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

Four IntelliZone Compact systems and fiber optics enable real-time monitoring and control of subsurface carbon capture and storage, Illinois, USA

### CHALLENGE
Optimize injection of more than 2.5 million t of CO$_2$ into the Mount Simon Sandstone over a three-year period.

### SOLUTION
Pioneer the application of four IntelliZone Compact* modular multizonal management systems and fiber-optic cables in two wells for monitoring carbon sequestration in real time.

### RESULTS
- Designed and installed with zero NPT two intelligent completions for CO$_2$ injection surveillance.
- Provided remote monitoring and operational control of downhole systems.
- Successfully cycled flow control valves (FCVs) and collected formation fluid samples for injection analysis.

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 t 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 t of CO$_2$ per day (more than 1 million t 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
- four IntelliZone Compact systems to isolate, monitor, and control the individual zones
- multiport packer and downhole quartz gauge for the deepest zone
- dual PT gauge for recording tubing and annulus pressure and temperature above the production packer
- gas lift mandrel for nitrogen injection
- remote-controlled hydraulic power unit (HPU) to actuate the 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 multivell 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.

### 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. The fiber-optic cables in both the injection and monitoring wells provide distributed temperature sensing (DTS) and distributed acoustic sensing (DAS) data for monitoring 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. 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 CO₂ 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 provided insight into the effects of CO₂ injection in the different zones. Opening the flow control valves enabled collection of downhole fluid samples to identify changes in reservoir conditions.

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