COURSE OVERVIEW IE0542

Plant Control System & Instrumented Protection System - Fundamental (E-Learning Module)

Course Title

Plant Control System & Instrumented Protection System - Fundamental (E-Learning Module)

Course Reference

IE0542

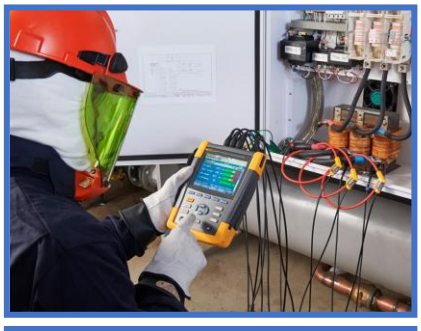
Course Format & Compatibility

SCORM 1.2. Compatible with IE11, MS-Edge, Google Chrome, Windows, Linux, Unix, Android, IOS, iPadOS, macOS, iPhone, iPad & HarmonyOS (Huawei)

Course Duration

30 online contact hours
(3.0 CEUs/30 PDHs

Course Description



This course is designed to provide participants with a detailed and fundamental overview of plant control system & instrumented protection system. It covers the construction industry regulations, electrical safety, OHM's law and hazards of electricity; the risk assessment/risk reduction, equipment life cycle, transport, installation, commissioning, maintenance, dismantling and basic precautions; the causes of accidents, prevent electrical accidents, firefighting, fire detection and fire prevention system; and the hierarchy control, risk assessment, lockout – tag out and the 6 step of LOTO procedure.

Further, the course will also discuss the directive and discuss new legislative developments, auto ignition temperature, temperature classes and the combination of protection methods; the selection criteria, enclosure protection, area classification, oil water separator, alternative procedure for classification, marking and temperature classification; the equipment categories, hazardous area classification and the selection of equipment; the temperature measurement, thermowell installation, level control system, temperature control system and pressure reduction system; and the pressure measurement, process variables, pressure measuring devices, pressure transmitters and transducers.

During this interactive course, participants will learn the various types of level measuring devices; the units of flow, basic properties of fluids, flow measuring system, quantity meters and rate of flow measurement; calibrating flow measuring devices; the SCADA, HMI, DCS and HART; the conversion factors, analysis equipment, gas chromatograph and hazardous area classification; the process control system, element and communications wizard measurement and importing graphics images; configuring events; the alarm state diagram; creating trend tags; configuring process analysis; and the process analysis properties.

Course Objectives

At the end of this course, the Trainee will be able to:-

- Apply and gain a fundamental knowledge on plant control system and instrumented protection system
- Explain the fundamentals of process measurement and control
- Describe the theory and equipment for pressure measurement and control
- Describe the theory and equipment for temperature measurement and control
- Describe the theory and equipment for level measurement and control
- Describe the theory and equipment for flow measurement and control
- Explain the basics of process control theory (process, manual and automatic control, open and closed loop and elements of a control system)
- Explain terms used in process control like controlled variable, manipulated variable, set point, actuators etc.
- Locate and identify the process measurement and control instruments in the plant
- List the different types of measuring elements (sensors) and explain their working
- List the different types of transmitters and explain their working
- List the different types of actuators and their working
- List the different types of controllers and their working
- Explain the difference between local control and DCS
- Explain the working of P&ID controller
- Explain how a process is controlled
- Operate local field instrumentation and control systems
- Describe the working of a safety loop-
- Explain the working of an Emergency Shutdown System (ESD)
- Discuss the construction industry regulations, electrical safety, OHM's law and hazards of electricity
- Illustrate risk assessment/risk reduction, equipment life cycle, transport, installation, commissioning, maintenance, dismantling and basic precautions

- Analyze the causes of accidents, prevent electrical accidents and apply firefighting, fire detection and fire prevention system
- Carryout hierarchy control, risk assessment, lockout – tag out and the 6 step of LOTO procedure
- Apply the directive and discuss new legislative developments, auto ignition temperature, temperature classes and the combination of protection methods
- Employ selection criteria, enclosure protection, area classification, oil water separator, alternative procedure for classification, marking and temperature classification
- Identify equipment categories and apply hazardous area classification and the selection of equipment
- Employ temperature measurement, thermowell installation, level control system, temperature control system and pressure reduction system
- Apply pressure measurement and describe process variables, pressure measuring devices, pressure transmitters and transducers
- Identify the various types of level measuring devices and discuss the units of flow, basic properties of fluids, selecting a flow measuring system, quantity meters and rate of flow measurement
- Calibrate flow measuring devices and recognize SCADA, HMI, DCS and HART
- Recognize conversion factors, analysis equipment, gas chromatograph and hazardous area classification
- Explain process control system, measuring element and communications wizard as well as import graphics images
- Configure events, illustrate alarm state diagram, create trend tags, configure process analysis and identify process analysis properties

Who Should Attend

This course provides a basic overview of plant control system & instrumented protection system for all power plant, system and control operators.

Training Methodology

This Trainee-centered course includes the following training methodologies:-

- Talking presentation Slides (ppt with audio)
- Simulation & Animation
- Exercises
- Videos
- Case Studies
- Gamification (learning through games)
- Quizzes, Pre-test & Post-test

Every section/module of the course ends up with a Quiz which must be passed by the trainee in order to move to the next section/module. A Post-test at the end of the course must be passed in order to get the online accredited certificate.

Course Certificate(s)

Internationally recognized certificates will be issued to all participants of the course.

Certificate Accreditations

Certificates are accredited by the following international accreditation organizations: -

- USA International Association for Continuing Education and Training (IACET)

  Haward Technology is an Authorized Training Provider by the International Association for Continuing Education and Training (IACET), 2201 Cooperative Way, Suite 600, Herndon, VA 20171, USA. In obtaining this authority, Haward Technology has demonstrated that it complies with the **ANSI/IACET 1-2013 Standard** which is widely recognized as the standard of good practice internationally. As a result of our Authorized Provider membership status, Haward Technology is authorized to offer IACET CEUs for its programs that qualify under the **ANSI/IACET 1-2013 Standard**.

  Haward Technology's courses meet the professional certification and continuing education requirements for participants seeking **Continuing Education Units** (CEUs) in accordance with the rules & regulations of the International Association for Continuing Education & Training (IACET). IACET is an international authority that evaluates programs according to strict, research-based criteria and guidelines. The CEU is an internationally accepted uniform unit of measurement in qualified courses of continuing education.

  Haward Technology Middle East will award **3.0 CEUs** (Continuing Education Units) or **30 PDHs** (Professional Development Hours) for participants who completed the total tuition hours of this program. One CEU is equivalent to ten Professional Development Hours (PDHs) or ten contact hours of the participation in and completion of Haward Technology programs. A permanent record of a participant's involvement and awarding of CEU will be maintained by Haward Technology. Haward Technology will provide a copy of the participant's CEU and PDH Transcript of Records upon request.

- British Accreditation Council (BAC)

  Haward Technology is accredited by the **British Accreditation Council** for **Independent Further and Higher Education** as an **International Centre**. BAC is the British accrediting body responsible for setting standards within independent further and higher education sector in the UK and overseas. As a BAC-accredited international centre, Haward Technology meets all of the international higher education criteria and standards set by BAC.

Course Fee

As per proposal

Course Contents

- Construction Industry Regulations: Electrical Safety
- Introduction
- Severity
- How Does Electricity Work:
- Ohm's Law Applied to Direct Current
- Ohm's Law Applied to AC Current
- Alternating Current
- Ohm's Law Applied to AC
- How is Electrical Energy Produced?
- Power in AC Circuit
- "Power Losses" and "Voltage Drop "
- Definitions
- Safety
- Hazard
- Harm
- Risk
- Risk=Hazard x exposure
- What are the Hazards of Electricity?
- Safety Signs and Tag Guide
- Risk Assessment/Risk Reduction:
- Equipment Life Cycle
- Transport
- Installation
- Commissioning
- Maintenance
- Dismantling
- Basic Precautions
- Types of Hazardous Energy
- Hazardous Energy
- Body Behavior According to Current Level Crossing Over
- Our Body Conducts Electricity – Body Behaviour

- Damages from Shock are Mainly Internal
- Damages Due to Electrical Arc
- HV or MV ARC Impact
- Direct and Indirect Contact
- Protection against Direct contacts
- TT Scheme – Earth Leakage Monitoring
- Protection Against Indirect Contacts
- Root Causes of Electrical Accidents
- Accidents Causes Generated by Non-strict Electrical Maintenance
- Accidents Causes Generated by Insufficient Training
- Defects in Safety Systems & Procedures
- Management Commitment
- Analysis of Causes of Accidents
- Preventing Electrical Accidents:
- Electrical Panels and Distribution
- Hand Held Electric Tools
- Overhead Powerline Hazards
- Wrong Methods, Wrong End
- Wrong Gear, Major Burns
- Lesson
- Never Approach Bare MV or HV
- Boundaries
- Personal Protective Equipment:
- Electrical Safety Equipment's
- Safety Kits
- Guarding
- Working at Height Personal Fall Protection Systems-Common Pieces of Equipment
- Safety Line Systems (Static Lines)
- Avoid Bad Contacts
- Protection Relays
- Internal Arc Withstanding Switchgear
- LV Current Limitation
- Summary

- Good Work Practice
- Electric Shock
- Lightning
- How does Lightning Form?
- Lighting Devices to Prevent Strike
- Electricity is One of the Most Common Causes of Fire Both in the Home and Workplace
- Fire Fighting and Fire Detection
- Fire in Electrical Equipment
- Fire Prevention System
- Pumps and Sprinkles for Fire Fighting
- Personal Protective Equipment – Applying the Standard
- Group HS Operational Standard: Personal Protective Equipment (PPE)
- Why a Standard on PPE?
- Expectation 1 - Review the Standard
- Expectation 2 – Perform a Gap Analysis
- HS Operational Standard
- Expectation 3 – Risk Assessment
- Expectation 4 – Site PPE Procedure
- Expectation 5 – Mandatory Minimum PPE
- What is the Hierarchy of Control?
- How to Conduct a Risk Assessment?
- Risk Assessment – Hazard Identification
- Risk Assessment –Hazard Recognition
- Risk Assessment – Determine Risk Level
- Site Deployment: Under the Responsibility of the Site Manager
- Cathodic Protection - How it Works
- Sacrificial Anode System
- Impressed Current System
- Criteria of Cathodic Protection
- Current Intensity Needed for Cathodic Protection
- Internal + External
- Sacrificial Anode Systems
- Sacrificial Magnesium Anodes

- Sacrificial Zinc Anode
- Sacrificial Aluminum Anode
- Impressed Current Anodes
- Silicon Iron Anodes
- Solar Powered Cathodic Protection Station
- Insulating Flange Kits
- Reference Electrodes
- Insulator Spacers for Casings
- Casing End Seals
- Zinc Ribbon
- Lockout – Tag out
- Overview
- Types of Energy
- 6 Step LOTO Procedure
- Prepare for Shutdown
- Shutdown Equipment
- Isolate the Equipment
- Attach the Lock and Tag
- Group lockouts
- Release or Block all Stored Energy
- Verify Equipment Isolation
- Lockout Steps
- Release from LOTO
- Contractors
- Who can remove Locks & Tags?
- Shift changes
- Restoring energy to the equipment/machine
- Potentially Explosive Atmospheres (ATEX)
- The ATEX Sector
- EU legislation: the ATEX Directive 94/9/EC
- Basic Elements
- Equipment: Groups and Categories
- Essential Health and Safety Requirements

- Conformity Assessment: Modules
- Conformity Assessment: Notified Bodies
- Markings
- Organizational Scheme for the ATEX 94/9/EC Directive
- Working Parties
- Market Surveillance
- How to Apply the Directive
- New Legislative Developments
- The NLF-Aligned ATEX Directive
- Transitional Period and Transposition
- ATEX Contact Point
- ATEX Enclosure - Examples
- Class I, Div. 1 Enclosure Installation
- Class I, Div. 2 Enclosure Installation
- EEx e (Increased Safety) - Zone 1 & 2 Enclosure Installation
- EEx d IIB (Flameproof) Enclosures for Zone 1 & 2, 21, 22
- EEx d IIC (Flameproof) Enclosures for Zone 1 & 2, 21, 22
- Hazardous Area Classification and The Selection of Equipment
- European System
- ATEX
- ATEX Directive 94/9/EC
- Directive 137
- ATEX Groups and Categories
- ATEX Zones
- ATEX 137
- Hazard - Gas, Mists or Vapors
- Gases/Vapors
- Hazard – Dusts
- Requirements
- ATEX Product Markings
- IEC
- Zone Identification
- Gas Groups

- Auto Ignition Temperature
- Temperature Classes
- Types of Protection
- Flameproof Enclosures “d”
- Enclose Ignition Source with a Tough Container
- Intrinsic Safety “i”
- Basic Principles
- Electric Spark Energy can be always smaller than the Ignition Energy
- Limiting Energy to the Field Device
- Intrinsically ib
- Intrinsically Ia
- Increased Safety “e”
- Powder/Sand Filled “q”
- Pressurized Apparatus “p”
- Pressurize clean air in the container
- Oil Immersion “o”
- Special Protection “s”:
- Type of Protection “n”:
- Type of Protection “m”:
- Combination of protection methods
- Selection criteria
- Selection of Equipment
- Enclosure Protection
- Area Classification
- Oil Water Separator
- Floating-Roof Tank
- Fixed Roof Tank
- Alternative Procedure for Classification
- Marking
- ATEX Marking
- Example of new marking
- Acronyms
- 4 Square Engineering Consultancy Limited

- Hazardous Locations Overview, Ignitions Sources, and Protection Concepts
- What is Potentially Explosive Atmosphere Certification and why might you need it?
- Deepwater Horizon
- Facts about Disaster
- What is an Explosion?
- The Fuel
- Fuel Properties
- Explosion Properties
- Temperature Classification
- Temperature Class
- Gas Grouping
- Combustible Dust
- Potential Ignition Sources
- Protection Concepts
- Flameproof (Explosion-proof) Ex d
- Intrinsic Safety
- Purged and Pressurized
- Increased Safety Ex e
- Oil Immersion Ex o
- Powder Filling Ex q
- Encapsulation
- Encapsulation Ex 'm'
- Type 'n' Protection for Zone 2
- Protection Concept for Dust Classified Areas
- Classification Schemes, Certification, and Design Guidelines
- An Explanation of ATEX, NEC and IEC Systems
- Equipment Groups
- Equipment Categories
- Zone Definitions
- Hazardous Area Classification
- Class/Division Definitions
- Correlation – Somewhat?
- Gas Groups (ATEX, IEC and NEC 505)

- IEC Zone System
- Apparatus Grouping
- Designing for Hazloc
- Certification Differences
- Equipment that needs ATEX
- ETL & cETL Listing for Hazloc
- Listing vs. Classification
- Other Evaluations Required
- IEC Ex Scheme
- Service Line Review
- Our Hazardous Location Credentials
- Hazardous Area Classification and the Selection of Equipment
- European System – ATEX
- Introduction
- Definitions
- ATEX Directive 94/9/EC
- What is ATEX?
- Directive 137
- Who Needs to Comply with the ATEX Directive?
- ATEX Directive Scope
- ATEX Groups and Categories
- ATEX Zones
- ATEX 137
- Hazard - Gas, Mists or Vapors
- Gases/Vapors
- Hazard – Dusts
- Equipment Selection (ATEX)
- CE Marking of Equipment
- ATEX Markings
- ATEX Product Markings
- Temperature Measurement
- Objectives/Introduction
- Describe the Temperature Variable

- Heat Transfer
- Convection
- Conduction
- Radiation
- Temperature Scales
- The Absolute Scale
- Expansion Type Thermometers
- Liquid in Glass Thermometers
- Filled Systems
- Applications
- Ambient Temperature Compensation
- Solid Expansion Types
- The Simple Rod Thermostat
- Bi-metal Strip Thermometers
- Operation
- Electrical Methods of Temperature Measurement
- The Resistance Temperature Detector (RTD)
- Construction
- Theory of Operation
- Temperature Resistance Values for a Pt 100.
- The Electrical Circuit
- Simple RTD Detector
- The Thermocouple
- Standard Thermocouples in Use
- Compensating Leads
- The Practical Thermocouple
- Millivolts (mV) Verses Temperature Type 'T' Thermocouple
- Cold junction at00C
- The Thermistor
- Radiation Temperature Detectors (Pyrometers)
- Typical Radiation Thermometer
- Pistol Grip Type Radiation Thermometer
- Thermowells

- Thermowell Installation
- The Electrical/Electronic Temperature Transmitter
- Rosemount E.T.T Model 444
- Sensor
- Electronics Unit
- Local Temperature Indicator
- A Typical E.T.T Installation
- Summary
- Color Codes for Thermocouple Extension and Compensating Cable
- Thermocouples Types
- RTD
- Single Loop Controller
- Abbreviation Table
- What is a Control Loop?
- Open Loop
- Advantages
- Disadvantages
- Closed Loop Control
- Feedback
- Process
- Detecting Elements
- Controllers
- Correcting Element
- Closed Loop Control Systems
- Example of A Closed Loop System
- Lags
- Process Lag
- Process Resistance
- Capacity
- Dead Time
- Example of Process Lag
- Process Lag Plot
- Measurement Lag

- Filled Thermometer
- Transmission Lag
- Response Lag
- Example System Showing Lags
- Control Modes
- Two Step Control
- Process Variable (PV) = Set-point (SP)
- Direct Action
- Reverse Action
- Application of Two Step Control
- Example: Temperature Control Loop
- Two Step Control Example – Level Control
- Operation
- Graphical Representation of Two Step Control (On/Off Control)
- Proportional Control
- Definition
- Proportional Band
- Proportional Control Transfer Curve
- Wide Proportional Band
- Offset
- Exercises
- Proportional Band Questions
- Proportional Band Effect
- Examples of Systems Using Proportional Only Control
- Level Control System
- Temperature Control System
- Pressure Reduction System
- Integral Action (Reset)
- Step response Integral Action
- Example of Proportional Plus integral Action Control
- Proportional Band Illustration
- Integral Action Time (Reset Time)
- Integral Action / Proportional Action

- The Effect of Altering Integral Action Time
- Control System with Integral Action
- Integral Saturation (Wind Up)
- Proportional Plus Integral Action Conclusion
- Derivative Action (Pre-Act)
- Effect of Derivative Action
- Derivative Action Time
- Example of A Process Which Will Benefit From Derivative Action
- Processes Not Benefiting from Derivative Action
- Combination of P + I + D Actions
- Proportional Action
- Integral Action
- Derivative Action
- Typical Applications
- The Effect of Proportional Plus Integral PID Effect in Control Response
- Pressure Measurement
- Introduction
- Describe Process Variables
- Pressure and Force
- Direction of Force
- Applied Force
- Atmospheric Pressure
- Pressure Scales
- Gauge Pressure Scale
- Absolute Pressure Scale
- Vacuum Scale
- Pressure Measuring Devices
- Manometer
- U-Tube Manometer
- Comparing Process Pressures
- Bourdon Tube
- C-Shaped Bourdon Tube
- Bourdon Tube Pressure Gauge

- Diaphragm Gauge
- Diaphragm Gauge- Two inputs
- Bellows Gauge
- Double Bellows Gauge
- Pressure Transmitters and Transducers
- The Pneumatic Signal Loop
- The Air Pressure Regulator
- The Electrical Pressure Transmitter
- Electrical Series Loop
- Summary
- Level Measurement
- Course Objective
- Introduction
- Types of Level Measuring Devices
- Summary
- Flow Measurement
- Objectives / Introduction
- Describe the Flow Variable
- Units of Flow
- Basic Properties of Fluids
- Selecting a Flow Measuring System
- Quantity Meters
- Rate of Flow Measurement
- Calibration of Flow Measuring Devices
- Other Methods of Flow Measurement
- Summary
- Control Systems & Equipment
- Unit Control Panel (UCP)
- Remote Control Panel
- SCADA (Supervisory Control and Data Acquisition)
- HMI (Human Machine Interface)
- Distributed Control System (DCS)
- HART (Highway Addressable Remote Transducer)

- Abbreviations
- Density Measurement
- Specific Gravity-Density
- Viscosity and Density (Metric Si Units)
- Density Measurements
- Engineering Basics
- Conversion Factors
- Motion Control Basics
- Analysis Equipment
- Watercut Meter
- Base Sediment & Water
- Gas Chromatograph
- Hazardous Area Classification
- Introduction
- Hazardous area classification
- Selection of apparatus according to zones
- Zone suitable apparatus
- Spark or transmitted flame ignition
- Gas group & representative gas
- Intrinsic safety
- Area classification
- Temperature classification in 'IEC' standard
- Methods of protection
- Conclusion
- Instrumentation Gas Analyzer – Inspection
- Probe
- Filters
- Heated line
- Cold dryer
- Pump
- Flow detection
- Condensate bottle
- Analyzer

- Faults
- Chimney probes
- In Situ
- Introduction to Process Control System
- Process Control System
- Measuring Element
- Client Configuration
- Managing Projects
- Definition of SCADA
- Citect's SCADA Product
- Citect Configuration Environment
- The Vijeo Citect Environment
- System Requirements
- Licensing
- Runtime System
- Citect Explorer
- Include Projects
- Project Editor
- Cicode Editor
- Citect Configuration Environment
- Managing Projects
- New Projects
- Clusters and Servers
- Computer Setup Wizard
- Backup & Restore
- Backup Options
- Backup to Removable Media
- Backup Management
- Restore as a New Project
- Setting Up Communications
- Vijeo Citect I/O
- Communications Wizard
- Wizard Via the Project Editor

- Communications Database Files
- /O Device Types
- Internal Disk, External I/O Dev
- After the I/O Wizard
- Forms
- Show Deleted Entries in Forms
- Accessing Help and Knowledge Base
- Test Communications
- Structured Tag Names
- Structured Tag Examples
- Tag Naming
- Backup, Backup & Think Again
- Save DBF Macro
- Add Tags using Excel
- The Save_dbf Macro
- Setting Up Communications
- Graphics
- Include Templates
- Drawing Objects
- Object Properties
- Pasteuriser Graphic Layout
- Useful Drawing Tips
- Expression Wizard
- Object Display at Runtime
- Symbol Sets
- Symbol Set Libraries
- Troubleshooting Tip
- ActiveX Controls
- Importing Graphics Images
- Adjust Colours
- Luminance vs. Saturation
- Create Image as Background
- Graphics

- Commands and Controls
- Slider Controls
- Touch Commands
- Keyboard Commands
- Keyboard Command Levels
- Understanding ArgValue
- User Privileges
- Genies
- Developing a Genie
- What is a Genie?
- Viewing Genie Properties
- Creating Genies
- Substitutions for Genies
- Substitutions in Genies
- Locating the Genies
- Popup Pages and Super Genies
- Super Genies
- Anatomy of a Pop-up Page
- Super Genie vs Popup Page
- Substitution in Super Genies
- Viewing System Pages or Popups
- HELP - AssWin Modes
- Popup Pages
- Super Genie - Animation Point
- Using the Cicode Editor
- OFS Server
- What is OPC?
- Vijeo Citect OPC Client
- OPC Access Paths
- Devices
- What are Devices?
- Device History Files
- Why Doesn't it Work?

- Events
- Configuring Events
- Global Events
- Cicode Functions Used
- Entering Cicode
- Alarm State Diagram
- Alarm Types
- Create Alarms
- Alarm Categories
- Logging Alarms to a Printer
- Device Groups
- Alarm Pages
- Alarm Groups
- Audible Alarms
- Alarm Properties as Tags
- Creating Alarm Property Tag
- Genies
- Pop-up Pages / SuperGenies
- Alarms
- Trends
- Displaying Trends
- Trend Tags
- Creating Trend Tags
- Types of Trends
- Trend History Logging
- Trend Template Styles
- Trend History Display
- Trend Groups
- Trend History Management
- Instant Trends
- Process Analyst
- Configure Process Analyst
- Displaying in Process Analyst

- Selecting Pens
- Analyst Help File
- Analyst View
- Process Analyst View
- Process Analyst vs Trends
- Alarm Display
- Cursor & Labels
- Process Analyst Properties
- Harmonics
- What are harmonics?
- Effects of 3rd Harmonic on Fundamental Wave
- Presence of Different Types of Harmonics in Fundamental Wave
- Effects of the Harmonics
- Sources of Harmonics
- Harmonics in VSD's
- Harmonics Due to Six Pulse Converter