



Marvin Blan No. 1 CO₂ Test Well

Drilling Overview

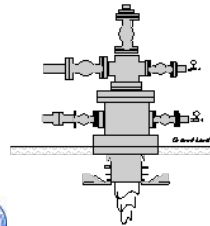
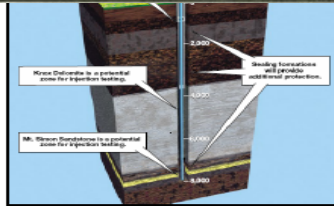
Key Learnings & Applications

Presentation
to
Kentucky Consortium for Carbon Storage
(KYCCS)

October 23, 2009

Presented by:

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Bill Armstrong, PE – Sandia Technologies, LLC



**Sandia
Technologies, LLC**

Overview

KGS Marvin Blan No. 1

- Drilling Overview
- Coring Results
- Testing Period

Key Learnings

- Drilling, Testing, Permitting, Consortium Partners

Observations/Reflections

- Safe, Successful Project
- Transferable Experience

Snapshot

Drilling

- Rig up April 14, 2009 NorAm Rig 2
- Spud well April 23, 2009
- Rig down June 17, 2009

Total of 63 days time; start (mob) to finish (de-mob)

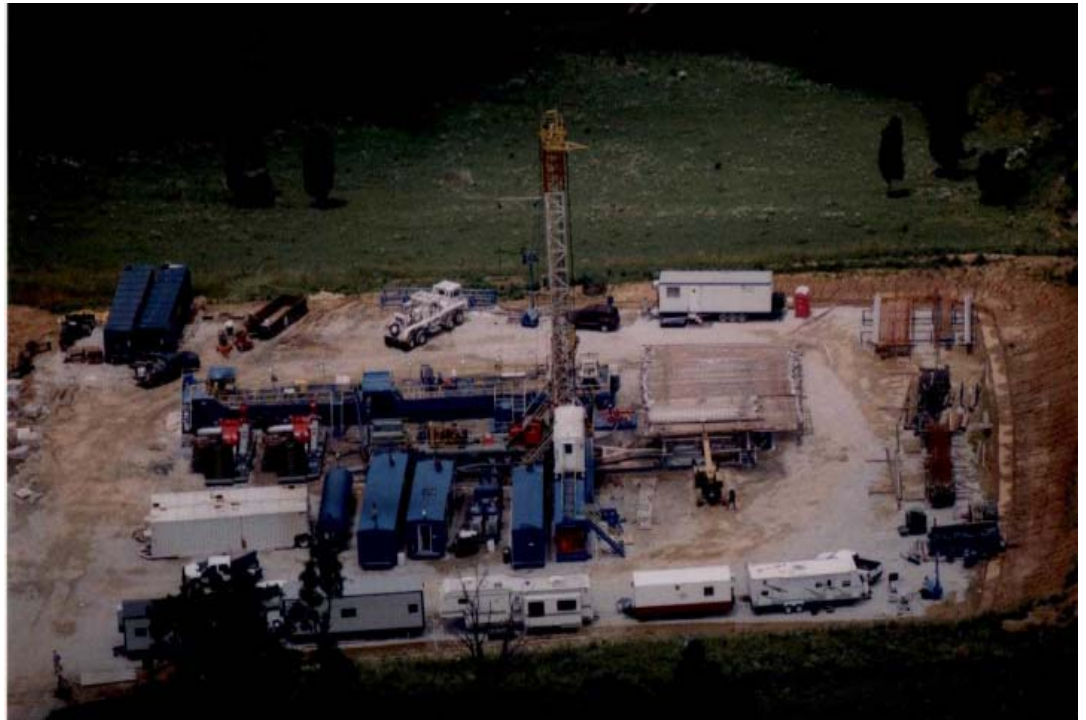
Actual Drilling hours 559 hrs for 8126 feet

Testing

- Rig up July 22, 2009, Nabors Millennium Rig # 1473
- Testing with KCl brine
- August 19-20 Inject CO₂ – 110 bbls @ 4 bpm (initial);
1655 bbls @ 4 bpm (constant rate)=1755 bbls
- Rig down August 23, 2009

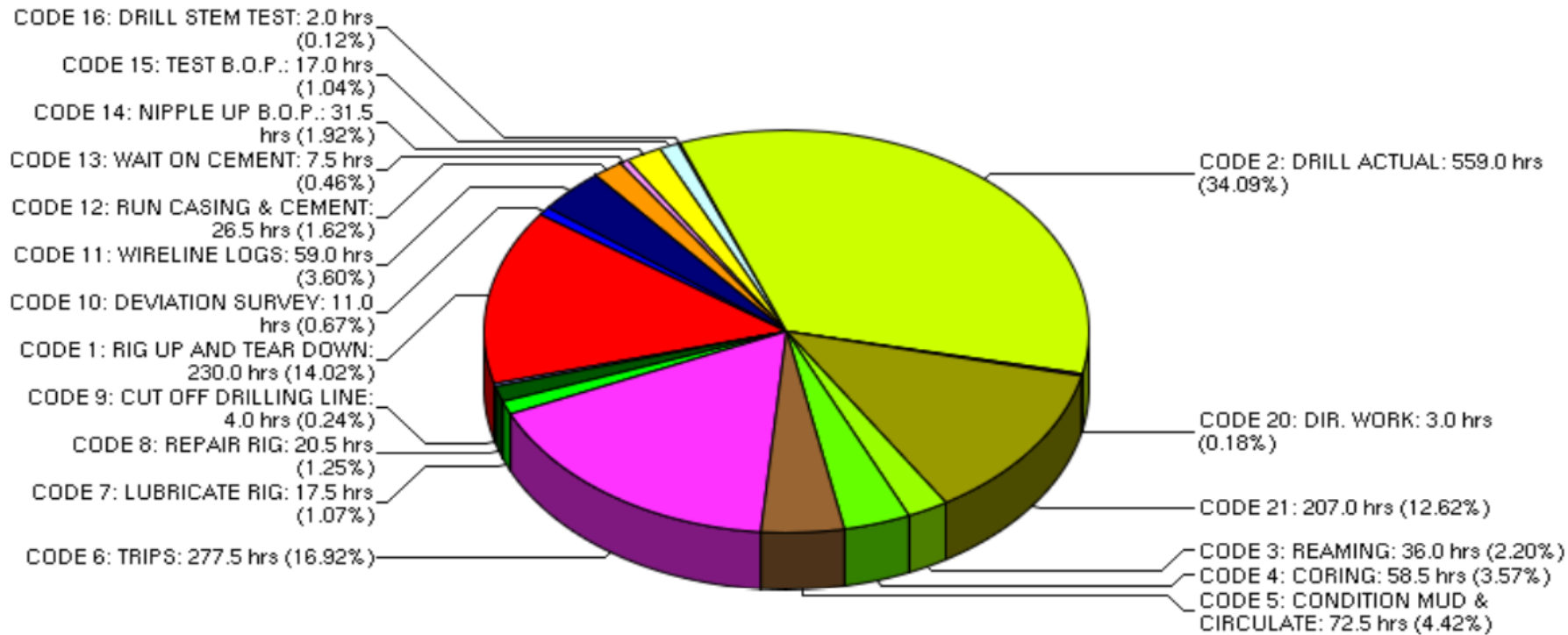
Drilling Factoids

- Actual Drilling time, 34%; 559 hours to drill 8,130 feet; average ROP = 14.5 feet
- Coring time, 3.57%; 58.5 hours for 395 feet, average ROP = 6.75 feet
- Wireline logs time; 3.6% in 59 hours
- Trips, reaming, conditioning mud, circulate, deviation survey time, 24.2% 397 hours
- Running Casing, cement time, 2.08%; 34 hours



Daily Drilling Reports Time Breakdown

Well name:	KGS Marvin Blan #1	Spud Date:	Apr 23,2009
Operator:	Sandia Technologies	Release Date:	Jun 17,2009
Contractor:	NorAm Drilling	From Date:	Apr 15,2009
Rig:	NorAm 2	To Date:	Jun 25,2009



TOTAL HOURS: 1640.0 hrs

Codes	Item	Percent	Total Hours
<u>Drilling, Coring, Reaming</u>			
2	Drill Actual	34.09	559.0
3	Reaming	2.20	36.0
4	Coring	3.57	58.5
5	Condition Mud & Circulate	4.42	72.5
6	Trips	16.92	277.5
10	Deviation Survey	0.67	11.0
12	Run Casing & Cement	1.62	26.5
13	Wait On Cement	0.46	7.5
11	Wireline Logs	3.60	59.0
	Totals		1107.5
<u>Maintenance</u>			
1	Rig-up and Tear-down	14.02	230.0
21	Downtime (Wait on)	12.62	207.0
14	Nipple up BOPs	1.92	31.5
8	Repair Rig	1.25	20.5
7	Lubricate Rig	1.07	17.5
15	Test BOPs	1.04	17.0
9	Cut Off Drilling Line	0.24	4.0
20	DIR Work	0.18	3.0
16	Drill Stem Test	0.12	2.0
	Totals		532.5

Data from PASON Rig Recording System

**Total of 1640 hours
Recorded.**

**46.125 days to reach
TD of 8130 feet**

Drilling Summary Highlights --1

- April 14-22 -- Rig-up NorAm Rig No. 2; spud mtgs, equipment setup.
- **April 23, 2009 2:00 PM** -- KGS Marvin Blan No. 1 was spudded with 17-1/2-inch bit from 51.5 feet to 441 feet.
- April 25-27 -- 13-3/8-inch surface casing set to 441 feet and cemented to surface
- April 28 – May 8 -- 11-inch Open Hole drilled from 441 to 3660 feet; included Core Points 1, 2, 3
- May 9 – Openhole logging; followed by 8-5/8-inch casing set to 3660 feet
- May 10-15 – Run cement bond log, makeup 7-7/8-inch drilling assembly, drill to 3,760 feet.
- May 16 – pickup 120-foot core barrel, Core St. Peter – Knox core from 3760 – 3883 in 6.5 hrs

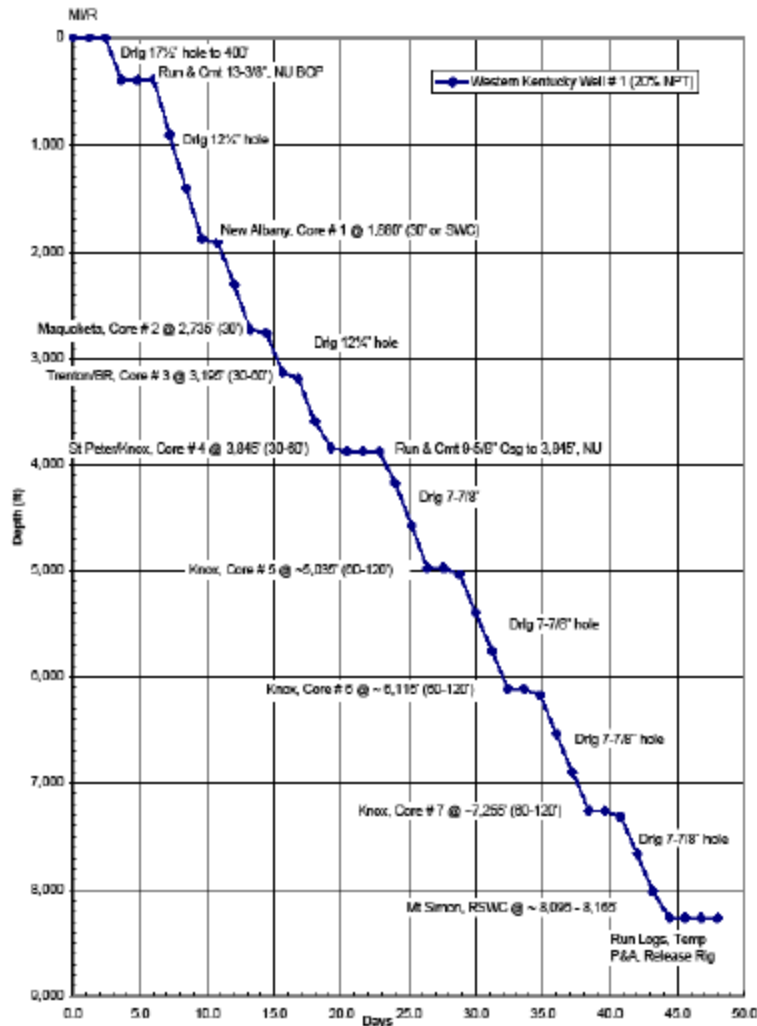
Drilling Summary Highlights -- 2

- May 16-19 – drill 7-7/8-inch hole to 4670 feet, increasing deviation. Change BHA drilling assembly to straighten hole.
- May 20-25 – drill 7-7/8-inch hole to 5,021 feet, Core 120-feet of Knox from 5021-5122 feet
- May 25-29 -- Use Schlumberger's Power V system (MWD string control) to correct borehole deviation. Drilling string stalled and locked up while drilling at 5580 feet. Pulled 30K to free string.
- May 30 – drill 7-7/8-inch hole from 5581-5845 feet, Knox drilling fluid loss of 10-20 bbls per hour to formation throughout the day. Flo Pro fluid and safe carb (calcium carbonate material) added to plug off lost Circulation zones. -- Vugs
- May 31 – drill 7-7/8-inch hole to 6072 feet, Drilling fluid loss of 8-10 bbls per hour, add lost circulation material, with KCl water to build volume.
- June 1-3 – drill 7-7/8-inch hole; lay down Schlumberger motor; core Knox resume drilling with new BHA; borehole straight < 1 degree deviation @ 6149 feet

Drilling Summary Highlights -- 3

- June 4-11 – drill 7-7/8-inch hole from 6149 to 8000 feet;
- June 12-14 -- core 8000-30 feet; ream hole, drill to TD at 8126 feet
- June 15-16 – openhole logging
- June 17, 2009 Released drilling rig at 6:00 PM

KGS #1 Well



46.1 days required to get through TD

Drilling Program

- Drilling to 8350 ft is expected to take ~45 days including time coring
- >300 ft of whole cores will be cut
 - New Albany Shale (30 ft)
 - Maquoketa Shale (30-60 ft)
 - Trenton/Black River (30-60 ft)
 - St Peter Sandstone/Knox Dolomite (60-120 ft)
 - Knox Dolomite (180-360 ft)
- Rotary sidewall cores will be cut in intervals without whole cores
 - New Albany Shale
 - Mt Simon Sandstone
- Extensive electric log program

Coring Summary

Surface Hole 11-inch (using 7-7/8-inch OD core barrel)

- Core #1 New Albany Shale 1875-1905'; 30-feet; 100% recovery
- Core #2 Maquoketa Shale 2800-2831'; 31-feet; 100% recovery
- Core #3 Black River Ls 3335-3396'; 61-feet; 100% recovery

Intermediate Hole 7-7/8-inch (using 7-7/8-inch OD core barrel)

- Core #3 St. Peter-Knox 3760-3883'; 123-feet; 100% recovery, (cut in 6.5 hours)
- Cores #4 and #5 Knox 5021-5049'; 28-feet; Knox 5049-5122' 73-feet; 101-feet total; 100% recovery
- Core #6 Knox 6130-6149'; 19-feet;
- Core #7 Basement 8100-8130'; 30-feet; 100% recovery

Total of 395 feet of Core Recovered; average ROP 6.7 ft/hr

Project Goals

- **Demonstrate CO₂ storage in deep saline reservoirs under the Western Kentucky Coal Field through the drilling and testing of an 8350 ft well in east-central Hancock County**
- **Demonstrate the integrity of reservoir sealing strata for long-term CO₂ storage in western Kentucky**
- **Demonstrate appropriate technologies for the evaluation of CO₂ storage in Kentucky deep saline reservoirs**
- **Publish the project results for use by government, industry, and the public in evaluating CO₂ storage in Kentucky**
- **Accomplish this project with consideration of the interests and concerns of the landowner, residents of Hancock County and western Kentucky, and the citizens of the Commonwealth**



Check list

Completed

Completed

Completed

Pending

Initial Phase
Completed
Pending Monitoring
And Phase II

Project Completed Safely with large quantity of Geologic, Reservoir, Drilling, Testing, Completion, Seismic, etc., etc..

Key Learnings & Lessons

General

- Front-end Technical Loading and planning essential to Project Success
- Project Goals, Objectives, Experiments defined, but flexibility was still present in testing, borehole conditions, logs, etc.
- Team Driven Approach worked great.
- Managed risk in wildcat unknown well portion

Innovative Solutions

- Open Hole Testing, saved considerable \$\$\$\$ for casing, cement, while also applying methodology in well interval testing/reservoir characterization
- Injection testing with KCL proved interval reservoir capability (pre-CO₂)
- Schlumberger's MWD drilling assembly used to solve borehole deviation situation
- RST Log runs, Boron logging, temperature and PLT suite indicated flow intervals.

Key Learnings & Lessons

Data Acquisition

- Pressure Transient data key to long term storage
- Continuous Monitoring, compilation of data necessary for regulatory needs and public comfort

Share Results

- Prepare final report for Regulators on technical aspects of testing.
- Perform Community outreach, meetings with landowners, gov't etc.
- Share technical findings, publish results, learnings

Project Observations/Reflections

- Project completed safely, no incidents, releases
- Completed in record time, from Concept to Design to Permit to Drilling to Testing – *kudos to Group, Technical team to achieve this significant Milestone!!!*
 - EPA Class V Permit 5 months + 30-day comment + 30-day EAB process
 - Drilling—559 hours drilling to get to 8130 feet
 - Testing—inject KCl and CO₂ into openhole
- Well and Project set a ‘high bar’ for research and test wells to emulate using a Consortium with Government-Industry-Consulting model
- Well Information is important, very transferable for additional projects and assessment for CO₂ storage.

Thank You

On behalf of Bill and Sandia Technologies, we appreciate being of service to the KY Project Team and letting us provide our company resources and injection well knowledge on this very interesting project.

We look forward to assisting you on future project endeavors and working with you get the message out from the successful Blan Well!!



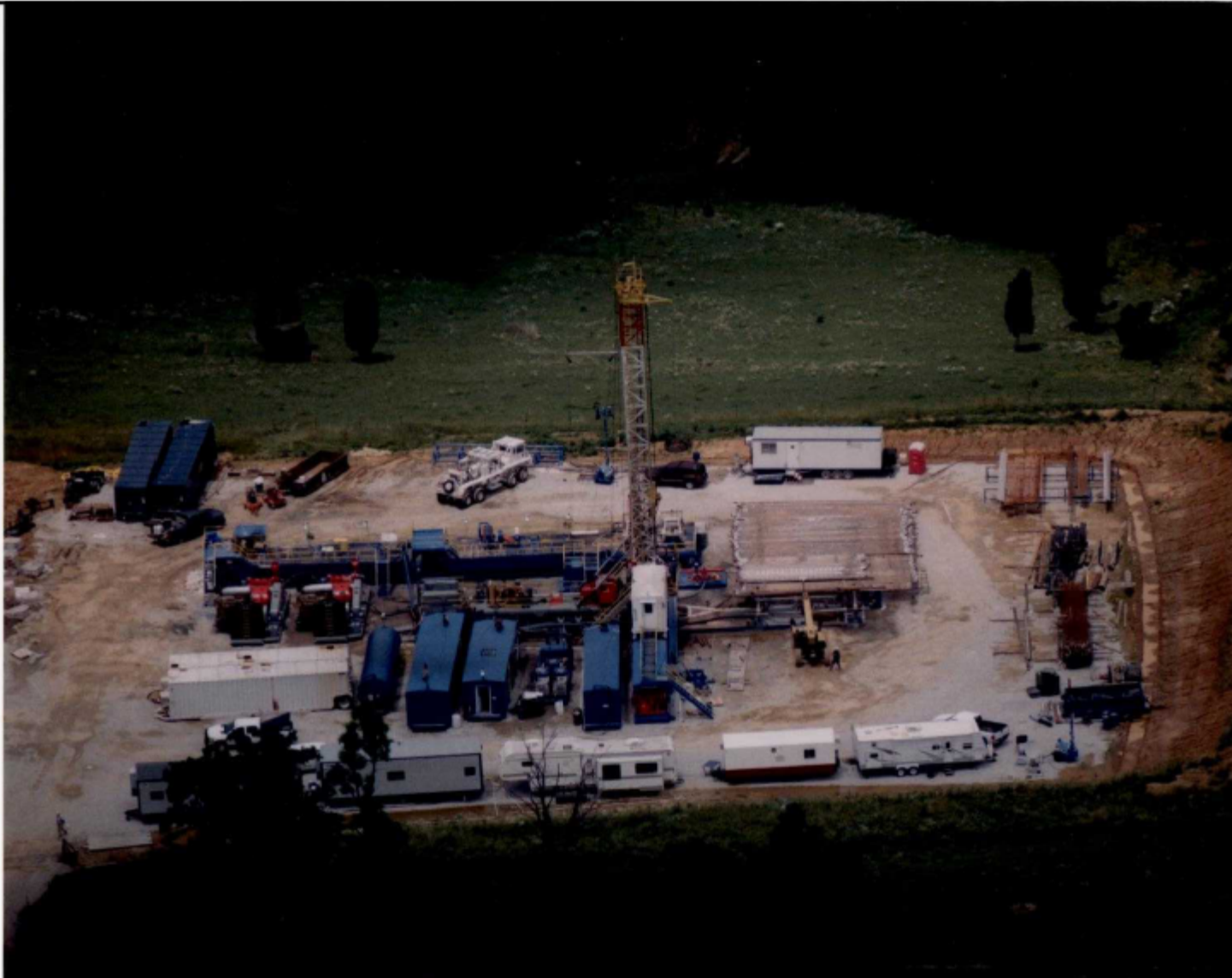
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Sandia Technologies, LLC -- Recent Activity

Recent CO₂ and Research Test Well Experience

- WestCarb -- Drilled and Completed, EPRI–Holbrook AZ CO₂ capture project, unfortunately limited reservoir no CO₂ injection.
- SECARB – continue work with TX BEG and Denbury Resources on Cranfield, MS CO₂ EOR pilot test and well installation
- Tri-Carb – Sandia/Conrad Geosciences, and Schlumberger Carbon Services awarded DOE Project for Geologic Characterization of Newark Triassic Rift Basin in NJ-NY area. NYSERDA funding partner (20% share) with tentative project site in Rockland Co., NY. An 8000 foot test well, cores, logs, DSTs, etc., no CO₂.



U.S. Department of Energy

National Energy Technology Laboratory



September 16, 2009



RECOVERY ACT

Site Characterization of Promising Geologic Formations for CO2 Storage

In September 2009, the U.S. Department of Energy announced the award of 11 projects worth \$75.5 million to conduct site characterization of promising geologic formations for CO2 storage. These Recovery Act projects will increase our understanding of the potential for these formations to safely and permanently store CO2.

MORE INFO

- Read the Funding Opportunity Announcement

The information gained from these projects (detailed below) will further DOE's efforts to develop a national assessment of CO2 storage capacity in deep geologic formations.



Congratulations To KGS COP Schlumberger and Sandia for their ARRA awards on various DOE funding projects.