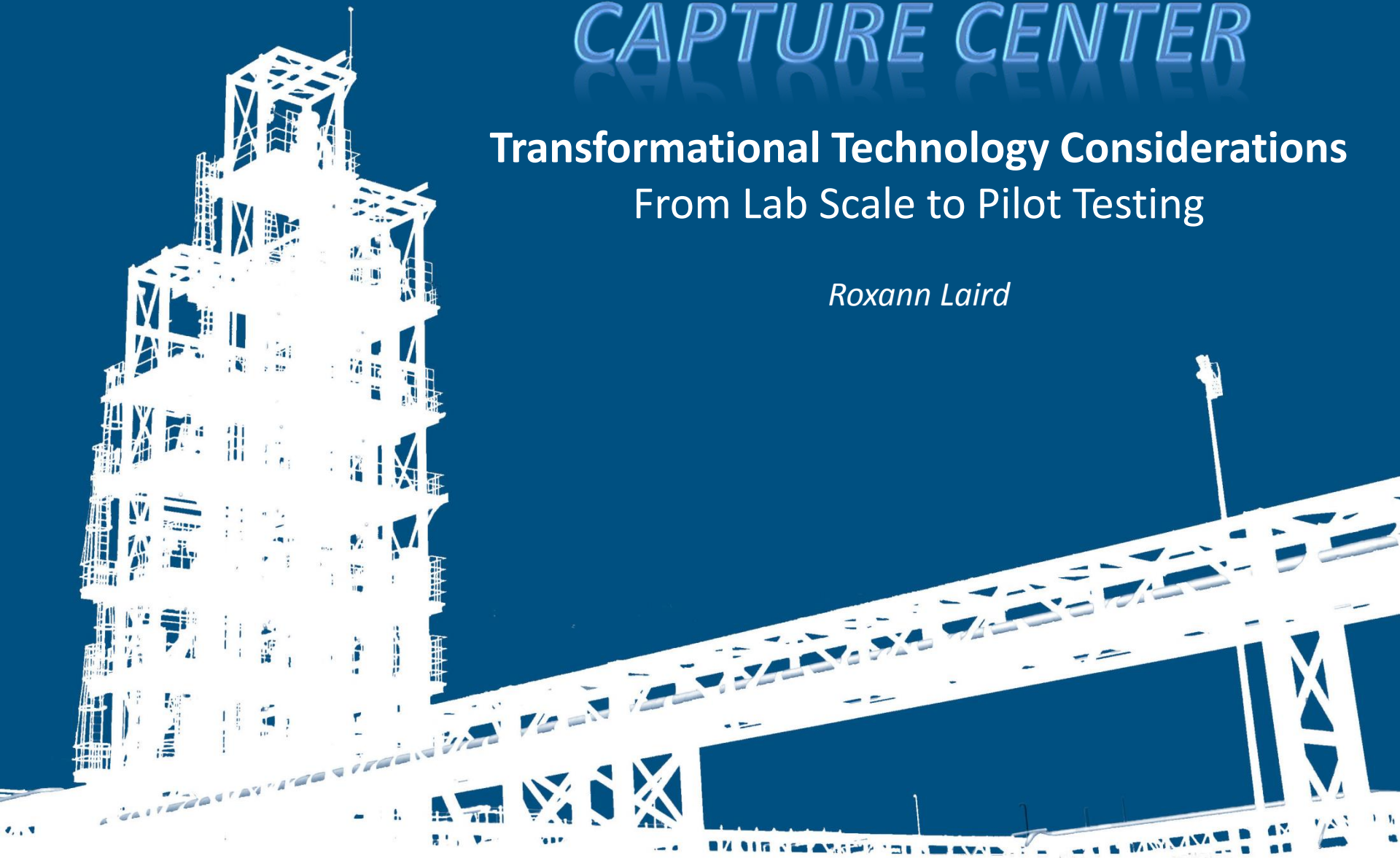
NATIONAL CARBON CAPTURE CENTER

Transformational Technology Considerations

From Lab Scale to Pilot Testing

Roxann Laird



*Offering a **world-class neutral** test facility and a highly specialized staff, to **accelerate the commercialization** of advanced technologies and enable coal based power plants to achieve **near-zero emissions (low cost CO_2)**.*

Post-Combustion CO_2 Capture

Gasification
Pre-Combustion CO_2 Capture

Project Facts

Performance Period
10/01/2008 to 09/30/2014

Total Project Value	**$251M**
DOE	$201M
Non-DOE	$50M

Award Number DE-NT0000749

Performance Period
6/05/2014 to 05/30/2019

Total Project Value	**$188M**
DOE	$150M
Non-DOE	$38M

Award Number DE-FE0022596

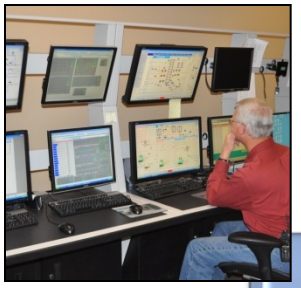
Technology Development Process

Evaluate and Screen Technologies

Define Scope of Work with Technology Developer

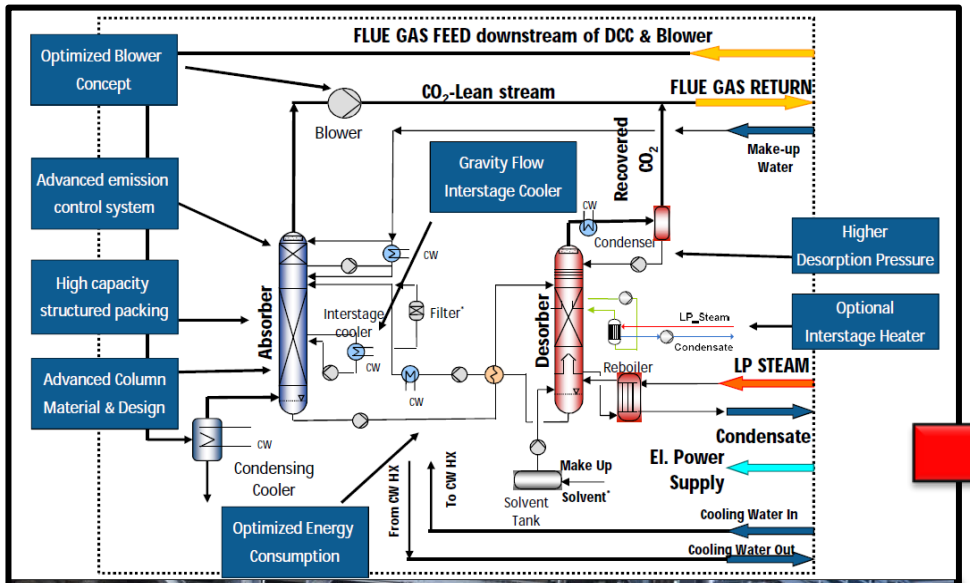
Design and Construct

Operate according to Test Matrix

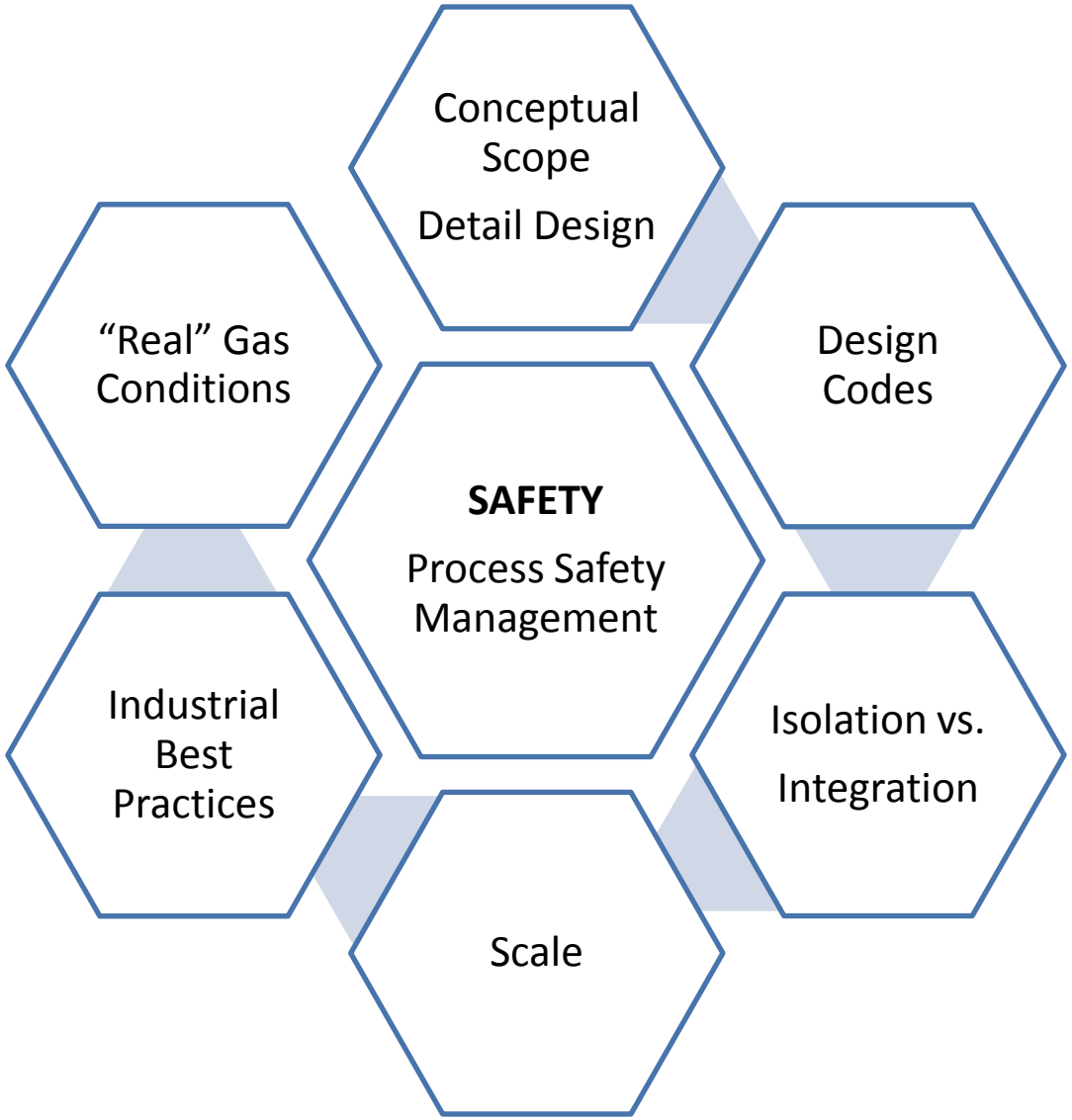


Analyze Data and Report

Challenges?


FLUE GAS FEED downstream of DCC & Blower
Optimized Blower Concept
CO_2-Lean stream
FLUE GAS RETURN
Blower
Recovered CO_2
Make-up Water
Advanced emission control system
Gravity Flow Interstage Cooler
CW
Condenser
Higher Desorption Pressure
High capacity structured packing
Absorber
Interstage cooler
Filter*
Desorber
LP_Steam
Condensate
Optional Interstage Heater
Advanced Column Material & Design
Reboiler
LP STEAM
Condensate
Condensing Cooler
From CW HX
To CW HX
Make Up Solvent*
Solvent Tank
El. Power Supply
Cooling Water In
Cooling Water Out
Optimized Energy Consumption

Lab Scale to Pilot Scale - Considerations

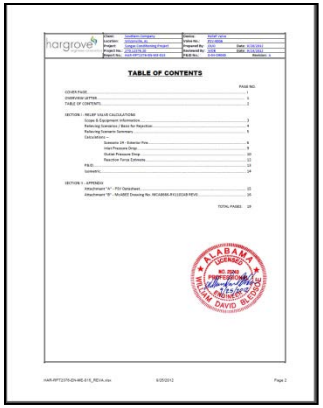


Process Safety Management

- Process Safety Information
- Process Hazard Analysis
- Operating Procedures
- Training
- Contractors
- Mechanical Integrity
- Hot Work
- Management of Change
- Incident Investigation
- Compliance Audits
- Trade Secrets
- Employee Participation
- Pre-startup Safety Review
- Emergency Planning and Response

Design Codes

- Most lab facilities are familiar with OSHA requirements, but may not construct equipment and processes according to design codes.
- Industrial facilities require design to be in accordance with ASME, API, NFPA, IBC, DHS, etc.
- State and local codes
  - Require certain pieces of equipment to be constructed to design standards (pressure vessels)
  - Alabama state laws require certain drawings to carry Alabama PE stamps (wiring drawings)
  - Alabama state laws require certain construction disciplines to have a certification and/or carry local licenses to perform work (master electricians, locally licensed contractors)



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H2 Supply w/ Fire Wall

Industrial Best Practices - example

In an industrial-scale environment piping, valves, and instrumentation may not be identified as easily as in a lab

Commercially-Representative Conditions

Developer's flue gas supply

≠

The real thing

- Actual MEA emissions higher than predicted due to presence of SO3 aerosol
- Although flue gas low in metals content, they accumulate in solvent
- SO_3 (present as ammonium sulfate/bisulfite) resulted in deposits forming in outlet of MTR flue gas compressor.

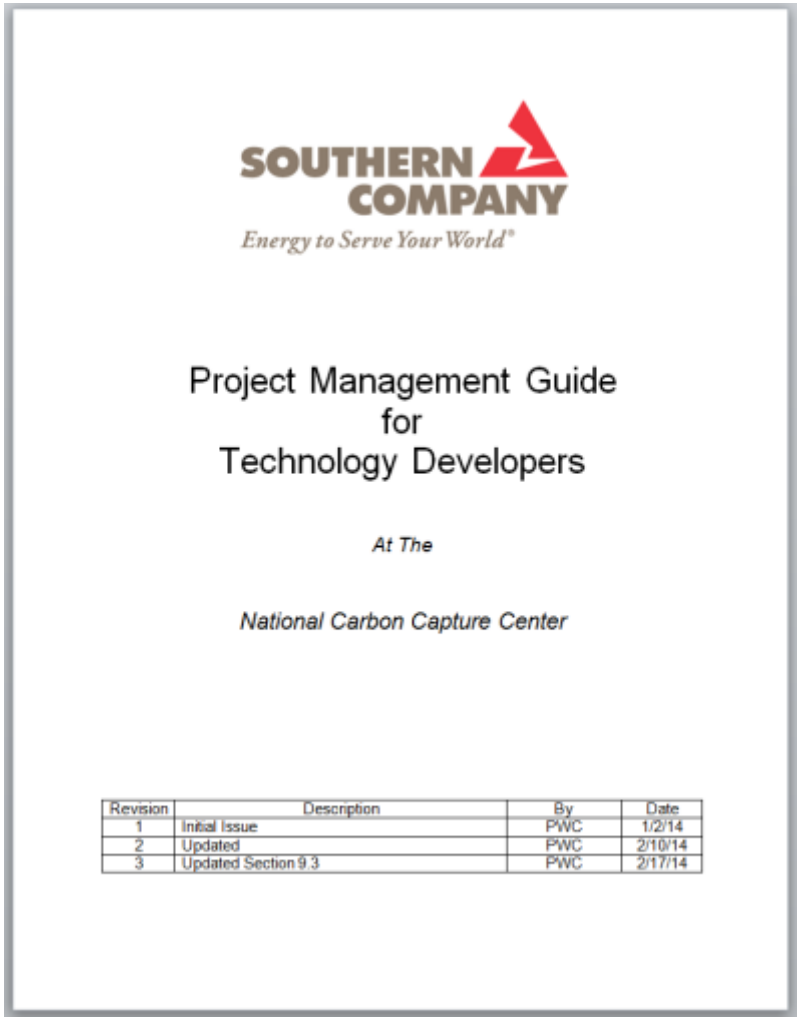
Lessons Learned

- Boundaries of Design Scope and Division of Responsibilities
- Contract Structure and Work Plan Requirements
- NCCC Utility Services Available
- NCCC Process Gas Composition
- Need for Standardized Methods for Determining Design Conditions
- Establishment of Method for Assigning Run Schedules
- Required Design Deliverables (what and when)
- Activities Requiring Qualified, Experienced Personnel (PE)
- Understanding of Controls Interface/Configuration
- Level of Operational/Process Support Available
- Guidance on Process Hazard Analysis
- Standardization on Documents that Require NCCC Review

Project Management Guide

Goals:

- Answer FAQ's more efficiently
- Develop Consistency between Developers
- Identify Typical Pitfalls and offer Guidance



SOUTHERN COMPANY

Energy to Serve Your World®

Project Management Guide
for
Technology Developers

At The

National Carbon Capture Center

Revision	Description	By	Date
1	Initial Issue	PWC	1/2/14
2	Updated	PWC	2/10/14
3	Updated Section 9.3	PWC	2/17/14

Defining Requirements

By clearly defining design requirements for critical portions of the process, we can address (in advance) the areas that require competent, experienced ***design*** engineering, and the documents that need to be provided to the NCCC to confirm that this has been done.

- **Tier 1 Information Package** – Initial Process information and preliminary design data provided to NCCC to allow Scope Development work to begin. Sufficient information for preliminary HAZOP's/DHR's.

- **Tier 2 Information Package** – Finalized Technology Partner Process and Design data that will allow the NCCC to proceed with cost estimate and detailed design/implementation

Defining Requirements

Tier 1 Information Package:

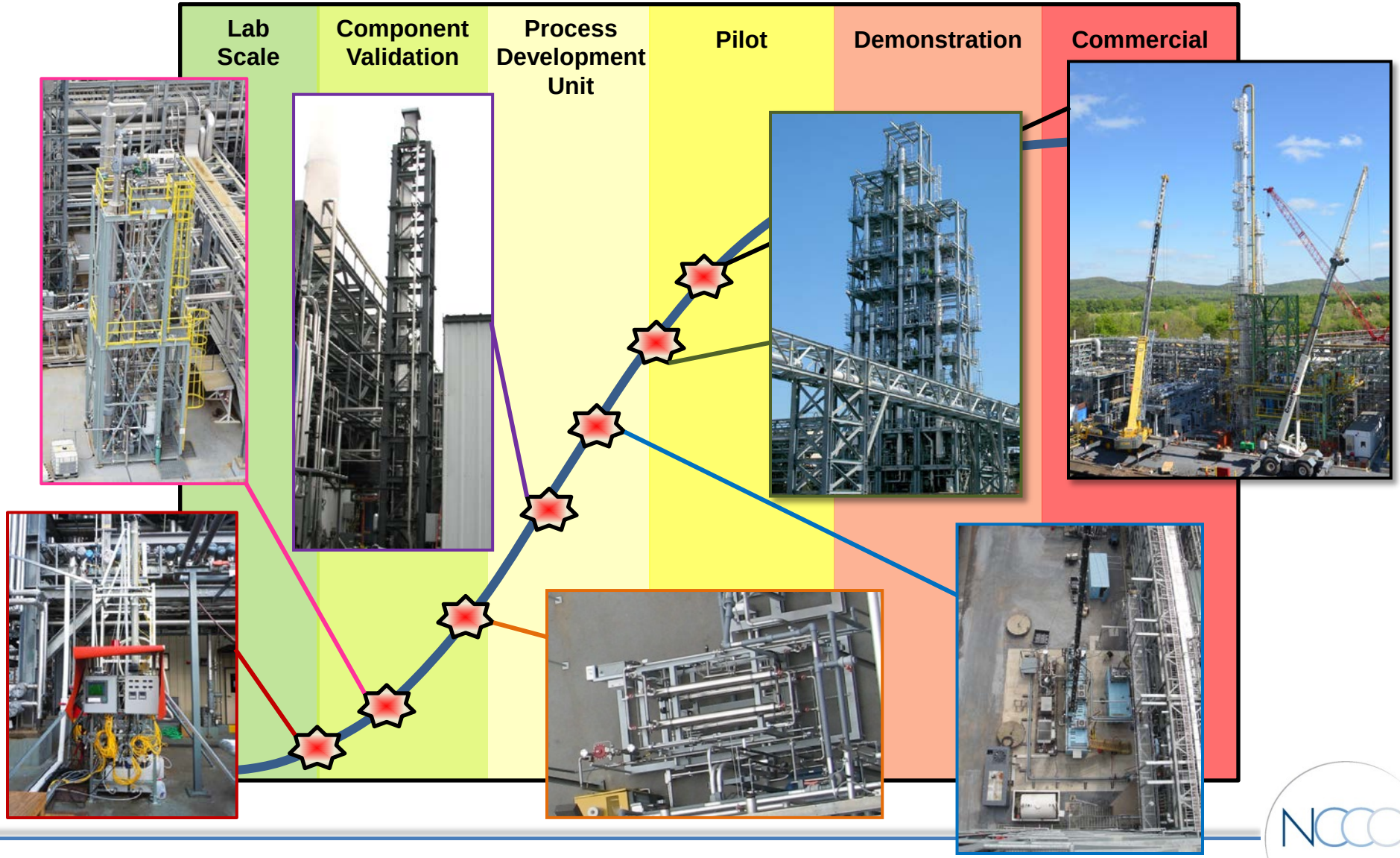
- General project background information and test objectives
- Process Flow Diagram
- Preliminary P&ID's
- Major Equipment Specifications
- Design Pressures and Temperatures for each line/component noted on P&ID's
- Process Description
- Completed Work Plan that has been agreed to by the NCCC and the test partner
- Desired pressures and capacities for all process flows (process gases, utilities, vents, waste streams, and electricity)
- Estimated Motor Loads
- Test Partner Project Milestone Schedule
- General dimensions of process skid(s)
- Requested analysis from NCCC as well as summary of analytical equipment provided by test partner

Defining Requirements

Tier 2 Information Package:

- Finalized P&ID's
- Equipment/Instrument Specifications
- Design Pressures and Temperatures for each piece of equipment, vessel, and all process piping (should be noted on the P&ID's)
- Finalized Material Specifications
- Final Pressure Vessel fabrication drawings, U-1 reports, and code calculations
- Finalized process capacities and line sizes
- Finalized design, fabrication, and assembly schedule
- Test plan including commissioning and startup sequence, test matrix, operating parameters, etc.
- Finalized design drawings of process skid(s) and equipment showing dimensional details, anchor bolt patterns, location of all tie-in points, and weight of skid(s)
- All electrical loads, single line diagram, and motor elementary diagrams
- System Communication needs* (connection to HMI's, DSL needs, wireless needs, etc.)

Lab to Pilot Scale testing – It can be done!



Acknowledgements

U.S. DEPARTMENT OF ENERGY

NETL

EPRI ELECTRIC POWER RESEARCH INSTITUTE

ArchCoal

Luminant

AEP AMERICAN ELECTRIC POWER

DUKE ENERGY

CLOUD PEAK ENERGY

NCCC