GREEN BAY EXPERIENCE – A NEW FLUID BED MUNICIPAL SLUDGE INCINERATOR COUPLED WITH A SLUDGE DRYER MEETING THE NEW MACT LLLL EMISSION LIMITS

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NJWEA 107th ANNUAL CONFERENCE & EXPOSITION

HARRAH'S ATLANTIC CITY

ATLANTIC CITY, NJ

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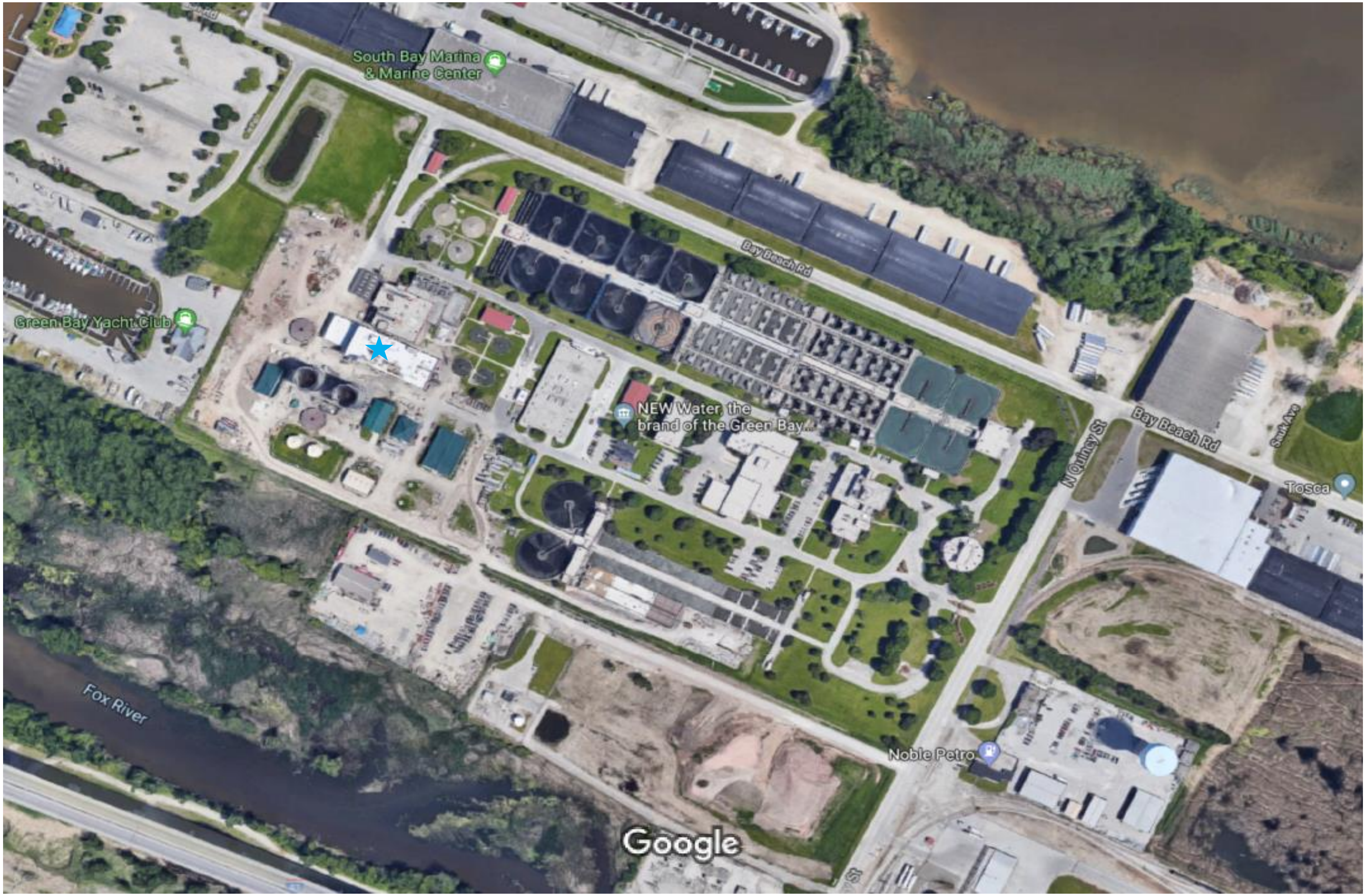
GREEN BAY WASTEWATER TREATMENT PLANT



TOPICS OF DISCUSSION

- Introduction
- Project Background
- Project Challenges
- Process Flow Diagram
- US EPA MACT LLLL Emission Limits
- Equipment
- Stack Test Emission Results and Performance Guarantees
- Operational Problems
- Conclusions

INTRODUCTION

- New Water (or the Green Bay Metropolitan Sewerage District) provides service to 18 municipal customers and serves 236,000 residents in the Green Bay metropolitan area (spread out in 285-square-mile-area).
- New Water owns and operates the Green Bay WWTP located at 2231 N. Quincy St., Green Bay, WI 54302.
- Green Bay WWTP is designed to treat an average of 30 million gallons of wastewater every day from surrounding communities.
- In 2011, facing infrastructure aging, stricter standards and increase in capacity, Green Bay WWTP went through a major solids handling upgrade.
- The upgrade consists of installation of two anaerobic digestors coupling with a CHP and a new fluid bed incineration system to replace the two existing multiple hearths.

PROJECT BACKGROUND

- Selected for the project – Jacobs (Consulting Engineer), CD Smith Contractor (GC) and SUEZ(Incineration System Supplier).

- Bid Format – Preselection of System Supplier followed by GC Selection.

  2013 – Equipment Selection – Award to SUEZ

  2015 – Selection of GC – Award to CD Smith Contractor

- Commissioning and performance testing completed in 2018. Compliance test was successful, first trial.

- Design Parameters:

  Heat Value: 10,500 btu/lb-vol

  Volatile: 64.9%, Total Solids: 39%

  Capacity: 51 DTPD

PROJECT CHALLENGES

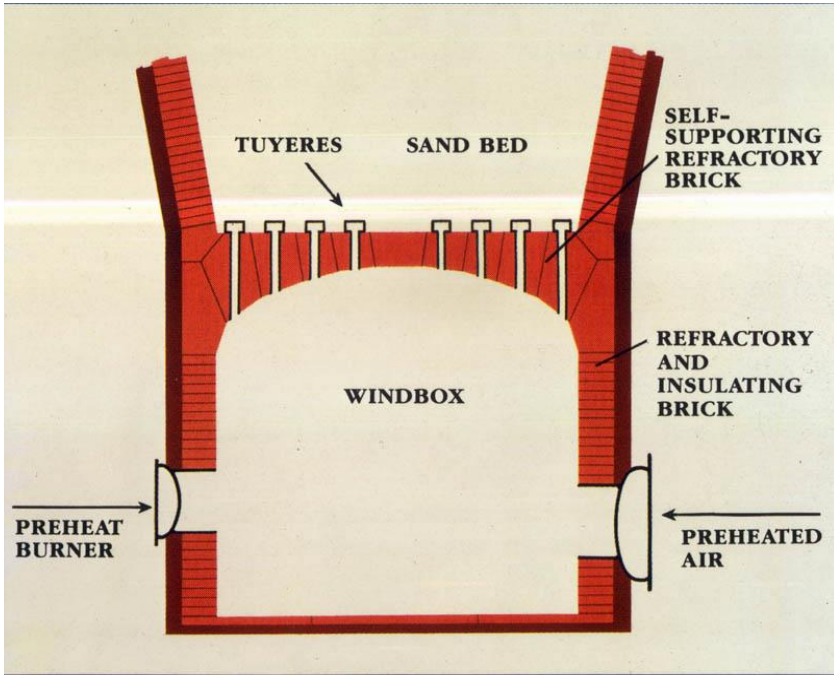
- Nature of Sludge – First time for SUEZ North America to build incinerator treating digested sludge with much higher solids content.

- Selection of Dryer – Thin film (short residence time,10-12 min) versus Disc dryer (60 min). Both are indirect, conduction dryers. Thin film is more flexible (faster response to sludge change due to short residence), but did not fit into the building. Disc dryer was selected.

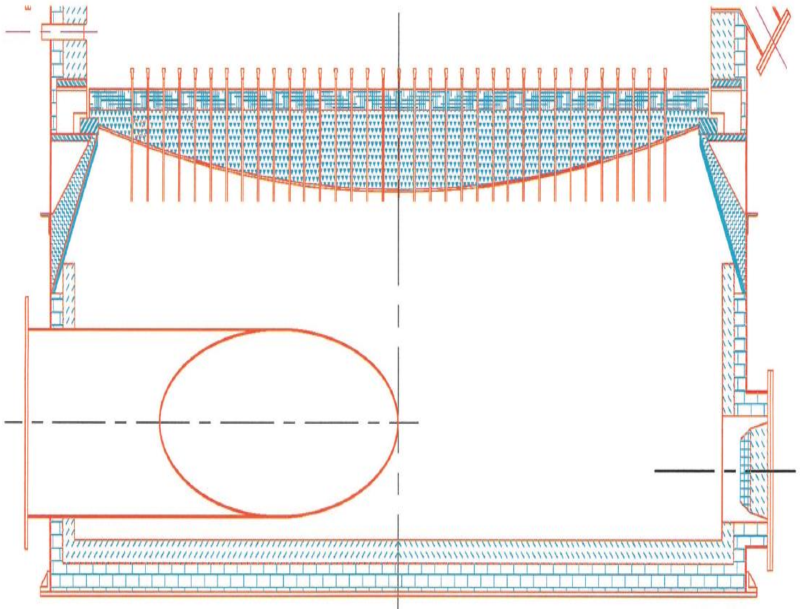
- Higher solids content typically means higher bed temperature and higher NOx. Ammonia injection guns were carefully considered.

- Selection of the Fluid Bed Distributor system.

PROJECT CHALLENGES
SELECTION OF THE FLUID BED DISTRIBUTOR



Refractory Arch Distributor



Metal Plate Distributor

Without an Air Preheater, temperature in the wind-box is very low, therefore either metal plate or refractory arch could be used as distributor

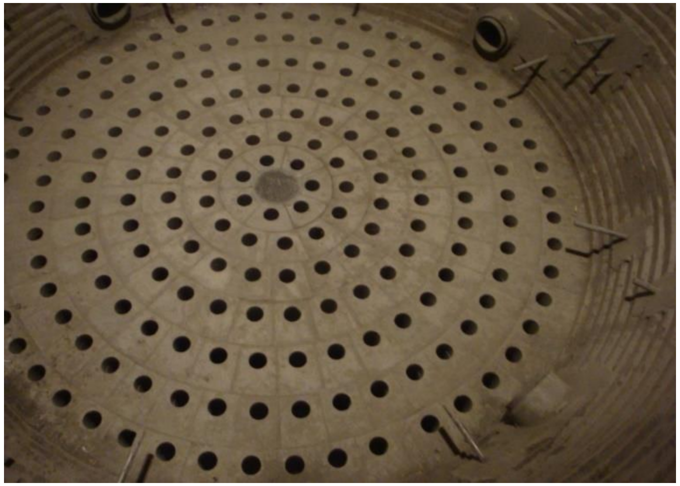
PROJECT CHALLENGES

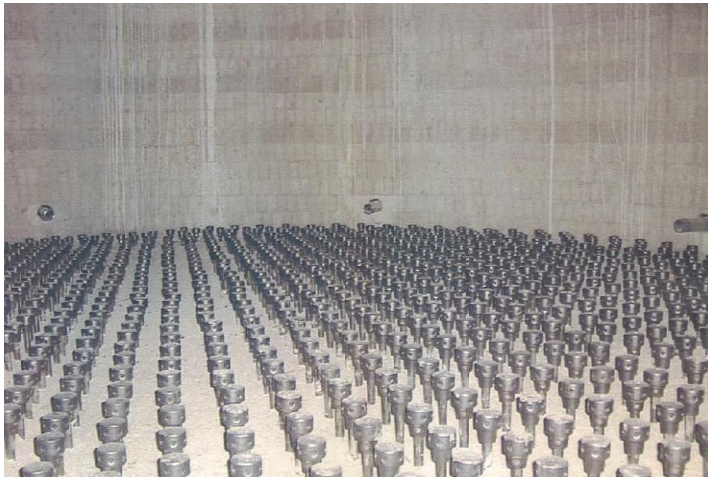
- Distributor System Evaluation

Costs of refractory distributor was slightly higher than metal plate

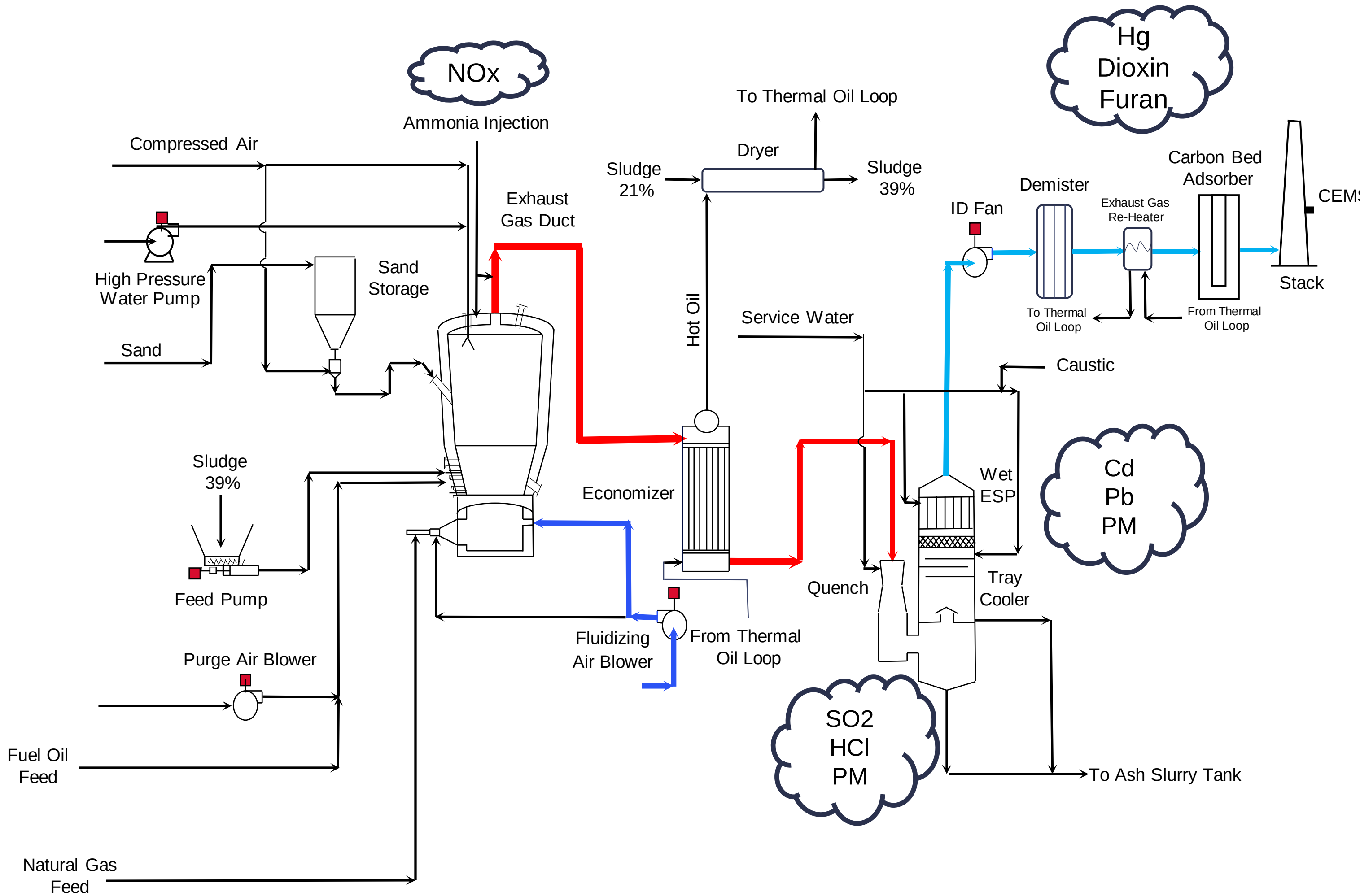
But, SUEZ decided to use a refractory arch distributor, because:

The preheat burner can be installed in the wind-box – less fuel and less time during startup
Refractory arch distributor is more resistant to thermal shock than metal plate.





PROCESS FLOW DIAGRAM AND COMPOSITION OF MAJOR EQUIPMENT



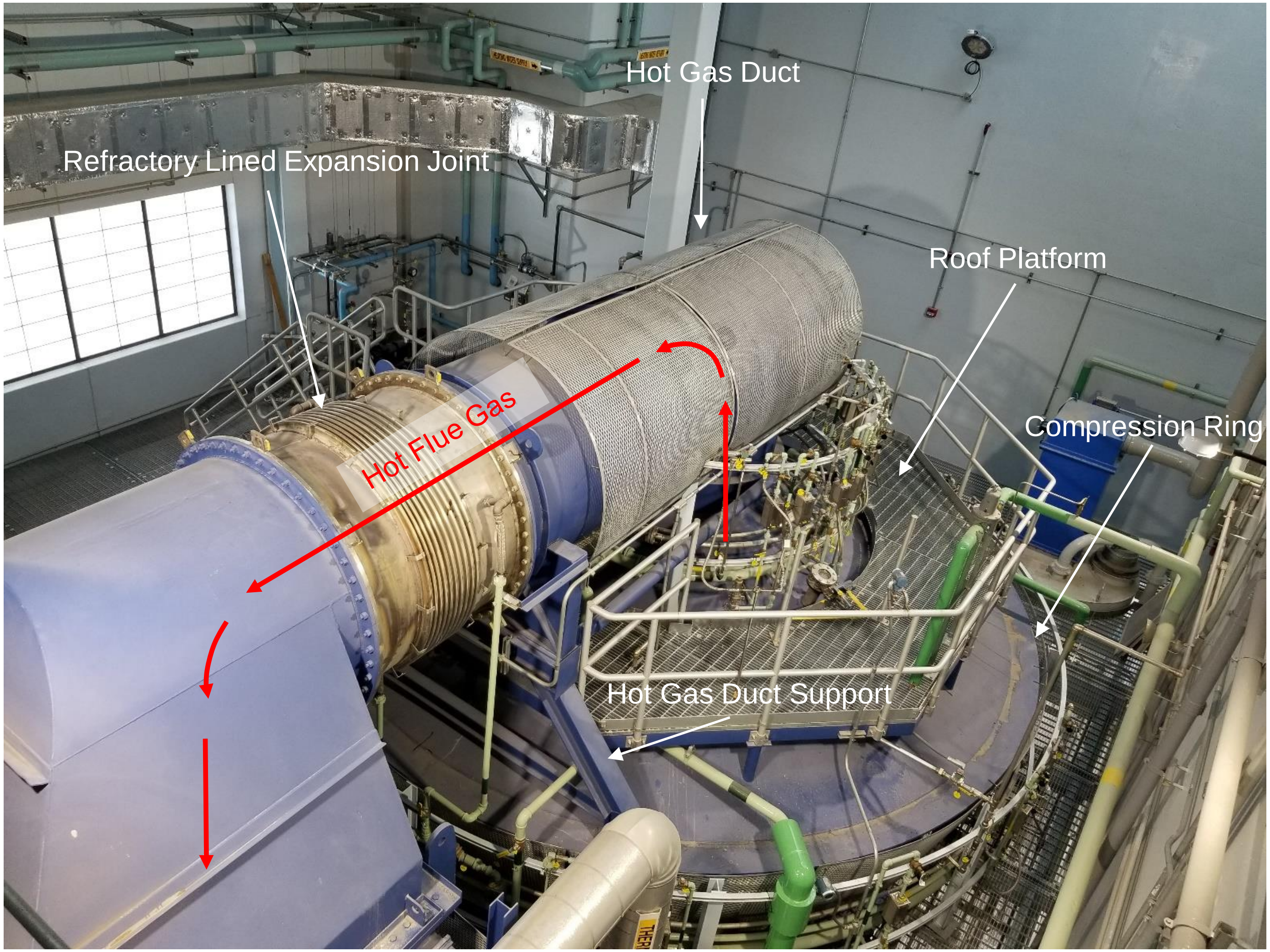
US EPA MACT LLLL LIMITS

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

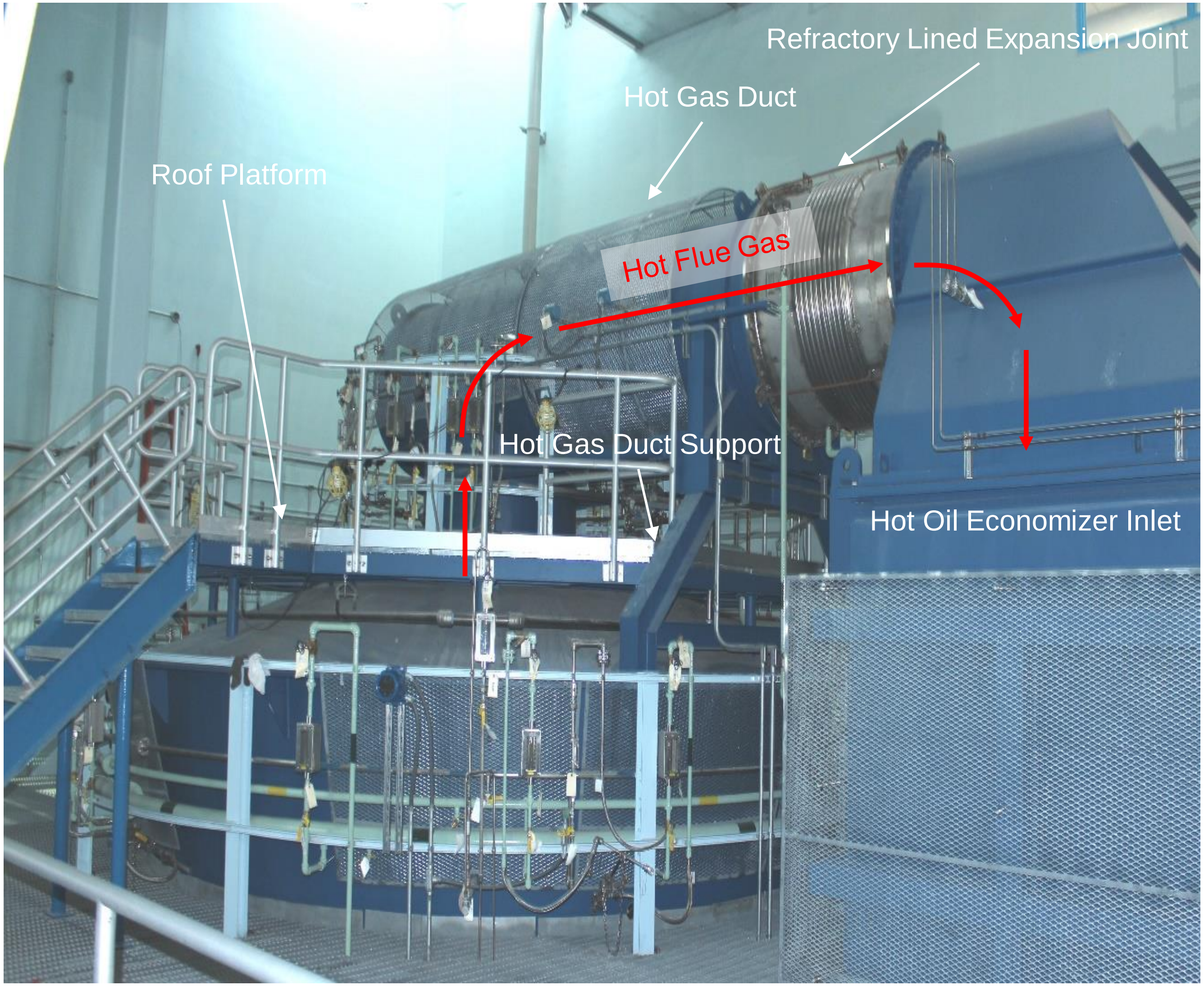
The only available technology to achieve mercury and dioxin/furans as required by MACT LLLL is Granulated Activated Carbon (GAC)

FLUIDIZING AIR BLOWER

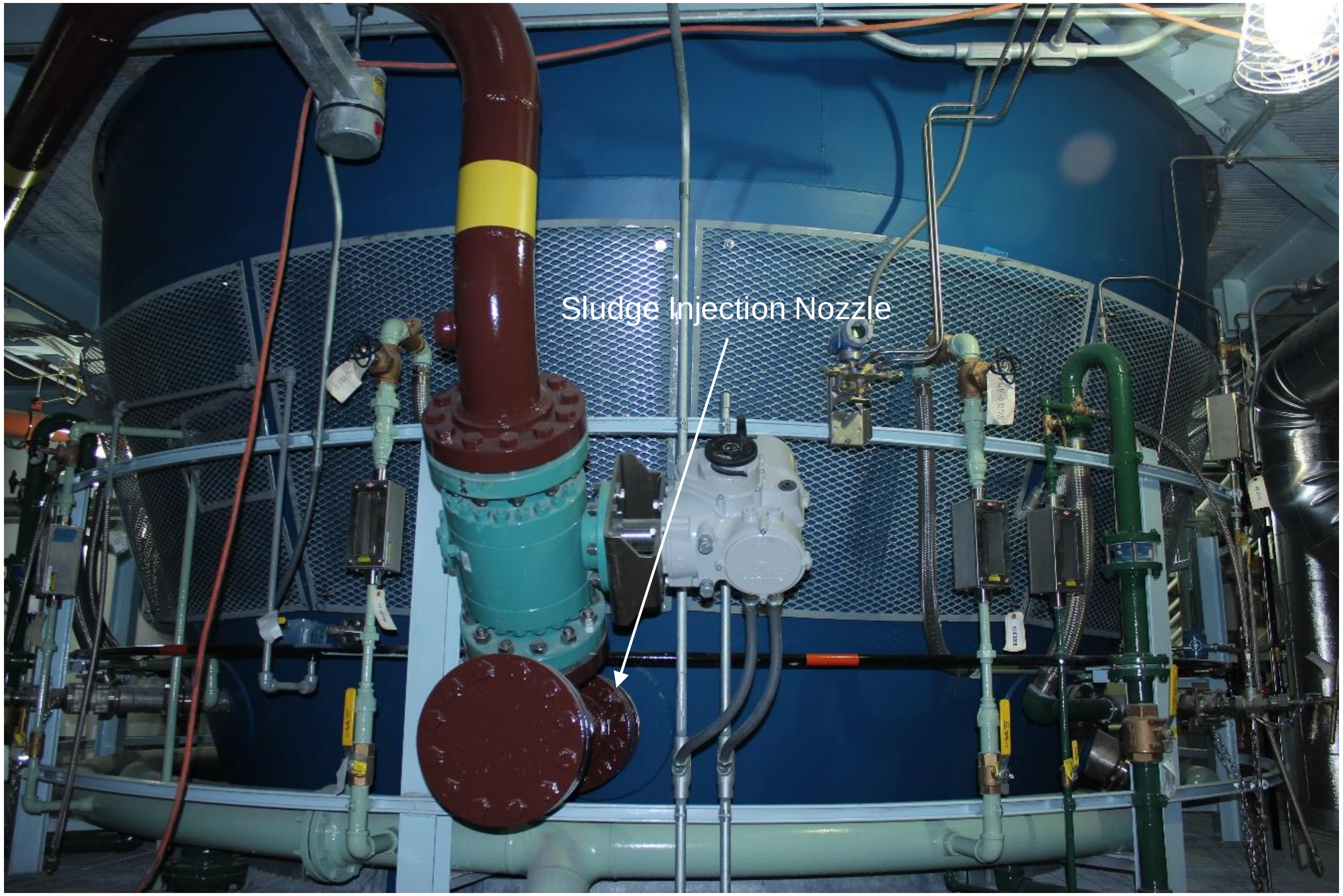
FLUID BED REACTOR



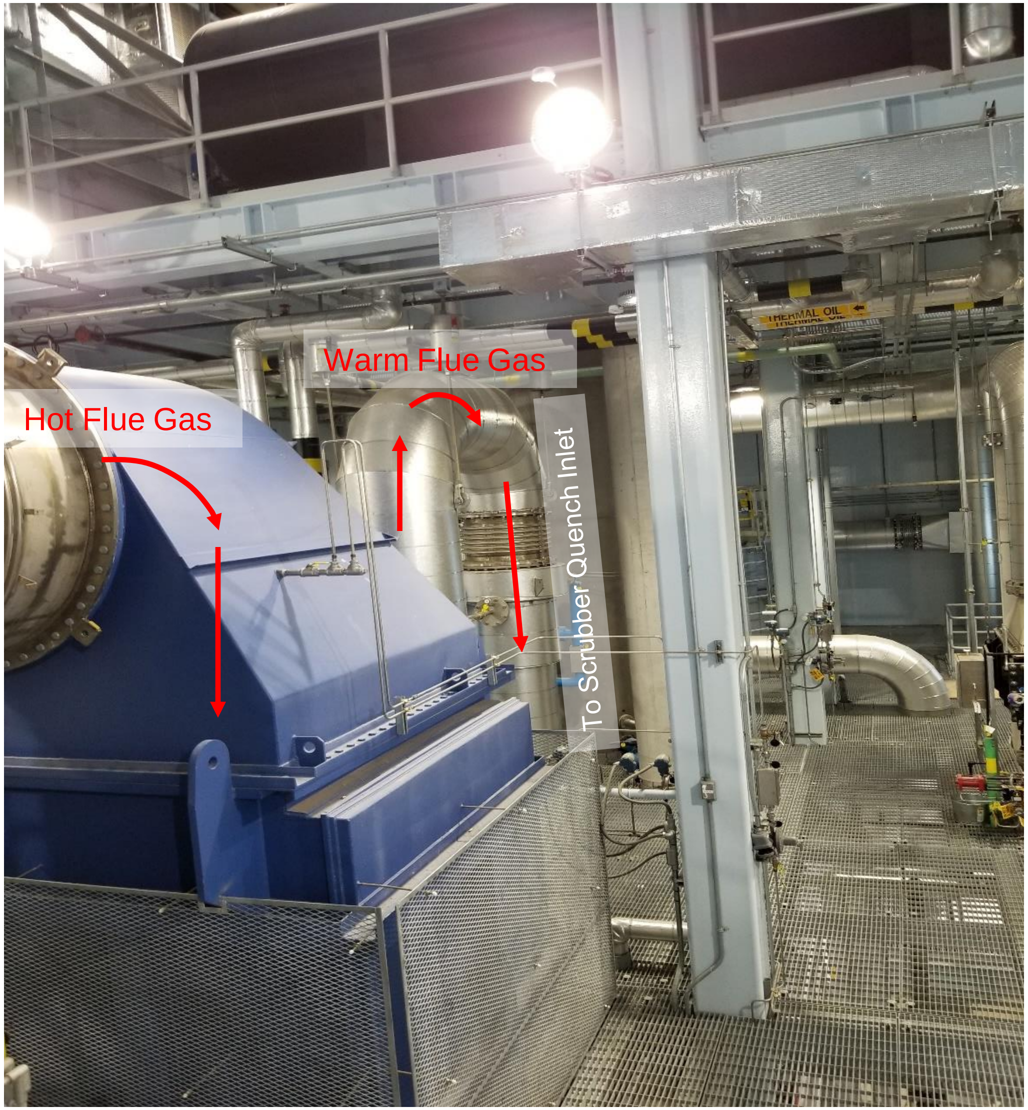
FLUID BED REACTOR



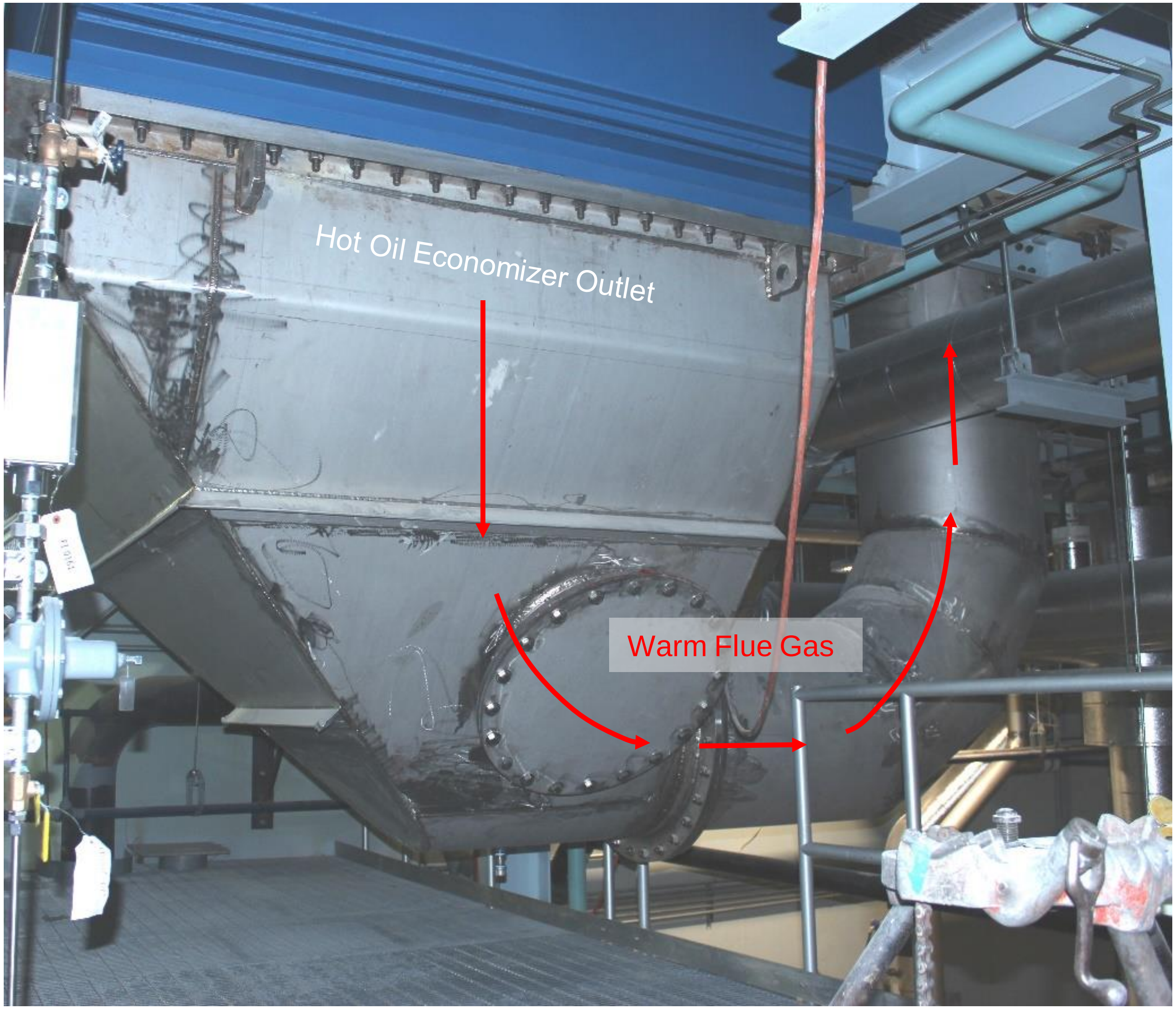
FLUID BED REACTOR (BED SECTION)



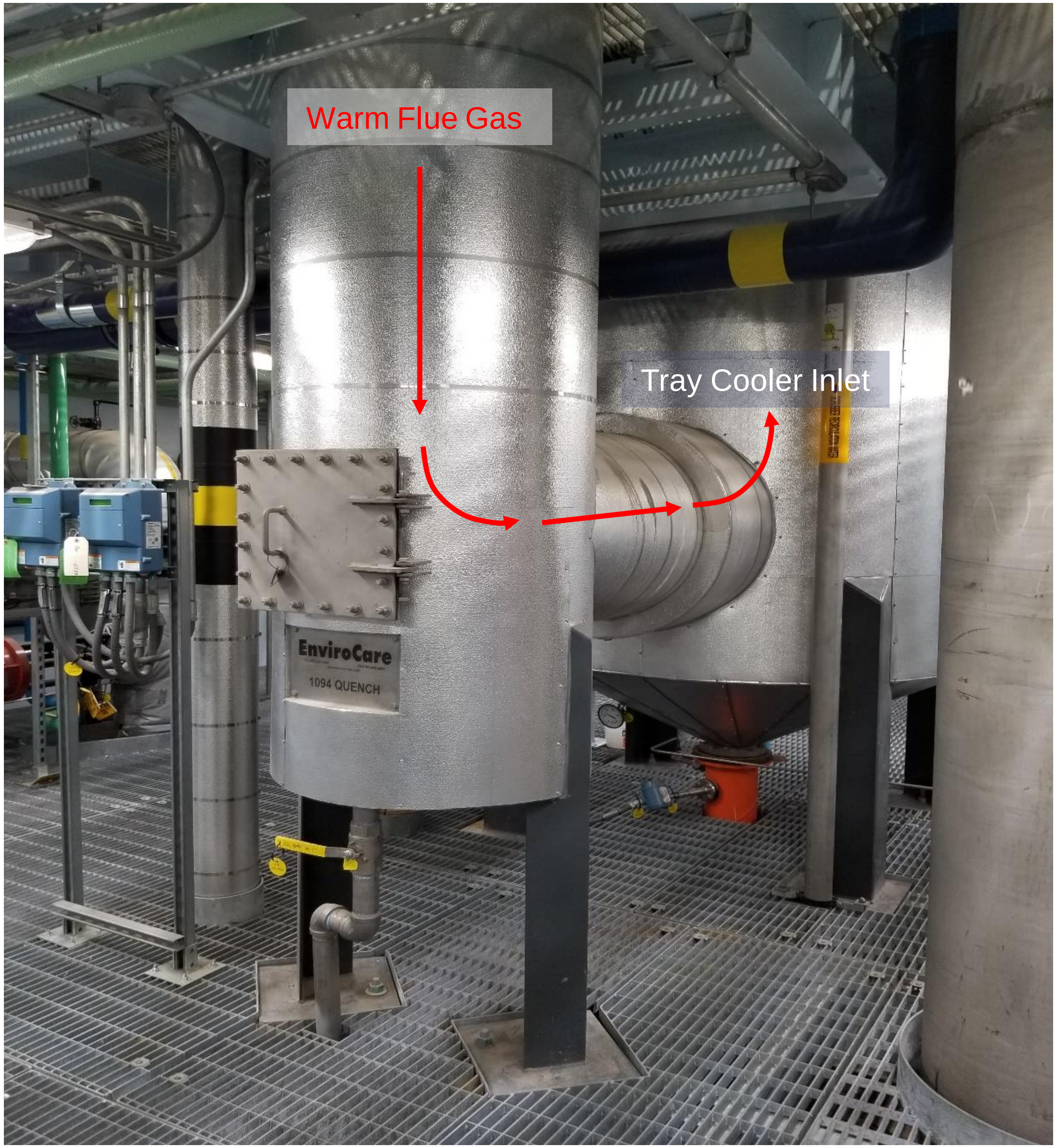
HOT OIL ECONOMIZER



HOT OIL ECONOMIZER

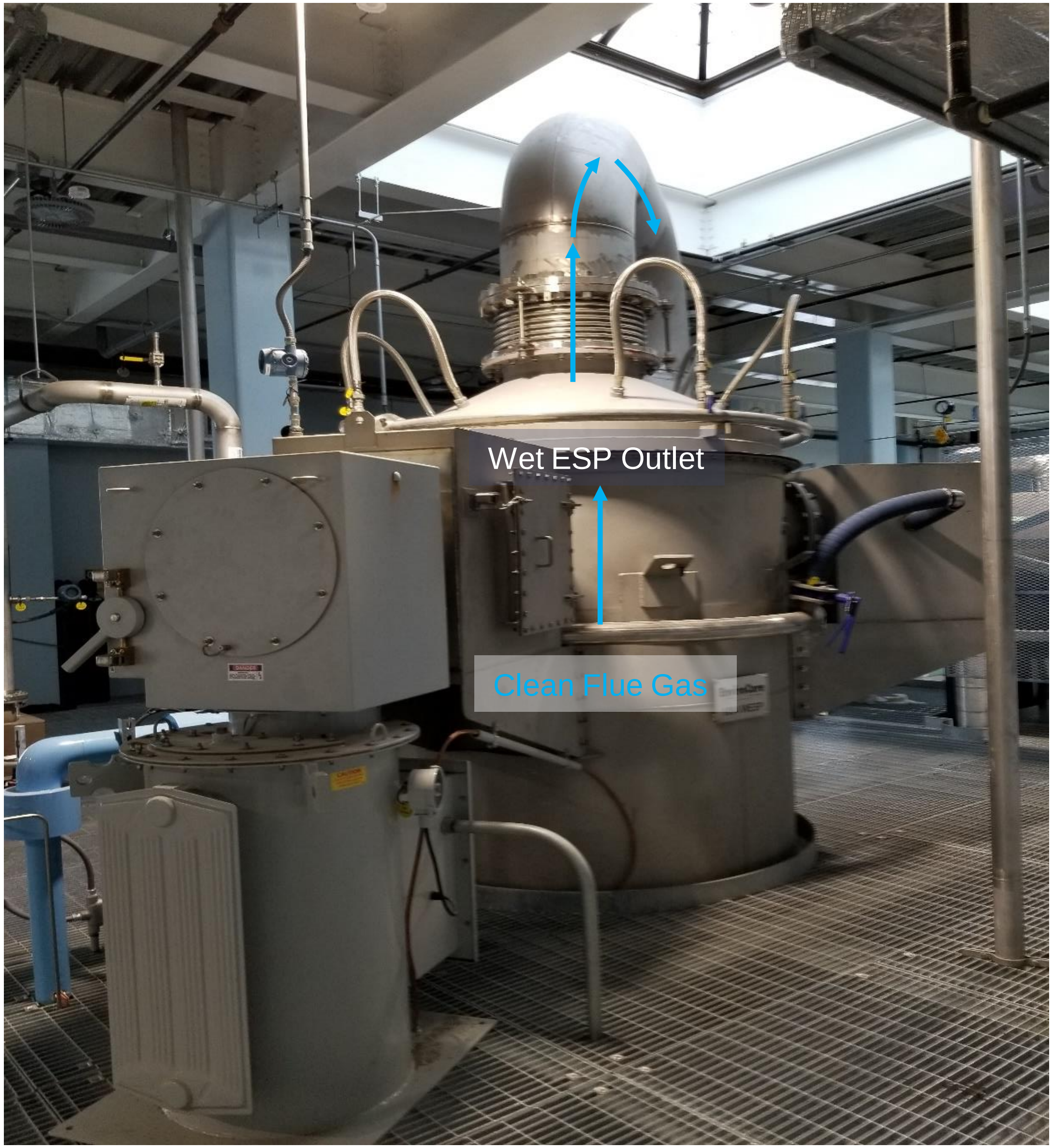


WET SCRUBBER QUENCH



WET SCRUBBER TRAY COOLER

WET ESP



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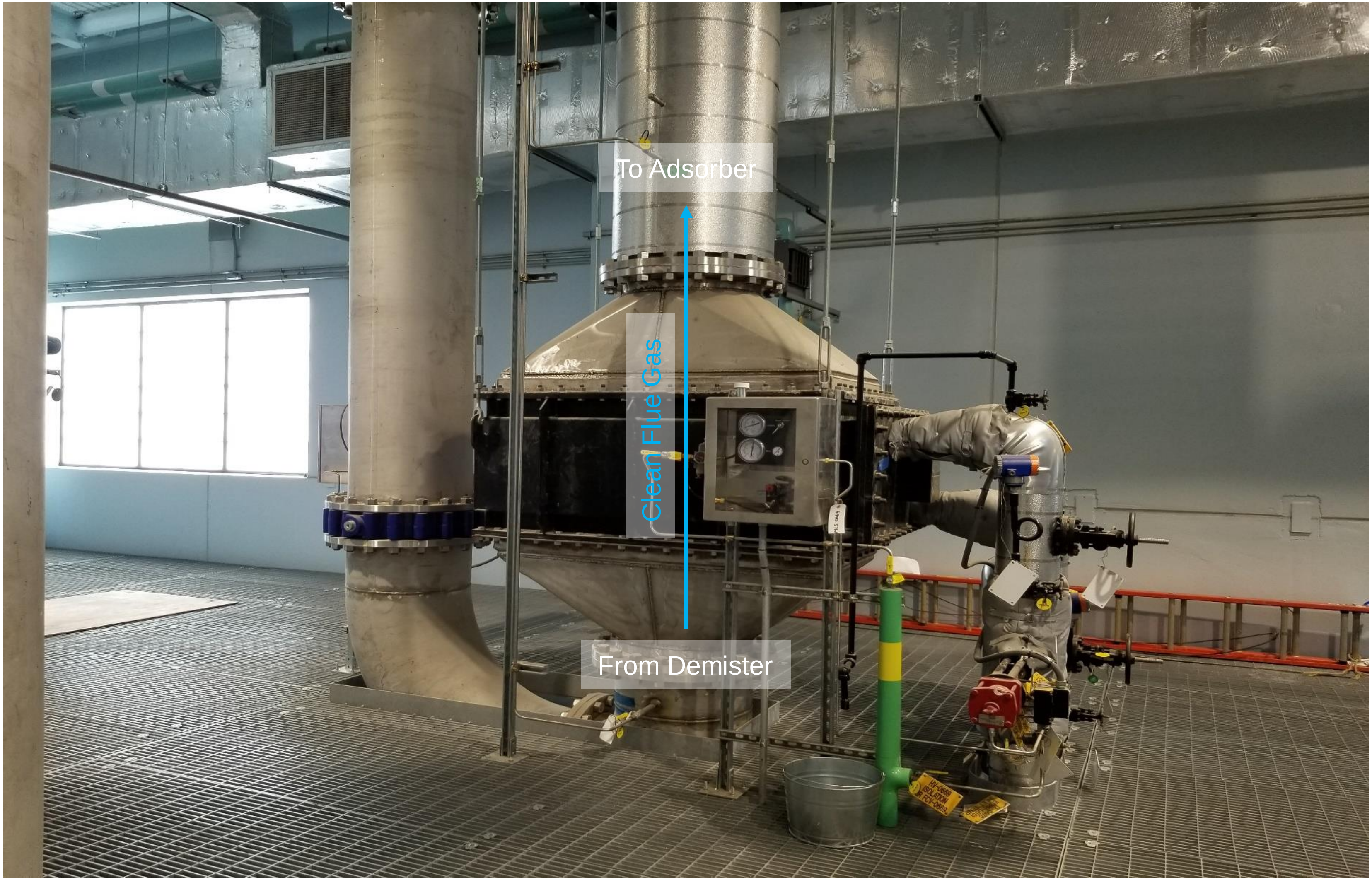
DEMISTER

EXHAUST GAS RE-HEATER (EGR)



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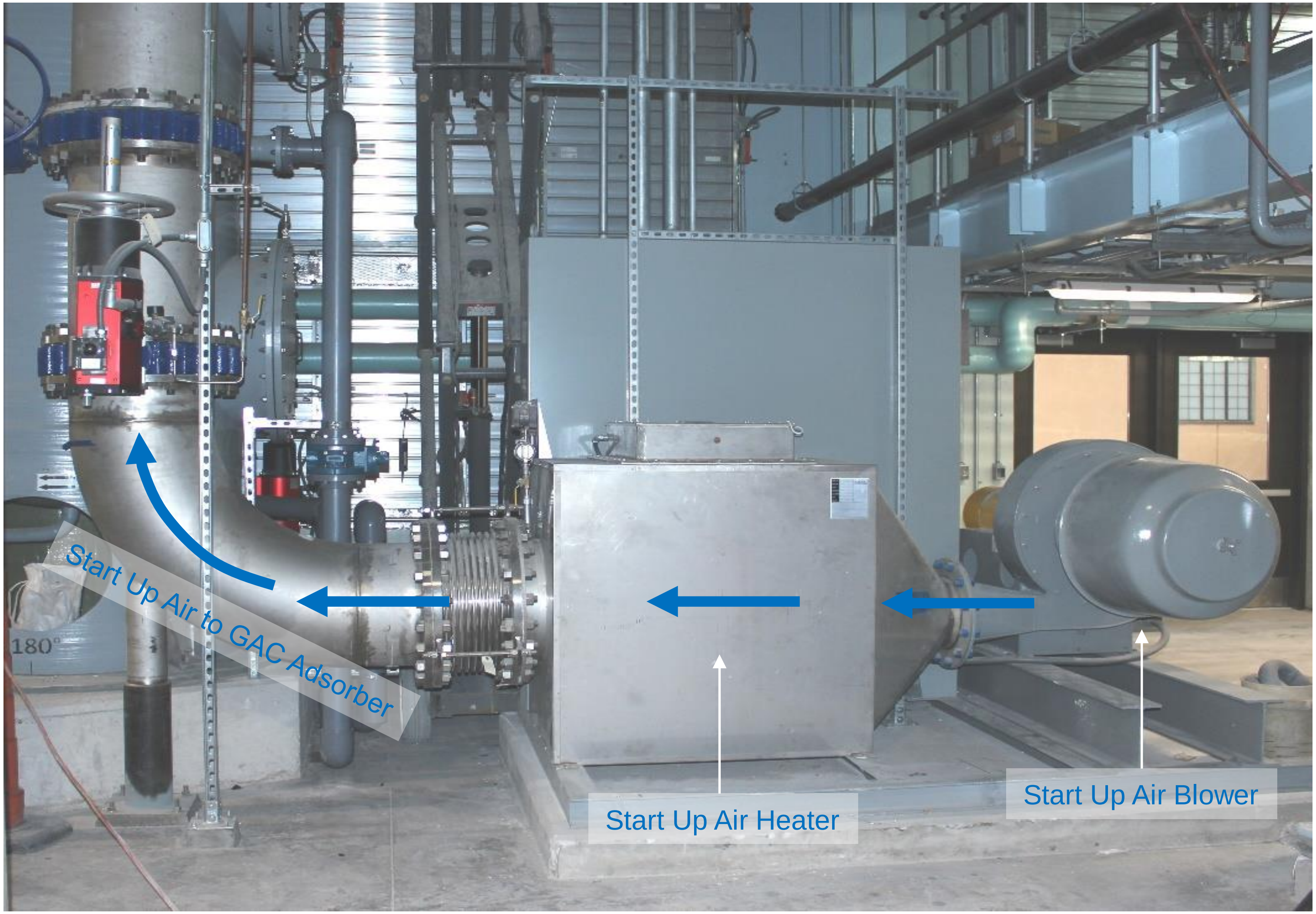
ADSORBER

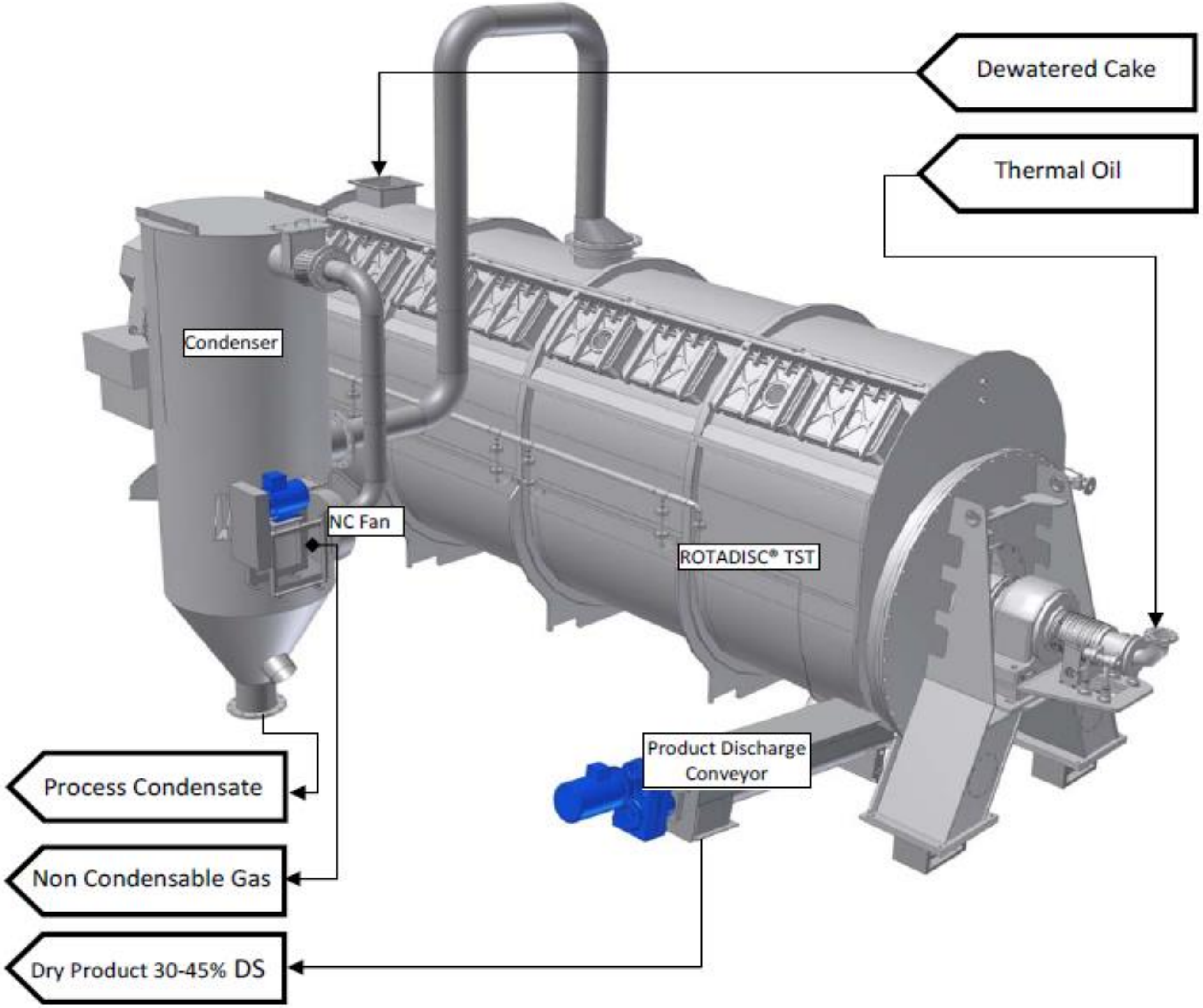
START UP HEATER SKID



PREHEAT FUEL TRAIN

PREHEAT BURNER

SLUDGE DRYER



SLUDGE DRYER

SLUDGE DRYER CONDENSER

NOx REMOVAL SYSTEM*

(*) No Longer in Service

STACK EMISSION TEST RESULTS* (OCTOBER 2018 & MAY 2019)

POLLUTANT	UNITS	MACT LLLL	AVERAGE TEST RESULT (2018)	AVERAGE TEST RESULT (2019)
Cd	mg/dscm	0.0011	<0.00007	<0.0002
CDD/CDF, TMB	ng/dscm	0.013	0.003	<0.0007
CDD/CDF, TEQ	ng/dscm	0.0044	0.0026	<0.0019
CO	ppmvd	27	1.2	0.37
HCl	ppmvd	0.24	<0.1	<0.07
Hg	mg/dscm	0.001	0.0002	<0.0002
NOx	ppmvd	30	12	12.8
Opacity	%	0	0	0
Pb	mg/dscm	0.00062	0.00049	0.00053
PM	mg/dscm	9.6	<0.6	<0.6
SO_2	ppmvd	5.3	0.1	3.4

* Corrected to 7% O_2

PERFORMANCE TEST RESULTS (DECEMBER 2018)

Performance Parameter	Guarantee	Test Result
Cold start-up fuel consumption – MJx10-3 (mm BTU)	118 (112)	106.7 (103.1)
Fuel oil consumption – MJx10-3/dry ton - (mm BTU/dry ton)*	0 (0)	0.6 (0.57)
Operating power consumption – kWh/dry ton	356	315
Net usable energy in thermal oil system – MJx10-3 (mm BTU)	1.19 (1.13)	3.05 (2.89)
Adsorbent consumption (activated carbon) – kg/dry ton (lb/dry ton)	0.23 (0.5)	0.11 (0.25)
Caustic consumption – kg/dry ton (lb/dry ton)	8.26 (18.2)	0.82 (1.81)
Ammonia consumption – kg/dry ton (lb/dry ton)	13.61 (30)	0 (0)
Hot stand by fuel oil usage after 2 days (49 hours) of hot stand by out of every 7 days (168 hours) – MJx10-3 (mm Btu)	19.13 (18.13)	15.29 (14.5)
Time to heat up the fluid bed reactor to be able to accept sludge (after hot stand by) - hours	1.5	1.01

* Sludge heat value of 22,644 kJ/kg (9,735 btu/lb) during the performance testing was lower than the design sludge heat value (24,423 kJ/kg / 10,500 btu/lb) resulting in auxiliary fuel consumption.

OPERATIONAL PROBLEMS

- Sand sifting into the cold windbox. Tuyere holes have been welded. Preheat burner have been used to increase the windbox temperature to 400F.

- Piston pump rams have been replaced with the new ones due to material failure.

Location of Damaged Piston Pump Rams (Red Arrows)

Damage Piston Pump Ram

OPERATIONAL PROBLEMS

- Carbon bed experienced a temperature excursion on Nov 7, 2019. Chavond Barry Engineering has been hired by New Water to perform a root cause analysis.

- Reversible screw conveyors had issues with leaks out of the joints. Ends of the screw conveyors had to be packed in to prevent sludge leaking out. Screws had to be replaced with upgraded material due to corrosion inside the screws.

- Lube ring installation resulted in lower friction inside the sludge piping and smoother operation between the centrifuge discharge and sludge dryer inlet.

- Sludge would get sticky, when dryness was above 38% resulting in the popping of screw conveyor tops. Clamps had to be installed to secure the conveyor tops.

CONCLUSIONS

- The system is currently operating and meeting all the environmental requirements per US EPA MACT LLLL.
- New Water (Green Bay, WI) was the **Second** new incinerator in the US meeting the MACT LLLL Emission Limits. **First** new incinerator in the US was Mattabassett (Cromwell, CT) passing the stack emission testing in 2016. **Third** new incinerator in the US was Hazleton (Hazleton, PA) passing the stack emission testing in 2022. All three incinerators have been supplied by SUEZ and meeting the MACT LLLL emission limits.
- Ammonia system is no longer in service to meet the NOx emission limit (30 ppmvd @ 7% O_2).
- Carbon bed temperature excursion problems have been resolved by Chavond Barry Engineering through a root cause analysis.
- With the exception of carbon bed, all other remaining operational problems have been fixed and the unit has been operating since the stack testing in 2018.

THANK YOU

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