

PG&E's 2024 Request Window Proposals

CAISO 2024-2025 Transmission Planning Process

September 24, 2024



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2024-2025 TPP Highlights

- **Fifteen Reliability Driven Projects Submitted to CAISO**
 - 13 projects seeking approval
 - 2 projects in conceptual stage seeking approval in this cycle
- **Key Drivers for the Projects:**
 - **Greater Bay Area (GBA) Load Growth:** 30% by 2034 , 50% by 2039 (forecasted peak load is 10.7 GW by 2034 and 12.3 GW by 2039)
 - **Central Valley Load Growth:** 22% by 2034, 44% by 2039
- 9 out of the 15 projects are in Greater Bay Area(GBA)
- For the proposed reconductoring projects, PG&E will conduct a thorough evaluation of the feasibility and cost-effectiveness of utilizing advanced conductors. The implementation of advanced conductors will be prioritized if they prove to be both technically feasible and economically advantageous by deferring or eliminating the need for costly infrastructure upgrades.



Transmission Project Proposals Overview

Fifteen Reliability Driven Projects Submitted to CAISO:

Greater Fresno Area

- West Fresno Voltage Support

Los Padres Area

- San Miguel New 70 kV Line

Sierra Area

- Gold Hill-El Dorado Reinforcement

Sacramento Area

- Cortina #3 60 kV Line Reconductoring
- Vaca Dixon-Davis Area Reinforcement

North Coast

- Konocti-Eagle Rock 60 kV Line Reconductoring



Transmission Project Proposals Overview

Greater Bay Area

- Pittsburg-Kirker 115kV Line Section Limiting Elements Upgrade
- Sobrante 230kV Bus Upgrade
- Moraga 230/115kV Transformer Bank Addition
- North Oakland Reinforcement
- South Oakland Reinforcement (Conceptual)
- Metcalf 500/230 kV Transformer Addition
- Jefferson-Stanford 60 kV Menlo to SLAC Tap Recabling
- San Mateo 230/115kV Transformer Bank Addition
- South Bay Area Reinforcement (Conceptual)

WEST FRESNO 115 KV VOLTAGE SUPPORT PROJECT

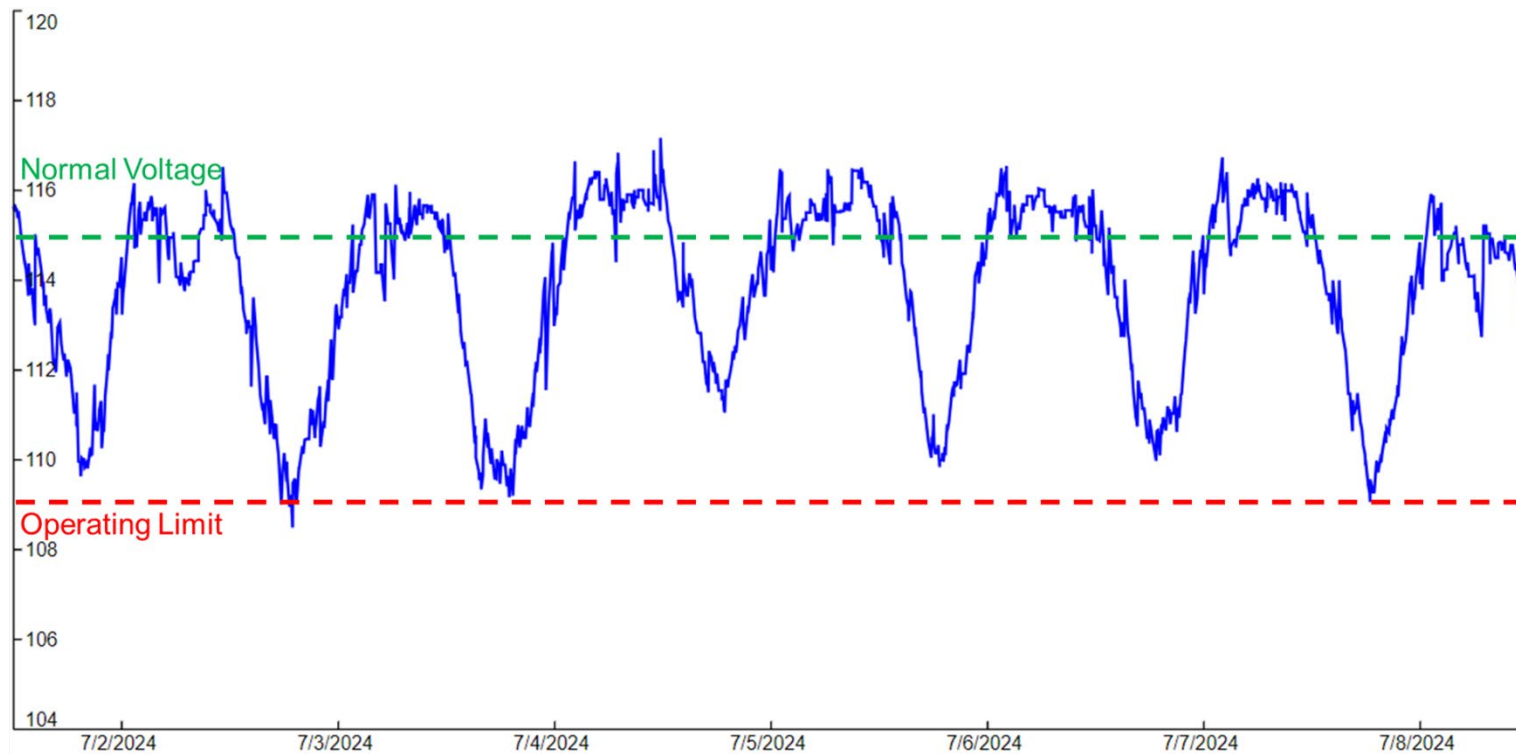


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Area Background

- West Fresno Substation is in Fresno County serving over 17,000 customers.
- PG&E Transmission Operation observed low voltage issues at West Fresno during summer peak conditions.
- PG&E Distribution Planning anticipates continuous load growth in the upcoming years.



West Fresno 115 kV Voltage Measurements



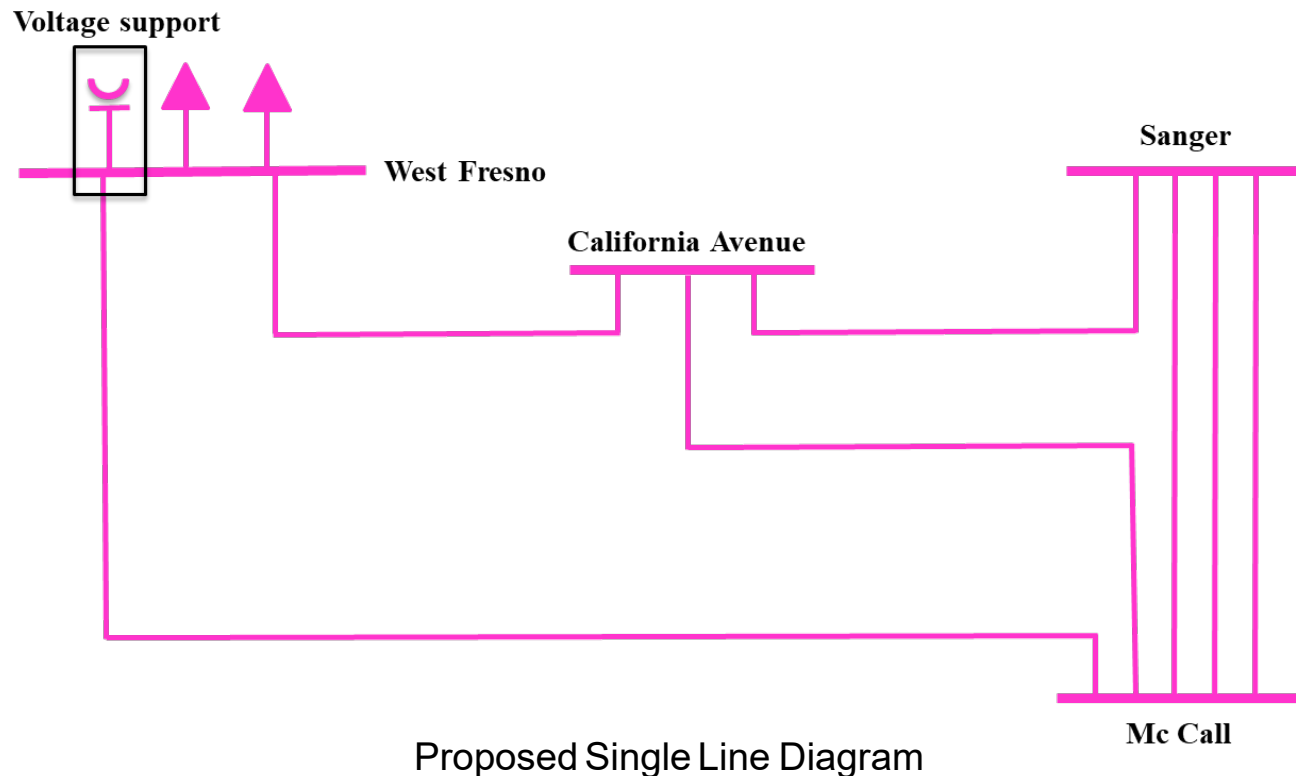
Assessment Results

- **Contingency Description:**
 - P0: Normal Condition
- **Power Flow Results:**

Substation	Pre-Project Voltage (p.u.)			Post-Project Voltage (p.u.)	Contingency	
	2026	2029	2034	2034	Category	Contingency Name
West Fresno	0.946	0.944	0.920	0.959	P0	Normal Condition

* As described in the previous slide the real-time voltages could be lower

- **Project Objectives:** Mitigate the P0 low voltage issue at West Fresno 115 kV Substation
- **Preferred Scope**
 - Install 75 MVar voltage support at West Fresno Substation
 - Expand West Fresno 115 kV bus as needed for voltage support installation



- **Proposed In-Service Date**
May 2031 or earlier
- **Estimated Cost**
\$30M - \$60M*
- **Other Alternatives Considered**
 - Alternative 1: Status Quo
is not chosen because it does not mitigate the NERC TPL Category P0 violations.
 - Alternative 2: Energy Storage
is not as cost-effective.

*AACE Level 5 quality estimates includes a +100% contingency.

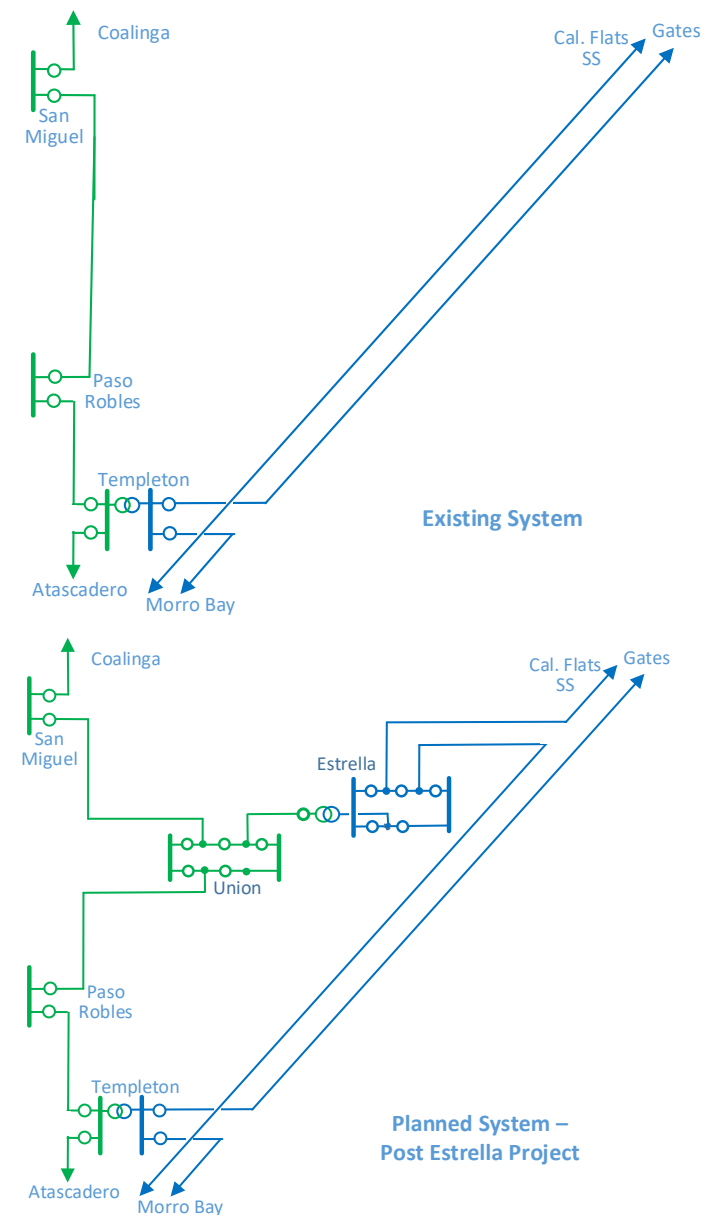
SAN MIGUEL SUBSTATION 70 KV NEW LINE PROJECT



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Area Background

- San Miguel Substation is supplied by two 70 kV lines, one from Paso Robles and one from Coalinga Substation via a 38-mile line; Loss of the line from Paso Robles (P1-2) will leave San Miguel supplied from Coalinga and result in low voltage violations.
- The planned Estrella Project in the area will not address the above violations.
- This area is expected to experience significantly higher load growth in the planning horizon. PG&E Distribution Planning has received multiple load requests in this area which include EV charging, and agriculture loads.
- As Paso Robles substation approaches its full capacity, future growth are expected to be supplied by San Miguel and Templeton (230 kV connected).





Assessment Results

- **Contingency Description:**
 - P1-2: San Miguel – Paso Robles 70 KV

- **Power Flow Results:**

Substation	Pre-Project Voltage (p.u.)			Post-Project Voltage (p.u.)	Contingency	
	2026	2029	2034	2034	Category	Contingency Name
San Miguel	0.796	0.820	0.726	0.966	P1-2	San Miguel-Paso Robles Line (2026, 2029) San Miguel-Union Line (2034)

- **Project Objectives:** Address NERC TPL-001-5 P1 thermal violation

- **Preferred Scope**

- Build approximately 3.4 miles of new 70 kV line section from San Miguel to a new tap connected to where the existing 70 kV line will be opened to loop into the future Union. A minimum summer emergency rating of 1048 Amps is required for the new line section.
- Terminate the new line section at San Miguel substation by adding a new position.

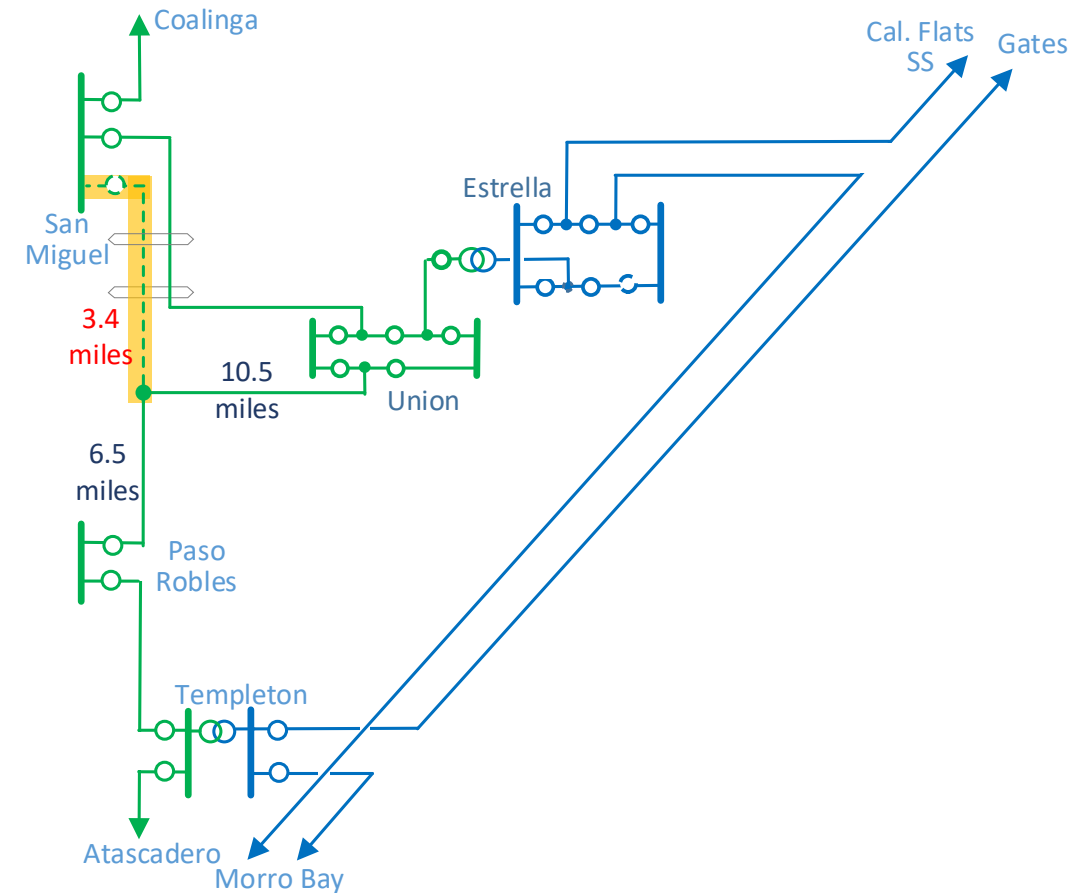
- **Proposed In-Service Date**

May 2032 or earlier

- **Estimated Cost**

\$15.5M - \$ 30M*

*AACE Level 5 quality estimates includes a +100% contingency.



Proposed Project Single Line Diagram

Alternative 1: Voltage Support at San Miguel

This alternative is not recommended because var support only provides limited amount of additional load serving capacity at San Miguel, which will not be sufficient to serve the projected load growth in long-term at San Miguel substation.

Alternative 2: Build a new 70 kV line to San Miguel from the Loop-in point on Union-Paso Robles; retire Coalinga-San Miguel and add a 2nd 230-70 kV transformer at Estrella by 2034.

This alternative builds upon the proposed project to eliminate the reliance on the Coalinga-San Miguel line which is a weak source for San Miguel. Coalinga-San Miguel 70 kV line crosses the High Fire Threat District (HFTD) area, and its retirement would reduce fire risks and maintenance costs on a long 38-mile line. PG&E will continue to monitor the load growth in this area to confirm the need and benefits of this alternative.

Alternative 3: Build a new 70 kV line from San Miguel to Union, or a new line from San Miguel to Paso Robles.

This alternative is not recommended due to longer length of the new line which results in higher cost.

GOLD HILL-EL DORADO REINFORCEMENT PROJECT



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Area Background

- Gold Hill Substation is a critical source of power for the El Dorado County
- The major loads include Shingle Springs, Diamond Springs, Placerville, and Apple Hill Substations. The total number of customers served from these substations is around 45,000.
- This corridor consists of Missouri Flat – Gold Hill #1, El Dorado – Missouri Flat #1 and Missouri Flat – Gold Hill #2, El Dorado – Missouri Flat #2 115 kV lines.
- About 8.4 miles out of 14.4 miles consist of copper conductor with constrained capacity.

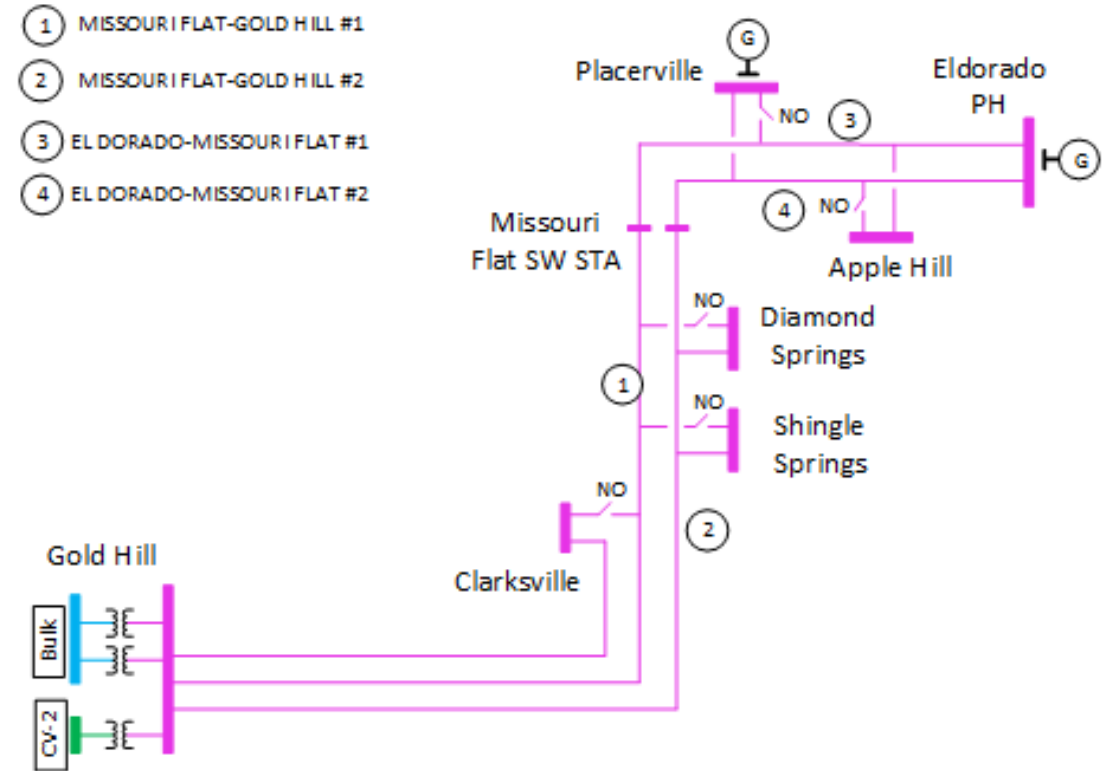


Figure: Existing Single Line Diagram



Assessment Results

- **Contingency Description:**
 - **P2-1:** Opening of the section (Gold Hill-Shingle Springs) on Missouri Flat – Gold Hill #2 115 kV line without a fault
- **Power Flow Results*:**

CVLY Peak		Pre-Project			Post-Project	Contingency	
Facility	Rating (SE)	2026	2029	2034	2034	Category	Contingency Name
EL DORADO-MISSOURI FLAT #2	377 A	219.1%	222.3%	Diverge	<70%	P2-1	MISSOURI FLAT-GOLD HILL #2 115KV (GOLDHILL-SHPRING2)

Substation	Pre-Project Voltage (p.u.)			Post-Project Voltage (p.u.)	Contingency	
	2026	2029	2034	2034	Category	Contingency Name
Shingle Springs	0.801 (23.1% dV)	0.797 (23.5% dV)	Diverge	>0.904	P2-1	MISSOURI FLAT-GOLD HILL #2 115KV (GOLDHILL-SHPRING2)

* As an interim mitigation, Operations can perform switching such as transferring Shingle Springs to Missouri Flat – Gold Hill #1 115 kV line which would greatly relieve the overloading on the El Dorado-Missouri Flat #2 115 kV line.

- **Project Objectives:** Resolve thermal overload and voltage issues under P2-1 contingency
- **Preferred Scope**
 - Serve Diamond Springs 115 kV Substation from MISSOURI FLAT-GOLD HILL #1 115 kV line
 - Convert Shingle Springs Substation 115 kV bus to BAAH
 - Reconductor ~8.8 circuit miles of the El Dorado – Missouri Flat #2 115 kV Line to achieve minimum 577 Amps of summer emergency rating
- **Proposed In-Service Date**
May 2032 or earlier
- **Estimated Cost**
\$63.5 M-\$127 M*

*ACE Level 5 quality estimates includes a +100% contingency

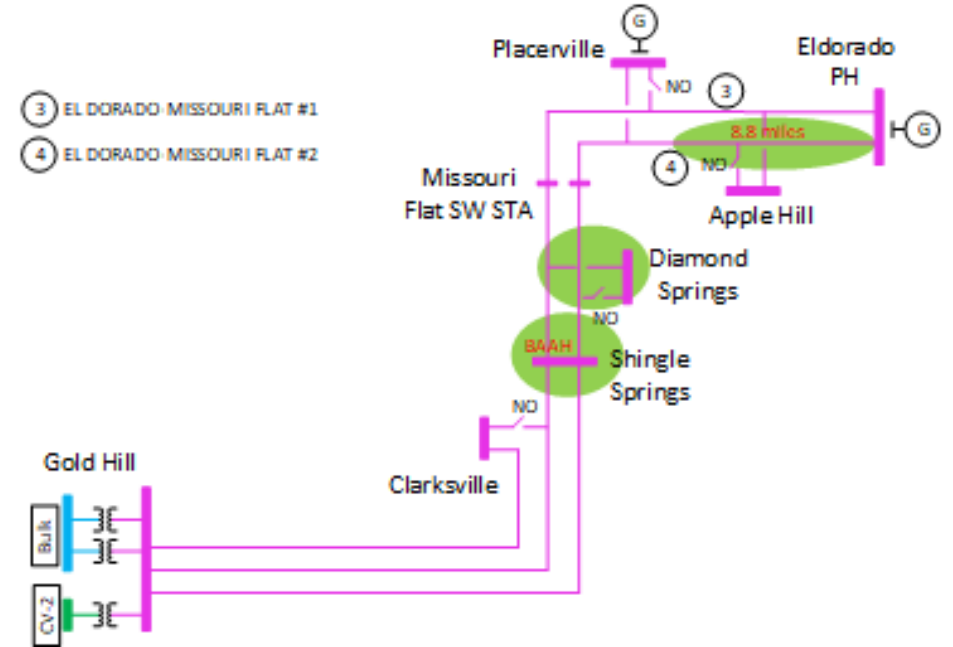


Figure: Proposed Single Line Diagram



Proposed Project (cont.)

- **Other Alternatives Considered**

- Alternative 1: Convert Missouri Flat to Ring Bus and reconductor MISSOURI FLAT-GOLD HILL #2 115 kV line.

Not recommended. MISSOURI FLAT-GOLD HILL #2 115 kV line is in relatively good condition.

- Alternative 2: Serving Shingle Spring and Apple Hill Substations on #2 line and Placerville and Diamond Springs Substations on #1 line; Reconductor EL DORADO-MISSOURI FLAT #1 & #2 ; and install shunt capacitor (30 Mvar) both at Shingle Spring and Diamond Spring Substations

Not recommended. The cost is higher than proposed project.

- Alternative 3: Install 40 MWx2 (30 MW plus 10 MW margin) Battery at Shingle Springs substation and 50 MW x2 (40 MW plus 10 MW margin) at Diamond Springs Substation and capacitor is needed at Shingle Spring and Diamond Springs substations.

Not recommended. Installing battery and shunt capacitor will trigger bus upgrades at both Shingle Springs and Diamond Springs Substations. The cost for this alternative will be comparable to the proposed project without having the benefit of offering higher load serving capability for this pocket for the longer term.

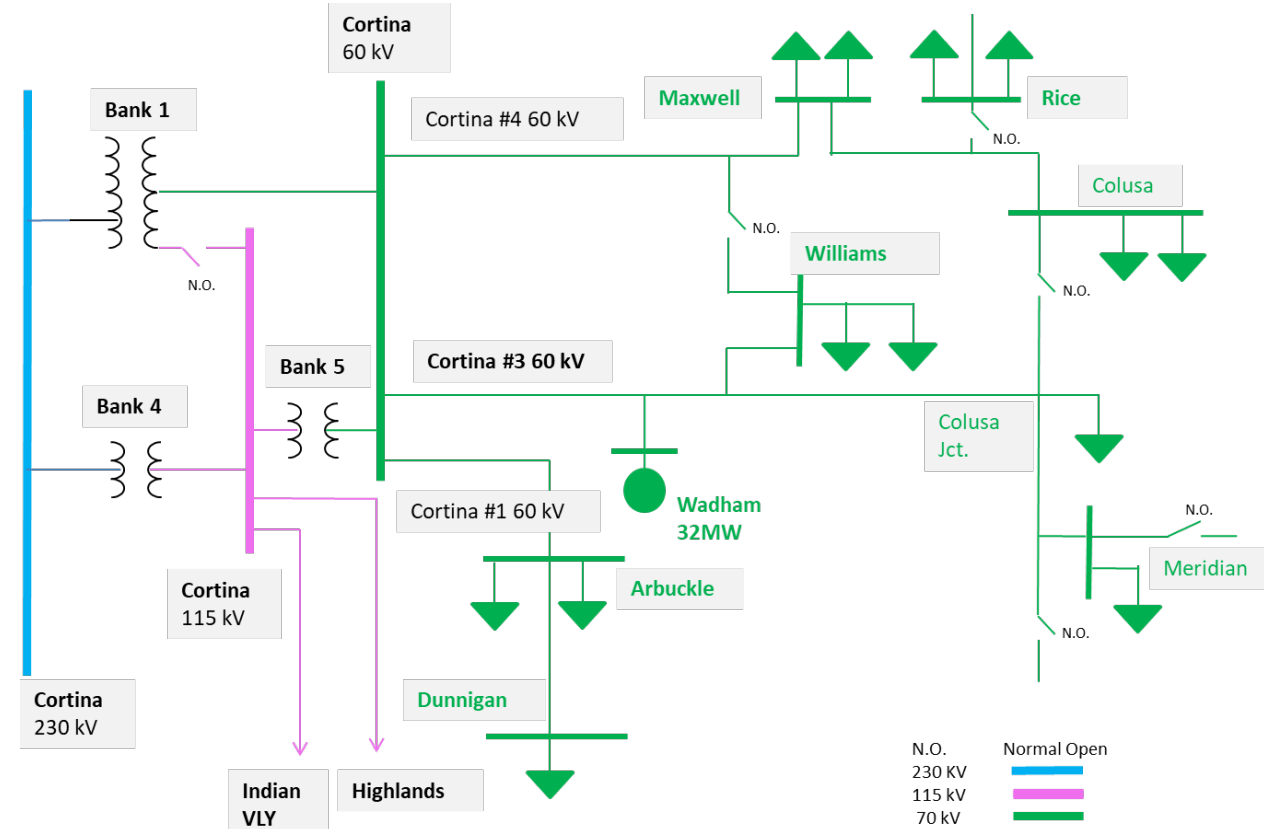
CORTINA #3 60 KV RECONDUCTORING PROJECT



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Area Background

- Cortina 60 kV pocket is located in Colusa County and serves about 14,800 customers.
- Within the pocket, Cortina #3 60 kV Line serves Williams, Colusa and Meridian substations in the Sacramento Area. The Williams Substation is currently radially served from the Cortina #3 60 kV line while the source from Cortina #4 60 kV line is normally open.
- The load at Williams substation is projected to increase significantly. One major portion of the load growth is due to the planned EV charging distribution load interconnection project of 20 MW that will be connected to Williams 60 kV substation.



Existing Single Line Diagram



Assessment Results

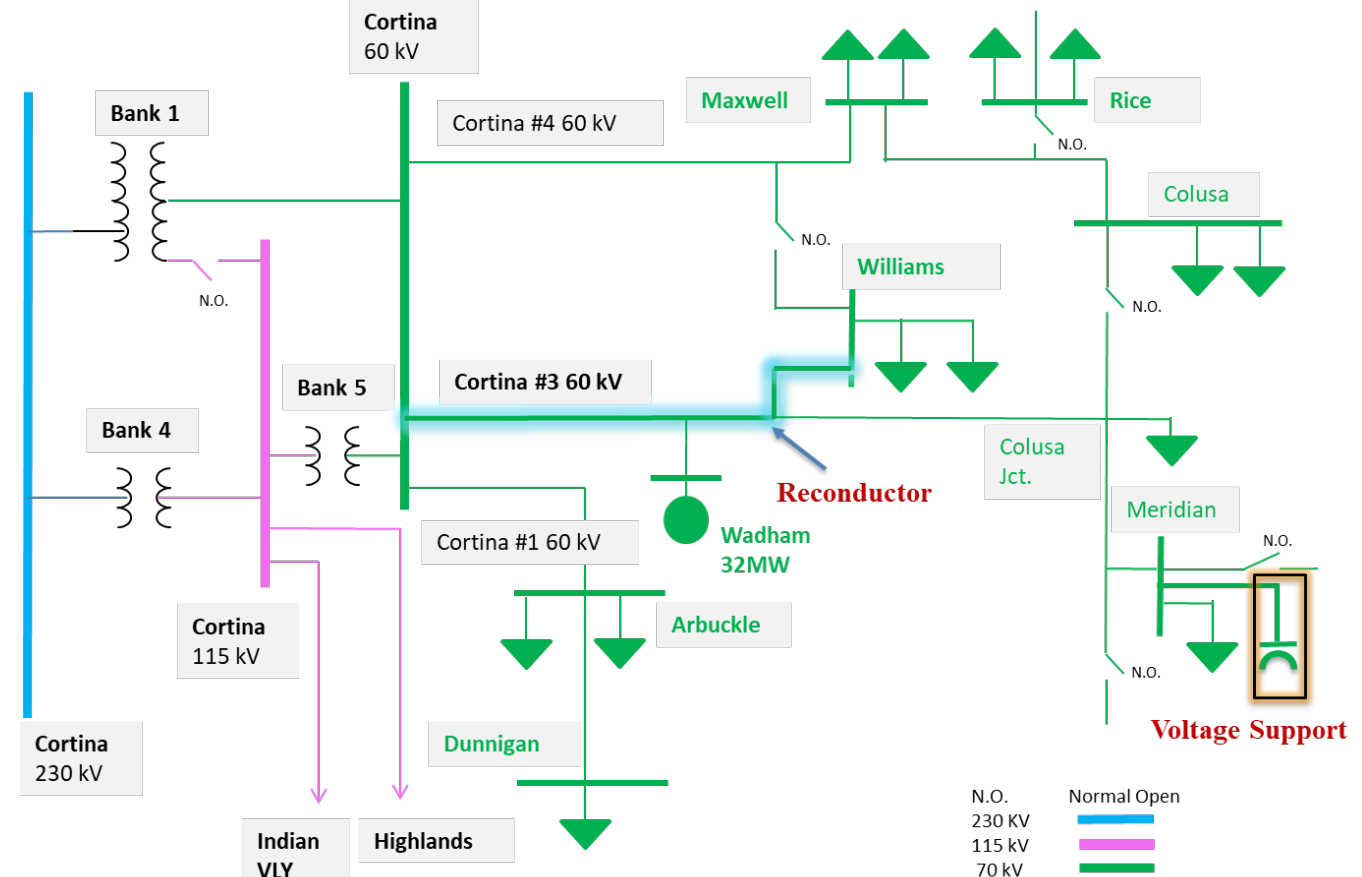
- **Contingency Description:**
 - P0, P1 Category Events
- **Power Flow and Voltage Results:**

Monitored		Pre-Project			Post-Project	Contingency	
Facility	Rating (MVA)	2026	2029	2034	2034	Category	Contingency Name
Cortina #3 60 kV Line (WADHAM JCT-WESCOT)	45 (SN)	173.0%*	177.4%	164.8%	60.7%	P0	Basecase
Cortina #3 60 kV Line (WESCOT-WILLIAMS)	30 (SN)	161.6%	164.8%	162.5%	41.7%	P0	Basecase
Cortina #3 60 kV Line (Cortina-Wadham Jct)	65 (SN)	103.7%	106.7%	100.8%	65.8%	P1	WADHAM-WADHAM JCT

Sacramento Summer Peak		Pre-Project (p.u.)			Post-Project (p.u.)	Contingency	
Facility	Rating (kV)	2026	2029	2034	2034	Category	Contingency Name
Colusa	60	0.909	0.891	0.915	0.967	P0	Basecase
Meridian	60	0.910	0.893	0.913	0.994	P0	Basecase
Colusa	60	0.898	0.872	0.899	0.950	P1	WADHAM-WADHAM JCT
Meridian	60	0.899	0.874	0.896	0.976	P1	WADHAM-WADHAM JCT

*The 20 MW distribution load interconnection project will have a gradual increase in near-term, reaching full capacity by 2030. Therefore, the potential overloads are expected to be lower in 2026 and 2029.

- **Project Objectives:** Address NERC TPL-001-5 P0, P1 thermal and voltage violations and increase load serving capability in Cortina 60 kV pocket.
- **Preferred Scope**
 - Reconductor ~ 9.0 miles between the Cortina Substation and Williams Substation on the Cortina #3 60 kV to achieve minimum conductor rating of 1014 AMPS for summer normal rating and 1127 AMPS for summer emergency rating.
 - Install a 15 MVAR shunt capacitor at Meridian 60 kV substation.



Proposed Single Line Diagram

- **Proposed In-Service Date:**
 - May 2031 or earlier
- **Estimated Cost :**
 - \$27.8M - \$55.5M *
- **Other Alternatives Considered:**
 - Alternative 1: Energy Storage

This alternative is not recommended because the energy storage charging capability is limited by the existing line capacity and will be further limited by the future load increase at Williams Substation.

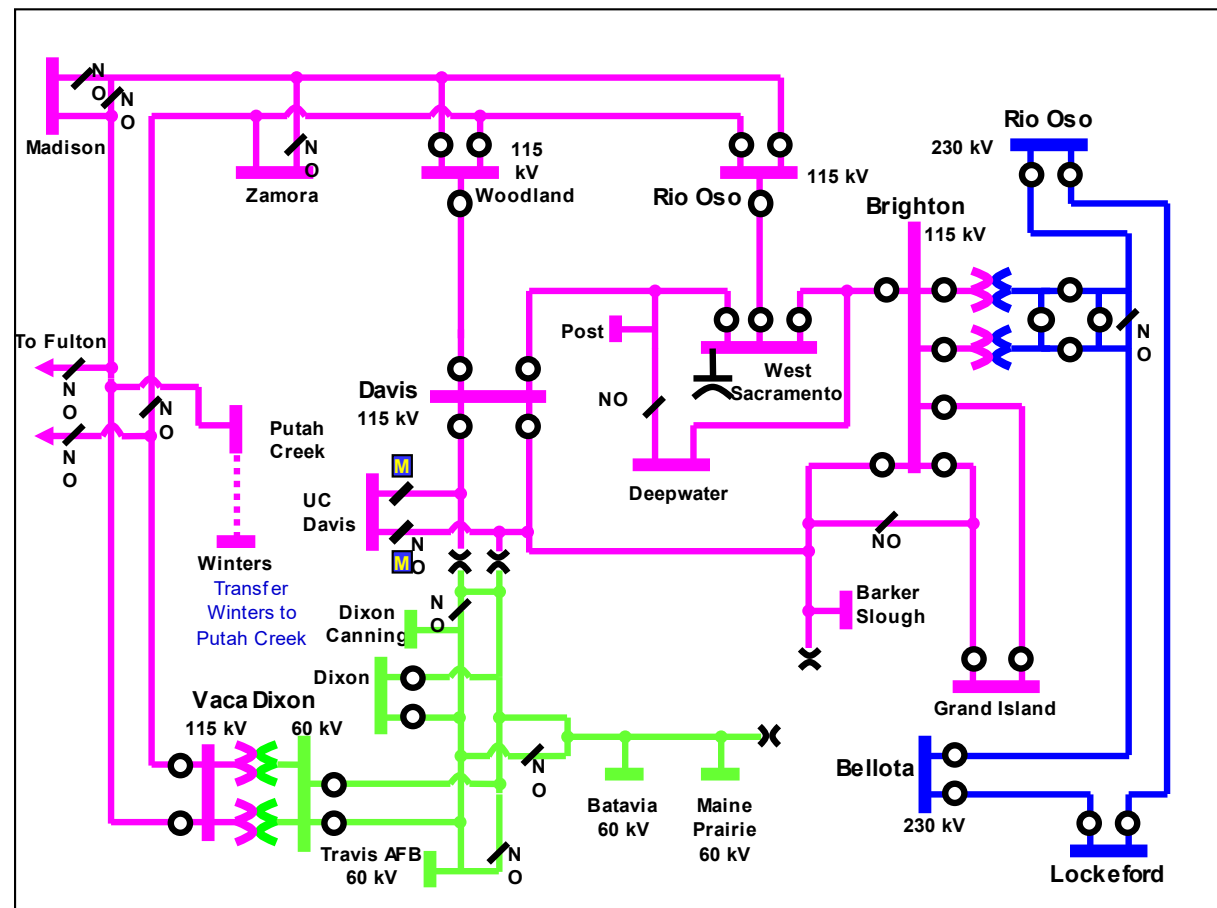
VACA DIXON-DAVIS AREA REINFORCEMENT PROJECT



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Area Background

- The Davis/Yolo area is in Yolo County and is part of PG&E's Sacramento Division. Davis, Woodland and West Sacramento are the largest cities PG&E provides service to in the county.
- Rio Oso and Vaca Dixon substations are the main sources for serving Davis area.
- The Davis area system is comprised of two 230 kV, three 115 kV, and three 60 kV lines:
 - Rio Oso-Brighton 230 kV Line
 - Brighton-Bellota 230 kV Line
 - Rio Oso-West Sacramento 115 kV Line
 - Rio Oso-Woodland Nos. 1 and 2 115 kV Lines
 - Dixon-Vaca Nos. 1 and 2 60 kV Lines
 - Vaca-Plainfield Junction 60 kV Line



Existing Single Line Diagram



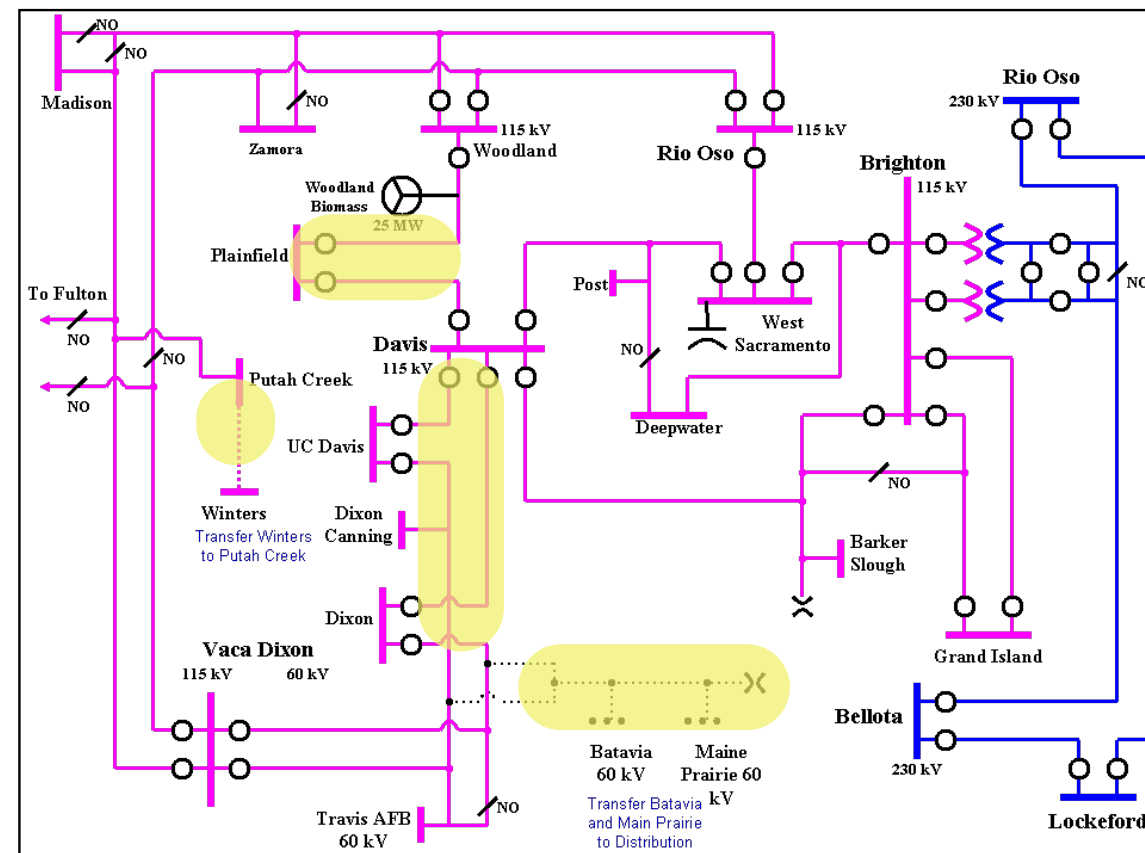
Assessment Results

- **Contingency Description:**
 - P1, P2, P6 and P7 Category Events
- **Power Flow Results:**

Monitored		Pre-Project			Post-Project	Contingency	
Facility	Rating (MVA)	2026	2029	2034	2034	Category	Contingency Name
Brighton-Davis 115 kV Line (BRIGHTN-HOWARDJCT)	512 Amps (SE)	82.8%	90.4%	105%	38.3%	P1	P1-2: BRIGHTN-W.SCRMNO 115KV
Woodland-Davis 115 kV Line	878 Amps (SE)	104.9%	89.7%	103%	6.9%	P2	P2-3: BRIGHTN - ME 115KV & BRIGHTN-W.SCRMNO LINE
Brighton-Davis 115 kV Line (BRIGHTN-HOWARDJCT)	512 Amps (SE)	150.3%	152.1%	179.9%	37.4%	P6	P6: WOODLAND-DAVIS 115KV & BRIGHTN-W.SCRMNO 115KV
W.Sacramento-Davis 115 kV Line	742 Amps (SE)	88.8%	89.3%	103.5%	31.9%	P6	P6: WOODLAND-DAVIS 115KV & BRIGHTON-DAVIS 115KV
Woodland-Davis 115 kV Line	878 Amps (SE)	126.0%	86.7%	108.7%	7.0%	P6	P6: BRIGHTON 230/115KV TB 10 & BRIGHTON 230/115KV TB 9
W.Sacramento-Davis 115 kV Line	742 Amps (SE)	88.9%	89.5%	106.5%	35.4%	P7	Rio Oso-West Sacramento 115 kV Line & West Sacramento-Brighton 115 kV Line

Proposed Project

- **Project Objectives:** Address NERC TPL-001-5 P1, P2, P6 and P7 thermal violations
- **Preferred Scope**
 - Reconductor and convert the two 60 kV lines between UC Davis and Vaca-Dixon to 115 kV operation with minimum emergency rating of 1400 Amps (each line ~26.8 miles).
 - Reconductor the two 115 kV lines between UC Davis and Davis with minimum emergency rating 1200 Amps (each line ~1.6 miles).
 - Convert Dixon Substation to 115 kV operation and loop into the Dixon-Vaca No. 2 Line.
 - Construct a switching station at UC Davis, looping into the Dixon-Vaca No. 1 Line.
 - Convert Plainfield Substation to 115 kV operation and loop into the Woodland-Davis 115 kV Line.
 - Transfer Maine Prairie substations to distribution service.

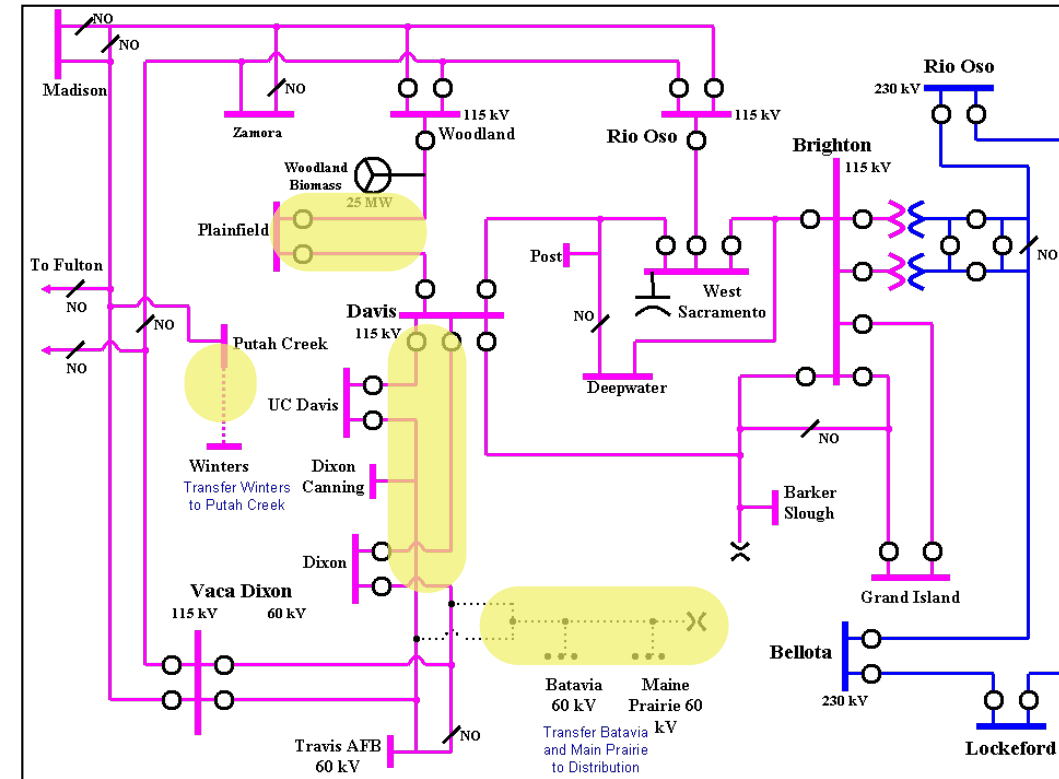


Proposed Single Line Diagram

- **Preferred Scope(cont.)**
 - Transfer the Winters Substation distribution load to Putah Creek Substation.
 - Connect Travis AFB and Travis AFB Hospital to the Dixon-Vaca Nos. 1 and 2 115 kV lines in a double-tap arrangement.
 - Reconductor the limiting sections of the West Sacramento-Davis (1.5 miles) 115 kV lines with higher capacity conductors that are rated to handle at least 1100 Amps under emergency conditions.

- **Proposed In-Service Date:**
 - May 2032 or earlier

- **Estimated Cost :**
 - \$278M and \$556M*



Proposed Single Line Diagram

*AACE Level 5 quality estimates includes a +100% contingency

- **Other Alternatives Considered:**

- Alternative 1: Build a new 115 kV Double Circuit Tower Line (DCTL)

This alternative proposes to build a new Double Circuit Tower Line (DCTL) between Vaca-Dixon Substation and the Davis/Woodland area and build two new 115 kV substations to offload the local 115 kV system. This alternative is not recommended due to higher cost.

- Alternative 2: Build a new 230 kV Double Circuit Tower Line (DCTL)

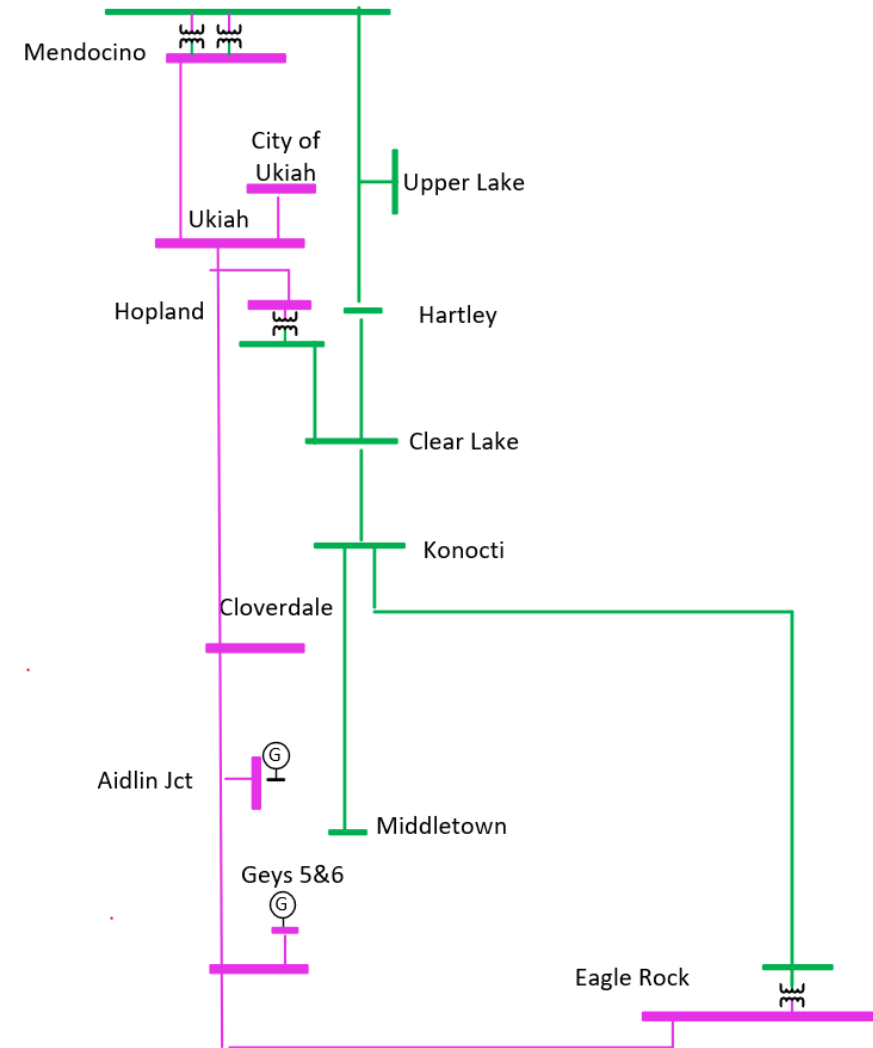
This alternative proposes to build a new Double Circuit Tower Line (DCTL) between Vaca-Dixon Substation and the Davis/Woodland area and build two new 230 kV substations to offload the local 115 kV system. This alternative is not recommended due to higher cost.

KONOCTI-EAGLE ROCK 60 kV RECONDUCTORING PROJECT



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- The Clearlake 60 kV System mainly serves electric customers in Upper Lake, Lakeport, Kelseyville, Hidden Valley Lake and Middletown communities in Lake County.
- The 60 kV system in the area is comprised of three 60 kV lines: Mendocino-Clearlake, Clearlake-Hopland, and Clearlake-EagleRock-Middletown and serves the area via five 60 kV substations: Upper Lake, Hartley, Clearlake, Konocti and Middletown.
- The Konocti-Eagle Rock 60kV line is part of the Eagle Rock to Mendocino 60kV line.
- The number of customers in the Eagle Rock 60kV system is approximately 20,000.



Existing Single Line Diagram

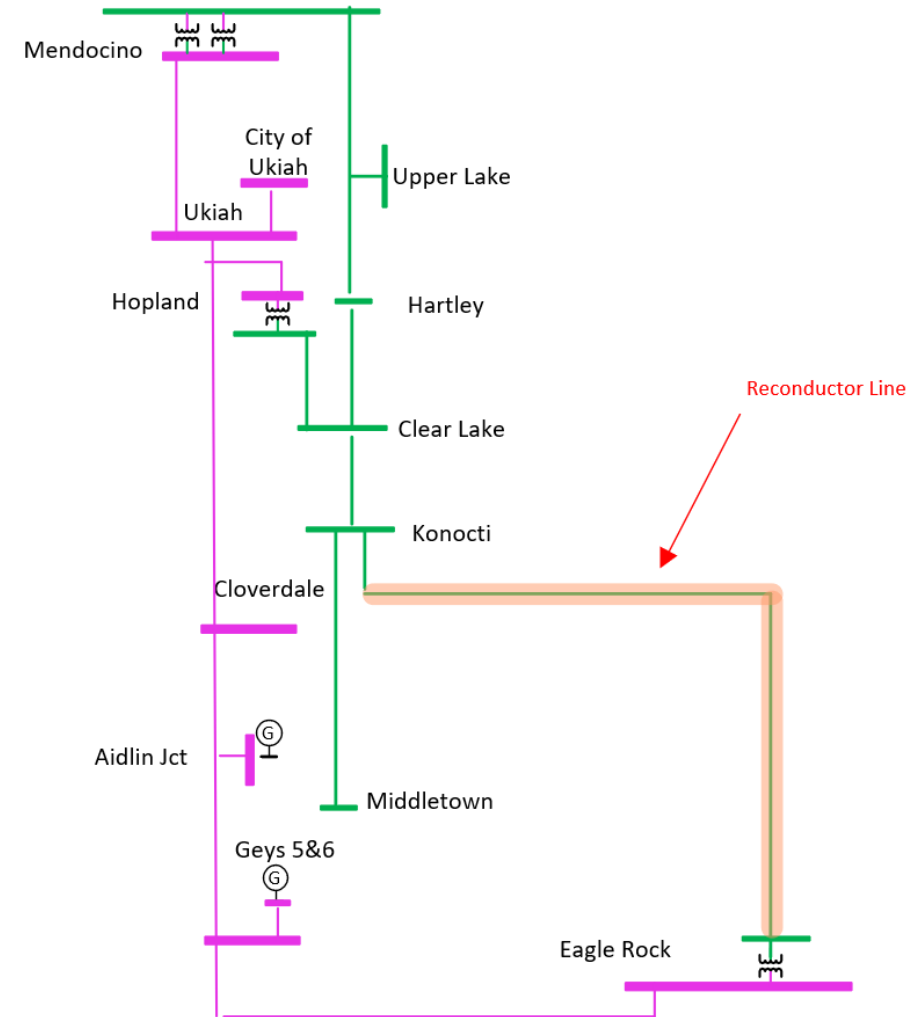


Assessment Results

- **Contingency Description:**
 - P1 category event that causes loss of GEYSERS #3-CLOVERDALE 115KV
 - P2 category event that causes loss section of GEYSERS #3-CLOVERDALE 115KV (CLOVRDLE-AIDLINJCT)
- **Power Flow Results**

Monitored		Pre-Project			Post-Project	Contingency	
Facility	Rating (MVA)	2026	2029	2034	2034	Category	Contingency Name
Konocti-Eagle Rock 60 kV	63 (SE)	97.0%	98.0%	109.8%	70.1%	P1	GEYSERS #3-CLOVERDALE 115KV
Konocti-Eagle Rock 60 kV	63 (SE)	98.62%	104.6%	111.3%	71.1%	P2-1	GEYSERS #3-CLOVERDALE 115KV (CLOVRDLE-AIDLINJCT)

- **Project Objectives:** The project objective is to mitigate thermal overload on Konocti-Eagle Rock 60 kV line.
- **Preferred Scope:**
Reconductor Konocti-Eagle Rock 60 kV (about 10.0 miles) to achieve minimum conductor rating of 954 AMPS for summer normal rating and 1100 AMPS for summer emergency rating
- **Proposed In-Service Date:**
 - May 2030 or earlier
- **Estimated Cost:**
 - \$16.25M - \$32.5M*



Proposed Single Line Diagram

*AACE Level 5 quality estimates includes a +100% contingency

- **Other Alternatives Considered**

- Alternative 1: Energy Storage

This alternative is not recommended due to high interconnection cost for the energy storage. Due to space limitations at Clear Lake and Konocti Substations the energy storage addition will trigger substation upgrade that will have a higher cost compared to the proposed project.

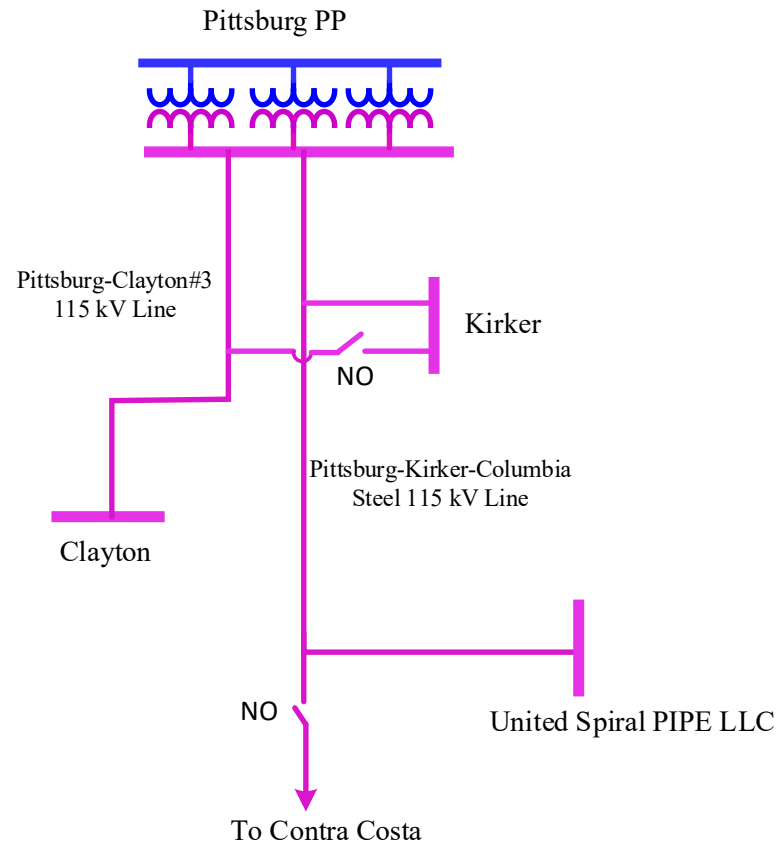
PITTSBURG-KIRKER 115KV LINE SECTION LIMITING ELEMENTS UPGRADE PROJECT



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Area Background

- Kirker 115 kV Substation is in Contra Costa County and serves over 27,000 transmission customers.
- Kirker substation is primarily fed from Pittsburg-Kirker-Columbia Steel 115 kV Line, with a backup feed from Pittsburg-Clayton#3 115 kV Line.



Existing Single Line Diagram



Assessment Results

- **Contingency Description:**

- P0: No Contingency

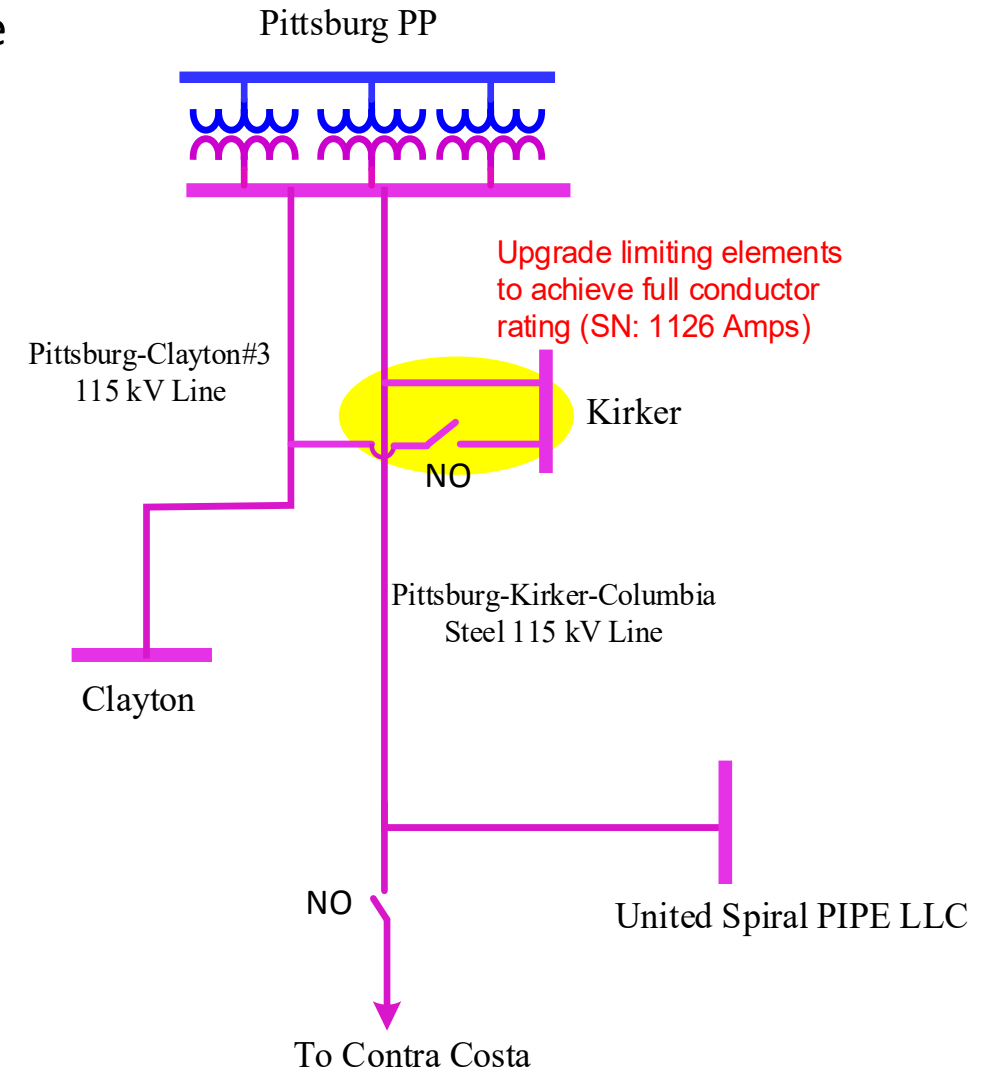
- **Power Flow Results:**

		Pre-Project			Post-Project	Contingency	
Facility	Rating (A)	2026	2029	2034	2034	Category	Contingency Name
Pittsburg–Kirker-Columbia Steel 115 kV Line (Kirker-Kirker Tap)	514 (SN*)	103.2%	105.7%	108.6%	49.6%	P0	None

*SN: Existing Summer Normal Rating

- **Project Objectives:** Increase Pittsburg-Kirker 115kV Line section capacity to address NERC TPL-001-5 P0 thermal violations.
- **Preferred Scope**
 - Upgrade any limiting elements on Pittsburg-Kirker-Columbia Steel 115kV Line for the section from Pittsburg to Kirker Substation to achieve 1126 Amps of summer normal rating.
- **Proposed In-Service Date:**
 - May 2028 or earlier
- **Estimated Cost :**
 - \$100K-\$200K*

*ACE Level 5 quality estimates includes a +100% contingency



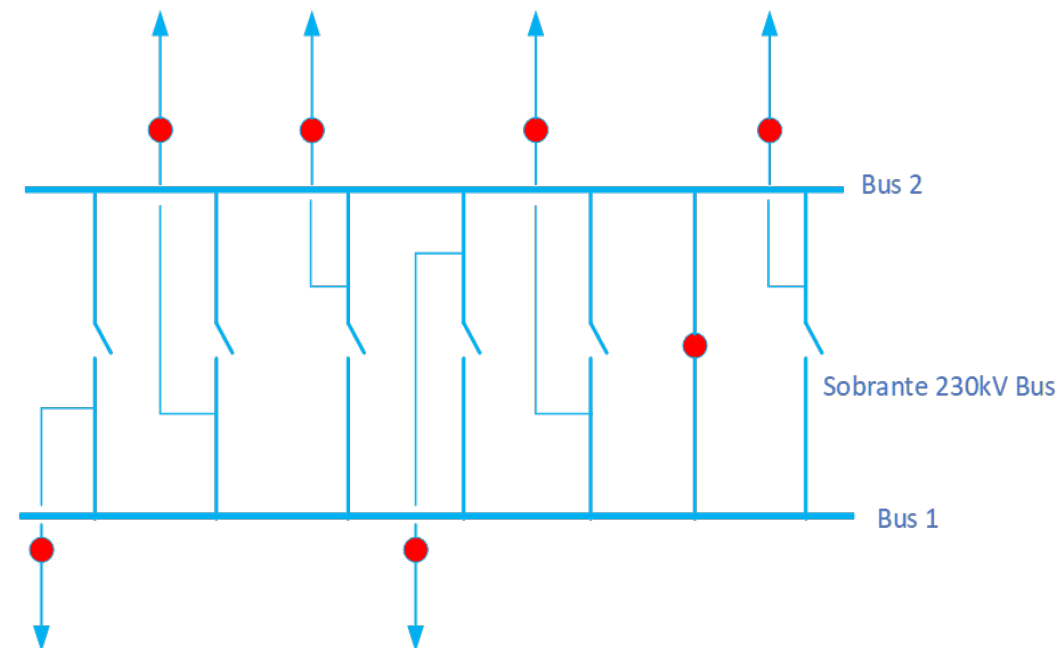
Proposed Single Line Diagram

SOBRANTE 230 KV BUS UPGRADE PROJECT



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- Sobrante Substation is in Contra Costa County and is the main source for serving the load at Tidewater, Tesoro, Christie, El Cerrito, Richmond, Standard Oil, San Pablo, Grizzly and Hillside Substations.
- Sobrante 230 kV Substation has four 230 kV transmission lines and two 230/115 kV transformer banks. The third 230/115 kV transformer bank was approved in the 2023-2024 CAISO Transmission Planning Process (TPP) with the expected in-service year of 2034.
- With the P2 contingency taking out the entire Sobrante 230 kV substations, most of the load will need to be served from Moraga source which leads to overloads on Sobrante-Moraga, Moraga-Claremont#1 and #2 115kV lines.



Existing Sobrante 230 kV Bus Configuration



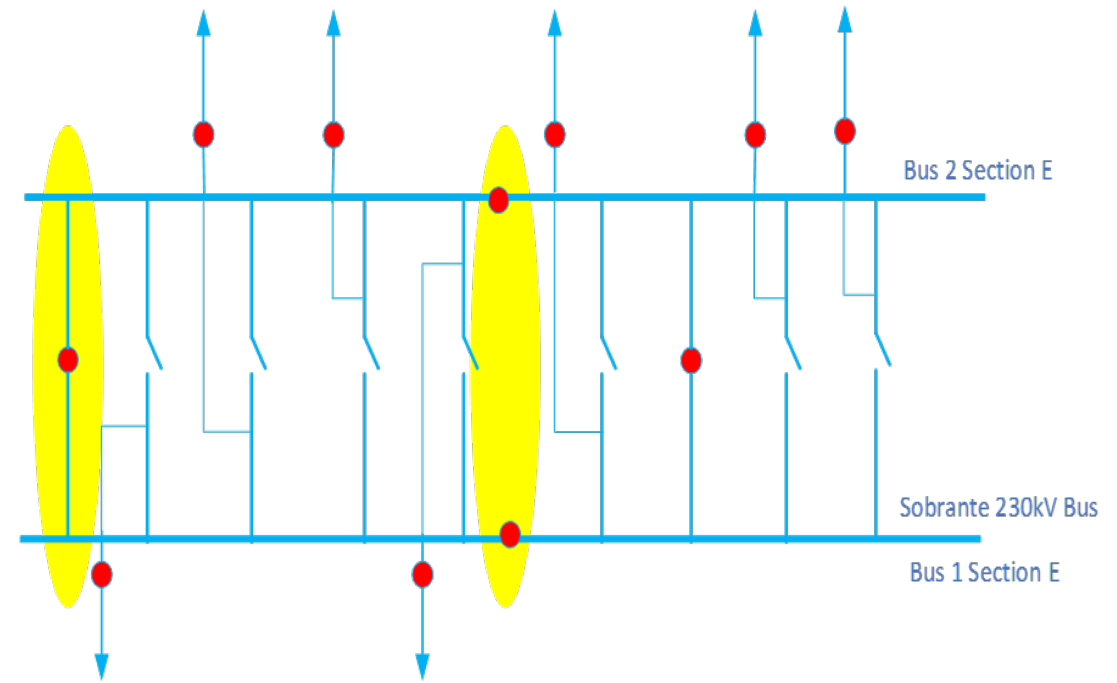
Assessment Results

- **Contingency Description:**
 - P2-4: SOBRANTE 230KV - SECTION 2D & 1D
- **Power Flow Results:**

		Pre-Project			Post-Project	Contingency	
Facility	Rating (A)	2026	2029	2034	2034	Category	Contingency Name
Sobrante-Moraga 115kV	1021 (SE*)	104.2%	98.6%	123.9%	62.8%	P2-4	SOBRANTE 230KV - SECTION 2D & 1D
Moraga-Claremont #1 115kV	557 (SE)	94.4%	97.6%	116.7%	87.4%	P2-4	SOBRANTE 230KV - SECTION 2D & 1D
Moraga-Claremont #2 115kV	557 (SE)	94.5%	97.7%	116.9%	87.6%	P2-4	SOBRANTE 230KV - SECTION 2D & 1D

*SE: Summer Emergency

- **Project Objectives:** Address NERC TPL-001-5 P2 thermal violations.
- **Preferred Scope**
 - Expand Sobrante 230 kV bus and split to two sections, section D and section E by adding two sectionalizing breakers and one bus-tie breaker.
 - Terminals for the future Sobrante 230/115 kV transformer bank #3 and two 230 kV lines will be connected to the section E. Terminals for the other two 230 kV lines and 230/115 kV transformer bank #1 & #2 will be connected to section D.
 - Upgrade protection systems as required.



Proposed Single Line Diagram



Proposed Project

- **Proposed In-Service Date:**
 - May 2033 or earlier
- **Estimated Cost :**
 - \$7.5M - \$15M*
- **Other Alternatives Considered:**
 - Status Quo: does not mitigate the P0 issues.
 - Convert Sobrante 230kV bus to BAAH: this alternative is not recommended due to its higher cost.

*AACE Level 5 quality estimates includes a +100% contingency

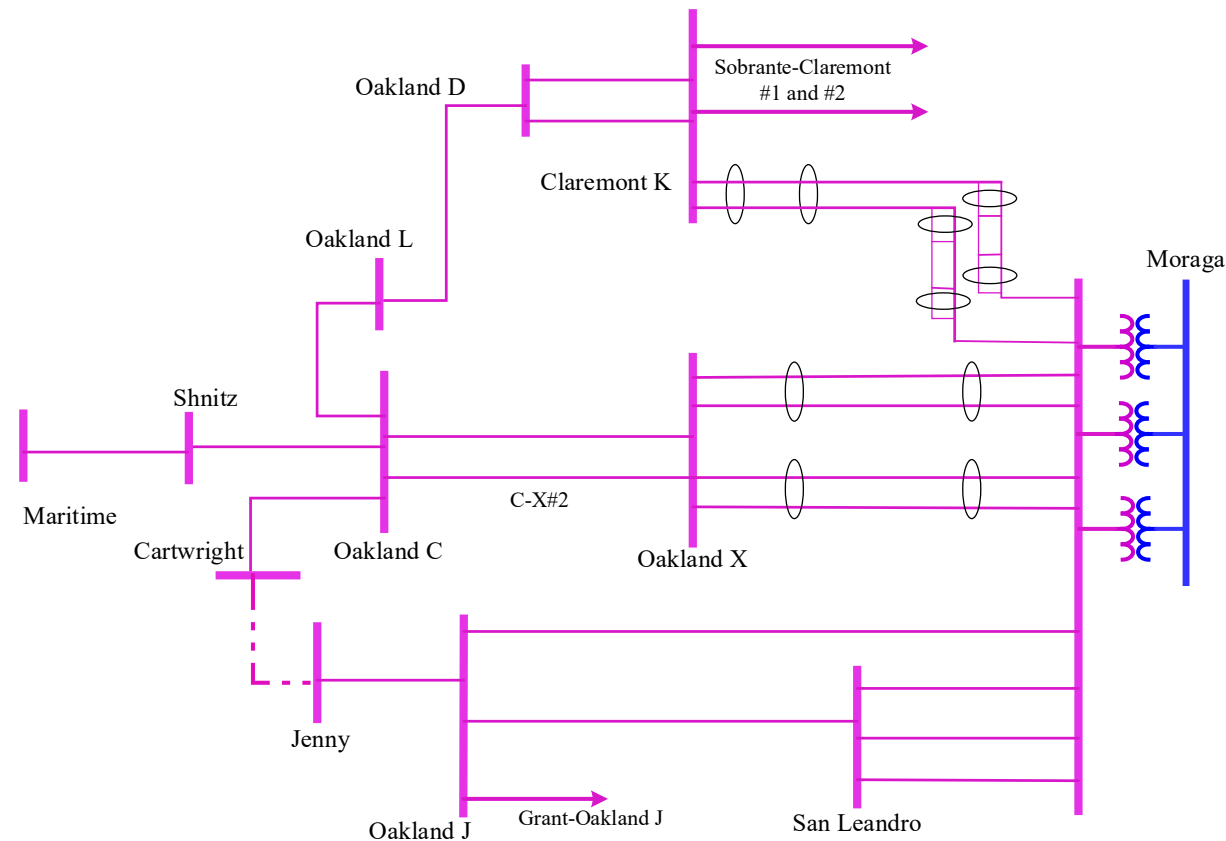
MORAGA 230/115 KV TRANSFORMER BANK ADDITION PROJECT



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Area Background

- Moraga Substation in Contra Costa County is part of the Pacific Gas and Electric's Diablo Division. Moraga Substation has three 230/115 kV transformers which are critical for serving customer loads within East Bay Area including cities of Oakland, Alameda and San Leandro.
- The Oakland area is experiencing rapid load increase due to industrial and commercial growth and the rise in the EV Charging and Electrification loads.
- Planning analysis shows that the P6 contingency of losing any two of the three Moraga 230/115 kV transformers, will overload the remaining transformer due to the increase in area load.



Existing Single Line Diagram



Assessment Results

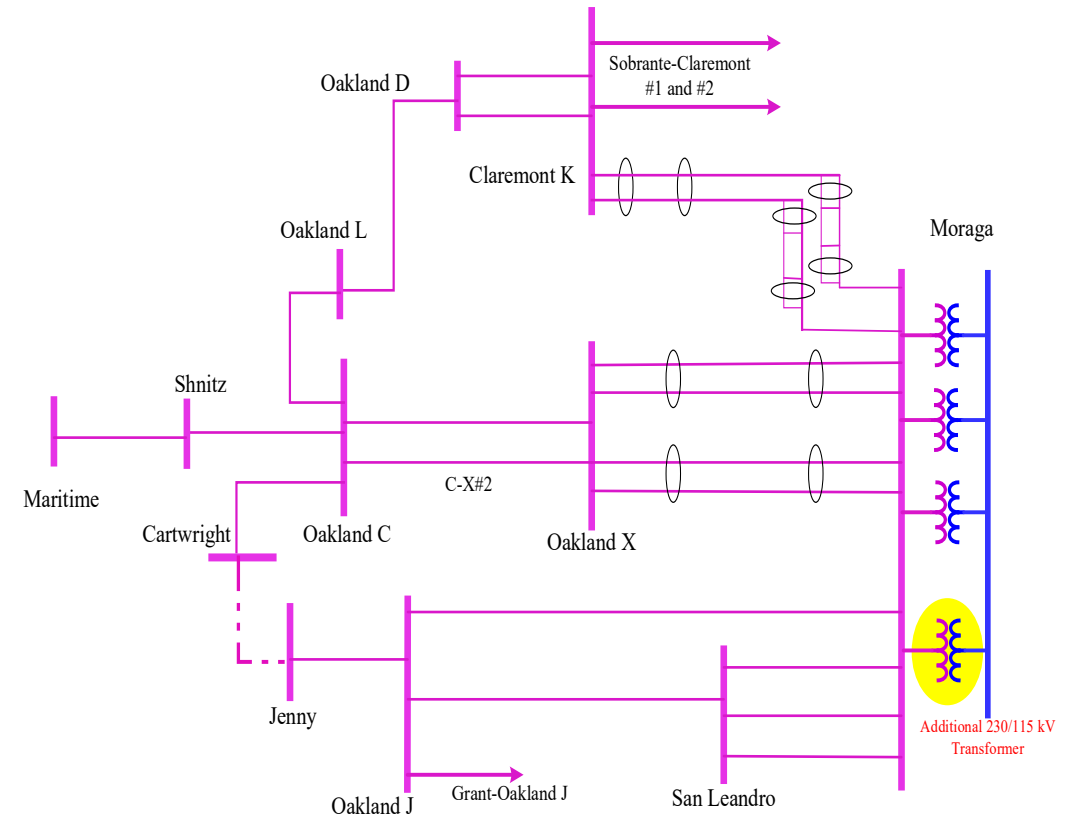
- **Contingency Description:**
 - P2: Moraga 230 kV Section 2D or Moraga D section 2D & Moraga E section 2E 115 kV
 - P6: Two of Three Moraga 230/115 kV Transformer Banks
- **Power Flow Results:**

Facility	Rating (A)	Pre-Project			Post-Project	Contingency	
		2026	2029	2034	2034	Category	Contingency Name
Moraga 230 kV/115 kV Transformer Bank #3	464 (SE*)	105.3%	98.1%	108.6%	67.4%	P2-2	Moraga 230 kV Section 2D
Moraga 230 kV/115 kV Transformer Bank #1	462 (SE)	109.6%	101%	109.4%	69.5%	P2-4	Moraga D section 2D & Moraga E section 2E 115 kV
Moraga 230 kV/115 kV Transformer Bank #1	462 (SE)	101.2%	106.8%	118.1%	77.3%	P6	Moraga 230 kV/115 kV Transformer Bank #2 and Bank#3
Moraga 230 kV/115 kV Transformer Bank #2	462 (SE)	101.2%	106.8%	118.1%	77.3%	P6	Moraga 230 kV/115 kV Transformer Bank #1 and Bank#3
Moraga 230 kV/115 kV Transformer Bank #3	464 (SE)	100.8%	106.4%	117.7%	77%	P6	Moraga 230 kV/115 kV Transformer Bank #1 and Bank#2

*SE: Summer Emergency

- **Project Objectives:** Address NERC TPL-001-5 P2 and P6 thermal violations.
- **Preferred Scope**
 - Install a new 230/115 kV transformer bank at Moraga Substation with minimum 420 MVA for summer normal rating and 462 MVA for summer emergency rating.
 - Upgrade Moraga 115 kV bus and any limiting elements to achieve full bank capacity.
- **Other Alternatives Considered:**
 - Energy Storage: there will not be sufficient capacity to charge this size of energy storage in the charging window.

- **Proposed In-Service Date:**
 - May 2031 or earlier
- **Estimated Cost :**
 - \$20M - \$40M*



Proposed Single Line Diagram

*AACE Level 5 quality estimates includes a +100% contingency

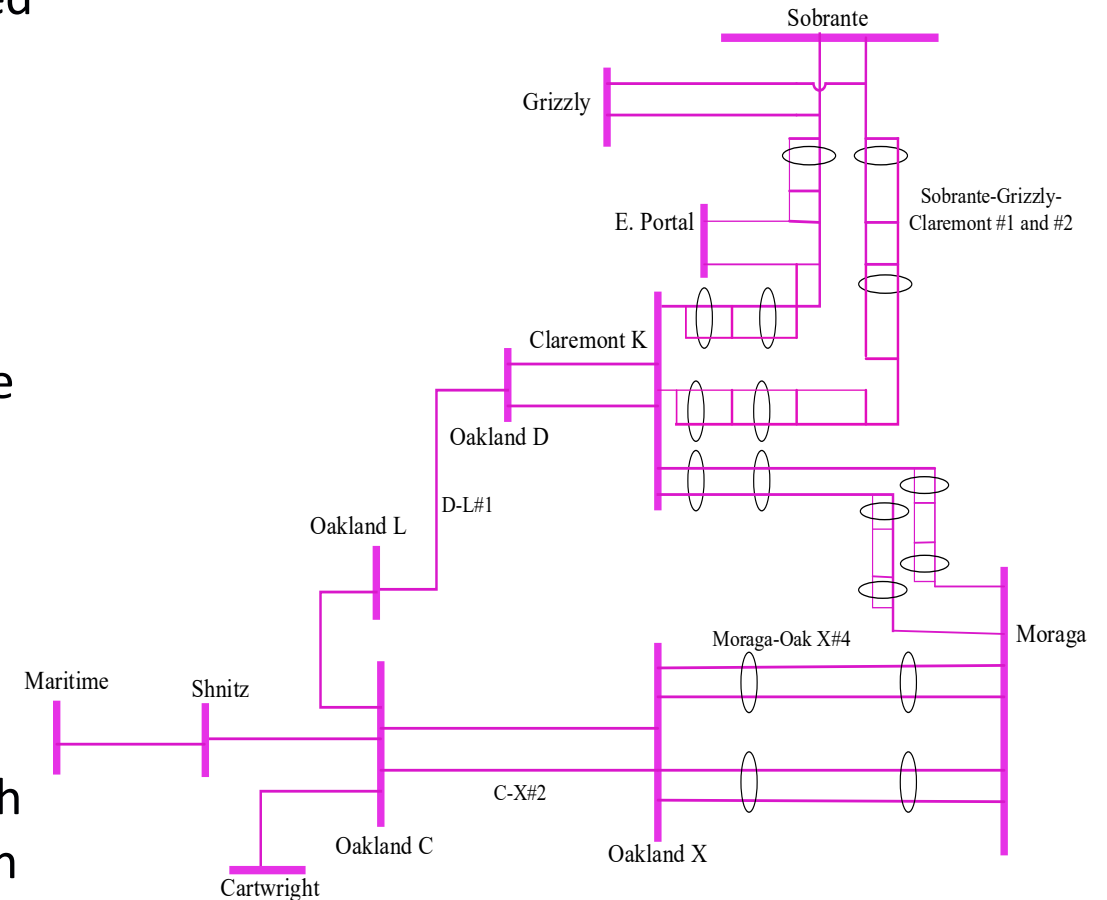
NORTH OAKLAND REINFORCEMENT PROJECT



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Area Background

- The North Oakland 115 kV pocket is mainly served by Moraga Substation via six 115 kV overhead transmission lines from Moraga Substation to Oakland X and Claremont Substations. These six 115 kV transmission lines provide power to Claremont, Oakland C, Oakland K, Oakland X, Oakland D, and Oakland L to serve the load in the North Oakland pocket.
- Three underground cables, Oakland C-X #2, Oakland C-X #3, and Oakland D-L #1, serve the load at Oakland L and Oakland C Substations.
- North Oakland area is experiencing rapid load increase due to industrial and commercial growth and the rise in the EV Charging and Electrification loads.



Existing Single Line Diagram



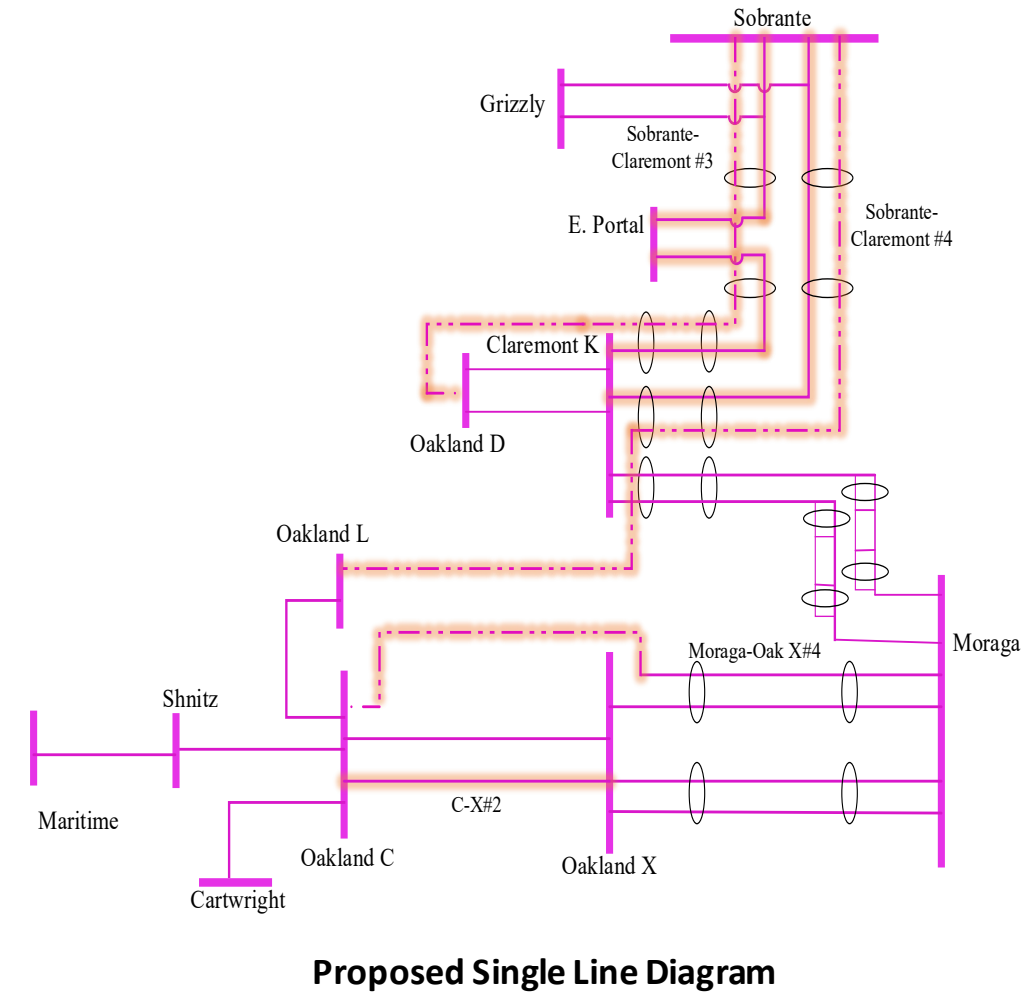
Assessment Results

- **Contingency Description:**
 - P1, P2, P3 and P6 Category Events
- **Power Flow Results**

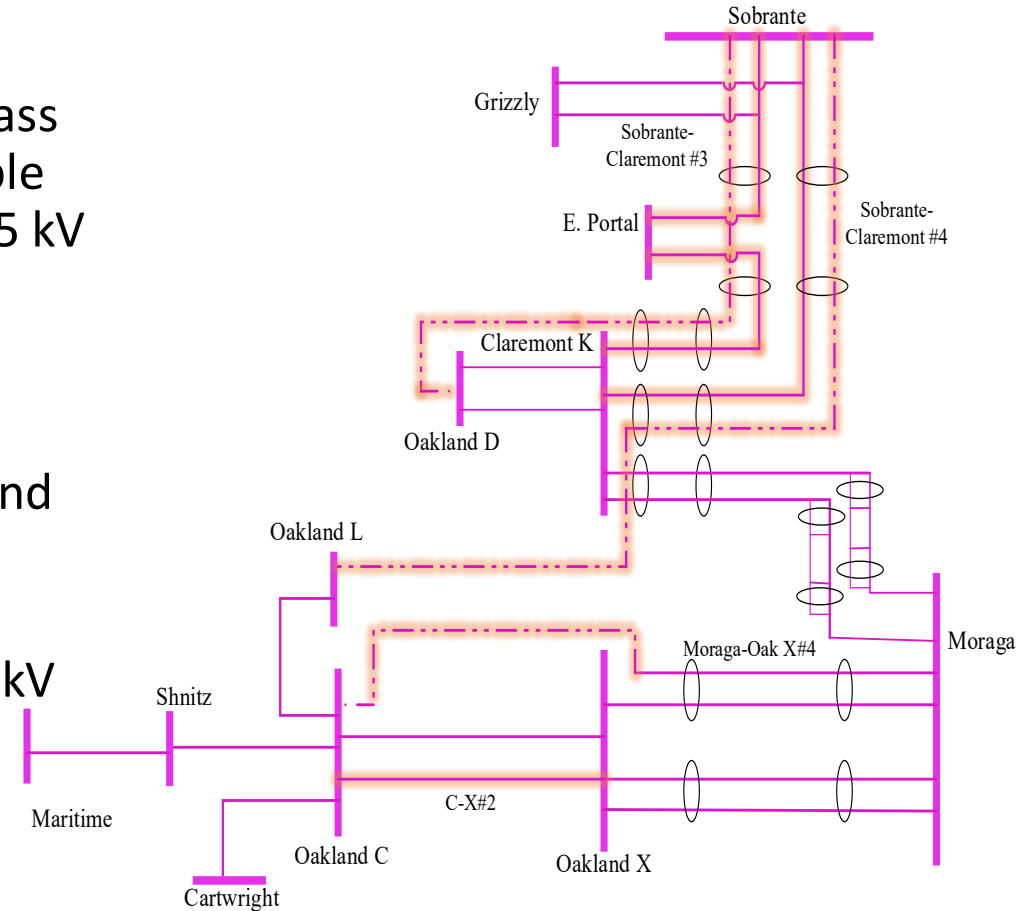
		Pre-Project			Post-Project	Contingency	
Facility	Rating (A)	2026	2029	2034	2034	Category	Contingency Name
C-L #1 115 kV Cable	790 (SE*)	103.6%	107.6%	127.5%	9.0%	P6	K-D#1 115 kV and K-D#2 115 kV
C-X #2 115 kV Cable	790 (SE)	127.3%	132.5%	145.1%	34.9%	P6	K-D#1 115 kV and K-D#2 115 kV
D-L #1 115 kV Cable	790 (SE)	127.1%	132.7%	158.9%	N/A	P6	C-X#2 115 kV and C-X#3 115 kV
K-D #1 115kV	1025 (SE)	86.3%	97.1%	114.3%	49.7%	P6	C-X#2 115 kV and K-D#2 115 kV
K-D #2 115kV	1042 (SE)	84.7%	95.3%	112.2%	48.7%	P6	C-X#2 115 kV and K-D#1 115 kV
Sobrante-Grizzly-Claremont#1 115kV	801 (SE)	64.9%	102.1%	113.6%	33.8%	P6	SOBRANTE-GRIZZLY-CLAREMONT #2 115KV and SOBRANTE-MORAGA 115KV
Sobrante-Grizzly-Claremont#2 115kV	801 (SE)	65.3%	106%	118.9%	31.9%	P6	SOBRANTE-GRIZZLY-CLAREMONT #1 115KV and SOBRANTE-MORAGA 115KV

*SE: Summer Emergency

- **Project Objectives:** Address NERC TPL-001-5 P1, P2, P3 and P6 thermal violations.
- **Preferred Scope**
 - Rebuild existing two Sobrante-Grizzly-Claremont #1 and #2 115 kV lines into four lines with at least 1714 Amps of summer normal rating. Two of the four lines will bypass Claremont Substation and connect to Oakland D and Oakland L Substations through new underground (UG) cable sections.
 - Build a new UG cable to connect one of the new rebuilt lines to Oakland D with at least 1380 Amps of summer normal rating.
 - Build a new UG cable to connect one of the new rebuilt lines to Oakland L with at least 1380 Amps of summer normal rating.



- **Preferred Scope (Cont.)**
 - Reroute the Moraga-Oakland X #4 line to bypass the Oakland X Substation. Build a new UG cable section to connect the Moraga-Oakland#4 115 kV line to Oakland C with at least 1380 Amps of summer normal rating.
 - Convert Oakland C to GIS.
 - Replace the Oakland C-X#2 115 kV underground cable with larger size cable with at least 1380 Amps of summer normal rating.
 - Disconnect existing Oakland D-Oakland L 115 kV cable.
- **Proposed In-Service Date:**
 - May 2032 or earlier
- **Estimated Cost :**
 - \$564M - \$1127M*



Proposed Single Line Diagram

*AACE Level 5 quality estimates includes a +100% contingency

- **Other Alternatives Considered:**

- **Alternative 1: Reconductor all the 115kV OH lines and UG cables in North Oakland Area**

- Since the majority of the reconductoring involves underground cables, achieving the same load-serving capability as the proposed project would result in higher costs. In addition, the North Oakland pocket will primarily rely on Moraga source.

- **Alternative 2: Build a new 230 kV submarine cable from Crockett to Oakland Area**

- This alternative proposes to bring a 230 kV source from Crockett through submarine cable. The cost is much higher in comparison to the recommended scope. In addition, to mitigate all the violations, this alternative still needs to install a RAS and reconductor most of existing OH lines/ UG cables.

- **Alternative 3: Build a new 230 kV line from Moraga/Sobrante to Oakland Area**

- This alternative proposes to bring a 230 kV source from Moraga/Sobrante substation. The cost is much higher in comparison to the recommended scope. In addition, to mitigate all the violations, this alternative still needs to reconductor most of existing OH lines/ UG cables.

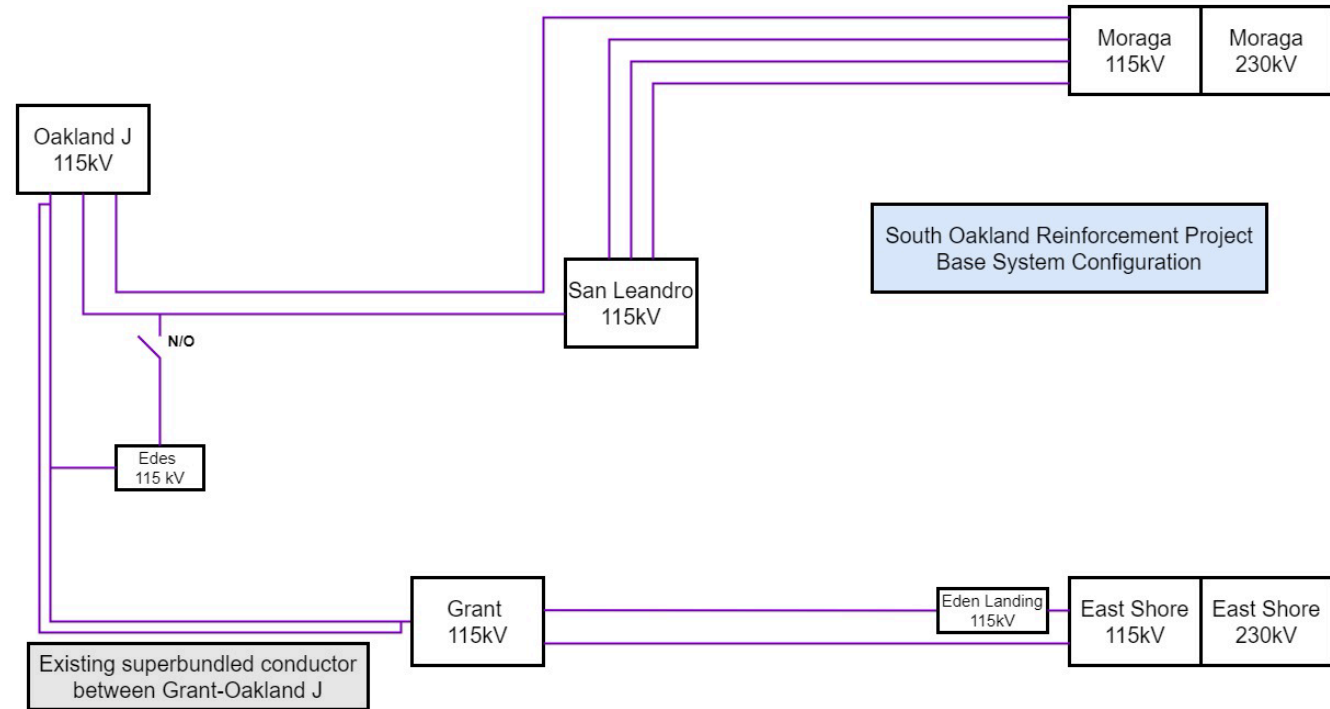
SOUTH OAKLAND AREA REINFORCEMENT PROJECT (CONCEPTUAL)



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Area Background

- The South Oakland load pocket consists of San Leandro, Oakland J, Edes, Grant, and Eden Landing 115 kV Substations.
- Moraga 230/115 kV Substation is a strong source to the area. East Shore is the other source but is considerably weaker compared to Moraga.
- Projected PG&E distribution customer load, CEC load projections for electrification, and data center development all contribute to significant load growth in this area.



Existing Single Line Diagram



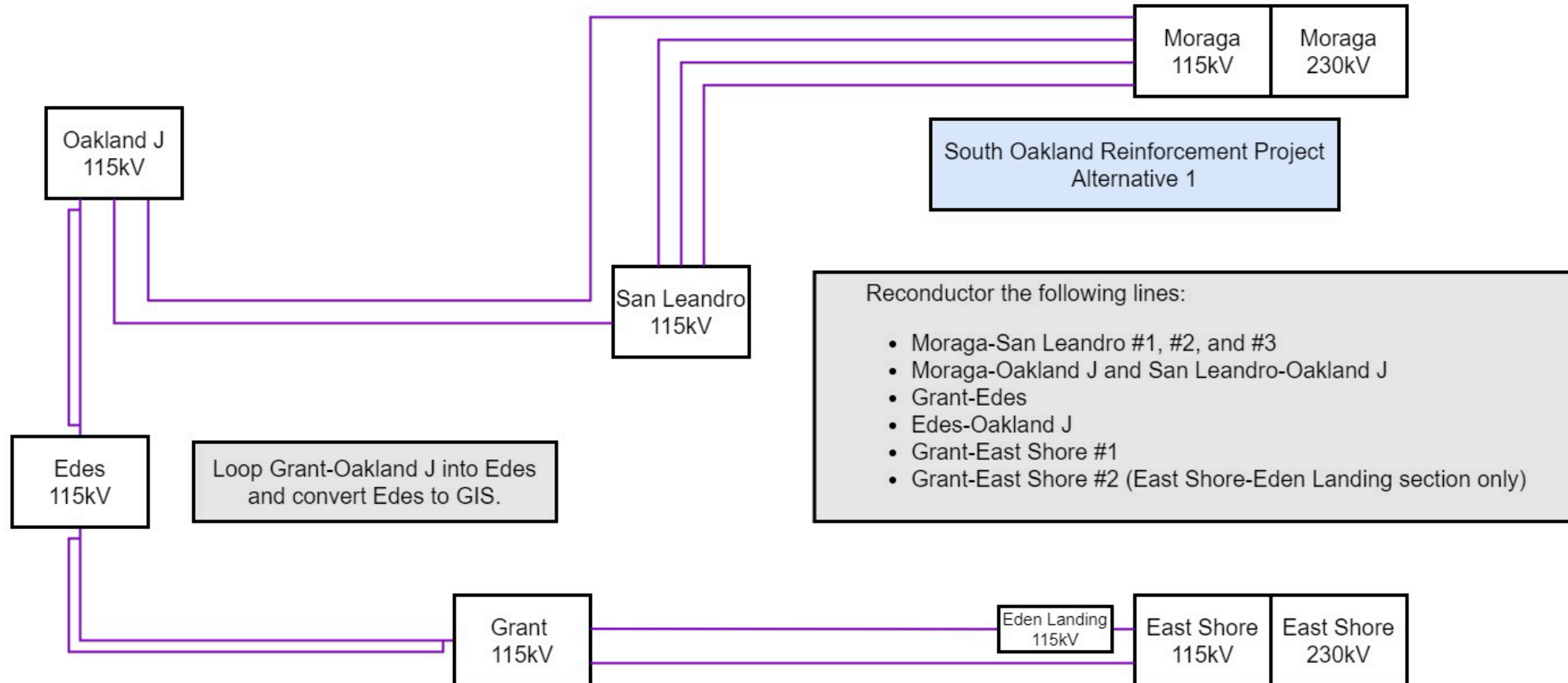
Assessment Results

- **Contingency Description:**
 - P2, P3 and P6 Category Events
- **Power Flow Results:**

Monitored Facility		Pre-Project				Contingency	
Facility	SE Rating (Amps)	2026 HS	2029 HS	2034 HS	2039 HS	Category	Contingency Name
		(%)	(%)	(%)	(%)		
Grant-Oakland J 115 kV Line	1603	110.0	116.7	133.0	Div.	P2-4	P2-4: MORAGA.E 115KV - SECTION 1E & 2E
Moraga-San Leandro #1 115 kV Line	556	120.4	147.1	169.0	223.9	P6	P6: MORAGA-SAN LEANDRO #2 115KV & MORAGA-SAN LEANDRO #3 115KV
Moraga-Oakland J 115 kV Line	710	96.7	135.1	157.6	Div.	P3	P3: RUSCTYECST1 18.00KV & RUSCTYECCT2 15.00KV & RUSCTYECCT1 15.00KV GEN UNITS & SAN LEANDRO-OAKLND J #1 115KV
San Leandro-Oakland J 115 kV Line	948	100.0	124.6	146.8	Div.	P3	P3: RUSCTYECST1 18.00KV & RUSCTYECCT2 15.00KV & RUSCTYECCT1 15.00KV GEN UNITS & MORAGA-OAKLAND J 115KV
East Shore-Eden Landing 115 kV Line	1144	<70	96.5	119.5	152.4	P6	P6: SAN LEANDRO-OAKLND J #1 115KV & GRANT-EASTSHORE #1 115KV
Grant-East Shore #1 115 kV Line	1144	<70	95.0	118.9	152.9	P6	P6: SAN LEANDRO-OAKLND J #1 115KV & GRANT-EASTSHORE #2 115KV

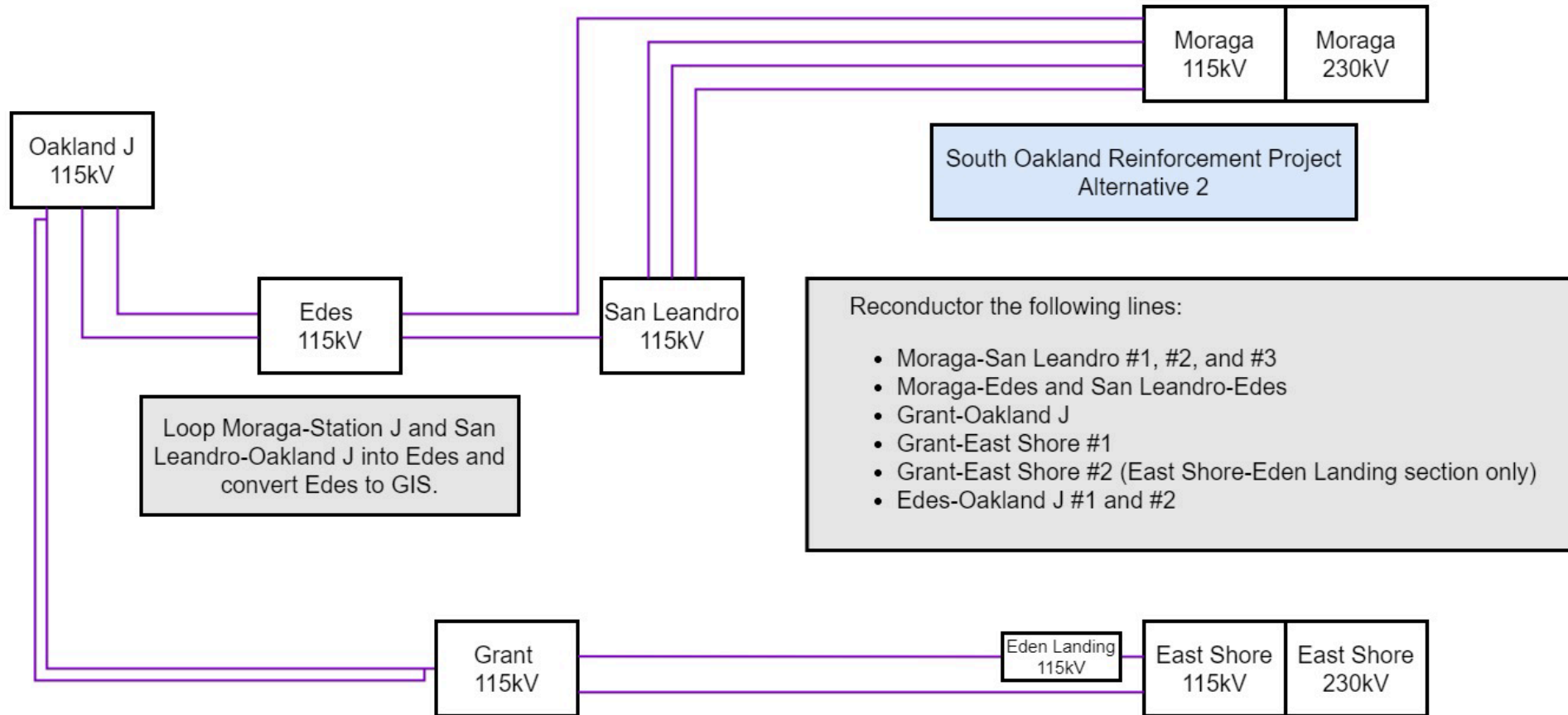
Proposed Project Alternative 1

- Alternative 1** : Loop in Edes 115 kV Substation to the Grant-Oakland J 115 kV line and reconductor all lines except for Eden Landing-Grant line.



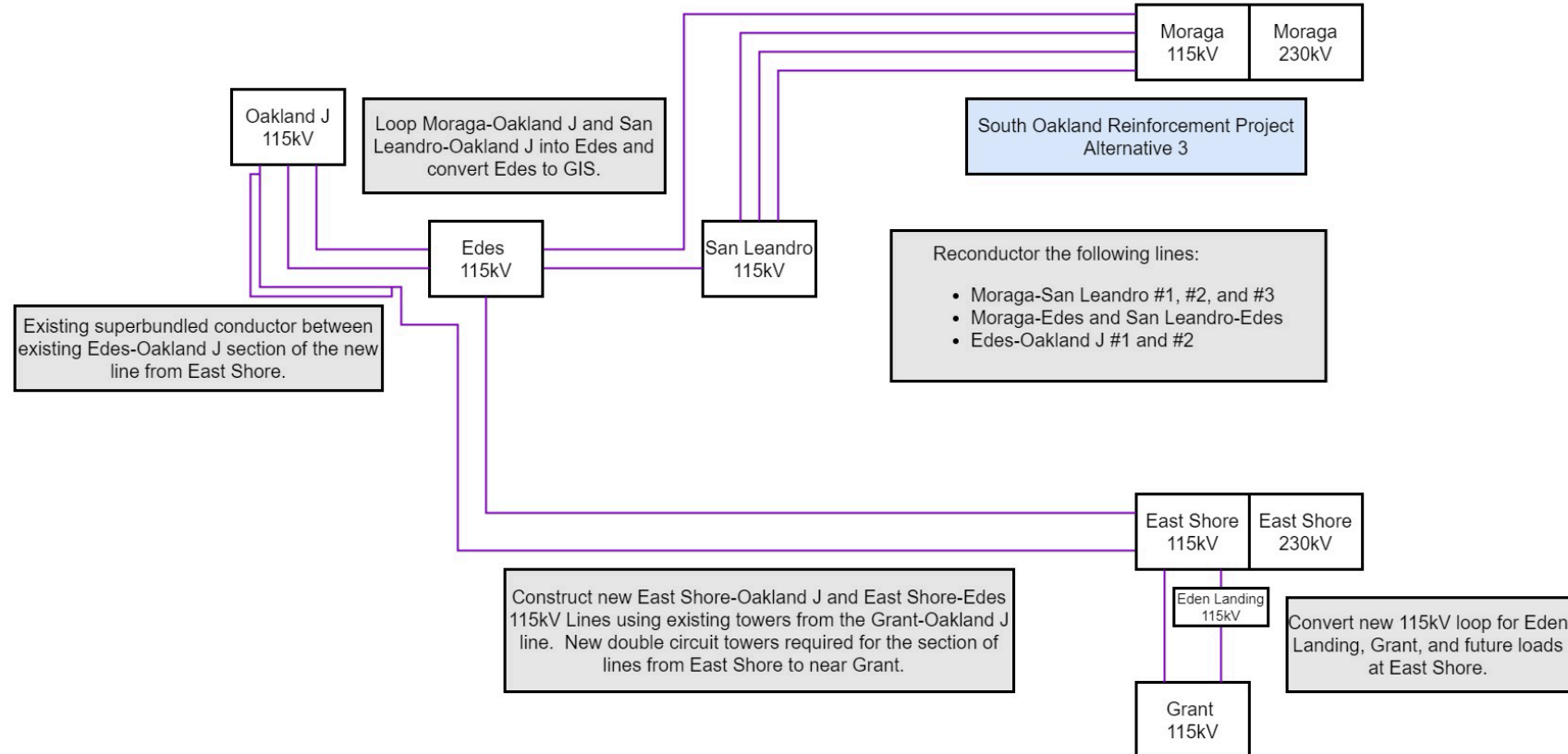
Proposed Project Alternative 2

- Alternative 2** : Loop in Edes 115 kV Substation to the Moraga-Oakland J and San Leandro-Oakland J 115 kV Lines creating the Moraga-Edes, San Leandro-Edes, and Edes-Oakland J #1 and #2 lines. Reconductor all lines except for Eden Landing-Grant.



Proposed Project Alternative 3

- Alternative 3:** Loop in Edes 115 kV Substation to the Moraga – Oakland J and San Leandro – Oakland J 115 kV lines creating the Moraga – Edes, San Leandro – Edes, and Edes – Oakland J #1 and #2 lines. Disconnect the Grant – Oakland J 115 kV line from Grant Substation; use the existing towers between Grant and Oakland J and construct two new line segments between East Shore and Grant to create new East Shore – Oakland J and East Shore – Edes 115 kV lines. Reconductor as necessary (detailed below).



- Alternatives 1 and 2 have similar reconductoring requirements while Alternative 3 rebuilds the East Shore area to avoid some of the reconductor work and bolster the system for future load interconnections.
- Studies of the proposed alternatives are ongoing to determine the most cost effective, feasible solution to mitigate all the overloads caused by the South Oakland area load increases and reinforce the local grid for long-term load growth

Comparison of the Alternatives Reconductoring and Rating Requirements

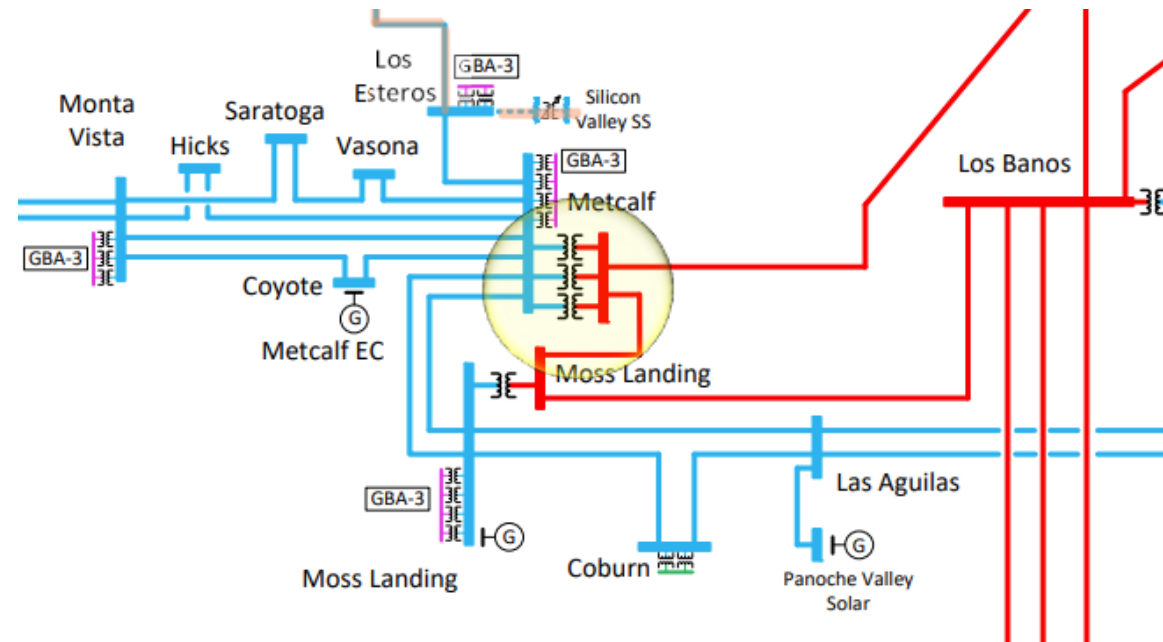
Alternative	Moraga-San Leandro #1, #2, and #3	Moraga-Oakland J	San Leandro-Oakland J	Moraga-Edes	San Leandro-Edes	Edes-Oakland J #1	Edes-Oakland J #2	Oakland J-Grant (Oakland J-Edes Alt 1)	Oakland J-Grant (Edes-Grant for Alt 1)	Grant-East Shore #1	Grant-East Shore #2 (East Shore-Eden Landing Section)	Grant-East Shore #2 (Grant-Eden Landing Section)
Alternative 1	1550 A	2150 A	2050 A	N/A	N/A	2150 A	N/A	2150 A	1900 A	1500 A	1550 A	Not required
Alternative 2	1550 A	N/A	N/A	2100 A	2100 A	1400 A	1400 A	1900 A		1250 A	1600 A	Not required
Alternative 3	1400 A	N/A	N/A	1500 A	1850 A	1144 A	1144 A	Rebuilt as a part of the East Shore-Oakland J and East Shore-Edes lines.		Rebuilt as a 115 kV load loop.		

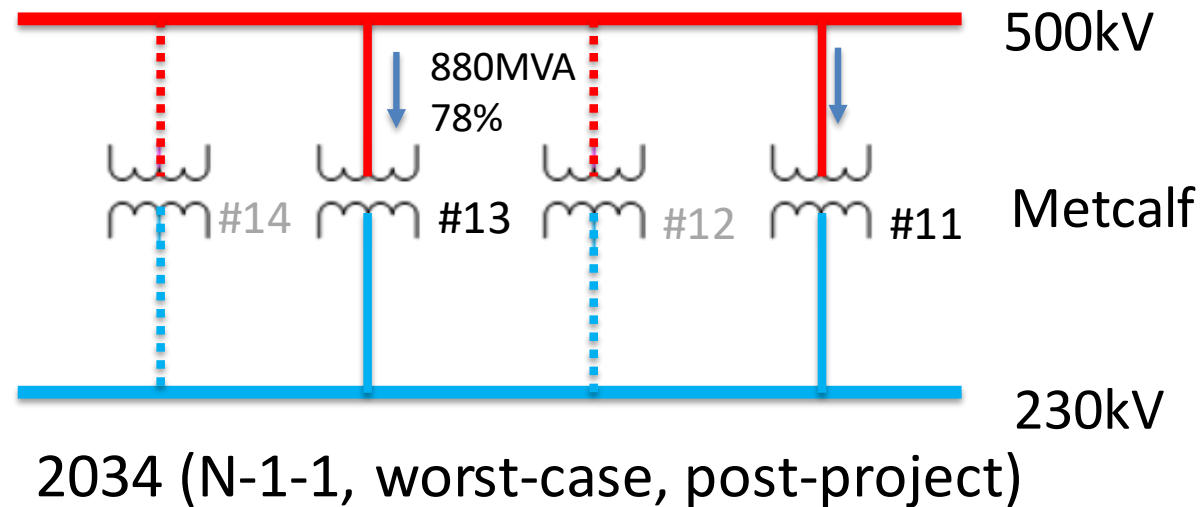
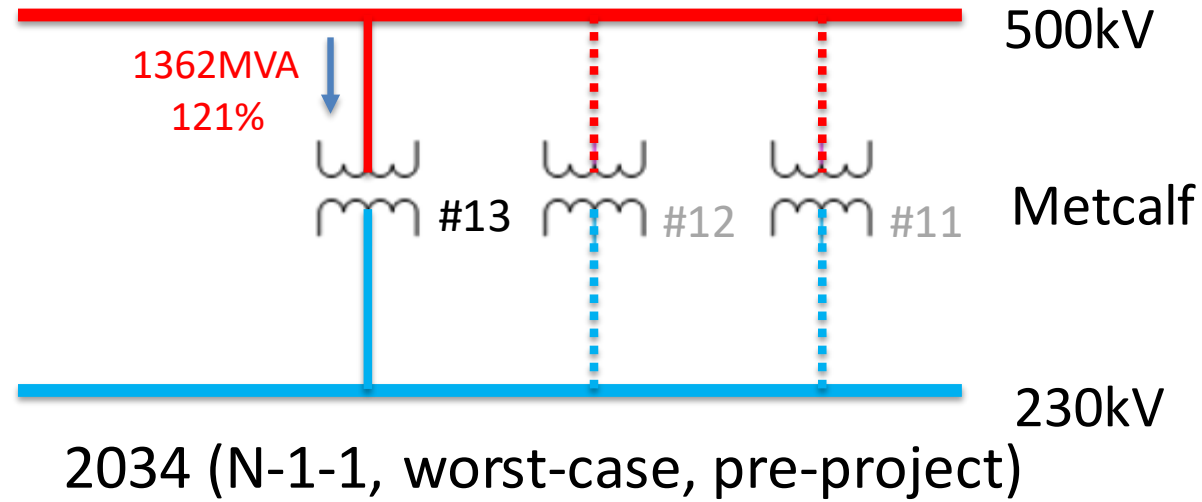
METCALF 500/230 KV TRANSFORMER BANK ADDITION PROJECT



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- Metcalf Substation is located in the Bay Area.
- Three existing 500/230 kV banks at the Metcalf Substation serve as one of the main sources feeding the San Jose/Silicon Valley area loads.
- The demand in this pocket is mainly driven by the distribution customers in Silicon Valley, and the newly interconnected large loads, such as data centers, etc.
- A P6 contingency for the loss of any two 500/230 kV transformer banks at Metcalf Substation results in an overload on the remaining transformer bank due to the increase in area load.





- **Contingency Description:**
 - P6: Loss of any two 500/230 kV transformer banks at Metcalf Substation

- **Power Flow Results:**

Monitored Facility		Pre-Project				Post-Project	Contingency	
Facility Name	Rating (MVA)	2026 (%)	2029 (%)	2034 (%)	2039 (%)	2034/2039 (%)	Category	Contingency Name
Remaining Metcalf 500/230 kV Bank	1122	104	96	121	147	78%/91.7%	P6	P6: Any two Metcalf 500/230 kV Bank Outage

- **Project Objectives:** The addition of a 4th 500/230 kV transformer bank protects against NERC TPL-001-5 Category P6 violations and mitigates thermal violations for the loss of any two 500/230 kV transformer banks at Metcalf Substation
- **Proposed Scope**
 - Install 4th new 500/230kV transformer bank (#14) at the Metcalf Substation to achieve at least 1120 MVA of summer normal and summer emergency rating.
 - Upgrade any limiting components as necessary to achieve full transformer capacity.
 - Relocate existing equipment within the substation to accommodate the new transformer.

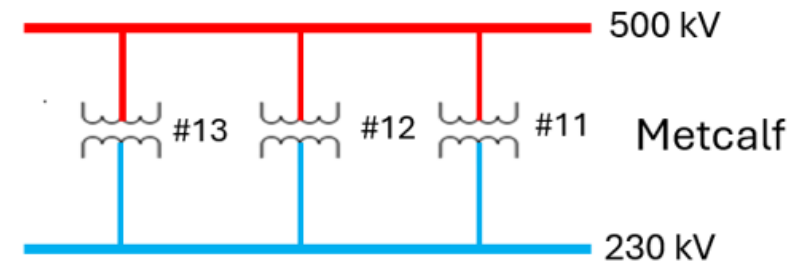


Figure 1- Pre-Project Single Line Diagram

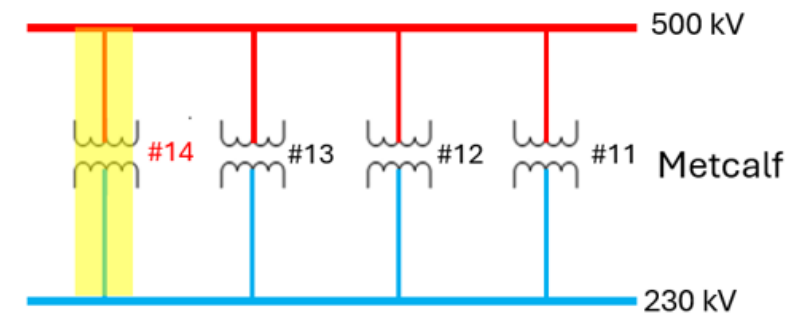


Figure 2- Proposed Single Line Diagram

- **Proposed In-Service Date**

- May 2034 or earlier

- **Estimated Cost**

- \$91M - \$182M*

- **Other Alternatives Considered**

- Alternative 1: Status Quo

This alternative is not recommended because it does not mitigate the NERC TPL P6 violations.

- Alternative 2: Energy Storage

This alternative is not recommended because the energy storage would not be able to mitigate the overload for future load increases.

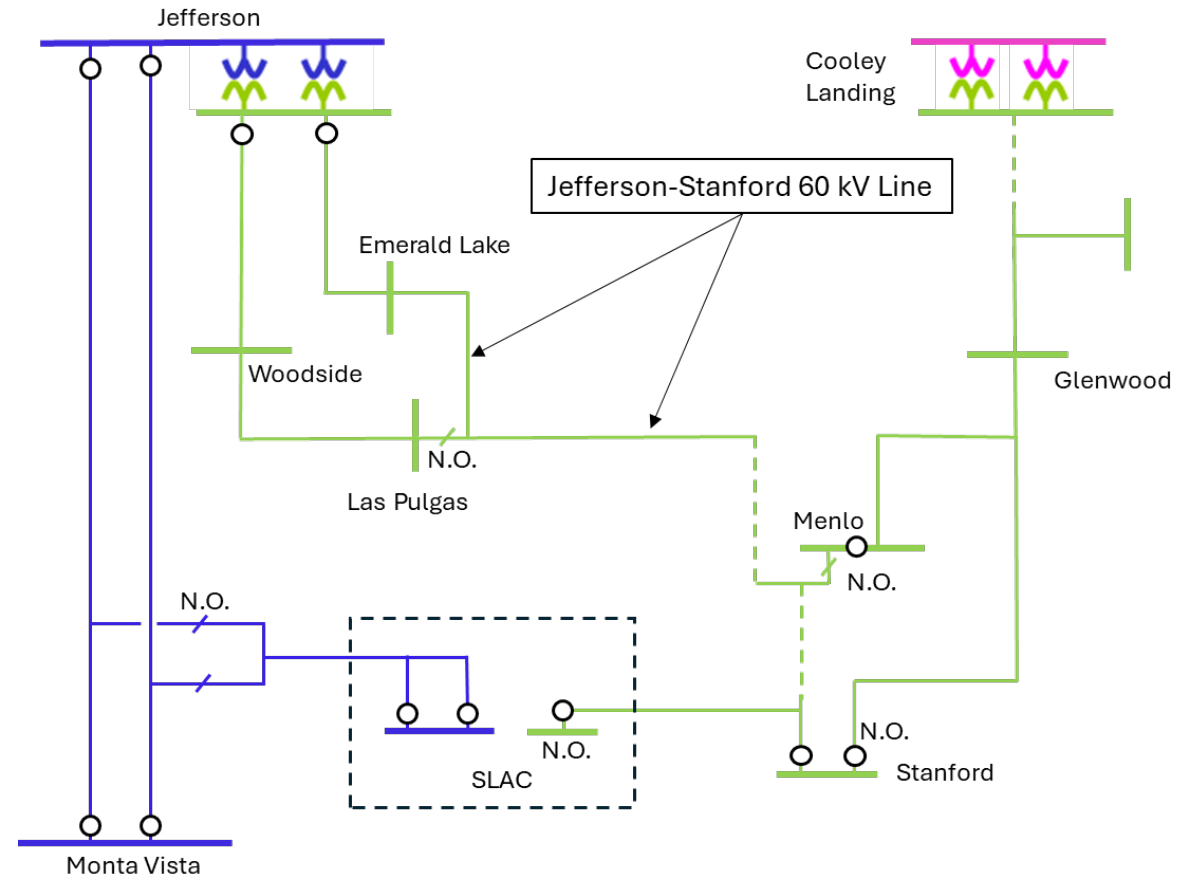
*AAE Level 5 quality estimates includes a +100% contingency

JEFFERSON-STANFORD 60 KV MENLO TO SLAC TAP RECABLING PROJECT



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- The Jefferson-Stanford 60 kV line is located in the Peninsula, Emerald Hills to West Menlo Park area. Powered by the Jefferson 60 kV switchyard, the line normally serves Emerald Lake Substation and Stanford University.
- The 60 kV transmission line has multiple overhead and underground sections. A recent underground cable rating study resulted in a 10% derate to the Menlo-SLAC Tap underground cable section.
- The historical peak load downstream of the Underground Cable can reach as high as 55MVA. If such peak demand returns, compounded with the derate, a normal overload condition could arise.





Assessment Results

- **Contingency Description:**
 - P0 (Normal Condition)
- **Power Flow Results:**

Monitored Facility		Pre-Project		Post-Project		Contingency
Facility Name	Rating (MVA)	2026 (%)	2029 (%)	2026 (%)	2029 (%)	Category
Menlo-SLAC 60 kV Tap UG Section	525	104.9	105.4	48.8	49.0	P0

- **Project Objectives**

Mitigate thermal overload under P0 condition

- **Preferred Scope**

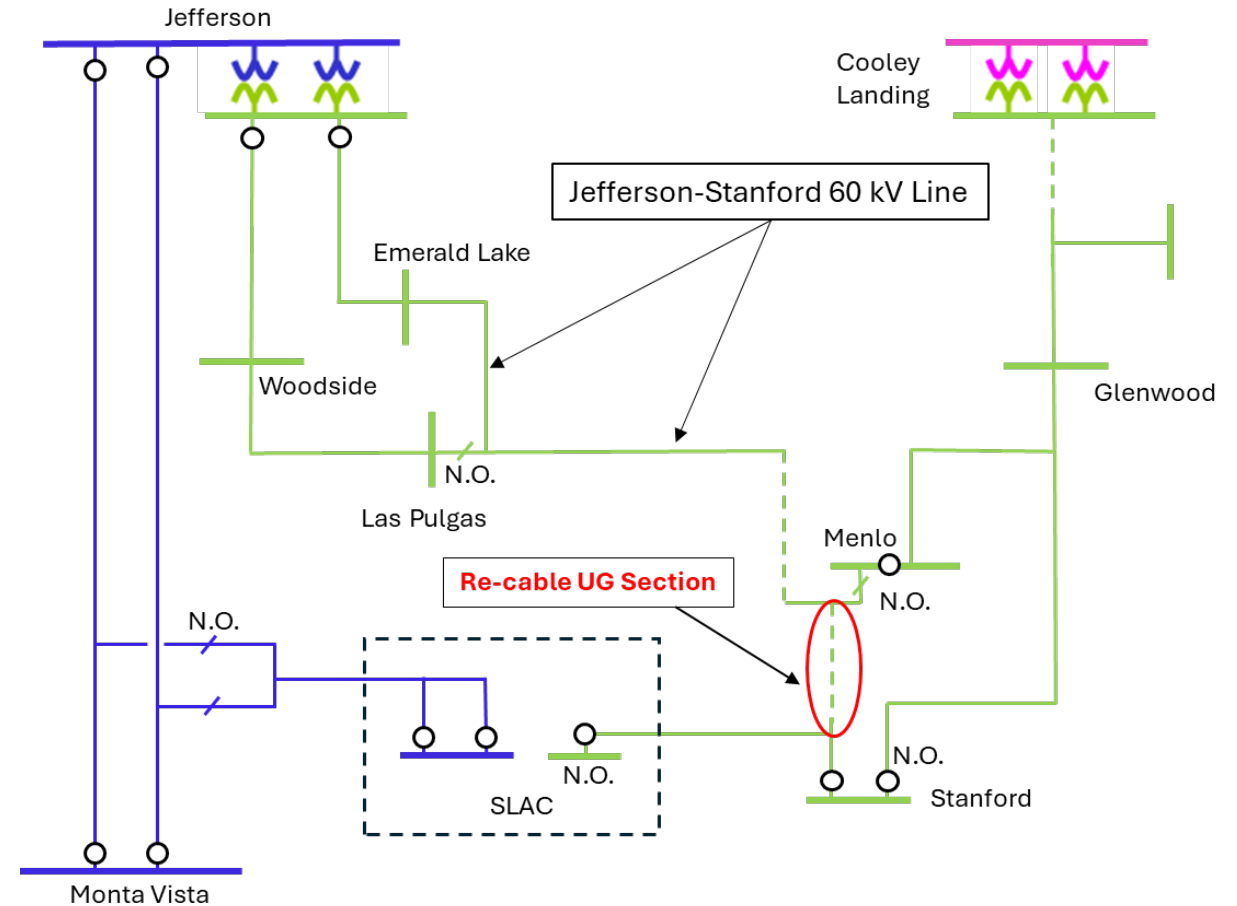
Replace existing cable (approx. 1 mile in length) with new and higher capacity cable

- **Proposed In-service Date**

— May 2029 or earlier

- **Estimated Cost**

— \$20 M-\$40 M*



*AACE Level 5 quality estimates includes a +100% contingency



Proposed Project (cont.)

- **Other Alternatives Considered**

- Alternative 1: Status Quo

- Not recommended. This alternative does not mitigate the NERC TPL P0 violation.

- Alternative 2: Replace Underground Cable With Overhead Line Permanently

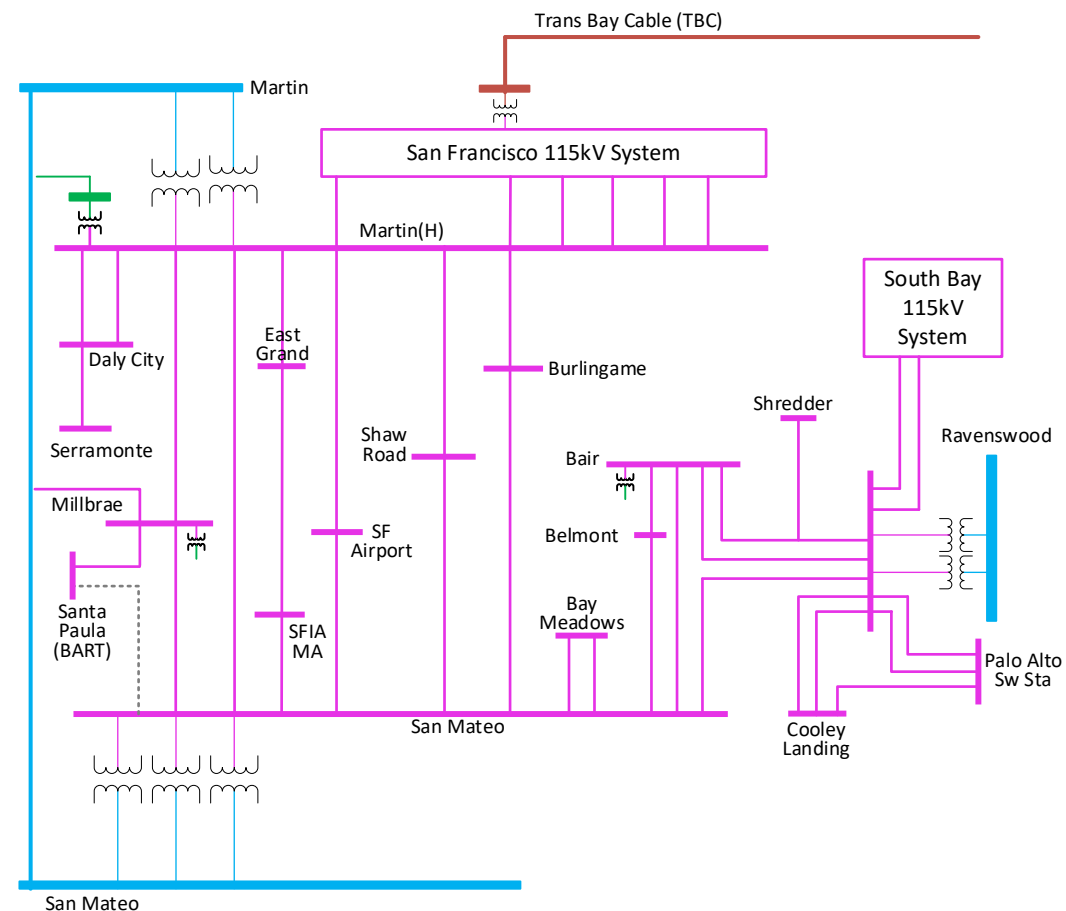
- Not recommended. Existing is an underground facility; choosing this alternative will generate local opposition.

SAN MATEO 230/115KV TRANSFORMER BANK ADDITION PROJECT



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- The San Mateo substation is in the Peninsula.
- Three existing 230/115kV banks at the San Mateo substation serve as one of the main sources feeding the San Francisco and the Peninsula 115kV system. Besides San Mateo 230/115kV banks, the other sources feeding the pocket include Trans Bay Cable, Martin and Ravenswood from North to South.
- The demand in this pocket is mainly driven by the distribution customers in San Francisco, and Peninsula area, the newly interconnected large load, such as data center, etc.





Assessment Results

- **Contingency Description:**
 - P6: San Mateo 230/115kV Bank No. 5 and 6 Outage

- **Power Flow Results:**

Monitored Facility		Pre-Project			Post-Project	Contingency	
Facility Name	Rating (MVA)	2026 (%)	2029 (%)	2034 (%)	2034 (%)	Category	Contingency Name
San Mateo 230/115kV Bank No. 7	462	120	123	138	93%	P6	P6: San Mateo 230/115kV Bank No. 5 and 6 Outage

- **Project Objectives:** This project protects against this NERC TPL-001-5 Category P6 violations and can mitigate the observed thermal violations.

- **Preferred Scope**

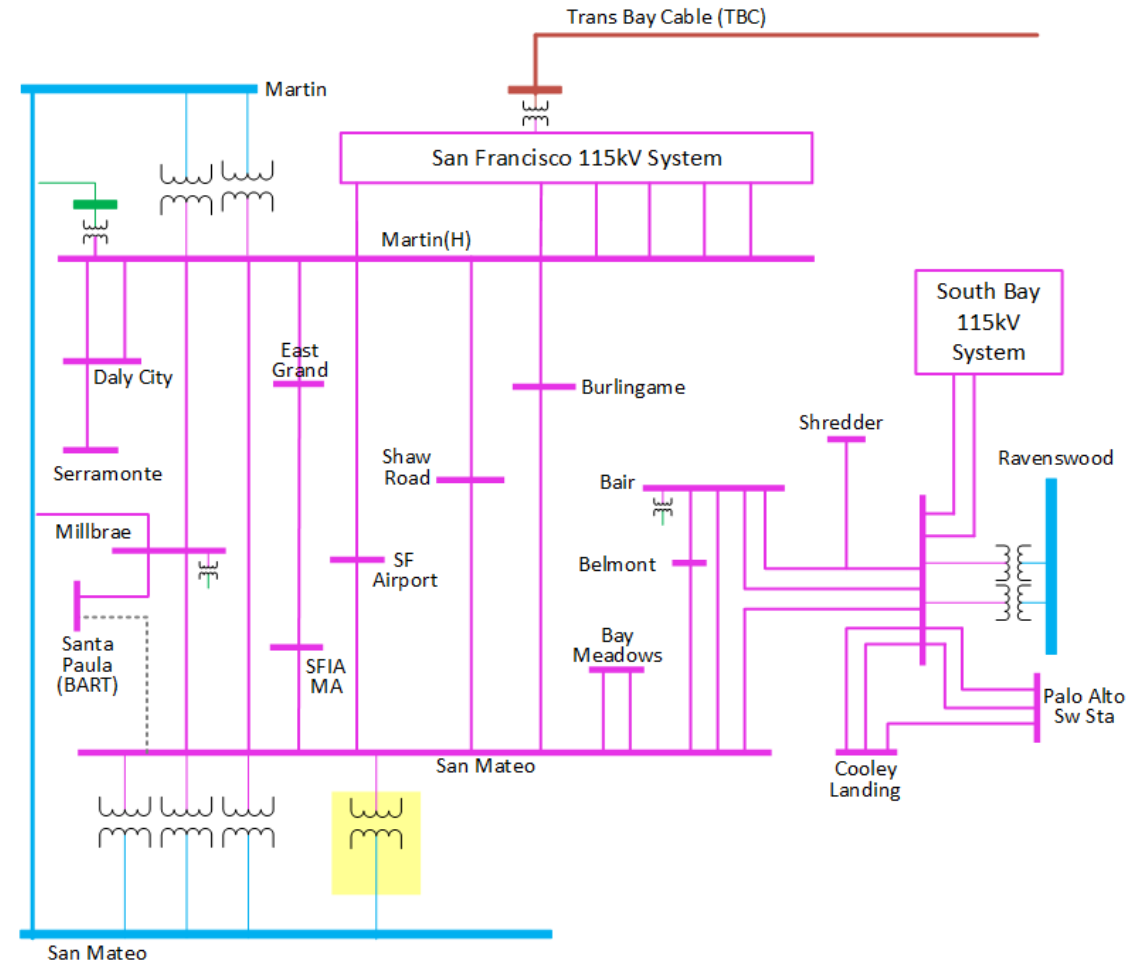
- Install a new 230/115 kV transformer at the San Mateo Substation to achieve minimum 420 MVA of summer normal rating and 462 MVA of summer emergency rating.
- Upgrade San Mateo 230 kV bus and any limiting components as necessary to achieve full transformer capacity.

- **Proposed In-Service Date**

- May 2032 or earlier

- **Estimated Cost**

- \$55M - \$110M*



*ACE Level 5 quality estimates includes a +100% contingency

- **Other Alternatives Considered**

- Alternative 1: Status Quo

This alternative is not recommended because it does not mitigate the NERC TPL P6 violations.

- Alternative 2: Energy Storage

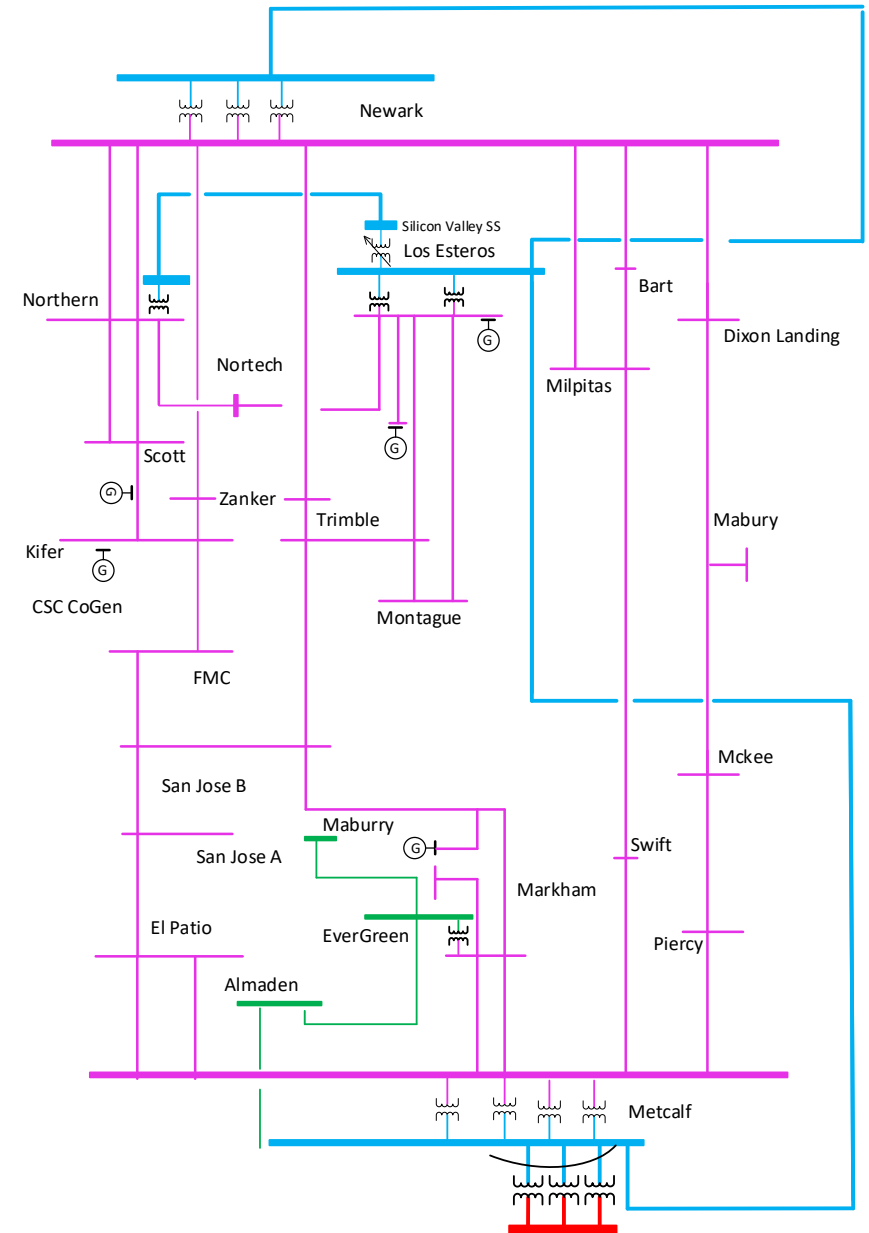
This alternative is not recommended because the energy storage charging capability is limited by the existing transformer/line capacity and will be further limited by the future load increase.

SOUTH BAY 115KV SYSTEMS REINFORCEMENT PROJECT (CONCEPTUAL)



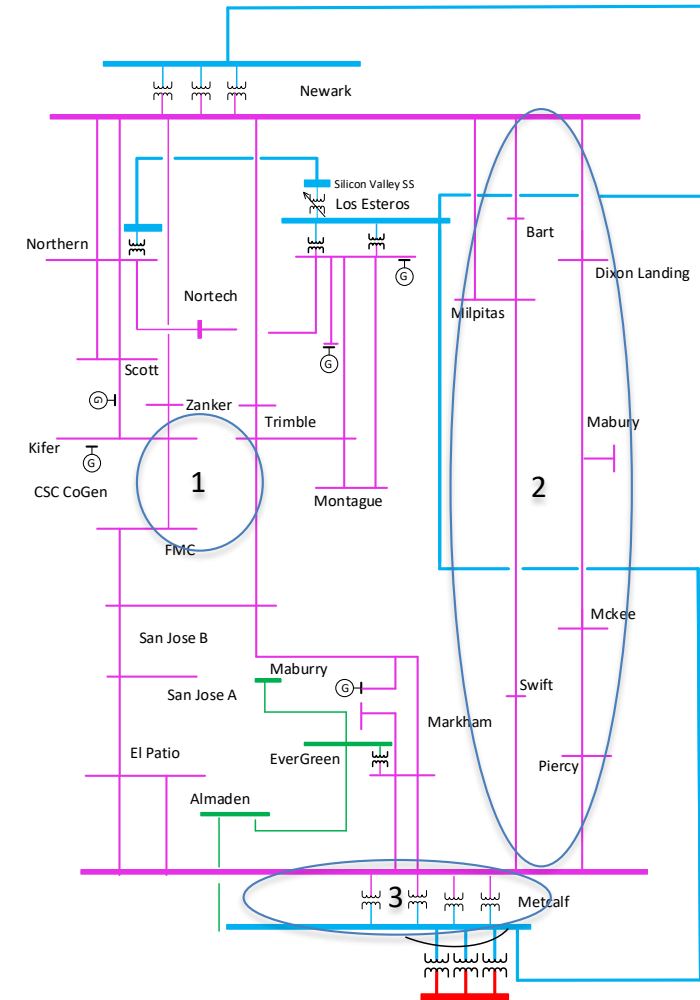
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- South Bay planning area is in Santa Clara County.
- The Silicon Valley Power (SVP) is within this area. Three SVP receiving stations receive power supplied from the PG&E 230kV and 115kV systems.
- The rest of the area is mainly served by the PG&E 115kV systems.
- This area hosts a lot of high-tech companies and serves as the warm bed for a lot of new technologies, such as Artificial Intelligence.
- The load forecast in this area is expected to increase about 56% from 2026 to 2039.

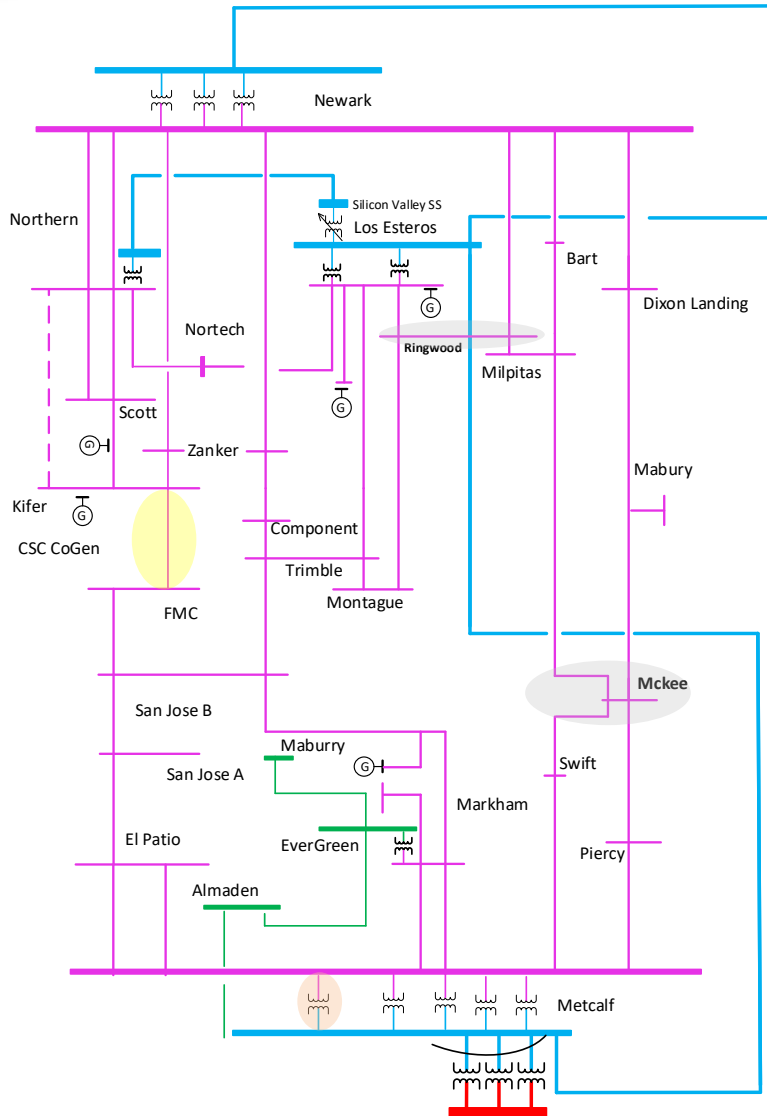


Project Alternatives (Conceptual)

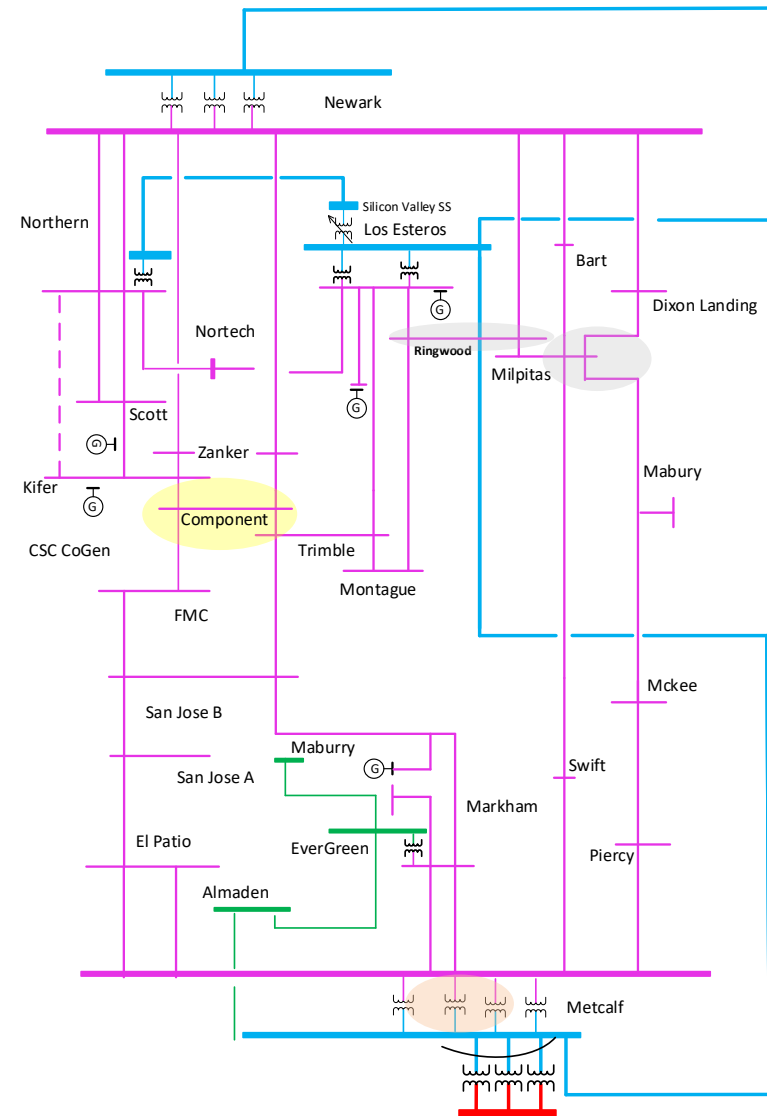
- **Project Objectives:** This project protects against possible NERC TPL-001-5 violations due to load increase in this area.
- **Project Alternatives Scope**
 - The 115kV system Reinforcement 1: PG&E and SVP 115kV Corridor Upgrade
 - Alternative 1A: Reconductor Kifer – FMC 115kV line
 - Alternative 1B: Loop the Component substation into the Kifer-FMC line and reconductor Kifer-Component and Component-Trimble 115kV line.
 - The 115kV system Reinforcement 2: East San Jose Capacity Upgrades
 - Project 1A: Combining the two 115 kV paths: Newark-Dixon Landing-McKee-Piercy-Metcalf and Newark-Milpitas/Ringwood-Swift-Metcalf, proposed location is McKee
 - Project 1B: Combining the two 115 kV paths: Newark-Dixon Landing-McKee-Piercy-Metcalf and Newark-Milpitas/Ringwood-Swift-Metcalf, proposed location is Milpitas
 - Project 2: Looping Los Esteros-Montague 115 kV line to Ringwood to connect Los Esteros to the East San Jose load pocket.
 - The 115kV system Reinforcement 3: Metcalf Substation 230/115kV Reinforcement
 - Alternative 3A: Adding the fifth 230/115kV transformer at the Metcalf Substation
 - Alternative 3B: Upgrade the 230/115kV banks to at least current standard size



Project Alternatives (Conceptual) (cont.)



- The 115kV system Reinforcement 1: PG&E and SVP 115kV Corridor Upgrade
- The 115kV system Reinforcement 2: East San Jose Capacity Upgrades
- The 115kV system Reinforcement 3: Metcalf Substation 230/115kV Transformer



- The 115kV system Reinforcement 1: PG&E and SVP 115kV Corridor Upgrade
- The 115kV system Reinforcement 2: East San Jose Capacity Upgrades
- The 115kV system Reinforcement 3: Metcalf Substation 230/115kV Transformer