COMPETENCY STANDARD

FOR

PLC OPERATION

(LIGHT ENGINEERING SECTOR)

Skills for Industry Competitiveness and Innovation Program (SICIP)
Finance Division, Ministry of Finance

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The Competency Standards for PLC operation serve as a foundational document for the development of curricula, teaching materials, and assessment tools specifically tailored for the Light Engineering sector. This document ensures that training activities align with industry requirements, enabling individuals who successfully meet the established standards through assessment to become qualified professionals in relevant roles within the sector.

Developed under the Skills for Industry Competitiveness and Innovation Program (SICIP), this document addresses the skills requirements critical for PLC operation. It is owned by the Finance Division of the Ministry of Finance of the People's Republic of Bangladesh.

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INTRODUCTION

The Skills for Industry Competitiveness and Innovation Program (SICIP) has the overall objective of developing a skilled workforce adept at handling new technologies, especially for emerging industries in Bangladesh. It will expand skills training and strengthen the development of the training ecosystem to address the skills requirements of the SICIP-selected industry sectors. The program aims to (i) increase the technology-oriented skilled workforce across emerging and priority sectors, (ii) promote inclusive skilling and upskilling opportunities for women and socially disadvantaged groups, (iii) incentivize industry-university partnerships to nurture innovation capacity and improve industry competitiveness, and (iv) foster skills for climate-resilient manufacturing processes and green technologies. The program is expected to benefit about 220,000 new and existing workers over a 6-year implementation period from 2024-2029.

The SICIP Program has, therefore, taken the initiative to enhance the employability and productivity of trainees by implementing market-responsive and job-focused training programs through public and private training providers. This will require the development of competency standards for each of the occupations/trades which will provide a structured framework in the learning process to guide training providers, ensure consistent training quality, and create an alignment between the skills provided by the training institutes and the needs of the industry.

This competency standard is therefore developed to improve skills following the job roles and skill sets of the occupation and ensure that the required skills are aligned with industry requirements.

The Competency Standard also suggests integration of YouTube or similar digital platforms or downloaded clips into classroom practice to ensure simulated creation of the contents so that learners are exposed to visual demonstrations before classroom instruction or practical session, which aligns with modern learning preference and supports flipped classroom models.

The document details the format, sequencing, wording, and layout of the Competency Standard for an occupation which comprises Units of Competence and its corresponding Elements.

OVERVIEW:

A **Competency Standard** is a written specification of the knowledge, skills, and attitudes required for the performance of a job or occupation or trade corresponding to the standard of performance required in the workplace.

Competency standard:

- provides a consistent and reliable set of components for training, recognizing, and assessing people's skills, and may also have optional support materials.
- enables industry-recognized qualifications to be awarded through direct assessment of workplace competencies
- encourages the development and delivery of flexible training that suits individual and industry requirements
- encourages learning and assessment in a work-related environment which leads to verifiable workplace outcomes.

Competency Standard has been developed by a working group comprised of occupation-specific experts from the industry/institution and relevant consultants of SICIP.

Competency Standards describe the skills, knowledge, and attitude needed to perform effectively in the workplace. Competency Standards acknowledge that people can achieve vocational and technical competency in many ways by emphasizing what the learner can do, not how or where they learned to do it.

With Competency Standards, assessment and training may be conducted at the workplace, at training organization, during regular work, or through work experience, work placement, work simulation or any combination of these.

A Unit of Competency describes a distinct work activity that would normally be undertaken by one person in accordance with industry standards.

Units of Competency are documented in a standard format that comprises:

- Reference to Industry Sector, Occupational Title and Occupational Description
- Unit code
- Unit title
- Unit descriptor
- Elements and performance criteria
- Variables and range statement
- Evidence guides

Together all the parts of a Unit of Competency:

- Describe a work activity
- Guide the assessor in determining whether the candidate is competent.

Identification and validation of units of competency and elements for each occupation were made by experts from various Light Engineering companies in industry consultative workshops.

The ensuing sections of this document comprise a description of the respective occupation with all the key components of a Unit of Competence:

- An overview of all Units of Competence for the occupation and their corresponding duration required for completion of training.
- The Competency Standards that include the Unit of Competency, Unit Descriptor, Elements and Performance Criteria, Range of Variables, Curricular Content Guide, and Assessment Evidence Guide.

Units & Elements at a Glance:

Generic Competencies (20 hrs.)

Code	Unit of Competency	Elements of Competency	Duration (Hours)
SICIP-LE-PLC-01-G	Apply Occupational Health and Safety (OHS) Practices in Workplace	1. Identify OHS policies and procedures 2. Practice personal health and safety procedures 3. Report hazards and risks 4. Respond to emergencies	10
SICIP-LE-PLC-02-G	Operate in a Self-Directed Team	1. Identify team goals and work processes 2. Communicate and cooperate with team members. 3. Work as a team member. 4. Solve problems as a team member	10
		Total Hour	**20**

Sector Specific Competencies (20 hrs.)

Code	Unit of Competency	Elements of Competency	Duration (Hours)
SICIP-LE-PLC-01-S	Apply Green Practices	1. Interpret green concepts 2. Minimize resource use in the workplace 3. Implement waste management practices	20
		Total Hour	**20**

Occupation Specific Competencies (320 hrs.)

Code	Unit of Competency	Elements of Competency	Duration (hours)
SICIP-LE-PLC-01-O	Implement Basic Electrical Circuits	1. Interpret electrical symbols, drawings and manual 2. Identify measuring devices 3. Conduct DC circuit experiments 4. Construct and implement AC circuits 5. Interpret single and three phase induction motor	30
SICIP-LE-PLC-02-O	Execute Electrical Sequence Circuit and Control Using Relay Logic	1. Interpret relay logic operation 2. Perform mechanical switching operation 3. Execute timer and counter application 4. Construct latch, DOL and star delta 5. Perform automatic forward reverse operation	40
SICIP-LE-PLC-03-O	Integrate Industrial Sensors and Actuators	1. Identify types of industrial sensors and classifications 2. Identify types of industrial actuators and classifications 3. Select sensors based on application and material properties 4. Execute sensors and actuators for industrial application	40
SICIP-LE-PLC-04-O	Implement PLC Installation and Wiring with Configuration	1. Prepare for works 2. Set up PLC hardware configurations with software tool 3. Establish communication between PLC and PC	60
SICIP-LE-PLC-05-O	Carry Out Ladder Diagram in PLC Programming	1. Prepare for ladder Diagram 2. Perform PLC programming using ladder diagram 3. Prepare PLC for operation	60
SICIP-LE-PLC-06-O	Perform Process Visualization (HMI)	1. Configure Human Machine Interface (HMI) panel Integration	30

		2. Perform process design in HMI 3. Carry out interface between PLC and HMI 4. Visualize the process in HMI	
SICIP-LE-PLC-07-O	Operate Pneumatic and Hydraulic System Using PLC	1. Identify pneumatic and hydraulic system components 2. Install and configure PLC 3. Develop PLC programs for pneumatic control system 4. Develop PLC programs Hydraulic control system 5. Test and run PLC-controlled pneumatic and hydraulic systems	40
SICIP-LE-PLC-08-O	Control Variable Frequency Drive (VFD) using PLC	1. Interpret Variable Frequency Drive (VFD) 2. Install and configure Variable Frequency Drive (VFD) 3. Operate Variable Frequency Drive (VFD) in different modes 4. Operate Variable Frequency Drive (VFD) using PLC	20
		Total Hour	**320 Hrs.**

COMPETENCY STANDARD: PLC OPERATION

The Generic Competencies

Unit of Competency: **APPLY OCCUPATIONAL HEALTH AND SAFETY (OHS) PRACTICES IN THE WORKPLACE**	**Nominal Duration:** 10 hrs.	**Unit Code:** SICIP-LE-PLC-01-G
Unit Descriptor: This unit covers knowledge, skills and attitudes required to apply occupational health and safety (OHS) practices in the workplace. It specifically includes the tasks of identifying OHS policies and procedures, practicing personal health and safety procedures, reporting hazards and risks, and responding to emergencies.		

Elements and Performance Criteria:
(Terms in the performance criteria that are written in **bold and underlined** are elaborated in the range of variables).

Elements of Competency	Performance Criteria
1. Identify OHS policies and procedures	1.1 **OHS policies** and safe operating procedures are read and understood. 1.2 Safety signs and symbols are identified and followed. 1.3 Emergency response, evacuation procedures and other contingency measures are determined.
2. Practice personal health and safety procedures	2.1 OHS policies and procedures are followed and practiced. 2.2 **Personal Protective Equipment (PPE)** is selected and used. 2.3 Personal health, hygiene and safety procedures are practiced.
3. Report hazards and risks	3.1 **Hazards and risks** are identified, assessed and controlled. 3.2 Incidents arising from hazards and risks are reported to authority. 3.3 Corrective actions are implemented to correct unsafe conditions in the workplace.
4. Respond to emergencies	4.1 Alarms and warning devices are responded. 4.2 **Emergency response plans and procedures** are implemented. 4.3 **First aid procedure** is applied during emergency situations.

Range of Variables

Variable	Range May include but not limited to:

1. OHS policies	1.1 International/ Local OHS requirements 1.2 Fire Safety Rules and Regulations 1.3 Industry Guidelines
2. Personal Protective Equipment (PPE)	2.1 Apron 2.2 Gloves 2.3 Safety shoes 2.4 Helmet 2.5 Face mask 2.6 Goggles and safety glasses 2.7 Ear plugs 2.8 Sun block 2.9 Chemical/Gas masks
3. Hazards and risks	3.1 Chemical hazards 3.2 Biological hazards 3.3 Physical Hazards 3.3.1 Machine hazards 3.3.2 Materials hazards 3.3.3 Tools and Equipment hazards
4. Emergency response plans and procedures	4.1 Firefighting procedures 4.2 Earthquake response procedures 4.3 Evacuation procedures 4.4 Medical and first-aid
5. First aid procedure	5.1 Washing of open wound 5.2 Washing chemically infected area 5.3 Applying bandage 5.4 Applying CPR (Cardiopulmonary Resuscitation) 5.5 Taking appropriate medicine

Curricular Content Guide:

1. Underpinning Knowledge	1.1 OHS workplace policies and procedures 1.2 Work safety procedures 1.3 Emergency procedures 1.3.1 Firefighting 1.3.2 Earthquake response 1.3.3 Explosion response 1.3.4 Accident response 1.4 Types of hazards (biological, chemical and physical) and their effects. 1.5 PPE types and uses 1.6 Personal hygiene practices 1.7 OHS awareness 1.8 Malfunctions and resolutions
2. Underpinning Skills	2.1 Identifying OHS policies and procedures 2.2 Applying personal work safety practices in the workplace 2.3 Identifying, assessing and controlling hazards and risks 2.4 Reporting incidents arising from hazards and risks 2.5 Responding to emergency procedures

	2.6 Maintaining physical well-being in the workplace 2.7 Using firefighting accessories and fire extinguishers 2.8 Implementing emergency response plans and procedures 2.9 Applying basic first aid procedures
3. Underpinning Attitudes	3.1 Commitment to occupational health and safety 3.2 Promptness in carrying out activities 3.3 Sincerity and honesty to duties 3.4 Environmental concerns 3.5 Eagerness to learn 3.6 Tidiness and timeliness 3.7 Respect for rights of peers and seniors in the workplace 3.8 Good relationships with peers, sub-ordinates and seniors in the workplace
4. Resource Implications	4.1 Workplace (simulated or actual) 4.2 PPEs 4.3 Firefighting equipment 4.4 Emergency response manual 4.5 First aid kits 4.6 Learning manual

Assessment Evidence Guide:

1. Critical Aspects of Competency	Assessment required evidence that the candidate: 1.1 described emergency procedures 1.2 followed OHS policies and procedures 1.3 selected and used personal protective equipment (PPE) 1.4 practiced personal health and safety procedures 1.5 identified, assessed and controlled hazards and risks 1.6 reported incidents arising from hazards and risks to the authority 1.7 implemented plans and procedures to respond emergency 1.8 applied basic first aid procedure
2. Methods of Assessment	Methods of assessment may include but not limited to: 2.1 Written test 2.2 Practical demonstration 2.3 Oral question 2.4 Portfolio (optional)
3. Context of Assessment	3.1 Competency assessment must be done in an assessment/training center or in an actual or simulated work place after completion of the training 3.2 Assessment should be done by a certified assessor or occupation-specific industry expert.

Unit of Competency: **OPERATE IN A SELF-DIRECTED TEAM**	**Nominal Duration:** 10 hrs.	**Unit Code:** SICIP-LE-PLC-02-G
Unit Descriptor: This unit covers the knowledge, skills and attitudes required to operate in a self-directed team. It specifically includes the tasks of identifying team goals and work processes, communicating and cooperating with team members, working and solving problems as a team member.		

Elements and Performance Criteria:
(Terms in the performance criteria that are written in **bold and underlined** are elaborated in the range of variables).

Elements of Competency	Performance Criteria
1. Identify team goals and work processes	1.1 Team goals and collaborative decision-making processes are identified. 1.2 Roles and responsibilities of team members are identified. 1.3 Relationships within team and with other workers are identified.
2. Communicate and cooperate with team members	2.1 Effective interpersonal skills are used to interact with team members and to contribute to activities and objectives. 2.2 Formal and informal **forms of communication** are used effectively to support team achievement. 2.3 Diversity in character is respected and valued in team functioning. 2.4 Views and opinions of other team members are understood, valued and practiced. 2.5 Workplace terminology is used correctly to assist communication.
3. Work as a team member	3.1 Duties, responsibilities, authorities, objectives and task requirements are identified and clarified with team. 3.2 Tasks are performed in accordance with organizational and team requirements, and workplace procedures & practices. 3.3 Team member's support to other members is appreciated and valued. 3.4 Agreed reporting lines are followed using standard operating procedure.
4. Solve problems as a team member	4.1 Current and potential problems faced by team are identified. 4.2 A solution to the problem is identified. 4.3 Problems are solved effectively and the outcome of the implemented solution is evaluated.

Range of Variables

Variable	Range May Include but not limited to:
1. Forms of communication	1.1 Agenda 1.2 Simple reports such as progress and incident reports 1.3 Job sheets 1.4 Operational manuals 1.5 Brochures and promotional material 1.6 Visual and graphic materials 1.7 Standards 1.8 OHS information 1.9 Signs

Curricular Content Guide:

1. Underpinning Knowledge	1.1 Team goals and collaborative decision-making processes 1.2 Roles and responsibilities of team members 1.3 Relationships within team and with other workers 1.4 Effective interpersonal skills to interact with team members 1.5 Effective formal and informal forms of communication 1.6 Value of diversity in team functioning 1.7 Correct use of workplace terminology 1.8 Team's duties, responsibilities, authorities, objectives and task requirements 1.9 Methods of identifying current and potential problems faced by a team 1.10 Effective problem-solving methods and evaluation of outcomes
2. Underpinning Skills	2.1 Identifying team goals and collaborative decision-making processes 2.2 Identifying roles and responsibilities of team members 2.3 Identifying relationships within team and with other workers 2.4 Using effective interpersonal skills to interact with team members and to contribute to activities and objectives 2.5 Using formal and informal forms of communication 2.6 Understanding and valuing views and opinions of other team members 2.7 Performing tasks in accordance with organizational and team requirements, and workplace procedures and practice 2.8 Appreciating and valuing team member's support to other members of the team

	2.9 Identifying current and potential problems faced by the team 2.10 Identifying solutions to the problem 2.11 Solving problems effectively and evaluating the outcome of the implemented solution
3. Underpinning Attitudes	3.1 Commitment to occupational health and safety 3.2 Promptness in carrying out activities 3.3 Sincerity and honesty to duties 3.4 Environmental concerns 3.5 Eagerness to learn 3.6 Tidiness and timeliness 3.7 Respect for rights of peers and seniors in the workplace 3.8 Good relationships with peers, sub-ordinates and seniors in the workplace
4. Resource Implications	The following resources must be provided: 4.1 Workplace (simulated or actual) 4.2 Work book 4.3 Learning & operational manuals 4.4 Workplace tools/equipment

Assessment Evidence Guide:

1. Critical Aspects of Competency	Assessment required evidence that the candidate: 1.1 described team's duties, responsibilities, authorities, objectives and task requirements 1.2 identified team goals and work processes 1.3 communicated and cooperated with team members 1.4 used effective interpersonal skills to interact with team members 1.5 worked as a team member 1.6 solved problems as a team member
2. Methods of Assessment	Methods of assessment may include but not limited to: 2.1 Written test 2.2 Practical demonstration 2.3 Oral questioning 2.4 Portfolio (optional)
3. Context of Assessment	3.1 Competency assessment must be done in an assessment/training center or in an actual or simulated work place after completion of the training 3.2 Assessment should be done by a certified assessor or occupation-specific industry expert

The Sector Specific Competencies

Unit of Competency: **APPLY GREEN PRACTICES**	**Nominal Duration:** 20 hrs.	**Unit Code:** SICIP-LE-PLC-01-S
Unit Descriptor: This unit covers the knowledge, skills and attitudes required to apply green practices. It specifically includes the tasks of interpreting green concepts, minimizing resource use in the workplace, and implementing waste management practices.		

Elements and Performance Criteria:
(Terms in the performance criteria that are written in **bold and underlined** are elaborated in the range of variables).

Elements of Competency	Performance Criteria
1. Interpret green concepts	1.1 **Principles of green practices** are explained. 1.2 **Sources of environmental impacts** during light engineering activities are identified. 1.3 Work activities contributing to environmental degradation, improper disposal of materials and excessive energy use are explained. 1.4 **Ways of mitigating environmental impacts** in light engineering sector are explained.
2. Minimize resource use in the workplace	2.1 Water, energy and raw material consumption are documented. 2.2 **Recyclable and non-recyclable items** are identified. 2.3 Procedures to reduce resource consumption are implemented. 2.4 Sustainable alternatives to fossil-based energy resources are explored and applied.
3. Implement waste management practices	3.1 **Different types of wastes** are identified. 3.2 Hazardous waste is disposed of according to environmental regulations. 3.3 Green habits to reduce wastes in personal and professional life are practiced.

Range of Variables

Variable	Range May include but not limited to:
1. Principles of green practices	1.1 Reducing energy consumption 1.2 6R for waste management 1.2.1 Refuse 1.2.2 Reduce 1.2.3 Reuse 1.2.4 Recycle 1.2.5 Recover 1.2.6 Repair

	1.3 Use of sustainable materials with low environmental impact 1.4 Recycling materials 1.5 Sustainable transportation
2. Sources of environmental impacts	2.1 Air pollution 2.1.1 Dust generation 2.1.2 Emission from machinery and vehicles 2.2 Water pollution 2.2.1 Debris and sediments 2.2.2 Chemical's leakage 2.3 Noise pollution 2.4 Waste generation 2.4.1 Waste 2.4.2 Non-recyclable and hazardous materials 2.5 Resource Depletion 2.5.1 Excessive use of raw materials 2.5.2 Non-renewable material uses like use of fossil fuel, steel cement etc.
3. Ways of mitigating environmental impacts	3.1 Utilizing energy-efficient equipment 3.2 Adopting renewable energy sources 3.3 Implementing site protection measures 3.4 Using reusable materials 3.5 Choosing sustainable materials 3.6 Using noise-reducing equipment and scheduling work appropriately 3.7 Optimizing logistics and delivery
4. Recyclable and non-recyclable items	4.1 Recyclable items 4.1.1 Metal 4.1.2 Wood 4.1.3 Brick 4.1.4 Concrete 4.2 Non-recyclable items 4.2.1 Paints and coatings 4.2.2 Contaminated materials like lead paint, asbestos 4.2.3 Treated wood
5. Different types of wastes	5.1 Wood waste 5.2 Metal waste 5.3 Plastic waste 5.4 Electrical system waste 5.5 Gypsum board waste 5.6 Packaging waste 5.7 Organic waste 5.8 Chemical West 5.9 Fuel/oil west

Curricular Content Guide

1. Underpinning Knowledge	1.1 Principles of green practices in light engineering sector 1.2 Ways of mitigating environmental impacts in light engineering sector 1.3 Key terms and symbols related to environmental sustainability in light engineering drawings 1.4 Sources of environmental impacts in light engineering 1.5 Methods to minimize resource consumption (water, energy, raw materials) 1.6 Waste management practices 1.7 Sustainable alternatives to fossil-based energy resources 1.8 Personal and workplace habits for reducing environmental impact
2. Underpinning Skills	2.1 Identifying sources of environmental impacts during light engineering activities 2.2 Identifying recyclable and non-recyclable items 2.3 Exploring and applying sustainable alternatives to fossil-based energy resources 2.4 Applying methods to minimize resource use in the workplace 2.5 Implementing waste management practices 2.6 Applying procedures for safely disposing of hazardous materials 2.7 Identifying different types of wastes 2.8 Documenting water, energy and material consumption in the workplace 2.9 Performing green practices in personal and professional activities
3. Underpinning Attitudes	3.1 Commitment to occupational health and safety 3.2 Promptness in carrying out activities 3.3 Sincerity and honesty to duties 3.4 Environmental concerns 3.5 Eagerness to learn 3.6 Tidiness and timeliness 3.7 Respect for rights of peers and seniors in the workplace 3.8 Good relationships with peers, sub-ordinates and seniors in the workplace
4. Resource Implications	4.1 Workplace (simulated or actual) 4.2 Different types of light engineering hand tools and power tools 4.3 Sustainable, re-cyclable, reusable materials 4.4 Work books 4.5 Operation and maintenance manuals 4.6 Waster segregation bins

	4.7 Learning manual 4.8 Energy-efficient equipment

Assessment Evidence Guide

1. Critical Aspects of Competency	Assessment required evidence that the candidate: 1.1 explained the principles of green practices in light engineering 1.2 identified sources of environmental impacts 1.3 implemented procedures to minimize resource use (water, energy, raw materials) 1.4 explained ways of mitigating environmental impacts in light engineering sector 1.5 disposed of hazardous waste in compliance with safety and environmental standards 1.6 practiced green habits to reduce waste in both personal and professional life 1.7 applied methods to minimize resource use in the workplace
2. Methods of Assessment	Competency should be assessed by: 2.1 Written test 2.2 Practical demonstration 2.3 Oral questioning 2.4 Portfolio (optional)
3. Context of Assessment	3.1 Competency assessment must be done in an assessment/training center or in an actual or simulated work place after completion of the training. 3.2 Assessment should be done by a nationally certified assessor or occupation-specific industry expert.

The Occupation Specific Competencies

Unit of Competency: **IMPLEMENT BASIC ELECTRICAL CIRCUITS**	**Nominal Duration:** 30 hrs.	**Unit Code:** SICIP-LE-PLC-01-O
Unit Descriptor: This unit covers the knowledge, skills and attitudes required to implement basic electrical circuits. It specifically includes the tasks of interpreting electrical symbols, drawings and manual, identifying measuring devices, conducting DC circuit experiments, constructing and implementing AC circuits and interpreting Single and Three Phase Induction Motor.		

Elements and Performance Criteria:
(Terms in the performance criteria that are written in **bold and underlined** are elaborated in the range of variables).

Elements of Competency	Performance Criteria
1. Interpret electrical symbols, drawings and manuals	1.1 **Electrical symbols** used in circuit diagrams are identified and understood. 1.2 **Electrical drawings** are identified to implement wiring and troubleshooting procedures. 1.3 Electrical manuals are identified and understood. 1.4 Wiring diagrams and schematics are understood. 1.5 Common electrical standards and codes are recognized.
2. Identify measuring devices	2.1 **Measuring devices** are identified based on the specific requirements of PLC operations. 2.2 Functionality of measuring devices are understood and explained. 2.3 Correct usage of measuring devices for testing and troubleshooting PLC circuits is understood.
3. Conduct DC circuit experiments	3.1 Ohm's Law is verified by measuring voltage, current, and resistance in a DC circuit. 3.2 Series circuits are constructed and tested. 3.3 Parallel circuits are constructed and tested. 3.4 Combined circuits (series and parallel) are created. 3.5 **Circuit theorems** are implemented and verified.
4. Construct and implement AC circuits	4.1 RL circuits are constructed and implemented. 4.2 RC circuits are constructed and implemented. 4.3 Resistor (R) and capacitor (C) components are connected. 4.4 RLC circuits are constructed and implemented. 4.5 **Resonance circuits** are designed and implemented.
5. Operate single and three phase induction motor	5.1 Single and three-phase induction motors are identified. 5.2 Single-phase and three-phase motors are connected and verified. 5.3 Correct starting methods for single-phase and three-phase induction motors are applied.

	5.4 Motor parameters are checked and adjusted to ensure optimal operation. 5.5 Single phase and three phase motors are operated. 5.6 Operation of the motor is monitored for abnormal conditions. 5.7 Motor's performance is tested.

Range of Variables

Variable	**Range** (Includes but not limited to:)
1. Electrical symbols	1.1 Source (AC/DC) 1.2 Resistor 1.3 Capacitor 1.4 Inductor 1.5 Switches 1.6 Relay coils 1.7 Magnetic contactor 1.8 Circuit breaker 1.9 Timer/counter 1.10 Overload 1.11 Motor 1.12 Pump 1.13 Valve 1.14 Sensors and actuators
2. Electrical drawings	2.1 Layout diagram 2.2 Schematic diagram 2.3 Wiring diagram
3. Measuring devices	3.1 Ammeter 3.2 Voltmeter 3.3 Multi meter 3.4 Techo meter 3.5 Watt meter 3.6 Clip on ammeter 3.7 Megger
4. Circuit theorems	4.1 Ohm’s law 4.2 Kirchhoff's voltage law 4.3 Kirchhoff's current law 4.4 Thevenin’s theorem 4.4.1 Norton’s theorem 4.4.2 Superposition theorem
5. Resonance circuits	5.1 Series resonance 5.2 Parallel resonance

Curricular Content Guide

1. Underpinning knowledge	1.1 Identify and understand electrical symbols used in circuit diagrams. 1.2 Identify electrical drawings to implement wiring and troubleshooting procedures. 1.3 Identify and understand electrical manuals. 1.4 Understand wiring diagrams and schematics. 1.5 Recognize common electrical standards and codes. 1.6 Identify measuring devices based on specific PLC requirements. 1.7 Understand and explain the functionality of measuring devices. 1.8 Understand correct usage of measuring devices for testing and troubleshooting PLC circuits. 1.9 Identify single-phase and three-phase induction motors.
2. Underpinning skills	2.1 Verifying Ohm's Law by measuring voltage, current, and resistance in a DC circuit. 2.2 Constructing and testing series circuits. 2.3 Constructing and testing parallel circuits. 2.4 Creating combined circuits (series and parallel). 2.5 Implementing and verifying circuit theorems. 2.6 Constructing and implementing RL circuits. 2.7 Constructing and implementing RC circuits. 2.8 Connecting resistor (R) and capacitor (C) components. 2.9 Constructing and implementing RLC circuits. 2.10 Designing and implementing resonance circuits. 2.11 Connecting and verifying single-phase and three-phase motors. 2.12 Operating single-phase and three-phase motors. 2.13 Testing the motor's performance.
3. Underpinning attitudes	3.1 Commitment to occupational health and safety 3.2 Promptness in carrying out activities 3.3 Sincerity and honesty to duties 3.4 Environmental concerns 3.5 Eagerness to learn 3.6 Tidiness and timeliness 3.7 Respect for rights of peers and seniors in the workplace 3.8 Good relationships with peers, sub-ordinates and seniors in the workplace
4. Resource implications	The following resources must be provided: 4.1 Workplace (simulated or actual) 4.2 Learning manual 4.3 Relays, timers, counters, wirings 4.4 Simulation/testing equipment 4.5 Drawings and sketches

Assessment Evidence Guide

1. Critical aspects of competency	Assessment must evidence that the candidate: 1.1 interpreted electrical symbols, drawings and manual 1.2 identified measuring devices 1.3 conducted DC circuit experiments 1.4 constructed and implemented AC circuits 1.5 interpreted Single and Three Phase Induction Motor
2. Methods of assessment	Methods of assessment may include but is not limited to: 2.1 Written test 2.2 Practical demonstration 2.3 Oral questioning 2.4 Portfolio (optional)
3. Context of assessment	3.1 Competency assessment must be done in an assessment/training center or in an actual or simulated work place after completion of the training. 3.2 Assessment should be done by a nationally certified assessor or occupation-specific industry expert.

Unit of Competency: **EXECUTE ELECTRICAL SEQUENCE CIRCUIT AND CONTROL USING RELAY LOGIC**	**Nominal Duration:** 40 hrs.	**Unit Code:** SICIP-LE-PLC-02-O
Unit Descriptor: This unit covers the knowledge, skills and attitudes required to execute electrical sequence circuit and control using relay logic. It specifically includes the tasks of interpreting relay logic operation, performing mechanical switching operation, executing timer and counter application, constructing latch, DOL and star delta, and performing automatic forward reverse operation.		

Elements and Performance Criteria:
(Terms in the performance criteria that are written in **bold and underlined** are elaborated in the range of variables).

Elements of Competency	Performance Criteria
1. Interpret Relay Logic Operation	1.1 Fundamental concepts of relay logic are identified and explained according to PLC operation principles. 1.2 **Components of relay logic circuits** are identified. 1.3 Relay logic components' functions are described. 1.4 Operation of relay logic circuits is interpreted. 1.5 Common relay **logic symbols** and notations are identified. 1.6 Application of relay logic in PLC operation processes is described.
2. Perform Mechanical Switching Operation	2.1 Mechanical switching devices are identified and described. 2.2 Mechanical switching operation procedures are followed. 2.3 The **contact status** is checked using multimeter. 2.4 **Boolean logic** operation using relay is executed. 2.5 Switching devices are operated as per the control system design. 2.6 Mechanical switches are inspected and tested for proper functioning before and after operation.
3. Execute Timer and Counter Application	3.1 **Timer** and **counter** applications are selected based on control system needs. 3.2 Timer and counter settings are configured according to application requirements. 3.3 Timer and counter operations are executed following standard procedures. 3.4 Timer and counter outputs are monitored and verified. 3.5 Faults or deviations in timer and counter performance are identified.
4. Construct Latch, DOL and Star Delta	4.1 Circuit diagrams for latch, DOL, and star-delta configurations are interpreted.

	4.2 Latch circuits are constructed by connecting relays, contacts, and coils as per standard wiring diagrams. 4.3 DOL starter circuits are assembled ensuring proper connections for motor start and stop functions. 4.4 Star-delta starter circuits are constructed following established wiring procedures. 4.5 Circuits are tested for correct operation.
5. Perform Automatic Forward Reverse Operation	5.1 Control circuit for forward and reverse operation is interpreted. 5.2 Automatic forward and reverse operation are executed using timer and counter. 5.3 Operation is tested to verify smooth and correct transition between forward and reverse motion. 5.4 Faults or abnormalities during operation are identified and reported for corrective actions.

Range of Variables

Variable	**Range** May include but not limited to:
1. Components of relay logic circuits	1.1 Switches 1.2 Relay 1.3 Magnetic Contactor 1.4 Timer 1.5 Counter 1.6 LED (light emitting diode) 1.7 Motor 1.8 Sensors
2. Logic symbols	2.1 Normally Open (NO) 2.2 Normally Close (NC) 2.3 Timer 2.4 Counter 2.5 Relay Coil 2.6 Magnetic contactor 2.7 Motor
3. Contact status	3.1 Normally Open (NO) 3.2 Normally Close (NC)
4. Boolean logic	4.1 AND 4.2 OR 4.3 NAND 4.4 NOR 4.5 XOR 4.6 XNOR
5. Timer	5.1 On-delay timer 5.2 Off-delay timer
6. Counter	6.1 Up counter 6.2 Down counter

Curricular Content Guide

1. Underpinning knowledge	1.1 Identify and explain fundamental concepts of relay logic as per PLC operation principles. 1.2 Identify the components of relay logic circuits. 1.3 Describe the functions of relay logic components. 1.4 Interpret the operation of relay logic circuits. 1.5 Identify common relay logic symbols and notations. 1.6 Describe the application of relay logic in PLC operation processes. 1.7 Identify and describe mechanical switching devices. 1.8 Identify faults or deviations in timer and counter performance. 1.9 Interpret circuit diagrams for latch, DOL, and star-delta configurations. 1.10 Interpret control circuits for forward and reverse operation. 1.11 Identify faults or abnormalities for corrective actions.
2. Underpinning skills	2.1 Following mechanical switching operation procedures. 2.2 Executing Boolean logic operations using a relay. 2.3 Operating switching devices as per the control system design. 2.4 Inspecting and testing mechanical switches for proper functioning before and after operation. 2.5 Configuring timer and counter settings according to application requirements. 2.6 Executing timer and counter operations following standard procedures. 2.7 Constructing latch circuits by connecting relays, contacts, and coils as per standard wiring diagrams. 2.8 Assembling DOL starter circuits ensuring proper connections for motor start and stop functions. 2.9 Constructing star-delta starter circuits following established wiring procedures. 2.10 Testing circuits for correct operation. 2.11 Interpreting control circuits for forward and reverse operation. 2.12 Executing automatic forward and reverse operation using timer and counter. 2.13 Testing operation to verify smooth and correct transition between forward and reverse motion.
3. Underpinning attitudes	3.1 Commitment to occupational health and safety 3.2 Promptness in carrying out activities

	3.3 Sincerity and honesty to duties 3.4 Environmental concerns 3.5 Eagerness to learn 3.6 Tidiness and timeliness 3.7 Respect for rights of peers and seniors in the workplace 3.8 Good relationships with peers, sub-ordinates and seniors in the workplace
4. Resource implications	The following resources must be provided: 4.1 Workplace (simulated or actual) 4.2 Learning manual 4.3 Relays, timers, counters, wirings 4.4 Simulation/testing equipment 4.5 Drawings and sketches

Assessment Evidence Guide

1. Critical aspects of competency	Assessment must evidence that the candidate: 1.1 interpreted relay logic operation 1.2 performed mechanical switching operation 1.3 executed timer and counter application 1.4 constructed latch, dol and star delta 1.5 performed automatic forward reverse operation
2. Methods of assessment	Methods of assessment may include but is not limited to: 2.1 Written test 2.2 Practical demonstration 2.3 Oral questioning 2.4 Portfolio (optional)
3. Context of assessment	3.3 Competency assessment must be done in an assessment/training center or in an actual or simulated work place after completion of the training. 3.4 Assessment should be done by a nationally certified assessor or occupation-specific industry expert.

Unit of Competency: **INTEGRATE INDUSTRIAL SENSORS AND ACTUATORS**	**Nominal Duration:** 40 hrs.	**Unit Code:** SICIP-LE-PLC-03-O

Unit Descriptor:

This unit covers the knowledge, skills and attitudes required to integrate industrial sensors and actuators. It specifically includes the tasks of identifying types of industrial sensors and classifications, identifying types of industrial actuators and classifications, selecting sensors based on application and material properties, and executing sensors and actuators for industrial application.

Elements and Performance Criteria:

(Terms in the performance criteria that are written in **bold and underlined** are elaborated in the range of variables).

Elements of Competency	Performance Criteria
1. Identify types of industrial sensors and classifications	1.1 Types of **industrial sensors** are interpreted. 1.2 Classifications of industrial sensors are identified and described. 1.3 Function and role of sensors are explained in relation to industrial applications. 1.4 Applications of industrial sensors are interpreted.
2. Identify types of industrial actuators and classifications	2.1 Types of **actuators** are interpreted. 2.2 Classifications of industrial actuators are identified and described. 2.3 Function and role of actuators are explained in relation to industrial applications. 2.4 Applications of industrial actuators are interpreted.
3. Select sensors based on application and material properties	3.1 Requirements of the application are analyzed to determine appropriate sensor types. 3.2 Relevant material properties and surface characteristics are identified. 3.3 **Sensor specifications** are reviewed and matched with application needs. 3.4 **Sensor technologies** are selected based on material properties and operational conditions. 3.5 Installation and operating environment constraints are evaluated to ensure sensor compatibility and reliability.
4. Execute sensors and actuators for industrial application	4.1 Sensors and actuators are selected and collected according to system specifications. 4.2 Installation sites for sensors and actuators are prepared and inspected to ensure compatibility and safety. 4.3 Sensors and actuators are installed and wired following manufacturer guidelines. 4.4 PLC programming is carried out as per job requirement. 4.5 Functional testing is conducted to verify correct sensor detection and actuator response. 4.6 Faults or malfunctions are identified, diagnosed, and rectified according to troubleshooting procedures.

Range of Variables

Variable	Range May include but not limited to:
1. Industrial sensors	1.1 Proximity 1.2 Photo 1.3 Limit Switch 1.4 Pressure 1.5 Temperature
2. Actuators	2.1 Linear 2.2 Rotary
3. Sensor specifications	3.1 Sensitivity 3.2 Range 3.3 Accuracy 3.4 Environmental suitability
4. Sensor technologies	4.1 Inductive 4.2 Capacitive 4.3 Ultrasonic 4.4 Photoelectric

Curricular Content Guide

1. Underpinning knowledge	1.1 Interpret types of industrial sensors. 1.2 Identify and describe classifications of industrial sensors. 1.3 Explain the function and role of sensors in industrial applications. 1.4 Interpret applications of industrial sensors. 1.5 Interpret types of actuators. 1.6 Identify and describe classifications of industrial actuators. 1.7 Explain the function and role of actuators in industrial applications. 1.8 Interpret applications of industrial actuators. 1.9 Identify, diagnose, and rectify faults or malfunctions following troubleshooting procedures.
2. Underpinning skills	2.1 Analyzing the requirements of the application to determine appropriate sensor types. 2.2 Reviewing sensor specifications and matching them with application needs. 2.3 Selecting sensor technologies based on material properties and operational conditions. 2.4 Evaluating installation and operating environment constraints to ensure sensor compatibility and reliability. 2.5 Selecting and collecting sensors and actuators

	according to system specifications. 2.6 Preparing and inspecting installation sites for sensors and actuators to ensure compatibility and safety. 2.7 Installing and wiring sensors and actuators following manufacturer guidelines. 2.8 Carrying out PLC programming as per job requirements. 2.9 Conducting functional testing to verify correct sensor detection and actuator response.
3. Underpinning attitudes	3.1 Commitment to occupational health and safety 3.2 Promptness in carrying out activities 3.3 Sincerity and honesty to duties 3.4 Environmental concerns 3.5 Eagerness to learn 3.6 Tidiness and timeliness 3.7 Respect for rights of peers and seniors in workplace 3.8 Good relationships with peers, sub-ordinates and seniors in workplace
4. Resource implications	Following resources must be provided: 4.1 Workplace (simulated or actual) 4.2 Computer/laptop/notebook 4.3 Learning manual 4.4 Software, hardware 4.5 System compatibility, protocols 4.6 Drawings, Job specifications and work instructions

Assessment Evidence Guide

1. Critical aspects of competency	Assessment must evidence that the candidate: 1.1 identified types of industrial sensors and classifications 1.2 identified types of industrial actuators and classifications 1.3 selected sensors based on application and material properties 1.4 executed sensors and actuators for industrial application
2. Methods of assessment	Methods of assessment may include but is not limited to: 2.1 Written test 2.2 Practical demonstration 2.3 Oral questioning 2.4 Portfolio (optional)
3. Context of assessment	3.1 Competency assessment must be done in an assessment/training center or in an actual or simulated work place after completion of the training. 3.2 Assessment should be done by a nationally certified assessor or occupation-specific industry expert.

Unit of Competency: **IMPLEMENT PLC INSTALLATION AND WIRING WITH CONFIGURATION**	**Nominal Duration:** 60 hrs.	**Unit Code:** SICIP-LE-PLC-04-O
Unit Descriptor: This unit covers the knowledge, skills and attitudes required to implement PLC installation and wiring with configuration. It specifically includes the tasks of preparing for works, setting up PLC hardware configurations with software tool and establishing communication between PLC And PC.		

Elements and Performance Criteria:
(Terms in the performance criteria that are written in **bold and underlined** are elaborated in the range of variables).

Elements of Competency	Performance Criteria
1. Prepare for works	1.1 Safe working practices are followed and **Personal Protective Equipment (PPE)** is worn as per workplace requirement. 1.2 Necessary tools and equipment are selected and prepared for Installation as job requirements. 1.3 Materials and **PLC components** are identified required for Installation and commissioning of PLC.
2. Setup PLC hardware configurations with software tool	2.1. Typical PLC components and the control devices are installed as per job requirement. 2.2. Sensors and switches are connected to a particular input and output of PLC. 2.3. **Cable connections** between the PLC and the **programming devices** are connected as per work instruction. 2.4. Connection is checked as per required specification. 2.5. **Protective devices** are set as per the user manual. 2.6. Required **software tool** is installed. 2.7. Selected hardware is configured using PLC software tools.
3. Establish communication between PLC and PC	3.1 Hardware devices are checked in accordance with user manual. 3.2 Address of PLC and PC are configured as per job requirement. 3.3 Communication between PLC and PC using **communication protocols** is established. 3.4 Communication between PLC & PC is verified.

Range of Variables

Variable	Range May include but not limited to:

PLC Operation

1. Personal Protective Equipment (PPE)	1.1 Apron 1.2 Safety helmet 1.3 Insulated Gloves 1.4 Insulated shoe
2. PLC components	2.1 Power supply unit/module 2.2 Input/output module 2.3 Mounting accessories 2.4 CPU unit 2.5 Communication module 2.6 Programming device 2.7 Front connector
3. Cable connections	3.1 RS 232 3.2 USB 3.3 Ethernet/Profinet 3.4 RS485 3.5 RS422 3.6 Profibus
4. Programming devices	4.1 Computer with programming software 4.2 Laptop with programming software
5. Protective devices	5.1 Fuse 5.2 Miniature Circuit Breaker (MCB)
6. Software tool	6.1 TIA Portal 6.2 GX Works 6.3 WPLSoft
7. Communication protocols	7.1 Profinet 7.2 USB 7.3 Modbus

Curricular Content Guide

1. Underpinning knowledge	1.1 Identify materials and PLC components required for installation and commissioning of PLC. 1.2 PLC components and control devices as per job requirements. 1.3 Sensors and switches to the appropriate input and output of the PLC. 1.4 Cable connections between the PLC and programming devices as per work instructions. 1.5 Required software tool. 1.6 Hardware using PLC software tools. 1.7 Hardware devices in accordance with the user manual. 1.8 Establish communication between the PLC and PC using communication protocols. 1.9 Verify communication between PLC and PC.
2. Underpinning skills	2.1 Selecting and preparing necessary tools and equipment for installation as per job requirements.

	2.2 Installing typical PLC components and control devices as per job requirements. 2.3 Connecting sensors and switches to the appropriate input and output of the PLC. 2.4 Connecting cable connections between the PLC and programming devices as per work instructions. 2.5 Checking connections according to required specifications. 2.6 Setting protective devices as per the user manual. 2.7 Installing the required software tool. 2.8 Configuring selected hardware using PLC software tools. 2.9 Checking hardware devices in accordance with the user manual. 2.10 Configuring the address of PLC and PC as per job requirements.
3. Underpinning attitudes	3.1 Commitment to occupational health and safety 3.2 Promptness in carrying out activities 3.3 Sincerity and honesty to duties 3.4 Environmental concerns 3.5 Eagerness to learn 3.6 Tidiness and timeliness 3.7 Respect for rights of peers and seniors in the workplace 3.8 Good relationships with peers, sub-ordinates and seniors in the workplace
4. Resource implications	The following resources must be provided: 4.1 Workplace (simulated or actual) 4.2 Computer/laptop/notebook 4.3 Drawings, job specifications and work instructions 4.4 PLC programming software (matching PLC brand and model) 4.5 Networking equipment (switches, routers, industrial ethernet) 4.6 Programming devices, protective devices, software tools and communications protocols

Assessment Evidence Guide

1. Critical aspects of competency	Assessment must evidence that the candidate: 1.1 prepared for works 1.2 set up PLC hardware configurations with software tool 1.3 established communication between PLC and pc
2. Methods of assessment	Methods of assessment may include but is not limited to: 2.1 Written test 2.2 Practical demonstration

	2.3 Oral questioning 2.4 Portfolio (optional)
3. Context of assessment	3.1 Competency assessment must be done in an assessment/training center or in an actual or simulated work place after completion of the training. 3.2 Assessment should be done by a nationally certified assessor or occupation-specific industry expert.

Unit of Competency: **CARRY OUT LADDER DIAGRAM IN PLC PROGRAMMING**	**Nominal Duration:** 60 hrs.	**Unit Code:** SICIP-LE-PLC-05-O
Unit Descriptor: This unit of competency covers the knowledge, skills and attitudes required to carry out ladder diagram in PLC programming. It specifically includes the tasks of preparing for ladder diagram, performing PLC programming using ladder diagram and preparing PLC for operation.		

Elements and Performance Criteria:
(Terms in the performance criteria that are written in **bold and underlined** are elaborated in the range of variables).

Elements of Competency	Performance Criteria
1. Prepare for ladder diagram	1.1 Safe work practices are followed and **Personal Protective Equipment (PPE)** are worn as required. 1.2 Necessary **software and hardware** are selected as per job requirements. 1.3 Table chart for sub-program, function, function block and data block are prepared. 1.4 **Programming components and ladder logic symbols** are identified required for ladder diagram of PLC.
2. Perform PLC programming using ladder diagram	2.1. Basic ladder logic symbols and components are identified according to instruction manual. 2.2. Ladder diagram is constructed by arranging symbols logically to represent the desired control sequence. 2.3. Input and output devices are mapped within the ladder diagram. 2.4. Ladder diagram is checked for logical consistency and observed through simulation. 2.5. Modifications and corrections are made to the ladder diagram based on testing results.
3. Prepare PLC for operation	3.1 Programming devices are collected. 3.2 PLC program required by specific application is developed. 3.3 PLC Program is imported from memory card if required. 3.4 PLC Program is compiled with diagnosis. 3.5 Programs are transferred to PLC and set the PLC in Run Mode. 3.6 Optimization of software is done to ensure the program after the first test run. 3.7 Final circuit testing and optimization is done to ensure no errors occur by the entire system.

Range of Variables

Variable	Range May include but not limited to:
1. Personal Protective Equipment (PPE)	1.1 Apron / overall 1.2 Goggles 1.3 Insulated Gloves 1.4 Insulated shoe
2. Software and hardware	2.1. Software 2.1.1 TIA Portal 2.1.2 GX Works 2.1.3 WPLSoft 2.2. Hardware 2.1.1 PLC CPU 2.1.2 Input module 2.1.3 Output module 2.1.4 Communication module 2.1.5 Communication cable 2.1.6 Programming cable
3. Programming components and ladder logic symbols	3.1. Make contact 3.2. Break contact 3.3. Analog contact 3.4. Relay coil 3.5. Inverted output 3.6. Analog output 3.7. All types of timers 3.8. Counter 3.9. Comparator 3.10. Mathematical functions

Curricular Content Guide

1. Underpinning knowledge	1.1 identify programming components and ladder logic symbols needed for PLC ladder diagrams. 1.2 Identify basic ladder logic symbols and components as per the instruction manual. 1.3 Ladder diagram by logically arranging symbols to represent the desired control sequence. 1.4 Map input and output devices within the ladder diagram. 1.5 Ladder diagram for logical consistency and observe through simulation. 1.6 Make modifications and corrections to the ladder diagram based on testing results. 1.7 Collect programming devices required for the PLC. 1.8 Develop the PLC program for the specific application. 1.9 Import the PLC program from the memory card if

	necessary. 1.10 Compile the PLC program with diagnostics. 1.11 Transfer the program to the PLC and set the PLC to Run Mode. 1.12 Optimize the software to ensure the program runs smoothly after the first test.
2. Underpinning skills	2.1 Selecting necessary software and hardware as per job requirements. 2.2 Preparing table charts for sub-programs, functions, function blocks, and data blocks. 2.3 Constructing ladder diagrams by arranging symbols logically to represent the desired control sequence. 2.4 Checking the ladder diagram for logical consistency and observing through simulation. 2.5 Making modifications and corrections to the ladder diagram based on testing results. 2.6 Developing the PLC program required for specific applications. 2.7 Compiling the PLC program with diagnosis. 2.8 Transferring the program to the PLC and setting the PLC in Run Mode. 2.9 Optimizing the software to ensure the program works after the first test run. 2.10 Conducting final circuit testing and optimization to ensure no errors occur in the entire system.
3 Underpinning attitudes	3.1 Commitment to occupational health and safety 3.2 Promptness in carrying out activities 3.3 Sincerity and honesty to duties 3.4 Environmental concerns 3.5 Eagerness to learn 3.6 Tidiness and timeliness 3.7 Respect for rights of peers and seniors in the workplace 3.8 Good relationships with peers, sub-ordinates and seniors in the workplace
4 Resource implications	The following resources must be provided: 4.1 Workplace (simulated or actual) 4.2 Computer/laptop/notebook 4.3 PLC programming software 4.4 Drawings, specifications and work instructions 4.5 Learning manual 4.6 PLC unit, control panel 4.7 Diagnostic tools

Assessment Evidence Guide

1. Critical aspects of competency	Assessment must evidence that the candidate: 1.1 prepared for ladder diagram 1.2 performed PLC programming using ladder diagram 1.3 prepared PLC for operation
2. Methods of assessment	Methods of assessment may include but is not limited to: 2.1 Written test 2.2 Practical demonstration 2.3 Oral questioning 2.4 Portfolio (optional)
3. Context of assessment	3.1 Competency assessment must be done in an assessment/training center or in an actual or simulated work place after completion of the training. 3.2 Assessment should be done by a nationally certified assessor or occupation-specific industry expert.

Unit of Competency: **PERFORM PROCESS VISUALIZATION (HMI)**	**Nominal Duration:** 30 hrs.	**Unit Code:** SICIP-LE-PLC-06-O
Unit Descriptor: This unit of competency covers the knowledge, skills and attitudes required to perform process visualization (HMI). It specifically includes the tasks of configuring human machine interface (HMI) panel integration, performing process design in HMI, carrying out interface between PLC and HMI and visualizing the process in HMI.		

Elements and Performance Criteria:
(Terms in the performance criteria that are written in **bold and underlined** are elaborated in the range of variables).

Elements of Competency	Performance Criteria
1. Configure human machine interface (HMI) panel integration	1.1 Concept and functions of Human Machine Interface (HMI) are interpreted and understood according to system requirements. 1.2 Different **HMI communication protocols** are established and configured. 1.3 Various HMI screens are created, selected, and programmed with soft buttons. 1.4 **Basic objects** and **elements** are created and configured. 1.5 Graphic objects are imported from the software library and integrated. 1.6 Analogue data tags are configured to enable real-time monitoring.
2. Perform process design in HMI	2.1 Process requirements and specifications are reviewed and interpreted. 2.2 Relevant process control parameters are identified into the HMI design. 2.3 Appropriate interactive elements are designed and configured to control and monitor the process. 2.4 Alarm and notification systems are integrated into the HMI. 2.5 Process design is simulated and tested within the HMI.
3. Carry out interface between PLC and HMI	3.1 Communication between the PLC and HMI is established using appropriate communication protocols. 3.2 Data exchange between the PLC and HMI is configured and verified for accuracy and reliability. 3.3 Communication settings are set according to system requirements. 3.4 Network connections and wiring are inspected and confirmed to ensure proper interface operation. 3.5 Troubleshooting procedures are applied to identify and

	resolve communication issues between PLC and HMI. 3.6 Interface performance is monitored.
4. Visualize the process in HMI	4.1 The process flow and operational parameters are interpreted and analyzed for visualization purposes. 4.2 Appropriate graphical elements and indicators are selected and configured to represent process variables accurately. 4.3 Process data is integrated and displayed in real-time on HMI screens using charts, gauges, and trend graphs. 4.4 Interactive components and alarms are incorporated to facilitate process control and monitoring. 4.5 The HMI visualization is tested and validated to confirm accuracy and responsiveness.

Range of Variables

Variable	Range May include but not limited to:
1. HMI communication protocols	1.1 Modbus 1.1.1 RS232 1.1.2 RS485 1.2 Profibus 1.3 TCP IP/Ethernet 1.4 ProfNet
2. Basic objects	2.1 Line 2.2 Ellipse 2.3 Circle 2.4 Rectangle 2.5 Text field 2.6 Graphic view 2.7 Trend view
3. Elements	3.1 I/O field 3.2 Symbolic I/O field 3.3 Graphic I/O field 3.4 Date/Time field 3.5 Bar 3.6 Switch 3.7 Button

Curricular Content Guide

1. Underpinning knowledge	1.1 Interpret and understand the concept and functions of Human Machine Interface (HMI) according to system requirements. 1.2 Establish and configure different HMI communication protocols. 1.3 Identify relevant process control parameters for inclusion in the HMI design.

	1.4 Interactive elements to control and monitor the process. 1.5 Establish communication between the PLC and HMI using appropriate communication protocols. 1.6 Interpret and analyze the process flow and operational parameters for visualization. 1.7 Select appropriate graphical elements and indicators to represent process variables accurately. 1.8 Display process data in real-time on HMI screens using charts, gauges, and trend graphs. 1.9 Interactive components and alarms for effective process control and monitoring.
2. Underpinning skills	2.1 Creating, selecting, and programming various HMI screens with soft buttons. 2.2 Creating and configuring basic objects and elements in the HMI. 2.3 Configuring analogue data tags to enable real-time monitoring. 2.4 Reviewing and interpreting process requirements and specifications. 2.5 Designing and configuring appropriate interactive elements to control and monitor the process. 2.6 Simulating and testing the process design within the HMI. 2.7 Configuring and verifying data exchange between PLC and HMI for accuracy and reliability. 2.8 Setting communication settings according to system requirements. 2.9 Inspecting and confirming network connections and wiring to ensure proper interface operation. 2.10 Applying troubleshooting procedures to identify and resolve communication issues between PLC and HMI. 2.11 Integrating and displaying process data in real-time on HMI screens using charts, gauges, and trend graphs.
3. Underpinning attitudes	3.1 Commitment to occupational health and safety 3.2 Promptness in carrying out activities 3.3 Sincerity and honesty to duties 3.4 Environmental concerns 3.5 Eagerness to learn 3.6 Tidiness and timeliness 3.7 Respect for rights of peers and seniors in the workplace 3.8 Good relationships with peers, subordinates and seniors in the workplace
4. Resource implications	The following resources must be provided: 4.1 Workplace (simulated or actual) 4.2 Computer/laptop/notebook 4.3 Learning manual

	4.4 Software, hardware 4.5 Drawings, specifications and work instructions 4.6 Communication protocols 4.7 HMI panels (touchscreens, monitors, etc.)

Assessment Evidence Guide

1. Critical aspects of competency	Assessment must evidence that the candidate: 1.1 configured Human Machine Interface (HMI) Panel Integration 1.2 performed Process Design in HMI 1.3 carried out interface between PLC and HMI 1.4 visualized the Process in HMI
2. Methods of assessment	Methods of assessment may include but is not limited to: 2.1 Written test 2.2 Practical demonstration 2.3 Oral questioning 2.4 Portfolio (optional)
3. Context of assessment	3.1 Competency assessment must be done in an assessment/training center or in an actual or simulated work place after completion of the training. 3.2 Assessment should be done by a nationally certified assessor or occupation-specific industry expert.

Unit of Competency: OPERATE PNEUMATIC AND HYDRAULIC CONTROL SYSTEM USING PLC	Nominal Duration: 40 hrs.	Unit Code: SICIP-LE-PLC-07-O

Unit Descriptor:

This unit of competency covers the knowledge, skills and attitudes required to operate pneumatic and hydraulic control system using PLC. It specifically includes the tasks of identifying pneumatic and hydraulic system components, installing and configuring PLC, developing PLC programs for pneumatic control system, developing PLC programs for hydraulic control system and testing & running PLC controlled pneumatic and hydraulic systems.

Elements and Performance Criteria:

(Terms in the performance criteria that are written in **bold and underlined** are elaborated in the range of variables).

Elements of Competency	Performance Criteria
1. Identify Pneumatic and Hydraulic System Components	1.1 Pneumatic system and Hydraulic system are interpreted and described. 1.2 **Components for pneumatic and hydraulic control system** are recognized and classified. 1.3 The operating principles of pneumatic and hydraulic components are interpreted. 1.4 Safety features associated with pneumatic and hydraulic systems are identified and explained.
2. Install and Configure PLC	2.1 Installation site and equipment for PLC integration with pneumatic and hydraulic systems are inspected and prepared. 2.2 PLC hardware components are installed and connected. 2.3 Wiring between PLC and pneumatic and hydraulic components are carried out. 2.4 PLC software is installed and configured to control pneumatic and hydraulic system operations.
3. Develop PLC Program for Pneumatic Control System	3.1 **Valve sequencing** is performed using PLC. 3.2 Two-step control system is executed to regulate and maintain pressure within specified limits. 3.3 Three-step control system is executed to provide enhanced pressure control as per system requirements.
4. Develop PLC Program for Hydraulic Control System	4.1 Valve sequencing is performed using PLC according to system requirements. 4.2 Two-step control system is executed to regulate pressure within specified parameters. 4.3 Three-step control system is executed to provide advanced pressure control.
5. Test and run PLC-Controlled Pneumatic and Hydraulic Systems	5.1 Control circuit for controlling pneumatic and hydraulic system is tested. 5.2 Operation of the systems is conducted according to

	testing protocols. 5.3 Faults and irregularities during operation are identified, diagnosed, and resolved. 5.4 System responses to control commands are monitored and recorded. 5.5 Test results and fault resolution actions are documented.

Range of Variables

Variable	**Range** May include but not limited to:
1. Components for pneumatic and hydraulic control system	1.1 Valves 1.2 Actuators 1.3 Pumps 1.4 Cylinders 1.5 Filters 1.6 Accumulators
2. Valve sequencing	2.1 Double cylinder operation 2.1.1 A+ B+: A- B- 2.1.2 A+B+: B- A- 2.1.3 A+A-: B+ B- 2.2 Lifting device 2.3 Traffic control

Curricular Content Guide

1. Underpinning knowledge	1.1 Interpret and describe pneumatic and hydraulic systems. 1.2 Recognize components for pneumatic and hydraulic control systems. 1.3 Interpret the operating principles of pneumatic and hydraulic components. 1.4 Identify and explain safety features associated with pneumatic and hydraulic systems. 1.5 Execute a three-step control system to provide enhanced pressure control as per system requirements. 1.6 Perform valve sequencing using PLC according to 1.7 Identify, diagnose, and resolve faults and irregularities during operation. 1.8 Monitor and record system responses to control commands.
2. Underpinning skills	2.1 Inspecting and preparing installation sites and equipment for PLC integration with pneumatic and hydraulic systems. 2.2 Installing and connecting PLC hardware components.

	2.3 Carrying out wiring between PLC and pneumatic and hydraulic components. 2.4 Installing and configuring PLC software to control pneumatic and hydraulic system operations. 2.5 Performing valve sequencing using PLC. 2.6 Executing a two-step control system to regulate and maintain pressure within specified limits. 2.7 Executing a three-step control system to provide enhanced pressure control as per system requirements. 2.8 Performing valve sequencing using PLC according to system requirements. 2.9 Executing a two-step control system to regulate pressure within specified parameters. 2.10 Executing a three-step control system to provide advanced pressure control. 2.11 Testing the control circuit for controlling pneumatic and hydraulic systems. 2.12 Conducting operation of the systems according to testing protocols.
3. Underpinning attitudes	3.1 Commitment to occupational health and safety 3.2 Promptness in carrying out activities 3.3 Sincerity and honesty to duties 3.4 Environmental concerns 3.5 Eagerness to learn 3.6 Tidiness and timeliness 3.7 Respect for rights of peers and seniors in the workplace 3.8 Good relationships with peers, subordinates and seniors in the workplace
4. Resource implications	The following resources must be provided: 4.1 Workplace (simulated or actual) 4.2 Computer/laptop/notebook 4.3 PLC hardware & software 4.4 Learning manual 4.5 Drawings, specifications and work instructions

Assessment Evidence Guide

1. Critical aspects of competency	Assessment must evidence that the candidate: 1.1 identified pneumatic and hydraulic system components 1.2 installed and configured PLC 1.3 developed PLC programs for pneumatic control system 1.4 developed PLC programs hydraulic control system 1.5 tested and runed PLC-Controlled pneumatic and hydraulic systems

2. Methods of assessment	Methods of assessment may include but is not limited to: 2.1 Written test 2.2 Practical demonstration 2.3 Oral questioning 2.4 Portfolio (optional)
3. Context of assessment	3.1 Competency assessment must be done in an assessment/training center or in an actual or simulated work place after completion of the training. 3.2 Assessment should be done by a nationally certified assessor or occupation-specific industry expert.

Unit of Competency: CONTROL VARIABLE FREQUENCY DRIVE (VFD) USING PLC	Nominal Duration: 20 hrs.	Unit Code: SICIP-LE-PLC-08-O
Unit Descriptor: This unit of competency covers the knowledge, skills and attitudes required to control variable frequency drive (VFD) using PLC. It specifically includes the tasks of interpreting variable frequency drive (VFD), installing and configuring variable frequency drive (VFD), operating variable frequency drive (VFD) in different modes and operating variable frequency (VFD) using PLC.		

Elements and Performance Criteria:
(Terms in the performance criteria that are written in **bold and underlined** are elaborated in the range of variables).

Elements of Competency	Performance Criteria
1. Interpret Variable Frequency Drive (VFD)	1.1 Functions of Variable Frequency Drive (VFD) are interpreted. 1.2 **Key components of VFD** are explained and described. 1.3 Common applications of VFDs in PLC operation are identified. 1.4 Specifications of VFD is interpreted.
2. Install and configure Variable Frequency Drive (VFD)	2.1 Installation site for the VFD is inspected. 2.2 VFD unit is installed securely according to manufacturer guidelines. 2.3 Power cables are connected to the VFD following wiring diagrams. 2.4 Motor is connected to the VFD, ensuring proper wiring and compatibility. 2.5 Controlling circuit for the VFD is installed and integrated with the control system. 2.6 **Motor parameters** are set accurately in the VFD. 2.7 **Controlling parameters** are configured according to application requirements.
3. Operate Variable Frequency Drive (VFD) in different mode	3.1 Motor speed control is performed using local or keypad control mode as per operational procedures. 3.2 Motor control is executed using terminal control mode or remote-control mode. 3.3 Motor direction control is applied to enable both forward and reverse operations safely. 3.4 VFD alarms and fault indicators are interpreted accurately to diagnose system status. 3.5 Appropriate responses to alarms are implemented following troubleshooting guidelines. 3.6 Operational parameters are monitored and adjusted to

	maintain desired motor performance.
4. Operate Variable Frequency Drive (VFD) using PLC	4.1 Safety protocols are followed during VFD operation. 4.2 VFD is connected to the PLC system and configured according to the required motor specifications. 4.3 PLC programming for controlling the VFD is created and verified. 4.4 Motor's speed and torque are adjusted using PLC by setting the desired frequency and voltage levels. 4.5 VFD parameters are monitored and adjusted to ensure smooth motor operation. 4.6 VFD operation is tested for proper performance.

Range of Variables

Variable	**Range** May include but not limited to:
1. Key components of VFD	1.1 Rectifiers 1.2 Inverters 1.3 Control units
2. Motor parameters	2.1 Rated power 2.2 Rated voltage 2.3 Rated current 2.4 Frequency 2.5 Number of poles 2.6 Efficiency 2.7 Rated RPM 2.8 Power factor (PF) 2.9 Insulation type
3. Controlling parameters	3.1 Source of operation command 3.2 Source of master frequency 3.3 Acceleration time 3.4 Deceleration time 3.5 Analogue input type 3.6 Digital input 3.7 Digital output

Curricular Content Guide

1. Underpinning knowledge	1.1 Interpret the functions of Variable Frequency Drive (VFD). 1.2 Explain and describe the key components of a VFD. 1.3 Identify common applications of VFDs in PLC/PLC operation. 1.4 Interpret the specifications of a VFD. 1.5 Interpret VFD alarms and fault indicators to diagnose system status. 1.6 Monitor and adjust VFD parameters to ensure smooth

	motor operation.
2. Underpinning skills	2.1 Inspecting the installation site for the VFD. 2.2 Installing the VFD unit securely according to manufacturer guidelines. 2.3 Connecting power cables to the VFD following wiring diagrams. 2.4 Connecting the motor to the VFD, ensuring proper wiring and compatibility. 2.5 Installing the controlling circuit for the VFD and integrating it with the control system. 2.6 Setting motor parameters accurately in the VFD. 2.7 Configuring controlling parameters according to application requirements. 2.8 Performing motor speed control using local or keypad control mode as per operational procedures. 2.9 Executing motor control using terminal control mode or remote-control mode. 2.10 Applying motor direction control to enable both forward and reverse operations safely. 2.11 Implementing appropriate responses to alarms following troubleshooting guidelines. 2.12 Monitoring and adjusting operational parameters to maintain desired motor performance. 2.13 Connecting the VFD to the PLC system and configuring it according to required motor specifications.
3. Underpinning attitudes	3.1 Commitment to occupational health and safety 3.2 Promptness in carrying out activities 3.3 Sincerity and honesty to duties 3.4 Environmental concerns 3.5 Eagerness to learn 3.6 Tidiness and timeliness 3.7 Respect for rights of peers and seniors in the workplace 3.8 Good relationships with peers, subordinates and seniors in the workplace
4. Resource implications	The following resources must be provided: 4.1 Workplace (simulated or actual) 4.2 Computer/laptop/notebook 4.3 Personal protective equipment (PPE) 4.4 Hardware (PLC, VFD) 4.5 PLC programming software 4.6 VFD configuration tools 4.7 Drawings, specifications and work instructions

Assessment Evidence Guide

1. Critical aspects of competency	Assessment must evidence that the candidate: 1.1 interpreted Variable Frequency Drive (VFD) 1.2 installed and configured Variable Frequency Drive (VFD) 1.3 operated Variable Frequency Drive (VFD) in Different Modes 1.4 operated Variable Frequency Drive (VFD) using PLC
2. Methods of assessment	Methods of assessment may include but is not limited to: 2.1 Written test 2.2 Practical demonstration 2.3 Oral questioning 2.4 Portfolio (optional)
3. Context of assessment	3.1 Competency assessment must be done in an assessment/training center or in an actual or simulated work place after completion of the training. 3.2 Assessment should be done by a nationally certified assessor or occupation-specific industry expert.

END OF COMPETENCY STANDARD

Workshop/Lab Facility Standard

Course Name:	PLC operation
Number of Trainees:	25

Course-wise Training Space:

- Computer Lab : 400 sft
- Workshop : 700-800 sft

Major Training Equipment and Training Facilities:

S.N.	Major Training Equipment and facilities	Required facilities
1.	Computer/Laptops with PLC software	25
2.	HMI (Human-Machine Interface)	10
3.	PLC with required modules (Siemens S7-1200, Mitsubishi and Delta)	10
4.	PLC to HMI communication cable	10
5.	PLC Programming cable	10
6.	Limit Switch	25
7.	Proximity Sensor	25
8.	Photo Electric	25
9.	Float Sensor	10
10.	Pressure Sensor/Transmitter	10
11.	Temperature Sensor RTD	10
12.	Temperature Sensor Thermocouple	10
13.	Push button switch (green)	50
14.	Push button switch (red)	25
15.	Selector switch	25
16.	Emergency stop switch	25
17.	Indication lamp	50
18.	Magnetic contactor	100
19.	Relay	100
20.	Timer	100

21.	Counter	25
22.	Three phase induction motor	10
23.	Single phase induction motor	05
24.	VFDs-Variable Frequency Drives	10
25.	Power supply	10
26.	Automatic voltage stabilizer	01
27.	Air compressor	01
28.	Hydraulic power pack	01
29.	Measuring devices set	01

The following conditions must be fulfilled –

- The institute shall not use the same facilities for any other projects/organizations offering a similar course.
- The institute must provide sufficient evidence to prove ownership of the proposed training equipment.

The list denotes the minimum training equipment and facility required to effectively conduct training for a specific course. Additionally, the institute must ensure that all other necessary training tools, equipment, and furniture are available to meet the requirement of competency standards (CS) provided by SICIP.

For the operation of training course on PLC operation, the institute must ensure the availability of at least 80% of the major training equipment and training facilities (according to the CS) to be eligible for SICIP training delivery. If the score is below 80%, the remaining equipment and facilities need to be installed before the commencement of the training.

The institute will also provide all other hand tools and power tools as per CS for 25 trainees. Also, they will arrange adequate seating arrangement and classroom setup for the 25 trainees.