Brown AND Caldwell

Northeast Ohio Regional Sewer District

Southerly WWTC Valve Selection and Flexible Aeration Control for Energy Efficiency

Northeast Ohio Regional Sewer District
Protecting Your Health and Environment

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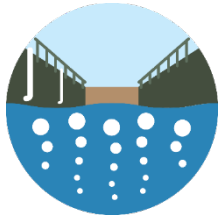
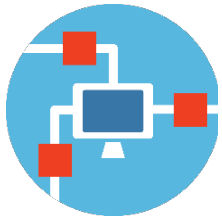
One Water Conference

Agenda

- NEORSD Overview
- Project Background and Objectives
- Equipment Selection
  - Blowers
  - Air Flow Control Valves
- Process Control
  - Constant Pressure
  - Most Open Valve
  - Flow based Most Open Valve



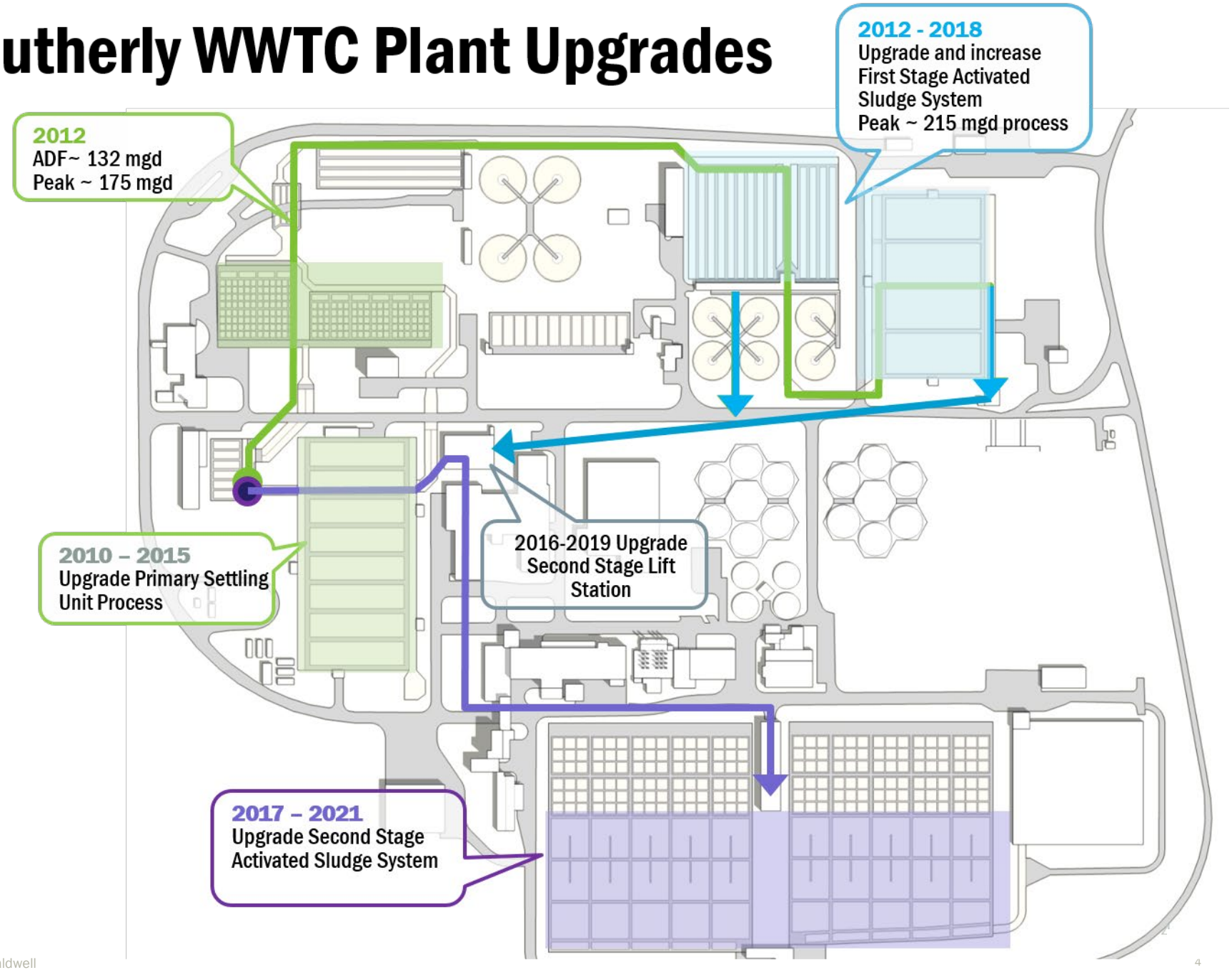


NEORSD Southerly WWTC

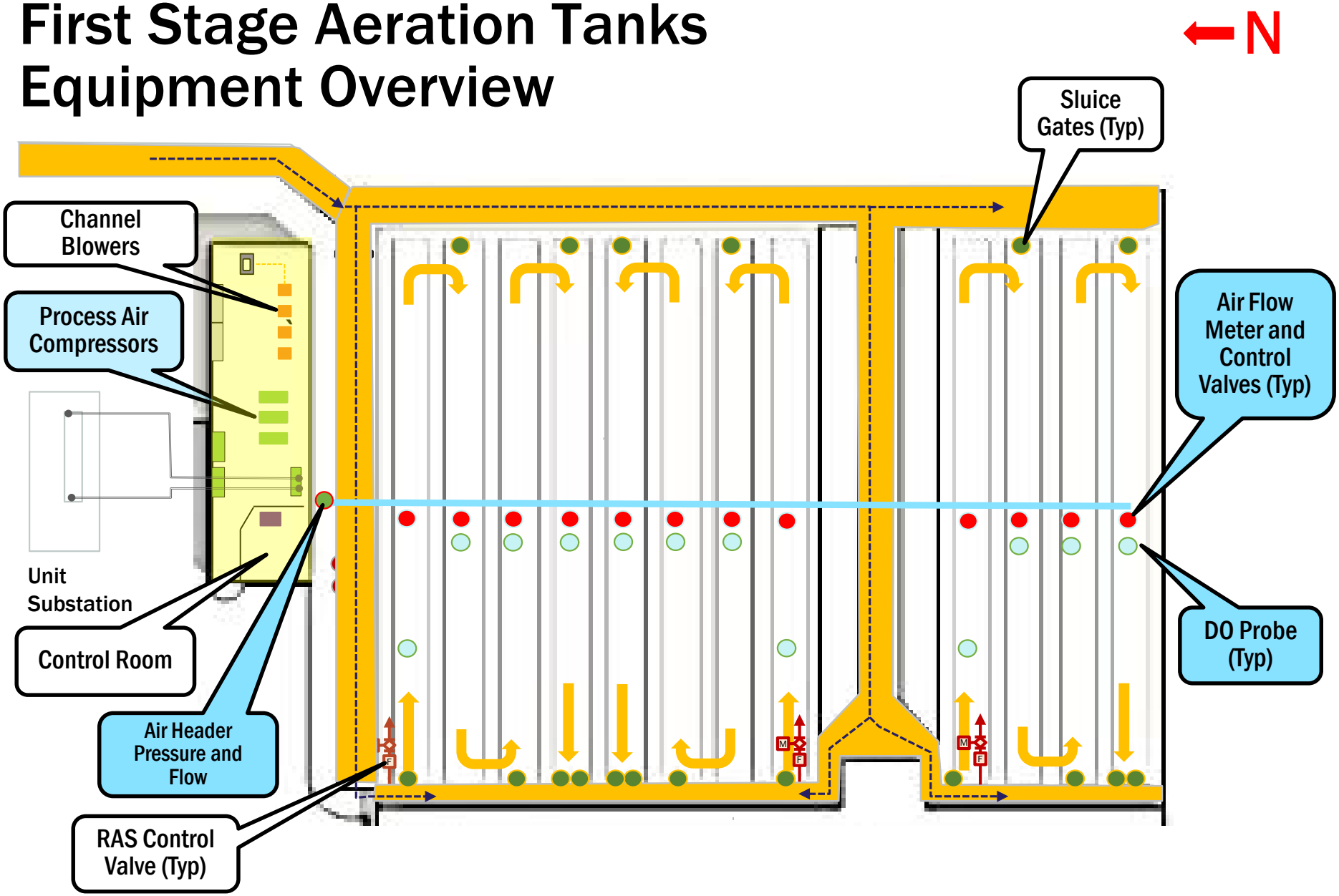
- Two-stage advanced treatment facility
- Serves 500,000 residents of Cleveland, OH and Suburbs
- First Stage Aeration System (FSAS)
  - Reduce carbonaceous biological oxygen demand prior to Second State Aeration System (SSAS)
- Two stages operate in series during wet weather
  - After FSAS capacity reached a portion of primary effluent directed to SSAS (capacity of 400 mgd)
- Although not as large as SSAS, FSAS accounts for over $500K per year in electrical consumption

Goal: Improve the mechanical reliability and efficiency of the unit process with improved automation and energy efficiency of the process air blowers.

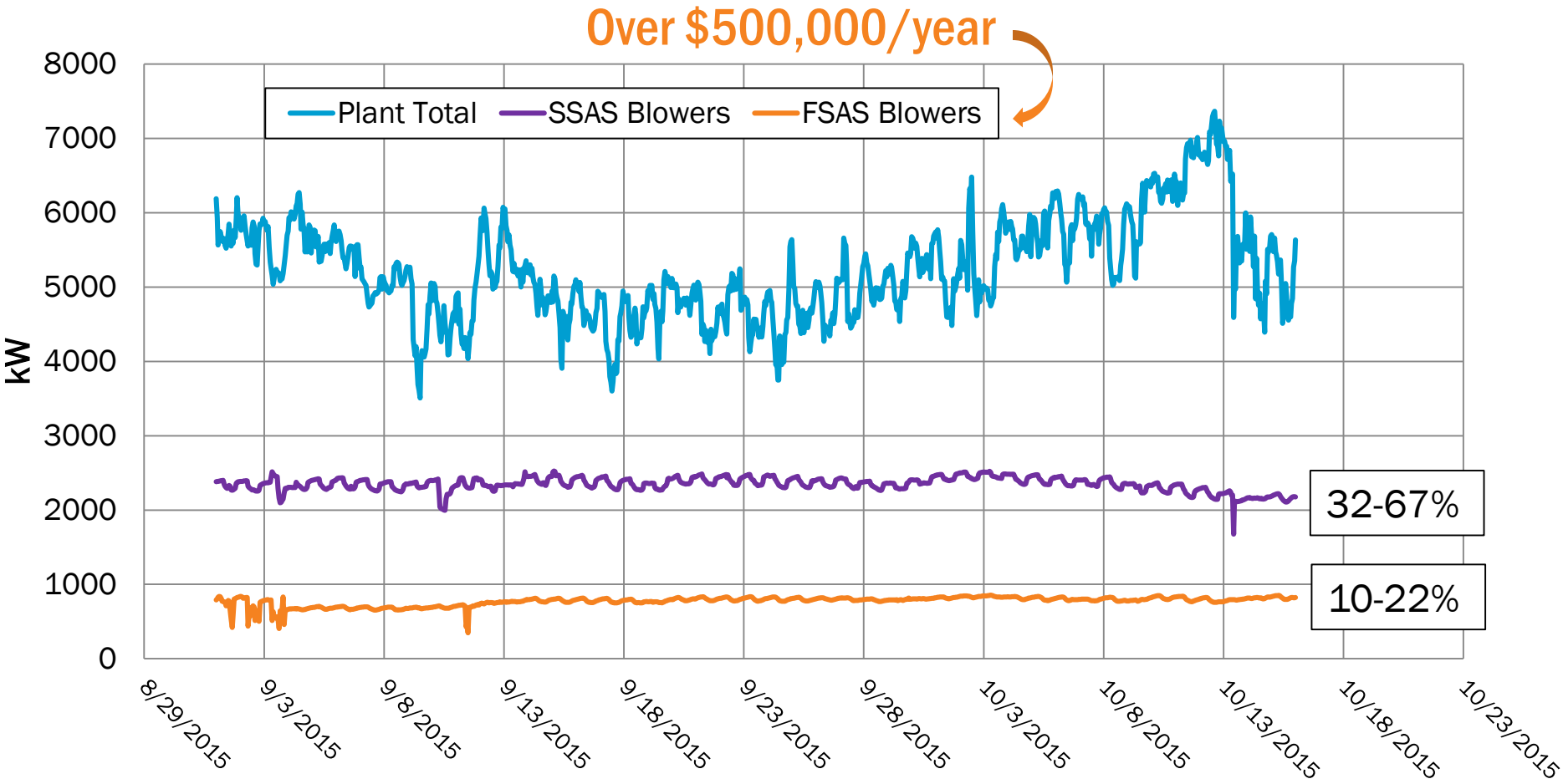
Southerly WWTC Plant Upgrades



First Stage Aeration Tanks Equipment Overview



Southerly WWTC Energy Demand



Project Objectives

- Provide greater operational flexibility and tighter control
- Consider regulatory changes
- Improve energy efficiency

Equipment selection and refined DO control has estimated savings of $150,000/year

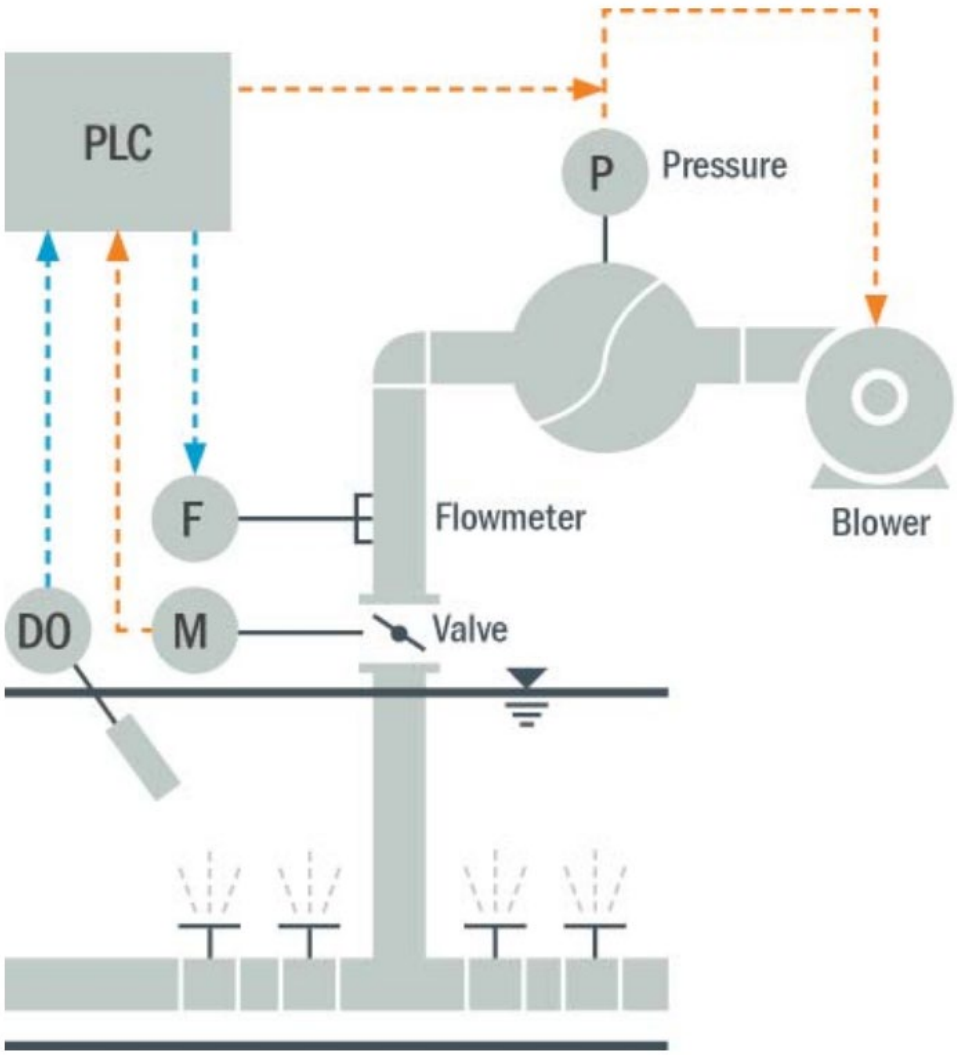
Path to Success

Equipment Selection

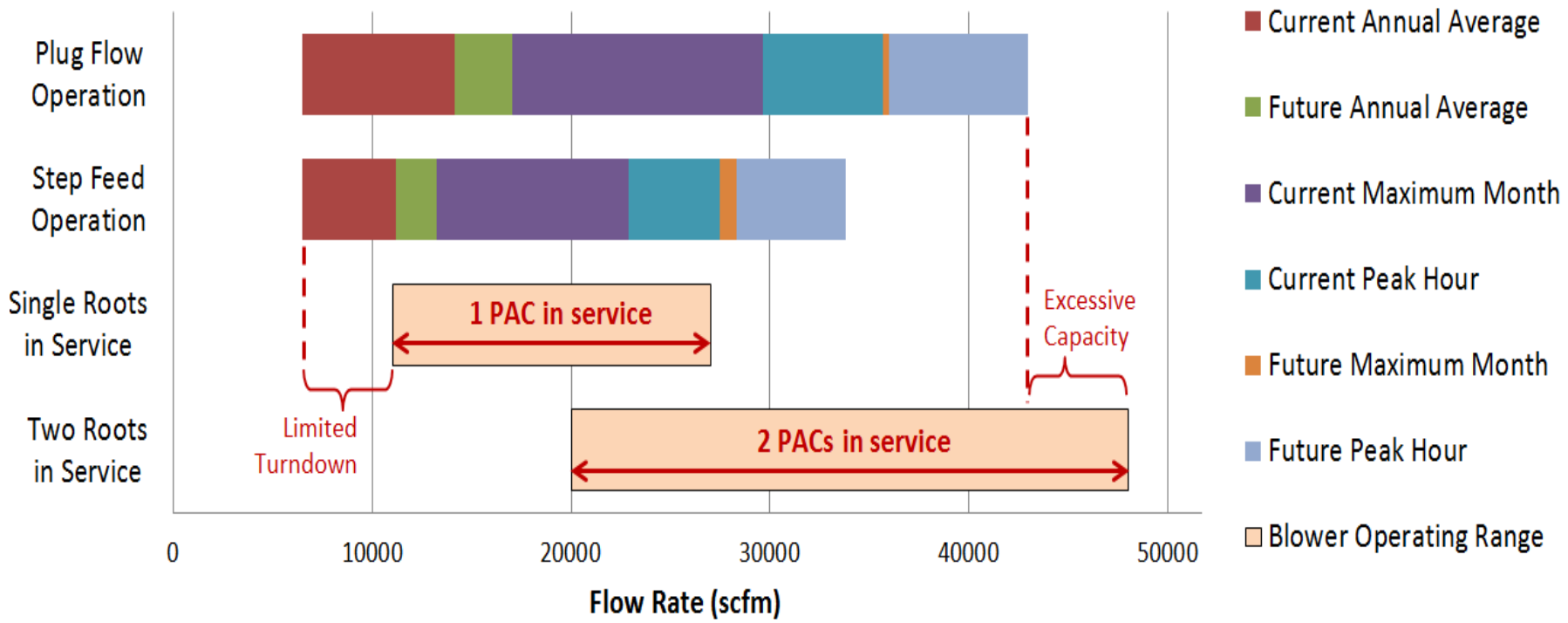
- Right size the blowers
- Minimize pressure loss in control and delivery
- Ceramic dome diffusers replaced with fine bubble membrane discs

Process Control

- Provide flexible process control to efficiently deliver the right amount of oxygen where and when it is needed

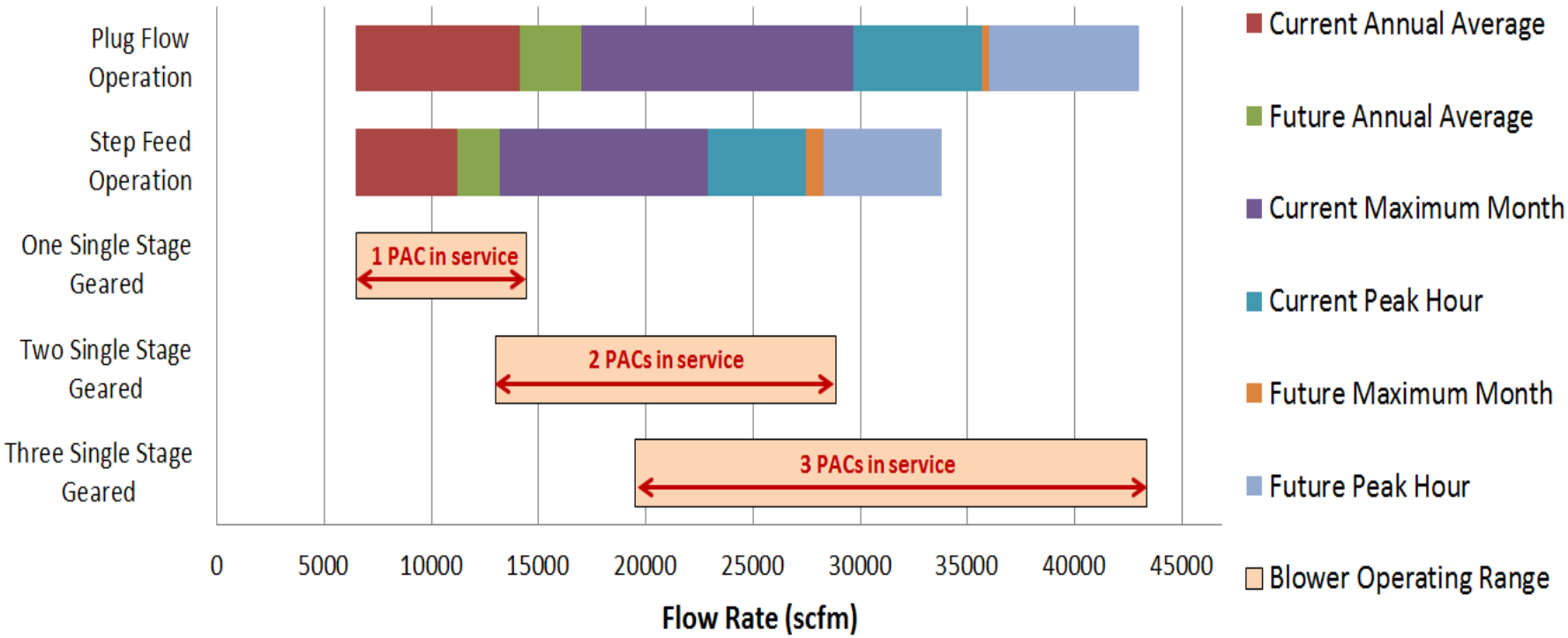


Existing First Stage Process Air Compressor Operating Envelope



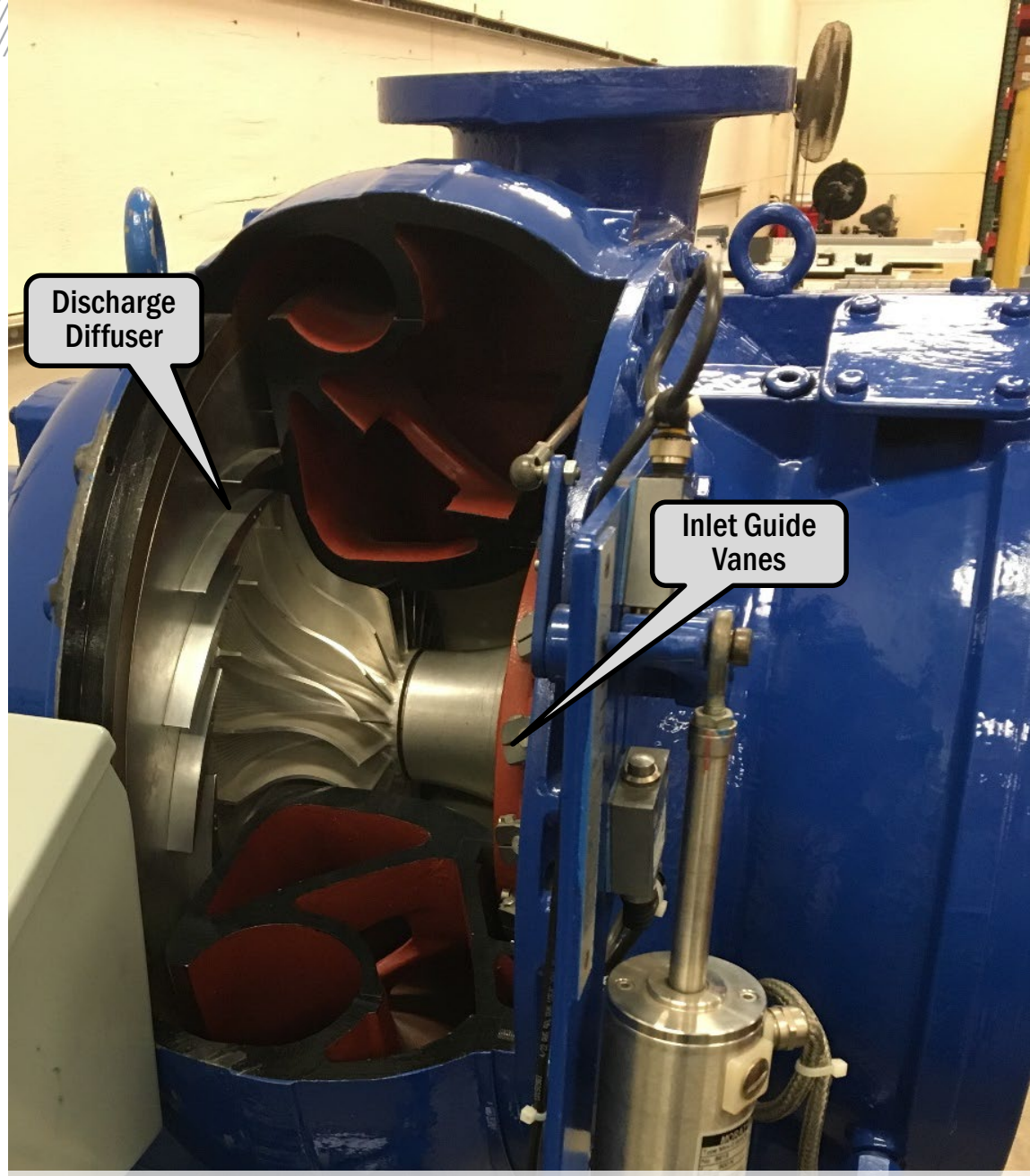
Step 1 // Blower Selection

- Maximize efficiency at normal operating conditions with greater turndown
- Decreased from 1250HP to 900HP blowers



Blower Features

- Constant speed - RVSS
- Capacity Control
- System Master Controller not provided by the Blower Manufacturer
- No automatic start/stop
- Note on Surge



WEFTEC Presentation Stand at Siemens Factory

Step 2 // Air Flow Control Valves

- Modulating control valve and thermal mass flow meter per pass (4 passes per tank)
- Balancing valve per zone (2 zones per pass)
- Actuator Technology
  - Hydraulic
  - Pneumatic
  - Electric Motor
- Control Valve Selection

Butterfly Valve

Common selection for this application

Lower capital investment compared to other valves

Quick opening (non-linear) performance particularly when at lower pressure drops

Typical range of control 30-70%

Not propriety

Photo: Nibco.com High performance butterfly valve

Control-Disk

Modified butterfly valve

Disk profile improves linear control range vs. standard butterfly valve

Typical range of control 15 - 70%

Proprietary

Photos: Fisher Control-Disk

Square Diaphragm Control Valve

Proportionally opening aperture improves linear control range vs. standard butterfly valves

Typical range of control
15 - 85%

Proprietary

Photo: Binder Group

Jet Control Valves

Expands linearity of response; nearly the full range of travel (10% open gives 10% flow)

Venturi shape provides some pressure regain

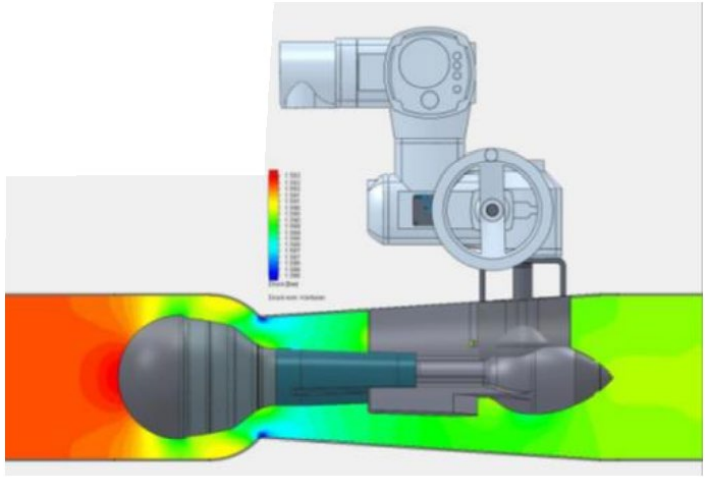
Lower pressure drop compared to other valves

“Bulb” shape straightens flow

Compact installation with flow meter installed at ½ pipe diameter upstream

Flow meter calibrated at factory

Proprietary



Photos: Binder Group

Control Valve Technologies

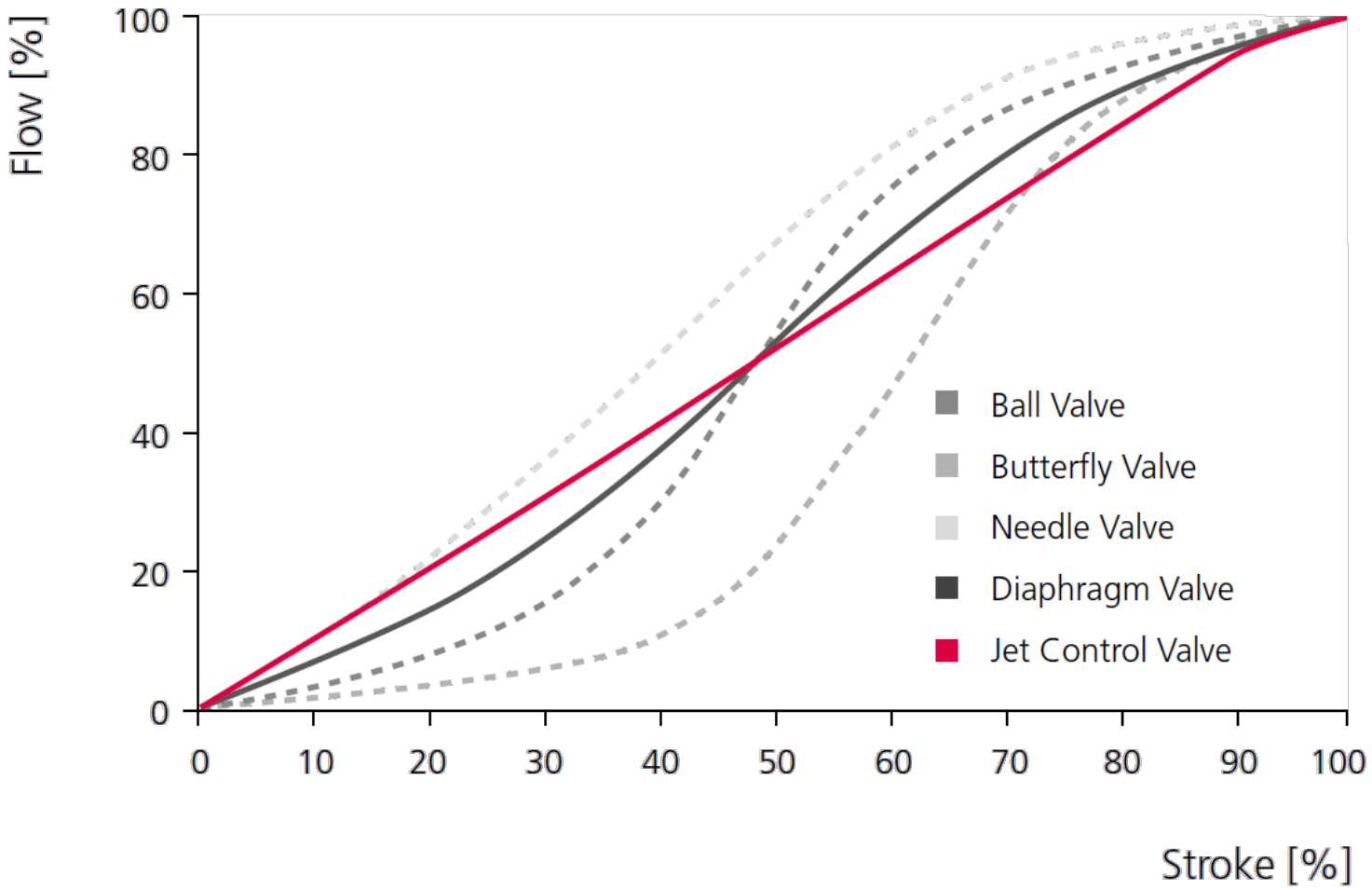


Chart from the Binder Group, manufacturer of the Jet Control Valve

Selection// The Jet Control Valve Investment

Extended consideration

- Site visit in Germany
- Longer warrantee
- Written spare and repair plan

Pressure regain – very low installed pressure drop

Estimated energy savings

- Assume 7-10 cents/kW*hr
- Assume 80% efficient blower
- Estimates a 0.45 – 0.57 psi decrease in pressure

  $12K - $18.5K per year at current loadings

1st installations in the USA

Flow Based Dissolved Oxygen Control

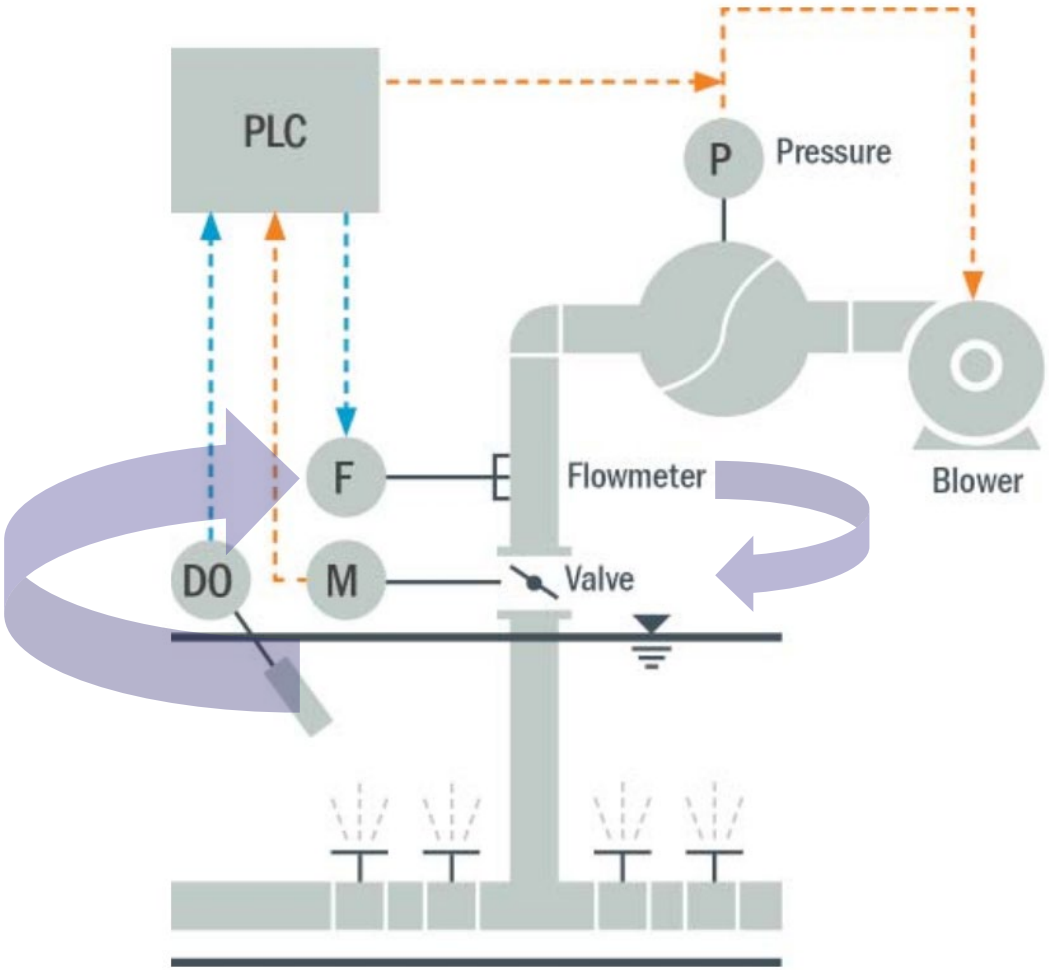
- Cascade Control
- Minimum Flow Set Point

Self Correcting

- Ambient Temperature
- Oxygen Transfer Rates
- Nutrient Loadings
- Forward Flow

Not Self Correcting

- Dirty DO probes



Pressure Control – 3 Automatic Control Modes

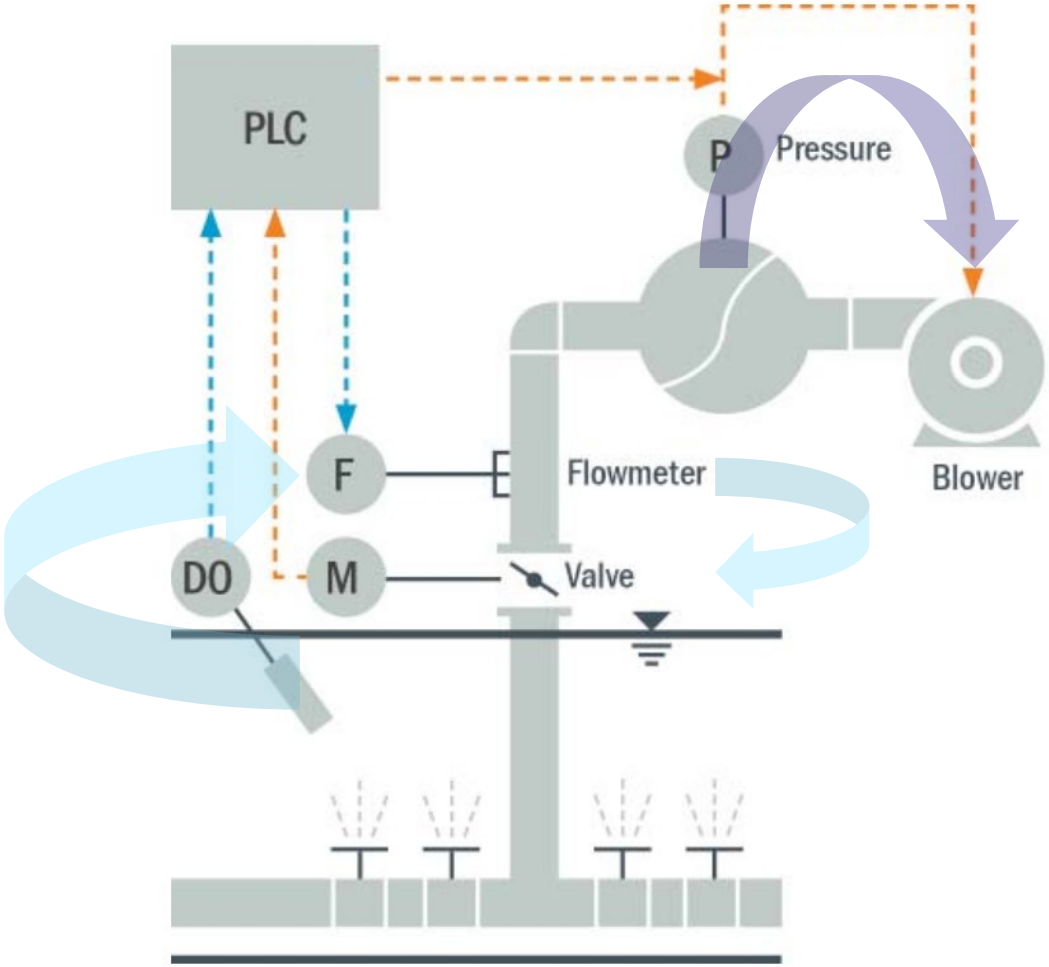
Functionality builds upon one another

Control Mode 1:

Constant Pressure

Current state of commissioning

Historical trending

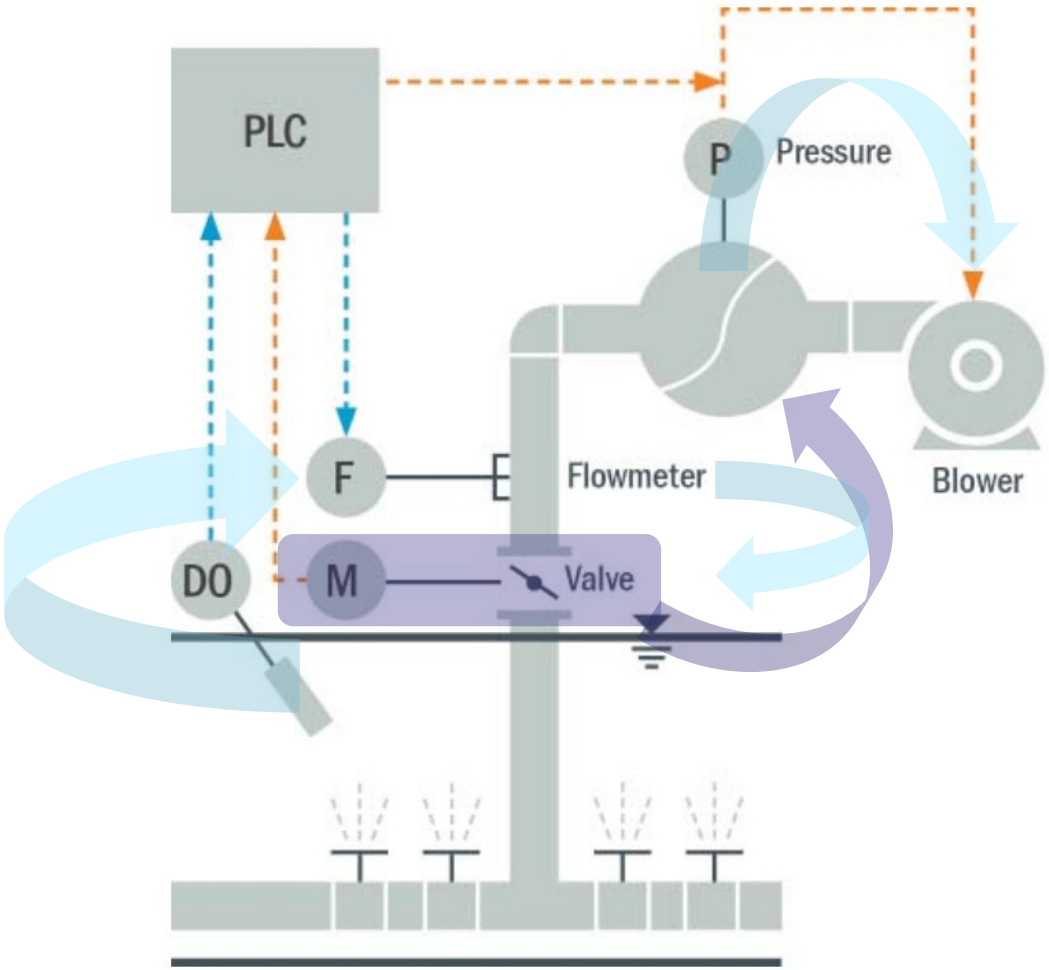


Stall the airplane!!! (scary idea in an aircraft…)

Optimized in aeration

Control Mode 2:

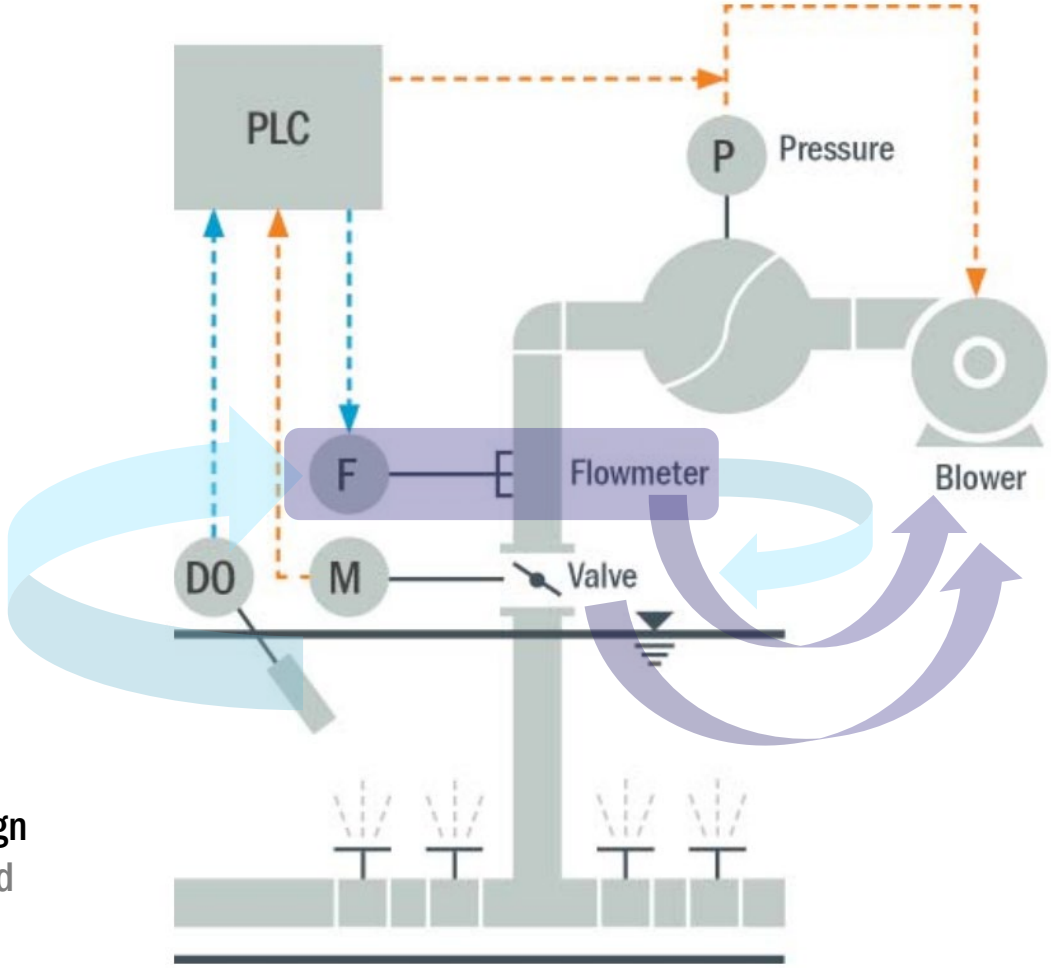
Most Open Valve (MOV)

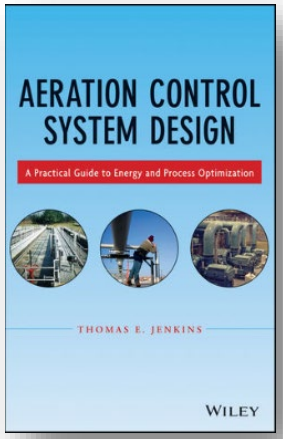


advancing * optimization

Control Mode 3:

Flow Based Most Open Valve





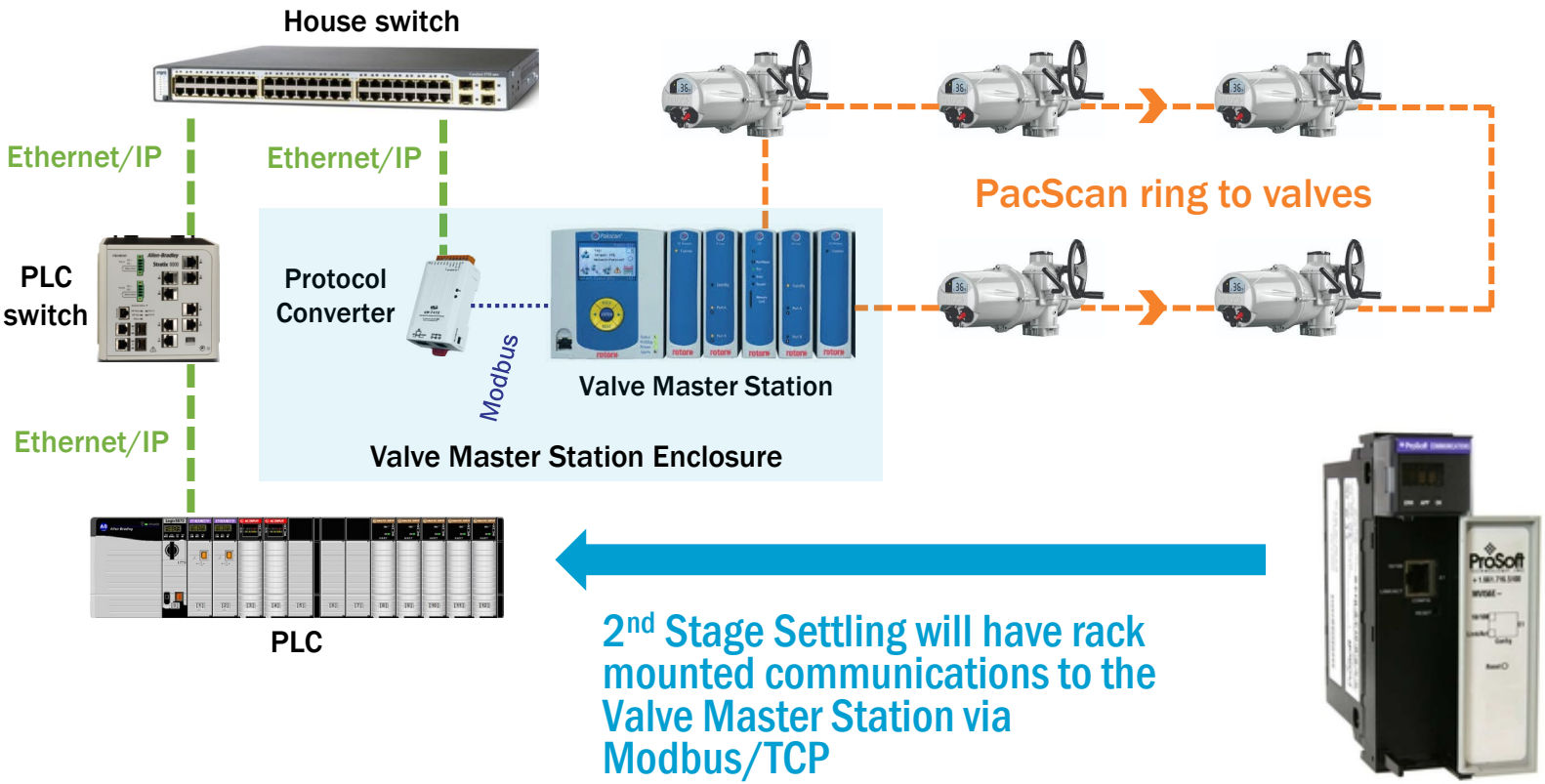
Tom Jenkins

Aeration Control System Design

A practical guide to energy and process optimization

Valve Control Network Topology

Network connectivity via Ethernet/IP drove a Rotork Valve Master Station solution with 3rd party protocol converter



Thank You

it's about connecting

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Brown AND Caldwell essential ingredients®

Presented by:

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