



# LARGE PILOT TESTING OF THE MTR MEMBRANE CAPTURE PROCESS

2023 FECM / NETL Carbon  
Management Research Project  
Review Meeting

August 28, 2023



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

**Award Name:** Large Pilot Testing of the MTR Membrane Post-Combustion CO<sub>2</sub> 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 CO<sub>2</sub> capture plant.



# The Large Pilot is the Culmination of a Robust Research and Development Effort

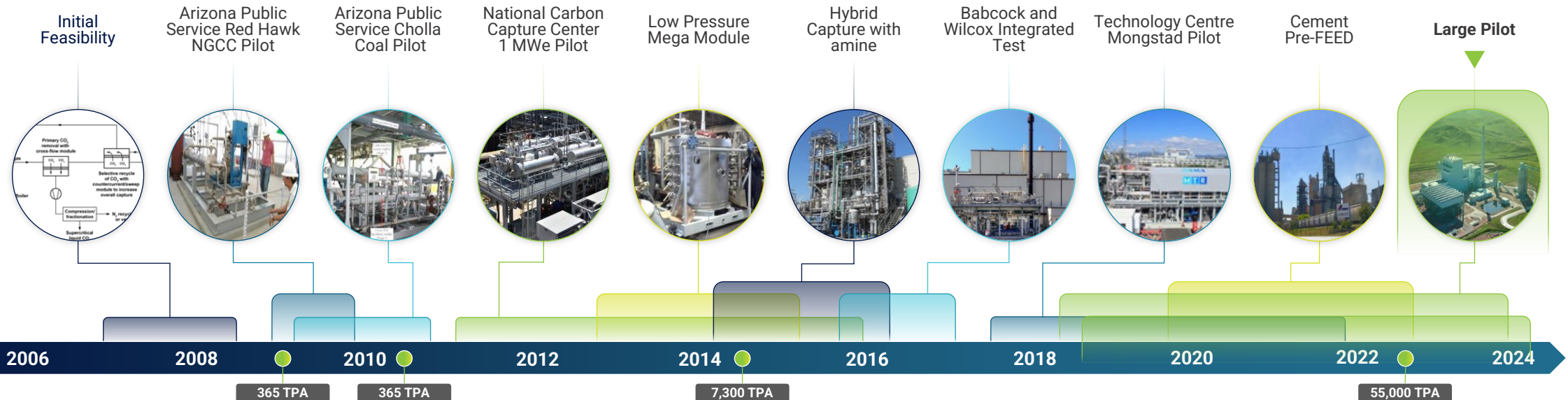
**15 Year**  
Relationship  
with DOE

**18+**  
DOE Awards  
Won

**>\$100mm**  
Total Funding  
Received from U.S.  
Government  
Agencies

- Support from the DOE has enabled MTR's capture technology from early concept to the point of commercialization
- Together the DOE and MTR have collaborated to provide US industrial and power plants with a compelling carbon capture solution

## Development Timeline



# Wyoming Integrated Test Center (ITC)



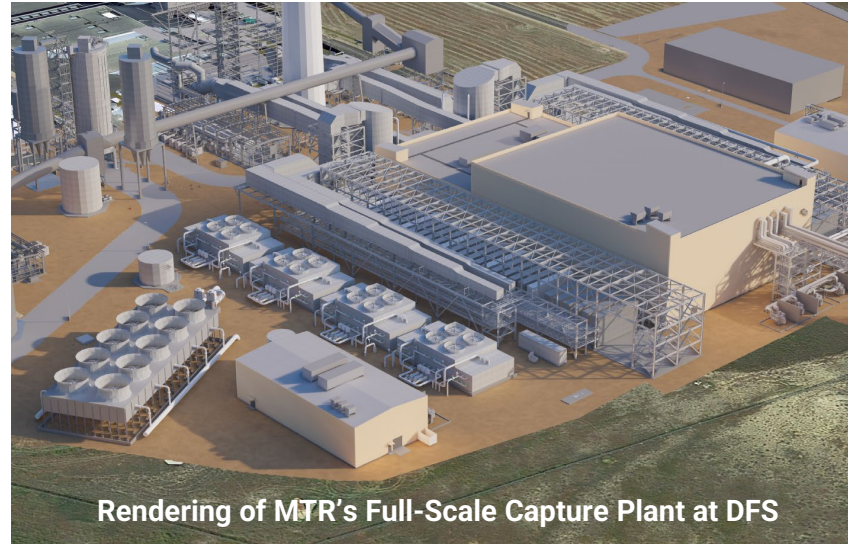
- Dedicated post-combustion carbon capture test center; opened 2018
- Facility sponsored by the State of Wyoming; Tri-State Generation and Transmission Association; National Rural Electric Cooperative Association; and Basin Electric Power Cooperative
- DFS supplies the Large and Small Test Centers with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



# The Dry Fork Station – 2022 Full-Scale FEED (DE-FE0031846)

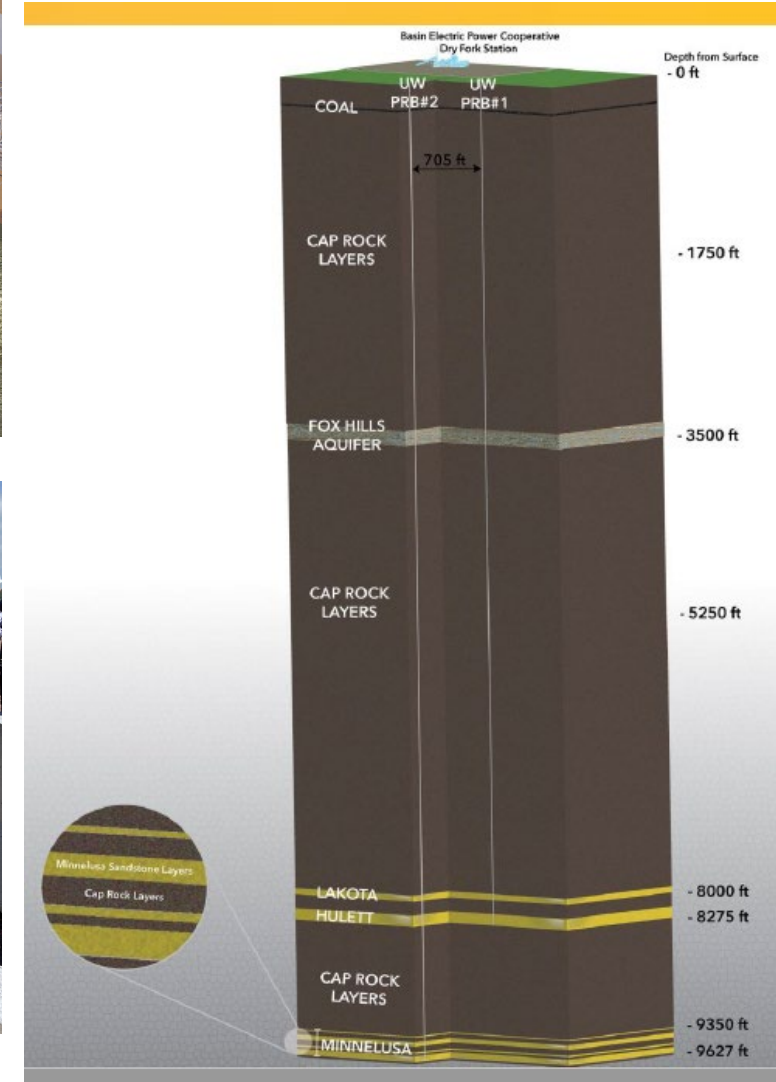


Basin Electric's Dry Fork Station Power Plant



Rendering of MTR's Full-Scale Capture Plant at DFS

Two wells (UW PRB#1 and UW PRB#2) completed and characterized



Wyoming CarbonSAFE CO<sub>2</sub> injection well PRB#2  
June 2022

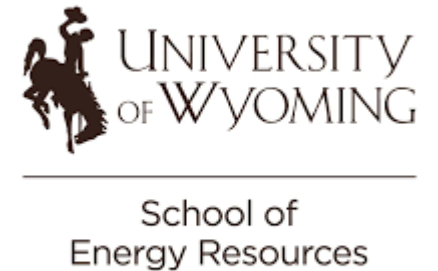
- Single unit, 440 MWe coal power plant in Gillette, WY
- Commissioned in 2011
- Low sulfur, sub-bituminous PRB coal from Dry Fork Mine
- Zero liquid discharge (ZLD) facility
- Home to the Wyoming Integrated Test Center (WITC)
- Home to the Wyoming CarbonSAFE project
- FEED study conducted to Level 2 (+/- 15%) completed summer 2022

# Supports the Recently Selected Phase 1 Demonstration Project – a Full-scale, Fully-integrated CCUS Project at Dry Fork Station



## The Large Pilot Features:

- Same process design and process conditions
- Same Polaris™ membrane packed into the same container
- Same 90% capture rate
- Processing the same flue gas
- Producing the same high-spec CO<sub>2</sub> product



TRIMERIC CORPORATION

Sargent & Lundy



**Kiewit**



# MTR's Large Pilot Plant at the Wyoming Integrated Test Center Will be the Largest of its Kind in the World

*And sets the stage for MTR's transition to the commercial carbon capture market*

Ceremonial Groundbreaking Event, May 2, 2023



**Todd Telesz**  
CEO Basin  
Electric

**Tim  
Merkel**  
MTR

**Brice  
Freeman**  
MTR

**Mark Gordon**  
WY Governor

**Brett  
Andrews**  
MTR

## Pilot Plant Statistics

- ▶ **~55,000**  
TPA of CO<sub>2</sub>
- ▶ **Mid-2024**  
Begin Operations

## Project Team



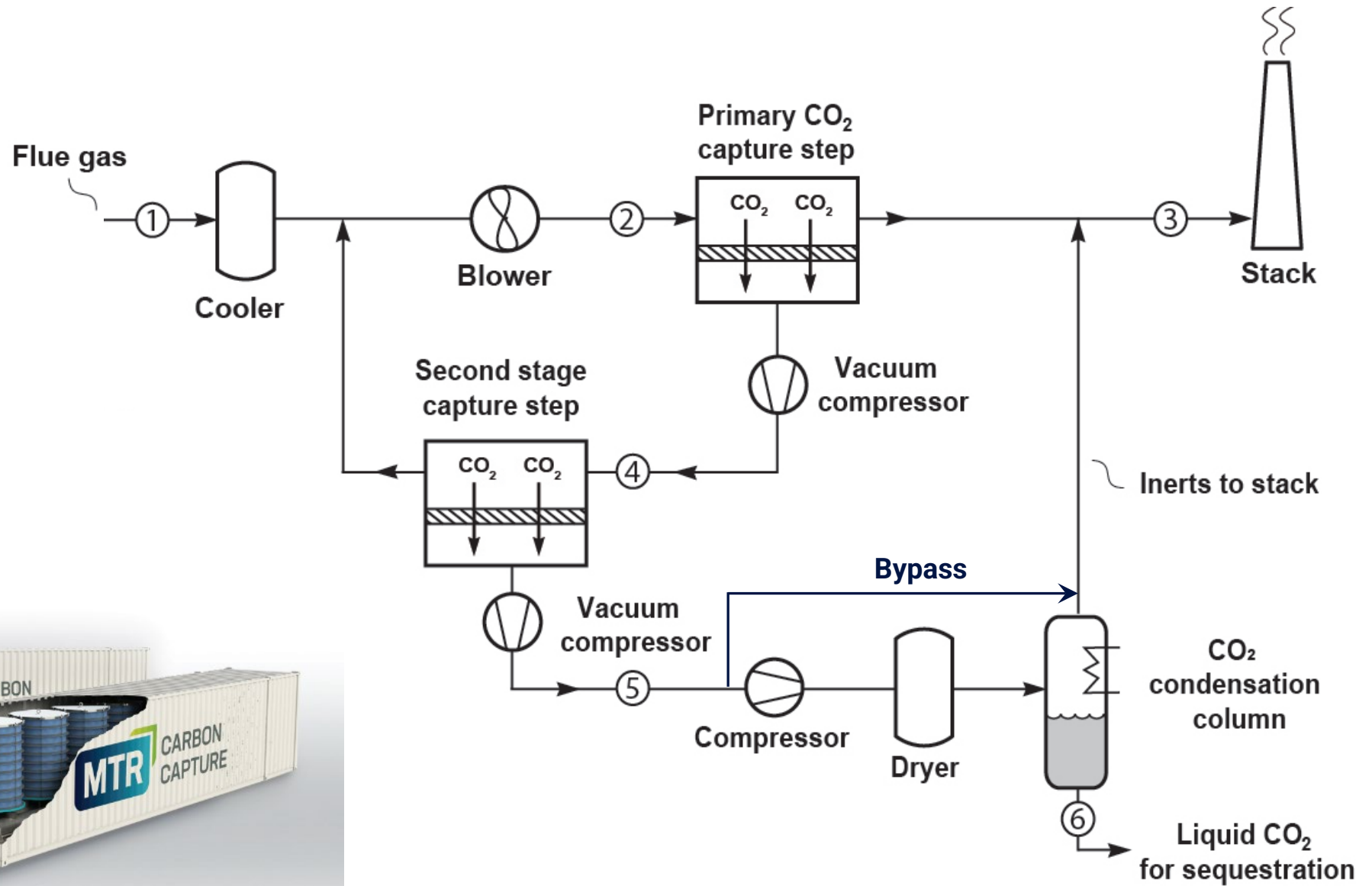
**GRAYCOR**



**Sargent & Lundy**

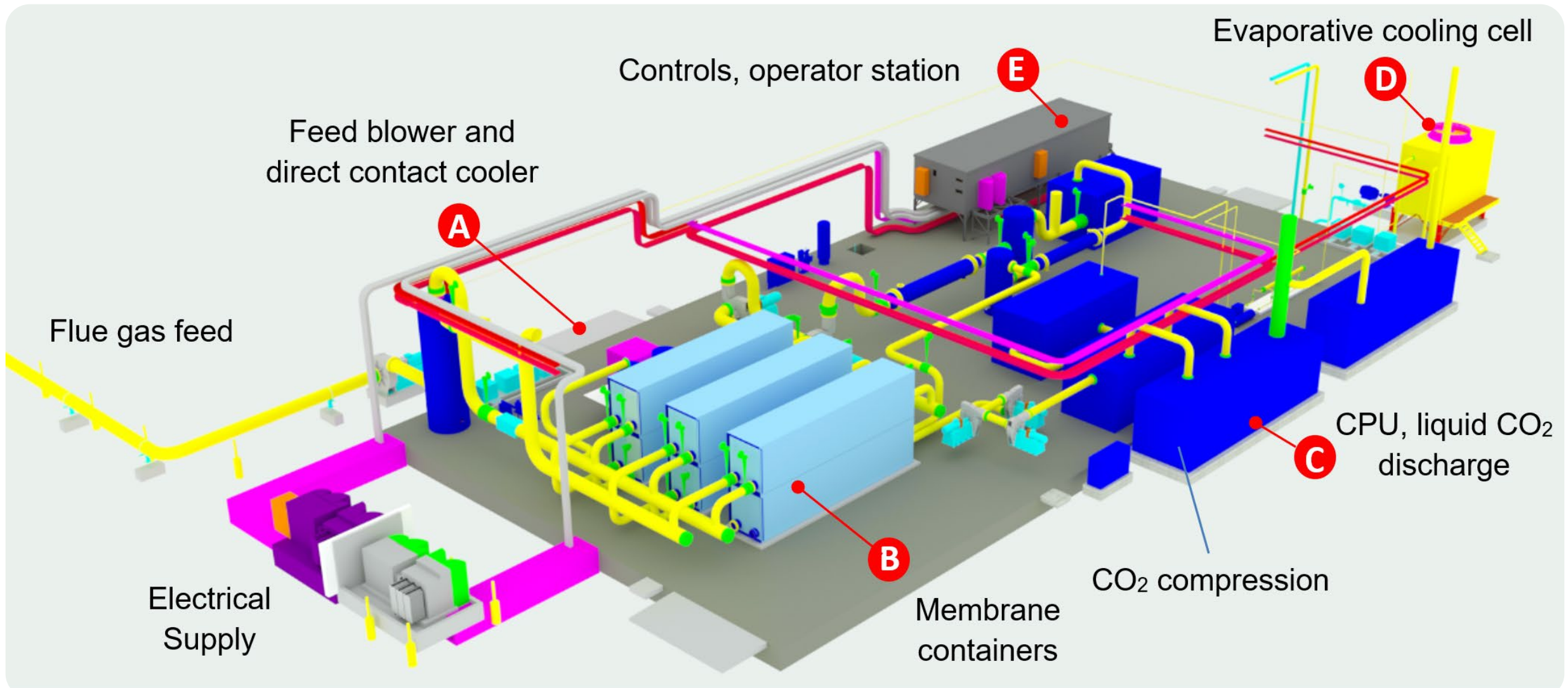


# Simplified Block Flow Diagram

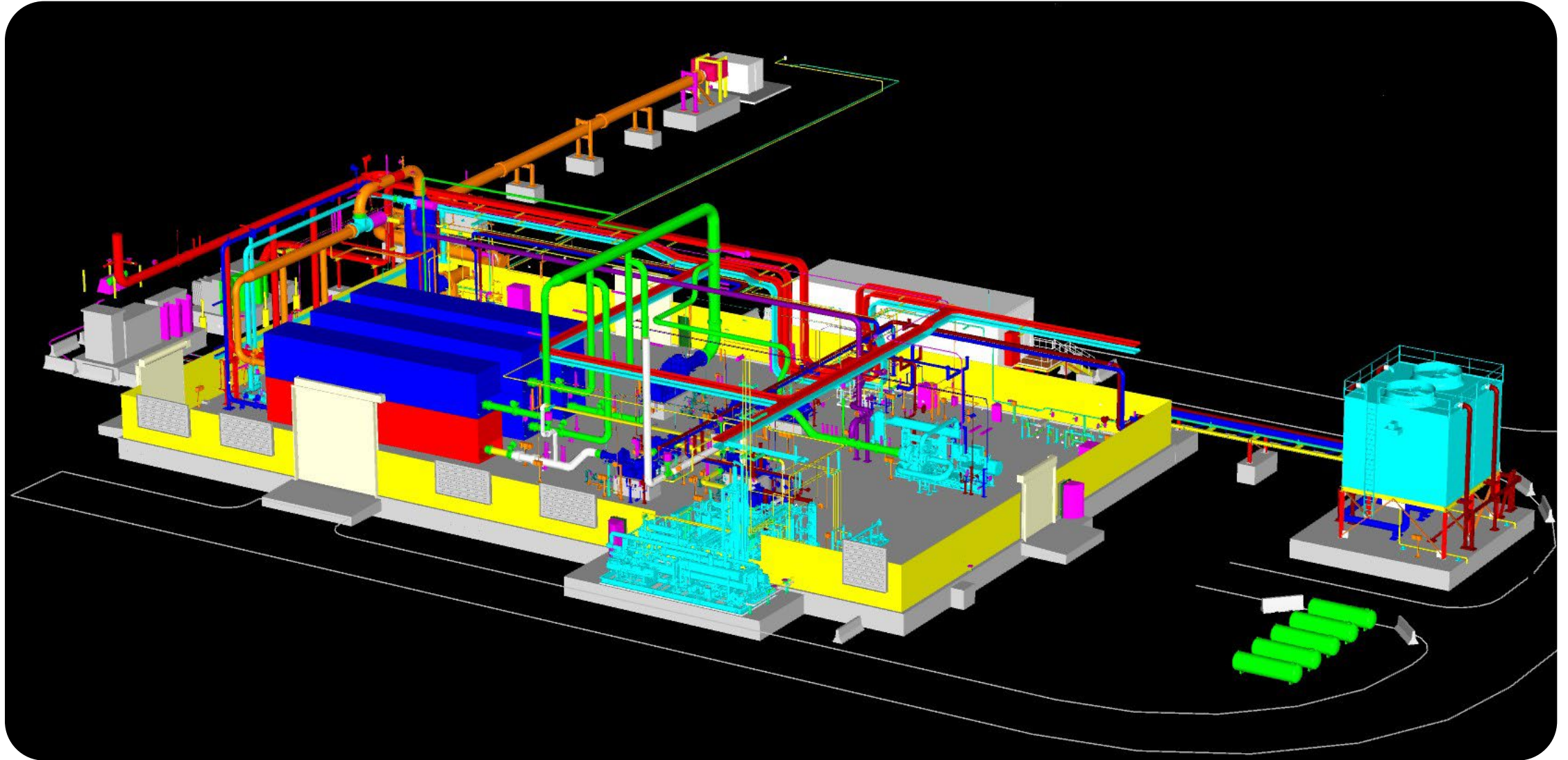




# General Arrangement of Process Equipment



# Detailed 3D Model for Construction





# Commercial Plate-and-Frame Injection Molded Membrane Housings are Key to Low-Cost, High-Volume Production



Metal housings produced for TCM small pilot system (DE-FE0031591)



Injected molder – production run of commercial plastic housings



Completed modules tested and ready for stacking and skidding (Aug 2023)



# 53' Shipping Container Fabricated and Ready to Ship





# Fabrication of One of Six Module Stack Base Units (Holds the Membrane Module Stacks)



# Challenges and Project Setbacks

- Project encountered budget increases
- Driven by effects from pandemic driven global supply chain disruptions
- Increases: CEPCI >34%; vendor quotes ~20%; rebar 54%; subcontractors ~30%
- Various remedies were implemented to preserve schedule and to address budget issues





# 30 TPD - CO<sub>2</sub> Main Compressor, DeHy and CO<sub>2</sub> Purification Skids Fabricated and Ready to Ship



August 28, 2023 New Braunfeld, TX



# Purchasing an Existing, but Unused Power Distribution Center (PDC), was Critical for Protecting the Project Schedule



MTR encountered major schedule slip for procuring electrical equipment

Project team and Emerson found an existing PDC at a power plant in South Carolina

The PDC was installed but not used and included certain needed equipment:

- 480V switchgear
- Breaker control cabinets
- Motor control center

Building needed to be certified for floor loads (new equipment) and roof loads (snow).



# Weather Has Caused Some Delays but Mostly Minor



August 1, 2023



August 9, 2023



# Offloading of the Two Cell Evaporative Cooling Tower (SPX, Marley)





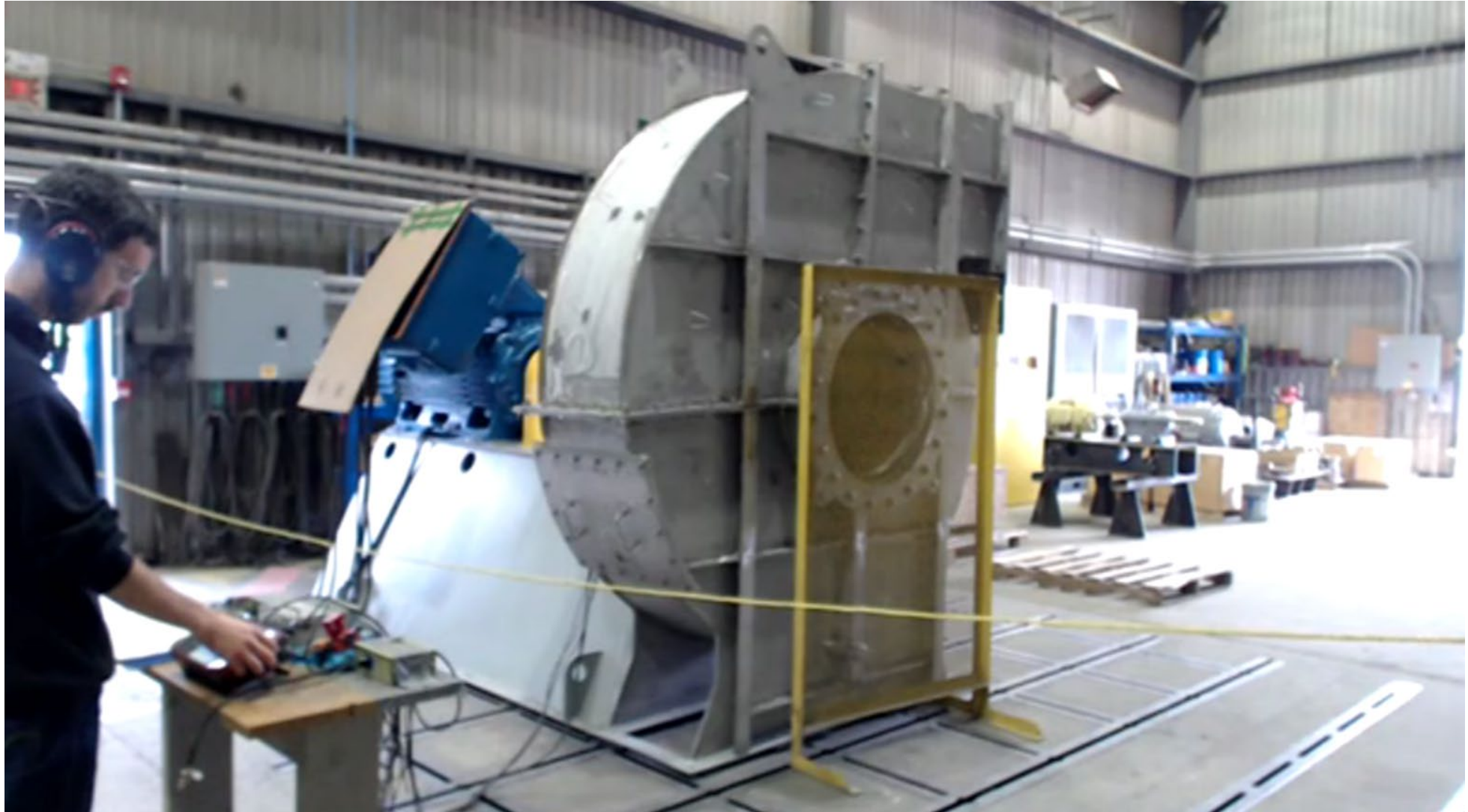
# Unloading the Direct Contact Cooler and Pump Skid



August 7, 2023



# Vibration Testing the Flue Gas Blower (Howden)





# Fabrication of a Vacuum Fan Housing which will Process the CO<sub>2</sub> Rich Permeate



Piller's Fabrication Shops in Moringen, Germany



# Main Foundations Excavations



July 2023



# Forming for the main Concrete Foundation





# Important Construction Milestones

## ➤ 23Q3

Civil works

Delivery of process equipment

Prepare plot space

## ➤ 23Q4

Pour concrete slab

Place equipment

Erect building

## ➤ 24Q1

Interconnection and piping

## ➤ 24Q2

Electrical and controls

Start commissioning



August 22, 2023



# Acknowledgements

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# THANK YOU

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Basin Electric's Dry Fork Station