Ex. IV-1

SED Supplemental Data Response to SoCalGas Data Request 3
Supplemental information is shown in red as of 1/6/2020.
Supplemental information is shown in blue as of 1/15/2020.
Supplemental Information is shown in green as of 1/23/2020 As a general note, includes the following objection with all information provided in green. SED was relying on SoCalGas's response to SED Data Request 52 in order to supplement its answers to this response. However, SoCalGas's responses to SED Data Request 52 were non-responsive and/or incomplete, in the fashion described in the specific answers. Therefore, SED is unable to provide the supplemental information it indicated it would on January 15, 2020 at this time. SED encourages SoCalGas to re-consider its response to SED Data Request 52, and provide specific, directly responsive, and complete answers. Data dumps or references saying that SoCalGas has already provided SED information are not responsive to the questions. Rather, specific responses showing exactly which documents are responsive are required to answer the question.
At this time, SED stands by all objections it indicated it would re-consider at the last meet and confer.
Supplemental information is shown in orange as of 1/30/2020.

General disclaimer: SED reserves the right to update Its data response, and has identified where SED requires more time in each answer. SED reserves the right to add to its answer to all question subparts requesting SED to identify the laws, rules, regulations and/or industry standards. Where SED has quoted from its testimony to answer a question, SED has omitted the footnotes from SED's testimony in the answer. However, these footnotes are all incorporated into each answer by reference.

1. YOU assert that SoCalGas failed to investigate the "blowout" from well Frew-3 (Violation 1 alleged in OPENING TESTIMONY).

a. Please describe the investigation that SED believes would have constituted an adequate response to the "blowout" from well Frew-3 on December 31, 1984.

SED objects to this question on the grounds that it mischaracterizes SED's testimony, and related role as the entity that is responsible for investigating this blowout. That is SoCalGas's (not SED's) mandated responsibility, pursuant to California Public Utilities Code Section 451. SED further objects to this question as unduly burdensome in that it requests SED to gather information related to the blowout that is or was in the control of SoCalGas, and analyze it to determine what type of investigation might have been adequate.

Despite the undue burden of this question, SED requires more time to answer this question, and reserves the right to provide an additional substantive answer.

b. Identify the laws, rules, regulations, and/or industry standards, if any, that SED believes require the investigation described in its response.

Despite, SED's objection to question 1a, SED understands this to be asking about the information from SED's testimony that is identified in the question, and answers accordingly. Please see the passage on SED Opening Testimony, pages 8 and 9, which states, "SED views SoCalGas's failure to investigate or analyze the failures or root causes of casing leaks, parted casings, or other failure events as separate violations of Section 451 as follows:

- One violation for failure to investigate the blowout from well Frew-3 spanning from December 31, 1984, the last possible date of the blowout, to October 23, 2015, the date of the incident.

c. Identify and produce all DOCUMENTS, aside from the Blade Report, that support SED's contention that SoCalGas failed to investigate the blowout from well Frew-3.

SED relies on the Blade Report for this violation. SED may update this answer at a later time.

d. Identify the basis on which YOU contend that this alleged failure is a violation of California Public Utilities Code Section 451 ("Section 451").

The basis for this violation is provided in Section II.B of SED's opening testimony. See also the answer to question 1b.

2. YOU assert that SoCalGas failed to investigate the "blowout" from well FF-34A (Violation 2 alleged in OPENING TESTIMONY).

a. Please describe the investigation that SED believes would have constituted an adequate response to the "blowout" from well FF-34A on December 31, 1990.

SED objects to this question on the grounds that it mischaracterizes SED's testimony, and related role as the entity that is responsible for investigating this blowout. That is SoCalGas's (not SED's) mandated responsibility, pursuant to California Public Utilities Code Section 451. SED further objects to this question as unduly burdensome in that it requests SED to gather information related to the blowout that is or was in the control of SoCalGas, and analyze it to determine what type of investigation might have been adequate.

Despite the undue burden of this question, SED requires more time to answer this question, and reserves the right to provide an additional substantive answer.

b. Identify the laws, rules, regulations, and/or industry standards, if any, that SED believes require the investigation described in its response.

Despite, SED's objection to question 2a, SED understands this to be asking about the information from SED's testimony that is identified in the question, and answers accordingly. Please see the passage on SED Opening Testimony, pages 8 and 9, which states, "SED views SoCalGas's failure to investigate or analyze the failures or root causes of casing leaks, parted casings, or other failure events as separate violations of Section 451 as follows:

- One violation for failure to investigate the blowout from well FF-34A, spanning from December 31, 1990, the last possible date of the blowout, to October 23, 2015, the date of the incident.

c. Identify and produce all DOCUMENTS, aside from the Blade Report, that support SED's contention that SoCalGas failed to investigate the blowout from well FF-34A.

SED relies on the Blade Report for this violation. SED reserves the right to update this answer at a later time.

d. Identify the basis on which YOU contend that this alleged failure is a violation of Section 451.

The basis for this violation is provided in Section II.B of SED's opening testimony. See also the answer to question 2b.

3. YOU assert that SoCalGas failed to investigate the three parted casings discovered on December 31, 1994 (Violation 4 alleged in OPENING TESTIMONY).

a. Please describe the investigation that SED believes would have constituted an adequate response to the three parted casings discovered on December 31, 1994.

SED objects to this question on the grounds that it mischaracterizes SED's testimony, and related role as the entity that is responsible for investigating the parted casings. That is SoCalGas's (not SED's) mandated responsibility, pursuant to California Public Utilities Code Section 451. SED further objects to this question as unduly burdensome in that it requests SED to gather information related to the question that is or was in the control of SoCalGas, and analyze it to determine what type of investigation might have been adequate.

Despite the undue burden of this question, SED requires more time to answer this question, and reserves the right to provide an additional substantive answer.

b. Identify the laws, rules, regulations, and/or industry standards, if any, that SED believes require the investigation described in its response.

Despite, SED's objection to question 3a, SED understands this to be asking about the information from SED's testimony that is identified in the question, and answers accordingly. Please see the passage on SED Opening Testimony, pages 8 and 9, which states, "SED views SoCalGas's failure to investigate or analyze the failures or root causes of casing leaks, parted casings, or other failure events as separate violations of Section 451 as follows:

- Four violations: One for failure to investigate each of the parted casings discovered between 1969 and 1994. As one of the parted casings must have been discovered in 1969 to set the beginning of the range, that first violation spans from December 31, 1969 the last possible date of its parting, to October 23, 2015, the date of the incident. Assuming that the remaining three parted casings were discovered December 31, 1994, those three separate violations each span from, at the latest, December 31, 1994 to October 23, 2015.

c. Did SED ever conduct an audit of SoCalGas relating to whether SoCalGas investigated the three parted casings discovered on December 31, 1994.

SED objects to this question as unduly burdensome on the grounds that it asks a question that SoCalGas does or should have the answer to. SoCalGas is or should be aware of audits that SED has conducted on SoCalGas. SED notes as part of its objection that SoCalGas should avoid asking questions to which SoCalGas does or should already have the answer in that they waste the limited time and staff resources of SED in this investigation. Failure to heed this instruction may result in SED identifying additional examples in which SoCalGas is not cooperating with SED's investigation.

d. Identify and produce all DOCUMENTS, aside from the Blade Report, that support SED's contention that SoCalGas failed to investigate the three parted casings discovered on December 31, 1994.

SED relies on the Blade Report for this violation. SED may update this answer at a later time.

e. Identify the basis on which YOU contend that this alleged failure is a violation of Section 451.

The basis for this violation is provided in Section II.B of SED's opening testimony. See also the answer to question 3b.

4. YOU assert that SoCalGas failed to investigate the first parted casing in 1969 (Violation 3 alleged in OPENING TESTIMONY).

a. Please describe the investigation that SED believes would have constituted an adequate response to the first parted casing in 1969.

SED objects to this question on the grounds that it mischaracterizes SED's testimony, and related role as the entity that is responsible for investigating this parted casing. That is SoCalGas's (not SED's) mandated responsibility, pursuant to California Public Utilities Code Section 451. SED further objects to this question as unduly burdensome in that it requests SED to gather information related to the question that is or was in the control of SoCalGas, and analyze it to determine what type of investigation might have been adequate.

Despite the undue burden of this question, SED requires more time to answer this question, and reserves the right to provide an additional substantive answer.

SED requires a complete answer to Data Request 52, Question 2 as a condition precedent to completing the answer to this question. For reference, that question asks:

Related to AC_CPUC_SED_DR_27_0000351 July 20, 1962, Tidewater prepared an evaluation of the SS reservoir for future Sesnon Gas Storage distributed for review before August PUC hearings. Please provide all correspondence, reports, studies and testimonies, and the final contract for acquisition of the Sesnon Gas Storage field that occurred between 1962 and 1973 between Tidewater (and its associates),

Pacific Lighting, and the PUC regarding assessment and acquisition of the Sesnon Gas Storage (Aliso Canyon).

In DR 52, Question 2, SED asked, Related to AC_CPUC_SED_DR_27_0000351 July 20, 1962, Tidewater prepared an evaluation of the SS reservoir for future Sesnon Gas Storage distributed for review before August PUC hearings. Please provide all correspondence, reports, studies and testimonies, and the final contract for acquisition of the Sesnon Gas Storage field that occurred between 1962 and 1973 between Tidewater (and its associates), Pacific Lighting, and the PUC regarding assessment and acquisition of the Sesnon Gas Storage (Aliso Canyon).

SoCalGas answered, SoCalGas objects to this request on the grounds that it is vague and ambiguous, and overly broad and unduly burdensome. SoCalGas further objects to this request to the extent it seeks information that is outside the scope of this proceeding as set forth in the Assigned Commissioner's Scoping Memo and Ruling dated September 26, 2019. Subject to and without waiving the foregoing objections, SoCalGas responds as follows. Please refer to SoCalGas' previously provided response to SED Data Request 17 ("DR- 17") dated March 30, 2018.

SED views this as a non-responsive answer to SED's good faith effort to ask SoCalGas a specific question, as the response to DR 17 is a data dump. Due to SoCalGas being non-responsive to SED's good faith efforts dispense of its duties to investigate SoCalGas from a safety perspective, SED will not add anything to this response at this time.

b. Identify the laws, rules, regulations, and/or industry standards, if any, that SED believes require the investigation described in its response.

Despite, SED's objection to question 4a, SED understands this to be asking about the information from SED's testimony that is identified in the question, and answers accordingly. Please see the passage on SED Opening Testimony, pages 8 and 9, which states, "SED views SoCalGas's failure to investigate or analyze the failures or root causes of casing leaks, parted casings, or other failure events as separate violations of Section 451 as follows:

- Four violations: One for failure to investigate each of the parted casings discovered between 1969 and 1994. As one of the parted casings must have been discovered in 1969 to set the beginning of the range, that first violation spans from December 31, 1969 the last possible date of its parting, to October 23, 2015, the date of the incident.

c. Did SED ever conduct an audit of SoCalGas relating to whether SoCalGas investigated the first parted casing in 1969.

SED objects to this question on the grounds that It Is unduly burdensome. As the entity that was audited, SoCalGas has or should have the answer to this question. SED reminds SoCalGas, pursuant to the meet and confer in November, that questions such as this one, where SoCalGas already has the answer, wastes limited SED staff time and resources, and should not be asked. The instant question should be withdrawn.

d. Identify the basis for SED's assumption that the first parted casing was discovered, at the latest, on December 31, 1969.

As noted on pages 8 and 9 of SED's opening testimony,

SED views SoCalGas's failure to investigate or analyze the failures or root causes of casing leaks, parted casings, or other failure events as separate violations of Section 451, as follows:

> Between 1969 and 1994, four wells were discovered to have parted casings. However, Blade found no evidence that SCG prepared root cause analyses, collected samples, performed lab analyses, or taken photos of failures, or developed failure analysis reports to document these failures. The only documents found were well operations daily reports where on-site rig activities were reported.

Each of these sentences reference to, and are based upon page 165 of the Blade Report. As that part of the report notes that four wells were discovered to have parted casings between 1969 and 1994, SED assumes that at one well had a parted casing that was discovered the last possible date of 1969, because that would be the basis for the start date of 1969. SED conservatively assumes the last day of 1969 as the start date of that violation, the last possible day that first well discovery could have happened.

SED reserves the right to update the date of this violation from conservative assumptions to more concrete dates if SED discovers additional information.

e. Identify the date on which YOU understand SoCalGas took control as operator of the ALISO CANYON.

SED objects to this question on the grounds that it is unduly burdensome in that SoCalGas Is asking a question to which SoCalGas demonstrably does or should already have the answer. SED reminds SoCalGas to avoid wasting SED limited staff time and resources asking such questions.

f. Identify and produce all DOCUMENTS, aside from the Blade Report, that support SED's contention that SoCalGas failed to investigate the first parted casing.

SED relies on the Blade Report for this violation. SED may update this answer at a later time.

g. Admit that SoCalGas could not have violated any requirement or order of the Commission with respect to the maintenance and operation of Aliso Canyon prior to assuming control as operator of ALISO CANYON.

SED concedes this point, provided that SoCalGas had no role in ownership, maintenance, operation, or any control whatsoever. SED reserves the right to amend its testimony accordingly.

h. Identify the basis on which YOU contend that this alleged failure is a violation of Section 451.

The basis for this violation is provided in Section II.B of SED's opening testimony. See also the answer to question 4b.

5. YOU assert that SoCalGas failed to investigate the remaining 54 leaks (Violations 7-60 alleged in OPENING TESTIMONY).

a. Please describe the "investigation" SED believes would have constituted a reasonable

response to each of the “remaining 54 leaks.”

SED objects to this question on the grounds that it mischaracterizes SED's testimony, and related role as the entity that is responsible for investigating the leaks. That is SoCalGas's (not SED's) mandated responsibility, pursuant to California Public Utilities Code Section 451. SED further objects to this question as unduly burdensome in that it requests SED to gather information related to the question that is or was in the control of SoCalGas, and analyze it to determine what type of investigation might have been adequate.

Despite the undue burden of this question, SED requires more time to answer this question, and reserves the right provide an additional substantive answer.

Generally, the 2014 investigation of FREW 2 demonstrates the type of investigation that would be reasonable to determine the extent and cause of earlier leaks detected by SoCalGas. While 2014 tools may be more refined, the basic tools have been available for decades.

SED requires an answer to Data Request 52 Question 9 as a condition precedent to providing a complete answer to this question. For reference, that question asks:

> In addition to the SIMP Model Studies performed in 2014 on FREW 2, identify all other similar studies performed on other Aliso wells prior to October 23, 2015. For each study identified, provide a complete copy of the resulting report(s) that present log interpretations and results. Each report should be provided in separate, searchable pdf document(s).

In Data Request 52, Question 9, SED asked,

In addition to the SIMP Model Studies performed in 2014 on FREW 2, identify all other similar studies performed on other Aliso wells prior to October 23, 2015. For each study identified, provide a complete copy of the resulting report(s) that present log interpretations and results. Each report should be provided in separate, searchable pdf document(s).

In response, to this question, SoCalGas stated,

SoCalGas objects to this request as vague and ambiguous, particularly with respect to the phrase "SIMP Model Studies" and term "similar," overly broad, and unduly burdensome. Subject to and without waiving the foregoing objections, SoCalGas responds as follows. SoCalGas interprets this request to seek information about the SIMP Pilot Project. Please refer to SoCalGas' response to SED Data Request 25 ("DR-25") dated August 14, 2018. Rather than providing an answer to a direct specific question, this is a data dump, referring to over 1500 documents. It was during SED's review of SoCalGas' response to DR 25 that the SIMP Model Study report of corrosion on well FREW 2 was found. In an ongoing effort to give SoCalGas credit for all investigations into well corrosion and anomalies, SED asked for similar reports. Due to the non-responsive answer of SoCalGas, SED must assume that SoCalGas performed no other studies of wells prior to 2015 that would have identified corrosion or anomalies in well

tubings or casings. Therefore, SED has no further comments on this issue at this time.

Despite, SED's objection to question 5a, SED understands this to be asking about the information from SED's testimony that is identified in the question, and answers accordingly. As noted on pages 8 and 9 of SED's opening testimony,

SED views SoCalGas's failure to investigate or analyze the failures or root causes of casing leaks, parted casings, or other failure events as separate violations of Section 451, as follows:

a. To avoid double counting violations, SED assumes that the 60 leaks identified before the Aliso Canyon incident included the six blowouts and parted casings identified above. As such, the remaining 54 leaks that went without investigation should constitute a separate set of up to 54 violations. At the latest, these violations began on October 22, 2015, the last possible date before the incident on October 23, 2015.

c. Did SED ever conduct an audit of SoCalGas relating to whether SoCalGas investigated the remaining 54 leaks.

SED objects to this question on the grounds that It Is unduly burdensome. As the entity that was audited, SoCalGas has or should have the answer to this question. SED reminds SoCalGas, pursuant to the meet and confer in November, that questions such as this one, where SoCalGas already has the answer, wastes limited SED staff time and resources, and should not be asked. The instant question should be withdrawn.

d. Identify and produce all DOCUMENTS, aside from the Blade Report, that support SED's contention that SoCalGas failed to investigate the "remaining 54 leaks."

SED relies on the Blade Report for this violation. SED may update this answer at a later time.

Blade reviewed the well files and did not find any records that suggested an investigation to determine the cause of leaks was performed for the 54 leaks. Based on recent review of well file FREW 2 compared to the SIMP Study for well file 2, it appears that SoCalGas may only add logs to the Well File, not reports or findings. Therefore, SED requires an answer to Data Request 52 Question 9 as a condition precedent to providing a complete answer to this question. For reference, that question asks:

> In addition to the SIMP Model Studies performed in 2014 on FREW 2, identify all other similar studies performed on other Aliso wells prior to October 23, 2015. For each study identified, provide a complete copy of the resulting report(s) that present log interpretations, analyses, test results, and results. Each report should be provided in separate, searchable pdf document(s).

Please refer to additional response in green to Question 5a above.

e. Identify the basis on which YOU contend that this alleged failure is a violation of Section 451.

The basis for this violation is provided in Section II.B of SED's opening testimony. See also the answer to question 5b.

6. YOU assert that SoCalGas "did not properly follow its own 1988 plan todetermine the condition of the casing in 12 wells" and SS-25. (OPENING TESTIMONY, page 10).

a. Please identify the law(s), regulations, or rules that required SoCalGas to test the production casing of its wells for metal loss on or about 1988.

SED objects to this question as mischaracterizing SED's testimony. SED's testimony asserts on page 10 that, "SoCalGas's failure to follow Its own 1988 plan to check the casing in 12 wells for metal loss violates Section 451." This violation does not discuss testing.

b. Please state the industry standard(s) for testing the production casing of oil and gas

storage wells that were in effect on or about 1988.

SED objects to this question as mischaracterizing SED's testimony. SED's testimony asserts on page 10 that, "SoCalGas's failure to follow Its own 1988 plan to check the casing In 12 wells for metal loss violates Section 451." This violation does not discuss testing.

c. Please identify all tools available, on or about 1988, which were designed to evaluate the metal loss in the production casing of oil and gas wells.

SED objects to this question as unduly burdensome. SoCalGas has access to the same information as SED, and can research the tools available at this time period as well as SED can, and this places an undue burden on SED to identify each tool available at the time. Notwithstanding this objection, SED identifies the following tools.

Tools available on or about 1988 that were designed to evaluate the metal loss in the production casing of oil and gas wells include the following:

Corrosion Logs were used to detect pitting and wall loss in casings as early as 1971. (*See* Donald L. Katz, AIME, U. of Michigan, "Monitoring Gas Storage Reservoirs," June 10, 1971, SPE PAPER No. 3287. *See also,* J.A. Bazzari, Getty Oil Co./Kuwait Oil Co., "Well Casing Leaks History and Corrosion Monitoring Study, Wafra Field," 1981, SPE PAPER No. 17930 (see log showing detection of wall thickness, Figure 4, page 53.)

Other tools designed to evaluate metal loss are included in the following passage:

"Corroded casing sometimes can be located by a high-resolution caliper log; spontaneous-potential logs have been used to locate depth intervals where active corrosion is taking place (Kendall, 1965). Commercial logging services are available for detecting corroded casing. An electromagnetic casing inspection log measures changes in the mass of metal between two coils; loss of mass may be due to corrosion (Edwards and Stroud, 1964). A pipe-analysis survey is run with a centralized probe that employs several coils (Bradshaw, 1976). This survey is reported to provide information on the thickness of casing penetrated by corrosion, whether the damage is internal or external, and isolated or circumferential. The electromagnetic-thickness survey measures the average casing thickness over an interval of about 0.6 m and can be used to monitor changes in thickness with time. Casing-inspection logging methods are summarized by Nielsen and Aller (1984)." EPA Web Archive: https://archive.epa.gov/esd/archive-geophysics/web/html/well_completion_logging.html

SED might provide additional future references.

SED adds the following reference, which is also included as an attachment.

1988.0101.SPWLA-1988-UU-NN

d. For each of the tools that YOU identify in response to Request 6(c), please describe YOUR understanding of the tool's efficacy in accurately identifying wall loss.

SED incorporates it's answer to question 6c by reference.

e. Identify the basis on which YOU contend that this alleged failure is a violation of Section 451.

The basis for this violation is provided in Section II.B of SED's opening testimony. See also the answer to question 6a.

7. YOU assert that SoCalGas did not "employ reasonable understanding of the groundwater depths relative to the surface casing shoe and production casing of well SS-25" prior to the drilling of two groundwater wells which were drilled for RCA purposes (OPENING TESTIMONY, page 39).

a. Please explain what YOU believe a "reasonable understanding of groundwater depths relative to the surface casing shoe and production casing of well SS-25" would have been.

SED objects to this question on the grounds that it mischaracterizes SED's testimony, and related role as the entity that is responsible for investigating the groundwater depths in the question. That is SoCalGas's (not SED's) mandated responsibility, pursuant to California Public Utilities Code Section 451. SED further objects to this question as unduly burdensome in that it requests SED to gather information related to the question that is or was in the control of SoCalGas, and analyze it to determine what type of understanding might have been adequate.

Despite the undue burden of this question, SED requires more time to answer this question, and may endeavor to provide an additional substantive answer.

SED requires an answer to Data Request 52 Question 7 as a condition precedent to providing a complete answer to this question. For reference, that question asks:

> Identify by well number all shallow water observation wells installed at the Aliso Canyon Storage Unit. For each well, provide:
>
> a. Well Number
> b. Installation record showing at least date drilled, depth of well, depth of water from surface.
> c. All data collected and recorded from these wells.
> d. One map showing location of shallow water wells at Aliso.

SED Data Request 52, Question 7 asked.

Identify by well number all shallow water observation wells installed at the Aliso Canyon Storage Unit. For each well, provide:
a. Well Number
b. Installation record showing at least date drilled, depth of well, depth of water from surface.

c. All data collected and recorded from these wells.
d. One map showing location of shallow water wells at Aliso.

SoCalGas responded to this question:

SoCalGas objects to this request as vague and ambiguous, particularly with respect to the phrase "shallow water observation wells," overly broad and unduly burdensome, and outside the scope of this proceeding as set forth in the Assigned Commissioner's Scoping Memo and Ruling dated September 26, 2019. Subject to and without waiving the foregoing objections, SoCalGas responds as follows. Prior to October 23, 2015, gas storage observation wells SS-5 and W3A were used to monitor pressure in the west and east field areas, respectively. Due to the incompleteness of this answer in failing to address subparts b, c, and d of Data Request 52, Question 7, SED is unable to answer this question at this time. Without knowing additional data that might have been available to SoCalGas, SED relies on the Blade Report for response to this question.

b. Identify the laws, rules, regulations, and/or industry standards, if any, that SED believes require SoCalGas to employ the understanding you explain in response to Request 7(a).

Despite, SED's objection to question 7a, SED understands this to be asking about the information from SED's testimony that is identified in the question, and answers accordingly. The rules include California Public Utilities Code Section 451, as identified in subsection a, which concludes on page 44 of SED opening testimony,

> By allowing groundwater to cause corrosion on the 7 inch and 11 ¾ inch casings on SS-25, SoCalGas violated Section 451. This violation begins on August 30, 1988, the date SoCalGas produced its Interoffice memo calling for inspections of the SS-25 casing, and continues to October 23, 2015, the beginning date of the incident.

The rules also include California Public Utilities Code Section 451, as identified in subsection b, which concludes on page 45 of SED opening testimony,

> SoCalGas's failure to assess the relationship between groundwater in and around the SS-25 wellsite, and the surface casing corrosion of that well on SS-25 constitute a violation of Section 451. This violation begins on August 30, 1988, the date SoCalGas produced its Interoffice Memo calling for inspections of the SS-25 casing, and continues to October 23, 2015, the beginning date of the incident.

To maintain its obligation to provide a safe system to protect employees and the public, SED expects SoCalGas will develop safe operation and maintenance standards and will implement them in the course of its normal business. These in-house procedures serve as a type of operating requirement for SoCalGas. As an example of SoCalGas not implementing its own standard, refer to SoCalGas' Company Operations Gas Standard for Pipeline Integrity - Design and Application of Cathodic Protection, SCG 186.002. This Standard was modified in 2000 to add cathodic protection for gas Storage, specifically well casings. Gas Storage management is charged with the responsibility of implementing the standard. Yet, 15 years later, well SS-25 failed from casing corrosion.

The NACE International standard practice provided in response to question 7c identifies procedures to determine the need for cathodic protection (CP) and the current requirements to achieve CP of well casings associated with oil and gas production and gas storage. It also outlines practices for the design and installation of CP systems and for their operation and maintenance. The purpose of this standard is to ensure more effective prevention of corrosion of well casings by making available reliable information about CP as it relates to well casings. This standard is intended for use by corrosion engineers in oil and gas production, especially those concerned with the CP of steel well casings. NEW REFERENCE: 2007.0101.NACE-SP0186-NN (Standard – first issued in 1986)

c. Identify and produce all DOCUMENTS, aside from the Blade Report, that support

SED's contention that SoCalGas did not employ a "reasonable understanding of the groundwater depths relative to the surface casing shoe and production casing of well SS-25" prior to the drilling of the two groundwater wells which were drilled for RCA purposes.

SED adds the following reference, which is provided as an attachments: SPE-3287-MS and SPE-17930-MS

d. Identify the basis on which YOU contend that this allegation is a violation of Section 451.

The basis for this violation is provided in Section II.B of SED's opening testimony. See also the answer to questions 7b and 7c. Also, see an additional new reference: 1978.0701.PETSOC-78-03-04_NN, SPE-17930-MS

8. YOU assert that SoCalGas did not "assess the relationship between groundwater in and around the SS-25 well site, and the surface casing corrosion of that well" (OPENING TESTIMONY, page 44).

SED objects to this question because it was already encompassed by all of question 7, and answered there. Therefore, SED incorporates by reference it's answers to question 7 in response to the questions for question 8.

a. Please identify the specific actions that YOU believe SoCalGas should have taken, prior to the SS-25 leak, to "assess" the relationship between the groundwater and the surface casing.

SED requires an answer to Data Request 52 Question 7 as a condition precedent to providing a complete answer to this question. For reference, that question asks:

> Identify by well number all shallow water observation wells installed at the Aliso Canyon Storage Unit. For each well, provide:
> a. Well Number
> b. Installation record showing at least date drilled, depth of well, depth of water from surface.
> c. All data collected and recorded from these wells.
> d. One map showing location of shallow water wells at Aliso.

See Response to Question 7a above.

b. Identify the laws, rules, regulations, or industry standards that required SoCalGas to assess the relationship between groundwater around the SS-25 well site, and the surface casing corrosion around that well.

The basis for this violation is provided in Section II.B of SED's opening testimony. See also the answer to question 7b, 7c, and 7d.

c. Identify the laws, rules, regulations, and/or industry standards, if any, that SED believes require SoCalGas to employ the specific actions you describe in response to Request 8(a).

The basis for this violation is provided in Section II.B of SED's opening testimony. See also the answer to question 8b.7(b).

d. Identify and produce all DOCUMENTS, aside from the Blade Report, that support SED's contention that SoCalGas did not "assess the relationship between groundwater in and around the SS-25 well site, and the surface casing corrosion of that well."

SED relies on the Blade Report for this violation. SED may update this answer at a later time.

See the answer to question 7b and c.

e. Identify the basis on which YOU contend that this allegation is a violation of Section 451.

The basis for this violation is provided in Section II.B of SED's opening testimony. See also the answer to question 8b.

9. YOU assert that SoCalGas had no systemic practices to protect surface casing strings against external corrosion and therefore did not employ "a proper understanding of the consequences of corroded surface casings and uncemented production casings" (OPENING TESTIMONY, page 45).

a. Please describe what YOU believe a "proper understanding of the consequences of corroded surface casings and uncemented production casings" would entail.

SED objects to this question on the grounds that it mischaracterizes SED's testimony, and related role as the entity that is responsible for investigating the information identified in the question. That is SoCalGas's (not SED's) mandated responsibility, pursuant to California Public Utilities Code Section 451. SED further objects to this question as unduly burdensome in that it requests SED to gather information related to the information identified in the question that is or was in the control of SoCalGas, and analyze it to determine what type of understanding might have been adequate.

Notwithstanding this objection, SED notes the follows: As discussed in certain scholarly articles, "Casing integrity and cement evaluation are not new concepts, in fact operators have evaluated reservoir and well integrity since the inception of underground storage a century ago." Pg.1, Sebastian Kamgang, et al & Baker Hughes Incorporated, "Innovative Cement and Casing

Corrosion Evaluation Technologies Provide Reliable Well Integrity Information In Natural Gas Storage Wells" 2017, SPWLA 58th Annual Logging Symposium, June 17-21, 2017

As an operator of multiple gas storage areas since as early as 1943, SoCalGas should by now have a thorough understanding of the consequences of corroded surface casings and uncemented production casings. A basic understanding would be that an uncemented casing that is exposed to soil and groundwater without any protection, such as cathodic protection, will corrode and eventually leak. A proper understanding of this concept would easily lead an engineer to the conclusion that some sort of protection is necessary to avoid the maintenance costs associated with repairs or replacement of a well. For additional information,
SED adds the following references: SPE-2910-MS, SPE-3287-MS and SPE-17930-MS, NACE-SP0186-NN, 1959.0519.API-59-199_NNN, 1974.0701.SPE-4682-PA_NNN, 2007.0627.SPE-108906-MS_NNN, 2007.0924.SPE-108195-MS_NNN, 2007.1111.SPE-108698-MS_NNN

b. Identify the laws, rules, regulations, and/or industry standards, if any, that SED believes require SoCalGas to employ the understanding you explain in response to Request 9(a).

Despite, SED's objection to question 9a, SED understands this to be asking about the information from SED's testimony that is identified in the question, and answers accordingly. The rules include California Public Utilities Code Section 451, as identified on page 47 of SED's testimony, which states,

> SoCalGas violated Section 451 because it did not have systematic practice to protect surface casing strings against external corrosion, and because it did not understand the consequences of corroded surface casings and uncemented production casings. This violation begins on August 30, 1988, the date SoCalGas produced its Interoffice Memo calling for inspections of the SS-25 casing, and continues to October 23, 2015, the beginning date of the incident.

Good completion practices include the use of drilling mud with an alkaline Ph; the circulation of cement for the entire length of the casing; use of similar metals in all parts of the structure; and the insulation of the well line from the casing. See page 2, 1970.0101.SPE-2910-MS (attached). See also 7.b

c. Identify and produce all DOCUMENTS, aside from the Blade Report, that support SED's contention that SoCalGas failed to employ "a proper understanding of the consequences of surface casing and uncemented production casings."

See response to 9a.

d. Identify the basis on which YOU contend that this allegation is a violation of Section 451.

The basis for this violation is provided in Section II.B of SED's opening testimony. See also the answer to questions 9a and 9b.

10. YOU assert that SoCalGas did not understand "the extent and consequences of the corrosion in other ALISO CANYON Storage wells" because of its alleged failure to investigate previous failures (OPENING TESTIMONY, page 7).

SED objects to this question because it was asked and answered. This question encompasses those that were asked already as part of this data request. See in particular, questions 1 through 6 and question 10 of this data request. This objection applies throughout the data response, and includes references to other data responses to show certain applicable data responses.

a. Please describe what YOU believe SoCalGas should have done to understand the "extent and consequences of the corrosion in other ALISO CANYON storage wells."

See responses to 6c and 9a

b. Identify the laws, rules, regulations, and/or industry standards, if any, that SED believes require SoCalGas to engage in the actions YOU explain in response to Request 10(a).

SED objects to this question because it was asked and answered.

c. Identify and produce all DOCUMENTS, aside from the Blade Report, that support SED's contention that SoCalGas failed to understand "the extent and consequences of the corrosion in other ALISO CANYON storage wells."

See response to 6c and 2012.1111.SPE-161983-MS_NNN

d. Identify the basis on which YOU contend that this allegation is a violation of Section 451.

The basis for this violation is provided in Section II.B of SED's opening testimony. See also the answer to questions 9a and 9b.

11. YOU assert that SoCalGas "did not attempt to understand causes of the leaks at 60 wells" at ALISO CANYON (OPENING TESTIMONY, page 11).

a. Do YOU contend that SoCalGas conducted no investigation at all for the leaks mentioned above?

SoCalGas has represented to the Commission that, "The casing leaks, as SoCalGas understands them to be identified in the Blade Report, were successfully assessed and addressed by SoCalGas and, where appropriate, further investigation was performed. In order to remediate any leaks, SoCalGas necessarily had to analyze and diagnose the issue, and then implement a fix, as needed." SED reserves the right to re-visit this issue once Blade has had an opportunity to address SoCalGas's statement, and pending SoCalGas providing underlying facts to show the veracity of this statement.

Upon further review, SoCalGas did a model SIMP study to determine the condition of the casing on Frew 2 in 2014. SED reserves the right to provide further updates to this answer in the future.

b. Identify and produce all DOCUMENTS, aside from the Blade Report, that support SED's response to Request 11(a).

See response to question 11a.

c. What do YOU contend constitutes a "leak"?

A leak is any failure of the well integrity that results in a release of gas to the surrounding reservoir soil, groundwater and/or to the atmosphere. Leaks include those leaks of 60 wells at Aliso Canyon, as identified by the Blade Report at page 4, as mentioned in footnote 42 of SED's opening testimony. See also page 9 of SED's testimony, which says,

> To avoid double counting violations, SED assumes that the 60 leaks identified before the Aliso Canyon incident included the six blowouts and parted casings identified above. As such, the remaining 54 leaks that went without investigation should constitute a separate set of up to 54 violations. At the latest, these violations began on October 22, 2015, the last possible date before the incident on October 23, 2015.

d. Please describe what actions YOU believe are necessary for a reasonable investigation of a leak.

SED objects to this question in that it mischaracterizes SED's testimony, and related role as the entity that is responsible for investigating leaks on SoCalGas's system. That is SoCalGas's (not SED's) mandated responsibility, pursuant to California Public Utilities Code Section 451. SED reserves the right to investigate and audit SoCalGas for safety related purposes.

SED also objects to this question as vague and overly broad. This question would have SED provide an up front commitment to what constitutes a necessary investigation of a leak for every instance without having the facts associated with a given leak, thereby potentially compromising the ability of SED's investigators to do their work when investigating leaks for safety related purposes.

Notwithstanding these objections, please refer to the responses to 6c, 9a and 10c

Please also see Blade's Response to SED Data Request 49, Questions 3 through 5. For context, these responses are replicated here.

2.3 Question 3

Does Blade agree with the statement that, "The Blade Report fails to recognize, however, that a 'formal investigation' of the type Blade appears to envision would likely entail a level of examination that would not be feasible for an active well, nor necessary. While Blade was able to cut, extract, and thoroughly examine the casing at well SS-25 because there were plans to abandon the well, it is not feasible for SoCalGas to perform the same level of failure analysis on active gas storage wells."

2.3.1 Response 3

Blade disagrees with the statement.

2.4 Question 4

If Blade agrees with the statement in question 3, please explain why.

2.4.1 Response 4

See Response 5.

2.5 Question 5

If Blade disagrees with any portion or all of the statement in question 3, please explain why it disagrees.

2.5.1 Response 5

Solution 6: Conduct a Casing Failure Analysis from the Blade Main Report, Section 5.3.1, Page 232, is replicated here for reference.

Solution 6: Conduct a Casing Failure Analysis

Despite numerous casing failures, no data were provided to indicate that failure causes were investigated. Casing failures need to be formally investigated so that their causes are identified and their implications are understood. Understanding and interpreting failures are critical to defining the propensity or risk of such failures field wide. Such analysis is an important part of any risk assessment. The cause may be straightforward, well specific, and easily mitigated. However, if the cause appears to systemic, or the potential consequences are serious, then a more comprehensive investigation is needed to evaluate the potential risks to other wells in the field so that the appropriate mitigation steps are taken. For example, failure investigation of casing OD corrosion in another well might have directed attention to SS-25 and other similar wells. Running an inner string or plugging a well are valid mitigations, but prior to such actions, the cause of the casing leak or failure should be understood. **The type of investigation should be commensurate with the risk and consequence of the failure, and should be part of the well integrity management system.**

As stated in Solution 6, the last sentence; "The type of investigation should be commensurate with the

risk and consequence of the failure, and should be part of the well integrity management system." It is understood that all failures cannot be treated like SS-25, nor should they. The level of investigation depends on many things including the depth of the failure. It may not be feasible, practical, or necessary, to recover production casing from a deep leak. However, inspection and diagnostic tools are available to determine the nature of the failure, such as, a hole, corrosion—internal or external over a large or small area, location of a failure—pipe body or connection, etc. Such data should be integrated and analyzed to assess the possible causes and develop some hypothesis that can be used to evaluate other wells with failures. Once the failure has been evaluated and understood, the appropriate steps can be taken to determine the disposition of the well. The well can be repaired (inner strings, etc.) or plugged and abandoned if not repairable or if the well is no longer needed. SoCalGas did repair wells or plugged and abandoned wells after the failures were identified.

e. Identify the laws, rules, regulations, and/or industry standards, if any, that YOU believe require SoCalGas to engage in the actions YOU describe in response to Request 11(d).

Despite, SED's objection to question 11d, SED understands this to be asking about the information from SED's testimony that is identified in the question, and answers accordingly.

SED's testimony on pages 8 and 9 state in part,

SED views SoCalGas's failure to investigate or analyze the failures or root causes of casing leaks, parted casings, or other failure events as separate violations of Section 451, as follows. . .

> To avoid double counting violations, SED assumes that the 60 leaks identified before the Aliso Canyon incident included the six blowouts and parted casings identified above. As such, the remaining 54 leaks that went without investigation should constitute a separate set of up to 54 violations. At the latest, these violations began on October 22, 2015, the last possible date before the incident on October 23, 2015.

In addition, See API RP 585, as identified in Blade's data response to SED Data Request 49, Question 6, which is replicated below for context.

2.6 Question 6
With regards to the statement, that, "a 'formal investigation' of the type Blade appears to envision would likely entail a level of examination that would not be feasible for an active well. . .", what levels of
examination are feasible for an active well that SoCalGas could have performed in Blade's opinion?

2.6.1 Response 6

This is addressed by Solution 7: Regulations Should Require a Level 1 (Per API RP 585) Analysis of All Failures in the Blade Main Report, Section 5.3.1, Page 232, replicated here for reference.

Solution 7: Regulations Should Require a Level 1 (Per API RP 585) Analysis of All Failures API RP 585 Pressure Equipment Integrity Incident Investigation, discusses failure investigation of pressure equipment [2]. The Aliso Canyon wells are a form of complex pressure vessels. A Level 1 type analysis of failures, as a minimum requirement, will identify the immediate causes of the failures or near misses and allow operators to understand the implications, if any.

Figure 8 shows the different levels of investigation as discussed in RP 585. A Level 1 investigation may be appropriate for most casing failures and can be done quickly with no disruption to field operations. API RP 585 was developed for Pressure Equipment Integrity Incident Investigation; however, Blade presents this as an option that could be applied to Gas Storage Well Integrity Management.

	Level 1 Investigations	Level 2 Investigations	Level 3 Investigations
Incident Characteristics	— Unexpected condition or damage found that if it had been allowed to progress would have led to loss of containment before the next scheduled outage or inspection interval. — Discovered PEI damage significantly beyond expectation but with no loss of containment or unit shutdown. — Small leaks (other than environmental fugitive emissions) from pressure equipment or joints that were easily contained. — Typically no fire, significant toxic release, injuries, or environmental damage would occur in a Level 1 incident.	— Leak from pressure equipment that resulted in or could have resulted in localized equipment damage, small to medium size release quantity, or small safety or environmental damage. — Unexpected pressure equipment failure from damage mechanisms or structural deterioration. — Unexpected pressure equipment damage or associated structural damage discovered that required equipment or unit shut down or immediate mitigation. — Repetitive Level 1 type characteristics in the same process or system.	Leak or rupture from pressure equipment that resulted in or could have resulted in significant process safety incident or environmental damage, equipment damage, large release quantity, or production loss.
Investigation Characteristics	Investigate using less structured analysis tools such as "What If" or "5-Whys." Uses evidence, judgment, and experience to identify causes.	Investigate using company or department causal factor identification or logic trees, seeking probable contributing and root causes.	Investigate using company structured root cause analysis (RCA) seeking to determine the deepest management system and cultural causes.
Team Makeup Recommended	Investigated by the PEI personnel from the affected area and trained in simple investigation techniques. Can be investigated by one person, possibly two. Involve subject-matter experts (SMEs) as needed.	Leader would be someone from the affected area trained in investigation techniques. Team members would include one to three others of different disciplines from the area; include at least one PEI person on the team. Involve SMEs as needed.	Leader would be someone trained in structured RCA and from another area of the plant or another business unit. There would be at least three team members and possibly from different disciplines or groups, such as inspection, operations, process engineering, maintenance, or process safety. Appropriate SMEs should be included on the team.
Initiation	Within a few days.	Begin investigation as soon as practical (e.g. 1 to 2 days).	Begin freezing and collecting evidence as soon as practical (e.g. within a few hours).
Sponsorship	Supervisor of investigator (First Line Supervisor).	Department Head level (Second Line Supervisor).	Management with overall responsibility for Safety Health Environment for the site.

Figure 8: API 585 Inspection Levels

Failed casing in an active well can be analyzed using casing wall thickness inspection, downhole camera, and other diagnostic tools as discussed in Section 2.2.1 Response 2. This may provide data that can be used to interpret causes for the casing failure.

f. Identify the basis on which YOU contend that this allegation is a violation of Section 451.

The basis for this violation is provided in Section II.B of SED's opening testimony. See also the answers to the other parts of Question 11.

12. YOU assert that the Aliso Canyon storage wells had "numerous casing leaks" and assert

that these leaks “may have been relevant to the conditions at SS-25.” (OPENING TESTIMONY, page 7).

a. Describe how each of the alleged “numerous casing leaks” were “relevant to the conditions at SS-25.”

SED objects to the request to describe how each of the alleged numerous casing leaks were relevant to the conditions at SS-25 as unduly burdensome. SED further objects to this question as mischaracterizing SED's testimony. SED stated that the leaks "may have been relevant to the conditions at SS-25", not that they "were" relevant. SED answers this question with the understanding that SoCalGas meant to replace the term "were" with "may have been".

The numerous casing leaks at the Aliso Canyon storage wells may have been indicators that other wells at the storage facility, including well SS-25, were also likely to experience leaks, as well as threats related to leaks, including the documented corrosion that the casing of well SS-25 had. While the Aliso field is geologically complex, except for recently drilled wells, all of the wells were constructed in the same time period of similar materials and are exposed to similar environmental and gas quality conditions. Specifically, the inclusion of SS-25 with other wells on a 1988 list for evaluation and the 2014 finding in the SIMP study of FREW 2 that the casing had numerous leaks, should have been sufficient information to cause SoCalGas to look more closely at SS-25 for corrosion or other causes of leaks.

b. Identify and produce all DOCUMENTS, aside from the Blade Report, that support SED’s contention that the “numerous casing leaks” “may have been relevant to the conditions at SS-25.”

SED relies on the Blade Report for this violation. SED may update this answer at a later time.

In the 2014 evaluation of FREW 2, there was clear evidence of external corrosion which should have raised an immediate concern for other wells exposed to similar conditions. Corrosion was extensive, including 82% loss with 0% remaining strength. See SoCalGas’s Data Response to SED Data Request 25.

SED requires an answer to Data Request 52 Question 9 as a condition precedent to providing a complete answer to this question. For reference, that question asks:

> In addition to the SIMP Model Studies performed in 2014 on FREW 2, identify all other similar studies performed on other Aliso wells prior to October 23, 2015. For each study identified, provide a complete copy of the resulting report(s) that present log interpretations and results. Each report should be provided in separate, searchable pdf document(s).

In Data Request 52, Question 9, SED asked,

In addition to the SIMP Model Studies performed in 2014 on FREW 2, identify all other similar studies performed on other Aliso wells prior to October 23, 2015. For each study identified, provide a complete copy of the resulting report(s) that present log interpretations and results. Each report should be provided in separate, searchable pdf document(s).

In response, to this question, SoCalGas stated,

SoCalGas objects to this request as vague and ambiguous, particularly with respect to the phrase "SIMP Model Studies" and term "similar," overly broad, and unduly burdensome. Subject to and without waiving the foregoing objections, SoCalGas responds as follows. SoCalGas interprets this request to seek information about the SIMP Pilot Project. Please refer to SoCalGas' response to SED Data Request 25 ("DR-25") dated August 14, 2018. Rather than providing an answer to a direct specific question, this is a data dump, referring to over 1500 documents. It was during SED's review of SoCalGas' response to DR 25 that the SIMP Model Study report of corrosion on well FREW 2 was found. In an ongoing effort to give SoCalGas credit for all investigations into well corrosion and anomalies, SED asked for similar reports. Due to the non-responsive answer of SoCalGas, SED must assume that SoCalGas performed no other studies of wells prior to 2015 that would have identified corrosion or anomalies in well tubings or casings. Therefore, SED has no further comments on this issue at this time.

13. Do YOU contend that SoCalGas has or had authority to compel Daniel Clayton of BOOTS AND COOTS to appear for an examination under oath in response to the SUBPOENAS? If so, state all facts, reasons, and grounds upon which YOU base YOUR contention.

SED objects to this question as vague in that it does not identify the page number or passage of SED's testimony that it is questioning. SED further objects to this question to the extent that it calls for legal conclusion with regards to SoCalGas's authority to compel Mr. Clayton to appear for examination under oath.

SED further objects to this question on the grounds that SoCalGas has asked SED to provide a legal justification for one of its asserted violations, which SoCalGas agreed it would not do in the pre-hearing conference.
SoCalGas's position was that SED should identify alleged violations with specificity in opening testimony. SED identified a concern that SoCalGas not cross-examine SED's witnesses as lawyers for concluding that there was a violation, and SoCalGas voiced no objection to this concern. SED has now proceeded in reliance on SoCalGas's assurance on the record that it would not cross-examine SED's witnesses for identifying the legal justifications for alleged violations in testimony, but this question does exactly that. For context and reference, SED quotes the pertinent portion of the transcript here.1
The next question concerns the deadline for SED to submit alleged violations and the factual and legal justifications for each alleged violation.· My question is

whether it would be reasonable to set a deadline of opening testimony for SED to submit alleged violations, and the factual justifications for each alleged violation, and set a deadline of opening briefs for SED to submit the legal justifications for its alleged violations?
Would any party like to respond to my question?· SoCalGas.
MR. STODDARD:· SoCalGas's position on this is that SED should identify the alleged violations with specificity in its opening testimony sooner, if possible; but in its opening testimony would be acceptable to SoCalGas as we had proposed in our prehearing conference statement.
MR. SHER:· Your Honor, SED would not necessarily be opposed to such if SoCalGas agreed now that it would not waste time cross-examining SED's witness as to their legal basis for tying violations to code sections, et cetera.
ALJ KENNEY:· Does SoCalGas have a response at this time?
MR. STODDARD:· SoCalGas is not going to waive any rights to cross-examination. Although, I would ask for clarification what exactly is meant by "legal basis" here?
MR. SHER:· The way your Honor set this out is that the violations would be set forth in the opening, and then the legal issues would be discussed in the briefing. To the degree -- it is highly unlikely that SED's witness will be a lawyer.· So we don't want SoCalGas, if we are going to do this all in our opening testimony, to cross-examine the witness as to their legal basis for concluding that this is a violation, for example, of 451.

MR. STODDARD:· SoCalGas does not object to that.
ALJ KENNEY:· Thank you.

[1] See I.19-06-016, Pre-hearing conference transcripts, pp. 43 : 11 to 44 : 28.

14. Do YOU contend that SoCalGas has or had authority to compel Mike Baggett of BOOTS AND COOTS to appear for an examination under oath in response to the SUBPOENAS? If so, state all facts, reasons, and grounds upon which YOU base YOUR contention.

SED objects to this question as vague in that it does not identify the page number or passage of SED's testimony that it is questioning. SED further objects to this question to the extent that it calls for legal conclusion with regards to SoCalGas's authority to compel Mr. Baggett to appear for examination under oath. SED incorporates the entirety of its objection on legal conclusion grounds in response to question 13 here.

15. Do YOU contend that SoCalGas was legally obligated to include a term in its STANDARD SERVICES AGREEMENT with BOOTS AND COOTS that required BOOTS AND COOTS to subject itself to the same provisions to cooperate with SED's pre-formal investigation that SoCalGas was required to follow? If so, state all facts, reasons, and grounds upon which YOU base YOUR contention.

SED objects to this question as vague in that it does not identify the page number or passage of SED's testimony that it is questioning. SED further objects to this question to the extent that it calls for legal conclusion with regards to the legal obligations that SoCalGas had to include one or more terms in its STANDARD SERVICES AGREEMENT with BOOTS AND COOTS. SED incorporates the entirety of its objection on legal conclusion grounds in response to question 13 here.

16. Do YOU contend that SoCalGas was legally obligated to include a term in its STANDARD SERVICES AGREEMENT with BOOTS AND COOTS that required BOOTS AND COOTS to respond to investigation-related inquiries from SED and/or Blade? If so, state all facts, reasons, and grounds upon which YOU base YOUR contention.

SED objects to this question as vague in that it does not identify the page number or passage of SED's testimony that it is questioning. SED further objects to this question in that it calls for a legal conclusion, asking for SED's views as to legal obligations of SoCalGas and requirements of Boots and Coots. SED incorporates the entirety of its objection on legal conclusion grounds in response to question 13 here.

17. Do YOU contend that YOU have or had jurisdiction over the contractors that SoCalGas engaged to perform services in connection with responding to the ALISO CANYON leak? If not, do YOU contend that including the provision noted on page 58 of the OPENING TESTIMONY (i.e., a provision that required the contractor "to subject itself

to the same provisions to cooperate with SED's pre-formal investigation that SoCalGas itself was required to follow") would have conferred upon YOU such jurisdiction over SoCalGas' contractors?

SED objects to this question in that it calls for a legal conclusion with respect to whether SED has had or does have jurisdiction over SoCalGas's contractors.
SED incorporates the entirety of its objection on legal conclusion grounds in response to question 13 here.

18. Identify all actions YOU believe SoCalGas should have taken to compel BOOTS AND COOTS personnel to comply with YOUR SUBPOENAS.

SED objects to this question in that it calls for a legal conclusion with respect to steps SoCalGas should have taken to compel Boots and Coots personnel to comply with SED's subpoenas.
SED incorporates the entirety of its objection on legal conclusion grounds in response to question 13 here.

19. Identify and produce all DOCUMENTS evidencing service of YOUR SUBPOENAS on BOOTS AND COOTS.

SED served subpoenas on SoCalGas to produce Boots and Coots, but not on Boots and Coots directly.

20. Identify all actions YOU took to compel BOOTS AND COOTS personnel to comply with YOUR SUBPOENAS.

SED served SoCalGas with subpoenas to produce Boots and Coots, but did not subpoena Boots and Coots personnel directly.

21. Identify the basis on which SED contends that the lack of terms in the STANDARD SERVICES AGREEMENT as discussed in Requests 15 and 16 is a violation of Section 451.

SED objects to this question as ambiguous and vague in that it does not identify the page number or passage of SED's opening testimony to which it is referring. SED further objects to this question as vague and ambiguous in that it does not clarify what "Requests 15 and 16" means, and does not clarify the passages to which the question is referring. If SED receives clarification, SED reserves the right to object to this question to the extent It calls on SED to make a legal conclusion. SED incorporates the entirety of its objection on legal conclusion grounds in response to question 13 here.

22. Produce all DOCUMENTS reflecting COMMUNICATIONS between YOU and BOOTS AND COOTS.

SED objects to this question as unduly burdensome on the grounds that it asks for extensive communications that could take extensive man hours to prove that there is not a single communication that SED has not turned over. Also because of undue burden on SED, SED does not understand this request to include those documents that SoCalGas forwarded from Boots and Coots to SED, or from SED to Boots and Coots. SED further objects to this request as vague and overly broad, asking for all communications between SED and Boots and Coots; not merely those that are within the scope of this proceeding.

Notwithstanding these objections, to the best of SED's knowledge at this time, SED has already produced to SoCalGas all documents reflecting communications between SED and Boots and Coots related to the instant proceeding. These include the Examination Under Oath transcripts of Mr. Danny Walzel and Mr. Mike Kopecky.

23. YOU assert on page 70 of YOUR OPENING TESTIMONY that "Data in the SS-25 file reveals an ongoing detection of leaks at the bottom of the well." Identify the specific data that YOU contend reveals an ongoing detection of leaks.

The specific data is provided In the Bates numbers shown in footnote 443 of SED's opening testimony; SS-25 Well File, Supporting Attachments SED 01774-01778, 01804-01810,[2] and 01894-01895.

24. YOU assert on page 72 of YOUR OPENING TESTIMONY that "The Well File for SS-25 is not kept in any particular order. Typically, such a file would be maintained in chronological order." State all facts, reasons, and grounds upon which YOU base YOUR assertion that gas storage well files are typically maintained in chronological order.

This statement is based on the condition of the well file provided in response to SED DR 1, which was a series of single page Pdf documents. SED assumes this first rendition of the file was a perfect copy of the files in the order in which they appeared in the SoCalGas well file on or about October 23, 2015. If this assumption is correct, the well file lacked any discernable order. And in comparing the SS-25 file with the similarly produced SS-25A and 25B well files, there appears to be documents missing from the SS-25 well file, such as Inter-Office memos that might address the ongoing indications of one or more leaks on temperature surveys and any proposed actions or maintenance actions. The SS-25 well file is also missing basic geologic and reservoir data that would normally be acquired during drilling or logging.

SED requires more time to answer this question, and reserves the right to provide an additional substantive answer.

25. YOU assert on page 74 of YOUR OPENING TESTIMONY that "SoCalGas records do not show operating records that would be reasonable to keep and mirror typical record

[2] SED's opening testimony states 018010. This is a typo, and is corrected to say 01810.

retention policies in the industry."

a. Identify all "record retention policies" that you contend are typical in the gas storage industry.

SED objects to this question as unduly burdensome. Despite the undue burden of this question, SED ~~requires more time to answer this question, and~~ ~~reserves the right to provide an additional substantive answer.~~

SoCalGas has a record retention policy dated November 30, 2013 that identifies the gas storage records to be kept for the life of the asset plus 5 years. See AC_CPUC_SED_DR_17_000024-25. To date, SoCalGas has not demonstrated to a reasonable degree that it kept all of these records for the Aliso Canyon Storage Facility. Records produced fail to show any organization such that the records would be readily accessible to those who need to access them, especially in the event of an emergency.

Examples of other industry record retention policies are provided as attachments. These policies include references to governing laws and regulations, which SoCalGas can obtain separately through its own library or law office.

1986.0601.GTR0004210_SP_210.4-4_Records_retention.pdf (Redacted)
GasTransmissionSystemRecordsOII_DR_CPUC_023-Q26Atch08_REDACTED.pdf
Pages 34-35.PG&E.P2-2-Guide.to.Record.Retention-2003.pdf (Redacted)

b. Did SED ever conduct an audit of SoCalGas relating to whether SoCalGas had record-keeping procedures that were "reasonable" or "mirror[ed] typical retention policies in the industry."

SED objects to this question as unduly burdensome. SoCalGas is the subject of all SED audits identified in the question, and has the information regarding whether it was the subject of any such audits. SED reminds SoCalGas to avoid wasting limited SED staff time with questions to which SoCalGas does or should demonstrably have the answer.

c. Produce all DOCUMENTS regarding "typical record retention policies in the industry."

SED objects to this question as unduly burdensome in asking for SED to produce all such typical record retention policies in the industry because SoCalGas should also have such information. Despite the undue burden of this question, SED ~~requires more time to answer this question, and reserves the right to provide an additional substantive answer.~~

See also attached in response to 25.a.

26. YOU assert on page 68 of YOUR OPENING TESTIMONY that "This failure to maintain basic records led to the inability to maintain wells in safe conditions and to supply critical operating data in response to emergencies."

a. Identify all instances in which YOU contend failure to maintain basic records by SoCalGas "led to the inability to maintain wells in safe conditions." For each such instance, identify the relevant well and record.

SED requires an answer to Data Request 52 Questions 1, 3, 4, 5, 6, 7, 8 and 9 as a condition precedent to providing a complete answer to this question.

b. Identify all instances in which YOU contend failure to maintain basic records by SoCalGas "led to the inability… to supply critical operating data in response to emergencies." For each such instance, identify the relevant well and record.

SED objects to this question as unduly burdensome in that it requests SED to gather information related to the question that is or was in the control of SoCalGas, and analyze it to determine what type of whether failure to maintain basic records by SoCalGas led to the inabilities identified in the question.

Despite the undue burden of this question, SED replies: Please refer to page 131 of the Blade Main Report, March 16, 2019, where Blade Identifies the difference between its determination of the Bottom Hole Pressure ("IPR") compared to the significantly lower pressure SoCalGas gave to DOGGR and the national laboratory for well kill calculations. For further analysis of the results of this difference, see the Blade Report. Records used by Blade for development of the BHP are discussed on pages 128-130 of the Blade Main Report. This discussion points out the problems with some historical data provided to Blade. But, at the basic level, SoCalGas had no current record of the BHP for SS-25, or for the reservoir when Well-SS-25 failed.

Supplementing the above statement. SoCalGas severely underestimated the Reservoir Pressure. (See Blade Vol 3. SS-25 Transient Well Kill Analysis, pp. 10 and 16.) In addition, SoCalGas used an incorrect gas flow of 30 MMscf/D, which should have been in the range of 80 to 93 MMscf/D. SoCalGas' own historical data showed well flow in excess of 80 MMScf/D. (see Blade Vol. 3 SS-25 Transient Well Kill Analysis, p. 37.) These Incorrect figures were apparently used by SoCalGas and Boot & Coots in developing kill procedures that failed. While SoCalGas did not produce evidence of utilizing models prior to kill attempt 7, SED assumes SoCalGas and its contractors, at a minimum, performed calculations to determine the ppg of fluid and pump pressures it would use in each kill attempt. Reservoir pressure, bottom hole pressure and well flow are critical factors in making such calculations. Underestimating these numbers led to repeated well kill failures. A responsible gas stororage operator should have current records that accurately reflect these critical operating data and those records should be readily available to engineering and operating personnel. SoCalGas failed in this respect, creating an

unsafe situation in which conditions at Well SS-25 could not be fully controlled by personnel and where an estimated 120,000 metric tons of methane were released into the atmosphere from the end of October 2015 to early February 2016.

SED requires an answer to Data Request 52 Questions 1, 3, 4, 5, 6, 7, 8 and 9 as a condition precedent to providing a complete answer to this question.

SED Data Request 52 Question 1 asked:

Related to AC_CPUC_0014712-20175 identify by AC.CPUC file number each Cathodic Protection Work Order Report that shows readings on a gas well casing.

SoCalGas's response to SED Data Request 52 Question 1 was non-responsive,

SoCalGas objects to this request on the grounds that it is vague and ambiguous, particularly with respect to the term "readings" and phrase "gas well casing." SoCalGas further objects to this request as overly broad and imposing an undue burden under Rule 10.1 of the Commission's Rules of Practice and Procedure to the extent it seeks to require SoCalGas to search through documents previously provided to SED and in SED's possession.

SED is unable to discern from SoCalGas's answer which exact documents SoCalGas means to be responsive to the question.

SED Data Request 52 Question 3 asked:

Related to AC_CPUC_SED_KITSON_0003008, provide all forms 3466 "Reporting of Gas Blown to Atmosphere" that reported the amount(s) of gas blown to atmosphere associated with the SS25 leak.

"SoCalGas's response to SED Data Request 52 Question 3 was non-responsive and incomplete, stating,

SoCalGas objects to this request to the extent it is vague and ambiguous and seeks information that is outside the scope of this proceeding as set forth in the Assigned Commissioner's Scoping Memo and Ruling dated September 26, 2019. Subject to and without waiving the foregoing objections, SoCalGas responds as follows. The amount of gas blown to atmosphere associated with the SS25 leak was not reported through Form 3466 "Reporting Gas Blown to Atmosphere."

SED Data Request 52 Question 4 asked:
Also related to AC_CPUC_SED_KITSON_0003008, provide all completed forms (please include an ID form number(s) or database name or names) that report the amount of oil discharged to the atmosphere and the amount(s) captured as liquid during the 2015-2016 SS-25 leak.

SoCalGas's response to SED Data Request 52 Question 4 was non-responsive and incomplete, stating,

SoCalGas objects to this request to the extent it is vague and ambiguous and seeks

information that is outside the scope of this proceeding as set forth in the Assigned Commissioner's Scoping Memo and Ruling dated September 26, 2019. Subject to and without waiving the foregoing objections, SoCalGas responds as follows. Form 3466 "Reporting Gas Blown to Atmosphere" referenced in AC_CPUC_KITSON_0003008 does not contemplate reporting oil discharge volumes.

SED Data Request 52 Question 5 asked:

Related to AC_CPUC_SED_DR17_0000163, provide (or identify DR response and bates numbers) records referenced in the "5.1 Records" section of Standard 224.02 for Wells SS-25, SS-25A and SS-25B.

SoCalGas's Response to Data Request 52 Question 5 answered:

SoCalGas objects to this request as overly broad, unduly burdensome, and outside the scope of this proceeding as set forth in the Assigned Commissioner's Scoping Memo and Ruling dated September 26, 2019. SoCalGas further objects to this request for failing to provide a defined time period to which SoCalGas may tailor its response. Subject to and without waiving the foregoing objections, SoCalGas responds as follows. SoCalGas interprets this request to seek information for the 3 months preceding October 23, 2015. Please see electronic documents with Bates range:

I1906016_SCG_SED_DR_52_0000001 through I1906016_SCG_SED_DR_52_0000036. Additional documents will be provided in an upcoming supplement to this response.

Due to the incomplete nature of this response, SED is unable to analyze it and answer the question at this time.

SED Data Request 52, Question 6 asked:

Also related to AC_CPUC_SED_DR17_0000163, provide daily records for the 3 months preceding October 23, 2015 and ALL records of sacrificial probes, including probe installation, failure and replacement.

SoCalGas's response to Data Request 52, Question 6 answered:

SoCalGas objects to this request as overly broad, unduly burdensome, and outside the scope of this proceeding as set forth in the Assigned Commissioner's Scoping Memo and Ruling dated September 26, 2019. Subject to and without waiving the foregoing objections, SoCalGas responds as follows. SoCalGas interprets this request to seek information for wells SS-25, SS25A, and SS-25B. Please refer to Response 5.

Due to the incomplete nature of this response, SED is unable to analyze it and answer the question at this time.

SED Data Request 52, Question 7 asked.

Identify by well number all shallow water observation wells installed at the Aliso Canyon Storage Unit. For each well, provide:
a. Well Number
b. Installation record showing at least date drilled, depth of well, depth of water from surface.
c. All data collected and recorded from these wells.
d. One map showing location of shallow water wells at Aliso.

SoCalGas responded to this question:

SoCalGas objects to this request as vague and ambiguous, particularly with respect to the phrase "shallow water observation wells," overly broad and unduly burdensome, and outside the scope of this proceeding as set forth in the Assigned Commissioner's Scoping Memo and Ruling dated September 26, 2019. Subject to and without waiving the foregoing objections, SoCalGas responds as follows. Prior to October 23, 2015, gas storage observation wells SS-5 and W3A were used to monitor pressure in the west and east field areas, respectively. Due to the incompleteness of this answer in failing to address subparts b, c, and d of Data Request 52, Question 7, SED is unable to answer this question at this time.

SED Data Request 52, Question 8 asked:

Related to AC_CPUC_SED_DR17_0000185, provide all records referenced in Section 5.1 collected, calculated and plotted during 2014-2015 for Aliso Canyon Storage Unit. Please state what form these records are kept in and where they are stored.

SoCalGas responded to Data Request 52, Question 8 as follows:

SoCalGas objects to this request as vague and ambiguous, particularly with respect to the phrase "Aliso Canyon Storage Unit," overly broad, and unduly burdensome. Subject to and without waiving the foregoing objections, SoCalGas responds as follows. SoCalGas interprets this request to seek information about the Aliso Canyon Gas Storage Field. Please see electronic document with Bates range: I1906016_SCG_SED_DR_52_0000037.

SED is unclear how this document responds to the question asked. Therefore, SED assumes from this response that SoCalGas is not maintaining the records per its own Standard.

In Data Request 52, Question 9, SED asked,

In addition to the SIMP Model Studies performed in 2014 on FREW 2, identify all other similar studies performed on other Aliso wells prior to October 23, 2015. For each study identified, provide a complete copy of the resulting report(s) that present log

interpretations and results. Each report should be provided in separate, searchable pdf document(s).

In response, to this question, SoCalGas stated,

SoCalGas objects to this request as vague and ambiguous, particularly with respect to the phrase "SIMP Model Studies" and term "similar," overly broad, and unduly burdensome. Subject to and without waiving the foregoing objections, SoCalGas responds as follows. SoCalGas interprets this request to seek information about the SIMP Pilot Project. Please refer to SoCalGas' response to SED Data Request 25 ("DR-25") dated August 14, 2018. The request is for records of Surface Pressure taken during shut-in, calculations and Plots. The documents provided may contain some of the information, but do not appear to fit the Records requirement in their Standard.

Rather than providing an answer to a direct specific question, DR 25 response is a data dump, of over 1500 documents in the middle of which SED found the SIMP Model Study report. Due to the non-responsive answer of SoCalGas, SED is unable to provide a further answer to this question at this time.

SED had asked the questions in DR 52 to gain a clearer understanding of how SoCalGas keeps records. Because SoCalGas did not provide any substantive responses, SED will assume SoCalGas either does not have responsive documents or, if it does, the documents cannot be found due to poor recordkeeping practices.

c. Identify the basis on which YOU contend that this alleged failure is a violation of Section 451.

SED objects to this question on the grounds that it mischaracterizes SED's testimony. SED does not use this point as the violation of Section 451. Instead, the violations are identified at the end of the section in which this sentence is found. Namely, the recordkeeping related violations in this section are articulated on SED opening testimony page 75, and state,

> In conclusion, SoCalGas' imprudent and unreasonable record keeping practices violated Section 451 three times; once for well SS-25, a second time for well SS-25A, and a third time for well SS-25B. The violation associated with well SS-25 begins June 6, 1973, the date that SoCalGas hydrotested their gas conversion of well SS-25. The violation associated with well SS-25A began December 7, 1972, the date that well SS-25A became operational according to DOGGR records. The violation associated with well SS-25B began October 29, 1973, the date that well SS-25B became operational according to DOGGR records.
>
> Each of these three violations end on October 23, 2015, as safety records in Well Files SS-25, SS-25A and SS-25B appeared to be missing up through the date of the well SS-25 incident.

27. YOU allege that SoCalGas knew that SS-25 released both crude oil and natural gas during the ALISO CANYON incident, but "did not disclose this fact to the Los Angeles County Department of Health." (OPENING TESTIMONY, page 51).

a. Identify all actions taken by YOU to independently verify the claims alleged by the California Department of Public Health ("DPH").

SED objects to this question on the grounds that it is unduly burdensome and overly broad, requiring SED to identify all actions it took to independently verify the claims alleged by DPH.

Notwithstanding these objections, SED requires more time to answer this question, and reserves the right to update its answer.

b. Confirm or deny that YOU considered SoCalGas' March 21, 2019 response letter to the DPH when preparing YOUR OPENING TESTIMONY.

SED objects to this question to the extent it requests information that is protected by attorney-client and work product privileges. Without waiving these privileges, the answer is yes, as shown in SED's opening testimony on pages 51 and 52. Specifically, the passage in SED's testimony that shows SED considered SoCalGas's response letter to DPH states,

"SoCalGas responded to the Department of Public Health asserting 'For all the above reasons, your suggestion that SoCalGas somehow withheld information or was otherwise not fully transparent with respect to the components of natural gas released during the incident, and your statements concerning DPH's ability to perform a health assessment, are simply incorrect.'" SED's testimony references the March 21, 2019 letter in footnotes 383 and 384 of its opening testimony, which are cited in this passage.

c. Produce any and all COMMUNICATIONS by and between SED and the DPH, from October 23, 2015 through and including December 6, 2019.

~~SED objects to this question on the grounds that it requests information that is protected by the common interest privilege.~~ SED withdraws this objection. As of the date of this updated data response, SED is still in the process of gathering these documents. SED will provide them to SoCalGas at a later date. To document the timing during which SED withdrew this objection,

On January 23, 2020, SED communicated with SoCalGas as follows:

"SED learned for the first time this morning from Los Angeles County Department of Public Health (LACDPH) its position that it never entered into a formal common interest privilege with Safety and Enforcement Division (SED) related to the Aliso Canyon Order Instituting Investigation. SED clarified with LACDPH that we had a misunderstanding with LACDPH, in that SED had understood that we had entered into such an agreement. SED also learned for the first time yesterday afternoon that LACDPH wrote to SoCalGas that LACDPH had no such common interest agreement with SED.

In light of these new developments, SED withdraws its objection to Southern California Gas Company's Data

Request 3, Question 27c. SED has begun the exercise of gathering the communications SED has had with LACDPH it is able to gather that are responsive to SoCalGas Data Request 3, Question 27 c. For reference, that question asks: “Produce any and all COMMUNICATIONS by and between SED and the DPH, from October 23, 2015 through and including December 6, 2019.

We will update you when we have an understanding as to when we will be able to turn them over to you.”

d. Produce any and all internal CPUC COMMUNICATIONS concerning DPH related to ALISO CANYON, from October 23, 2015 through and including December 6, 2019.

SED objects to this question on the grounds that it requests information that is protected by attorney client and work product privileges. SED also objects to this question on the grounds that it is unduly burdensome.

28. YOU allege that SoCalGas “did not have a well specific, well control plan that considered transient kill modeling or well deliverability. There was not quantitative understanding of well deliverability, although data were available, and well-established industry practices existed for such analysis.” (OPENING TESTIMONY, page 28).

a. Identify the “well-established industry standards” you reference on page 28 of YOUR OPENING TESTIMONY.

SED objects to this question as mischaracterizing its testimony, which uses the term "well-established industry practices"; not "well-established industry standards". SED understands the question to be asking about "well-established industry practices", and will answer the question with this understanding.

This statement is based upon excerpts quoted from the Blade Report, pages 5 and 238.

b. Identify and produce all DOCUMENTS, aside from the Blade Report, that include or reference the “well-established industry standards” you identify in response to Request 28(a).

SED further objects to this question as unduly burdensome in that it requests SED to gather all documents that include well-established industry standards.

Despite the undue burden of this question, SED requires more time to answer this question, and reserves the right to provide an additional substantive answer.

For reference to "simulations," a term used before "modeling" but essentially the same thing, refer to Donald L. Katz, AIME, U. of Michigan, "Monitoring Gas Storage Reservoirs," June 10, 1971, SPE PAPER No. 3287.

c. Identify the basis on which YOU contend that this allegation is a violation of Section 451.

SED objects to this question as mischaracterizing its opening testimony. The violations in this section are identified in this section on pages 38 and 39, and are quoted here.

> Given that SoCalGas had no well kill control plans and there are no data indicating transient modeling -- any modeling -- or analysis conducted to design the second through sixth well kill attempts, and such modeling would have provided the necessary information to successfully kill the well, SoCalGas violated Section 451.
>
> The Section 451 violation began November 13, 2015, the day SoCalGas unsuccessfully executed the second well kill attempt without modeling, and continued through February 11, 2016, the date of the successful relief well kill attempt. Because the second through sixth well kill attempts should have been successful with proper modeling, shareholders should be required to pay all expenses associated with each one. Also, because the relief well was started on December 4, 2015, after the second well kill attempt, the relief well would not have been needed had the second well kill attempt been properly modeled. As such, shareholders should be required to pay all expenses associated with the relief well. SoCalGas's failure to provide well kill programs for relief well #2, well SS-25A and well SS-25B each constitute one violation of Section 451, for a total of three violations. Each of these violations span from November 13, 2015, the date
> SoCalGas unsuccessfully executed the second well kill attempt, to February 11, 2016, the date of the successful relief well kill attempt.
>
> Because surface plumbing failures prevented the well from being kept filled and the wellhead and surface casing were structurally unstable by kill attempt 6,276 such damage appears to have resulted from the prior unsuccessful kill attempt, thereby compromising the ability of kill attempt 7 to kill the well and end the safety consequences of the SS-25 leak. According to Blade, pumping for kill attempt 7 was terminated due to rocking of the wellhead and a subsequent failure of the injection connection. In other words, the ability to succeed on the seventh kill attempt was impaired by at least certain of the prior unsuccessful kill attempts, which should have been successful. This is a violation of Section 451.
>
> The apparent conservative start date of this violation is November 25, 2015, the date that well kill attempt #6 was made. This violation continued until February 11, 2016, the date of the successful relief well kill attempt.
>
> The basis for these violations is provided in the SED's opening testimony, Section II.B.5, pages 28 to 39.

29. YOU allege that the Division of Oil, Gas and Geothermal Resources ("DOGGR")

responded to a 1994 SoCalGas proposal by stating, in part, "'Therefore, the monitoring program and static temperature surveys currently used by the Gas Company could be used to satisfy compliance of the requirements for mechanical integrity found in this section [California Code of Regulations Section 1724.10(k)(5)].'" (OPENING TESTIMONY, page 15). Do YOU disagree that DOGGR affirmatively stated that SoCalGas' activities complied with the cited regulation? If so, identify all grounds for your position.

SED's position is precisely that from SED testimony page 15, which SoCalGas quoted in the question. The grounds for the position is shown in the quote, and based upon the Blade Report at page 198, as cited in footnote 75.

30. Do YOU contend that YOU have authority to fine utilities for actions that are not within SED's regulatory purview, but instead are regulated exclusively by DOGGR?

SED objects to this question on the grounds that it calls for a legal conclusion as to SED's authority and SED's regulatory purview, as well as the exclusive regulatory purview of DOGGR. SED further objects to the question as argumentative, that it assumes facts not in evidence, that it mischaracterizes SED's testimony, that it is vague and ambiguous in that it fails to provide context, vague as to time, and that it is overly broad.

31. Provide all contracts SED is aware of between underground gas storage operators, entered into during an emergency situation, that include a provision requiring the contractor to subject itself to the same provisions to cooperate with an investigation, by a regulator that has no jurisdiction over the contractor, as the principal.

SED objects to this question as vague in that it does not reference a page of SED's testimony; vague as to time; overly broad in asking for SED's awareness of all underground gas storage operators, including those not regulated by the Commission; and unduly burdensome.

Ex. IV-2

I.19-06-016: Safety and Enforcement Division Response to Southern California Gas Company Data Request 7

1. Do you contend in YOUR OPENING TESTIMONY (on page 3 and Section II.B.1.a) that SoCalGas should have conducted an "investigation of blowout from well Frew-3?" If so, identify all laws, regulations, industry standards, internal rules or policies that support your contention.

SED objects to this question as asked and answered. See SED's Response to Data Request 3, question 1. SED reminds SoCalGas to cease asking questions to which it demonstrably has the answer in order to avoid wasting limited SED staff time.

2. Do you contend in YOUR OPENING TESTIMONY (on page 3 and Section II.1.a) that SoCalGas should have conducted an "investigation of blowout from well-FF34A?" If so, identify all laws, regulations, industry standards, internal rules or policies that support your contention.

SED objects to this question as asked and answered. See SED's Response to Data Request 3, question 2. SED reminds SoCalGas to cease asking questions to which it demonstrably has the answer in order to avoid wasting limited SED staff time.

3. Do you contend in YOUR OPENING TESTIMONY (on page 3 and Section II.B.1.a) that SoCalGas should have conducted an "investigation of one of four parted well casings?" If so, identify all laws, regulations, industry standards, internal rules or policies that support your contention.

SED objects to this question as asked and answered. See SED's Response to Data Request 3, question 4. SED reminds SoCalGas to cease asking questions to which it demonstrably has the answer in order to avoid wasting limited SED staff time.

4. Do you contend in YOUR OPENING TESTIMONY (on page 3 and Section II.B.1.a) that SoCalGas should have conducted an "investigation of any of three parted well casings?" If so, identify all laws, regulations, industry standards, internal rules or policies that support your contention.

SED objects to this question as asked and answered. See SED's Response to Data Request 3, question 3. SED reminds SoCalGas to cease asking questions to which it demonstrably has the answer in order to avoid wasting limited SED staff time.

5. Do you contend in YOUR OPENING TESTIMONY (on page 3 and Section II.B.1.a) that SoCalGas should have conducted an "investigation of 54 well leaks?" If so, identify all laws, regulations, industry standards, internal rules or policies that support your contention.

SED objects to this question as asked and answered. See SED's Response to Data Request 3, question 5. SED reminds SoCalGas to cease asking questions to which it demonstrably has the answer in order to avoid wasting limited SED staff time.

6. Do you contend in YOUR OPENING TESTIMONY (on page 3 and Section II.B.1.b) that SoCalGas should have "check[ed the] internal casing of 12 wells for metal loss?" If so, identify all laws, regulations, industry standards, internal rules or policies that support your contention.

Not precisely. SED's testimony asserts on page 10 that, "SoCalGas's failure to follow its own 1988 plan to check the casing in 12 wells for metal loss violates Section 451."

This passage corresponds with the passage quoted in the question, and referenced on page 3 of the testimony.

7. Do you contend in YOUR OPENING TESTIMONY (at page 3 and Section II.B.1.b) that SoCalGas should have "check[ed the] internal casing of well SS-25?" If so, identify all laws, regulations, industry standards, internal rules or policies that support your contention.

Not precisely. SED's testimony provides on page 12 that, "SED considers SoCalGas's failure to investigate the specific corrosion problems on Well SS-25 its own separate violation of California Public Utilities Code Section 451. This violation spans from August 31, 1988, the last date that the SoCalGas's 1988 memo could have identified it, to October 23, 2015."

This passage corresponds with the passage quoted in the question, and referenced on page 3 of the testimony.

8. Do you contend in YOUR OPENING TESTIMONY (at page 3 and Section II.B.2.a) that SoCalGas should have "implement[ed] a risk or integrity management program for Aliso Canyon storage facility?" If so, identify all laws, regulations, industry standards, internal rules or policies that support your contention.

Not precisely. SED's testimony provides on page 16 that, "SoCalGas's failure to implement any form of risk assessment program or wellbore integrity management plan on the Aliso Canyon storage facility prior to October 23, 2015, beginning in 2009,77 and continuing through October 23, 2015, constitutes a separate violation of Section 451 for each day it failed to implement the risk assessment program."

This passage corresponds with the passage quoted in the question, and referenced on page 3 of the testimony.

9. Do you contend in YOUR OPENING TESTIMONY (at page 3 and Section II.B.2.b) that SoCalGas should have "detect[ed] corrosion on well SS-25" at least in part from "risk assessment of Aliso?" If so, identify all laws, regulations, industry standards, internal rules or policies that support your contention.

Not precisely. SED's testimony provides on page 17 that, "SED finds that the failure to detect corrosion on SS-25 that resulted in part from SoCalGas's failure to perform a risk assessment on Aliso Canyon is a separate violation of Section 451, beginning December 31, 2009, and continuing through October 23, 2015."

This passage corresponds with the passage quoted in the question, and referenced on page 3 of the testimony.

10. Do you contend in YOUR OPENING TESTIMONY (at page 3 and Section II.B.2.c) that SoCalGas should have "start[ed] well integrity program in 2009?" If so, identify all laws, regulations, industry standards, internal rules or policies that support your contention.

Not precisely. SED's testimony provides on page 18 that, "SoCalGas's failure to start the well integrity program in 2009 because it could not yet collect the cost of the program in rates constituted its own

separate violation of Section 451. This violation began on December 31, 2009 and continued until October 23, 2015."

This passage corresponds with the passage quoted in the question, and referenced on page 3 of the testimony.

11. Do you contend in YOUR OPENING TESTIMONY (at page 3 and Section II.B.3) that SoCalGas should not have "[o]perat[ed] well SS-25 without backup mechanical barrier to 7-inch production casing?" If so, identify all laws, regulations, industry standards, internal rules or policies that support your contention.

Not precisely. SED's testimony provides on page 25 that, "SED finds that SoCalGas violated Section 451 by operating well SS-25 without a backup mechanical barrier to the 7-inch production casing. In August 1988, an internal SoCalGas memo recommended that a casing inspection survey be run on 20 wells to "determine the mechanical condition of each well casing." Given SoCalGas's failure to inspect the casing of SS-25 in response to its own August 1988 memo, this violation spans from the end of August 1988 until October 23, 2015."

This passage corresponds with the passage quoted in the question, and referenced on page 3 of the testimony.

12. Do you contend in YOUR OPENING TESTIMONY (at page 3 and Section II.B.4) that SoCalGas should not have "[o]perat[ed] Aliso without internal policies that required well casing wall thickness inspection and measurement?" If so, identify all laws, regulations, industry standards, internal rules or policies that support your contention.

Not precisely. SED's testimony provides on page 27 that, "Although there were no regulatory requirements for wall thickness measurements to be done, SoCalGas operated its Aliso Canyon storage facility without internal policies that required well casing wall thickness inspection and measurement in violation of Section 451. The span of this violation extends from the issuance of the memo in August 1988 to October 23, 2015, the date of the incident."

This passage corresponds with the passage quoted in the question, and referenced on page 3 of the testimony.

13. Do you contend in YOUR OPENING TESTIMONY (at page 3 and Section II.B.5) that SoCalGas could have "successfully execute[d any or all of] well SS-25 kill attempt numbers 2 through 7" with "proper modelling?" If so, identify all laws, regulations, industry standards, internal rules or policies that support your contention.

Not precisely. SED's testimony provides on pages 38 and 39 that, "In Blade's view, the first well kill attempt was a reasonable response because the extent of the failure in SS-25 was unknown. Also in Blade's view, the scope of the well-control problem should have been better understood 20 days after the first well kill attempt because that time was spent gathering the data about well condition and preparing the site for the subsequent well kill operations. Given that SoCalGas had no well kill control plans and there are no data indicating transient modeling -- any modeling -- or analysis conducted to design the second through sixth well kill attempts, and such modeling would have provided the necessary information to successfully kill the well, SoCalGas violated Section 451.

The Section 451 violation began November 13, 2015, the day SoCalGas unsuccessfully executed the second well kill attempt without modeling, and continued through February 11, 2016, the date of the successful relief well kill attempt. Because the second through sixth well kill attempts should have been successful with proper modeling, shareholders should be required to pay all expenses associated with each one. Also, because the relief well was started on December 4, 2015, after the second well kill attempt, the relief well would not have been needed had the second well kill attempt been properly modeled. As such, shareholders should be required to pay all expenses associated with the relief well.

This passage corresponds with the passage quoted in the question, and referenced on page 3 of the testimony.

14. Do you contend in YOUR OPENING TESTIMONY (at page 3 and Section II.B.5) that SoCalGas should have "provide[d] well kill programs for relief well #2, well SS-25A and well SS-25B?" If so, identify all laws, regulations, industry standards, internal rules or policies that support your contention.

Not precisely. SED's testimony provides on pages 38 and 39 that, "SoCalGas's failure to provide well kill programs for relief well #2, well SS-25A and well SS-25B each constitute one violation of Section 451, for a total of three violations. Each of these violations span from November 13, 2015, the date SoCalGas unsuccessfully executed the second well kill attempt, to February 11, 2016, the date of the successful relief well kill attempt." This passage corresponds with the passage quoted in the question, and referenced on page 3 of the testimony.

15. Do you contend in YOUR OPENING TESTIMONY (at page 4 and Section II.B.5) that SoCalGas should have "[p]revent[ed]… [the] surface plumbing failure on SS25?" If so, identify all laws, regulations, industry standards, internal rules or policies that support your contention.

Not precisely. SED's testimony provides on page 39 that, "Because surface plumbing failures prevented the well from being kept filled and the wellhead and surface casing were structurally unstable by kill attempt 6, such damage appears to have resulted from the prior unsuccessful kill attempt, thereby compromising the ability of kill attempt 7 to kill the well and end the safety consequences of the SS-25 leak. According to Blade, pumping for kill attempt 7 was terminated due to rocking of the wellhead and a subsequent failure of the injection connection. In other words, the ability to succeed on the seventh kill attempt was impaired by at least certain of the prior unsuccessful kill attempts, which should have been successful. This is a violation of Section 451.

The apparent conservative start date of this violation is November 25, 2015, the date that well kill attempt #6 was made. This violation continued until February 11, 2016, the date of the successful relief well kill attempt."

This passage corresponds with the passage quoted in the question, and referenced on page 3 of the testimony.

16. Do you contend in YOUR OPENING TESTIMONY (at page 4 and Section II.B.6) that SoCalGas should have "assess[ed] the relationship between groundwater in and around the SS-25 wellsite and surface casing corrosion of SS-25?" If so, identify all laws, regulations, industry standards, internal rules or policies that support your contention.

SED objects to this question as asked and answered. See SED's response to SoCalGas Data Request 3, questions 7 and 8. SED reminds SoCalGas to cease asking questions to which it demonstrably has the answer in order to avoid wasting limited SED staff time.

17. Do you contend in YOUR OPENING TESTIMONY (at page 4 and Section II.B.7) that SoCalGas should have had a "systematic practice to protect casing strings against external corrosion?" If so, identify all laws, regulations, industry standards, internal rules or policies that support your contention.

SED objects to this question as asked and answered. See SED's response to SoCalGas Data Request 3, question 9. SED reminds SoCalGas to cease asking questions to which it demonstrably has the answer in order to avoid wasting limited SED staff time.

18. Do you contend in YOUR OPENING TESTIMONY (at page 4 and Section II.B.7) that SoCalGas should have had cemented production casings? If so, identify all laws, regulations, industry standards, internal rules or policies that support your contention.

SED objects to this question as asked and answered. See SED's response to SoCalGas Data Request 3, question 9. SED reminds SoCalGas to cease asking questions to which it demonstrably has the answer in order to avoid wasting limited SED staff time.

19. Do you contend in YOUR OPENING TESTIMONY (at page 4 and Section II.B.8) that SoCalGas should "have [had] continuous pressure monitoring system for well surveillance?" If so, identify all laws, regulations, industry standards, internal rules or policies that support your contention.

Not precisely. SED's opening testimony provides on page 50 that, "SoCalGas violated Section 451 by not having a continuous pressure monitoring system for well surveillance because it prevented an immediate identification of the SS- 25 leak and accurate estimation of the gas flow rate. This violation lasted from October 23, 2015 to February 12, 2016, the duration of the incident."

This passage corresponds with the passage quoted in the question, and referenced on page 4 of the testimony.

20. Do you contend in YOUR OPENING TESTIMONY (at page 6 and Section II.C.3) that SoCalGas had "[i]mprudent and unreasonable recordkeeping practices associated with well SS-25?" If so, identify all laws, regulations, industry standards, internal rules or policies that support your contention.

Not precisely. SED's opening testimony at page 75, states,

"In conclusion, SoCalGas' imprudent and unreasonable record keeping practices violated Section 451 three times; once for well SS-25, a second time for well SS-25A, and a third time for well SS-25B. The violation associated with well SS-25 begins June 6, 1973, the date that SoCalGas hydrotested their gas conversion of well SS-25. The violation associated with well SS-25A began December 7, 1972, the date that well SS-25A became operational according to DOGGR records. The violation associated with well SS-25B began October 29, 1973, the date that well SS-25B became operational according to DOGGR records.

Each of these three violations end on October 23, 2015, as safety records in Well Files SS-25, SS-25A and SS-25B appeared to be missing up through the date of the well SS-25 incident.

This passage corresponds with the passage quoted in the question, and referenced on page 6 of the testimony.

21. Do you contend in YOUR OPENING TESTIMONY (at page 6 and Section II.C.3) that SoCalGas had "[i]mprudent and unreasonable recordkeeping practices associated with well SS-25A?" If so, identify all laws, regulations, industry standards, internal rules or policies that support your contention.

See response to question 20.

22. Do you contend in YOUR OPENING TESTIMONY (at page 6 and Section II.C.3) that SoCalGas had "[i]mprudent and unreasonable recordkeeping practices associated with well SS-25B?" If so, identify all laws, regulations, industry standards, internal rules or policies that support your contention.

See response to question 20.

23. Do you contend in YOUR OPENING TESTIMONY (at page 6 and Section II.C.3) that SoCalGas should have "record[ed] continuous wellhead pressure?" If so, identify all laws, regulations, industry standards, internal rules or policies that support your contention.

Not precisely. SED's opening testimony provides at page 75 as follows: "Also, SoCalGas's failure to monitor the wellhead pressure of well SS-25 continuously, a problem throughout Aliso Canyon natural gas storage facility, was a violation of Section 451 because it deprived SoCalGas of a key piece of information that would have helped kill the well leak that began on October 23, 2015. This violation began October 15, 2015, the last time SoCalGas collected a pressure reading on the well, and continued until October 23, 2015, the beginning of the incident."

This passage corresponds with the passage quoted in the question, and referenced on page 6 of the testimony.

24. Do you contend in YOUR OPENING TESTIMONY (at pages 73-74) that SoCalGas was required to keep ground water and/or cathodic protection records? If so, identify all laws, regulations, industry standards, internal rules or policies that support your contention.

Yes. As noted on pages 73 and 74 of SED's opening testimony,

"<u>Missing Ground Water and Cathodic Protection Records; an Unsafe Practice.</u>
There is also no evidence that SoCalGas created or kept ground water records, or other records of measurements relative to external corrosion of underground pipe in their SS-25, SS-25A or SS-25B Well Files. It is reasonable to expect a prudent well field operator to collect such records so they would be able to predict the life of pipe and plan for replacements or repairs in a safe and timely manner. Because SoCalGas lacked records, it had limited ability to assess the potential for, or predict external corrosion in well piping. Groundwater records would be a basic record kept by any company utilizing steal in underground construction. SoCalGas is well aware of this requirement because it maintains underground natural gas pipelines all over Southern California which has
cathodic protection to prevent corrosion. For the same reason, SoCalGas should have utilized cathodic protection on the wells. However, SoCalGas Well File records for SS-25, SS-25A, and SS-25B contain no report or studies regarding well corrosion from exposure to groundwater, or cathodic protection."

The violation associated with this is shown on page 75 of SED's opening testimony, which states,

"In conclusion, SoCalGas' imprudent and unreasonable record keeping practices violated Section 451 three times; once for well SS-25, a second time for well SS-25A, and a third time for well SS-25B. The violation associated with well SS-25 begins June 6, 1973, the date that SoCalGas hydrotested their gas conversion of well SS-25. The violation associated with well SS-25A began December 7, 1972, the date that well SS-25A became operational according to DOGGR records. The violation associated with well SS-25B began October 29, 1973, the date that well SS-25B became operational according to DOGGR records."

25. Do you contend in YOUR OPENING TESTIMONY (at page 74) that SoCalGas was required to "collect[] and record[] basic operational data on a regular (typically continuous) or daily basis?" If so, identify all laws, regulations, industry standards, internal rules or policies that support your contention.

Yes. As shown on pages 74 and 75 of SED's Opening testimony,

"Operating Records Missing; an Unsafe Practice. SoCalGas records do not show operating records that would be reasonable to keep and mirror typical record retention policies in the industry. For instance, collecting and recording of basic operational data on a regular (typically continuous or daily basis) is a prudent and reasonable requirement to ensure ongoing safe operations and timely identification of problems. At the very least, any measurements made or calculated on a routine basis should be recorded in the Well File for future reference. For instance, SoCalGas was not monitoring well head pressure continuously, or even daily for the injection/extraction wells. In SoCalGas' words, "Underground gas storage wells at Aliso Canyon were not equipped with continuous pressure monitoring. Pressure measurements were collected on a weekly basis. The last pressure reading on SS-25 casing was collected on 10/15/15. The measurement was 2595 psig."458 As a result, when the company needed to kill the well on October 23, 2015, it did not have a current bottom hole pressure, a key piece of data for their selection of the appropriate weighting materials. SoCalGas was not monitoring reservoir or bottom hole pressure for the wells and only calculated reservoir pressure from well head pressure on two wells, one in the east and one in the west field. SoCalGas states that "At Aliso Canyon, surface wellhead pressures in designated pressure monitoring wells are used to determine 'bottom hole' or 'reservoir pressure.' During the timeframe requested, wells Standard Sesnon 5 (SS5) and Ward 3A (W3A) were primarily utilized for this purpose, for the west field and east field, respectively."459 Blade reports that the Bottom Hole pressure for SS-25 that SoCalGas was using to design the kill weight of fluid to pump down SS-25 after it failed was too low, leading to multiple failures in kill attempts. This multi-staged disaster was a direct result of not collecting and recording accurate well data.

In conclusion, SoCalGas' imprudent and unreasonable record keeping practices violated Section 451 three times; once for well SS-25, a second time for well SS-25A, and a third time for well SS-25B. The violation associated with well SS-25 begins June 6, 1973, the date that SoCalGas hydrotested their gas conversion of well SS-25. The violation associated with well SS-25A began December 7, 1972, the date that well SS-25A became operational according to DOGGR records. The violation associated with well SS-25B began October 29, 1973, the date that well SS-25B became operational according to DOGGR records.

Each of these three violations end on October 23, 2015, as safety records in Well Files SS-25, SS-25A and SS-25B appeared to be missing up through the date of the well SS-25 incident."

26. Do you contend in YOUR OPENING TESTIMONY (at page 74) that SoCalGas was required to keep records of "measurements relative to external corrosion of underground pipe in their SS-25, SS-25A or SS-25B Well Files?" If so, identify all laws, regulations, industry standards, internal rules or policies that support your contention.

SED understands this question to be asking about the passage that begins on page 73 and continues onto page 74. Assuming SED's understanding is correct, the answer is yes. That passage states,

"There is also no evidence that SoCalGas created or kept ground water records, or other records of measurements relative to external corrosion of underground pipe in their SS-25, SS-25A or SS-25B Well Files. It is reasonable to expect a prudent well field operator to collect such records so they would be able to predict the life of pipe and plan for replacements or repairs in a safe and timely manner. Because SoCalGas lacked records, it had limited ability to assess the potential for, or predict external corrosion in well piping. Groundwater records would be a basic record kept by any company utilizing steal in underground construction. SoCalGas is well aware of this requirement because it maintains underground natural gas pipelines all over Southern California which has cathodic protection to prevent corrosion. For the same reason, SoCalGas should have utilized cathodic protection on the wells. However, SoCalGas Well File records for SS-25, SS-25A, and SS-25B contain no report or studies regarding well corrosion from exposure to groundwater, or cathodic protection."

The violation that results in part from this point is found on page 75, which states,

"In conclusion, SoCalGas' imprudent and unreasonable record keeping practices violated Section 451 three times; once for well SS-25, a second time for well SS-25A, and a third time for well SS-25B. The violation associated with well SS-25 begins June 6, 1973, the date that SoCalGas hydrotested their gas conversion of well SS-25. The violation associated with well SS-25A began December 7, 1972, the date that well SS-25A became operational according to DOGGR records. The violation associated with well SS-25B began October 29, 1973, the date that well SS-25B became operational according to DOGGR records."

Ex. IV-3

1. With regard to YOUR statement in YOUR OPENING TESTIMONY at page 38 that "SoCalGas had no well kill control plans," please respond to the following questions:

a. Define "well kill control plans" as used above.

Response: For this violation, SED relied on conclusions identified in the Blade Main Report, p. 159 Conclusion: "Kill Attempts #2-6 failed because the kill fluids used were not dense enough to kill the well. There were not data that indicated transient modeling was conducted to design these kill attempts. So calculations may have been done; however, gas flow rates were not incorporated into any kill design. Each kill attempt caused additional damage to the wellhead and well site." SED's wording "no well kill control plans" refers to the lack of transient modeling as Blade describes in the conclusion above and the fact that Blade had reviewed SoCalGas' Operations Standards and did not find any standards applicable to the SS-25 well failure. (Blade Main Report, p.A-1) At the time the testimony was produced, SED relied on no other documentation. Please refer to Blade Main Report including all relevant references and supporting documents provided by Blade.

b. Identify and describe any and all information YOU considered, evaluated, or assessed in connection with the statement above.

Response: Refer to response to 1.a

c. Produce any and all DOCUMENTS identified in response to Request 1(b) above which were not provided to YOU by SoCalGas.

Response: Refer to response to 1.a

d. If YOU contend well kill control plans, as defined in response to Request 1(a) above, were required, state all facts supporting YOUR contention.

Response: Refer to response to 1.a

e. Identify all DOCUMENTS supporting YOUR response to Request 1(d) above.

Response: Refer to response to 1.a

f. Identify all LAWS supporting YOUR response to Request 1(d) above.

Response: Refer to response to 1.a. SoCalGas has a responsibility under PU Code 451 to manage its system in a safe manner.

g. Identify all INDUSTRY STANDARDS supporting YOUR response to Request 1(d) above.

Response: Refer to response to 1.a

h. Produce all DOCUMENTS in YOUR possession that support YOUR response to Request 1(g) above.

Response: Refer to response to 1.a

2. With regard to YOUR statement in YOUR OPENING TESTIMONY at pages 38-39 that "SoCalGas's failure to provide well kill programs for relief well #2, well SS-25A and well SS-

25B each constitute one violation of Section 451, for a total of three violations," please respond to the following questions:

a. Define "well kill programs," as used above.

Response: At the time Opening Testimony was filed, SED understood from the Blade Main Report that SoCalGas had no Relief well plans in place for SS-25, SS-25A or SS-25B. Blade recommended in Solution 8, Blade Main Report p. 233, "Well Specific Detailed Well-control Plan . . . A relief well plan for each well that considers the surface location and overall approach." SED relies on the Blade Main Report, including all references and supplemental reports provided by Blade. SED uses "program" in this statement to refer to Blade's use of the term "plan." SED further understood that SoCalGas did not have a standard for planning and drilling relief wells. (Blade Main Report p. A-1, Table 43). SED considers a standard to be an overall program but also notes that a standard would not specifically provide a site specific relief well plan for each well as recommended by Blade.

b. State all facts supporting YOUR contention that SoCalGas' alleged failure to provide a "well kill program" (as defined in YOUR response to Request 2(a)) for relief well #2 constitutes a violation of Section 451).

Response: See SED response to 2.a. In addition, SED concluded that the lack of a ready, site specific plan resulted in unnecessary delays in siting and planning the relief well for SS-25, which created an additional length of time when gas was being released from the well, exposing personnel and local residents to gas elements, as well as creating hazardous air emissions that harmed the environment, thus violating Section 451.

c. Identify all DOCUMENTS supporting YOUR response to Request 2(b) above.

Response: See SED response to 2.a

d. Identify all LAWS supporting YOUR response to Request 2(b) above.

Response: See SED response to 2.b.

e. Identify all INDUSTRY STANDARDS supporting YOUR response to Request 2(b) above.

Response: See SED response to 2.a

f. Produce all DOCUMENTS in YOUR possession that support YOUR response to Request 2(e) above.

Response: See SED response to 2.a

g. State all facts supporting YOUR contention that SoCalGas' alleged failure to provide a "well kill program" (as defined in YOUR response to Request 2(a)) for well SS-25A constitutes a violation of Section 451.

Response: See SED response to 2.a. The lack of a site specific plan can lead to the same circumstances as occurred in SS-25 if the well fails. The lack of planning appropriately creates an unsafe condition in violation of Section 451.

h. Identify all DOCUMENTS supporting YOUR response to Request 2(g) above.

Response: See SED response to 2.g

i. Identify all LAWS supporting YOUR response to Request 2(g) above.
Response: See SED response to 2.g

j. Identify all INDUSTRY STANDARDS supporting YOUR response to Request 2(g) above.
Response: See SED response to 2.g

k. Produce all DOCUMENTS in YOUR possession that support YOUR response to Request 2(j) above.
Response: See SED response to 2.g

l. State all facts supporting YOUR contention that SoCalGas' alleged failure to provide a "well kill program" (as defined in YOUR response to Request 2(a)) for well SS-25B constitutes a violation of Section 451.
Response: See SED response to 2.g.

m. Identify all DOCUMENTS supporting YOUR response to Request 2(l) above.
Response: See SED response to 2.g

n. Identify all LAWS supporting YOUR response to Request 2(l) above.6
Response: See SED response to 2.g

o. Identify all INDUSTRY STANDARDS supporting YOUR response to Request 2(l) above.
Response: See SED response to 2.g

p. Produce all DOCUMENTS in YOUR possession that support YOUR response to Request 2(o) above.
Response: See SED response to 2.g

q. Do YOU contend that SoCalGas was required to "provide well kill programs" for any wells that had already been killed? If so, state all facts supporting YOUR contention.
Response. SoCalGas Question 2 refers specifically to relief wells, not wells that had already been killed. SED does not understand how question 2.q. applies to wells that have already been killed, since all Aliso wells have been killed at one time or other for routine maintenance purposes. SED acknowledges that SoCalGas had a standard for routine well kills, as identified in the Blade Main Report, p. A-1, Table 43. Please refer to SED response to 2.a.

Ex. IV-4

Safety and Enforcement Division Response to Southern California Gas Company's Data Request 9.
Date Registered: April 17, 2020 (Served on April 16, 2020, but after 5 pm)
Requested Due Date: April 30, 2020.

1. Are YOU aware of the policies or practices of other gas storage operators, prior to or at the time of the LEAK, with respect to well integrity management of underground gas storage facilities? If so,

SED objects to this question as irrelevant. California Public Utilities Code Section 451 requires SoCalGas to operate its natural gas storage system safely for the public, its employees and patrons.[1] To have safely operated its system in compliance with California Public Utilities Code Section 451, prior to or at the time of the LEAK, it was SoCalGas's responsibility, not that of SED, to be aware of policies or practices of other gas storage operators with respect to well integrity management of underground gas storage facilities.

SED further objects to the term "other gas storage operators" overly broad in that it refers to gas storage operators world wide rather than those regulated in California, which is SED's jurisdiction. SED objects to the term "other gas storage operators" as vague. SED also objects to this request as unduly burdensome, asking for SED's to ask all of its staff who might be aware of such policies or practices of this undefined universe of gas storage operators.

Notwithstanding these objections, SED responds as follows. No.

a. Please identify each such operator.

Not applicable. (N/A.)

b. For each operator identified, please describe the operator's policies or practices with respect to well integrity management of underground gas storage facilities.

N/A.

c. For each operator identified, please produce all records documenting such policies or practices.

N/A.

d. For each operator identified, describe whether YOU have ever audited or investigated the operator for its well integrity management practices related to underground gas storage, including when the audit/investigation occurred and the outcome of the audit/investigation.

N/A.

2. Are YOU aware of the policies or practices of other gas storage operators, prior to or at the time of the LEAK, with respect to groundwater relative to underground gas storage well casings? If so,

[1] For reference, California Public Utilities Code Section 451 provides in part that, "Every public utility shall furnish and maintain such adequate, efficient, just, and reasonable service, instrumentalities, equipment and facilities. . .as are necessary to promote the safety, health, comfort, and convenience of its patrons, employees, and the public."

SED objects to this question as irrelevant. California Public Utilities Code Section 451 requires SoCalGas to operate its natural gas storage system safely for the public, its employees and patrons.[2] To have safely operated its system in compliance with California Public Utilities Code Section 451, prior to or at the time of the LEAK, it was SoCalGas's responsibility, not that of SED, to be aware of policies or practices of other gas storage operators with respect to underground gas storage well casings.

SED further objects to the term "other gas storage operators" overly broad in that it refers to gas storage operators world wide rather than those regulated in California, which is SED's jurisdiction. SED objects to the term "other gas storage operators" as vague. SED also objects to this request as unduly burdensome, asking for SED's to ask all of its staff who might be aware of such policies or practices of this undefined universe of gas storage operators.

Notwithstanding these objections, SED responds as follows. No.

a. Please identify each such operator.

N/A.

b. For each operator identified, please describe the operator's policies or practices with respect to their understanding of groundwater relative to underground gas storage well casings.

N/A.

c. For each operator identified, please produce all records documenting such policies or practices.

N/A.

d. For each operator identified, describe whether YOU have ever audited or investigated the operator for failure to understand groundwater relative to its underground gas storage well casings, including when the audit/investigation occurred and the outcome of the audit/investigation.

N/A.

3. Are YOU aware of the policies or practices of other gas storage operators, prior to or at the time of the LEAK, with respect to the application of cathodic protection to surface casing? If so,

SED objects to this question as irrelevant. California Public Utilities Code Section 451 requires SoCalGas to operate its natural gas storage system safely for the public, its employees and patrons.[3] To

[2] For reference, California Public Utilities Code Section 451 provides in part that, "Every public utility shall furnish and maintain such adequate, efficient, just, and reasonable service, instrumentalities, equipment and facilities. . .as are necessary to promote the safety, health, comfort, and convenience of its patrons, employees, and the public."

[3] For reference, California Public Utilities Code Section 451 provides in part that, "Every public utility shall furnish and maintain such adequate, efficient, just, and reasonable service, instrumentalities, equipment and facilities. . .as are necessary to promote the safety, health, comfort, and convenience of its patrons, employees, and the public."

have safely operated its system in compliance with California Public Utilities Code Section 451, prior to or at the time of the LEAK, it was SoCalGas's responsibility, not that of SED, to be aware of policies or practices of other gas storage operators with respect to application of cathodic protection to surface casing.

SED further objects to the term "other gas storage operators" overly broad in that it refers to gas storage operators world wide rather than those regulated in California, which is SED's jurisdiction. SED objects to the term "other gas storage operators" as vague. SED also objects to this request as unduly burdensome, asking for SED's to ask all of its staff who might be aware of such policies or practices of this undefined universe of gas storage operators.

Notwithstanding these objections, SED responds as follows. No.

a. Please identify each such operator.

N/A.

b. For each operator identified, please describe the operator's policies or practices with respect to the application of cathodic protection to surface casing.

N/A.

c. For each operator identified, please produce all records documenting such policies or practices.

N/A.

d. For each operator identified, describe whether YOU have ever audited or investigated the operator for its failure to apply cathodic protection to its underground gas storage well casing(s), including when the audit/investigation occurred and the outcome of the audit/investigation.

N/A.
4. Are YOU aware of the policies or practices of other gas storage operators, prior to or at the time of the LEAK, with respect to well specific well kill plans? If so,

SED objects to this question as irrelevant. California Public Utilities Code Section 451 requires SoCalGas to operate its natural gas storage system safely for the public, its employees and patrons.[4] To have safely operated its system in compliance with California Public Utilities Code Section 451, prior to or at the time of the LEAK, it was SoCalGas's responsibility, not that of SED, to be aware of policies or practices of other gas storage operators with respect to specific well kill plans.

SED further objects to the term "other gas storage operators" overly broad in that it refers to gas storage operators world wide rather than those regulated in California, which is SED's jurisdiction. SED objects to the term "other gas storage operators" as vague. SED also objects to this request as unduly

[4] For reference, California Public Utilities Code Section 451 provides in part that, "Every public utility shall furnish and maintain such adequate, efficient, just, and reasonable service, instrumentalities, equipment and facilities. . .as are necessary to promote the safety, health, comfort, and convenience of its patrons, employees, and the public."

burdensome, asking for SED's to ask all of its staff who might be aware of such policies or practices of this undefined universe of gas storage operators.

Notwithstanding these objections, SED responds as follows. No.

a. Please identify each such operator.

N/A.

b. For each operator identified, please describe the operator's policies or practices with respect to well specific well kill plans.

N/A.

c. For each operator identified, please produce all records documenting such policies or practices.

N/A.

d. For each operator identified, describe whether YOU have ever audited or investigated the operator for its failure to have in place well specific well kill plans, including when the audit/investigation occurred and the outcome of the audit/investigation.

N/A.

5. Are YOU aware of the policies or practices of other gas storage operators, prior to or at the time of the LEAK, with respect to gas storage well failure investigations? If so,

SED objects to this question as irrelevant. California Public Utilities Code Section 451 requires SoCalGas to operate its natural gas storage system safely for the public, its employees and patrons.[5] To have safely operated its system in compliance with California Public Utilities Code Section 451, prior to or at the time of the LEAK, it was SoCalGas's responsibility, not that of SED, to be aware of policies or practices of other gas storage operators with respect to gas storage well failure investigations.

SED further objects to the term "other gas storage operators" overly broad in that it refers to gas storage operators world wide rather than those regulated in California, which is SED's jurisdiction. SED objects to the term "other gas storage operators" as vague. SED also objects to this request as unduly burdensome, asking for SED's to ask all of its staff who might be aware of such policies or practices of this undefined universe of gas storage operators.

Notwithstanding these objections, SED responds as follows. No.

a. Please identify each such operator.

N/A.

[5] For reference, California Public Utilities Code Section 451 provides in part that, "Every public utility shall furnish and maintain such adequate, efficient, just, and reasonable service, instrumentalities, equipment and facilities. . .as are necessary to promote the safety, health, comfort, and convenience of its patrons, employees, and the public."

b. For each operator identified, please describe the operator's policies or practices with respect to gas storage well failure investigations.

N/A.

c. For each operator identified, please produce all records documenting such policies or practices.

N/A.

d. For each operator identified, describe whether YOU have ever audited or investigated the operator for its failure to conduct underground gas storage well failure investigations, including when the audit/investigation occurred and the outcome of the audit/investigation.

N/A.

6. Are YOU aware of the policies or practices of other gas storage operators, prior to or at the time of the LEAK, with respect to mechanical integrity testing of gas storage wells? If so,

SED objects to this question as irrelevant. California Public Utilities Code Section 451 requires SoCalGas to operate its natural gas storage system safely for the public, its employees and patrons.[6] To have safely operated its system in compliance with California Public Utilities Code Section 451, prior to or at the time of the LEAK, it was SoCalGas's responsibility, not that of SED, to be aware of policies or practices of other gas storage operators with respect to mechanical integrity testing of gas storage wells.

SED further objects to the term "other gas storage operators" overly broad in that it refers to gas storage operators world wide rather than those regulated in California, which is SED's jurisdiction. SED objects to the term "other gas storage operators" as vague. SED also objects to this request as unduly burdensome, asking for SED's to ask all of its staff who might be aware of such policies or practices of this undefined universe of gas storage operators.

Notwithstanding these objections, SED responds as follows. No.

a. Please identify each such operator.

N/A.

b. For each operator identified, please describe the operator's policies or practices with respect to mechanical integrity testing of gas storage wells.

N/A.

c. For each operator identified, please produce all records documenting such policies or practices.

N/A.

[6] For reference, California Public Utilities Code Section 451 provides in part that, "Every public utility shall furnish and maintain such adequate, efficient, just, and reasonable service, instrumentalities, equipment and facilities. . .as are necessary to promote the safety, health, comfort, and convenience of its patrons, employees, and the public."

d. For each operator identified, describe whether YOU have ever audited or investigated the operator for its failure to conduct mechanical integrity testing of its underground gas storage wells, including when the audit/investigation occurred and the outcome of the audit/investigation.

N/A.

7. Are YOU aware of the policies or practices of other gas storage operators, prior to or at the time of the LEAK, with respect to maintenance of records for daily site inspections of underground gas storage wells? If so,

SED objects to this question as irrelevant. California Public Utilities Code Section 451 requires SoCalGas to operate its natural gas storage system safely for the public, its employees and patrons.[7] To have safely operated its system in compliance with California Public Utilities Code Section 451, prior to or at the time of the LEAK, it was SoCalGas's responsibility, not that of SED, to be aware of policies or practices of other gas storage operators with respect to maintenance of records for daily site inspections of underground gas storage wells.

SED further objects to the term "other gas storage operators" overly broad in that it refers to gas storage operators world wide rather than those regulated in California, which is SED's jurisdiction. SED objects to the term "other gas storage operators" as vague. SED also objects to this request as unduly burdensome, asking for SED's to ask all of its staff who might be aware of such policies or practices of this undefined universe of gas storage operators.

Notwithstanding these objections, SED responds as follows. No.

a. Please identify each such operator.

N/A.

b. For each operator identified, please describe the operator's policies or practices with respect to maintenance of records for daily site inspections of underground gas storage wells.

N/A.

c. For each operator identified, please produce all records documenting such policies or practices.

N/A.

d. For each operator identified, describe whether YOU have ever audited or investigated the operator for its failure to maintain records for daily site inspections of underground gas storage wells, including when the audit/investigation occurred and the outcome of the audit/investigation.

[7] For reference, California Public Utilities Code Section 451 provides in part that, "Every public utility shall furnish and maintain such adequate, efficient, just, and reasonable service, instrumentalities, equipment and facilities. . .as are necessary to promote the safety, health, comfort, and convenience of its patrons, employees, and the public."

N/A.

8. Are YOU aware of the policies or practices of other gas storage operators, prior to or at the time of the LEAK, with respect to transient kill modeling for well control operations of uncontrolled releases of hydrocarbons from gas storage wells.

SED objects to this question as irrelevant. California Public Utilities Code Section 451 requires SoCalGas to operate its natural gas storage system safely for the public, its employees and patrons.[8] To have safely operated its system in compliance with California Public Utilities Code Section 451, prior to or at the time of the LEAK, it was SoCalGas's responsibility, not that of SED, to be aware of policies or practices of other gas storage operators with respect to transient kill modeling for well control operations of uncontrolled releases of hydrocarbons from gas storage wells.

SED further objects to the term "other gas storage operators" overly broad in that it refers to gas storage operators world wide rather than those regulated in California, which is SED's jurisdiction. SED objects to the term "other gas storage operators" as vague. SED also objects to this request as unduly burdensome, asking for SED's to ask all of its staff who might be aware of such policies or practices of this undefined universe of gas storage operators.

Notwithstanding these objections, SED responds as follows. No.

a. Please identify each such operator.

N/A.

b. For each operator identified, please describe the operator's policies or practices with respect to maintenance of records for daily site inspections of underground gas storage wells.

N/A.

c. For each operator identified, please produce all records documenting such policies or practices.

N.A.

d. For each operator identified, describe whether YOU have ever audited or investigated the operator for its failure to conduct transient kill modeling prior to implementing a well control operation by top kill, including when the audit/investigation occurred and the outcome of the audit/investigation.

N.A.

9. Do YOU contend that transient modeling must be performed prior to all well control operations by top kill?

[8] For reference, California Public Utilities Code Section 451 provides in part that, "Every public utility shall furnish and maintain such adequate, efficient, just, and reasonable service, instrumentalities, equipment and facilities. . .as are necessary to promote the safety, health, comfort, and convenience of its patrons, employees, and the public."

SED objects to this question as irrelevant. California Public Utilities Code Section 451 requires SoCalGas to operate its natural gas storage system safely for the public, its employees and patrons.[9] To safely operate its system in compliance with California Public Utilities Code Section 451, SoCalGas is required to determine whether transient modeling or other modeling must be performed prior to each particular well control operation, and prior to each given well kill.

SED also objects to the term "all well control operations by top kill" as overly broad and vague. Notwithstanding these objections, SED answers as follows: No.

a. If so, produce any and all documents, publications, or industry standards that support YOUR position.

N/A.

b. If not, please describe how a well control operator would determine the circumstances under which transient modeling would be necessary or required for a well control operation by top kill?

SED objects to this question as irrelevant. California Public Utilities Code Section 451 requires SoCalGas to operate its natural gas system safely for the public, its employees and patrons. To comply with Section 451, SoCalGas is required to determine the circumstances under which transient modeling is necessary or required for a well control operation by top kill.

[9] For reference, California Public Utilities Code Section 451 provides in part that, "Every public utility shall furnish and maintain such adequate, efficient, just, and reasonable service, instrumentalities, equipment and facilities. . .as are necessary to promote the safety, health, comfort, and convenience of its patrons, employees, and the public."

Ex. IV-5

Response to Data Request

Response to SED Data Request-78

Prepared for:
Mr. Darryl Gruen
CPUC Legal Division

Purpose:

Blade response to the CPUC Data Request SED 78 related to real time pressure monitoring, ground water, surface casing, cathodic protection, and risk assessment from the Reply Testimony of Mr. Tim Hower and Mr. Charlie Stinson on behalf of SoCalGas.

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Table of Contents

1 Background

The Legal Division of the California Public Utilities Commission issued a Data Request to Blade Energy Partners (Blade) on April 15, 2020. Data Request No: SED 78 is related the Preliminary Investigation of Southern California Gas Company's Aliso Canyon Storage Facility.

The CPUC questions (from file: "I1906016 SED DR 78 Final.pdf") are included verbatim followed by the Blade responses to the questions.

The questions are related to the document titled: *Chapter I, Prepared Reply Testimony of Tim Hower and Charlie Stinson of MHA Petroleum Consultants on behalf of Southern California Gas Company (U 904 G)* (file name: "1_Ch. I - MHA - Hower and Stinson (A Final).pdf").

2 Questions and Responses

2.1 Question 1

1. Please refer to the following passage on pages 35 and 36.

   "SED's testimony regarding real time pressure monitoring ("RTPM") is unclear. At deposition, SED's witness clarified that the reason RTPM was important was that it could have enabled SoCalGas to identify and remediate the leak at SS-25, which she believes had been present for years at an earlier point in time. [Footnote omitted.] The facts, however, are otherwise: the leak and failure at SS-25 was a sudden event and there was no pre-existing leak. Ms. Felts testimony on this issue is also inconsistent with Blade's report. As such SED's contention here is simply without any factual basis or support." With this passage in mind, please answer the following:

2.1.1 Blade Responses

a. Does Blade agree that this passage can conclude that, "the leak and failure at SS-25 was a sudden event and there was no pre-existing leak."?

   Yes.

   Examination of the failed casing joint extracted from SS-25 during the Root Cause Analysis (RCA) indicated that the 7 in. casing failure was caused by external corrosion resulting in reduced casing wall thickness that bulged outward and ruptured in the axial (longitudinal) direction. The rupture was a sudden event caused by internal well pressure that exceeded the burst capacity of the reduced wall casing in a localized area of external corrosion. Following the axial rupture, gas expansion through the rupture caused localized cooling. The cooling caused the casing to become brittle and the 7 in. casing parted circumferentially leaving a gap between the upper and lower sections of casing. Both the axial rupture and the circumferential failure were sudden events that happened within a few hours of each other. Additional details regarding the two failure events are discussed in the Blade Main Report *Root Cause Analysis of the Uncontrolled Hydrocarbon Release from Aliso Canyon SS-25* [1, p. 3] and the Blade supplemental report *SS-25 Casing Failure Analysis* [2, pp. 73-77].

   Blade requested information related to when SoCalGas personnel last visited the SS-25 site before the leak on October 23, 2015. SoCalGas responded and provided details on the condition of the well and site prior to October 23, 2015 [3, p. 3]. The SoCalGas response stated the following:

   > The last visit to the SS25 pad before October 23, 2015 was on October 22, 2015 during the daily well inspection. The daily well inspection revealed no issues, no smell complaints were received, and the most recent weekly pressure readings indicated no anomalies. In addition, no wells in the immediate vicinity of the SS25 wellsite or the other two wells at the SS25 wellsite (SS25A and SS25B) showed elevated surface casing pressures or any unusual pressures from the previous days.

   As part of the RCA, Blade analyzed the historical temperature, pressure, and noise logs for SS-25. The details are included in the Blade supplemental report *SS-25 Temperature, Pressure, and Noise Logs Analysis* [4]. The conclusion was that there was no pre-existing 7 in. casing leak. Additionally, there were no physical observations from well inspections and weekly pressure measurements that indicated a pre-existing problem.

b. If not, why not?

Not applicable. Blade agrees that no pre-existing 7 in. casing leak existed.

c. In Blade's assessment, was there a pre-existing leak in well SS-25 prior to October 23, 2015?

No.

There were no data or evidence that indicated a pre-existing 7 in. casing leak in SS-25 prior to October 23, 2015.

d. If so, why?

Not applicable. Blade agrees that there was no pre-existing leak.

e. In Blade's assessment, can the possibility that there was a pre-existing 7 in. casing leak in well SS-25 prior to October 23, 2015 be ruled out?

Yes.

f. If so, why?

There were no data or evidence that indicated a pre-existing 7 in. casing leak in SS-25 prior to October 23, 2015.

g. If not, why not?

Not applicable. The data and evidence indicate there was no pre-existing 7 in. casing leak.

h. Provide additional context and documents as necessary to support these answers.

Included in the responses to Question 1 a, 1 c, and 1 f.

Additional context is provided in the document "*Blade Response to SED Data Request-58 Rev 1 05-15-2020.pdf*" in responses 17–25, which address logs, surveys, and the non-existence of historical casing leaks.

2.2 Question 2

2. Please refer to the following passage on page 36: "Ms. Felts also appears to be arguing separately that RTPM would have provided flow rate data that could have been utilized in the well kill. [Footnote 143] As a general matter, SED's allegations regarding real time pressure monitoring, and the Blade analysis on which it appears to be based, are highly speculative." Footnote 143 then references pages 270 through the beginning of 272 of Ms. Felts's deposition transcripts, which provide in part the following on pages 271 to 272:

"Q So what would a continuous real-time pressure monitoring system have provided that they couldn't have collected prior to the blowout?

A The way I connect this is that the real-time monitoring system would have probably prevented the blowout because they would have detected the leak at a lesser amount and shut in the well; so they would have had their readings at that point in time. But if they shut in the well, they wouldn't have to use the readings."

2.2.1 Blade Responses

a. In Blade's expert opinion, if a real-time monitoring system had been operational prior to October 23, 2015, could it have detected a leak in well SS-25 on October 23, 2015?

Yes, assuming that the word "leak" refers to the sudden rupture of the 7 in. casing on October 23, 2015.

Prior to the October 2015 incident, the monitoring program at Aliso Canyon was weekly manual surveillance of wellhead pressures. A real-time pressure monitoring system that included the tubing, tubing × production casing annulus, and production casing × surface casing annulus pressures could have been used to detect the changes in pressure in the tubing and annuli caused by a 7 in. casing rupture. The changes in pressure could have been evaluated and it could have been determined that a rupture had occurred. The changes in pressure would have been significant, indicating that the gas flow path had deviated from normal operations. In summary, the pressure data from the monitoring points could have been used to detect the rupture, to help diagnose the problem and to quantify the leak rate.

b. Would such a system likely have detected such a leak in well SS-25 prior to October 23, 2015?

Assuming the phrase "such a leak" means a 7 in. casing rupture with similar parameters as the one on October 23, 2015, data from a real-time pressure monitoring system could have been used to detect a 7 in. casing leak in well SS-25 occurring prior to October 23, 2015.

c. If Blade has experience with real-time monitoring systems, how would Blade describe their effectiveness with respect to detecting leaks?

Blades experience has been that these real-time monitoring systems are effective in detecting pressure excursions.

d. Please provide context to explain and documentation to support each answer as necessary.

See the responses to Question 2 a, 2 b, and 2 c.

2.3 Question 3

3. Please refer to the following passage on page 39.

"SED further alleges that if a SCADA system were installed, it would have provided insight into the size of the leak. Presumably, by the "size of the leak", SED (and Blade) mean the gas flow rate of the leak. But this is impossible. A SCADA system would have provided no information at all as to the magnitude of the gas leak. A SCADA system measures surface tubing and casing pressures and, if equipped with a well flow meter, the injection or production rate at the wellhead. At the time of the leak, the SS-25 well was injecting gas at a rate of approximately 70 MMscf per day. That is the rate that the SCADA system would have measured, and that rate has absolutely nothing to do with the magnitude of the downhole gas leak. Once the well was shut-in, the gas injection rate would now be zero, but the SCADA system would still not be measuring any flow rate associated with the gas leak because the SCADA system measures data at the wellhead. As the Blade report states, most of the gas from the leak would have "flowed through the heavily weathered and vertically fractured top 200-300 ft. of formation, however, some would have flowed horizontally through permeable or fractured layers away from the SS-25 well site, and some would have remained in the subsurface." It is not possible for a real-time measurement system at the wellhead to detect and measure the gas flow rate outside the wellhead flowing through the geologic strata.

The SED allegations in respect of SCADA are unfounded. SCADA on individual wells was not an industry standard in 2015 in gas storage fields developed in depleted oil and gas fields (80% of the U.S. gas storage fields). SCADA would not have yielded any useful information as to the location or extent of the gas leak in the SS-25 well. And, most importantly, a SCADA system would have made

absolutely no difference in the events that transpired at the SS-25 well on October 23, 2015 and thereafter."

2.3.1 Blade Responses

a. In Blade's view, would a SCADA system have enabled the measurement of casing and tubing pressures below the SS-25 wellhead if it had been installed prior to October 23, 2015?

   Yes.

b. If so, would the sorts of casing and tubing pressures that this SCADA system would have measured on well SS-25 enabled the operator to detect leaks on the well?

   Yes.

   A typical SCADA system collects well data, such as tubing and annulus pressures. A change in the tubing and casing pressures could be used by an operator as notification that something has changed at the well. Additional diagnoses of the well condition and pressures could be used to determine what caused the changes in pressure. Causes could include a leak in the surface equipment at the well or a downhole leak in the tubing or casing that changed the gas flow path.

c. Could real-time flow readings have been helpful in determining the flow rate of the leak at any time during the SS-25 111 days after the well failed?

   No.

   Blade interprets "*real-time flow readings*" as the gas flow rate from a device on the flow line to or from the well to measure the gas flow rate to the well while injecting or gas flow rate from the well while withdrawing gas. In a downhole leak scenario, the flowline would be shut-in and no flow would be measured to or from the well. The gas flow from the reservoir to the casing leak in SS-25 was escaping to shallow formations and to the atmosphere and therefore would not have been measured by a real-time gas flow measuring device on the flow line.

   After the well failed, injection gas to the well was shut-in as stated in the response to a data request from Blade to SoCalGas [3, p. 1]. Therefore, if equipment to provide real-time flow reading had been available, it would have been disabled and isolated after the well failed and not helpful to determine the flow rate of the leak.

d. If so, please explain how the data could be used.

   Not applicable. The gas leak flow rate would not have been measured with a flow rate measuring device on the flow line.

   As discussed in the Blade Main Report [1, p. 230] a real-time pressure monitoring system could have provided immediate identification of the time of the SS-25 leak. At this point, the injection gas to the well could have been stopped and this could have prevented the brittle circumferential parting of the casing from occurring. The tubing and casing pressures could have been used to estimate the gas leak rate from the reservoir to the 7 in. casing leak as described in the Main Report [1, p. 132].

e. Are SCADA on individual wells an industry standard in gas storage fields developed in depleted oil and gas fields anytime post 2015?

   Blade is not aware of an industry standard that requires SCADA for individual wells. Blade is aware of the requirement for a real-time data gathering system, such as Supervisory Control and Data

Acquisition (SCADA) for Underground Gas Storage wells in California that was a requirement to be employed by January 1, 2020 [5, p. 257].

2.4 Question 4

4. Please refer to page 21, and the passage that states: "Given that the purpose of the surface casing is to protect groundwater zones during the initial drilling and completion of the well, which was done in 1953 and 1954, and that the oversight of the surface casing operation was reviewed and approved by the DOGGR, there really is no reason for SoCalGas to have a "reasonable understanding of the groundwater depths relative to the surface casing shoe and production casing of well SS-25" as is alleged by in the SED testimony".

   With this passage in mind, please answer the following:

2.4.1 Blade Responses

a. In Blade's assessment, should SoCalGas have had a reasonable understanding of groundwater depths relative to the surface casing shoe and production casing of well SS-25 prior to October 23, 2015?

   Yes.

   The SS-25 well architecture relied on a single barrier, namely the production casing, to maintain the well integrity. All threats to the integrity of the production casing should have been identified, evaluated, and mitigated. External corrosion resulting from groundwater exposure is such a threat. One way of identifying and evaluating this threat is a knowledge of the groundwater regime, including groundwater depths. Another way is to routinely inspect the production casing, which could have detected the external corrosion before it compromised the production casing. It is likely that the knowledge of the groundwater regime would have led to routine inspections of the production casing as a mitigation strategy, with the wall thickness reduction results serving as a factor to determine the inspection frequency. Groundwater locations identified from the SS-9 pad boreholes and logs are discussed in the Blade Main Report, Section 2.7 and Blade Supplementary Report, Volume 2, Aliso Canyon Field Hydrology.

b. If the answer is yes, in Blade's assessment, what sorts of safety consequences could have resulted from SoCalGas not having a reasonable understanding of the groundwater depths relative to the surface casing shoe and production casing of well SS-25?

   SoCalGas did not know the groundwater regime and, therefore, did not realize that groundwater exposure posed a threat to wellbore integrity.

c. Provide explanation and documentation as necessary to support your answers.

   Explanations are provided in responses to Question 4 a and 4 b above.

2.5 Question 5

5. Please refer to pages 21 and 22, and the passage that states, "Based on the historical data in the Aliso Canyon field, there was no reason for SoCalGas to anticipate there might be a potential problem with corrosion of the production casing at a depth above the surface casing shoe inside the annulus between the production casing and the surface casing, as occurred in the SS-25 well. Blade investigated the occurrences of shallow corrosion throughout the field. Regarding the 27 wells they identified that demonstrated shallow corrosion, Blade determined that almost all of the wells had

production casing external corrosion present below the surface casing shoe. Excluding the SS-25, only one well, P-50A, had production casing external corrosion above the surface casing shoe. [Footnote omitted.] Thus, corrosion on the production casing above the surface casing shoe was very rare. . . Knowledge of the hydrogeology and groundwater is only relevant for the design and implementation of the surface casing. [Footnote omitted]. With this in mind, please answer:

2.5.1 Blade Responses

a. Does Blade agree that, "Based on the historical data in the Aliso Canyon field, there was no reason for SoCalGas to anticipate there might be a potential problem with corrosion of the production casing at a depth above the surface casing shoe inside the annulus between the production casing and the surface casing, as occurred in the SS-25 well?

   Yes.

b. Why or why not?

   Although external casing corrosion was historically observed in Aliso Canyon wells, corrosion above casing shoe was observed only in P50A and SS-25 wells.

c. Is knowledge of hydrology and groundwater only relevant for the design and implementation of the surface casing?

   No, it is also relevant for the management of wellbore integrity.

d. Why or why not?

   Corrosion resulting from groundwater is a threat to wellbore integrity; therefore, knowledge and understanding of the groundwater behavior is necessary. The management of wellbore integrity needs to consider hydrology and groundwater.

   The SS-25 well used a single-barrier architecture, relying solely on the integrity of the production casing. In such single-barrier wells, the failure of the production casing will result in the loss of integrity of the well, as happened during the 2015 SS-25 incident. The evidence of shallow corrosion in the 27 wells (as referenced in the statement above) should have indicated that corrosion from groundwater was a factor threatening the wellbore integrity.

2.6 Question 6

6. Please refer to the following passage on pages 23 and 24, which states: "The Blade report also correctly points out that "[t]he function of the surface casing is to isolate fresh water sources and also provide a string for drilling the deeper hole for gas storage or oil production. The surface casing is not intended to provide any further barriers to gas or oil.[Footnote omitted.] "Thus, SoCalGas cannot be faulted for the condition of corrosion on the surface casing and any escaping gas through holes in the surface casing, which were caused post-leak, [Footnote omitted.] because the purpose and objective of surface casing is not to provide a barrier to gas or oil leaving the wellbore."

   With this passage in mind, please answer:

2.6.1 Blade Responses

a. Does Blade agree with the statement that the purpose and objective of surface casing is not to provide a barrier to gas or oil leaving the wellbore?

Yes.

b. If so, is this the only purpose and objective of surface casing with regards to safety?

As stated in Question 6, the purpose of surface casing is to isolate fresh water sources and to provide well control to safely drill the hole section below the surface casing. While drilling the hole section below the surface casing, the surface casing is used for well control with blowout preventer (BOP) equipment installed on the surface casing. The BOP and surface casing protect the rig personnel and surface equipment in the event of a well control situation by providing a method to shut the well in and safely remove the hydrocarbons from the wellbore. Once the gas and/or oil is safely removed from the wellbore, the drilling fluid hydrostatic pressure provides the primary well control barrier. The BOP and surface casing provide a secondary well control barrier for safety while drilling below the surface casing.

Once the production casing is set, the purpose of the surface casing is to isolate fresh water. The barrier to oil and gas is then provided by the production casing, cement, and wellhead equipment.

c. Provide context and explanation as well as documentation as necessary to support your answers.

See the Question 6 b response.

d. Would knowledge of corrosion on the surface casing provide the operator with any useful information related to the safety of the well?

Yes, assuming corrosion information on the surface casing can be obtained.

e. Why or why not?

Monitoring corrosion of the surface casing with the production casing in place is difficult with today's technology. There are no known quantitative corrosion evaluation tools available to reliably detect, monitor, and measure remaining wall thickness caused by corrosion of the surface casing. The production casing is inside the surface casing, isolating it, and preventing running casing inspection surveys directly in the surface casing.

Corrosion of surface casing is usually identified after the production casing is removed from the well. When the production casing is recovered, it exposes the surface casing and an inspection survey can be run in the surface casing to evaluate wall thickness and determine its condition.

When surface casing corrosion information is available, it can be used to determine if the corrosion is external or internal. External corrosion may indicate that corrosive conditions exist in the shallow zones and mitigation can be evaluated to protect future surface casing from metal loss in new wells that may be drilled in the area. Internal corrosion of the surface casing may indicate that corrosive conditions exist in the surface casing × production casing annulus and corrosion on the outside of the production casing is possible as was the case for the SS-25 production casing.

f. If so, what information would such knowledge have provided?

If the casing inspection survey showed reduced wall thickness of the surface casing because of corrosion, it should have resulted in the evaluation of nearby wells to determine if this had been a unique problem in one well or if there was reason to suspect the problem was more widespread in the field or an area in the field.

2.7 Question 7

7. Please refer to the Section entitled, "Cathodic Protection is not Industry Standard and Was Not Necessary for SS-25." On pages 25 through 27.

2.7.1 Blade Responses

a. Note the passage in this section that states, "Cathodic protection can be an effective tool to prevent corrosion in shallow surface casing strings. While not an industry standard, the technology is used in some gas storage fields with known areas of high corrosion. Recall that, Aliso is not one of those areas: the Blade report documented finding no pattern of corrosion associated with well age, well location, or depth. Thus, given that the SS-25 well is not in a corrosion "hot spot," the operator must balance the limited benefits of using cathodic protection to shield the surface casing versus the potential limitations and downsides." With this in mind, please answer:

i. If Blade disagrees with how it has been characterized in this passage, please explain how and correct the characterizations.

Blade is not certain on what the pronoun "it" in question 7. a. i. refers to. We assume "it" refers to cathodic protection of the surface casing in the Blade responses.

Aliso Canyon wells did exhibit production casing corrosion according to casing inspection logs and the SoCalGas Rate Case testimonies. There were no data on the condition of the surface casing in the Rate Case testimonies.

ii. Even if there is no documented pattern of corrosion associated with corrosion, in Blade's expert opinion, is this a valid justification for SoCalGas to not cathodically protect wells at Aliso Canyon natural gas storage facility?

If there is no pattern of corrosion then cathodic protection of the surface casing is not necessary.

iii. Why or why not?

In the absence of corrosion, the need for cathodic protection is not justified.

iv. In Blade's assessment, was it possible for SoCalGas to forecast whether any of its wells at Aliso could be experiencing corrosion?

The issue of shallow corrosion on production casing and surface casing was summarized in the Blade Supplementary Reports titled "Aliso Canyon Shallow Corrosion Analysis" and "Aliso Canyon Surface Casing Evaluation". Forecasting will require a corrosion study and that was discussed in the Blade Main Report.

v. If SoCalGas could have predicted corrosion on some or all wells, could SoCalGas have forecasted the severity of the corrosion for purposes of planning integrity assessments?

Surface casing cannot be easily logged as discussed previously in Question 6. e. Aliso Canyon had only four wells, in addition to SS-25, with surface casing logs. This discussion is summarized in the supplementary report titled "Aliso Canyon Surface Casing Evaluation". Forecasting will require a corrosion study and that was discussed in the Blade Main Report.

vi. In Blade's assessment, should the answers to questions 7.a.iv and 7.a.v factored into deciding whether to cathodically protect wells at Aliso in order to protect against corrosion that could evolve into leaks?

Yes, if surface casing corrosion was anticipated then cathodic protection system should have been considered.

vii. Provide context, explanation, and documentation as necessary to support your answers.

Refer to the responses provided in Question 7 a.

b. Note the passage in this section that states, "Similarly, within the areal 'footprint' of a cathodic protection system, all wells must be protected. The Aliso Canyon field is not only a gas storage field, but there are non-storage operations within the field boundaries accessing shallower hydrocarbon production. These shallow wells are not operated by SoCalGas. If SoCalGas were to install cathodic protection only on its gas storage wells, any shallow hydrocarbon wells operated by others at the field would suffer increased corrosion and loss of well integrity because of the cathodic protection currents."

With this passage in mind, please answer the following:

i. Does Blade agree with the assertions in this passage?

Yes, Blade agrees. The interference of cathodic protection systems is well known in the industry, and unintended corrosion due to CP systems is not uncommon.

ii. In Blade's view, is there any reason that Blade is aware of as to why all wells at Aliso Canyon natural gas storage facility could not have been successfully cathodically protected prior to October 23, 2015?

SoCalGas did employ cathodic protection systems for some wells in Aliso Canyon. The design intricacies of a cathodic protection system for all Aliso Canyon wells was beyond the scope of the RCA.

c. Note the passage in the section that states, "Cathodic protection typically works very well on protecting surface pipelines or shallow gas gathering lines, where the resistivity of the environment around the steel is known and relatively uniform. However, in the case of vertical surface casing which extends to a depth of approximately 1,000 feet, such as the SS-25 well, the resistivity of the soils can change suddenly and dramatically with variations in depth. This results in an extremely difficult engineering solution to design a cathodic protection scheme that accounts for the rapid changes in soil resistivity and balances the current applied in the cathodic protection system. When multiple wells are added to the equation, such as would be the case around the SS-25 well pad, the problem becomes increasingly more difficult and complex. Any imbalance in the applied current will have the undesired effect of increasing corrosion."

i. Does Blade agree with the assertions in this passage?

Yes, designing a cathodic protection system for all wells is a complex process and requires detailed engineering.

ii. In Blade's view, would it be possible and cost effective to design a cathodic protection scheme that accounts for the factors described in this passage in instances with multiple wells within close proximity of one another?

Designing a cathodic protection system for all wells is a complex process and requires detailed engineering to determine the feasibility and cost benefit.

iii. Provide context, explanation and documentation as necessary to support your answers.

See the responses to Question 7 c.

d. Note the passage in the section that states, Finally, the axial rupture of the production casing occurred at a depth of 892 feet, which was inside the surface casing of the well. The Blade report clearly states, "While a cathodic protection system would have provided corrosion protection to the 11 ¾ in. casing, it would not have protected the 7 in. casing inside the 11 ¾ in. casing." [Footnote omitted.] Thus, an independent corrosion protection mechanism like cathodic protection would not have been useful in this case, contrary to the suggestions made in the SED testimony. With this passage in mind, please answer:

i. Does Blade agree with the statements in this passage, including that cathodic protection would not have been useful in the case of protecting the 7 inch or 11 ¾ inch casing of well SS-25?

Yes, Blade agrees. A cathodic protection system could have prevented the external corrosion on the 11 ¾ in. casing. A cathodic protection system could not have prevented the 7 in. casing corrosion. This is discussed on Page 215 of the Blade Main Report.

ii. Please explain why or why not.

The production casing inside the surface casing from surface to 990 feet in SS-25 could not be protected with cathodic protection. The production casing was inside the surface casing, consequently any cathodic currents would have been shielded by the surface casing and would not have reached the production casing.

2.8 Question 8

8. On page 28, a passage states,

"Prior to 2007, SoCalGas did assess risk as part of ongoing operations, even if it was not documented as a formal risk assessment program; this was consistent with the standard practices of other operators." Footnote 115 at the end of this passage states, "See eg., Ex. I-62 (Testimony of Phillip E. Baker, Southern California Gas Company, 2016 General Rate Case, A.-14-11-004 at PEB-5 – PEB-8). Based upon this reference, please see the following passages from Ex.I-62.

In Ex. I-62, at PEB-5, a passage states, "While we have historically managed risk at our storage facilitated by relying on more traditional monitoring activities and identification of potential component failures, we believe that it is critical that we adopt a more proactive and in-depth approach. Historically, safety and risk considerations for wells and their associated valves and piping components have not been addressed in past rate cases to the same extent that distribution and transmission facilities have been under the Distribution and Transmission integrity management programs."

In Ex. I-62 at PEB-6, a passage states, "Currently, risk assessment of our storage system is of a qualitative nature and is based on our long experience in operating and managing SoCalGas ' storage facilities. During routine system assessments, we monitor the condition of our assets and consider the risks they may pose on safety, reliability, and the environment."

Please also refer to the passage on page 173 of the Blade Root Cause Analysis, indicating that SoCalGas made a recommendation in August 1988 to run casing inspection surveys and pressure test the casing in 20 Aliso Canyon wells used as casing flow wells [57] [58].[1] SS-25 was on the list of wells

[1] This question is not the same as question 2 because it asks about SoCalGas's self-described "long experience in operating SoCalGas' storage facilities", whereas question 2 asks about SoCalGas's self described "formal risk assessment program that began in 2007, or its implemented "Replace and Inspect" initiative". The bolding and underlining in this question are meant to highlight the different language.

and was considered a low priority well. Inspection surveys were run in seven of the 20 wells and included in all five high priority wells; five of the seven wells showed penetration of up to 60% in. Logs on two of the seven wells have not been located for review. Four of the five wells that [sic] showed numerous indications of wall loss above the surface casing shoe. Based on the high percentage of wells with significant penetration, the question remains as to why the remaining 13 wells were not inspected in the 2-year period as recommended. The Interoffice correspondence documents and additional details regarding the 20 wells are included in a separate report: *Review of the 1988 Candidate Wells for Casing Inspection* [59].

On pages 28 and 29, it states, "Second, starting in 2007 SoCalGas had a formal risk assessment program, which focused on wellbore integrity management. SoCalGas implemented a "Replace and Inspect" initiative, which included conducting wellbore integrity evaluations at Aliso Canyon and performing remedial work, if necessary, based on the results. SoCalGas implemented the initiative two years prior to Mr. Mansdorfer's 2009 recommendation for a similar initiative. The initiative included the inspection of the integrity of the production casing in the storage wells. Moreover, the "Replace and Inspect" initiative included detailed evaluations of the wellbore integrity and replacement of well hardware equipment, such as wellhead valves and the well tubing and packer. As a result of this initiative, SoCalGas permanently removed six wells, of approximately 30 wells inspected, from service based on their downhole condition."

With these passages in mind, please answer the following:

2.8.1 Blade Responses

a. In Blade's expert opinion, should SoCalGas's professed risk assessment pre-dating 2007 as part of ongoing operations and formal risk assessment program starting in 2007 have included those wells in the Interoffice correspondence documents and additional details regarding the 20 wells included in the report entitled "Review of the 1988 Candidate Wells for Casing Inspection"?

   Yes.

   A field wide risk assessment related to casing integrity should have included all Aliso Canyon field wells including the 1988 Candidate Wells for Casing Inspection [6, pp. 41-44] (AC_CPUC_0000063 – AC_CPUC_0000066). A risk assessment should have identified that the "casing flow wells of 1940s and 1950s vintage" were approximately 20 years older in 2007 with higher risks than in 1988. Blade interprets casing flow wells as wells that inject and/or withdraw via the production casing × tubing annulus. Wells completed as "casing flow wells" had no secondary barrier to contain the gas pressure if the primary production casing barrier failed. Wells with this type of completion design would be considered higher risk compared to wells completed with a primary and secondary barrier.

b. In Blade's expert opinion, should SoCalGas's professed risk assessment pre-dating 2007 as part of ongoing operations and formal risk assessment program starting in 2007 have prompted SoCalGas to inspect all of those wells in the "Review of the 1988 Candidate Wells for Casing Inspection" report?

   Yes.

   A risk assessment should have identified the casing flow wells of 1940s and 1950s candidate wells as wells needing to be inspected and pressure tested to determine the mechanical condition of the production casing as stated in the Interoffice Correspondence dated August 30, 1988 [6, pp. 41-44].

c. In Blade's expert opinion, should SoCalGas's professed risk assessment pre-dating 2007 as part of ongoing operations and formal risk assessment program starting in 2007 have prompted SoCalGas to take steps to address the metal loss identified on Aliso wells at the "Review of the 1988 Candidate Wells for Casing Inspection" report?

   Yes.

   The casing inspection technology post 2000 had evolved compared to 1988 technology. Improved inspection log technology could have been used to confirm the inspection log anomalies identified in the 1988 and 1989 logging program and to inspect additional wells.

d. If so, what steps should SoCalGas have taken?

   The log and/or risk assessment results should have dictated the next steps.

e. Provide explanation, context and documentation as necessary to support your answers.

   See the responses to Question 8 a, 8 b, 8 c, and 8 d.

   Blade is not sure of the meaning of footnote 1 in Question 8, paragraph 4 and assumed the footnote was not relevant to the questions to Blade in this data request. The footnote refers to a Question 2, but Question 2 in this document appears to be related to a different subject than Question 8.

2.9 Question 9

9. Please note the following as context for the following question. Safety and Enforcement Division contends that Southern California Gas Company, as a natural gas operator regulated in the state of California, is required to follow the requirements provided under California Public Utilities Code Section 451. In particular, SED contends that Southern California Gas Company is required to follow the provision quoted here:

   "Every public utility shall furnish and maintain such adequate, efficient, just, and reasonable service, instrumentalities, equipment, and facilities. . .as are necessary to promote the safety, health, comfort, and convenience of its patrons, employees, and the public."

   Accepting this as true for purposes of this question, please answer the following:

   With regards to the reply testimony of Southern California Gas Company that was served on March 23, 2020, what additional concerns does Blade have with:

2.9.1 Blade Responses

a. SoCalGas's[2] safe operation of its Aliso Canyon Natural gas storage facility prior to October 23, 2015?

   Blade has no additional concerns.

b. SoCalGas's efforts to kill well SS-25 beginning on October 23, 2015?

   Blade has no additional concerns.

[2] For purposes of this and all questions in discovery to Blade, reference to SoCalGas includes reference to Halliburton and Boots & Coots, as well as all other contractors SoCalGas hired to operate Aliso Canyon natural gas storage facility, and to kill well SS-25.

3 References

[1] Blade Energy Partners, "Root Cause Analysis of the Uncontrolled Hydrocarbon Release from Aliso Canyon SS-25," 2019.

[2] Blade Energy Partners, "SS-25 Casing Failure Analysis," 2019.

[3] SoCalGas, "Blade-Follow Up Request_82918_1.pdf," 2018.

[4] Blade Energy Partners, "SS-25 Temperature, Pressure, and Noise Logs Analysis," 2019.

[5] California Department of Conservation, "Statutes and Regulations, Geologic Energy Management Division," 2020.

[6] SoCalGas, "SS-25 Well Documentation (from SoCalGas)_N.pdf".

Ex. IV-6

California
Department of
Conservation
Geologic Energy Management Division

Stakeholder outreach

Overview and Talking Points

Alan Walker
Geologic Energy Management Division
(916) 323-2258
Alan.Walker@conservation.ca.gov

Senate Bill 463-Stern

- On October 12, 2019 Senate Bill 463 was approved by Governor Newsom.
- Public Resources Code section 3186.3 requires CalGEM to “review and, if necessary, revise its natural gas storage well policy and regulations to address the root causes identified . . . in response to the independent root cause analysis of the 2015 well leak at the Aliso Canyon gas storage facility[.]”
- Senate Bill 463 added a new section– Public Resources Code 3181.5– on chemical disclosure that CalGEM plans to clarify with this rulemaking. This section requires operators to provide “a complete chemical inventory of the materials, of any phase, that may be emitted from the gas storage well in the event of a reportable leak . . . periodically, as determined by the division, but no less than annually.”

Chemical Disclosure Questions -Public Health Professionals

- What constitutes “sufficient accuracy and precision to inform the determination of public health impacts from the release of these materials to the environment”? (Public Resources Code section 3181.5).
- Would safety data sheets achieve this goal?
- What are key changes that would trigger an update to chemical disclosures?
- What are other important considerations?

Chemical Disclosure Questions- All Stakeholders

- What information is already available that could meet the requirement to disclose all material “of any phase, that may be emitted from the gas storage well in the event of a reportable leak”? (Public Resources Code section 3181.5).

- What constitutes “sufficient accuracy and precision to inform the determination of public health impacts from the release of these materials to the environment”? (Public Resources Code section 3181.5).

- What are key changes that would trigger an update to chemical disclosures?

Root Cause Analysis Questions- All Stakeholders

Cathodic Protection

- Public Resources Code section 3186.3, subdivision (a), requires CalGEM to consider “requirements for cathodic protection measures for well casings, where appropriate, on a well-by-well or field-by-field basis.”
- What are specific factors that must be evaluated to determine if cathodic protection should be utilized on a well?
- What are risk factors for implementing cathodic protection?
- What qualifications are required to be considered an expert capable of determining the need for cathodic protection?
- What constitutes sufficient accuracy and precision to inform corrosion potential of the environment impacting the well?

Root Cause Analysis Questions- All Stakeholders

Near Miss and Safety Related Conditions

- Public Resources Code section 3186.3, subdivision (c), requires CalGEM to consider “requirements for investigating leaks and other pressure equipment integrity incidents that present a risk of leaks as determined by the division.”

Root Cause Analysis Questions- All Stakeholders

Near Miss and Safety Related Conditions

- The independent root cause analysis suggests the adaptation of API 585 Pressure Equipment Integrity Incident Investigation "A Level 1 type analysis of failures, will identify the immediate causes of the failures or near misses", into regulations including:
  - Near miss: The discovery of equipment degradation or process operating conditions outside of acceptable limits that requires immediate action to shut down the equipment and/or perform repairs to avoid a loss of containment, usually the results of some form of damage mechanism such as those covered in API 571, but did not result in a loss of containment or structural stability.
  - Mandated reporting.
- What are your questions, comments, and concerns with the implementation of these updates?

Root Cause Analysis Questions- All Stakeholders

Near Miss and Safety Related Conditions

- If 49 C.F.R. § 191.23– which governs reporting of safety-related conditions– is integrated into the rulemaking package, what additional factors may need to be considered beyond what is covered by federal law?

Root Cause Analysis Questions- All Stakeholders

Individual Well Control Plans

- Public Resources Code section 3186.3, subdivision (b), requires CalGEM to consider "requirements for well control plans for a gas storage field, that include the range of flow properties possible in the event of an uncontrolled well release."
- Should individual well control plans include the following:
  - Pressure Transient analysis (PTA)?
  - Well-Specific Inflow Performance Relationship (IPR) Curve?
  - Estimate of absolute open flow potential (AOFP)?

California
Department of Conservation

THANK YOU

Questions?
Please send any comments to
undergroundgasstorageregs@conservation.ca.gov

Alan Walker
Alan.Walker@conservation.ca.gov

Ex. IV-7

SOUTHERN CALIFORNIA gas COMPANY

INTEROFFICE CORRESPONDENCE

TO M. E. Melton FROM D. J. Anderson DATE Oct. 24, 1990

SUBJECT Radial Model of FF-34A Incident

BACKGROUND

On Monday evening, September 10, a downhole flowing condition was discovered in well Fernando Fee-34A. A pressure drawdown of 140 psig was recorded on the tubing/casing annulus, indicating the presence of a leak in the 8-5/8 inch casing. The leak was stopped when the well was killed at 10:20 a.m. the next morning. I developed a radial reservoir model to simulate gas migration updip from well FF-34A. The model was developed to determine the volume of gas lost at FF-34A, the gas distribution over time, and the time for gas to reach surface outcrops.

RESULTS

1. Based on the pressures recorded at well MA-5A, approximately 123 MMCF of gas was lost to a shallow zone in FF-34A. The zone of interest is a sequence of interbedded sandstones and shales over the interval 1500'-2000'. The shut-in pressures observed at MA-5A on September 11th and 13th compare closely with array pressures calculated in the model.

2. Gas breakthrough occurred in layer two on day six of the simulation (September 12). At six days, gas was detected in each radial segment in sector two of the model. Moving updip from FF-34A, the gas percentages found in sector two were 22.4%, 3.98%, 0.92%, 0.13%, and 0.04%. The gas saturation of 0.04% was found at a radius of 1570' from FF-34A. Assuming the shallow zone outcrops at a radius of 1500' or greater, six days is a good estimate of when gas might show up as seepage at the surface. However, the relative permeability at .04% is very low; in fact, it is probably below the critical gas saturation. Unless there are fractures or high permeability streaks, gas would not flow at high rates to the surface.

3. Figures 1 through 7 show the updip expansion of gas in layer two over forty-five days. Layer two is the most permeable layer in the model. The gas saturations remain low (0.1%) as gas percolates updip toward the surface. The highest gas saturations remain within two hundred feet of FF-34A. After forty-five days, the gas bubble expanded to a radius of 1200 feet, where saturations of 0.1% were detected.

DISCUSSION

Flowrate from NAPS

An estimate of the downhole flowrate for FF-34A was made using nodal analysis. The well mechanical showing wellhead pressures prior to and during the leak is shown in Figure 9. A flowrate of 35 MMCF/D was calculated using a flowing pressure of 2500 psig and a reservoir pressure of 3153 psig. A flowing wellhead pressure of 2460 psig was recorded in the field; however, 40 psig was added to the field pressure as a correction for depth. In the analysis, a backpressure exponent of 0.75 and a flow coefficient of 0.91 $MCFD/PSI^2$ were used. (Please see Table I.)

Initialization

A four-layer radial model was used to represent the zone of gas migration. Moving outward from the center of the model, it was divided into radii of 160', 420', 800', 1200' and 2100'. The model was designed with a 45° dip to the north. The shallow zone rock properties are as follows:

TABLE OF PROPERTIES

Property	Layer 1	Layer 2	Layer 3	Layer 4
Permeability	50 md.	75 md.	15 md.	15 md.
Thickness	55 ft.	20 ft.	50 ft.	100 ft.
Porosity	20%	24%	18%	18%

A total zone thickness of 225' was used based on the gas saturations discovered over the interval 1500'-2000' in well FF-34B. The model was initialized with an initial average pressure of 565 psia and 572 MMSTB of water in place. All layers were initialized with a gas/water contact depth of 400 feet. The date of initialization was September 6, 1990.

Simulation

The pressure history match was based on shut-in pressures observed on the number one annulus of MA-5A. To simulate the shallow well leak, gas was injected into FF-34A at a rate of 35 MMCF/D. Injection continued at this rate for three days (September 7-9). On the fourth day, the injection rate was reduced to 18 MMCF/D. By September 11, a total volume of 123 MMCF of gas had been injected. On this date, the maximum surface pressure recorded on MA-5A's

number one annulus was 760 psig. Assuming the annulus was filled with water, the surface pressure calculates to a zone pressure of 1309 psig. This compares closely with a grid block pressure of 1242 psig calculated by the model. On September 13, the shut-in surface pressure on the #1 annulus was 325 psig. The calculated zone pressure at this time was 835 psig. The model calculates a grid block pressure of 879 psig on this date.

The calculated pressures did not match the observed pressures on other surrounding wells (i.e., FF-34, FF-34B). I attribute this to the combined influence of variable fluid saturations and inter-bedded sands and shales that have irregular permeability patterns.

Wells FF-34, FF-34B, MA-3, MA-4, and MA-5A were produced at low gas rates (50-100 MCFD) to simulate the effect of surface blowdown and venting through fractures. The well locations are shown on Figure 8. A water producing well was completed updip at a radius of 1570' from the gas injection well. The water well was produced at a rate of 50 STB/D to simulate the surface outcrop.

DJA:ll
Attachment (see attached envelope)

cc: N. W. Buss
File AC1103

Ex. IV-8

WELL ACTIVITY REPORTS FOR FREW 3

DATE	ACTIVITY/REMARKS
6/14/84	(Continued) NOTE: When talking to the Shift Supervisor who worked the Sunday afternoon (6/10) the high annulus pressure was discovered on F-3, he said the well was taking far more gas than normal while on injection. He noted it sounded as if twice the volume of gas was being taken by the well. Flo-Log ran a temperature survey and noise log. Temperature ran at 100'/min from 500'-1500'. A 3 cooling anomaly was noted at 1160' and a smaller anomaly noted at 1100'. The noise log showed a large separation between the 200 Hz and the other three frequencies with all frequencies exited. The word used to describe the sound would be "crackling" or "popping". No disconcernable shifts in the frequencies were noted with the log being taken down to 3500'. Three different noise tools were used and all three were the same noise level. NOTE: The only hypothesis on the condition of the well would be the casing has a hole, split or is ported around 1100'. The subsequent feeding of the leak caused hydrates to form and back up all the way to the SSSV ports. This is supported by the "crackling" of the noise log which sounds like a very small amount of gas slowly moving and the inability of the temperature bombs to get below the ports at the SSSV thus showing some "plug" located there. Halliburton killed the well with 67# polymer. The first 100 Bbls was a 100+ cp viscosity pill followed by regular mix polymer using the constant tubing pressure method. The tubing pressure declined as normal to less than 100# with no casing pressure buildup. After approximately 100 Bbls had been pumped, the casing pressure began to decline from 1220#. This continued until 200 Bbls had been pumped when the tubing pressure finally kicked and the casing pressure was 800#. The remainder of the gas was vented as the kill proceeded. Once the casing pressure was zero (at approximately 350 Bbls, hole volume, 300 Bbls), returns were waited upon but never received. Eventually pumped a total of 580 Bbls of fluid into hole at 5 BPM with no returns. The tubing pressure did begin to rise slightly before we ran out of the fluid. Well was then shut-in. Both casing and tubing pressure was zero.

WELL ACTIVITY REPORTS FOR FREW 3

DATE	ACTIVITY/REMARKS
8/18/81	Pruett pulled SSSV, cost $515.00
8/19/81	Pruett pulled choke, cost $265.34
8/20/81	Ran temperature survey
8/31/81	Triangle ran sound log, cost $3,172.04
9/15/81	Otis ran SSSV, test OK, cost $1,235.00
10/27/81	Otis rigged up to pull SSSV, no complete
12/3/81	Otis set SSSV & BHC, will test on 12/4
12/4/81	Otis set SSSV & BHC, test OK
1/11/82	Pruett pulled SSSV
1/16/82	Pruett pulled BHC, blew-out and re-ran BHC
1/17/82	Pruett pulled BHC, blew-out second time
1/18/82	Sand testing
3/30/82	Ran temperature survey
10/20/82	Ran temperature survey, anomaly @ 7650'. Run A/A
12/16/82	Noise log run, no noise
6/8/83	Ran temperature survey, no anomaly
12/12/83	Ran temperature survey, no anomaly
4/2/84	Ran temperature survey, cooling anomaly at shoe
4/10/84	Ran detail temperature survey, confirms cooling from 6750'-7791' at shoe. A noise log will be run at high inventory due to low structural position of well.
6/10/84	Operations noted sudden jump in surface annulus pressure to 550#; repeated attempts to blowdown annulus were unsuccessful
6/11/84	Ran temperature survey which looked very abnormal; hottest temperature noted was around 80 F so assumed temperature bomb had malfunctioned.
6/13/84	MacCarlisle checked seals on wellhead, neither seal was leaking. Ran temperature survey which showed extreme cooling. Surface temperature was 38 and temperature @ 7750' was only 82. It should be noted both surveys (11th & 13th) could not be run through the tubing, but the survey run on 4/2/84 could go through; possible hydrates (?) all the way to SSSV ports. Continued trying to blowdown annulus, but it will rise back to 460# from 250# in minutes.
6/14/84	Baker set 500 Bbl tank on site for well kill. Test center came out and took sample of gas coming from annulus. Helium content on annulus was 560 ppm thus showing it was definitely Aliso gas and it was coming from a leak somewhere. Checked DA-2 (Del Aliso 2) which is in close proximity but only showed 24 ppm. No movement in that direction. Annulus pressure on F-4 increased abruptly from 30# to 180#. Looks like definite migration to F-4.

WELL ACTIVITY REPORTS FOR Frew 3

DATE	ACTIVITY/REMARKS
3/1/79	Pipe construction completed. Opened SSSV and put well on csg. W/D SIWHP 2560
3/30/79	Ran temperature survey
4/3/79	Archer-Reed rigged up and pulled separation tool. Latched onto SSSV but could not pull
4/9/79	Jarred on SSSV all day but could not pull. Ordered out braided wire unit for Monday
4/10/79	Archer-Reed removed SSSV
7/26/79	Ran temperature survey to BHC. Will have choke pulled and complete survey to bottom
7/27/79	Hanson Wireline pulled .770 BHC to complete temperature survey to bottom of well
7/31/79	Ran temperature survey to bottom of well.
10/24/79	Pruett ran BHP survey
11/2/79	Archer-Reed set BHC. Empty choke holder, ID 1.0
11/7/79	Ran BHP survey
11/20/79	Gurevich ran BHP survey
11/28/79	Pruett ran BHP survey
1/8/80	Ran 8 hr sand test. 1.0 BHC, SIWHP 2560, Pup 520; Pdn 520, Tup 69, Q 45
1/10/80	Archer-Reed pulled 1.0 BHC
1/14/80	Gurevich ran temperature & BHP survey. Archer-Reed ran scratcher
1/15/80	Archer-Reed ran XL sleeve shifter. Ran SSSV and separation tool tested valve as follows: S/I T 2560, S/I C 2590 1. Bled tubing to 1470, held good 2. Bled tubing to atmosphere 3. Bled casing to 1950, valve was closed 4. Pressure casing to 2400 5. Pressure tubing slowly to 2200, valve opened at about 1300. Test OK.
1/16/80	Ran sand test. 24-hours, 1.125 SSSV, SIWHP 2580; Pup 585; Pdn 585; Tup 67; Q 30
6/9/80	Archer-Reed pulled separation tool & SSSV. Cost $296.50
6/10/80	Gurevich ran temperature survey
6/20/80	Triangle ran noise survey. Survey shows some noise in WSO area of well. Will run R/A survey to verify. Cost #2185.00
6/24/80	Triangle attempted R/A survey. Panel problems in truck. Took to shop. Be back on Monday
7/7/80	Triangle ran R/A survey in shoe - WSO area of well. Cost $1700.10
10/20/80	Shut-in BHP survey
10/27/80	Pruett BHP survey
10/31/80	Archer Reed set 1.0 BHC. Cost $220.00
11/3/80	Pruett BHP survey
12/23/80	Archer-Reed set SSSV. Cost $370.50
3/20/81	Harry ran BHP
3/27/81	Harry ran BHP
6/4/81	Fred ran temperature survey
6/10/81	Fred ran temperature survey

Ex. IV-9

ORDER INSTITUTING INVESTIGATION ON THE COMMISSION'S OWN MOTION INTO THE OPERATIONS AND PRACTICES OF SOUTHERN CALIFORNIA GAS COMPANY WITH RESPECT TO THE ALISO CANYON STORAGE FACILITY AND THE RELEASE OF NATURAL GAS, AND ORDER TO SHOW CAUSE WHY SOUTHERN CALIFORNIA GAS COMPANY SHOULD NOT BE SANCTIONED FOR ALLOWING THE UNCONTROLLED RELEASE OF NATURAL GAS FROM ITS ALISO CANYON STORAGE FACILITY (I.19-06-016)

SOUTHERN CALIFORNIA GAS COMPANY

(DATA REQUEST SED-SCG-65 DATED APRIL 6, 2020)

SOCALGAS RESPONSE DATED APRIL 27, 2020

SoCalGas provides the following Responses to the Safety & Enforcement Division (SED) data request dated April 6, 2020 in I.19-06-016. The Responses are based upon the best available, nonprivileged information that SoCalGas was able to locate through a diligent search within the time allotted to respond to this request, and within SoCalGas' possession, custody, or control. SoCalGas reserves the right to supplement, amend or correct the Responses to the extent that it discovers additional responsive information.

SoCalGas objects to the instructions submitted by SED and to the continuing and indefinite nature of this request on the grounds that they are overbroad and unduly burdensome. Special interrogatory instructions of this nature and continuing interrogatories are expressly prohibited by California Code of Civil Procedure Section 2030.060(d) and 030.060(g), respectively. SoCalGas will provide responsive documents in existence at the time of its response. Should SED seek to update its request, SoCalGas will respond to such a request as a new data request in the future.

SoCalGas submits these Responses, while generally objecting to any Request that fails to provide a defined time period to which SoCalGas may tailor its Response, and to the extent that any Request is overly broad, vague, ambiguous, unduly burdensome, assumes facts, or otherwise fails to describe with reasonable particularity the information sought. SoCalGas further submits these Responses without conceding the relevance of the subject matter of any Request or Response. SoCalGas reserves the right to object to use of these Responses, or information contained therein, in any dispute, matter or legal proceeding. Finally, at the time of this Response, there are no pending oral data requests from SED to SoCalGas.

QUESTION 2:

Beginning on page 12, the testimony states, "Many of the Casing 'Leaks' Identified by SED Were Insignificant and Are Irrelevant to What Occurred at SS 25. . .SED's assertion, which is based solely on Blade's report [footnote omitted], mischaracterizes 60 well casing issues of varying cause and degree as relevant 'leaks.' SED seeks to show a 'pattern of SED's and Blade's assertions appear to be premised on the assumption that these casing issues were somehow similar to the circumstances that led to the failure at SS-25. [footnote omitted]. In fact, Blade's report combines a number

of different well conditions as 'leaks,' including perforations intentionally made by SoCalGas for water shut off tests and stage collar leaks. These well conditions have no relation to corrosion and present little risk of reason for concern. . .Blade's list of 63 relevant casing failures incorrectly includes the following:"

On pages 13-16, the passage then adds 11 bullet points which appear to make separate contentions in apparent support of this assertion. Most of footnotes 50 through 87 refer to Exhibits I-16 through I-60. In addition, footnote 85 references the SS-4-0 well file. Footnote 69 references Volume 4 of the Blade Report pages 25-28 and 39. Footnote 82 references Volume 4 of the Blade Report at pages 24, 25, 28, 29 and 31. For Each of these references to a Well File, please highlight or underline the exact sentence(s) that support the assertions in the testimony that cite the reference.

.

Response 2:

SoCalGas objects to this request to the extent it is argumentative in implying that the contentions regarding the 11 bullet points are not in support of the assertion in the first paragraph above. SoCalGas further objects to this request to the extent it is overly broad and unduly burdensome to the extent that SoCalGas has already provided specific pages from large well files in support of its positions; SoCalGas notes that it did not cite to the entire well files in support of its contentions but provided specific pages. Subject to and without waiving the foregoing objections, SoCalGas responds as follows:

Pursuant to the testimony on pages 13-16, the individual wells are discussed via 11 separate bullet points. In order to provide consistency and for ease of readability, SoCalGas presents its responses to this question in the same format:

> **P-12**: See Blade Report, Volume 4, Table 14, Page 41, entry for January 1970, indicating a casing leak in 6 5/8 inch casing. SoCalGas notes that 1970 is prior to the well's conversion to a gas storage well.
>
> **SS-14**: Blade Report, Volume 4, Table 14, "Unable to test 7 inch casing at 156 feet". See previously produced document with Bates range AC_CPUC_0035016, entry from 5/14/76. This indicates that there is no casing leak at 156 ft. The well was successfully pressure tested from surface to 8,000'

under 2500 psi pressure. The well was subsequently successfully pressure tested from surface to 1,000' under 3000 psi pressure.

SS-17: See Blade Report, Volume 4, Table 14, Page 47, entry for July 1952: "Leak in 7 in. casing at 5.238 ft while drilling sidetrack hole using a whipstock." SoCalGas notes that 1952 is prior to the well's conversion to a gas storage well.

P-47: See previously produced document with Bates range AC_CPUC_0106570, 1973 Workover Report, noting (within the Notice of Intention to Deepen, Redrill, Plug or Alter Casing in Well) that the proposed work is as follows: "Jet perforate four ½" holes per foot and/or perforate two ½" holes per foot in the Sesnon zone as required to convert well to a gas storage well". This notice was filed in January 1973 and the referenced work was done in March 1973.

P-25R (4 leaks noted by Blade): See Blade Report, Volume 4, Table 14, Page 41; 4 separate casing leaks were noted in January and February, 1973. See also Prepared Reply Testimony, Chapter I (Hower/Stinson), Ex. I-20; page 14, showing a Notice of Well Work filed on January 15, 1973. This notice includes a reference to the following job: "Perforate and/or re-perforate in the Sesnon and Frew zones between 7876' and 8560' as required to convert well to a gas storage well".

FF-35E: See Blade Report, Volume 4, Table 14, Page 39; showing 2 separate casing leaks were noted in August and November, 1972. See also Prepared Reply Testimony, Chapter I (Hower/Stinson), Ex. I-21, page 1, showing the well was spud on 8-6-72. The daily drilling record for 8-27-72 on page 2 shows a leak in the stage collar at 1919' squeezed with cement. Further, the daily drilling record for 11-6-72 on page 5 shows a leak in the collar at 2344'. Both of the above casing leaks were clearly identified and mitigated during the initial drilling and testing of the FF-35E well during the conversion of the field to gas storage.

SF-2: A review of DOGGR records indicates that the well was drilled in 1953,

with workovers in 1956, 1961 and 1976. As there was no well work conducted in the period between 1961 and 1976, the work done on well SF-2 during 1976 was part of the conversion of the field to gas storage. See previously produced document with Bates range AC_CPUC_0109110, entry showing 6/7/67, documenting that the original wellhead was removed and a new wellhead installed on the well at that time. See also the entry of 6/10/76 on previously produced document with Bates range AC_CPUC_0109111, documenting of pressure testing from 9160' to surface, from 4500' to surface, etc. This is known as block testing. Both of the activities documented in the two entries (replacement of wellhead and block pressure testing) are indicative of well work that would be done during the conversion of a well to gas storage operations.

MA-1B: See Blade Report, Volume 4, page 15, stating "[w]ell MA-1B had a leak in the 8 5/8 in. casing while drilling". Clearly, this indicates the well was being drilled as a new storage well.

FF-32F: See Blade Report, Volume 4, Table 14, page 38, showing a casing leak in the 8 5/8" stage collar at 2001' in January, 1986. Stage collars leaks have nothing to do with corrosion or poor integrity of the well casing. See also Prepared Reply Testimony, Chapter I (Hower/Stinson), Ex. I-26, entry for 1/23/86, stating "[u]sing wireline, oriented Baker patch from 1978' – 2023' across stage collar at 2001'."

SS-25A: See Blade Report, Volume 4, Table 14, page 47, noting that in October, 1981 "a casing patch was set over a stage collar at 2,990'." See also Prepared Reply Testimony, Chapter I (Hower/Stinson), Ex. I-27, wellbore diagram, confirming the same.

FF-32E: See Blade Report, Volume 4, Table 14, page 38, showing a "leak in 8 5/8" stage collar at 2,988 ft." in September, 1975. See also the wellbore diagram in Prepared Reply Testimony, Chapter I (Hower/Stinson), Ex. I-29, confirming installation of a casing patch leak at 2967' to 3009', across the stage collar located at 2988'.

P-26B: See Blade Report, Volume 4, Table 14, page 42, showing a "casing leak in 8 5/8" stage collar at 2,793 ft." in August, 1981. See also the wellbore diagram in Prepared Reply Testimony, Chapter I (Hower/Stinson), Ex. I-33, confirming repair of a casing patch leak at 2726' to 2773', across the stage collar located at 2749'. Note that the original recorded depth of the stage collar was 2793', but was later located at 2749'.

SS-25B: See Blade Report, Volume 4, Table 14, page 47, showing that in October, 1976 a casing patch was set across the stage collar. See also the wellbore diagram in Prepared Reply Testimony, Chapter I (Hower/Stinson), Ex. I-36, confirming the location of a casing patch leak at 2907" to 2929', over the stage collar at 2918'.

FF-35B: See Blade Report, Volume 4, Table 14, page 39, noting that September 1978 a leak was detected "in [the] 8 5/8" casing at 3,997 ft. at stage collar. Set casing patch 4.016-3,974 ft." See also the entry on Prepared Reply Testimony, Chapter I (Hower/Stinson), Ex. I-39 for September 15, 1978, noting that a casing patch was set "at 4,016 - top 3,974' (42') over stage collar leak at 3997'."

SS-44A: See Blade Report, Volume 4, Table 14, page 48, entry for July 1978, noting a "[l]eak in 8 5 in. stage collar at 3,958 ft. Set a casing patch." See also Prepared Reply Testimony, Chapter I (Hower/Stinson), Ex. I-40, entry for July 11, an 8 5/8" casing patch was set from 3936' to 3978' over stage collar at 3958'."

P-47: The Prepared Reply Testimony, Chapter I (Hower/Stinson), incorrectly identifies this leak at 7,328' as a repair of water shut-off holes. The leak was found while testing and plugging water shut off holes in the casing at 8,138', but was not associated with the water shut off.

Frew-3: See Blade Report, Volume 4, Table 14, page 40, stating: "Well P&A. Leak in 5 ½ in. inner casing at 7,500 ft. Ran 5 ½ in. USIT log, anomaly at 7,532-7,548 ft. Tight spot in 7 in. casing at 7,543 feet. Leak in 7 in. casing 2,643 – 2,658 ft. Ran 7 in. USIT log, anomaly at 3,233 ft." The leak in the 5

½ in. inner string is a legitimate leak and was counted as such. However, the leak behind that inner string, in the 7 in. casing, was remediated via the running of the inner string. The leak was originally identified in January 1986, per referenced Blade table 14. The 5 ½ in. inner string was run to repair that leak. The leak should not be counted again when the 5 ½ in. inner string is ripped out of the well during plug and abandon operations.

FF-35C: See Blade Report, Volume 4, Table 14, page 39, entry for September 1990, stating "[v]ertilog showed possible penetration at 6832 ft, 2350 ft 40-60% penetration, 966 ft > 60% penetration." This is not indicative of a casing leak. See also Ex. I-44, page 1, entry for 9-19-90, indicating "[f]ound areas of corrosion in 8 5/8" casing at 6832', 2350', and 966'." See also Prepared Reply Testimony, Chapter I (Hower/Stinson), Ex. I-45, page 1, entry for 9-21-90, indicating, "[f]inished running in well with packer and bridge plug. Set bridge plug at 6895' (top) and tested to 1500 psi (5601' – 6895'). Recovered bridge plug and set at 5633'. Tested 8 5/8" casing to 900 psi (0' – 5633'). Set bridge plug at 4407' and tested 8 5/8" casing to 1500 psi (0' – 4107'). All tests good – no leaks."

P-32 (2 leaks noted by Blade): See Blade Report, Volume 4, Table 14, page 42, stating in the entry for September, 2016, "POH inner casing. Squeezed cement leaks in 7 in casing at 654-845 ft and 1,300 – 1,323 ft. Ran and cemented 5 ½ in. inner casing". The Blade entry clearly shows that the holes in the 7 in casing were behind an inner string and were, therefore, not casing leaks as they were mitigated by the inner string. The only reason this work was done in 2016 was due to the new regulations from DOGGR post SS-25 incident.

P-35: See Blade Report, Volume 4, Table 14, page 43, entry of February 2016, indicating Vertilog showed penetration indications at various depths. However, Prepared Reply Testimony, Chapter I (Hower/Stinson), Ex. I-49, page 9, entry for daily operations for 3/1/2016 – 3/2/2016, indicates multiple pressure tests were run throughout the entire wellbore with all indicating "Good Test."

ORDER INSTITUTING INVESTIGATION ON THE COMMISSION'S OWN MOTION INTO THE OPERATIONS AND PRACTICES OF SOUTHERN CALIFORNIA GAS COMPANY WITH RESPECT TO THE ALISO CANYON STORAGE FACILITY AND THE RELEASE OF NATURAL GAS, AND ORDER TO SHOW CAUSE WHY SOUTHERN CALIFORNIA GAS COMPANY SHOULD NOT BE SANCTIONED FOR ALLOWING THE UNCONTROLLED RELEASE OF NATURAL GAS FROM ITS ALISO CANYON STORAGE FACILITY (I.19-06-016)

SOUTHERN CALIFORNIA GAS COMPANY

(DATA REQUEST SED-SCG-65 DATED APRIL 6, 2020)

SOCALGAS RESPONSE DATED APRIL 27, 2020

SS-4A: See Blade Report, Volume 4, Table 14, page 45 indicating that the SS-4A well had a leak repaired in January 2017 between 753 – 860 feet. This was not the case. The cement squeeze operations referenced by Blade were actually associated with pre-abandonment operations conducted on a production casing behind an inner casing string. See electronic documents with Bates range I1906016_SCG_SED_DR_65_0000002 through I1906016_SCG_SED_DR_65_0000004. Perforations are noted between the depths of 815 – 825 feet. These perforations were required by DOGGR so that SoCalGas could pre-abandon zones at the base of the fresh water behind the production casing prior to cementing an inner string of casing. There was no casing leak.

P-42C: This was not a casing leak. See Prepared Reply Testimony, Chapter I (Hower/Stinson), Ex. I-53. Note entry on 11-14-76: "RIH to 6,790 attempted to test 9 5/8" casing lap and 7 5/8" casing to RBP @ 7,490." A casing, or liner, lap refers to the interval between the liner top and the shoe of the outer casing. Thus, the leak referred to in the P-42C well file was an issue with an internal seal between the casing and a liner.

Ward 3A: See Blade Report, Volume 4, Table 14, page 48, indicating casing damage and a leak in December 2016. In August of 2016, the entire casing string was successfully pressure tested to 1000 psi as witnessed and approved by DOGGR. See electronic document with Bates range I1906016_SCG_SED_DR_65_0000001. The leaks noted subsequent to this successful testing were associated with milling operations on a packer initiated on 12/5/2016. See electronic documents with Bates range I1906016_SCG_SED_DR_65_0000005 through I1906016_SCG_SED_DR_65_0000012. Any damage caused to the casing was associated with these internal milling operations and not external corrosion.

P-32B: See Blade Report, Volume 4, Table 9, pages 24 and 25. Three separate casing leak events are counted by Blade. All of these holes were in the same 8 5/8" casing string and identified at the same time. Per the referenced Table 9 in the Blade Report; Volume 4, the holes were all

remediated with the same 7" liner. This should have been counted as one singular casing leak event by Blade and not three separate events. Thus, we have excluded two casing leaks from Blade's total count.

SS-4A: See Blade Report, Volume 4, Table 9, page 28. Two separate casing leak events are counted by Blade. See also Prepared Reply Testimony, Chapter I (Hower/Stinson), Ex. I-56, page 3, entries for 1-8-79 and 1-9-79, showing the identification of the holes within the same casing string. These holes were all remediated during the same workover. This should have been counted as one singular casing leak event by Blade and not two separate events. Thus, we have excluded one casing leak from Blade's total count.

MA-5A: See Blade Report, Volume 4, Table 9, page 31. Two separate casing leak events are counted by Blade. The holes were identified within the same casing string at the same time. These holes were all remediated during the same workover. This should have been counted as one singular casing leak event by Blade and not two separate events. Thus, we have excluded one casing leak from Blade's total count.

SoCalGas notes that bullets 7 – 11 do not discuss casing leaks, but instead discuss four separate events of parted casings. Therefore, SoCalGas relies on its Prepared Reply Testimony, Chapter I (Hower/Stinson), pages 15-16 to cover the discussion of these issues.

Ex. IV-10

Response to Data Request

Response to SED Data Request-58

Prepared for:
Mr. Darryl Gruen
CPUC Legal Division

Purpose:
Blade response to the CPUC Data Request SED 58 related to Vertilog technology and the casing failure in SS-25 from Reply Testimony of Mr. Robert Carnahan on behalf of SoCalGas.

Date:
May 15, 2020

Version:
1

Project Number:
N/A

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Version Record

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Version	Date	Description of Change

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1 Background

The Legal Division of the California Public Utilities Commission issued a Data Request to Blade Energy Partners (Blade) on March 30, 2020. Data Request No: SED 58 related the Preliminary Investigation of Southern California Gas Company's Aliso Canyon Storage Facility.

The CPUC statements (from file: "I1906016 SED DR 58 Final.pdf") are included verbatim followed by the Blade answers to the questions.

The page numbers and figure numbers in the verbatim statements refer to a document titled: Chapter II, Prepared Reply Testimony of Robert A. Carnahan, P.E. on behalf of Southern California Gas Company (U 904 G). File name: "2_Ch. II - Exponent - Carnahan (A Final).pdf".

2 Statements and Responses

2.1 Statement 1

Pages 1 and 2: "[Public Advocates Office's] allegations presuppose that the Vertilog technology at that time [1988] was reliable and accurate. That is not the case."

2.1.1 Blade Response

1. Does Blade Energy Partners agree or disagree with the statement?

   Disagree.

2. If Blade disagrees with any portion of the statement, why?

   The Vertilog or equivalent technology that existed in 1988 was capable of detecting and discriminating metal loss features, with only its sizing and characterization capabilities being limited compared to the current technology. That being said, it was the best technology available at the time for monitoring metal loss in casing and was sufficient to indicate the presence of corrosion issues.

   Mr. Carnahan incorrectly references a quote [page 2, line 12] found in a Pipeline & Gas Journal article (footnote #9). The original quote, which is related to pipeline inspection, is being misapplied to downhole logging. The complete quote is:

   > "Historically, the results of the first-generation MFL tools were not very satisfactory, but BG (British Gas) and then PII developed advanced electronics and analysis algorithms and software which set new standards in the industry."

   In Mr. Carnahan's testimony [at page 2, line 12, and page 8, line 13], he modifies the quote as follows:

   > "Historically, however, the results of the first generation of MFL tools were not very satisfactory.[9]"

   The original quotation notes the advances in technology but were not acknowledged by Mr. Carnahan. The statement by Goedecke, the original author, about first-generation magnetic flux leakage (MFL) tools and subsequent advances in technology was in reference to pipeline inspection tools. These first-generation MFL tools were developed from approximately 1959–1965 [1, 2, 3]. The first commercial effort to collect information using MFL tools was by AMF Tuboscope in 1965; the name of the tool was the Linalog [1, 2, 3]. By 1983, 112,000 km of pipeline had been inspected [4]. Mr. Carnahan mischaracterizes the Vertilog as a first-generation MFL tool but there were significant advances in MFL technology that began in the pipeline industry [2] prior to the Vertilog's deployment into oil and gas wells in the mid 1970's.

   Mr. Carnahan negatively portrays the Vertilog [page 2, line 8], "… as a mechanism that attempts to utilize Magnetic Flux Leakage (MFL) to detect casing metal loss[8]." The footnote #8 that Mr. Carnahan refers to was a 1977 Society of Petroleum (SPE) paper [5] written by employees of the logging company Dresser Atlas, which would later become part of Baker Hughes. The word "*attempts*" is not used in the reference. Although Mr. Carnahan describes the working principles of the Vertilog, he fails to provide the context that MFL and eddy current technology for the use of corrosion inspection were well established in oil and gas pipeline operations. The SPE paper's authors describe the Vertilog tool as follows:

It is a quantitative measurement of corrosive damage, indicating if the metal loss is internal or external, and if it is isolated or circumferential. Holes in the casing can be identified as well as parted casing. This survey in conjunction with other measurements, can be used to detect, monitor, and establish preventive techniques for corrosive problems.

Figure 1 shows the Vertilog and Digital Vertilog (DVRT) performance specifications as of 1991 (provided by Mr. Rod Foster, Well Integrity Senior Advisor, Baker Hughes). The two tools are essentially the same tool and sensor system but the DVRT has upgraded electronics for improved acquisition and computerized processing [6]. The DVRT was deployed in approximately 1991, superseding the Vertilog. As a point of reference, the DVRT was considered by Blade[i] for use in logging of the 11 3/4 in. surface casing as part of the SS-25 RCA. Considering the wall thickness of 0.317 in. (for 7 in. 23 ppf production casing in SS-25), the Vertilog and DVRT could detect defects deeper than 30% or 0.095 in. and size them +/- 15% or 0.048 in. For the Vertilog and DVRT, a 50% deep defect could be sized between 35–65%. In comparison, the High Resolution Vertilog (HRVRT) can detect defects that are deeper than 15% or 0.048 in. and size them +/- 10% or 0.032 in. For the HRVRT, a 50% deep defect could be sized between 40-60%.

Measurement Range:	30 to 90% penetration of the casing wall in single string
Absolute Accuracy:	±15% of actual pit depth in single string casing for isolated pitting, when casing information such as weight, grade, etc. is available
Repeatability:	±10% of first reading if pipe was fully magnetized on first pass
Sensitivity:	Casing defects as small as 0.375 in. (9.5 mm) in diameter with as little as 30% penetration can be detected and recorded at 100 ft/min (30.5 m/min) in single string
Radial Investigation:	Tool is designed to inspect the full casing circumference
Depth of Investigation:	100% of the wall of the inside casing

Figure 1: Performance Specifications for the Vertilog, and Digital Vertilog from 1991

Table 1 shows a listing of casing inspection logs that were downloaded from the DOGGR website [7] during the course of Blade's RCA; the logs are within 10 years of the proposed dates of the 1988 Interoffice Correspondence 2-year logging program [8]. As discussed in Blade's Main RCA report [9, p. 204], Blade's position is that SoCalGas made a recommendation to run the Vertilog in 20 wells that concerned them at the time. Blade reviewed the logs listed in the table that were run in approximately the same time frame as the 1988 Interoffice Correspondence. Although we did not perform an exhaustive study; in our opinion, the Vertilog was superior to the inspection tools of its day, specifically, the Welex Casing Inspection Log, McCullough Electronic Casing Caliper, and Schlumberger Electromagnetic Thickness Log. The recommendation to run Vertilog casing inspections in 20 wells appeared to Blade to have been based on using the best available technology at that time for the purpose of assessing the mechanical condition of casing flow wells completed in the 1940s and 1950s.

[i] In 2016–2017, the DVRT was the was only MFL tool available to inspect the 11 3/4 in. casing. Although the sensor system was developed in the mid-1970's with upgraded electronics in approximately 1991, the DVRT was still in-service and was initially Blade's primary MFL logging option. Because it was important to attain the most accurate data, Blade requested that Baker Hughes and its vendor, Microline Technology Corporation, adapt the HRVRT to 11 3/4 in. casing size. The DVRT was not used in the SS-25 RCA.

Mr. Carnahan's assertion is that the Vertilog was unreliable and inaccurate and combined with other factors, would not have prevented the SS-25 incident. His basis for finding the Vertilog unreliable and inaccurate is derived from his numerical comparison of five (5) Vertilogs from 1988–1990 to various HRVRT and USIT logs run in 2013 and 2016–2018. This is an approach that would not have been available to SoCalGas in the late 1980s or early 1990s. Certainly, logging technology of 2010s would be expected to be more accurate than that of late 1980s and early 1990s. However, this does not mean that the older logging tools did not provide useful or actionable information.

For example, in 1989, researchers evaluated four types of casing inspection tools, stating the following [10]:

> Electromagnetic casing inspection logs are commonly used in the industry to survey the condition of casing. Logs may be used to estimate the amount of pitting, degree of corrosion, wall thinning, changes in diameter, and other casing features. Occasionally, casing inspection logs are used to investigate a casing failure in a well. Interpretations of casing inspection logs may be used to determine the type of remedial work on a well where a casing failure has occurred, or they may be an important factor in a commercial casing failure claim.

There are key concepts in this paper related to casing inspection tools available in 1989. The first was that casing inspection tools were commonly used for detecting pitting, degree of corrosion, and wall thinning. The second was the authors describe MFL technology, specifically mentioning the Vertilog, as capable of being able to distinguish between split and parted casing.

Two of the wells in Table 1 had underground blowouts, namely F-3 and FF-34A, which were logged in 1986 and 1991 respectively. These dates bookend the Vertilog logging campaign outlined in the 1988 Interoffice Correspondence. Note that the Schlumberger Ultrasonic Imager (USIT) was run in P-42B in 1993, which was not that long after the September 10, 1990 FF-34A casing failure and when the Vertilog logging campaign was discontinued.

Table 1: Aliso Canyon Casing Inspection Logs within 10 years of 1988–1990

Well	Date	Vendor	Log Name
FF-35B	August 31, 1978	McCullough	Electronic Casing Caliper
SS-1	February 27, 1980	McCullough	Electronic Casing Caliper
MA-1A	February 28, 1985	McCullough	Electronic Casing Caliper
F-3 [b]	January 31, 1986	Welex	Casing Inspection Log
F-4 [a c]	September 6, 1988	Western Atlas	Vertilog
P-37 [a]	October 11, 1988	Western Atlas	Vertilog
P-46 [a, c]	October 19, 1988	Western Atlas	Vertilog
SS-9 [a, c]	December 16, 1988	Western Atlas	Vertilog
SS-8 [a, c]	January 17, 1989	Western Atlas	Vertilog
P-32C	July 26, 1989	Western Atlas	Vertilog
P-34 [a, d]	November 2, 1989	Western Atlas	Vertilog
FF-35B [c, d]	November 11, 1989	Western Atlas	Vertilog
MA-1A	December 27, 1989	Western Atlas	Vertilog
F-2 [a, d]	January 11, 1990	Western Atlas	Vertilog

Well	Date	Vendor	Log Name
FF-35C	September 18, 1990	Western Atlas	Vertilog
SS-14	March 5, 1991	Halliburton	Casing Inspection Log
FF-34A [b]	May 11, 1991	Schlumberger	Electromagnetic Thickness Log
P-42B	January 11, 1993	Schlumberger	Ultrasonic Imaging Tool
P-68B	May 27, 1993	Halliburton	Casing Inspection Log
SS-14	May 26, 1998	Halliburton	Casing Inspection Log
SF-2	November 19, 1999	Schlumberger	Ultrasonic Imaging Tool

[a] – Wells listed in the 1988 Memo (F-4, P-37, P-46, SS-9, SS-8, P-34, F-2)
[b] – Wells that had blowouts (F-3, FF-34A)
[c] – Wells reviewed by Mr. Carnahan (F-4, P-46, SS-9, SS-8, FF-35B)
[d] – Logs not available on the DOGGR website (P-34, FF-35B, F-2)

Mr. Carnahan's spreadsheet analysis neglects important findings that are visible graphically on the log. There is considerable information that can be derived from looking at the log image. Different logs employ different technology; the characterization and sizing of features may appear different. Most logging companies have some version of the cement bond log with variable density (CBL – VDL) for the determination of zonal isolation (i.e., to evaluate if the cement is an effective barrier). Although these logs have been utilized for over 50 years, the best way to interpret the presence of cement and the bond to pipe and formation is to *look* at the log. There are wavy, chevron, zigzag, and other patterns that have meaning. This is the same for the Vertilog and other casing inspection logs. There is data in the patterns.

Blade performed an analysis of F-4's 1988 Vertilog as part of the RCA [11] comparing it to the 2016 Ultrasonic Imager (USIT) log. Figure 2 shows these two logs with the Vertilog on the left and USIT on the right. To aid in interpretation from joint to joint, the logs have been adjusted so that the casing connections of each log are aligned. External metal loss is denoted by blue text at A, B, and C on the Vertilog's Flux Leak track, and by the same letter on the USIT's wall thickness track. At A-A, external metal loss is found just above a connection. At B-B, external metal loss is found approximately midway in the joint. At C-C, there is external metal loss below a connection. The point here is the two logs found the same defects.

There was good agreement between the logs at most depths. However, in some cases, the logs did not agree. It should not be assumed that the 2016 USIT log was the more accurate one. In Blade's experience, MFL tools are better at detecting pitting corrosion. In general, it's a flawed concept to compare one log tool to another and automatically claim one is more accurate than the other. Log data has to be compared to truth data (direct measurements of defects) to assess log performance. In today's era, repeatability and reproducibility of pipeline inspection tools are verified independently in pull-through tests (e.g., Pipeline Research Council International Integrity and Inspection projects). Even today, very little data has been published in testing downhole logging tools in controlled environments. An independent comparison of casing inspection logging tools spanning decades does not exist, however, the Vertilog and other casing inspection tools could have been used as an indicator of an issue.

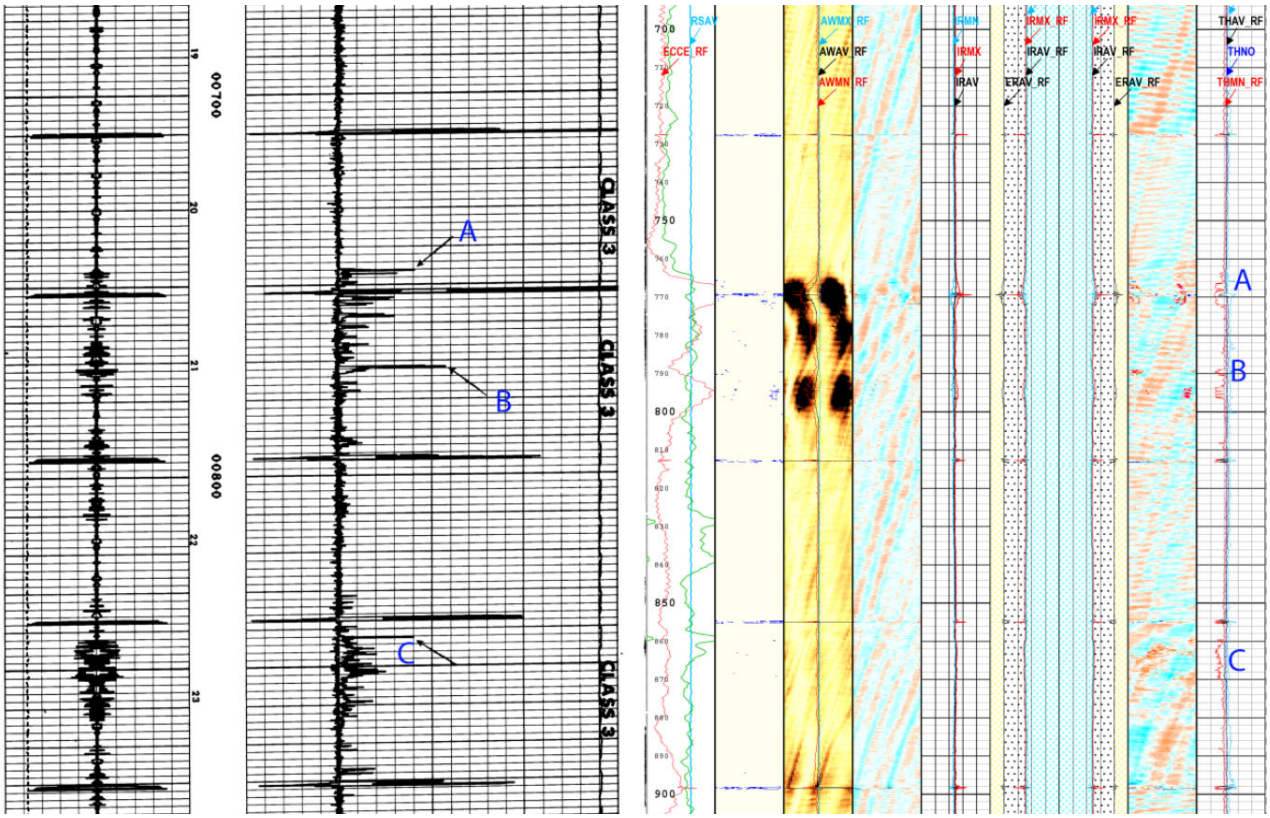


Figure 2: F-4 1988 Vertilog (Left) and 2016 USIT (Right) Comparison

3. Is there any context either in or outside of Mr. Carnahan's testimony that Blade wishes to add in order to explain its answers? If so, please provide it and explain.

   SoCalGas had a two-year plan in 1988 to determine the mechanical condition of the casing in 20 wells originally completed in the 1940s and 1950s. Blade reviewed the records of all 20 wells to evaluate subsequent casing inspections and the casing problems that occurred in the following years. A number of casing problems were identified. SoCalGas made a recommendation to run casing inspection logs in 20 wells that concerned them at the time, and the opportunity to inspect the casing in SS-25 was missed. There is no way to know what an inspection of the SS-25 casing would have shown in 1988, but it is possible that corrosion was present and detectable, and steps could have been taken to avoid the leak in 2015 [9, pp. 2, 160, 173–181, 204-205] [12].

   The fact is that SS-25 and other 1988 Interoffice Correspondence wells did not get inspected according to plan.

4. If Blade accepts any part of the statement as true, does it change any of the conclusions Blade reached in its Root Cause Analysis?

   Even if Blade accepted Mr. Carnahan's statement as true, it would not change any of the conclusions Blade reached in its Root Cause Analysis.

5. If the answer to question 3 is yes, which conclusions change and what must they say now?

   Not Applicable. No conclusion changes are needed.

2.2 Statement 2

Pages 3 and 4: “While useful to a certain extent, the Vertilog technology circa 1988 suffered from certain substantial deficiencies.”

2.2.1 Blade Response

1. Does Blade Energy Partners agree or disagree with the statement?

   Disagree.

2. If Blade disagrees with any portion of the statement, why?

   The Vertilog circa 1988 was useful because it could be used to assess casing integrity in terms of the location and severity of metal loss.

3. Is there any context either in or outside of Mr. Carnahan’s testimony that Blade wishes to add in order to explain its answers? If so, please provide it and explain.

   See the response to Statement 1, Question 3.

4. If Blade accepts any part of the statement as true, does it change any of the conclusions Blade reached in its Root Cause Analysis?

   Mr. Carnahan’s statement does not change the RCA conclusions.

5. If the answer to question 3 is yes, which conclusions change and what must they say now?

   Not applicable. No conclusion changes are needed.

2.3 Statement 3

Page 4: “For example, the Vertilog technology did not provide a method for differentiating isolated pitting from general corrosion.”

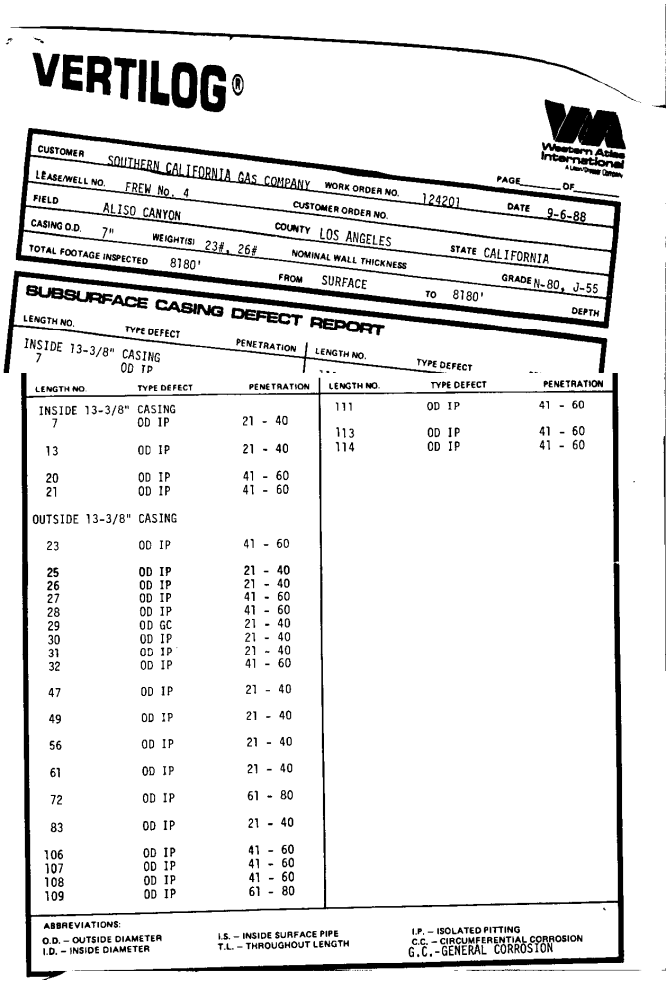
2.3.1 Blade Response

1. Does Blade Energy Partners agree or disagree with the statement?

   Disagree.

2. If Blade disagrees with any portion of the statement, why?

   The Vertilog was capable of differentiating general corrosion from isolated pitting. The methodology is discussed in a previously referenced SPE paper [5]. Figure 3 shows the F-4 Vertilog Defect Report. Isolated pitting is denoted by IP and general corrosion is denoted by GC.



VERTILOG®

Western Atlas International

CUSTOMER SOUTHERN CALIFORNIA GAS COMPANY WORK ORDER NO. 124201 PAGE ____ OF ____

LEASE/WELL NO. FREW No. 4 CUSTOMER ORDER NO. DATE 9-6-88

FIELD ALISO CANYON COUNTY LOS ANGELES STATE CALIFORNIA

CASING O.D. 7" WEIGHT(S) 23#, 26# NOMINAL WALL THICKNESS GRADE N-80, J-55

TOTAL FOOTAGE INSPECTED 8180' FROM SURFACE TO 8180' DEPTH

SUBSURFACE CASING DEFECT REPORT

INSIDE 13-3/8" CASING
7 OD IP

LENGTH NO.	TYPE DEFECT	PENETRATION
INSIDE 13-3/8" CASING 7	OD IP	21 - 40
13	OD IP	21 - 40
20	OD IP	41 - 60
21	OD IP	41 - 60
OUTSIDE 13-3/8" CASING		
23	OD IP	41 - 60
25	OD IP	21 - 40
26	OD IP	21 - 40
27	OD IP	41 - 60
28	OD IP	41 - 60
29	OD GC	21 - 40
30	OD IP	21 - 40
31	OD IP	21 - 40
32	OD IP	41 - 60
47	OD IP	21 - 40
49	OD IP	21 - 40
56	OD IP	21 - 40
61	OD IP	21 - 40
72	OD IP	61 - 80
83	OD IP	21 - 40
106	OD IP	41 - 60
107	OD IP	41 - 60
108	OD IP	41 - 60
109	OD IP	61 - 80
111	OD IP	41 - 60
113	OD IP	41 - 60
114	OD IP	41 - 60

ABBREVIATIONS:
O.D. – OUTSIDE DIAMETER
I.D. – INSIDE DIAMETER
I.S. – INSIDE SURFACE PIPE
T.L. – THROUGHOUT LENGTH
I.P. – ISOLATED PITTING
C.C. – CIRCUMFERENTIAL CORROSION
G.C. – GENERAL CORROSION

Figure 3: F-4 Vertilog Defect Summary Report, GC – General Corrosion and IP Isolated Pitting

3. Is there any context either in or outside of Mr. Carnahan's testimony that Blade wishes to add in order to explain its answers? If so, please provide it and explain.

   See the response to Statement 1, Question 3.

4. If Blade accepts any part of the statement as true, does it change any of the conclusions Blade reached in its Root Cause Analysis?

   No.

5. If the answer to question 3 is yes, which conclusions change and what must they say now?

   Not applicable. No conclusion changes are needed.

2.4 Statement 4

Page 5: "Another problem with Vertilog is that there are multiple permutations associated with the analysis of metal loss at any given depth, resulting in inherent uncertainty when interpreting the results."

2.4.1 Blade Response

1. Does Blade Energy Partners agree or disagree with the statement?

Disagree.

2. If Blade disagrees with any portion of the statement, why?

   Casing inspection logs of all types can be processed and analyzed using different criteria and assumptions. There is inherent uncertainty in interpreting all casing inspection logs. The process is not automated with only one set of answers. Log analysts use their best judgement to provide most probable interpretations. See below for standard verbiage for casing inspection logs from Baker Hughes:

   FF-32A, HR Vertilog, 2016

   > In making interpretations of logs our employees will give customer the benefit of their best judgment. But since all interpretations are opinions based on inferences from electrical or other measurements, we cannot, and we do not guarantee the accuracy or correctness of any interpretation. We shall not be liable or responsible for any loss, cost, damages, or expenses whatsoever incurred or sustained by the customer resulting from any interpretation made by any of our employees.

3. Is there any context either in or outside of Mr. Carnahan's testimony that Blade wishes to add in order to explain its answers? If so, please provide it and explain.

   See the response to Statement 1, Question 3.

4. If Blade accepts any part of the statement as true, does it change any of the conclusions Blade reached in its Root Cause Analysis?

   No.

5. If the answer to question 3 is yes, which conclusions change and what must they say now?

   Not applicable. No conclusion changes are needed.

2.5 Statement 5

Page 7: "Additional flaws of Vertilog were its inability to distinguish between defects and hardware (such as centralizers and scratchers) and its difficulty interpreting corrosion located near the surface casing shoe."

2.5.1 Blade Response

1. Does Blade Energy Partners agree or disagree with the statement?

   Disagree.

2. If Blade disagrees with any portion of the statement, why?

   Blade would agree that the tool will have difficulty interpreting corrosion above, but not below, the shoe.

   Blade agrees with "…flaws of Vertilog were its inability to distinguish between defects and hardware (such as centralizers and scratchers)...". However, there is a key omission in Mr. Carnahan's testimony regarding the method in which the tool designers had envisioned solving this issue. References [5, 6] describe the use of accurate casing records to address the interpretation of centralizers and scratchers. The quote from [6, p. 1] below explains this issue clearly:

   > In the earlier Vertilog survey, casing hardware (e.g., scratchers and centralizers) caused responses which are similar to corrosive defect responses. Often casing records must be relied upon for identifying the log responses due to scratchers and centralizers, to insure [sic] that these responses

are not misinterpreted as casing defects. If the records are accurate, casing hardware responses are not mistakenly interpreted as defects. If the records are inaccurate, casing hardware responses can be interpreted as corrosive defects.

During the course of Blade's Analysis of Aliso Canyon Wells with Casing Failures study, numerous well records were analyzed. In our opinion, many of the well records that SoCalGas inherited from previous operators did not include an accurate location for centralizers and scratchers. Blade also reviewed hundreds of casing inspection logs from Aliso Canyon. It was common for the production casing string (e.g., 7 in., or 8 5/8 in. casings) to include a few joints of casing that were a different weight than reported. In other words, in the 200 or so joints that comprise the production casing string, it was likely that an occasional joint of thicker or thinner walled casing was run in the wrong position. This may not have any bearing on the casing string's pressure capacity. Inaccurate records on centralizers, scratchers, and casing weight and dimensions could result in Vertilog defect misinterpretation.

3. Is there any context either in or outside of Mr. Carnahan's testimony that Blade wishes to add in order to explain its answers? If so, please provide it and explain.

   In Blade's opinion, the Vertilog may overstate metal loss in multi-string casing configurations where an outer casing exists over part of the casing being inspected; this is discussed in the *Aliso Canyon Shallow Corrosion Analysis* supplementary report [11, p. 34].

4. If Blade accepts any part of the statement as true, does it change any of the conclusions Blade reached in its Root Cause Analysis?

   No.

5. If the answer to question 3 is yes, which conclusions change and what must they say now?

   Not applicable. No conclusion changes are needed.

2.6 Statement 6

Page 20: "Pressure testing is intended to detect existing casing leaks, not wall loss."

2.6.1 Blade Response

1. Does Blade Energy Partners agree or disagree with the statement?

   Agree.

2. If Blade disagrees with any portion of the statement, why?

   Not applicable. Blade agrees with the statement.

3. Is there any context either in or outside of Mr. Carnahan's testimony that Blade wishes to add in order to explain its answers? If so, please provide it and explain.

   No.

4. If Blade accepts any part of the statement as true, does it change any of the conclusions Blade reached in its Root Cause Analysis?

   No conclusion changes are needed.

5. If the answer to question 3 is yes, which conclusions change and what must they say now?

Not applicable. No conclusion changes are needed.

2.7 Statement 7

Pages 24-25, which states:

The Blade main report and various supplementary reports assert that the SS-25 7-in. casing's vertical rupture and circumferential parting were two separate events, with the circumferential parting occurring some period of time after the initial vertical rupture, but while the well was still on injection. To the contrary, it is evident the SS-25 7-in. casing vertical rupture and circumferential parting occurred as a single event, as illustrated in Figure 12 and Figure 13, and for the reasons described below:

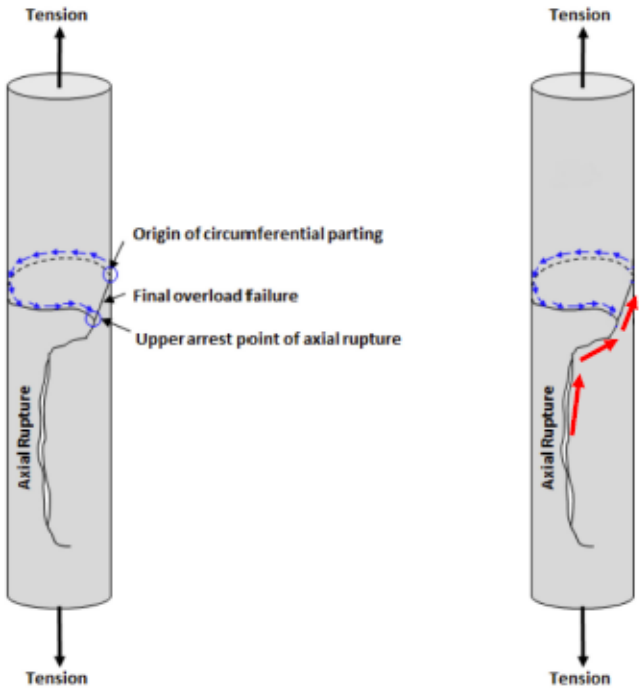


Figure 12. Left: Figure 70 from page 73 of Blade main report. Right: Corrected Figure 70 with red arrows added, which in addition to existing blue arrows, show actual crack propagation direction. The upper vertical fracture did not arrest abruptly at the location indicated by Blade. The circumferential fracture simply ran into the existing (mostly) vertical fracture and stopped (location of lowest blue arrow).

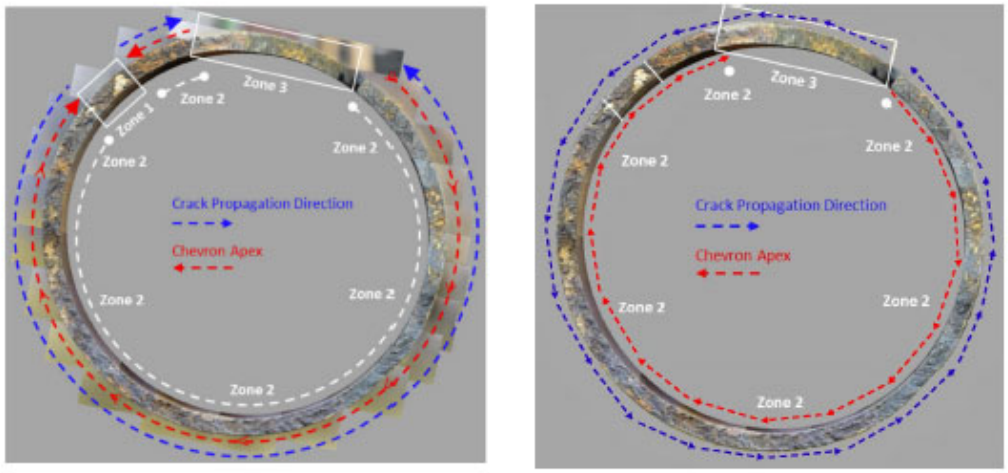


Figure 13. Left: Figure 69 from Blade main report. Right: Corrected Figure 69 showing actual crack growth direction.

2.7.1 Blade Response

1. Does Blade Energy Partners agree or disagree with the statement?

   Disagree.

2. If Blade disagrees with any portion of the statement, why?

   Mr. Carnahan's statement does not take into consideration all of the facts provided in Blade's Main and supplementary reports. Central to the argument are two facts. First, there are arrest turning points on both ends of the axial rupture. Second, there is no continuity of chevron marks from the axial rupture to the circumferential parting. This is further discussed in detail below.

   On page 54 in Section 2.4 of Blade's Main Report [9], it clearly states: "Visual and stereoscopic examination of the circumferential parting showed that the failure was not a continuation of the axial rupture, but rather re-initiated near the corner on one side of the parted casing. The origin site was determined based on chevron marks identified on the fracture surface. Figure 47 is a (a) laser scan and (b) image which identifies the upper arrest point, circumferential parting initiation site, and the final overload failure. Figure 48 is stitched stereo images showing the chevron marks and propagation direction of the circumferential parting. These observations indicate that the axial rupture and circumferential parting were two separate events despite their close proximity, and that they are most likely related to each other. This is discussed in more detail later within this section." Figures 47 and 48 are extracted from the Blade Main Report.

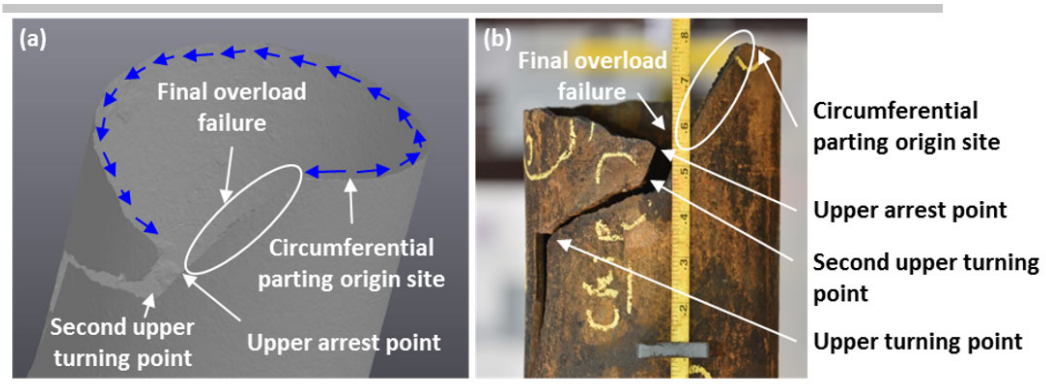


Figure 47: (a) Laser Scan and (b) Photo Indicating Circumferential Parting Initiation Site and Final Failure

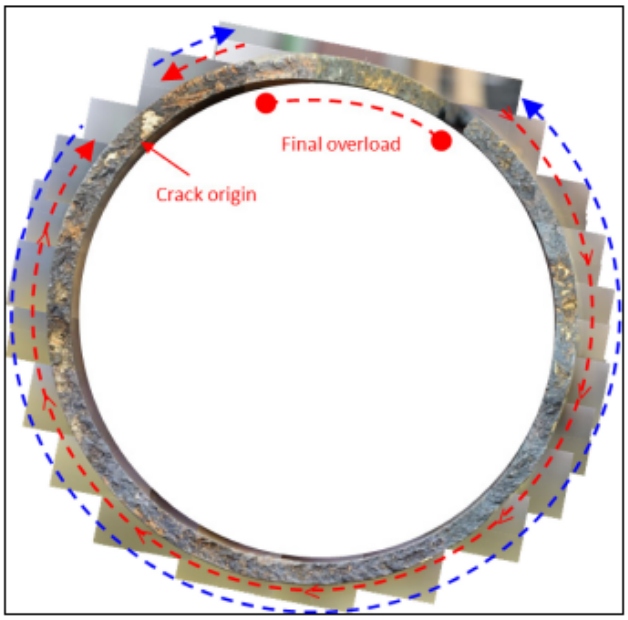


Figure 48: Stitched Images of the Lower Circumferential Parting Fracture Surface

Additional evidence is provided by Blade (Figure 67 on page 71 of Blade's Main report) illustrates the three zones of the circumferential parting. Figure 67 (a) is a stereo image showing the three zones, origin, and the direction of the crack propagation. Figure 67 (b) is a 3D schematic showing the overall circumferential parting steps. Figure 67 (c) is a close-up of the Zone 3 fracture surface, which does not exhibit any chevron marks, thus there is no continuity of the axial fracture.

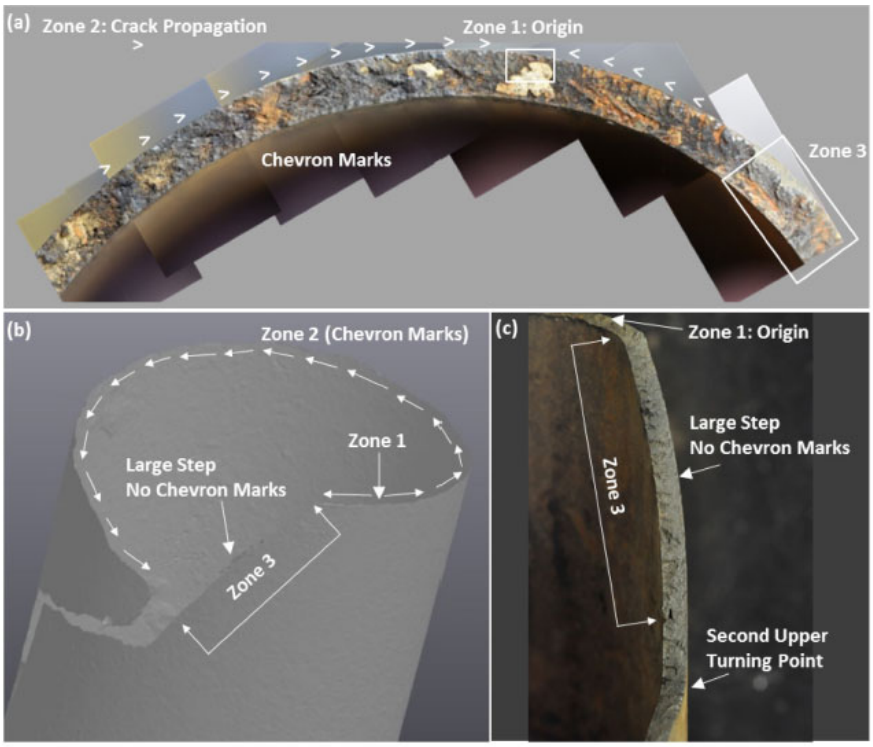


Figure 67: (a) Stereo Image (b) 3D Schematic of Zones (c) Macro Image of Three Zones

Based on the factual evidence shown above (pages 72 and 73 in Blade's Main report), Blade concluded "Additional detailed visual and stereoscopic examination showed that the circumferential parting was not an extension of the axial rupture. Chevron marks produced by the circumferential parting did not follow the chevron marks produced by the axial rupture. The initiation site and chevron marks produced by the circumferential parting were located approximately 3.7 in. (94 mm) from the upper arrest point of the axial rupture. Figure 70 (i.e., Figure 12 above quoted by Mr. Carnahan's testimony) is a schematic of the crack path for the axial rupture and circumferential parting. The schematic shows how the circumferential parting initiated above the arrest point of the axial rupture. The crack propagated circumferentially until it reached the axial rupture arrest point. The final ligament failed due to the axial load generated by the weight and tension of the 7 in. casing string. **The axial rupture and circumferential parting are thought to be two separate events because there was no evidence that the chevron marks from the axial rupture continued into the circumferential parting.** The close proximity of the two failures suggests that they are related despite being two separate events." (emphasis added)

Blade has followed the well established guidelines described in the literature, for example, *Fracture Appearance and Mechanisms of Deformation and Fracture*, Metals Handbook Vol. 11, 2011, pages 559-561 [13], and determined that the SS-25 failure consisted of two separate events because of the absence of evidence showing a single pathway of chevron marks connecting the axial fracture with the circumferential parting. There is no continuity of chevron marks from axial to circumferential. There is an arrest point on the axial fracture as shown by the metallurgical evidence. These facts have to be rationalized in any interpretation of the failure sequence.

Blade disagrees with the interpretation in Mr. Carnahan's testimony.

3. Is there any context either in or outside of Mr. Carnahan's testimony that Blade wishes to add in order to explain its answers? If so, please provide it and explain.

No additional context is required. The factual evidence provided in Blade's reports support the fracture sequence described in the report.

4. If Blade accepts any part of the statement as true, does it change any of the conclusions Blade reached in its Root Cause Analysis?

   Blade does not accept any part of Mr. Carnahan's statement as true. If Blade were to accept Mr. Carnahan's primary assertion that the vertical rupture and the circumferential part were one event, then it would only change Blade's interpretation on the failure sequence. However, it would not change the failure analysis conclusions. The failure was caused by 85% metal loss due to external corrosion. It would not change any of the RCA conclusions.

5. If the answer to question 3 is yes, which conclusions change and what must they say now?

   Not applicable, no conclusions change.

2.8 Statement 8

The SS-25 fracture surface exhibits clear chevron marks at a number of locations. Chevron marks denote the direction of propagation of cracks in steels – the apex of the chevron points toward the fracture origin (Figure 14). Chevron marks on the SS-25 fracture surface show clearly that the circumferential fracture is an extension of the axial fracture (Figure 15). This interpretation is consistent with remarkably similar chevron marks shown in a textbook on failure analysis (Figure 16).

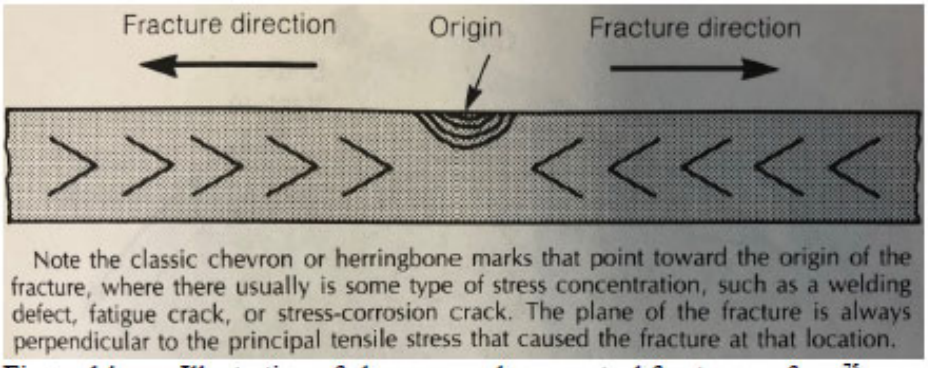


Figure 14. Illustration of chevron marks on a steel fracture surface.[75]

Figure 15. Figure 68 from page 72 of Blade main report. Red rectangle encloses backward chevron marks drawn by Blade. Red chevron marks inserted above are consistent with chevron marks present on the fracture surface. Blade misidentifies the chevron marks as flowing towards the origin. Based on both my physical inspection on February 27-28, 2020, and my analysis of this image, the chevron marks travel to the right, as indicated by the red arrows at the bottom of the figure.

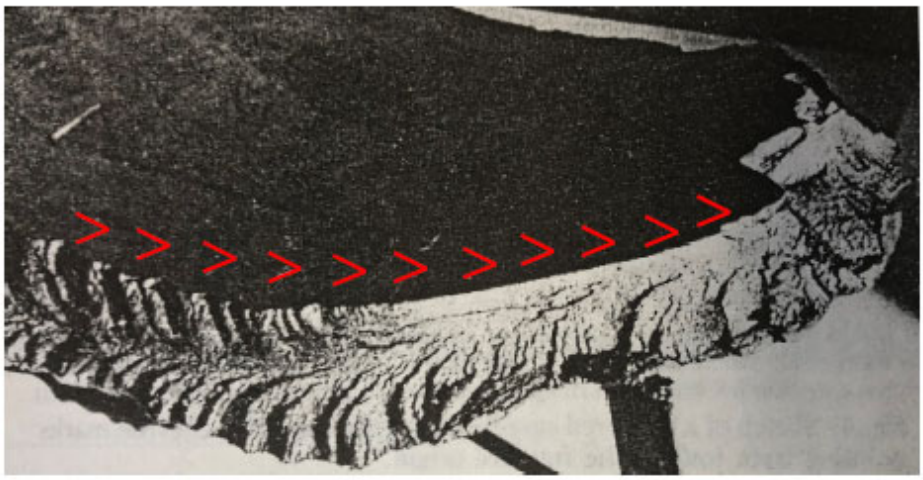


Figure 16. Fragment of a thick-walled fractured drum. The fracture, which started at the right, ran rapidly to the left, resulting in a well-defined chevron pattern.[76]

2.8.1 Blade Response

1. Does Blade Energy Partners agree or disagree with the statement?

   Disagree.

2. If Blade disagrees with any portion of the statement, why?

   Blade disagrees with Mr. Carnahan's testimony because he does not show with metallurgical evidence, the extension of the axial fracture to the circumferential parting. Therefore, there is no metallurgical evidence to support the interpretation that axial rupture and circumferential parting are one event.

   Mr. Carnahan's testimony correctly states that "the SS-25 fracture surface exhibits clear chevron marks at a number of locations. Chevron marks denote the direction of propagation of cracks in steels—the apex of the chevron points toward the fracture origin (Figure 14 provided by Mr. Carnahan in his testimony)", however, he incorrectly states that, "chevron marks on the SS-25

fracture surface show clearly that the circumferential fracture is an extension of the axial fracture (Figure 15)". Mr. Carnahan did not show where in the figure that he clearly saw the chevron marks extending from the axial fracture to the circumferential fracture. In contrast, as previously indicated in Blade's response to Mr. Carnahan's Statement 7, Blade provided macro- and micro-fractographic evidence in the Main and Supplementary Reports, see Figure 67 on page 71 of the Main Report, which shows no chevron marks present after the axial fracture was arrested and no chevron marks on the final overload rupture.

The figure below (Figure 68 (a), page 72 of Blade Main Report) shows no chevron marks on the final overload rupture. For clarity, we have annotated the upper corner on the right-hand side of the figure with the green arrow) indicating no chevron marks on the final overload failure of Zone 3 of the circumferential parting. On the circumferential fracture surface there is no extension of the axial fracture chevron marks.

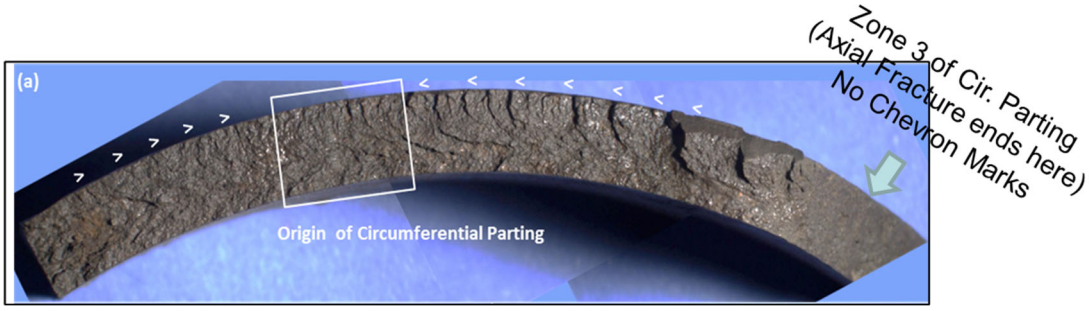


Figure 68 (a), Page 72 Blade Main Report

In the caption of Figure 15 below, Mr. Carnahan states "Blade misidentified the chevron marks as flowing towards the origin. Based on both my physical inspection on February 27-28, 2020, and my analysis of the image, the chevron marks travel to the right, as indicated by the red arrows at the bottom of the figure."

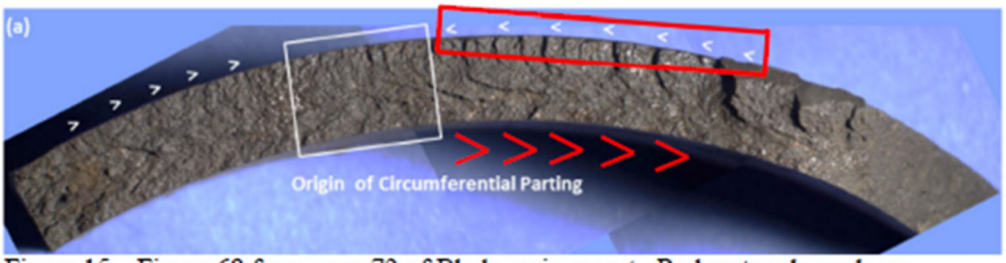


Figure 15. Figure 68 from page 72 of Blade main report. Red rectangle encloses backward chevron marks drawn by Blade. Red chevron marks inserted above are consistent with chevron marks present on the fracture surface. Blade misidentifies the chevron marks as flowing towards the origin. Based on both my physical inspection on February 27-28, 2020, and my analysis of this image, the chevron marks travel to the right, as indicated by the red arrows at the bottom of the figure.

Blade disagrees with the statement because the visual and stereomicroscopic examinations performed by Blade showed that the apexes of the chevron marks are in the opposite directions around the origin. This is further clarified in Figure 68(a), page 72 of the Blade Main Report below that shows the chevron marks point back towards the origin from either side of the origin. For

clarity, white dashed lines have been added to the figure to outline the chevron marks that point back towards the origin from either side of the origin. This is inconsistent with Figure 16 of Mr. Carnahan's testimony.

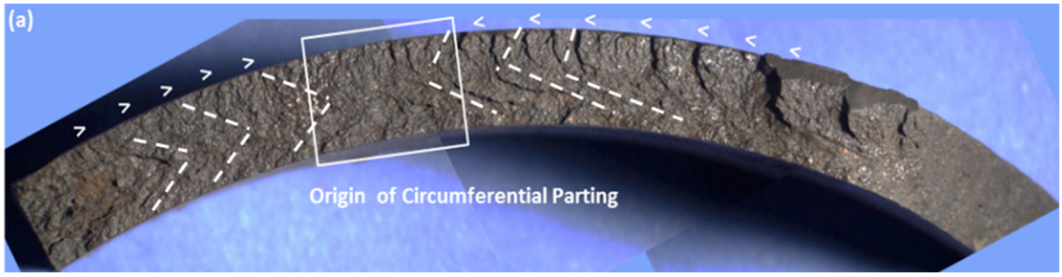


Figure 68 (a), Page 72 Blade Main Report

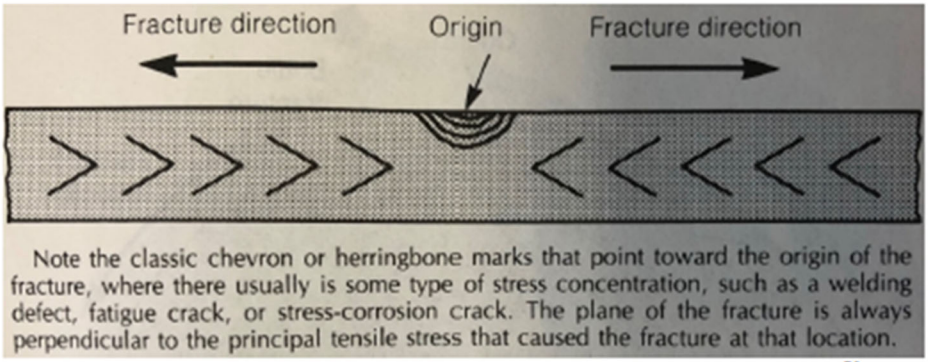


Figure 14. Illustration of chevron marks on a steel fracture surface.[75]

Figure 16. Fragment of a thick-walled fractured drum. The fracture, which started at the right, ran rapidly to the left, resulting in a well-defined chevron pattern.[76]

In summary, the explanation provided in the Blade Main and Supplementary reports demonstrates the existence of two events in the failure process:

- The chevron marks are not continuous and do not extend from the axial rupture to the circumferential parting. See Figure 67(a) on page 71 of the Blade Main Report.

- There is a clear indication of arrest at the end of the axial fracture path as shown in the Blade supplementary report *SS-25 Casing Failure Analysis Report* [14]on page 121, Figure 142.
- There are chevron markings in opposite directions on the circumferential fracture surface which point towards the origin, see Figures 68 and 69 on page 72 of the Main Report and Figure 160 on page 134 and Figures 161 and 162 on page 135 of the supplementary report.

3. Is there any context either in or outside of Mr. Carnahan's testimony that Blade wishes to add in order to explain its answers? If so, please provide it and explain.

   No.

4. If Blade accepts any part of the statement as true, does it change any of the conclusions Blade reached in its Root Cause Analysis?

   Blade does not accept any part of Mr. Carnahan's statement as true. If Blade were to accept Mr. Carnahan's primary assertion that the vertical rupture and the circumferential part were one event, then it would only change Blade's interpretation on the failure sequence. However, it would not change the failure analysis conclusions. The failure was caused by 85% metal loss due to external corrosion. It would not change any of the RCA conclusions.

5. If the answer to question 3 is yes, which conclusions change and what must they say now?

   Not applicable, no conclusions change.

2.9 Statement 9

Blade's contention that a separate fracture origin exists on the circumferential portion of the fracture is incorrect (Figure 17). Rather than a fracture origin, this area is merely a continuation of the circumferential portion of the fracture. Fracture surface markings within the hypothesized origin are the same as or similar to those outside of the origin.

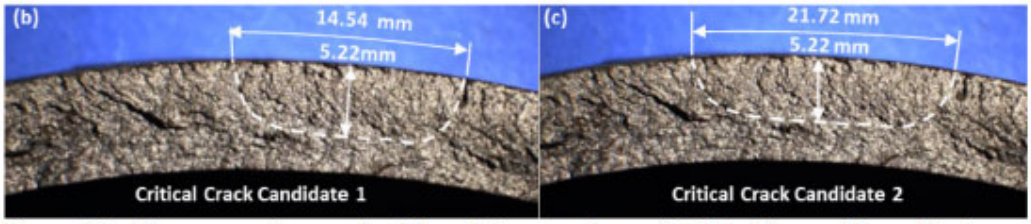


Figure 17. There are no features in either of the areas shown in Blade Figures 68b or 68c that suggest the existence of a fracture origin.

2.9.1 Blade Response

1. Does Blade Energy Partners agree or disagree with the statement?

   Disagree.

2. If Blade disagrees with any portion of the statement, why?

An examination of the chevron marks in Figure 17 (i.e., Figure 68 in Blade's Main Report, page 72), showed that the features inside the origin were different from chevron marks outside the origin. The examination identified an area (the origin) that was absent of chevron marks but had chevron marks on either side pointing towards it. For clarity, white dashed lines have been added to outline the chevron marks that point back towards to the origin from either side of the origin. This observation is consistent with the illustration, Figure 14, provided by Mr. Carnahan.

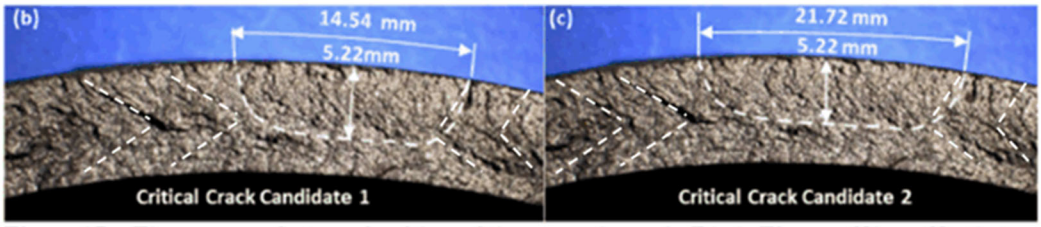


Figure 17. There are no features in either of the areas shown in Blade Figures 68b or 68c that suggest the existence of a fracture origin.

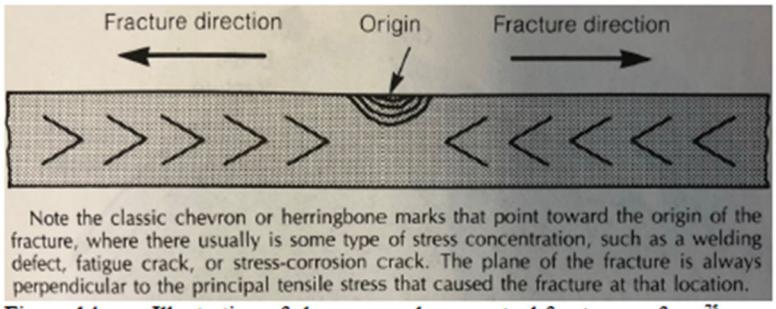


Figure 14. Illustration of chevron marks on a steel fracture surface.[75]

3. Is there any context either in or outside of Mr. Carnahan's testimony that Blade wishes to add in order to explain its answers? If so, please provide it and explain.

   No.

4. If Blade accepts any part of the statement as true, does it change any of the conclusions Blade reached in its Root Cause Analysis?

   Blade does not accept any part of Mr. Carnahan's statement as true. If Blade were to accept Mr. Carnahan's primary assertion that the vertical rupture and the circumferential part were one event, then it would only change Blade's interpretation on the failure sequence. However, it would not change the failure analysis conclusions. The failure was caused by 85% metal loss due to external corrosion. It would not change any of the RCA conclusions.

5. If the answer to question 3 is yes, which conclusions change and what must they say now?

   Not applicable, no conclusions change.

2.10 Statement 10

The Blade report says nothing about how this alleged fracture origin came into existence. If the origin was created during the casing manufacturing process or by a sub-critical crack growth mechanism such as fatigue or stress-corrosion, the surface of the origin would appear distinctly different.

2.10.1 Blade Response

1. Does Blade Energy Partners agree or disagree with the statement?

   Disagree.

2. If Blade disagrees with any portion of the statement, why?

   Blade disagrees with Mr. Carnahan's testimony because there is a SEM micrograph in the Blade supplementary report that clearly identifies the circumferential fracture origin. This has not been referenced or discussed in Mr. Carnahan's testimony.

   Blade showed that "the SEM examination of Zone 1 identified a pre-existing crack-like flaw on the OD side of the origin", see Figures 168 and 169 on pages 140 – 141 of the *SS-25 Casing Failure Analysis* supplementary report. The crack-like flaw was shallow, with a measured maximum depth of 196 µm. This was a pre-existing flaw and was associated with the origin of the circumferential fracture. Figure 170 in the same supplementary report shows an EDS analysis indicating that the surface of the flaw was severely oxidized by a scale that could not be removed during cleaning. The adjacent fracture surface was easily cleaned and clearly showed cleavage facets. This observation suggests that the flaw existed prior to the circumferential parting. This OD surface flaw may have promoted brittle cracking to form the origin of the circumferential parting, even though the flaw was shallow. The presence of a pre-existing OD oxidized flaw clearly exhibits that the circumferential parting had a separate initiation site. This information was not considered in Mr. Carnahan's testimony.

   A complete validation of the size of the origin (i.e., the critical crack size for circumferential parting) is given in Section 2.4.4 of Blade's Main Report (page 74) and in Section 4.3 of the *SS-25 Casing Failure Analysis* supplementary report (page 164). Further discussion on this topic in detail is given in the next section, i.e., Blade's response to Mr. Carnahan testimony Statement 11, Section 2.11 in this document.

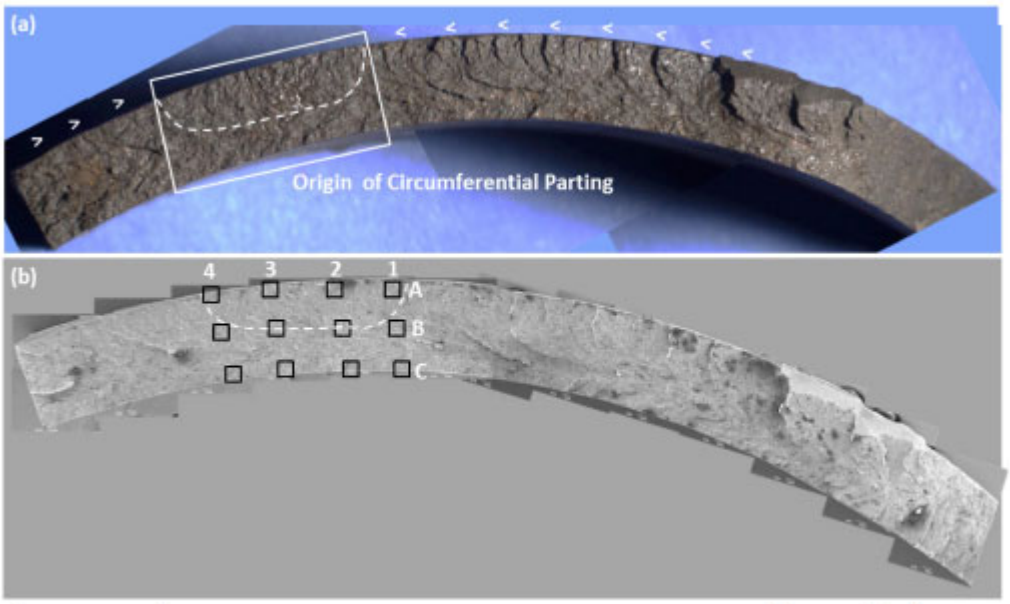


Figure 168: Specimen C023A1A1A (a) Stereo and (b) SEM Images of Zone 1 (Origin) Investigation Areas

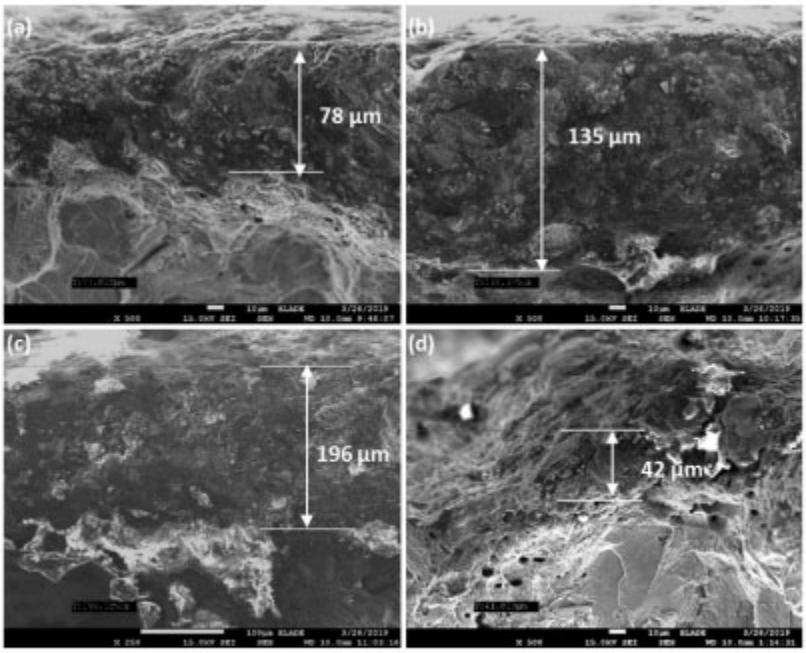
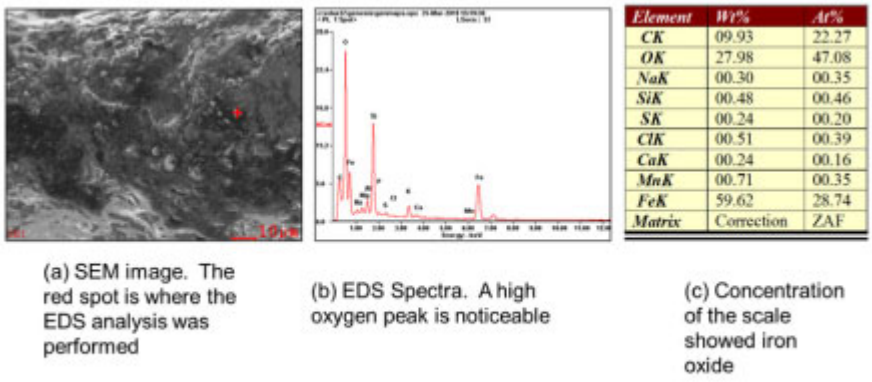


Figure 169: SEM Images of Pre-existing Flaws at (a) 1A, (b) 2A, and (d) 4A Taken at 500×, and (c) 3A Taken at 250×



Element	Wt%	At%
CK	09.93	22.27
OK	27.98	47.08
NaK	00.30	00.35
SiK	00.48	00.46
SK	00.24	00.20
ClK	00.51	00.39
CaK	00.24	00.16
MnK	00.71	00.35
FeK	59.62	28.74
Matrix	Correction	ZAF

(a) SEM image. The red spot is where the EDS analysis was performed

(b) EDS Spectra. A high oxygen peak is noticeable

(c) Concentration of the scale showed iron oxide

Figure 170: EDS Results for Pre-Existing Flaws

3. Is there any context either in or outside of Mr. Carnahan's testimony that Blade wishes to add in order to explain its answers? If so, please provide it and explain.

   No.

4. If Blade accepts any part of the statement as true, does it change any of the conclusions Blade reached in its Root Cause Analysis?

   Blade does not accept any part of Mr. Carnahan's statement as true. Blade did identify an origin for the circumferential fracture, the evidence was provided by the stereo microscopic and SEM micrographs in the Blade supplementary report. If, however, Mr. Carnahan's testimony is considered to be true, it would not change the failure analysis conclusions. The failure was caused by 85% metal loss due to external corrosion. It would not change any of the RCA conclusions.

5. If the answer to question 3 is yes, which conclusions change and what must they say now?

Not applicable, no conclusions change.

2.11 Statement 11

Blade's inability to determine the size of alleged fracture origin (they report it as 5.22 mm deep and either 14.54 mm long or 21.72 mm long$_{72}$) is consistent with the absence of features identifying it as an origin.

2.11.1 Blade Response

1. Does Blade Energy Partners agree or disagree with the statement?

   Disagree.

2. If Blade disagrees with any portion of the statement, why?

   Blade did identify two semi elliptical areas as possible critical crack sizes (origin) for the circumferential parting based on thorough examination with the stereo microscope and SEM; it was 5.22 mm deep and either 14.54 mm long or 21.72 mm long. The exact length is later established in the Blade report as 21.72 mm long.

   Blade identified the fracture origin of the circumferential parting based on the observed apexes of the chevron marks pointing at the origin, along with the presence of a pre-existing OD oxidized flaw. This was also discussed in Statements 9 and 10. Blade identified two semi elliptical areas as possible critical crack sizes (origin) for the circumferential parting based on thorough examination with the stereo microscope and SEM, one is 14.54 mm long x 5.22 mm deep and the other one 21.72 mm long with the same depth, see pages 71 and 72 of Blade's Main Report and Section 3.3.1 on page 134 of Blade's supplementary report *SS-25 Casing Failure Analysis* for details. Figure 17 provided by Mr. Carnahan in Statement 9 (i.e., Figure 68 in Blade's Main Report, page 72), with added dashed lines to outline the chevron marks), showed that the features inside the origin were different from chevron marks outside the origin. The examination identified an area (the origin) that was absent of chevron marks but had chevron marks on either side pointing at it.

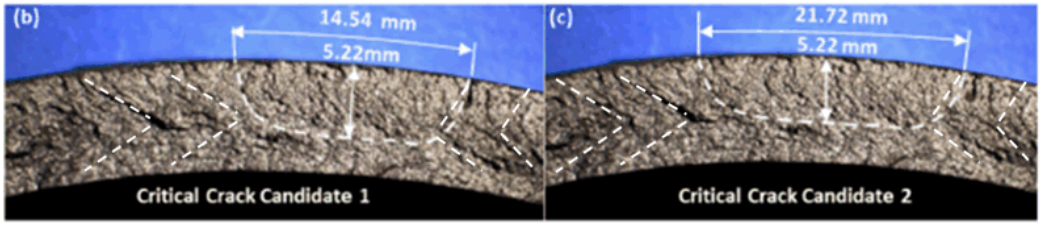


Figure 17. There are no features in either of the areas shown in Blade Figures 68b or 68c that suggest the existence of a fracture origin.

The location of the origin is often well identified, and uncertainty in origin sizing is not uncommon. Therefore, it is common practice that the identified candidate flaw sizes are often validated or refined using fracture mechanics methods or FEA and other methodologies. Such an approach was undertaken for the circumferential flaw.

The validation of the two possible sizes of the origin (critical crack size) for circumferential parting was performed using the following approach:

- Fracture mechanics calculation of the applied stress intensity factor for each of the possible origin size, i.e., the driving force for circumferential parting using the flaw size and axial load

as per API 579 [15] and BS 7910 [16] procedures (see Section 4.3.1 of the *SS-25 Casing Failure Analysis* supplementary report, pages 164-165 for details)

- Fracture toughness from CVN was estimated as a function of temperature using API 579 and BS7910 recommended procedures (see Section 4.3.3 of the supplementary report, pages 167-168 for details)
- An independent estimate of the casing temperature at time of failure using a thermo hydraulic model (see Section 4.3.4 of the supplementary report, page 169 for details)

By comparing the validation methods above, one of the two possible size of the origin, that is, the one having the size of 21.72mm long x 5.22 mm deep was validated as the most likely critical crack size for the circumferential parting. This is discussed in detail in Blade Main and supplementary reports.

For this failure, Blade integrated two different approaches to refine the origin. The origin was first established using microscopy and visual observations. Next, Blade used fracture mechanics and temperature, followed by toughness (established through laboratory testing) to finalize the origin size. Using one methodology such as, macro- and micro- fractographic methods, to interpret failure is inadequate for failure analysis; such interpretation has to be consistent with quantitative fracture mechanics estimates.

Consequently, Blade has unequivocally established that the circumferential parting initiated from the origin identified by using microscopy, visual observations and fracture mechanics.

3. Is there any context either in or outside of Mr. Carnahan's testimony that Blade wishes to add in order to explain its answers? If so, please provide it and explain.

   No.

4. If Blade accepts any part of the statement as true, does it change any of the conclusions Blade reached in its Root Cause Analysis?

   Blade does not accept any part of Mr. Carnahan's statement as true. If Blade were to accept Mr. Carnahan's assertion that "Blade's inability to determine the size of alleged fracture origin (they report it as 5.22 mm deep and either 14.54 mm long or 21.72 mm long) is consistent with the absence of features identifying it as an origin", then it would only change Blade's interpretation on the failure sequence. However, it would not change the failure analysis conclusions. The failure was caused by 85% metal loss due to external corrosion. It would not change any of the RCA conclusions.

5. If the answer to question 3 is yes, which conclusions change and what must they say now?

   Not applicable, no conclusions change.

2.12 Statement 12

Blade's scanning electron microscope (SEM) photos of the hypothesized origin show predominantly cleavage features.[73] Blade reported that no noticeable changes in fracture mode were observed outside of the origin[74] and their SEM photographs corroborate this. As such, the hypothesized origin must have been created by mechanical force in the same manner as the circumferential parting.

2.12.1Blade Response

1. Does Blade Energy Partners agree or disagree with the statement?

   Disagree.

2. If Blade disagrees with any portion of the statement, why?

   Because the circumferential parting had initiated from a crack-like surface flaw at a temperature below the steel ductile to brittle transition temperature (DBTT), the micro fracture mode would be cleavage. One would not expect any noticeable change in the micro fracture mode outside of the origin that was produced at the same temperature below the ductile to brittle transition temperature of the steel. This was a temperature driven fracture mode. The absence of a ductile origin is consistent with the low temperature experienced, prior to circumferential parting and after the axial rupture, due to escaping gas. As discussed previously, data from all aspects of the failure (metallurgical, loads, temperatures) should be integrated to deliver a precise interpretation. Just interpreting metallurgical data alone is inadequate. A comprehensive interpretation is crucial to identifying the fracture sequence.

   The SEM images below show the origin was initiated from a crack like surface flaw by cleavage (Figures 169 and 170 on page 141, *SS-25 Casing Failure Analysis* supplementary report).

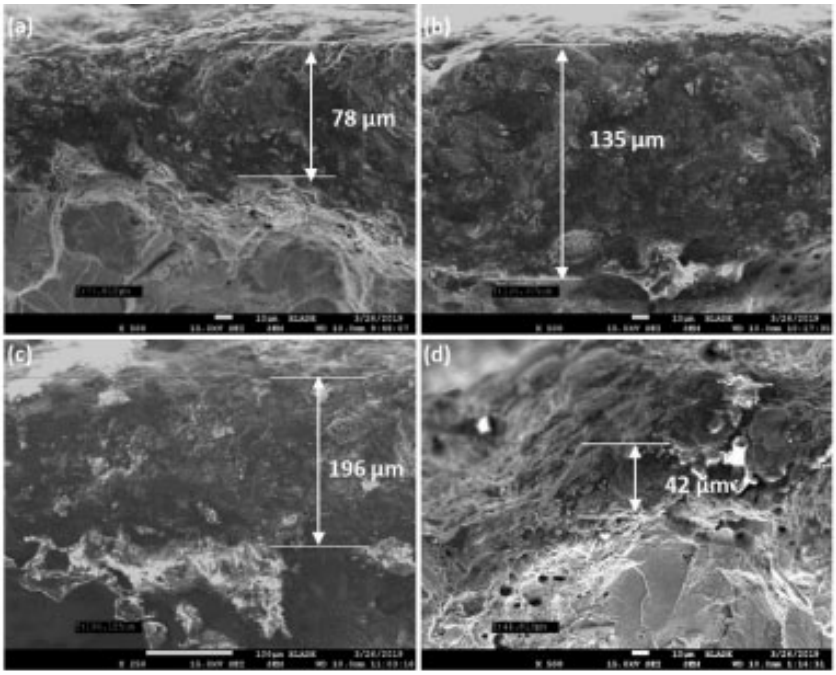
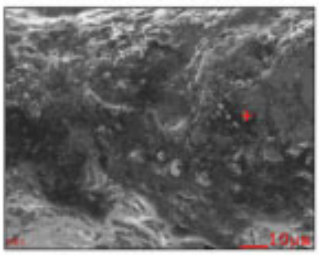
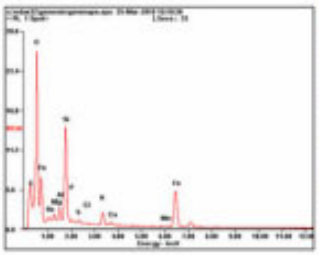


Figure 169: SEM Images of Pre-existing Flaws at (a) 1A, (b) 2A, and (d) 4A Taken at 500×, and (c) 3A Taken at 250×



(a) SEM image. The red spot is where the EDS analysis was performed



(b) EDS Spectra. A high oxygen peak is noticeable

Element	Wt%	At%
CK	09.93	22.27
OK	27.98	47.08
NaK	00.30	00.35
SiK	00.48	00.46
SK	00.24	00.20
ClK	00.51	00.39
CuK	00.24	00.16
MnK	00.71	00.35
FeK	59.62	28.74
Matrix	Correction	ZAF

(c) Concentration of the scale showed iron oxide

Figure 170: EDS Results for Pre-Existing Flaws

3. Is there any context either in or outside of Mr. Carnahan's testimony that Blade wishes to add in order to explain its answers? If so, please provide it and explain.

   No.

4. If Blade accepts any part of the statement as true, does it change any of the conclusions Blade reached in its Root Cause Analysis?

   Blade does not accept any part of Mr. Carnahan's statement as true. If Blade were to accept Mr. Carnahan's assertion: that "Blade's scanning electron microscope (SEM) photos of the hypothesized origin show predominantly cleavage features. Blade reported that no noticeable changes in fracture mode were observed outside of the origin and their SEM photographs corroborate this. As such, the hypothesized origin must have been created by mechanical force in the same manner as the circumferential parting", then it would only change Blade's interpretation on the failure sequence. However, it would not change the failure analysis conclusions. The failure was caused by 85% metal loss due to external corrosion. It would not change any of the RCA conclusions.

5. If the answer to question 3 is yes, which conclusions change and what must they say now?

   Not applicable, no conclusions change.

2.13 Statement 13

Blade's analysis of the circumferential parting is logically flawed. According to Blade's analysis and calculations, the origin was required for circumferential parting to occur as a separate event. But the fracture mode of the origin is the same as that of the circumferential parting, begging the question as to how the origin came into existence, since mechanical loads were insufficient to cause a separate circumferential parting in the absence of the origin.

2.13.1 Blade Response

1. Does Blade Energy Partners agree or disagree with the statement?

   Disagree.

2. If Blade disagrees with any portion of the statement, why?

Blade's analysis of the circumferential parting followed well-established guidelines for determination of the failure origin, and the evidence of discontinuity of chevron marks between circumferential parting and axial rupture provide a sound scientific basis to conclude that the circumferential parting occurred as a separate event. The circumferential fracture mode was a temperature driven process, consequently, the origin has cleavage features that is consistent with fracture under low temperatures.

The rationale for Blade's findings has been discussed in the responses to Statements 10, 11, and 12.

Moreover, as indicated in the previous Statement, on pages 140 – 142 of the *SS-25 Casing Failure Analysis* supplementary report, Blade clearly indicated that "the SEM examination of Zone 1 of the circumferential parting identified a pre-existing, crack-like flaw on the OD side of the origin. The OD surface flaw may have promoted brittle cracking from the origin of the circumferential parting, even though the flaw was shallow". In other words, a brittle crack (i.e., the origin) was initiated from the crack like surface flaw at a temperature below ductile to brittle transition temperature (DBTT) and the brittle crack size was larger than the critical crack size at that temperature, resulting in crack instability and the circumferential brittle parting. One would not expect any noticeable change in micro fracture mode within and outside of the origin that was produced at a temperature below ductile to brittle transition temperature of the steel. This was temperature driven fracture mode.

A complete validation of the size of the origin (critical crack size) is given in Section 2.4.4, pages 74 – 79 of Blade's Main Report and Section 4.3, pages 164 – 169 of the *SS-25 Casing Failure Analysis* supplementary report.

3. Is there any context either in or outside of Mr. Carnahan's testimony that Blade wishes to add in order to explain its answers? If so, please provide it and explain.

   No.

4. If Blade accepts any part of the statement as true, does it change any of the conclusions Blade reached in its Root Cause Analysis?

   Blade does not accept any part of Mr. Carnahan's statement as true. If Blade were to accept Mr. Carnahan's assertion that "Blade's analysis of the circumferential parting is logically flawed.", then it would only change Blade's interpretation on the failure sequence. However, it would not change the failure analysis conclusions. The failure was caused by 85% metal loss due to external corrosion. It would not change any of the RCA conclusions.

5. If the answer to question 3 is yes, which conclusions change and what must they say now?

   Not applicable, no conclusions change.

2.14 Statement 14

For there to have been a circumferential fracture separated in time from the vertical fracture, the vertical fracture would have to arrest (stop). There is no fractographic evidence showing arrest of the vertical fracture extending upward from the area of the burst. The vertical fracture extending downward from the area of the burst arrested most likely because it was approaching thicker material at the casing threaded connection.

2.14.1 Blade Response

1. Does Blade Energy Partners agree or disagree with the statement?

   Disagree.

2. If Blade disagrees with any portion of the statement, why?

   There are two issues raised here by Mr. Carnahan: (a) there is no fractographic evidence showing arrest of the vertical fracture extending upward from the area of the burst and (b) the vertical fracture extending downward from the area of the burst arrested most likely because it was approaching thicker material at the casing threaded connection. Blade's response to Mr. Carnahan's testimony is as follows:

   Issue (a): there is no fractographic evidence showing arrest of the vertical fracture extending upward from the area of the burst.

   Blade's Response to Issue (a): Blade did provide extensive macro and micro fractographic evidence showing arrest of the vertical fracture extending upward from the area of the burst. The evidence was provided and discussed in the *SS-25 Casing Failure Analysis* supplementary report on page 76 (Figure 78), page 81 (Figure 86, Macro), page 82 (Figure 87, Macro), page 109 (Figures 123, 124, Macro), page 121 (Figures 142 and 143, Macro), page 122 (Figure 144 Micro), page 124 (Figure 146 Micro), and page 146 (Figure 178 Macro).

   As stated in the supplementary report, Figure 78 (page 76) and Figure 86 (page 81) illustrates the upper (upward) turning point, second upper (upward) turning point, and arrest point. The images show the upper (upward) section of the axial rupture. Figure 87 (page 82) shows the lower (downward) turning and arrest points.

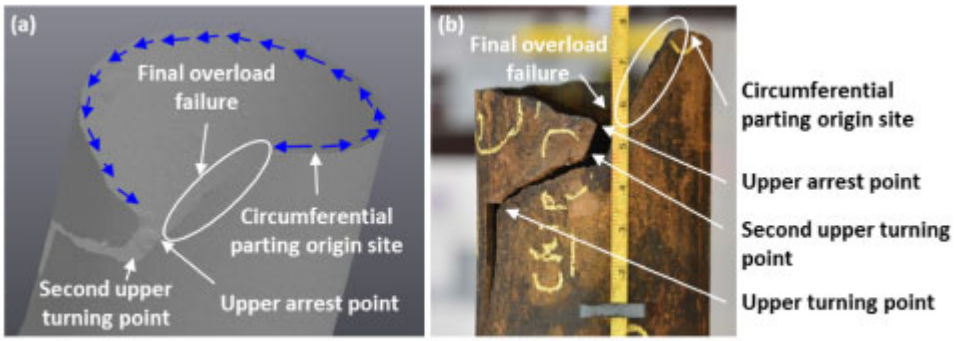


Figure 78: (a) Laser Scan and (b) Circumferential Parting

Figure 86: Macro Image of the Two Upper Turning Points and Single Arrest Point

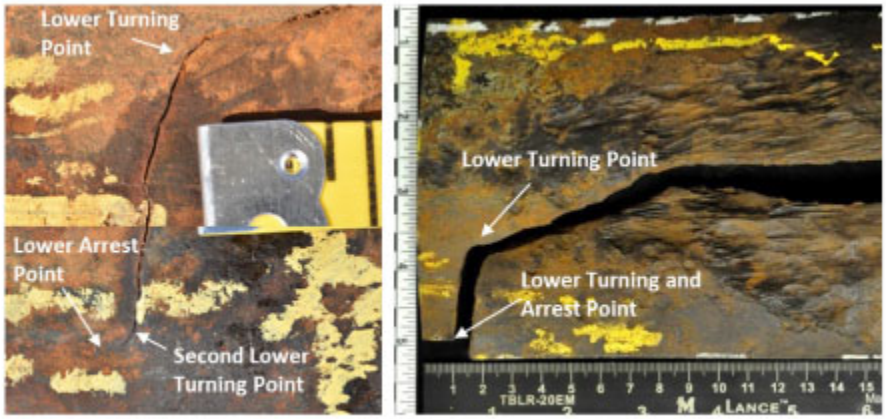


Figure 87: Macro Images of the Lower Turning and Arrest Points

Figure 142 (page 121 in the supplementary report) below shows more detail on the second upper (upward) turning point and upper (upward) arrest area. The upper (upward) arrest area is identified by a slight angle change on the inclined surface. The fracture surface of the upper (upward) arrest area shows no chevron marks because the axial crack was arrested.

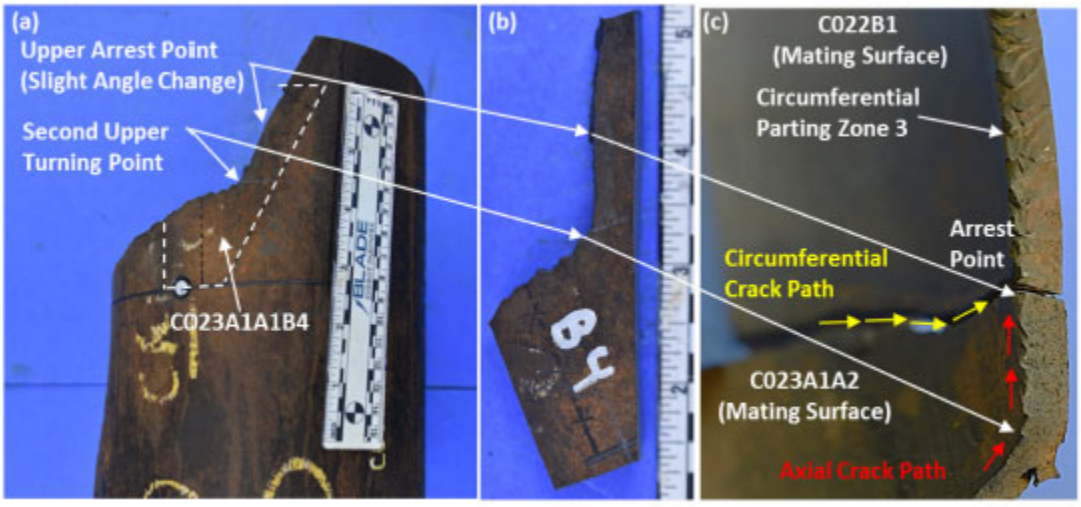


Figure 142: Specimen C023A1A1B4 Extraction

Figure 146 (page 124 of the supplementary report) below are the SEM images of the axial upper (upward) arrest area showing no cleavage facets. There are two observations in the arrest region that support the fact that the crack was arrested. First is the absence of chevron marks observed with a stereo microscope. Secondly, the absence of cleavage facets, observed using a SEM in the same region. Both of these factors support the interpretation that the axial crack slowed down and arrested in this region around a temperature of 80°F. Had the crack propagated per Mr. Carnahan's hypothesis, there should have been chevron marks and cleavage facets in this axial to circumferential transition region, identified as Zone 3.

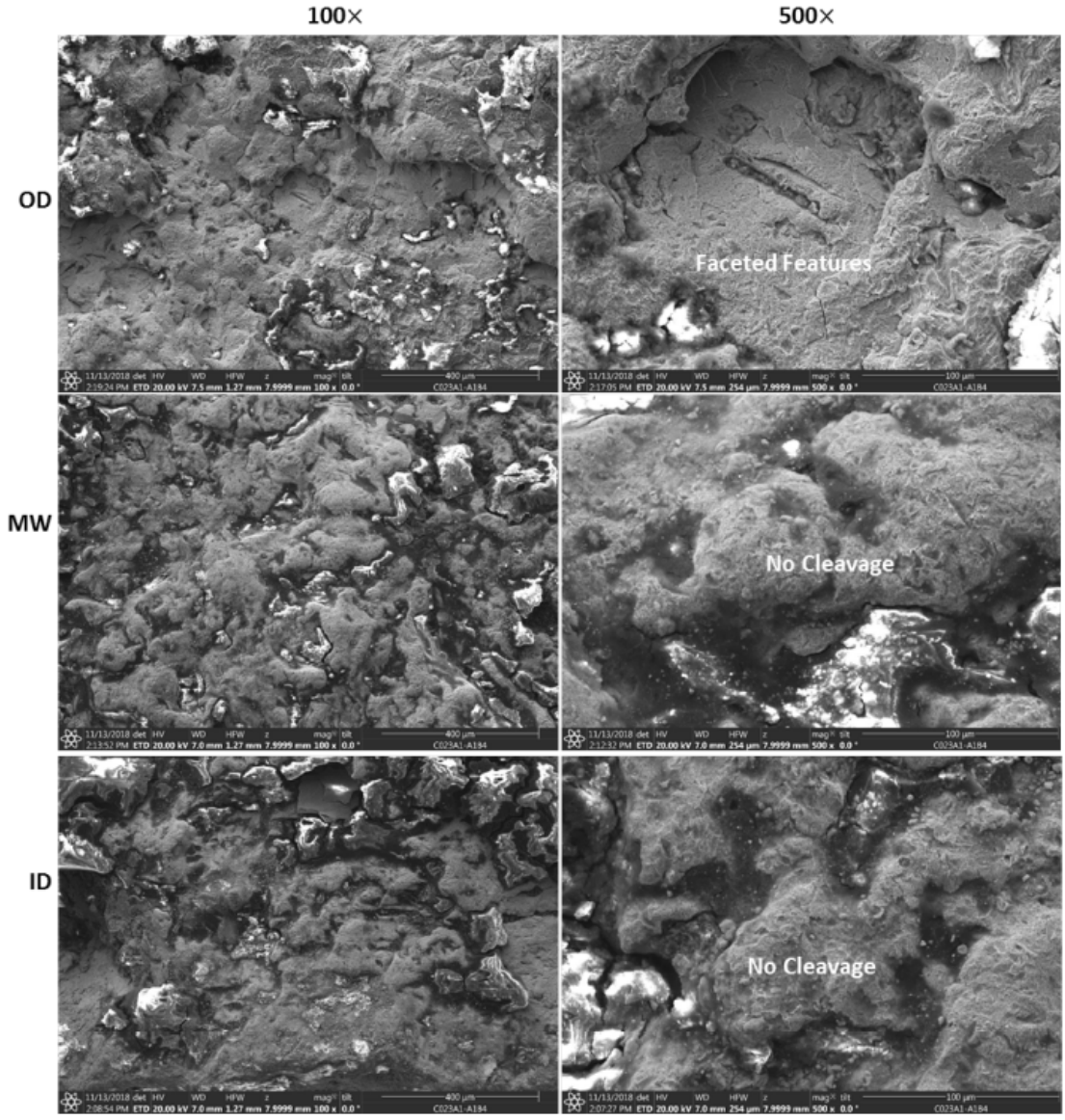


Figure 146: Specimen C023A1A1B4 A3 Showing OD, MW, and ID at 100× and 500×

Figure 178 (a) (page 146 of the supplementary report) shows a schematic of Zone 3 of final circumferential parting. The yellow arrow points to Figure 178 (b) and (c) that show macro and stereo images at a higher magnification of Zone 3. The images show a step-like appearance on the

ID side of the fracture surface. The OD side of the fracture surface appears to be smooth. The fracture surface shows no evidence of chevron marks.

The SEM examination (Figure 180 on page 148 of the supplementary report) showed that the fracture surface near the OD side was mostly cleavage separation, while the ID side showed a mix of cleavage facets and a woody type of plastic deformation. The fracture surface morphology at the mid-wall was a combination of the OD and ID morphologies. This evidence is consistent with the brittle overload failure at temperature below ductile-brittle transition temperature (DBTT).

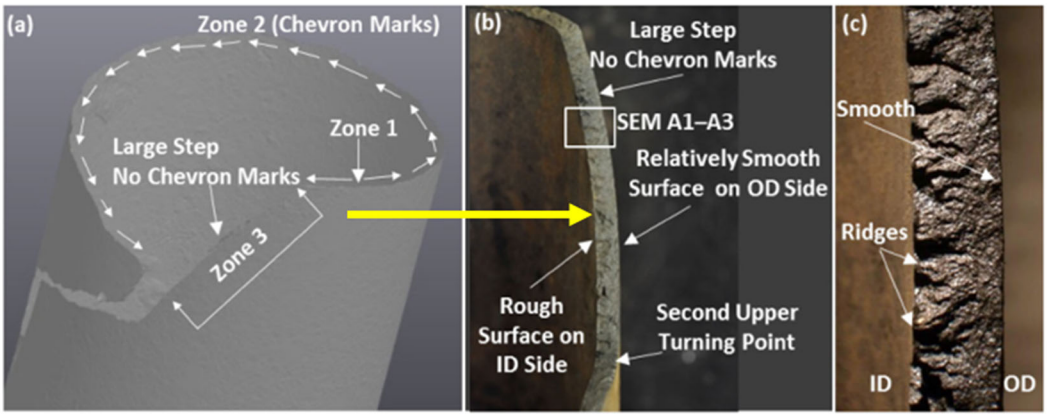


Figure 178: (a) Schematic and (b) (c) Image of Zone 3 (Final Overload Failure)

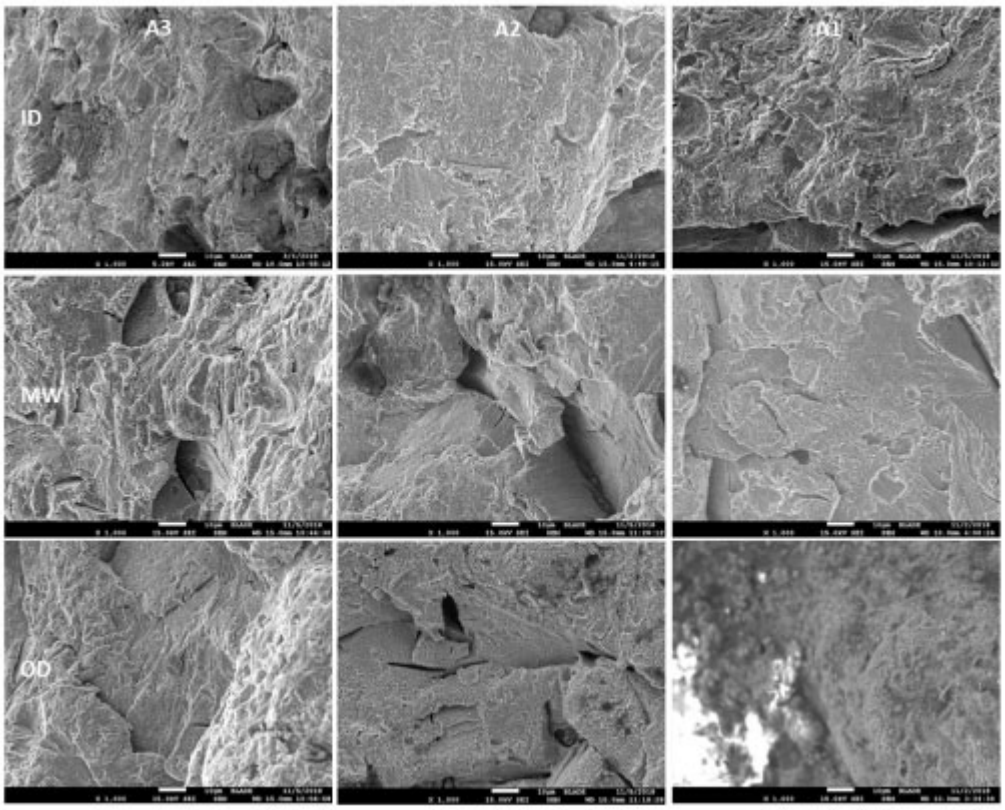


Figure 180: Fracture Surface Morphologies near the ID, MW, and OD Taken at 1,000×

Based on evidence discussed above and other data, Blade's Main Report states on page 54 "Visual and stereoscopic examination of the circumferential parting showed that the failure was not a

continuation of the axial rupture, but rather re-initiated near the corner on one side of the parted casing". If it was a single event from the axial (vertical) rupture to the circumferential parting, there should be a single continuous pathway of chevron marks. The evidence does not support a single event because both the upward arrest area of the axial rupture and Zone 3 of circumferential parting do not contain chevron marks. Therefore, the vertical and circumferential fracture are two separate events with their own initiation sites.

Issue (b): the vertical fracture extending downward from the area of the burst arrested most likely because it was approaching thicker material at the casing threaded connection.

Blade's response to Issue (b): Blade disagrees with Mr. Carnahan's statement that the crack may have arrested at the wall thickness change near the connection. The arrest point was about 9 in. from the start of the change in wall thickness of the casing pin connection, therefore the arrest is not coincident with the wall thickness change. However, Blade does agree that the connection contributed to the lower arrest point. Blade has addressed this issue in its supplementary report *SS-25 Casing Failure Analysis* (Section 3.2.1, page 78). Figure 81 (page 79) shows that the origin was not symmetrically located at the center of the rupture. The non-symmetric location of the origin can be explained by the proximity of the origin to connection 22. The axial crack initiated in Zone 1 and propagated in opposite directions. The lower (i.e., "downward" used by Mr. Carnahan) crack front propagated towards connection 22, which provided additional constraint. Parameters that may contribute to the constraint include connection make up stresses and residual stresses due to local deformation. The upper crack was not influenced by any additional constraint allowing the crack to propagate further before arresting.

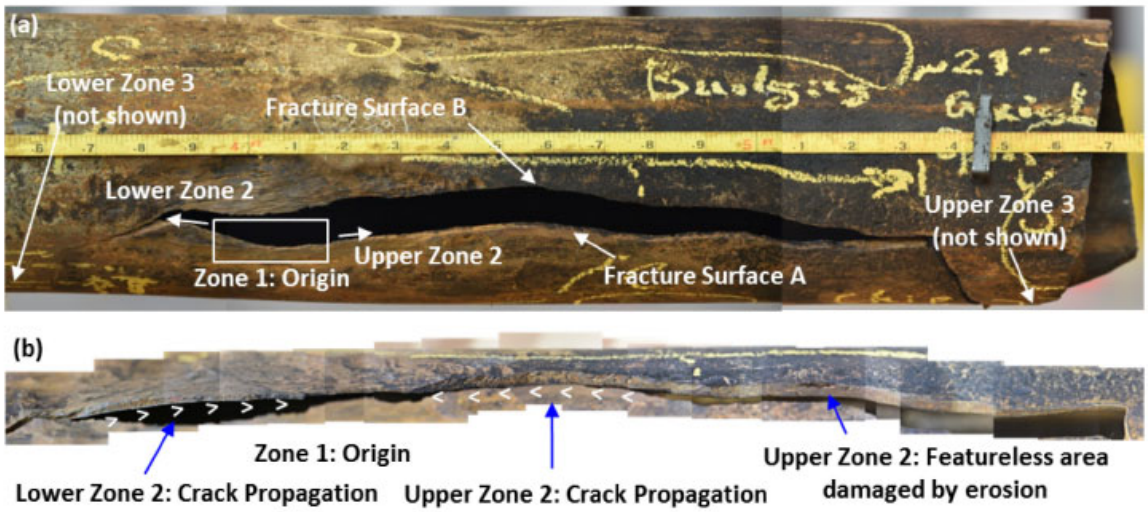


Figure 81: (a) Front and (b) Top Views of Fracture Surface B Identifying Zones 1 and 2

3. Is there any context either in or outside of Mr. Carnahan's testimony that Blade wishes to add in order to explain its answers? If so, please provide it and explain.

   No.

4. If Blade accepts any part of the statement as true, does it change any of the conclusions Blade reached in its Root Cause Analysis?

   Blade does not accept any part of Mr. Carnahan's statement as true. If Blade were to accept Mr. Carnahan's assertion then it would only change Blade's interpretation on the failure sequence.

However, it would not change the failure analysis conclusions. The failure was caused by 85% metal loss due to external corrosion. It would not change any of the RCA conclusions.

5. If the answer to question 3 is yes, which conclusions change and what must they say now?

   Not applicable, no conclusions change.

2.15 Statement 15

The 7-in. casing did not have to become cold for the circumferential fracture to occur. The fracture that extended vertically upward from burst area did not require cooling of the material. Similarly, no further cooling would be required for this fracture to change direction and propagate circumferentially.

2.15.1 Blade Response

1. Does Blade Energy Partners agree or disagree with the statement?

   Disagree.

2. If Blade disagrees with any portion of the statement, why?

   There were two events. The axial rupture happened at a temperature around 80°F. However, following the axial rupture the temperature dropped locally, and then the circumferential parting occurred. Blade has provided extensive evidence to support this interpretation.

   Firstly, Mr. Carnahan's testimony "The 7-in. casing did not have to become cold for the circumferential fracture to occur" ignores the evidence provided in Blade's Main Report, is subjective, and without any basis. The fact is, as stated on page 55 in Blade's Main Report, that "the circumferential parting was brittle, which was different from the axial rupture. No evidence of local plastic deformation or overload necking was observed near the fracture surfaces on either side of the circumferential parting" and "a temperature for the circumferential parting was estimated to be in the range of –76°F to –38°F (–60°C to –39°C)" based on the critical defect size and fracture mechanics models (API 579 FAD and BS7910 FAD) (Table 6 on page 79 of the Main Report) and a series of CVN tests (Sections 4.3.1, pages 164 – 166 of the *SS-25 Casing Failure Analysis* supplementary report).

   Mr. Carnahan does not address the absence of local plastic deformation or lack of overload necking in the circumferential parting region, which would be required to validate or support Mr. Carnahan's contention. Further, Mr. Carnahan has not assessed the fact that the tensile load was low and could not have failed the casing in the circumferential orientation unless the temperature dropped and the toughness was reduced. Integration of stresses, metallurgical factors and temperature is necessary here to interpret the failure sequence.

   Secondly, Blade agrees with Mr. Carnahan's testimony that "The fracture that extended vertically upward from burst area did not require cooling of the material". In Blade's Main Report, it is clearly stated that the axial rupture occurred at an estimated temperature of 80°F; this estimate was based on the historical temperature profile data at the failure depth of 892 ft (joint 22) and is consistent with observed bulging and ductile tearing associated with the axial rupture (page 74 in Section 2.4.4 of Blade's Main Report). Blade never states anywhere in the report that the fracture that extended vertically upward from the burst area required cooling of the material.

   Thirdly, Blade disagrees with Mr. Carnahan's statement "Similarly, no further cooling would be required for this fracture to change direction and propagate circumferentially". This statement is

not relevant to the failure at SS-25.There were two events, the axial rupture occurred at 80°F, whereas the circumferential parting occurred at a much lower temperature. This has been previously discussed in detail. There is a preponderance of evidence that supports Blade interpretation.

3. Is there any context either in or outside of Mr. Carnahan's testimony that Blade wishes to add in order to explain its answers? If so, please provide it and explain.

   No.

4. If Blade accepts any part of the statement as true, does it change any of the conclusions Blade reached in its Root Cause Analysis?

   Blade does not accept any part of Mr. Carnahan's conclusion in the above statement. Blade does agree with Mr. Carnahan's testimony "The fracture that extended vertically upward from burst area did not require cooling of the material." This is consistent with Blade's conclusion in its reports. Mr. Carnahan's testimony, if accepted to be true in its totality, it would not change the failure analysis conclusions. The failure was caused by 85% metal loss due to external corrosion. It would not change any of the RCA conclusions.

5. If the answer to question 3 is yes, which conclusions change and what must they say now?

   Not applicable, no conclusions change.

2.16 Statement 16

There is no mechanical reason for the upward extending vertical fracture to arrest. The stress intensity at the tip of the fracture, essentially the driving force for fracture, was increasing as the fracture became longer.

2.16.1 Blade Response

1. Does Blade Energy Partners agree or disagree with the statement?

   Disagree.

2. If Blade disagrees with any portion of the statement, why?

   Fracture mechanics text books [17] [18] [19] and extensive literature [20] [21] [22] [23] [24] have explained the crack arrest concept. The driving force for a running crack is dynamic and decays as a function of time, as described in fracture mechanics text books and literature. It depends on two factors: (a) the rate of internal pressure drop due to the release of liquid or gas and (b) the resistance to crack propagation that is dependent on the material's crack arrest toughness (CVN, KJ, CTOA, etc.). Developing the methods for arrest of a running crack in steels is the focus of fracture mechanics for safety and minimizing consequences of rupture [20] [21] [22]. The evidence provided by the SS-25 RCA has shown that the running axial crack in the SS-25 7 in. casing was arrested.

   Figure 4 presents a schematic of the failure process [25]. The sketch in the red box conceptually summarized the conditions for crack arrest, that is, a through-wall defect ruptures but arrests if the pressure is low, and/or if the pipe material toughness is high.

   The differential pressure at the time of the SS-25 7 in. casing axial rupture was 2,405 psi (Table 5, page 156, *SS-25 Casing Failure Analysis* supplementary report), the calculated hoop stress is only

42.6% of actual yield strength, which was a low stress failure, i.e., a low driving force for failure. On the other hand, the temperature at the time of the axial rupture was 80°F. The material exhibited high ductility and toughness. Therefore, this was a low driving force and high resistance failure condition, which falls in the crack arrest category. Therefore, the upward crack would eventually be arrested.

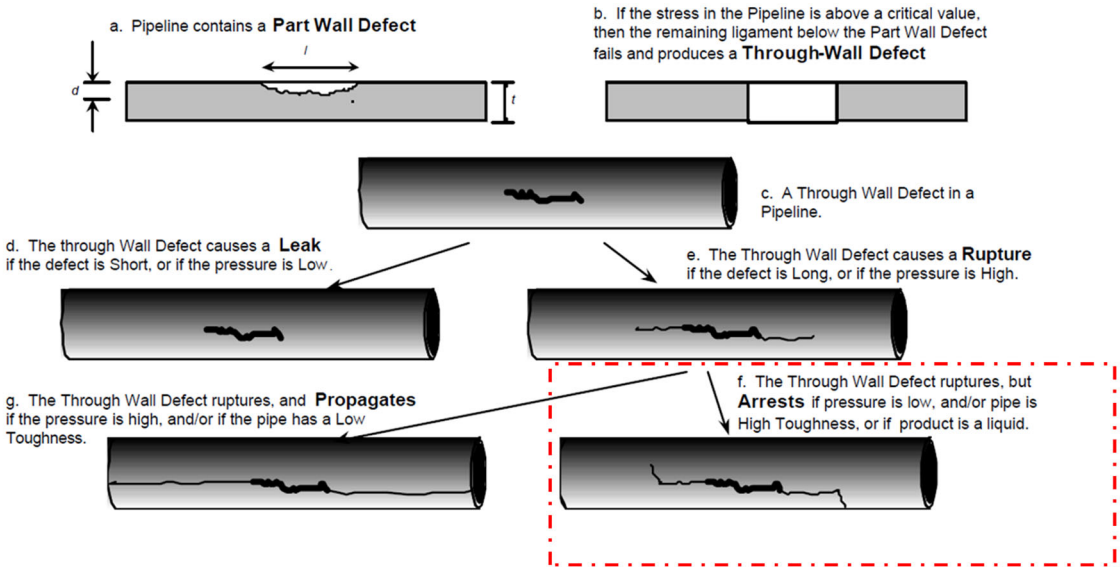


Figure 4: Pipe Failure Process

The crack arrest phenomenon as observed in the SS-25 7 in. casing has been discussed in literature, for example ASM Handbook Volume 12 *Fractography Visual Examination and Light Microscopy* and Vol. 20 *Material Selection and Design Chapter Using Failure Analysis in Material Selection*. The figure below is reproduced from ASM Vol 20 showing the arrested axial crack in a full section of X60 grade line pipe by ductile fracture at 13°C (56°F) which is 8°F above its 50% shear-area. The crack, moving at 278 ft/s (85 m/s), stopped after a short distance. The fracture was ductile and the line pipe was tough enough at this temperature to arrest the crack.

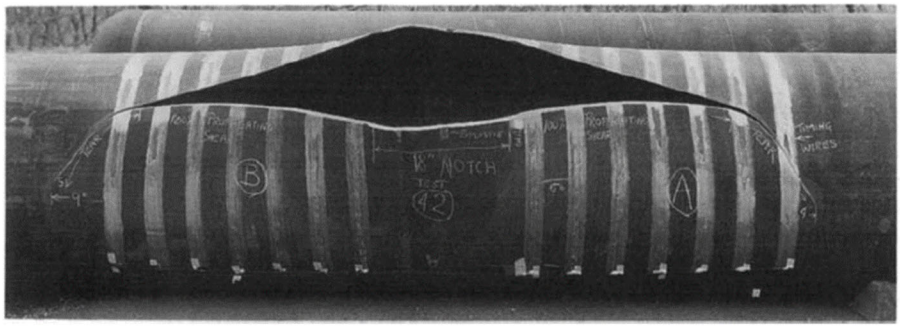


Fig. 1 Ductile fracture of a full section X60 grade line pipe tested at 56 °F (13 °C), which is 8 °F above its 50% shear-area DWTT

Therefore, Blade disagrees with Mr. Carnahan's statement "There is no mechanical reason for the upward extending vertical fracture to arrest. The stress intensity at the tip of the fracture, essentially the driving force for fracture, was increasing as the fracture became longer". This statement is inconsistent with literature data and understanding regarding running cracks and crack arrest phenomena. Blade supplementary report, *SS-25 Failure Analysis*, on page 73 states,

> "The visual examination showed that during the axial rupture, plastic bulging occurred first with slow ductile tearing due to the internal pressure. Tearing instability occurred once the axial flaw reached the critical size and was followed by a rapid crack propagation in the axial direction that left behind chevron marks (Figure 76 [c]). The crack changed direction (upper and lower turning points) and finally arrested due to dynamic energy consumption (17) (18) (19). There were two turning points on the upper and lower side of the rupture. This phenomenon is not uncommon for an axial rupture."

3. Is there any context either in or outside of Mr. Carnahan's testimony that Blade wishes to add in order to explain its answers? If so, please provide it and explain.

   No.

4. If Blade accepts any part of the statement as true, does it change any of the conclusions Blade reached in its Root Cause Analysis?

   Blade does not accept any part of Mr. Carnahan's statement as true. If Blade were to accept Mr. Carnahan's assertion that "There is no mechanical reason for the upward extending vertical fracture to arrest. The stress intensity at the tip of the fracture, essentially the driving force for fracture, was increasing as the fracture became longer", then it would only change Blade's interpretation on the failure sequence. However, it would not change the failure analysis conclusions. The failure was caused by 85% metal loss due to external corrosion. It would not change any of the RCA conclusions.

5. If the answer to question 3 is yes, which conclusions change and what must they say now?

   Not applicable, no conclusions change.

2.17 Statement 17

Pages 28-30 of Mr. Carnahan's testimony, which states:

The cooling shown on the SS-25 temperature logs at this depth was not indicative of a leak. The movement of gas into or out of the storage zone always causes localized cooling; indeed, cooling behavior where a storage well meets the reservoir has been well known for many years, as can be seen in Figure 19.

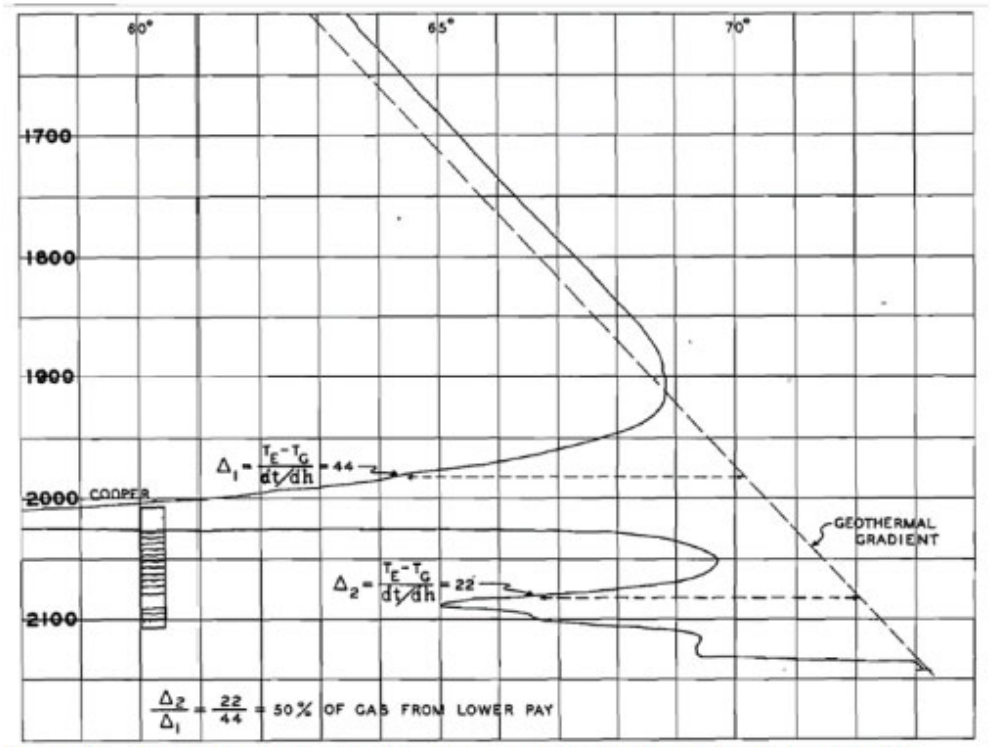


Figure 19. Gas well temperature log showing cooling at the packer and perforation (Bird, 1954).

2.17.1 Blade Response

1. Does Blade Energy Partners agree or disagree with the statement?

   Agree.

2. If Blade disagrees with any portion of the statement, why?

   Not applicable. Blade agrees with the statement.

3. Is there any context either in or outside of Mr. Carnahan's testimony that Blade wishes to add in order to explain its answers? If so, please provide it and explain.

   Blade discussed this phenomenon in supplementary report *SS-25 Temperature, Pressure, and Noise Log Analysis* [26, p. 16].

4. If Blade accepts any part of the statement as true, does it change any of the conclusions Blade reached in its Root Cause Analysis?

   No.

5. If the answer to question 3 is yes, which conclusions change and what must they say now?

   Not applicable. No conclusion changes are needed.

2.18 Statement 18

All storage wells at Aliso Canyon exhibit the same or similar cooling at that depth. For example, Figure 20 shows that Fernando Fee 32A and Porter 72A both exhibit cooling at the bottom of the wells, and the same is true for SS-25A and SS-25B (Figure 21).

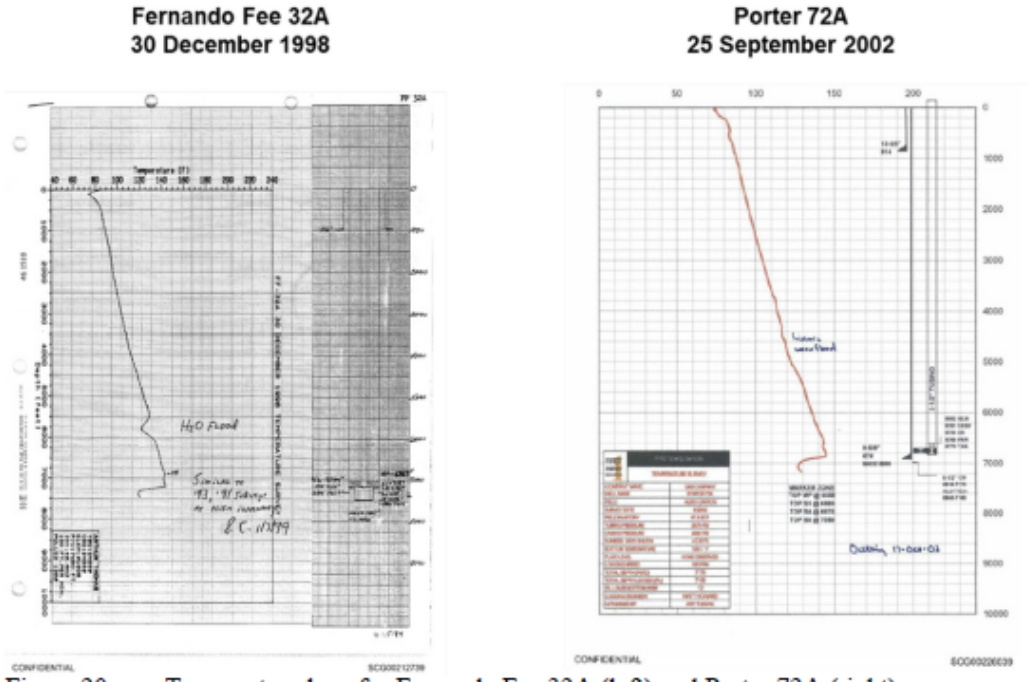


Figure 20. Temperature logs for Fernando Fee 32A (left) and Porter 72A (right).

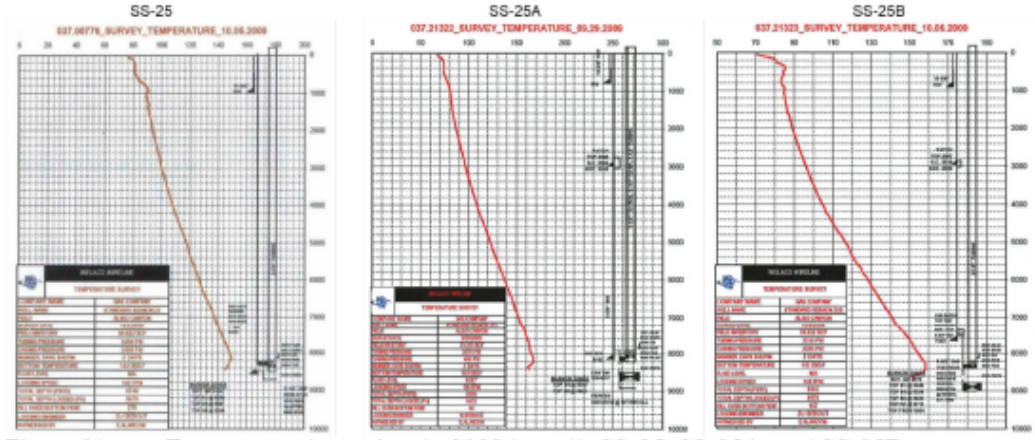


Figure 21. Temperature logs taken in 2009 in wells SS-25, SS-25A, and SS-25B.

2.18.1 Blade Response

1. Does Blade Energy Partners agree or disagree with the statement?

   Agree.

2. If Blade disagrees with any portion of the statement, why?

Not applicable. Blade agrees with the statement.

3. Is there any context either in or outside of Mr. Carnahan's testimony that Blade wishes to add in order to explain its answers? If so, please provide it and explain.

   Blade agrees with this statement, and has discussed the cooling in a supplementary report [27, p. 16].

4. If Blade accepts any part of the statement as true, does it change any of the conclusions Blade reached in its Root Cause Analysis?

   No.

5. If the answer to question 3 is yes, which conclusions change and what must they say now?

   Not applicable. No conclusion changes are needed.

2.19 Statement 19

Some temperature surveys over the years reported possible slight leakage in the vicinity of the production casing shoe and noise logs were run following a number of these temperature surveys. SoCalGas performed noise logs in SS-25 on the following ten dates: September 8, 1978, December 11, 1978, August 8, 1979, November 24, 1981, February 23, 1983, April 11, 1984, July 27, 1984, November 7, 1991, November 7, 2006, and June 1, 2012. None of these noise logs indicate a gas leak in the production casing. None of these noise logs indicate a gas leak in the production casing or at the production casing shoe.

2.19.1 Blade Response

1. Does Blade Energy Partners agree or disagree with the statement?

   Blade agrees with, "None of these noise logs indicate a gas leak in the production casing."

   Blade disagrees with, "None of these noise logs indicate a gas leak . . . at the production casing shoe."

2. If Blade disagrees with any portion of the statement, why?

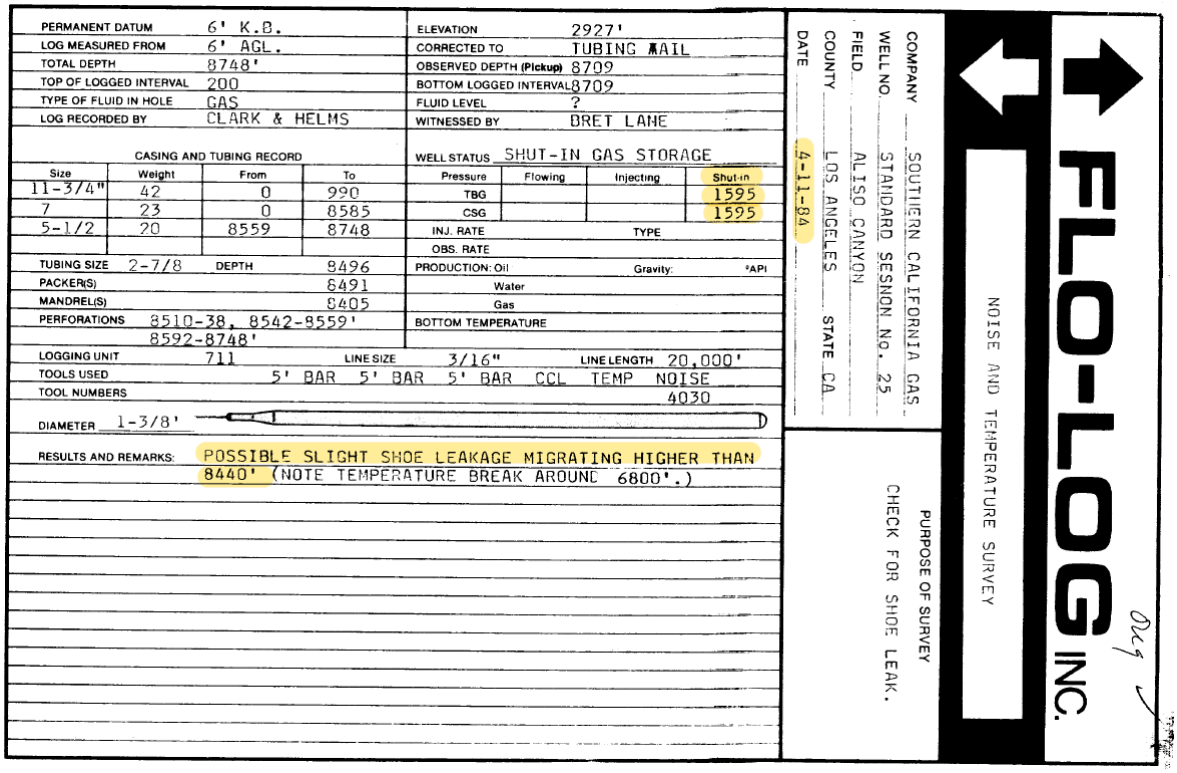
   One of the noise logs, performed on April 11, 1984, identified a possible leak near the production casing shoe. Multiple temperatures logs and a radioactive tracer survey were run during this period. This casing shoe leak was not observed in subsequent noise logs. More importantly, there was never any indication via noise or temperature logs of any casing integrity issues prior to October 23, 2015 incident.

3. Is there any context either in or outside of Mr. Carnahan's testimony that Blade wishes to add in order to explain its answers? If so, please provide it and explain.

   Figure 5 shows the April 11, 1984 log [28]. Denoted in yellow in the Results and Remarks section is, "POSSIBLE SLIGHT SHOE LEAKAGE MIGRATING HIGHER THAN 8440'" at a shut-in pressure of 1,595 psi. Note the purpose of the survey was to "CHECK FOR SHOE LEAK".

   Figure 6 shows the July 27, 1984 log [29]. Denoted in yellow in the Results and Remarks section, "NO INDICATION OF ANY GAS LEAKAGE" at a shut-in pressure of 2,390 psi. Also note the purpose of the survey was to "TO CHECK FOR GAS LEAKAGE AT THE CASING SHOE AND/OR THE W. S. O. ". The W. S. O. refers to the water shut off perforations.

The shut-in tubing and casing pressures during the July 27, 1984 noise survey is 795 psi higher than during April 11, 1984 noise survey. Leaks are almost always more prominent when the pressures are higher. If the casing shoe leak was present it should have been evident at the higher pressure (i.e., inventory) and observed on the July 27, 1984 noise log and subsequent logs.



PERMANENT DATUM 6' K.B. | ELEVATION 2927'
LOG MEASURED FROM 6' AGL. | CORRECTED TO TUBING TAIL
TOTAL DEPTH 8748' | OBSERVED DEPTH (Pickup) 8709
TOP OF LOGGED INTERVAL 200 | BOTTOM LOGGED INTERVAL 8709
TYPE OF FLUID IN HOLE GAS | FLUID LEVEL ?
LOG RECORDED BY CLARK & HELMS | WITNESSED BY BRET LANE

CASING AND TUBING RECORD

Size	Weight	From	To
11-3/4"	42	0	990
7	23	0	8585
5-1/2	20	8559	8748

TUBING SIZE 2-7/8 DEPTH 8496
PACKER(S) 8491
MANDREL(S) 8405
PERFORATIONS 8510-38, 8542-8559' 8592-8748'

WELL STATUS SHUT-IN GAS STORAGE

Pressure	Flowing	Injecting	Shut-in
TBG			1595
CSG			1595

INJ. RATE TYPE
OBS. RATE
PRODUCTION: Oil Gravity: °API
Water
Gas
BOTTOM TEMPERATURE

LOGGING UNIT 711 LINE SIZE 3/16" LINE LENGTH 20,000'
TOOLS USED 5' BAR 5' BAR 5' BAR CCL TEMP NOISE
TOOL NUMBERS 4030
DIAMETER 1-3/8'

RESULTS AND REMARKS: POSSIBLE SLIGHT SHOE LEAKAGE MIGRATING HIGHER THAN 8440' (NOTE TEMPERATURE BREAK AROUND 6800'.)

COMPANY SOUTHERN CALIFORNIA GAS
WELL NO. STANDARD SESNON No. 25
FIELD ALISO CANYON
COUNTY LOS ANGELES STATE CA
DATE 4-11-84

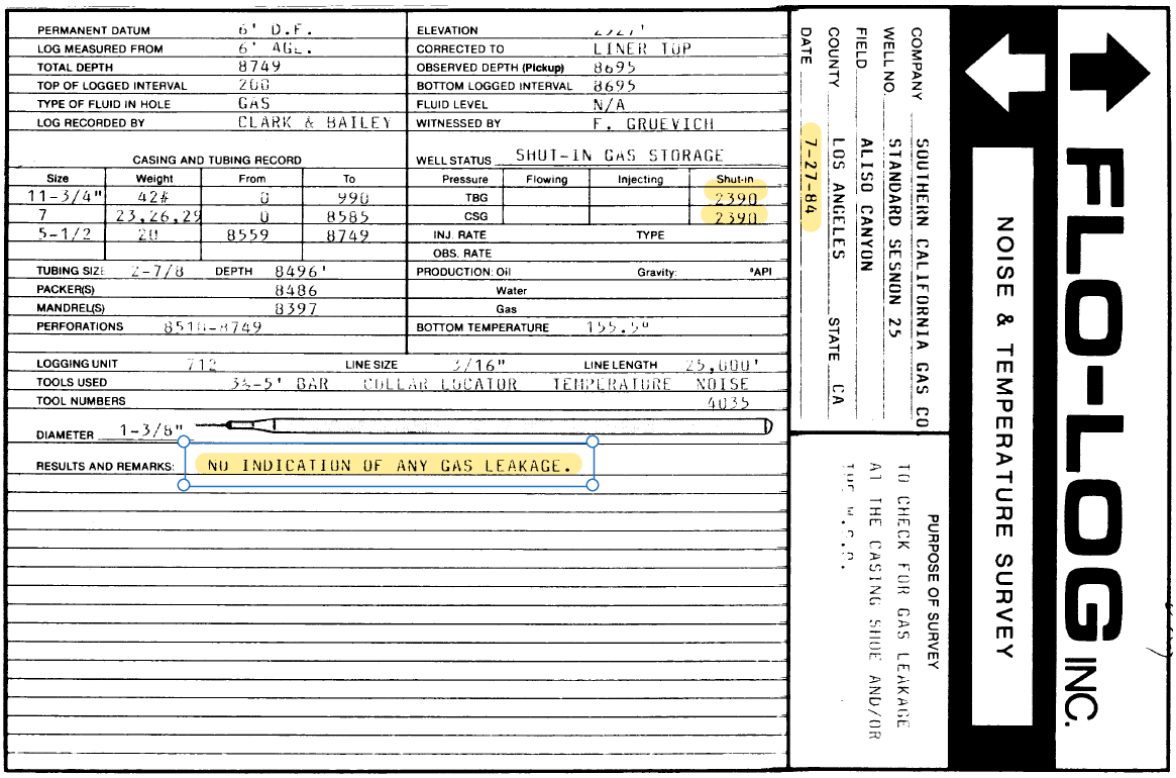
PURPOSE OF SURVEY
CHECK FOR SHOE LEAK.

NOISE AND TEMPERATURE SURVEY

FLO-LOG INC.

Dec 7

Figure 5: SS-25, Noise Log Header on April 11, 1984, "Possible Slight Shoe Leakage", 1,595 psi



PERMANENT DATUM	6' D.F.	ELEVATION	2927'
LOG MEASURED FROM	6' AGL.	CORRECTED TO	LINER TOP
TOTAL DEPTH	8749	OBSERVED DEPTH (Pickup)	8695
TOP OF LOGGED INTERVAL	200	BOTTOM LOGGED INTERVAL	8695
TYPE OF FLUID IN HOLE	GAS	FLUID LEVEL	N/A
LOG RECORDED BY	CLARK & BAILEY	WITNESSED BY	F. GRUEVICH

CASING AND TUBING RECORD

Size	Weight	From	To
11-3/4"	42#	0	990
7	23,26,29	0	8585
5-1/2	20	8559	8749

WELL STATUS: SHUT-IN GAS STORAGE

	Pressure	Flowing	Injecting	Shut-in
TBG				2390
CSG				2390

INJ. RATE ____ TYPE ____
OBS. RATE ____

TUBING SIZE 2-7/8 DEPTH 8496'
PACKER(S) 8486
MANDREL(S) 8397
PERFORATIONS 8510-8749
PRODUCTION: Oil ____ Gravity: ____ °API
Water ____
Gas ____
BOTTOM TEMPERATURE 155.2°

LOGGING UNIT 712 LINE SIZE 3/16" LINE LENGTH 25,000'
TOOLS USED 3⅜-5' GAR COLLAR LOCATOR TEMPERATURE NOISE
TOOL NUMBERS 4035
DIAMETER 1-3/16"

RESULTS AND REMARKS: NO INDICATION OF ANY GAS LEAKAGE.

COMPANY SOUTHERN CALIFORNIA GAS CO
WELL NO. STANDARD SESNON 25
FIELD ALISO CANYON
COUNTY LOS ANGELES STATE CA
DATE 7-27-84

PURPOSE OF SURVEY
TO CHECK FOR GAS LEAKAGE AT THE CASING SHOE AND/OR TOP OF CMT.

NOISE & TEMPERATURE SURVEY

FLO-LOG INC.

Figure 6: SS-25, Noise Log Header on July 27, 1984, "No Indication of Any Gas Leakage", 2,390 psi

There is a supplementary report titled *SS-25 Temperature, Pressure, and Noise Logs Analysis* [26], and the focus of that report was to assess any evidence of any pre-existing casing integrity issue on SS-25. No temperature, pressure, or noise anomalies in the surveys indicated a preexisting casing failure before the October 23, 2015 incident [9, p. 31]. Casing shoe leaks (i.e., gas from storage zone traveling out of that zone behind casing) were not the focus – these types of leaks would not have any bearing on the corrosion and subsequent casing failure at 892 ft.

4. If Blade accepts any part of the statement as true, does it change any of the conclusions Blade reached in its Root Cause Analysis?

   No change. There were no indications of a preexisting casing integrity issue.

5. If the answer to question 3 is yes, which conclusions change and what must they say now?

   No conclusion changes are needed.

2.20 Statement 20

A radioactive tracer survey performed on July 29, 1984 reported possible slight leakage behind pipe from top perf at 8510 ft up to around 8430 ft and 8190 ft. This survey indicates gas flowing up to the bottom of the cap rock at approximately 8182 ft and into the permeable S1 formation.

2.20.1 Blade Response

1. Does Blade Energy Partners agree or disagree with the statement?

   Agree.

2. If Blade disagrees with any portion of the statement, why?

   Not applicable. Blade agrees with the statement.

3. Is there any context either in or outside of Mr. Carnahan's testimony that Blade wishes to add in order to explain its answers? If so, please provide it and explain.

   See the response to Statement 18 question 3.

4. If Blade accepts any part of the statement as true, does it change any of the conclusions Blade reached in its Root Cause Analysis?

   No change. There were no indications of a preexisting casing integrity issue.

5. If the answer to question 3 is yes, which conclusions change and what must they say now?

   Not applicable. No conclusion changes are needed.

2.21 Statement 21

The noise logs display four curves, representing sound at frequencies of 200 Hz, 600 Hz, 1,000 Hz, and 2,000 Hz, respectively. Low frequency noise (200 and 600 Hz) is usually indicative of surface noise or low rate flow of fluids behind casing. High frequency noise (1,000 and 2,000 Hz) is usually indicative of the flow of gas, bubbling of gas in liquids, or high-rate gas flow. The interpretation of noise logs is well-established: a sharply-defined, high-frequency noise over a short length of casing is an indication of a gas leak.

2.21.1 Blade Response

1. Does Blade Energy Partners agree or disagree with the statement?

   Agree.

2. If Blade disagrees with any portion of the statement, why?

   Not applicable. Blade agrees with the statement.

3. Is there any context either in or outside of Mr. Carnahan's testimony that Blade wishes to add in order to explain its answers? If so, please provide it and explain.

   No.

4. If Blade accepts any part of the statement as true, does it change any of the conclusions Blade reached in its Root Cause Analysis?

   No change. There were no indications of a preexisting casing integrity issue.

5. If the answer to question 3 is yes, which conclusions change and what must they say now?

   Not applicable. No conclusion changes are needed.

2.22 Statement 22

There are no such sharply-defined, high-frequency noises over short lengths of casing in the SS-25 noise logs that would indicate the presence of a gas leak. In some of the logs, there is a noticeable sharp peak in noise, but these were caused by the operators testing the noise logging tool prior to entering the

completion equipment at or below 8,000 ft., and these operator tests are clearly labeled on the logs (see, e.g., November 24, 1981 log).

2.22.1 Blade Response

1. Does Blade Energy Partners agree or disagree with the statement?

   Agree.

2. If Blade disagrees with any portion of the statement, why?

   Not applicable. Blade agrees with the statement.

3. Is there any context either in or outside of Mr. Carnahan's testimony that Blade wishes to add in order to explain its answers? If so, please provide it and explain.

   No.

4. If Blade accepts any part of the statement as true, does it change any of the conclusions Blade reached in its Root Cause Analysis?

   No change in the conclusions.

5. If the answer to question 3 is yes, which conclusions change and what must they say now?

   Not applicable. No conclusion changes are needed.

2.23 Statement 23

SoCalGas performed the noise log of December 11, 1978 from 5,800 to 7,770 ft., and that log measured no anomalous noise. The logs of November 7, 2006 and June 1, 2012 were performed for the entire length of the well and measured no anomalous noise.

2.23.1 Blade Response

1. Does Blade Energy Partners agree or disagree with the statement?

   Agree.

2. If Blade disagrees with any portion of the statement, why?

   Not applicable. Blade agrees with the statement.

3. Is there any context either in or outside of Mr. Carnahan's testimony that Blade wishes to add in order to explain its answers? If so, please provide it and explain.

   No.

4. If Blade accepts any part of the statement as true, does it change any of the conclusions Blade reached in its Root Cause Analysis?

   No change in the conclusions.

5. If the answer to question 3 is yes, which conclusions change and what must they say now?

   Not applicable. No conclusion changes are needed.

2.24 Statement 24

SoCalGas performed the remaining noise logs performed in 1978, 1979, 1981, 1984 (2 runs), and 1991 to assess potential leaks. All logs measured generally shallow low frequency noise (200 to 600 Hz). These low-frequency measurements are interpreted to originate from surface noise at the Aliso Canyon site or operations in nearby wells, which is common and described by McKinley [1995].84 The 1978 log includes operator comments referencing surface noise.

2.24.1 Blade Response

1. Does Blade Energy Partners agree or disagree with the statement?

   In general, Blade agrees with this statement. Noise originating from surface was detected in some logs and this source of the noise was documented in the Results and Remarks section of the log.

2. If Blade disagrees with any portion of the statement, why?

   Blade disagrees with, “All logs measured generally shallow low frequency noise (200 to 600 Hz).” Some, but not all, logs have measured shallow noise.

3. Is there any context either in or outside of Mr. Carnahan’s testimony that Blade wishes to add in order to explain its answers? If so, please provide it and explain.

   No.

4. If Blade accepts any part of the statement as true, does it change any of the conclusions Blade reached in its Root Cause Analysis?

   No change in the conclusions.

5. If the answer to question 3 is yes, which conclusions change and what must they say now?

   Not applicable. No conclusion changes are needed.

2.25 Statement 25

The same six logs also measured noise across all four frequency ranges slightly above the packer and completion equipment at the base of the well, and across the storage formation. Such noise is expected and is associated with movement of gas in the storage formation and through the completion equipment. The 1991 log includes operator comments regarding noise interpreted as “bubbling” at a depth of about 7,500 ft., which is shown in the excerpt of the log in Figure 22. As can be seen in the figure, the noise log was repeated over the depth range of 7,200 ft. to 7,600 ft. and the indicated bubbling noise was not detected.

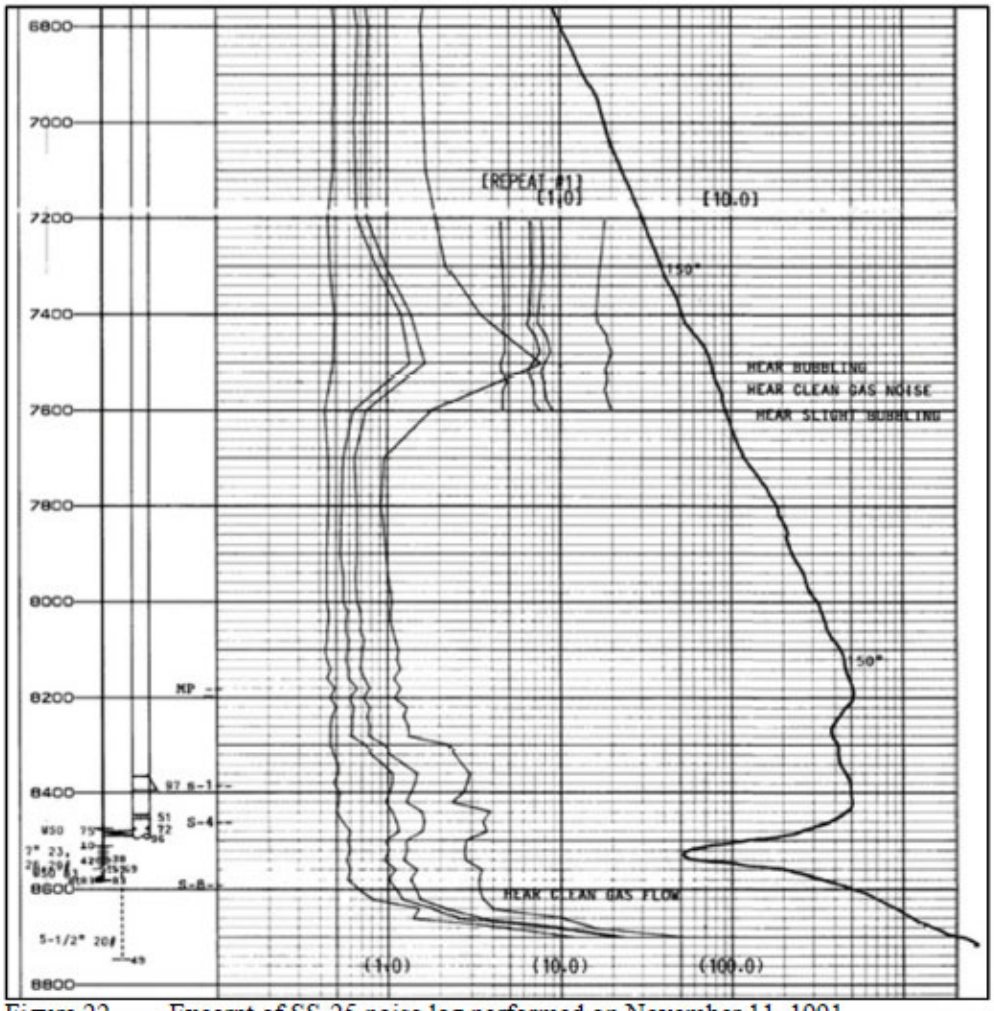


Figure 22. Excerpt of SS-25 noise log performed on November 11, 1991.

2.25.1 Blade Response

1. Does Blade Energy Partners agree or disagree with the statement?

   Disagree.

2. If Blade disagrees with any portion of the statement, why?

   Blade disagrees with "The same six logs also measured noise across all four frequency ranges slightly above the packer and completion equipment at the base of the well, and across the storage formation." Not all the logs were run across the packer, completion equipment and storage formation. For example, in the December 8, 1978 log, the deepest observation point was approximately 7,900 ft, which is above the packer and storage formation.

   Blade agrees that in the repeat section from 7,200–7,800 ft bubbling noise was not detected.

3. Is there any context either in or outside of Mr. Carnahan's testimony that Blade wishes to add in order to explain its answers? If so, please provide it and explain.

   No.

4. If Blade accepts any part of the statement as true, does it change any of the conclusions Blade reached in its Root Cause Analysis?

   No change in the conclusions.

5. If the answer to question 3 is yes, which conclusions change and what must they say now?

   Not applicable. No conclusion changes are needed.

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