

Large Pilot Testing of the MTR Membrane Post-Combustion CO₂ Capture Process (DE-FE0031587)

2022 Carbon Management Project Review Meeting Brice Freeman, Richard Baker

August 16, 2022

DE-FE0031587; FOA-1788 – Large Pilot Project

- DOE-NETL Project Manager: Sai Gallokota
- **Project Team:** Membrane Technology and Research, Inc. (MTR; Prime), Wyoming Integrated Test Center (WITC; Host), Sargent & Lundy, Trimeric, Graycor
- **Overall Goal:** Design, build, and operate a 10 MW_e Large Pilot membrane capture system

Phase I	Phase II	Phase III
(2018-2019)	(2019-2021)	(2021-2026)
FeasibilitySite selectionCreate team	FEED studyBudgetingPermitting	 Fabrication, installation, and operation of a fully featured 10 MWe Large Pilot capture plant



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 (BP3 through 12/31/2023)
- Phase III Funding: \$51,669,939 DOE + \$15,470,245 cost share = \$67,170,184 total
- DOE-NETL Project Manager: Sai Gallokota
- 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.
- **<u>Project Plan for Phase III</u>**: Perform final design, then procure, fabricate, install and commission the Large Pilot at the WITC. Conduct long term operations of a 10 MWe fully featured membrane-based CO₂ capture plant.



Carbon Capture Development Timeline





Development Objectives

- Develop MTR's capture technology to TRL 7
- Demonstrate all aspects of the capture process:
 - Plant interconnection
 - Flue gas pretreatment
 - Commercial membrane products
 - Producing an EOR spec CO₂ product
 - Same process equipment and MOC
 - Full operability and dynamic control
- Conduct a short parametric test campaign
- Long period of steady-state operation





Full-Scale FEED Project (DE-FE0031846)

The Large Pilot will demonstrate the same operating conditions featured in our fullscale FEED project at Dry Fork Station





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Simplified Process Design





Planar Membrane Modules and Containerized Skid



MTR



Small pilot testing at the Technology Center Mongstad (TCM) DE-FE0031591

Commercial form factor of MTR's containerized membrane skid



Commercial Membrane Module Housings

- The validated plate-and-frame module type is transitioning into its commercial form
- Dramatic cost reduction
- Designed for high-volume manufacturing
- Compatible for all postcombustion capture applications







First delivery of module stacks to MTR



Basin Electric's Dry Fork Station (DFS)



- Single unit, 440 MWe coal fired power plant in Gillette, WY
- Commissioned in 2011
- Low sulfur, sub-bituminous PRB coal from the Dry Fork Mine.
- Zero liquid discharge facility
- Low NOx burners w/ OFA, SCR, dry lime fluidized bed, FF
- Cooling via an air-cooled condenser
- Home to the Wyoming
 Integrated Test Center
- Home to the Wyoming CarbonSAFE project

Wyoming Integrated Test Center (WITC)



- 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 Cooperate
- DFS supplies the Large and Small Test Centers with a slipstream of flue gas
- Power, water, utilities and flue gas connections are in place







MTR's 10 MWe Large Pilot at the Wyoming ITC



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General Arrangement of Process Equipment





Activities in the Current Budget Period



Q1 - 2022

- ✓ Detailed design
- Equipment procurement
- Membrane manufacturing and module production
- \circ Site construction
- \circ $\,$ Installation and shakedown
- o Commissioning

Q1 - 2024

TRIMERIC CORPORATION Sargent & Lundy









Managing Inflationary Cost Escalation

- Phase III budget developed in Q3/4-20, submitted Jan 2021, awarded Q4-21.
- Subject to the full effects of pandemic driven global supply chain disruptions
- Increases: CEPCI >34%; vendor quotes ~20%; steel and rebar ~50%; subcontractors ~30%
- Solution:
 - Rebudget the project
 - Some additional federal cost share
 - Reduction in the size of the compression and purification back-end

CO₂ compression and purification section was downsized



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