

Developing Compliant Documentation

PHMSA and API Recommended Practices for Underground Storage Facilities

Abstract

In 2015, the American Petroleum Institute (API) published API Recommended Practice 1170: *Design and Operation of Solution-mined Salt Caverns Used for Natural Gas Storage* and API Recommended Practice 1171: *Functional Integrity of Natural Gas Storage in Depleted Hydrocarbon Reservoirs and Aquifer Reservoirs* for the best management practices of underground storage facilities, including integrity management, risk management, and emergency preparedness.

These recommended practices have gained traction within the industry, bearing increasing relevance in light of a mandate issued to the Pipeline and Hazardous Material Safety Association (PHMSA) to develop safety standards for underground storage facilities. PHMSA has recommended operators use API 1170 and 1171 until PHMSA fulfills the safety standard mandate. Industry operators can take a proactive approach assessing, improving, and expanding their documented Integrity Management plans and procedures.

Introduction

The Hutchison, Kansas incident in 2001 and the more recent 2015 methane gas leak in Los Angeles, California increased state legislators' calls for action over the need for oversight of integrity inspection, maintenance, and recordkeeping programs for underground storage facilities for natural gas.

Owners and operators of underground storage facilities are committed to ensuring safe operations and integrity of these facilities. To fulfill this commitment, industry operators of these facilities collaborated with state and federal regulators, the American Gas Association (AGA), and the Interstate Natural Gas Association of America (INGAA) to develop by consensus the two new recommended practices, API 1170 and 1171. The work to develop and publish the recommended practices took place over a period of about three years and followed the rigorous accredited process of the American National Standards Institute (ANSI).

On December 9, 2015, a bipartisan Senate committee approved the Securing America's Future Energy: Protecting Our Infrastructure of Pipelines and Enhancing Safety (SAFE PIPES) Act reauthorization bill, which approved funding to financially support PHMSA for four more years. On June 22, 2016, President Obama signed the bill into law.

In consideration of both historic and recent incidents, The SAFE PIPES Act increases PHMSA's regulatory jurisdiction and enhances its authority over underground natural gas storage facilities. These types of storage include:

- Depleted hydrocarbon reservoir storage, which provides the greatest amount of natural gas underground storage capacity.
- Solution mined salt cavern storage, which contains about a quarter of all natural gas that is stored underground.

- Aquifer reservoir storage, which is rare and expensive to develop because of unknown factors such as geologic characteristics and reservoir capacity.

One of the new SAFE PIPES Act provisions directs PHMSA to develop minimum safety standards for underground storage facilities using existing, agreed upon consensus standards. Currently, there are no standards for natural gas reservoir or cavern storage for the operation, environmental protection, and integrity management. The Interstate Oil and Gas Compact Commission (IOGCC) Natural Gas Storage in Salt Caverns-a Guide for State Regulators and older API Recommended Practices, such as API RP 1114 Design of Solution-Mined Underground Storage Practices, do exist.

For this new scope of responsibility, PHMSA issued an advisory bulletin, ADB-2016-02 Safe Operation of Underground Storage Facilities for Natural Gas, on February 5, 2016. In the bulletin, PHMSA encourages underground natural gas storage facility operators to implement API Recommended Practice 1170, API Recommended Practice 1171, and the IOGCC Guide for State Regulators voluntarily. Moreover, based on conclusions drawn from PHMSA's research, improved documentation is a focal point in these new regulations and contributes towards the standardization and enforcement of safety practices.

Minimum Uniform Safety Standards for Underground Storage Facilities

A primary directive of the 2015 SAFE PIPES Act is for PHMSA to issue a national regulatory program of minimum uniform safety standards. Although many states have excellent standards and applicable guidelines, the objective of this new action is to establish a unified framework for the oversight of underground storage facilities.

Specifically, §60103A of the SAFE PIPES Act states, "Not later than 2 years after the date after the enactment of this Act, the Secretary of Transportation, in consultation with the heads of other relevant Federal agencies, shall issue minimum safety standards, incorporating, to the extent practicable, consensus standards for the operation, environmental protection, and integrity management of underground storage facilities." One consideration is for the Secretary to take into account existing consensus standards.

As with the reauthorization of the 2011 SAFE PIPES Act, the minimum safety standards will include a requirement for documented functional integrity plans, including safety, inspection, monitoring, risk management, and operation and maintenance procedures. ADB-2016-02 states, "Operators should have comprehensive and up-to-date processes, procedures, mitigation measures, periodic assessment and reassessments, and emergency plans in place to maintain the safety and integrity of all underground storage wells and associated facilities whether operating, idle, or plugged."

Pipeline companies and local distribution companies who own and operate storage facilities have the opportunity to augment their current documentation, such as Pipeline Integrity Plans and procedures and Public Awareness plans. Independent storage service providers who own and operate underground storage facilities may need to develop and implement new integrity management programs that adhere strictly to PHMSA's new mandates.

Because of the geographic and geologic diversity in storage operations, which will need to be addressed in integrity programs, the integrity management approach will vary for each asset.

The propelling force behind this directive resides in the consensus standards mandate from the 2015 Safe Pipes Act that was intended to assure the safe design, construction, operation, maintenance, and repair of underground natural gas storage facilities.

National consensus standards can carry the equivalent weight of law, as their various aspects and verbiage are either incorporated into regulations or referenced in full.

PHMSA itself recognizes consensus standards from recommended practices that were developed and maintained by the API, the American Society of Mechanical Engineers (ASME), and the National Association of Corrosion Engineers (NACE). With this in mind, it is apparent that the API recommended practices are well staged for adoption and integration into PHMSA's upcoming regulations.

API Underground Storage Recommended Practices

API's newly developed recommended practices address many of the issues that PHMSA is seeking to resolve from the SAFE PIPES Act mandates.

Published in July 2015, API Recommended Practice 1170: *Design and Operation of Solution-mined Salt Caverns Used for Natural Gas Storage*:

- Requires that operators maintain or develop Operation and Maintenance procedures that are specific to the cavern and wellhead to which the procedures apply.
- Requires emergency, workover, inspection, and testing procedures for the operational facilities.

Published in September 2015, API Recommended Practice 1171: *Functional Integrity of Natural Gas Storage in Depleted Hydrocarbon Reservoirs and Aquifer Reservoirs*:

- Requires that operators have established procedures for the construction, operations, and maintenance of underground storage reservoirs and wells in place prior to the development of a new facility.
- Provides recommendations and guidance for Risk Based Assessment and Risk Management.
- Recommends integrating underground storage plans and procedures with other regulatory requirements that were established in the 2011 SAFE PIPES Act.
- Permits the modification of programs such as Pipeline Integrity Management, Public Awareness, Management of Change, and Control Room Management to include underground storage requirements.

These recommended practices further define requirements for developing and maintaining new procedures that are specific to underground reservoirs, including drilling, well workover, emergency plans, and integrity monitoring and management. Natural Gas operators with underground storage facilities can use these recommended practices as a basis to improve underground storage programs as they integrate advancements from across the industry.

The recommended practices further offer operators a standard by which to assess the functional integrity of their underground storage facilities from the design and construction phases; during operations, inspection, and maintenance; and through to the abandonment and recordkeeping processes.

This network of oversight and regulation will help effectively reduce incidents while safeguarding the people, environment, property, and equipment surrounding the operation of underground storage facilities. As with any aspect of the industry, adherence to standardized documentation demonstrates and enforces compliance with the recommended practices and PHMSA.

Documentation Recommended Practices

According to Isan Akyar in *Latest Research into Quality Control*, “Standardization is defined as an activity that gives rise to solutions for repetitive application to problems in various disciplines.” Akyar goes on to quote Akanksha Saxena, who defines Standard Operating Procedures (SOPs) as “. . . sets of instructions having the force of a directive, covering those features of operations which lend themselves to a definite or standardized procedure without loss of effectiveness.” Akyar asserts that standardization directly contributes to solving problems by creating predictable, efficient operations.

PHMSA recognizes that any lapse in such standardization (as Akyar describes) or similar procedural deficiencies can lead to incorrect operations. API 1170 and 1171, as well as the IOGCC Guide for State Regulators, call for the use of dedicated procedures in all phases of underground storage facility development and operation, taking into consideration the unique geomechanics and geologic differences of facilities or wells.

To be effective in the context that API describes, procedures must be:

- Replicable and consistent, producing predictable results.
- Simply written and easy for the user to learn, follow, and be trained by.
- Constructed as coherent, stable documents that are simple to modify and maintain.
- Made accessible for users under a well-defined document control program.

Writing resources such as the Handbook of Technical Writing, The Chicago Manual of Style, and other editing guides augmented by recommended practices for writing in the industry can aid in meeting these criteria.

Table 1 describes recommended practices for writing SOPs (Jain 2008). These recommended practices can also apply to programs, plans, and other types of documentation.

Table 1: Benefits of Standard Operating Procedures

Recommended Practice	Explanation
Write and use procedures to document compliance with government regulations.	<ul style="list-style-type: none"> • Well-written SOPs help to verify that government regulations are satisfied. • Failure to write and use well-defined SOPs communicates to government regulators that a company is not serious about compliance.
Use procedures as training documents.	SOPs can be used as the basis for standardized training for employees who are new to an activity and for re-training.
Provide personnel with all the safety, health, environmental, and functional information necessary to perform work.	<ul style="list-style-type: none"> • SOPs give evidence that a company’s intention is to operate safely. • Placing value only on production while disregarding safety, health, and the environment is costly. • Training employees in all aspects of doing a job helps to prevent accidents, fines, and litigation.
Perform operations consistently to achieve quality control.	SOPs specify job steps that help standardize processes and products to ensure quality.

Recommended Practice	Explanation
Use procedures as historical records.	<ul style="list-style-type: none"> SOPs document the how, why, and when of steps in a process and provide a factual basis for revision when a process or equipment is changed. As people change jobs, undocumented knowledge and skills disappear. Regularly maintained SOPs document knowledge and the best practices.

PHMSA Statistics and Procedures

PHMSA compiles operator-provided pipeline incident data annually to obtain statistics and trends of incidents over time. These statistics are provided to the public, stakeholders, and the federal government to evaluate and improve safety measures. PHMSA uses this data to assess safety trends, guide the development of new initiatives, and establish the need for safety standards and integrity management programs.

Well-designed and defined procedures, including safety standards, have historically been prominent among corrective initiatives. According to PHMSA, incidents resulting from procedural deficiencies are typically reported under the category of “Incorrect Operations,” which accounts for more than ten percent of the incident causes. Procedural deficiencies include the lack of written procedures, incorrect or otherwise outdated procedures, failure to follow and implement a procedure, and insufficient training on procedures.

Figure 1 illustrates a summary of categorized incidents according to PHMSA’s 2011 – 2015 records.

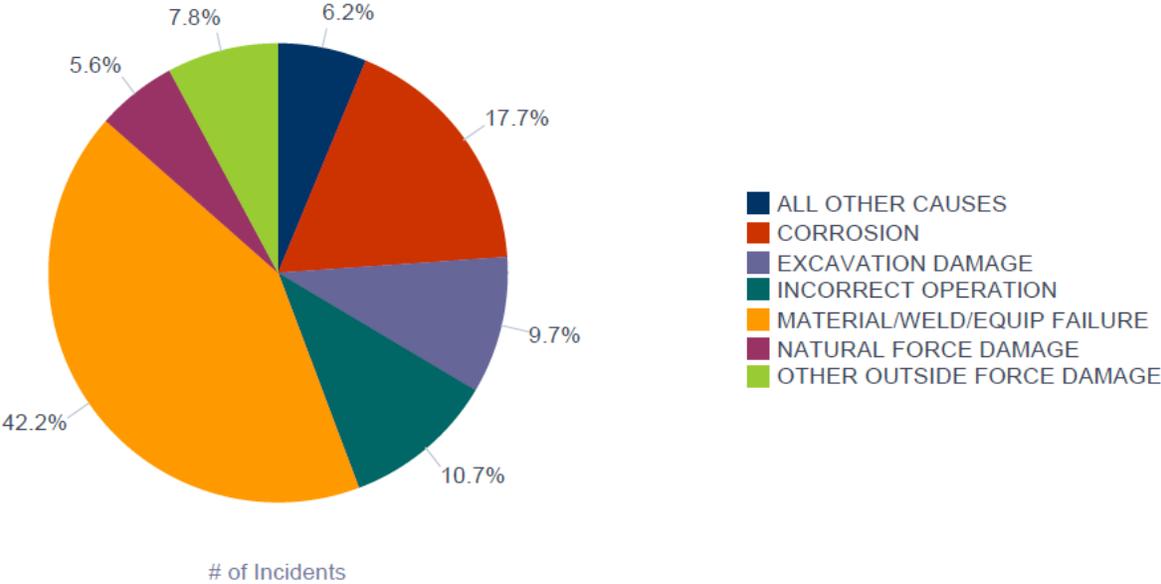


Figure 1: 5-year Averages of All Incidents (2011-2015)

“Incorrect Operation” is the third largest contributor of the seven categories of incidents, cumulatively resulting in more than \$100 million losses to the industry over a five-year period (refer to the PHMSA Data & Statistics Pipeline Incidents: 20 Year Trends site on the PHMSA website). Although this in itself is a remarkable figure, procedural deficiencies can be identified as a contributing factor in most categories within this graph.

For example, if material design, fabrication, or assembly standards are not strictly met, malfunctions and failures may occur during operations. Similarly, when a corrosion application or welding procedure is not correctly performed because of insufficient training or preparation, the corrosion inhibitor or weld can fail. If third party operators do not fully understand proper excavation processes or diligently adhere to excavation procedures, third party damage during excavation could occur.

The data PHMSA has compiled highlights the importance of standards and procedures in averting critical incidents. Developing and using effective standards and procedures is one core action to take toward reducing incidents for these major categories, which, in turn, leads to a safer work environment and a decrease in financial loss.

Plan and Procedure Assessments

Plan and procedure assessments provide a method for determining gaps, redundancies, and inconsistencies within documentation. During documentation assessments, operators who use SOPs provide subject matter expertise. The assessments not only target opportunities for improvement, but also identify gaps between content of the procedures and compliance with API recommended practices, guides, or PHMSA recommendations and regulations. Such assessments can provide feedback concerning end user accessibility and reader level, procedural design traits and tactics, or even opportunities where new procedures should be implemented.

To conduct a plan and procedure analysis, a technical writer performs an initial gap analysis. The writer compares current plans and procedures to the recommended practices described in API 1170 or 1171 and the IOGCC Guide, documenting the gap analysis results and potential gaps or conflicts among the plans, procedures, and the practices or guide.

Subject matter experts (SMEs) collaborate to review the gap analysis results, confirming the scope of revision and providing an indispensable basis of technical knowledge. This collaboration ensures that the integrity of the original content is preserved as elements from the new API Recommended Practices as well as the IOGCC Guide are addressed. If the SME chooses, he or she can identify additional company requirements and operational practices where procedures may be beneficial.

Coinciding with this gap analysis is an audience analysis, which evaluates the population of end users for the documentation. For underground storage facilities, this includes engineering personnel, drilling personnel, installation personnel, safety personnel, and field and control room operators. This analysis helps to determine the needs and expectations of each user who is affiliated with the documentation, which in turn makes it possible for the documents to be preemptively equipped with the information each user needs. This process is essential to saving time and money following publication of the SOPs. Without it, documents can only be refined from retroactive feedback after implementation and unnecessarily introduce all the risks associated with using incomplete processes.

Following the audience analysis, the technical writer conducts an evaluation of the document format. A well-designed procedure allows the user to quickly access necessary information, distinguishing between types of content by an intuitive and instructive format.

A design must reflect any unique company conventions while allowing for seamless integration of advancing industry guidelines. The writer achieves a good design by creating tools and styles that are built into a template, resulting in uniform documents that are easy to maintain.

Document production then enters a stage of thorough preparation before launching into development of all documents. Establishing detailed parameters, requirements, roles and responsibilities, and stage gates from the outset of a project allows for fast and accurate development, thereby reducing room for errors, misunderstandings, and subsequent rework.

The technical writer documents these details in the final piece of the assessment, which is a project plan that provides the road map for the completion of plans and procedures. The project plan also details the management of change requirements, an organized rollout of the plans and procedures, and training requirements.

By applying this systematic method for developing and producing documentation, using API 1170 or API 1171 and the IOGCC Guide for State Regulators, underground storage operators can effectively prepare for the new PHMSA safety standard requirements.

Conclusion

The provision for PHMSA to develop minimum safety standards for natural gas underground storage facilities affects operators by requiring them to develop processes and procedures for the safe design, construction, operation, and maintenance of these facilities. Using industry consensus recommended practices as guidance, and conjoined with a strategic documentation process, the proactive development of operating procedures will reduce the time and cost imposed by these directives. The effective implementation of these procedures in training and work activities allows for knowledge sharing, and optimization of operation processes, and it can lead to a reduction in incidents, thereby building a safer industry.

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