



# Co-Gen Wastewater Treatment for Coal-Fired Energy Plants

---

NETL Virtual Project Review Meeting  
DE-FE0031669  
September 17, 2020



# Co-Gen Wastewater Treatment for Coal-Fired Energy Plants Project

- Type of Contract:
  - DOE Co-Op (DOE/NETL)
- Period of Performance:
  - October, 2018 to March, 2021
- Total Contract Value:
  - \$748.8K PLUS \$187.2K Cost Share



Produced Water  
Proof-of-Concept Test



Produced Water (Inlet),  
Condensed steam (Outlet)

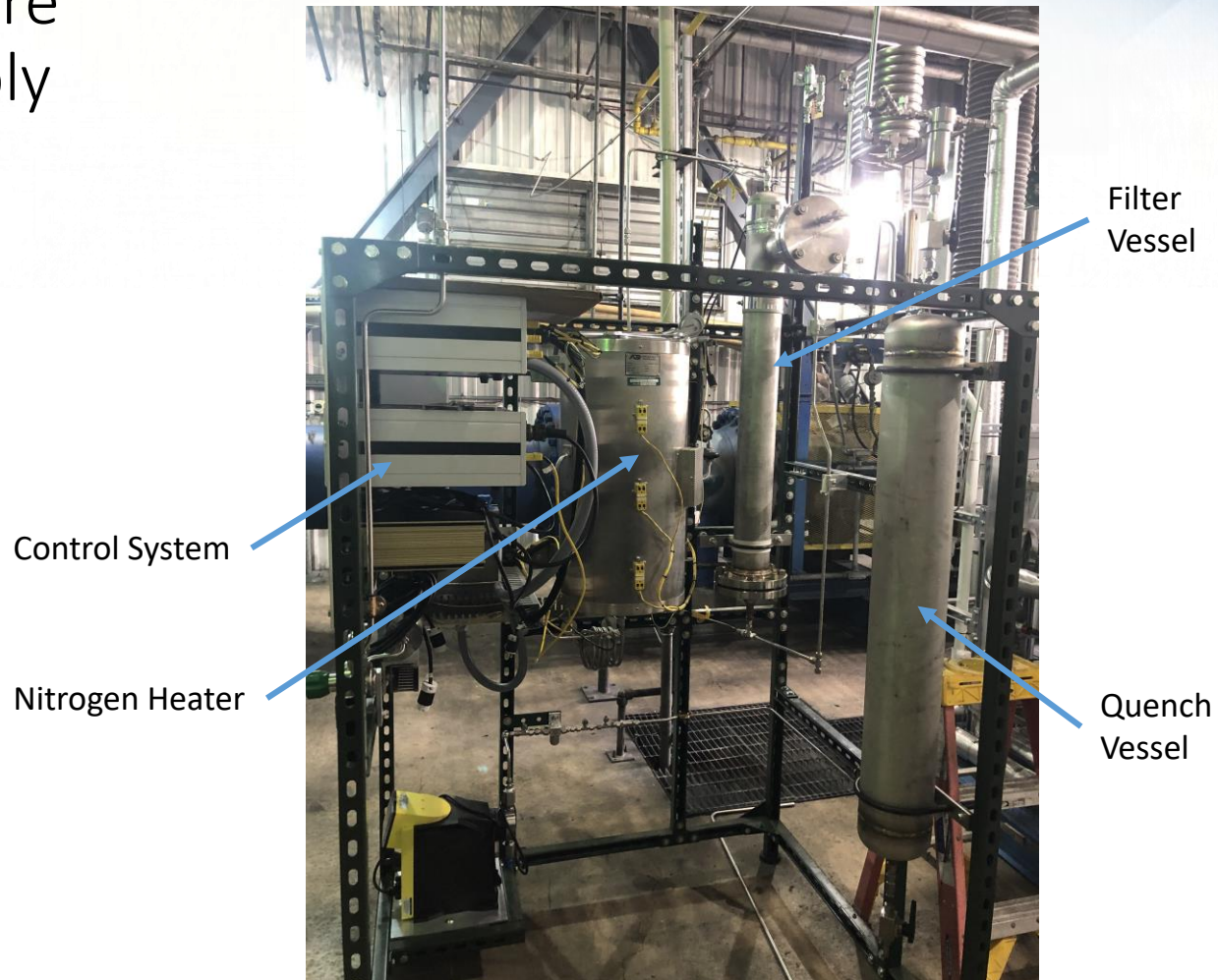
# Project Objectives

- Show clear, economic solution for FGD wastewater treatment supported by detailed analyses and trade studies
  - Review system configuration options
  - Select an optimized solution
- Complete experiments to document the solubility, transport and/or capture of Critical Pollutants of Concern (CPoC) species
  - Liquid and gas phase
  - Information will be essential to guide work on the first objective and determine economic options for CPoC removal

# Project Approach

- Innovative process will reduce the net cost of water treatment
  - Generate power to offset capital investment and operational expenses
  - Portion of the wastewater stream will be heated and filtered and then used as a working fluid in a turbine
- Verify concept makes economic sense
  - Complete system modeling and economic assessment of options
  - System study and economic evaluation will define the most attractive system configuration
- Address a key implementation risk
  - Investigate additives in the case that some CPoC are not readily separated from the steam stream
  - Complete Filter Testing and Analysis
    - Size/Design/Procure/Fabricate Test System

# Hardware Assembly

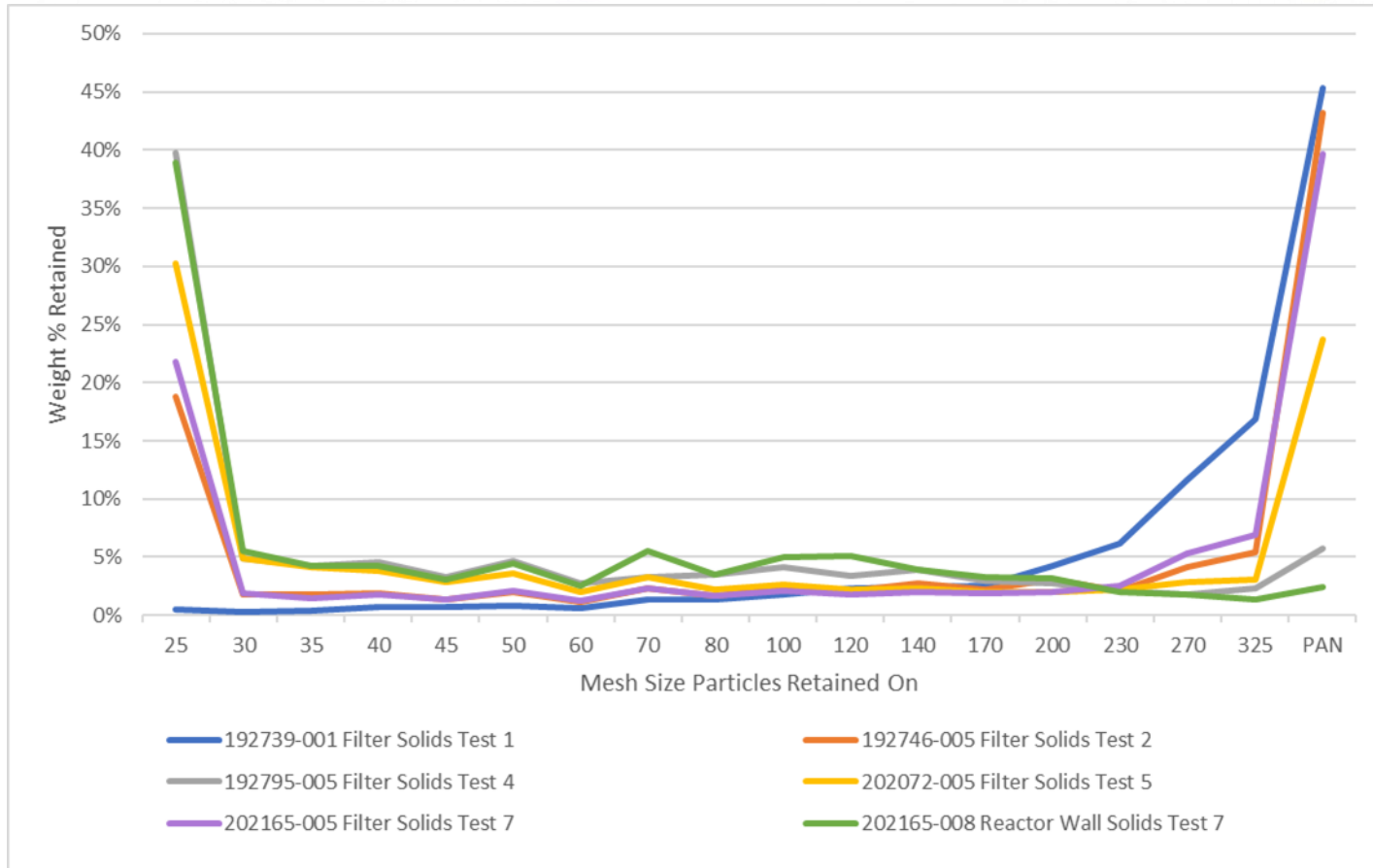


# Testing Summary – Simulated FGD Water

- Focused on Effluent Limitation Guidelines from the 2015 Rule
  - Hg & Se - added As, Nitrates, other pollutants in later tests
- Completed 12 simulated water filtering tests
  - Examined three nozzles and three filters
  - Selected filter and nozzle for actual FGD water testing
- Typically captured >83% of the water and solids (vapor small/not measured)
- Optimized test apparatus through simulated water testing.
- Typical TDS results - Before ~27,000 ppm; After ~234 ppm
  - Se meets release criteria
  - Hg does not meet release criteria – very stringent
  - As met criteria – one test to date
  - Nitrates higher than release criteria
- Water available for re-use in the facility – reduce fresh water needed
- First FGD water test planned for 9/15

# Solids Summary

## Broad size distribution good for candle filter



# Summary of Effluent Results

## Mercury Analysis

	Synthetic water analyzed, mg/L	Hg Gas Phase (sorbent), ug/L gas	Hg Gas Phase With Guard (sorbent), ug/L gas	% Reduction
Test 2	0.022	0.000721	-	-
Test 3	0.0224	0.000970	-	-
Test 4	0.3	0.0000672	-	-
Test 5	0.29	0.0000299	-	-
Test 7	0.22	0.00116	-	-
Test 9	0.0219	0.0000784	0.0000223	71.56%
Test 10	0.237	0.0045806	0.0000828	98.19%
Test 11	0.0669	0.0027643	0.0000759	97.25%

- Water and solid samples indicate Hg in vapor form as feared/expected
- Mercury content rose after Test 7 due to passivation of test equipment. Began testing effectiveness of an activated carbon bed to reduce mercury vapor emissions.
  - Carbon bed reduced mercury in the vapor phase by up to 98%.



# Summary of Effluent Results

## Selenium Analysis

	Synthetic water analyzed, mg/L	Process Water analyzed, mg/L
Test 1	1.54	< 0.01
Test 2	1.29	< 0.003
Test 3	1.63	0.014
Test 4	0.41	0.0033
Test 5	0.48	0.00395
Test 7	3.86	< 0.0025
Test 9	2.81	0.00251
Test 10	2.47	0.617
Test 11	5.00	0.014

- Significant reduction in Selenium
  - Typically two-to-three orders of magnitude
  - Highlighted tests met release criteria of 0.0075 mg/L (2015 Rule)

# Next steps

- Run the three FGD samples (3-4 tests)
- Additional analysis on solids particle size
- Post processing of effluent to address Hg content
- Complete analysis of results