



State of California • Natural Resources Agency  
Department of Conservation  
**Division of Oil, Gas, and Geothermal Resources**  
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Edmund G. Brown Jr., Governor  
Kenneth A. Harris Jr., State Oil and Gas Supervisor

January 17, 2017

**Via Electronic and U.S. Mail**

Mr. Rodger Schwecke  
Vice President  
Transmission and Storage  
Southern California Gas Company  
555 West 5th Street, GT21C3  
Los Angeles, CA 91505  
[RSchwecke@semprautilities.com](mailto:RSchwecke@semprautilities.com)

RE: FINDINGS REGARDING THE COMPLETION OF REQUIREMENTS IN THE  
OCTOBER 21, 2016 SAFETY CHECKLIST FOR THE ALISO CANYON STORAGE  
FACILITY

Dear Mr. Schwecke:

This letter responds to your letter dated November 1, 2016, requesting authorization to resume injection of natural gas in the Aliso Canyon Storage Facility. By letter dated October 21, 2016, the Division of Oil, Gas, and Geothermal Resources (Division) and California Public Utility Commission (CPUC) gave Southern California Gas Company a checklist of safety-based requirements to complete related to the Aliso Canyon Storage Facility. The requirements originated from the Governor's State of Emergency Proclamation, Division Order 1109, Senate Bill 380,<sup>1</sup> and additional measures identified by the Division and CPUC as necessary to ensure the Aliso Canyon Storage Facility's safety. The checklist divides the requirements into three categories based on whether SoCalGas must complete them (1) prior to requesting authorization to resume injection, (2) prior to the Division and CPUC authorizing injection to resume, and (3) after injection resumes.

SoCalGas submitted to the Division and CPUC, as appropriate, data required by the checklist and followed up with additional submissions upon either agency's request. The Division and CPUC inspected the Aliso Canyon Storage Facility on November 8, 9, and 10, 2016 to determine compliance with requirements in the checklist. The Air Resources Board was also part of the State's inspection team. After carefully evaluating the data submitted and inspection results, the Division and CPUC find as follows:

1. SoCalGas fully satisfied the requirements that the checklist directed SoCalGas to complete prior to requesting authorization to resume injection (i.e., the gas storage well comprehensive safety review).
2. SoCalGas has partially satisfied the requirements that the checklist directed SoCalGas to complete before the Division and CPUC authorize injection to resume. SoCalGas appears to be on track to complete the remaining requirements.

<sup>1</sup> Senate Bill 380 (Pavley, Chapter 14, Statutes of 2016) codified in part at Public Resources Code section 3217.

3. SoCalGas submitted detailed work plans outlining compliance with the requirements to be completed after injection resumes. The Division and CPUC, as appropriate, reviewed the work plans. In some cases, the Division or CPUC determined that revisions were necessary to ensure the safety of the Aliso Canyon Storage Facility, and SoCalGas revised the work plan accordingly. The Division and CPUC are satisfied that the work plans or revised work plans, as appropriate, are complete and adequate.

The Technical Safety Compliance Inspection Results enclosed with this letter provide additional or more detailed findings made by the Division and CPUC in evaluating compliance with the checklist. Analysis by Lawrence Berkley, Lawrence Livermore, and Sandia National Laboratories of the geotechnical hazard element of your risk management plan for the Aliso Canyon Storage Facility is also enclosed.

Because the gas storage well comprehensive safety review is complete and there is progress in fulfilling other checklist requirements, the Division will schedule and notice the public meeting that SB 380 requires before resumption of injection may be authorized. The meeting will provide the public an opportunity to comment on the safety review findings and other matters related to the Aliso Canyon Storage Facility potentially resuming injection.

If you have any questions regarding this letter or the enclosed report, please contact me at (916) 323-1777 or [Ken.Harris@conservation.ca.gov](mailto:Ken.Harris@conservation.ca.gov).

Sincerely,

  
Kenneth A. Harris Jr.,  
State Oil and Gas Supervisor

Enclosures (2)

**California Public Utilities Commission**  
**and**  
**Division of Oil, Gas, and Geothermal Resources**  
**Technical Safety Compliance Inspection Results**

January 17, 2017

This document addresses consideration by the Division of Oil, Gas, and Geothermal Resources (DOGGR or Division) and the California Public Utility Commission (CPUC) of a request from Southern California Gas Company (SoCalGas) for permission to resume injection at the Aliso Canyon Storage Facility. Each of the requirements (Requirement #1 through Requirement #23) were specified in the October 21, 2016 checklist created by the CPUC and DOGGR to ensure safety of the Aliso Canyon Storage Facility were addressed by SoCalGas. On November 1, 2016 SoCalGas sent a letter to the Division and CPUC stating it had completed the safety checklist requirements. Documentation of completing the requirements was provided by SoCalGas in a companion document titled "Attachment B" with a checklist (Checklist #1 through Checklist #23) for each requirement.

A joint team comprised of the CPUC, the California Air Resource Board (CARB), and the Division evaluated the documentation in Attachment B to ensure each task was conducted thoroughly and to verify the outcomes. The results of the evaluation of the checklists, verified with an on-site inspection on November 8, 9 and 10 by the joint team, and all subsequent related actions are listed below.

- **Requirement #1:** Provide a detailed, current, and accurate status report for all 114 wells at the facility, identifying whether the wells have: (1) passed Battery 1 and Battery 2 testing, (2) conducted Battery 1 testing and been isolated from the reservoir, or (3) been plugged and abandoned.
  - **Findings:**
  - SoCalGas has provided this information in Attachment B, Checklist #1.
  - The Division began its comprehensive gas storage well safety review (safety review) prior to the checklist compliance inspection. The testing regime specified in the safety review requires that every active storage well in the Aliso Canyon Storage Facility undergo two batteries of rigorous tests. The first battery of testing includes a temperature and noise log. The second battery of tests includes a casing inspection using electromagnetic and ultra-sonic technologies, and a multi-arm caliper, a cement bond log, and a positive pressure test. The Division has reviewed and verified the results of the tests and have made them publicly available on the Department of Conservation's website.
  - The inspection team found SoCalGas' Checklist #1 and the on-site conditions are compliant with the safety review's testing regime. The joint team also completed a visual, on-site inspection of all injection wells, all wells with a rig on location, and a majority of isolated wells. The team verified the conditions of all wells and readings at SoCalGas' Aliso Canyon Operations Center. During the inspection, the team verified that there was no detectable methane leakage via infrared camera technology, that digital pressure recordings of well pressures were timely and accurate, and that all Division requirements of the Aliso Canyon Storage Facility Safety Review were met.

- **Requirement #2:** Provide proposed maximum field working pressure for withdrawals, injections, and any well stimulations for the field and for each operating well.
  - **Findings:**
  - SoCalGas provided this information in Attachment B, Checklist #2.
  - The inspection team found Checklist #2 compliant, after a revision was jointly identified by DOGGR and SoCalGas during the inspection. It was determined that the Maximum Surface Operating Pressure (MSOP) would be 2,476 pounds per square inch gage (psig) for the compressor discharge during the first phase of operations.
  - Once all wells are remediated, SoCalGas may request consideration to adjust the MSOP.
  
- **Requirement #3:** Equip all active storage wells at the facility with tubing-and-packer completions that isolate the tubing-casing annulus.
  - **Findings:**
  - SoCalGas fulfilled this requirement in Attachment B, Checklist #3.
  - The inspection team found Checklist #3 and the on-site conditions compliant. The Checklist states that all wells authorized for return to service must contain tubing and packer. The installations were verified with well diagrams and two pressure tests (tubing, packer and casing). All injection wells passed the pressure tests.
  
- **Requirement #4:** Provide a Risk Management Plan in accordance with DOGGR's emergency regulations that includes an effective facility-wide emergency response plan, and effective geologic and geotechnical hazard mitigation protocols
  - **Findings:**
  - SoCalGas submitted a Risk Management Plan in Attachment B, Checklist #4.
  - The inspection team found Checklist #4 and the on-site conditions are compliant, conditioned upon further study as recommended by subject matter experts at the Berkeley, Sandia and Lawrence Livermore National Laboratories (National Laboratories). Additional study in conjunction with the National Laboratories to evaluate seismic risk mitigation measures will be undertaken beginning in 2017.
  
- **Requirement #5:** Provide a current spill contingency plan in accordance with DOGGR's regulations.
  - **Findings:**
  - SoCalGas submitted a plan in Attachment B, Checklist #5.
  - The inspection team found Checklist #5 and the on-site conditions are compliant. The team completed an on-site inspection of facilities, documents, and spill kit materials; examined redacted facilities map and process flow diagrams in the plan; examined the redacted Tank Information Summary (Table 1) in the plan; inspected secondary containment of tanks at Sesnon 2 and Porter gathering plants, Porter compressor and injection plant; inspected spill containment kits at Sesnon 2 and Porter gathering plants; and examined additional containment measures near waterways.

- **Requirement #6:** Provide the internal corrosion assessment and mitigation plan to the CPUC as stated in SoCalGas' September 26, 2016 letter to the CPUC.
  - **Findings:**
  - SoCalGas submitted the plan in Attachment B, Checklist #6.
  - The inspection team found the checklist and on-site conditions are compliant. SoCalGas conducted an internal corrosion assessment on surface injection and withdrawal pipelines as directed in the CPUC's Safety and Enforcement Division's Directive issued September 20, 2016. The assessment was conducted in accordance with the Gas Standards and DNV-GL Internal Corrosion protocols. SoCalGas provided additional Failure Analysis data and discussed the Preventative and Mitigative measures going forward. SoCalGas provided CPUC the final Failure Analysis Report prepared by its contractor, DNV-GL. SoCalGas discussed the content and conclusions of the draft copy of its Failure Analysis report of a pinhole leak on November 8, 2016. SoCalGas delivered the final Failure Analysis report to CPUC on Nov 9, 2016.
  
- **Requirement #7:** A fitness for service analysis, demonstrating that the Aliso Canyon Storage Facility is safe to resume injection operations, signed by SoCalGas's President, Chief Operating Officer or Chief Executive Officer three days prior to resuming injection. As part of this fitness for service analysis, SoCalGas was required to explain how the facility is safe to operate prior to completion of the Root Cause Analysis of how and why SS-25 failed.
  - **Findings:**
  - SoCalGas submitted the analysis in Attachment B, Checklist #7.
  - The inspection team found Checklist #7 and on-site conditions are compliant. The CPUC reviewed SoCalGas' Operations and Maintenance safety assurance records and conducted field verifications on November 9-10, 2016. The CPUC conducted safety assurance review and field verifications that included function test of the critical safety control devices. CPUC's engineers did not observe any probable violations.
    - Provide a master list of all equipment and pipelines associated with the gas injection and withdrawal system.
      - Submitted in Checklist #7.
      - The inspection team found Checklist #7 and the on-site conditions are compliant. The CPUC conducted records review and field verification of SoCalGas' surface facilities' fitness for service. The CPUC conducted safety assurance review and field verifications that included function test of critical safety control devices that are associated with gas injection and withdrawal system. The CPUC's engineers did not observe any probable violations. CPUC's safety assurance inspection results are available upon request.
    - Provide test results and/or function inspection verification report of the equipment and pipelines associated with the gas injection and withdrawal system, including the Emergency Shutdown Devices (ESD).
      - Submitted Checklist #7.
      - The inspection team found Checklist #7 and the on-site conditions are compliant. CPUC performed field verification inspections of the surface facilities used in the injection and withdrawal process. CPUC conducted safety assurance review and field verifications that included function test of critical safety control devices that are associated with gas injection and withdrawal system. CPUC's

engineers did not observe any probable violations. CPUC's safety assurance inspection results are posted to the CPUC web page.

- Provide a list of all dual-purpose pipelines (bi-directional flow pipelines injection/withdrawal) and associated block demarcation valves and the facility's ESD inspection records.
  - Submitted in Checklist #7.
  - The inspection team found Checklist #7 and the on-site conditions are compliant. SoCalGas clarified that it does not maintain dual-purpose flow pipelines (bi-directional flow pipelines injection/withdrawal). All its flow lines are either dedicated to injection or withdrawal function starting from the manifold. CPUC conducted field verification of the absence of dual-purpose flowlines during the joint inspection with DOGGR. CPUC's engineers did not observe any probable violations. CPUC's safety assurance inspection results are available upon request.
- **Requirement #8:** Provide a proposed maximum operating pressure for each operating well.
  - **Findings:**
  - SoCalGas submitted a work plan in Attachment B, Checklist #8.
  - The inspection team found Checklist #8 and the on-site conditions are compliant. The Division concluded that to maintain a reservoir pressure below 2,926 pounds per square inch absolute (psia) at the Porter 69G well, the maximum surface operations pressure will be 2,476 pounds per square inch gauge (psig).
- **Requirement #9:** Prior to resuming injection, equip all wells to be employed at the facility with real-time pressure monitors in the tubing and the tubing-casing annulus. The continuous annular pressure monitoring devices should be equipped with alarms. An action plan should be provided to DOGGR and other parties containing the alarm level settings for each pressure being monitored and a response plan for steps that will be taken if an alarm sounds.
  - **Findings:**
  - SoCalGas submitted a policy and procedure in Attachment B, Checklist #9.
  - The inspection team found Checklist #9 and the on-site conditions are compliant. The three agencies comprising the inspection team were all represented in each of three teams that completed the on-site inspection. All relevant wellsite pressure readings matched those shown at SoCalGas' operations center. Several wells had evidence of biogenic gas rather than injection/reservoir storage gas in one or more annulus. The Division and SoCalGas agreed to a methodology to verify biogenic gas and a procedure to resolve the significance of and response to any anomalous pressures. This will be incorporated into Division regulations, but meanwhile SoCalGas will comply with the methodology established.
- **Requirement #10:** Complete a leak survey for the entire facility at least a week prior to resuming injection operations, with all results reported to CPUC within three days of completion and prior to resuming operations.
  - **Findings:**
  - SoCalGas submitted a work plan in Attachment B, Checklist #10.
  - The inspection team found Checklist #10, at the time of the inspection, and the on-site conditions are compliant, subject to completion and submission of the

leak survey to CARB at least one week prior to resuming injection. CARB is in discussion with SoCalGas for additional information.

- **Requirement #11:** Prior to resuming injection, provide a written procedure for dealing with any production tubing leaks and production casing/tubing annulus pressure increases – include the SoCalGas “make safe” procedure and any follow up actions.
  - **Findings:**
  - SoCalGas submitted a pressure monitoring plan in Attachment B, Checklist #11.
  - The inspection team found Checklist #11 is compliant, but needs to be updated on the issue of sustained surface casing pressure. The Division required SoCalGas to develop an updated protocol regarding the issue of sustained surface casing pressure and the need for uniform definitions on labeling of annulus’ (A1, A2, etc.).
  
- **Requirement #12:** Provide function test records to DOGGR for each downhole device.
  - **Findings:**
  - SoCalGas submitted a testing plan in Attachment B, Checklist #12.
  - The inspection team found Checklist #12 and the on-site conditions are compliant. Subsurface safety valves are not present in any wells currently designated for injection/production at this time. Function testing of sliding sleeves are proven via successful casing and tubing/packer pressure tests. If a sliding sleeve valve did not function properly and seal the tubing from the annulus, the pressure tests would fail.
  
- **Requirement #13:** At least once during the two-week period prior to resuming injection, conduct a downwind flight to measure total site methane emissions.
  - **Findings:**
  - SoCalGas submitted a plan in Attachment B, Checklist #13.
  - The inspection team found Checklist #13 and the on-site conditions are on track for compliance. A plan to conduct the flight is in place and must be completed and submitted to CARB prior to resuming injection.
  
- **Requirement #14:** Complete a leak survey for the entire facility within 72 hours after resuming injection operations, with results reported to CPUC and CARB within three days of completion of the survey. Reportable leaks shall be immediately reported to the appropriate agencies as required by law.
  - **Findings:**
  - SoCalGas submitted a work plan in Attachment B, Checklist #14.
  - The inspection team found Checklist #14 and the on-site conditions are on track for compliance. A plan to conduct the flight is in place and must be completed after 72 hours of resuming injection. The results will be submitted to CARB within two weeks of resuming injections.
  
- **Requirement #15:** In addition to the daily monitoring for leaks required under DOGGR’s regulations, complete leak surveys for the entire facility immediately after one month of injection operations and quarterly thereafter for one year (five surveys total), with results reported to CPUC and CARB within seven days of completion. After the first year, leak surveys must be completed in line with applicable CARB regulations.
  - **Findings:**
  - SoCalGas submitted a work plan in Attachment B, Checklist #15.

- The inspection team found Checklist #15 and the on-site conditions are on track for compliance. A plan to conduct the leak surveys is in place and must be completed one month after resuming injection and quarterly thereafter. The results will be submitted to CARB within two weeks of completing each survey.
- **Requirement #16:** Provide a leak detection protocol consistent with DOGGR's emergency regulation, Senate Bill 887 (2016), and best practices based on a consultation with CARB.
  - **Findings:**
  - SoCalGas submitted Attachment B, Checklist #16.
  - The inspection team found Checklist #16 and the on-site conditions are compliant, upon specified protocol modifications and final consultation with CARB. The updates will include more detailed information about the use of optical gas imaging (OGI) detection equipment and use of an alternative instrument in inclement weather.
- **Requirement #17:** Report daily reservoir pressure estimates to CPUC/DOGGR during the first 30 days of resuming injection.
  - **Findings:**
  - SoCalGas submitted a work plan in Attachment B, Checklist #17.
  - The inspection team found Checklist #17 and the on-site conditions are on track for full compliance. The maximum reservoir pressure at Porter 68B will be 2,897 psia. SoCalGas will dedicate the Porter 69G well as a gas storage reservoir pressure observation well.  
The maximum pressure in the Porter 69G well will be 2,926 psia. This pressure is equivalent to a maximum shut-in-tubing-pressure (SITP) of 2,476 psig at the surface. SoCalGas will report daily average SITP to DOGGR's Coastal District and CPUC on a weekly basis. These reports will be sent electronically to the Coastal District, and SoCalGas will notify the Ventura office should SITP exceed 2,476 psig.
- **Requirement #18:** Report daily reservoir injection and withdrawal volume measurements to CPUC and DOGGR during the first 30 days of resuming injection.
  - **Findings:**
  - SoCalGas submitted a work plan in Attachment B, Checklist #18.
  - The inspection team found Checklist #18 and the on-site conditions are on track for compliance. SoCalGas will report field daily net injection and withdrawal each week. SoCalGas will also report field cumulative injection and withdrawal each week. These reports will be sent electronically to the Division's Coastal District.
- **Requirement #19:** Report average daily tubing and annulus pressure measurement to CPUC and DOGGR during the first 30 days of resuming injection.
  - **Findings:**
  - SoCalGas submitted a work plan in Attachment B, Checklist #19.
  - The inspection team found the work plan for Checklist #19 and the on-site conditions are compliant. The SoCalGas plan for reporting is on track for compliance. SoCalGas will report peak and daily average pressure for tubing and all annuli to the Coastal District and CPUC on a weekly basis. The reports will be sent electronically to the Coastal District in a spreadsheet. The template to be



used to supply the pressure and volume data to the Division shall be submitted for review and approval before use.

- **Requirement #20:** Conduct a function test on each downhole device at least once every six months and submit test records to DOGGR, Coastal District.
  - **Findings:**
  - SoCalGas submitted a test plan in Attachment B, Checklist #20.
  - The inspection team found the work plan for Checklist #20 and the on-site conditions are compliant. The SoCalGas plan for reporting is on track for compliance. SoCalGas shall provide a list of the types of downhole devices installed along with the manufacturer's recommendation for the testing of each device. Sliding sleeve valve function will be confirmed by tubing and annular pressure differential. Subsurface safety valves will be tested by cycling the valve every six months and a written report will be submitted to the Coastal District. The Division will be notified 48 hours prior to conducting any test to allow witnessing by a Division engineer.
  
- **Requirement #21:** Complete testing or fully plugging and abandoning (P&A) each well that was isolated within one year of isolation.
  - **Findings:**
  - SoCalGas submitted a work plan for Attachment B, Checklist #21.
  - The inspection team found the work plan for Checklist #21 and the on-site conditions are compliant. The SoCalGas plan for well P&A's is on track for compliance. SoCalGas has provided a proposed schedule using 12 workover rigs. This schedule will be subject to 60-day progress meetings with the Coastal District. Options shall be explored and approved for implementation for the addition of competent workover rigs and associated equipment if delays are encountered.
  
- **Requirement #22:** Address all data gaps that DOGGR has identified in SoCalGas's project file.
  - **Findings:**
  - SoCalGas submitted a work plan for Attachment B, Checklist #22.
  - The inspection team found the work plan and timeline for Checklist #22 is on track for compliance. Coastal District staff previously specified the requirements in a letter to SoCalGas. While some data has been received, not all of the information adequately fulfills the requirements of California Code of Regulations, title 14, section 1724.7 (data elements). Figures in some of the documents submitted are unclear or lack data. SoCalGas indicated that all of the updates will be provided by February 7, 2017.
  
- **Requirement #23:** After injection has resumed, conduct two downwind flights to measure total site methane emissions. The two post-injection measurements must be within one week of each other. If both measurements show the site to emit below 250 kg CH<sub>4</sub> per hour, no further flights will be required. If the measurements suggest that there are leaks, then the flights must continue until the leaks have been fixed, no new leaks have been found, and emissions are below 250 kg CH<sub>4</sub> per hour. The exact timing of the flights will depend on favorable weather conditions that allow the flights to take successful measurements of total methane emissions from the site.

- **Findings:**
- SoCalGas submitted a work plan for Attachment B, Checklist #23.
- The inspection team found that the work plan for Checklist #23 is compliant and SoCalGas is on track for compliance. A plan to conduct the flights is in place. The results will be submitted to CARB within two weeks of the flights.

December 12, 2016

Ken Harris, PG  
State Oil & Gas Supervisor  
California Department of Oil, Gas & Geothermal Resources  
801 K Street, MS 18-05  
Sacramento, CA 95814

Re: Seismic Hazards at Aliso Canyon

Dear Mr. Harris,

This letter is in response to your request for the Lab Team's consideration of the seismic hazards and risks at the Aliso Canyon Gas Storage facility. We have been provided Supplement #2 to Southern California Gas' Storage Risk Management Plan, which addresses geologic and geotechnical hazards. SoCalGas' Supplement #2 correctly points out the fact that Aliso Canyon exists in an area with a high probability of a significant earthquake in the next 50 years. The extensive faulting of the region and the hazards at Aliso Canyon, which are endemic to the wider San Fernando Valley, are well known and documented by the USGS and others.

Given the Santa Susana fault system transects the Aliso Canyon wells and the existence of other nearby faults, a risk exists from ground shaking and direct shearing/deformation of well casings. The hazards from ground shaking can be determined through accepted methodologies, such as performing quantitative probabilistic seismic hazard analysis (PSHA). Similar to ground shaking, methods exist for the description of probabilistic fault displacement analysis (PFDA).

The methodology for translating a probabilistic seismic shaking hazard into a risk through structural analysis of buildings and surface infrastructure follows well known processes. However, in our review of published literature and in discussions with hazard and risk practitioners, we have not yet identified a formal seismic risk assessment process specific to oil and gas wells. The richest body of supporting science for assessment of impacts of fault slippage on wells can be found in the oil and gas industry's analysis of formation compaction, which considers deformation of casing induced by formation strains. The work of Abou-Sayed et al., (2004) and Dusseault et al., (1998) analyze casing strain as a result of formation deformation. The South Belridge Field near Bakersfield, California has undergone significant compaction and has a high percentage of wells that have failed from casing deformation. Detailed elasto-plastic geomechanical finite element modeling was used by Hilbert Jr. et al., (1999) to understand the complex interaction between the engineered casing-cement system and the surrounding rock at Belridge Field.

In our review of Supplement #2, we highlight two additional considerations for hazard assessment. The first consideration concerns Section 2.2.2.1 - The Santa Susana Fault, where the U. S. Geological Survey 2009 PSHA online model has been utilized to broadly look at risks in the greater San Fernando Valley. The last sentence states, "further scrutiny of this modeled probability may be warranted." We concur with this statement and believe a more granular review of the site-specific ground shaking hazard associated with the Santa Susana fault system will provide better insight into the seismic hazard at Aliso Canyon.

Our second consideration is in regards to damage to wells caused by fault slippage. Supplement #2 notes in section 2.2.1.3 – Well and Caprock Integrity that data are being collected for use in a geomechanical study of fault strength. It goes on to state that "An investigation of potential fault

slippage under fluid injection conditions at Aliso Canyon may be warranted to determine criticality.” We concur and believe that a PFDA conducted for the faults transecting the Aliso Canyon wells will better inform the level of hazard to consider.

Following the two considerations above (performing a refined PSHA and PFDA) will provide a more detailed understanding of the seismic hazards at Aliso Canyon. We believe that Southern California Gas should then undertake the next step of using the improved knowledge of the hazards to consider the risks to subsurface infrastructure. Consultants with expertise in quantitative risk assessment of wellbore systems should be engaged in carrying out a detailed analysis of formation-wellbore interaction under seismic loading. A risk assessment should incorporate the designs of the wells being used at Aliso Canyon. We would like to emphasize that this type of study is not commonly undertaken and to our knowledge there is no industry wide accepted methodology or design standard for seismic risk to wellbores. Supplement #2 Section 3.3.7 ‘Withdrawal from Tubing String Only’ indicates that operation through tubing/packer improves the resiliency of the wellbore. We concur that this is a reasonable assumption, but believe that detailed structural analysis of the Aliso Canyon wellbore designs incorporating the results from a PSHA and a PFDA of the Santa Susana Fault System will better inform the risk management process for operation of Aliso Canyon.

Supplement #2 Section 3.3: ‘Mitigation Measures for Geologic and Geotechnical Hazards’ details Southern California Gas’ activities to address geotechnical hazards. As such, we do not believe that the recommended detailed seismic studies require immediate action, but they should be planned and executed in a deliberate manner. The recommended seismic risk analysis can be incorporated into a continuous improvement process for risk management at Aliso Canyon and inform future risk mitigation activities. We envision a two-step process where the initial step will be to perform a PSHA and PFDA focused on the Santa Susana fault system at Aliso Canyon. Once the hazard analysis has been completed, the severity of the hazards can then be used to develop a detailed work plan for risk evaluation.

References:

Abou-Sayed, A.S., Meng, F.H., and Wang, G., Compaction-induced wellbore failure and fault instability: a hybrid approach, ARMA/NARMS 04-594, presented at Gulf Rocks 2004, the 6<sup>th</sup> North America Rock Mechanics Symposium, Houston, TX, June 5–9 2004.

Dusseault, M.B., Bruno, M.S., and Barrera, J., Casing shear: causes, cases, cures, SPE 48864, presented at 1998 SPE Intl. Oil and Gas Conference and Exposition, Beijing, November 2–4 1998.

Hilbert Jr., L.B., Gwinn, R.L., Moroney, T.A., and Deitrick, G.L., Field-scale and wellbore modeling of compaction-induced casing failures, SPE Drill. & Completion, 14 (2) June 1999.

Sincerely,



Barry M. Freifeld



Douglas A. Blankenship



Scott A. Perfect



William Foxall



Steve Bauer



Joshua White

Lawrence Berkeley National  
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Lawrence Livermore National  
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