Application of a Comprehensive Environmental Permitting Approach for the Michigan Basin Test Site, Midwest Regional Carbon Sequestration Partnership

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Acknowledgements- Project Team

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Dave Barnes and Bill Harrison

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Charlie Byrer

Robert Mannes and Joe Herpst

Additional Contributions by Numerous Other MRCSP Team Members

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Presentation Objectives

• Project Summary/Site Description
• Initial Site Screening
• Preliminary Geological Assessment
• Well installation/completion
• EPA Underground Injection Control Permit
• Injection, MMV Plans
• Conclusions
Project Summary

• MRCSP is one of seven U.S. DOE/NETL Regional C Seq. Partnerships.
• Eight-state region of IN, KY, MD, MI, NY, OH, PA, and WV.
• Phase I Launched, fall 2003; Phase II commenced October 2005.
• Michigan Basin site is one of three geologic test sites.
Site Description- Test Site

• The location is 16 km east of Gaylord, Otsego Co., Michigan.
Site Description - Otsego County Test Site

- Charlton 30/31 field, S. Dover/N. Chester Township, Otsego County, Michigan
Site Description - Geologic Setting

Michigan Basin

Natural Resources Canada

Oil and Gas

Northern Michigan Reef Trend Oil & Gas Fields

Devonian Antrim Shale Gas Play

Test Site

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Site Description - Geologic Framework

- Mature sedimentary basin.
- Paleozoic sedimentary rocks ~2900 m deep and overlie Precambrian bedrock.
- Primary targets = Bass Islands Dolomite-Bois Blanc (972-1071 m).
- Containment layers: Amherstburg-Lucas formations (682-972 m).

Depth (m) | Formation Name | General Lithology
--- | --- | ---
0 | Glacial | Glacial
500- | Antigonish | Sandstone, shale
1000- | Dark Antigonish | Sandstone, shale
1500- | Traverse LS | Limestone, dolomite
2000- | Antigonish | Sandstone, shale
2500- | Lucas LS | Limestone, dolomite
3000- | Amherstburg | Sandstone, shale
3500- | Bois Blanc | Dolomite
4000- | Bass Is. | Limestone
4500- | Sauble Group | Sandstone, shale
5000- | Niagara Arch | Limestone, dolomite
5500- | Niagara Arch | Limestone, dolomite
6000- | Quinnsburg SH | Sandstone, shale
6500- | Utica SH | Sandstone, shale
7000- | Trenton LS | Limestone
7500- | Black River LS | Limestone
8000- | Trenton LS | Limestone
8500- | Ancroft SS | Sandstone
9000- | St. Pater SS | Sandstone, shale
9500- | Jacobsville SS | Sandstone
10000- | Jacobsville SS | Sandstone

Aquifer
Antrim Shale Gas Play
Containment Intervals
CO2 Storage Target
Niagara Reef Oil Play
Other Targets in Michigan Basin
Site Description - Geologic Framework

Target - Bass Islands Dolomite

Containment - Amherstburg

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Site Description- CO₂ Source

- CO₂ available from DTE Turtle Lake gas processing plant
- Antrim Shale gas contains 5-30% CO₂ and is removed in amine based separation process
- CO₂ dried and compressed at Core Energy Chester 10 facility
- CO₂ periodically piped as needed along ~13 km CO₂ pipeline for EOR floods in Niagaraan Reef oil fields
Site Description - System Diagram

- Bass Islands Dolomite-Bois Blanc deep saline formations primary target
- Amherstburg and Lucas formations and salt layers provide containment
- Drilled new injection well and retrofitted plugged well for monitoring
- Plan is to inject up to 10,000 metric tons over 60-90 days

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Initial Screening

Screen site for surficial features in project area:

- Natural Areas
- Historic Sites
- Flood Plain
- Wetlands
- RCRA/CERCLA sites
- Transmission lines
- FAA/FCC sites
- Surficial geology
- Construction

Example- floodplain map. Note: this is not for the Michigan Basin Site.

Example- historical aerial photo. Note: this is not for the Michigan Basin Site.
NEPA Environmental Questionnaire

• National Environmental Policy Act (NEPA) environmental questionnaire completed for test system prior to site work.
• Questionnaire submitted to DOE and the project received categorical exclusion.

U.S. DEPARTMENT OF ENERGY
ENVIRONMENTAL QUESTIONNAIRE

I. BACKGROUND

The Department of Energy’s (DOE) National Environmental Policy Act (NEPA) Implementing Procedures (10 CFR 1021) require careful consideration of the potential environmental consequences of all proposed actions during the early planning stages. DOE must determine at the earliest possible time whether such actions require either an Environmental Assessment or an Environmental Impact Statement, or whether they qualify for Categorical Exclusion. To comply with these requirements, an Environmental Questionnaire must be completed for each proposed action to provide DOE with the information necessary to determine the appropriate level of NEPA review.

II. INSTRUCTIONS

Separate copies of this Environmental Questionnaire should be completed by the principal offeror and each proposed subcontractor. In addition, if the proposed project includes activities at different locations, an independent questionnaire should be prepared for each location. Supporting information can be provided as attachments.

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Preliminary Geological Assessment

- Evaluate test site based on existing geological reports, maps, well logs, and other data.
- Performed by Michigan Basin Core Research Laboratory of Western Michigan University (Dave Barnes, Bill Harrison)
- Identify any regional geological features that may affect tests.
Well installation/completion

• Test well drilled on oil and gas well permit with Michigan State Department of Environmental Quality Geological and Land Management Division.
• Permit requires well site review of any features that may be affected by drilling (i.e. wetlands, public water supplies, buildings, etc.).
Well installation/ completion

• Well Permit
  • Construction Specifications
  • Casing, cement plans
  • Drilling procedures
  • Blowout prevention

• State Environmental Impact Assessment:
  • Pit location/construction
  • Cuttings disposal plan
  • Brine disposal plan
  • Mitigation of Impacts from Drilling Plan
  • Soil erosion and Sedimentation Plan
  • Site restoration plan
USEPA Underground Injection Control Permitting

- Geologic test sites are following USEPA Underground Injection Control (UIC) program: “Using the Class V Experimental Technology Well Classification for Pilot Carbon Geologic Sequestration Projects- UIC Program Guidance (UICPG #83).”

**EPA UIC Program**
- Protect human health and the environment, drinking water
- Establish operating, monitoring, closure, review protocols
EPA Underground Injection Control Permitting

- Permit application submitted to Region V EPA
- Supporting Attachments Subset

A- AREA OF REVIEW METHODS
B- MAPS OF WELL/AREA OF REVIEW
C- CORRECTIVE ACTION PLAN AND WELL DATA
D- MAPS AND CROSS SECTIONS OF USDWS
E- NAME AND DEPTH OF USDWS
F- MAPS AND CROSS SECTIONS OF GEOLOGIC STRUCTURE OF AREA
G- GEOLOGICAL DATA ON INJECTION AND CONFINING ZONES
H- OPERATING DATA
I- FORMATION TESTING PROGRAM
J- STIMULATION PROGRAM
K- INJECTION PROCEDURES
L- CONSTRUCTION PROCEDURES
M- CONSTRUCTION DETAILS
N- CHANGES IN INJECTED FLUID
O- PLANS FOR WELL FAILURES
P- MONITORING PROGRAM
Q- PLUGGING AND ABANDONMENT PLAN
R- NECESSARY RESOURCES
S- AQUIFER EXEMPTIONS
T- EXISTING EPA PERMITS
U- DESCRIPTION OF BUSINESS
Example - Attachment B  Maps of Well/Area of Review

- AOR based on STOMPCO2 sims
- AOR to be validated with monitoring

STOMPCO2 Simulations
Example- Attachment H Operating Data

- Injectate characterization
- Injection rate
- Injection pressures
- Injection pressure limit
**Example- Attachment Q  Plugging and Abandonment Plan**

- Plug well across perforated intervals.
- Cement across shallow aquifer.
- Plugging estimate and bond.

**Charlton 30/31 Field**

**State Charlton #4-30**

**Permit No. 57916**

**Otsego County**

**538 T11N R1W**

**Wellbore After Plugging**

- Cut & cap 8 5/8" and 11 3/4" w/1/2" steel plate
- 100' cmt plug 170' above
- 8 5/8" cement retainer w/100' cmt below and 50' cmt on top
- 5 1/2" Liner Lap @ ± 3538 Ft.
- 8 5/8" 32# Seamless J-55 to 3604' - 9
- 5 1/2" 2250' 15.5# Seamless J-55 - 274 Sx
- 5 1/2" cement retainer w/50' cmt below and 50' cmt on top
- Perfs 5462'-5488'
- TD 5800'

**State Charlton #4-30**

**Wellbore After Plugging**

- 5-1/2" cement retainer w/50' cmt below and 50' cmt on top
- 7 7/8" hole
- 10" Drive - 72 Ft.
- 11 3/4" 47# - 804 Ft. - 475 Sx to Surf.
- 176' fillup
- 8 5/8" cement retainer w/100' cmt below and 50' cmt on top
- 5 1/2" Liner Lap @ ± 3538 Ft.
- 5 1/2" 2250' 15.5# Seamless J-55 - 274 Sx
- Perfs 5462'-5488'
- TD 5800'
EPA Underground Injection Control Issues- (Based on USEPA Guidance)

• **Time scale/operational limitations** - while a limited test, the project should generate useful data to evaluate the possibility of larger projects.

• **Area of Review** - based on initial modeling, will be validated with modeling and monitoring.

• **Well construction** - utilize experience from EOR operations in the area.

• **Communication** - working with Region V EPA, field operator, State DEQ, DOE, and many others to implement test.
Injection Plans

- Injection of up to 10,000 metric tons CO$_2$ over 2-3 months.
- Injection rate may be adjusted to explore injectivity.
Monitoring

• Comprehensive monitoring program is planned to track injection test.
• Plan includes injection system monitoring.
• More research oriented monitoring aimed at studying the behavior of CO$_2$ in the subsurface.

<table>
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<th>Michigan Basin</th>
<th>Time (Months)</th>
<th>Active Injection</th>
<th>Post</th>
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<tr>
<td></td>
<td></td>
<td>Pre</td>
<td></td>
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<tr>
<td>4-D Seismic (with WMU program)</td>
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</table>
Conclusions

• Comprehensive permitting approach helps facilitate CO$_2$ sequestration from site screening to closure.

• Many permitting procedures are established for drilling and underground injection.

• Much of the environmental permitting involves basic tasks that would be completed with any large construction project. They also help out with other aspects of the project.

• Monitoring program for MRCSP tests likely to exceed typical injection wells due to research objectives of the project.
The End

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