

# CLEVELAND EXPERIENCE – THREE NEW FLUID BED MUNICIPAL SLUDGE INCINERATORS AND A STEAM TURBINE TO GENERATE POWER

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BALLY'S ATLANTIC CITY, NEW JERSEY

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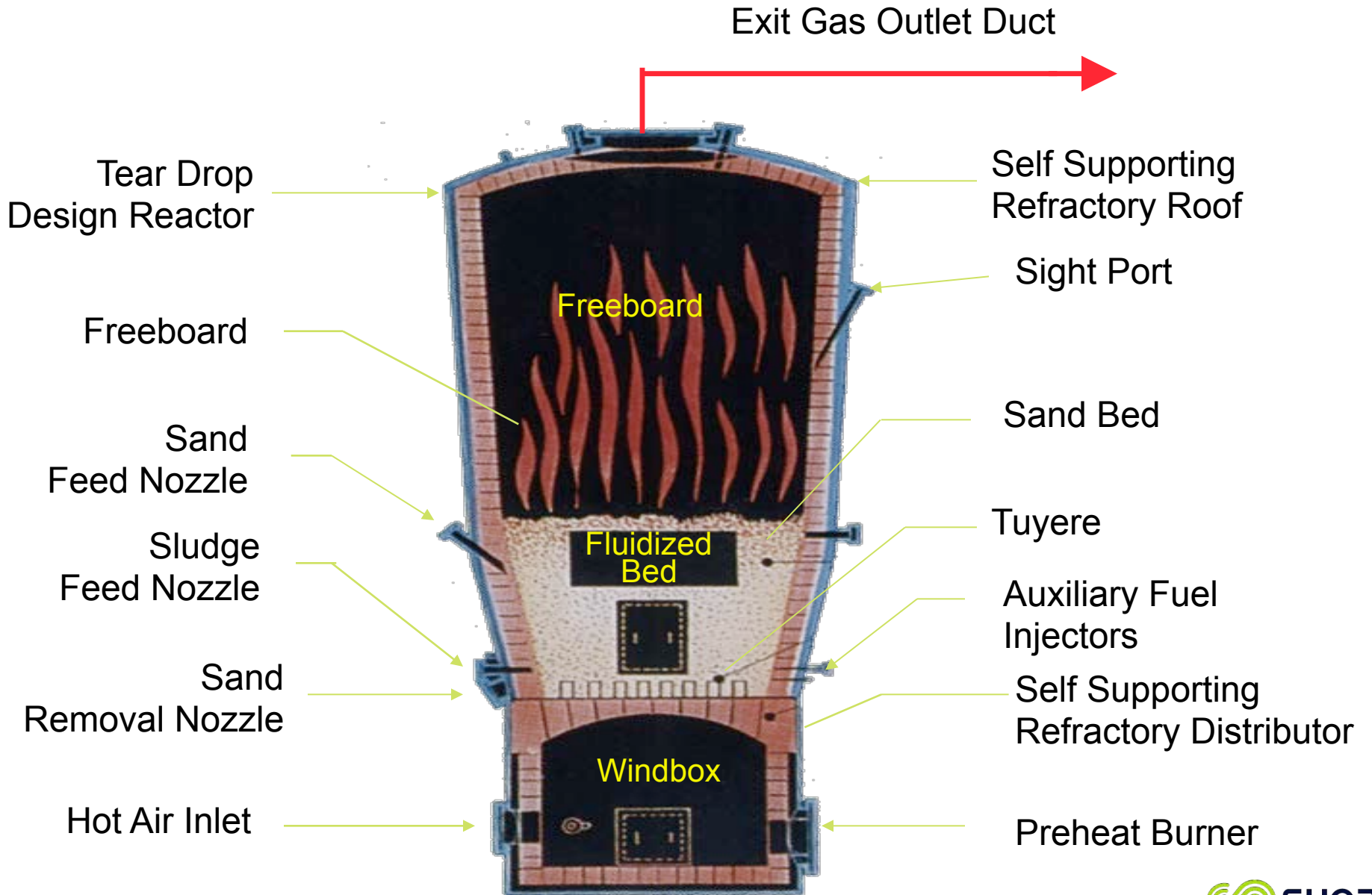
ready for the resource revolution



# TOPICS OF DISCUSSION

- Introduction
- Process Flow Diagram
- Cross Section of Fluid Bed
- Equipment Pictures
- Emission Results and Compliance
- Thermylis<sup>®</sup> Advantages
- Conclusions

# CROSS SECTION OF FLUID BED



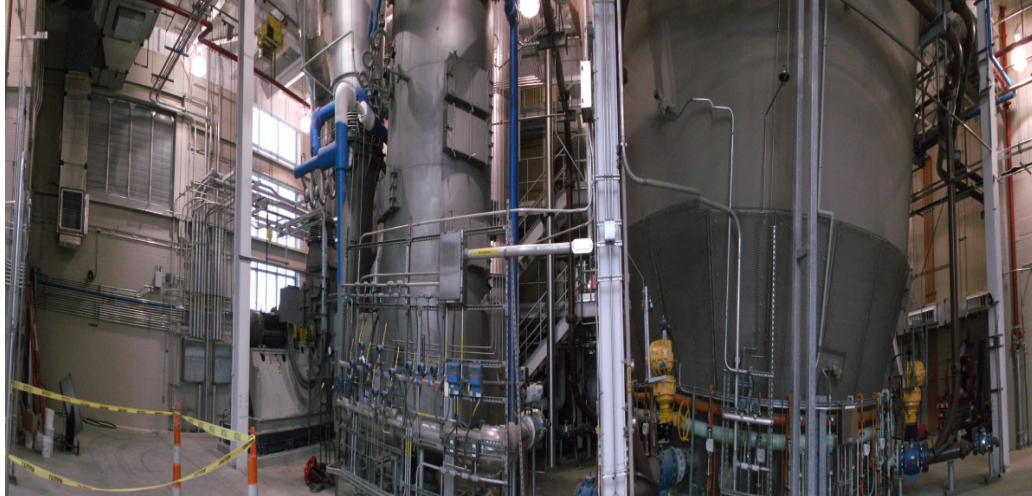
# INTRODUCTION

- Southerly Wastewater Treatment Center is located at 6000 Canal Road, Cuyahoga Heights, Ohio.
- The plant is owned and operated by North East Ohio Regional Sewer District (NEORSD).
- The average plant treatment capacity is 473 ML/d. Maximum wastewater treatment capacity is 1.5 BL/d.
- Southerly plant has three new fluid bed incinerators (one stand by) with three heat recovery systems producing superheated steam to generate power through a steam turbine. All three units supplied by SUEZ.
- All three fluid bed units are of type hot wind-box with refractory arch air distributor and refractory lined wind-box.

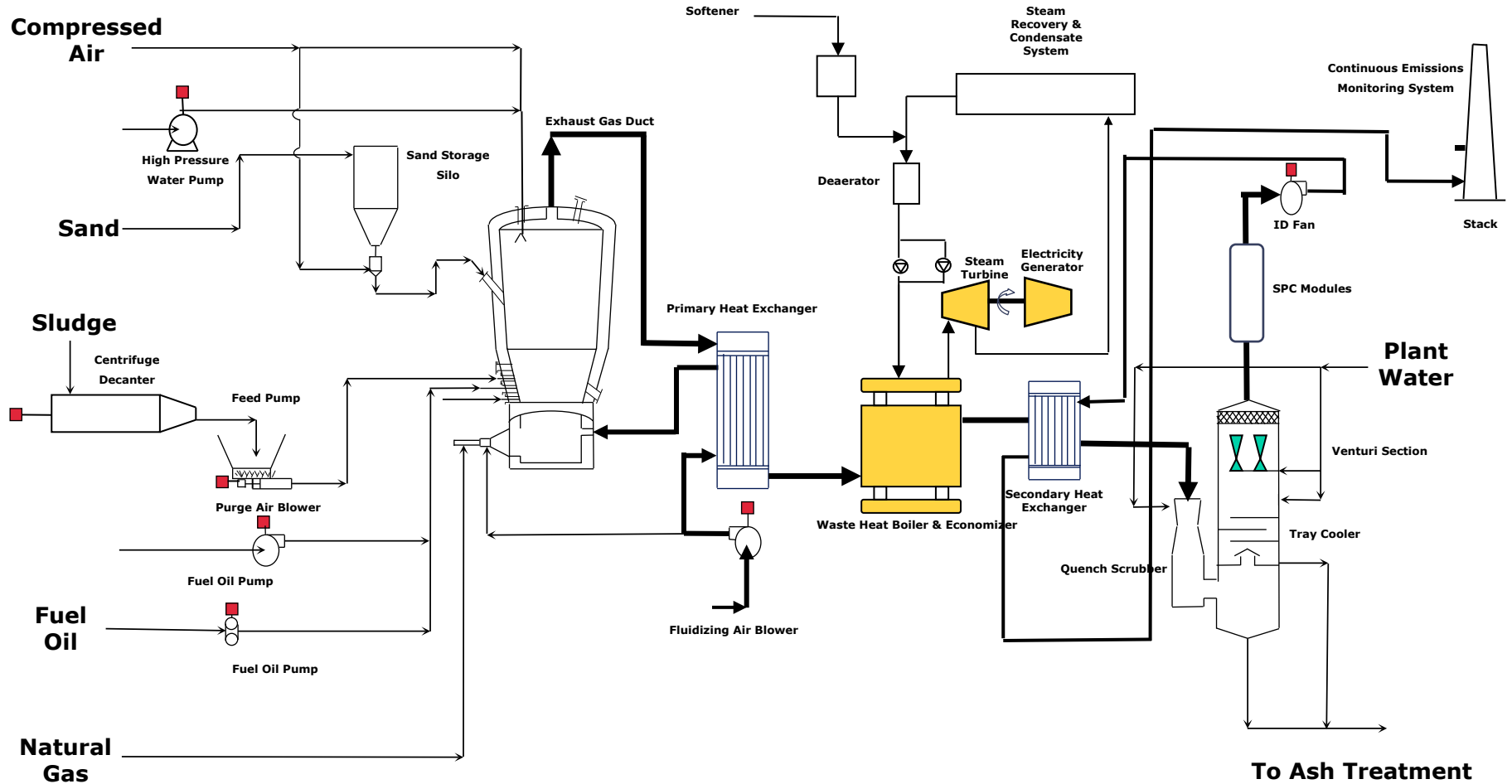
# INTRODUCTION

- Each fluid bed unit has the capacity to incinerate 90.72 MDTPD.
- Turbine is designed to generate 2.4 MW when two incinerators are in operation with 11,975 kg/hr steam flow.
- All three units have been retrofitted in 2015 with the mercury removal system supplied by EnviroCare International (ECI) to be in compliance with the US EPA MACT Quad M emissions limits.
- The mercury removal system includes patented Gore modules installed in a single vessel.
- Stack emission tests in 2015 and 2016 indicated that all three units were in compliance with the MACT emission limits (MMMM).

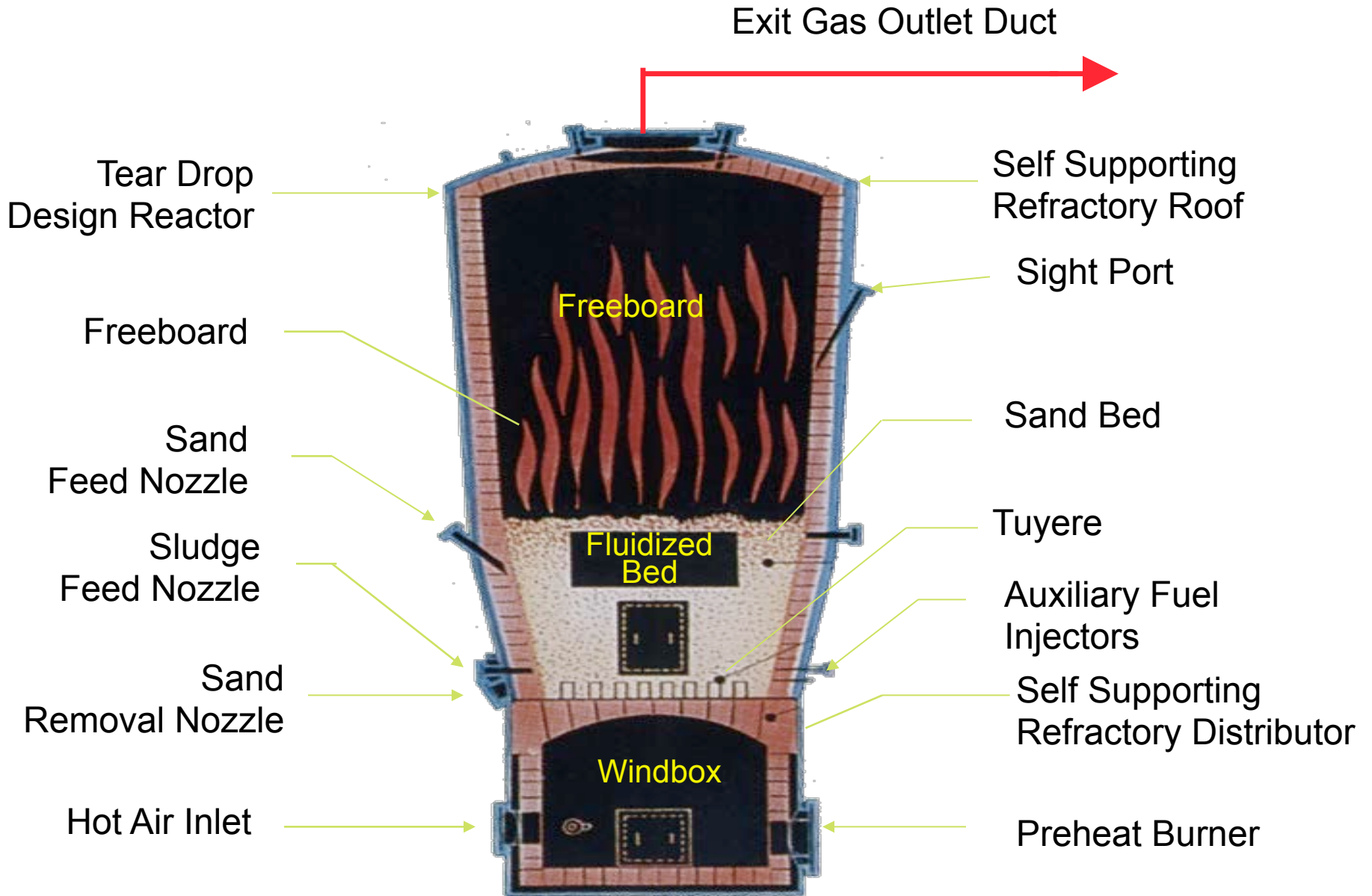
# CLEVELAND FLUID BED INCINERATORS



# PROCESS FLOW DIAGRAM



# CROSS SECTION OF FLUID BED





# EQUIPMENT PICTURES

# FLUID BED REACTOR



# PRIMARY HEAT EXCHANGER



# SECONDARY HEAT EXCHANGER



# WET SCRUBBER



# ID FAN



# SPC MODULES

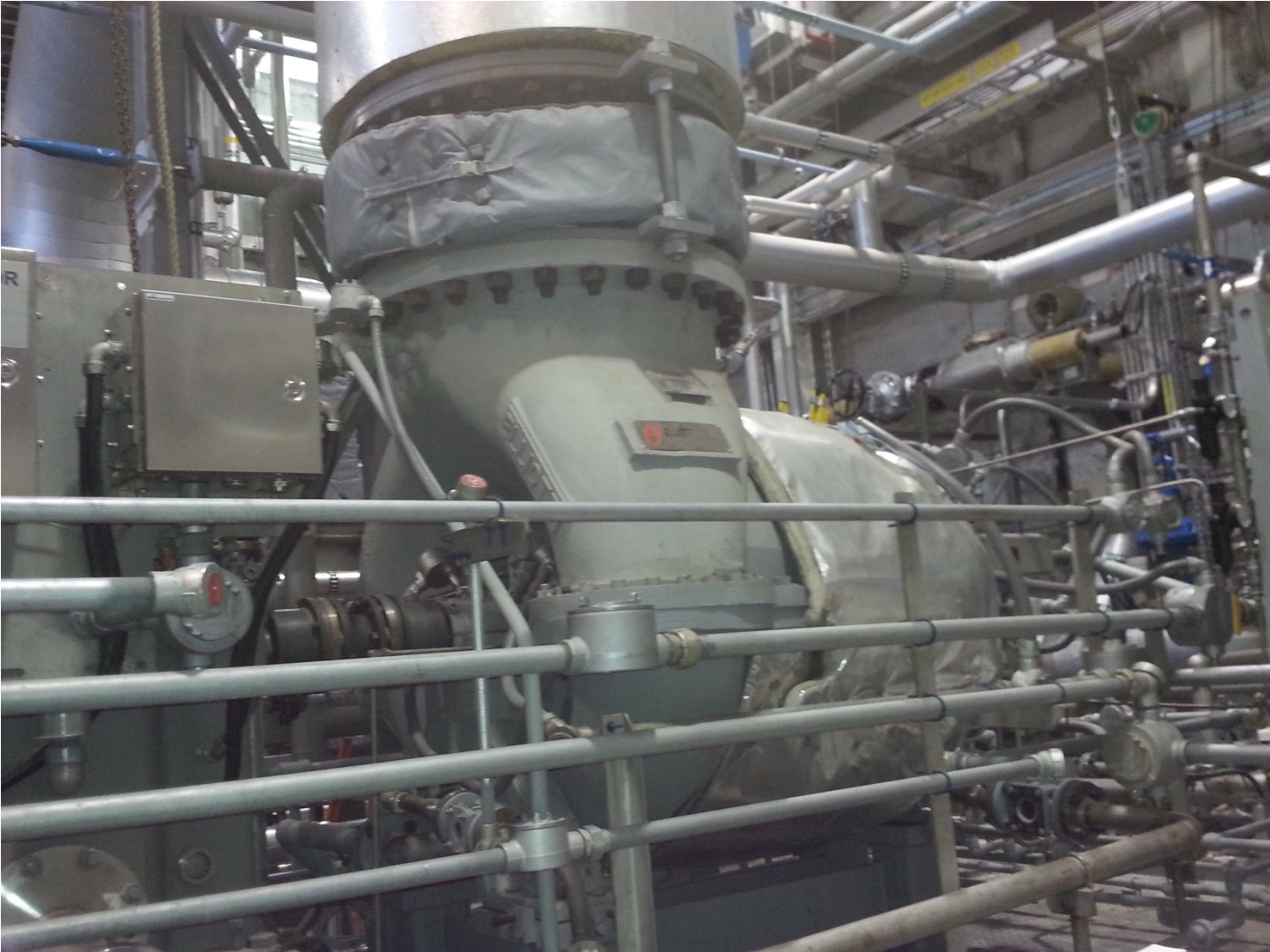


# WASTE HEAT BOILER





# STEAM TURBINE



# STACK WITH PLUME SUPPRESSION SYSTEM



# STACK TEST RESULTS

# UNIT NO. 1, 2 & 3 STACK EMISSION TEST RESULTS

		MACT	No. 1	No. 2	No. 3
<b>Cd</b>	mg/dscm	<b>0.0016</b>	<0.00017	<0.00025	<0.00030
<b>CDD/CDF, TMB</b>	ng/dscm	<b>1.2</b>	-	-	-
<b>CDD/CDF, TEQ</b>	ng/dscm	<b>0.1</b>	0.0043	N/A	0.0177
<b>CO</b>	ppmvd	<b>64</b>	<1.3	<2.26	<1.2
<b>HCl</b>	ppmvd	<b>0.51</b>	<0.1	<0.18	<0.091
<b>Hg</b>	mg/dscm	<b>0.037</b>	<0.014	<0.0028	<0.0065
<b>NOx</b>	ppmvd	<b>150</b>	80.2	102.4	60.6
<b>Opacity</b>	%	<b>0</b>	0	0	0
<b>Pb</b>	mg/dscm	<b>0.0074</b>	<0.00029	0.00076	<0.00033
<b>PM</b>	mg/dscm	<b>18</b>	1.104	<1.03	0.83
<b>SO2</b>	ppmvd	<b>15</b>	8.1	<5.92	8.5

Unit No. 2 was tested on Dec 1<sup>st</sup>, 2015. Unit No. 1 and 2 were tested on Jan 20<sup>th</sup>, and Jan 21<sup>st</sup>, 2016, respectively

# THERMYLIS® ADVANTAGES

- Intermittent Operation: Quick start ups following daily or weekend shutdowns with less fuel usage.
- Feed Variability: Better handling of feed with varying chemical properties such as moisture, volatile content and resulting net heating value.
- Ease of Control and Automation: Controlling bed temperature is easier.
- Lower Auxiliary Fuel Usage: Hot windbox design provides self sufficient combustion with 650C fluidization air.
- Lower Labor: Only one person can operate the system.
- Lower Maintenance: No slag or carbon deposit build up on the equipment.
- Lower NO<sub>x</sub> and CO Formation: Fuel NO<sub>x</sub> and Thermal NO<sub>x</sub> much lower for fluid bed due to lower freeboard temperature, lower excess air and non-existence of local hot spots in the bed. Burner is used only for start up. High level of turbulence, excellent mixing in the bed and longer gas residence time also contribute to lower emissions.

# ***CONCLUSIONS AFTER 3 YEARS OF FLUID BED OPERATION AT CLEVELAND***

- System meets or exceeds all environmental requirements.
- System has proven to be reliable.
- Minimal fuel usage.
- Maintenance and operational costs have been minimal.
- No sand loss.
- Operation and control is simple.
- System has been accepted by the Community.