

**UNITED STATES OF AMERICA
BEFORE THE
FEDERAL ENERGY REGULATORY COMMISSION**

California Independent System Operator)
Corporation)

Docket No. EL14-22

**REPORT OF THE CALIFORNIA INDEPENDENT SYSTEM OPERATOR
CORPORATION ON NATURAL GAS AND ELECTRIC COORDINATION**

I. Introduction

The California Independent System Operator Corporation (CAISO) files this report on natural gas and electric coordination consistent with the directives of the Federal Energy Regulatory Commission.¹ This report provides a brief overview of the CAISO's efforts to improve natural gas and electric coordination, in particular as a result of the gas storage constraints at the Aliso Canyon gas storage facility in southern California. This report also provides information on the time required for the CAISO to publish day-ahead market results during 2016, the causes for any delays, and the steps the CAISO is taking to mitigate any delays. Finally, this report identifies operational challenges related to gas-electric coordination issues – apart from the constraints at the Aliso Canyon natural gas storage facility – that affected natural gas fired generators in the CAISO's balancing authority area during 2016. The report discusses mitigation efforts explored by the CAISO in connection with these challenges.

II. Background

On April 16, 2015, the Commission adopted a final rule – Order No. 809 – that revised the Commission's regulations relating to the scheduling of transportation service

¹ *Cal. Indep. Sys. Operator Corp.*, 153 FERC ¶ 61,315 (2015) (*December 2015 Order*) at P 45.

on interstate natural gas pipelines.² As part of Order No. 809, the Commission modified the timely nomination cycle for natural gas scheduling from 11:30 a.m. Central Time to 1:00 p.m. Central Time.³ In separate proceedings, the Commission also directed each independent system operator and regional transmission operator to: (1) adjust the time at which it posts the results of its day-ahead energy market and reliability unit commitment process (or equivalent) to a time that is sufficiently in advance of the timely and evening nomination cycles to allow natural gas-fired resources to procure natural gas supply and pipeline transportation capacity to serve their obligations; or (2) show cause why such changes are not necessary.

The CAISO submitted a compliance filing to demonstrate why it does not need to change the timing of its day-ahead market close and publication of market results, notwithstanding the Commission's adoption of changes to scheduling practices of interstate natural gas pipelines in Order No. 809. The CAISO's current day-ahead energy market closes at 10:00 a.m. Pacific Time (i.e. 12:00 p.m. Central Time) and the CAISO publishes its market results at 1:00 p.m. Pacific Time (i.e. 2 p.m. Central Time). The CAISO argued that its current day-ahead scheduling process provides sufficient opportunity for gas-fired resources to secure natural gas and pipeline transportation services. The CAISO asserted there was no evidence to reflect that under normal conditions natural gas-fired resources participating in the CAISO markets cannot obtain gas transportation service to support their day-ahead electric schedules. After obtaining stakeholder feedback, the CAISO concluded that maintaining the current timing for day-

² *Coordination of the Scheduling Processes of Interstate Natural Gas Pipelines and Public Utilities*, 151 FERC ¶ 61,049 (Order No. 809) (2015).

³ *Id.* at P 87.

ahead market close and publication of market results was more reliable, more efficient, and less disruptive than the alternative of moving the timing of this process to earlier in the day.

In its *December 2015 Order*, the Commission accepted the CAISO's compliance filing but directed the CAISO to submit an annual informational report to explain ongoing efforts to improve natural gas-electric coordination, including efforts to improve solve times of its day-ahead market. The Commission's *December 2015 Order* stated that the CAISO's informational report should also identify whether any natural gas-fired generators within the CAISO has experienced any operational challenges related to gas-electric coordination issues, and identify what actions the CAISO undertook to mitigate such events.

III. The CAISO has worked to improve natural gas and electric coordination, in particular as a result of the gas storage constraints at the Aliso Canyon gas storage facility in southern California

Over the last year, the CAISO has actively worked with state authorities, natural gas utilities and CAISO market participants to ensure it can manage electric grid reliability concerns arising from the natural gas storage constraints at the Aliso Canyon gas storage facility in southern California. The storage field at Aliso Canyon has been an integral part of the part of the gas and electric systems and limitation on its use has the potential to create adverse impacts on electric grid reliability.⁴

⁴ Aliso Canyon Risk Assessment Technical Report Prepared by the Staff of the California Public Utilities Commission, California Energy Commission, the California Independent System Operator Corporation, the Los Angeles Department of Water and Power, and Southern California Gas Company, at 5-7 (Apr. 5, 2016) (Risk Assessment Report). The Risk Assessment Report is available on the CAISO website page for the Aliso Canyon Gas-Electric Coordination stakeholder initiative. <http://www.caiso.com/informed/Pages/StakeholderProcesses/AlisoCanyonGasElectricCoordination.aspx>

As the Commission is aware, a significant gas leak was detected at Aliso Canyon in October 2015.⁵ On January 6, 2016, the Governor of California issued an Emergency Proclamation that included a number of directives related to the leak, including the continuation of a moratorium on gas injections into Aliso Canyon and a directive that the California Public Utilities Commission (CPUC) and the California Energy Commission (CEC), in coordination with the CAISO, “shall take all actions necessary to ensure the continued reliability of natural gas and electricity supplies in the coming months during the moratorium.”⁶ Among the actions taken was the establishment of an Inter-Agency Task Force and the preparation and issuance of the Risk Assessment Reports and the Reliability Action Plans, by the members of the Inter-Agency Task Force.

The CAISO undertook a stakeholder initiative to explore gas-electric market coordination concerns raised by the limited operations of the Aliso Canyon natural gas storage facility. During this initiative, the Commission hosted a panel at its May 2016 open meeting to foster discussion on how to minimize impacts on electric grid reliability. The Commission issued an order on June 1, 2016 that conditionally accepted tariff revisions proposed by the CAISO to mitigate the limited operation of the Aliso Canyon on a temporary basis.⁷ The Commission also held a technical conference in September 2016 to discuss implementation of these mitigation measures and, subsequently, conditionally accepted the CAISO’s proposal to extend some of these

⁵ The leak was not sealed until February 18, 2016.

⁶ See January 6, 2016 Proclamation of State of Emergency issued by California Governor Edmund G. Brown, Jr. at the following website: <https://www.gov.ca.gov/news.php?id=19264>

⁷ *Cal. Indep. Sys. Operator Corp.*, 155 FERC ¶ 61,224 (2016). The CAISO’s filings supporting this order are available in Commission Docket ER16-1649.

measures through November 30, 2017.⁸ To date, collaboration among the CAISO, California state agencies, Reliability Entities, neighboring balancing authority areas, Southern California Gas (SoCalGas), and CAISO market participants has mitigated adverse impacts to the electric grid in southern California. The Commission's attention to this matter and willingness to authorize the CAISO to take interim market and operational mitigation measures have helped ensure electric grid reliability over the last year.

In addition to efforts to develop and implement mitigation measures associated with operating limits at the Aliso Canyon gas facility, the CAISO also coordinated with SoCalGas and interested parties in proceedings before the CPUC to implement rules to manage imbalances on the SoCalGas system as well as new curtailment rules.⁹ During 2016, SoCalGas implemented enhanced use of operational flow orders to alert gas customers to imbalances and ensure adequate gas pressure on its system. With respect to gas curtailment rules, SoCalGas' tariff now defines ten local service zones for the purpose of more precisely defining an area subject to a curtailment order. The tariff rules also revise the curtailment order of gas load to protect a percentage of electric generation load from curtailment prior to other non-core usage. These changes will allow SoCalGas to more effectively implement gas curtailments taking into consideration electric grid reliability. The CAISO has modified its operating procedures

⁸ *Cal. Indep. Sys. Operator Corp.*, 157 FERC ¶ 61,151 (2016). The CAISO's filings supporting this order are available in Commission Docket ER17-110.

⁹ See CPUC Decision 16-06-021, *Decision Approving Daily Balancing Proposal Settlement Agreement* and CPUC Decision 16-07-008, *Decision Adopting Curtailment Procedures Settlement Agreement* in Application 15-06-020. Information on this docket and copies of these Decisions are available on the CPUC's website at the following link: <https://apps.cpuc.ca.gov/apex/f?p=401:5:0::NO:RP,5,RIR,57,RIR::>

to reflect how it will coordinate with gas pipeline operators to implement new curtailment rules.¹⁰ Both efforts highlight the increased awareness and recognition of the nexus between natural gas and electric system reliability.

In addition to its Aliso Canyon focused initiatives, the CAISO completed other stakeholder initiatives that resulted in tariff changes that will improve gas-electric market coordination. The first of these efforts led to the Commission to issue an order in May 2016 accepting tariff revisions so that the market would more accurately reflect a generator's gas usage and costs when operated at minimum load in the event of a temporary increase to the generator's minimum load.¹¹ The second of these efforts resulted in changes that included allowing market participants to rebid commitment costs in CAISO's real-time market if a resource was not committed in the day-ahead market or residual unit commitment process and changes to no longer generate bids in the real-time market if not submitted in the real-time market under certain circumstances. While these market changes were also part of the temporary Aliso Canyon measures, the Commission approved making them permanent in a November 2016 order.¹² These measures improve gas-electric market coordination by improving market participants' ability to reflect gas availability and gas system operational constraints in CAISO market bids.

The CAISO has also recently started a stakeholder initiative to comprehensively examine market design features related to suppliers' flexibility to submit supply offers

¹⁰ See CAISO Operating Procedure 4120 (<http://www.caiso.com/Documents/4120.pdf>) and 4120C (<http://www.caiso.com/Documents/4120C.pdf>).

¹¹ Letter order dated May 6, 2016 in Commission Docket ER16-1265.

¹² *Cal. Indep. Sys. Operator Corp.*, 157 FERC ¶ 61,138 (2016).

that reflect their willingness to provide energy at a given price based on their own expectation of costs and risks.¹³ The outcome of this initiative should improve gas-electric coordination because the changes under consideration would likely improve market participants' ability to reflect gas availability and gas system operational constraints in CAISO market bids. Finally, the CAISO may initiate a stakeholder initiative in 2017 to examine whether to extend the temporary Aliso Canyon market provisions to reflect gas system operational constraints or to make them permanent as well as whether the CAISO should also apply them outside of southern California.

During its stakeholder initiative to examine measures to mitigate constraints at Aliso Canyon, the CAISO discussed with stakeholders whether it should revisit the timing of publishing day ahead market results. As the Commission is aware, the CAISO publishes its day-ahead market results after the timely cycle deadline for the gas-day, which increases the risk of a mismatch of nominated gas flow and actual gas demand. Based on this discussion, the CAISO determined to explore other measures, largely based on stakeholder feedback that the CAISO should focus on other market mechanisms to better align nominations with real-time gas burn to help mitigate reliability concerns for summer 2016. Moreover, stakeholders continued to identify uncertainty of incremental changes to day-ahead schedules in real-time as posing a more significant risk for reliability and this risk would not be addressed by moving the day-ahead market timeline. Finally, stakeholders expressed concern about the energy price risk associated with having to submit day-ahead energy bids prior to completing

¹³ More information about this initiative is available on the CAISO's website at the following link: http://www.caiso.com/informed/Pages/StakeholderProcesses/CommitmentCosts_DefaultEnergyBidEnhancements.aspx

energy procurement for the next trading day and expressed concern that moving the day-ahead market earlier would increase load forecast error and variable energy resource output forecast error. For these reasons, the CAISO elected not to propose moving its day-ahead market clearing process to earlier in the day in order to publish results prior to the gas timely nomination cycle.¹⁴

IV. The CAISO continues to work to improve its day ahead market publication time

The CAISO acknowledges that the timing of its day-ahead market does not fully align with the timing of the day-ahead gas nomination cycles. This imposes challenges for gas procurement and nominations to meet CAISO commitments or dispatches. The CAISO's day-ahead market publication time of 1 p.m. Pacific Time does not provide day-ahead market schedules in advance of the gas timely nomination cycle – the most liquid trading period for the next gas day. As a result, gas-fired generators may need to procure natural gas to meet the CAISO day-ahead market schedules in the evening nomination cycle to the extent they did not anticipate day-ahead market schedules and procure gas in advance. The CAISO recognizes the importance of ensuring that it issue its day-ahead market results by 1 p.m. Pacific Time to allow entities to procure gas in the evening nomination cycle. Figure 1 provides the trend of publication times since October 2015 through November 2016. The flat line reflects the target of 1 p.m. Pacific Time to publish day-ahead market results, while the line in blue reflects the daily publication time trend. When the line in blue is above the red line the CAISO did not meet its publication time target.

¹⁴ See Revised Draft final Proposal dated May 4, 2016 at pp. 8-10.
http://www.caiso.com/Documents/RevisedDraftFinalProposal_AlisoCanyonGas_ElectricCoordination.pdf

Figure 1
Publication Time for Day-Ahead Market Results

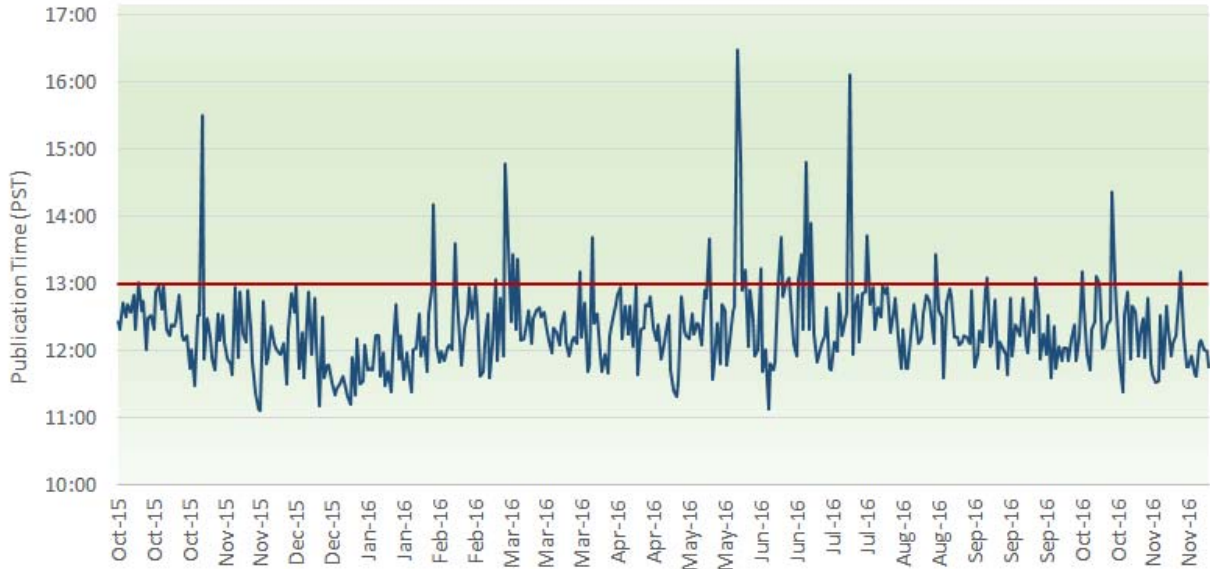
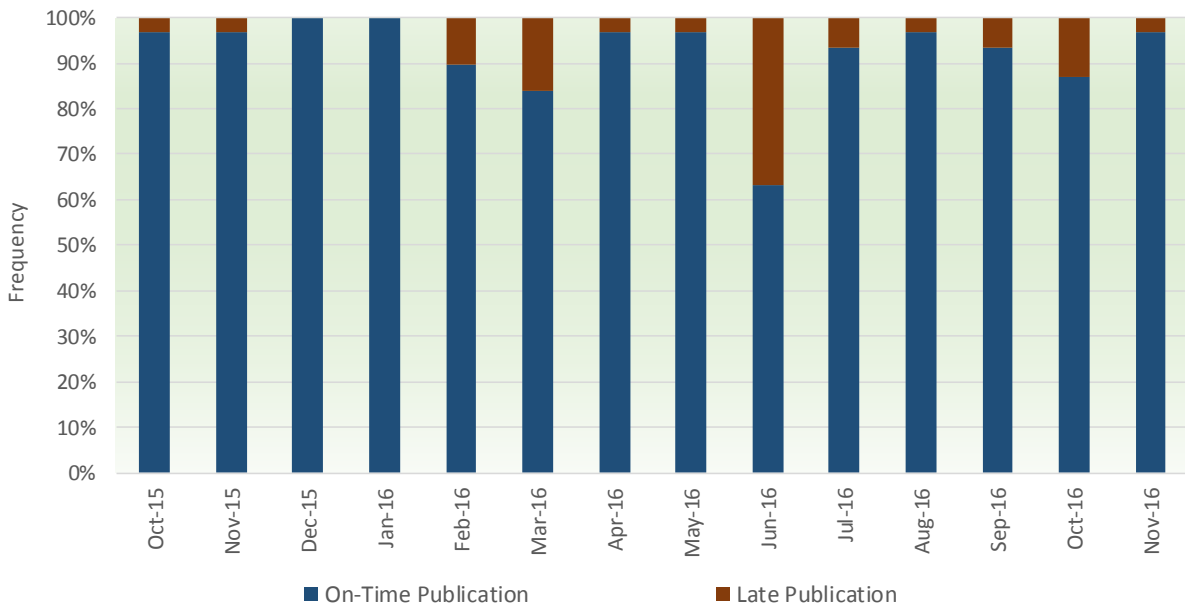


Figure 2 reflects a monthly summary of the frequency that the CAISO published its day-ahead market results on time (blue bars) and the frequency the CAISO has published day-ahead market results late (red bars).

Figure 2
Monthly Summary of Timely Day-Ahead Market Results



Since October 1, 2015 through December 3, 2016, the CAISO published day-ahead market results on time for 92.3% of operating days. There are a variety of reasons why the CAISO may not be able to publish day ahead market results on time.

These reasons include:

- **Incorrect input data:** The market relies on a set of different data inputs, including data related to external balancing authority areas. The input data in some cases may reflect errors that can result in an erroneous or infeasible market solution. During the market run, the CAISO must attempt to resolve these issues and may re-run certain portions of the day-ahead market. In some extreme cases, the CAISO may need to rerun all of its day ahead market processes. Incorrect input data may include, default switch positions, quality of data for load distribution constraint definition, transmission limits, or outages.
- **Software issues:** There are instances when software upgrades, or network model upgrades, or a software defect renders market solutions incorrect. In some of these instances, the issue may interfere with the CAISO completing the day-ahead market run (i.e. not obtaining a solution). In other cases, the CAISO's software may identify an available solution that reflects pricing errors. The CAISO will re-run the market if it cannot obtain a solution and attempt to resolve any pricing issues before publishing the day-ahead market solution to avoid after the fact price correction. Another factor related to software is slower market run times,

which results from software or hardware issues or incorporating complicated market constraints.

- **Direct Current Solution:** Another instance that has resulted in the CAISO publishing day ahead market results after 1 p.m. Pacific Time is when the market produces a direct current (DC) solution. The CAISO aims to obtain market results with an alternate current (AC) solution, but the CAISO's market software will solve with a DC solution at times because of issues involving converging power flows under an AC solution. When this happens, the CAISO will seek to resolve these DC solutions in order to publish market results based on an AC solution. This effort can require rerunning the market process from the beginning, which may result in the CAISO publishing day ahead market results late.

The CAISO took various actions to publish day-ahead market results earlier after it started to publish day-ahead market results late more often in the first half of 2015. To reduce solve times, the CAISO upgraded its market hardware and enhanced the constraint formulations in the market for committing resources. The CAISO also has started to expand its validation work for the day-ahead market by undertaking some of this work well in advance of the day-ahead market run. This effort seeks to identify and resolve issues prior to running the financially binding market. The CAISO also added more detailed information to its full network model to reflect operations of adjacent balancing authority areas joining the Energy Imbalance Market. This information has improved the ability to identify power flows that may create anomalous market results. Finally, the CAISO has improved the quality of data it uses to reflect load distribution

factors and transmission switch positions in the network model. The CAISO hopes these efforts will increase the frequency of publishing day-ahead market results on time.

V. Operational challenges related to gas-electric coordination issues have occurred in 2016 and the CAISO has taken steps to mitigate these events

As referenced in Section III of this report, the CAISO has spent considerable time during 2016 monitoring, assessing and actively supporting reliability related actions in Southern California because of Aliso Canyon's operation limits. The CAISO helped manage multi-agency studies of gas and electric system conditions during both the summer and winter seasons in 2016. The CAISO worked together with SoCalGas to support rule revisions and additions that greatly improved delivery of on-system gas.

In addition to managing operations without the use of Aliso Canyon gas storage facility, the CAISO experienced two isolated events involving gas-related conditions. One of these events was the gas price spike after Memorial Day weekend in 2016. After long weekends, natural gas prices may be higher because there is not any gas trading over the long weekend. On the morning after the Memorial Day weekend, the gas price for day-ahead gas transactions for the Pacific Gas and Electric (PG&E) Citygate hub on the Intercontinental Exchange (ICE) was 28 percent higher than the gas price index published the prior evening that would be used for the day-ahead market. In this situation, the CAISO triggers a manual process for the day-ahead market to use the current ICE gas prices. On June 1, 2016, in preparation for running the day-ahead market for trade date June 2, 2016, the CAISO implemented this manual process and used the updated higher gas prices in the day-ahead market run. Since the final ICE index became available until after 11:30 a.m. Pacific Time the CAISO had to stop the original market run and start from the beginning to rerun the day-ahead

market. The CAISO allowed market participants to re-submit bids in light of the use of the updated gas price. This resulted in the CAISO publishing the day-ahead market results after 1 p.m. Pacific Time.

On June 20, 2016, the CAISO experienced another gas-related event. SoCalGas had an unplanned compressor station outage that affected their ability to support electric generation connected to their system. The CAISO discussed options with SoCalGas to ensure both the natural gas and electric systems would continue to operate reliably. In this case, SoCalGas directed partial gas delivery curtailments to two electric generators and the CAISO issued exceptional dispatches for these units to reduce output. Both units responded and the gas system pressures returned to acceptable levels.

Both PG&E and SoCalGas issued operational flow orders to manage pressure on their gas systems during 2016. These operational flow orders were in anticipation of potential upcoming low gas system pressure and incentivized gas customers, including electric generators, to bring more gas onto the system. In addition, maintenance activities on gas pipelines have resulted in gas delivery curtailments to certain electric generators because of locational flow restrictions.

The CAISO's system operations and outage departments have actively coordinated with gas pipeline operators in connection with operational flow orders, curtailment watches and outage requests. For example, the CAISO and SoCalGas hold daily calls to confirm forecasted gas burn rates and discuss potential weather changes. CAISO system operations personnel also call SoCalGas' operational personnel whenever they see significant deviations from the agreed to burn rates, or when the

CAISO starts fast-start electrical generators to meet rapidly increasing load. All of these actions are in addition to outage coordination efforts between the CAISO and each intrastate and interstate gas pipeline operator under the terms on the CAISO's tariff and applicable nondisclosure agreements. This coordination has helped mitigate instances involving stress to the gas pipeline systems and ensure they do not pose a threat to electric grid reliability.

VI. Conclusion

The CAISO appreciates the Commission's ongoing support of electric and gas coordination activities undertaken by ISO/RTOs. The CAISO will continue to work with affected interests to coordinate reliable electric and natural gas system operations in 2017 as well as continue to work to improve its ability to consistently publish day ahead market results by 1 p.m. Pacific Time.

Dated: December 19, 2016

Respectfully submitted,

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CERTIFICATE OF SERVICE

I hereby certify that I have served the foregoing document upon all of the parties listed on the official service list for the captioned proceeding, in accordance with the requirements of Rule 2010 of the Commission's Rules of Practice and Procedure (18 C.F.R. § 385.2010).

Dated at Folsom, California this 19th day of December 2016.

/s/ Grace Clark
Grace Clark