Veolia Philadelphia Rapid Start Boilers

Design/Construction Challenges and Solutions

WM Group Engineers

VEOLIA ENERGY
Background

• Project result of negotiations between the U Penn and Veolia

• WM Group worked with Veolia to maintain U Penn on District Thermal

• WM Group retained to design Rapid Start Plant after agreement was made
Project Goals

• Design for a plant with an ultimate capacity of 1,000,000 lb./hr.

• Capable of full capacity in 8 minutes

• Divided into phases, first phase 500,000 lb./hr.

• Must be in operation by end of subsequent summer (2012), with penalty for delays
Challenges

1. Creating space in existing plant for new boilers
2. Transportation of boilers
3. Construction in active plant
4. Rapid start requirement
5. Plant layout in confined space
6. Utility Phasing
7. Vertical constrictions
8. Basement access
9. Boiler and Deaerator Rigging
10. Numerous misc. technical challenges
Solution

• Proactive Design and Management
  • Alternative to “In-basket management”
  • Actively anticipate challenges and plan accordingly
Challenge 1: Creating Space

• Installation in existing early 1900’s coal fired plant
• Existing boilers contained asbestos in mortar
• Had to limit removal
Challenge 2: Transportation

- Train to barge, to crawler to building
- 2 month delivery frame
- Used “skates” to clear existing pipe rack
Challenge 3: Active Plant

- 20,000 SF space full of active steam and power lines
- Identified operational lines
- Time constraints dictated field identification of lines and demolition parallel to boiler project design
Challenge 4: Rapid Start Requirements

• Boiler must come to full capacity in under 8 minutes
• Considered sparging tubes, drum heaters
• Chose sparging tubes for overall first cost and operating cost
Challenge 5: Plant Layout

• Major Components:
  • 2x D-Type Boilers
  • 900 HP Force Draft Fans
  • Economizers
  • DA Tank
  • Blowdown Systems
  • Feedwater Systems
  • Electrical Components
Challenge 6: Utility Phasing

• Steam Shutdowns
  • Timed tie-ins to steam system with planned steam shutdowns

• Electrical Shutdowns
  • Existing electrical equipment had to be removed to make space for boilers
  • Quickly designed new electrical system and tie-ad in when utility was bringing in new service.
  • Routing of the new sub-stations had to avoid existing boilers.
Challenge 7: Vertical Restrictions

- FD Fan in basement, Boiler on main level, economizer and DA at mezzanine level
- NPSH restrictions limited BFW piping options
- Strait runs of breeching and shared stack limited CEMS placement.
Challenge 8: Basement Access

- Existing active sump pumps had to remain to support Turbine Hall.
- 900 HP FD fan constructed over sump
- Ventilation requirements:
  - 200,000 CFM combustion air
  - 49,000 general ventilation
Challenge 9: Boiler and Deaerator Rigging

- Boiler rigged through offset opening in wall
- Required geotechnical analysis of retaining wall where crane was perched (built in early 1900s)
- DA tank maneuvered vertically into position
Challenge 10: Design Challenges

- Majority equipment pre-purchased by Veolia:
  - Boiler
  - DA Tank
  - BFW Pumps
  - CEMS
  - BMS/CCS
  - FD Fan
  - CFDs
  - UPS

- Designed without definitive data from pre-purchased vendors

- FD Fan selection grew in size during design. Determined CFD modeling of unique inlet air box not necessary.
Conclusion

- Proactive design allowed project to go from design to fully operational in just over 1 year.

- Existing plant maintained operation throughout demo and construction.

- District Steam now has increased reliability and greener source of energy.
Thank You
Rapid Start Boiler Requirements

- Specified boiler had to come to full capacity in under 10 minutes
- Considered Sparging Tubes, Drum Heaters
- Selected:
  - Water tube D-Type boiler
  - Sparging tubes.
  - Able to come to full capacity (250,000 lb./hr. at 250, psig 40F superheat) in 8 minutes
  - Dual Fuel (NG and No2)
  - 6:1 turndown
  - Economizer
Existing Space Limitations

- Existing early 1900’s coal boiler plant sited for new boilers
- Boiler mortar contained asbestos
- Required detailed survey and identification of active and inactive lines in operating plant
- Mounted 900 HP fans overtop of below grade sump pits
- Verification of weldability of existing steel
- Analyzed existing stack
- Existing opening limitations
Rigging Obstacles

- Transported from Oklahoma to Philadelphia (Train to barge to truck)
- Reviewed routes with rigging vendors
- Boiler rigged through offset opening in wall
- Required geotechnical analysis of retaining wall where crane was perched (built in early 1900s)
- DA tank maneuvered vertically into position
Tight Design and Construction Timeframe

- Provided Design in 3 Phases
  - Phase 1 - Fuel Connections
  - Phase 2 - Steam Connection (Staged for execution with coincident work at 24/7 facility)
  - Phase 3 - Major Installation
- Deadline with Penalties
- Design Phase: Mid 2011 to Dec 2011
- Construction: Jan 2012 to July 2012
Cost Constraints

• Pre-purchased majority of major equipment
  • Required close coordination between pre-purchased equipment and “Phase 3” installation.

• Selectively demolished existing equipment to avoid unnecessary asbestos abatement
Summary

- Project delivered on time without penalties for late deployment
- Plant now able to provide rapid start backup of existing turbine steam production.