

Variable Frequency Drives

More Reliability, Less Houseload, More Profit



Why Variable Frequency Drives?

By upgrading to Variable Frequency Drives (VFDs), plants derive significant benefits including increased reliability, reduction in electrical houseload, improved flow control and environmental benefits.

Targeted applications include the replacement of motor speed controls for Reactor Recirculation Pumps, Condenser Circulating Water Pumps, Motor-Generator (M-G) set applications or any large pumps with the need to control process flow.

In addition to saving energy, proven VFD technology can improve profitability through enhanced control and reduced maintenance. Also, VFDs address the obsolescence of aging M-G sets, improving reliability and reducing maintenance.

Why Choose AREVA? More Value.

We combine our engineering expertise with proven solutions from best-in-class supplier partners. AREVA offers the Siemens ROBICON Perfect Harmony VFD as the best motor and pump speed control solution for the nuclear industry. As a single-point-of-accountability for engineering, equipment, and project management, AREVA can minimize your risk in delivering the project on schedule and on budget.

Availability: We provide equipment that offers outstanding protection against single fault vulnerabilities.

Reliability: We provide high-quality drives that are field-proven in more than 4,000 installations around the world.

Installed Cost: Modular designs enable us to install the equipment in configurations that economically meet site requirements. The ROBICON Perfect Harmony VFD does not require a special motor design. The existing motor may be used, saving customers additional capital dollars and installation time.

Maintainability: Simple structure and design allow for easy maintenance.

Support: As the leading supplier of nuclear products and services in the United States, AREVA is prepared to support you. The use of industry standard components from long standing and reliable partners ensures long-term parts availability.

AREVA brings extensive global experience to engineered retrofits in nuclear power plants. We capitalize on our knowledge of plant processes to support electrical system evaluations and provide solutions for the nuclear industry.

The Advantages of VFDs for the Nuclear Industry

Higher Efficiency and Reduced Power Consumption

VFDs allow you to operate motors and pumps at the precise speed needed for your process. With the ability to vary motor and pump speed, system efficiency is increased. This enhanced control allows you to only consume the energy required for system needs.

Compared to a fixed-speed pump with flow controlled via valve, VFDs can provide large savings in energy consumption.

Higher Reliability and Availability

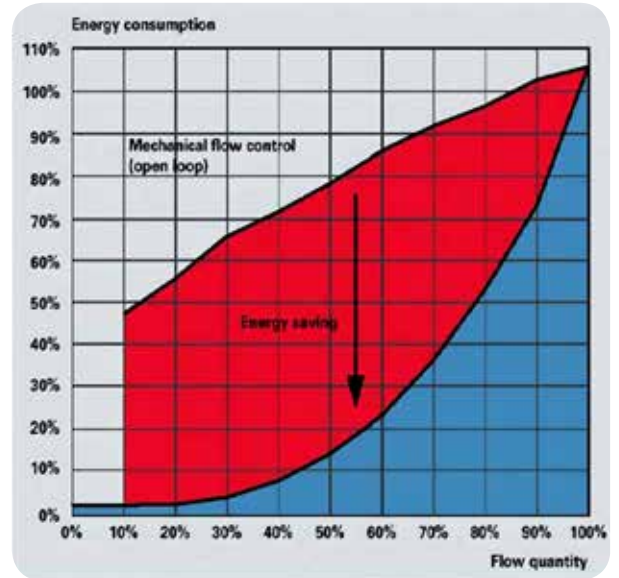
VFDs have proven to be more reliable than Motor-Generator sets. One nuclear plant reported a four-fold increase in system reliability after the installation of VFDs on their Reactor Recirculation Pump motors.

The ROBICON Perfect Harmony VFD features a patented design configuration where the power cells are linked together to build the required power output of the drive system. This patented design gives the ROBICON Perfect Harmony many advantages when it comes to power quality and reliability. Redundant control and power cell design ensures the VFD remains operational in the unlikely event of a component failure.

Reduced Maintenance

Perfect Harmony VFDs significantly reduce maintenance. By replacing aging equipment, VFDs can reduce parts requirements, eliminate mechanical linkages, scoop tube adjustments and oil handling concerns with M-G sets.

IGBTs from the market leader in IGBT technology.



VFDs can provide large savings in energy consumption.

Improved Diagnostics

Operating data and online diagnostics in Perfect Harmony systems are available in several communication protocols and are user friendly. System status information can be available online and easily accessed. Permanent self-diagnostics and automatic alarms provide operations and maintenance personnel with real-time performance data.

Better Control

Existing mechanical systems typically control flow at +/- 5% of rated speed. The ROBICON Perfect Harmony VFDs can improve flow control to +/- 0.5% of rated speed. If necessary, VFDs can be operated at above base speed providing increased flow rates with existing equipment. In addition, the patented technology meets IEEE-519 requirements for electric harmonics.

Soft Start

The ROBICON Perfect Harmony can be used to "soft start" a motor. The controlled start up minimizes current in rush to motor windings, which can extend motor life.

Better Support

Our equipment supplier partner offers 24/7 support, service hotlines and on-call service for VFDs.

Better Integration into the Automation System

VFDs can be integrated into higher level automation via open communication protocols. This allows for better control interface, status monitoring, alarms and operator visualization.

Environmental Benefits

VFDs may help address environmental issues such as compliance with certain provisions of the Federal Clean Water Act such as Rule 316(b). Environmental Protection Agency studies have shown that a reduction in fish intrusion is directly proportional to the reduction in flow rate at the intake structure. The ability to reduce flow rate as necessary is a key benefit of VFDs. VFDs also reduce motor power consumption and increase condenser efficiency by varying flow rate, resulting in incremental capacity gains during the summer.

Why Invest the Capital? More Return on Investment.

Many motors in nuclear plants run at outputs that are higher than required by the plant process.

For example:

- Recirculation pumps and other large pumps have control valves to reduce flow, resulting in a significant loss of energy.
- Cooling water pumps that always run at the same speed, independent from the temperature of the water.
- Large air handler fans that have no speed control despite changing air temperature.

The result is unnecessary energy consumption and stress on components, resulting in high maintenance and repair costs.

In the power generation industry, with increasing emphasis on competitiveness, Variable Frequency Drives are used extensively. The reduction in houseload is often substantial resulting in a quick pay back.

Example:

- Utility customers replaced the control of two reactor recirculation pump motors with Variable Frequency Drives. This resulted in a savings of approximately 2.5 MWe.
- Return to grid / Return on investment =
 $2.5 \text{ MWe} \times 7,920 \text{ hr} \times \$80/\text{MWhr} =$
 $\$1,584,000/\text{yr}.$

Notes: Calculation based on 330 days of operation in a single year with average cost of \$80 per MWhr.

Focus: Plant Applications

Many plants have a history of equipment failures and forced outages associated with Flow Control Valves (FCV) and M-G sets. Problems have resulted in forced outage rates as high as several days per year. Millions of dollars have been spent on improved instruments, more rigid mounting and other efforts, often without long-lasting effect.

AREVA's team enhances the way reactor power is controlled with VFD solutions. The VFDs control speed and flow over the entire range from start-up to 100% power. Flow control valves can be locked fully opened, and M-G sets can be removed. What does this mean for you?

- More Reliability: Forced outages caused by FCV failures, M-G set and scoop tube control problems can be eliminated.
- More Profit: Houseload will typically be reduced by thousands of MW hours per year.
- Better Performance: Reactor power excursions may be minimized due to more accurate controls.

Services:

AREVA is highly experienced in providing solutions to the nuclear industry. AREVA's team provides comprehensive services and a single point of accountability, offering customers:

- Project evaluations to replace existing configurations with VFDs (feasibility analysis, conceptual study, budgetary estimate/proposal).
- Integrated projects including specifications, design change packages, procurement, power supply system evaluation, EMI/RFI analysis, core flow analysis, engineering and delivery of the components.
- Comprehensive project management.
- Civil, mechanical, and electrical system design, modification packages and installation support.
- Project licensing/10CFR50.59 evaluations.
- FSAR updates.
- Update of design basis documents.
- Systems specifications/drawings and modifications for all affected systems.
- Development of operations, maintenance, and testing procedures associated with VFD implementation.
- QA/QC for the complete design and installation process.



Key Application Benefits

Reactor Recirculation Pumps

- Potential of 4 MWe of released capacity
- Addresses M-G set obsolescence
- Reduced maintenance
- Eliminates oil handling issues
- Improved flow regulation
- Extended core life

Cooling Water Pumps

- Reduces debris intrusion
- Reduces fish intrusion
- Reduced motor power consumption
- Increases condenser efficiency
- Reduces pump and valve wear

Large Pumps with Control Valves

- Potential to eliminate control valves
- Improves flow control
- Typical applications include motor driven feedwater pumps / condensate pumps

AREVA Inc.

7207 IBM Drive, Charlotte, NC 28262

Len LaCrosse

Product Development Manager

Electrical Products Division

len.lacrosse@areva.com

Tel: 704.805.2068 – Cell: 704.617.0364

or your VP, Key Accounts:

Tel: 704.805.2410

us.areva.com

The data and information contained herein are provided solely for illustration and informational purposes and create no legal obligations by AREVA. None of the information or data is intended by AREVA to be a representation or a warranty of any kind, expressed or implied, and AREVA assumes no liability for the use of or reliance on any information or data disclosed in this document. ©2015 AREVA Inc. All rights reserved.