

Demonstration of Advanced CO₂ Capture Process Improvements for Coal-Fired Flue Gas

DE-FE0026590

Kickoff Meeting

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Project Team



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Project Background



- Southern Company Services Research and Technology Management group is charged with investigating and demonstrating new technologies applicable to the electric utility industry
- SCS owns a 25 MW amine-based CO₂ capture process (MHI's KM-CDR) at Plant Barry and has tested improvements such as the DOE-funded HES project (with MHIA and AECOM)



Plant Barry Host Site



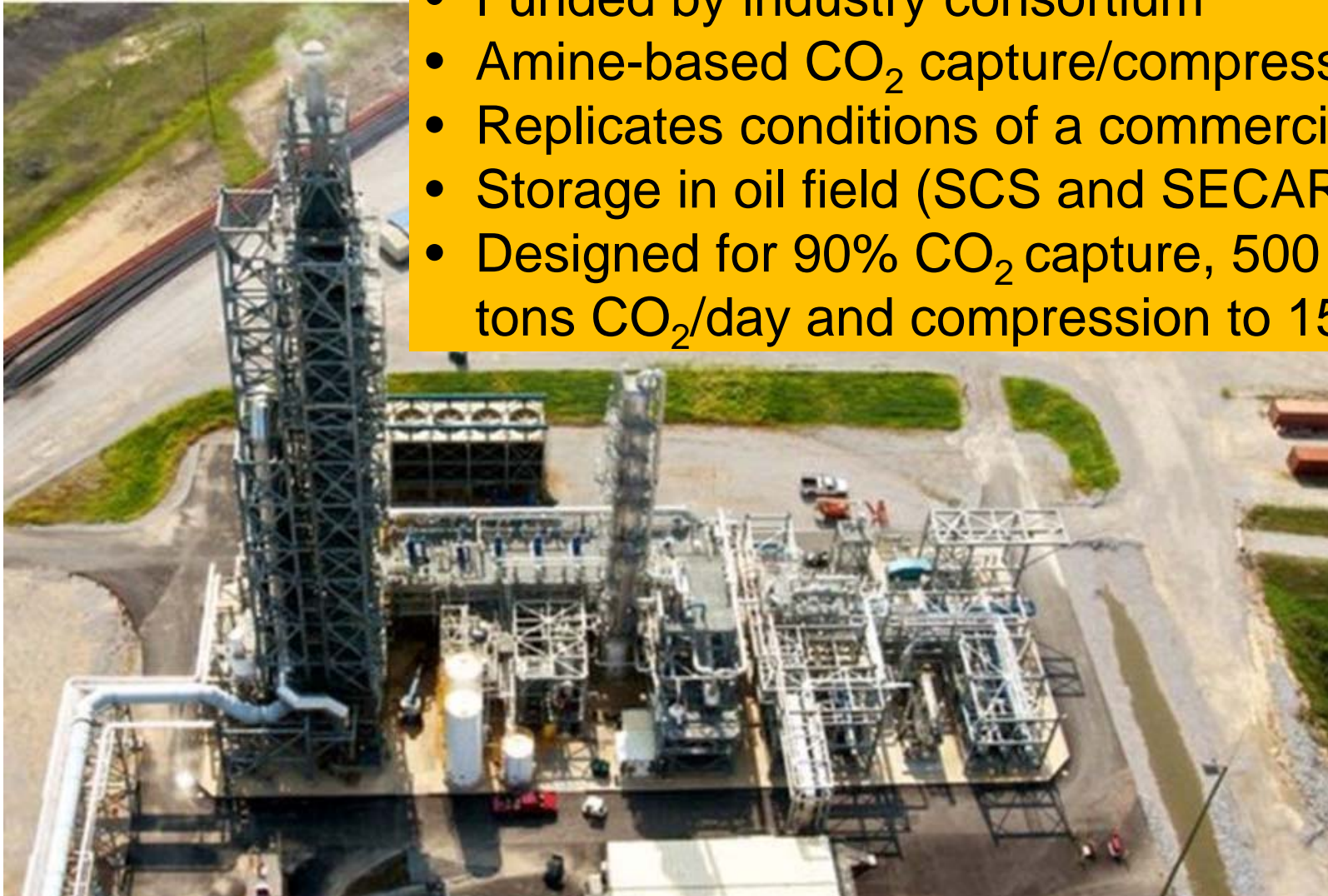
- 770 MW nameplate CE T-fired SC Boiler
- Total site capacity – 2700 MW
 - 1500 MW coal
 - 1200 MW NGCC

PLANT BARRY
ENVIRONMENTAL PROJECTS

25 MW KM-CDR at Plant Barry



- Funded by industry consortium
- Amine-based CO₂ capture/compression
- Replicates conditions of a commercial unit
- Storage in oil field (SCS and SECARB)
- Designed for 90% CO₂ capture, 500 metric tons CO₂/day and compression to 1500 psig



Project Background



SCS and MHI have considered possible process improvements during operation of KM-CDR:

- Pre-Scrubber
 - Absorber
 - Regenerator
 - Compressor
 - Solvent
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Project Objectives



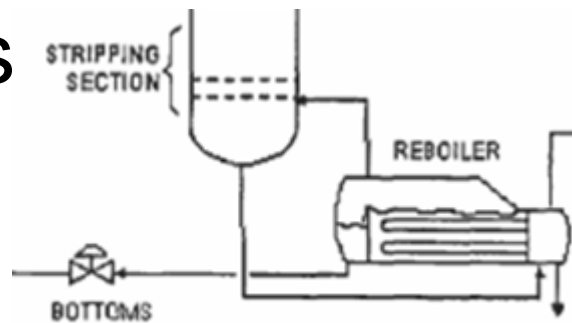
- Develop and quantify viable cost and energy saving methods for the capture and sequestration of CO₂ produced from pulverized coal (PC) combustion
 - **BIR:** Construct and test built-in-reboiler to confirm technology is suitable for the regenerator
 - **PMM:** Complete Particulate Management Test to determine maximum allowable PM concentration and determine if solvent purification steps can be eliminated
 - **NSL:** Demonstrate performance and energy efficiency improvements of New Solvent A over KS-1 and MEA
- Evaluate the technical and economic feasibility of full-scale implementation of this

Built-in Reboiler (BIR)

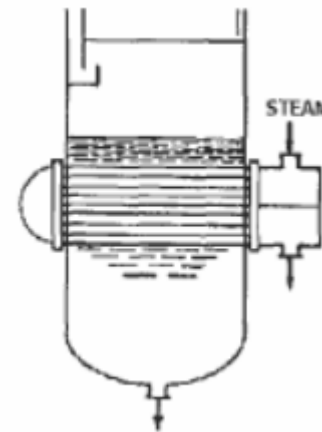


- BIR will replace regenerator reboiler and stripper with integrated unit
 - Reduced capital and operating cost and footprint
- Welded-plate heat exchanger, designed for high condensation or evaporation duty,

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Conventional



Integrated

Built-in Reboiler (BIR) Testing Details



- Reboiler Performance Test:
 - Confirm design performance
- Parametric Testing:
 - Assess performance under a range of operating parameters
- Long Term Operation Test:
 - Assess long term operability
- Internal Inspection:
 - Inspect for potential damage or fouling

Particulate Matter Management (PMM)



- Mimic higher PM levels in the flue gas via partial bypass of Plant Barry wet FGD
 - Solvent purification system will be turned off to mimic removal of the filtering process
 - Quench, deep FGD and reclaimer are expected to control increased PM and SO₂ to level needed to prevent performance degradation
 - Reduce capital and operating cost for the CCS system
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Particulate Matter Management (PMM) Testing Details



– Baseline Test:

- Confirm baseline conditions and performance without FGD bypass

– Higher PM Loading Test:

- With FGD bypass, measure PM concentration and suspended solids (SS), and monitor conditions and performance

– Reclaiming Test:

- Operate reclaimer to remove and analyze SS

– Inspection:

- Conduct internal inspection potential damage, accumulation or fouling.

New Solvent A Testing (NSL)



- Replacement of KS-1 solvent with New Solvent A
 - Developed by MHIA
 - Amine based solvent similar to KS-1

Advantages of New Solvent A



- New Solvent A regeneration steam consumption
 - Reduced 5.1% from KS-1
 - Reduced 37% from MEA
- Steam consumption savings significantly outweigh cost increases due to higher solvent circulation

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Relative Comparison of Solvent Characteristics

	MEA	KS-1	New Solvent A
Steam Consumption	1	0.68	0.65
Solvent Circulation	1	0.6	0.83
Solvent Degradation	1	0.1	0.1
Corrosion Inhibitor Required	Yes	No	No
Solvent Emission	1	0.1	0.1

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New Solvent A Testing (NSL) Details



- **Baseline Test:**
 - Confirm baseline performance of New Solvent A
 - **Optimization Test:**
 - Vary operating parameters to verify performance
 - **Long Term Operation Test:**
 - Confirm performance and verify solvent degradation rate
 - **Reclaiming Test:**
 - Perform reclaiming operation to confirm operability and stability.
 - **Inspection:**
 - Conduct internal inspection for potential corrosion
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BIR, PMM and NSL Performance Comparison with DOE Targets



	Supercritical PC w MEA CCS (Case 12)	Supercritical PC w KM-CDR CCS with HES	Supercritical PC w KM-CDR CCS with HES, BIR, PMM and NSL	Supercritical PC w KM-CDR CCS with HES, BIR, PMM and NSL + Aux. Turbine	DOE Targets
COE (mils/kW)	106.6	81.9	80.6	76.9	74.6 by 2030 (-30% from Case 12)
LCOE (mils/kW)	135.2	103.9	102.3	97.5	94.6 by 2030 (-30% from Case 12)
Cost of CO₂ capture (\$/tonne)	47.8	30.7	29.2	25.5	40.0 by 2025 30.0 by 2030

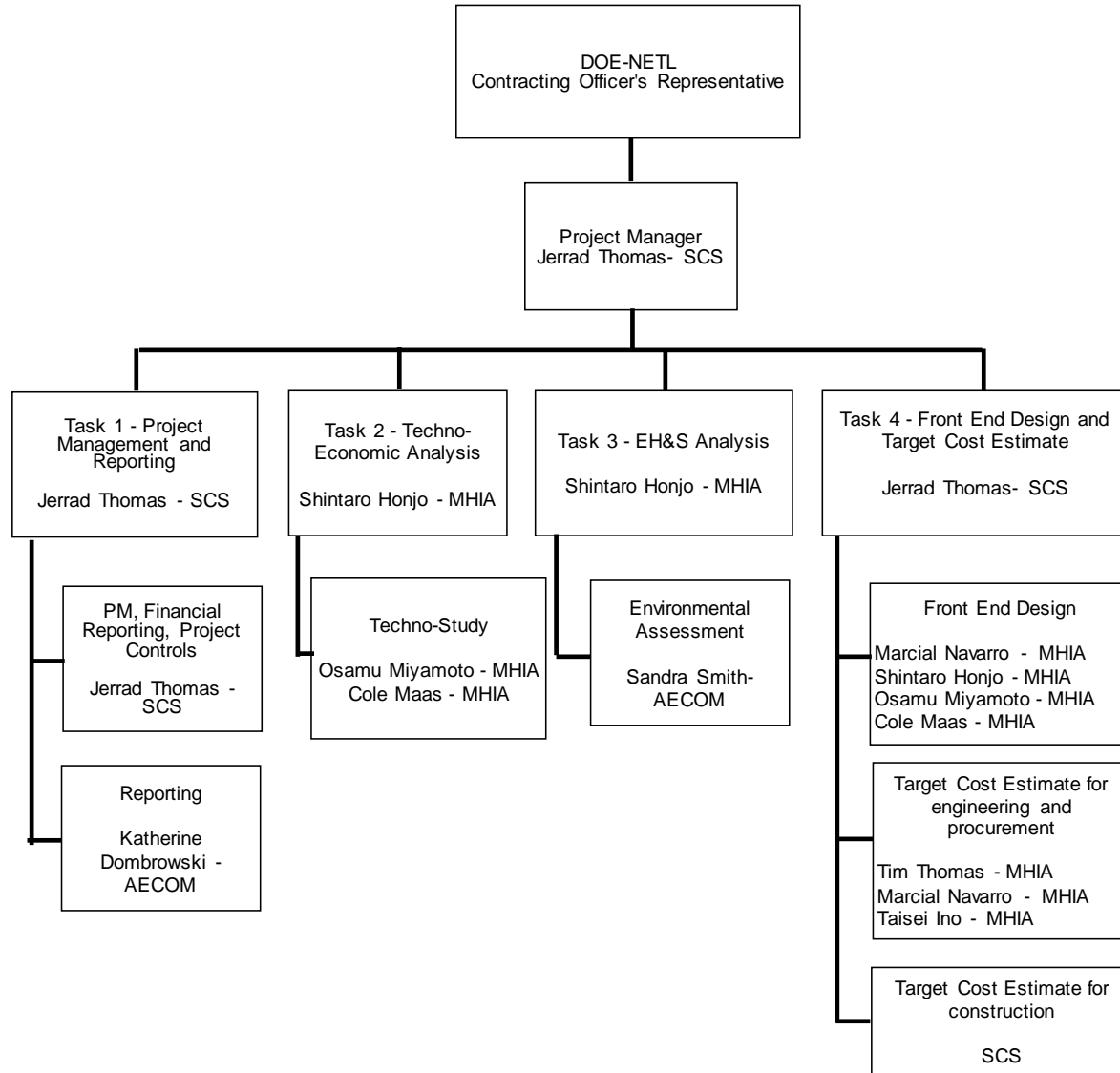
Challenges and Risk Management



- First test of New Solvent A on coal-fired flue gas
 - All indications are that it will perform well
 - BIR has been tested at 2.5MW and performed well
 - Trade off between schedule and desired test plan
 - PMM testing with New Solvent A not currently included
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Project Organization: Phase 1

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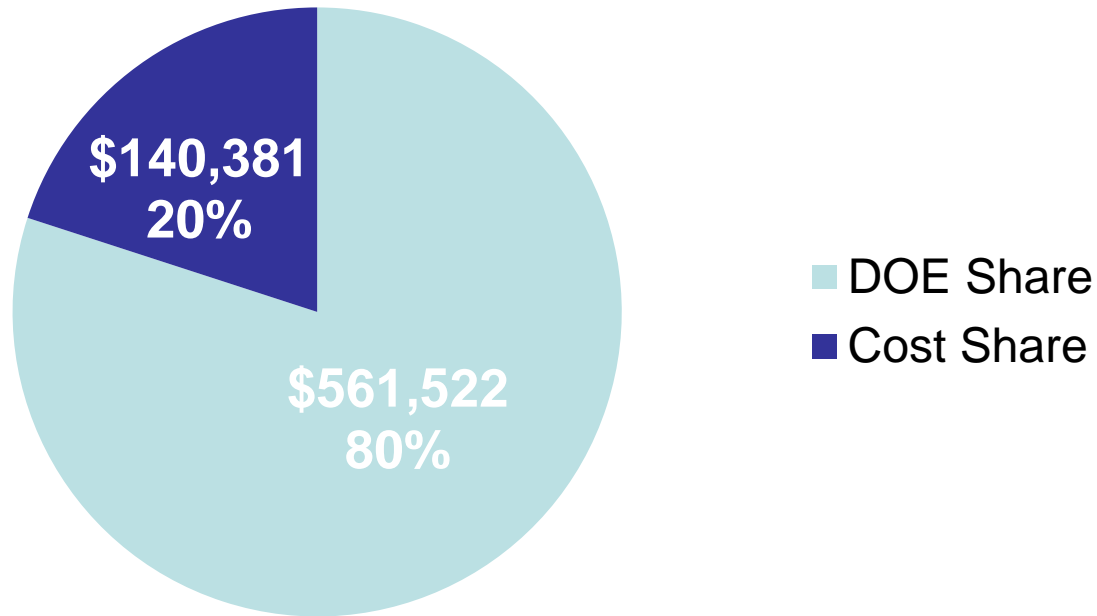


Project Structure: Phase 1 Budget



Phase 1 (BP1) will last 1 year (10/1/15-9/30/15)

BP1 Costs



Project Schedule



Phase 1 (BP1) Schedule

			2015			2016						
			Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul
Budget Period		Start Date	End Date	Q1			Q2		Q3		Q4	
Months After Contract Award				Budget Period 1								
Task 1: Project Management and Reporting			10/1/2015	9/30/2015								
1.1 Project Management			10/1/2015	9/30/2015	■	■	■	■	■	■	■	■
Task 2: Techno-Economic Analysis			10/1/2015	12/31/2015								
2.1 Techno-Economic Analysis Reporting			10/1/2015	12/31/2015	■	■	■					
Task 3: EH&S Analysis			1/1/2016	3/31/2016								
3.1 EH&S Reporting			1/1/2016	3/31/2016			■	■	■			
Task 4: Front End Design and Target Cost Estimate			1/1/2016	3/31/2016								
4.1 Basic Engineering			1/1/2016	3/31/2016			■	■	■			
4.2 Target Cost Estimation			1/1/2016	3/31/2016			■	■	■			

Project Structure: Tasks



- Task 1: Project Management and Reporting
 - BP1-BP5
- Task 2: Techno-Economic Analysis
 - BP1
- Task 3: EH&S Analysis
 - BP1
- Task 4: Front End Design and Target Cost Estimate
 - BP1

Task 1: Project Management



- Subtask 1.1- Project Management
 - Develop project and ensure coordination with each other and DOE/NETL including project management, submission of deliverables following the PMP

Task 2: Techno-Economic Assessment



- Creation and submission of preliminary Techno-Economic Assessment for 550 MW Greenfield Pulverized Coal plant including:
 - General process flow diagrams
 - Material and energy balances
 - Stream Tables
 - Economic analysis following QGESS
 - Cost estimates for equipment and consumables

Task 3: EH&S Analysis Report



- Creation and submission of EH&S Analysis Report for test objectives:
 - Summary of HAZOP
 - Summary of potential emissions
 - Regulatory implications of emissions

Task 4: Front End Design and Target Cost Estimate



- Subtask 4.1- Basic Engineering
 - Final PFD, General Arrangement and Elevation Sketch
 - Pilot plant utilities and waste generation
 - BIR feed conditions
 - Start-up, steady-state, and shut-down procedures
 - Subtask 4.2- Target Cost Estimation
 - A cost estimate covering tasks related to execution of the proposed items
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Phase 1 Project Milestones



Milestone	Budget Period	Associated Task(s)	Milestone Description	Planned Completion Date	Proposed Verification Method
1	1	1	Updated Project Management Plan	10/31/15	PMP file
2	1	1	Kick Off Meeting	11/30/15	Presentation file
3	1	1, 2	Final Draft Techno-Economic Analysis Submitted	12/31/15	Draft Techno-Economic Analysis file
4	1	4	Target Cost Estimate and EH&S Analysis Finalized	3/31/16	Quarterly Progress Report

Phase 1 Deliverables



10/31/15	Updated Project Management Plan
12/31/15	Initial Techno-Economic Assessment
3/31/16	Phase 1 Technology Engineering Design and Economic Analysis Report Phase 1 Technology Gap Analysis Process model files used for Phase I systems analysis Phase 1 EH&S study Phase 1 Topical Report Updated Project Management Plan Phase 2 Environmental Questionnaire
6/30/16	Executed Financial agreements Executed Host Site Agreements Updated Representations and Certifications

Current Project Status



- Initial TEA: In progress
- EH&S Study: Initial work
- Target Cost Estimate: Not yet started

Questions?

