



GP-1106 - LNG/CNG Portable Supply Asset Management Plan

Gas Plan

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1. Executive Summary

This asset management plan (AMP) provides an assessment of condition and risk of the portable Line of Business (LoB) of the LNG/CNG portable asset family (AF) and includes a program plan detailing risk mitigations based on strategic objectives and asset maintenance, applied over the life cycle of the assets.

The plan is developed with a five-year planning horizon to align with the Gas Operations five-year financial outlook and is updated annually. It describes the physical assets included in this 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 considers the impact on support areas such as training and guidance documents.

This AMP is consistent with the Asset Management Strategy and Objectives plan, the guidance document for the development of AMPs.

1.1. Asset Overview

The physical assets of this AF consist of approximately 200 portable units that store liquefied natural gas (LNG) and compressed natural gas (CNG) and can be transported over highways on trailers. This equipment is used by PG&E to supplement or substitute for pipeline flowing supplies. Also included is roughly another 25 trailers with equipment used to vaporize LNG or warm CNG for delivery to pipeline systems, and to control the pressure of both LNG and CNG to levels suitable for the receiving pipeline systems.

1.2. Strategic Objectives

Gas Operations sets annual corporate Line of Sight (LoS) goals that cascade throughout the organization. AF objectives are created using these LoS goals as a framework and developed both from a bottom-up and top-down approach. After analyzing asset risk and condition within the LoS framework, the 2015 portable strategic asset objectives developed are as follows. Alignment with LoS goals is presented in Section 4.

1. **Loss of Containment** - Maintain a zero significant loss of containment incident count.
2. **Equipment Integrity Management** – Maintain equipment integrity so that safety, reliability and costs are at acceptable levels. (Zero significant loss of containment incident count and 99.9% reliability of customer service during injection operations, within approved budget limits.)
3. **Transportation Equipment** - Reduce the number of transportation equipment near-hits and incidents by 90% over the period from 2014-2016.
4. **Transportation Performance** – Maintain a zero significant incident count.
5. **Training/Procedures** - Training, standards, and work procedures are in place by the end of 2016.
6. **Service Reliability** - Maintain 99.9% reliability of customer service during injection operations.
7. **Service Availability** – Maintain sufficient equipment and personnel capability to support pipeline construction and operations, as judged by hydrotesting, construction and operations management.



1.3. Asset and Data Condition

Much of the portable equipment is relatively new and universally in good condition, and most have expected long service lives. The equipment inventory has increased more than ten times in size since 2011 in response to a steady increase in demand from PG&E Gas Operations clients of the services provided by this AF. However, some trailer component integrity may still be inadequate; resolving these situations has been a major initiative in 2015 that will be completed in 2016.

The implementation of PG&E's SAP maintenance module for this asset family which began in 2012 will continue to serve as the primary database to support increased quantitative analysis in the future. Most of the new data to be added to data already in place in SAP has been identified. This effort includes key performance indicators under study to assess the value of such indicators.

A critical aspect of data gathering and use for risk assessments is that the best AF data will continue to come in the form of discussion or near-term maintenance assessments from technicians, transmission specialists and engineers intimately involved with day-to-day maintenance and operations, rather than from numerical databases of longer-term (months or years) component performance. This process already occurs routinely, and has been effective in a number of instances in which equipment performance or maintenance activities have been analyzed for changes in risk. In a relatively short period of time from the initial discovery of an operation or maintenance situation that is a potential increase in risk, technicians and engineers can compare recent experience, consider trends (sometimes consulting historical data in SAP), reassess risks and develop and prioritize mitigation plans far more quickly than is possible with longer-term large statistical models required for far larger equipment inventories. The relatively compact organization combined with the limited amount of equipment in this AF are the basis for the effectiveness of this approach.

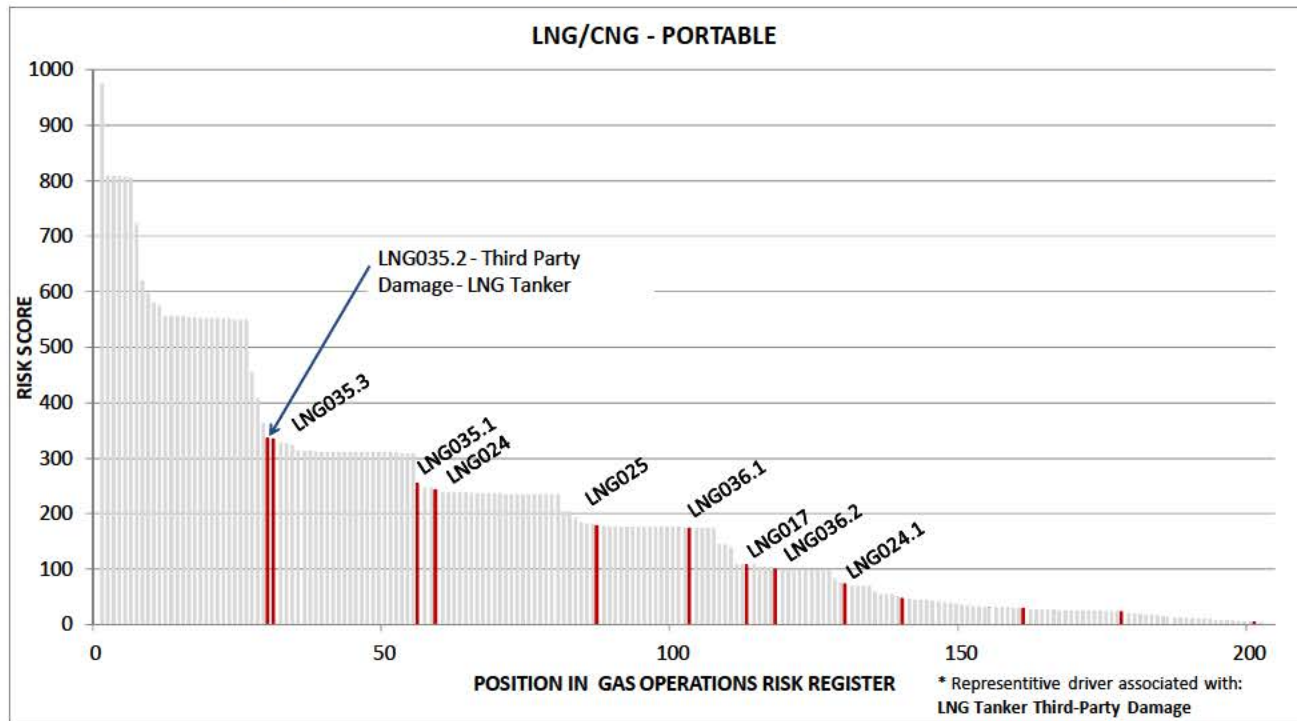
1.4. Key Risks

EORM developed a criteria used to identify enterprise level risks. Furthermore, due to Gas Operations' level of granularity, the risk drivers were aggregated or "rolled up" to allow for consistent calibration with all PG&E lines of business. The rolled up risks incorporate multiple "risk drivers" from the Gas Operations risk register. Additional details regarding the roll up methodology can be found in the Strategic Asset Management Plan.

This AMP is based on the risks developed for this AF within Gas Operations. This AF has no enterprise-level risks.

Figure 1 below displays the position of the LNG/CNG AF risks (red) for the portable LoB within the Gas Operations risk register. The portable risks are no higher than 60th out of the 200 plus Gas Operations Risks.

Figure 1 - Portable Key Risk Score Histogram



1.5. High Level Program Overview

The AMP focuses on managing and reducing risk in the most efficient and effective manner possible. As the plan matures, focus on optimizing risks, performance and costs will continue to be strengthened. Proposed programs involve both capital and expense funding and in some cases address more than one area of risk. Descriptions of the scope of each program are found in Section 4. The pace, trajectory, scope, and anticipated budgets for these proposed programs align with the submittals included in the last Gas Transmission and Storage Rate Case for transmission assets.

The portable LoB has undertaken or is planning a number of mitigations to reduce safety, reliability and cost risks.

Table 1 presents a brief summary of the top portable equipment risks found in the Gas Operations risk register. Section 2.4 discusses the risks in greater detail, and a table of all portable risks included in the Gas Operations risk register is provided in Appendix C.



Table 1 – Key Portable Threats and Risks

Threats	Risk ID	Risk Description	Primary Mitigation and Controls	Mitigation Metric
Third-Party Damage	LNG16	<p><u>Third-Party Damage - LNG Tanker Transportation Collision (System Safety)</u> - Risk of vehicular accident (e.g., driver failure or unable to avoid, or third party action or equipment failure) may result in LNG tanker rupture, loss of containment and severe safety impact. Large financial impact due to impact on safety, but no loss of reliability, no regulatory and no environmental impact.</p> <p><i>Current controls and funding in place are sufficient, though improvements are constantly being sought and implemented.</i></p>	Driver and transportation service provider competency, transportation planning, emergency response	<ul style="list-style-type: none"> • Significant loss of containment or other incident counts during transportation operations • Incidents/events and near hit incident/event counts involving transportation operations
Third-Party Damage	LNG17.0	<p><u>Third-Party Damage - LNG Tanker Parked (Safety) (System Safety)</u> - Risk of collision of a vehicle or other object with LNG Tanker (Portable Supply Equipment parked) may result in tank rupture, significant loss of containment, fire and/or explosion that could cause severe safety impacts.</p> <p><i>Current controls and funding in place are sufficient, though improvements are constantly being sought and implemented.</i></p>	Designs, maintenance, operations, and operator competency	<ul style="list-style-type: none"> • Count of collision caused loss of containment while parked incidents
Equipment Related Third-Party Damage	LNG18	<p><u>Equipment & Third-Party Damage - CNG Trailer Transportation Incident</u> - Risk of vehicular incident (e.g., driver failure or unable to avoid, or third party action; or PG&E/contractor equipment failure) may result in collisions or other incidents, and possibly CNG cylinder loss of containment and/or other severe safety impact.</p> <p><i>The inclusion of trailer running gear failure is applicable to ALL portable equipment trailers but is included here in the largest risk for this AF.</i></p> <p><i>Current controls and funding in place are sufficient, though improvements are constantly being sought and implemented.</i></p>	Equipment design, condition and maintenance q/c	<ul style="list-style-type: none"> • Significant loss of containment or other incident counts during transportation operations • Incidents/events and near hit incident/event counts involving transportation operations



Threats	Risk ID	Risk Description	Primary Mitigation and Controls	Mitigation Metric
Equipment Related Incorrect Operations	LNG24.0	<u>Equipment -LNG Vaporizer Operations Failure (Safety) (System Safety)</u> - Risk of vaporizer operations failure may result in loss of containment leading to major safety impacts, and possible substantial financial loss, loss of reliability, reduced capacity, customer outage (7k to 20k) along with LNG into pipeline. Highest consequence vaporizer failure. (P95) <i>Current controls and funding in place are sufficient, though improvements are constantly being sought and implemented.</i>	Designs, maintenance, operations, and operator competency	Significant loss of containment event counts during injection operations.
Equipment Related Incorrect Operations Third Party Damage	LNG25	<u>Equipment -CNG Injection Equipment Ops Failure (Safety)</u> – Site risk of CNG injection operations failure or third party damage may result in loss of containment leading to major safety impacts, and possible substantial financial loss, loss of reliability, reduced capacity, significant customer outage. <i>Current controls and funding in place are sufficient, though improvements are constantly being sought and implemented.</i>	Designs, maintenance, operations, and operator competency	Significant loss of containment event counts during injection operations.
Incorrect Operations Third Party Damage	LNG36.1 LNG36.2	Risk of traffic incident without regard to cargo. Risk of loss of containment during transportation. <i>Current controls and funding in place are sufficient, though improvements are constantly being sought and implemented.</i>	Designs, maintenance, operations, and operator competency	Various to examine maintenance, equipment and accident statistics.
Third Party Damage	LNG35.1	Risk of third-party causing LNG release resulting in fire while stored in Yuba city yard	Tanker designs, security, location, LNG storage practices.	Location, security and design implementation
	LNG35.2	Risk of third party causing massive LNG release and fire in Yuba City yard		
	LNG35.3	Risk of third-party causing LNG fire/explosion using LNG tanker stolen from Yuba City yard <i>LNG storage practices have been temporarily revised to limit storage volumes at Yuba City. The short and midterm site security improvements are complete as of mid-2016, and the search for a supplemental low risk site for LNG storage is underway. The remaining long-term security improvements at the Yuba City site are expected be addressed during the next year as part of a larger Gas Operations site security program.</i>		



2. Asset Inventory and Condition Overview

2.1. Asset Overview

This AF consists of equipment which can store and transport gas on public highways, and deliver this gas to PG&E pipelines or PG&E customer piping systems to supplement or substitute for pipeline flowing supplies. The equipment falls into two basic categories:

- Portable gas supplies in the form of LNG tanker and CNG trailers pulled by conventional third-party truck tractors.
- Portable injection equipment which allows the delivery of gas from tankers and trailers to PG&E customers or pipeline systems.

In some instances, the storage/transportation equipment is separate from the injection equipment, and in other instances, the storage, transportation and injection equipment is integrated into a single portable platform.

PG&E's Transportation and Aviation Services Department (T&AS) is responsible for the maintenance and compliance for the highway running gear (consisting of the trailer frame and axle assembly) of the portable equipment described in Table 2 below. A service level agreement is in place between T&AS and LNG/CNG that addresses the supporting roles for the two organizations regarding primarily the design and maintenance of trailers.

Table 2 – Asset Overview

Asset	Description
Portable LNG Tankers	Insulated tankers (tank truck trailers) that can store and transport natural gas in liquid form. Ten large LNG supply tankers with total approximate storage capacity of 8 million scf. An additional six are expected to be in service by mid-2016. <ul style="list-style-type: none">• Insulated tank 48-foot long truck trailers that can store and transport 650-900 Mcf of natural gas in LNG form.• LNG is stored at pressures that range from 70 to 200 psig and temperatures of typically -260° F.
Portable Fired LNG Vaporizers	Seven semi-truck trailer mounted heat exchanger, natural gas odorizer, valves, piping and controls. Accepts unodorized LNG from an LNG tanker and delivers odorized gas at the correct pressure and temperature to PG&E's pipeline system or large customer. <ul style="list-style-type: none">• 500 mcfh maximum delivery rate from LNG tankers to pipelines.
Portable Ambient LNG Vaporizers	Two trailers that can vaporize LNG for injection with heat from ambient air instead of from the use of gas-fired boilers. Operation is less complex such that fewer personnel are required, and reliability risks are lower.
Large CNG Tube Trailers	24 large supply CNG tube trailers consisting of 24 to 48-foot long truck trailers containing a number of high-pressure cylinders, that can store and transport CNG. Storage capacities range from 60 to 150 Mscf. CNG is stored at pressures of typically 2400 psig.

Asset	Description
Gap Trailer	<p>19 small trailers that contain both CNG storage tubes, ambient heat exchangers and pressure regulation equipment, which serve as self-contained storage and injection systems.</p> <ul style="list-style-type: none"> • 13 large trailers with 9 Mcf storage and of 5 Mcfh injection capacity. • Six medium trailers with 9 Mcf storage and of 5 Mcfh injection capacity. • CNG is stored at pressures of typically 3,600 psig.
CNG Injection Trailers (Trim Heater and Ambient)	<p>Small trailer mounted heat exchanger, piping and pressure regulation equipment. Accepts CNG from CNG tube trailers and delivers gas at the correct pressure and temperature to PG&E's pipeline system or large customer.</p> <ul style="list-style-type: none"> • 13 trailers total, natural gas fired and ambient temperature heat exchanger systems. • Individual trailer injection volumes range from 10 to 60 Mcfh
Small CNG Storage/Injection Trailers.	<p>Small trailer mounted CNG storage pressure vessel, heat exchanger, piping and controls equipment. Delivers gas at the correct pressure and temperature to PG&E's pipeline system or customer.</p> <ul style="list-style-type: none"> • 26 small bottle trailers with 1,800 scf storage and of 500 scfh injection capacity.
Portable CNG Storage/Injection Modules	<p>Stackable containers containing high-pressure storage vessels, piping and controls. Delivers gas at the correct pressure and temperature to PG&E's pipeline system or customer.</p> <ul style="list-style-type: none"> • 90 Individual portable modules, with 2,250 scf storage and 500 scfh injection capacity.

2.2. Asset Inventory and Condition

The availability of asset condition data varies across asset types within the AF. An effort is underway to improve data collection and condition assessment data with enhancements to SAP, the Transportation and Administrative Services (T&AS) maintenance management system, and off-line data sets that are discussed in further detail in Section 4. Asset inventory and condition is detailed by asset type in the following sections.

2.2.1. Physical Assets

Much of the portable equipment is relatively new and universally in good condition, and most have expected long service lives. The equipment inventory has increased more than 10-fold in size since 2011 in response to a steady increase in demand from PG&E Gas Operations clients of this AF.

Table 3 presented below summarizes the condition of assets. RAG status is defined as follows:

RAG status	Asset Condition
Green	Like new reliability, maintenance and operations (RM&O)
Amber	RM&O ranges from satisfactory to substandard
Red	Unacceptable RM&O



Table 3 – Portable Asset Condition Summary

ASSET	CONTROLS	PIPING, VALVES AND STORAGE VESSELS	OTHER
LNG Tankers	G – as-new reliability but age variations	G – as-new reliability but age variations	
LNG Vaporizers	G – as-new reliability but age variations	G – as-new reliability but age variations	G Generator/air system are maintained as a critical assets
CNG Tube Trailers	n/a	G – as-new reliability but age variations	G Interlock air system is maintained as a critical asset
CNG Gap Trailer	n/a	G – as-new reliability but age variations	
CNG Bottle Trailers	n/a	G – as-new reliability but age variations	
CNG Module	n/a	G – as-new reliability. 1 yr. age	
CNG Trim Regulation Trailer	n/a	G – as-new reliability but age variations	
Ambient Regulation Trailers	n/a	G – as-new reliability but age variations	
All trailer running gear	Service Level Agreement with Transportation Services Q/C of designs and maintenance	n/a	G – Trailer running gear equipment integrity shortfalls have largely been resolved, and maintenance systems are now in place to preserve that. Service procedures are still being completed.

2.2.2. Data

OVERVIEW

A critical aspect of data gathering and use for risk assessments is that the best AF data will continue to come in the form of discussion or near-term maintenance assessments from technicians, transmission specialists and engineers intimately involved with day-to-day maintenance and operations, rather than from numerical databases of longer-term (months or years) component performance. This process already occurs routinely, and has been effective in a number of instances in which equipment performance or maintenance activities have been analyzed for changes in risk. In a relatively short period of time from the initial discovery of an operation or maintenance situation that is a potential increase in risk, technicians and engineers can compare recent experience, consider trends, reassess risks and develop and prioritize mitigation plans far more quickly than is possible with longer-term large statistical models required for far larger equipment inventories. The relatively compact organization combined with the limited amount of equipment in this AF are the basis for the effectiveness of this approach.



This AMP includes the expansion or initiation of data gathering and assessments that will improve the quantity and quality of data regarding asset condition. This is expected to support improved risk assessments, remaining service life assessments, and investment/maintenance spending planning.

PRESSURE CONTAINING EQUIPMENT DATA

Quantitative and qualitative reliability/outage and repair data is sufficiently available to support risk analysis and to develop mitigation initiatives in the form of longer-term obsolescence management planning including near-term major investment plans (e.g., major component additions in the AMP timeframe, eventual rebuild or replacement in the long term) as well as near-term maintenance expense and other capital replacement plans.

SAP Data System - Asset health data-gathering is already included in the SAP work management system used by LNG/CNG, and is being expanded in the 2015 to 2017 timeframe to further improve asset health data. Corrective maintenance data in the system is already used by engineers and technicians when assessing asset health and risks, and in the development of changes in risk mitigation, asset maintenance and asset investment. Data that is expected to become more readily available that is quantitative to a greater degree than is currently available is expected to contribute to refinement of risk analysis and risk reduction efforts. However, this additional data is not expected to substantially change the understanding of the assets since the limited size of the asset pool allows employees to remain in contact with all assets and SAP corrective maintenance data is already robust, so that asset condition and risks are well understood.

TRAILER RUNNING GEAR DATA

The T&AS maintenance management system as well as an off-line system employed by LNG/CNG are currently in use to capture asset health data. While this is effective, work will continue to explore reduced reliance on manual off-line systems and to migrate further to reliance on the T&AS on-line system.

3. Threats and Risks

Risks are tracked in an enterprise-wide risk register, a central repository where risk names, descriptions and scores as determined by utilization of Enterprise and Operational Risk Management's (EORM's) risk criteria along with other pertinent information are documented. The risk register is updated and refined as additional information is obtained and evaluated.

The risk management framework is fully integrated into PG&E's Investment Planning Process (IPP). This framework complements risk assessment processes already in place via integrity management programs. Additional information about the integrated planning process can be found in the Asset Management Strategy and Objectives document, GP-1100.

3.1. Threat and Risk Identification

The asset family owners work with their teams to identify the threats to their assets. For the LNG/CNG AF team, personnel knowledge of the equipment, industry experience elsewhere, and various codes serve as the basis for categorizing and evaluating the threats specific to this equipment, including National Fire Protection Association Standard 52 (NFPA52), various ASME equipment related codes,



codes that apply to CNG vehicle fuel system equipment; as well as ASME B31.8S, the standard for managing the integrity of transmission pipeline assets. The threat categories set forth in ASME B31.8S are presented in Table 4 below:

Table 4 – Portable 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• Construction/Fabrication• Equipment threats
Time-Independent	Not influenced by time	<ul style="list-style-type: none">• Third Party Damage• Incorrect Operation• Weather and Outside Forces

In addition to these code threats, PG&E recognizes risks related to its obligation to serve, both in terms of ensuring reliable delivery of natural gas and increasing capacity to meet demand, as well as risks posed by an inadequate response to and recovery from emergencies.

AF personnel including internal and external subject matter experts (SMEs) are involved in the process to identify threats and risks, and assess available data sources to determine impact and frequency scoring which leads to the relative risk score associated with each threat. AF risks are calibrated across both Gas Operations and the entire PG&E enterprise.

3.1.1. Primary Threats and Mitigations

The threat matrix in Appendix B lists the primary threats that are applicable to the station LoB and briefly summarizes the applicable threats. The discussion in Appendix B supports the information presented in the threat matrix.

3.1.2. Key Portable Risks

This section presents a subset of the results from the assessments that are documented in RET2 (ref. Appendix A) and presented in Appendix C.

Risks have been identified, updated and published in the AMP revisions associated with the threat categories in the threat matrix, and prioritized for both Gas Operations (addressing risks across asset families) and within the asset family.

The Gas Operations risks register contains 15 risks for portable assets.

Figure 2 below displays the risk score position of the LNG/CNG AF risks (red) for the portable LoB within the set of risk scores across the entire Gas Operations risk register. The largest portable LoB risks are shown numbered. Numbers correspond to Table 5 that follows the figure.

Figure 2 - Portable Key Risk Score Histogram

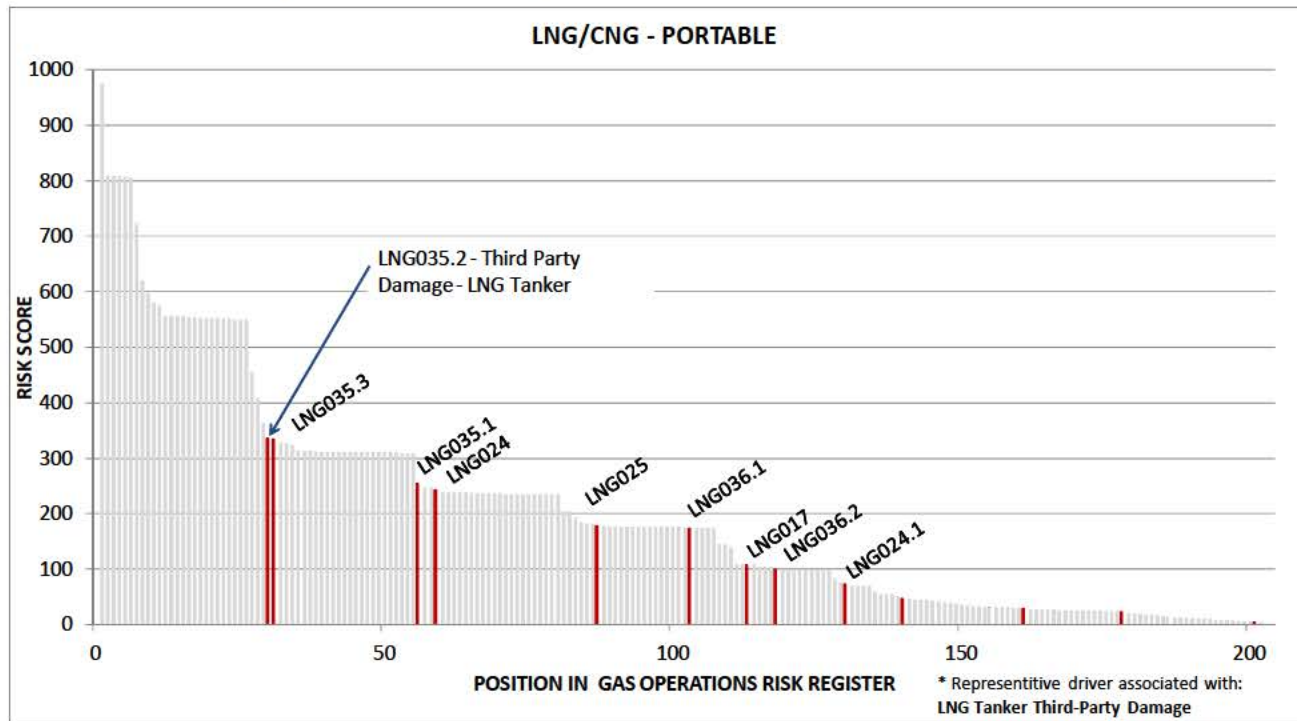


Table 5 below presents a brief summary of the top five CNG portable risks found in the Gas Operations Combined Risk Register. Section 4 discusses the risks in greater detail.

Table 5 – Key Portable Risks

Risk ID	Risk Description	Threats
LNG17.0	<p><u>Third-Party Damage - LNG Tanker Parked (Safety) (System Safety)</u> - Risk of collision of a vehicle or other object with LNG Tanker (Portable Supply Equipment parked) may result in tank rupture, significant loss of containment, fire and/or explosion that could cause severe safety impacts.</p> <p><i>Security vulnerability assessment completed regarding project site set up practices.</i></p>	Third-Party Damage
LNG24.0	<p><u>Equipment -LNG Vaporizer Operations Failure (Safety) (System Safety)</u> - Risk of vaporizer operations failure may result in loss of containment leading to major safety impacts, and possible substantial financial loss, loss of reliability, reduced capacity, customer outage (7k to 20k) along with LNG into pipeline. Highest consequence vaporizer failure. (P95)</p> <p><i>Standards and procedures and associated training are being strengthened.</i></p>	Equipment Related Incorrect Operations



Risk ID	Risk Description	Threats
LNG25	<p><u>Equipment -CNG Injection Equipment Ops Failure (Safety)</u> – Site risk of CNG injection operations failure or third party damage may result in loss of containment leading to major safety impacts, and possible substantial financial loss, loss of reliability, reduced capacity, significant customer outage.</p> <p><i>Standards and procedures and associated training are being strengthened. Security vulnerability assessment completed regarding project site set up practices.</i></p>	Equipment Related Incorrect Operations
LNG36.1	<p><u>Risk of traffic incident without regard to cargo.</u> PG&E portable equipment without regard to size or loss of containment is involved in a transportation incident, such as a multi-vehicle collision.</p>	Third-Party Damage
LNG36.2	<p><u>Risk of loss of containment during transportation.</u> Significant loss of containment event (LNG is viewed as the most substantial) during transportation, such as a multi-vehicle collision and cargo fire.</p>	Equipment Related Incorrect Operations
LNG35.1	<p><u>Risk of third-party causing LNG release resulting in fire while stored in Yuba city yard.</u> Third-party releases LNG from a single tanker and ignites it in Yuba City yard.</p> <p><i>LNG storage practices have been adjusted in 2016 to reduce volumes at the site. Security for the site continues to be increased. Search is underway for supplemental storage yard.</i></p>	Third-Party Damage
LNG35.2	<p><u>Risk of third party causing massive LNG release and fire in Yuba City yard.</u> Third party releases LNG from multiple tankers and ignites in Yuba City yard resulting in fire damage to many tankers and fire/explosion damage to adjacent building(s).</p> <p><i>LNG storage practices have been adjusted in 2016 to reduce volumes at the site. Security for the site continues to be increased. Search is underway for supplemental storage yard.</i></p>	Third-Party Damage
LNG35.3	<p><u>Risk of third-party causing LNG fire/explosion using LNG tanker stolen from Yuba City yard.</u> Third-party moves an LNG tanker from the Yuba City yard to a densely populated area causing fire and explosion with massive damage.</p> <p><i>LNG storage practices have been adjusted in 2016 to reduce volumes at the site. Security for the site continues to be increased. Search is underway for supplemental storage yard.</i></p>	Third-Party Damage
LNG36.1	<p><u>Risk of traffic incident without regard to cargo.</u> - PG&E portable equipment without regard to size or loss of containment is involved in a transportation incident, such as a multi-vehicle collision.</p> <p><i>Portable equipment running gear maintenance program has been strengthened substantially in early 2016. Transportation service contractor QC is being increased.</i></p>	

Risk ID	Risk Description	Threats
LNG36.2	<p><u>Risk of loss of containment during transportation.</u> - Significant loss of containment event (LNG is viewed as the most substantial) during transportation, such as a multi-vehicle collision and cargo fire.</p> <p><i>Portable equipment running gear maintenance program has been strengthened substantially in early 2016. Transportation service contractor QC is being increased.</i></p>	

A table of all risks for this AF in the Gas Operations risk register is provided in Appendix C.

3.2. Integrity Management Programs

The LNG/CNG facility integrity management program (FIMP) consists of a variety of integrated activities intended to ensure the safe, environmentally responsible, reliable and economical operation of assets by ensuring control and containment of service fluids (e.g., gas, lube oil), and by ensuring that equipment meets or exceed design life at reasonable operating costs given its intended purpose and actual operating conditions.

The FIMP for this LoB identifies, assesses and mitigates risks detailed in this AMP.

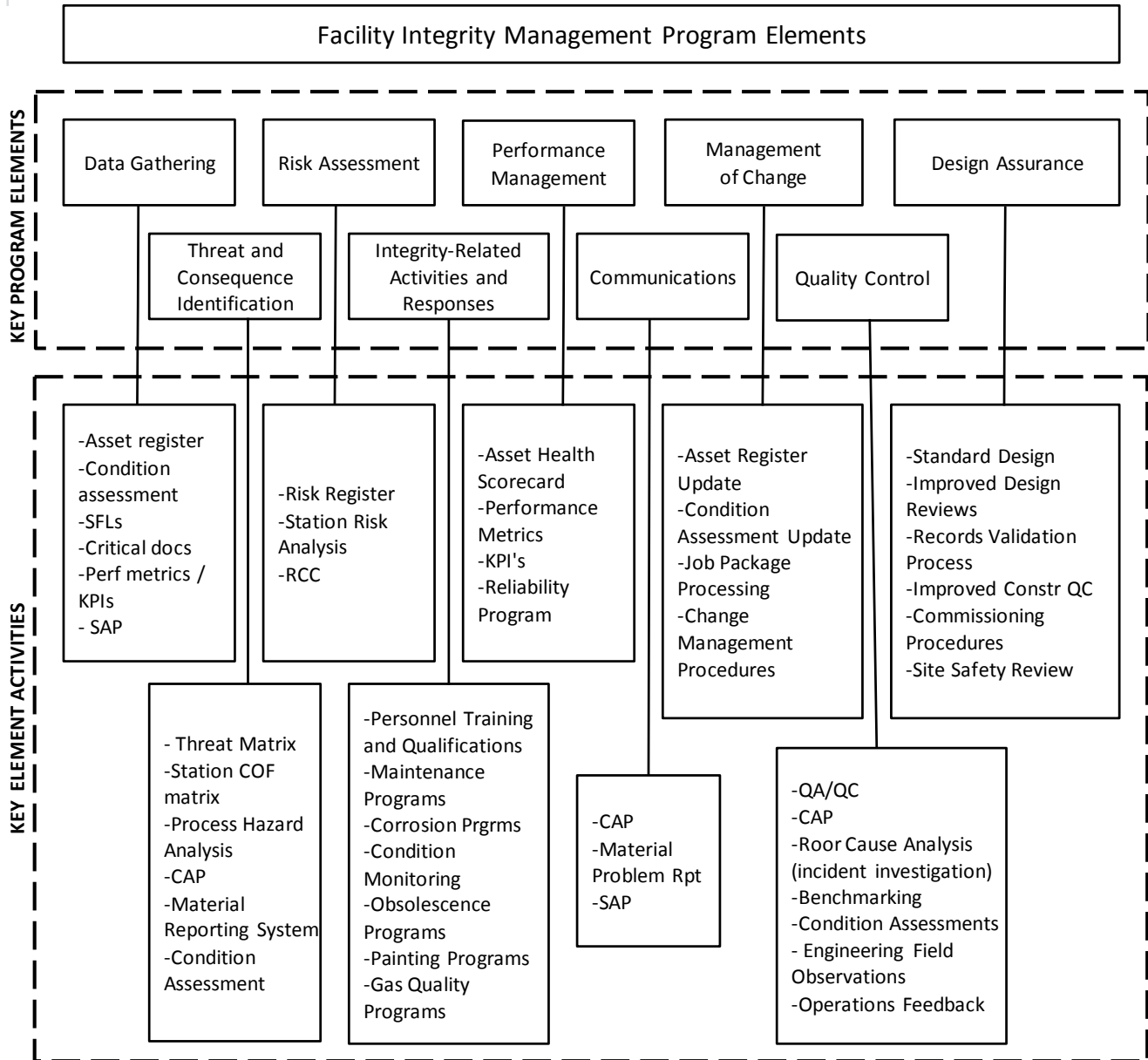
While a number of station LoB risk management elements are already in place and integrated with each other, the continued development by this AF of a FIMP for stations throughout the 2013 through 2017 timeframe is expected to improve the integration of existing and future risk and integrity management activities, and to ensure that integrity management is comprehensive and effective. The AF's goal is to develop a world-class FIMP including the following elements:

- Data gathering (including storage and retrieval)
- Threat identification and consequences
- Risk assessment and prioritization
- Integrity-related activities (including the specification of maintenance and inspection, and auditing and condition assessment activities to address compliance and reliability needs)
- Response actions for inspection and maintenance findings
- FIMP performance management
- Reporting and communication of FIMP issues
- Facility change management (how to address changes to facilities so that appropriate asset management information is updated and tracked)
- Quality control requirements to ensure FIMP requirements are being met and lessons learned are incorporated into the program
- Design-related activities to ensure that FIMP requirements are included in design of facilities
- Increased application of process safety

The portable AMP is very much a part of this FIMP for the LNG/CNG AF.

An initial summary of the elements of the FIMP is shown in Figure 3 below.

Figure 3 - FIMP Elements



4. Desired State, Strategic Objectives, Programs and Risk Mitigations

The AF strategic objectives have been developed to optimize asset life cycle by maintaining and improving asset condition and adequately mitigating risks and threats. These strategic objectives, which support Gas Operations' Line of Sight (LoS) goals, have been established to align investment in the AF

with the asset management strategy, reduce risks, and ultimately realize Gas Operations' corporate vision. The desired state is incorporated into the strategic objective statements in Table 6 below, and detailed in Table 8 further below.

Using these inputs, a long-term plan has been defined to meet the portable AF and corporate objectives.

Section 4.1 presents maps of the relationships between several aspects of goals, objectives, programs and mitigations. Section 4.2 provides an overview of programs to address risk and the AF strategic objectives, and presents the desired state and current status relative to desired state.

4.1. Strategic Objectives, Programs and Mitigations Alignment

The strategic objectives mapped to Gas Operations objectives are as follows. In the instance where the strategic objective is not clearly the desired state, a supplemental remark is provided for clarity.

Table 6 - AF Strategic Objectives and Metrics mapped to Gas Operations LoS Goals

Gas Operations LoS Goals	Portable Strategic Objectives / Desired State	Metrics
Safety Reliability Customer	1. Loss of Containment - Maintain a zero substantial loss of containment incident count.	Count of substantial loss of containment events
Safety Reliability Customer Affordability	2. Equipment Integrity Management – Maintain current equipment integrity (excluding transportation equipment)	<ul style="list-style-type: none"> Count of substantial loss of containment events Injection operations equipment reliability. Count of customer outages during injection operations.
Safety Reliability Affordability	3. Integrity of Equipment required for Transportation - Reduce the number of transportation equipment near-hits and incidents by 90% over the period from 2014-2016. The desired state is to have zero near-hits and incidents.	<ul style="list-style-type: none"> Count of substantial loss of containment events. Counts of various equipment statistics, including equipment-related incidents/events and near hit incidents/events.
Safety Compliance Reliability Affordability	4. Performance while in Transport – Maintain a zero at-fault serious incident count.	<ul style="list-style-type: none"> Incident counts during transportation. Near hit incident/event counts.
Safety Compliance Reliability People Customer	5. Training/Procedures - Training, standards, and work procedures are in place by the end of 2016.	Training standards, work procedures percent complete.
Reliability Customer	6. Service Reliability - Maintain 99.9% reliability of customer service during injection operations.	Count of customer outage during injection operations.



Gas Operations LoS Goals	Portable Strategic Objectives / Desired State	Metrics
Reliability Customer Affordability	7. 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.

The strategic objectives are supported by specific risk mitigation initiatives as follows. Further detail is provided following this table, and in two companion files listed in Appendix A (Drivers and Controls, and Planned Mitigations).

Table 7 – AF Strategic Objectives Mapped to AF Risk Mitigation and Control Initiatives

Programs and Mitigations	Portable Strategic Objectives						
	1. Loss of Containment	2. Obsolescence Management	3. Transportation Equipment	4. Transportation Performance	5. Training/ Procedures	6. Service Reliability	7. Service Availability
A) Management of Injection Operations Loss of Containment	X	X			X	X	
B) Managing Risks of Collision Caused Loss of Containment While Parked	X				X	X	
C) Equipment Integrity Management	X	X			X	X	
D) Integrity of Equipment required for Transportation	X	X	X	X	X		
E) Performance while in Transport	X	X		X	X		
F) LNG Supply Management						X	
G) CNG Supply Management						X	
H) Service Availability		X				X	X
I) Records Management	X				X		
J) Compliance					X		

4.2. Programs and Mitigations

Table 8 presents an overview of the programs introduced in Section 4.1 above. Remarks regarding the desired state are included to provide the reader with a more complete understanding of the AF status relative to the desired states. Metrics that help understand the health and accomplishments of these programs are presented above in Table 6.



Table 8 – Program Summary, Portable Equipment

Program:	A) Management of Injection Operations Loss of Containment
Risks Addressed:	LNG24, LNG24.1, LNG25
Timeframe:	Ongoing
Desired State	<ul style="list-style-type: none"> • Maintain a zero significant loss of containment incident count. <i>The AF has been successful at keeping this count is zero since the last event in September 2013. This success is expected to continue.</i> • Minimize near hit incident/event counts. <i>A system to effectively track this data is not yet in place but efforts will continue to achieve this.</i> • All incidents or near hits lead to improved procedures, training and/or engineering. <i>This is currently being consistently achieved as an ongoing control.</i>
<p>Scope:</p> <p>This program has been developed to address threats and risks of loss of containment of LNG or CNG during injection operations. Scope includes the following: Continue to employ current practices for</p> <ul style="list-style-type: none"> • LNG injection control system designs, including redundant controls. • CNG injection control system designs. • Equipment maintenance. Current resources are sufficient to address all code required maintenance as well as best practices. Equipment is not operated unless maintenance is current and asset health is excellent. • Operator training and competency testing. • Inherently safe design. • Effective maintenance which minimizes abnormal operations. • Site selection, design/configuration. • Site security plan. • Risk management plan for storage and operations sites. • Strengthening of process safety practices. <p><i>Mitigation is judged to be good, though more mitigation is being sought and implemented.</i></p> <p><i>Funding for maintenance and training is contained in the expense budget. Funding for site services is provided by pipeline projects. Funding for design is included in the capital budget (see program H above in this table).</i></p>	
Responsibilities	<ul style="list-style-type: none"> • Portable engineering has overall responsibility for inherently safe designs, and maintenance and operating procedures. • LNG/CNG engineering and maintenance organizations are responsible for maintaining equipment integrity.



Program:	B) Managing Risks of Loss of Containment while Parked caused by Collision or Third Party Damage
Risks Addressed:	LNG17, LNG17.1, LNG19.0, LNG19.1, LNG21
Timeframe:	2015 – 16: assessments and implementation. Ongoing control beyond that.
Desired State	Maintain zero count of loss of containment incidents due to collisions or third party damage while parked. <i>The AF has been successful at keeping this count is zero.</i>
Scope: This program has been developed to address threats and risks of loss of containment due to collision or third party damage while trailers containing LNG or CNG are parked. Scope includes the following: <ul style="list-style-type: none">• Continue with current level of quality control for equipment, including design and maintenance of tanker and vaporizer, and continue to seek opportunities for improvement.• Continue with current level of engineering, planning and operations employee training and competency.• Continue to employ current practices for site selection, design/configuration (traffic control, fencing and traffic barriers).• Continue to enhance and employ site security plans.• Continue to employ current practices for emergency, safety and security procedures and training• Continue to enhance and employ emergency responder training• Continue to strengthen process safety practices. <i>Mitigation is judged to be good, though more mitigation is being sought and implemented.</i>	
Responsibilities	<ul style="list-style-type: none">• Portable engineering has overall responsibility for inherently safe designs, and maintenance and operating procedures.• LNG/CNG engineering and maintenance organizations are responsible for maintaining equipment integrity.



Program:	C) Equipment Integrity Management -
Risks Addressed:	LNG24.0, LNG24.1, LNG25
Timeframe:	Ongoing equipment maintenance, innovation, and obsolescence management program
Desired State	<p>All pressure containing and associated equipment consistently performs as intended.</p> <ul style="list-style-type: none">• Zero significant loss of containment incident count. <i>The AF has been successful at keeping this count is zero since the last event in September 2013. This success is expected to continue.</i>• 99.9% reliability of customer service during injection operations. <i>Pending QC of the data in 2016 to confirm, the AF believes that it has achieved this level of reliability.</i>
<p>Scope:</p> <p>This program has been developed to reduce safety, reliability and financial risks associated with portable equipment integrity shortfalls. It addresses pressure containing and natural gas processing equipment. Scope includes the following: Continue to employ current practices for</p> <ul style="list-style-type: none">• Quality control for equipment, including design and maintenance.• Ongoing maintenance to identify and correct (repair or replace) smaller components that present unacceptable risk levels.• Innovation in the type and design of equipment, that results in reductions in risks associated with safety, reliability and cost efficiency.• The expansion of asset health management data systems both off-line and in the Transportation and Aircraft Services work management program to capture and report on trailer running gear performance and maintenance.• Strengthening of process safety practices. <p>Most pressure-containing and related equipment is far from the end of its useful service life (refer to Section 2) so large-scale replacements are not contemplated in the near-term. Replacement of components that have outlived their useful service life is performed on a small scale as part of routine maintenance. Replacement of components to improve performance is also routinely performed.</p> <p>The trailer running gear integrity program is addressed separately further below.</p> <p><i>Mitigation is judged to be good, though more mitigation is being sought and implemented.</i></p>	
Responsibilities	<ul style="list-style-type: none">• Portable engineering has overall responsibility for inherently safe designs, and maintenance and operating procedures.• LNG/CNG engineering and maintenance organizations are responsible for maintaining equipment integrity.



Program:	D) Integrity of Equipment required for Transportation
Risks Addressed:	LNG16, LNG18, LNG20 <i>The inclusion of trailer running gear failure is applicable to ALL portable equipment trailers but is included in LNG18 as the largest risk for this AF.</i>
Timeframe:	2015: assessments and implementation. Ongoing control beyond that.
Desired State	Zero near-hits and incidents. In the interim, reduce the number of transportation equipment near-hits and incidents by 90% over the period from 2014-2016.
Scope: This program has been developed to reduce safety risks associated with transportation equipment. Scope includes the following: Continue to employ and enhance current practices for <ul style="list-style-type: none">• Inspection during and after fabrication combined with acceptance testing.• Maintenance of service level agreement between portable LoB and PG&E Transportation Services Department.• QC review of trailer running gear designs.• QC review of trailer running gear maintenance policies and practices.• QC actual maintenance and condition.• Asset health management data systems under development to capture and report on trailer running gear performance and maintenance.• Best practices investigation with the hazardous materials and other industry, and implementation as appropriate.• Implementation of site safety plans. <i>Mitigation for trailer running gear is now judged to be green, which is a substantial improvement over 2015. Maintenance organization and programs are satisfactorily in place.</i>	
Responsibilities	<ul style="list-style-type: none">• PG&E's Transportation and Aircraft Services Department is responsible for maintenance and transportation equipment integrity



Program:	E) Performance While in Transport
Risks Addressed:	LNG16, LNG18
Timeframe:	2015 – 17: assessments and implementation. Ongoing control beyond that.
Desired State	Maintain zero at fault or avoidable transportation near-hits and incidents.
Scope: This program has been developed to reduce safety risks associated with transportation human performance. Scope includes the following: Continue to employ and enhance current practices for <ul style="list-style-type: none">• Driver training and competency.• Quality control over driver training and competency.• Industry benchmarking.• Timing and routing of transportation.• Emergency safety security procedures and training.• Emergency responder training. <i>Mitigation is judged to be good, though more mitigation is being sought and implemented.</i>	
Responsibilities	<ul style="list-style-type: none">• LNG/CNG portable LoB is responsible for these scope items.



Program:	F) LNG Supply Management
Risks Addressed:	LNG28
Timeframe:	Ongoing control to support diversity of supply, and planning/scheduling of injection operations.
Desired State	Mitigation in place reduces this risk to satisfactory levels as judged by the AF.
Scope: <p>This program has been developed to implement initiatives and mitigations to reduce the risks associated with loss of LNG supply. Scope includes: Continue to employ and enhance current practices for</p> <ul style="list-style-type: none">Achieving and maintaining diversity of supply - PG&E purchases LNG from multiple suppliers which improves the likelihood of supply availability in the event of a temporary LNG production outage from one of the suppliers. <i>Effectiveness of strategy is largely untested, but supply diversity is practiced whenever practical.</i>PG&E control over scheduling LNG injection services that allows PG&E to defer projects that depend on LNG injection in situations where LNG supply constraints arise. <i>Strategy is effective at avoiding customer outages, but at undesirable increased pipeline project cost.</i>PG&E control over sufficient tanker inventory prior to the start of any significant LNG injection project that reduces the dependence on LNG supplies. <i>Strategy effectiveness is being increased with addition of more tankers in PG&E's portable equipment inventory.</i>PG&E control over the design and construction planning for projects, so that projects can be interrupted or revised without substantial customer outages, in the event of a major LNG supply disruption. <i>Strategy is effective, but at undesirable increased costs to projects so is considered a strategy of last resort.</i>	
Responsibilities	<ul style="list-style-type: none">LNG/CNG portable LoB is responsible for these scope items.



Program:	G) CNG Supply Management
Risks Addressed:	LNG29
Timeframe:	Ongoing control to support diversity of supply, and planning/scheduling of injection operations.
Desired State	Mitigation in place reduces this risk to satisfactory levels as judged by the AF.
Scope: This program has been developed to implement initiatives and mitigations to reduce the risks associated with loss of CNG supply. Continue to employ and enhance current practices for: <ul style="list-style-type: none">• Number of PG&E CNG stations.• Addition of CNG tube trailer filling equipment at existing CNG stations.• Reliability of PG&E CNG stations.• Adding locations dedicated only to tube trailer filling.• Acquisition of additional CNG trailers. <i>Existing mitigation is now satisfactory, but more mitigation is under implementation in 2016 and beyond which will reduce the risk further.</i> <i>Funding for CNG station capability expansion is included in the station capital budget. Funding for station maintenance is contained in the station expense budget</i>	
Responsibilities	<ul style="list-style-type: none">• LNG/CNG station LoB is responsible for CNG station reliability and expansion.• LNG/CNG portable LoB is responsible for planning and the tube trailer inventory.

Program:	H) Service Availability
Risks Addressed:	LNG31
Timeframe:	Ongoing
Desired State	Sufficient equipment and personnel capability is in place to support pipeline construction and operations, as judged by hydrotesting, construction and operations management.

Scope:

The program was developed to implement initiatives and mitigations to reduce the risks associated with limitations on service availability relative to demand. Scope includes the following:

- Continued expansion of portable equipment inventory as has been achieved over the last several years, to continue to increase capacity to support demands by PSEP replacement and hydrotesting projects.
- Continue to employ and enhance current practices for comprehensive planning of project scope and schedule performed to maximize the use of portable equipment.
- Continue to diversify and the collection of assets, to allow projects to be supported even if the portable equipment available is sub optimum.

PG&E forecasts purchasing additional equipment such as tube trailers and compressors to support a similar level of strength test work and the expanded work to upgrade pipelines for ILI, which can also have lengthy outages. This new equipment will also be available to support other outages on the system as needed. The LoB is proposing to expand its infrastructure in from 2016 out through 2020 to meet the demands for pipeline work planned for this time period. This includes both portable capacity increase, portable vaporizer emissions reductions and portable compression to reduce pipeline project raw methane emissions. Proposed expenditures are in the 2018/19 GTS rate case work papers as of mid-2016, and result from the 2016 S1 process.

	2016 Budget (LNG/CNG & T&AS)	2017 Proposed	2018 Proposed	2019 Proposed	2020 Proposed
Total	\$ 10,375,000	\$ 4,475,000	\$ 5,005,000	\$ 5,445,000	\$ 4,085,000

\$2.6 million in the 2016 budget is being funded by PG&E's Transportation and Aviation Services Department, not Gas Operations.

If the actual funding levels are reduced below these proposed funding levels, the continued growth of the inventory of portable assets will be slower, which increases the potential for deferral of some pipeline projects that depend on portable supplies. Asset investments proposed here to provide the most cost-effective and best functionality solution for base level work, will continue to be supplemented by temporary third party assets and services as appropriate.

Existing mitigation is satisfactory as long as asset capability expansion continues to meet the demands of PG&E's pipeline work.

- Pipeline project cost increases are currently rarely caused by the unavailability of portable services. However, problems and increased costs can arise when the preferred or optimum project schedule or scope must be modified to accommodate the availability and capability of portable equipment. The exception is made for large projects for which the required portable inventory (LNG tanker) expansion would be excessive, such that contracting for temporary capability is undertaken.*
- Project scheduling has a typical annual cycle of high and low activity, resulting in periods of high demand that exceeds the capacity of the portable equipment inventory, separated by periods of*



<p><i>demand below the capability of the portable equipment inventory.</i></p> <ul style="list-style-type: none">• <i>Large LNG jobs in 2015 and 2016 have required contracting for LNG tanker transportation and the additional transfer operation off-site. The effectiveness of this may contribute to improved assessment of mitigation status.</i>• <i>Experience from the CNG jobs in 2015 may contribute to improved assessment of mitigation status.</i>	
Responsibilities	<ul style="list-style-type: none">• LNG/CNG portable LoB is responsible for these scope items.
Program:	I) Records Management
Risks Addressed:	LNG30, LNG33
Timeframe:	2015 – 16, followed by ongoing control
Desired State	A mature, comprehensive records management system is in place by the end of 2016
<p>Scope:</p> <p>This program has been developed to implement initiatives and mitigations to reduce the risks associated with records shortfalls. Scope includes:</p> <ul style="list-style-type: none">• A thorough review of all documentation is underway to identify gaps, and strengthen documentation where required during 2014 – 2016.• Review of documentation (e.g., bill of materials, specifications, manuals) to identify opportunities for further improvement is an ongoing activity.• A process safety benchmarking program in early 2014 is resulting in an improved understanding of additional opportunities for further strengthening of documentation; action items are being addressed in 2014 and beyond. <p><i>Existing mitigation is satisfactory – Documentation is present and in good condition in most instances. For example, the vaporizer PHA identified solid maintenance and operating manuals in place, although opportunities to strengthen further were also identified; these are underway in 2014/2015/16.</i></p> <p><i>Funding is contained in the expense budget, and is sufficient to accomplish the records management improvements planned.</i></p>	
Responsibilities	<ul style="list-style-type: none">• LNG/CNG portable engineering and maintenance are responsible for these scope items.

Program:	J) Compliance
Risks Addressed:	LNG33 Shortfall in design, maintenance or operations relative to code requirements (not included as a specific compliance risk in the Gas Operations risk register).
Timeframe:	2015 – 16 assessment; continuous control thereafter.
Desired State	<ul style="list-style-type: none"> • A mature, comprehensive records management system is in place by the end of 2016. • LoB in compliance with applicable codes. • No Notice of Violations from regulatory agencies • Training, standards, and work procedures are in place by the end of 2016.
Scope: This program has been developed to implement initiatives and mitigations to reduce the risks associated with compliance shortfalls. While the existing high level of compliance limits this risk, opportunities for further strengthening have been identified: <ul style="list-style-type: none"> • Code-required maintenance is central to the maintenance program. Equipment is not operated if this maintenance is not current. • Designs and maintenance of pressure containing components to ASME and DOT code. • Design and maintenance of trailer running gear is executed according to DOT codes. Mitigation includes DOT inspections and testing at specified intervals • Compliance with DOT requirements for hazmat transportation security has been identified as either in need of strengthening or clarification from the DOT – resolution is planned by the end of 2014. <p><i>Mitigation is judged to be good, though more mitigation is proposed.</i></p> <p><i>Funding for maintenance and compliance is contained in the expense budget. Funding for design is included in the capital budget (see program H above in this table).</i></p>	
Responsibilities	<ul style="list-style-type: none"> • LNG/CNG portable engineering and maintenance are responsible for these scope items.

The latest program investment plan information can be found at the following links:

- Transmission S1: [2015 GT S1](#)
- Transmission S2: [2015 GT S2](#)

5. Areas for Continuous Improvement

This section presents summaries of the key initiatives that are being undertaken as prospective improvements to the management of portable assets.

Table 9 - Areas for Continuous Improvement

Risk Process <ul style="list-style-type: none"> • Evaluate risks impacting multiple asset families • Improve evaluation of asset interdependencies and risks that impact multiple asset families • Formalize the identification processes for life cycle risk
Performance Metrics <ul style="list-style-type: none"> • Refine leading and lagging performance indicators in order to measure, monitor and report on asset performance and condition
Repair vs. Replace <ul style="list-style-type: none"> • Documented criteria and decision-making when repairing vs. replacing a component
Forecasts <ul style="list-style-type: none"> • Improve the relationship between Session D, S1, and S2 to better prioritize and optimize the programs and projects, and to better link these to the threat matrix and risk register. • Align Investment Planning systems to asset families to enable accurate allocation and forecasting of capital and expense by asset family
Asset Management Plan <ul style="list-style-type: none"> • Continue to work with other asset families to develop consistency in plan content • Ensure asset management plans are a major source of asset family information and incorporate information from the Threat Matrices, Risk & Compliance Committee meetings, and Session D • Improve criteria for identifying mitigation program status, including benchmarking criteria, program effectiveness metrics, and funding fulfillment.
Process Safety <ul style="list-style-type: none"> • Develop and implement changes to bring performance towards industry best practices (see below)
Human and Equipment Performance Metrics <ul style="list-style-type: none"> • Explore the implementation of improvements to near hit event data systems (see below)
Equipment Life Cycle Planning



- Develop and implement life cycle planning for LNG and CNG storage vessels.

Process Safety Gaps

The LNG/CNG AF has identified a variety of areas in which improvements can be made to better integrate a variety of process safety elements within the AF. This information was developed through benchmarking of AF process safety activities with a variety of other hazardous industry operators, led by the Gas Operations Process Safety Department.

While efforts are underway to address some of the issues identified, and while the AF performance in many areas is solid, many areas are appropriate for further study, possible initiatives development, and implementation.

The schedule for this work has not yet been established. Expense funding level is uncertain, and is central to assessing what of this can be accomplished in the near-term.

Near Hit Event Information System

A "near hit" event is commonly referred to as a "close call", in which an injury or equipment damage nearly occurred but did not. Understanding the circumstances often helps improve designs, maintenance or operating procedures, or employee training. Most organizations find that this information is difficult to collect for several reasons, though valuable when collected.

LNG/CNG Engineering and Operations is collecting and using near hit event information when it becomes available, but the availability is still very limited as is sometimes the case for the application of the information.

In addition to entering the near hit events into CAP, a means to improve the availability of information regarding near hit events will continue to be explored by LNG/CNG in an attempt to improve the contributions this information makes to reducing safety, reliability and financial risks.



Appendices

A Related Documents

The following documents contain more detailed information that is integral to the asset management activities. In some instances the most current versions are maintained with the AF. Other references reside on the shared drive.

Table 10 - Related Documents

Document	Description/Discussion	File Name or Link
RET2	<p>Detailed AF risk register displaying risk scoring numbers and rationale, graphics comparing risks over time, etc. Used by AF SMEs to update risks throughout the year, to report risks periodically to senior management, and to report annually during the Gas Operations risk refresh process.</p> <p>The Gas Operations record is maintained on ECTS. The source document remains this file noted, in possession of AF SMEs.</p>	<p>AF-specific file: RET2.1LNGCNG_RiskRefres h2016 051916.xlsx ECTS</p>
Gas Risk Register	The risk register captures all risks outlined in this plan at the date of publish	http://gasrisk/
Mitigations	<p>This table captures the variety of mitigations associated with the risks in the Gas Operations risk register, the corresponding status, and the expected completion dates.</p> <p>The Gas Operations record is maintained on ECTS. The source document remains this file noted, in possession of AF SMEs.</p>	<p>AF-specific file: ECTS LNG-CNG Mitigations052416.xlsx ECTS</p>
Drivers and Controls	<p>This table captures the variety of drivers and ongoing controls associated with the risks in the Gas Operations risk register, and the corresponding status.</p> <p>The Gas Operations record is maintained on ECTS. The source document remains this file noted, in possession of AF SMEs.</p>	<p>AF-specific file: DriversCntrls_V1 020416.xlsm ECTS</p>
Chapter 4A Gas Transmission and Storage Rate Case	Chapter 4A and the associated work papers present the near-term capital and expense funding plans for the AF.	
Asset family investment planning forecast	Retained by investment planning for S1 and S2 planning purposes.	
Enterprise and Operational Risk Management Standard and Procedures	RISK-5001S, RISK-5001P-01, RISK-5001P-02, RISK-5001P-03	http://pgeatwork/Guidance/RiskCompliance/Pages/default.aspx
Gas Asset Management Policy	TD-01	http://www/techlib/default.asp?body=manuals/uo_standard/uo_policies.htm



Document	Description/Discussion	File Name or Link
Gas Operations Asset Management System Risk Management Standard and Procedure	TD-4011S, TD-4011P-01	http://www.techlib/default.asp?body=manuals/uo_standard/s/TD4011S.htm
Gas Operations Risk and Compliance Committee Charter	GOV-1021S	http://pgeatwork/Guidance/Governance/Pages/default.aspx
Asset Management Strategy and Objectives	GP-1100	http://www.techlib/default.asp?body=gas_plans.htm
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	
Gas Storage Asset Management Plan	GP-1108	

B Threat Matrix and Key Threats

Figure 4 – Approved Portable Threat Matrix

This approved version is supplemented by Figure 5 that follows, since Figure 5 is more current and displays more accurate content.

Primary Causes of Failures		Primary Mitigation Measures (highest impact on risk reduction – from left to right)				
Time Dependent Threats	External Corrosion	<ul style="list-style-type: none">Inadequate paintAtmospheric conditions	Design	Regular Inspection	Painting Program	
	Internal Corrosion	<ul style="list-style-type: none">MIC/CO2Presence of water	Inspection & Testing Program	CNG Dehydration & Gas Quality	Design Specifications	
	Stress Corrosion Cracking	<ul style="list-style-type: none">Gas temperaturePressure cycling	Pressure & Leak Testing	Inspection	Design	
Stable Threats	Manufacturing	<ul style="list-style-type: none">Poor quality manufactureInadequate specifications	Material / Equipment Specs	Vendor QC	Acceptance Testing	Maintenance & Inspections
	Construction/ Fabrication	<ul style="list-style-type: none">Incorrect constr practicesInadequate QC/inspection	Field QC/ Inspection	Construction Procedures	Construction Specifications	Acceptance Testing
	Equipment Related	<ul style="list-style-type: none">wear from useIncorrect sizing/design	Process Safety / Design	Maintenance & Inspection	Work Procedures	
Time Independent Threats	Third-Party Damage	<ul style="list-style-type: none">Highway motoristTerrorism / vandalism	Transportation System Quality	Storage Yard Security	Operations Security	
	Incorrect Operations	<ul style="list-style-type: none">Inadequate ProceduresInadequate TrainingHuman Error	Process Safety / Design	O&MI Documents	M&O Training	Work Procedures
	Weather & Outside Forces	<ul style="list-style-type: none">LightningFloodingSeismic events	Process Safety / Design	Equipment Storage & Operations Siting		

Availability and Quality of the Asset Data

complete

partial

weak

MITIGATION COLOR KEY

GREEN = Meets or exceeds industry best practices AND controls are adequate

RED = Does not meet industry best practices AND current controls are not adequate

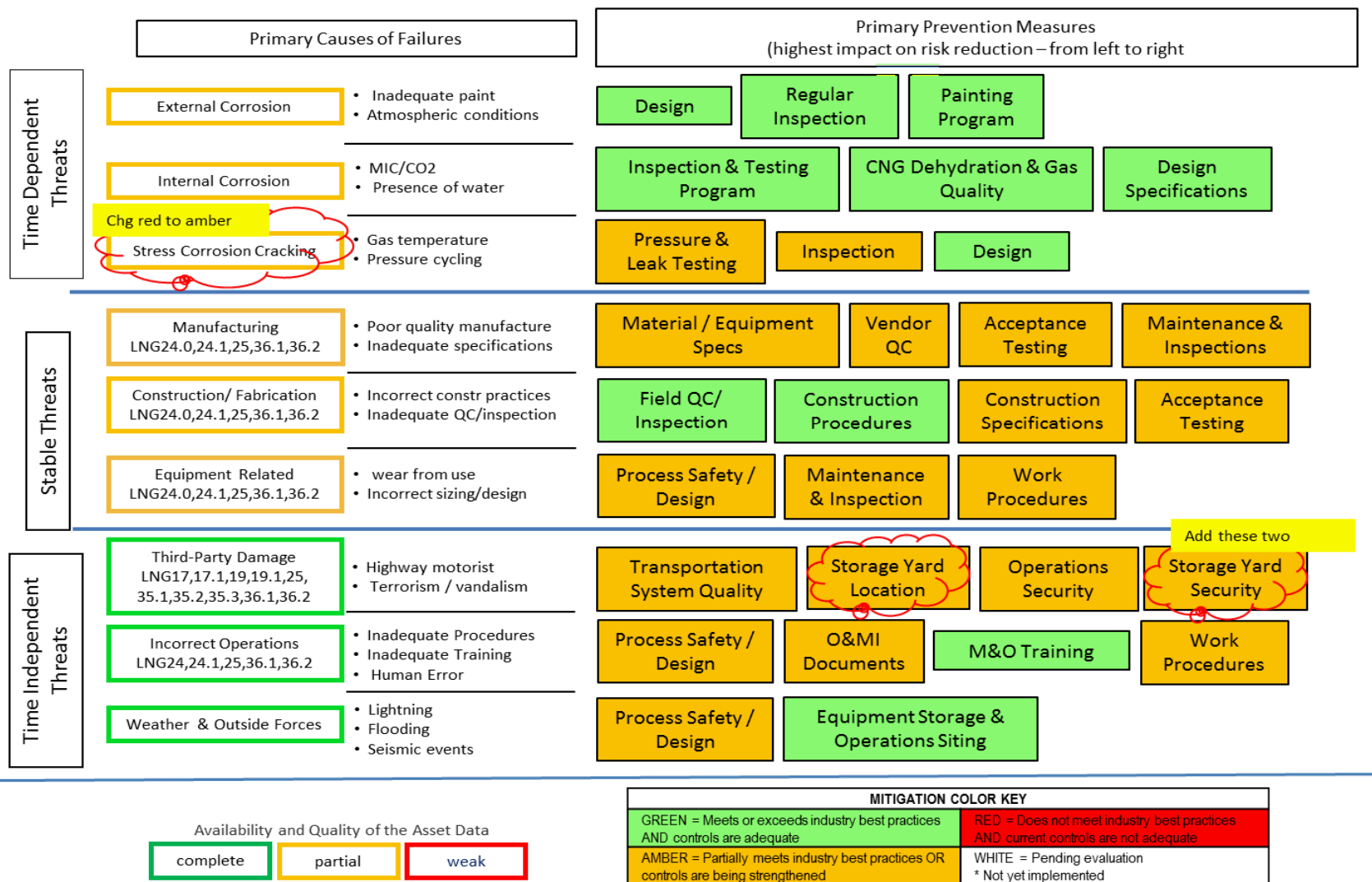
AMBER = Partially meets industry best practices OR controls are being strengthened

WHITE = Pending evaluation
* Not yet implemented

Revised 03/18/15

Figure 5 – Revised Draft Portable Threat Matrix (not yet approved)

LNG28, 29, 31 are not included here since they do not fit the B31.8S threat list.

Threat Matrix (LNG/CNG) PORTABLE EQUIPMENT


Revised 03/18/15, , 4/25/16 draft, not yet approved by RCC

The most current version of the threat matrix as of mid-2016 is presented here as Figure 5. It reflects changes proposed since the March 2015 approved edition was reviewed but not changed in the fall of 2015. Proposed changes are displayed on Figure 5 and discussed below.

Mitigation status colors are a judgment of status with respect to natural gas controls and piping industry best practices. Even in situations where PG&E believes it to be the CNG fueling industry best practice, amber is used for some mitigation, since further improvements are needed to achieve best-in-class for the natural gas controls and piping industry.

A high rate of change to mitigation status is common to this AF, since shortfalls in mitigation are often corrected soon after discovery. The relatively small size of the AF often allows this quick reaction.

The following is a brief summary of threats in the context of this AF:

External Corrosion

The risks associated with this threat category are low. Portable equipment is above ground and therefore subject to only atmospheric corrosion. Equipment external surface condition is readily visible to PG&E personnel who are frequently working on and around the equipment, and corresponding risks are easily mitigated.

Internal Corrosion

While the risks associated with this threat category are believed to be low based on inspection data for piping and storage vessels. Gas quality is less conducive to this threat than that found in PG&E's pipeline system because of the lower water content within the piping. Internal inspections of storage cylinders are included in the five year hydrotesting and inspection cycle.

Stress Corrosion Cracking

While the risks associated with this threat category are believed to be low based on industry experience and a preliminary assessment of the susceptibility of CNG station assets to SCC, the AF recognizes that it lacks sufficient data to judge this risk fully, so expansion of the assessment of this risk is underway. Since the AF has a better understanding of the conditions under which SCC can occur, and a preliminary assessment has been performed that indicates these conditions do not exist in this AF, the data availability/quality is proposed to be changed from red to amber.

Manufacturing

The risks associated with this threat category are believed to be low based on PG&E's operating experience, however, strengthening of the assessment of the associated risks will continue. Portable pressure containing equipment is universally mature technology, and the AF experience with the equipment is sufficient to identify favored manufacturers and components, all of which contribute to minimizing this risk.

Construction/Fabrication

The risks associated with this threat category are believed to be low based on PG&E's construction and operating experience, and oversight/QC of portable construction, maintenance and repair work.



Portable technicians receive considerable technical training and are well integrated with engineers and SMEs which helps ensure maintenance quality is high. However, expansion of the assessment of this risk will continue.

Equipment Related

This is one of the major threat categories for the AF. The integrity of pressure containing equipment is central to the risks of safety and reliability. Portable equipment consists of a great number and variety of pressure containing components. Refer to risk LNG 24 and 25 addressed in Section four.

Third-Party Damage

This remains the area of highest risk score: Refer to risks LNG 16, 17 and 18 in Section 4. Two new preventative measures are proposed to be added to the threat matrix, to reduce the risks associated in particular with storage sites for LNG tankers.

Incorrect Operations

The complexity of the equipment and the high CNG pressures or large LNG volumes involved present significant safety and reliability risks if operating errors are made by PG&E personnel. Refer to risks LNG 24 and 25 in Section 4.

Weather and Outside Forces

While this risk is believed to be low based on PG&E's operating experience, expansion of the assessment of this risk will continue.



C Asset Family Risks

This table presents a summary of the key risks for this AF included in the Gas Operations 2015 risk register. More detail is provided in a companion document, RET2 (refer to Appendix A). Risks associated with the Orca (LNG storage and dispensing trailer) are not shown, since this equipment is out of service.

Table 11 - Key Risks

Risk ID	Threats	Risk Description and Status Summary
LNG17.0	Third-Party Damage	<u>Third-Party Damage - LNG Tanker Parked (Safety) (System Safety)</u> - Risk of collision of a vehicle or other object with LNG Tanker (Portable Supply Equipment parked) may result in tank rupture, significant loss of containment, fire and/or explosion that could cause severe safety impacts. <i>Security vulnerability assessment completed regarding project site set up practices.</i>
LNG17.1	Third-Party Damage	<u>Third-Party Damage - LNG Tanker Parked (Reliability) (System Safety)</u> - Risk of collision of a vehicle or other object with LNG Tanker (Portable Supply Equipment parked) may result in tank rupture, significant loss of containment, fire and/or explosion that could cause severe reliability impacts. <i>Security vulnerability assessment completed regarding project site set up practices.</i>
LNG19.0	Third-Party Damage	<u>Third-Party Damage - CNG Tube Trailer Parked (Safety) (System Safety)</u> - Risk of collision of a vehicle or other object with CNG Tube Trailer (Portable Supply Equipment parked) or third party vandalism may result in vessel damage, significant loss of containment, fire and/or explosion that could cause extensive safety impacts. (P95) <i>Security vulnerability assessment completed regarding project site set up practices.</i>
LNG19.1	Third-Party Damage	<u>Third-Party Damage - CNG Tube Trailer Parked (Reliability) (System Safety)</u> - Risk of collision of a vehicle or other object with CNG Tube Trailer (Portable Supply Equipment parked) may result in vessel damage, and significant loss of containment, fire and/or explosion that could cause reliability impacts. (P50) <i>Security vulnerability assessment completed regarding project site set up practices.</i>
LNG24.0	Equipment Related	<u>Equipment -LNG Vaporizer Operations Failure (Safety) (System Safety)</u> - Risk of vaporizer operations failure may result in loss of containment leading to major safety impacts, and possible substantial financial loss, loss of reliability, reduced capacity, customer outage (7k to 20k) along with LNG into pipeline. Highest consequence vaporizer failure. (P95) <i>Standards and procedures and associated training are being strengthened.</i>



Risk ID	Threats	Risk Description and Status Summary
LNG24.1	Equipment related Incorrect Operations	<u>Equipment - LNG Vaporizer Outage (Reliability) (System Safety)</u> - Risk of vaporizer (portable equipment during operation) injection failure due to equipment failure, other outside force, or operator error may result in major loss of supply to customers and possible safety impact, substantial financial loss, along with LNG into pipeline. Highest overall risk of LNG vaporizer outage (excluding highest consequence. (P50) <i>Standards and procedures and associated training are being strengthened.</i>
LNG25	Equipment related Incorrect Operations Third Party Damage	<u>Equipment -CNG Injection Equipment Ops Failure (Safety)</u> – Site risk of CNG injection operations failure or third party damage may result in loss of containment leading to major safety impacts, and possible substantial financial loss, loss of reliability, reduced capacity, significant customer outage. <i>Standards and procedures and associated training are being strengthened. Security vulnerability assessment completed regarding project site set up practices.</i>
LNG28	Reliability of Service	<u>LNG Commodity Shortfall (System Safety)</u> - Risk of LNG supply reliability shortfall may result in absence of portable equipment support for construction projects or emergency response, resulting in higher project costs or decreased customer service reliability. <i>CNG station obsolescence management plan continues, resulting in continued improvement of station reliability. A new portable compressor was commissioned in April 2016 to support CNG portable operations.</i>
LNG29	Reliability of Service	<u>CNG Commodity Shortfall (Reliability) (System Safety)</u> - Risk of CNG supply reliability shortfall may result in absence of portable equipment support for construction projects or emergency response, resulting in higher project costs or decreased customer service reliability. <i>CNG station obsolescence management plan continues, resulting in continued improvement of station reliability. A new portable compressor was commissioned in April 2016 to support CNG portable operations.</i>
LNG31	Financial	<u>Insufficient Portable Equipment</u> - Risk of insufficient portable equipment may result in major financial impacts to pipeline projects and decreased service reliability to customers. <i>Equipment additions are continuing based on the needs of pipeline construction and testing, and significant capital additions are forecast to continue over the next five years since equipment and staffing levels to be achieved within the next few years are proving to be insufficient relative to the continued increasing demand from PG&E pipeline projects. Capital replacement of equipment and vaporizers in particular, is expected to continue driven by obsolescence management and emissions regulation changes.</i>
LNG35.1	Third-Party Damage	<u>Risk of third-party causing LNG release resulting in fire while stored in Yuba city yard.</u> - Third-party releases LNG from a single tanker and ignites it in Yuba City yard. <i>LNG storage practices have been adjusted in 2016 to reduce volumes at the site. Security for the site continues to be increased. Investigation is underway for a supplemental LNG storage site.</i>



Risk ID	Threats	Risk Description and Status Summary
LNG35.2	Third-Party Damage	<p><u>Risk of third party causing massive LNG release and fire in Yuba City yard.</u> - Third party releases LNG from multiple tankers and ignites in Yuba City yard resulting in fire damage to many tankers and fire/explosion damage to adjacent building(s).</p> <p><i>LNG storage practices have been adjusted in 2016 to reduce volumes at the site. Security for the site continues to be increased. Investigation is underway for a supplemental LNG storage site.</i></p>
LNG35.3	Third-Party Damage	<p><u>Risk of third-party causing LNG fire/explosion using LNG tanker stolen from Yuba City yard.</u> - Third-party moves an LNG tanker from the Yuba City yard to a densely populated area causing fire and explosion with massive damage.</p> <p><i>LNG storage practices have been adjusted in 2016 to reduce volumes at the site. Security for the site continues to be increased. Investigation is underway for a supplemental LNG storage site.</i></p>
LNG36.1	Third-Party Damage	<p><u>Risk of traffic incident without regard to cargo.</u> - PG&E portable equipment without regard to size or loss of containment is involved in a transportation incident, such as a multi-vehicle collision.</p> <p><i>Portable equipment running gear maintenance program has been strengthened substantially in early 2016. Transportation service contractor performance is solid but QC is being increased.</i></p>
LNG36.2	Third-Party Damage Equipment Related	<p><u>Risk of loss of containment during transportation.</u> - Significant loss of containment event (LNG is viewed as the most substantial) during transportation, such as a multi-vehicle collision and cargo fire.</p> <p><i>Portable equipment running gear maintenance program has been strengthened substantially in early 2016. Transportation service contractor performance is solid but QC is being increased.</i></p>

D Stakeholders Role and Responsibilities Matrix

Table 12 – Key contacts

Name	Role	Contact details
Steve Sheridan	Acting Senior Manager, LNG/CNG Engineering and Operations	209-401-5706 SESR@pge.com
Thane Pilkington	Supervisor, Portable Engineering, LNG/CNG Engineering and Operations	530-401-0445 TLPc@pge.com

Table 13 – Stakeholders and responsibilities

Stakeholder	Responsibilities / Issues
PG&E Gas Operations portable service clients	<ul style="list-style-type: none"> Provide requirements for portable services sufficiently far in advance to allow the development and execution on a schedule that provides all clients with the best possible portable services. Engineer portable service projects with contingency plans which address the potential for disruption in CNG and particularly LNG supplies.
PG&E Transportation and Aircraft Services	<ul style="list-style-type: none"> Provide maintenance management of the highway trailer portion of the portable assets. Support loss of containment and vehicle collision risk mitigation through maintaining appropriate performance and condition of the trailers. Help resolve the limited versatility and value of PG&E portable vehicles because of the corporate constraint that these vehicles operate only within the borders of California.
PG&E Corporate Security	<ul style="list-style-type: none"> Provide technical support for the security vulnerability assessments for LNG and CNG storage sites.
LNG Third Party Suppliers	<ul style="list-style-type: none"> Provide LNG, and LNG availability forecast.
Government Health and Safety First Responder Organizations	<ul style="list-style-type: none"> Emergency response to minimize risk to health and safety. Participate in training to support optimum response in emergencies.
Third Party Transportation Service Providers	<ul style="list-style-type: none"> Provide truck tractors and drivers to transport LNG tankers and CNG tube trailers with hazmat certification. Provide quality control over equipment and operator integrity to minimize transportation risks.
Third Party DOT Certified CNG and LNG Equipment Inspectors	<ul style="list-style-type: none"> Provide inspection for certain equipment to confirm integrity and compliance (including inspection and testing).



E Summary of Integrated Programs

The table below summarizes the programs of work contained within this AMP that are relevant to and documented in other asset family AMPs. The table highlights which programs are applicable to multiple asset families and which plan has included forecast costs. This also ensures there is no duplication in forecasted program costs.

Table 14 - Integrated Programs

Programs of Work	Capital (C) / Expense (E)	Transmission Pipe	Distribution Mains and Services
All programs that support risk management and operation – The portable LoB exists to offset absence of or shortcomings in both distribution and transmission pipeline flowing supply. Refer to Section 2.1.	C&E	X	X

Interdependencies

The primary interdependencies within PG&E consist of

1. PG&E pipeline construction programs that rely on portable supplies to support customers during pipeline outages. The demand for supply provided by portable equipment continues to expand, as PG&E pipeline project work expands and the project managers become more familiar with the benefits that portable supplies provide to such projects.
2. PG&E pipeline operations that rely on portable supplies to support customers during unplanned outages. As with planned outages, a solid demand persists for portable equipment to support customers when unplanned pipeline outages occur as a result of equipment failure or third-party damage.
3. The planned increase in portable capability to provide cross compression services PG&E pipeline construction programs, to reduce raw methane emissions. Investment is planned into portable compressors that can be used to transfer gas out of pipelines during construction projects instead of blowing gas to atmosphere, resulting in a new dependency by pipeline construction and operations on LNG/CNG.



F Glossary of Acronyms and Abbreviations

Table 15 – Acronyms and abbreviations

Acronym	Meaning
AF	AF
AFO	AF Owner
AMP	Asset Management Plan
ANSI	American National Standards Institute
ASME	American Society of Mechanical Engineers
Bcf	Billion cubic feet
BHP	Brake Horsepower
CFH	Cubic Feet per Hour
CM	Corrective Maintenance
CNG	Compressed Natural Gas
CoF	Consequence of Failure
CP	Cathodic Protection
DOT	Department of Transportation
ESD	Emergency Shut Down
FPI	Future Performance Indicator
GGE	Gas Gallon Equivalents
KPI	Key Performance Indicator
LNG	Liquefied Natural Gas
LoB	Line of Business
LoF	Likelihood of Failure
M&O	Maintenance and Operations
Mcf	Million cubic feet
MWC	Major Work Category
NFPA	National Fire Protection Association
NOV	Notice of Violation
OEM	Original Equipment Manufacturer
PG&E	Pacific Gas and Electric
PSEP	Pipeline Safety Enhancement Plan
psig	Pounds per Square Inch Gage
SCC	Stress Corrosion Cracking
SME	Subject Matter Expert



G Change Log

Section	Date	Change	Reason for Change	Implication of Change
Entire AMP	September 2014	Extensive changes throughout, most notably updated risks and mitigation discussions.	Updated for 2014	Maturing of risk mitigation and risk management process in general, consolidation of mitigation activities into Appendix C
	5/25/15	Updated threat matrix	GasOps direction	
Entire AMP	Q4 2014 / Q1 2015	Update to \$\$, 1/15/15 asset mgmt. review objectives added to Apdx C		
Entire AMP	June, 2015	Update content and format throughout	Improve forward view, update content in general and consistency with other AMPs. Address feedback from internal and external plan stakeholders.	More fully developed written explanations of strategic objectives and alignment of the AMP with those.
Entire AMP	June, 2016	Update content		

H Equipment Integrity and Obsolescence Management

This appendix supplements Section 4.

Mitigation of asset health risks is performed as needed throughout the life of the assets, to preserve a high level of integrity. Figure 6 below presents the expected life of most portable assets, which forms the planned replacement schedule out through 2055. The useful service life of these assets is uncertain in most cases, but investments will be proposed to partially or completely replace assets to address the risks as these assets near the end of their useful service lives.

In some cases the service life of the pressure containing equipment may be prudent to preserve indefinitely, though the trailer frame and running gear may need periodic replacement. In some of these cases, some of the pressure containing equipment with shorter service lives than cylinders are tanks may be replaced or rebuilt periodically, again to preserve the service life of the entire asset indefinitely. The service lives shown on Figure 6 illustrates the AF expectations as of now. Over the next decade the AF understanding of the deterioration rates of these assets will improve, which will result in adjusted and improved confidence in the service lives depicted on Figure 6.

Overall asset health ratings 1, 4, 7, 10 correspond to the asset health scoring and are depicted on Figure 6 as follows.

1 = GREEN - like new ReliabilityM&O	4 = GREEN/AMBER satisfactory RM&O	7 = AMBER/RED substandard RM&O	10 = RED unacceptable RM&O (at or near the end of its service life / obsolete)
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Progression over time is shown by the scores deteriorating from 1 to 4 as the assets age and approach the end of their useful life. As this plan is improved, the progression may vary from that with partial rebuilds (e.g., 4 back to 1 because of a component replacement, and then aging back to 4 and eventually to 7).

Because of the high standards placed on the integrity of portable equipment and the latitude of choosing not to operate any equipment that is in any way unsatisfactory, the deterioration is never allowed to reach the health score of 10, and once the health score reaches 7, the equipment is rebuilt or replaced.

The legibility of Figure 6 is limited since small font has been used in favor of displaying virtually all portable assets on a single chart out beyond 2050. Its use here is not intended to be the precise reference used by AF SMEs in the day-to-day management of asset life, but rather to show readers of this AMP a broad view of the estimated life cycle for the portable equipment inventory.

Figure 6 - Obsolescence Management Estimate Life Cycle Overview

CCC – this was not complete in the version you reviewed, but is now presented here.

[illegible]



LONG PORT LNG0000004 ORCA LNG ORCA PORTABLE FUELER ORCA ©2010 Pacific Gas & Electric Company. All rights reserved. Page 40 of 55

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I Asset Images

This Appendix supplements the description presented in Section 2.

LNG Tanker



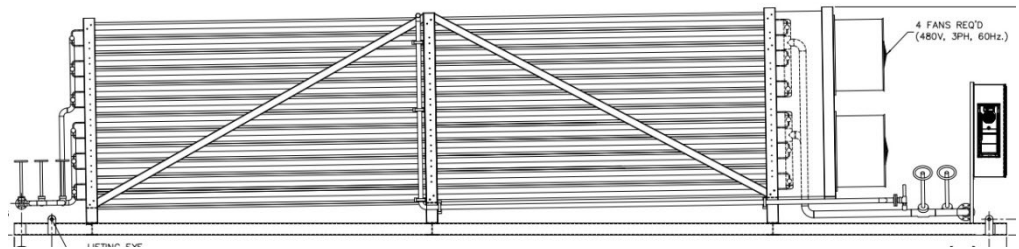
LNG Vaporizer



Ambient LNG Vaporizers



Forced Draft LNG Vaporizers



CNG Tube Trailers



Gap Trailers



CNG Injection Trailers (Trim Heater and Ambient)



Small CNG Storage/Injection Trailers



Portable CNG Storage/Injection Modules



J Metrics

The following table provides a list of metrics associated with the strategic objectives for the portable LoB.

The AF maintains other metrics in addition to these that support improved understanding of asset health and business circumstances.

Table 16 - Metrics for Strategic Objectives

Program	Metrics
A) Management of Injection Operations Loss of Containment	<ul style="list-style-type: none"> Count of substantial loss of containment events during injection operations, accompanied by root cause analysis of any significant loss of containment. Training standards, work procedures percent complete.
B) Managing Risks of Loss of Containment while Parked caused by Collision or Third Party Damage	<ul style="list-style-type: none"> Count of collision caused loss of containment while parked incidents. Count of near hit incident/events. Training, standards, and work procedures percent complete.
C) Equipment Integrity Management	<ul style="list-style-type: none"> Count of substantial loss of containment events, accompanied by root cause analysis of any significant loss of containment. Injection operations equipment reliability. Count of customer outages during injection operations. Training, standards, and work procedures percent complete.
D) Integrity of Equipment required for Transportation	<ul style="list-style-type: none"> Count of substantial loss of containment equipment-related events during transportation operations, accompanied by root cause analysis of any significant loss of containment. Counts of incidents/events and near hit incident/event counts involving equipment-related transportation operations, accompanied by root cause analysis. Training, standards, and work procedures percent complete. Various statistics related to equipment maintenance and health.
E) Performance While in Transport	<ul style="list-style-type: none"> Incident counts during transportation, accompanied by root cause analysis. Near hit incident/event counts during transportation, accompanied by root cause analysis. Training, standards, and work procedures percent complete.
F) LNG Supply Management	<ul style="list-style-type: none"> Customer outage during injection operations. Count of LNG supply disruptions or near disruptions.
G) CNG Supply Management	<ul style="list-style-type: none"> Count of customer outage during injection operations. Count of CNG supply disruptions or near disruptions.
H) Service Availability	<p>Sufficient equipment and personnel capability to support pipeline construction and operations, as judged by work streams that this AF supports.</p> <p><i>The optimum equipment inventory level is not one which is capable of always responding to all work streams that this AF supports; rather, it is a balance between these needs and the flexibility of these needs (e.g., rescheduling work, or planning effectively to accomplish work with the existing portable inventory).</i></p>



I) Records Management	<ul style="list-style-type: none">• Records management system percent complete. .
J) Compliance	<ul style="list-style-type: none">• Records management system percent complete.• Count of notice of violations.• Count of findings from self-initiated audits by SMEs.• Training standards, work procedures percent complete.

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