FACT SHEET FOR PARTNERSHIP FIELD VALIDATION TEST

Midwest Regional Carbon Sequestration Partnership (MRCSP)

NETL Cooperative Agreement DE-FC26-05NT42589

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Submitted by Battelle

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Appalachian Basin Geologic Test at R.E. Burger Power Plant	
Principal Investigator	Dave Ball, Battelle (614-424-4901; balld@battelle.org)
Test Location	FirstEnergy R.E. Burger Plant, Shadyside, Ohio
Amount and Source of CO_2	1,000-3,000 metric tons Source = Possibly Powerspan ECO2 emissions control module at R.E. Burger plant or a commercial source as backup (TBD)
Field Test Partners (Primary Sponsors)	FirstEnergy
	Ohio Geological Survey (Ohio Department of Natural Resources)

Summary of Field Test Site and Operations:
The location is along the Ohio River near Shadyside, Ohio, across from Moundsville, West Virginia (Figure 1). The general area is moderately developed and populated. The test site is located at FirstEnergy's R.E. Burger facility, a 413 MW coal-burning power plant. The plant is located on 100 acres on the floodplain along a bend in the Ohio River, with terrain becoming hilly away from the Ohio River Valley. The plant is an industrial setting, with multiple generators, coal staging areas, and other facilities.

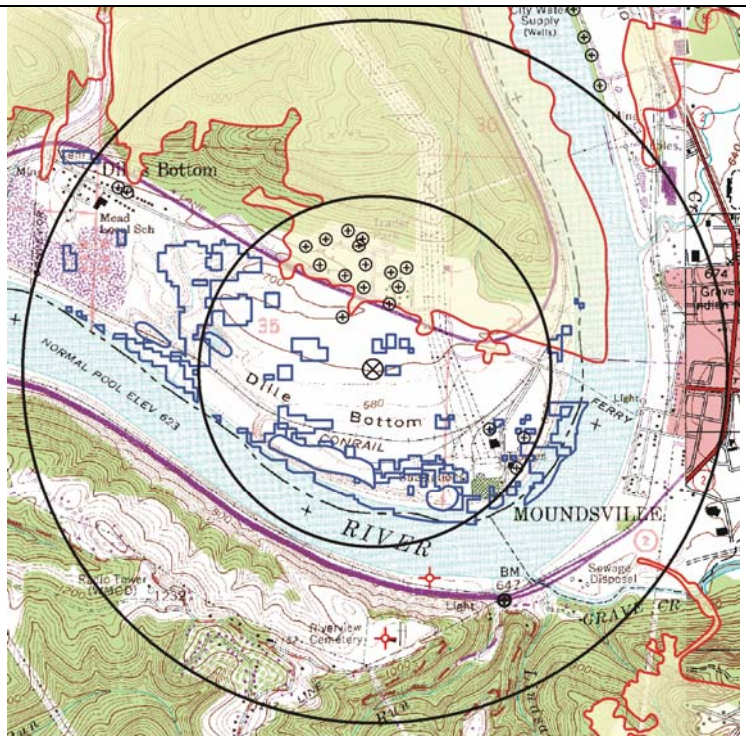

Figure 1. Site location map

The objective at this site is injection testing in deep saline reservoirs (Figure 2). FirstEnergy plans to host a pilot test of Powerspan's ECO2 technology that would be capable of capturing CO_2 at their R.E. Burger plant during 2008. This would provide an opportunity to test an integrated CO_2 capture, handling, and injection system in this tri-state area of the Appalachian Basin. For this location, the potential sources include the Powerspan CO_2 capture technology (being demonstrated under a separate project), commercial supplies, or gas processing plants in the area.

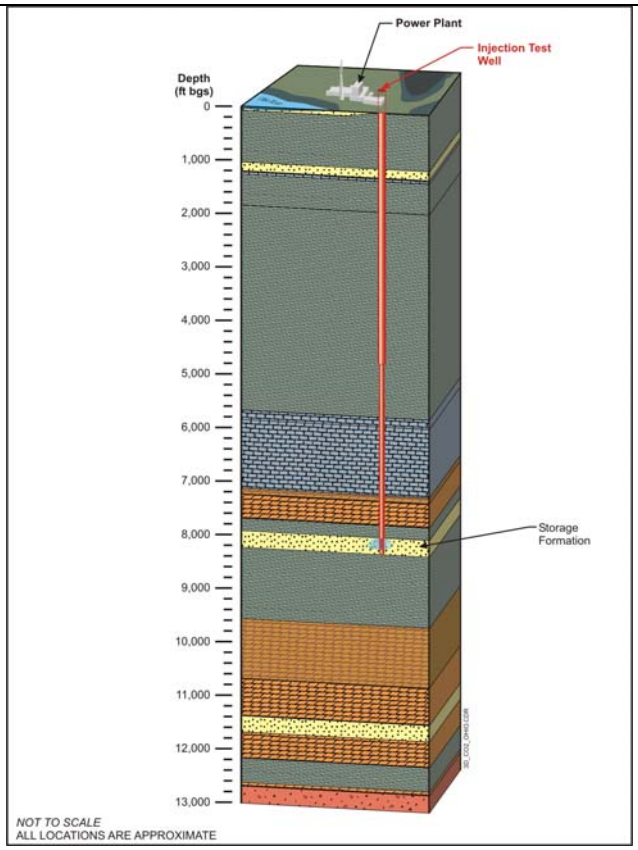

Figure 2. Conceptual diagram of CO_2 sequestration tests for East Bend site

The site is located in the Appalachian Basin, a regional structure in which sedimentary rocks form an elongated basin stretching across West Virginia, Pennsylvania, Ohio, Kentucky, and Maryland. The site is on the western flank of the basin where rocks slope toward a structure called the Rome Trough, a Cambrian-age rift valley in the deep subsurface. Younger sedimentary rocks drape over the Rome Trough and thicken to depths over 20,000 ft below the surface. More substantial deformation is present toward the Allegheny Front well east of the study area.

Due to its size, there are numerous options for geologic CO_2 storage in the Appalachian Basin. Storage targets may vary considerably with location, and most areas have multiple options for storage. However, most capacity is present in deeper sandstone rock layers. Numerous caprocks are present throughout the basin. A preliminary review of the geology present at the Appalachian Basin site shows that several storage reservoirs exist in the deep subsurface of the site.

Medina Group ("Clinton") − The Medina Group refers to a series of interbedded sandstones, siltstone, shales, and limestones of Early Silurian age. A large amount of oil and gas has been produced from this group of rocks in central Ohio to northwestern Pennsylvania. Drillers often named the group of rocks the "Clinton," and this terminology is still used to this day. Most oil and gas production in the Medina Group is limited to areas east and northeast of the site. Our test well dug in January and February 2007 revealed the Clinton formation to be about 200 ft thick at this site at a depth of around 8,100 ft, but it is not clear how much of the interval would be suitable for CO_2 storage as the formation changes in character as it deepens in the Rome Trough.

Oriskany Sandstone − This sandstone formation is present in most of West Virginia, Pennsylvania, Maryland, and Ohio. MRCSP Phase I mapping suggested that the formation is highly variable in thickness in the study area; however, some wells have encountered Oriskany sandstones with a suitable fraction of pore space to be considered for storage. Our test well showed that this formation exists at around 5,900 ft

depth and is about 30 feet thick deep in the study area.

There is a history of gas production in shallow sands, Devonian shales, and the Oriskany Sandstone in the study area and a significant natural gas show was present at this site. These formations may be penetrated by active or abandoned oil and gas wells. Rocks in the Appalachian Basin are saturated with very concentrated brines (or oil and gas). Several salt solution wells completed in the Salina Group are present in the study area. The site is located adjacent to the Rome Trough where a series of faults lead into the trough. No faults are present through the project area.

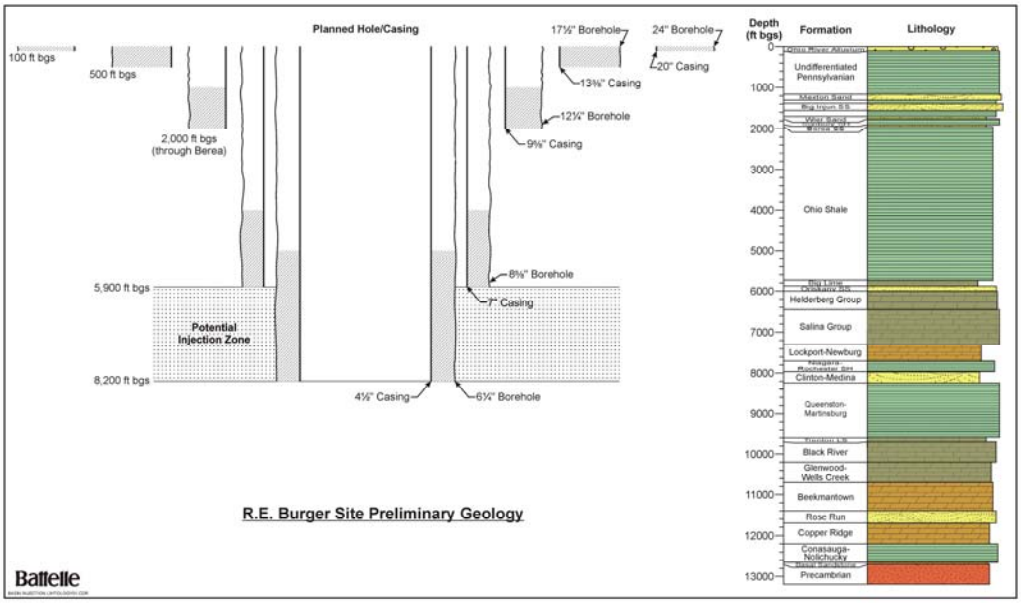

Figure 3. Geologic stratigraphic column showing estimated lithology for the R.E. Burger Site (the test well is planned to penetrate to the "Clinton Sandstone")

The overall plan for the R.E. Burger site includes a thorough site characterization and injection testing possibly integrated with the Powerspan ECO2 process; otherwise CO_2 will be obtained from regional source(s). General steps of the site plan are listed as follows:

1) Preliminary Geologic Assessment of Potential Storage Reservoirs and Caprocks − This work is completed and involved compiling available well logs, developing geologic cross-sections, delineating target storage reservoirs, and identifying any issues related to geologic storage that may affect the project. Ohio Department of Natural Resources will complete most of this task with assistance from West Virginia and Pennsylvania Surveys.
2) 2-D Seismic Survey − A 2-D seismic survey was completed in July 2006 through the site in two transects, each about 5 miles long. This survey helped delineate geologic framework for the tests. In addition, a "quasi-3-D" line approximately 1-mile long was completed through the test site to assess feasibility of 3-D seismic methods at the site. No faulting or other major problems were observed.
3) Site Characterization Field Work − Based on results of the preliminary geologic assessment, additional site characterization field work was completed. At the Appalachian Basin site, a moderate amount of oil and gas exploration information existed, mostly from shallower intervals, but the deeper units were relatively uncertain. Therefore, a test well was dug in January/February 2007 to a depth of about 8300 ft. Coring, logging, brine sampling, and testing were carried out in the test and the results are summarized below.
4) CO_2 Injection Testing and Monitoring −The goal is to inject several thousand (~3,000) metric tones of CO_2 into one or more of the target storage reservoirs. We hope to link the injection to a proposed Powerspan ECO2 pilot test planned at the Burger site on a separate project, pending resolution of the schedules for the two projects. We anticipate that the injection will occur over a period of seven months. At this point, injection in a single well is being planned. Several options are being considered for

monitoring.
5) Post-injection Monitoring and Site Closure − Once injection has been completed, some closure monitoring will be performed to assess fate of the injected CO_2.

Currently, the preliminary geologic assessment has been completed. A 2-D seismic survey, consisting of two perpendicular lines, has also been completed through the site. Drilling and logging of a test well of about 8300 feet depth has been completed. A work plan will be developed prior to starting field work, including site health and safety plan(s). Preparation of an injection permit application is in progress working with Ohio EPA, the regulatory body governing the UIC process for Ohio.

Research Objectives:
The objective at the R.E. Burger site is injection testing in deep saline reservoirs. This site represents a fairly typical setting for an area in the Appalachian Basin where numerous coal burning power plants exist. As such, information gathered at this site would be useful for a major CO_2 source area in the MRCSP region. Several significant CO_2 injection targets are also present in the area, including the Oriskany Sandstone and Medina ("Clinton") sandstones. This site also offers potential to investigate coal and black shale units that are being considered for CO_2 sequestration.

FirstEnergy plans to pilot test an enhanced version of the Powerspan technology (ECO2) that would be capable of capturing CO_2 at its R.E. Burger plant during 2007. This would provide an opportunity to test an integrated CO_2 capture, handling, and injection system in this tri-state area of the Appalachian Basin. The Powerspan system under construction at this site is considered a great asset. This system may be included in an integrated, pilot-scale, CCS system at the plant. The work should be valuable in advancing both capture system and carbon storage applications. The site is located on an active plant which is providing property access for the field work and other support that should aid in completing the project.

Summary of Modeling and MMV Efforts (Use the table provided for MMV):
Modeling of the site is in progress based on the data gained by the test well and seismic survey.

Monitoring technologies for CO_2 sequestration were reviewed and a subset of options was selected based on the proposed injection system specifications and geologic setting. A complete monitoring plan and schedule will be determined after site characterization efforts are finished.

The proposed monitoring methods are shown in Table 1 for the R.E. Burger site. The target injection formations are 5,000-8,000 ft deep and no other wells within miles penetrate these depths. This limits monitoring options. Another deep monitoring well is not practical for the site because it would be too expensive to justify for a short period of injection testing. Consequently, most monitoring will focus on methods that can be applied in the injection well.

Accomplishments to Date:
The R.E. Burger project is well into the field work phase. Major tasks have involved preliminary geologic assessment, a 2-D seismic survey, drilling of a test well, and permitting,:

- Site preparation activities, including defining an area at the Plant suitable for a test well location, were completed. The test well location was selected and cleared with the plant personnel.
- A preliminary geologic assessment was completed by the Ohio Geological Survey describing the regional geologic setting, target sequestration rock formations, and other issues.
- A test well of just over 8300 feet depth was completed in February 2007. The test well was logged in considerable detail including taking of sidewall cores at various depths.
- Permitting discussions were completed with the Ohio EPA UIC program to determine Underground Injection Control (UIC) procedures for the test well and injection tests. A permit to construct the test well was started.
- A 2-D seismic survey was completed through the injection site July 12-23, 2006, to delineate the

arrangement of deep rock layers at the site. The survey lines consisted of two 5.5 mile long perpendicular routes through the test well site. In addition, a shorter 1-mile long survey was completed through the test site to increase resolution around the test zone. Data are currently being processed. Raw data indicate that no faults or other structures are present in the study area, just gently-dipping sedimentary layers. Some stronger reflectors were present at about 1.0 ms.

- In addition, a shorter 1-mile long survey was completed through the test site to increase resolution around the test zone. This line was run to investigate the distribution of key sequestration targets near the injection well location and determine whether 3-D seismic methods would be suitable for the site.
- Initial review of the logging data from the test well suggests that the Oriskany Sandstone is present at a depth of 5923-5954 ft and the "Clinton"-Medina was present at a depth of 8118-8318 ft. While the character of these formations needs to be confirmed, it appears that the formations may be suitable targets for the injection tests
- As part of the survey, a comprehensive stakeholder outreach program was completed for the FirstEnergy Plant employees, local residents, and the media. This effort helped introduce the MRCSP to the local public and established the program for future work.

Summarize Target Sink Storage Opportunities and Benefits to the Region:

- The site is located in a major CO_2 source area in the Appalachian Basin and MRCSP. Results at this site will be applicable to other power plants in the Ohio River Valley.
- Added value from using CO_2 from Powerspan emissions control system in the area of carbon capture and separation.
- Added value in performing the test at an active power plant to demonstrate CO_2 sequestration in a real-world setting.
- Added value from partnering with a major power company toward promoting CCS in the energy industry.

Cost*:

Total Project Cost: $23,745,399

DOE Share: $17,458,272 (73.52%)

Non-Doe Share: $6,287,127 (26.48%)

(*) Costs are for overall MRCSP Phase II proje

Field Project Key Dates:

Baseline Completed: Spring, 2007

Drilling Operations Completed: February 2007

Injection Operations Begin: Late Summer 2008 (depe on Powerspan's schedule)

MMV Events: TBD

Table 1. Measurement Technologies Employed at Field Test Site

Measurement Technique	Measurement Parameters	Application
Water composition	CO_2, HCO_3, CO_3^{2-} Major ions Trace elements Salinity	Quantifying solubility and mineral trapping Quantifying CO_2-water-rock interactions Detecting leakage into shallow groundwater aquifers
Subsurface pressure	Formation pressure Annulus pressure Groundwater aquifer pressure	Control of formation pressure below fracture gradient Wellbore and injection tubing condition Leakage out of the storage formation

Well logs	Brine salinity Sonic velocity CO_2 saturation	Tracking CO_2 movement in and above storage formation Tracking migration of brine into shallow aquifers Calibrating seismic velocities for 3D seismic surveys

Source: IPCC Special Report on Carbon Dioxide Capture and Storage