Agenda
Special Studies Stakeholder Call

Kim Perez

Stakeholder Engagement and Policy Specialist

2016-2017 Transmission Planning Process Stakeholder Call

June 13, 2016

2016-2017 Special Studies Stakeholder Call - Today's Agenda

Topic	Presenter
Agenda	Kim Perez
Study Scope Overview for Special Studies	Neil Millar
Economically-Driven Early Retirement of Gas Fired Generation Special Study	Yi Zhang
Gas-Electric Reliability Special Study	David Le
Frequency Response Assessment-Generation Modeling Special Study	Irina Green
Next Steps	Kim Perez

Overview
Special Studies Stakeholder Call

Neil Millar

Executive Director, Infrastructure Development

2016-2017 Transmission Planning Process Stakeholder Call

June 13, 2016

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

- Aging assets and addressing emerging reliability needs
- State policies on eliminating use of coastal waters for once-through cooling at thermal generation
- State policies for renewable energy focusing on achieving a 33% renewables portfolio standard by 2020 *and now 50% by 2030*
- Advancement of behind the meter solar PV generation
- Possible implications from greenhouse gas reduction goals of 1990 levels by 2020
- Possible implications from federal Clean Power Plan

Special studies are being conducted in the 2016-2017 planning cycle to assist consideration of these issues

- Three of these studies are the subject of today's call:
  - Potential for Economically-Driven Retirement of Gas Generation
  - Gas-Electric Reliability Coordination
  - Frequency Response – Generation Modeling
- Other special studies are being discussed in other processes:
  - Required Performance Characteristics for Slow Response Local Capacity Resources
  - 50% Renewable Generation analysis
  - Update to Benefits Analysis of Large Energy Storage

Regarding the update to the study of potential benefits of large energy storage:

- Initial analysis at 40% RPS was conducted in the 2015-2016 planning cycle
- The ISO indicated that the study in the 2015-2016 transmission plan will be updated to consider a 50% RPS scenario and that an updated 50% analysis will be included in the 2016-2017 planning cycle using updated assumptions.
- The 2016-2017 analysis will be documented in the 2016-2017 plan as a special study.
  - This analysis will also consider transmission-related economic benefits in including potential congestion benefits provided by potential large energy storage sites

Economic Early Retirement of Gas Fired Generation Special Study – Scope and Methodology

Yi Zhang

Regional Transmission Engineer Lead

June 13, 2016

2016-2017 Transmission Planning Process Stakeholder Call

Study motivation and goals

- SB350 requires to meet a 50% renewable energy goal by 2030, which will alter the ability of gas-fired generation to compete in the ISO market
- Identify areas of potential economic early retirement of gas-fired generation as a result of the increasing renewable penetration
- Identify local and system level operational reliability and congestion issues due to the potential early retirement of gas-fired generators
- Provide high-level insights in maintaining the existing path limits

Study scopes

- Preliminarily screening to identify areas of potential early retirement using the ISO's 2015-2016 production cost models (PCM) with 50% renewable portfolios
- Power flow and stability studies modeling the identified potential early retirement using ISO's 2016-2017 power flow cases
  - Path ratings, nomograms
  - System level transient stability & thermal issues
  - Local reliability issues (thermal, voltage, etc.)
- Congestion assessment using ISO's 2016-2017 PCM

Screening criteria for potential areas of early retirement

- The following three criteria are used to identify early retirement
  - Capacity factor below typical historical values, and
  - Not contribute to ancillary services, and
  - Not required to meet LCR
- The latest long-term LCR results are used
  - 2020 LCR for PG&E areas
  - 2025 LCR for SCE and SDG&E areas
- If generators do not meet both CF and AS criteria, but are required to meet LCR, then they will replace system generators with similar technical specifications
- System RA is not evaluated in this study

Applied capacity factors for different types of generators

Generator Type in TEPPC PCM	Average CF*
CCWhole-NatGas-Aero	0.52
CCWhole-NatGas-Industrial	0.52
CCWhole-NatGas-SingleShaft	0.52
CCWhole-SynGas	0.52
ST-NatGas	0.11
ST-OtherGas	0.11
ICE-NatGas	0.07
CT-NatGas-Aero	0.04
CT-NatGas-Industrial	0.04
CT-OtherGas	0.04
CT-SynGas	0.04

*Based on EIA and CEC historical data

http://www.eia.gov/electricity/monthly/epm_table_grapher.cfm?t=epmt_6_07_a

http://www.energy.ca.gov/2014publications/CEC-200-2014-005/CEC-200-2014-005.pdf

Next steps

- Conducting preliminary screening
- Power flow and stability studies using 2016-2017 ISO's power flow cases
- Production cost simulation using 2016-2017 ISO's PCM with 50% renewable portfolios
- Will provide update at the September 21-22 stakeholder meeting

Gas-Electric Reliability Coordination Special Study – Scope and Methodology for Northern & Southern California

David Le
Senior Advisor Regional Transmission Engineer
Binaya Shrestha
Regional Transmission Engineer Lead

2016-2017 Transmission Planning Process Stakeholder Call
June 13, 2016

Overview

Southern California discussion:

- Recap of previous transmission planning related studies
- Discuss the importance of Aliso Canyon gas storage and the synergy between gas storage and gas pipelines in maintaining reliability in Southern California
- Proposed gas-electric coordination transmission planning studies for the 2016-2017 cycle
- Study schedule

Northern California discussion:

- Background information
- Discuss proposed studies in the current transmission planning cycle
- Study schedule (same as above)

Southern California Related Transmission Planning Study Discussion

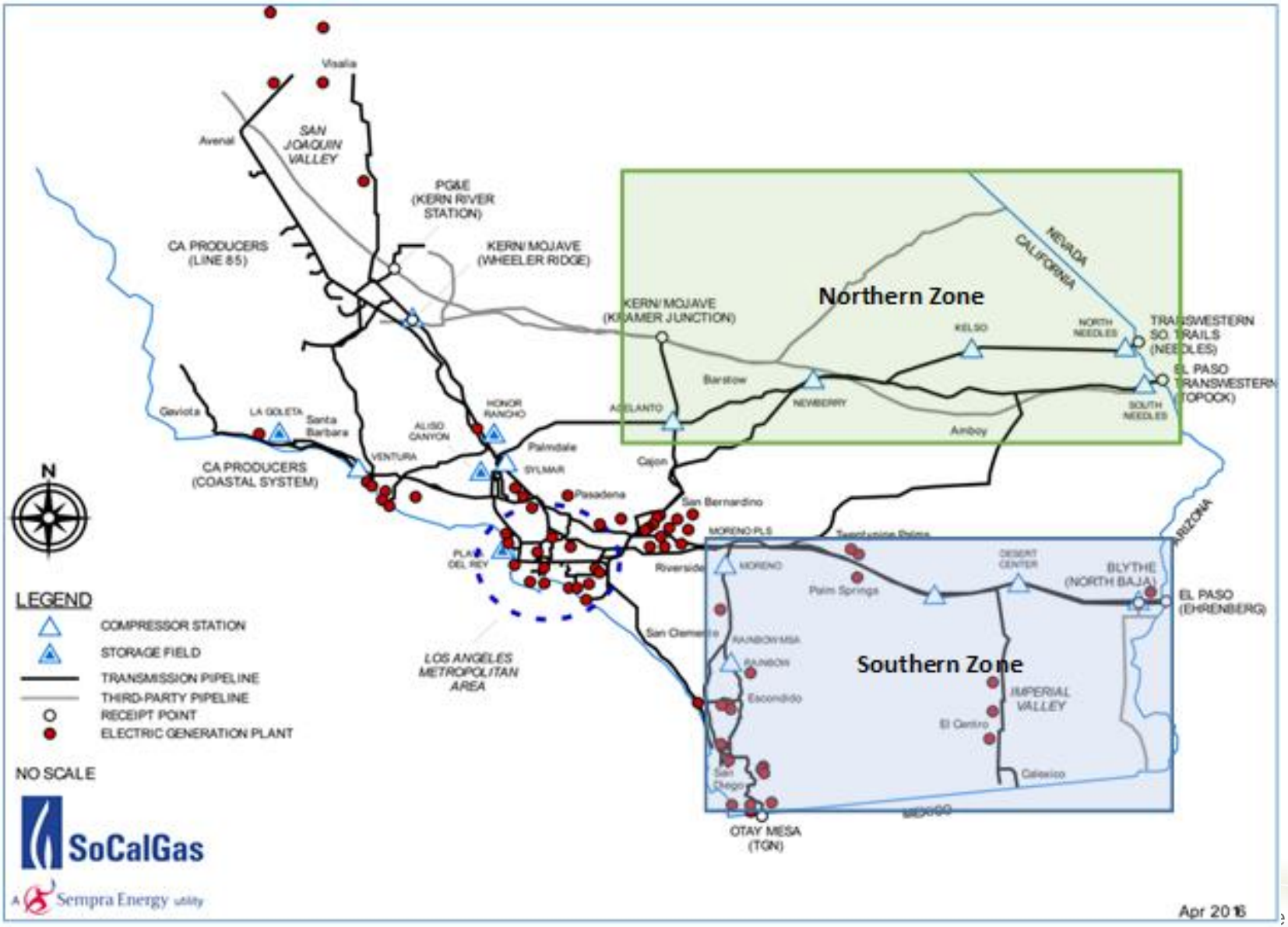
Recap of Previous Transmission Planning Related Studies

- Background information on the Southern California gas system and previous transmission planning related studies (i.e., a summer assessment with one major gas transmission pipeline scheduled maintenance outage and a winter gas curtailment study) were provided at the ISO 2015-2016 Transmission Planning Process Stakeholder Meeting No. 2 on September 21 – 22, 2015 and Meeting No. 4 on February 18, 2016.
- The following is the link to the presentation:

  https://www.caiso.com/Documents/PresentationPTOProposedMitigationSolutions_Sep22_2015.pdf and

  http://www.caiso.com/Documents/PresentationDraft20152016TransmissionPlanStakeholderMeetingFeb182016.pdf
- These transmission reliability assessments were performed prior to the Aliso Canyon gas leak incident, which was first discovered on October 23rd, 2015, and before its potential impact became apparent.

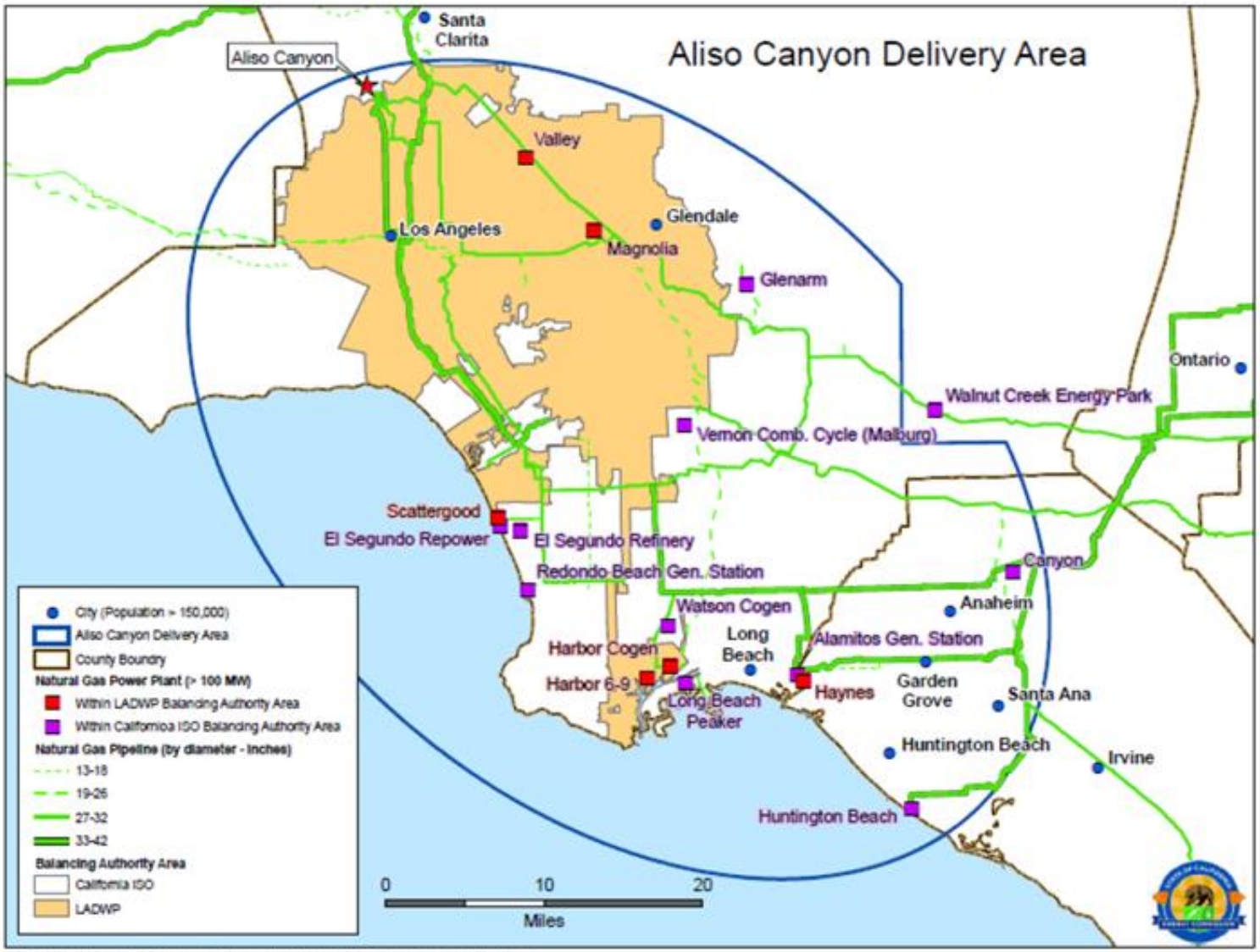
Gas Storage Plays an Important Role In Maintaining Gas and Electric Reliability in Southern California



Gas is delivered by a network of major gas pipelines and gas storage facilities

- Major gas storage facilities include the following:
  - La Goleta (12 Bcf storage capacity) is located in Santa Barbara County
  - Honor Rancho (26 Bcf storage capacity) is located in the Los Angeles County near the foothills of Valencia
  - Aliso Canyon (86 Bcf storage capacity) is located in the Santa Susana Mountains in the Los Angeles County north of Porter Ranch neighborhood of the City of Los Angeles
  - Playa Del Rey (2.6 Bcf storage capacity) is located near Balloma Wetlands between Marina Del Rey and LAX in the Los Angeles County
- Major interstate gas pipelines include the following:
  - El Paso Natural Gas Company
  - North Baja – Baja Norte Pipeline, which takes gas off the El Paso Pipeline at the California/Arizona border, and delivers that gas through California into Mexico
  - Kern River Transmission Company
  - Mojave Pipeline Company
  - Questar's Southern Trails Pipeline Company
  - Transwestern Pipeline Company

The Aliso Canyon gas storage provides gas to 17 power plants in the LA Basin



Aliso Canyon Gas Storage Constraint and Its Importance to Southern California Reliability

- Aliso Canyon is the largest gas storage field
  - Inventory capacity of 86.2 Bcf
  - Withdrawal capacity at 1,860 MMcfpd
  - Typically used during summer time to provide hourly peak electric generation demands throughout the day, which cannot be met with pipeline supplies because of the magnitude and speed that these peak demand require
  - Currently holds about 15 Bcf of storage under moratorium of new injections until comprehensive review and inspection of storage wells is completed

Aliso Canyon Gas Storage Constraint and Its Importance to Southern California Reliability

- The Reliability Task Force consisting of the CEC, CPUC, ISO, and LADWP with participation from SoCal Gas Company completed the Aliso Canyon Risk Assessment Technical Report (http://www.energy.ca.gov/2016_energypolicy/documents/2016-04-08_joint_agency_workshop/Aliso_Canyon_Risk_Assessment_Technical_Report.pdf) quantifying a range of days where gas curtailments resulting from significant system risk would be likely if Aliso Canyon were not available for withdrawal for the summer 2016 time frame.

Proposed Longer Term Transmission Planning Studies Evaluating the Potential Impact Without Aliso Canyon

- The scope of the summer 2016 operational reliability assessments from the risk assessment technical report will be incorporated into an expanded scope for the mid-term (2021) and potential long-term (2026) transmission planning analysis in the 2016-2017 planning cycle.
- This would include considerations of four study scenarios as discussed in the Aliso Canyon Risk Assessment Technical Report as the following:
  - **Scenario 1** – Aliso Canyon unavailable; supply shortfall of 150 MMcfpd of gas between scheduled and actual gas flows
  - **Scenario 2** – Scenario 1 plus a non-Aliso Canyon gas storage outage, reducing 400 MMcfd of system capacity
  - **Scenario 3** – Scenario 1 plus a pipeline outage reducing 500 MMcfd of system capacity
  - **Scenario 4** – Combination of Scenarios 1, 2 and 3 resulting in an overall reduction of 900 MMcfd of system capacity.

Proposed Longer Term Transmission Planning Studies Evaluating the Potential Impact Without Aliso Canyon

- In addition, a winter assessment for the mid-term planning horizon (2021) will be performed with the Aliso Canyon unavailable. The winter peak load study case will be modified from the 2021 spring light load to model with about 62% of summer peak load for SCE and 66% of summer peak load for SDG&E service areas. The transmission planning assessment will incorporate the scope of the operational studies for the 2016-2017 winter.
- Loads between 2021 and 2026 will be compared with the peak load shift impact to determine if there is significant change to undertake a longer term assessment

Northern California Related Transmission Planning Study Discussion

2016-2017 TPP Northern California Gas-Electric Coordination Study Scope

- Gather information about gas system, capacity and supply network to gas-fired power plant in Northern California.
- Investigate plausible conditions which could result in gas curtailment to power plant resulting in significant reduction in electric generation.
- To the point such conditions are identified, perform studies to identify any adverse impact to electric system reliability.

Backbone – Pipeline Capacity

Line 400/401

- Firm Capacity = 2023 mmcfd

Line 300

- Firm Capacity = 1010 mmcfd

Backbone – Storage Capacity

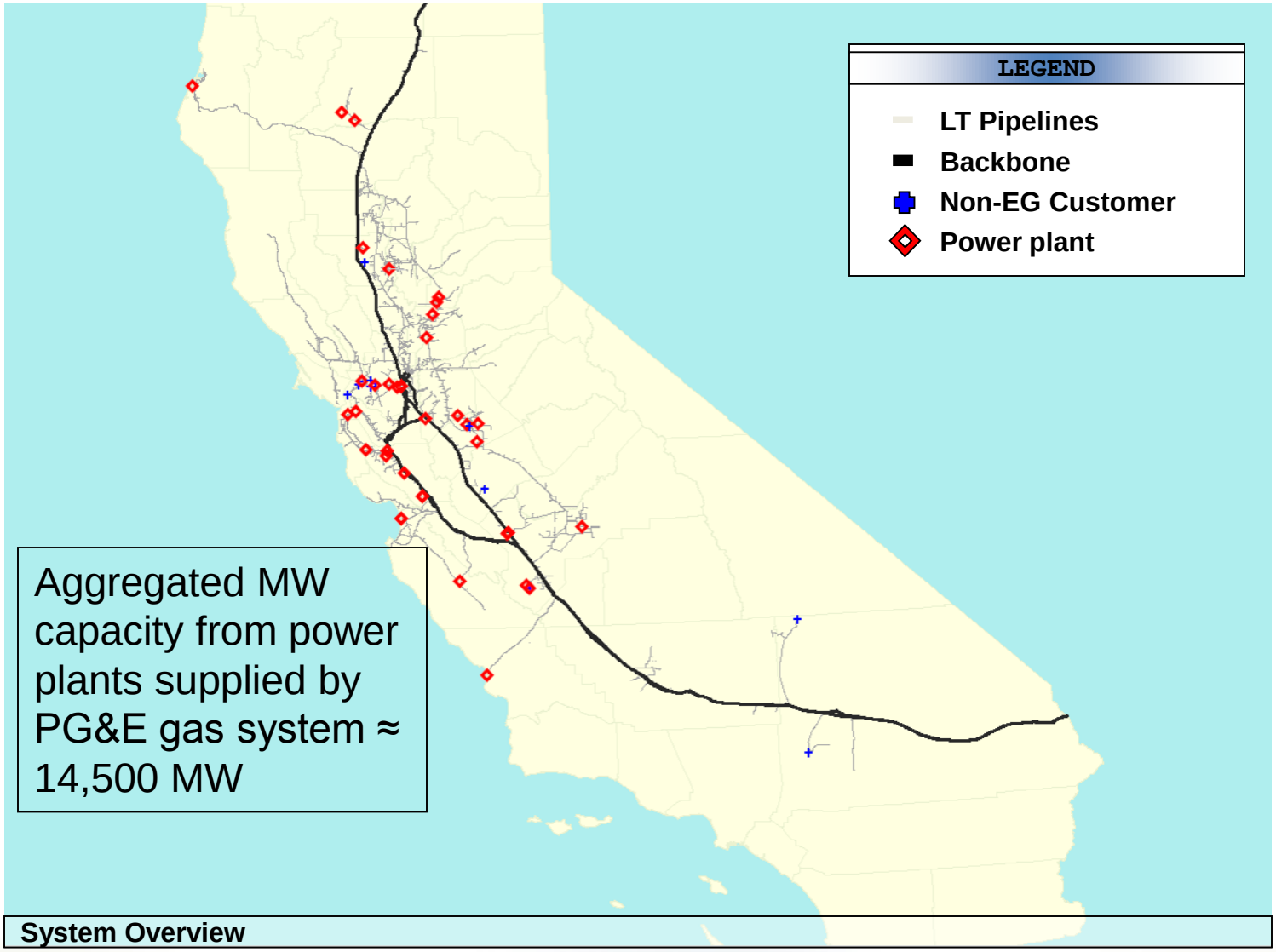
PG&E Storage Capacity

	Working Inventory (Bcf)	Supply (MMscf/d)
Total 2016	**105**	**2,215**
McDonald Island	82	1,686
Los Medanos	16	360
Pleasant Creek	2	69
Gill Ranch	5	100

Independent Storage Providers (ISPs)

	Working Inventory (Bcf)	Supply (MMscf/d)
Total 2016	**133**	**2,300**
Wild Goose	75	950
Lodi Storage	32	750
Central Valley Storage	11	300
Gill Ranch Storage (75%)	15	300

Gas-fired Power Plant Supplied by PG&E Gas System



Gas-fired Power Plant Supplied by Kern River-Mojave Gas System

Aggregated MW capacity from power plants supplied by Kern River-Mojave gas system ≈ 2,200 MW (PG&E service area) and ≈ 1,600 MW (SCE service area)

Source: https://www.gljpublications.com/maps/mojave.gif

Next Steps and Approach

- Assessment of gas demand versus capacity under normal and plausible outage conditions.
- Assessment of historical outages and corresponding impact (curtailment) on gas-fired power plant generation.
- Determination of threshold of MW generation curtailment in critical areas based on local capacity requirements.
- To the point conditions which could result in gas curtailment resulting in significant reduction in electric generation are identified, perform studies to identify any adverse impact to electric system reliability.

Study Schedule

Milestones	Schedule
Complete Study Plan	May 1, 2016
Present study plan to stakeholders during a stakeholder call	June 13, 2016
Perform Gas-Electric Reliability Assessment	June 1 – October 31, 2016
Provide update	September 21 – 22, 2016
Present draft results at the third 2016-2017 TPP Stakeholder Meeting	November 16, 2016
Incorporate Study Results in the Draft 2016-2017 Transmission Plan	December 2016 – January 2017
Provide further edits as necessary for the Final Draft 2016-2017 Transmission Plan	February 2017

Frequency Response Assessment-Generation Modeling Special Study – Scope and Methodology

Irina Green

Senior Advisor, Regional Transmission North

2016-2017 Transmission Planning Process Stakeholder Call

June 13, 2016

Drivers for the Study

- Frequency response studies performed in the 2015-2016 Transmission Plan showed optimistic results regarding frequency response
- Actual measurements of the generators' output were lower that the generators' output in the simulations
- Therefore models update and validation is needed
- New NERC Standards MOD-032-1 and MOD -033-1 require to have accurate validated models
- Generation owners are responsible for providing the data, and the ISO is responsible for the model validation

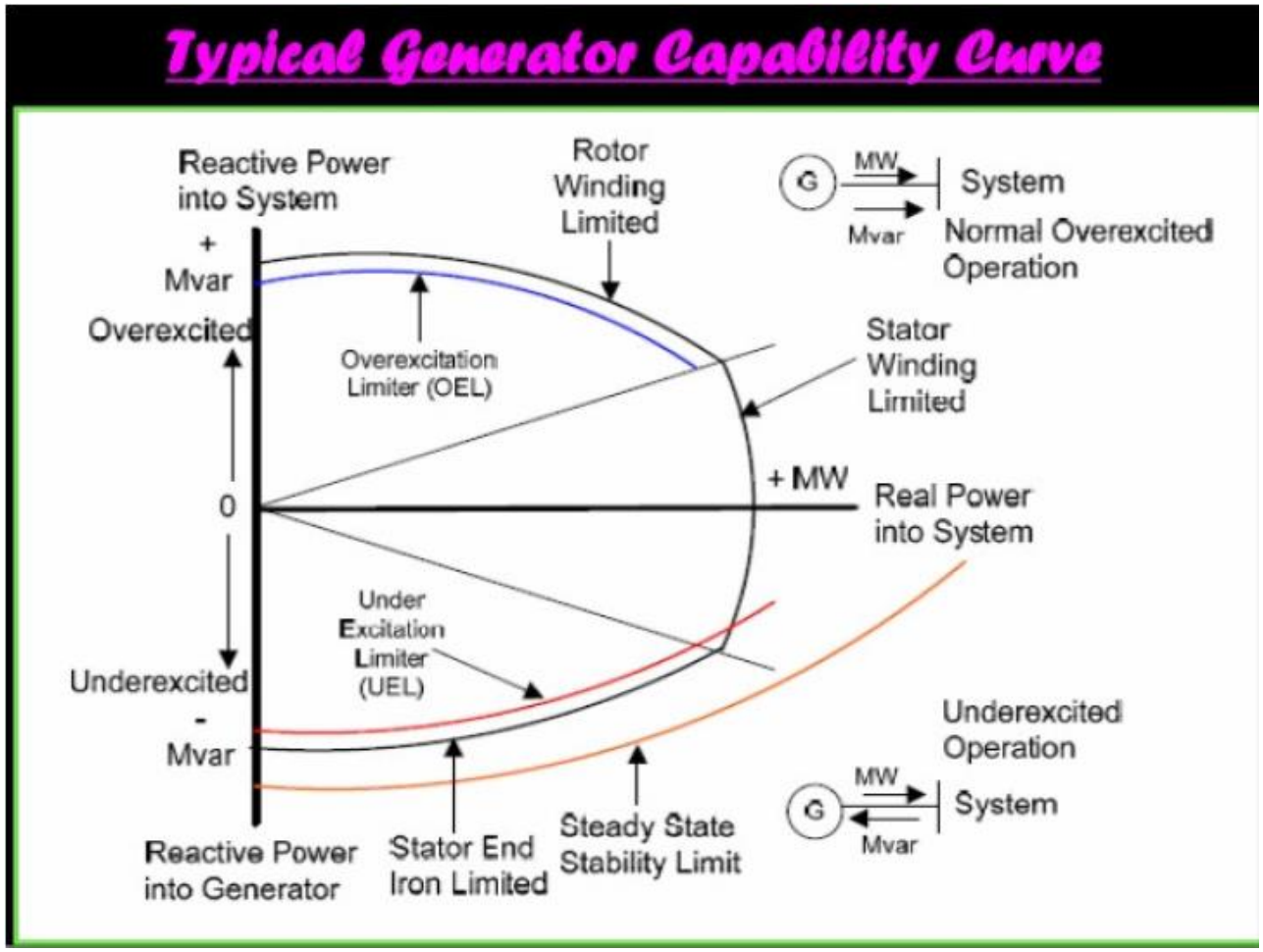
NERC Standard MOD-032-1
Data for Power System Modeling and Analysis

- This standard applies to the CAISO as Planning Coordinator
- Need to develop steady-state, dynamic and short-circuit modeling data requirements and reporting procedures
- Balancing Authority, Generator Owner, Load Serving Entity, Resource Planner, Transmission Owner, and Transmission Service Provider has to provide the data
- MOD-032-1 includes data that has to be provided, including dynamic data for generators for dynamic stability studies
- Any technical concerns need to be resolved, and updated data need to be provided if needed

NERC Standard MOD-033-1
Steady State and Dynamic System Model Validation

- This standard applies to the CAISO as Planning Coordinator
- Requires to implement a documented process for model validation
- Model validation is based on events on the Planning Coordinator's portion of the existing system, although system-wide disturbances can also be used
- Reliability Coordinator and System Operator provide actual system behavior data
- Planning Coordinator performs model validation by comparing simulation and actual system behavior

Generator Modeling Issues in the CAISO Studies
Possible inadequate reactive capability modeling



- Applicable both to power flow and dynamic stability
- If reactive capability of the unit is represented accurately?
- New versions of GE PSLF software allow to model the whole curve

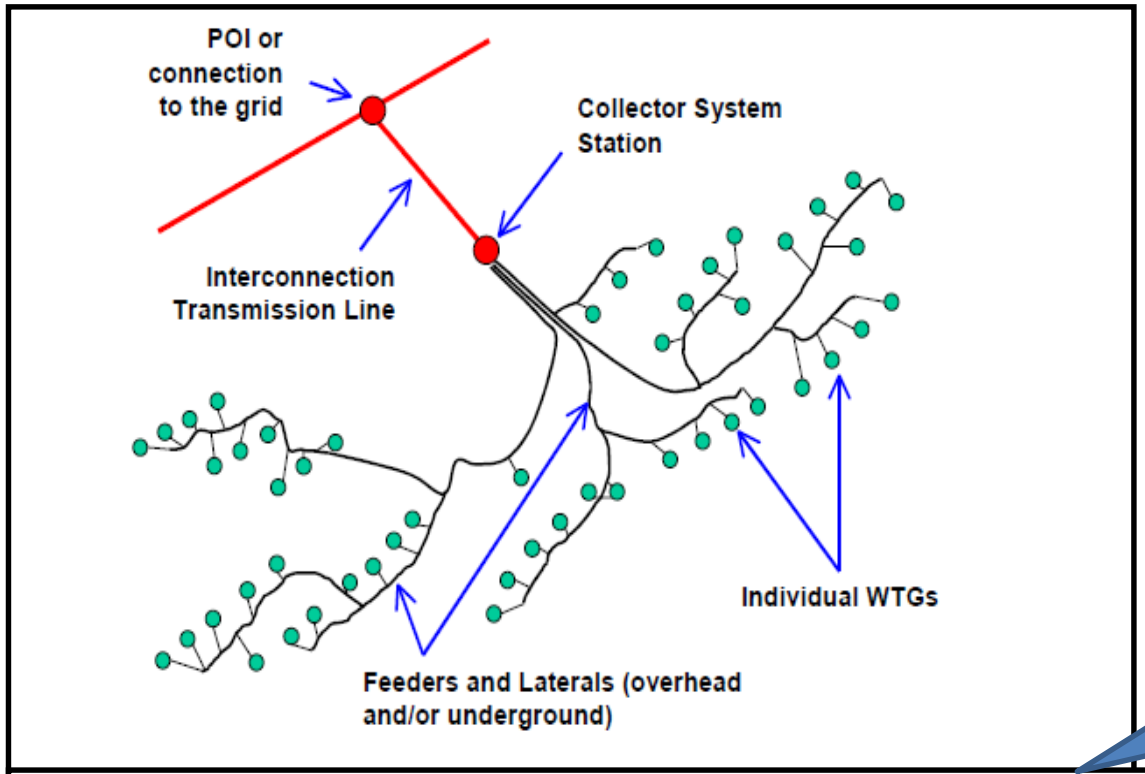
Generator Modeling Issues in the CAISO Studies Possible inadequate reactive capability modeling (continued)

- Inverter-based renewable generators – often not clear if the generator is providing reactive support to regulate voltage
- Power flow model may not match dynamic stability model
- Inverter-based generators are capable of providing reactive support, but this option may not be used
- Accurate data is needed, since reactive capability of inverter-based generation may have significant impact on system performance

Generic Models, Missing Models, Incorrect Models

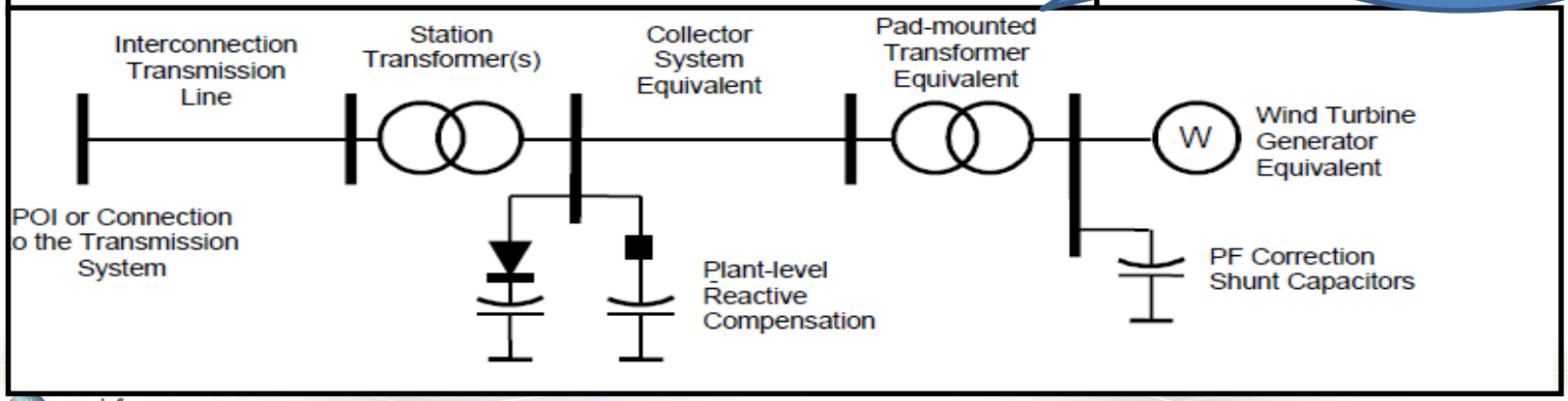
- For future projects, which equipment will be used may not be determined, thus typical generic models are used
- Although testing is required prior to commercial operation, it may not be done and generic models remain in the database
- New or existing models in the dynamic stability database may have missing components, such as control systems or protection
- Missing models of collector systems and step-up transformer for solar and wind farms. Generators are modeled on high-voltage buses, which may give incorrect results
- Incorrect models – wind generators modeled as thermal, solar PV modeled as wind, wind generators modeled as incorrect type
- Erroneous values of model parameters – may cause oscillations in simulations, which is not happening in real life

Example - Collector System for Wind Farms or Solar PV



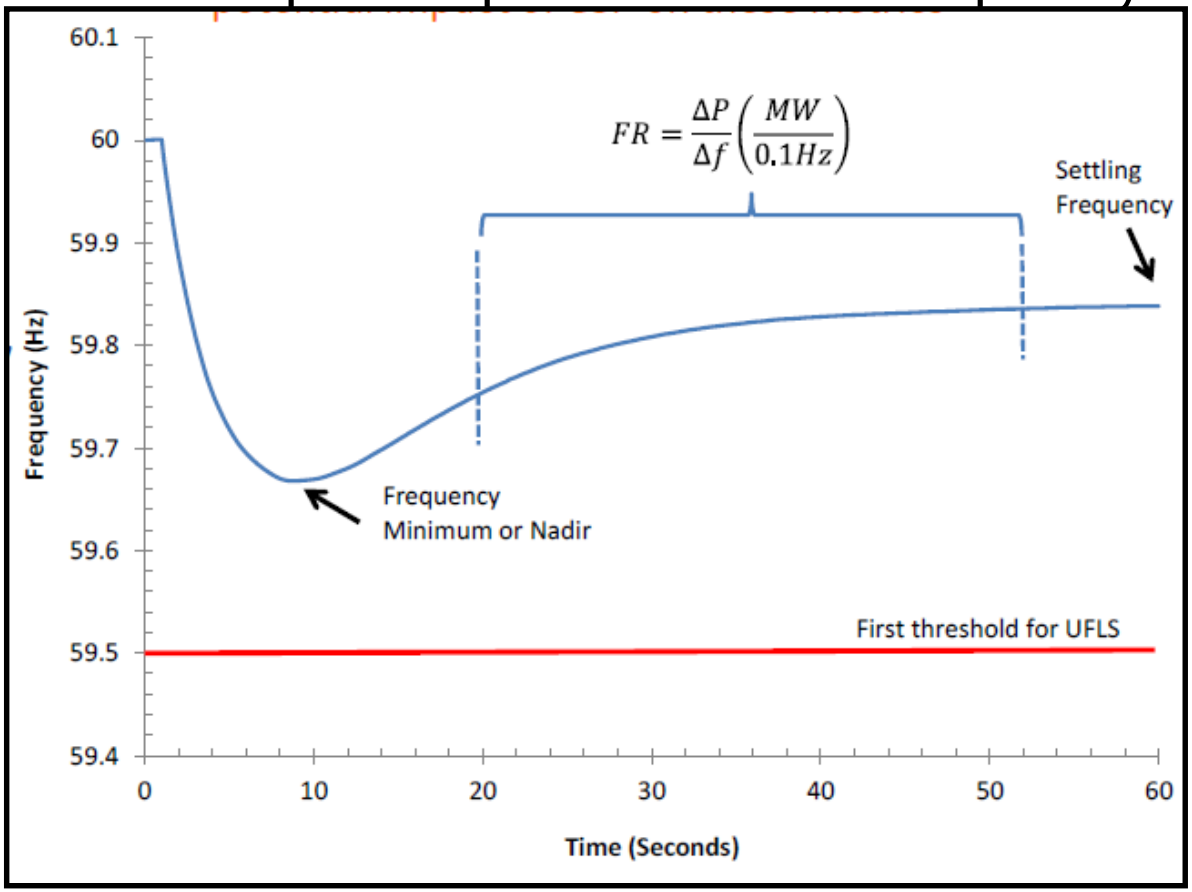
Wind or Solar PV plant should not be modeled as one unit on high voltage bus

Single – machine equivalent representation



More Modeling Issues
Generator Models in Dynamic Stability

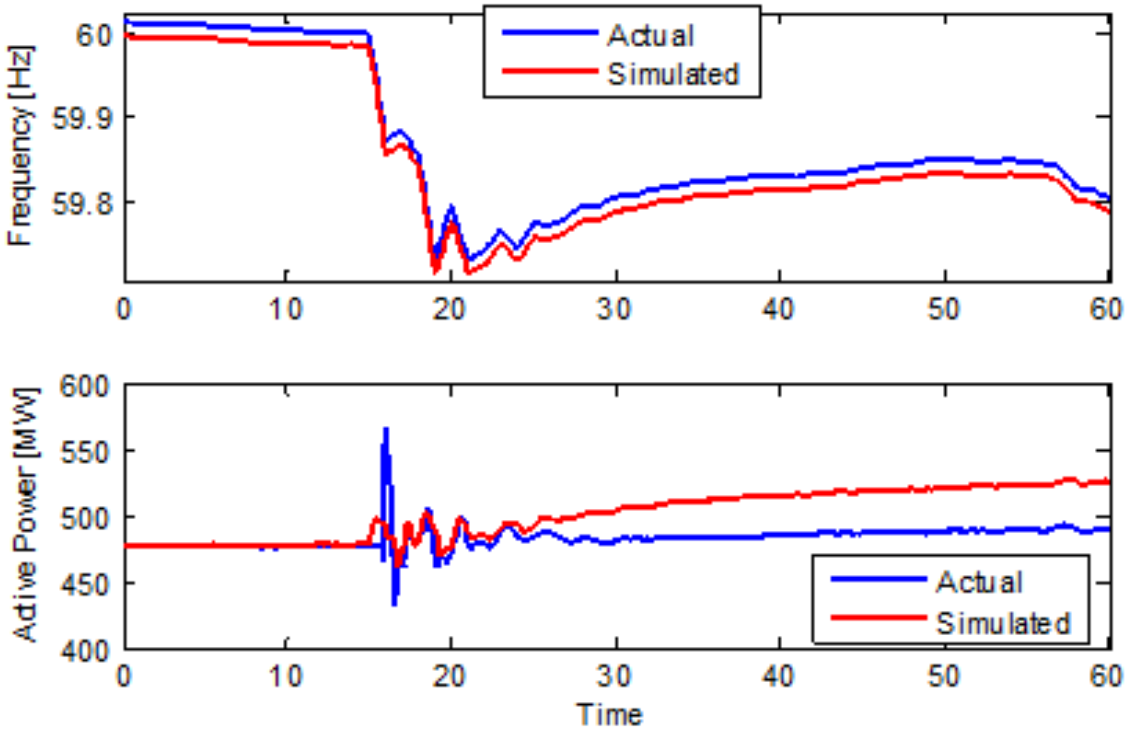
- Inadequate representation of frequency response



Accurate models of governors are needed to ensure compliance with the NERC Standard BAL-003

Mismatch between Simulations and Measurements

- The studies and real time measurements showed discrepancies in the system performance, especially in the generation output.
- These discrepancies need to be investigated.



Study Plan and Methodology

- Identify missing models or missing model components
- Identify models that have deficiencies and require upgrades
- Point to generators that are modeled with generic models with typical parameters and obtain more accurate models of the units
- The models with deficiencies will be identified by comparison of the real time measurements and the simulation results, or if measurements are not available, by unrealistic performance in the simulations
- This task will be performed in coordination with the System Operations who will provide the real-time measurement data.
- Updated models will be reported to WECC to be included in the dynamic stability model database.

QUESTIONS?

COMMENTS?

Next Steps
Special Studies Stakeholder Call

Kim Perez

Stakeholder Engagement and Policy Specialist

2016-2017 Transmission Planning Process Stakeholder Call

June 13, 2016

2016-2017 Special Studies Stakeholder Call - Next Steps

Date	Milestone
June 13, 2016	ISO presents assumptions and study scope to stakeholders
June 13 – 27, 2016	Stakeholder comments to be submitted to regionaltransmission@caiso.com
September 21-22, 2016	Status update
November 16, 2016	Present special study results
January 2017	Incorporate study results in the Draft 2016-2017 Transmission Plan