



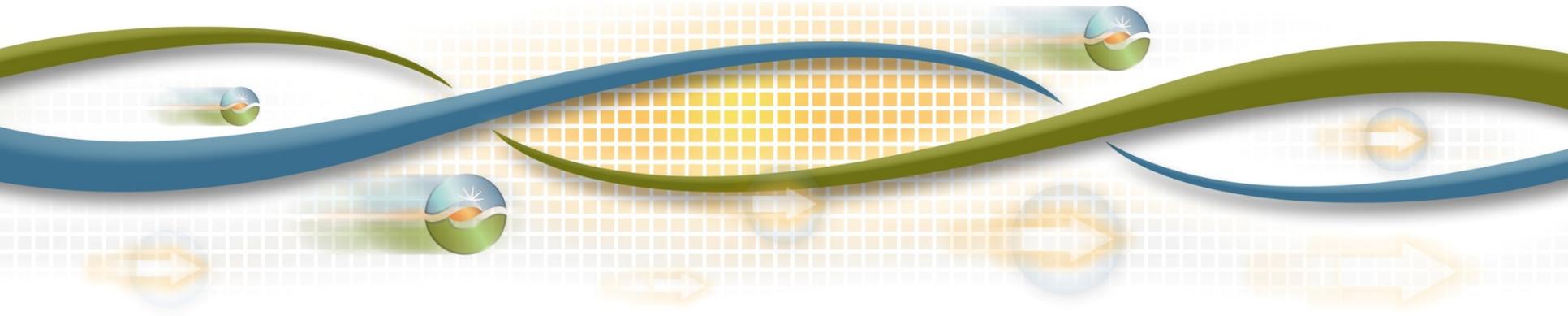
Agenda

Less than \$50 Million Projects and Preliminary Economic Assessment Results

Kim Perez

Stakeholder Engagement and Policy Specialist

*2017-2018 Transmission Planning Process Stakeholder Meeting
November 16, 2017*



2017-2018 Transmission Planning Process Stakeholder Meeting - Agenda

Topic	Presenter
Introduction	Kim Perez
Overview & Key Issues	Neil Millar
Less than \$50 Million Project Approvals, Cancellations or Scope Modifications <ul style="list-style-type: none"><li data-bbox="112 743 780 786">• SDG&E – Sub-Transmission<li data-bbox="112 825 672 868">• SDG&E – Main System<li data-bbox="112 906 421 949">• PG&E Area	Charles Cheung Frank Chen Binaya Shrestha and Jeff Billinton
Preliminary Economic Assessment	Yi Zhang
Wrap-up & Next Steps	Kim Perez

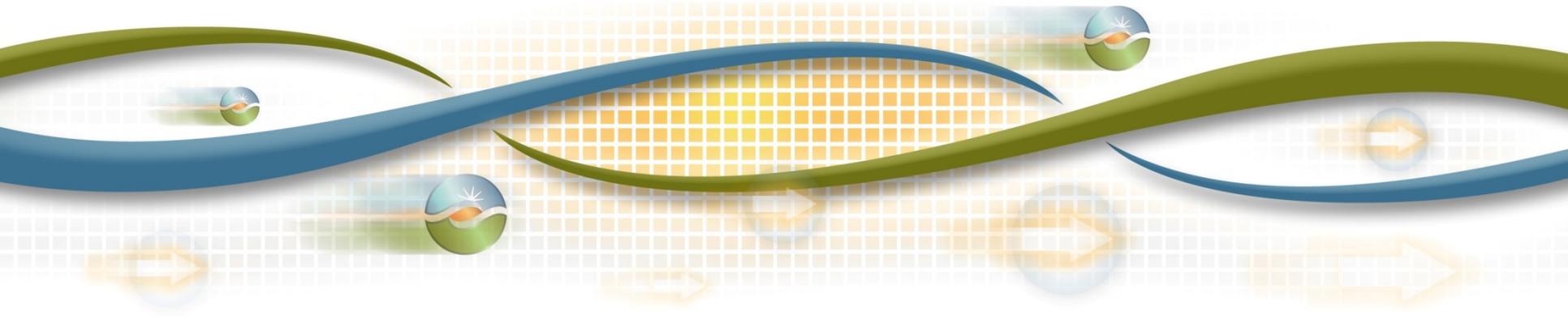


Introduction and Overview

Policy-Driven and Economic Assessment

Neil Millar
Executive Director, Infrastructure Development

2017-2018 Transmission Planning Process Stakeholder Meeting
November 16, 2017



2017-2018 Transmission Planning Process

January 2017

April 2017

March 2018

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

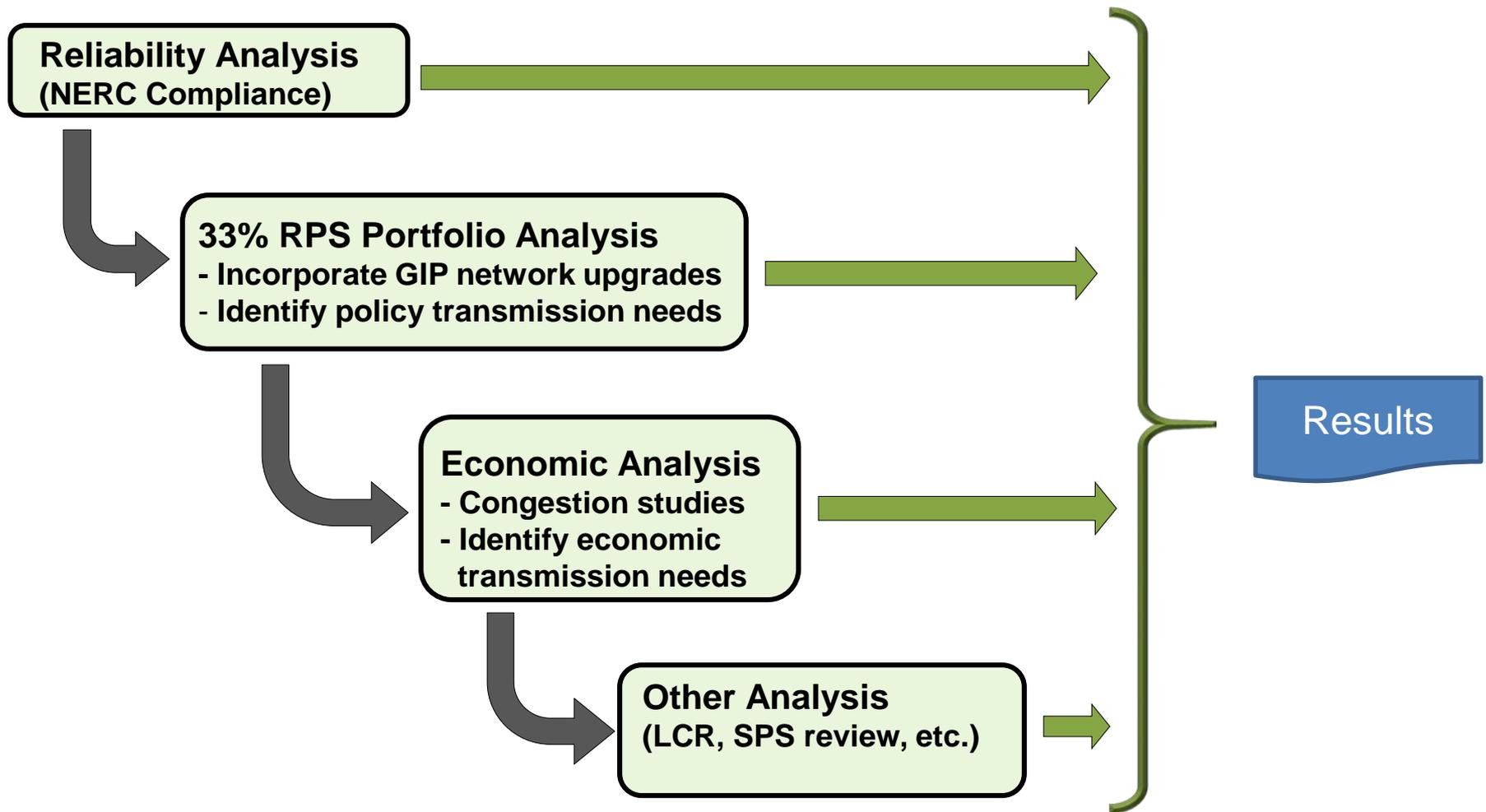
- Reliability analysis
- Renewable (policy-driven) analysis
- Economic analysis

Publish comprehensive transmission plan with recommended projects

Phase 3 Procurement

ISO Board for approval of transmission plan

Development of 2017-2018 Annual Transmission Plan



2017-2018 Ten Year Plan Milestones

- Preliminary reliability study results were posted on August 15
- Stakeholder session September 21st and 22nd
- Comments received October 6
- Request window closed October 15
- **Today's session - preliminary policy and economic study results and update on other issues**
- Comments due by November 30
- Draft plan to be posted January, 2017

Renewable Portfolio Standard Policy Assumptions

- Portfolio direction received from the CPUC and CEC on June 13, 2016:

“Recommend reusing the “33% 2025 Mid AAEE” RPS trajectory portfolio that was used in the 2015-16 TPP studies, as the base case renewable resource portfolio in the 2016-17 TPP studies”

- The CPUC confirmed that the same portfolio, focusing on 33% RPS, should be relied upon for policy-driven analysis in the 2017-2018 TPP.

(Assigned Commissioner’s Ruling, February 2, 2017, Order Instituting Rulemaking to Develop an Electricity Integrated Resource Planning Framework and to Coordinate and Refine Long-Term Procurement Planning Requirements)

- As no material changes were identified that would impact the 2016-2017 results, no additional policy-driven analysis was conducted in 2017-2018 cycle other than special study activities

Update on management approval process for projects less than \$50 million:

- Each year, only those projects less than \$50 million are considered for management approval that:
 - Can reasonably be addressed on a standalone basis
 - Are not impacted by policy or economic issues that are still being assessed.
 - Are not impacted by the approval of the transmission plan (and reliability projects over \$50 million) by the Board of Governors in March, 2015
- When such projects are identified (in November), approving these projects allows streamlining the review and approval process of the annual transmission plan in March of the next year
- Management only approves those projects after the December Board of Governors meeting
- Reliability transmission projects less than \$50 million have been identified for management approval – and modifications and cancellation – ahead of the March Board of Governors meeting
- Other projects less than \$50 million will be identified in January and dealt with in the approval of the comprehensive plan in March.

Other study efforts in progress:

- Six special studies were conducted in this cycle:
 - Risks of early economic retirement of gas fleet
 - Large scale storage benefits
 - 50% Renewables and Interregional Coordination

2016-2017 addendum reports being finalized

 - Slow response resources in local capacity areas (*technical analysis essentially complete, focus now implementation issues*)
 - Gas/electric reliability coordination (*CPUC process in progress*)
 - Continuation of frequency response efforts through improved modeling (*in progress*)
- Continued review of previously-approved projects in PG&E territory (*in progress – a number of projects being discussed today*)

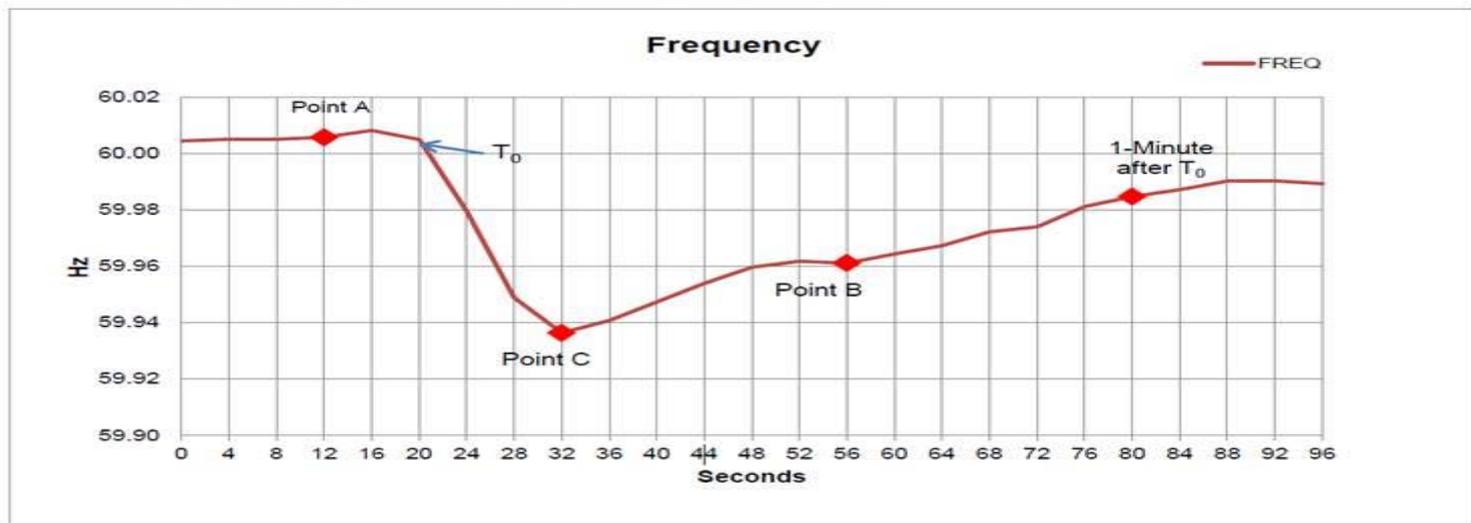
Introducing a new proposal to add Phasor Measurement Units (PMUs) to all CAISO Interties:

- The ISO proposes that PMUs be added to all ISO intertie transmission facilities to other balancing areas
- Phasor measurement units will enhance accuracy of measurements to demonstrate compliance with NERC Reliability Standard BAL-003-1.1

The ISO must meet frequency response obligation based on net actual interchange measurements

- The ISO's median score in response to NERC designated frequency events for the compliance year must meet or exceed its frequency response obligation
- For compliance purposes, frequency response reflects the change in interchange over the change in frequency for a period of time following a frequency disturbance

Figure 1: Illustration of Primary Frequency Response



Phasor measurement units will enhance accuracy of measuring net actual interchange

- The ISO proposes to require PMUs – estimated at \$30,000 per installation – at all interties at the boundary of its balancing authority area to provide more precision regarding the system's net actual interchange after a frequency disturbance event
- The ISO invites comments on requirements for metering and accuracy of data from these devices

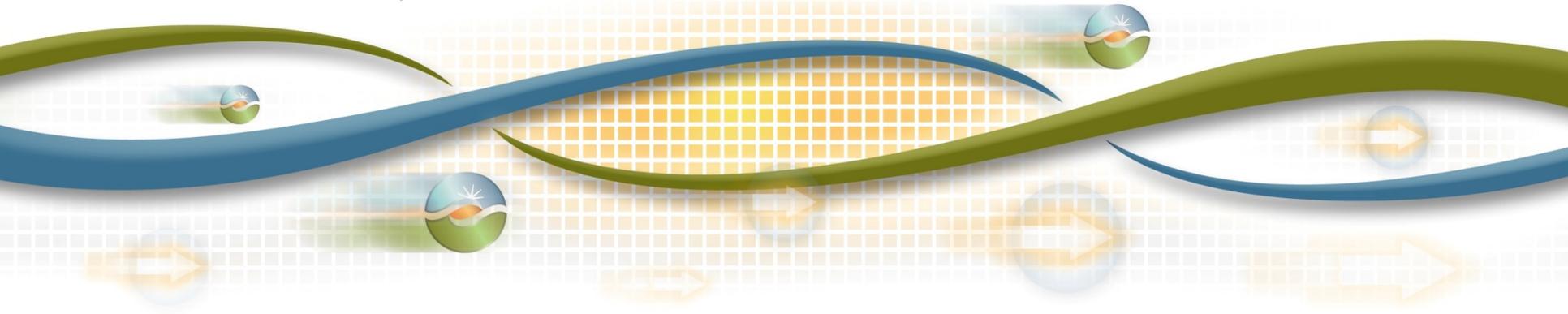


Reliability Projects less than \$50 Million

San Diego Gas & Electric Area Sub-Transmission

Charles Cheung
Sr. Regional Transmission Engineer

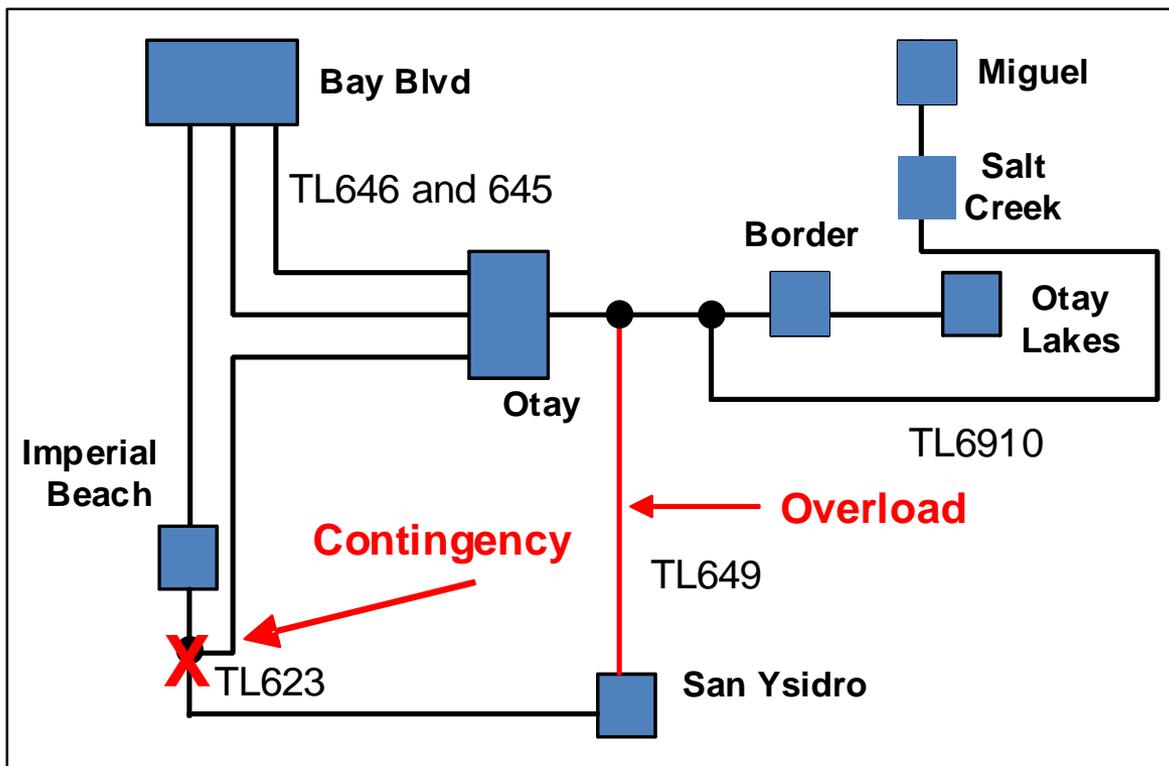
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ISO Recommendations on Proposed Projects San Diego Gas & Electric Area

Project Name	Type of Project	Submitted By	Cost of Project	Is Project Found Needed
Otay 69 kV Reconfiguration Project	Reliability	SDG&E	\$36~47 M (\$6.5~8.4 M approved)	Partial Approval

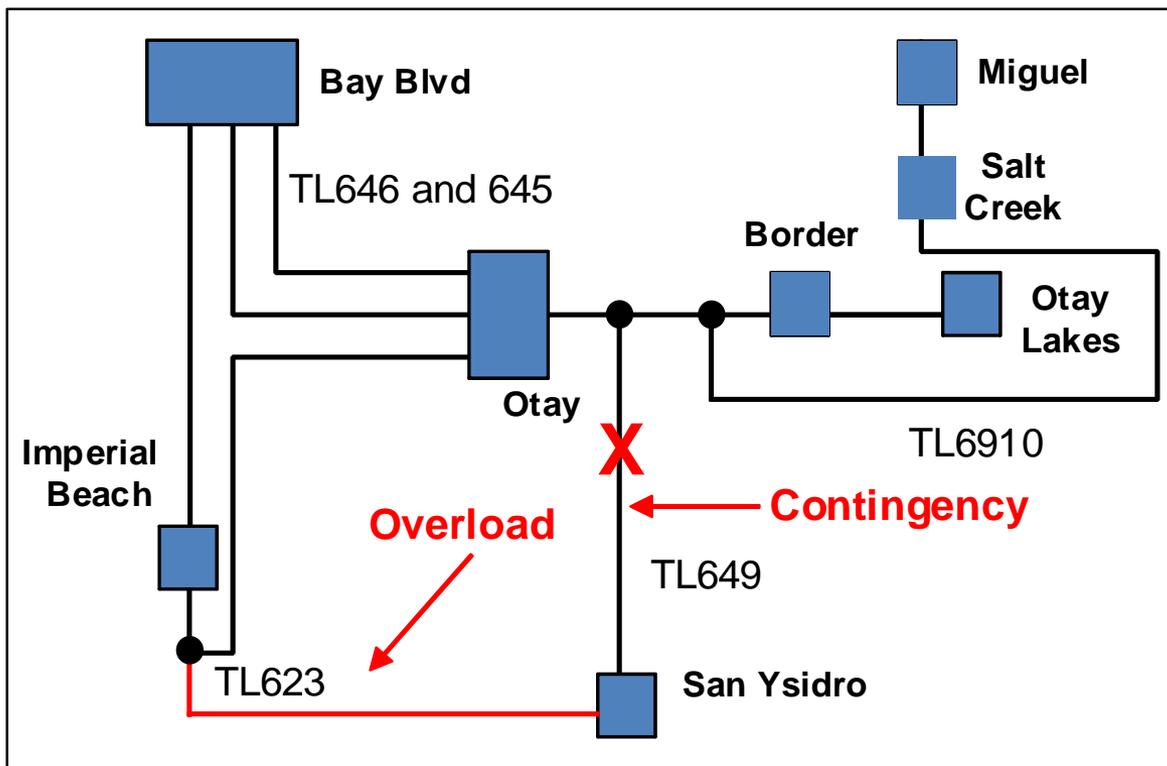
Category P1/P2.1 Thermal Violation (1)



Otoy Lake Tap – San Ysidro 69 kV

- Thermal overload
 - ❖ TL649D overload at 100% for N-1 outage of TL623 with Peak Load at San Ysidro (All Peak cases)
- Potential Mitigation
 - ❖ Network Upgrade
 - ❖ 10 MW of 2-hour Preferred resources at San Ysidro

Category P1/P2.1 Thermal Violation (2)



Otab Tap - San Ysidro 69 kV

- Thermal overload
 - ❖ TL623C overload at 100% for N-1 outage of TL649 with Peak Load at San Ysidro (All Peak cases)
- Potential Mitigation
 - ❖ Network Upgrade
 - ❖ 10 MW of 2-hour Preferred resources at San Ysidro

Otay 69 kV Reconfiguration Project

Submitted by: SDG&E

Need: Support the growing demand at the San Ysidro substation

Project Scope: Remove the taps on TL623 and TL649, extend the lines to Otay substation, and reconductor TL623, TL649, and TL647

Cost: \$36-47 million

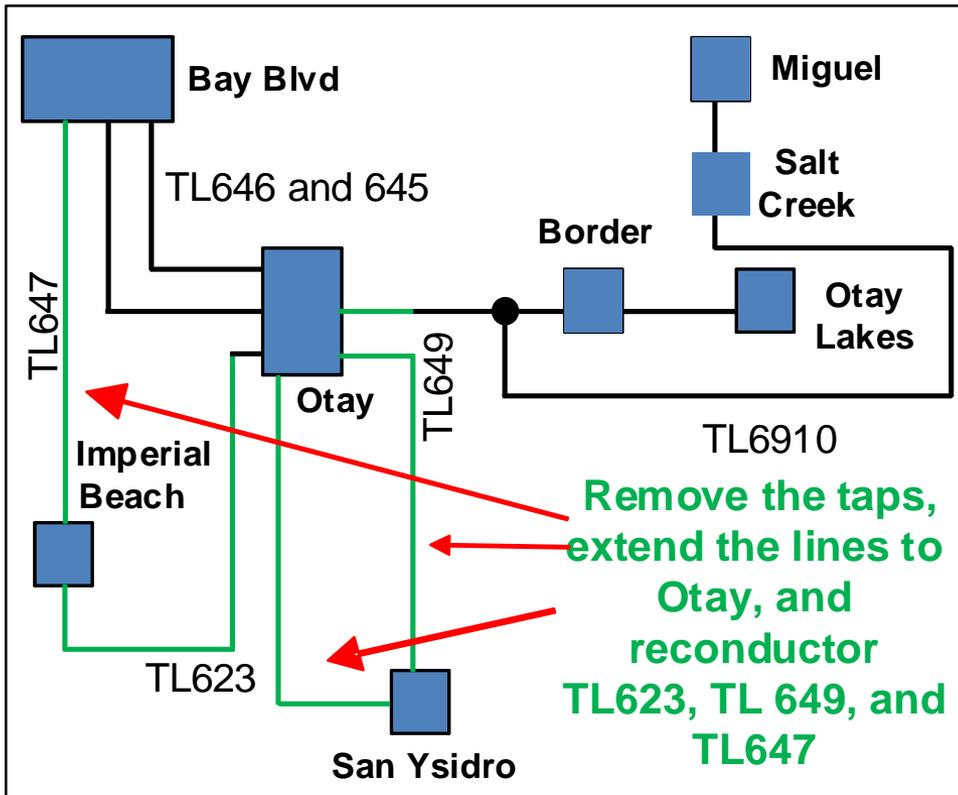
Alternative 1: Reconductor only the two lines connecting to the San Ysidro substation

Alternative 2: Preferred Resources as transmission assets, 2 sets of 2-hour battery, 5 MW capacity each (20 MWh in total).

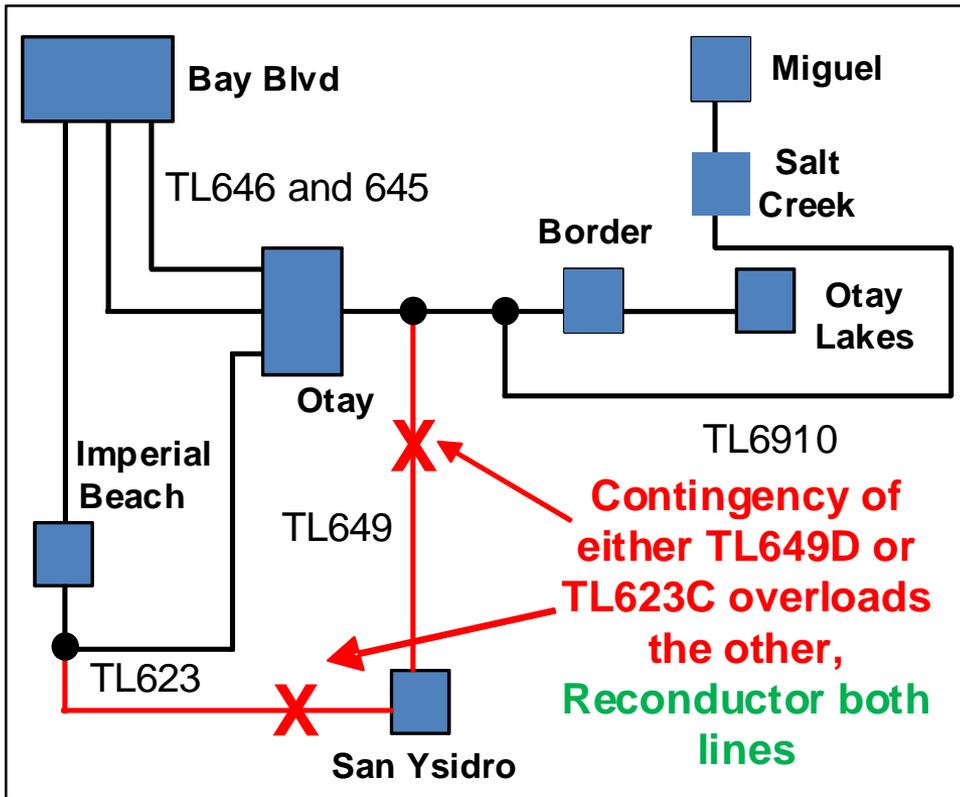
Expected In-Service: June 2020

Interim Plan: Drop up to 5 MW of Load in San Ysidro

Recommended Action: Partial Approval for Alternative 1 option



Alternative 1



Project Scope: Reconstructor the existing two lines connecting to San Ysidro (TL623C to 102/102 MVA and TL649D to 97/136 MVA)

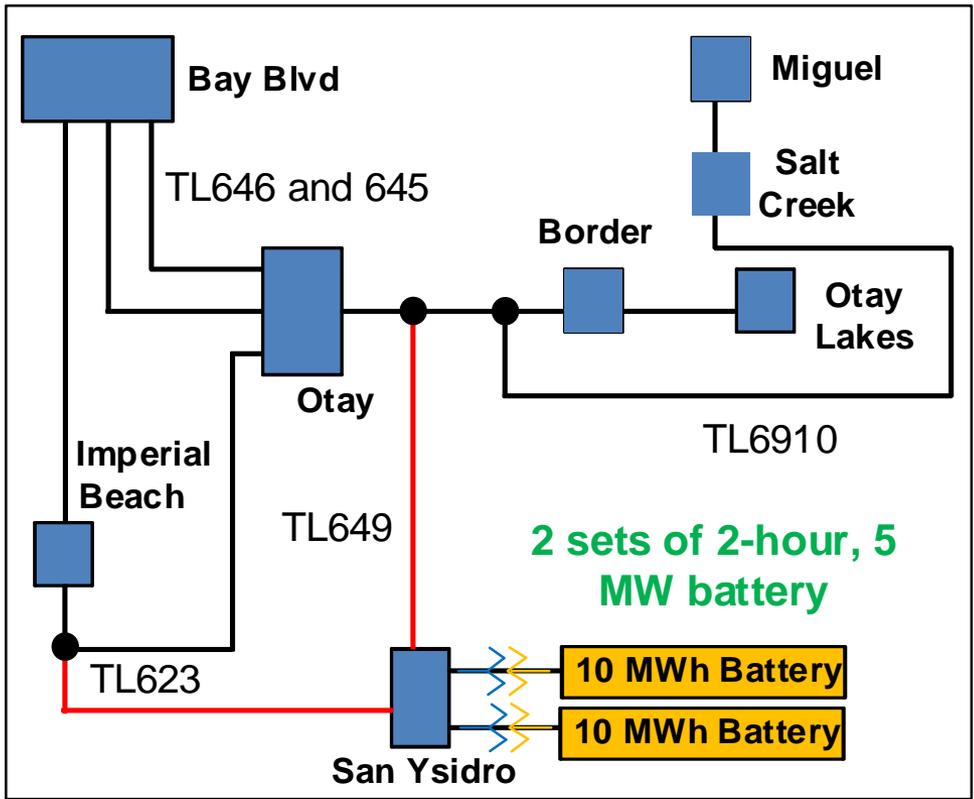
Cost: \$6.5-8.4 million

Expected In-Service: June 2020

Interim Plan: Drop up to 5 MW of Load in San Ysidro

Recommended Action: Approval by the CAISO Executives

Alternative 2



Project Scope: 2 sets of 2-hour battery, 5 MW capacity each (20 MWh in total).

Cost: \$13 million (\$650 per kWh, 20 MWh in total)

Expected In-Service: June 2020

Interim Plan: Drop up to 5 MW of Load in San Ysidro

Recommended Action: Not recommended



Reliability Projects less than \$50 Million SDG&E Main System

Frank Chen

Regional Transmission Engineer Lead

*2017-2018 Transmission Planning Process Stakeholder Meeting
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ISO Recommendations on Project Submittals

Project Name	Type of Project	Submitted By	Cost of Project	Is Project Found Needed
Development of 30-Minute Emergency Ratings on Suncrest Banks #80 and #81	Reliability	CAISO/SDG&E	Less than \$1 M	Yes
Previously approved Mission-Penasquitos 230 kV Circuit Project	Reliability	CAISO	\$25~30 M	No

Development of 30-Minute Emergency Ratings on Suncrest Banks #80 and #81

Submitted by: CAISO/SDG&E

Need: Category P6 overload in high density urban area (2018~)

Project Scope: Upgrade line drop of Suncrest Banks #80 and #81 to achieve a 30-minute emergency rating

Cost: less than 1 million

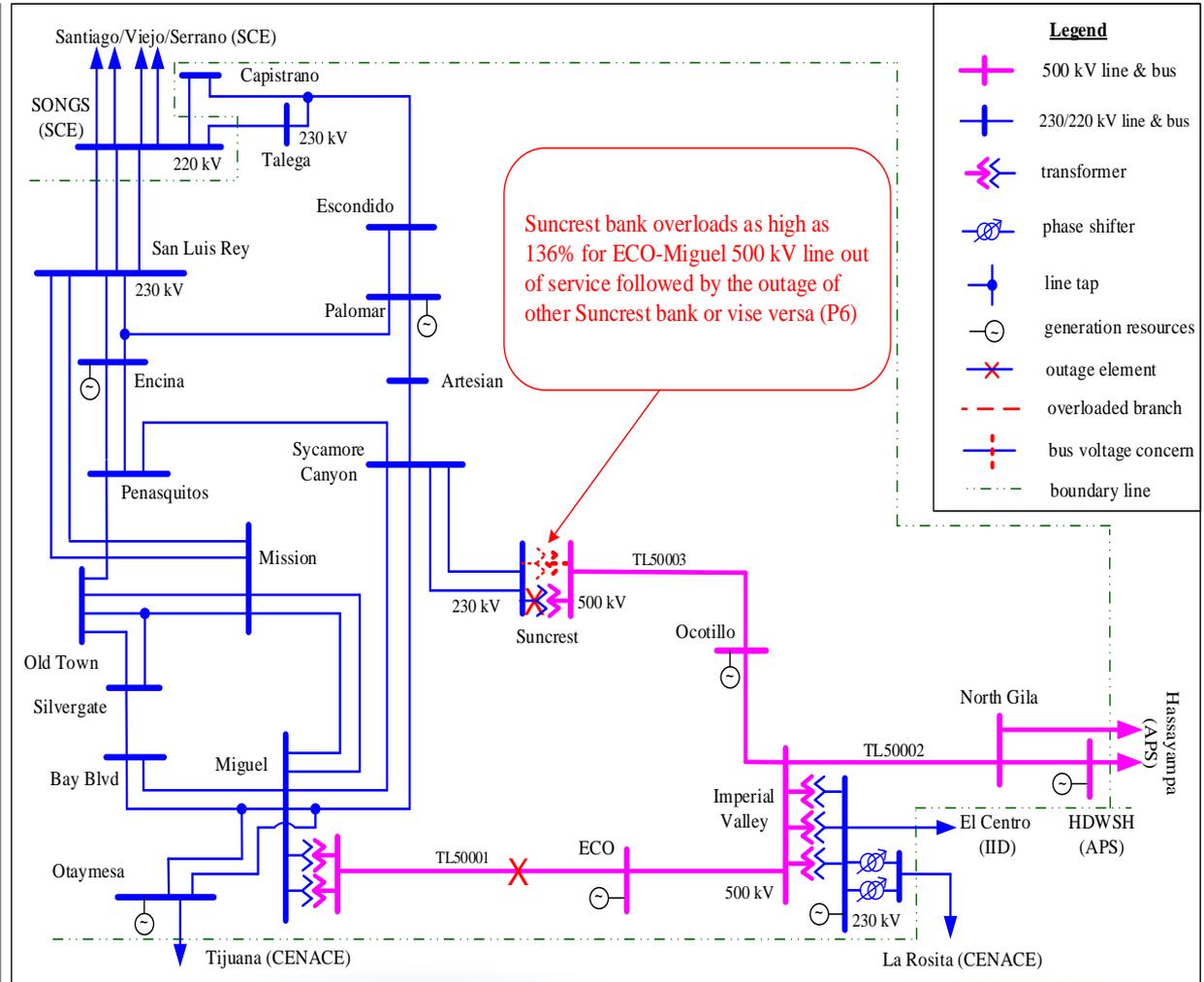
Other Considered Alternatives: Develop a RAS dropping gen in the greater IV area

Expected In-Service: June 2018

Interim Plan: None

Potential Issues: The bank overloads for the loss of ECO-Miguel 500 kV line followed by the outage of other bank or vice versa (P6)

Recommended Action: Concurrence by the CAISO Executives



Cancellation of Mission-Penasquitos 230 kV Circuit Project

Submitted by: CAISO

Original need: Category P6 overload in high density urban area with original project scope of SX-PQ 230 kV line. The project was approved in the 2014 ~2015 TP (shown in adjacent diagram)

Current need: None with CPUC approved project scope of SX-PQ 230 kV line

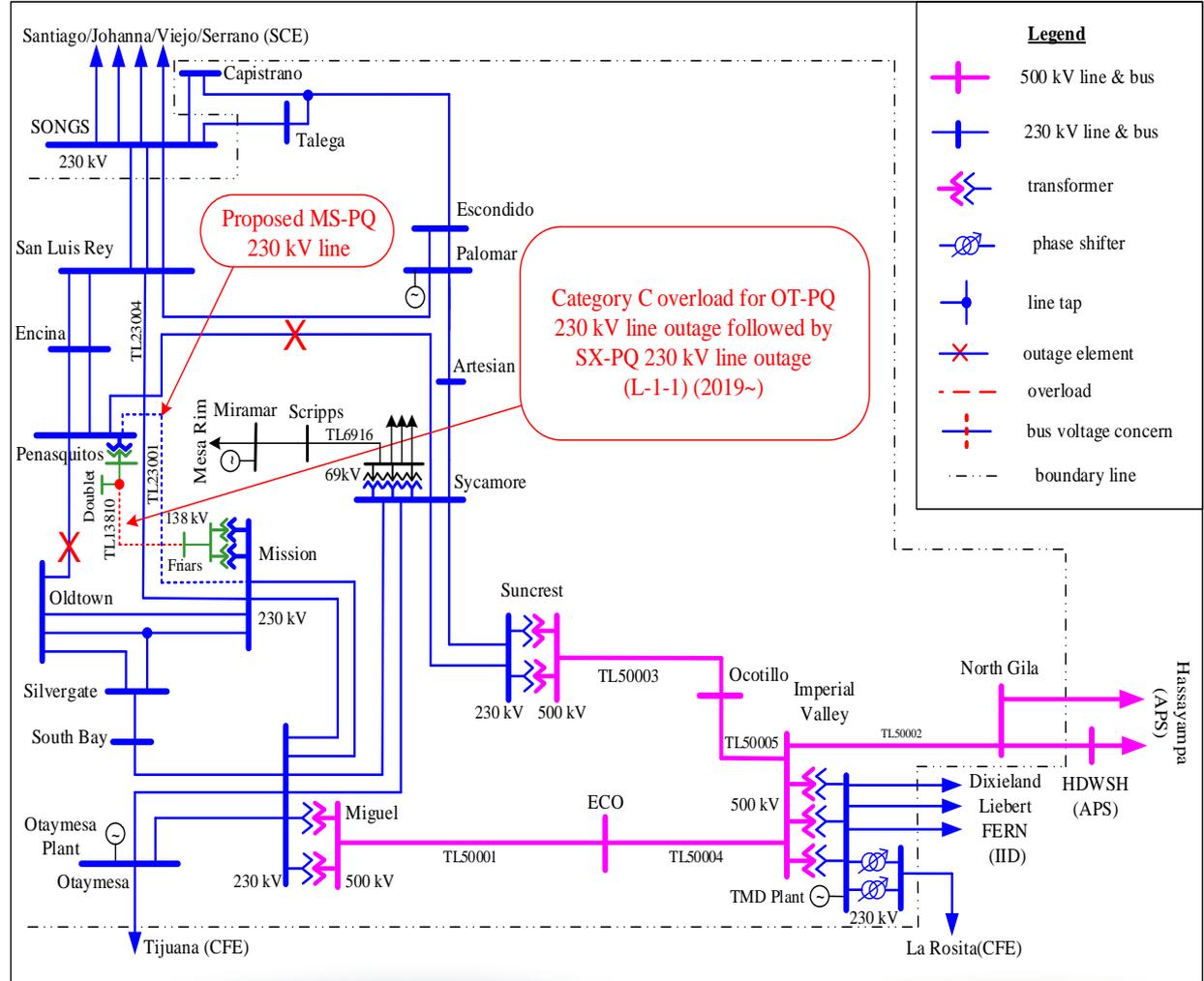
Mitigation:

- No mitigation is required for reliability
- No mitigation is required for generation deliverability
- No mitigation is required for LCR

Alternative: None

Cost Avoided: \$25~30 millions

Recommended Action: Approve cancellation of the Project by the CAISO Executives

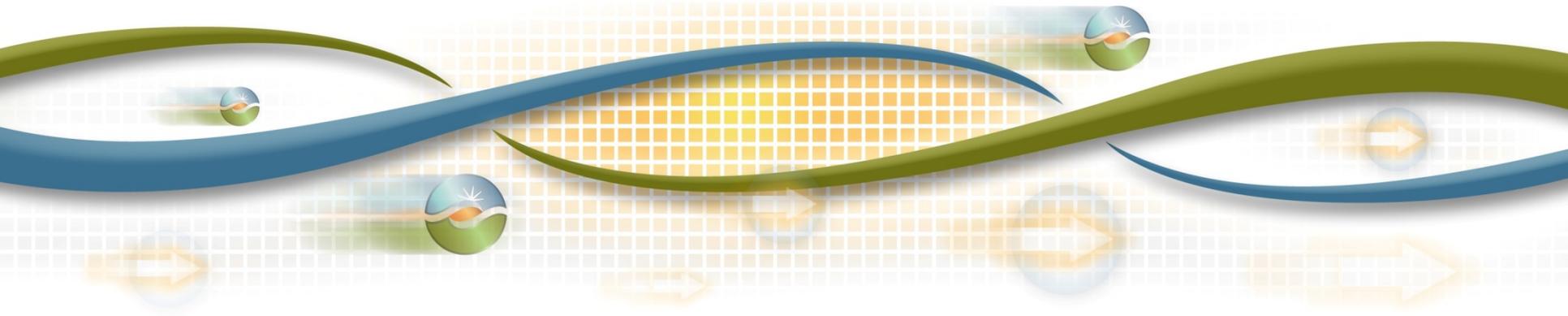




2017-2018 TPP Projects Recommendations – PG&E Area

Binaya Shrestha
Regional Transmission Engineer Lead

2017-2018 Transmission Planning Process Stakeholder Meeting
November 16, 2017



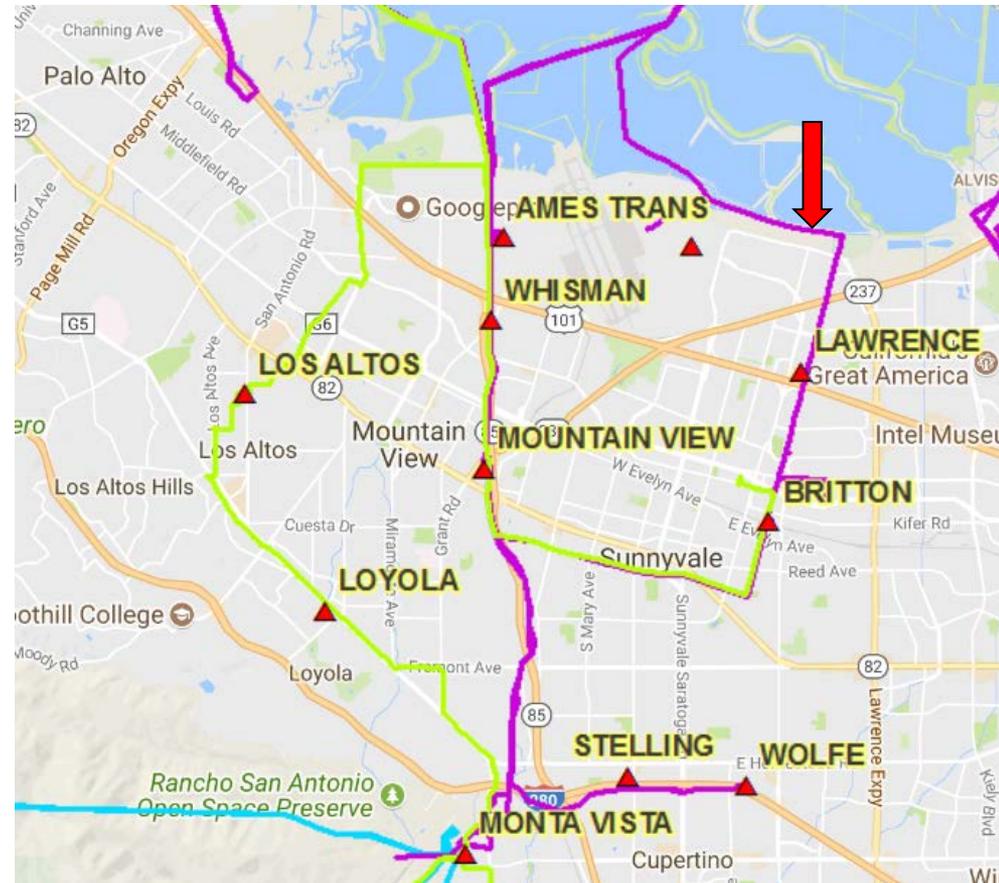
Presentation Outline

- New < \$50 million projects concluded at this time for approval recommendation
- Review of previously approved projects
 - Projects modeled in base cases are still required to meet reliability needs
 - Projects not modeled in base cases
 - < \$50 million projects concluded at this time to proceed with current scope
 - < \$50 million projects concluded at this time to be canceled
 - < \$50 million projects concluded at this time to proceed with revised scope
 - > \$50 million projects will have assessments included in the draft ISO 2017-2018 Transmission Plan to be posted by January 31, 2018 for stakeholder comment.
 - Review of projects approved in 2012-2013 Transmission Plan in the Central California Study

New Projects Recommended for Approval (Less than \$50M projects)

Newark-Lawrence 115 kV Line Upgrade (Greater Bay Area)

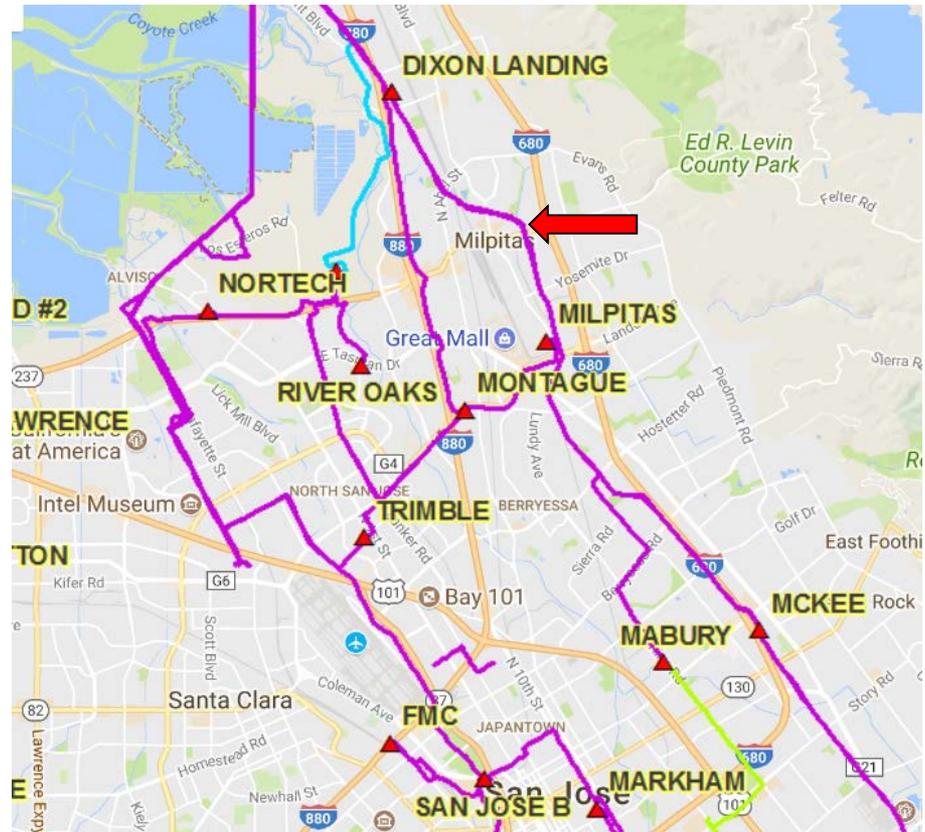
- Reliability Assessment Need
 - NERC Categories P7 starting 2019 and P6 thermal overloads starting 2022.
 - Overloads worsen in peak-shift and high CEC forecast sensitivities.
- Project Submitter
 - ISO
- Project Scope
 - Upgrade limiting equipment
 - circuit breaker at Newark
- Project Cost
 - \$1.5M-\$2M
- Alternatives Considered
 - Rerate
 - Battery Energy Storage
- Recommendation
 - Approval



Map source: PG&E solar photovoltaic and renewable auction mechanism (PV RAM) project map

Newark-Milpitas #1 115 kV Line Upgrade (Greater Bay Area)

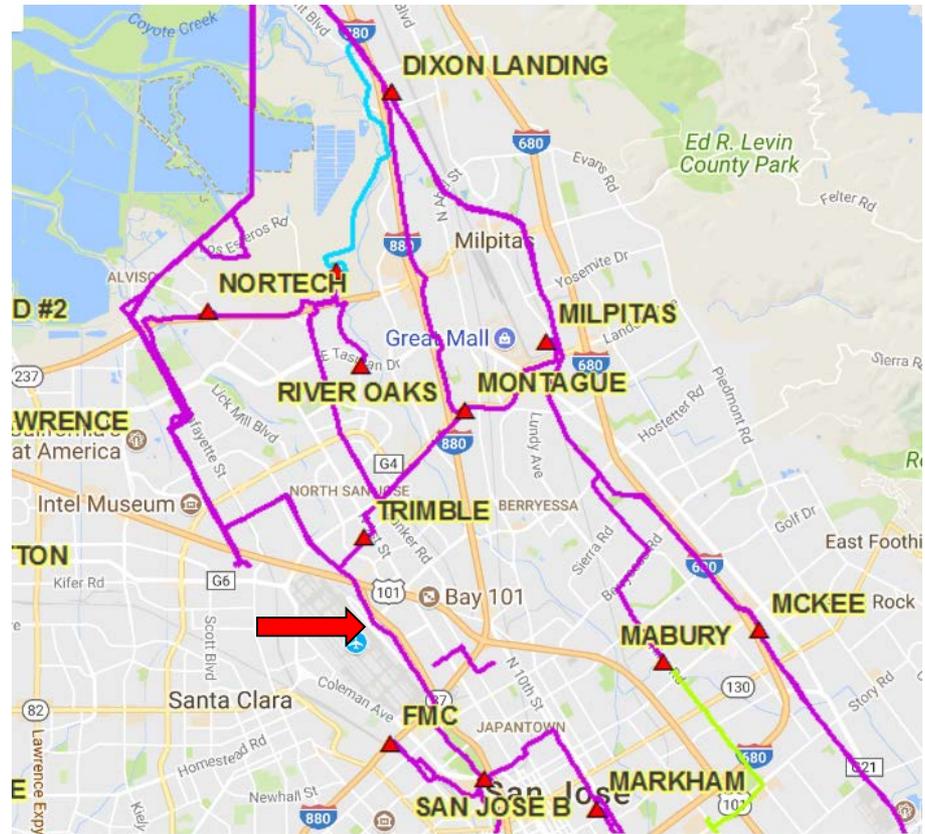
- Reliability Assessment Need
 - NERC Categories P6 starting 2019.
 - Overloads worsen in peak-shift and high CEC forecast sensitivities.
- Project Submitter
 - ISO
- Project Scope
 - Upgrade limiting equipment
 - circuit breaker at Newark
 - Terminal conductor
- Project Cost
 - \$1.5M-\$2M
- Alternatives Considered
 - Rerate
 - Battery energy Storage
- Recommendation
 - Approval



Map source: PG&E solar photovoltaic and renewable auction mechanism (PV RAM) project map

Trimble-San Jose B 115 kV Line Upgrade (Greater Bay Area)

- Reliability Assessment Need
 - NERC Categories P6 starting 2022.
 - Overloads worsen in peak-shift and high CEC forecast sensitivities.
- Project Submitter
 - ISO
- Project Scope
 - Upgrade limiting equipment
 - circuit breaker at Newark
- Project Cost
 - \$3M-\$4M
- Alternatives Considered
 - Rerate
 - Battery Energy Storage
- Recommendation
 - Approval



Map source: PG&E solar photovoltaic and renewable auction mechanism (PV RAM) project map

Coburn-Oil fields 60 kV system (Central Coast / Los Padres)

- Reliability Assessment Need
 - NERC Categories P3.
- Project Submitter
 - PG&E
- Project Scope
 - Install 10 MVAR shunt capacitor at Oil Fields
- Project Cost
 - \$7M-\$10M
- Alternatives Considered
 - Local generation
- Recommendation
 - Approval

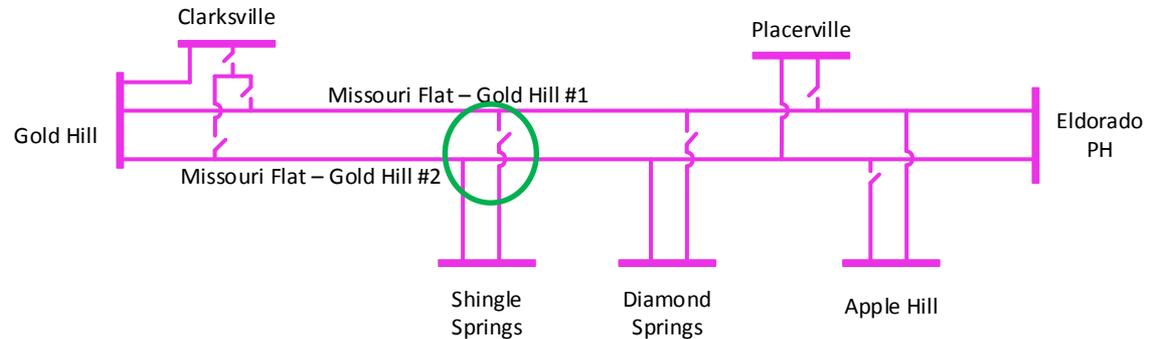


Map source: PG&E solar photovoltaic and renewable auction mechanism (PV RAM) project map

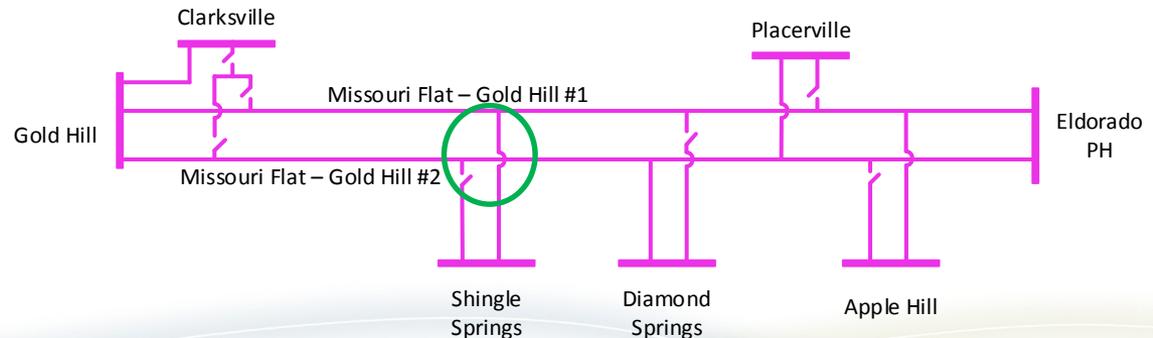
Shingle Springs Reconfiguration (Central Valley)

- Reliability Assessment Need
 - NERC Categories P2-1 thermal overloads on the Gold Hill to Eldorado 115 kV lines
- Recommendation
 - Move Shingle Springs load from Gold Hill – Missouri Flats #2 to #1

Existing configuration:



Recommended configuration:



Review of Previously Approved Projects

Previously Approved Transmission Projects

< 50M projects concluded at this time to proceed with current scope

Project Name	Area	Alternatives Considered	Reason
Metcalf-Evergreen 115 kV Line Reconductoring	Greater Bay Area	Power flow control device	Alternative doesn't resolve all reliability issues
Los Esteros 230 kV Substation Shunt Reactor	Greater Bay Area	None	No reasonable lower cost alternative available
Ravenswood – Cooley Landing 115 kV Line Reconductor	Greater Bay Area	•Cooley Landing 115 kV bus upgrade	•Doesn't resolve all overloads on this line
		•New 115 kV source to Palo Alto	•Palo Alto issues are addressed separately
		•Normally close tie between Ames and Monta Vista 115 kV systems.	•Doesn't resolve overloads on this line
Moraga-Castro Valley 230 kV Line Capacity Increase Project	Greater Bay Area	None	No reasonable lower cost alternative available
Glenn 230/60 kV Transformer No 1 Replacement	North Valley	None	BCR Project
Delevan 230 kV Substation Shunt Reactor	North Valley	None	No reasonable lower cost alternative available
Mosher Transmission Project	Central Valley	None	BCR Project
Vierra 115 kV Looping Project	Central Valley	None	No reasonable lower cost alternative available
Bellota 230 kV Substation Shunt Reactor	Central Valley	None	No reasonable lower cost alternative available
Ignacio 230 kV Substation Shunt Reactor	North Coast / North Bay	None	No reasonable lower cost alternative available
Wilson Voltage Support	Fresno	None	No reasonable lower cost alternative available
Midway-Temblor 115 kV Line Reconductor and Voltage Support	Kern	None	No reasonable lower cost alternative available
Wheeler Ridge Voltage Support	Kern	None	No reasonable lower cost alternative available

Previously Approved Transmission Projects

< 50M projects concluded at this time to be canceled

Projects recommended for cancelation without any further action

Project Name	Area	Reason
Los Esteros-Montague 115 kV Substation Equipment Upgrade	Greater Bay Area	No need identified
Evergreen-Mabury Conversion to 115 kV	Greater Bay Area	"Metcalf-Piercy & Swift and Newark-Dixon Landing 115 kV Upgrade" project sufficient to address need
Glenn #1 60 kV Reconductoring	North Valley	No need identified
Napa – Tulucay No. 1 60 kV Line Upgrades	North Coast / North Bay	No need identified
Ashlan - Gregg and Ashlan - Herndon 230 kV Line Reconductor	Fresno	No need identified
Caruthers - Kingsburg 70 kV Line Reconductor	Fresno	No need identified
Kearney - Caruthers 70 kV Line Reconductor	Fresno	No need identified
Reedley 115/70 kV Transformer No. 2 Replacement Project	Fresno	No need identified

Projects recommended for cancelation with further action not requiring ISO approval

Project Name	Area	Further Action
Table Mountain – Sycamore 115 kV Line	North Valley	Recommend to PG&E to install an SPS
Stagg – Hammer 60 kV Line	Central Valley	Recommend to PG&E to install an SPS
Rio Oso – Atlantic 230 kV Line Project	Central Valley	Recommend to PG&E to upgrade protection and develop operating measure

Previously Approved Transmission Projects

< 50M projects concluded at this time to proceed with revised scope

Area	Project Name	Approved Project		Revised Scope	
		Original Scope	Cost (current estimate)	Revised Scope	Cost
GBA	NRS-Scott #1 115 kV line Reconductor	Reconductor NRS-Scott #1 115 kV line	\$4M	Reconductor NRS-Scott #1 & #2 115 kV lines	\$6M
NVLY	Cottonwood 115 kV Substation Shunt Reactor	Install a 100 Mvar shunt reactor at Cottonwood 115 kV bus	\$17M-\$19M	Replace existing 230/115 kV transformers with new transformers with LTC	\$15M
NVLY	Cascade 115/60 kV No2 Transformer Project and Cascade – Benton 60 kV Line Project	•Cascade 115/60 kV Transformer No. 2	\$20M-\$30M	•Cascade 115/60 kV Transformer No. 2	\$10M-\$20M
		•High side breaker on the existing transformer		•High side breaker on the existing transformer	
		•Cascade-Benton 60 kV line			
CVLY	Rio Oso Area 230 kV Voltage Support	•Rio Oso SVC (+200/-175Mvar)	\$30M-\$40M	Rio Oso SVC(+200/-260Mvar)	\$24M
		•Atlantic Capacitor bank			
CVLY	Pease 115/60 kV Transformer Addition and Bus Upgrade	•Pease transformer addition	\$30M	•Pease transformer addition	\$30M
		•Bus upgrade		•Bus upgrade	
		•UVLS in the interim		•No UVLS	
CVLY	Mosher Transmission Project (BCR project)	Reconductor the line with 2x715 AAC conductor	\$10M-\$20M	Reconductor the line with single 715 AAC conductor	\$15M

Previously Approved Transmission Projects

< 50M projects concluded at this time to proceed with revised scope

Area	Project Name	Approved Project		Revised Scope	
		Original Scope	Cost (current estimate)	Revised Scope	Cost
NCNB	Fulton-Fitch Mountain 60 kV Line Reconductor (Fulton-Hopland 60 kV Line)	Reconductor Fulton – Hopland 60 kV line	\$29M	•Reconductor Fulton – Hopland 60 kV line	\$31M
				•Re-rate another section of the Fulton – Hopland 60 kV Line	
				•Re-rate the Fitch Mountain #2 60 kV Tap	
NCNB	Clear Lake 60 kV System Reinforcement	•Build a new 115 kV line to Middletown Substation	\$50M	•Reconductor Clear Lake – Hopland 60 kV line	\$14M
		•Install a new 115/60 kV transformer at Middletown Substation		•Install a 10-15 MVAR shunt capacitor at Middletown 60 kV substation	
NCNB	Ignacio – Alto 60 kV Line Voltage Conversion	•Replace limiting equipment on the Ignacio- San Rafael No. 1 115 kV Line at the San Rafael Substation	\$50M	•Reconductor Ignacio- San Rafael #1 115 kV Line and Ignacio – Alto 60 kV Line	\$37M
		•Convert the Ignacio – Alto 60 kV Line from Ignacio Substation to Greenbrae Substation to 115 kV and loop the new 115 kV line into San Rafael Substation.		•Add shunt capacitors at Greenbrae 60 kV Substation	
		•Install 20-30 MVAR shunt capacitor at Greenbrae 60 kV Substation		•Reconductor Ignacio- San Rafael #3 115 kV Line and upgrade limiting equipment.	



Central California Study (2012-2013 Transmission Plan) Project Review

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	Current Estimated In-Service Date	Current Estimated Cost
Series Reactor on Warnerville-Wilson 230 kV Line	2017	\$12 million
Gates #2 500/230 kV Transformer Addition	2022	\$60 million
Kearney - Hearndon 230 kV Line Reconductoring	2019	\$13 million
Gates-Gregg 230 kV Line	2022	\$200 million

Reliability Need

- 2012-2013 Transmission Plan
 - Project was approved as a Reliability-driven project with potential renewable integration benefits
 - Reliability needs identified to start in the 2023 to 2029 timeframe
- 2016 and 2017 Assessment
 - 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

2026 Area Loads with Pumps versus Capability

(Non Summer Months – when oversupply conditions are expected)

2016-2017 TPP
Assessment is still
valid

- Load profile is similar
- BTM-PV in 2015 IEPR is consistent with the 2016 IEPR Update

ISO updating the
detailed load forecast
analysis based on
2017-2018 TPP



Uncertainty Could Impact Need

- Load Forecast
 - Distributed PV installed capacity and output
 - Increase in PV growth rate would decrease benefit
 - Reduction in PV growth rate would increase benefit
 - **Note:** *CEC Demand Analysis Work Group meeting on November 8 on the 2017 IEPR revised demand forecast indicates significant increase in Distributed PV*
<http://dawg.info/meetings/dawg-demand-forecasting-pup-2017-iepr-revised-demand-forecast-and-related-methodological>
 - Load growth
 - Higher load growth and Fresno area forecast would increase benefit
 - Lower load growth and Fresno area forecast would decrease benefit
- Expanding over-supply timeframe to summer periods
 - Increase the benefits

Project Review Preliminary Assessment

Project	Assessment
Series Reactor on Warnerville-Wilson 230 kV Line	<u>Is required</u> and is under construction with December 2017 in-service date
Gates #2 500/230 kV Transformer Addition	<u>Is required.</u> Generation deliverability in area is relying on upgrade, reliability issues identified in Bulk System studies and supports Helms pumping
Kearney - Hearndon 230 kV Line Reconductoring	<u>Further assessment still required; however appears to be required.</u> Supports Helms pumping and some congestion identified in economic assessment.
Gates-Gregg 230 kV Line	<u>Further assessment still required; however does not appears to be required.</u> Supports Helms pumping.

Gates-Gregg 230 kV Transmission Line Project

Next Steps

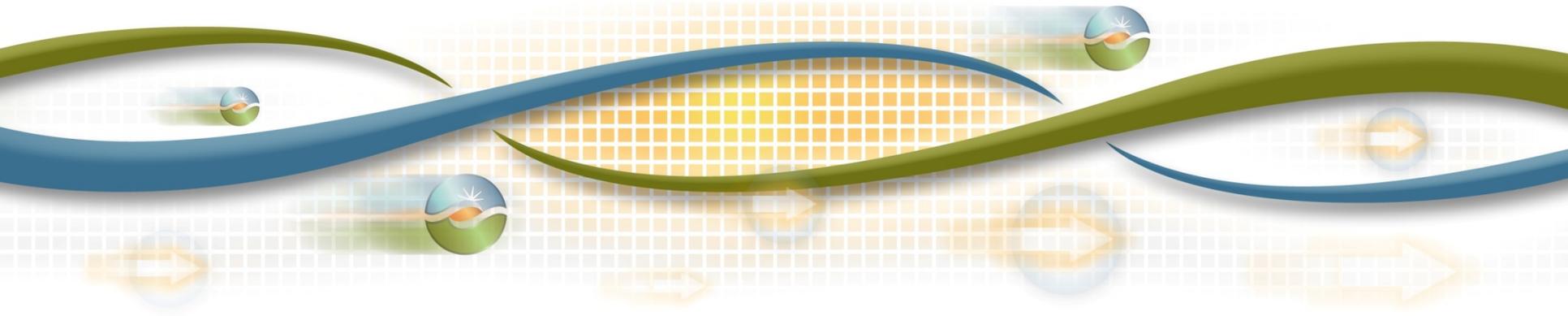
- At this time, there does not appear to be sufficient economic benefits to support the Gates-Gregg 230 kV Transmission Line Project
- ISO will update the detailed analysis and economic assessment based on cost of renewable curtailment in the draft ISO 2017-2018 Transmission Plan to be posted by January 31, 2018 for stakeholder comments.
- Based upon the assessment in the 2016-2017 TPP along with the preliminary assessment in the 2017-2018 TPP, the ISO is considering cancelling the Gates-Gregg 230 kV Transmission Line Project in the ISO 2017-2018 transmission planning process
 - The decision will be based upon the final updated assessment



Preliminary Results of Congestion and Economic Assessments

Yi Zhang
Regional Transmission Engineer Lead

2017-2018 Transmission Planning Process Stakeholder Meeting
November 16, 2017



Summary of database development since last stakeholder meeting

- Modeling updates identified in ADS PCM development
- Latest CEC load forecast for 2027 for all CAISO areas
- Network models in ISO reliability power flow basecases
 - Transmission topology and ratings
 - Load distribution
 - Generator location
- Transmission constraints
 - Critical contingencies identified in reliability and LCR studies
 - Nomograms
 - Scheduled outage/derate

Summary of congestions (1)

Area or Branch Group	Costs T (M\$)	Duration_T (Hrs)	Note
BOB SS (VEA) - MEAD S 230 kV line	10.63	542	From Bob SS to Mead S flow
SDGE IV-SD Import	10.18	1,791	From IV area to San Diego flow
PG&E NCNB	6.40	247	May impact geothermal generator output in PG&E NCNB area
PG&E/TID Exchequer	4.20	2,166	May impact Exchequer hydro generator output
Path 45	2.72	565	Bi-directional between the ISO and CFE systems
PG&E POE-RIO OSO	1.37	104	May impact POE and nearby hydro generator output
COI Corridor	0.76	32	Including congestions on COI and its downstream lines
Path 26	0.45	25	Mainly from South to North flow
SCE Devers-RedBluff 500 kV line	0.29	13	From east to west flow
IID-SDGE (S line)	0.28	122	From IID to SDGE flow

Summary of congestions (2)

Area or Branch Group	Costs T (M\$)	Duration_T (Hrs)	Note
Moenkopi-Eldorado 500 kV	0.25	19	From Moenkopi to Eldorado flow
Path 24	0.23	95	From PG&E to NVE flow
Path 15/CC	0.22	13	Bi-directional
PG&E Fresno	0.18	89	Correlated with Helms pumping
SDGE North	0.16	35	From South to North flow
SCE J.HINDS-MIRAGE 230 kV line	0.14	35	From J.Hinds to Mirage
Path 52 Silver Peak-Control 55 kV	0.10	1,057	From SCE to NVE flow
SCE Inyo Phase Shifter	0.08	3,071	Flow direction is from SCE to LADWP
Path 61/Lugo - Victorville	0.06	18	From Lugo to Victorville flow
PG&E/Sierra MARBLE transformer	0.02	39	From PG&E to NVE flow
PG&E GBA	0.01	2	From LASAGUILASS to MOSSLNSW 230 kV line, subject to PG&E N-1 Mosslanding-LosBanos 500 kV

High level analysis – ISO tie-lines

- Some ISO tie-lines showed congestion in exporting direction

Constraints	Costs T (M\$)	Duration T (Hrs)	Limitation
BOB SS (VEA) - MEAD S 230 kV line	10.63	542	Line rating
Path 24 (PG&E-Nevada)	0.23	95	Path rating
Path 52 (NVE-SCE Inyo/Control area)	0.10	1057	Path rating
SCE Inyo Phase Shifter	0.08	3071	Phase shifter rating
Path 61/Lugo - Victorville	0.06	18	Path rating from Lugo to Victorville
PG&E/Sierra MARBLE transformer	0.02	39	Transformer rating

High level analyses – Path 45 and San Diego/IV areas

- Path 45 congestion was bi-directional

Direction	Cost (\$M)	Duration (Hr)	Note
ISO to CFE	1.46	21	Mainly due to high renewable output in IV area
CFE to ISO	1.26	538	Mainly due to economic dispatch

- IID-SDGE 230 kV line congestions (from north to south)

Constraints	Cost (\$M)	Duration (Hr)
El Centro to Imperial Valley 230 kV line, subject to SDGE N-1 N.Gila-Imperial Valley 500kV	0.28	121

- IV-San Diego Import

Constraints	Cost (\$M)	Duration (Hr)
TJI to OtayMesa 230 kV line, subject to SDGE N-1 Eco-Miguel 500 kV with RAS	9.98	1751
TJI to OtayMesa 230 kV line, subject to SDGE N-1 Ocotillo-Suncrest 500 kV with RAS	0.10	18
TJI to OtayMesa 230 kV line, subject to SDGE N-2 Suncrest-Sycamore 230 kV #1 and #2 with RAS	0.07	19
Suncrest to Sycamore 230 kV line, subject to SDGE N-1 Suncrest-Sycamore 230 kV line with RAS	0.03	3

High level analyses – Path 26 and Path 15

- Path 26 congestion

Constraints	Costs T (M\$)	Duration T (Hrs)	Limitation
Wirlwind to Midway 500 kV line	0.28	8	Line rating (South to North flow)
Path 26	0.18	17	Path rating (South to North flow)

- Path 15 congestion

Constraints	Costs T (M\$)	Duration T (Hrs)	Limitation
Midway to Gates 500 kV line #1 (S->N flow)	0.18	5	Line rating
Gates to Panoche 230 kV line, subject to PG&E N-2 Gates-Gregg and Gates-McCall 230 kV	0.04	4	Line rating
P15 Midway-LosBanos (N->S flow)	0.01	3	Path rating (N->S)

High level analyses – PG&E Fresno

- Some congestions correlated with Helms pumping

Constraints	Costs T (M\$)	Duration T (Hrs)	Correlated with Helms pumping?
COTTLE-MELONES 230 kV line #1	0.08	6	No
KEARNEY-HERNDON 230 kV line #1	0.07	8	Yes
HENRITTA 70.0/230 kV transformer #4	0.02	74	Yes
BORDEN-GREGG 230 kV line, subject to PG&E N-1 Borden-Storey1-Wilson 230kV	0.01	1	Yes

High level analyses – COI and its downstream corridor

- COI planning nomograms and annual scheduled outages/derate were modeled

Constraints	Costs T (M\$)	Duration T (Hrs)	Limitation
P66 COI	0.69	28	Path rating (4800 MW and derated rating)
Table MT to Tesla 500 kV line	0.04	2	Line rating
ISO v COI Summer 3-1	0.03	1	Nomogram
Table MT to Vaca-Dixon 500 kV line	0.01	1	Line rating

- Less COI congestion was observed in the preliminary result comparing with the last planning cycle mainly as load forecast went down

High level analyses – Other noticeable or new identified congestions

- Line flows injecting to Southern CA areas

Constraints	Costs T (M\$)	Duration T (Hrs)	Limitation
DEVERS-REDBLUFF 500 kV line #2	0.29	13	Line rating
MOENKOPI-ELDORDO 500 kV line #1	0.25	19	Line rating
J.HINDS-MIRAGE 230 kV line #1	0.14	35	Line rating

- San Diego North (all are from south to north)

Constraints	Costs T (M\$)	Duration T (Hrs)	Limitation
MELRSETP-SANMRCOS 69 kV line, subject to SDGE N-2 EN-SLR and EN-SLR-PEN 230 kV	0.13	33	Line rating
ENCINATP-SANLUSRY 230 kV line, subject to SDGE N-1 EN-SLR 230 kV	0.02	2	Line rating

Economic planning study requests

#	Study request	Major concerns or potential benefits described by study request submitters
1	Bob Tap to Mead upgrade	Benefit of reducing curtailment, participant benefit
2	COI congestion	COI congestion due to scheduling limit
3	Mira Loma - Red Bluff 500 kV line	Benefit of reducing LA Basin LCR and LA Basin/SD combined LCR
4	Devers - Suncrest 500 kV line or Alberhill – Sycamore 500 kV line with OtayMesa-Sycamore loop-in to Suncrest	Benefit of reducing LA Basin LCR and LA Basin/SD combined LCR
5	Renewable Energy Express* (AC-DC Conversion of N. Gila-IV-MG)	Benefit of reducing LA Basin LCR and LA Basin/SD combined LCR
6	Round Mtn. - Cottonwood 230 kV lines flow control devices	COI nomogram with the flow control devices
7	SunZia and 1500 MW wind in NM	Renewable integration
8	LCR benefit evaluation (South Bay-Moss Landing, Wilson, LA Basin, SD/IV)	LCR benefit

* Also evaluated in Inter-regional transmission planning (ITP) process

Next steps

- Perform detail production cost simulations and economic assessments
- Review study requests and perform economic assessments if needed
- Present the final results and recommendations in the fourth stakeholder meeting of 2017~2018 planning cycle

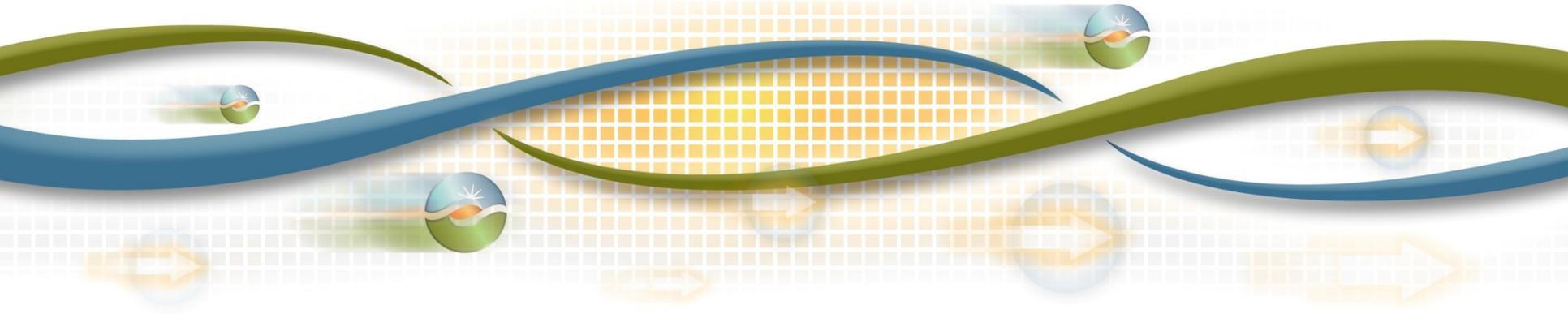


Next Steps

Kim Perez

Stakeholder Engagement and Policy Specialist

*2017-2018 Transmission Planning Process Stakeholder Meeting
November 16, 2017*



2017-2018 Transmission Planning Process

Next Steps

- Comments due November 30
 - regionaltransmission@caiso.com
- ISO recommended projects:
 - Management approval of new reliability projects, cancelations and scope modifications presented today that are less than \$50 million will take place after the December ISO Board of Governors Meeting
 - All new projects as well as cancelations and scope modifications of reliability projects over \$50 million requiring ISO Board of Governors approval will be included in draft plan to be issued for stakeholder comments by January 31, 2018