Full-Scale FEED Study For a 816 MWe Capture Plant at the Prairie State Generating Company Using Mitsubishi Heavy Industries of America Technology

Kevin C OBrien, PhD
Director, Illinois Sustainable Technology Center
Director, Illinois State Water Survey
Prairie Research Institute
University of Illinois at Urbana-Champaign

Jason Dietsch
Assistant Research Engineer
Prairie Research Institute
University of Illinois at Urbana-Champaign

DOE/NETL 2021 Carbon Management and Natural Gas & Oil Research Project Review Meeting
Pittsburgh, PA / August 2, 2020

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Cooperative Agreement No. DE-FE0031841

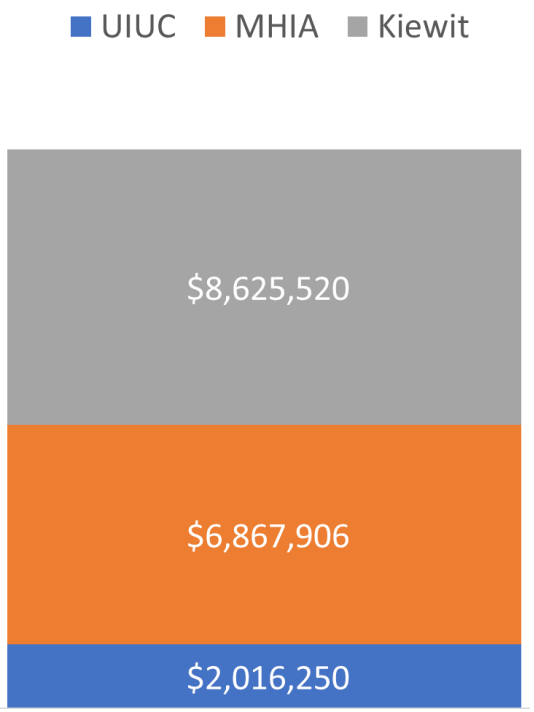
PROJECT OVERVIEW

Funding: $17,509,676

DOE: $14,004,676

20% Cost Share: $3,505,000 (PSGC)

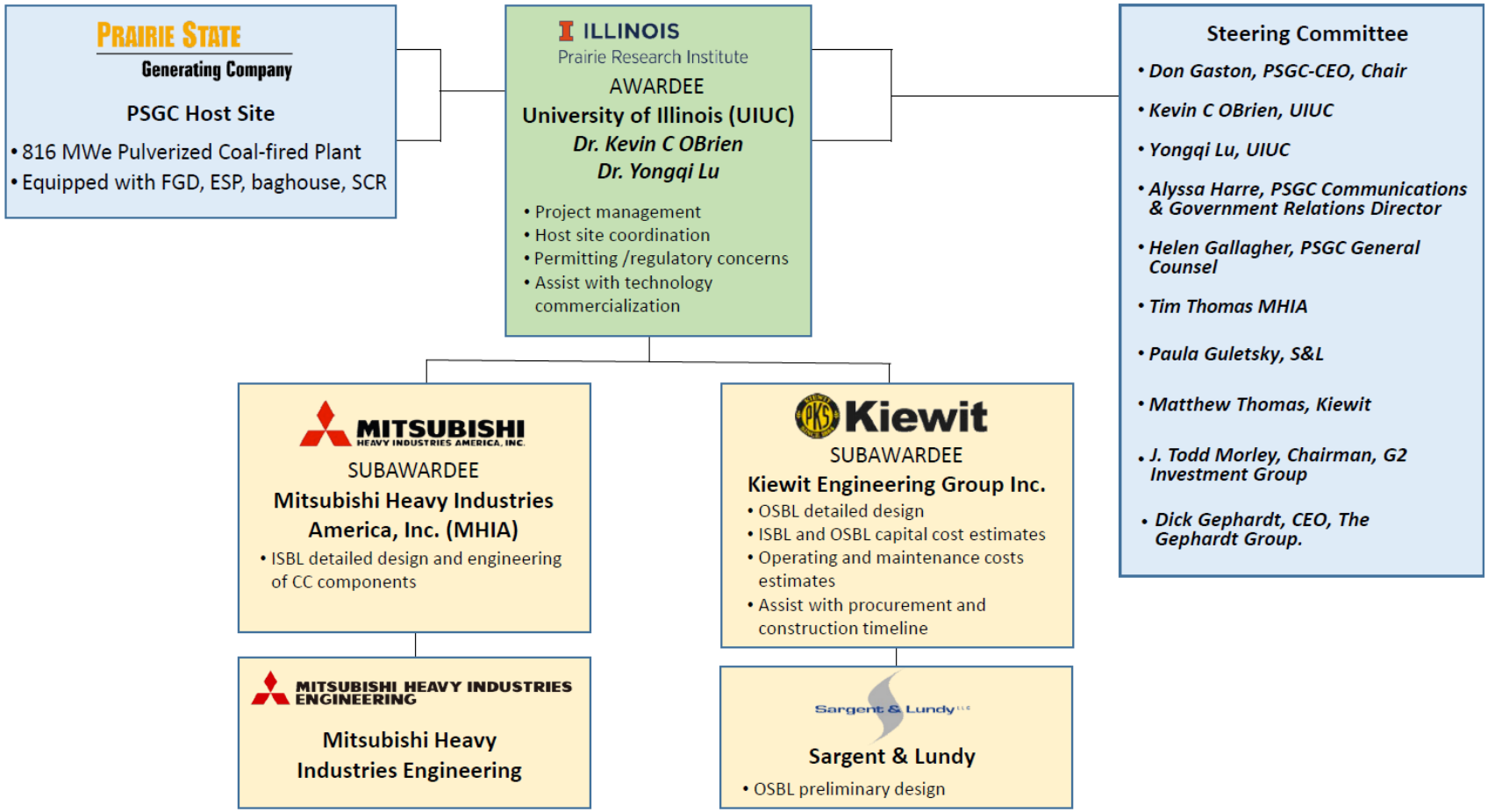
Work Period: 1 Jan 2020 – 31 Dec 2021



PROJECT OBJECTIVES:

Overall: Perform a Front-End Engineering Design (FEED) study for the retrofit of the Prairie State Generation Company's (PSGC) coal-fired power plant with post-combustion carbon capture. The FEED study will outline the use of Mitsubishi Heavy Industries' (MHI) Advanced KM CDR Process™ to retrofit one of PSGC's two generating units (approximately 816 MWe). The FEED study will enable PSGC to move forward with actual build/operate in future work.

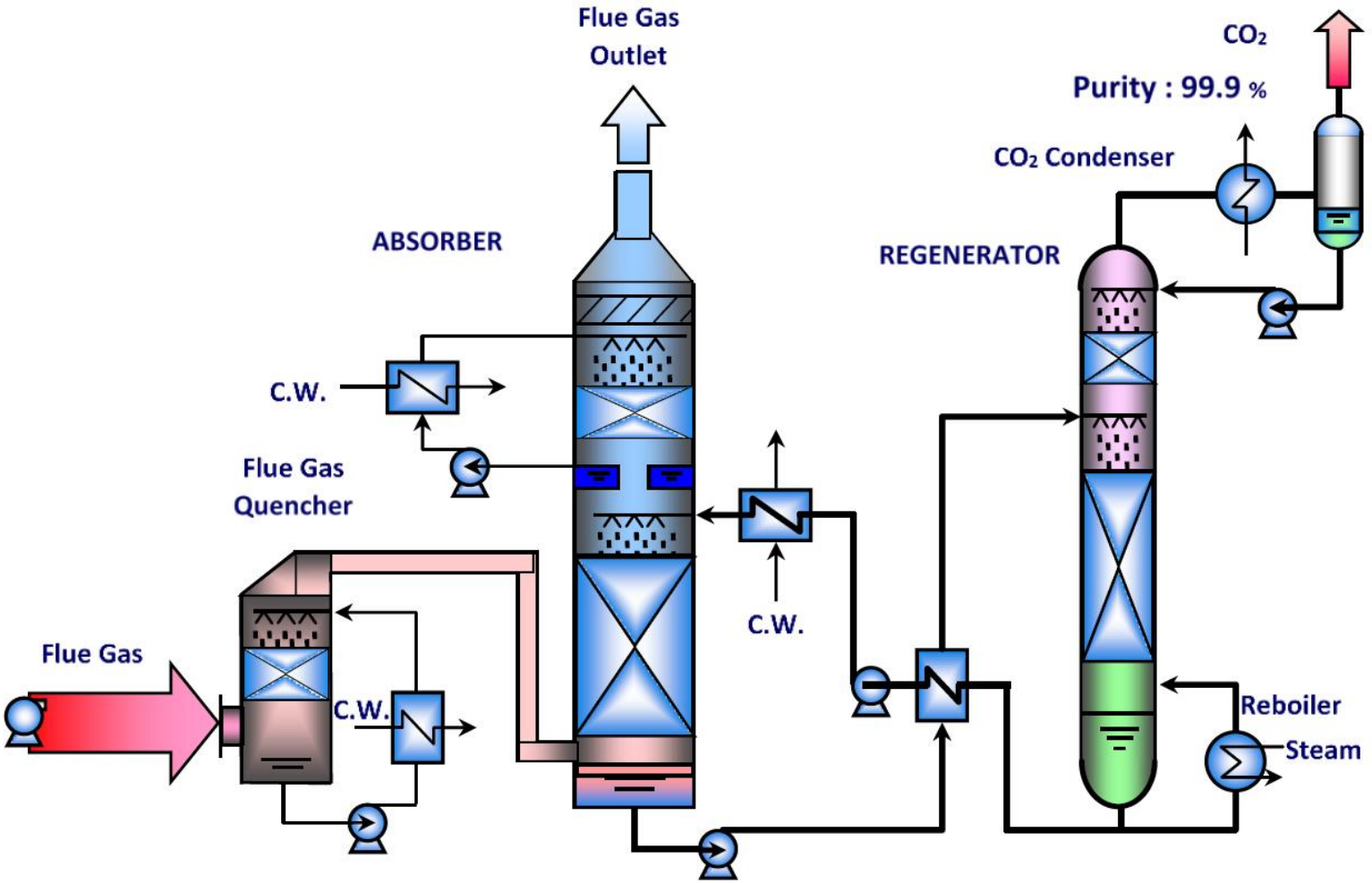
Project Team Management Structure



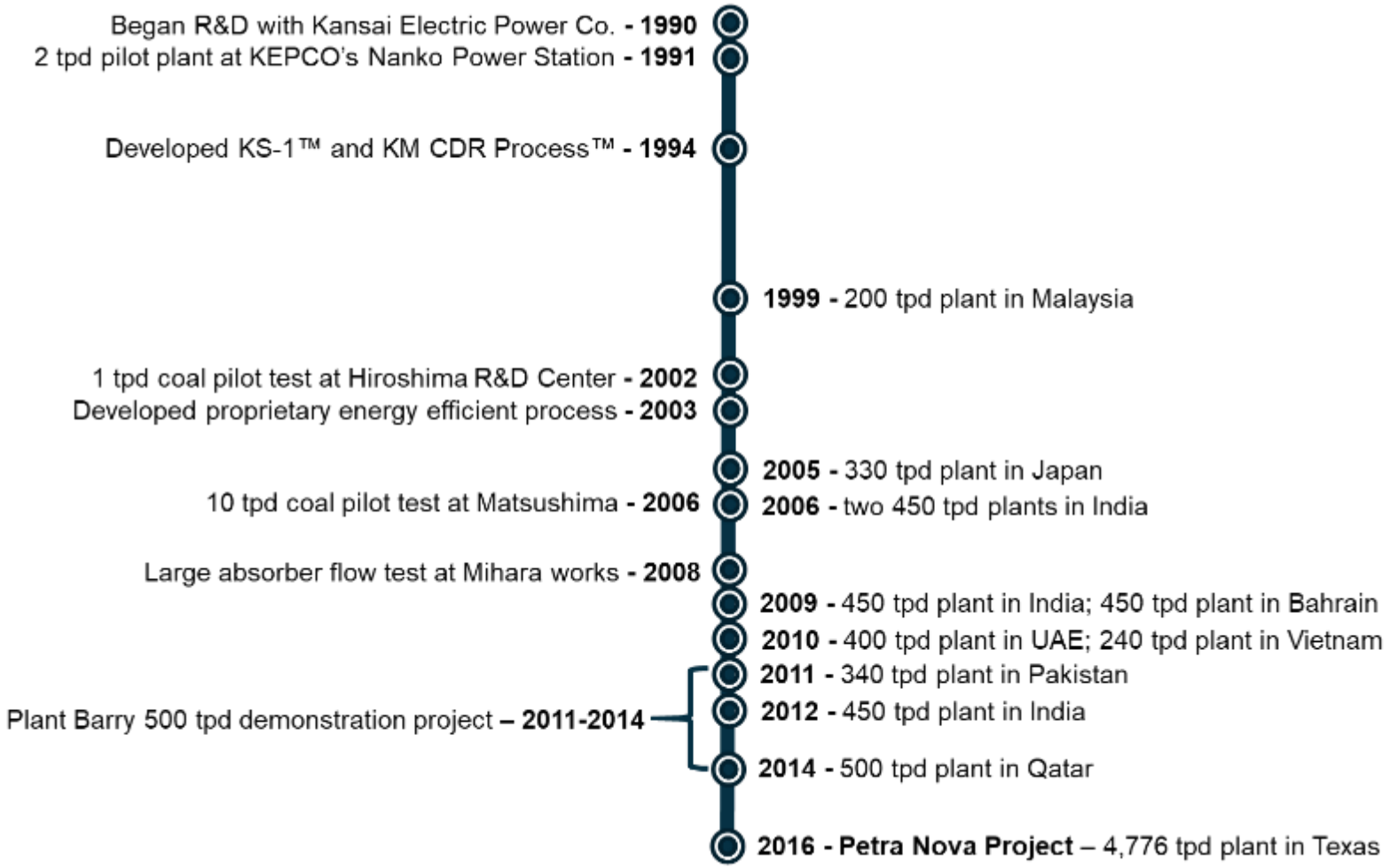
FRONT-END ENGINEERING DESIGN STUDIES FOR CARBON CAPTURE SYSTEMS ON COAL AND NATURAL GAS POWER PLANTS

TECHNICAL BACKGROUND

Mitsubishi Heavy Industries' (MHI) Advanced KM CDR Process™



Project Technology Development 1990 - present



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Opportunity to Evaluate Improved Solvent (KS-21)

Parameters Relative to KS-1™	KS-1™	KS-21™
Volatility	100	50-60
Thermal degradation rate	100	30-50
Oxidation rate	100	70
Heat of absorption	100	85

Thermal stability

- Reduce thermal degradation and allow higher stripping T and P, reducing compression work

Oxidative stability

- Potentially more tolerant to impurities
- Reduce amine oxidation and HSS formation rate

Volatility

- Reduce amine loss from emission and cost of water wash system
- Steam consumption savings outweigh cost increases due to higher solvent circulation

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Key Activity

TECHNICAL APPROACH / PROJECT SCOPE

Project Tasks

Task #	Task
1.0	Project Management and Planning
2.0	Front-End Engineering Design (FEED) Study
2.1	Design Basis
2.2	Preliminary Engineering
2.3	ISBL Detailed Engineering
2.4	OSBL Detailed Engineering
2.5	Studies and Investigations
2.6	Cost Assessment
3.0	Regulatory and Permitting at Host Site
4.0	Final FEED Study Package

Project Milestones

Task / Subtask #	Deliverable Title	Due Date
~~1.0~~	~~Project Management Plan Update~~	~~3/3/2020~~
~~2.0~~	~~Design Basis Document Complete~~	~~10/30/20~~
~~2.0~~	~~Report on Utility Requirements~~	~~11/19/20~~
~~3.0~~	~~Preliminary Regulatory and Permitting Pathway~~	~~2/18/21~~
~~2.0~~	~~HAZOP Review~~	~~4/30/21~~
~~2.0~~	~~Impact on Kaskaskia Watershed Document Complete~~	~~5/28/21~~
~~2.0~~	~~Constructability Review Complete~~	~~6/30/21~~
3.0	Regulatory and Permitting Analysis Complete	8/6/2021
2.0	Detailed Engineering Document Complete	11/30/21
4.0	Final Report Submitted	12/31/21
4.0	FEED Study Package Complete	12/31/21

Risk & Mitigation Strategy

Description of Risk	Probability	Impact	Risk Management Mitigation and Response Strategies
Technical / Scope Risks			
Insufficient water supply	Low	Low	• Studies outlined in SOPO - explore various options to source the cooling and makeup the cooling and makeup water demands of the capture system including supply from host site vs. an external source.
Uncertainty associated with the need of identifying steam and electric sourcing	Low	Low	• Studies outlined in SOPO - explore options to address these issues. Can apply learnings from Petra Nova Project.
Costs / Schedule Risks			
Project cost and/or schedule overruns	Low	High	• Team has previous experience conducting FEED studies on budget and on time
Management / Planning Risks			
Availability of key personnel for project	Low	Medium	• Commitments received from partner organizations
Uncertainty of permitting agencies and timelines	Low	Low	• Meetings with relevant agencies for previous projects enabled baseline knowledge for timelines and requirements
EH&S Risks			
Air (amine and CO_2) emission management	Low	Low	• Leverage experience from Petra Nova Project to meet strict VOC permit requirements • Built into ISBL design criteria
Wastewater stream management	Low	Medium	• Studies outlined in SOPO – explore options to address these issues
External Factors Risks			
Negative stakeholder response to FEED study	Low	Low	• Discussions with elected officials have received very positive support
Financial Risks			
Cost share for project not obtained or insufficient	Low	High	• Cost share authorized by host site's Board of Directors • Host site is financially stable

Key Activity

PROGRESS AND CURRENT STATUS

Carbon Capture Facility Location

Source: Google Earth

Carbon Capture Facility Location

Carbon Capture Facility Location

Duct Tie-in

OSBL

- Duct Tie-in
- Ductwork to facility
- Auxiliary Boilers
- Cooling Tower
- Administration Building
- Water Treatment
- Wastewater Treatment
- Raw Water Pipeline
- Raw Water Storage Pond
- Storage Tanks
- Utility Systems
- Fire Protection Layout
- Roads and Storm Drainage
- Site Lighting

ISBL

- Draft Fan
- Flue Gas Quencher
- Absorber
- Regenerator
- Product Compressor

Studies

Steam and Electric Sourcing Study

- Auxiliary Boiler
  - Purchasing power from the grid

Transportation Study

- Identified and evaluated transportation routes to bring equipment and modules to the site

Water Supply Study

- Draw raw water from the Kaskaskia River
- Build a storage pond for drought conditions

Studies

Water and Wastewater Treatment Study

- Selected the systems for treatment of incoming raw water and exiting wastewater

Cooling Water System Study

- Closed loop system with draft cooling tower

Compressor System Overpressure Relief

- Evaluation of overpressure relief locations long the compression path

Studies

Constructability Review

- Evaluate and identify construction access, lay-down areas, lift plans, and sequencing of construction work

Project Execution Schedule

- A detailed project schedule will be developed to aid in the overall construction timeline and costs associated with the contractors

Hazard and Operability (HAZOP) Review

- An in-depth examination of the ISBL section to identify and evaluate any process or equipment risks. Recommendations for changes to the system design or operation will be made based on the HAZOP findings

Key Activity

REMAINING TASKS

Moving Forward

- Continued Review of Design to Identify Ways to Lower Costs
- Contracting/Procurement Strategy
- Project Capital Cost Estimate (+/- 15%)
- Completion of Regulatory and Permitting Analysis
- FEED Study Package Completed
- Submission of Final Report

Acknowledgements

Name	Organization
Andrew Jones	National Energy Technology Laboratory / U.S. Department of Energy
Don Gaston, Javier Arzola, Rich Meyer	Prairie State Generating Company
Kevin O'Brien, Yongqi Lu, Vinod Patel, Stephanie Brownstein, Jason (Zhenxing) Zhang, Jason Dietsch	Prairie Research Institute / University of Illinois Urbana-Champaign
Tim Thomas, Tiffany Wu, Cole Maas	MHIA
Keisuke Iwakura, Shintaro Kiuchi	MHIENG
Matt Thomas, Alan Donovan, Bob Slettehaugh, Bryan Lofgreen	Kiewit Engineering Group
Paula Guletsky, Anthony Baker	Sargent & Lundy

This project is supported by the U.S. Department of Energy / National Energy Technology Laboratory (DOE/NETL) through Cooperative Agreement No. DE-FE0031841

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