TRAINING REGULATIONS

PV SYSTEMS INSTALLATION NC II

CONSTRUCTION SECTOR

TECHNICAL EDUCATION AND SKILLS DEVELOPMENT AUTHORITY
East Service Road, South Superhighway, Taguig City, Metro Manila

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CONSTRUCTION - ELECTRICAL SUB-SECTOR

PV SYSTEMS INSTALLATION NC II

TRAINING REGULATIONS FOR

PV SYSTEMS INSTALLATION NC II

SECTION 1 PV SYSTEM INSTALLATION NC II QUALIFICATION

The PV SYSTEMS INSTALLATION NC II Qualification consists of competencies that a person must achieve to enable him/her to perform site assessment, check PV components and materials' compliance, install and commission PV system and prepare documentation requirements for PV systems installation.

This Qualification is packaged from the competency map of Construction – as shown in Annex A.

The Units of Competency comprising this Qualification include the following:

CODE NO.	BASIC COMPETENCIES
	Units of Competency
500311105	Participate in workplace communication
500311106	Work in a team environment
500311107	Practice career professionalism
500311108	Practice occupational health and safety procedures

CODE NO.	COMMON COMPETENCIES
	Units of Competency
CON724201	Prepare construction materials and tools
CON311201	Observe procedures, specifications and manuals of instruction
CON311202	Interpret technical drawings and plans
CON311203	Perform mensurations and calculations
CON311204	Maintain tools and equipment

CODE NO.	CORE COMPETENCIES
	Units of Competency
CON724325	Perform site assessment
CON724326	Check PV components/materials compliance
CON724327	Install PV system
CON724328	Perform PV System Testing and Commissioning

A person who has achieved this Qualification is competent to be:

- PV Systems Installation Technician; or
- PV Systems Commissioning Technician

SECTION 2 COMPETENCY STANDARDS

This section gives the details of the contents of the units of competency required in PV SYSTEMS INSTALLATION NC II. These units of competency are categorized into basic, common and core competencies.

BASIC COMPETENCIES

UNIT OF COMPETENCY : PARTICIPATE IN WORKPLACE COMMUNICATION

UNIT CODE : 500311105

UNIT DESCRIPTOR : This unit covers the knowledge, skills and attitudes required to gather, interpret and convey information in response to workplace requirements.

ELEMENT	PERFORMANCE CRITERIA ***Italicized*** terms are elaborated in the Range of Variables
1. Obtain and convey workplace information	1.1 Specific and relevant information is accessed from ***appropriate sources*** 1.2 Effective questioning , active listening and speaking skills are used to gather and convey information 1.3 Appropriate ***medium*** is used to transfer information and ideas 1.4 Appropriate non- verbal communication is used 1.5 Appropriate lines of communication with supervisors and colleagues are identified and followed 1.6 Defined workplace procedures for the location and ***storage*** of information are used 1.7 Personal interaction is carried out clearly and concisely
2. Participate in workplace meetings and discussions	2.1 Team meetings are attended on time 2.2 Own opinions are clearly expressed and those of others are listened to without interruption 2.3 Meeting inputs are consistent with the meeting purpose and established ***protocols*** 2.4 ***Workplace interactions*** are conducted in a courteous manner 2.5 Questions about simple routine workplace procedures and maters concerning working conditions of employment are asked and responded to 2.6 Meetings outcomes are interpreted and implemented
3. Complete relevant work related documents	3.1 Range of ***forms*** relating to conditions of employment are completed accurately and legibly 3.2 Workplace data is recorded on standard workplace forms and documents 3.3 Basic mathematical processes are used for routine calculations 3.4 Errors in recording information on forms/ documents are identified and properly acted upon 3.5 Reporting requirements to supervisor are completed according to organizational guidelines

RANGE OF VARIABLES

VARIABLE	RANGE
1. Appropriate sources	1.1 Team members 1.2 Suppliers 1.3 Trade personnel 1.4 Local government 1.5 Industry bodies
2. Medium	2.1 Memorandum 2.2 Circular 2.3 Notice 2.4 Information discussion 2.5 Follow-up or verbal instructions 2.6 Face to face communication
3. Storage	3.1 Manual filing system 3.2 Computer-based filing system
4. Forms	4.1 Personnel forms, telephone message forms, safety reports
5. Workplace interactions	5.1 Face to face 5.2 Telephone 5.3 Electronic and two way radio 5.4 Written including electronic, memos, instruction and forms, non-verbal including gestures, signals, signs and diagrams
6. Protocols	6.1 Observing meeting 6.2 Compliance with meeting decisions 6.3 Obeying meeting instructions

EVIDENCE GUIDE

1. Critical aspects of competency	Assessment requires evidence that the candidate: 1.1 Prepared written communication following standard format of the organization 1.2 Accessed information using communication equipment 1.3 Made use of relevant terms as an aid to transfer information effectively 1.4 Conveyed information effectively adopting the formal or informal communication
2. Underpinning knowledge and attitudes	2.1 Effective communication 2.2 Different modes of communication 2.3 Written communication 2.4 Organizational policies 2.5 Communication procedures and systems 2.6 Technology relevant to the enterprise and the individual's work responsibilities
3. Underpinning skills	3.1 Follow simple spoken language 3.2 Perform routine workplace duties following simple written notices 3.3 Participate in workplace meetings and discussions 3.4 Complete work related documents 3.5 Estimate, calculate and record routine workplace measures 3.6 Basic mathematical processes of addition, subtraction, division and multiplication 3.7 Ability to relate to people of social range in the workplace 3.8 Gather and provide information in response to workplace Requirements
4. Resource implications	4.1 Fax machine 4.2 Telephone 4.3 Writing materials 4.4 Internet
5. Methods of assessment	5.1 Direct Observation 5.2 Oral interview and written test
6. Context of assessment	6.1 Competency may be assessed individually in the actual workplace or through accredited institution

UNIT OF COMPETENCY: WORK IN TEAM ENVIRONMENT

UNIT CODE : 500311106

UNIT DESCRIPTOR : This unit covers the skills, knowledge and attitudes to identify role and responsibility as a member of a team.

ELEMENT	PERFORMANCE CRITERIA ***Italicized*** terms are elaborated in the Range of Variables
1. Describe team role and scope	1.1 The ***role and objective of the team*** is identified from available ***sources of information***
	1.2 Team parameters, reporting relationships and responsibilities are identified from team discussions and appropriate external sources
2. Identify own role and responsibility within team	2.1 Individual role and responsibilities within the team environment are identified
	2.2 Roles and responsibility of other team members are identified and recognized
	2.3 Reporting relationships within team and external to team are identified
3. Work as a team member	3.1 Effective and appropriate forms of communications used and interactions undertaken with team members who contribute to known team activities and objectives
	3.2 Effective and appropriate contributions made to complement team activities and objectives, based on individual skills and competencies and ***workplace context***
	3.3 Observed protocols in reporting using standard operating procedures
	3.4 Contribute to the development of team work plans based on an understanding of team's role and objectives and individual competencies of the members.

RANGE OF VARIABLES

VARIABLE	RANGE
1. Role and objective of team	1.1 Work activities in a team environment with enterprise or specific sector 1.2 Limited discretion, initiative and judgement maybe demonstrated on the job, either individually or in a team environment
2. Sources of information	2.1 Standard operating and/or other workplace procedures 2.2 Job procedures 2.3 Machine/equipment manufacturer's specifications and instructions 2.4 Organizational or external personnel 2.5 Client/supplier instructions 2.6 Quality standards 2.7 OHS and environmental standards
3. Workplace context	3.1 Work procedures and practices 3.2 Conditions of work environments 3.3 Legislation and industrial agreements 3.4 Standard work practice including the storage, safe handling and disposal of chemicals 3.5 Safety, environmental, housekeeping and quality guidelines

EVIDENCE GUIDE

1. Critical aspects of competency	Assessment requires evidence that the candidate: 1.1 Operated in a team to complete workplace activity 1.2 Worked effectively with others 1.3 Conveyed information in written or oral form 1.4 Selected and used appropriate workplace language 1.5 Followed designated work plan for the job 1.6 Reported outcomes
2. Underpinning knowledge and attitude	2.1 Communication process 2.2 Team structure 2.3 Team roles 2.4 Group planning and decision making
3. Underpinning skills	3.1 Communicate appropriately, consistent with the culture of the workplace
4. Resource implications	The following resources MUST be provided: 4.1 Access to relevant workplace or appropriately simulated environment where assessment can take place 4.2. Materials relevant to the proposed activity or tasks
5. Method of assessment	Competency may be assessed through: 5.1 Observation of the individual member in relation to the work activities of the group 5.2 Observation of simulation and or role play involving the participation of individual member to the attainment of organizational goal 5.3. Case studies and scenarios as a basis for discussion of issues and strategies in teamwork
6. Context of assessment	6.1 Competency may be assessed in workplace or in a simulated workplace setting 6.2 Assessment shall be observed while task are being undertaken whether individually or in group

UNIT OF COMPETENCY: PRACTICE CAREER PROFESSIONALISM

UNIT CODE : 500311107

UNIT DESCRIPTOR : This unit covers the knowledge, skills and attitudes in promoting career growth and advancement.

ELEMENT	PERFORMANCE CRITERIA ***Italicized*** terms are elaborated in the Range of Variables
1. Integrate personal objectives with organizational goals	1.1 Personal growth and work plans are pursued towards improving the qualifications set for the profession 1.2 Intra- and interpersonal relationships ~~is~~ are maintained in the course of managing oneself based on performance ***evaluation*** 1.3 Commitment to the organization and its goal is demonstrated in the performance of duties
1. Set and meet work priorities	2.1 Competing demands are prioritized to achieve personal, team and organizational goals and objectives. 2.2 ***Resources*** are utilized efficiently and effectively to manage work priorities and commitments 2.3 Practices along economic use and maintenance of equipment and facilities are followed as per established procedures
2. Maintain professional growth and development	3.1 ***Trainings and career opportunities*** are identified and availed of based on job requirements 3.2 ***Recognitions*** are sought/received and demonstrated as proof of career advancement 3.3 ***Licenses and/or certifications*** relevant to job and career are obtained and renewed

RANGE OF VARIABLES

VARIABLE	RANGE
1. Evaluation	1.1 Performance Appraisal 1.2 Psychological Profile 1.3 Aptitude Tests
2. Resources	2.1 Human 2.2 Financial 2.3 Technology 2.3.1 Hardware 2.3.2 Software
3. Trainings and career opportunities	3.1 Participation in training programs 3.1.1 Technical 3.1.2 Supervisory 3.1.3 Managerial 3.1.4 Continuing Education 3.2 Serving as Resource Persons in conferences and workshops
4. Recognitions	4.1 Recommendations 4.2 Citations 4.3 Certificate of Appreciations 4.4 Commendations 4.5 Awards 4.6 Tangible and Intangible Rewards
5. Licenses and/or certifications	5.1 National Certificates 5.2 Certificate of Competency 5.3 Support Level Licenses 5.4 Professional Licenses

EVIDENCE GUIDE

1. Critical aspects of competency	Assessment requires evidence that the candidate: 1.1 Attained job targets within key result areas (KRAs) 1.2 Maintained intra - and interpersonal relationship in the course of managing oneself based on performance evaluation 1.3 Completed trainings and career opportunities which are based on the requirements of the industries 1.4 Acquired and maintained licenses and/or certifications according to the requirement of the qualification
2. Underpinning knowledge and attitude	2.1 Work values and ethics (Code of Conduct, Code of Ethics, etc.) 2.2 Company policies 2.3 Company-operations, procedures and standards 2.4 Fundamental rights at work including gender sensitivity 2.5 Personal hygiene practices
3. Underpinning skills	3.1 Appropriate practice of personal hygiene 3.2 Intra and Interpersonal skills 3.3 Communication skills
4. Resource implications	The following resources **MUST** be provided: 4.1 Workplace or assessment location 4.2 Case studies/scenarios
5. Methods of assessment	Competency may be assessed through: 5.1 Portfolio Assessment 5.2 Interview 5.3 Simulation/Role-plays 5.4 Observation 5.5 Third Party Reports 5.6 Exams and Tests
6. Context of assessment	6.1 Competency may be assessed in the work place or in a simulated work place setting

UNIT OF COMPETENCY : **PRACTICE OCCUPATIONAL HEALTH AND SAFETY PROCEDURES**

UNIT CODE: **500311108**

UNIT DESCRIPTOR: This unit covers the outcomes required to comply with regulatory and organizational requirements for occupational health and safety.

ELEMENT	PERFORMANCE CRITERIA ***Italicized*** terms are elaborated in the Range of Variables
1. Identify hazards and risks	1.1 ***Safety regulations*** and workplace safety and hazard control practices and procedures are clarified and explained based on organization procedures 1.2 ***Hazards/risks*** in the workplace and their corresponding indicators are identified to minimize or eliminate risk to co-workers, workplace and environment in accordance with organization procedures 1.3 ***Contingency measures*** during workplace accidents, fire and other emergencies are recognized and established in accordance with organization procedures
2. Evaluate hazards and risks	2.1 Terms of maximum tolerable limits which when exceeded will result in harm or damage are identified based on threshold limit values (TLV) 2.2 Effects of the hazards are determined 2.3 OHS issues and/or concerns and identified safety hazards are reported to designated personnel in accordance with workplace requirements and relevant workplace OHS legislation
3. Control hazards and risks	3.1 Occupational Health and Safety (OHS) procedures for controlling hazards/risks in workplace are consistently followed 3.2 Procedures for dealing with workplace accidents, fire and emergencies are followed in accordance with organization OHS policies 3.3 ***Personal protective equipment (PPE)*** is correctly used in accordance with organization OHS procedures and practices 3.4 Appropriate assistance is provided in the event of a workplace emergency in accordance with established organization protocol
4. Maintain OHS awareness	4.1 ***Emergency-related drills and trainings*** are participated in as per established organization guidelines and procedures 4.2 ***OHS personal records*** are completed and updated in accordance with workplace requirements

RANGE OF VARIABLES

VARIABLE	RANGE
1. Safety regulations	May include but are not limited to: 1.1 Clean Air Act 1.2 Building code 1.3 National Electrical and Fire Safety Codes 1.4 Waste management statutes and rules 1.5 Philippine Occupational Safety and Health Standards 1.6 DOLE regulations on safety legal requirements 1.7 ECC regulations
2. Hazards/risks	May include but are not limited to: 2.1 Physical hazards – impact, illumination, pressure, noise, vibration, temperature, radiation 2.2 Biological hazards- bacteria, viruses, plants, parasites, mites, molds, fungi, insects 2.3 Chemical hazards – dusts, fibers, mists, fumes, smoke, gasses, vapors 2.4 Ergonomics • Psychological factors – over exertion/ excessive force, awkward/static positions, fatigue, direct pressure, varying metabolic cycles • Physiological factors – monotony, personal relationship, work out cycle
3. Contingency measures	May include but are not limited to: 3.1 Evacuation 3.2 Isolation 3.3 Decontamination 3.4 (Calling designed) emergency personnel
4. PPE	May include but are not limited to: 4.1 Mask 4.2 Gloves 4.3 Goggles 4.4 Hair Net/cap/bonnet 4.5 Face mask/shield 4.6 Ear muffs 4.7 Apron/Gown/coverall/jump suit 4.8 Anti-static suits
5. Emergency-related drills and training	5.1 Fire drill 5.2 Earthquake drill 5.3 Basic life support/CPR 5.4 First aid 5.5 Spillage control 5.6 Decontamination of chemical and toxic 5.7 Disaster preparedness/management
6. OHS personal records	6.1 Medical/Health records 6.2 Incident reports 6.3 Accident reports 6.4 OHS-related training completed

EVIDENCE GUIDE

1. Critical aspects of competency	Assessment requires evidence that the candidate: 1.1 Explained clearly established workplace safety and hazard control practices and procedures 1.2 Identified hazards/risks in the workplace and its corresponding indicators in accordance with company procedures 1.3 Recognized contingency measures during workplace accidents, fire and other emergencies 1.4 Identified terms of maximum tolerable limits based on threshold limit value- TLV. 1.5 Followed Occupational Health and Safety (OHS) procedures for controlling hazards/risks in workplace 1.6 Used Personal Protective Equipment (PPE) in accordance with company OHS procedures and practices 1.7 Completed and updated OHS personal records in accordance with workplace requirements
2. Underpinning knowledge and attitude	2.1 OHS procedures and practices and regulations 2.2 PPE types and uses 2.3 Personal hygiene practices 2.4 Hazards/risks identification and control 2.5 Threshold Limit Value -TLV 2.6 OHS indicators 2.7 Organization safety and health protocol 2.8 Safety consciousness 2.9 Health consciousness
3. Underpinning skills	3.1 Practice of personal hygiene 3.2 Hazards/risks identification and control skills 3.3 Interpersonal skills 3.4 Communication skills
4. Resource implications	The following resources must be provided: 4.1 Workplace or assessment location 4.2 OHS personal records 4.3 PPE 4.4 Health records
5. Method of assessment	Competency may be assessed through: 5.1 Portfolio Assessment 5.2 Interview 5.3 Case Study/Situation
6. Context of assessment	6.1 Competency may be assessed in the work place or in a simulated work place setting

COMMON COMPETENCIES

UNIT OF COMPETENCY: PREPARE CONSTRUCTION MATERIALS AND TOOLS

UNIT CODE : CON724201

UNIT DESCRIPTOR : This unit covers the knowledge, skills and attitudes on identifying, requesting and receiving construction materials and tools based on the required performance standards.

ELEMENT	PERFORMANCE CRITERIA ***Italicized*** terms are elaborated in the Range of Variable
1. Identify materials	1.1 ***Materials*** are listed as per job requirements 1.2 Quantity and ***description of materials*** conform with the job requirements 1.3 ***Tools*** and accessories are identified according to job requirements
2. Requisition materials	2.1 Materials and tools needed are requested according to the list prepared 2.2 Request is done as per ***company standard operating procedures (SOP)*** 2.2 Substitute materials and tools are provided without sacrificing cost and quality of work
3. Receive and inspect materials	3.1 Materials and tools issued are inspected as per quantity and specification 3.2 Tools, accessories and materials are checked for damages according to enterprise procedures 3.3 Materials and tools are set aside to appropriate location nearest to the workplace

RANGE OF VARIABLES

VARIABLE	RANGE
1. Materials and Tools	1.1 Electrical supplies 1.2 Structural 1.3 Plumbing 1.4 Welding/pipefitting 1.5 Carpentry 1.6 Masonry
2. Description of Materials and Tools	2.1 Brand name 2.2 Size 2.3 Capacity 2.4 Kind of application
3. Company standard procedures	3.1 Job order 3.2 Requisition slip 3.3 Borrower slip

EVIDENCE GUIDE

1. Critical aspects of competency	Assessment requires evidence that the candidate: 1.1 Listed materials and tools according to quantity and job requirements 1.2 Requested materials and tools according to the list prepared and as per company SOP 1.3 Inspected issued materials and tools as per quantity and job specifications 1.4 Tools provided with appropriate safety devices
2. Underpinning knowledge and attitude	2.1 Types and uses of construction materials and tools 2.2 Different forms 2.3 Requisition procedures
3. Underpinning skills	3.1 Preparing materials and tools 3.2 Proper handling of tools and equipment 3.3 Following instructions
4. Resource implications	The following resources should be provided: 4.1 Workplace location 4.2 Materials relevant to the unit of competency 4.3 Technical plans, drawings and specifications relevant to the activities
5. Method of assessment	Competency in this unit must be assessed through: 5.1 Direct observation and oral questioning
6. Context of assessment	6.1 Competency may be assessed in the workplace or in a simulated workplace 6.2 Competency assessment must be undertaken in accordance with the endorsed TESDA assessment guidelines

UNIT OF COMPETENCY: **OBSERVE PROCEDURES, SPECIFICATIONS AND MANUALS OF INSTRUCTIONS**

UNIT CODE : **CON311201**

UNIT DESCRIPTOR : This unit covers the knowledge, skills and attitudes on identifying, interpreting, applying services to specifications and manuals and storing manuals.

ELEMENT	PERFORMANCE CRITERIA ***Italicized*** terms are elaborated in the Range of Variables
1. Identify and access specification/manuals	1.1 Appropriate manuals are identified and accessed as per job requirements 1.2 Version and date of manual are checked to ensure that correct specification and procedures are identified
2. Interpret manuals	2.1 Relevant sections, chapters of specifications/ manuals are located in relation to the work to be conducted 2.2 Information and procedure in the manual are interpreted in accordance with industry practices
3. Apply information in manual	3.1 ***Manual*** is interpreted according to job requirements 3.2 Work steps are correctly identified in accordance with manufacturer's specification 3.3 Manual data are applied according to the given task 3.4 All correct sequencing and adjustments are interpreted in accordance with information contained on the manual or specifications
4. Store manuals	4.1 Manual or specification is stored appropriately to prevent damage, ready access and updating of information when required in accordance with company requirements

RANGE OF VARIABLES

VARIABLE	RANGE
1. Procedures, specifications and manuals of instructions	Kinds of Manuals: 1.1 Manufacturer's Specification Manual 1.2 Repair Manual 1.3 Maintenance Procedure Manual 1.4 Periodic Maintenance Manual

EVIDENCE GUIDE

1. Critical aspects of competency	Assessment requires that the candidate: 1.1 Identified and accessed specification/manuals as per job requirements 1.2 Interpreted manuals in accordance with industry practices 1.3 Applied information in manuals according to the given task 1.4 Stored manuals in accordance with company requirements
2. Underpinning knowledge and attitude	2.1 Types of manuals used in construction sector 2.2 Identification of symbols used in the manuals 2.3 Identification of units of measurements 2.4 Unit conversion
3. Underpinning skills	3.1 Reading and comprehension skills required to identify and interpret construction manuals and specifications 3.2 Accessing information and data
4. Resource implications	The following resources should be provided: 4.1 All manuals/catalogues relative to construction sector
5. Method of assessment	Competency should be assessed through: 5.1 Direct observation 5.2 Questions/interview Assessment of underpinning knowledge and practical skills may be combined
6. Context of assessment	6.1 Competency assessment must be undertaken in accordance with the endorsed TESDA assessment guidelines 6.2 Assessment may be conducted in the workplace or a simulated environment

UNIT OF COMPETENCY: INTERPRET TECHNICAL DRAWINGS AND PLANS

UNIT CODE : CON311202

UNIT DESCRIPTOR : This unit covers the knowledge, skills and attitudes on analyzing and interpreting symbols, data and work plan based on the required performance standards.

ELEMENT	PERFORMANCE CRITERIA ***Italicized*** terms are elaborated in the Range of Variables
1. Analyze signs, symbols and data	1.1 ***Technical plans*** are obtained according to job requirements 1.2 Signs, symbols and data are identified according to job specifications 1.3 Signs symbols and data are determined according to ***classification*** or as appropriate in ***drawing***
2. Interpret technical drawings and plans	2.1 Necessary ***tools, materials*** and equipment are identified according to the ***plan*** 2.2 Supplies and materials are listed according to specifications 2.3 Components, assemblies or objects are recognized as required 2.4 Dimensions are identified as appropriate to the plan 2.5 Specification details are matched with existing/available resources and in line with job requirements 2.6 Work plan is drawn following the specifications
3. Apply freehand sketching	3.1 Where applicable, correct freehand sketching is produced in accordance with the job requirements

RANGE OF VARIABLES

VARIABLE	RANGE
1. Technical plans	Including but not limited to: 1.1 Electrical plans 1.2 Structural plans 1.3 Architectural plans 1.4 Plumbing plans 1.5 Welding Procedures Specifications (WPS)
2. Work plan	2.1 Job requirements 2.2 Installation instructions 2.3 Components instruction
3. Classification	Including but not limited to: 3.1 Electrical 3.2 Mechanical 3.3 Plumbing
4. Drawing	4.1 Drawing symbols 4.2 Alphabet of lines 4.3 Orthographic views - Front view - Right side view/left side view - Top view - Pictorial 4.4 Schematic diagram 4.5 Electrical drawings 4.6 Structural drawings 4.7 Plumbing drawings - Water - Sewerage/Drainage - Ventilation 4.8 Welding symbols
5. Tools and materials	Including but not limited to: 5.1 Compass 5.2 Divider 5.3 Rulers 5.4 Triangles 5.5 Drawing tables 5.6 Computer

EVIDENCE GUIDE

1. Critical aspects of competency	Assessment requires that the candidate: 1.1 Identified and determined signs, symbols and data according to work plan, job requirements and classifications 1.2 Identified tools and equipment in accordance with job requirements 1.3 Listed supplies and materials according to blueprint specifications 1.4 Drawn workplan following specifications 1.5 Determined job specifications based on working/technical drawing
2. Underpinning knowledge and attitude	2.1 TRADE MATHEMATICS • Linear measurement • Dimension • Unit conversion 2.2 BLUEPRINT READING AND PLAN SPECIFICATION • Electrical, mechanical plan, symbols and abbreviations • Drawing standard symbols 2.3 TRADE THEORY • Basic technical drawing • Types technical plans • Various types of drawings • Notes and specifications
3. Underpinning skills	3.1 Interpreting drawing/orthographic drawing 3.2 Interpreting technical plans 3.3 Matching specification details with existing resources 3.4 Following instructions 3.5 Handling of drawing instruments
4. Resource implications	The following resources should be provided: 4.1 Workplace 4.2 Drawings and specification relevant to task 4.3 Materials and instrument relevant to proposed activity
5. Method of assessment	Competency should be assessed through: 5.1 Direct observation 5.2 Questions/interview 5.3 Written test related to underpinning knowledge
6. Context of assessment	6.1 Competency assessment may occur in the workplace or in any appropriate simulated environment 6.2 Assessment shall be observed while task are being undertaken whether individually or in group 6.3 Competency assessment must be undertaken in accordance with the endorsed TESDA assessment guidelines

UNIT OF COMPETENCY: PERFORM MENSURATIONS AND CALCULATIONS

UNIT CODE : CON311203

UNIT DESCRIPTOR : This unit covers the knowledge, skills and attitudes on identifying and measuring objects based on the required performance standards.

ELEMENT	PERFORMANCE CRITERIA ***Italicized** terms* are elaborated in the Range of Variable
1. Select measuring instruments	1.1 Object or component to be measured is identified, classified and interpreted according to the appropriate regular ***geometric shape*** 1.2 Measuring tools are selected/identified as per object to be measured or job requirements 1.3 Correct specifications are obtained from relevant sources 1.4 Appropriate measuring instruments are selected according to job requirements 1.5 Alternative measuring tools are used without sacrificing cost and quality of work
2. Carry out measurements and calculations	2.1 Accurate ***measurements*** are obtained according to job requirements 2.3 Alternative measuring tools are used without sacrificing cost and quality of work 2.4 ***Calculation*** needed to complete work tasks are performed using the four basic process of addition (+), subtraction (-), multiplication (x) and division (/) including but not limited to: trigonometric functions, algebraic computations 2.5 Calculations involving fractions, percentages and mixed numbers are used to complete workplace tasks 2.6 Numerical computation is self-checked and corrected for accuracy 2.7 Instruments are read to the limit of accuracy of the tool 2.8 Systems of measurement identified and converted according to job requirements/ISO 2.9 Workpieces are measured according to job requirements

RANGE OF VARIABLES

VARIABLE	RANGE
1. Geometric shape	Including but is not limited to: 1.1 Round 1.2 Square 1.3 Rectangular 1.4 Triangle 1.5 Sphere 1.6 Conical
2. Measuring instruments	Including but not limited to: 2.1 Micrometer (In-out, depth) 2.2 Vernier caliper (out, inside) 2.3 Dial gauge with mag, std. 2.4 Straight edge 2.5 Thickness gauge 2.6 Torque gauge 2.7 Small hole gauge 2.8 Telescopic gauge 2.9 Try-square 2.10 Protractor 2.11 Combination gauge 2.12 Steel rule 2.13 Voltmeter 2.14 Ammeter 2.15 Mega-ohmeter 2.16 Kilowatt hour meter 2.17 Gauges 2.18 Thermometers
2. Measurements and calculations	3.1 Linear 3.2 Volume 3.3 Area 3.4 Wattage 3.5 Voltage 3.6 Resistance 3.7 Amperage 3.8 Frequency 3.9 Impedance
	3.10 Conductance 3.11 Capacitance 3.12 Displacement 3.13 Inside diameter 3.14 Circumference 3.15 Length 3.16 Thickness 3.17 Outside diameter 3.18 Taper 3.19 Out of roundness 3.20 Oil clearance 3.21 End play/Thrust clearance

EVIDENCE GUIDE

1. Critical aspects of competency	Assessment requires that the candidate: 1.1 Selected and prepared appropriate measuring instruments in accordance with job requirements 1.2 Performed measurements and calculations according to job requirements/ ISO
2. Underpinning knowledge and attitude	2.1 TRADE MATHEMATICS / MENSURATION • Four fundamental operation • Linear measurement • Dimensions • Unit conversion • Ratio and proportion • Trigonometric functions • Algebraic equations
3. Underpinning skills	3.1 Performing calculation by addition, subtraction, multiplication and division; trigonometric functions and algebraic equations 3.2 Visualizing objects and shapes 3.3 Interpreting formulas for volume, areas, perimeters of plane and geometric figures 3.4 Proper handling of measuring instruments
4. Resource implications	The following resources should be provided: 4.1 Workplace location 4.2 Problems to solve 4.3 Measuring instrument appropriate to carry out tasks 4.4 Instructional materials relevant to the propose activity Assessment of underpinning knowledge and practical skills may be combined
5. Method of assessment	Competency should be assessed through: 5.1 Actual demonstration 5.2 Direct observation 5.3 Written test/questioning related to underpinning knowledge
6. Context of assessment	6.1 Competency assessment may occur in workplace or any appropriate simulated environment 6.2 Assessment shall be observed while task are being undertaken whether individually or in group 6.3 Competency assessment must be undertaken in accordance with the TESDA assessment guidelines

UNIT OF COMPETENCY: MAINTAIN TOOLS AND EQUIPMENT
UNIT CODE : CON311204

UNIT DESCRIPTOR : This unit covers the knowledge, skills and attitudes on checking condition, performing preventive maintenance and storing of tools and equipment based on the required performance standards.

ELEMENT	PERFORMANCE CRITERIA ***Italicized*** terms are elaborated in the Range of Variables
1. Check condition of tools and equipment	1.1 ***Materials, tools and equipmen***t are identified according to classification and job requirements 1.2 Non-functional tools and equipment are segregated and labeled according to classification 1.3 Safety of tools and equipment are observed in accordance with manufacturer's instructions 1.4 Condition of ***PPE*** are checked in accordance with manufacturer's instructions
2. Perform basic preventive maintenance	2.1 Appropriate lubricants are identified according to types of equipment 2.2 Tools and equipment are lubricated according to preventive maintenance schedule or manufacturer's specifications 2.2 Measuring instruments are checked and calibrated in accordance with manufacturer's instructions 2.4 Tools are cleaned and lubricated according to standard procedures 2.4 Defective instruments, equipment and accessories are inspected and replaced according to manufacturer's specifications 2.6 Tools are inspected, repaired and replaced after use 2.7 Work place is cleaned and kept in safe state in line with OHSA regulations
3. Store tools and equipment	3.1 Inventory of tools, instruments and equipment are conducted and recorded as per company practices 3.3 Tools and equipment are stored safely in appropriate locations in accordance with manufacturer's specifications or company procedures

RANGE OF VARIABLES

VARIABLE	RANGE
1. Materials	Including but not limited to: 1.1 Lubricants 1.2 Cleaning materials 1.3 Rust remover 1.4 Rugs 1.5 Spare parts
2. Tools and equipment	Including but not limited to: 2.1 Tools - Cutting tools - hacksaw, crosscut saw, rip saw - Boring tools - auger, brace, gimlet, hand drill - Holding tools - vise grip, C-clamp, bench vise - Threading tools - die and stock, taps 2.2 Measuring instruments/equipment
3. PPE	Including but not limited to: 3.1 Goggles 3.2 Gloves 3.3 Safety shoes 3.4 Aprons/Coveralls
4. Forms	4.1 Maintenance schedule forms 4.2 Requisition slip 4.3 Inventory Form 4.4 Inspection Form 4.5 Procedures

EVIDENCE GUIDE

1. Critical aspects of competency	Assessment requires that the candidate: 1.1 Selected and used appropriate processes, tools and equipment to carry out task 1.2 Identified functional and non-functional tools and equipment 1.3 Checked, lubricated and calibrated tools, equipment and instruments according to manufacturer's specifications 1.4 Replaced defective tools, equipment and their accessories 1.5 Observed and applied safe handling of tools and equipment and safety work practices 1.6 Prepared and submitted inventory report, where applicable 1.7 Maintained workplace in accordance with OHSA regulations 1.8 Stored tools and equipment safely in appropriate locations and in accordance with company practices
2. Underpinning knowledge and attitude	**2.1 SAFETY PRACTICES** • Use of PPE • Handling of tools and equipment • Good housekeeping **2.2 MATERIALS, TOOLS AND EQUIPMENT** • Types and uses of lubricants • Types and uses of cleaning materials • Types and uses of measuring instruments and equipment **2.3 PREVENTIVE MAINTENANCE** • Methods and techniques • Procedures
3. Underpinning skills	3.1 Preparing maintenance materials, tools and equipment 3.2 Proper handling of tools and equipment 3.3 Performing preventive maintenance 3.4 Following instructions
4. Resource implications	The following resources should be provided: 4.1 Workplace 4.2 Maintenance schedule 4.3 Maintenance materials, tools and equipment relevant to the proposed activity/task
5. Method of assessment	Competency should be assessed through: 5.1 Direct observation 5.2 Written test/questioning relevant to Underpinning knowledge
6. Context of assessment	6.1 Competency assessment may occur in workplace or any appropriate simulated environment 6.2 Competency assessment must be undertaken in accordance with the endorsed TESDA assessment guidelines

CORE COMPETENCIES

UNIT OF COMPETENCY : PERFORM SITE ASSESSMENT

UNIT CODE : CON724325

UNIT DESCRIPTOR : This unit deals with the knowledge, skills and attitudes in performing site assessment.

ELEMENT	PERFORMANCE CRITERIA ***Italicized*** terms are elaborated in the Range of Variables
1. Validate parameters for the installation	1.1 Ocular survey of ***location/area*** is performed in accordance with design considerations and validated with the use of ***prescribed instruments*** 1.2 ***Installation parameters*** of the system design are validated against existing site conditions 1.3 Variances in the parameters of ***components***, if any, are identified and noted in the installation checklist form
2. Prepare installation data sheet	2.1 Installation layout is prepared following existing safety standards, accepted best practices, and user preferences 2.2 Components lay out is prepared according to the installation data sheet 2.3 Final layout takes into account validated parameters 2.4 ***Logistical considerations*** are taken into account and noted in the report.

RANGE OF VARIABLES

VARIABLE	RANGE
1. Location/Area	1.1 Roof 1.2 Ground area 1.3 Ceiling 1.4 Wall 1.5 Ventilated area 1.6 Not-ventilated area 1.7 House area in square meters 1.8 Mode of Transportation/hauling 1.9 Degree of ease/difficulty of access to site 1.10 Weather data
2. Prescribed instruments	2.1 Magnetic Compass 2.2 Measuring Tapes 2.3 Altimeter 2.4 GPS 2.5 Transit 2.6 Video 2.7 Push/pull rule tape 2.8 Camera
3. Installation parameters	3.1 Work area 3.2 Shading 3.3 Structure characteristics 3.4 Soil type/condition 3.5 Flow rate of water source
4. Components	4.1 PV Module/array 4.2 Support structures 4.3 Charge Controller/regulator 4.4 Battery/battery bank 4.5 Inverter/converter 4.6 Lighting fixtures and accessories 4.7 Convenience outlets for appliances and devices 4.8 Wires and cables 4.9 Fastening fixtures
5. Logistical Considerations	5.1 Transport/hauling 5.2 Storage of materials/supplies 5.3 Security Condition 5.4 Work schedules 5.5 Access Road 5.6 Insurance requirement 5.7 Board and lodging 5.8 Food/drinking water 5.9 Travel expenses 5.10 Weather/climate 5.11 Contingency fund 5.12 Porters

EVIDENCE GUIDE

1. Critical aspects of competency	Assessment requires evidence that the candidate 1.1 Performed site assessment 1.2 Validated installation design parameters 1.3 Determined locations of all components 1.4 Validated parameters for the installations 1.5 Prepared installation data sheet
2. Underpinning knowledge and attitudes	2.1 PV technology and systems 2.2 Principles of electricity 2.3 Electrical load characteristics 2.4 Safety working habits 2.5 Basic mathematical operations 2.6 System components characteristics 2.7 Instruments used in site assessment 2.8 Enterprise goals, targets, and measures 2.9 Environmental requirements 2.10 Principles of decision making strategies and techniques 2.11 Observant/attentive to details 2.12 Honest 2.13 Courteous
3. Underpinning skills	3.1 Interpretations of installation electrical drawing 3.2 Preparing materials & instruments 3.3 Surveying skills and experience 3.4 Communication skills 3.5 Interpersonal Skills 3.6 Instrument surveying skills 3.7 Drawing specification skills 3.8 Mapping skills 3.9 Using range of formal problem solving technique 3.10 Solution evaluation skills
4. Resource implications	The following resources must be provided: 4.1 Drawings/Specifications relevant to task 4.2 Site/location map 4.3 Materials/instruments relevant to site assessment 4.4 Forms
5. Method of assessment	Competency must be assessed through: 5.1 Demonstration and observation with question 5.2 Oral/written examination 5.3 Portfolio 5.4 Third party report
6. Context of assessment	6.1 Competency may be assessed in the workplace or in a simulated workplace 6.2 Competency assessment must be undertaken in accordance with the endorsed TESDA assessment guidelines

UNIT OF COMPETENCY : **CHECK PV COMPONENTS/MATERIALS COMPLIANCE**

UNIT CODE : **CON724326**

UNIT DESCRIPTOR : This unit covers the knowledge, skills and attitudes in checking PV components/materials compliance prior to installation.

ELEMENT	PERFORMANCE CRITERIA ***Italicized*** terms are elaborated in the Range of Variables
1. Identify components/ materials and specifications for inspection/ testing	1.1 ***Components/Materials*** are listed as per job requirements 1.2 Component/Material ***specifications*** are listed for inspection/testing 1.3 Components/materials are identified in line with job order requirements 1.4 Components/materials are inspected for damage in line with enterprise requirements 1.5 Damaged component/materials and accessories are recorded/noted and reported to supervisor
2. Interpret manuals	2.1 Relevant sections and chapters of specifications/manuals are located in relation to the work to be conducted 2.2 Information and procedure in the manual are interpreted in accordance to the job requirement 2.3 Testing procedure are prepared according to the manufacturers' specifications. 2.4 Manuals of components/materials and accessories are interpreted in line manufacturer/supplier/specification
3. Identify and prepare test instruments	3.1 ***Test instruments*** are listed as per job order requirement 3.2 Test instrument specifications are complied with in accordance to the test procedure requirement
4. Inspect/test components and materials	4.1 ***Testing procedures*** are identified in accordance with the manufacturer's specifications 4.2 Tests results are recorded in material testing forms 4.3 Inspection/Testing is accomplished without causing damage to components and materials and injury to self and others 4.4 Task is performed using ***personal protective equipment (PPE)***
5. Report test results	5.1 Test results are evaluated against the manufacturer's specifications 5.2 Report is made on the compliance or non-compliance of the material according to manufacturer's specifications
6 Notify completion of work	6.1 Final checks are made to ensure that work conforms with instructions and job requirements 6.2 Supervisor is notified upon completion of work 6.3 Tools, equipment and any surplus resources and materials are, where appropriate, cleaned, checked and returned to storage in accordance with established procedures 6.4 Work area is cleaned up and made safe according to occupational health and safety (OH & S) regulation

RANGE OF VARIABLES

VARIABLE	RANGE
1. Components materials	1.1 PV Module/array 1.2 Support structures 1.3 Charge Controller/regulator 1.4 Battery/battery bank 1.5 Inverter/converter 1.6 Lighting fixtures and accessories 1.7 Convenience outlets for appliances and devices 1.8 Wires and cables 1.9 Fastening fixtures
2. Specifications	2.1 Voltage 2.2 Current 2.3 Voltage settings 2.4 Specific gravity 2.5 Illumination of lights 2.6 International Electro-technical Commission (IEC) and other certifying bodies 2.7 Dimension (length, diameter/size, thickness) 2.8 IP/NEMA outdoor ratings (tropicalized, sunlight-resistant)
3. Test instruments	3.1 Voltmeter 3.2 Ammeter 3.3 Variable Power Supply 3.4 Hydrometer 3.5 Lux meter 3.6 Multi-meter 3.7 Clamp meter
4. Test procedures	4.1 Measurement of terminal voltage 4.2 Measurement of current flow 4.3 Measurement of voltage settings of charge controller/regulator 4.4 Measurement of specific gravity of battery electrolyte solution 4.5 Measurement of illumination output of lights
5. Personal protective equipment (PPE)	5.1 Goggles 5.2 Rubber gloves 5.3 Safety shoes 5.4 Leather apron 5.5 Hard hat

EVIDENCE GUIDE

1. Critical aspects of competency	Assessment requires evidence that the candidate: 1.1 Identified and selected components/materials 1.2 Checked quality and ratings of test equipment 1.3 Inspected/Tested components/materials 1.4 Reported and replaced defective materials and tools to supervisor 1.5 Checked PV components and materials compliance 1.6 Identified and prepare test instruments 1.7 Interpreted manuals 1.8 Inspected PV components and materials for damage in line with job requirement
2. Underpinning knowledge and attitudes	2.1 Basic principles of electricity 2.2 Electrical measuring instruments 2.3 Basic mathematics 2.4 IEC and other certifying body standards 2.5 IP/NEMA standards 2.6 Product Standards (PS) 2.7 Selection and usage of tools 2.8 Personal Protective Equipment (PPE) 2.9 Types and uses of PV components/materials 2.10 Different forms 2.11 Requisition procedure 2.12 Types of PV specifications and tools 2.13 Common materials 2.14 Common damage to PV components/materials/ accessories 2.15 Safety Conscious 2.16 Observant/Attentive to details 2.17 Safety conscious 2.18 Honest 2.19 Patience
3. Underpinning skills	3.1 Visual assessment of components/materials 3.2 Preparing materials/tools/tests 3.3 Using test instruments, tools, and equipment 3.4 5S Skills 3.5 Reading and interpreting manufacturer's specifications and manuals 3.6 Mathematical skills 3.7 Proper handling of PV components/materials 3.8 Following instructions
4. Resource implications	The following resources MUST be provided: 4.1 Workplace location 4.2 Tools and equipment appropriate for the activity 4.3 Manufacturer's manual 4.4 Personal Protective Equipment (PPE) 4.5 Inspection/testing instruments 4.7 PV Components/materials appropriate for electrical installation lay-out

5. Method of assessment	Competency must be assessed through: 5.1 Demonstration and observation with question 5.2 Written/oral examination 5.3 Portfolio 5.4 Third party
6. Context of assessment	6.1 Competency may be assessed in the workplace or in a simulated workplace 6.2 Competency assessment must be undertaken in accordance with the endorsed TESDA assessment guidelines

UNIT OF COMPETENCY : INSTALL PV SYSTEMS

UNIT CODE : CON724327

UNIT DESCRIPTOR : This unit covers the knowledge, skills and attitude in installing stand alone PV system 1 KW or less.

ELEMENT	PERFORMANCE CRITERIA ***Italicized*** terms are elaborated in the Range of Variables
1. Plan and prepare work	1.1 Electrical drawings are read and interpreted to determine job order requirements 1.2 Type and quantity of ***system components*** and other materials are identified in line with job order requirements 1.3 ***Tools and equipment*** are selected in line with job order requirements 1.4 ***Personal protective equipment (PPE)*** are identified and selected in line with safety requirements 1.5 Instructions in preparation for work activity are communicated clearly and confirmed to ensure that the instructions are understood. 1.6 Procedure for planning and preparation of work is checked to ensure that it is done correctly and in accordance to established company standards procedure to ensure safety. 1.7 All components/materials needed to the work are obtained and estimated according to established procedures and plans
2. Install PV components	2.1 Pre-installation procedures are performed as per manufacturer's recommendation 2.2 Procedures for installation of PV components are performed in line with job order requirements 2.3 Schedule of work is followed based on agreed time and quality standards 2.4 Consultations/ instructions are sought with supervisor/end user if unplanned events or conditions occur 2.5 Ongoing checking of quality of work is undertaken in accordance with instructions and requirements 2.6 Conductors/wires are terminated/splice in accordance with existing PV component standards 2.7 Installation of PV system is accomplished without causing damage to components, materials, supplies and minimum wastage, and injury to self/others. 2.8 Safety procedures are followed based on ***regulations***
3. Notify completion of work	3.1 Final checks are made to ensure that work conforms with plans/ drawings/instructions and requirements 3.2 Supervisor is notified upon completion of work 3.3 Tools, equipment and any excess materials, where appropriate, are cleaned, checked and returned to storage in accordance with established safety procedures 3.4 Work area is cleaned and made safe

4. Obtain and convey information	4.1 Specific and relevant information about the system installed is accessed from ***appropriate sources*** 4.2 Effective questioning and speaking skills are used to gather and convey information 4.3 Appropriate ***medium*** is used to transfer information. 4.4 Conduct of conveying information is carried out clearly and concisely. 4.5 Conveying information is conducted in a courteous manner appropriate to the cultural background of the costumer/s.
5. Complete relevant work related documents	5.1 ***Forms*** relating to the conduct of job are completed accurately 5.2 Reporting requirements are completed according to the guidelines

RANGE OF VARIABLES

VARIABLE	RANGE
1. System components	1.1 Solar Module(s) 1.2 Support structures 1.3 Charge Controller/regulator 1.4 Battery/battery bank 1.5 Inverter 1.6 Wires and accessories 1.7 Protective devices such as: 1.7.1 Disconnect switch 1.7.2 Fuse 1.7.3 Breakers 1.7.4 Diodes 1.7.5 Low-voltage disconnect 1.8 DC – DC converters 1.9 Grounding system 1.10 Lighting fixtures and accessories 1.11 Convenience outlets for appliances and devices 1.12 Loads (AC and DC lights, water pumps, and/or appliances)
2. Tools and equipment	2.1 Tools: 2.1.1 Screwdrivers 2.1.2 Pliers 2.1.3 Wrenches 2.1.4 Hammer 2.1.5 Electrician's knife 2.1.6 Hacksaw 2.1.7 Cross cut saw 2.1.8 Hand drill 2.2 Measuring instruments 2.2.1 Clamp meter 2.2.2 Ammeter 2.2.3 Voltmeter 2.2.4 Multimeter 2.3 Ladder/scaffolding
3. Personal protective equipment (PPE)	May include but not limited to: 3.1 Rubber gloves 3.2 Leather gloves 3.3 Safety shoes 3.4 Hard hat 3.5 Goggles 3.6 Electrician's holster 3.7 Safety belts 3.8 Safety clothes/pants
4. Regulations	4.1 Philippine Electrical Code 4.2 Electrical safety 4.3 Mechanical safety 4.4 Civil safety

5. Appropriate sources	5.1 Components Specification and Manual. 5.2 Suppliers 5.3 Dealers 5.4 Trade personnel 5.5 Industry bodies 5.6 Distributors
6. Medium	6.1 Information discussion 6.2 One on one communication 6.3 Group interaction 6.4. Vernacular speaking
7. Forms	7.1 Customer manual 7.2 Warranty documents 7.3 Product procedures 7.4 Product specifications 7.5 Product features 7.6 Product instruction

EVIDENCE GUIDE

1. Critical aspects of competency	Assessment requires evidence that the candidate: 1.1 Interpreted work instructions 1.2 Selected tools, materials, and components for PV installation 1.3 Used personal protective equipment 1.4 Demonstrated procedures for installation of PV components 1.5 Followed safety procedures 1.6 Cleaned worksite/housekeeping 1.7 Stored excess materials including tools 1.8 Accessed information relevant in conducting users' briefing/ orientation regarding the installed system. 1.9 Correctly followed work instructions 1.10 Made final checks to ensure work conforms with the installation drawing plan 1.11 Communicated effectively to ensure safety and effective work operations
2.Underpinning knowledge and attitude	2.1 PV system operation 2.2 PEC requirements 2.3 Installation procedures for PV components 2.4 Work ethics 2.5 Respect for area/site cultural practices 2.6 Awareness of peace and order situation in the area and site condition 2.7 Safety practices 2.7.1 Personal protective equipment (PPE) 2.7.2 Safe handling of tools 2.7.3 Safety signs/symbols 2.7.4 Knowledge of workplace/equipment hazards 2.7.5 Housekeeping 2.8 Electrical Installation Drawing and Specification 2.8.1 Electrical wiring diagram 2.8.2 Mechanical symbols/abbreviation 2.9 Trade Theory 2.9.1 Principles of electricity 2.9.2 Principles and operation of accessories/parts 2.9.3 Installation procedure 2.9.4 Selection of units and components 2.10 Tools/Materials uses and specification 2.10.1 Types of electrical controllers 2.10.2 Types of PV Modules 2.10.3 Types of loads 2.10.4 Types of wires 2.10.5 Types of fuse 2.10.6 Types of circuit breakers 2.10.7 Types of water pumps 2.10.8 Types of hammer 2.10.9 Types of screwdriver 2.10.10 Types of soldering irons 2.10.11 Types of pliers 2.10.12 Types of wrenches 2.10.13 Types of fastening fixtures

3. Underpinning skills	3.1 Reading and interpretation of codes, symbols and diagrams 3.2 Interpreting plan and details 3.3 Preparing materials 3.4 Interpreting product and technical brochures 3.5 Use of hand tools and equipment 3.6 Splicing, Dressing and Terminating wires 3.7 Soldering Techniques 3.8 Practice safe working habits 3.9 Performing first aid 3.10 Tracing circuits 3.11 Follow simple spoken language 3.12 Ability to relate to people of social range 3.13 Interpreting product and technical brochures
4. Resource implications	The following resources **MUST** be provided: 4.1 Work area 4.2 Drawings and specifications relevant to the task 4.3 Complete system components and accessories 4.4 Tools and equipment appropriate for installation of PV components 4.3 Personal Protective Equipment (PPE) 4.4 IEC materials (e.g. flipcharts))
5. Method of assessment	Competency must be assessed through: 5.1 Direct observation with questioning 5.2 Written/Oral examination 5.3 Demonstration with questioning
6. Context of assessment	6.1 Competency may be assessed in the workplace or in a simulated workplace 6.2 Competency assessment must be undertaken in accordance with the endorsed TESDA assessment guidelines

UNIT OF COMPETENCY : **PERFORM PV SYSTEMS TESTING AND COMMISSIONING**

UNIT CODE : **CON724328**

UNIT DESCRIPTOR : This unit covers the knowledge, skills, and attitude in testing and commissioning installed PV systems.

ELEMENT	PERFORMANCE CRITERIA ***Italicized terms*** are elaborated in the Range of Variables
1. Prepare to commission PV system	1.1 Work instructions are validated to ensure clear understanding of job requirements 1.2 ***Commissioning procedures*** are planned according to manufacturer's instructions and job order requirements 1.3 ***Personal protective equipment (PPE)*** needed to complete job order requirements are obtained according to established procedures 1.4 ***Tools, measuring instruments and materials*** needed for commissioning are obtained according to established procedures
2. Commission PV system	2.1 Each component and the whole system are checked if operational and are installed according to established procedures and job order requirements 2.2 Corrective measures or rectifications on the installation are made in line with established procedures 2.3 PV systems is activated according to commissioning procedures 2.4 Occupational health and safety procedures are followed during commissioning
3. Inspect and notify completion of work	3.1 Final inspection is undertaken to ensure that commissioning of PV system meets job requirements 3.2 ***Commissioning document*** is accomplished and written report is prepared using the prescribed format and submitted to the supervisor 3.3 Work completed is notified to a supervisor and customer according to established procedure 3.4 Proper housekeeping is observed and practiced in accordance with occupational health and safety standards 3.5 Customer is oriented on the use of the installed system according to company procedures and manufacturer's instruction.

RANGE OF VARIABLES

VARIABLE	RANGE
1. Commissioning procedures	1.1 PV module/array functional test 1.2 Charge controller/Regulator functional test 1.3 Battery functional test 1.4 Load Test 1.5 High potential test
2. Personal protective equipment (PPE)	2.1 Mask 2.2 Safety goggles or face shield 2.3 Gloves (rubber/leather) 2.4 Safety harness 2.5 First aid kit 2.6 Hard hat 2.7 Safety shoes 2.8 Leather apron 2.9 Safety belts 2.10 Electrician holster kit 2.11 Safety clothes/pants 2.12 Insulating mat
3. Tools, measuring instruments, and materials	3.1 Tools 3.1.1 Screwdrivers 3.1.2 Pliers 3.1.3 Wrenches 3.1.4 Ladder/scaffolding 3.1.5 Magnetic compass 3.1.6 Spirit level 3.2 Measuring instrument 3.2.1 Clamp meter 3.2.2 Multi-meter 3.2.3 Hydrometer 3.3 Materials 3.3.1 Wires and cables 3.3.2 Connectors 3.3.3 Clamps 3.3.4 Electrical tape 3.3.5 Oil and grease 3.3.6 Fuse 3.3.7 Diodes 3.3.8 Staple wires, screws and nails 3.3.9 Asphalt/sealant (if needed) 3.3.10 Distilled water 3.3.11 Bolts and nuts
4. Commissioning documents	4.1 CD for Solar Home System 4.2 CD for Battery Charging Station 4.3 CD for School Electrification

EVIDENCE GUIDE

1. Critical aspects of competency	Assessment requires evidence that the candidate: 1.1 Planned the commissioning procedure and prepared the necessary tools, equipment, and materials necessary to conduct the activity 1.2 Demonstrated commissioning procedures according to established procedures and job order requirements 1.3 Notified completion of work to supervisor and customer. 1.4 Undertaken final inspection to ensure the installation met job order requirements 1.5 Demonstrated proper housekeeping in accordance with occupational health and safety standards
2.Underpinning knowledge and attitude	2.1 PV system and individual components functionality and standard operating ranges 2.2 Common system/equipment malfunctions and basic corrective or techniques 2.3 Commissioning procedures for PV systems and parts of a commissioning document 2.4 Basic principles of electricity 2.5 Use and proper handling of tools and test instruments 2.6 Occupational health and safety standards 2.7 PEC requirements 2.8 Awareness of peace and order situation, cultural practices, and other site conditions 2.9 Work Ethics
3.Underpinning skills	3.1 Interpreting electrical drawings 3.2 Tracing schematic diagrams and circuits 3.3 Handling of tools, test instruments, and materials 3.4 Communication skills 3.5 Interpersonal skills 3.6 Perform first aid
4. Resource implications	The following resources MUST be provided: 4.1 Actual site or workplace with PV system to be commissioned 4.2 Tools, measuring instruments, and materials appropriate for PV system commissioning 4.3 Electrical installation drawings and installation data sheet 4.4 Forms • Commissioning document • Acceptance document 4.5 Personal protective equipment (PPE)
5. Method of assessment	Competency must be assessed through: 5.1 Demonstration and observation with questioning 5.2 Written/Oral examination 5.3 Third Party Report 5.4 Portfolio
6. Context of assessment	6.1 Competency may be assessed in the workplace or in a simulated workplace 6.2 Competency assessment must be undertaken in accordance with the endorsed TESDA assessment guidelines

SECTION 3 TRAINING STANDARDS

These guidelines are set to provide technical and vocational education and training (TVET) providers with information and other important requirements to consider when designing training programs for PV Systems Installation NC II.

3.1 CURRICULUM DESIGN

Course Title: PV SYSTEMS INSTALLATION **NC Level: NC II**

Nominal Training Duration: 284 Hrs

18 Hours (Basic)
72 Hours (Common)
194 Hours (Core)

Course Description:

The course is designed to enhance the knowledge, desirable attitudes and skills of a PV Systems installation technician in accordance with industry standards. It covers core competencies such as: perform site assessment, check PV components and materials' compliance, install and commission PV system and prepare documentation requirements for PV systems installation.

It also includes competencies in workplace communication; work in a team environment, practice career professionalism, practice occupational health and safety, prepare construction materials and tools, perform mensuration and calculation, maintain tools and equipment, observe procedures, specifications and manuals of instructions and interpret technical drawings and plans.

To obtain these, all units prescribed for this qualification must be achieved:

BASIC COMPETENCIES
18 Hours

Unit of Competency	Learning Outcomes	Methodology	Assessment Approach
1. Participate in workplace communication	1.1 Obtain and convey workplace information. 1.2 Complete relevant work related documents. 1.3 Participate in workplace meeting and discussion.	▪ Group discussion ▪ Interaction ▪ Lecture ▪ Reportorial	• Written test • Practical/Performance test • Interview
2. Work in a team environment	2.1 Describe and identify team role and responsibility in a team. 2.2 Describe work as a team member.	▪ Group Discussion/ Interaction ▪ Case study ▪ Simulation	• Written test • Observation • Simulation Role playing • Case studies and scenarios

3. Practice career professionalism	3.1 Integrate personal objectives with organizational goals. 3.2 Set and meet work priorities. 3.3 Maintain professional growth and development.	▪ Interactive-lecture ▪ Simulation ▪ Demonstration ▪ Self-paced instruction ▪ Group discussion ▪ Structured activity ▪ Film viewing	• Role play • Interview • Written exam • Demonstration • Portfolio assessment
4. Practice occupational health and safety	4.1 Identify hazards and risks 4.2 Evaluate hazard and risks 4.3 Control hazards and risks 4.4 Maintain occupational health and safety awareness	▪ Interactive-lecture ▪ Simulation ▪ Symposium ▪ Group dynamics ▪ Film viewing ▪ Self-paced instruction	• Case/Situation analysis • Interview • Practical examination • Written examination

COMMON COMPETENCIES
72 Hours

Unit of Competency	Learning Outcomes	Methodology	Assessment Approach
1. Prepare construction materials and tools	1.1 Identify materials and tools applicable to a specific construction job 1.2 Request appropriate materials and tools 1.3 Receive and inspect materials	• Lecture - Demonstration • Self-paced Instruction • Group Discussion • Power Point Presentation	▪ Oral Questions ▪ Direct observation ▪ Written Test
2. Observe procedures, specifications and manuals of instructions	2.1 Identify, access, and interpret specification/manuals. 2.2 Apply information in manual. 2.3 Store manuals.	▪ Classroom discussion/ Lecture ▪ Self-paced instruction ▪ Demonstration	▪ Practical exam ▪ Oral exam ▪ Written test/ questioning
3. Interpret technical drawing	3.1 Analyze sign, symbols and data 3.2 Interpret technical drawing and plans 3.3 Apply freehand sketching	▪ Demonstration ▪ Classroom discussions ▪ Self-paced instruction	▪ Direct observation ▪ Practical exam ▪ Written test / questioning

4. Perform mensurations and calculation	4.1 Select measuring instruments 4.2 Carry out measurements and calculations	▪ Lecture-demonstration ▪ Self-paced instruction ▪ Group discussion ▪ Actual demonstration ▪ Classroom discussion	▪ Oral questioning ▪ Direct Observation ▪ Written test / questioning ▪ Actual demonstration
5. Maintain tools and equipment	5.1 Check condition of tools and equipment 5.2 Perform basic preventive maintenance 5.3 Sharpen edge and tooth cutting tools 5.4 Store tools and equipment	▪ Lecture – Demonstration ▪ Self-paced instruction ▪ Group discussion ▪ Classroom discussion	▪ Oral questioning ▪ Direct observation ▪ Written test/ questioning ▪ Practical exam

CORE COMPETENCIES
194 Hours

Unit of Competency	Learning Outcome	Methodology	Assessment Approach
1. Perform site assessment	1.1 Validate Parameters for the Installation 1.2 Prepare Installation Data Sheet 1.3 Prepare site assessment report	▪ Lecture-demonstration ▪ Case Studies ▪ Self-paced instruction ▪ Group discussion	▪ Direct observation with questions ▪ Demonstration with questions ▪ Oral/written examination
2. Check PV components/ materials compliance	2.1 Inspect and test components and materials 2.2. Interpret individual component manuals 2.3 Report test results	▪ Lecture-demonstration ▪ Case Studies ▪ Self-paced instruction ▪ Group discussion	▪ Direct observation with questions ▪ Oral/written examination

3. Install PV system	Preparing Documentation on PV Systems 3.1 Plan and prepare work 3.2. Complete relevant work related documents Installing PV Components 3.3 Install PV Module/Panel/Array 3.4 Install Controller 3.5 Install Battery 3.6 Install Inverter Installing Electrical Wiring 3.7 Prepare electrical tools, materials and equipment 3.8 Read and interpret electrical diagrams 3.9 Install lighting and power circuit using electrical non-metallic conduit. 3.10 Install light and power circuit using sheathed non-metallic cable 3.11 Install light and power circuit using electrical non-metallic surface raceway.	▪ Lecture-demonstration ▪ Self-paced instruction ▪ Group discussion	▪ Direct Observation ▪ and Questioning ▪ Demonstration ▪ Oral/written examination
4. Perform PV system testing and commissioning	4.1 Prepare to commission PV system 4.2 Commission PV system 4.3 Inspect and notify completion of work	▪ Lecture-demonstration ▪ Self-paced instruction ▪ Group discussion	▪ Oral/Written test ▪ Demonstration with questioning ▪ Observation with questioning ▪ Third party report

3.2 TRAINING DELIVERY

The delivery of training should adhere to the design of the curriculum. Delivery shall be guided by the 10 basic principles of competency-based TVET:

- The training is based on curriculum developed from the competency standards;
- Learning is modular in its structure;
- Training delivery is learner-centered and should accommodate individualized and self-paced learning strategies;
- Training is based on work that must be performed;
- Training materials are directly related to the competency standards and the curriculum modules;
- Assessment is based on the collection of evidence of the performance of work to the industry required standard;
- Training is based both on and off-the-job components;
- Training program allows for recognition of prior learning (RPL) or current competencies;
- Training allows for multiple entry and exit; and
- Training programs are registered with the UTPRAS.

- The competency-based TVET system recognizes various types of delivery modes, both on and off-the-job as long as the learning is driven by the competency standards specified by the industry. The following training modalities may be adopted when designing training programs:

- The dualized mode of training delivery is preferred and recommended. Thus programs would contain both in-school and in-industry training or fieldwork components. Details can be referred to the Dual Training System (DTS) Implementing Rules and Regulations.

- Modular/self-paced is a competency-based training modality wherein the trainee is allowed to progress at his/her own pace. The trainer only facilitates the training delivery.

- Peer teaching/mentoring is a training modality wherein fast learners are given the opportunity to assist the slow learners.

- Supervised Industry Training or On-the-Job Training is an approach in training designed to enhance the knowledge and skills of the trainee through actual experience in the workplace to acquire specific competencies prescribed in the training regulations.

- Distance learning is a formal education process in which majority of the instruction occurs when the students and instructor are not in the same place. Distance learning may employ correspondence study, or audio, video or computer technologies.

- Project-based instruction is an authentic instructional model or strategy in which students plan, implement and evaluate projects that have real world applications.

3.3 TRAINEE ENTRY REQUIREMENTS

This section specifies the qualifications of trainees and educational experience. Other requirements like health and physical requirements are also stated. Passing entry written examinations may also be indicated if necessary.

To qualify as trainee for PV Systems Installation Technician NC II, a candidate must possess the following:

- Can communicate both orally and in written
- Physically and mentally fit to undergo training
- At least 18 years old

3.4 LIST OF TOOLS, EQUIPMENT AND MATERIALS PV SYSTEMS INSTALLATION NC II

Recommended list of tools, equipment and materials for the training of 25 trainees for PV Systems Installation NC II.

TOOLS		EQUIPMENT		MATERIALS	
QTY	**ITEM**	**QTY**	**ITEM**	**QTY**	**ITEM**
5 pcs.	Spirit level	5 units	DC drill	2 rolls	Wire AWG #12 - PDX
5 pcs.	Hack saw	25 units	Multi-meter	2 rolls	Wire AWG #12 - Royal Cord
12 sets.	Pliers 9" (electrician, long nose, side cutter)	5 units	Clamp meter	5 rolls	Electrical tape
12 sets	Screwdrivers	25 units	Hydrometer	1 box	Wood screw ½" x 8
12 sets.	Combination Wrenches - open & box (6mm – 14 mm)	5 units	Battery Cell tester	50 m	Circular loom (mica tubing 3/8")
12 pcs.	Wire stripper	10 pcs.	PV module	25 pcs.	Receptacle surface type
25 pcs.	Magnetic Compass	10 pcs.	Controller	25 pcs.	Receptacle flush type
		12 pcs.	Battery	25 pcs.	CO (DC)
12 pcs.	Tools holster	5 pcs.	Battery Box	10 pcs.	Junction Box (4x4)
12 pcs.	Measuring tape	10 pcs.	Support Structure - single module	25 pcs.	Convenient outlet c.o. (flush type) 2 gang w/ plate and cover
5 pcs.	Claw hammer	5 pcs.	Variable Power Supply (output 5-	10 pcs.	Tumbler switch

			30VDC, 30 A)		
5 pcs.	Cross Cut Saw	25 pcs.	Safety goggles	12 pcs.	Incandescent bulb 50 w/ 250V AC
		25 pcs.	Hard hat	12 pcs.	CFL 11 W 12Vdc
		25 pcs.	Safety Gloves	12 pcs.	Connectors
.		5 pcs.	Safety Belt	12 pcs.	Clamps
.		5 pcs	Support Structure - double module	2 packs	Battery grease
		1 pcs.	Inverter (full sine) 200 VA	1 boxes	Fuse
		1 pcs.	Inverter (modified) 500 VA	1 boxes	Diodes
		1 pc.	Oscilloscope w/ accesories	2 rolls	Wire AWG #14 - PDX
				2 rolls	Wire AWG #14 - Royal Cord
				5 boxes	Staple Wire 1”
				50 pcs.	PVC clamp ½
				20	PVC conduit ½,
				20 pcs.	Junction box PVC
				20 pcs.	Connectors PVC, ½
				10 pcs.	Elbow PVC ½
				5 sets	Panel board with 15 amp circuit breaker
				20 pcs.	Switch (3 way with plate and cover)
				10 pcs.	Switch (single pole with plate and cover)
				1 pc.	Whiteboard 4 x 8 x ¾
				1 pc.	Whiteboard 4 x 4 x ¾ with movable stand
				1 box	Whiteboard marker, assorted color
				2 pcs.	Whiteboard eraser magnetic

3.5 TRAINING FACILITIES
PV SYSTEMS INSTALLATION NC II

Based on a class intake of 25 students/trainees, below are the space requirement & their sizes:

TEACHING/LEARNING AREAS	SIZE IN METERS	AREA IN SQ. METERS	TOTAL AREA IN SQ. METERS
Lecture/Demo Area	6 x 5	30	30
Laboratory Area	8 x 8	64	64
Learning Resource Area	3 x 5	15	15
Wash, Toilet, & Locker Room	3 x 5	15	15
Circulation**			33
Total Area			**157**

***** Area requirement is equivalent to 30% of the total teaching/learning areas***

3.6 TRAINER QUALIFICATIONS (TQ)

PV SYSTEMS INSTALLATION NC II

- Must be a holder of at least PV Systems Installation NC II,
- Must have undergone training on Training Methodology II (TM II) [1]
- Must be computer literate
- Must be physically and mentally fit
- Must have at least 2 years relevant industry experience and/or teaching experience[2]
- Must be a civil-service eligible or holder of appropriate professional license issued by the Professional Regulatory Commission (for government positions only)

[1] This shall be changed to ":Must be a holder of Trainer Qualification Level II (TQII) or equivalent" upon promulgation by the TESDA Board of the TQ/AQ training regulations

[2] Optional. Only when required by the hiring institution

Reference: TESDA Board Resolution No. 2004 03

3.7 INSTITUTIONAL ASSESSMENT

Institutional assessment is undertaken by trainees to determine their achievement of units of competency. A certificate of achievement is issued for each unit of competency.

SECTION 4 NATIONAL ASSESSMENT AND CERTIFICATION ARRANGEMENTS

4.1. To attain the National Qualification of **PV Systems Installation NC II**, the candidate must demonstrate competence all the units listed in Section 1. Successful candidates shall be awarded a National Certificate signed by the TESDA Director General.

4.2. The qualification of **PV Systems Installation NC II** may be attained through demonstration of competence through a single comprehensive project-type assessment covering all required units of competency of the qualification.

Install PV Systems

- Perform Site Assessment
- Check PV Components/Materials Compliance
- Install PV System
- Perform PV System Testing and Commissioning

4.3. Assessment shall focus on the core units of competency. The basic and common units shall be integrated or assessed concurrently with the core units.

4.4. The following are qualified to apply for assessment and certification:

4.4.1. Graduates of formal, non-formal and informal including Enterprise-based training programs

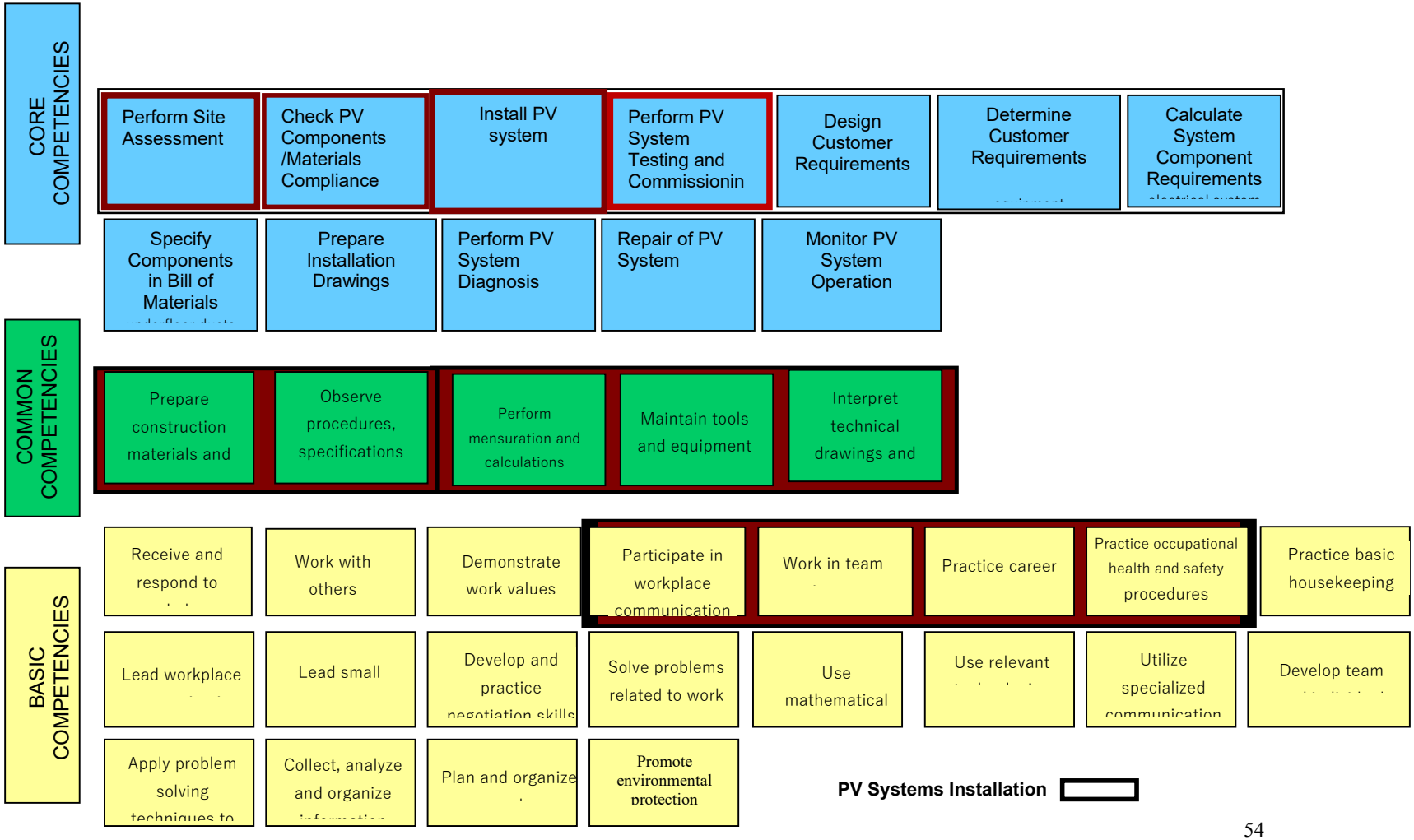
4.4.2. Experienced Workers (wage-employed or self-employed)

4.5. The guidelines on assessment and certification are discussed in detail in the *Procedures Manual on Assessment* and *Certification* and *Guidelines on the Implementation of the Philippine TVET Qualification* and *Certification System (PTQCS).*

ANNEX A

COMPETENCY MAP
(CONSTRUCTION SECTOR-ELECTRICAL SUB-SECTOR)

PV SYSTEMS INSTALLATION NC II



DEFINITION OF TERMS

1. **Photovoltaic (PV)** – a technology that uses a solar module in order to convert light or energy from the sun to electricity

2. **PV Module** – a device composed of solar cells that convert light or energy from the sun to electricity.

3. **PV Panel** – a group of PV modules connected in series and/or parallel in a single support structure

4. **PV Array** – a group of PV modules connected in series and/or parallel in different support structures

5. **Load** – are devices such as lighting fixtures, appliances, or the likes that requires electricity

6. **Battery** – a device that stores electricity typically rated in Ampere-hours. For PV systems in the Philippines, car batteries are commonly used.

7. **Controller** – an electronic device used to cut off charging to the battery when the battery is full and to disconnect the battery from the load when the battery charge is getting low

8. **Direct current** – unidirectional flow of electricity, usually type of power being stored in batteries

9. **Alternating current** – current that periodically changes its magnitude and direction, commonly derived directly from the grid-connected power sources

10. **Functional Test** – test procedures being done on the different PV components based on their rated operating ranges such as controller set-points, battery voltage, Voc and Isc of PV modules.

11. **Controller Set-points** – the maximum and minimum settings that corresponds to the predetermined depth of discharge and maximum charge of a battery

12. **Maximum depth of discharge** – is the state of charge of a battery that will provide maximum life cycles before it needs replacement

13. **Commissioning** – the process in which a machine or system is put in operation

14. **Installation data sheet** – record or document of information containing the final installation lay-out and system specification

15. **Power** – the delivery of energy typically measured in Watts

16. **Energy** – actual work done by the electricity, typically measured in Watt-hours

17. **Parallel connection** – connecting the positives together and separately to connect the negatives together

18. **Series connection** – connecting the positives of one source to the negative of another

19. **Certification** - is the process of verifying and validating the competencies of a person through assessment

20. **Certificate of Competency (COC)** – is a certification issued to individuals who pass the assessment for a single unit or cluster of units of competency

21. **Common Competencies** - are the skills and knowledge needed by all people working in a particular industry

22. **Competency** - is the possession and application of knowledge, skills and attitudes to perform work activities to the standard expected in the workplace

23. **Competency Assessment** - is the process of collecting evidence and making judgments on whether competency has been achieved

24. **Competency Standard (CS)** - is the industry-determined specification of competencies required for effective work performance

25. **Context of Assessment** - refers to the place where assessment is to be conducted or carried out

26. **Core Competencies** - are the specific skills and knowledge needed in a particular area of work - industry sector/occupation/job role

27. **Critical aspects of competency** - refers to the evidence that is essential for successful performance of the unit of competency

28. **Elective Competencies** - are the additional skills and knowledge required by the individual or enterprise for work

29. **Elements** - are the building blocks of a unit of competency. They describe in outcome terms the functions that a person performs in the workplace.

30. **Evidence Guide** - is a component of the unit of competency that defines or identifies the evidences required to determine the competence of the individual. It provides information on critical aspects of competency, underpinning knowledge, underpinning skills, resource implications, assessment method and context of assessment

31. **Level** - refers to the category of skills and knowledge required to do a job

32. **Method of Assessment** - refers to the ways of collecting evidence and when, evidence should be collected

33. **National Certificate (NC)** – is a certification issued to individuals who achieve all the required units of competency for a national qualification defined under the Training Regulations. NCs are aligned to specific levels within the PTQF

34. **Performance Criteria** - are evaluative statements that specify what is to be assessed and the required level of performance

35. **Qualification** - is a cluster of units of competencies that meet job roles and are significant in the workplace. It is also a certification awarded to a person on successful completion of a course in recognition of having demonstrated competencies in an industry sector

36. **Range of Variables** - describes the circumstances or context in which the work is to be performed

37. **Recognition of Prior Learning (RPL)** – is the acknowledgement of an individual's skills, knowledge and attitudes gained from life and work experiences outside registered training programs

38. **Resource Implications** - refers to the resources needed for the successful performance of the work activity described in the unit of competency. It includes work environment and conditions, materials, tools and equipment

39. **Basic Competencies** - are the skills and knowledge that everyone needs for work

40. **Training Regulations (TR)** – refers to the document promulgated and issued by TESDA consisting of competency standards, national qualifications and training guidelines for specific sectors/occupations. The TR serve as basis for establishment of qualification and certification under the PTQF. It also serves as guide for development of competency-based curricula and instructional materials including registration of TVET programs offered by TVET providers

41. **Underpinning Knowledge** - refers to the competency that involves in applying knowledge to perform work activities. It includes specific knowledge that is essential to the performance of the competency

42. **Underpinning Skills** - refers to the list of the skills needed to achieve the elements and performance criteria in the unit of competency. It includes generic and industry specific skills

ACKNOWLEDGEMENTS

The Technical Education and Skills Development Authority (TESDA) wishes to extend thanks and appreciation to the many representatives of business, industry, academe and government agencies who donated their time and expertise to the development and validation of this Training Regulations.

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