Abstract

Carbon Capture and Storage (CCS) wells are constructed using standard oilfield equipment and generally supervised by oilfield personnel; however, the goals of CCS wells are much different from a typical oil and gas well. The standard to which wellbore integrity is held in CCS wells is higher than the standard for a conventional oil and gas well because they are regulated by the US EPA as part of the Underground Injection Control (UIC) program. The methods used for evaluation are more sophisticated as well including detailed logging and integrity characterization. From the initial well planning and all the way through well construction process it has to be emphasized that the goal of the well drilling is to drill a hole that will facilitate a successful cementing operation; i.e., as straight and as close to gauge as possible. A slight change in penetration rate or different pump pressures can adversely affect the borehole as well as the cement integrity for the entire well.

Recent experience with CCS well construction highlights challenges. Three CCS monitoring wells were constructed recently as part of a project called “Establishing an Early Carbon Dioxide Storage (ECO2S) Complex in Kemper County, Mississippi” (Project ECO2S). UIC requirements specify that the long-string casing be cemented to surface, to simplify cementing operations each well was cemented in a single stage. Single-stage cementing required balancing the slurry properties and density with set cement properties and CO2 resistance. The integrity of each of the wells was assessed considering the geologic setting using open-hole logs, the hole conditions, casing setting and centralization details, cement pumping data, and cased-hole integrity logs.

Two wells had cement returns surface. One well lost much of the cement to the surrounding formations (no returns to surface). Technical contributions of this work include how detailed logging can be used to identify contaminated cements, how cement operations and hole conditions can be designed reduce poor cement outcomes, how to balance operational needs for successful cementing with long term requirements of the well and how cultural differences in planning and operations between oil and gas and CCS can affect integrity. Overall, the results of the Project ECO2S well integrity assessment provides lessons learned to construction of CCS and other wells that may need to be constructed to withstand CO2 exposure including CO2-EOR wells.
The casing and cementing program must prevent movement into or between USDWs. A cement 34-1, and MPC 10-4, were drilled to allow detailed characterization of the subsurface at the site. The for casing, cement, and other materials to be compatible with stored CO2 and subsurface conditions. The US EPA Class VI requirements require regional deep saline aquifer system. store commercial volumes of CO2 within the storage projects capable of storing CO2 by Storage Assurance Facility Enterprise United States Department of Energy’s Carbon projects called “Establishing an Early Carbon Dioxide Storage Complex in Kemper County, Mississippi” (Phase E.)

LESSONS LEARNED FROM RECENT CCS WELL CONSTRUCTION PROJECTS

MONITORING WELL DESIGN AND CONSTRUCTION

The wells were designed to meet the US EPA Class VI design requirements with the surface and long string casings cemented to surface. The long string sections of the wells were designed with chrome casing and CO2 resistant cement across the potential storage zones and through the caprock.

The wells were drilled to approximately 5400 to 5700 ft. chrome casing and CO2 resistant cement across the potential storage zones and through the caprock.

Lessons learned: Close attention is required during drilling to achieve adequate penetration rates and bonding but inside the surface casing and in the area just below there is evidence of mud contamination.

The drilling contractor was charged prior to drilling this well. A large hole was drilled (17.5’) and larger than expected (15’) in the well indicated severe washout and hole enlargement. This was detected during the cementing operation when cement contaminated mud was encountered at the surface very early in the cementing process. Pump rates were maximized and the lower section of the hole was cut and then bonded but inside the surface casing and in the area just below there is evidence of mud contamination.

The construction of the monitoring wells for Prepos EGS, provided an opportunity to identify and characterize CO2 resistant cement across the potential storage and through the approach. It is critical to cementing operations each well was cemented in a single stage. Single-stage cementing required balancing the slurry properties and density with set cement properties and CO2 resistance.

The integrity of each of the wells was assessed considering the geologic setting using open-hole logs, the hole conditions, casing setting and centralization details, cement pumping data, and logging confirmed cement to surface. The isolation scanner confirmed cement to surface for first 66 joints (3140’), every other joint (50p) and every third joint to surface.

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CONCLUSIONS

The construction of the monitoring wells for Prepos EGS provided an opportunity to identify and characterize CO2 resistant cement across the potential storage and through the approach. It is critical to cementing operations each well was cemented in a single stage. Single-stage cementing required balancing the slurry properties and density with set cement properties and CO2 resistance.

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LESSONS LEARNED

Lesson learned: Good hole cleaning practices and surface execution are very important in obtaining a good cement job. Monitor well selection is that with good planning a well that has a compromised cement log can be successfully repaired.

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