

## CPC TRAINING MODULES

### **Module 1: *Field Instrumentation for the Process Industry (2 days)***

#### **Pre requisite:**

None

#### **Training Objectives:**

- understanding of measurement principles
- understanding development of instrument specification
- understanding criteria for selecting the right instrument

#### **Training Agenda:**

##### I.-Introduction

- Mission of a Process Plant
- Contribution of Field instrumentation
- P&ID ans ISA S5.1
- Main process variables : Pressure, Level, Temperature and Flow

##### II.-Specification and Selection of Field Instrument

- General Criteria
  - Process conditions : service and design conditions
  - Industrial environment : IP, ATEX, EMC, PED
- Metrological Performance
  - Vocabulary and Definitions
  - Errors and type of Errors
  - Calibration curve characteristics
  - Response time
- Others: MTBF, MTTR, TOC
- Conclusion

##### III.-Introduction to Sensor Types

- Capacitive
- Resistive
- Piezo
- Magnetic
- Others

##### IV.-Pressure Instrumentation

- Manometer (Toricelli, Bourdon)

- Membrane
- Differential Pressure
- Absolute Pressure
- Hook up principles
- Separators and Capillaries
- Calibration procedure

#### V.-Level Instrumentation

- Local instrument: level glass
- DP
- Float
- Displacement tube
- Capacitive
- Ultrasonic
- Radar
- Gamma Ray
- Load Cells
- Level switch
- Calibration procedure

#### VI.-Temperature Instrumentation

- Thermometers
- PT100
- Thermocouple
- Thermowells
- Sources of errors
- Transmitters
- Calibration procedure

#### VII.-Flow Instrumentation

- DP Cell
- Magnetic
- Vortex
- Turbine
- Ultrasonic
- Variable area
- Mass Flow
- Selection Guide
- Calibration Procedure

## **Module 2: Control Valves (1 day)**

### **Pre requisite:**

Field instrumentation module or good understanding of P&ID

### **Training Objectives:**

- understanding of the role of the control valve
- understanding the limitations of control valves
- understanding specification and selection procedure

### **Training Agenda:**

I.-Defining the problem: Why do we need a control valve?

II.-Type of valves

III.-Actuators

IV.-Defining and understanding CV

V.-Valve Characteristics

VI.-Noise, Cavitation and Choke Flow

VII.-Selection Procedure

### **Module 3: Fundamentals of Process Control (2 days)**

#### **Pre requisite:**

Good understanding of P&ID

#### **Training Objectives:**

- understanding of process dynamics
- understanding regulatory control techniques
- introduction to multivariable control

#### **Training Agenda:**

##### I.-Introduction to Control Loop Stability

- Single capacitance process
- Gain and time constant
- Dead time process
- Multi capacitance process
- Transfer Function
- Basic components of a control loop

##### II.-Introduction to Feedback P&ID Controller

##### III.-Block Diagrams Approach

##### IV.-Experimental Determination of Process Dynamics

##### V.-Control Loop Stability and Control Performance

##### VI.-Basic Control Techniques

- ratio control
- split range control
- multiple split range control
- cascade control
- feed forward control
- selective and override control

##### VII.-Examples of Basic Control

##### VIII.-Introduction to Advanced (Multivariable) Control

- relative gain matrix
- decoupling of interacting loops

##### IX.-Application of Advanced Control to Distillation Columns

## **Module 4: PID Tuning (1 day)**

### **Pre requisite:**

Fundamentals of Process Control Module or good understanding P&ID and process dynamics

### **Training Objectives:**

- Understanding of feedback control and role of P, I and D
- Understanding of process behavior
- Understanding tuning principles and techniques

### **Training Agenda:**

I.-Introduction to feedback PID control

II.-Role of P, I and D

III.-Process Behavior: Steady State or Integrative

IV.-Identification of the Process Response

V.-Tuning Techniques, Tuning Parameters and Control Loop Performance

VI.-Application to Flow, Pressure and Level control

VII.-Application to Temperature control

VIII.-Improvements of Controlability

- re-ranging field instrumentation
- linearization of process
- cascade control and tuning of cascade loops
- anti reset windup

**Module 5: *Advanced Regulatory Control Techniques (2 or 3 days)***

**Pre requisite:**

Modules 3 and 4

**Training Objectives:**

Development of Advanced Control Structures on the Client Process

**Training Agenda:**

To be developed jointly by CPC and Client on basis of case study

## **Module 6: Anti-Surge Control (2 or 3 days)**

### **Pre requisite:**

None

### **Training Objectives:**

- Understanding centrifugal compressors performance curves
- Understanding the surge phenomena and how it is controlled
- Understanding how the Antisurge Controller Operates
- Understanding the Antisurge Control Valve
- Understanding centrifugal compressor integration for process control.

### **Training Agenda:**

Day 1 :

I.- Introduction to Compressors

II.- Centrifugal compressors performance curves

III.- The Surge Phenomena

IV.- The Antisurge Control Map

V.- How to Control de Surge : The Anti-surge Controller

VI.- The Surge Detector

Day 2 :

VII.- The Anti-surge Control Valve

VIII.- Compressor integration in Process control.

Day 3:

IX.- Safety interlocks and start-up/stop sequence.

X.- Practical Case

XI.- Tips to Avoid Production Losses due to Issues Around ASC