

MODULE VIII

DISTRIBUTED CONTROL SYSTEMS INSTALLATION AND MAINTAINANCE

UNIT CODE: 0714 551 18A

TVET CDACC UNIT CODE: ENG/CU/IA/CR/03/6/MA

Relationship to occupational standards

This unit addresses the unit of competency: Install and maintain distributed control systems

Duration of unit: 240 hours

Unit description

This unit equips an individual with the competencies required in installation and maintenance of distributed control systems (DCS). These competencies include conducting DCS system site survey, planning DCS installation, installing DCS and maintaining DCS.

Summary of learning outcomes

By the end of the unit of learning, the trainee will be able to;

S/No	Learning Outcome	Duration (Hrs.)
1	Conduct distributed control system site survey	60
2	Plan distributed control system installation	60
3	Install distributed control system	60
4	Maintain distributed control system	60
	TOTAL HOURS	240

Learning outcomes, content and suggested assessment methods

Learning outcome	Content	Suggested assessment methods
1. Conduct distributed control system site survey	1.1 Site survey aspects 1.1.1 Power requirements 1.1.2 User requirements 1.1.3 Communication infrastructure 1.1.4 Environmental considerations	• Oral assessment • Portfolio of evidence • Interviews • Third party report • Written assessment

Learning outcome	Content	Suggested assessment methods
	1.1.5 Cable routes 1.1.6 Instrumentation systems 1.1.7 Compatibility with existing systems 1.1.8 Scalability 1.1.9 Reliability 1.1.10 Cost 1.2 Assembling survey tools and equipment 1.2.1 Tools 1.2.1.1 Tape measure 1.2.1.2 Laser distance meter 1.2.1.3 Camera 1.2.1.4 Multimeter 1.2.1.5 Stationery 1.2.1.6 Infrared thermometer 1.2.1.7 Cable tracer 1.2.1.8 Ladder 1.2.1.9 Flashlight 1.2.2 Equipment 1.2.2.1 Power analyser 1.2.2.2 Megohmmeter 1.2.3 Personal computer Classifications of tools used. 1.2.4 Importance of tools and Equipment	• Oral assessment • Portfolio of evidence • Interviews • Third party report • Written assessment • Practical assessment • Projects

Learning outcome	Content	Suggested assessment methods
	1.2.5 Safety precautions of tools and equipment. 1.3 Performing the site survey 1.3.1 Conducting measurements 1.3.2 Evaluating site conditions 1.4 Generating the site survey report 1.4.1 Documenting findings 1.4.2 Presenting data per workplace procedures	
2 Plan distributed control system installation	2.2 Introduction to distributed control systems 2.2.1 Overview of DCS 2.2.2 Definition and key components 2.2.3 DCS vs. PLC vs. SCADA 2.2.4 Applications in various industries 2.3 DCS Architecture 2.3.1 System components 2.3.2 Control processors, I/O modules, and field devices 2.3.3 Human-machine interface (HMI) 2.3.4 Communication networks 2.4 Control strategies 2.4.1 Feedback and feedforward control	• Oral assessment • Portfolio of evidence • Interviews • Third party report • Written assessment • Practical assessment • Projects

Learning outcome	Content	Suggested assessment methods
	2.4.2 Distributed vs. centralized control 2.5 Installation design. 2.5.1 Project specifications 2.5.2 Integrating user requirements 2.6 Preparing the installation work plan 2.6.1 Timelines for workplan 2.6.2 Allocating resources 2.7 Installation Supplies 2.7.1 Identifying necessary equipment 2.7.2 Safety precautions to consider. 2.7.3 Uses and operations of Installation supplies. 2.8 Practice: Plan distributed control system installation	
3 Install distributed control system	3.2 Usage of personal protective equipment (PPE) 3.2.1 Helmet 3.2.2 Hand gloves 3.2.3 Safety shoes 3.2.4 Harness 3.2.5 Safety goggles 3.3 Structured wiring 3.3.1 Cable routing and laying	• Oral assessment • Portfolio of evidence • Interviews • Third party report • Written assessment • Practical assessment • Projects

Learning outcome	Content	Suggested assessment methods
	3.3.2 Cable labelling practices 3.4 Accessories and equipment mounting 3.4.1 Accessories 3.4.1.1 Terminal blocks 3.4.1.2 Switches 3.4.1.3 Sockets 3.4.1.4 PLCs 3.4.1.5 Displays 3.4.1.6 Safety interlocks 3.4.1.7 Relays 3.4.1.8 Contactors 3.4.1.9 Sensors. 3.4.2 Equipment 3.4.2.1 Enclosures 3.4.2.2 Switchgear 3.4.2.3 Distribution panel 3.4.2.4 Control panels 3.4.2.5 PLCs 3.4.2.6 Electrical drives 3.5 Terminating wires 3.5.1 Connecting cables as per layout. 3.6 Conducting system tests 3.6.1 Functionality tests 3.6.2 Electrical continuity and safety	

Learning outcome	Content	Suggested assessment methods
	3.7 Site Housekeeping and waste disposal 3.7.1 Packaging material 3.7.2 Stripped cable insulation 3.7.3 Faulty components and equipment 3.8 Practical installation of a DCS in a controlled environment	
4 maintain distributed control system	4.2 Maintenance schedule 1.1.1 Maintenance frequency 1.1.2 Maintenance tasks 4.3 Usage of maintenance tools and equipment. Types of tools used. 4.3.1 Spares tools 4.3.2 Multimeters 4.3.3 Clamp meters 4.3.4 Power analysers 4.3.5 Hand tools equipment 4.3.6 Lifting gear 4.3.7 Cable pulling equipment 4.3.8 Blower 4.3.9 Megohmmeter Spares 4.3.10 PLCs 4.3.11 Electrical drives 4.3.12 Interface cards	• Oral assessment • Portfolio of evidence • Interviews • Third party report • Written assessment • Practical assessment • Projects

Learning outcome	Content	Suggested assessment methods
	4.3.13 Stand-alone controllers 4.3.14 Switches 4.3.15 Sockets 4.3.16 Luminaires 4.3.17 Power electronic components 4.3.18 Indicator lights 4.4 Carrying out maintenance tasks 4.4.1 Performing inspections and tests 4.4.2 Conducting cleaning and tightening 4.4.3 Replacing faulty components 4.5 Preparing maintenance reports 4.5.1 Documenting maintenance activities. 4.5.2 Communicating findings to stakeholders 4.6 Hands-on installation and maintenance 4.6.1 Practical installation of a DCS in a controlled environment 4.6.2 Simulated troubleshooting and maintenance scenarios 4.7 Practice: maintenance of a DCS in a controlled environment	

Suggested delivery methods

- Direct instruction method
- Group discussions

Recommended resources for 25 trainees

S/No.	Category/item	Description/specifications	Quantity	Recommended ratio (item: trainee)
A	Tools			
1.	Multimeters	Digital multimeters for measuring voltage, current, and resistance	5 pcs	1:5
2.	Clamp meters	For measuring electrical current	5 pcs	1:5
3.	Power analyzers	For analyzing power quality and consumption	5 pcs	1:5
B	Learning facilities & infrastructure			
4.	Lecture/theory room	Approximately 60 sqm	1	1:25
5.	Workshop	Approximately 80 sqm	1	1:25
6.	Laboratory	Approximately 80 sqm	1	1:25
B	Materials and supplies			
7.	Indicator lights	For visual feedback in control systems	10 pcs	2:5
8.	Field devices	Various devices used in field applications	10 pcs	2:5

9.	Overalls	Protective clothing for trainees	25 pcs	1:1
10.	Safety boots	Protective footwear for safety during training	25 pairs	1:1
11.	Safety glasses	Eye protection during practical activities	25 pcs	1:1
12.	Helmets	Head protection for safety	25 pcs	1:1
C	Equipment			
13.	PLC controllers	For hands-on programming and control exercises	4 unit	4:25
14.	DCS training kits	Complete training setups for distributed control systems	1 unit	1:25
15.	Demo hardware panels	For practical demonstrations and hands-on training	1 unit	1:25
16.	DCS controllers	For controlling distributed systems in training	5 units	1:5
17.	DCS Simulation Software	Software for simulating DCS operations	1 license	N/A
18.	Computer workstations	Complete workstation setup for each trainee with DCS software	25 pcs	1:1
19.	Sensors	Assorted	10	2:5
20.	Actuator	Assorted	10	2:5
D	Equipment			

21.	Network equipment	For networking and communication in training setups	4 units	4:25
22.	Cable pulling equipment	To assist with installation and cable management	2 units	
23.	Blowers	For cooling and ventilation during training	4 units	4:25
24.	Megohmmeters	For insulation resistance testing	5 units	1:5
25.	Computers/workstations	25 computers with DCS simulation software installed for hands-on training	25 pcs	1:1
E	Reference materials			
26.	DCS textbooks	Comprehensive textbooks covering DCS theory and applications	Adequate	
27.	DCS vendor documentation	Manuals and guides from DCS equipment manufacturers	Adequate	
28.	Installation, maintenance, and operational manuals	For practical guidelines on equipment use and maintenance	Adequate	
29.	Online learning materials	Journals, websites, and whitepapers for additional resources	Adequate	