

Filer City Biomass Carbon Removal and Storage (BiCRS) Net-Negative Study

Project Number: DE-FE0032262

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NorthStar Clean Energy

2023 Carbon Management Research Project Review Meeting
August 28 – September 1, 2023

Project Overview

– Funding

- DOE: \$1,416,224
 - Cost Share: \$903,913
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– Overall Project Performance Dates

- Award Date – 08/01/2023
- Basis of Design for Project Finalized – 10/01/2023
- DOE Kick-off Meeting – 10/30/2023
- Preliminary Process Design Review – 11/20/2023
- Initial Engineering Design Package – 12/29/2023
- Overall Cost Estimate and Cost of Capture Review – 04/01/2024
- Final Engineering Design Package – 04/15/2024
- Final DOE Report and Presentation – 7/12/2024

Project Overview

– Project Participants

- DOE/NETL - Sponsor
- NorthStar Clean Energy – Prime
- Babcock & Wilcox – Bio-Energy Carbon Capture and Support Services
- Sargent & Lundy – EPC Engineering and Support Services

– Overall Project Objectives

- Confirm availability of sustainably sourced biomass – 20 years – completed January 2023.
- Existing boilers to be retrofitted to fire 100% woody biomass.

Project Overview

- Overall Project Objectives
 - 95% CO₂ removal from flue gas at design conditions
 - Capture ~ 500,000 tonnes of CO₂/year
 - Supply 30 MWs of base load 24/7 carbon-free electricity and process stream
 - Prove viability of business case - AACE Class 4 estimate
 - Create a Community Benefits Plan
 - Begin construction in 2025
 - COD in 2026

Project Background

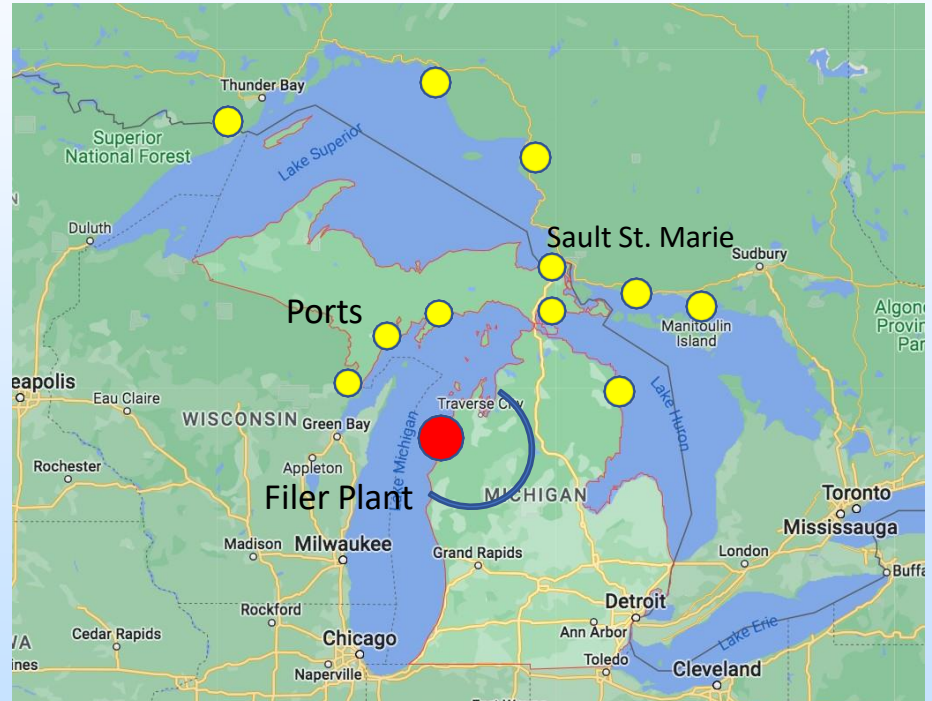


Project Background

- The Project reached commercial operations in 1990 - A partnership between Tondu Corp/CMS Enterprises (now NorthStar Clean Energy)
- Corporate commitment to stop burning coal in 2025
- Project is located on Manistee Lake with access to Lake Michigan
- Based on our biomass studies there are over 61 million tons of unutilized sustainable biomass within trucking distance of the Filer Plant.

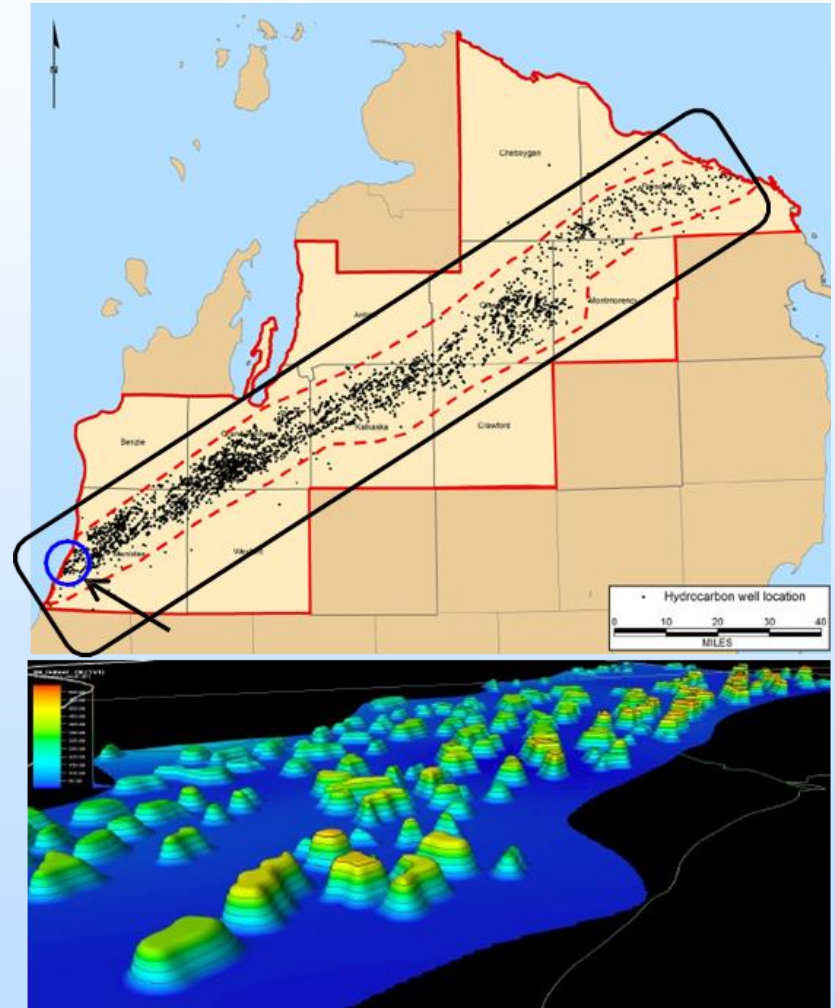
Project Background - Biomass Availability

The Manistee National Forest is adjacent to the Filer Plant and much of this forest needs the removal of dying and overcrowded trees for forest health management. In addition to locally source biomass, there are numerous ports within a short shipping distance of the Filer Dock with the capacity to meet the Filer City Plant requirement many times over.



Project Background

- Project is located less than ½ mile from existing pipeline infrastructure for transport of CO₂ to the highly studied Niagaran Reef trend.
- There are over 140 reefs with the potential to store between 500,000 and 2,000,000 tonnes of CO₂ each.
- Strong relationship with Core Energy – who has an CO₂ Monitoring, Reporting, and Verification (MRV) Plan approved Environmental Protection Agency (EPA) covering the entire Reef Trend.



Technical Approach

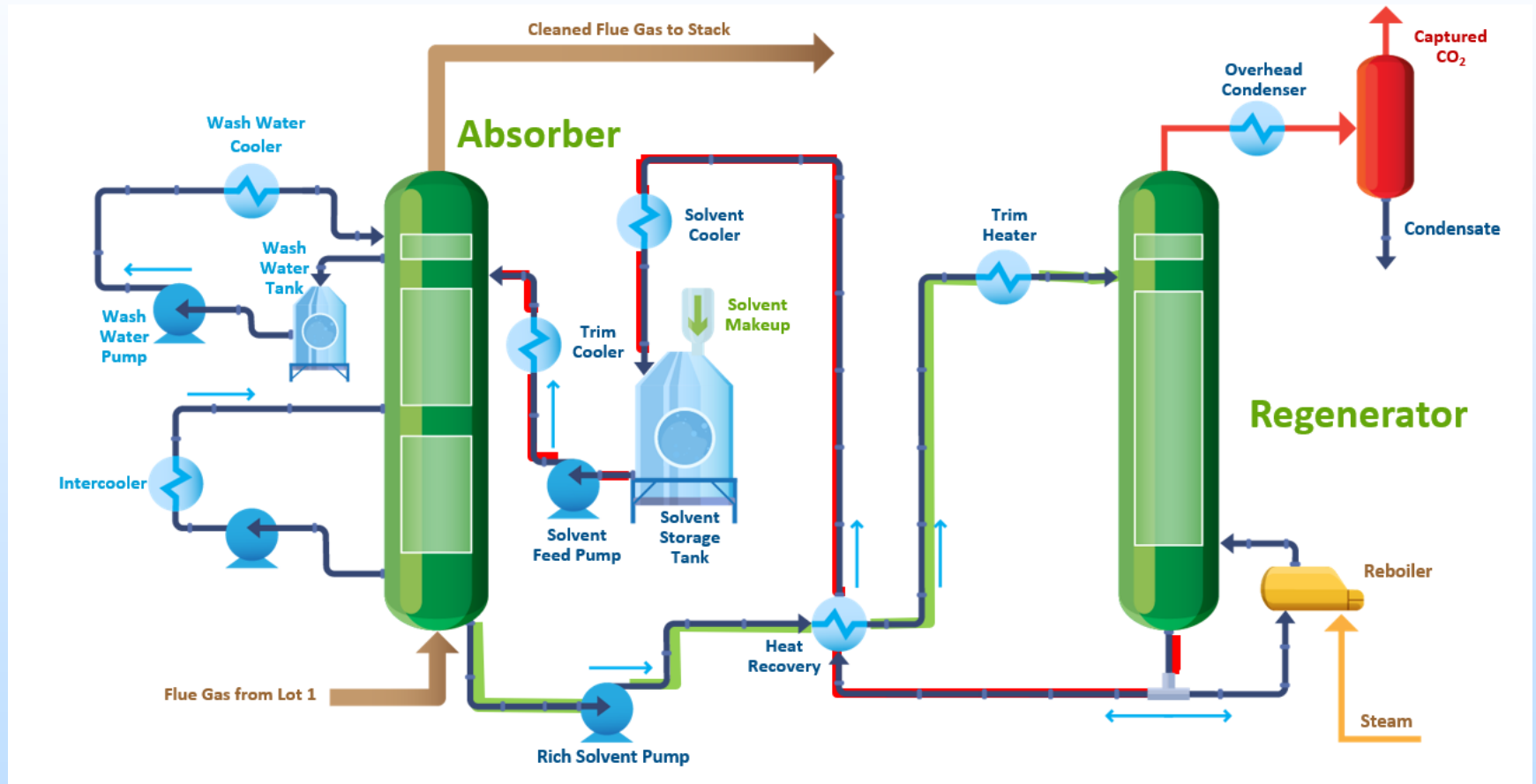
- **Babcock & Wilcox - SolveBright CO2 Capture System**
- Amine-Based Solvent Scrubbing Process – solvent agnostic
- The two major pieces of equipment:
 - Absorber: contacts solvent with incoming flue gas to absorb CO2 into solution
 - Regenerator: CO2 rich solvent from absorber routed to regenerator where heat is added to strip the CO2 from the solvent.
- CO2 lean solvent exits bottom of regenerator and can be used again for CO2 removal in the absorber

Technical Approach

- Prior to carbon capture the exhaust gas from the repowered existing boilers gas will route through:
 - Selective non-catalytic reduction (new)
 - Dust collectors (existing)
 - Spray dryer absorbers (existing)
 - Baghouse (existing)

Technical Approach

Amine-Based Solvent Scrubbing Process



Summary Slide

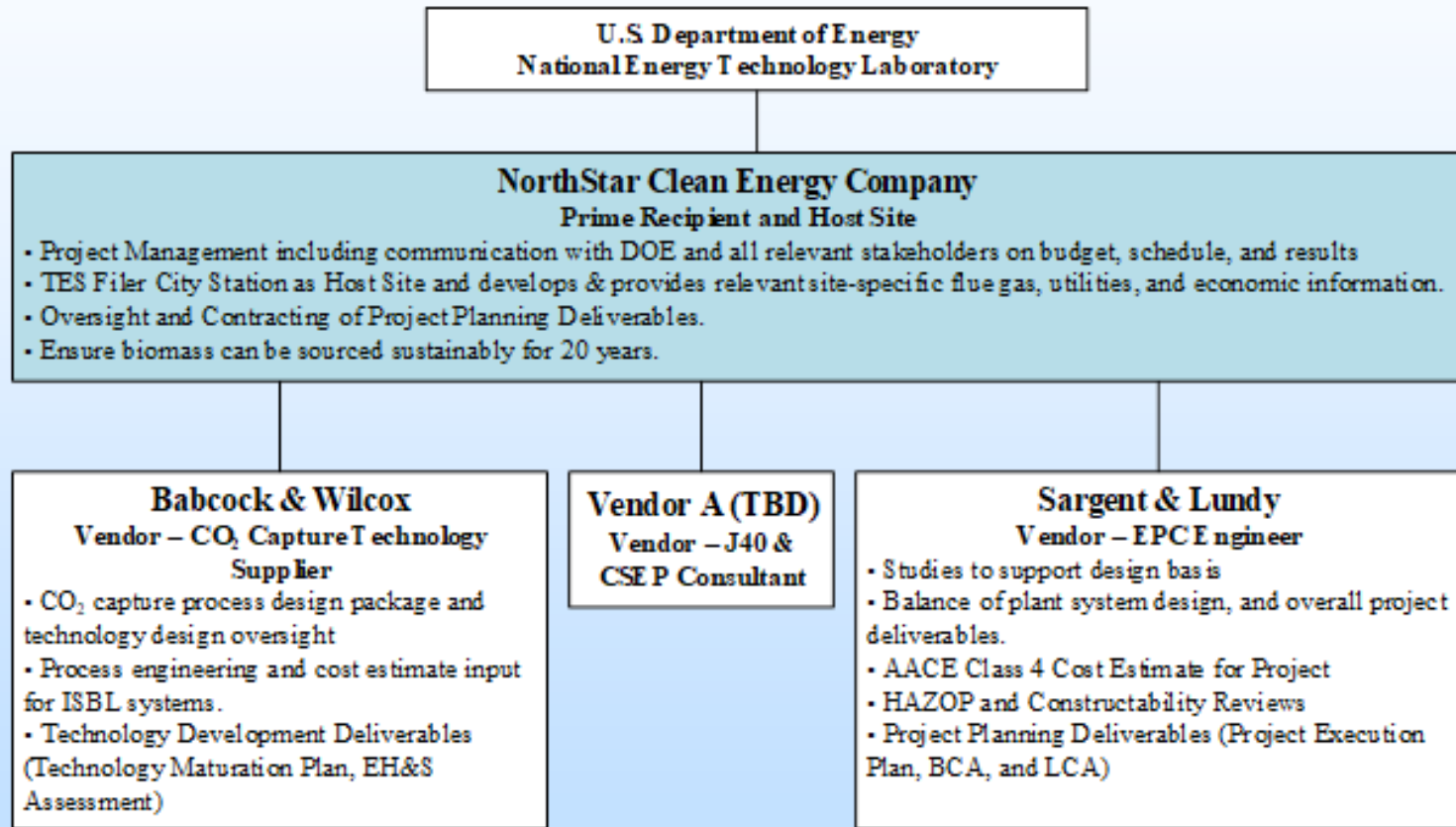
1. The Filer Plant is debt free with the capability to be converted to a BECCS facility. The existing facility and its supporting infrastructure would cost in excess of \$350 million to replicate.
2. A CO₂ pipeline exists 2,600 feet from the Filer Plant that can deliver the captured CO₂ to secure geologic storage for sequestration.
3. An EPA approved under Subpart RR sequestration MRV plan exists that provides ample locations to sequester the captured CO₂ in deep geologic formations within 10 miles of the Filer Plant.
4. No Title V EPA permitting required.
5. No electric interconnection is required.
6. No new property to be acquired.
7. Operating crews are in place.
8. Adjacent deep water port facilities allow for low-cost shop-built components to be delivered directly to the site.
9. There is ample sustainable waste wood to fuel the facility with existing supply chains to support 500,000 tonnes of captured atmospheric CO₂ per year.
10. Over the first 12 years of commercial operation over \$1.2 billion million of positive economic impact will accrue to Michigan supporting 220 permanent jobs in the depressed Northern Michigan economy.

Acknowledgements

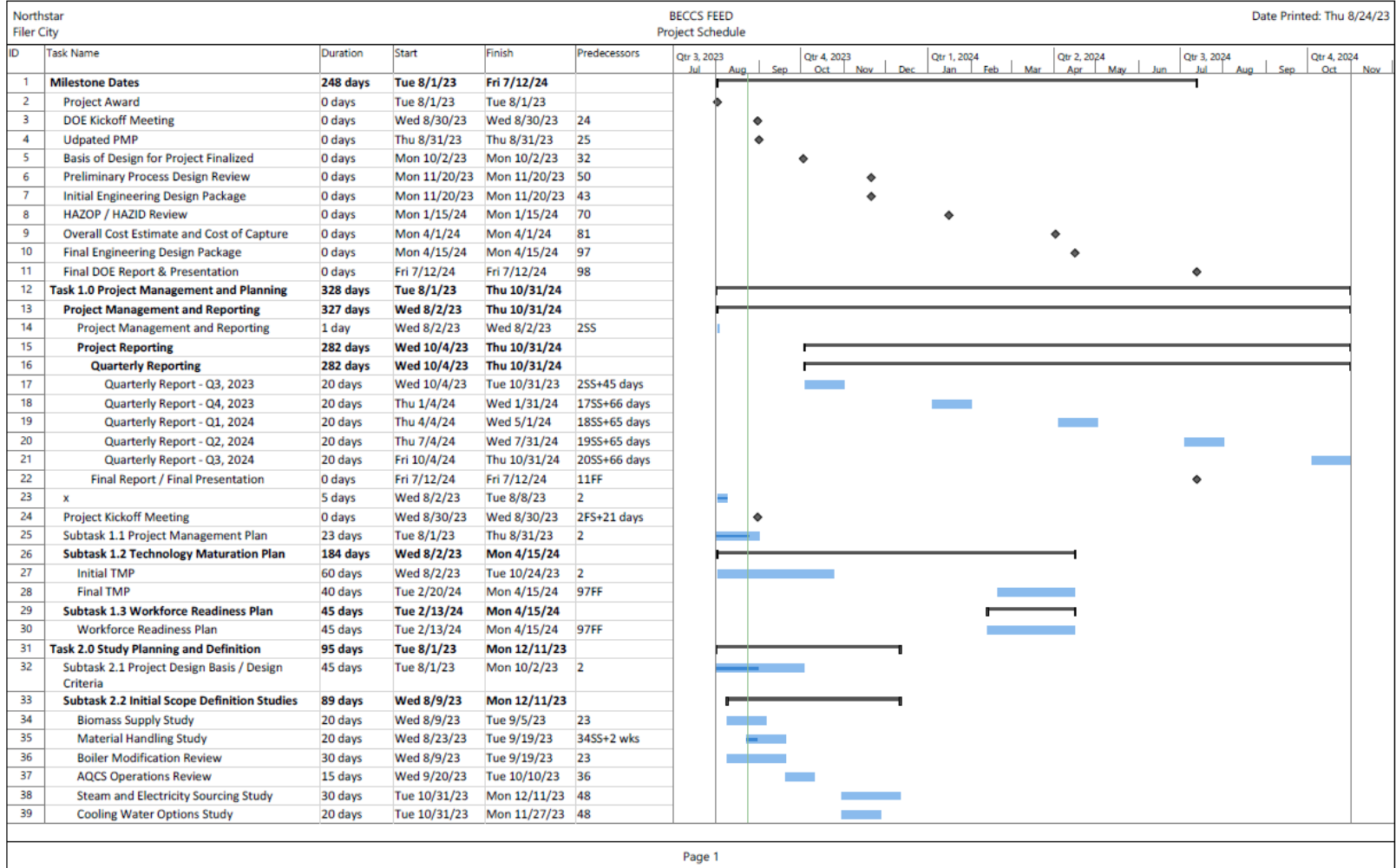
- Tondu Corp
- Sargent & Lundy
- B&W
- Filer City Plant Staff
- NorthStar Staff – PM, Engineering, Sales and Marketing

Appendix

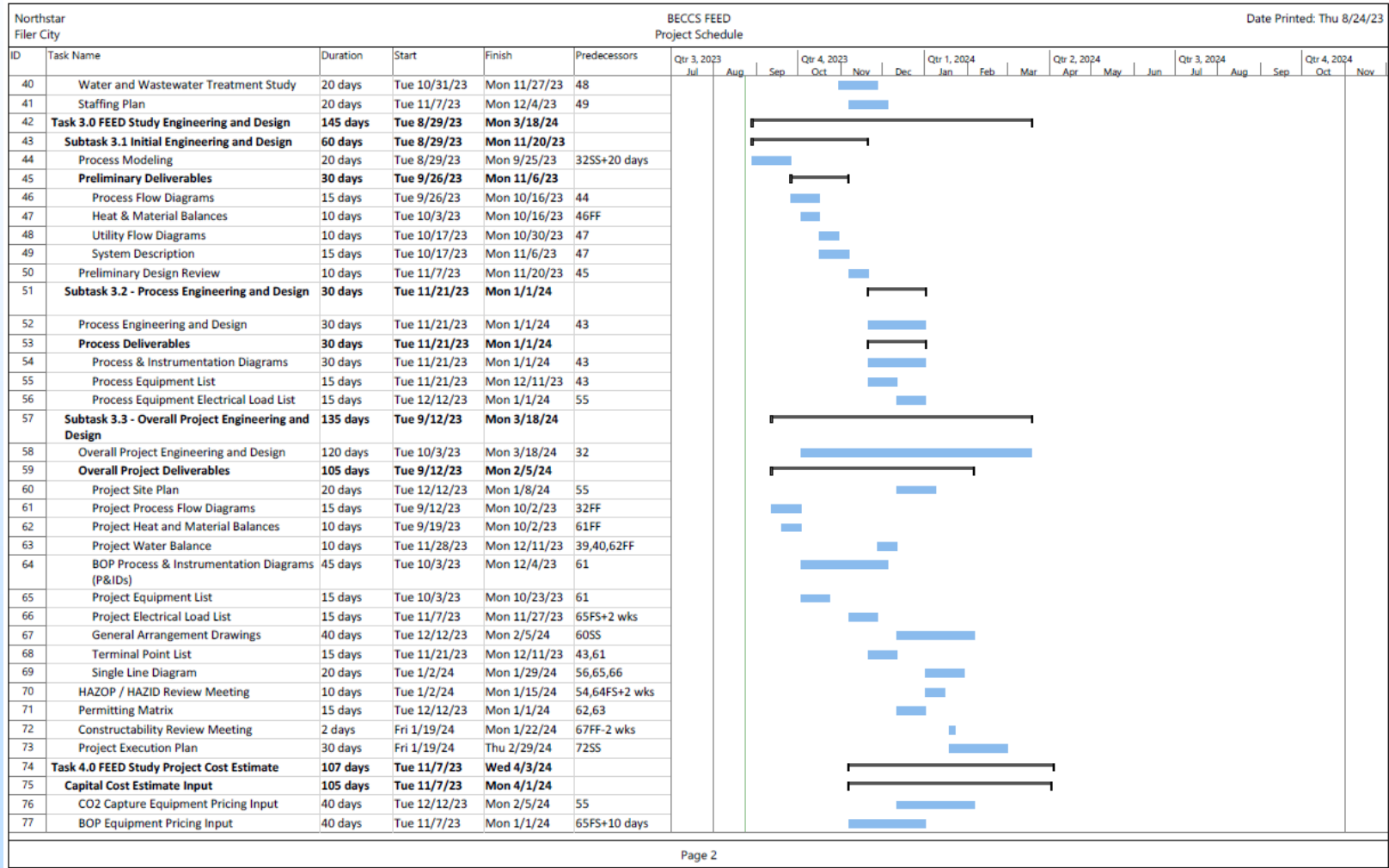
Organization Chart



Gantt Chart



Gantt Chart



Gantt Chart

