SOLUTION MINING RESEARCH INSTITUTE
679 Plank Road
Clifton Park, NY 12065, USA

Telephone: +1 518-579-6587
www.solutionmining.org

Technical Conference Paper

An Alternative Cavern Gas Storage Design Offers a New Service Profile

Kenneth L Beckman
Tomball, Texas

SMRI Fall 2023 Technical Conference
2-3 October 2023
San Antonio, Texas, USA

Solution Mining Research Institute Fall 2023 Technical Conference

San Antonio, Texas, USA 2-3 October 2023

An Alternative Cavern Gas Storage Design Offers a New Service Profile

Kenneth L Beckman

Beckman and Associates, Consultants Inc. Tomball, Texas, USA

Abstract

Underground Natural Gas Storage has evolved over time to provide new and different gas supply services while continuing to serve the domestic natural gas industry, primarily local distribution companies and pipeline companies in traditional supply and demand service established over 100 years ago in North America. The recent hiatus in storage development has ended with the arrival of a new customer group, the LNG Export Terminal operators. The intra and interstate pipeline companies are responding to the current 13 Bcf/d (0.368 Bcm) currently projected to be 28 Bcf/d (0.79 Bcm by 2029) of feedgas demand with flow reversals in existing facilities and new construction of special purpose feedgas pipelines. The shale gas producers are drilling through a monetary gas price low anticipating future high prices. But as nearly one quarter of America's gas demand is heading overseas by 2029, how will disruptions in that daily load be handled? Gas storage, cavern operators in particular, will necessarily do that duty.

LNG Liquefaction trains are variously sized from 150,000 Mcf to 700,000 Mcf (4.248 to 19.822 MMm^3) of daily flow. Export facilities develop multiple trains, with site demand ranging from 1.25 Bcf/d to 4.5 Bcf/d (35,396 to 127,430 MMm^3/d). These facilities have diurnal demand swings resulting from liquefaction efficiency losses with daily temperature fluctuations of approximately 15% of daily volume. Additionally, the facilities periodically suffer shutdowns of one or more liquefaction trains, effectively pushing back on the feedgas pipeline volumes up to 7,000 Mcf (0.198 MMm^3) of gas in an hour for a single large volume train.

Dealing with sudden large imbalances requires "No-Notice" storage injection service directly interconnected with the feedgas pipeline. Salt cavern gas storage provides a desirable tool to manage both predictable daily demand swings and unanticipated imbalances. But unlike traditional cavern gas storage service, which is withdrawal deliverability focused, this customer group is injection capacity focused. And injection capacity is compression intensive, which translates to Capital Expenditure (CapEx) intensive.

One gas supply management solution calls for a different cavern facility design, allowing for a shift towards shallower caverns operating at lower pressures with larger tubulars capable of greater flows of gas in very short periods of time. This design solution reduces compressor CapEx, increases gas flows on injection and still can provide traditional

cavern gas storage service profiles. It often does require larger caverns, higher base gas volumes, and is most efficient when operated with ANSI 900 header pipeline design.

A hypothetical design solution is presented with a comparison to a deeper cavern design demonstrating the advantages and issues necessary to construct a more efficient cavern storage service for the LNG Export customer class.

Key words: Salt Cavern Design, LNG Export Customer