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**CSA Z341 STANDARDS: THE 2022 EDITION
AND CASE STUDIES OF PRODUCTION CASING CORROSION**

Alex Reed, Keyera Corporation, Calgary, Alberta, Canada
Jug Manocha, Ameta Projects Inc., London, Ontario, Canada
Rocky Halbgewachs, SaskEnergy, Regina, Saskatchewan, Canada
Brent Generoux, Secure Energy Services, Calgary, Alberta, Canada
Henry Seidlitz, Lonquist & Co., Regina, Saskatchewan, Canada

Abstract

In March 2022, CSA Group published the eighth edition of the CSA Z341 Series of Standards “Storage of hydrocarbons in underground formations”. This standard is prepared by technical committee consisting of members who are directly involved in the engineering and operation of the underground storage facilities and consists of storage operators, industry consultants and regulatory staff. The focus of the document is to ensure storage operations are operated within peer developed requirements.

The Z341.1 standard covers the storage of natural gas in naturally formed geological reservoirs. Z341.2 is the standard for storage of gaseous and liquid hydrocarbons in solution-mined salt caverns. Disposal of liquid and solid oilfield wastes from hydrocarbon production in solution mined salt caverns is dealt with in Z341.4. This series is intended to establish essential requirements and minimum standards for the design, construction, operation, maintenance, abandonment, and safety of underground storage systems.

Some of the major changes in the 2022 edition include:

- clarifications for precommissioning pressure tests;
- oxygen ingress into each casing annulus is to be minimized;
- casing inspection requirements have been adjusted for reservoir storage wells;
- definition and adjustment of operating and test pressures for cavern wells;
- adjustments to requirements for cavern mechanical integrity tests;
- procedures for calculating mass balance inventories of natural gas caverns for mechanical integrity tests and annual inventory monitoring has been introduced;
- addition of procedure requirements for wells with naturally occurring radioactive materials; and
- fine-tuning of cavern pre-abandonment preparations.

Based on the findings of a 2014 cavern fire incident and recent experiences of finding production casing corrosion at shallow depths, it is apparent that water and air/oxygen presence in the surface casing annulus is a concern. The new edition requires minimization of air/oxygen ingress into each casing annulus. It is known that even with cement reported to surface, air/oxygen and water can enter the surface casing and cause severe corrosion of the pressure-bearing production casing.

Case studies are presented where corrosion-caused production casing leaks were found either by surface casing vent flows or by casing inspection logs during a workover. Each operator has used different approaches to address the issue including: replacement of corroded casing joints; installation of a casing patch over the corroded interval; and by placing mineral oil and/or corrosion-inhibiting fluid in the surface casing annulus. These case studies are reviewed with the incidents summarized and lessons learned, and how these are addressed into the new edition of the standard.