Design and Operation of Solution-mined Salt Caverns Used for Liquid Hydrocarbon Storage

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Design and Operation of Solution-mined Salt Caverns Used for Liquid Hydrocarbon Storage

1 Scope

This recommended practice (RP) provides the functional recommendations for salt cavern facilities used for liquid hydrocarbon storage service and covers facility geomechanical assessments, cavern well design and drilling, and solution mining techniques and operations, including monitoring and maintenance practices. This RP is based on the accumulated knowledge and experience of geologists, engineers, and other personnel in the liquid hydrocarbon storage industry and promotes public safety by providing a set of industry accepted design and operation guidelines. This RP recognizes the nature of subsurface geological diversity and stresses the need for in-depth, site-specific geomechanical assessments, with a goal of long-term facility integrity and safety.

This RP includes the cavern well system (wellhead, wellbore, and cavern) from the emergency shutdown (ESD) valve to the cavern and facilities that have a significant impact on the safety and integrity of the cavern system. It also includes a structure for risk assessment for salt cavern facilities used for liquid hydrocarbon storage service.

This RP may be applied to existing facilities at the discretion of the user.

This RP does not apply to caverns used for the storage of gaseous products, natural gas, brine production, or waste disposal, nor to caverns that are mechanically mined, or depleted hydrocarbon or aquifer underground gas storage systems. This RP does not cover facility piping.

1.1 Overview

Storage of liquid hydrocarbons in solution-mined salt caverns has been utilized in the United States since the late 1940s. Today, storage of liquid hydrocarbons in caverns developed in both domal and bedded salt formations is utilized throughout the world.

Salt caverns can act as long-term, seasonal storage vessels; or they may serve as short-term, operational storage. Caverns can also be inserted into the production plant/pipeline systems to prevent supply interruptions when maintenance or emergency shutdowns occur, or to “float” on pipelines to optimize operations.

Storage of liquid hydrocarbons in a salt cavern may require careful review to ensure that the product is compatible with the salt. Chemical and physical properties of the salt at the cavern depth and at the pressure anticipated should be reviewed to verify that unwanted chemical or physical reactions do not occur. Incompatibility of product and salt is rarely a problem for most hydrocarbons. Examples of exceptions are storage in salt caverns where sulfides are present and storage of jet fuels with de-icing agents that absorb water.

In summary, storage of liquid hydrocarbons in salt caverns can provide an economical, safe, and environmentally sound method to store large quantities of compatible materials.

1.2 Applicable Rules and Regulations

This document was written to provide a technical reference for the development and operations of solution-mined salt caverns used for the storage of liquid hydrocarbons, and is not intended to represent or reflect any regulatory requirement. Depending on location and nature of the project, the recommended practices herein may address items that are in conflict with some regulatory requirements. If this occurs, the regulatory requirement supersedes the recommended practice unless an appropriate waiver or variance is granted from the issuing agency. A thorough review of the applicable rules and regulations is to be performed prior to the design of solution-mined liquid storage caverns to ensure ongoing compliance.