# Pacific DC Intertie Upgrade and Mission-Old Town Flow Control Upgrade

*Expedited Approval Consideration*

April 25, 2017

# ISO Management is considering the expedited approval of two transmission projects, each of which is under $50 million.

Today's stakeholder call:

- Review the background of expedited approval process
- Present and discuss each of the two projects:
  - Pacific DC Intertie upgrade (SCE)
  - Mission-Old Town Flow Control upgrade (SDG&E)
- Review next steps and request stakeholder feedback

# Expedited Approval Process (BPM 4.12.2.1)

- ISO executive management may consider approval of a solution with capital costs of less than $50 million on an expedited basis if the following conditions are met:
  1) there is an urgent need for the solution
  2) there is a high degree of certainty that the solution will not conflict with other solutions being evaluated in Phase 2 (of Transmission Planning Process)
  3) the need to accelerate the solution is being driven by the ISO's evaluation process or external circumstances

- Such a solution that requires an earlier approval will be presented for a stakeholder review

- CAISO management will brief the governing board

- *Assuming one or both projects proceed, ISO Management approval could take place in early May.*

# Pacific DC Intertie upgrade

- Bonneville Power Administration has been proceeding with upgrades at Celilo that will enable a path rating increase from 3100 to 3220 MW north to south.
- A small amount of surface re-contouring/grading has been found to be needed to facilitate the arrangement – currently estimated to in the range of hundreds of thousands of dollars.
- SCE must fund its share of the grading costs to receive its share – approximately 60 MW – of the capacity increase.
- The ISO understands the urgency is contractual in nature – if SCE does not fund its share of the costs, it loses its opportunity to capture its share of the increase.

# ISO Considerations:

- Despite the relatively small capital cost, the project is fundamentally an “economic driven” transmission cost and SCE seeking ISO approval is prudent.
- The 60 MW incremental capacity to SCE is extremely cost effective, being less than $10/kW if the total grading costs reached $1 million.
- Not acting on the incremental cost and capturing the capacity benefits foregoes the benefits enabled by the rest of SCE’s interest in the facility.
- Barring new information to the contrary, the ISO is interested in moving forward with approval.

# Mission – Old Town Flow Control Upgrade

- The purpose is to provide a partial mitigation and minimize additional local capacity requirements for the summer of 2018 in the San Diego sub-area if the Sycamore-Penasquitos 230 kV transmission project is delayed.
- The Sycamore-Penasquitos project is currently scheduled for late June 2018 completion – deferred from the original June 1, 2018 target
- SDG&E indicate that the project is currently on schedule, but there are real and material risks to this schedule that support managing the risk of a delay
- The ISO is therefore considering an SDG&E proposal to employ Smart Wires technology as a partial mitigation.

# Preliminary Analysis

# Smart Wire Solution to manage risk of SX-PQ 230 kV Line delay

Frank Chen - Regional Transmission Engineer Lead

Stakeholder Call, April 25, 2017

# CEC Updated Load Forecast for the San Diego area

| | 2018 (MW) |
|---|---|
| CEC Load Forecast | 4,786 |
| CEC BTM PV Peak Shift Adjustment | 138 |
| Peak Load Adjusted with BTM PV Peak Shift Scenario | 4,924 |

# Major Assumptions

1. Encina power plant unit #1 is retired by Q1 2017 but could receive an extension and be relied upon “last” as needed

2. Imperial Valley phase shifting transformers are in service by Q2, 2017

3. Suncrest SVC project is assumed to be delayed, and the 500 kV series capacitors on SWPL and SPL are therefore not by-passed so as to avoid low voltage concern on Suncrest 500 kV bus for the P1 outage of ECO-Miguel 500 kV line

4. Assessment considers the impact of the Sycamore-Penasquitos 230 kV line not being in service by June 1, 2018

# System Constraints in the system limit the amount of generation adjustments available

1. To avoid N-1-1 contingency overload concerns on the Mission-Old Town and Miguel-Mission 230 kV lines, generation output of Otay Mesa & Pio Pico plants should be reduced after the 1st outage.
2. However, the following total minimum output at Otay Mesa & Pio Pico should be maintained to prevent the S-Line overload concern for the NG-IV line outage:
    - 260 MW with 859 MW available at Encina
    - 530 MW with 500 MW available at Encina

# Overload concern identified with 859 MW available at Encina (#2,3,4,5,GT)

1. The Mission-Old Town 230 kV lines overloads as high as 127% for the Otay Mesa-Miguel-Bay Blvd 3-terminal 230 kV line outage followed by the Mission-Silvergate-Old Town 3-terminal 230 kV line or vice versa (P6 or N-1-1)

2. The Mission-Old Town Tap 230 kV section overloads as high as 119% for the Otay Mesa-Miguel-Bay Blvd 3-terminal line outage followed by the Mission-Old Town 230 kV line or vice versa (P6 or N-1-1)

# Additional overload concerns identified if only 500 MW generation is available at Encina

1. The Mission-Old Town and the Mission-Old Town Tap 230 kV lines overload as high as 140% and 132% for the category P6 or N-1-1 contingencies

2. One of the Miguel-Mission 230 kV lines overloads as high as 121% but within the 5-minute rating for the Otay Mesa-Miguel-Bay Blvd three-terminal line outage followed by the other Miguel-Mission 230 kV line or vice versa (P6 or N-1-1)

3. Sycamore 230/138 kV BK60 overloads as high as 114% but within its 30-minute rating for the Otay Mesa-Miguel-Bay Blvd three-terminal line outage followed by the Sycamore-Palomar 230 kV line or vice versa (P6 or N-1-1)

# Smart Wires Solution and its Alternative With 859 MW available at Encina

| | Potential Mitigation Alternatives | |
|---|---|---|
| | Operational Procedure Solution to Shed Load | Smart Wires Solution |
| Overload concerns on the Mission–Old Town & Mission–Old Town Tap 230 kV lines | up to 180 MW within 30 minutes after the 1st outage | 3 ohms |

# Smart Wires Solution and its Alternative With 500 MW available at Encina

| | Potential Mitigation Alternatives | |
|---|---|---|
| | Operational Procedure Solution to Shed Load | Smart Wires Solution |
| Overload concerns on the Mission–Old Town & Mission–Old Town Tap 230 kV lines | up to 370 MW within 30 minutes after the 1st outage | 5 ohms (Recommended) |
| Miguel – Mission 230 kV lines overload concern | up to 470 MW within 5 minutes after the 2nd outage | 2.5 ohms (Not recommended) |
| Sycamore 230/138 kV BK 60 overload | up to 130 MW within 30 minutes after the 2nd outage | 18 ohms (Not recommended) |

# Appendix A:

## Table A-1: Power Flow Results With 859 MW available at Encina

| Overloaded Facility | Worst Contingency | Category | 2018 Peak Loading (%) | | Potential Mitigation Solutions |
|---|---|---|---|---|---|
| | | | With System Adjustment | W/O System Adjustment | |
| 22596 OLD TOWN - 22504 MISSION 230 Ckt #1 | Line OTAYMESA-B.BLVD-MIGUEL 230 Ckt 1 and Line OLDTOWN-MISSION-SILVERGATE 230 Ckt 1 | P6 | 113.30 | 126.60 | Smart Wire option in size of 3 ohms, along with operational procedure (OP) re-dispatching gen; otherwise, up to 180 MW of load in the Old Town area would be shed after the first contingency |
| 22597 OLDTWN TAP - 22504 MISSION 230 Ckt #1 | Line OLD TOWN to MISSION 230 Ckt 1 and Line OTAYMESA-B.BLVD-MIGUEL 230 Ckt 1 | P6 | 106.91 | 119.23 | |

# Appendix A:
## Table A-2 Power Flow Results With 500 MW available at Encina

| Overloaded Facility | Worst Contingency | Category | 2018 Peak Loading (%) | | Potential Mitigation Solutions |
|---|---|---|---|---|---|
| | | | With System Adjustment | W/O System Adjustment | |
| 22596 OLD TOWN - 22504 MISSION 230 Ckt #1 | Line OTAYMESA-B.BLVD-MIGUEL 230 Ckt 1 and Line OLDTOWN-MISSION-SILVERGATE 230 Ckt 1 | P6 | 129.46 | 140.12 | Smart Wire solution in size of 5 ohms, along with OP re-dispatching gen; otherwise, up to 370 MW of load in the Old Town area would be shed after the 1st outage |
| 22597 OLDTWN TAP - 22504 MISSION 230 Ckt #1 | Line OLD TOWN to MISSION 230 Ckt 1 and Line OTAYMESA-B.BLVD-MIGUEL 230 Ckt 1 | P6 | 121.99 | 131.80 | |
| 22464 MIGUEL - 22504 MISSION 230 Ckt #2 | Line MIGUEL to MISSION 230 Ckt 1 and Line OTAYMESA-B.BLVD-MIGUEL 230 Ckt 1 | P6 | 107.84 | 121.26 | The 5-minute emergency ratings could be relied on to shed up to 470 MW load in the Mission and Old Town areas after the 2nd outage. |
| 22464 MIGUEL - 22504 MISSION 230 Ckt #1 | Line MIGUEL to MISSION 230 Ckt 2 and Line OTAYMESA-B.BLVD-MIGUEL 230 Ckt 1 | P6 | 107.38 | 120.75 | |
| 22832 SYCAMORE - 22831 SYCAMORE 230/138 BK 60 | Line PEN to SYCAMORE 230.0 Circuit 1 and Line OTAYMESA-B.BLVD-MIGUEL 230 Ckt 1 | P6 | 106.52 | 114.34 | The 30-minute emergency rating could be relied on to shed up to 130 MW load in the 138 kV system from Sycamore to Encina after the 2nd outage |

# Old Town - Mission 230 kV
## Project Overview

April 25, 2017

# Old Town – Mission Project Overview

# Project Scope

## Driving Factors

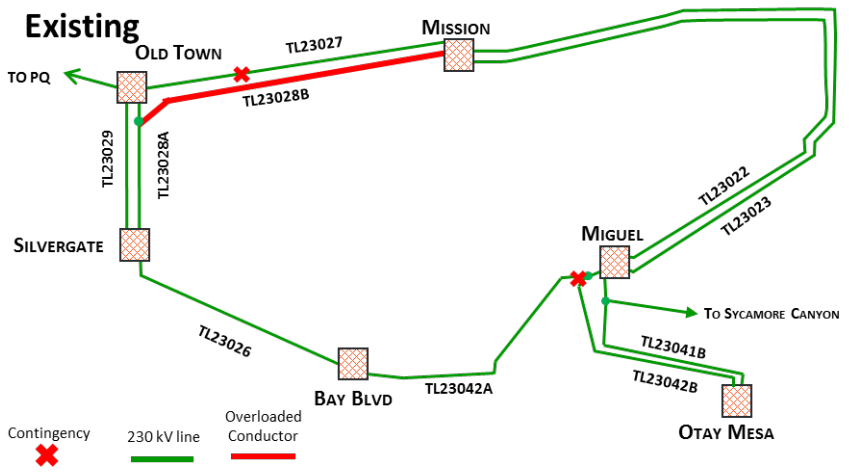
- Combination of SX-PQ ISD of June 30, 2018 and uncertainty of Encina generation availability.
- NERC Cat P6 overload of 159.2% on TL23028B (MS-OTTP) caused by the N-1-1 of TL23042 and TL23027
- NERC Cat P6 overload of 168.5% on TL23027 (MS-OT) caused by the N-1-1 of TL23042 and TL23028

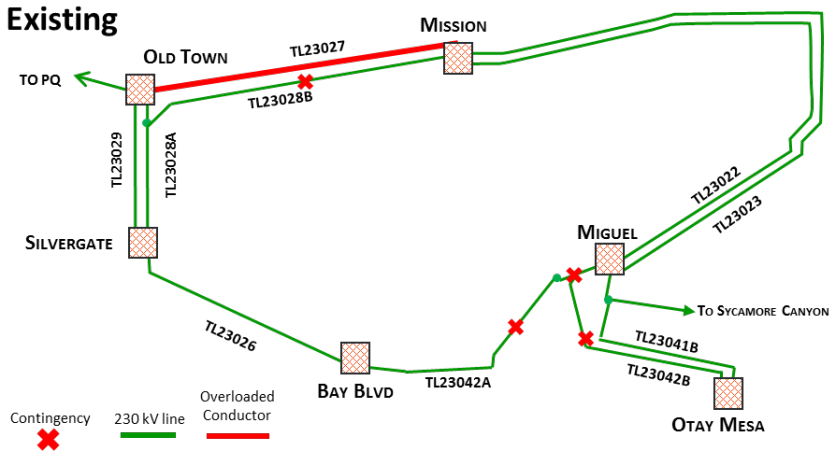
## Scope

- Install Smart Wires power flow control devices on TL23027/28
- Flexible transmission solution with six to twelve month time frame.
- In-Service Date = June 1, 2018

## Benefits

- Smart Wires solution may be scaled in size to match the Encina generation available in Summer 2018 to mitigate the P6 violation.
- Allows for optimizing existing transmission system
- SmartWires devices can be redeployed as system needs change.



# Project Description

## SmartWires Flexible Transmission Solution

- Power flow studies indicate that increasing the apparent impedance of TL23027/28, in conjunction with dispatch of expected available Encina generation, will mitigate the post-contingency overloads on both tie lines.
- The Smart Wires solution is cost-effective, is able to be online by the need date of June 1, 2018, and can be re-deployed after SX-PQ comes online.
- The SmartWires devices will be installed at the Mission Substation ends of TL23027/28.
- **Cost: $6-12 million**
- Details of the scalable SmartWires scope, cost, and schedule will be discussed by the technology provider later in this presentation.

# Other Project Alternatives Considered

## Penasquitos-Old Town Phase-Shifting Transformer (PST)

- Power flow studies indicate that installation of a 400 MVA +/- 30 deg. phase-shifting transformer controlling flow on TL23013 (PQ-OT) would provide loading relief on TL23027/28 with no Encina dispatch required. **(Cost: $8-10 million)**
- Minimum lead time for a PST is **12-18 months**, making the ISD infeasible.

## Utilize All Encina Generation

- Power flow studies indicate that with all Encina generation available, with no other mitigations the overload conditions would still exist.

## Series Reactor

- Cost and schedule similar to PST solution, but not as effective.

## Reconductor TL23027 and TL23028

- Reconductoring could be accomplished either with bundled ACSR conductors or a single high-temperature ACAR (or similar) conductor **(Cost $20-30 million),** but permitting/construction lead times make the ISD infeasible.

# Smart Wires Solution and Product Overview

# Uncertainty and the Need for Flexible Transmission Solutions

SDGE A Sempra Energy utility

SMART WIRES REIMAGINE THE GRID

Rapidly changing generation

Unpredictable future load

Resistance to permitting new lines

Energy prices drive economic growth

Responding to this new paradigm, Smart Wires technology was developed by utilities for utilities…

Georgia Tech NEETRAC National Electric Energy Testing, Research and Applications Center

BGE

Southern Company

TVA

…and has been adopted across the globe

PG&E

People. Power. Possibilities. Central Hudson A FORTIS COMPANY

western power

minnesota power AN ALLETE COMPANY

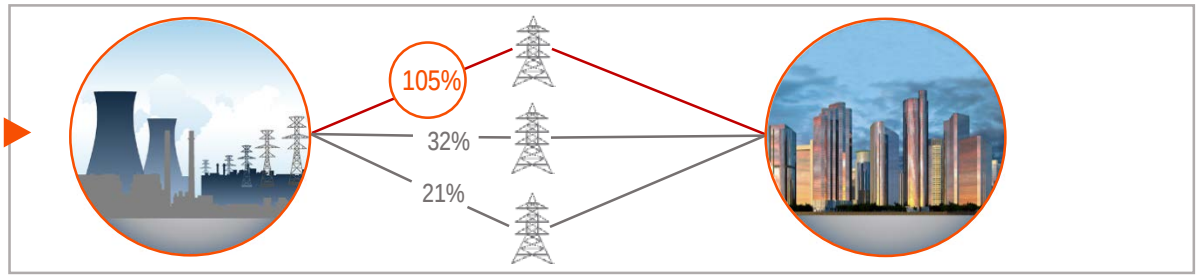
EIRGRID

TransGrid

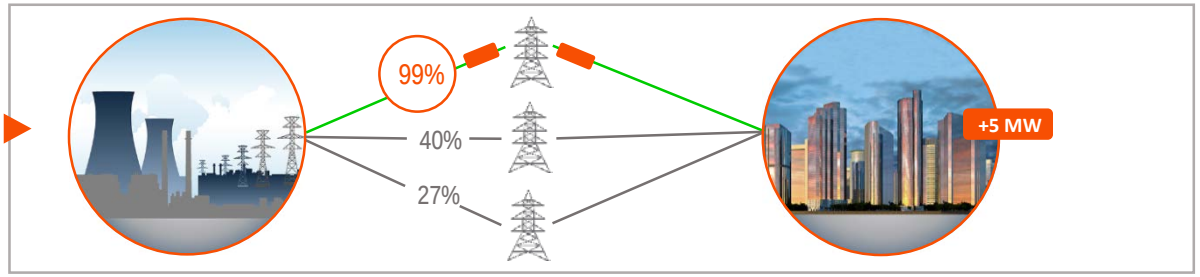
Rte

# How does it work?

**Before Smart Wires**
Simplified planning scenario predicts future overload




**With Smart Wires Power Guardian®**
Power is pushed to alternate lines with spare capacity, resolving overload




The Smart Wires EPIC Project 1.09C met its objective of demonstrating *"safe and effective operation of [the Guardian technology] on PG&E's transmission system to reduce line flow."*

PG&E tested key operational measures, including availability and reliability of the units both of which achieved >99.9%. The report[1] also notes the ability of the technology to *"offer portability and flexibility"* and *"be deployed several years faster at a significantly lower cost".*

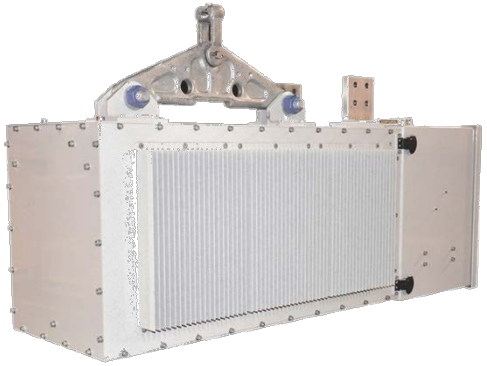
[1]Link to the EPIC report:
https://www.pge.com/pge_global/common/pdfs/about-pge/environment/what-we-are-doing/electric-program-investment-charge/PGE-EPIC-Project-1.09C.pdf

# What is a Power Guardian?

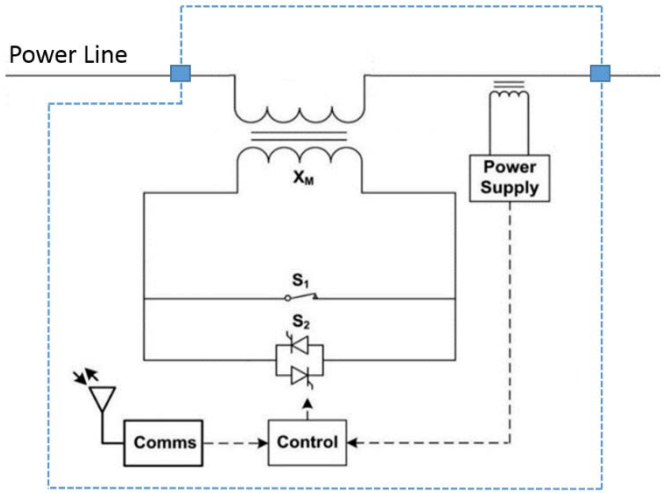
*The Power Guardian is a Modular Flexible AC Transmission System (M-FACTS) device which increases the line reactance of transmission lines by injecting magnetizing reactance in series with the line. These devices effectively push power away from the line on which they are installed.*

**Power Guardian in Horizontal Orientation:**

Shown without corona rings



**Power Guardian Electrical Schematic:**




**Designed to be…**

1. **Modular**
2. **Scalable**
3. **Re-configurable**
4. **Plug-&-Play**

**…to best address short-term and near-term needs while delivering the value of flexibility and re-deployability**

***Technical specifications available at: www.smartwires.com/guardian***

# Project Cost

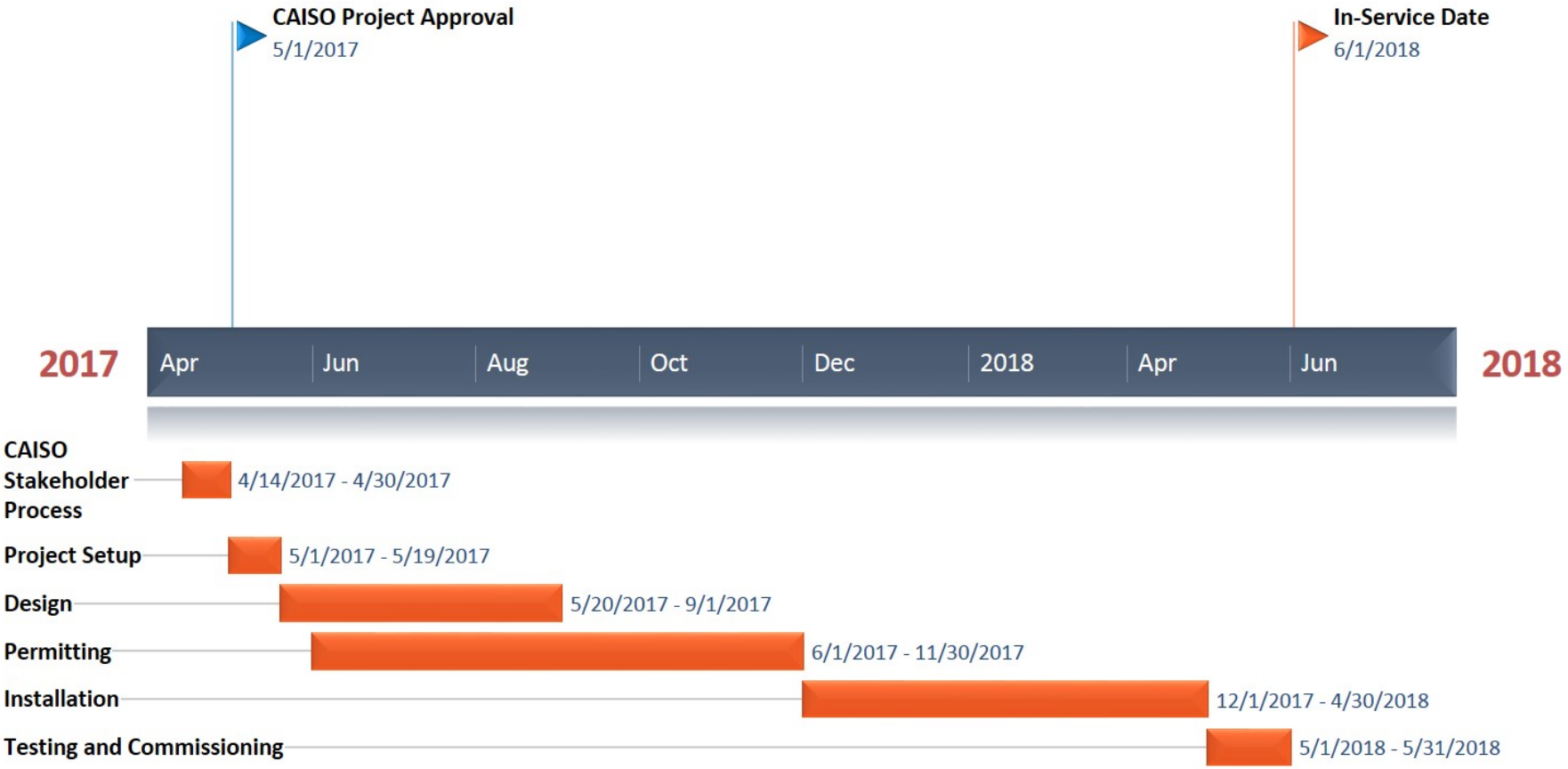
- The breadth of the Smart Wires power flow control deployment correlates with the amount of Encina generation online in Summer 2018

- The Smart Wires power flow control deployment can be **modified, expanded, or redeployed** to meet changing system needs

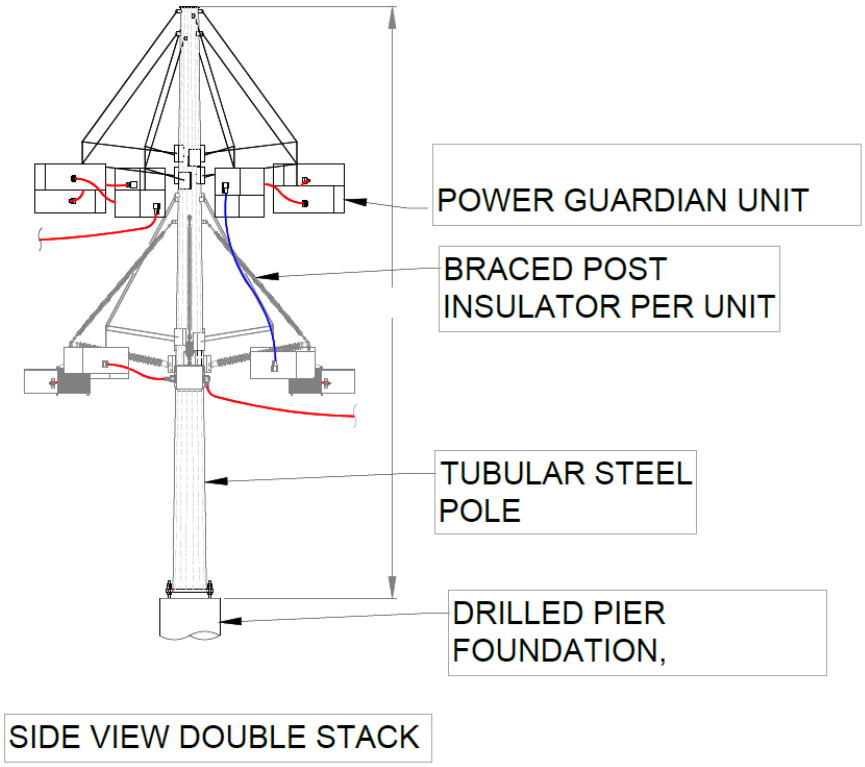
***Estimated project cost based upon Encina generation online in Summer 2018***

| Ohms | Encina [MW] | Load Shed Needed [MVA] | Load Shed Avoided w/Smart Wires deployment [MVA] | Smart Wires Full Install Cost |
|---|---|---|---|---|
| 8.1 | 300 | 0 | 600 | **$9-12M** |
| 7.4 | 400 | 0 | 565 | **$8-11M** |
| 5.9 | 650 | 0 | 475 | **$7-10M** |
| 4.2 | 960 | 0 | 345 | **$6-9M** |

# Project Timeline



# Old Town – Mission 230 kV Installation




SIDE VIEW DOUBLE STACK

# Additional Information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# Based on the above information, the ISO is considering the 5 ohm Smart Wires alternative, as it:

- Provides a low cost mitigation strategy in the event the Sycamore-Penasquitos line is delayed
- Has a reasonable probability of being available by June, 2018
- Relies on largely readily re-deployable equipment, suited to meeting an interim need

# Next Steps

- Stakeholder call today – April 25, 2017
- ISO Board of Governors meeting on May 1, 2017
  - not an approval item
- Stakeholder comments to regionaltransmission@caiso.com by close of business May 2, 2017.
- Assuming ISO proceeds, ISO approval in early May