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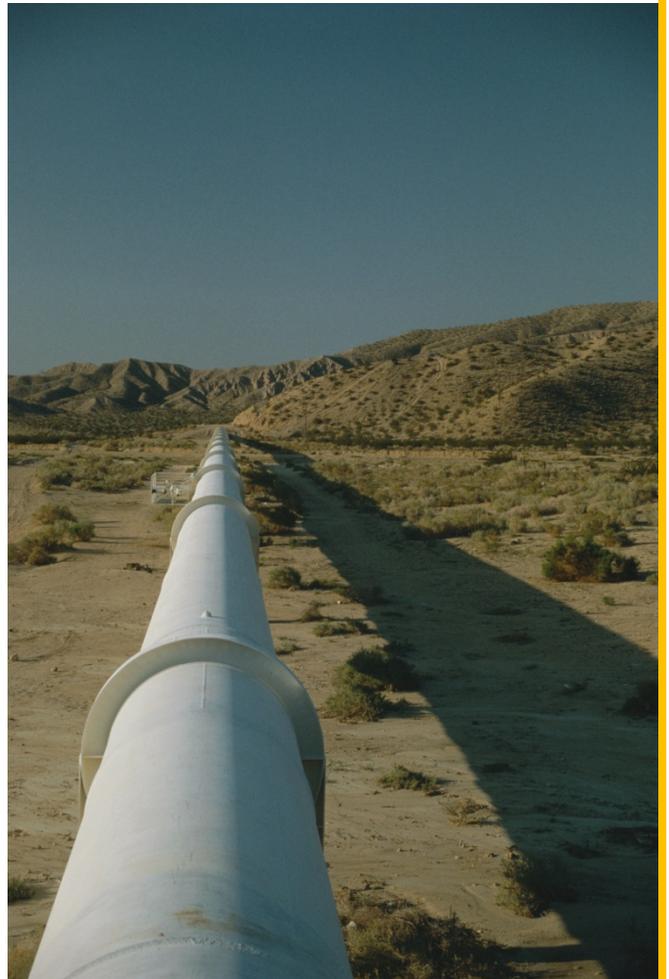
2016 GAS SAFETY PLAN



*Pacific Gas and
Electric Company*[®]

2016 GAS SAFETY PLAN

OCTOBER 19, 2016





October 19, 2016

Dear Reader,

We continue to make strides towards our goal of becoming the safest, most reliable gas utility in the United States. The 2016 Gas Safety Plan provides a high-level, programmatic view of both the work we accomplished in 2015, and our plan moving forward to achieve this goal.

We used this annual update opportunity to reorganize the plan so that our long-term goals and progress towards those goals are more visible. You will notice changes in this document. In 2017, we will begin serving the plan in March with a focus on 2016 data; this year's plan focuses on 2015 year-in-review data. Second, by consolidating language and focusing our message on the performance data, we were able to present important Gas Operations information in a streamlined manner making the plan accessible to a broader audience, for example using endnotes for greater readability.

Our team worked diligently to re-imagine the plan as a more engaging document that reflects our dedication to safety of the people we have the privilege to serve. We hope that you too find our plan an informative read that readily spotlights key safety activities, the rationale for those activities, our long-term goals, and our progress towards achieving those goals.

We are proud of our commitment and progress towards Gas Safety Excellence and continue to strive towards being the safest, most reliable gas utility in the United States.

The Gas Operations Executive Committee

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PACIFIC GAS AND ELECTRIC COMPANY GAS SAFETY PLAN

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PACIFIC GAS AND ELECTRIC COMPANY GAS SAFETY PLAN

I. INTRODUCTION

As a provider of natural gas, Pacific Gas and Electric Company (PG&E or Company) transports a flammable product under pressure in and around the communities PG&E serves. The gas business has inherent risks, so PG&E’s employees work around the clock, 365 days a year to keep the general public, customers, contractors, and employees safe.

The 2016 Gas Safety Plan (Plan) reports on the progress PG&E has made to become the safest, most reliable gas company in the United States. PG&E’s Gas Safety Excellence Program permeates every aspect of the Company’s gas operations. Some Gas Safety Excellence elements include understanding PG&E assets and the threats those assets face, making sure that employees and contractors have the tools, training, procedures, and records they need to safely and effectively perform construction, operations and maintenance on the system, risk-prioritizing, and resourcing the workload for today and tomorrow.

The purpose of PG&E’s Plan is to demonstrate PG&E’s commitment to safe and reliable operations. In alignment with state regulatory framework,¹ this Plan explains how PG&E puts the safety of the public, customers, employees, contractors and the gas system first, and how the Company has made safety investments in processes and infrastructure that are consistent with best practices in the gas industry.

While more remains to be done, PG&E has made great progress in achieving Gas Safety Excellence over the last five years. Figure 1 provides a summary of PG&E’s performance in key areas that demonstrates PG&E’s commitment to safety, whether for emergency response, maintaining a safe system or modernizing the system.

		2010	2015
	GAS ODOR RESPONSE TIMES		
	Average response time in minutes ¹	33.3	20.3
	Percent response within 60 minutes	94.4%	99.6%
	SCADA VISIBILITY AND CONTROL POINTS		
	Transmission pressures and flows	1,300	2,480
	Distribution pressures and flows	295	1,310
	LEAK BACKLOG		
	Open Grade 2 and 2+ leak indications	12,203	94
	DIG-IN REDUCTION		
	Excavation damage/1,000 excavation tickets	3.5	2.11

	2010	2011-15
GAS TRANSMISSION		
Miles of pipeline replaced	9	>155
Miles of pipeline hydrotested	0	>750
Miles of pipeline made piggable	130	>415
Automated valves installed	0	235
Percent of system with GPS centerline data ²	0%	100%
GAS DISTRIBUTION		
Miles of main replaced ³	27	>310

1 Data represents top decile in the nation

2 GPS survey was completed for 100% of accessible transmission pipeline system using highly precise mapping tools

3 In 2014 all known remaining cast-iron pipe was decommissioned

Figure 1 – Key Gas Performance Metrics

This 2016 update reiterates PG&E’s commitment and vision to become the safest, most reliable natural gas system in the nation. PG&E relies on its Gas Safety Excellence framework to fuel this commitment and vision. The following sections of the Plan provide more information on how PG&E is achieving Gas Safety Excellence, including updates on the Company’s safety goals and commitments to public, customer, employee, and contractor safety.

The Plan describes PG&E’s goals in pursuit of Gas Safety Excellence. Safety culture, process safety, and asset management are the bedrock of these efforts and include key programs such as the Corrective Action Program and PG&E’s safety committees. The Plan reviews how PG&E manages risk—both the inherent risk of the assets *and* the risk of working on those assets safely. PG&E describes how it achieves safety through asset management by discussing how the Company identifies risk, prioritizes risks and then works to mitigate them, highlighting the three major categories of gas system risk the Company manages: loss of containment, loss of gas supply, and inadequate emergency response.

The Plan then reviews how PG&E qualifies, trains and engages the workforce to mitigate risk by working on its assets safely. This section includes information about PG&E’s workforce training and qualifications programs, and how PG&E ensures compliance. Finally, the Plan presents PG&E’s efforts to continuously improve over time.

The following section describes how PG&E sets its strategic goals. Ultimately, PG&E’s progress in achieving Gas Safety Excellence is dependent on effective and clear organizational goals.

1. THE PURSUIT OF GAS SAFETY EXCELLENCE

Gas Safety Excellence is PG&E’s strategic framework within gas operations to achieve the vision of becoming the safest, most reliable gas utility in the nation. This framework is designed to improve

safety, manage risk, drive continuous improvement, and help guide the long-term strategy for Gas Safety. Gas Safety Excellence is demonstrated by:

- Putting **SAFETY** and people at the heart of everything
- Investing in the **RELIABILITY** and integrity of PG&E’s gas system
- Continuously improving the effectiveness and **AFFORDABILITY** of PG&E’s processes

PG&E’s Gas Safety Excellence is an overlapping combination of three key standards-based programs, Safety Culture, Process Safety, and Asset Management.

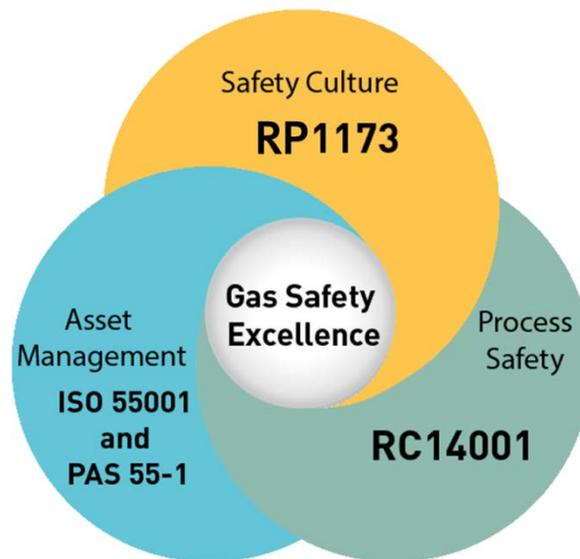


Figure 2 – PG&E Gas Safety Excellence Framework

2. PG&E’S GOALS

Gas Operations’ annual goals are developed through the “Line of Sight” process. This process incorporates Integrated Planning Executive Guidance with key themes and strategies developed through PG&E’s annual, multi-year strategic and work plan development processes, Session D, Session 1 and Session 2.² “Line of Sight” aligns business strategy with six key themes: Safe, Reliable, Affordable, Customer, People, and Compliance. This planning process results in strategic goals to drive action throughout the business.

Strategic goals developed under Gas Safety Excellence include: (1) eliminating public safety related incidents; (2) being in the first quartile nationally for employee and contractor safety and eliminating serious injuries; (3) meeting all reliability commitments, such as reducing unplanned outages; (4) meeting customer commitments and being in the first quartile for customer satisfaction; (5) being in the first quartile for employee engagement; and (6) meeting all regulatory commitments. Related goals and metrics are cascaded throughout the organization to provide each employee a clear understanding of how their actions support PG&E’s vision and commitment to be the safest, most reliable gas utility in the nation. These items are discussed in more detail throughout this update.

a) PUBLIC SAFETY

In 2015, PG&E met and exceeded its goals for a number of safety related programs. The three instances below highlight where PG&E found continued success on its mission to become an industry leader in safety excellence. For example, In-Line Inspections, Emergency Response Time, and Third Party Dig-Ins are three critical metrics that demonstrate PG&E’s commitment to public and employee safety.

- **In-Line Inspection:** In 2015, PG&E increased pigability to roughly 24% of the approximately 6,600 miles of the Gas Transmission system and used in-line inspection tools to inspect just over 265 miles of transmission main. Approximately two-thirds of PG&E’s transmission system (about 4,500 miles) has been or will be upgraded to accept in-line inspection tools.
- **Emergency Response Time:** Industry-leading performance with a 20.33 minute average response time to gas odor calls despite implementing more stringent emergency evaluation criteria that resulted in PG&E responding to nearly double the call volume.
- **Third Party Dig-In:** 2.11 dig-ins per 1,000 Underground Service Alert tickets received—down from 2.42 in 2014.



Figure 3 – PG&E is 35% complete with its goal to make 4,500 miles of its system pigable



Figure 4 – PG&E responded to the 2014 Napa earthquake with no loss of service to customers



Figure 5 – World Ag Expo “811 Sandbox.” If children “strike” a line, a buzzer goes off

b) WORKFORCE SAFETY

PG&E depends on its trained, knowledgeable and capable workforce to provide safe, reliable service to customers. As such, PG&E’s goal is to provide a safe and secure workplace where each employee is appropriately trained and equipped to complete their work without incident. PG&E’s goal is zero safety incidents. In 2015, Gas Employees were involved in 34 Lost Time Injuries and 15 Serious Preventable Motor Vehicle Incidents. To reduce workplace incidents and continue towards PG&E’s goal for an incident free workforce, PG&E initiated several projects that will support this goal in 2016 [See Section: *Safety Projects page 49*].

c) REWARDING SAFETY EXCELLENCE

PG&E’s performance goals reinforce expectations regarding management decisions and allocation of resources. In 2015, PG&E revised its performance goals and a portion of its compensation (known as the Short-Term Incentive Plan) for non-represented employees. Safety is now the single largest factor in performance goals, representing 50 percent of the total. The remaining two factors—customer satisfaction and financial performance—are each weighted at 25 percent.³ This adjustment reflects PG&E’s continued emphasis on the importance of public and employee safety.

II. SAFETY CULTURE

Safety culture represents the alignment of human performance with the organizational strategy. Aligned goals provide employees with a clear understanding of how their work supports the goals of their department and, ultimately, the Company vision. PG&E understands that a workforce that is convinced they have full support of their leaders on safety matters will do the right thing, in the right way, at the right time, even when no one is looking. PG&E's focus is to nurture a culture based on trust where employees feel comfortable speaking up, stopping jobs, sharing incidents or near hits, and learning from one another.

PG&E recognizes that maintaining a positive safety culture requires continual diligence throughout the organization to address issues including complacency, fear of reprisal, overconfidence, and normalization of deviance. Employees are encouraged to report and act on safety concerns, including through PG&E's Corrective Action Program, which further fosters an environment of accountability and ownership where significant and essential behavioral changes can occur at all levels.

To demonstrate its continued progress in achieving Gas Safety Excellence, and in particular, its commitment to nurturing a robust safety culture through adopting a safety management system, PG&E adopted and implemented the American Petroleum Institute's (API) Recommended Practice (RP) 1173, Pipeline Safety Management System Requirements.⁴ PG&E earned a certificate of compliance to the requirements of API RP 1173 from an independent third party auditor in November 2015. PG&E is the first company to earn this distinction.

1. EMPLOYEE ENGAGEMENT

Demonstrating to all employees that the Company values their ideas, input, and personal development, including providing training opportunities leads to an engaged workforce. PG&E has created a strong line of sight between organizational objectives and the work performed on the gas asset system by employees. By aligning corporate strategies and work plans, PG&E supports a fluid bottom-up flow of ideas and feedback to enable continuous improvement in the business.

Gas Operations' executive leadership team visits offices and field locations to speak directly with employees and hear firsthand their thoughts on what PG&E is doing well and where improvements are needed. However, talking to and listening to employees alone is not enough to demonstrate to employees that PG&E's leadership wants their input and ideas on how to improve. To show the focus on engagement, PG&E leadership has created specific engagement activities around key aspects of work, heavily leveraging employee feedback. For example, the selection of new gas crew trucks that are replacing the aging fleet was almost entirely led by field employees. PG&E is in the process of building a new gas training facility with extensive employee engagement around design, layout, training

areas, and equipment. Additionally, course content and technology development are being led by cross functional employee teams. The Company is also working hard to close the feedback loop by developing easy-to-use and centralized mechanisms to obtain employee feedback through its Corrective Action Program.

PG&E also has established gas technical teams that include: front-line employees who meet to review and provide input on updates to procedures, Grassroots Safety teams, division and district teams that meet to identify and resolve local safety issues. These teams provide additional input and recommendations on Gas Operations’ processes from the perspective of people who perform the work. The end goal for PG&E’s approach to employee engagement is to incorporate meaningful employee input into operations decisions.

a) CORRECTIVE ACTION PROGRAM

In October 2013, PG&E implemented the Corrective Action Program to offer employees a simple method to identify and report issues related to gas assets and processes. The types of issues seen in the Corrective Action Program entries include employee concerns or suggestions, operational events, audit findings, or issues with facilities or tools, records, training and safety. The Gas Corrective Action Program ensures that issues are categorized, assessed for risk and assigned to an owner to implement effective corrective actions that will help prevent recurrence.



Figure 6 – Corrective Action Program Process

The Corrective Action Program employs a standardized approach (Figure 6), including a Notification Review Team that meets daily to review the previous day’s Corrective Action Program submittals, to properly investigate and identify the causes underlying the issue and address them appropriately. Initiators receive notification when the item they submitted is closed. The Corrective Action Program provides real-time data, transparency, trending capabilities, and feedback to promote

continuous learning focused on improving the safety and reliability of PG&E’s operations. In 2015, the second full year of the program, PG&E received 10,072 submitted issues, and resolved 7,249 (Figure 7). This represents a 140 percent growth from 2014, reflecting increasing employee engagement and continued support from PG&E leadership. The remaining of the 2,823 submitted issues are assigned to an issue owner and have a scheduled completion date.

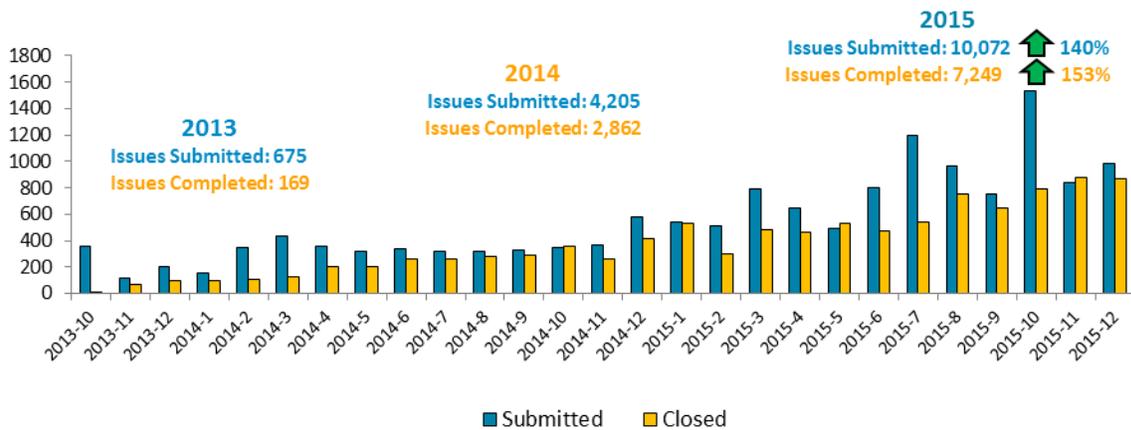


Figure 7 – Corrective Action Program Issues Submitted and Completed

Corrective Action Program is used widely to identify continuous improvement opportunities and to engage PG&E employees in supporting Gas Safety Excellence.

b) COMPLIANCE AND ETHICS HELPLINE

PG&E’s Compliance and Ethics Helpline is a toll-free telephone number available to employees, contractors, consultants, suppliers and customers 24 hours a day, 7 days a week. The Helpline, managed by Navex Global, can be used for both guidance on conduct matters and legal and regulatory requirements or to report situations that may require investigation. Callers have the option of remaining anonymous with any call. In addition to the Helpline channel, the following methods are available to raise concerns and ask for guidance on a range of company policy topics:

- Submitting concerns through the Navex Global web-based submittal service;
- Calling, emailing or sending a letter or fax to the Compliance and Ethics Department directly; and
- Meeting with a Compliance and Ethics staff member.

Concerns and questions raised with Compliance and Ethics are addressed and tracked.

The volume of Helpline calls received in 2015 was roughly 3.9 calls per 100 employees. This falls within the normal range of 0.3 to 10.3 calls per 100 employees according to a benchmark report prepared by Navex Global.

c) MATERIAL PROBLEM REPORTING

In addition to the Helpline and Corrective Action Program, PG&E encourages employees to report and act on problems with any materials, tools, gas/electric/other equipment or infrastructure through the Material Problem Reporting system. PG&E also leverages the Corrective Action Program reporting process to route material related problems to the Material Problem Reporting system. This process is cross-functional and relies on employees at all levels of the business to identify potential safety issues stemming from material problems. PG&E measures the number of days to address Material Problem Reports to evaluate timeliness in resolving identified problems. A key metric PG&E monitors is the average age of the Material Problem Report closure. The average age of Material Problem Reports in 2015 was 36 days, within a single day of the 2015 target of 35 days. Material Problem Reports can be identified from two different sources: Material problems identified as material arrives at PG&E's facilities or field sources identifying material problems after material receipt by PG&E. The 2016 target for resolving incoming material quality problems is 20 days on average.

2. PG&E CORPORATE SAFETY COMMITTEES

PG&E's safety governance structure drives a consistent safety culture and ensures PG&E is aligned on safety strategy and results. Table 1 illustrates the interrelationship between PG&E's Corporate and Gas Operations safety committees.

Table 1 – Safety Committees	
Board of Directors Nuclear, Operations, and Safety Committee	Oversees matters relating to safety, operational performance and compliance. Conducts an annual evaluation of PG&E's performance in accordance with its Corporate Governance Guidelines
Chairman's Safety Council	Provides overall governance of safety guides the enterprise safety strategy and philosophy. Assures continuous improvement of public, employee, and contractor safety performance
Gas Operations Safety Council	Sponsors initiatives to improve Line of Business safety. Monitors Line of Business safety performance and initiatives. Ensures safety initiatives adequately address risks
Grass Roots Safety Teams	Employee-led efforts to identify opportunities to improve safety, define and validate possible solutions, and implement and promote safety initiatives

Attachments 1 and 2 are the charters for the Board of Directors Nuclear, Operations, and Safety Committee, and the Chairman's Safety Council.

III. PROCESS SAFETY

The second pillar in Gas Safety Excellence is a robust plan to develop and implement Process Safety Management.⁵ Process safety, developed by the chemical industry, is focused on the prevention of low frequency, high consequence incidents and mitigation of their consequences. Process safety is based on the idea that a process has multiple layers of protection so that the chemical

or in PG&E's case, the natural gas, is always contained, even if a layer of protection fails. A Process Safety Management system has been developed at PG&E to safely manage assets across their entire life cycle. Process Safety Management is applied to gas projects and existing facilities. The Process Safety Management system is used for engineering of facilities, maintenance of equipment, facility changes, and ensuring safe operation.

PG&E is making a diligent and multi-year effort to commit to process safety, understand hazards and risks, manage risk, and learn from experience. PG&E's commitment in implementing process safety led to certification to chemical industry standard RC14001[®] (Responsible Care[®] and International Standards Organization (ISO) 14001)⁶ in 2016. PG&E is the first utility in the world to attain this certification.

The "Commit to Process Safety" foundational block includes ensuring that all levels of the organization continually drive the improvement of process safety culture. "Doing the right thing" all the time is especially important to PG&E because of the widespread and expansive locations of pipeline and facilities throughout California.

PG&E employs tools, such as Process Hazard Analysis and Quantitative Risk Assessment, in a systematic manner to identify hazards and assess risks. The goal is to be able to prioritize the risks and ensure there are adequate safeguards in place. Ultimately, the management system is designed such that PG&E's risks are continuously reduced by a risk based decision making approach.

To Manage Risk, a set of measures to mitigate identified risks, known as safeguards or layers of protection, are documented, verified, maintained, and their performance tracked. In addition, by managing field changes through change control (or Management of Change), PG&E is able to ensure that changes to a process do not inadvertently introduce new hazards or unknowingly increase risk of existing hazards.

Learning from Experience is a set of formal processes which include incident investigations, audits, metrics to monitor performance and sharing lessons learned throughout the organization. The purpose of this foundational block is to understand vulnerabilities so that future incidents can be prevented. Sharing provides organizational awareness. Auditing also provides feedback to the organization for continuous improvement. For example, process strengths and weaknesses were identified as a result of the RC14001[®] certification audit. PG&E is using the feedback to further strengthen process safety.



Figure 8 – The PG&E Process Safety Method

By achieving RC14001 certification, PG&E Gas Operations has committed to comply with the elements of Responsible Care® which incorporate process safety and the ISO 14001 environmental management system standard. Currently, federal regulations do not require utilities like PG&E to comply with the Process Safety Management principles. However, in alignment with its goal of becoming the safest, most reliable gas utility in the United States, PG&E has been at the forefront of creating and

implementing a risk-based informed Process Safety Management system as a best practice for the gas utility industry.

PG&E measures process safety performance to ensure that the management system is robust and working as designed. The four foundational blocks are further divided into 20 elements (Figure 8, The PG&E Process Safety Method). A survey of each element’s performance is periodically conducted. When performance gaps are identified, plans are developed and implemented to strengthen process safety. Targets are set for the future and improvement plans are implemented. A follow-up assessment is conducted to ensure progress toward goals and verify performance improvement.

IV. ACHIEVING SAFETY THROUGH ASSET MANAGEMENT

PG&E builds, operates and maintains pipeline infrastructure to transport, store, and deliver gas to customers over Northern and Central California. PG&E faces inherent risks and hazards associated with operating a linear asset system that passes through populated areas and a wide variety of terrain. The three primary risks confronting PG&E’s natural gas system are a loss of gas containment, a loss of gas supply, and an inadequate response to emergencies. As part of PG&E’s Gas Safety Excellence Program, PG&E created its third pillar of Gas Safety Excellence, an asset management system to address these three categories of risk. The basis of achieving safety through asset management is to know PG&E

assets and their condition, and to mitigate the risks they face. The following section describes PG&E's asset management system, the asset families, how PG&E's Gas Operations manages risk, and provides an overview of the current risk portfolio.

1. ASSET MANAGEMENT SYSTEM

PG&E has implemented an asset management system to help drive the business toward achieving its commitment to the safe, reliable, affordable management and operation of PG&E's gas assets. Using the international PAS 55-1 and ISO 55001 standards as guidance, PG&E's asset management system focuses on:

- Identifying and reducing operational and enterprise risk,
- Maintaining an asset management framework and directing organizational focus on the most important asset risks and opportunities,
- Proactively managing the condition of gas assets, and
- Meeting or exceeding the requirements of federal, state, and local codes, regulations and requirements in an environmentally sustainable manner.

The Asset Management Policy (TD-01) (**Attachment 3**) lays the foundation for PG&E's Gas Asset Management system while the vision and strategy for enhancing the system is documented in the Strategic Asset Management Plan (**Attachment 4**). PG&E also maintains risk-based Asset Management Plan for its gas assets, which are living documents that evolve as new data becomes available. Finally, PG&E reports regularly to the California Public Utilities Commission (CPUC or Commission) on its safety and reliability investments (**Attachments 5**).

2. ASSET FAMILY STRUCTURE

Since assets can face different types of risk, PG&E developed an asset family structure to recognize and manage these differences yet drive consistency in the way PG&E thinks about and addresses risks. PG&E identified eight asset families within Gas Operations:



We will be the safest, most reliable gas company in the United States

Asset Families

- 1 Gas Storage
- 2 Compression & Processing
- 3 Transmission Pipe
- 4 Measurement & Control
- 5 Distribution Mains
- 6 Distribution Services
- 7 Customer-connected Equipment
- 8 Liquefied Natural Gas/Compressed Natural Gas

Natural Gas System Overview Asset Families

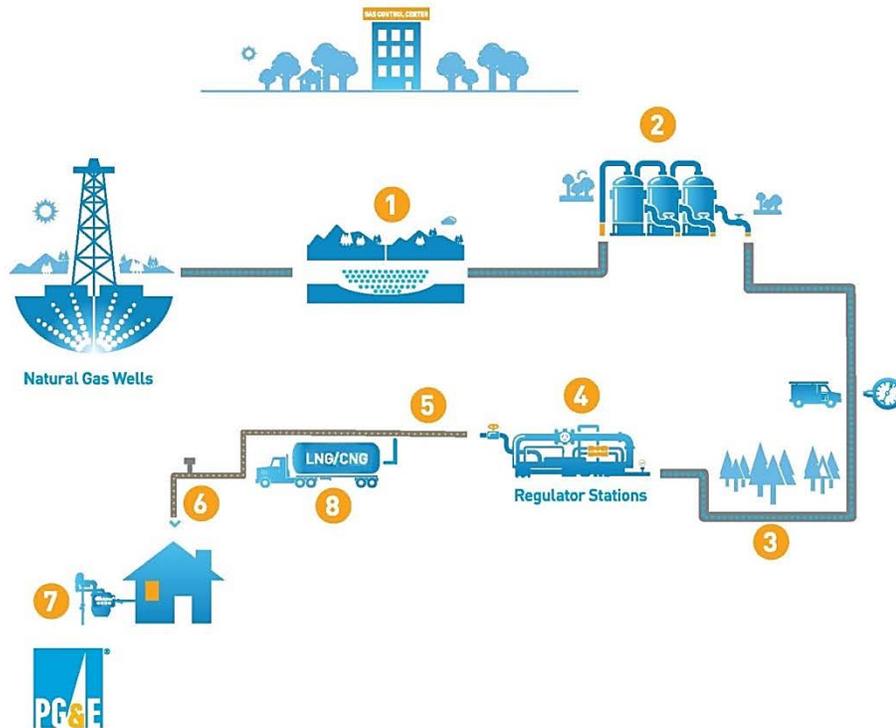


Figure 9 – Natural Gas System Overview – Asset Families

Each asset family has an Asset Family Owner who is responsible for knowing the asset condition, the risks to the assets, and for developing a risk-based Asset Management Plan. By associating each asset with a family, and designating an Asset Family Owner, Gas Operation’s ensures that: (1) each threat can be adequately identified; (2) the condition of the asset and the quality of the data about the asset can be appropriately assessed; (3) the threats and risks facing the asset are identified and assessed; and (4) mitigation efforts can be developed and executed effectively. The Asset Family Owner leads the preparation of the Asset Management Plan for each asset family that describes:

- Physical characteristics and location of the assets
- Asset and asset data condition
- Asset threats and risks
- Programs to address asset risks
- Objectives for the desired state of the assets

These Asset Management plans are living documents evolving as new data become available. The following section summarizes the types of assets in each family, the function these assets serve in the gas system, and progress towards achieving Asset Management Plan objectives.

a) GAS STORAGE

The Gas Storage Asset Family includes PG&E's owned and operated underground natural gas storage facilities at McDonald Island, Los Medanos, and Pleasant Creek. These storage facilities allow PG&E to store natural gas for high-demand periods or take advantage of seasonal gas pricing. In concert with the Compression and Processing Asset Family, these assets perform a key role in system reliability. The primary assets within this family include 117 storage wells, 14 miles of transmission pipe, 89 downhole safety valves, 217 uphole safety valves, and 191 well meters, and 3,404 acres of storage reservoirs.



Figure 10 – Example of a Gas Storage Asset Family Wellhead

The Gas Storage Asset Management Plan describes the strategy for mitigating and managing risk for this asset family and achieving the established asset management objectives. Some key objectives include the following:

Table 2 – Gas Storage Asset Management Plan Objectives and Progress To-Date	
Overall Objective/Goals	Progress Towards Goal
Complete baseline well production casing assessments on 117 wells by 2025.	Number of baseline assessments performed: 2013 – 6 wells 2014 – 6 wells 2015 – 6 wells
Evaluate Well Integrity Management Plan (WELL) enhancements and incorporate by 2017.	2015 – Drafted WELL documentation 2016 – Submitted final WELL documentation to the Division of Oil, Gas and Geothermal Resources for approval and identified improvements to WELL to incorporate in 2017 publication
Assess work on transmission pipeline through Transmission Integrity Management Program by 2017.	2014 – Began internal corrosion site specific plan baseline assessments 2015 – Completed internal corrosion site specific plan baseline assessments 2016 – Completed written monitoring and assessment plans; Created 10-Year Storage Pipe Plan to assess pipe integrity
Continue Process Hazard Analysis and Pre-Startup Safety Reviews on all well, surface equipment, and pipeline in storage asset family.	Number of PHAs and PSSRs complete: 2014 – 2 PHAs and 0 PSSRs 2015 – 3 PHAs and 7 PSSRs 2016 – Targeting 4 PHAs and PSSRs

The Gas Storage Asset Management Plan describes these objectives in detail in **Attachment 6**. Please see **Attachment 7** for PG&E's recently filed Gas Storage Safety Report that provides information on the Los Medanos, Pleasant Creek, and McDonald Island storage facilities.

b) COMPRESSION AND PROCESSING

The Compression and Processing Asset Family includes 38 company-owned compressor units, associated equipment installed at compressor stations, and compressor units and gas processing

facilities installed at three underground storage facilities for a total of nine compressor stations. Additionally, this asset family includes 105 gas odorizers and associated equipment installed system wide. These stations support the system’s reliability and the odor added to gas at these points helps keep PG&E customers safe when gas arrives at their service point.

The Compression and Processing Asset Management Plan describes the roadmap for achieving the asset management strategy and how PG&E delivers the management objectives. Some of the key strategic objectives are listed in Table 3.

Table 3 – Compression and Processing Asset Management Plan Objectives and Progress To-Date	
Overall Objective/Goal	Progress Towards Goal
Use Long-Term Compression Investment Plan information to inform 2019 Gas Transmission & Storage Rate Case	First iteration of plan published
Reduce total number of compressor unscheduled shutdowns by 10% per year	Number of unscheduled shutdowns per year: 2013 – 649 2014 – 711 2015 – 330 (54% reduction from 2014)
Evaluate 100% of Transmission Total Station Features by end of 2019	2016 Forecast: Complete evaluations of 19,625 of 81,799 estimated total station features
Implement site-specific corrosion monitoring programs to enhance existing programs by 2018	Atmospheric corrosion program in place Internal corrosion program for large facilities under development
Apply Facility Integrity Management Principles to all stations by 2025	Maturity model completed in 2015 FIMP at 24% complete in 2015
Complete Physical Security Upgrades at Critical Facilities by 2021	22 of 105 milestone tasks complete in 2015 2016 Forecast: 42% complete
Critical documents defined by TD-4551S are completed by 2019	Program implementation in 2016

The Compression and Processing Asset Management Plan is found in **Attachment 8**.

c) TRANSMISSION PIPE

The Transmission Pipe asset family consists of approximately 6,600 miles of line pipe and major components, such as valves, used in transporting natural gas.⁷ PG&E’s Transmission Integrity Management Program (TIMP) is one of the programs that govern how PG&E assesses integrity performance and identifies risks that need mitigation within the Transmission Pipe asset family. TIMP is a core foundation of PG&E’s ongoing efforts to provide safe and



Figure 11 – Transmission Pipeline Construction Site

reliable service, consistent with industry best practices, and is based on the federal TIMP regulations.⁸ By 2015 year-end, PG&E’s damage prevention efforts were near the top of the 2nd quartile across the nation. PG&E is also making progress in updating its gas transmission Supervisory Control and Data Acquisition assets, achieving 94% visibility into backbone transmission, and 31% visibility into local transmission.

The Transmission Pipe Asset Management Plan describes the roadmap for mitigating and managing risk for this asset family and achieving the established asset management objectives. The plan’s objectives include the following:

Table 4 – Transmission Pipe Asset Management Plan Objectives and Progress To-Date	
Overall Objective/Goal	Progress Towards Goal
Apply integrity management principles to transmission pipelines covering 100% of population living along transmission pipelines by 2030	Developing a methodology to aggregate occupancy count across all ASME B31.8S threats
Evaluate the scope of and assessing for Stress Corrosion Cracking and Internal Corrosion risks based on data by 2019	2015: 0 Stress Corrosion Cracking and 0 Internal Corrosion immediate anomalies were reported (and therefore, 0 required repair). PG&E plans to report on a Stress Corrosion Cracking finding in its 2016 Plan
Improve system data to enhance threat and risk analysis by executing on Data Quality Improvement roadmap by 2020	PG&E is implementing quantitative risk assessments for its Transmission Pipe in 2016
Proactively manage assets by planning integrity assessments three years in advance by 2017	3-year planning timeline and project list in development targeting 2016 development cycle
Improve system capacity, reliability, and improve employee safety by meeting 100% of design day conditions, eliminating high risk, and reducing medium risk manual operation in APD conditions by 2019	2015: 26 high risk manual operations
Update PG&E’s gas transmission SCADA assets and technology to improve recognition and response to significant transmission events by 2021	Current system visibility is 94% for backbone transmission and 31% for local transmission, improving recognition, response to significant events
Industry leading damage prevention program	2015: Near the top of the 2 nd quartile 2016 Goal: Top quartile

The Transmission Pipe Asset Management Plan describes these objectives in more detail and is included as **Attachment 9**.

d) MEASUREMENT AND CONTROL

PG&E’s measurement and control assets measure large customer gas usage, regulate the flow of gas and control gas pressure. The assets in this family perform a critical role in system safety by preventing overpressure events. Additionally, in concert with the Compression and Processing Asset Family, these assets perform a key role in system reliability. The physical assets within this family include 3 gas terminals, 428 gas transmission pressure regulating and meter stations, 2,397 distribution pressure regulating stations, 2,433 services tapped off of high pressure regulators, 26 large customer meter sets, and 48 gas quality analyzers. PG&E’s Measurement and Control equipment is located both above and below ground and located in vaults and includes: Terminals, Complex Regulation Stations, and Simple Regulation Stations (as in Figure 12).



Figure 12 – An Above Ground Simple Gas Regulation Station

The Measurement and Control Asset Management Plan describes the roadmap for achieving the asset management strategy and how PG&E delivers the management objectives. Some of the key strategic objectives include the following:

Table 5 – Measurement and Control Asset Management Plan Objectives and Progress To-Date	
Overall Objective/Goal	Progress Towards Goal
Apply Facility Integrity Management principles to all T&D stations by 2025	Maturity model was completed in 2015 FIMP at 24% complete in 2015
Eliminate large overpressure events by 2018	Large overpressure events per year: 2013 – 9 2014 – 7 2015 – 7
Complete physical security upgrades at critical facilities by 2021	22 of 105 milestone tasks completed in 2015 2016 Forecast: 42 complete
Implement corrosion monitoring programs to enhance existing programs by 2018	Atmospheric corrosion program in place Internal corrosion program for large facilities under development
Accomplish Obsolescence Management by maintaining the turnover of the fleet to 60 years	Average age of transmission and distribution station fleet: 2015 – 58 years

The Measurement and Control Asset Management Plan is provided in **Attachment 10.9**

e) DISTRIBUTION MAINS AND SERVICES

Distribution Mains and Services asset families have been combined for asset management planning purposes into a single plan. This combined asset family includes over 42,400 miles of pipeline that connects to the gas measurement and control asset family on the upstream side and transports



Figure 13 – Distribution Main Replacement Project

natural gas to customers throughout the service area. It also includes over 3.4 million service lines that deliver gas from the distribution mains to the assets in the Customer Connected Equipment family on the downstream side. The programs associated with the Distribution Mains and Services asset family are focused on the inspection, analysis, and replacement of Distribution Mains and Services assets. PG&E continues to identify and assess threats to Distribution Mains and Services assets and works to mitigate those threats, including through its Distribution Integrity Management Program, in a continuous effort to maintain a safe system. Some of the key strategic objectives include the following:

Table 6 – Key Distribution Mains and Services Metrics	
PG&E's Commitment to Safety	Progress Towards Goal
Reduce third-party dig-ins to first quartile by 2016	PG&E set a 2015 target of 2.06 dig-ins per 1,000 tickets. In 2015, PG&E experienced 2.11 dig-ins per 1,000 tickets.
Reduce major over-pressurization events to 0 by 2018	2013: 12 2014: 8 2015: 16
Identify all potential cross-bores and remediate by 2023	Inspections planned through 2015: 97,000 Inspections completed as of December 31, 2015: 85,101

The Distribution Mains and Services Asset Management Plan provides additional information on these objectives and is included in **Attachment 11.10**

f) CUSTOMER CONNECTED EQUIPMENT

The Customer Connected Equipment Asset Family comprises approximately 4.5 million meters and associated regulators, over-protection devices, shut-off valves, piping, and fittings that connect the gas distribution service to the customer. Customer meters are used to measure gas usage to support the billing function.

The Customer Connected Equipment Asset Management Plan provides an assessment of condition and risk of the Customer Connected Equipment asset family and includes the identifications of risks, mitigations, strategic objectives and asset maintenance, for the life cycle of the assets. The plan’s key objectives are included in Table 7:

Table 7 – Customer Connected Equipment Asset Management Plan Strategic Objectives and Progress To-Date	
PG&E’s Commitment to Safety	Progress Towards Goal
Meet Meter Protection Program regulatory commitments by Dec 2016	2015: 408,500 units - 99.8% complete
Implement a policy that minimizes the number of new indoor meter sets installed during new reconstruction projects by 2017	At year end of 2015 a strategy was developed to support the policy development and implementation
Reach a steady state of backlog of 12,000 meter set leaks by 2018	2015 Beginning Year Inventory: 52,000 <ul style="list-style-type: none"> • Influx of work: 55,000 • Completed: 41,000 2015 End of Year Inventory: 66,000
Identify and remove problematic regulators by 2018	Over 1,700 completed in 2015 - 100% of plan

The CCE Asset Management Plan is included as **Attachment 12.11**

g) LIQUEFIED NATURAL GAS AND COMPRESSED NATURAL GAS

The Liquefied Natural Gas/Compressed Natural Gas asset family portable assets provide natural gas supplies to offset or supplement pipeline flowing supplies for planned outages, winter peak load shaving, unplanned outages, and in emergency situations. The Liquefied Natural



Figure 14 – PG&E’s LNG Assets at Work

Gas/Compressed Natural Gas asset family consists of 200 portable units and 25 trailers. In 2015, there were no loss of containment events. The portable Liquefied Natural Gas/Compressed Natural Gas Asset Management Plan describes its objectives in detail and is included in **Attachment 13**.

The Liquefied Natural Gas/Compressed Natural Gas asset family consists of 32 Compressed Natural Gas station assets to supply the natural gas that fuels PG&E and third-party vehicles, and

provides very high pressure gas supply to the portable Compressed Natural Gas equipment. Over the last few years, PG&E has instituted an industry-leading inspection program to assure the integrity of customer Compressed Natural Gas vehicle fuel systems. In 2015, 97% of PG&E’s natural gas fueling customers submitted their 3-year vehicle certificates of inspection.

Table 8 – Liquefied Natural Gas/Compressed Natural Gas Safety Success	
PG&E’s Commitment to Safety	Progress Towards Goal
Driving towards zero significant liquefied natural gas/compressed natural gas loss of containment events	2015: No loss of containment events 2015 Activities: Maintenance of Liquefied Natural Gas/Compressed Natural Gas equipment and assets. Liquefied Natural Gas/Compressed Natural Gas equipment training development and operating training
Implementing an industry-leading inspection program to improve safety inspection certifications from less than 20% to 99% of Compressed Natural Gas fuel customer vehicles	2015: 97% of natural gas fueling customers presented 3-year cylinder certification
Reduce risk of portable natural gas transportation traffic incidents by reducing equipment issues through an improved maintenance program	2015: Completed major inspection and upgrades of all Liquefied Natural Gas/Compressed Natural Gas portable over-the-road assets to establish baseline standard 2016: Will dedicate internal transportation services resources to maintenance

The Liquefied Natural Gas/Compressed Natural Gas station Asset Management Plan describes its objectives in detail and is included as **Attachment 14**.

3. RISK MANAGEMENT PROCESS

Transporting natural gas involves moving a flammable product under pressure to where PG&E’s customers live, cook, heat their homes, and warm their offices—and as such, risk management is an important part of the natural gas business. PG&E’s Risk Management team prioritize risks based on how likely an event is to occur and how severe it might be. This team provides direction to PG&E’s gas operations employees who work 365 days a year to mitigate these risks. Success is determined by having a robust process, making continuous improvement in the process and in risk mitigation progress, such as meeting PG&E’s long-term goal to make its system capable of In-Line Inspection.

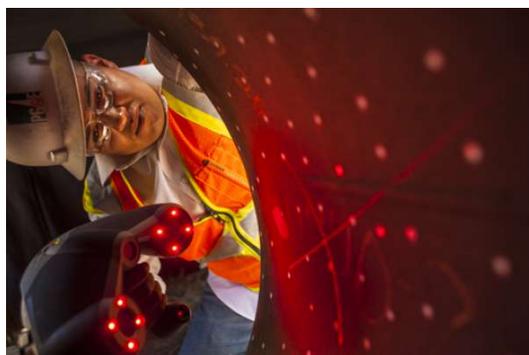


Figure 15 – Gas Pipeline Inspection

While the hazards and risks associated with natural gas is inherent, PG&E can and does build layers of protection into company processes and plans. Like Swiss cheese, any one process may fail in a way that presents hazards, but when each layer of protection is placed on top of one another, the likelihood of risks occurring are minimized. This is why, in many instances, PG&E implements multiple mitigations or layers of protection. For example, for the loss of supply risk and the threat of

excavation damage, PG&E manages multiple mitigation programs such as pipeline markers, locate and mark of facilities, and stand-by during excavation.

To identify and address risk, PG&E follows a comprehensive enterprise and operational risk management process. PG&E's Enterprise and Operational Risk Management plans allow PG&E to manage assets and risks at an enterprise and operational level. PG&E defines "Enterprise Risks" as those that potentially could have a catastrophic impact to PG&E. All Enterprise Risks are reported to the Board of Directors each year, where mitigation plans and status of mitigation efforts are discussed. Operational risks are managed at the Line of Business level, with oversight provided by each Line of Business' Risk and Compliance Committee, which meets monthly. Each of the Committees is charged with oversight of risk management activities within the Line of Business including, but not limited to, reviewing risk assessments, approving risk response plans, and overseeing their implementation, and monitoring risks on the Line of Business' risk register. By assessing and managing risks from both points of view, PG&E can better manage the interdependencies and drive for consistency in risk management across the Company. In addition, this process increases senior management and board engagement in risk-informed decision-making by involving them in decisions as the process unfolds, and gives those individuals charged with managing specific assets line of sight to other risks in the enterprise. As an example, the enterprise-level risk with the most significant impact on Gas Operations was identified as Catastrophic Failure—Pipeline from the Transmission Pipe asset family, as part of the 2015 risk assessment process.

Each year, using a consistent methodology in accordance with the Enterprise Operational Risk Management guidelines, Gas Operations identifies, assesses and ranks its risks in a Risk Register. The development of the Gas Operations Risk Register is governed by the Gas Operations Risk and Compliance Committee. Gas Operations communicates its top risks, identified in the Risk Register, to PG&E's executive leadership team at the Integrated Planning Process "Risk and Compliance Session," typically in the first to second quarter timeframe of each year. This process, referred to as "Session D," endeavors to reflect the highest risks to the business, and mitigation of these risks is then addressed in the corporate strategy and the executable investment plans as part of Session 1 and Session 2. Risks, including the key risks for each asset family identified during Session D, are captured within the Asset Management Plans, mitigation programs, and work projects.



Figure 16 – Two PG&E Welders

a) ENTERPRISE AND OPERATIONAL RISK MANAGEMENT

As part of PG&E’s Session D process, the Company develops its enterprise-level risks. Enterprise risks are communicated across the company and undergo additional review and monitoring throughout the year. As the result of the risk refresh process and the 2015 Session D, Gas Operations identified 221 risk drivers, of which 46 are at the enterprise level. These 46 Enterprise Risk Drivers can be grouped into eight Enterprise Risks. Table 9 reflects the 46 Enterprise Risk Drivers mapped into the eight Enterprise Risk groups:

Table 9 – 2015 Gas Enterprise Risks	
Risk	Description of Risk and Risk Drivers
Catastrophic Failure – Pipeline	Rupture of transmission pipeline may result in loss of containment and/or uncontrolled gas flow leading to potential public safety issues, prolonged outages, property damages and/or significant environmental damage. The drivers of this risk include: External Corrosion, Internal Corrosion, Stress Cracking Corrosion, Manufacturing Related Defects, Welding/Fabrication Related Defects, Equipment Failure, Weather and Related Outside Forces – Land Movement (including Seismic), Incorrect Operations
Catastrophic Failure – Natural Gas Storage	Failure of storage assets may result in loss of containment and/or uncontrolled gas flow leading to potential public and employee safety issues, prolonged outages, property damages and/or environmental damage. The drivers of this risk include: Internal Corrosion and/or Erosion, External Corrosion, Manufacturing Related Defects, Third Party Damage, Seismic, Welding/Fabrication Related Defects
Catastrophic Failure – Distribution Mains and Services	Cross Bore in Urban Area: The risk of third-party sewer clearing may result in damage to distribution pipeline, loss of containment, and/or migration of gas leading to significant property damage or potential public safety issues.
Catastrophic Failure – Compression and Processing	Failure of compression and processing facility may result in loss of containment leading to potential public and employee safety issues and loss of service impacting reliability. The drivers of this risk include: Physical Security, Seismic, Manufacturing Related Defects, Welding/Fabrication Related Defects, Incorrect Operations External Corrosion, Internal Corrosion and/or Erosion Stress Cracking Corrosion
Records Management (Cross-Cutting Risk)	Not implementing fully an effective records management program and controlling data quality may result in the failure to construct, operate or maintain a safe system. For non-asset departments, not implementing fully an effective records management program and controlling data quality may result in inadequate business processes. At the enterprise-level, there is an expectation that the company improve its overall information and records management program to ensure records are traceable, verifiable, accurate and complete.
Catastrophic Failure – Measurement and Control	The risk of an overpressure event may result in the failure of downstream transmission pipelines or distribution assets with loss of containment leading to potential public safety issues. The drivers of this risk include: Seismic, Equipment Failure, Incorrect Operations, Welding/Fabrication Related Defects
Cybersecurity	The threat to critical infrastructure by digital means the loss of security over control systems and customer data is a threat to public privacy, safety and trust. As a protection measure, PG&E does not provide specific information to the public on the specific threats or controls in place.
Failure to Meet Core Customer Demand for Design Standard Abnormal Peak Day	The risk of not meeting core customer demands as part of the Abnormal Peak Day design criteria could result in uncontrolled outages which may lead to gas leakage into customer homes and potential public safety issues.

Some risks impact more than one Line of Business, also called Cross-Cutting Risks. These risks also follow the enterprise and operational risk management process. The cross-cutting risks are owned by a

Line of Business and the impacted Lines of Business provide their input and subject matter expertise during the risk management process. The gas business is impacted by several cross-cutting risks owned by other Lines of Business as displayed in Table 10 below. The organization actively works with those Line of Businesses to develop and monitor mitigations for these risks.

Risk	Description
Qualified Workforce	The risk of an employee or non-employee working without meeting appropriate legal, regulatory and PG&E-defined requirements. “Requirements” include qualifications (skills, competencies, abilities, knowledge, certifications) for the defined job or work. This may result in one or more of the following: work procedure errors, legal or regulatory non-compliance, cybersecurity breaches, localized outages, damage to property or assets belonging to PG&E, another corporation, a government organization or a member of the public, injury or death to an employee or member of the public.
Records Management	Not implementing fully an effective records & information management program and controlling data quality may result in the failure to construct, operate, or maintain a safe system. Additionally, inadequate business processes and system controls related to the collection, maintenance and disposition of records and information can result in non-compliance, security gaps, and insufficient or inaccurate data for critical decision making.
Employee Safety	The inability to fully identify, evaluate, and mitigate workplace exposures may result in serious injury and/or fatalities.
Contractor Safety	Failure to comply with contractor pre-qualification and field oversight processes may result in serious injury and/or fatalities.
Cybersecurity	Introduction of malware or execution of commands by authorized and unauthorized users or hackers, use of infected removable media, exposure to phishing, visitation to infected websites, or exploitation of remote connections may lead to the disruption of the confidentiality, integrity, and/or availability of business control applications, computing, data, or networks.
Changing Green House Gas Regulations	Incompatible and/or stringent state and federal Green House Gas regulations may result in unaffordable cost increases to customers.
Business Model Risk	The risk of a regulatory decision or series of decisions, that result in a sustained loss of risk adjusted rate of return.

PG&E continues to improve its risk management process. PG&E is an active participant in the CPUC’s Risk OIR, R.13-11-006, *Order Instituting Rulemaking to Develop a Risk-Based Decision-Making Framework to Evaluate Safety and Reliability Improvements and Revise the Rate Case Plan for Energy Utilities*. CPUC’s Risk OIR, R.13-11-006, developed guidance and requirements for risk-based rate case showings. PG&E will continue to review its risk management process for improvement opportunities that align with stakeholder expectations and regulatory requirements.

4. RECORDS AND INFORMATION MANAGEMENT

PG&E’s Gas Operations records management team, as part of the Enterprise Records and Information Management Program, focuses on the deployment of consistent and integrated records processes that support operational safety, regulatory compliance and knowledge management. Gas Records and Information Management is responsible for assessing and inventorying physical and electronic records, establishing specialized plans for critical records, and monitoring the process controls for managing and protecting records. Examples of Records and Information Management initiatives completed in 2015 include:

- Aligning gas records-related standards with revised corporate policies, including the Gas Operations Records and Information Standard which defines the requirements for the maintenance, storage and disposition of official records and the Gas Operations Vital Records Standard which defines the requirements for the maintenance and protection of critical records.
- Transferring of more than 2,000 boxes of paper records from field locations to centralized off-site storage. These ongoing recordkeeping initiatives also support PG&E’s efforts to maintain PAS 55-1 and ISO 55001 certifications.
- 92.4% of gas employees completed mandatory annual records training.

A foundational component of the Gas Records and Information Management Program is the Records and Information Management Coordinator Network, established in 2014. This network of approximately 125 coordinators covering 140 field offices facilitates communications between the Gas RIM team and the field offices. The Gas RIM team provides quarterly training to the coordinators and supports them as they coach field office employees in meeting PG&E’s recordkeeping requirements.

In addition, Records and Information Management continues to implement the comprehensive roadmap developed in May 2014. The Gas Records and Information Management roadmap addresses requirements, observations and commitments made around improving records management. Table 11 details some key Records and Information Management roadmap initiatives and drivers.

Table 11 – Gas Operations Records and Information Management Roadmap Highlights	
Key Roadmap Initiatives	Roadmap Drivers
Assessing and inventorying physical and electronic records	<ul style="list-style-type: none"> • Records related remedies and recommendations adopted by the CPUC in the San Bruno Oil Penalties decision issued in April 2015 • ARMA International’s Information Governance Maturity Model – Level 3 • Continued certification of PAS 55-1 and ISO 55001
Establishing vital records plans	
Training and educating employees on records management responsibilities	
Validating the records inventory, information storage systems, and controls for managing records	

5. MITIGATING LOSS OF CONTAINMENT

PG&E takes a proactive approach to reducing the loss of containment risk, or the unintended release of natural gas. The mitigation programs and projects to address loss of containment vary significantly in size and scope, from installing pipeline markers over the assets as visual identifiers to inspecting, testing, and replacing assets that may be deemed beyond their useful life. In all types, scope, and scale of projects (or programs) PG&E remains focused on identifying the right work to protect the public from a loss of containment event, both now and into the future.

a) DAMAGE PREVENTION

Damage Prevention consists of multiple processes working together to help prevent damage from incorrect operations and primarily excavation activities. Activities include Public Awareness, Dig-In Prevention, and Locate and Mark. PG&E's Damage Prevention processes are reviewed annually. Each process is described in detail in the next sections.

Damage Prevention also includes marking the field location of underground facilities as requested through the Underground Service Alert One-Call system, Underground Service Alert ticket management, investigations associated with dig-ins, and damage claims. The marking of underground utilities is governed by California Government Code 4216 and the process is driven by industry best practices.

PUBLIC AWARENESS

PG&E's Public Awareness Program conducts educational outreach activities for professional excavators, local public officials, emergency responders, and the general public who lives, works, and plays within PG&E's service territory. The program communicates safe excavation near pipelines, required actions prior to excavating near underground pipelines, pipeline location and gas safety information through a variety of methods throughout the year including bill inserts, e-mails, postcards, mass media advertising, press releases and participation in community meetings and events.

PG&E communicates gas safety information three times each year, and in 2015, reached approximately 6 million paper bill customers and nearly 1.8 million e-mails to those customers who receive paperless billing. In addition to the bill inserts and e-mail campaigns, PG&E also sent targeted direct mail pieces to over 425,000 of those living or working within 1,000 feet of a PG&E gas transmission pipeline. These targeted audiences include school administrators, excavators, emergency responders, public officials, landscapers, sewer and plumbing companies, farmers, homeowner associations, master meter accounts, and those who live or work near



Figure 17 – 811 Call Before You Dig Workshop Attendance

PG&E's right-of-way, un-odorized pipelines or storage and compressor facilities. PG&E also conducted 35 "811 Call Before You Dig" contractor workshops, reaching over 1,200 attendees. 2015 Public Awareness highlights include:

- Developed online educational content for excavators, which includes legal requirements, the proper use of hand-digging tools, potholing requirements, best practices to perform prior to using power-operated equipment and other safe digging behaviors.
- Developed safe-digging advertising, targeting areas with a high number of dig-ins. 33,417 message showings occurred during 2015 with an estimated 132 million views of digital, bilingual billboards with cycling “Call 811 Before You Dig” messaging. Bilingual traffic radio sponsorships also aired across PG&E’s service territory and was heard an estimated 64 million times.
- In October, PG&E conducted targeted outreach in cities with a high number of dig-ins. The outreach included job site visits, 811 training for top damaging companies and meeting with local leadership to discuss continued partnership for community safety. These targeted efforts resulted in over 1,700 field visits and 325 stopped jobs at sites where 3rd party excavation work was being performed. These jobs were stopped due to not having a valid Underground Service Alert ticket.¹²

DIG-IN PREVENTION

PG&E continues to push for improved performance in this area by determining the root causes of excavation damage to PG&E’s facilities, identifying process improvements to reduce damages, and actively pursuing cost recovery from contractors responsible for excavation damage. Dig-In Prevention is a proactive program that directly and positively affects public and employee safety by striving to reduce the number of potentially dangerous excavation damage incidents. PG&E’s Dig-In Prevention programs were instrumental in reducing the average number of dig-ins per 1,000 tickets from 2.42 in 2014 to 2.11 in 2015.

Dig-In prevention is a key component of PG&E’s Damage Prevention Program and PG&E’s 2014 performance was 2.42 dig ins per 1,000 tickets, compared to a statewide average of 3.8 dig-ins per 1,000 tickets.

PG&E improved performance in this area. At year-end 2015, PG&E’s 12 month rolling average was 2.11 dig-ins per 1,000 tickets.

Table 12 below provides information on a number of projects or process improvements Dig-In Prevention utilizes.

Table 12 – Dig-In Prevention	
PG&E’s Commitment to Safety	Promoting Safety
DiRT or Dig-In Reduction Team	Deploying investigators to oversee and enhance PG&E’s ability to investigate dig-ins, patrol active dig-ins and excavations, and intervene when non-compliant and unsafe activities are identified.
Gold Shovel Standard*	Require contractors excavating on behalf of PG&E to obtain the Gold Shovel certification. Acknowledge all contractors who practice safe excavation; monitor habitual offenders who fail to demonstrate safe practices. Unsafe contractors lose their certification.
811 Ambassador Program	PG&E employee training to identify unsafe excavation activities and take appropriate intervention measures.
Aerial Patrolling	Identifying and intercepting threats to the transmission system.
Damage Prevention Manual & Training	Providing clear and concise instruction around dig-in prevention measures like troubleshooting “difficult to locate” facilities.

* Beginning January 1, 2016, contractors who wish to excavate or subcontract out excavation work for PG&E must obtain Gold Shovel Standard Certification by making a commitment to safe digging practices in accordance with the California “One Call Law” (California Government Code 4216) and the Common Ground Alliance best practices for excavation. To become Gold Shovel Standard certified, contractors must perform no more than two dig-ins within a rolling 12-month period and develop and adhere to a Dig-In Prevention Policy.

LOCATE AND MARK PROGRAM

The Locate and Mark Program is designed to mitigate the potential risk of damage to underground facilities by identifying and marking assets for potential excavators within a 48-hour window. Federal pipeline safety regulations¹³ and California state law¹⁴ require that PG&E belong to, and shares the costs of, operating the regional “one-call” notification system. Builders, contractors, and others planning to excavate, must use this system to notify underground facility owners, like PG&E, of their plans to excavate. PG&E then provides the excavators with information about the location of its underground facilities. Information is normally provided by having a PG&E locator visit the work site and place color coded surface markings to show where any pipes and wires are located. Because of its large service territory, PG&E belongs to two regional one-call systems which share a common toll-free, 3-digit “811” telephone number. The California one-call systems are commonly referred to as Underground Service Alert.

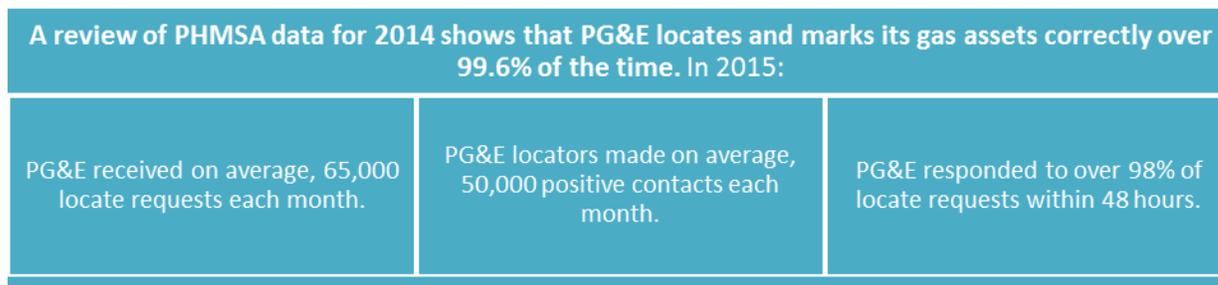


Figure 18 – Key Locate and Mark Statistics

b) DISTRIBUTION PIPELINE REPLACEMENT

An important element of providing safe gas distribution service is replacing aging assets. PG&E uses relative risk in prioritizing its pipeline replacement projects. Risk factors include age, material type, leak history, cathodic protection, seismic impact, proximity to the public, and other operational factors. In addition to gas main replacement, the program covers related service replacement and meter relocation work.

PG&E has three pipeline replacement programs to improve distribution safety: Gas Pipeline Replacement Program, Aldyl-A Plastic Replacement Program, and Main Replacement Reliability Program. PG&E's objective is to maintain an asset age limited to less than 100 years.

Table 13 – Pipeline Replacement		
Gas Pipeline Replacement Program	Aldyl-A Plastic Pipe	Main Replacement Reliability
Over the past 30 years the GPRP Program, focused on the replacement of cast iron and pre-1940 steel pipe, has enabled PG&E to deactivate all cast iron main (over 830 miles of pipe). GPRP is now focused on replacing pre-1940 steel pipe. In 2015 the GPRP Program replaced 28 miles of pipe.	Since PG&E began its Aldyl-A Replacement Program in 2012, PG&E has replaced about 143 miles. In 2015, approximately 62 miles of Aldyl-A were replaced. PG&E continues to increase the replacement of Aldyl-A year-over-year in recognition of the approximately 5,450 miles of known inventory.	The Reliability Main Replacement Program focuses on the replacement of pipeline not covered by the GPRP or Aldyl-A programs and will continue to help move the distribution systems average age closer to the national average. In 2015, PG&E replaced 13 miles of distribution pipe through this program.

c) CROSS-BORE MITIGATION

A cross-bore is a gas main or service that has been installed unintentionally, using trenchless technology, through a waste-water, or storm-drain system. Cross-bores pose a gas system risk in that they can cause gas leaks into the sewer system if damaged during mechanical sewer cleaning operations. PG&E has an inspection program to identify and remediate cross-bores, and a public outreach program that provides safety information to PG&E customers, sewer districts, public works agencies, licensed plumbers, and the plumbers union. In addition, PG&E is implementing a Cross-Bore Prevention Program that proactively uses video camera inspections to verify no damage has occurred to sewer lines when using trenchless construction methods on new construction projects.

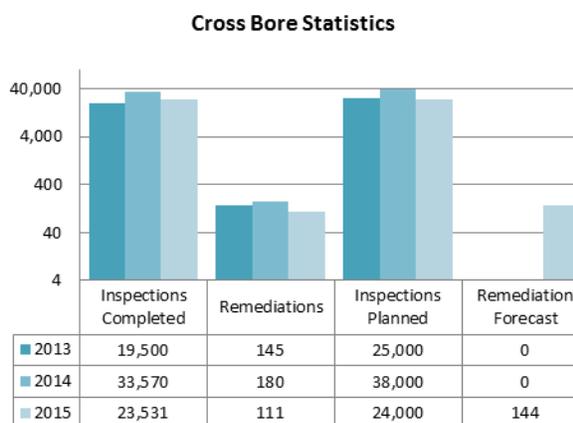


Figure 19 – Cross-Bore Statistics

The goal of PG&E’s Cross-Bore Inspection Program is to identify cross-bores by completing inspections of potential conflict locations and repairing all occurrences as they are discovered.

PG&E completed 23,531 inspections in 2015 (76,601 inspections since 2013). PG&E finds about 6.5 cross-bores per 1,000 inspections—consistent with the reported industry benchmark of about 2 per mile.

d) STRENGTH TESTING

The hydrotesting process, a form of strength testing, takes a pipeline out of service, clears it of gas, cleans it internally, then fills it with water to pressures usually at or exceeding 1.5 times the maximum allowable operating pressure. This process allows PG&E to find pipeline defects that could subsequently cause a rupture or leak, and then repair these defects or anomalies in the pipeline. The process also results in a



Figure 20 – Overhead View of Large Strength Test, Including Water Storage Tanks

test record that establishes the operating pressures the pipe can withstand. A secondary benefit of hydrotesting is that the pipeline is typically upgraded to allow for navigation of the cleaning tools (pigs), allowing PG&E to run inspection tools at later dates [See Section: *In-Line Inspection page 28*]. Thus, hydrotesting ensures a margin of safety for the transmission pipeline, and reduces the likelihood of future loss of containment events that could pose a risk to public safety.

PG&E’s ultimate goal is to strength test or replace untested pipeline within 12-15 years of year-end 2011. Once completed, PG&E will have a test record for its entire Gas transmission pipeline. In 2015, PG&E completed approximately 79 miles of hydrotesting (Table 14). This work brings PG&E to a total of approximately 763 miles hydrotested since 2011. The pipeline miles proposed for strength testing in 2016 are prioritized based first on integrity management threats and then on testing untested pipe or pipe lacking a record of a test.

Table 14 – Hydrostatic Strength Testing Program				
Strength Test (miles)	2011-2013	2014	2015	Total
PSEP	549	135	0	684
Post-PSEP	0	0	79	79
Total	549	135	79	763

PG&E’s 4-year goal between 2015-2018 for hydrotesting is 680 miles.¹⁵ In 2017 and 2018, PG&E is concentrating on long-line testing to meet the 680 mile goal, and short segments will be spread over a 5-year period.

e) VINTAGE PIPE REPLACEMENT

A significant portion of PG&E’s natural gas transmission pipeline system—approximately 50 %—was designed, manufactured, constructed, and installed before the advent of California’s 1961 pipeline safety laws. While age alone does not pose a threat to pipeline integrity, PG&E has determined that some vintage pipeline features, in particular pipeline with certain welds, bends, and fittings located in areas subject to land movement, are most appropriately managed through replacement.

Examples of “Vintage Pipe”



Figure 21 – Wrinkle Bends

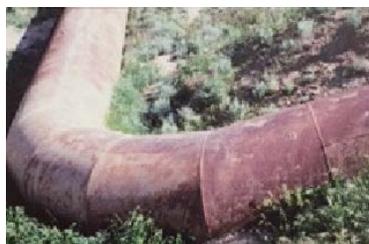


Figure 22 – Miter Bends



Figure 23 – Orange Peel Reducers

PG&E has identified approximately 630 miles of transmission pipe,¹⁶ with some of the characteristics that make it more susceptible to certain construction threats. Of those 630 miles identified, PG&E further identified approximately 478 miles of pipe where vintage fabrication and construction threats interact with land movement.¹⁷ In 2015, approximately 5.8 miles of pipe was replaced and 4.23 miles was retired.

Table 15 – Vintage Pipe Replacement Program		
	Miles Complete/Target	% Cumulative Occupancy Addressed
Pre-2015	11 miles	24%
2015	10.03 miles	26%
Program Target:	478 miles	100%

Once PG&E has identified vintage pipelines interacting with land movement, its replacement is prioritized by replacing sections of pipeline closest to highest density population areas. At PG&E’s current and planned rate, the program will address the risk of pipe containing vintage fabrication and construction threats that interact with land movement for 90% of the population with this threat by 2025 and will reach 100% of the population by 2037.

f) IN-LINE INSPECTION

PG&E’s In-Line Inspection Program uses technologically advanced inspection tools, often called “smart pigs,” to reliably assess the internal and external condition of transmission pipe and ensure the safety of the community. Prior to running an In-Line Inspection tool in a pipeline, a pipeline must be modified with portals called “launchers” and “receivers” and pipeline features that would obstruct the passage of the tool must be modified or removed to make the pipeline piggable. After the pipeline is

upgraded to accommodate an In-Line Inspection tool, cleaning and inspection “runs” are conducted to collect data about the pipe. This data is analyzed for pipeline anomalies that must be remediated through the Direct Examination and Repair process where the anomaly is exposed, examined and repaired as necessary. The information from Direct Examination and Repair is used to generate mitigation activities to improve the long-term safety and reliability of the pipeline.

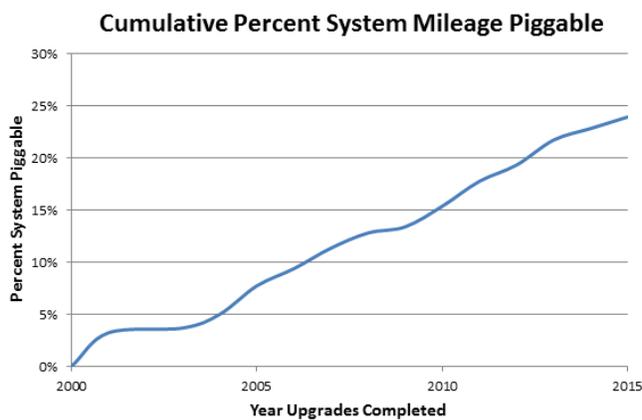


Figure 24 – Cumulative % System Mileage Piggable

In-Line Inspection is the MOST RELIABLE pipeline integrity assessment tool currently available to natural gas pipeline operators to assess the internal and external condition of transmission line pipe.

The Traditional¹⁸ In-Line Inspection Program is ramping up to complete more projects in the next ten years than ever before to reach the goal of 66 percent total system mileage piggable. As of 2015, approximately 24% of the system is piggable relative to PG&E’s goal to make approximately 66% of the system piggable by traditional means. Much of PG&E’s pipeline was installed decades before In-Line



Figure 25 – A Magnetic Flux Leakage Tool AKA a “Smart Pig” Used to Assess Pipeline for Damage

Inspection was invented and making pipelines capable of accepting traditional In-Line Inspection often involves replacement of ancillary assets like valves and fittings that may block the passage of the In-Line Inspection tool and installing launchers and receivers that allow tools to be inserted. Today, about 35% of the PG&E system is not capable of supporting the

running of traditional In-Line Inspection tools because of design elements like low pressure and/or low flows, small diameter pipelines, short sections of pipeline or facility configurations, such as drips or blow downs. Figure 24 details PG&E’s progress to-date to upgrade pipelines to make them capable of accepting traditional In-Line Inspection tools.

g) CORROSION

All of PG&E's metallic assets are susceptible to corrosion, a natural, time dependent process where metal degrades (rusts) due to its interaction with the environment. Gas transmission, storage, and distribution assets primarily comprised of steel piping carrying compressed natural gas may experience degradation due to external corrosion, internal corrosion, or stress corrosion cracking. External corrosion is degradation of the pipe due to interaction of the steel with the



Figure 26 – Example of Corroded Pipe

atmosphere, soil (buried piping), and/or water (submerged piping). Internal corrosion is degradation of the pipe due to interaction of the steel with the natural gas being transported. Stress corrosion cracking is degradation of the pipe due to cracks induced from the combined influence of tensile stress¹⁹ and a corrosive environment. The material degradation associated with all forms of corrosion may reduce the integrity of steel assets and threaten PG&E's ability to safely and reliably transport natural gas. PG&E assesses the risk of External Corrosion, Internal Corrosion, and Stress Corrosion Cracking independently because each requires a different form of mitigation.

Given the risk profile associated with corrosion, PG&E has sought out highly qualified corrosion experts from around the country, enhanced procedures, and incorporated systematic, risk-based methodologies to its corrosion control approach. PG&E's efforts are resulting in more accurate data on which to make decisions related to the identification and mitigation of corrosion risks, improving the safety and reliability of PG&E's assets.

For example, PG&E mitigates the threat of External Corrosion by ensuring that assets are installed with appropriate coatings and by applying Cathodic Protection to buried or submerged structures. Cathodic protection mitigates corrosion through the application of direct current through the soil and/or water to the steel piping. Coatings mitigate corrosion by forming a barrier between the steel and environment. As coating systems on buried and submerged piping systems cannot readily be inspected for degradation, the use of coatings in conjunction with cathodic protection provides an additional layer of protection for buried or submerged assets.

PG&E also monitors for conditions that may limit the ability to maintain adequate levels of cathodic protection on buried or submerged assets. Such conditions include electrically shorted casings and electrical interference from electric transmission equipment, municipal rail systems, and other operators' corrosion control systems. Overall, corrosion control at PG&E consists of the programs below:

Table 16 – Corrosion Control Programs	
Program	Program Description
Atmospheric Corrosion	Addresses deterioration of coating systems on assets designed for above ground use. In 2015, PG&E addressed 65 transmission pipeline spans and inspected over a million gas meters.
Casings	Identifies and remediates electrically shorted cased crossings. PG&E remediates more than 60 shorted casings in 2015.
Cathodic Protection	Designs, installs, and maintains Cathodic Protection systems to prevent corrosion. In 2015, PG&E monitored and maintained cathodic protection on approximately 26,000 miles of steel pipe line.
Close Interval Survey	Collects survey data pertinent to Cathodic Protection levels, coating condition, and other issues at intervals between test points. PG&E surveyed more than 100 miles of transmission pipeline in 2015.
Corrosion Investigations	Investigates the cause of insufficient Cathodic Protection levels or other issues and recommends mitigating solutions.
Electrical Interference – AC	Mitigates the threat of alternating current interference with investigative modeling and installation of grounding and/or shielding equipment. PG&E modeled more than 200 locations in 2015 and installed multiple grounding systems, AC coupon test stations, and other mitigating measures.
Electrical Interference – DC	Addresses the risk of direct current interference with investigation and installation of Cathodic Protection, bonding, or other equipment. In 2015, PG&E installed 5 capital systems and conducted 175 investigations of potential interference.
Internal Corrosion	Monitors for and mitigates the threat of Internal Corrosion with probe, coupon, and drip monitoring, chemical treatment, Internal Corrosion investigations, non-destructive examination, and other activities.
Routine Maintenance	Pipeline safety regulations require PG&E to conduct rectifier checks; pipe-to-soil, casing-to-soil, and other reads; and atmospheric corrosion inspections on a regular basis. PG&E has grown its crew of corrosion mechanics and instituted a Line of Progression plan to strengthen the mechanics’ skillset and expertise.
Test Stations	Installs test stations in areas where there are inadequate test points along pipeline. PG&E aims to install more than 1,000 of these by the end of 2017 to meet goal of 1 test station per mile of pipe.

PG&E continues to advance its goal of fully implementing cathodic protection best practices, which include a combination of monitoring, investigation, and remediation work governed by utility standards and procedures. PG&E actively participates in corrosion research conducted by the Pipeline Research Council International and supports efforts to incorporate the results of such research into corrosion control regulations and standards through its participation in NACE International, the Interstate Natural Gas Association of America, and the American Gas Association. PG&E continues to advance its goal of building a best-in-class corrosion control program by incorporating industry corrosion control standards, peer operator experience, third party evaluations, and corrosion research into its standards and procedures.

h) EARTHQUAKE FAULT CROSSINGS

PG&E’s Fault Crossings Program addresses the specific threat of land movement at active earthquake faults, which subject a pipeline to external loads due to seismic events. The program is

consistent with California law, which requires natural gas operators to prepare for and minimize damage to pipelines from earthquakes. PG&E performs system wide studies to address both the anticipated geologic movement and pipeline mechanical properties to manage the integrity of the pipe (Table 17). Additional mitigation work is then prioritized, following each study, by taking into account the likelihood of failure (the probability that the fault will trigger a seismic event), and the consequences of failure (including the impact on the local population, PG&E system reliability and the environment). Mitigation typically includes modified trench designs, trench adjustment, pipe replacement, or installation of automated isolation valves.

Table 17 – Earthquake Fault Crossing Program		
	Studies ¹	Crossings Mitigated ²
Pre-2015	52	24
2015	65	18*

*2015 – 14 crossings are FFS per current design

- 1 Studies are conducted to determine if pipe is fit for service (FFS) with geological, pipe assessments.
- 2 Crossing is mitigated if pipe meets or is designed, retrofitted, or replaced to satisfy the FFS criteria.



Figure 27 – Pipe Deformation Due to a Creeping Fault

i) LEAK SURVEY

Pipeline safety regulations require PG&E to conduct routine leak surveys on its distribution and transmission systems to find gas leaks. The frequency of the leak surveys depend on the type of facility, operating pressure and class location of the pipe.

PG&E outlines current requirements, standards and guidelines for the Leak Survey and Detection Program in its procedures.²⁰ In 2015, PG&E surveyed over 800,000 services and over 10,000 gas transmission pipeline miles for compliance. PG&E plans to complete surveys for nearly 870,000 services in 2016, over 1.1 million services in 2017 and about 14,000 miles of transmission pipeline in 2016. The increases are due to a transition to a 4-year leak survey cycle on services previously on a 5-year leak survey cycle,²¹ and a transmission General Order (GO-112F) change in survey frequency of some gas transmission pipeline.²² Summaries of PG&E’s 2017 Leak Survey cycles for its distribution and transmission pipeline systems are shown in Table 18 below:

Table 18 – Leak Survey Frequency		
Facility Types		Survey Frequency
All Company facilities w/in business districts and public buildings	Distribution (MAOP <60 psig)	Annual
Buried metallic facilities not under Cathodic Protection and not covered by an annual requirement		3 years
Balance of underground distribution facilities		5 years
DOT Transmission All Odorized Transmission	Transmission (MAOP > 60 psig)	Semi-Annual
Gathering: Class 1, 2, 3 and 4	Transmission (MAOP > 60 psig)	Semi-Annual
Stations: Class 1, 2, 3, and 4	Transmission (MAOP > 60 psig)	Semi-Annual
Perimeter of Enclosed Electric Substations and Switching Stations		Every 6 months

In 2015, PG&E fully implemented the use of an advanced leak detection technology (Picarro Surveyor) into a standard leak management operating model called Super Crew.²³ PG&E’s Super Crew model is an end-to-end leak management process that begins with performing what would traditionally be multiple weeks of leak survey in one week, using the Picarro Surveyor. The second step in the model’s process is to immediately repair all hazardous leaks identified during the survey and to

Initiated in 2014 as a gas distribution pilot program, SUPER CREW is a cross-functional team that surveys and repairs leaks following an end-to-end process. The team utilizes Picarro Surveyor technology mounted on vehicles. This technology is 1,000x more sensitive than other leak detection equipment.

schedule for repair within 90 days all identified leaks that meet the schedulable leak criteria. Finally, PG&E bundles the scheduled leak repair job packages and performs all of the leak repairs in a month or two rather than over a multi-month period. PG&E met 40% of its 5-year distribution system compliance survey requirements using its Super Crew.

In 2016, PG&E plans to utilize the Super Crew model in 100% of its divisions, completing nearly 70% of its 5-year compliance survey using Picarro technology. As PG&E transitions its 5-year compliance survey to a 4-year survey cycle in 2017, it will continue its expanded use of its Super

Crew in all of its divisions. The expanded use of Super Crew and the acceleration of leak survey cycle will support PG&E in its ability to: (1) find and fix more leaks, thereby eliminating more potential hazards to the public; (2) significantly reduce the number of Grade 2 and 2+ open leaks present on the system at any time (the leaks that occur between surveys); and (3) reduce greenhouse gas emissions.

To further enhance its distribution Leak Survey process, initiatives are currently in progress and being implemented to support PG&E’s transition to a 4-year leak survey cycle including implementing technology to enable an end-to-end

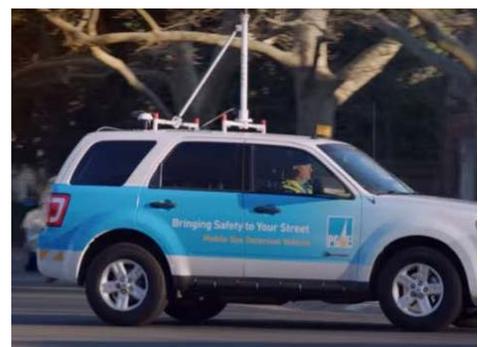


Figure 28 – PG&E’s Super Crew Performing a Leak Survey

paperless leak survey process, and integration with enterprise systems. Once completed, PG&E will have a test record for its entire Gas transmission pipeline.

In addition to the increase in compliance leak survey, PG&E will continue to support other types of survey in 2017 including, but not limited to, distribution integrity management, applicant installed pipelines, transmission integrity management, regulatory surveys of storage facilities, and other special project requests.

j) LEAK REPAIR

Similar to Leak Survey, pipeline safety regulations and guidelines require PG&E to repair certain leaks to maintain and assure the safety of the system and the public. PG&E's trained and operator-qualified personnel classify leaks into four grades (Grade 1, 2, 2+ and 3) based on the severity and location of the leak, the risk the leak presents to persons or property, and the likelihood that the leak will become more serious within a specified amount of time. PG&E's leak grading and resulting leak repair practices exceed industry guidance, as set by the American Society of Mechanical Engineers Gas Piping Technology Committee Guide for Gas Transmission and Distribution Piping systems in a few ways. For instance, PG&E uses an additional grading and repair category between Grade 1 and Grade 2 leaks (Grade 2+ leaks) requiring repair within 90 days, and Grade 3 leaks are monitored at least every 15 months.²⁴ PG&E now also repairs, rather than rechecks, above-ground Grade 3 leaks, and has begun repairing some below-ground Grade 3 leaks on its distribution system.

Also similar to Leak Survey, PG&E utilizes its Super Crew to support gas distribution leak repair. During survey, Super Crew has the ability to find more leaks utilizing advanced technology faster, which in turn provides a number of leaks requiring some form of repair in a short amount of time. Having all of the work required in an area at one time provides opportunity to bundle



Figure 29 – PG&E's Super Crew at Work

work locations and effectively maximize the utilization of resources. In 2015, the Super Crew repaired many of the nearly 48,000 gradable leaks on the gas distribution system. Those repairs aided PG&E in its lowest open leak inventory of Grade 2+ and Grade 2 leaks at the end of any year, at 94 leaks. PG&E continues to utilize Super Crew in 2016 and beyond, and looks to maintain a below 100 open leak inventory of Grade 2+ and Grade 2 leaks at the end of each year going forward.

PG&E is also increasing leak repair on its transmission pipeline system. In accordance with the CPUC's General Order 112F, PG&E will begin repairing previously monitored Grade 3 leaks on its transmission pipeline system within 12 months (not to exceed 15 months) of detection.

PG&E continues to review and improve its standards, procedures, field processes and equipment in an effort to further reduce the public safety risk of and the emissions from gas leaks.

k) PIPELINE PATROL AND MONITORING

Pipeline Patrol is a federally required activity that is essential to protecting the integrity of primarily PG&E gas transmission facilities from external threats and, in doing so, helps to increase public safety. Patrol is performed by operator-qualified personnel who observe surface conditions near the right-of-way of transmission pipelines and select distribution facilities. Patrollers identify and report a variety of observations including abnormal operating conditions, potential threats to pipeline integrity (e.g., digging, farm-field ripping, boring, blasting, etc.), new construction that may affect Class Location or High Consequence Areas, vegetative cover, and structural encroachments.

In 2015, Aerial Patrol patrolled an average of 4.5x times the mileage required by the Code of Federal Regulations, for a grand total of 127,000 miles.

PG&E primarily utilizes aerial methods to conduct patrols, with ground personnel dispatched to investigate observations made from the air. Exceeding federal requirements, PG&E’s Pipeline Patrol Program seeks to conduct patrols of the entire transmission system on a monthly basis, as well as meet an internal goal to patrol pipelines located in High Consequence Areas (populated areas) a second time each month. Special patrols may also be performed following natural disasters or other incidents as necessary. Aerial patrols provide real-time knowledge of on the ground activities and the surveillance helps PG&E to identify and stop unsafe excavation practices before dig-ins occur.

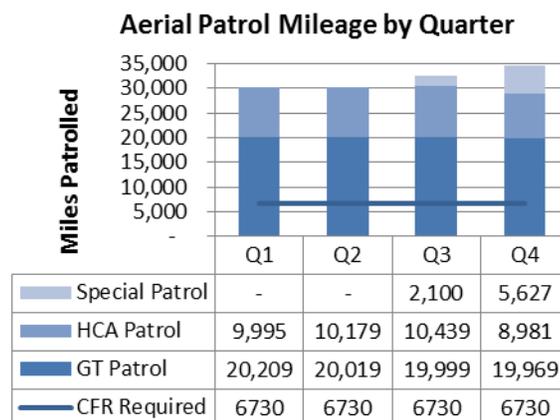


Figure 30 – 2015 Aerial Patrol Mileage by Quarter

In 2015, Aerial Patrol patrolled four and half times the mileage required by the Code of Federal Regulations, for a total of 127,000 miles. Additional accomplishments included:

- Acquiring and implementing use of fixed-wing aircraft with advanced camera systems.
- Establishing a centralized team of dedicated ground patrollers with mobile solutions.
- Publishing a revised pipeline patrol utility procedure (TD-4412P-07, Rev. 6).

l) PIPELINE MARKERS

The single leading cause of damage to underground pipelines, including catastrophic failures, is a “dig-in,” when contact is made with a pipeline, resulting in the release of natural gas. A dig-in is an example of a loss of containment event. Pipeline markers and indicators, an important damage prevention tool, are used to indicate the approximate location of the respective pipeline along its route. Installing markers is required by pipeline safety regulations because markers contribute to public awareness and damage prevention, which in-turn reduces the risk of loss of containment.

The Pipeline Markers are signs on the surface above or near the natural gas pipelines located at frequent intervals along the pipeline Right-of-Way. The markers are typically found at various important points along the pipeline route including highway, railway, waterway intersections, spans,



Figure 31 – Attention-Grabbing PG&E Pipeline Markers Mark Pipeline Right-of-Way

angle points (bends), and other road crossings. These markers display the name of the operator and a telephone number where the operator can be reached in the event of an emergency. They are meant to be highly visible along the Right-of-Way and appear in different forms as in the examples in Figure 31.

In the event of an emergency or natural disaster, markers may be the only indication to the public and emergency responders that natural gas pipelines are in the area. A correctly-installed and well-maintained marker serves in this capacity 24 hours a day, 365 days a year.

In 2015, PG&E installed 18,309 markers, representing a 600 percent increase over 2014 installations. In 2016, PG&E is targeting to install, repair, or maintain around 9,000 markers.

m) COMMUNITY PIPELINE SAFETY INITIATIVE

Community Pipeline Safety Initiative is a multi-year program funded by PG&E’s shareholders extending through 2017 that is designed to enhance safety by reducing risk to the integrity of the transmission pipelines, and improving access to PG&E Right of Ways. PG&E’s main effort is focused on identifying and removing structures and trees above and around the pipelines that represent potential risks to safety. PG&E’s remaining Community Pipeline Safety Initiative Program projects are listed below:

- **Pipeline Centerline** – This project included surveying the gas transmission pipeline system by using precise mapping tools with Global Positioning System coordinates, and entering the GPS coordinates into a new Geographic Information System. This project was completed in December 2013 and allows PG&E to precisely locate and monitor its gas transmission pipelines.
- **Encroachment Clearance** – This project includes locating, staking, mapping the center of the pipeline, and checking the area above the pipeline for any structures or vegetation that could interfere with PG&E’s ability to maintain, inspect, and safely operate the pipeline. This is followed by remediation of any such encroachments deemed unacceptable for the safe maintenance and operation of the pipeline. The main focus of the program is to remove structures and trees from PG&E Right of Ways. PG&E is working with home owners and cities on these efforts to identify the best solutions. In 2015, PG&E cleared 93 miles of structures and 380 miles of vegetation. Since program inception, PG&E has cleared 160 miles of structures and 450 miles of vegetation.
- **Vegetation Management** – This project is focused on keeping PG&E’s Right-of-Way open and free of “non-compatible vegetation.” Along with structure clearing, this improves PG&E’s ability to respond in emergency situations.

The efforts under the Community Pipeline Safety Initiative Program strengthen PG&E’s ongoing pipeline safety programs, improve the ability to identify and prevent risks to pipelines, and give PG&E better access to inspect, test, and maintain pipelines.

6. MITIGATING LOSS OF SUPPLY

In 2015, PG&E transported and delivered about 1,000 billion cubic feet of gas.²⁵ To provide context, a cubic foot of gas is enough to fill a basketball and 1,000 cubic feet is enough to meet the needs of an average home for five days.²⁶ PG&E works year-round to assure system reliability through its management of system pressure, capacity, monitoring, and controls. The following sections discuss PG&E’s programs designed to mitigate the risk of losing gas supply.

a) SYSTEM PRESSURE AND CAPACITY

PG&E designs and operates its gas system to ensure safe pressure regulation and adequate gas supplies. PG&E continuously monitors the pressure of its system [See Section: *Gas System Operations and Control* page 42]. Additionally, PG&E measures and works to reduce over-pressure events. PG&E’s pipeline capacity is sized to provide all core customers, PG&E’s residential and small commercial customers, with uninterrupted service on a one-day-in-90-year cold temperature event (referred to as an Abnormal Peak Day), and to provide all customers, including non-core, (large commercial, industrial or institutional customers) with uninterrupted service on a one-day-in-two-year event (referred to as a Cold Winter Day). PG&E’s gas system was successfully tested in real-time in December of 2013, when the system experienced two days below the one-day-in-two-year Cold Winter Day standard.

Sacramento experienced colder temps, below the Cold Winter Day for five days. However, PG&E was able to provide continuous gas service to all core customers and, consistent with system planning, requested curtailments of up to 61 non-core customers, customers whose rate agreement includes a curtailment provision.

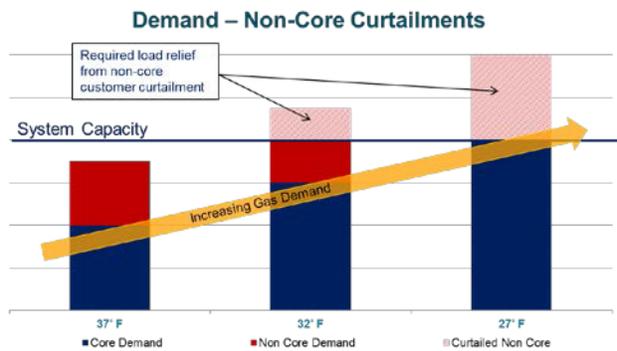


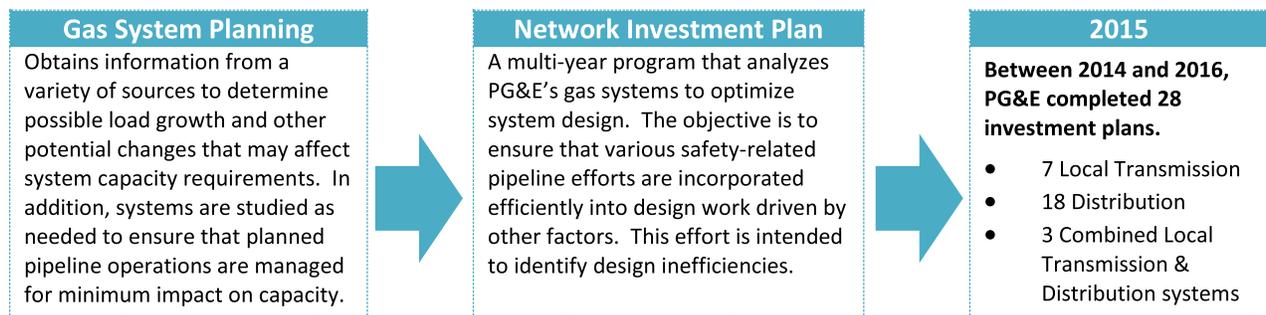
Figure 32 – How Demand for Gas Affects Capacity

Insufficient capacity, resulting in reliability issues, can pose significant public health and safety risks. For instance, a lack of pipeline capacity could lead to a loss of gas service that customers depend on for daily life activities including space heating, water heating, and cooking. In very cold weather, loss of space heating can itself be life-threatening, and can

prompt customers to use unsafe heating alternatives. Loss of gas service can also lead to extinguished pilots and the subsequent potential for un-combusted gas entering affected buildings. In some scenarios, loss of gas service can affect electric generation, which can also result in health and safety concerns.

PG&E drives the quality of its planning effort through a matrix of tools, processes, personnel, standards, internal and external data, and documentation that provide the appropriate level of oversight and control to its management team.

Figure 33 – Gas System Planning



b) OVERPRESSURE ELIMINATION INITIATIVE

A pipeline that operates at higher than the Maximum Allowable Operating Pressure presents an operational risk to the safety of employees and contractors working on the facilities and the public who live around these facilities (See **Attachment 15** for PG&E's Maximum Allowable Operating Pressure standard). This is not a normal operating situation

In 2015, PG&E experienced 30 overpressure events, continuing PG&E's overall positive trend down from 775 events in 2011.

and is referred to as an overpressure event. Human error and equipment failure continue to be the two most common causes of an overpressure event. Overpressure events can stress pipelines and may lead to loss of containment. Large excursion events (such as those graphed in Figure 34) are those that are most likely to have significant safety and operational impacts to PG&E’s gas system, and represent events where overpressure protection equipment did not adequately perform its intended function. In 2012, PG&E began an initiative to eliminate system overpressure events. In 2015, PG&E continued to implement priority actions to eliminate overpressure events by evaluating and implementing station design and construction best practices, implementing a locking and tagging process to prevent out-of-service assets from mistakenly being returned to service and other clearance improvements, and developing training with communication to bring improved awareness of overpressure risk factors. PG&E will conclude these actions in 2016. PG&E also continues to install hundreds of additional SCADA points annually to increase gas system real-time visibility in the Control Center with the ability to proactively prevent and minimize overpressure events.

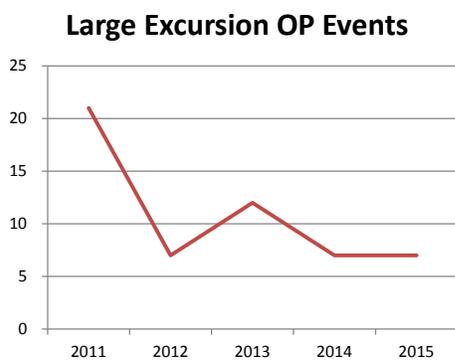


Figure 34 – 42% Reduction in Overpressure Events Since 2013 and 76% Reduction Since 2011

Additionally, PG&E is investigating predictive analytics, to determine if it is possible to identify equipment with degraded operational performance so that proactive preventative action can be taken before an overpressure event occurs. PG&E continues to modify operations and upgrade gas system regulation equipment to provide greater separation between normal operating pressures and the maximum allowable operating pressure. Each activity contributes to the goal of reducing overpressure events, contributing to system safety.

c) OPERATIONS CLEARANCE PROCEDURE

An important part of public and employee safety is the use of the Gas Clearance procedure. Clearance procedures are an added safety step to confirm that a plan and procedure to protect employee and public safety is in place before work is performed on either the transmission or distribution gas system. The Clearance Procedure is used for all work that impacts gas flows, pressures, remote monitoring and control, or gas quality and all clearances are approved by Gas Control.

The gas clearance processes for transmission and distribution were reviewed in 2015, and as a result, the clearance procedures for transmission and distribution were aligned to a single process. This alignment was performed to eliminate gaps and improve consistency and execution. Lean Six Sigma was applied through a Utility Process Improvement team to map “as is” and “to be” processes as well

as identify areas of concern to be addressed by the teams. A cross-functional team revised the gas clearance procedures and updated the Gas Clearance electronic tool. Finally, new training was created for employees to learn and understand the newly updated clearance process.

In 2015 the clearance procedure was revised to add hazardous energy control. The procedure, called Lock Out Tag Out, uses process safety principles to add an additional layer of safety to the clearance process. “Lockout/tagout” refers to specific practices and procedures to safeguard employees from the unexpected energization or startup of machinery and equipment, or the release of hazardous energy during service or maintenance activities.²⁷ PG&E benchmarked other companies to develop the procedure in compliance with Federal and CAL-OSHA Lock Out Tag Out requirements. Training for Lock Out Tag Out was developed in 2015 for all employees and contractors performing clearances.

d) SUPPLIER QUALITY FOR DISTRIBUTION AND TRANSMISSION

The Supplier Quality Assurance organization is responsible for assuring the safety and quality of material provided by PG&E’s suppliers. If non-conforming material is purchased to be used in pressurized gas systems it might introduce a safety risk to employees, the public and to the gas infrastructure.

PG&E’s Supplier Quality Assurance group collaborates with engineering, construction, and supply chain to create rigorous standards for incoming material, and assures that qualified suppliers provide PG&E material that meets PG&E’s product qualification requirements. While the process for materials and suppliers for gas distribution and transmission are adapted to the unique needs of the business Figure 35, illustrates the general Supplier Quality Assurance process. Using this process, Supplier Quality Assurance has reduced the rate of defective parts per million from 5,251 in 2013 to approximately 1,373 in 2015, a 74% decrease over three years.

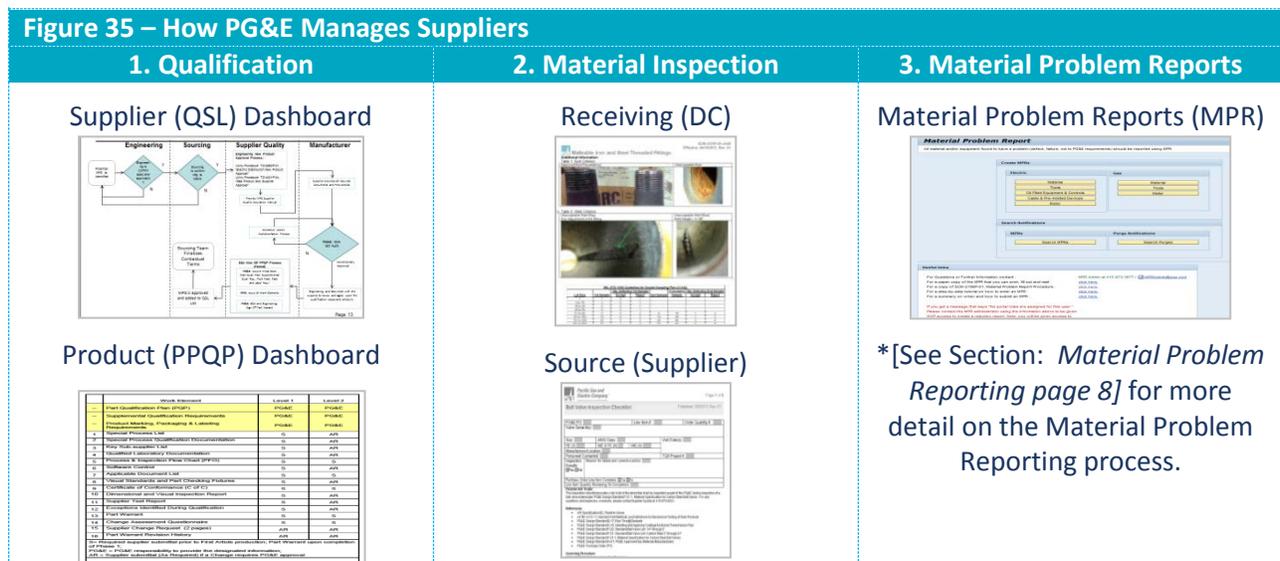


Figure 35 (Continued) – How PG&E Manages Suppliers



Two continuous improvement efforts illustrate PG&E’s commitment to mitigating supplier risk. First, in February 2016, PG&E achieved certification with the International Standards Organization ISO-9001, the international standard for Quality Management Systems.²⁸ Second, in winter 2015, Supplier Quality Assurance began to build a web-based electronic system that will make it easier for suppliers to comply with the Supplier Change Request process and continue to confirm that their materials conform to PG&E’s specifications. The project will prevent suppliers from changing the specifications of their products without PG&E’s knowledge and approval. PG&E also continues its Supplier Audit Program. In 2015, PG&E completed 89 supplier audits which encompass approximately 30% of its critical and high-risk suppliers, an increase of 78% over 2014.

7. MITIGATING INADEQUATE RESPONSE AND RECOVERY

PG&E has many programs in place to mitigate the risk of loss of containment and loss of supply described in the preceding sections. However, PG&E is fully prepared to respond to and recover from unplanned events. PG&E’s policies and procedures have been revised to provide effective system controls for both equipment and personnel to limit damage from accidents, explosions, fires and dangerous conditions. It is PG&E’s policy to:

Objective	Description
Establish Command	Determine the Incident Commander, set up an Incident Command Post, activate Emergency Center(s), if necessary
Assess Situation	Gather information about emergency, assess the situation in coordination with appropriate 911 agency(ies) and PG&E Gas Control Center
Make Safe	Make area safe for public, employees and others
Communicate/Notify	Communicate to/notify the appropriate PG&E personnel, regulatory agencies, public agencies such as fire, police, city and county emergency operations, GCC, customers and media
Restore	Restore gas service
Recover	Deactivate ICP and/or Emergency Centers and return to business as usual

Figure 36 – Basic Emergency Procedure Objectives

- Plan for natural and manmade emergencies such as fires, floods, storms, earthquakes, cyber disruptions, and terrorist incidents;
- Respond rapidly and effectively, consistent with the National Incident Management System principles, including the use of the Incident Command System, to protect the public and to restore essential utility service following such emergencies;
- Help alleviate emergency related hardships; and
- Assist communities to return to normal activity.

All PG&E emergency planning and response activities are governed by the following priorities:

- Protect the health and welfare of the public, PG&E responders, and others;
- Protect the property of the public, PG&E, and others;
- Restore gas and electric service and power generation;
- Restore critical business functions and move towards business as usual; and
- Inform customers, governmental agencies and representatives, the news media, and other constituencies.

PG&E uses the structure of the Incident Command System to complete key steps in the incident response. The key incident response objectives in Figure 36 represent a typical process flow through the cycle of an incident. Note: every incident may not necessarily follow this exact sequence. For example, it may be appropriate to “Make Safe” at several points during the response process and not just after “Assess the Situation.”

The next section discusses programs in place to mitigate threats that have the potential to prevent PG&E from responding in a timely manner.

a) GAS SYSTEM OPERATIONS AND CONTROL

PG&E’s Transmission and Distribution Gas Control Center monitors and controls the flow of gas across PG&E’s system 24 hours a day, 365 days per year, to ensure that it is received and delivered safely and reliably to customers. The Gas Control Center provides near instantaneous visibility on the gas system. This allows PG&E to prevent, quickly react to, and mitigate issues that may pose a safety risk to the public and PG&E employees.

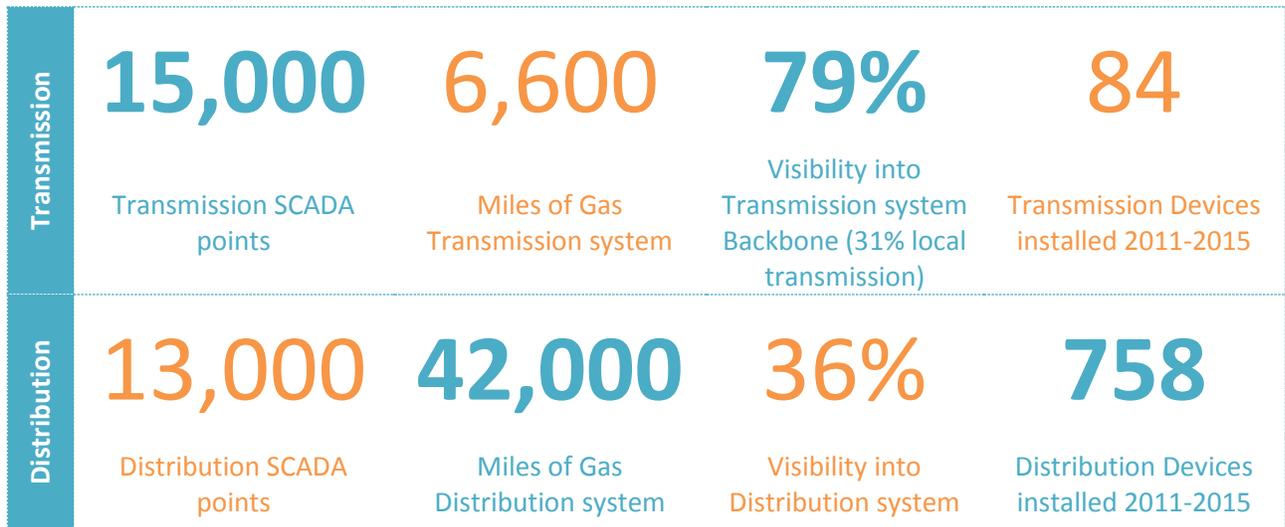


Figure 37 – PG&E’s Progress in Enhancing System Visibility through SCADA

PG&E’s Gas Transmission Control Center, Gas Distribution Control Center and Gas Dispatch functions are co-located in a single facility. The co-location of these three functions enables the company to better communicate, share information, and monitor the systems to provide superior emergency response coordination. This visibility, monitoring, control and response capability is important to PG&E’s vision for long-term gas safety excellence.

For the Gas Control Center to be effective, a key control need is situational awareness—the ability to identify, process, and comprehend the critical elements of information about what is happening. PG&E’s operators use billions of data records comprising a mix of near real-time gas system operational data, and a variety of geo-spatial, time dependent and historical information that relates to the gas system, to provide critical information to Gas Control to aid in decision-making. These data are packaged and alarmed to focus the operators’ attention on abnormal situations as well as easily bundle information to quickly assess a developing issue.



Figure 38 – PG&E’s Gas Control Center features a 90 foot-long video wall with current operational information to augment the Gas SCADA system

b) CYBER SECURITY

PG&E's natural gas operations involve significant risk management activities, including addressing the threat of cyber security. PG&E increasingly relies on evolving and complex operational and information technology systems. The company's network infrastructures are becoming more interconnected with third-party systems. The failure of the Utility's operational and information technology systems and networks could significantly disrupt operations or cause harm to the public or employees.

To address the threat of cyber-attack, PG&E proactively assesses industry best practices and invests in cyber mitigations and controls. PG&E is investing in a portfolio of projects to reduce the risks posed by various cyber threats. The threats PG&E has identified and plans to withstand and rapidly recover from when necessary are:

- Supply chain (new hardware infected with malware)
- Malicious intrusions (insider or outsider)
- Attacks of vulnerable end-point devices and network infrastructure
- Unidentified software defects
- Exploiting employee security mistakes or errors

PG&E regularly puts these controls to the test by participating in exercises such as the North American Electric Reliability Corporation (NERC) grid security and emergency response exercise, GridEx.²⁹ During the exercise, PG&E and other utility participants experienced simulated unusual control system operation and received reports of substation break-ins and un-staffed aerial vehicle surveillance—then malware intrusions and coordinated physical attacks. These exercises test PG&E's emergency response processes, including partnerships with industry, law enforcement and government agencies (such as the FBI, Department of Energy, Department of Homeland Security and the NSA).

c) VALVE AUTOMATION

PG&E's Valve Automation Program is designed to accelerate emergency response in the event of a gas transmission pipeline rupture. This program builds upon the scope and principles in PG&E's Pipeline Safety Enhancement Plan. The Pipeline Safety Enhancement plan replaced, automated, and upgraded gas shut-off valves across PG&E's gas transmission system from 2011-2014 and the



Figure 39 – Valve Automation at Edgewood Park

Pipeline Safety Enhancement Plan’s scope of work was completed in 2015. In 2015, an additional 18 valves were installed through the 2015 Gas Transmission and Storage Rate Case Valve Automation program (Base).

Table 19 – Valve Automation (Pipeline Safety Enhancement Plan)				
Valve Automation (units)	2011-2013	2014	2015	Total
PSEP	134	74	9	217
Base	0	0	18	18
Total	134	74	27	235

The Valve Automation Program allows transmission pipeline to be rapidly isolated through remote control valve technology. Installation of automated isolation capability on major pipelines in heavily populated areas may reduce property damage and danger to emergency personnel and the public in the event of a pipeline rupture. PG&E’s control room personnel have received extensive training to help them recognize and act on system conditions warranting immediate isolation of pipeline systems and planned SCADA installations to continue to increase system visibility are ongoing [See Section: *Gas System Operations and Control page 42*]. PG&E’s ability to recognize and act on system conditions warranting immediate isolation of pipeline was tested in 2015 following a significant gas dig-in in Bakersfield. PG&E’s Gas Control Center immediately detected a pressure reduction and initiated the closure of automated control valves within four minutes. PG&E arrived on-site within 31 minutes. PG&E restored service to the majority of the approximately 90 impacted customers within 24 hours.

d) EMERGENCY RESPONSE

Two main components of Gas Emergency Response are the Gas System Operations Control Room Management standard and the Gas Emergency Response Plan. Please see **Attachment 16** for PG&E’s Gas System Operations Control Room Management standard and **Attachment 17** for the Gas Emergency Response Plan.

In the event of an emergency the operator qualified Gas Control personnel are trained to use the incoming data providing situational awareness and to maintain a bias for action. If an emergency involves a pipeline rupture, Gas Control will immediately initiate and execute shutdown zone plans to remotely isolate gas pipeline systems surrounding the affected area. If required, shutdown zone plans may also require Gas Control to direct field personnel to respond to critical locations for the execution of manual valve operations. To maintain compliance and aid in the management of abnormal and/or emergency operating conditions, PG&E developed a control room management plan and provided training for all gas control personnel. The plan outlines PG&E’s 911 Notification Process. The process requires PG&E’s control room personnel to make an immediate 911 notification to facilitate situational awareness. This ensures that public safety emergency response centers are aware of a potential

gas-related incident, and also allows them to share any additional information that they might have already received. This notification is triggered upon the following SCADA alarm conditions:

- Relief valve open alarm venting gas to atmosphere;
- Automatic shut off valve closed alarm indicating isolation of a section of pipeline;
- Activation of a pressure drop-rate high alarm indicating a high differential across one of the newly-installed remote control isolation valves; and
- Activation of a pressure alarm indicating possible pipeline rupture (confirmed valid by verification of upstream and downstream pressure sites and correlated supply source metered flow increase).

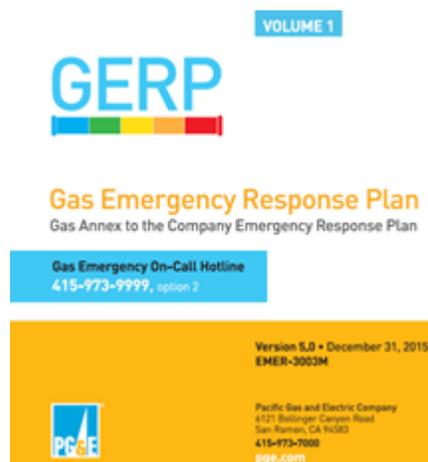


Figure 40 – The Gas Emergency Response Plan as of Dec 31 2015

In order to improve focus on real-time monitoring, transmission control operators are assigned to monitoring the north or south portion of the system. For distribution control, geographical assignments are broken out by Northern, Bay, Central Coast, and Central Valley. At any given time, operators are responsible for monitoring their assigned areas [See Section: *Gas System Operations and Control page 42*].

The Gas Emergency Response Plan (GERP)³⁰ describes the roles and responsibilities of PG&E’s emergency response personnel, which include a single person who assumes command and designates specific duties for the team responding to the incident.

Additionally, PG&E has a fleet of Mobile Command Vehicles to respond more rapidly to natural gas or electric emergencies. PG&E has six Mobile Command Vehicles and four Emergency Communication Trailers, which are used with the Mobile Command Vehicles to enhance radio communications in the event of poor radio coverage.

COMPANY EMERGENCY RESPONSE PLAN

The purpose of the Company Emergency Response Plan (CERP) is to assist the gas and electric businesses with a safe, efficient, and coordinated response to an emergency event. For a copy of PG&E’s 2015 Company Emergency Response Plan, please see **Attachment 18**.

The Company Emergency Response Plan provides a broad outline of PG&E’s organizational structure and describes the activities undertaken in response to emergency situations. The Company Emergency Response Plan presents a response structure with clear roles and responsibilities and identifies coordination efforts with outside organizations (government, media, other gas and electric utilities, essential community services, vendors, public agencies, first responders, and contractors).

The Company Emergency Response Plan follows a logical flow from general emergency response concepts and guidelines to specific emergency management organizational structure, roles, responsibilities, and processes. When appropriate, the plan also references supporting procedures and other response materials. In addition, PG&E maintains approximately 48 Business Continuity Plans, which describe how PG&E will continue essential business operations in the event of a disruption to facilities, technology or personnel.

GAS EMERGENCY PREPAREDNESS AND RESPONSE

The Gas Emergency Preparedness group assists Gas Operations with emergency planning, preparedness, response, and review. This group maintains the Gas Emergency Response Plan, leads exercises, facilitates after action reviews and participates in industry activities designed to impart best practices. The group facilitates the use of the Incident Command System, a systematic, proactive approach for all levels of governmental and non-governmental organizations and the private sector to work together during an incident to reduce the loss of life, damage to property and harm to the environment. Further, the team supports the Gas organization's local emergency centers, called Operations Emergency Centers, and the Gas Emergency Center, which is co-located with the Gas Control Center. These centers are activated according to criteria outlined in PG&E's Gas Emergency Response Plan.

Throughout 2015, the Gas Emergency Preparedness group:

- Conducted 35 instructor led trainings;
- Facilitated 16 Operations Emergency Center exercises;
- Facilitated 6 Gas Emergency Center exercises (one for each of 5 Gas Emergency Center teams, including senior leadership participation in command and general staff Incident Command System roles); and
- Supported the response to 44 emergency activations requiring activation of the local operations emergency center.



Figure 41 – On Left: PG&E Public Safety Emergency Preparedness attended 61 safety fairs and conferences in 2015. On Right: Largest ever PG&E LNG/CNG Operation (in 2015) instructs emergency personnel

Frequent outreach to first responders strengthens how PG&E coordinates when emergencies happen. In 2015, Public Safety Emergency Preparedness completed the following efforts in partnership and close coordination with first responders and local governments:

1. Delivered 672 First Responder Workshops to more than 9,000 first responders. These workshops train First Responders to safely respond to gas and electric emergencies and exactly how to access the PG&E gas transmission pipeline mapping system
2. Met with 368 fire departments with PG&E gas facilities which are 100% of fire departments that respond to incidents with its gas commodity. These meetings focused on contingency plans in the event of an emergency
3. Hosted 10 Public Safety Liaison Meetings across the service territory to share PG&E's emergency response plans. These meetings had representatives from federal, state, county and city governmental agencies
4. Public Safety Emergency Preparedness attended and presented Public Safety materials for both gas and electric at 61 Safety Fairs and Conferences reaching over 8,000 people, including first responders and the general public
5. Supported the largest PG&E Liquid Natural Gas/Compressed Natural Gas operation, conducted in Santa Cruz County. Trained fire and law enforcement personnel on Liquid Natural Gas/Compressed Natural Gas procedures and emergency operations. More than 46,000 PG&E customers were supported by these operations
6. Responded to 155 dig-in incidents. Public Safety Emergency Preparedness acted as an Agency Representative between PG&E and the first responder community.
7. Responded to nine wildland fire incidents where the potential of fires compromising gas lines were occurring. The Public Safety Emergency Preparedness team worked with state and federal fire agencies to mitigate the potential for the damage to PG&E's infrastructure



Figure 42 – From Top Left Clockwise: (1) First Responder Workshop, (2) Public Safety Liaison Meeting, (3) Emergency Responder Guide, (4) PG&E and Fire Department Responds to a Dig-in, and (5) Wildfire Response

V. WORKFORCE SAFETY

PG&E’s work requires well-trained personnel to correctly perform work activities. Therefore, the Company invests in recruiting and retaining, providing ongoing development and training once personnel are hired, and maintaining supportive controls for employee and contractor work. Fully engaging PG&E’s employees in the Gas Safety Excellence journey results in field personnel who surface trending problems which can be fixed before they become urgent problems. For example, PG&E employees have worked together to address excavation safety with an enhanced excavation manual, excavation safety workshops and training curriculum updates. PG&E believes that well-trained, fully-engaged employees are a key component of Gas Safety Excellence.

1. WORKFORCE SIZE

An appropriately sized workforce and access to qualified contractors is an important aspect of performing work safely and maintaining the safety of PG&E’s gas system. Gas Operations and its human resource partners collaborate to define the workforce needs and recruit qualified employees to perform work safely and efficiently. PG&E has robust training programs to develop its workforce and relies on the unique capabilities of various staff augmentation firms as needed.

In 2015 PG&E Gas Operations added 450 new full time employees. In 2014, the Gas organization added 323 employees, and in 2013, added 647. To further support pipeline safety and reliability, PG&E increased the Gas Operations’ workforce in 2015 for key functions, including Locate and Mark, Leak Survey, Corrosion, and Inspections.

2. SAFETY PROJECTS

In 2015 PG&E deployed a number of projects designed to improve employee safety. Table 20 summarizes four workforce safety projects.

Table 20 – Examples of PG&E’s 2015 Workforce Safety Projects			
Below you can find a brief review of 4 projects which are critical to reinforcing and maintaining workforce safety			
Serious Incidents and Fatalities (SIF)	Safety Leadership Development	Personal Protective Equipment Matrix	Phone Free Driving
Program focuses efforts on near hits without management or engineering controls and with potential for serious injury or fatality. Injuries and near-hits evaluated to have potential for serious injury or fatality receive a deeper evaluation and increased management oversight to prevent repeat occurrences.	Program designed to improve the enterprise safety performance by improving the leadership experience and awareness of safety behaviors. Taught in six all day workshops over an 18 month period, this program includes one-on-one coaching by Safety Leadership Coaches and 360 degree feedback surveys.	Collaborative development of a tool, available for use by all employees, to evaluate the correct personal protective equipment for the task being performed. The project developed a matrix based on the tasks performed by each department in Gas which should reduce injuries due to incorrect Personal Protective Equipment by 25%.	Industry leading, proactive policy to prevent use of cellular communication while operating motor vehicles. Any distraction while driving increases the risk of accidents and injuries. By preventing the use of cellular devices with the exception of emergency situations PG&E will reduce motor vehicle incidents and improve both public and employee safety.

3. WORKFORCE TRAINING

The cornerstone of safe and reliable gas facility design, construction, maintenance, operations, and retirement is maintaining a workforce of highly-skilled, competent and experienced technical employees. Training program improvement priorities are determined and driven by regulatory changes, new tools and instruments, standards and policy changes and strengthened Operation Qualification requirements.

In November 2015, PG&E broke ground on a brand-new, state-of-the-art gas training facility in Winters, California, and expects to be delivering curriculum at that facility by early 2017. The facility's master plan was established with input from a cross-section of PG&E's technical workforce and is based on that team's experience and benchmarking of industry training facilities. The facility will include a utility village to provide realistic scenarios for leak survey, leak pinpointing, and emergency response. Other features include an industry-leading measurement and control flow lab to provide hands-on training for instrumentation and regulation equipment found in the field, and a construction training area that will include hands-on excavation, shoring, and other construction-related activities.

In early 2012, PG&E finished a comprehensive benchmark study that compared PG&E's gas training to other utilities. Three recommendations were made in support of employee training and PG&E's Gas Operations training program identified approximately 400 courses that would be developed and/or enhanced between 2012 and 2016. In 2015, PG&E updated 105 courses, bringing the total of updated courses to 70% of its 400 course planned curriculum goal. The three recommendations and their status as of July 2016 are included in Table 21 below.

In 2015, 105 new course publications included:

- 87 courses upgraded to improve the training quality;
- 44 courses migrated from the lines of business to the training organization;
- 6 courses where PG&E purchased vendor curricula that met PG&E's needs.

In 2015, Gas Operations implemented a training governance committee to review the end-to-end program health from guidance documents, to training, to qualifications, to Quality Control, for key organizations performing construction, operations, maintenance, cathodic protection and gas service activities.

Table 21 – Gas Operation Training Recommendations 2012-2015	
2012 Recommendation	Progress as of Dec 31, 2015
Develop programs that support employees throughout their career	<ul style="list-style-type: none"> • Courses were developed or realigned to support new lines of progression • 7 apprentice programs in Gas Operations that have been developed or are currently being developed to move employees to journey-level competency • Increased focus on refresher training to maintain skill and competence of existing employees
Broaden technology solutions and leverage external curriculum	<ul style="list-style-type: none"> • 60% of curriculum built in 2015 was web-based or on other technology based medium • Leveraged vendors for training to provide employees with industry-recognized certifications
Implement continuous training improvement processes	<p>In 2015, Gas Operations Training implemented:</p> <ul style="list-style-type: none"> • A Gas Operations Training Governance Committee to review major training requests and align training projects with gas operation priorities • Training Effectiveness studies in partnership with Quality Management and operator qualifications teams to determine how effective key training programs are and how to improve them

4. GAS OPERATOR QUALIFICATIONS

PG&E’s Gas Qualifications Department maintains and implements qualification programs covering welding, plastic pipe joining, and operator qualifications pursuant to federal and state regulations and industry best-practices.

PG&E requires that all employees, contractors and third-party utility installers participate in mandatory training, and possess all appropriate qualifications to perform any work on pipeline facilities. A qualified operator has the expertise to complete work correctly and is part of the team that helps PG&E meet its commitment to public and employee safety.



Figure 43 – Employees Sitting for Written Examinations

Pipeline tasks require specific competencies in order to be performed safely and reliably. These competencies are reflected in the “Knowledge, Skills, and Abilities” needed for each task; “Knowledge, Skills, and Abilities” are determined by a group of subject matter experts specific to each topic. An individual’s KSAs are assessed via a combination of written and performance (practical demonstration) evaluations and candidates must score 100% on each component of an exam to be “qualified.” Evaluations are primarily geared towards safety and recognizing and addressing abnormal operating conditions. Qualifications must be renewed every six months, one year or three years depending on the task and applicable regulations. Initial qualifications follow training.

For new personnel, experience is gained through Span-of-Control and formal training. Span-of-Control allows a person in training to practice their skills in real-world conditions under the

direction and observation of a qualified person and gives the qualified person(s) the opportunity to advise, correct, and if required, take over the performance of the task to ensure safety.

By maintaining a qualified workforce, PG&E is in position to efficiently and appropriately recognize and respond to any abnormal operating conditions that may pose a threat to the safety of the public, employees or assets.

PG&E's Gas Qualifications Department actively participates in benchmarking and process improvement initiatives with other utilities and other industries across the country in order to continuously find ways to increase the expertise of the workforce. Currently, PG&E is a voting member on an ASME industry best practice standard, called Pipeline Personnel Qualification,³¹ which aims to further improve on the regulations covering gas industry qualifications.

5. CONTRACTOR SAFETY, TRAINING AND OVERSIGHT

Much like full-time PG&E employees, contractors are an important aspect of PG&E's highly skilled, competent, and experienced technical workforce. Since contractors often work with PG&E's assets and infrastructure that directly impact employee and public safety, the Company holds contractors to the same standard of safety as PG&E employees. In order to adhere to this high standard, PG&E follows a four step process (Figure 44) for contractor safety, training and oversight.



Figure 44 – Four Step Process to Contractor Safety and Oversight

Prior to starting a job, PG&E *pre-qualifies* contractors and subcontractors, and confirms they are qualified to complete the contracted work. PG&E is continuing to improve its contractor pre-qualification process. Today, PG&E evaluates the contractor's qualifications and industry metrics, including a host of personnel injury metrics. Contractors on major capital projects are also given in-person and computer-based training on PG&E's quality and safety expectations, and typical hazards associated with the work.

Once construction on a major capital project has started, PG&E builds a *plan* for contractor performance and clearly communicates contract terms that hold contractors accountable for safety and quality. Job-site observations start during pre-job walk-throughs to evaluate site specific hazards prior to starting work. PG&E then schedules regular meetings with contractors to *oversee* their work and makes sure expectations are met. In addition to regular oversight, PG&E inspects contractor work and a quality assurance team randomly checks project completion from beginning to end. On a quarterly basis, PG&E's leadership and contractor leadership meet to understand opportunities to improve the overall Contractor Safety and Oversight program.

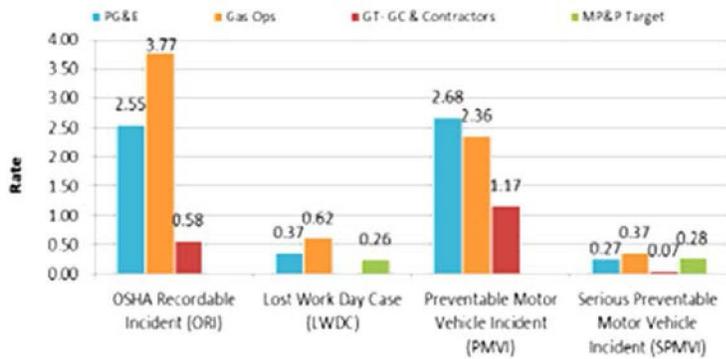


Figure 45 – 2015 Safety Performance

Contractor performance is tracked throughout the year and compared to Company performance. As shown in Figure 45, metrics track injuries and motor vehicle incidents. In 2015, contractors had zero Lost Work Day cases while working over 3 million hours.

In addition to lagging indicators, PG&E tracked the number of “Good Catches,” where team members identify and resolve a hazards before an incident occurs, to trend areas of improvement. As shown in Figure 46, in 2015 contractors submitted 867 Good Catches.

GOOD CATCHES 2015 Monthly Reports

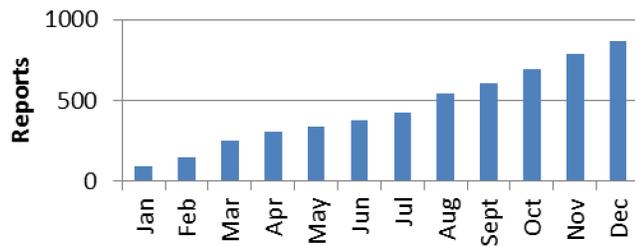


Figure 46 – Good Catches

6. PARTNERSHIP WITH LABOR UNIONS

Union-represented employees make up almost 70 percent of PG&E’s workforce, a part of the workforce that is integral to the Company providing safe and reliable gas service. PG&E frequently



Figure 47 – 70% of Gas Operations’ Workforce is Represented by the IBEW and the ESC

works with its union partners to identify opportunities for training, process improvement, and other investments in the safety of its union-represented employees and the public. To that end, in 2015 and 2016, PG&E continued to collaborate with union leadership on projects such as improving

emergency response and “make safe” times for blowing gas situations, enhanced lines of progression, the Mapping Advancement Program,³² and PG&E’s Leak Survey Optimization Program, also known as Super Crew.

The line of progression effort has updated job duties, training and certification for almost every represented field based position. These changes have driven improved training and certifications for the company’s workforce (NACE certification³³ for corrosion mechanics, as one example), improving the safe and compliant delivery of service.

An important example of collaboration between PG&E and union leaders is the Leak Optimization Program, commonly referred to as “Super Crew,” which incorporates advanced leak detection technology, and includes a streamlined and bundled approach to finding and fixing leaks. The benefits of this program include a significant increase in leaks found, improved work performance, enhanced system reliability, and increased public safety. Currently, PG&E is partnering with the International Brotherhood of Electrical Workers on additional safety-related improvements [See Section: *Leak Survey, Leak Repair pages 32, 34*].

VI. COMPLIANCE FRAMEWORK

PG&E’s business of providing natural gas to millions of Californians comes with responsibility for public, workforce and environmental safety in compliance with state and federal requirements. PG&E believes a compliant organization does the right thing, even when no one is looking.

PG&E’s compliance vision is built on these enablers:

- Employee expertise
- Providing employees the right information at the right time
- Making available the right resources at the right time
- Implementing supportive controls

1. BUILDING EXPERTISE

PG&E employees require specialized skills to be able to perform their jobs and to find and fix problems. The Company invests in training employees to perform work and to fix problems safely, quickly and effectively. In its 2015 Session D review of operational risks and foundational compliance requirements, PG&E identified Operator Qualifications as a top compliance risk and developed mitigations that include digitizing records to provide easier access to qualification information, expanding program elements for new Operator Qualifications, and strengthening procedures. As discussed in the previous section, PG&E has also strengthened the rigor of qualification exams. [See Section: *Workforce Training page 50*] and [See Section: *Gas Operator Qualification page 51*] for more information.

2. THE RIGHT INFORMATION TO DO THE WORK

We can't fix what we don't know about. Doing the right work depends on having the right information available, when employees need it. The right information starts with knowing what assets need to be worked on, the type of work to be completed, where the asset is located, and the procedures necessary to perform the work. PG&E uses an SAP Work Management module to maintain its asset registry and to identify the right work [See Section: *The Right Resources to Do the Job page 56*], pipeline mapping systems to ascertain where the asset is located, and the operations and maintenance manual, located on PG&E's digital Technical and Information Library, to dictate the correct procedures to perform the work.

The SAP Work Management Module (gas transmission asset migration completed in 2015) identifies assets that must be maintained and the schedule for doing so. PG&E uses it to plan who will do the work, when it will be done, where it will be done, and what will be done. This system organizes PG&E's efforts to accurately identify the work to be completed, schedule the work for timely completion, and cost-effectively schedule resources.

PG&E has two pipeline GIS mapping systems, one for natural gas transmission and another for distribution. These systems contain geospatial information about the pipeline system including, in some cases, detailed information about asset history, materials, manufacturer and location. These systems help PG&E to effectively conduct integrity management program work, locate mains and services, and plan for construction. PG&E works continuously to improve the quality of the information in both mapping systems. As an example, PG&E has been using its Corrective Action Program to identify, track and complete mapping corrections. Additionally, PG&E is focused on mapping timeliness, using continuous improvement methods to reduce time to map assets following construction completion. In 2015, mapping expanded the scope of its timeliness metric to include mapping small repair jobs (also known as expense jobs) and introduced additional quality control steps that increased the time to map a job above the 35-day goal. These additional activities increased job visibility and record quality. Mapping intends to increase staffing in 2016 to realign mapping cycle time with the goal.

Mapping Metrics	2015 Goal	2015 Results
Time from Construction-Complete to Mapping-Complete	32 Days	47 Days
Average Mapping Corrections Time (through Corrective Action Program Process)	30 Days	34 Days

Finally, PG&E proactively updates and maintains tools like the O&M manual so that employees have ready access to the most up-to-date and compliant specifications, standards and procedures. The company has identified an opportunity to make these manuals easier to use, thereby making it easier

for employees and contractors to be compliant. And, in 2016, PG&E will begin to consolidate the Transmission and Distribution manuals into a single volume.

3. THE RIGHT RESOURCES TO DO THE JOB

Once the correct work has been identified, employees need the right resources to be able to complete the work in a timely and safe way—whether through technology or traditional tools and equipment. For instance, PG&E has introduced mobile technology for several key processes, including aerial patrols, access to and management of locate and mark tickets and leak repair forms (see Figure 48). In 2012, PG&E modernized gas crew trucks and introduced mobile command vehicles to provide incident management support.

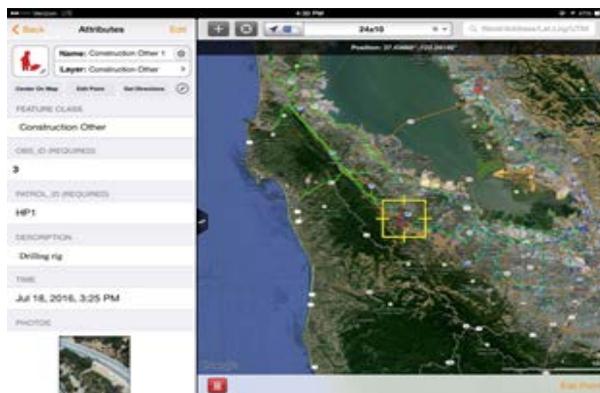


Figure 48 – Screenshot of iPad GIS application used by Aerial Patrol in monitoring potential excavation observations

4. SUPPORTIVE CONTROLS

As PG&E works to achieve its compliance culture vision, several programmatic controls are in place to help the organization meet its regulatory compliance obligations. Table 23 summarizes some of the programmatic controls that PG&E uses as a building block to create an effective compliance culture:

Table 23 – Compliance Controls

Building Quality Management (QM) –The QM group assesses and provides direct feedback on the work quality for PG&E’s important safety programs, including locate and mark, regulatory station maintenance, and as-built record development. [See Section: *Quality Management page 57*], and for a detailed program description, see **Attachment 19**.

Conducting Internal Audits (IA) – PG&E’s IA team performs arm’s length reviews for all of the company’s lines of business, including Gas Operations, and is responsible for assessing control adequacy.

Submitting Self-Reports (ALJ 274) – PG&E is committed to self-report compliance issues and to take prompt mitigative action. In total, PG&E filed 13 ALJ 274 reports in 2015.

Participating in Safety and Enforcement Division (SED) Inspections – In advance of SED inspections, PG&E self-evaluates gas divisions and districts and additional programs, such as Operator Qualification, Emergency Management and Integrity Management, and provides results to SED. PG&E’s assessors spent approximately 6,500 hours in 2015 identifying and supporting issue resolution. PG&E strives to resolve issues raised by self-evaluations within the same inspection cycle.

Performing Causal Analysis – Similar to the continuous improvement mechanism in PG&E’s Process Safety method, Causal Analyses are post-incident investigations that include an assessment for compliance failure. These analyses commonly identify root causes, and lead to recommendations to prevent or mitigate future reoccurrence. PG&E performed 13 causal analysis evaluations in 2015.

Evaluating National Transportation Safety Board (NTSB) Reports – The NTSB investigates all serious pipeline incidents. PG&E subject matter experts routinely review NTSB reports to learn from pipeline incidents. As a result, PG&E may adopt new approaches to addressing threats, change work procedures or develop new training.

Evaluating Pipeline and Hazardous Materials Safety Administration (PHMSA) Bulletins – PHMSA regularly issues safety advisories for pipeline operators. As new safety information comes to light at other gas companies in the US, PHMSA issues bulletins to help operators take preventative action. PG&E received, reviewed and acted on two bulletins in 2015.

As outlined in this Plan's Risk Management Process section, the Gas Operations Risk and Compliance Committee leads the organization's identification, prioritization and communication of the top operational risks and foundational compliance requirements to the gas business. The Committee's oversight role of the Gas Operations risk mitigation work is a critical contribution to PG&E's system of controls. The Committee is composed of senior leaders in the gas business up to and including the President of Gas Operations, and the Senior Vice President of Gas Operations at PG&E. The Committee prioritizes Gas Operations' risk and compliance activities and commitments. Additionally, the Committee reviews Internal Audit findings, regulatory compliance and audit results, and approves action plans to address compliance issues. Governance at this level is instrumental in surfacing trends and identifying best practices, and expanding implementation of successful and safe practices to the rest of the business, one of PG&E's many efforts to continually improve its gas business.

VII. CONTINUOUS IMPROVEMENT

Continuous Improvement is the mechanism through which PG&E continues to evolve from being reactive to proactive in the journey to Gas Safety Excellence. By continuously taking a critical eye to existing practices, and identifying the root cause of challenges that arise, PG&E can move to correct problems before they result in compliance violations or in harm to PG&E employees or the public. While continuous improvement is embedded in most PG&E procedures, a few programs are highlighted below.

1. QUALITY MANAGEMENT

Gas Operations achieved a number of significant quality milestones in 2015. One of the biggest accomplishments is the creation of the Quality Management System manual, which describes the quality vision, policy and framework within Gas Operations. In 2015, the Quality Management team:

- Established a Quality and Process Improvement Committee to oversee and provide implementation direction to the Quality Recommendations Response Plan and process improvement initiatives, including process management and controls.
- Transferred process and program auditing responsibilities to Internal Auditing for better alignment and to provide corporate oversight.
- Evaluated and performed gap analyses using different quality frameworks such as Malcolm Baldrige, ISO 9001 and ISO 29001 to identify improvement opportunities.
- QMS manual was approved for Gas Operations. QMS describes the quality vision, policy and framework and describes key business processes in place to achieve and sustain Gas Safety Excellence.
- 14 QM programs were reviewed and met the API 1173 certification requirements.
- QM performed 33,575 quality assessments in the field and office.

The fundamental principles in the Quality Management System leverage the “Plan, Do, Check, Act” (PDCA) framework (refer to Figure 49) that is instrumental to PG&E’s implementation of Gas Safety Excellence. PDCA is an iterative four-step management method used in business for the control and continuous improvement of processes and products. Just as a circle has no end, the PDCA cycle should be repeated again and again for continuous improvement.

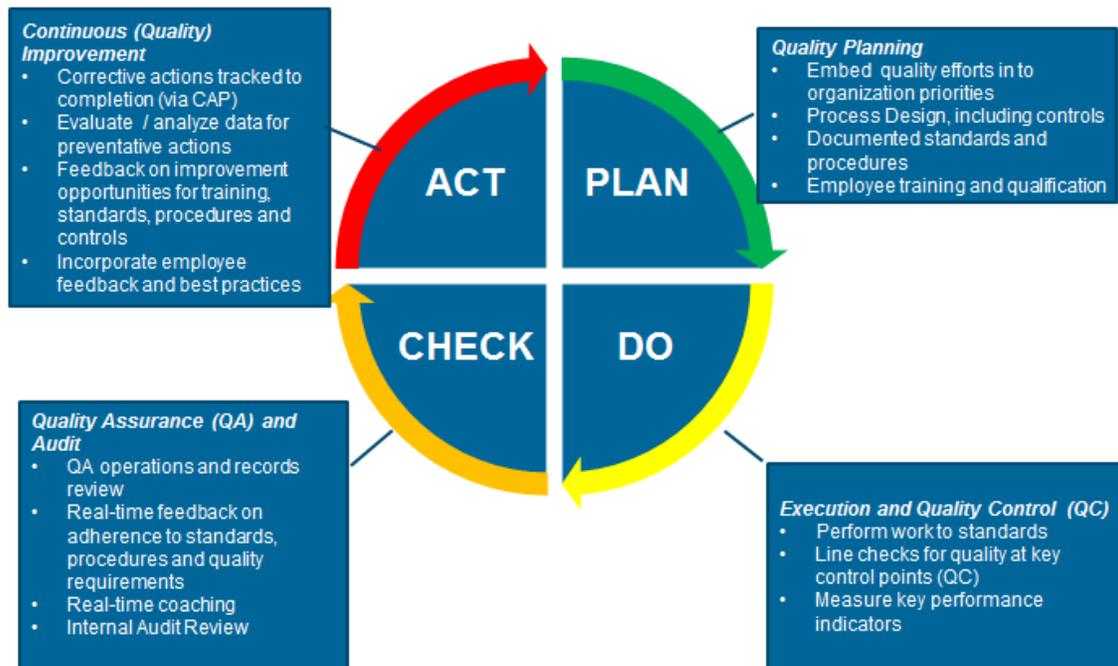


Figure 49 – The Quality Management Process

The Gas Quality Management organization is responsible for centralized quality assurance activities and helping others integrate quality control points into processes within Gas Operations. Quality Assurance activities include conducting quality assessments in the field and with recordkeeping either in real-time (as work is being performed) or after-the-fact. Both approaches allow for mentoring and coaching opportunities for the PG&E employees or contractors doing the work and ensure that necessary corrections are made. There are currently 14 active Quality Management programs as of 2015 which are shown in Table 24 below.

Table 24 – Quality Management Programs as of 2015	
Leak Survey	Post Repair Leak Survey
Locate & Mark	Distribution Construction
Distribution Re-dig	Transmission Construction
Field Service	Regulator Station Maintenance
Valve Maintenance	Rotary Meter Installation and Maintenance
Corrosion Control	Transmission and Distribution and Maintenance
Internal Records Review	Field Service Records Review

In 2015, Quality Management made tremendous progress in generating awareness and focus on quality across Gas Operations. Some of these achievements include incorporating quality into multiple department goals and developing a Quality Index metric to provide insights on quality for the key processes in Gas Operations. The Quality Index measures the collective performance of eight Quality Assessment programs representing Gas Operation’s higher risk areas. These eight programs are Transmission Construction, Distribution Construction, Locate and Mark, Leak Survey, Post Repair Leak Survey, Instrumentation and Regulation – Regulators, Instrumentation and Regulation – Valves, and Field Services – Gas Service Representative. The Quality Index performance for 2015 in Figure 50 shows an overall favorable trend in quality as the year progressed. The Quality Index started at 0.4 in quarter 1, improved to 0.6 and 0.8 in quarters 2 and 3, and finally ending the year at 0.9. Although the Quality Index target of 1.0 was not met in 2015, Gas Operations is on track to meet or exceed this target in 2016.

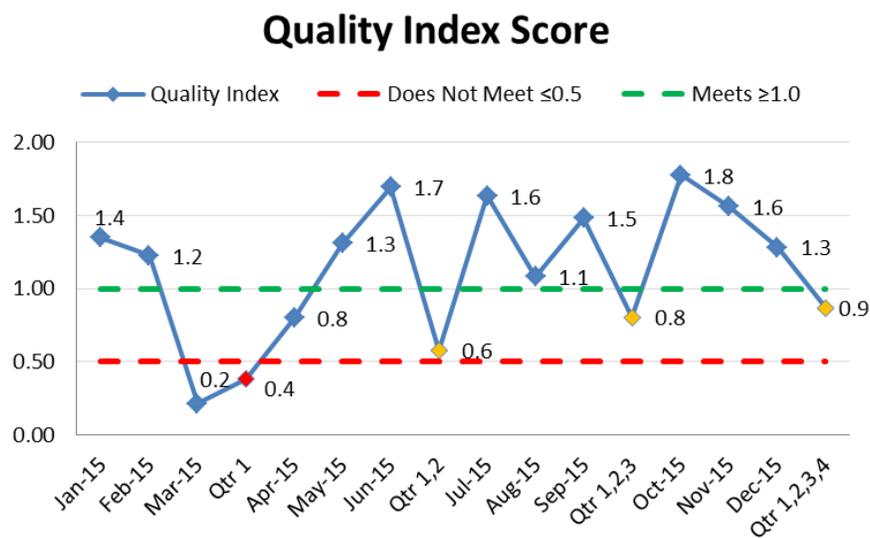


Figure 50 – Quality Index Score

2. RESEARCH AND DEVELOPMENT

Research and Development and Innovation identifies, adapts, qualifies and implements innovative solutions in the Gas Operations business to improve its performance measured in public and work safety, customer satisfaction, environmental impact, regulatory compliance, communication, and cost effectiveness.

The Research and Development and Innovation Program is embedded in Gas Operations through the continuous improvement process of Gas Safety Excellence and prioritized based on the results of the Risk Management Process, assuring that projects and innovations align with the most critical needs of the business. In this framework each Research and Development project is assessed using multiple

criteria that not only weighs its strengths and weaknesses to justify decisions but also defines the actions that must be engaged early in the life cycle to prepare its successful deployment. As a result, the Research and Development and Innovation Program includes more than 150 projects that balance short (one year) and long-term objectives (three to five years).

In order to optimize resource allocations, PG&E participates in numerous collaborative efforts through national and international Research and Development organizations such as PRCI, NYSEARCH, and Operations Technology Development (Gas Technology Institute). In addition, PG&E monitors and tests emerging technologies developed through PHMSA's collaborative Research and Development Program as well as the California Energy Commission, which assigns a specific budget to Gas Pipeline Integrity improvement within its Public Interest Energy Research Program. Two of PG&E's many Research and Development projects, the In-Line Inspection robot for unpiggable pipelines and the paperless as-built collection project are described to provide more detail on how the R&D contributes to improved asset knowledge.

In-Line Inspection Robot for Unpiggable Pipeline

The Explorer 30/36 is the largest platform of the Explorer series of robotic In-Line Inspection tools specifically made for unpiggable pipelines. Their ability to be inserted into live pipelines using portable launchers/receivers, to navigate sharp bends, diameter changes and valves independently of the flow and pressure of gas is a technological breakthrough for gas utilities to inspect



Figure 51 – 2013 – The Explorer 30/36 Robotic ILI Tool is Demonstrated in Fremont

sections of transmission pipelines that could not be accessed by traditional pigs in the past. The Explorer 30/36 robotic In-Line Inspection tool was equipped with a Magnetic Flux Leakage sensor allowing it to detect external corrosion pits, a laser-based tool to assess mechanical damage, and two high resolution cameras to produce imagery for additional integrity analysis.

Paperless As-built Data Collection

On December 11th, 2015, PG&E completed a six month field test where all information about pipes and fittings installed for new distribution projects was collected in real time in the ditch by construction crews simply scanning bar codes.

Crews also captured the precise location of each asset with a high performance GPS that were automatically combined with other information to create the complete record of the performed construction instantaneously. No direct data entry is required from workers, which eliminates errors and misinterpretations.

Based on the success of this proof of concept, PG&E is now exploring the deployment of such a solution across its distribution system. The ultimate goal is a paperless as-built process covering all aspects of pipeline construction to assure complete, accurate and traceable records made available to all as soon as assets are installed in the ground.



Figure 52 – PG&E Operators and R&D Team Members Reading Information From Bar Codes, GPS

3. ‘SUPER GAS OPERATIONS’

Super Gas Operations began in the summer of 2014 to address feedback from frontline employees about needed improvements in operations processes. Inaccurate information in SAP and incomplete job packages resulted in poor work planning and other inefficiency. Super Gas Operations set out to solve these problems. Super Gas Operations also supports PG&E’s commitment to becoming the safest and most reliable gas company in the country by enabling “the Right Work at the Right Time.”

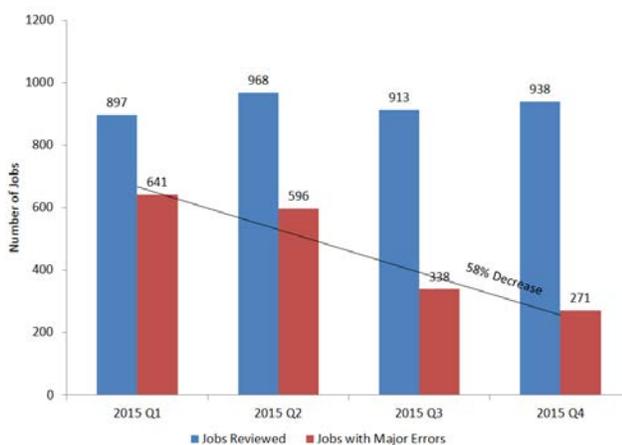


Figure 53 – Super Gas Operations Demonstrated a Steadily Decreasing Error Rate in Job Packages in 2015

Super Gas Operations helps PG&E teams to better plan the work, improve the flow of work, and increase visibility into a true rolling 90-day plan of “shovel-ready” work; thus allowing crews to increase their focus on safety and actual construction activities. Super Gas Operations will continue to drive safety improvements by implementing processes, roles and responsibilities, and performance management structures that enable consistent and standardized visibility to PG&E’s key Gas

Operations safety metrics. The program is scoped to conclude in 2018, bringing Lean Management design principles to process improvements in the remaining work streams across Gas Operations.

Super Gas Operations works to:

- Improve work visibility through clean data
- Provide Work Plan prioritized shovel-ready work
- Promote process consistency and lean performance management
- Provide tools and processes that allow for a continuous improvement mindset
- Improve timely and accurate job documentation

4. BENCHMARKING AND BEST PRACTICES

Benchmarking is an important step in PG&E's overall continuous improvement effort, and is used to identify industry best practices. Best practices include, but are not limited to, widely-recognized natural gas practices that directly enhance public and personnel safety over time. Benchmarking is one component of understanding what may constitute an industry best practice, and is accomplished by both formal and informal means. There may also be more than one single industry "best practice" in any given program area. Therefore, PG&E's best practice identification often begins with identifying a published industry standard that provides guidance and sets overall direction for a program or technical discipline and discussing with other utilities. When standards are not readily identifiable, PG&E may employ various methods, such as reaching out to industry associations, experts, and other utilities, to discuss best program approaches, and then develop detailed procedure manuals to document the practices. PG&E relies on various outlets for benchmarking best practices such as reviewing standards written by Subject Matter Experts and public agency publications, and participating in industry associations. How PG&E utilizes each of these outlets is described in the next sections.

a) STANDARDS WRITTEN BY SUBJECT MATTER EXPERTS

One informal benchmarking practice that PG&E pursues is identification and use of standards written and reviewed by SMEs. Sometimes these standards are referred to as "consensus" standards, meaning that the publisher believes that they represent proven practices in that particular field. In addition to seeking best practice standards that originate in the U.S., PG&E identifies international standards for best practices, including European and International Standards Organization. PG&E has adopted for use several European standards. In another example, PG&E pursued the certification of ISO 55000, the recently available international asset management standard, and has both achieved and sustained certification.

PG&E relies on associations such as the ASME (an association of more than 130,000 members in 158 countries) and the API (a national trade association representing the interests of the oil and natural gas industry) to facilitate the development of best practices, prescribe codes and standards for the

natural gas industry, to provide forums such as conferences and meetings for like members to learn about relevant best practices, publish best practice literature, industry reports, and relevant industry statistics, and to provide technical continuing education. Some of PG&E's foundational risk management and gas program activities follow ASME standards and API consensus standards that are referenced in code, such as B31.8S, Managing System Integrity of Pipeline Systems and RP 1162, Public Awareness Programs.

b) AGENCY PUBLICATIONS

PG&E reviews relevant agency documents to gain insight into what regulatory and investigation agencies view as best practices. PG&E incorporates input from previous proceedings and reviews, including the CPUC, the NTSB, PHMSA, and reviewers contracted by these entities.

As an example, PG&E has a procedure to ensure appropriate responses to PHMSA advisories and any proposed or final rulemaking notices from other regulatory agencies. The procedure expedites reviewing, assigning, and tracking of all Gas Transmission and Distribution related advisory bulletins and proposed or final rulemaking notices from any regulatory agency in a timely manner.

c) PEER ASSOCIATIONS

Benchmarking is performed with a variety of utility and non-utility entities to improve PG&E's understanding of how other companies manage various operational programs, including best practices related to safety. For instance, PG&E personnel learn about best practices from interacting with peers and industry experts in organizations such as the Interstate Natural Gas Association of America (INGAA), American Gas Association (AGA), NACE International (formerly known as the National Association of Corrosion Engineers), API, ASME, Southern Gas Association (SGA) and other organizations.

PG&E employees participate in and present at a variety of industry conferences. These conferences are gatherings of industry representatives with similar backgrounds to discuss best practices, review emerging practices,

Table 25 – PG&E AGA Committee Participation

BEST PRACTICES

- Program Coordinator
- Steering Committee Member

DISCUSSION GROUPS

- Compression Operations
- Damage Prevention
- GPS/GIS & Work Management Systems
- Management of Company Standards
- Pipeline Expansion
- Pipeline Safety Management System Management
- Pipeline Safety, Compliance, Oversight
- Quality Management Task Group
- TIMP Risk Models

OPERATIONS COMMITTEES

- Building Energy Codes & Standards Committee
- Corrosion Control Committee
- Distribution & Transmission Engineering
- Distribution Construction & Maintenance
- Distribution Measurement Committee
- Gas Control Committee
- Operating Section Managing Committee
- Operations Safety Regulatory Action Committee
- Plastic Materials Committee
- Process Safety Committee
- Safety and Occupational Health Committee
- Supplemental Gas Committee
- Transmission Measurement Committee
- Transmission Pipeline Operations Committee
- Underground Storage Committee
- Utility and Customer Field Services Committee

share operating information, and build networks for future best practice sharing. Some of the peer-to-peer associations PG&E participates in are described below in more detail.

d) AMERICAN GAS ASSOCIATION (AGA)

As part of PG&E's continuous improvement commitment to safety in Gas Operations, the company is an active member of the AGA. The AGA helps PG&E share, validate and learn about gas safety best practices through targeted Operating Committees and Discussion Groups with peer organizations (Table 25 – PG&E AGA Committee Membership List). For example, PG&E participated in the AGA SOS Survey Program by both distributing and responding to surveys with topic-specific information requests throughout the year and utilizes the data provided by other US utility gas companies.

e) INTERSTATE NATURAL GAS ASSOCIATION OF AMERICA (INGAA)

INGAA and the INGAA Foundation develop consensus guidelines and position papers based on the input of its members. PG&E considers these materials to constitute evidence of natural gas transmission pipeline companies "best practices" and are widely recognized in the industry as such. INGAA has a membership base that owns approximately 200,000 miles of natural gas pipeline in the U.S. PG&E relies on INGAA to facilitate the identification, development and sharing of best practice materials.

f) NATIONAL ASSOCIATION OF CORROSION ENGINEERS (NACE) INTERNATIONAL

PG&E also relies on NACE International to identify and develop standards, test methods and material recommendations that are widely regarded as best in the field of corrosion and specifically for Cathodic Protection and coatings. NACE International creates these materials through the subject matter expertise of its members. NACE International has over 28,000 members in over 100 countries.

g) WESTERN ENERGY INSTITUTE

WEI is the premier Western association of energy companies that implements strategic, member-driven forums, identifies critical industry issues and facilitates dynamic and timely employee development opportunities. WEI provides forums for exchanging timely information on critical industry issues, information about industry best practices and skills training. PG&E also participates on several committees.

h) ADDITIONAL BENCHMARKING EFFORTS

In addition to the numerous associations, PG&E also uses informal means of benchmarking including using the expertise brought to the Company by new-hires and contractors with industry experience, by attending trade conferences, and by information sharing with other utilities.

PG&E also uses benchmarking to facilitate continuous improvement. When possible, PG&E benchmarks metrics to understand performance against peers. Industry performance also informs target-setting. The following chart lists a few key safety metrics that PG&E benchmarks against other utilities:

Table 26 – Key Benchmarking Metrics Included in Business Performance Review or at the Short Term Incentive Plan Level	
PG&E’s Commitment to Safety	Measurement
Emergency Odor Response	Average response time
Year-End Grade 2 Leak Backlog	Per 1,000 miles of mains and services
Year-End Grade 3 Leak Backlog	Per 1,000 miles of mains and services
Lost Work Day Case Rate*	Lost work days per 200,00 hours worked
Third Party Dig-In Reduction	Number of dig-in incidents per 1,000 tickets

* *This measure is benchmarked at the company level.
Comparative data associated with these benchmarks may be protected by confidentiality or non-disclosure agreements. Please contact PG&E.*

VIII. CONCLUSION

The 2016 Gas Safety Plan Update demonstrates PG&E’s commitment and progress in implementing processes, programs and procedures to achieve its vision to becoming the safest and most reliable natural gas utility in the nation. The Gas Safety Excellence framework guides how PG&E operates, conducts, and manages all parts of its business by putting the safety of the public, PG&E’s customers, and PG&E’s employees and contractors at the heart of everything it does; investing in the reliability and integrity of its gas system; and, by continuously improving the effectiveness and affordability of its processes. PG&E has made continued progress in its journey to achieve Gas Safety Excellence, as measured by both tactical and aspirational longer term goals. In addition, PG&E continuously invests in its facilities, employees, technology, and operations to enhance the long term safety, reliability and affordability of its system.

IX. ENDNOTES

- 1** In October 2011, the California legislature signed into law SB 705, which declared “[i]t is the policy of the state that the commission and each gas corporation place safety of the public and gas corporation employees as the top priority.” SB 705 was codified as Public Utilities Code §§ 961 and 963(b)(3).
- 2** Session 1 is the first session of the Integrated Planning process in the year and includes an overview of each Line of Business’ strategy and goals over a 3-5 year timeline to mitigate the risks identified during Session D process. Session 2 is the second session and involves the work execution planning that provides the allocation of budget and resources to execute the required work for the following year to mitigate the risks identified during the Session D process.
- 3** 2015 weighted goals are 50% Safety, 25% Customer, and 25% Financial. In 2014, the weighted totals were: 40% Safety, 35% Customer, and 25% Financial.
- 4** American Petroleum Institute Recommended Practice Pipeline Safety Management System Requirements (API RP 1173) outline specific best practices for safe and effective pipeline operations underpinned by a healthy safety culture. For more information, please see **Attachment 20** – API RP 1173 Fact Sheet.
- 5** This system was designed based the elements of Process Safety developed by the Center for Chemical Process Safety, a branch of the American Institute of Chemical Engineers.
- 6** RC 14001 was developed by the American Chemistry Council, and is based on Responsible Care® Management System and ISO 14001 environmental management systems standard.
- 7** The Transmission Pipe asset family includes valves outside of station boundaries and not otherwise included in the Measurement and Control asset family, which are those valves defined in TD-4551S – Station Critical Documentation. An example of valves included in the Transmission Pipe asset family includes manually operated mainline valves.
- 8** As set forth in 49 Code of Federal Regulations Part 192, Subpart O.
- 9** Additionally, a more in-depth discussion of distribution Measurement and Control-related projects for which PG&E is requesting funding is provided in Exhibit (PG&E-3), Chapter 5 of the 2017 General Rate Case.
- 10** A more in-depth discussion of specific programs such as ongoing pipeline replacement programs, cross-bores and other distribution-related reliability programs are covered in Exhibit (PG&E-3), Chapter 4 of PG&E’s 2017 General Rate Case.
- 11** A more in depth discussion of specific programs such as regulator replacement, leak repair and atmospheric corrosion remediation can be found in Exhibit (PG&E-3), Chapter 6A of PG&E’s 2017 General Rate Case.
- 12** A USA ticket is the authorization to excavate issued by the 811 services PG&E and other utilities use. The ticket validates that all underground utilities have been appropriately marked at the excavation site. The ticket further provides special instructions to excavators, such as, “hand dig” or “stand-by required” when excavators dig around certain natural gas pipeline.
- 13** 49 CFR §192.614.
- 14** California Government Code §4216.
- 15** PG&E’s 2015-2018 hydrostatic testing goal is based on the CPUC’s 2015 Gas Transmission & Storage Rate Case Decision (D. 16-06-056).

- 16 Identified mileage does not include welds.
- 17 This program does not address the threats posed when natural gas pipelines cross active earthquake faults. Please refer to PG&E's Earthquake Fault Crossing Program.
- 18 Traditional In-Line Inspection is a term used to refer to In-Line Inspection tools that run via propulsion by the pressure and flows of the gas stream. Non-traditional In-Line Inspection methods are also being employed by PG&E under some circumstances where pressures and flows and/or pipeline lengths are too short to feasibly run traditional In-Line Inspection tools.
- 19 Tensile stress is when equal and opposite forces are applied on a body, in this case a pipeline.
- 20 See **Attachment 21** for the Leak Survey Process (TD 4110P-01).
- 21 R.15-01-008. Recommendations include a transition to a 3-year leak survey cycle in 2017. This decision is currently pending. See **Attachment 22** for the Order Instituting Rulemaking (OIR) on Leak Abatement and its recommendations.
- 22 General Order 112F (**See Attachment 23**).
- 23 Originated as a gas distribution pilot program in 2014, the Super Crew model an end-to-end process executed by a cross-functional team that travels around the service area to survey and repair leaks, utilizes Picarro Surveyor technology that is mounted on a vehicle and is 1,000 times more sensitive than other leak detection equipment.
- 24 In addition to Leak Survey recommendations, R. 15-01-008 includes acceleration of leak repairs. See **Attachment 22**.
- 25 2016 California Gas Report, Prepared by the California Gas and Electric Utilities.
- 26 American Gas Association, 2016: <http://playbook.aga.org/#p=42>.
- 27 "Lockout/tagout" refers to specific practices and procedures to safeguard employees from the unexpected energization or startup of machinery and equipment, or the release of hazardous energy during service or maintenance activities. This requires, in part, that a designated individual turns off and disconnects the machinery or equipment from its energy source(s) before performing service or maintenance and that the authorized employee(s) either lock or tag the energy-isolating device(s) to prevent the release of hazardous energy and take steps to verify that the energy has been isolated effectively. If the potential exists for the release of hazardous stored energy or for the reaccumulation of stored energy to a hazardous level, the employer must ensure that the employee(s) take steps to prevent injury that may result from the release of the stored energy.
- 28 This certification will be discussed in more detail in the 2017 Gas Safety Plan.
- 29 <http://www.nerc.com/pa/CI/CIPOutreach/GridEX/NERC%20GridEx%20III%20Report.pdf>
- 30 Volume 1 of the Gas Emergency Response Plan contains the Introduction, Emergency Organization and Responsibilities, Concept of Operations, Coordination and Communication, Performance Indicators, Training and Exercises, After Action Reports and Appendices A through E. Volume 2 contains Internal Gas Operations Resource Directory including PG&E personnel contact lists, communications information, logistics, materials, tools, and equipment for use during emergencies. Volume 1 of the 2015 version is provided as **Attachment 17**. The 2015 Gas Emergency Response Plan was published on December 31, 2015.
- 31 ASME B31-Q.

- 32** Mapping Advancement Program is a two year training program comprised of 17 Workstation Based Training modules to be completed in conjunction with on-the-job training that enables mappers to move from a Mapping Technician to a Senior Mapper.
- 33** NACE, formerly known as the National Association of Corrosion Engineers, is an international organization focused on developing industry standards for corrosion management, teaching best practices, and researching corrosion issues. NACE provides multiple certificate programs in a variety of corrosion management areas.

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XII. APPENDIX C – LIST OF ATTACHMENTS

- Attachment 1 – Board of Directors Nuclear, Operations and Safety Committee Charter
- Attachment 2 – Chairman’s Safety Council Charter
- Attachment 3 – PG&E’s Gas Asset Management Policy (TD-01)
- Attachment 4 – PG&E’s Strategic Asset Management Plan
- Attachment 5 – PG&E’s 2015-02 Gas Distribution Pipeline Safety Report and 2015-02 Gas Transmission Storage and Safety Report
- Attachment 6 – 2015 Gas Storage Asset Management Plan
- Attachment 7 – PG&E’s 2016 Gas Storage Safety Report
- Attachment 8 – 2015 Compression and Processing Asset Management Plan
- Attachment 9 – 2015 Transmission Pipe Asset Management Plan
- Attachment 10 – 2015 Measurement and Control Asset Management Plan
- Attachment 11 – 2015 Distribution Mains and Services Asset Management Plan
- Attachment 12 – 2015 Customer Connected Equipment Asset Management Plan
- Attachment 13 – 2015 Liquefied Natural Gas and Compressed Natural Gas Asset Management Plan
- Attachment 14 – Liquefied Natural Gas and Compressed Natural Gas Station Asset Management Plan
- Attachment 15 – 2015 MAOP Establishment Standard
- Attachment 16 – PG&E’s 2015 Control Room Management Standard (TD-4436S)
- Attachment 17 – 2015 Gas Emergency Response Plan
- Attachment 18 – PG&E’s 2015 Company Emergency Response Plan
- Attachment 19 – Gas Operations Quality Management System
- Attachment 20 – API RP 1173 Fact Sheet
- Attachment 21 – Leak Survey Process (TD 4110P-01)
- Attachment 22 – Order Instituting Rulemaking (R. 15-01-008) – Leak Abatement and Acceleration of Leak Repairs Recommendations
- Attachment 23 – General Order 112 F

APPENDIX B

(Appendix B consists of one (1) archival grade CD. The contents of the CD include Attachments 1 through 23 to Pacific Gas and Electric Company's 2016 Gas Safety Plan and Compliance Statement. The CD has been provided to the Commission's Docket Office for filing.)