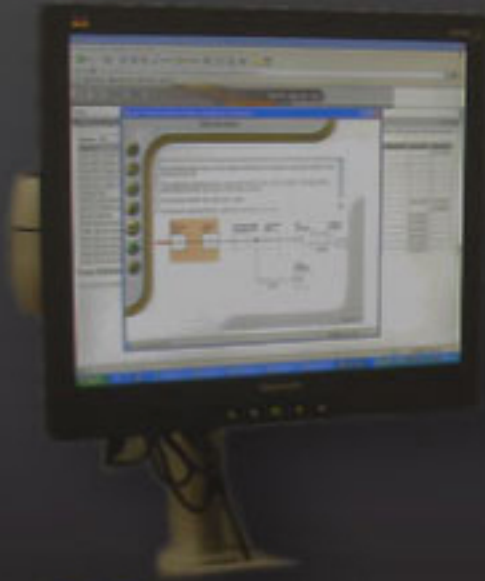


**Shovel Electrical  
eLearning Course  
Catalog**

**P&H**



**Peak Services**



# eLearning



P&H Knowledge and Development Department is proud to announce the availability of Online eLearning content. eLearning is the delivery of self paced learning, training, or educational content, by electronic means. P&H Peak Services eLearning can be accessed by P&H employees through our MineNet website by clicking on Learning Center or by end customers through a website link provided by P&H Peak Services.

## Lesson Duration:

Each Lesson within a module is designed with a 45-minute duration in mind. However, eLearning is self-paced instruction; actual lesson duration will vary per student.

## Target Audience:

Electricians, Technicians, and Engineers who will service and maintain all aspects of a P&H Mining Shovel.

## Description:

eLearning is the delivery of self paced learning, training, or educational content, by electronic means. It's also a means of providing follow-up training to our online Needs Analysis Assessment. eLearning provides several advantages over traditional training methods:

- Ideal for situations where people are in various locations, and a large amount of people need to be trained on consistent information.
- Improved retention of materials.
- Correct equipment usage.
- Available anywhere to vital information.
- Quicker productivity.
- Reduced overall costs.
- Consistent content delivery.
- Self paced.

## Prerequisites:

Students should have a basic working knowledge of computers, and fundamental understanding of Electronics and Electrical Systems.

## Lesson Location:

eLearning can be accessed on any computer that has internet access.

## Main Concepts:

- Module 3, Product Overview
- Module 4, Power Electronics
- Module 5, Control Systems
- Module 6, Drive Systems
- Module 8, Miscellaneous Electrical Equipment
- Module 9, HMI Devices

## Technological Requirements:

- Internet Explorer 6.0 or better
- Java 1.5 or better
- Flash Player 7 or better
- Windows Media Player

## Index of eLearning

### **Module 2**    FOR MINEPRO EMPLOYEES ONLY

- Lesson 2.1    General Safety Precautions
- Lesson 2.2    Electrical Hazards
- Lesson 2.3    Mechanical Hazards
- Lesson 2.4    Noise Hazards
- Lesson 2.5    Fire Hazards
- Lesson 2.6    Operational Hazards

### **Module 3**

- Lesson 3.1    Shovel Operation Overview
- Lesson 3.2    Shovel Orientation
- Lesson 3.3    Shovel Electrical Overview
- Lesson 3.4    Centurion Control System – Touch Panels
- Lesson 3.5    Shovel Electrical Overview AC Shovels
- Lesson 3.6    P&H Centurion Control Systems – Touch Panels - AC

### **Module 4**

- Lesson 4.1    Power Distribution
- Lesson 4.2    Power Conversion
- Lesson 4.3    Protection Circuits
- Lesson 4.4    RPC Theory and Operation
- Lesson 4.5    DC Motor Theory and Operation
- Lesson 4.6    DC Motor Maintenance (Field)
- Lesson 4.7    Power Distribution AC Shovels
- Lesson 4.8    Protection Circuits AC Shovels
- Lesson 4.9    IGBT Supply Unit
- Lesson 4.10    Inverter Unit
- Lesson 4.11    Brake Chopper
- Lesson 4.12    AC Motor Theory and Operation

### **Module 5**

- Lesson 5.1.1    AC800
- Lesson 5.1.2    Remote I/O
- Lesson 5.1.3    Communication Devices
- Lesson 5.2    SLC500 Family
- Lesson 5.3    PLC 5 Family

### **Module 6**

- Lesson 6.1    Drive Control Module
- Lesson 6.1.6    AC80
- Lesson 6.2    Drive Control Module (Avtron)
- Lesson 6.3    Drive Control Module (Analog)
- Lesson 6.4    Drive Control Unit - AC

### **Module 8**

- Lesson 8.1    UPS
- Lesson 8.2    Fiber Optic Connectors and Cables
- Lesson 8.3    Copper Profibus Wire
- Lesson 8.5    Triprite
- Lesson 8.6    Milltronics
- Lesson 8.7    Payload
- Lesson 8.8    Power Quality Meter

### **Module 9**

- Lesson 9.5    TNAC

## Lesson 2.1 General Safety Precautions FOR MINEPRO EMPLOYEES ONLY

### Course Description

In this Lesson you will learn about the general safety issues associated with P&H Electric Mining Shovels.

### Objectives

- State the purpose of a Lockout/Tagout program.
- Identify sources of safety information/references.
- Identify the responsibilities of all crew members.
- State the purpose of planning a job.

### Lesson Outline

- Topic 2.1.1 Lockout/Tagout
- Review Topic 2.1.1
- Topic 2.1.2 Safety Sources
- Topic 2.1.3 Responsibilities of All Crew Members
- Topic 2.1.4 Planning the Job
- Review Topic 2.1.2, 2.1.3, and 2.1.4

**P&H**

Module 2  
Lesson 2.1

**P&H PEAK SERVICES**  
YOUR KNOWLEDGE AND DEVELOPMENT RESOURCE

**General Safety Precautions**

Lockout/Tagout ✓  
Safety Sources ✓  
Responsibility of All Crew Members  
Planning the Job

You must complete the review for the prior Topics with a 70% or better to continue through this lesson.

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## Lesson 2.2 Electrical Hazards FOR MINEPRO EMPLOYEES ONLY

### Course Description

This Lesson will help you identify some common sense electrical safety rules you can use to be safe while working on the electrical equipment. Along with this common sense electrical safety rules, teaches you how to perform a general Risk Analysis that will help you identify those electrical hazards that are associated with your particular situation.

### Objectives

- Identify and describe safety concerns on P&H Electrical Mining Shovels as related to electrical hazards.
- Describe how to perform a risk analysis of the electrical system.
- State the definition ESD and explain how to avoid damaging equipment through the transfer of static energy.

### Lesson Outline

- Topic 2.2.1 General Electrical Safety
- Review topic 2.2.1
- Topic 2.2.2 Risk Analysis
- Review Topic 2.2.2
- Topic 2.2.3 ESD
- Review Topic 2.2.3

Topic 2.2.1 General Electrical Safety

**Work Planning**

When planning and performing work on electrical systems and equipment, keep these principles in mind:

- Plan every job.
- Think about what could go wrong.
- Use the right tools for the job.
- Use procedures, drawings and other documents as tools to do the job.
- Isolate the equipment from energy sources.
- Identify the electric shock and arc flash, as well as other hazards that may be present.
- Minimize the hazard by guarding or approach limitations.
- Test every circuit, every conductor, every time before you touch.

Use personal protective equipment (PPE) as a last line of defense in case something goes wrong.

Ensure service personnel have the skills, knowledge, tools, and experience to do this work safely.

Page

**Lesson 2.3 Mechanical Hazards**  
**FOR MINEPRO EMPLOYEES ONLY**

**Course Description**

This Lesson will help you identify some common sense mechanical safety rules you can use to be safe while working on the equipment. Along with these common sense mechanical safety rules, this Lesson teaches you how to perform a general Risk Analysis that will help you identify those mechanical hazards that are associated with your particular situation.

**Objectives**

- Identify and describe safety concerns on P&H Electric Mining Shovels as related to mechanical hazards.
- Describe how to perform a risk analysis of the mechanical system.

**Lesson Outline**

- Topic 2.3.1 General Mechanical Safety
- Review Topic 2.3.1
- Topic 2.3.2 Risk Analysis
- Review Topic 2.3.2


**Topic 2.3.1 General Mechanical Safety**

**Working Safety**

One of the best ways to prevent electrical accidents is to be aware of electrical dangers in the workplace. Once hazards have been identified, they must be pointed out and proper steps taken by a qualified person.

The following, where used, will improve the safety of the workplace:

- Maintain good housekeeping and cleanliness.
- Identify and control potential hazards.
- Anticipate problems.
- Resist pressure to hurry up.
- Plan and analyze for safety in each step of a project.
- Document work.
- Use properly rated test equipment and verify its condition and operation before and after use.
- Know and practice applicable emergency procedures.
- Become qualified in CPR and first aid and maintain current certifications.
- Wear appropriate Personal Protective Equipment, or PPE.
- Refer to system drawings and perform system walk downs.
- Electrical equipment should be maintained in accordance with the manufacturer's instructions.
- Ensure that work is adequately planned through an approved work control process.



Page 4 of 9

**Lesson 2.4 Noise Hazards**  
**FOR MINEPRO EMPLOYEES ONLY**

**Course Description**

This Lesson will identify some common sense noise hazard prevention you can use to be while working on the equipment.

**Objectives**

- Identify and describe safety concerns as related to noise hazards.

**Lesson Outline**

- Topic 2.4.1 Noise Sampling
- Topic 2.4.2 Hearing Safety
- Review Lesson 2.4

**Topic 2.4.1 Noise Sampling**

**MSHA Table 62-1 Reference Duration**

dBA	T (hours)
80	32.0
85	16.0
86	13.9
87	12.1
88	10.6
89	9.2
90	8.0
91	7.0
92	6.1
93	5.3
94	4.6
95	4.0
96	3.5
97	3.0
98	2.6
99	2.3
100	2.0
101	1.7
102	1.5
103	1.3
104	1.1
105	1.0
106	0.87
107	0.76
108	0.66
109	0.57
110	0.50
111	0.44
112	0.38
113	0.33
114	0.29
115	0.25

At no time shall any excursion exceed 115 dBA. For any value, the reference duration (T) in hours is computed by:

$$T = \frac{8}{2} \left( \frac{L-90}{5} \right)^2$$

where L is the measured A-weighted, slow response sound pressure level.

Page 10 of 10

## Lesson 2.5 Fire Hazards FOR MINEPRO EMPLOYEES ONLY

### Course Description

This Lesson provides information on the different types and classes of fires, the types of fire extinguishers used on P&H Electric Mining Shovels and how to use them, and provides some basic fire safety rules to use while performing work on P&H Electric Mining Shovels.

The information provided in this Lesson is intended as an introduction to fires, fire extinguishers, and fire safety. It is not a comprehensive reference. Be aware that fires are dangerous, and many aspects of fire safety are not discussed here. For more in-depth information, refer to your local, state, country, province, region, etc., ordinances.

### Objectives

- Identify different types of fires and explain their different characteristics.
- Explain how to use the fire extinguisher provided on P&H Mining Equipment.
- Explain what the Automatic Fire Suppression System, provided on some P&H Electric Mining Shovels, is.
- Identify basic fire prevention rules as they apply to P&H Electric Mining Shovels.

### Lesson Outline

- Topic 2.5.1 Types of Fires
- Review Topic 2.5.1
- Topic 2.5.2 Fire Extinguishers
- Review Topic 2.5.2
- Topic 2.5.3 Fire Prevention and Control
- Review Topic 2.5.3

5

**Topic 2.5.3 Fire Prevention and Control**

**Firefighting, Evacuation, and Rescue Procedures**

Establish emergency firefighting, evacuation, and rescue procedures. These procedures shall be coordinated in advance with available firefighting organizations.

Fire alarm procedures or systems shall be established to promptly warn every person who could be endangered by a fire.

Fire alarm systems shall be maintained in operable condition.

Establish and keep current a specific escape and evacuation plan to be followed in the event of a fire.

All employees shall be instructed in current escape and evacuation plans, fire alarm signals, and applicable procedures to be followed in case of fire.

Plans for escape and evacuation shall include the designation and proper maintenance of adequate means for exit from all areas where persons are required to work or travel including buildings and

Typical Shovel Deck Plan. Click on an arrow to see an escape

Page

## Lesson 2.6 Operational Hazards FOR MINEPRO EMPLOYEES ONLY

### Course Description

This lesson will describe some basic safety rules associated with operating a P&H Electric Mining Shovel. It will also provide information on performing a risk analysis which will help you identify safety concerns that may be specific to your working environment.

### Objectives

- Identify and describe safety concerns on P&H Electric Mining Shovels as related to Operational Hazards.
- Describe how to conduct a risk analysis on operating a P&H Electric Mining Shovel.

### Lesson Outline

- Topic 2.6.1 Operator Qualifications
- Review Topic 2.6.1
- Topic 2.6.2 Operator Conduct and Responsibility
- Review Topic 2.6.2
- Topic 2.6.3 Risk Analysis
- Review Topic 2.6.3

**Topic 2.6.1 Operator Qualifications**

**Operators Qualifications**

P&H Mining Equipment strongly recommends that operators and operator trainees meet the following qualifications:

- An operator must be able to distinguish colors, regardless of the position of the color, if color differentiation is required for operation of the shovel.
- An operator must have adequate hearing for the specific operation, with or without hearing aid.
- An operator must have sufficient strength, endurance, agility, coordination, and speed of reaction to meet the demands of shovel operation.

[Next](#)

Page 4 of 4

## Lesson 3.1 Shovel Operation Overview

### Course Description

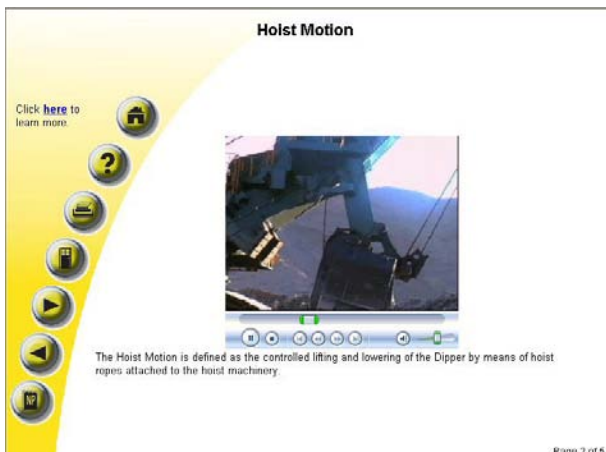
In this Lesson you will learn about the different motions associated with a P&H Electric Mining Shovel and the controls used by the Operator.

### Objectives

- By the end of this lesson the learner will be able to describe the different motions associated with P&H Electric Mining Shovels.
- By the end of this lesson the learner will be able to describe the basic Operator Controls associated with the Loading Control Center.
- By the end of this lesson the learner will be able to describe the basic Operator Controls associated with older style P&H Electric Mining Shovels.

### Lesson Outline

- Topic 3.1.1 Motions
- Topic 3.1.1 Motions Review
- Topic 3.1.2 Shovel Controls
- Topic 3.1.2 Shovel Controls Review



## Lesson 3.2 Shovel Orientation

### Course Description

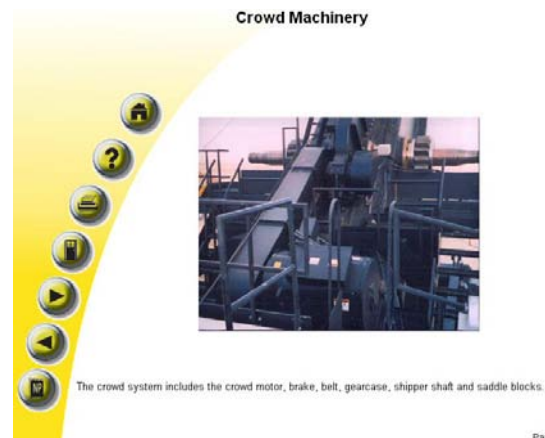
In this Lesson you will learn where common shovel mechanical and electrical components are located and get a brief description of their purpose.

### Objectives

- By the end of this lesson the learner will be able to describe the different exterior components associated with P&H Electric Mining Shovels.
- By the end of this lesson the learner will be able to identify and locate components associated with the exterior of the shovel.
- By the end of this lesson the learner will be able to describe the different interior components associated with P&H Electric Mining Shovels.
- By the end of this lesson the learner will be able to identify different shovel deck plans and locate components associated with those deck plans.

### Lesson Outline

- Topic 3.2.1 Shovel Exterior Components
- Topic 3.2.1 Shovel Exterior Components Review
- Topic 3.2.2 Machinery Deck Layout
- Topic 3.2.2 Machinery Deck Layout Review



## **Lesson 3.3 Shovel Electrical Overview**

### **Course Description**

In this Lesson you will learn where common shovel electrical components are located and get a brief description of their purpose.

### **Objectives**

- By the end of this lesson the learner will be able to locate and state the purpose of the components used in distributing power on a P&H Electric Mining Shovel.
- By the end of this lesson the learner will be able to locate and state the purpose of the components used in converting power on a P&H Electric Mining Shovel.
- By the end of this lesson the learner will be able to locate and state the purpose of the major protection circuits associated with a P&H Electric Mining Shovel.
- By the end of this lesson the learner will be able to locate and state the purpose of components used for Reactive Power Compensation on a P&H Electric Mining Shovel.
- By the end of this lesson the learner will be able to locate and state the purpose of the DC Motors associated with a P&H Electric Mining Shovel.

### **Lesson Outline**

- Topic 3.3.1 Power Distribution
- Topic 3.3.1 Power Distribution Review
- Topic 3.3.2 Power Conversion
- Topic 3.3.2 Power Conversion Review
- Topic 3.3.3 Protection Circuits
- Topic 3.3.3 Protection Circuits Review
- Topic 3.3.4 Reactive Power Compensation
- Topic 3.3.4 Reactive Power Compensation Review
- Topic 3.3.5 DC Motors
- Topic 3.3.5 DC Motors Review

## **Lesson 3.4 Centurion Control System**

### **Course Description**

In this Lesson you will learn about the new Operator interface, or Touch Panel, associated with the Centurion Control System.

### **Objectives**

- Upon completion of this lesson the student will be able to explain and identify the different parts of the Centurion Control System Touch Panel.
- Upon completion of this lesson the student will be able to identify and navigate through the various Operational Screens associated with the Centurion Control System Touch Panel.
- Upon completion of this lesson the student will be able to identify and navigate through the various Diagnostic Screens associated with the Centurion Control System Touch Panel.
- Upon completion of this lesson the student will be able to identify and navigate through the various Setup Screens associated with the Centurion Control System Touch Panel.
- Upon completion of this lesson the student will be able to identify and navigate through the various Activity Screens associated with the Centurion Control System Touch Panel.
- Upon completion of this lesson the student will be able to identify and navigate through the various Help Screens associated with the Centurion Control System Touch Panel.

### **Lesson Outline**


- Topic 3.4.1 Touch Panel Basics
- Topic 3.4.1 Touch Panel Basics Review
- Topic 3.4.2 Operation Screens
- Topic 3.4.2 Operation Screens Review
- Topic 3.4.3 Diagnostic Screens
- Topic 3.4.3 Diagnostic Screens Review
- Topic 3.4.4 Setup Screens

## Lesson 3.4 Centurion Control System (cont.)

### Lesson Outline (cont.)

- Topic 3.4.4 Setup Screens Review
- Topic 3.4.5 Activity Screens
- Topic 3.4.5 Activity Screens Review
- Topic 3.4.6 Help Screens
- Topic 3.4.6 Help Screens Review

**Touch Panel Screens Categories**



The screens on a Centurion Control System Shovel have been redesigned to eliminate large amounts of text. These screens can be broken down into the following categories:

- Operation Screens
- Diagnostics Screens
- Setup Screens
- Activity Screens
- Help Screens

Certain functions can only be accessed when in the correct mode. For example, Maintenance Setup can only be done while in the Setup or Maintenance Mode. When in the Operation Mode, these Setup screens can not be accessed.

Page 3 of 11

## Lesson 3.5 Shovel Electrical Overview AC Shovel

### Course Description

This Lesson provides the learner with a general overview of some of the electrical components of the P&H AC Shovel.

### Objectives

- Have a basic understanding of the Power Distribution on a P&H AC Shovel.
- Have a basic understanding of the purpose of the different Protection Circuits used on a P&H AC Shovel.
- Identify the location of the AC Motors used on a P&H AC Shovel.

### Lesson Outline

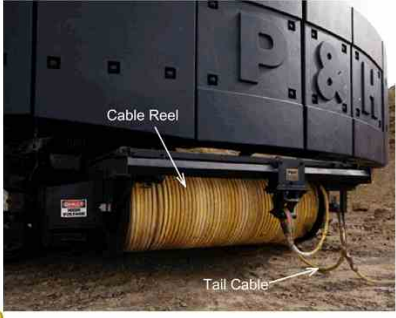
- Topic 3.5.1 Power Distribution
- Review Topic 3.5.1
- Topic 3.5.2 Protection Circuits
- Review Topic 3.5.2
- Topic 3.5.3 AC Motors
- Review Topic 3.5.3

**Topic 3.5.1 Power Distribution**

**Tail Cable**

The Tail Cable, typically carries the high voltage supply, ground, and ground circuit check wires, to the Lower High Voltage Cabinet through cable clamp and armored cable connector on the front of the cabinet door. On some shovels a Cable Reel is used to protect the Tail Cable and keep it from coiling up at the back of the shovel.

The Tail Cable is sometimes referred to as the Trail Cable.



## Lesson 3.6 Centurion Control System – Touch Panels AC Shovel

### Course Description

This Lesson introduces the Shovel Operator and Maintenance Technician to the different screens associated with a Centurion AC Shovel Touch Panel.

### Objectives

- Have a thorough understanding of the layout of a Centurion AC Shovel Touch Panel.
- Have a thorough understanding of the Operation Screens and how to navigate through them.
- Have a thorough understanding of the Diagnostic Screens and how to navigate through them.
- Have a thorough understanding of the Setup Screens and how to navigate through them.
- Have a thorough understanding of the Activity Screens and how to navigate through them.
- Have a thorough understanding of the Help Screens and how to navigate through them.

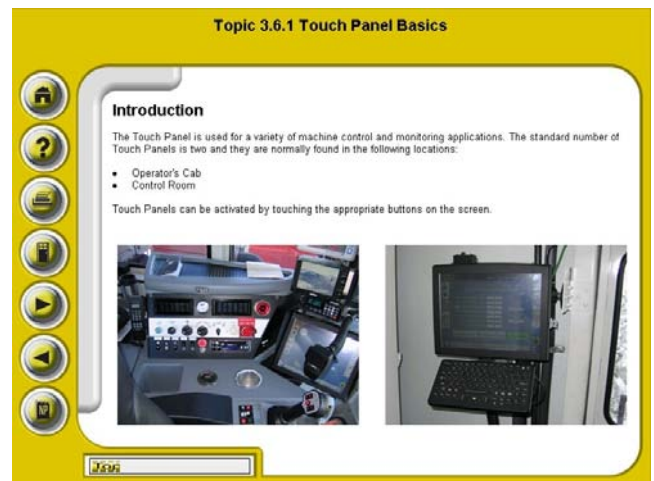
### Lesson Outline

- Topic 3.6.1 Touch Panel Basics
- Review Topic 3.6.1
- Topic 3.6.2 Operation Screens
- Review Topic 3.6.2
- Topic 3.6.3 Diagnostic Screens
- Review Topic 3.6.3
- Topic 3.6.4 Setup Screens
- Review Topic 3.6.4
- Topic 3.6.5 Activity Screens

## Lesson 3.6 Centurion Control System – Touch Panels AC Shovel

### Lesson Outline (cont.)

- Topic 3.6.6 Help Screens
- Review Topics 3.6.5 and 3.6.6



## Lesson 4.1 Power Distribution

### Course Description

This lesson provides Maintenance Personnel with the knowledge of High Voltage Distribution on P&H Electric Mining Shovels.

The shovel converts input electrical energy to output mechanical energy in the DC motion motors to move the mechanical components and assemblies of the shovel in the process of loading.

### Objectives

- Identify all safety issues and conduct a risk analysis.
- Identify and explain the purpose of all the major components utilized.
- Demonstrate proficiency in loading, configuring, usage and application of test equipment and remote programming panels as required.
- Remove and replace faulty components including a failure analysis.
- Explain the relationship to the rest of the shovel systems.
- Analyze schematics, control diagrams, and relevant documentation utilized for troubleshooting and repair.
- Describe the purpose of the High Voltage Systems in relation to overall Electric Mining Shovel operation.
- Identify critical personal safety procedures when working on P&H Mining Equipment's High Voltage Systems.
- Assess risk to humans and machine related to maintaining and servicing the High Voltage Systems.
- Describe the purpose of all major Assemblies of the High Voltage System.

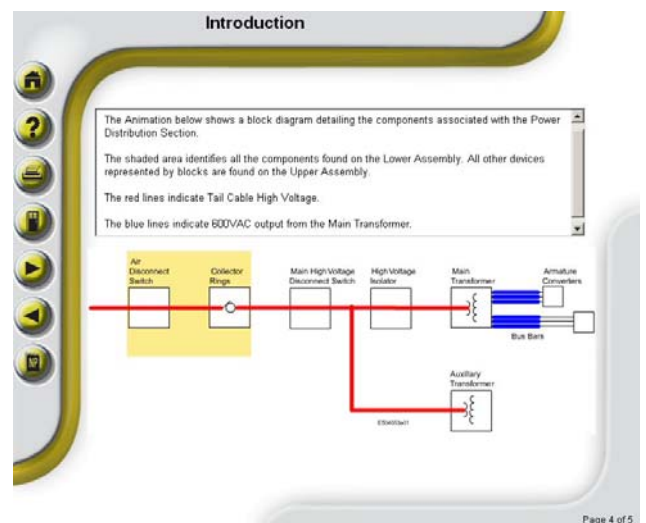
### Lesson Outline

- Introduction
- Topic 4.1.1 Tail Cable

## Lesson 4.1 Power Distribution (cont.)

### Lesson Outline (cont.)

- Topic 4.1.2 Air Disconnect Switch with Earthing
- Review Topics 4.1.1 and 4.1.2
- Topic 4.1.3 Collector Ring Assemblies
- Review Topic 4.1.3
- Topic 4.1.4 High Voltage Cabinet
- Topic 4.1.5 Key Interlock System
- Review Topic 4.1.4 and 4.1.5
- Topic 4.1.6 Main Transformer
- Review Topic 4.1.6
- Topic 4.1.7 Bus Bars
- Topic 4.1.8 Suppression
- Review Topic 4.1.7 and 4.1.8
- Topic 4.1.9 Auxiliary/Field Transformer
- Review Topic 4.1.9



## Lesson 4.2 Power Conversion

### Course Description

This lesson provides Maintenance Personnel with the basic knowledge of Power Conversion used on a P&H Mining Shovels.

### Objectives

- Identify all safety issues and conduct a risk analysis.
- Identify and explain the purpose of all the major components utilized.
- Demonstrate proficiency in loading, configuring, usage and application of test equipment and remote programming panels as required.
- Remove and replace faulty components including a failure analysis.
- Explain the relationship to the rest of the shovel systems.
- Analyze schematics, control diagrams, and relevant documentation utilized for troubleshooting and repair.

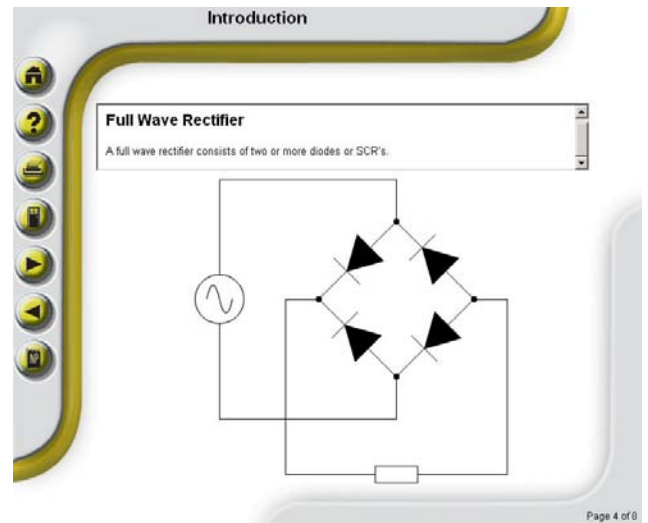
### Lesson Outline

- Introduction
- Topic 4.2.1 Power Conversion - Theory of Operation
- Subtopic 4.2.1.1 AC Characteristics
- Review of Subtopic 4.2.1.1
- Subtopic 4.2.1.2 Diodes and Rectification
- Review of Subtopic 4.2.1.2
- Subtopic 4.2.1.3 Full Wave and Bridge Rectifiers
- Review of Subtopic 4.2.1.3
- Subtopic 4.2.1.4 Three Phase Diode Bridges

## Lesson 4.2 Power Conversion (cont.)

### Lesson Outline (cont.)

- Review of Subtopic 4.2.1.4
- Subtopic 4.2.1.5 SCR Rectification
- Review of Subtopic 4.2.1.5
- Subtopic 4.2.1.6 Three Phase AC and Firing Angles
- Review of Subtopic 4.2.1.6
- Subtopic 4.2.1.7 Bridge Configurations
- Review of Subtopic 4.2.1.7
- Topic 4.2.2 SCR Testing
- Topic 4.2.3 Converter Cabinet Layout
- Review Topics 4.2.2 and 4.2.3



## Lesson 4.3 Protection Circuit

### Course Description

This lesson provides Maintenance Personnel with knowledge of the Protection Circuits located on P&H Electric Mining Shovels.

The Protection Circuits provide overcurrent, overvoltage, ground fault, harmonic, transient, and phasing protection for sensitive and expensive components on the electric mining shovel.

### Objectives

- Identify all safety issues and conduct a risk analysis.
- Identify and explain the purpose of all the major components utilized.
- Demonstrate proficiency in loading, configuring, usage and application of test equipment and remote programming panels as required.
- Remove and replace faulty components including a failure analysis.
- Explain the relationship to the rest of the shovel systems.
- Analyze schematics, control diagrams, and relevant documentation utilized for troubleshooting and repair.

### Lesson Outline

- Introduction
- Topic 4.3.1 Instantaneous Overload Relay
- Review Topic 4.3.1
- Topic 4.3.2 Ground Fault Relays
- Review Topic 4.3.2
- Topic 4.3.3 Suppression Circuits
- Review Topic 4.3.3
- Topic 4.3.4 Phase Monitor Relay
- Review Topic 4.3.4

## Lesson 4.3 Protection Circuit (cont.)

### Lesson Outline (cont.)

- Topic 4.3.5 Diverter Circuits
- Review Topic 4.3.5
- Topic 4.3.6 Main Phase Sensing Relay
- Review Topic 4.3.6



## Lesson 4.4 RPC Theory and Operation

### Course Description

In this Lesson you will learn about Reactive Power Compensation, or RPC, theory, and the components used for RPC on a P&H Electric Mining Shovel.

### Objectives

- Identify all safety issues and conduct a risk analysis.
- Identify and explain the purpose of all the major components utilized.
- Demonstrate proficiency in loading, configuring, usage and application of test equipment and remote programming panels as required.
- Remove and replace faulty components including a failure analysis.
- Explain the relationship to the rest of the shovel systems.
- Analyze schematics, control diagrams, and relevant documentation utilized for troubleshooting and repair.

### Lesson Outline

- Introduction
- Introduction Review
- Topic 4.4.1 RPC Theory of Operation
- Review of Topic 4.4.1
- Topic 4.4.2 RPC Power Circuit Operation
- Review of Topic 4.4.2
- Topic 4.4.3 RPC Control Circuit Operation
- Review of Topic 4.4.3
- Topic 4.4.4 RPC Cabinet Layout
- Review of Topic 4.4.4
- Topic 4.4.5 RPC Troubleshooting
- Review of Topic 4.4.5

## Lesson 4.5 DC Motor Theory and Operation

### Course Description

This Lesson describes the types of DC Motors used by P&H Mining Equipment, their Construction, Operation, and characteristics.

### Objectives

- Identify the components used in the construction of a DC Motor.
- Understand the function of those components.
- State the function of torque in a DC Motor and how it is developed.
- Describe how Counter Electromotive Force, (CEMF) is developed in a DC Motor.
- Describe the relationship between field current and magnetic field size in a DC Motor.
- State the function of the CEMF that is developed in a DC Motor.
- Describe how the speed of a DC Motor is adjusted.
- Describe the relationship between armature current and armature torque produced in a DC Motor.
- Identify the P&H application of DC Motor configurations.

### Lesson Outline

- Topic 1 P&H Mining DC Motors
- Topic 2 Types of DC Motors
- Topic 3 DC Motor Construction
- Topic 4 Principles of Operation
- Topic 5 Generator Action in a DC Motor
- Topic 6 Armature Reaction
- Topic 7 DC Motor Speed Control

## **Lesson 4.6 DC Motor Maintenance (Field)**

### **Course Description**

This Lesson describes the inspection and maintenance practices associated with the Peak Performance of P&H DC Motors.

### **Objectives**

- Understand the elements associated with Motor Peak Electrical Performance.
- Be able to describe and identify Satisfactory Commutator surface conditions.
- Be able to describe and identify Commutator surface conditions for concern.
- Be able to describe and identify Unsatisfactory Commutator surface conditions.
- Understand the steps necessary to maintain the proper Commutator surface conditions.
- Understand the importance and steps required for inspecting and maintaining the Brushes and Brush Holders on P&H DC Electric Motors.
- Understand the steps required for replacing the Brushes on P&H DC Electric Motors.
- Describe grease lubrication practices for P&H DC Electric Motors.
- Identify the locations of lube points associated with P&H DC Electric Motors.
- Understand the lubrication requirements for replacement P&H DC Electric Motors.
- Understand the lubrication procedures for P&H DC Electric Motors during and after extended storage.
- Understand the lubrication procedures for remanufactured P&H DC Electric Motors.
- Understand and describe the conditions associated with Insulation Failures.
- Understand and be able to describe the steps required for performing Insulation Resistance Inspection for P&H DC Electric Motors.

## **Lesson 4.6 DC Motor Maintenance (Field) (cont.)**

### **Objectives (cont.)**

- Understand the conditions that cause detrimental conditions for P&H DC Electric Motors.
- Be able to describe the inspections process for P&H DC Electric Motors first time use.
- Be able to describe the inspections process for P&H DC Electric Motors after Start-up.

### **Lesson Outline**

- Topic 4.6.1 Introduction
- Topic 4.6.2 Commutator Maintenance
- Review Topics 4.6.1 and 4.6.2
- Topic 4.6.3 Brush Maintenance
- Review Topic 4.6.3
- Topic 4.6.4 Lubrication Practices
- Review Topic 4.6.4
- Topic 4.6.5 Insulation System
- Topic 4.6.6 Insulation Resistance Inspection
- Review Topics 4.6.5 and 4.6.6
- Topic 4.6.7 Detrimental Conditions
- Topic 4.6.8 Motor Inspection
- Review Topics 4.6.7 and 4.6.8

## Lesson 4.7 Power Distribution AC Shovel

### Course Description

This lesson provides Maintenance Personnel with the knowledge of High Voltage Distribution on P&H AC Electric Mining Shovels.

The shovel converts input electrical energy to output mechanical energy in the AC motion motors to move the mechanical components and assemblies of the shovel in the process of loading

### Objectives

- Have a thorough understanding of the high voltage distribution of a P&H AC Shovel.
- Understand the purpose and function of the Tail Cable.
- Understand some basic safety principles associated with the handling of the Tail Cable.
- Identify the basic components of a Tail Cable.
- Understand the purpose, function, and operation of the Air Disconnect Switch with Earthing.
- Identify the location and components of the Lower High Voltage Cabinet.
- Understand the purpose, function, and operation of the Collector Ring Assembly.
- Identify the location and components of the Collector Ring Assembly.
- Understand the purpose, function, and operation of the Upper High Voltage Cabinet.
- Identify the location and components of the Upper High Voltage Cabinet.
- Understand the purpose, function, and operation of the Main Transformer Contactor.
- Understand the purpose, function, and operation of the Key Interlock System.
- Understand the purpose, function, and operation of the Main Transformer.
- Identify the location and components of the Main Transformer.

## Lesson 4.7 Power Distribution AC Shovel (cont.)

### Objectives

- Understand the purpose, function, and operation of the Auxiliary Transformer.
- Identify the location and components of the Auxiliary Transformer.
- Understand the purpose, function, and operation of the Lighting Transformer.
- Identify the location and components of the Lighting Transformer.

### Lesson Outline

- Introduction
- Topic 4.7.1 Tail Cable
- Topic 4.7.2 Air Disconnect Switch with Earthing
- Review Topics 4.7.1 and 4.7.2
- Topic 4.7.3 Collector Ring Assembly
- Topic 4.7.4 High Voltage Cabinet
- Topic 4.7.5 Key Interlock System
- Review Topics 4.7.3, 4.7.4, and 4.7.5
- Topic 4.7.6 Main Transformer
- Topic 4.7.7 Auxiliary Transformer
- Topic 4.7.8 Lighting Transformer
- Review Topics 4.7.6, 4.7.7, and 4.7.8

## Lesson 4.8 Protection Circuits AC Shovel

### Course Description

This lesson provides Maintenance Personnel with knowledge of the Protection Circuits located on the Shovel.

Protection Circuits provide overcurrent, ground fault, undervoltage, and phasing protection for sensitive and expensive components on the Shovel.

### Objectives

- Have a thorough understanding of the purpose, location, and operation of the Main Transformer Thermal Overloads, or TTMT.
- Have a thorough understanding of the purpose, location, and operation of the Instantaneous Overload Relay, or QTTM.
- Have a thorough understanding of the purpose, location, and operation of the Ground Fault Relays, GFRM and GFRA.
- Have a thorough understanding of the purpose, location, and operation of the Main Phase Sensing Relay, or PSR.
- Have a thorough understanding of the purpose, location, and operation of the Undervoltage Monitor, or UVM.
- Have a thorough understanding of the purpose, location, and operation of the E-Stop Safety Relay, or ESSR.

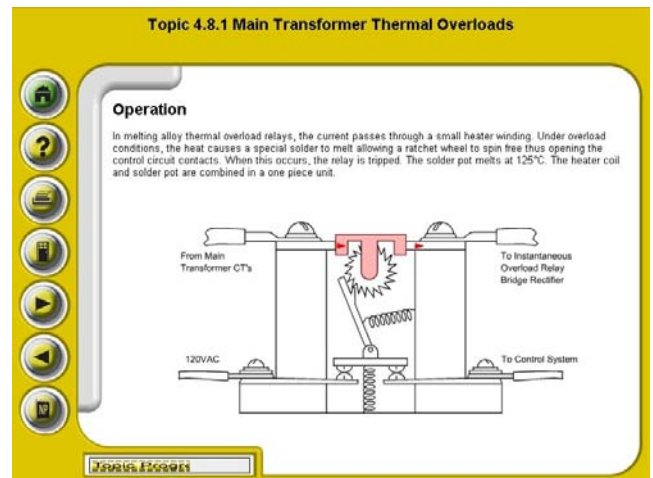
### Lesson Outline

- Topic 4.8.1 Main Transformer Thermal Overloads
- Review Topic 4.8.1
- Topic 4.8.2 Instantaneous Overload Relay
- Review Topic 4.8.2
- Topic 4.8.3 Ground Fault Relays
- Review Topic 4.8.3
- Topic 4.8.4 Main Phase Sensing Relay
- Review Topic 4.8.4

## Lesson 4.8 Protection Circuits AC Shovel (cont.)

### Lesson Outline (cont.)

- Topic 4.8.5 Undervoltage Monitor
- Review Topic 4.8.5
- Topic 4.8.6 E-Stop Safety Relay
- Review Topic 4.8.6



## Lesson 4.9 IGBT Supply Unit

### Course Description

This Lesson describes the purpose, component location, operation, removal and replacement of the IGBT Supply Unit used on P&H AC Shovels.

### Objectives

- Have a basic understanding of the Theory of IGBT Technology.
- Be able to locate the AC Drive System Module on a typical Shovel Deck Plan.
- Be able to locate the IGBT Supply Unit within the AC Drive System Module.
- Be able to identify the components associated with the IGBT Supply Unit.
- Have an understanding of the purpose and function of the LCL Line Filter.
- Have an understanding of the purpose and function of the IGBT Supply Module.
- Understand the proper procedure for removing and replacing the modules of the IGBT Supply Unit.

### Lesson Outline

- Topic 4.9.1 IGBT Theory
- Topic 4.9.2 IGBT Supply Unit Location
- Review Topic 4.9.1 and 4.9.2
- Topic 4.9.3 IGBT Supply Unit Operation
- Review Topic 4.9.3
- Topic 4.9.4 Removing and Replacing Modules
- Review Topic 4.9.4

## Lesson 4.10 Inverter Unit

### Course Description

This Lesson describes the purpose, component location, operation, removal and replacement of the Inverter Unit used on P&H AC Shovels.

### Objectives

- Be able to locate the AC Drive System Module on a typical Shovel Deck Plan.
- Be able to locate the Inverter Unit within the AC Drive System Module.
- Be able to identify the components associated with the Inverter Unit.
- Have an understanding of the purpose and function of the Inverter Module.
- Understand the proper procedure for removing and replacing the modules of the Inverter Unit

### Lesson Outline

- Topic 4.10.1 Inverter Unit Location
- Topic 4.10.2 Inverter Unit Operation
- Review Topic 4.10.1 and 4.10.2
- Topic 4.10.3 Removing and Replacing Modules
- Review Topic 4.10.3



## Lesson 4.12 AC Motor theory and Operation

### Course Description

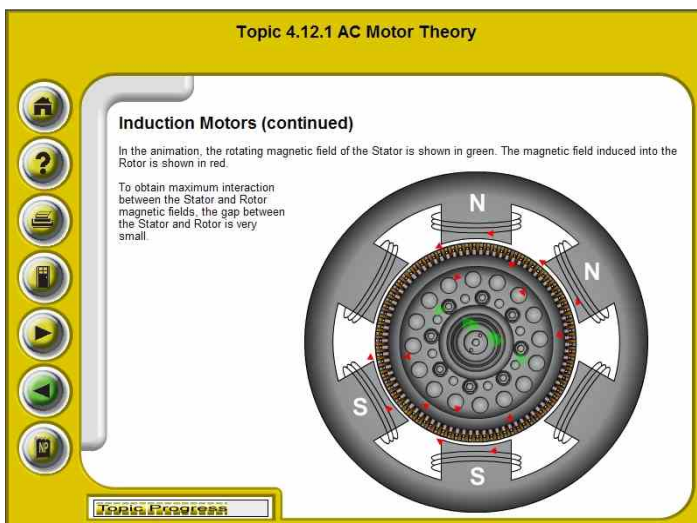
This Lesson provides information on the theory of operation and maintenance practices associated with P&H AC Motors.

### Objectives

- Have a thorough understanding of AC Motor theory as it relates to Induction Motors.
- Have a working vocabulary of the components associated with the AC Motors on P&H equipment.
- Understand the proper maintenance practices required to keep P&H AC Motors operating at optimal performance

### Lesson Outline

- Topic 4.12.1 AC Motor Theory
- Review Topic 4.12.1
- Topic 4.12.2 Types of Motors
- Topic 4.12.3 AC Motor Maintenance
- Review Topics 4.12.2 and 4.12.3



## Lesson 5.1.1 AC800

### Course Description

This tutorial provides the electrical maintenance technician or end-user of P&H Mining Equipment with the necessary knowledge and working skills to maintain the Advant Controller 800 used on electric mining shovels.

### Objectives

- Describe the purpose of the AC800 Controller.
- Locate and identify the components of the AC800 Controller.
- Identify/explain the function of each component of the AC800 Controller.
- Remove and replace the AC800 Controller.
- Remove and replace the external battery backup for the AC800 Controller.
- Remove and replace the Communication Interface modules for the AC800 Controller.
- Download the AC800 Controller application.
- Describe the AC800 Controller troubleshooting procedures and corrective actions.

### Lesson Outline

- Theory of Operation
- Hardware Overview
- Installation
- Software Overview
- Control Builder Basics
- Procedures
- System Maintenance and Troubleshooting

## Lesson 5.1.2 Remote I/O

### Course Description

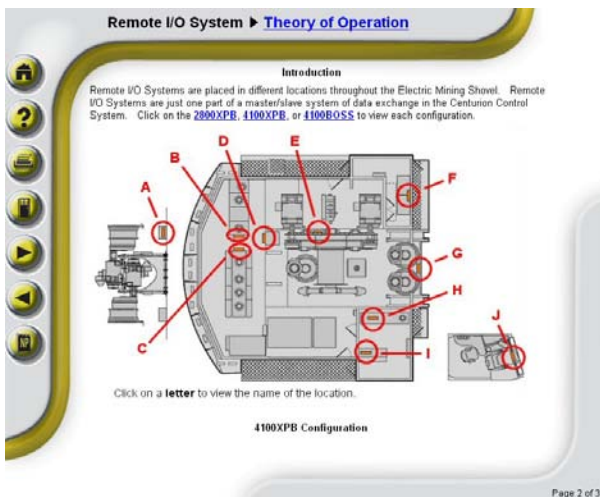
This tutorial provides the electrical maintenance technician or end-user of P&H Mining Equipment with the necessary knowledge and working skills to maintain the Remote I/O System used in the Centurion Control System.

### Objectives

- Describe the purpose of the Remote I/O System.
- Locate and identify the main components of the Remote I/O System.
- Identify the function of each main component of the Remote I/O System.
- Remove and replace the I/O devices.
- Perform diagnostics of the Remote I/O System.

### Lesson Outline

- Theory of Operation
- Components
- Module Diagnostics
- Install and Remove



## Lesson 5.1.3 Communication Devices

### Course Description

This tutorial provides the electrical maintenance technician or end-user of P&H Mining Equipment with the necessary knowledge and working skills to maintain the Communication Devices used in the Centurion Control System.

### Objectives

- Know the purpose of the Communication Devices.
- Locate and identify each Communication Device.
- Identify/explain the function of each Communication Device.

### Lesson Outline

- Ethernet Electrical Lean Switch
- Profibus Optical Bus Terminal
- Profibus Resolver Interface Module
- Power Rail Booster
- DDCS Branching Unit



## **Lesson 5.2 SLC500 Family**

### **Course Description**

Welcome to the Module 5, Lesson 5.2 SLC 500 Family. In this Lesson you will learn about the components of the SLC 500 Family.

### **Objectives**

- Be able to identify the components associated with the SLC 500 Family.
- Understand the steps required for removing and installing the Power Supply associated with the SLC 500 Family.
- Identify the SLC 500 Processor.
- Understand the different communication protocols associated with the SLC 500 Processor.
- Understand the modes of operation associated with the SLC 500 Processor.
- Understand how to use the Status Indicators associated with the SLC 500 Processor for troubleshooting.
- Understand the steps required to remove and install the SLC 500 Processor Battery.
- Understand the theory of operation of the Remote I/O Scanner associated with the SLC 500 Family.
- Understand the purpose of the AMCI Resolver Interface Module.
- Understand how to use the Status Indicators associated with the AMCI Resolver Interface Module for troubleshooting.
- Understand the purpose of the Profibus Scanner.
- Understand how to use the Status Indicators associated with the Profibus Scanner for troubleshooting.
- Have a general understanding of the I/O Modules associated with the SLC 500 Family.

## **Lesson 5.2 SLC500 Family (cont.)**

### **Objectives (cont.)**

- Have a basic understanding of the Ladder Diagram Terminology associated with the Lesson 5.2 SLC500 Family (Cont.)
- Ladder Program of the SLC 500 Processor.
- Understand the theory of operation of the Remote I/O Adapter associated with the Flex I/O System.
- Understand how to use the Status Indicators associated with the Flex I/O System Remote I/O Adapter for troubleshooting.
- Have a general understanding of the I/O Modules associated with the Flex I/O System.
- Have an understanding of how the Flex I/O System communicates with the SLC 500 Processor.

### **Lesson Outline**

- Topic 5.2.1 Components
- Topic 5.2.2 SLC 500 Processor
- Topic 5.2.3 RIO Scanner
- Review Topics 5.2.1, 5.2.2, and 5.2.3
- Topic 5.2.4 Remote I/O
- Review Topic 5.2.4
- Topic 5.2.5 Flex I/O
- Review Topic 5.2.5



## Lesson 5.3 PLC 5 Family

### Course Description

Welcome to Lesson 5.3 PLC5 Family. This Lesson provides information on the PLC5 Controller, I/O and Remote I/O Modules, and installation of the components of the PLC5 Family.

### Objectives

- Understand the purpose of the PLC5 Controller.
- Have an understanding of the connectors associated with the PLC5 Controller.
- Understand how to set up the Dip Switches associated with the PLC5 Controller.
- Understand the 3 positions of the Key Switch associated with the PLC5 Controller.
- Understand how to use the Status LED's on the PLC5 Controller for maintenance and troubleshooting.
- Understand the steps required to remove and install the battery for the PLC5 Controller.
- Understand the steps required to remove and install the EEPROM for the PLC5 Controller.
- Have a basic understanding of the Ladder Diagram Terminology associated with the Ladder Program of the PLC5 Controller.
- Have a basic understanding of the different I/O Modules associated with the PLC5 Family.
- Understand how to use the Status LED's on the PLC5 Family I/O Modules for maintenance and troubleshooting.
- Understand the purpose of the Remote I/O Adapter Module.
- Understand how to set up the Dip Switches associated with the Remote I/O Adapter Module.
- Understand how to use the Status LED's on the Remote I/O Adapter Module for maintenance and troubleshooting.

## Lesson 5.3 PLC5 Family (cont.)

### Objectives (cont.)

- Understand how to set up the Chassis Power Supply Configuration Jumper.
- Understand how to set up the Dip Switches associated with the Chassis.
- Understand how to install/remove the I/O modules in the Chassis.

### Lesson Outline

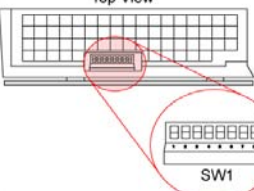
- Topic 5.3.1 Controller
- Review Topic 5.3.1
- Topic 5.3.2 I/O and Remote I/O
- Review Topic 5.3.2
- Topic 5.3.3 Installation
- Review Topic 5.3.3

**Topic 5.3.1 Controller**

**Dip Switch Assemblies**

The graphic below shows a close up view of the SW1 Dip Switch Assembly on the top of the PLC5 Controller. Roll your mouse over SW1 to see a description of the Dip Switch settings.

**Top View**



The Processor is set up in Station 0. Dip Switches 1-6 should be set to On.

Dip Switch 7 should always be set to the Off position. This switch is not used.

Dip Switch 8 is On when the Processor is used in the Adapter Mode, or as a Slave. Off when the Processor is used in the Scanner Mode, or as the Master. In the P&H application, the Processor is the Master so the switch should be set to the Off position.

Station Number	1	2	3	4	5	6
0	on	on	on	on	on	on
1	off	on	on	on	on	on
2	on	off	on	on	on	on
3	off	off	on	on	on	on

**SW1**

Pressed in at top, Closed (on)

Pressed in at bottom, Open (off)

Page

## Lesson 6.1 Drive Control Module

### Course Description

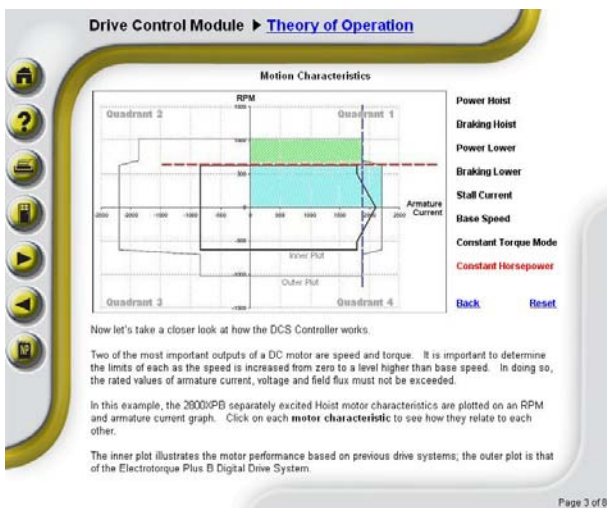
This tutorial provides the electrical maintenance technician or end-user of P&H Mining Equipment with the necessary knowledge and working skills to understand the theory of operation of the DCS 600.

### Objectives

- Explain the purpose of the DCS 600.
- Locate and identify the hardware components of the DCS 600.
- Identify/explain the function of each hardware component of the DCS 600.
- Identify/explain the DCS 600 troubleshooting procedures and corrective actions.

### Lesson Outline

- Theory of Operation
- Hardware Overview
- DriveWindows
- Troubleshooting Process



## Lesson 6.1.6 AC80

### Course Description

This Lesson provides information on the AC80 and associated components.

### Objectives

- Understand the purpose and function of the AC80.
- Have knowledge of the circuit cards associated with the AC80 and where they are located.
- Have a thorough understanding of the LED's associated with the AC80 and how to derive error codes generated by those LED's in a fault condition.
- Have a basic understanding of the front panel controls and connectors of the AC8.
- Understand the purpose and function of the NPBA-80.
- Understand the function of the Status LED's associated with the NPBA-80.
- Have a basic understanding of the front panel controls and connectors of the NPBA-80.
- Understand the purpose and function of the Analog I/O Modules.
- Understand the function of the LED's associated with the Analog I/O Modules.
- Understand the purpose and function of the Digital I/O Modules.
- Understand the function of the LED's associated with the Digital I/O Modules

### Lesson Outline

- Topic 6.1.6.1 AC80 Advant Controller
- Topic 6.1.6.2 Troubleshooting
- Review Topics 6.1.6.1 and 6.1.6.2
- Topic 6.1.6.3 NPBA-80 PROFIBUS Adapter Module

## Lesson 6.1.6 AC80 (cont.)

### Lesson Outline (cont.)

- Topic 6.1.6.4 Analog I/O Modules
- Topic 6.1.6.5 Digital I/O Modules
- Review Topics 6.1.6.3, 6.1.6.4, and 6.1.6.5

**Topic 6.1.6.2 Troubleshooting**

**Error Codes (continued)**

To understand the error code displayed by the LED's, they must be read in hexadecimal. To read the hexadecimal display, the LED's are given the following values:

- LED's S0 and S4 have a value of 1
- LED's S1 and S5 have a value of 2
- LED's S2 and S6 have a value of 4
- LED S3 has a value of 8

Add the values of the LED's vertically to determine the error code.

- If no LED is illuminated, the value is 0.
- If the value of the illuminated LED's total 0-9, use that specific value.
- If the value of the illuminated LED's totals 10-15:

- 10 equals A
- 11 equals B
- 12 equals C
- 13 equals D
- 14 equals E
- 15 equals F

Click [here](#) to see some examples.

F	●	●	R
B	●	●	P
T1	●	●	T2
S7	●	●	S3
S6	●	●	S2
S5	●	●	S1
S4	●	●	S0

**Learn More**

## Lesson 6.2 Drive Control Module (Avtron)

### Course Description

In this Lesson you will learn about the Electrotorque Plus A Drive Control Module - Avtron.

### Objectives

- Upon completion of this lesson the student will be able to explain the Theory of Operation of the P&H Electrotorque Plus A Control System.
- Upon completion of this lesson the student will be able to identify and explain the Armature Feedback Circuits used on the P&H Electrotorque Plus A Control System.
- Upon completion of this lesson the student will be able to identify and explain the Field Feedback Circuits used on the P&H Electrotorque Plus A Control System.
- Upon completion of this lesson the student will be able to identify and explain the purpose of the Circuit Cards associated with the Electrotorque Plus A Advanced Firing Modules.
- Upon completion of this lesson the student will have a basic understanding of the Keypad / Display used to navigate the parameters associated with the Electrotorque Plus A Advanced Firing Modules.
- Upon completion of this lesson the student will have a basic understanding of the front panel Diagnostic LED's associated with the Electrotorque Plus A Advanced Firing Modules.
- Upon completion of this lesson the student will be able to identify the location of components in the Control Cabinet.

### Lesson Outline

- Topic 6.2.1 Introduction
- Topic 6.2.2 Theory of Operation
- Review Topics 6.2.1 and 6.2.2
- Topic 6.2.3 Armature Feedback Circuit
- Topic 6.2.4 Field Feedback Circuit

## Lesson 6.2 Drive Control Module (Avtron) (cont.)

### Lesson Outline (cont.)

- Review Topic 6.2.3 and 6.2.4
- Topic 6.2.5 Hardware Overview
- Review Topic 6.2.5
- Topic 6.2.6 Control Cabinet
- Review Topic 6.2.6

**Topic 6.2.2 Theory of Operation**

**Specified Electrical Data Sheets**

An example of a Specified Electrical Data Sheet, or SED, is shown below. Showel specific values for Stall Ia, Peak Power, Maximum Va, and Strong or Weak If are provided on the SED Sheet. The SED Sheet can be used to plot out the specific Motion Characteristic.

MODEL:		SPECIFIED ELECTRICAL DATA		ISSUED:	
SER. #	FILE	PK POWER	QBS	BY	CONFIRMED
HOIST	ARMATURE *****	V-A1 (HST)	850 VDC		
	VOLTAGE - VOLTS	V-A1 (LOW)	550 VDC		
(2)	CURRENT - AMPS	I-A2 (STALL)	2100		
K-925		I-A1 (PK. POW.)	1785		
Rated =		I-A3 (LOWER)	546		
1340 A.	FIELD *****				
G.R.#	CURRENT - AMPS	I-F1 (FULL)	137		
51.6667		MIN. I-F2 (WEAK)	55		
		F2/F1 RATIO	0.40		

Page 7 of 12

## Lesson 6.3 Drive Control Module (Analog)

### Course Description

In this Lesson you will learn the necessary knowledge and working skills to understand the theory of operation of the Electrotorque Control.

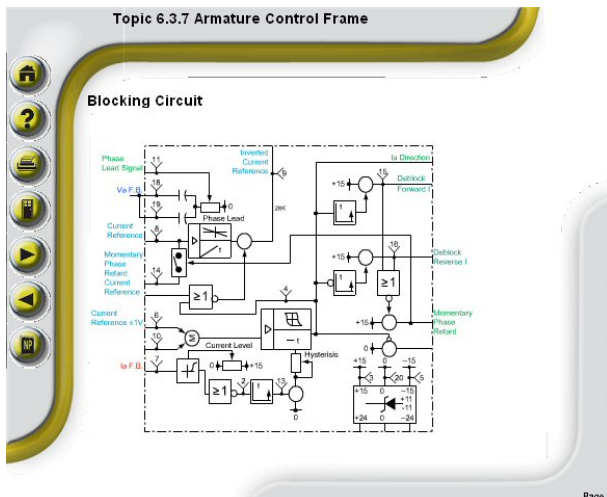
### Objectives

- Upon completion of this lesson the student will be able to identify and explain the different Logic Circuits used on the circuit cards of the Electrotorque Control Frame.
- Upon completion of this lesson the student will be able to identify and explain the different Flip Flop Circuits used on the circuit cards of the Electrotorque Control Frame.
- Upon completion of this lesson the student will be able to identify and explain the different Operational Amplifiers used on the circuit cards of the Electrotorque Control Frame.
- Upon completion of this lesson the student will be able to explain the Theory of Operation of the P&H Electrotorque Control System.
- Upon completion of this lesson the student will be able to identify and explain the Armature Feedback Circuits used on the P&H Electrotorque Control System.
- Upon completion of this lesson the student will be able to identify and explain the Armature Control Frame circuit cards used on the P&H Electrotorque Control System.
- Upon completion of this lesson the student will be able to identify and explain the Field Feedback Circuits used on the P&H Electrotorque Control System.
- Upon completion of this lesson the student will be able to identify and explain the Field Control Frame circuit cards used on the P&H Electrotorque Control System.
- Upon completion of this lesson the student will be able to identify and explain the RPC Control Frame circuit cards used on the P&H Electrotorque Control System.
- Upon completion of this lesson the student will be able to identify the location of the Control Frame circuit cards in the Control Cabinet.

## Lesson 6.3 Drive Control Module (Analog) (cont.)

### Lesson Outline (cont.)

- Topic 6.3.1 Theory Of Operations
- Topic 6.3.2 Logic Circuits
- Review Topics 6.3.1 and 6.3.2
- Topic 6.3.3 Flip Flop Circuits
- Review Topic 6.3.3
- Topic 6.3.4 Operational Amplifiers
- Review Topic 6.3.4
- Topic 6.3.5 Theory of Operation
- Review Topic 6.3.5
- Topic 6.3.6 Armature Feedback Circuits
- Topic 6.3.7 Armature Control Frame
- Review Topics 6.3.6 and 6.3.7
- Topic 6.3.8 Field Feedback Circuits
- Topic 6.3.9 Field Control Frame
- Review Topics 6.3.8 and 6.3.9
- Topic 6.3.10 RPC Control Frame
- Topic 6.3.11 Control Cabinet
- Review Topics 6.3.10 and 6.3.11



## Lesson 6.4 Drive Control Unit AC Shovel

### Course Description

This Lesson describes the purpose, component location, and operation, of the Drive Control Unit used on P&H AC Shovels. Also discussed is the operation of the Drive Control Unit Control Panel, CDP 312R.

### Objectives

- Be able to locate the Control Cabinet on a typical Shovel Deck Plan.
- Be able to locate the Drive Control Units within the Control Cabinet.
- Be able to identify the connectors associated with the Drive Control Unit.
- Have an understanding of the purpose, function, and operation of the Drive Control Unit.
- Have an understanding of the function of the Option Modules associated with the Drive Control Unit.
- Understand the buttons and controls associated with the CDP 312R, Drive Control Unit Control Panel.

### Lesson Outline

- Topic 6.4.1 System Overview
- Topic 6.4.2 Drive Control Unit Location
- Review Topics 6.4.1 and 6.4.2
- Topic 6.4.3 Drive Control Unit
- Review Topic 6.4.3
- Topic 6.4.4 CDP 312R
- Review Topic 6.4.4



## Lesson 8.2 Fiber Optic Connectors and Cables

### Course Description

The Drive Control Modules, AC800, and Remote I/O Systems on P&H Centurion Electric Mining Shovels contain high-speed communication links utilizing fiber-optic cabling.

Fiber Optic communication not only provides high-speed communication but also offers electrical noise immunity of the communication link. Although this proven technology is quite rugged, the possibility always exists for physical damage or replacement requirements.

### Objectives

- Understand general information regarding Plastic Fiber Optics with Simplex Connectors and the tools utilized in the P&H Centurion System.
- Describe how to set the cutting depth of the cable knife.
- Describe how to strip the outer jacket of the Plastic Fiber Optic Cable.
- Describe how to remove the buffer from the Plastic Fiber Optic Cable.
- Describe how to fit Simplex connectors to Fiber Optic Cable.
- Describe how to grind and polish Simplex Connectors.
- Describe how to assemble a Plug Adapter.

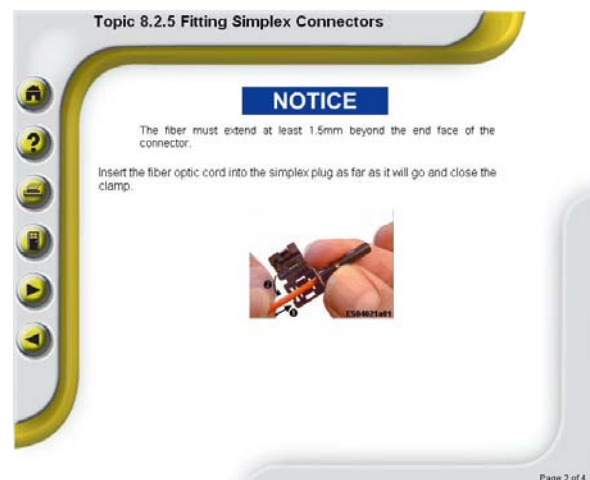
### Lesson Outline

- Required Tools
- Topic 8.2.1 General Information
- Review
- Topic 8.2.2 Cable Knife Cutting Depth
- Review
- Topic 8.2.3 Stripping the Outer Jacket
- Review

## Lesson 8.2 Fiber Optic Connectors and Cables (cont.)

### Lesson Outline (cont.)

- Topic 8.2.4 Removing the Buffer
- Review
- Topic 8.2.5 Fitting Simplex Connectors
- Review
- Topic 8.2.6 Grinding and Polishing
- Review
- Topic 8.2.7 Assembling the Plug Adapter
- Review



## Lesson 8.3 Copper Profibus Wire

### Course Description

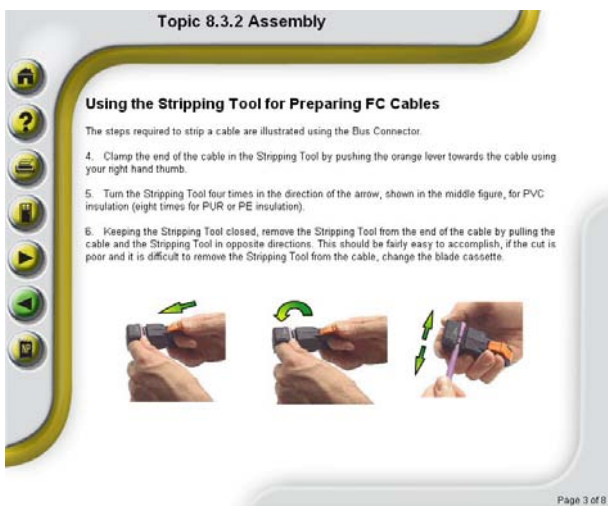
This Lesson provides the learner with instructions for fast and easy assembly of PROFIBUS copper cables.

### Objectives

- Upon completion of the Lesson, the learner will be able to identify the different components associated with the Bus Connector.
- Upon completion of this Lesson, the learner will have the knowledge to assemble PROFIBUS copper cables.

### Lesson Outline

- Introduction
- Topic 8.3.1 Bus Connector
- Topic 8.3.2 Assembly
- Review Lesson 8.3



## Lesson 8.5 Triprite

### Course Description

This tutorial provides the electrical maintenance technician or end-user of P&H Mining Equipment with the necessary knowledge and working skills to understand the TripRite System.

### Objectives

- Describe the basic Theory of Operation of the TripRite.
- Locate and identify the hardware components of the TripRite.
- Identify/explain the function of each hardware component of the TripRite.
- Identify/explain the function of software used on the TripRite.
- Locate and identify the hardware components of the Drive Monitor.
- Identify/explain the function of each hardware component of the Drive Monitor.
- Identify/explain the TripRite troubleshooting procedures and corrective actions.

### Lesson Outline

- Theory of Operation
- Hardware Overview
- Software Overview
- Drive Monitor
- Troubleshooting

## **Lesson 8.6 Milltronics**

### **Course Description**

This Lesson provides detailed information on the MultiRanger Lube Level Sensor used on P&H Electric Mining Shovels.

### **Objectives**

- Describe the purpose and function of the MultiRanger Lube Level Sensor.
- Describe the components associated with the MultiRanger and the MultiRanger Lube Level Sensor.
- Setup and use the different tools used to interface with the MultiRanger Lube Level Sensor.
- Navigate the Touch Panel to view the screens applicable to the Lube System.
- Have the knowledge required to perform basic maintenance and troubleshooting techniques on the MultiRanger Lube Level Sensor.

### **Lesson Outline**

- Introduction
- Topic 8.6.1 Components
- Review Topic 8.6.1
- Topic 8.6.2 Interfacing
- Review Topic 8.6.2
- Topic 8.6.3 Transducer
- Topic 8.6.4 Touch Panel Lube Screens
- Topic 8.6.5 Maintenance and Troubleshooting
- Review Topic 8.6.3, 8.6.4 and 8.6.5

## **Lesson 8.7 Power Quality Meter**

### **Course Description**

This information provides information on Payload. Payload is based on software models that are run on an industrial PC platform called PC/104, with an EBX style motherboard. Both of these (EBX & PC/104) are military duty components used in rough shock and vibration applications such as tanks and armored fighting vehicles. It is an embedded system, meaning that it relies on static hard drives rather than rotating media hard drives, like an office PC.

### **Objectives**

- Upon completion of this Lesson the student will be able to identify and explain the components associated with the Payload System.
- Upon completion of this Lesson the student will be able to explain the theory of operation of the Payload System.
- Upon completion of this Lesson the student will understand the steps required to install the Payload System onto P&H Electric Mining Shovels.
- Upon completion of this Lesson the student will be able to identify and explain the different fault display associated with the Payload System.
- Upon completion of this Lesson the student will understand basic troubleshooting techniques to use on the Payload System.

### **Lesson Outline**

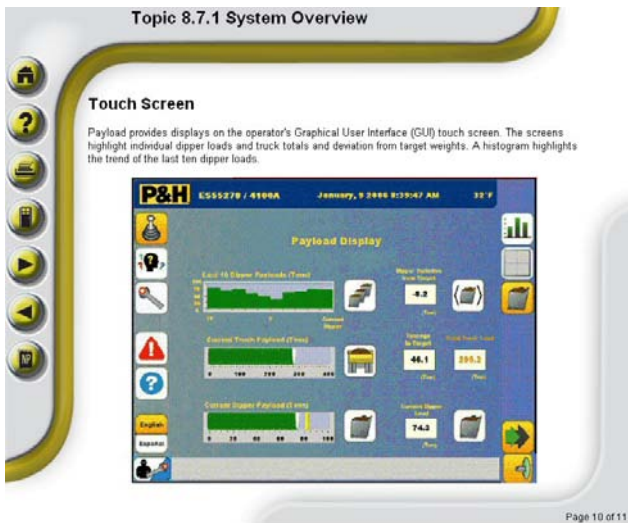
- Topic 8.7.1 System Overview
- Review Topic 8.7.1
- Topic 8.7.2 Theory of Operation
- Review Topic 8.7.2
- Topic 8.7.3 Installation
- Review Topic 8.7.3



## Lesson 8.7 Payload (cont.)

### Lesson Outline (cont.)

- Topic 8.7.4 GUI Fault Displays
- Review Topic 8.7.4
- Topic 8.7.5 Troubleshooting
- Review Topic 8.7.5



## Lesson 8.8 Power Quality Meter

### Course Description

This Lesson provides information on the specifications, controls and indicators, programming, and monitoring of recorded values for the Power Quality Meters provided on P&H Mining Equipment.

### Objectives

- Be introduced to the Power Quality Meter and understand basic features, how it's connected, what it can measure, it's alarms, how it communicates, and its base specifications.
- Have a thorough understanding of the front panel controls and indicators and use them to navigate to the Power Quality Meter Setpoints for programming and Actual Values for monitoring.
- Have a thorough understanding of the Power Quality Meter Programming Setpoint messages by using the front panel controls to navigate and learn about each message.

### Lesson Outline

- Topic 8.8.1 Introduction
- Topic 8.8.2 Specifications
- Review Topics 8.8.1 and 8.8.2
- Topic 8.8.3 Controls and Indicators
  - Review Topic 8.8.3 - PQM
  - Review Topic 8.8.3 – PQMII
- Topic 8.8.4 Programming
  - Review Topic 8.8.4 - PQM
  - Review Topic 8.8.4 – PQMII
- Topic 8.8.5 Monitoring
  - Review Topic 8.8.5 – PQM
  - Review Topic 8.8.5 – PQM

## Lesson 9.5 TNAC

### Course Description

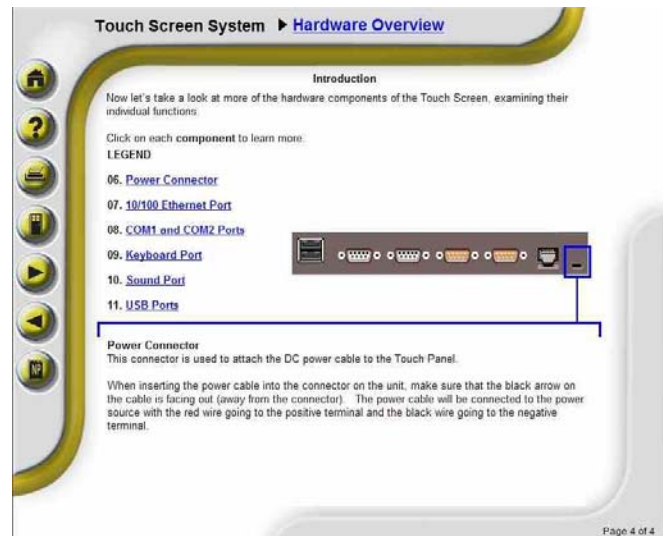
This tutorial provides the electrical maintenance technician or end-user of P&H Mining Equipment with the necessary knowledge and working skills to understand the Touch Screen System.

### Objectives

- Identify/explain the purpose of the Touch Screen System.
- Locate and identify the hardware components of the Touch Screen System.
- Identify/explain the function of each hardware component of the Touch Screen System.
- Identify/explain the functions available in the Touch Screen System.
- Identify/explain the Touch Screen troubleshooting procedures and corrective actions.

### Lesson Outline

- Theory of Operation
- Hardware Overview
- Procedures Overview
- Operation Screen Procedures
- Diagnostic Screen Procedures
- Setup Screen Procedures
- Activity Screen Procedures
- Help Screen Procedures
- Troubleshooting



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- eLearning is the primary delivery method for knowledge based training.
- The eLearning provided by Peak Services is Competency Based.
- eLearning content is available to the learner 24 hours a day, 7 days a week, 365 days per year.
- All lessons will be provided via the Internet from the P&H Learning Center.
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- Peak Services highly recommends pre and post-assessments.

### Pre-Assessments:

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### Post-Assessments:

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