

MODULE OVERVIEW

This module discusses the characteristics of and theory behind process control systems. Trainees will learn about the types of control loops, control loop components, process control applications, and process control modes.

PREREQUISITES

Please refer to the Course Map in the Trainee Module. Prior to training with this module, it is recommended that the trainee shall have successfully completed the following:

Core Curriculum; Pipeline Core, Modules 66101-02 and 66102-02; Pipeline Electrical and Instrumentation Level One; Pipeline Electrical and Instrumentation Level Two, Modules 64201-02 through 64203-02

OBJECTIVES

Upon completion of this module, the trainee will be able to:

1. Define process measurement and control.
2. Discuss process characteristics that demand process control.
3. Describe the elements of an instrumentation control loop, including
 - Detector (sensor)
 - Transducer
 - Amplifier or signal conditioner
 - Transmitter
 - Controller
 - Final element (control valve)
4. Define and describe process control loop types, including
 - Feedforward
 - Feedback
 - Cascade
 - Ratio
5. Define and describe process controller modes, including
 - On-off control (two-position control)
 - Modulating control
 - Proportional (P)
 - Integral (I)
 - Derivative (D)
 - Proportional and integral (PI)
 - Proportional and derivative (PD)
 - Proportional, integral, and derivative (PID)
6. Discuss various types of process control applications and loops.

PERFORMANCE TASKS

Under the supervision of the instructor, the trainee should be able to:

1. Draw and accurately label a block diagram for a typical basic process control loop.
2. Identify the major components and signals in a given set of P&IDs.
3. Satisfactorily identify the accuracies, ranges, spans, and/or linearities of given instrumentation from typical documentation.
4. Tune a control loop as set up by the instructor.

SAFETY CONSIDERATIONS

Ensure that the trainees are equipped with appropriate personal protective equipment. Emphasize the importance of following all safety precautions and procedures when working with power tools.

PREPARATION

Before teaching this module, you should review the Module Outline, Objectives, Performance Tasks, and the Materials and Equipment List. Be sure to allow ample time to prepare your own training or lesson plan and gather all required equipment and materials.

MATERIALS AND EQUIPMENT LIST

Transparencies	Copies of <i>49 CFR Part 192</i> (Gas) and/or <i>49 CFR Part 195</i> (Liquid)
Markers/chalk	Copies of your company policy and procedures manual
Blank acetate sheets	Copies of the 2002 (or latest) edition of the <i>National Electrical Code</i> [®]
Transparency pens	Copies of <i>API Recommended Practices 2003</i>
Pencils and scratch paper	Drawing paper
Module Examinations*	A variety of detectors/sensors
Performance Profile Sheets*	Sample valve characteristic curves
Copies of Quick Quiz**	Calculators
Overhead projector and screen	
Whiteboard/chalkboard	
Appropriate personal protective equipment	

** Located in the Annotated Instructor's Guide for this module.

* Performance Sheets for this module are available from NCCER's Instructor Resource Center at www.nccerirc.com.

For information and updates about accessing the Module Examinations, visit www.nccer.org/testing.

MODULE OVERVIEW

This module discusses pipeline supervisory control systems, data highways, and protocols. Trainees will learn how to draw a block diagram, as well as to identify symbols in a ladder logic drawing and in a data flow system.

PREREQUISITES

Please refer to the Course Map in the Trainee Module. Prior to training with this module, it is recommended that the trainee shall have successfully completed the following:

Core Curriculum; Pipeline Core, Modules 66101-02 and 66102-02; Pipeline Electrical and Instrumentation Level One; Pipeline Electrical and Instrumentation Level Two, Modules 64201-02 through 64204-02

OBJECTIVES

Upon completion of this module, the trainee will be able to:

1. Explain pipeline supervisory control systems.
2. Explain programmable logic controllers (PLCs), human-machine interfaces (HMIs), and remote terminal units (RTUs).
3. Explain data highways and protocols.
4. Explain Supervisory Control and Data Acquisition (SCADA) related communications.

PERFORMANCE TASKS

Under the supervision of the instructor, the trainee should be able to:

1. Identify symbols typically used in a ladder logic drawing.
2. Discuss the importance of protocols.
3. Draw a block diagram of a typical SCADA system.
4. Identify and discuss components of a data flow system from a drawing provided by the instructor.

SAFETY CONSIDERATIONS

Ensure that the trainees are equipped with appropriate personal protective equipment. Emphasize the importance of following all safety precautions and procedures when working with power tools.

PREPARATION

Before teaching this module, you should review the Module Outline, Objectives, Performance Tasks, and the Materials and Equipment List. Be sure to allow ample time to prepare your own training or lesson plan and gather all required equipment and materials.

MATERIALS AND EQUIPMENT LIST

Transparencies	Copies of <i>49 CFR Part 192</i> (Gas) and/or <i>49 CFR Part 195</i> (Liquid)
Markers/chalk	Copies of your company policy and procedures manual
Blank acetate sheets	Copies of <i>ANSI C37.1</i>
Transparency pens	Sections of shielded and unshielded twisted pair wiring, coaxial cable, and fiber-optic cable
Pencils and scratch paper	Sample drawings of data flow systems
Module Examinations*	Sample block diagrams of SCADA systems
Performance Profile Sheets*	Large sheets of plain drawing paper
Overhead projector and screen	
Whiteboard/chalkboard	
Appropriate personal protective equipment	

* Performance Sheets for this module are available from NCCER's Instructor Resource Center at www.nccerirc.com.

For information and updates about accessing the Module Examinations, visit www.nccer.org/testing.

MODULE OVERVIEW

This module covers power systems and transformers. Trainees will learn to identify transformer types, make transformer connections, and maintain and test transformers.

PREREQUISITES

Please refer to the Course Map in the Trainee Module. Prior to training with this module, it is recommended that the trainee shall have successfully completed the following:

Core Curriculum; Pipeline Core, Modules 66101-02 and 66102-02; Pipeline Electrical and Instrumentation Levels One and Two

OBJECTIVES

Upon completion of this module, the trainee will be able to:

1. Describe power systems.
2. Describe the function of transformers.
3. Identify transformer types.
4. Explain transformer connections.
5. Maintain and test transformers.

PERFORMANCE TASKS

Under the supervision of the instructor, the trainee should be able to:

1. Make tap adjustments.
2. Demonstrate the ability to connect instruments to potential and current transformers.
3. Connect transformers in different configurations.
4. Test for an open winding.
5. Test for grounded winding.

SAFETY CONSIDERATIONS

Ensure that the trainees are equipped with appropriate personal protective equipment. Emphasize the importance of following all safety precautions and procedures when working with power tools.

PREPARATION

Before teaching this module, you should review the Module Outline, Objectives, Performance Tasks, and the Materials and Equipment List. Be sure to allow ample time to prepare your own training or lesson plan and gather all required equipment and materials.

MATERIALS AND EQUIPMENT LIST

Transparencies	Copies of your company's policy and procedures manual
Markers/chalk	Copies of the <i>National Electrical Code</i> [®] , latest edition
Blank acetate sheets	Various types of transformers and equipment for examining and inspecting them
Transparency pens	Equipment for adjusting taps
Pencils and scratch paper	Sample electrical diagrams
Module Examinations*	Potential and current transformers and instruments
Performance Profile Sheets*	Equipment necessary for connecting transformers
Overhead projector and screen	Transformer nameplates (or pictures of them)
Whiteboard/chalkboard	Testing equipment and transformers to test
Appropriate personal protective equipment	Transformer bushings and oil
Copies of your local code	

* Performance Sheets for this module are available from NCCER's Instructor Resource Center at www.nccerirc.com.

For information and updates about accessing the Module Examinations, visit www.nccer.org/testing.

MODULE OVERVIEW

This module familiarizes trainees with the various types of switchgear and motor controllers. Trainees will learn how to identify, test, and maintain individual components and circuit connections and will learn maintenance requirements of this equipment.

PREREQUISITES

Please refer to the Course Map in the Trainee Module. Prior to training with this module, it is recommended that the trainee shall have successfully completed the following:

Core Curriculum; Pipeline Core, Modules 66101-02 and 66102-02; Pipeline Electrical and Instrumentation Levels One and Two; Pipeline Electrical and Instrumentation Level Three, Module 64301-02

OBJECTIVES

Upon completion of this module, the trainee will be able to:

1. Explain voltage levels (low, medium, and high).
2. Explain switchgear components.
3. Explain characteristics of low- and medium-voltage MCCs.
4. Explain the difference between switchgear and MCCs.
5. Explain the cause and consequences of poor power factor and describe a solution.
6. Explain the types of cables used in pipeline facilities, including shielded and nonshielded.
7. Test and maintain switchgear, MCCs, and cable.
8. Make a high-voltage splice or termination.

PERFORMANCE TASKS

Under the supervision of the instructor, the trainee should be able to:

1. Make a high-voltage splice or termination.
2. Test and maintain switchgear.
3. Test and maintain cables.
4. Test and maintain MCCs.

SAFETY CONSIDERATIONS

Ensure that the trainees are equipped with appropriate personal protective equipment. Emphasize the importance of following all safety precautions and procedures when working with power tools.

PREPARATION

Before teaching this module, you should review the Module Outline, Objectives, Performance Tasks, and the Materials and Equipment List. Be sure to allow ample time to prepare your own training or lesson plan and gather all required equipment and materials.

MATERIALS AND EQUIPMENT LIST

Transparencies	IEEE <i>Recommended Practice for Electric Power Distribution for Industrial Plants</i>
Markers/chalk	Photos or drawings of several types of MCCs
Blank acetate sheets	Copies of <i>Figure 8</i> with all text covered
Transparency pens	Copies of a motor control schematic and wiring diagram
Pencils and scratch paper	Materials and equipment required for splicing cables
Module Examinations*	Spliced cables with each type of termination
Performance Profile Sheets*	Equipment for examining a switchboard
Overhead projector and screen	Equipment for maintaining and inspecting switchgear
Whiteboard/chalkboard	Equipment for maintaining and inspecting circuit breakers
Appropriate personal protective equipment	Equipment for maintaining, testing, and inspecting MCCs
Copies of your local code	
Copies of your company's policy and procedures manual	
Copies of <i>National Electrical Code</i> [®] articles on cable or the entire NEC	
Various types of cables, cable cutters, and AWG gauge	

* Performance Sheets for this module are available from NCCER's Instructor Resource Center at www.nccerirc.com.

For information and updates about accessing the Module Examinations, visit www.nccer.org/testing.

MODULE OVERVIEW

This module covers the principles of operation and maintenance of standby and emergency power systems. Trainees will learn how to test generators, batteries, chargers, inverters, converters, and UPSs.

PREREQUISITES

Please refer to the Course Map in the Trainee Module. Prior to training with this module, it is recommended that the trainee shall have successfully completed the following:

Core Curriculum; Pipeline Core, Modules 66101-02 and 66102-02; Pipeline Electrical and Instrumentation Levels One and Two; Pipeline Electrical and Instrumentation Level Three, Modules 64301-02 and 64302-02

OBJECTIVES

Upon completion of this module, the trainee will be able to:

1. Identify and explain the function of standby generators on pipeline systems; perform the maintenance and testing relevant to generators.
2. Identify and explain the function of batteries on a pipeline system; perform the maintenance and testing relevant to batteries.
3. Identify and explain the function of battery chargers on a pipeline system; perform the maintenance and testing relevant to chargers.
4. Identify and explain the function of inverters on a pipeline system; perform the maintenance and testing relevant to inverters.
5. Identify and explain the function of converters on a pipeline system; perform the maintenance and testing relevant to converters.
6. Identify and explain the function of rotary and static UPSs on pipeline systems; perform the maintenance and testing relevant to UPSs.

PERFORMANCE TASKS

Under the supervision of the instructor, the trainee should be able to:

1. Adjust the frequency of the output voltage of a generator set.
2. Take specific gravity readings.
3. Clean and maintain batteries.
4. Measure cell voltage.
5. Adjust float and equalize voltage on a charger.
6. Connect AC and DC power to an inverter.

SAFETY CONSIDERATIONS

Ensure that the trainees are equipped with appropriate personal protective equipment. Emphasize the importance of following all safety precautions and procedures when working with power tools.

PREPARATION

Before teaching this module, you should review the Module Outline, Objectives, Performance Tasks, and the Materials and Equipment List. Be sure to allow ample time to prepare your own training or lesson plan and gather all required equipment and materials.

MATERIALS AND EQUIPMENT LIST

Transparencies	Standby generator and equipment required for inspection of standby generators
Markers/chalk	Equipment for measuring specific gravity
Blank acetate sheets	Batteries and equipment required for load and impedance tests
Transparency pens	Batteries for inspection and necessary equipment
Pencils and scratch paper	Charger and necessary equipment for floating and equalizing voltage on a charger
Module Examinations*	Charger and necessary equipment for maintenance and testing
Performance Profile Sheets*	Inverters and necessary equipment for maintenance and testing
Copies of Quick Quiz**	Converter and necessary equipment for inspection
Overhead projector and screen	UPS system and necessary equipment for maintenance and testing
Whiteboard/chalkboard	
Appropriate personal protective equipment	
Copies of your local code	
Copies of your company's policy and procedures manual	
Copies of the <i>National Electrical Code</i> [®]	

** Located in the Annotated Instructor's Guide for this module.

* Performance Sheets for this module are available from NCCER's Instructor Resource Center at www.nccerirc.com.

For information and updates about accessing the Module Examinations, visit www.nccer.org/testing.

MODULE OVERVIEW

This module focuses on power quality and on the equipment and devices used to correct power conditions and restore good power quality.

PREREQUISITES

Please refer to the Course Map in the Trainee Module. Prior to training with this module, it is recommended that the trainee shall have successfully completed the following:

Core Curriculum; Pipeline Core, Modules 66101-02 and 66102-02; Pipeline Electrical and Instrumentation Levels One and Two; Pipeline Electrical and Instrumentation Level Three, Modules 64301-02 through 64303-02

OBJECTIVES

Upon completion of this module, the trainee will be able to:

1. Define power quality in terms of clean, constant power.
2. Explain the power systems used at pipeline facilities.
3. Identify the different types of power quality defects and explain their effects on power quality.
4. Identify power system protection and conditioning equipment and explain its function.
5. Explain the different types of electrical noise, the problems it poses for pipeline electrical equipment, and ways to minimize it.
6. Explain different solutions for electrical noise problems.
7. Explain static electricity and the effect it has on sensitive electronic equipment.
8. Explain the different types of system verification testing.
9. Explain equipment maintenance.

PERFORMANCE TASKS

Under the supervision of the instructor, the trainee should be able to:

1. Install and test surge arrestors.
2. Given one or more situations involving poor power quality and the related cause, select the appropriate system protection and/or conditioning device used to correct the problem.
3. Demonstrate the ability to test a UPS system.

SAFETY CONSIDERATIONS

Ensure that the trainees are equipped with appropriate personal protective equipment. Emphasize the importance of following all safety precautions and procedures when working with power tools.

PREPARATION

Before teaching this module, you should review the Module Outline, Objectives, Performance Tasks, and the Materials and Equipment List. Be sure to allow ample time to prepare your own training or lesson plan and gather all required equipment and materials.

MATERIALS AND EQUIPMENT LIST

Transparencies	Appropriate personal protective equipment
Markers/chalk	Copies of your local code
Blank acetate sheets	Copies of your company's policy and procedures manual
Transparency pens	Copies of the <i>National Electrical Code</i> [®] , latest edition
Pencils and scratch paper	Photos of voltage regulators
Module Examinations*	Photo or drawing of a power center
Performance Profile Sheets*	Several grounding wrist straps
Copies of Quick Quiz**	Power quality equipment, manufacturers' recommendations, and necessary materials or tools
Overhead projector and screen	
Whiteboard/chalkboard	

** Located in the Annotated Instructor's Guide for this module.

* Performance Sheets for this module are available from NCCER's Instructor Resource Center at www.nccerirc.com.

For information and updates about accessing the Module Examinations, visit www.nccer.org/testing.

MODULE OVERVIEW

This module introduces various types of motors, engines, and turbines. Trainees will learn how to perform verification and maintenance tasks on prime movers in the pipeline system.

PREREQUISITES

Please refer to the Course Map in the Trainee Module. Prior to training with this module, it is recommended that the trainee shall have successfully completed the following:

Core Curriculum; Pipeline Core, Modules 66101-02 and 66102-02; Pipeline Electrical and Instrumentation Levels One and Two; Pipeline Electrical and Instrumentation Level Three, Modules 64301-02 through 64304-02

OBJECTIVES

Upon completion of this module, the trainee will be able to:

1. Describe electric motors.
2. Explain engines.
3. Explain turbines.

PERFORMANCE TASKS

Under the supervision of the instructor, the trainee should be able to:

1. Verify space heaters are working.
2. Verify and calibrate protection systems.
3. Connect an electric motor for the correct rotation.
4. Change the bearing oil in a motor.
5. Perform insulation resistance testing on a motor.
6. Identify components of systems discussed in the module.

SAFETY CONSIDERATIONS

Ensure that the trainees are equipped with appropriate personal protective equipment. Emphasize the importance of following all safety precautions and procedures when working with power tools.

PREPARATION

Before teaching this module, you should review the Module Outline, Objectives, Performance Tasks, and the Materials and Equipment List. Be sure to allow ample time to prepare your own training or lesson plan and gather all required equipment and materials.

MATERIALS AND EQUIPMENT LIST

Transparencies	Copies of your company's policy and procedures manual
Markers/chalk	Copies of the <i>National Electrical Code</i> [®] , latest edition
Blank acetate sheets	Sample frame sizes and any necessary tables
Transparency pens	Necessary materials, equipment, and company/manufacturer procedures for
Pencils and scratch paper	Verifying the proper operation of space heaters
Module Examinations*	Verifying protection systems
Performance Profile Sheets*	Connecting an electric motor for the correct rotation
Overhead projector and screen	Electrically testing motor bearings
Whiteboard/chalkboard	Motor, oil, and necessary equipment for changing bearing oil in a motor
Appropriate personal protective equipment	
Copies of your local code	

* Performance Sheets for this module are available from NCCER's Instructor Resource Center at www.nccerirc.com.

For information and updates about accessing the Module Examinations, visit www.nccer.org/testing.

MODULE OVERVIEW

This module addresses the auxiliary systems that support the pipeline industry. Trainees will learn about the types and maintenance of building, fire, security, vapor recovery, injection, water treatment, cathodic protection, and blend systems.

PREREQUISITES

Please refer to the Course Map in the Trainee Module. Prior to training with this module, it is recommended that the trainee shall have successfully completed the following:

Core Curriculum; Pipeline Core, Modules 66101-02 and 66102-02; Pipeline Electrical and Instrumentation Levels One and Two; Pipeline Electrical and Instrumentation Level Three, Modules 64301-02 through 64305-02

OBJECTIVES

Upon completion of this module, the trainee will be able to:

1. Identify and explain building systems.
2. Identify and explain fire systems.
3. Identify and explain security systems.
4. Identify and explain vapor recovery systems.
5. Identify and explain injection systems.
6. Identify and explain water treatment systems.
7. Identify and explain cathodic protection systems.
8. Identify and explain blend systems.

PERFORMANCE TASKS

Under the supervision of the instructor, the trainee should be able to:

1. Maintain a rectifier.
2. Identify any of the auxiliary systems found at a given pipeline facility.

SAFETY CONSIDERATIONS

Ensure that the trainees are equipped with appropriate personal protective equipment. Emphasize the importance of following all safety precautions and procedures when working with power tools.

PREPARATION

Before teaching this module, you should review the Module Outline, Objectives, Performance Tasks, and the Materials and Equipment List. Be sure to allow ample time to prepare your own training or lesson plan and gather all required equipment and materials.

MATERIALS AND EQUIPMENT LIST

Transparencies	Whiteboard/chalkboard
Markers/chalk	Appropriate personal protective equipment
Blank acetate sheets	Copies of your local code
Transparency pens	Copies of the <i>National Electrical Code</i> [®] , latest edition
Pencils and scratch paper	Photo of a pipeline facility building
Module Examinations*	Necessary equipment, company policy and procedures, and documentation forms for rectifier maintenance and blend system maintenance
Performance Profile Sheets*	
Copies of Quick Quiz**	
Overhead projector and screen	

** Located in the Annotated Instructor's Guide for this module.

* Performance Sheets for this module are available from NCCER's Instructor Resource Center at www.nccerirc.com.

For information and updates about accessing the Module Examinations, visit www.nccer.org/testing.

MODULE OVERVIEW

This module provides a comprehensive overview of the Supervisory Control and Data Acquisition (SCADA) system. Trainees will learn about the components of the SCADA system as well as how to troubleshoot system problems.

PREREQUISITES

Please refer to the Course Map in the Trainee Module. Prior to training with this module, it is recommended that the trainee shall have successfully completed the following:

Core Curriculum; Pipeline Core, Modules 66101-02 and 66102-02; Pipeline Electrical and Instrumentation Levels One and Two; Pipeline Electrical and Instrumentation Level Three, Modules 64301-02 through 64306-02

OBJECTIVES

Upon completion of this module, the trainee will be able to:

1. Explain the functions and importance of control systems in pipeline operations.
2. Explain the various methods of communication used on the pipeline system.
3. Explain the functions and components of the Supervisory Control and Data Acquisition (SCADA) system.
4. Explain the functions and components of programmable logic controller (PLC) systems.
5. Explain the functions and methods for redundant systems.
6. Explain troubleshooting methods for pipeline control systems.

PERFORMANCE TASKS

Under the supervision of the instructor, the trainee should be able to:

1. Draw a block diagram of a SCADA system.
2. Given a set of circumstances, react to a communications failure.
3. Identify the four major hardware components of a PLC.
4. Troubleshoot a SCADA system using the 7-step procedure.

SAFETY CONSIDERATIONS

Ensure that the trainees are equipped with appropriate personal protective equipment. Emphasize the importance of following all safety precautions and procedures when working with power tools.

PREPARATION

Before teaching this module, you should review the Module Outline, Objectives, Performance Tasks, and the Materials and Equipment List. Be sure to allow ample time to prepare your own training or lesson plan and gather all required equipment and materials.

MATERIALS AND EQUIPMENT LIST

Transparencies	Copies of your company's policy and procedures manual
Markers/chalk	Overhead projector and screen
Blank acetate sheets	Whiteboard/chalkboard
Transparency pens	Appropriate personal protective equipment
Pencils and scratch paper	Copies of your local code
Module Examinations*	A variety of SCADA screenshots
Performance Profile Sheets*	Documentation of an actual or hypothetical troubleshooting procedure
Copies of Quick Quiz**	

** Located in the Annotated Instructor's Guide for this module.

* Performance Sheets for this module are available from NCCER's Instructor Resource Center at www.nccerirc.com.

For information and updates about accessing the Module Examinations, visit www.nccer.org/testing.