Getting it Hot and Doing It Fast:

Lessons Learned from Upgrading a Fluidized Bed Incinerator in Manchester, NH

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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

Project Needs Identified Through Facilities Plan

- 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

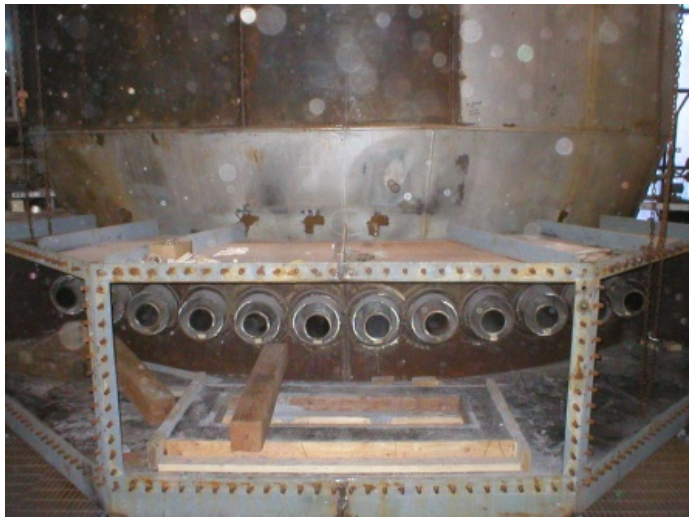
- Typical Change Order Process
  - 2 – 8 weeks
  - ~ $90k - $350K per CO item In sludge disposal
- Double Shifts (Refractory Installation)
  - Saved 25 days ~ $145K

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

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