Hands-On

PLCs and SCADA Systems

Programmable Logic Controllers and Supervisory Control / Data Acquisition

Course Description

This extensive course covers the essentials of SCADA and PLC systems, which are often used in close association with each other. A selection of case studies are used to illustrate the key concepts with examples of real world working SCADA and PLC systems in the water, electrical and processing industries.

This course will be an excellent opportunity to network with your peers, as well as to gain significant new information and techniques for your next SCADA / PLC project. Although the emphasis of the course will be on practical industry topics highlighting recent developments, using case studies, the latest application of SCADA, PLC technologies and fundamentals will be covered.

The question is which PLC is being used. We present this course focusing on the generic PLC and use the open programming IEC 61131-3 standard. For specific examples we use the Allen Bradley range, but are not selling Allen Bradley or for that matter any other PLC!

This course is designed to benefit you with practical up-to-date information on the application of PLC systems to the automation and process control industries. It is suitable for people who have little or no exposure to PLCs, but expect to become involved in some or all aspects of PLC installation. It aims to give practical advice from experts in the field, to assist you to correctly plan, program and install a PLC with a shorter learning curve and more confidence. While the course is ideal for electricians, technicians and engineers who are new to PLCs, much of the material covered will be of value to those who already have some basic skills, but need a wider perspective for larger and more challenging tasks ahead. The information covered advances from the basics to challenge even the most experienced engineer in the industry today.

Students Will Learn

- **Fundamentals of SCADA systems**
- **Essentials of SCADA software configuration**
- **Tricks and tips in installation of SCADA systems**
- **Essentials of telecommunications links**
- **Use of Industrial Ethernet in SCADA systems**
- **OPC and SCADA systems**

- **SCADA network security issues**
- **How to troubleshoot SCADA systems**
- **Specifying PLC hardware and installation criteria**
- **Describe PLC software structure**
- **How to write medium level PLC programs (using ladder-logic)**
- **Troubleshooting a typical PLC system**
- **Specifying PLC systems**

Target Audience

This course is ideal for electricians, technicians and engineers who are new to PLCs, much of the material covered will be of value to those who already have some basic skills, but need a wider perspective for larger and more challenging tasks ahead. The information covered advances from the basics to challenge even the most experienced engineer in the industry today.

Prerequisites

Some experience in PLCs and/or SCADA would be beneficial, but not required.

Course Outline

MODULE 1: INTRODUCTION

Introduction and brief history of PLCs
Alternative control systems - where do PLCs fit in?
Why PLCs have become so widely accepted
Lingering concerns about PLCs

FUNDAMENTALS OF PLC HARDWARE
Block diagram of typical PLC
PLC processor module - memory organisation
Input and output section - module types
Power supplies

MODULE 2: BACKGROUND TO SCADA

Fundamentals and definition of terms
Comparison of SCADA, DCS, PLC and
Smart instruments
Typical SCADA installations

SCADA SYSTEM HARDWARE
Comparison of SCADA, DCS, PLC and Smart instruments
Remote Terminal Unit (RTU) structure
Analog and digital input/output modules
Application programs
PLCs used as RTUs
Master site structure
Communications architectures
Point-to-point and point-to-multipoint systems
System reliability and availability
Configuration of a master station

MODULE 3: FUNDAMENTALS OF PLC SOFTWARE

Methods of representing Logic, Boolean Algebra, instruction code and graphical presentation
Fundamental ladder logic instruction set
Comparison of different manufacturers, memory and data representation and instruction code

USING LADDER LOGIC FOR SIMPLE DIGITAL FUNCTIONS
The basic rules
Comparison of relay ladder diagrams
The concept of the 'scan' and how to apply it
Infinite fan-out
Contact 'normal' states
Positive and negative logic
Basic Boolean functions
The usefulness of DeMorgan's Law

USING REGISTERS (WORDS)
Number systems, Timers, Types of register data, Counters, Bit shift and rotate, Table functions and Register (Matrix) logic functions

MODULE 4: SCADA SYSTEMS SOFTWARE

Components of a SCADA system
Software - design of SCADA packages
Configuration of SCADA systems
Building the user interface
Connecting to PLCs and other hardware
SCADA system design
The Twelve Golden Rules

MODULE 5: GOOD PROGRAMMING HABITS

Keeping track of addresses and data used

Looking ahead - how will programs be maintained?
Practical methods to improve quality: organization of code, thorough documentation and simplifying changes

GOOD INSTALLATION PRACTICE
Location of hardware
Good wiring practice
Cable spacing, power distribution and wire numbering
Reducing noise and interference
Screening and shielding

MODULE 6: HUMAN MACHINE INTERFACES (HMIs)

Human and ergonomic factors
HMI configuration
Design and layout
Alarming and reporting philosophies
Alarm system design

GOOD INSTALLATION PRACTICE
Recommended installation practice
Ergonomic considerations

MODULE 7: ADVANCED CONTROL WITH PLCs

The concept of reusable logic
Examples, drive logic and alarm handling
Use of advanced programming functions
Matrix logic
Table functions and indirect addressing
Example: simple display driver

BATCH PROCESSES AND SEQUENTIAL CONTROL
Remembering the program state
Creating a 'stepper'
Step advance
Fault detection and recovery
Operator intervention
Multiple recipes or alternative paths
Sequential function charts

PID CONTROL
The importance of timing and scan time
When PID is not always appropriate:
- Intermittent measurements
- Long transport delays

SAFETY PROGRAMMABLE SYSTEMS

Why regular PLCs should not be used for safety functions
Programmable electronic logic solvers
Safety certification
Certified programming systems
Application examples
Growth of networked safety devices and certified networks
Integrated safety systems

MODULE 8: LANDLINE MEDIA Background to cables
Noise and interference on cables
Twisted pair cables and fibre optic cables
Public network provided services

WIDE AREA NETWORK (WAN) TECHNOLOGIES
Digital hierarchies, T1 and E1
Packet switching
Frame relay
ATM
SDH/sonnet

LOCAL AREA NETWORKS (LANs)
Ethernet networks
Industrial Ethernet
TCP/IP
LAN connectivity: bridges, routers and switches
Redundancy options
Web based Industrial SCADA
Wireless
OPC

MODULE 9: INTRODUCTION TO IEC 61131-3
Concepts
Common elements
Programming languages: structured text
Function block diagrams

MODULE 10: SCADA NETWORK SECURITY Introduction
Authentication and encryption
SCADA firewalls
Firewall architectures and guidelines

TROUBLESHOOTING AND MAINTENANCE
Troubleshooting SCADA systems
Maintenance tasks

SPECIFICATION OF SYSTEMS

Common pitfalls, Standards, Performance criteria, Testing, Documentation and Future trends

MODULE 11: BUILDING A PLC PANEL, AS WELL AS GENERAL COMMISSIONING, TESTING AND UPGRADING

Electrical design & construction
Commissioning & Installation
Simulation & Testing
Problem Isolation & Faultfinding
Upgrading of control systems

MODULE 12: INDUSTRIAL COMMUNICATIONS PROTOCOLS
RS-232 interface standard
RS-485 interface standard
Fieldbus
Modbus
DNP3.0

MODEMS
Introduction and principles
Asynchronous/synchronous
Modulation techniques
Error detection and correction
Troubleshooting

Delivery Method

Instructor-Led with numerous case-studies and exercises.

Equipment Requirements

(This apply's to our hands-on courses only)

BTS always provides equipment to have a very successful Hands-On course. BTS also encourages all attendees to bring their own equipment to the course. This will provide attendees the opportunity to incorporate their own gear into the labs and gain valuable training using their specific equipment.

Course Length

4 Days