National Carbon Capture Center: Post-Combustion Focus Project NT0000749

Doug Maxwell

2010 NETL CO_2 Capture Technology Meeting

September 15, 2010

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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."

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National Carbon Capture Center

- New Cooperative Agreement DE-NT0000749 effective October 1, 2008 for five years through September 31, 2013

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

DOE/NETL Project Manager – Mike Mosser

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U.S. Department of Energy

National Carbon Capture Center

at the Power Systems Development Facility

PARTICIPANTS:

DEPARTMENT OF ENERGY · UNITED STATES OF AMERICA

NETL
NATIONAL ENERGY TECHNOLOGY LABORATORY

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EPRI | ELECTRIC POWER RESEARCH INSTITUTE

AEP AMERICAN® ELECTRIC POWER

Luminant

Peabody

ACI
ARCH COAL, INC.

RioTinto

NRG

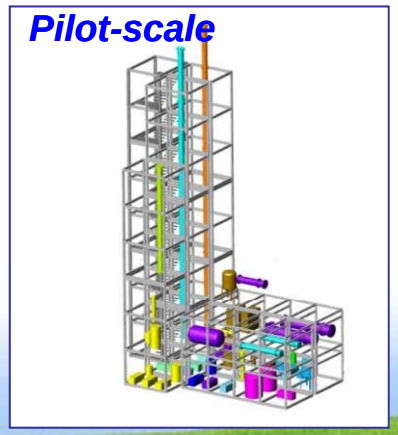
Managed by Southern Company Services, Inc.

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



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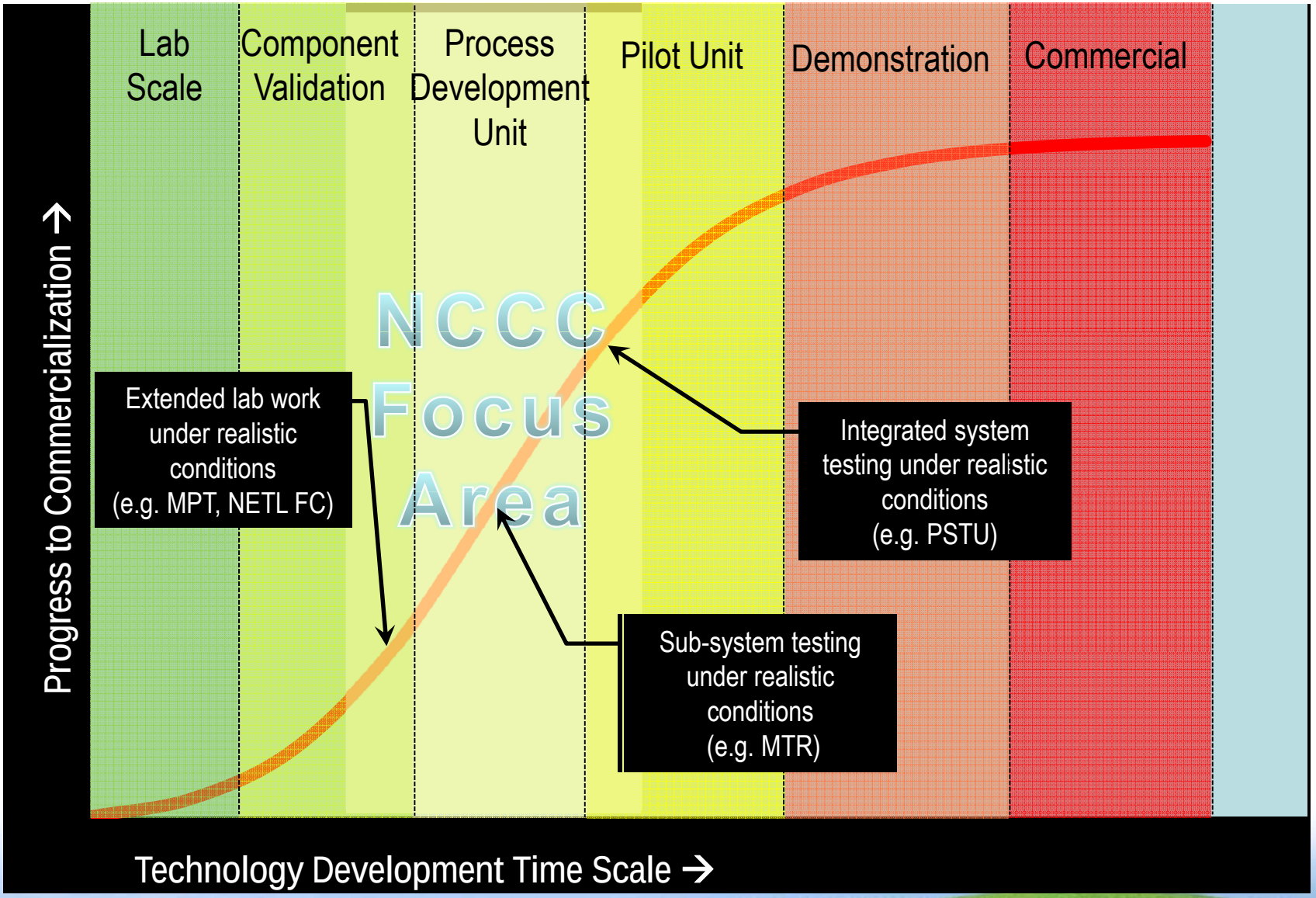
Focus of NCCC Technical Program



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Located at the Power Systems Development Facility (PSDF) in Wilsonville, Alabama

Pre-combustion CO2 capture facility

Post-combustion CO2 capture facility

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Topics Today

Pilot Solvent Test Unit (PSTU) Process Design and Test Planning

&

Post-Combustion Carbon Capture Center (PC4) Construction Update

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Alabama Power Plant E.C. Gaston
Wilsonville, Alabama

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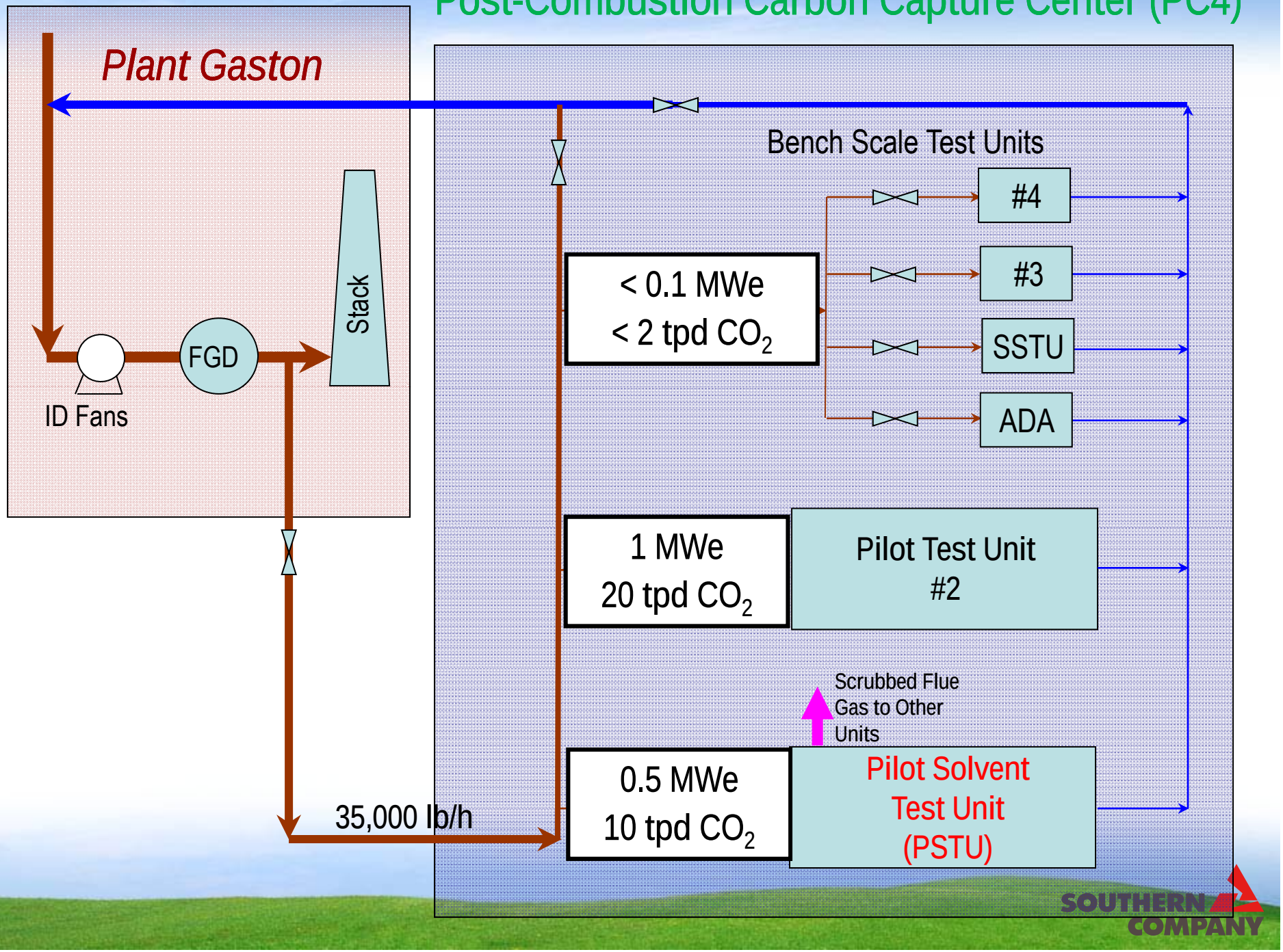
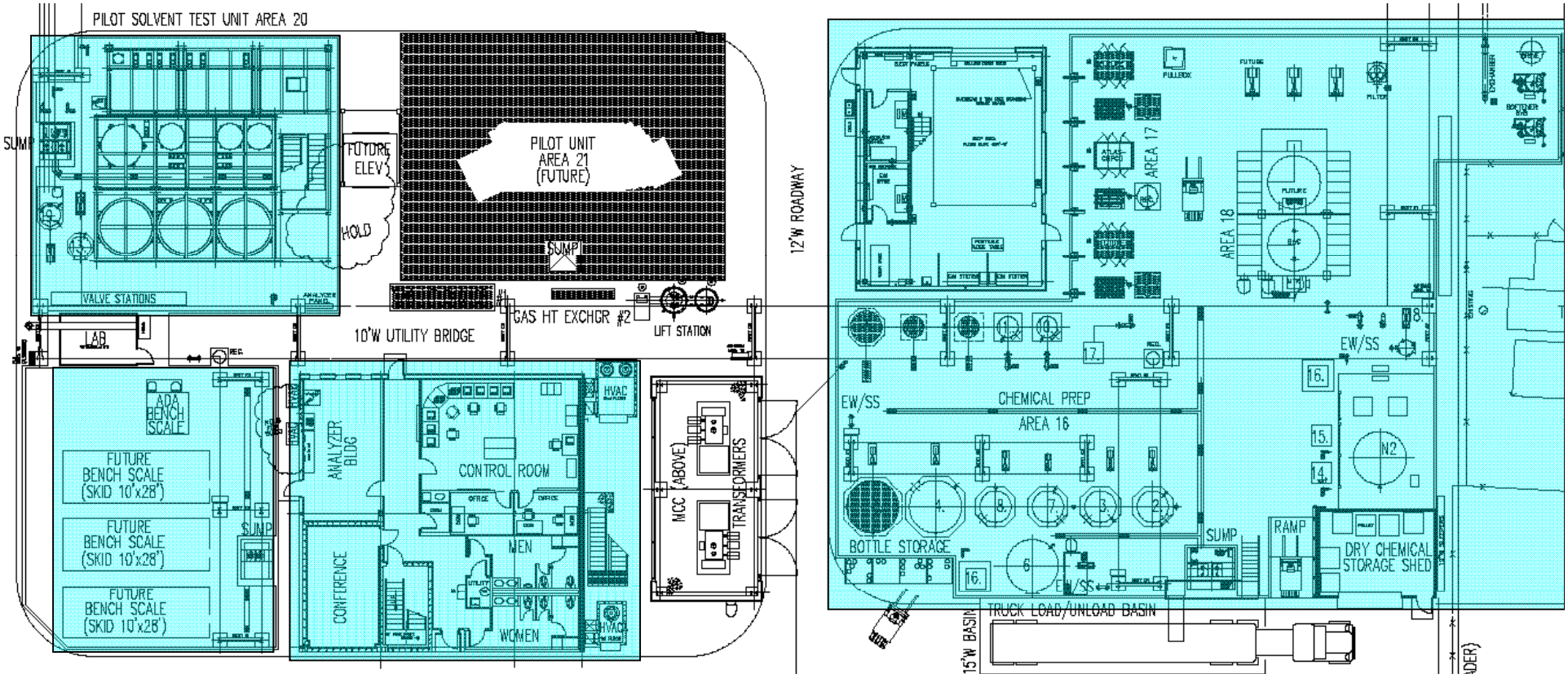
Post-Combustion Carbon Capture Center (PC4)



Post-Combustion Layout

PSTU

Balance of Plant



Bench Scale

Control Room Admin Building

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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 3rd party developers
- Baseline solvent for sizing: 20-30%wt MEA
- Overall CO_2 removal rate: ≥ 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

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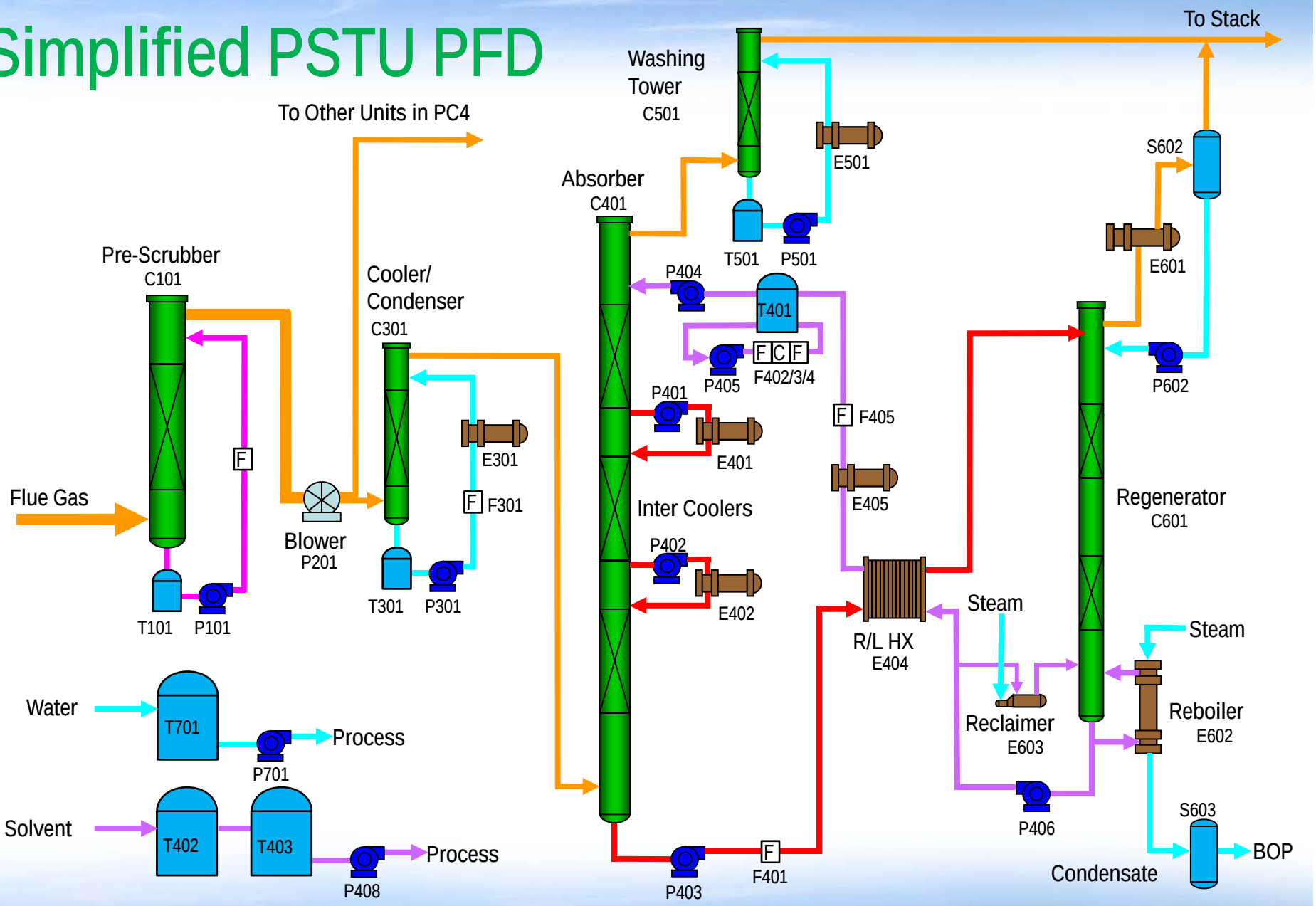
Simplified PSTU PFD



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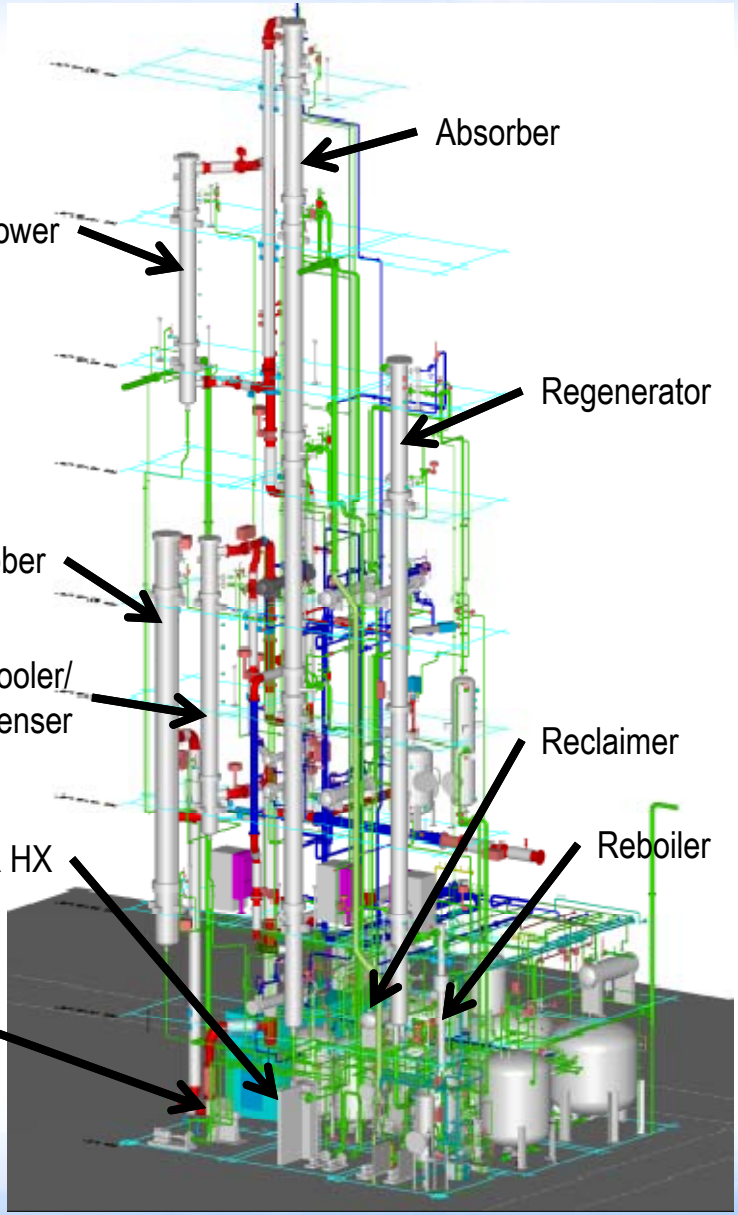
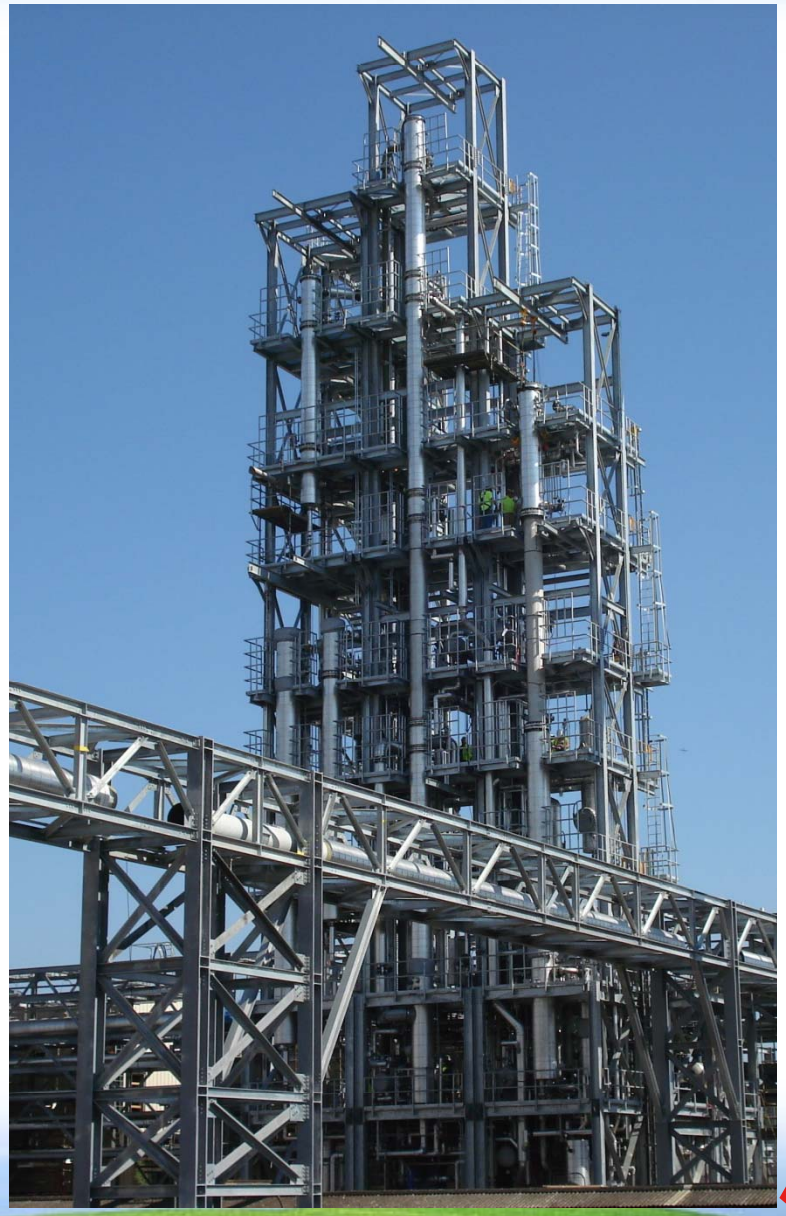
PSTU – A Flexible Test Platform





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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

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PSTU Test Planning

Item	Media	Tentative Schedule	Duration
Commissioning	Water & 20% MEA	4Q ‘10 – 1Q ‘11	As Needed
Baseline Run	MEA	1Q , 2011	500~1000 hr
B&W	New Solvent	2Q, 2011	TBD
Developer A	New Solvent	TBD	TBD
Developer B	New Solvent/System	TBD	TBD
Developer C	New Solvent/System	TBD	TBD
…	…	…	…

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)

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Performance Evaluation

Objective: CO_2 Removal ≥ 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

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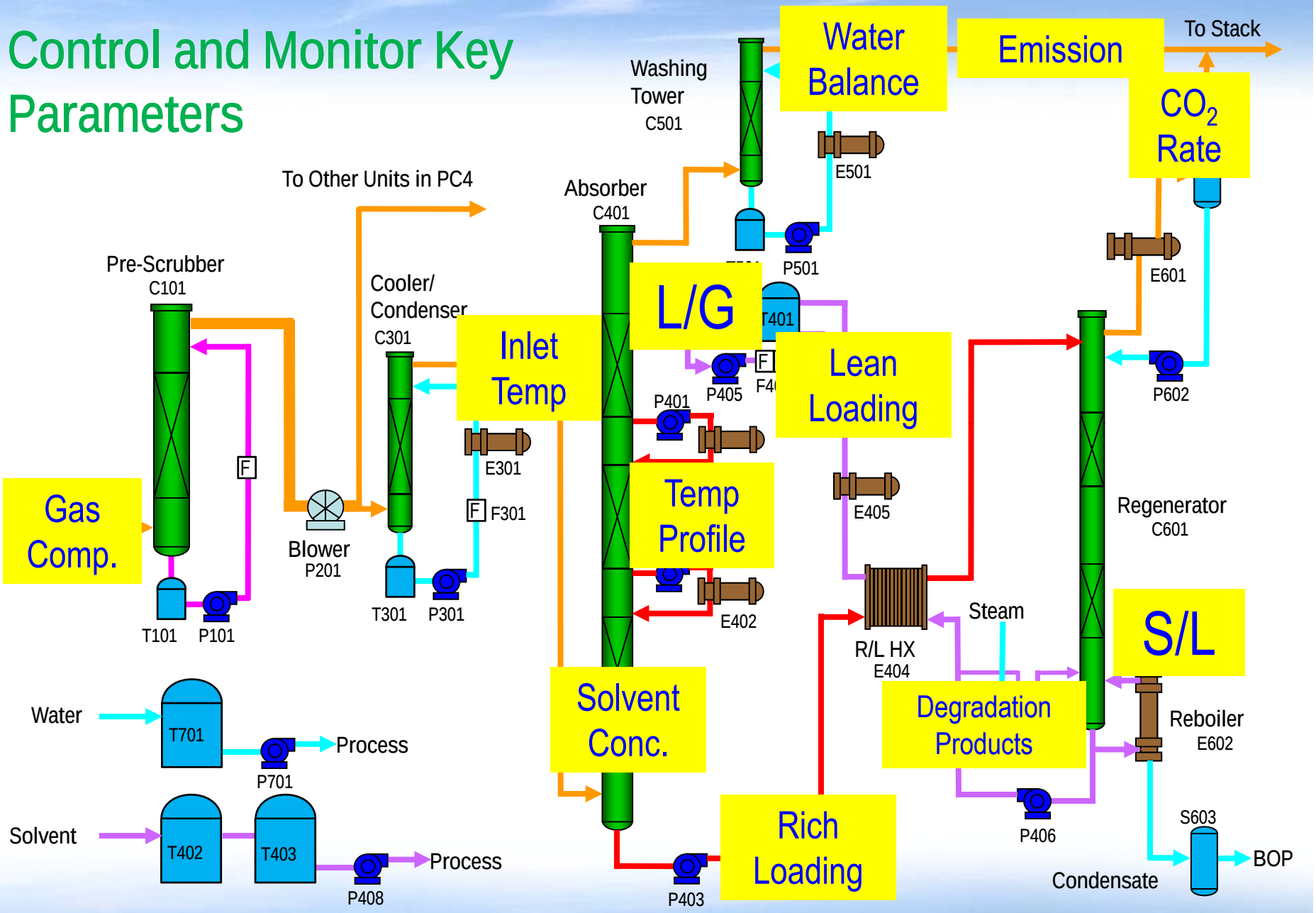
Control and Monitor Key Parameters



Solvent Evaluation

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

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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

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Post-Combustion Site Preparation

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Site Preparation & Plant Tie-Ins

Reroute Underground Piping & Underground Firewater System

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

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Caisson and Column Foundation

- **72 Caissons**
- **30 Micropiles**
- **28 utility bridge support column units**

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Modular Utility Bridge Assembly

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Modular Utility Bridge Assembly

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Modular Utility Bridge Assembly

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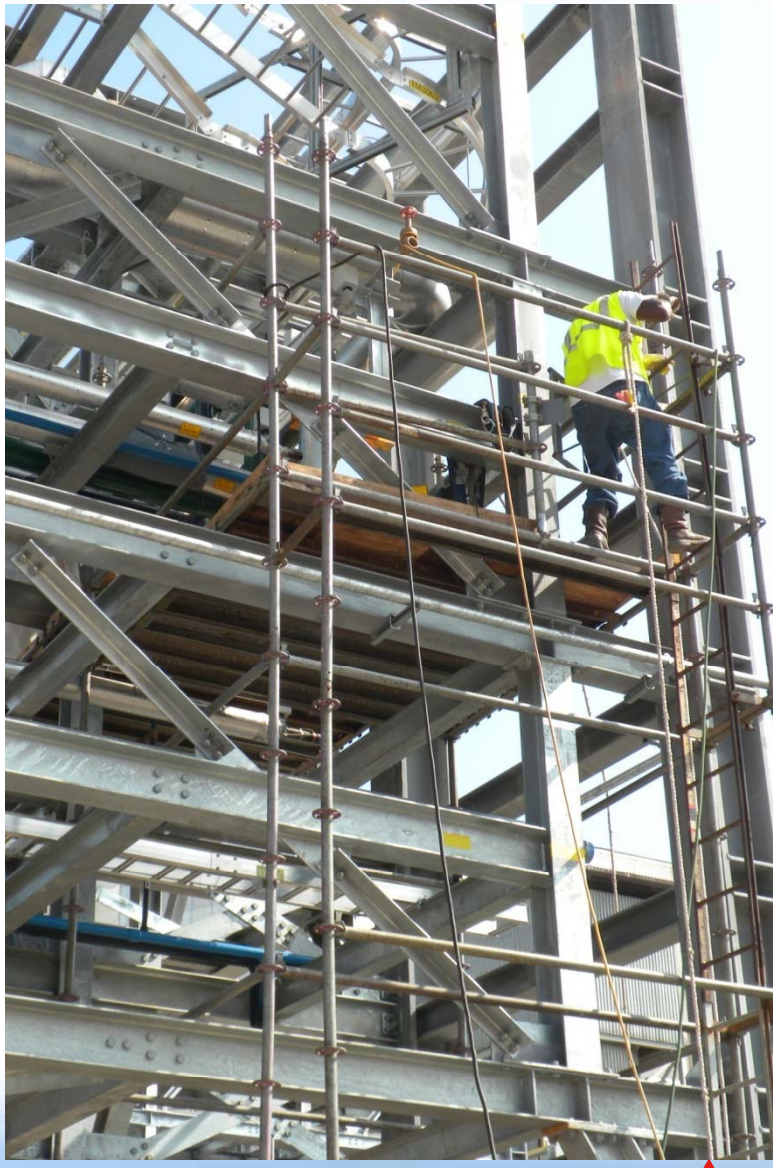
Bridge Module Interconnections



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Pilot Solvent Test Unit Assembly

Pilot Solvent Test Unit Delivery

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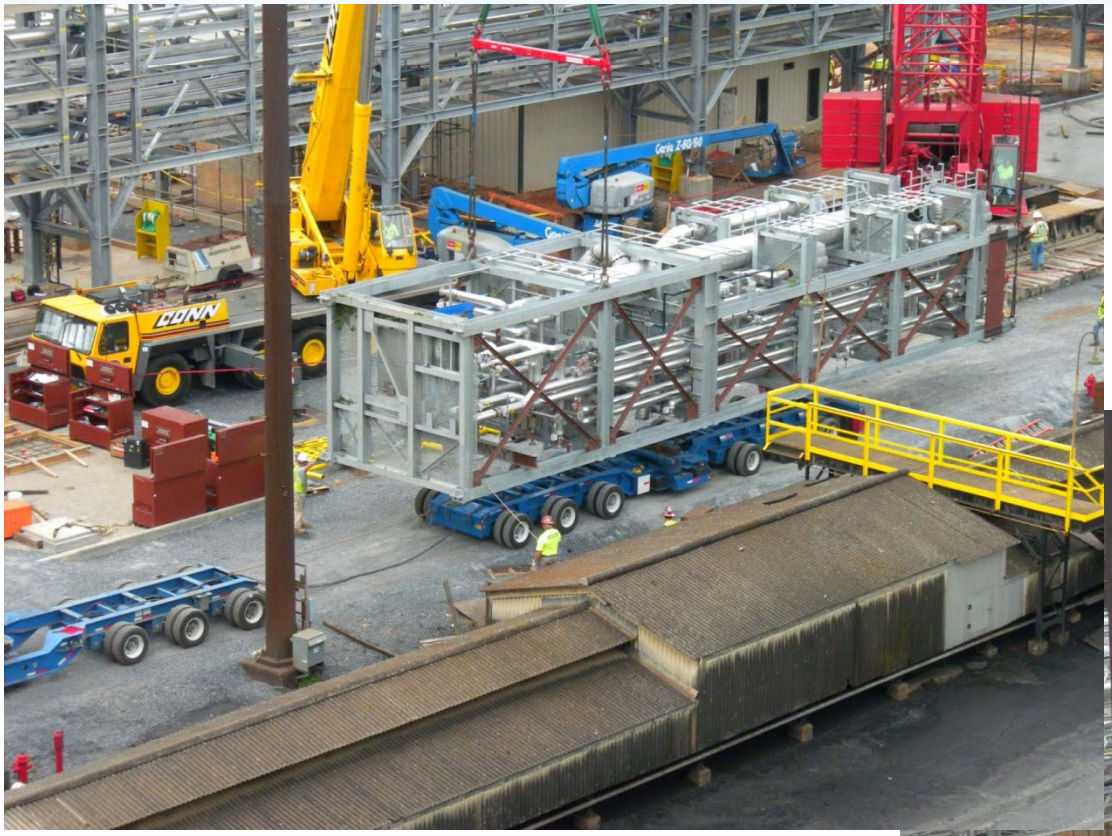
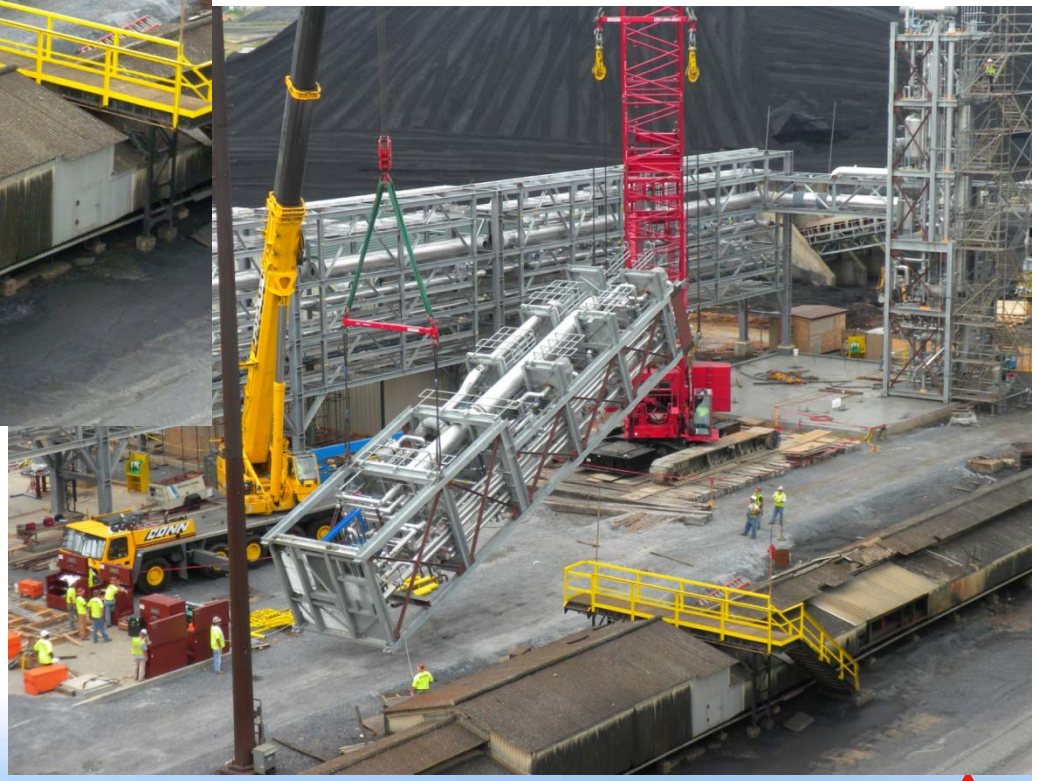
Pilot Solvent Test Unit Installation





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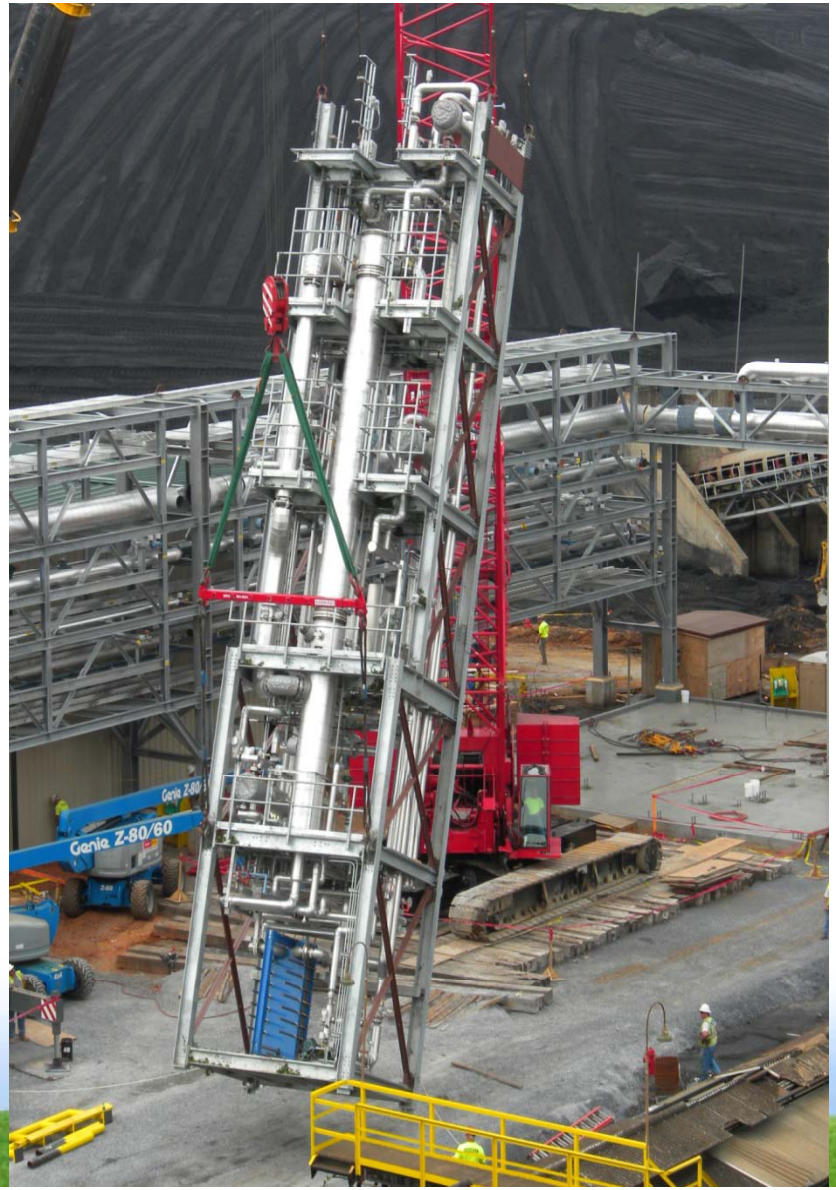
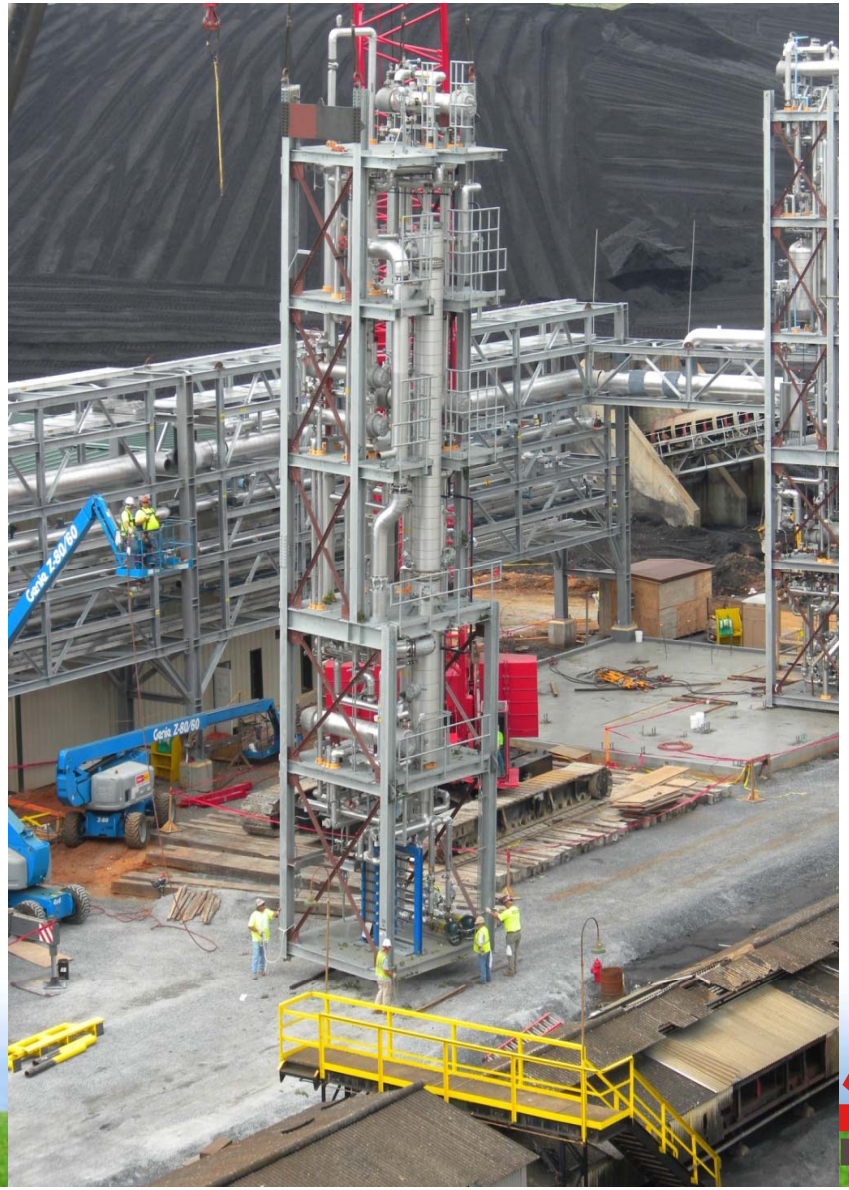
Pilot Solvent Test Unit Installation





Pilot Solvent Test Unit

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Balance of Plant

Cooling Tower

Solvent Storage Tanks

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Control Room/Admin Building

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Transformer & MCC Building Installation

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Questions?

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