



Rodger R. Schwecke
Vice President
Gas Transmission and Storage

Southern California Gas Company
555 W. 5th Street, GT21C3
Los Angeles, CA 90013
Tel: 213.244.2140
RSchwecke@semprautilities.com

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Elizaveta Malashenko
Director, Safety and Enforcement Division
California Public Utilities Commission
505 Van Ness Avenue
San Francisco, California 94102

RE: Safety and Enforcement Division's Directive to Southern California Gas Company to conduct Internal Corrosion Threat Assessment on all Aliso Canyon's Injection and Withdrawal Pipelines

Dear Ms. Malashenko:

The Aliso Canyon storage facility is critical to the reliability of natural gas and electricity service in Southern California, and SoCalGas remains committed to providing safe and reliable energy to the millions of Californians who rely on us each day. As directed in your September 20, 2016 letter to Mr. Jimmie Cho, SoCalGas conducted a root cause analysis of the pinhole leak at Ward 3A and conducted an Internal Corrosion Threat Assessment on injection and withdrawal pipelines at the Aliso Canyon Storage Facility. This letter provides the results of that analysis and Internal Corrosion Threat Assessment, and describes SoCalGas' mitigation plan and follow-up activities.

Given the relatively short time-frame provided for this analysis and assessment, SoCalGas implemented a focused response to SED's directive, while continuing to move forward with activities required to comply with Senate Bill 380 and prior directives from the CPUC. SoCalGas continues to maintain a minimum 420 MMcfd of withdrawal capacity to meet energy reliability needs, as directed by the Commission.

I. Root Cause Analysis of the pinhole at Ward 3A

SoCalGas engaged Det Norske Veritas / Germanischer Lloyd (DNV/GL) to perform a root cause analysis (RCA) of the pinhole on well Ward 3A's withdrawal pipeline. DNV/GL personnel joined SoCalGas onsite on Thursday, September 22 to direct the investigation, coordinate the metallurgical evaluation, and ascertain the circumstances of the pinhole leak in order to perform and document the RCA.

The RCA was conducted in three parts. First, SoCalGas and DNV/GL performed an ultrasonic inspection of the pinhole and surrounding area. Second, SoCalGas and DNV/GL removed the pipe segment containing the pinhole and completed a visual inspection of the segment. Third, SoCalGas submitted the three-foot pipe segment containing the isolated pit to the DNV/GL laboratories for

metallurgical testing. A detailed summary of the activities, testing and observations to date regarding the pinhole in the Ward 3A withdrawal pipeline is enclosed as Appendix A to this letter.

Current observations confirm the pinhole was located at the six o'clock position in a slightly low spot within a generally horizontal segment of pipe. In addition, the post-1970 electric resistance welded seam was at the six o'clock position. No other indications of corrosion or wall loss have been noted near the pinhole. DNV/GL is expected to provide preliminary results of the RCA in about two weeks. The final results of the RCA are anticipated to be available in about four weeks, to allow sufficient time to obtain the full results of metallurgical testing.

II. Internal Corrosion Threat Identification

In accordance with the September 20, 2016 letter SoCalGas has initiated an Internal Corrosion Threat Identification of Aliso Canyon's injection and withdrawal pipelines. SoCalGas is applying Gas Standard 167.0229/G8025, *Internal Corrosion Management Plan (ICMP)* to complete the threat identification. The ICMP provides a consistent process of threat identification, data analysis and evaluation for internal corrosion that is compliant with 49 CFR Part 192.477, Tariff Rule No. 30, and Industry Standards.¹ The ICMP is applicable to all transmission pipelines encompassed by the Transmission Integrity Management Program (TIMP),² including applicable lines operated by SoCalGas' Storage organization.

Consistent with the ICMP, pipelines that have similar characteristics to the pipe segment with the pinhole were identified for further assessment. SoCalGas also incorporated working information generated by the RCA, as well as historical internal corrosion experience with withdrawal and injection pipelines at Aliso Canyon as part of the threat identification. In addition, SoCalGas is in the process of evaluating the scope of this assessment to include piping systems with more frequent use in order to provide an additional measure of confidence in the SoCalGas' facilities.

SoCalGas' Internal Corrosion Threat Identification at Aliso Canyon

SoCalGas began the ICMP threat identification process by designating piping systems that are influenced by storage production/withdrawal gas. SoCalGas performed a comprehensive review of these piping systems in order to focus on areas that may be most potentially susceptible to internal corrosion, based on review of operation data or physical inspection (*e.g.* non-destructive evaluations, operational observations, integrity assessments, etc.) In the case of Aliso Canyon, the zone of influence applies to the entire storage field, specifically to the withdrawal and systems with bi-directional flow. The withdrawal system is exposed to a variety of elements when natural gas is withdrawn from the storage zone and, thus, it has a potential for internal corrosion distinct from injection piping. Pipelines dedicated to injection only (*i.e.*, not subject to withdrawal or dual-function) carry dry gas that satisfies Tariff 30. Thus, these pipelines are reasonably assumed to be of low susceptibility to internal corrosion. Accordingly, the withdrawal system is the focus of this threat identification effort.

¹ NACE SP0106-2006, Standard Practice, *Control of Internal Corrosion in Steel Pipelines and Piping Systems*.

² Regulatory Code Reference: 49 CFR 192 Subpart O.

Upon completion of the internal corrosion threat identification and susceptibility review, the next step in the ICMP is for SoCalGas to conduct an internal corrosion environment review. This comprehensive review includes, but is not limited to, a review of pipeline attributes, elevation profiles, operating conditions/history, and (seasonal) mode of operation to help determine if pipeline segments within the zone of influence may have been exposed to environmental conditions that could lead to internal corrosion, or conversely are unlikely to have exposure to conditions associated with internal corrosion.

As part of the operating condition, SoCalGas reviewed the flow and frequency of the withdrawal pipelines. Based on operational experience, withdrawal pipelines that are continually flowing natural gas have not demonstrated a historical concern with regard to internal corrosion, as electrolytes tend to accumulate in areas of restricted flow (*e.g.*, bends, diameter changes, etc.) or low spots, when stagnation occurs (*i.e.*, no flow or “dead legs”). Therefore, threat identification effort is further focused on pipe segments of the withdrawal system that experience stagnant flow conditions similar to the pipe segment that experienced the pinhole (Ward 3A), particularly pipe segments which are located at low spots in proximity to the source of liquids. SoCalGas designated these pipe segments as higher priority for the initial evaluation of the internal corrosion threat using non-destructive testing.

Based on initial observations and testing of the pinhole, the bottom interior one third of the pipe was subject to water accumulation and is the likely agent for the development of a corrosion cell. Stagnant flow combined with liquid accumulation points have been identified as contributing factors that may have promoted the development of the pinhole that occurred on Ward 3A withdrawal piping. Please be aware that these findings are preliminary and our final conclusions will be provided in the forthcoming root cause analysis after all data has been gathered and analyzed.

To augment the existing ICMP methodology, SoCalGas reviewed Aliso Canyon piping systems to identify areas with similar operational characteristics to Ward 3A’s withdrawal piping specifically:

- Systems with a history of operation that experience extended periods of no flow similar to the Ward 3A withdrawal line, and
- Areas configured with low/flat spots that can potentially accumulate liquids similar to the pinhole location in the Ward 3A withdrawal pipeline segment.

Systems that qualify under both of these conditions are designated as higher priority for targeted evaluation using B-Scan ultrasonic technology at designated low/flat spots.

Piping Identified for Non-Destructive Evaluation

Review of the available flow history of Ward 3A (91 months of flow data) shows that the piping associated with the well was in a “no-flow” state 90% of the time. Consistent with the ICMP plan, applying this percentage as the criteria for identification of piping systems with similar or more severe operation (*i.e.* greater than or equal to 90% no flow operation) conditions, four systems were identified as potential candidates with similar susceptibility to internal corrosion as the Ward 3A

withdrawal pipeline segment:

1. AGW 736-FB [Standard Sesnon (SS) – 44 withdrawal piping]
2. AGW 661-BB [Mission Adrian (MA) – 04 withdrawal piping]
3. AGW 741-BB [Mission Adrian (MA) – 03 withdrawal piping]
4. Ward – 3

SoCalGas then physically reviewed these four systems onsite to identify low/flat spots on the piping with the highest potential for liquid accumulation. Following this review, SoCalGas eliminated the Ward 3 pipeline segment from review, because the piping associated with this well has been removed from service.³ SoCalGas then subjected the potential liquid accumulation points of the remaining three systems to B-scan ultrasonic inspection on the bottom half of the pipe. UT scans were conducted for a minimum of five feet in the upstream and downstream direction from the identified location in order to detect and characterize any associated wall loss anomalies. Additionally, SoCalGas surveyed the full circumference every five feet in order to confirm the average wall thickness of the pipe body.

Results of the threat prioritization and wall loss evaluations are summarized in Table 1. In all cases, the deepest detected wall loss areas are not susceptible to leakage, and remaining strength of the piping demonstrates satisfactory safety factors that are well in excess of minimum code requirements.

Table 1

Well Name	Line Name	MAOP (psi)	Diameter (in)	Grade (psi)	Wall Thickness (in)	Remaining Wall Thickness (in)	Pit Depth (in)	% Wall Loss	Predicted Failure Pressure (psi)	Safety Factor (Predicted Failure Pressure/MAOP)
MA 03 & MA 04	AGW661BB	710	6.625	42000	0.254	0.179	0.075	30%	2979	4.20
	AGW741BB	710	4.5	35000	0.250	0.143	0.107	43%	3074	4.33
	AGA607FB 3"	710	4.5	35000	0.562	0.532	0.030	5%	10766	15.16
	AGA607FB 4"	710	3.5	35000	0.416	0.389	0.027	6%	10122	14.26
SS 44	AGW736FB	710	6.625	42000	1.000	0.810	0.190	19%	6191	8.72
		710	3.5	35000	0.5	0.357	0.143	29%	9772	13.69

Table 1 shows the B-Scan ultrasonic technology testing results indicating the lowest safety factor and deepest pits for the piping systems at three well sites identified as being similar to Ward 3A. Sample locations with the lowest safety factor for each piping system are highlighted in blue, and the locations at each well piping system with the deepest pits are highlighted in yellow.

Expansion of the Inspection Criteria for Prioritized Threat Identification

Using the Ward 3A well operational history as the starting point, the 90% “no flow” condition was reviewed to include 80% “no flow” conditions in order to broaden the number of pipelines subject to identification of low points for B-Scan inspection using ultrasonic technology. While this effort continues, SoCalGas has been able to make substantial progress toward either physical inspection of these systems, or implementation of mitigative measures to prevent leakage. Table 2 below builds

³ While similar in operational history to Ward-3A, Ward 3 was eliminated from further consideration since there is no associated piping with the potential for fluid accumulation.

upon Table 1 to provide a summary of this effort and the follow-on actions that have either taken place or are in progress.

Table 2

Well Name	Line Name	MAOP (psi)	Diameter (in)	Grade (psi)	Wall Thickness (in)	Remaining Wall Thickness (in)	Pit Depth (in)	% Wall Loss	Predicted Failure Pressure (psi)	Safety Factor (Predicted Failure Pressure/MAOP)
SS 05	AGW526BB	710	4.5	35000	0.225	0.207	0.018	8%	4191	5.9
		710	4.5	35000	0.786	0.53	0.256	33%	11538	16.25
P 12	AGW569FB	710	10.75	35000	0.377	0.319	0.058	15%	2783	3.92
		710	10.75	35000	0.450	0.384	0.066	15%	3354	4.72
	AGW569-A	710	10.75	35000	0.288	0.27	0.018	6%	2294	3.23
FF 32E	AGW575FB	710	3.5	35000	0.212	0.202	0.010	5%	5226	7.36
		710	4.5	35000	0.807	0.642	0.165	20%	13538	19.07
	AGB551FB	710	4.5	35000	0.531	0.503	0.028	5%	10176	14.33
SS 8	AGW673BB	710	12.75	35000	1.050	0.995	0.055	5%	7184	10.12
		710	12.75	35000	1.545	1.209	0.336	22%	9561	13.47
	AGB586FB	710	6.625	42000	0.227	0.196	0.031	14%	3156	4.45
FF 35D	AGW561BB	710	8.625	35000	0.270	0.215	0.055	20%	2346	3.3
		710	12.75	35000	0.600	0.43	0.170	28%	3359	4.73
	710	12.75	35000	0.340	0.28	0.060	18%	2075	2.92	

Table 2 summarizes the B-Scan ultrasonic testing results of the lowest safety factor and the deepest pits for the five additional piping systems at well sites that meet the 80% ‘no flow’ condition. The location of the lowest safety factor for each piping system is highlighted in blue, and locations with the deepest pits in the piping system are highlighted in yellow. One location had both the lowest safety factor and the deepest pit for that pipeline segment and is highlighted in green.

III. Mitigation Plan

The September 20, 2016 letter directs SoCalGas to submit a mitigation plan to prevent reoccurrence of the leak at Ward 3A. Depending upon both the findings from inspections, and particular environmental and operational circumstances, SoCalGas’ mitigation activities may include:

- Segment isolation and pressure reduction
- Repair
- Cylindrical replacement
- Abandonment
- Additional non-destructive testing and/or
- Additional assessment.

Existing Evaluation Criteria and Procedures

SoCalGas will use established procedures to evaluate the results of the pipeline inspections as part of this effort. Gas Standard 182.0050, *MAOP Evaluation of Corroded Pipe* provides guidelines for evaluating the impact of corrosion on pipelines and determination of predicted failure pressure. Gas Standard 167.0235, *Immediate Repair Conditions – Transmission Pipelines*; provides guidelines for using the results from Gas Standard 182.0050 to determine repair requirements. These two Gas Standards incorporate the requirements presented in Federal Code of Federal Regulations (CFR) 192.933 and ASME B31.8S when evaluating the sampling results. These requirements call for the immediate response to any anomalies with greater than 80% wall loss or a predicted failure pressure

less than or equal to 1.1 times the maximum allowable operating pressure at the location of the anomaly.

Mitigative Actions

Once SoCalGas identifies a condition as requiring mitigation, SoCalGas considers three general mitigation measures:

1. repair,
2. replacement, or
3. isolation and pressure reduction (including abandonment).

Repair and Replacement: SoCalGas follows its established procedure, Gas Standard 223.0180, *Repair of Defects in Steel Pressure Piping*, for mitigating any identified condition when the evaluation of the sampling results indicates that a repair of an anomaly is required. Operations personnel may opt for cylindrical replacement of a segment, as necessary, when circumstances warrant an approach other than repair.

Pressure Reduction: SoCalGas follows Gas Standard 182.0050, *MAOP Evaluation of Corroded Pipe*, if it is determined that a pressure reduction is the most appropriate mitigation measure for the condition.

In cases where inspection results are not conclusive, or further evaluation is warranted, SoCalGas may perform additional non-destructive evaluation or assessment in order to more completely characterize and evaluate initial findings. These additional inspections are conducted in accordance with established procedures for inspection and evaluation. Depending on the particular condition identified, one or more of the following assessment and inspection Gas Standards established by SoCalGas may be used to more completely characterize and evaluate the initial findings:

- Gas Standard 167.0209, *External Corrosion Direct Assessment Procedure*
- Gas Standard 167.0210, *In-Line Inspection Procedure*
- Gas Standard 167.0211, *Bellhole Inspection Requirements*
- Gas Standard 167.0220, *In-Line Inspection Surveys Standard*
- Gas Standard 167.0240, *Assessment of Pipeline Integrity Using Guided Wave UT*

Copies of these potentially applicable Gas Standards are provided as Appendix B.

Additionally, work continues to proceed on the development and implementation of a comprehensive Underground Storage Corrosion Control Manual as part of the SoCalGas Storage Risk Integrity Management Plan submitted to the California Division of Oil, Gas, and Geothermal Resources in August, 2016. The manual will ultimately provide a structured framework for the corrosion control of all wells, piping, and reservoir within the Gas Storage organization.

IV. Timetable to Complete Follow-Up Work

As committed in my September 22, 2016 response to your September 20, 2016 letter, SoCalGas provides the following proposed timetable to complete any follow-up work identified as a result of the RCA and ICTI.

- SoCalGas will provide the results of DNV/GL's Root Cause Analysis when it is finalized. As described above, we expect this to take about four weeks.
- SoCalGas has completed the ICTI for the Aliso Canyon storage injection and withdrawal pipelines. As discussed above, the lines similar in character to the Ward 3A withdrawal line showed no significant evidence of pitting (see Table 1).
- SoCalGas identified an additional set of withdrawal lines with a lower "no flow" condition of 80%. SoCalGas performed tests on a portion of these lines as described in Table 2. As with the lines similar in character to the Ward 3A withdrawal line, these withdrawal pipelines showed no significant evidence of pitting (see Table 2). This set of withdrawal lines included lines for three facilities that require additional work to perform ultrasonic testing. These well withdrawal lines are associated with:
 1. Mission Adrian (MA) – 1A
 2. Mission Adrian (MA) – 5A
 3. Fernando Fee (FF) – 34B

SoCalGas has isolated and lowered the pressure in these withdrawal lines to 40 PSI. SoCalGas will complete internal corrosion inspections on these three additional piping systems, those that meet the 80% "no flow" condition, by Monday, October 17, 2016. Until this testing is completed, those systems will remain isolated and at reduced pressure.

- SoCalGas will complete a leak patrol and survey as part of our efforts to resume injection operations at Aliso Canyon.

As previously stated in my September 22, 2016 letter, SoCalGas' first priority is safety and SoCalGas takes this matter very seriously. SoCalGas took swift action to appropriately address the directives in your September 20, 2016 letter and validate the integrity of withdrawal lines at the Aliso Canyon storage facility. Please do not hesitate to contact me if you have any further questions or concerns regarding the pinhole leak in the withdrawal line at Ward 3A.

Sincerely,



Rodger R. Schwecke
Vice President, Gas Transmission and Storage

Appendix A: Root Cause Analysis of Pinhole in Ward 3A Withdrawal Pipeline
Appendix B: Cited SoCalGas Gas Standards

cc: Edward Randolph, CPUC, Energy Division, Director
Jimmie Cho, Senior Vice President, Gas Operations & System Integrity
Doug Schneider, Vice President, System Integrity & Asset Management
Dan Skopec, Vice President, Regulatory Affairs