Importance of Well Integrity Measurements Throughout the CCS Project Lifecycle

Paper Ref : **SPWLA-2024-0015**

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Abstract:

In the carbon capture and sequestration (CCS) operating environment, assurance of well integrity becomes both more important and more technically challenging than in typical oil and gas operations. Its importance is amplified by government regulators who are well aware of the risks and consequences associated with an eventual loss of containment of stored CO2 and insist on a high level of scrutiny. For the operator, a catastrophic loss of containment could spell a premature end to the operating phase of the project at a huge financial loss. Meanwhile, the technical challenge of assuring well integrity is amplified by the corrosive, buoyant, and highly mobile nature of CO2 in the subsurface and by the long service lifetime (100 years+) required by these projects. Ironically, the measurement of well integrity may be complicated by the exotic well construction materials selected to address these very challenges.
Nonetheless, measurements of well integrity play a critical role and will continue to do so throughout the lifetime of CCS projects in at least four ways:

1. Identifying and assessing the condition of legacy wells within the area of review (AOR)
2. Verifying and validating the placement of CO2-resistant cement (or other material) and/or the condition of CO2-resistant casing strings upon construction of new wells
3. Proactive continuous or periodic time-lapse monitoring of the casing, annulus, and near-wellbore region
4. Diagnostic measurements to pinpoint suspected eventual deficiencies, characterize them, and develop remediation plans

We review a broad range of well integrity measurements, including acoustic and ultrasonic logs, electromagnetic logs, mechanical caliper logs, pulsed-neutron logs, distributed measurements of temperature and acoustic vibration made via either permanently installed or temporarily deployed fiber optic, oxygen activation logs, production logs, and the old-fashioned mechanical integrity test. We discuss the applicability of each class of measurement to the various phases of CCS projects, illustrated by North American examples.
We examine the impact of special materials such as CO2-inert cement or epoxy resins on both the measurement and the interpretation of well integrity. We also consider the impact of corrosion-resistant alloys on the casing integrity monitoring strategy. The end result is a recommended well-construction and monitoring strategy for CCS projects, balancing considerations of operational practicality, regulatory requirements, and the true risks faced by the project to assure safe and continuous operation and containment for the next century.

Bio:

Dirk Valstar is a Well Integrity Domain Champion for Wireline at SLB. He has more than 30 years of experience in the oil and gas industry and has worked all over the world in a variety of environments, initially as a field engineer and currently provides technical support to both customers as well as in house in the continental United States on Well Integrity logs and interpretation. He graduated from Delft University in the Netherlands with a MSc in Petroleum Engineering.

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