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**NORTH DAKOTA**



Critical Challenges. Practical Solutions.



Energy & Environmental Research Center (EERC)

# **INITIAL ENGINEERING, TESTING, AND DESIGN OF A COMMERCIAL-SCALE POSTCOMBUSTION CO<sub>2</sub> CAPTURE SYSTEM ON AN EXISTING COAL-FIRED GENERATING UNIT**

CO<sub>2</sub> Capture Technology Project Review Meeting

August 29, 2019

Pittsburgh, Pennsylvania

Jason Laumb, Principal Engineer

# PROJECT TEAM AND INDUSTRY SPONSORS

- State of North Dakota
- ALLETE (BNI, ACE, and MP)
- Minnkota Power
- MHI
- Burns & McDonnell
- EERC



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# GOALS AND OBJECTIVES

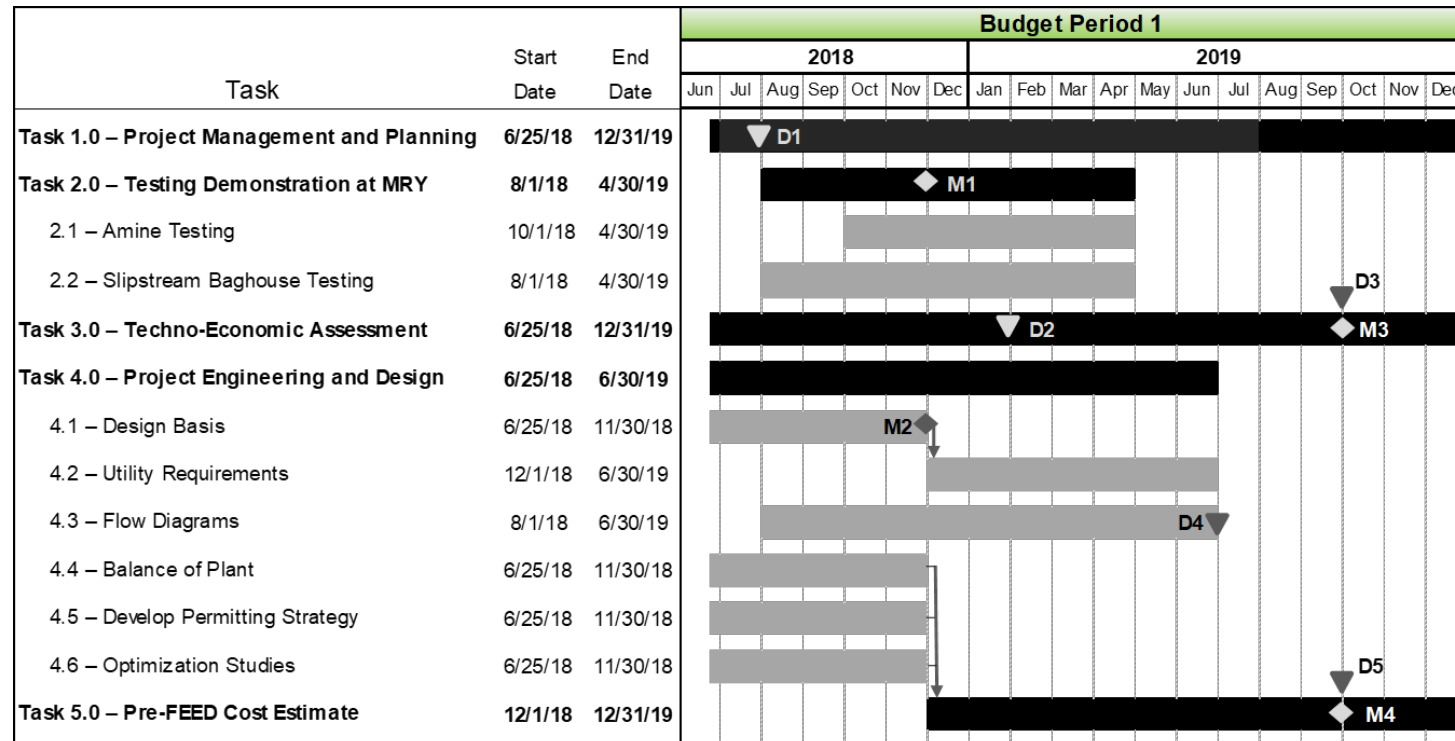
- The goal of the project is to determine retrofit costs for a postcombustion CO<sub>2</sub> capture system on an existing coal-fired electric generating unit. Specific objectives to support this goal include the following:
  - Design a fully integrated postcombustion CO<sub>2</sub> capture system for Milton R. Young Unit 2 (MRY2).
  - Evaluate KS-1 solvent on lignite coal-derived flue gas to refine critical design parameters.
  - Complete a techno-economic assessment (TEA) in accordance with DOE's bituminous baseline study (B12B).
  - Complete a pre-front-end engineering and design (FEED) analysis of the specified postcombustion CO<sub>2</sub> capture system at MRYS.

# PROJECT STRUCTURE

- Task 1 – Project Management and Planning
- Task 2 – Testing Demonstration at MRY2
- Task 3 – Techno-Economic Assessment
- Task 4 – Project Engineering and Design
- Task 5 – Pre-FEED Cost Estimate



# PROJECT TIME LINE



LR 7/18/18

Deliverables ▼	Milestones ◆
D1 – Updated PMP	M1 – Initiated Field Testing
D2 – Updated TMP	M2 – Design Basis Determined
D3 – Complete TEA	M3 – Complete TEA
D4 – HAZOP Review	M4 – Complete Preliminary Pre-FEED Analysis
D5 – Constructability Review	



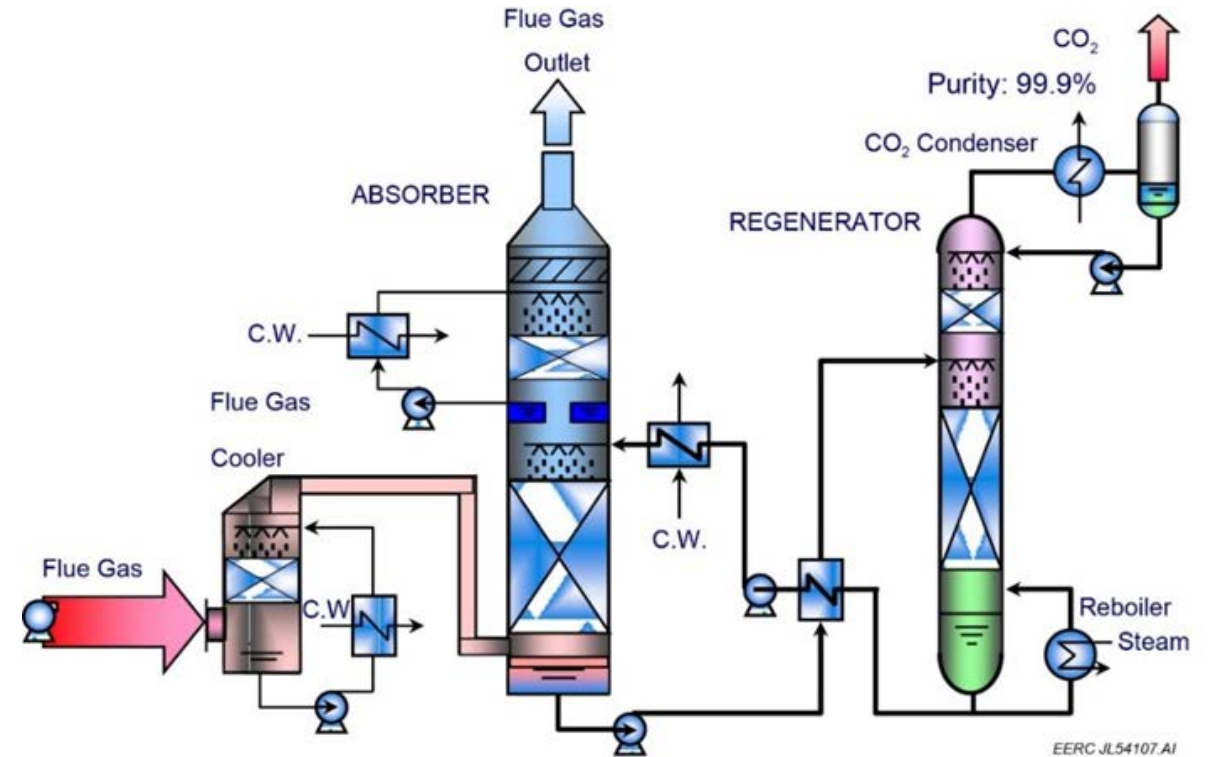
# PROJECT DETAILS – MRY2

- Minnkota Power MRY2
  - 477-MW lignite-fired unit
    - ◆ Overfire air (OFA)
    - ◆ Selective noncatalytic reduction (SNCR)
    - ◆ Halogenated powdered activated carbon (PAC)
    - ◆ Electrostatic precipitator (ESP)
    - ◆ Wet flue gas desulfurization (FGD)
  - Provides power to eastern North Dakota and northern Minnesota



# PROJECT DETAILS – CAPTURE TECHNOLOGY

- MHI Capture Technology
  - KM CDR Process (KS-1 Solvent)
    - ◆ Flue gas pretreatment
    - ◆ CO<sub>2</sub> recovery
    - ◆ Solvent regeneration
    - ◆ CO<sub>2</sub> compression and dehydration
  - Based on technology used at Petra Nova





# PROJECT DETAILS – CAPTURE INTEGRATION

- Fully integrated steam supply system
  - IP/LP crossover
- 95% capture on MRY2 entire flue gas stream
  - 12,157 tons/day
- Solvent reclaiming
  - Based on field tests
- Aerosol mitigation technology
  - Aerosol impacts based on testing

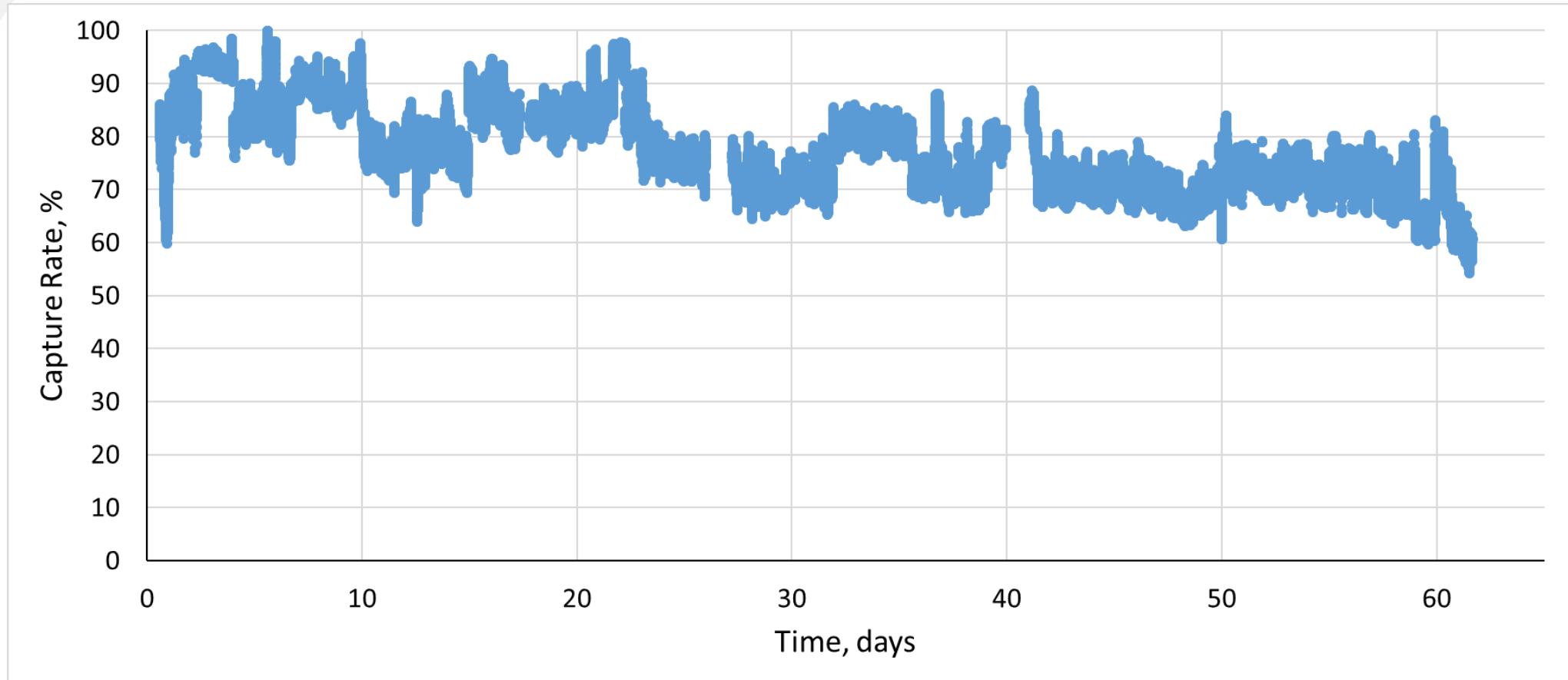


# PRE-FEED

- Project final report nearing completion.
  - Pre-FEED cost estimate
  - Layout
  - HAZOP
  - Constructability
  - Steam integration report
  - Transportation study
  - Completed technology maturation plan

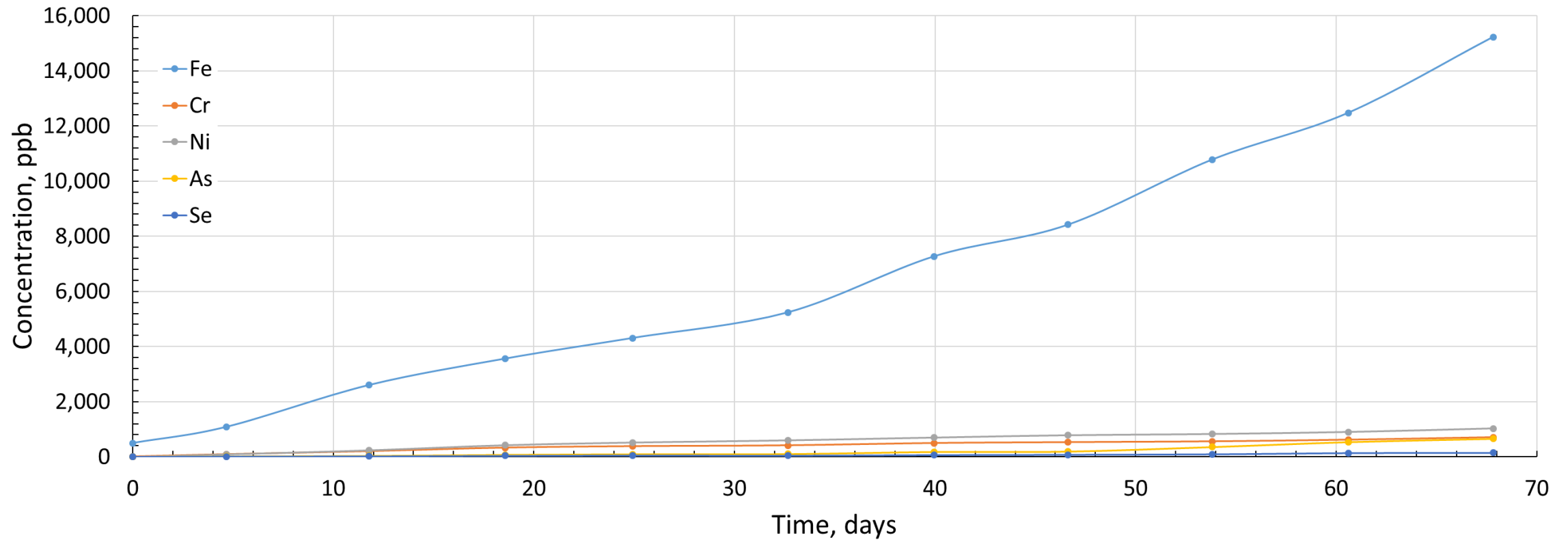


# CAPTURE DEMONSTRATION

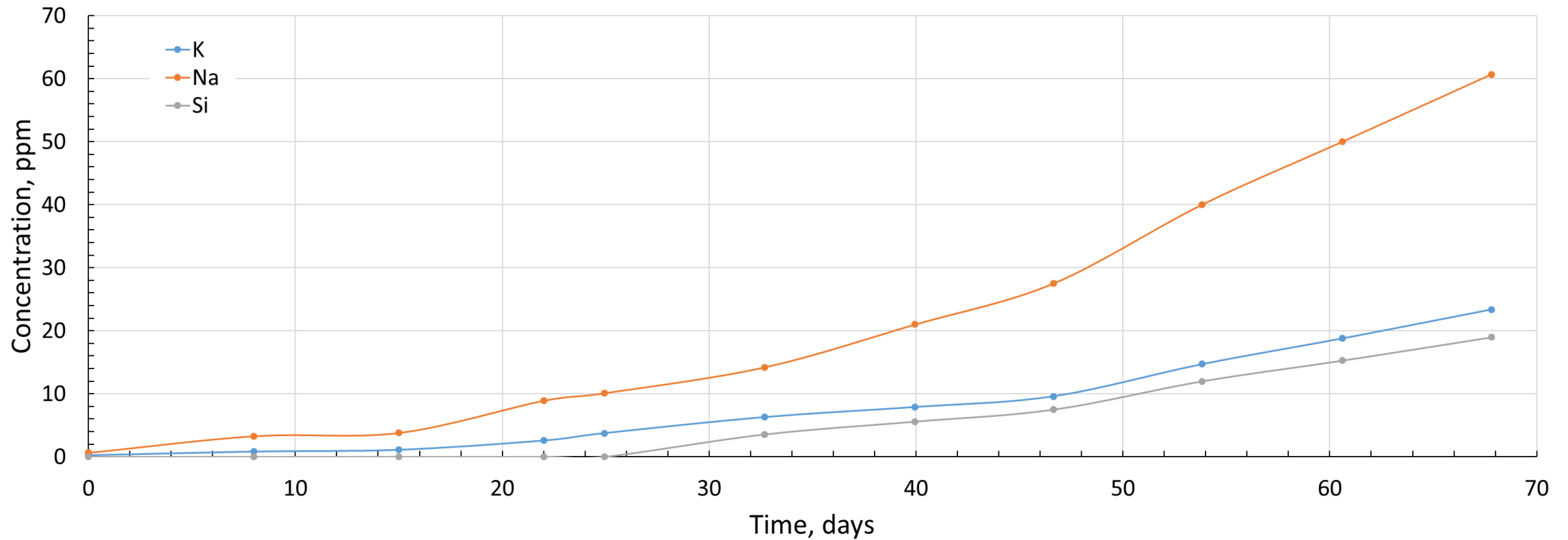


- Three months completed.
- Reclaimer technology was not installed.
- Capture percentage decreased in part because of lake water warming.

# METALS CONCENTRATION

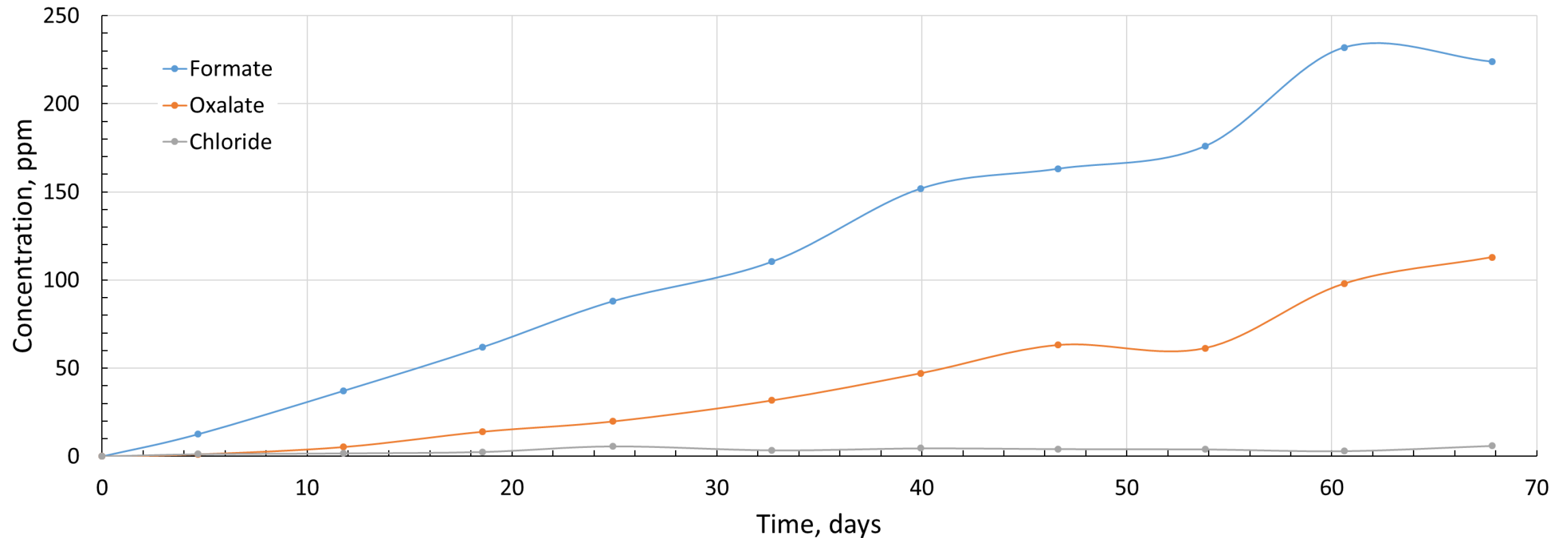


# METALS CONCENTRATION, CONT.

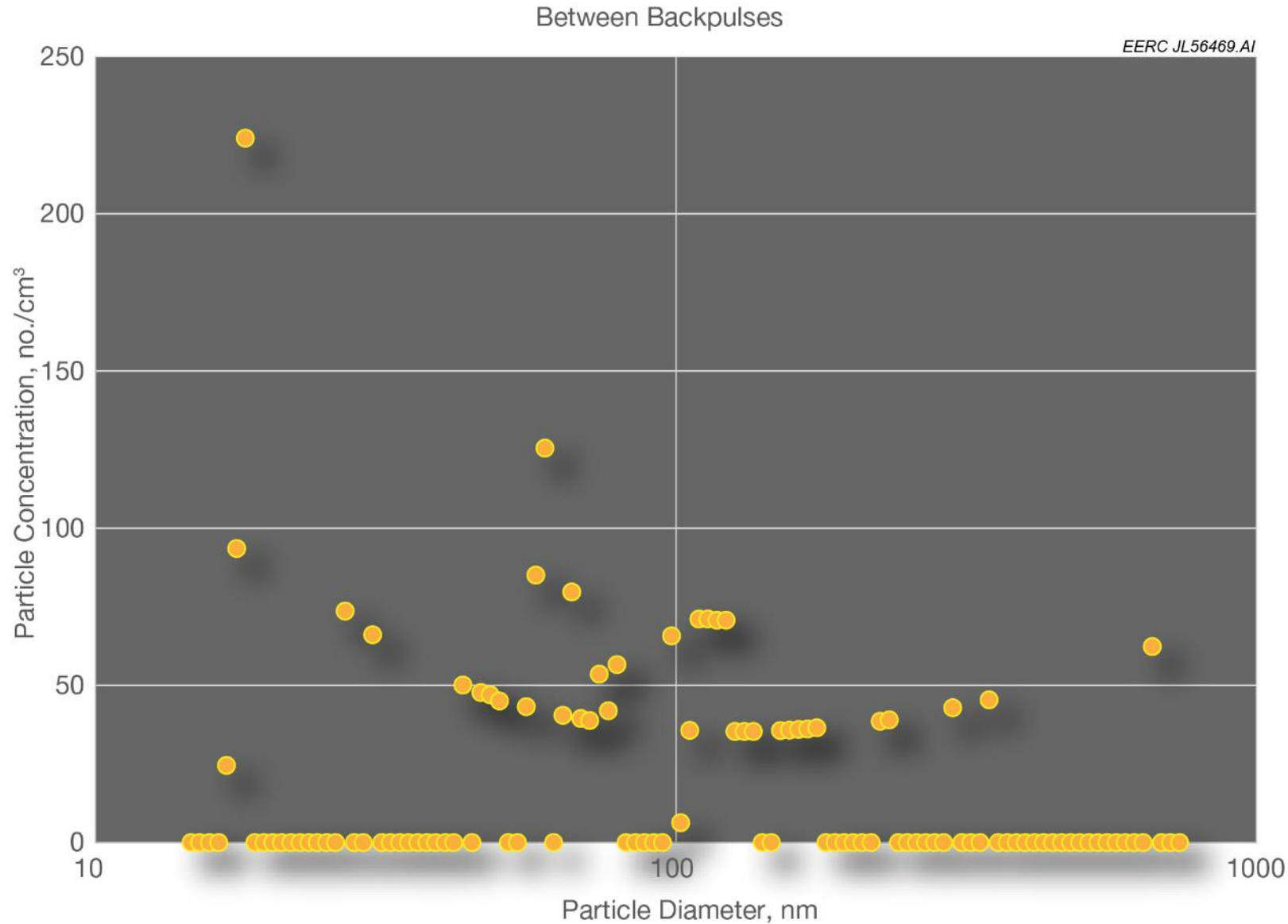




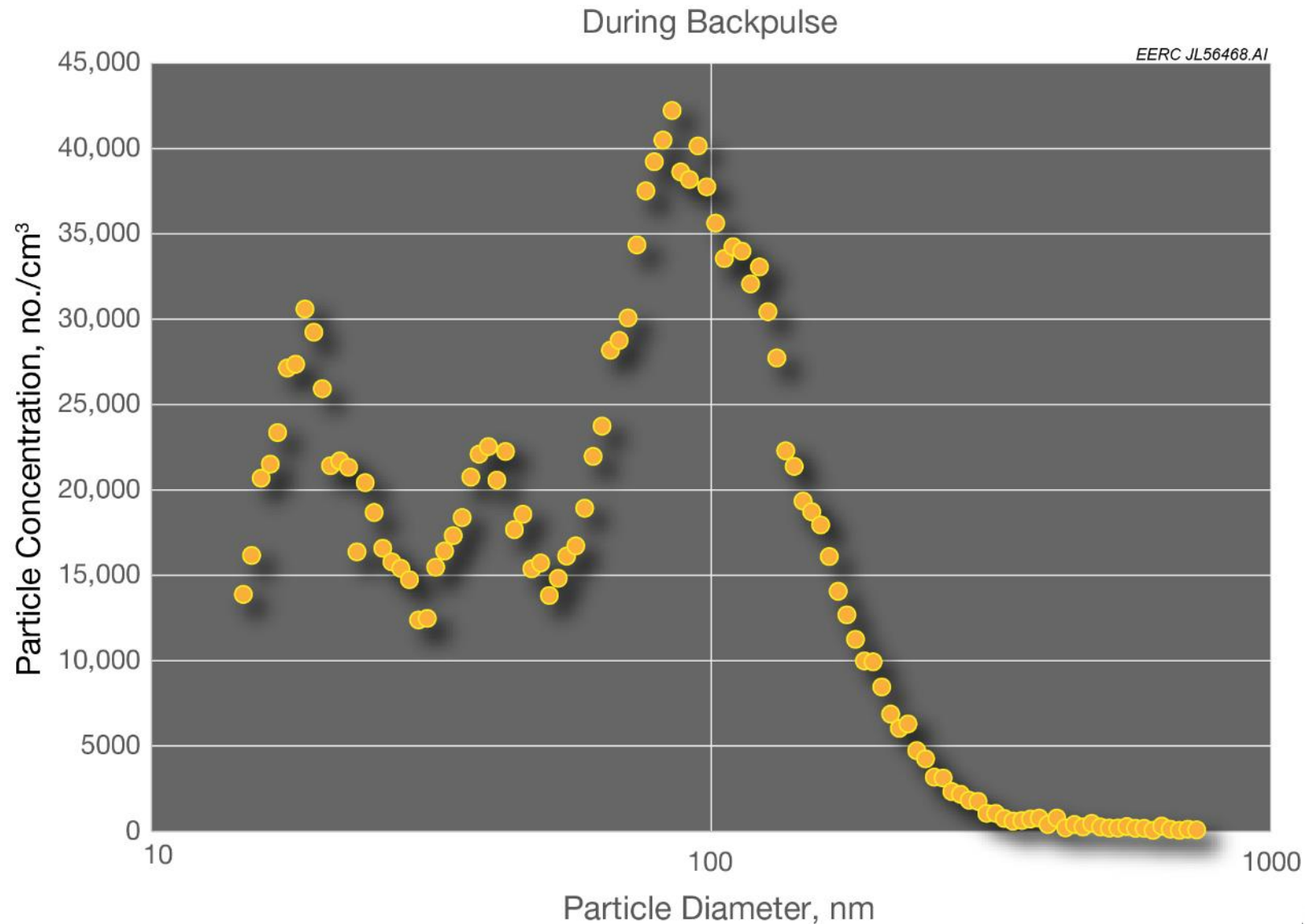
# ANIONS AND SALTS CONCENTRATION



# BAGHOUSE TESTING – PRIOR TO PULSE



# BAGHOUSE TESTING – DURING PULSE



# KEY FINDINGS TO DATE

- Cooling water temperature is important! (even in North Dakota summer).
- Metals concentrations in solvent have increased over time.
  - Expected because of lack of reclaimer on pilot system.
- Baghouses release aerosols during bag-cleaning cycles.
  - Unknown the impact this will have on multichamber systems.
  - Test your fuel if at all suspicious!

# FUTURE WORK

- All fieldwork was completed on August 23.
  - Decommissioning of equipment.
  - Heat exchanger analysis.
  - Metals analysis on solvent.
  - Reduce remaining field data.
- Final pre-FEED report completed September 30, 2019.
  - Project final December 31, 2019.





# CONTACT INFORMATION

## **Energy & Environmental Research Center**

University of North Dakota  
15 North 23rd Street, Stop 9018  
Grand Forks, ND 58202-9018

**[www.undeerc.org](http://www.undeerc.org)**

701.777.5114 (phone)

701.777.5181 (fax)

**Jason D. Laumb**

**Principal Engineer, Advanced Energy Systems  
Group Lead**

[jlaumb@undeerc.org](mailto:jlaumb@undeerc.org)





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