PRACTICAL
MACHINERY AND AUTOMATION SAFETY
FOR INDUSTRY

WHAT YOU WILL LEARN:

- How to identify hazards of machines and do risk assessments
- The essential design principles for safety-related electrical controls
- The meaning and application of "safety category" and "SIL"
- How international standards can help you develop your safety applications
- The principles of safety PLCs and safety networks
- The basics of CE marking and the EU safety regulations for machinery

WHO SHOULD ATTEND:

- Control Engineers & Technicians
- Electrical Engineers
- Instrumentation and Control Engineers & Technicians
- Compliance Engineers
- Machinery Designers & System Integrators
- Safety Professionals, Health & Safety Officers
- Production Managers
- Automation Engineers
- Process Control Engineers
- System Integrator Designers
- Systems Engineers
- Electronic Technicians
- Process Engineers
- Electronic Engineers
- Design Engineers
- Test Engineers
- Consulting Engineers

The Workshop

The technology of safety related control systems plays a major role in the provision of safe working conditions throughout industry. At the same time safety controls must not be seen as an obstacle to production performance and efficiency. It pays to have safety controls that work reliably without slowing down production or causing irritation to the operators.

Perhaps your company is wasting money on inappropriate safety interlocks that waste production time and still do not satisfy safety regulations? Perhaps your technicians and engineers could improve production at the plant through using smarter safety systems?

This workshop aims to provide you with the knowledge to tackle machinery safety control problems at a basic and practical level whilst following the best available international standards. It begins with an overview of machinery safety issues, introducing the concepts of hazard identification and risk reduction. The workshop highlights the major international standards that are used to support compliance with EU regulations and uses these as a basis for the design procedures. This approach will assist you to follow best practices for safety system applications wherever your plant is situated and is essential if you are exporting into the EU.

The workshop looks at the risk assessment processes used to identify hazards and to quantify the risks inherent in a machine. This enables engineers to define the safety functions to be provided by safety related electrical controls. The workshop then introduces the concepts of safety categories as defined by standard EN 954 and illustrates the principles of failsafe design, fault tolerance and self-testing.

With design procedures established the workshop now provides an introduction to machinery protection devices such as guards, enclosures with interlocks and guard monitoring relays, locking systems, safety mats, photo electric and electro sensitive principles and the application of light curtains. Application examples such as guard door interlocking applications, two-hand controls, muting, area protection of robot installations and motion detection are then discussed.

The workshop introduces the principles of safety-certified PLCs focusing on practical useful information showing the differences between PLCs designed for safety and those for regular control duties. It also provides an outline of the principles of networking of safety devices including the integration of safety and regular control systems in complete packages.

The workshop introduces the recently established standards IEC 61508 and IEC 62061 for functional safety of programmable systems. It explains the concepts of safety integrity levels (SILs) and their relationship to safety categories and highlights key issues associated with software based safety applications.

Pre-requisites

A basic working knowledge of electrical engineering concepts is useful but not essential as there will be a brief revision at the commencement of the class.

The Program

INTRODUCTION TO MACHINERY SAFETY PRINCIPLES

- Course outline and objectives
- Definition of a machine and the scope of machinery controls
- Examples of common hazards & typical safety system solutions
- Principles of risk assessment and risk reduction
- Introduction to the safety lifecycle method of engineering

Practical 1: Exercise in calculating risk parameters

GUIDE TO REGULATIONS AND STANDARDS

- Introduction to European Directives, Regulations and Standards
- CE marking and the EU machinery directive
- Obligations of suppliers and end users
- Type A, B and C safety standards
- USA Regulations and Standards
- Concept of Control Reliability

Practical 2: Questionnaire on CE marking and compliance

RISK ASSESSMENT & RISK REDUCTION METHODS

- Risk assessment procedure based on EN1050
- How to do risk estimation and risk ranking
- Developing risk reduction by design and by safeguarding
- Practical example of a risk assessment and risk reduction steps

Practical 3: Hazard study and risk assessment exercise on a power tool

- Risk reduction provided by safety control systems
- Documentation and software tools for risk assessment.

Practical 4: Predict an accident rate using fault tree analysis

DESIGN PROCEDURES FOR SAFETY CONTROLS

- Introduction to safety control standards EN 954 and IEC 62061
- Procedures for the design of safety controls
- Failure modes and principles of fail safe design
- Explanation of safety categories (EN 954) and SILs (IEC 62061)
- Specification of safety requirements and selection of categories
- Circuit application examples for categories 1 to 4

Practical 5: Determine the safety categories for a production line

DEVICES: E-STOPS AND THE SAFETY RELAY

- Emergency stop functions and types.
- How does an E-stop safety relay work?
- Practical safety relays and typical applications
- Guard monitoring applications
- Programmable and electronic monitoring devices
- Bus connected monitors.

Practical 6: Design an Emergency stop system for a conveyor

DEVICES: SENSORS AND CONTROLS

- Overview of sensors and safety devices
- Choices of protection methods
- Fixed & moveable guards
- Sensing devices for guards
- Application examples: Guard interlocking systems
- Presence sensing devices including safety mats and proximity sensors
- Principles of light beams, light curtains and laser scanners.

Practical 7: Outline design of an access guarding system

SAFETY CONTROL APPLICATIONS

- How to choose the right safety control system
- Selection factors for the protection method
- Comparison of physical guarding with other safety methods
- Application of hold-to-run and two-hand controls
- Motion detection and run down safeguarding.
- Presence sensing and access guarding examples for light curtains
- Calculation of safety distances
- Application examples for muting, blanking, single-and double-break operating modes

Practical 8: Calculate safety distance for a light curtain application

PROGRAMMABLE SYSTEMS FOR SAFETY CONTROLS

- The pros and cons of using of PLCs in safety
- Why a general purpose PLC should not be used for safety duties
- Key performance features of a safety-certified PLC?
- Software characteristics of a safety PLC
- Application programming using certified function blocks
- PLC types and features
- Introduction to safety-related field bus systems.

NEW STANDARDS FOR PROGRAMMABLE SYSTEMS

- Introduction to IEC 61508 general standard for functional safety.
- Using the safety life cycle method for management of safety
- IEC 62061, a new standard for machinery controls
- How safety integrity levels are defined for machinery safety

MACHINERY SAFETY MANAGEMENT

- Maintenance and safety issues in the factory.
- Validation and proof testing of installed safety systems
- Upgrading the safety of existing machines.

Practical 9: Checklist for safety compliance

REVISION OF KEY POINTS