Aliso Canyon Gas Electric Coordination Discussion

Market Surveillance Committee Meeting

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Aliso Canyon Gas Electric Coordination - Overview

- Beginning Summer 2016, ISO anticipates the limited operability of Aliso Canyon to affect electric operations.
  - ISO participating in inter-agency task force to asses reliability risks associated with limited operations
  - ISO initiating expedited stakeholder process to explore mechanisms or other tools to address risks
- Under stakeholder process, ISO seeks to:
  1. Evaluate reliability risks due to limited operations,
  2. Evaluate how daily gas balancing requirements proposed affect resources' ability to manage generation assets,
  3. Identify and develop market mechanisms or tools necessary to support reliability and ensure markets are not adversely impacted.

Aliso Canyon Gas Electric Coordination - Proposal

- Address gas burn limitations due to supply or deliverability concerns on gas system through:
  - Introducing gas availability constraint that would restrict maximum generation dispatch to within a gas burn level
  - Reserving internal transfer capability (Path 26), if necessary, to ensure ISO can reliably deliver energy
- Address imbalances between real-time and day-ahead that could adversely impact reliability through:
  - Increasing access to information prior to day-ahead by releasing 2 day-ahead advisory results
  - Introducing gas balancing constraint holding gas burn to within a tolerance band of day-ahead scheduled burn

Aliso Canyon Gas Electric Coordination - Proposal

- Increase efficiency of real-time re-dispatch through using real-time gas price information in cost estimates
- Accelerate implementation of board approved policies to allow commitment cost re-bidding and opportunity to seek after-the-fact cost recovery
- Routinely use best day-ahead gas price information since manual price spike procedure will soon not be supportable
- Continue to evaluate how it might collaborate with gas company so curtailments across gas system will not adversely affect electric reliability system-wide or locally

ADDRESS GAS BURN LIMITATIONS DUE TO SUPPLY OR DELIVERABILITY

Propose **gas availability constraint** to reflect limited supply to affected generators

- Used to reflect identified physical supply or deliverability limitation as result of:
  - Outage to storage facilities
  - Outage to pipeline
  - Non-EFO Curtailments
  - Emergency Flow Orders (EFO)
- Cost of violating constraint reflected in LMP

Propose **gas availability constraint** to reflect limited supply to affected generators

$$\sum_{i \in S} \alpha_i \left(P_{i,t}\right) \leq RHS_t$$

Where limit is set as:

$$RHS_t = R_h$$

S	Set of generators in affected area
P	Power output (MW)
$\propto_i$	Energy (MW) to million cubic feet (MMcf) gas conversion factor (Masterfile heat rate value at given MW output * unit conversion factor)
RHS_t	Right hand side limit enforcing upper bound constraint which is an hourly value in MMcf provided by gas company
R_h	Daily upper bound deviation allowance relative to day-ahead market schedule

Propose to reserve internal transfer capability (ATC) in day-ahead for real-time use

- Reserve ATC on Path 26, if necessary, to ensure ISO can reliably deliver energy into Southern California
- Establish amount reserved, if any, based on anticipated gas and electric conditions
- ISO could manually release reserved capability in real-time, if needed
- Reserving ATC:
  - Will allow system to respond to greater real-time changes in Southern California's load
  - Might result in scheduling more Southern California generation, increasing gas usage

ISO continuing to evaluate its procedures for planning and reflecting in its markets outages or curtailments

- Recommend moving electric reliability check to earlier in process during confirmation of curtailment details
- Recommend requesting changes to pro rate curtailment prior to first notification of gas company based on system and local reliability concerns
- Recommend compiling a joint procedure agreed upon by both parties and hosting a joint training for affected generators on process for gas-electric coordination
- Recommend reviewing outage card definitions and ensuring BPM matches ISO intent for various fuel cards

ADDRESS GAS BURN LIMITATIONS DUE TO SUPPLY OR DELIVERABILITY

Release 2 day-ahead market results to improve market participants ability to plan for gas procurement

- Market participants can plan based on expectations of where economics will place them in the supply stack through forward planning based on fundamentals and market signals
- Market participants do not have visibility into day-ahead schedules resulting from inclusion of constraints
- ISO determined there would be insufficient benefit from moving the day-ahead market timeline to provide day-ahead results in advance of timely deadline
- ISO proposes to release the 2 day-ahead market run results through CMRI

Propose **gas balancing constraint** to mitigate risk of gas burn imbalances outside tolerance band in RTM

- Used to hold the burn of ISO generators across the SoCalGas and SDG&E system to the day-ahead schedules' burn plus a tolerance band (MMcfd)
- Constraint would be enforced when risk of excessive imbalances could adversely impact gas and electric reliability such as:
  - If day-ahead gas forecast is greater than 3 BCF then tolerance band across day is less than ISO share of 150 MMcfd
  - If day-ahead gas forecast is less than 3 BCF then tolerance band could be wider than ISO share of 150 MMcfd
- Cost of violating constraint reflected in LMP

Propose gas balancing constraint to mitigate risk of gas burn imbalances outside tolerance band in RTM

$$LHS_t \leq \sum_{i \in S} \alpha_i \left(G_{i,t} - \bar{G}_{i,t}\right) \leq RHS_t$$

Where limits are set as follows:

$$LHS_t = \beta_t R_l$$

$$RHS_t = \gamma_t R_h$$

$$\sum_{1}^{N} \beta_t = \sum_{1}^{N} \gamma_t = 1$$

S	Set of generators in affected area
G	Real-time market dispatch
$\bar{G}$	Day-ahead market schedule
$\propto_i$	Energy (MW) to million cubic feet (MMcf) gas conversion factor (Masterfile heat rate value at given MW output * unit conversion factor)
LHS_t	Left hand side limit enforcing lower bound constraint
RHS_t	Right hand side limit enforcing upper bound constraint
R_l	Daily lower bound deviation allowance relative to day-ahead market schedule
R_h	Daily upper bound deviation allowance relative to day-ahead market schedule
β_t	Allowance distribution coefficients associated with lower bound limit over the intervals of a trading day
γ_t	Allowance distribution coefficients associated with upper bound limit over the intervals of a trading day

INCREASE EFFICIENCY OF REAL-TIME RE-DISPATCH USING REAL-TIME GAS PRICE INFORMATION

Propose using real-time gas price information to increase efficiency of real-time re-dispatch

Option 1: Generators bid gas price and transport cost

- Submit (1) commodity price and (2) transport cost
- Used to calculate commitment cost & default energy bid
- Bid cost recovery for each generator will be based on its bid-in gas commodity price and gas transportation cost
- ISO routinely monitor and refer anomalous behavior:
  - If behavior flagged then refer for (1) audit process and/or (2) refer to FERC
  - If information found inaccurate then ISO would clawback profits, for example 200% BCR

Propose using real-time gas price information to increase efficiency of real-time re-dispatch

Option 1: Generators bid gas price and transport cost

- ISO will determine at what time the calculation would need to be performed, such as T-135
- ISO will need to determine how frequently it can re-calculate its cost estimates using the submitted commodity price and transport costs
- ISO will need to determine how frequently audits should be performed to ensure sufficient oversight

Propose using real-time gas price information to increase efficiency of real-time re-dispatch

Option 2: volume weighted average price of trades

- Use fuel region gas price index that is the sum of **real-time gas price estimate**, gas transport cost, cap-and-trade credits and miscellaneous (verifiable) costs
- Real-time gas price estimate:
  - Prior to 5PM PST: Volume weighted average price
  - After 5PM PST: Volume weighted average price plus noncompliance charge (e.g. 150% of next day index)

Propose using real-time gas price information to increase efficiency of real-time re-dispatch

Option 2: volume weighted average price of trades

- ISO will determine at what time the calculation would need to be performed, such as T-135
- ISO will need to determine appropriate window of trades to use to calculate, such as the prior 4 hours
- Calculation would be: $I = \Sigma (P \cdot V) / T$

I = Volumetric Weighted Average Index Price,

P = price or premium of individual transaction,

V = volume of individual transaction,

$\sum(P \cdot V)$ = sum of each transaction's price multiplied by its volume,

T = total volume of all qualifying transactions.

Propose using real-time gas price information to increase efficiency of real-time re-dispatch

Option 2: volume weighted average price of trades

- This proposal would be consistent with ISO's existing cost estimate framework
- However there are various challenges with adopting this option:
  - Very few ICE transactions, majority of trades off-ICE
  - No visibility into market participant level data for gas exchange trades
  - No authority to monitor exchange traded gas transactions

Propose using real-time gas price information to increase efficiency of real-time re-dispatch

- If neither option can be implemented, ISO could propose to change the margin of error applied to commitment cost and default energy bid estimates
- The commitment cost bid cap is currently 125 percent of calculated costs under the proxy cost option and the default energy bid adder is currently 10 percent.
- An open question is what change to these thresholds would be appropriate in the interim until longer term market solution can be implemented?

Propose accelerating implementation of elements from commitment cost bidding improvements

- Accelerate implementation of:
  - RTM rebidding of commitment costs for resources without day-ahead schedule until committed
  - After-the-fact cost recovery at FERC with addition of incremental energy offers
- ISO notes that improvements to real-time gas price estimates are necessary to ensure after-the-fact recovery proposal would be used for extreme outlier events and not used to routinely recover costs unrecoverable due to existing market design gap

PROPOSE LONG-TERM MARKET ENHANCEMENT FOR DAY-AHEAD GAS PRICES

Proposal to routinely use improved day-ahead gas price index

- Manual price spike procedure functionality will no longer be possible due to ICE changing its timing of its printed price to 11:30AM PST
- ISO proposes to implement a routine use of GD2 timely trading's price information as the basis for its cost estimates in the day-ahead
- ISO proposes to propose one of the two options discussed for real-time with the following adjustments:
  - For Option 1, add to day-ahead bids the gas commodity price and gas transport cost values
  - For Option 2, apply methodology consistent with ICE

Q&A

REFERENCE MATERIALS – ISSUE PAPER BACKGROUND AND WORKING GROUP SLIDES

Background – Aliso Canyon Impact

Oct. 2015, discovered Aliso Canyon leak

Jan. 2016, Gov. Brown issued proclamation of state of emergency

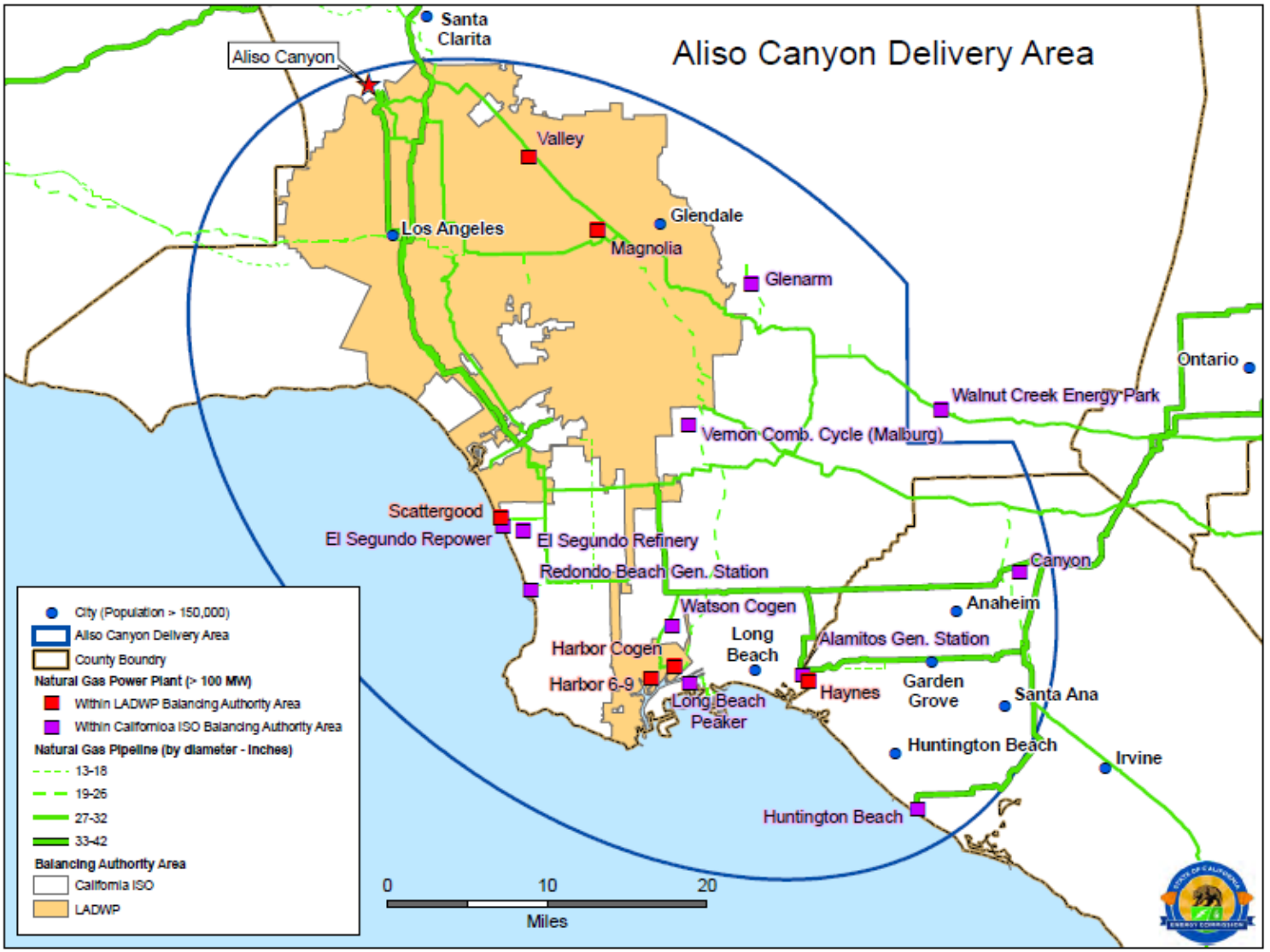
- Continue prohibition on injecting gas into the storage facility
- Direct CPUC, CEC an ISO to coordinate to ensure continued reliability

Jan. 2016, multi-agency technical working group looking at short-term reliability risks associated with summer and peak winter operations due to limited operations of Aliso Canyon facility

Feb. 2016, State regulators confirmed gas leak sealed but continued moratorium on new injections until Division of Oil, Gas, and Geothermal Resources complete inspections

Mar. 2016, SoCalGas and SDG&E filed motion to establish interim daily balancing requirements effective May 1, 2016 (5% tolerance band / 150% of gas daily penalty)

Aliso Supports ~9,800 MW: 40% LADWP/ 60% in CAISO; Critical for Peak Day and Contingency Reserve Situations



Capacity of Pipe and Other Storage Indicates General Risk

Supply/Demand	System Design (Bcf/day)	Actual Experience (Bcf/day)
Pipeline Capacity Supply	3.8	3.0
Other Storage Supply (without Aliso)	1.7	1.0
TOTAL SUPPLY	5.5	4.0
Peak Winter Gas Demand	-5.0	-5.0
RESERVE MARGIN	0.5	(1.0)

- Typical outages can reduce capacity 0.5-1.0 Bcf/day
- Electric generation typically requires 1.0-2.0 Bcf/day

Analysis Verified Risks to Reliability

1. Scheduled flowing gas can fail to meet actual demand

2. Planned and unplanned outages on gas system often limit pipeline and other storage availability

3. Rapid ramping of electric generation can exceed dynamic capability of gas system
   - i.e. contingency recovery, renewable generation following

4. Cold weather to east can reduce gas supplies for California

Analysis Assessed Actual Operations on 4 Key Days

DATE	CONDITION	TOTAL DEMAND (Bcf per Day)
9/16/14	LADWP Peak Day	3.5
7/30/15	Large Electric Generation Ramp	3.2
9/9/15	CAISO – Large Difference between Day Ahead and Real Time actual + LADWP 2015 Peak	3.2
12/15/15	Winter Day and High Electric Generation	3.3

Key Findings:

- Gas system unable to tolerate mismatches between scheduled gas and actual flows if Aliso gas is not used
- Situation is worse if planned or unplanned outages occur

Confirmed: Serious Risk to Gas/Electric Reliability this Summer

- If Aliso is not used, the LA Basin can expect 16 summer days of gas curtailment in 2016
  - electric generators are first to be curtailed

- Up to 14 summer days may require electric service interruption, potentially to millions of customers

	Scenario	Gas Quantity Curtailed (8 peak hours HE14-HE21)	Days of Gas Curtailment Risk for Electric Generators (Summer)	Gas Curtailment Interrupts Electricity Service (Summer)
A.	150 MMcf mismatch between scheduled gas and actual demand	84 Mmcf	2	Not Likely
B.	Mismatch plus outage at other storage field	224 Mmcf	2	Likely
C.	Mismatch plus pipeline outage	280 Mmcf	9	Yes
D.	Mismatch plus outage both on other storage and pipeline	513 Mmcf	3	Yes

Background – FERC Order 809

Nomination Cycle	Nomination Deadline (PST)	Notification of Nominate (PST)	Nomination Effective (PST)	Bumping of interruptible transportation
Timely	9:30 a.m. 11:00 a.m.	2:30 p.m. 3:00 p.m.	7:00 a.m. Next Day	N/A
Evening	4:00 p.m.	8:00 p.m. 7:00 p.m.	7:00 a.m. Next Day	Yes Yes
Intra-day 1	8:00 a.m.	12:00 p.m. 11:00 a.m.	3:00 p.m. Current Day 12:00 p.m. effective	Yes Yes
Intra-day 2	3:00 p.m. 12:30 p.m.	7:00 p.m. 3:30 p.m.	7:00 p.m. Current Day 4:00 p.m. effective	No Yes
Intra-day 3	5:00 p.m.	8:00 p.m.	8:00 p.m. effective	No

Background - Alignment natural gas & electric markets