



# **GP-1107 - CNG Station 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 CNG station line of business (LoB) of the LNG/CNG 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 Strategic Asset Management Plan, the guidance document for the development of AMPs.

### 1.1. Asset Overview

The physical assets of this asset family consist of 32 CNG stations ("stations"), 24 of which are accessible by third-party customers. The stations provide fuel to over 3,000 third-party customer vehicles ranging from individuals to large corporate fleets, and serve as a backup fuel supply to customer-owned stations when those customer-owned stations are not available due to closures, breakdowns, or maintenance. The stations also provide fuel to over 350 CNG vehicles in PG&E's own fleet, and provide refilling capabilities for PG&E's portable CNG equipment used to maintain natural gas service to PG&E's residential, commercial and industrial customers.

Stations consist of equipment permanently installed to dry, compress, store and dispense CNG. Stations are located throughout PG&E's service territory at PG&E service center yards.

### 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 2016 station strategic asset objectives developed are as follows. Alignment with LoS goals is presented in Section 4.

1. **Loss of Containment** - Reduce substantial loss of containment events in stations by 50% from 2014 through 2017.
2. **Obsolescence Management** - Complete accelerated obsolescence management plan to reach a steady-state optimum pace.
3. **Training/Procedures** – Training, standards, and work procedures are in place by the end of 2016.
4. **Drive-Offs** - Reduce drive-off events by 10% year-over-year.
5. **Station Availability** - Maintain a station dispensing availability of 99.8% or better.
6. **Document Upgrade** – Complete the first phase consisting of the most critical station documents by 12/31/16.

7. **Predictive Maintenance** - Implement an industry best practice predictive maintenance program for compressors and high failure risk components by 12/31/17.
8. **Compliance** – Maintain the existing continuous compliance review program and resolve issues as scheduled.

### 1.3. Asset and Data Condition

Most stations have been in service over 20 years, and while some station equipment is relatively new as a result of recent replacement investments, many stations still contain equipment which is nearing or beyond the end of its useful service life. Replacements of station components are planned every year for obsolescence management.

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.

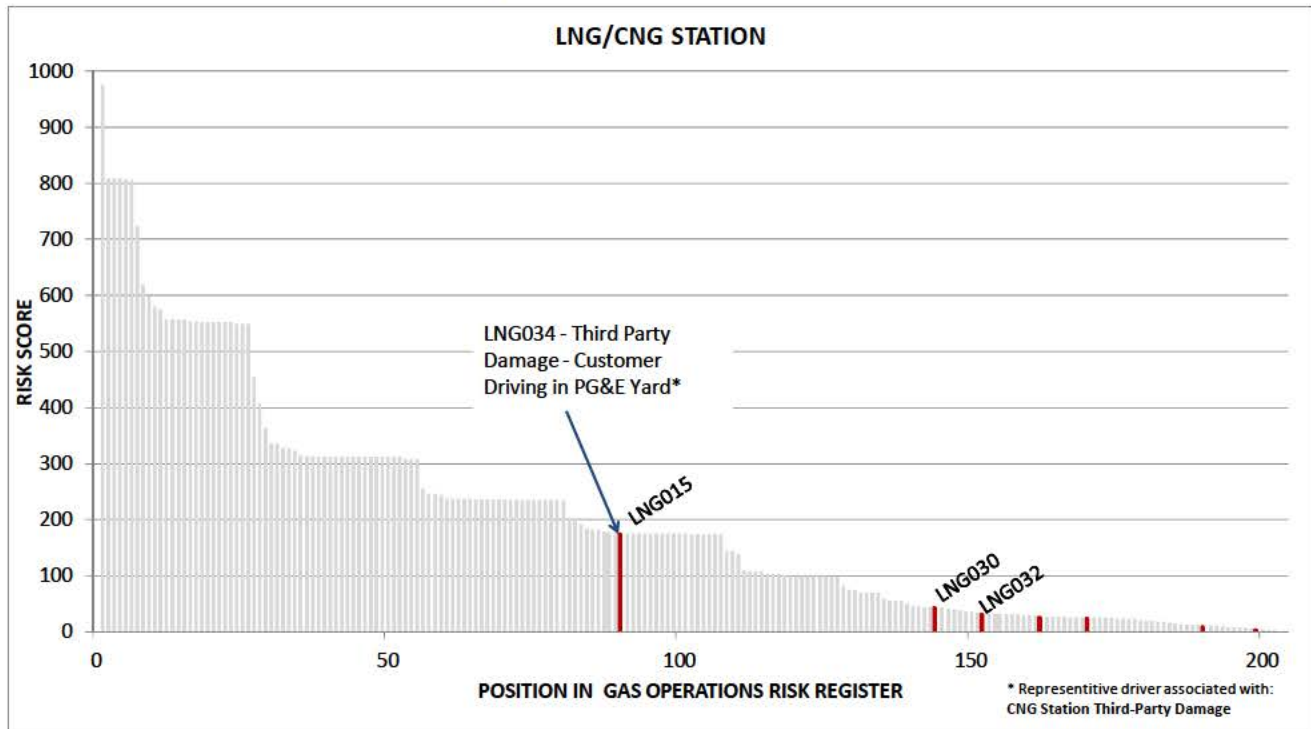
### 1.4. Key Risks

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, which are those with the highest safety impact scores, but a rolled up risk (LNG 034) has been created it appears on the figure below.

Figure 1 below displays the position of the LNG/CNG AF risks (red) for the station LoB within the Gas Operations risk register.

**Figure 1 - Gas Operations Risk 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. Programs have been proposed to address risks that are not currently adequately mitigated. The 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 General Rate Case that included CNG station assets.

The CNG station LoB has undertaken or is planning a number of mitigations to reduce risk while maintaining reliability and investing efficiently.

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

**Table 1 – Key Station Threats and Risks**

Threat	Risk ID	Risk description & Status Summary	Primary Mitigation and Controls	Mitigation Metric
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Threat	Risk ID	Risk description & Status Summary	Primary Mitigation and Controls	Mitigation Metric
Third Party Damage	LNG12	Fueling Station Drive Away - Safety – Risk: Loss of containment leading to a fire, extensive safety impact, financial loss, loss of reliability (days or weeks long outage), reduced capacity, repair costs. Drivers: Risk of inadvertent dispenser equipment or vehicle damage by fuel customers (drive off) which is common. Ranks 117 <sup>th</sup> in the Gas Operations risk register. <i>Current mitigation is unsatisfactory, but mitigation implemented in 2014, 2015 and 2016 has begun to reduce this risk, and mitigations will continue to be expanded. .</i>	<ul style="list-style-type: none"> <li>• Install video surveillance equipment</li> <li>• Establish consequences for customers who cause drive-off incidents</li> </ul>	Count of drive-off events
Third Party Damage	LNG15	CNG Tank Rupture - Safety – Risk: Loss of containment and shrapnel (rupture and high energy release) with severe safety impact, financial loss, loss of reliability (days or weeks long outage), reduced capacity, repair costs. Drivers: Natural gas vehicle tank rupture due to integrity management shortfall by customer <i>PG&amp;E's program to drive improvements in customer equipment integrity is now mature, which is believed to have substantially reduced this risk. Work continues to drive further reductions in risk.</i>	2016: Continue with implementation of requirement for customers to provide periodic evidence of successful inspection of vehicle fuel system equipment, in order to retain access to PG&E fuel stations.	<ul style="list-style-type: none"> <li>• Count of substantial loss of containment events</li> <li>• Percent of existing customers with valid, current vehicle fuel system inspection documentation in file</li> </ul>
Incorrect Operations	LNG30	Station Documentation - Safety – Risk: Major safety impacts on personnel or the public. Drivers: Incomplete documentation for CNG stations combined with new less-experienced personnel may result in engineering or operations errors. <i>Continued enhancement of existing drawings is also underway as an on-going routine maintenance and operations activity.</i>	<ul style="list-style-type: none"> <li>• Complete the development of critical drawings</li> <li>• Personnel training</li> <li>• Inherently safe design</li> <li>• Further improvements to records systems</li> </ul>	<ul style="list-style-type: none"> <li>• Records management system percent complete.</li> <li>• Station critical documents development percent complete.</li> </ul>
Equipment	LNG32/ 32.1	Station Compressor and Component - Safety – Risk: Pressure/shrapnel that could cause major safety impacts to nearby personnel. Drivers: Compressor (station) or component material failure. <i>Current mitigation is unsatisfactory, but mitigation being implemented in the obsolescence management plan through the early 2020s (refer to Appendix H) is expected to substantially reduce this risk.</i>	<ul style="list-style-type: none"> <li>• Equipment maintenance and quality control</li> <li>• Personnel training</li> <li>• Equipment design and process safety</li> </ul>	Significant loss of containment counts



Threat	Risk ID	Risk description & Status Summary	Primary Mitigation and Controls	Mitigation Metric
Third Party Damage	LNG34	Risk of customer unsafe driving or driving error may result in fatality and/or substantial equipment damage. <i>Dispenser relocation project is proposed in the capital spending plan to extend from 2017 through 2019.</i>	<ul style="list-style-type: none"> <li>Customer training and information</li> <li>Customer account suspension</li> <li>Planned relocation of dispensers</li> </ul>	Not yet established

## 2. Asset Inventory and Condition Overview

### 2.1. Asset Overview

This asset family consists of 32 CNG stations, 24 of which are accessible by third party customers. The stations provide fuel to over 3,000 third-party vehicles for a customer group consisting of large municipal transportation organizations, large fleet organizations (e.g., UPS, AT&T), individual customers and to nearly 350 PG&E vehicles. They also serve as a backup fuel supply to customer-owned stations when those customer-owned stations are not available due to closures, breakdowns, or maintenance, and provide the CNG for PG&E's portable CNG equipment used to maintain natural gas service to PG&E's residential, commercial and industrial customers. Portable compressors are also part of the asset family inventory, and are used as backup compression for CNG station compressors and to fill PG&E portable equipment. Table 2 below provides a brief overview.

Stations consist of equipment permanently installed to dry, compress, store and dispense CNG. Stations are located throughout PG&E's service territory at PG&E service center yards.

**Table 2 - Asset Overview**

Asset	Description
<b>CNG Stations</b>	Stations at fixed locations which compress pipeline natural gas into high-pressure on-site storage, and dispense high-pressure CNG to vehicles and PG&E portable CNG storage and transportation equipment. <ul style="list-style-type: none"> <li>32 stations with total combined CNG dispensing capacity of over 5,000 cubic feet per minute (CFM), and individual station dispensing rates ranging from 2 CFM to 650 CFM.</li> </ul>
<b>CNG Hurricane Compressors</b>	Trailer mounted internal combustion engine driven natural gas compressors. Used primarily as backup to CNG station compressors and to refill tube trailers with gas supplied from PG&E natural gas pipelines. <ul style="list-style-type: none"> <li>Three trailers with ~50 horsepower compressor driver and one with 100 horsepower.</li> <li>Capability is comparable to some of the fixed compressors in CNG stations.</li> </ul>
<b>Portable Skid-Mounted Compressor</b>	Skid mounted electric motor driven natural gas compressor that can be moved by trailer to portable CNG project sites to refill any and all of LNG/CNG's portable CNG equipment, or to stations on a temporary basis to support station outages. This unit is rated at 200 hp which provides much faster fill rates than the Hurricane units, but requires a large generator or temporary connection to a utility electrical grid for power. Commissioned in April 2016.





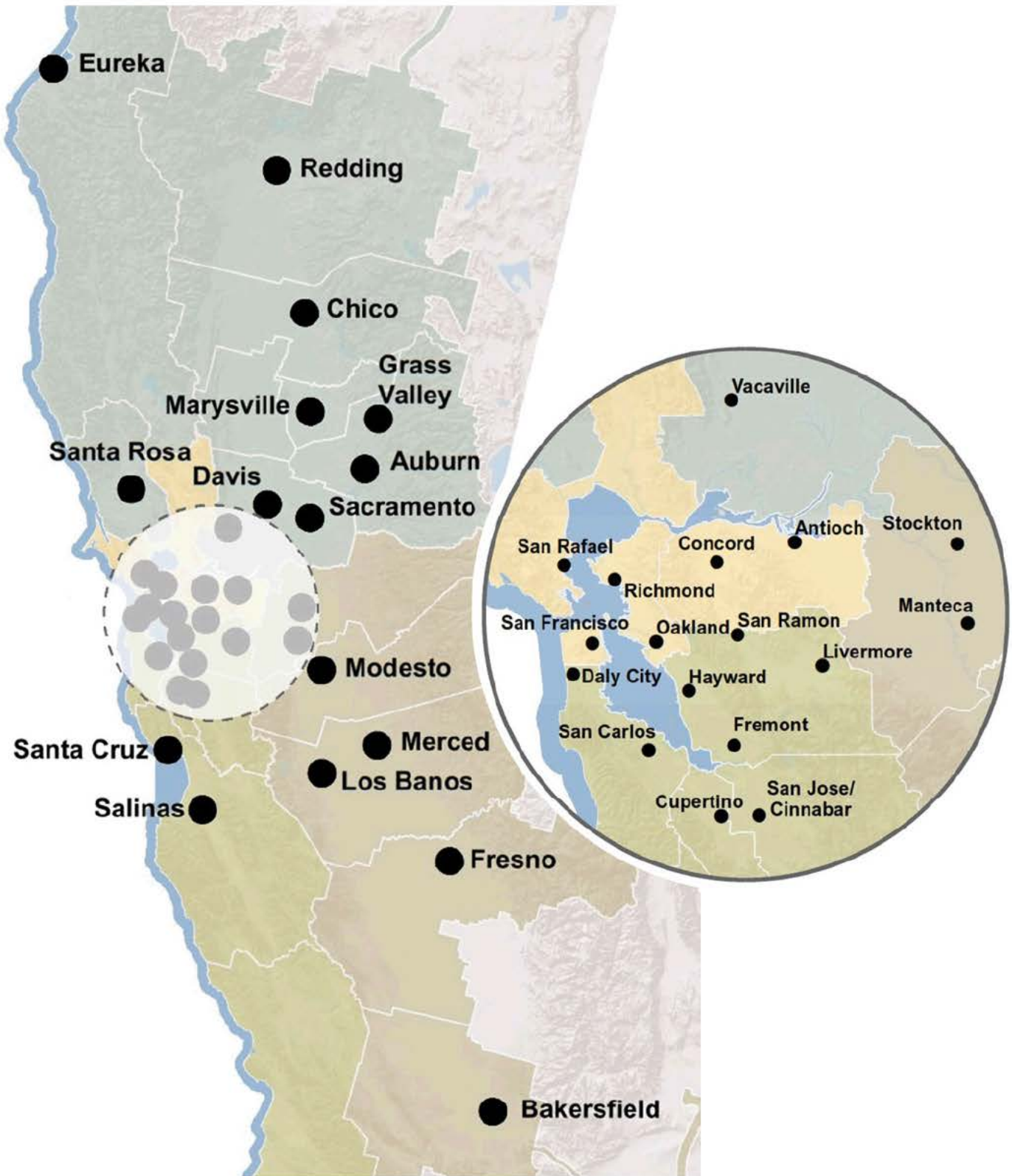
Dispensers and station compression and storage equipment are found located both inside and outside of PG&E service center security fencing. Station equipment is protected from vehicle damage by concrete filled steel posts. Station electrical power and natural gas are supplied by PG&E (with the exception of Sacramento which is supplied electricity by the Sacramento Municipal Utility District).

CNG fuel sale transactions are logged at each station by a magnetic stripe card reader (standard plastic credit card technology) and processed by PG&E's Energy Data Services (EDS) Department. Prospective customers must apply for a fueling card, and be trained by PG&E personnel before being granted access to a fueling station. Fuel delivered to each station is measured and accounted for through PG&E's G-NGV1 tariff as a PG&E usage of transmission or distribution supply gas. Third party CNG customers are billed on the G-NGV2 tariff, that is for compressed gas leaving the station to customers. Station electrical power consumption is billed to the station operating budget.

PG&E's CNG stations are distributed throughout PG&E's service territory as shown on

Figure 2 below.

Figure 2 - Map of CNG Station Locations



## 2.2. Asset Inventory and Condition

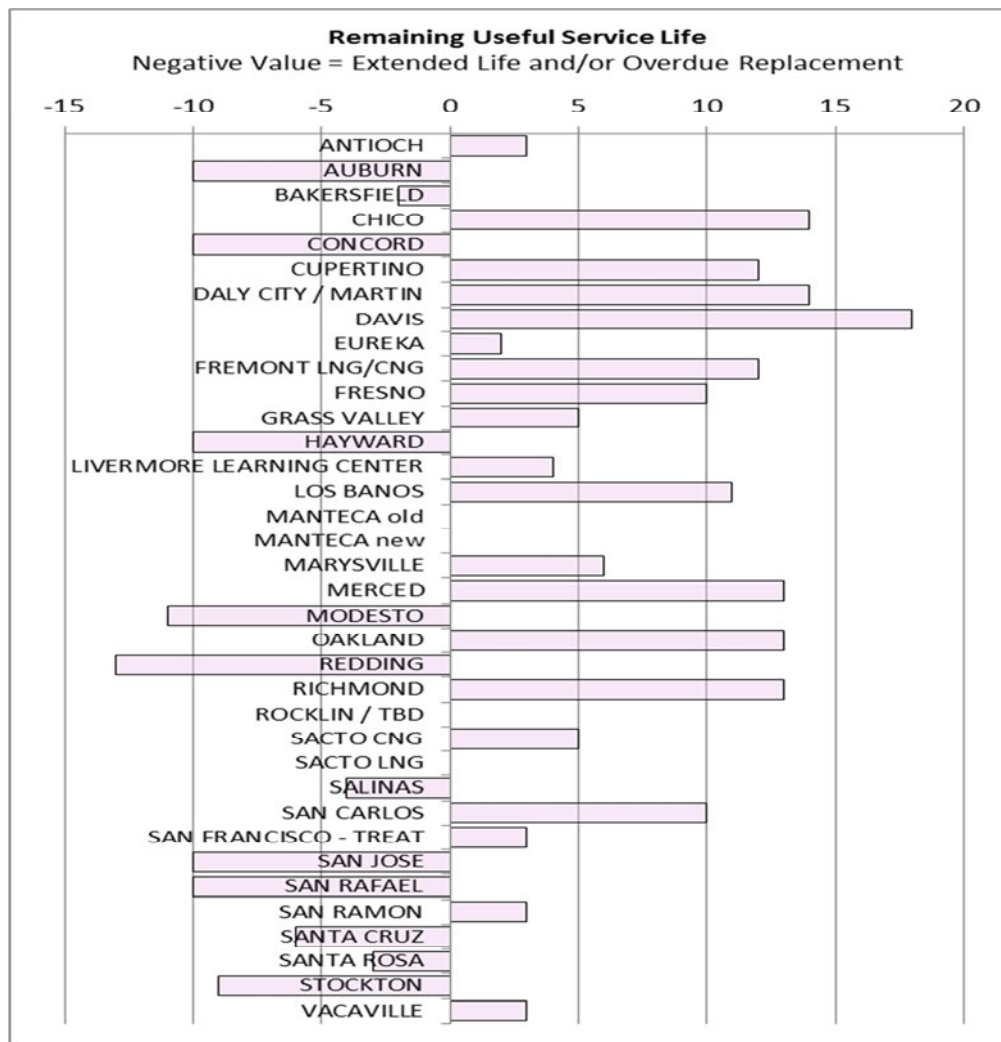
The availability of asset condition data varies across asset types within the AF. An effort is underway to improve data collection and condition assessment data with enhancements to both SAP and off-line data sets that are discussed in further detail in Section 4. Asset inventory and condition is detailed by asset type in the following sections. A table detailing station and equipment condition is provided in Appendix J.

### 2.2.1. Physical Assets

Figure 3 and Table 3 that follows summarize the condition of assets in this family.

Compressors and related major components such as control systems in a number of CNG stations have reached or are beyond their useful service lives – the compressors and related major equipment at 13 CNG stations are scheduled for replacement in the 2015-2020 time frame. One major rebuild was completed in 2015, and two are scheduled for completion in 2016.

**Figure 3 - Remaining Life as of 2016**





The following summarizes the circumstances that support these figures:

- The assessment of remaining useful service life is complex. Age, usage level, condition (maintenance history, and outage type, frequency, duration) and consequences of failure are all elements which are considered. Condition is addressed briefly in Table 3 below.
- For many asset components such as ASME storage vessels, canopies and other structural elements, and electric and gas supply equipment, the service life is much longer than for the compressor and related equipment. Forecast remaining life is supported by condition assessments performed during maintenance and operations, combined with industry experience.
- The service lives of some components may not be as long as for the compressors, such as dispenser and electrical/electronic controls.
- Relatively short remaining service lives for some asset components are typically based on factors such as obsolescence (e.g., no longer supported by the original manufacturer so parts are unavailable) or condition (e.g., continued repair is less economical than replacement).
- Far more equipment has outlived its useful service life or is obsolete, than is desirable. The obsolescence management plan is replacing equipment at a faster pace over the next 5 to 10 years in order to resolve this, after which, replacement rates will slow to a pace that is sustainable for the long term.

This asset management plan 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 and investment/maintenance spending planning.

**Table 3 - Asset Condition Summary**

Asset Class Aspect	Condition / Age / History
CNG Stations	
Condition Overview	Equipment with limited useful service life consists of compressors and compressor components (moving parts), electronics, and soft goods in control valves/regulators. Equipment in compressor stations typically has a useful life of 20 years and the majority of the equipment is replaced on those intervals. The service lives of structural elements and primary natural gas storage vessels at the facilities are viewed as 30 years or longer.
Condition Summary	AGE: Varies from 0 to 24+ USAGE: Average of approximately 6000 hrs. per year. QUALITATIVE CONDITION DESCRIPTION: Fair/poor. Compressors and supporting equipment at 20 stations are nearing or beyond the end of useful service lives and are scheduled for replacement in 12 stations in the 2015-2020 time frame.



Asset Class Aspect	Condition / Age / History
CNG Portable Compressors	
Condition Overview	<p>Portable "Hurricane" compressors are 9 to 12 years old but were reconditioned over the last 3 to 4 years. Equipment with limited useful service life consists of compressors and compressor components (moving parts), electronics, and soft goods in control valves/regulators. This equipment has an expected service life of 5 to 10 years, and will be replaced rather than reconditioned on the next obsolescence management cycle.</p> <p>A new portable compressor has been commissioned early in 2016, when unexpected useful service life of at least 10 years.</p>
Condition Summary	<p><u>Hurricanes:</u></p> <p>AGE: 9-12 years, rebuilt and upgraded with new controls and safety features in 2010-2014.</p> <p>USAGE: Average approximately 800 hours per year each.</p> <p>QUALITATIVE CONDITION DESCRIPTION: Good - Reliability and corrective maintenance levels are not as good as those for new equipment, but satisfactory for current operating needs. Equipment is modernized technology but still not as reliable or effective as desired; and in the early stages of its service life.</p> <p><u>New portable compressor:</u></p> <p>New as of early 2016. Condition will be better understood upon completion of the first major operation project occurring in June 2016.</p>

### 2.2.2. Data Summary

#### 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.

#### 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., fueling station compressor replacements in the AMP timeframe) 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.

### 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 – Station Threat Categories**

Threat Category	Description	Specific Threats
<b>Time-dependent</b>	Potentially increase over time	<ul style="list-style-type: none"> <li>• External Corrosion</li> <li>• Internal Corrosion</li> <li>• Stress Corrosion Cracking</li> </ul>
<b>Stable or “Resident”</b>	Present, or potentially inherent in the asset, but do not grow over time or pose a threat unless influenced by another condition or failure mechanism	<ul style="list-style-type: none"> <li>• Manufacturing</li> <li>• Construction/Fabrication</li> <li>• Equipment Related</li> </ul>
<b>Time-Independent</b>	Not influenced by time	<ul style="list-style-type: none"> <li>• Third Party Damage</li> <li>• Incorrect Operation</li> <li>• Weather and Outside Forces</li> </ul>

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 CNG Station 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 nine risks for CNG stations.

Figure 4 below displays the risk score position of the LNG/CNG AF risks (red) for the CNG station LoB within the set of risk scores across the entire Gas Operations risk register. The largest station LoB risks are shown numbered. Numbers correspond to Table 5 that follows the figure.



**Figure 4 - Gas Operations Risk Score Histogram**

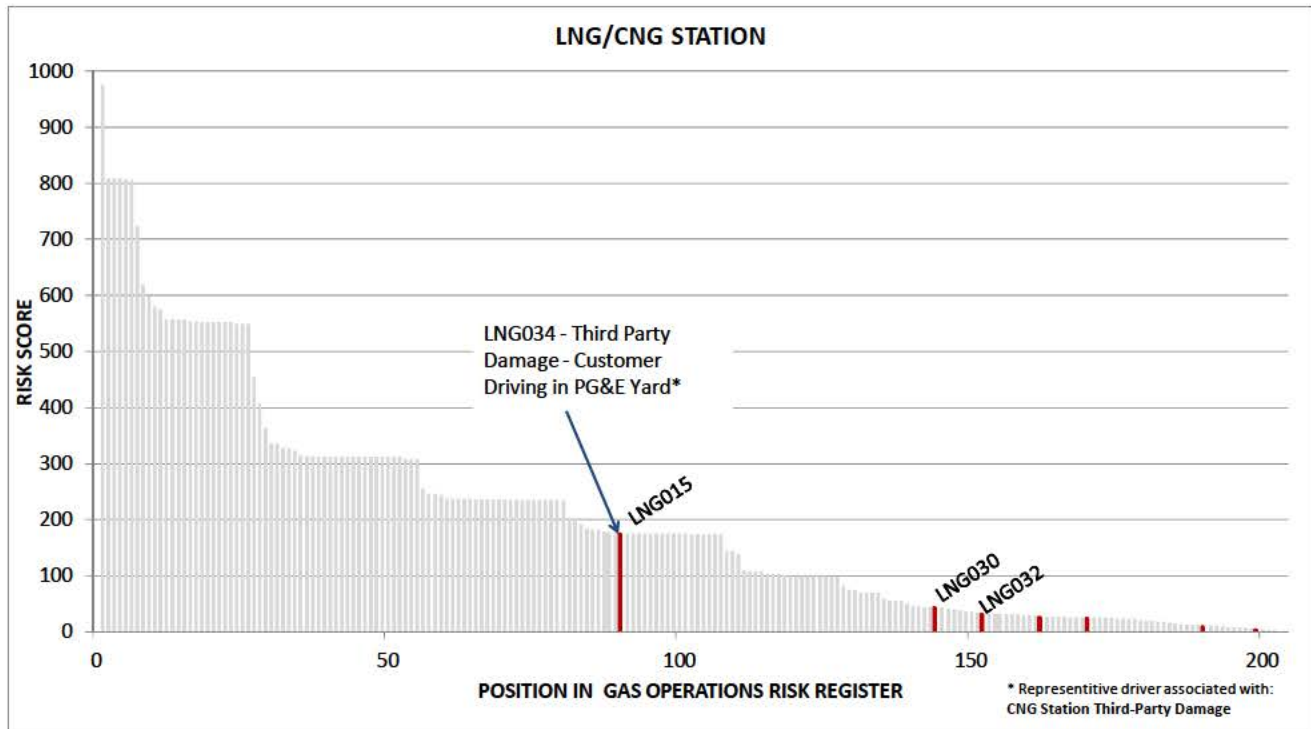


Table 5 below presents a brief summary of the key CNG station risks contained in the Gas Operations combined risk register. All CNG station risks are listed in Appendix C.

**Table 5 - Risk Summary**

Risk ID	Risk Description	Threats
LNG12	<p><u>Fueling Station Drive Away - Safety</u> - Risk of inadvertent dispenser equipment damage by fuel customers (drive off) which is common, may result in loss of containment leading to a fire, extensive safety impact, financial loss, loss of reliability (days or weeks long outage), reduced capacity, repair costs.</p> <p><i>Mitigation results while improved over the 2013-16 period are still unsatisfactory. Work continues to explore and implement current and new approaches to attempt to further reduce events.</i></p>	Third-Party Damage
LNG15	<p><u>CNG Vehicle Tank Rupture - Safety</u> - Risk of CNG vehicle tank rupture due to integrity management shortfall by customer may result in loss of containment (rupture and high energy release) with severe safety impact, financial loss, loss of reliability (days or weeks long outage), reduced capacity, repair costs.</p> <p><i>PG&amp;E's program to drive improvements in customer equipment integrity is now mature, which is believed to have substantially reduced this risk. Work continues to drive further reductions in risk.</i></p>	Third-Party Damage

Risk ID	Risk Description	Threats
LNG30	<p><u>Station Documentation - Safety</u> - Risk of incomplete documentation for CNG stations may result in engineering or operations errors that may cause major safety impacts on personnel or the public.</p> <p><i>Development of new critical documentation is the major mitigation effort underway during 2014-16, and will continue beyond 2016. Continued enhancement of existing documentation is also underway as an on-going routine maintenance and operations activity.</i></p>	Incorrect Operations
LNG32/ 32.1	<p><u>Station Compressor and Component – Safety and Reliability</u>- Risk of compressor (station) or component material failure may result in pressure/shrapnel that could cause major safety impacts to nearby personnel, or adversely impact reliability.</p> <p><i>Mitigation being implemented in the obsolescence management plan through the early 2020s (refer to Appendix H) will end the practice of operating equipment that is beyond its useful service life - this will substantially reduce this risk.</i></p>	Equipment
LNG34	<p><u>Risk of customer unsafe driving or driving error may result in fatality and/or substantial equipment damage.</u> This risk is both an AF risk in the Gas Operations risk register but as noted on Figure 4 above is also a roll up risk for Gas Operations in the PG&amp;E enterprise-wide risk register - as a roll up risk it represents all of the third-party damage risks for this AF.</p> <p><i>Dispenser relocation project to resolve this is proposed in the capital spending plan to extend from 2017 through 2019.</i></p>	Third-Party Damage

### 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

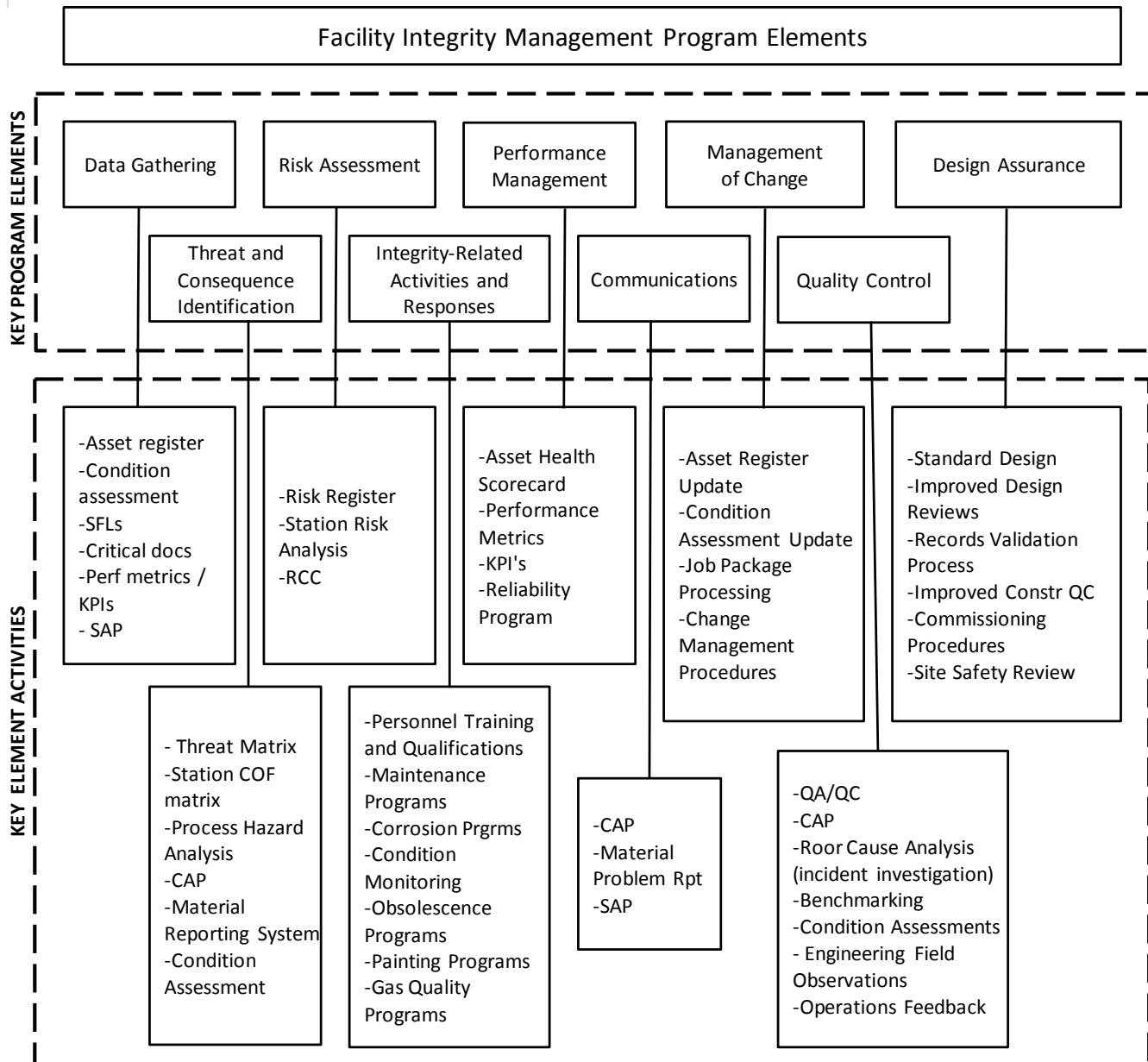
This station AMP is very much a part of this FIMP for the LNG/CNG AF.

An initial summary of the elements of the FIMP is shown in Figure 5 below.





**Figure 5 – 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 that 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 station 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 LoS goals are as follows. In those circumstances where the strategic objective is not clearly the desired state, supplemental remarks are provided for clarity.

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

Gas Operations LoS Goals	CNG Station Strategic Objectives / Desired State	Metrics
Safety Reliability Customer	<p>1. Loss of Containment - Reduce substantial loss of containment events in stations by 50% from 2014 through 2017.</p> <p>Desired state is zero substantial loss of containment incidents.</p>	<ul style="list-style-type: none"> <li>Count of drive-off events.</li> <li>Count of substantial loss of containment events.</li> <li>Percent of existing customers with valid, current vehicle fuel system inspection documentation in file.</li> <li>Count of vandalism events.</li> <li>Training standards, work procedures percent complete.</li> </ul>
Safety Reliability Customer Affordability	<p>2. Obsolescence Management - Complete scheduled obsolescence management plan.</p> <p>Desired state is for the obsolescence management plan to proceed as scheduled, so that beginning 5 to 7 years from now, no station has a 10 health score. See Appendix K, Figure 9.</p>	<ul style="list-style-type: none"> <li>Significant loss of containment counts during operations, accompanied by root cause analysis of any significant loss of containment.</li> <li>Compressor and dispensing reliability.</li> <li>Count of stations in 10 health level realm.</li> </ul>



Gas Operations LoS Goals	CNG Station Strategic Objectives / Desired State	Metrics
Safety Reliability People	3. Training/Procedures – Training standards, work procedures are in place by the end of 2016.  Desired state is for these materials to be in place.	<ul style="list-style-type: none"> <li>Records management system percent complete.</li> <li>Station documents development percent complete.</li> <li>Training standards, work procedures percent complete.</li> </ul>
Safety Compliance Reliability Customer	4. Drive-Offs - Reduce drive-off events by 10% year-over-year.  Desired state is to achieve and then maintain zero drive-off events.	<ul style="list-style-type: none"> <li>Count of drive-off events.</li> </ul>
Reliability Customer	5. Station Availability - Maintain a station dispensing availability of 99.8% or better.	<ul style="list-style-type: none"> <li>Compressor and dispensing reliability.</li> </ul>
Safety Compliance People Customer	6. Document Upgrade – Complete the first phase consisting of the most critical station documents by 12/31/16.  Desired state is completion of all critical station documents.	<ul style="list-style-type: none"> <li>Records management system percent complete.</li> <li>Critical documents development percent complete.</li> <li>Training standards, work procedures percent complete.</li> </ul>
Reliability Customer Affordability	7. Predictive maintenance program is in place by the end of 2017.  Desired state is that predictive maintenance has been evaluated and applied as appropriate.	<ul style="list-style-type: none"> <li>Program development percent complete.</li> </ul>
Compliance	8. Compliance – Maintain zero notice of violations from regulatory agencies.	<ul style="list-style-type: none"> <li>Records management system percent complete.</li> <li>Count of notice of violations.</li> <li>Count of significant findings from self-initiated audits by SMEs.</li> </ul>

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	CNG Station Strategic Objectives							
	1. Loss of Containment	2. Obsolescence Management	3. Training/ Procedures	4. Drive-Offs	5. Station Availability	6. Document Upgrade	7. Predictive Maintenance	8. Compliance
A) Third-Party Damage Risk Management - Require customers to comply with safe operating practices, impose consequences on offending customers; improve education of customers; improve ability to identify customers; reduce fuel theft or unpaid sales risk management.	X		X	X	X			X
B) Station Documentation Improvement - Address equipment reliability and safety risks through improved documentation. Various - Development of critical documents; staff training enhancement; inherently safe design.	X		X		X	X		X
C) Equipment Integrity and Obsolescence Management Address equipment related safety, reliability and cost risks. Replace old and obsolete station equipment; ongoing maintenance, best engineering and operations practices research and implementation	X	X			X	X	X	X
D) Compliance Related Risks - Address compliance risks. Improve documentation, work to update Cal OSHA Title 8; self-initiated audits of facilities, maintenance and operations;	X	X	X			X		X

## 4.2. Programs and Mitigations Overview

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, CNG Stations**

<b>Program:</b>	A) Third Party Risk Management
<b>Risks Addressed:</b>	LNG12, LNG13, LNG14, LNG15, LNG34
<b>Timeframe:</b>	2015 – 17, followed by ongoing control
<b>Desired State</b>	<ul style="list-style-type: none"> <li>• <u>Achieve zero drive-off events.</u> In the interim, reduce drive-off events by 10% year-over-year. Reductions in drive off event counts achieved in the initial stages of the program have not been sustained through 2015 into early 2016, suggesting that the low hanging fruit has been achieved and future reductions will be far more difficult. PG&amp;E's reduction efforts will continue but while the desired state is zero drive off events, a modest reduction year-over-year is now viewed to be the worthwhile but potentially overly optimistic objective.</li> <li>• <u>Achieve zero significant loss of containment of customer vehicle fuel systems.</u> Such events happen less often than once per year, so statistics for rare events are difficult to use for conclusions. No events have occurred during the last two years. Access for a number of customers was suspended because of customer failure or inclination not to comply with PG&amp;E's new vehicle fuel system inspection requirements, and the remaining customers have largely completed inspections, all of which improve confidence that the desired risk reductions have been achieved. See immediately below.</li> <li>• <u>100% valid customer vehicle fuel system inspections on file no older than three years as required by code.</u> We are satisfied with the current results that are hovering between 96 and 98%, but are continuing to push towards 100%.</li> <li>• <u>Maintain zero count of vandalism incidents.</u> No significant vandalism incidents have occurred over the last few years.</li> <li>• <u>A mature, comprehensive customer overdue account procedures are implemented that prevent significant overdue bill amounts.</u> Work continues to integrate LNG/CNG customer service activities with PG&amp;E Billing to achieve this. A tighter process as desired should be in place in 2016 or 2017.</li> <li>• <u>Uncollected fuel charges are limited (not yet resolved).</u> See immediately above.</li> <li>• <u>Training standards, work procedures are in place by the end of 2016.</u> Many high priority guidance documents are now in place but the effort is still under way.</li> <li>• <u>Dispensers are not located inside of PG&amp;E service center yards by the end of 2019.</u> Dispenser relocation project to resolve this is proposed in the capital spending plan to extend from 2017 through 2019.</li> </ul>





**Scope:**

This program was developed to reduce safety risks associated with

- customer fueling station drive-off incidents
- customer vehicle CNG fuel system integrity shortfalls
- dispenser vandalism
- customers driving in PG&E service center yards to gain access to CNG fuel dispensers

The scope includes:

- **CUSTOMER**

- Continue the current program to provide customer training when new accounts are opened.
- Maintain and improve customer signage at stations.
- Continue to provide special mailings to customers advising of the importance of safe practices and the consequence that fueling customers may be denied access to PG&E's stations.
- Establish and enforce consequences for customers who cause drive-off incidents that are believed will reduce the incident frequency and therefore the likelihood of an event with adverse safety impacts.
- Continue to expand efforts to increase customer awareness regarding the risks importance of safe driving inside PG&E service center yards through signage, mailing content, customer training and customer on-site awareness programs.
- Continue to impose consequences for customers who perform unsafe driving in service center yards by promoting awareness and reporting among PG&E employees at these yards.
- Continue with efforts to attempt to establish PG&E employee drive-off events as motor vehicle incidents (MVI's) to help emphasize the importance of attention to proper fueling procedures during fueling operations.

- **ENGINEERING/MAINTENANCE/PROJECTS**

- Continue to develop and maintain critical SME technician and engineer capability in-house through hiring, training and work experience.
- Continue to assess and benchmark dispenser design and maintenance in search of opportunities to reduce risk of overpressure.
- Continue the current program for technician maintenance and repair of dispenser hose breakaway devices.
- Continue with the newly initiated program to install video surveillance equipment at stations to improve PG&E's ability to establish with certainty, the customer identity in drive-off incidents, or to gather data on dispenser vandalism.
- Develop and implement capital work proposals for moving dispensers from inside service center yards to outside the yards along public streets.

- **ADMINISTRATIVE**

- Continue the program that requires customers to provide evidence of successful inspection of vehicle fuel system equipment, in order to retain access to PG&E fuel stations

<b>Responsibilities</b>	<ul style="list-style-type: none"><li>• Station customer care is overseeing the customer communication/training activities and the administrative controls for customer CNG vehicle integrity and customer account issues.</li><li>• Station engineers and technicians provide customer vehicle integrity QC in the field.</li></ul>
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<b>Program:</b>	B) Station Documentation Improvement
<b>Risks Addressed:</b>	LNG30
<b>Timeframe:</b>	2015 – 16, followed by ongoing control
<b>Desired State</b>	<ul style="list-style-type: none"> <li>• <u>Desired state is completion of all critical station documents. In the near term important station documents are in place by the end of 2016. Many high priority guidance documents are now in place and the most critical documents are expected to be in place as scheduled. However, the effort is expected to continue for several years beyond that.</u></li> <li>• <u>A mature, comprehensive records management system is in place by the end of 2016. A guidance document is now in place for LNG/CNG records management that is expected to achieve this objective by the end of 2016.</u></li> <li>• <u>Training standards, work procedures are in place by the end of 2016. Many high priority guidance documents are now in place but the effort is still underway in support of meeting this objective.</u></li> </ul>
<b>Scope:</b> This program was developed to reduce safety, reliability and financial risks associated with incorrect operations due to documentation shortfalls. The scope includes: <ul style="list-style-type: none"> <li>• Continue efforts underway to develop critical documents and drawings for portions of the stations and equipment, and provide training to ensure that they are consulted for maintenance and engineering work.</li> <li>• Continue with efforts underway to strengthen personnel competency through training, testing and work experience to reduce the likelihood of a human error that could result in a safety or reliability incident.</li> <li>• Continue with current practices to employ inherently safe design of equipment to reduce the likelihood that equipment will fail with a potential adverse safety impact, even if human error occurs.</li> <li>• Continue with current practices to employ inherently safe objectives and practices during maintenance of equipment to reduce the likelihood that equipment will fail with a potential adverse safety impact, even if human error occurs.</li> <li>• Continue with the ongoing review of documentation (e.g., bill of materials, specifications, manuals) to identify opportunities for further improvement.</li> <li>• Continue to employ process safety benchmarking (begun in early 2014) to continue to improve AF understanding of additional opportunities for further strengthening of documentation.</li> </ul>	
<b>Responsibilities</b>	<ul style="list-style-type: none"> <li>• Station engineering group with support from technicians is responsible for guidance document program improvement.</li> <li>• The AF training lead and maintenance organization are responsible for maintenance practice integrity.</li> </ul>



<b>Program:</b>	C) Equipment Integrity and Obsolescence Management
<b>Risks Addressed:</b>	LNG32, LNG32.1
<b>Timeframe:</b>	ongoing obsolescence management program
<b>Desired State</b>	<ul style="list-style-type: none"> <li>Beginning 5 to 7 years from now, no station has a 10 health score. See Appendix K, Figure 9.</li> <li>Achieve and then maintain zero substantial loss of containment incidents. In the interim, reduce significant loss of containment incident count by 50% from 2014 to 2017. Counts have already dropped by a factor of 10 over the last several years, but a longer data history is needed to improve confidence in the validity of this observation as an established trend.  <u>All incidents or near hits lead to improved procedures, training and/or engineering. This is currently being consistently achieved as an ongoing control.</u></li> <li>Equipment and resulting customer service is reliable. Reliability concerns persist but are being addressed through the obsolescence management plan as well as routine corrective maintenance to improve asset health where practical. Satisfactory reliability is expected to be achievable over a 5 to 10 year horizon.</li> <li>Predictive maintenance program has been evaluated and applied as appropriate by the end of 2017. Staffing and resource shortfalls in general are constrained and may hamper the achievement of this.</li> </ul>
<b>Scope:</b> This program was developed to reduce safety, reliability and financial risks associated with compressor station equipment integrity shortfalls. Scope includes: <ul style="list-style-type: none"> <li>Continue with current practices for quality control for equipment, including design and maintenance.</li> <li>Continue with current practices for ongoing maintenance that meets code requirements, exceeds code based on manufacturer recommendations or more stringent AF practices, and identifies and corrects (repair or replace) smaller components that present unacceptable risk levels.</li> <li>Continue with current practices for innovation in the type and design of equipment that results in reductions in risks associated with safety, reliability and cost efficiency.</li> <li>Continue with the obsolescence management program that replaces equipment that has outlived its useful service life, or presents unacceptable safety, reliability and/or financial risks. Refer to the investment expenditure proposal below and Appendices H and J.</li> <li>Continue to enhance asset health data (primarily in SAP) for station equipment.</li> <li>Continue to strengthen the use of process safety practices such as pre-startup safety reviews, change management procedures, and employing a number of versions of process hazard assessments</li> </ul> Appendix K provides more detail on this program.  Mitigation being implemented in the obsolescence management plan through the early 2020s (refer to Appendix H) will end the practice of operating equipment that is beyond its useful service life - this will substantially reduce this risk.	
<b>Responsibilities</b>	<ul style="list-style-type: none"> <li>Station engineering has overall responsibility for implementing the station obsolescence management program investments.</li> <li>LNG/CNG engineering and maintenance organizations are responsible for maintaining equipment integrity.</li> </ul>

<b>Program:</b>	D) Compliance Related Risks
<b>Risks Addressed:</b>	LNG33 Shortfall in design, maintenance or operations relative to code requirements (not included as a specific compliance risk in the Gas Operations risk register).
<b>Timeframe:</b>	2015 – 16 assessment; continuous control thereafter
<b>Desired State</b>	<ul style="list-style-type: none"> <li>• <u>Maintain zero notice of violations from regulatory agencies.</u></li> <li>• <u>A mature, comprehensive records management system is in place by the end of 2016. A guidance document is now in place for LNG/CNG records management that is expected to achieve this objective by the end of 2016.</u></li> <li>• <u>LoB in compliance with applicable codes. While this has been achieved with respect to all known information, audits will continue and issues will continue to be corrected as found.</u></li> <li>• <u>No Notice of Violations from regulatory agencies. This is been achieved to date.</u></li> <li>• <u>Training standards, work procedures are in place by the end of 2016. Many high priority guidance documents are now in place but the effort is still underway in support of meeting this objective.</u></li> </ul>
<b>Scope:</b> This program was developed to reduce compliance risks associated with compressor station documentation and maintenance practices. Scope includes: <ul style="list-style-type: none"> <li>• Continue with the project to create critical drawings that will resolve much of the compliance risk. Mitigation is judged to be improved once the project is complete in perhaps 2017, but further improvements will be pursued beyond that, particularly to manuals addressing engineering, operations and maintenance.</li> <li>• Continue with efforts to seek variances relative to Cal OSHA Title 8 compliance. This code is not complete, largely because these requirements are no longer consistent with the current industry best practices or other more progressive codes. These risks are expected to be resolved but timing is uncertain. No other operators comply with current Cal OSHA. <ul style="list-style-type: none"> <li>○ Title 8 requirements for Cal OSHA Section 530 regarding electrical area classifications are inconsistent with newer, more progressive National Electric Code requirements that are universally employed in industry.</li> <li>○ The requirement for annual tank relief valve testing in Cal OSHA Section 541 conflicts with the NFPA 52 industry standard that requires testing on 3-year interval.</li> </ul> </li> </ul> <p><i>Mitigation is judged to be satisfactory since lack of compliance with CalOSHA Title 8 requirements is not expected to result in adverse regulatory action and does not result in increased safety/reliability/financial risks. It nonetheless deserves resolution. Mitigation will be complete once open issues are resolved.</i></p>	
<b>Responsibilities</b>	<ul style="list-style-type: none"> <li>• Station engineering and LNG/CNG maintenance leadership is responsible for implementing the records management procedure.</li> <li>• Station engineering is responsible for addressing Cal OSHA issues.</li> </ul>

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

Distribution S1: [2015 Distribution S1](#)

Distribution S2: [2015 Distribution S2](#)

## 5. Areas for Continuous Improvement

This section lists initiatives that either will or may be undertaken as improvements to the management of station assets.

**Table 9 – Areas for Continuous Improvement**

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

### 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:  <a href="#">RET2.1LNGCNG_RiskRefres h2016 051916.xlsx</a>            ECTS</p>
Gas Risk Register	The risk register captures all risks outlined in this plan at the date of publish	<a href="http://gasrisk/">http://gasrisk/</a>
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:  <a href="#">ECTS LNG-CNG Mitigations052416.xlsx</a>            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:  <a href="#">DriversCntrl V1 020416.xlsm</a>            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	<a href="http://pgeatwork/Guidance/RiskCompliance/Pages/default.aspx">http://pgeatwork/Guidance/RiskCompliance/Pages/default.aspx</a>
Gas Asset Management Policy	TD-01	<a href="http://www.techlib/default.asp?body=manuals/uo_standard/uo_policies.htm">http://www.techlib/default.asp?body=manuals/uo_standard/uo_policies.htm</a>



Document	Description/Discussion	File Name or Link
Gas Operations Asset Management System Risk Management Standard and Procedure	TD-4011S, TD-4011P-01	<a href="http://www.techlib/default.asp?body=manuals/uos_standards/TD4011S.htm">http://www.techlib/default.asp?body=manuals/uos_standards/TD4011S.htm</a>
Gas Operations Risk and Compliance Committee Charter	GOV-1021S	<a href="http://pgeatwork/Guidance/Governance/Pages/default.aspx">http://pgeatwork/Guidance/Governance/Pages/default.aspx</a>
<b>Strategic Asset Management Plan</b>	GP-1100	<a href="http://www.techlib/default.asp?body=gas_plans.htm">http://www.techlib/default.asp?body=gas_plans.htm</a>
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	
Strategic Risk Management Plan	GP-2100	
LNG/CNG Asset Family Video	Asset Family Owner introduces the LNG/CNG Asset Family and how what you do every day makes a difference in how we are managing and maintaining the health of our assets.	

## B Threat Matrix and Key Threats

This approved version is supplemented by Figure 7 that follows, since Figure 7 is more current and displays more accurately content.

**Figure 6 – Approved Station Threat Matrix**

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"> <li>Condensation under vessel insulation</li> <li>Inadequate coating</li> <li>Atmospheric conditions</li> </ul>	Cathodic Protection	Regular Inspection	Painting Program	Design
	Internal Corrosion	<ul style="list-style-type: none"> <li>MIC/CO2</li> <li>Presence of water</li> </ul>	Dehydration	Inspection		
	Stress Corrosion Cracking	<ul style="list-style-type: none"> <li>Gas temperature</li> <li>Pressure cycling</li> </ul>	Leak Testing	Inspection		
Stable Threats	Manufacturing	<ul style="list-style-type: none"> <li>Poor quality manufacture</li> <li>Inadequate specifications</li> </ul>	Material/ Eqpmt Specs	Vendor QC	Acceptance Testing	Warranty & Contract
	Construction/ Fabrication	<ul style="list-style-type: none"> <li>Incorrect constr practices</li> <li>Inadequate QC/inspection</li> </ul>	Design/BOM	Field QC/Inspection	Construction Specifications	Construction Procedures
	Equipment Related LNG 32, 32.1	<ul style="list-style-type: none"> <li>Age, wear from use</li> <li>Obsolescence</li> <li>Incorrect sizing/design</li> </ul>	Maintenance & Inspection	Equipment Replacement	Process Safety / Design	
Time Independent Threats	Third-Party Damage LNG 12-15	<ul style="list-style-type: none"> <li>Customer errors</li> <li>Terrorism / vandalism</li> </ul>	Process Safety / Design	Customer Education	Customer Account Termination	Code Enforcement
	Incorrect Operations LNG 30, 33	<ul style="list-style-type: none"> <li>Inadequate Procedures</li> <li>Inadequate Training</li> <li>Human Error</li> </ul>	Process Safety / Design	M&O Training	Critical Docs	Work Procedures
	Weather & Outside Forces	<ul style="list-style-type: none"> <li>Lightning</li> <li>Flooding</li> <li>Seismic events</li> </ul>	Maintenance & Inspection	Process Safety / Design		Remedial Fueling Retraining

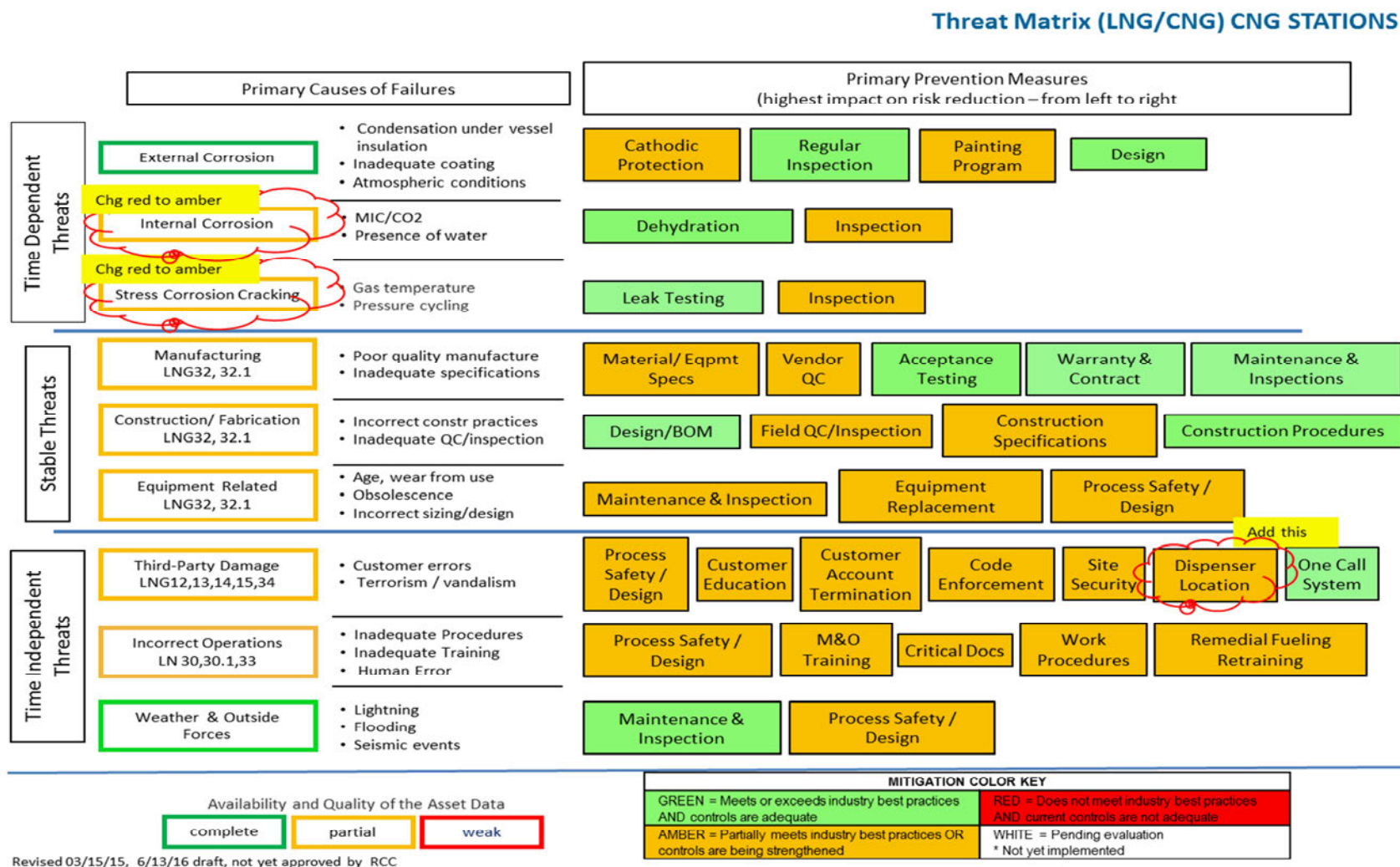
Availability and Quality of the Asset Data		
complete	partial	weak

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 03/15/15

Figure 7 – Updated Draft Station Threat Matrix (not yet approved)





The most current version of the threat matrix as of mid-2016 is presented here as Figure 7. 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 7 and discussed below.

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. Most station 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 inside the stations, and corresponding risks are easily mitigated. However, some buried carbon steel and stainless steel piping does exist, so modest risk of corrosion and prospective loss of containment has been identified and is being addressed.

#### Internal Corrosion

While the risks associated with this threat category are believed to be low based on inspection data for piping and storage vessels, and while gas quality is less conducive to this threat than that found in PG&E's pipeline system because of the lower water content within station piping, expansion of the assessment of this risk is planned.

#### Stress Corrosion Cracking

While the risks associated with this threat category are believed to be low based on CNG station 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. Station 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 station rebuild and repair work. Station 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. Stations consist of a great number and variety of pressure containing components, many of which are subjected to pressure cycling and vibration that can



accelerate wear and increase failure rates. Equipment obsolescence is also a main contributor to risks associated with this threat. Refer to risk LNG 32 addressed in Section four.

#### Third-Party Damage

This remains the area of highest risk score: customer (third-party) vehicle fuel system integrity risks have been decreased through PG&E initiatives, but remain a concern; customer drive-offs will remain a concern until PG&E is able to reduce the frequency of these events. Refer to risks LNG 15 and LNG 12 in Section 4. A risk driver added in the 2016 risk refresh captures the risk associated with CNG fuel customers driving inside PG&E service center yards to reach the CNG fuel dispenser. A preventative measure consisting of the location of the dispenser is proposed to be added to the threat matrix, since many dispensers are located outside of service center yards, and a proposal is under development to move those that remain inside.

#### Incorrect Operations

The complexity of the stations and the high pressures involved present significant safety and reliability risks if operating errors are made by PG&E personnel. Refer to risk LNG 30 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 an expanded summary of the key risks from that found in Table 11, Section 3.1.2 for this AF included in the Gas Operations 2015 risk register. More detail regarding the risk scoring rationale is provided in a companion document, RET2 (refer to Appendix A).

**Table 11 - Key Risks**

Risk ID	Threats	Risk description & Status Summary
LNG12	Third-Party Damage	<p><u>Fueling Station Drive Away - Safety</u> - Risk of inadvertent dispenser equipment damage by fuel customers (drive off) which is common, may result in loss of containment leading to a fire, extensive safety impact, financial loss, loss of reliability (days or weeks long outage), reduced capacity, repair costs</p> <p><i>Mitigation results while improved over the 2013-16 period are still unsatisfactory. Work continues to explore and implement current and new approaches to attempt to further reduce events.</i></p>
LNG13	Third-Party Damage	<p><u>Dispenser Vandalism - Safety</u> - Risk of Dispenser (Fueling Station) failure caused by vandalism may result in dispenser outage and pressure/shrapnel that could cause moderate safety impacts to nearby personnel.</p> <p><i>Existing mitigation consists of equipment design that minimizes the risk, and is satisfactory.</i></p>
LNG14	Third-Party Damage	<p><u>Fuel Theft – Financial</u> - Risk of fuel theft from the Dispenser (Fueling Station) or under collection accounts could result in loss of revenue.</p> <p><i>Current mitigation is satisfactory</i></p>
LNG15	Third-Party Damage	<p><u>CNG Vehicle Tank Rupture - Safety</u> - Risk of CNG vehicle tank rupture due to integrity management shortfall by customer may result in loss of containment (rupture and high energy release) with severe safety impact, financial loss, loss of reliability (days or weeks long outage), reduced capacity, repair costs.</p> <p><i>PG&amp;E's program to drive improvements in customer equipment integrity is now mature, which is believed to have substantially reduced this risk. Work continues to drive further reductions in risk.</i></p>
LNG30	Incorrect Operations	<p><u>Station Documentation - Safety</u> - Risk of incomplete documentation for CNG stations may result in engineering or operations errors that may cause major safety impacts on personnel or the public.</p> <p><i>Development of new critical documentation is the major mitigation effort underway during 2014-16, and will continue beyond 2016. Continued enhancement of existing documentation is also underway as an on-going routine maintenance and operations activity.</i></p>
LNG30.1	Incorrect Operations	<p><u>Incorrect Station Operations – Safety</u> - Risk of engineering or human operations errors that may cause major safety impacts on personnel or the public.</p> <p><i>Training is solid, and is continuously improved in conjunction with documentation (see LNG30) and process safety improvements.</i></p>



Risk ID	Threats	Risk description & Status Summary
LNG32	Equipment	<p><u>Station Compressor and Component - Safety</u> - Risk of compressor (station) or component material failure may result in pressure/shrapnel that could cause major safety impacts to nearby personnel.</p> <p><i>Mitigation being implemented in the obsolescence management plan through the early 2020s (refer to Appendix H) will end the practice of operating equipment that is beyond its useful service life - this will substantially reduce this risk.</i></p>
LNG32.1	Equipment	<p><u>Combined Station Compressor and Component - Reliability</u> - Risk of compressor (Fueling Station) material failure may result in reliability risk.</p> <p><i>See LNG32 above.</i></p>
LNG34	Third-Party Damage	<p><u>Risk of customer unsafe driving or driving error may result in fatality and/or substantial equipment damage.</u> - Customer driving inside PG&amp;E service center yard for CNG vehicle fueling may strike a PG&amp;E employee walking in the yard. This risk is both an AF risk in the Gas Operations risk register but as noted on Figure 4 above is also a roll up risk for Gas Operations in the PG&amp;E enterprise-wide risk register - as a roll up risk it represents all of the Third-party damage risks for this AF.</p> <p><i>Dispenser relocation project to resolve this is proposed in the capital spending plan to extend from 2017 through 2019.</i></p>
n/a	Compliance	<p>Documentation – See LNG30 above</p> <p><i>Shortfall of critical documents exists relative to both code requirements and industry best practices. While not scored as a key risk for this AF, compliance risk is identified as its own category within the Gas Operations risk assessment program. The shortfall for CNG stations is of concern, and mitigation is under way that over the 2016/17 time frame is expected to resolve much if not all of this risk.</i></p>
n/a	Compliance	<p>Lack of compliance with CalOSHA requirements is not expected to result in adverse regulatory action and does not result in increased safety/reliability/financial risks, but deserves resolution.</p> <p><i>PG&amp;E continues to work with CalOSHA to address shortcomings of CalOSHA regulations relative to other current, more progressive industry regulations and best practices. Timing of resolution is uncertain.</i></p>

## D Stakeholder Roles and Responsibilities Matrix

**Table 12 - Key Contacts**

Name / Title	Role	Contact Information
Steve Sheridan	Acting Senior Manager, LNG/CNG Engineering and Operations	209-401-5706 <a href="mailto:SESr@pge.com">SESr@pge.com</a>
Matt Creedon	Supervisor, Station Engineering, LNG/CNG Engineering and Operations	415-238-0476 <a href="mailto:MTCe@pge.com">MTCe@pge.com</a>

**Table 13 - Stakeholders and Responsibilities**

Stakeholder	Responsibilities / Issues
PG&E Gas Operations CNG fueling service clients	<ul style="list-style-type: none"> <li>Provide requirements for CNG fueling services to allow the development and execution of CNG station reliability and availability plants.</li> </ul>
Third party CNG fueling service clients	<ul style="list-style-type: none"> <li>Properly manage the integrity of vehicle fuel tanks.</li> <li>Follow correct procedures when dispensing fuel.</li> </ul>
Government Health and Safety First Responder Organizations	<ul style="list-style-type: none"> <li>Emergency response to minimize risk to health and safety.</li> <li>Participate in training to support optimum response in emergencies.</li> </ul>



## 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 CNG station LoB provides fuel to vehicles that are used in performing construction and emergency response, and provides CNG to the portable LoB that exists to offset absence of or shortcomings in both distribution and transmission pipeline flowing supply.	C&E	X	X

### Interdependencies

The primary interdependencies within PG&E consist of

1. PG&E fleet vehicles that rely on CNG stations for fuel. For example, crew trucks in some areas are fueled by CNG. In an emergency response to an event such as a major earthquake, the LNG/CNG station LoB will respond to address any operations difficulties that arise in the CNG stations needed to support PG&E's fleet vehicles involved in PG&E's response to the earthquake.
2. Emergencies that involve unplanned pipeline system outages (e.g. third-party damage, ground motion). These are often supported by LNG/CNG portable CNG equipment to provide or restore gas service to customers as a temporary alternative to flowing pipeline supply. CNG equipment is filled by compressed gas from CNG stations so station reliability and performance directly supports this aspect of pipeline operations.
3. Planned pipeline outages. Similar to support for emergency response, the CNG stations' role in filling CNG portable equipment supports planned pipeline outages that occur routinely for pipeline replacement, upgrading and hydrotesting projects.



## F Glossary of Acronyms and Abbreviations

Table 15 – Acronyms and abbreviations

Acronym	Meaning
AF	Asset Family
AFO	Asset Family 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
Entire AMP	Q4 2014 / A! 2015	Update to \$\$, 1/15/15 asset mgmt. review objectives added to Apdx C		
Entire AMP	Q2 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 risks through major station rebuilds and compressor replacements is effective at addressing a variety of risks, but personnel and funding resource constraints have in the past prevented the replacement work from keeping pace with the rate at which equipment becomes obsolete. As a result, some equipment remains in service longer than desired; in these circumstances, safety risks are managed through maintenance and repair, but at suboptimum reliability and economic levels.

Investment decisions for the CNG stations are based on safety, reliability and operating cost risks, compliance requirements, and industry best practices where possible. Strategic objectives are in place to help guide decisions regarding the investment decisions within the AF. Funding is first allocated to compliance and baseline maintenance required to for the system to be safe and reliable and economical. A risk-based investment decision making process is included in the investment decisions. Investment decisions are also made where possible to improve progress towards industry best practices.

Capital investments are made primarily for obsolescence management, which addresses safety, reliability and economic risks.

Additional investments are proposed for the 2015 – 2017 timeframe for two new CNG stations to improve geographic diversity for refilling PG&E's portable CNG equipment. The Manteca site is expected be in operation by the end of 2016. The addition of the site in the Rocklin area is still in the concept development phase. These two locations are included in Figure 8 below.

Figure 8 below presents the planned replacement schedule out through 2025, which is the near-term portion of the full plan that addresses replacements out through 2050. Investments are proposed to address the risks associated with aging and obsolete major station components.

The station life cycle used is shown in the “Projected Service Life” column. Actual rebuild/replacement investment schedules can vary based factors such as station utilization level and environment, and not only the condition of the equipment, but on the availability of assets needed to accomplish the investments. In spite of the uncertainty, this model is useful in reasonably portraying the life cycles of the stations and the AF plans for major rebuild investment.

Overall station health ratings 1, 4, 7, 10 correspond to the asset health scoring and are depicted on Figure 8 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 to 7 to 10 as the assets age and approach the end of their useful life, though the progression may vary from that with partial rebuilds (e.g., 10 to 7 because of a component replacement, and then aging back to 10 as appears for Bakersfield due to 2015 controls upgrade).





**Figure 8 – Obsolescence Management Investment Plan Overview**

ASSET	REMARKS	Duty Level	Projected Service Life (yrs)	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
ANTIOCH	n/a	12%	n/a	4	4	4	REMOVE							
AUBURN	Underperforming – existing storage is 4kpsi storage which precludes 3.6k temperature compensated filling (below industry standard). Compressor and storage upgrade planned to meet industry standards.	18%	15	10	10	10	10	1	1	1	1	1	4	4
BAKERSFIELD	Compressor controls upgrade planned for 2016/17.	11%	20	10	10	4	4	7	10	1	1	1	1	1
CHICO	Tube trailer fill addition completed 2015.	14%	20	1	1	4	4	4	4	4	4	4	4	4
CONCORD	2016 installed new compressors but having maintenance/reliability issues.	33%	15	10	10	10	1	1	1	1	4	4	4	4
CUPERTINO	Some compressor capacity and reliability shortcomings.	31%	15	1	1	4	4	4	4	4	4	4	4	4
DALY CITY / MARTIN		11%	20	4	4	4	4	4	4	4	4	4	4	4
DAVIS		10%	20	1	1	1	1	1	4	4	4	4	4	4
EUREKA	May add storage. Upgrade planned for 2017 to address compliance and capacity issues.	0%	10	4	4	1	1	1	4	4	4	4	4	7
FREMONT LNG/CNG	LNG system indefinitely out of service	0%	20	4	4	4	4	4	7	1	1	1	1	1
FRESNO		18%	20	4	4	4	4	4	4	4	4	4	4	7
GRASS VALLEY	Capacity shortfall issues	35%	15	4	4	4	4	4	1	1	1	1	4	4
HAYWARD	Station upgrade to be completed 2016	18%	15	10	1	1	1	1	4	4	4	4	4	4
LIVERMORE LEARNING CENTER		1%		4	4	4	4	MAY REMOVE - UNRESOLVED						
LOS BANOS		5%	20	4	4	4	4	4	4	4	4	4	4	7
MANTECA old		0%												
MANTECA new	Construction and completion planned for 2016	0%	20		1	1	1	1	1	1	4	4	4	4
MARYSVILLE		7%	20	4	7	4	4	4	7	7	1	1	1	1
MERCED	Rebuild included gas and fire detection as of August 2014.	26%	15	1	1	1	1	4	4	4	4	4	4	4
MODESTO		12%		1	1	1	MAY REMOVE - UNRESOLVED							
OAKLAND	Impact protection assessment not yet completed. Best practice improvements to be scheduled.	4%	20	4	4	4	4	4	4	4	4	4	4	4
REDDING	Capacity shortfall issues for portable assets	0%	10	4	4	1	1	1	4	4	4	4	4	7
RICHMOND		4%	20	4	4	4	4	4	4	4	4	4	4	4
ROCKLIN / TBD	Potential new portable supply N Valley	0%	20											
SACTO CNG	Storage upgrade included in planned work, to increase storage pressure to be consistent with industry standard.	10%	20	4	4	4	4	4	7	7	1	1	1	1
SACTO LNG		0%												
SALINAS	Storage capacity is being increased with q3 work.	8%	20	10	10	1	1	1	1	1	1	4	4	4
SAN CARLOS	Tube trailer fill added.	19%	15	4	4	4	4	4	4	4	4	4	7	7
SAN FRANCISCO - TREAT	Dispenser location inside the yard to be addressed.	8%	20	4	7	7	7	10	10	1	1	1	1	1
SAN JOSE		24%	15	10	10	1	1	1	1	4	4	4	4	4
SAN RAFAEL		23%	15	10	1	1	1	1	4	4	4	4	4	4
SAN RAMON		0%	25	4	4	4	4	MAY REMOVE - UNRESOLVED						
SANTA CRUZ		26%	15	10	10	10	10	10	1	1	1	1	4	4
SANTA ROSA	Storage capacity is being increased with q3 work.	13%	20	10	10	1	1	1	1	1	1	4	4	4
STOCKTON	Underperforming – existing storage is 4kpsi storage which precludes 3.6k temperature compensated filling (below industry standard). Compressor and storage upgrade planned to meet industry standards.	27%	15	10	10	10	1	1	1	1	4	4	4	4
VACAVILLE	Controls partially upgraded	12%	20	4	4	7	7	1	1	1	1	1	1	4



## I Asset Images

Grass Valley, storage in the foreground, compressor and controls hidden behind.



San Jose / Cinnebar compressor enclosure for sound and weather.



Daly City compressor



Daly City overview – station canopy



Belmont storage relief valve system







Concord Storage



Hurricane portable compressor





## Mobile CNG-1 Compressor





## J Condition Summary

The following supplements Section 2.2 of this asset management plan. Red/Amber/Green (R/A/G) status is included, supplemented by brief summary details.

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 16 - Asset Condition Summary**

ASSET	P = public	COMPRESSORS AND CONTROLS	PIPING, VALVES	ALARM / ESD SYSTEM	CARD READER & DISPENSER	STORAGE VESSELS & CONTROLS	SLOW FILL SYSTEM	TUBE TRALER FILL SYSTEM	OVERALL SITE	CRITICAL DOCUMENTS	REMARKS
ANTIOCH		G -	G -	G -	G -	G -	G -	G -	G -	A - drwgs but no manuals	n/a
AUBURN	P	A - Compr controls outlived useful life - not easy to work on even though still serviceable	A - Same era as other stations have piping issues - need to assess	G -	G -	G -	G -	G -	A - Piping issues - need to assess	A - drwgs but no manuals	Underperforming - existing storage is 4kpsi storage which precludes 3.6k temperature compensated filling (below industry standard). Compressor and storage upgrade planned to meet industry standards.
BAKERSF IELD	P	A - Compr controls outlived useful life - not easy to work on even though still serviceable	A - era is when other stations have piping issues - need to assess	G -	G -	G -	G -	G -	A - Piping issues - need to assess. Older compr controls	A - incomplete drwgs & incomplete manuals	Compressor controls upgrade planned for 2016/67.





ASSET	P = public	COMPRESSORS AND CONTROLS	PIPING, VALVES	ALARM / ESD SYSTEM	CARD READER & DISPENSER	STORAGE VESSELS & CONTROLS	SLOW FILL SYSTEM	TUBE TRALER FILL SYSTEM	OVERALL SITE	CRITICAL DOCUMENTS	REMARKS
CHICO	P	G -	G -	G -	G -	G -	G -	G -	G -	A - complete drwgs but incomplete manuals	Tube trailer fill addition completed 2015.
CONCOR D	P	A - Compr controls outlived useful life - not easy to work on even though still serviceable. New compressors are unsatisfactory	A - possible system component replacement needed (valves due to lower reliability/higher leak rates)	G -	G -	G -	G -	G -	A - Piping & component issues	A - complete drwgs but incomplete manuals	2016 installed new compressors but having maintenance/reliability issues issues.
CUPERTI NO	P	G - Station rebuilt in 2014	G -	G -	G -	G -	N/A	N/A	G -	G -	Some compressor capacity and reliability shortcomings.
DALY CITY / MARTIN	P	G -	G -	G -	G -	G -	N/A	G -	G -	G -	
DAVIS	P	G - Station rebuilt in 2014	G -	G -	G -	G -	N/A	G -	G -	G -	
EUREKA		G -	G -	G -	N/A	N/A	N/A	N/A	G -	R - no records	May add storage. Upgrade planned for 2017 to address compliance and capacity issues.
FREMONT LNG/CNG		G -	G -	G -	G -	G -	N/A	N/A	G -	G -	LNG system indefinitely out of service
FRESNO	P	G -	G -	G -	G -	G -	N/A	G -	G -	G -	
GRASS VALLEY	P	G -	G -	G -	G -	G -	N/A	N/A	G -	A - incomplete drwgs & incomplete manuals	Capacity shortfall issues
HAYWARD	P	A - Compr controls outlived useful life - not easy to work on even though still serviceable	A - era is when other stations have piping issues - need to assess Add'l recovery tank needed (compr gas function) lifts PRV	G -	G -	G -	n/a	G -	A - Compr, piping & controls	A - incomplete drwgs & incomplete manuals	Station upgrade to be completed 2016



ASSET	P = public	COMPRESSORS AND CONTROLS	PIPING, VALVES	ALARM / ESD SYSTEM	CARD READER & DISPENSER	STORAGE VESSELS & CONTROLS	SLOW FILL SYSTEM	TUBE TRALER FILL SYSTEM	OVERALL SITE	CRITICAL DOCUMENTS	REMARKS
LIVERMORE LEARNING CENTER		A – Compr controls outlived useful life – not easy to work on even though still serviceable	G -	G -	G -	G -	n/a	n/a	G -	A – incomplete drwgs & incomplete manuals	
LOS BANOS	P	G -	G -	G -	G -	G -	n/a	n/a	G -	G -	
MANTECA old		N/A out of svc	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	
MANTECA new											Construction and completion planned for 2016
MARYSVILLE	P	A – Compr controls outlived useful life – not easy to work on even though still serviceable	A – assessment needs to be conducted	G -	G -	G -	n/a	G -	A – Compr, piping & controls	R – no asbuilt drwgs or manuals	
MERCED	P	G – 2014 station rebuild completed	G -	G -	G -	G -	n/a	G -	G -	G -	Rebuild included gas and fire detection as of August 2014.
MODESTO		G -	G -	G -	G -	G -	G -	n/a	G -	A – good drwgs but incomplete manuals	
OAKLAND		A – reconductoring needed under NEC. Skid vibration mitigation needed.	G -	G -	G -	G -	G -	G -	A – reconductoring / skid vibration	A – good drwgs but incomplete manuals	Impact protection assessment not yet completed. Best practice improvements to be scheduled.
REDDING		G -	G -	G -	n/a	G -	G -	G -	G -	A – simple but should be added	Capacity shortfall issues for portable assets
RICHMOND	P	G -	G -	G -	G -	G -	G -	G -	G -	G -	
ROCKLIN / TBD											Potential new portable supply N Valley



ASSET	P = public	COMPRESSORS AND CONTROLS	PIPING, VALVES	ALARM / ESD SYSTEM	CARD READER & DISPENSER	STORAGE VESSELS & CONTROLS	SLOW FILL SYSTEM	TUBE TRALER FILL SYSTEM	OVERALL SITE	CRITICAL DOCUMENTS	REMARKS
SACTO CNG	P	G -	A – assessment needs to be conducted	G -	G -	G -	n/a	n/a	A – Compr, piping & controls	A – incomplete drwgs & manuals	Storage upgrade included in planned work, to increase storage pressure to be consistent with industry standard.
SACTO LNG		n/a - out of service	n/a - out of service	n/a - out of service	n/a - out of service	n/a - out of service	n/a - out of service	n/a - out of service	n/a - out of service	n/a - out of service	
SALINAS	P	R – compr replacement proposed for 2016	A – resolve with compr work	G -	G -	G -	G -	n/a	R – Compr & controls	A – good drwgs but incomplete manuals	Storage capacity is being increased with q3 work. Addtn of gas/fire detection planned for 2014/2015
SAN CARLOS	P	G -	G -	G -	G -	G -	G -	planned	G -	G -	Tube trailer fill added.
SAN FRANCIS CO - TREAT	P	A – Compr & controls starting to become a reliability problem.	G -	G -	G -	G -	G -	n/a	A – Dispenser location inside yard is a security / safety risk that needs to be addressed	A – incomplete drwgs & manuals	Dispenser location inside the yard to be addressed.
SAN JOSE	P	A – Compr controls outlived useful life – not easy to work on even though still serviceable	A - assessment needed	G -	G -	G -	G -	n/a	A – Compr, piping & controls	A – incomplete drwgs & manuals	
SAN RAFAEL	P	A – Compr controls outlived useful life – not easy to work on even though still serviceable	R – assessment planned	G -	G -	G -	G -	n/a	A – Compr, piping & controls	A – incomplete drwgs & manuals	
SAN RAMON		G -	G -	G -	n/a	n/a	G -	n/a	G -	G -	





ASSET	P = public	COMPRESSORS AND CONTROLS	PIPING, VALVES	ALARM / ESD SYSTEM	CARD READER & DISPENSER	STORAGE VESSELS & CONTROLS	SLOW FILL SYSTEM	TUBE TRALER FILL SYSTEM	OVERALL SITE	CRITICAL DOCUMENTS	REMARKS
SANTA CRUZ	P	A – Compr and controls replacement due to deterioration from harsh environment	G -	G -	G -	G -	n/a	n/a	A – Compr & controls	A – incomplete drwgs & manuals	
SANTA ROSA	P	R – compr replacement proposed for 2016	A – resolve with compr work	G -	G -	G -	G -	n/a	R – Compr & controls	A – complete drwgs but incomplete manuals	Storage capacity is being increased with q3 work.
STOCKTO N	P	A – Compr controls outlived useful life – not easy to work on even though still serviceable	A – Same era as other stations have piping issues – need to assess	G -	G -	G -	G -	G -	A – Piping issues – need to assess	R – no asbuilt drwgs or manuals	Underperforming – existing storage is 4kpsi storage which precludes 3.6k temperature compensated filling (below industry standard). Compressor and storage upgrade planned to meet industry standards.
VACAVILL E	P	A – Compr controls work underway. Compressors have some useful life left.	A – needs to be assessed	G -	G -	G -	n/a	G -	A – Compr, piping & controls	A – incomplete drwgs & manuals	Controls partially upgraded

## K Expenditure Plan for Obsolescence Management

A central objective of both the capital and expense spending is continued safe, reliable and economical operation of the stations. The facility integrity management plan that contains this AMP and the obsolescence management plan is designed and implemented to support the central objective.

The spending plan is designed to balance the organization's capability for rebuilding major station components, the funding that is available, and the rate at which stations and equipment condition deteriorates with use and the passage of time.

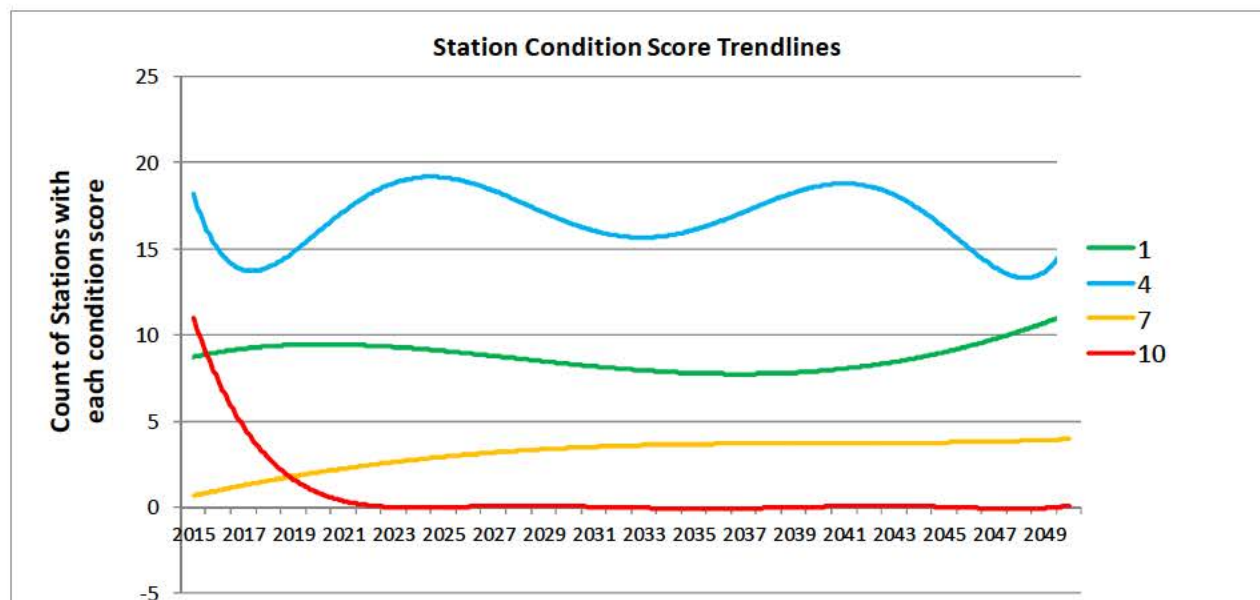
The overall station health ratings 1, 4, 7, 10 are defined as follows.

- 1 = like new ReliabilityM&O
- 4 = satisfactory RM&O
- 7 = substandard RM&O
- 10 = unacceptable RM&O (at, near or beyond the end of its service life).

Overall health ratings are determined based solely on SME judgment at this time. Appendices H and J above provide information regarding the overall health ratings and the expected change over time.

Figure 9 below displays the forecast number of stations in each of the four asset health ratings from now to 2050. It is built on the lifecycle model that is presented in Appendix H. Over the near-term, the large number of stations judged to have a 10 health rating (essentially obsolete) is forecast to be reduced to meet the objective of zero by the early 2020s.

**Figure 9 – Forecast Station Asset Health Score Over Time**



The ideal program design should seek to reduce large year-over-year variation in these lines. However, doing that requires that a very precise understanding exists of the deterioration rate of stations – asset condition is not precise, and the deterioration rate cannot be accurately forecast, so the basic trends are all that should be





considered. As described immediately above, the desired trend is to achieve zero stations with a health score of 10, and to attain conditions where most stations are either judged to be 1 or 4.

If no constraints existed on resource availability for major capital replacements, the ideal objective would be to drive the number of stations with the 10 score to zero as soon as practical, since those stations by definition are not satisfactorily reliable and are requiring uneconomic levels of expense spending in order to remain in operation.

Funding and execution constraints exist, so this plan is developed considering such constraints, and the number of stations with a 10 score will take some time to be driven to zero. While this approach addresses some risks more slowly than desired by the AF, the resulting risk management is acceptable since if the AF considers risks to be unacceptable the circumstances are addressed immediately or operations are suspended until the unacceptable risks are resolved. Risks that remain are largely reliability and maintenance/operations costs.

The capital investment plan in Table 18 below reflects the 2016 S1 results, corresponds to the near-term in Figure 9 above and reduces the count of 10 score stations. Beyond 2022, station and major station capital replacement projects are scheduled to attempt to continue to keep the number of stations with a 10 score at zero, yet to defer major expenditures until the station is solidly into the 7 score category to avoid less economical early replacement and shorter life.

**Table 17 - Near Term Capital Spending Plan**

MWC 31 Projects (station major component replacement)	2016 Budget	2017 Proposed	2018 Proposed	2019 Proposed	2020 Proposed	2021 Proposed
Total	\$4,000,000	\$4,000,000	\$4,000,000	\$4,200,000	\$4,000,000	\$4,100,000
MWC GM Projects	2016 Plan	2017 Plan	2018 Plan	2019 Plan	2020 Plan	2021 Plan
NGV Customer Support	\$700,000	\$720,000	\$740,000	\$760,000	\$780,000	\$800,000
Station Compliance Audit Resolution	\$100,000	\$200,000	\$100,000	\$50,000	\$50,000	\$50,000
Engineering Upgrades and Correctives	\$100,000	\$200,000	\$100,000	\$100,000	\$100,000	\$100,000
Update Record Drawings	\$120,036	\$100,000	TBD	TBD		
Total	\$1,020,036	\$1,220,000	\$940,000	\$910,000	\$930,000	\$950,000

#### IMPLICATIONS OF DEPARTURE FROM THIS SPENDING PLAN

Higher capital replacement spending would be recommended if no compromise is needed regarding spending levels and if greater execution capacity existed in the AF. However, since capital resources and execution capacity are constrained, compromises are needed. Operations risks for equipment planned to be replaced further into the future will be managed within the existing capital and expense spending plans, whatever they become over time.

A benefit received by constraining annual investment levels is that execution risk is lower, and capital replacement work over the next decade can be closer to level year over year.



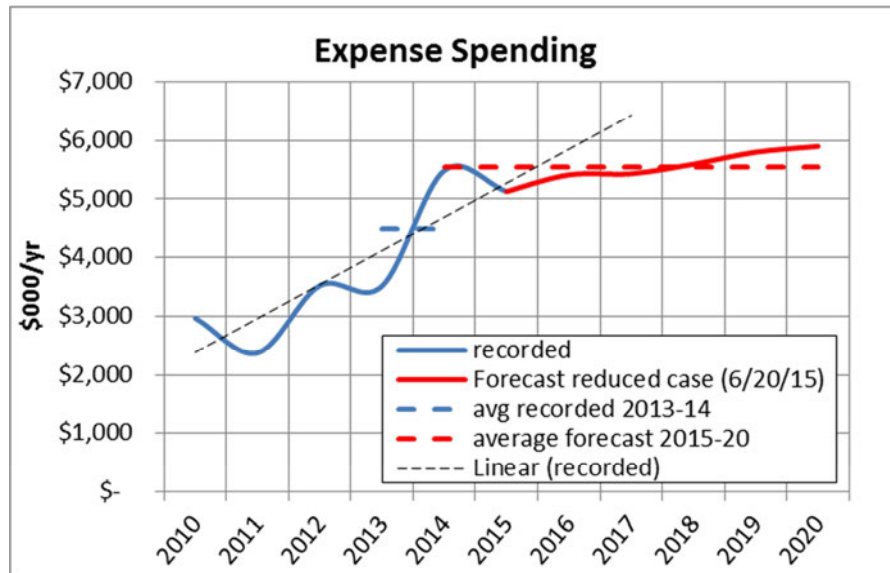


If capital replacement resources are constrained further, the number of 10 score stations in operation will remain high or at least above zero, resulting a trade-offs between continued increases in expense spending to preserve reliability. If expense resources are not increased, station reliability would be expected to suffer. Safety as the highest priority aspect of operations is not permitted to suffer.

The expense spending shown below in Figure 10 below is associated with the compromise described above, and is consistent with the station health score progression shown in Figure 9 above. If instead the capital funding is something lower than that shown in Table 18 above, the reduction over time in the number of 10 score stations will be slower than that shown in Figure 9 above, and circumstances closer to those that currently exist will persist – reliability and expense spending to extend the life of assets that have reached the end of their design service life will suffer.

While no precise forecast has made of expense spending associated with a dramatically lower capital spending plan, the rate of historical expense increase can give some insight into the potential expense requirements if reliability is to be maintained at some reasonable level. Alternatively, if expense spending is held constant, reliability is certain to suffer.

**Figure 10 - Near Term Expense Spending Plan**





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