

REQUIRED SKILLS AND KNOWLEDGE – UEENEEK148A		
KS01-EK148A	Photovoltaic LV installations	<u>USING 360 TRAINER</u>
Topic and Description	NIDA Lesson	CARD #
<p>T1 PV array installation requirements encompassing:</p> <ul style="list-style-type: none"> • OH&S requirements and methods for working on roofs. • common methods of roof construction (rafters and tile battens) and methods to ensure integrity of waterproofing. • common types of roof mounted and free-standing PV array frame construction and methods of tilt angle adjustment. • fixing methods for different roof types. • array mounting methods for north orientation roof sections and non-north facing roof sections. • aesthetic considerations in choosing an appropriate array location and type of mounting. • the mounting and fixing methods for at least one type of commercially available building integrated PV product. 		
<p>T2 Electrical PV array installation requirements encompassing:</p> <ul style="list-style-type: none"> • methods used in wiring and connecting PV arrays as per the Australian Standards AS 4509 and AS5033 • considerations involved in wiring of series connected PV modules in order to minimise power losses due to shading. • PV array wiring diagram including the placement of blocking and bypass diodes. • considerations involved in choosing the location of associated system equipment including regulators, d.c. control board, inverters and inverters for grid connected systems. • cable route from PV array/s to inverters so as to minimise the route length. 	<p>Home Energy Systems 7231-114-130 Home Solar Energy System Fundamentals . . .</p> <ul style="list-style-type: none"> ▪ Explain home solar energy operation. ▪ Describe solar resources and their uses for home energy. ▪ Recognize safe home solar energy maintenance methods. ▪ Recognize home solar energy common tools. ▪ Read a home solar energy block diagram to identify the major subsystems. ▪ Operate a home solar energy system using a block diagram. ▪ Verify the operation of the home solar energy system using sensors, monitors and display devices. ▪ Examine the operation of the home solar energy system. 	ES101, ES102, ES104, ES105, ES106, ES107

<p>T3 System installation and maintenance encompassing:</p> <ul style="list-style-type: none"> • installation work on a PV power system in accordance with relevant standards and OH&S guidelines. • correct isolation and shutdown procedures prior to carrying out maintenance tasks. • routine maintenance tasks on PV arrays. • required vegetation control to remove or reduce shading or soiling on a PV array 	<p>Introduction 7231-112-130 Introduction to Renewable Energy Systems .</p> <ul style="list-style-type: none"> ▪ Express the need for renewable energy. ▪ Explain the four interdependent elements of renewable energy systems. ▪ Understand renewable energy sources. ▪ Describe energy conversion technologies. <p>7231-112-160 Energy Sources and Site Surveys</p> <ul style="list-style-type: none"> ▪ Describe renewable energy resources (wind, solar, hydroelectric, ocean wave, ocean tidal, ocean current, ocean thermal conversion, geothermal). ▪ Illustrate energy resources (wind, solar). ▪ Explain the use of a site survey. ▪ Describe how to perform a site survey. <p>Solar Energy Systems 7231-118-130 Solar Thermal System Fundamentals ---</p> <ul style="list-style-type: none"> ▪ Express the need for solar thermal power as a renewable energy. ▪ Differentiate non-concentrating and concentrating thermal collectors. ▪ Explain the three main classes of solar thermal collectors. ▪ Examine solar pool heating systems. ▪ Examine solar water heating systems. ▪ Examine solar space heating systems. ▪ Examine parabolic trough systems. ▪ Examine solar dish (Stirling engine) systems. ▪ Examine solar power tower systems. <p>7231-118-160 Solar Photovoltaic System Fundamentals</p> <ul style="list-style-type: none"> ▪ Express the need for solar photovoltaic power as a renewable energy. ▪ Explain the photovoltaic (PV) effect and construction. ▪ Describe solar resources. ▪ Describe general solar photovoltaic personal protective equipment. ▪ Explain proper installation procedures. ▪ Recognize safe installation and maintenance methods. ▪ Recognize solar PV system common tools. ▪ Read a solar photovoltaic system block diagram to identify the major subsystems. ▪ Set up and initialize a solar PV system following a given procedure. ▪ Operate a solar photovoltaic system using a block diagram. 	<p>ES101, ES102, ES104, ES105, ES106, ES107, ES182</p> <p>ES101, ES102, ES104, ES105, ES106, ES107, ES182</p> <p>ES101, ES102, ES104, ES105, ES106, ES107</p>
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	<ul style="list-style-type: none">▪ Verify the operation of a solar photovoltaic system using sensors, monitors, and display devices.▪ Examine the operation of each solar photovoltaic subsystem. 7231-118-190 Solar Photovoltaic System Maintenance and Diagnostics▪ Recognize solar photovoltaic preventive/scheduled and unscheduled maintenance routines.▪ Describe physical inspection techniques for solar photovoltaic systems.▪ Recognize unscheduled maintenance routines.▪ Describe when unscheduled maintenance is necessary.▪ Set up and initialize a solar PV system following a given procedure.▪ Perform a solar photovoltaic system operational check.▪ Show proper use of measurement devices.▪ Examine solar photovoltaic system fault isolation procedures▪ Demonstrate the ability to diagnose a defective subsystem in a solar photovoltaic system using fault isolation procedures. 7231-118-220 Solar Photovoltaic System Malfunctions and Troubleshooting .▪ Examine the troubleshooting process for solar photovoltaic systems.▪ Describe the basic tools used to troubleshoot solar photovoltaic systems.▪ Set up and initialize a solar PV system following a given procedure.▪ Validate system operation using sensors, displays, and monitoring devices.▪ Verify symptoms of solar photovoltaic subsystem malfunctions.▪ Use a digital multimeter and oscilloscope to take measurements.▪ Troubleshoot malfunctioning subsystems in a solar photovoltaic system. 7231-118-920 Commercial Solar Energy Systems Post-Test (Theory)▪	
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<p>T4 Inverters encompassing:</p> <ul style="list-style-type: none"> • types of inverters used in grid connected systems. • AS symbol for a low voltage inverter • the basic function of an inverter. • simple block diagram of a typical inverter used in grid connected system 		
<p>T5 Inverter operation encompassing:</p> <ul style="list-style-type: none"> • the basic principle of operation of a single phase inverter (using switch analogue) • the operation of an inverter bridge and half-bridge configuration. • operation of a FET inverter • connection of a grid inverter and measurement of the inverter parameters for various loads 		
<p>T6 Inverter characteristics encompassing:</p> <ul style="list-style-type: none"> • the characteristics which distinguish inverters suitable for grid connected photovoltaic array application from standard inverters. • using waveform diagrams, the function of PWM techniques in square wave, modified square wave and synthesised sine wave inverters • output voltage waveforms for square wave, modified square wave and synthesized sine wave inverters showing typical voltages and periodic times • the six (6) essential inverter specifications 		
<p>T7 PV grid connected system operation encompassing:</p> <ul style="list-style-type: none"> • block diagram of a PV grid connected system. • operation of grid interactive PV systems including synchronisation, safety feature, power flow control, passive and active anti-islanding, and metered energy for systems. 	<p>7231-114-190 Home Hybrid Energy System Fundamentals</p> <ul style="list-style-type: none"> ▪ Explain home backup power generation. ▪ Explain home inverter and grid-tied interface operation. ▪ Describe hybrid home energy system integration. ▪ Recognize safe home hybrid energy maintenance methods. ▪ Recognize home hybrid energy common tools. 	<p>ES101, ES102, ES104, ES105, ES106, ES107,</p>

<ul style="list-style-type: none"> schematic diagrams of common grid connected inverter circuit configurations including metering arrangements, isolation and connection with respect to RCDs in accordance with AS 4777.1. 	<ul style="list-style-type: none"> Read a home hybrid energy block diagram to identify the major subsystems. Operate a home hybrid energy system using a block diagram. Verify the operation of the home hybrid energy system using sensors, monitors, and display devices. Examine the operation of each home hybrid energy subsystem. <p>7231-114-220 Home Energy System Maintenance and Diagnostics . .</p> <ul style="list-style-type: none"> Recognize typical home energy preventive, scheduled, and unscheduled maintenance routines. Describe general inspection techniques for home energy systems. Recognize unscheduled maintenance routines. Describe when unscheduled maintenance is necessary. Set up and initialize a home energy system following a given procedure. Perform a home energy operational check. Show proper use of measurement devices. Examine home energy system fault isolation procedures. Demonstrate the ability to diagnose a defective subsystem in a home energy system using fault isolation procedures. <p>7231-114-250 Home Energy System Malfunctions and Troubleshooting .</p> <ul style="list-style-type: none"> Examine the troubleshooting process for home energy systems. Describe the basic tools used to troubleshoot home energy systems. Set up and initialize a home energy system following a given procedure. Validate system operation using sensors, displays, and monitoring devices. Verify symptoms of home energy subsystem malfunctions. Use a digital multimeter to take measurements. Troubleshoot malfunctioning subsystems in a home energy system. 	<p>ES182</p> <p>ES101, ES102, ES104, ES105, ES106, ES107, ES182</p> <p>ES101, ES102, ES104, ES105, ES106, ES107</p>
<p>T8 Installation of grid connected inverters encompassing:</p> <ul style="list-style-type: none"> major installation requirements for all system components which will ensure correct operation, long life, safety and ease of maintenance consistent with AS 4509, AS 4086.2, AS/NZS 3000 		

<p>and relevant OH&S guidelines</p> <ul style="list-style-type: none"> • selection of a suitable location for the PV array, inverter and other components, at a given installation site in accordance with AS2676.2 and AS3011.2, and the considerations given in AS4509 and AS4086.2. • typical installation configurations for grid connection of energy systems via inverters • the function and operation of a "grid protection device" as specified in AS4777 • array wiring plan for series connected modules to minimise power loss due to shading at a particular site. • installation requirements for a grid connected system. • labelling and signage requirements for switchboards supplied with power from grid connected inverters, as set out in AS 4777.1. • the additional requirements for UPS systems as specified in AS4777.1. • installation of a PV grid connected system 		
<p>T9 System commissioning and maintenance encompassing:</p> <ul style="list-style-type: none"> • the isolation procedures required for grid connected inverters. • relevant commissioning procedures including start-up and shut-down procedures for grid connected inverter systems in accordance with AS 4509. • testing a grid connected inverter system for correct operation. • location and rectification of an electrical fault within a PV array/inverter and wiring. • maintenance schedule for a grid connected PV power system. • performing commissioning work on a PV power system in accordance with AS 4509, AS 4086.2, AS/NZS 3000 and AS 3010.1 	<p>7231-114-190 Home Hybrid Energy System Fundamentals</p> <ul style="list-style-type: none"> ▪ Explain home backup power generation. ▪ Explain home inverter and grid-tied interface operation. ▪ Describe hybrid home energy system integration. ▪ Recognize safe home hybrid energy maintenance methods. ▪ Recognize home hybrid energy common tools. ▪ Read a home hybrid energy block diagram to identify the major subsystems. ▪ Operate a home hybrid energy system using a block diagram. ▪ Verify the operation of the home hybrid energy system using sensors, monitors, and display devices. ▪ Examine the operation of each home hybrid energy subsystem. <p>7231-114-220 Home Energy System Maintenance and Diagnostics . .</p> <ul style="list-style-type: none"> ▪ Recognize typical home energy preventive, scheduled, and unscheduled maintenance routines. ▪ Describe general inspection techniques for home energy systems. 	<p>ES101, ES102, ES104, ES105, ES106, ES107, ES182</p> <p>ES101, ES102, ES104, ES105, ES106,</p>

	<ul style="list-style-type: none"> ▪ Recognize unscheduled maintenance routines. ▪ Describe when unscheduled maintenance is necessary. ▪ Set up and initialize a home energy system following a given procedure. ▪ Perform a home energy operational check. ▪ Show proper use of measurement devices. ▪ Examine home energy system fault isolation procedures. ▪ Demonstrate the ability to diagnose a defective subsystem in a home energy system using fault isolation procedures. <p>7231-114-250 Home Energy System Malfunctions and Troubleshooting .</p> <ul style="list-style-type: none"> ▪ Examine the troubleshooting process for home energy systems. ▪ Describe the basic tools used to troubleshoot home energy systems. ▪ Set up and initialize a home energy system following a given procedure. ▪ Validate system operation using sensors, displays, and monitoring devices. ▪ Verify symptoms of home energy subsystem malfunctions. ▪ Use a digital multimeter to take measurements. ▪ Troubleshoot malfunctioning subsystems in a home energy system. 	<p>ES107, ES182</p> <p>ES101, ES102, ES104, ES105, ES106, ES107</p>
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Performance Tests available for this competency: