Risk Assessment Case Study: Mountaineer CO$_2$ Sequestration Site

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Mountaineer Project Background
a.k.a. “Ohio River Valley CO₂ Storage Site”

Overall Objective- Provide an understanding of the viability of carbon sequestration as greenhouse gas reduction technology by performing an integrated demonstration of CCS in Ohio R. Valley.

✔ Phase I- Regional capacity evaluation.

✔ Phase II- CO₂ injection modeling, economic & engineering assessment, geochemical experiments.

✔ Phase III- Test well drilling, seismic, reservoir testing, rock coring at Mountaineer Power Plant. Design and feasibility study.

✔ Potential Future Effort- Pilot-scale carbon capture and storage (CCS) at power plant, injection, storage monitoring.
Site Location/Environmental Setting

- 1300 MW AEP Mountaineer Power Plant, New Haven, WV, on the Ohio River along U.S. Route 62.
Mountaineer Project Plans/Assumptions

- Develop test-scale integrated carbon capture and storage system.
- Capture and injection of <0.5% plant emissions into deep saline formation (rate depends on slipstream capture specs ~20-100 metric ton CO2/day).
- Several years of continuous injection & monitoring.
- Entire system to be contained on plant site.
Mountaineer Site Characterization

- First CO₂ sequestration test well at active power plant.
- Testing provides extensive suite of quantitative parameters.
- Reservoir testing completed to test injectivity.

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Regional Site Characterization

- Regional data helps define sequestration potential in the region.
Mountaineer Recent Progress

- Reservoir testing in carbonates (Copper Ridge “b-zone”) indicates permeability up to several hundred mD across 200 ft.
- STOMPCO2 reservoir modeling indicates injection rates of 100s of ktonnes CO2/year possible in both Rose Run Sandstone and Copper Ridge “b-zone”.

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Risk Assessment Methodology

1) **Features, Events, and Processes (FEP)**  
   **Performance and Safety Screening**  
   - Systematic, qualitative screening  
   - High-level effort to identify important items for the project

2) **Integrated Numerical Modeling Approach**  
   - Integrated assessment framework to address risk and consequence  
   - Quantitative methods

- Comprehensive site characterization provides knowledge base and site-specific parameters for risk assessment.
Performance and Safety Screening for the Mountaineer CO$_2$ Storage Site Using Features, Events, and Processes Database

1. Apply systematic screening procedure to the Mountaineer site for geologic storage of CO$_2$.

2. Identify potential performance and safety risk items.

3. Provide guidance on injection system design, monitoring program, reservoir simulations, and other risk assessment efforts.
FEP Screening Process

Level 1 Screening (143 Items)
- Screen out 69 Items not applicable, policy or legacy issues

Level 2 Screening (74 Items)
- Screen out 54 Items addressed by general site conditions and/or site characterization results

Level 3 Screening (20 Items)
- Screen out 14 Items accounted for by testing at site and/or system specifications

6 Items (address in design, monitoring, additional testing and analysis)
INTEGRATED MODELING APPROACH FOR RISK ASSESSMENT OF MOUNTAINEER CO2 SEQUESTRATION PROJECT

• Fate and transport models can serve as an effective basis for developing integrated risk assessment and permitting tools for a given site.

• We used STOMPCO2, a reservoir-scale numerical model and extended it further, to develop an integrated assessment framework.

• This tool can support risk and consequence assessment, monitoring networks design and permitting guidance needs.
Integrated Assessment Model

An integrated, reservoir scale model can support Engineering Design, Risk & Consequence Assessment, Permitting, Site Monitoring & Verification

Monitoring Networks
Atmosphere
Soil  Water-bodies
Vadose Zone
Overburden & Aquifer
Caprock Integrity  Wells Integrity
Injection, Fate & Transport
Path Forward

• Integrate risk items into MMV program.
• System design for CCS.
• System construction and testing.
• Verification of long-term sequestration.
• Investigate up-scale issues.
Questions to Consider:

• Other risk issues beyond leakage (i.e. system integrity, long-term injectivity, economic risk)?

• Might a CCS system actually reduce risk in some areas (i.e. air emissions from existing power plant)? Example: Mountaineer plant will require SO\textsubscript{X} scrubber before CCS is possible. Isn’t this a good thing? How does it factor into our risk assessment? Are we ignoring it?

• False positive risks from near surface monitoring?

• Reconciling risk conclusions/recommendations with existing Class I and gas storage applications? Gas storage and waste injection wells generally have lesser risk analysis and MMV.