



LARGE PILOT TESTING OF THE MTR MEMBRANE CAPTURE PROCESS

2024 FECM / NETL Carbon
Management Research Project
Review Meeting

August 5, 2024



DE-FE0031587

DE-FE0031587 (FOA-1788) - Phase III Overview

Award Name: Large Pilot Testing of the MTR Membrane Post-Combustion CO₂ Capture Process

Phase III Project Period: 10/1/21 to 9/30/26

Phase III Funding: \$58,078,814 DOE + \$28,211,718 cost share = \$86,290,542 total

DOE-NETL Project Manager: Nicole Shamitko-Klingensmith

Project Team: MTR (prime), WITC (Host), Sargent & Lundy, Trimeric, Graycor

Overall Goal: To demonstrate the performance and abilities of MTR's membrane-based capture system through the operation of a Large Pilot as a final step of commercialization.

Project Plan for Phase III: Perform final design, then procure, fabricate, install and commission the Large Pilot plant at the WITC. Conduct long term operations of a 10 MWe fully featured membrane-based CO₂ capture plant.

MTR's Objectives for Large Pilot Project

- Demonstrate MTR's carbon capture technology at the small commercial scale
- Gain experience with dynamic operation of balance-of-plant equipment
- Determine fate of all minor flue gas species and quantify co-capture capabilities
- Characterize the water streams captured throughout the capture process
- Obtain long-term steady-state operational data under optimized process conditions

Wyoming Integrated Test Center (ITC)



- Dedicated post-combustion carbon capture test center; opened 2018
- Facility sponsored by the State of Wyoming; Tri-State Generation and Transmission Association; National Rural Electric Cooperative Association; and Basin Electric Power Cooperative
- DFS supplies the Large and Small Test Centers with a slipstream of flue gas
- Power, water, utilities and flue gas connections are in place

DE-CD00000015 - Phase 1 Demonstration Project

A Full-scale, Fully-integrated CCUS Project at Dry Fork Station



TRIMERIC CORPORATION



Kiewit

Sargent & Lundy



EERC

Energy & Environmental Research Center®
Putting Research into Practice

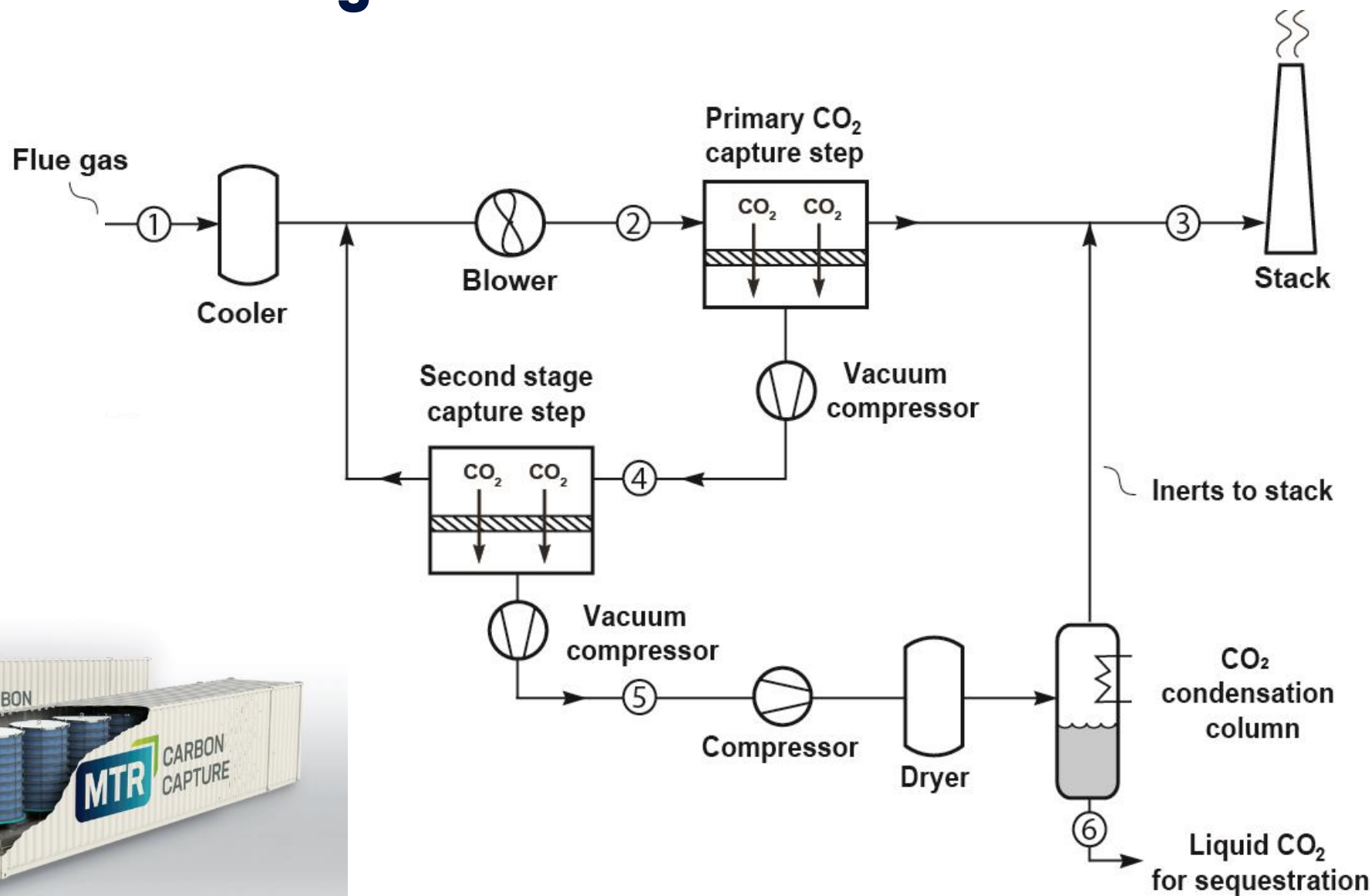


UNIVERSITY
OF WYOMING

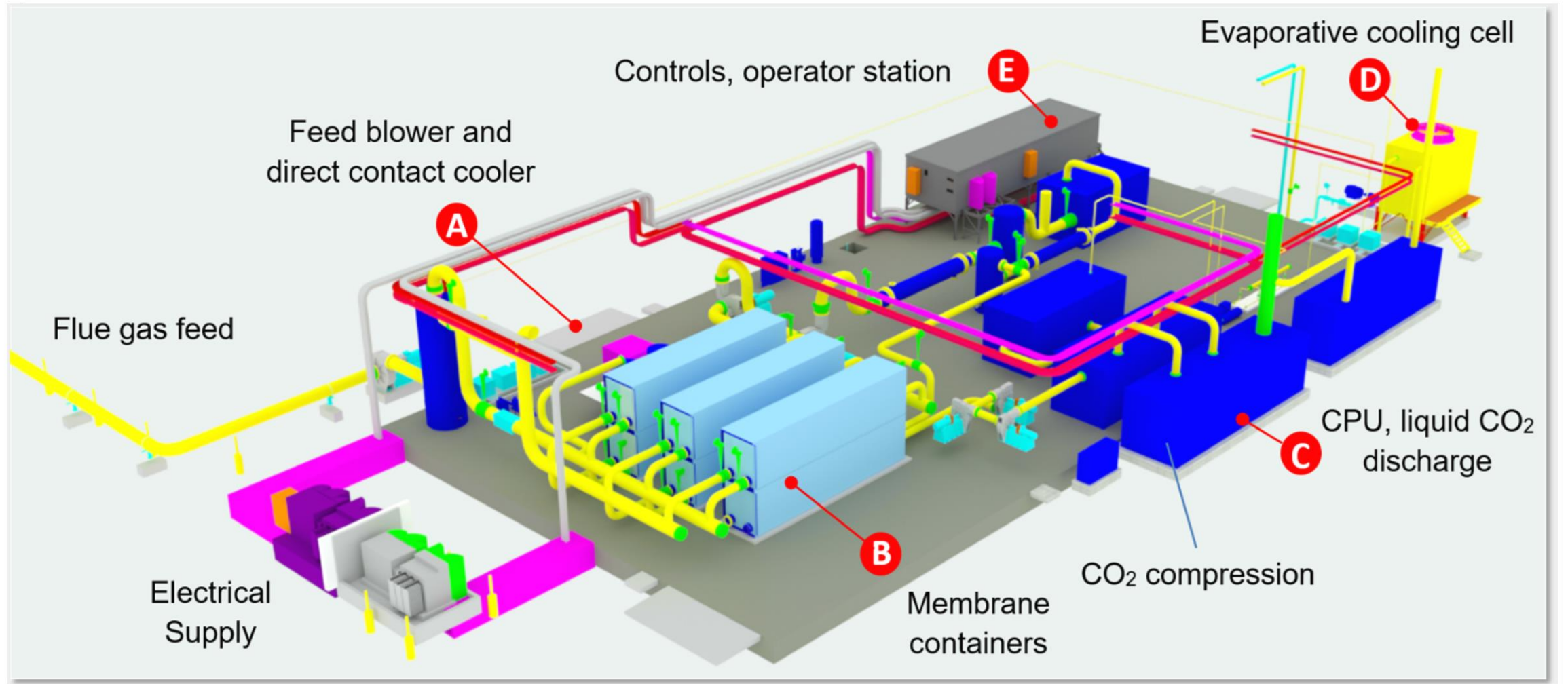
School of
Energy Resources



Simplified Process Diagram



General Arrangement of Process Equipment



Construction Progress - Activities During This Time Last Year

Host		
Technology Provider		
EPCm		
Constructor		
Engineering Services		



Pouring Foundations for the Capture Plant



Process Equipment Begins to Arrive and Assembly of the Capture Building Begins



Process Equipment arrives – Flue gas blower



Steel members for the building are erected

Placing First Pieces of Process Equipment & Building Dry-In



Direct Contact Cooler



Large Pilot Capture Building

Arrival and Placement of First Skidded System; the CPU



Compression and Dehydration



CO₂ Liquefaction and Distillation

Large- and Small-Bore Pipe Spools Arrive & Cooling Tower Placed



Evaporative Cooling Tower

DCC Placed and Auxiliary Steel (Pipe Racks) Installed



Direct Contact Cooler - Feb



Direct Contact Cooler - April



Installing process piping

First and Second Stage Vacuum Fans



Permeate Vacuum Fans



Flue Gas Tie-in to the ITC and Duct Run to the Capture Building



Duct run from ITC tie-in to the flue gas blower



ITC tie-in and transition section

Electricians Installing Cable Trays and Preparing for the PDC Building



Electrical cable trays and piers for the PDC building



Cable tray waterfalls and penetration towards PDC building

Electricians Installing Cable Trays and Preparing for the PDC Building



Placement of PDC building



PDC building installed with stairs and walkways

DCC Placed and Auxiliary Steel (Pipe Racks) Installed



PDC Interior – electrical switchgear and motor controllers



Electricians terminating cables

Running Electrical Conduits/Cables to the Cooling Tower



Electrical connections to the cooling tower

Interior of Capture Building Showing CPU and Rotating Equip.



Interior of Capture Building Facing Permeate Flanges



Delivery of Container #1 & ITC Showcase Event (May 8)



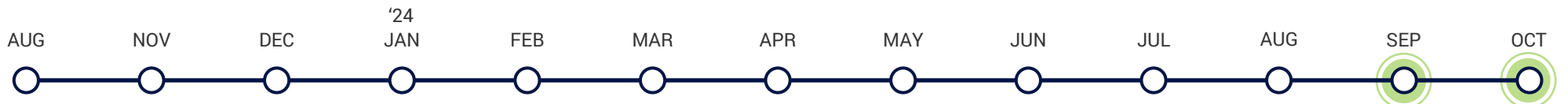
Delivery of first membrane container



Part of the ITC tours given during their May 8 Showcase event

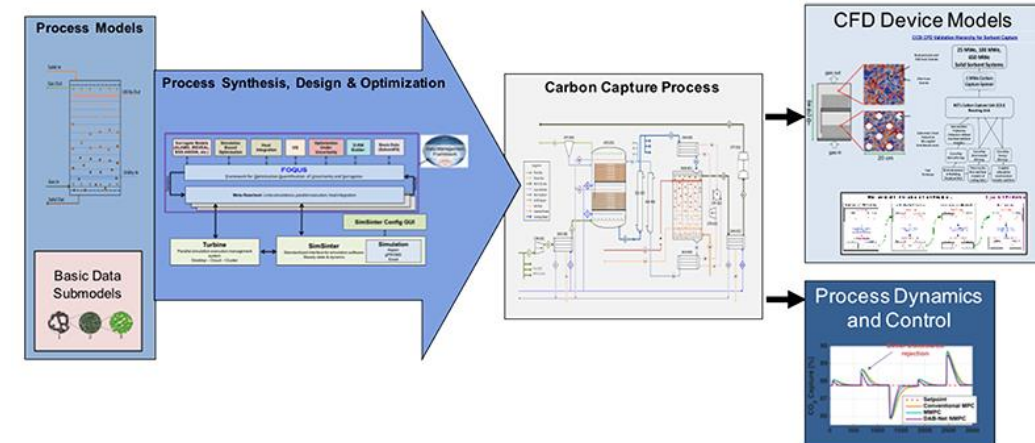
Commissioning Schedule

Equipment	Vendor	Pre-Commissioning		Commission (Air)		Commission (Flue Gas)	
		Start	End	Start	End	Start	End
Instrument Air Compressor	###	28-Aug	30-Aug				
UPS	###	26-Aug	28-Aug				
Membrane A Fans	###	9-Sep	20-Sep	23-Sep	27-Sep	14-Oct	18-Oct
Membrane B Fans	###	9-Sep	20-Sep	23-Sep	27-Sep	14-Oct	18-Oct
Membrane A Compressor	###	9-Sep	20-Sep	23-Sep	27-Sep	14-Oct	18-Oct
Flue Gas Booster Fan	###	16-Sep	18-Sep	18-Sep	20-Sep	14-Oct	18-Oct
Direct Contact Cooler	###	18-Sep	20-Sep			14-Oct	18-Oct
VFD's (FGBF/CW Fans)	###	16-Sep	18-Sep			14-Oct	18-Oct
VFD's (Piller Fans)	###	16-Sep	19-Sep			14-Oct	18-Oct
CPU	###	14-Oct	18-Oct			24-Oct	25-Oct



MTR Collaboration with Carbon Capture Simulation for Industry Impact (CCSI²)

- Regular meetings started earlier this summer
 - CCSI² team creating a reduced order membrane process model that will reduce uncertainty
 - MTR has provided input and output data from the MTR proprietary model under anticipated field test conditions
 - MTR providing process model assumptions
- CCSI² assisting parametric test plan by developing Design of Experiments framework
 - CCSI² providing feedback on draft parametric test plan
 - MTR and CCSI² team to have Large Pilot site visit on September 25



MTR Large Pilot Field Test Monitoring Capabilities

Extensive analytical characterization tools will be used to quantify co-capture potential

Emission Item	Characterization Capabilities
Gas Composition	Rosemount Quantum Cascade Laser analyzer will continuously measure CO₂ , O₂ , H₂O , SO₂ , NH₃ , NO , NO₂ , and N₂ for all process streams for the duration of the field test
Gas Composition	Extended gas composition analysis of various process streams will occur on a limited basis. Test will quantify minor species, such as HCl and speciated volatile hydrocarbons, sulfur compounds, or oxygenates
Particulate Matter	EPA Method 5 & 202 test will quantify particulate matter amounts, size and concentration distribution of various process streams
Water Quality Analysis	Water samples from 8 process locations will tested monthly
Water Recovery	Water flow through 8 process lines will be measured and logged throughout the field test to quantify the water recovery rates within the capture plant

Lessons Learned

Engineering / Design

- Involve your Constructor during the development of the 3D model

Procurement

- Evaluate the option to procure used or existing new-unused equipment
- Include schedule contingency for overseas shipments
- Negotiating terms and conditions with equipment OEMs is not straight forward nor fast

Construction

- Constructors can be quick to generate change orders but slow to identify credits
- A quality and experienced on-site construction project manager is critical
- Constructor should be a flexible, inventive, and creative scheduler

Acknowledgements

This material is based upon work supported by the Department of Energy under Award Number DE-FE0031587 (Large Pilot)

Disclaimer

This report was prepared as an account of work sponsored by an agency of the United States Government. Neither the United States Government nor any agency thereof, nor any of their employees, makes any warranty, express or implied, or assumes any legal liability or responsibility for the accuracy, completeness, or usefulness of any information, apparatus, product, or process disclosed, or represents that its use would not infringe privately owned rights. Reference herein to any specific commercial product, process, or service by trade name, trademark, manufacturer, or otherwise does not necessarily constitute or imply its endorsement, recommendation, or favoring by the United States Government or any agency thereof. The views and opinions of authors expressed herein do not necessarily state or reflect those of the United States Government or any agency thereof.



THANK YOU

www.mtrccs.com

ccs@mtrinc.com

