

WTE CAPITAL REFURBISHMENTS

Extending the Life of WTE Facilities Another 20 Years

OVERVIEW OF WTE FACILITIES IN US

- 73 Facilities Currently Operating in the US
 - $_{\circ}~$ 36 operating 30 years or less
 - $_{\odot}~$ 37 operating more than 30 years
- WTE Major Benefits
 - $_{\circ}$ Proven Technology
 - $_{\circ}~$ Can process 99%+ of waste stream
 - $_{\circ}~$ Direct Combustion Process
 - $_{\odot}~$ Volume Reduction of 90%+
 - $_{\circ}~$ Generate Electricity and/or Steam
 - $_{\circ}~$ Up to 650 kWh/ton net electric
 - $_{\circ}$ Sell Recovered Metals

Current Age of the 73 US Operating WtE Facilities





WTE FACILITY SHUTDOWNS

- Detroit RRF, Detroit, MI
- Warren RRF, Warren, NJ
- Wallingford RRF, Wallingford, CT
- WASTEC, Wilmington, NC
- Jackson County RRF, Jackson, MI
- Wheelabrator Claremont, Claremont, NH
- MERC, Biddeford, ME
- Harford WTEF, Joppa, MD



Maine Energy Recovery Company Biddeford, ME

WTE PLANT MAINTENANCE PRACTICES

- Annual or bi-annual scheduled outages
- Unscheduled outages
- Extended cold iron outages
- Pressure part repairs and replacements
- During outages work is completed on:

 Boilers, Scrubbers, Air Pollution Control (APC) Equipment, Power Generation Equipment, Electrical Systems, Pumps, Fans, Motors.....

DESPITE THE FACT THAT THESE FACILITIES PERFORM COMPREHENSIVE ROUTINE MAINTENANCE MANY WTE FACILITIES NEED TO INVEST SIGNIFICANT CAPITAL TO EXTEND FACILITY USEFUL LIFE ANOTHER 20YEARS

CAPITAL PROJECT DRIVERS

- Components at End of Useful Life
- Improved Reliability
- Ensure Throughput Capacity is Sustained
- Stabilize or Reduce O&M Costs
- Increase Revenues/Gain Additional Revenue Streams
- Improve Aesthetics
- Comply with Future Emissions Requirements

CAPITAL REFURBISHMENT PROJECTS

- Cost of refurbishment projects highly variable
- Variables:
 - **o** Maintenance History (Has it been maintained at "Industry Standard")
 - Contract Terms ("Handback" provisions)
 - $_{\circ}$ Plant Condition
- Some "typical" end of term projects:
 - New Cranes/Grapples
 - Ash Discharger Replacement
 - Boiler Waterwall Replacement
 - Generator Bank Replacement
 - Economizer Bank Replacement
 - Scrubber Rebuild/Replacement

- APC Flue Gas Ductwork Replacement
- Baghouse Rebuild/Replacement
- Sootblower Rebuild
- Cooling Tower Rebuild

CAPITAL REFURBISHMENT PROJECTS

MSW HANDLING

- Front End Processing Equipment (RDF plants)
- o Cranes
- o Grapples
- LOWER FURNACE
 - $_{\circ}$ Feed Chute
 - Feed Table
 - $_{\circ}$ $\,$ Grates and Grate Support Structure
 - o Ash Discharger
- BOILER
 - $_{\circ}$ $\,$ Waterwall Tube Panels
 - o Boiler Screen Tubes
 - o Generation Banks (Convective Zones)
 - $\circ \quad \text{Superheater Screen Tubes}$
 - $_{\circ} \quad \text{Superheater Tube Bundles}$
 - $_{\circ}$ $\,$ Economizer Section $\,$
 - $_{\circ}$ Air Preheater
 - $_{\circ}$ Sootblowers
 - $_{\circ}$ Auxiliary Burners
 - o Insulation & Lagging

- APC
 - Flue Gas Ductwork
 - o Scrubber Refurbishment
 - o Baghouse Refurbishment
 - $_{\circ}$ Carbon Injection System
 - Lime/Slurry Injection System
 - Ammonia Injection System (NOx)
- ASH HANDLING
 - o Bottom Ash Conveyors
 - Ferrous Magnets
 - o Non-Ferrous Eddy Current Separators
 - Vibrating Pan Conveyors
 - Belt Conveyors
 - Screw Conveyors
 - Pugmills
- SITE CIVIL/ARCHITECTURAL
 - Receiving Floor Repairs
 - Receiving Pit Wall Repairs
 - o Ash Building Floor Repairs
 - o Ash Building Bunker Repairs
 - o Landscaping/Repaving Work
 - o General Building Repairs (roof/siding/painting)

- BALANCE OF PLANT
 - Turbine Rotor/ Casing/Diaphragms
 - Generator
 - Boiler Feedwater Pumps
 - o Condenser Retubing
 - o High Pressure Feedwater/Steam Piping
 - o Closed Loop Cooling Water
 - Cooling Tower/Air Cooled Condenser/Once Through
 - CEMS System Upgrades
 - DCS System Upgrades
 - Air Compressors
 - o Stack
 - $_{\circ}$ $\,$ ID fans and motors $\,$
 - Other Fans and Pumps
 - Electrical Power Systems
 - o UPS Systems
 - Rolling Stock
 - Truck Scales
 - Fire Protection
 - \circ HVAC



TYPICAL SECTIONS OF COMBUSTION TRAIN



FEED TABLE & GRATES







ASH DISCHARGERS





BOILER WATERWALL TUBES





FIRST PASS TILE/OVERLAY/REFRACTORY





SUPERHEATER TUBES





BOILER TUBE OVERLAYS

- Superheater and Waterwall Corrosion/Erosion Protection:
 - $_{\circ}$ Inconel
 - $_{\circ}\,$ Tube Shields
 - $_{\circ}$ Colmonoy
 - Refractory/Backcast Tile
- Areas of Application
 - $_{\circ}$ First Pass waterwalls
 - $_{\circ}$ Superheater tubes
 - $_{\circ}$ Convective zone evaporator



ECONOMIZER TUBES





SCRUBBER VESSEL







SCRUBBER VESSEL

- Traditional Material
 - o Carbon Steelo 316L Stainless Steel
- Advanced Alloys to Consider
 Inconel
 - Hastelloy C-22 "wall paper"
- Areas of Application
 - $_{\odot}\,$ Scrubber vessel
 - $_{\odot}\,$ Scrubber hoppers



BAGHOUSE



Roof Replacement



Tubesheet



Hopper Replacement

POWER GENERATION

- Turbine
 - ∘ Turbine Rotor, Diaphragms, Seals
 - $_{\circ}$ Lube oil system
 - $_{\circ}$ Bearings
 - Inlet Valves/Extraction Valves
- Generator
 - $_{\circ}$ Rotor, Stator
- Controls
- Condenser
- Cooling Tower





FACILITY ENHANCEMENTS

- Metals Recovery
 - Cost/Benefit based on recovery rate and metals price:
 - Ferrous
 - Non-ferrous
- Variable Frequency Drives:
 - Cost/Benefit based on Electric Rates
 and operating characteristics
 - ACC fans, ID fans, FD Fans

- NOx Reduction
 - Enhanced SNCR
 - Staged Combustion for Nox
 - Flue Gas Recirculation
- Semi Dry Ash System

THANK YOU.

QUESTION & COMMENTS

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