



MUE008

Pumps & Valves Operations, Control, Maintenance & Troubleshooting

Course Introduction:

Pumps and valves are at the heart of most industrial processes, and the second most common machine in the world. Because they are so common, pumps and valves are often overlooked as a potential source of improved productivity, or a cause of excess costs if not operated properly. Plant managers, maintenance engineers and production supervisors should adhere to best practices and understand the operational do's and don'ts for employing pumps and valves properly in manufacturing and industrial applications. This training provides an overview of how to operate pumps and valves properly and the performance parameters that need to be monitored in a preventive or predictive monitoring program. It also describes continuous monitoring systems, with several case studies on how they can be applied to improve system performance and reduce maintenance costs.

The course will introduce detailed, comprehensive, generic overview of the design attributes, maintenance and testing protocols, and historical regulatory issues related to motor-operated valves (MOVs). To provide a solid introduction to MOV technical and regulatory issues, both general valve issues and motor-actuator items are covered. MOV diagnostic testing and refurbishment are also addressed in this module.

The course will introduce delegates to the different types of pumps, motors and drives and their associated terminology. Centrifugal and positive - displacement pumps packing, mechanical seals and sealing systems, bearings and couplings will all be discussed.

Course Objectives:

Upon successful completion of this course, the delegates will be able to:

- Understand the different types of pumps and their associated terminology
- Understand Centrifugal and positive displacement pumps, packing, mechanical seals and sealing systems, bearings and couplings
- Understand the different parameters affecting the operation of valves
- Ability to select the right valve for the particular application and to perform the necessary calculation for valve sizing
- Ability to perform troubleshooting of systems involving valves
- Ability to decide on the right maintenance plan concerning different types of valves
- Recognize the valve and motor-actuator types, with emphasis on the most common types found in nuclear power plants.
- Identify valve and actuator subcomponents and their functions for the electrical, mechanical, and control components.
- Explain the basic operation of the various valve and actuator designs used in typical MOV service.
- Demonstrate awareness of the chronological history of nuclear industry regulatory requirements associated with MOVs and the operating experiences that were the initial drivers.
- Identify applicable codes, standards, and industry design guidance applicable to MOVs.
- Identify applicable industry users' groups and their charters that are associated with MOVs.
- Identify the principles, technical parameters, and techniques used in selecting and sizing appropriate actuators.

- Describe typical MOV electrical issues (circuitry, alternating vs. direct current motors, degraded voltage, etc.).
- Identify the requirements for stress calculations including weak-link analysis, seismic analysis, and actuator capability calculations.
- Identify Environmental Qualification (EQ) requirements per 10 CFR 50.49 and applicable vendor requirements and their impact on valve components and lubricants.
- Identify industry accepted preventive/predictive maintenance regimens and frequencies, including the underlying bases of the MOV maintenance program at nuclear power plants.
- Diagnose the cause of the issue that requires troubleshooting by using some examples of MOV operational problems or issues.
- Explain the different methods for measuring the operational performance of MOVs through diagnostic testing.
- Identify points required to meet the MOV acceptance criteria by using typical diagnostic traces.
- Explain any observed degradations or anomalies from a typical diagnostic trace or series of traces.
- Recall industry operating experience with respect to MOV failures and the resulting corrective actions put in place to prevent recurrence.
- Explain the need for valve/actuator replacement.
- Identify common MOV modifications required for the plant MOV program.
- Explain the requirements for post-modification testing of the valve/actuator combination after refurbishment or replacement

Who Should Attend?

- Facility / Utility Engineers
- Operation Personnel
- Mechanical Engineer
- Electrical Engineer
- Maintenance and Troubleshooting Personnel
- High Pressure Pumps Operators
- Supervisors & Technicians
- Team Leaders

Course Outline:

PUMPING SYSTEMS

- Introduction
 - Pump Types and Terminology
 - Pump Performance (Centrifugal and Positive Displacement)
- Understanding Head
 - Types of Head: Friction, Pressure, Static & Velocity
 - Friction in Valves, Piping & Fittings
 - Calculating Actual Head in a System
- Cavitation in Pumps and Valves

- Net Positive Suction Head (NPSH)
- Vapor and Gas Cavitation
- Flashing vs. Cavitation

PUMP TYPES

- Positive Displacement Pumps
 - Reciprocating Pumps
 - Reciprocating Pump Valves
 - Rotary Pumps – scroll and gear types
 - Failure Mechanisms – identification and monitoring
- Centrifugal Pumps
 - Centrifugal Pump Theory
 - Pump Components
 - Matching Pumps with Drivers
 - Performance Analysis
 - Failure Mechanisms – identification and monitoring

ACHIEVING PUMP RELIABILITY

- Sealing Systems
 - Conventional Packing Glands, Mechanical Seals & Flush Plans
 - Seal Failure Mechanisms
 - Maintenance and Repair of Mechanical Seals
- Bearings – failure modes and how to extend life
 - Lubrication
 - Plain Bearings
 - Anti-Friction Bearings
- Couplings & Alignment
 - Couplings
 - Alignment & Balancing
 - Foundations & Bedplates

VALVES TECHNOLOGY

- Types of Valves (globe, gate, ball, plug, check)
- Flow Characteristics
 - Flow through Valves
 - Valve Flow Characteristics
 - Linear, Quick Opening & Equal %
- Valve Sizing
 - Calculating the Correct CV Value
 - Selecting Valve Size Using Valve Coefficient
 - Calculations for Correct Valve Selection
- Sealing Performance
 - Leakage Classifications

- Sealing Mechanisms
- Valve Stem Seals

CONTROL VALVES

- Functions of valves
- Methods of regulation
- Control Valve Types
- Valve end connections
- Valves seating
- Valve Control

MOTOR OPERATED VALVES

- Motor Operated Valves: History and Application
- Valves and Actuators: Types, Usage, and Operation
- Theory of Design Basis Operation: Rising-Stem MOVs, Quarter-Turn MOVs, and Motor Actuators
 - Design Basis Stem Thrust
 - Design Basis Stem Torque
 - Design Basis Actuator Capability
- MOV Laboratory – Actuator Disassembly, Assembly, and Switch Setting
- MOV Regulatory Requirements
- Periodic Verification
 - ASME OM Code – Mandatory Appendix III and Code Case OMN-1
 - Diagnostic Testing Overview
- MOV Laboratory – Test Stand Operation, Data Analysis, and Rate-of-Loading Demonstration

RELIEF AND SAFETY VALVES: FUNCTION AND OPERATION

- Relief Valves Types
- Relief Valve Parts
- Direct Acting and Pilot Control
- Applications
- Relief valves problems
- Applications of Rupture Discs

VALVES TROUBLESHOOTING & MAINTENANCE

- High Pressure Drop
 - Pressure Recovery Characteristics
 - Flow Choking
 - High Velocities
- Water Hammer
 - What causes water hammer?
 - Solutions for Water Hammer
- Troubleshooting the Control & Isolation Valves
 - Review of Common Faults

- Developing a Preventive Maintenance Plan

VARIABLE SPEED DRIVES

- Basic principles of AC Variable-Speed Drives (VSD's), constant torque region, constant power (extended speed) region, four quadrant operation
- Power semiconductors, diode, thyristor (SCR), IGBT, MOSFET, GTO and others
- Inverters, Voltage-source and Current-source, Pulse Width Modulated (PWM) inverters
- Two-level pulse width modulated inverter, DC link energy and capacitor sizing, regeneration or dynamic slowdown, dynamic breaking, regeneration
- PWM waveforms and analysis, effects of PWM on motor bearings and insulation and life expectancy, Volts/Hertz control, start up and operation, dynamics, PWM rectifier inverter systems
- Switching transients, harmonics and power factor, failures, common failure modes, fault current limit, device explosion rating, device application, thyristor failures and testing, identification of failed Thyristor and Diode, testing of Thyristor and Diode
- AC drive applications issues, Line power factor, Effect of AC input on drive operation, IGBT switching transients, insulation voltage stress, motor winding voltage distribution, Radiated and Conducted Electromagnetic Interferences (EMI), cable terminating (matching) impedance, inverter output filter, EMI filtering
- Cabling details for AC drives, cable details, motor, cable, and power system grounding, motor bearing currents, motor shaft grounding brush, reduction of stator to rotor capacitance value, motor cable wiring practices
- Summary of application rules for AC drives and selection criteria
- Maintenance, common failure modes, motor application guidelines
- Control systems, low performance and open loop operation, medium performance and closed loop operation, high performance and closed loop operation, current feedback control, speed control, sensor less drives, evaluation and comparison. Industry standards and case studies.

Course Certificate:

International Center for Training & Development (ICTD) will award an internationally recognized certificate(s) for each delegate on completion of training.

Course Methodology:

A variety of methodologies will be used during the course that includes:

- (30%) Based on Case Studies
- (30%) Techniques
- (30%) Role Play
- (10%) Concepts
- Pre-test and Post-test

- Variety of Learning Methods
- Lectures
- Case Studies and Self Questionnaires
- Group Work
- Discussion
- Presentation

Course Fees:

To be advised as per the course location. This rate includes participant's manual, Hand-Outs, buffet lunch, coffee/tea on arrival, morning & afternoon of each day.

Course Timings:

Daily Course Timings:

08:00 - 08:20	Morning Coffee/Tea
08:20 - 10:00	First Session
10:00 - 10:20	Recess (Coffee/Tea/Snacks)
10:20 - 12:20	Second Session
12:20 - 13:30	Recess (Coffee/Tea/Snacks)
13:30 - 15:00	Last Session

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