REQUIRED SKILLS AND KNOWLEDGE – UEENEEK125A		
KS01-EK125A **Photovoltaic power systems** ***USING 360 TRAINER***		
Topic and Description	**NIDA Lesson**	**CARD #**
1 Daily irradiation encompassing: • definition of the terms: declination angle, reflectance, sunshine hours, extraterrestrial irradiation, Latitude, direct and diffuse radiation, azimuth and altitude angles, radiance, solar window, tilt angle, solstice, equinox • units and symbols for irradiation and irradiance • interpretation of solar radiation data tables and contour maps. • measuring solar irradiance with a solarimeter. • how radiation varies throughout the year on the surface of a fixed collector. • determining, using field measurements and a sun path diagram, the times and dates when a PV array will be shaded by obstacles at a particular site. • calculation of the daily average irradiation on a horizontal plane given extraterrestrial irradiation, location constants and sunshine hour data. • calculation of the monthly mean daily irradiation falling on a PV array for each month of the year, adjusted for the effects of shading, using irradiance and irradiation data tables and a sun path diagram and/or appropriate software. • selection of an appropriate tilt angle for fixed and seasonally-adjustable PV arrays at an given latitude	**Introduction** 7231-112-130 Introduction to Renewable Energy Systems . ▪ Express the need for renewable energy. ▪ Explain the four interdependent elements of renewable energy systems. ▪ Understand renewable energy sources. ▪ Describe energy conversion technologies. 7231-112-160 Energy Sources and Site Surveys ▪ 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. **Solar Energy Systems** 7231-118-130 Solar Thermal System Fundamentals --- ▪ 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. 7231-118-160 Solar Photovoltaic System Fundamentals . . . . ▪ 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.	ES101, ES102, ES104, ES107, ES108, ES109

	▪ 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. ▪ 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.	ES101, ES102, ES104, ES107, ES108, ES109 ES101, ES102, ES104, ES107, ES108, ES109

	7231-118-920 Commercial Solar Energy Systems Post-Test (Theory) .	

T2 Photovoltaic modules encompassing: • definition of the terms: cell, module, array, mono-crystalline, poly-crystalline, amorphous, band gap energy, semi-conductor • diagram of a basic crystalline silicon PV cell, showing its physical structure, with at least five major features labelled • major steps in the production of PV modules based on bulk silicon cells, in comparison with the production of thin film PV modules. • basic physical principles of PV cell operation for the main types of commercially available PV modules. • efficiency, spectral response, cost and typical applications of the main types of commercially available PV modules. • new photovoltaic technologies currently being developed towards commercialisation, and their major features. • mechanical and electrical features necessary for the long life of a PV module under a wide range of operating conditions.	**Home Energy Systems** 7231-114-130 Home Solar Energy System Fundamentals . . . ▪ 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
T3 Module characteristics encompassing: • definition of the terms: I-V curve, fill factor, operating point, maximum power point (MPP), cell temperature co-efficient, nominal operating cell temperature (NOCT), current, voltage and power output co-efficient. • equivalent circuit for a PV cell, labelling each of the elements and the polarity of the terminals. • family of I-V curves for a PV module, labelling major points and showing the effects of variation in irradiance and variation in cell temperature. • major ratings of a PV module from manufacturer's information or nameplate data. • determination of the operating point of a PV module with a resistive load, a constant voltage source or any other load with known I-V characteristics, using the load line method.	7231-114-190 Home Hybrid Energy System Fundamentals ▪ 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 ▪ Examine the operation of each home hybrid energy subsystem. 7231-114-220 Home Energy System Maintenance and Diagnostics ▪ Recognize typical home energy preventive, scheduled, and unscheduled maintenance routines. ▪ Describe general inspection techniques for home energy systems. ▪ Recognize unscheduled maintenance routines.	ES101, ES102, ES104, ES105, ES106, ES107, ES182 ES101, ES102, ES104, ES105, ES106,

• configuration of a typical PV array, including the function, placement and ratings of blocking and bypass diodes. • the effect of partial shading of a PV module or array, the impact of bypass diodes and the significance of their configuration on output current in typical operating conditions. • calculation of the power at MPP, and the power under typical battery charging conditions, of a PV module, given irradiance and ambient air temperature. • calculation of the daily energy output of a PV array in accordance with AS 4509.2, and by using "rule of thumb" de-rating factors. • the scope and content of Australian or international standards relevant to the performance of PV modules. • the electrical characteristics of a PV module according to relevant Australian or International standards, using an outdoor test method.	▪ 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. 7231-114-250 Home Energy System Malfunctions and Troubleshooting ▪ 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. 7231-114-920 Home Energy Systems Post-Test (Theory) .	ES107, ES182 ES101, ES102, ES104, ES105, ES106, ES107

Performance Tests available for this competency: