WEA2017

Installation of High Speed Blowers

Cuts Electrical Costs & Improves Operations

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Outline

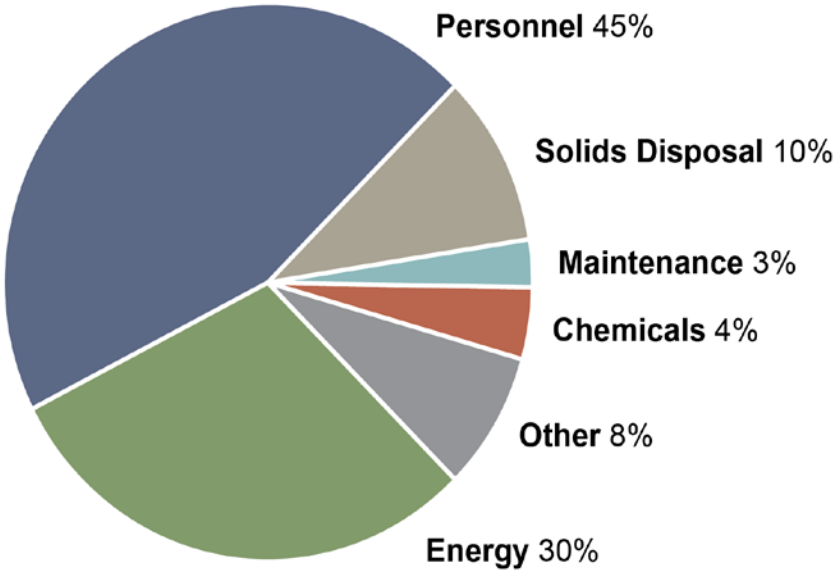
- ✓ Background
- ✓ Evaluation
- ✓ Blower Features
- ✓ Blower Project Examples
  - Existing Conditions
  - Design Considerations
  - Proposed Improvements
  - Lessons Learned
- ✓ Take Away Recap
- ✓ Questions

Background

Energy Costs for W/WW Industry

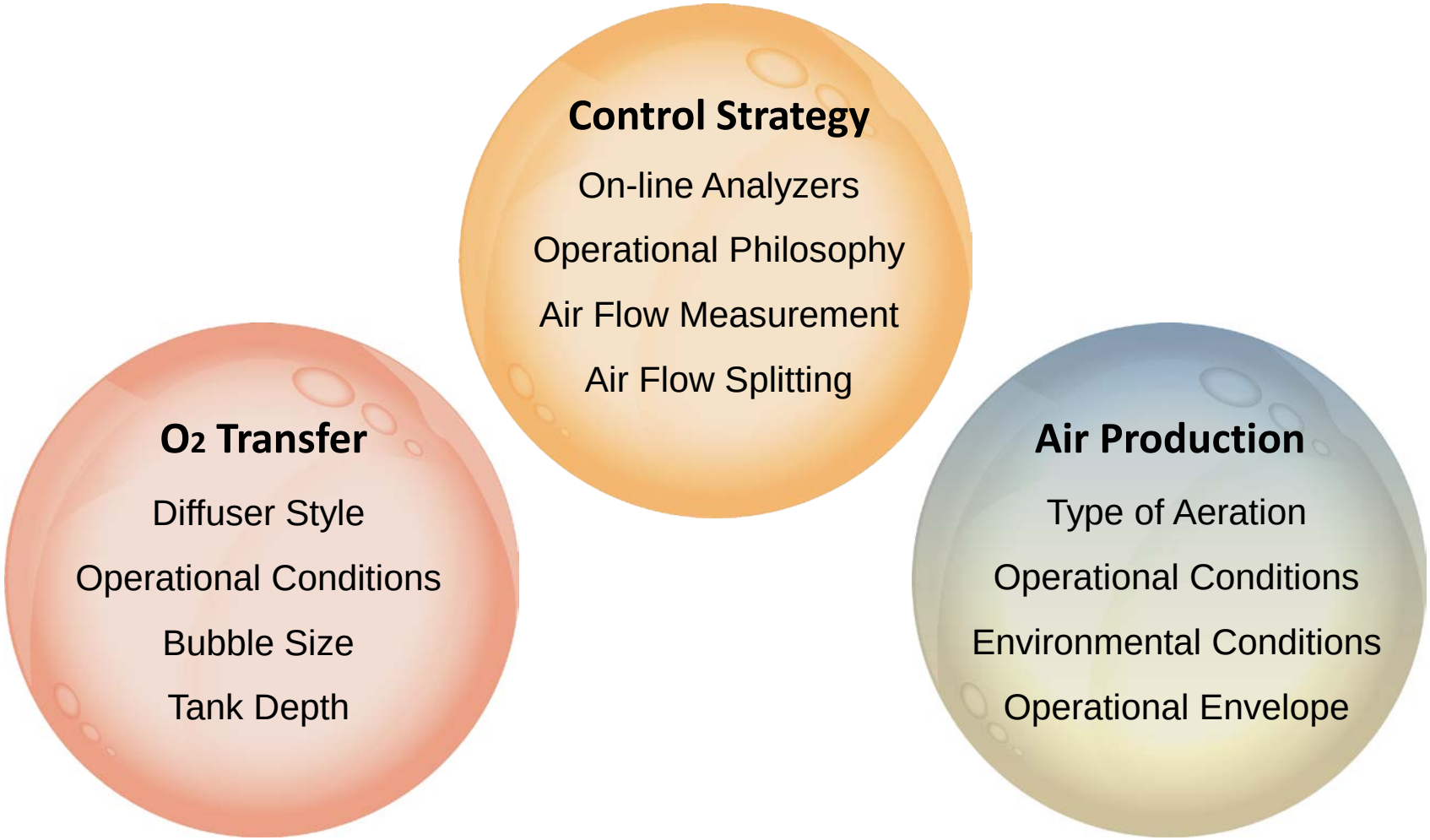
- ✓ Energy costs are rising
- ✓ Stricter treatment regulations are coming
- ✓ W/WW 3% of the nation's energy use (Source-EPA)
- ✓ W/WW largest energy user for municipal utilities
- ✓ Largest energy use at WWTP is aeration
- ✓ Operating budgets stagnant or declining
  - More automation
  - Reduce energy

Operating Cost Distribution at W/WW



Background

Aeration System Components

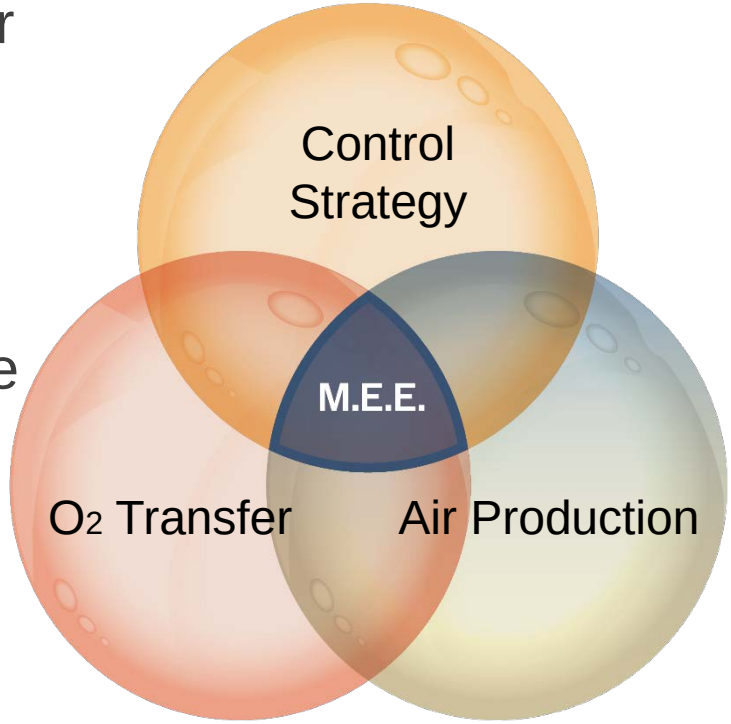


Background

Aeration System

“Most Energy Efficient” Operation

- ✓ Three systems must work together
- ✓ Improvements to one system will impact the other two systems
- ✓ Example: Install new diffusers, increase transfer efficiency, reduce air required, blowers may than be oversized
- ✓ Work on weakest area



M.E.E. – Most Energy Efficient

Focus Today Is…

Control Strategy

On-line Analyzers

Operational Philosophy

Air Flow Measurement

Air Flow Splitting

O_2 Transfer

Diffuser Style

Operational Conditions

Bubble Size

Tank Depth

Blowers

Air Production

Type of Aeration

Operational Conditions

Environmental Conditions

Operational Envelope

Evaluation

Past Aeration Systems were often Oversized

Designed on static criteria

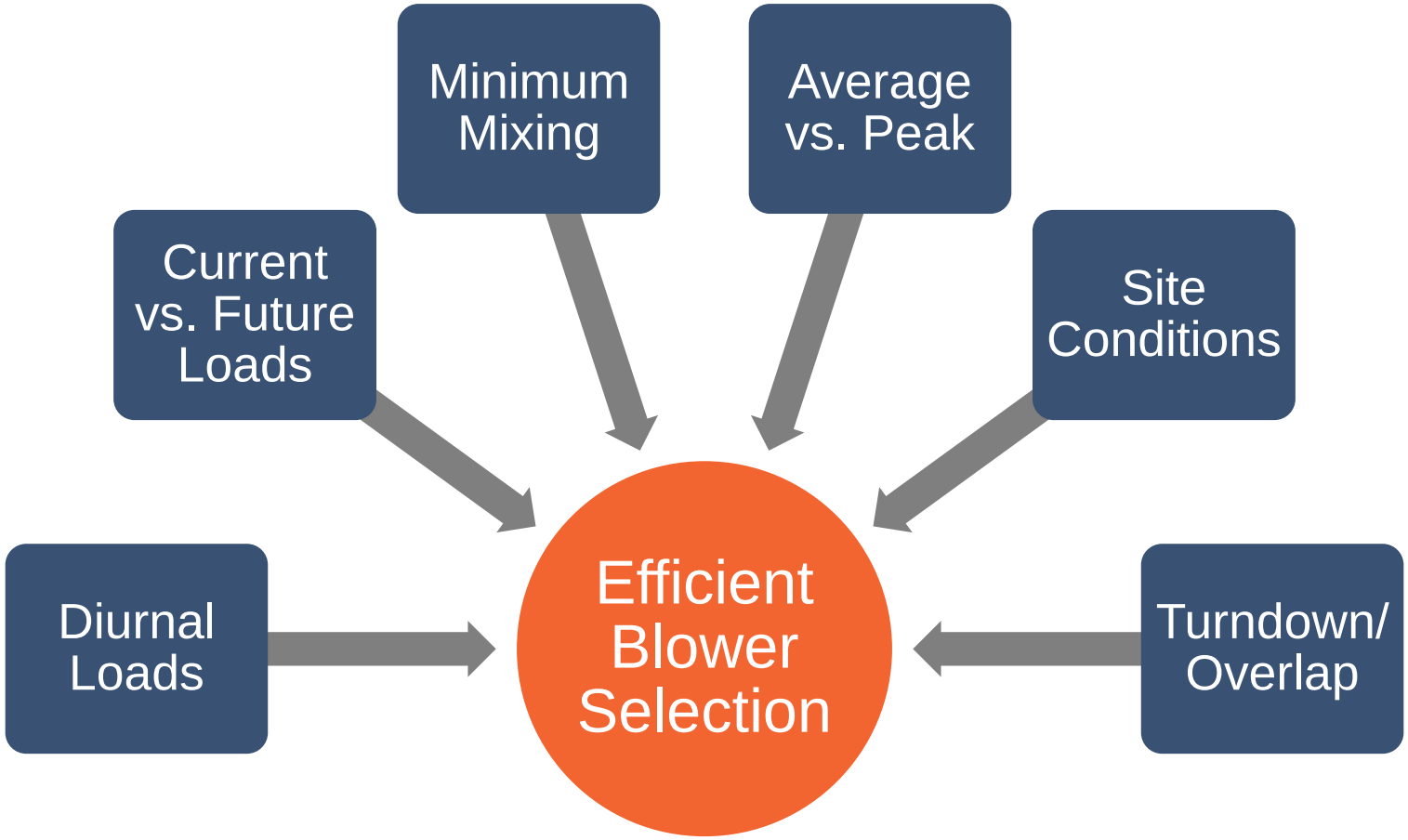
- Average and maximum loads
- Not transient conditions

Typical results

- Gaps
- Aerobic zones too large
- Too many diffusers per basin

Evaluation

Correct blower sizing – probably the most important detail



Evaluation

- ✓Examine several operating conditions
- ✓Consider mixing requirement based on tank volume
- ✓Calculate diffuser minimum airflow (if appropriate)

Criteria	Season			Weighted Average (scfm)
	Winter (scfm)	Summer (scfm)	Transitional (scfm)	
Min Hour	1,400	1,430	1,400	1,410
Min Day	1,400	1,430	1,400	1,410
Min Week	1,400	1,430	1,400	1,410
Min Month	1,400	1,430	1,400	1,410
Avg Annual	1,850	1,990	1,880	1,900
Max Month	2,680	2,560	2,720	2,670
Max Week	3,680	3,580	3,670	3,400
Max Day	3,730	3,600	3,700	3,430
Max Hour	3,900	3,600	3,900	3,580
Current Avg	**1,850**	**1,990**	**1,880**	**1,900**
Future Avg	**2,930**	**3,030**	**2,980**	**2,980**

Evaluation

Blower Technologies

- ✓ Positive Displacement
- ✓ Multistage Centrifugal
- ✓ Single-Stage Centrifugal
- ✓ High-Speed Direct Drive Centrifugal (Turbo)

Evaluation

High Speed Direct Drive (Turbo) Blowers

- ✓ Motor / blower speed varied with VFD
  - More efficient turndown than multistage
  - VFD/controls integrated into blower package
  - Manufacturers protective of blower controls
  - Typically 3 control modes; discharge pressure, airflow, and dissolved oxygen
- ✓ Blower and motor directly coupled

Evaluation

High Speed Blower Options

- ✓ Bearings require no lubrication
  - Air foil bearing - inlet air creates air foil around shaft
  - Magnetic bearing - electronic control system continuously monitors and adjusts magnets to position shaft
- ✓ Limited max size
  - ~ 6,000 scfm with airfoil bearing (2X with dual core air bearing)
  - ~10,000 scfm with mag bearing
- ✓ Reduced noise and vibration
  - Noisy during startup/shutdown due to blow-off

Blower Design Considerations

- ✓ Turndown and avoiding gaps with new blowers
- ✓ Available manufacturer’s offerings
- ✓ Site visits and/or references
- ✓ Equipment and piping layout
- ✓ Equipment/installation cost plus electrical cost (O&M)

Blower Project 1

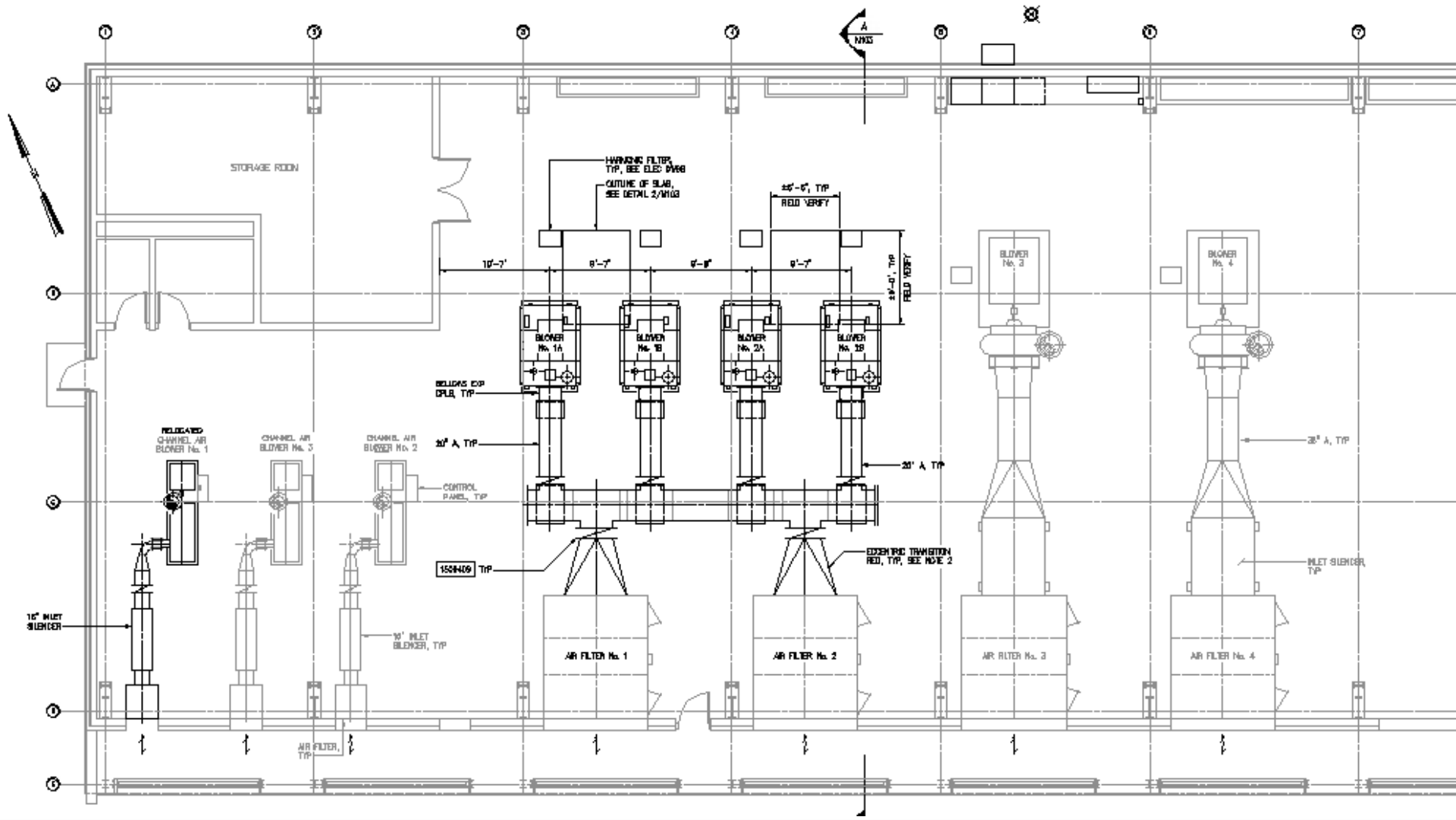
Existing

- ✓ Four 1500 hp single stage centrifugal blowers
- ✓ 28,000 scfm (turndown limited to 18,000 - 20,000 scfm);
- ✓ Typical demand 12,000 scfm (70 mgd plant)

Additional Design Considerations

- ✓ Size required (400+ hp)
- ✓ Made selection, negotiated price for sole source

Blower Project 1



Blower Project 1

Proposed

- ✓ Four 400 hp high speed turbo blowers with magnetic bearings with one master control panel
- ✓ 8,000 scfm each

Blower Project 1

Lessons Learned

- ✓ Site visits always worthwhile, talk to operators
- ✓ Once you select manufacturer(s), have them review specification to confirm they can meet details.
- ✓ Require sole source supplier to review/comment on drawings too
- ✓ For negotiated equipment pricing, address client's standard payment terms and conditions in negotiation
- ✓ Beware of long equipment delivery schedules
- ✓ Consider annual maintenance visit for first 5 yrs
- ✓ Larger units have separate harmonic filters

Blower Project 2

Existing

- ✓ Two 200 hp multistage centrifugal blowers
- ✓ 3,000 scfm each
- ✓ Typical demand 2,000 scfm (4 mgd plant)
- ✓ Often mixing limited and over-aerating

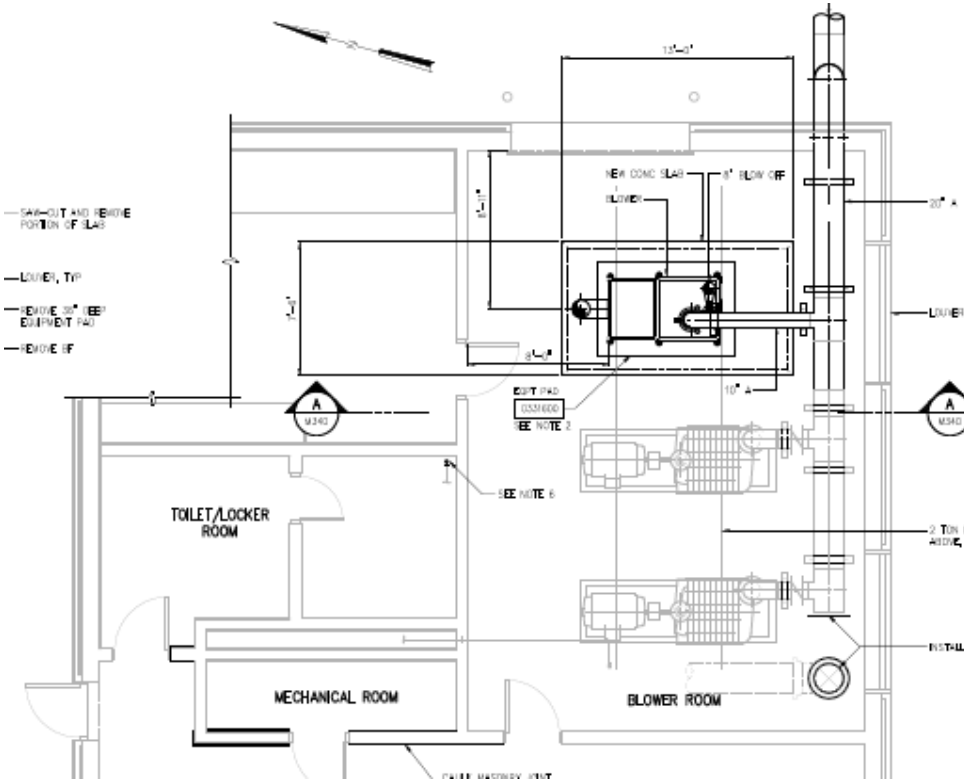
Additional Design Considerations

- ✓ Smaller blowers, more options
- ✓ Competitively bidding three manufacturers

Blower Project 2

Proposed

- ✓ One 150 hp high speed turbo blower
- ✓ 1,200 to 2,400 scfm capacity)
- ✓ Meet existing demand and provide turndown
- ✓ Use existing multistage blowers to meet high demand condition



Blower Project 2

Lessons Learned

- ✓ Challenging to competitively bid high speed blowers; no two blowers have the same features
- ✓ Manufacturers will not agree with everything in your specification. Decide what features are most important to you.
- ✓ More experience and options available with smaller turbo blowers (<200 hp)
- ✓ Prefer to control blower based on discharge header pressure control and control DO using control valves at tanks
- ✓ Beware of late comments on discharge piping

Blower Project 3

Existing

- ✓ Plant with vertical aerators in Oxidation Ditches
- ✓ Expanding by adding Aeration Basins with flexibility to meet future nutrient limits at 16 mgd

Additional Design Considerations

- ✓ New blower building
- ✓ Listed three manufacturers

Blower Project 3

Proposed

7 new high speed turbo blowers (2@150 hp and 5@200 hp) in new blower building

Blower Project 3

Lessons Learned

- ✓ Challenging path to lock in blowers
  - ✓ Not all manufacturers can meet “Made in USA” provisions; get documentation in writing
  - ✓ Consolidation of blower companies during project can have impacts on submittal and delivery process
  - ✓ Confirm source of blowers curves early (theoretical vs. actual blower data)
- ✓ Proprietary blower controls challenging to integrate with “blower system controls”

Take Away Recap

- ✓ Can lower electrical costs and improve turndown and control of your aeration system…if properly designed.
- ✓ Consider key air demand points (diurnal, mixing, today, future, min and max) when selecting blowers (number and size)
- ✓ These installed project examples cut electrical costs by about 20-30%
- ✓ Blower manufacturers each have different standard features.
- ✓ Check references and visit installations
- ✓ Competitively bidding high speed blowers is challenging. Clearly state what is exceptions are acceptable.
- ✓ Require confirmation of capacity through factory and/or field testing.

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