Statistical Analysis of CO_2 Exposed Wells to Predict Long-Term Leakage Through the Development of an Integrated Neural-Genetic-Algorithm

Award Number: DE-FE0009284

Project Summary:

This project worked to develop a novel hybrid model utilizing a neural-genetic algorithm to predict long-term leakage risks for wells exposed to carbon dioxide (CO_2). Specific project objectives included: (1) the creation of likely leakage scenarios for specific well attributes; (2) the compilation of a wellbore database from existing wells from the Texas Gulf Coast area and statistical analysis of the data; (3) the development of a neural-genetic algorithm model which predicts leakage risk for wells based on the Texas Gulf Coast data; and (4) the verification of model results by conducting field sampling including sidewall core samples, pressure testing data, and well logs of existing wells and comparing those results with the model.

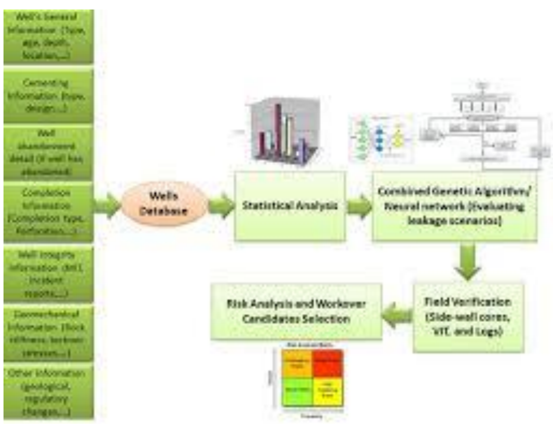

Figure 1: Project work-flow and a visual depiction of the algorithm development process.

Prime Performer:
University of Louisiana at Lafayette

Key Performers:
Schlumberger Carbon Services
Missouri University

Principal Investigator:
Boyun Guo

Project Duration:
4/1/2013 – 3/31/2017

Performer Location:
Lafayette, Louisiana

Field Sites:
Cranfield site, Mississippi

Program:
Carbon Transport & Storage

Project Outcomes:

This project developed a novel hybrid model to predict long-term leakage risks for wells exposed to CO_2. The project compiled a wellbore database from existing wells in the Texas Gulf Coast area, conducted a statistical analysis of the data, and developed a well Leakage Safe Probability Index as a function of four failure indicators determined by four groups of independent variables. The variables used to create the failure indicators were: (1) well schematics, studied to relate the depth of surface casing and placement of cement to the base of usable quality water; (2) well age indicator, assigned based on the age of the well combined with the number of years since it was first exposed to CO_2; (3) cement type, evaluated against the pressure, temperature, stress, and fluids it is exposed to for suitability to the application; and (4) cement sheath integrity, quantified based on its ability to safely withstand the minimum and maximum pressures the well has been or will be exposed to. Once the algorithm was trained, it was tested again in a field lab study at the Regional Carbon Sequestration Partnership Cranfield Project monitoring wells.

Presentations, Papers, and Publications

Final Report: Statistical Analysis of CO_2 Exposed Wells to Predict Long Term Leakage through the Development of an Integrated Neural-Genetic Algorithm (July 2017) Boyun Guo, Andrew Duguid, Ronar Nygaard