

PG&E's 2019 Request Window Proposals

CAISO 2019-2020 Transmission
Planning Process

September 26, 2019

Seven Projects Seeking CAISO Approval:

Yosemite/Fresno

- Borden 230/70 kV Transformer Bank #1 Capacity Increase
- Wilson-Oro Loma 115 kV Line Reconductoring

Stockton

- Bellota 230 kV Bus Upgrade

Greater Bay Area

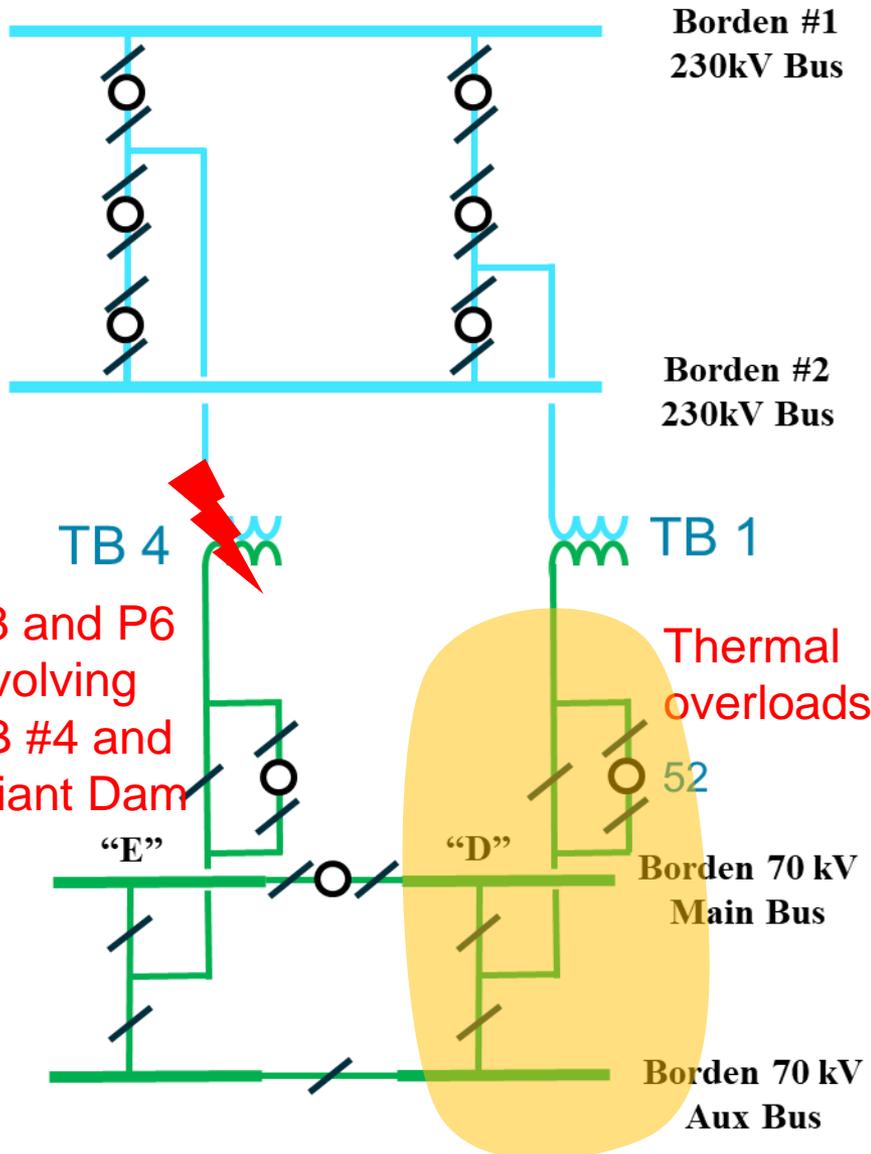
- East Shore 230 kV Bus Terminals Reconfiguration
- Newark 230/115 kV Transformer Bank #7 Circuit Breaker Addition
- Northern Oakland Area Reinforcement

North Coast/North Bay

- Tulucay-Napa #2 60 kV Line Capacity Increase

BORDEN 230/70 KV TRANSFORMER BANK #1 CAPACITY INCREASE

Area Background



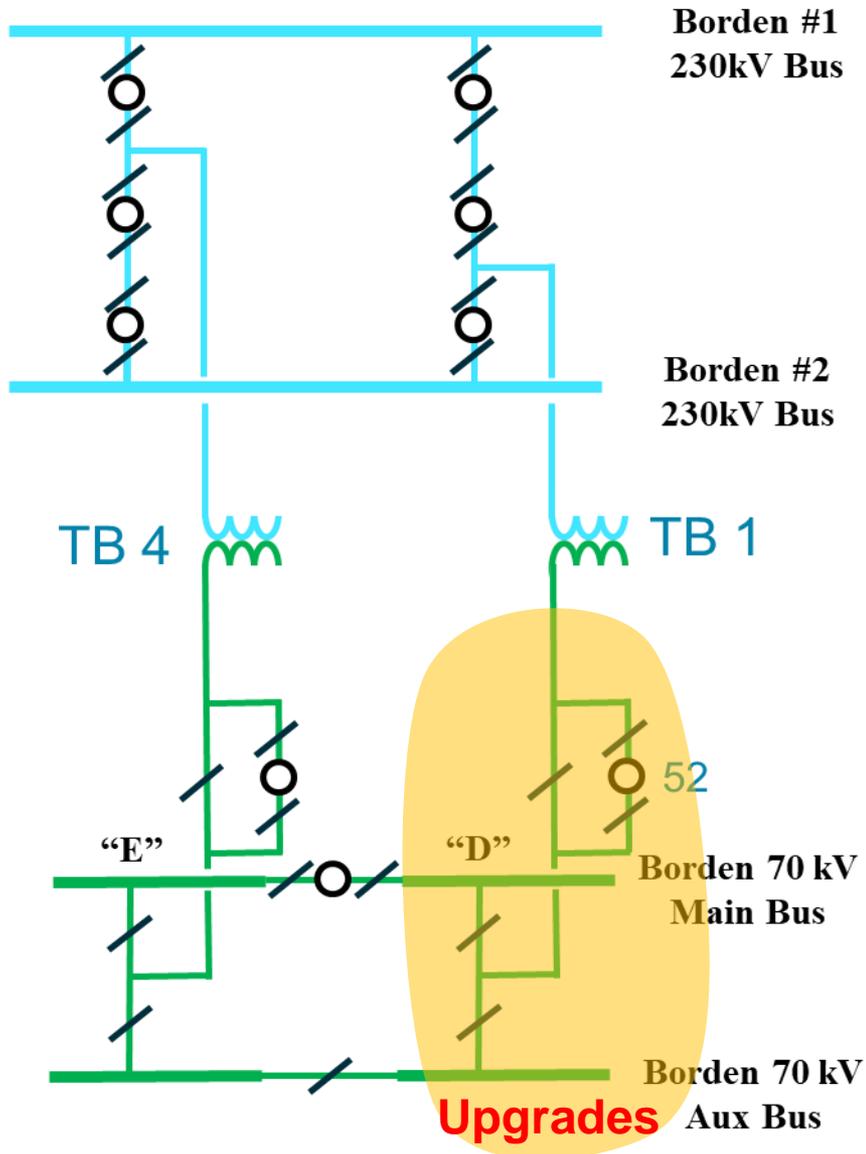
- Borden substation serves as the main source of power for City of Madera and its surrounding areas. Friant Dam Power Plant serves as another source for this area.
- 200 MVA (Normal) / 220 MVA (Emergency) for both Borden 230/70 kV transformers.
- Several limiting elements exist for TB #1, including section “D” of the 70 kV bus and bank breaker etc.
- TB #1 is currently rated as 114 MVA (Normal) /141 MVA (Emergency) in base line models.

Contingency Description:

- P3: Friant Dam Gen Unit 2 and Borden 230/70 kV TB4
- P6: Borden 230/70 kV TB4 and Friant-Coppermine 70 kV line

Power Flow Results:

Fresno Peak		Pre-Project			Post-Project	Contingency	
Facility	Rating* (MVA)	2021	2024	2029	2029	Category	Contingency Name
Borden 230/70 kV Transformer Bank 1	141	105.7%	110.9%	107.7%	69.0%	P3	Friant Dam 6.60kV Gen Unit 2 & Borden 230/70kV TB 4
Borden 230/70 kV Transformer Bank 1	141	110.4%	115.6%	112.5%	72.1%	P6	Borden 230/70kV TB 4 & Friant - Coppermine 70kV



Preferred Scope

- Upgrade breaker CB 52 and associated switches to match the Transformer Bank 1's full capacity
- Upgrade Borden 70 kV bus section "D" to match the Transformer Bank 1's full capacity

Proposed In-Service Date

- Jan. 2025

Estimated Cost

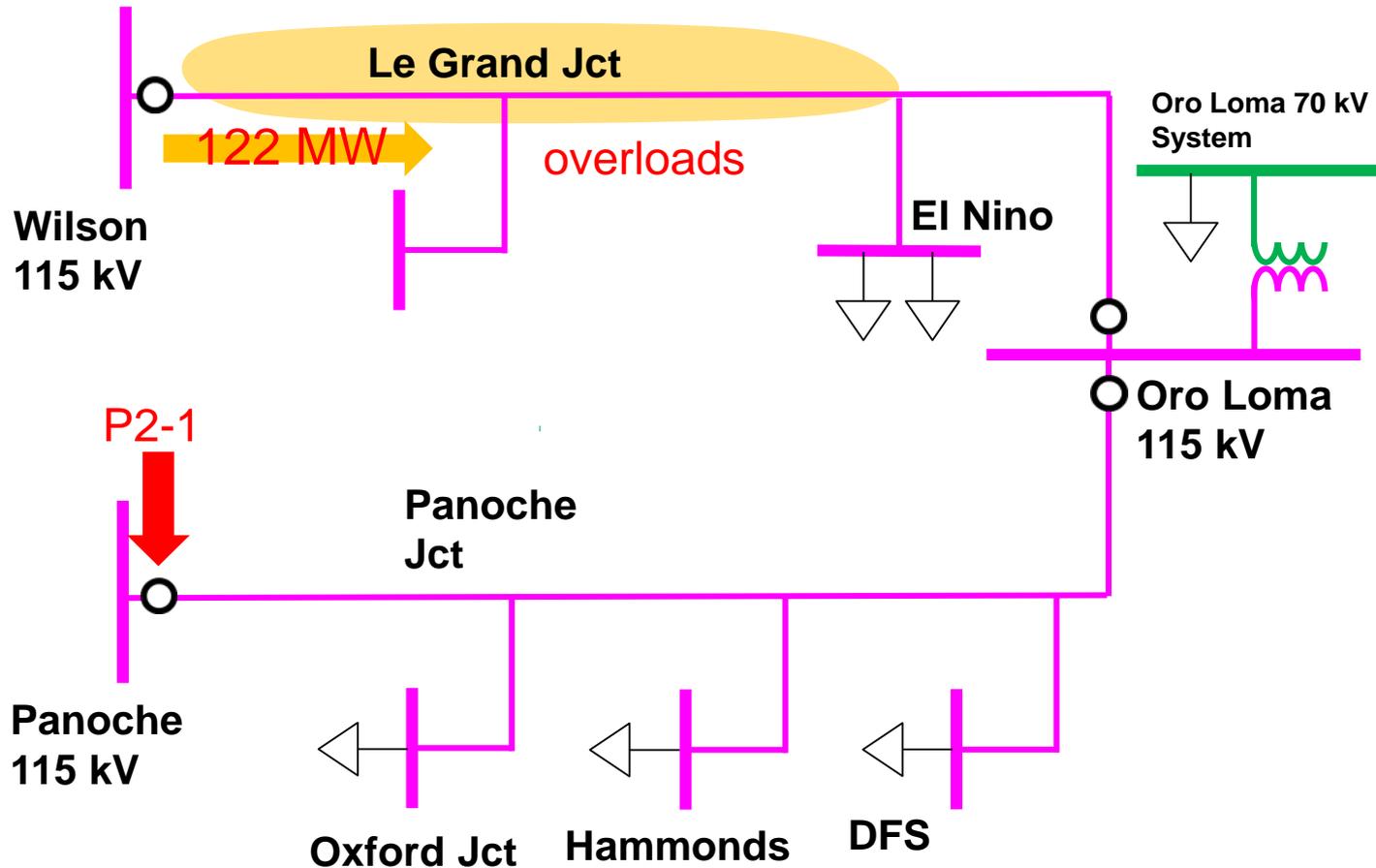
- \$11.5 M - \$23 M*

Other Alternatives Considered

- Status Quo
- Energy storage

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

WILSON-ORO LOMA 115 KV LINE RECONDUCTORING



- 120 MW in this pocket
- Panoche-Oro Loma 115 kV Line and Wilson-Oro Loma 115 kV Line serve as the sources.
- Panoche substation serves as the main source in base line cases.

Contingency Description:

- **P2-1: Opening the Panoche end of Panoche-Oro Loma line without a fault such that all the loads are served by Wilson-Oro Loma 115 kV line from a single source point.**

Power Flow Results:

Fresno Peak		Pre-Project			Post-Project	Contingency	
Facility	Rating* (A)	2021	2024	2029	2029	Category	Contingency Name
Wilson – Oro Loma 115 kV Line (Wilson-008/002)	512	107.7%	111.6%	123.6%	82.4%	P2-1	Panoche – Oro Loma 115 kV
Wilson – Oro Loma 115 kV Line (008/002-EL NIDO)	514	107.2%	111.2%	123.2%	82.4%	P2-1	Panoche – Oro Loma 115 kV
Wilson – Oro Loma 115 kV Line (Wilson-008/002)	512	107.7%	111.6%	123.5%	82.3%	P2-2	Panoche 2 115kV Section 2D
Wilson – Oro Loma 115 kV Line (008/002-EL NIDO)	514	107.3%	111.1%	123.1%	82.3%	P2-2	Panoche 2 115kV Section 2D
Wilson – Oro Loma 115 kV Line (Wilson-008/002)	512	107.6%	111.6%	124.3%	82.7%	P2-4	Panoche 1 Section 1D & Panoche 2 Section 2D 115kV
Wilson – Oro Loma 115 kV Line (008/002-EL NIDO)	514	107.2%	111.2%	123.9%	82.7%	P2-4	Panoche 1 Section 1D & Panoche 2 Section 2D 115kV

Preferred Scope

- Reconductor ~9 circuit miles between Wilson and El Nido Substation (Wilson-002/004 section and 008/002-El Nido section) on the Wilson-Oro Loma 115 kV Line with larger conductor to achieve at least 650 Amps of summer emergency rating (preferably 715.5-37 AAC conductor).
- Remove any other limiting elements

Begin Point	WILSON	002/004	008/002
End Point	002/004	008/002	EL NIDO
Conductor	336.4-30/7,ACSR	715.5-37,AAC	397.5-19,AAC
ET Conductor Grouping	SINGLE	SINGLE	SINGLE
Conductor Loading Zone	N	N	N
Normal Wind Speed	2	2	2
Emergency Wind Speed	2	2	2
Section Length (in Miles)	2.72	5.53	6.51

Proposed In-Service Date

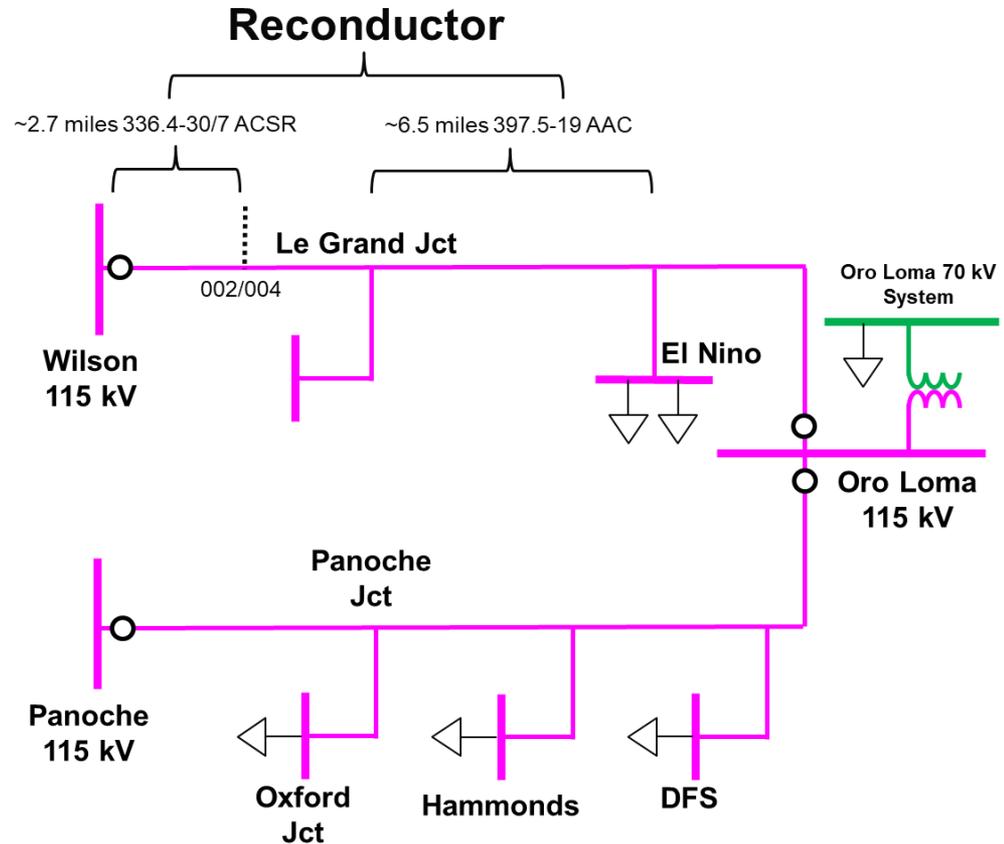
- Jan. 2026

Estimated Cost

- \$11.3 M - \$22.7 M*

Other Alternatives Considered

- Status Quo
- Rerate
- Energy storage

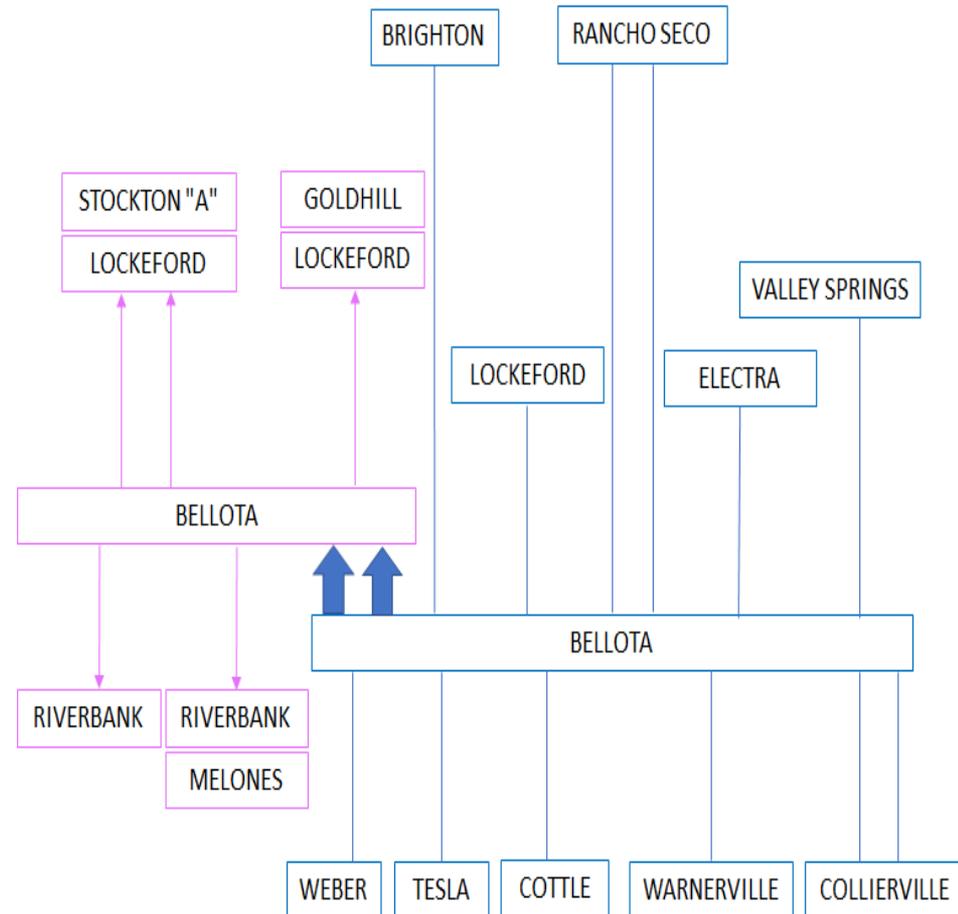


*AACE Level 5 quality estimates includes a +100% contingency

BELLOTA 230 KV BUS UPGRADE

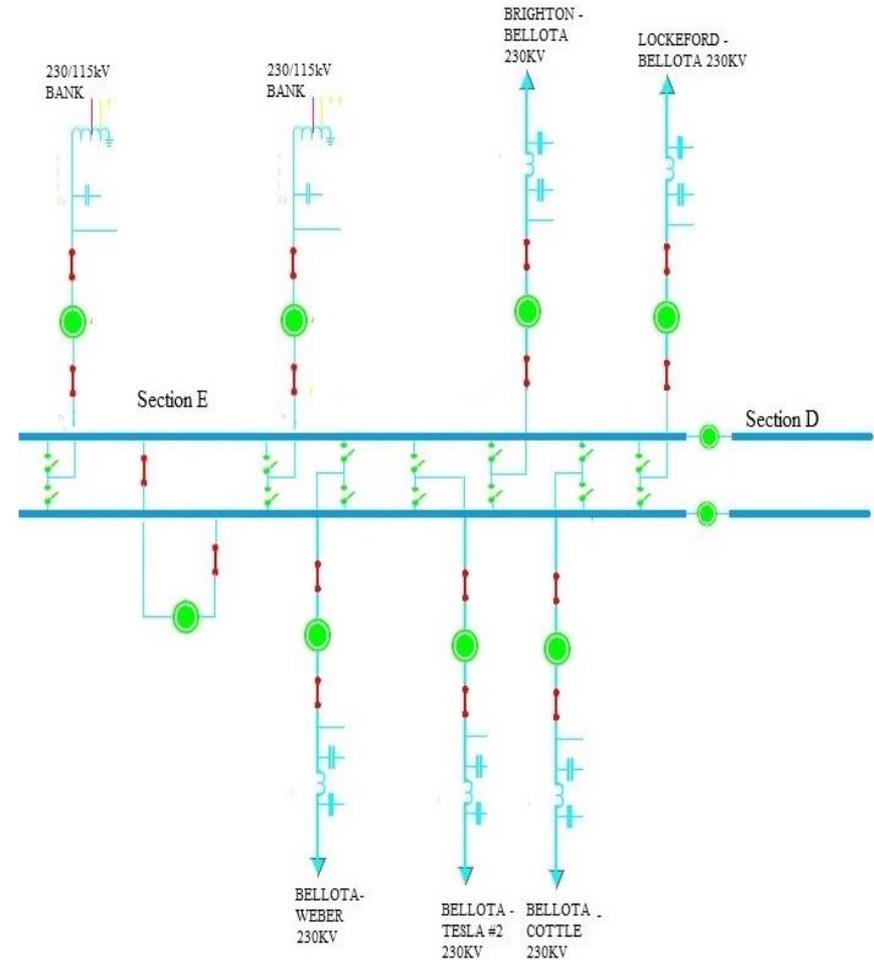
Area Background

- Bellota is located east of the city of Stockton in San Joaquin County.
- Bellota substation, Tesla substation and local generators are major sources to Stockton 115 kV Load pocket.
- Bellota Substation has 12 - 230 kV transmission lines; two (2) 230-115 kV, 200 MVA transformer banks and five (5) 115 kV transmission lines



Bellota 230 kV Bus Configuration

- Bellota 230 kV Bus is a double bus, single breaker with two sections (Section D and Section E).
- Both transformer banks and Lockeford-Bellota 230 kV, Brighton-Bellota 230 kV, Bellota-Cottle 230 kV, Bellota-Weber 230 kV, Bellota-Tesla #2 230 kV Lines are connected to the section E

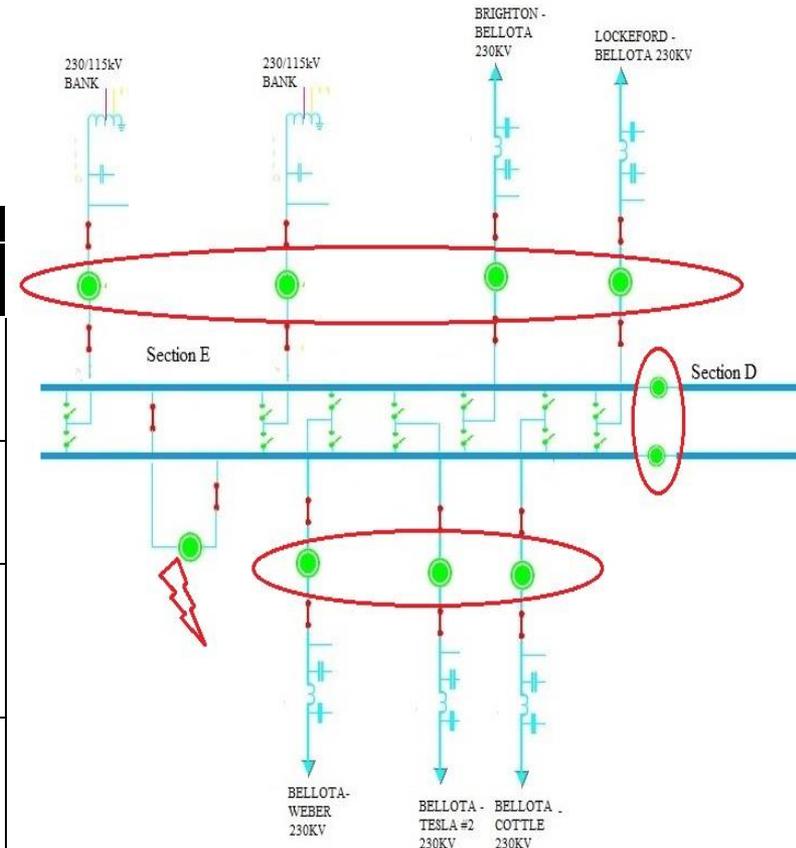


Contingency Description:

Simultaneous loss of transformer bank #1 & bank #2 due to fault at bus tie breaker of Bellota 230 kV section E will lead to loss of Bellota source to the area load pocket and local voltage collapse under summer peak condition.

Power Flow Results:

Facility Name	Facility Rating (MVA)	Pre Project			Post Project	Contingency	
		2021	2024	2029	2029	Category	Contingency Name
HAMMER - COUNTRY CLUB 60KV	62.4	NConv (DC 104.6%)	NConv (DC 106.9%)	NConv (DC 91.9%)	96.2%	P2-4	BELLOTA 230KV - SECTION 1E & 2E
STANISLS-MELONES-RIVRBKJT 115kV	64.9	NConv (DC 115.6%)	NConv (DC 121.0%)	NConv (DC 124.4%)	<70.0%	P2-4	BELLOTA 230KV - SECTION 1E & 2E
STANISLAUS-MELONES SW STA-MANTECA #1 115kV	64.9	NConv (DC 103.5%)	NConv (DC 108.4%)	NConv (DC 111.8%)	<70.0%	P2-4	BELLOTA 230KV - SECTION 1E & 2E
BELLOTA-RIVERBANK-MELONES SW STA 115kV	102.4	NConv (DC 166.0%)	NConv (DC 170.4%)	NConv (DC 173.4%)	<70.0%	P2-4	BELLOTA 230KV - SECTION 1E & 2E

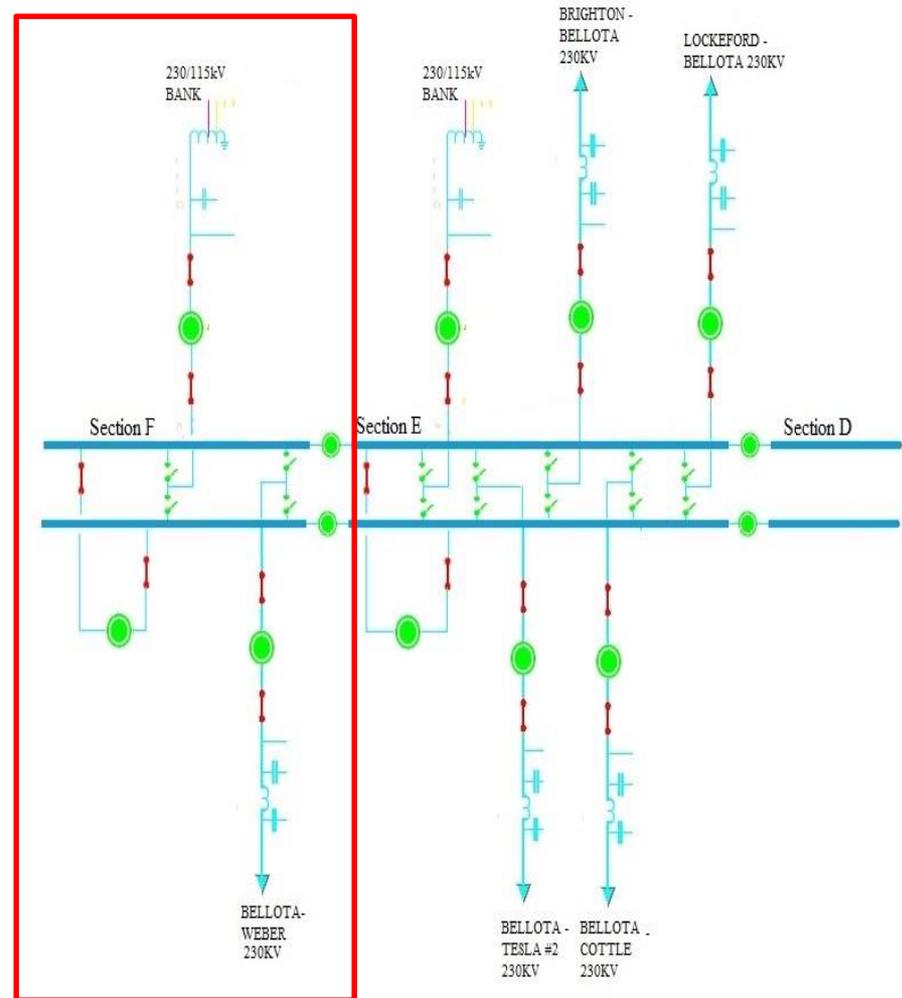


Project Objective:

- This project will mitigate the voltage collapse due to NERC category P2 internal breaker fault on Section E of Bellota 230 kV bus

Preferred Scope

- Expand and split Section E of Bellota 230 kV to separate into two sections
- Relocate the terminals of 230/115 kV Transformer bank #2 and Bellota-Weber 230 KV line to the new section
- Make protection system upgrades as required



New Section E

Proposed In-Service Date

- January 2026

Estimated Cost

- \$20M to \$40M*

Other Alternatives Considered

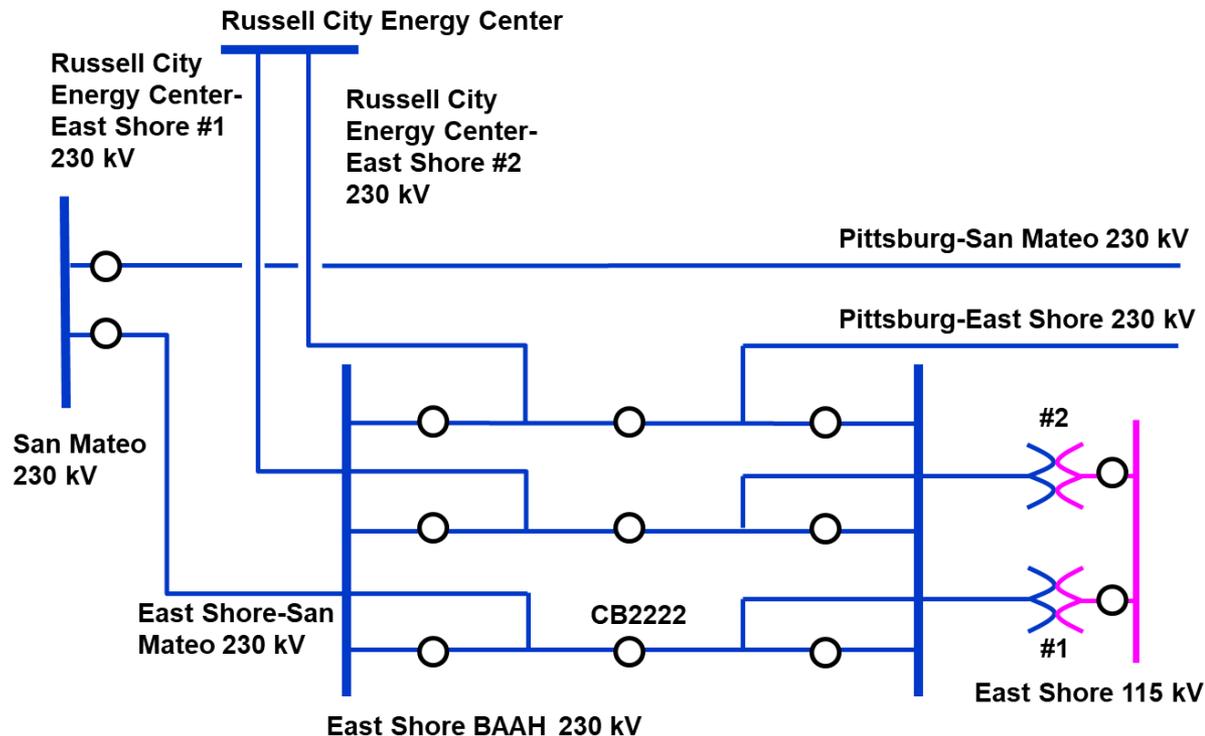
- Convert Section E of Bellota 230kV bus to BAAH. this alternative is not recommended due to its higher cost.
- Connect Bellota 230/115 kV Bank #2 to section 2D using underground cable or relocating the transformer. This alternative is not recommended because it will create new NERC P2 violations

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

EAST SHORE 230 KV BUS TERMINALS RECONFIGURATION

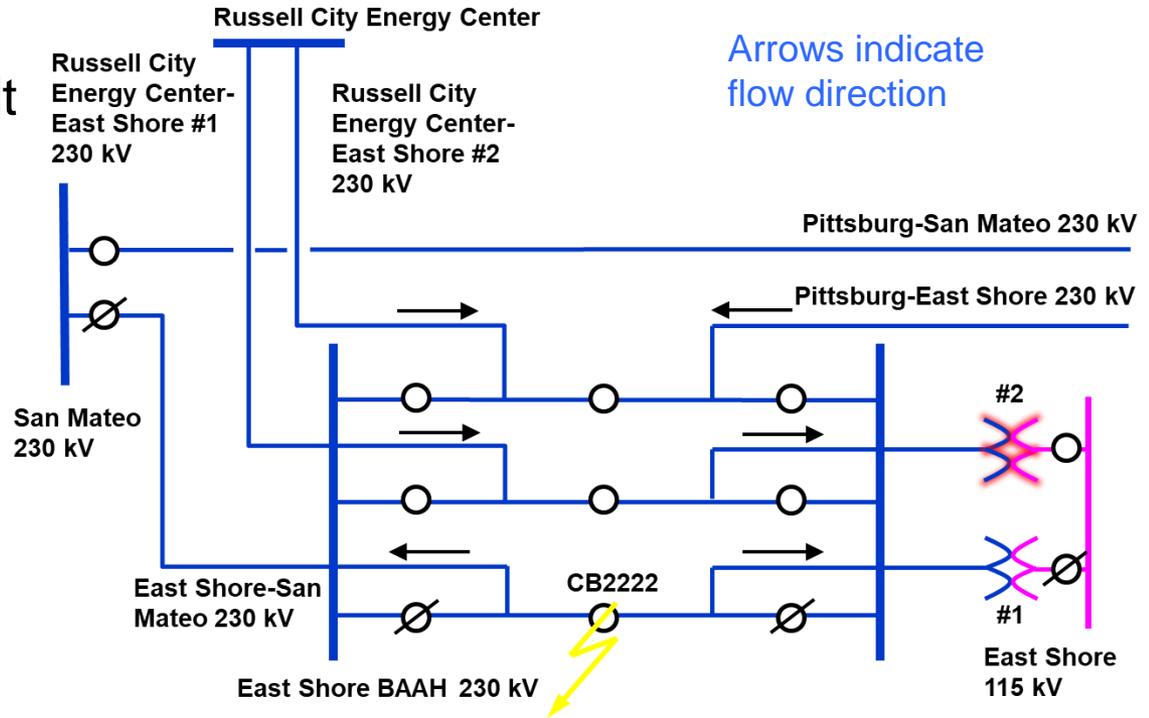
Area Background

- East Shore Substation is located in the City of Hayward within the Mission division and serves as a 230 kV source for the local 115 kV system, including Grant, Mt. Eden, and Dumbarton Substations.
- East Shore Substation is connected with Pittsburg, San Mateo and Russell City Energy Center (RCEC) so that it can deliver the power to the Peninsula area via the East Shore-San Mateo 230 kV line and serve the local load via transformer bank #1 and #2



Contingency Description:

- P2-3 internal breaker fault CB 2222
- East Shore-San Mateo 230 kV line and 230/115 kV Transformer bank #1 tripped



Power Flow Results:

#	Facility	Facility Rating (MVA)	Pre Project			Post Project		Contingency	
			2021	2024	2029	2024	2029	Category	Contingency Name
1	EAST SHORE 230/115 kV TRANSFORMER NO. 2	462 MVA	105%	105%	111.4%	57.5%	71.5%	P2	P2-3: E. SHORE 230kV - Middle Breaker Bay 3

Project Objective:

- Pair one import line (power flowing into the bus) with one export line (power flowing out from the bus) in each bay

Preferred Scope

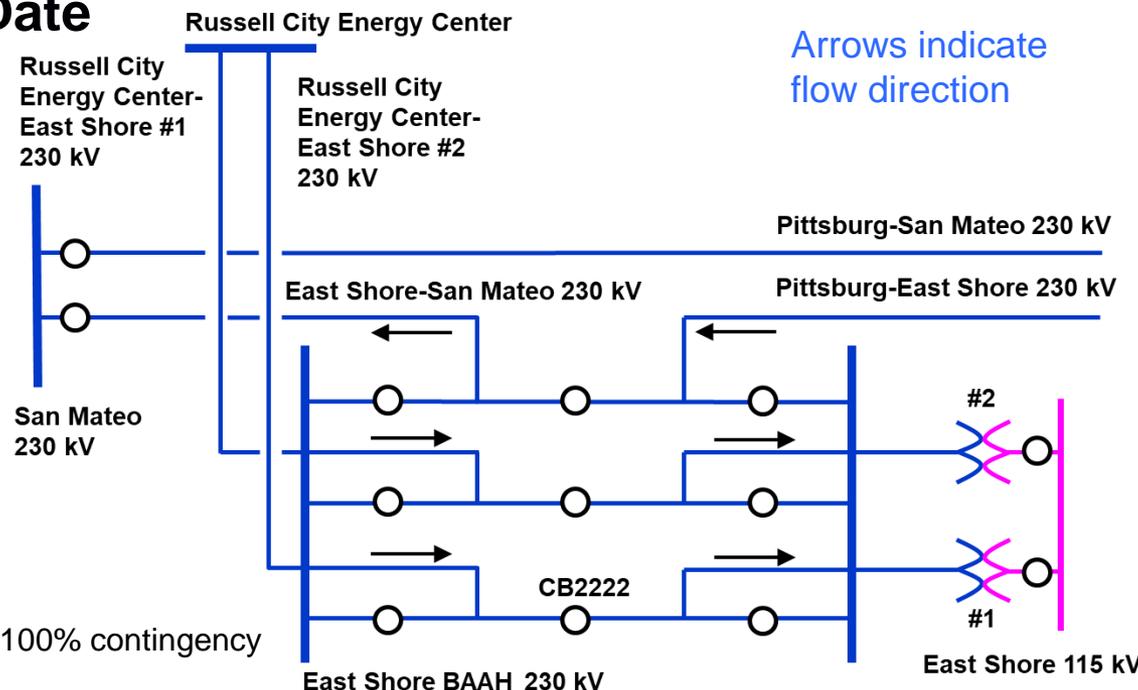
- Swap East Shore - San Mateo 230 kV line and Russell City Energy Center- East Shore #2 line terminal positions at East Shore 230 kV BAAH Substation

Proposed In-Service Date

- January 2024

Estimated Cost

- \$2M - \$4M*



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

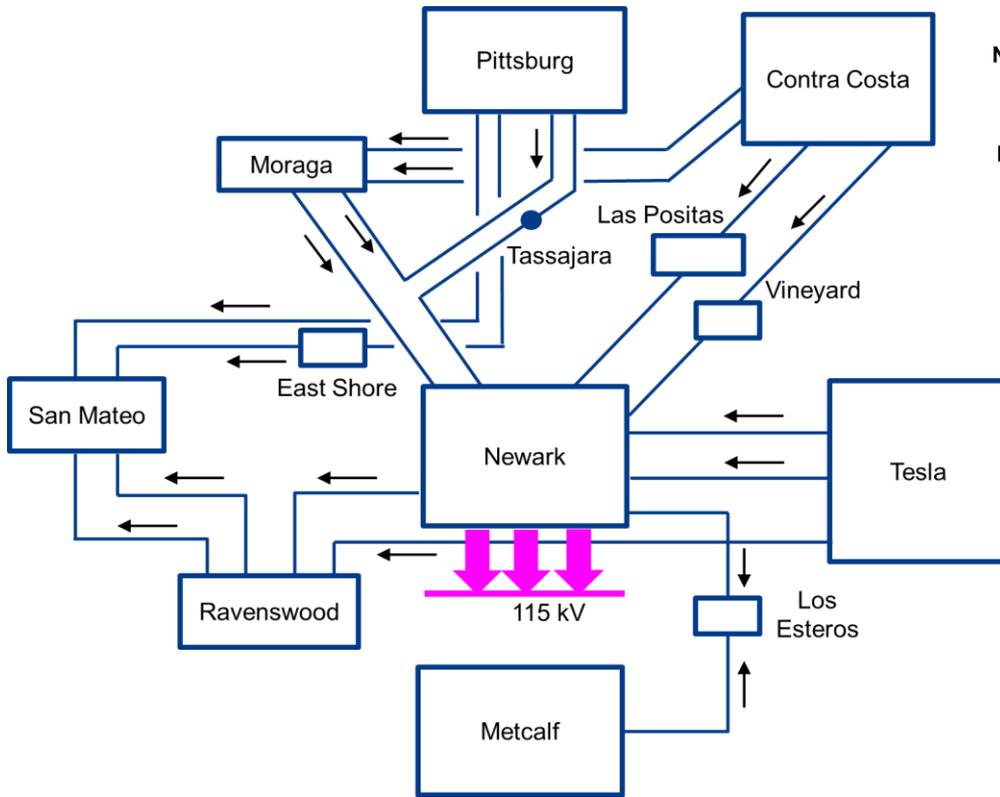
Other Alternatives Considered

- Swap transformer BK1 and Russell City Energy Center - East Shore #1 terminal positions
- Swap transformer BK1 and Russell City Energy Center - East Shore #2 terminal positions

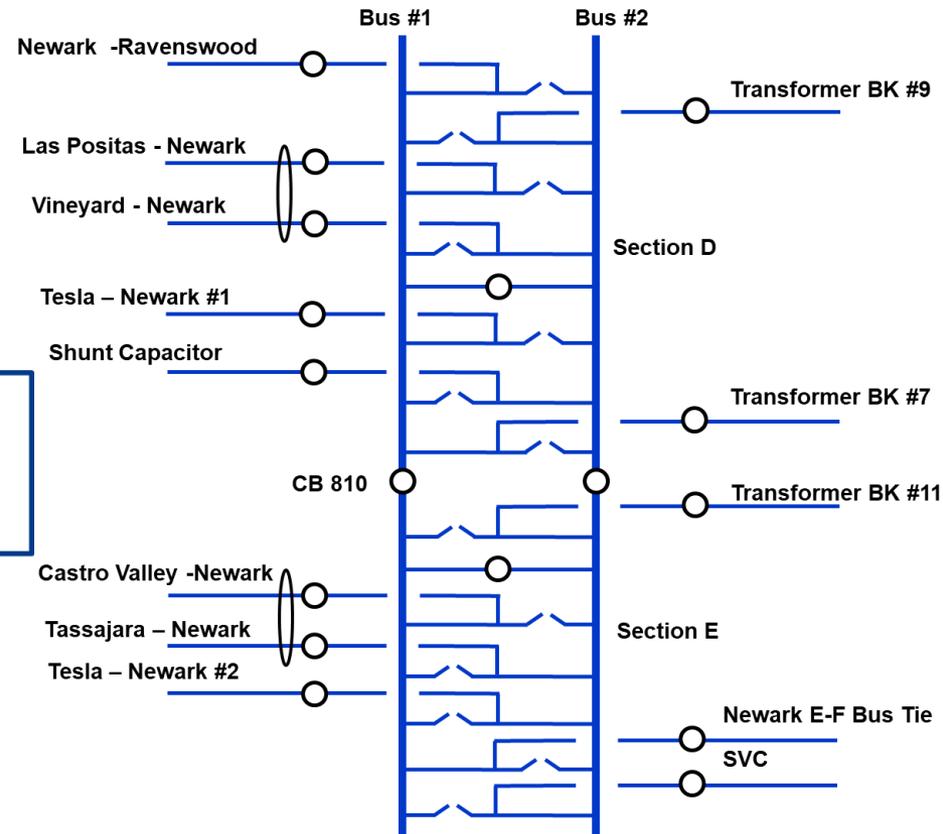
NEWARK 230/115 KV TRANSFORMER BANK #7 CIRCUIT BREAKER ADDITION

- Newark Substation is located in the City of Fremont (Mission division)
- It serves as a critical substation which transfers power from Pittsburg, Contra Costa and Tesla 230 kV substations to the South Bay, San Francisco and Peninsula areas.
- It has direct connections with Diablo, East Bay, Peninsula, South Bay, and Stockton areas with numerous 230 kV and 115 kV transmission lines.
- Newark Substation serves as a main source of power for the South Bay 115 kV system through three 230/115 kV transformer banks.

Newark Transmission System



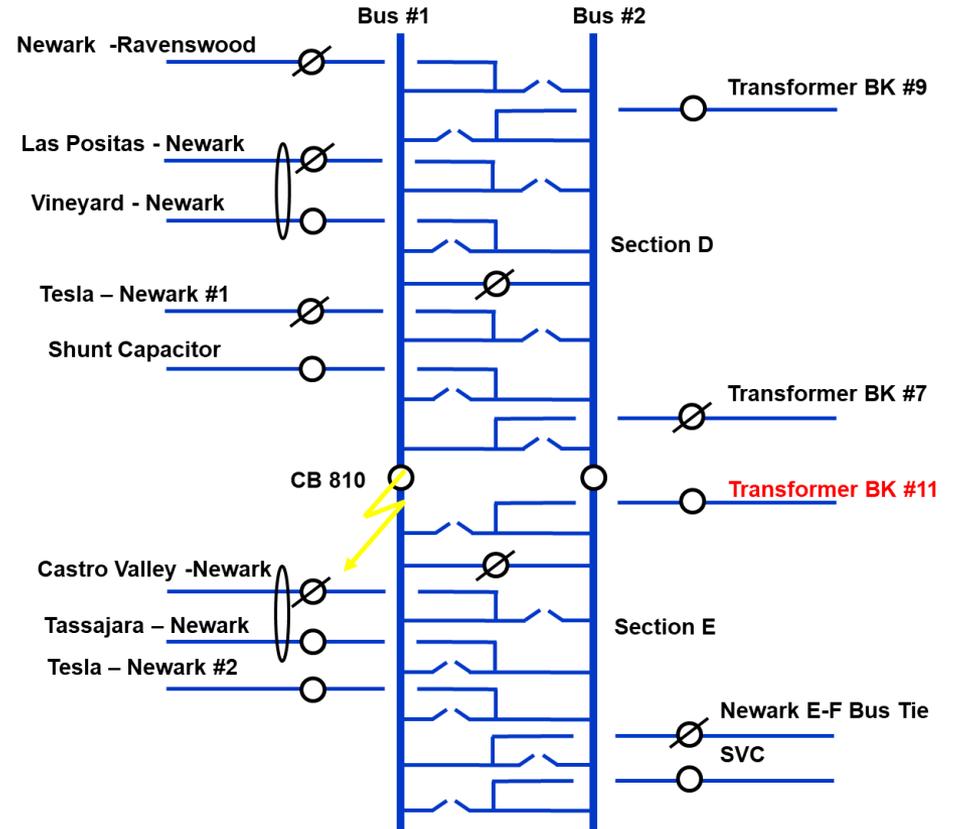
Newark 230 kV System



Newark 230 kV Substation
Section D & Section E

Contingency Description:

- P2-4 bus sectionalizing breaker CB810 fault
- Bus section 1D and 1E out
- Elements tripped
 - Newark - Ravenswood 230 kV line
 - Las Positas - Newark 230 kV line
 - Tesla - Newark 230 kV line
 - Transformer Bank #7
 - Castro Valley - Newark 230 kV line
 - Newark E-F Bus Tie



Power Flow Results:

#	Facility	Facility Rating (MVA)	Pre Project			Post Project		Contingency	
			2021	2024	2029	2024	2029	Category	Contingency Name
1	Newark 230/115 kV TRANSFORMER NO. 11	420 MVA	103.2%	100%	105%	70%	73.3%	P2	P2-4: Newark D Section 1D & Newark E Section 1E 230kV

Project Objective:

- To keep all three Newark 230/115 kV transformer banks in service to deliver power without causing any overloads on any banks during this contingency

Preferred Scope

- Add second high voltage side circuit breaker to NEWARK 230/115 kV transformer #7
- Change this transformer bank connection to Double Bus Double Breaker

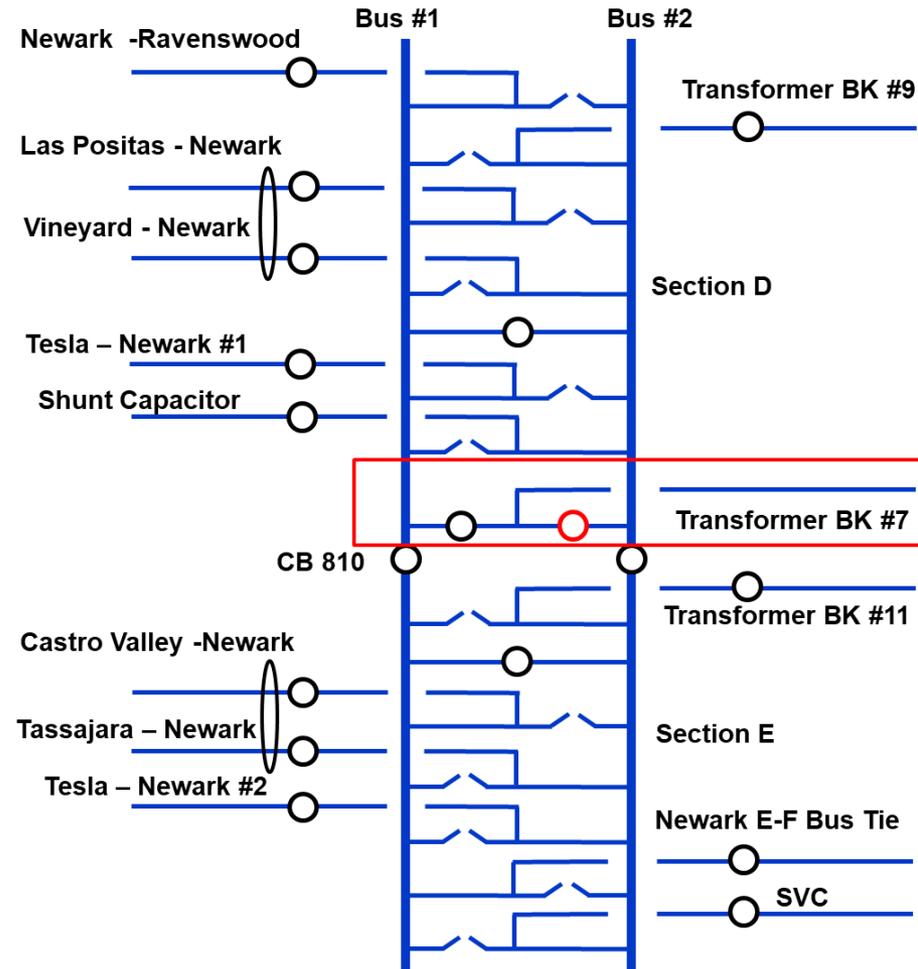
Proposed In-Service Date

- January 2024

Estimated Cost

- \$3M - \$6M *

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

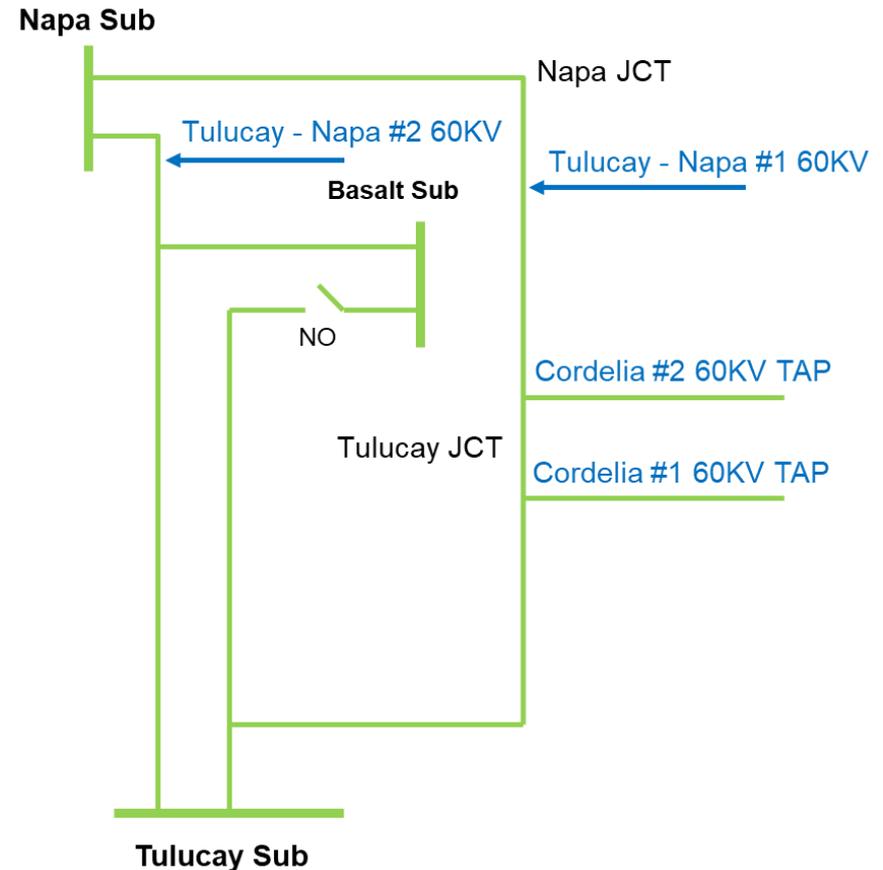


Other Alternatives Considered

- Install a 230/115 kV transformer bank connecting to Newark 230 kV bus section E. This alternative is not recommended because it would not be feasible due to the space issue and will not be cost effective.

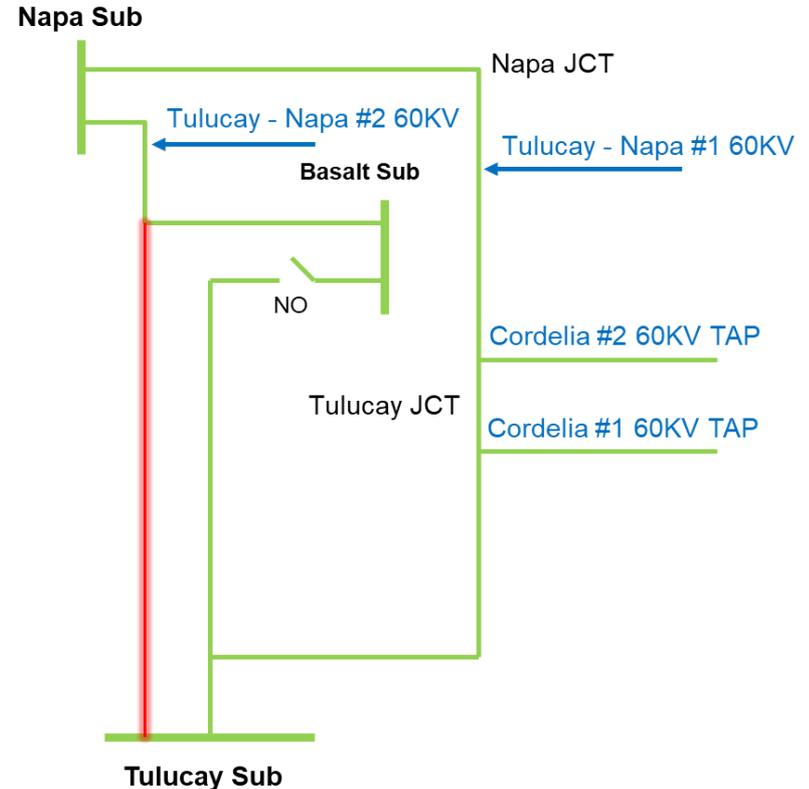
TULUCAY-NAPA #2 60 KV LINE CAPACITY INCREASE

- Napa – Tulucay No. 2 60 kV Line is in Napa County, within PG&E’s North Bay Division
- Napa – Tulucay No.1 and No. 2 lines provide service to Napa 60 kV substation with about 19500 electric customers
- Napa – Tulucay No.2 is approximately 4 miles long and it also serves about 5600 customers at Basalt substation
- The 2019 projected summer peak load at Napa and Basalt substations is approximately 77 MW and it is forecasted to increase at a rate of 0.8 MW or 1.08 % per year



Contingency Description:

- P0: Normal Operation (No Contingency)
- Napa – Tulucay No. 2 60 kV line on the section from Tulucay to Basalt Tap could overload by 1.5% in 2024 and by 10.2% in 2029



Power Flow Results:

Facility Name	Facility Rating (Amps)	Pre-Project			Post-Project		Contingency	
		2021	2024	2029	2024	2029	Category	Contingency Name
Napa – Tulucay No. 2 60 kV	741	97.5	101.5	110.2	<70	<70	P0	No Contingency

Preferred Scope

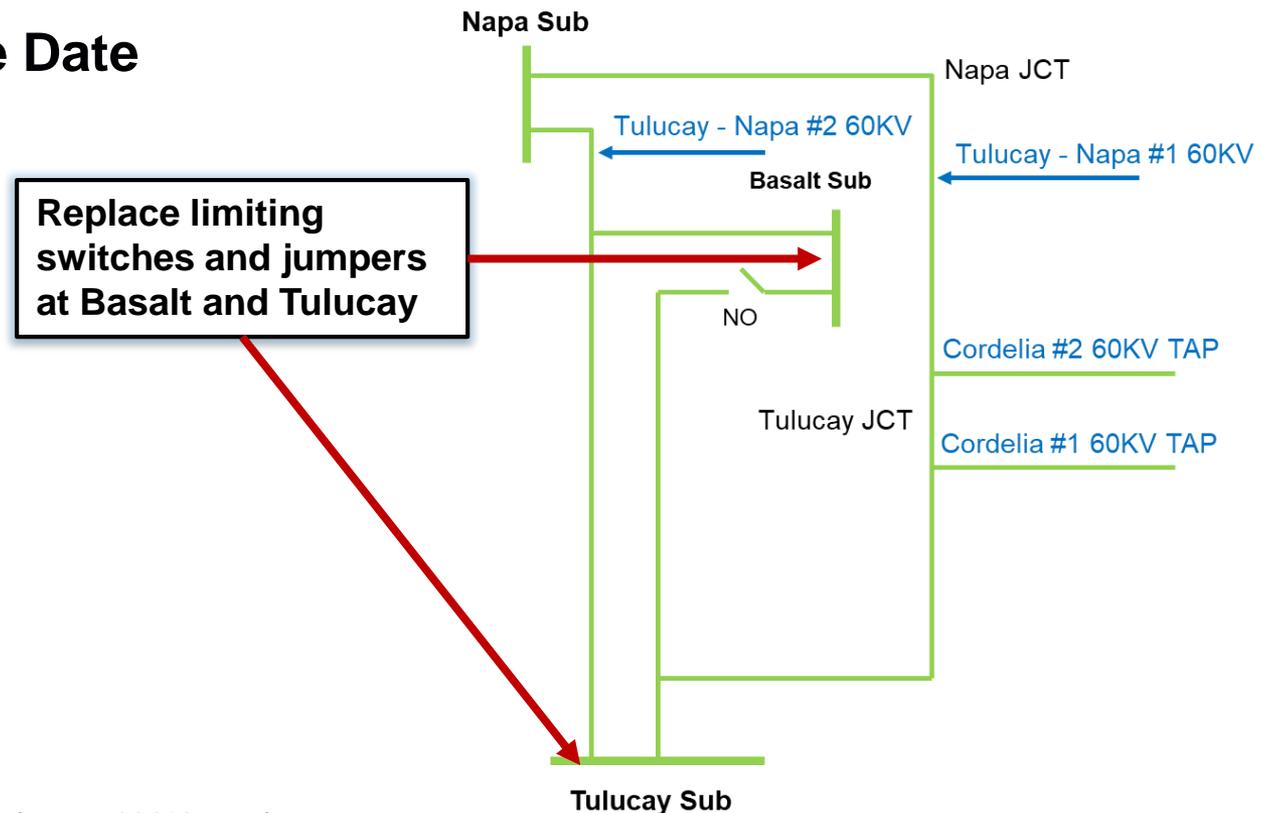
- Replace limiting switches and jumpers at Basalt and Tulucay 60 kV substations to match the conductor rating of 1126 Amps
- Upgrade any other associated terminal equipment to achieve the maximum conductor rating

Proposed In-Service Date

- May 2023

Estimated Cost

- \$5M - \$10M*

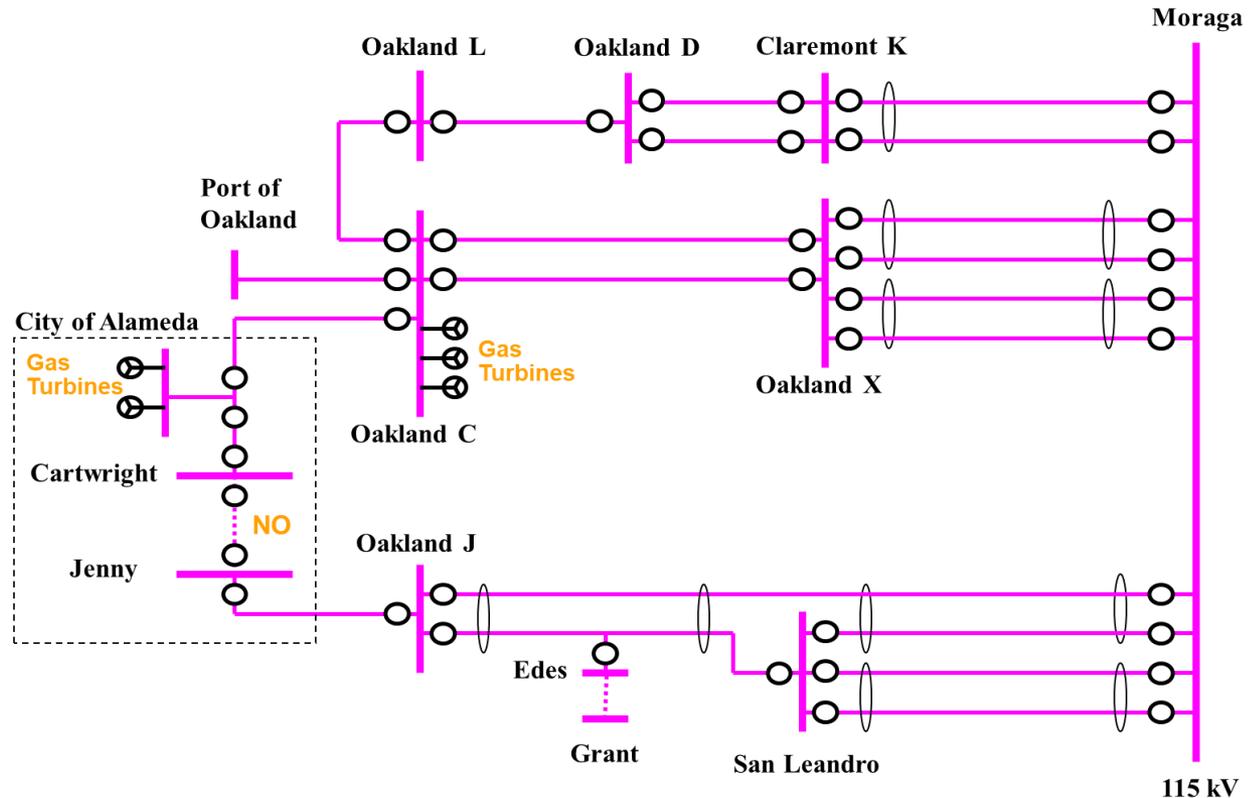


*AACE Level 5 quality estimates includes a +100% contingency

NORTHERN OAKLAND AREA REINFORCEMENT PROJECT

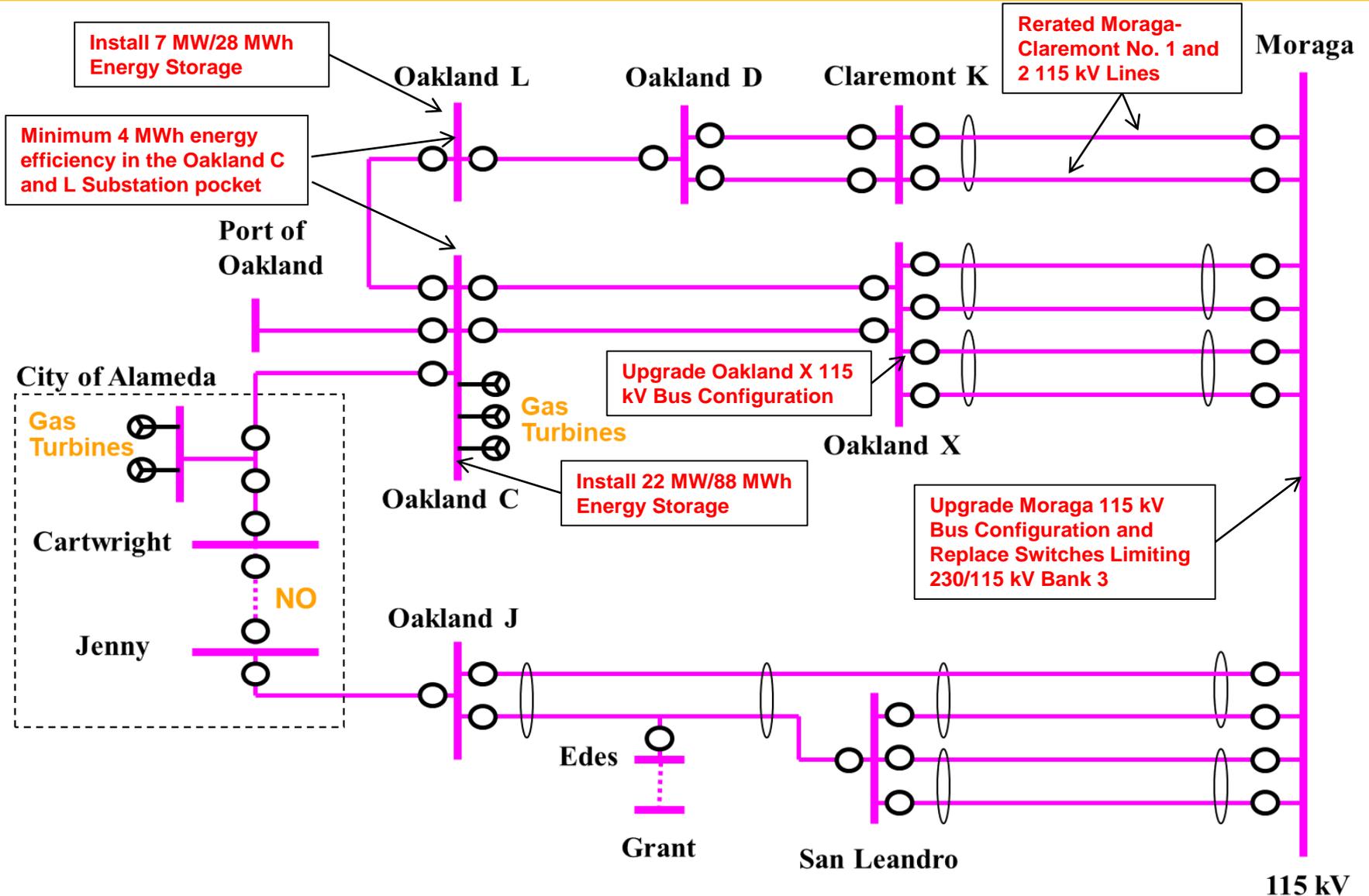
- Oakland area is served from Moraga Substation via 115 kV overhead transmission lines and underground cables
- The area consist of two separate load pockets: North and South Oakland. Port of Oakland receives PG&E wholesale contract service from the North, as does part of Alameda Municipal Power (under normal operations)
- Two generation facilities exist in the area:

- 1) Oakland Power Plant (Capacity: 165 MW)
- 2) City of Alameda CTs (Capacity: 49 MW)



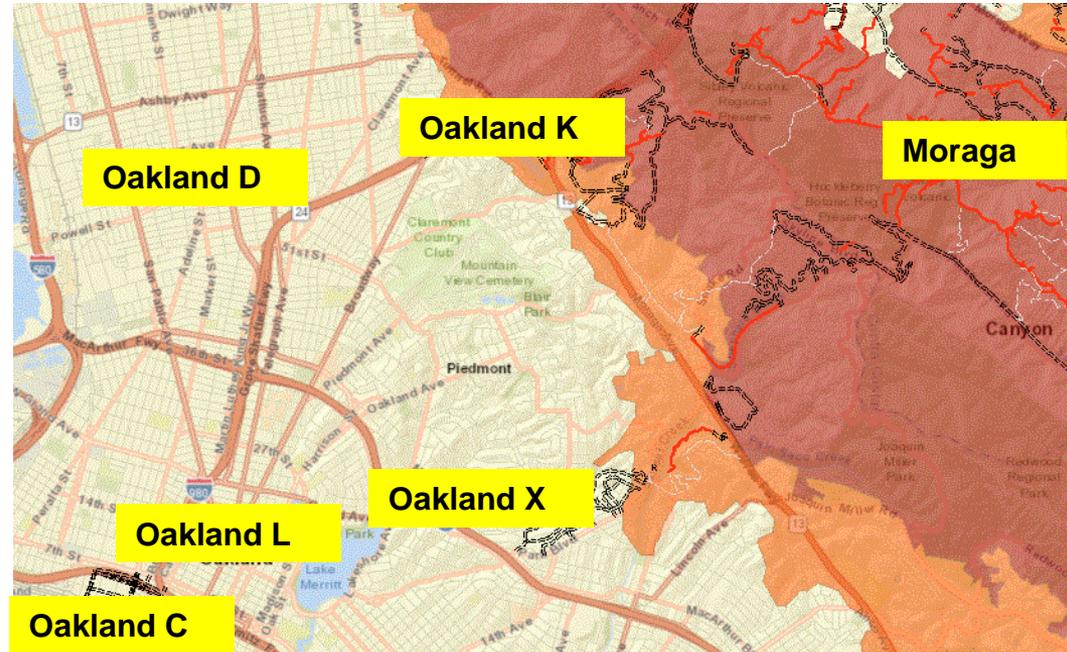
- Oakland Power Plant began commercial operations in 1978, and currently operates under an annual Reliability Must Run (RMR) Contract.
- CAISO identified the possible retirement of the Oakland Power Plant as a long-term reliability concern for the East Bay area.
- In the 2017-2018 TPP, CAISO approved the “Oakland Clean Energy Initiative (OCEI)” with in-service date of 2022.
- As approved, OCEI project proposes the following:
 - Substation upgrades at Moraga 115kV Bus and Oakland X, rerating of Moraga-Claremont 115 kV lines #1 and #2
 - Procurement of 22 MW (peak) and 88 MWh energy storage at Oakland C Substation
 - Procurement of 7 MW (peak) and 28 MWh energy storage at Oakland L Substation
 - Procurement of a minimum of 4 MWh over local peak energy efficiency in the Oakland C and L Substation pocket

Oakland Clean Energy Initiative



Moraga – Oakland X 115kV Lines

- Four overhead lines, that traverses through undeveloped land and residential neighborhoods
- Lines cross Tier-2 and Tier-3 High-Fire Threat District (HFTD) areas
- Identified as needing lifecycle upgrade of transmission structures
- Addressing 2010 NERC recommendations to industry



2019-2020 Reliability Assessment

- A growth in the net load forecasts has been observed in the North Oakland pocket
- Need for additional transmission capacity to meet long-term demand has already emerged in year-10 studies
- Due to known challenges involved in construction, permitting and clearances of transmission projects in the Oakland area, prolonged implementation periods (~7- 10 years) are expected
- OCEI is needed to ensure sustained reliability in the area until any long-term plan becomes operational
- Upgrades on Moraga 230 kV substation are identified to be required to mitigate NERC P2 category contingencies

To address Northern Oakland area challenges, PG&E explored several alternatives, comparing feasibility, public safety, cost, wildfire risks and long-term reliability impacts.

Project Objectives:

- Improve public safety by reinforcing the transmission infrastructure, relocating portions of the lines from residential neighborhoods and decreasing the number of lines in high-fire risk areas
- Increase Northern Oakland load serving capability to address future reliability concerns in the area
- Addressing 2010 NERC recommendations to industry

Proposed Project Components:

- 1) Rebuild Moraga-Oakland X 115 kV Lines
- 2) Reconductor Moraga-Claremont #1& #2 115 kV Lines
- 3) Build a New 115 kV Line from Oakland X to Oakland L
- 4) Upgrade Moraga 230 kV Substation

1

MORAGA-OAKLAND X LINES REBUILD

Moraga-Oakland X Lines Rebuild

Preferred Scope

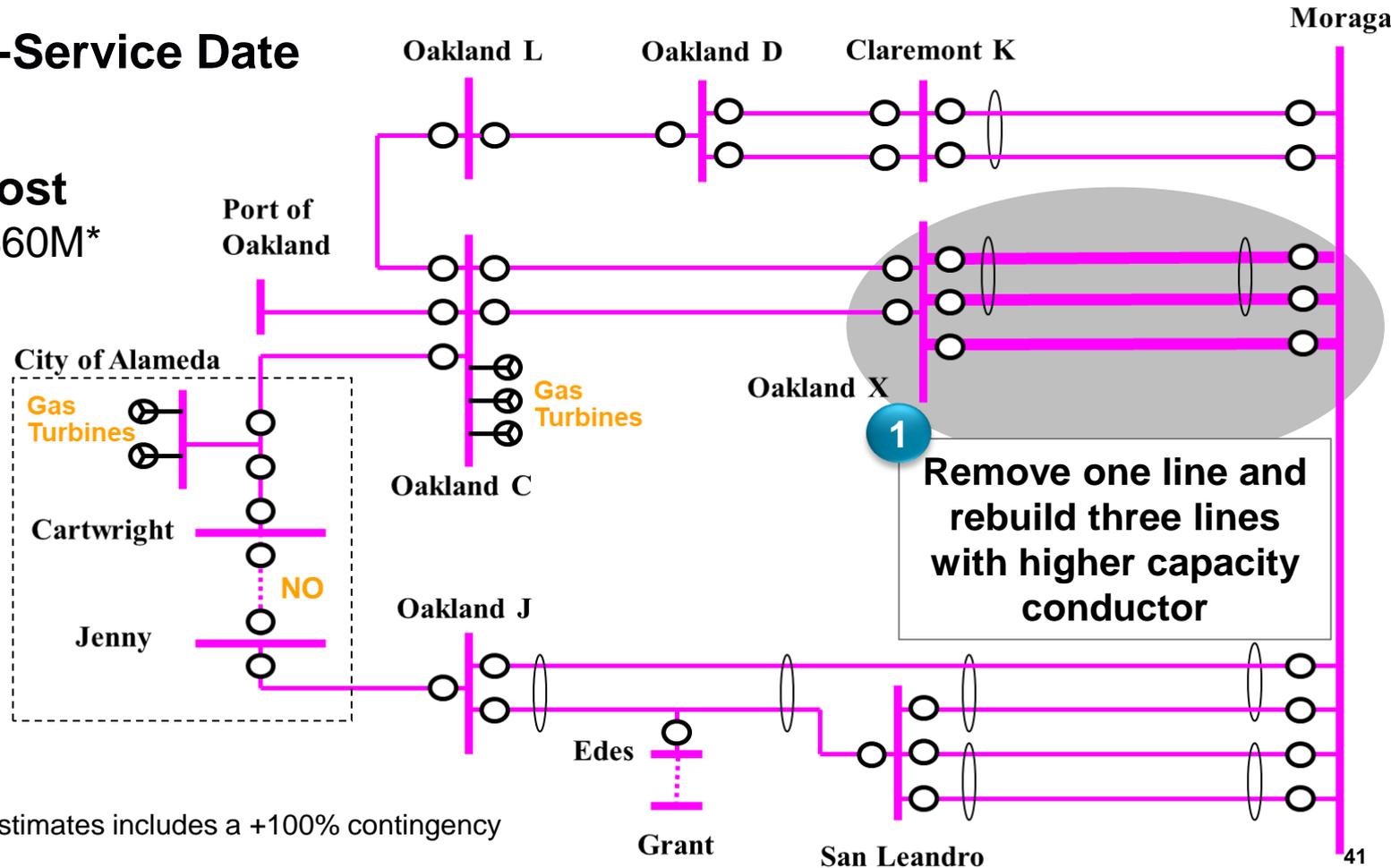
- Remove one line and rebuild three of the Moraga-Oakland X 115 kV lines with conductor rated for 1100 Amps or higher summer emergency rating

Proposed In-Service Date

- May 2027

Estimated Cost

- \$180M - \$360M*



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

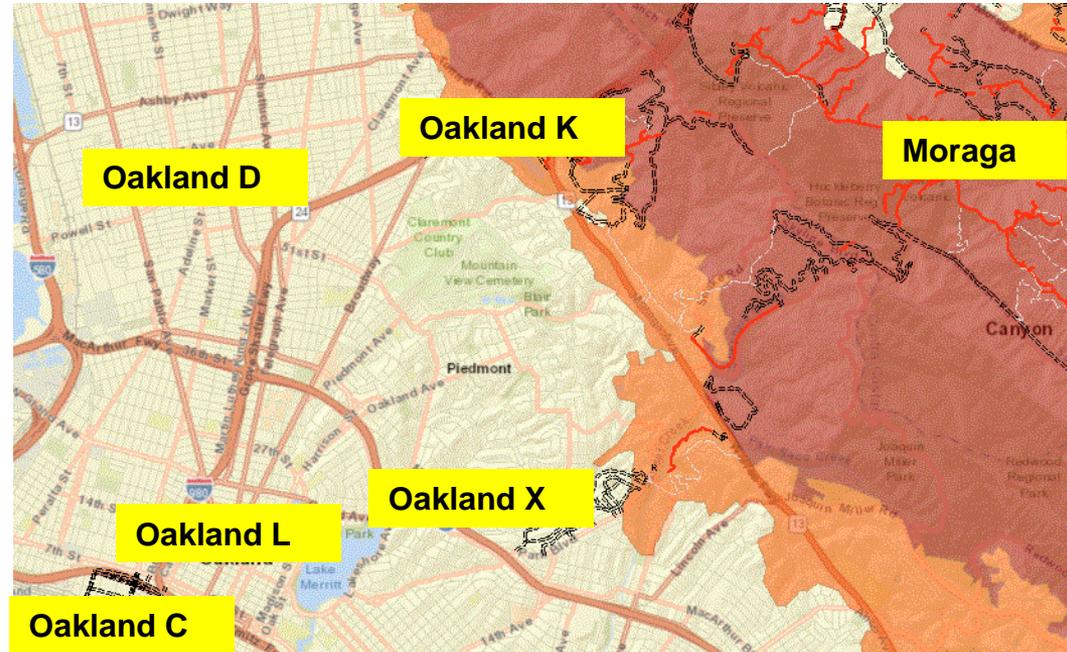
Power Flow Results after Moraga-X Lines Rebuild

Facility Name	Facility Rating (Amps)	Pre-Project	Post-Project	Contingency	
		2029	2029	Category	Contingency Name
D-L #1	790	98.7	103.5	P2	MORAGA 230kV - Section 2D & 1D
Moraga-Claremont #1 115kV	557	102.9	106.8	P2	SOBRANTE 230kV - Section 2D & 1D
Moraga-Claremont #1 115kV	557	99	105.8	P2	CLARMNT - 2D 115kV & SOBRANTE-GRIZZLY-CLAREMONT #2 line
Moraga-Claremont #1 115kV	557	99	105.8	P2	CLARMNT - 2D 115kV & SOBRANTE-GRIZZLY-CLAREMONT #1 line
Moraga-Claremont #1 115kV	557	99	105.8	P2	CLARMNT 115kV Section 2D
Moraga-Claremont #1 115kV	557	97.6	101.2	P6	MORAGA-CLAREMONT #2 115kV & DEC STG1 24.00kV & DEC CTG1 18.00kV & DEC CTG2 18.00kV & DEC CTG3 18.00kV Gen Units
Moraga-Claremont #1 115kV	557	99.7	103.5	P6	SOBRANTE 230/115kV TB 1 & SOBRANTE 230/115kV TB 2
Moraga-Claremont #2 115kV	557	103	107	P2	SOBRANTE 230kV - Section 2D & 1D
Moraga-Claremont #2 115kV	557	97.7	101.3	P3	MORAGA-CLAREMONT #1 115kV & DEC STG1 24.00kV & DEC CTG1 18.00kV & DEC CTG2 18.00kV & DEC CTG3 18.00kV Gen Units
Moraga-Claremont #2 115kV	557	99.9	103.7	P6	SOBRANTE 230/115kV TB 1 & SOBRANTE 230/115kV TB 2

2

MORAGA-CLAREMONT LINES RECONDUCTORING

- Moraga-Claremont #1& #2 115 kV lines are approximately 4.6 miles and currently rated at 94 MVA summer emergency rating
- These lines have been rerated as part of the OCEI project
- Even with the rerate, these lines identified to be overloaded for certain P6 contingencies in 2019-2020 TPP Assessment for year-10 summer peak condition
- Rebuilding Moraga-Oakland X lines as three higher capacity lines, will cause new violations on the Moraga-Claremont lines for some local P2 and P6 contingencies
- Moraga-Claremont lines reside in Tier-2 and Tier-3 High-Fire risk areas



Moraga-Claremont Lines Reconductoring

Preferred Scope

- Reconductor Moraga-Claremont #1 & #2 115kV lines with conductor rated for 1100 Amps or higher summer emergency rating

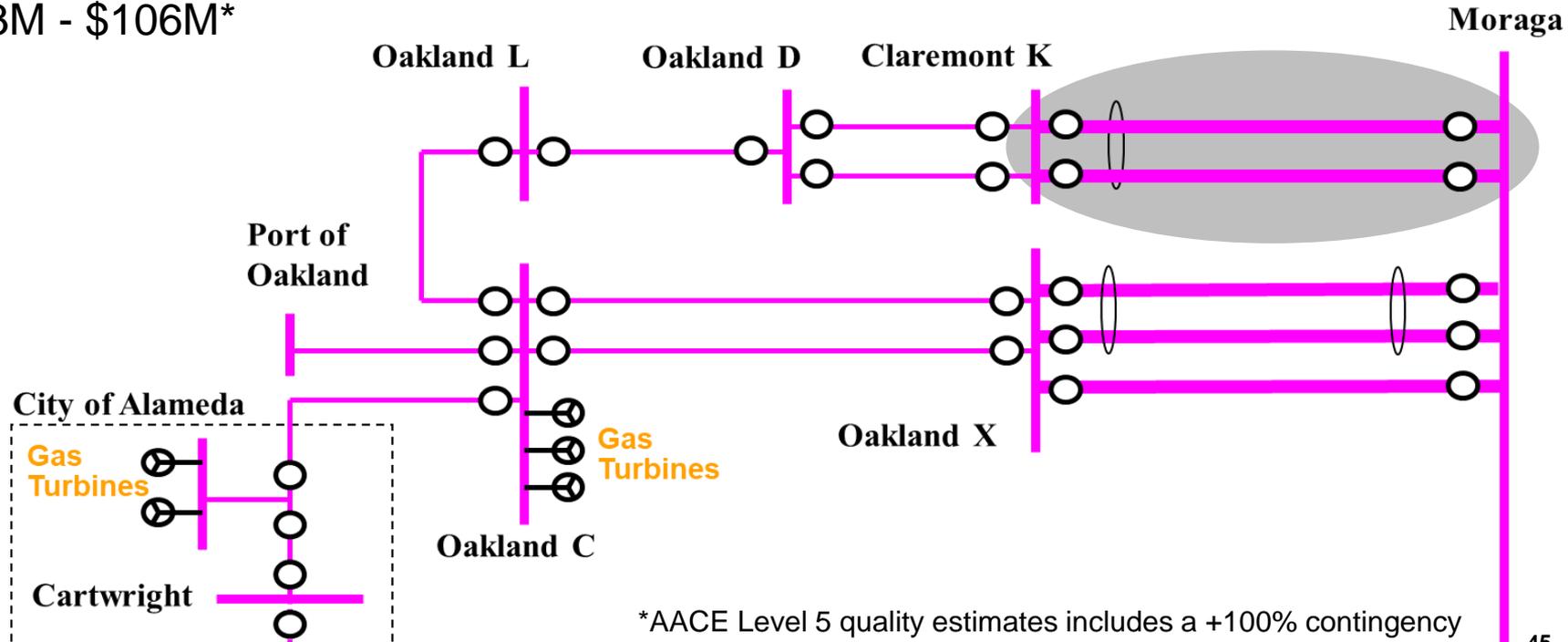
Proposed In-Service Date

- May 2027

Estimated Cost

- \$53M - \$106M*

2
Two lines reconducted with higher capacity conductor



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



Power Flow Results: Remaining Concerns

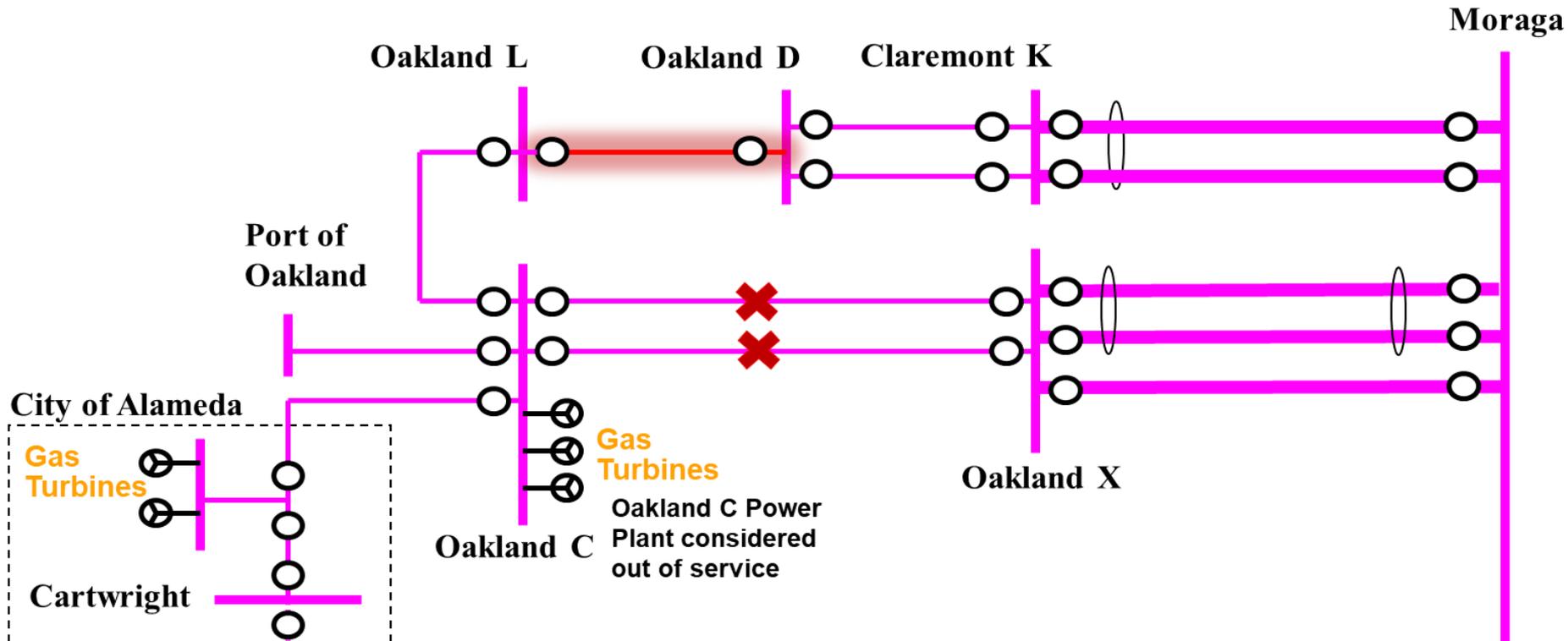
Facility Name	Facility Rating (Amps)	Pre-Project	Post-Project	Contingency	
		2029	2029	Category	Contingency Name
C-L #1	790	109	108.4	P2	CLARMNT 115kV - Section 2D & 1D
C-L #1	790	109.3	108.7	P6	K-D #1 115kV & K-D #2 115kV
C-X #2	790	121.3	120.7	P2	CLARMNT 115kV - Section 2D & 1D
C-X #2	790	106.5	100.7	P6	C-X #3 115kV & DEC STG1 24.00kV & DEC CTG1 18.00kV & DEC CTG2 18.00kV & DEC CTG3 18.00kV Gen Units
C-X #2	790	121.7	121.1	P6	K-D #1 115kV & K-D #2 115kV
C-X #2	790	142	141.4	P6	D-L #1 115kV & C-X #3 115kV
C-X #2	790	106.3	103.1	P6	C-X #3 115kV & MORAGA-CLAREMONT #2 115kV
C-X #2	790	106.3	103.1	P6	C-X #3 115kV & MORAGA-CLAREMONT #1 115kV
D-L #1	790	102.2	101.8	P2	OAK C115 115kV Section ME
D-L #1	790	104.8	104.5	P2	OAK C115 - ME 115kV & OAKLAND C-MARITIME line
D-L #1	790	98.7	104.6	P2	MORAGA 230kV - Section 2D & 1D
D-L #1	790	142.4	142	P6	C-X #2 115kV & C-X #3 115kV

Contingency Description

- Multiple outage of Oakland C-X#2 and C-X#3

Overloaded Facility

- Oakland D-L#1

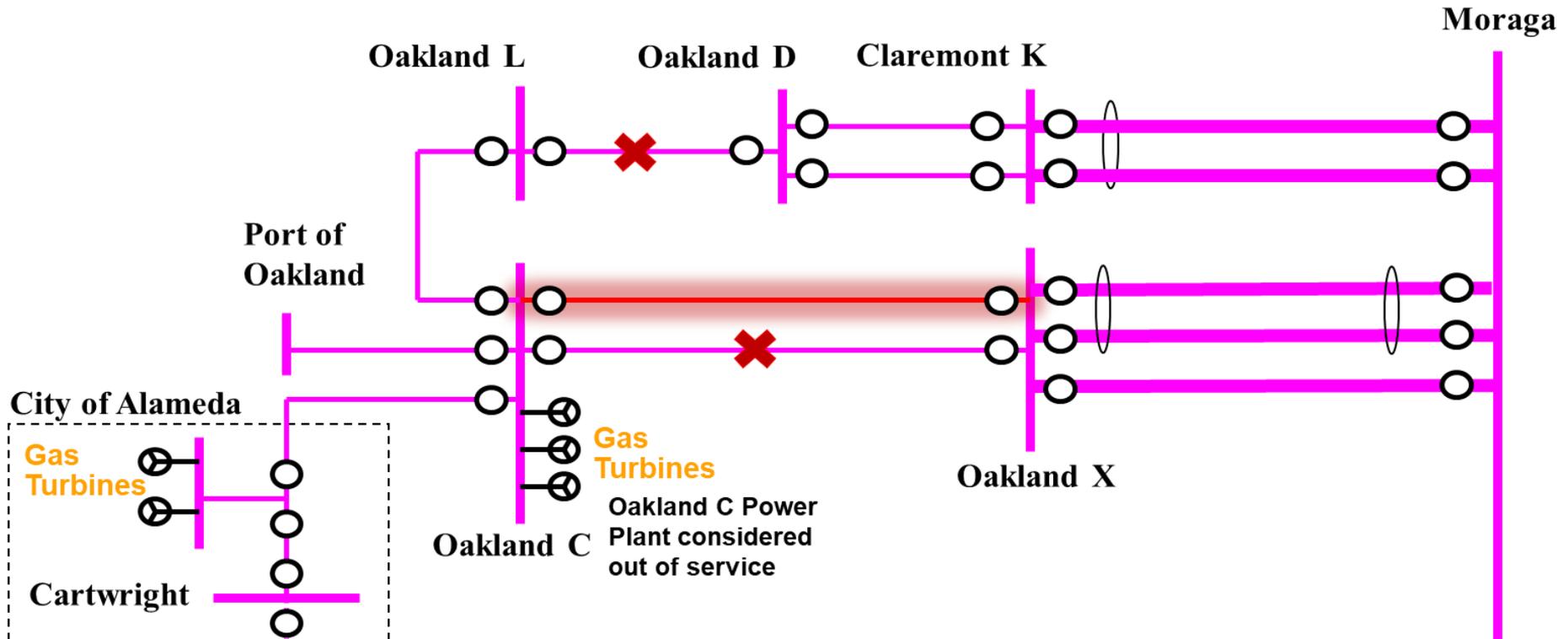


Contingency Description

- Multiple outage of Oakland D-L#1 and C-X#3

Overloaded Facility

- Oakland C-X#2

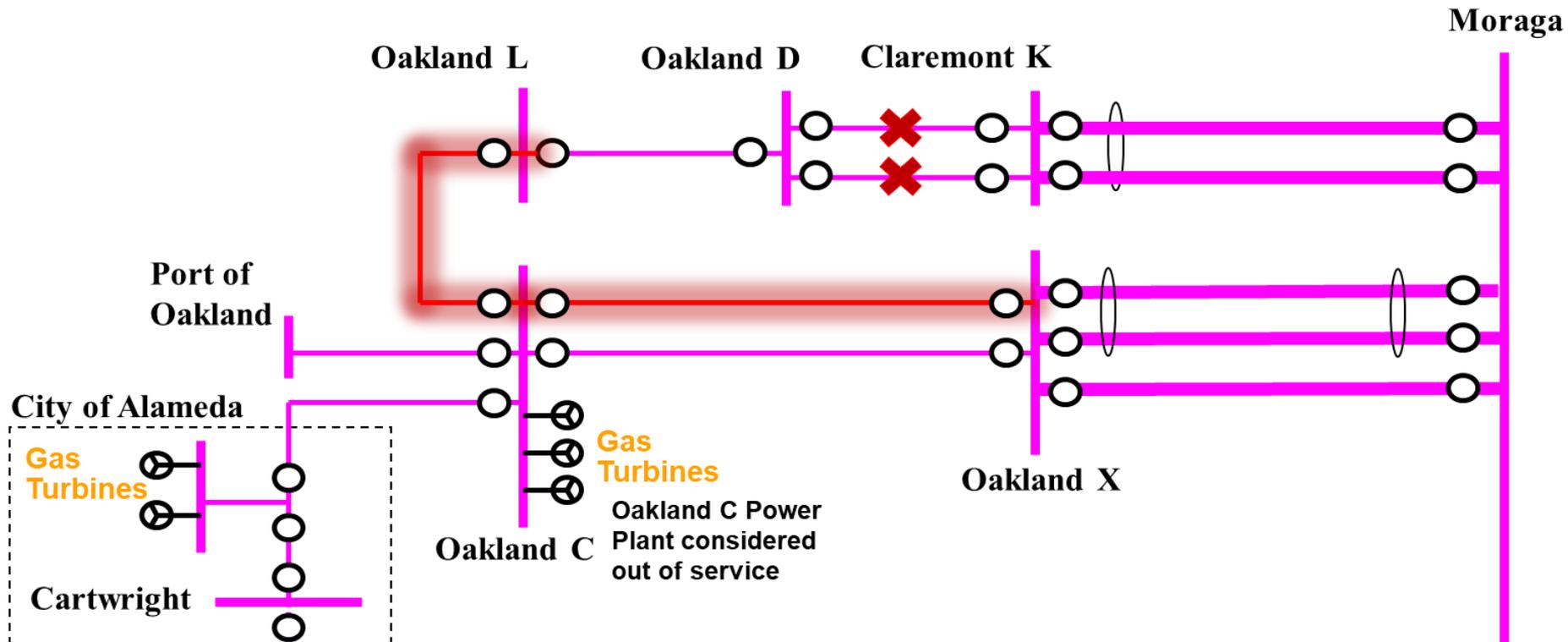


Contingency Description

- Multiple outage of Oakland K-D#1 and K-D#2

Overloaded Facilities

- Oakland C-X#2 and Oakland C-L#1



3

NEW OAKLAND X TO OAKLAND L 115 KV LINE

Load Forecast in Northern Oakland Area

- Oakland C, D and L substations net conforming load forecasts for year 10 has increased about 28 MW or 12% from past two TPP cycle
- Shift in the peak loading time and more precise modeling of the Distributed Generation (DG), significantly reduced the DG contribution at the peak time
- Forecasted Energy Efficiency (EE) in the pocket also decreased by 11 MW
- PG&E also expects more load growth which has not yet been accounted for in the forecasts due to new distribution load addition like Oakland stadium and electrification plans

Year-10 Conforming Load Forecast Changes for Oakland C, D and L

Year-10 Load Forecast	Year 2027(2017-2018 TPP)	Year2029(2019-2020 TPP)
Gross Load Forecast	272	270
Net Load Forecast	226	254
EE (Energy Efficiency)	27	16
DG (Distributed Generation)	17.91	0

Why a long-term transmission capacity addition is proposed?

- Mitigate remaining P6 concerns in the area
- Meet the long-term forecasted load growth
- Prolonged implementation periods
- New alternatives made possible by Moraga-Oakland X lines reinforcement plans

Preferred Scope

- Build a new 115 kV line from Oakland X to Oakland L substation with conductor rated for 1100 Amps or higher summer emergency rating

Proposed In-Service Date

- May 2027

Estimated Cost

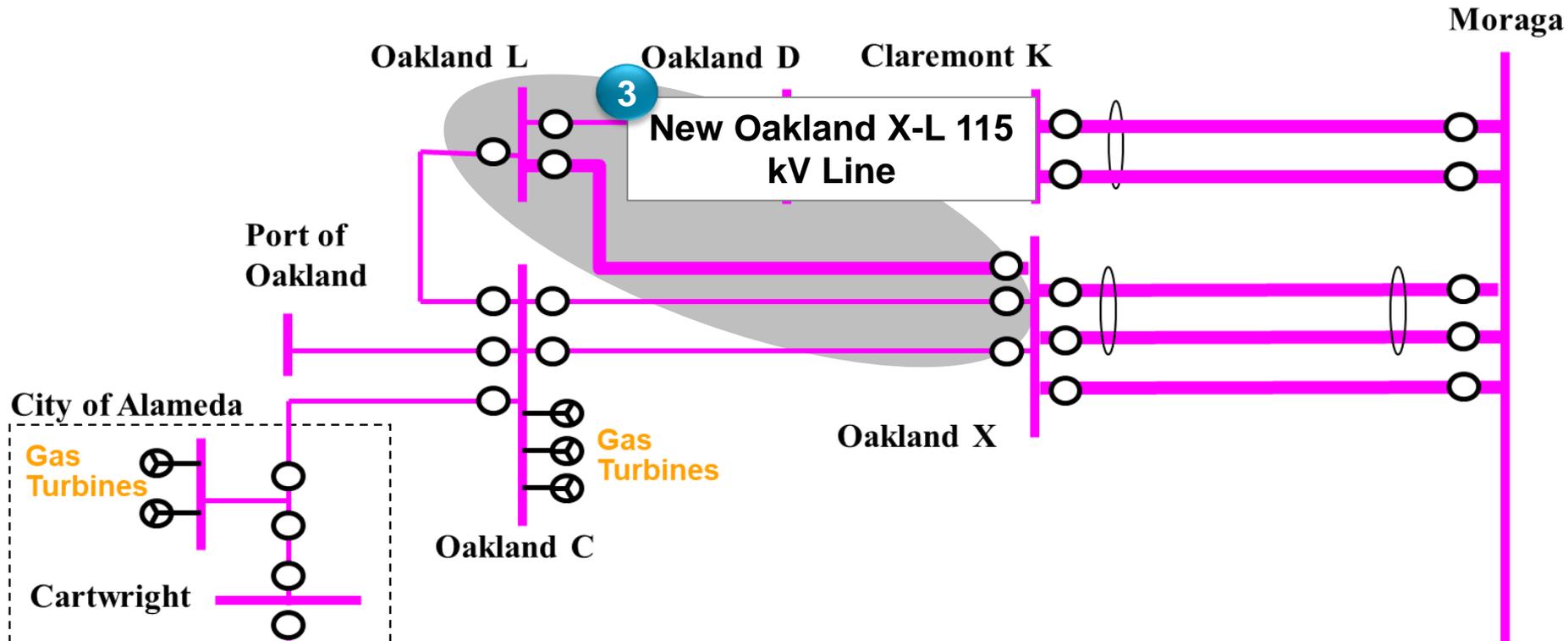
- \$114M - \$228M*

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

New Oakland X to Oakland L Line

Other Alternatives Considered

- Looping Oakland C-X #3 Line into Oakland L
- New 115 kV Cable from Claremont K to Oakland L



Power Flow Results: Single Event P2 Concerns

Facility Name	Facility Rating (Amps)	Pre-Project	Post-Project	Contingency	
		2029	2029	Category	Contingency Name
C-L #1	790	109	<70	P2	CLARMNT 115kV - Section 2D & 1D
C-X #2 [9962]	790	121.3	73.7	P2	CLARMNT 115kV - Section 2D & 1D
D-L #1 [9963]	790	104.8	<70	P2	OAK C115 - ME 115kV & OAKLAND C-MARITIME line
D-L #1 [9963]	790	98.7	104.3	P2	MORAGA 230kV - Section 2D & 1D
Moraga-Claremont #1 115kV	557	102.9	<70	P2	SOBRANTE 230kV - Section 2D & 1D
Moraga-Claremont #2 115kV	557	103	<70	P2	SOBRANTE 230kV - Section 2D & 1D
Moraga-Oakland X #1 115kV	406	114.1	<70	P2	CLARMNT 115kV - Section 2D & 1D
Moraga-Oakland X #1 115kV	406	106.9	<70	P2	MORAGA.E 115kV - Section 2E & 1E
Moraga-Oakland X #2 115kV	406	114.1	<70	P2	CLARMNT 115kV - Section 2D & 1D
Moraga-Oakland X #2 115kV	406	106.9	<70	P2	MORAGA.E 115kV - Section 2E & 1E
Moraga-Oakland X #3 115kV	406	113.4	<70	P2	CLARMNT 115kV - Section 2D & 1D
Moraga-Oakland X #4 115kV	406	113.4	<70	P2	CLARMNT 115kV - Section 2D & 1D

Power Flow Results: Multiple Event P6 Concerns

Facility Name	Facility Rating (Amps)	Pre-Project	Post-Project	Contingency	
		2029	2029	Category	Contingency Name
C-L #1	790	109.3	<70	P6	K-D #1 115kV & K-D #2 115kV
C-X #2	790	102.5	<70	P6	C-X #3 115kV & CRCKTCOG 18.00kV Gen Unit 1
C-X #2	790	106.5	<70	P6	C-X #3 115kV & DEC STG1 24.00kV & DEC CTG1 18.00kV & DEC CTG2 18.00kV & DEC CTG3 18.00kV Gen Units
C-X #2	790	104.2	<70	P6	C-X #3 115kV & LMECCT2 18.00kV & LMECCT1 18.00kV & LMECST1 18.00kV Gen Units
C-X #2	790	102.6	<70	P6	IGNACIO-SOBRANTE 230kV & C-X #3 115kV
C-X #2	790	102.2	<70	P6	C-X #3 115kV & SOBRANTE 230/115kV TB 1
C-X #2	790	121.7	<70	P6	K-D #1 115kV & K-D #2 115kV
C-X #2	790	102.1	<70	P6	K-D #1 115kV & C-X #3 115kV
C-X #2	790	102	<70	P6	K-D #2 115kV & C-X #3 115kV
C-X #2	790	142	<70	P6	D-L #1 115kV & C-X #3 115kV
C-X #2	790	106.3	<70	P6	C-X #3 115kV & MORAGA-CLAREMONT #2 115kV
C-X #2	790	106.3	<70	P6	C-X #3 115kV & MORAGA-CLAREMONT #1 115kV
D-L #1	790	142.4	<70	P6	C-X #2 115kV & C-X #3 115kV
Moraga-Claremont #1 115kV	557	104.1	<70	P6	C-X #2 115kV & C-X #3 115kV
Moraga-Claremont #2 115kV	557	104.3	<70	P6	C-X #2 115kV & C-X #3 115kV

Power Flow Results: Multiple Event P6 Concerns

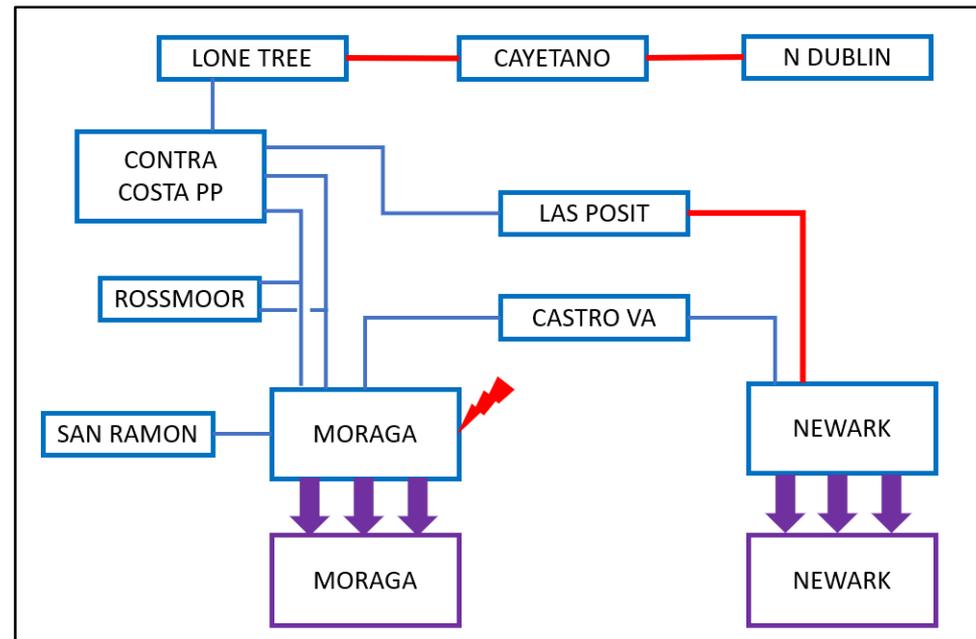
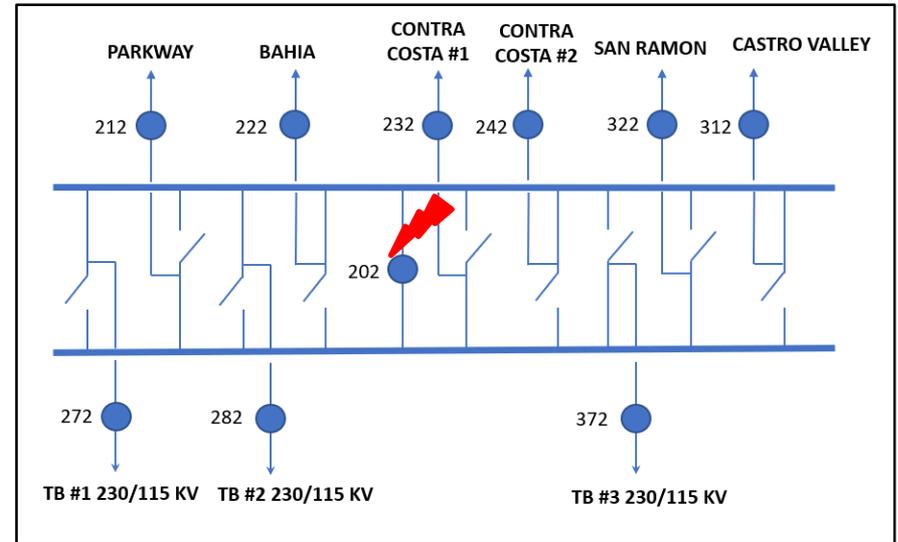
Facility Name	Facility Rating (Amps)	Pre-Project	Post-Project	Contingency	
		2029	2029	Category	Contingency Name
Moraga-Oakland X #1 115kV	406	114.4	<70	P6	K-D #1 115kV & K-D #2 115kV
		110.2	<70	P6	MORAGA-OAKLAND #2 115kV & D-L #1 115kV
		109.8	<70	P6	MORAGA-OAKLAND #4 115kV & D-L #1 115kV
		109.8	<70	P6	MORAGA-OAKLAND #3 115kV & D-L #1 115kV
Moraga-Oakland X #2 115kV	406	114.4	<70	P6	K-D #1 115kV & K-D #2 115kV
		110.2	<70	P6	MORAGA-OAKLAND #1 115kV & D-L #1 115kV
		109.8	<70	P6	MORAGA-OAKLAND #4 115kV & D-L #1 115kV
		109.8	<70	P6	MORAGA-OAKLAND #3 115kV & D-L #1 115kV
Moraga-Oakland X #3 115kV	406	113.7	<70	P6	K-D #1 115kV & K-D #2 115kV
		109.5	<70	P6	MORAGA-OAKLAND #2 115kV & D-L #1 115kV
		109.5	<70	P6	MORAGA-OAKLAND #1 115kV & D-L #1 115kV
		109.5	<70	P6	MORAGA-OAKLAND #4 115kV & D-L #1 115kV
Moraga-Oakland X #4 115kV	406	113.7	<70	P6	K-D #1 115kV [9966] & K-D #2 115kV
		109.5	<70	P6	MORAGA-OAKLAND #2 115kV & D-L #1 115kV
		109.5	<70	P6	MORAGA-OAKLAND #1 115kV & D-L #1 115kV
		109.5	<70	P6	MORAGA-OAKLAND #3 115kV & D-L #1 115kV

4

MORAGA 230 KV BUS UPGRADE

Project Background

- Moraga 230 kV substation transfers power flowing from Contra Costa PP (Marsh Landing, Birds Landing and Gateway Generation) and Vaca-Dixon to Oakland, San Ramon, Castro Valley and Newark Areas
- With current bus configuration, P2-4 internal breaker fault on CB 202 will result in loss of the entire 230 kV station
- Based on the 2019-2020 TPP assessment results, this contingency will cause overloads on
 - Lone Tree -Cayetano 230kV,
 - North Dublin- Cayetano 230kV,
 - Las Positas-Newark 230kV and
 - Sobrante-Grizzly-Claremont #2 115kV



Preferred Scope

- Add two sectionalizing breakers and a bus tie breaker to Moraga 230 kV bus.
- Installation and modification of bus differential protection scheme

Proposed In-Service Date

- August 2024

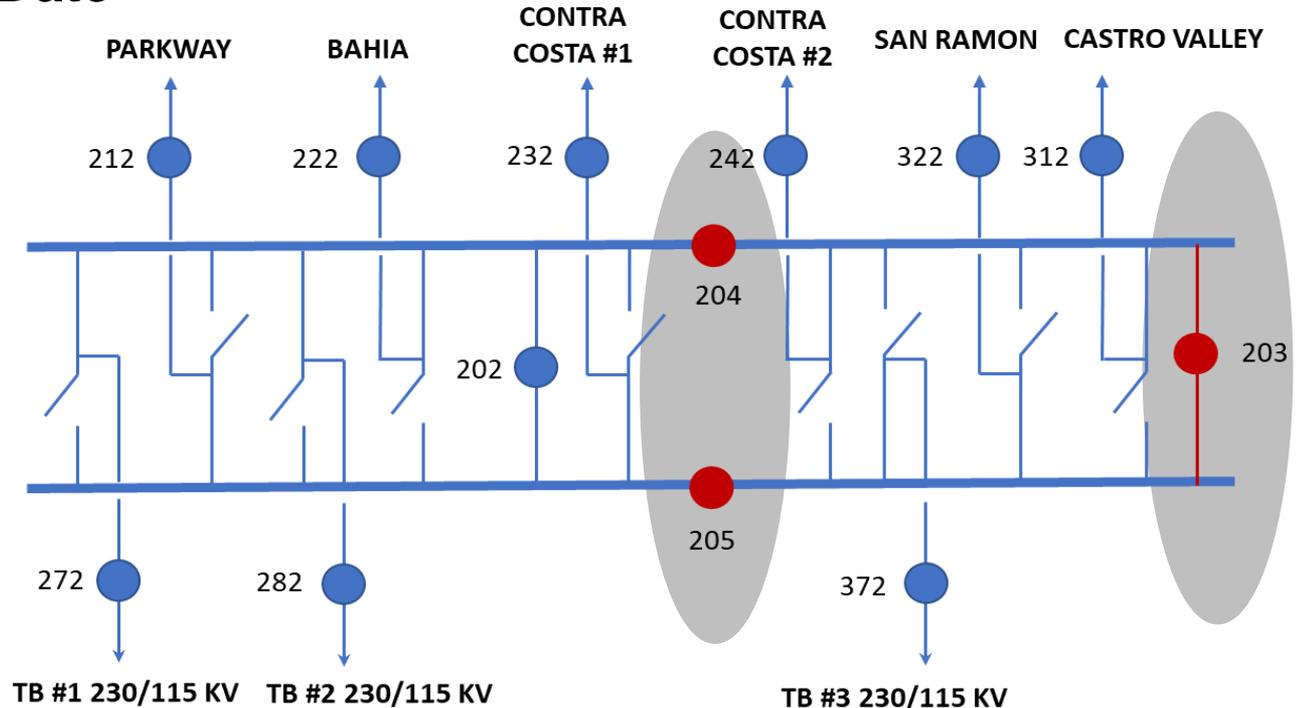
Estimated Cost

- \$17M - \$34M*

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

Other Alternatives Considered

- *Alternative 1:* Convert Moraga 230 kV to BAAH
- *Alternative 2:* Reconductoring overloaded lines



Facility Name	Facility Rating (Amps)	Pre-Project			Post-Project		Contingency	
		2021	2024	2029	2024	2029	Category	Contingency Name
LONE TREE-CAYETANO 230kV	1005	105.7	105	110.1	87.3	92.1	P2	MORAGA 230kV - Section 2D & 1D
NORTH DUBLIN-CAYETANO 230kV	1004	100.8	100	104.4	82.2	86.3	P2	
LAS POSITAS-NEWARK 230kV	849	97.1	97.8	101.2	74.2	76.7	P2	
SOBRANTE-GRIZZLY-CLAREMONT #2 115kV	801	<70	96.3	104.9	54.2	63.6	P2	
LONE TREE-CAYETANO 230kV	1005	N/A	N/A	N/A	81.8	95.4	P2	MORAGA 230kV - Section 2E & 1E
NORTH DUBLIN-CAYETANO 230kV	1004	N/A	N/A	N/A	85.5	89.6	P2	
LAS POSITAS-NEWARK 230kV	849	N/A	N/A	N/A	78.5	81.1	P2	
SOBRANTE-GRIZZLY-CLAREMONT #2 115kV	801	N/A	N/A	N/A	<70	<70	P2	

Proposed Project

- 1) Rebuild Moraga- Oakland X 115 kV four-line path with three lines with conductor rated for 1100 Amps or higher summer emergency rating
- 2) Reconductor Moraga-Claremont #1& #2 115kV lines with conductor rated for 1100 Amps or higher summer emergency rating
- 3) Build a new 115 kV line from Oakland X to Oakland L substation with conductor rated for 1100 Amps or higher summer emergency rating
- 4) Upgrade Moraga 230 kV Bus (Add sectionalizing breakers and a bus tie breaker to Moraga 230 kV bus)

Proposed In-Service Date

- May 2027

Total Estimated Cost

- \$364M - \$728M*

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