

Kettleman Compressor Station (Avenal) Incident Investigation Report

SAFETY AND ENFORCEMENT DIVISION
GAS SAFETY AND RELIABILITY BRANCH

April 7, 2025

Final Report

Report Date:	April 7, 2025
Investigators:	Wai Yin (Franky) Chan
Date incident reported to CPUC	July 10, 2024
Utility:	Pacific Gas and Electric Company (PG&E)
Date and Time of the Incident:	July 10, 2024 @ 21: 00 Hours
Location of the Incident:	Avenal, CA, Kings County



California Public
Utilities Commission

Table of Contents

Executive Summary	3
Summary of Incident	3
Incident Investigation	5
Summary of Incident and Investigation	5
Fatalities / Injuries	5
Property Damage	5
Utility Facilities Involved	5
Investigators	5
Documents Reviewed	5
SED Investigation Process	6
Reporting Requirements	6
SED Investigation	6
Incident Description	7
Chronology of Important Events and Incident Investigation Activities	13
July 8, 2024	13
July 9, 2024	13
July 10, 2024	13
July 10, 2024	13
July 10, 2024	13
July 10, 2024	13
July 11, 2024	14
November 6, 2024	14
Findings and Corrective Actions	15
PG&E'S Root Cause Evaluation	15
SED's Findings	17
SED's Recommendations	21
SED's Observations	21
Conclusion	24
Appendices	25
Appendix A: Glossary of terms	25
Appendix B: Documents Reviewed	26
Appendix C: Field Investigation and Interview	28

Executive Summary

Summary of Incident

On Wednesday, July 10, 2024, Pacific Gas and Electric (PG&E) confirmed a release of gas at Kettleman Compressor station resulting in an injury necessitating in-patient hospitalization. During clearance operations, an ignition occurred during a purging sequence. PG&E crews closed the valve right away stopping the flow of gas. Emergency services were called. The injured PG&E employee was transported in an ambulance to Hanford, and eventually was flown on a helicopter to a hospital in Fresno. This incident was reported to the Department of Transportation (DOT) and California Public Utilities Commission (CPUC) due to a release of gas resulting in an injury requiring hospital admission and at least one overnight stay. PG&E submitted its Root Cause Evaluation (RCE) report to Safety and Enforcement Division (SED) on November 6, 2024 with its investigation of this incident by a cross-functional team of its Subject Matter Experts. PG&E's RCE report is comprehensive and detailed in its process and the identification of relevant data.

At the time of the incident, the PG&E personnel and contractors were supporting the valve replacement work at Kettleman Compressor Station under Project S-1391 and work clearance document (WCD) #80252165 according to the RCE report. The clearance included blowing down and purging gas from the PG&E system (establishing clearance), to allow the PG&E contractors to perform construction work, then purging air from and reintroducing gas back into the system (removing clearance to restore the system). PG&E's Gas Operations team conducts clearance and purging work per PG&E's TD-4441S Gas Clearances and A-38 Purging Gas Facilities respectively.

On the morning of July 9, 2024, the day before the incident, while purging out-of-service (clearing the system) in preparation for construction, the RCE report indicated that the project crew members were concerned about reaching acceptable gas-in-air levels and deviated from the clearance document steps. During troubleshooting, a blind flange, downstream of Valve 78 (V-78), was removed to provide an additional fresh air source for the air movers. The RCE report indicated that this blind flange was ultimately not reinstalled, and the flange removal was neither a step in the existing clearance, nor was it added using the red line clearance revision process detailed in TD-4441P-10 "System New Clearances for Gas Transmission Facilities" Section 3.8 for Revising an Active Clearance.

On July 10, 2024, following completion of construction, clearance activities to re-introduce gas and purge air from the system were initiated. PG&E's RCE report identified the following important events leading to the incident:

- The approved clearance required Valve 56 (V-56) to be "checked open" (fully open) for purging, however, it had been closed for stem seal replacement work on July 8, 2024 and only partially opened prior to the purge – operations that had not been documented nor approved as part of the sequence of operations in the clearance.
- Gas was re-introduced to the system from a 34-inch control valve (V-90), a clearance point with 618psig differential. There are two ways to operate V-90, manual hydraulic and manual

pneumatic. When attempting to manually operate V-90 hydraulically, oil unexpectedly discharged from the actuator's manual hydraulic override system relief valve and the valve failed to operate. V-90 was then partially opened using the manual pneumatic controls. This method is not effective for fine throttling as required for purging in Design Standard A-38.

Gas from V-90 began to displace air at multiple vent locations per the established clearance plan. According to the RCE report, it is suspected that because of the partial open position of V-56, a greater amount of gas flow was directed toward V-78. Instead of gas exiting the half-inch diameter vertical vent valve downstream of V-78 as approved in the clearance, gas exited the full 6-inch pipe opening horizontally where the blind flange had been removed on July 9, 2024. The RCE report indicated that gas flowed directly into an opposing blind flange 18-inches away at V-79, and this resulted in deflection in all directions, including into the excavation below. Within minutes, a hazardous air-gas plume developed. At approximately 1842, the air-gas plume ignited, resulting in serious burns to one PG&E personnel and minor injuries to others nearby. Other PG&E personnel in the area immediately responded, attending to the seriously injured employee, and extinguishing various spot fires using pre-staged fire extinguishers. According to the RCE report, the PG&E personnel at V-90 closed the valve to shut in the gas shortly before ignition, allowing the flame to extinguish within about one minute. The RCE report indicated that the seriously injured employee received 2nd and 3rd degree burns and was airlifted to a specialized burn unit. The employee has since been released.

SED investigated the incident and concluded that PG&E committed probable violations of General Order (G.O.) 112-F, Reference Title 49 Code of Federal Regulations (CFR), Part 192, Sections 192.13(c) and 192.805(b).

Incident Investigation

Summary of Incident and Investigation

On July 10, 2024, Pacific Gas and Electric (PG&E) personnel confirmed a Department of Transportation (DOT) reportable incident that occurred at PG&E's Kettleman Compressor Station in the city of Avenal, Kings County, California. The incident occurred during the valve replacement work at Kettleman Compressor Station under Project S-1391 and work clearance document #80252165. Following the completion of construction, clearance activities to re-introduce gas and purge air from the system were initiated. Gas was re-introduced to the system from a 34-inch control valve 90 (V-90). Gas from V-90 began to displace air at multiple vent locations per the established clearance plan. Instead of gas exiting the half-inch diameter vertical vent valve downstream of Valve 78 (V-78) as approved in the clearance, gas exited the full 6-inch pipe opening horizontally where the blind flange had been removed on July 9. Gas flowed directly into an opposing blind flange 18-inches away at Valve-79. This resulted in deflection in all directions, including into the excavation below. Within minutes, a hazardous air-gas plume developed. At approximately 1842, the air-gas plume ignited, resulting in serious burns to one PG&E employee and minor injuries to others nearby. Other PG&E employees in the area immediately responded, attending to the seriously injured PG&E employee, and extinguishing various spot fires using pre-staged fire extinguishers. A PG&E employee at V-90 closed the valve to shut in the gas shortly before ignition, allowing the flame to extinguish within about one minute. The seriously injured PG&E employee received 2nd and 3rd degree burns and was airlifted to a specialized burn unit. The PG&E employee has since been released. There was no customer impact.

Fatalities / Injuries

One injury requiring in-patient hospitalization was reported.

Property Damage

An estimated total cost of \$1,578,600 property damage was reported due to the incident.

Utility Facilities Involved

Kettleman Compressor Station equipment and piping in Avenal, CA.

Investigators

	Name	Title
1.	Wai Yin (Franky) Chan	SED, Senior Utilities Engineer Specialist

Documents Reviewed

See Appendix B.

SED Investigation Process

Reporting Requirements

General Order (G.O.) 112-F Section 122.2 requires that each operator report to the California Public Utilities Commission (CPUC) of each incident that meets the criteria as outlined in Section 122.2(a). Since this incident involves a release of gas from a pipeline and resulted in a personal injury necessitating in-patient hospitalization and an estimated property damage of \$50,000 or more, PG&E reported the incident to Safety and Enforcement Division (SED) on July 10, 2024. PG&E also reported this incident to the Department of Transportation (DOT) since G.O. 112-F Section 122.1 requires that each operator complies with the requirements of 49 Code of Federal Regulations (CFR) Part 191 for the reporting of incidents. Because of the personal injury and property damage, this incident meets the definition of an incident as written in Part 191.3(1)(i) and 191.3(1)(ii).

SED Investigation

The Gas Safety and Reliability Branch (GSRB) of SED began the investigation of this pipeline incident on July 11, 2024. A Senior Utilities Engineer-Specialist (SUE-Specialist) was assigned the role of lead investigator. SED's investigation of this incident involved a field investigation at the incident site and interview with PG&E's Kettleman District pipeline operation supervisor. SED also prepared and submitted several data requests to PG&E. SED reviewed PG&E's Root Cause Evaluation (RCE) report, pertinent PG&E employee training records, PG&E's Operator Qualification records, and related operation and maintenance standards and procedures.

The purpose of this investigation was to determine whether there were probable violations of G.O. 112-F Reference Title 49 Code of Federal Regulations (CFR) Part 192, that may have caused or contributed to the incident. Furthermore, SED was interested in determining if the operator was implementing corrective actions to prevent similar incidents in the future.

Incident Description

PG&E's data request responses included PG&E's internal Root Cause Evaluation (RCE) report that PG&E prepared from its investigation of this incident by a cross-functional team of its Subject Matter Experts. PG&E's RCE report is comprehensive and detailed in its process and the identification of relevant data. The RCE applied various tools for analysis including Barrier Analysis, Organization Learning Tool (OLT), and Human Factors Analysis Classification System (HFACS). Furthermore, the barrier analysis identified existing and potential barriers that impacted the incident.

The RCE report provided PG&E's detailed information regarding the roles and responsibilities during the Station Project S-1391. It examined employees' interview statements. Some of the information contained in the RCE report matches the information SED collected during its field investigation and interview with the PG&E Kettleman District pipeline operation supervisor.

PG&E's RCE report indicated that Station Project S-1391 was designed to repair the leaks identified on the valve actuators in Kettleman Compressor Station by replacing three valves. According to the RCE report, on July 8, 2024 at 0605, final authorization was obtained from the PG&E Gas Control Center (GCC) for Work Clearance Document (WCD) # 80252165. At 0640, clearance operations began, and valves were positioned to isolate piping for project work. At 0925, Valve-94 (V-94) was slowly opened to blowdown the isolated piping to atmospheric pressure. The initial pressure of the isolated piping was 634 psig and was confirmed flat (0 psig) at 1222. At 0842, Valve-56 (V-56) was checked open as required by the clearance. However, at 1225, it was closed in preparation for the gland and stem seal replacement work. The RCE report indicated that the closure of V-56 was not documented in the clearance nor was it identified as a required step during clearance planning.

According to PG&E's RCE report, on July 9, 2024, at 0416, clearance operations resumed, and PG&E took steps to purge the isolated piping out of service in preparation for construction by the contractor. Air movers were installed at various locations to displace the gas with air to achieve an acceptable Lower Explosive Limit (LEL) reading at monitored locations. At 0545, after initial efforts failed to achieve an acceptable LEL, a blind flange, downstream of Valve-78 (V-78), was removed for additional fresh air. According to the RCE report, the blind flange that was removed had an installed, half-inch diameter, vertical hand valve assembly intended for blowdown and purging. Figure 1 shows the configuration with the half-inch diameter vertical vent valve intended for purging at V-78.



Figure 1: Half-Inch Diameter Vertical Vent Valve Intended for Purging At V-78

The RCE report indicated that this hand valve had been included as a technical object in the clearance, defined as “VENT D/S V-78,” and incorporated into the system configuration for clearance operations. The RCE found that the removal of this blind flange ultimately resulted in an un-intended system configuration of a 6-inch horizontal opening pointing directly into an opposing 6-inch blind flange 18 inches away. Figure 2 shows a picture from the RCE report with V-78 and its blind flange hanging.

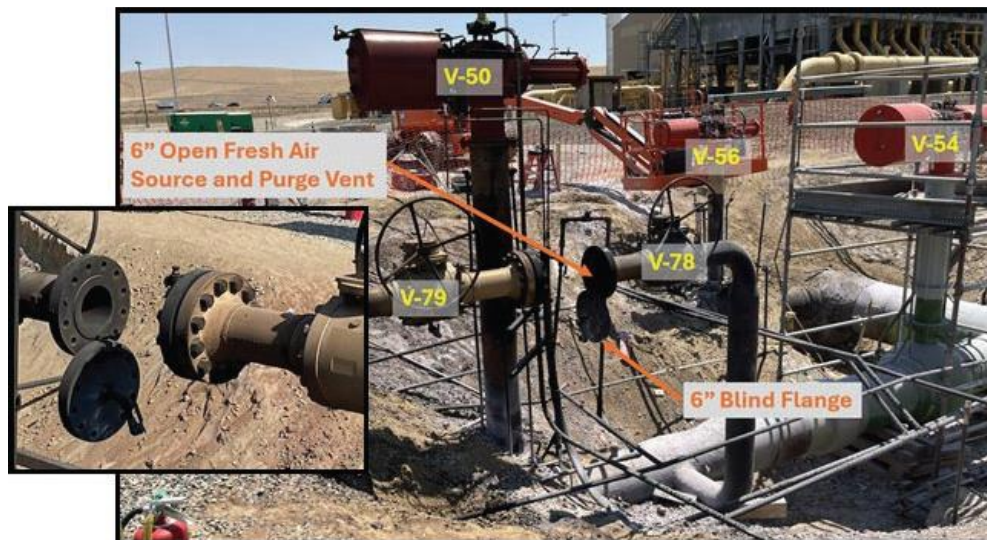


Figure 2: Valve-78 Blind Flange Removed (shown hanging)

According to the RCE report, acceptable LEL readings were achieved after removing the blind flange. At 0822, the isolated piping was confirmed clear, and the system was released to the contractor for construction. At 0923, the contractor began the cut out and removal of the existing 24-inch Valve-54 (V-54) and the 34-inch by 24-inch tee assembly. At 1209, the contractor began installing the new 34-inch by 24-inch tee. The RCE report indicated that by 1422, installation of the tee was completed, but the installation of the final tie-in piece, including V-54, was left for the following day. As a result of the 24-inch end of the tee being open to atmosphere, air moving operations continued overnight to maintain acceptable air-gas levels. The gland and stem seal replacement work on V-56 continued through the end of the shift.

PG&E's RCE report indicated that on July 10, 2024, at 0631, an acceptable LEL was confirmed at sampling locations and the contractor resumed construction work. At 1141, the new V-54 was installed and ready for non-destructive examination (NDE). At 1324, the NDE was confirmed acceptable, and the construction was considered complete. At 1705, the stem seal repair work on V-56 was completed. Then V-56 was partially opened prior to the beginning of the purge back into service. According to the RCE report, as the clearance had previously called for checking V-56 fully open, the closure, and subsequent partial opening of V-56, was not in alignment with the clearance instructions nor PG&E's Gas Design Standard (GDS) A-38, "Purging Gas Facilities," which states: "*All open valves must be fully open except isolation valves and the throttled driver valve, if used.*"

According to the RCE report, on July 10, 2024, at 1707, the clearance was reported "on test" to GCC in preparation for purging the isolated piping back into service and the PG&E employees were positioned at specific locations to monitor for 100% gas. At 1808, direction was provided to the PG&E employee to operate Valve-90 (V-90) for the reintroduction of gas. Figure 3 shows V-90.



Figure 3: V-90 Detail View

V-90 is a 34-inch buried full port ball valve with a high-head extension. It is equipped with a pneumatic double acting actuator with a hydraulic backup override. The RCE report indicated that the intent was

to slowly open the valve with the hydraulic override system. At 1808, the differential across V-90 was approximately 618 psid. Upon attempting to open the valve with the hydraulic override system, oil was discharged from the relief port and the valve failed to turn. According to the RCE report, the last maintenance of V-90 was performed in May of 2024 without any deficiencies found, and the exact failure mechanism of the hydraulic override system prior to the incident is unknown. The RCE report indicated that a decision was then made to utilize the actuator's pneumatic system to open the valve. The RCE found that this method is not effective for fine throttling. At 1825, V-90 was opened and gas was re-introduced into the system. A PG&E employee, Transmission Project Clearance Operations (TPCO) Lead Gas Control Technician 1 (TLT-1) positioned at the monitoring location near V-20, provided direction, by text message, to the PG&E employee operating V-90 Gas Pipeline Operation and Maintenance (GPOM) Gas Control Tech 2 (GCT-2). An increase in gas flow was made three times. At 1843, it had been indicated that too much gas had been sent. V-90 was immediately closed when excess flow was recognized through audible and haptic indication.

PG&E's RCE report indicated that gas exited the 6-inch diameter opening downstream of V-78 directly into an opposing blind flange 18-inches away during the operation of V-90. Gas was deflected in all directions, including into the excavation below, creating a large dust and debris cloud. The RCE report indicated that ignition occurred shortly after the formation of this cloud and lasted for approximately 1 minute, self-extinguishing as gas flow was shut off at V-90 prior to ignition. According to the RCE report, the precise ignition source and location could not be determined to a certainty, but an electrostatic discharge from the generated dust cloud cannot be ruled out as the ignition source and is more likely than other ignition sources considered. Section 8 of the RCE report provides a discussion of the event technical detail including analysis of the ignition. Figure 4 shows the gas movement at the time of ignition. The RCE found that a greater amount of gas flow was directed toward Valve-78 (V-78) at the time of the incident because V-56 was partially opened instead of fully opened.

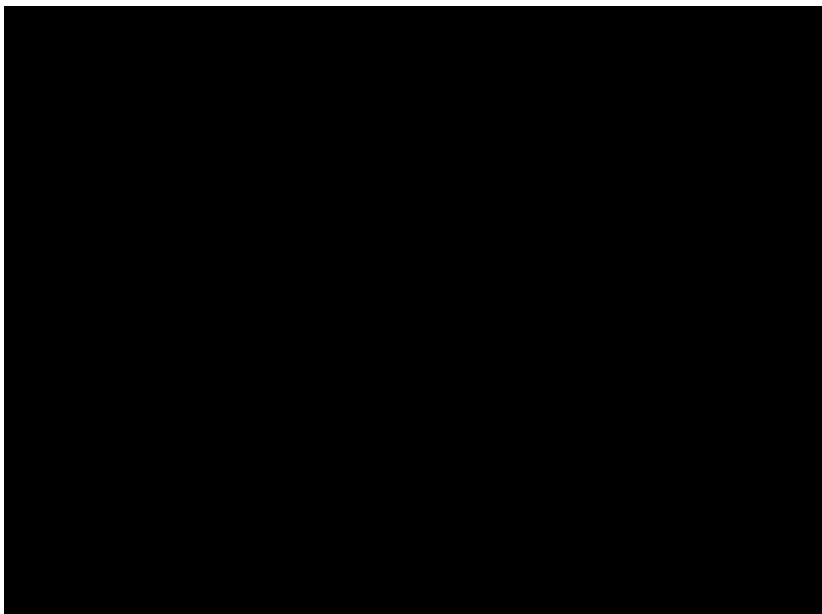


Figure 4: Gas Movement While Performing Purging into Service Operations At The Time Of Ignition

Figure 5 shows the location of the PG&E employee positions at the time of ignition. At the start of the purge, GPOM Operator Mechanic 1 (GOM-1) had been standing approximately 10-feet away from the 6-inch horizontal opening at V-78. They began to vacate the area when they noticed the rapidly growing debris cloud. As they were running away from their initial location, the cloud ignited, injuring GOM-1 and causing 1st, 2nd, and 3rd, degree burns to their arms, hands, back and neck. The PG&E employees nearby immediately responded and tended to the injured employee. Two additional employees experienced minor first-aid injuries. Emergency services were called, and notifications were made to the PG&E Leadership and Safety. Kettleman Compressor Station was secured and made safe until further direction could be obtained. SED investigator arrived at the incident site the next day on July 11, 2024, at approximately 1300 and conducted an interview with PG&E's Kettleman District pipeline operation supervisor. The information collected by SED through its field investigation and data request is consistent with the detail description of the incident in the PG&E RCE report.

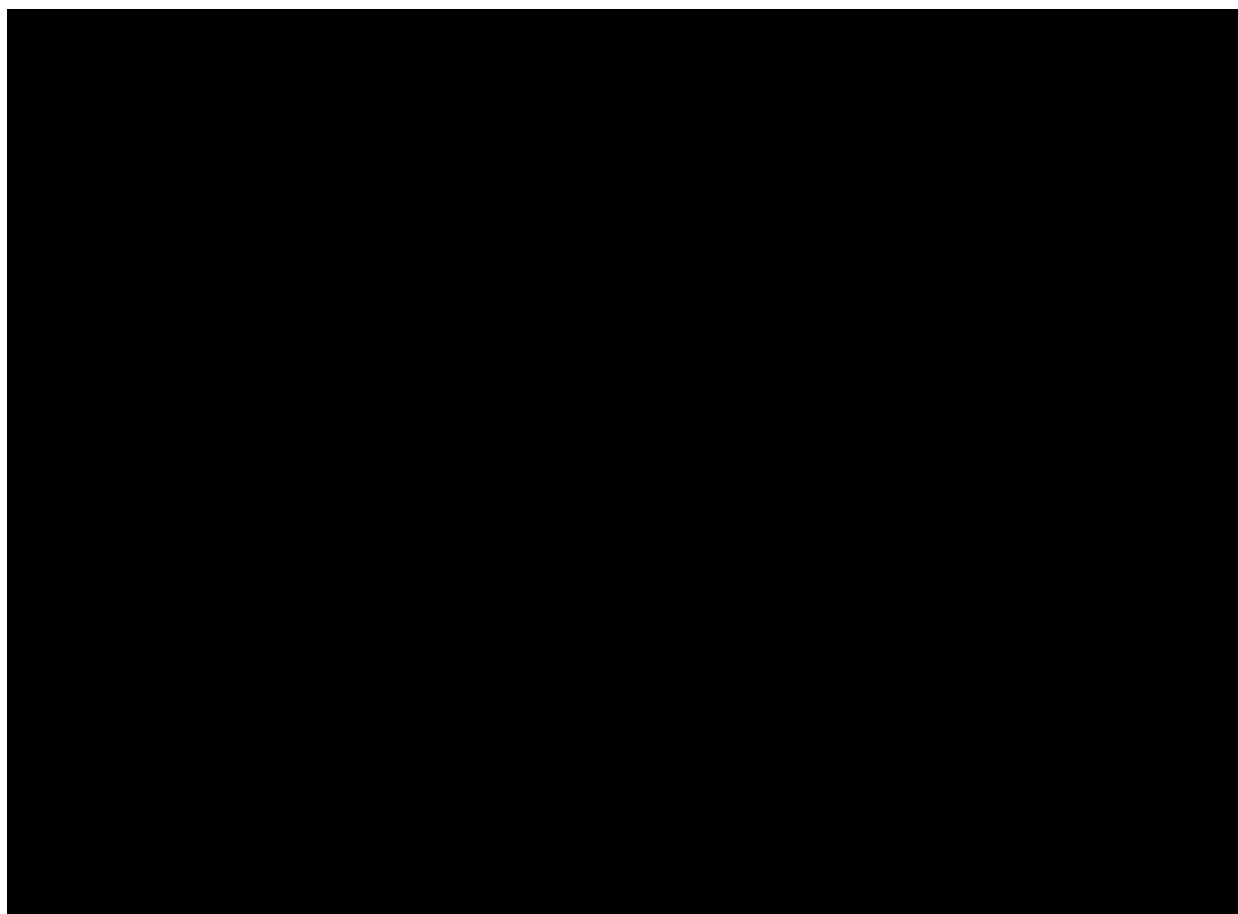


Figure 5: Location of the PG&E employee positions at the time of ignition

PG&E employees directly involved, provided direction, training, supervisory oversight, witnesses, or subject matter experts were either interviewed by the PG&E RCE Team and/or provided written statements. PG&E RCE Team used the data from these interviews to populate analysis tools (Barrier, HFACS, OLT) for PG&E's RCE report. The report code in the RCE report, the actual position, and the assigned role of these PG&E employees are listed below in Table 1.

Table 1. PG&E Employees Job Positions and Roles according to the RCE Report

Report Code	Actual Position	Assigned Role for WCD #80252165
FE-1	Facility Engineer (Kettleman)	Endorser for clearance document.
GCC-1	Gas Clearance Coordinator 1	Assumed clearance writing duties after Gas Clearance Coordinator 3 changed roles. Created the approved WCD #80252165 being executed on 7/10/2024.
GCC-2	Gas Clearance Coordinator 2	Assisted Gas Clearance Coordinator 1 with revisions to WCD #80252165 after incident on 7/10/2024
GCC-3	Gas Clearance Coordinator 3	Involved in initial draft of WCD #80252165
GCT-1	GPOM Gas Control Technician 1 (Kettleman)	Assumed Clearance Supervisor (CS) duties on WCD #80252165 after purge ignition event on 7/10/2024.
GCT-2	GPOM Gas Control Technician 2 (Kettleman)	Stationed at V-90 performing purge drive pressure throttling at time of ignition event on 7/10/2024.
GCT-3	GPOM Gas Control Technician 3 (Kern)	Roving support during clearance execution 7/8/2024 through 7/10/2024.
GCT-4	GPOM Gas Control Technician 4 (Kern)	Roving support during clearance execution 7/8/2024 through 7/10/2024.
GCT-5	GPOM Gas Control Technician 5 (Rio Vista)	Performed stem seal and gland plate repairs on V-56 while isolated and blown down on 7/9/2024.
GMC-1	GPOM M&C Coordinator (Kettleman)	Attended clearance meetings for S-1391 and developed WCD #80252165 with Clearance Writers 1 and 2. Stationed at V-56 prior to ignition occurring on 7/10/2024.
GOM-1	GPOM Operator Mechanic 1 (Kettleman)	Stationed at V-78 performing sampling of gas during purge into service (seriously injured coworker).
GS-1	GPOM Supervisor (Kettleman)	PG&E management oversight of Kettleman GPOM personnel. Not present on site when ignition occurred on 7/10/2024.
GSP-1	Gas System Planning Engineer (L-300 Backbone)	Endorser for clearance document.
GTM-2	GPOM Transmission Mechanic 2 (Kettleman)	Clearance Supervisor (CS) leading the purge into service operation on 7/10/2024. Stationed at V-90 when the ignition occurred.
PE-1	Project Engineer (S-1391)	Endorser for clearance document per TD-4441P-10, however, not included in clearance routing.
SNF-1	Snelson Welding Foreman	Led Snelson welding crew for tie-in of V-54 on 7/9/2024 and 7/10/2024.
TLM-1	TPCO Lead Mechanic Welder In-Service (South)	Stationed at V-J air mover and gas sampling location during purge out of service on 7/9/2024.
TLT-1	TPCO Lead Gas Control Technician 1 (South)	Roving clearance support during the clearance execution. Replaced as Clearance Supervisor (CS) prior to start of clearance work. Directed throttling of V-90 remotely during purge into service while monitoring flow at purge vents.
TTM-1	TPCO Transmission Mechanic 1 (South)	Air mover operation and purge gas sampling at the V-94 permanent vent stack during purge out of service. Assisting at V-90 during purge into service and ignition on 7/10/2024.
TTM-3	TPCO Transmission Mechanic 3 (South)	Stationed at V-78 and V-54 during purge out-of-service work, including removal of blind flange at V-78 on 7/9/2024.
TTM-4	TPCO Transmission Mechanic 4 (Central)	Performed stem seal and gland plate repairs on V-56 while isolated and blown down on 7/9/2024.
TUW-1	TPCO Utility Worker 1 (South)	Roving support during clearance execution 7/8/2024 through 7/10/2024.
TUW-2	TPCO Utility Worker 2 (South)	Assisting TPCO Transmission Mechanic 1 at V94 air mover and gas sampling location during purge out of service on 7/9/2024.

Chronology of Important Events and Incident Investigation Activities

This section provides a chronology of the important events leading to the incident and investigative activities undertaken after the incident occurred.

July 8, 2024

On July 8, 2024, at 0842, Valve-56 (V-56) was checked open as required by the clearance however, at 1225, it was closed in preparation for the gland and stem seal replacement work. Closure of V-56 was not documented in the clearance nor was it identified as a required step during clearance planning.

July 9, 2024

On July 9, 2024, at 0545, after initial efforts failed to achieve an acceptable LEL, a blind flange, downstream of Valve-78 (V-78), was removed for additional fresh air. The blind flange that was removed had an installed, half-inch diameter, vertical hand valve assembly intended for blowdown and purging. This hand valve had been included as a technical object in the clearance, defined as “VENT D/S V-78,” and incorporated into the system configuration for clearance operations. The removal of this blind flange ultimately resulted in an un-intended system configuration of a 6-inch horizontal opening pointing directly into an opposing 6-inch blind flange 18 inches away.

July 10, 2024

On July 10, 2024, at 1705, the stem seal repair work on Valve-56 (V-56) was completed. Then V-56 was partially opened prior to the beginning of the purge back into service. Because V-56 was partially opened instead of fully opened, a greater amount of gas flow was directed toward Valve-78 (V-78) at the time of the incident.

July 10, 2024

On July 10, 2024, at 1808, upon attempting to open Valve-90 (V-90) with the hydraulic override system, oil was discharged from the relief port and V-90 failed to turn. The RCE report indicated that a decision was then made to utilize the actuator’s pneumatic system to open the valve. The RCE Team found that this method is not effective for fine throttling.

July 10, 2024

On July 10, 2024, at 1825, Valve-90 (V-90) was opened and gas was re-introduced into the system. A PG&E employee, Transmission Project Clearance Operations (TPCO) Lead Gas Control Technician 1 (TLT-1) positioned at the monitoring location near Valve-20 (V-20), provided direction, by text message, to the PG&E employee operating V-90 Gas Pipeline Operation and Maintenance (GPOM) Gas Control Tech 2 (GCT-2). An increase in gas flow was made three times.

July 10, 2024

On July 10, 2024, at 1843, it had been indicated that too much gas had been sent from V-90 to V-78. V-90 was immediately closed when excess flow was recognized through audible and haptic indication. PG&E’s RCE report indicated that gas exited the 6-inch diameter opening downstream of V-78 directly into an opposing blind flange 18-inches away during the operation of V-90. Gas was deflected

in all directions, including into the excavation below, creating a large dust and debris cloud. The RCE report indicated that ignition occurred shortly after the formation of this cloud and lasted for approximately 1 minute, self-extinguishing as gas flow was shut off at V-90 prior to ignition.

July 11, 2024

On July 11, 2024, at approximately 1300, SED investigator arrived at the incident site and conducted an interview with PG&E's Kettleman District pipeline operation supervisor.

November 6, 2024

On July 11, 2024, at 1329, PG&E provided a copy of the Final Root Cause Evaluation Report to the SED investigator.

Findings and Corrective Actions

PG&E'S Root Cause Evaluation

PG&E initiated an internal investigation titled Root Cause Evaluation (RCE) that involved PG&E's cross-functional team of Subject Matter Experts (Team). The Team conducted an in-depth analysis and applied several root cause evaluation tools including a Barrier Analysis, Organizational Learning Tool (OLT), and Human Factors Analysis Classification System (HFACS). The Team prepared the RCE report based on its investigation and analysis. The RCE report made the following written observations:

- In recent years, Corrective Actions were implemented with the intent to improve safety performance and change behaviors while performing Gas Clearance and Purging Work. Despite Gas organization efforts, Leadership has not been successful in setting and enforcing expectations for job task hazard awareness, reinforcing desired safe behaviors, and maintaining a culture of continuous learning. Subsequent Leadership has also been ineffective coaching to standards adherence and communicating safety direction.
- PG&E no longer defines Safety as the absence of events, but by the presence of controls that provide workers the capacity to fail safely. Standards and guidance are in place for high energy hazard recognition, Organizational Culture & Safety Mindset (Safety Culture), and Human Performance Tools. Contrary to the expectation that all PG&E Functional Area Leaders prioritize high energy controls and the capacity to fail safely, Gas Leaders are inconsistently reinforcing these processes, principles, and tools.
- Prior to purging into service, gas coworkers failed to recognize a high energy essential control had been disabled (removed) during the purge out of service. This allowed high-energy to be released in a hazardous manner and prevented the coworkers from failing safely.
- Over relying on the human performance of Gas coworkers in the field to identify and address system configuration risks, such as preventing hazardous air /gas mixtures while purging, fails to demonstrate a collective focus on safe outcomes and high energy hazard mitigation.
- Routine Human Performance errors and repeat causes of ignition, purging, and Clearance events indicate ongoing gaps in adherence to these standards as well as knowledge and skills gaps related to safe Clearance and purging practices.
- Currently, no adequate hands-on training exists for purging, which is a critical aspect of building competency. This applies broadly to work groups such as Gas Clearance Writers, Endorsers, Approvers, Clearance Supervisors, Project Managers, Engineering, Operations, Maintenance, and associated leaders.
- Wide-spread gaps were discovered in worker and leader knowledge of system design, which impacts the ability to maintain configuration control during Clearance Work activities.
- Despite a strong reporting culture within Gas, issues potentially impacting safety are not consistently addressed and corrected commensurate with their significance. Identification and resolution of a broad spectrum of problems, are not adequately identified through trending and assessment to improve performance, including organizational issues.

The RCE report identified the following root cause:

Causes:

- Root Cause-1: Failure to achieve effective change in safe behaviors and the implementation of essential controls to mitigate high-energy hazards.
 - Contributing Cause-1: Configuration control is not rigorously applied when executing clearance work.
 - Contributing Cause-2: Gas coworker fundamental knowledge and proficiency challenges.
 - Contributing Cause-3: Failure to Recognize Risk and Address Causes of Repeating Events.

SED's Findings

SED's investigation noted the following findings:

1). G.O. 112-F Referenced Title 49 CFR, Part 192, Section 192.13 What general requirements apply to pipelines regulated under this part.

§ 192.13 What general requirements apply to pipelines regulated under this part:

(c) Each operator shall maintain, modify as appropriate, and follow the plans, procedures, and programs that it is required to establish under this part.

- **PG&E's Gas Design Standard (GDS), A-38-1h, "Purging Gas Facilities" (Publication Date: 04/12/2023, Effective Date: 07/01/2023)**

According to the RCE report, the following items in PG&E's GDS A-38 were not addressed:

- *The required purge drive pressure. If the purge will be done in multiple segments, include the purge drive pressure for each segment.*
- *The expected duration of each segment of the purge, as well as the overall purging operation*

The RCE report indicated that this information is critical to ensure an adequate purge velocity and flowrate. The minimum purge velocity must be met to avoid stratification and excessive mixing that occur when velocity is too low and other hazards (projectiles, increased range of flammability, etc.) when velocity is too high. The expected purge duration is critical as well, as it allows for the identification of potential abnormal operating conditions (AOCs) when purge end points do not meet the expectation. According to the RCE report, without the ability to monitor purge drive pressure and expected duration, the clearance team was severely limited in their capacity to identify hazards, apply essential controls, and fail safely.

According to the RCE report, PG&E Gas Design Standard A-38 requires the use of a drive pressure gauge, so the crew understands how much gas is being introduced into the system while "purging into service". However, the RCE report indicated that there was not a gauge installed, so the only indicator of the amount of gas being introduced would be through sound or feel at a purge point. Because a gauge was not installed, SED found that the following requirements in PG&E's GDS A-38 were not followed:

- *On the section to be purged and near the upstream mainline valve, install a pressure gauge that is accurate and readable within 1 psi so that the inlet pressure can be observed. (The gauge should be connected through several feet of flexible tubing to minimize vibration.)*
- *Open throttle control valve steadily while monitoring the inlet pressure gauge. Continually monitor the pressure and gradually adjust the throttle control valve throughout the purge.*

- **PG&E's Gas Design Standard (GDS), A-38.3-0a, "Temporary Vent Stacks" (Publication Date: 12/16/2020, Effective Date: 03/16/2021)**

According to the RCE report, PG&E's GDS A-38.3 covers the installation of vent extensions to allow gas and air/gas mixtures to escape into the atmosphere without hazard during purging

and blowdown operations. The RCE report indicated that temporary vent extensions are a key safety control to protect coworkers and the public in the vicinity of the escaping gas or air/gas mixture from the associated noise, dust/debris, and odor as well as allowing the operation to “fail safely” if an unintended ignition should occur. SED found that the purge vent location at V-78 during the purge into service, where the 6-inch blind flange was removed and not reinstalled, did not meet the following requirements in PG&E’s GDS A-38.3:

- *Vent stacks must be of adequate height to provide enough clearance out of the excavation, and pointed in a safe direction away from any potential hazards. If it is not feasible to extend stack above the excavation due to depth, ensure personnel are at a safe distance away from the location and height of the stack.*
 - *Flanged connections must be fully bolted and tightened with appropriately rated gasket and welded per appropriate weld procedure. If there are any threaded connections in assembly, follow requirements for threaded components.*
- **PG&E’s Code of Safe Practices (CSP) Section 1304, “Vent Stacks” and 1305, “Sources of Ignition or Fire Near Escaping Gas”**

According to the RCE report, PG&E’s CSP Section 1304 and 1305 also cover the installation of vent extensions to allow gas and air/gas mixtures to escape to the atmosphere without hazard during purging and blowdown operations. SED found that the purge vent location at V-78 during the purge into service, where the 6-inch blind flange was removed and not reinstalled, did not meet the following requirements in PG&E’s CSP Section 1304 and 1305:

- *Vent stacks shall be of sufficient size and height to minimize the hazard of releasing gas in the work area...*
 - *Gas shall not be blown against the side of an excavation; it must be vented upward.*
- **PG&E’s Work Clearance Document (WCD) # 80252165**

According to the RCE report, steps in the Clearance were not adhered to that should have been followed to maintain worker safety and system configuration control such as removing the Valve-78 (V-78) downstream flange that also removed a vertical vent valve downstream of V-78 (VENT D/S of V-78) as it was mounted to the face of the blind flange, not fully opening Valve-56 (V-56) per the WCD after maintenance was performed, and not fine throttling Valve-90 (V-90) or monitoring purge drive pressure. The blind flange was dropped at the direction of a supporting Clearance Supervisor and was not reinstalled prior to Purging into Service. SED found that the following sequence of operations in PG&E’s WCD # 80252165 were not followed:

- *Operation No. 18 Operation: CHECK OPEN Technical Object: V-56*
- *Operation No. 38 Operation: OPEN Technical Object: VENT D/S V-78*
- *Operation No. 52 Operation: POSITION Technical Object: V-90 Remarks: R/MOL, SLOWLY PURGE PER A-38*

PG&E is in probable violation of G.O. 112-F, Reference Title 49 CFR, Part 192, Section 192.13(c) for failure to ensure the four procedures above were properly followed.

2). G.O. 112-F Referenced Title 49 CFR, Part 192, Sections 192.805 Qualification program and 192.803 Definition.

§ 192.805 Qualification Program States in part:

Each operator shall have and follow a written qualification program. The program shall include provisions to:

- (a) Identify covered tasks.*
- (b) Ensure through evaluation that individuals performing covered tasks are qualified...*

Furthermore,

§ 192.803 Definitions states:

Abnormal operating condition means a condition identified by the operator that may indicate a malfunction of a component or deviation from normal operations that may:

- (a) Indicate a condition exceeding design limits; or*
- (b) Result in a hazard(s) to persons, property, or the environment.*

Evaluation means a process, established and documented by the operator, to determine an individual's ability to perform a covered task by any of the following:

- (a) Written examination;*
- (b) Oral examination;*
- (c) Work performance history review;*
- (d) Observation during:*
 - (1) Performance on the job,*
 - (2) On the job training, or*
 - (3) Simulations; or*
- (e) Other forms of assessment.*

Qualified means that an individual has been evaluated and can:

- (a) Perform assigned covered tasks; and*
- (b) Recognize and react to abnormal operating conditions.*

The PG&E Root Cause Evaluation (RCE) team reviewed the training requirements and Operator Qualifications (OQs) for the work being performed during the execution of Work Clearance Document (WCD) #80252165 and identified that it did not provide an adequate level of detail or require significant On the Job Training (OJT) necessary to ensure knowledge, skills, and proficiency for safe execution of the tasks. The PG&E RCE team identified the following gaps:

- **OQ Task: 07-01 Purging with Gas and/or Air**

This OQ task requires a score of 80% or higher on an open book, written test, administered on a computer. PG&E personnel have full access to all relevant documents (A-38 (Rev 1g), A-38.3 (Rev 0a), TD4150P-01 (rev 1b), TD-4170P01 (rev 0)) that the questions on the test were built from along with a “key word” search function. Most written tests are followed by a performance evaluation that PG&E personnel must pass to become qualified. 07-01 has no performance evaluation. 07-01 also has no formal training program. Purging and venting is briefly discussed during Clearance Class (Gas-9658) but there is not a dedicated training for purging and venting. The RCE team indicated that purging and venting is high-risk and performed frequently.

- **OQ Task: 17-01 Valve Operations and Maintenance**

This OQ task requires a score of 80% or higher on an open book, written test, administered on a computer. PG&E personnel have full access to all relevant documents that the questions on the test were built from along with a “key word” search function. PG&E personnel must also pass a performance evaluation. The performance being evaluated is the closing and opening of a pin off tee. Once completed this qualifies PG&E personnel to maintain and operate every type of non-actuated valve PG&E has in its system. There is no dedicated training on Valve operations and maintenance, however it is covered in several training courses offered in the Gas Control Tech. Apprenticeship (GPOM-2000, GPOM-3000 and GPOM-4000).

- **OQ Task: 14-01 Control Valve Systems (Actuated Valves)**

This OQ task requires a score of 80% or higher on an open book, written test, administered on a computer. PG&E personnel have full access to all relevant documents that the questions on the test were built from along with a “key word” search function. PG&E personnel must also pass a performance evaluation. The performance evaluation has PG&E personnel demonstrate the person can bump test a Becker control valve with one specific type of controller. There is a wide variety of power Actuated Valves in the PG&E system with many different operator and controller configurations. Lack of understanding of the functionality of the pneumatic and hydraulic operation of V-90 in an abnormal operating configuration were contributors to this ignition event. Lack of specific training for this equipment combined with inadequate experience could have led to incorrect actions taken during execution of the purge drive steps taken prior to ignition.

Based on the gaps identified by the PG&E RCE team, SED believes that PG&E’s OQ training and evaluation for the three OQ tasks above (07-01, 17-01, and 14-01) were inadequate to ensure

individuals performing these cover tasks are qualified. According to the definition, qualified means that an individual has been evaluated and can perform assigned covered tasks; and recognize and react to abnormal operating conditions. As demonstrated by this incident, PG&E personnel were not able to recognize and react to some of the abnormal operating conditions found during this purging operation such as removal of the vertical vent valve, gas venting horizontally, and failed hydraulic operation of V-90.

Therefore, PG&E is in probable violation of G.O. 112-F, Reference Title 49 CFR, Part 192, Sections 192.805(b) for failure to have an adequate OQ training program and sufficient evaluations to ensure individual performing OQ tasks 07-01, 17-01, and 14-01 are qualified.

SED's Recommendations

1. PG&E should take the appropriate steps to address SED Finding #1
2. PG&E should take the appropriate steps to address SED Finding #2

SED's Observations

This section details five (5) observations SED made over the course of the investigation. SED will follow-up and monitor the progress of PG&E's proposed corrective actions.

Observation 1:

PG&E has implemented the following actions to address the Extent of Condition (EOC) identified in PG&E's RCE report.

Extent of Condition Object: Worker performing any Gas non-vertical purging that enables the creation of a hazardous air/gas mixture with potential for ignition.

Extent of Condition Defect: Ignition of a hazardous air/gas mixture while purging or venting at a Gas Transmission Location.

EOC Actions:

- Stand Down on horizontal Purging and venting activities unless authorized per Engineering and Operation and Maintenance (O&M) Director approval.
- Publish interim field guide and training on A-38 (Blowdown and Purging).
- Eliminate horizontal purging and venting excluding fixed engineered purging and venting systems.
- Approve pre-engineered vent stack use for depressurizing and vent/filter blowdown.
- Eliminate pneumatic operated valves during manual purging (non-automatic).

- Establish emergency response guidance and actions for how to respond to an injured coworker and isolate energy source should ignition occur.

Observation 2:

PG&E has proposed or initiated the following corrective actions to address Root Cause-1 identified in PG&E's RCE report.

Root Cause-1 Statement: Failure to achieve effective change in safe behaviors and the implementation of essential controls to mitigate high-energy hazards.

Corrective Actions:

- Develop and implement a 5-year Gas Organization Safety and Culture Achievement Plan. The Plan should provide a unified vision, direction, and goals that will enable all Gas Coworkers to achieve high standards for the prioritization of safety. Establish a Leadership Development program for all Gas leaders, including those who play a critical role in managing work in the field such as Crew Leads, Clearance Supervisors, Project Engineers, and Project Managers.
- In alignment with industry guidance and best practice, implement purging exclusion zone criteria such that no people, impedances, or sources of ignition are in the direct vicinity of a hazardous air/gas plume while performing any type of blowdown and purging work.
- Install permanent vent stacks where exclusion zones, coworker safety, or public safety may be challenged. In locations where permanent stacks cannot be installed, stage engineered piping in the immediate vicinity to ensure the stack extension is readily available for planned or emergency clearance work.
- Develop and implement an action plan to improve early coordination of risk identification, high-energy hazard mitigating actions, and adherence to Clearance and Purging work preparation processes.

Observation 3:

PG&E has proposed or initiated the following corrective actions to address Contributing Cause-1 identified in PG&E's RCE report.

Contributing Cause-1 Statement: Configuration control is not rigorously applied when executing clearance work.

Corrective Actions:

- In partnership with Gas Engineering, design and develop "Configuration Control Devices" (CCDs) to be used as unique and distinct Clearance Operations robust tagging devices that prevent inadvertent operation or removal of equipment and components within a clearance boundary (e.g., use of CCD clamp on blind flanges that have permanently affixed vent valves).
- In partnership with the International Brotherhood of Electrical Workers (IBEW), evaluate Clearance Supervisor classification to determine if opportunities exist to further refine and/or delineate roles and responsibilities.

- Implement Clearance and Tagging performance monitoring process with criteria for classifying Clearance-related events.

Observation 4:

PG&E has proposed or initiated the following corrective actions to address Contributing Cause-2 identified in PG&E's RCE report.

Contributing Cause-2 Statement: Gas coworker fundamental knowledge and proficiency challenges.

Corrective Actions:

- Develop and Implement training for General Clearance and Lock out Tag out (LOTO) Awareness, Clearance Writing, and Clearance Supervising of complex Clearances.
- Develop and issue Field-based A-38 Job-Aid and accompanying training for Gas Transmission blowdown, purging, and venting work.

Observation 5:

PG&E has proposed or initiated the following corrective actions to address Contributing Cause-3 identified in PG&E's RCE report.

Contributing Cause-3 Statement: Failure to recognize risk and address causes of repeating events.

Corrective Actions:

- Implement gas cross-functional trending of Corrective Action Program (CAP) for topics including, but not limited to, occupational safety, process safety, and organizational culture that indicate strengths and opportunities.
- Develop Quality Improvement Plan Process. Identify critical or high-risk processes that require a Quality Improvement Plan and determine appropriate improvement plan cycle for each.

Conclusion

Based on the records, interviews, and the RCE report that SED reviewed during this investigation, SED concluded that PG&E committed probable violations of General Order (G.O.) 112-F, Reference Title 49 Code of Federal Regulations (CFR), Part 192, Sections 192.13(c) and 192.805(b).

PG&E's failure to address the required purge drive pressure and expected duration of the purge in accordance with PG&E's Gas Design Standard A-38 is a probable violation of 49 CFR Part 192, Section 192.13(c).

Furthermore, PG&E's failure to use a drive pressure gauge during purging in accordance with PG&E's Gas Design Standard A-38 is a probable violation of 49 CFR Part 192, Section 192.13(c).

In addition, PG&E's failure to purge in a safe direction in accordance with PG&E's Gas Design Standard A-38.3, Code of Safe Practices Section 1304, and Code of Safe Practices Section 1305 is a probable violation of 49 CFR Part 192, Section 192.13(c).

Additionally, PG&E's failure to follow its Work Clearance Document (WCD) # 80252165 to fully open Valve-56, open the vertical vent valve downstream of Valve-78 for purging, and fine throttle Valve-90 during purge is a probable violation of 49 CFR Part 192, Section 192.13(c).

Finally, PG&E is in probable violation of 192.805(b) for its failure to have an Operator Qualification (OQ) program and evaluations to ensure individual performing OQ tasks 07-01, 17-01, and 14-01 are qualified.

Appendices

Appendix A: Glossary of terms

ACRONYM/ABBREVIATION	DEFINITION
AOC	Abnormal Operating Conditions
CAP	Corrective Action Program
CCD	Configuration Control Devices
CFR	Code of Federal Regulation
CPUC	California Public Utilities Commission
CS	Clearance Supervisor
DOT	Department of Transportation
EOC	Extent of Condition
GCC	Gas Control Center
GDS	Gas Design Standard
GO	General Order
GPOM	Gas Pipeline Operation and Maintenance
GSRB	Gas Safety and Reliability Branch
HFACS	Human Factors Analysis Classification System
IBEW	International Brotherhood of Electrical Workers
LEL	Lower Explosive Limit
LOTO	Lock out Tag out
NDE	Non-destructive Examination
O&M	Operation and Maintenance

OLT	Organization Learning Tool
OQ	Operator Qualification
PG&E	Pacific Gas and Electric Company
PHMSA	Pipeline & Hazardous Materials Safety Administration
RCE	Root Cause Evaluation
SED	Safety and Enforcement Division
TPCO	Transmission Project Clearance Operations
WCD	Work Clearance Document

Appendix B: Documents Reviewed

1.	GO Kettleman Compressor Station Ignition RCE Evaluation Report
2.	PG&E Incident Report PHMSA F 7100.2
3.	PG&E Incident Report CPUC File No. 420
4.	PG&E's Response to SED's Data Request Index No. 17124 7/11/2024
5.	PG&E's Response to SED's Data Request Index No. 17124 7/18/2024
6.	PG&E's Response to SED's Data Request Index No. 17124 7/31/2024
7.	PG&E's Response to SED's Data Request Index No. 17157 8/16/2024
8.	PG&E's Response to SED's Data Request Index No. 17208 9/12/2024
9.	PG&E's Response to SED's Data Request Index No. 17215 9/24/2024

10.	PG&E's Response to SED's Data Request Index No. 17215 11/6/2024
11.	PG&E's Response to SED's Data Request Index No. 17344 12/19/2024
12.	Gas Standard A-38.1 Installation and Operation of Air Movers
13.	Kettleman Compressor Station Operating Diagram
14.	Valve-90 Gas Valve Maintenance Records from 6/15/2015 to 5/22/2024
15.	Projects S-1391 and S-1315 Construction Documents
16.	Work Clearance Document # 80252165
17.	Operator Qualification records of Technician on-site
18.	Gas Design Standard A-38 Purging Gas Facilities
19.	Code of Safe Practices 1304-1305
20.	Gas Design Standard A-38.3 Temporary Vent Stacks
21.	Gas Design Standard A-38 Purging Gas Facilities

Appendix C: Field Investigation and Interview

SED investigator arrived at the incident site on Thursday, July 11, 2024, at approximately 13:00 hours. An interview with PG&E's Kettleman District pipeline operation supervisor was conducted. The supervisor was not at the scene at the time the ignition and injury occurred, but he had returned to the scene shortly after the event and had spoken separately with each of the PG&E employees who witnessed the event. None of these employees were available for interviews at the time of SED's arrival due to extended hours worked to make the incident site safe the previous night and the need to follow drug and alcohol testing protocols.

According to the supervisor, the event occurred at approximately 18:40 hours and the PG&E crews were purging the air out of the pipe with natural gas by slowly opening a 34" valve (V-90) in preparation for bringing another newly replaced valve to service. This work is part of PG&E's valve replacement projects S-1315 and S-1391. At the time the discharge gas/air mixture caught on fire, the injured PG&E employee (Employee 1) was monitoring the mixture concentration with his device (air ranger) outside of the excavated area where the new valve was installed.

Another PG&E employee (Employee 2) was manually opening valve V-90 slowly for the purging operation. He immediately closed the valve V-90 to stop the flow of gas when he saw the fire. The fire lasted approximately two minutes. Multiple fire extinguishers were used. According to the PG&E supervisor, the PG&E crews observed a cloud of dust blown up from the ground before the ignition when Employee 1 turned around and tried to run away from the scene. Employee 1's back was severely burned and might not be released from the hospital for weeks. The supervisor said that the scene was not altered after the event last night. SED observed many fire extinguishers placed at various locations at the site. SED also observed the damage on the pipe caused by the fire. PG&E started an investigation for this incident and the PG&E investigator was also on-site at the time of SED's arrival. The cause of the ignition had not yet been determined.