

# VFDS AND ELECTRIC MOTOR CONTROL TRAINING



April 10-11, 2018	Richmond, BC
April 12-13, 2018	Edmonton, AB
April 16-17, 2018	Saskatoon, SK
April 18-19, 2018	Winnipeg, MB
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# VFD TRAINING

## We Are Canada's Leader In VFD Training

Prerequisite: Should have moderate understanding of motor theory and motor control operation characteristics.

This innovative and comprehensive Electrical VFD Training Course will be presented by Paul Wright who has more than 35 years of field and engineering experience with Motors and Variable Speed Drives. He is one of the most respected experts on Variable Speed Drive Applications providing technical support and application assistants for all industrial and commercial sectors.

This two day presentation will highlight the proper installation of Variable Frequency Drives into the distribution system. VFDs are being installed more frequently today;

### INTERESTED IN COST EFFECTIVE, PROFESSIONAL ON-SITE VFD TRAINING??

We can present this VFD/Motor Control Training Program to your electrical engineering and maintenance staff, on your premises, tailored to your specific equipment and requirements. Randy Hurst, President, The Electricity Forum, is ready to help you deliver this program for your staff.

however there are still several installations with VFD Issues being ignored or incorrectly being addressed. Examples of improper installations will be discussed to indicate potential problems that can cause damaging consequences.

PHYSICAL VFD DEMONSTRATION FEATURED: Along with the normal course theory, there is a practical component added with displays of sample VFD Cables and two models of open Chassis VFDs to see all the internal components that make up the VFD. Also an operating VFD Motor demo will be shown outlining some of the more important VFD Control Features.

### VFD TRAINING COURSE BENEFITS

- Learn the Fundamentals of Variable Frequency Drives
- Update Yourself on the Latest Advancements in VFDs
- Learn the Latest Improvements in Motor Efficiency
- Practical Approaches and Problem-Solving Solutions
- Learn How to Solve Common VFD Problems
- Learn Practical Troubleshooting Techniques
- Reduce Equipment Downtime and Operating Costs
- Reduce Reliance on Outside Service Companies
- Make Sure Your Equipment is Up and Running

## AGENDA - DAY 1

### 1. TYPICAL DISTRIBUTION SYSTEM OVERVIEW

This seminar will discuss the Distribution components that make up a typical system and how they relate and impact the VFD and Motor selection.

- Point of Common Coupling
- Fault Capacity
- Transformers
- Capacitors
- Switchgear
- Low Voltage MCCs
- VFDs
- Motors
- Other Loads

### 2. FUNDAMENTALS OF ELECTRICITY

This will provide basic information for the various components that make up the control and power circuitry associated with VFDs. Resistors, Reactors and Capacitors will be discussed to show how they are utilized in the overall VFD package.

### 3. EVOLUTION OF SEMICONDUCTORS

Semiconductors have evolved with increased performance, efficiency and switching speed over the past few decades. However we are still waiting for the next new switching device that will provide a significant improvement in efficiency (very little losses) and switching frequency allowing VFDs to be 50% of the present size.

- Diodes
- Thyristors (SCRs)
- Insulated Gate Bipolar Transistors
- New power switch expectations

### 4. MECHANICAL FUNDAMENTALS

The review of the fundamentals of torque, force, speed, inertia, acceleration and Horsepower will be discussed for various common industrial applications such as fans, pumps, conveyors etc. With a good understanding of these basic factors, the student will be able to see why the correct selection of Motors and VFDs differ for a given application.

### 5. UNDERSTANDING HOW THE VOLTAGE AND FREQUENCY AFFECT MOTOR PERFORMANCE

A quick overview of motor theory will be presented for fixed speed operation and then we discuss how the motor behaves differently on VFD Power. We will show the relationship of changing of the voltage and frequency will impact the development of torque and the speed of the motor. We will also discuss the differences in the Torque/Current versus Speed curve for motor on a fixed speed application versus that for a VFD operation.

### 6. UNDERSTANDING VFDs

This presentation will discuss the topology of today's low voltage VFDs used with PWM or Vector

Control schemes. The function of the Rectifier, Pre Charge Circuit, DC Bus Capacitors, Chopper Circuit and Inverter section will be discussed. Discuss when to select PWM Control (V/Hz) or Vector Control operating modes. Discuss the selection of the voltage and current ratings of the VFD and the individual components that make up the complete system to show how the reliability of the VFD is improved. The student will learn how to select the VFD models from various Manufacturers that will be more reliable and have longer Mean Time Between Failures (MTBF).

- VFD Overview
- Enclosures Types
- Voltage rating and Tolerance
- Current Capacity and Overload Capability
- VFD System Components
- Disconnect Switch or Circuit Breaker
- Line Filtering
- Surge Protection
- Fused Control Power
- 120Vac and 24VDC control
- Contactors and Bypass Control Schemes
- Motor Filters
- Analog Isolators
- Enclosure Heating and Cooling Requirements
- Dedicated Customer Field Connection Terminal Blocks

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## 7. BENEFITS OF USING VARIABLE FREQUENCY DRIVES

The many benefits of using Variable Speed Drives will be discussed for several different applications such as fans, pumps conveyors and process machines. Several common reasons for using VFDs from Energy Savings, Unlimited Starting and Reversing, Precise Process control, Extension of Equipment Life will be reviewed. Significant capital and operating costs reduction possibilities will be shown.

## 8. VFD COMPONENT LAYOUT

The topology overview of the typical 3 phase schematic of a VFD will be shown with pictures

of the various components that make up the VFD system. Two disassembled VFDs will be on display for the students to see the complete insides of the VFD internal components.

The following areas will be pointed out:

- Incoming Line Terminals
- DC Bus Connection
- Pre-charge resistor and Contactor
- DC Bus Filter Capacitors
- Control Power circuitry for 24, 12 and 5 Volt logic
- Inverter Driver circuitry
- IGBT Power Module
- Current sensor modules (HALL EFFECT SENSORS)
- Motor Connection Terminals

## 9. VFD DEMONSTRATION

A VFD and Motor will be operated to show some of the more common basic features that a VFD system uses. Several VFD features will be discussed and demonstrated.

- Acceleration and Deceleration Ramp Time
- Coast to Stop
- Fast Stop
- Minimum Speed
- Maximum Speed
- Automatic Restart
- Power Loss Ride-through
- Reversing

## DAILY SUMMARY AND SEMINAR WRAP UP

# AGENDA - DAY 2

## 10. POWER QUALITY AND UP STREAM ISSUES

This presentation will look at the line side issues that a VFD may have on the power system. All the following issues will be discussed along with the recommended solution(s) for each issue:

- Fault Capacity
- Harmonic Limitations (Voltage and Current Distortion)
- Power Quality
- Power Factor
- Voltage and Tolerance
- Transients and Surges

## 11. MOTOR AND CABLE DOWN-STREAM ISSUES

This presentation will look at the load side issues downstream of the VFD that may create issues in the motor circuit. All the following issues will be discussed along with the recommended solution(s) for each issue:

- Bearing Currents
- Reflective Waves in Cables
- $dv/dt$  stress > 500 Volts per micro second
- Peak Voltage Stress > 1000 Volts
- Reactor,  $dv/dt$  and Motor Filters

- VFD Cables
- Radio Frequency and Electro Magnetic Interference

## 12. PARAMETER SELECTION

Most VFD applications need about 30 to 50 parameters to be set to make the VFD function properly for a given application. The selection of a few special programmable functions may be required, adding another 10 or so parameters. Unfortunately the microprocessor used in today's VFDs provides access to hundreds if not thousands of different parameters. The short parameter list for several different VFD vendors will be reviewed. Special functions like Auto restart, Rotating Start and Kinetic Buffering will be discussed to show which applications they could be used on.

## 13. PROGRAMMING AND TESTING:

The most common 50-70 VFD setting parameters will be discussed. We will provide a sample parameter list for a couple of VFD manufacturers. Storing and saving parameter sets in EPROM in VFD and in some keypads

The testing of the VFD packaged system is a very important procedure that makes the whole System complete. This verifies the controls and power wiring function as specified. A good testing program enables the VFD to be installed and commissioned on site without any issues. The proposed testing and commissioning procedures will be discussed.

- Routine Testing
- Certified Full Load Testing
- Heat Run Testing in 40°C ambient

## 14. REVIEW OF VFD SPECIFICATION

A sample of a universal VFD specification will be provided that addresses all the unique potential issues that may impact the proper operation of the VFD System. This specification is the base of purchasing a VFD solution that will provide many years of trouble free operation.

## DAILY SUMMARY AND SEMINAR WRAP UP

All students attending this presentation will receive electronic copy of the 9 Presentations plus several papers and booklets discussing the course and related material.

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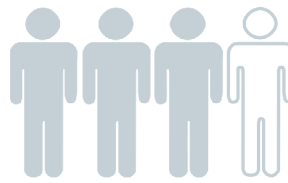
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The Electricity Forum reserves the right to cancel any conference it deems necessary and will, in such event, make a full refund of the registration fees.

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The fee includes forum participation, refreshments and presentation in paper format.

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