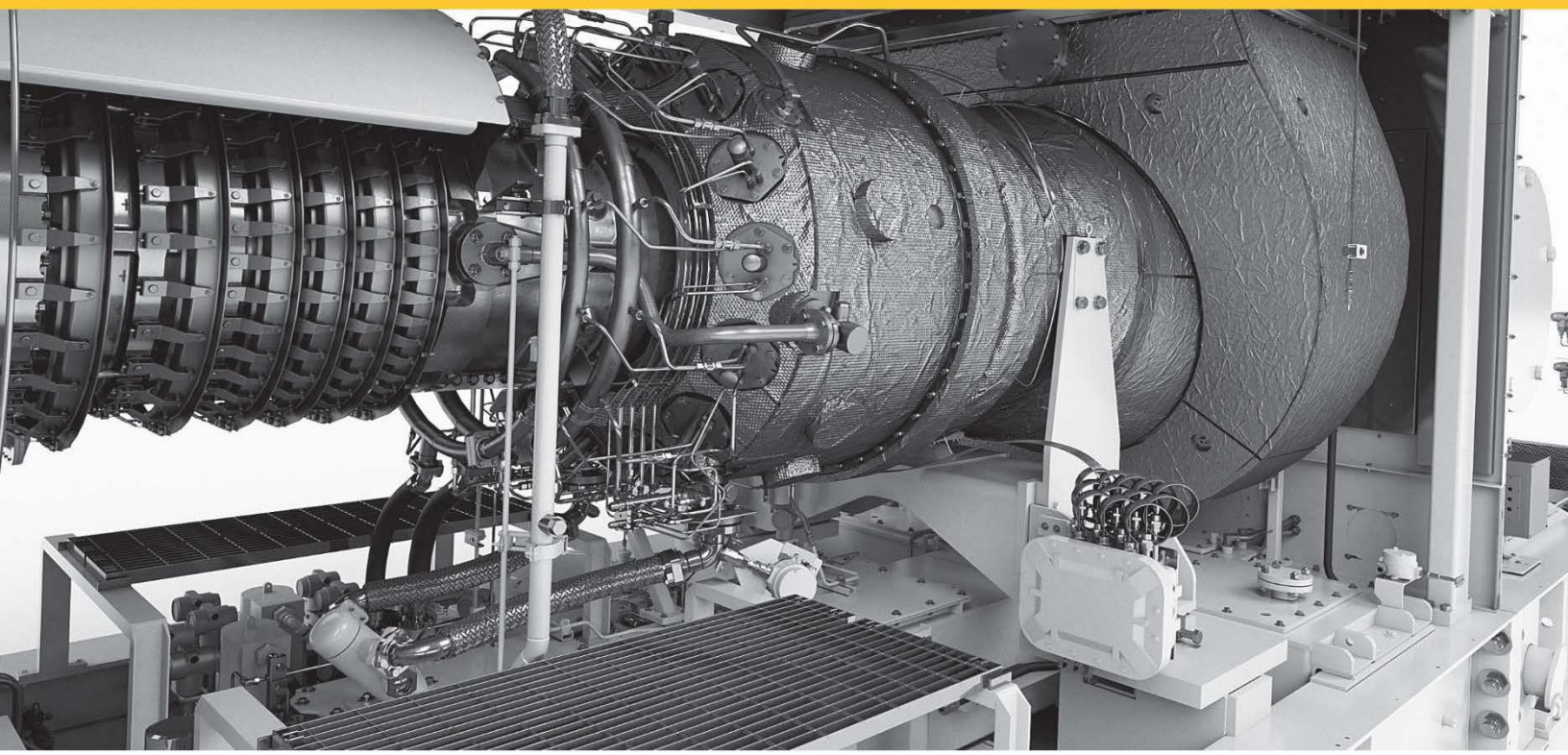
Solar Turbines
A Caterpillar Company

TOTAL LIFE CYCLE SUPPORT

A CULTURE OF CUSTOMER CARE



TECHNICAL TRAINING

eLearning Catalog

CONTENTS

PACKAGE OPERATING PRINCIPLES

This learning plan will provide a turbo-machinery package operator and maintenance technician with the knowledge and skills necessary to operate the package safely and efficiently. This requires a degree of background knowledge of the package systems and system components, the working relationship between the components, and their operating sequences. Therefore, the purpose and function of each of the package major components and support systems will be explained, as well as the components in each system, and the sequences of operation. Common malfunction conditions will be discussed, along with the significance of each, the probable causes, and the recommended action for each condition. The students will thus be able to recognize which abnormal conditions may be influenced and corrected by adjusting operational conditions, and which will require further investigation and "maintenance-based" corrective action.

LEARNING PLAN CONFIGURATION

The following table should be referenced when determining the configuration of a Package Operating Principles (POP) learning plan. The package application and configuration will fine tune the learning plan.

POP	Package			Engine		Start			Lube		Fuel					Controls		Seal		Driven Equip		Operations		Maintenance
	Compressor	Generator	Mechanical Drive	1 Shaft	2 Shaft	DAC	Pneumatic	Hydraulic	Compressor Set	Generator Set	Gas	Liquid	Dual Fuel	SoLoNOx Gas	SoLoNOx Liquid	SoLoNOx Dual Fuel	Turbotronic 4	Turbotronic 5	Wet Seals	Dry Seals	Compressor	Generator	Compressor Set	Generator Set	
Compressor	X				X	Choose 1			X		Choose 1						Choose 1		Choose 1		X		X		X
Generator		X		Choose 1		Choose 1				X	Choose 1						Choose 1					X		X	X
Mechanical Drive			X		X	Choose 1			X		Choose 1						Choose 1								X

The Package Operating Principles learning plan is comprised of the following training units:

- Package Description
- Engine
- Start
- Lube Oil
- Fuel
- Controls
- Compressor Seals (Compressor Packages Only)
- Driven Equipment (Compressor / Generator Packages Only)
- Operations (Compressor / Generator Packages Only)
- Package Maintenance

AVAILABLE LANGUAGES

- English
- Spanish
- German

TRAINING UNITS

PACKAGE DESCRIPTION – COMPRESSOR SET (50000)
PACKAGE DESCRIPTION – GENERATOR SET (50001)
PACKAGE DESCRIPTION – MECHANICAL DRIVE (50002)

Level: 1

Language: English, Spanish, German

This unit describes the purpose of a Solar Compressor, Generator, or Mechanical Drive Package, the package major components, and the ancillary equipment needed to support the package operation.

LEARNING OBJECTIVES

1. State the purpose of the equipment package
2. Describe the package orientation referring to the forward and aft, and left and right designations
3. Identify the major package components
4. Identify the package ancillary equipment

ENGINE – 1 SHAFT (50136)
ENGINE – 2 SHAFT (50137)

Level: 1

Language: English, Spanish, German

This unit discusses the purpose of the engine and how it operates. It provides details on how the engine is internally constructed. Also discussed are the monitoring and control aspects of the engine, including problems that might be encountered, and general maintenance requirements for the engine.

LEARNING OBJECTIVES

1. Describe the purpose and basic operation of a Gas Turbine Engine
2. Describe the four operating stages of the Brayton Cycle
3. Identify and describe the function of the main engine sub-assemblies
4. Describe typical engine instrumentation
5. Describe engine operational sequences
6. Identify and describe the engine-related data on the HMI display screens
7. Describe typical engine problems and their possible causes
8. Describe the general engine maintenance requirements

START – DIRECT AC (50005)
START – HYDRAULIC (50006)
START – PNEUMATIC (50007)

Level: 1

Language: English, Spanish, German

This unit describes the Start System used on Solar turbomachinery packages. This includes the purpose and function of the system; the hardware needed to support them; the operational sequences. operator interface; typical malfunctions; and general maintenance requirements

LEARNING OBJECTIVES

1. State the purpose of the start system
2. Identify and describe the function of the major system components
3. Describe the operational sequences of the start system
4. Describe the interface with the control and display systems
5. Describe typical start system malfunctions
6. Describe the start system general maintenance requirements

LUBE OIL – COMPRESSOR SET (50138)
LUBE OIL – GENERATOR SET (50139)

Level: 1

Language: English, Spanish, German

This unit describes the Lube Oil System used on Solar turbomachinery packages. This includes the purpose and function of the system; the hardware needed to support them; the operational sequences. operator interface; typical malfunctions; and general maintenance requirements

LEARNING OBJECTIVES

1. State the purpose of the lube oil system
2. Identify and describe the function of the major system components
3. Describe the operational sequences of the lube oil system
4. Describe the operational sequences of the lube oil system
5. Describe the interface with the control and display systems
6. Describe typical lube oil system malfunctions
7. Describe the lube oil system general maintenance requirements
8. Describe the lube oil specification, and also the oil analysis process

FUEL – GAS (50140)
FUEL – LIQUID (50141)
FUEL – DUAL (50142)
FUEL – SOLONOX GAS (50143)
FUEL – SOLONOX LIQUID (50144)
FUEL – SOLONOX DUAL (50145)

Level: 1

Language: English, Spanish, German

This unit describes the Fuel System used on Solar turbomachinery packages. This includes the purpose and function of the system; the hardware needed to support them; the operational sequences. operator interface; typical malfunctions; and general maintenance requirements

Variations in the fuel system include gas only, liquid only, and dual fuel. Additionally, the package configuration may be Standard Combustion, or may include Solar's low emissions SoLoNOx system.

FUEL SYSTEM LEARNING OBJECTIVES

1. State the purpose of the fuel system
2. Identify and describe the function of the major system components
3. Describe the operational sequences of the fuel system
4. Describe the interface with the control and display systems
5. Describe typical fuel system malfunctions
6. Describe the fuel system general maintenance requirements

SOLONOX LEARNING OBJECTIVES

1. Describe what NOx and CO emissions are, and how they impact our environment
2. Describe the combustion conditions under which NOx and CO are formed
3. Describe how the SoLoNOx system reduces exhaust emissions
4. List the typical emissions guarantees
5. State the purpose of the pilot fuel system and describe its operation
6. Describe how variable geometry is used to control emissions
7. Describe what is known as the BAM system, and state why it is needed
8. Describe the basic operational sequences of the SoLoNOx system

DUAL FUEL LEARNING OBJECTIVES

1. State the purpose and capabilities of a Dual Fuel System
2. State which hardware components are common to both fuel system
3. Describe the events initiated by a Gas Fuel to Liquid Fuel transfer command
4. Describe the events initiated by a Liquid Fuel to Gas Fuel transfer command

CONTROLS – TURBOTRONIC 4 (50146)
CONTROLS – TURBOTRONIC 5 (50147)

Level: 1

Language: English, Spanish, German

This unit will acquaint you with the overall purpose of Solar's Turbotronic control system. It will discuss each of the five basic control loop elements, as well as describe the typical on and off-skid configuration setups of turbine installed systems.

This unit will also familiarize you with the various hardware components that make up the Turbotronic control system. These components are mounted at various locations and are interconnected by a communications network that relays information to and from the RSLogix Controller and the turbine package. Additionally, the system performs communications with other specialized control devices, such as the Variable Frequency Device, Fire System, and Vibration System.

LEARNING OBJECTIVES

1. Describe the purpose and function of the Turbotronic control system
2. Describe the various configurations of the control system
3. Describe the function of the major components that comprise the Turbotronic control system
4. Describe the communications paths between the components

COMPRESSOR SEALS – WET (50019)
COMPRESSOR SEALS – DRY (50020)

Level: 1

Language: English, Spanish, German

This unit describes the Compressor Seal System used on Solar turbomachinery packages. This includes the purpose and function of the system; the hardware needed to support them; the operational sequences. operator interface; typical malfunctions; and general maintenance requirements

Variations in the seal system include dry gas and wet seal systems.

LEARNING OBJECTIVES

1. State the function of the seal system
2. Describe the operating principles of the seal system
3. Identify and describe the function of the seal system major components
4. Describe the operational sequences of the seal system during startup, normal operation, and shutdown
5. Identify the seal system data displayed on the HMI screens
6. List and describe some common seal system malfunctions

DRIVEN EQUIPMENT – COMPRESSOR (50148)

Level: 1

Language: English, Spanish, German

This unit describes the operational theory and practical application of a centrifugal gas compressor used on Solar turbomachinery packages. It identifies and describes the function of the main internal components, and addresses operational details related to the safe and proper operation of a compressor within the facility process gas system, including options for automated process control. Also included is a review of the various process valves associated with the compressor package. The topics of compressor surge, surge detection, and surge avoidance will also be discussed.

LEARNING OBJECTIVES

1. Describe the operational theory of a centrifugal gas compressor
2. Identify the main internal components installed within a centrifugal gas compressor
3. Describe how the major internal compressor components function
4. Identify and state the function of the compressor instrumentation
5. Identify and state the function of the process valves
6. Describe the operation and sequencing of the process valves
7. Describe the basic principles of compressor process control
8. Describe centrifugal compressor head versus flow characteristics
9. Define the term “surge” as it applies to the centrifugal compressor
10. List the symptoms, effects, and causes of surge
11. Describe the basic principle of a surge avoidance system
12. Describe the basic principle of a surge detection system
13. Describe the features of the HMI Surge Display Screen

DRIVEN EQUIPMENT – GENERATOR (50149)

Level: 1

Language: English, Spanish, German

This unit describes the operational theory and practical application of an electrical generator used on Solar turbomachinery packages. It discusses the principles of electro-magnetic power generation, and how they apply to the design, construction, and operation of a typical generator used on a Solar package. It discusses the operation of the generator package, including the various configuration options that may be selected to maximize the operating efficiency, especially when operated in parallel with other generator packages, or the grid.

LEARNING OBJECTIVES

1. Describe the principles of electro-magnetic induction
2. Describe 3-phase electrical characteristics and how a 3-phase electrical signal is generated using electro-magnetic induction
3. Explain transformer operation and how transformers are used in 3-phase electrical power generation
4. List and describe the function of typical 3-phase electrical generator major components
5. Describe basic generator synchronizing principles and describe the generator synchronizing process
6. Explain the characteristics of real, reactive, and apparent power
7. Describe basic generator load sharing principles
8. Classify power system operational modes using industry and Solar terminology
9. Determine the control system configuration options for various operational scenarios

OPERATIONS – COMPRESSOR SET (50150)
OPERATIONS – GENERATOR SET (50151)

Level: 1

Language: English, Spanish, German

This training unit describes the overall operations of a typical Solar package, including startup and shutdown procedures, monitoring parameters during operations, and an overview of engine performance monitoring.

LEARNING OBJECTIVES

1. Describe the commands and indications available on the Human Machine Interface (HMI)
2. List the prestart configuration and precautions that should be followed for safe operation
3. Describe the procedures to start the unit and put the unit online
4. List the operating parameters that should be monitored during normal operation
5. Describe the different shutdown categories
6. Describe the basic concept of engine performance
7. List and describe the factors that affect engine performance
8. Describe the basic operational indicators associated with engine performance
9. List the data that should be recorded to perform basic engine performance trending
10. Describe possible problems indicated by various trends in performance data

PACKAGE MAINTENANCE PRINCIPLES (50025)

Level: 1

Language: English, Spanish, German

This unit will describe the methods, requirements, and resources needed to perform routine maintenance on Solar turbo-machinery packages.

LEARNING OBJECTIVES

1. Describe various methods and approaches of maintaining turbo-machinery
2. Describe the advantages of Solar's recommended method of maintaining turbo-machinery
3. Describe methods of trending operational data for routine maintenance planning
4. List and describe special tooling, equipment, and typical spare parts required for routine maintenance activities on Solar turbo-machinery
5. List and describe the available technical information sources used to support routine maintenance activities
6. Identify typical routine maintenance data and requirements for various sub-system components

SMT60 PACKAGE OPERATING PRINCIPLES

This learning plan will provide a turbo-machinery package operator and maintenance technician with the knowledge and skills necessary to operate the SMT60 package safely and efficiently. This requires a degree of background knowledge of the package systems and system components, the working relationship between the components, and their operating sequences. Therefore, the purpose and function of each of the package major components and support systems will be explained, as well as the components in each system, and the sequences of operation. Common malfunction conditions will be discussed, along with the significance of each, the probable causes, and the recommended action for each condition. The students will thus be able to recognize which abnormal conditions may be influenced and corrected by adjusting operational conditions, and which will require further investigation and "maintenance-based" corrective action.

Due to the unique characteristics of the SMT60 package, the Package Operating Principles learning plan for the SMT60 is pre-designed. When selecting this option, the package type (i.e. SMT60) will automatically configure the complete learning plan.

LEARNING PLAN CONFIGURATION

The SMT60 Package Operating Principles learning plan is comprised of the following training units:

- Package Description
- Engine
- Start
- Lube Oil
- Fuel – SoLoNOx Gas
- Controls
- SMT60 Medium Voltage System
- Generator Operations
- Operations
- SMT60 Assembly and Disassembly

AVAILABLE LANGUAGES

- English

TRAINING UNITS

PACKAGE DESCRIPTION – SMT60 (50051)

Level: 1
Language: English
This unit describes the purpose of a Solar SMT60 Package, the package major components, and the ancillary equipment needed to support the package operation.

LEARNING OBJECTIVES

1. State the purpose of the SMT60 package
2. Identify the location of the major package components
3. Describe the enclosure ventilation airflow
4. Describe the features and functions of the HMI Enclosure Display screen

ENGINE – SMT60 (50052)

Level: 1
Language: English
This unit discusses the purpose of the engine and how it operates. It provides details on how the engine is internally constructed. Also discussed are the monitoring and control aspects of the engine, including problems that might be encountered, and general maintenance requirements for the engine.

LEARNING OBJECTIVES

1. Describe the purpose and basic operation of a Gas Turbine Engine
2. Describe typical engine instrumentation
3. Identify and describe the engine-related data on the HMI display screens
4. Describe the engine operational sequences

START – SMT60 (50053)

Level: 1
Language: English
This unit describes the Start System used on Solar SMT60 packages. This includes the purpose and function of the system; the hardware needed to support them; the operational sequences. operator interface; typical malfunctions; and general maintenance requirements.

LEARNING OBJECTIVES

1. State the purpose of the Direct-Drive AC Start System
2. Identify and describe the function of the major start system components
3. Describe the operational sequences of the start system
4. Describe the interface with the control and display systems
5. Describe typical start system malfunctions

LUBE OIL – SMT60 (50054)

Level: 1
Language: English
This unit describes the Lube Oil System used on Solar SMT60 packages. This includes the purpose and function of the system; the hardware needed to support them; the operational sequences. operator interface; typical malfunctions; and general maintenance requirements

LEARNING OBJECTIVES

1. State the purpose of the lube oil system
2. Identify and describe the function of the major system components
3. Describe the information found on the HMI Lube Details Screen
4. Describe the operational sequences of the lube oil system
5. State some common causes of typical lube oil system malfunctions

FUEL – SOLONOX GAS – SMT60 (50055)

Level: 1
Language: English
This unit describes the SoLoNOx Fuel System used on Solar SMT60 packages. This includes the purpose and function of the system; the hardware needed to support them; the operational sequences. operator interface; typical malfunctions; and general maintenance requirements

LEARNING OBJECTIVES

1. State the purpose of the fuel system
2. Identify and describe the function of the major components
3. Identify the fuel system data displayed on the HMI screens
4. Describe the operational sequences of the system
5. State some common causes of typical fuel system malfunctions

CONTROLS – SMT60 (50056)

Level: 1
Language: English
This unit will acquaint you with the overall purpose of Solar's Turbotronic Control System. It will discuss each of the five basic control loop elements. This unit will also familiarize you with the various hardware components that make up the Turbotronic control system. These components are mounted at various locations and are interconnected by a communications network that relays information to and from the RSLogix Controller and the turbine package.

LEARNING OBJECTIVES

1. Describe the overall purpose and function of the Turbotronic control system
2. Describe the system hardware that comprises the Turbotronic control system
3. Describe the operator interface with the control system
4. State the software that would be required if system maintenance needs to be carried out

SMT60 MEDIUM VOLTAGE SYSTEM (50057)

Level: 1
Language: English
This unit will discuss the electrical distribution throughout the SMT60 package and review the medium voltage drawings.

LEARNING OBJECTIVES

1. State the purpose of the various voltage systems on the SMT60 package
2. Describe the electrical power flow path from the generator to the MCC and customer connection
3. Identify the components on the medium voltage drawings
4. List the voltages present at various locations on the SMT60 package

GENERATOR OPERATIONS – SMT60 (50058)

Level: 1
Language: English
This unit will discuss the operation of the generator package, including the various configuration options that may be selected to maximize the operating efficiency, especially when the generator is operated in parallel with other generator packages, or the grid.

LEARNING OBJECTIVES

1. Describe basic generator synchronizing principles
2. Describe the generator synchronizing process
3. Classify power system operational modes using industry and Solar terminology
4. Determine the control system configuration options for various operational scenarios

OPERATIONS – SMT60 (50059)

Level: 1
Language: English
This unit will discuss the operating procedures of the SMT60.

LEARNING OBJECTIVES

1. Describe the commands and indications available on the Human Machine Interface, or HMI
2. List the prestart configuration and precautions that should be followed for safe operation
3. Describe the procedures to start the unit and put the unit online
4. List the operating parameters that should be monitored during normal operation
5. Describe the different shutdown categories

SMT60 ASSEMBLY AND DISASSEMBLY (50060)

Level: 1
Language: English
This unit will describe the basic process for the assembly and disassembly of the SMT60, to be completed before and after each transportation.

LEARNING OBJECTIVES

1. List the documentation, specifications, and procedures required for proper assembly and disassembly of the SMT60
2. Describe the requirements for placement and set up of the SMT60
3. List the steps of the mechanical set up procedures
4. List the steps of the electrical set up procedures
5. Describe the procedures to disassemble and prepare the SMT60 for transportation

SMT130 PACKAGE OPERATING PRINCIPLES

This learning plan will provide a turbo-machinery package operator and maintenance technician with the knowledge and skills necessary to operate the SMT130 package safely and efficiently. This requires a degree of background knowledge of the package systems and system components, the working relationship between the components, and their operating sequences. Therefore, the purpose and function of each of the package major components and support systems will be explained, as well as the components in each system, and the sequences of operation. Common malfunction conditions will be discussed, along with the significance of each, the probable causes, and the recommended action for each condition. The students will thus be able to recognize which abnormal conditions may be influenced and corrected by adjusting operational conditions, and which will require further investigation and "maintenance-based" corrective action.

Due to the unique characteristics of the SMT130 package, the Package Operating Principles learning plan for the SMT130 is pre-designed. When selecting this option, the package type (i.e. SMT130) will automatically configure the complete learning plan.

LEARNING PLAN CONFIGURATION

The SMT130 Package Operating Principles learning plan is comprised of the following training units:

- Package Description
- Engine
- Start
- Lube Oil
- Fuel – SoLoNOx Gas
- Controls
- Package Electrical Systems
- Operations
- Operating Procedures

AVAILABLE LANGUAGES

- English

TRAINING UNITS

PACKAGE DESCRIPTION – SMT130 (60853)

Level: 1
Language: English
This unit describes the purpose of a Solar SMT60 Package, the package major components, and the ancillary equipment needed to support the package operation.

LEARNING OBJECTIVES

1. State the purpose of the SMT130 package
2. Identify the location of the major package components
3. Describe the enclosure ventilation airflow
4. Describe the features and functions of the HMI Enclosure Display screen

ENGINE – SMT130 (60854)

Level: 1
Language: English
This unit discusses the purpose of the engine and how it operates. It provides details on how the engine is internally constructed. Also discussed are the monitoring and control aspects of the engine, including problems that might be encountered, and general maintenance requirements for the engine.

LEARNING OBJECTIVES

1. Describe the purpose and basic operation of a Gas Turbine Engine
2. Describe typical engine instrumentation
3. Identify and describe the engine-related data on the HMI display screens
4. Describe the engine operational sequences

START – SMT130 (60855)

Level: 1
Language: English
This unit describes the Start System used on Solar SMT130 packages. This includes the purpose and function of the system; the hardware needed to support them; the operational sequences. operator interface; typical malfunctions; and general maintenance requirements.

LEARNING OBJECTIVES

1. State the purpose of the Direct-Drive AC Start System
2. Identify and describe the function of the major start system components
3. Describe the operational sequences of the start system
4. Describe the interface with the control and display systems
5. Describe typical start system malfunctions

LUBE OIL – SMT130 (60856)

Level: 1
Language: English
This unit describes the Lube Oil System used on Solar SMT130 packages. This includes the purpose and function of the system; the hardware needed to support them; the operational sequences. operator interface; typical malfunctions; and general maintenance requirements

LEARNING OBJECTIVES

1. State the purpose of the lube oil system
2. Identify and describe the function of the major system components
3. Describe the information found on the HMI Lube Details Screen
4. Describe the operational sequences of the lube oil system
5. State some common causes of typical lube oil system malfunctions

FUEL – SOLONOX GAS – SMT130 (60857)

Level: 1
Language: English
This unit describes the SoLoNOx Fuel System used on Solar SMT130 packages. This includes the purpose and function of the system; the hardware needed to support them; the operational sequences. operator interface; typical malfunctions; and general maintenance requirements

LEARNING OBJECTIVES

1. State the purpose of the fuel system
2. Identify and describe the function of the major components
3. Identify the fuel system data displayed on the HMI screens
4. Describe the operational sequences of the system
5. State some common causes of typical fuel system malfunctions

CONTROLS – SMT130 (60858)

Level: 1
Language: English
This unit will acquaint you with the overall purpose of Solar's Turbotronic Control System. It will discuss each of the five basic control loop elements. This unit will also familiarize you with the various hardware components that make up the Turbotronic control system. These components are mounted at various locations and are interconnected by a communications network that relays information to and from the RSLogix Controller and the turbine package.

LEARNING OBJECTIVES

1. Describe the overall purpose and function of the Turbotronic control system
2. Describe the system hardware that comprises the Turbotronic control system
3. Describe the operator interface with the control system
4. State the software that would be required if system maintenance needs to be carried out

PACKAGE ELECTRICAL SYSTEMS – SMT130 (60859)

Level: 1
Language: English
This unit will discuss the electrical distribution throughout the SMT130 package and review the medium voltage drawings.

LEARNING OBJECTIVES

1. State the purpose of the various voltage systems on the SMT130 package
2. Describe the electrical power flow path from the generator to the MCC and customer connection
3. Identify the components on the medium voltage drawings
4. List the voltages present at various locations on the SMT130 package

OPERATIONS – SMT130 (60860)

Level: 1
Language: English
This course will discuss the operation of the generator package on the SMT130, including the various configuration options that may be selected to maximize the operating efficiency.

LEARNING OBJECTIVES

1. Describe basic generator synchronizing principles
2. Describe the generator synchronizing process
3. Describe basic generator load sharing principles
4. Classify power system operational modes using industry and Solar terminology
5. Determine the control system configuration options for various operational scenarios

OPERATING PROCEDURES – SMT130 (60861)

Level: 1
Language: English
This unit will discuss the operating procedures of the SMT130.

LEARNING OBJECTIVES

1. Describe the commands and indications available on the Human Machine Interface, or HMI
2. List the prestart configuration and precautions that should be followed for safe operation
3. Describe the procedures to start the unit and put the unit online
4. List the operating parameters that should be monitored during normal operation
5. Describe the different shutdown categories

POWER GENERATION PRINCIPLES & APPLICATIONS

This learning plan covers the purpose, function, configuration, and operation of a Solar generator package when integrated with an industrial power generation and distribution system. It will include a review the basic concepts of electrical power generation along with the controls and protection needed for generators. Overviews will be given of the major components of a generator system, including voltage regulation, fuel control governors, switchgear, transformers, and protective devices. The different types of load and power will be described, along with the principles of load sharing for both real and reactive load. The control system configurations for various operational scenarios will be discussed, including Island Mode and Grid Mode. Lastly, operational scenarios are reinforced using an online Generator Operation Simulation. Learning plan topics include:

1. Generator Package Overview
2. Fundamentals of Electricity
3. Electromagnetic Induction
4. Generator Construction and Function
5. Generator Systems
6. Generator Synchronizing
7. Generator Speed and Voltage Control
8. Generator Load Sharing
9. Power Systems Operations
10. Generator Protection

LEARNING PLAN CONFIGURATION

The Gas Compressor Principles & Applications learning plan is comprised of the following training units:

- Generator Package Overview
- Fundamentals of Electricity
- Electromagnetic Induction
- Generator Construction and Function
- Generator Systems
- Generator Synchronizing
- Generator Speed and Voltage Control
- Generator Load Sharing
- Power Systems Operations
- Generator Protection

AVAILABLE LANGUAGES

- English
- Spanish

TRAINING UNITS

GENERATOR PACKAGE OVERVIEW (50161)

Level: 1
Language: English, Spanish
This training unit will introduce the purpose, different configurations, and major components that comprise a typical Solar turbomachinery package used in the electrical power generation application.

LEARNING OBJECTIVES

1. Describe the purpose and typical uses of a Solar generator package
2. Describe the different configurations of a Solar generator package
3. Identify the major components of a Solar generator package

FUNDAMENTALS OF ELECTRICITY (50162)

Level: 1
Language: English, Spanish
This course will describe some of the fundamental properties of electricity that lay the foundation for an understanding of electrical power generation. Voltage, current flow, and electrical resistance are discussed, along with an introduction to electrical power.

LEARNING OBJECTIVES

1. Describe the basic principles of electricity
2. Describe the relationship between electricity and magnetism
3. Define various electrical properties

ELECTROMAGNETIC INDUCTION (50163)

Level: 1
Language: English, Spanish
This training will build on previous courses that described some of the fundamental properties of electricity to examine how those properties can be applied towards industrial power generation.

LEARNING OBJECTIVES

1. Describe how AC power is produced in an industrial generator
2. Describe the operating principles of a transformer
3. Describe the use of transformers on Solar generator packages

GENERATOR CONSTRUCTION AND FUNCTION (50164)

Level: 1
Language: English, Spanish
This training unit will describe how the principles of electromagnetic induction are applied in the construction and function of a brushless generator for 3-phase industrial power generation. It will also discuss the typical layout of the main generator connections, and the instrumentation integral with or mounted on a typical generator.

LEARNING OBJECTIVES

1. List the major components of a brushless AC generator
2. Describe the function of each major component
3. Describe the operation of a brushless AC generator
4. Describe the main generator connections
5. Describe typical generator instrumentation

GENERATOR SYSTEMS (50165)

Level: 1
Language: English, Spanish
This training unit will describe how a Solar generator package integrates with a typical plant electrical system. We'll begin with an overview of typical generator switchgear, followed by a brief discussion of generator protection devices that help ensure safe and efficient operation of the package.

LEARNING OBJECTIVES

1. Describe the general electrical layout of a typical industrial plant
2. Define the term "switchgear"
3. Identify the main categories of switchgear
4. List and describe basic generator protection devices
5. Summarize the IEEE switchgear device naming conventions

GENERATOR SYNCHRONIZING (50166)

Level: 1
Language: English, Spanish
This training will describe the principles of generator synchronizing, and how that is achieved on a Solar generator package. The required generator and bus parameters that need to be matched will be described, along with the methods and devices that enable this matching.

LEARNING OBJECTIVES

1. Define synchronization and describe the requirement to synchronize electrical systems
2. List the parameters to be matched during synchronizing
3. Describe the methods and devices used to match the parameters for synchronizing

GENERATOR SPEED AND VOLTAGE CONTROL (50167)

Level: 1
Language: English, Spanish
This training will describe generator speed and voltage control including the factors that affect speed and voltage, as well as the systems used to control them.

LEARNING OBJECTIVES

1. Identify the systems used for generator speed control
2. Describe the factors that affect generator speed
3. Identify the systems used for generator voltage control
4. Describe the factors that affect generator voltage

GENERATOR LOAD SHARING (50168)

Level: 1
Language: English, Spanish
This training describes the terminology related to generator load sharing and the methods used to share both real and reactive load.

LEARNING OBJECTIVES

1. Define terminology related to generator load such as, real power, reactive power, apparent power, and power factor
2. Describe how generators share real and reactive load in island mode and grid mode

POWER SYSTEMS OPERATIONS (50169)

Level: 1
Language: English, Spanish
This training describes the process to choose the appropriate generator control mods for various operational scenarios.

LEARNING OBJECTIVES

1. Describe generator operational modes using Solar terminology
2. Identify determining factors for generator control mode selections
3. Determine control system configurations for different operational scenarios

GENERATOR PROTECTION (50170)

Level: 1
Language: English, Spanish
This training unit will describe how a typical industrial generator is monitored and protected against electrical malfunctions, using switchgear-installed devices and Solar control system devices. It will also discuss the basic causes of a range of protection malfunctions.

LEARNING OBJECTIVES

1. Describe the requirements for generator protection
2. Describe generator protection devices – located in Switchgear
3. Describe generator protection devices – located in Solar Control Panel
4. Evaluate a range of common generator protection malfunctions

GAS COMPRESSOR PRINCIPLES & APPLICATIONS

This learning plan is an excerpt from the Compressor Set Package Operating Principles designed for technicians who need to focus on the design, construction, operation, and performance of a boost compressor and its associated systems. This will provide the student with the knowledge to evaluate the operation of the compressor package and enhance their ability to troubleshoot common problems on the seal, process valve, and surge control systems. Compressor performance theory and calculations are covered, which will allow the students to perform a basic performance evaluation. Learning plan topics include:

1. General Compressor Package Description
2. Gas Properties
3. Compressor Theory of Operation
4. Compressor Operations
5. Compressor Surge Fundamentals
6. Compressor Performance Monitoring Fundamentals
7. Compressor Seal Systems

LEARNING PLAN CONFIGURATION

The Gas Compressor Principles & Applications learning plan is comprised of the following training units:

- Package Description – Compressor Set
- Properties of Natural Gas
- Driven Equipment – Compressor
- Compressor Seals – Wet
- Compressor Seals – Dry

AVAILABLE LANGUAGES

- English
- Spanish

TRAINING UNITS

PACKAGE DESCRIPTION – COMPRESSOR SET (50000)

Level: 1
Language: English, Spanish
This unit describes the purpose of a Solar Compressor, Generator, or Mechanical Drive Package, the package major components, and the ancillary equipment needed to support the package operation.

LEARNING OBJECTIVES

5. State the purpose of the equipment package
6. Describe the package orientation referring to the forward and aft, and left and right designations
7. Identify the major package components
8. Identify the package ancillary equipment

PROPERTIES OF NATURAL GAS (50086)

Level: 3
Language: English, Spanish
This training will discuss the properties of natural gas used in centrifugal compressors, especially in relation to how different mixtures of gas will have different characteristics.

LEARNING OBJECTIVES

1. Describe the composition of a gas mixture
2. Describe the pressure-enthalpy diagram and define the physical and thermodynamic properties obtained
3. Define the difference between volumetric and mass flow and calculate compression power required
4. Define the real gas equations of state
5. Calculate the composition and properties of a mixture of two or more gas streams

DRIVEN EQUIPMENT – COMPRESSOR (50148)

Level: 1
Language: English, Spanish
This unit describes the operational theory and practical application of a centrifugal gas compressor used on Solar turbomachinery packages. It identifies and describes the function of the main internal components, and addresses operational details related to the safe and proper operation of a compressor within the facility process gas system, including options for automated process control. Also included is a review of the various process valves associated with the compressor package. The topics of compressor surge, surge detection, and surge avoidance will also be discussed.

LEARNING OBJECTIVES

1. Describe the operational theory of a centrifugal gas compressor
2. Identify the main internal components installed within a centrifugal gas compressor
3. Describe how the major internal compressor components function
4. Identify and state the function of the compressor instrumentation
5. Identify and state the function of the process valves
6. Describe the operation and sequencing of the process valves
7. Describe the basic principles of compressor process control
8. Describe centrifugal compressor head versus flow characteristics
9. Define the term “surge” as it applies to the centrifugal compressor
10. List the symptoms, effects, and causes of surge
11. Describe the basic principle of a surge avoidance system
12. Describe the basic principle of a surge detection system
13. Describe the features of the HMI Surge Display Screen

COMPRESSOR SEALS – WET (50019)
COMPRESSOR SEALS – DRY (50020)

Level: 1

Language: English, Spanish

This unit describes the Compressor Seal System used on Solar turbomachinery packages. This includes the purpose and function of the system; the hardware needed to support them; the operational sequences. operator interface; typical malfunctions; and general maintenance requirements

Variations in the seal system include dry gas and wet seal systems.

LEARNING OBJECTIVES

1. State the function of the seal system
2. Describe the operating principles of the seal system
3. Identify and describe the function of the seal system major components
4. Describe the operational sequences of the seal system during startup, normal operation, and shutdown
5. Identify the seal system data displayed on the HMI screens
6. List and describe some common seal system malfunctions

CENTRIFUGAL COMPRESSOR PERFORMANCE AND CONDITION EVALUATION

This course is intended for those desiring an in-depth knowledge of Solar Turbines centrifugal compressor performance evaluation, to determine the condition of the equipment. The course builds on a foundation of natural gas properties, thermodynamics, and aerodynamics and expands that knowledge to practical, useful performance and condition evaluation applications. It provides the knowledge required to interpret the performance curves to predict what the centrifugal compressor performance should be, measure and calculate what the performance actually is, and compare actual to predicted to evaluate centrifugal compressor condition. Learning plan topics include:

1. Thermodynamic Properties of Natural Gas Mixtures
2. Centrifugal Compressor Performance Curves
3. Effects of Variables on Curves and Surge Control
4. Measuring Centrifugal Compressor Performance
5. Analyzing Compressor Performance Data
6. TT4000 Gas Compressor Condition Monitoring

LEARNING PLAN CONFIGURATION

The Centrifugal Compressor Performance and Condition Evaluation learning plan is comprised of the following training units:

- Properties of Natural Gas
- Centrifugal Compressor Performance Curves
- Effects of Variables on Centrifugal Compressor Curves
- Measuring Centrifugal Compressor Performance
- Analyzing Centrifugal Compressor Performance
- TT4000 Gas Compressor Data Analysis

AVAILABLE LANGUAGES

- English
- Spanish

TRAINING UNITS

PROPERTIES OF NATURAL GAS (50086)

Level: 3
Language: English, Spanish
This training will discuss the properties of natural gas used in centrifugal compressors, especially in relation to how different mixtures of gas will have different characteristics.

LEARNING OBJECTIVES

1. Describe the composition of a gas mixture
2. Describe the pressure-enthalpy diagram and define the physical and thermodynamic properties obtained
3. Define the difference between volumetric and mass flow and calculate compression power required
4. Define the real gas equations of state

5. Calculate the composition and properties of a mixture of two or more gas streams

CENTRIFUGAL COMPRESSOR PERFORMANCE CURVES (50087)

Level: 3
Language: English, Spanish
This training will discuss how Solar predicts the performance of a new and clean compressor and look at various ways the data may be displayed.

LEARNING OBJECTIVES

1. Explain centrifugal compressor operation
2. Describe how the manufacturer predicts the performance of a centrifugal compressor
3. Read the head-capacity curve to find the predicted performance of a gas compressor
4. Describe the purpose and use of other compressor curve formats

EFFECTS OF VARIABLES ON CENTRIFUGAL COMPRESSOR CURVES (50088)

Level: 3
Language: English, Spanish
This training will discuss how changes in gas composition, pressure or temperature can affect the gas compressor curves that assess the machine's performance.

LEARNING OBJECTIVES

1. Describe how the HEAD-CAPACITY curve changes with changing operating conditions
2. Describe how the DIMENSIONAL curve changes with changing operating conditions

MEASURING CENTRIFUGAL COMPRESSOR PERFORMANCE (50089)

Level: 3
Language: English, Spanish
This training unit describes the purpose of compressor performance testing in the field, as well as the instrumentation and procedures required to complete a test.

LEARNING OBJECTIVES

1. Describe the operational factors that affect compressor performance
2. Describe the purpose of compressor testing and the main information sources
3. Describe how to measure gas compressor performance parameters
4. Calculate testing uncertainty of calculated parameters
5. Calculate actual gas compressor performance using PC software

ANALYZING CENTRIFUGAL COMPRESSOR PERFORMANCE (50090)

Level: 3
Language: English, Spanish
This training unit describes how to compare actual compressor performance to predicted compressor performance in order to determine and evaluate compressor condition.

LEARNING OBJECTIVES

1. Evaluate compressor condition using single point analysis
2. Evaluate compressor condition using the full speed line analysis
3. Evaluate how compressor condition has changed over time using trend analysis

TT4000 GAS COMPRESSOR DATA ANALYSIS (50091)

Level: 3
Language: English, Spanish
This training unit will review the data available on typical TT4000 display screens and describe how data can be trended over time for compressor evaluation.

LEARNING OBJECTIVES

1. Describe the terms used on the TT4000 compressor performance screen
2. Explain how to use trend plots to evaluate compressor condition

TURBOTRONIC 5 CONTROL SYSTEM OPERATIONS

This learning plan is the online version of Solar's 5-day instructor-led Turbotronic 5 Control System Operations course. It is designed for package operators or maintenance technicians who are required to perform basic first line control system tasks with minimal guidance from Solar field service. The learning plan will cover the knowledge and skills required to help maintain the package in a serviceable state under several scenarios, including the following:

1. Using the control system program to determine the conditions for package alarms or shutdown
2. Reloading the control system program following a component replacement or system malfunction
3. Loading a revised control system program that may have been received from Solar
4. Modifying Tunable Program Constants
5. The use of the control system indications for basic troubleshooting (for example, the use of module LED's to verify operation)

LEARNING PLAN CONFIGURATION

The Turbotronic 5 Control System Operations learning plan is comprised of the following training units:

- Controls – Turbotronic 5
- Control System Logic
- Software Applications
- Logix Project Framework
- Turbotronic 5 Standards and Security
- Troubleshooting Methods

AVAILABLE LANGUAGES

- English
- Spanish

TRAINING UNITS

CONTROLS – TURBOTRONIC 5 (50147)

Level: 1
Language: English, Spanish
This unit will acquaint you with the overall purpose of Solar's Turbotronic Control System. It will discuss each of the five basic control loop elements, as well as describe the typical on and off-skid configuration setups of turbine installed systems.

This unit will also familiarize you with the various hardware components that make up the Turbotronic control system. These components are mounted at various locations and are interconnected by a communications network that relays information to and from the RSLogix Controller and the turbine package. Additionally, the system performs communications with other specialized control devices, such as the Variable Frequency Device, Fire System, and Vibration System.

LEARNING OBJECTIVES

1. Describe the purpose and function of the Turbotronic Control System
2. Describe the various configurations of the Control System
3. Describe the function of the major components that comprise the Turbotronic control system
4. Describe the communications paths between the components

CONTROL SYSTEM LOGIC (50152)

Level: 3
Language: English, Spanish
This training unit describes of how simple logic to control a piece of industrial equipment is formed, essentially using what is known as Boolean Logic. This basic understanding of Boolean Logic will help later when the logic in the Turbotronic 5 system is discussed. A functional description of each ladder logic instruction is provided, and application examples of each are illustrated. To tie everything together, the training unit concludes with some application exercises, where you'll be given the opportunity to create some ladder logic based on functional requirements of turbine package control.

LEARNING OBJECTIVES

1. Describe how the status of discrete and analog devices can be represented as binary logic symbols
2. Describe the various logic symbols used to represent turbine sequencing and control
3. Demonstrate the ability to interpret basic turbine control and sequencing functions
4. Demonstrate an understanding of the basic instructions used in the controller in a Turbotronic control system
5. Describe the execution sequence utilized by the controller in a ladder logic program
6. Create ladder logic to replicate specified control logic functions

SOFTWARE APPLICATIONS (50153)

Level: 3
Language: English, Spanish
Two main Rockwell Software applications will be discussed in this unit. The first is Studio 5000 Logix Designer which was previously known as RSLogix 5000. This is the "programming software" that contains the ladder logic and function block logic to monitor and control the turbine package. The second is RSLinx, which manages communications between the various devices on the network. Additionally, this unit reviews the project file structure including locating and navigating the backup files and the ACD files. Additionally, the Logix toolbars and help menu will be briefly discussed.

LEARNING OBJECTIVES

1. Describe the purpose of the software applications that support the Turbotronic 5 Control system
    a. Studio 5000 Logix Designer (RSLogix 5000)
    b. RSLinx
2. Describe the process to distribute a Turbotronic 5 project to a programming terminal
3. Describe the process to open a Turbotronic 5 project
4. Describe the various screen sections of RSLogix 5000 / Logix Designer

LOGIX PROJECT FRAMEWORK (50154)

Level: 3
Language: English, Spanish
This unit discusses the controller properties and general features. How to find logic elements, such as Search, Cross Reference, Goto, and Browse Logic will also be covered. The unit then provides an overview of project organization within the software. Safety critical control and add-on instructions are also discussed. And finally, this unit covers Tags, with respect to tag scope (Controller-scoped or Program-scoped), types of tags, and data types.

LEARNING OBJECTIVES

1. Describe the available information found in the Controller Properties dialog
2. Demonstrate the ability to use the following functions of RSLogix 5000 / Logix Designer to locate information in and navigate through a Turbotronic 5 controller program
    a. Controller Properties
    b. Search
    c. Cross Reference
    d. Goto
    e. Browse Logic
3. Describe the Logix project organization used by Solar
4. Describe Safety Critical Control Systems
5. Describe Add-On Instructions and Structured Text
6. Describe the use of Tag Databases in Logix programs
7. Define Base and Alias tags
8. List the typical data types used in Solar projects

TURBOTRONIC 5 STANDARDS AND SECURITY (50155)

Level: 3
Language: English, Spanish
This unit builds on Logix instruction sets, program structure, and tag databases to illustrate several programming conventions Solar uses to accomplish needed functionality. This includes scaling analog values, annunciating alarms and shutdowns, and the use of program constants. This unit also discusses the FactoryTalk Security software by Rockwell. This includes permission sets, including how and why they are used. The discussion concludes the access permissions of various personnel, and how customers can utilize this software.

LEARNING OBJECTIVES

1. Describe the typical Solar programming conventions for analog scaling
2. Describe the typical Solar programming conventions for alarm and shutdown annunciation
3. Describe the Solar programming convention for HART analog scaling
4. Describe the use of Program Constants in a Solar Turbotronic project
5. Describe the purpose of FactoryTalk Security as used with a Turbotronic 5 project
6. Describe the use of Permission Sets in a Solar project
7. Describe program access for Solar and non-Solar personnel

TROUBLESHOOTING METHODS (50156)

Level: 3
Language: English, Spanish
This unit describes how logical functions control and sequence the package mounted devices. This leads into troubleshooting skills, including the use of the display screens as a diagnostic tool. These display screens will include normal operations as well as Alarms and Historical data screens. Other troubleshooting tools that will be discussed include the use of technical drawings and circuit testing. And finally, this unit covers some of the online tasks that may be needed for operation and maintenance of the Solar package.

LEARNING OBJECTIVES

1. Demonstrate the ability to cross-reference physical package devices to Logix tags
2. Describe the basic function of typical turbine control and sequencing logic
3. Identify the skills needed to troubleshoot a problem
4. Identify information sources or data that can assist troubleshooting a problem
5. Describe methods used to troubleshoot a problem using package drawings and control system indications
6. Describe basic DLR fault detection in a Turbotronic 5 control network
7. Configure communications drivers using RSLinx
8. Download, upload and go online with the controller
9. Make simple ladder logic edits for maintenance and test purposes
10. Set, enable and remove forces in the ladder logic for discrete and analog instructions
11. Modify tunable program constants in the software

BORESCOPE

Internal inspection of Solar gas turbine engines using borescope equipment is an integral part of proper package maintenance by Solar Field Employees and equipment end-users. This learning plan covers the theoretical execution of internal inspection via borescope. A blended learning option is available that combines a series of theoretical topics delivered via eLearning with a 2-day hands-on workshop conducted at a Solar training center.

LEARNING PLAN CONFIGURATION

The Borescope Theory learning plan is comprised of the following training units:

- Introduction to Gas Turbine Borescope Inspections (50092)
- Borescope Component Descriptions (50094)
- Borescope Principles and Applications (50095)
- Borescope Component Failure Modes (50096)
- Borescope Inspection Reports (50097)

An in-person lab is also available that allows hands-on practice in one of Solar Turbines' training centers. This option is only available as a Single Customer solution, where a single customer can fill the minimum seat requirement, and would include the following course:

- Borescope Inspection Hands-On Workshop (10409)

AVAILABLE LANGUAGES

- English
- Spanish

TRAINING UNITS

INTRODUCTION TO GAS TURBINE BORESCOPE INSPECTION (50092)

Level: 2
Language: English, Spanish
This training unit describes the basic purpose of a borescope inspection, the types of equipment available, and the preparation steps.

LEARNING OBJECTIVES

1. Describe the purpose of a borescope inspection
2. Describe the characteristics of rigid, flexible, and digital borescope equipment
3. Describe the capabilities of the three borescope types and their advantages and disadvantages
4. Describe the preparation for a gas turbine engine borescope inspection

BORESCOPE COMPONENT DESCRIPTIONS (50094)

Level: 2
Language: English, Spanish
This training unit will familiarize you with the terms, definitions, and acronyms used during borescope inspections of Solar gas turbine engines and provides an overview of the gas turbine components applicable to borescope inspection.

LEARNING OBJECTIVES

1. Define the terminology related to borescope inspection, including terms, important definitions and related acronyms
2. List and describe major engine components related to borescope inspection

BORESCOPE PRINCIPLES AND APPLICATIONS (50095)

Level: 2
Language: English, Spanish
This training unit describes Solar's engine product line in relation to borescope-related knowledge of engine models, configuration, borescope access points, and tools.

LEARNING OBJECTIVES

1. Describe typical borescope field tools and their uses during a borescope inspection
2. Identify the different borescope port locations on each engine in Solar's product line

BORESCOPE COMPONENT FAILURE MODES (50096)

Level: 2
Language: English, Spanish
This training unit will describe component failure modes in relation to gas turbine borescope inspection.

LEARNING OBJECTIVES

1. Describe the forces observed in a gas turbine engine during startup, normal operation, and shutdown
2. Describe the typical failure modes found in a gas turbine engine
3. Describe the failure modes associated with the components inside a gas turbine engine

BORESCOPE INSPECTION REPORTS (50097)

Level: 2
Language: English, Spanish
This training unit describes the purpose and best practices for completion of a borescope inspection report. Simplified borescope report templates are provided for a range of Solar engine models.

LEARNING OBJECTIVES

1. Describe the purpose of a borescope inspection report
2. Describe the proper information and content to include in a borescope inspection report

MAJOR COMPONENT REMOVAL AND REPLACEMENT

This learning plan will introduce the student to the safe practices, procedures, and techniques used during package major component removal and replacement. Additionally, it focuses on the sources of information, methods, and special tooling used by Solar to complete these tasks as part of routine or scheduled maintenance activities. A blended learning option is available that combines a series of theoretical topics delivered via eLearning with a 3-day hands-on workshop conducted at a Solar training center.

LEARNING PLAN CONFIGURATION

The Major Component Removal and Replacement Theory learning plan is comprised of the following training units:

- Intro to Major Component Removal & Replacement (50106)
- MCRR Planning and Preparation (50107)
- MCRR Performing and Post Work (50108)
- Major Component Rigging and Lifting Overview (50118)

An in-person lab is also available that allows hands-on practice in one of Solar Turbines' training centers. This option is only available as a Single Customer solution, where a single customer can fill the minimum seat requirement, and would include the following course:

- MCRR Hands-On Workshop (10420)

AVAILABLE LANGUAGES

- English
- Spanish

TRAINING UNITS

INTRODUCTION TO MAJOR COMPONENT REMOVAL & REPLACEMENT (50106)

Level: 2

Language: English, Spanish

This training unit describes the Solar's maintenance practices, and how major component removal and replacement fit into these practices.

LEARNING OBJECTIVES

1. Describe the methods and benefits of turbomachinery maintenance
2. Identify package major components and reasons for their removal and installation
3. List the major steps for a typical major component removal and replacement task

MCRR PLANNING AND PREPARATION (50107)

Level: 2
Language: English, Spanish
This training unit describes the planning and preparation requirements for a typical major component replacement task, with a focus on a Centaur 40 engine change as an example.

LEARNING OBJECTIVES

1. Identify the safety requirements prior to commencing a major component removal and installation
2. Identify possible sources of information and procedures for major component removal and installation
3. Identify the tools and equipment necessary to perform major component removal and installation

MCRR PERFORMING AND POST WORK (50108)

Level: 2
Language: English, Spanish
This training unit describes the execution of a typical major component replacement task, including the necessary verifications and other post-work tasks, with a focus on a Centaur 40 engine change as an example.

LEARNING OBJECTIVES

1. List and describe the major steps in a typical major component exchange job
2. List and describe the critical set points to be verified during a typical major component exchange job
3. List and describe the operational verifications to be completed during a typical major component exchange job
4. List and describe the major component exchange post work requirements

MAJOR COMPONENT RIGGING AND LIFTING OVERVIEW (50118)

Level: 2
Language: English, Spanish
This training unit provides essential knowledge in relation to safe rigging a lifting practices. The purpose is to ensure that trainees are able to safely participate in the hands-on activities, such as rigging a Solar engine for removal and installation.

LEARNING OBJECTIVES

1. Describe the general responsibilities and limitations that apply to rigging and lifting operations
2. Identify the basic rigging equipment used on Solar turbo-machinery
3. Describe the pre-use and periodic inspection procedures and criteria that apply to common rigging equipment
4. Describe basic rigging and lifting techniques used on Solar turbo-machinery
5. Identify important considerations relating to rigging and lifting operations

MACHINERY ALIGNMENT

This learning plan will introduce the student to the safe practices, procedures, and techniques used during package machinery alignment. Focus is placed on Solar specific alignment information and performing machinery alignment techniques using dial indicators. A blended learning option is available that combines a series of theoretical topics delivered via eLearning with a 3-day hands-on workshop conducted at a Solar training center.

LEARNING PLAN CONFIGURATION

The Machinery Alignment Theory learning plan is comprised of the following training units:

- Alignment Precision Measuring Equipment (50100)
- Principles of Machinery Alignment (50101)
- Solar Alignment Information (50102)
- Dial Indicator Alignment Techniques (50103)

An in-person lab is also available that allows hands-on practice in one of Solar Turbines' training centers. This option is only available as a Single Customer solution, where a single customer can fill the minimum seat requirement, and would include the following course:

- Alignment Hands-On Workshop (10419)

AVAILABLE LANGUAGES

- English

TRAINING UNITS

ALIGNMENT PRECISION MEASURING EQUIPMENT (50100)

Level: 2
Language: English
This training describes the principles and use of the precision measuring equipment used during alignment of Solar turbomachinery.

LEARNING OBJECTIVES

1. Describe the basic principles of a Vernier Scale
2. Describe basic procedures for taking measurements using Vernier Calipers; External Micrometers; Internal Micrometers; Dial Indicators; Go/No Go Gauge; Machinists' Level; and Feeler Gauges
3. Correctly measure the dimensions of selected test pieces

PRINCIPLES OF MACHINERY ALIGNMENT (50101)

Level: 2
Language: English
This training describes basic alignment terminology, various alignment techniques, and conditions that affect alignment.

LEARNING OBJECTIVES

1. Define the term alignment
2. Identify machinery problems that may be caused by poor alignment
3. List and describe different methods used for machinery alignment
4. Describe conditions that can negatively affect final alignment accuracy

SOLAR ALIGNMENT INFORMATION (50102)

Level: 2
Language: English
This training describes the sources of information and software tools available for machinery alignment.

LEARNING OBJECTIVES

1. Identify the sources of alignment information
2. Identify the information available in the Mechanical Interface drawings
3. Identify the location of the Solar Alignment Program
4. Describe the functionality of the Solar Alignment Program

DIAL INDICATOR ALIGNMENT TECHNIQUES (50103)

Level: 2
Language: English
This training describes the typical steps necessary to complete a machinery alignment - pre-alignment checks, measurement sweeps, machinery movement considerations, and final alignment checks.

LEARNING OBJECTIVES

1. Describe typical pre-alignment setup procedures
2. List the steps required to complete a rough alignment procedure
3. Identify machinery positions compared to measurement sweep data
4. List typical machinery movement considerations
5. List the steps required to complete final alignment verifications

VIBRATION FUNDAMENTALS

This course focuses on the principles of turbomachinery vibration, covering the methods used to collect vibration data and perform basic first line analysis.

The first part of the course discusses the basic principles of vibration, the terminology used and how the time domain compares to the frequency domain. The purpose of conducting vibration monitoring is then covered, listing and describing the causes of increased vibration levels on turbo-machinery. This lesson is followed by information covering the different types of vibration monitoring equipment installed on Solar and Turbomach packages. The course then covers the principles and setup of the CSI 2130 vibration analyzer using the off-route / jobs mode. This is followed with a lesson on how to confirm that the collected data is valid and perform a basic first-line analysis to identify the most common causes of turbo-machinery vibration (unbalance, misalignment, gear problems, bearing problems).

A blended learning option is available that combines a series of theoretical topics delivered via eLearning with a 2-day hands-on workshop conducted at a Solar training center.

LEARNING PLAN CONFIGURATION

The Vibration Fundamentals Theory learning plan is comprised of the following training units:

- Fundamentals of Vibration (50109)
- Purpose of Vibration Monitoring (50110)
- Vibration Sensors (50111)
- Vibration Monitoring Systems (50112)
- Basic Vibration Analysis (50113)

An in-person lab is also available that allows hands-on practice in one of Solar Turbines' training centers. This option is only available as a Single Customer solution, where a single customer can fill the minimum seat requirement, and would include the following course:

- Vibration Fundamentals Hands-on Workshop (10421)

AVAILABLE LANGUAGES

- English

TRAINING UNITS

FUNDAMENTALS OF VIBRATION (50109)

Level: 2
Language: English
This training describes the fundamentals of vibration as it applies to any mechanical system and defines important related vibration concepts and terminology.

LEARNING OBJECTIVES

1. Define the basic terms used in vibration analysis
2. Describe the Time Domain
3. Describe the Frequency Domain

PURPOSE OF VIBRATION MONITORING (50110)

Level: 2
Language: English
This training covers the factors that affect vibration on Solar turbomachinery packages; Solar's vibration monitoring practices; and the advantages of effective implementation of these practices.

LEARNING OBJECTIVES

1. Describe the effects of increased vibration levels on Solar equipment
2. List and describe the causes of increased vibration levels
3. List and describe acceptable limits placed on vibration through alarm and shutdown levels
4. List and describe the principles and advantages of vibration monitoring as part of a machinery maintenance schedule

VIBRATION SENSORS (50111)

Level: 2
Language: English
This training describes the various vibration sensors used on Solar engines, gearboxes, and driven equipment, and how their use reflects their suitability for the specific purpose, and the evolution of technologies.

LEARNING OBJECTIVES

1. Describe the use of Radial Proximity Probe Systems on Solar equipment
2. Describe the use of Velocity Transducers on Solar equipment
3. Describe the use of Accelerometers on Solar equipment
4. Describe the use of Dynamic Pressure Sensors on Solar Equipment
5. Describe the use of Axial Proximity Probe Systems on Solar equipment

VIBRATION MONITORING SYSTEMS (50112)

Level: 2
Language: English
This training describes the various vibration monitoring systems used on Solar turbomachinery packages, including the basic installation and hardware / software configuration considerations.

LEARNING OBJECTIVES

1. List the different types of vibration monitoring systems used by Solar
2. Describe the installation of each type of vibration monitoring system
3. Describe the basic hardware / software configuration of each type of vibration monitoring system, where applicable

BASIC VIBRATION ANALYSIS (50113)

Level: 2
Language: English
This training describes the use of basic vibration data to identify vibration-related machinery issues and perform a basic analysis of the causal factors.

LEARNING OBJECTIVES

1. Identify erroneous vibration data
2. Describe the steps of basic vibration analysis

VIBRATION FUNDAMENTALS HANDS-ON WORKSHOP (10421)

Level: 2
Language: English
This hands-on workshop will allow the trainees to expand on the knowledge gained in the various theory-based vibration training units by applying that knowledge towards practical acquisition of vibration data, and basic evaluation of that data. While the vibration analyzers used during the hands-on activities may vary according to availability, the principles will apply across the range of commonly-used equipment.

LEARNING OBJECTIVES

1. Describe the functionality of common vibration data collection tooling, for example those manufactured by CSI (2120 or 2130), or Pruftechnik (VIBXPERT)
2. Demonstrate the ability to utilize vibration data collection equipment to collect data from operating equipment or rotor-kit simulators
3. Demonstrate the ability to validate vibration data and perform basic analysis in relation to common turbomachinery issues

ELECTRICAL FOUNDATION

This learning plan introduces foundational electrical theory associated with systems and components of Solar packages and ancillary equipment. It begins with a review of core electrical theory, including electromagnetism, DC and AC circuit configuration, and power generation. Following the electrical core review, topics of motors, motor control centers, and battery systems are discussed.

LEARNING PLAN CONFIGURATION

The Electrical Foundation learning plan is comprised of the following training units:

- Basic Electrical Theory and Practices
- Motors
- Motor Control Centers
- Battery Systems

AVAILABLE LANGUAGES

- English

TRAINING UNITS

BASIC ELECTRICAL THEORY AND PRACTICES (10611)

Level: 1
Language: English
This unit covers basic electrical theory and the application of that theory towards routine maintenance and troubleshooting of a Solar control system. The overall intent is to provide the knowledge and skills necessary to work safely and efficiently on a Solar control console and associated low voltage equipment. The course concludes with an introduction to AC power generation and transformers.

LEARNING OBJECTIVES

3. Describe the fundamental principles of electricity, the methods of producing electricity, and the relationship between electricity and magnetism
4. Demonstrate the ability to solve problems for basic series DC circuits
5. Demonstrate the ability to solve problems for basic parallel DC circuits
6. Describe the use of common components in basic DC circuits
7. Describe the layout of a typical Solar control console
8. Describe the principles of AC power generation and the construction of a typical brushless generator
9. Describe the principles and typical Solar applications of a transformer

MOTORS (10612)

Level: 1
Language: English
This unit covers an introduction to the principles, construction, operation, and maintenance of AC and DC motors. Each lesson contains review questions that will help you verify your understanding of each sub-topic as you progress through the lesson. In addition, you should complete the graded end of course test in order to gain credit for the entire course.

LEARNING OBJECTIVES

1. Describe the principles of operation of a motor
2. Describe the construction of a motor
3. Describe the methods of motor starting and control
4. Describe common faults and basic inspection and testing procedures for a motor

MOTOR CONTROL CENTERS (10613)

Level: 1
Language: English
This unit covers an introduction to the principles, construction, and operation of Motor Control Centers, or MCC's, as used to support Solar turbomachinery packages. Each lesson contains review questions that will help you verify your understanding of each sub-topic as you progress through the lesson. In addition, you should complete the graded end of course test in order to gain credit for the entire course.

LEARNING OBJECTIVES

1. Identify common symbols found on electrical drawings and describe the various types of electrical drawings available for Motor Control Centers
2. State the purpose of a Motor Control Center (MCC) as well as identify and state the function of devices on a basic MCC

BATTERY SYSTEMS (10614)

Level: 1
Language: English
This unit covers an introduction to the principles, construction, and operation of batteries and battery chargers, as used to support Solar turbomachinery packages. Each lesson contains review questions that will help you verify your understanding of each sub-topic as you progress through the lesson. In addition, you should complete the graded end of course test in order to gain credit for the entire course.

LEARNING OBJECTIVES

1. Describe the common types of batteries installed on Solar equipment
2. Describe the battery maintenance requirements
3. Describe the common types of battery chargers installed on Solar equipment
4. Describe the battery charger maintenance requirements

STAND-ALONE COURSES

TRAINING UNITS

DRY SEAL RECOMPRESSION SYSTEM (DSR) (50047)

Level: 1
Language: English
Describes the purpose, components, system interface, operational sequences, and general maintenance requirements of Solar's Dry Seal Recompression System, or DSR.

LEARNING OBJECTIVES

1. State the purpose of the Dry Seal Recompression System (DSR)
2. Identify and describe the DSR major components and ancillary equipment
3. Describe the operational sequences of the DSR
4. Describe the interface with the control and display systems
5. Describe the DSR system general maintenance requirements

PROCESS VENT RECOMPRESSION SYSTEM (PVR) (50048)

Level: 1
Language: English
Describes the purpose, components, system interface, operational sequences, and general maintenance requirements of Solar's Process Vent Recompression System, or PVR.

LEARNING OBJECTIVES

1. State the purpose of the Process Vent Recompression System (PVR)
2. Identify and describe the PVR major components and ancillary equipment
3. Describe the operational sequences of the PVR
4. Describe the interface with the control and display systems
5. Describe the PVR system general maintenance requirements