is still the appropriate mitigation
- ISO is planning to provide assessment of review at November 16 stakeholder meeting

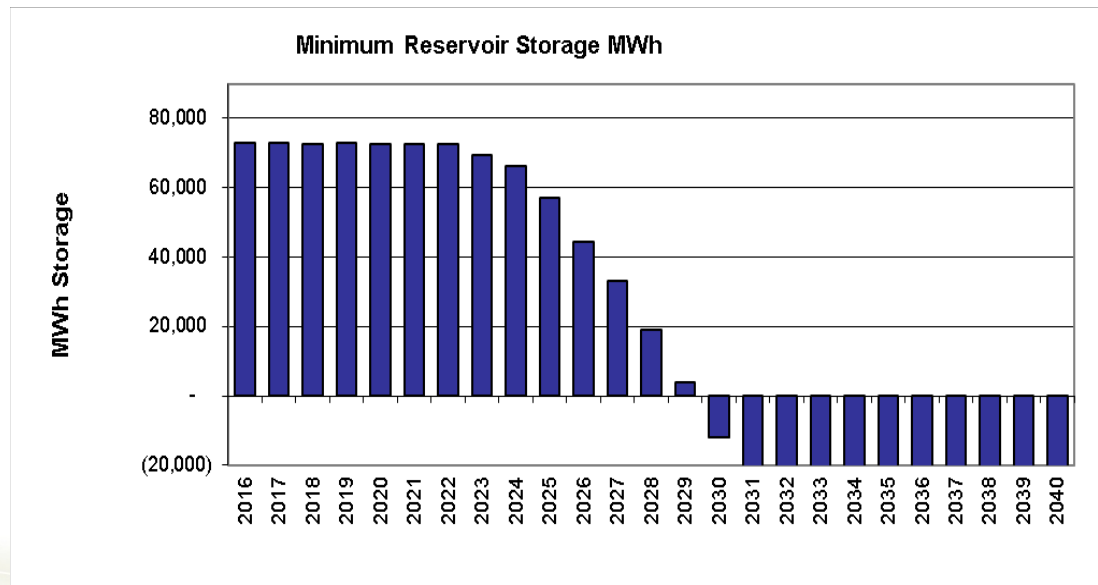


# Preliminary Review of Gates-Gregg 230 kV Line Project

# 2012-2013 Transmission Plan

## Reliability Need

- PG&E water analysis showed that by 2029 there would not be adequate water to satisfy the reliability needs of the HELMs generation due to the system limitations to be able to pump enough water at HELMs for needed levels of storage.
  - The decline in the availability of stored water – due to lack of pumping opportunities - starts to occur in the 2023 timeframe.



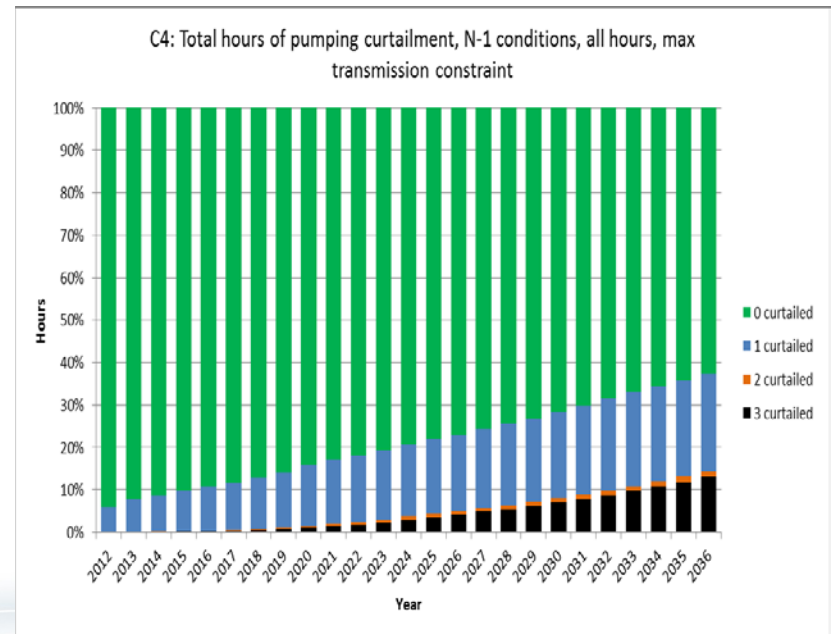
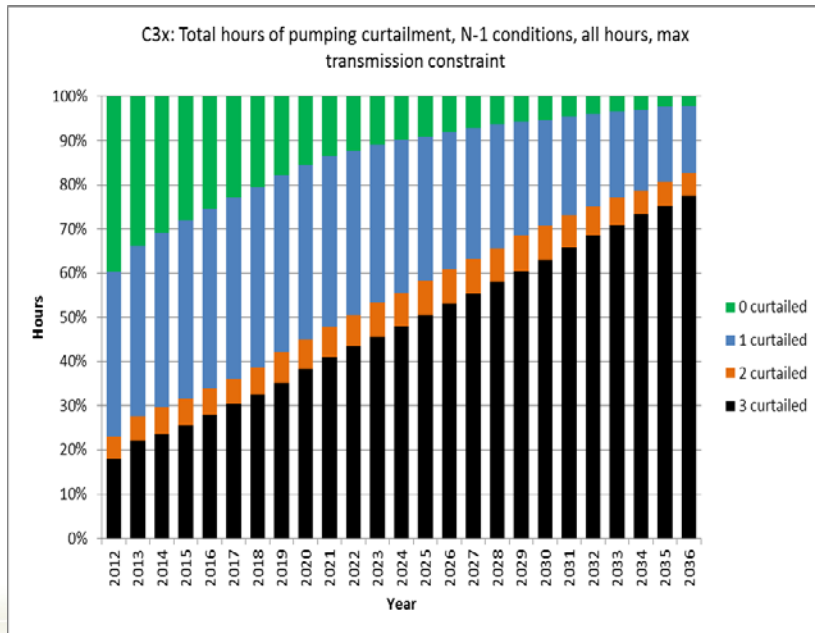
# 2012-2013 Transmission Plan

## HELMS Curtailment

- The following indicates the percentage of time HELMS would be curtailed.

With series reactor, Gates 500/230kV Transformer and reconductoring projects

With 3 projects **plus Gates-Gregg line**



# 2012-2013 Transmission Plan

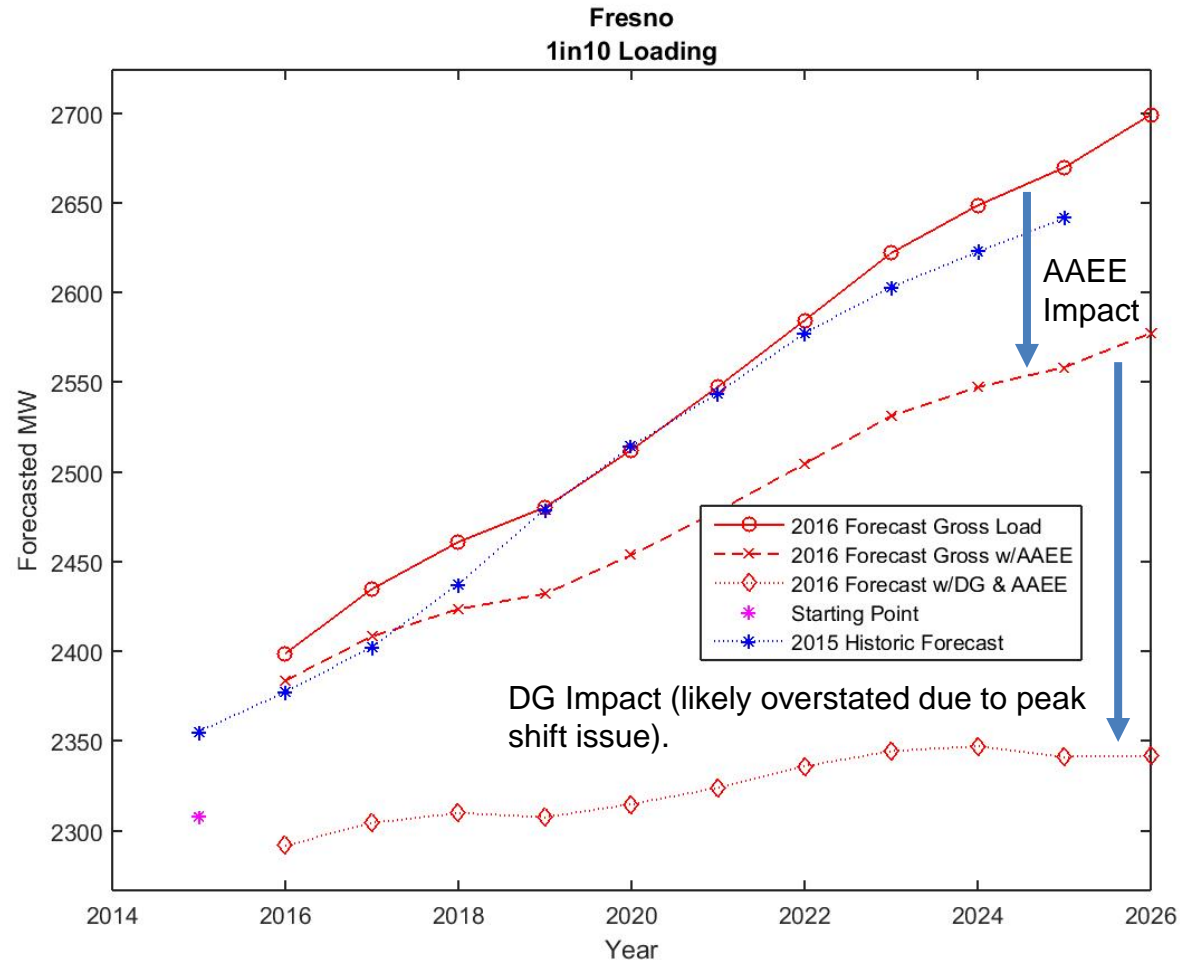
## *Central California Study*

- The following was approved in the ISO 2012-2013 Transmission Plan to address the:
  - reliability needs of the Central California/Fresno area;
  - the pumping requirements of HELMs for area reliability; and
  - provide flexibility for the HELMs Pump Storage facility to provide ancillary services and renewable integration requirements.

Project	Estimated In-Service Date	Estimated Cost
Series Reactor on Warnerville-Wilson 230 kV Line	2017	\$20-30 million
Gates #2 500/230 kV Transformer Addition	2017	\$75-85 million
Kearney - Hearndon 230 kV Line Reconductoring	2017	\$15-25 million
Gates-Gregg 230 kV Line	2022 <sup>(1)</sup>	\$115-145 million

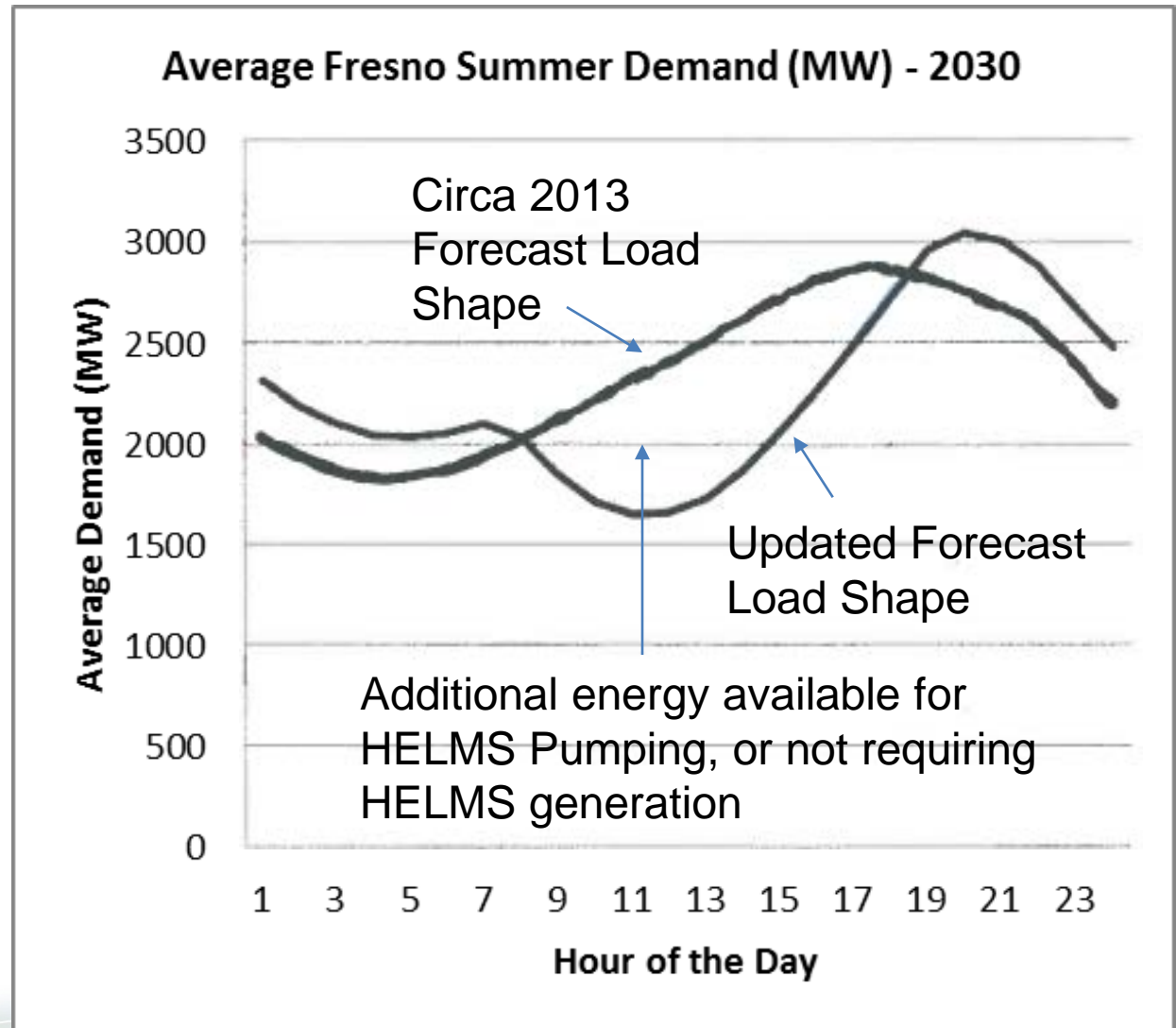
# The 2015 IEPR load forecast is causing the review of a number of approved projects, as in the Fresno area:

- Reduced load forecast overall
- Reductions are likely overstated due to peak shift issues, but are still material



# Impact of increased behind the meter solar generation:

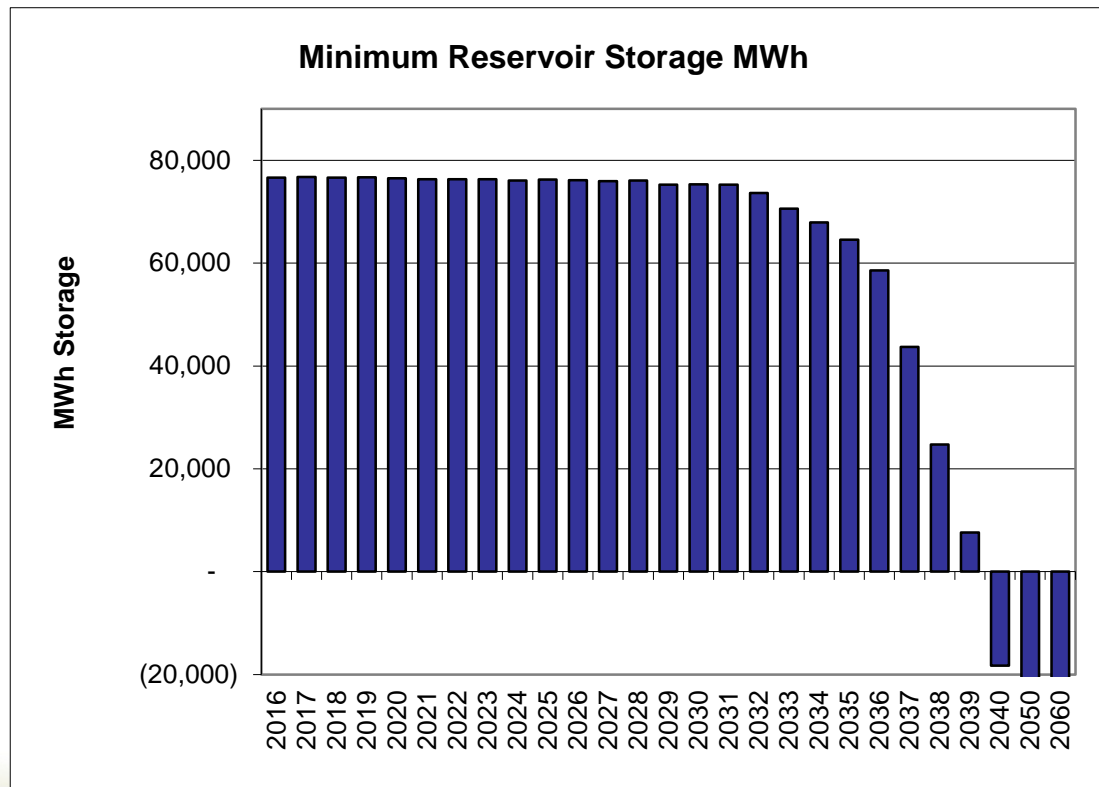
- The impact is to create additional pumping opportunities, or reduce the local need for energy to be generated by HELMS



# 2016 Need Assessment

## Reliability Need

- The decreased local area “energy” needs and increased pumping opportunities have pushed the reliability need out 10 years, beyond the effective planning horizon, shifting the need from Reliability Need to Renewable Integration Need



# 2016 Assessment of Need

- Starting case was 2017 Spring Off-Peak from the 2015-2016 TPP
- No Hydro Online in the cases
- Minimum generation to maintain adequate voltage levels
- 12 different case configurations:
  - No New Projects case
  - Case with 3 Projects
    - Gates #2 500/230 kV transformer addition;
    - Series Reactor on Warnerville-Wilson 230 kV line; and
    - Kearney-Herndon 230 kV reconductoring
  - Case with 4 Projects
    - Gates #2 500/230 kV transformer addition;
    - Series Reactor on Warnerville-Wilson 230 kV line; and
    - Kearney-Herndon 230 kV reconductoring
    - Gates-Gregg 230 kV line (which is what PG&E is filing CPCN for);
- Each case was divided into 3 Pumping scenarios
  - Single
  - Double
  - Triple



# Transmission System Capability Assessment

- **Current System** **1750 MW**
- **With 3 Projects** **1980 MW**
  - Warnerville-Wilson 230 kV series reactor
  - Gates Gregg 500/230 kV transformer addition
  - Kearney-Herndon 230 kV line reconductor
- **With 4 Projects** **2605 MW**
  - 3 projects plus
  - Gates-Gregg 230 kV line

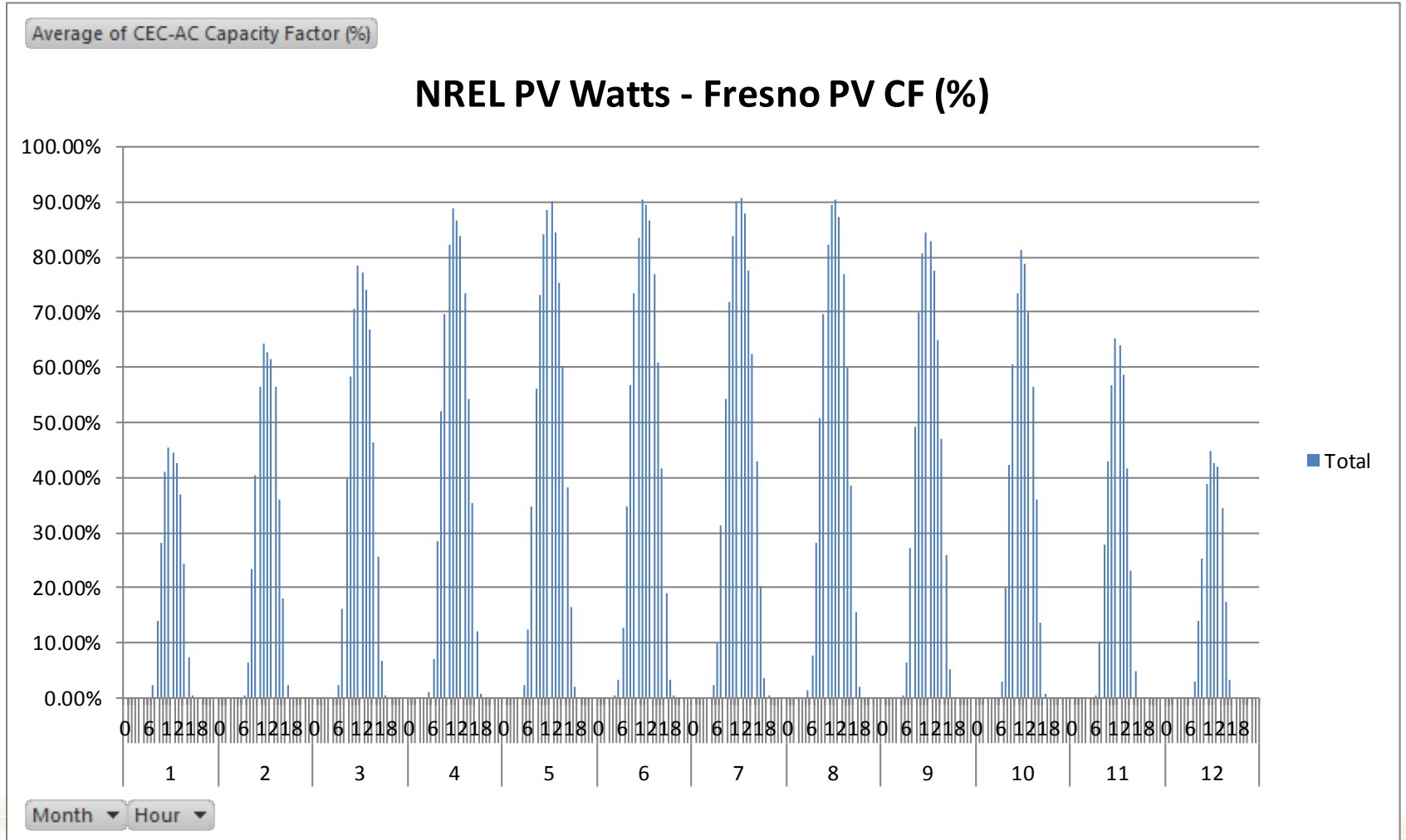
# 2016 Need Assessment

## Fresno Area Current Forecast

- Started with 2015 Fresno Area hourly load data
- Increased based upon area forecast growth rate
- Reduced load based upon CEC forecast of distributed generation using Fresno PV profiles (note PG&E forecasts are higher yet for installed PV.)

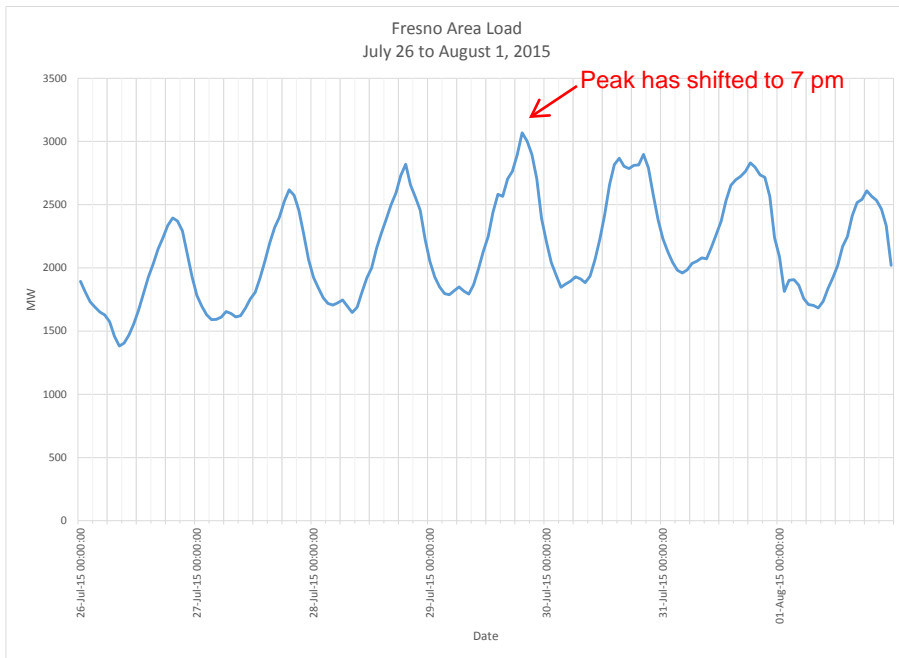
GFA CEC DG Forecast 2016 (Cumulative growth)	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026
Capacity	59.65	106.81	140.55	176.13	215.01	261.16	314.89	376.77	444.12	516.25	593.96

# Fresno Distribution PV Capacity Factor Profiles

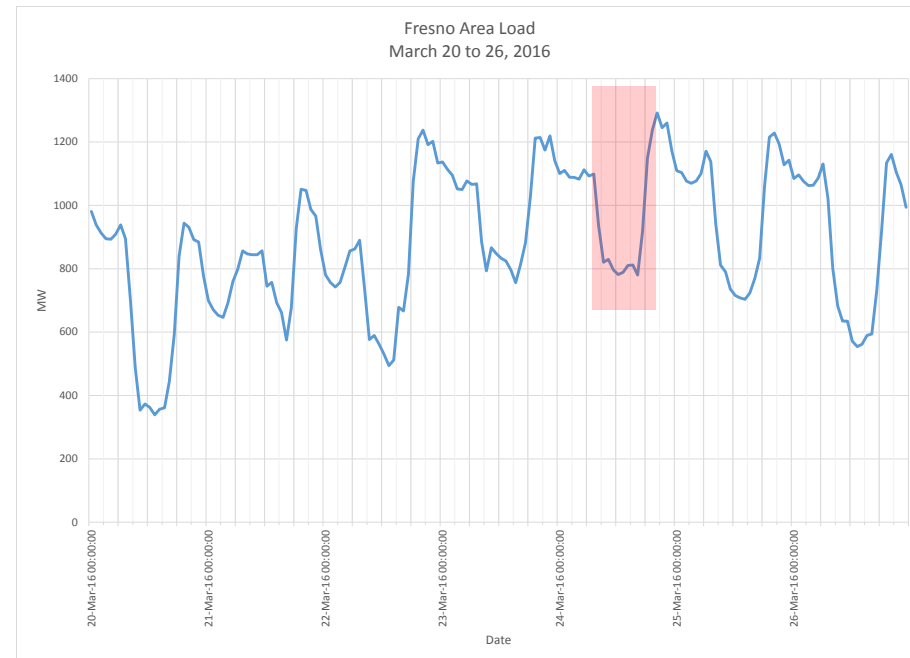


# Current Fresno Load Profiles

## Summer 2015

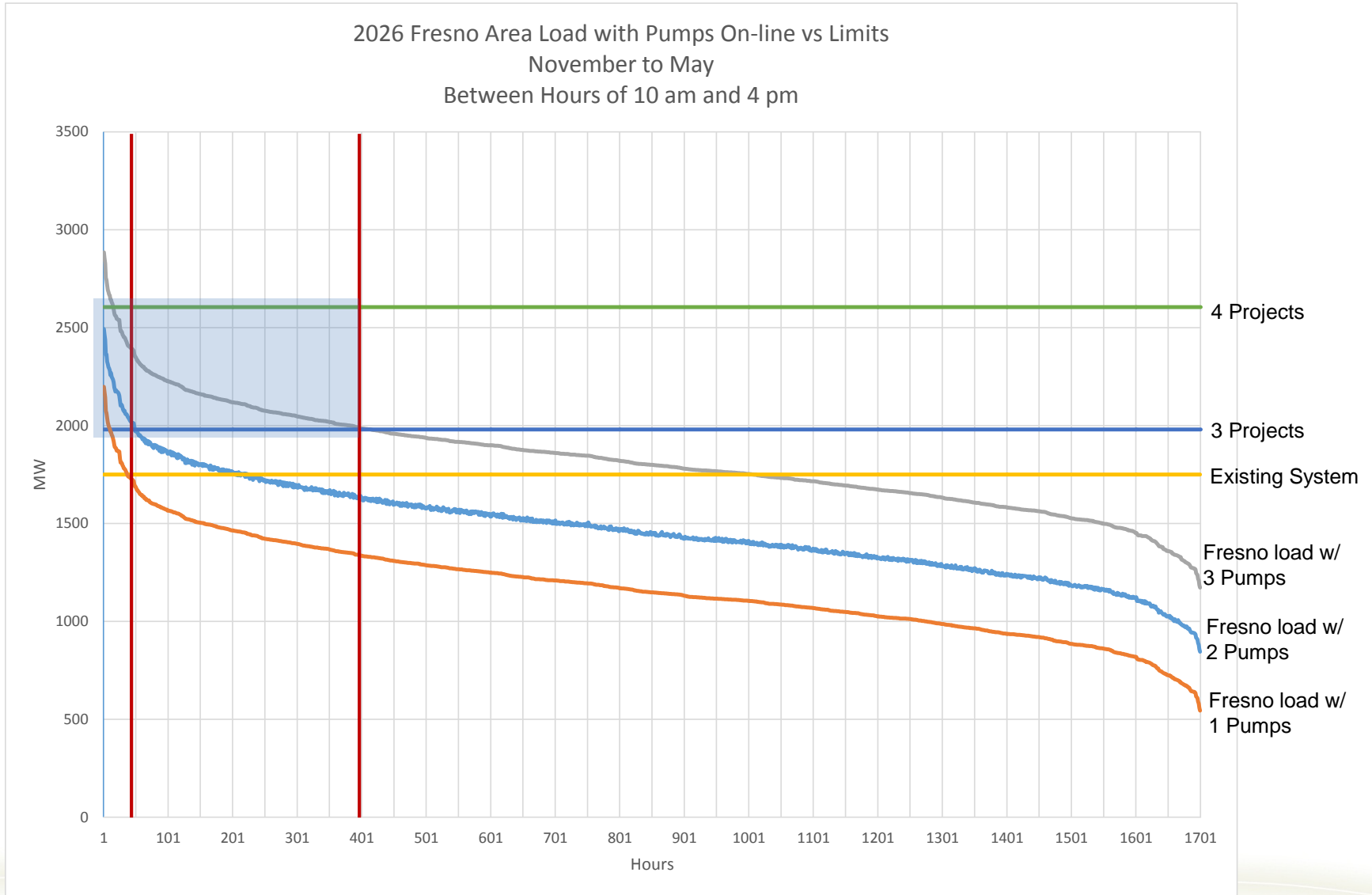


## Spring 2016



# 2026 Area Loads with Pumps versus Capability

(Non Summer Months – when oversupply conditions are expected)



# Uncertainty Could Impact Need

- Load Forecast
  - Distributed PV installed capacity
    - Additional PV would decrease benefit
  - Distributed PV Output
    - Cloud cover or unavailability could limit pumping capability during these times
  - Load growth
    - Additional load would increase benefit
- Maintenance of Fresno Transmission Facilities
- Expanding over-supply timeframe to summer periods
  - Increase the benefits

# Gates-Gregg 230 kV Transmission Line Project

## Next Steps

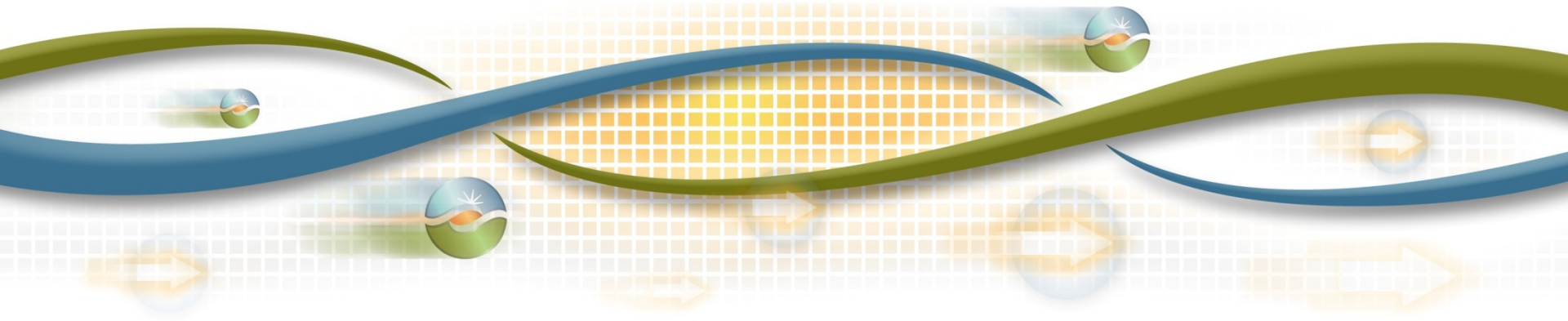
- Continue to assess value of pumping and renewable curtailment
- Continue to assess benefits for Fresno area renewable generation development
- ISO is planning to present assessment and recommendation at November 16 stakeholder meeting.



# SCE Metro Area Preliminary Reliability Assessment Results

Nebiyu Yimer  
Regional Transmission Engineer Lead

2016-2017 Transmission Planning Process Stakeholder Meeting  
September 21-22, 2016





# SCE Metro Area



- Includes Los Angeles, Orange, Ventura counties and surrounding area
- Comprised of 500 kV and 230 kV transmission facilities
- 1-in-10 summer peak net load of 19,377 MW in 2026
- 12,150 MW of existing generation of which 6100 MW is scheduled for retirement.
- 2147 MW of approved resources (LA Basin & Moorpark)

# Metro Area Study Scenarios

## 5 Base Scenarios

Scenario	Load	Dispatched Gen – Conv	Dispatched Solar/Wind	Path 26, PDCI (MW)	Path 46 (MW)
2018 SP	1-in-10 mid with low-mid AAEE	11,235	36%/0%	7,047	8,436
2021 SP		10,554		6,206	9,236
2026 SP		11,860		4,741	8,234
2018 OP	65% of net 1-in-2	4,427	93%/ 93%	-792	6241
2021 LL	50% of net 1-in-2	3,118	0%/93%	1,890	6209

## 5 Sensitivity Scenarios

Scenario	Base	Main change
S1 - high CEC load	2021 SP	824 MW increase in SoCal load
S2 - no BTM PV	2018 SP	976 MW reduction in SoCal gen.
S3 - no BTM PV	2026 SP	2240 MW reduction in SoCal gen.
S4 - high ren. output	2021 SP	6478 MW increase in SoCal ren. gen.
S5 - high Redondo output	2018 SP	952 MW increase in El Nido area gen.

# Metro Area Assessment Summary

- The base assessment identified:
  - Thermal overload due to P6 multiple contingency – 4
- In addition, the sensitivity assessment identified:
  - Thermal overload due to P6 multiple contingency – 1
  - Thermal overload due to P7 multiple contingency – 2
- Compared to last year results:
  - 3 new loading issues
  
- Potential Mitigation Solutions:
  - Operating solutions

# Base scenario overloads (P6)

1. Mira Loma 500/230 kV Tr. #4 (L-1/L-1)
2. Mira Loma 500/230 kV Tr. #1 & #2 (T-1/L-1)
3. Mira Loma–Serrano 500 kV line (L-1/L-1)

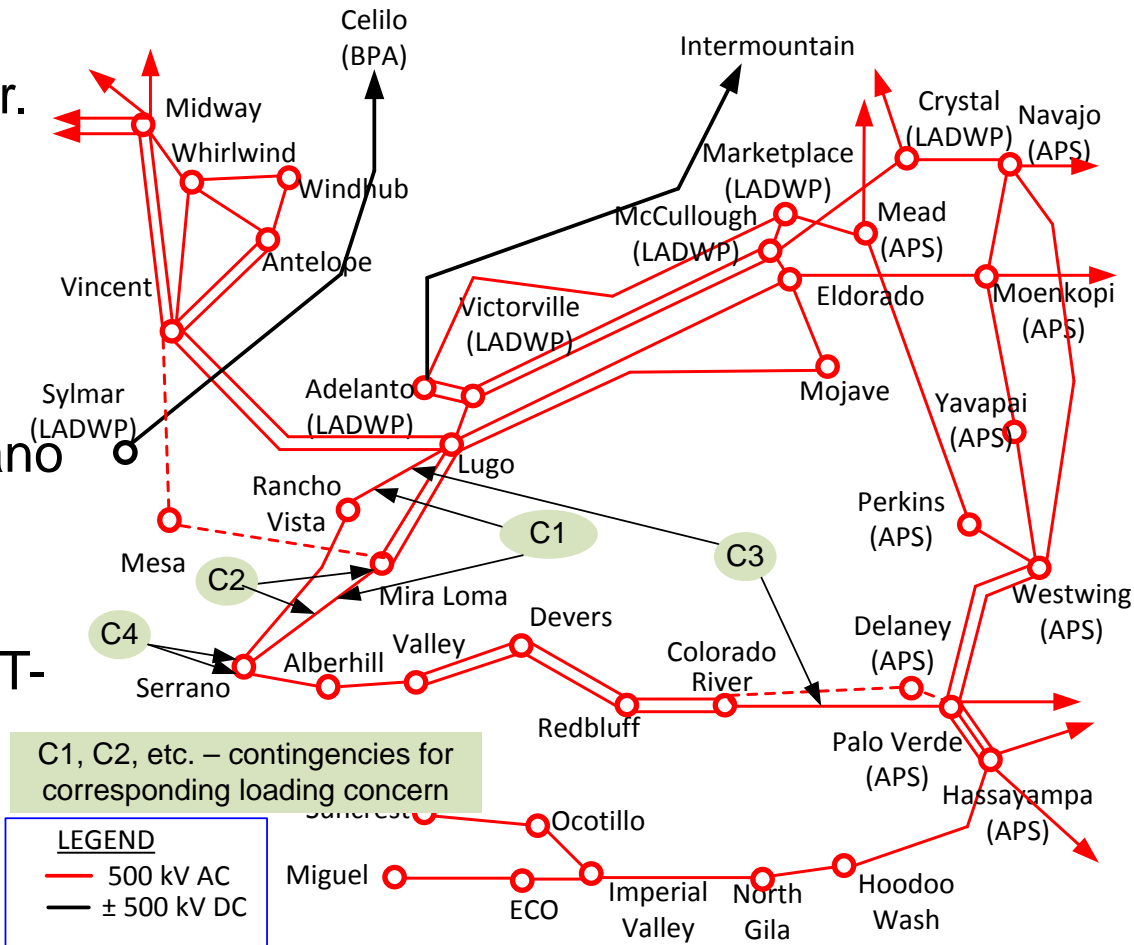
Potential mitigation:

- Loop Rancho Vista–Serrano line into Mira Loma

4. Serrano 500/230 kV Tr. (T-1/T-1)

Potential mitigation:

- Existing operating procedures until single phase spares are energized

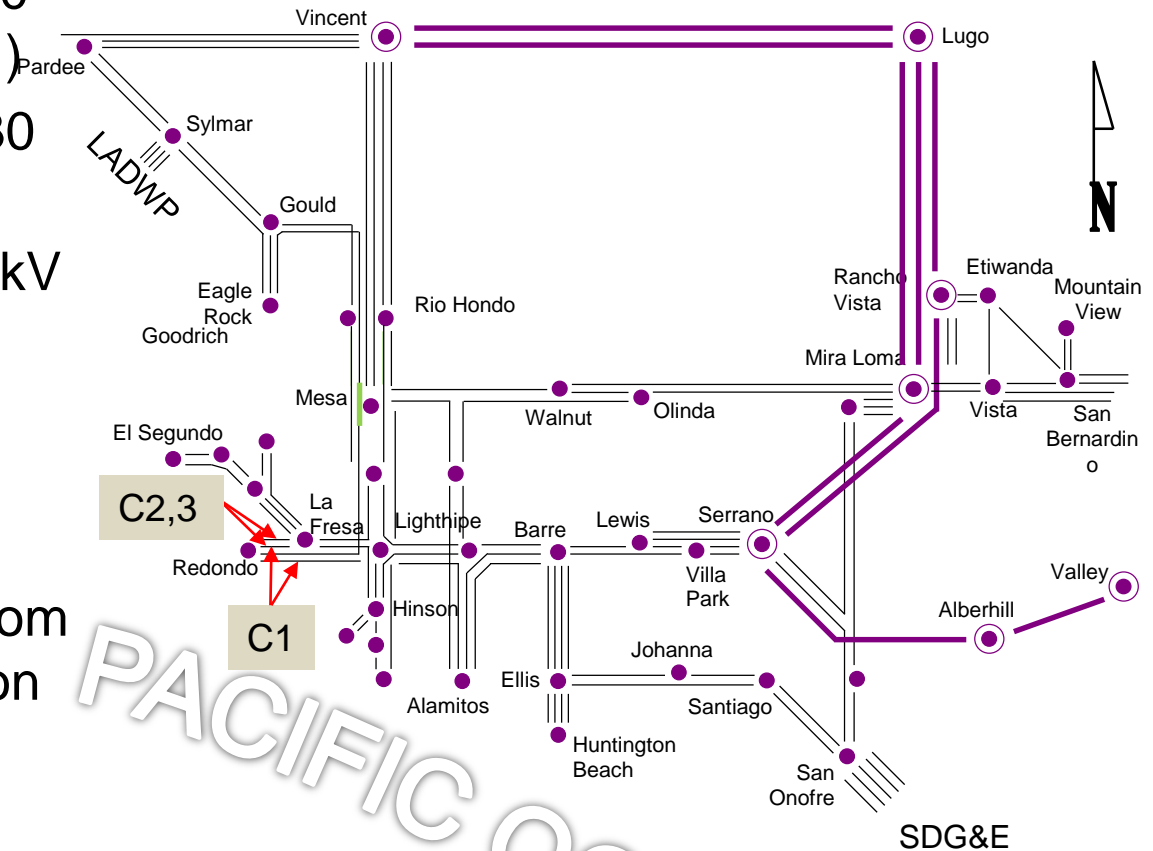


# Sensitivity scenario overloads (P6/P7)

1. La Fresa–Redondo 230 kV #1/#2 lines (L-1/L-1)
  2. Redondo–Lighthipe 230 kV line (L-2)
  3. Lighthipe–Hinson 230 kV line (L-2)
- 2018 SP high Redondo generation case
  - Redondo–Mesa/Mesa–Vincent #2 de-looped from Mesa during construction

Potential mitigation:

- Limit local generation during the construction phase



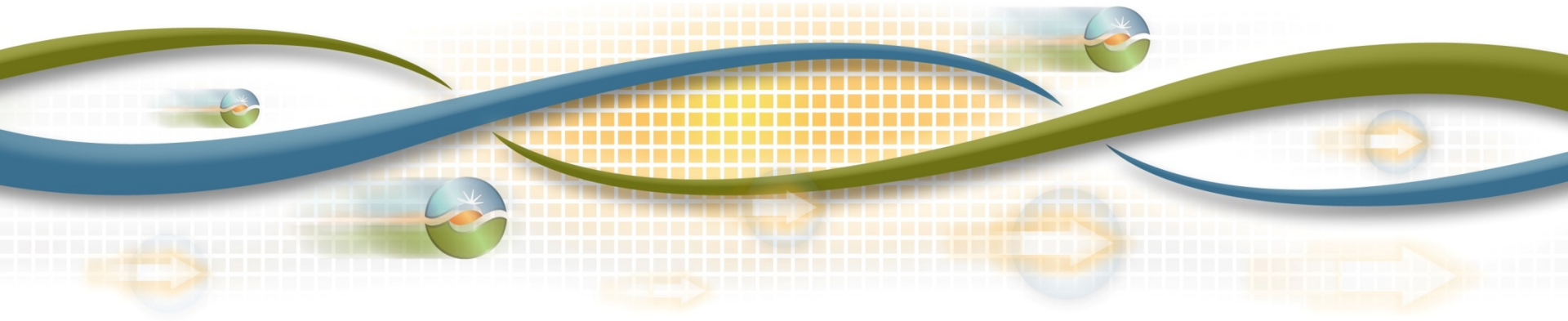
Thank you



# SCE Eastern Area Preliminary Reliability Assessment Results

Charles Cheung  
Senior Regional Transmission Engineer

2016-2017 Transmission Planning Process Stakeholder Meeting  
September 21-22, 2016



# SCE Eastern Area



- Includes the SCE and MWD owned transmission systems in the Riverside County around and west of the Devers Substation
- Generation: over 3,288 MW of generation
- Comprised of 500, 230 and 161 kV transmission facilities.
- Summer Peak net load of 1,381 MW (Including MWD pump loads) in 2026



# SCE Eastern Area Assessment

- The assessment identified:

- Without allowable system adjustments:

- Thermal overload due to Category P1, P6 and P7
    - Transient instability due to Category P7

- With allowable system adjustments:

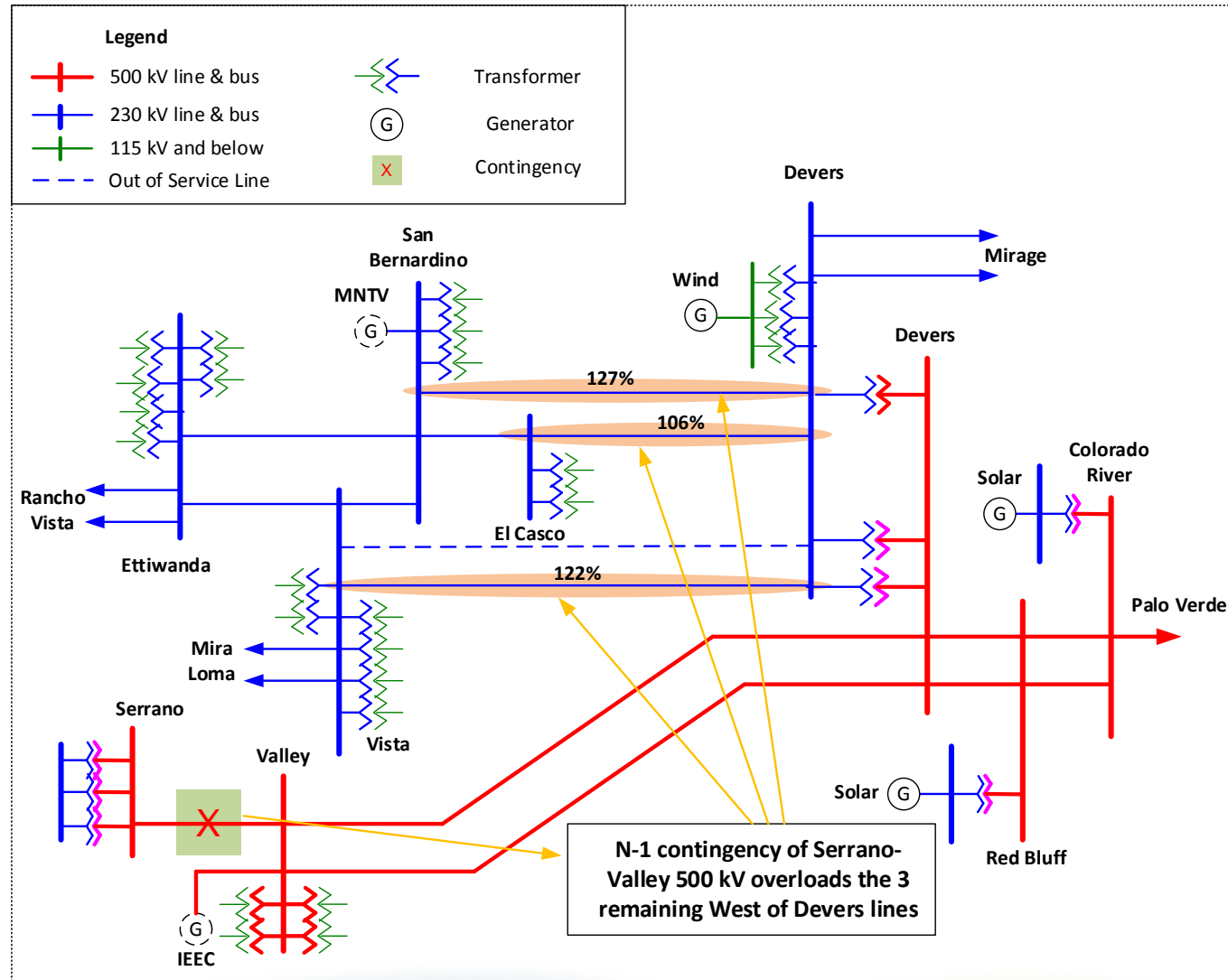
- None

# SCE Eastern Area Proposed Solutions

- Potential Mitigation Solutions
  - System adjustment before/after contingency
  - SPS, Congestion Management
  - West of Devers 230 kV lines upgrade to be completed in 2020

# SCE Eastern Area – Results

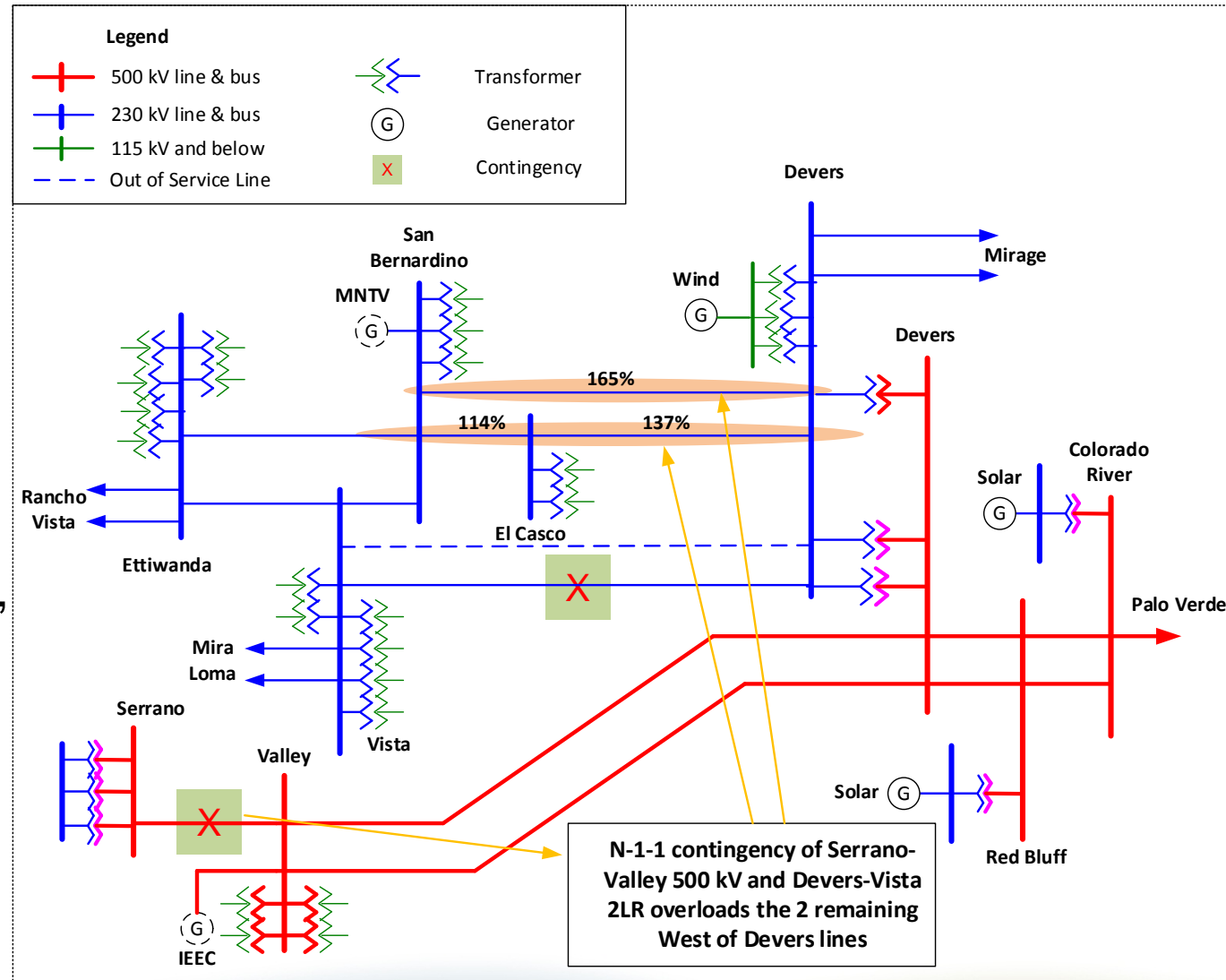
- Thermal Overload
  - West of Devers 230 kV lines (P1, N-1, 2018 Off-Peak)
  
- Potential Mitigation:
  - Inland Empire SPS, WOD SPS, Congestion Management





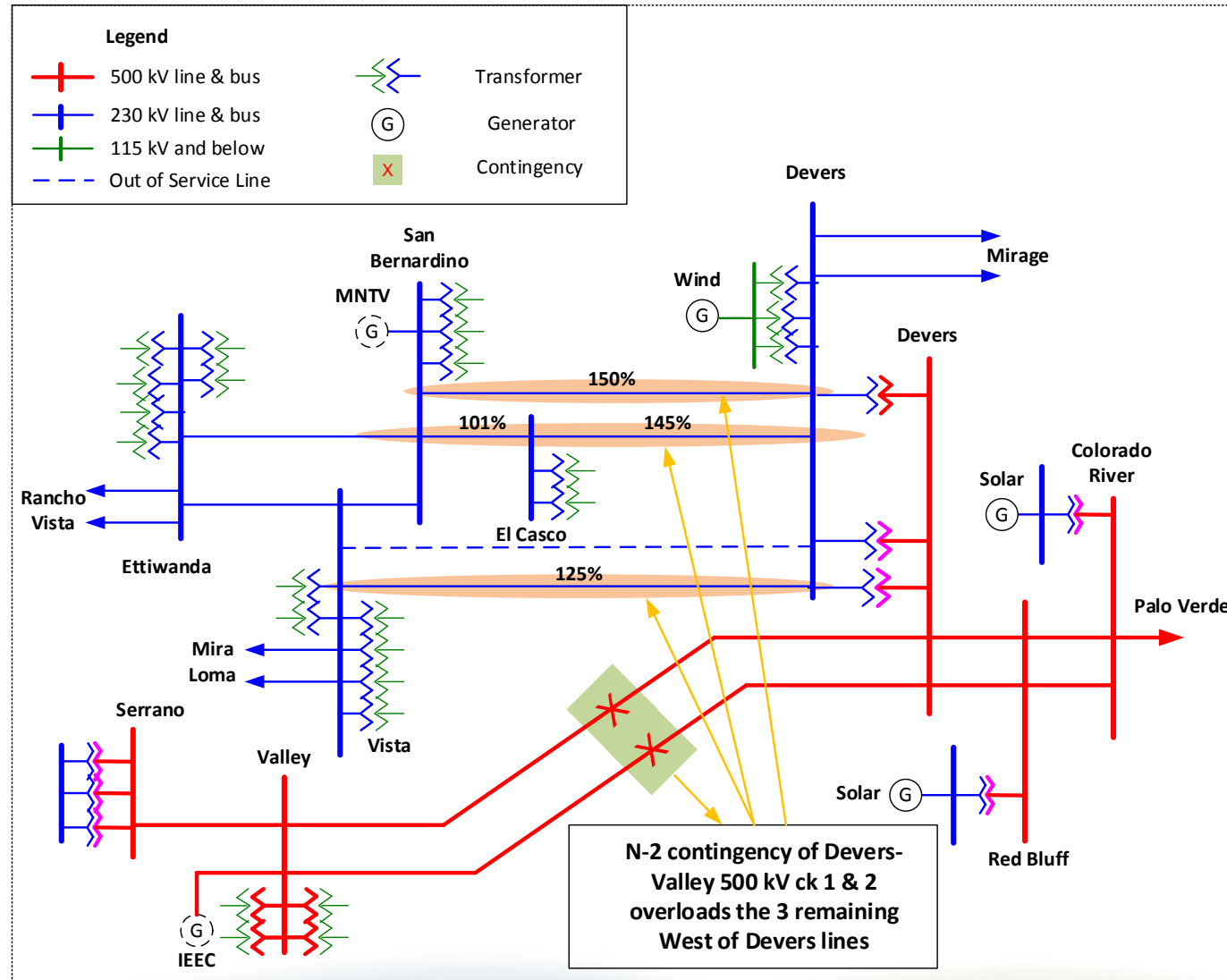
# SCE Eastern Area – Results

- Thermal Overload
  - West of Devers 230 kV lines (P6, N-1-1, 2018 Off-Peak)
  
- Potential Mitigation:
  - Inland Empire SPS, WOD SPS, Congestion Management



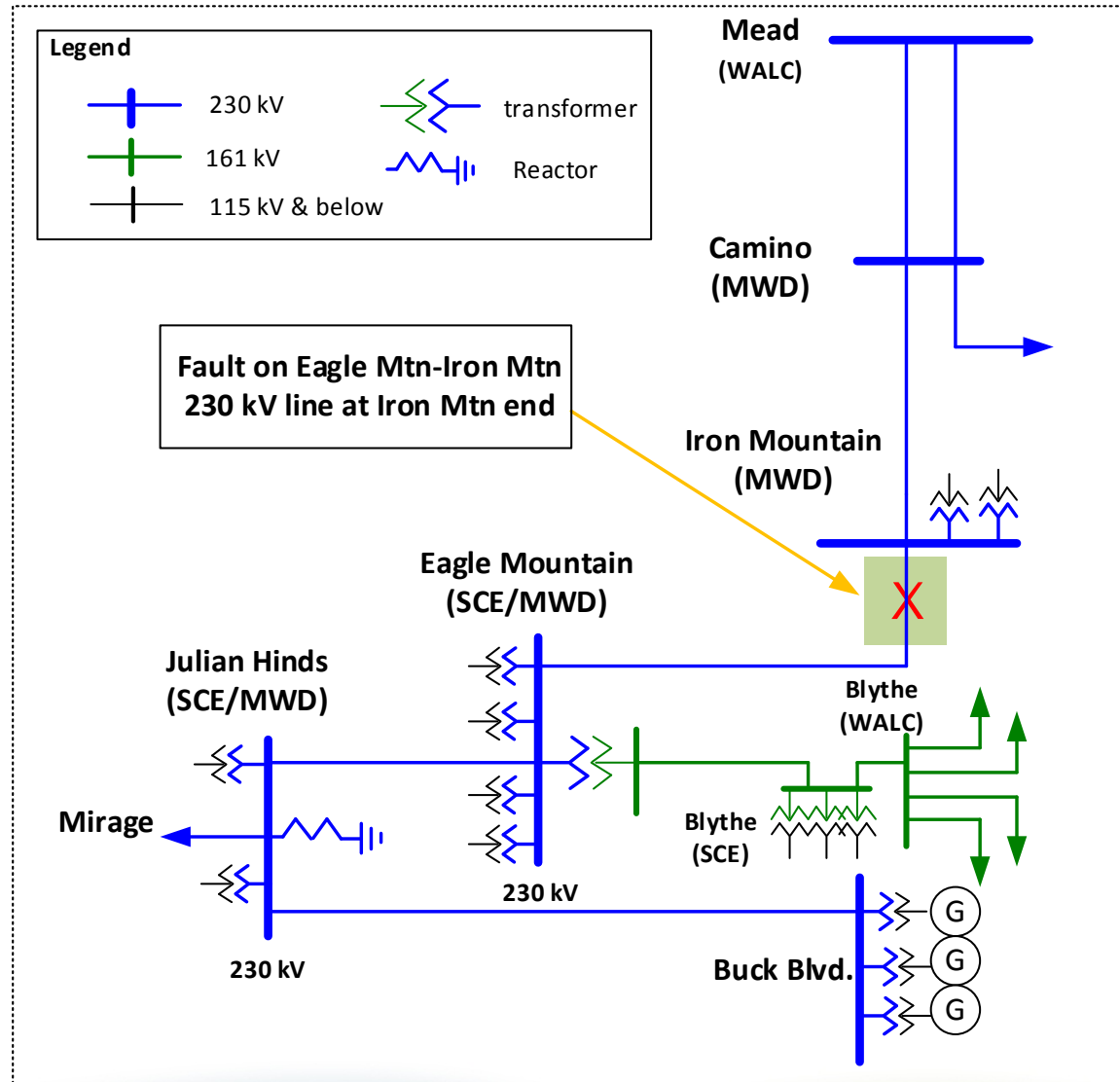
# SCE Eastern Area – Results

- Thermal Overload
  - West of Devers 230 kV lines (P7, N-2, 2018 Off-Peak)
  
- Potential Mitigation:
  - WOD SPS, Congestion Management



# MWD Area – Results

- Transient Stability
  - 3-Phase Line Fault on Eagle Mountain-Iron Mountain 230 kV line at Iron Mountain end
  
- Potential Mitigation:
  - Install Redundant Relay



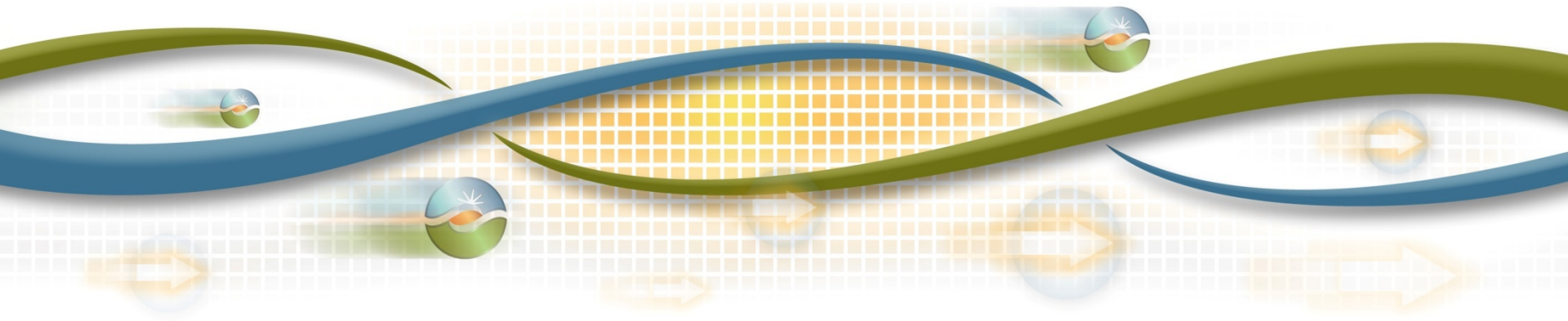


# Tehachapi and Big Creek Corridor Preliminary Reliability Assessment Results

Mudita Suri

Regional Transmission Engineer

2016-2017 Transmission Planning Process Stakeholder Meeting  
September 21<sup>st</sup>-22<sup>nd</sup>, 2016





# Tehachapi and Big Creek Corridor Area



- Comprised of 230 kV transmission facilities.
- Over 6,518 MW of existing generation.
- Existing pumping load of 720 MW.
- Summer Peak load of 2,025 MW in 2026.

# Study Scenarios

- 5 Study Base Case Scenarios

Scenario	Load	Gen. Dispatch – Conv.	Gen. Dispatch – renewables	Preferred Res. & Storage
2018 Summer Peak	1-in-10 mid – Low-mid AAEE	< Max	Solar - 36% Wind - 0%	Not dispatched
2021 Summer Peak				
2026 Summer Peak				
2018 Spring Off-Peak	~ 65% 1-in-2	< Max	Solar - 93% Wind - 93%	
2021 Spring Light Load	~ 50% 1-in-2	~ 0	Solar - 0% Wind - 93%	

# Study Scenarios

- 5 Study Sensitivity Scenarios

Scenario	Baseline	Change
S1- High Load	2021 Summer Peak	CEC High load growth 1-in-10 scenario
S2- No BTM PV	2018 Summer Peak	No Behind-the-meter PV
S3- No BTM PV	2026 Summer Peak	No Behind-the-meter PV
S4- High RE	2021 Summer Peak	Wind at 40% and Solar at 93%
S5- Low Hydro	2021 Summer Peak	Extreme low hydro drought simulation

# Tehachapi and Big Creek Corridor Area Assessment Summary

- The assessment identified:
  - No concerns were identified in Study Base Case Scenarios.
  - No concerns were identified in Sensitivity Scenarios S1, S2, S3, and S4.
  - Thermal overload due to one Category P1, two Category P3, one Category P7, and twelve Category P6 contingencies were identified in Study Sensitivity Scenario 5 (low hydro).
- Compared to last year results:
  - As per the study plan, drought generation assumptions were simulated for Big Creek hydro (base case and sensitivity).

# Base Case: Big Creek Generation Assumption

- NERC TPL-001-4 planning standard effective 01/01/16 only allows up to 75 MW of load shed for a N-1 contingency
- Objective: To identify minimum hydro generation required to mitigate N-1 overloads in Big Creek area (without any load arming)
- Assumption: The study assumes hydro operation for reliability needs
- Result: Minimum total generation needed for 1308MW Big Creek load level = 520MW (380MW hydro)

# Low Hydro Sensitivity: Big Creek Generation Assumption

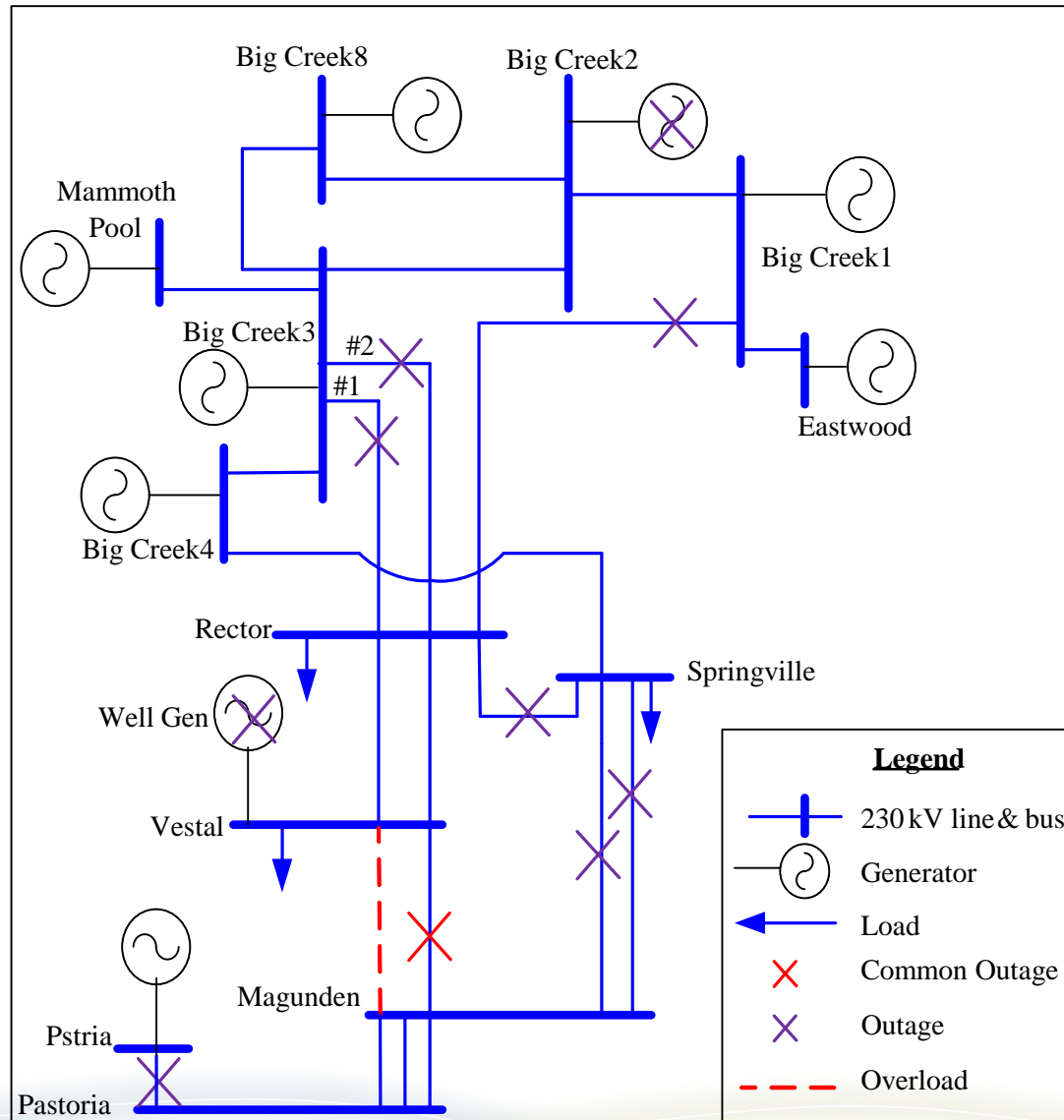
- Objective: To simulate extreme low hydro drought generation condition
- Methodology: Worst hydro generation periods (during peak load hours) were analyzed from 2015 Summer to evaluate lowest generation amounts
- Result: Total Big Creek generation, to simulate worst 2015 hydro periods = 330MW (240MW hydro)
- Further market investigation reflected sufficient hydro availability present in the market for reliable operation

# S5: Tehachapi and Big Creek Corridor Area – Results

- Thermal overload

- Magunden-Vestal 230 kV 1 or 2 overloaded for multiple contingencies (P1, P3, P6, and P7).

- Rector load shed for mitigating worst N-1 overload = 170MW



# Tehachapi and Big Creek Corridor Area Potential Mitigation Solutions

- Potential Mitigation Solutions
  - Thyristor Controlled Series Capacitors (TCSC).
  - Line upgrades
  - PGE - SCE connection line
  - PGE - SCE connection substation
  - Manage hydro generation to utilize during peak hours.
  - Modify RAS arming for low hydro conditions.
  - Additional new Preferred Resources and Energy Storage.



# Post Transient & Stability Assessment Summary

Contingency	Category	Study	Mitigation
Pardee-Bailey 230kV and Bailey -Pastoria 230kV	N-1-1	Low Voltage (Post- Transient analysis)	Operating Procedure
Big Creek 1-Big Creek 2 230 kV	N-1	Instability (Transient analysis)	Protection Project- OD of 12/31/2017

Thank you!

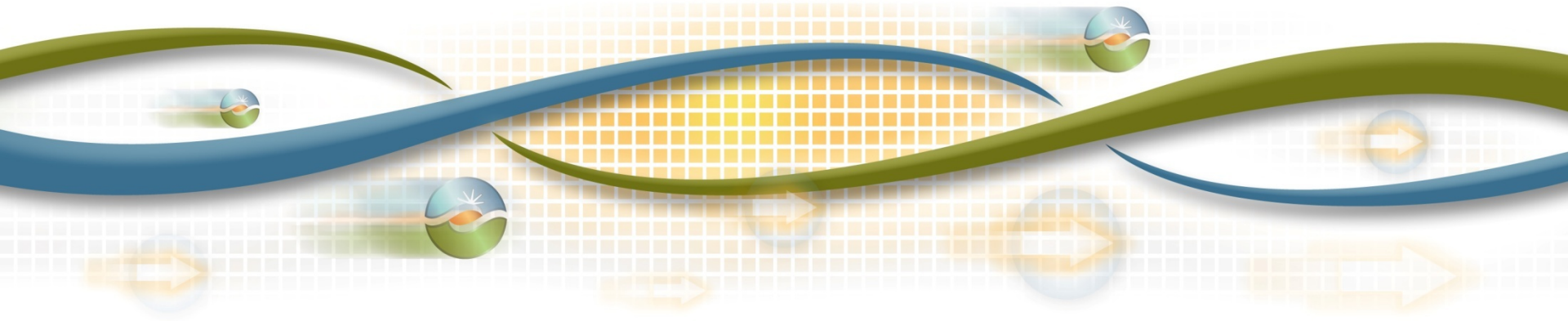
Questions?



# North of Lugo Area Preliminary Reliability Assessment Results

David Le  
Senior Advisor Regional Transmission Engineer

2016-2017 Transmission Planning Process Stakeholder Meeting  
September 21-22, 2016



# North of Lugo (NOL) Area



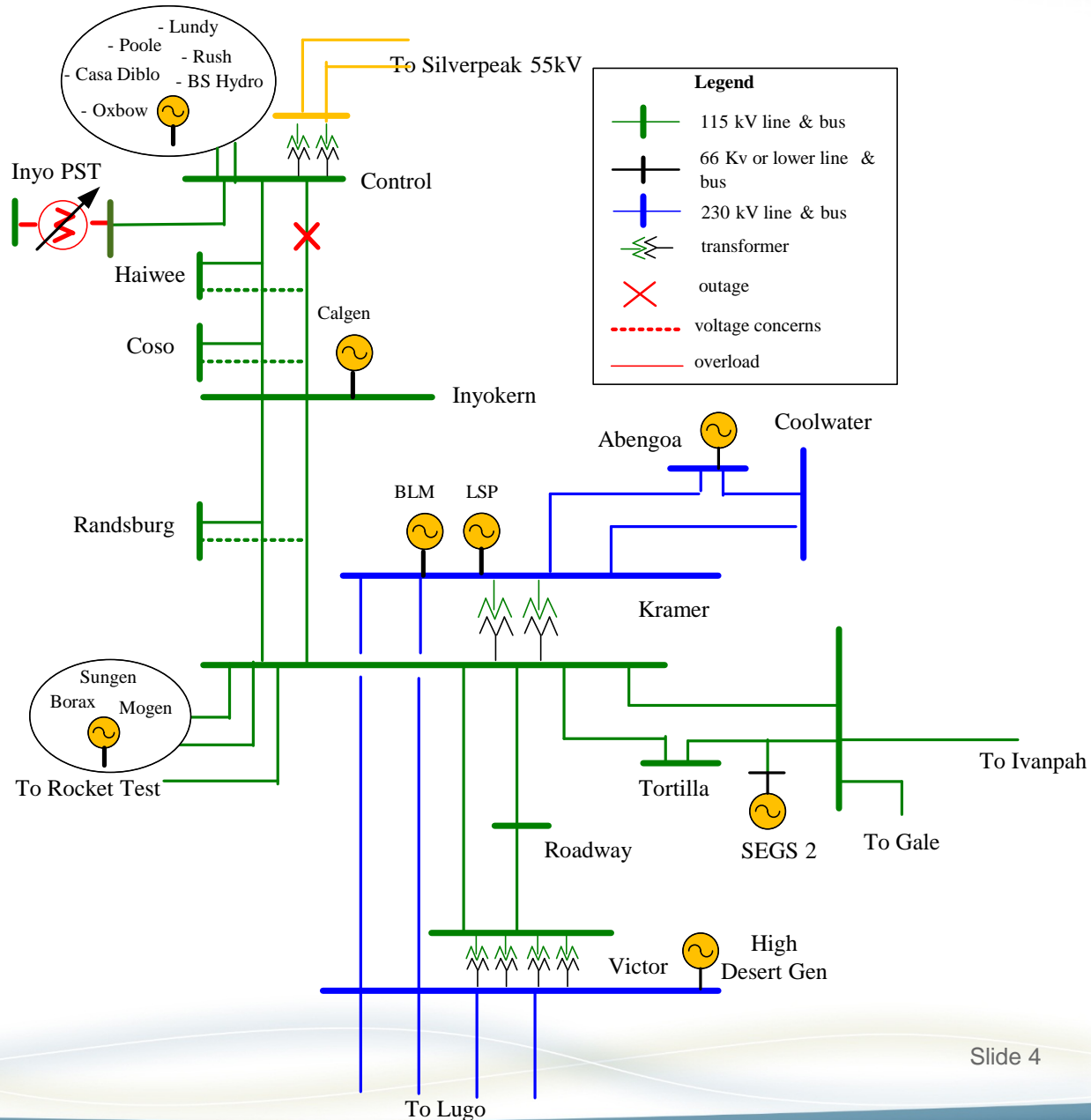
- Comprised of 55, 115, and 230 kV transmission facilities
- More than 2,100 MW of generation
- Summer peak loads of 814, 798 and 781 MW in 2018, 2021 and 2026, respectively. These include AAEE and PV distributed generation as forecast by the CEC.

# North of Lugo area assessment summary

- The assessment identified the following reliability concerns:
  - 1 facility overload due to category P1 outage
  - 1 divergence issue for category P6.1.1
  - 4 post-transient divergence issues for category P5.5 (delayed bus section fault clearing)
  - 3 facility overloads due to category P6 outages
  - 3 transient undamped voltage oscillation issues for further investigation due to category P4.2 outages (stuck breaker attempting to clear a transmission line)
  - 3 no transient voltage recovery (to 80% of pre-contingency voltage) issues for further investigation due to category P4.2 (stuck breaker attempting to clear a transmission line)
  - 2 local transient instability issues due to category P5.5 (delayed bus fault clearing)
  - 1 undamped angular oscillation issue due for further investigation due to category P6.1.1 (overlapping outage involving two transmission lines)
- Compared to last year results:
  - Load modeled in north of Lugo area is lower than previous planning cycle

# NOL – P1 steady-state reliability concerns

- P1 - thermal overload on Inyo phase shifter
- Potential Mitigation:
  - Utilize higher short-term emergency rating (2-hr)
  - Congestion management



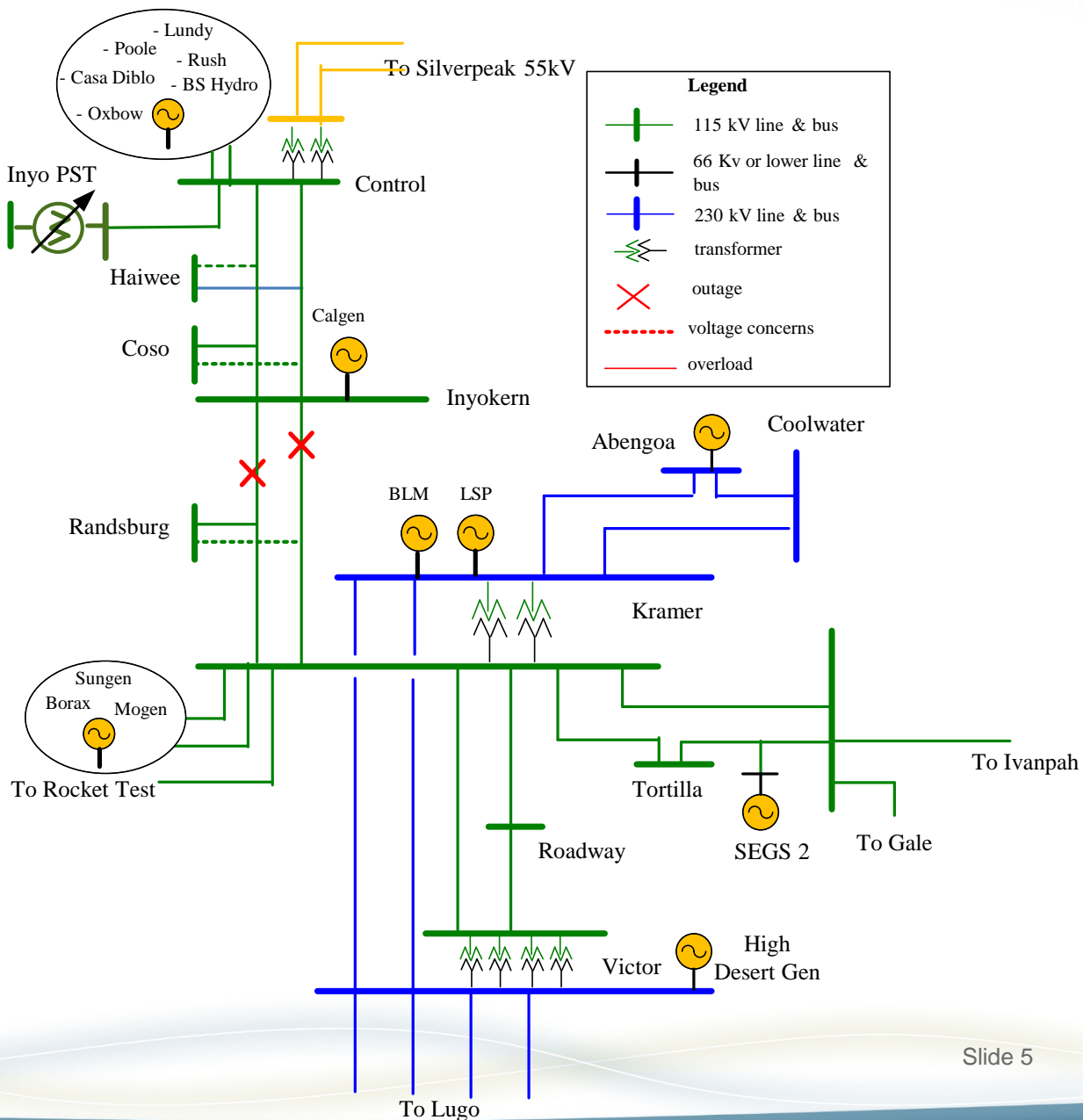
# NOL – P6 Post-transient and steady-state reliability concerns

## Case divergence

- Inyokern-Kramer 115 kV #1 and Inyokern-Tap 701-Kramer-Randsburg 115 kV

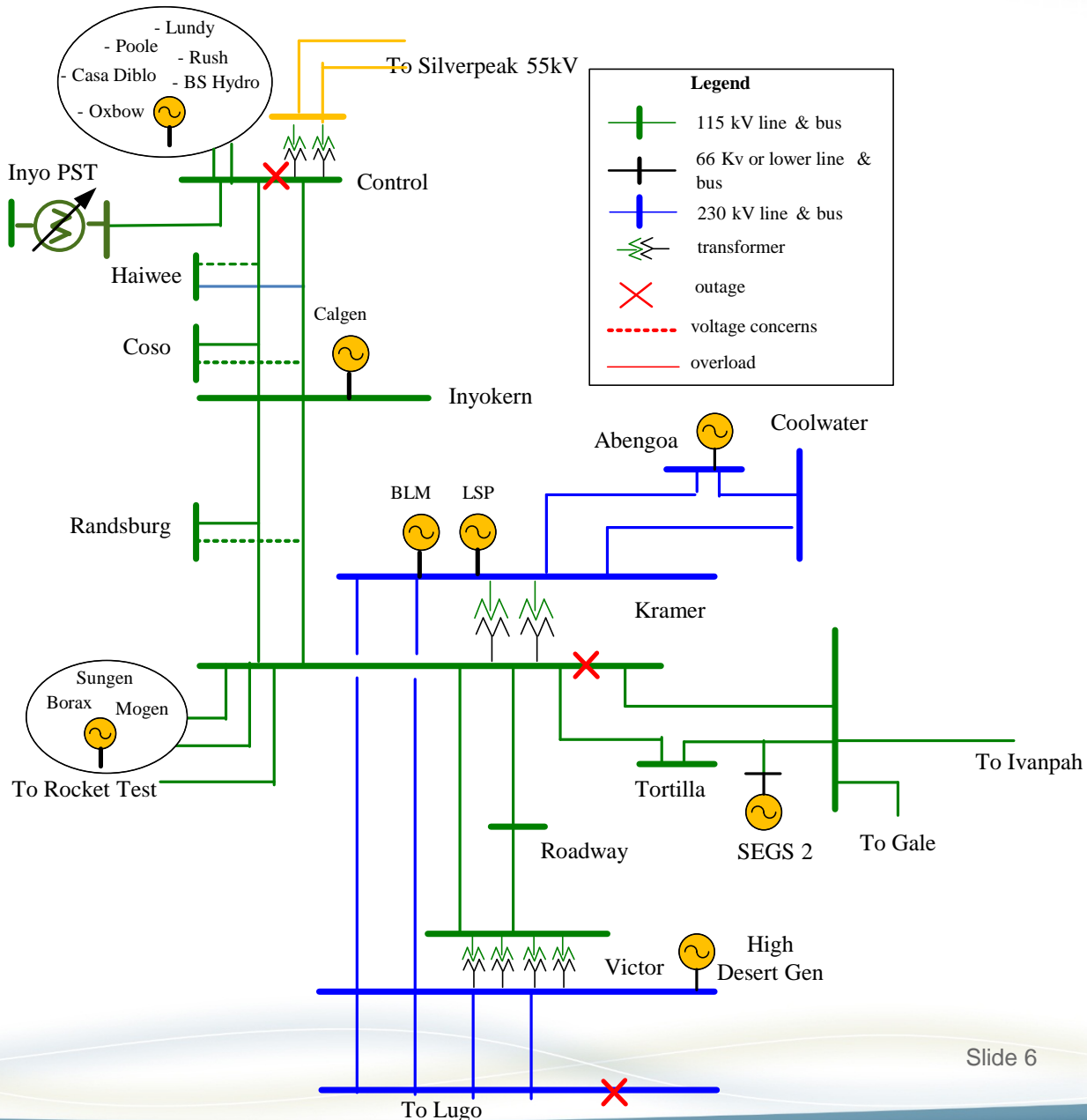
## Potential Mitigation:

- New operating procedure to curtail generation as part of system adjustment between contingencies



# NOL – P5.5 Transient, post-transient and steady-state reliability concerns

- Case divergence (post transient and steady state)
  - Kramer 115 kV north (or south) bus section delayed fault clearing
  - Control 115 kV bus section delayed fault clearing
  - Lugo 230 kV bus section delayed fault clearing
- Transient instability
  - Local transient instability north of Lugo area due Lugo bus section delayed fault clearing
- Potential Mitigation
  - Further investigation on the protection system and impacted transmission facilities
  - Investigate transmission option of installing backup relays for clearing bus section faults





# NOL – P4.2 Transient stability reliability concerns

## Undamped transient voltage oscillations

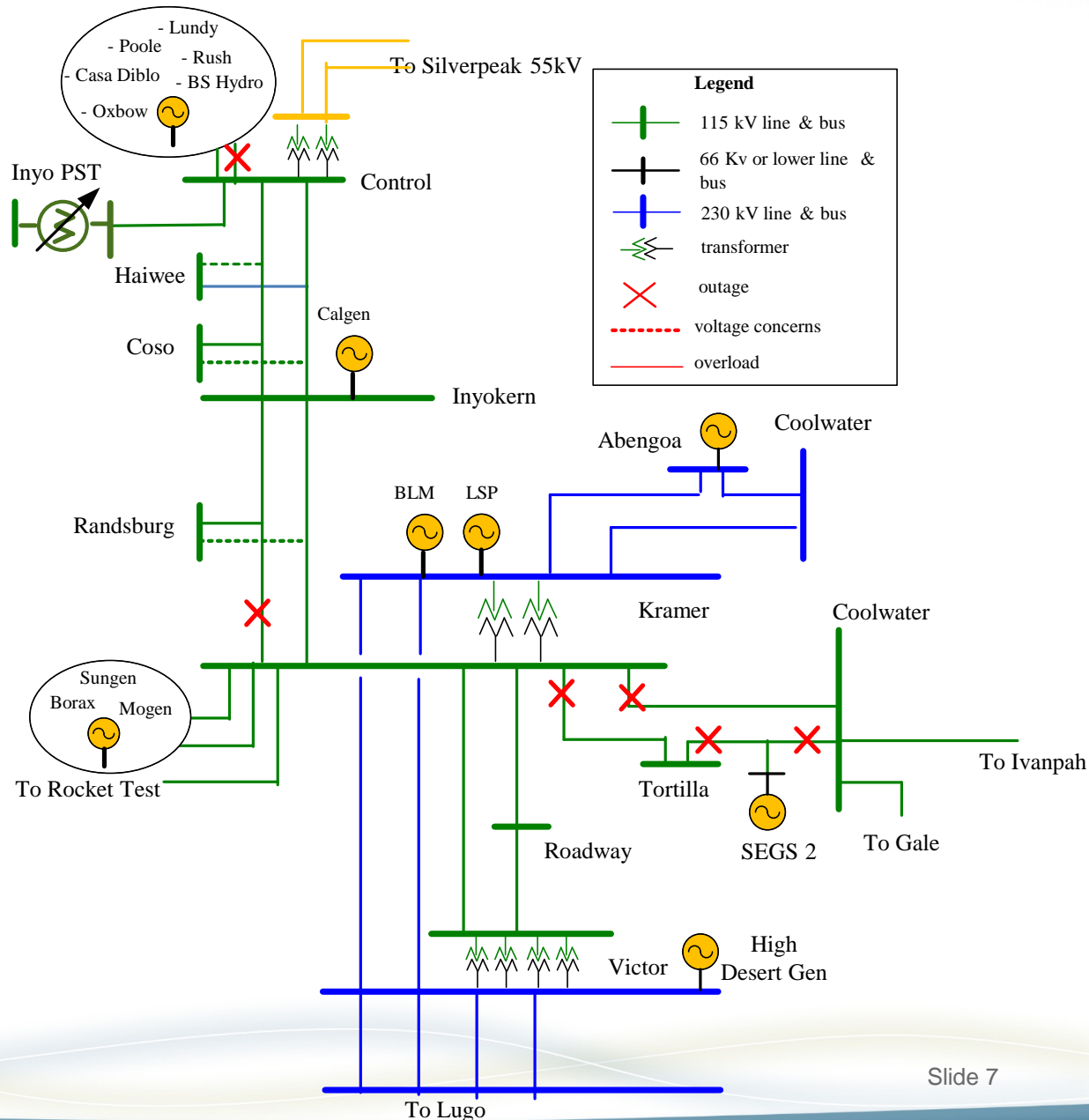
- Control-Casa Diablo 115 kV line (fault at 20% from Control, stuck breaker at Casa Diablo)
- Cool Water–SEGS-Tortilla 115 kV line (fault at 20% from either Cool Water or at Tortilla)

## Voltage recovery is less than 80% of pre-contingency voltage

- Kramer-Cool Water 115 kV line (fault at 20% from Kramer)
- Kramer-Inyokern-Randsburg 115 kV line (fault at 20% from Kramer)
- Kramer-Tortilla 115 kV line (fault at 20% from Kramer)

## Potential Mitigation

- Further investigation on the protection system
- Investigate and consider local breaker failure backup (LBFB) scheme



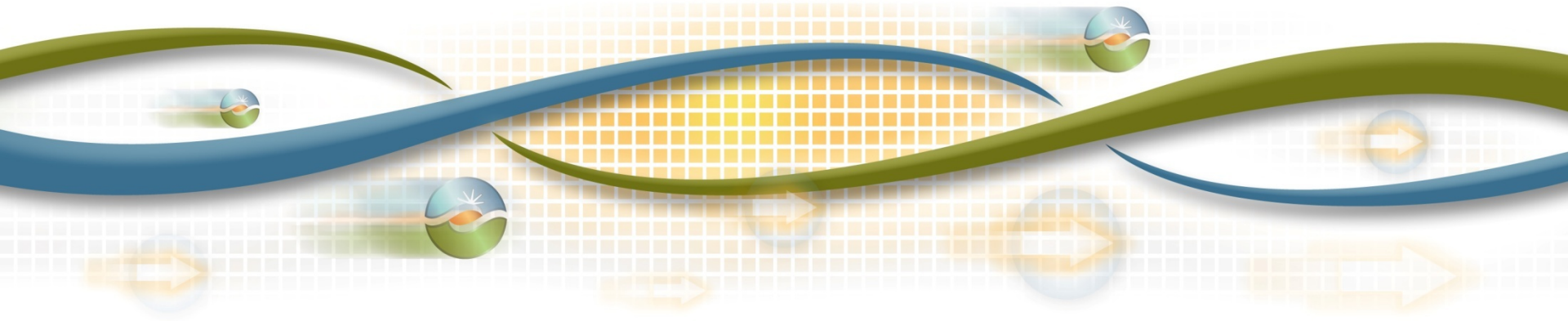
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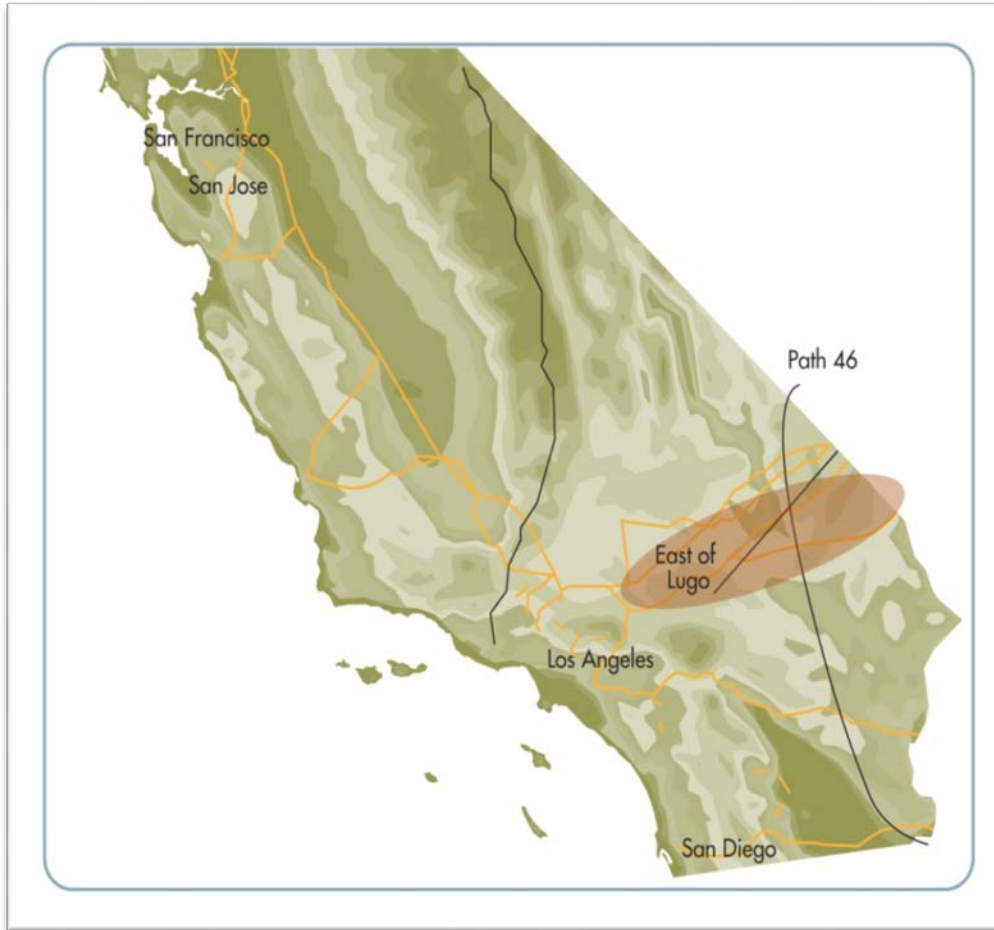
# East of Lugo Area Preliminary Reliability Assessment Results

Meng Zhang  
Sr. Regional Transmission Engineer

2016-2017 Transmission Planning Process Stakeholder Meeting  
September 21-22, 2016



# East of Lugo (EOL) Area



- Includes Eldorado, Mohave, Merchant, Ivanpah, CIMA, Pisgah, Mountain Pass, Dunn Siding and Baker substations
- The total generation in the area is around 880 MW.
- Comprised of 115, 230 & 500 kV transmission facilities.
- Summer Peak load of 14 MW in 2026

# EOL Area Assessment Summary

- The assessment identified:
  - Two facility overloads due to category P6 outages
  - One facility overloads due to category P1 outage in the sensitivity study
  - One post-transient facility overload due to category P6 outage
  - Voltage fails to recover following two category P4.2 outages (stuck breaker attempting to clear a transmission line)
  - No voltage deviation issues identified for all categories
  - No high/low voltage issues identified for all categories
- Compared to last year's results:
  - Same Lugo – Victorville 500kV Line overload
  - Same Ivanpah 230/115kV transformer overload
  - New transient issues identified for category P4.2 outages
  - Eldorado 500/230kV Bank AA outage is assumed included in the Ivanpah RAS as recommended in 2015/16 TPP.

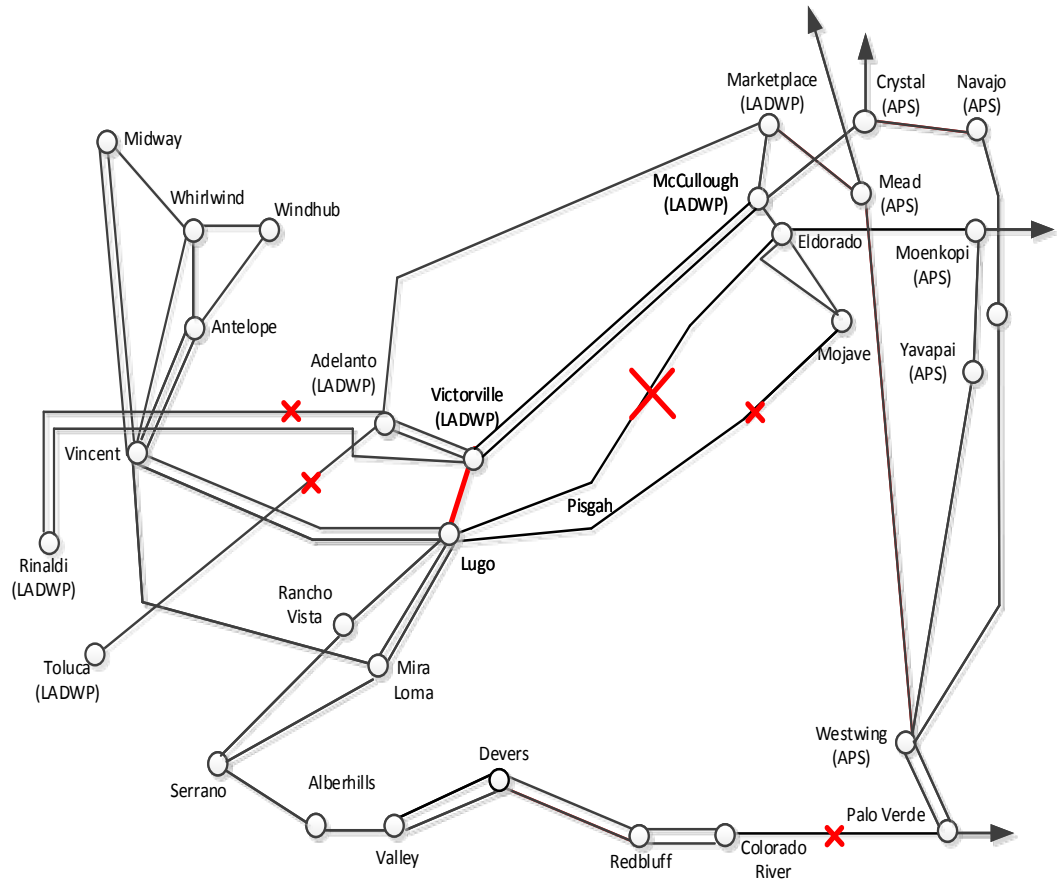
# EOL Area Potential Mitigation Solutions

- Congestion management
- Mitigation for Lugo – Victorville 500kV Line overload:
  - Upgrade line and terminal equipment to increase line ratings
- Mitigation for transient voltage recovery issues: install Local Breaker Failure Back-up (LBFB) at Pisgah Substation.



# EOL Area: Lugo – Victorville Thermal Issues

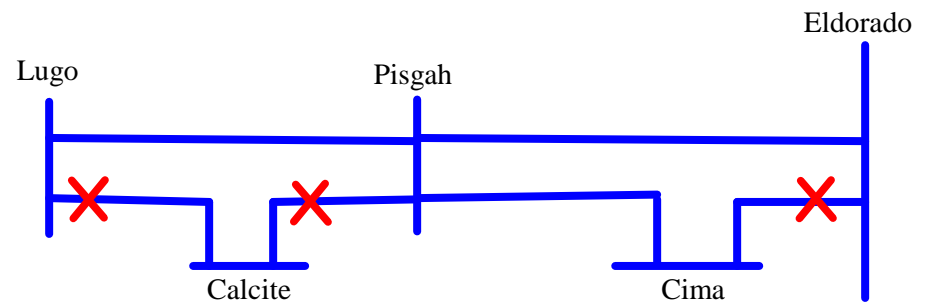
- Lugo – Victorville 500kV Line is observed to be overloaded following multiple P6 contingencies in all base cases except 2021 summer light load case.
- The line is also overloaded following Eldorado – Lugo 500kV single line outage in 2021 heavy renewable sensitivity case.
- In post-transient study, the line is observed to be overloaded following loss of both Lugo – Mohave and Eldorado – Lugo lines in all summer peak cases.
- Potential Mitigation
  - Upgrade line and terminal equipment for both SCE and LADWP portions.





# EOL Area: Transient Stability Issues

- Voltage dips at Cima and Pisgah 230kV buses are greater than 30% and voltages fail to recover with stuck breaker at Pisgah 230kV:
  - I. Eldorado – Cima – Pisgah 230kV Line single phase fault at 20% from Eldorado
  - II. Lugo – Pisgah 230kV Line single phase fault 20% from Lugo
  - III. Calcite – Pisgah 230kV Line single phase fault 20% from Calcite (2021 and beyond)
- Potential Mitigation
  - Install Local Breaker Failure Back-up (LBFB) scheme at Pisgah Substation.



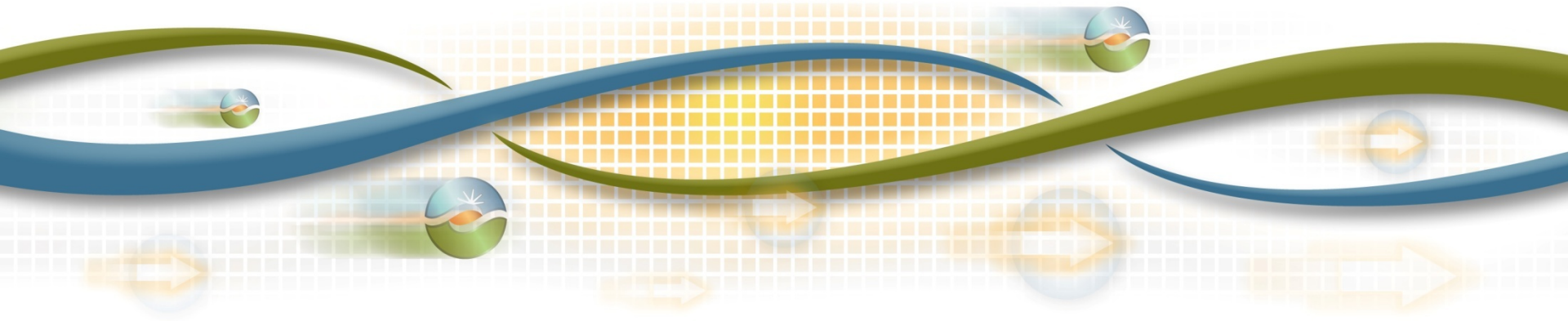
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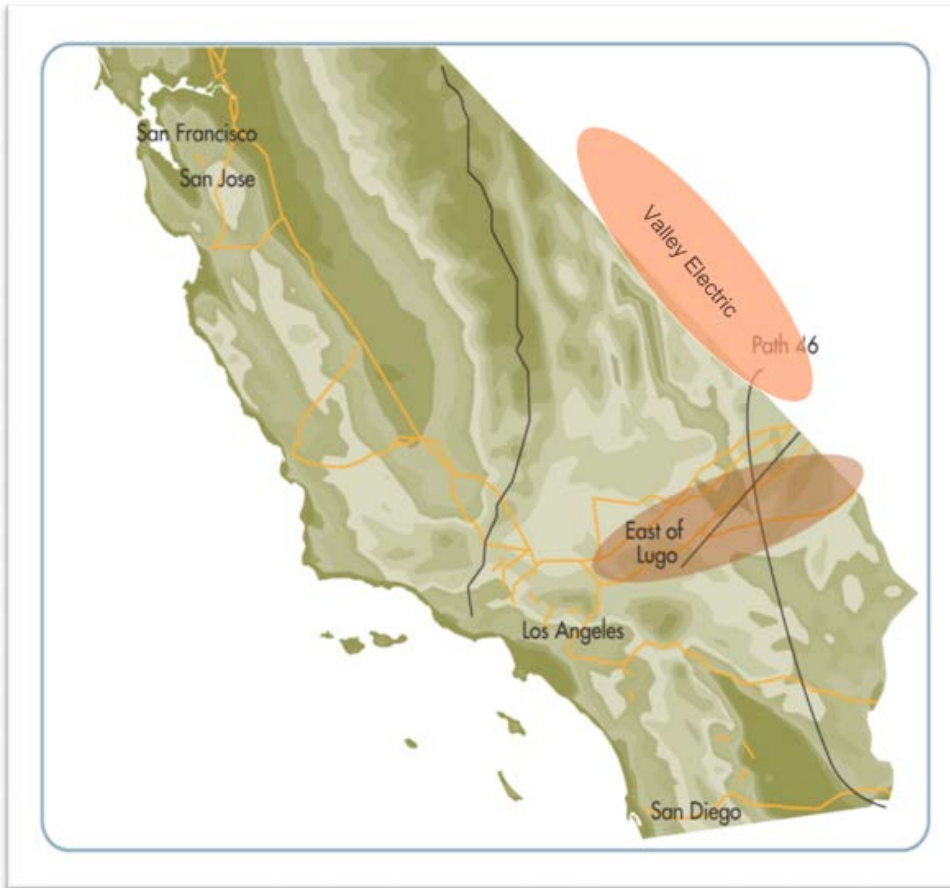
# Valley Electric Area Preliminary Reliability Assessment Results

Meng Zhang  
Sr. Regional Transmission Engineer

2016-2017 Transmission Planning Process Stakeholder Meeting  
September 21-22, 2016



# Valley Electric Association (VEA) Area



- VEA system is connected to WAPA's Mead 230kV substation, WAPA's Amargosa 138kV substation, NV Energy's Northwest 230kV substation and shared buses at Jackass 138kV and Mercury 138kV stations
- Approximately 13 MW of renewable generation is modeled.
- Comprised of 138 and 230 KV transmission facilities under ISO control
- 2026 summer peak load is approximately 155 MW

# VEA Assessment Summary

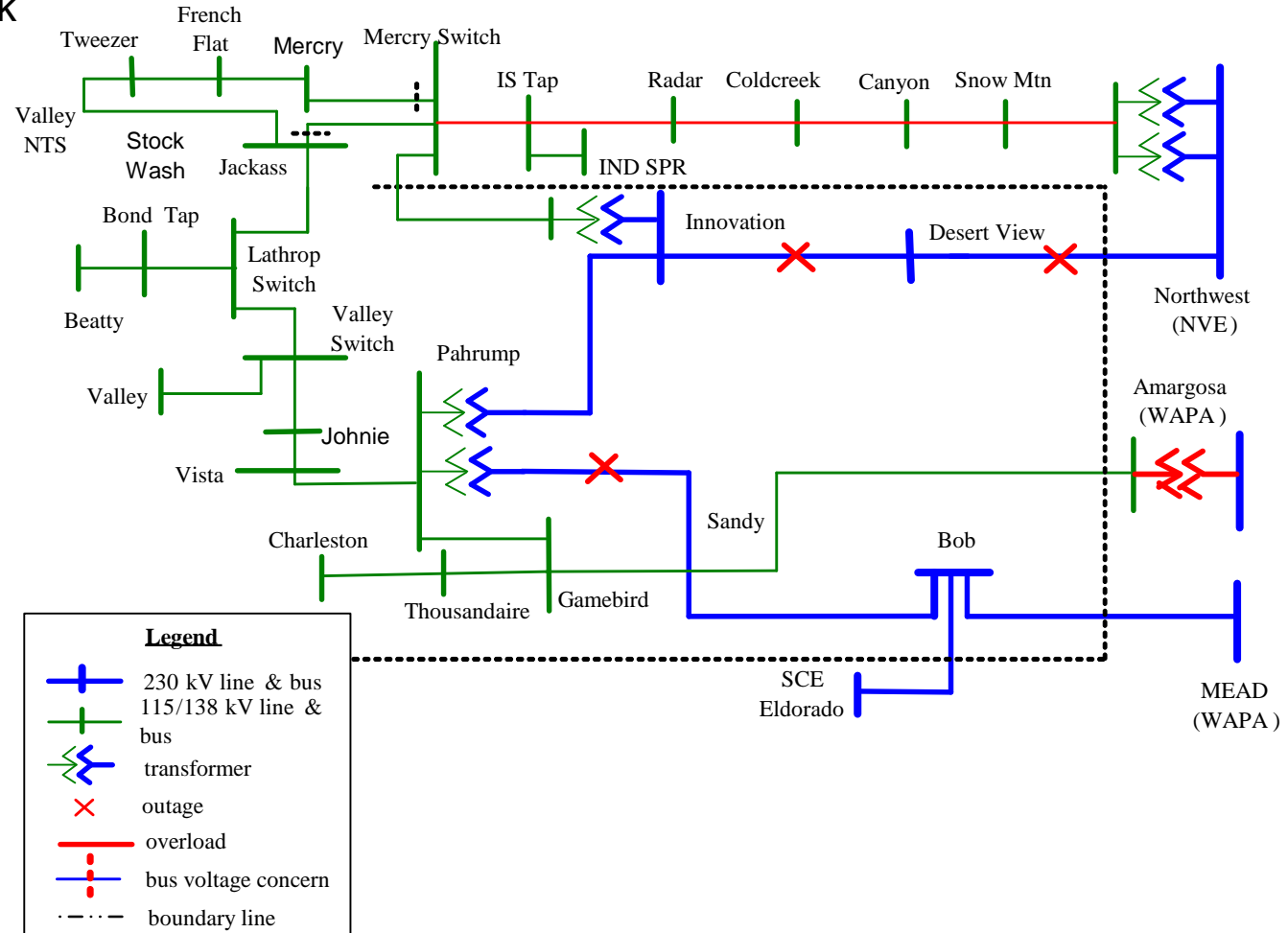
- The assessment identified:
  - 2 facility overloads due to category P6 outages
  - 2 230kV buses with high/low voltage concerns for category P6 outages.
  - Entire 138kV system experiencing high/low voltage concerns for category P6 outages
  - 3 buses with voltage deviation concerns for category P1 outage
  - Multiple 138kV and 230kV buses with voltage deviation concerns for category P6 outages
- Compared to last year results:
  - Very similar to last year's results since the planned upgrades modeled in this year's TPP base cases are the same as in last year's
  - As recommended in 2015/16 TPP, the Eldorado 500/230kV Bank AA outage is assumed to be included in the Ivanpah RAS.

# VEA Potential Mitigation Solutions

- Existing UVLS in VEA area
- Operational action plan for category P6 outages, switching after the first outage.

# VEA: Thermal Loading Issues

- Amargosa 230/138kV bank and Northwest – Mercury Sw 138kV Line are observed overloaded in 2018, 2021 and 2026 summer peak cases for multiple P6 outages.
- Potential Mitigation
  - Existing UVLS
  - Operation action plan, switching after first outage.



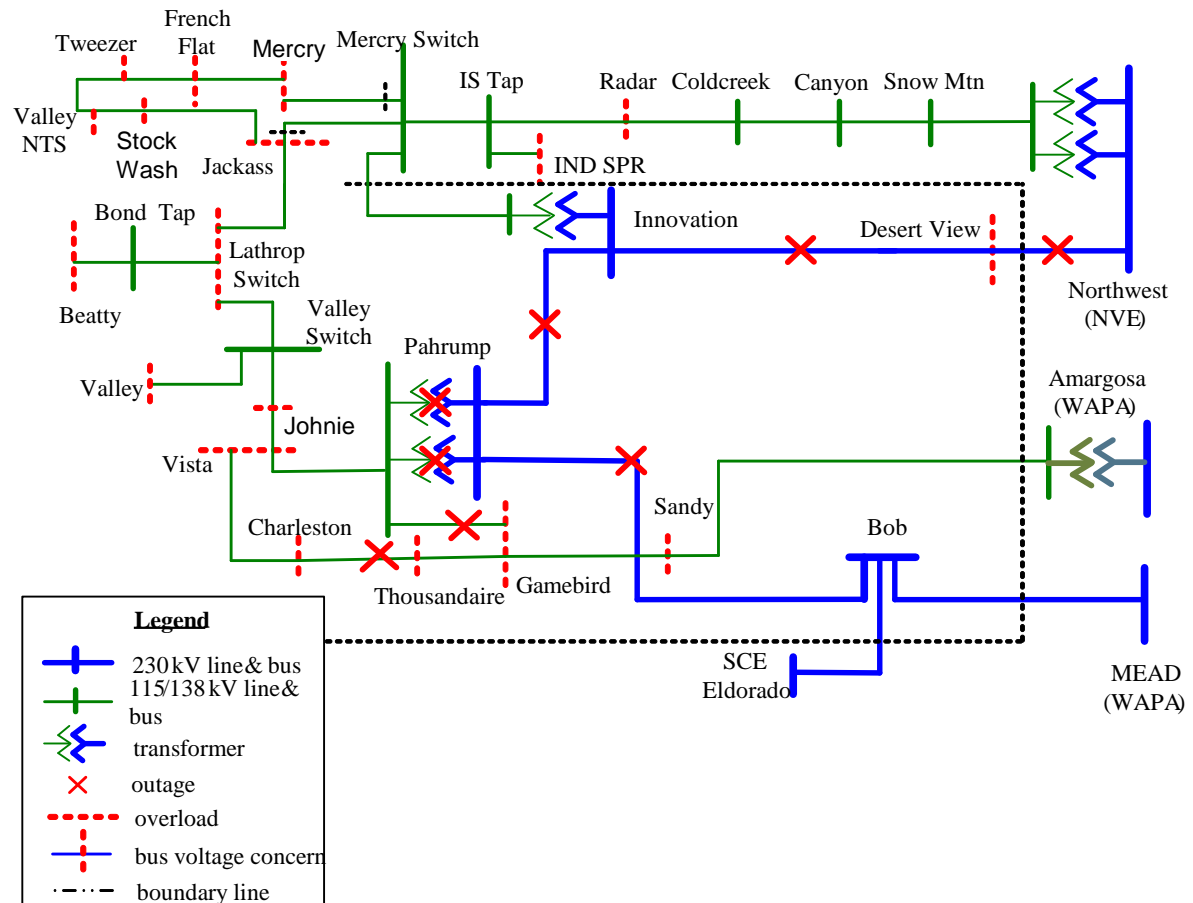
# VEA: High/Low Voltage Issues

- Low voltage at Desert View 230kV bus following loss of Northwest – Desert View & Pahrump – Mead (Bob SS) 230kV lines in 2018, 2021 and 2026 summer peak cases and 2018 summer off-peak case. High voltage at the bus is observed for the same outage in 2021 summer light load case.

- Low voltages across 138kV system for loss of Pahrump 230kV source in 2021 and 2026 summer peak cases. Worst contingency: Innovation – Desert View & Pahrump – Bob SS 230kV line.

## Potential Mitigation

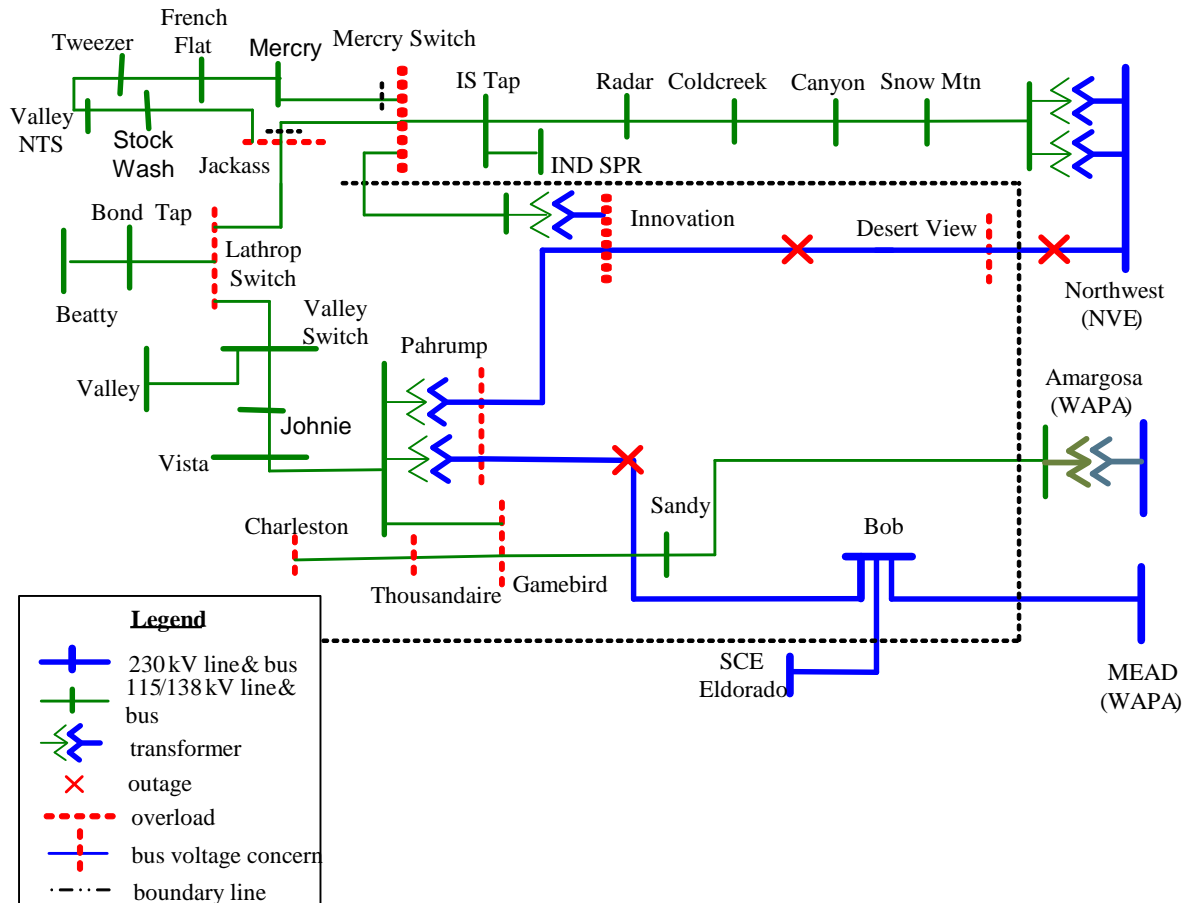
- Existing UVLS and operation switching after first outage.
- Change the transformer taps to 1 at Innovation and Pahrump substations.





# VEA: Voltage Deviation Issue

- Voltage deviations at Charleston, Thousandaire and Gamebird 138kV buses are found greater than 5% in 2018 following the Pahrump – Gamebird 138kV Line outage.
- Voltage deviations are found greater than 10% at three 230kV buses for multiple P6 outages in all the cases and at three 138kV buses for 2021 and 2026 summer peak cases.
- Potential Mitigation**
  - Planned Charleston – Vista 138 kV line will mitigate 138 kV
  - Existing UVLS and operation switching after first outage.



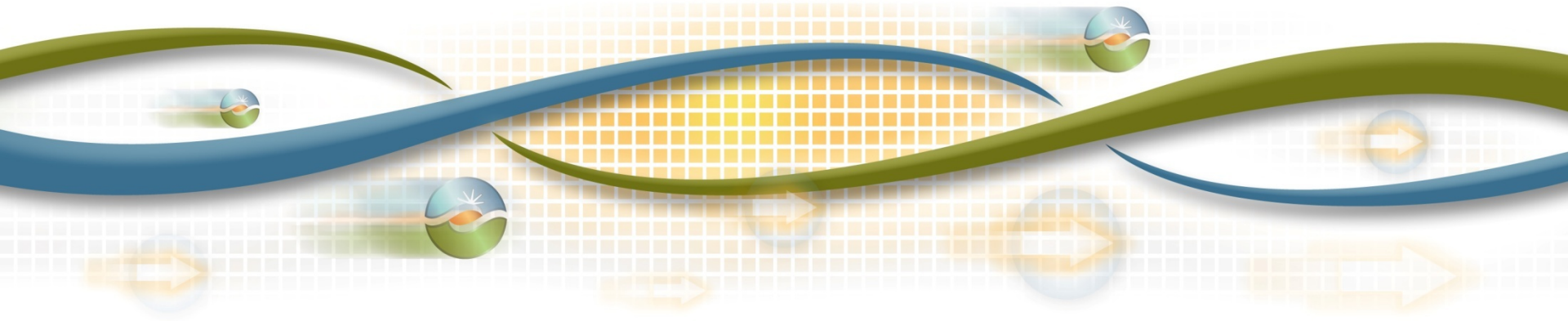
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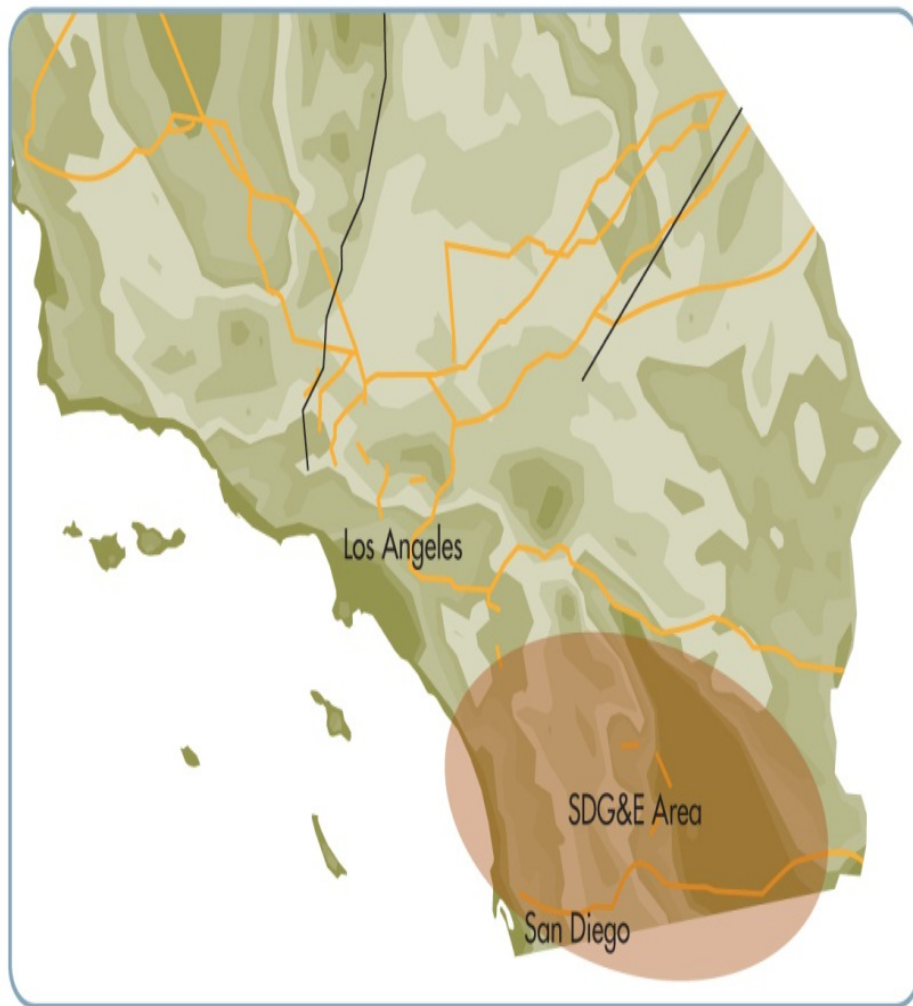
# San Diego Gas & Electric Bulk Transmission Preliminary Reliability Assessment Results

Frank Chen  
Senior Regional Transmission Engineer

2016-2017 Transmission Planning Process Stakeholder Meeting  
September 21-22, 2016



# SDG&E Bulk Transmission System



- Comprised of 500 kV and 230 kV transmission facilities

- Peak Loads

1-in-10 load forecast (MW)	2018	2021	2016
Gross Peak Load	5171	5235	5429
Low-Mid AAEE	-112	-197	-344
Behind-the-Meter Solar PV	-254	-330	-505
Net Peak Load	4805	4708	4580

- Areas resources under CAISO control

	2018	2021	2026
San Diego Metro	2845	2749	2712
East County	396	396	396
Ocotillo	265	265	265
Imperial Valley	2387	2387	2387
APS	925	925	925
total in MW	6818	6722	6685

- Collaborated with neighboring systems on study assumptions

# Reliability Assessment Summary

- The assessment identified:
  - ❖ 9 branches 500 kV overloaded for P1/P2/P3/P4/P6 outages
  - ❖ 14 branches 230 kV overloaded for P1/P2/P3/P4/P6/P7 outages
  - ❖ 1 branch 230 kV flow exceeded its protection relay setting
  - ❖ 1 high voltage concern for P1/P2/P4/P6 outages
  - ❖ 1 transient voltage concern for P6 outage

## Reliability Assessment Summary - Cont'd

Compared to assumptions in the last planning cycle:

- ❖ The 2026 load demand forecast was 812 MW lower than the 2025 level
- ❖ operational renewable resources increased by 472 MW in the greater Imperial area
- ❖ transmission lines relay settings were monitored

## Reliability Assessment Summary - Cont'd

### Compared to last planning cycle results:

- ❖ overload concern on the Imperial Valley-El Centro 230 kV tie line due to system changes
- ❖ previously identified overload on the Bay Blvd 230/69 kV banks disappeared
- ❖ Imperial Valley 500/230 kV banks overloads become less severe

# Potential Mitigation Solutions

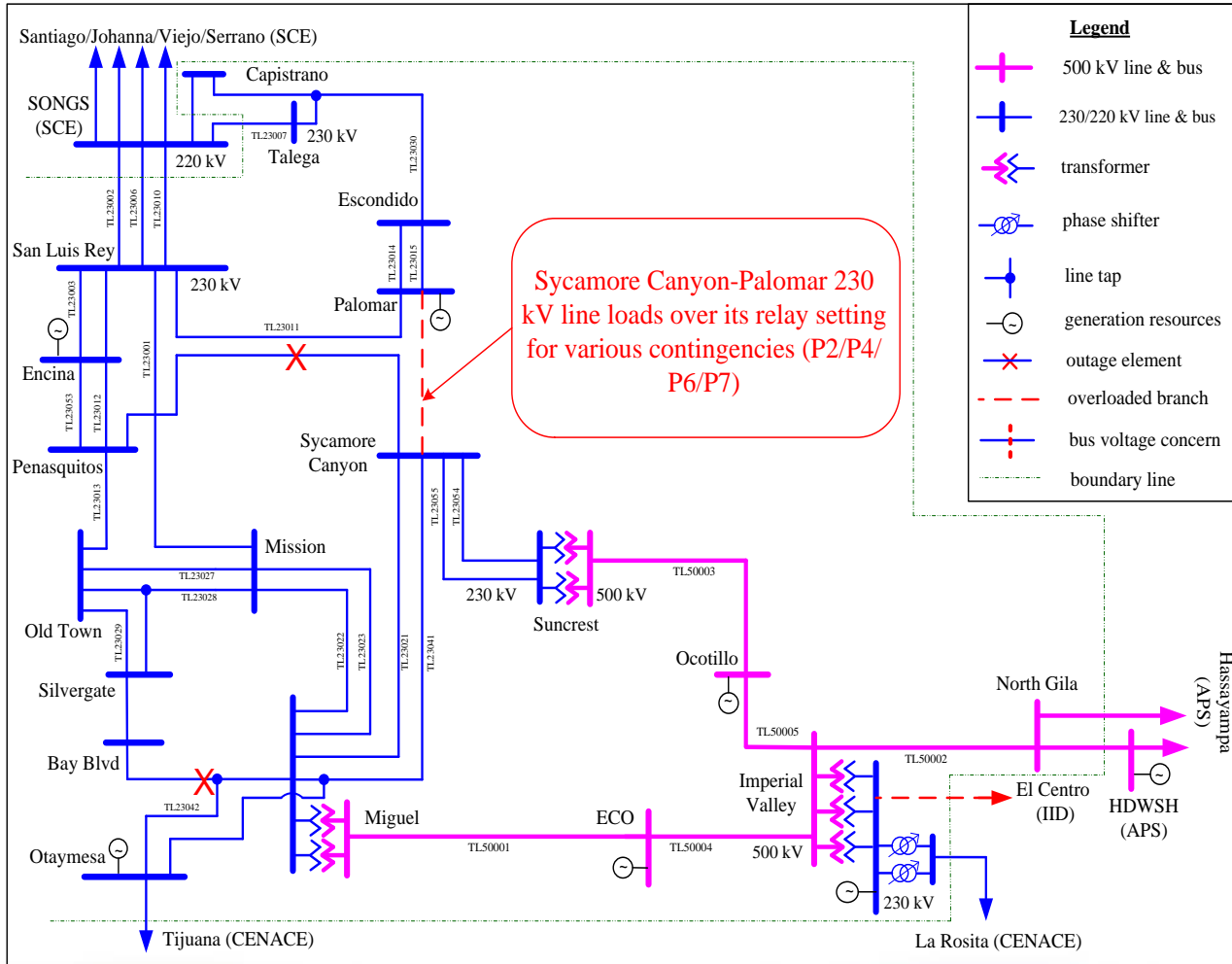
- ❖ preferred resources and energy storage
- ❖ ISO electricity market and operation procedure to manage the reliability of its controlled grid
- ❖ operational solutions or SPS modifications that are similar to what were recommended in previous planning cycle to manage the P1/P2/P3/P4/P6 thermal overload concerns in SWPL/SPL with the Imperial Valley phase shifting transformers in service



## Potential Mitigation Solutions - Cont'd

- ❖ reset protection directional relay for Sycamore-Palomar 230 kV line (TL23051)
- ❖ develop an operation procedure with thirty-minute ratings to address the Imperial Valley 500/230 kV banks overload concerns
- ❖ implement a coordinated control scheme between planned Suncrest SVC facility and the existing shunt capacitors/reactors in SDG&E's Suncrest 500/230 kV substation

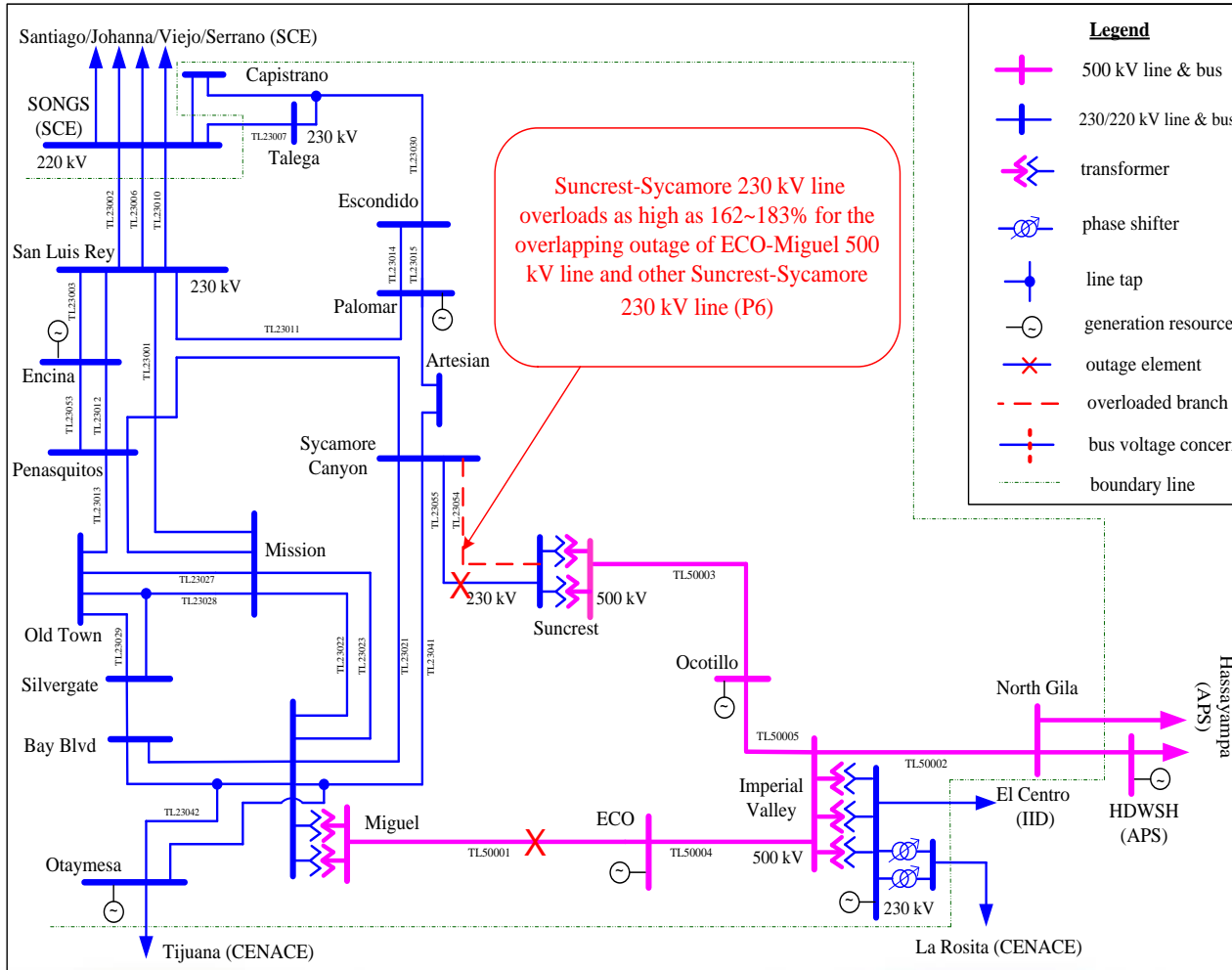
# Thermal Overload Concern – (1)



## Sycamore-Palomar 230 kV line (TL23051)

- flow exceeding its directional relay setting
  - ❖ for various contingencies (P2/P4/P6/P7)
- Potential Mitigation
  - ❖ reset TL23051 protection directional relay, which is currently lower than the line (TL23051) ampacity

# Thermal Overload Concern – (2)



## Sycamore-Suncrest 230 kV lines (TL23054/TL23055)

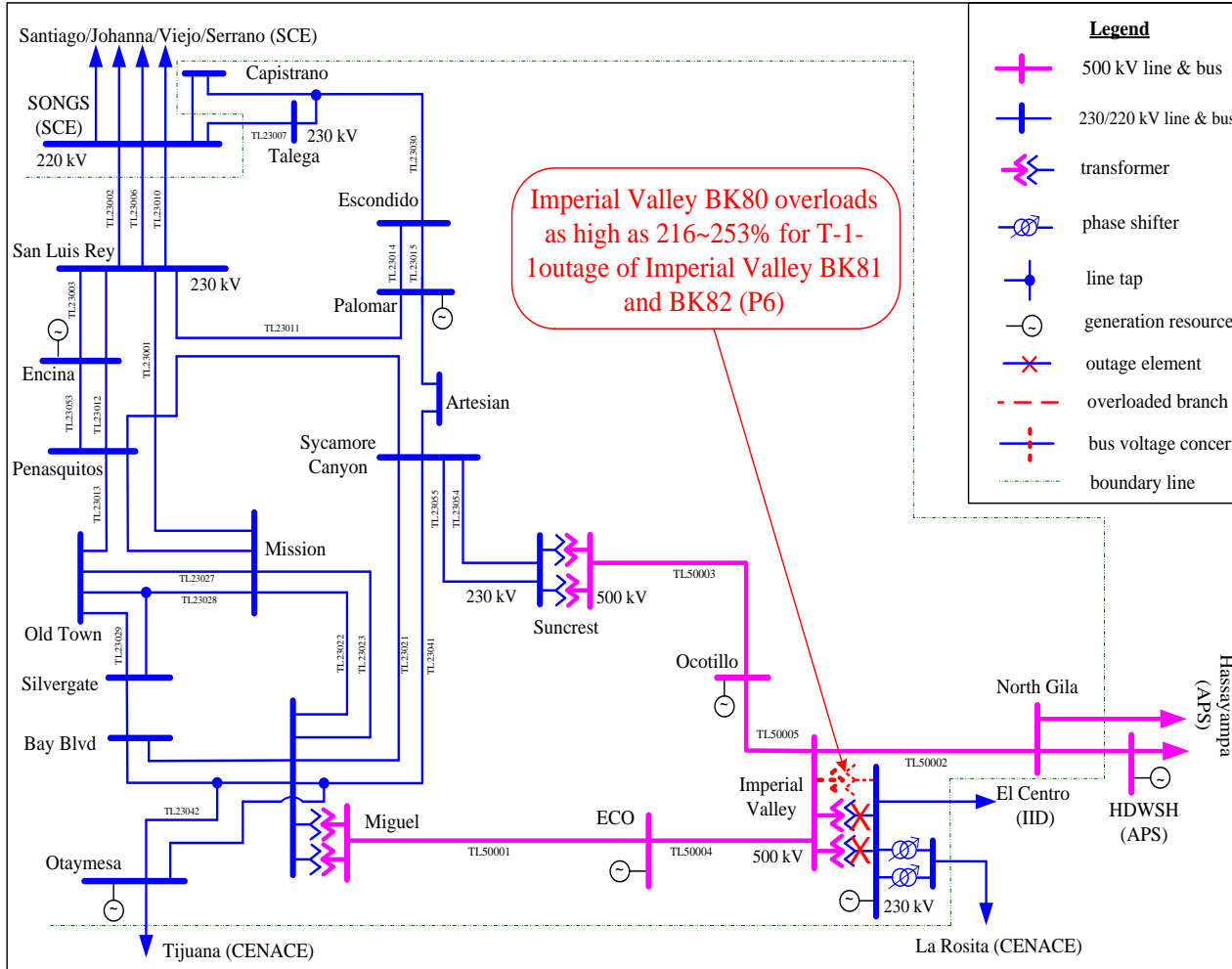
### Thermal Overload

- ❖ for the N-1-1 outage of ECO-Miguel 500 kV line and the other Suncrest-Sycamore 230 kV line

### Potential Mitigation

- ❖ new SPS to open the Ocotillo-Suncrest 500 kV line instead of TL23055 or TL23054 for the outage of TL23054 or TL23055

# Thermal Overload Concern – (3)



## IV Banks #80, #81, and #82

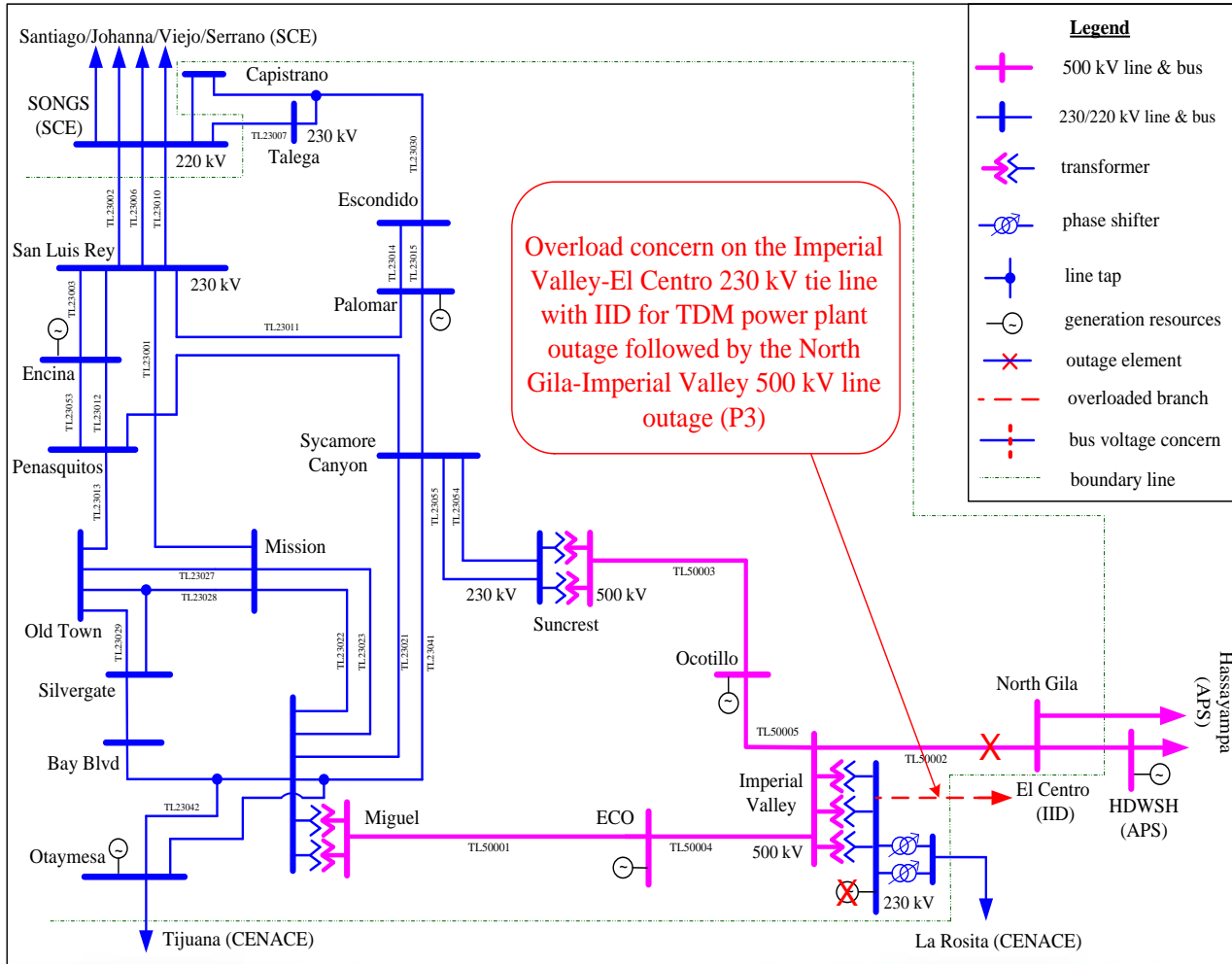
### Thermal Overload

- ❖ for CB #8022 internal fault/stuck breaker (P2/P4)
- ❖ for various P6 outages

### Potential Mitigations

- ❖ modify SPS dropping generation in IV
- ❖ develop an operation procedure with thirty-minute rating
- ❖ re-dispatch generation in the San Diego area as needed after the 1<sup>st</sup> outage

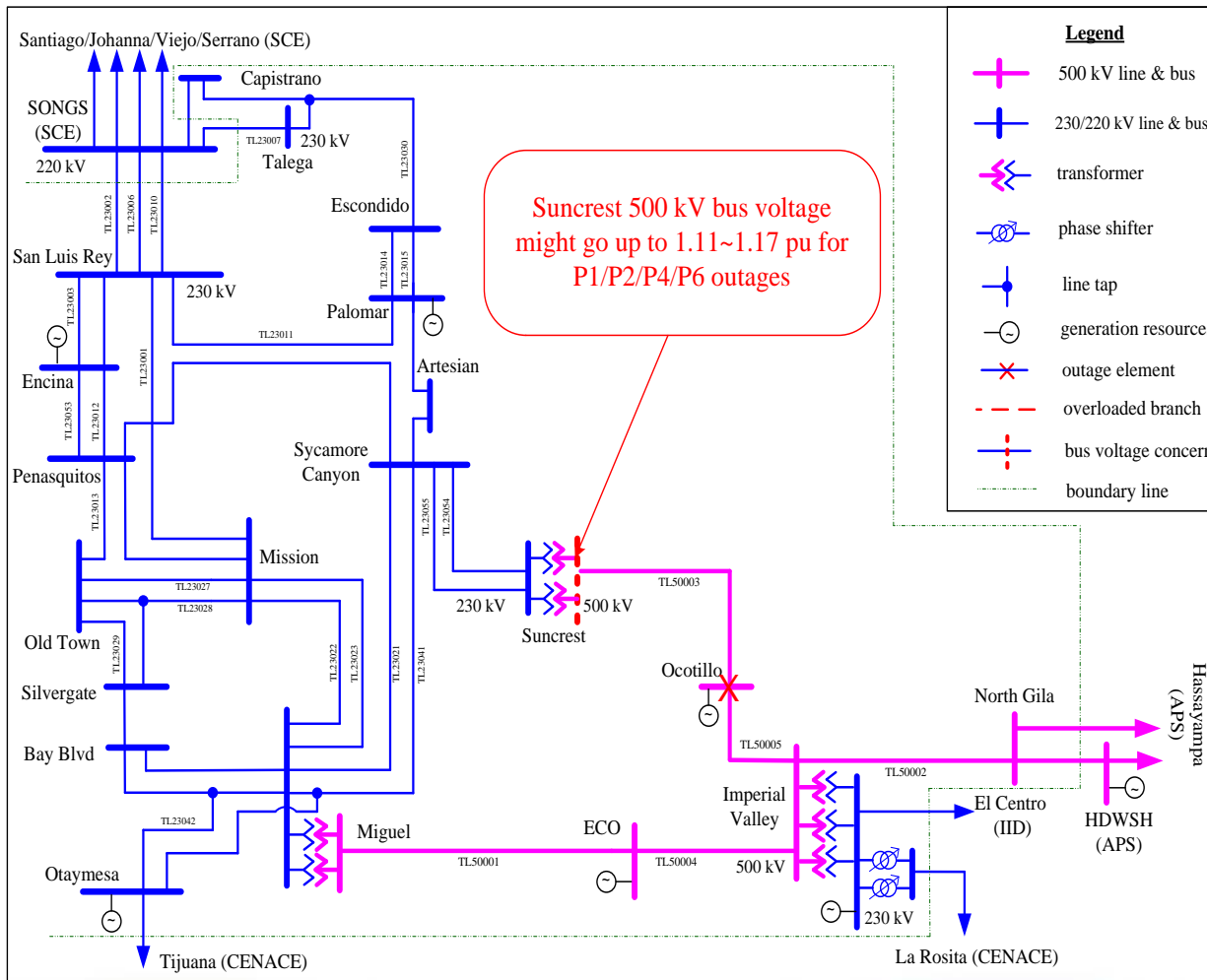
# Thermal Overload Concern – (4)



## Imperial Valley-EI Centro 230 kV tie line with IID

- Thermal Overload
  - ❖ for TDM power plant out of service followed by the North Gila-Imperial Valley 500 kV line outage (P3)
- Potential Mitigation
  - ❖ rely on the ISO electricity market and operation procedure to manage the reliability of its controlled transmission grid

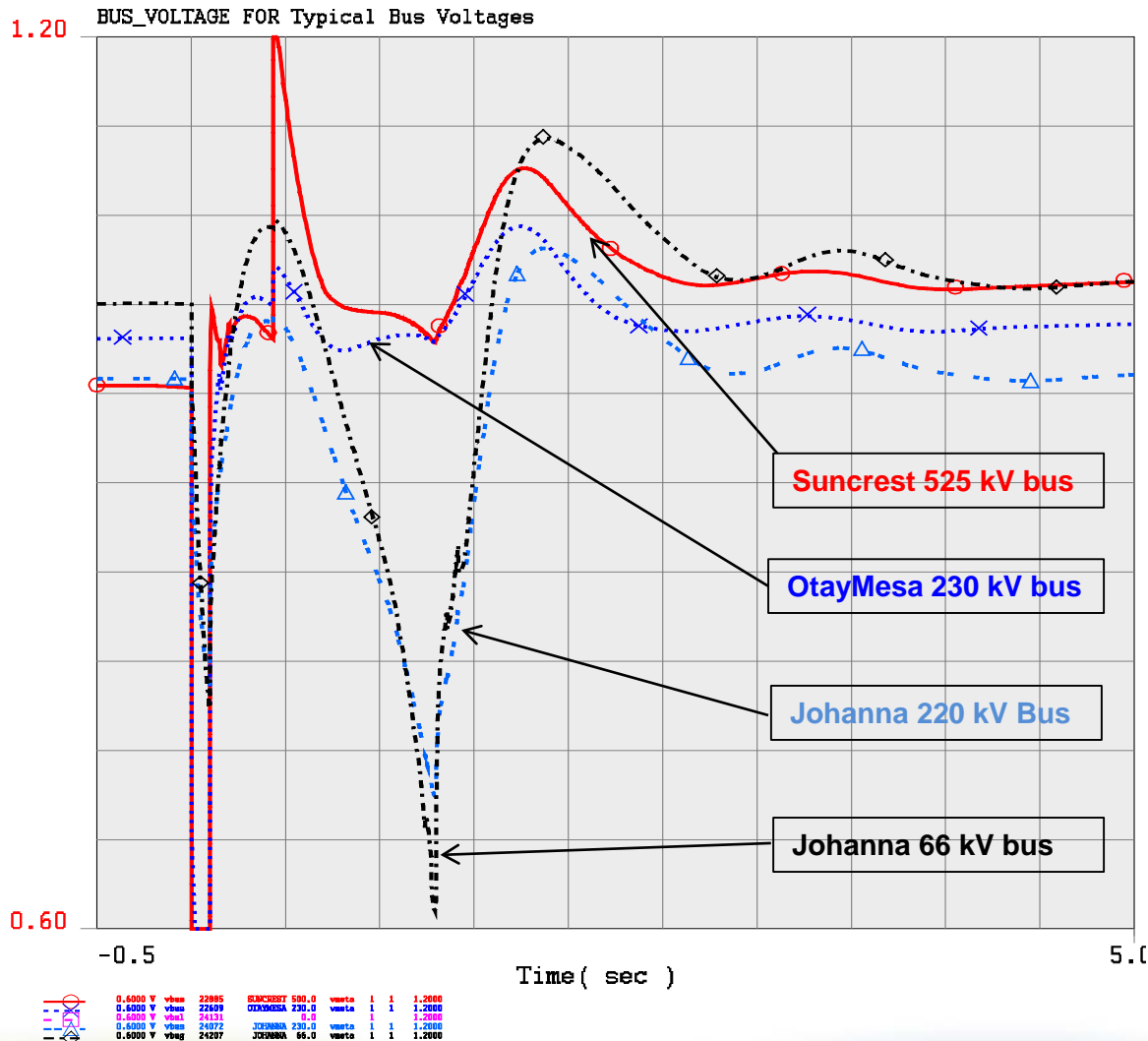
# High Voltage Concern



## Suncrest 500 kV Bus

- High voltage concern w/o coordination between planned Suncrest SVC facility and the existing shunt capacitors/reactors at Suncrest 500/230 kV substation for
  - Ocotillo CB #2T breaker fault or stuck breaker (P2/P4)
  - P1 and P6 outages
- Potential Mitigation
  - implement a coordinated control scheme between the SVC facility and the existing shunt capacitors/reactors

# Transient Instability Concern



## Transient Voltage Dip Concern

- Transient voltage dip exceeds the 30% of WECC performance criterion at ValleySC/Johanna /Santiago/Ellis/VillaPK/Barre/Mesa Cal/Padua/LwisAnm 69/115 kV buses in SCE for the ECO-Miguel 500 KV line out of service followed by a three-phase-to-ground fault on one of the Sycamore-Suncrest 230 kV lines (TL23054 or TL23055) outage
- Potential Mitigation
  - ❖ further evaluation



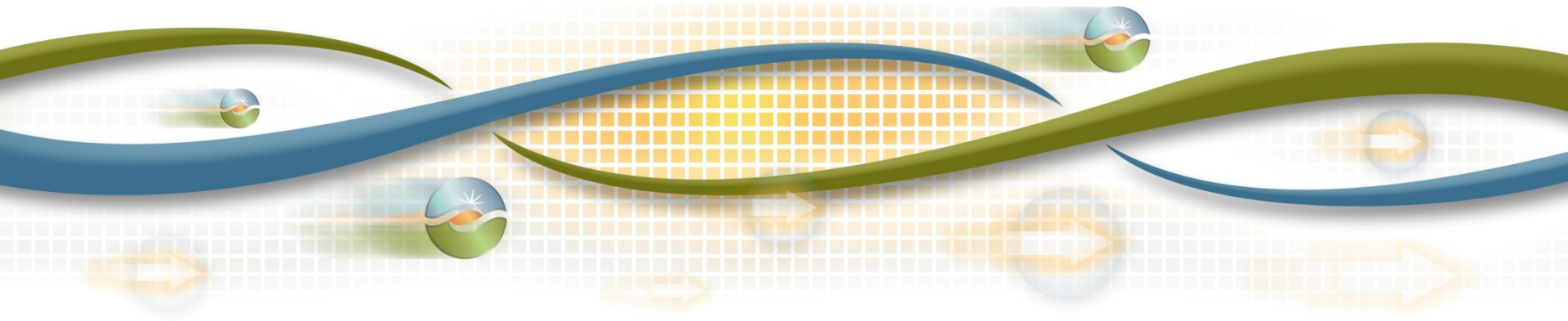
# San Diego Gas & Electric Area Sub-Transmission Preliminary Reliability Assessment Results

Charles Cheung

Senior Regional Transmission Engineer

2016-2017 Transmission Planning Process Stakeholder Meeting

September 21-22, 2016





# Study Scenarios

- 5 Baseline Scenarios:
  - 2018 Summer Peak
  - 2021 Summer Peak
  - 2026 Summer Peak
  - 2018 Spring Off-Peak
  - 2021 Spring Light Load
- 3 Sensitivity Scenarios:
  - 2018 Summer Peak with no Behind-the-meter PV
  - 2021 Summer Peak with Heavy Renewable & Minimum Gas Gen
  - 2026 Summer Peak with no Behind-the-meter PV

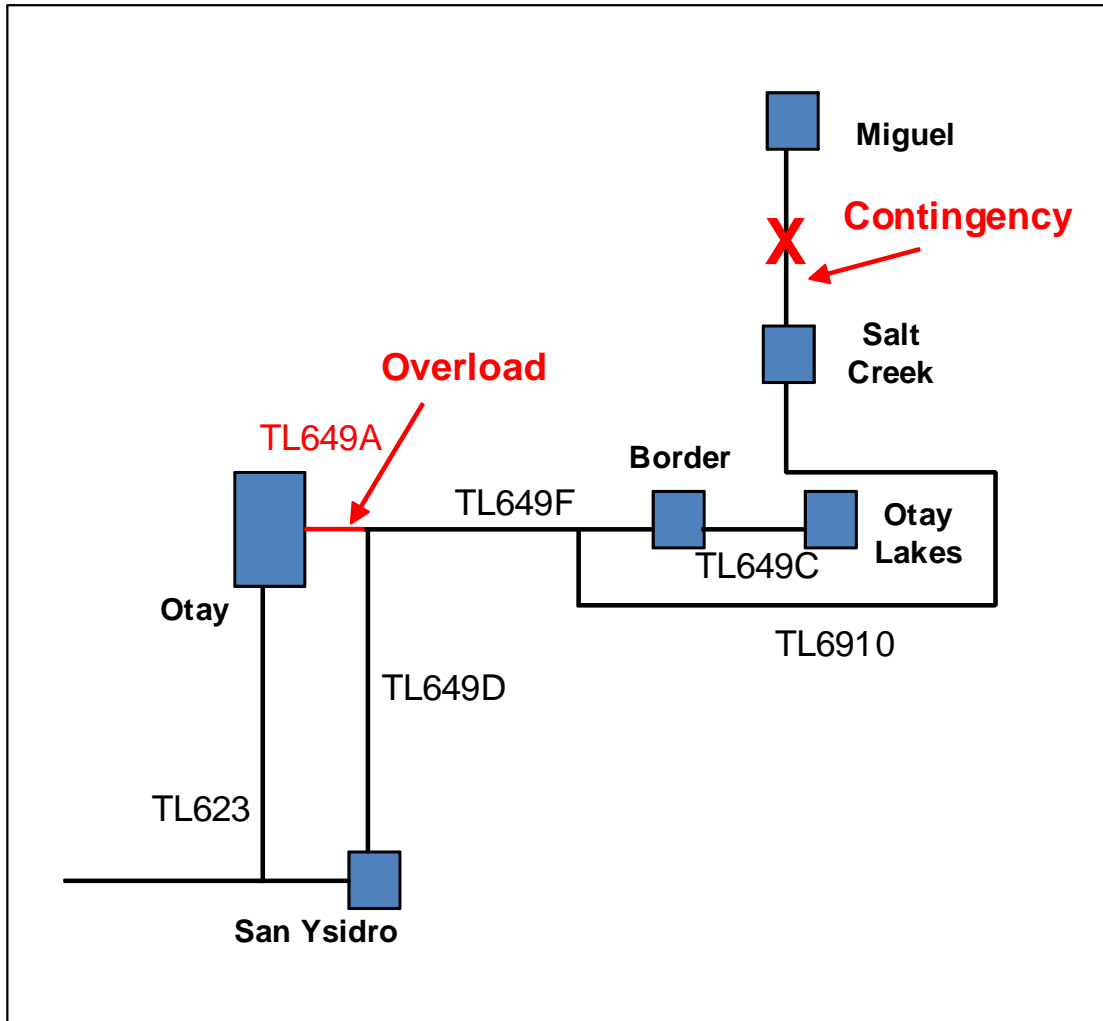
# SDG&E Area Sub-Transmission Assessment Summary

- The assessment identified:
  - Thermal overloads due to Category P1 – 1, P2 – 16, P2.1 – 6, P3 – 3, P4 – 1, P6 – 59 and P7 – 8
- Compared to last year results:
  - A few thermal violations in the 69 kV sub-transmission system due to multi-terminal line contingencies (P2.1)
  - Fewer thermal violations and voltage instability in the sub-transmission system due to reduction of load

# SDG&E Area Sub-Transmission Mitigation

- Potential Mitigation Solutions:
  - Network upgrades to address sub-transmission Category P6 issues
  - Operation Procedure, SPS

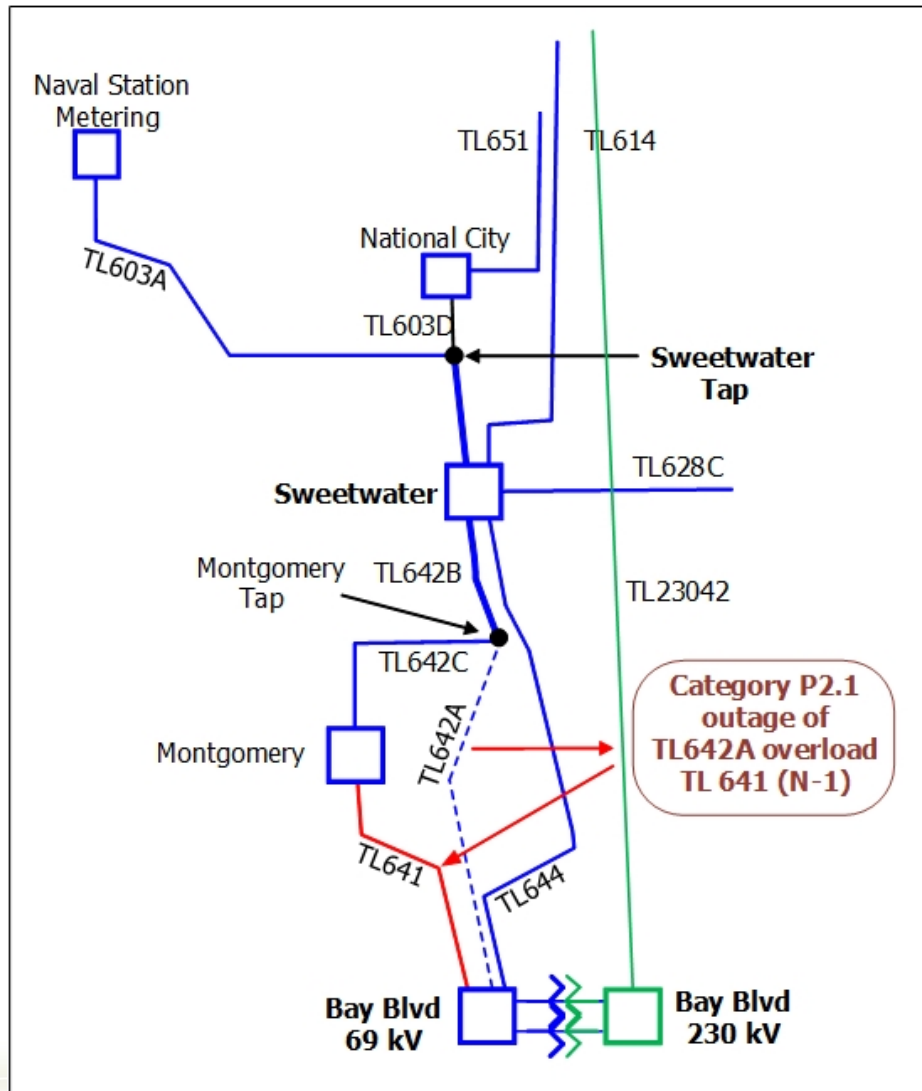
# Category P1 Thermal Violation



## Otay - Otay Tap 69 kV

- Thermal overload
  - ❖ TL649A overload for N-1 outage of TL6964 when generators near Border substations are out
- Potential Mitigation
  - ❖ Network Upgrade
  - ❖ Dispatch local generators

# Category P2.1 Thermal Violation



## Bay Blvd-Montgomery 69kV

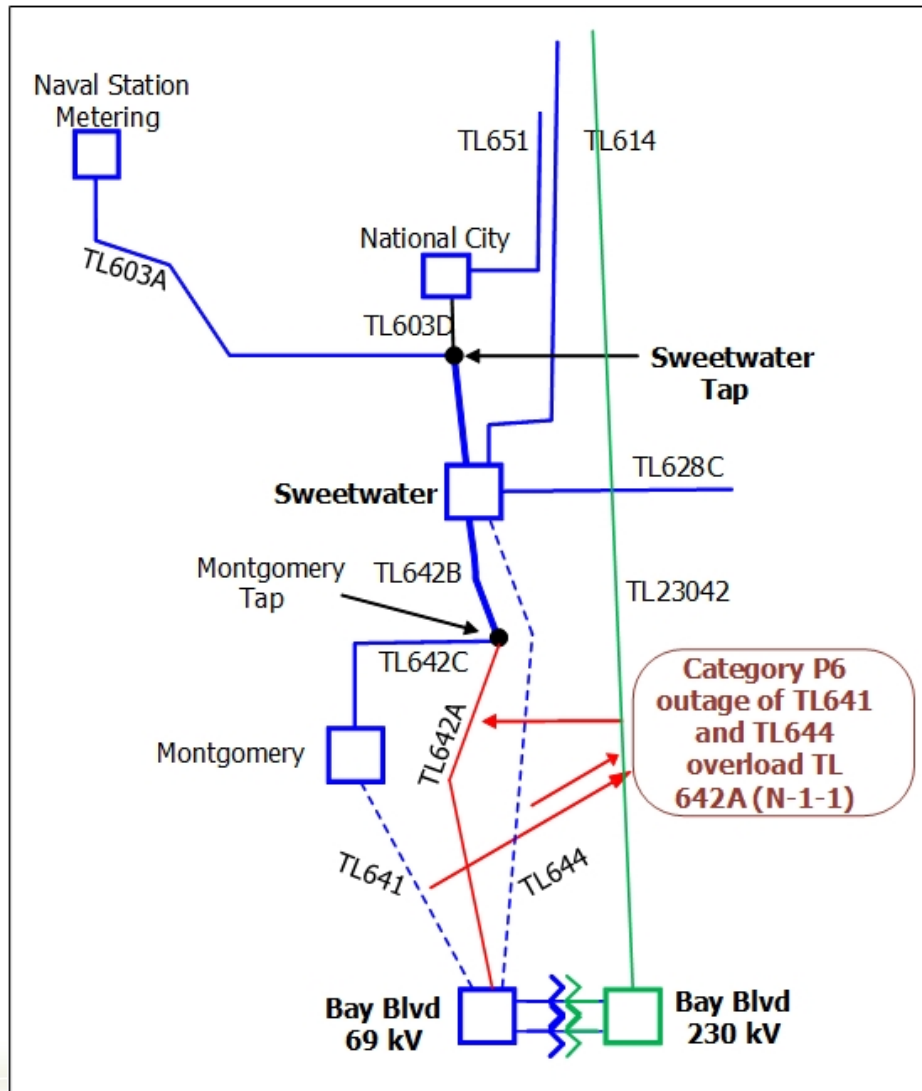
### ■ Potential Mitigation

- ❖ TL641 overload for N-1 outage of TL642A (2021SP and 2026SP) after Bay Blvd substation and transformers in service

### ■ Potential Mitigation

- ❖ SPS to trip Bay Blvd Transformer
- ❖ Re-conductor Bay Blvd-Montgomery 69 kV

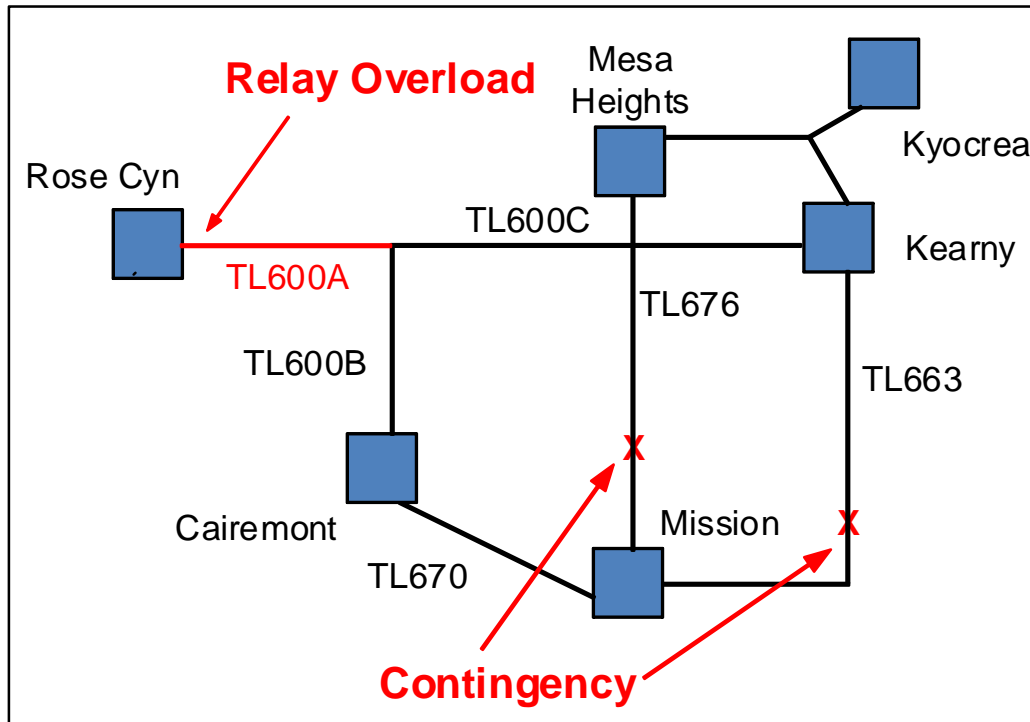
# Category P6 Thermal Violation



## Bay Blvd-Montgomery Tap 69kV

- Thermal overload
  - ❖ TL642A overload for N-1-1 outage of TL641 and TL644 (2021SP and 2026SP) after Bay Blvd substation and transformers in service
- Potential Mitigation
  - ❖ SPS to trip Bay Blvd Transformer
  - ❖ Re-conductor Bay Blvd-Montgomery Tap 69 kV

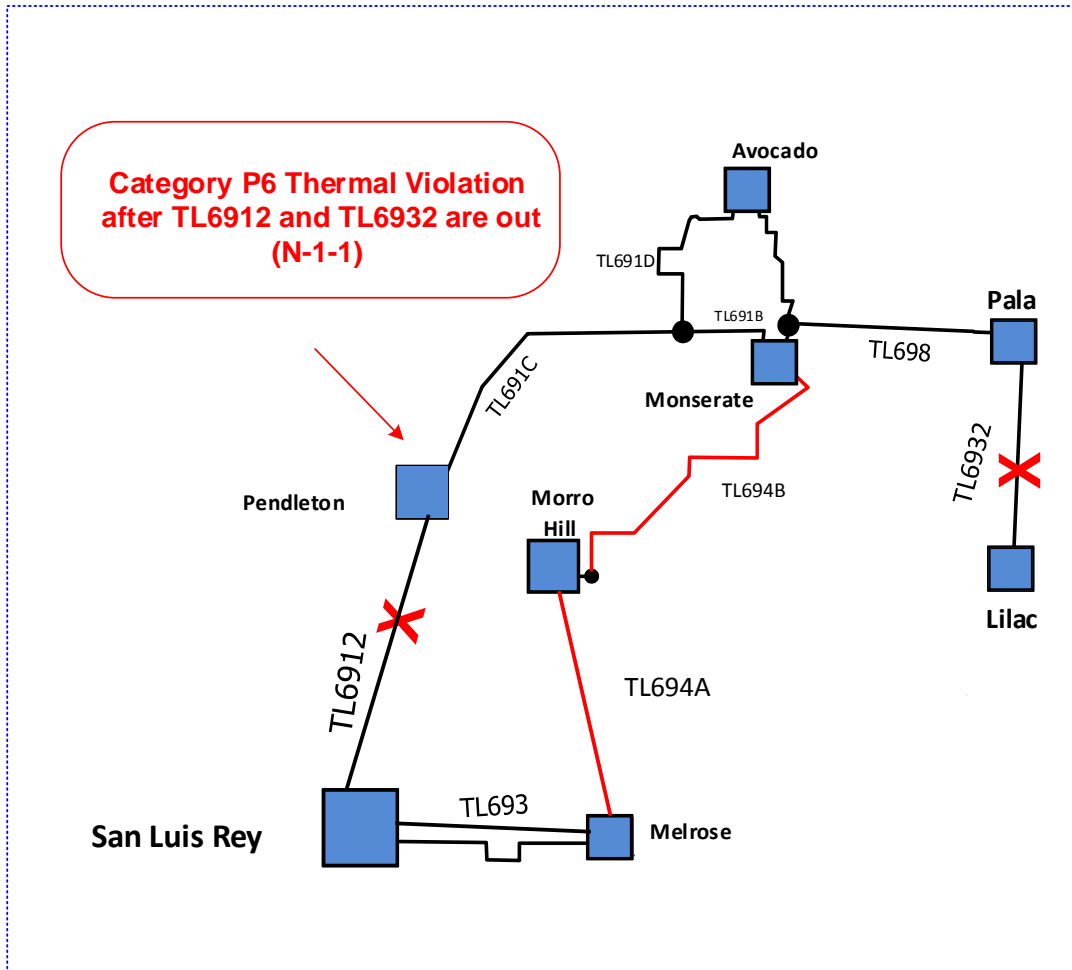
# Category P6 Thermal Violation



## Rose Cyn- Clairemont Tap 69 kV

- Thermal overload
  - ❖ TL642A overload for N-1-1 outage of TL663 and TL676 (2026SP)
- Potential Mitigation
  - ❖ Upgrade Relay Rating on Rose Cyn end

# Category P6 Thermal Violation



## Melrose-Morro Hill-Monserate 69 kV

- Thermal overload
  - ❖ TL694A and TL694B overload for N-1-1 outage of TL6912 and TL6932 when Pala generators are out
- Potential Mitigation
  - ❖ Network Upgrade
  - ❖ Dispatch Pala generators