Getting it Hot and Doing It Fast:
Lessons Learned from Upgrading a Fluidized Bed Incinerator in Manchester, NH

Matt Formica – AECOM
Fred McNeill – City of Manchester, EPD
Presentation Outline

• Background
• Project Initial Needs
• Project Development
• Design / Construction
• Project Benefits
• Lessons Learned
Background – Project Location

- Manchester, NH
- Largest City in NE North of Boston
- Population 107,000
- 375 miles of sewer (50% combined)
- 10 Pump Stations
- WWTF (34 mgd) Serves:
  - Manchester
  - Goffstown
  - Londonderry
  - Bedford
Background – Sludge Incineration

• WWTP Sludge Disposal - Incineration

• Single Fluidized Bed Incinerator (FBI) Replaced Two Multiple Hearth Incinerators 1994

• No Backup Incinerator – Off Site Disposal

• FBI Size
  – 3,500 lbs/hr, dry
  – 15,910 lbs/hr, wet @ 22%

• FBI - Batch Burning Operation
  – 2 to 3 days on 2 to 3 days off
FBI Operations and Issues

• FBI - Air Distribution System Used to Fluidize Bed 6’ Bed of Sand
  – Two blowers (350 hp and 400 hp)
  – Large duct work
  – Interior air piping
  – “Boat” style air diffusers

• Piping and Diffusers were Failing
  – Corrosion
  – Erosion
  – Heat damage
  – Ten years old
• 2004 WWTP Facility Plan Awarded to AECOM

• 2005 Letter Report Recommended Rehabilitation Measures
  – Change to new pipe tuyere system
  – Refractory lined 80” duct repairs
  – Shell patch repairs/replacement
  – Internal refractory repairs/replacement
Work Added to the Project

- **2006 Economizer Failure**
  - Air/Water heat exchanger
  - Reuses FBI’s heat
  - Heats two largest buildings
  - $50,000 /month in heating oil savings
May 2007 Inspection

• May 2007 Annual Internal/External Inspection

• Previous Repair Recommendations Now Required Replacement
  – Economizer inlet and outlet ducts
  – Incinerator flue gas outlet
  – Economizer inlet and outlet plenums
2008 Design – Comprehensive Upgrade

- Project Started in 2005 – New Air Distribution/Minor Repairs
- Project Became in 2008 - Comprehensive Upgrade
- Other Upgrades Added
  - CEMS
  - Process oxygen meter
  - Venturi scrubber
- New Features Added
  - Recuperator bypass
  - 350 HP and 400 HP blower soft starts
2009 Construction - Need for Speed

• No Redundant Incinerator

• Off Site Sludge Hauling
  – ~ $125,000/mo

• Loss of Economizer Use
  – ~ $50,000/mo

• Increased Operating Costs
  – Polymer
  – Electrical
  – Labor

• Odor Issues
  – Employees
  – Neighbors
Construction – Phase 1 Economizer

- City Pre-Purchases the Economizer Summer of 2009

- Project Bid in September, awarded in December for $3.21 million and work starts on day 1

- Incinerator Off Line 2 Months

- Economizer Installed
Phase 2 FBI Upgrade – Shutdown Findings

- Internal Inspection During Economizer Shut Down
- Significant Refractory Damage
- Full Refractory Replacement/Upgrade
  - Use of a mastic coating on the shell (acid condensation)
  - Use of castable insulation (reduce gas/ash migration behind the refractory).
  - Full roof replacement
  - Gas seal ring
Phase 2 – Upgrade Opportunity

• Chance to Replace/Upgrade Components – Do it right the first time

• Penetrations
  – 8 inch sand port
  – New 4 inch sand port
  – Manway
  – Sludge nozzles
  – Oil guns
  – Water guns
  – Thermocouples/sleeves
Need for Speed – Streamline CO Process

- Change Order Process (streamlined)
  - Collaborative request/CO development
  - Contractor’s undocumented rough estimate time/$
  - Go no-go decision with State involvement
  - Contractor procurement of materials/subs
  - CO work starts

- Subsequent Documentation Follow Up
  - Formal CO proposals
  - Proposal reviews
  - CO finalization
  - Formal contract CO development/reviews
  - Execution
Construction – Time Savers

• Typical Change Order Process
  – 2 – 8 weeks
  – ~ $90k - $350K per CO item In sludge disposal

• Double Shifts (Refractory Installation)
  – Saved 25 days ~ $145K
Construction Completed February 2011

- FBI Received a Full Upgrade with Many Improvements
- Incinerator Off Line for Eight Months
- Total Project Cost $4.5 M
  - not including sludge hauling
  - Project payback < 3 years
Finished Product - February 2011

• New Tuyere Design
  – Reduce sand intrusion
  – Ability to blow out sand between burns
  – Address previous failures
Project Benefits

• Improved FBI Reliability and Reduced Maintenance

• Reduced Operational Costs
  – Less oil
  – Less polymer
  – Less electricity
  – Less labor

• Improved Heat Retainage (25%)
  – Longer down between burns

• Reduced Voltage Starters on 400 hp and 350 hp blowers
  – Elimination of electrical surges
Lessons Learned

• Plan Ahead
  – Upgrades and repair are Inevitable
  – Minimize need for minor repair to become major
  – Poor Conditions will Degrade Rapidly

• Regular Inspections
  – Increase frequency with age and as issues become more apparent
Lessons Learned (continued)

• Understand Full Impact of Additional Work
  – Cost of work items
  – Cost of sludge hauling

• Example
  – $5K CO that takes two weeks
  – Real cost $93K!

• Don’t Under Estimate Costs
  – Sludge Hauling, oil use, polymer
  – 25% of project costs
  – Increase Construction Contingency!
Lessons Learned (continued)

• Successful Streamlined CO Approach Mirrors Design Build

• All parties must be reasonable, fair, and equitable
  – Owner
  – Engineer
  – Contractor
  – Funding agencies
Questions

Matthew.Formica@AECOM.com
AECOM, 701 Edgewater Dr., Wakefield, MA 01880

Fmcneill@manchesternh.gov
Manchester Environment of Environmental Protection,
300 Winston St, Manchester, NH 03103