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. (U904G).

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CHAPTER III

PREPARED REPLY TESTIMONY OF L. WILLIAM ABEL ON BEHALF OF SOUTHERN CALIFORNIA GAS COMPANY (U 904 G)

March 20, 2020

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CHAPTER III

I. INTRODUCTION.

The purpose of my testimony is to explain that SoCalGas acted reasonably and prudently in connection with the SS-25 well control operation. In doing so, I will also discuss why the Safety and Enforcement Division's ("SED") Opening Testimony regarding the SS-25 well control response is in many respects incorrect, and speculative.

I base my testimony on the expertise I have gained from more than 44 years of experience with well control operations. I have participated in more than 500 well kill operations in my career, and have personally supervised and designed well capping and kill operations in over 60 wells. Before becoming a well control consultant, I worked for various industry-leading well control organizations all over the world, participating in both relatively routine well kills and specialized well kill scenarios. In addition, I have published numerous articles and a textbook on the subject, which are further detailed in my attached curriculum vitae.[1]

Based on my decades of knowledge and experience, it is my opinion that SoCalGas acted reasonably and prudently in response to the SS-25 leak, including its engagement and supervision of its well control contractor, Boots & Coots Company ("Boots & Coots"). SED's allegations that SoCalGas mismanaged the SS-25 well control efforts (Violations 79-83) appear to be premised on: (1) a misunderstanding of a gas operator's role in an emergency well kill scenario, (2) an incomplete set of information regarding the transient kill modeling performed by Boots & Coots, and (3) total speculation as to the effectiveness of the modeling outputs proposed by Blade Energy Partners ("Blade"). I further note that SED's allegations appear to be based entirely on the Blade Report[2]—with little to no independent verification of Blade's findings and conclusions.

[1] Ex. III-1.
[2] Blade Energy Partners, Root Cause Analysis of the Uncontrolled Hydrocarbon Release from Aliso Canyon SS-25, May 16, 2019 ("Blade Report").

II. SOCALGAS' LEAK RESPONSE, INCLUDING ENGAGEMENT AND MONITORING OF BOOTS & COOTS, WAS PRUDENT AND REASONABLE.

SED's Opening Testimony alleges that SoCalGas lacked the "necessary skills to monitor and manage" its well control specialist.[3] Based on my review of the records and evidence, SED's assertion is unfounded. As a preliminary matter, SoCalGas' initial response to the leak was prudent and consistent with industry practice. Upon discovery of the SS-25 leak on October 23, 2015, SoCalGas immediately mobilized to implement a standard top kill.[4] SoCalGas had to abort its initial top kill attempt on October 24, 2015 because it became apparent that there was a blockage in the tubing, evidenced by the excessive pressure, the immediate return of fluid when pumping down the production casing, and observation of increased gas flow releasing from the cracks around the SS-25 well pad.[5]

While SoCalGas' engineers had regularly killed wells in the normal course of managing SoCalGas' gas storage fields, the indications from this event suggested the SS-25 leak was not a typical leak event, and required specialized expertise.[6] While emergency well control incidents are extremely rare, when they do arise, the need for specialized outside well control experts is common. As a result, it is very rare, and unnecessary, for operators to staff in-house well control experts. Rather, the generally accepted industry practice is to hire experienced outside experts, as needed. It is against this backdrop that SoCalGas, on the evening of October 24, 2015, contacted Boots & Coots for their assistance in controlling well SS-25. This was a prudent decision.

I am familiar with Boots & Coots and believe they were fully qualified to perform well kill and relief well operations at SS-25. Boots & Coots is particularly well known in the oil and gas industry for its long history of successful high-profile well control projects, including extinguishing over a hundred of the oil well fires intentionally set by Iraqi soldiers during the

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[3] SED Opening Testimony at 36.
[4] SED admits that SoCalGas' initial kill attempt was reasonable (*See* SED Opening Testimony at 30).
[5] Ex. III-2 (Division of Oil, Gas, and Geothermal Resources, History of Oil or Gas Well, SS-25, Nov. 21, 2016).
[6] *Id*.

Persian Gulf War. In my opinion, Boots & Coots was the best suited well control expert available, in part because of Boots & Coots' affiliation with Halliburton Energy Services (a leading provider of oil well servicing by providing pumping, drilling, and chemical services). This allowed SoCalGas to leverage its engagement of Boots & Coots for Halliburton's expertise in additional areas such as high quality directional drilling, logging, proximity tools, pumping services, and fluid additives, all from a single source.

SoCalGas contacted Boots & Coots the evening of October 24, 2015, and Boots & Coots arrived at Aliso Canyon the next day, October 25, 2015.[7] After Boots & Coots personnel arrived on site and were briefed by SoCalGas, Boots & Coots assumed primary control of the well control operation at SS-25; SoCalGas then monitored and managed Boots & Coots personnel in the manner that is generally accepted in the industry. In all emergency well control operations, the customary role of the operator (here, SoCalGas) is to provide information about the well and reservoir, access to local resources common to the region, rapid procurement of necessary materials and services and, most importantly, coordinate with local authorities and regulators (e.g., CPUC, DOGGR) to allow the well control provider (Boots & Coots) to focus on the well kill. Here, consistent with industry practice, SoCalGas oversaw and approved Boots & Coots' recommended well control plans, but did not determine the manner in which Boots & Coots prepared or executed its well kill operations.

Significantly, and counter to what SED alleges in its Opening Testimony, SED's expert witness conceded that SoCalGas' personnel had the "necessary skills to monitor and manage" Boots & Coots. SED's sole sponsoring witness, Margaret Felts, stated during her February 5, 2020 deposition that the experience necessary to oversee well control contractors or subcontractors would be that of a "reservoir engineer[]," or a "drilling engineer."[8] This is true: the core skills necessary to manage a well control operation, such as SS-25, include many of the same skills developed by SoCalGas' reservoir and drilling engineers through performing

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[7] Ex. III-3 (Boots & Coots Daily Operations Reports, Oct. 25, 2015 ("B&C DORs")).

[8] Ex. I-10 (Margaret Felts Depo. Tr. 150:3–151:11 (Feb. 5, 2020)).

workovers, drilling wells, and conducting supporting operations such as location building, contracting and procurement of well services, materials purchasing, warehousing, and quality control. These are also the roles held by SoCalGas' Chief Executive Officer, who oversaw the SS-25 well control operations, in the course of his more than 30-year career with SoCalGas.

In addition, as summarized, in part, in SoCalGas' Opening Testimony,[9] SoCalGas acted prudently in response to the leak by, among other things:

- Ensuring that Boots & Coots personnel had all information, equipment, contractors, and supplies necessary for Boots & Coots to do its job and execute its designed well kill plan;[10]

- Promptly organizing and mobilizing pump-to-kill equipment to the site as quickly as feasible in a safe and efficient manner; the leak was discovered in the afternoon and the pump-to-kill was accomplished the next morning;

- Implementing a formal emergency response command and control system, and an Incident Command Structure per FEMA standards, so that the well control efforts could be managed in the most expedient manner possible (e.g., one senior Incident Commander with the authority to make critical decisions on the fly so the project could proceed without delay); and

- Maintaining site security and safety of all personnel involved and those in and around sensitive areas (i.e., "hot" zone), on a 24/7 basis.

Ultimately, based on the records that I have evaluated and my extensive experience and expertise in well control operations, SoCalGas' leak response was prudent, reasonable, and consistent with industry practice. Further, SoCalGas displayed the necessary expertise to monitor and manage its well control experts.

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[9] Prepared Opening Testimony of Rodger Schwecke on Behalf of Southern California Gas Company, Nov. 22, 2019.

[10] *See* SED Opening Testimony Exhibit, SED00635-00786 (Danny Walzel and James Kopecky, Examination Under Oath ("EUO"), Tr. 75:27-76:17; 92:10-19 (Aug. 8, 2018)); Ex. III-4 (Danny Walzel Depo. Tr. 237:19-238:22 (Feb. 21, 2020)).

III. SED INCORRECTLY ASSUMES TRANSIENT MODELING IS REQUIRED FOR ALL TOP KILL ATTEMPTS, THAT IT WAS NOT PERFORMED IN CONNECTION WITH THE SS-25 WELL KILL EFFORT, AND THAT INDUSTRY STANDARDS REQUIRE WELL-SPECIFIC WELL CONTROL PLANS BASED ON TRANSIENT MODELING.

SED's principal complaint regarding the SS-25 well control operations is that SoCalGas "[f]ail[ed] to successfully execute well SS-25 kill attempt numbers 2 through 7, due to lack of proper modelling."[11] However, SED fails to recognize that: (a) kill modeling, particularly transient kill modeling, is not typically employed for *all* top kill operations, but is used as needed, on a case-to-case basis, (b) Boots & Coots *did* in fact perform transient modeling after its second well kill attempt on SS-25 and before each subsequent attempt, and (c) SoCalGas' operating standards for routine well kill operations were reasonable and consistent with industry standard practice.

A. Transient Kill Modeling Is Not A Standard Practice, Nor Required, for Every Top Kill Operation.

As an initial matter, SED incorrectly assumes that a reasonable top kill attempt necessarily requires transient kill modeling. By way of background, there are two approaches for modeling a well kill: (1) steady state, and (2) transient. A steady state model consists of a set of equations based on the assumption that flow rate does not change over time (i.e., steady state). A steady state model incorporates many variables, including the following essential inputs: flow path geometry, formation fluid composition, formation gas and liquid properties, reservoir

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[11] See SED's alleged Violation No. 79 (SED Opening Testimony at 3). SED further states:

> There were no data that indicated transient modeling, any modeling, or analysis was conducted to design the second through sixth well kill attempts. Some calculations may have been done; however, gas flow rates were not incorporated into any kill design. The decisions appeared to be based on the static reservoir pressure and this would be inadequate and inappropriate for designing kills. SoCalGas-provided information suggested that the well-control company was using 30 MMscf/D as the well flow rate. It is unclear whether this information was ever used in any modeling. Flow rate and kill fluid density have to be designed by using established industry modeling tools before preparing an operational plan to ensure the well is killed.

(SED Opening Testimony at 34). *See also*, *id*. at 38 ("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."). Both SED and Blade concede that SoCalGas' first well kill attempt was "a reasonable response because the extent of the failure in SS-25 was unknown." SED Opening Testimony at 30, 38 (citing Blade Report at 148).

pressures and temperature, strength of the reservoir (or assumed flow rate), exit conditions where flow exits the model (its diameter), kill fluid properties (density and viscosity), and geothermal temperature gradient. Transient (also known in the industry as "non-steady state") models sequence runs with changing variables over a period of time. The outputs for transient models are families of data (best interpreted by the user as curves) for each parameter of interest over time (e.g., a relevant parameter for well kill operations would be change of bottom hole pressure over time, as pumping occurs and then stops).

While transient kill modeling may be useful in certain instances, it is not well-accepted industry practice for all well control efforts by top kill. In fact, out of the more than 500 well control operations I have participated in during my career (approximately 90% of which were top kill operations), *I have never relied on transient kill modeling for a top kill well control effort*.[12] Most well kill operations do not employ a sophisticated transient computer-aided analysis and suffice with a steady state model in conjunction with the real-time observations by personnel on site performing the actual pumping operations.[13] In my experience, wells similar to SS-25 have been successfully controlled without the aid of a transient analysis. Notably, well kills were historically accomplished, successfully, prior to the invention of the first commercially available transient modeling tool. Nevertheless, here, Boots & Coots did in fact employ transient kill modeling after it determined modeling was appropriate.

B. Boots & Coots Conducted Transient Kill Modeling.

At a February 21, 2020 deposition that I attended, Boots & Coots' senior well control specialist engineer, Danny Walzel, clarified that after Boots & Coots' second well kill attempt,

[12] In one instance I used transient modeling in connection with a top kill operation, but the modeling was not done for the purposes of modeling the well kill. Rather, I performed the modeling to project whether the tubing could safely be lowered (dropped) into the well. Even there, the transient model failed to generate accurate prediction of actual events.

[13] For example, for two well projects that I helped bring under control (Elf Congo relief well project, circa 1986 and Total Bekapi Incident circa 1984) the well control team successfully killed the wells with the aid of steady state modeling.

Boots & Coots performed transient modeling to help inform the SS-25 well control operations.[14] Based on Mr. Walzel's testimony, it is my understanding that the computer containing the transient modeling prepared by Mr. Walzel was later stolen from Mr. Walzel's truck, and never recovered.[15] I find it unusual that SED asserts violations against SoCalGas for not employing transient kill modeling without first having verified this fact during SED's August 8, 2018 examination of Mr. Walzel. While SED asked Mr. Walzel about the formulae and calculations used in Boots & Coots' dynamic kill of SS-25, none of SED's *five* questioners asked Mr. Walzel whether the dynamic kill of SS-25 involved transient modeling.[16]

Further, contrary to SED's assertions that Boots & Coots may have implemented its well kill attempts based on a flow rate that was too low (30 MMscf/D), as described in SoCalGas' Reply Testimony Chapter IV (Walzel/Haghshenas), Boots & Coots' transient modeling estimated and modeled gas flow rates ranging from 15-70 MMscf/d.[17] This technique is commonly referred to as "running sensitivities." Running sensitivities of various rates during well kill modeling is a well-known technique that informs the modeler if that variable will have a significant impact on the kill rates needed. I further understand that Mr. Walzel took a conservative approach whereby he used flow rate inputs that were higher than any estimates that may have been provided by SoCalGas so as to provide an added cushion or safety factor.[18]

As Mr. Walzel testified at his deposition, while there were many factors to consider for purposes of the modeling, Boots & Coots was very concerned about implementing a kill attempt that "might damage the wellhead and lose access to the well."[19] As further described below, this

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[14] Ex. III-4 (Danny Walzel Depo. Tr. 76:18-25 (Feb. 21, 2020)); *see also* SoCalGas Reply Testimony Chapter IV (Walzel/Haghshenas) at 5.

[15] *See Id*. at 77:1-78:14; SoCalGas Reply Testimony Chapter IV (Walzel/Haghshenas) at 5.

[16] *See, e.g.*, SED Opening Testimony Exhibit, SED00635-00786 (D. Walzel and J. Kopecky EUO Tr. 49:15-52:28 (Aug. 8, 2018)). Significantly, SED's Senior Utilities Engineer Specialist was present and asked questions during this EUO, and did not apparently find it necessary to ask Boots & Coots whether it conducted transient modeling in advance of any kill attempts. (*See, e.g.*, *id.* at 137:16-138:12).

[17] Ex. III-4 (Danny Walzel Depo. Tr. 134:18-135:7 (Feb. 21, 2020)); SoCalGas Reply Testimony Chapter IV (Walzel/Haghshenas) at 6.

[18] *Id.* at 138:2-139:6; *see also* SoCalGas Reply Testimony Chapter IV (Walzel/Haghshenas) at 8.

[19] *Id*. at 141:4-16; *see also* SoCalGas Reply Testimony Chapter IV (Walzel/Haghshenas) at 8-9.

was not a concern Blade had to consider when it performed its after-the-fact modeling years after the leak had been brought under control. In light of the foregoing, I believe that Boots & Coots took a measured, reasonable approach to the well kill operation as evidenced in the pump schedules for kill operations 2 through 7, where pump rates and density were refined from one kill to another, in a gradual and measured manner.[20]

C. SoCalGas' Operating Standards for Well Kill Operations Were Reasonable and Consistent with Industry Standard Practice.

SED further alleges that SoCalGas did not have a "well specific, well control plan that considered transient kill modeling."[21] SED appears to argue that gas storage operators must have well specific, well control plans that consider transient modeling. To the extent SED is making such an argument, it is without basis. SoCalGas' operating standards applicable to well kill operations were reasonable and consistent with industry standard practice. It is not an industry standard practice for gas storage operators to have well-specific control *plans* in place that consider transient modeling. Moreover, it is impractical to perform transient modeling for various possible failure scenarios on the theory that a future leak *might* closely match the transient model detailed in the operator's gas standard or plan.

First, SoCalGas had reasonable well control standards in place for routine well kill operations. SoCalGas' well control standards were sufficient insofar as they addressed the most probable well control scenarios and response methods. While these standards are not specific to each of SoCalGas' wells, they provide a standard procedure for how to kill any well based on various factors. I have reviewed SoCalGas' Operations Standard with respect to routine well kills, and find that the described procedures agree with the prudent practices of other operators within the gas storage industry. Moreover, SoCalGas' operating standards have proven

[20] *See*, Ex. III-5 (Kill Plans, attempt #s 2-6); *see also*, Ex. III-3 (B&C DORs).

[21] SED Opening Testimony at 28 ("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.") (*Emphasis added*).

successful over many years of operation in responding to the most probable well control incidents that arise in the industry.

For example, SoCalGas' "Company Operations Standard Well Operations – Well Kill"[22] standard defines the policy, responsibilities and procedures and type fluids that may be used to kill and control a well in the field. It also describes the equipment necessary to accomplish a well kill operation along with a piping configuration to employ during the pump-to-kill operation. This standard is consistent with generally accepted industry practices and, in my judgement, would effectively address the most probable well control scenarios. In addition, SoCalGas' "Routine Well Kills" standard[23] addresses the planning, preparation, and pump-to-kill procedure for constant tubing pressure, with guidelines for the acceptable gas to be vented during a routine kill operation. I found this standard to be consistent with those in the industry for routine well kill operations.

Second, there is no single "transient modeling plan" that can be developed for a given storage well, which can account for every possible leak occurrence. A robust well kill strategy is dependent upon the flow rate of the leak. That well flow rate in turn is dependent on a number of variables, including: the reservoir pressure of the storage zone, the permeability of the reservoir rock, the gas consistency (which is highly variable with pressure and temperature), obstructions or restrictions to gas flow within the well tubing and/or annulus along the flow path to the surface, the depth where the gas exits the wellbore (e.g., the surface, the base of the surface casing, or a deep casing leak), and thetortuosity,[24] and ability of gas to flow through the leak point and exit the wellbore. The importance of this last point cannot be overstated.

[22] Ex. III-6 (SoCalGas, Company Operations Standard Gas Operations, 224.0030).
[23] Ex. III-7 (SoCalGas, Company Operations Standard Gas Operations, 224.045).
[24] "Tortuosity" is a term used in the oil and gas industry to describe "[a] measure of deviation from a straight line. It is the ratio of the actual distance traveled between two points, including any curves encountered, divided by the straight line distance. Tortuosity is used by drillers to describe wellbore trajectory, by log analysts to describe electrical current flow through rock and by geologists to describe pore systems in rock and the meander of rivers." *See e.g.*, Schlumberger, Oilfield Glossary, available at: https://www.glossary.oilfield.slb.com/en/Terms/t/tortuosity.aspx.

All other things being equal, a well with gas leaking at the surface (for example, at the wellhead) will have a very different gas flowrate than a well with gas leaking from a small hole in the casing at 3,000 feet that must travel through cement, rubble and debris along its flow path. As there are an infinite number of possible scenarios and combinations for the leak and the gas flow rate, there would be an infinite number of kill strategy solutions. During the SS-25 leak it was not possible for Boots & Coots to determine the severity of the casing failure, the exact location of the shallow gas leak, nor the precise flow path of the gas from the wellbore to the surface.[25] Thus, there was no way at that point in time to accurately estimate the gas flow rate nor its precise flow path of the SS-25 leak.

SED apparently believes that a "transient modeling plan" is something that SoCalGas should have designed in advance of any well leak, and had the plan sitting on a bookshelf ready to serve as a reference if a significant leak occurred. This ignores the reality that there is no "one size fits all" solution for a transient modeling plan. Each leak presents a unique scenario and must first be individually assessed before a proper response is formulated. If one did prepare a pre-incident well kill plan with transient modeling, the model would necessarily assume an incorrect flow path and reservoir pressure and almost certainly would not be accurate. Generally (and always in the case of a relief well) there is sufficient time to model the gas flow while logistics are being put in place to attempt a kill, and thus pre-incident plans that involve transient modeling are unnecessary and provide no benefit to the actual well kill operation.

IV. SED'S WELL KILL MODELING DERIVES FROM PERFECT HINDSIGHT, FAILS TO CONSIDER SAFETY, AND IS ENTIRELY SPECULATIVE.

SED makes a number of speculative assertions, particularly in support of SED's allegation that transient kill modeling would have resulted in an earlier well kill, including the following:

- "Boots & Coots' second through sixth kill attempts failed because the kill fluid used was not dense enough."[26]

[25] SoCalGas Reply Testimony Chapter IV (Walzel/Haghshenas) at 7.
[26] SED Opening Testimony at 30.

- With respect to the second kill attempt: "12 ppg fluid at a flow rate of 9 to 10 bbl/min would have brought the well under control. Also, the well could have been killed by pumping 15 ppg fluid at 6 bpm."[27]

- With respect to the third through sixth kill attempts: "[F]luid densities were not high enough to kill the well at realistic pump rates for any of the four kill attempts. The well could have been killed with either 12 ppg or 15 ppg kill fluid at realistic pump rates (6-8 bpm)."[28]

- With respect to the seventh kill attempt, "the well should have been killed with either 12 ppg fluid pumped at 6 bpm or 15 ppg fluid pumped at 5 bpm."[29]

- "A transient kill model would have revealed that a kill fluid density of 12 ppg or higher at flow rates around 10 bpm would have successfully controlled the well with pump pressures below the wellhead rating. The well could therefore have been top killed earlier."[30]

- "[T]he 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."[31]

These assertions are made only with the benefit of hindsight, and are unburdened by several significant considerations impacting Boots & Coots' well control efforts, including the safety of onsite personnel, the condition of the wellhead, well vibration, and the size and extent of the crater forming around the wellhead.[32] Further, Blade's modeling, which is the sole reference SED relies upon in making its allegations, benefits from data points that were not available to Boots & Coots during the leak response. Moreover, Blade relies on a number of assumptions that are questionable, and fails to consider others—even with the benefit of hindsight. Of course, Blade's modeling was never tested in connection with any actual top kill attempt, and neither Blade nor SED can state with any degree of certainty that Blade's transient

[27] SED Opening Testimony at 30-31.
[28] *Id.* at 31.
[29] *Id.*
[30] *Id.*
[31] *Id.* at 35.
[32] In addition to these safety considerations, Boots & Coots faced several logistical and regulatory challenges, including severe winds, and compliance with regulations and permitting in connection with the transportation of required equipment and acceptable well kill fluids.

modeling outputs would have actually brought SS-25 under control.

Blade's modeling simply represents an academic exercise to calculate the kill fluid density and pump rate that theoretically *could have* killed SS-25, and fails to account for several important safety considerations that impacted Boots & Coots' well kill efforts. First, as Boots & Coots explained to SED during SED's August 2018 examination, the first step upon arriving at a well control event is to secure the area and ensure the safety of personnel.[33] Indeed, as discussed in SoCalGas' opening testimony, safety is a paramount consideration in any well control operation, and the response to the SS-25 leak was no different—extensive measures were implemented to mitigate the risk of ignition.[34] Second, in designing a well kill plan, a well control company must take extreme caution not to implement a well kill operation that may worsen the leak, and thereby increase the risk of ignition, or jeopardize the success of subsequent kill attempts. Boots & Coots appropriately considered these factors, and made adjustments to its kill operations accordingly.

For example, given the restriction of the wellhead's working pressure rating, and the internal geometry of the tubing, it was mandatory that Boots & Coots personnel limit the pump rate and/or fluid density to maintain well integrity and formation pressure below fracture gradient and to keep pump pressure within ratings of the surface equipment.[35] Mr. Walzel testified that while the SS-25 wellhead equipment was rated to 5,000 PSI, given the unknown condition of the leak, Boots & Coots set a "safety limit" or "safety factor" well below the working pressure of the equipment.[36] I believe that it was prudent for Boots & Coots to have set

[33] SED Opening Testimony Exhibit, SED00635-00786 (D. Walzel and J. Kopecky EUO Tr. 21:10-13 (Aug. 8, 2018)).
[34] *See e.g.*, SoCalGas Opening Testimony Chapter II (Schwecke) at 4-6, 8-9.
[35] *See* SED Opening Testimony Exhibit, SED00635-00786 (D. Walzel and J. Kopecky EUO Tr. 98:17-28 (Aug. 8, 2018)) ("[T]he gas velocity exiting well bore, we couldn't overcome with the limitations that we had for pump rates, which were tied to our pressure, which is tied to the wellhead equipment, and, you know, there was still a lot of unknowns at that time: Where the hole might be; what -- where the gas was coming into the well and leaving the tube, and, you know, there's still some unknowns, but it all comes down to, could we pump fast enough and not exceed our pressures of the wellhead.").
[36] SED Opening Testimony Exhibit, SED00635-00786 (D. Walzel and J. Kopecky EUO Tr. 34:6-21 (Aug. 8, 2018)); Ex. III-4 (Walzel Depo. Tr. 122:17-123:7; 205:22-206:8 (Feb. 21, 2020)); *see also* SoCalGas Reply Testimony Chapter IV (Walzel/Haghshenas) at 8.

a safety factor so as to not risk damaging the wellhead. As Mr. Walzel further testified, damage to the wellhead could have caused Boots & Coots to lose access to the well[37] and, more importantly, would have exacerbated the leak, further increasing the release rate to the atmosphere and compromising subsequent well control efforts.[38]

Further, Boots & Coots' pumping operations were implemented not only in consideration of the pressure rating of the surface equipment, but also based on observation of the wellhead's physical response to pumping operations. Mr. Walzel described that during certain pumping operations, the SS-25 wellhead was "moving around a lot," which at times caused Boots & Coots to slow or stop pumping operations and, in one case, broke the flow lines on the 7-inch tubing and casing, and the nipple on the wellhead.[39] While it does not appear that Blade's modeling accounted for these safety considerations, Boots & Coots appropriately tailored its kill operations—in real-time—to limit the potential risk of further damaging the well and compromising safety.

Second, Blade had the benefit of gathering more precise data points that were not available to Boots & Coots while planning, modeling, and executing its well kill attempts: 1) the precise depth and severity of damage to the production casing, and 2) the flow path of the gas from the 7" casing leak to the surface. Indeed, computer modeling is sensitive to the well geometry (i.e., leak depth, severity, and flow path), which means that more precise information will produce more accurate modeling outputs. However, precise flow path geometry is typically unavailable during an active leak response. This was the reality that Boots & Coots encountered. While Blade was able to determine that the production casing had completely parted at 892 feet after extracting and examining the 7" casing, Boots & Coots could only estimate the flow path geometry based on real-time observation and analysis of pumping operations. Second, after extracting the 7" casing, Blade had the advantage of using a video camera to analyze the 11-3/4"

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[37] Ex. III-4 (Walzel Depo. Tr. 133:13:21; 225:11-20 (Feb. 21, 2020)).
[38] SoCalGas Reply Testimony Chapter IV (Walzel/Haghshenas) at 8-9.
[39] Ex. III-4 (Walzel Depo. Tr. 226:20-227-10 (Feb. 21, 2020)).

casing and observe holes—which Blade determined were the “likely consequence of the axial rupture” of the 7” casing.[40] The existence of holes in the surface casing is significant because it impacts the flow path of the leak and, in turn, the accuracy of the transient modeling. Accordingly, while Blade was able to extract the 7” casing to gather additional data to incorporate into its modeling, Boots & Coots could not have done the same. The practical impact of this disparity in information is that Blade’s modeling was refined by additional data points that were not available to Boots & Coots.

Lastly, Blade’s model disregarded other key variables in pertinent well control operations. Blade’s primary design variables were fluid density and pump rate. Other parameters such as viscosity, fluid stability, availability, and toxicity must also be considered. Further, not only must a kill operation stop the gas flow, the well must be stable when the kill fluid column is in a static state (i.e., after pumping stops). The pressure profile and corresponding tubular and wellbore integrity (which changes with depth) must also be considered and not exceeded. Because the Blade Report did not analyze these additional parameters, it is unknown if the fluid characteristics proposed by Blade (and alleged by SED) would have killed the well.

In sum, Blade’s post-hoc transient modeling was an academic exercise that cannot fairly be compared to Boots & Coots’ task of working on site under real-time constraints, and dealing with practical, field-level concerns (e.g., severe weather, wellhead condition, and safety of personnel). Even assuming Blade’s transient modeling generated reasonable outputs, there is no basis for SED to claim that Boots & Coots should have killed SS-25 sooner—particularly as early as the second attempt (on November 13, approximately 3 weeks after the leak commenced)—when Blade needed 5-6 weeks to model a well kill,[41] not including time spent on the investigation and casing removal. Boots & Coots’ approach of increasing pump rate and fluid density over well kill attempts 2 through 7 reflects a measured and logical process that did

[40] Blade Report at 119.
[41] Ex. III-8 (Ravi Krishnamurthy Depo. Tr. 1056:22-1058:23 (Nov. 22, 2019)).

not compromise safety in the process of bringing the well under control.

V. SED'S ALLEGED VIOLATIONS 80-82 LACK MERIT.

SED also asserts Violations 80-82 based on SoCalGas' alleged "Failure to provide well kill programs for relief well #2, well SS-25A and well SS-25B."[42] While SED failed to cite the underlying basis for these violations in its Opening Testimony,[43] SED recently clarified that these alleged violations are based on the Blade Report's "Solution 8," which recommends a "relief well plan for each well that considers the surface location and overall approach."[44] SED further described that these violations are based on SED's understanding that SoCalGas did not have a "standard for planning and drilling relief wells."[45] However, SED again fails to recognize that it is not industry standard practice to have in place a pre-failure program or standard for planning and drilling relief wells and, as described below, such a standard would provide no practical benefit.

Based on my decades of experience, when an uncontrolled hydrocarbon release requires a relief well to bring a well under control, the industry standard practice is to begin preparing the plan after the decision is made that a relief well is, or likely may be, required. There is good reason why a pre-existing plan or standard that considers the "surface location and overall approach" for a relief is generally unnecessary. First, because the drilling of a relief well is a highly technical operation, requiring the regulatory approval and oversight,[46] the relief well process is necessarily more time and planning intensive than well control operations by top kill. Further, the overwhelming number of well control operations are successfully controlled by top kill and, therefore, relief wells are typically not required. For these reasons, it is typically not the

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[42] SED Opening Testimony at 3, 38-39.
[43] *See* SED Opening Testimony at 38-39.
[44] Ex. III-9 (Blade Report at 233; *see also*, SED Response to SoCalGas' Eighth Data Request, March 12, 2020).
[45] *See*, SED Response to SoCalGas' Eighth Data Request, March 12, 2020 (Ex. III-9).
[46] *See*, SoCalGas Opening Testimony Chapter II (Schwecke) at 14-18; *see also*, Ex. III-10 (SoCalGas' Notice of Intention to Drill New Well, Porter 39A, Nov. 17, 2015); Ex. III-11 (Division of Oil, Gas & Geothermal Resources ("DOGGR"), Permit to Conduct Well Operations, Nov. 23, 2015).

first option for well control operations. Instead, prudent operators first plan for and execute well control efforts by top kill, while planning for a relief well in parallel. This is precisely how SoCalGas proceeded.

As detailed in the Opening Testimony of Rodger Schwecke, SoCalGas began considering the prospect of a relief well in October 2015 and, in November 2015—while top kill efforts continued—selected the site for relief well #1 (Porter 39A).[47] Then, on November 17, 2015, two days after the third top kill attempt, SoCalGas filed a Notice of Intention with DOGGR to drill a relief well.[48] While SoCalGas awaited DOGGR's approval, SoCalGas directed Boots & Coots' relief well personnel to prepare a drilling plan, which Boots & Coots presented on November 25, 2015, within two days of SoCalGas' receipt of the required DOGGR permit.[49] This series of events demonstrates why a pre-existing well-specific relief well plan is generally unnecessary; that is, relief well contingency planning occurs in parallel with well control efforts by top kill and so a pre-existing well kill plan would have made no difference in the relief plan approach.

As it relates specifically to post-leak plans for relief well #2, SS-25A, and SS-25B, the relief well program developed for SS-25 was sufficient because the relief well plan for SS-25 was easily adaptable for relief well #2, SS-25A, or SS-25B. Given that the wells all share the same reservoir depths and intercept points relative to the reservoir, the relief well plan for SS-25 was adaptable to the other wells, with very minor modifications. Further, SED's proposal is inconsistent with industry standard. In my career, I've observed only one instance where well kill plans for neighboring wells were concurrently in place at the outset of a relief well operation. Even in that instance, I believed that it was unnecessary. That scenario was also distinguishable because the neighboring wells there were production wells, and the well control team was concerned with accidentally making contact with those wells while drilling the relief well. Here, SS-25A and SS-25B had already been hydrostatically controlled (respectively, on October 31,

[47] SoCalGas Opening Testimony Chapter II (Schwecke) at 14-18.
[48] Ex. III-10 (SoCalGas' Notice of Intention to Drill New Well, Porter 39A, Nov. 17, 2015).
[49] Ex. III-11 (DOGGR, Permit to Conduct Well Operations, Nov. 23, 2015).

and November 1, 2015)[50] prior to commencing work on the relief well, so that concern did not apply.

VI. CONCLUSION.

For the foregoing reasons, and based on my experience, knowledge, and expertise gained from participating in more than 500 well kill operations worldwide, I conclude that SoCalGas' actions in response to the SS-25 leak were prudent, reasonable, and consistent with industry standards and practices.

This concludes my prepared reply testimony.

[50] Ex. III-2 (Division of Oil, Gas, and Geothermal Resources, History of Oil or Gas Well, SS-25, Nov. 21, 2016).

WITNESS QUALIFICATIONS

My name is Leo William "Bill" Abel. My business address is ABEL Engineering LLP, 4740 Ingersoll Street, Suite 102 Houston, Texas 77027.

Credentials and Qualifications

1. I am the founder and managing director of ABEL Engineering LLP ("ABEL"). I hold a B.S. of Civil Engineering from Texas Tech University, Lubbock, Texas. I hold a Masters of Business Administration (MBA) from Southern Methodist University, Dallas, Texas. I am a licensed Professional Engineer in the state of Texas. My qualifications are described in greater detail below and summarized in my curriculum vitae, attached as **Exhibit III-1**.

2. I have expertise in well control operations, relief well drilling, dynamic kill operations, fluids dynamics, structural engineering, pressure control devices such as valves and blowout preventors. I have published 33 trade journal articles and one textbook on pressure control and blowout solutions. I hold 6 USA (and foreign) patents on pressure control devices and methods for capping wells.

3. From 1977 through 1980 I was employed by ARAMCO in Saudi Arabia as a member of the drilling department. In that time, I was exposed to snubbing operations, underground blowouts, surface blowouts and fires and relief well drilling. The drilling department had the task of controlling 6 blowouts in that time frame and I was an integral part of these control teams.

4. From 1981-1982 Grace Shursen & Moore Associates employed me to manage a drilling company (5 rigs) and also participated in well control operations in their consulting business and perform high rate dynamic kills, snubbing operations and well kills.

5. From 1983-1984 I was the drilling and purchasing manager for Funk Exploration in Oklahoma City and oversaw drilling completion and frac of ~250 wells.

6. In late 1984 I formed ABEL Engineering as an Oklahoma corporation and then move to Texas and changed the name to ABEL Engineering/Well Control Co. as a Texas corporation in 1989 and converted the business to ABEL Engineering LLP in 2008 and this continues through today. In this period, there were short ventures with Wild Well Control, Inc. ('93-'95) and then IWC Engineering Service ('95-'96) where ABEL operations were suspended. ABEL became active in 1996 through today. I have other interests in IP (patents) and pressure control equipment ABEL HPSN Services LLC that owns and operates frac equipment in a rental market.

7. Since 1977 I have participated in over 500 well kill operations worldwide and have personally supervised and designed well capping and kill operations in over 60 wells.

ABEL capped and controlled 41 blowouts in the Kuwait Oil Fire project with a single team in 70 days. We have performed the highest pressure freeze operation in the industry (8800 psi through 4 strings of pipe) in Indonesia.

8. Additionally, I have appeared in over 14 legal cases as an expert witness.

9. I have not previously testified before the Commission.