

GP-1100 – Strategic Asset Management Plan

Gas Plan

Document Number: GP-1100
August 1, 2016

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1. Executive Summary

PG&E has drafted this Strategic Asset Management Plan (StAMP), which is the Gas Operations asset management strategy, to establish the approach PG&E is taking to managing its physical assets through the asset life cycle to achieve the desired future performance. This asset management strategy has been derived from the asset management policy and is aligned to both the corporate and Gas Operations strategy.

PG&E's Gas Operations asset management vision is to attain the optimum balance of asset risk, performance, and cost. This vision is accomplished through a fully engaged workforce, a clear understanding of asset condition based on high quality data, and a spirit of continual learning and improvement.

Achievement of this vision is delivered through activities associated with the strategic objectives drafted by each of the eight asset families:

1. Gas Storage
2. Transmission Pipe
3. Compression & Processing
4. Measurement & Control
5. LNG/CNG
6. Distribution Mains
7. Distribution Services
8. Customer Connected Equipment (CCE)

Each asset family has drafted a 5-year strategic plan to achieve the respective strategic objectives, which include a risk-based approach to managing the assets to reduce risk. These strategic objectives were drafted given the current regulatory and market environments in PG&E's service territory. However, there are several regulatory and market demand uncertainties that have the potential to impact these strategic objectives in the future.

In addition to the activities associated with the asset family strategic objectives, the asset families identified activities to further strengthen PG&E's gas asset management system by performing a self-assessment against the PAS-55 and ISO 55001 clauses. Several key activities were identified as high priority:

- Clarify and document asset management roles and responsibilities
- Develop and implement a communications plan for asset management
- Develop and implement formal asset management training
- Research data quality standards, perform data quality gap analysis, and develop data quality improvement roadmaps for all asset families
- Research life cycle costing analysis methods and perform life cycle costing analyses on all assets
- Develop a long-term investment plan for compression assets
- Develop and implement a framework for collecting benchmarking information and industry best practices to make this information available to all Gas Operations employees



- Develop and lead the Institute of Asset Management (IAM) Bay Area Branch to enhance knowledge of asset management in the region
- Maintain compliance with PAS 55 and ISO 55001

Activities to address all high priority gaps are currently underway or complete.

There are also several initiatives to strengthen PG&E's gas asset management system that have not yet begun or are in the early stages of development. These initiatives are included in a list of continuous improvement items. Examples of these items are:

- Identification and evaluation of interdependent infrastructure risks, which includes interdependencies between gas asset families as well as other PG&E lines of business and non-PG&E assets which have an interdependency with PG&E's gas assets
- Develop criteria for life cycle decision making and implement processes to increase proactive versus reactive asset decisions
- Identification of personnel implications of the asset management strategy
- Exploration of probabilistic risk approaches to better quantify risk
- Quantification of risk reduction

In an effort to remain on the path of continuous improvement, the self-assessment against the PAS and ISO standards will be refreshed annually with input from the various clause owners as well as the asset families. The subsequent roadmap will be refreshed accordingly along with this strategic plan.

2. Introduction

2.1 Scope and Purpose of this Document

PG&E has drafted this Strategic Asset Management Plan (StAMP), which is the Gas Operations asset management strategy, in accordance with Publicly Available Standard (PAS) 55 and International Standards Organization (ISO) 55001. The Gas Operations asset management strategy establishes the approach PG&E is taking to managing its physical assets through the asset life cycle to achieve the desired future performance. This asset management strategy has been derived from the asset management policy and is aligned to both the corporate and Gas Operations strategy. PG&E's asset management system conforms to the requirements that are found in both PAS 55 and ISO 55001 and includes the following key elements¹:

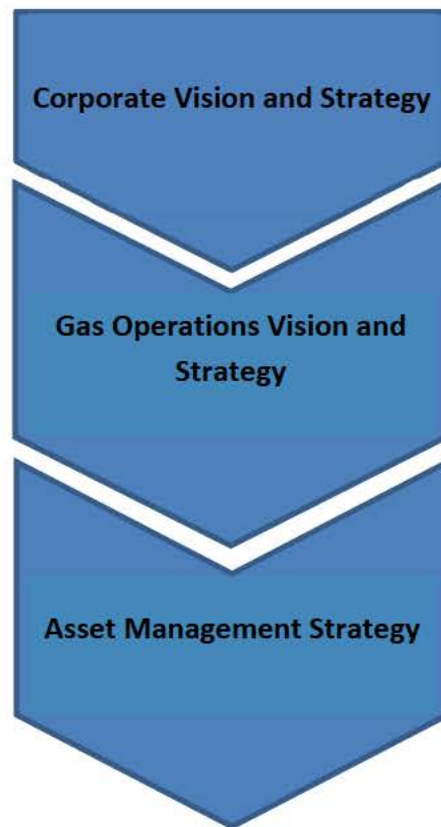
- Clearly defined organizational context;
- Leadership commitment and direction, and roles and responsibilities;
- Multi-level planning for assets and asset management;
- Support for effective management: resources (including competence), tools and information;
- Operational control of the management system and dependent asset systems;
- Evaluation of the performance of the management system and dependent asset systems;
- Improvement, including correction and prevention in a quality-process environment.

The asset management strategy will be reviewed annually to ensure it remains fit for purpose and to support continuous improvement of the asset management planning process. This review typically occurs after Session D, PG&E's risk evaluation period, and should:

- Focus on the overall performance of the asset management system not only forming the basis of asset management planning, but achieving the safety, reliability, affordability, and clean service objectives of Gas Operations and the Company;
- Establish new or updated asset management objectives for continual improvement, appropriate for the coming period;
- Consider the business planning process and the alignment of asset management planning;
- Confirm that the identified risks remain appropriate.

The diagram below shows the levels of the organization and depicts the need for consistency and alignment in the individual strategies and objectives at all levels.

¹ Excerpt from 'An Anatomy of Asset Management', Version 3; published by the Institute of Asset Management (IAM), December 2015.

Figure 1 – Levels of the Organization

The PG&E vision is to be “The safest and most reliable utility in the United States.” To achieve this vision, PG&E must consider the requirements of all of its key stakeholders. These stakeholders include customers, regulators/legislators, shareholders, employees/contractors, and suppliers.

The PG&E vision and strategy are delivered in Gas Operations through both line of sight goals and Gas Safety Excellence. Line of sight goals clearly define strategic actions that are intended to create alignment throughout Gas Operations and help to focus on the ‘right’ work through better informed decision making. It ensures engagement with all stakeholders to create an integrated approach towards a safety culture while continuously improving performance and meeting external obligations. Line of sight is about creating a clear connection between individual work goals, values and behaviors, the goals of the local work team, the goals of the overarching department, and the goals of Gas Operations and PG&E. Clarity that results from line of sight goals will create a more rewarding work environment through employee engagement, workforce planning, diversity and training.

2.2 Gas Safety Excellence

Gas Safety Excellence (GSE) is our strategic framework to help us achieve our vision of becoming the safest, most reliable gas company in the United States. It is PG&E’s safety management system designed to improve safety, manage risk, and drive continuous improvement. It provides guidance on how we operate, conduct, and manage all parts of our business.

GSE is demonstrated by:

- Putting safety and people at the heart of everything;
- Investing in the reliability and integrity of our gas system;
- Continuously improving the effectiveness and affordability of our processes.

Figure 2 – Gas Safety Excellence – Safety Management System



Safety Culture

A culture of safety at PG&E includes a systematic approach to safety incident investigations, an integrated Corrective Action Program to identify and rectify issues, and a non-punitive reporting of safety issues.

Asset Management

Asset management includes knowing the condition of our assets, understanding the risks to those assets and implementing asset risk reduction strategies, and optimizing asset life cycle decision making in pursuit of the asset management strategic objectives.

Process Safety

Process Safety includes identifying and analyzing low-frequency high-consequence hazards, operating within established parameters, reviewing safety for pre-startups, and embedding process safety principles in engineering and design standards.

In order to ensure continuous improvement in each of the areas of GSE, PG&E pursued certification aligned with each area, including American Petroleum Institute (API) Recommended Practice 1173, Responsible Care (RC) 14001, and PAS 55 / ISO 55001, respectively. As shown in Figure 3 above, there are areas of overlap among these standards. The requirements of these standards are the foundation of PG&E's safety management system. They guide the management of PG&E's large number of physical assets.



3. Current Asset Management System Overview

3.1 Asset Management System Organization

PG&E's asset management system is designed to comply with both PAS 55 and ISO 55001, however, the system is organizationally aligned with PAS 55. PAS 55 separates asset management into a number of different but related subjects, referred to as clauses. Each clause of PAS 55 is assigned an owner, who is accountable for ensuring continued compliance with their respective clause(s). The list of clause owner(s) for each clause can be found on the GSE website, <http://GSE>. Following are the PAS 55 clauses:

Table 1 – PAS 55 Clauses

PAS 55 Clause Number	PAS 55 Clause Name
4.2	Asset Management Policy
4.3.1, 4.3.2, 4.3.3	Asset Management Strategy, Objectives & Plans
4.3.4	Contingency Planning
4.4.1	Structure, Authority & Responsibilities
4.4.2	Outsourcing of Asset Management Activities
4.4.3	Training, Awareness & Competence
4.4.4	Communication, Participation & Consultation
4.4.5	Asset Management System Documentation
4.4.6	Information Management
4.4.7	Risk Management
4.4.8	Legal & Other Requirements
4.4.9	Management of Change
4.5.1	Life Cycle Activities
4.5.2	Tools, Facilities & Equipment
4.6.1	Performance & Condition Monitoring
4.6.2	Investigation of Asset-Related Failures, Incidents & Nonconformities
4.6.3	Evaluation of Compliance
4.6.4	Audit

PAS 55 Clause Number	PAS 55 Clause Name
4.6.5	Improvement Actions
4.6.6	Records
4.7	Management Review

3.2 Asset Overview

The assets have been divided into asset families in order to effectively and efficiently manage the PG&E gas system physical assets and develop a planned approach to work management and prioritization driven through a risk-informed approach. Each asset family has an asset family owner who is responsible for working with subject matter experts to identify and manage risks within their asset family and develop programs of work to mitigate the risk while optimizing cost and performance.

PG&E's gas business objectives are delivered through eight asset families which were approved by the Asset Management Steering Committee in August 2012:

1. Gas Storage
2. Transmission Pipe
3. Compression & Processing
4. Measurement & Control
5. LNG/CNG
6. Distribution Mains
7. Distribution Services
8. Customer Connected Equipment (CCE)

While the management of most asset families is described in individual asset management plans, the management of distribution mains and services is addressed in a single asset management plan due to the complementary risks and programs of work associated with the two asset families. The other exception is the management of assets in the LNG/CNG asset family, which is addressed in two separate asset management plans, LNG/CNG Portable and CNG Stations, since these two groups of assets have different risks and mitigation programs.

The management of these families of assets is essential to meet PG&E's obligations as a gas utility business. These families of assets need to be proactively managed throughout their lifecycles to avoid deterioration in safety or performance.

The asset families were formed based on groups of similar assets. A graphical description of the asset families and boundaries is shown below, followed by a tabular description of each asset family. Each asset family has its own set of strategic objectives and is subject to different physical asset risks and consequential business impacts. This structure builds into an asset management system where risks, performance, and investment can be optimized.



Figure 3 – Asset Family Assets and Boundaries

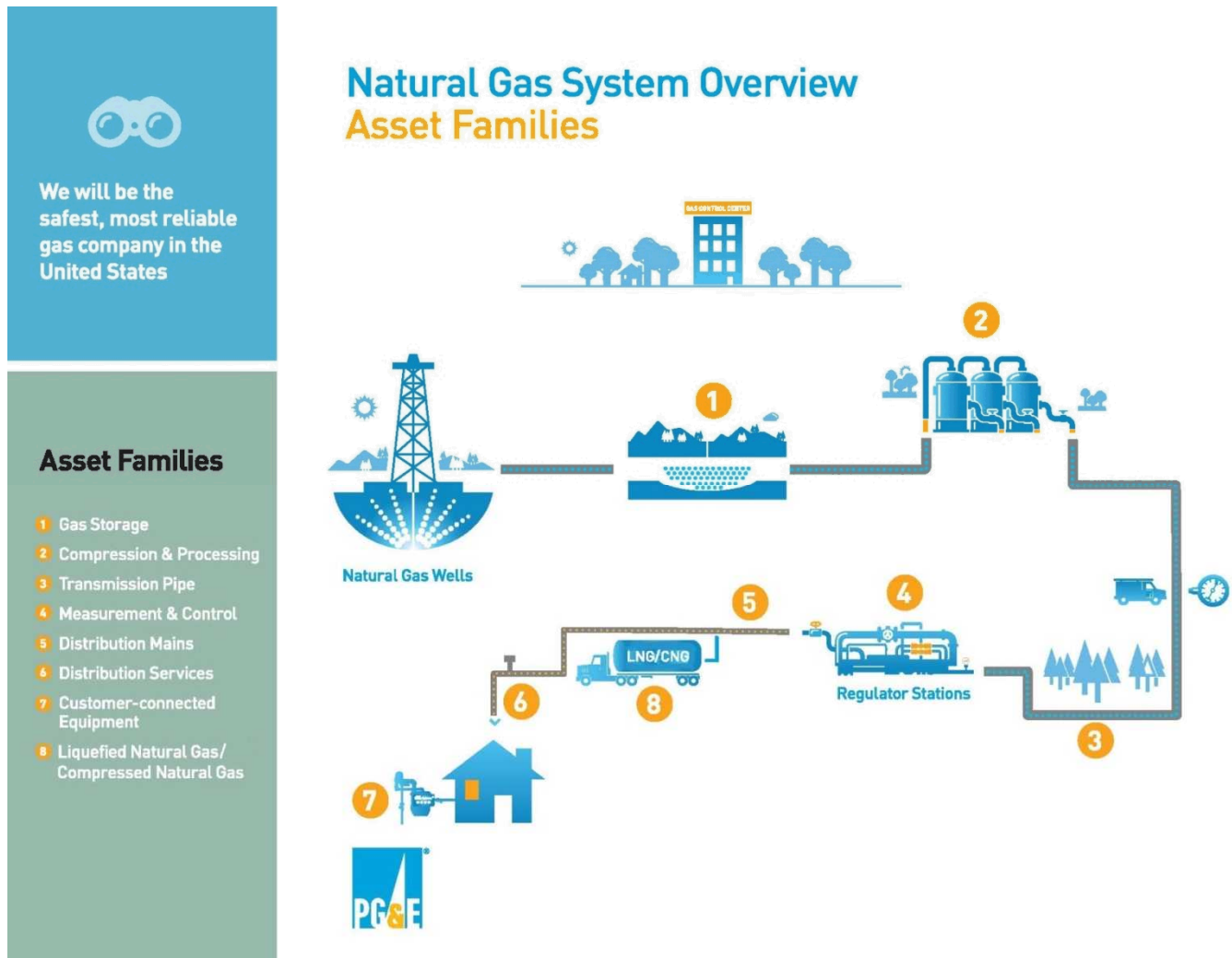




Table 2 – Asset Family Description

Asset Family	Description
Gas Storage	The Gas Storage Asset Family consists of three underground onshore gas storage fields: McDonald Island, Los Medanos and Pleasant Creek. PG&E also owns a 25% interest stake in Gill Ranch storage facility. Asset types include storage reservoirs, storage wells, transmission pipe, and surface equipment.
Transmission Pipe	The Transmission Pipe Asset Family consists of line pipe used in transporting natural gas as well as related major components, such as manually operated valves, fittings, casings, Supervisory Control and Data Acquisition (SCADA) systems, cathodic protection equipment, and drips, and transports gas from receipt points into PG&E's natural gas transmission system until the gas is delivered into PG&E's natural gas distribution system. It includes natural gas pipeline owned and operated by PG&E and the Standard Pacific transmission pipeline system. This asset family also includes gas gathering assets, which transport natural gas from independent storage provider facilities to the Transmission pipeline system.
Compression & Processing	The Compression & Processing Asset Family includes the compressor units and associated equipment installed at the nine transmission compressor stations; and compressor units and gas processing facilities installed at the three underground storage facilities. Additionally, this asset family includes gas odorizers and associated equipment installed system-wide.
Measurement & Control	The Measurement and Control Asset Family consists of pressure regulation facilities and includes transmission pressure regulation stations, terminals, distribution district regulation stations, distribution high pressure regulator sets, large customer meter sets, and gas quality monitoring equipment.
LNG / CNG ²	The LNG/CNG Asset Family is comprised of portable equipment for storing, transporting and delivering liquefied natural gas (LNG) and compressed natural gas (CNG), that supplements or substitutes for pipeline flowing supplies for short time periods. It also includes 32 fixed CNG stations that provide CNG as fuel to third party and PG&E motor vehicles and CNG to asset family CNG storage and transportation trailers; and four trailer mounted gas compressors and one portable compressor module used primarily as backup to CNG station compressors and to refill CNG storage and transportation trailers.
Distribution Mains ³	The Distribution Mains Asset Family is comprised of over 42,000 miles of pipeline plus associated valves, fittings, and related components that transport gas downstream of a distribution center (that serves three or more customers) or a Farm Tap (a transmission tap that serves one or two customers) to deliver natural gas to customer service lines throughout the service area. This asset family also includes all related SCADA systems and cathodic protection equipment.

² This asset family has been split into two asset management plans; LNG/CNG Portable Equipment and CNG Stations as the two types of assets carry different risks and mitigation programs.

³ Distribution mains and services form one asset management plan due to the complementary risks and programs of work associated with the two asset families.

Asset Family	Description
Distribution Services ⁴	The Distribution Services Asset Family is comprised of approximately 3.34 million service lines plus associated valves, fittings, and related components downstream of a distribution main that transports natural gas to customers. This asset family also includes all related cathodic protection equipment.
Customer Connected Equipment (CCE)	Customer connection equipment is comprised of over 4.4 million billing meters and associated regulators, over-protection devices, shut-off valves, and related components that connect the gas distribution service to the customers' residence or business.

3.3 Integrated Planning Process

PG&E has developed an annual Integrated Planning Process consisting of interconnected sessions that together form the framework of how PG&E will deliver on its most important strategic initiatives. These sessions drive the development and implementation of: the Line of Business (LOB) Risk and Compliance Mitigation plan (Session D); 5-year Operating Plan (Session 1); and 1-year Execution plan (Session 2).

Each LOB identifies and evaluates risks, specific to the LOB, as part of Session D. PG&E broadly categorizes its risks into two groups: (1) enterprise risks and (2) operational risks. The enterprise risks, as defined by the Enterprise and Operational Risk Management (EORM) team, are those that could have a catastrophic impact to the Company, as described by impact category Level 7 in the Company's Risk Evaluation Tool (RET) model. All enterprise risks are reported to the Board of Directors each year, where mitigation plans and status of mitigation efforts are discussed. Operational risks arise from assets, people, processes and technologies within specific LOBs within the company, such as the Gas Operations LOB. The operational risks are managed at the LOB level, with oversight provided by their respective Risk and Compliance Committees (RCCs). Risks are tracked in a company-wide risk register, a central repository where risk names, risk descriptions, risk scores (as determined by utilization of EORM's risk criteria), drivers, controls, mitigations, and other pertinent information are documented. The risk register is updated and refined as additional information is obtained and evaluated.

⁴ Distribution mains and services form one asset management plan due to the complementary risks and programs of work associated with the two asset families.



Figure 4 – Integrated Planning Process



August 26, 2014
Prepared for 2015 GTS Rate Case

3.3.1 Risk Refresh Process

Gas Operation's annual update of its Session D is performed through its Risk Refresh Process. This process provides a consistent and transparent method to identify, assess, rank, and identify programs to mitigate risk. Additionally, the process is directly aligned to the enterprise-wide Integrated Planning Process as discussed above. Gas Operations stakeholders through this process typically include:

- Asset Family Owners (including Gas System Operations organization)
- Asset Family Principals
- Gas Operations Risk Management team
- Gas Operations Process Owners
- EORM
- Gas Operations Senior Leadership

There are three principal, overarching potential events for Gas Operations: (1) loss of containment; (2) loss of supply and service; and (3) inadequate response and recovery:



- 1) **Loss of containment:** Event that gas will escape the system in an uncontrolled manner. PG&E's plan to mitigate this risk is driven by its operational risk assessment and integrity management programs including Distribution Integrity Management, Transmission Integrity Management, and Damage Prevention, among others. These programs focus on identifying ways to mitigate the risks associated with identified "threats," including corrosion, natural forces, excavation damage, other outside force damage, material, weld or joint failure, equipment failure, and incorrect operation.
- 2) **Loss of supply and service:** Event that PG&E will be unable to deliver natural gas to one or more customers. PG&E's plan to mitigate this risk is largely driven by Systems Operations and by the new Gas Control Center. Systems Operations is focusing on three risk mitigation drivers: (1) process; (2) visibility; and (3) control. PG&E will be instituting new processes and installing a significant number of additional monitoring and control points to mitigate these risks. In addition to Systems Operations, PG&E's efforts to mitigate this risk include investing in capacity, including new business, investing in training so that people execute work properly and investing in technology.
- 3) **Inadequate response and recover:** Event that, if there is an unplanned loss of containment or loss of supply or service, PG&E will not be able to adequately respond to make the situation safe. Mitigating this risk involves proper training, a robust emergency response plan including an established and structural Incident Command System (ICS), and coordination both internally as well as with external first response agencies.

Gas Operations uses these events as its basis to identify risks that may result across all asset families. Furthermore, as part of PG&E's evaluation of pipeline safety relative to Loss of Containment, potential threats are considered as outlined in the American Society of Mechanical Engineers (ASME) and the Code of Federal Regulations. This standard is specifically designed to provide the operator with the information necessary to develop and implement an effective pipeline integrity management program utilizing proven industry practices and processes. Gas Operations applies the processes and approaches within this Standard to each of the eight asset families, as appropriate.

Table 3 – ASME B31.8S Threat Categories

Threat Category	Description	Specific Threats
Time-dependent	Potentially increase over time	<ul style="list-style-type: none">• External Corrosion• Internal Corrosion• Stress Corrosion Cracking
Stable or "Resident"	Present, or potentially inherent in the pipeline, but do not grow over time or pose a threat unless influenced by another condition or failure mechanism	<ul style="list-style-type: none">• Manufacturing Related Defects• Welding / Fabrication related• Equipment

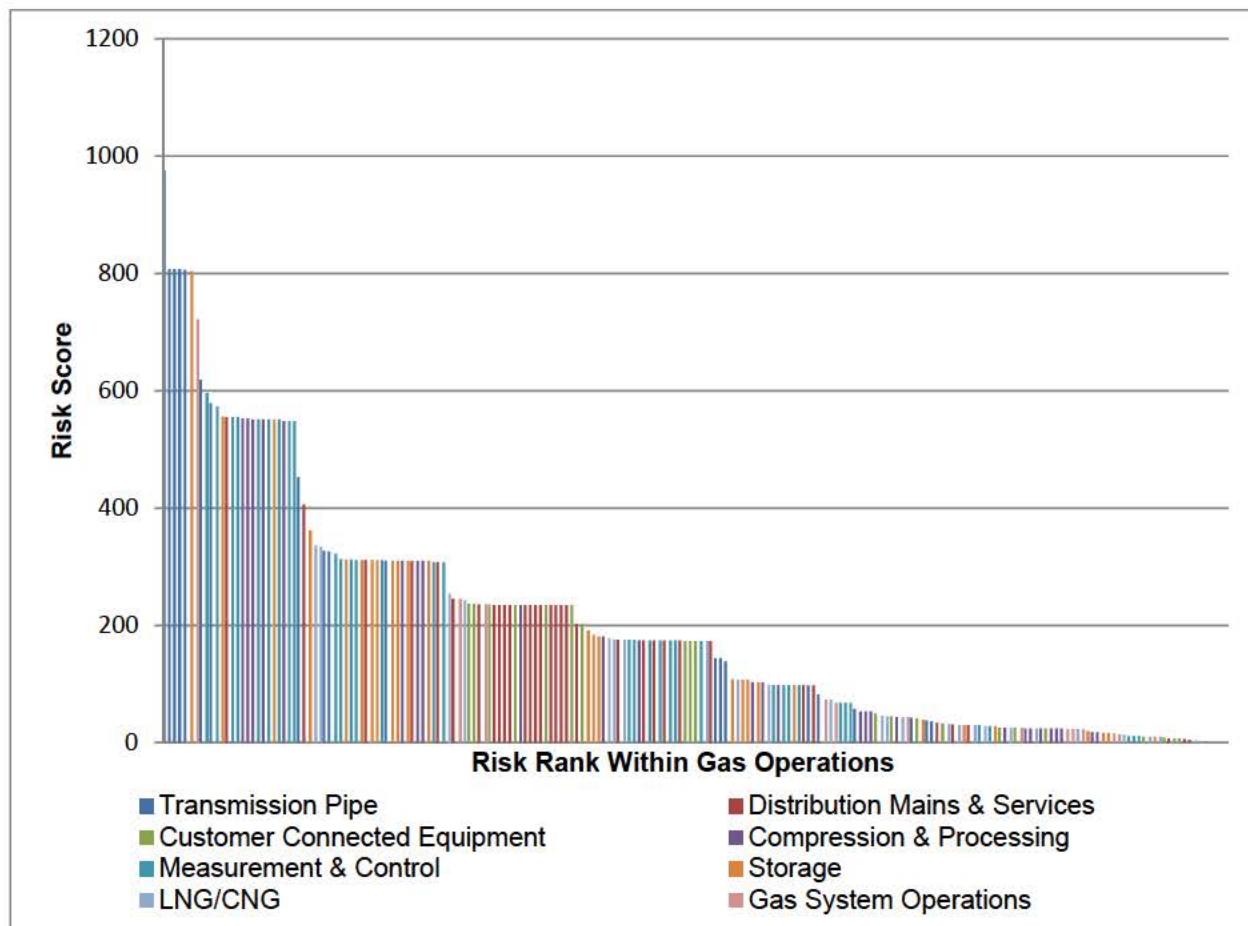


Threat Category	Description	Specific Threats
Time-Independent	Not influenced by time	<ul style="list-style-type: none">• Third Party / Mechanical Damage• Incorrect Operational procedure• Weather and Outside Forces

PG&E has an obligation to serve all customers located in its service area. Two significant threats to this are reliability (ability to meet customer demand) and emergency response (recovery from a major emergency or disaster).

The procedure for completing risk assessment, developing risk response strategy, and monitoring and reporting out on risk status and metrics is explained in RISK-5001P-01, Enterprise and Operational Risk Management Procedure. While the formal Integrated Planning Process is employed as described above, risks may also be identified, assessed, and addressed immediately, if warranted.

Figure 5 – Gas Operations Risk Profile





3.3.2 Mitigation Strategies and Controls

Once the risk register is assembled, risk mitigation strategies and controls are developed to address primary risk drivers, which are documented in each Asset Family's Threat Matrix. In addition, the Threat Matrix lists status for each mitigation measure to identify if the measure exceeds, partially meets, or does not meet industry best practice. Similarly, status is provided for each threat category to report the availability and quality of the asset data and adequacy of controls. The Asset Family Owners review their Threat Matrices on a rotating basis with senior Gas Operations management at monthly Risk and Compliance Committee meetings. The Threat Matrices are appended to the Session D materials. The Threat Matrix is the tool used by the AFOs and SMEs to illustrate the proposed programs and projects that are summarized in the Asset Management Plans.

3.3.3 Investment Planning Process

The executable investment plan is developed as part of Session 1, and Session 2 of the overall integrated planning process. The investment plans included in Session 1, the multi-year strategic plan, and Session 2, the multi-year execution plan, incorporate the risks identified during Session D and the mitigating programs identified in the Asset Management Plans. The investment plan included in Session 1 is preliminary and strategic and identifies funding at a program level, while the investment plan in Session 2 includes provides specific project opportunities and program refinements to inform execution. At the end of Session 1 and again at the end of Session 2, the PG&E executive team provides review and approval. In both Session 1 and Session 2, Investment Planning completes a risk-informed investment prioritization process that enables Gas Operations to prioritize investments across Asset Families to develop a plan that is driven by risk, incorporates other support costs, takes into account resource, execution, and system constraints, and considers affordability. The process involves the steps outlined below.

The first step is to classify the programs or projects to identify key work drivers. Once the work is classified, each program or project is assigned a Program and Project Risk Score based on likelihood and consequence scores for Safety, Environmental, and Reliability. The Program and Project risk scoring process uses a framework to assess consequence and likelihood that is aligned with the framework utilized in the development of the Gas Operations Risk Register. Investment Planning works with subject matter experts to discuss the key risks mitigated by a given program to determine the appropriate consequence and likelihood scores for programs. The Program and Project Risk Scores are validated and calibrated by Asset Family Owners. Based on the classification and calibrated risk scoring for projects or programs, Investment Planning builds a preliminary investment portfolio. Once the preliminary investment portfolio is compiled, Investment Planning collects information on constraints to analyze the ability to execute on the portfolio of investments. Constraints include resources required, availability of the gas system to handle the system clearances required, and work execution constraints such as permits, materials and contracts.

A series of meetings with the AFOs and their teams, the Investment Planning team and the Finance and IT Governance Committee, ensue to refine the portfolio over a several-month period, culminating in approval by the Gas Operations senior management team. Finally, the plan is submitted after Session 1 to the senior most levels of the company for review and discussion on risk, strategy, execution and

affordability. When refinements are then made during Session 2, an additional senior level review and approval are performed to finalize work for the coming year. Any necessary adjustments are made following the executive discussions before the final plan is approved.

For further information regarding the Gas Operations Integrated Planning Process, see the EORM Risk Management Standard.

3.3.4 Integrity Management

The risk management framework is fully integrated into PG&E's Integrated Planning Process to ensure risk informs mitigation strategies, which in turn drives the allocation of resources and investments. This framework complements risk assessment processes already in place via integrity management programs.

The following integrity management programs mitigate asset level risk:

Transmission Integrity Management Program (TIMP)

The TIMP program is a mature, well-defined program for assessing the risk related to different segments of pipe on the system and taking action to prevent or mitigate these risks. The approach for assessing risk is based on an assessment of likelihood and consequence of a leak or rupture, and uses the nine threats listed in the threat matrix to identify high-risk segments. While the TIMP risk management process contains many elements that overlap with risk assessment processes within the risk register, it is a separate process that considers threats to individual segments of pipe as opposed to the system as a whole.

Distribution Integrity Management Program (DIMP)

PG&E's Distribution Integrity Management Program, based on the federal Distribution Integrity Management Program (DIMP) regulation (49 Code of Federal Regulations (CFR) 192, subpart P, adopted December 4, 2009 at 74 FR 63929), evaluates and ranks the risks to the gas distribution system and proposes mitigations to address those risks. The risk process for this program gathers, reviews and integrates data to calculate risk, prioritizes preventive and mitigative measures, and monitors for operational changes that may require additional actions. Additional information about the DIMP Risk Management Process can be found in PG&E Procedure Number RMP-15 Revision 5 (Risk Management Procedure - Gas Distribution Integrity Management Program).

Facility Integrity Management Program (FIMP)

PG&E's Facility Integrity Management Program (FIMP), identifies, assess, and mitigates risks in order to reduce both the likelihood and consequences of gas transmission facility incidents. This includes facilities within the Measurement & Control and Compression & Processing asset families. While the approach for assessing risk within FIMP has similarities to TIMP/DIMP, it should be noted that an integrity management program for facilities is, by definition, quite different from an integrity management program (IMP) for a pipeline. These differences are driven by the nature of the assets to be managed (scope) and the resulting objectives (program purpose) for those assets as well as vastly differing life cycles.



Table 4 – Comparison of Facility and Pipe IM Programs⁵

Element	TIMP/DIMP	FIMP
Scope	Assets are relatively uniform (i.e., pipelines of varying grades, wall thickness, and diameter)	Disparate asset types
Program Goal	The safe environmentally responsible and reliable service of pipelines by working towards minimizing loss of containment events)	The safe environmentally responsible and reliable service of all pipeline system facilities, exclusive of pipeline, by ensuring control and containment of service fluids (e.g., gas, lube oil), and equipment meets or exceed design life given its intended purpose and actual operating conditions
Asset Life Cycle	Long life cycle	Life cycles vary significantly and assets with long life cycles often contain numerous components with short life cycles

⁵ Canadian Energy Pipeline Association, “Facilities Integrity Management Program Recommended Practice”, 1st Edition, May 2013

3.4 Asset Data

Data serves as the foundation of PG&E's asset management system by informing both the risk analysis and establishing the condition of the assets. The data have varying levels of availability, quality, and accessibility. Some of the data used include:

- Geospatial information (e.g. location, land use, geotechnical hazards, soil type, etc.)
- Preventive and corrective actions
- Root cause and direct cause analysis results
- Internal and external audit results
- Asset attribute data (e.g., age, diameter, wall thickness, coating type, etc.)
- Operations and maintenance history
- Manufacturing and construction practices
- Subject matter expertise
- Integrity assessment reports

While all asset families have some understanding of their data availability, quality, and accessibility, data maturity levels vary by asset family. This will continue to be an area of focus, not only to improve current circumstances, but in the future as data needs continue to change with improved technologies and understanding of our assets.

3.5 Strategic Objectives

The Company's vision is encompassed in seven strategic objectives:

- Public Safety, aspiring to zero public safety incidents
- Employee and Contractor Safety, achieving top quartile safety records
- Compliance, being 100% compliant with regulatory requirements
- Reliability, adhering to peak day performance during cold weather days and abnormal peak days
- Employee Engagement, achieving our corporate employee engagement goals
- Customer Satisfaction, achieving our utility customer satisfaction goals
- Efficiency, achieving first quartile controllable costs

In addition to the Company's strategic objectives set forth above, Gas Operations has its own set of strategic objectives:

Safe: Safety First / Find It and Fix It

- Identify the right work and improve the condition of our assets to eliminate all public safety incidents
- Drive sustainable implementation of process safety principles and practices across our operations
- Improve emergency preparedness and event response by engaging effectively with first responders and the public as one PG&E



- Promote a learning culture driven by systematic identification, rigorous evaluation and effective resolution of issues using Corrective Action Program (CAP)
- Reinforce safety culture and promote workforce wellness to finish each task injury and incident free

Reliable: Do the Right Work in the Right Way

- Plan, prioritize and execute the right work in the right way
- Implement a Quality Management System across our asset management, process management, work management and field execution processes

Compliance: Do the Right Thing

- Strengthen compliance programs to meet or exceed regulatory commitments
- Enhance process controls, records quality and continue to evolve the Gas Operations Records Management program maturity

Affordable: One Company, One Way

- Foster a process-driven organization by expanding the deployment of Super Gas Operations (SGO), Super Crew, Project Delivery System (PDS) and a centralized resource management model to drive work efficiency and do more work

Customer: Do Say Ratio = 1

- Rebuild trust and strengthen our relationships with customers, regulators, and local communities by always acting with integrity and through open, honest, transparent, and timely actions
- Strategically position gas business by selectively participating in new markets utilizing natural gas

People: Build Unity and Trust

- Support the success of our workforce with improved engagement, training and development, work processes, organizational effectiveness, tools and technology, while continuing to promote our partnership with the Engineers and Scientists of California (ESC) and International Brotherhood of Electrical Workers (IBEW)

These Gas Operations objectives are in turn supported by strategic objectives specific to each Gas Operations asset family, presented in the following set of tables.



Table 5 – Storage Asset Family Strategic Objectives

Gas Operations Objectives	Storage Asset Family Strategic Objective	Metric
Safe	<p>Asset Management - Effective and efficient asset management of gas storage facilities to identify the right work and to optimize the condition of our assets based on prioritization of risk.</p> <ul style="list-style-type: none"> Complete baseline well production casing assessments by 2025. Evaluate WELL (Well Integrity Management Program) gaps and enhancements by 2017. Assess work on transmission pipe through TIMP by 2017. GPOM, FIMP, and Reservoir Engineering identify, prioritize, and complete high risk open corrective work by 2017. 	<ul style="list-style-type: none"> Percent complete Percent complete Percent complete Percent complete
Safe	<p>Process Safety - Ensure safe design, operations, maintenance, and execution of right work through the integration of process safety in the gas storage facilities.</p> <ul style="list-style-type: none"> Continue Process Hazard Analysis (PHA) and Pre-Startup Safety Reviews (PSSR) on all well, surface equipment, and pipeline in the storage asset family. Conduct annual emergency response drills related to an uncontrolled flow from a storage well. 	<ul style="list-style-type: none"> Number of PHA and number of PSSR Annual drills complete
Affordable	<p>Facility Performance - Foster a culture of continuous improvement to optimize facility performance and risk reduction through design, operations, maintenance, and execution of the right work.</p> <ul style="list-style-type: none"> Gas Operations continue to evaluate proposed regulatory and legislative initiatives and its impact on facility performance and risk reduction mitigations. 	<ul style="list-style-type: none"> Percent complete
Reliable / Customer	<p>Capacity - Meet system and customer storage capacity needs by optimizing short and long-term performance through the use of management of change, operational and maintenance procedures, and workforce involvement.</p> <ul style="list-style-type: none"> Gas Operations continue to evaluate capacity requirements from storage to meet system needs and balancing risk reduction mitigations and reliability projects executed in 2017-2020. Continue to conduct full field maximum flow tests annually and publish results. Continue to conduct individual well flow tests annually and publish results. 	<ul style="list-style-type: none"> Percent complete Percent complete Percent complete
Compliance	<p>Compliance - Satisfy commitments with regard to Integrity Management, Accounting and Environmental regulations by achieving no violations through auditing processes and procedures.</p>	<ul style="list-style-type: none"> Number of Notices of Violation (NOVs)



Gas Operations Objectives	Storage Asset Family Strategic Objective	Metric
Safe	<p>Data - Improve data quality, availability, and accessibility to enhance risk analyses and decision-making, moving from solely Subject Matter Expert input to more data informed.</p> <ul style="list-style-type: none"> Develop and implement Gas Storage Asset Management Systems (GSAMS) and Asset Health Scorecard (AHS) data to enhance risk analysis on well assets for 2019 Session D. 	<ul style="list-style-type: none"> Percent complete
Safe / People	<p>Training - Recruit, retain, and train a qualified and motivated workforce (employees and contractors) through identifying the needed training and developing line of progression for the operation and maintenance of the storage facilities.</p> <ul style="list-style-type: none"> Identify, analyze, and implement 5-year training/development profiles for Reservoir Engineering by 2016. Review, revise, and develop operator training for storage well operations by 2018. 	<ul style="list-style-type: none"> Percent complete

Table 6 – Transmission Pipe Asset Family Strategic Objectives

Gas Operations Objectives	Transmission Pipe Asset Family Strategic Objective	Metric
Safe / Compliance	Apply integrity management principles to pipelines covering 100% of the population living along pipelines by 2030	Percent population associated with pipelines where Integrity Management principles have been applied
Safe / Compliance	Evaluate scope of and assess for Stress Corrosion Cracking (SCC) and Internal Corrosion (IC) risks based on improved data by 2019	% of segments assessed for SCC & IC (where these threats apply)
Compliance	Improve system data to enhance threat and risk analysis by executing the activities laid out in the Data Quality Improvement roadmap by 2020	Data Quality Improvement Roadmap implementation (% complete)
Compliance / Affordable	Manage assets proactively by planning integrity assessments 3 years in advance by 2017	Number of integrity assessments planned 3 years in advance
Safe / Reliable / Customer	Improve system capacity, reliability, meet 100% of design day conditions, and eliminate high risk manual operations and reduce medium risk manual operation in APD conditions by 2019	<ul style="list-style-type: none"> Number of high risk manual operations Number of medium risk manual operations Number of large transmission overpressure events



Gas Operations Objectives	Transmission Pipe Asset Family Strategic Objective	Metric
Safe / Reliable / Customer	Update PG&E's gas transmission SCADA assets and technology to improve recognition and response to significant transmission events by 2021	<ul style="list-style-type: none"> • Execution of backbone transmission SCADA visibility improvements (% complete) • Execution of local transmission SCADA visibility improvements (% complete)
Safe / Reliable / Compliance	Maintain a first quartile Damage Prevention program to further reduce transmission dig-ins	<ul style="list-style-type: none"> • Number of third-party gas dig-ins per 1,000 Underground Service Alert (USA) tags/tickets for gas

Table 7 – Compression & Processing Asset Family Strategic Objectives

Gas Operations Objective	Compression & Processing Asset Family Strategic Objective	Metric
Safe / Reliable / Affordable	Use Long-Term Compression Investment Plan information to inform 2018 GT&S Rate Case	Percent of plan development milestones met
Reliable	Reduce total number of compressor unscheduled shutdowns by 10% per year	Number of unscheduled outages compared to target
Safe	Evaluate 100% of Transmission Total Station Features by end of 2019	Number of features evaluated each year compared to target
Safe	Implement site-specific corrosion monitoring programs to enhance existing programs by 2018	Number of stations with fully implemented monitoring programs
Safe / Reliable	Apply Facility Integrity Management principles to (T and/or D) all stations by 2025	Percent of FIMP elements implemented at each station
Safe / Reliable	Complete Physical Security Upgrades at Critical Facilities by 2021	Percentage of milestones completed versus plan
Safe / Reliable	Critical documents defined by TD-4551S are completed by 2019	Percent complete of Critical Documents program



Table 8 – Measurement & Control Asset Family Strategic Objectives

Gas Operations Objective	Measurement & Control Asset Family Strategic Objective	Metric
All Transmission and Distribution Facilities		
Safe / Reliable	Apply Facility Integrity Management principles to all transmission and distribution stations by 2025	Percent complete of implementation of FIMP elements
Safe / Reliable	Eliminate large overpressure events by 2018	Number of large overpressure events per year
Safe	Complete physical security upgrades at critical facilities by 2021	Progress of program to perform security upgrades at critical facilities
Safe	Implement corrosion monitoring programs to enhance existing programs by 2018	Execution of execution of expense and capital programs to mitigate corrosion risks
Safe / Reliable	Develop action plan for the “extent of condition” issues by 2017	Number of CAP items related to construction or fabrication issues
Safe / Reliable	Accomplish Obsolescence Management by maintaining the turnover of the fleet to 60 years	Number of station re-builds
Safe / Reliable	Complete Critical documents defined by TD-4551S by 2019 for Transmission, and by 2024 for Distribution	Percent complete of Critical Documents project
Safe	Evaluate 100% of Transmission Total Station Features by end of 2019	Percent complete of Transmission Total Station Features
Safe / Reliable / Affordable	Implement program to improve visibility of condition and criticality of Distribution stations by 2018	Percent complete of condition assessment for Distribution stations

Table 9 – LNG/CNG (Portable) Asset Family Strategic Objectives and Metrics

Gas Operations Objective	LNG/CNG (Portable) Asset Family Strategic Objectives	Metrics
Safe / Reliable / Customer	Loss of Containment - Maintain a zero substantial loss of containment incident count.	Count of substantial loss of containment events
Safe / Reliable / Customer / Affordable	Equipment Integrity Management – Maintain equipment integrity so that safety, reliability and costs are at acceptable levels.	<ul style="list-style-type: none"> Count of substantial loss of containment events Injection operations equipment reliability Count of customer outages during injection operations



Gas Operations Objective	LNG/CNG (Portable) Asset Family Strategic Objectives	Metrics
Safe / Reliable / Affordable	Transportation Equipment - Reduce the number of transportation equipment near-hits and incidents by 90% over the period from 2014-2016.	<ul style="list-style-type: none"> Count of substantial loss of containment events Count of various equipment statistics, including equipment-related incidents/events and near hit incident/event counts
Safe / Compliance / Reliable / Affordable	Transportation Performance – Maintain a zero significant incident count.	<ul style="list-style-type: none"> Incident counts during transportation Near hit incident/event counts
Safe / Compliance / Reliable / People / Customer	Training/Procedures - Training, standards, and work procedures are in place by the end of 2016.	Training standards, work procedures percent complete
Reliable / Customer	Service Reliability - Maintain 99.9% reliability of customer service during injection operations.	Count of customer outage during injection operations
Reliable / Customer / Affordable	Service Availability – Maintain sufficient equipment and personnel capability to support pipeline construction and operations, as judged by hydrotesting, construction and operations management.	Sufficient equipment and personnel capability to support pipeline construction and operations, as judged by work streams that this AF supports

Table 10 – LNG/CNG (CNG Station) Asset Family Strategic Objectives and Metrics

Gas Operations Objective	LNG/CNG (CNG Station) Asset Family Strategic Objectives	Metrics
Safe / Reliable / Customer	Loss of Containment - Reduce substantial loss of containment events in stations by 50% from 2014 through 2017.	<ul style="list-style-type: none"> Count of drive-off events Count of substantial loss of containment events Percent of existing customers with valid, current vehicle fuel system inspection documentation in file Count of vandalism events Training standards, work procedures percent complete



Gas Operations Objective	LNG/CNG (CNG Station) Asset Family Strategic Objectives	Metrics
Safe / Reliable / Customer / Affordable	Obsolescence Management - Complete accelerated obsolescence management plan to reach a steady-state optimum pace.	<ul style="list-style-type: none"> Significant loss of containment counts during operations, accompanied by root cause analysis of any significant loss of containment Compressor and dispensing reliability Count of stations in 10 health level realm
Safe / Reliable / People	Training/Procedures – Training, standards, and work procedures are in place by the end of 2016.	Training standards, work procedures percent complete
Safe / Compliance / Reliable / Customer	Drive-Offs - Reduce drive-off events by 10% year-over-year	Count of drive-off events
Reliable / Customer	Station Availability - Maintain a station dispensing availability of 99.8% or better	Compressor and dispensing reliability
Safe / Compliance / People / Customer	Document Upgrade – Complete the first phase consisting of the most critical station documents by 12/31/16	<ul style="list-style-type: none"> Records management system percent complete Critical documents development percent complete Training standards, work procedures percent complete
Reliable / Customer / Affordable	Predictive Maintenance - Implement an industry best practice predictive maintenance program for compressors and high failure risk components by 12/31/17.	Program development percent complete
Compliance	Compliance – Maintain the existing continuous compliance review program and resolve issues as scheduled.	<ul style="list-style-type: none"> Records management system percent complete Count of notice of violations Count of significant findings from self-initiated audits by SMEs



Table 11 – Distribution Mains & Services Asset Family Strategic Objectives

Gas Operations Objective	Distribution Mains & Services Asset Family Strategic Objective	Metric
Compliance	Improve completeness and accuracy of digital data to support a data driven risk management process by 2020	Percent complete - Data driven risk management process
Compliance	Document all Abnormal Operating Conditions (AOCs) in the Work Management (WM) system by 2020	Percent of AOCs documented in the Work Management (WM) system
Safe	Identify all potential cross bores and remediate by 2023	Percent inspections complete Percent repairs completed within 90 days of identification
Safe	Reduce the size of emergency shutdown zones in areas that have significant exposure to external hazards by 2023	Number of Emergency shutdown zones reduced
Safe	Reduce 3 rd party dig-ins to first quartile by 2016	Number of 3rd party dig-ins per 1,000 USA tickets
Safe	Reduce major over-pressurization events to 0 by 2018	Number of distribution overpressure events
Reliable	Evaluate cathodic protection systems on steel distribution mains and services by 2018	Percent CPAs down greater than 90 days
Reliable	Maintain annual open leak backlog at less than 100 Grade 2 leaks	Number of Grade 2 leaks backlog
Safe / Reliable	Replace pipelines that cannot be cathodically protected within 5 years of identification	Miles of main replaced
Safe / Reliable	Achieve a replacement rate that limits asset age to 100 years by 2030	Miles of main replaced
Reliable / Customer	Achieve 100% SCADA visibility by 2020	Execution of distribution SCADA visibility improvements (% complete)



Table 12 – Customer Connected Equipment Asset Family Strategic Objectives

Gas Operations Objectives	Customer Connected Equipment Asset Family Strategic Objectives	Metric
Safe	Meet meter protection regulatory commitments by 2016	100% of meters within the program are protected
Safe	Implement a policy that minimizes the number of new inside meter sets installed during new reconstruction projects by 2017	Policy fully (100%) implemented by November 17, 2017
Reliable	Reach a steady state backlog of 12,000 meter set leaks by 2018	Number of backlog for meter set leaks
Reliable	Identify and remove problematic regulators by 2018	Number of Regulator Replacement
Reliable	Reduce unplanned meter change-outs by 2020	Percent reduction of unplanned meter change-outs
Reliable	Maintain meter accuracy within industry accepted standards	Customer bills adjusted after mailing

4. Achieving Asset Management Excellence

4.1 Asset Management Vision

PG&E's corporate vision,

To be the safest and most reliable utility in the United States,

is fully supported by the Gas Operations asset management vision:

To attain the optimum balance of asset risk, performance, and cost.

This vision is accomplished through a fully engaged workforce, a clear understanding of asset condition based on high quality data, and a spirit of continual learning and improvement.

4.2 Path to Achieving the Gas Operations Vision of Asset Management Excellence

In addition to the asset family strategic objectives presented in Section 3.4 of this document, additional activities were identified by the asset families who performed a self-assessment against the PAS and ISO clauses using guidance made available by the Institute of Asset Management⁶. The roadmap of activities that was the result of this self-assessment can be found in Appendix D of this document. A self-assessment using the IAM guidance will be refreshed annually with the help of the various clause owners and asset families.

To address the gaps identified in our asset management system, several key activities were identified as high priority⁷:

- Clarify and document asset management roles and responsibilities – COMPLETE
- Develop and implement a communications plan for asset management
- Develop and implement formal asset management training
- Research data quality standards, perform data quality gap analysis, and develop data quality improvement roadmaps for all asset families
- Research life cycle costing analysis methods and perform life cycle costing analyses on all assets
- Develop a long-term investment plan for compression assets – COMPLETE

⁶ Visit <http://theiam.org> for the Self Assessment Methodology tool

⁷ High priority actions are labeled as such in the roadmap activity column. High priority actions were determined using the following criteria:

- Activity is necessary for continued PAS 55/ISO-55001 compliance
- Additional maturity/roadmap activities are dependent upon the completion of the activity
- Activity addresses a major gap or clause that has a low maturity score
- Activity is not projected to be complete as of the publication date of the self-assessment results



- Develop and implement a framework for collecting benchmarking information and industry best practices to make this information available to all Gas Operations employees
- Develop and lead the Institute of Asset Management (IAM) Bay Area Branch to enhance knowledge of asset management in the region
- Maintain compliance with PAS 55 and ISO 55001

While most of these activities have completion dates, shown in the roadmap in Appendix D, some activities, including IAM Bay Area Branch involvement and compliance with PAS 55 and ISO 55001, are ongoing.

All improvement activities listed above shall be monitored by the Senior Director of Asset Knowledge and Integrity Management for continued progress. The Gas Safety Excellence team will support the Senior Director of AK&IM in the monitoring of compliance with PAS 55 and ISO 55001.

4.3 Uncertainties

PG&E is a regulated utility and should therefore be aware of proposed regulation and evaluate its potential impact on the business. In addition, the natural gas market impacts several aspects of PG&E's business. Changes in the regulatory or market environment have the potential to impact achievement of the asset family strategic objectives as well as the asset management system improvement activities outlined in Section 4.2. Furthermore, these same regulatory or market changes have the potential to shift the focus of the Gas Operations organization, resulting in new strategic objectives. Following are some of the regulatory and market changes that may influence implementation of PG&E's gas asset management system:

- California Senate Bill 1371 – Natural Gas: Leakage Abatement
- California Assembly Bill 32 – California Global Warming Solutions Act
- Division of Oil, Gas & Geothermal Resources (DOGGR) proposed regulation
- Pipeline & Hazardous Materials Safety Administration proposed rule making
- Climate change hazards, including drought, subsidence, flooding, sea level rise, temperature extremes
- Increased solar power usage
- Technological advancements

PG&E continues to monitor these and any new potential regulatory or market changes that may create challenges or opportunities for the business.

5. Roles & Responsibilities

PG&E's Gas asset management system involves all Gas Operations personnel in order to attain the optimum balance of cost, risk and performance of gas assets. However, some individuals in the Company hold specific responsibilities as described in Table 12, below. The following RACI matrix shows the roles and responsibilities associated with key asset management deliverables.

Table 13 – Key Asset Management Documentation RACI Matrix

Asset Management Documentation \ Role	President of Gas	Senior VP of Gas	VP of Asset & Risk Management	Senior Director, Asset Knowledge & Integrity Management	Senior Director, Enterprise Programs	Asset Family Owner (AFO)	Asset Family Principal	Principal Asset Management Specialist, Gas Operations	PAS 55 / ISO 55001 Clause Owner
Asset Management Policy (TD-01)	I	I	A	R	I	I	I	R	I
Strategic Asset Management Plan (GP-1100)	I	I	A	R	I	I	I	R	I
Asset Management Plans (GP-1101 through GP-1108)	I	I	A	A	I	R	R	I	I
Gas Operations Asset Management System Documentation (TD-4060S)	I	I	I	A	I	I	I	R	I



Table 14 – Asset Management System Roles & Responsibilities

Role	Asset Management System Responsibilities	Asset Management Competencies
President of Gas	<ul style="list-style-type: none">• Serve as Champion for the Gas Asset Management System within Gas Operations and Company• Support Gas Asset Management System• Review and approve Asset Management Policy	<ul style="list-style-type: none">• Understand:<ul style="list-style-type: none">○ The organization's strategic plan○ The organization's risk management framework○ Legislative and regulatory frameworks○ Relevant developments in the business environment and the changes these cause in stakeholder expectations○ The impact of changing economic and stakeholder expectations on the long term management of assets
Senior Vice President of Gas	<ul style="list-style-type: none">• Support Gas Asset Management System• Review and approve Asset Management Policy• Help shape asset management culture	<ul style="list-style-type: none">• Understand:<ul style="list-style-type: none">○ The organization's strategic plan○ The organization's risk management framework○ Legislative and regulatory frameworks○ Relevant developments in the business environment and the changes these cause in stakeholder expectations○ The impact of changing economic and stakeholder expectations on the long term management of assets
Vice President, Asset & Risk Management	<ul style="list-style-type: none">• Support Gas Asset Management System• Review and approve Asset Management Policy, Strategic Asset Management Plan, and individual asset family Asset Management Plans• Help shape asset management culture• Review and approve Integrated Planning Process materials	<ul style="list-style-type: none">• Understand:<ul style="list-style-type: none">○ The organization's strategic plan○ The organization's risk management framework○ Legislative and regulatory frameworks○ Relevant developments in the business environment and the changes these cause in stakeholder expectations○ The impact of changing economic and stakeholder expectations on the long term management of assets



Role	Asset Management System Responsibilities	Asset Management Competencies
Senior Director, Asset Knowledge & Integrity Management	<ul style="list-style-type: none">• Provide direction on strategic vision of asset management system• Review and approve Asset Management Policy, Strategic Asset Management Plan, individual asset family Asset Management Plans, and Gas Asset Management Documentation Standard (TD-4060S)• Provide direction on implementing the asset management strategy• Support Gas Operations in understanding asset management principles of proactively managing assets throughout the asset life cycle• Support development of asset management teams• Help shape asset management culture• Review and approve Integrated Planning Process materials	<ul style="list-style-type: none">• Understand:<ul style="list-style-type: none">○ The organization's strategic plan○ The organization's risk management framework○ Legislative and regulatory frameworks○ How Gas Operations AM strategies support business goals○ AM strategies and how these are reflected in AM objectives and plans○ Asset management decision-making: capital investment, operations and maintenance, lifecycle cost and value optimization, resourcing strategy and optimization, shutdowns and outage strategy and optimization, ageing assets strategy○ The inter-relationship of business and AM processes○ Relevant developments in the business environment and their impact on stakeholder expectations○ The effect of stakeholder expectations on AM plans○ The impact of changing economic/stakeholder expectations on day-to-day management and long term management of assets○ The concept and importance of culture as applied to organizations○ Values, assumptions and behaviors that are consistent, and inconsistent, with PG&E's vision and strategy
Senior Director, Enterprise Programs	<ul style="list-style-type: none">• Facilitate audits and surveillance visits with third party auditors and certifying bodies	<ul style="list-style-type: none">• Understand:<ul style="list-style-type: none">○ How Gas Operations AM strategies support business goals○ AM strategies and how these are reflected in AM objectives and plans○ The inter-relationship of business and AM processes



Role	Asset Management System Responsibilities	Asset Management Competencies
Asset Family Owner (AFO)	<ul style="list-style-type: none">• Provide direction on strategic vision for asset family• Support development of strategic vision of asset management system• Review and approve Asset Management Plan(s)• Understand risks associated with assets in asset family• Provide direction in development of materials for Integrated Planning Process• Appraise investment options for the asset family• Support application of whole life cycle costing principles within the asset family• Approve business cases for creation or acquisition of assets within the asset family• Support rationalization and optimization of assets within the asset family• Approve renewal or decommissioning of assets within the asset family• Review progress and performance against asset family strategic objectives• Help define asset information requirements• Provide direction in asset management information system specification, selection, and integration	<ul style="list-style-type: none">• Understand:<ul style="list-style-type: none">○ The organization's strategic plan○ The organization's risk management framework○ Legislative and regulatory frameworks○ How Gas Operations AM strategies support business goals○ AM strategies and how these are reflected in AM objectives and plans○ Asset management decision-making: capital investment, operations and maintenance, lifecycle cost and value optimization, resourcing strategy and optimization, shutdowns and outage strategy and optimization, ageing assets strategy○ The inter-relationship of business and AM processes○ Relevant developments in the business environment and their impact on stakeholder expectations○ The effect of stakeholder expectations on AM plans○ The impact of changing economic/stakeholder expectations on day-to-day management and long term management of assets○ The importance of identifying how future planning can be improved○ Asset information strategic requirements



Role	Asset Management System Responsibilities	Asset Management Competencies
Asset Family Principal	<ul style="list-style-type: none">• Support development of strategic vision for asset family• Revise and maintain Asset Management Plan(s)• Understand risks associated with assets in asset family and support AFO in understanding risks• Develop materials for Integrated Planning Process• Support appraisal of investment options for the asset family• Support application of whole life cycle costing principles within the asset family• Support rationalization and optimization of assets within the asset family• Monitor and review progress and performance against asset family strategic objectives• Help define asset information requirements• Support asset management information system specification, selection, and integration	<ul style="list-style-type: none">• Understand:<ul style="list-style-type: none">○ The organization's strategic plan○ The organization's risk management framework○ Legislative and regulatory frameworks○ How Gas Operations AM strategies support business goals○ AM strategies and how these are reflected in AM objectives and plans○ Asset management decision-making: capital investment, operations and maintenance, lifecycle cost and value optimization, resourcing strategy and optimization, shutdowns and outage strategy and optimization, ageing assets strategy○ The inter-relationship of business and AM processes○ Relevant developments in the business environment and their impact on stakeholder expectations○ The effect of stakeholder expectations on AM plans○ The impact of changing economic/stakeholder expectations on day-to-day management and long term management of assets○ The importance of identifying how future planning can be improved○ Asset information strategic requirements



Role	Asset Management System Responsibilities	Asset Management Competencies
Principal Asset Management Specialist, Gas Operations	<ul style="list-style-type: none">• Develop strategic vision of asset management system• Review and maintain Strategic Asset Management Plan, Asset Management Policy, and Gas Asset Management Documentation Standard (TD-4060S)• Facilitate revision of individual asset family Asset Management Plans and review for consistency• Work with others to implement the asset management strategy• Support Gas Operations in understanding asset management principles of proactively managing assets throughout the asset life cycle• Develop asset management teams• Help shape asset management culture through implementation of asset management communications plan• Facilitate improved understanding of asset management techniques in asset families through benchmarking and research of relevant books, articles, trainings• Engage in international, national, regional, and local asset management communities	<ul style="list-style-type: none">• Understand:<ul style="list-style-type: none">○ The organization's strategic plan○ The organization's risk management framework○ Legislative and regulatory frameworks○ How Gas Operations AM strategies support business goals○ AM strategies and how these are reflected in AM objectives and plans○ Asset management decision-making: capital investment, operations and maintenance, lifecycle cost and value optimization, resourcing strategy and optimization, shutdowns and outage strategy and optimization, ageing assets strategy○ The inter-relationship of business and AM processes○ Relevant developments in the business environment and their impact on stakeholder expectations○ The effect of stakeholder expectations on AM plans○ The impact of changing economic/stakeholder expectations on day-to-day management and long term management of assets○ The importance of identifying how future planning can be improved○ Asset information strategic requirements○ Investment appraisal and optimization techniques○ Methods and techniques for cost and performance analysis



Role	Asset Management System Responsibilities	Asset Management Competencies
PAS 55 / ISO 55001 Clause Owner	<ul style="list-style-type: none">• Support Gas Operations in understanding asset management principles of proactively managing assets throughout the asset life cycle• Ensure compliance with relevant PAS 55 and ISO 55001 clause(s)	<ul style="list-style-type: none">• Understand:<ul style="list-style-type: none">○ The organization's strategic plan○ Legislative and regulatory frameworks○ How Gas Operations AM strategies support business goals○ AM strategies and how these are reflected in AM objectives and plans○ Asset management decision-making: capital investment, operations and maintenance, lifecycle cost and value optimization, resourcing strategy and optimization, shutdowns and outage strategy and optimization, ageing assets strategy○ The inter-relationship of business and AM processes○ The impact of changing economic/stakeholder expectations on day-to-day management and long term management of assets○ The importance of identifying how future planning can be improved



6. Continuous Improvement Opportunities

Development of some areas in the asset management strategy and plans is incomplete and therefore still in progress. These are considered areas of continuous improvement. The following is a list of examples of key areas of improvement applicable to the asset families:

- Management of change evaluation for asset management system organizational transition to ISO 55001 alignment
- Strengthening engagement from asset management system stakeholders
- Shared or multiple asset family risk identification and evaluation
- Interdependent infrastructure risk identification and evaluation (includes PG&E and non-PG&E assets which have an interdependency with PG&E's gas assets)
- Formalize the process for identifying risks throughout the asset life cycle
- Develop criteria for life cycle decision making
- Development of the asset health scorecard and asset criticality
- Identification of financial risks to the business through utilization of the risk matrix
- Improved data capture, quality and availability
- Identification of personnel implications of the asset management strategy
- Continue developing linkage between Session D (risk evaluation) and Sessions 1 and 2 (investment planning)
- Work with EORM to continue improvement of the Risk Evaluation Tool and associated scoring criteria and standardize Session D materials
- Develop method to account for "unknowns" (e.g. effectiveness of controls) associated with risks as well as "knowns" (e.g. data)
- Consider the effect of current mitigations in potentially creating additional risks
- Exploration of probabilistic risk approaches to better quantify risk
- Quantification of risk reduction
- Benchmarking

These are areas that will continue to evolve and improve as more thorough data sets and understanding of asset condition are developed over time.

APPENDICES



A. Change Log

The following table summarizes revisions since the previous publication of GP-1100: Asset Management Strategy & Objectives, Revision 2, 8/18/2015.

Table 15 – Strategic Asset Management Plan Change Log

Section	Change	Reason for Change	Implication of Change
Document Name	Changed name of document to Strategic Asset Management Plan	Consistent with how PG&E and asset management community refer to this plan	Ensure all related documents reflect this change
Entire Plan	Reformatted structure and added content	Consistent with leaders in asset management community	
Entire Plan	Moved all guidance for Asset Management Plan development to Appendix C	Body of this plan focuses on asset management strategy	Communicate new location of guidance to Asset Families



B. Related Documents

The following table lists documents associated with this strategic asset management plan.

Table 16 – Related Documents

Related document	Document Number / Description	Link
Gas Asset Management Policy	TD-01	TD-01
Strategic Asset Management Plan	GP-1100	Gas Safety Plans / Asset Management
Distribution Mains and Services Asset Management Plan	GP-1102	
Customer Connected Equipment Asset Management Plan	GP-1103	
Measurement and Control Asset Management Plan	GP-1104	
Compression and Processing Asset Management Plan	GP-1105	
LNG/CNG Portable Supplies Asset Management Plan	GP-1106	
CNG Station Asset Management Plan	GP-1107	
Gas Storage Asset Management Plan	GP-1108	

C. Asset Management Plan Structure

Each Asset Family shall author and maintain an Asset Management Plan, which specifies the activities, resources, responsibilities and timescales for each asset family to implement PG&E's asset management strategy and deliver the asset management objectives across the following life cycle activities: a) creation, acquisition or enhancement of assets; b) utilization of assets; c) maintenance of assets; d) decommissioning and/or disposal of assets.

The plan shall be developed with a 5-year planning horizon to align with the Gas Operations 5-year financial outlook and be updated annually. It shall describe the physical assets included in the asset family, the current condition and desired future state of the assets, the key risks associated with the asset family, and the investments planned or in progress to mitigate and reduce these risks. Beyond the physical assets, the plan shall consider the impact on support areas such as human resources, training, guidance documents, and technology.

This appendix provides guidance for the development of the Asset Management Plans, in an effort to maintain consistency among each of the Plans.

Each asset management plan shall be structured in the following manner⁸:

1. Executive Summary (limited to only a few pages)
 - 1.1. Asset Overview
 - 1.2. Strategic Objectives
 - 1.3. Asset and Data Condition
 - 1.4. Key Risks
 - 1.5. High Level Program Overview
2. Asset Inventory and Condition Overview
 - 2.1. Asset Overview⁹
 - 2.2. Asset Inventory¹⁰ and Condition¹¹

⁸ This structure is intended to be a general guide to assist in providing consistency. Slight deviations may exist due to the specific needs of the asset family.

⁹ Each individual asset management plan should include the following information relative to asset overview:

- A map indicating overall location of assets within the PG&E service territory
- A brief description of the major assets (components or facilities) included in the asset family

¹⁰ Each individual asset management plan should include the following information relative to asset inventory:

- A description indicating an inventory of each major asset included in the asset family

¹¹ Each individual asset management plan should address the following relative to current asset condition to the extent information is available:

- Existing condition or risk models for each asset type
- Current condition results for each asset type
- Data sources, quality and assessability for each asset type
- Desired condition for each asset type



3. Threats and Risks
 - 3.1. Threat and Risk Identification¹²
 - 3.2. Integrity Management Programs
4. Desired State, Strategic Objectives, Programs and Risk Mitigations
 - 4.1. Strategic Objectives, Programs and Mitigations Alignment¹³
 - 4.2. Programs and Mitigations Overview¹⁴
5. Areas for Continuous Improvement ¹⁵
6. Related Information (Mandatory Appendices)

Appendices shall be included in each asset management plan as appropriate to capture pertinent data that further describes the status and activities for the asset family. They include:

- A. Related Documents: This should include a list of key reference documents, including other asset management plans, risk policies, asset management policies, and other pertinent references.
- B. Threat Matrix and Key Threats: The outcome of Session D should be provided in the form of threat matrices for the specific asset family.
- C. Asset Family Risks: The list of asset family risks from Session D should be presented in tabular format from highest to lowest risks.
- D. Stakeholder Roles and Responsibilities Matrix: Each asset family plan should include the general stakeholder roles and responsibilities matrix. This matrix is the same for all asset management plans.
- E. Summary of Integrated Programs: A tabular summary of the programs of work contained within this asset management plan that are relevant to and documented in other asset family asset

¹² Each individual asset management plan should include the following information relative to risk and threat identification:

- Table of threats
- Description of how threats apply to the asset family
- Table of key risks from Risk Register for the asset family

¹³ Each asset family plan shall incorporate a table that provides the asset family strategic objectives aligned with the seven Gas Operations strategic objectives

¹⁴ Each asset management plan shall include programs and mitigations designed to meet the seven strategic objectives. The specific information required is:

- Table showing mitigation programs against the asset family strategic objectives. This table is a matrix identifying which objectives are impacted by the various mitigation programs
- Table identifying each program and risk mitigation including program name, risks mitigated, timeframe, desired outcome and brief scope description for the program.

¹⁵ Each asset management plan shall include a list of continuous improvement activities that are applicable to the asset family.



management plans. The table highlights which programs are applicable to multiple asset families. This table is the same for all asset management plans.

- F. Glossary of Acronyms and Abbreviations: This appendix should include a list of acronyms appropriate to the asset families. To the extent possible, this glossary should be common to all asset management plans.
- G. Change Log: A change log should be provided which identifies the following information:
 - 1. Section of asset management plan affected
 - 2. Description of the change
 - 3. Reason for the change
 - 4. Implication of the change

Other Appendices: As appropriate for each asset management plan, additional information may be provided to explain the specific asset family strategy, current condition, results, and other data.

Asset management plans shall provide a reference to compliance with the Strategic Asset Management Plan or list any differences, where appropriate. The asset management plan(s) shall be communicated to all relevant stakeholders to the level of detail appropriate to their participation or business interests in the delivery of the plan(s). Due to the diverse range of information needs of stakeholders, references to documentation should be included where more comprehensive information of asset risks, mitigations, and management programs can be found while briefly addressed in the asset management plan.



D. Asset Management System Roadmap

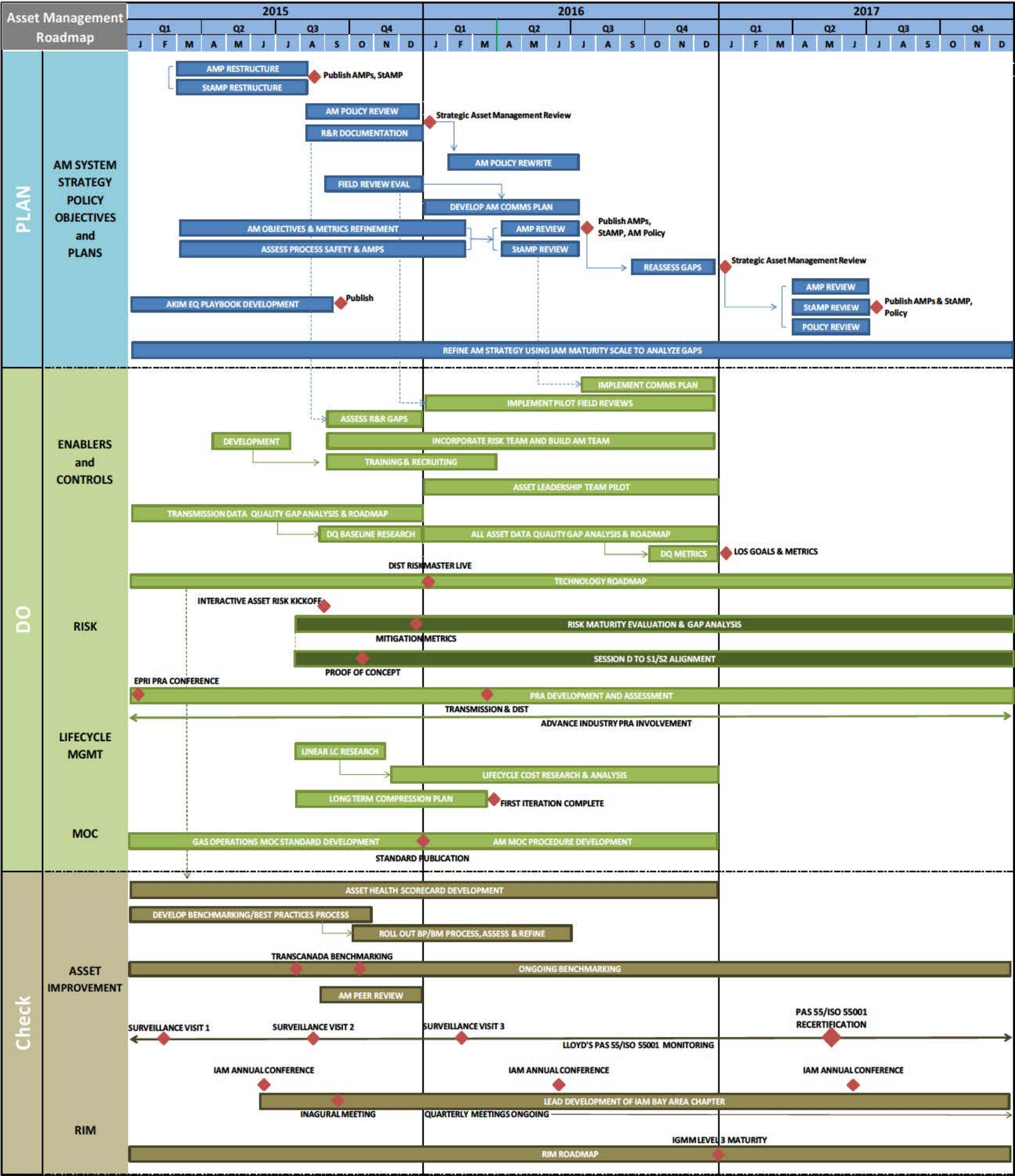
After completion of the maturity assessment and gap analysis, a strategic asset management Roadmap was created to address the identified gaps. Roadmap activities were identified through systematic benchmarking, best practices research and internal SME discussion. Some of the internal and external benchmarking parties included:

- Institute of Asset Management
- Minnesota Department of Transportation
- London-Heathrow Airport
- Network Rail
- PG&E Electric Operations
- PG&E Power Generation (Hydro)

Several other initiatives are underway internally at PG&E in the spirit of continuous improvement and many of these roadmaps have projects and programs that influence asset management maturity. Therefore, this roadmap was developed to complement other existing roadmaps, such as the Records and Information Management & Technology roadmaps, which are referenced in this roadmap. The Asset Management roadmap can be seen below.

The roadmap can also be found on the Gas Asset Management webpage (<http://GAM>).

Figure 6 – Gas Operations Asset Management Roadmap, 2015



E. 2016 Risk Refresh Process

As the Gas Operations risk management framework continued to improve year of year, the 2016 Risk Refresh Process followed a similar process to prior years in its evaluation of the risk register by evaluating available information gathered throughout the year, from various sources such as, process hazard assessments Corrective Action Program, operations maintenance forms, internal audit, and SME input. The Gas Operations annual risk management process is aligned to the EORM process. Details of the process can be found in the Enterprise and Operational Risk Management Process, RISK-5001P-01. The Gas Operations Risk Management process can be categorized into four major steps: (i) Integrity Asset Threat Classification; (ii) Risk Identification and Evaluation; (iii) Risk Response; (iv) Risk Monitoring and Reporting. Additional details on these steps can be found in the 2017 GRC Testimony, Exhibit 3 Chapter 3.

2016 Risk Refresh Process Improvements

Although Gas Operations risk management process is aligned to the EORM procedure, there were two primary improvements performed in the 2016 Risk Refresh Process:

1. Risk Drive Roll-Up Methodology
2. External SME Independent Review

Previously, Gas Operations evaluated their risks using the enterprise tools at a more granular level than other LOBs. The first Gas Operations risk register developed in 2013 included 87 risks, then 200 risks in 2014, and 221 risks in 2015. The level of granularity by which risks are identified and evaluated reflect an increase in maturity in the Gas Operations Risk Management Framework.

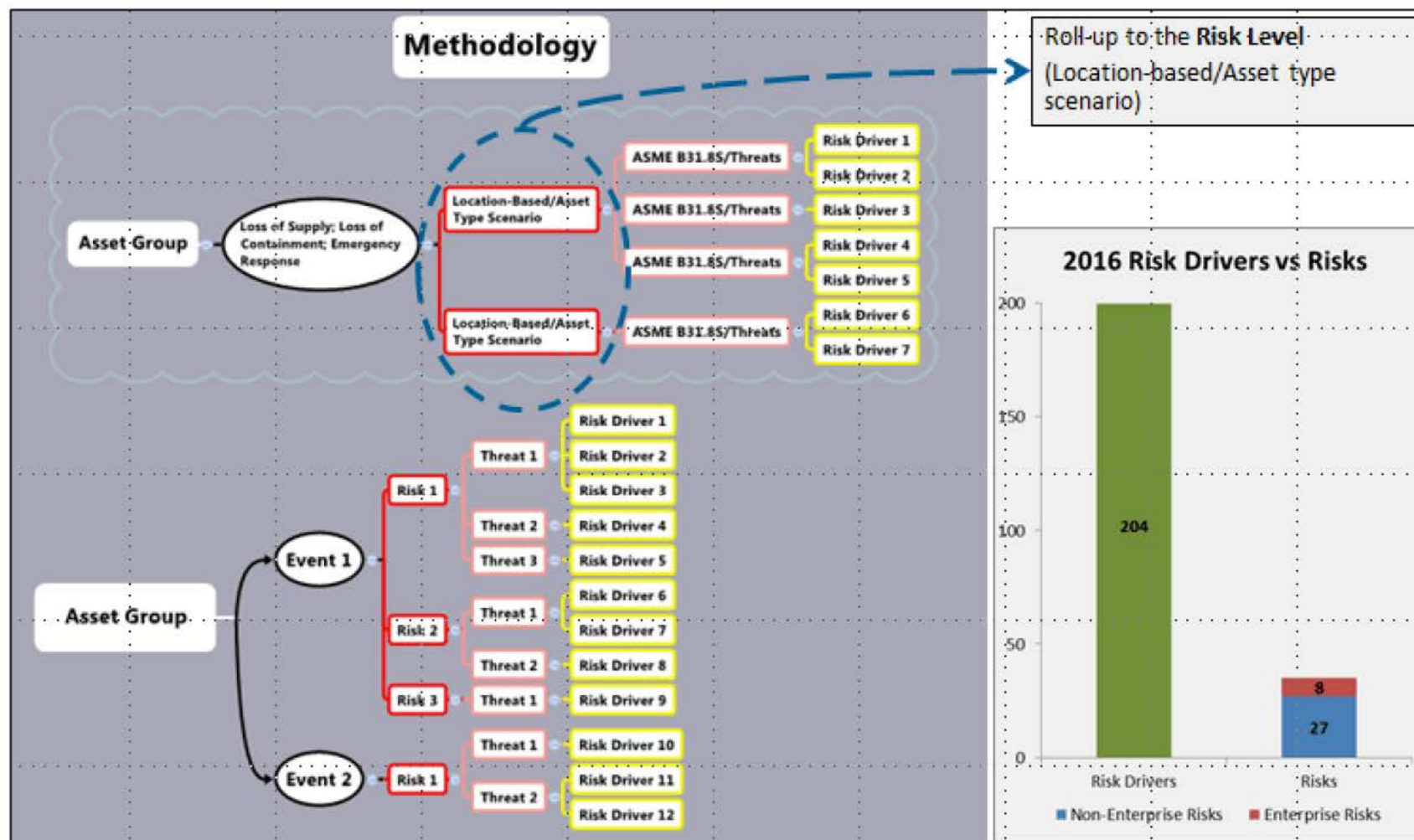
However, the increased granularity relative to other LOBs made enterprise calibrations problematic across the company. Gas Operations risks were more specific and acute relative to other LOBs, who were identifying risks at a higher level. As a result, in 2016, Gas Operations developed and implemented a Risk Roll-Up Methodology that can aggregate and categorize the granular risks in order to enable a more consistent calibration at the enterprise level. The granular risks that Gas Operations had previously identified were labeled as “Risk Drivers” and the grouped risks that they roll into are labeled as Rolled-Up Risks.

It is important to note that this methodology is not a quantitative roll-up but rather a qualitative roll-up. Gas Operation’s logic of the roll-up follows the process below:

1. Group all risk drivers by ASME B31.8s threat categories
2. Determine the risk location or asset risk scenario
3. Determine the event-based risk (e.g., Transmission Pipeline Failure – Rupture with Ignition)

The risk driver with the highest risk score was used to represent the event-based risk. The figure below displays a visual representation of the methodology Gas Operations used to roll up all of its 2016 risks across the asset families.

Figure 7 – Visual Representation of Gas Operations Roll-Up Methodology



Additional information on the impact of the risk roll-up for the 2016 risk register can be found below.

Another improvement over the 2015 Risk Refresh Process was to introduce external subject matter experts (SMEs) to perform independent reviews of each asset family's risk register. The external SMEs were asked to review the asset family risk registers, identify any gaps in terms of risks on the risk register, and determine if the risk scores and rankings were reasonable from an industry perspective. The feedback provided by the SMEs was incorporated in the results of the risk identification and evaluation process. The external SMEs provided an unbiased validation of the asset family risk registers.

Table 17 – Risk Register Refresh Third Party Subject Matter Experts (SMEs)

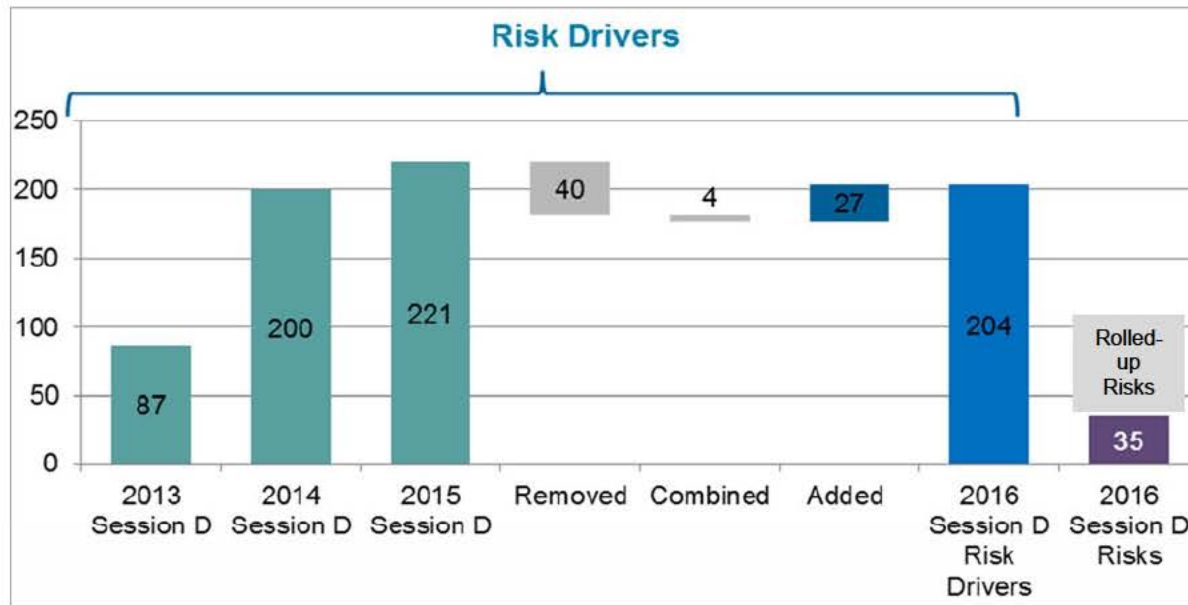
Asset Family	Consultant/SME	Company
Transmission Pipe	Mark Hereth	Process Improvement Consultants, LLC
Distribution Mains & Services	Richard Sanders	RES Services, LLC
Customer Connected Equipment	Richard Sanders	RES Services, LLC
Measurement & Control and Compression & Processing	Jim Witte	Southwest Research Institute (SWRI)
	Nathan Poerner	Southwest Research Institute (SWRI)
LNG/CNG	Daniel Cantieri	Independent Consultant
	David Eppler	Eppler Logistics
	Brent Kreighbaum	Eppler Logistics
Storage	Mike Whims	Michael J. Whims Consulting, LLC

2016 Risk Refresh Process Results

The 2016 risk refresh process began with the evaluation of the 221 risks on the 2015 Session D risk register. Upon evaluation for the 2016 process, 40 risk drivers were removed, 4 risk drivers were combined, and 27 risk drivers were added resulting in 204 risk drivers. Then the Risk Roll-Up methodology described above was applied, resulting in grouping the 204 risk drivers into 35 rolled-up risks.



Figure 8 – Risk Register Changes, 2013 to 2016



The development of the 2016 risk register was calibrated at 4 levels throughout the risk refresh process. These calibration sessions review the risk registers at various levels to ensure consistent application of the risk taxonomy and for reasonableness.

Table 18 – Risk Score Calibration Sessions

Calibration Session	Participants	Date
Intra-asset family/ intra-risk group	AFOs, asset family principals, risk management, risk owners, internal and/or external subject matter experts	
Across risk owners	AFOs, asset family principals, risk management, risk owners, internal subject matter experts, Senior Director of Asset Knowledge and Integrity Management, Vice President of Asset and Risk Management, Vice President of Gas Engineering and Design, Senior Director of Gas System Operations, Senior Director of Transmission & Distribution Construction	November 9, 2015 November 19, 2015
Across lines of business	Enterprise Operational Risk Management team, all LOB risk management teams	December 3, 2015 January 7, 2016 February 4, 2016
Officer Calibration across lines of business	Officers with expertise in each consequence category	January 19, 2016



The 2016 Session D meeting was concluded on March 3-4, 2016. Gas Operation's 35 Rolled-Up risks included 7 Enterprise Risks.

Table 19 – Gas Operations Enterprise Risks

Rank	Enterprise Risk
1	Transmission Pipeline Failure – Rupture with Ignition
2	Natural Gas Storage Failure – Loss of Containment with Ignition at Storage Facility
3	Failure to Maintain Capacity for System Demands
4	Measurement & Control Failure – Release of Gas with Ignition Downstream
5	Measurement & Control Failure – Release of Gas with Ignition at M&C Facility
6	Construction Defect with Release of Gas with Ignition on Distribution Facility
7	Compression & Processing Failure – Release of Gas with Ignition at Manned Processing Facility