TRAINING REGULATIONS

PV System Design NC III

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 SYSTEM DESIGN NC III

TRAINING REGULATIONS FOR
PV System Design NC III

Section 1 PV SYSTEM DESIGN NC III QUALIFICATIONS

The **PV SYSTEM DESIGN NC III** Qualification consists of competencies that a person must achieve to be able to determine customer solar-energized load requirements and calculate system components requirements (system sizing) of small solar home systems up to 1kWp. It also include competency to prepare and specify components in Bill of Materials and prepare Installation drawing.

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

The units of competency comprising this qualification include the following:

Code	BASIC COMPETENCIES
500311109	Lead workplace communication
500311110	Lead small teams
500311111	Develop and practice negotiation skills
500311112	Solve problems related to work activities
500311113	Use mathematical concepts and techniques
500311114	Use relevant technologies

Code	COMMON COMPETENCIES
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	CORE COMPETENCIES
CON311301	Determine Customer Requirements
CON311302	Calculate System Components Requirements (System Sizing)
CON311303	Specify Components in Bill of Materials
CON311304	Prepare Installation Drawing

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

- PV System Designer; or
- PV System Design Technician

SECTION 2: COMPETENCY STANDARDS

This section gives the details of the contents of the basic, common, and core units of competency required for **PV System Design NC III.**

BASIC COMPETENCIES

UNIT OF COMPETENCY : LEAD WORKPLACE COMMUNICATION

UNIT CODE : 500311109

UNIT DESCRIPTOR : This unit covers the knowledge, skills, and attitudes required to lead in the dissemination and discussion of ideas, information, and issues in the workplace.

ELEMENT	PERFORMANCE CRITERIA ***Italicized*** terms are elaborated in the Range of Variables
1. Communicate information about workplace processes	1.1 Appropriate ***communication method*** is selected 1.2 Multiple operations involving several topics areas are communicated accordingly 1.3 Questions are used to gain extra information 1.4 Correct sources of information are identified 1.5 Information is selected and organized correctly 1.6 Verbal and written reporting is undertaken when required 1.7 Communication skills are maintained in all situations
2. Lead workplace discussions	2.1 Response to workplace issues are sought 2.2 Response to workplace issues are provided immediately 2.3 Constructive contributions are made to workplace discussions on such issues as production, quality and safety 2.4 Goals/objectives and action plan undertaken in the workplace are communicated
3. Identify and communicate issues arising in the workplace	3.1 Issues and problems are identified as they arise 3.2 Information regarding problems and issues are organized coherently to ensure clear and effective communication 3.3 Dialogue is initiated with appropriate personnel 3.4 Communication problems and issues are raised as they arise

RANGE OF VARIABLES

VARIABLE	RANGE
1. Methods of communication	1.1 Non-verbal gestures 1.2 Verbal 1.3 Face to face 1.4 Two-way radio 1.5 Speaking to groups 1.6 Using telephone 1.7 Written 1.8 Internet

EVIDENCE GUIDE

1. Critical aspects of competency	Assessment requires evidence that the candidate: 1.1 Dealt with a range of communication/information at one time 1.2 Made constructive contributions in workplace issues 1.3 Sought workplace issues effectively 1.4 Responded to workplace issues promptly 1.5 Presented information clearly and effectively written form 1.6 Used appropriate sources of information 1.7 Asked appropriate questions 1.8 Provided accurate information
2. Underpinning knowledge and attitude	2.1 Organization requirements for written and electronic communication methods 2.2 Effective verbal communication methods
3. Underpinning skills	3.1 Organize information 3.2 Understand and convey intended meaning 3.3 Participate in variety of workplace discussions 3.4 Comply with organization requirements for the use of written and electronic communication methods
4. Resource implications	The following resources **MUST** be provided: 4.1 Variety of Information 4.2 Communication tools 4.3 Simulated workplace
5. Method of assessment	Competency may be assessed through: 5.1 Competency in this unit must be assessed through 5.2 Direct Observation 5.3 Interview
6. Context of assessment	6.1 Competency may be assessed in the workplace or in simulated workplace environment

UNIT OF COMPETENCY : LEAD SMALL TEAMS

UNIT CODE : 500311110

UNIT DESCRIPTOR : This unit covers the knowledge, skills and attitudes to lead small teams including setting and maintaining team and individual performance standards.

ELEMENT	PERFORMANCE CRITERIA ***Italicized*** terms are elaborated in the Range of Variables
1. Provide team leadership	1.1 ***Work requirements*** are identified and presented to team members 1.2 Reasons for instructions and requirements are communicated to team members 1.3 ***Team members' queries and concerns*** are recognized, discussed and dealt with
2. Assign responsibilities	2.1 Duties, and responsibilities are allocated having regard to the skills, knowledge and aptitude required to properly undertake the assigned task and according to company policy 2.2 Duties are allocated having regard to individual preference, domestic and personal considerations, whenever possible
3. Set performance expectations for team members	3.1 Performance expectations are established based on client needs and according to assignment requirements 3.2 Performance expectations are based on individual team members duties and area of responsibility 3.3 Performance expectations are discussed and disseminated to individual team members
4. Supervised team performance	4.1 ***Monitoring of performance*** takes place against defined performance criteria and/or assignment instructions and corrective action taken if required 4.2 Team members are provided with ***feedback***, positive support and advice on strategies to overcome any deficiencies 4.3 ***Performance issues*** which cannot be rectified or addressed within the team are referenced to appropriate personnel according to employer policy 4.4 Team members are kept informed of any changes in the priority allocated to assignments or tasks which might impact on client/customer needs and satisfaction 4.5 Team operations are monitored to ensure that employer/client needs and requirements are met 4.6 Follow-up communication is provided on all issues affecting the team 4.7 All relevant documentation is completed in accordance with company procedures

RANGE OF VARIABLES

VARIABLE	RANGE
1. Work requirements	1.1 Client Profile 1.2 Assignment instructions
2. Team member's concerns	2.1 Roster/shift details
3. Monitor performance	3.1 Formal process 3.2 Informal process
4. Feedback	4.1 Formal process 4.2 Informal process
5. Performance issues	5.1 Work output 5.2 Work quality 5.3 Team participation 5.4 Compliance with workplace protocols 5.5 Safety 5.6 Customer service

EVIDENCE GUIDE

1. Critical aspects of competency	Assessment requires evidence that the candidate: 1.1 Maintained or improved individuals and/or team performance given a variety of possible scenario 1.2 Assessed and monitored team and individual performance against set criteria 1.3 Represented concerns of a team and individual to next level of management or appropriate specialist and to negotiate on their behalf 1.4 Allocated duties and responsibilities, having regard to individual's knowledge, skills and aptitude and the needs of the tasks to be performed 1.5 Set and communicated performance expectations for a range of tasks and duties within the team and provided feedback to team members
2. Underpinning knowledge	2.1 Company policies and procedures 2.2 Relevant legal requirements 2.3 How performance expectations are set 2.4 Methods of Monitoring Performance 2.5 Client expectations 2.6 Team member's duties and responsibilities
3. Underpinning skills	3.1 Communication skills required for leading teams 3.2 Informal performance counseling skills 3.3 Team building skills 3.4 Negotiating skills
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 task
5. Method of assessment	Competency may be assessed through: 5.1 Direct observations of work activities 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 assessment may occur in workplace or any appropriately simulated environment 6.2 Assessment shall be observed while task are being undertaken whether individually or in-group

UNIT OF COMPETENCY: DEVELOP AND PRACTICE NEGOTIATION SKILLS

UNIT CODE : 500311111

UNIT DESCRIPTOR : This unit covers the skills, knowledge, and attitudes required to collect information in order to negotiate to a desired outcome and participate in the negotiation.

ELEMENT	PERFORMANCE CRITERIA ***Italicized*** terms are elaborated in the Range of Variables
1. Plan negotiations	1.1 Information on ***preparing for negotiation*** is identified and included in the plan 1.2 Information on creating ***non verbal environments*** for positive negotiating is identified and included in the plan 1.3 Information on ***active listening*** is identified and included in the plan 1.4 Information on different ***questioning techniques*** is identified and included in the plan 1.5 Information is checked to ensure it is correct and up-to- date
2. Participate in negotiations	2.1 Criteria for successful outcome are agreed upon by all parties 2.2 Desired outcome of all parties are considered 2.3 Appropriate language is used throughout the negotiation A variety of questioning techniques are used 2.4 The issues and processes are documented and agreed upon by all parties 2.5 Possible solutions are discussed and their viability assessed 2.6 Areas for agreement are confirmed and recorded Follow-up action is agreed upon by all parties

RANGE OF VARIABLES

VARIABLE	RANGE
1. Preparing for negotiation	1.1 Background information on other parties to the negotiation 1.2 Good understanding of topic to be negotiated 1.3 Clear understanding of desired outcome/s 1.4 Personal attributes 1.4.1 self awareness 1.4.2 self esteem 1.4.3 objectivity 1.4.4 empathy 1.4.5 respect for others 1.5 Interpersonal skills 1.5.1 listening/reflecting 1.5.2 non verbal communication 1.5.3 assertiveness 1.5.4 behavior labeling 1.5.5 testing understanding 1.5.6 seeking information 1.5.7 self disclosing 1.6 Analytic skills 1.6.1 observing differences between content and process 1.6.2 identifying bargaining information 1.6.3 applying strategies to manage process 1.6.4 applying steps in negotiating process 1.6.5 strategies to manage conflict 1.6.6 steps in negotiating process 1.6.7 options within organization and externally for resolving conflict
2. Non verbal environments	2.1 Friendly reception 2.2 Warm and welcoming room 2.3 Refreshments offered 2.4 Lead in conversation before negotiation begins
3. Active listening	3.1 Attentive 3.2 Don't interrupt 3.3 Good posture 3.4 Maintain eye contact 3.5 Reflective listening
4. Questioning techniques	4.1 Direct 4.2 Indirect 4.3 Open-ended

EVIDENCE GUIDE

1. Critical aspects of competency	Assessment requires evidence that the candidate: 1.1 Demonstrated sufficient knowledge of the factors influencing negotiation to achieve agreed outcome 1.2 Participated in negotiation with at least one person to achieve an agreed outcome
2. Underpinning knowledge and attitude	2.1 Codes of practice and guidelines for the organization 2.2 Organizations policy and procedures for negotiations 2.3 Decision making and conflict resolution strategies procedures 2.4 Problem solving strategies on how to deal with unexpected questions and attitudes during negotiation 2.5 Flexibility 2.6 Empathy
3. Underpinning skills	3.1 Interpersonal skills to develop rapport with other parties 3.2 Communication skills (verbal and listening) 3.3 Observation skills 3.1 Negotiation skills
4. Resource implications	The following resources **MUST** be provided: 4.1 Room with facilities necessary for the negotiation process 4.2 Human resources (negotiators)
5. Method of assessment	Competency may be assessed through: 5.1 Observation/demonstration and questioning 5.2 Portfolio assessment 5.3 Oral and written questioning 5.4 Third party report
6. Context of assessment	6.1 Competency to be assessed in real work environment or in a simulated workplace setting.

UNIT OF COMPETENCY : SOLVE PROBLEMS RELATED TO WORK ACTIVITIES

UNIT CODE : 500311112

UNIT DESCRIPTOR : This unit of covers the knowledge, skills and attitudes required to solve problems in the workplace including the application of problem solving techniques and to determine and resolve the root cause of problems.

ELEMENT	PERFORMANCE CRITERIA ***Italicized*** terms are elaborated in the Range of Variables
1. Identify the problem	1.1 Variances are identified from normal operating parameters; and product quality 1.2 Extent, cause and nature are of the problem are defined through observation, investigation and ***analytical techniques*** 1.3 ***Problems*** are clearly stated and specified
2. Determine fundamental causes of the problem	2.1 Possible causes are identified based on experience and the use of problem solving tools / analytical techniques. 2.2 Possible cause statements are developed based on findings 2.3 Fundamental causes are identified per results of investigation conducted
3. Determine corrective action	3.1 All possible options are considered for resolution of the problem 3.2 Strengths and weaknesses of possible options are considered 3.3 Corrective actions are determined to resolve the problem and possible future causes 3.4 **Action *plans*** are developed identifying measurable objectives, resource needs and timelines in accordance with safety and operating procedures
4. Provide recommendation/s to manager	4.1 Report on recommendations are prepared 4.2 Recommendations are presented to appropriate personnel. 4.3 Recommendations are followed-up, if required

RANGE OF VARIABLES

VARIABLE	RANGE
1. Analytical techniques	1.1 Brainstorming 1.2 Intuitions/Logic 1.3 Cause and effect diagrams 1.4 Pareto analysis 1.5 SWOT analysis 1.6 Gant chart, Pert CPM and graphs 1.7 Scattergrams
2. Problem	2.1 Non – routine process and quality problems 2.2 Equipment selection, availability and failure 2.3 Teamwork and work allocation problem 2.4 Safety and emergency situations and incidents
3. Action plans	3.1 Priority requirements 3.2 Measurable objectives 3.3 Resource requirements 3.4 Timelines 3.5 Co-ordination and feedback requirements 3.6 Safety requirements 3.7 Risk assessment 3.8 Environmental requirements

EVIDENCE GUIDE

1. Critical aspects of competency	Assessment requires evidence that the candidate: 1.1 Identified the problem 1.2 Determined the fundamental causes of the problem 1.3 Determined the correct / preventive action 1.4 Provided recommendation to manager These aspects may be best assessed using a range of scenarios / case studies / what ifs as a stimulus with a walk through forming part of the response. These assessment activities should include a range of problems, including new, unusual and improbable situations that may have happened.
2. Underpinning knowledge and attitude	2.1 Competency includes a thorough knowledge and understanding of the process, normal operating parameters, and product quality to recognize non-standard situations 2.2 Competency to include the ability to apply and explain, sufficient for the identification of fundamental cause, determining the corrective action and provision of recommendations 2.2.1 Relevant equipment and operational processes 2.2.2 Enterprise goals, targets and measures 2.2.3 Enterprise quality, OHS and environmental requirement 2.2.4 Principles of decision making strategies and techniques 2.2.5 Enterprise information systems and data collation 2.2.6 Industry codes and standards
3. Underpinning skills	3.1 Using range of formal problem solving techniques 3.2 Identifying and clarifying the nature of the problem 3.3 Devising the best solution 3.4 Evaluating the solution 3.5 Implementation of a developed plan to rectify the problem
4. Resource implications	4.1 Assessment will require access to an operating plant over an extended period of time, or a suitable method of gathering evidence of operating ability over a range of situations. A bank of scenarios / case studies / what ifs will be required as well as bank of questions which will be used to probe the reason behind the observable action.

5. Methods of assessment	Competency may be assessed through: 5.1 Case studies on solving problems in the workplace 5.2 Observation The unit will be assessed in a holistic manner as is practical and may be integrated with the assessment of other relevant units of competency. Assessment will occur over a range of situations, which will include disruptions to normal, smooth operation. Simulation may be required to allow for timely assessment of parts of this unit of competency. Simulation should be based on the actual workplace and will include walk through of the relevant competency components.
6. Context for Assessment	6.1 In all workplace, it may be appropriate to assess this unit concurrently with relevant teamwork or operation units.

UNIT OF COMPETENCY: USE MATHEMATICAL CONCEPTS AND TECHNIQUES

UNIT CODE : 500311113

UNIT DESCRIPTOR : This unit covers the knowledge, skills and attitudes required in the application of mathematical concepts and techniques.

ELEMENT	PERFORMANCE CRITERIA ***Italicized*** terms are elaborated in the Range of Variables
1. Identify mathematical tools and techniques to solve problem	1.1 Problem areas are identified based on given condition 1.2 ***Mathematical techniques*** are selected based on the given problem
2. Apply mathematical procedure/solution	2.1 Mathematical techniques are applied based on the problem identified 2.2 Mathematical computations are performed to the level of accuracy required for the problem 2.3 Results of mathematical computation is determined and verified based on job requirements
3. Analyze results	3.1 Result of application is reviewed based on expected and required specifications and outcome 3.2 ***Appropriate action*** is applied in case of error

RANGE OF VARIABLES

VARIABLE	RANGE
1. Mathematical techniques	May include but are not limited to: 1.1 Four fundamental operations 1.2 Measurements 1.3 Use/Conversion of units of measurements 1.4 Use of standard formulas
2. Appropriate action	2.1 Review in the use of mathematical techniques (e.g. recalculation, re-modeling) 2.2 Report error to immediate superior for proper action

EVIDENCE GUIDE

1. Critical aspects of competency	Assessment requires evidence that the candidate: 1.1 Identified, applied and reviewed the use of mathematical concepts and techniques to workplace problems
2. Underpinning Knowledge	2.1 Fundamental operation (addition, subtraction, division, multiplication) 2.2 Measurement system 2.3 Precision and accuracy 2.4 Basic measuring tools/devices
3. Underpinning skills	3.1 Applying mathematical computations 3.2 Using calculator 3.3 Using different measuring tools
4. Resource implications	The following resources **MUST** be provided: 4.1 Calculator 4.2 Basic measuring tools 4.3 Case Problems
5. Methods of assessment	Competency may be assessed through: 5.1 Authenticated portfolio 5.2 Written Test 5.3 Interview/Oral Questioning 5.4 Demonstration
6. Context for Assessment	6.1 Competency may be assessed in the work place or in a simulated work place setting

UNIT OF COMPETENCY: USE RELEVANT TECHNOLOGIES

UNIT CODE : 500311114

UNIT DESCRIPTOR : This unit of competency covers the knowledge, skills, and attitude required in selecting, sourcing and applying appropriate and affordable technologies in the workplace.

ELEMENT	PERFORMANCE CRITERIA ***Italicized*** terms are elaborated in the Range of Variables
1. Study/select appropriate technology	1.1 Usage of different ***technologies*** is determined based on job requirements 1.2 Appropriate technology is selected as per work specification
2. Apply relevant technology	2.1 Relevant technology is effectively used in carrying out function 2.2 Applicable software and hardware are used as per task requirement 2.3 ***Management concepts*** are observed and practiced as per established industry practices
3. Maintain/enhance of relevant technology	3.1 Maintenance of technology is applied in accordance with the ***industry standard operating procedure***, ***manufacturer's operating guidelines*** and ***occupational health and safety procedure*** to ensure its operative ability 3.2 Updating of technology is maintained through continuing education or training in accordance with job requirement 3.3 Technology failure/ defect is immediately reported to the concern/responsible person or section for ***appropriate action***

RANGE OF VARIABLES

VARIABLE	RANGE
1. Technology	May include but are not limited to: 1.1 Office technology 1.2 Industrial technology 1.3 System technology 1.4 Information technology 1.5 Training technology
2. Management concepts	May include but not limited to: 2.1 Real Time Management 2.2 KAIZEN or continuous improvement 2.3 5s 2.4 Total Quality Management 2.5 Other management/productivity tools
3. Industry standard operating procedure	3.1 Written guidelines relative to the usage of office technology/equipment 3.2 Verbal advise/instruction from the co-worker
4. Manufacturer's operating guidelines/ instructions	4.1 Written instruction/manuals of specific technology/ equipment 4.2 General instruction manual 4.3 Verbal advise from manufacturer relative to the operation of equipment
5. Occupational health and safety procedure	5.1 Relevant statutes on OHS 5.2 Company guidelines in using technology/equipment
6. Appropriate action	6.1 Implementing preventive maintenance schedule 6.2 Coordinating with manufacturer's technician

EVIDENCE GUIDE

1. Critical aspects of competency	Assessment requires evidence that the candidate: 1.1 Studied and selected appropriate technology consistent with work requirements 1.2 Applied relevant technology 1.3 Maintained and enhanced operative ability of relevant technology
2. Underpinning knowledge and attitude	2.1 Awareness on technology and its function 2.2 Repair and maintenance procedure 2.3 Operating instructions 2.4 Applicable software 2.5 Communication techniques 2.6 Health and safety procedure 2.7 Company policy in relation to relevant technology 2.8 Different management concepts 2.9 Technology adaptability
3. Underpinning skills	3.1 Relevant technology application/implementation 3.2 Basic communication skills 3.3 Software applications skills 3.4 Basic troubleshooting skills
4. Resource implications	The following resources **MUST** be provided: 4.1 Relevant technology 4.2 Interview and demonstration questionnaires 4.3 Assessment packages
5. Method of assessment	Competency must be assessed through: 5.1 Interview 5.2 Actual demonstration 5.3 Authenticated portfolio (related certificates of training/seminar)
6. Context of assessment	6.1 Competency may be assessed in actual workplace or simulated environment

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	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 attitude 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 work plan 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

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 attitude 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: MANTAIN 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.

ELEMENTS	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 in the ***forms*** 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

VARIABLES	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, grinlet, 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 : **DETERMINE CUSTOMER REQUIREMENTS**

UNIT CODE : **CON311301**

UNIT DESCRIPTOR : This unit covers the skills, knowledge and attitude in determining customer requirements for simple solar home systems less than 1 kW.

ELEMENT	PERFORMANCE CRITERIA ***Italicized terms*** are elaborated in the Range of Variables
1. Assess current and future electrical needs of customer and site characteristics	1.1 Forms for ***site*** assessment are accomplished according to ***company standards***. 1.2 Forms for ***load*** assessment are accomplished according to company standards. 1.3 Interviews are conducted in accordance with company procedures. 1.4 Assessment is conducted within the prescribed time.
2. Recommend options for simple solar home system	2.1 ***System*** recommendation takes into account data gathered information 2.2 Recommendation is appropriate to the ***customer requirement.***

RANGE OF VARIABLES

VARIABLE	RANGE
1. Site	1.1 Space 1.2 Shading 1.3 Geographic condition, i.e., island, mountainous, plain
2. Company standard	2.1 Job orders 2.2 Load computation sheet 2.3 Available components specification
3. Load	3.1 Lights 3.2 TV/ radio 3.3 Electric fans 3.4 Electric tools (small electrical hand tools)
4. System	4.1 DC only 4.2 AC/DC 4.3 AC only
5. Customer requirement	5.1 Application 5.1.1 Lighting 5.1.2 Entertainment 5.1.3 Livelihood 5.2 Size 5.2.1 Small (1-2 modules) 5.2.2 Less than 1 kW

EVIDENCE GUIDE

1. Critical aspects of competency	Assessment requires evidence that the candidate: 1.1 Assessed current and future electrical needs of customer 1.2 Recommended options for simple solar home system
2. Underpinning knowledge and attitude	2.1 Photovoltaic technology and systems 2.2 Principles of electricity (Ohm's Law, AC/DC systems) 2.3 Electrical loads characteristics (wattage, current, voltage) 2.4 Basic mathematical operations 2.5 Patient 2.6 Observant/attentive to details 2.7 Honest
3. Underpinning skills	3.1 Communication skills 3.2 Using basic electrical measuring instruments 3.3 Interpersonal skills
4. Resource implications	The following resources must be provided: 4.1 Data gathering forms 4.2 Electrical measuring instruments 4.3 Pen and paper 4.4 Calculator 4.5 Compass
5. Method of assessment	Competency must be assessed through: 5.1 Observation and demonstration with questioning 5.2 Demonstration with questioning 5.3 Written/oral examination 5.4 Portfolio 5.5 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 : **CALCULATE SYSTEM COMPONENTS REQUIREMENTS (SYSTEM SIZING)**

UNIT CODE : **CON311302**

UNIT DESCRIPTOR : This unit covers the skills, knowledge and attitudes in calculating components of simple solar home systems up to 1 kWp.

ELEMENT	PERFORMANCE CRITERIA ***Italicized terms*** are elaborated in the Range of Variables
1. Calculate energy demand	1.1 ***Load*** demand is listed in a tabulated form based on costumer requirements. 1.2 Energy demand is summed up for each load.
2. Determine battery capacity	2.1 Maximum Depth of Discharge is determined based on manufacturer's specification 2.2 Battery capacity is calculated based on the days of autonomy and daily load demand
3. Calculate array size	3.1 Minimum solar insolation is determined from data by the weather bureau. 3.2 Array size is calculated in accordance to the insolation data 3.3 Array size, including the mounting structure, is adjusted based on the environmental factors
4. Determine peak AC load and inverter size (if applicable)	4.1 Peak AC load demand is determined based on costumer's requirements. 4.2 Inverter size is calculated based on the manufacturers' specifications.
5. Calculate the size of the charge controller/regulator	5.1 Size of the charge controller/regulator is determined based on the calculated array size. 5.2 Task is done according to standard ***calculations***, including system losses, wiring, and site assessment data.

RANGE OF VARIABLES

VARIABLE	RANGE
1. Load	Load may include: 1.1. Lights 1.2. TV/ radio 1.3. Electric fans 1.4. Electric tools (small electrical hand tools)
2. Calculations	2.1 Module heating 2.2 Wire voltage drop 2.3 Dirt accumulation 2.4 Array degradation 2.5 Inverter efficiency 2.6 Battery efficiency 2.7 Charge controller/regulator efficiency 2.8 Battery-module voltage mismatched 2.9 Grounding protection

EVIDENCE GUIDE

1. Critical aspects of competency	Assessment requires evidence that the candidate calculated the system components requirements (system sizing).
2. Underpinning knowledge and attitude	2.1 PV technology 2.2 Available commercial standard units/sizes 2.3 Principles of electricity 2.4 Loads characteristics 2.5 Basic mathematics 2.6 Data repositories, i.e. weather data 2.7 Basic costing 2.8 Weather data interpretation 2.9 Photovoltaic system optimization
3. Underpinning skills	3.1 Mathematical skills 3.2 Use of computing instrument 3.3 Weather data analysis
4. Resource implications	The following resources must be provided: 4.1 Calculator 4.2 System sizing forms 4.3 Pen and paper 4.4 Site assessment form (filled-out) 4.5 Weather data 4.6 Manufacturer's manual 4.7 PEC
5. Method of assessment	Competency must be assessed through: 5.1 Written exam 5.2 Third party assessment 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

UNIT OF COMPETENCY : **SPECIFY COMPONENTS IN BILL OF MATERIALS**

UNIT CODE : **CON311303**

UNIT DESCRIPTOR : This unit covers the skills, knowledge, and attitude in specifying components in the bill of materials for simple solar home systems up to 1kWp.

ELEMENT	PERFORMANCE CRITERIA ***Italicized terms*** are elaborated in the Range of Variables
1. Select components	1.1 ***PV system components*** are select based on the system sizing requirements. 1.2 Components are select based on existing ***safety and quality standards***.
2. Prepare bill of materials	2.1 Quantities are determined based on the system sizing requirements. 2.2 Bill of materials is prepared based on a ***prescribed format***.

RANGE OF VARIABLES

VARIABLE	RANGE
1. PV Systems Components	1.1 Photovoltaic module 1.2 Support structures 1.3 Battery/battery banks 1.4 Charge controller/regulator 1.5 Inverter 1.6 Loads 1.7 Metal structures 1.8 Wire/cables 1.9 Lighting accessories/fixtures
2. Safety and Quality Standards	2.1 PV Gap 2.2 IEC certification 2.3 Philippine Electrical Code 2.4 Philippine National Standards for Battery
3. Prescribed format	Prescribed format may include data such as: 3.1 Type of materials and specification 3.2 Quantity of materials to be used 3.3 Estimated cost

EVIDENCE GUIDE

1. Critical aspects of competency	Assessment requires evidence that the candidate: 1.1 Prepared the bill of materials for the designed Photovoltaic system. 1.2 Specified the bill of materials for the designed Photovoltaic system.
2. Underpinning knowledge and attitude	2.1 Photovoltaic technology 2.2 Available commercial sizes 2.3 System design 2.4 Availability of components 2.5 Safety standards 2.6 Quality standards 2.7 Patient 2.8 Honest 2.9 Observant 2.10 Active 2.11 Sort, Straighten, Shine, Systemize and Sustain (5S)
3 Underpinning skills	3.1 Mathematical skills 3.2 Data Analysis skills 3.3 Research skills 3.4 Computation skills 3.5 Sorting skills
4 Resource implications	The following resources must be provided: 4.1 Components Specification 4.2 Philippine Electrical Code 4.3 Forms 4.4 Job Order 4.5 Internet 4.6 Computer/Calculator
5 Method of assessment	Competency must be assessed through: 5.1 Demonstration with Questioning 5.2 Observation with questioning 5.3 Written Exam 5.4 Third party assessment 5.5 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

UNIT OF COMPETENCY : **PREPARE INSTALLATION DRAWING**

UNIT CODE : **CON311304**

UNIT DESCRIPTOR : This unit covers the skills, knowledge, and attitude in preparing installation drawings for simple solar home systems up to 1kWp

ELEMENT	PERFORMANCE CRITERIA ***Italicized terms*** are elaborated in the Range of Variables
1. Identify drawing requirements	1.1 Requirements are determined based on customer requirements and/or relevant documents. 1.2 Drawing requirements are confirmed with concerned personnel.
2. Prepare electrical diagram	2.1 Electrical drawing is prepared using standard electrical symbols and notation. 2.2 Electrical diagram is finalized including all ***electrical components*** specified in the bill of materials.
3. Prepare mechanical drawing	3.1 Mechanical drawing is prepared using standard mechanical symbols and notation. 3.2 Mechanical drawing is finalized including all ***mechanical components*** specified in the bill of materials. 3.3 Completed drawings are submitted for approval in accordance with standard operating procedures.
4. Issue drawing	4.1 Approved drawings are reproduced and issued to concerned personnel in accordance with standard. 4.2 Approved drawings are catalogued and stored in accordance with standard operating procedures.

RANGE OF VARIABLES

VARIABLE	RANGE
1. Electrical components	1.1 Photovoltaic module wiring 1.1.1 Bypass diode 1.1.2 Blocking diode 1.1.3 Photovoltaic Array Disconnect 1.2 Charge Controller 1.2.1 Wiring Connection 1.2.2 BCC Disconnect 1.3 Battery Bank 1.3.1 Battery Connection 1.3.2 Battery Disconnect 1.4 Disconnect Fuses 1.5 Electrical Loads 1.6 Inverter 1.7 Grounding protection 1.8 Surge and Lightning protection 1.9 Types of wires/cables 1.10 Wire gauge
2. Mechanical components	Photovoltaic array support structure 2.1 Foundation 2.2 Mounting structure 2.3 Photovoltaic array layout 2.4 Conduit wiring/Race way 2.5 Battery/battery bank enclosure 2.6 Charge controller/regulator enclosure 2.7 Light Fittings fixture enclosure 2.8 Indicate compass orientation 2.9 Disconnects/connects Location 2.10 Grounding Electrode location 2.11 Dimension

EVIDENCE GUIDE

1. Critical aspects of competency	Assessment requires evidence that the candidate: 1.1 Prepared electrical drawings that include all components specified in the bill of materials 1.2 Prepared mechanical drawings that include all components specified in the bill of materials.
2. Underpinning knowledge and attitude	2.1 Photovoltaic technology 2.2 Principles of electricity 2.3 Basic Mathematical Computation 2.4 Electrical and Mechanical drawing symbols and notations 2.5 Detail oriented in electrical and mechanical drawing 2.6 Patience 2.7 Observant 2.8 Honest
3. Underpinning skills	3.1 Mathematical Skills 3.2 Computation skills 3.3 Drawing skills 3.4 Skill in the use of drawing instrument 3.5 Analytical skills
4. Resource implications	The following resources must be provided: 4.1 Calculator 4.2 Pen & paper 4.3 Drawing instrument 4.4 Bill of Materials 4.5 Manufacturer's specification 4.6 Philippine Electrical Code 4.7 Drawing supplies and accessories
5. Method of assessment	Competency must be assessed through: 5.1 Observation and demonstration with questioning 5.2 Third party assessment 5.3 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

3.1 CURRICULUM DESIGN

Course Title: PV System Design **NC Level:** NC III

Nominal Training Duration: 148 hours

20 hrs – Basic Competencies
72 hrs – Common Competencies
56 hrs – Core Competencies

Course Description:

The course is designed to enhance the knowledge, skills and desirable attitudes of a PV System Design Technician in accordance with industry standards. It covers core competencies such as: Determine customer requirement; Calculate PV system components (system sizing) of small solar home systems up to 1kWp. It also include competency to prepare and specify components in Bill of Materials and prepare Installation drawing.

Basic competencies such as: Lead workplace communication; Lead small teams; Develop and practice negotiation skills; Solve problems related to work activities; Use mathematical concepts and techniques and Use relevant technologies are included.

It also include common competencies such as; 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.

BASIC COMPETENCIES
20 hrs

Unit of Competency	Learning Outcomes	Methodology	Assessment Approach
1. Lead workplace communication	1.1 Communicate information about workplace processes. 1.2 Lead workplace discussions. 1.3 Identify and communicate issues arising in the workplace	• Group discussion • Role Play • Brainstorming	• Observation • Interviews
2. Lead small teams	2.1 Provide team leadership. 2.2 Assign responsibilities among members. 2.3 Set performance expectation for team members. 2.4 Supervise team performance	• Lecture • Demonstration • Self-paced (modular) • Case studies	• Demonstration • Written exam

3. Develop and practice negotiation skills	3.1 Identify relevant information in planning negotiations 3.2 Participate in negotiations 3.3 Document areas for agreement	• Lecturette • Role playing • Practical exercises	• Written test • Demonstration
4. Solve workplace problem related to work activities	4.1 Explain the analytical techniques. 4.2 Identify the problem. 4.3 Determine the possible cause/s of the problem.	• Direct observation • Simulation/role playing • Case studies	• Written test • Practical/ performance test
5. Use mathematical concepts and techniques	5.1 Identify mathematical tools and techniques to solve problem 5.2 Apply mathematical procedures/solution 5.3 Analyze results	• Lecturette • Self-pace • Group discussion • Practical Work Approach • Research study	• Written test • Demonstration • Oral Interview
6. Use relevant technologies	6.1 Study/ select appropriate technology 6.2 Apply relevant technology 6.3 Maintain/enhance relevant technology	• Lecturette • Self-pace • Group discussion • Film showing	• Written test • Interview

COMMON COMPETENCIES
72 hrs

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 questioning ▪ Direct observation ▪ Written / Oral 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	▪ Practical exam ▪ Direct observation ▪ 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 ▪ Classroom discussion ▪ Actual demonstration	▪ Direct observation ▪ Oral questioning ▪ Written test or examination ▪ 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	▪ Direct observation of application of tasks. ▪ Oral questioning ▪ Written test or examination ▪ Practical exam

CORE COMPETENCIES
56 hrs

Unit of Competency	Learning Outcomes	Methodology	Assessment Approach
1. Determine customer requirements	1.1 Assess current and future electrical needs of customer and site characteristics 1.2 Recommend options	▪ Lecture-demonstration ▪ Self-paced instruction ▪ Group discussion	▪ Observation with questioning ▪ Demonstration with questioning ▪ Written/oral examination
2. Calculate System Components Requirements (System Sizing)	2.1 Calculate Energy Demand 2.2 Determine Battery Capacity 2.3 Calculate Array Size 2.4 Determine Peak AC load and inverter size (if applicable) 2.5 Calculate the minimum power specification (size) of the controller	▪ Lecture-demonstration ▪ Self-paced instruction ▪ Group discussion	▪ Written exam

3. Specify Components in Bill of Materials	3.1 Select Components 3.2 Prepare Bill of Materials	▪ Lecture-demonstration ▪ Self-paced instruction ▪ Group discussion	▪ Written exam
4. Prepare installation drawing	4.1 Prepare Electrical Diagram 4.2 Prepare Mechanical Drawing	▪ Lecture-demonstration ▪ Self-paced instruction ▪ Group discussion	▪ Written exam

3.2 TRAINING DELIVERY

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

- The training is based on curriculum developed from the competency standards;
- Learning is modular in its structure;
- Training delivery is individualized and self-paced;
- 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 in the collection of evidence of the performance of work to the industry required standard;
- Training is based both on and off-the-job components;
- Allows for recognition of prior learning (RPL) or current competencies;
- Training allows for multiple entry and exit; and
- Approved training programs are nationally accredited.

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 learning is a competency-based training modality wherein the trainee is allowed to progress at his 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 a 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 instructors are not in the same place. Distance learning may employ correspondence study, or audio, video or computer technologies.

3.3 TRAINEE ENTRY REQUIREMENTS

The trainees who wish to enter the course should possess the following requirements:

- Have undergone training on PV Systems Installation National Certificate Level II
- Can communicate both orally and in writing
- Must be physically and mentally fit to undergo training
- At least 18 yrs old

3.4 LIST OF TOOLS, EQUIPMENT, AND MATERIALS

Recommended list of tools, equipment, and materials for the training of 25 trainees for PV System Design NC III:

TOOLS		EQUIPMENT		MATERIAL	
Qty.	Description	Qty.	Description	Qty.	Description
25 units	Magnetic Compass	25 pcs	Calculator	5 vol.	Philippine Electrical Code
		25 units	Drawing table	25 each	Drawing supplies and accessories
		10 units	Computers with appropriate application software	25 each	Drawing instrument
		5 vol.	Reference books (weather data)	25 each	Pen & paper
				5 catalogs	Manufacturer's specification and manuals
				5 lot	Forms (job order, system sizing forms, site assessment forms)
				25 each	System sizing forms

3.5 TRAINING FACILITIES

Based on class size of 25 students/trainees the space requirements for the teaching/learning and circulation areas are as follows:

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 System Design NC III

- Must be a holder of PV System Design NC III
- Must have undergone Training Methodology (TM II)[1]
- Must be computer literate
- Must be physically and mentally fit
- Have at least 2 years job/ industry 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 System Design NC III**, the candidate must demonstrate in all the units listed in Section 1. Successful candidates shall be awarded a **National Certificate III** signed by the TESDA Director General.

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

4.2.1. **Prepare PV System Design**

- Determine Customer Requirements
- Calculate System Component Requirements (System Sizing)
- Specify Components in Bill of Materials
- Prepare Installation Drawing

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:

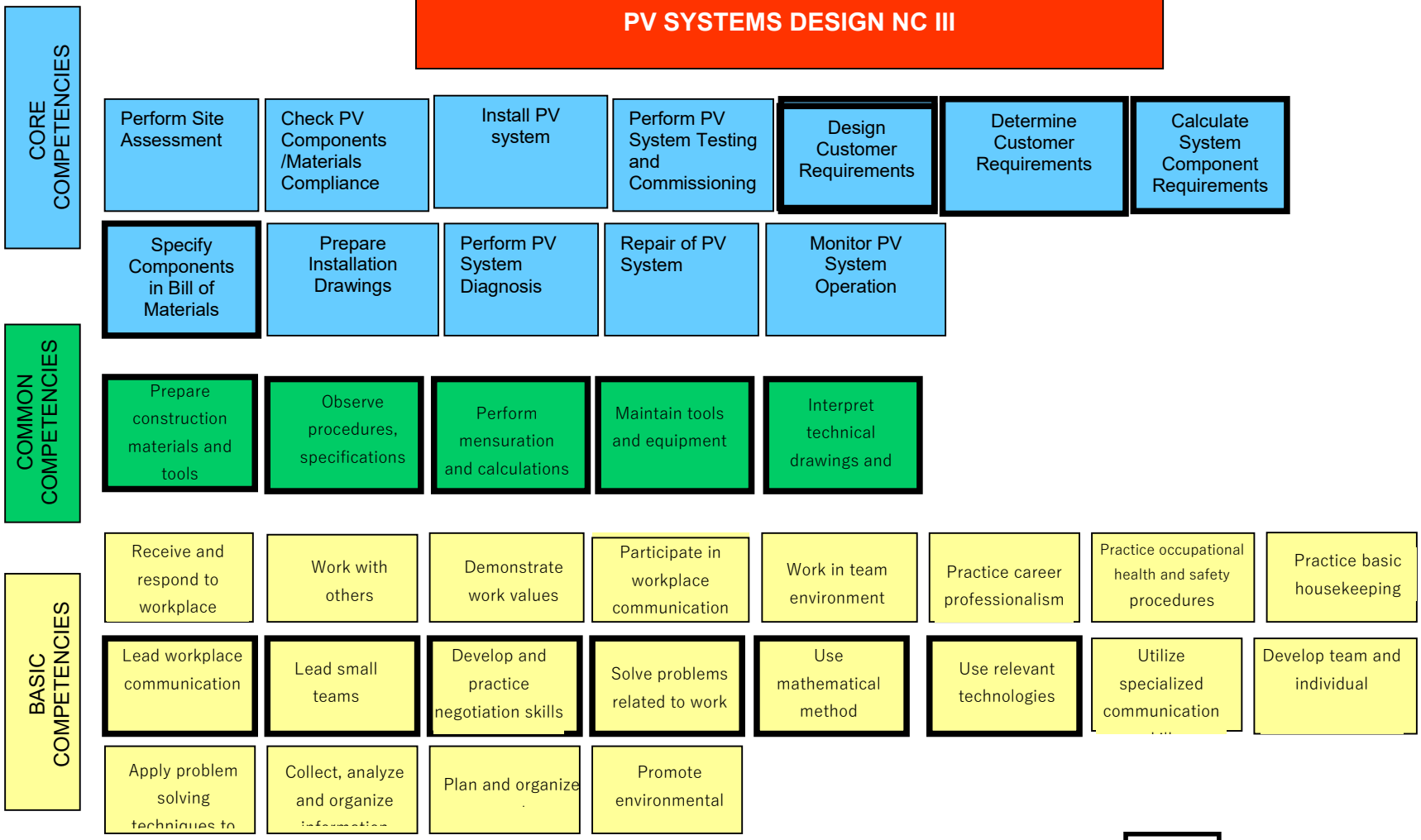
4.4.1. Graduate of formal, non-formal, and informal including enterprise-based training programs.

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 DESIGN NC III



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 competency 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 and attitude**- 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

43. **Depth of Discharge (DoD)** - is a an alternate method to indicate a battery's State of charge (SOC). The DOD is the inverse of SOC: as one increases, the other decreases. While the SOC units are percent points (0% = empty; 100% = full), the units for DOD can be Ah (e.g.: 0 = full, 50 Ah = empty) or percent points (100% = empty; 0% = full)

44. **Solar insolation** - is a measure of solar radiation energy received on a given surface area in a given time. It is commonly expressed as average irradiance in watts per square meter (W/m^2) or kilowatt-hours per square meter per day ($kW \cdot h/(m^2 \cdot day)$).

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