City of Los Angeles

Department of Public Works

Office of Petroleum and Natural Gas Administration and Safety

Aliso Canyon Storage Facility Update

A Report on Council File 15-1380-S12
Division of Oil, Gas, and Geothermal Resources (DOGGR) / Comprehensive Safety Review / Consent Decree Settlement Agreement / Geologic, Seismologic and Geomechanical Hazards Report

February 6, 2020

Prepared by:

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Sonny Berberade, Senior Environmental Engineer

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Updates

DOGGR to CalGEM

Effective January 1, 2020, California's regulatory entity for oil, gas, and geothermal production has an updated focus and a new name: The California Geologic Energy Management Division (CalGEM). Housed within the California Department of Conservation, CalGEM replaces the Division of Oil, Gas, and Geothermal Resources (DOGGR). This change came as a result of Assembly Bill 1057 (Assemblymember Limón, D-Santa Barbara), which was signed by Governor Newsom on October 12, 2019.

The division began in 1915, when the focus was on the development and production of petroleum resources. The mission has since evolved, and protection of public health, safety, and the environment are heightened priorities. In addition, CalGEM is also helping to guide the broader transition to a low-carbon future.

The two acronyms DOGGR and CalGEM will be used interchangeably as the change is very recent and many documents still bear the DOGGR name.

Current Status of the Aliso Canyon Storage Facility

On July 19, 2017, the California Public Utilities Commission (CPUC) and Department of Conservation, Geologic Energy Management Division (CalGEM, formerly DOGGR) announced that the Aliso Canyon natural gas storage facility in Los Angeles County could reopen at greatly reduced capacity.

This decision followed months of rigorous inspections, testing and engineering analyses, and the implementation of new safety protocols at the facility operated by Southern California Gas Company (SoCalGas). The robust oversight is to ensure the protection of the public and environment following a major methane gas leak that began in October 2015 and was halted after four months.

In consultation with nationally recognized experts from the Lawrence Livermore, Lawrence Berkeley, and Sandia National Laboratories, CalGEM completed a comprehensive safety review of the 114 wells at the facility. Each well was required to either pass a battery of tests to potentially be eligible to resume gas injection or be taken out of operation and isolated from the reservoir (test results). Wells that were isolated from the reservoir were ultimately required to be plugged and abandoned–that is, filled with cement and permanently sealed.

As of March 8, 2019 of the 114 active wells at the facility:

- 65 injection wells have passed all required tests and are back in service
- 41 wells are permanently isolated from the gas storage reservoir, their wellbores filled with a combination of fluid and cement

- 3 wells are isolated, awaiting further tests to determine whether they will be returned to service or plugged and abandoned
- 4 wells are plugged and abandoned
- The 1 well that was the source of the methane leak was taken out of operation

All wells that are allowed to inject gas into the Aliso Canyon facility are now required to:

1. Install and operate real-time pressure monitors that provide immediate notification to the operator when pressures deviate from normal in the well's interior tubing and its annular space.
2. Operate with lowest possible operating pressure on the tubing-casing annulus.
3. Inject and withdrawal only through interior metal tubing; under no circumstances will dual (tubing and casing) injection and withdrawal be approved for any wells.
4. Undergo testing of any downhole devices (e.g., valves, diverters) after the device has been installed and prior to the well resuming operation.
5. Undergo testing of any downhole devices every six months.
6. Comply with of the state's Underground Injection Control regulations.
7. Establish a facility-wide emergency response plan and a safety and spill prevention plan.

Per the CPUC, withdrawals of natural gas from Aliso Canyon wells that have passed the required CalGEM tests are allowed when demand exceeds the supply available using the non-Aliso storage fields. These withdrawals must be in compliance with the Aliso Canyon Withdraw Protocol. Pursuant to Senate Bill 380, the CPUC also has an active proceeding I.17-02-002 to determine the feasibility of minimizing or eliminating use of the Aliso Canyon facility while maintaining energy and electric reliability for the region.

CalGEM and the CPUC are conducting parallel root-cause analyses of the well failure at Aliso Canyon. Those will follow an independent root-cause analysis by Blade Energy Partners that CalGEM and the CPUC directed SoCalGas to conduct.

Additionally, per an agreed-upon work plan, CalGEM required SoCalGas to conduct studies on seismic risk using approved third-party consultants. CalGEM will review the findings with recognized experts from the National Laboratories to determine whether they meet requirements.

Report

This report covers Item 1 of Council Motion# 15-1380-S12 (Lee-Bonin) instructing the City's Petroleum and Natural Gas Safety Administrator to work with all necessary departments and agencies to provide a detailed report back on the status of the following items:

a. California Division of Oil, Gas and Geothermal Resources (DOGGR)'s Comprehensive Safety Review of Wells.
b. Consent Decree Settlement Agreement - including methane mitigation fund, fence-line monitoring, and long-term health study.
c. DOGGR's Geologic, Seismologic, and Geo-mechanical Hazards Report.

d. California Public Utilities Commission's (CPUC) Investigation into the operations and practices with respect to Aliso Canyon and the blowout.
e. CPUC's Investigation into the feasibility of minimizing or eliminating Aliso Canyon from Southern California's energy portfolio.
f. The feasibility of conducting a City-funded, independent health study.
g. CPUC's Aliso Canyon Current Withdrawal Protocol.

Item 2 and 3 responses were drafted by the City of Los Angeles Fire Department (LAFD), specifically Deputy Chief Trevor Richmond, Operations Valley Bureau:

2. INSTRUCT the Los Angeles Fire Department (LAFD) to report back on the feasibility of conducting an annual briefing with Southern California Gas Company (SoCalGas) on operations and safety at the Aliso Canyon Facility.

3. INSTRUCT the LAFD to report back on the feasibility of working with SoCalGas on conducting joint annual fire drills and other safety trainings at the Aliso Canyon facility.

Item 1
a. DOGGR's Comprehensive Safety Review of Wells

The Department of Conservation, Division of Oil, Gas, and Geothermal Resources (Division) consulted with independent technical experts from the Lawrence Berkeley, Lawrence Livermore, and Sandia National Laboratories ("National Labs") to develop the requirements of the facility safety review. The National Labs experts independently reviewed and concurred with the testing requirements for the safety review. The comprehensive safety review requirements were released on February 17, 2016.

Status

The comprehensive safety review was completed and DOGGR issued findings on July 19, 2017 determining that the safety requirements of Senate Bill 380 have been fulfilled. The comprehensive safety review required that each of the 114 active wells in the Aliso Canyon facility either pass a thorough battery of tests in order to resume gas injection or be taken out of operation and be isolated from the underground gas reservoir.

All the remaining wells that passed the comprehensive battery of tests were subject to stringent new retrofit and inspection requirements:

- Active wells are now equipped with real-time pressure monitors.
- The company must conduct routine aerial monitoring for the presence of any methane.
- Well heads are inspected daily using infrared and other leak-detecting technology.
- All of the wells used for injection and production have new steel tubing and new seals (known as packers) inside the wellbore.

- The gas pressure in the storage reservoir has been reduced, from 3,600 PSI to 2,926 PSI.
- Another layer of protection ensures that gas flows only through an inner steel pipe. This allows the outer casing to serve as a secondary safety barrier.

Details: Safety Review Requirements

The comprehensive safety review tests consisted of casing assessments including temperature logs, noise logs, casing wall thickness inspections, a cement bond log, caliper inspections and pressure tests. The division also developed required actions if the wells were to resume normal operations or were to be taken out of operation and isolated from the formation. A brief explanation of each test is below:

Temperature Logs: If the casing in the well is not intact, gas leaking out of the casing will expand and cool, and reduce temperatures within the well. A temperature test that verifies no cooling is taking place in any part of the well indicates that the casing has maintained integrity and no leaks exist.

Noise Logs: If the well has a leak, gas will escape from the well bore causing a sound that can be detected by a sensor capable of detecting the sound of gas flowing. The absence of sound above the reservoir indicates an effective seal of the well.

Casing Wall Thickness Inspections: If the inspection reveals thinning of the casing, the current strength of the casing will be calculated. A passing test for a casing wall thickness inspection would show no thinning of the casing that diminishes the casing's ability to contain at least 115% of the well's maximum allowable operating pressure.

Cement Bond Log: This is a sonic test that measures the adherence between cement and the external casing of the well, and also the contact between the cement anchor of the well and the underground gas reservoir. A passing test for a cement bond log shows no significant spaces between cement and casing, or between cement and the gas storage formation and cap rock.

Multi-Arm Caliper Inspection: This inspection measures any internal degradation or significant changes to the well's shape. A passing test for a multi-arm caliper inspection would show no deformation or thinning of the casing that diminishes the casing from being able to properly contain at least 115% of each well's maximum operating pressure.

Pressure Tests: Pressure tests increase the pressure within the interior metal tubing of the well, and in the annular space between this interior tubing and the well's outer casing, to determine the well's ability to withstand normal operating pressures. A passing test for a pressure test would show a minimum pressure loss when the pressure is raised to a level of 115% of the maximum operating pressure.

Item 1

b. Consent Decree Settlement Agreement - including methane mitigation fund, fence- line monitoring, and long-term health study

On August 8, 2018, Southern California Gas announced that they entered into a settlement agreement with the Los Angeles City Attorney's Office, the County of Los Angeles, the California Office of the Attorney General, and the California Air Resources Board (CARB) to resolve all outstanding claims by those government bodies against the company related to the 2015-2016 natural gas leak at the Aliso Canyon natural gas storage facility. Under the $119.5-million settlement, the utility will pay civil penalties along with $25 million for the long-term health study and $26.5 million for greenhouse gas emissions projects, reimburse the city, county and state governments for costs associated with their response to the leak.

The $26.5 million will be disbursed as loans to the mitigation project developer. Those loans and interest will then be ultimately directed into (1) the Aliso Canyon Recovery Account created by Senate Bill 801 (2017, Stern), where they can be allocated by the Legislature to pay for further mitigating impacts on local air quality, public health, and ratepayers resulting from the well failure at Aliso Canyon including evaluation of any negative effects on public health.; and (2) the Aliso Canyon Supplemental Environmental Projects Fund, described below.

The Aliso Canyon Supplemental Environmental Projects (SEP) Fund is located in the Attorney General's Office and created by the Aliso Canyon litigation settlement. Up to $10 million in the fund may be directed to projects that cause criteria air pollutant, toxic air contaminant, or greenhouse gas (GHG) emissions reductions in the South Coast Air Basin, as specified in the SoCalGas SEP Agreement, Appendix D to the Consent Decree.

The expectation is that the repayments will be partially directed to these funds around 2026, and fully directed to these funds once mitigation is achieved by 2031. Every project will repay the entire loan investment with interest over the ten-year period that mitigation is achieved. SoCalGas will not receive any repayment of the $26.5 million and interest.

The remaining $93 million of the total settlement will be directed as follows:

- $45.4 million to the Aliso Canyon Supplemental Environmental Project Fund run by the City of Los Angeles (City), Los Angeles County (County) and the California Attorney General's Office
- $21 million in penalties for the City, the County, and the Attorney General's Office
- $19 million for CARB, the City, the County, and the Attorney General's Office to cover their leak response and litigation costs.
- $7.6 million held in reserve for mitigation, if needed.

The mitigation portion of the settlement will provide for new investment in the San Joaquin Valley and its disadvantaged communities, as well as the jobs and business opportunities that come with this type of investment. By putting the methane into a pipeline instead of burning it on-site for electrification, as is now done with some dairy methane, the settlement will also avoid localized NO emissions generated by using the biomethane for electrical generation.

1) Methane Mitigation Fund/Greenhouse gas emission reduction projects

The Mitigation Agreement is part of the settlement and outlines the terms and conditions governing SoCalGas's obligation to cause full mitigation of the Aliso Canyon methane leak. Under the Mitigation Agreement, SoCalGas will pay $26.5 million to cause the construction of dairy digester projects in California that will reduce at least 109,000 metric tons of methane emissions. The agreement also describes monitoring, verification, and reporting of methane mitigation and backstops to ensure mitigation occurs, including the availability of an additional $7.6 million to fund additional mitigation projects if California Air Resources Board (CARB) identifies that mitigation is not being achieved on the expected timelines.

CARB staff determined 109,000 metric tons of methane is the amount of emission reductions needed for full mitigation of the climate impacts of the Aliso Canyon natural gas leak.

CARB developed a Short-Lived Climate Pollutant (SLCP) Strategy in response to Senate Bill (SB) 605 (Stats. 2014, Lara) to identify measures to reduce short-lived, yet potent GHG's such as methane to curb the significant climate forcing impact of these "super-pollutants." Dairy manure is responsible for 25 percent of California's methane emissions and the SLCP Strategy identifies that various actions at dairy farms, including operation of dairy digesters, can result in significant, near-term reductions in methane emissions.

SoCalGas will pay $26.5 million to an account to be directed as loans to California Bioenergy (CalBio) to build 12 dairy digester projects, three conditioning facilities, and pipelines to connect the digesters to the conditioning facilities and common carrier pipelines system. These projects are in the Kern, Hanford and West Visalia areas. The digesters will capture uncollected manure methane as biogas, which will be upgraded to biomethane pipeline standards at the conditioning facilities, and then injected into the common carrier pipeline for use as transportation fuel in California. These projects will reduce at least 109,000 metric tons of methane emissions within a ten-year period, starting from the project's date of operation, and produce biomethane that will displace fossil fuels in transportation without adversely impacting air quality. It is estimated that this biomethane will displace about 47 million gallons of diesel fuel and non-renewable natural gas in California by 2031.

The Mitigation Projects are expected to be constructed and in operation by 2021 with full mitigation achieved within ten years, by 2031. The projects must be in operation by 2024 to have their full emissions reductions count towards mitigation, therefore there is motivation to ensure projects are operating and operating effectively at the earliest possible date.

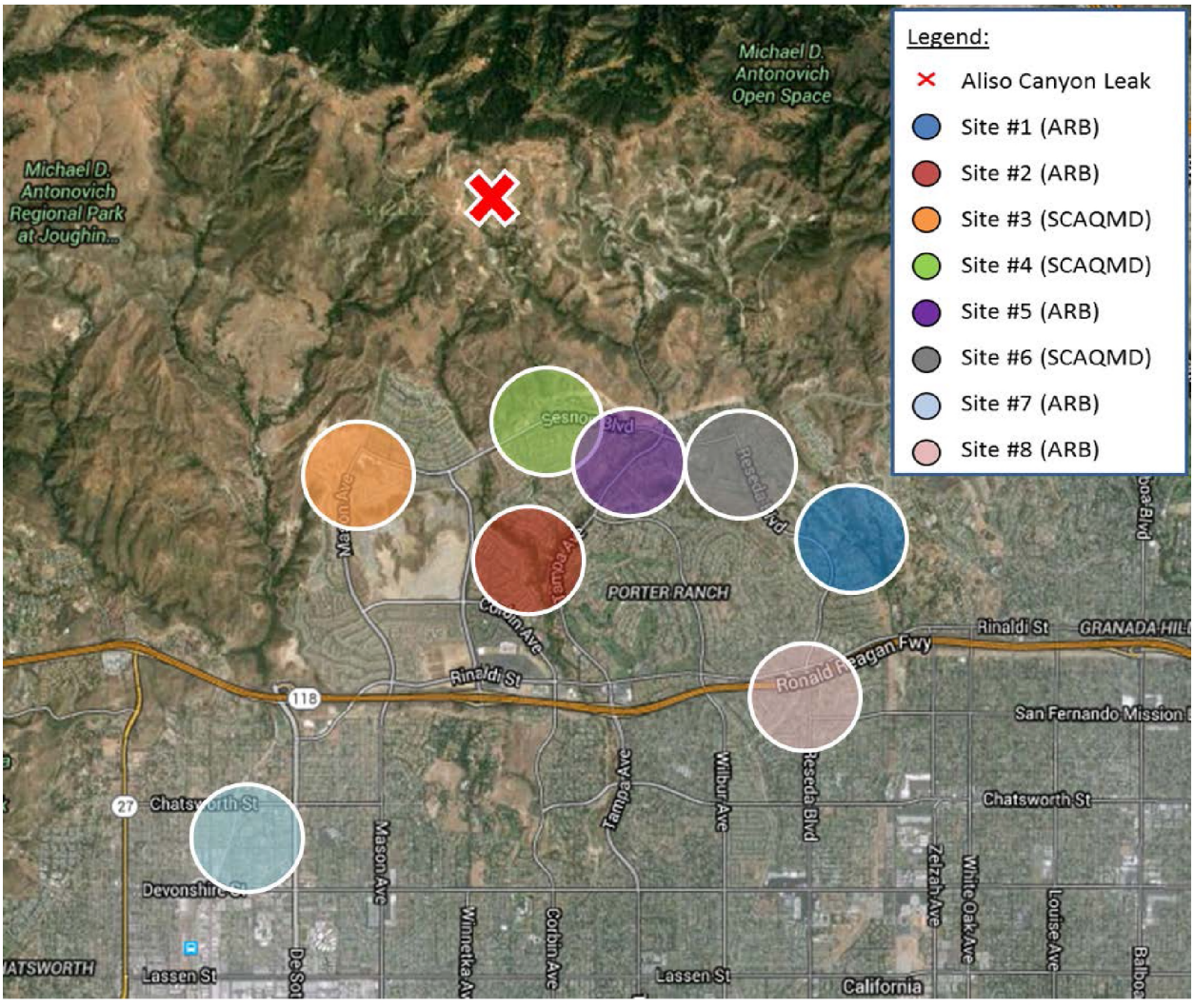
As projects come into operation, CARB will review documentation confirming that each project has become operational and will review quantification methodologies to identify how much methane is reduced at each project. CARB will provide mitigation implementation updates on its website (https://ww2.arb.ca.gov/our-work/programs/aliso-canyon-natural-gas-leak/about).

2) Fence-line Monitoring

Historical Monitoring: CARB and SCAQMD

The South Coast Air Quality Management District (SCAQMD) and the California Air Resources Board (CARB) previously provided monitoring to the Porter Ranch community area. After several months of typical ambient methane levels CARB removed their 5 methane monitors (Sites 1, 2, 5, 7, 8) in late July 2016 (See Figure 1). The highest level of methane measured in the community since the leak was 230 ppm, although such high levels were not seen with any regularity.

Figure 1. Monitoring sites from the archived CARB website



The archived CARB website address (https://ww3.arb.ca.gov/research/aliso_canyon/community_methane_monitoring.htm)

The SCAQMD continued to operate 3 real time monitors, and one of the two benzene monitors previously run by ARB for a period of time, until September 2017. The archived SCAQMD website: (http://www.aqmd.gov/home/news-events/community-investigations/aliso-canyon-update/air-sampling/xxx/xxx)

Current Monitoring: Infrared Fence-Line Methane-Monitoring System

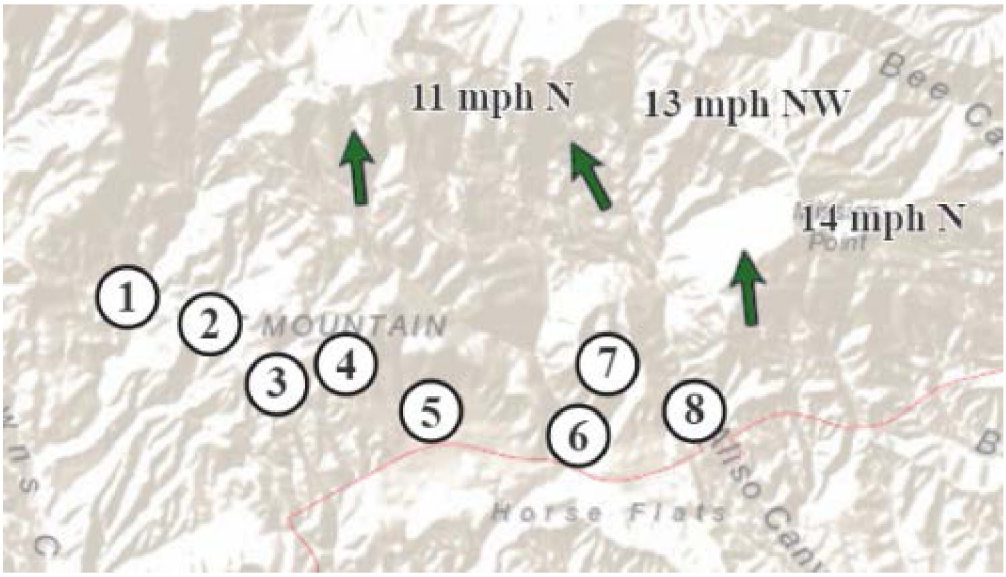
Aliso Canyon currently has daily scanning of each well using sensitive infrared thermal imaging cameras that can detect leaks. The system helps monitor the amount of methane in the air along the border of the facility nearest the Porter Ranch community.

The infrared methane-monitoring system is composed of eight infrared sensors strategically located near or along the southern border of the facility, or "fence-line." These sensors are being continuously monitored 24 hours a day, seven days a week by trained staff in the SoCalGas operations center. This methane monitoring site is maintained and operated by SoCalGas with support from the consulting firm AECOM.

The eight infrared monitors installed at Aliso Canyon measure the parts per million (ppm) of methane in the air by sending an infrared beam between a sender and receiver. This is specifically a methane detection system. It does not monitor for other molecules or compounds (benzene, etc.).

The interactive web page (https://sem.secmcs.com/MethaneMonitoring/) displays a map indicating the location of the fence-line methane monitoring devices. By clicking on any of the fence-line monitor icons, you can view a chart with data showing monitored methane levels in parts per million, recorded in five-minute increments over the previous 24 hours. In addition to methane levels, the online tool displays data from three weather stations in the area.

Figure 2. Aliso Canyon Infrared Fence-Line Methane Monitoring System



The California Air Resources Board states that 1.9 – 2 parts per million (ppm) is the normal background level of methane for the Porter Ranch Area. That is the normal level that would be detected most of the time so, a flat line at 2 ppm means that the monitors do not detect any methane above normal background levels. Results greater than 3 ppm suggest some additional source of methane, and results greater than 10 ppm suggests a considerable additional amount of methane is present.

If the SoCalGas fence-line system detects levels averaging at or above 8 parts per million for 20 or more minutes, they send out a team of technicians to that site to investigate. The technicians use sensitive hand-held technology that can detect methane at levels below what human senses can detect. They investigate because methane readings can potentially be impacted by weather conditions, such as rain, fog, and dust, which may interrupt the infrared beam. A temporary increase in the readings on one monitor may not necessarily mean that elevated levels of methane are present.

SoCalGas installed the fence-line monitoring system as an additional safety feature at Aliso Canyon. The system is not designed to be SoCalGas's primary source of detecting a leak; there are pressure monitors installed on every well at the facility and SoCalGas monitors the data around-the-clock. Additionally, SoCalGas trained technicians do inspections of each well four times a day, including the use of sensitive infrared cameras to detect leaks smaller than what human senses can detect.

If SoCalGas does detect any sort of leak or emission, they would begin their normal process to address the leak and appropriately notify agencies and the community.

3) Long Term Health Study

The Los Angeles County Department of Public Health (LACoPH) is coordinating the $25 million long-term Health Research Study. This study will examine the impacts of the 2015 disaster at the Aliso Canyon natural gas storage facility. The $25 million is part of the $119.5 million Southern California Gas Company settlement reached by the California Air Resources Board, the California Attorney General's Office, the City of Los Angeles and the County of Los Angeles with the Southern California Gas Company.

In March 2019, the Los Angeles County Department of Public Health (LACoPH) received the $25 million and began to involve and inform the local community. The Los Angeles County Department of Public Health values community feedback throughout the Health Research Study process. In Summer 2019 LACoPH began to facilitate community input on the health concerns and ideas for the Health Research Study by forming a Community Advisory Group (CAG) and establishing an expert panel to develop best practices for the study. LACoPH also worked to develop a scoring tool with the community. In February 2020 LACoPH plans to announce the scientific panel members. This scientific panel will help develop the goals and priorities of the research projects.

Bids for the Health Research Study will likely go out in Spring 2020 and will be evaluated by the expert panel. The research project will likely be awarded in late 2020 or early 2021. LACoPH is planning for three years to complete the research. After that time, there will be an evaluation point to see if there is more that can be done. The funds can last as long as 10 years, depending on how they are apportioned. It is very likely that there will be multiple studies over time rather than one large study to assess the long term health effects.

Monthly Community Advisory Group (CAG) meetings have been held since August 2019 and occur on the fourth Monday of the month at the Granada Hills Charter High School from 6 p.m. to 8 p.m. City representatives can attend, follow progress and present ideas there.

SCAQMD Health Study

South Coast Air Quality Management District (SCAQMD) staff are working to implement the $1 million health study of the impacts of the Aliso Canyon gas leak incident. In late 2017, SCAQMD staff conducted a community meeting to solicit input on the health study, and, in February 2018, provided a summary of the feedback received. SCAQMD staff established a Health Study Technical Advisory Group (HSTAG), which includes scientists from local, state and federal agencies, faculty from universities, and two community members selected by the Porter Ranch Neighborhood Council (PRNC). The HSTAG is helping to draft the scope of the health study, and will assist in integrating community comments to the draft Request for Proposals (RFP). Results from the health study could help inform the development of other scientific studies to answer any key questions that remain after SCAQMD's study is completed. SCAQMD staff will also be working with the Los Angeles County Department of Public Health to implement their $25 million health study that was

funded through the settlement announced in August 2018. (http://www.aqmd.gov/home/news-events/community-investigations/aliso-canyon-update/prior-meetings)

Timeline and Next Steps

- November 2, 2018 RFP Considered by SCAQMD Governing Board If SCAQMD Governing Board approves, then next steps:
- Jan 31, 2019 (no later than 5:00pm PST) Proposals Due
- February-March 2019 Proposal Evaluations
- April 2019 Committee Consideration
- May 2019 Governing Board Consideration
- June 2019 Earliest Anticipated Contract Execution

Item 1
c. DOGGR's Geologic, Seismologic, and Geo-mechanical Hazard Report

As part of the Southern California Gas(SoCalGas) risk assessment of the facility, DOGGR required SoCalGas to assess the potential geologic, seismologic, and geomechanical hazards at Aliso Canyon, including landslides, ground shaking, and fault displacement. SoCalGas assembled a team of renowned experts in various scientific and engineering fields to conduct the geologic, seismologic, and geomechanical studies. Their work plans were reviewed and approved by DOGGR and independent experts from the National Labs.

Status

Draft reports of the studies were made available to DOGGR and the National Labs on March 20, 2019. SoCalGas has submitted these draft reports for review and comment by DOGGR and the National Labs. SoCalGas has already taken several steps to mitigate risks, including operating at a reduced reservoir pressure, converting all active wells to tubing-only flow, and sealing with cement and abandoning over 40% of the wells at the facility.

SoCalGas is working with DOGGR and the National Labs to finalize the studies and identify and implement additional, appropriate measures to mitigate and prevent these risks.

Details

The work completed by the expert team has involved extensive scientific and engineering analyses of the wells at the facility and the facility's geology, including cutting-edge approaches to assessing potential geologic, seismologic, and geomechanical risks.

As a general matter, the studies defined the nature of hazards and a wide range of potential risks at Aliso Canyon, including landslides, ground shaking, and fault displacement. Some of the risks are an inherent part of operating any facility and living in Southern California; others are more specific to the design and operations at Aliso Canyon. Overall, the studies found the seismic risks at Aliso

Canyon are relatively low, and indicate these risks can be reasonably managed and/or mitigated over the life of the facility.

Landslides

The experts determined that landslides do not pose a significant threat to Aliso Canyon or the public at large. These risks occur largely during major rain events or earthquakes, and SoCalGas has already taken steps to "harden" its wells from this threat. A few wells were found to be in areas of potential landslide activity, and steps are already being taken to make them secure. No gas storage wells have been lost to a landslide in the facility's 46-year history.

Storage Zone Integrity

The experts concluded that the gas stored under Aliso Canyon is confined within the storage zone by impervious rock and other geologic structures on all sides, with the cap rock and other boundaries providing good sealing properties.

Earthquake Ground Shaking and Fault Displacement

The hazards imposed by earthquakes in the area include both ground shaking and fault displacement. Notably, all structures in Southern California face some of these hazards. The State of California does not have an earthquake design standard for underground gas storage facilities. However, the State generally requires various above-ground structures to be designed to withstand levels of ground shaking or fault displacements that correspond to an annual return period of 475, 975 or 2,475 years. Most new buildings are required to withstand an earthquake that might be expected every 475 years; new bridges and dams every 975 years; and some essential facilities are designed to withstand even a 2,475-year event.

For ground shaking, the experts concluded that Aliso Canyon can withstand subsurface shaking expected from an earthquake on any nearby fault, including the San Andreas Fault. They considered it noteworthy that Aliso Canyon withstood the 1994 Northridge earthquake, a magnitude 6.7 event whose epicenter was only 7.5 miles away. That event caused Aliso Canyon and adjacent areas to experience some of the largest earthquake ground motions ever measured in the world. Aliso Canyon suffered only minor surface and subsurface damage, and no gas was released to the surface. Recent testing and upgrades to the operating wells at Aliso Canyon have further strengthened the facility's ability to withstand future ground shaking.

For fault displacement, the experts have determined that all of the active wells at Aliso Canyon cross the Santa Susana Fault at various depths. Modeling and testing conducted by the experts indicate that the gas storage wells at Aliso Canyon are able to withstand a 475-year event, which is the standard applied to many new buildings. Larger earthquake events associated with 975 or 2,475 return periods could damage some wells, and possibly allow gas to leak from the well system at depth.

Flow Simulations

The experts have performed simulations to calculate the potential flow rates to surface along the Santa Susana Fault and the active wells. The studies found that Aliso Canyon's wells can withstand a 475-year event, with no well damage below the surface that would cause a leak. For the extreme, 975 and 2,475-year return periods, simulations show that wells may be damaged and:

• Gas movement does not produce any flow to surface along the Santa Susana Fault; and

• Could only potentially flow to surface along the well infrastructure.

Even in such an unlikely event, and if all active wells were damaged, the study indicates that the expected release would be approximately 1 MMscf over one year. The studies also define other gas flow scenarios and provide insights that can be used to help address these risks.

Item 1

d. California Public Utilities Commission's (CPUC) Investigation into the operations and practices with respect to Aliso Canyon and the blowout.

The California Public Utilities Commission (CPUC) and the Department of Conservation's Division of Oil, Gas, and Geothermal Resources (DOGGR) initiated a formal root cause analysis of the leak at SS-25 through an independent third-party contractor. In January 2016 Blade Energy Partners (Blade) was selected by CPUC and DOGGR to conduct the independent Root Cause Analysis (RCA) of the SS-25 Well blow out without supervision or interference from any entity. A RCA is a systematic process for identifying the root causes of problems or events and defining methods for responding to and preventing them.

Status

On May 17, 2019 CPUC and DOGGR, announced that Blade Energy Partners completed its independent root cause analysis of the leak at Southern California Gas Company's (SoCalGas) Aliso Canyon Natural Gas Storage Facility that began on October 23, 2015.

Blade's report was issued to the public and is available on the CPUC's Aliso Canyon webpage at www.cpuc.ca.gov/aliso.

Among Blade Energy Partners's findings:

- The leak's direct cause was a rupture of the outer 7-inch well casing due to microbial corrosion from the outside resulting from contact with groundwater.
- SoCalGas did not conduct detailed follow-up inspections or analyses after previous leaks. Blade identified more than 60 casing leaks at Aliso Canyon before the October 2015 incident going back to the 1970s, but no failure investigations were conducted by SoCalGas.

- SoCalGas lacked any form of risk assessment focused on well integrity management and lacked systematic practices of external corrosion protection and a real-time, continuous pressure monitoring system for well surveillance.
- Updated well safety practices and regulations adopted by DOGGR address most of the root causes of the leak identified during Blade's investigation.

A video from Blade discussing the report:
https://www.youtube.com/watch?reload=9&v=Z3D1DvqBcgU&feature=youtu.be

Details

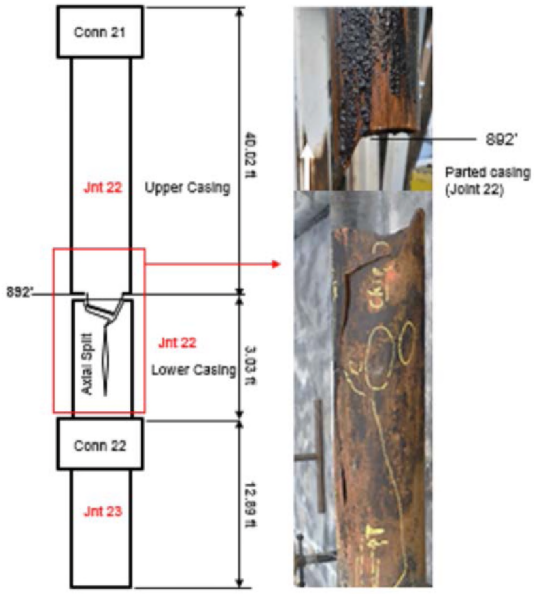
During its RCA, Blade ran several well logging diagnostic tools including Spectral Noise Log (SNL) and High Precision Temperature (HTP) logs to take high precision measurements of the subsurface temperature in the tubulars and to identify possible areas of fluid flow behind the well's 7-inch Casing. The other diagnostic tools Blade deployed were Magnetic Image Defectoscope (MID) and Micro Vertilog (MVRT) logs. These logging tools are designed to inspect downhole tubulars for potential pipe body damage and defects. The MID log tools are capable of assessing metal loss and other anomalies through three barriers of tubulars in one run (2-7/8-inch tubing, 7-inch Casing and 11-3/4-inch Casing) and determine whether there has been metal loss. The MVRT log tool was used to detect internal and external metal loss by assessing defects on the inside and outside diameter (ID & OD) of the 2-7/8-inch tubing. The results of these logs suggested the following:

- The HPT log showed a significant low temperature anomaly at 140 and 340 ft. where the temperature at each depth was measured at 46ºF. The SNL recorded distinct noise anomalies between 252 and 294 ft., and around the 11-3/4" casing shoe from 820 to 1,200 ft.
- The 7-inch Casing exhibits significant metal loss at 895 ft. and at 4,456 ft. as evidence by the results of the MID-2 log results.
- The 11-3/4" casing exhibited significant metal loss at 151 ft. and at 192 ft. depths based on the MID-3 log results.
- The tubing extraction revealed that the 7-inch Casing had an axial split
- Corrosion pits observed on the 7-inch Casing
- 11-3/4-inch Casing appeared to have through-wall metal loss (holes) starting around 150' to 300

Blade performed an extensive and detailed investigation that leveraged modern material science technology and tools to evaluate the metallurgy, mechanics, chemistry and microstructure of the tubing and casing. The company also employed the latest state-of-the art diagnostic technologies such as Macro-Fractographic Examination, Stereo Microscopy, Micro-Fractographic Examination, Scanning Electron Microscopy (SEM), Focused Ion Beam (FIB X), Finite Element Modelling (FEM) and many more. Given the strength and effectiveness of these advanced and superior technological

tools, Blade was able to diagnose, analyze and draw conclusions on the primary root causes of the SS-25 blow-out.

Figure 3. SS-25 Well 7 Inch Casing Corrosion, Parting and Axial Split



Since the leak, the CPUC and DOGGR have taken aggressive steps to prevent a similar leak from occurring again, including DOGGR's stringent new regulations for all underground natural gas storage reservoirs. Enacted immediately after the leak began and made permanent on October 1, 2018, the regulations ensure that no single point of failure in a well can cause a release of gas into the atmosphere.

Item 1

e. CPUC's Investigation into the Feasibility of Minimizing or Eliminating Aliso Canyon from Southern California Energy Portfolio

On January 27, 2017, the CPUC issued an Order Instituting Investigation pursuant to Senate Bill 380 (SB380) to determine the feasibility of minimizing or eliminating the use of the Aliso Canyon natural gas storage facility (CPUC Proceeding I.17-02-002). SB 380 directs the Commission to "determine the feasibility of minimizing or eliminating the use of the Aliso Canyon natural gas storage facility while maintaining energy and electric reliability."

November 8, 2019

The November 8, 2019 CPUC wrote a response letter to Senator Stern and Assemblymember Smith stating the following:

Current Status of the Aliso Canyon Order Instituting Investigation Pursuant to SB 380

In order to accomplish SB 380's statutory goal of determining the "feasibility of minimizing or eliminating" the use of Aliso Canyon while maintaining reliability, the CPUC studies are designed to answer two sequential questions both of which are grounded in the declining reliance on natural gas in California.

The first question is what are the gaps or needs that may be left by a storage field that is minimized or eliminated – in other words, what happens if customers are relying more on low carbon generation, flowing gas, and demand reductions rather than on a large underground storage field? The CPUC staff's hydraulic and production cost modeling work will be completed in Q2 2020 because, as CPUC encountered significant challenges with finding a consultant to perform the hydraulic modeling required, and have instead deployed modelers on the CPUC's staff to conduct the studies. This data is critical because it informs stakeholders about where impacts to residential customers and electric generation customers appear in the absence of the Aliso storage field.

The second question is about replacement or transition scenarios. The CPUC plan has long been to launch a phase in which parties and the community discuss replacement or transition scenarios, such as: more gas demand reduction than even our current suite of programs, use of pipelines instead of a storage field, and identifying and catalyzing development of a portfolio of low carbon generation resources that can replace the natural gas-fired plants that Southern California relies on today. On November 13, 2019, the CPUC staff team will present the initial customer cost impact modeling results and key pieces of our hydraulic data development at a public workshop at 9:00 AM on November 13, 2019, at the CPUC's Los Angeles office, 320 W. Fourth Street, Fifth Floor. At that workshop, one key presentation will focus on staff's data development to date that will be used in our hydraulic modeling. The CPUC team has developed data inputs that represent 1-in10 peak day and 1-in-35 extreme peak day demand conditions for core and non-core customers, as well as Southern California Gas core customer hourly gas demand profiles. Those data inputs are indications of circumstances in which the Aliso storage field is used today and in which a replacement energy resource (or resources) would be used in the future. Further, staff's forthcoming production cost modeling study incorporates the portfolio of lower carbon resources identified in the CPUC's Integrated Resource Plan (IRP) proceeding. The IRP portfolio meets the statewide target of reducing GHG emissions to 40 percent below 1990 levels by 2030. This means that we are studying the future of the Aliso storage field with an assumption of electric generation that is based more on renewables, battery storage, and other low-carbon resources in 2030 than the resources that exist today. Assuming less need for gas fired generation in the future allows us to examine a reduced need for the Aliso Canyon storage field.

Current CPUC Efforts to Reduce Reliance on Gas

The CPUC has several demand-side programs and policies in place that are focused on reducing demand for natural gas. In addition, CPUC staff's modeling uses the Energy Commission's load

forecast, which incorporates assumptions about declining reliance on natural gas in California. Below is additional detail about CPUC programs and modeling assumptions:

- **Building Decarbonization:**

The CPUC opened the Building Decarbonization proceeding (Rulemaking 19-01-011) to implement Senator Stern's bill, SB 1477, which establishes two pilot programs aimed at reducing GHG emissions in both new and existing buildings. The CPUC held a number of workshops (one of which Senator Stern attended), received party comments from more than two dozen stakeholders, and recently released a staff proposal that states the CPUC's interest "in targeting some activities in the areas of natural gas infrastructure failures, particularly the area around Aliso Canyon in Southern California." A proposal is now under development that would build on the staff proposal and parties' reactions to it. In 2020, the proceeding will begin to address more comprehensive policies and strategies for decarbonizing buildings in California, with reduced natural gas use being a central component of efforts moving forward.

- **Application by Southern California Gas for a Gas Demand Response Program:**

At the direction of the CPUC, Southern California Gas ran a first of its kind residential gas demand response program in 2017, 2018, and 2019 by taking advantage of smart thermostats. Southern California Gas filed an application in November 2018 seeking authorization to expand these pilots and create a new gas demand response program for commercial and industrial customers.

- **Gas-to-Electric Fuel Substitution Supported with Energy Efficiency Funds:**

The CPUC recently revised longstanding rules to allow energy efficiency funds to be used for customers who wish to switch from gas to electric appliances, such as electric heat pumps. (R.13-11-005)

- **San Joaquin Valley Pilots:**

Pursuant to AB 2672, the CPUC recently approved $50 million in pilot programs to provide heat pumps and other technologies to residents of 11 disadvantaged communities in the Central Valley who lack access to natural gas. (R.15- 03-010)

- **Aliso OII and the Energy Commission Integrated Energy Proceeding Report (IEPR) Load Forecast Assumptions:**

Our Aliso OII studies incorporate the aggregate effects of these load reduction strategies by using the Energy Commission's vetted and approved long-range demand forecasts. That forecast includes the growing trends for energy efficiency, rooftop solar, electric vehicles, demand response, and other load-reducing programs over time in California – again informing our modeling of the need for the Aliso Canyon storage field in the future.

The Aliso OII modeling takes into account anticipated reduced gas demand as we analyze a potential wind-down of the field. We understand that the facility has impacted the community, and

SB 380 sets forth a process to reevaluate and plan for a future without this infrastructure. We will soon complete our work to understand the functioning of the system. That careful modeling work will inform possible alternatives, including planning consistent with the July 2017 letter from the California Energy Commission to former CPUC President Michael Picker.

Latest Developments

November 18, 2019

On November 18, 2019 California Governor Gavin Newsom wrote to request additional action by the CPUC to expedite planning for the permanent closure of the Aliso Canyon natural gas storage facility. He expressed concern that the current proceeding would not yield the fastest and most workable path toward closure of the facility. In addition, he felt it would be insufficient to shorten the 10-year timeline for closure outlined in 2017.

December 10, 2019

On December 10, 2019 CPUC wrote a response describing the following actions that they will immediately take addressing the feasibility of reducing or eliminating the use of Aliso Canyon:

1) We will launch a new phase in our current investigation addressing the feasibility of reducing or eliminating the use of Aliso Canyon pursuant to Senate Bill 380 (Pavley, 2016), in which we will obtain input from stakeholders about infrastructure and demand reduction programs that should be considered as potential replacements for the services provided by Aliso Canyon.
2) We are beginning the process of engaging a third-party independent expert, as your letter requests, who will launch work to identify possible alternatives to the facility and scenarios to inform a path to closure.

More updates will likely be forthcoming in 2020.

Item 1

f. Feasibility of Conducting a City-funded, Independent Health Study

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Feasibility

In speaking with public health experts, nearly five years after the blow-out, it is feasible to piece things together forensically and conduct forms of analysis like Atmospheric Transport Modeling and Exposure modeling. However, one missing factor has been the composition of the gas that was part of the blow-out. Even without that, modeling is possible. For example, it is possible to create models with varying degrees of aromatic hydrocarbons (Benzene), volatile organic compounds (VOCs) and semi-volatile organic compounds, but it would not be an exact explanation of what occurred. Costs to model with various concentrations of VOCs are approximately $100,000 to $300,000 per model.

It is also possible to do a birth outcome study at the household level, but there would need to be a sufficient sample size of those exposed during the blow-out period of 10/23/15 to 2/12/16.

Another possible study would involve looking at medical records, emergency room visits and cardiovascular events. Each of these types of studies would be in the range of $100,000 to $300,000.

It was not recommended to sample air, soil, blood hair or urine for signs of the event nearly five years ago. This would not be productive as the bio markers for benzene are out of a human system in 8-12 hours and significantly more time has passed since the event.

Cost per study: Approximately $100,000 to $300,000.

Total cost of all 5 types of studies: Approximately $500,000 to $1.5 million

It is recommended that LA City participate in the current effort that LA County Public Health is leading rather than creating a separate effort. LA County Public Health has sufficient funding from the settlement dedicated to performing this study. LA County Public Health has worked hard to establish credibility and buy-in and facilitated engagement with the local community. A robust study will be done through this process.

To start a new study directed by LA City, funds would have to be found and allocated. The effort would also have to be overseen by City staff, preferably with some degree of knowledge of health related issues. The City typically defers to LA County Public Health on health related matters as they house the expertise so there may be some barriers to finding qualified City staff.

Recent Effort: 2018 California Council on Science and Technology Study

To address part of the Governor's 2016 state of emergency proclamation related to Aliso Canyon, the State of California sought more information about all of the underground natural gas storage fields in California, and the California Council on Science and Technology (CCST) was asked to provide the State with an up-to-date technical assessment. In consultation with the California Public Utilities Commission (CPUC), the State Energy Resources Conservation Commission, the State Air Resources Board, and the Division of Oil, Gas, and Geothermal Resources, the assessment includes a broad review of the potential health risks and community impacts associated with their operation, fugitive gas emissions, and the linkages between gas storage, California's current and future energy needs, and its greenhouse gas reduction goals. See full report at (https://ccst.us/ccst-report-assesses-the-long-term-viability-of-underground-natural-gas-storage-in-california/)

Health Assessment: Key Findings

1. There are a number of human health hazards associated with underground gas storage (UGS) in California that are predominantly attributable to exposure to toxic air pollutants and gas-fueled fires or explosions during large loss of containment (LOC) events.
    - However, many UGS facilities also emit multiple health-damaging air pollutants during routine operations —formaldehyde in particular, which is of concern for the health of workers and nearby communities.
2. Large LOC events (e.g., the 2015 Aliso Canyon incident) can clearly cause health symptoms and impacts in nearby populations and are a key challenge for risk management efforts.
3. UGS facilities located in areas of high population density and in close proximity to populations are more likely to cause larger population morbidity attributable to exposures to substances emitted to the air than facilities in areas of low population density or further away populations.
4. During large LOC events, if emitted gases are ignited, the explosion hazard zone at UGS facilities can extend beyond the geographic extent of the facility, creating flammability hazards to nearby populations.
5. Workers on site are likely exposed to higher concentrations of toxic chemicals during both routine and off-normal operations, and workers on site have greater chance of exposure to fire or explosions during LOC events.
6. There is uncertainty with respect to some of the mechanisms of human health harm related to the 2015 Aliso Canyon incident and other UGS LOC events in the future. This is mostly attributable to the lack of access to data on the composition of stored gas in the facilities and limitations of air quality and environmental monitoring during and after these events. While our research team attempted repeatedly to obtain the relevant gas composition data, we were unsuccessful.
7. California-specific as well as other peer-reviewed studies relevant to California on human health hazards associated with UGS facilities are scarce.

Key Recommendations from Health Assessment

1. Require that the composition of gas withdrawn from the storage reservoir be disclosed, along with any chemical use on site that could be leaked, intentionally released, or entrained in gas or fluids during loss of containment (LOC) events.
2. Require facility-specific meteorological (e.g., wind speed and direction) data-collection equipment be installed at all UGS facilities.
3. Require that monitoring approaches to air quality and human health be appropriately and rapidly implemented both during routine operations and during LOC events.
4. Require that steps be taken to decrease exposure of nearby populations to toxic air pollutants emitted from UGS facilities during routine operations and LOC incidents. These steps could include:

- Increase application and enforcement of emission control technologies to limit air pollutant emissions
- Replace gas-powered compressors with electric-powered compressors to decrease emissions of formaldehyde
- Implement minimum-surface setbacks between UGS facilities and human populations.

5. Require that UGS workplaces conform to requirements of CalOSHA and federal OSHA (Occupational Safety and Health) to protect the health and safety of all on-site workers, regardless if operators are legally bound to comply.

The CCST study was completed in 2018 and has not been updated since.

Item 1

g. CPUC's Aliso Canyon Withdrawal Protocol

Status

On July 23, 2019 the CPUC released the latest Withdrawal Protocol.

Details

This July 23, 2019 Aliso Canyon Withdrawal Protocol replaced the November 2, 2017, version in its entirety. Southern California Gas Company (SoCalGas) may withdraw gas from the Aliso Canyon natural gas storage facility (Aliso Canyon) consistent with the protocol defined below. Aliso Canyon may be used for withdrawals only if any of the following conditions are met:

1. Preliminary[1] low Operational Flow Order (OFO) calculations for any cycle result in a Stage 2 low OFO or higher for the applicable gas day;

2. Aliso Canyon is above 70% of its maximum allowable inventory between February 1 and March 31; in such case, SoCalGas may withdraw from Aliso Canyon until inventory declines to 70% of its maximum allowable inventory;[2]

3. The Honor Rancho and/or La Goleta fields decline to 110% of their month-end minimum inventory requirements (shown in Table 1 below) during the winter season;[3] and/or

4. There is an imminent and identifiable risk of gas curtailments created by an emergency condition that would impact public health and safety or result in curtailments of electric load that could be mitigated by withdrawals from Aliso Canyon.

Table 1: Month-End Minimum Inventory (Bcf)

	Nov.	Dec.	Jan.	Feb.	March
Aliso Canyon	5.7	5.1	4.4	3.8	2.1
Honor Rancho	13.9	13.2	12.6	7.5	5.0
La Goleta	8.0	7.9	7.7	7.6	7.5
Playa del Rey	1.9	1.9	1.5	1.1	0.7
Total	29.5	28.1	26.2	20.0	15.3

[1] Preliminary low OFO calculations for a Gas Day shall be made: 1) prior to Cycle 1 using previous day's receipts, previous day's prices, and forecasted send outs; 2) prior to Cycle 2; and 3) prior to Cycle 3.

[2] This measure is designed to ensure that there is enough system wide injection capacity by April 1 (the start of the injection season) to fill the non-Aliso fields to a sufficient inventory level to meet summer demand.

[3] This measure is designed to ensure that adequate inventory levels remain at the non-Aliso fields before the end of each winter month. Southern California Gas' Aliso Canyon Risk Assessment Technical Report 2018-19 Supplement identified month-end minimum inventory requirements needed to preserve withdrawal rates for core reliability.

The CPUC may update the Withdrawal Protocol if it determines that a modification of the month end minimum inventory requirements is necessary. Withdrawals shall be made in a manner that ensures safety, maintains the integrity of the wells and storage facility, and is consistent with all rules and regulations concerning the safe use of Aliso Canyon. If Aliso Canyon is used for withdrawals based on the conditions stipulated above, Aliso Canyon's inventory and withdrawal capacity shall be made available for balancing and for scheduling to entities who both serve core customers and own storage rights.

Southern California Gas and the California Independent System Operator (CAISO) and the Los Angeles Department of Water and Power (LADWP) shall continue to coordinate to maintain gas and electric system reliability.

Curtailments

If curtailments are required despite Aliso Canyon withdrawals, SoCalGas shall consult with the CAISO and the LADWP before and during any curtailment. In the event of a curtailment, the priority of service under Southern California Gas Rule No. 23 shall remain in place.

Noticing

Prior to withdrawing gas from Aliso Canyon, SoCalGas shall post a Critical Notice to Envoy informing customers and the public that a withdrawal will take place and providing the reason for initiating the withdrawal as defined above. Whenever Aliso Canyon's inventory and withdrawal capacity are made available for balancing and for scheduling by customers who own storage rights, customers will be notified through the auto-generated notification in SoCalGas' Envoy system, which includes the OFO calculation and capacity utilization.

Reporting

Within 24 hours after the start of a withdrawal period, SoCalGas shall notify the CPUC's Energy Division (Energy Division) about the withdrawal event and state which of the above condition(s) led to the withdrawal event. If Condition 1 led to withdrawals from Aliso Canyon, SoCalGas shall provide all information included in the preliminary low OFO calculations, including price information. If Condition 4 led to withdrawals, SoCalGas shall provide all relevant information about the emergency event and what other options were considered in addition to use of Aliso Canyon.

In a monthly report to be provided on the third business day after each month in which withdrawals from Aliso Canyon occurred, SoCalGas shall provide the CPUC's Energy Division both a confidential and public report with a full description of the events and conditions leading up to the Aliso Canyon withdrawal(s). The report shall include:

1. The total and hourly withdrawals from the field;
2. The pre- and post-withdrawal Aliso Canyon working gas inventory;
3. The inventory of the non-Aliso fields before and after the Aliso Canyon withdrawal(s);
4. The geographical and/or the time price spread used in determining the OFO stages for the day(s) of the withdrawal(s) and the two days immediately preceding and following;
5. Weather conditions in the SoCalGas service territory for the day(s) of the withdrawal(s) and the day immediately preceding the initiation of withdrawal(s);
6. The hourly pipeline receipts for the calendar day(s) on which a withdrawal was made and the day immediately preceding the initiation of withdrawal(s);
7. The hourly withdrawals by field from non-Aliso storage facilities for the calendar day(s) on which a withdrawal was made and the day immediately preceding the initiation of withdrawal(s);
8. Demand response activations and Dial It Down Alerts;
9. Information concerning any anomalies experienced during the operation of the field.

Effective Date

This protocol is effective beginning July 23, 2019. The protocol shall remain in effect, subject to modification, through the completion of the CPUC Investigation (I.) 17-02-002 or such time as determined based on conditions.

Item 2
LAFD to report back on annual briefing with SoCalGas on operations and safety at the Aliso Canyon facility &

Item 3
LAFD to report back on joint annual fire drills and other safety trainings with SoCalGas at the Aliso Canyon facility

The City of Los Angeles Fire Department (LAFD) is presently involved with and executing a number of safety measures in partnership with the Los Angeles County Fire Department and SoCalGas (aka Sempra Utilities).

Beginning in July of 2017 the LAFD was involved with staff from Sempra Utilities in developing an Emergency Response Plan (ERP). This was a collaborative effort with Los Angeles County Fire Department (LACOFD) and the LAFD to develop a comprehensive guide that helped define critical infrastructure and key resources (CIKR) at the facility. The objective of this plan was to direct first responders on the best way to manage an emergency incident at the facility. Additionally, maps were generated that clearly defined key access points to the facility and how to make emergency contact with site managers. In December of 2018, the ERP was complete and distributed to key first responders in both the LAFD and LACOFD.

In May of 2019, the Emergency Manager from Sempra Utilities gave a presentation on first responder considerations when dealing with natural gas leaks. This presentation was given at a monthly chief's meeting in LAFD Operations Valley Bureau (OVB).

In September of 2019, the LAFD and LACOFD participated in a training exercise at the facility to practice utilizing the ERP. The training exercise utilized many resources from both the LAFD and LACOFD and is expected to occur annually from this point forward.

Additionally, the Emergency Manager notifies the LAFD every time there is a withdraw of natural gas from the storage facility. This is typically a routine procedure that occurs during the colder winter months.

Conclusion

The LAFD understands and realizes the impact of this catastrophic event on the Porter Ranch community. Going forward, the LAFD will continue work with the Emergency Manager at Sempra Utilities and the LACOFD to find better ways to manage emergency incidents at the facility.

The directive of this council file was to discuss the feasibility of working with SoCalGas on an annual basis in both a training environment as well as annual briefings. Presently, the LAFD meets with the facility emergency managers once every two months and executes drills once a year. It is expected that this will continue into the foreseeable future.

Disclaimer: If the scope of this request had been broader or additional items requested for evaluation, then the findings may have been different. There may also be additional records that were not accessible or available for consideration in this report.

If you have any questions, please contact me at (213) 978-2679 or via email at Erica.Blyther@lacity.org.