GEOLOGIC MODELING AND SIMULATION AT THE AQUISTORE SITE: A GUIDE TO MVA DEPLOYMENT

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ABSTRACT

The Plains CO_2 Reduction (PCOR) Partnership, through the Energy & Environmental Research Center (EERC), continues to support the Petroleum Technology Research Centre (PTRC) Aquistore project. This support has been in the form of geologic characterization, involvement in the Science and Engineering Research Committee (SERC), public outreach, developing geologic models, and running predictive simulations on the expected injection program at the site. The Aquistore project, part of the world's first commercial postcombustion carbon capture, utilization, and storage project from a coal-fired power-generating facility, the SaskPower Boundary Dam, located in Saskatchewan, Canada, will act as buffer storage site for the captured CO_2. The Aquistore site includes one injection well and a 152-meter offset observation well. At nearly 3400 meters below the surface, the targeted saline system provides a secure location for the storage of CO_2.

To better understand the storage implications of injecting CO_2 at the Aquistore site, the EERC constructed multiple geologic model realizations and ran three predictive simulation scenarios on each realization. These models and simulations were used to assess the effect that geologic uncertainty and different operational parameters play in the breakthrough time at the monitoring well, pressure change, and CO_2 plume evolution. Modeling components varied in the development of these realizations include shale volume, porosity, variogram range, structural interpretation, and net-to-gross reservoir in the six sand and six shale units traceable throughout the regional study area.

Three operational cases were selected to cover a range of possible injection scenarios that may be experienced at the Aquistore site. Case 1 ran for 30 days of injection (35 months of postinjection) at an injection rate of 1000 tonnes of CO_2/day for a total of 30,000 tonnes of CO_2 injected. Case 2 injected 301 tonnes of CO_2/day for 3 years for a total of 330,000 tonnes of CO_2. Case 3 cycled the injection of 1000 tonnes of CO_2/day for 30 days, followed by a 2-month shut-in period. This cycle was repeated until 330,000 tonnes of CO_2 had been injected (about 3 years). Case 1 was designed to evaluate first CO_2 breakthrough times, the accompanying pressures at the observation well, and the CO_2 plume extents. Cases 2 and 3 were designed to evaluate the effects of operational considerations on pressure evolution, CO_2 plume extent, and other resultant differences. The simulation results of each injection scenario were incorporated back into the geologic models to plot the areal distribution of these parameters. Results of this investigation have provided insight into the timing and magnitude of the reservoir's response to CO_2 injection. These elements, in turn, will ultimately aid in the planning, development, and deployment of monitoring, verification, and accounting activities at the Aquistore site.