secarbon.org

SECARB

Southeast Regional Carbon Sequestration Partnership (SECARB)

The Mississippi Test Site

Field Test Location
Escatawpa, Mississippi

Amount and Sources of CO_2
3,020 Tons (short) of Natural CO_2 (donation)

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Field Test Partners

Primary Sponsors
DOE/NETL
SSEB

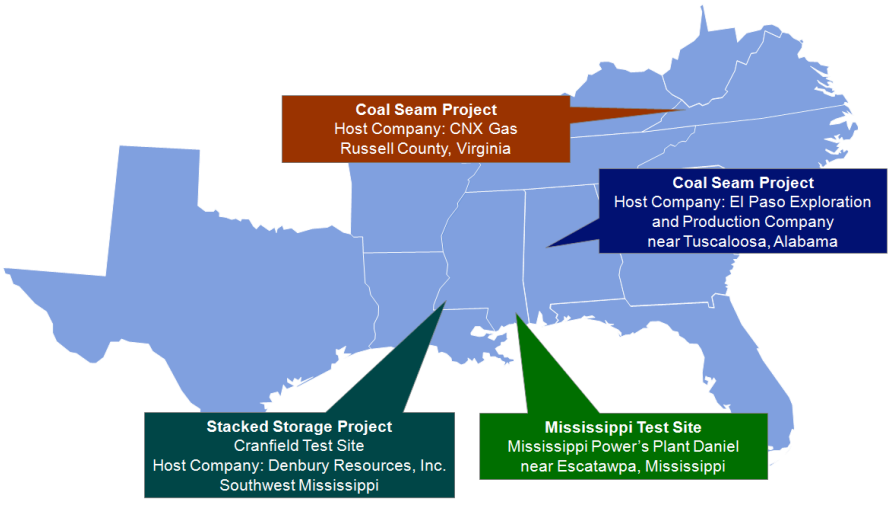
Industrial Partners
Advanced Resources International
Denbury Resources, Incorporated
Duke Energy
Tennessee Valley Authority

Summary of Field Test Site and Operations

The Southeast Regional Carbon Sequestration Partnership's (SECARB) Saline Reservoir Field Test was conducted at Mississippi Power Company's Plant Daniel, a power generation facility capable of delivering over 1,000 megawatts of coal-fired electricity into the Jackson County power grid. Situated near the town of Escatawpa, the power plant property covers about 1,600 acres of surface area in southeast Mississippi (Figure 1).

One injection well and one observation well was drilled, to depths exceeding 9,500 feet, to access the Massive Sand Unit of the Lower Tuscaloosa Formation for a carbon dioxide (CO_2) pilot injection study. A Class 5 Underground Injection Control (UIC) permit was issued from the Mississippi Department of Environmental Quality (MDEQ) for the injection well, which met Class 1 non-hazardous well standards.

The observation well was drilled first to provide site-specific subsurface data from coring, geophysical well logging, and vertical seismic profiling. The data were analyzed to confirm the viability of the test site to safely inject and store CO_2. A robust monitoring, verification and accounting (MVA) program was implemented for environmental safety and to monitor the movement of the injected CO_2 in the target formation. Monitoring protocols included soil flux, tracers, groundwater quality, geophysical logging and seismic profiling. Extensive outreach and education was performed at each phase of site activities.



SECARB Phase II Geographic Region and Field Test Site Locations

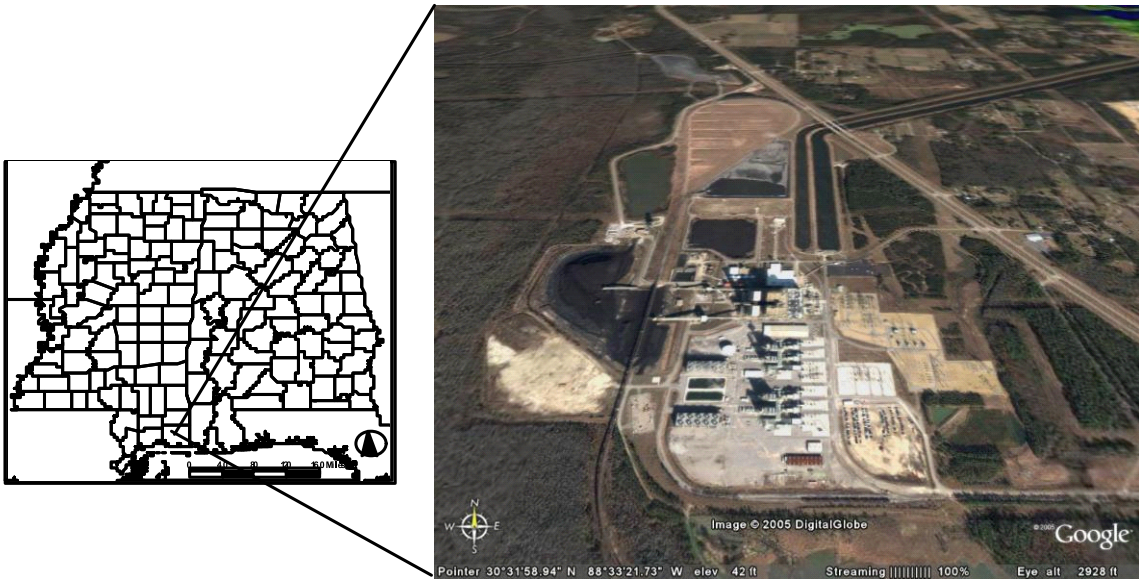


Figure 1. Plant Daniel Location Map

Research Objectives

The purpose of this project is to identify and validate that deep saline reservoirs located near large coal-fired power plants along the Mississippi Gulf Coast can be used for safe geological storage of CO_2. In the Gulf Coast region, the Lower Tuscaloosa Massive Sand Unit has been identified as a promising, high capacity CO_2 storage reservoir that could serve this purpose.

Using a small-scale CO_2 injection test, the project team has built an initial foundation of knowledge based on experience and science that will help assure safe, secure, and publicly accepted geologic storage along the Gulf Coast. Test activities leading to this assurance included: (1) constructing geological and reservoir maps to assess secure CO_2 storage in the subsurface; (2) conducting reservoir simulations to estimate CO_2 injection rate, storage capacity, and the long-term fate of injected CO_2; (3) addressing state/local regulatory issues for permitting CO_2 injection; (4) fostering public education and outreach to build public confidence and acceptance; (5) safely injecting over 3,000 tons of CO_2; and (6) conducting longer-term monitoring to establish the location and security of the CO_2 plume.

Summary of Modeling and Monitoring, Verification and Accounting Efforts

Time-lapse vertical seismic profile (VSP) surveys and pulsed-neutron logging were used in an attempt to determine the distribution of CO_2 in the subsurface, but results were somewhat inconclusive. However, numerous surface monitoring methods were deployed to ensure safety and the storage integrity of the Massive Sand Unit. These methods included: (1) comparison of post-injection soil CO_2 flux measurements to pre-injection baseline and background fluxes; (2) tagging the CO_2 with perfluorocarbon (PFT) tracers and monitoring for their presence at the surface; and (3) using wellhead and down hole pressure measurement to ensure well integrity. A listing of MVA protocols is shown in Table 1.

Table 1. MVA Techniques Deployed at the Mississippi Test Site.

Measurement Technique	Measurement Parameters	Application
Introduced tracers	• Travel time • Identification sources of CO_2	• Tracing leakage
Water composition	• CO_2, HCO_3, CO_3^{2-} • Major ions • Trace elements • Salinity	• Detecting leakage into shallow groundwater aquifers
Subsurface pressure	• Formation pressure • Annulus pressure	• Control of formation pressure below fracture gradient • Wellbore and injection tubing condition
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
Vertical seismic profiling	• P and S wave velocity • Reflection horizons • Seismic amplitude attenuation	• Detecting detailed distribution of CO_2 in the storage formation • Detection leakage through faults and fractures
CO_2 land surface flux monitoring	• CO_2 fluxes between the land surface and atmosphere • atmosphere	• Detect, locate and quantify CO_2 releases

Accomplishments to Date

To date, the project has completed all site activities. Key accomplishments include:

- Developed a plan to conduct the sequestration experiment on the grounds of the Plant Daniel Electric Generating Facility, approved in April 2006 by Mississippi Power Company.
- Participated in a Mississippi Power sponsored "neighbor meeting" to discuss the project and inform the public. The technical team participated in the interactive discussion with the public, using various visual aids (posters, rock samples, etc.) to convey our message.
- A Class 5 UIC injection well permit application was prepared and submitted to the Mississippi Department of Environmental Quality (MDEQ) An injection permit application was not submitted for the observation well.
- In August, 2007, MDEQ held a public meeting to complete the regulatory requirements for the Class V Experimental Well Application. No additional questions were received by the MDEQ and the injection permit was issued.
- Baseline soil flux and groundwater monitoring was initiated in September 2007 prior to CO_2 injection.
- Drilling permits for the planned injection and observation wells were submitted and issued by the Mississippi Oil and Gas Board. The injection well drilling permit entailed a thorough technical application; the observation well drilling permit required only an application for an administrative permit.
- In February 2008 drilling of the monitoring and injection wells was initiated. Both wells were successfully drilled, cased, and cemented by early April. The injection well was constructed to Class I non-hazardous well standards requested by the MDEQ
- Geophysical logs, cores, and fluid samples were collected and analyzed to characterize the reservoir.
- A baseline VSP survey was conducted in late April 2008 and post-injection VSP was conducted in December

2008 for the purpose of monitoring the size and shape of the CO_2 plume.

- Approximately 3,020 tons of CO_2 were injected into the Lower Tuscaloosa Massive Sand Unit in October of 2008.
- Following CO_2 injection, the injection well was certified as fit for continued use via mechanical integrity testing and both wells were relinquished to the site host. The well pad was re-graded and seeded, completing site restoration activities.
- Surface and subsurface monitoring tasks have been completed.
- Final have been completed, documenting lessons learned, project and model results, and site closure activities.

Target Sink Storage Opportunities and Benefits to the Region

The target formation for the SECARB Phase II project is the Massive Sandstone Unit of the Lower Tuscaloosa Formation, a Cretaceous age sandstone saline reservoir. The Tuscaloosa Massive Sandstone occurs throughout the entire subsurface distribution of the Gulf of Mexico Coastal Plain from western Florida to Texas (where it is defined as the time-equivalent Woodbine Formation). A type stratigraphic column of the Gulf Coast Region is shown in Figure 2. The Lower Tuscaloosa contains an upper section of alternating shale and sand and a basal section, the Massive Sand Unit, which contains a thick package of clean, medium- to coarse-grained predominantly quartz sand. The Formation was deposited during a major period of global sea-level rise and its deposition has been interpreted as an upward gradation from fluvial and deltaic sedimentation (the Massive Sand) to marine shelf deposition (alternating sand and shale).

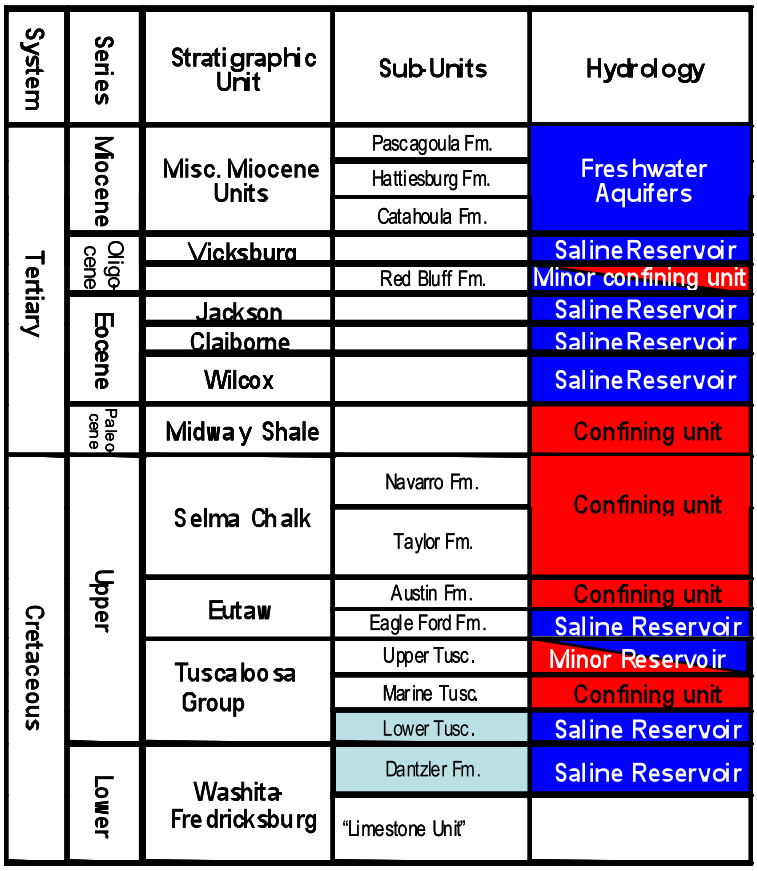


Figure 2. Type Stratigraphic Column of the Gulf Coast Region

The target formation is representative of the geology that could be used to store 50 percent of the CO_2 produced in the SECARB region during the next 100 years.

The Lower Tuscaloosa Formation is a key component of a larger, regional group of similar formations, in terms of deposition and character, called the Gulf Coast Wedge. This wedge of sediments spans the entire region (from the Gulf of Mexico, through Texas, Louisiana, Mississippi, Alabama, Florida, Georgia, South Carolina, North Carolina and Virginia) and includes some of the largest saline sinks (in terms of areal extent and capacity) for the SECARB region as well as the United States.

CO_2 injection tests into the Lower Tuscaloosa Formation will yield confidence in the storage capacity of these other Cretaceous and Tertiary sediments due to the similar lithologic characteristics, analogous depositional environments, proven seals, and moderately complex structural settings exhibited by all of the six Mesozoic and Cenozoic formations in the region.

The CO_2 storage capacity of the SECARB region has been recently assessed using conservative methodology set forth by the Geological Working Group's subcommittee on storage capacity. Annual stationary point-source emissions of CO_2 have been estimated to be 1,047 Mt (MIT 2007). Using this range of reported capacity, the Gulf Coast Wedge has the capacity to accommodate these emissions for 300 to 1,200 years, should one hundred percent of this CO_2 in the region need to be captured and stored.

Cost			**Field Project Key Dates**	
Total Field Project Cost:	$6,755,246		Baseline Completed:	12/2007
DOE Share:	$5,121,233	75.8%	Drilling Operations Completed:	04/2008
Non-DOE Share:	$1,634,013	24.2%	Injection Operations Completed:	10/2008

Field Test Schedule and Milestones (Gantt Chart):

Tasks	FY2006				FY2007				FY2008				FY2009				FY2010			
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
3.1 Project Definition	■	■	■																	
3.2 Design	■	■	■	■	■	■	■	■												
3.3 Implementation							■	■	■	■	■	■	■							
3.4 Operations									■	■	■	■	■	■	■	■				
3.5 Closeout/Reporting																■	■			

This material is based upon work supported by the U.S. Department of Energy National Energy Technology Laboratory under DE-FC26-04NT42590.