EERC Technology… Putting Research into Practice

The Plains CO_2 Reduction (PCOR) Partnership

Lignite Field Phase II Validation Test

Burke County, North Dakota

John Harju

Energy & Environmental Research Center

Regional Carbon Sequestration Partnerships Initiative Review Meeting

December 13, 2007

Lignite for CO_2 Sequestration and Enhanced Coalbed Methane (ECBM)

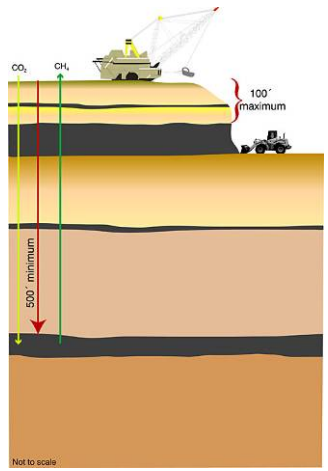
Lignite Goal and Objectives

Goal

- Determine the feasibility of simultaneous CO_2 sequestration and natural gas production from a lignite coal seam.

Objectives

- Inject CO_2 into lignite coal seam and monitor CO_2 fate in the reservoir.
- Determine the potential for CBM production from the lignite seam.
- Determine the potential for production enhancement by CO_2 injection.
- Develop Regional Technology Implementation Plan for CO_2 sequestration in lignite coal.



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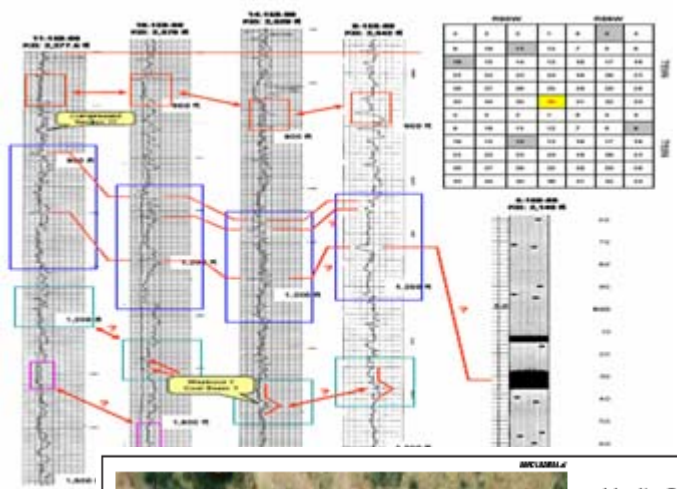
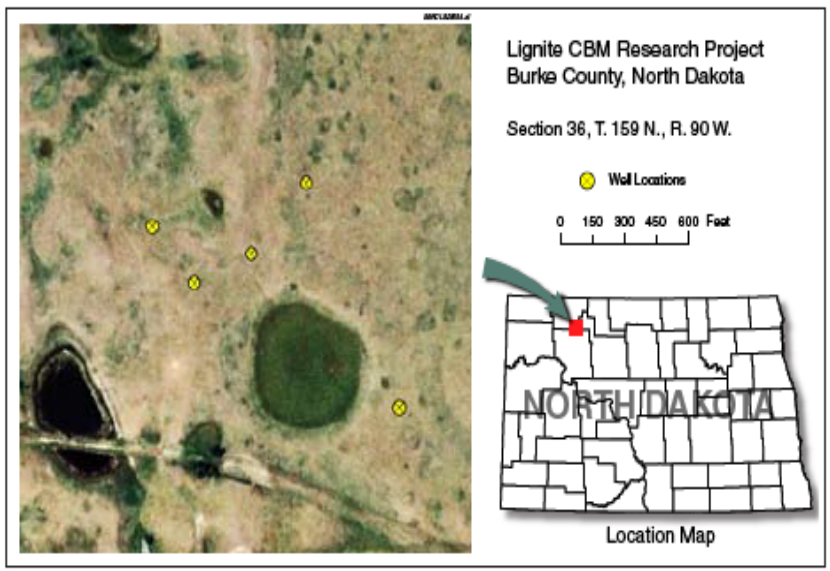
Test Design Activities



Analysis of the existing well data served for choosing the location of the test site and supported the creation of a preliminary numeric model of the coal seam using ECLIPSE.



Five-spot well configuration allows for effective and efficient operation and monitoring of the water production and CO_2 injection program.

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Field-Based Characterization Activities

Conducted during well drilling operations.

- Last of five wells was drilled on August 29, 2007.
- Geophysical logging suite.
- Core and cuttings collection and description.

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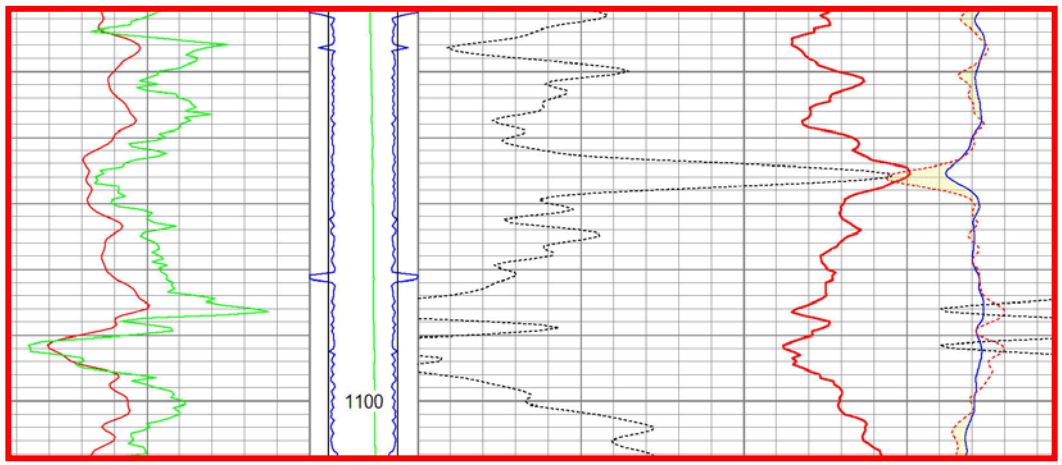
Geophysical Logging Activities

- Schlumberger
  - Platform Express Log Suite
  - Sonic
- Competition Wireline Services
  - Pulse Neutron



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Formation Logging Activities

- Schlumberger Platform Express Log Suite
  - Measurements
    - Porosity
    - Resistivity
    - Natural radiation (sand/shale)
    - Bore hole diameter
- Sonic
  - Used for
    - Pore pressure prediction
    - Determination of density
    - Estimation of rock elastic constants
    - Bulk compressibility estimation

Formation Logging

- Elemental capture spectroscopy
- Multiarm caliper
- Acoustical

Core Evaluation Activities

Lab studies on the recently collected core are being conducted by TerraTek, Inc., the Energy & Environmental Research Center, and the National Energy Technology Laboratory.

- Gas content
- Gas specific gravity
- CH_4 and CO_2 isotherms
- Diffusion coefficient
- Gas desorption time
- Coal ash and moisture contents
- Coal density and compressibility
- Rock porosity and permeability

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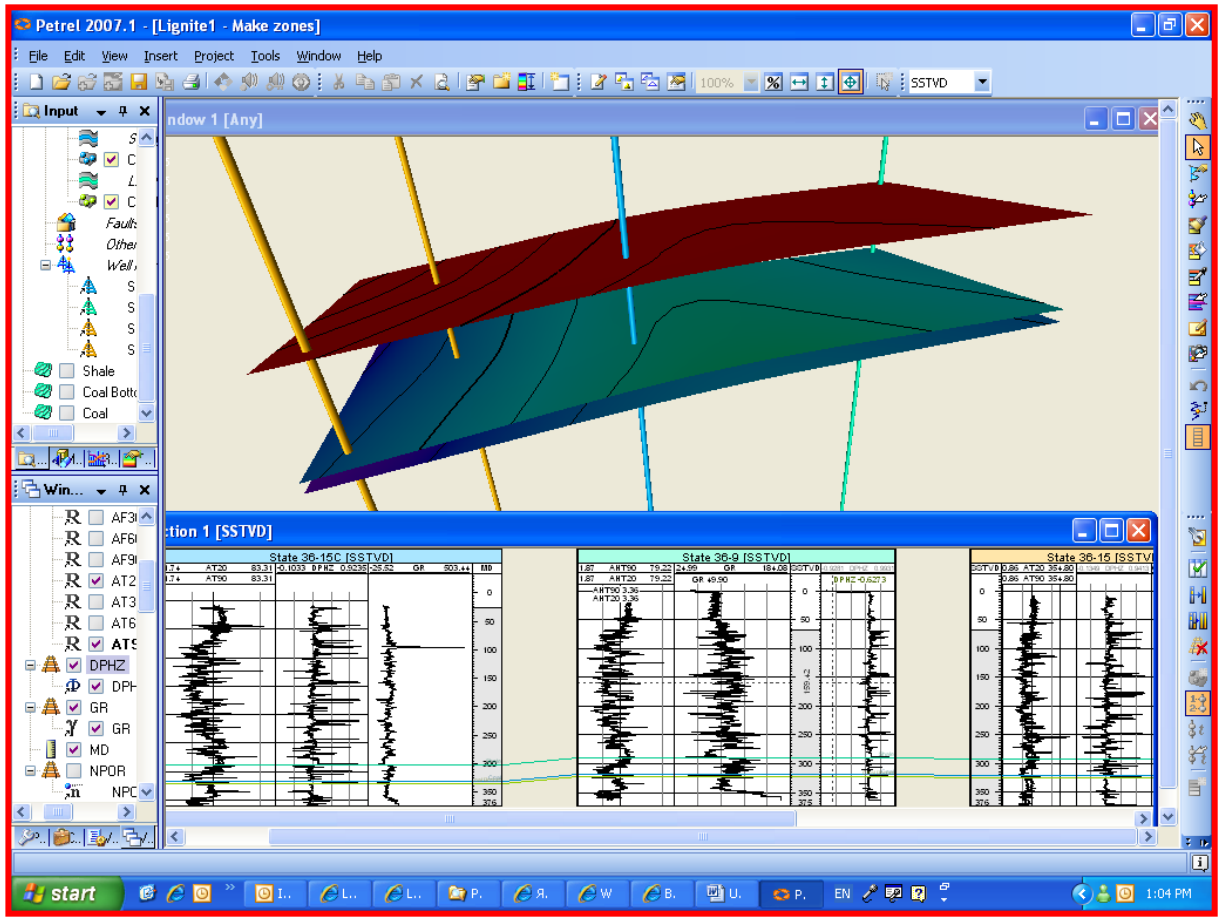
Geological Modeling Activities

- Geophysical logs have been used to model:
  - Stratigraphy
  - Structure
  - Petrophysical properties
- Schlumberger Petrel has been used for the model creation.



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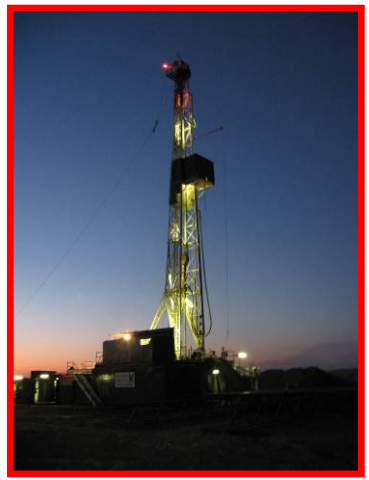
Key Results

- Well drilling is completed.
- Logging is completed, and logs are being processed in collaboration with Schlumberger.
- Core is collected, and its analysis by TerraTek is in progress.
- All five wells have been perforated, and initial swabbing has occurred.
- Canister tests are nearly complete.



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Key Results

- Tight-hole status has been requested.
- Initial geological model has been created.
- Preliminary simulations have been run which provide guidance for the possible outcome of CO_2 injection activities in the coal seam.

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Path Forward–Monitoring, Mitigation, and Verification (MMV) Efforts

- Pressure and water quality measurements from monitoring wells.
- May include tiltmeter and microseismic.
- MMV plans will be finalized after analysis of collected field data.

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Path Forward

- Complete log processing and laboratory- and field-scale tests
- Anticipated field-scale experiments
  - Pump test
- Conduct well stimulation if necessary

Path Forward

- Use acquired log data, core analysis and in situ monitoring data to create simulation model and begin modeling CO_2 fate
- Complete UIC permit application
- Begin CO_2 injection
- Implement MMV program.
- Develop Regional Technology Implementation Plan

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