Fly Ash Reinjection

After converting a common stack to a single stack in 2019, MP needed a method to perform an RCA while no longer having the ability to detune or bypass the PCE. This presentation will cover the PCE and stack configuration, options considered, preparations for testing, testing and results.

Bobbi Jean Greenwalt
Minnesota Power

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Overview

- Common Stack, initial 2014 PS-11 Correlation
  - PCME 181WS (extractive, forward scatter)
- Conversion to a single stack in 2019
  - 380MW wet-scrubbed unit
- Detuning no longer an option
- Successful RCA using PM spiking (fly ash reinjection)

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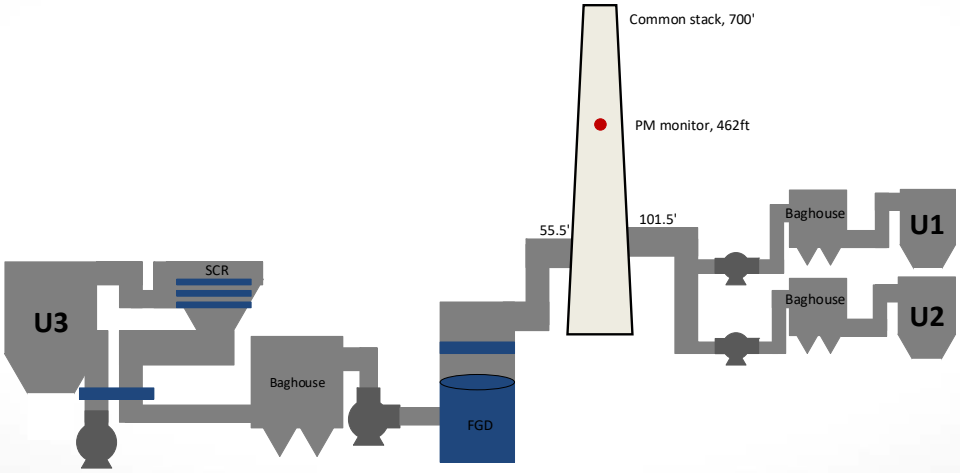
Flue Gas Path – Original Correlation



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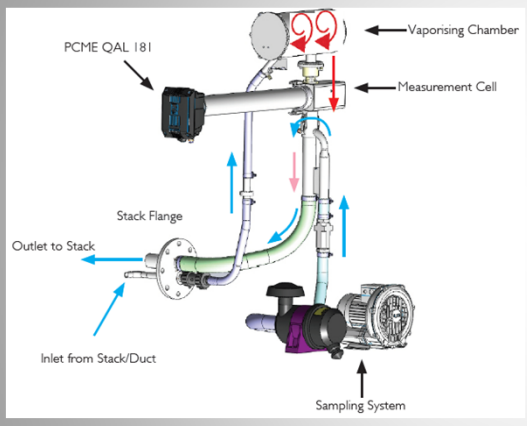
PM CEMS



PCME 181WS

Boswell Unit 3 Installation

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Original Correlation – Detuning (bag removal)
December 2014

- No method to bypass Unit 3
- Unable to bypass U1 or U2 Baghouse
- Final solution – U1/U2 bag removal
  - Pros
    - Simple
    - Effective
    - Repeatable (successful RCA 2017)
  - Cons
    - Time consuming

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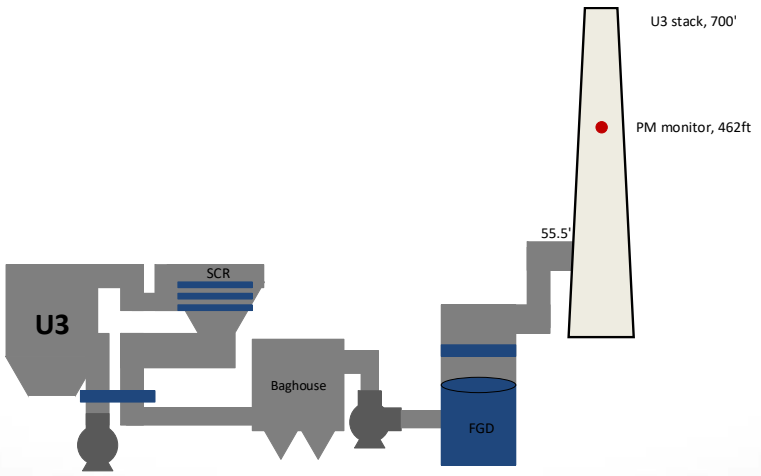
Flue Gas Path – Post Unit 1&2 Retirement



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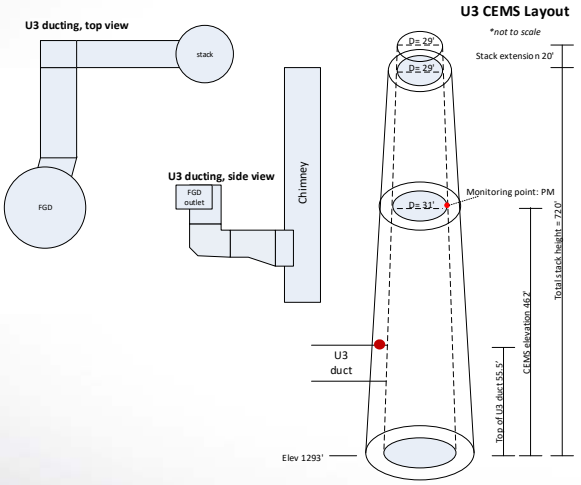
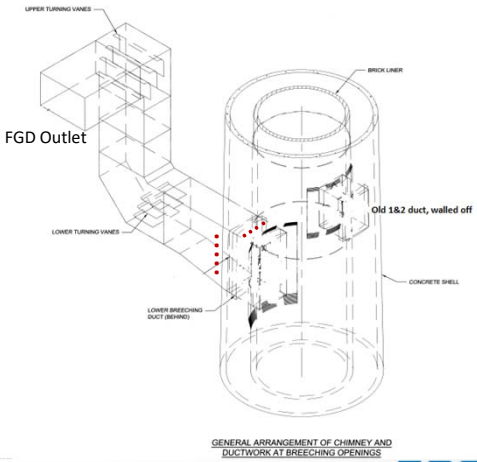
Flue Gas Path – Post Retirement Detail





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FGD Outlet to Stack

FGD Outlet to Stack

Exterior Stack Ports

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Detuning Options Considered

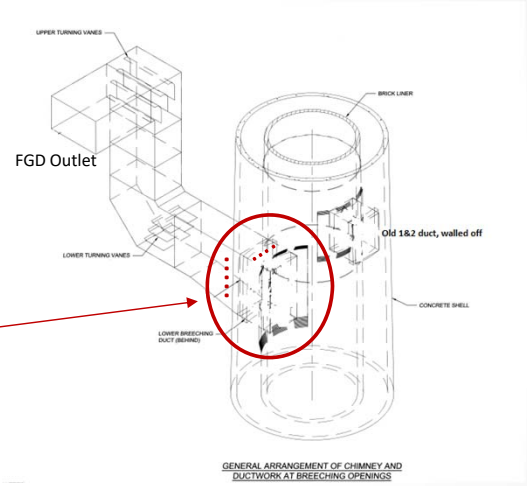
1. Baghouse Bypass
   - Concerns:
     - FGD particulate scrubbing
     - FGD contamination
2. FGD Detuning
   - Concerns:
     - System not designed for detuning or bypass
     - PM loading levels (if achievable) would require unit shutdown
     - FGD fouling

PM Spiking (Fly Ash Reinjection)

- B3 Systems, Inc
  - Load native fly ash into a feeder
  - Gravimetric feed control
  - 60ft feed line with (2) 1.5” probes

Site Preparations

- Site Walk Down
  - Ash densities
    - Lightest ash, downstream compartment
  - Flow studies
    - Stratification
    - PM port location
  - Port locations
    - Horizontal (4) in stack annulus
    - Vertical (5) outside stack
    - HG CEMS interference



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Testing - Setup

- Plant resources
  - 10’ x 10’ staging area
  - Power (2) 110VAC/20A circuit
  - Air compressors (or 40-50 scfm plant air supply)
  - Cooling water, compressors (1.5 gpm)
  - Fly ash
    - (7) 55-gallon drums
    - Sealed, protected from elements
    - 2 week maximum “shelf-life”

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Testing - Responsibilities

- I&C
  - All CEMS passed daily calibrations & fully operational
  - Stand-by support
- Plant Environmental & Operations
  - Full, steady load
  - Oversight
- Stack Tester – TRC
  - Method 5 runs
  - On-site analysis
  - Correlation curve analysis
- Fly Ash Injection vendor – B3 Systems, Inc
  - Maintain steady state injection rates for mid and high PM load runs

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Testing

- Response Correlation Audit (RCA)
  - 12 runs
  - 60 minute runs
  - 4 days + 1 contingency day
  - Level 1 = baseline (normal ops)
  - Level 2 = mid (25-75%)
  - Level 3 = high (50-100%)
- Day 1
  - Safety training, set-up
  - Fly ash injection trial run

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Testing

Day 2 (runs 1-5)

Run 1 – level 1 (normal operations)

Run 2 – level 2 (spiked)

Run #	Level	Set Point	Actual
2	2 (mid)	406.22 lb/hr	207.59 lb/hr

Problem: Frequent plugging

Solution: Dual probes

Run 3, 4, 5 – level 3 (spiked)

Run #	Level	Set Point	Actual
3	3 (high)	350 lb/hr	313.26 lb/hr
4	3 (high)	350 lb/hr	340.37 lb/hr
5	3 (high)	350 lb/hr	345.45 lb/hr

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Testing

Day 3 (runs 6-10)

Run 6 – level 1 (normal operations)

Run 7 – level 3

Run 8,9,10 – level 2

Run #	Level	Set Point	Actual
7	3 (high)	350 lb/hr	312.24 lb/hr
8	2 (mid)	150 lb/hr	149.98 lb/hr
9	2 (mid)	150 lb/hr	149.97 lb/hr
10	2 (mid)	150 lb/hr	150.25 lb/hr

Day 4 (runs 11-12)

Run 11,12 – Level 1 (normal operations)

Demobilization

COMPLETE!!

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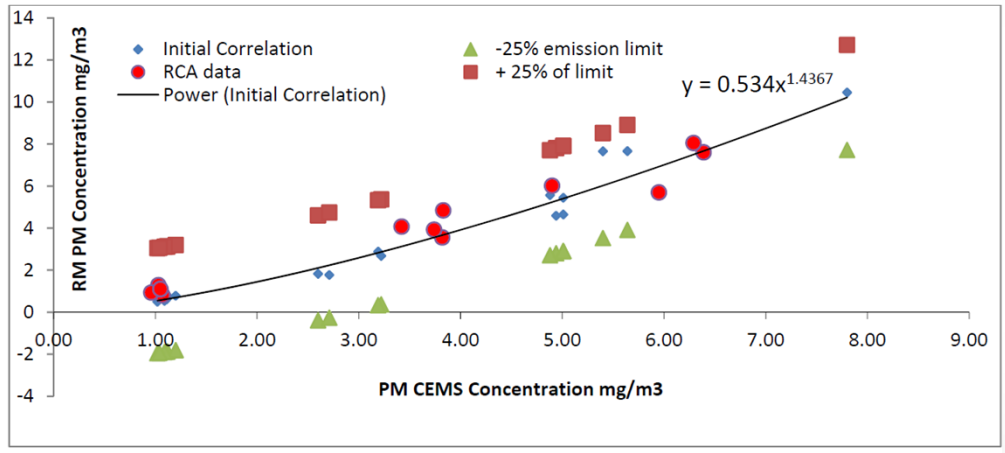
Results



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Questions?

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