



National Transportation Safety Board
Office of Railroad, Pipeline and Hazardous Materials Investigations
Human Performance and Survival Factors Division
Washington, D.C. 20594

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Survival Factors Group Chairman's Factual Report

February 9, 2011

A. Accident Information

Operator: Pacific Gas & Electric Company
Location: San Bruno, California
Date: September 9, 2010
Time: 1811 PDT¹
Number: DCA10MP008

B. Survival Factors Group Members

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¹ All times are pacific daylight time (PDT) and based on the 24-hour clock unless otherwise noted.

C. Accident Summary

On September 9, 2010, at approximately 1811 PDT, a 30-inch diameter section of a multi-diameter intra-state natural gas transmission pipeline (Line 132) owned and operated by Pacific Gas & Electric Company (PG&E) ruptured in a residential area in San Bruno, California. The rupture occurred at approximately mile point 39.28, at the intersection of Earl Avenue and Glenview Drive in the city of San Bruno. PG&E estimated that 47.6 million standard cubic feet of natural gas were released as a result of the rupture. The rupture created a crater approximately 72 feet long by 26 feet wide. A pipe segment approximately 28 feet long was found about 100 feet south of the crater. The released natural gas was ignited sometime after the rupture; the resulting fire destroyed 38 homes and damaged 63. Eight people were killed, numerous individuals were injured, and many more were evacuated from the area.

Line 132 is regulated by the California Public Utilities Commission (CPUC). According to the PG&E survey sheets, the ruptured pipe (part of Segment 180 that is approximately 1,742-foot long) was constructed from 30-inch diameter seamless steel pipe (API 5LX) Grade X42 with 0.375-inch thick wall. The pipeline was coated with hot applied asphalt, and was cathodically protected. The ruptured pipeline segment was installed circa 1956. The specified maximum operating pressure for the ruptured pipeline was 375 pounds per square inch gauge (psig). According to PG&E, the maximum allowable operating pressure for the line was 400 psig. Just before the accident, PG&E was working on their uninterruptable power supply system at Milpitas Terminal, which is located about 39.28 miles southeast of the accident site.

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D. Details of the Investigation

1.0 Emergency Response

The first 911 call was received about 1811.² The caller reported that there was a huge explosion and fire near Skyline Boulevard. The first San Bruno police department resources were dispatched at 1811, and the first unit arrived at 1812. The first San Bruno fire department resources were enroute at 1813 and arrived on scene within seconds.

1.1 Initial Response

While at their station at Sneath Lane and Claremont Drive in San Bruno, the crew of engine 52 heard an explosion. The crew heard a loud boom and felt the station shaking. Looking east, they observed a large wall of fire about 200 feet in the air. The captain of engine 52 notified the dispatch center that there was a large structure fire on Claremont Drive. He requested the dispatch center to initiate a structure fire assignment to Claremont Drive.

Engine 52 responded to the north side of accident area and was the first fire company on scene. As they surveyed the accident area, the captain requested second and third alarms. Battalion Chief 18, who also responded to the north side of the accident area, requested a fourth alarm.

Battalion Chief 9, who responded to the south side of the accident area, observed several structures and the Crestmoor Canyon wildland area on fire. Battalion Chief 9 requested a fifth alarm.³

A representative from the county dispatch center responded to the accident area. Requests for additional response resources were relayed through this representative. A staging area was established in a grocery store parking lot at Glenview Drive and San Bruno Avenue.

Engine 51 and truck 51 responded to south side of the accident area. Engine 51 reported that hydrants in the Glenview Drive area were dry. Battalion Chief 9 requested that a representative of the city water department respond to the command post.

² Calls to 911 are received at the San Mateo County Office of Public Safety Communications.

³ A sixth alarm was requested at 1923.

On his arrival, the San Bruno fire chief assumed incident command. Fire operations were supervised by a Division Chief from Millbrae Fire Department and were organized into area command.⁴ Battalion chiefs supervised each area.

Because a water line in the accident area was damaged, fire hydrants in this area were dry. South San Francisco Fire Department engines helped to establish a water supply. A water supply was established at Sequoia and Fleetwood Drive, and about 2000 feet of large diameter supply hose was deployed. A second water supply was established at San Bruno Avenue and Glenview Drive, and about 1000 feet of large diameter supply hose was deployed.

The fire chief coordinated unified command and established the command post at Glenview Drive and San Bruno Avenue in a gas station parking lot. A battalion chief from the North County Fire Authority⁵ was the deputy incident commander. A planning section and a communications branch were established.

A battalion chief from Cal Fire was the liaison for air operations. A second Cal Fire battalion chief was assigned to the wildland branch which included the Crestmoor Canyon area. A third Cal Fire battalion chief was assigned to supervise the water tenders section. An aircraft rescue and fire fighting vehicle was requested from San Francisco International Airport.

The fire operations supervisor declared the incident a mass casualty incident. A medical group was established. A division chief was the supervisor of the medical group. Medical units were located north and south of the incident.

Police officers from San Bruno and mutual-aid organizations conducted evacuations and secured the area. California Highway Patrol troopers closed highways in the immediate area. San Bruno police officers with assistance of the San Mateo County Sheriff's Office conducted missing persons and wellness checks. San Bruno activated its emergency operations center. A recreation center was opened and staffed by the Red Cross for evacuees.

Many residents in the accident area self-evacuated. Fire crews and police officers conducted door to door searches of houses. Twenty-one people were transported to hospitals by ambulance. Forty-five people were transported to hospitals by private vehicle.

⁴ According to the Federal Emergency Management Agency, area command is a command organization established to oversee the management of large or multiple incidents.

⁵ The North County Fire Authority serves the communities of Brisbane, Daly City, and Pacifica in San Mateo County.

1.2 Conclusion of the Response

During the next 2 days, fire operations continued to monitor the accident area for hot spots. The logistics, planning, and finance sections continued operations. A damage assessment branch was established, and the structural stability of the houses in the area were assessed and documented. At 2000 on September 11, incident command was transferred to the San Bruno Police Department.

See Appendix A for a transcript of fire department radio communications.

See Appendix B for incident reports from the fire department.

See Appendix C for a list of responding fire departments.

2.0 Medical Information

According to the San Mateo County Coroner's Office, eight people sustained fatal injuries.⁶ According to San Mateo County Emergency Medical Services, 58 people were treated for injuries at hospitals.

See Appendix D for an injury list.

3.0 Public Awareness Programs

3.1 Regulatory Information

The CPUC adopted and enforces Federal pipeline regulations.⁷ Title 49 *Code of Federal Regulations* (CFR) Part 192 requires natural gas pipeline operators to develop and implement a written continuing public education program. Pipeline operators have been required to have written programs as of June 20, 2006. The regulation states that the program must provide awareness information to the public, appropriate government organizations, and excavators. The awareness information must include information about:

- Use of a one-call notification system

⁶ Title 49 *Code of Federal Regulations* 830.2 defines fatal injury as "any injury which results in death within 30 days of the accident" and serious injury as "an injury which: (1) requires hospitalization for more than 48 hours, commencing within 7 days from the date the injury was received; (2) results in a fracture of any bone (except simple fractures of fingers, toes, or nose); (3) causes severe hemorrhages, nerve, or tendon damage; (4) involves any internal organ; or (5) involves second or third-degree burns, or any burn affecting more than 5 percent of the body surface."

⁷ See CPUC General Order 112E for further information.

- Possible hazards associated with releases from a gas pipeline
- Physical indications that a release has occurred
- Steps that should be taken in the event of a release
- Procedures for reporting such an event

Public awareness programs must follow the guidance in the American Petroleum Institute's (API) Recommended Practice 1162 (RP 1162) *Public Awareness Programs for Pipeline Operators*.⁸ RP 1162 was incorporated by reference into the pipeline regulations.⁹

See Appendix E for 49 CFR 192.616.

3.2 API Recommended Practice 1162

3.2.1 Overview

RP 1162 establishes guidelines for pipeline operators to develop, manage, and evaluate public awareness programs. RP 1162 states:

- Public awareness and understanding of pipeline operations is vital to the continued safe operation of pipelines.
- Public Awareness Programs should address the needs of different audiences within the community.
- Public awareness messages need to provide a broad overview of how pipeline operate, the hazards that may result from activity in close proximity to pipelines and those hazards possible due to pipeline operations, and the measures taken to prevent impact to public safety, property or the environment.

RP 1162 contains guidance for the development and administration of public awareness programs. RP 1162 identifies audiences that should receive awareness messages, the content of baseline awareness messages, and the frequency of the messages for each audience. Audiences defined in the standard include the affected public, emergency officials, and local public

⁸ *Public Awareness Programs for Pipeline Operators*, American Petroleum Institute (Washington, DC: API Publishing Services, 2003).

⁹ *Federal Register*, vol. 70, no. 96 (May 19, 2005), p. 28833.

officials. The standard also provides guidance for the review and evaluation of awareness programs.

3.2.2 Baseline Awareness Messages and Frequency of the Messages – Transmission Operators

For all audiences, the baseline awareness messages include: pipeline purpose and reliability, the awareness of hazards and prevention measures taken, and how to get additional information.

Table 1. RP 1162 baseline messages for transmission pipeline operators.

Audience	Message	Frequency	Method
Residents along the right-of-way	Damage prevention awareness Leak recognition and response Pipeline location information	Baseline: Once every 2 years	Targeted distribution of print materials Pipeline markers
Emergency officials	Emergency preparedness communications Pipeline location information	Baseline: annual	Personal contact, or Targeted distribution of print materials, or Group meetings
Public Officials	Emergency preparedness communications Pipeline location information	Baseline: Once every 3 years	Targeted distribution of print materials

3.2.3 Baseline Messages and Frequency of the Messages – Distribution Operators

For all audiences, the baseline awareness messages include: pipeline purpose and reliability, the awareness of hazards and prevention measures taken, and how to get additional information.

Table 2. RP 1162 baseline messages for distribution pipeline operators.

Audience	Message	Frequency	Method
Customers	Damage prevention Leak recognition and response	Baseline: twice per year	Bill stuffers
Emergency officials	Emergency preparedness communications	Baseline: annual	Print materials, or Group meetings
Public Officials	Emergency preparedness communications	Baseline: Once every 3 years	Targeted distribution of print materials

3.2.4 Program Evaluation

RP 1162 establishes the requirements for the evaluation of public awareness plans. RP1162 states that the evaluation should include two areas: the process and program effectiveness.

RP 1162 states that operators should evaluate *the process* annually. This evaluation should determine if the program has been implemented and documented according to the public awareness plan. RP 1162 states that operators should evaluate *program effectiveness* “no more than four years apart.” This evaluation should determine if the awareness messages are reaching the audiences and if the audiences understand the messages.

3.3 PG&E Public Awareness Program Plan

PG&E’s public awareness plan was completed in 2006 and most recently revised in 2009. According to the program plan:

The objective of PG&E’s Pipeline Public Awareness Plan is to enhance public safety and environmental protection through increased public awareness and knowledge.

The public awareness program plan describes the baseline messages and frequency of the messages. The plan defines affected public audiences for the local distribution system and the transmission system. The affected public (distribution) is defined as any persons receiving

PG&E gas or electric service. The affected public (transmission) is defined in part as residents located adjacent of the pipeline centerline. According to the program plan, the baseline plan for the affected public (transmission) is a direct mail program for those persons who do not receive the bill stuffers. The following table summarizes the frequency and method for *baseline* public awareness messages for audiences.

Table 3. PG&E’s baseline public awareness program.

Audience	Frequency	Method
Affected public (distribution)	Twice per year	Bill stuffers
Affected public (transmission)	Every 2 years	Targeted direct mail
Emergency officials	Annual	Targeted distribution of print material, or Group meeting
Public Officials	Every 3 years	Letters

See Appendix F for PG&E’s summary table for public awareness messages.

See Appendix G for PG&E’s public awareness program plan.

3.4 PG&E’s Recent Public Awareness Program Activities

The following sections describe PG&E’s recent public awareness program activities for the affected public, emergency officials, and public officials. These sections were compiled from public awareness program documents provided by PG&E.

3.4.1 Affected Public – Distribution

For the years 2009 and 2010, PG&E public awareness mailing-list records for the affected public (distribution) were reviewed for the addresses in the San Bruno neighborhood affected by the accident. The search of the records was conducted by street address. The following table shows the San Bruno streets included in this search.

Table 4. San Bruno streets included in a search of PG&E public awareness records.

Affected Neighborhood Streets
Glenview Drive
Earl Avenue
Claremont Drive
Fairmont Drive
Concord Way
Vermont Way
Plymouth Way
Hampton Court
Estates Drive
Daley Court
Crosby Court
Moore Court
Windsor Court

The search included 376 San Bruno addresses. Of the 376 addresses, 369 of those addresses received a bill stuffer twice in 2009 and twice in 2010. For the year 2010, two addresses were listed once and received one bill stuffer. For the year 2009, two addresses were listed once and received one bill stuffer, and one address was not on the mailing list.

See Appendix H for a map of the affected neighborhood.

See Appendix I for an example of a bill stuffer for the affected public (distribution).

3.4.2 Affected Public - Transmission

The affected public (transmission) is defined in part as residents located adjacent of the pipeline centerline. According to the program plan, the baseline plan for the affected public (transmission) is a direct mail program for those persons who do not receive the bill stuffers. For the years 2008 and 2010, PG&E public awareness mailing-list records for the affected public (transmission) were reviewed for the Peninsula Division. For the mailing conducted in 2008,

there were 3346 records for addresses in Sunnyvale, California (Santa Clara County). For the mailing conducted in 2010, there were 1438 records for address in East Palo Alto and Palo Alto (San Mateo County). See the previous section for information about the bill stuffers for customers.

See Appendix J for an example of a brochure for the affected public (transmission).

3.4.3 *Emergency Officials*

3.4.3.1 Baseline Public Awareness Program

The Pipeline Association for Public Awareness (PAPA)¹⁰ conducts awareness program for emergency officials and public officials. PAPA distributes these program materials for PG&E and other participating member pipelines. PG&E is a member and a participant of PAPA.

For emergency officials, PAPA provided a *Pipeline Emergency Response Guidelines* book,¹¹ a CD with training scenarios, an emergency contact directory, and the *Pipeline Awareness Newsletter* to emergency response agencies in the Peninsula Division. The following table lists some of the organizations that were included on PAPA's emergency officials' mailing list for San Bruno in 2009 and 2010. According to the documents provided, no pipeline maps or location-specific information is provided in this mailing.

¹⁰ According to PAPA, it is a nonprofit corporation established in 2004 to provide educational information concerning pipeline safety and emergency preparedness to residents and businesses located near pipelines, emergency responders and public officials in communities with pipelines and excavators working near pipelines.

¹¹ *Pipeline Emergency Response Guidelines*, Pipeline Association for Public Awareness (Golden, Colorado: Pipeline Association for Public Awareness, 2010).

Table 5. Excerpts from the mailing list for local emergency response agencies for 2010 and 2009.

Organization	2010 addressee	2009 addressee
San Bruno Fire Department	Interim Fire Chief	Interim Fire Chief
San Bruno Police Department	Police Chief, and Records Supervisor	Police Chief, and Records Supervisor
Skyline College	Chief of Security	Chief of Security
San Mateo County Office of Emergency Services	Area Coordinator	Area Coordinator
San Mateo County Public Safety Communications	Communications Director	Communications Director

See Appendix K for the cover letter for the 2009 and 2010 mailings for emergency officials.

See Appendix L for a list of San Mateo County emergency officials mailing list for 2010.

3.4.3.2 Supplemental Public Awareness Program

Public Liaison Workshop

PG&E conducts public awareness liaison workshops for emergency officials. On March 25, 2010, PG&E held a workshop for officials in San Mateo County. The following table shows some of the organizations who were invited to participate in the workshop.

Table 6. Excerpts from the public liaison workshop invitation list for March, 25, 2010.

Organization Name	Invitees
City of San Bruno	Police Chief
City of San Bruno	Fire Chief
County of San Mateo	Sheriff
County of San Mateo	Director, Office of Emergency Services

As compiled from PG&E records, the table below shows some local organizations that attended the workshop.

Table 7. Excerpts from public liaison workshop attendance record for March 25, 2010.

Organization	Attendees
County of San Mateo Office of Emergency Services	1
City of San Bruno	1

See Appendix M for a public liaison workshop invitation letter.

See Appendix N for a list of San Mateo County organizations invited to the workshop.

See Appendix O for a list of organizations that attended the public liaison workshops held in 2009 and 2010.

See Appendix P for a public liaison workshop agenda.

Responding to Gas and Electric Emergencies Seminar

Beginning in 2009, PG&E began to offer *Responding to Gas and Electric Emergencies* seminars to emergency response organizations. The training describes how to safely operate around gas and electric lines. As compiled from PG&E records, the table below shows the dates and places that the seminars were offered in 2010.

Table 8. *Responding to Gas and Electric Emergencies* seminars held in 2010 for the Peninsula Division.

Location	Date
San Jose	January 19, 2010
Stockton	February 4, 2010
West Sacramento	March 8, 2010
West Sacramento	March 12, 2010
Guerneville	March 18, 2010
Dublin	March 29, 2010
Ukiah	April 24, 2010
Santa Cruz	May 25, 2010
Berkeley	June 4, 2010
Chico	June 14, 2010
Redding	June 15, 2010
Stockton	July 28, 2010
Fairfield	August 6, 2010

As compiled from PG&E records, the following table shows the attendees for these seminars in 2010.

Table 9. Excerpts from the attendance list for the *Responding to Gas and Electric Emergencies* seminars held in 2010.

Event Date	Event City	Organization	Attendee
August 6, 2010	Fairfield	Palo Alto Fire Department	Apparatus Operator - Paramedic
March 29, 2010	Dublin	Menlo Park Fire Protection District	Engineer
February 4, 2010	Stockton	North County Fire Authority	Battalion Chief, Training Division

See Appendix Q for an announcement flyer for a *Responding to Gas and Electric Emergencies* seminar.

See Appendix R for a complete list of attendees for *Responding to Gas and Electric Emergencies* seminars 1 for 2009 and 2010.

See Appendix S for a list of attendees for *Responding to Gas and Electric Emergencies* seminars for 2009 and 2010.

PG&E Website

The PG&E website includes a *First Responder Beware* site. At this site, emergency responders can order the *Responding to Utility Emergencies* book and instructor CD.¹² The book provides instruction of electric and gas systems and guidelines for responding to utility emergencies. PG&E provides these materials to emergency response organizations without a charge. The website also lists scheduled *Responding to Gas and Electric Emergencies* seminars.

3.4.4 Public Officials

For public officials, PAPA provided the *Pipeline Awareness Newsletter* to government organizations in the Peninsula Division. Awareness materials for PG&E are mailed to public officials yearly. The following table lists the city departments that were included on PAPA's mailing list for public officials for San Bruno in 2010 and 2009.

¹² *Responding to Utility Emergencies*, Michael Callan. (Chester, Maryland: Red Hat Publishing, Inc., 2004).

Table 10. San Bruno city departments as listed for the mailing to public officials for 2010 and 2009.

2010	2009
Building Inspection	Building Inspection
City Clerk	City Clerk
City Council	City Council
Engineering Admin	Engineering Admin
Human Resources	Fleet Maintenance
Planning and Zoning	Planning and Zoning
Storm Department	Storm Department
TV Cable Department	Water Corp Yard
Utility Billing	
Water Corp Yard	

See Appendix T for an example brochure for public officials.

3.5 PG&E's Program Evaluation

3.5.1 PG&E Annual Program Review

The PG&E public awareness program review period is from June to June. The review dated December 2009 reviewed the period from June 2008 to June 2009. The review documents baseline and supplemental program events that occurred during the review period such as mailings, meetings, and a review of website content. The following table shows the program events documented in the review and if the event date was documented in the review.

Table 11. Baseline and supplemental program events documented in the 2009 program review.

	Baseline program events	Supplemental program events	Supplemental event dates documented?
Affected public (distribution)	Bill stuffers	Agricultural events Mark and locate meetings One-call system participation PG&E website	Yes Yes Yes N/A
Affected public (transmission)	Bill stuffers	Agricultural events Mark and locate meetings One-call system participation PG&E website	Yes Yes Yes N/A
Emergency officials	PAPA mailing	Emergency drills Emergency training Joint meeting PG&E website	No No No N/A
Public officials	PAPA mailing		N/A

See Appendix U for the public awareness program review conducted in 2009.

3.5.2 PG&E Program Effectiveness Review

A program effectiveness review was conducted by The Paradigm Alliance, Inc. (Paradigm) and is dated June 2010. For this review, Paradigm mailed public awareness brochures with business reply mail survey postcard to 15,302 addresses. The addresses are near the right-of-way and include the audiences defined in RP 1162. Eight weeks after the mailing, 20 survey postcard were returned to Paradigm. The table below summarizes the responses from the survey postcards.

Table 12. Summary of the responses for the survey postcards.

Question	Yes	No	Blank
Do you or someone you know work or live near a pipeline?	7	9	4
Have you seen any information about pipeline safety within the last two years?	3	14	3
If you noticed what appears to be a pipeline leak, would you call 911?	17	0	3
Have you or anyone you know ever discovered a buried pipeline while digging?	17	0	3
Have you ever heard of the “One-Call” system before reading this brochure?	2	14	3 ¹³

¹³ In the review report, only nineteen responses to this question are documented.

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