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DEPARTMENT OF TRANSPORTATION

Pipeline and Hazardous Materials Safety Administration

[Docket No. PHMSA-2016-0016]

Pipeline Safety: Safe Operations of Underground Storage Facilities for Natural Gas

AGENCY: Pipeline and Hazardous Materials Safety Administration (PHMSA); DOT.

ACTION: Notice; Issuance of Advisory Bulletin.

SUMMARY: PHMSA is issuing this advisory bulletin to remind all owners and operators of underground storage facilities used for the storage of natural gas, as defined in 49 CFR part 192, to consider the overall integrity of the facilities to ensure the safety of the public and operating personnel and to protect the environment. Operators are reminded to review their operations to identify the potential of facility leaks and failures caused by corrosion, chemical damage, mechanical damage, or other material deficiencies in piping, tubing, casing, valves, and associated facilities and the importance of reviewing the location and operations of shut-off and isolation systems and reviewing and updating emergency plans as necessary.

FOR FURTHER INFORMATION CONTACT: Operators of pipelines subject to regulation by PHMSA should contact Mr. Kenneth Lee at 202-366-2694 or e-mail to: kenneth.lee@dot.gov.

Intrastate gas pipeline and underground storage facility operators should contact the appropriate state pipeline safety authority. A list of state pipeline safety authorities is provided at: www.napsr.org.

SUPPLEMENTARY INFORMATION:

I. Background

On October 23, 2015, Southern California Gas Company's (SoCal Gas) Aliso Canyon Well SS25 failed, causing a sustained and uncontrolled natural gas leak in an area known as Porter Ranch in Los Angeles, California. At the present time, the well leak is believed to be from the subsurface (downhole) well casing. The well was drilled in 1953 and was later converted to natural gas storage well in 1972. Over 4,400 households (families) have been relocated due to the natural gas odorant (mercaptans) according to the Aliso Canyon Incident Command briefing report issued on February 01, 2016. On January 6, 2016, California Governor Jerry Brown issued a proclamation declaring the Aliso Canyon incident a state emergency. After repeated unsuccessful attempts to contain the leak, a relief well is being drilled to plug the leaking well. The Aliso Canyon underground storage field, which can store up to 86 billion cubic feet of natural gas, has 115 storage wells, and is the second largest storage facility of its kind in the United States. The root cause of this failure is the subject of ongoing investigations and assessments and the root cause analysis is being conducted by an independent third party expert firm. PHMSA is working closely with the State of California to provide technical assistance and to support State regulatory agencies related to their response and oversight activities.

Since 2001 several accidents involving underground gas storage facilities have occurred and two of the more extensive accidents that occurred in Texas and Kansas are highlighted below. On August 19, 2004, the Market Hub Partners Moss Bluff storage facility located in Liberty County, Texas, had a well control incident and natural gas fire at Cavern #1. Over a period of six and one-half days, approximately 6 billion cubic feet of natural gas in the cavern was released and burned. The fire eventually self-extinguished, and late on August 26, 2004, installation of a blowout prevention valve was completed, effectively placing the well back under control. The Moss Bluff storage facility was comprised of three separated underground caverns leached out of a salt formation beneath the surface; a compressor station to help move natural gas into and out of the caverns; well head assemblies on each of the caverns for operational control purposes; and natural gas, fresh water and salt water (brine) piping and related facilities to facilitate transportation and/or holding of those materials. A detailed investigation by company personnel and outside consultants determined the accident was caused by a separation of the 8 5/8-inch well string inside the cavern; a breach of the 8-inch brine piping above ground; and the separation of the wellhead assembly above the cavern.

On January 17 and 18, 2001, another accident occurred at the Yaggy underground natural gas storage field operated by Kansas Gas Service, where a wellbore failure which led to a series of gas explosions in Hutchinson, Kansas. The storage field injected natural gas at a depth of 600 to 900 feet underground into salt caverns. Gas leaked from the storage field well production casing, migrated approximately nine miles underground, and then traveled to the surface through old brine, or salt wells, in the Hutchinson, Kansas area. An explosion in downtown Hutchinson destroyed two businesses, damaged 26 other businesses, and killed two persons in a mobile home park. Approximately 143 million cubic feet of natural gas leaked from the storage field.

In this Advisory Bulletin, PHMSA recommends that all operators of underground storage facilities used for the storage of natural gas, as defined in 49 CFR Parts 192, have processes, procedures, mitigation measures, periodic assessments and reassessments, and emergency plans to maintain the safety and integrity of all wells and associated storage facilities whether operating, idled, or plugged. These processes and procedures should take into consideration the age, construction, maximum operating pressures, operating and maintenance history, product, corrosion, casing and tubing condition (including chemical and mechanical damage), cement condition and depths or heights, safety valves (surface and subsurface), operation of each well, and the amount of time elapsed since the most recent assessment.

II. Advisory Bulletin (ADB-2016-02)

To: Owners and Operators of Underground Pipeline and Storage Facilities.

Subject: Safe Operation of Underground Storage Facilities for Natural Gas

Advisory: Operators of underground storage facilities used for the storage of natural gas, as defined in 49 CFR part 192, should review their operating, maintenance, and emergency response activities to ensure the integrity of underground storage facilities are properly maintained. This bulletin is intended to inform operators about recommended practices and to urge operators to take all necessary actions, including but not limited to those set forth in this bulletin, to prevent and mitigate breach of integrity, leaks, or failures at their underground storage facilities and to ensure the safety of the public and operating personnel and to protect the environment.

Operators should have comprehensive and up-to-date processes, procedures, mitigation measures, periodic assessments and reassessments, and emergency plans in place to maintain the safety and integrity of all underground storage wells and associated facilities whether operating, idled, or plugged. Operators must adhere to applicable State regulations for the permitting, drilling, completion, and operation of storage wells. In developing, implementing, and updating their safety and integrity programs, we encourage underground gas storage facility operators to reference PHMSA Advisory Bulletin 97-04, dated July 10, 1997, and to voluntarily implement American Petroleum Institute (API) Recommended Practices (RP) 1170, "Design and Operation of Solution-mined Salt Caverns Used for Natural Gas Storage, First Edition, July 2015," API RP 1171 "Functional Integrity of Natural Gas Storage in Depleted Hydrocarbon Reservoirs and Aquifer Reservoirs, First Edition, September 2015," and Interstate Oil and Gas Compact Commission (IOGCC) standards entitled "Natural Gas Storage in Salt Caverns--A Guide for State Regulators" (IOGCC Guide), as applicable. The IOGCC Guide provides safety standards for the design, construction, and operation of gas storage caverns. Copies of the API recommended practices can be obtained at <http://www.api.org/Publications-Standards-and-Statistics/Publications/Government-cited-Safety-Documents>. Copies of the IOGCC Guide can be obtained from the Interstate Oil and Gas Compact Commission, 900 N.E. 23rd Street, Oklahoma City, Oklahoma 73152-3127 (phone: 405/525-3556; e-mail: iogcc@oklaosf.state.ok.us). API has an accredited process to develop recommended practices and standards that involves industry, manufacturers, engineering firms, construction contractors, the public, academia, and government.

In addition, operator's operating and maintenance (O&M) processes and procedures should be reviewed and updated at least annually, unless operational inspections for integrity warrant shorter review periods. O&M processes and procedures should include data collection and integration, risk assessments, monitoring, operational limits, mitigation measures, and record keeping for any underground storage facility threat that could impact public safety, operating personnel, or the environment due to leakage, failure, or abnormal operating conditions whether above ground or underground. At a minimum, operator actions should include, but not be limited to, the following:

1. Operators should verify that the pressure required to inject intended natural gas volumes, including any maximum treating and stimulation pressures for the underground storage well, does not exceed the design pressure limits of the reservoir, wells, wellheads, piping, casing, tubing, or associated facilities, and document such verification.
2. The operator should monitor all wells for the presence of annular gas or liquids by measuring and recording annular pressure, including between casing and tubing strings at the wellhead, and any known annular flow on a periodic basis.
3. The operator should inspect the wellhead assembly and attached pipelines for each of the wells used in an underground storage facility on a periodic basis, with the frequency of the inspections defined by the operator's risk assessment. This inspection should include leak detection technology and monitoring of casing pressure changes at the wellhead. The operator's selection and usage of leak detection technology should take into consideration detection limits for natural gas or any liquids, response time, reproducibility, accuracy, distance from source, background lighting conditions, geography, and meteorology.
4. The operator should conduct periodic functional tests of all surface and subsurface safety valve systems and wellhead pipeline isolation valve(s) for proper function and ability to shut-off or isolate the well as required for operational and emergency situations. Deficiencies, test failures, and equipment that do not meet functional specifications should be repaired or replaced promptly in order to assure the well's ability to control and isolate natural gas flows from the reservoir and well. Inoperable surface and subsurface safety valves on storage well(s) should be either repaired, removed or replaced, the well temporarily plugged, or alternative equivalent safety measures implemented.
5. When evaluating the need for subsurface safety valves on new, removed, or replaced tubing strings or production casing, operators should perform risk assessments in a manner that reviews at a minimum the API RP 1171 criteria. Where subsurface safety valves are not installed on wells, risk assessments should be used to inform decisions on integrity inspection frequencies and reassessment intervals, and mitigation criteria and procedures for the well production casing and tubing should be evaluated and implemented as necessary.

6. Operators should conduct ongoing assessments for the verification and demonstration of the mechanical integrity of each well and related piping and equipment used in the underground storage facility. The relevant factors to consider in verifying and demonstrating well integrity should include as a minimum: well service life history; design; construction; maximum operating pressures (injection, withdrawal, maximum treating and stimulation); product, corrosion, casing and tubing condition; cement condition and depths or heights; safety valves (surface and subsurface); operation of each well; and the time interval since the most recent assessment and past assessment findings.
7. Operators should have a corrosion monitoring and integrity evaluation program that includes the following:
 - (i) Evaluation of casing and tubular integrity and identification of defects caused by corrosion or other chemical or mechanical damage;
 - (ii) Corrosion potential of wellbore-produced fluids and solids, including the impact of operating pressure on the corrosion potential of wellbore fluids and analysis of partial pressures;
 - (iii) Corrosion potential of annular and any packer fluid;
 - (iv) Corrosion potential of current flows associated with cathodic protection systems;
 - (v) Corrosion potential of all formation fluids, including fluids in formations above the storage zone;
 - (vi) Corrosion potential of un-cemented casing annuli, including static liquid levels;
 - (vii) Corrosion potential of pipelines and other production facilities attendant to the underground storage facility including the corrosion potential of adverse-current flows associated with their cathodic protection systems; and
 - (viii) Periodic usage of the appropriate well log evaluations (such as corrosion, cement bond, temperature, noise, caliper and other appropriate assessment logs for integrity evaluations of the production casing and tubing strings) to determine well integrity, mitigation measures, and reassessment intervals to maintain the pressure rating and flow isolation characteristics of the well for all downhole pipe, cement, and any other isolation equipment.

8. Procedures for the evaluation of well and attendant storage facilities should include analysis of facility flow erosion, hydrate potential, individual facility component capacity and fluid disposal capability at intended gas flow rates and pressures, and analysis of the specific impacts that the intended operating pressure range could have on the corrosive potential of fluids in the system.
9. Identification of potential threats and hazards associated with operation of the underground storage facility should include the following:
 - (i) Evaluation of risk (likelihood of events and consequences related to the events);
 - (ii) Determination of a risk ranking to develop and implement preventive and mitigative measures;
 - (iii) Documentation of risk evaluation and decision basis for preventive and mitigative measures implemented;
 - (iv) Provision for data feedback and validation; and
 - (v) Regular, periodic risk assessment reviews to update information, and evaluate risk management effectiveness.
10. For ongoing verification and demonstration of the integrity of the underground storage reservoir or cavern, operators should use appropriate monitoring techniques such as the monitoring of pressure and periodic pressure surveys, inventory (injection & withdrawal of all products), product levels, cavern subsidence, and the findings from adjacent production and water wells, and observation wells used to monitor underground storage including any integrity changes.
11. Emergency procedures should identify the types of emergencies for which the operator should notify public emergency response officials, personnel training, periodic communication with local emergency response officials, identification of the local area impacted, notices to the public, and identification of any third-party service providers or technical experts needed in the event of an emergency. Emergency procedures should be reviewed, conducted, and updated at least annually.

12. Records of the processes, procedures, assessments, reassessments, and mitigation measures required should be maintained for the life of the storage well.

Issued in Washington, DC on February 02, 2016, under authority delegated in 49 CFR 1.97.

Alan K. Mayberry,

Deputy Associate Administrator for Policy and Programs.

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