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Variable Frequency Drive Retrofitting in Legacy Facilities

Introduction

Variable frequency drives (VFDs) are the backbone of industrial system precision and efficiency, but legacy hardware can limit performance over time. Aging VFD models often fall short of today's rigorous standards, whereas modern VFDs extend equipment life and reduce costs. This article explores how retrofitting VFDs with the latest technology helps maintain operational control.

Overview

Nearly 70% of all industrial electrical energy use goes into electric motors. By varying the frequency of the input electricity, VFDs bring process and quality improvements in industrial applications as well as preventing energy waste. To determine if VFD upgrades are necessary, initial audits should evaluate VFD and motor age, insulation classification, bearing condition, and cable specifications.

Retrofit projects often use existing cabinetry, but they require careful planning to accommodate the new drive and manage heat effectively. In older plants, retrofitting VFDs may also require additional filters to protect sensitive equipment from electrical noise. It is important to verify whether the motor is inverter-duty rated, particularly its insulation class, to ensure it can withstand voltage spikes.

When retrofitting a VFD, base the choice on the motor's full-load amperage, voltage, and application load rather than just horsepower. Additionally, existing conduits, wiring, and panel capacity should be evaluated to confirm they can support the retrofit. Cable runs must also be assessed to prevent reflected wave phenomena, which can lead to premature motor insulation failure.

Finally, review the current VFD bypass functionality, if it is absent, the retrofit unit should include an integrated manual bypass to allow soft-starter or across-the-line starting in the event of VFD failure.

Key Benefits of Retrofitting Legacy VFDs

Key benefits of retrofitting legacy VFDs include:

- VFD integration can save 30% or more energy when optimized, however, without proper integration with the building management system, these savings may not be fully realized.
- The soft-start capability of a retrofit VFD preserves motor integrity by eliminating startup power spikes and impulse loads.
- Upgrading VFDs helps older facilities meet modern sustainability goals and energy regulations.
- Newer filtration and ventilation solutions associated with retrofit VFDs promote healthier indoor environments by enabling improved fan control, resulting in better air quality.
- Modernizing components in retrofit VFDs extends the lifespan of existing systems and equipment.
- Retrofit VFDs eliminate high-stress, full-speed operation that often causes legacy motors to fail, significantly reducing maintenance and parts expenses.
- Integration within a VFD retrofit enables maintenance teams to monitor parameters such as energy consumption (kW), speed, and fault diagnostics directly on the main human-machine interface (HMI)/supervisory control and data acquisition (SCADA) screen.

Challenges of Retrofitting Legacy VFDs

Older VFDs were not designed with today's energy-efficient upgrades in mind, and integrating modern components into existing systems requires technical evaluation to ensure compatibility.

In addition, there is significant complexity involved in incorporating new sensors and control systems with legacy equipment. Upfront investment also remain a key challenge for companies weighing the benefits of VFD modernization.

Furthermore, executing VFD replacements during peak demand periods is operationally complex, necessitating a rigorous transition strategy to maintain system uptime while minimizing any operational impacts.

Important Aspects: Retrofitting VFDs in Industrial Facilities

Before retrofitting a VFD, conduct a life-cycle cost analysis to confirm the return on investment (ROI) by comparing the long-term costs of repairing, replacing, or retrofitting the unit. As a rule of thumb, retrofitting is most effective when the investment can be recovered in less than three years and the base hardware is expected to last at least another eight years.

It is important to verify motor horsepower and insulation class prior to retrofitting, along with performing a full system

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assessment to prevent electrical noise and future breakdowns. Compliance with IEEE 519 standards must be ensured by implementing harmonic mitigation techniques to keep the total harmonic distortion below 5%, while also verifying transformer capacity, evaluating cumulative non-linear loads, and confirming that new VFDs will not cause resonance issues with existing power factor correction capacitors.

To maximize maintenance savings and protect equipment during startup, the retrofit should focus on preventing electrical discharge bearing damage, optimizing ramp speeds, and securing the drive's operating environment.

Additionally, use VFD-rated shielded cable length per manufacturer's recommendation to prevent voltage spikes, ensuring the shield is grounded properly to protect motor bearings from electrical noise.

Finally, to maximize energy savings, the VFD retrofit should be integrated with a programmable logic controller or building automation system, as lacking building management system connectivity can limit system performance, optimization, and operational control.

Conclusion

Retrofitting legacy VFDs with state-of-the-art technology VFDs provide a high ROI pathway to equipment modernization and reduced operational overhead. These advanced drives offer superior reliability and simplified integration, making them a versatile solution for nearly any facility size.

By enhancing motor durability and reducing energy waste, a modern VFD retrofit not only pays for itself, but it also transforms routine maintenance repairs and increases operational system performance.

References

1. Herwegh, Damien. Expand Motor Life Expectancy with Clean Power Variable Frequency Drives. 31 July 2023, Expand-Motor-Life-Expectancy-With-Clean-Power-Variable-Frequency-Drives.pdf
2. Herwegh, Damien , and Simon Leblond. The next Generation of Variable Frequency Drives - Efficiency without Drawbacks. June 2021, The Next Generation of Variable Frequency Drives.pdf
3. Herwegh, Damien. Solving Harmonics with SmartD's Clean Power VFD. 8 July 2024, Solving Harmonics with SmartD's Clean Power VFD.pdf
4. Mirus International Inc., and Stuluz Air Technology Systems Inc. A Practical and Effective Way of Applying IEEE Std 519-2014 Harmonic Limits.Microsoft Word - Thesis 1, by Tamal Aditya, White Paper - IEEE Std 519-2014 Harmonic Limits.pdf
5. Sashilal, M, et al. RESEARCH to STUDY VARIABLE FREQUENCY DRIVE and ITS ENERGY SAVINGS. 2013, Research to Study Variable Frequency Drive and Its Energy Savings
6. Twin City Fan. A Practical Guide for Using Variable Frequency Drive Systems in Air Movement Applications. July 2018, www.tcf.com/wp-content/uploads/2018/08/VFDs-For-Fans-A-Practical-Guide-White-Paper.pdf.