

VFD Vacuum Pumps Do's and Don'ts

Ron Marshall, Marshall Compressed Air Consulting
Keynote Speaker

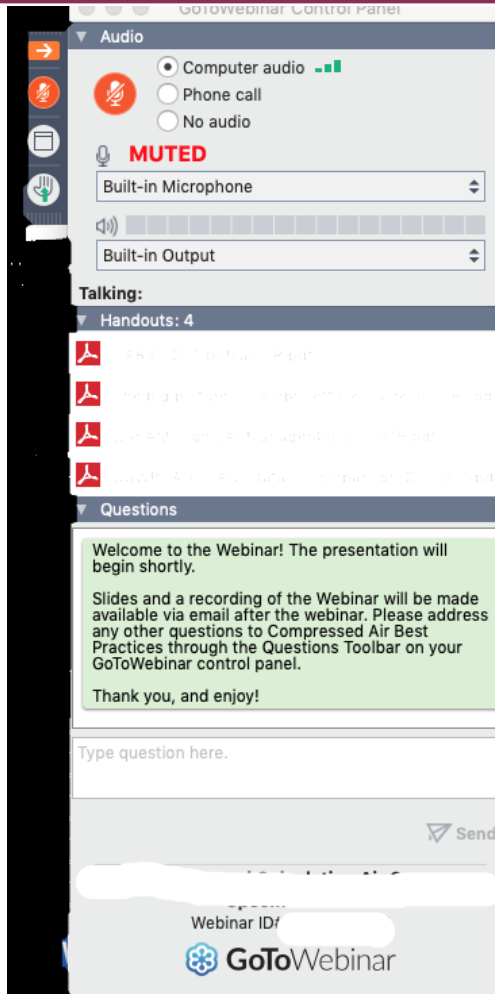
The recording and slides of this webinar will be made available to attendees via email later today.

PDH Certificates will be e-mailed to attendees by within 2 days.

Sponsored by



Q&A Format



- Panelists will answer your questions during the Q&A session at the end of the Webinar.
- Please post your questions in the Questions Window in your GoToWebinar interface.
- Direct all questions to Blower & Vacuum Best Practices® Magazine

Sponsored by



Handouts

COMPRESSED AIR EFFICIENCY

Saving you energy, time & money!



CompressedAirAudit.com

VACUUM SOLUTIONS

Product range

PLUS Intelligent vacuum solutions 0.0015 - 0.0075 Torr 2.5 - 1,000 ACFM	RS Oil lubricated rotary vane vacuum pumps 0.0015 - 0.0075 Torr 2.5 - 1,000 ACFM	MINN Dry claw vacuum pumps and compressors 15 - 150 Torr 27.0 CFM 23.5 - 617 ACFM
COBISA Industry Dry screw vacuum pumps 0.0015 - 0.0075 Torr 10 - 1,471 ACFM	COBISA Sanitation Dry screw vacuum pumps 0.0015 - 0.0075 Torr 85 - 7,885 m³/h	PANDA/PUMBA Vacuum boosters 0.0 Torr max. 18.75 - 75 Torr 105 - 6,872 ACFM
SECO Dry-running rotary vane vacuum pumps and compressors 15 - 110 Torr 8.7 - 27.8 gpm 2 - 19.4 CFM	TYR Rotary lobe blowers 14.75" HgA 14.0 gpm 88 - 2,318 ACFM	HUCKPACK Once-through oil-lubricated rotary vane vacuum pumps 0.0 Torr max. 2.5 - 15.7" HgA 28 - 5,504 ACFM
DOUGHERN Liquid ring vacuum pumps and compressors 25 - 110 Torr 18 gpm 18 - 6,471 ACFM	ZEBRA Two-stage oil-lubricated rotary vane vacuum pumps 0.0005 Torr 0.5 - 168 m³/h	SAMOI Side channel blowers 0.0 Torr max. 2.5 - 15.7" HgA 28 - 5,504 ACFM
FOSSA Scroll vacuum pumps 0.0015 - 0.010 Torr 10 - 42 m³/h	TORRE Multi-stage rotary lobe vacuum pumps 0.0015 - 0.00075 Torr 100 - 400 m³/h	BANGU Diffusion vacuum pumps 1 - 7.10" HgA 10,000 - 25,000 m³
MAF Gas abatement systems 100 - 4000 SLPM capacity	TAPOR Leak detectors 0.1 - 10" HgA (2x)	VACUUM SYSTEMS Tailored to your needs

BUSCH

HELIUM LEAK TESTING

FOR INDUSTRIAL, ANALYTICAL AND PRODUCTION APPLICATIONS



COMPLETE YOUR VACUUM SOLUTION WITH LEAK TESTING

- Why helium mass spectrometer leak detection?
- Wide range, high sensitivity for qualitative and quantitative testing
 - Inboard vacuum test or outboard sniffing pressure test
 - Highest accuracy and most reliable form of leak testing
 - High resolution analyzer cell able to distinguish between He4, H43 & H2
 - Low ambient helium concentration and inert gas makes ideal tracer gas
 - No "ghost" readings as helium cannot be created by process
 - Fast helium diffusion allows pinpoint localization of leaks



www.buschusa.com

© Busch Vacuum Solutions

BEST PRACTICES

2022 EXPO OCTOBER 3-6 ATLANTA

COMPRESSED AIR / VACUUM / COOLING

cabpxpo.com



Event Brochure

Sustainable, Safe & Reliable
ON-SITE UTILITIES
Powering Automation

Sponsored by



The Magazine for Quality & Reliability in Energy-Efficient Blower & Vacuum Systems

BLOWER & VACUUM BEST PRACTICES

blowervacuumbestpractices.com



Disclaimer

All rights are reserved. The contents of this publication may not be reproduced in whole or in part without consent of Smith Onandia Communications LLC. Smith Onandia Communications LLC does not assume and hereby disclaims any liability to any person for any loss or damage caused by errors or omissions in the material contained herein, regardless of whether such errors result from negligence, accident, or any other cause whatsoever.

All materials presented are educational. Each system is unique and must be evaluated on its own merits.

Featured Vacuum Presentations at the Best Practices 2022 EXPO & Conference



Sizing Vacuum Pumps for Reliability and Efficiency

Dayne Crowley,
Product Manager,
Gardner Denver
Nash



Optimized Maintenance and Water Usage of Liquid Ring Vacuum Pumps in Paper Industry

Dan Barnette, Vice
President, E.W. Klein
& Co.



How to Save 90% of Water Consumption on a Liquid Ring Vacuum Pump

Eddie Ostervold,
President, E.W. Klein
& Co.



System Design: Dry vs. Wet Vacuum Pumps in Plastics

Tie Duan, Solutions
Engineer, E.W. Klein &
Co.



Food Processing Best Practice On-Site Utility Guides for Cooling Water, Nitrogen, Compressed Air & Vacuum

Roderick Smith,
Publisher, Best
Practices Magazine &
Expo



Roundtable Discussion: Vacuum Audit Case Study and Need for Energy Incentives Targeting Vacuum Systems?

Ron Marshall, Chief
Auditor, Marshall
Compressed Air
Consultants

At the end of the
webinar, we are having
a fun contest for a
chance to win a free full
conference pass valued
at \$675!

Best Practices EXPO Contest

John Spears, Pneumatics Technician, DENSO Manufacturing TN, played in our contest during our *ASME PTC 13 Wire-to-Air Performance Test Code for Blower Systems Part 2* Webinar on 7/28 and won a free full conference pass to the Best Practices 2022 EXPO & Conference

Congratulations John!

At the end of the webinar, we are having a fun contest for a chance to win a free full conference pass valued at \$675!

VFD Vacuum Pumps Do's and Don'ts

Introduction

Blower & Vacuum Best Practices Magazine



Sponsored by



About the Speaker



Ron Marshall

Marshall Compressed Air Consulting



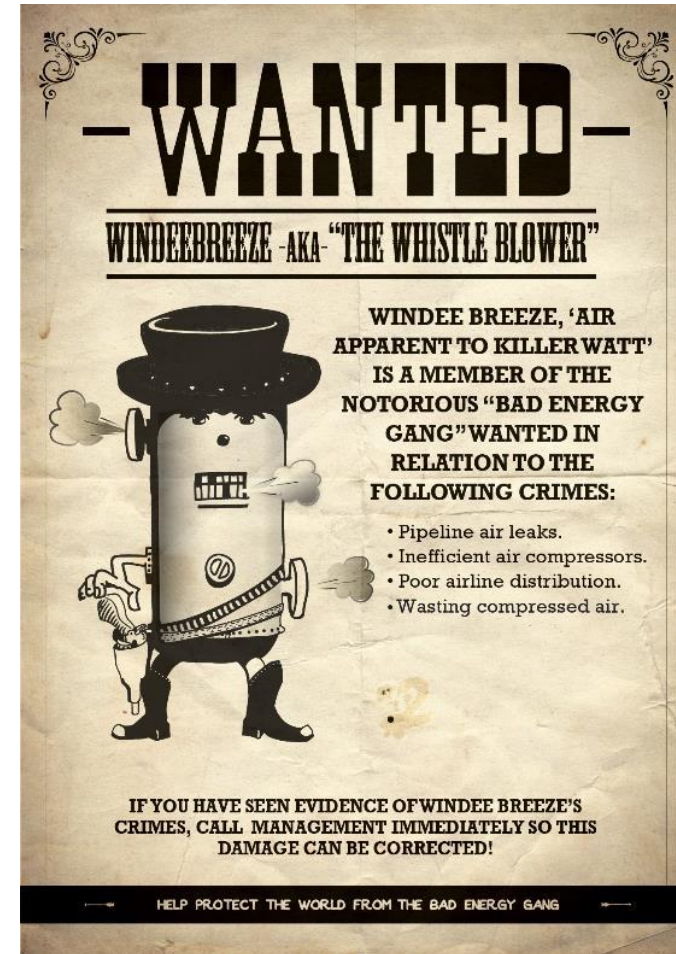
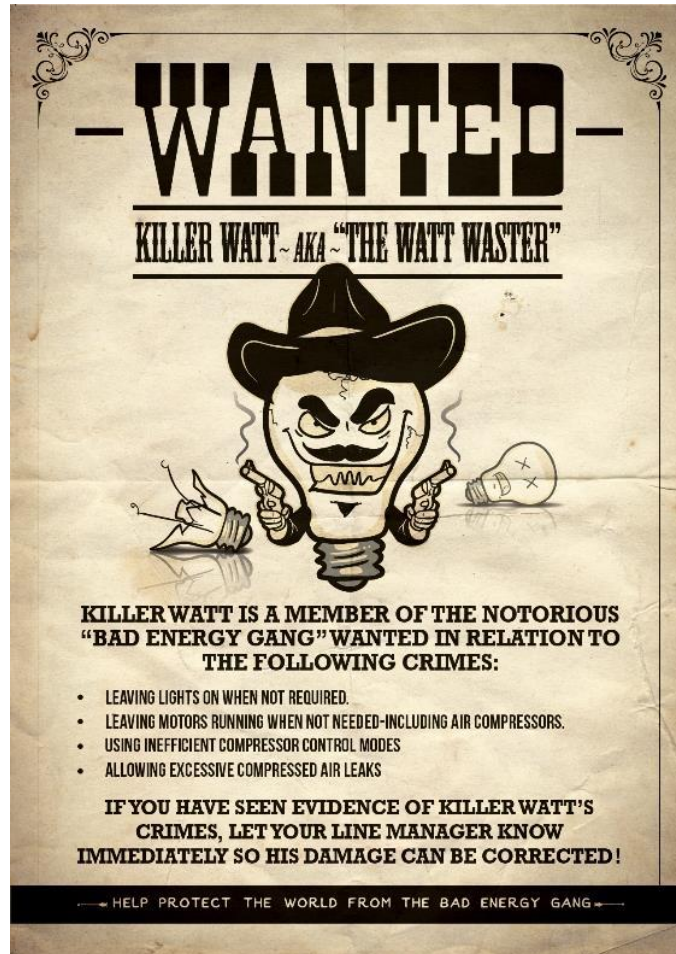
- Consultant MCAC
- 38 Years with Power Utility
- 27 Years Technical Support
- CAC Level 2 Instructor
- International Trainer UNIDO
- 600+ Projects Completed



Sponsored by



Wanted Energy Wasters



Clarification (Confession)

- Most of my experience is in compressed air assessment
- I have lots of experience good and bad with VFD compressed air controls

That being said:

- I have found system costs usually relate to the size of the vacuum pumps and how they are controlled
- I find a lot of vacuum leaks when assessing compressed air
- I am always curious how much these leaks cost and if anything can be saved

Vacuum exists
between these



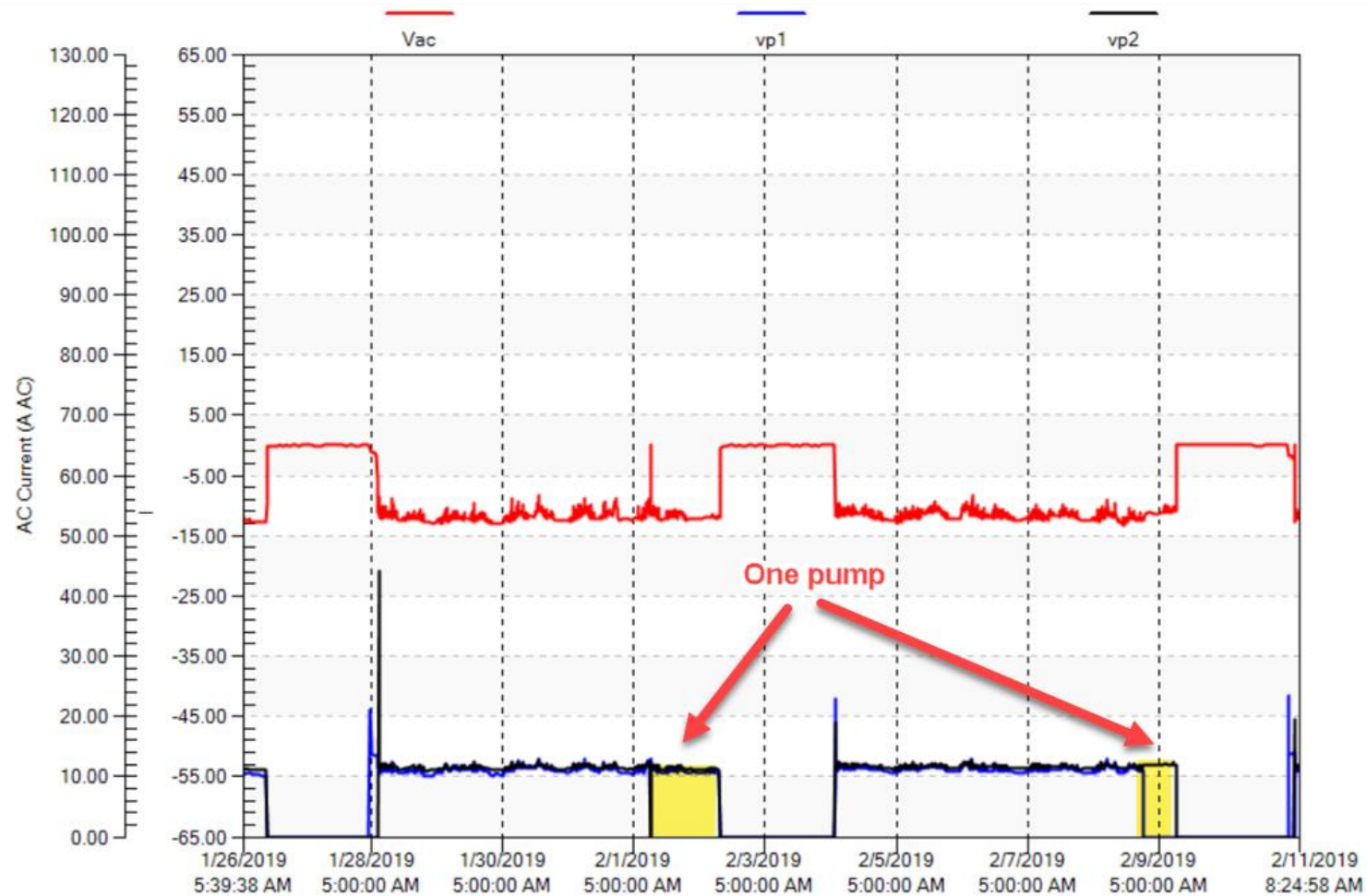
Vacuum Do's and Don'ts

Don't

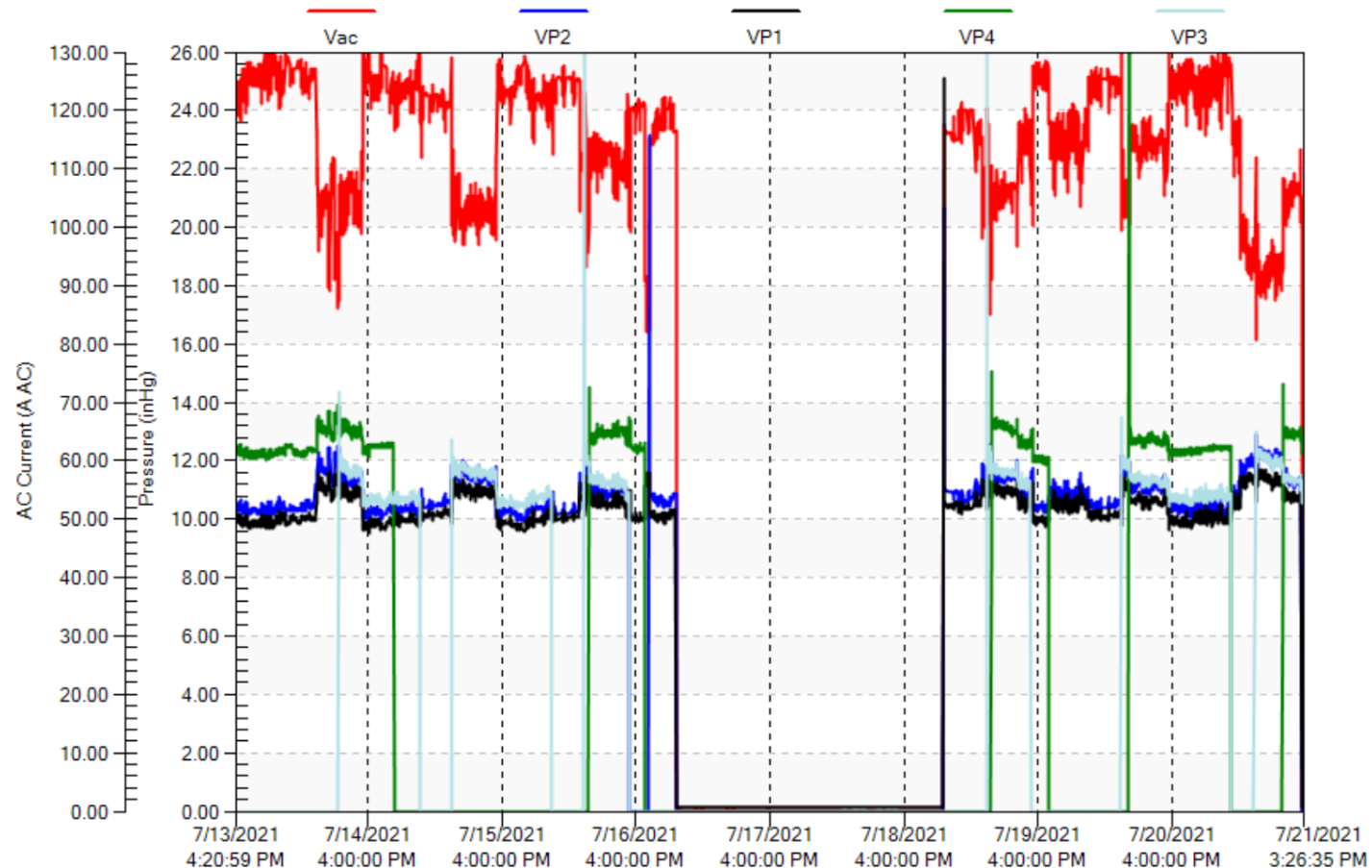
- Allow the system to run uncontrolled and uncoordinated
- Ignore the control range and VFD size
- Ignore system leakage



Uncontrolled

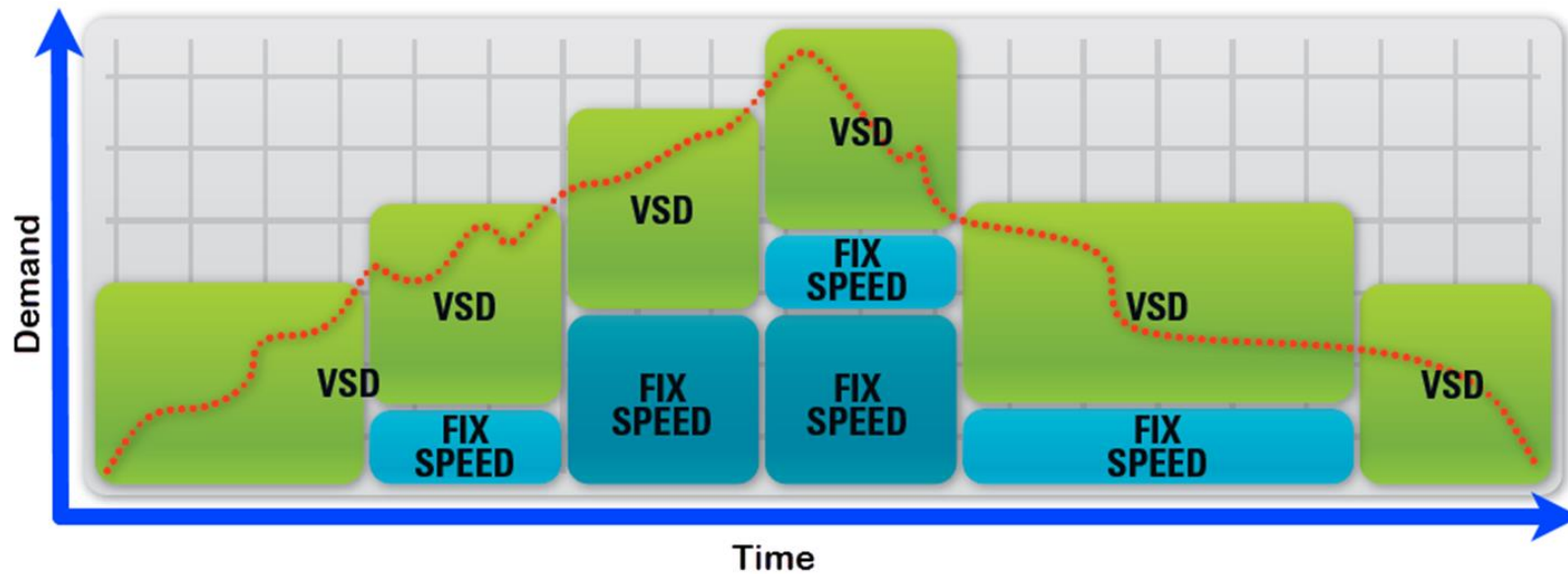


Manual controlled



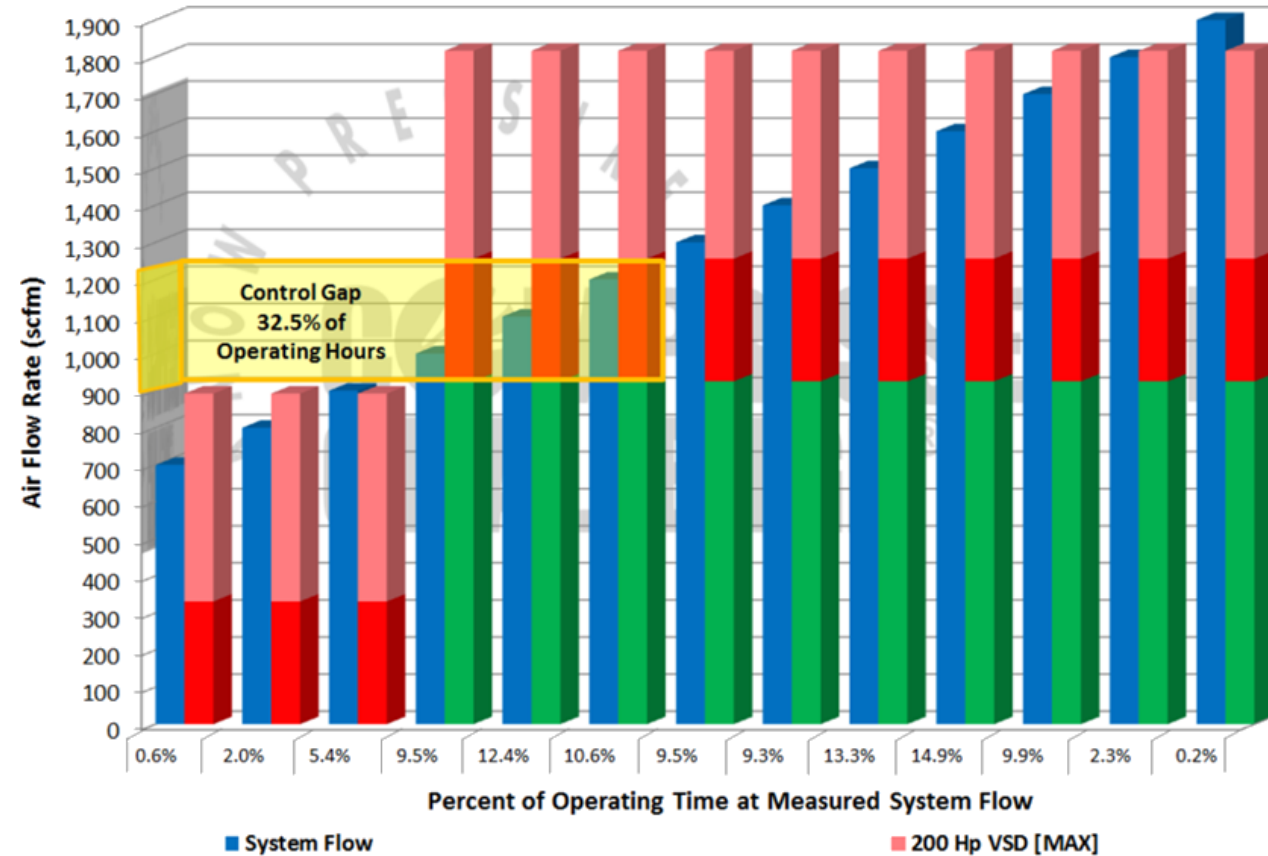
Control Range and Size Coordination

In multi systems the VFD control ranged must be equal to or larger than the base units.



Control Gap

Consequence of this is control gap where pumps will fight for control



Leaks

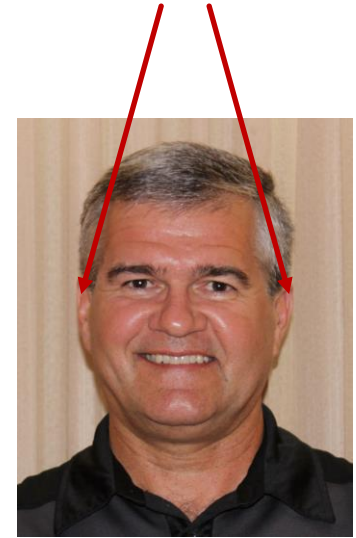


Finding Vacuum (and compressed gas) Leaks

- Most basic tool are the detectors on the side of your head
- But these are almost useless in a noisy industrial environment
- Use ultrasonic detector to block out industrial noise

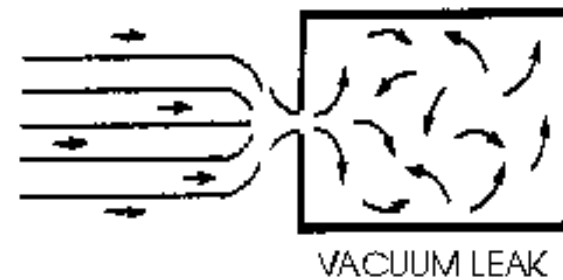


Basic detectors



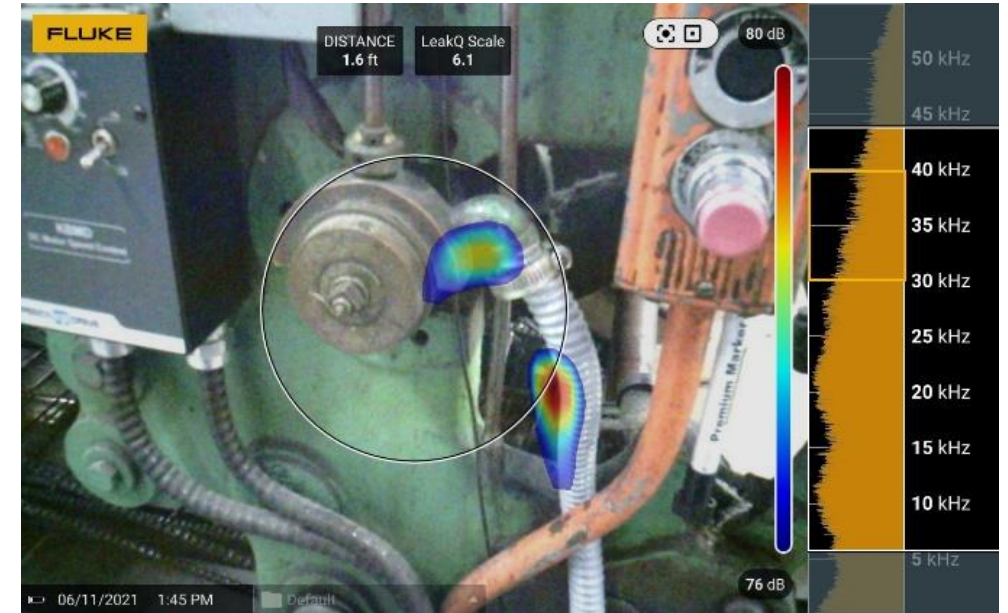
How Ultrasonic Leak Detection Works

- During a leak, a fluid (liquid or gas) moves from a high pressure to a low pressure
- As it passes through the leak site, a turbulent flow is generated with strong ultrasonic components, which are heard through headphones and seen as intensity increments on the meter
- It can be generally noted that the larger the leak, the greater the ultrasound level



Vacuum Leak Consequences

- Lower vacuum level due to higher loading
- Poor performing processes
- Need for additional capacity
- Higher heat loading
- Higher electrical costs
- Higher maintenance costs



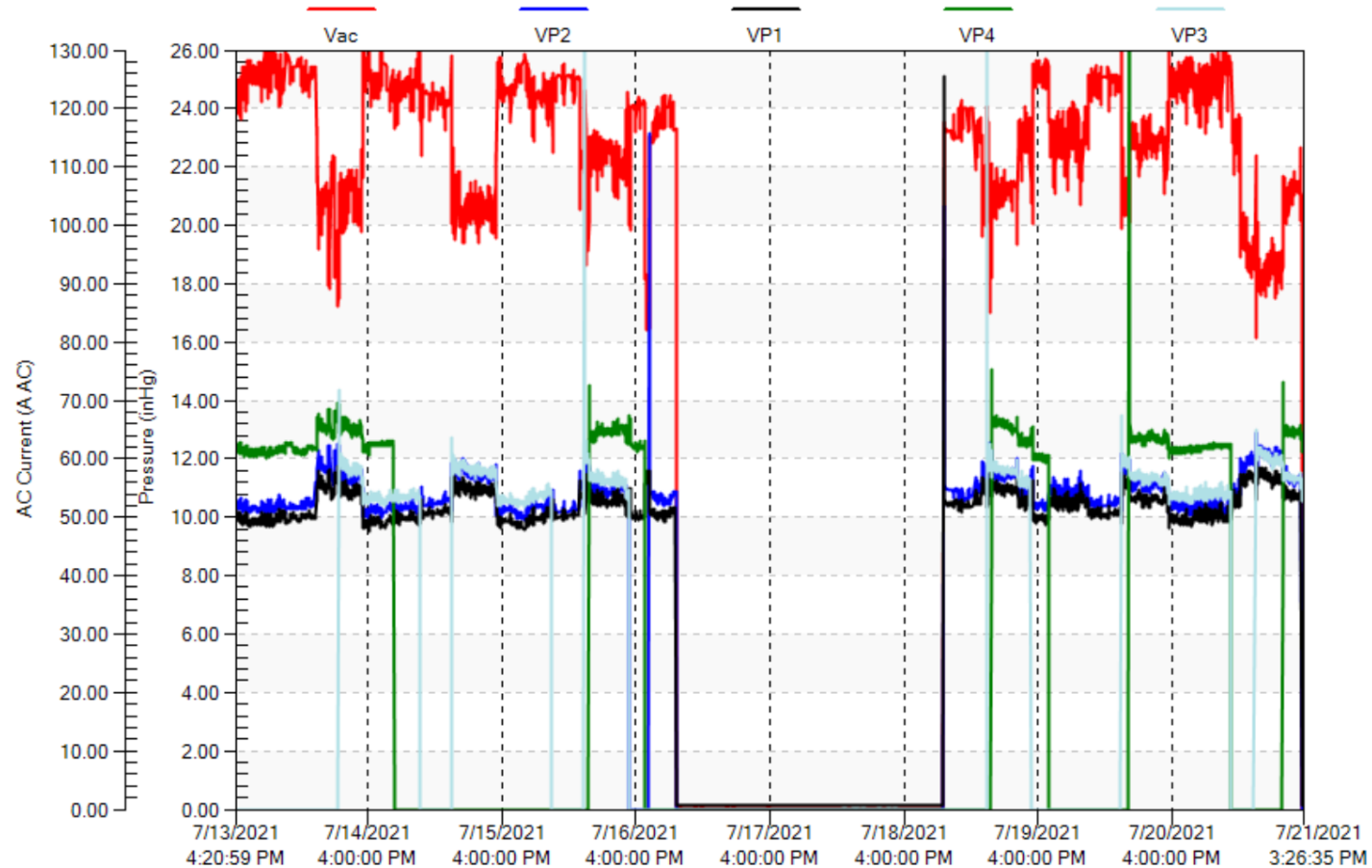
Do's and Don'ts

Do

- Keep the vacuum level and low and flat as possible
- Set up the VFD as lead machine
- Size the control range to avoid control gap
- Fix leaks and eliminate end uses

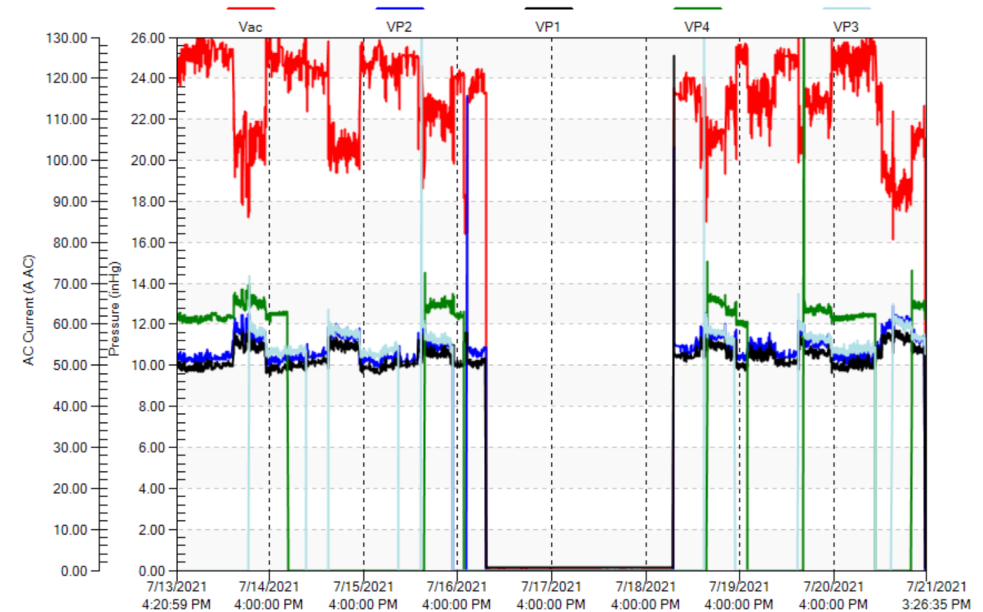


Profile not flat – excessive level



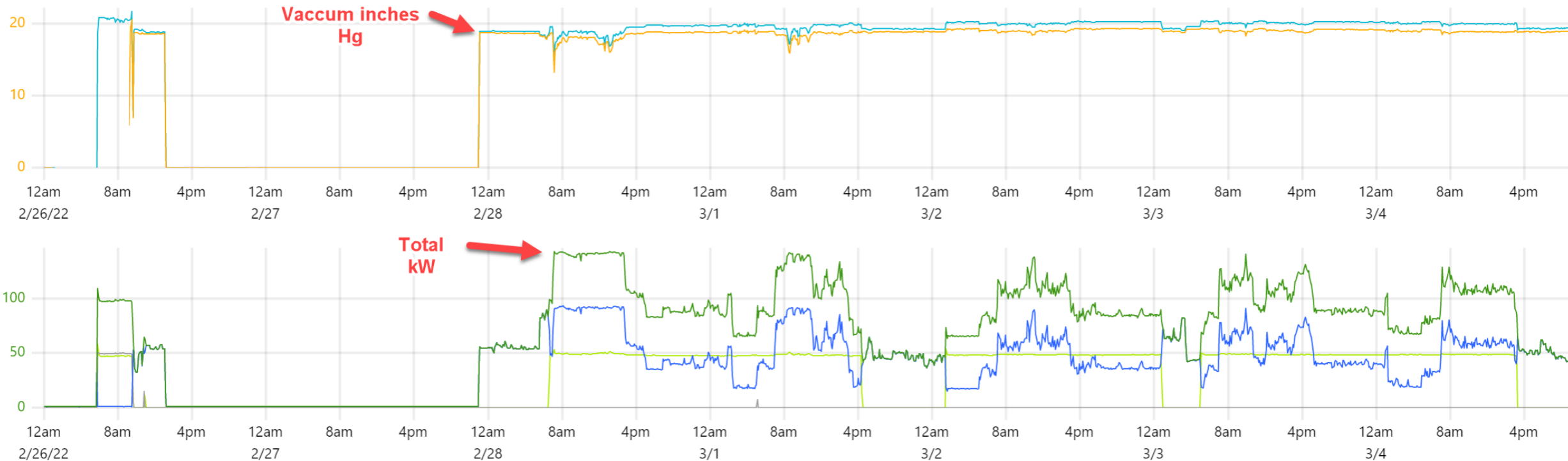
Poor Power Turn-down

- Most PD fixed speed pumps have poor power turn-down – limited return on leak repair effort
- Poorly controlled systems consume about the same energy all the time
- Example system only needs 20 inches but floats to 26 inches and as low as 17 inches
- When flow goes down the vacuum level rises, making the existing pumps equivalently smaller
 - $\text{Scfm} = P_{\text{abs}} / P_{\text{atm}} \times \text{icfm}$
 - At 20"Hg vacuum = $(30-20)/30 \times 1000 = 333 \text{ scfm}$
 - At 25"Hg vacuum = $(30-25)/30 \times 300 = 166 \text{ scfm}$
- Vacuum level actually controlling pump capacity



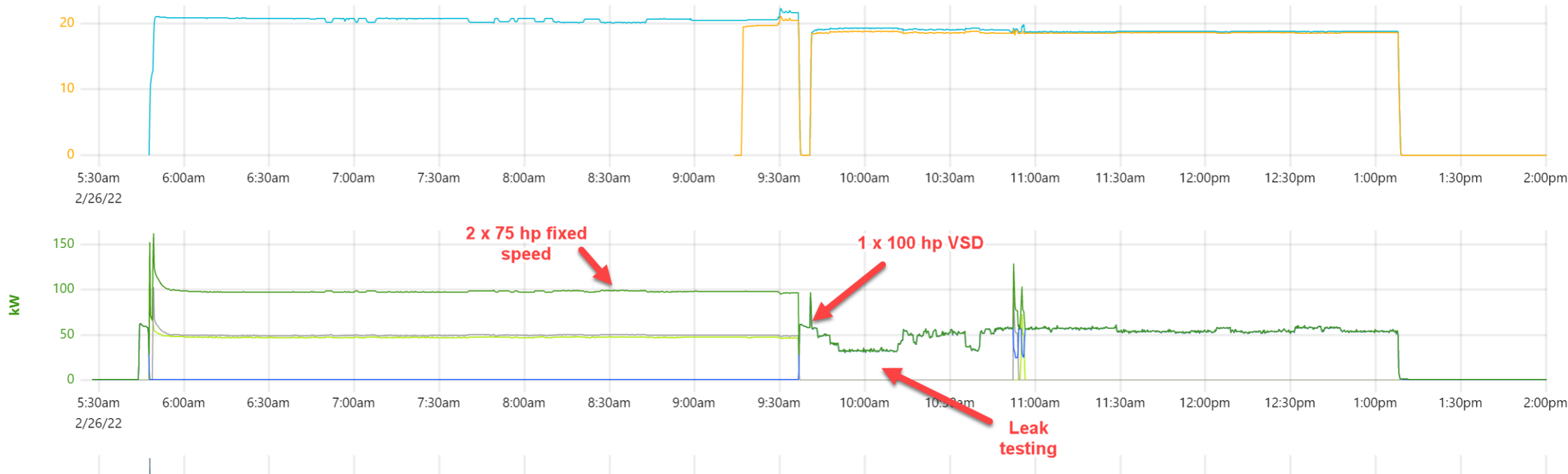
Solution: Variable Speed Technology Example (in October magazine)

- VSD pumps have very good turn down
- VSD controls vacuum level – 20 inches – much improved
- VSD 100 hp, base 75 hp



Solution: Variable Speed Technology Example

- VSD pump in this case almost equal to 3 x 75 hp
- VSD can be used for leakage testing



Solution: Variable Speed Technology Example

- 100 kW VSD in this case almost equal to 3 x 75 hp
- More accurate vacuum level
- Lower noise level
- Reduced leaks
- 35% electrical savings worth \$26,000 per year
- Significant utility incentive



Summary

- If properly sized, VFD can help get system under control
- Stabilized vacuum at lower level saves \$
- Good turn down unlocks leak repair savings
- New VSD pump technology can save \$ and provide good return on leak efforts



About the Speaker



Geoffrey Cresswell
Busch Vacuum Solutions

- Product Marketing Manager, Busch Vacuum Solutions
- Rotary Vane Technology and Vactest Product Lines
- 10 years of centrifugal pump experience
- Worked with applications across many Commercial and Industrial market segments

Sponsored by



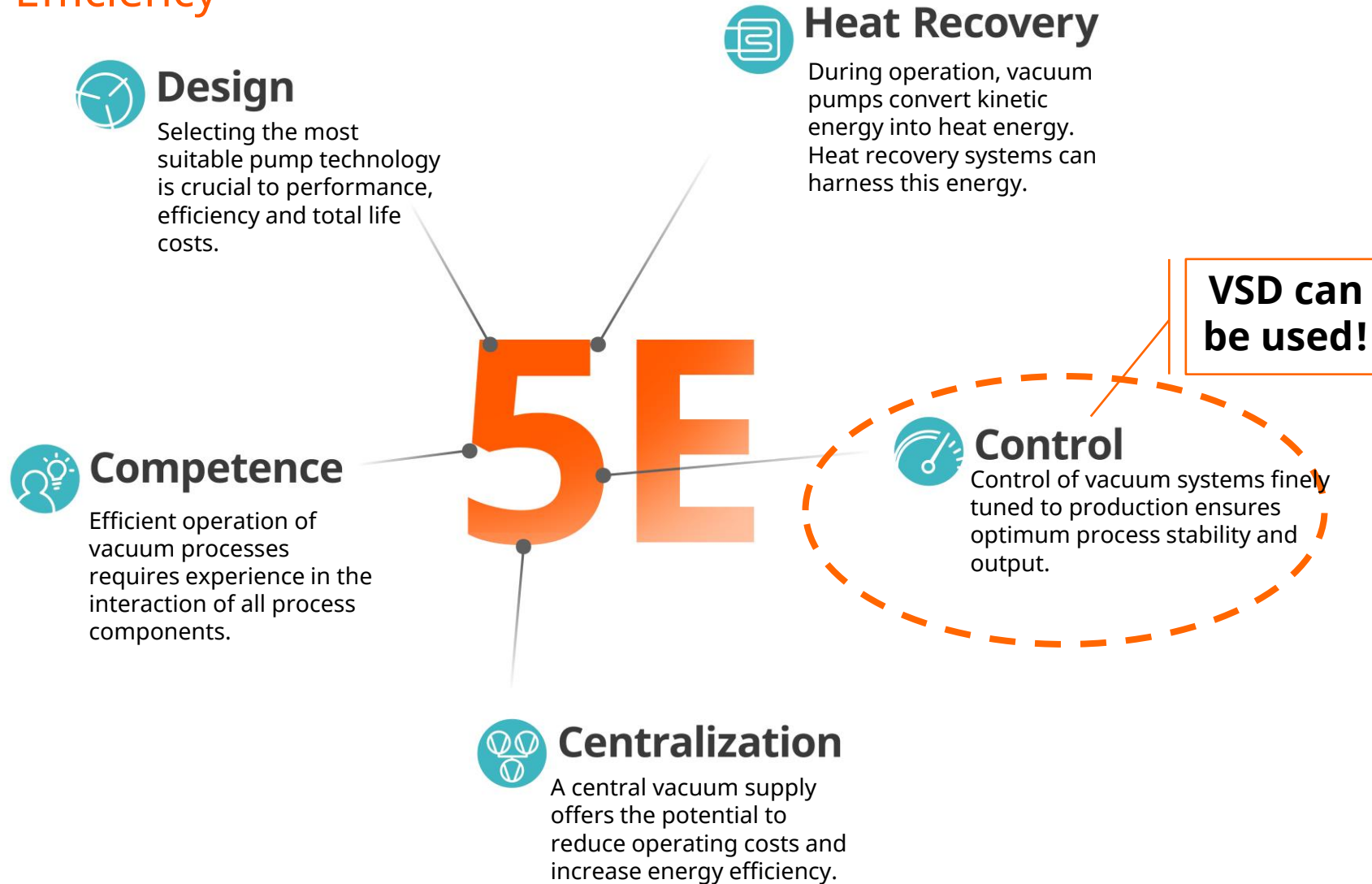


VFD VACUUM PUMPS – DO'S & DON'TS

Geoffrey Cresswell | August 18, 2022

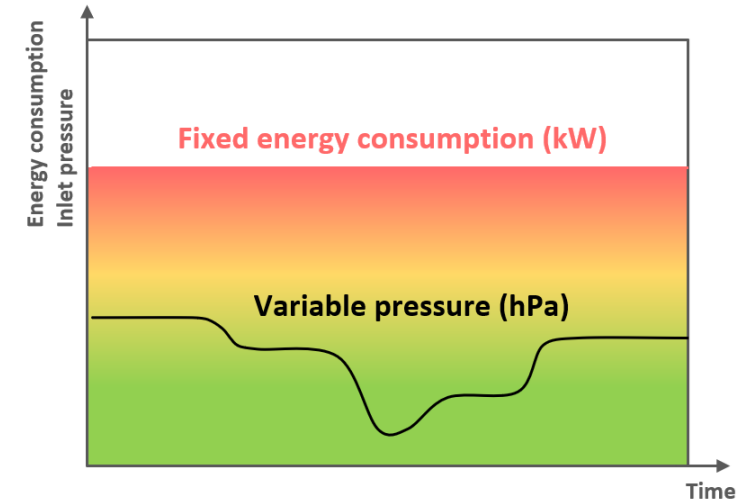
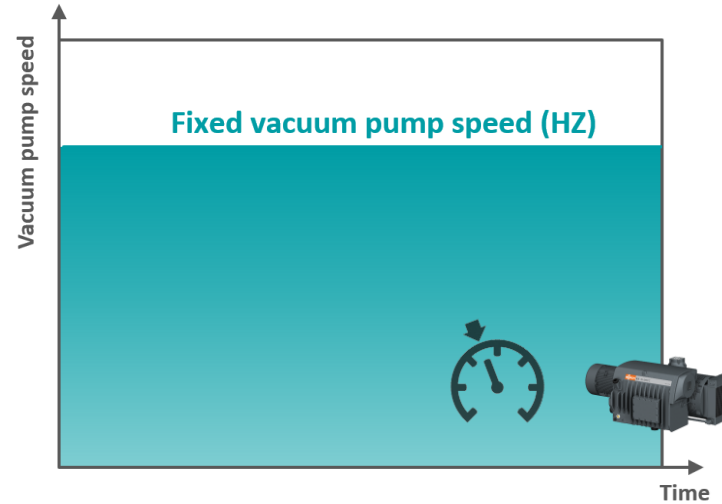
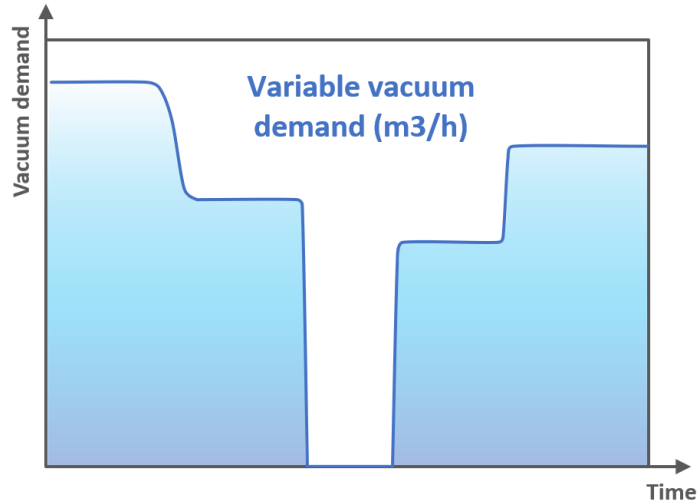
Vacuum Performance Optimization

5-Elements of Efficiency



VSD on Vacuum Equipment

Control Logic



Variable demand

+

Fixed supply

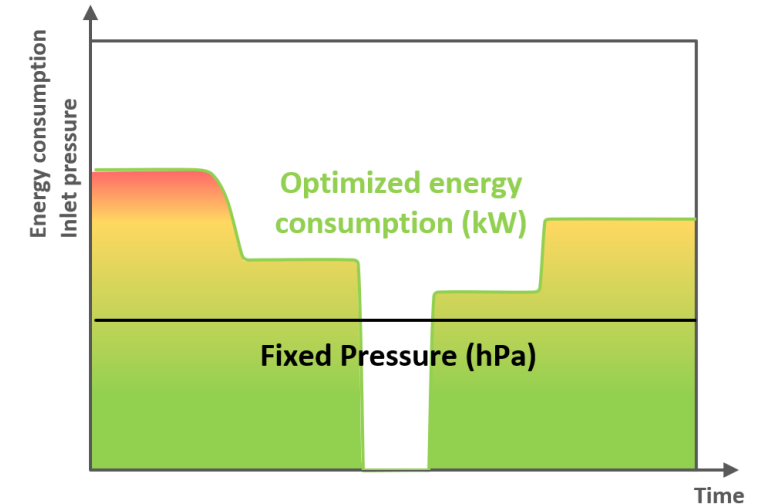
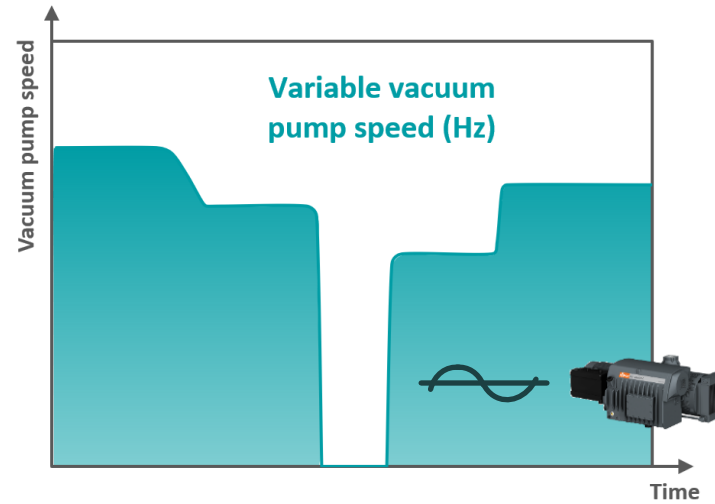
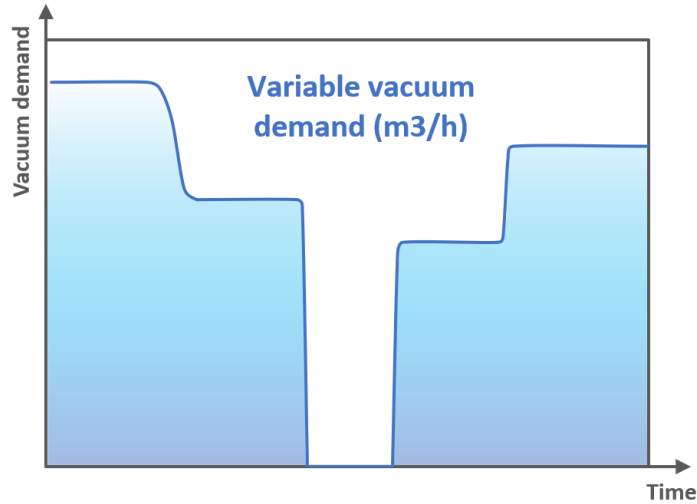
=

Variable results

**Nonoptimized energy
consumption**

VSD on Vacuum Equipment

Control Logic



Variable demand

+

Variable supply

=

Fixed results

-60% Energy consumption 

Using Variable Speed Drives (VSD) on vacuum equipment

Busch Vacuum Solutions perspective

- For decades, Busch has designed and operated VSDs on pumps and central systems
- Step #1: determine **if** your application benefits from Variable Speed Drives
 - There are many ways to optimize your process besides VSDs!
 - If yes, we ensure you are **really** getting the benefits you expect.

VSDs are not a one-size-fits all!



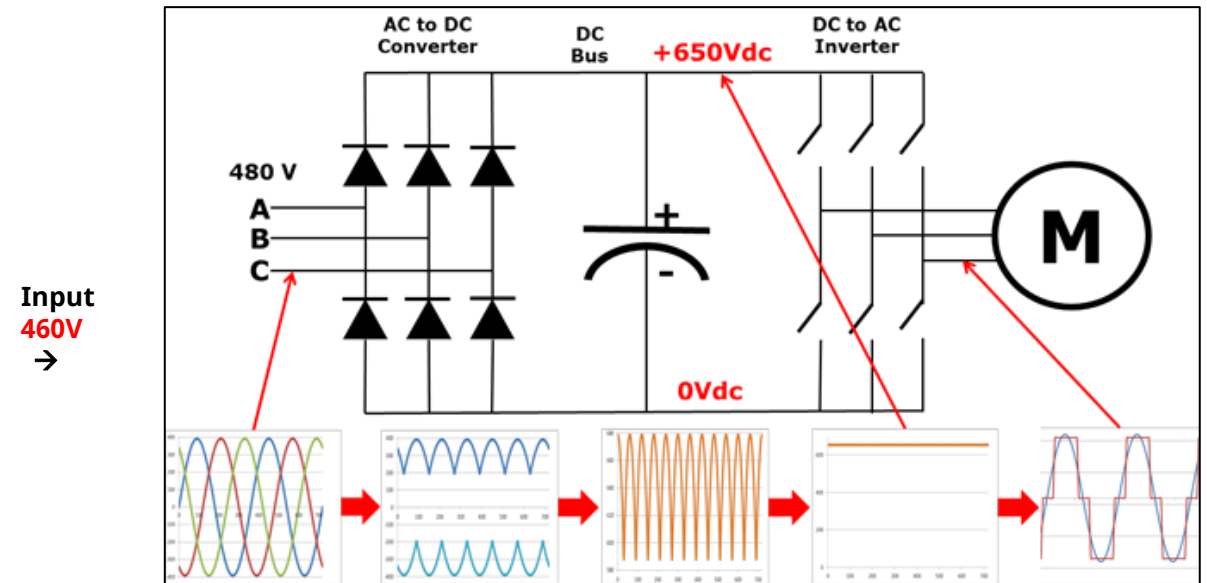
VSD Introduction

How does it work?

- Stage 1: Converts 3-phase alternating current (AC) to direct current (DC).
- Stage 2: (Bus Filter): Removes AC ripples from DC converter waves
- Stage 3: (Inverter): Convert DC to AC

VSD output voltage and frequency determined by control logic and inverter stage via control scheme called Pulse Width Modulation (PWM).

VSD Sine Wave Processing



VSD on Vacuum Equipment

General Pros & Cons

PROS +

- Potential energy cost savings.
- Better process control possible.
- Improved monitoring capabilities to verify against design parameters.
- Reduced pump wear at lower speeds.
- Best suited for processes with significant demand variation.
- Helps qualify for Energy Rebates.

CONS –

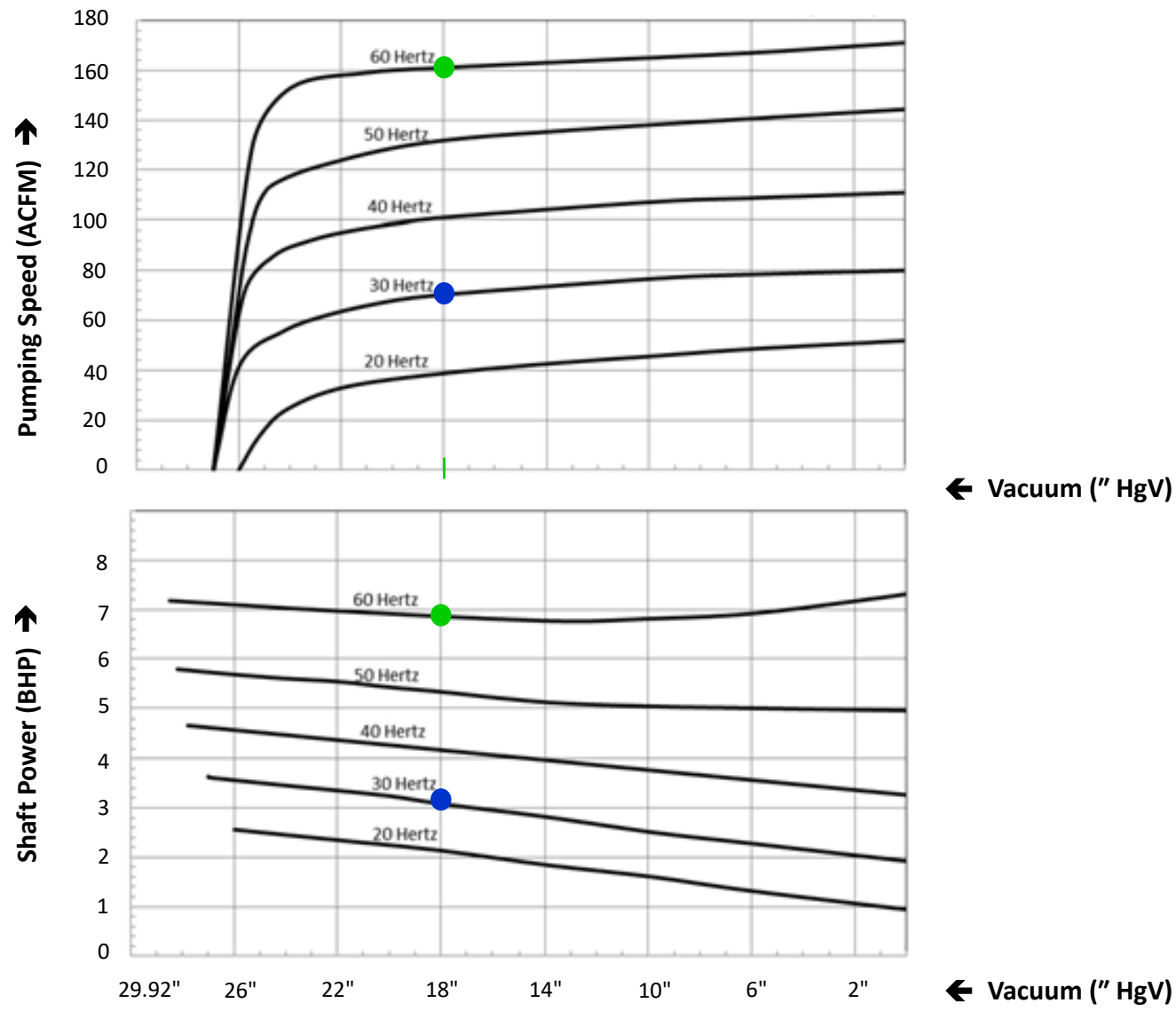
- Higher capital cost.
- VSD could be misapplied and not save energy.
- Higher potential of structural resonance issues.
- Risks due to additional devices and controls requirements.
- Controls expertise needed for optimal performance could add to cost.

*Source: US Department of Energy
Variable Speed Pumping (Executive Summary 2014)*



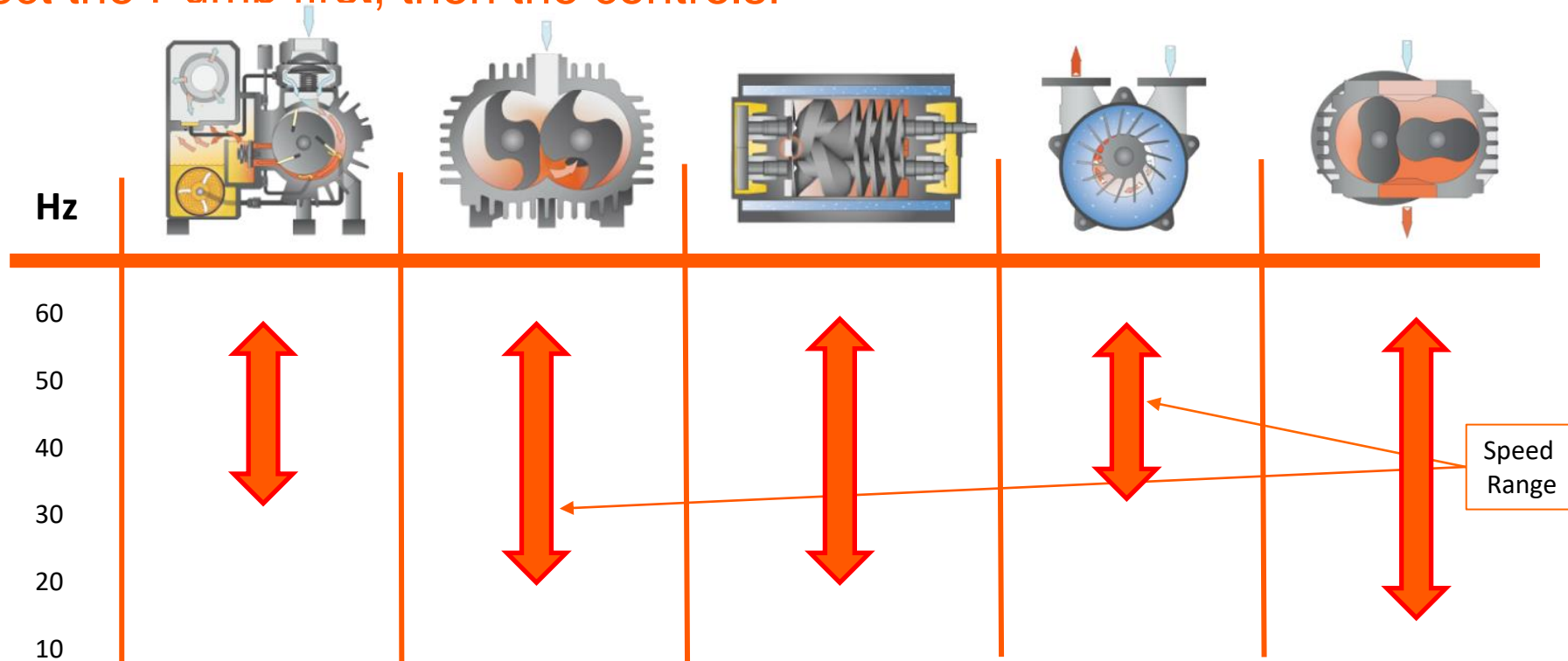
VSD on Vacuum Equipment

Performance curve basics



VSD on Vacuum Equipment

Tip 1 – Select the Pump first, then the controls!

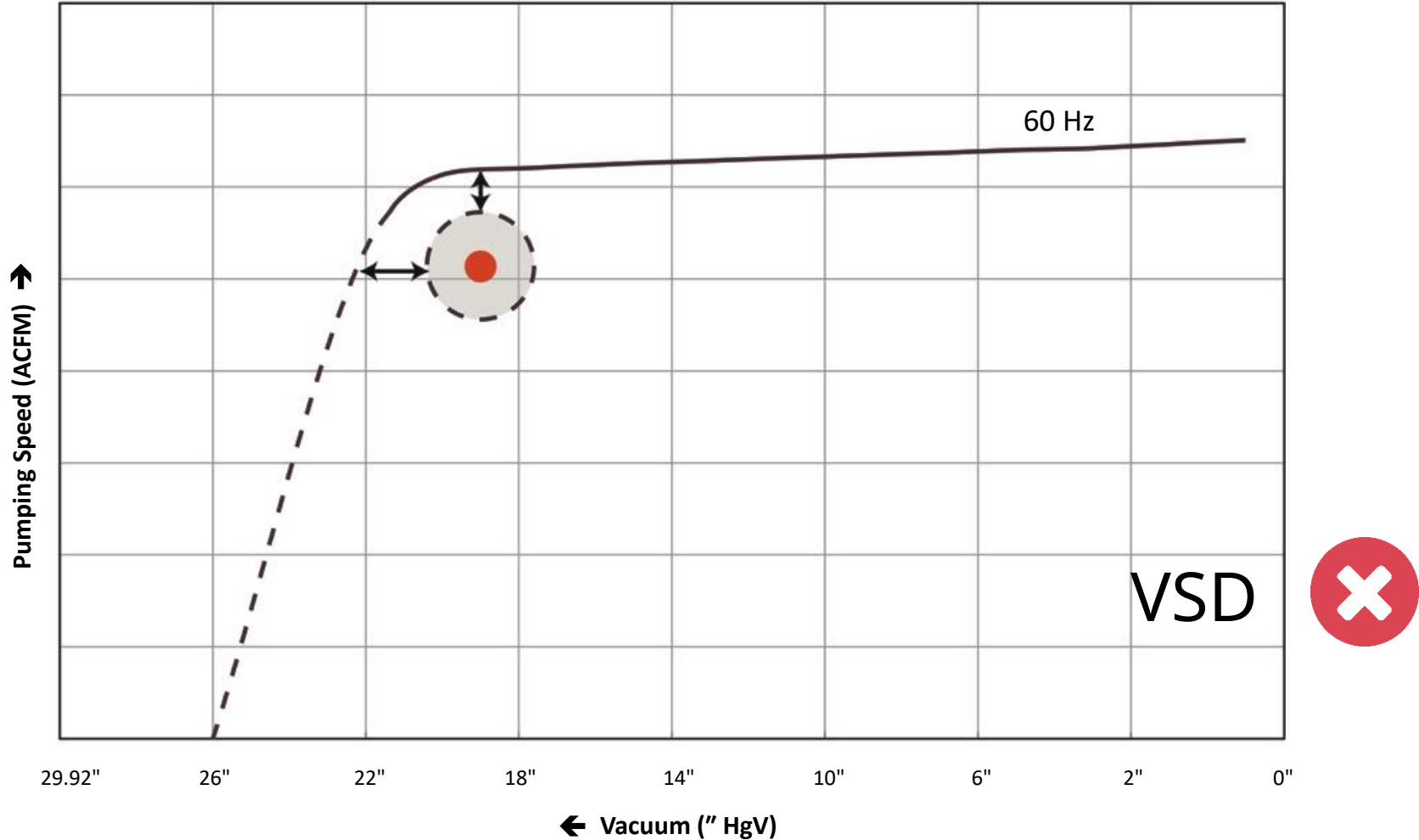


Why is this important?

- First, pick a pump technology most suitable for your unique process needs.
- Allowable speed regulation is dependent on pump technology used.
- Pump efficiencies (HP / CFM) are better at higher frequencies.

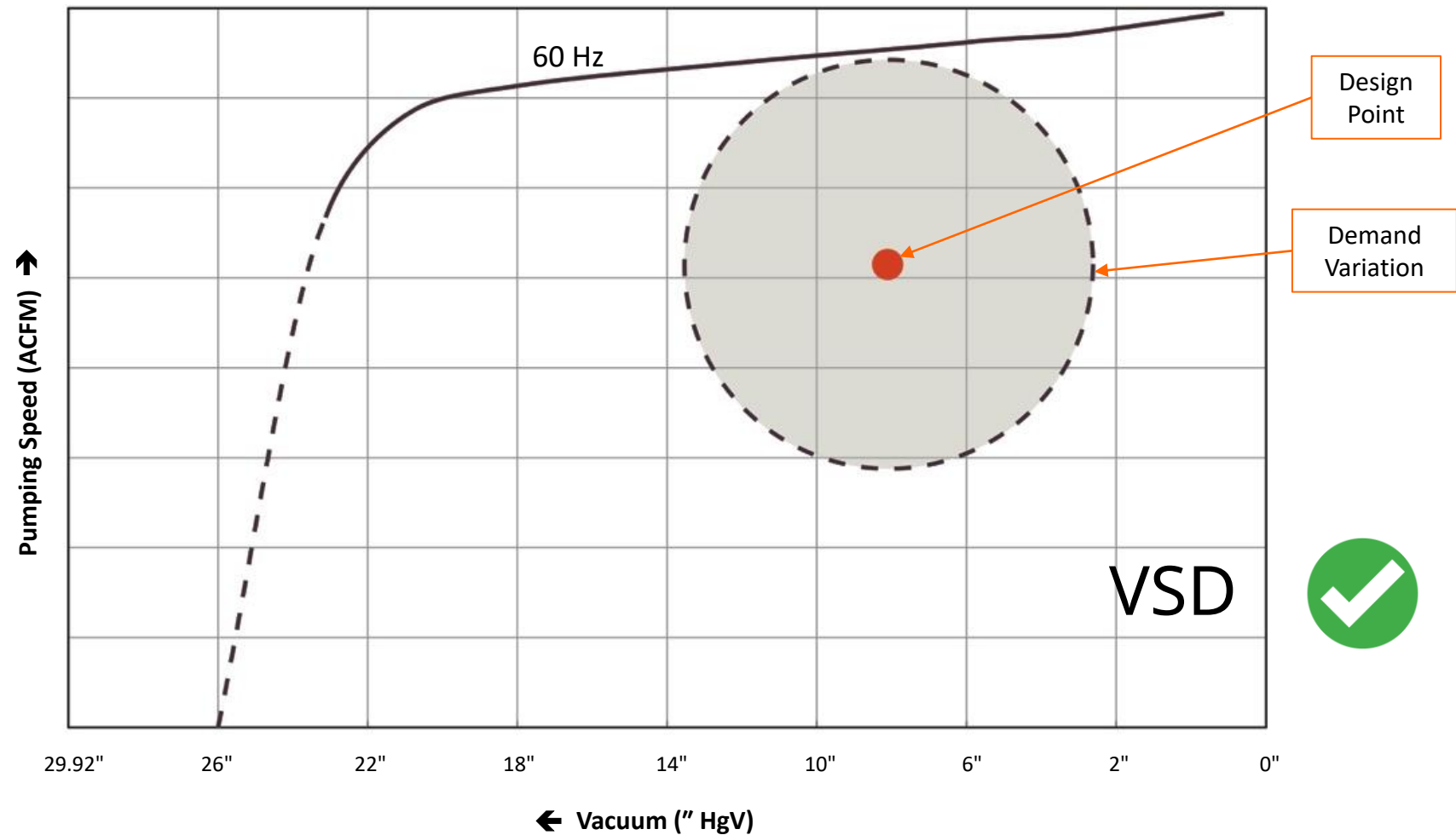
Application Evaluation

TIP 3 – Consider both VSD and Lead/Lag configurations



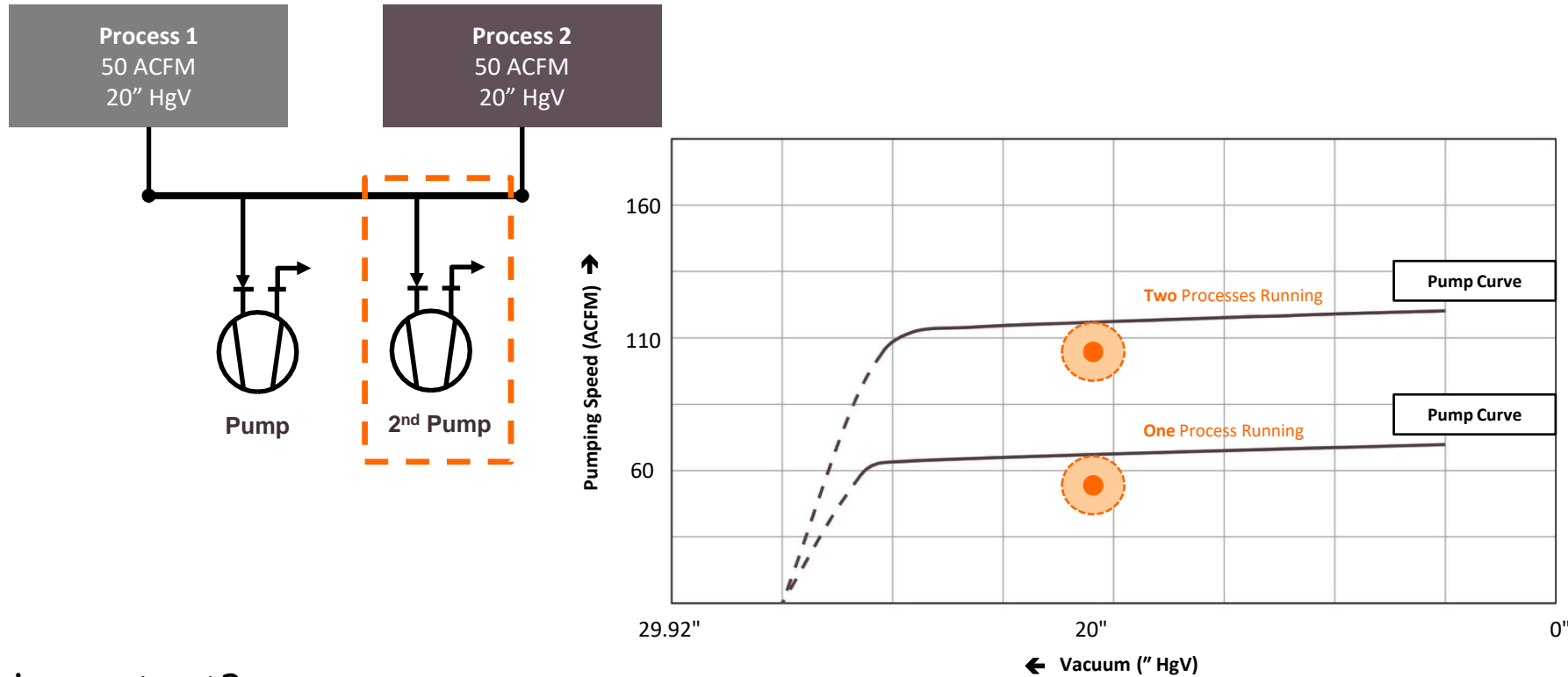
Application Evaluation

TIP 3 – Consider both VSD and Lead/Lag configurations



VSD on Vacuum Equipment

TIP 3 – Consider both VSD and Lead/Lag configurations



Why is this important?

- VSD is not the solution for all applications.
- Multiple fixed speed pumps offer simplicity, higher efficiency and redundancy.

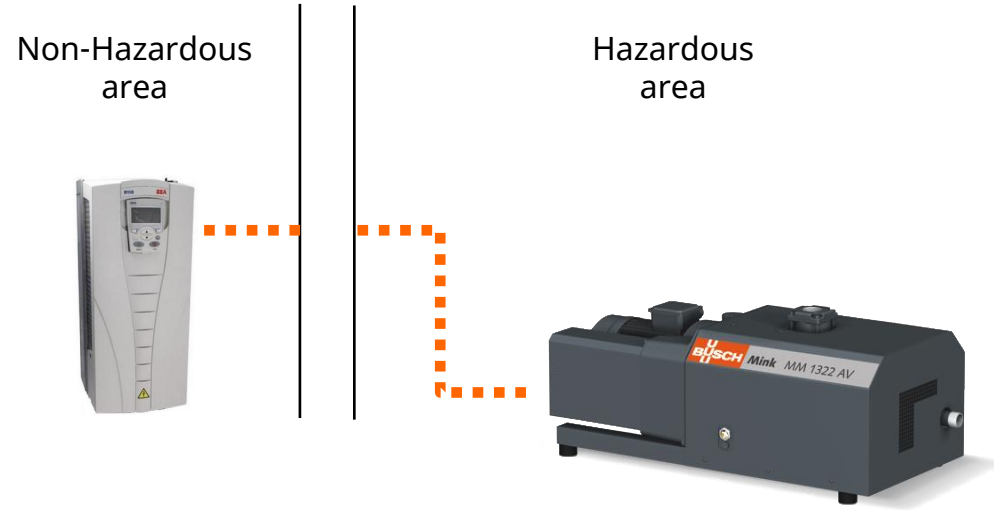
VSD 

VSD on Vacuum Equipment

TIP 3 – Consider all the options



VSD mounted
on Pump



VSD (external) located
remotely

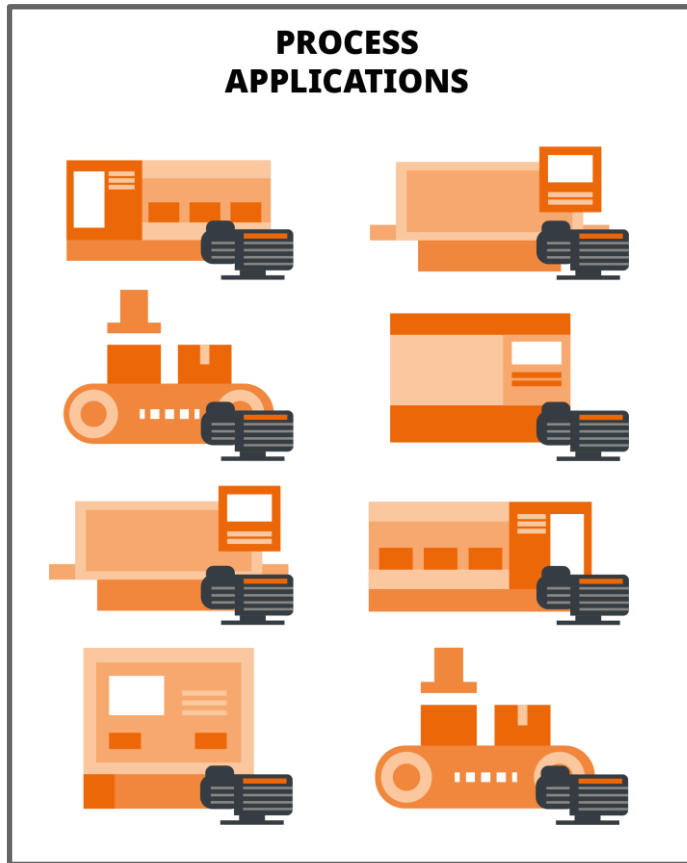
Why is this important?

- Controls should be easily accessible for operators.
- Cost benefits to installing VSD and Control Panels outside of hazardous areas.

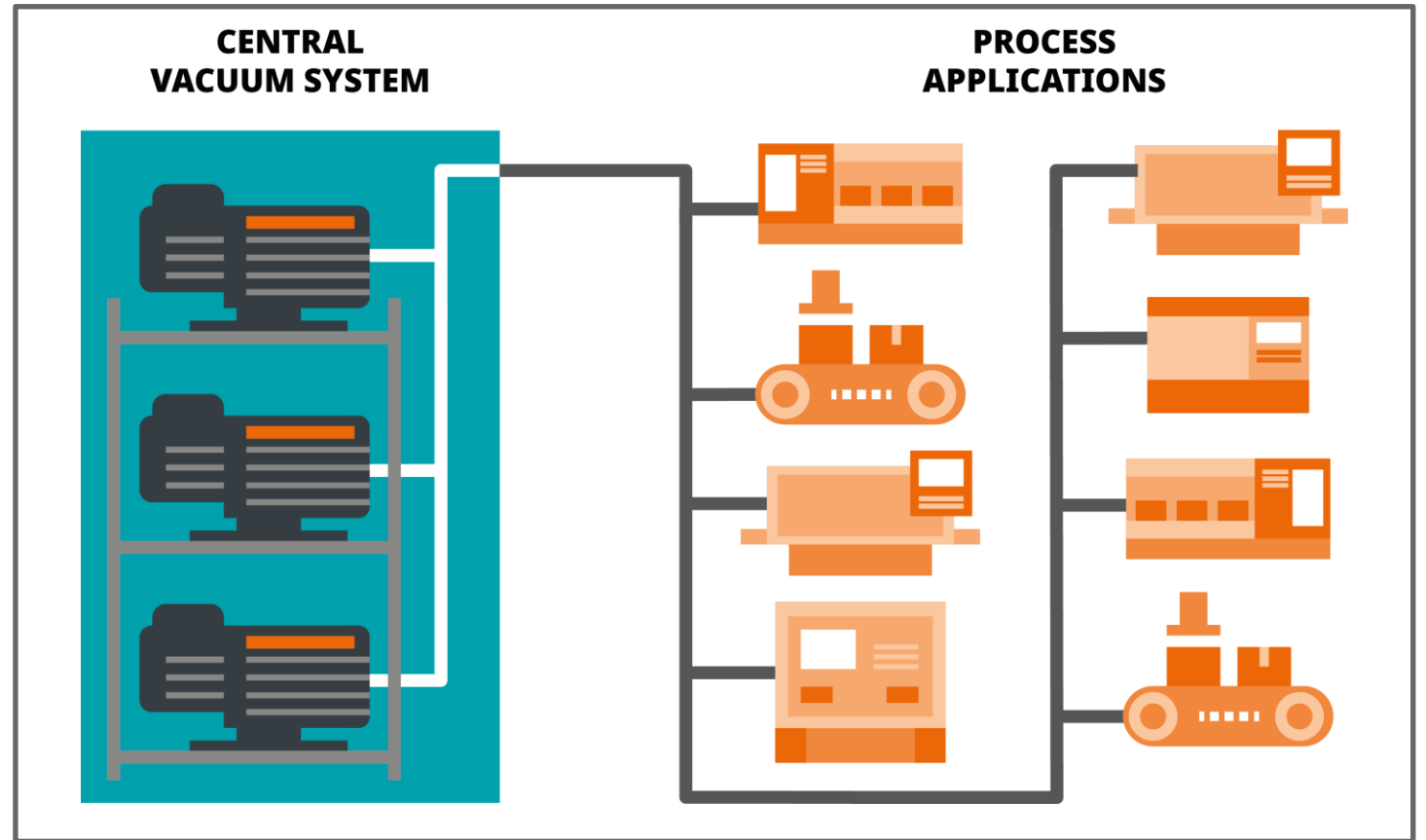
VSD on Vacuum Equipment

TIP 4 – Consider Central Vacuum Systems

Decentralized vacuum supply

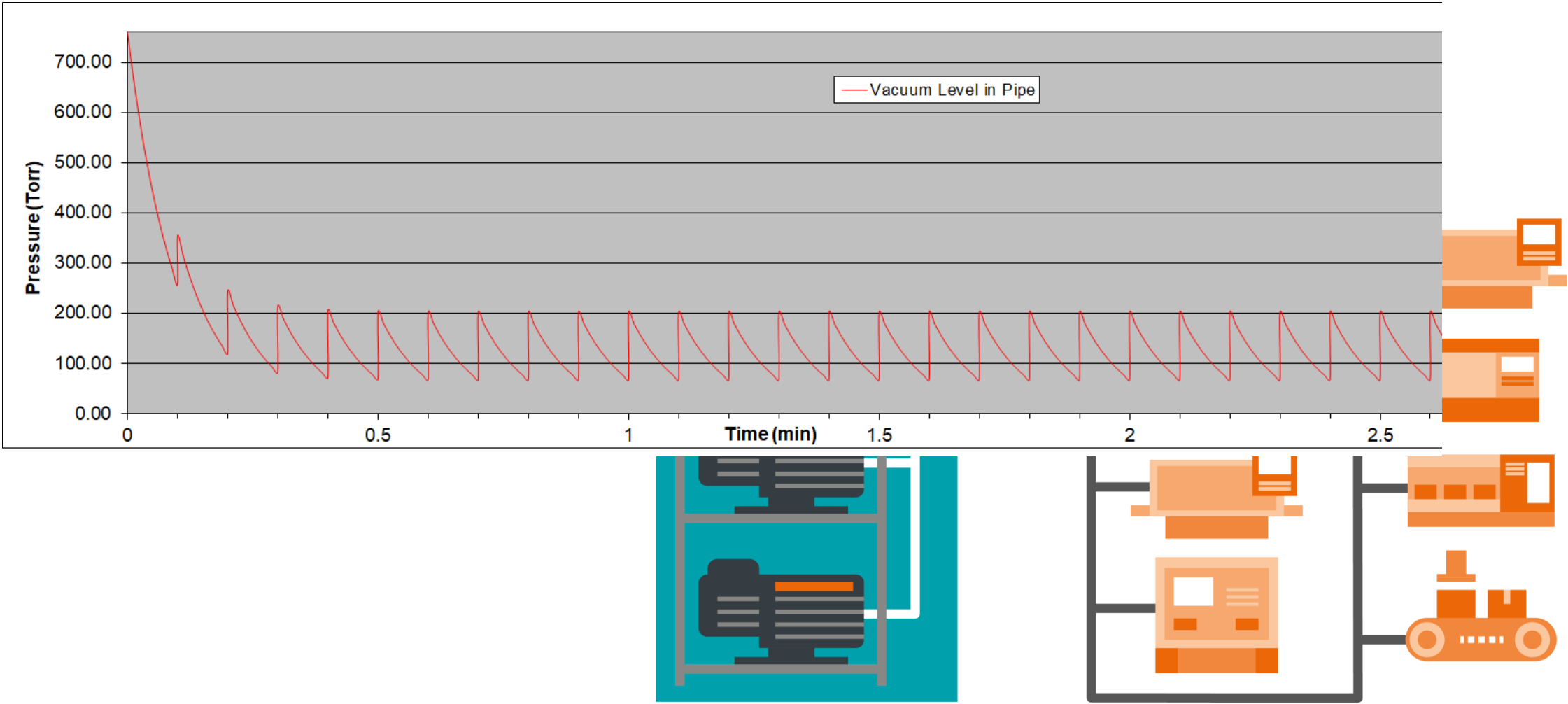


Centralized vacuum supply



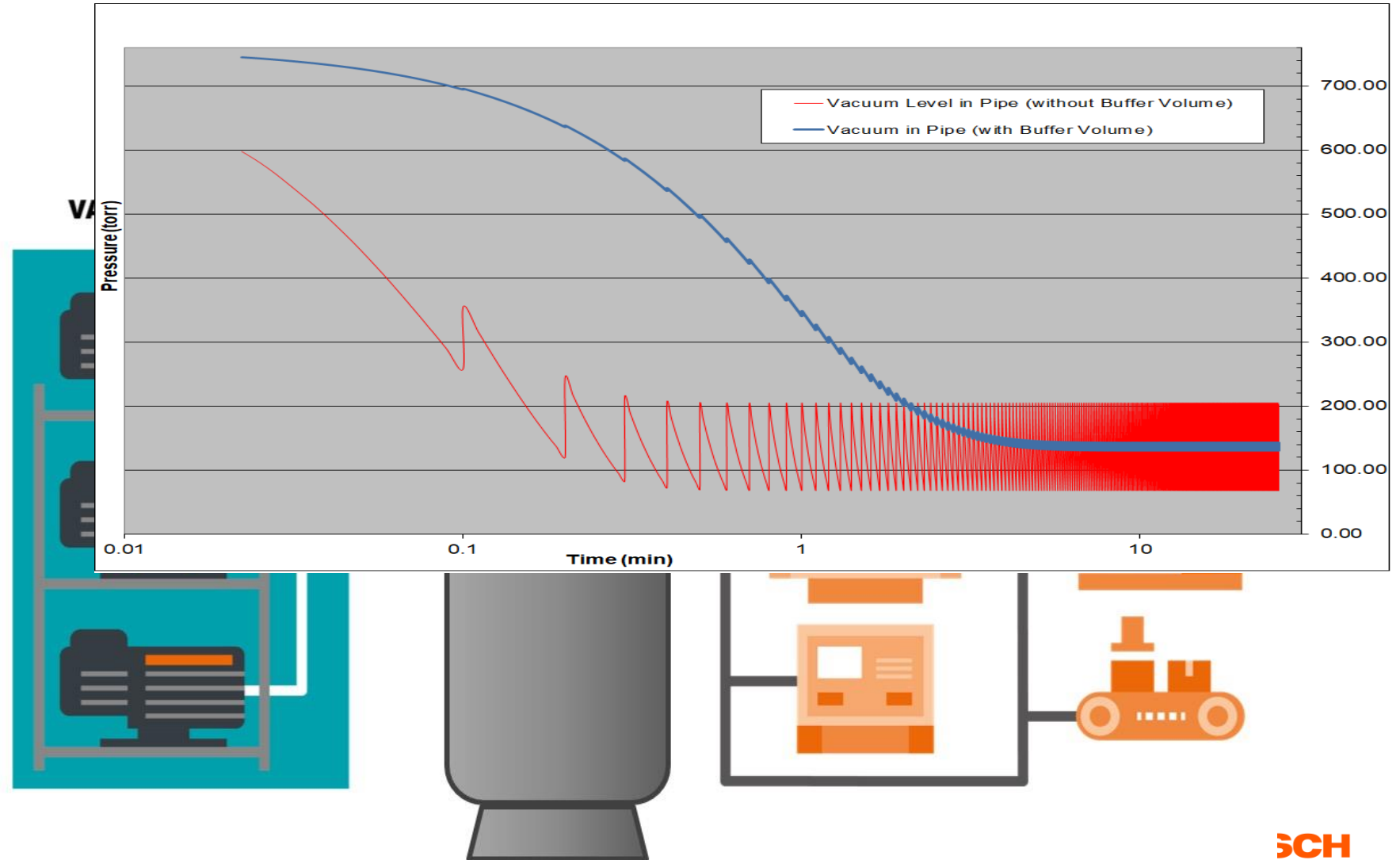
VSD on Vacuum Equipment

TIP 4 – Consider Central Vacuum Systems



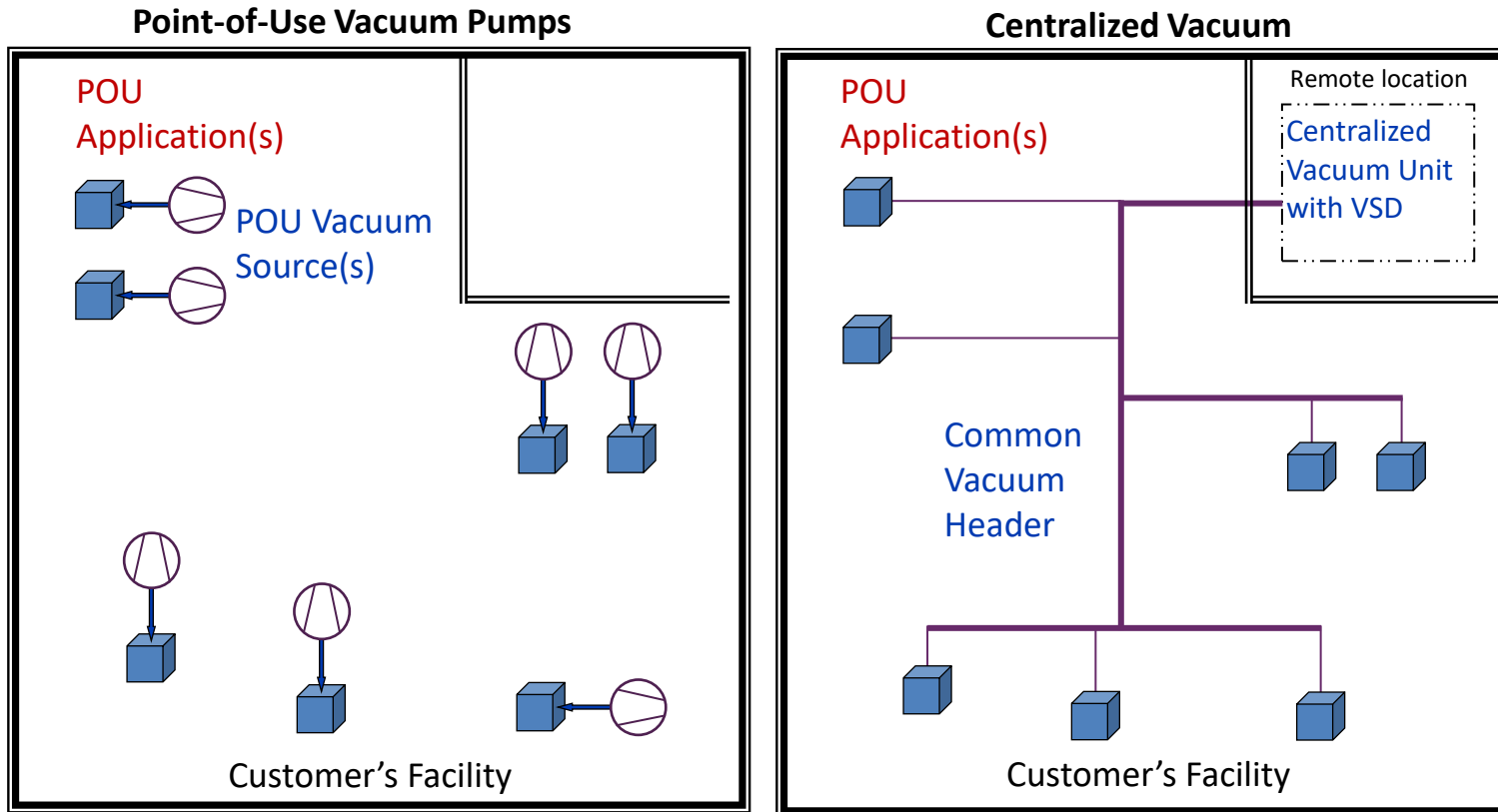
VSD on Vacuum Equipment

TIP 4 – Consider Central Vacuum Systems with Buffer Volume



VSD on Vacuum Equipment

TIP 4 – Consider Central Vacuum Systems with VSD!



Why is this important?

- Centralized VSD can “trim” system performance to match the demand.
- Reduced noise, heat and footprint in production area.

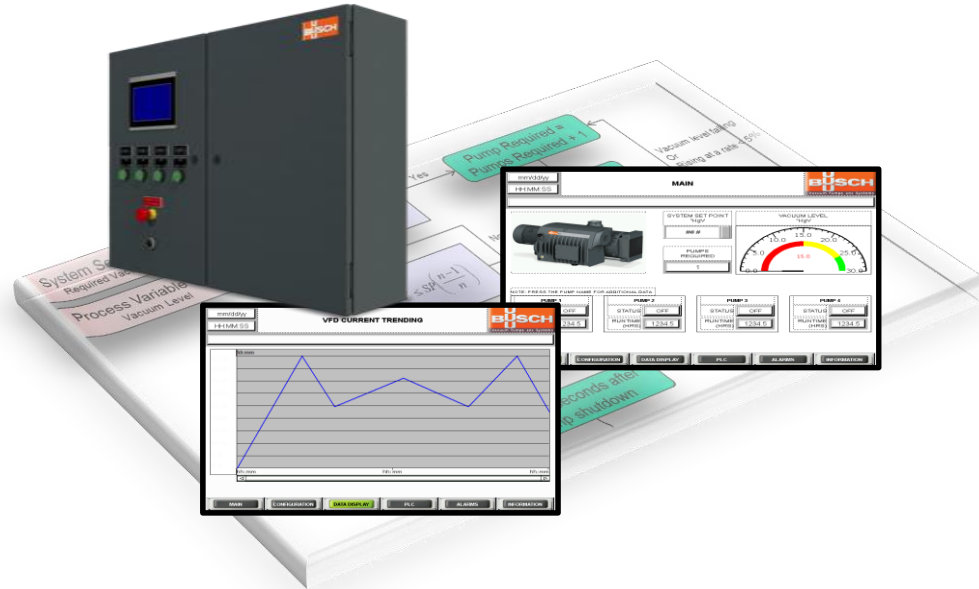
VSD on Vacuum Equipment

TIP 5 – Use the correct features and options

VSD with Sensor



Control Panel w/ VSD & Sensor



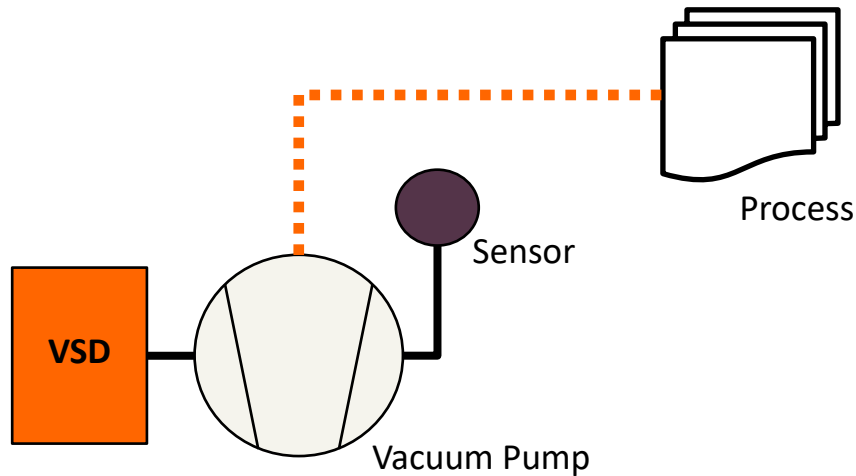
Why is this important?

- Control Panel with Programmable Logic Controller (PLC) simplifies coordination of multiple pumps and optimizing efficiencies.
- USB connectivity makes communication, programing and monitoring easy.
- Many standard VSD enclosure types to choose from: NEMA 1, 12, 4, 4X etc.

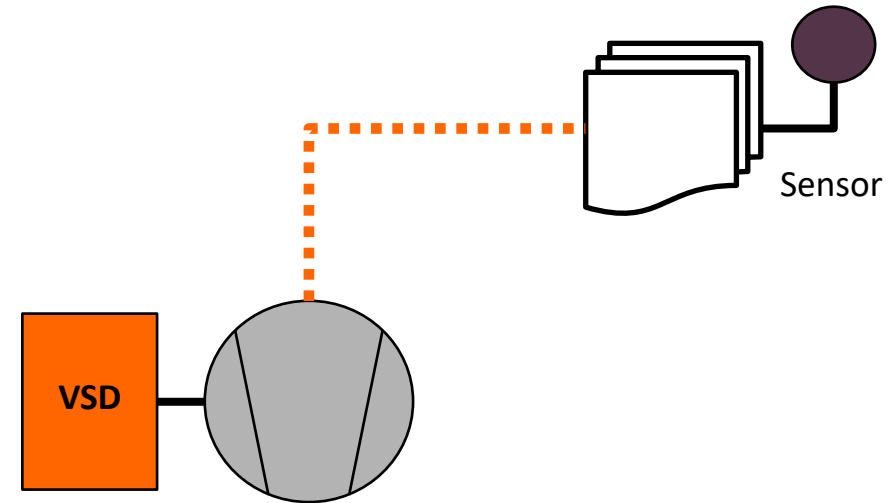
VSD on Vacuum Equipment

TIP 5 (continued) – Sensor Location

Sensor on Vacuum Pump Suction



Sensor on Process (away from pump)



Why is this important?

- Sensor provides real time feedback to VSD from a location that is critical to the process.
- If sensor is installed at process, VSD can respond faster to demand changes.

Summary

VSD on Vacuum Equipment



- **Remember the Tips!**
- **Vacuum process evaluation:**
 - Does my process flow requirement match my pump's capacity at 60Hz?
 - Is there significant demand variation in my vacuum application?
 - Am I using a closed loop pressure control system with automatic valves for pressure regulation?
 - Can I benefit from Energy Savings or Rebates?
 - Do I have process "idle" times? Are they substantial?
 - Do I have in-house expertise to program and monitor VSDs or would I prefer a complete turn-key control panel?
 - If a VSD is beneficial for me, do I have a preference on make/model to stay consistent with my existing plant equipment?
- **Choose the appropriate pump technology before implementing controls!**
- **Conduct a comprehensive vacuum optimization study** (i.e., Busch's 5-Elements of Efficiency program).

Thank you!

Geoffrey Cresswell

Busch Product Marketing Manager
Rotary Vane Vacuum Pumps & VACTEST Vacuum Gauges
Geoffrey.Cresswell@buschusa.com

www.buschusa.com

Best Practices EXPO Contest

Play for a chance to win a **FREE Full Conference Pass** to the Best Practices 2022 EXPO & Conference!! This is a \$675 value! This contest is open to factory personnel, compressed air distributors, utility incentive programs and engineering firms. Exhibiting and sponsor companies are not qualified. Winners will be randomly selected from those who submitted a correct answer and notified tomorrow via email.

Please submit your answer in the questions box.

What Should you do with a VFD Vacuum Pump?

A

- Ignore the Control Range

B

- Set up VFD as the Lead Machine

C

- Ignore System Leakage

Best Practices EXPO Contest

Play for a chance to win a **FREE Full Conference Pass** to the Best Practices 2022 EXPO & Conference!! This is a \$675 value! This contest is open to factory personnel, compressed air distributors, utility incentive programs and engineering firms. Exhibiting and sponsor companies are not qualified. Winners will be randomly selected from those who submitted a correct answer and notified tomorrow via email.

Please submit your answer in the questions box.

What Should you do with a VFD Vacuum Pump?

A

- Ignore the Control Range

✓ B

- Set Up VFD as the Lead Machine

C

- Ignore System Leakage

VFD Vacuum Pumps Do's and Don'ts

Q&A

Please submit any questions through the Question Window on your GoToWebinar interface, directing them to Blower & Vacuum Best Practices Magazine. Our panelists will do their best to address your questions and will follow up with you on anything that goes unanswered during this session.

Thank you for attending!

Sponsored by



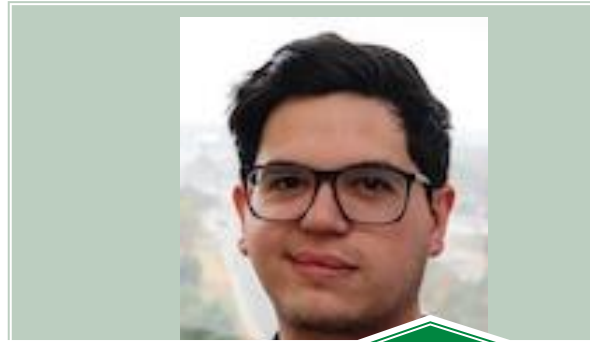
Thank you for attending!

The recording and slides of this webinar will be made available to attendees via email later today.

PDH Certificates will be e-mailed to Attendees by within 2 days

August 2022 Webinar

Avoiding Production Downtime: Real Time ISO 8573-1 Compressed Air Quality Monitoring and Audits



Francisco Lara

Airtec Global
Keynote Speaker

Sponsored by



Be smart. Measure it.

Thursday, August 25, 2022 – 2:00 PM EST

Register for free at

www.airbestpractices.com/webinars