

California Public Utilities Commission

**Aliso Canyon Working Gas Inventory,
Production Capacity, Injection Capacity,
and Well Availability for Reliability**

Revised Report – Public Utilities Code Section 715

Energy Division

1/17/2017

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Introduction

Public Utilities Code (PU Code) Section 715 requires the California Public Utilities Commission (CPUC) to publish a report assessing the need for natural gas from the Aliso Canyon storage facility to meet the region's natural gas and electricity demand. Specifically, the statute requires the CPUC to determine:

1. *The range of working gas necessary at the Aliso Canyon storage facility to ensure safety and reliability at a just and reasonable rates in California;*
2. *The amount of natural gas production at the facility needed to meet safety and reliability requirements;*
3. *The number of wells and associated injection and production capacity required; and*
4. *The availability of sufficient natural gas production wells that have satisfactorily completed required testing and remediation.*

On June 28, 2016, the CPUC issued the report required by PU Code Section 715. The report was based on working conditions of the field at the time and the fact that new injections would likely be prohibited over the course of the summer. The report acknowledged that it would need to be update in the future as conditions in the field changed. This update to the report addresses near-term winter and summer seasons based on the existing conditions of both the Aliso facility and the Southern California Gas Company (SoCalGas) system.¹ These conditions are likely to change over time depending on operational capabilities of wells in the field, SoCalGas' ability to inject into the field, and the effectiveness of mitigation measures. Additionally, the impact of new regulations concerning storage fields will potentially limit, at least in the short term, the ability of other SoCalGas storage facilities to absorb any shortfalls due to conditions at Aliso. These changing conditions will require the CPUC to further update this report in the future.

The determination of whether and how the storage facility will be used over the long term will be the subject of a CPUC proceeding, which by statute must begin no later than July 1, 2017.

As written, the statute requires the four determinations to be made independent of each other. That is, the determination of the amount of inventory necessary for reliability in determination 1 is to be identified independently of whether there is sufficient injection and production capacity. However, these factors are interrelated. For example, since withdrawal rates increase with higher pressure, fewer wells are needed to achieve a specific production rate when the volume of gas in the facility is increased.

¹ For planning purposes SoCalGas defines winter as beginning on November 1 and ending on March 31. Summer begins April 1 and ends on October 31.

This report endeavors to make the statutorily required determinations based on current conditions, while acknowledging that a variety of combinations of inventory, capacity, and wells could address the identified reliability needs. Additionally injections into the field are currently prohibited and even if injections were authorized this winter a fairly minimal volume of gas could be injected into the field to impact winter reliability; the report must take this limitation into account.

The report and its findings are based on the Aliso Canyon Risk Assessment Technical Report dated April 4, 2016, that addressed summer reliability risks, and the Aliso Canyon Winter Risk Assessment Technical Report dated August 23, 2016. These reports were prepared by the CPUC, the California Energy Commission (CEC), the California Independent System Operator (CAISO), and the Los Angeles Department of Water and Power (LADWP), and the reports were independently reviewed by Los Alamos National Lab and other outside experts.² SoCalGas also participated in the preparation of the two technical assessments.

This report also considers:

1. *The methodology and revised tables that form the monthly gas balance and storage simulation that was prepared by the California Energy Commission and incorporated in the Aliso Canyon Gas and Electric Reliability Winter Action Plan (Winter Action Plan);*³
2. *Forecasted gas demand information provided by SoCalGas for the 2016 California Gas Report (CGR);*⁴
3. *Publicly available data including information posted on the Sempra Envoy website (<https://scgenvoy.sempra.com>), which provides historical daily operating information including information on sendout and receipts and storage injections and withdrawals; and*

² These two reports have undergone an independent review by the Los Alamos National Lab and Walker & Associates ([Independent Review of Hydraulic Modeling for Aliso Canyon Risk Assessment](#). Walker & Associates Consultancy, Los Alamos National Laboratory. August 19, 2016). The review noted that the modeling used in the technical assessments is consistent methodologically with industry practice. Further the review noted that the modeling produced reasonable outcomes and that the SoCalGas capacity estimates used are appropriate.

³ [Aliso Canyon Gas and Electric Reliability Winter Action Plan](#). California Public Utilities Commission, California Energy Commission, the California Independent System Operator and the Los Angeles Department of Water and Power. August 22, 2016. The gas balance and storage simulation examines supply and demand over the course of the winter and considers system wide needs and their impact on Aliso. The gas balance analysis was prepared by the California Energy Commission (CEC) independent of SoCalGas. The analysis included herein relies on the balance analysis in the August 22, 2016, Winter Action Plan, as modified by the CPUC and CEC and updated to reflect current information.

⁴ [2016 California Gas Report](#). Southern California Gas Company, Pacific Gas and Electric Company, San Diego Gas & Electric Company, Southwest Gas Corporation City of Long Beach Gas & Oil Department, Southern California Edison Company.

- ◆ Additional data provided by SoCalGas in response to CPUC data requests.

Statutorily Required Determinations

Consistent with SB 380, the CPUC has a statutory requirement to make four determinations concerning the Aliso Canyon storage facility prior to the approval of injections. These determinations are summarized below; the background and analysis supporting these determinations are provided later in this report.

1. *The range of working gas necessary at the Aliso Canyon storage facility to ensure safety and reliability at just and reasonable rates in California:*

The CPUC has determined that 29.7 Bcf of inventory at the Aliso Canyon Storage Field is necessary for SoCalGas to maintain safe and reliable service, limited by the mandated maximum safe operating pressure as specified by Division of Oil Gas and Geothermal Resources (DOGGR). As seasonal demand declines the inventory may be appropriately drawn down if necessary but should be maintained with a range that is managed to remain above 15.4 Bcf at the low and managed to target 29.7 Bcf. Managing the facility in this manner is estimated to address safety and reliability needs and will provide flexibility to respond to gas market conditions to support just and reasonable rates.

The 29.7 Bcf inventory level cannot be achieved for the much of the 2016/17 winter season. This reflects the injection rates for the wells available (as discussed in Determinations #3 and #4 below) and the fact that a portion of the 2016/17 winter season will already have passed by the time that injections could begin. However, mid-season injections that increase the amount of working gas and the field production rates for the remainder of the winter season will contribute to improved safe and reliable service for winter gas demands.

Storage has historically been used as a means of hedging against both seasonal differences in natural gas prices and short-term spikes in prices resulting from pipeline constraints or extreme weather events. Purchasing natural gas in times of year when it is inexpensive reduces the need for the utility and noncore users to purchase gas at peak-demand times when it can be significantly more expensive. Consequently, complying with the statutory requirement to maintain just and reasonable rates, suggests that at times storage inventories may need to be kept at levels above what is needed strictly for reliability. However, natural gas production in North America is at historic highs, resulting in low wholesale prices and minimal differentials between off

season and on season prices. So while future updates to this report may need to account for storage's ability to ensure just and reasonable rates, storage inventories in Aliso Canyon in 2017 will likely have little impact on rates in the current gas supply environment.⁵

2. *The amount of natural gas production at the facility needed to meet safety and reliability requirements:*

To meet reliability requirements, the CPUC estimates that SoCalGas needs to provide .839 Bcf per day (Bcfd) of production (withdrawal capacity) to meet winter peak-day needs, which are typically at their maximum in the month of January. A production level of .906 Bcfd is required to meet peak summer demand. As indicated below, this level of production is not currently available.

3. *The number of wells and associated production and injection capacity required:*

Using estimates based on current plans, a total of 66 wells producing at estimated withdrawal levels equivalent to production rates at a 29.7 Bcf inventory are needed to meet the highest production/withdrawal rate, which is the summer peak-day need of .906 Bcfd. There is no significant difference (65 vs. 66) in the number of wells estimated as necessary to serve the winter peak of .839 Bcfd. These numbers incorporate anticipated well reliability rates and losses due to mitigation measures underway in the 'West Field' at Aliso.⁶ It is noted that wells not yet brought into service may not perform at the same level estimated for wells included in current plans.

Based on current estimates, a level of 66 wells may not be achieved until the fourth quarter of 2017.

Using estimated injection rates and the 31 wells that are expected to be available the beginning of January, it would take approximately eight weeks⁷ to

⁵ A review of historical rates charged by SoCalGas and relative to peer companies used by SoCalGas Gas Acquisition indicate that rates have remained largely stable and even decreased and there has been no discernible change in SoCalGas rates relative to those of the peer companies. Note: Peer company comparisons are reviewed for relative position evaluation only and are not intended to be used for rate-to-rate comparison purposes.

⁶ The western part of the field is currently limited to one well making access to gas in this part of the field limited and reducing the overall withdrawal capacity of the field.

⁷ Using information from SoCalGas, an injection rate of 250 MMcfd for 30 days then improving to 300 MMcfd was calculated to require approximately 8 weeks. At more optimistic rates of 300 to 350 each day and adding 6 wells over the period, the inventory level could potentially be achieved in six weeks. Note: the fact that the wells may be available does not presuppose that injection will have been approved at the beginning of January.

increase the current inventory of 14.9 Bcf to the 29.7 Bcf working range identified in Determination #1.

4. *The availability of sufficient natural gas production wells that have satisfactorily completed required testing and remediation:*

There are currently 29 wells that have completed the required testing and remediation and are available for service. SoCalGas indicates that this number will increase to 31 in January of 2017. SoCalGas' intent is to continue having DOGGER test wells that have currently been isolated. For those wells that have passed DOGGER tests, SoCalGas will complete any remediation needed and then wells will become available for service. However, it is noted that a significant number of wells may need to be plugged and abandoned. Based on SoCalGas estimates and considering wells that may need to be plugged and abandoned the number of wells available may increase by as few as four wells per month.

Assuming that on average an additional 4 wells can be returned to service per month it will take a minimum of 9 months to add the 35 wells necessary to reach a total of 66 operating wells. Under the most optimistic production rates presented in Determination #3 66 wells are required to reach the withdrawal rates necessary to meet winter peak day production.

In summary, the current number of wells available, even assuming optimistic production rates, is not sufficient to assure reliability in the short term. As additional wells are tested and brought into service and with improved withdrawal rates, capacity requirements should, under current estimates, be able to be met; however, the timing is such that there will not be enough completed wells for the 2016/17 winter season nor will there be sufficient wells available to meet a peak summer day demand.

To summarize the interdependence of these determinations, Determination #1 above accurately states the inventory level required, but as indicated in Determination #4 there currently are not enough wells to support the production required for reliability at their current withdrawal rates. However, increasing the amount of inventory beyond the amount identified for working gas volume needs in Determination #1 would increase the withdrawal capacity of each well, which would reduce the number of wells required to achieve the withdrawal rates needed for reliability purposes.

Background

In response to a gas leak at Aliso Canyon, on January 21, 2016, the CPUC ordered SoCalGas to continue to withdraw gas from Aliso Canyon until the facility reached an inventory level of 15 Bcf.⁸ The withdrawals were ordered to reduce the pressure in the field thereby lowering the rate at which gas leaked and facilitating efforts to stop the leak. Based on then current conditions, 15 Bcf was identified as necessary to provide sufficient supply to meet reliability risks through the end of the 2015/16 winter season, meet summer reliability risks, and maintain sufficient pressure in the field to support adequate withdrawal capacity rates.⁹ Due to a mild end to the 2015/16 winter, a mild summer, coordination between the balancing authorities and SoCalGas, and the implementation and effectiveness of a number of mitigation measures developed by the energy agencies,¹⁰ no material withdrawals were made during the summer. The inventory remains slightly below 15 Bcf (specifically, at 14.9 Bcf).¹¹

At the time SoCalGas was ordered to reduce Aliso inventory to 15 Bcf, it was anticipated that no gas injections would be made at Aliso until the facility was determined to be safe for operation including ongoing injections and withdrawals of inventory. This anticipated limitation on injections was later codified in Senate Bill (SB) 380 signed by the Governor on May 10, 2016. SB 380 placed a moratorium on injections into the field pending each well passing a series of well safety tests or being isolated or taken out of service. Injections cannot be resumed until this process is completed and the entire field has been determined to be safe for operations. This determination is to be made by the DOGGR, and the CPUC's Executive Director must concur with DOGGR's determination.¹²

⁸ Letter from Executive Director, California Public Utilities Commission Timothy Sullivan to Jimmie Cho, Senior Vice President, Southern California Gas Company, "Aliso Canyon Draw Down Levels," January 21, 2016.

⁹ The Preliminary Staff Analysis, February 16, 2016, prepared by the Energy Division of the California Public Utilities Commission provides a discussion of the determination of the 15 Bcf inventory level.

¹⁰ Aliso Canyon Action Plan to Preserve Gas and Electric Reliability for the Los Angeles Basin. California Public Utilities Commission, California Energy Commission, California Independent System Operator, Los Angeles Department of Water and Power. April 5, 2016, p. 24.

¹¹ On August 1, 2016, in response to a request from SoCalGas, the CPUC authorized withdrawals from Aliso Canyon for the purpose of flow testing. The testing provided information that allowed SoCalGas to determine the number of wells that should be kept available for withdrawal in order to meet reliability standards. The tests reduced the inventory by a nominal amount. Authorization to Perform Flow Testing on Specified Wells at Aliso Canyon Storage Facilities. Letter from Timothy Sullivan, Executive Director, CPUC. August 1, 2016.

¹² DOGGR oversees the drilling, operation, maintenance, and plugging and abandonment of oil, natural gas, and geothermal wells.

As required by SB 380, the CPUC issued its preliminary report addressing the 2016 summer gas season on June 28, 2016. This revised report determines the needed gas ranges for reliability purposes for both winter and summer seasons based on the existing conditions of both the Aliso facility and the SoCalGas system, recognizing that conditions are likely to change overtime requiring further updates of this report.

Current Situation

Twenty-nine Aliso wells have successfully completed DOGGR testing.¹³ The remaining wells have been isolated from the field. Having completed these steps, on November 1, 2016, SoCalGas requested authorization to resume injections at Aliso Canyon.¹⁴ That request initiated the review and inspection of the field; at a point in the future, a public meeting will be held and a decision will be made about whether the storage field can be operated safely.

Authorization to inject would allow both withdrawing gas from and injecting gas into the field and for Aliso to be used to support operations and manage reliability. However, there is significant uncertainty concerning both injection and withdrawal capacity and the amount of inventory achievable over the short term at Aliso. That uncertainty reflects questions concerning the performance of the wells using tubing only as required by SB 380 rules (vs. flowing gas through tubing and casing) and the performance of the field as pressure increases with injections.

Further, the injection season for winter reliability traditionally ends at the end of October. As winter progresses the opportunity to inject will compete with the need to withdraw to meet winter demand. In order to build inventory at Aliso, SoCalGas will need to rely on its other three storage fields for withdrawals as injections are made into Aliso. At times demand may require that all fields be used for withdrawal providing very limited or no opportunity for injections.

Additionally, as winter demand in California and nationwide begins to build, competition for gas will limit the availability and/or increase the cost of gas for injection. Under certain winter circumstances all available gas that can be brought into the system will need to be

¹³ The actual number of wells is subject to change. Additional wells may be approved and made available for service (pending the DOGGR/CPUC certification that the field is safe for use) in the near term and a well may be taken out of service if issues are identified. Information concerning the number of wells and their status is current as of 11/4/16. It is anticipated that additional wells will go through testing and, if approved, be incorporated into use pending the certification that the field is safe for use.

¹⁴ Letter from Rodger R. Schwecke (Vice President, Gas Transmission and Storage, SoCalGas) to both Kenneth A. Harris Jr. (State Oil and Gas Supervisor, Division of Oil, Gas, and Geothermal Resources) and Timothy Sullivan (Executive Director, California Public Utilities Commission), "Safety Review for Underground Gas Storage Facilities at Aliso Canyon," November 1, 2016.

dedicated to serving current demand, and none will be available for injection. Under more extreme winter conditions, gas flows into the system may not be available in the amounts needed to meet demand. Under these conditions, storage including Aliso has historically been used to offset the resulting shortfalls in flowing supplies.

Given the uncertainties noted above, the inventory level and availability of wells needed to support necessary withdrawals indicated in this report are subject to change as conditions change and new information becomes available.

Winter and Summer Reliability

The following sections present winter and summer risks and the level of inventory necessary at Aliso Canyon in order to address these risks.

Winter Reliability

The critical role of the Aliso Canyon storage facility is expressed in the independent review conducted by the Los Alamos National Laboratory and Walker & Associates. The report states:

“The most critical concern for the winter season is the availability of the reserve in the Aliso Canyon storage facility. Using the gas stored in Aliso Canyon is very important to reducing the risk of gas curtailments and electrical service interruption this coming winter. Because in the past the Aliso Canyon facility has provided a large reserve supply of gas in the winter, SoCalGas was previously able to supply the LA Basin with that supply while servicing areas outside of the LA Basin with flowing supplies from pipeline interconnections. Without this reserve available, SoCalGas will have to choose whether to maintain service to their peripheral customers or supply those within the basin.”¹⁵

As explained below in more detail, an Aliso inventory level of 29.7Bcf is necessary for winter reliability and should be managed around this level, although the level can drop to as low as 15.4 Bcf at the end of the winter season. This 29.7 Bcf inventory level is needed to meet 1-in-10 peak-day demand, maintain a gas balance across the entire SoCalGas system during the winter season and provide a reasonable level of system wide storage at the beginning of the summer season.

A number of mitigation measures from the Summer Action Plan are continuing through the winter, and new measures for the winter also have been implemented. However, while the impact of some summer measures can be taken into account when addressing summer

¹⁵ Op. cit., Independent Review of Hydraulic Modeling for Aliso Canyon Risk Assessment. p. 16.

reliability, there is no data yet indicating whether and to what extent the existing and new measures will impact winter demand.

Peak Day Demand

To serve its core and noncore customers during winter, SoCalGas must be able to meet a 1-in-10 year peak-day demand.¹⁶ That peak-day demand is largely driven by weather and the weather's impact on the various customer end uses.

Under existing conditions, and considering current outages and historic receipt utilization that are expected to last into the winter season, the Aliso Canyon Winter Risk Assessment Technical Report (Winter Technical Assessment) determined that SoCalGas could support a gas demand of 4.1 Bcfd without the use of Aliso Canyon. Anything exceeding this level of demand would require curtailment of gas to electric generators.¹⁷ The balancing authorities—the CAISO and LADWP—determined through a joint power-flow study that electric reliability could be satisfied for 1-in-10 year winter peak electric load conditions with a minimum gas burn of 96 MMcfd by electric generation in the SoCalGas/SDG&E service territories (required to meet a defined level of risk; i.e., N-1) associated with the “next worst single contingency” and to as low as 22 MMcfd under normal pre-contingency conditions and the ability to import generation into the LA Basin.¹⁸ These lower levels could be managed by resupply options. Resupply will require efforts to re-dispatch to other energy resources including gas-fired generation served by providers other than SoCalGas. These resources are limited to imports or other uncommitted gas resources.¹⁹ However, if demand of 4.1 Bcfd cannot be supported, further curtailments of gas to electric generators

¹⁶ Core customers are made up of residential homes, small commercial buildings and operations, and small industrial customers. Core customers represent over 95% of SoCalGas customers. During the winter they typically represent approximately 60% of peak gas demand. Noncore customers consist of large industrial and commercial customers including electric generators (power plants), hospitals, and oil refineries. During the winter noncore electric generation customers represent approximately 20% of peak gas demand and other noncore the remaining 20%.

¹⁷ SoCalGas Rule No. 23 defines the process and service priority in the event of a curtailment. During the winter up to 60% of dispatchable electric generation (eg) is first curtailed and up to 40% for the summer. Following eg curtailment up to 100% of non-eg noncore customers are next to be curtailed (with the exception that refineries will not be curtailed below a defined minimum usage requirements). The next step curtails any remaining refinery load and eg not already curtailed. This is followed by remaining, smaller demand, noncore customers and then ultimately core customers.

¹⁸ Aliso Canyon Winter Risk Assessment Technical Report dated August 23, 2016, “Summary of Electric Filings” p. 31.

¹⁹ Aliso Canyon Winter Risk Assessment Technical Report. California Public Utilities Commission, California Energy Commission, the California Independent System Operator, the Los Angeles Department of Water and Power and Southern California Gas Company, August 23, 2016. P. 38.

would be required and these would likely require curtailment of electric load without the use of Aliso Canyon.

For the winter season the forecast peak day to meet both core and noncore demand as determined in the SoCalGas Triennial Cost Allocation Proceeding²⁰ (TCAP) reaches a high of 5.293 Bcf. However, a lower winter peak-day demand based on an updated demand forecast is provided in SoCalGas’ most recent 2016 California Gas Report. At its highest, this newer peak demand level is forecast to be 4.939 Bcf. The lower level is based on a decline in winter electric generation demand resulting from an increase in renewable energy sources and replacement of older gas generation with new, more efficient generation. Consequently, the CPUC considers this lower demand to be sustainable over time, and as such this lower demand level is used in this reliability analysis instead of the values from the TCAP analysis that were used in the previous version of this report.

The minimum inventory at Aliso Canyon necessary to support the forecast January peak demand of 4.939 Bcfd is 29.4 Bcf.

After January, the forecast peak day declines and the inventory level could proportionately decline. The level of inventory needed in Aliso to support peak-day demand for each of the months is shown below. The highest peak month amount is used as the determining amount.

Aliso Inventory Requirement for Winter Peak Day Demand

Table 1 Most Recent demand forecasts based on 2016 CGR data²¹

<u>Month</u>	<u>Peak Demand</u>	<u>Withdrawal Need</u>	<u>Aliso Inventory*</u>
January	4.939 Bcf.	.839 Bcf	29.4 Bcf
February	4.653 Bcf.	.553 Bcf	20.9 Bcf
March	4.428 Bcf.	.328 Bcf	15.4 Bcf

*Inventory necessary to provide sufficient pressure to support indicated Withdrawal Need

Balancing

The peak-day demand and the hydraulic analysis used in the Winter Technical Assessment is focused on the need to serve load on a given peak day. However, it does not consider the demand supply requirements over the course of the winter season and the role that Aliso

²⁰ SoCalGas and San Diego Gas and Electric filed Application (A.) 14-12-017 to open the proceeding.

²¹ Peak demand amounts are based on CGR assumptions, data, and calculation methodology but are not currently included in the 2016 report. A higher rate of inventory, 29.7 BCF is required to meet summer peak day demand and discussed later in this report.

storage plays in meeting those needs. To address this issue, the Aliso Canyon Gas and Electric Winter Action Plan (Winter Action Plan) incorporated a “balance analysis” conducted by the California Energy Commission (CEC). As described in the Winter Action Plan, the gas balance analysis provides a calculation of the margin/difference between demand and gas supply each month. The Winter Action Plan notes that a gas balance “is a standard utility planning tool that simply compares supply . . . to demand to see if all demand can be served.”²² The analysis covers the entire winter season as well as the remainder of the year. As stated in the Winter Action Plan, “Looking across the entire year allows modeling of total monthly injections and withdrawals for their impact to monthly inventory levels.”²³ As noted in the Winter Action Plan the balance analysis looks at periods longer than a single day. The analysis “cannot assess the impact of intraday events or calculate operating line pressures.”²⁴ However, the balance analysis does compare supply to demand to see how much excess (or shortfall) may exist. As such, it provides an initial indication of potential curtailments and their magnitude. It also allows simulation of the resulting month-end and season-end storage inventory.

As indicated in the following paragraphs and table, the inventory necessary for winter peak-day demand is above what is needed on an average monthly basis as shown in the balance analysis. As such, the inventory needed for winter peak days addresses the needs identified in the balance analysis and represents the inventory necessary for reliability.

The balance analysis identifies the difference between demand and required supply in millions of cubic feet (MMcf) and this difference is also expressed as a “reserve margin,” i.e., the percent by which supply available through the system exceeds or falls below the demand. It also provides an indication in percentage terms of how much supply can be lost, for example due to outages or supply shortfalls, while still serving demand.²⁵ There is no explicit reserve margin requirement. The balance analysis in the Winter Action Plan generally raises concerns when the reserve margins drop below 10%. The reserve margin recognizes that the balance analysis is based on an average day around which there can be a significant range above or below that average depending on exact conditions. It is worth noting that since the balance analysis is based on conditions over the period of a month the

²² Aliso Canyon Gas and Electric Reliability Winter Action Plan. California Public Utilities Commission, California Independent System Operator, California Energy Commission and the Los Angeles Department of Water and Power, August 22, 2016. p. 27.

²³ *Ibid.* p.27.

²⁴ *Ibid.* p. 13.

²⁵ See Table 2 Winter Balance Analysis. For example, in Table 2 where supply is 3225 and demand is 2530, the reserve margin is 27%. Supply-Demand = Difference and Difference/Supply = Reserve: $(3223 - 2530 = 695)$ and $695/3225$ (the supply) = 27%.

reserve of 10% is not necessarily sufficient to cover all peak day conditions (however, these conditions have been considered in our prior discussion of peak-day demand).

The balance analysis in the Winter Action Plan determines results under normal and cold weather conditions. For the purposes of this report a revised analysis was conducted based on a cold weather/dry hydro year winter scenario (1-in-35 year cold temperatures and a 1-in-10 year with low hydroelectric output).²⁶ The new analysis was adjusted from the Winter Action Plan to consider updated conditions and to reflect more accurately end-of-season inventory levels across the system. The results, shown in the following table, indicate that an inventory level of 21 Bcf is needed to maintain a reasonable reserve margin. However, the reserve margin that can be achieved is less than a desired 10% margin for most of the winter period, November through February. While these lower margins are concerning, mitigation measures carried over from summer and new winter measures are likely to reduce demand and result in a higher reserve margin. It should be noted however that the winter impact of the mitigation measures is not known nor can it be reasonably determined.

The balance analysis indicates that, with injections as below, combining the end of March Aliso inventory of 15.6 Bcf with what would remain in SoCalGas' other non-Aliso storage facilities results in a system wide inventory of 24.7 Bcf. A system-wide inventory level at the beginning of summer of 24.7 Bcf is below the average SoCalGas system wide beginning summer storage inventory of 66 Bcf experienced over the last ten years but above the low beginning of summer inventory of 23.8 Bcf in 2014. The balance analysis for the winter months is shown on the following Table 2.

²⁶ Under the analyses presented in the Winter Action Plan there is only a small difference, 1.2 Bcf, between levels of demand over the course of a 'normal temperature' versus the cold/dry winter scenario.

Table 2 Winter Balance Analysis

	End Summer	Winter Months Nov-Mar				
	Oct	NOV*	DEC	JAN	FEB	MAR
DEMAND						
Demand Total(MMcf/d)	2530	2944	3563	3440	3372	2918
Non Aliso Inj	0	110	0	0	0	0
Aliso Inj	0	0	187	100	0	0
Total Injection	0	110	187	100	0	0
Total System Throughput	2530	3054	3750	3540	3372	2918
SUPPLY						
Pipeline	3225	3225	3225	3225	3225	3225
Storage Withdrawal						
Non Aliso	0	0	700	425	155	0
Aliso	0	0		50	180	0
Total	0	0	700	475	335	0
TOTAL SUPPLY	3225	3225	3925	3700	3560	3225
BALANCE	695	171	175	160	188	307
RESERVE MRG	27%	6%	5%	5%	6%	11%
STORAGE Bcf						
Non Aliso	45	48.3	26.6	13.425	9.1	9.1
ALISO INVENORY	15	15.0	19.9	21.0	15.6	15.6
TOTAL STORAGE INVENTORY	60	63.3	46.462	34.387	24.647	24.647

*Injections and November inventory based on 11.17.16 actual and forecast Sempra Envoy posting

As noted previously the 21 Bcf shown as the resulting inventory needed for January is below the amount of withdrawal needed to meet peak day demand. Therefore, the higher peak demand levels identified in this report, rather than the gas balance analysis, define the inventory levels necessary to provide safe and reliable service. The balance analysis

confirms that monthly demand levels are adequately met by the peak day driven inventory levels previously identified.

Summer Reliability

During the winter months Aliso plays a role both in managing peak winter day demand and overall system balancing. During the summer months, total system demand decreases dramatically and the most essential function of Aliso is meeting peak day summer demand—and in particular rapid ramps in demand—to serve electric generation in the Los Angeles Basin. In addition to this primary summer function, Aliso may also be required to address system-wide problems due to unexpected outages on either the gas or the electric system. Full explanations of the dynamics of summer supply, demand, and the operation of the SoCalGas system under summer conditions is presented in the [Aliso Canyon Action Plan to Preserve Gas and Electric Reliability for the Los Angeles Basin](#), April 5, 2016 (Summer Action Plan) and the [Aliso Canyon Risk Assessment Technical Report](#) April 4, 2016 (Summer Technical Assessment) and are not replicated here.

Aliso's role in addressing peak summer days was identified in the Summer Technical Assessment. The assessment described the risk using four scenarios. Scenario 4 presents the worst case which combines the impact of a high demand day, a shortfall of 150 MMcf in supply versus forecast demand, and two overlapping outages.²⁷ Similar to the winter analysis, the scenarios were considered in light of the ability to manage electric demand without access to Aliso withdrawals such that electric load would not need to be curtailed. The analysis indicated that Scenario 1 could be managed without the use of Aliso. However the remaining three scenarios could not be managed without the use of Aliso. By default, the capability to solve for Scenario 4 allows for solving the remaining conditions of concern, Scenario 2 and Scenario 3, so from a reliability perspective, Scenario 4 represents the controlling scenario.²⁸

Scenario 4 begins with an original curtailment of 1.1 Bcf. After the balancing agencies (the CAISO and LADWP) take all available actions a short fall remains. The scenario is based on a peaking demand for an eight-hour period resulting in a curtailment. During this eight-hour period demand is calculated to be 1.4 times the average, off-peak hourly rate. Meeting this level of demand in each of the eight peaking hours requires a daily capacity withdrawal

²⁷ [Aliso Canyon Risk Assessment Technical Report](#). California Public Utilities Commission, California Energy Commission, the California Independent System Operator, the Los Angeles Department of Water and Power, and Southern California Gas Company, April 4, 2016. pp. 49 – 51.

²⁸ The preliminary report of June 28, 2016, was completed before the implementation of tighter balancing rules and as a result does not account for the impact of tighter balancing rules. Without the balancing rules, given the inventory in the field, Scenario 4 could not be solved. This report considers the impact of balancing rules on summer reliability.

rate of 1.119 Bcf/d. To generate this level of withdrawal, an Aliso working gas inventory of 22.4 Bcf would be required.²⁹

Impact of Tighter Non-Core Balancing

A key summer mitigation measure was to tighten the mismatch between the amount of gas that noncore customers use and the amount they bring in on a given day. Traditionally, the availability of significant storage allowed for considerable flexibility in meeting the mismatch using storage assets. Without the use of Aliso that flexibility is significantly decreased. Operating experience suggests that tightened balancing can eliminate a mismatch during the summer of 150 MMcf.³⁰ Eliminating this mismatch (essentially increasing supply by 150 MMcf) directly reduces the amount of the original curtailment identified in the four Summer Technical Assessment scenarios. Accounting for the reduction allows Scenario 2 to be solved without the use of Aliso. It also reduces the amount needed to solve for Scenario 4, and by default, Scenario 3.

Applying the 150 MMcf reduction to Scenario 4 results in lowering the withdrawal rate requirement from 1.119 Bcf/d to .906 Bcf/d. This lower withdrawal rate requirement reduces the inventory needed at Aliso from 35 Bcf to 29.7 Bcf. With the potential to re-inject during the summer season SoCalGas should be able, using the 31 approved wells (which number will likely increase before summer), to maintain this level.

Production Capacity

The range of inventory to which Aliso Canyon should be managed is defined by the production capacity required for reliability. As indicated above and assuming reasonably expected flowing supply, the key drivers of winter reliability are the ability to withdraw for a peak winter day and to supply the system with sufficient gas to balance. That demand level is supported by an inventory level of 29.4 Bcf. That inventory and the resulting production rate can decrease consistent with the range of inventory indicated in

²⁹ The Preliminary Staff Analysis of February 2016 identified that 15 Bcf would be sufficient to meet demand through the summer *except* for days when gas-fired electric generation in the LA Basin requires withdrawals at a rate in excess of .888 Bcf/d. On those days, a requirement for any part of the day that gas be withdrawn from Aliso at a withdrawal rate greater than .888 will not be met. (see [Preliminary Staff Analysis](#), California Public Utilities Commission, Energy Division. February 16, 2016. p. 40.). The Aliso Canyon Technical Report of April 2016 identified a required withdrawal rate in excess of .888. A rate of 1.119 Bcf/d was determined as necessary to meet an identified risk presented in Scenario 4 (scenarios 2 and 3 could potentially be addressed at the 15 Bcf inventory level. The above analysis targets an inventory level that will solve for Scenario 4 taking into account the effectiveness of tighter summer balancing rules.

³⁰ As indicated in the section discussing winter this measure is continued into winter. However, given different demand levels and the source of demand the amount for summer is not necessarily applicable to winter and the winter impact cannot be determined at this time.

Determination 1. As indicated in the previous table, Aliso Inventory Requirement for Winter Peak Day Demand, at the end of the winter season, i.e., March, the necessary inventory could be drawn down to 15.4 Bcf with the intent of rebuilding the inventory to manage to the summer peak requirement of 29.7 Bcf.

Wells Necessary to Support Production and Injection Capacity

Production/Withdrawal

Based on flow tests that have been conducted by SoCalGas, at an inventory level of approximately 15 Bcf the average production rate per tested well at Aliso Canyon is 10.5 MMcfd. At this rate, 80 wells would be required to meet the winter reliability withdrawal rate of .839 Bcfd. Critically, this number of wells is not achievable nor are flow rates at a 15 Bcf inventory likely to be maintained. As noted previously, it is likely that only a total of 66 wells will be made available between the current number of 31 and the fourth quarter of 2017. The required production rates to meet reliability requirements are likely to be achieved only when the full 66 wells are in operation and only if their withdrawal capacity approximates the results estimated from the current 31 wells³¹. As such, until that time there remains a reliability risk – if significantly fewer than 66 wells are able to be brought on line in 2017, then increases to inventory beyond the 29.7 Bcf identified in this report may be needed to achieve the level of production associated with maintaining reliability. Consequently, this report should be revised appropriately as the 29.7 inventory level is approached and any additional information concerning withdrawal capacity is identified.

Injection

Based on rates as reported by SoCalGas the average current injection per well is approximately 8 MMcfd. Using the 29 fully tested wells that have passed all safety tests to inject at an injection rate of 8 MMcfd equates to a total injection rate of 232 MMcfd. In January SoCalGas estimates that it will have 31 wells available for injection. These wells will have a total injection capacity of approximately 248 MMcfd. As noted previously at estimated rates it will take approximately eight weeks of injection to achieve an inventory level of 29.7 Bcf.

As noted earlier, the analysis and conclusions in this report are based on current information, and many of these determinations are likely to change as a result of changes in field operations, the impact of mitigation measures, and any other relevant factors. These factors and their impact should be reviewed periodically to determine if adjustments to Aliso inventory levels are merited.

³¹ The estimated number assumes a rate that, based on a higher inventory varies from the flow test rate.