Schlumberger

US Department of Energy and ADM Optimize Carbon Sequestration Using Multizonal Intelligent Completion

Modular intelligent completion equipment and Optiq Schlumberger fiber-optic solution enable real-time monitoring and control of subsurface carbon storage, Illinois, USA

Pioneering application of multizone intelligent completion and fiber-optic cables for distributed temperature sensing (DTS) and distributed acoustic sensing (DAS) in real time has enabled remote monitoring and control; it has also optimized injection and sequestration of >2.5 million metric tons of CO_2 into the subsurface over a 3-year period.

Large carbon sequestration project required efficient execution

The Illinois Industrial Carbon Capture and Storage (ICCS) project is administered by the US Department of Energy's Office of Fossil Energy. This commercial-scale project involves the capture and storage of more than 2.5 million metric tons of CO_2 from Archer Daniels Midland Company's (ADM's) ethanol facility in Decatur, Illinois, over a period of three years.

ADM constructed and operates a collection, compression, and dehydration facility capable of delivering up to 2,755 metric tons of CO_2 per day (more than 1 million metric tons annually) to the injection and sequestration site for storage approximately 7,000 ft underground in the Mount Simon Sandstone. Schlumberger was responsible for seismic data collection and processing, geologic modeling, and reservoir simulation as well as for the design, construction, and characterization of a 3,500-ft-deep geophysical monitoring well, 7,000-ft-deep injection well, and 7,000-ft-deep monitoring well.

Schlumberger proposed innovative application of intelligent completions

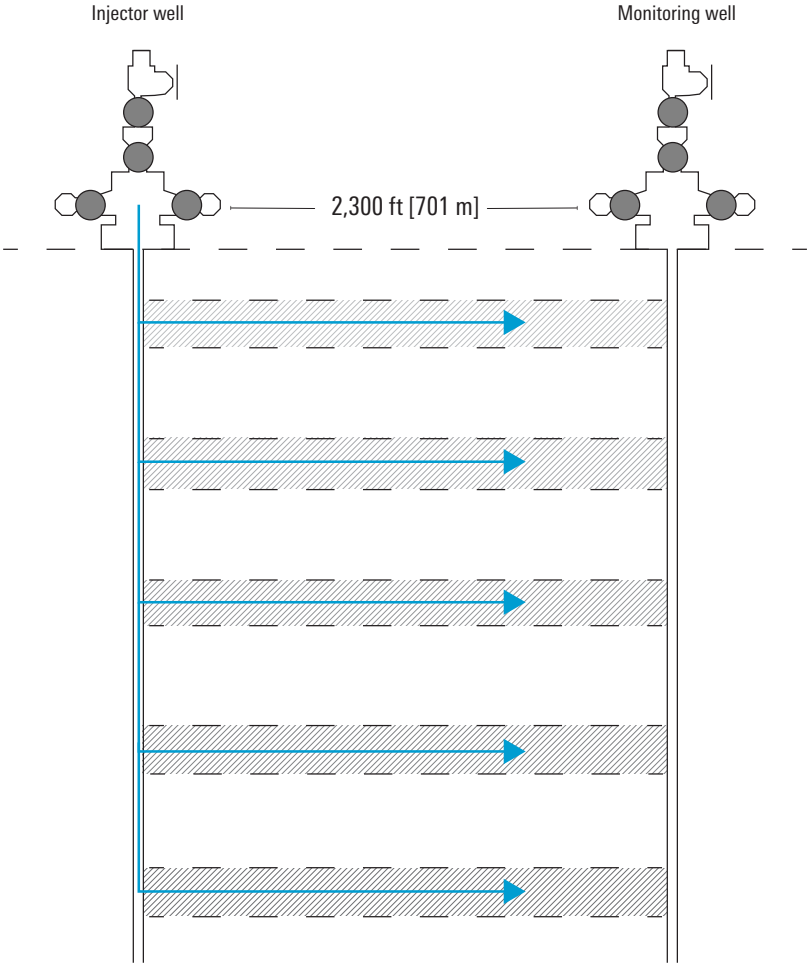
A five-zone intelligent completion was installed in the monitoring well and included

- equipment to isolate, monitor, and control each of four zones
- multiport packer and pressure and temperature (PT) gauge using a quartz sensor for the deepest zone
- dual PT gauge for recording tubing and annulus PT above the production packer
- gas lift mandrel for nitrogen injection
- remote-controlled hydraulic power unit (HPU) to actuate the flow control valves (FCVs)
- control line containing two optical fibers, extending from surface to the top packer.

The completion in the injection well included

- production packer
- control line containing two optical fibers extending from surface to the top packer
- dual PT gauge, also positioned above the packer.

A multiwell acquisition unit and the WellWatcher Connect* wellsite data transmission system were used to transmit data between the wellsite and ADM's office in town, as well as for remote control of the HPU to actuate the downhole FCVs.

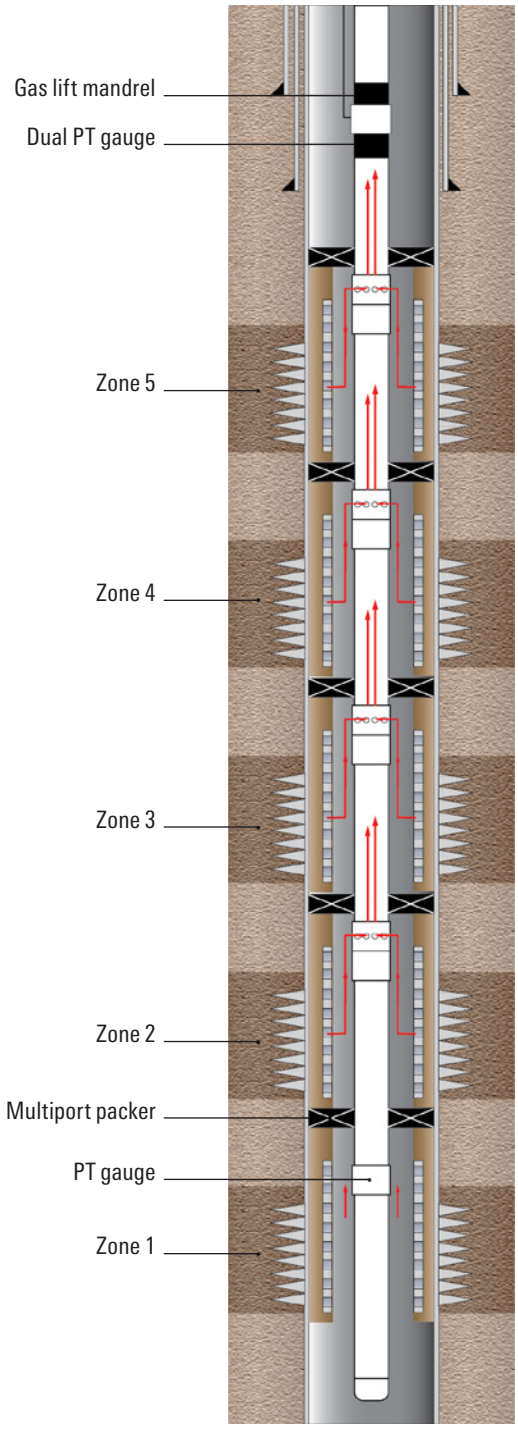


Captured carbon is pumped into the multilayered reservoir, and samples are regularly taken from the monitoring well to ascertain the storage behavior.

Flawless completion and data acquisition

The gauge measurements in the monitoring well provide valuable insight into the impact of injection on the various zones. Nitrogen is injected through the gas lift mandrel when required, to reduce the hydrostatic pressure in the wellbore, encouraging flow of formation fluids. The FCVs are then opened remotely, and samples of downhole fluids are collected to identify changes in reservoir conditions. An Optiq* Schlumberger fiber-optic solution was deployed using two fiber-optic cables in both the injection and monitoring wells. In each case, one cable is used for DTS and the other for DAS. The distributed measurement data is used to monitor well injection performance and well integrity (mechanical integrity test or MIT) by detecting leaks. Schlumberger geoscientists provide quality control and interpretation of temperature, pressure, acoustic log, and fluid sample data, followed by reservoir simulation and modeling.

Innovative completion design, meticulous planning and deployment, and close collaboration between ADM and Schlumberger resulted in flawless and timely project execution with zero NPT. Remote surveillance and actuation of the FCVs as well as sample collection have been successfully implemented. Pleased with the efficient installation and the clear insight into CO_2 injection operations resulting from the monitoring system design, ADM plans to use intelligent completions in a second carbon sequestration project.



A five-zone intelligent completion in the monitoring well provides insight into the effects of CO_2 injection in the different zones. Opening the flow control valves enables collection of downhole fluid samples to identify changes in reservoir conditions.

slb.com/intelligent

Schlumberger