DE-FE-0031595
Commercial Carbon Capture Design & Costing (C3DC)

Project Kick-off Meeting

Principal Investigator: Alfred (Buz) Brown, Ph.D.
Project Manager: Jenn Atcheson
Technical Lead: Andy Awtry

July 19, 2018

DE-FE-0031595

Project Overview

- “ION Engineering Commercial Carbon Capture Design & Costing”
- Project Period of Performance:
  May 30, 2018 – November 29, 2019
- Funding
  - DOE-NETL: $2,797,961
  - ION & Partners: $699,500

Budget Directive & Overall Project Objective

- **2017 Omnibus Appropriations Bill:**

  "The agreement provides $6,000,000 to support a new solicitation for initial engineering, testing, and design-related work for a commercial-scale, post-combustion carbon dioxide capture project on an existing coal-fueled generating unit. Within available funds, the Department shall provide to the Committees on Appropriations of both Houses of Congress an estimate of the costs required to fully retrofit such a unit."

- **C3DC Project:**

  The overall objective of the project is to provide a detailed design and cost estimate for a commercial scale carbon dioxide capture facility retrofitted onto an existing coal-fueled power station. The project team will design and cost a 300 MWe slipstream capture facility for retrofit onto Nebraska Public Power District's Gerald Gentleman Station's Unit 2 (GGS).

ION's CO_2 Capture Technology Development

ION is developing its technology by leveraging existing research facilities

2010

ION Engineering
Lab-pilot
0.01 MWe, $4M
Boulder, CO, USA

2012

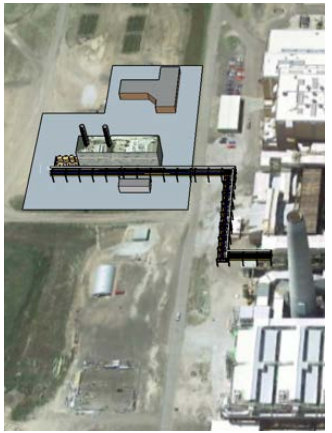
Univ. of N. Dakota
EERC
0.1 MWe, $2M
Grand Forks, ND, USA

2015

National Carbon
Capture Center
0.5 MWe, $10M
Wilsonville, AL, USA

2016 - 2017

CO_2 Technology
Centre Mongstad
12 MWe, $15M
Mongstad, Norway



2018 - 2019

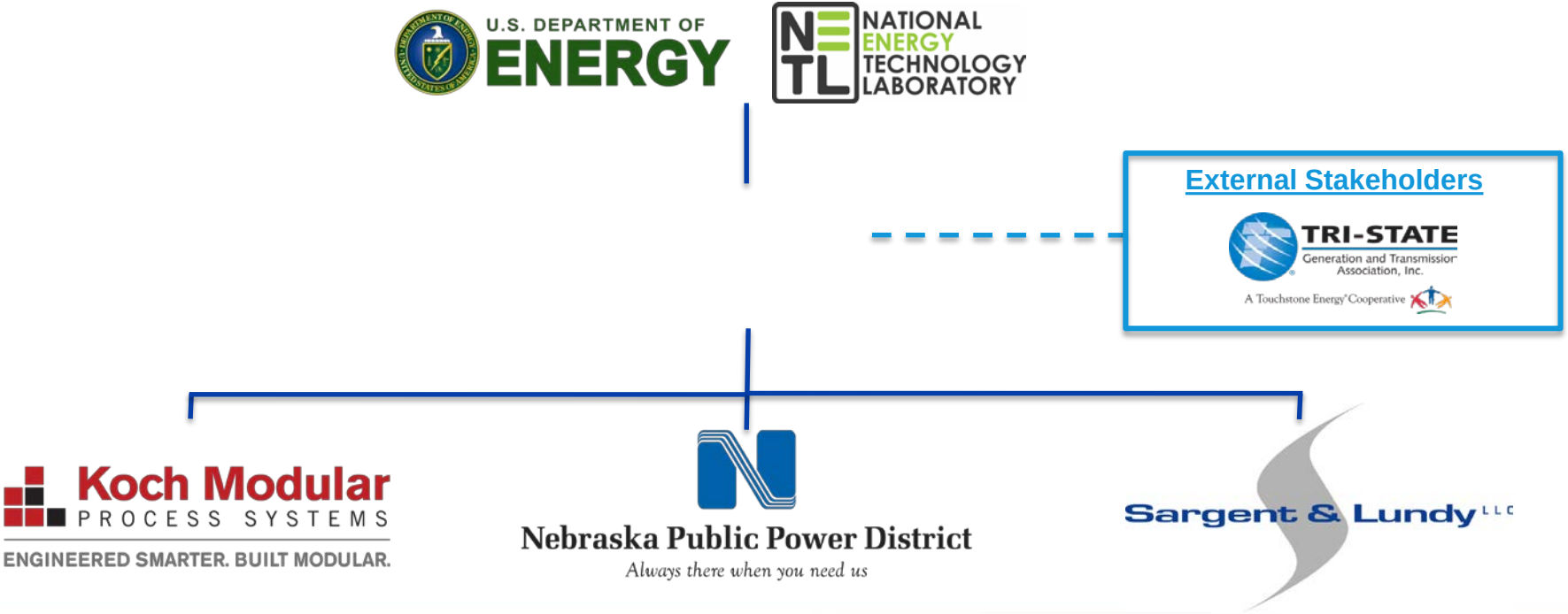
Design & Costing
Commercial Retrofit
300 MWe
Sutherland, NE, USA

Nebraska Public Power District

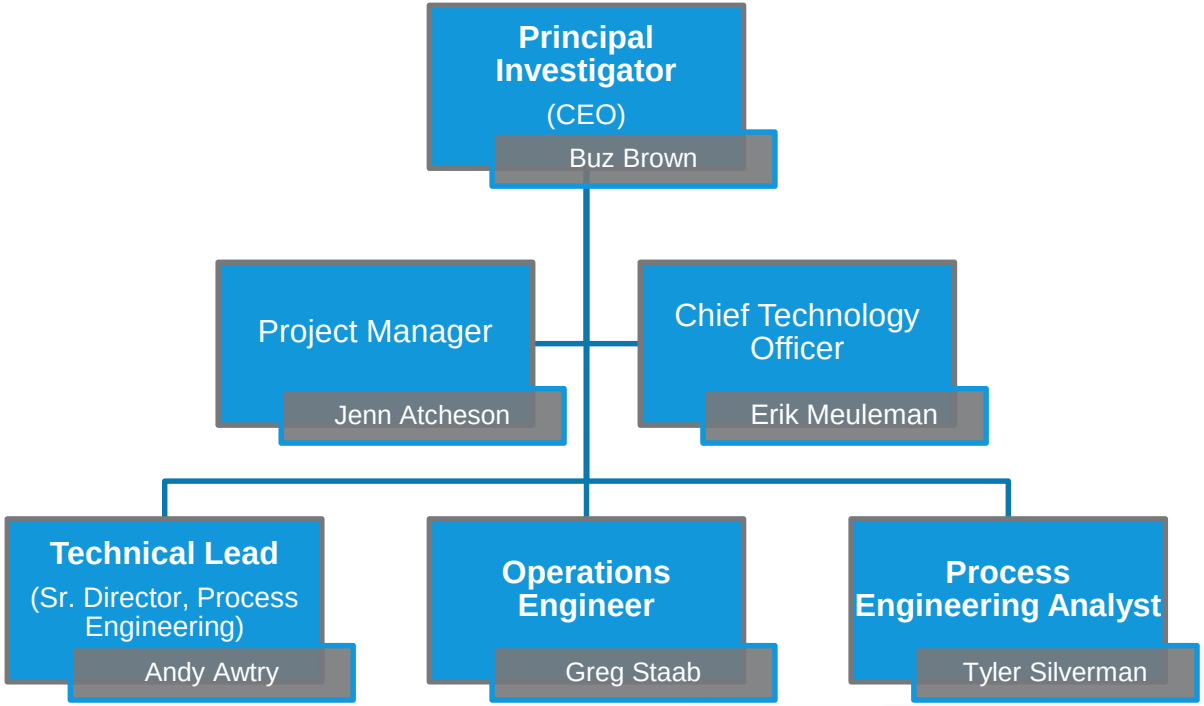
Host Site – Gerald Gentleman Station

- Located in Sutherland, Nebraska
- Largest generating station in Nebraska
- Two coal-fired units with total capacity of 1,365 MW
  - Unit 1 – 1979 – 665 MW
  - Unit 2 – 1982 – 700 MW
    - C3DC will be focused on Unit 2
- Fueled by Powder River Basin Coal

C3DC Project Team



ION Project Personnel



Project Overview

Summary of SOPO Tasks

- Task 1 – Project Management
- Task 2 – CO_2 Capture Island Design
- Task 3 – Balance of Plant (BOP) & Integration of Capture Island
- Task 4 – Supplemental Studies & Investigations
- Task 5 – Cost Estimating
- Task 6 – Reporting

Task 1 – Project Management

Primary Organization: ION

- **Subtask 1.1** – Monitor, Control & Communicate Project Status
- **Subtask 1.2** – Revision and Maintenance of the Project Management Plan
- **Subtask 1.3** – Financial, Administrative and Legal Management
- **Subtask 1.4** – Environmental, Health & Safety
- **Subtask 1.5** – Briefings and Technical Presentations

Task 2 – CO_2 Capture Island Design

Primary Organizations: ION & KMPS

- **Subtask 2.1** – Preliminary Design – ION & KMPS
  - Basis of design
  - Process Flow Diagrams
  - System description
- **Subtask 2.2** – Detailed Design – ION & KMPS
  - Process equipment design
  - Process control description
  - P&IDs

Task 3 – Balance of Plant & Integration of CO_2 Island

Primary Organizations: ION, S&L, NPPD

- **Subtask 3.1** – Preliminary Design
  - Overall Project Design Basis
  - Overall PFDs
  - BOP System Design Description
- **Subtask 3.2** – Critical Design
  - Overall Material & Heat Balances
  - Overall control description & architecture
  - Overall equipment list
  - BOP P&IDs
  - Foundation, sitework, ductwork, structural steel, pipe rack design
  - Overall General Arrangement Drawings

Task 4 – Supplemental Studies & Investigations

Primary Organizations: ION, S&L, NPPD

- **Subtask 4.1 –** Steam and Electric Sourcing Study
- **Subtask 4.2 –** Heat Rate Improvement Study
- **Subtask 4.3 –** Solvent Disposal Investigation
- **Subtask 4.4 –** Waste Water Treatment Study
- **Subtask 4.5 –** Permitting Study & Review
- **Subtask 4.6 –** Hazard and Operability Review (HAZOP)
- **Subtask 4.7 –** Constructability Review

Task 5 – Costing

Primary Organizations: ION, S&L, KMPS

- **Subtask 5.1** – CO_2 Capture Equipment Pricing
- **Subtask 5.2** – Balance of Plant Equipment Pricing
- **Subtask 5.3** – Construction Costing
- **Subtask 5.4** – Project Indirect Costs
- **Subtask 5.5** – Operating & Maintenance Costs

Task 6 – Reporting

Primary Organizations: ION, S&L, NPPD, KMPS

- **Subtask 6.1** – Technology Maturation Plan
- **Subtask 6.2** – Techno-Economic Analysis
- **Subtask 6.3** – Final Detailed Design and Cost Estimate for a Commercial-Scale, Post-Combustion CO_2 Capture System

Project Schedule

C3DC Project Schedule		Budget Period 1																
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
		Jun-18	Jul-18	Aug-18	Sep-18	Oct-18	Nov-18	Dec-18	Jan-19	Feb-19	Mar-19	Apr-19	May-19	Jun-19	Jul-19	Aug-19	Sep-19	Oct-19	Nov-19
Task 1	**Project Management**	M1	D1/M2	M3		D4/M4	M5											D5	D6	D7/M7
Task 2	**CO2 Capture Island Design**																			
2.1	Preliminary Design																			
2.2	Critical Design																			
Task 3	**Balance of Plant (BOP) and Capture Island Integration**																			
3.1	Preliminary Design																			
3.2	Critical Design																			
Task 4	**Supplemental Studies & Investigations**																			
4.1	Steam & Electric Sourcing Study																			
4.2	Heat Rate Improvement Study																			
4.3	Solvent Disposal Investigation																			
4.4	Waste Water Treatment Study																			
4.5	Permitting Study & Review																			
4.6	Hazard and Operability Review (HAZOP)																			
4.7	Constructability Review																			
Task 5	**Costing**																			
5.1	CO2 Capture Equipment Pricing																			
5.2	Balance of Plant Equipment Pricing																			
5.3	Construction Costing																			
5.4	Project Indirect Costs																			
5.5	Operating & Maintenance Costs																			
Task 6	**Reporting**																			
6.1	Technology Maturation Plan																			
6.2	Techno-economic Analysis																			
6.3	Final Detailed Design & Cost Estimate (Class 3)																			

Project Overview

Deliverables

#	Corresponding Task/Subtask	Title/Description
D1	1.0	**Update Project Management Plan**
D2	4.6	**HAZOP Review**
D3	4.7	**Constructability Review**
D4	6.1	**Technology Maturation Plan**
D5	6.2	**Techno-Economic Analysis**
D6	6.3	**Final Detailed Design and Cost Estimate for a Commercial-Scale, Post-Combustion CO_2 Capture System – Class 3 Estimate**
D7	6.3	**Topical Report containing the Final Detailed Design and Cost Estimate for a Commercial-Scale, Post-Combustion CO_2 Capture System**

Project Overview

Milestones

#	Corresponding Task/Subtask	Title/Description	Target Completion Date	Completed Date
M1	1.0	**Project Team Kickoff Meeting**	4/25/2018	4/25/2018
M2	1.0	**Updated PMP**	7/01/2018	
M3	1.0	**DOE Project Kickoff Meeting**	7/19/2018	
M4	4.7	**Technology Maturation Plan**	8/30/2018	
M5	6.1	**Preliminary Design Review**	9/25/2018	
M6	6.2	**Critical Design Review**	1/15/2019	
M7	6.3	**Final DOE Presentation**	11/15/2019	

U.S. DEPARTMENT OF ENERGY

NATIONAL ENERGY TECHNOLOGY LABORATORY

Nebraska Public Power District

ION ENGINEERING

Sargent & Lundy LLC

TRI-STATE Generation and Transmission Association, Inc.
A Touchstone Energy® Cooperative

Koch Modular PROCESS SYSTEMS
ENGINEERED SMARTER. BUILT MODULAR.

THANKS