

FIRST COMPLETION DESIGN IN THE UK TO USE WELDED COMPLETIONS FOR A NEW LARGE ONSHORE GAS STORAGE DEVELOPMENT IN SALT CAVERNS

Ross Fawthrop, E.ON UK

Nicolas Bonnier, Geostock

Raymond Bublak and Jens Schubert, UGS

Clive Jackson and Thomas Robb, Halliburton

Abstract

A new, large gas storage facility was constructed in the UK with 8 underground caverns in the Cheshire Triassic salt (top at ~450 m and bottom at ~700 m below ground). Each well was drilled vertically from a separate well pad and completed using a two-trip welded completion. A 13-3/8-in. permanent packer was run on drill pipe in saturated brine and set hydraulically using a packer setting plug dropped from the surface. Right hand rotation released the running tool, and the well was circulated with completion fluid prior to recovering the drill pipe. Thereafter, the ratch-latch anchor, 9-5/8-in. tubing, and the 9-5/8-in. safety valve were run in and anchored into the permanent packer. In this case (derived from maximum temperature situations, steel qualities, annular fluid etc.), a pre-tension of over 65 tons was calculated and applied to the tubing string to ensure that the tubing would remain in tension over its entire length, even when operated at its maximum temperature.

This paper discusses the merits of welded completions compared to threaded completions, the qualification and testing of the weld procedures, the modification to the completion equipment, and the successful installation of a welded completion. Weld procedures for the 9-5/8-in. tubing were available but had to be revised to suit the different materials used in the completion equipment. The temperature range of the cavern was 0°C (32 F) to 60°C (140F), and the completion equipment and raw material was selected and qualified for this low temperature.

Gas storage completions can experience large temperature swings during the injection and production operations, and this cyclic loading was analyzed and mitigated by keeping the tubing in tension during the life of the well. A tensile load of zero at the packer was used during the worst case of high temperature injection operations. An extensive tubing-movement analysis was conducted to accurately determine the overpull required at surface to keep the string in tension during the life of the well for both injection and production operations.

The discussion covers the successful installation of welded completions at E.ON's Holford UK underground natural-gas storage facility, concluding that in this application, welded completions would provide an improved 'through-life' solution compared to conventional threaded completions.