# MATTABASSETT EXPERIENCE – THE FIRST NEW FLUID BED MUNICIPAL SLUDGE INCINERATOR IN THE US MEETING THE NEW MACT LLLL EMISSION LIMITS

Arthur Simonian, P.E., LEED, Mattabassett District
David Stille, Mattabassett District
Mike Manfre, Mattabassett District
Gary Claytor, SUEZ
Ken Glass, P.E., SUEZ
Levent Takmaz, Ph.D., SUEZ

**NJWEA 104th ANNUAL CONFERENCE & EXPOSITION**

**BALLY'S ATLANTIC CITY**

**ATLANTIC CITY, NJ**

**May 7th, 2019**

ready for the resource revolution

suez

# MATTABASSETT Water Pollution Control Facility (WPCF)

# TOPICS OF DISCUSSION

- Introduction
- Process Flow Diagram
- US EPA MACT Limits
- Equipment
- Stack Test Emission Results
- Operational Difficulties with Fixed Carbon Bed Adsorber
- Conclusions

# INTRODUCTION

- Mattabassett District provides wastewater treatment services to four communities in Connecticut (New Britain, Middletown, Cromwell and Berlin).
- Mattabassett District owns and operates the Mattabassett Water Pollution Control Facility (WPCF) located at 245 Main Street in Cromwell, CT.
- The plant operates 24 hours a day, 7 days a week and 365 days a year.
- Mattabassett Plant is designed to treat an average of 12 to 21 million gallons of wastewater every day. Expected peak wastewater flow is 80 million gallons per day.
- Biosolids produced at the plant are dewatered using GEA Westfalia centrifuges and then sent to Thermylis® System supplied by SUEZ.
- Mattabasssett Thermylis® System is in compliance with the new MACT (Maximum Achievable Control Technology) emission limits.
- MACT was issued by US EPA on March 21st, 2011.

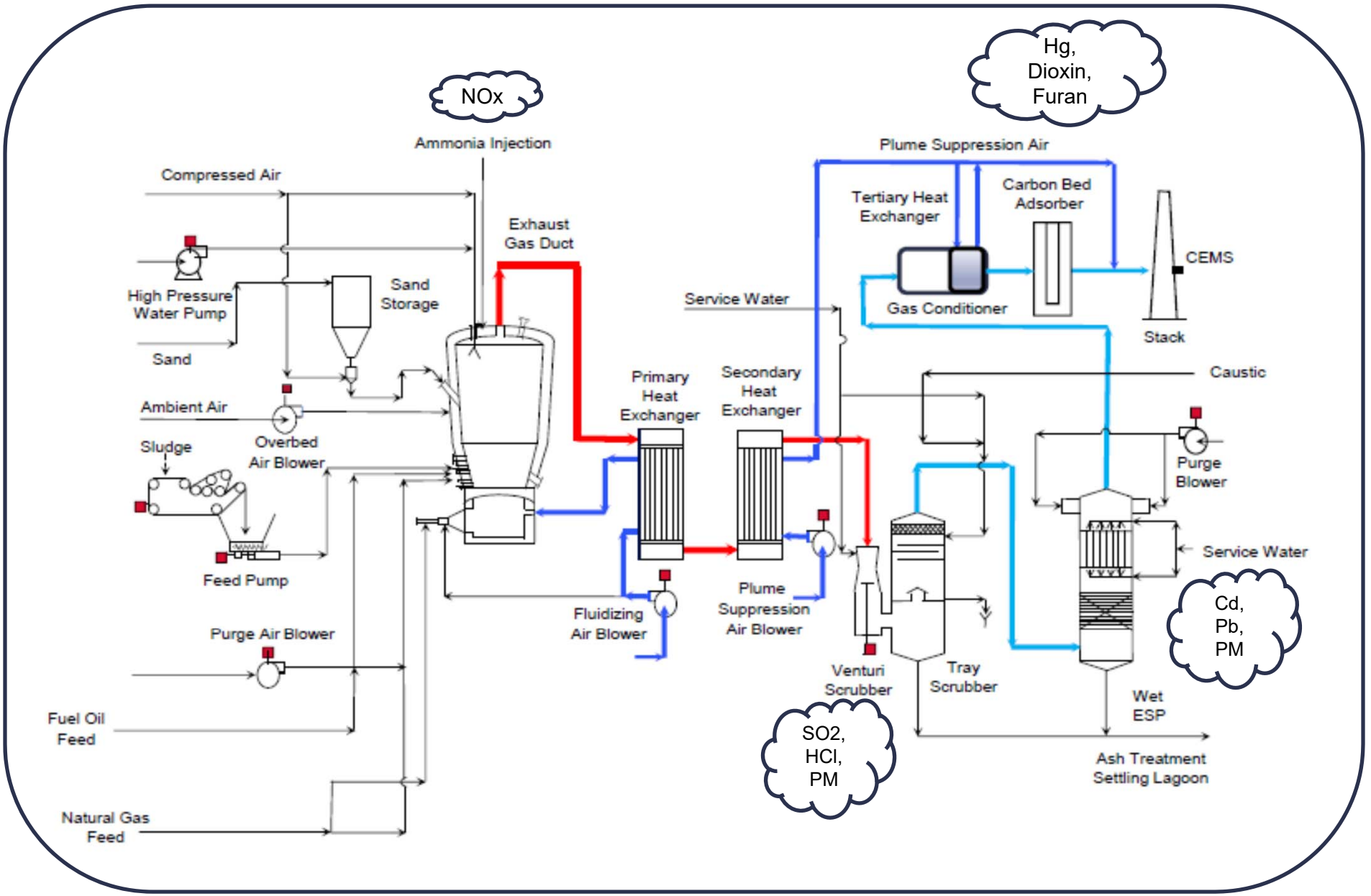
# INTRODUCTION

- MACT applies to new and existing municipal sludge fluid bed incineration plants in the US.
- US EPA requires MACT compliance by March 21st, 2016 for all plants in operation in the US. Plants not in compliance with MACT should be retrofitted or shut down completely.
- Mattabassett incinerator has been the first new fluid bed incinerator in the US starting up and passing through the stack emission testing in April 2016 meeting the new MACT LLLL emission limits.
- Fixed carbon bed adsorber has experienced an unexpected temperature excursion after the commissioning resulting in equipment damage on August 22nd, 2016.
- Damage to the equipment has been repaired on-site. The unit was started-up in May 2017 with the revised PLC program and O&Ms. Since the start-up in May 2017, the unit has been running continuously without experiencing any temperature excursions.

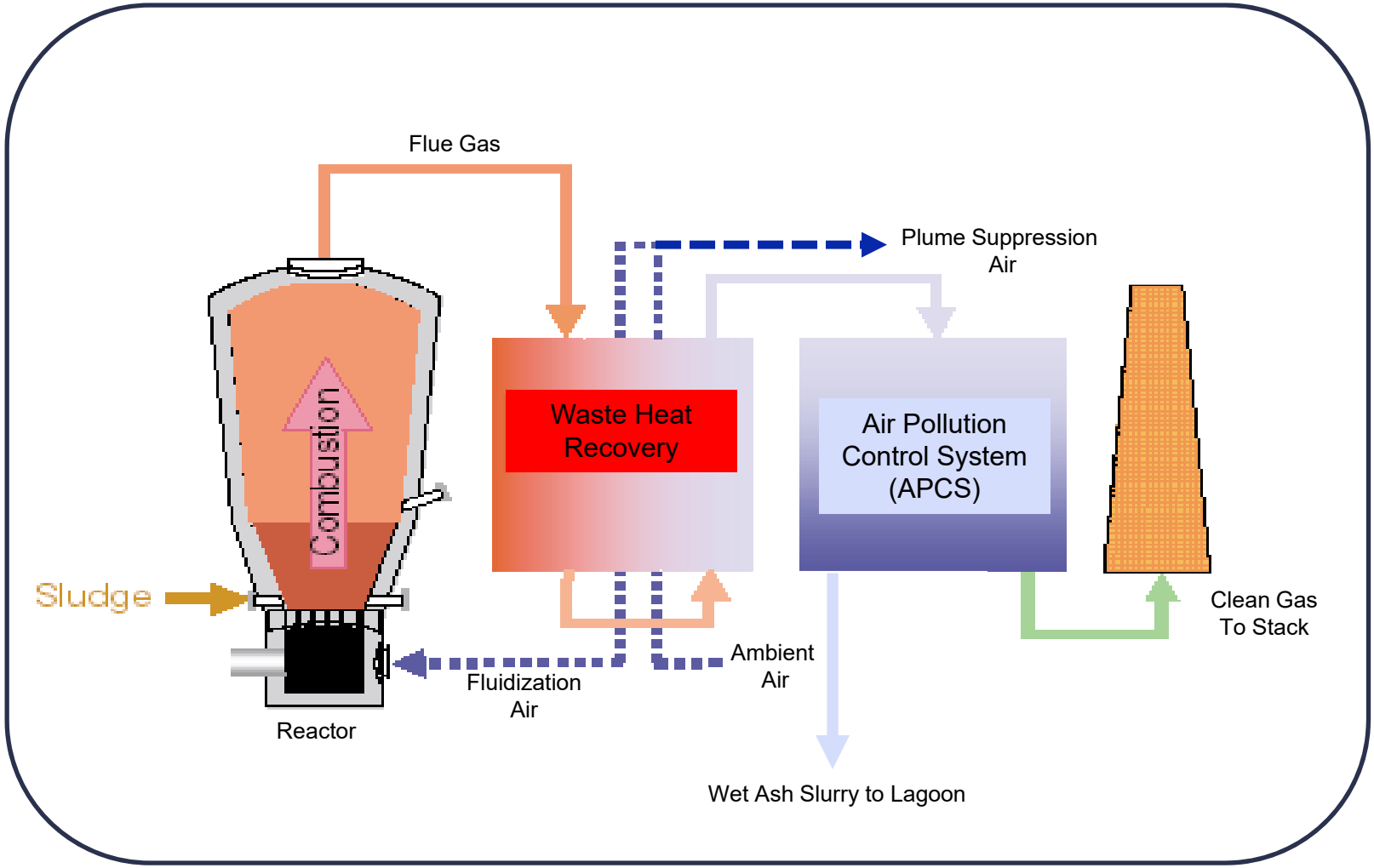
# INTRODUCTION

- Design Parameters:
  - Heat Value: 9,627 btu/lb-vol
  - Volatile: 85.87%
  - Total Solids: 25%
  - Capacity: 36 DTPD
- Historical Timeline:
  - SUEZ Award: 2010
  - Contractor Bid: 2011
  - PO From Contractor to SUEZ: 2012
  - Sludge Injection: 2015
  - Stack Testing: 2016

# PROCESS FLOW DIAGRAM



# PROCESS BLOCK DIAGRAM

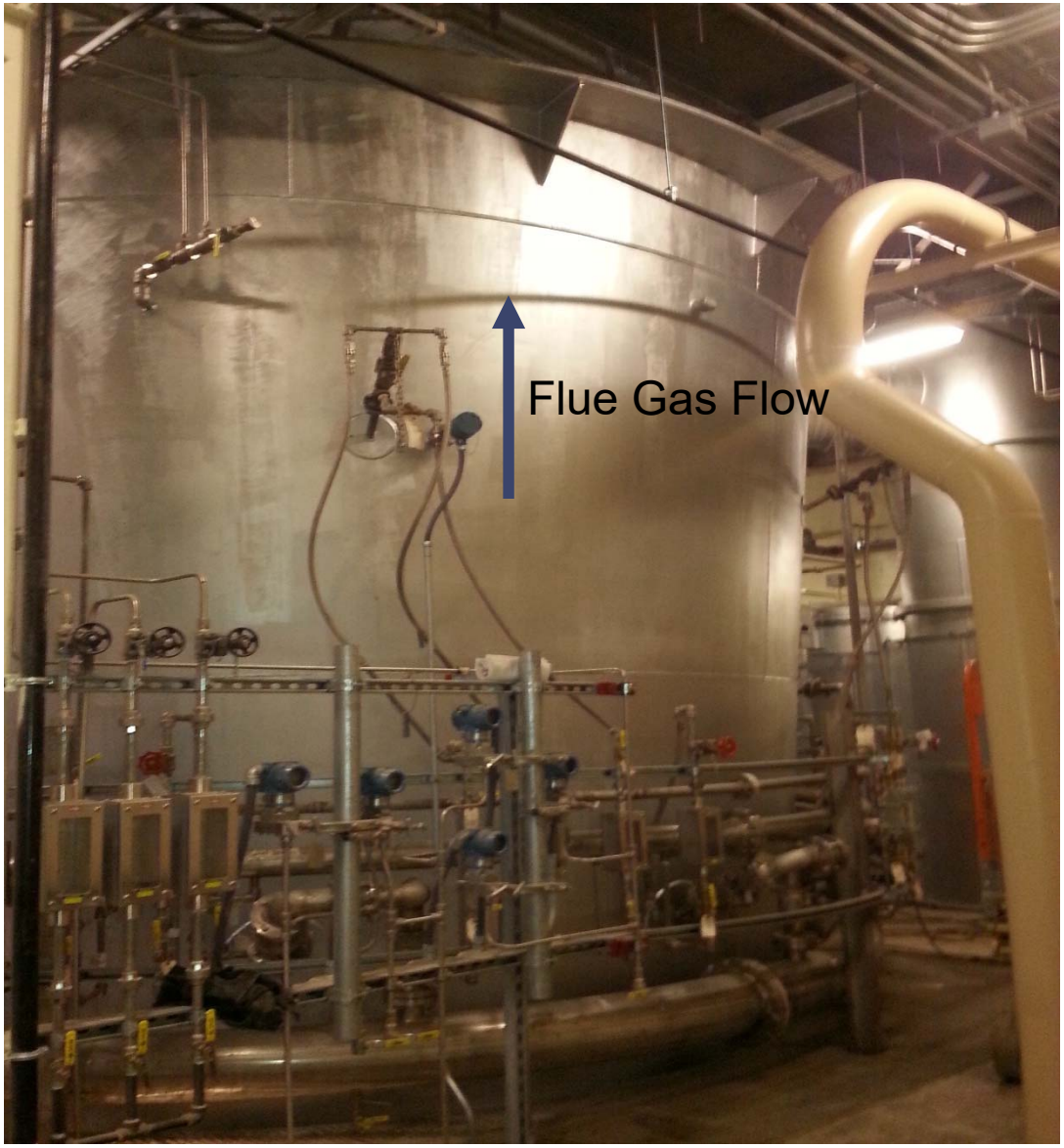


# US EPA MACT LIMITS

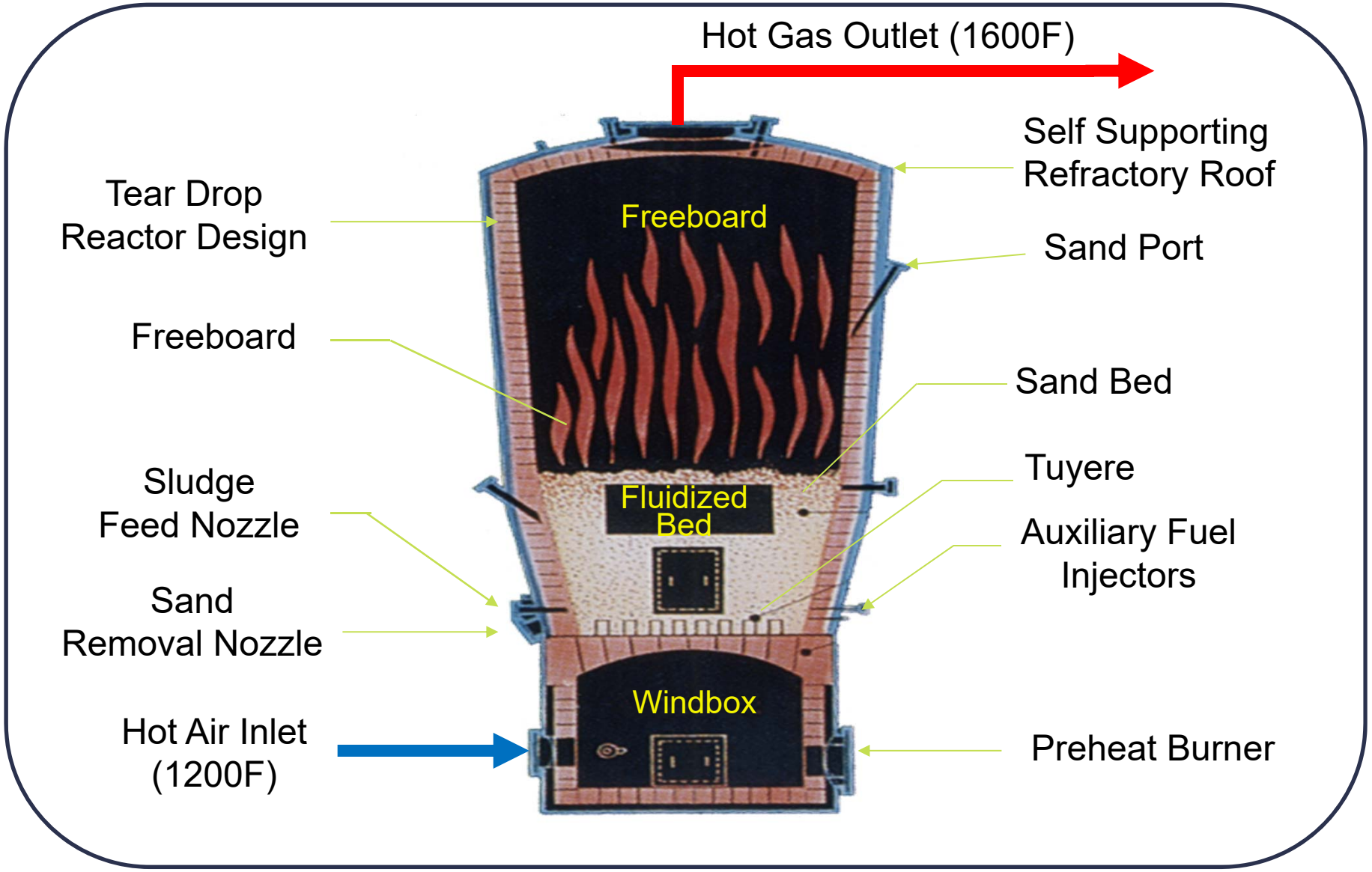
## EPA Guideline for NEW and EXISTING FB Incinerators

| Pollutant | Units | Existing FB (@ 7% $O_2$) | New FB (@ 7% $O_2$) |
|---|---|---|---|
| Cd | mg/dscm | 0.0016 | 0.0011 |
| CO | ppmvd | 64 | 27 |
| HCl | ppmvd | 0.51 | 0.24 |
| Hg | mg/dscm | 0.037 | 0.0010 |
| $NO_x$ | ppmvd | 150 | 30 |
| Pb | mg/dscm | 0.0074 | 0.00062 |
| PCDD/PCDF,TEQ | ng/dscm | 0.1 | 0.0044 |
| PCDD/PCDF,TMB | ng/dscm | 1.2 | 0.013 |
| PM | mg/dscm | 18 | 9.6 |
| $SO_2$ | ppmvd | 15 | 5.3 |

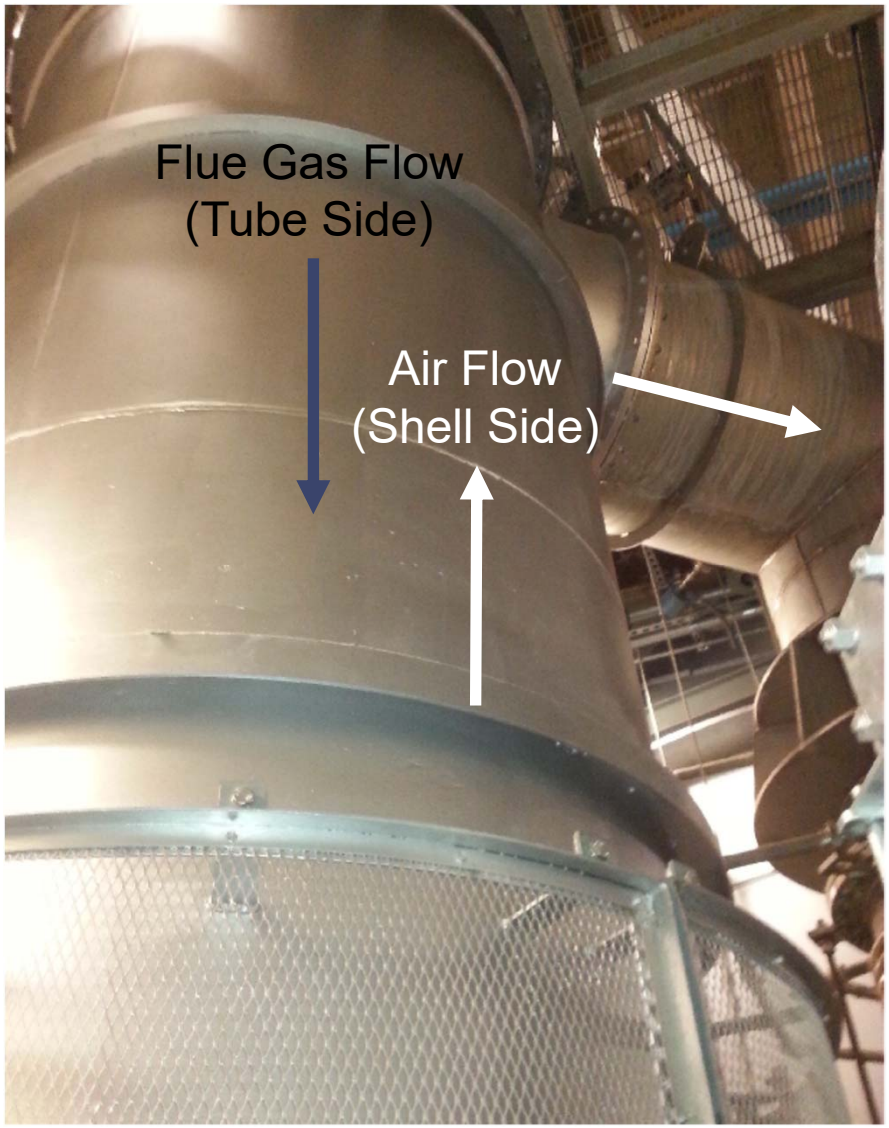
# FLUID BED REACTOR



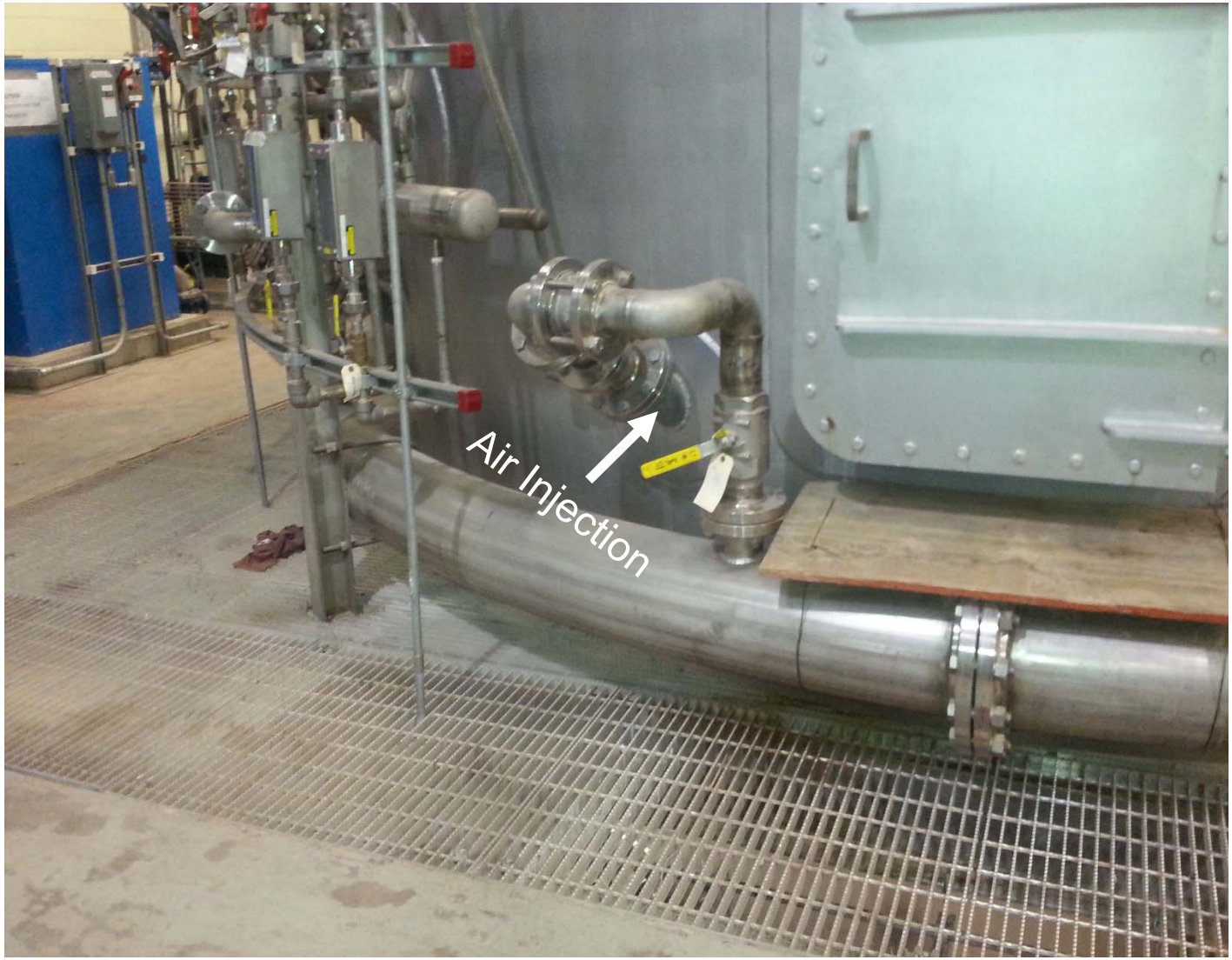
# FLUID BED REACTOR



# PRIMARY HEAT EXCHANGER



# OVERBED AIR SYSTEM



# NOx REMOVAL SYSTEM*

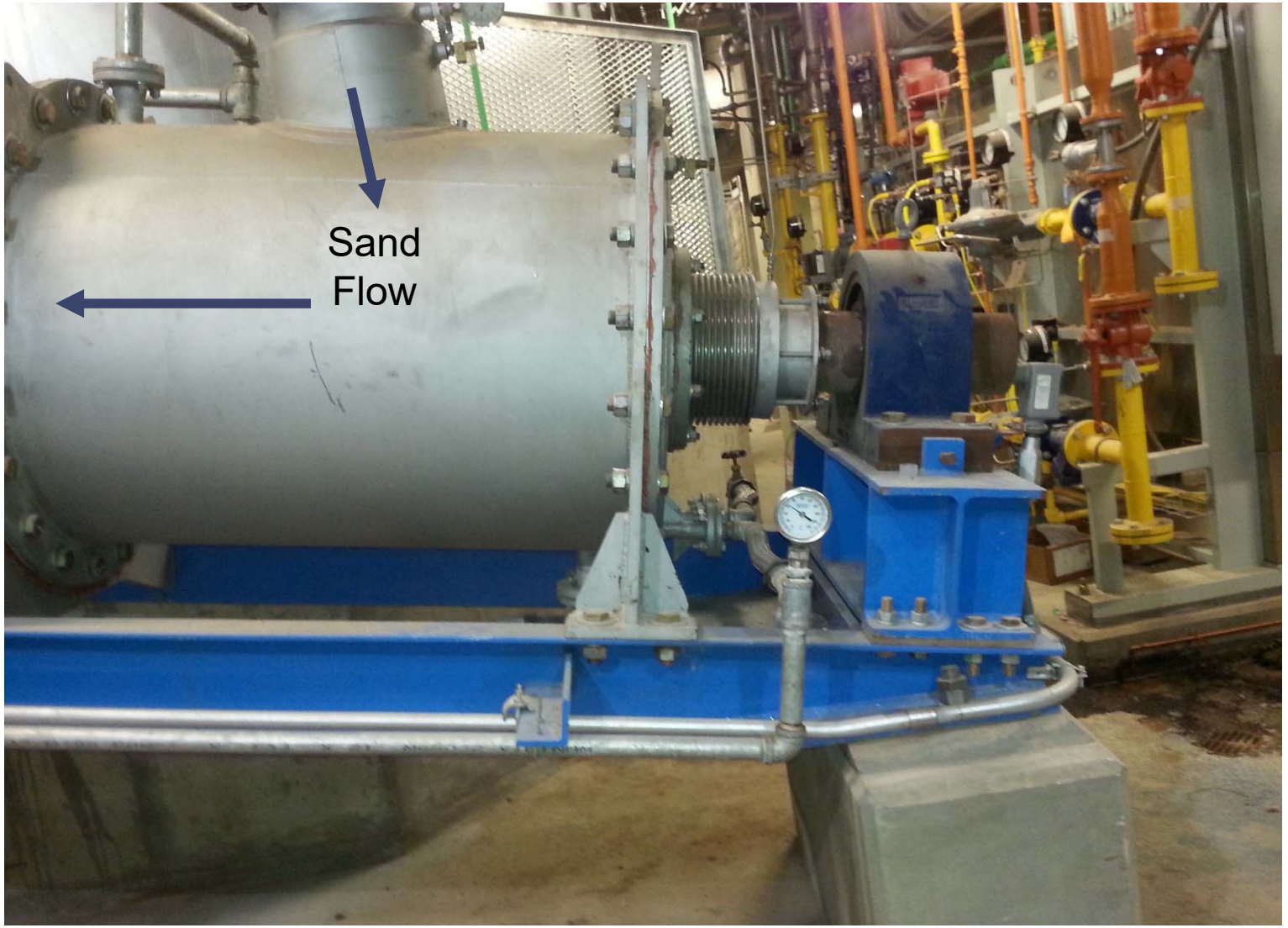

(*) No Longer in Service

# NOx REMOVAL SYSTEM*


(*) No Longer in Service

# SAND FEED SYSTEM

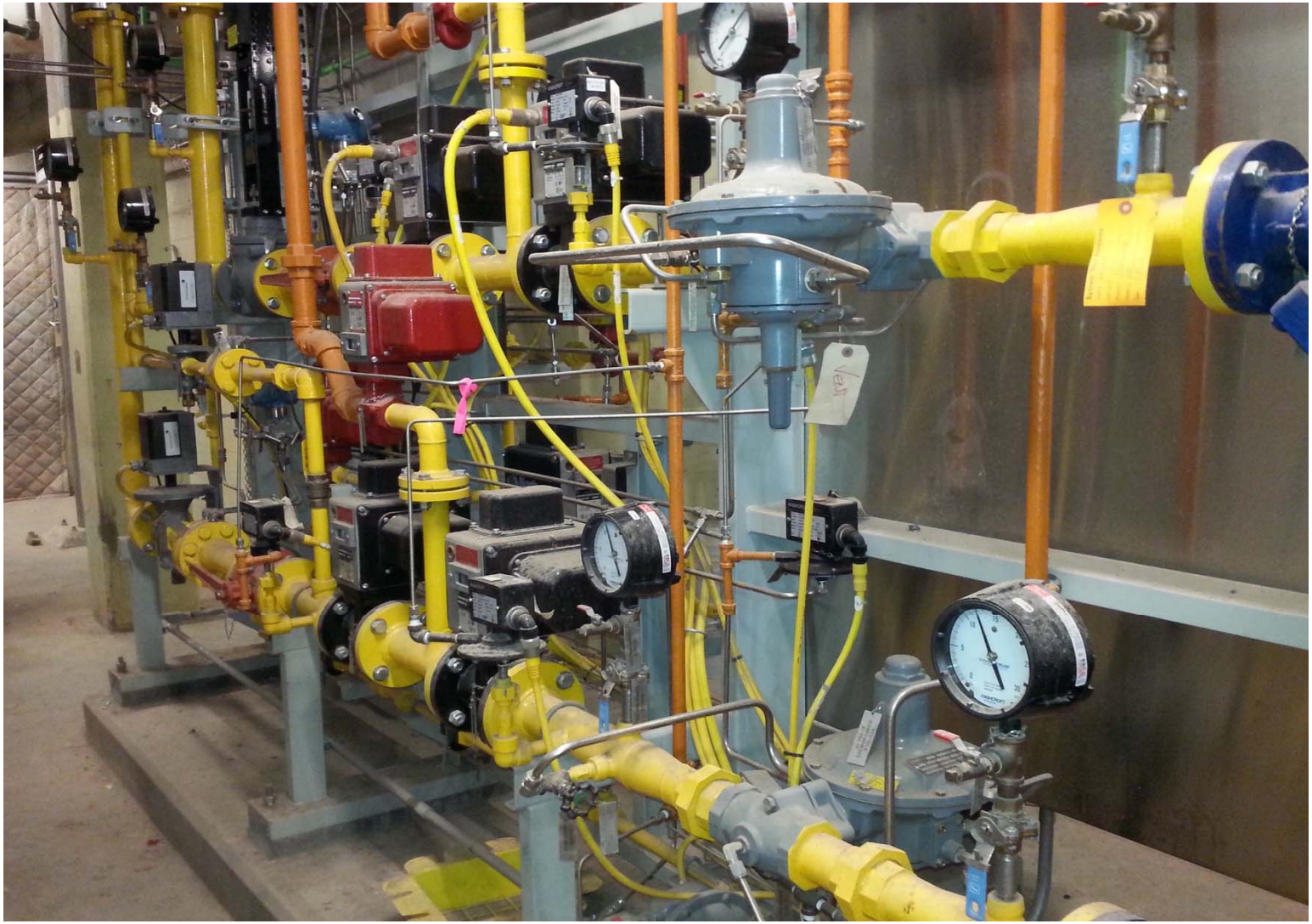
# SAND COOLING SCREW



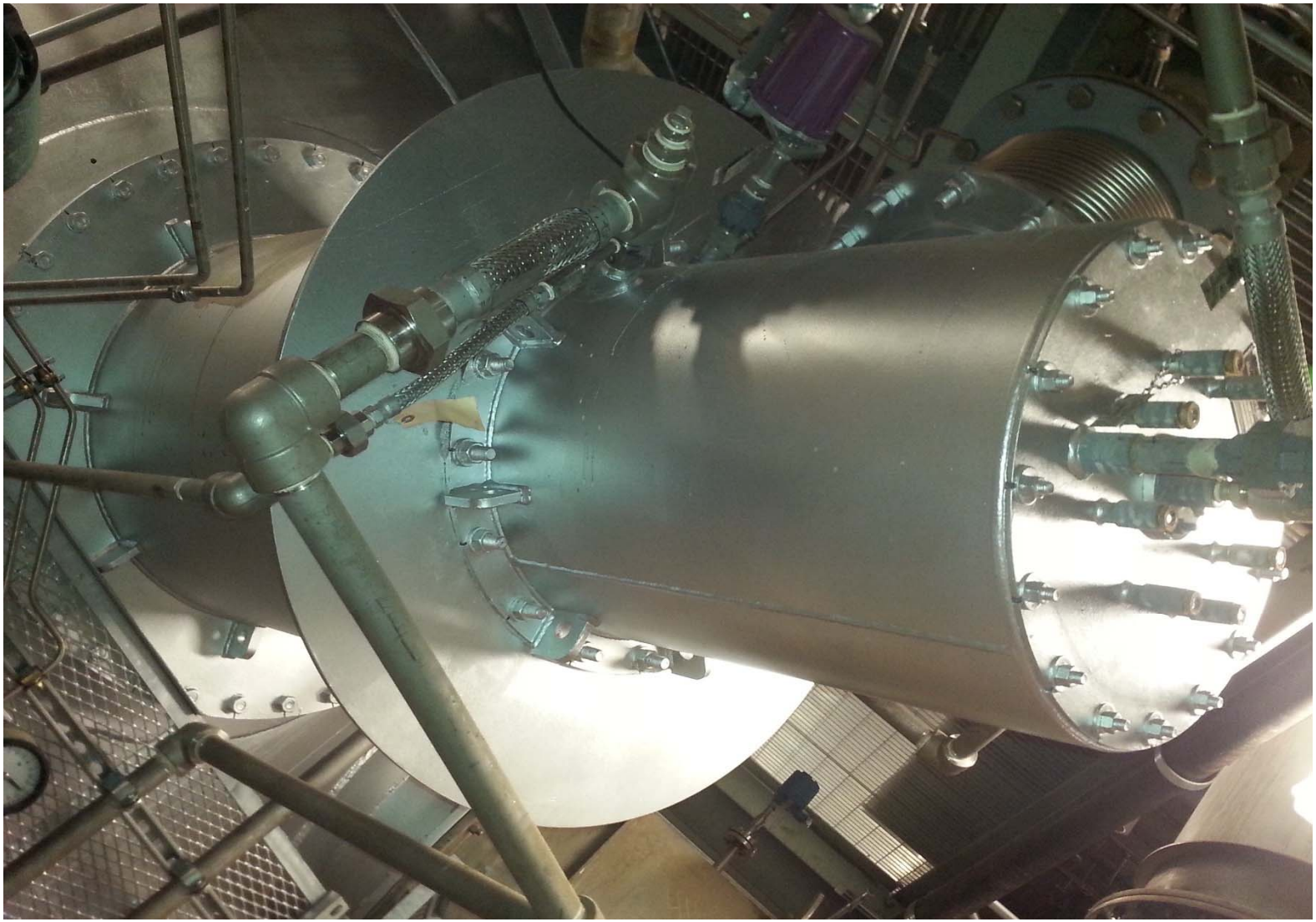
# SAND COOLING SCREW

# SAND COOLING SCREW

# PREHEAT FUEL TRAIN



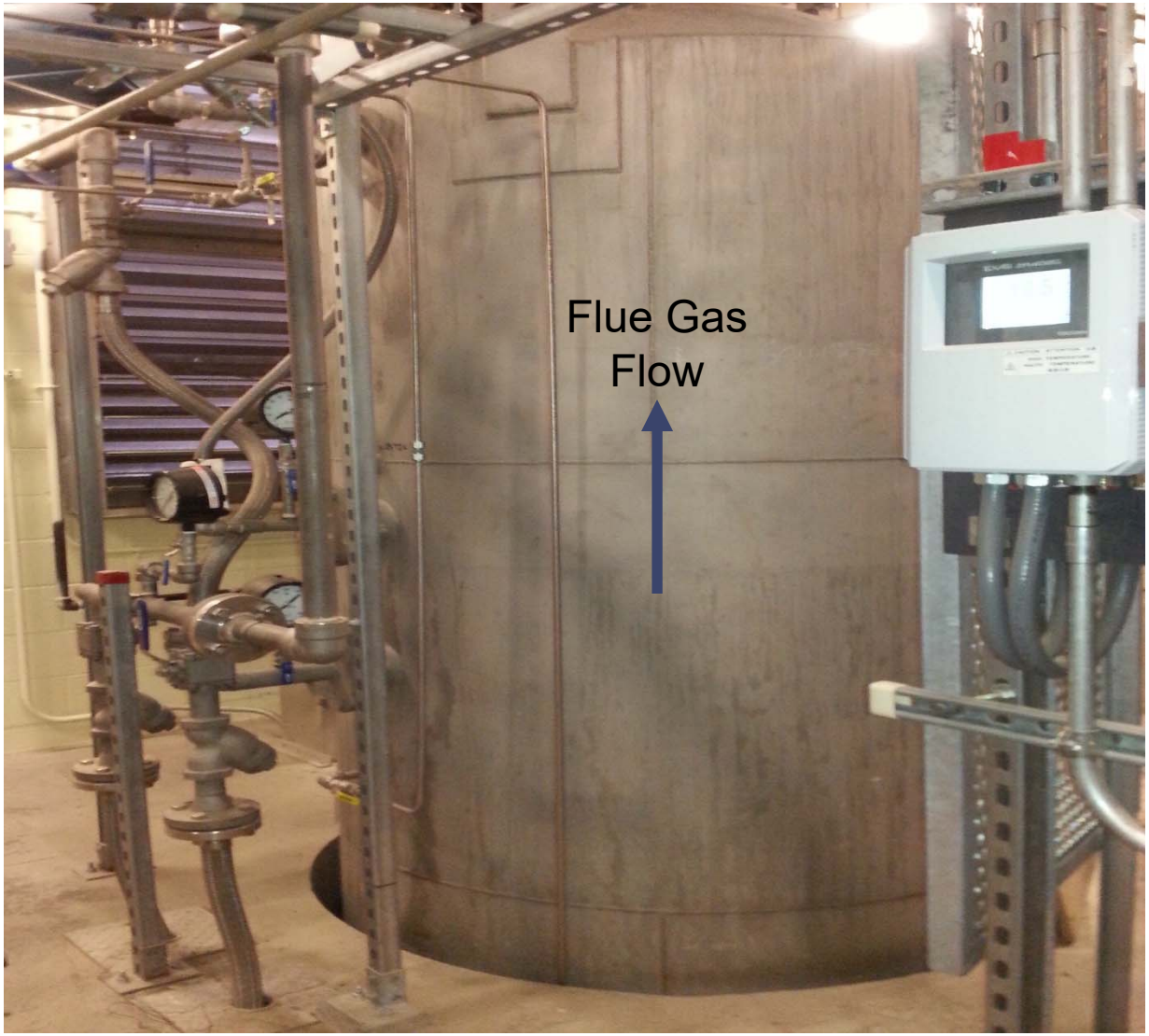
# PREHEAT BURNER



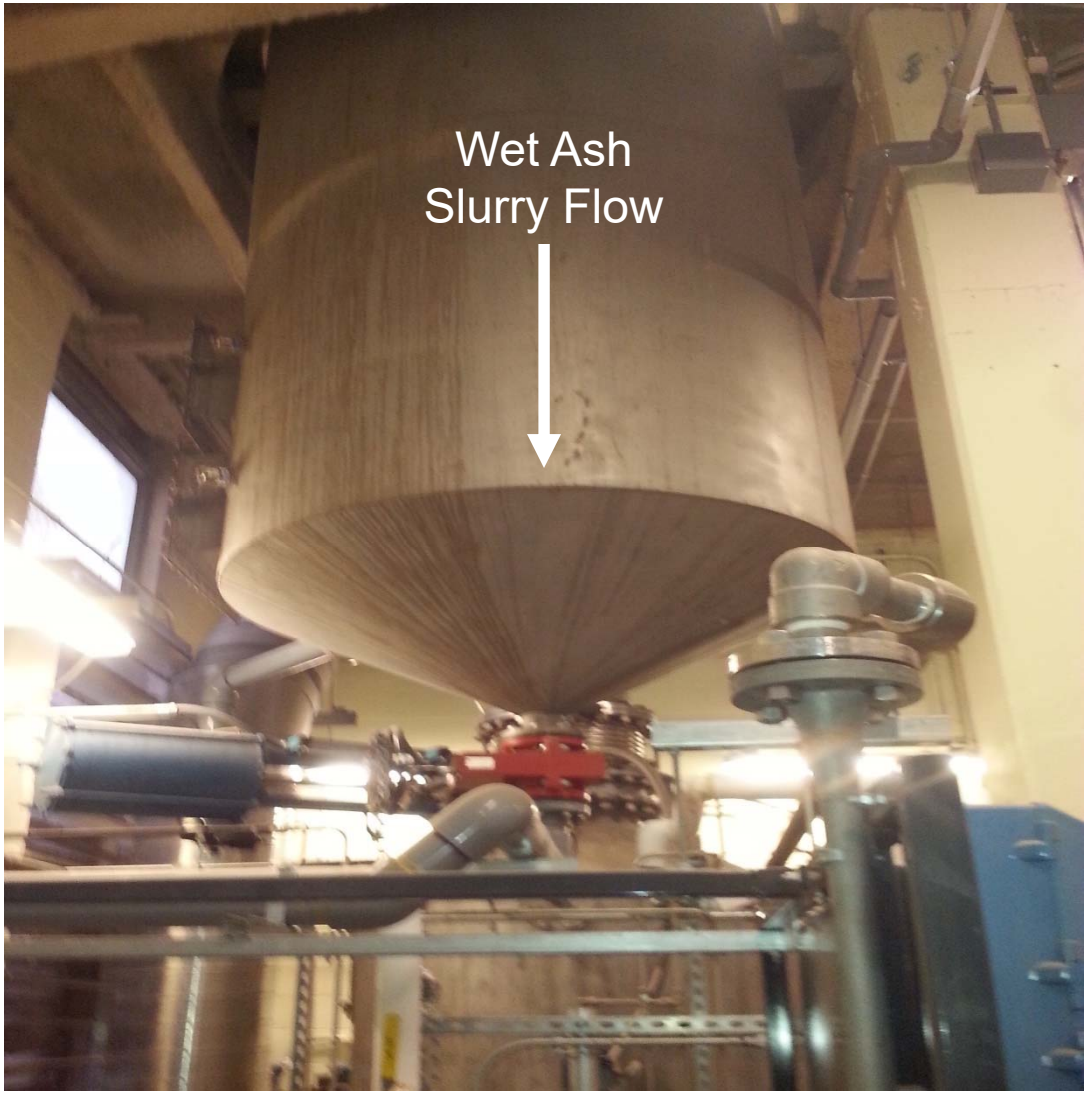
# FLUIDIZING AND OVERBED AIR BLOWERS

# PLUME SUPPRESSION BLOWER

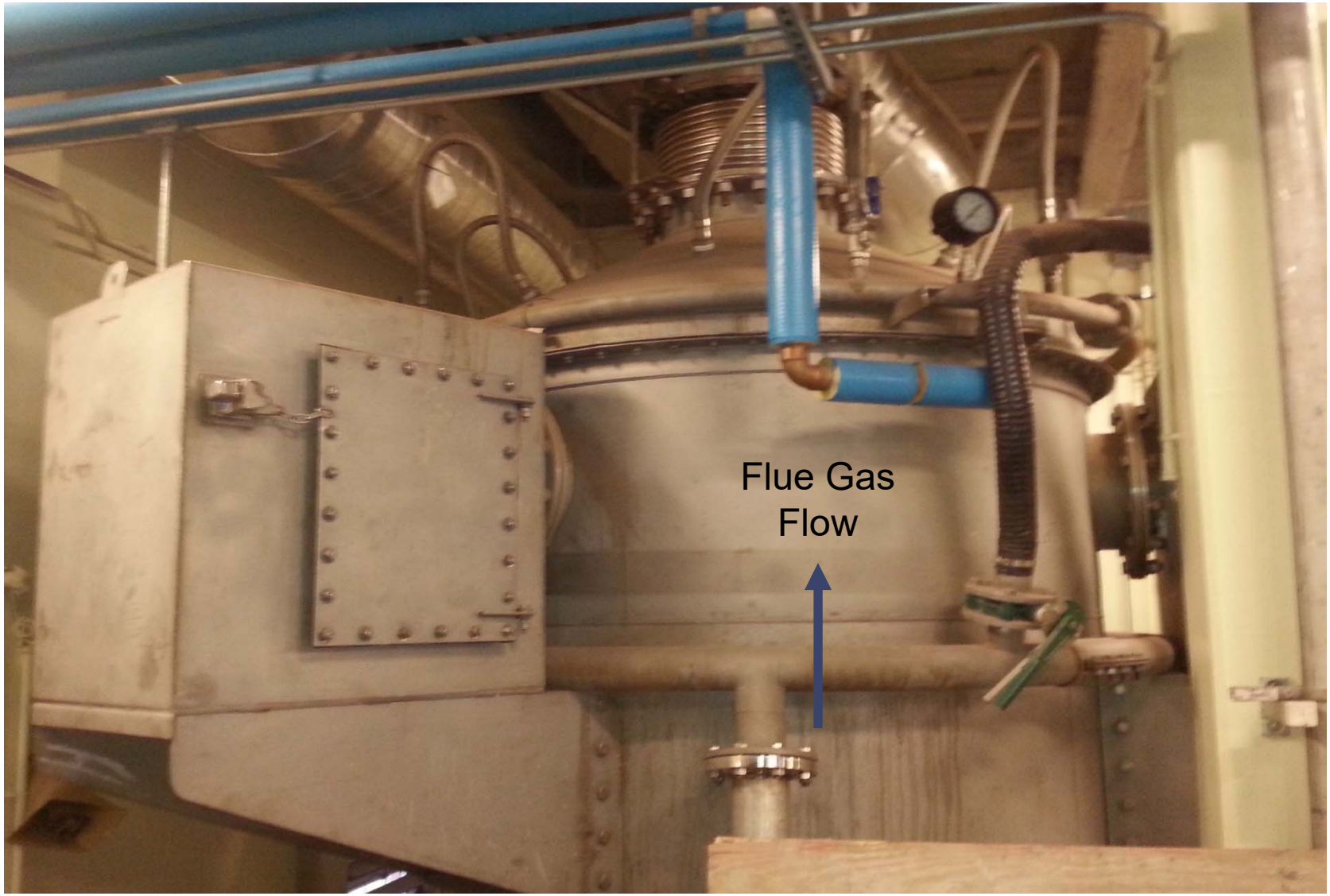
# WET SCRUBBER



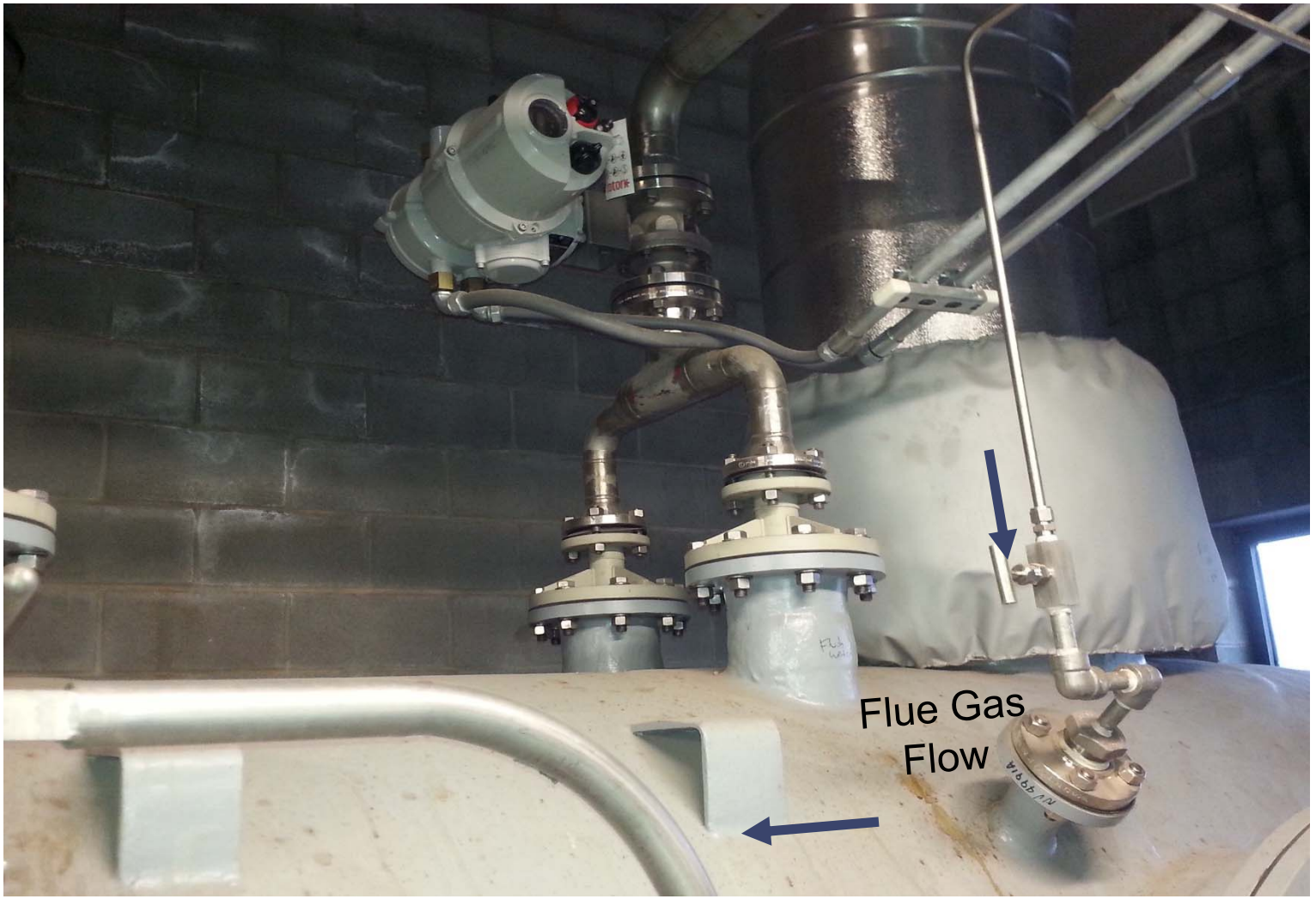
# WET SCRUBBER



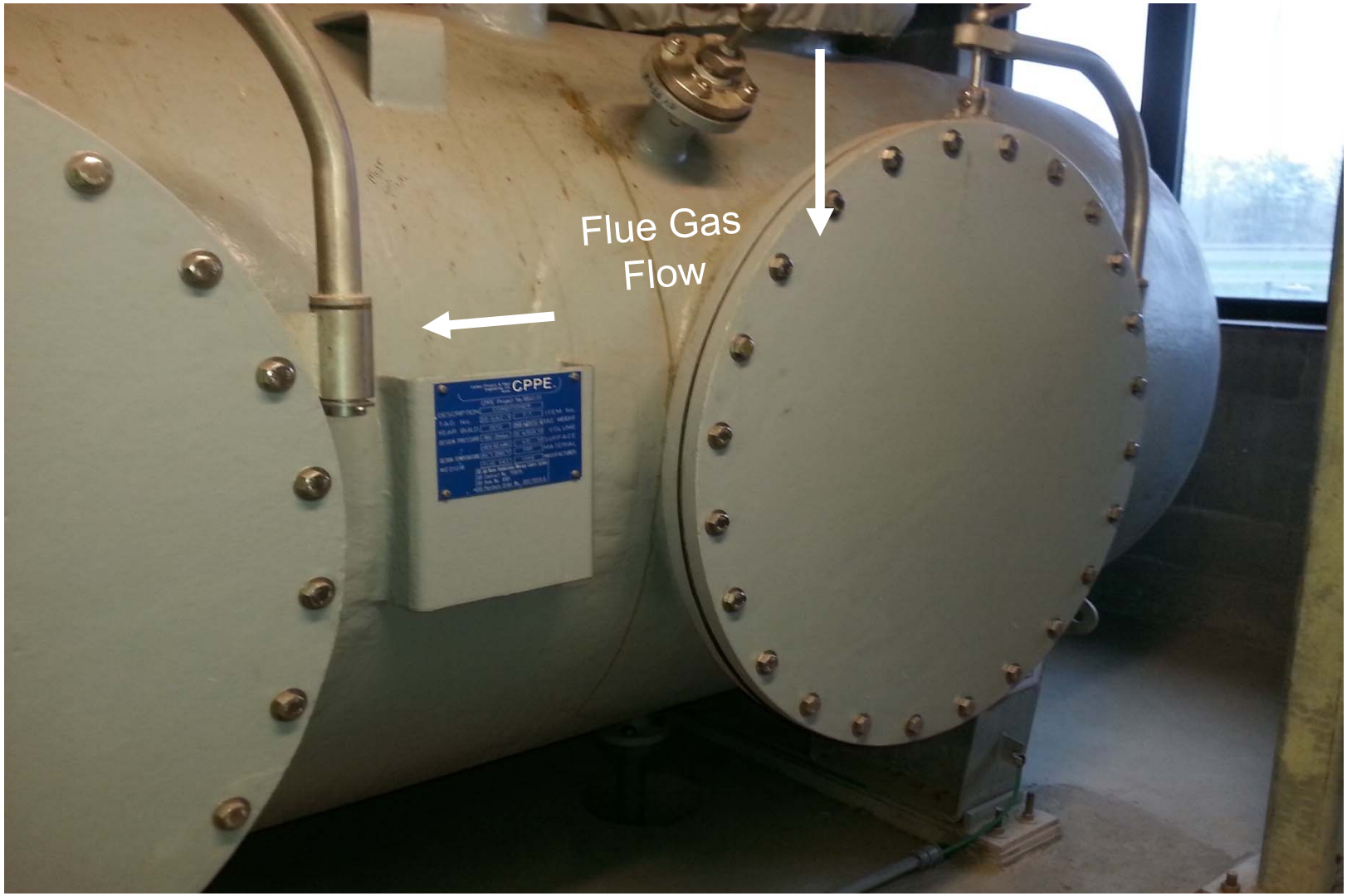
# WET ESP



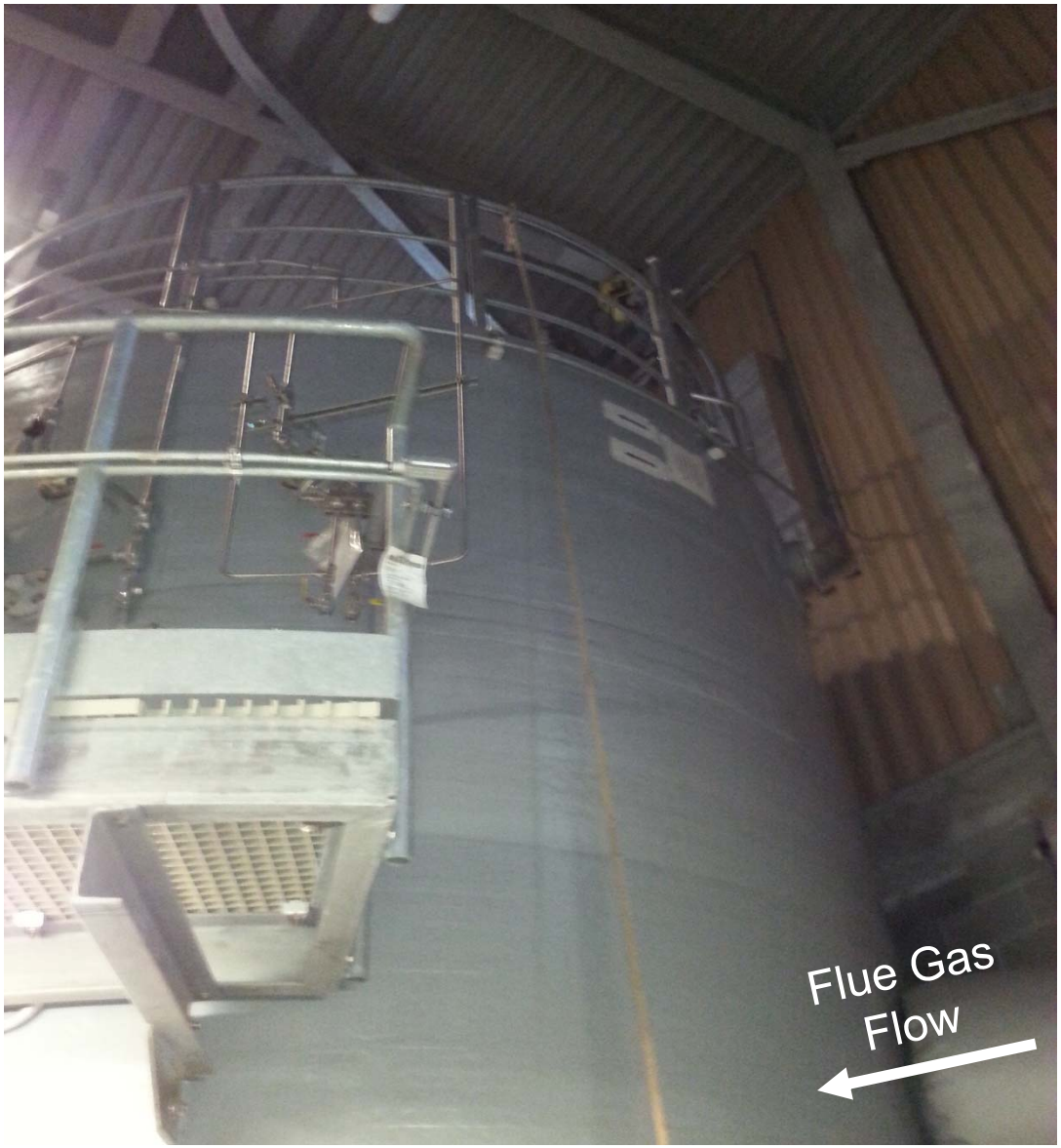
# GAS CONDITIONER



# GAS CONDITIONER

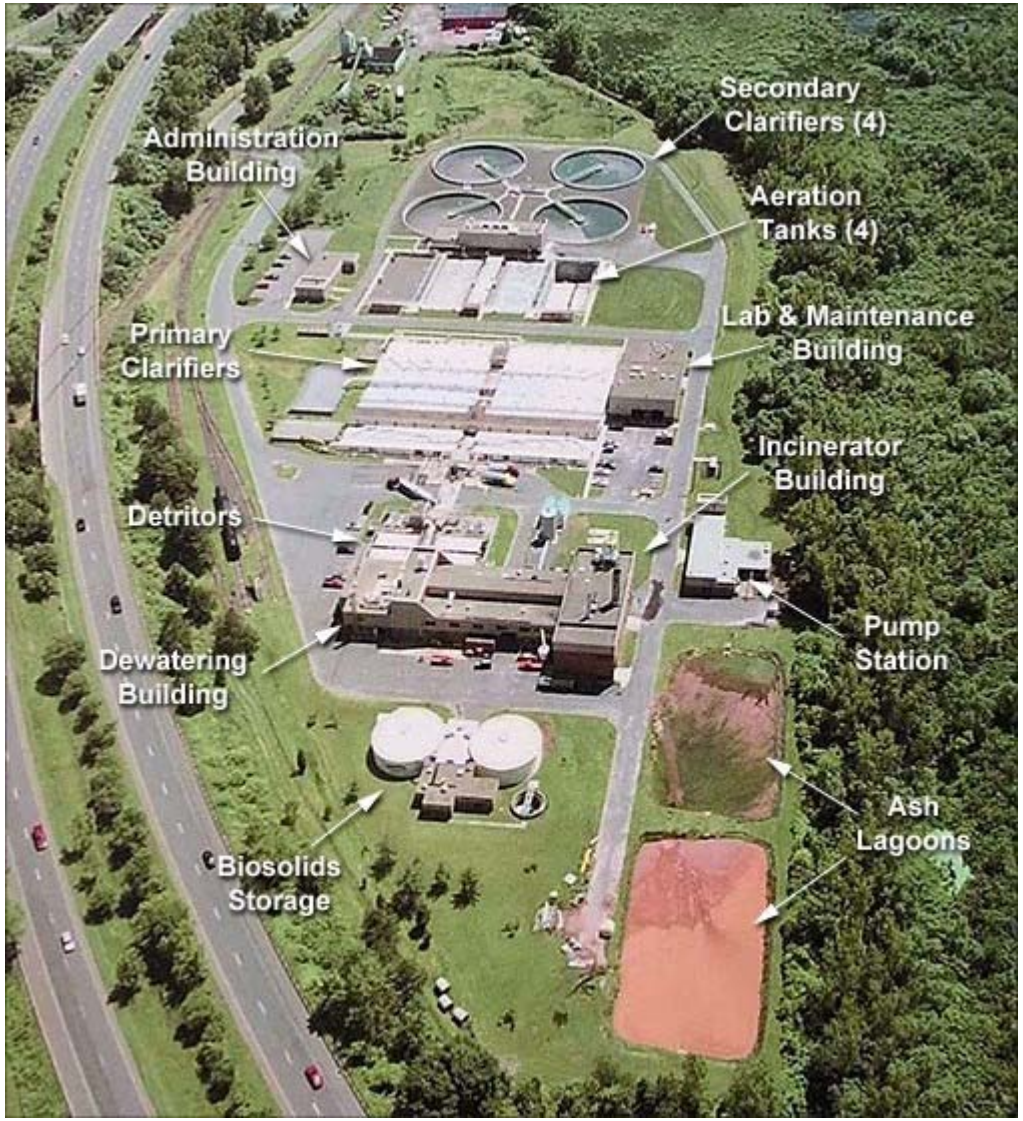


# GAC ADSORBER



# STACK

# ASH LAGOONS

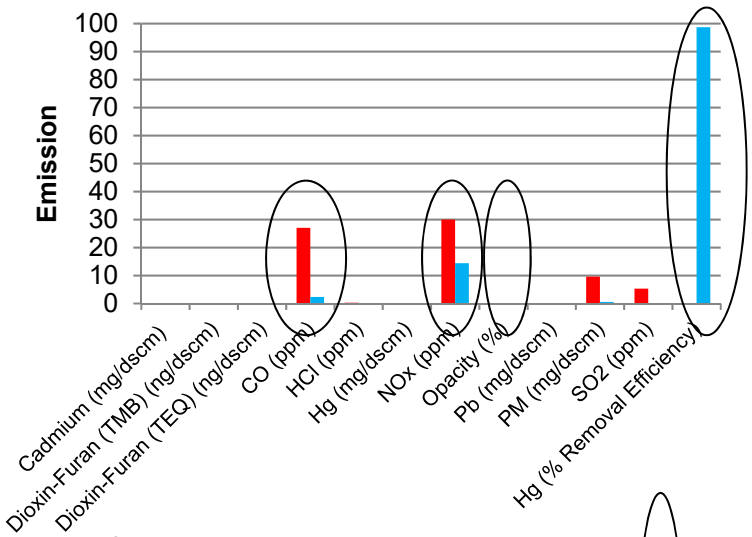

Secondary Clarifiers (4)
Administration Building
Aeration Tanks (4)
Lab & Maintenance Building
Primary Clarifiers
Incinerator Building
Detritors
Pump Station
Dewatering Building
Ash Lagoons
Biosolids Storage

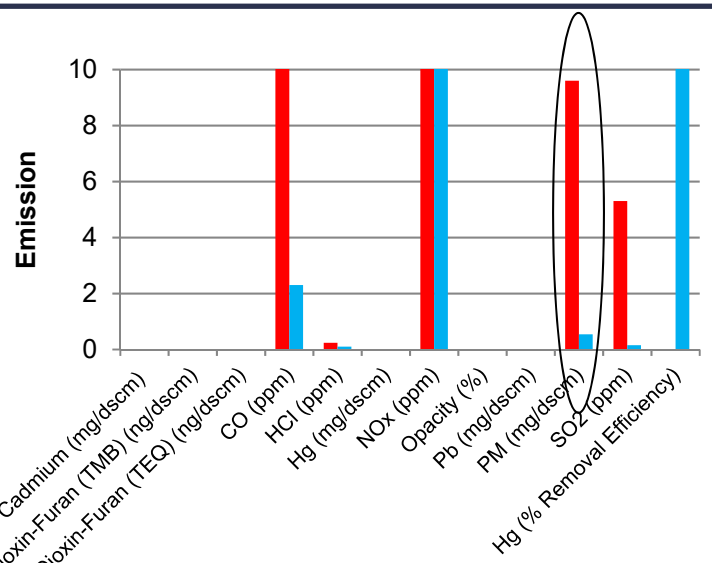
# STACK EMISSION TEST RESULTS*
# (APRIL 2016)

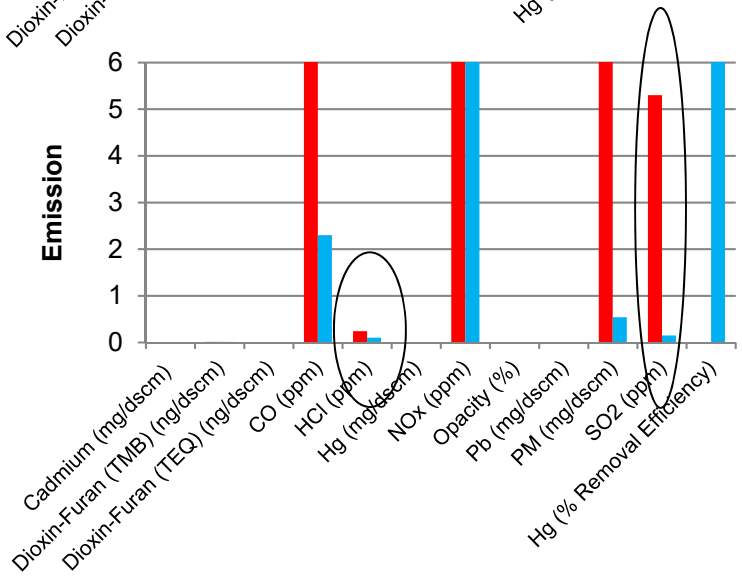
| | | d $2ƒ | ƒ<~ƒ#⁄<~"^ƒ |
|---|---|---|---|
| Cd | mg/dscm | 0.0011 | <0.000052 |
| CDD/CDF, TMB | ng/dscm | 0.013 | 0.0125 |
| CDD/CDF, TEQ | ng/dscm | 0.0044 | 0.00034 |
| CO | ppmvd | 27 | 2.3 |
| HCl | ppmvd | 0.24 | 0.102 |
| Hg | mg/dscm | 0.001 | 0.00068 |
| NOx | ppmvd | 30 | 14.4 |
| Opacity | % | 0 | 0 |
| Pb | mg/dscm | 0.00062 | 0.00038 |
| PM | mg/dscm | 9.6 | 0.54 |
| SO2 | ppmvd | 5.3 | 0.15 |
| | | | |
| Hg | % Rem Eff | | 98.70 |

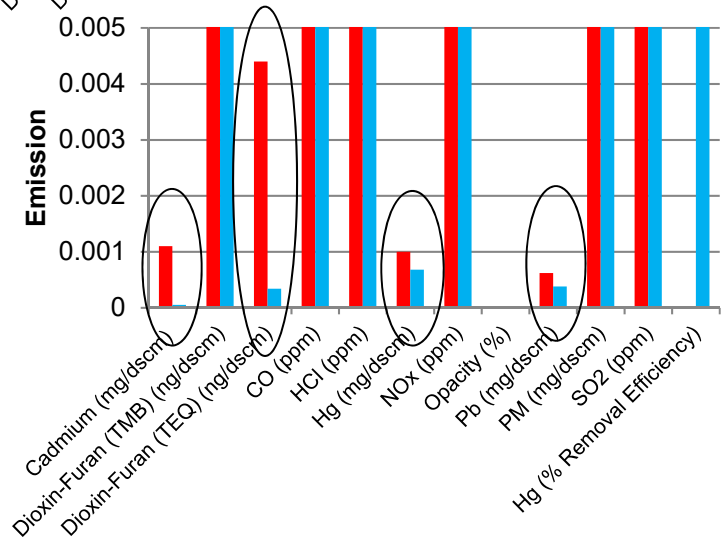
* Corrected to 7% O2

# STACK EMISSION TEST RESULTS*
# (APRIL 2016)




* Corrected to 7% O2

# ALTERNATE MONITORING PLAN FOR $NO_x$

- The Mattabassett District has submitted a request to the EPA and CTDEEP (Connecticut Department of Energy and Environmental Protection) for an Alternate Monitoring Plan for $NO_x$ compliance during the annual performance stack test.

- Monitoring $NO_x$ with Continuous Emission Monitoring System (CEMS) was not achievable especially during Start Up, Shutdowns, Sludge Feed Interruptions and Sand Addition (<30 ppmvd @ 7% $O_2$). Monitoring $NO_x$ through $NO_x$ analyzer was originally in the Site Specific Monitoring Plan. $NO_x$ analyser was part of the CEMS.

- Mattabassett District provided approximately one year's of $NO_x$ emission data to EPA and CTDEEP to show that under certain conditions of oxygen at reactor exhaust, bed temperature and sludge feed, the plant could meet the 30 ppmvd $NO_x$ emission limit, only when burning sludge under controlled conditions:
  - Bed temperature < 1445F (12 hour block average)
  - Oxygen at reactor exhaust < 8.5% (12 hour block average)
  - 0.9 DT/HR minimum sludge feed (12 hour block average) – Designed for 1.5 DT/HR

- A stack emission test was performed in August 2018 to determine the $NO_x$ emissions under controlled conditions.

# STACK EMISSION TEST RESULTS*
# (AUGUST 2018)

| | | d $2ƒ | ƒ<~ƒ#⧀<~"^ƒ |
|---|---|---|---|
| Cd | mg/dscm | 0.0011 | <0.000061 |
| CDD/CDF, TMB | ng/dscm | 0.013 | NA |
| CDD/CDF, TEQ | ng/dscm | 0.0044 | NA |
| CO | ppmvd | 27 | NA |
| HCl | ppmvd | 0.24 | NA |
| Hg | mg/dscm | 0.001 | 0.000548 |
| NOx | ppmvd | 30 | 15.4 |
| Opacity | % | 0 | NA |
| Pb | mg/dscm | 0.00062 | 0.00019 |
| PM | mg/dscm | 9.6 | NA |
| SO2 | ppmvd | 5.3 | NA |
| | | | |
| Hg | % Rem Eff | | NA |

* Corrected to 7% O2

# OPERATIONAL DIFFICULTIES WITH FIXED CARBON BED ADSORBER

- Mattabassett plant experienced a temperature excursion resulting in equipment damage on August 22nd, 2016.
- A task force has been set up by SUEZ to investigate the root cause of the temperature excursion.
- Damage to the equipment has been repaired on-site. The unit was started-up in May 2017 with the revised PLC program and O&Ms.
- Since the start-up in May 2017, the unit has been running continuously without experiencing any temperature excursions.

# OPERATIONAL DIFFICULTIES WITH FIXED CARBON BED ADSORBER

- Automated water quench system has been installed on top of the carbon bed adsorber to spray water during the emergency to quench the carbon bed.
- CO analyzers have been installed at the inlet and outlet of the adsorber to determine the increase in CO levels from inlet to outlet.
- The hot stand-by time of mercury removal system has been decreased to eight hours maximum. The system will be shut down through PLC automatically after eight hours of hot stand-by. Longer than eight hours of hot stand by time was causing the carbon to become extremely dry. During the switching from hot stand-by to normal operation, dry carbon was experiencing a temperature excursion due the introduction of flue gas having moisture.
- Number of thermocouples reading the carbon bed temperature has been increased from four to six.
- Scrubber outlet temperature has been decreased to have lower temperatures at fixed carbon bed adsorber inlet through increasing the scrubber tray water.

# OPERATIONAL DIFFICULTIES WITH FIXED CARBON BED ADSORBER

- Start up heater skid air temperature has been decreased to 130F from 154F.
- Adsorber clean gas inlet temperature has been set at 25F above the scrubber outlet temperature. Originally, this temperature difference has been set at 45F during the initial start-up in 2016.
- Center carbon layer has been removed from the adsorber to provide increased heat dissipation.
- New alarms and interlocks have been implemented in the PLC program to prevent future temperature excursions.
- Based on the current PLC logic, during the cold start-up, mercury removal system start-up blower is energized for two hours without heating for humidity stabilization inside the fixed carbon bed adsorber. During the shut-down, blower is energized, until the carbon bed temperature reaches 100F before isolating the adsorber.

# CONCLUSIONS

- System meets or exceeds all environmental requirements.
- System has proven to be reliable operating 24/7/365.
- Minimal auxiliary fuel usage.
- Maintenance and operational costs have been minimal.
- No sand loss into windbox.
- System has been accepted by the community.
- Fixed carbon bed showed significantly high mercury removal efficiency (98.7%).
- Improved system design, revised PLCs and O&M showed that fixed carbon beds can be operated without having any temperature excursions.

# THANK YOU