



National Transportation Safety Board

Washington, D.C. 20594

February 25, 2020

Investigator in Charge Factual Report

A. Accident Identification

Operator: Pacific Gas & Electric
Location: San Francisco, CA
Incident Date: February 6, 2019
NTSB No.: PLD19MR001

B. Party Members

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Investigator in Charge
Emergency Response Group Chairman
National Transportation Safety Board

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Asst. Investigator in Charge
Operations Group Chairman (Field)
National Transportation Safety Board

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C. Accident Summary

On February 6, 2019, at 1:07 p.m. Pacific standard time, a third-party contractor, Kilford Engineering, Inc. (Kilford) damaged a Pacific Gas & Electric Corporation (PG&E) 4-inch natural gas main at the connection to a 2-inch main during excavation for fiberoptic conduit installation. The release of gas and its subsequent ignition led to a fire (Figure 1). The event occurred in the Richmond District, a residential neighborhood in the northwest corner of San Francisco, California, at the intersection of Geary Boulevard and Parker Avenue. There were no injuries or fatalities; however, the natural gas service to 328 customers was curtailed temporarily, and about 100 people were evacuated by the San Francisco Police Department (SFPD) and the San Francisco Fire Department (SFFD). At the time of the release, the sky was clear; the wind was from the east-northeast about 10 mph, and the temperature was 52°F.



Figure 1. Emergency responders at the accident location. (Photograph by Santiago Mejia, *The Chronicle*.)

In response to the fire, SFFD and PG&E set up a unified incident command. SFFD focused on containing the fire and minimizing its spread, using four working groups to surround the burning building until PG&E could isolate and shut down the gas line, removing the fuel source. The isolation of the

affected segment required turning off six street-level valves located at various points in the area and mechanically squeezing off a 4-inch polyethylene main.

During the two and a half hours that elapsed while PG&E personnel isolated the flow of natural gas to the affected segment, SFFD cordoned off the area, applied water to the flames, and provided a water curtain to ensure the fire did not spread beyond the adjacent building, 3300 Geary Boulevard.

On the day of the fire, Kilford was installing multiple segments of 2-inch high density polyethylene conduit within 4-inch polyvinyl chloride piping to accommodate fiberoptic cabling along Geary Boulevard and a 30-foot portion of Parker Avenue. Kilford had five employees at the site; three were assigned to a different area along the sidewalk about 50 feet from the origin of the gas release, while the remaining employees were assigned to the excavation area where the breach occurred. The work included mechanical excavation by a mini motorized excavator with a bucket attachment, as well as manual excavation by laborers with hand shovels.

At the accident location, the excavated area contained a 4-inch polyethylene main which ran parallel to Geary Boulevard, with a 2-inch polyethylene branch connection that tied into the 4-inch main and ran parallel to Parker Avenue. The operating pressure of the system was 46 pounds per square inch, gauge (psig), with a maximum allowable operating pressure of 60 psig.

To install the conduit, workers had to remove the concrete that covered the area which had been saw-cut prior to the day of the accident. Once the concrete was jackhammered into pieces using a hydraulic attachment on a skid steer, the debris was removed for off-site disposal, and the soil was removed with a mini excavator and a hand shovel. At the time of the gas release, the mini excavator was positioned at the edge of the excavation with the bucket within the trench. Because of the delay between the release and ignition, all five employees avoided injury because they were far enough away from the breach point before ignition occurred.

An inward-facing bend in the 2-inch main was found 1.25 inches from the outlet of the fused saddle

connection (Figure 2). Further details on the physical evidence can be found within the Materials Laboratory Factual Report.



Figure 2. 2-inch to 4-inch branch connection post-accident. (Photograph by Federal Bureau of Investigation Evidence Response Team)

About 20 minutes after the fire started, a PG&E Gas Maintenance and Construction crew began excavation on the 4-inch polyethylene main to perform a squeeze-off; this work was completed about an hour later. At 3:06 p.m., PG&E Gas Pipeline Operations and Maintenance employees closed the first valve. The final valve was closed about 3:36 p.m., and the gas-fueled fire was extinguished shortly after at 3:38 p.m.

After the gas-fueled fire was extinguished, SFFD began work to contain and control the building fires started by the initial fire. PG&E replaced the damaged portion of pipeline with like materials and began work to purge and restart the line. By 10:00 p.m. the following day, all services were either relit or one attempt to relight had been made.

D. Accident Site

The accident occurred at the northwest corner of the intersection of Geary Boulevard and Parker Avenue in the Richmond District of San Francisco, California (Figure 3). The nearest address to the site is 3300 Geary Boulevard, San Francisco, CA 94118.

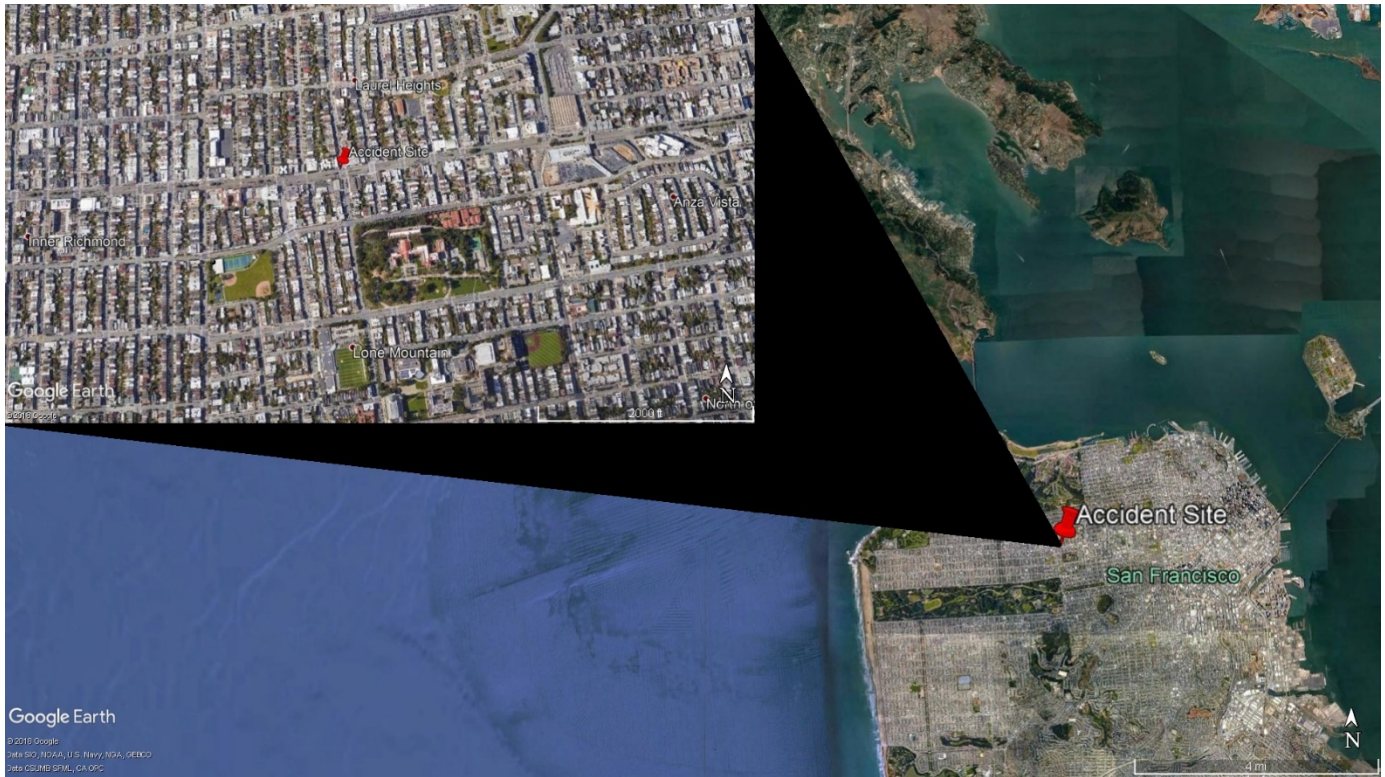


Figure 3. San Francisco Google Earth satellite image with close-up of accident site; dropped red pin indicates location of accident.

E. Pipeline System

Pacific Gas and Electric Company (PG&E) is a large natural gas and energy company based in San Francisco, CA with around 24,000 employees. PG&E is a subsidiary of PG&E Corporation and was created in 1905. Their natural gas and electric service area covers about 45 million acres and services around 16 million customers. PG&E's natural gas system consists of 42,141 miles of distribution pipelines, 6,438 miles of transmission pipelines, and various storage facilities.

The lines involved in this accident are part of PG&E's natural gas distribution pipelines located within the San Francisco Division, which encompasses the entirety of San Francisco. PG&E has several

different teams who work on the pipelines within this division in the field in different functions, including Gas Maintenance and Construction (GM&C), Gas Pipeline Operations and Maintenance (GPOM), Locate and Mark (L&M) and Gas Field Services. These various groups will be explained in further detail throughout the narrative of this report.

At the location of this accident, a 4-inch natural gas main was connected to a 2-inch natural gas main through the use of a saddle-fused medium-density polyethylene branch connection. This branch connection, known as a 4-inch by 2-inch high-volume tapping tee, was most likely manufactured by Uponor and was installed in 2000.¹ The two mains feed several service lines and are interconnected to other mains, including a 6-inch steel main. The last leak survey in this area was performed in April and May of 2018, and no leaks were found. See Table 1 below for additional specifications on the two pipelines directly involved in this accident.

Iron Pipe Size (IPS)	4-inch	2-inch
Material	Medium Density Polyethylene	Medium Density Polyethylene
Manufacturer	Uponor Aldyl Company	Uponor Aldyl Company
Year Manufactured	1996	1999
Year Installed	1997	2000
Specification	ASTM-D2513	ASTM-D2513
Standard Dimension Ratio	13.5	11
Average Depth of Cover ²	42 inches	42 inches

Table 1. Pipeline specifications for mains involved in accident.

The Maximum Allowable Operating Pressure (MAOP), as determined by 49 CFR 192.621, for both mains was 60 pounds per square inch gauge (psig). At the time of the accident, the pressure in the mains

¹ Uponor Aldyl Corporation was acquired in 2004 by PW Eagle, Inc., which is currently known as US Poly and is an affiliated company of JM Eagle, the world’s largest manufacturer of plastic pipe.
² Based on measurements taken post-accident.

was about 46 psig, which was typical for this time of year.³

ATTACHMENTS: 1, 2, 3, 4 & 5

Publicly available sources: PG&E Website – Company Profile

1. Supervisory Control and Data Acquisition (SCADA)

PG&E uses Supervisory Control and Data Acquisition (SCADA) to monitor the operation of their distribution system. Their Gas Distribution Control Center (GDCC) is located in San Ramon, CA and is staffed by management, distribution gas system operators, gas system planning engineers, and clearance coordinators, among others. See Section K, Emergency Response Activities, for further description of these various roles.

The PG&E Distribution SCADA system is comprised of 3,218 data points, 2,037 of which are providing live data via remote terminal units and 1,181 points that call in once a day to update or when a Hi-Hi, Low, or Low-Low alarm triggers the device to cry out.⁴ These data points are solely used to monitor the pipeline systems; adjustments to operating conditions require GDCC operators to call Gas Operations personnel to make changes to equipment in the field.

SCADA records show a drop in pressure for the distribution system segment known as San Francisco HP starting around 1:07:30 p.m. Pacific standard time on February 6, 2019.⁵ This is consistent with other data sources for the time the release began. The system did not signal a Low or Low-Low alarm, as the pressure only dropped around 1.25 psi during the release at the nearest two pressure transmitters, which were located 0.5 miles and 0.9 miles from the release point.⁶

PG&E does not currently use rate-of-change alarms and has stated the “current focus of [their]

³ The nearest pressure transmitter to the accident site was located 0.5 miles away. This value is based on hydraulic model calculation.

⁴ Hi-Hi alarms trigger when the measured quantity exceeds a certain prescribed value, generally approaching the MAOP of the segment. Low alarms trigger when the measured quantity falls below a certain prescribed value, and Low-Low alarms trigger at an even lower threshold than the Low alarms and are a more critical alarm.

⁵ HP stands for High Pressure.

⁶ The Low alarm settings for these pressure transmitters were 21 psig and 40 psig, respectively.

SCADA system is on tracking regulator performance rather than identifying dig-ins.”⁷ PG&E provided the following elaborative text regarding their SCADA system as it relates to third party damage:

Because the settings are designed to identify system underperformance in serving customer load and not to identify dig-ins, PG&E does not expect an alarm to trigger during a dig-in event. PG&E has received some Low or Low-Low alarms during dig-in events, but only if the dig-in occurs in the immediately vicinity of a SCADA monitoring site and if pressure exceeded the High-High or Low limits. These settings are consistent with the design of all PG&E gas distribution SCADA sites. PG&E has determined that the most reliable, timely notifications of dig-ins comes from the public making 911 calls to report an emergency.

ATTACHMENTS: 1, 6, 7

F. Excavator Crew, Equipment, and Preparation

Verizon Sourcing, LLC (Verizon) contracted MasTec Network Solutions, Inc. (MasTec) to install conduit for fiberoptic cabling, including the necessary excavation work involved. MasTec subsequently subcontracted this work to Advanced Fiber Works, Inc. (Advanced Fiber). Lastly, Advanced Fiber subcontracted Kilford Engineering, Inc. (Kilford) to execute the conduit installation.

Kilford’s scope of work included trench excavation to a maximum depth of 36 inches and installation of 2-inch high density polyethylene conduit inside of 4-inch polyvinyl chloride piping and associated handholes from 3310 Geary Boulevard to the intersection of Geary Boulevard and Masonic Avenue in the northmost lane heading west.^{8,9} The scope of work excluded obtaining necessary permits, surveying, engineering, final pavement restoration, posting for no parking, excavating in rock, and shoring of trenches. The contractor executing the work, as stated in the agreement between Mas Tec and Verizon,

⁷ Rate-of-change alarms identify swift changes in pressure, whether they be increases or decreases, outside of the range of normal operational swings.

⁸ The scope of work for this project involved the installation of 10 handholes.

⁹ Over this distance of about 6 standard city blocks, the scope of work called for 1888 feet of trenching and 3798 feet of conduit installation.

was responsible for notifying all public utilities via one-call “48 hours prior to construction activity,” as well as “potholing each utility to determine size, location, and depth prior to crossing.”¹⁰ The scope of work also stated that unless “otherwise noted, contractor shall maintain a minimum of 24 inches separation from existing utilities.”

Kilford is currently licensed by the California Department of Consumer Affairs Contractors State License Board (CSLB) to perform excavation work within the state of California, as is MasTec, under the classification of Class A - General Engineering Contractor.¹¹ Advanced Fiber and Verizon are not currently licensed in the state of California. Kilford was issued their first CSLB license on October 26, 2018 and had been in business for a little over three months at the time of the accident.^{12,13}

In preparation for the excavation involved in the scope of work, Kilford submitted a one-call ticket, USA-X90210166, on January 21, 2019 as well as a second ticket, USA-X902201229, on January 22, 2019.¹⁴ PG&E closed ticket USA-X902201229 on January 24, 2019 due to incorrect location information provided on the ticket. The PG&E locator clarified the requested location on ticket USA-X90210166 with the Kilford requestor as a six-block section of the north side of Geary Boulevard between Emerson Street and Parker Avenue. From January 28, 2019 to January 29, 2019, the PG&E locator located and marked all buried utility lines within a 50-foot wide segment on the north side of Geary Boulevard from Emerson Street to Parker Avenue using white, red, yellow, and blue spray paint, as appropriate for each utility.¹⁵ Visual evidence and documentation show the PG&E locator properly marked and located all PG&E natural

¹⁰ One-call is also known as 811, which is the phone number to call to request a locate of buried utilities in an area where excavation is to occur.

¹¹ MasTec is also licensed as a C-10 Electrical Contractor, C-7 Low Voltage Systems Contractor, and B – General Building Contractor.

¹² Interview testimony states Kilford had been in business for 4 months, which is inconsistent with CSLB licensing.

¹³ Common Ground Alliance’s Best Practices Guide Version 16.0 Section 2.7 recommends that excavation contractors “possess the qualifications necessary to conduct such activities in a manner that is skillful, safe, and reliable.”

¹⁴ The state of California Government Code, Title 1, Division 5, Chapter 3.1, Article 2, Section 4216.2(b) states the excavator is to place the one-call ticket no earlier than 14 calendar days before the proposed start of work. From the time of ticket to date of saw-cutting was 14 calendar days; from the time of ticket to the date of trenching was 16 calendar days.

¹⁵ 49 Code of Federal Regulations Part 192.614 requires pipeline operators to participate in a one-call center and provide locate and mark services to excavators that notify the operator of any planned excavation work in the region of their facilities.

gas facilities within the requested area, including the branch connection where the damage occurred and both the 4-inch and 2-inch natural gas mains. The Kilford employee who requested the one-call tickets and reviewed the marks with the PG&E locator was not on site for the excavation work; he later performed a walk-through with another Kilford employee, the operator of a mini excavator, one week prior to the start of work.¹⁶

On Monday February 4, 2019 and Tuesday February 5, 2019, an employee of Sullivan's Concrete Sawing saw-cut an approximate 4-foot wide strip of concrete road-top from 3310 Geary Boulevard to the intersection of Geary Boulevard and Cook Street. The concrete was saw-cut in the northmost lane of Geary Boulevard heading west, about 8 feet from the sidewalk. Two Kilford employees assisted in this activity.

To perform the scope of work on February 6, 2019, Kilford had five employees on site. Two employees were actively involved in the mechanical excavation: the operator of a mini-excavator and the spotter.¹⁷ The other three employees performed a variety of other tasks, including hand digging using shovels and installing conduit. The operator of the mini excavator acted as job foreman and was certified as a Competent Person in Trench and Excavation Safety.¹⁸

Kilford had a 2018 CAT 305E2 CR mini excavator, purchased in November of 2018, to perform mechanical excavation. The CAT 305E2 CR, produced by Caterpillar Inc., has a maximum dig depth of 144 inches and 40.2-horsepower engine. The digging force when using the bucket is 10050 lbs. The attached bucket has three teeth which are 2 inches wide and 3 inches apart and connected via a 3-inch wide welded bar (Figures 4 and 5).

¹⁶ Common Ground Alliance's Best Practices Guide Version 16.0 Section 5.4 recommends the excavator request a meeting with the locator prior to the marking of utility locations on major or large projects.

¹⁷ Common Ground Alliance's Best Practices Guide Version 16.0 Section 5.18 recommends the contractor have an observer to assist the excavator operator when operating around underground utilities; this person is often referred to as a spotter.

¹⁸ An OSHA "competent person" is defined as "one who is capable of identifying existing and predictable hazards in the surroundings or working conditions which are unsanitary, hazardous, or dangerous to employees, and who has authorization to take prompt corrective measures to eliminate them." [29 CFR 1926.32(f)]



Figure 4. CAT 305E2 CR mini excavator in storage post-accident.



Figure 5. Closer-in view of bucket attachment post-accident.

Kilford also used a CAT 226 skid steer with an SBU 220 hydraulic breaker attachment in order to break up the saw-cut concrete. The CAT 226 has a 58-horsepower engine and is also produced by Caterpillar Inc. The SBU 220, produced by Atlas Copco Group, can perform between 720 and 1380 impacts per minute at an operating pressure range between 1450 and 2175 psi.

Kilford used a variety of other equipment such as hand tools (shovels, brushes, pry bars, hammers), power tools (drills, Sawzall, grinder), a cut-off saw, measuring tapes, lifting slings, chains, shackles, steel plates, and compaction equipment (Jumping Jack & Vibro Plate Compactor).

Two employees of City Rise Safety and Services Traffic Control performed traffic control activities. Geary Boulevard is a busy thoroughfare, and a traffic control contract team was required to complete work safely. At the time of the incident, one of the two traffic control technicians was blocking the portion of Geary Boulevard where the excavation was taking place and about 50 feet of the block prior using cones and signage.

ATTACHMENTS: 8 through 23

Publicly Available: Kilford CSLB License # 1046192, MasTec CSLB License # 984138, Caterpillar Website - CAT 305E2 CR Specifications (mini excavator)

G. Events Leading Up to the Accident¹⁹

From about 7:30 AM to 8:30 a.m., Kilford employees held a safety briefing where they discussed topics such as personal protective equipment, finding utilities, and damage to tools.²⁰ The pre-job safety briefing form was incompletely filled-out and signed by 4 of the 5 employees on site. By 9:00 a.m., traffic control was completed and in place.²¹ The closer traffic control technician was located about 5 feet from the corner of Geary Boulevard and Parker Avenue. There were no representatives of any of the utility companies, including PG&E, at the excavation site until after the accident occurred.²²

Excavation work began that morning around 9:00 a.m. in front of 3310 Geary Boulevard. The CAT 226 skid steer with BNU 220 attachment was used to break the concrete road-top from 3310 Geary Boulevard to 3300 Geary Boulevard and along 30 feet of Parker Avenue, which was then removed using the CAT 305E2 CR mini excavator.²³

The next task after removing the concrete road-top was to excavate a large enough area in front of 3310 Geary Boulevard to install a 4-foot by 4-foot by 4-foot handhole.²⁴ This excavation was accomplished by a combination of hand digging using shovels and mechanical excavation using the bucket attachment on the mini excavator. After this was accomplished, all 5 employees worked to install the

¹⁹ All times in Section G, Events Leading Up to the Accident, are in Pacific Standard Time (PST), and are on February 6, 2019, unless noted otherwise.

²⁰ Common Ground Alliance's Best Practices Guide Version 16.0 Section 5.1.2 recommends the excavator review the location of all underground utilities with their employees prior to the start of the excavation. Section 5.1.0 recommends the use of a pre-excavation checklist, which includes verifying all utilities have been marked and checking "for any visible signs of underground facilities, such as pedestals, risers, meters, and new trench lines."

²¹ Differing testimony has the time traffic control was prepared at 8:30 a.m.

²² Common Ground Alliance's Best Practices Guide Version 16.0 Section 5.3.3 recommends the owner of a utility should be on site to monitor activities if the utility owner deems it necessary.

²³ The State of California Government Code, Title 1, Division 5, Chapter 3.1, Article 2, Section 4216.4(a)(2)(B) states an excavator may use power-operated equipment for the removal of pavement if there are no known utilities within such pavement.

²⁴ Interior dimensions of handhole.

handhole.

Excavation continued down Geary Boulevard in the direction of Parker Avenue by a combination of mechanical and manual means until the trench was sufficiently deep to lay conduit.²⁵ The spotter and operator then continued mechanical excavation about 50 feet to the east along Parker Avenue, while the other three employees remained near the newly installed hand-hole and installed conduit along Geary Boulevard.²⁶ The scope of work called for three lines of conduit to run from the handhole east until the intersection with Parker Avenue, where one of the three lines of conduit would run north along Parker Avenue 30 feet to a telecom pole and the other two lines would continue east along Geary Boulevard towards Spruce Street (Figure 6).

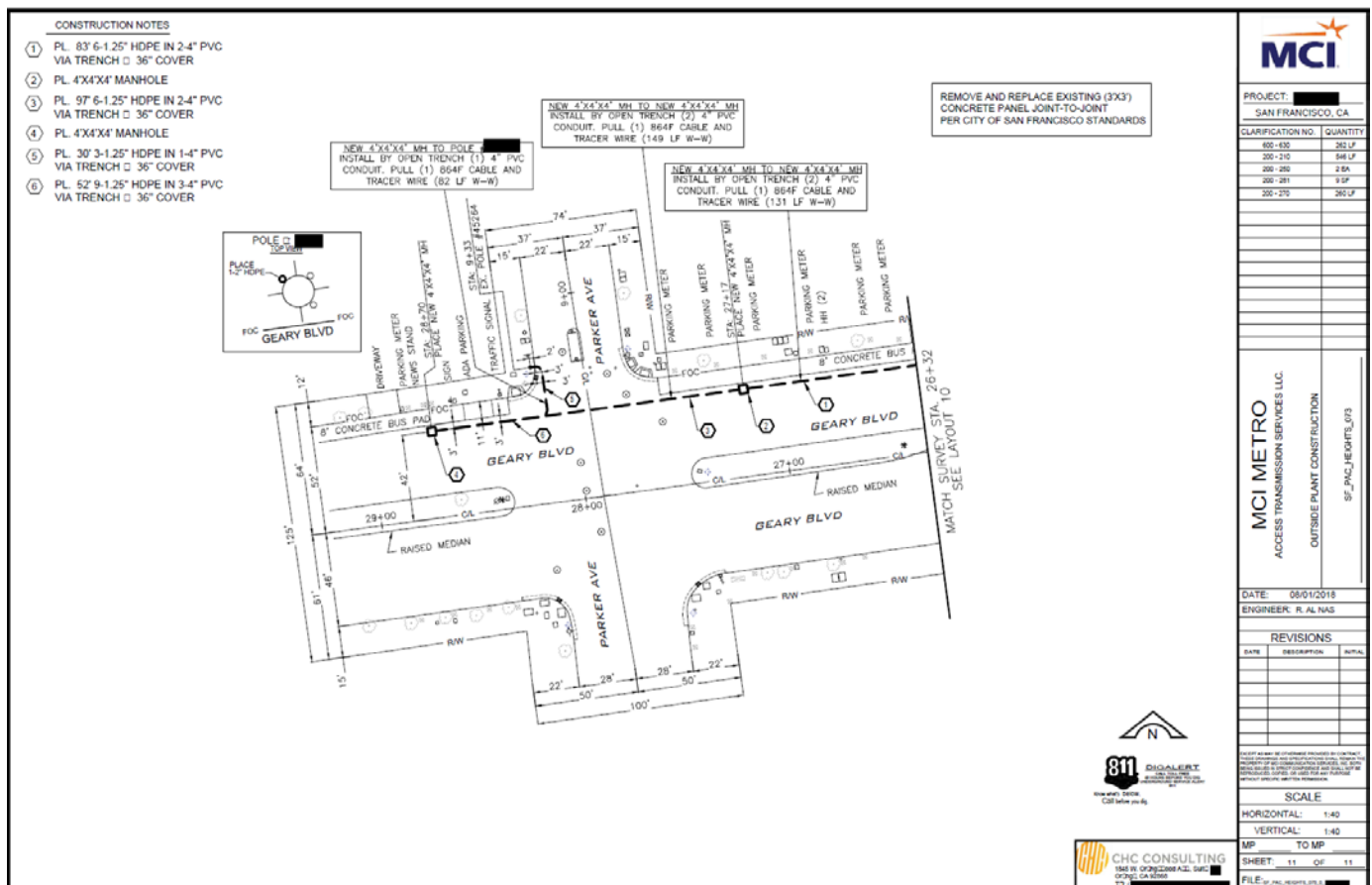


Figure 6. CAD plans for scope of work. Items 4, 5 & 6 were being executed on the day of the accident. Bold dashed line indicates the location of the conduit to be installed, and bold squares indicate the location of handholes to be installed.

²⁵ Scope of work required the trench to have been 36 inches deep.

²⁶ Testimony of the operator states this distance was 70 feet; this is inconsistent with engineering drawings of the project.

In excavation work, particularly excavation involving mechanical digging with heavy equipment, communication between the spotter and equipment operator is critical. The spotter determines the depth of underground utilities and performs various other critical safety tasks, such as making the operator aware of personnel in the area or other hazards. As the view is limited from inside the cab of a backhoe or similar excavation machinery, the operator relies heavily on the spotter to provide them with an awareness of the situation around them. Kilford’s spotter, who primarily communicates in Spanish with English as a second language, states that he used verbal communication in English and hand signals to communicate with the operator on the location of various utilities throughout this project; Kilford’s operator also stated they used a combination of hand signals and English to communicate.²⁷

Likewise, the operator performs a critical role in this two-sided communication process by communicating their intentions to the spotter, requesting information, following spotter guidance, and above all, operating the equipment safely. It is incumbent upon the operator to not mechanically dig within the tolerance zone of any existing utilities, which is 2 feet from the center of the mark made during the one-call response, until their exact locations have been confirmed by hand tools.^{28,29} This requires that all existing utility lines in the area to be excavated have their locations confirmed.^{30,31}

Confirming the location of existing utilities is a two-part process wherein the spotter (a) identifies the utilities’ locations via the use of one-call markings and a probe and then (b) uses lower impact techniques to expose the top of the pipeline, such as pot holing, vacuum methods, or pneumatic tools.^{32,33}

²⁷ The spotter stated: “My English is about 40, 50 percent, and I speak to him in English.” During the interview, an interpreter assisted the spotter.

²⁸ The State of California Government Code, Title 1, Division 5, Chapter 3.1, Article 2, Section 4216.4(a)(1) defines the tolerance zone as 24 inches from the center of the mark in the case of a single mark or 24 inches plus half the specified buried utility width as measured from the outer edges if the full dimensions of the buried facility are marked.

²⁹ In July of 2020, this rule will change. The state of California Government Code, Title 1, Division 5, Chapter 3.1, Article 2, Section 4216.4(a)(2)(C) states that “beginning July 1, 2020, an excavator may use power-operated or boring equipment, as determined by the board, prior to determining the exact location of subsurface installations.”

³⁰ Location in this case refers to location horizontally as well as vertically (depth).

³¹ State of California Government Code, Title 1, Division 5, Chapter 3.1, Article 2, Section 4216.4(a)(1).

³² Hand digging in a localized area is also known as pot holing.

³³ These lower impact methods as well as a few others are recommended by Common Ground Alliance’s Best Practices Guide Version 16.0 Sections 5.19 and 5.20 for all excavation within a tolerance zone of 18 inches from the outside of existing utilities, with the exception of pavement removal.

Location confirmation should be done at regular intervals and at all places where the existing utility and excavation area intersect.

The spotter stated neither of the natural gas mains nor the branch connection had been exposed during the course of the excavation.³⁴ The spotter noted the presence of a metal utility pipe and electrical lines, but he did not see any yellow polyethylene pipe within the trench; no portion of the gas mains was visible to him in either in the trench portion running west to east along Geary Boulevard or in the trench portion running south to north along Parker Avenue. Contradicting the spotter's testimony, the operator stated that the 4-inch and 2-inch natural gas mains were both exposed, but he could not recall where the confirmation exposures were, except that they were not in the immediate area of the branch connection and that the entirety of both mains was not exposed.³⁵ The traffic control technician stated that from where he was located, he could see a one to three-foot portion of the 4-inch main exposed, though he could not recall exactly where the exposure was.

The operator stated that mechanical excavation was not performed within two feet of the natural gas mains. Contradicting this statement, the operator also stated the mini excavator was used to a depth of 30 inches and that the natural gas pipelines were 48 inches deep, which would be a clearance of 18 inches.^{36,37} However, physical evidence shows the depth-of-cover for the mains was 42 inches, giving a clearance of 12 inches if the digging depth was 30 inches.^{38,39} The spotter stated mechanical excavation was done to a depth of two feet from the top of the concrete layer.⁴⁰

³⁴ The spotter stated that all utilities were exposed fully, including a metal pipe and electrical transmission lines. However, he repeatedly stated that there were no yellow pipelines visible at any time during the excavation.

³⁵ At one point in the interview, the operator states the 4-inch main was exposed 4 inches away from the interconnect with the 2-inch main, but at a later point in the interview, he states he could not remember where the lines were exposed. The operator was consistent with his statements that the branch connection was not exposed.

³⁶ Scope of work required a depth-of-cover of 36 inches for the conduit to be installed properly.

³⁷ Common Ground Alliance's Best Practices Guide Version 16.0 Section 5.19 states that mechanical excavation should not occur within a tolerance zone of 18 inches of the outside of existing utilities, whereas State of California Government Code, Title 1, Division 5, Chapter 3.1, Article 2, Sections 4216 and 4216.4(1)(a) have a tolerance zone of 2 feet from the centerline of one-call markings.

³⁸ Post-accident measurements show the depth-of-cover was 42 inches.

³⁹ Depth-of-cover measurement is from the center top of the two mains; it does not account for the extended height of the branch connection.

⁴⁰ The spotter asserted at another point during the interview that mechanical excavation was done to a depth of 30 inches.

While the three other Kilford employees laid conduit along Geary Boulevard in the trench, the operator and the spotter worked to excavate along Parker Avenue. The operator mechanically removed soil, starting at the telecom pole about 30 feet north of the intersection and heading south towards Geary Boulevard. He then moved the excavator to the southeast corner of the excavation trench, parallel to Geary Boulevard and directly south of the natural gas branch connection. From that position, the operator began connecting the trench along Parker Avenue with the trench along Geary Boulevard using the bucket extended along the north-south axis, parallel to Parker Avenue, at the intersection of the two streets. The operator and spotter both stated the tracks of the excavator were facing east and west; the traffic control technician stated the tracks of the excavator were facing north and south.⁴¹

The spotter was in the trench 5 to 7 feet away from the excavator, observing the mechanical excavation, when a loud sound and eruption of soil occurred. At different times during the interview, the spotter stated the bucket of the excavator was (a) resting on the top of the soil or (b) lifting soil from the trench when this eruption occurred. In both cases, the spotter stated the bucket was about 1 ½ to 2 feet away from the soil eruption point. The operator stated this distance was 3 feet and that he was mechanically excavating at the time. The traffic control technician stated the bucket of the excavator was being used when the gas release occurred in the general area of the bucket; however, his back was turned towards oncoming traffic and away from the trench at the time of the release. The physical evidence from the pipeline shows recent mechanical damage consistent with an outside force to the branch connection and 4-inch main. Further details on the collected evidence are available in the Materials Laboratory Factual Report.

ATTACHMENTS: 11, 16, 23 through 26

Publicly Available: State of California Government Code, Title 1, Division 5, Chapter 3.1, Article 2, Sections 4216 to 4216.24; Common Ground Alliance Best Practices, Version 16.0

⁴¹ The traffic control technician's testimony regarding the orientation of the excavator is consistent with the as-found condition of the excavator post-fire.

H. Excavator Post-Damage Activities

The release of gas from the damaged branch connection was apparent to the excavation crew due to a loud sound and soil being thrown into the air. The spotter states he immediately climbed out of the trench and ran to the north, away from the release site. The operator states he left the excavator, then remembered he left his phone in the excavator cab and went back. When he went back to the excavator to retrieve his phone, the gas ignited. The operator was uncertain if he had left the excavator on or turned it off; the spotter states the excavator was left off. The traffic control technician stated the operator moved the mini excavator bucket out of the trench after the gas started releasing.⁴² The other three employees also ran from the direction of the release. None of the five Kilford employees were injured, nor was the traffic control technician.⁴³ There are no indications in the interviews or provided documentation that any Kilford employees called 911, 811, or PG&E after the gas release or that any of the Kilford employees attempted to evacuate the public from the surrounding area or buildings.⁴⁴ The photographs below show the mini excavator as found after the fire was extinguished (Figures 7 and 8).

⁴² This is consistent with photographs taken of the excavator as found after the fire had been put out.

⁴³ The traffic control technician was knocked down by the force of the initial eruption but did not require medical attention.

⁴⁴ Common Ground Alliance's Best Practices Guide Version 16.0 Section 5.24 states that when an excavator discovers or causes damage to a buried utility, they should contact the utility owner and 811. Section 5.25 further states that if "the damage results in the escape of any flammable, toxic, or corrosive gas or liquid or endangers life, health, or property, the excavator responsible immediately notifies 911 and the facility owner/operator." The excavator is also recommended to take "reasonable measures to protect everyone in immediate danger, the general public, property, and the environment until the facility owner/operator or emergency responders arrive and complete their assessment."

109–199 Parker Ave, San Francisco, CA 94118



Figure 7. Photograph of the trench along Parker Avenue and the mini excavator as found post-fire. View facing due south. Photograph courtesy of PG&E.

109–199 Parker Ave, San Francisco, CA 94118



Figure 8. Photograph of the trench along Geary Boulevard and the mini excavator as found post-fire. View facing due west. Photograph courtesy of PG&E.

About 6 seconds after gas began releasing from the pipeline, an unknown ignition source caused the gas to ignite.⁴⁵ The flames, which extended above the height of a two-story building, impinged upon Hong Kong Lounge II, a fully occupied restaurant located at 3300 Geary Boulevard. Restaurant employees and patrons self-evacuated the restaurant immediately, and there were no injuries to the public. The photograph below shows the accident scene with the fire ongoing (Figure 9).



Figure 9. Photograph of accident scene during emergency response. View from the southeast corner of the intersection of Geary Boulevard and Parker Avenue. Photograph courtesy of PG&E.

Two PG&E employees spoke with the Kilford operator during the emergency response: a Gas Service Representative (GSR) and a Dig-in Reduction Team (DiRT) investigator. The first GSR on-scene met with the excavator to have him fill in a Gas Dig-in First Responder Form with the details of what occurred. The GSR stated that the operator wrote down that “he was shoveling and it exploded.”

The DiRT investigator also met with the operator of the excavator to discuss the accident, as well as the Kilford employee who had been present during the 811 locate walkthrough. During her discussion

⁴⁵ The spotter and traffic control technician state the amount of time between the release and ignition was 6 seconds, whereas the operator states this time as 20 seconds.

with the operator, he stated that the tee caused him an issue “because it was higher than the 2-inch gas line that he exposed and he thought that he had enough room.” The DiRT investigator concluded that Kilford had struck the branch connection while mechanically excavating within the tolerance zone due to a failure to properly expose the 2-inch and 4-inch mains and branch connection.

Further details on the events which occurred after the initiation of the accident, including other PG&E activities and actions taken by the San Francisco Fire Department (SFFD), San Francisco Police Department (SFPD), and other organizations are summarized later in this report in Section K, Emergency Response Activities.

ATTACHMENTS: 16, 23, 25 through 29

I. Excavator Procedures and History

1. Employee Code of Safe Practices and Other Policies

Kilford’s Employee Code of Safe Practices covers issues such as competent person, stop work authority, safety meetings, emergency action plans, and excavation and trenching practices.

Kilford designates the competent person on site as “responsible for hazard recognition and protection.” As stated in Kilford procedures, the competent person, who is also known as the job foreman, “has complete authority to suspend work activities and remove exposed employees from work locations;” all other employees are urged to stop and seek instruction if they “have a safety problem related to this job or have any doubt as to the safety of any work activity including the use of tools and equipment.” Safety meetings are conducted at a minimum weekly by the foreman, and attendance is mandatory for all employees on the job site.

One section of Kilford’s procedures covers activities to be undertaken in case of an emergency, known as an emergency action plan. Among the listed emergencies are natural gas leaks and explosions. In the event of an emergency, employees’ “first response shall be whatever action limits continuing damage.” The emergency action plan has the phone number for local emergency dispatch as well as 911. These

procedures do not specify that Kilford should contact 911 or utility operators in the case of a line strike.

The final section of Kilford’s Employee Code of Safe Practices covers excavation and trenching. It states that trenches 5 feet deep or less do not require shoring when under the observation of a competent person who deems the trench to be stable and trenches less than 4 feet deep do not require ladders. This section reiterates that the competent person has full stop work authority. Excavation work is not to begin until 811 has been notified at least two days in advance of any proposed work and the area has been “marked as specified in Government code 4216.”⁴⁶ A meeting is required between existing utility owners and Kilford “prior to the start of excavation to determine any actions or activities necessary to verify the location of that installation;” as previously stated, PG&E performed a walkthrough of the locate marks with a Kilford employee one week prior to the excavation work.

Kilford has two additional policies relating to excavation: Field Manual for Trenching, and Excavation Competent Person Manual. The Field Manual for Trenching is a quick guide which covers OSHA policies and safety practices, mainly centered around prevention of cave-ins and proper benching and shoring. The Excavation Competent Person Manual covers relevant OSHA regulations in detail. 29 Code of Federal Regulations (CFR) Part 1926.651(b)(3) states that “exact location of the [underground] installations shall be determined by safe and acceptable means” whenever the excavation approaches the marked location of buried utilities.

Kilford did not provide records of any training provided to their employees. The operator of the excavator had served as project foreman, superintendent and safety representative for a different contractor since 2006 and performed supervisory activities in those roles.

ATTACHMENTS: 12, 13, 16, 30 through 33

2. Prior Utility Damage History

On January 12, 2019, Kilford damaged a 2-inch copper water main during excavation work for

⁴⁶ The code referenced by Kilford here is inferred as State of California Government Code, Title 1, Division 5, Chapter 3.1, Article 2, Sections 4216 to 4216.24.

Mastec on Hawthorne Street between Folsom Street and Harrison Street in San Francisco, CA.⁴⁷ Kilford was issued their first CSLB license on October 26, 2018 and had been in business for eleven weeks when the damage to the water main occurred. The water main was 10 inches below grade in rocky ground/concrete located directly under a wooden beam.⁴⁸ Kilford states they used a bucket attachment with sharp teeth and no welded blunt blade on the mini excavator due to difficult terrain.⁴⁹ During mechanical excavation to create a trench for fiberoptic conduit installation, the teeth of the bucket penetrated the water main as stated in the after-incident reports.⁵⁰ Kilford states the water main was unmarked and provided a one-call ticket but no documentation showing the line was not marked prior to excavation.⁵¹ See Figures 10 and 11 below for photographs of the scene after the line strike and the damaged pipe in trench.

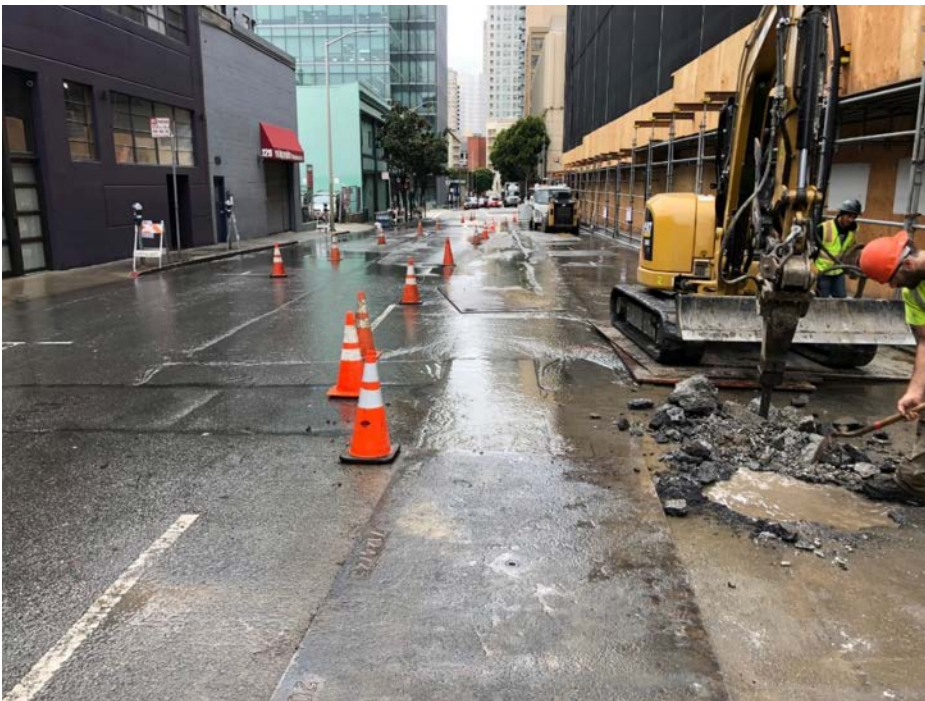


Figure 10. Hawthorne Street after water main damaged. CAT 305 E2 excavator on right with jackhammer attachment. View facing northwest.

⁴⁷ Initial incident report has the date of line strike as January 14, 2019. Initial information identified the line as a water main; later information provided refers to the line as a water service line, not main.

⁴⁸ Initial incident report has the depth-of-cover of the water main as 18 inches.

⁴⁹ This is the same CAT 305 E2 mini excavator used during the events of February 6, 2019. Photographs show a jackhammer attachment on the excavator.

⁵⁰ Photographs show the excavator near the line strike area after the incident with a jackhammer attachment, not a toothed bucket. Documentation from Kilford states a toothed bucket was used and was the implement which damaged the pipe.

⁵¹ The one-call ticket for this project as received by the NTSB did not contain positive confirmation from the San Francisco Water Department. No photographs in the damage area prior to excavation were available which showed the lack of markings; the only pre-excavation photograph is in a different portion of the excavation area.

Photograph courtesy of Kilford Engineering, Inc.



Figure 11. Damaged water main on Hawthorne Street. Photograph courtesy of Kilford Engineering, Inc.

ATTACHMENTS: 16, 22, 34, 35

J. California Damage Prevention Regulatory Bodies and Rules

1. Contractors State License Board

In the state of California, contractors are licensed by the Department of Consumer Affairs Contractors State License Board (CSLB). The CSLB was created in 1929 and is headed by a 15-member Board composed of 5 contractors and 10 public members, including a labor representative, a local building official, and a statewide senior citizen organization representative. Appointments to the CSLB are made by the Governor of California and the California State Legislature. The approximate 400 staff employees of the CSLB oversee the licenses of about 300,000 contractors, including investigating customer complaints against contractors and any resulting disciplinary actions.

In order for an excavation company to obtain a Class A – General Engineering Contractor license, they are required to obtain a contractor bond and worker’s compensation insurance and must have one employee with four years of practical journey-level experience within the previous ten years, known as the

“qualifier.”^{52,53} This qualifier must also pass a required examination and undergo a criminal background check. Multiple employees may be added to the license, but only officers of the company (minimum two) are required to be registered under the corporate license and the employee serving as qualifier who has the “knowledge, experience, and skills to manage the daily activities of a construction business (including field supervision).” The qualifier for Kilford was the employee who performed the walkthrough of the 811 locate the week prior to the incident and is also the Chief Executive Officer of Kilford. The only other individual registered on Kilford’s license was the operator of the mini excavator, who is registered as an officer of Kilford.

Enforcement actions from the CSLB fall into three categories:

1. Licensing issues, such as failure to be adequately bonded, cancellation of workers’ compensation insurance, not reporting a civil judgment against the licensee to the CSLB, or lack of a qualifier
2. Response to consumer complaints, such as poor workmanship, building code violations, project abandonment, failure to pay subcontractors, suppliers or employees, or lack of diligence in executing a construction project
3. Contractors illegally performing work without a license

If the investigation from CSLB staff into any of these three categories results in the finding that a violation(s) has been committed by the contractor, the CSLB can suspend the license, require the licensee to obtain an additional disciplinary bond, enforce a probation period with agreed upon terms and conditions, revoke the license, request an injunction to halt the activity, require the company to pay a fine to cover investigation and enforcement costs, and/or refer the issue to the local district attorney for criminal charges.⁵⁴ When a contractor is found to have violated California state law, they are issued a

⁵² Three of these four years may be substituted with equivalent education and/or technical training.

⁵³ This employee can be an officer of the company or responsible managing employee, such as a job foreman.

⁵⁴ In 2018, the CSLB referred 1785 cases for criminal prosecution.

citation with a fine.⁵⁵ More serious enforcement actions are referred to as an “accusation” and stay on public record from the time the accusation is issued to either (a) five years from the date of return to compliance, or (b) in the case of suspension or probation, for seven years from the date of the settlement of the accusation. Accusation enforcement actions include suspension, revocation of license, and restitution order to the injured party.⁵⁶ There are currently no outstanding citations or accusations against Kilford.

The California Contractors License Law & References Book, as written and approved by the CSLB, discusses excavating and trenching regulations.⁵⁷ The main code relevant to this accident is the State of California Code of Regulations (CCR), Title 8, Division 1, Chapter 4, Subchapter 4, Article 6, Sections 1539 to 1541. In CCR 1541(b)(3), the code requires that whenever excavation is to be performed near existing buried utilities, “the exact location of the installations shall be determined by safe and acceptable means that will prevent damage to the subsurface installation” and provides a reference to State of California Government Code (GOV), Title 1, Division 5, Chapter 3.1, Article 2, Section 4216.4. As stated in CCR 1541(b)(5), if an excavator damages any underground facility, they “shall immediately notify” the operator/owner of the buried utility. If the excavator does not have contact information for the owner of the utility, they should contact the one-call center to obtain information on the utility and then notify them accordingly.⁵⁸ Additionally, this code section requires that if damage occurs to a high priority subsurface installation that “results in the escape of any flammable, toxic, or corrosive gas or liquid or endangers life, health or property, the excavator responsible shall immediately notify 911.”⁵⁹ The

⁵⁵ In 2018, the CSLB issued 2,025 citations and collected \$2,148,521 in civil penalties from those citations. \$794,197 was ordered in restitution to the injured parties as a result of the citations.

⁵⁶ In 2018 via accusation, the CSLB revoked 395 licenses, recovered \$521,136 in fines for investigative costs, and ordered \$605,518 in restitution to the injured parties.

⁵⁷ The relevant version of the California Contractors License Law & References Book at the time of the accident was the 2019 edition.

⁵⁸ The one-call center is referred to in the code as a “regional notification center” and is also commonly called the 811-call center.

⁵⁹ CCR Title 8, Division 1, Chapter 4, Subchapter 4, Article 6, Section 1541(b)(1)(B) states: “High priority subsurface installations are high pressure natural gas pipelines with normal operating pressures greater than 415 kPA gauge (60 p.s.i.g.), petroleum pipelines, pressurized sewage pipelines, conductors or cables that have a potential to ground of 60,000 volts or more, or hazardous materials pipelines that are potentially hazardous to employees, or the public, if damaged.”

referenced code GOV 4216.4 further requires the excavator “call 911 emergency services upon discovering or causing damage” to any high priority subsurface installations or any time in which damage to a natural gas or hazardous liquid pipeline “results in the escape of any flammable, toxic, or corrosive gas or liquid,” regardless of normal operating pressure. Neither interviewee from Kilford noted that they contacted 811, 911, or PG&E after the gas release, and there is no evidence in San Francisco Department of Emergency Management call logs to show Kilford contacted 911 post-accident.

The remainder of CCR 1539 to 1541 refers to proper one-call location prior to excavation work and safe practices for excavation, such as hazard identification and shoring requirements. In CCR 1541(k), the code puts responsibility on the competent person on scene to inspect for hazardous conditions during the excavation and requires that should the competent person find any issues, the “exposed employees shall be removed from the hazardous area until the necessary precautions have been taken to ensure their safety.”

The CSLB also currently has the authority to enforce GOV 4216 to 4216.24. These regulations cover a wide variety of topics, including one-call and location prior to excavation, required excavator response in the event of damages, tolerance zone for mechanical excavation, applicable civil penalties in the case of a violation, and creation of the California Underground Facilities Safe Excavation Board. These regulations are footnoted throughout this document as appropriate.

ATTACHMENTS: 16, 25, 27, 28

Publicly Available: CSLB Website – About Us, CSLB 2018 Annual Report, California Contractors License Law and References Book, Kilford CSLB License # 1046192, State of California Code of Regulations, Title 8, Division 1, Chapter 4, Subchapter 4, Article 6, Sections 1539 to 1541; State of California Government Code, Title 1, Division 5, Chapter 3.1, Article 2, Sections 4216 to 4216.24

2. Dig Safe Board

Investigation of accidents involving facilities damaged during excavation are the purview of the California Underground Facilities Safe Excavation Board, also known as the Dig Safe Board, which was

established by the Dig Safe Act of 2016 to “investigate accidents, develop excavation safety standards and coordinate education and outreach programs.” The Board is comprised of nine members who are appointed by the Governor of California and the California State Legislature and falls under the umbrella of the California Office of the State Fire Marshal. The first meeting of the Dig Safe Board was held on January 9, 2018, and 8 other meetings were held in 2018. As of the end of 2018, the Dig Safe Board had 10 staff members including a Chief of Investigations, two Supervising Investigators, and one Special Investigator.⁶⁰ An additional 4 Special Investigators were onboarded in early 2019. California State Legislature’s Budget Act of 2017-18 authorized a total of 21 staff members.

The Dig Safe Act of 2016 directed the Dig Safe Board to enforce GOV 4216 to 4216.24, which outlines requirements to prevent damage to existing utilities and actions that must be taken should such damages occur.⁶¹ The Dig Safe Board’s 2018 Results Report states they intend to start enforcing GOV 4216 to 4216.24 starting on July 1, 2020.

The Dig Safe Board is also charged with creating new rules and regulations “where none currently exist to improve worker and public safety across the state.”⁶² One regulation has been passed which relates to fees used to fund the Dig Safe Board; two rulemakings are currently proposed and under review. GOV 4216.18 states that the Dig Safe Board must also pass a “set of standards relevant to safety practices in excavating around subsurface installations and procedures and guidance in encouraging those practices.” These standards must address how utility operators and excavator contractors can prove compliance with GOV 4216.2, 4216.3, 4216.4 and 4216.10 and define “reasonable care” as it relates to using hand-tools within the tolerance zone.⁶³

⁶⁰ Staff refers to all employees of the Dig Safe Board who are not Board Members.

⁶¹ The Dig Safe Board is required to investigate possible violations of State of California Government Code (GOV), Title 1, Division 5, Chapter 3.1, Article 2, Section 4216 to 4216.24 as stated in GOV 4216.19.

⁶² Authority to create new rules and regulations is given in State of California Government Code, Title 1, Division 5, Chapter 3.1, Article 2, Section 4216.22.

⁶³ State of California Government Code, Title 1, Division 5, Chapter 3.1, Article 2, Section 4216.2 relates to 811 locate tickets, 4216.3 discusses field marks made during the locate, 4216.4 covers excavation within the tolerance zone and required notifications upon damages, and 4216.10 outlines requirements for areas of continual excavation.

The Dig Safe Board held a 45-day comment period for their Area of Continual Excavation, Investigation, & Enforcement Rulemaking from May 17, 2019 to July 1, 2019. This proposed rulemaking adds regulations to the CCR under Title 19, Division 4, Chapters 1 to 4, from Section 4000 to 4361. Chapter 2 of this proposed code covers investigations, and if passed, substantively changes the current communications and investigations processes.⁶⁴ Chapter 3 defines what sanctions the Dig Safe Board has the authority to issue and the process by which any potential violations are resolved.

The Dig Safe Board intends to use a progressive enforcement process of (1) warnings, (2) mandatory education, and finally, (3) fines. The training course which will be used to meet the Dig Safe Board's imposed education sanctions is currently being built in-house. This course will cover materials from GOV 4216 to 4216.24, one-call center information, and the Common Ground Alliance's (CGA) Best Practices Guide through the use of three case studies of past dig-in events in California and another state. The course is anticipated to be complete and ready for use in enforcement in July of 2020.

The Dig Safe Board held a 45-day comment period for their Contact Information, Area of Continual Excavation, and Power Tools Rulemaking from November 8, 2019 to December 23, 2019. The proposed rulemaking adds additional regulations to the CCR under Title 19, Division 4, Chapters 1 to 4.

In July of 2020, the Dig Safe Board will be required to allow power tools and boring equipment to be used within the tolerance zone of a buried utility prior to locating that utility, according to GOV 4216.4(a)(2)(C). This requirement was addressed by the Dig Safe Board in proposed CCR 4501, which allows excavators to use specific, small power tools strictly for the purposes of determining the exact location of underground installations if lower-risk circumstances are met.

In the time before the Dig Safe Board is fully established with all rulemakings and authority, the

⁶⁴ Proposed CCR Section 4100 requires the excavator, after immediately calling 911, to notify the local one-call center within 2 hours of any damage to a natural gas or hazardous liquid pipeline, regardless of if product is released. The one-call center must then notify the Dig Safe Board within 1 hour after they receive notification. Proposed Section 4150 provides authority to investigators of the Dig Safe Board, and Section 4151 also gives these investigators access to any necessary records or sites in order to perform their investigations.

California Public Utilities Commission (CPUC) maintains its enforcement authority as it relates to natural gas excavation damage prevention. When the proposed rulemakings are implemented, the CPUC will maintain its ability to issue sanctions under its specific authority, separate from the Dig Safe Board. In 2016, the CPUC issued 12 Notices of Probable Violation (NOPV) for violations of federal law.⁶⁵ These NOPV determinations were issued to CPUC-jurisdictional natural gas operators, not excavation contractors, as the CPUC does not have jurisdiction over contractors. As of the date of this report, the CPUC has issued no NOPV determinations to PG&E for this accident.⁶⁶

ATTACHMENTS: 36 and 37

Publicly Available: Dig Safe Board Website – About Us; Dig Safe Board 2018 Results Report; Dig Safe Board 2019-2020 Education and Outreach Plan; Dig Safe Board August 2019 Meeting Line Item 4 Staff Report; State of California Government Code, Title 1, Division 5, Chapter 3.1, Article 2, Sections 4216 to 4216.24; State of California Code of Regulations, Title 8, Division 1, Chapter 4, Subchapter 4, Article 6, Section 4010; Notice of Proposed Rulemaking, State of California Code of Regulations, Title 8, Division 1, Chapter 4, Subchapter 4, Article 6, Sections 4000 to 4361; Notice of Proposed Rulemaking, State of California Code of Regulations, Title 8, Division 1, Chapter 4, Subchapter 4, Article 6, Sections 4003(a)(1), 4305, 4310, 4345, 4401, 4501

3. Damage Prevention Program Oversight

In 2016, the Pipeline and Hazardous Materials Safety Administration (PHMSA) performed an audit of California’s enforcement of damage prevention law and deemed it inadequate.⁶⁷ Multiple state agencies, including the CPUC, the California Office of the State Fire Marshal, and the California Attorney General’s Office stated to PHMSA that no enforcement actions or civil penalties had been issued for violations of the

⁶⁵ A NOPV informs the natural gas operator they are being charged with probable violations of pipeline safety statutes or regulations. These allegations are accompanied by either a proposed compliance order identifying actions the operator is required to take, proposed civil penalties for these alleged violations, or both.

⁶⁶ Further details on federal and state pipeline code are provided in referenced document “Summary of Pipeline Regulations.”

⁶⁷ The damage prevention law referred to in the PHMSA inadequacy letter is State of California Government Code, Title 1, Division 5, Chapter 3.1, Article 2, Sections 4216 to 4216.24.

damage prevention law in the prior calendar year.^{68,69} In 2017, PHMSA audited the State of California again, and again found the state’s enforcement of damage prevention law to be inadequate.

PHMSA uses the following 7 criteria to determine the adequacy of state programs for damage prevention:⁷⁰

1. Does the state have enforcement authority, including civil penalties?
2. Is there a designated enforcement body?
3. Is the state using its authority and making enforcement records available to the public?
4. Does the state have a reliable means of learning about damages?
5. Does the state have damage investigation practices that are adequate to determine the at-fault party when damage occurs?
6. At a minimum, does state law require that:
 - a. Excavators must call 811 before digging
 - b. Excavators must "respect the marks"
 - c. If damage to a pipeline occurs:
 - i. Excavator must report damage to operator at earliest practical moment.
 - ii. If release occurs, excavator must call 911.
7. Are exemptions from the damage prevention law limited? Written justification of exemptions is required.

Due to the determined inadequacy of California’s damage prevention enforcement, PHMSA has the authority to enforce federal damage prevention laws contained within 49 Code of Federal Regulations

⁶⁸ Current regulation allows for the issuance of civil penalties to excavators in amounts not to exceed \$10,000 for negligent violations and \$50,000 for knowing and willing violations of State of California Government Code, Title 1, Division 5, Chapter 3.1, Article 2, Sections 4216 to 4216.24, as stated in 4216.6(a)(1) and 4216.6(a)(2).

⁶⁹ Common Ground Alliance’s Best Practices Guide Version 16.0 Section 7.3 recommends “penalties for failure to comply with the damage prevention laws and regulations.” This penalty system is recommended to have a tiered structure with different levels of violation, addressing both mitigating and aggravating factors, dependent on the level of severity and repeat offense(s). No excavators are to be made exempt from the penalty system. Sections 7.1 and 7.3 state training is to be used as an alternative or supplement to civil penalties.

⁷⁰ 49 Code of Federal Regulations (CFR) Part 198.55.

(CFR) Part 196. 49 CFR 196.103 states that excavators are required to place a one-call ticket, not excavate prior to location and marking of all underground facilities and excavate “with proper regard for the marked location of pipelines” in order to prevent damage. 49 CFR 196.107 requires the excavator to notify the pipeline operator as soon as practicable if any damages occur. 49 CFR 196.109 requires the excavator to notify 911 as well if the damage to the pipeline “causes the release of any PHMSA regulated natural and other gas or hazardous liquid.”

PHMSA’s authority to enforce 49 CFR 196 does not restrict the state of California from enforcing federal and state regulations alongside PHMSA. In its most recent letter to the Dig Safe Board, PHMSA provided the following statement regarding their ruling:

PHMSA is pleased to learn of the establishment of the California Underground Facilities Safe Excavation Board. It is our hope that once the Board is fully established and has developed the necessary rulemaking, that the enforcement program will satisfy PHMSA's requirements and be deemed adequate.

In their audits, PHMSA did not find fault with the majority of the state of California’s regulations on damage prevention. Instead, the programs were deemed inadequate because these regulations were not routinely enforced. No agency within the state of California is currently enforcing GOV 4216 to 4216.24 on a systematic basis; the CSLB has historically only enforced those regulations when a complaint has been filed against a contractor accusing a violation.^{71,72,73}

Two pathways currently exist in the state regulations for enforcement in the future. The first pathway is in GOV 4216.6(c)(1), which states that once the Dig Safe Board has investigated an accident and determined a violation occurred, the CSLB must consider the Dig Safe Board’s findings and either

⁷¹ According to CPUC data, there were 5,256 damages to underground natural gas facilities from excavation in 2016.

⁷² From PHMSA 2017 audit of California’s damage prevention program.

⁷³ Common Ground Alliance’s Best Practices Guide Version 16.0 Section 4.16 recommends “a proper investigation is performed to determine not only the responsible party but also the root cause of the damage” every time an underground facility is damaged.

accept, amend, or reject them.^{74,75} If accepted or amended, “the Contractors’ State License Board shall enforce the provisions of [GOV 4216 to 4216.24] on contractors,” This rule is currently not in practical use, since the Dig Safe Board has not finalized its rulemakings on investigation. The second pathway is in GOV 4216.6(e); in July of 2020, the Dig Safe Board will have the authority to directly enforce GOV 4216 to 4216.24 on parties under its jurisdiction.

ATTACHMENTS: 36 through 41

Publicly Available: Title 49 Code of Federal Regulations 196; Title 49 Code of Federal Regulations Part 198; State of California Government Code, Title 1, Division 5, Chapter 3.1, Article 2, Sections 4216 to 4216.24

K. Emergency Response Activities⁷⁶

1. Pacific Gas & Electric

i Initial Notification, Establishment of Command, Field Resource Acquisition

At 1:12 p.m., a call was made into PG&E’s Customer Call Center by an unknown individual.⁷⁷ At 1:14 p.m., a call was made into PG&E’s Gas Dispatch and Scheduling Center from the San Francisco Department of Emergency Management 9-1-1 call center, notifying PG&E of an explosion and active fire.⁷⁸ These calls were the first notifications to PG&E of the accident; there were no alarms or significant trends to indicate to the Gas Distribution Control Center (GDCC) that a release had occurred. A Gas Maintenance and Construction (GM&C) supervisor was notified of the incident by the Gas Dispatch and Scheduling Center and was designated as the Incident Management Team (IMT) lead at

⁷⁴ The Dig Safe Board is also required to refer cases based on investigation results as stated in the state of California Government Code, Title 1, Division 5, Chapter 3.1, Article 2, Section 4216.19(d).

⁷⁵ This rule has been further strengthened through a Memorandum of Understanding (MOU) between the Dig Safe Board and the CSLB which was ratified in November of 2018.

⁷⁶ All times in Section K, Emergency Response Activities, are in Pacific Standard Time (PST), and are on February 6, 2019, unless noted otherwise.

⁷⁷ PG&E’s Gas Emergency Response Plan (GERP) Section 3.2.1.1 discusses how PG&E can be notified of an incident and who is internally and externally notified once the incident is known. Notification proceeded as outlined in the GERP.

⁷⁸ The San Francisco Fire Department’s “Natural Gas Leaks” procedures note that PG&E should be notified whenever a gas leak is suspected.

1:17 p.m.⁷⁹

Once the IMT lead was notified of the incident, he began dispatching personnel to the scene, starting with five GM&C foremen and their crews in the order of their distance from the site. His next notification was to the Superintendent of the San Francisco Division, who he then designated as the Incident Commander (IC). The IC dispatched to the scene at that time and arrived about 20 minutes later, around 1:45 p.m. The IMT lead also designated another GM&C supervisor as a Deputy IC to assist the IC.

While the IC traveled to the scene, the IMT lead and the GDCC continued dispatching resources: a gas mechanic to obtain tools to squeeze-off a 6-inch steel main, a Gas Service Representative (GSR) to get on-scene information for the IMT and GDCC back in the office, and a Gas Pipeline Operations and Maintenance (GPOM) supervisor to prepare his crew for any necessary valve closures.^{80,81}

The first GM&C crew, which was dispatched at 1:19 p.m., arrived at the site at 1:29 p.m. PG&E's first GSR onsite, who was also dispatched at 1:19 p.m., arrived on scene at 1:33 p.m. This GSR called the GDCC at 1:34 p.m. to confirm the main was struck; he did not perform any evacuations of the public as the San Francisco Fire Department (SFFD) and San Francisco Police Department (SFPD) had already begun evacuations of the public prior to his arrival on scene.⁸² The GPOM supervisor, who was notified at 1:30 p.m., dispatched his crew to the incident scene between 1:35 p.m. and 1:40 p.m. after getting in a

⁷⁹ PG&E has structured teams of support staff for emergency response known as Incident Management Teams. These teams oversee emergency response activities within their local areas, and staff the local Operational Emergency Center in case of an escalated response. Each field division has its own designated IMT staff, which may be exchanged or supplemented as needed.

⁸⁰ PG&E's Gas Emergency Response Plan states that one of the first activities completed by PG&E personnel in the event of an accident is to evaluate how severe the incident is, known internally as an "Incident Level." The level of response, including amount of allocated resources, varies based on this incident level, as determined by the IC. In this case, since the IC was traveling, the IMT lead performed some of the duties of the IC by determining which resources to allocate.

⁸¹ PG&E's Gas Emergency Response Plan Section 3.2.1.3.1 defines the initial resource deployed in all incidents requiring a field response as a Gas Service Representative. This individual performs a variety of tasks on scene, including requesting additional resources, evacuating the public, eliminating ignition sources, and shutting off gas service, if possible and safe to do so.

⁸² PG&E procedure TD-6100P-04, Gas Event Evacuation, discusses when public evacuations are necessary and how to perform them (including details such as establishing a safe zone location and not ringing doorbells when evacuating structures). PG&E's Gas Emergency Response Plan Section 3.2.3 also lays out make-safe activities, including evacuating the public.

safe position to make a call.

The gas mechanic with the 6-inch steel squeezers encountered traffic issues, so the Deputy IC requested police escorts for the mechanic, himself, and his GM&C crew, which were not granted. The Deputy IC stated the police escort was not granted as the officer did not believe that was a service the SFPD offered. PG&E procedure “911 Notification Process” states the GDCC will request assistance from 911 dispatch if PG&E personnel are delayed due to traffic.⁸³ According to provided PG&E and SFPD documentation, the GDCC did not make a police escort request from 911 dispatch. Currently there is no Memorandum of Understanding (MOU) between PG&E and SFPD.

ATTACHMENTS: 5, 27, 29, 42 through 49

ii Initial Valve Isolation Plan, Excavations for Squeeze-offs

While field resources were being gathered, the Senior Distribution Gas System Operator (SDGSO) in the GDCC verbally requested a valve isolation plan (VIP) at 1:28 p.m. A valve isolation plan is used by field personnel to isolate the damaged portion of pipeline and stop the release of gas through the use of squeeze-off(s) and/or valve closure(s).⁸⁴ It is developed by the Gas System Planning (GSP) team and executed by GM&C crews (squeeze-offs) and GPOM technicians (valve closures). The GSP team had already begun work on an initial VIP around 1:24 p.m.⁸⁵ This plan consisted of two squeeze-offs, one on a 4-inch medium density polyethylene distribution main on Parker Avenue to the north of the incident site, and one on a 6-inch steel main in the center of Geary Boulevard to the south of the incident site. Once the IC arrived onsite, he notified the GDCC of his arrival and requested the VIP at 1:46 p.m.; work to create the finalized VIP was already underway as noted above.

⁸³ Excerpt from PG&E Procedure “911 Notification Process”: “During an emergency operating condition, such as a natural gas related fire, explosion or pipeline rupture, GTCC or GDCC will request assistance if knowledge is acquired that PG&E First Responders have been delayed due to traffic, etc.”

⁸⁴ A squeeze-off is a method used to stop the flow of gas in polyethylene or small diameter steel pipe by uniformly compressing the pipe between parallel bars until the inside surfaces make solid and even contact.

⁸⁵ PG&E’s Gas Emergency Response Plan Section 3.2.3.2.4 states that the Gas System Planning team’s goal in creating the VIP is to determine the best method of isolating the damaged portion of pipe while also minimizing customer impacts.

The first GM&C crew on-scene began work at 1:35 p.m. to excavate the 4-inch medium density polyethylene main on Parker Avenue as part of the initial VIP while the full VIP was still being developed. This team used mechanical digging techniques to break up the asphalt covering the portion of pipe to be exposed and hand-dug the remainder of the dig using pneumatic spades and hand tools. All other excavations completed by PG&E mentioned in this narrative used this same technique of minimum mechanical excavation paired with hand-digging. Prior to start of work, no one-call tickets, emergency or otherwise, were filed by PG&E for this excavation or for any others performed as described in Section K of this report.^{86,87,88} All individuals who performed excavations were operator-qualified with unexpired certifications of completion.

The GM&C supervisor instructed his crew to squeeze off the 4-inch polyethylene distribution main, which was concurred by the IMT lead and the IC. The squeeze-off of the 4-inch polyethylene main was successfully completed at 2:34 p.m. The GM&C technician who performed the squeeze-off was operator qualified with an unexpired certificate of completion.

In consultation with the IC, the Deputy IC's GM&C crew began work at 1:50 p.m. to excavate the 6-inch steel main in the center of Geary Boulevard. In that area, a 12-inch steel main interconnects to the 6-inch steel main. The first attempt to excavate the 6-inch main was started before the 12-inch main was located. This dig site was chosen based off of an old gas marking for the 6-inch main (date and purpose of marking unknown) far enough away from the fire that the Deputy IC felt it was safe for his GM&C crew to proceed.

⁸⁶ The state of California Government Code, Title 1, Division 5, Chapter 3.1, Article 2, Section 4216.2(g) exempts excavators from the normal requirement for positive confirmation from all utilities in an 811 locate in emergency situations.

⁸⁷ Common Ground Alliance's Best Practices Guide Version 16.0 Part 5.26 "allows excavation to begin immediately to restore service or to stop a hazardous situation from getting worse in the case of a gas or pipeline leak." In the case of an emergency, the CGA recommends "maintenance or repairs may be made immediately, provided that the excavator notifies the one call center and facility owner/operator as soon as reasonably possible."

⁸⁸ The PG&E Deputy IC believed that an emergency one-call ticket may have been submitted by PG&E after digging had started but was uncertain.

After the excavation of the 6-inch steel main was already underway, three PG&E locators used a Vivax vLoc-9800 and a Pipehorn 800-HL to locate the 12-inch steel main. All employees involved in the locate and mark of the 12-inch main were operator qualified with unexpired certificates of completion. The locators determined the 12-inch main was to the north of the current dig site, after experiencing difficulties with low readings due to restrictions with hook-on points.⁸⁹ See Figure 12 below for a basic drawing depicting how the various mains were connected in this area.



Figure 12. Basic map depicting general location of mains involved in the accident and emergency response. Diagram courtesy of Pacific Gas & Electric.

Once the locate crew recognized the first dig site was south of the interconnect to the 12-inch main and a squeeze-off there would not effectively isolate the segment, the first excavation was abandoned. A second excavation site was chosen to the north of the newly located 12-inch main and

⁸⁹ A hook-on point is a location where a locator can attach equipment in order to accurately read the correct location of a pipe or tracer wire.

closer to the fire. The Deputy IC spoke with SFFD and requested a water curtain for his GM&C crew, which was provided by the SFFD during the remainder of this excavation. This excavation was not completed prior to the valve closures covered in sub-section iv (Finalized Isolation Plan, Valve Closures), thus the 6-inch steel main was never squeezed-off.

ATTACHMENTS: 42, 44, 45, 47, 50 through 58

Publicly Available: State of California Government Code, Title 1, Division 5, Chapter 3.1, Article 2, Sections 4216 to 4216.24

iii Response Escalation/Corporate Resource Allocation

To support emergency response, PG&E has three levels of escalating back-office support known as the Operational Emergency Center (OEC), Gas Emergency Center (GEC), and Emergency Operations Center (EOC) which are activated accordingly when the incident reaches certain criteria.

The San Francisco Division OEC was activated by the IMT lead at 2:06 p.m., who led the OEC as OEC commander from that time forward. PG&E has 18 gas OECs that each cover a separate operating division of PG&E gas assets; each OEC maintains its own IMT roster of employees who staff it during emergency response. An OEC “directs and coordinates the personnel necessary to assess damage, make-safe, restore service, and communicate status information internally and externally.”

The second level of support is the GEC, which supports the OEC and covers higher level responsibilities. At 2:07 p.m., the GEC located in San Ramon, CA was activated. GEC tasks include all communications with external stakeholders such as local governments and the media, compiling information on a system-wide scale, and requesting any needed mutual assistance. Positions in the GEC mirror those in the OEC.

The final level of support is the EOC, which is used in major events that include both natural gas and electric service issues and very high severity incidents in one or both utilities. This level of support

was not used in response to this incident.

ATTACHMENTS: 42, 43, 47

iv Finalized Isolation Plan, Valve Closures

The GSP team began working on the Valve Isolation Plan (VIP) as soon as the initial squeeze-off plan had been determined. This team used news video coverage as well as communications with the OEC to determine how the excavations and associated squeeze-offs were progressing to adjust their plan.

At 1:55 p.m., a screenshot of the Synergi program showing the numbers of the valves to be closed without GIS location data was sent to the GDCC.⁹⁰ Around 2 p.m., the GSP team delegated the manual research of GIS location data for the valves to the planning engineers located within the OEC. The screenshot of the VIP without GIS location data (valve numbers only) was sent at 2:01 p.m. from the GDCC and was not successfully received by the GPOM supervisor. Difficulties were noted with the function of Microsoft Outlook, making it hard to confirm the VIP screenshot had been received, and some individuals were known to not have received the VIP; the GSP supervisor stated “we weren't completely sure who was actually getting the e-mails,” and “we received some feedback from [field personnel] that they weren't getting everything we were sending.” The VIP screenshot was sent again by the GDCC at 2:36 p.m. because of the original failed email at 2:01 p.m. and was successfully received at that time.

The local planning engineer within the OEC provided the valve locations to the GSP team at 2:22 p.m. At that time, the GSP supervisor requested the local planning engineer also send it along to the OEC, which was done at an unknown time. At 2:41 p.m., the GSP team completed the packaging of the VIP with GIS location data and provided it to the OEC. Issues with Microsoft Outlook continued to be

⁹⁰ Synergi is the hydraulic modeling software used by PG&E.

observed at 2:41 p.m. when the GSP supervisor did not receive the packaged VIP; however, other individuals who did receive it were able to forward it on to the OEC. The final VIP with the added location data was sent out to field personnel at 2:45 p.m. from the GDCC and was successfully received by the GPOM supervisor.

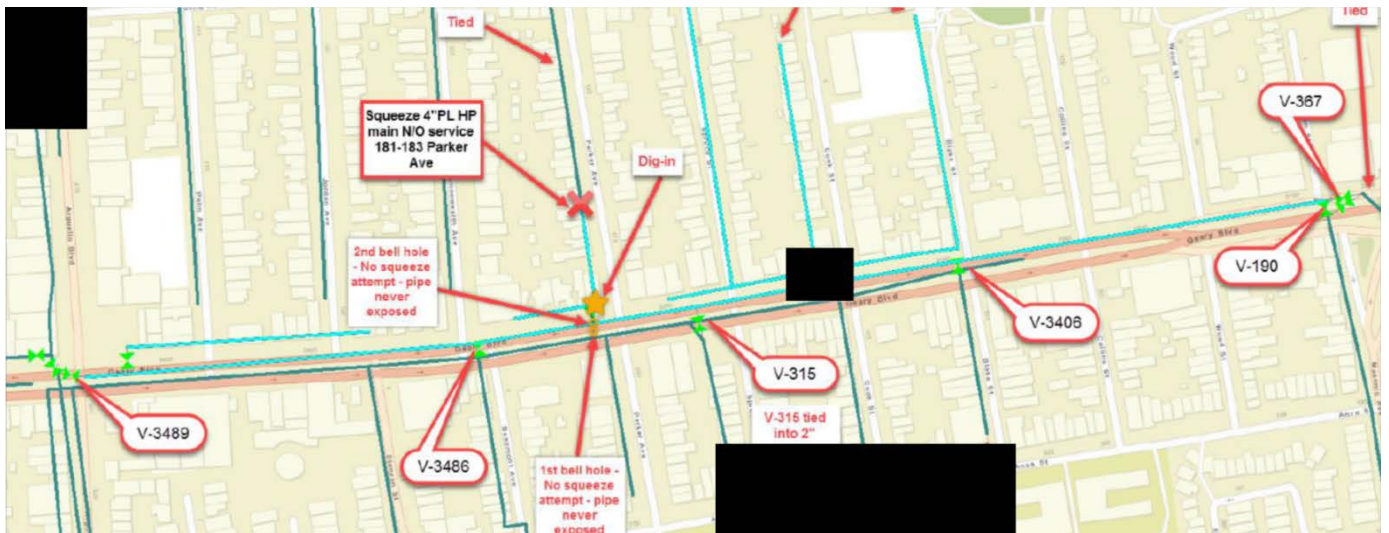


Figure 13. Final Valve Isolation Plan. Diagram courtesy of Pacific Gas & Electric.

The final VIP is shown above in Figure 13. Note the star labeled as “Dig-in” indicates the location where the line was damaged, all circles labeled as “V-#” indicate valves to be closed, “Tied” indicates an interconnect to another mainline, and “Dead-End” indicates the main ends at that point.

The GPOM crew, who had arrived on scene around 2:05 p.m., immediately began closing valves once they received the final VIP with GIS data. The IC directed this activity and noted the closures via phone as they occurred. Both GPOM technicians involved in the valve closures and the two GM&C technicians who assisted them were operator qualified with unexpired certificates of completion. All of the valves were accessible and not paved over.⁹¹ Table 2 below outlines when each valve was closed.

⁹¹ A previous NTSB recommendation, P-82-003, requires PG&E to have emergency valves operated during annual inspections. This recommendation was issued by the NTSB in response to an accident on August 25, 1981, where the isolation of a natural gas main damaged by a third party was impeded by paved over valves. The recommendation was closed acceptable on August 31, 1982.

Valve Number	Time of Closure
V - 3486	3:05 p.m.
V - 3489	3:15 p.m.
V - 315	3:20 p.m.
V - 190	3:31 p.m.
V - 367	3:36 p.m.
V - 3406	3:36 p.m.

Table 2. Valve Closure Times

Once the valves were closed, the fire was extinguished shortly after at 3:38 p.m.⁹² The first GM&C supervisor on scene, concerned the SFFD had inadvertently put out the fire, asked SFFD to halt operations at the fire source. The SFFD complied as requested, but the IC confirmed shortly after that time the gas was isolated. The total volume of natural gas released was self-reported by PG&E as 1.924 million cubic feet (MMCF), as calculated using hydraulic modeling software Synergi and accounting for known atmospheric temperature and duration.

ATTACHMENTS: 27, 42, 44, 46, 50, 51, 55, 59 through 61

Publicly Available: NTSB Recommendation P-82-003

v Repair of Damaged Segment, Restart and Relights

The GDCC sent a list of affected customers requiring service lines to be shut-in to the field at 2:17 p.m. after being created by the GSP team. An updated version of this list was sent out again at 3:03 p.m., and the finalized customer list was sent at 3:57 p.m. Once the damaged pipe segment was isolated, GSRs used this list to shut-in all 328 affected customers. All services were isolated by 10:45 p.m.

The IC directed crews to begin work to purge and repair the line while the GSRs were shutting-in

⁹² San Francisco Fire Department's Computer Assisted Dispatch data indicates the fire was out at 3:37 p.m.

affected services. After water from the SFFD response was pumped out of the trench where the damage occurred, the first GM&C crew cut-out the damaged pipe segment and repaired the line. 4 electrofusion couplings, one high volume 2-inch to 4-inch tee, about 2 feet of 2-inch polyethylene pipe, and about 5 feet of 4-inch polyethylene pipe were used to repair the pipeline to its original design. The employee who performed all of the plastic fusions and the employee who tapped the tee after fusion were operator qualified with unexpired certificates of completion. No complications were observed during the repair. The GM&C supervisor stated the repair was “a pretty regular repair” and was similar to two other repairs completed two weeks prior. The pipe segment which was cut out was kept in PG&E custody under a documented chain of custody until the NTSB took custody on February 9, 2019. The diagram below outlines the repairs (Figure 14).

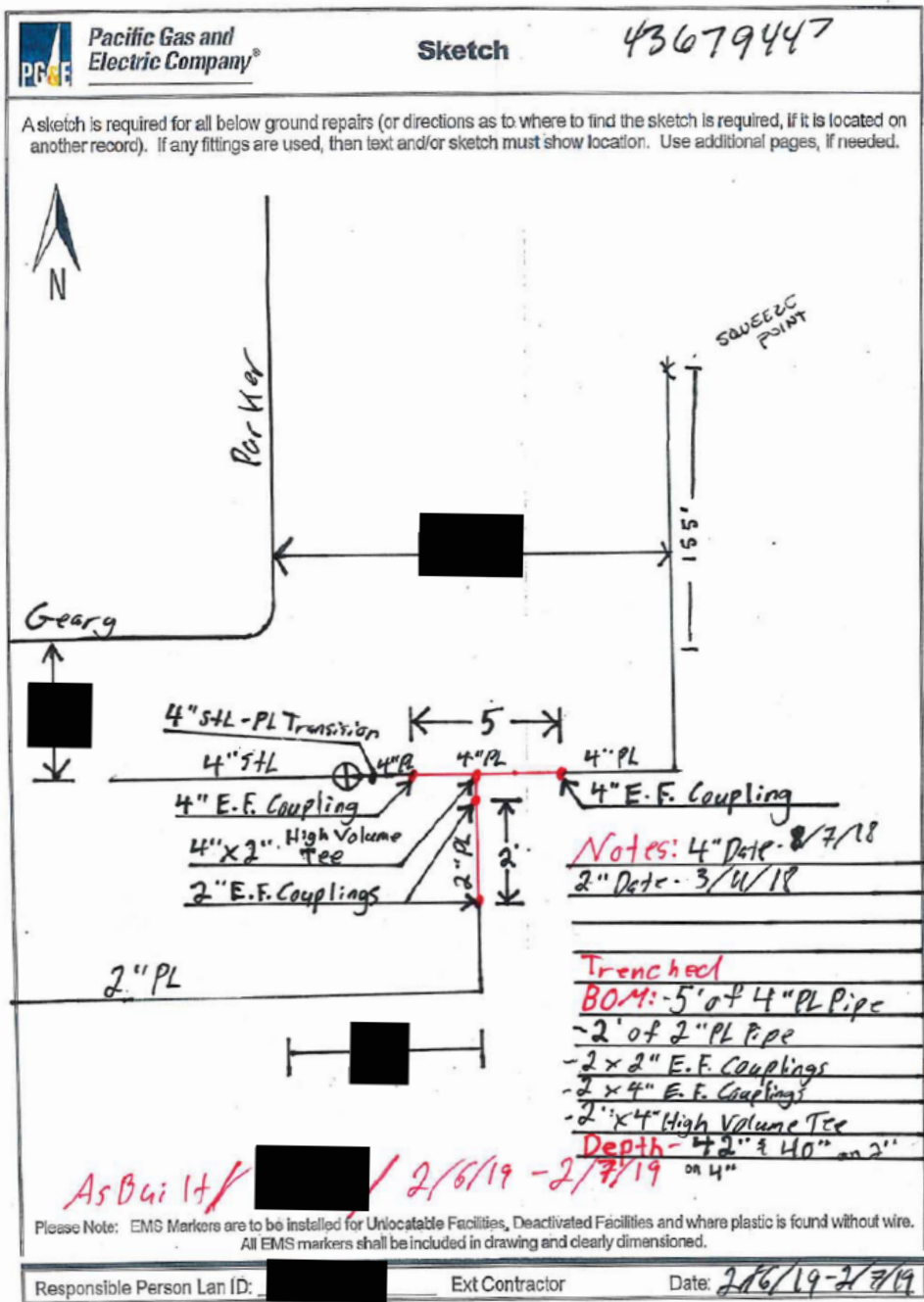


Figure 14. Sketch showing repairs completed to the 4-inch and 2-inch mains, including materials and fittings used. Drawing courtesy of Pacific Gas & Electric.

After repairing the line, the next step in the restart process was to purge the isolated segment since a significant amount of water entered the isolated segment from SFFD equipment during the emergency

response to the fire.⁹³ An Emergency Work Clearance Document (EWCD) was developed that detailed the specific steps necessary to remove all water and reintroduce gas to the isolated system, the order of valve openings and squeezer removal, and then how to restart the line at full pressure.⁹⁴ This document was completed and approved at 9:15 p.m. by the senior distribution coordinator, clearance supervisor, and gas system planning engineer. All four employees who performed the purge in the field were operator qualified with unexpired certificates of completion.

The approved purge process consisted of the following steps:

1. Close V-314 (closest valve to the damaged pipe segment, previously inaccessible due to the fire).	2. Open V-367 and purge through all 9 risers until 100% gas achieved (no remaining water, determined using a gas monitor).	3. Open V-190.	4. Open V-3406.
5. Open V-315.	6. Open V-3486.	7. Open V-3489.	8. Open V-314 and purge at this stub valve until 100% gas.
9. Close V-314 after 100% gas achieved.	10. Complete the repairs to the damaged portion of main and confirm soundness using a soap test and pressure test.	11. Raise the squeezer on the 4-inch polyethylene main on Parker Avenue and perform the final purge at the service at 3340 Geary Boulevard.	12. Open V-314 and report to the GDCC that the clearance process is complete.

Table 3. Clearance process steps with step numbers and actions taken.

Complications were observed during this planned clearance process. Because of the delays in purging, the IC began working on back-up plans for CNG mobilization and pigging, which later were not necessary to execute. The first purge attempt was unsuccessful on the evening of February 6, 2019 when water was discovered to still be present in the lines at 3375 Geary Boulevard at 11:39 p.m.; thus

⁹³ Purging is a process by which water, air, and other undesirables are expelled from a pipeline and natural gas is reintroduced.

⁹⁴ PG&E's Gas Emergency Response Plan Section 3.2.3.3.6 defines clearance as the process by which PG&E evaluates risk in operations and defines a specific set of activities to be performed whenever work is done which "affects gas pressure, flow or quality, deactivation or activation of facilities, affects remote monitoring and control, or may impact the ability to maintain service to customers." Additionally, PG&E procedure TD-4441P-04 further details the creation of the Emergency Work Clearance Document (EWCD), revising the EWCD as necessary, isolating the system, repairing and returning equipment to service, reporting the clearance as complete, and record retention.

100% gas was not achieved.

The Deputy IC recognized that the initial purge plan did not account for a portion of the 12-inch main, which still contained a significant amount of water between the lowest riser and lowest valve, between which was an approximate elevation differential of 250 feet. In order to remove this water, it was necessary to perform an additional excavation at the intersection of Geary Boulevard and Arguello Boulevard so that a saber valve fitting could be welded onto the 12-inch main.⁹⁵ The GM&C technician who performed the weld and tap procedure was operator qualified with unexpired certificates of completion and had completed his bi-annual welder recertification earlier on the morning of February 6, 2019. Prior to the welding, a procedural variance was approved by the pipeline integrity group. The procedure to which the variance applied related to making positive confirmation that the pipeline was not inserted with plastic pipe.

After completing the welding procedure, the purge to 100% gas took about 5 and a half hours to complete and was successfully finished at about 4:00 p.m. on February 7, 2019.⁹⁶ Relights were started immediately afterwards at the direction of the IC.

At 5:52 p.m. on February 7, 2019, the GPOM team started their portion of the clearance process by opening V-190, and then the crew continued to open the remainder of the previously closed valves and remove the squeezer in the order outlined in the EWCD plan above. By 10:00 p.m. on February 7, 2019, all services were either relit or one attempt to relight had been made.⁹⁷ The clearance process was noted as fully complete on February 8, 2019 at 2:51 p.m.

ATTACHMENTS: 42, 44 through 46, 51, 55, 62 through 70

2. San Francisco Fire Department, San Francisco Police Department, and Other City of San

⁹⁵ A saber valve is a specialized fitting used primarily to purge or equalize gas.

⁹⁶ Interview with PG&E's IC indicated a completion time of 4:30 p.m., not 4:00 p.m.

⁹⁷ Some services were unable to be relit on February 7, 2019 due to the residents not being home, so the GSRs were unable to enter the houses.

Francisco Response

i Initial Notification, Establishment of Command

At 1:08 p.m., the San Francisco Fire Department (SFFD) received notification of a fire and possible explosion at the intersection of Geary Boulevard and Parker Avenue from a member of the public through the San Francisco Department of Emergency Management (SFDEM) 9-1-1 call center. Multiple further notifications from the public were received prior to and after SFFD personnel arrived on scene. Video recordings taken from a bank located across the street from the accident scene indicate the fire started around 1:07 p.m., which is consistent with the notification time from the public. Video evidence does not show the impact to the pipe, only the resulting fire.

Battalion 7, Engine 10, and Truck 10 were dispatched to the scene at 1:09 p.m., all of which were en route within one minute and on scene by 1:12 p.m.⁹⁸ The battalion chief of Battalion 7 called a working fire with a gas explosion and requested a full box at 1:13 p.m.^{99,100} A SFFD Assistant Chief was dispatched at 1:17 p.m. and assumed command as the IC for the SFFD incident response. The battalion chief of Battalion 7 requested all units station one block away from the fire due to the fire severity and requested the San Francisco Police Department (SFPD) perform evacuations in a half-block radius around the scene at 1:17 p.m. while the SFFD IC was en route.¹⁰¹ SFPD had already begun performing evacuations and controlling traffic at 1:10 p.m., as they were first on scene.

ATTACHMENTS: 27, 28, 71 through 73

ii Containment Strategy, Command Posts

⁹⁸ News release from the SFFD indicates Battalion 7 was dispatched at 1:08 p.m.

⁹⁹ News release from the SFFD indicates the Working Fire was called at 1:18 p.m., but this could refer to when additional resources were dispatched, as the Computer Aided Dispatch print-out indicates the working fire was called at 1:13 p.m., which is consistent with the testimony of the SFFD IC.

¹⁰⁰ A full box is also known as a first alarm assignment. It indicates the level of response necessary by the fire department.

¹⁰¹ Testimony of the SFFD IC indicated the battalion chief of battalion 7 and the SFFD IC requested evacuations within 1 block, not ½ block of the fire building. SFPD Computer Aided Dispatch data indicates a ½ block radius for initial evacuation requests.

As the SFFD IC approached the site, he was able to see flames from three blocks away, so he pulled a second alarm at 1:20 p.m.¹⁰² When the IC arrived at 1:22 p.m., he “quickly recognized that [the SFFD was] not going to be able to put out the gas fire;” instead, the fire centered at 3300 Geary Boulevard must be contained and surrounded until the fuel source was removed by PG&E.^{103,104} Only after the fuel source had been removed would it be safe for the SFFD to fully extinguish the fire. The IC set up the SFFD command post on the southeastern corner of Geary Boulevard and Parker Avenue at 1:24 p.m. and deployed 4 battalions on all sides of the fire to keep it contained as noted in the below Figure 15.¹⁰⁵ The assignments were as follows:

- Alpha: Battalion 7 - Keep the fire from spreading along Geary Boulevard to the east or west
- Bravo: Battalion 2 – At the fire source to minimize damage to the fire building at 3300 Geary Boulevard and the neighboring buildings
- Charlie: Battalion 5 – Keep the fire from spreading along Parker Avenue to the north, centered on 195 Parker Avenue
- Delta: Battalion 4 – Minimize radiant heat impacts on the neighboring H&R Block building at 3236 Geary Boulevard using a water curtain

In Figure 15 below, B & B2 are buildings worked by the Bravo team. C is the building worked by the Charlie team. D & D2 are buildings worked by the Delta team. FB is the fire building, 3300 Geary Boulevard. CP indicates the location of the SFFD command post. Arrows indicate the covered areas by each team. Not pictured is additional staging, which was located on Spruce Street.¹⁰⁶

¹⁰² A second alarm assignment escalates the response and dispatches additional resources to the fire.

¹⁰³ The isolation plan discussed in the previous section addresses the steps PG&E took to accomplish the fuel removal.

¹⁰⁴ SFFD procedures for Class 2 Flammable Gases specifically state that the fire is not to be put out unless the gas has first been shut off.

¹⁰⁵ SFPD Computer Aided Dispatch data indicates the SFFD command post was set-up at 1:18 p.m., prior to the arrival of the SFFD IC.

¹⁰⁶ Additional staging here refers to firefighters on standby, water support, and other backup for the actively working crews.

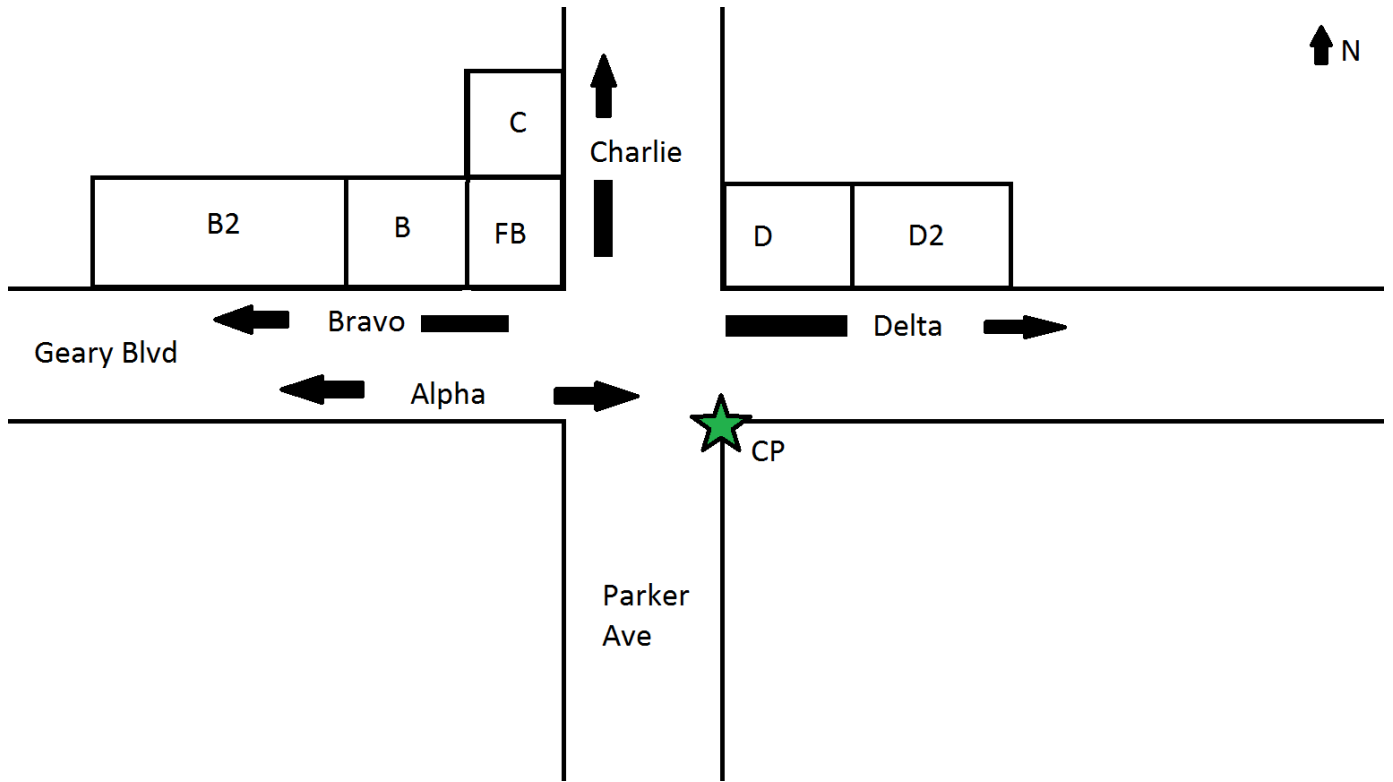


Figure 15. San Francisco Fire Department Response Teams.

The SFPD command post was established at 1:15 p.m. at the intersection of Geary Boulevard and Commonwealth Avenue, was later relocated to the intersection of Spruce Street and Geary Boulevard at 1:22 p.m., and was finally moved to the southeast corner of Geary Boulevard and Parker Avenue at 1:51 p.m. for ease of communications with SFFD.

ATTACHMENTS: 27, 28, 72 through 75

iii Fire Containment and Other Pre-Isolation Activities

13 engines, 5 trucks and 6 battalions dispatched to the fire over the course of the response, as well as specialized apparatus and staff such as rescue squads, EMS, and PIO, for a total of 41 units and 130 firefighters. Table 4 below indicates the dispatch and arrival times for various significant SFFD resources.

Name	Dispatch Time	Arrival Time	Designation
Battalion 7	1:09 p.m.	1:12 p.m.	Alpha
Engine 10	1:09 p.m.	1:12 p.m.	Bravo
Truck 10	1:09 p.m.	Not Recorded	Bravo
Safety Officer 2	1:13 p.m.	Not Recorded	IC/CP
Engine 31	1:17 p.m.	1:18 p.m.	Bravo
Engine 21	1:17 p.m.	1:18 p.m.	Alpha
Truck 12	1:17 p.m.	1:19 p.m.	Alpha
Battalion 5	1:17 p.m.	1:21 p.m.	Charlie
Division 2 Chief	1:17 p.m.	1:22 p.m.	IC/CP
Rescue 1	1:17 p.m.	1:24 p.m.	Bravo
Engine 12	1:18 p.m.	1:23 p.m.	Charlie
Engine 38	1:20 p.m.	1:42 p.m.*	Charlie
Engine 14	1:20 p.m.	1:23 p.m.	Delta
Engine 3	1:20 p.m.	1:42 p.m.*	Alpha
Engine 51	1:20 p.m.	Not Recorded	Delta
Truck 5	1:20 p.m.	1:23 p.m.	Charlie
Battalion 2	1:20 p.m.	1:25 p.m.	Bravo
SFFD Chief of Department	1:22 p.m.	2:12 p.m.	IC/CP
Battalion 4	1:22 p.m.	1:27 p.m.	Delta
Engine 22	1:36 p.m.	Not Recorded	Alpha
Engine 36	1:36 p.m.	2:29 p.m.	Charlie
Engine 24	1:36 p.m.	1:47 p.m.	Charlie
Engine 41	1:36 p.m.	2:29 p.m.	Charlie
Truck 3	1:36 p.m.	1:38 p.m.	Delta
Truck 6	1:36 p.m.	1:58 p.m.	Alpha
Truck 1	1:39 p.m.	1:40 p.m.	Bravo
Engine 6	1:39 p.m.	1:41 p.m.	Charlie
Battalion 1	1:39 p.m.	1:42 p.m.	Not Recorded
Engine 5	Not Recorded	Not Recorded	Charlie

*Times may not be accurate to actual arrival time and could be a delayed report; at the same time (1:42 p.m.), Engine 10 is reported on scene when it had already arrived at 1:12 p.m.

Table 4. San Francisco Fire Department Response Equipment and Arrival Times

As SFFD companies arrived at the working fire in response to the second alarm pulled at 1:20 p.m., they were instructed to assist with water supply and provide other support to the designations Bravo, Charlie, and Delta.

The SFFD IC pulled a third alarm at 1:36 p.m., and 4 additional engines and 2 trucks were dispatched at that time. When these units arrived, the SFFD IC had them on stand-by initially and then gradually assigned them to water supply or to assist designation Charlie.

At designation Delta, units on the roof and within the structure ensured there was no fire impingement into the building. The radiant heat caused some windows to break, but the fire did not spread into 3236 Geary Boulevard.

At designation Bravo, the building at 3300 Geary Blvd was deemed unsafe to enter for fire containment efforts while the gas-fed fire was ongoing, as there were concerns the building would collapse on the corner closest to the active gas flame.

At 3:30 p.m., the SFFD IC made an inquiry into a possible broken water main in the excavation trench. This was later confirmed to be a false report; no water main was struck by Kilford during the excavation or later by other parties during the response.

ATTACHMENTS: 27, 72 through 74, 76

iv Preservation of Life

Starting at 1:10 p.m., the SFPD evacuated all buildings within one-half block except for those within 2 buildings of the active fire, which the SFFD evacuated.^{107,108} At 1:31 p.m., SFFD requested the evacuation of the remainder of the block to the north of the fire building along Parker Avenue between Geary Boulevard and Euclid Avenue. All buildings within one-half block of the fire building to the south, east and west and one block to the north were cleared as fully evacuated at 1:56 p.m.

SFPD additionally evacuated all individuals at a nursery school located at 150 Parker Avenue at 1:30 p.m. as an additional precaution.¹⁰⁹ Roosevelt Middle School, located at 460 Arguello Boulevard about 0.3 miles from the fire building, was instructed to shelter-in-place at 1:53 p.m. by the SFPD at the request of PG&E.

¹⁰⁷ Testimony of the SFFD IC indicated the battalion chief of battalion 7 and the SFFD IC requested evacuations within 1 block, not ½ block of the fire building. SFPD Computer Aided Dispatch data indicates ½ block radius for initial evacuation requests.

¹⁰⁸ It was unsafe for the SFPD to enter buildings any closer than 2 buildings from the fire building. SFFD firefighters have training and personal protective equipment which enables them to more safely evacuate buildings in the nearby vicinity of a fire at a lower risk to themselves than SFPD officers.

¹⁰⁹ SFPD data did not indicate the number of individuals evacuated at the nursery school.

The battalion chief of Battalion 7 received reports that 3 excavation workers were missing, so when the first alarm was pulled, Rescue 1 was dispatched. The SFFD IC received a report that 5 of the excavation workers were unaccounted for, so when Rescue 1 arrived at 1:24 p.m., he ordered the rescue squad to perform a surface primary search surrounding the explosion and, if possible, to perform a primary search into 3300 Geary Boulevard.¹¹⁰ This search, including both floors of 3300 Geary Boulevard, was completed by 1:48 p.m. with a negative result.¹¹¹ A secondary search was performed by multiple SFFD companies.¹¹² Afterwards, a SFPD sergeant who had spoken with the foreman of the Kilford crew communicated to the SFFD IC that all of the excavation workers were accounted for. This SFPD sergeant brought the Kilford foreman to the SFFD command post at 2:06 p.m., whereupon the foreman confirmed to the SFFD IC that none of his crew were missing.¹¹³

At 1:45 p.m., one of the Kilford employees notified SFPD that the excavator at the site contained a diesel fuel tank, which posed a secondary explosion risk. Documentation and interviews do not provide information on steps taken, if any, to prevent the explosion of the mini excavator's fuel tank.

SFPD controlled public access to the active fire area by blocking the main and side streets for a 4-block radius centered on the fire building and re-routing traffic flow around that area.

ATTACHMENTS: 27, 28, 72

v Interactions with Pacific Gas & Electric

At 1:23 p.m., PG&E's Senior Distribution Gas System Operator located in the GDCC contacted the SFFD through the SFDEM 9-1-1 call center to provide an estimated arrival time for PG&E

¹¹⁰ A primary search is the rapid search of an area to find victims who can be aided during an emergency scene. A surface primary search is a search of an exterior area (such as the sidewalks surrounding the excavation trench), while a primary search is a search of a specific building. A secondary search is a complete search of the entire area for all possible victims.

¹¹¹ A negative result indicates no individuals were found by the rescue squad.

¹¹² A SFFD company consists of three or more firefighters organized as a team, who are led by a fire officer and equipped to perform certain operational functions.

¹¹³ The Kilford foreman was the operator of the mini excavator.

employees of 1:39 p.m.¹¹⁴ A PG&E employee, who reported to the PG&E IC, served as the liaison officer to the SFFD IC and provided him with updates for the remainder of the emergency response. At an unknown time during the response by SFFD, PG&E's liaison officer provided an estimate of one hour to complete isolation and shut down of the gas release. SFFD also provided a water curtain to the crew performing the second excavation for the attempted squeeze-off of the 6-inch steel main, as noted previously.

On the northwest side of Parker Avenue near the intersection with Geary Boulevard, 2 electric poles caught fire. SFFD requested PG&E shut off electricity, so PG&E discontinued electric service to about 3000 customers in the area around the release to reduce the number of possible ignition sources.¹¹⁵ An electric crewman was confirmed to be onsite at 1:18 p.m. and electric service was confirmed as shut-off at 2:26 p.m.

ATTACHMENTS: 27, 28, 42, 43, 47, 51, 72

vi Fire Control and Extinguishment, Post-fire

Once PG&E had isolated the damaged segment and stopped the flow of gas, groups Charlie and Bravo made entry into the structures outlined in Figure 15 to extinguish the fires. The fires were contained at 3:51 p.m., 15 minutes after the fuel source was removed, and the fires were controlled at 4:24 p.m., 33 minutes later.¹¹⁶ During this last portion of the response, water supply became limited due to the large amount of work being performed all at the same time. The San Francisco Water Department assisted with the water supply issue, as they had representatives on scene who arrived at 1:20 p.m.¹¹⁷

¹¹⁴ PG&E procedure "911 Notification Process" directs GDCC personnel to immediately notify 911 Emergency Response Centers whenever an incident is or can become a threat to the safety of the public, property, or the environment via the use of trigger criteria; in this case, 911 dispatch notified PG&E first, and later PG&E called back to update SFFD on PG&E response status.

¹¹⁵ PG&E's Gas Emergency Response Plan Section 3.2.3 outlines activities to make an emergency scene safe, including eliminating ignition sources.

¹¹⁶ The SFFD IC stated in his interview that the fire containment and fire control each took approximately 20 minutes.

¹¹⁷ The San Francisco Water Department is automatically notified of fire response events.

As the response wound down, the IC began releasing units from the scene. Command was relinquished from the SFFD IC to the battalion chief of Battalion 7 around 5 p.m. Fire watches were performed from 5:00 p.m. until 11:21 p.m. by two fire engines and two battalion trucks on rotation.

A reunification center with representatives from the Red Cross was held in front of Mel's Diner, directly across from the scene at the corner of Cook Street and Geary Boulevard.

Three arson investigators from the Bureau of Fire Investigation later determined that the fires caused a combined estimated 8 million dollars of property damage to 3250 Geary Boulevard, 3300 Geary Boulevard, 3308 Geary Boulevard, and 3310 Geary Boulevard, as well as an additional 2 million dollars of property damage to the buildings' contents. The fire cause was categorized as Accidental.¹¹⁸

The San Francisco Department of Public Works (DPW), who had representatives on site at 3:40 p.m., red-tagged 3300 Geary Boulevard as an unsafe building. The DPW later issued an emergency order to the owner of 3300 Geary Boulevard to remove and repair the fire damage; the building was not condemned.¹¹⁹ Including the DPW, the city of San Francisco had 11 separate entities respond to this incident, either remotely or at the scene: SFDEM, SFPD, Medical, SFFD, 911 Dispatch, DPW, Water Department, Mayor's Office, and Economic Works.

ATTACHMENTS: 72, 73, 77

L. Similar Prior Events on PG&E and Safety Initiatives

1. CPUC Data

Since January of 2017, 10 third-party damage accidents involving PG&E pipelines have met state reporting criteria in the city of San Francisco, including this accident. The average length of time from the line strike to system isolation was 1 hour and 10 minutes. The shortest time to isolation was 28 minutes

¹¹⁸ A fire deemed to be "Accidental" means that no suspected arson or other foul play occurred to initiate the fire.

¹¹⁹ The DPW also issued a notice of violation to the building owner and required the owner to obtain permits to perform repairs to make the building safe.

and the longest time to isolation was 2 hours and 29 minutes, which occurred during this accident.

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2. SFFD Data

SFFD provided information on 8 specific events over the last 2 years which they considered to be have lengthy response times for PG&E to arrive on scene. 5 of these events were due to third-party damage and the other 3 were caused by gas leaks. Not all of these incidents involved ignition, and all were located in San Francisco. The length of time from when PG&E was requested to arrive on site by SFFD to when PG&E arrived with proper equipment varied from 32 to 86 minutes.

During the interview with the SFFD IC, he expressed a desire for PG&E crews to be able to respond to active gas release scenes faster. Below is an excerpt from his interview:

Well, we need to get you guys there faster. I mean, we have PG&E Gas and Electric events all the time, nothing of this major, but, I mean, we need you guys there faster. So, either being able to respond Code 3 or Plan B, I guess, is possibly a police escort to get you from Point A to Point B, but I mean it almost seems like it should be automatically dispatched on any working fire. And maybe you are, but we're not getting you there.

ATTACHMENTS: 72, 79

3. PG&E Data

PG&E data from 2012 to 2018 shows PG&E lowered their system-wide average make safe/shut-in time by 38% for service line incidents (2018 average of 43.3 minutes) and by 54% for main line incidents (2018 average of 88.77 minutes). See Table 5 below for the average time it took PG&E to shut in the gas in San Francisco for the prior 5 years.

Year	Incidents involving main lines	Incidents involving service lines
2014	49.8	33.7
2015	57.3	38.6
2016	62.7	32.9
2017	76.2	34.0
2018	63.4	31.2

Table 5. Average make safe/shut-in time in minutes for the city of San Francisco by year.

ATTACHMENTS: 57, 80

i PG&E Emergency Response Safety Initiatives

PG&E Gas Operations leadership holds monthly meetings to review incidents with long duration responses (generally lasting over 120 minutes) that occurred during the prior month. The following excerpt details these meetings, known as the Monthly SITG Review Meeting, as provided by PG&E:

These meetings, which are hosted by the Shutting in the Gas (SITG) process owner, are attended by supervisors, superintendents and directors from the Gas Maintenance and Construction and Field Services groups, managers and supervisors from the Gas Distribution Control Center, and the director and manager from the Gas Dispatch Center. There are four main elements to each meeting: (1) review metrics from the previous month and [year-to-date] results for both mains and services, (2) incident review of the previous month’s long duration events, (3) share lessons learned and best practices, and (4) roundtable.

From these meetings, PG&E has developed ongoing initiatives for improvement, as summarized in Table 6 below.

Description	Status
Pursue shoring trailers to aide in delivering shoring to active events	Reviewing divisions that do not own shoring and identifying costs and implementation strategy of trailers
Reinforce the use of emergency trailers on all main damages	Discussed on each call, emphasize utilization is a best practice
Pursue OQ of GSRs to squeeze steel pipe less than 1 inch in diameter	Requires union agreement
Develop audit of response communications	Launched in February 2019
Develop metric to measure quality data entry of incident details	Launched in February 2019
Identified 212 issues (union agreement)	Regularly engage union leadership to work with represented employees to respond to events. Want to improve 212 language to promote prompt after hours response

Table 6. PG&E Shutting in the Gas Review Meeting Initiatives

Since 2012, PG&E has implemented the following emergency response improvements:

- Creation of the monthly SITG Review meeting
- Increased ability to squeeze 1.5-inch or smaller plastic pipe from about 50% of GSRs to 100%
- Yearly plastic squeeze training for all Field Service employees
- Purchased emergency trailers with emergency equipment for all divisions
- Purchased additional steel squeezers for 2-inch to 8-inch steel pipe, housed on emergency trailers
- Implemented Emergency Management Tool to alert GM&C when notified by emergency organizations
- Established dual response protocol to dispatch both GM&C and Field Service resources
- Implemented regular communication protocols between GDCC and IC
- Changed thought process from “blowing to atmosphere is safe” to “shut in is priority over keeping customers in service”

ATTACHMENTS: 57

Appendix A: Abbreviations and Definitions

Abbreviation or Phrase	Full Name (if applicable)	Definition
Accusation	n/a	A more serious charge of violation from the CSLB, often involving suspension or revocation of the licensee.
Actuation of a valve	n/a	The process of operating a valve to move it from open to closed or closed to open. In this document, valves were actuated during the initial emergency response to close them and later during the clearance process to open them.
CCR	State of California Code of Regulations	A subset of state of California laws.
CFR	Code of Federal Regulations	Regulations of the United States Government. Includes regulations for PHMSA and OSHA in various sections.
CGA	Common Ground Alliance	A non-profit dedicated to preventing damage to underground infrastructure by promoting effective damage prevention practices.
Citation	n/a	A charge of violation of state law from the CSLB, often accompanied by a fine.
Competent Person	n/a	An OSHA "competent person" is defined as "one who is capable of identifying existing and predictable hazards in the surroundings or working conditions which are unsanitary, hazardous, or dangerous to employees, and who has authorization to take prompt corrective measures to eliminate them." [29 CFR 1926.32(f)]
CP	Command Post	The headquarters for incident command during emergency response. Generally, the IC and support staff leadership are located here.
CPUC	California Public Utilities Commission	State agency responsible for enforcing state and federal pipeline regulations.
CSLB	Department of Consumer Affairs Contractors State License Board	Licensing agency for all contractors within the state of California.
Customer Line/Piping	n/a	A line used to move natural gas from a distribution meter to appliances. It is owned by the homeowner or commercial building owner.
Dig Safe Board	California Underground Facilities Safe Excavation Board	California agency responsible for investigating accidents stemming from excavation activities.
DiRT	Dig-in Reduction Team	PG&E's internal investigation team that determines causes of dig-ins to PG&E assets.

Abbreviation or Phrase	Full Name (if applicable)	Definition
EWCD	Emergency Work Clearance Document	Any work that affects gas pressure, flow or quality, deactivation or activation of facilities, affects remote monitoring and control, or may impact the ability to maintain service to customers requiring a gas clearance. Clearances are prepared with the input of the team that will perform the work, the engineering team, and the team that executes the clearance. Clearance initiation includes identifying a way to safely isolate the work area, maintain service to customers, and to develop the steps that will be taken to isolate the work area. Every request for a clearance must be requested and scheduled through, and then managed by, the GDCC. The clearance plan is documented through the EWCD.
FB	Fire Building	Central building in which the fire is located and from which the fire may spread if not contained.
Full Box	n/a	Requesting a full box, also known as striking the box, is a firefighting term used to call an alarm for a working fire. It designates the severity of the fire and the needed resources.
Gas	n/a	Natural gas, commonly used in home appliances such as stovetops and water heaters, which is distributed to residences and businesses through a combination of mains, services, and customer lines
GDCC	Gas Distribution Control Center	Control center responsible for SCADA operations of all PG&E gas distribution systems.
GEC	Gas Emergency Center	The GEC supports the OEC and covers higher level responsibilities. These tasks include all communications with external stakeholders such as local governments and the media, as well as compiling information on a system-wide scale. The GEC sets “system-level priorities and strategies.”
GERP	Gas Emergency Response Plan	PG&E’s overarching document which discusses emergency response to natural gas distribution and transmission incidents.
GM&C	Gas Maintenance and Construction	Repairs damaged facilities and provides labor for emergencies, such as closing riser valves during curtailments. Generally, the work that construction crews do in a gas incident is not substantially different from their normal assignments. Gas Construction Crews are a mobile work force and are located at various locations across the service territory. GC Gas also has a Measurement and Controls construction team that can support controls construction at stations, automated valves, SCADA, etc.
GOV	State of California Government Code	A subset of state of California laws.
GPOM	Gas Pipeline Operations and Maintenance	Operates compressor stations, gas storage fields, valves, regulators, and control equipment to bring the gas incident under control and/or maintain the system safely while emergency repairs are being made.

Abbreviation or Phrase	Full Name (if applicable)	Definition
GSP	Gas System Planning	During emergencies, Gas System Planning (GSP) provides hydraulic planning and modeling support for immediate Make-safe. GSP provides immediate hydraulic operational support to bring the gas system to a safe condition. GSP addresses the need for shutting in portions of the system to make-safe by determining the best method for system isolation and resulting impacts to customers on the remaining portions of the gas system. GSP also facilitates the development of contingency strategies for incidents.
GSR	Gas Service Representative	GSRs respond to customer-initiated gas service calls, perform routine maintenance of PG&E assets, and typically, in the case of a gas leak or report of gas odor, are the first personnel to respond.
Handhole	n/a	Handholes are access points to electrical or telecom equipment that can be used for maintenance as well as serving as a junction for conduits coming from several different directions. They are also known as pull boxes, access boxes, underground utility boxes, junction boxes, underground enclosures, manholes, and splice boxes.
Hi-Hi Alarm	High-High Alarm	Hi-Hi alarms trigger when the measured quantity exceeds a certain prescribed value, generally approaching the MAOP of the segment.
I&R	Instrumentation and Regulation	A prior name for GPOM
IAP	Incident Action Plan	IAPs contain the incident objectives that the Incident Commander or Unified Command establishes and address tactics for the planned operational period.
IC	Incident Commander	The Incident Commander is the individual responsible for on-scene incident activities, including developing incident objectives and ordering and releasing resources. The Incident Commander has overall authority and responsibility for conducting incident operations.
ICS	Incident Command System	The Incident Command System (ICS) is a structure that can be used to manage and coordinate emergency response activities from many different groups
IMT	Incident Management Team	These teams oversee emergency response activities within their local areas, and staff the local Operational Emergency Center in case of an escalated response. Each field division has its own designated IMT staff, which may be exchanged or supplemented as needed.
Isolation plan	n/a	A specific plan of activities which if implemented will result in the isolation of a specific segment of pipe.
Kilford	Kilford Engineering, Inc.	Excavation contractor involved in this accident.
Lo Alarms	Low Alarms	Low alarms trigger when the measured quantity falls below a certain prescribed value.

Abbreviation or Phrase	Full Name (if applicable)	Definition
Lo-Lo Alarms	Low-Low Alarms	Low-Low alarms trigger at an even lower threshold than Low alarms and are a more critical alarm.
L&M	Locate & Mark	PG&E's Locate and Mark (L&M) function is to locate and mark the approximate position of PG&E's underground gas, electric, and fiber optic lines so that excavators—whether contractors, landscapers, or homeowners—can avoid striking underground utilities.
Main	n/a	A distribution line that serves as a common source of supply for more than one service line
MAOP	Maximum Allowable Operating Pressure	The maximum pressure at which a pipeline or segment of a pipeline may be operated under federal law.
NOPV	Notice of Probable Violation	A NOPV informs the natural gas operator they are being charged with probable violations of pipeline safety statutes or regulations. These allegations are accompanied by either a proposed compliance order identifying actions the operator is required to take, proposed civil penalties for these alleged violations, or both.
OEC	Operational Emergency Center	The OEC is a physical location that allows staff to provide management oversight at the division and/or district level. The OEC is staffed by an IMT comprised of corresponding positions that are found in both the GEC and the EOC. The OEC directs and coordinates the personnel necessary to assess damage, make-safe, restore service, and communicate status information internally and externally. An OEC identifies staff to manage a transmission, distribution or storage incident.
OP	Operational Period	A specified period of time (determined by the IC), generally 12 to 24 hours.
OSHA	Occupational Safety and Health Administration	Federal agency responsible for regulations and enforcement of such laws related to worker safety.
PE	polyethylene	Polyethylene is the most common plastic produced today.
PG&E	Pacific Gas & Electric	Company whose natural gas distribution lines were involved in this accident.
PHMSA	Pipeline and Hazardous Materials Safety Administration	Federal agency responsible for regulations and enforcement of such laws related to natural gas and liquid pipelines and hazardous materials transportation.
Purge plan	n/a	A specific plan of activities which if implemented will result in the removal of all free water and other impurities from the pipeline.
Qualifier	n/a	Individual with 4 years of practical journeyman experience that

Abbreviation or Phrase	Full Name (if applicable)	Definition
SCADA	Supervisory Control and Data Acquisition	A computer system for gathering and analyzing real time data. SCADA systems are used to monitor and control a plant or equipment in industries such as telecommunications, water and waste control, energy, oil and gas refining and transportation.
SDGSO	Senior Distribution Gas System Operator	The senior gas controller operating the SCADA system used by the GDCC.
Service Line	n/a	A distribution line that transports gas from a common source of supply to an individual customer, to two adjacent or adjoining residential or small commercial customers, or to multiple residential or small commercial customers served through a meter header or manifold. A service line ends at the outlet of the customer meter or at the connection to a customer's piping, whichever is further downstream, or at the connection to customer piping if there is no meter.
SFDEM	San Francisco Department of Emergency Management	Local organization which coordinates activities for all city emergency response groups.
SFFD	San Francisco Fire Department	Local fire department that responded to this accident.
SFPD	San Francisco Police Department	Local police department that responded to this accident
Synergi	n/a	The hydraulic modeling software which GSP uses to create their isolation plans.
Unified IC	Unified Incident Command	When more than one agency has incident jurisdiction, or when incidents cross political jurisdictions, the use of Unified Command enables multiple organizations to perform the functions of the Incident Commander jointly. Each participating partner maintains authority, responsibility, and accountability for its personnel and other resources while jointly managing and directing incident activities through the establishment of a common set of incident objectives, strategies, and a single Incident Action Plan (IAP).
VIP	Valve isolation plan	A version of the isolation plan that includes valve names and coordinates whose closure would result in stopping the release of gas.

Appendix B: List of Attachments

1. PG&E Response to Data Requests - Questions 12851.01 to 12851.17
2. PG&E Response to Data Requests - Question 12859.01
3. PG&E Response to Data Requests - Questions 12913.01 and 12913.02
4. PG&E Leak Survey History, 2018.
5. PG&E Response to Data Requests - Questions 13699.01 and 13699.02
6. PG&E Response to Data Requests - Questions 13226.01 and 13226.02
7. PG&E SCADA Graphical Trend Data, February 6, 2019.
8. Contract between Verizon and MasTec
9. Contract between MasTec and Advanced Fiber
10. Contract between Advanced Fiber and Kilford
11. Fiberoptic cable installation scope of work
12. One-call ticket #USA-X90210166, January 21, 2019.
13. One-call ticket #USA-X902201229, January 22, 2019.
14. PG&E One-call Tickets Timeline with Photographs, 2019.
15. Kilford Photographs of Saw-cutting, February 5, 2019.
16. Interview of Kilford Excavator Operator, February 9, 2019.
17. Kilford Excavator Operator Competent Person Card, 2017.
18. Kilford Proof of Purchase of Mini Excavator
19. Kilford Skid Steer Specs
20. Kilford Proof of Purchase of Breaker Attachment
21. Kilford Breaker Attachment Specs
22. Kilford Response to Data Requests - Email - Equipment & Prior Incident
23. Interview of Traffic Control Technician, February 9, 2019.
24. Kilford Safety Briefing Documentation, February 6, 2019.
25. Interview of Kilford Spotter, February 9, 2019.
26. PG&E Dig-in Reduction Team Investigation Report, 2019.
27. San Francisco Fire Department Computer Aided Dispatch Log for February 6, 2019.
28. San Francisco Police Department Computer Aided Dispatch Log for February 6, 2019.
29. Interview of PG&E Gas Service Representative, February 9, 2019.
30. Kilford Employee Code of Safe Practices
31. Kilford Field Manual for Trenching
32. Kilford Excavation Competent Person Manual
33. Resume of Kilford Excavator Operator
34. Kilford Photographs of Prior Incident
35. Kilford Prior Incident Reports
36. PHMSA Audit of California Damage Prevention, 2017.
37. PHMSA Summary of Title 49 Code of Federal Regulations Parts 198 and 196
38. PHMSA Determination of Inadequacy, Letter to the Dig Safe Board Executive Officer, 2018.
39. PHMSA Determination of Inadequacy, Letter to the state of California Attorney General, 2016.
40. PHMSA Damage Prevention Program Evaluation Criteria
41. Memorandum of Understanding between the Dig Safe Board and Contractor State Licensing Board, 2018.
42. Timeline of Events from PG&E data
43. Interview of PG&E Operational Emergency Center Commander, February 9, 2019.
44. Interview of PG&E Incident Commander, February 9, 2019.
45. Interview of PG&E Deputy Incident Commander, February 9, 2019.
46. Interview of PG&E Gas Pipeline Operations and Maintenance Supervisor, February 9, 2019.

47. Excerpts from PG&E Gas Emergency Response Plan, Revision 8.0, 2018.
48. Excerpts from PG&E Procedure TD-6100P-04, Gas Event Evacuation, 2014.
49. Excerpts from PG&E 911 Notification Process, 2018.
50. Interview of PG&E Gas System Planning Supervisor, February 10, 2019.
51. Interview of PG&E Gas Maintenance and Construction Supervisor, February 9, 2019.
52. OQ records for 18 PG&E employees who performed excavation work
53. OQ records for PG&E employee who performed squeeze-off
54. OQ records for 3 PG&E locators
55. Summary of PG&E Operator Qualifications.
56. PG&E Response to Data Requests - Email regarding 12-inch Steel Main Locates, February 9, 2019.
57. PG&E Response to Data Requests - Questions 12919.01 to 12919.16
58. PG&E Affected Mains Basic Map.
59. PG&E Final Valve Isolation Plan diagram.
60. OQ records for 4 PG&E employees who operated valves
61. PG&E Response to Data Requests - Questions 12861.01 to 12861.03
62. PG&E Repair Report with Sketch
63. OQ records for PG&E employee who performed fusion
64. OQ records for PG&E employee who performed tap
65. Physical Evidence NTSB Chain of Custody.
66. PG&E Emergency Work Clearance Document, February 6, 2019.
67. OQ records for 4 PG&E employees who performed purge
68. OQ records for PG&E Welder
69. Welder Performance Records for PG&E Welder, 2018-2019.
70. Excerpts from PG&E Procedure TD-4441P-04, Emergency Clearances for Gas Distribution Facilities, 2015.
71. Still Image from Security Camera Footage, February 6, 2019.
72. Interview of SFFD Incident Commander, February 10, 2019.
73. San Francisco Fire Department News Release for Incident #19015528, February 6, 2019.
74. San Francisco Fire Department Incident Command System Forms
75. Excerpts from San Francisco Fire Department Procedures
76. PG&E Response to Data Requests - Email regarding Water Main, July 2, 2019.
77. San Francisco Department of Public Works Emergency Order, Notice of Violation, and Explanation of Status
78. CPUC Record of PG&E Response Times in San Francisco, 2017 - 2019.
79. SFFD Record of PG&E Response Times for Longer Events in San Francisco, 2017 - 2019.
80. PG&E Record of PG&E Make Safe Times in San Francisco, 2012 - 2018.

Publicly Available Sources

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- Caterpillar Website – CAT 305E2 CR Specifications
- Common Ground Alliance Best Practices, Version 16.0
- CPUC Website - About Us
- CPUC Website - Natural Gas and Oil Regulation
- CSLB Annual Report, 2018
- CSLB Website - About Us
- Dig Safe Board 2019-2020 Education and Outreach Plan
- Dig Safe Board Fee Regulation, State of California Code of Regulations, Title 8, Division 1, Chapter 4, Subchapter 4, Article 6, Section 4010

- Dig Safe Board Meeting Staff Report, August 2019, Line Item 4
- Dig Safe Board Notice of Proposed Rulemaking, State of California Code of Regulations, Title 8, Division 1, Chapter 4, Subchapter 4, Article 6, Sections 4000 to 4361
- Dig Safe Board Notice of Proposed Rulemaking, State of California Code of Regulations, Title 8, Division 1, Chapter 4, Subchapter 4, Article 6, Sections 4003(a)(1), 4305, 4310, 4345, 4401, 4501
- Dig Safe Board Results Report, 2018
- Dig Safe Board Website - About Us
- Kilford CSLB License # 1046192
- MasTec CSLB License # 984138
- NAPSRS Website – About Us
- NTSB Prior Recommendation P-82-003, 1981
- PG&E Website - Company Profile
- State of California Code of Regulations, Title 8, Division 1, Chapter 4, Subchapter 4, Article 6, Sections 1539 to 1541
- State of California Government Code, Title 1, Division 5, Chapter 3.1, Article 2, Sections 4216 to 4216.24
- Title 49 Code of Federal Regulations Part 196
- Title 49 Code of Federal Regulations Part 198

Other Docket Items:

- Summary of Federal and State Regulations
 - Excerpts from CPUC Code, Division 1, Part 1, Chapter 4.5
 - Excerpts from CPUC General Order 112-F
 - Excerpts from Title 49 Code of Federal Regulations Part 191
 - Excerpts from Title 49 Code of Federal Regulations Part 192
- National Response Center Incident Report #1237005
- National Response Center Incident Report #1237131
- PHMSA Form F 7100.1 #20190024-31741 (30 Day Report)
- Accident scene photographs