PHMSA Requirements for Underground Storage of Natural Gas

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Overview
The Pipeline and Hazardous Materials Safety Administration (PHMSA) has issued new minimum federal safety standards for underground natural gas storage facilities. This ruling is effective January 18, 2017 and operators of storage systems must implement these regulations no later than January 18, 2018.

These regulations also incorporate by reference two new API recommended practices, RP 1170 for salt cavern storage systems and RP 1171 for depleted reservoir storage systems. Operators must comply with the entire RP’s for newly constructed system and selected portions for existing systems. All operators must begin annual reporting by July 18, 2017.

TRC Capabilities
TRC has the experience, skills, and capabilities to assist any operator in meeting compliance with these requirements by January 18, 2018 by evaluating the operators existing system and programs, and then filling any gaps to be in compliance. Operators will first be required to develop plans and programs for their systems, which will be followed by any physical changes to assets and then long term inspections, integrity assessments, and maintenance. TRC has the necessary skill set to perform the evaluations, assist in developing plans for filling any compliance gaps and recommending asset changes.

As a team TRC has unparalleled expertise in the development of O&M manuals, procedures, integrity programs, risk assessment analysis, and preventative/mitigative programs. Further, TRC has the necessary expertise to develop operational, maintenance, control, and technical procedures. Should any downhole expertise be needed for the detailed development of plans or programs, Baker Hughes, who is partnering with TRC, can provide those resources.

TRC offers a comprehensive and innovative technology practice that offers advanced cloud infrastructure, state of the art Geographic Information System (GIS) solutions, and flexible scalable interfaces to data in a real time environment. Connecting key stakeholders, business professionals, and operational staff in the office and in the field.

TRC also has extensive expertise in the collection and management of records to ensure assets are validated as traceable, verifiable and complete (TVC). This process can be a strenuous effort for owner operators. Often the digital conversion, migration, scanning, indexing, etc. is beyond the in-house manpower available for this type of work. TRC has the staff, processes, expertise, and experience to fulfill this need.

After development of programs and procedures for operators, TRC can also perform the risk assessments, integrity analysis, and engineering design required to meet long term compliance. Baker Hughes can perform all of the necessary downhole integrity and mechanical testing required for long term compliance.

TRC can provide “one-stop” service for underground storage integrity solutions that ensure compliance with these new regulations – both in the short and long term.

Regulatory Requirements
Shown below is an outline of the new regulatory requirements for salt cavern and depleted reservoir systems. These outlines describe the key elements of the programs.

API RP 1170 - Design and Operations of Solution Mined Salt Caverns Used for Natural Gas Storage

Summary - This RP provides functional recommendations to operators for the assessment, design, drilling, mining, operating, maintenance, integrity, and abandonment of solution mined salt
caverns for the underground storage of natural gas. The cavern well system includes the cavern, wellbore, wellhead, and emergency shutdown (ESD) systems. This RP can be applied to both new and existing facilities.

PHMSA Applicability - On or before January 18, 2018, operators of existing systems must meet the requirements of Sections 9 (Gas Storage Operations), 10 (Cavern Integrity Monitoring), and 11 (Cavern Abandonment). Operators of new facilities must meet all requirements of the RP.

Existing Cavern Compliance - Listed below is a summary of the key regulatory requirements by section that are required for each cavern and/or storage field:

**Section 9 - Gas Storage Operations**
- Minimum and Maximum Operating Limits:
  - Maximum injection and withdrawal rates
  - Minimum and maximum pressure at the casing seat
  - Minimum and maximum pressure at the wellhead
  - Maximum gas injection temperature
- Equipment:
  - New wellhead that wasn’t exposed to brine during solution mining
  - ESD valves installed on or near the wing valves
  - Measurement of gas in and out of the cavern
- Instrumentation, Control, and Shutdown:
  - SCADA system to monitor, control, and record conditions in the cavern
  - Audible or visual alarms to alert operators of upset conditions
  - ESD system to isolate a cavern in the event of an emergency
  - Overpressure protection system to isolate a cavern to prevent overpressure
  - Pressure monitoring of the cemented annulus between the production casing and the next cemented casing
  - Fire, gas, and heat detection near the wellhead
- Inspection and Testing:
  - Integrity monitoring program (covered in Section 10)
  - SCADA system testing and calibration
  - ESD system testing and calibration
- Workovers:
  - Cavern specific job plans
  - Site Security and Safety
  - Controlled access to the caverns and facility
  - Emergency assembly areas
  - Visitors and Contractors
  - Closed circuit television cameras and recording
  - Facility communications
  - Personal protective equipment
  - Lock out tag out system
  - Man down system
  - Wellhead identification
  - Vehicle barriers

**Section 10 – Cavern Integrity Monitoring**
- Cavern System
  - Mechanical integrity test – gas filled
  - Inventory verification
  - Downhole monitoring
  - Hysteresis curve analysis
- Wellbore
  - Mechanical integrity test – nitrogen/brine interface
  - Caliper log
  - Magnetic flux leakage log
  - Ultrasonic noise log
  - Temperature log
  - Cement bond log
  - Downhole camera
- Cavern
  - Sonar survey
  - Total depth log
  - Subsidence monitoring
- Wellhead
  - Ultrasonic thickness measurement
  - Cemented annulus pressure monitoring
- Holistic and Comprehensive Approach
  - Best practice
  - Risk assessment
  - Multiple monitoring methods
  - Opportunity based approach
- Integrity Monitoring Program
  - Formal written program
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- Identification of cavern system components
- Monitoring method and frequency
- Inventory verification
- Data analysis
- Periodic effectiveness review
- Review of Integrity Monitoring Methods

Section 11 – Cavern Abandonment
- Abandonment Objectives
- Abandonment Design
- Removal of Stored Gas
- Wellbore Integrity Test
- Removal of Downhole Equipment
- Production Casing Inspection
- Sonar Survey
- Long Term Monitoring

API RP 1171 – Functional Integrity of Natural Gas Storage in Depleted Hydrocarbon Reservoirs and Aquifer Reservoirs

Summary: This RP provides guidance to operators for the functional integrity of depleted hydrocarbon reservoirs and aquifer reservoirs for the storage of natural gas, and covers design, construction, operation, monitoring, maintenance, and documentation practices. The storage system includes the reservoir, wellbore, wellhead, and emergency shutdown (ESD) systems. This RP can be applied to both new and existing facilities.

PHMSA Applicability – On or before January 18, 2018, operators of existing systems must meet the requirements of Sections 8 (Risk Management for Gas Storage Operations), 9 (Integrity Demonstration, Verification, and Monitoring Practices), 10 (Site Security and Safety, Site Inspections, and Emergency Preparedness and Response), and 11 (Procedures and Training). Operators of new facilities must meet all requirements of the RP.

Existing Reservoir Compliance - Listed below is a summary of the key regulatory requirements by section that are required for each well and/or reservoir:

Section 8 – Risk Management for Gas Storage Operations
- Risk Management Program
- Data Collection and Integration
  - Data Sources
- Threat and Hazard Identification and Analysis (Threats and Consequences)
  - Wells
    - Physical integrity
    - Design
    - Operation and maintenance
    - Intervention
    - Third party damage
    - Outside force – natural causes
  - Reservoir
    - Third party damage
    - Geologic uncertainty
    - Fluid compatibility issues
  - Surface
    - Third party damage
    - Outside force – natural causes
- Risk Assessment Methodology
- Preventive and Mitigative Measures
  - Wells
    - Physical integrity
    - Design
    - Operation and maintenance
    - Intervention
    - Third party damage
    - Geologic uncertainty
    - Reservoir fluid compatibility issues
  - Reservoir
    - Third party damage
    - Geologic uncertainty
    - Fluid compatibility issues
  - Surface
    - Third party damage
    - Outside force – natural causes
- Periodic Review and Reassessment
  - Effectiveness assessment
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Section 9 – Integrity Demonstration, Verification, and Monitoring Practices
- Storage System Integrity Maintenance and Risk Based Evaluation
- Well Integrity Demonstration, Verification, and Monitoring
  - Well Integrity Evaluation
  - Well Integrity Monitoring
- Reservoir Integrity
  - Geological Characterization
  - Buffer Zone
  - Third Party Activity
  - Observation Wells
  - Gas Composition
- Gas Inventory Assessment
  - Total Inventory
  - Data Quality
  - Hydrocarbon Reservoir Methodology
  - Aquifer Reservoir Methodology
  - Additional Actions
- Flow and Pressure Monitoring
  - Monitoring
  - Deviations
  - Flow Erosion
- Integrity Nonconformance and Response
- Recordkeeping
  - Documentation and Retention

Section 10 – Site Security and Safety, Site Inspections, and Emergency Preparedness and Response
- Site Security and Safety
  - Flammables
- Ingress and Egress
  - Roads
  - Fences and Enclosures
- Signage
- Site Inspections
  - Procedures
  - Risk Mitigation
- Emergency Preparedness/Emergency Response
  - Response Plan
  - Training
  - Blowout Contingency Plan

Section 11 – Procedures and Training
- Procedures
  - Construction, Operations, and Maintenance Procedures
  - Content Review
  - Adequacy Review
  - Records Retention
- Operations and Maintenance Procedures
- Emergency Plans
  - Plan Effectiveness
- Well Work
  - MOC During Drilling, Completion, and Servicing
- Interaction with Control Room
- Integrity and Risk Management
  - Review of Procedures
- Safety and Environmental Programs
- Public Awareness and Damage Prevention
  - Coordination of Programs
- Management of Change Process
- Training
  - O&M Personnel
  - Supervisory Personnel
  - Contractor Personnel
- Records
  - Documentation and Retention
  - Training Records

Recordkeeping