HIGH EFFICIENCY BLOWERS
A CASE STUDY

JOHN LINDSTROM – CITY OF PUEBLO, CO
RICH HENDERSON – BLACK & VEATCH
PROJECT OVERVIEW

- Secondary Treatment Conversion of Trickling Filter/Solids Contact to Biological Nutrient Removal (BNR)
  - Design Flow – 19 mgd MMF
  - Effluent Limit Driven – Nitrogen and Phosphorous

- Addition of Preanoxic, Anaerobic, and Anoxic Reactors (PAAR Complex)

- Double Oxic Reactor Volume
  - 294K to 588k cubic feet

- Blower Capacity
  - Old - 7,344 scfm Firm Capacity, 500 hp
  - New – 20,800 scfm Firm Capacity, 1324 hp
PLANNING

• Why High Speed Turbo Blowers?
  • Energy Efficiency
  • Low Maintenance
  • Size – Utilization of Existing Space

• Manufacturer Preference?
  • ABS – Magnetic Bearing
  • HSI, APG-Neuros, KTurbo (Aerzen) – Airfoil Bearing
  • Turblex – Inlet Guide Vanes
    • Decided Not to Include
      • Larger Size Ranges Still in Development During Our Design
PLANNING – ENERGY EFFICIENCY

Made Early Decision That All HSTBs Basically Equal in Efficiency

Efficiency vs. Turndown of Various Blowers (Compressors)

- IGV & VD Single Stage
- High Speed Turbo Gearless
- Single Stage IGV Only
- Multistage
- Positive Displacement

Note: Curves illustrate an entire family of blowers and are for comparative purposes only. Contact blower manufacturers for efficiencies at specific design conditions.

Courtesy of Turbex, Inc.
PLANNING - ENERGY EFFICIENCY

• Maximize Efficiency Through Control
  • Master Control Panel
  • DO Control – Minimize Over Aeration
  • Most Open Valve Control
    • DO Controls Valve Position, Valve Position (MOV) Controls Pressure (Main Header) Set Point, Blowers Work to Maintain Pressure Set Point
PLANNING – MAINTENANCE

• ABS, Neuros, HSI, KTurbo  Virtually Maintenance Free
  • Filters

• Cooling Systems
  • ABS, K-Turbo – Air Cooled
    • K-Turbo – Discharged to Process
  • ABS – Separate Discharge Pipe
  • Neuros, HSI – Liquid Cooled
    (Larger Sizes)
  • Neuros – Internal
  • HSI - External
PLANNING – USE OF EXISTING SPACE

54 foot x 26 foot
PLANNING – USE OF EXISTING SPACE
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PLANNING – MANUFACTURER PREFERENCE

• U.S. Installations
  • How Many, How Long
  • ABS – DePere, WI (2004)

• Service Centers
  • HSI – Proven Record with Traditional Blowers
    • Houston, TX
  • All Others Fairly Limited

• Proprietary Equipment
  • KTurbo – Everything Within Machine Made by KTurbo
    • Including VFD and Local Control Panels
PLANNING – MANUFACTURER PREFERENCE

- **Controls**
  - Master Control Panel
  - In House or Working Relationship with Specific Companies

- **Cooling System**

- **Air versus Magnetic Bearing**

- **Costs**
  - ABS
  - HSI and Neuros
  - KTurbo
PLANNING – MANUFACTURER PREFERENCE

• Preferred Manufacturers Ranking
  • ABS – Preference for the Air Cooled; Mag Bearing; Years In Operation in U.S.
  • Neuros and HSI – Mainly Equal in Quality/References; HSI Manufacturing History
  • KTurbo – Proprietary Equipment Not Favorable
DESIGN AND BIDDING

• Efficiency
  • Didn’t Specify Efficiency
    • Maximum Power Draw (Wire to Air)
    • Master Control Panel – Experienced Integrator

• No Evaluated Bids
  • Testing Standards

• Competitive Pricing

• Designed Around ABS
  • Planning Phase Work
EFFICIENCY – MASTER CONTROL PANEL

- Integrator
- How Do Blowers Interact With One Another
- Most Open Valve Control

Does the Blower System Supplier have at least 5 years in-house I&C experience with the dissolved oxygen/most open valve method of blower control, along with the capabilities to construct and program the MCP?

- YES
  - Blower System Supplier may use their own I&C department. Proof of experience will be required. Projects cited must be in full-scale operation. Mandatory meetings will be required between Blower System Supplier, General Contractor, and General Contractor’s I&C Subcontractor in order to coordinate flowmeters, control valves, dissolved oxygen meters, and any other appurtenances required fully functioning air delivery delivery system.

- NO
  - Blower System Supplier may retain the services of their own I&C subcontractor. Proof of experience will be required. Projects cited must be in full-scale operation. Mandatory meetings will be required between Blower System Supplier, Blower System Supplier’s I&C Subcontractor, General Contractor, and General Contractor’s I&C Subcontractor in order to coordinate flow meters, control valves, dissolved oxygen meters, and any other appurtenances required for a fully functioning air delivery system.

Does the Blower System Supplier have an established working relationship with an I&C Subcontractor? “Established working relationship” refers to a minimum of three completed jobs (in full-scale operation) with the I&C Subcontractor. The completed jobs shall have used dissolved oxygen/most open valve blower control, and the I&C Subcontractor must have provided the MCP along with all of the programming.

- YES
  - Blower Supplier shall retain the services of the General Contractor’s I&C Subcontractor for use as the Control System Supplier.

- NO
Testing

- No Test Standard For HSTBs
  - Utilize ASME PTC 10 or ISO 5389
- CAGI/ISO Committee
  - Target: Available by Spring 2012 on CAGI site
  - ~3 years for Adoption by ISO, Annex to 5389
- ASME
  - Target: 1 to 2 years
  - New Standard, PTC-13
COMPETITIVE PRICING

• Named Four Manufacturers
  • Three Price Ranges
  • ABS Most Expensive; KTurbo Least Expensive
  • Open Specification, Others Wouldn’t Bid Directly Against KTurbo

• Broke Blowers Down by Tiers – Bid Alternates
  • Tier 1 (Base Bid, Designed Layout) – Mag Bearing, Non Proprietary VFD and LCP
  • Tier 2 (Bid Alt) – Air Bearing, Non Proprietary VFD and LCP
  • Tier 3 (Bid Alt) – Air Bearing
COMPETITIVE PRICING

BID ALTERNATE 1 – Adjustment to Base Bid for Furnishing Tier 2 or Tier 3 Blower System Suppliers

Bidder is required to offer Bid Price Adjustments using pricing from all Tier 2 and Tier 3 blower system suppliers offering pricing for the Project. Bidder offers the following Bid Price Adjustments:

<table>
<thead>
<tr>
<th>Tier 2 Blower System Supplier</th>
<th>Add/Deduct (indicate one)</th>
<th>Bid Price Adjustment ($)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. HSI</td>
<td>Deduct</td>
<td>$290,000</td>
</tr>
<tr>
<td>2. Neuros</td>
<td>Deduct</td>
<td>$170,000</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Tier 3 Blower System Supplier</th>
<th>Add/Deduct (indicate one)</th>
<th>Bid Price Adjustment ($)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. K Turbo</td>
<td>No Bid</td>
<td></td>
</tr>
</tbody>
</table>
ISSUES WITH BID ALTERNATIVE APPROACH

• Design of New Layout If ABS Wasn’t Within Budget
  • Contractors Aren’t Designers
  • Did They Price Work The Same
  • One Contractor Didn’t Bid the Alternates
STATUS OF PROJECT

• Blowers Have Been Checked Out by ABS
• Operational Testing – Two to Three Weeks
• Primary Effluent to New Process End of June
QUESTIONS