National Carbon Capture Center: Post-Combustion Focus
Project NT0000749

Doug Maxwell

2010 NETL CO₂ Capture Technology Meeting
September 15, 2010
Southern Company Facts and Figures

- Regulated Utilities
  - Alabama Power
  - Georgia Power
  - Gulf Power
  - Mississippi Power
  - Southern Nuclear

- Competitive Power
  - Southern Power
  - Southern Generation

- Other
  - Southern LINC Wireless
  - Southern Telecom

- >42,900 MW of capacity
- Diversified sources of energy (2009 generation)
  - 57% coal
  - 23% gas
  - 16% nuclear
  - 4% hydro

“ACSI
The highest rated electric utility in America by the American Customer Satisfaction Index over the past 10 years.”
National Carbon Capture Center

- New Cooperative Agreement DE-NT0000749 effective October 1, 2008 for five years through September 30, 2013

- National Carbon Capture Center established at Power Systems Development Facility in Wilsonville, AL

DOE/NETL Project Manager – Mike Mosser
The National Carbon Capture Center

Managed and Operated for DOE by Southern Company

Bringing together science and innovation in technology development, along with real-world testing capability, to achieve cost-effective and reliable capture of carbon dioxide from coal-based power generation.

- Flexible testing at various scales
- Facilities for scale-up from bench to engineering-scale
- Collaboration with wide variety of participants and partners
- Finding “best-in-class” technology
- Accelerated path to cost-effective CO2 capture technology
- All 3 major areas of CO2 Capture:
  - Post Combustion
  - Pre-combustion
  - Oxy-combustion
Focus of NCCC Technical Program

Technology Development Time Scale

- **Lab Scale**
- **Component Validation**
- **Process Development Unit**
- **Pilot Unit**
- **Demonstration**
- **Commercial**

Progress to Commercialization

- Extended lab work under realistic conditions (e.g. MPT, NETL FC)
- Integrated system testing under realistic conditions (e.g. PSTU)
- Sub-system testing under realistic conditions (e.g. MTR)
Located at the Power Systems Development Facility (PSDF) in Wilsonville, Alabama

Pre-combustion CO2 capture facility
Post-combustion CO2 capture facility
Topics Today

Pilot Solvent Test Unit (PSTU) Process Design and Test Planning &
Post-Combustion Carbon Capture Center (PC4) Construction Update
Pilot Solvent Test Unit

- Build a highly flexible test bed using a real flue gas for post-combustion CO$_2$ capture
- Long-term testing of newly-developed and potential solvents from 3$^{rd}$ party developers
- Baseline solvent for sizing: 20-30\% wt MEA
- Overall CO$_2$ removal rate: $\geq$ 90\%
- Flue gas flow rate: 5,000 lb/hr (~0.5 MW, ~10 t/d CO$_2$)
- Turndown ratios: 2:1 for gas, 3~5:1 for liquid
- Modular structure arrangement
- Flexible process configuration and testing conditions
PSTU – A Flexible Test Platform

- Absorber
- Wash Tower
- Regenerator
- Pre-Scrubber
- Cooler/Condenser
- Reclaimer
- L/R HX
- Reboiler
- Blower
Next Steps

- Complete PSTU and BOP Installation
- System Integrity and Functional Check
- PSTU/BOP System Commissioning
- Baseline Tests with MEA
- Test New Solvents from Developers
## PSTU Test Planning

<table>
<thead>
<tr>
<th>Item</th>
<th>Media</th>
<th>Tentative Schedule</th>
<th>Duration</th>
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<tbody>
<tr>
<td>Commissioning</td>
<td>Water &amp; 20% MEA</td>
<td>4Q '10 – 1Q '11</td>
<td>As Needed</td>
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<td>Baseline Run</td>
<td>MEA</td>
<td>1Q, 2011</td>
<td>500~1000 hr</td>
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<tr>
<td>B&amp;W</td>
<td>New Solvent</td>
<td>2Q, 2011</td>
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<td>New Solvent</td>
<td>TBD</td>
<td>TBD</td>
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<tr>
<td>Developer B</td>
<td>New Solvent/System</td>
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<td>TBD</td>
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<tr>
<td>Developer C</td>
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PSTU Equipment Design Validation

**Items:**

- Hydraulic Performance (Q, P, ΔP, H, ...)
- Thermal Performance (E, T, ΔT, Approach, Heat Loss, ...)
- Instrument Accuracy and Rangeability
- Control Logic and Strategy (Global, Local, ...)
- Operability and Flexibility (Robustness, Turndown, ...)

**Methods and Approaches:**

- Separate and Independent Measurements of Key Parameters (Cross-Check)
- Calibrations of Key Instruments
- Heat and Material Balance
- Modeling and Simulation
- Gas and Liquid Analyses (Lab Analysis to Cross-Check)
Performance Evaluation

Objective: CO$_2$ Removal $\geq$ Goal (e.g., 90%)

While: Minimizing Energy and Water Consumption

By Optimizing:

- Lean and Rich Loading (CO$_2$/Solvent)
- Solvent Circulation Rate (L/G Ratio)
- Steam Consumption (S/L Ratio)
- Temperature Profile (Reaction, Regeneration, Bed, In/Out, …)
- Hardware/Process Configuration (Packing, Flow Path, …)
- Other Parameters

Design of Experiment (DoE)  Develop Test Matrix
Solvent Evaluation

- Kinetics
- Loading Capacity
- Heat of Reaction
- Regeneration Energy Consumption
- Degradation Potential and Products
- Corrosion Intensity
- Others
Summary

• Our **Objective** – Establish a Flexible Test Bed
• Our **Mission** – Test New Solvents
• Our **Results** – Get Data to Advance Technology
• Our **Status** – It Will Be Ready Soon
Post-Combustion Site Preparation
Site Preparation & Plant Tie-Ins

Reroute Underground Piping & Underground Firewater System

Flue Gas Supply
Flue Gas Return
Utilities (steam, water…)

[Images of construction work and pipeline installations]
Caisson and Column Foundation

- 72 Caissons
- 30 Micropiles
- 28 utility bridge support column units
Modular Utility Bridge Assembly
Modular Utility Bridge Assembly
Pilot Solvent Test Unit Delivery
Pilot Solvent Test Unit Installation
Pilot Solvent Test Unit Installation
Pilot Solvent Test Unit
Balance of Plant

Cooling Tower

Solvent Storage Tanks
Transformer & MCC Building Installation