Troubleshooting and Repair of Control Panels

Course 308

PARTICIPANT GUIDE

SIGNALS TRAINING CONSORTIUM

Troubleshooting and Repair
of Control Panels

Participant Guide

Signals Maintenance Training Consortium

COURSE 308

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How to Use the Participant Guide

Purpose of the Course

The purpose of the *Troubleshooting and Repair of Control Panels* course is to assist the participant in gaining knowledge in troubleshooting and repairing control panels and their use in testing and troubleshooting interlockings.

Approach of the Book

Each course module begins with an outline, a statement of purpose and objectives, and a list of key terms. The *outline* will discuss the main topics to be addressed in the module. *Learning objectives* define the basic skills, knowledge, and abilities course participants should be able to demonstrate to show that they have learned the material presented in the module. A list of *key terms* identifies important terminology that will be introduced in each course module. *Review exercises* conclude each module to assist the participants in reviewing key information.

Module 1

PRINCIPLES OF TROUBLESHOOTING

Outline

Purpose and Objectives

The purpose of this module is to provide an overview to troubleshooting signal systems equipment and machinery within the context of general troubleshooting and best practices.

Following the completion of this module, the participant should be able to complete the exercises with an accuracy of 70% or greater:

- Examine the importance of troubleshooting
- Restate the troubleshooting process
- Identify troubleshooting steps
- Identify troubleshooting best practices
- Apply troubleshooting principles to some common signal systems problems and causes

Key Terms

- Four Ds: Define Decide, Do, Document
- Symptom Index Table
- Root Cause Analysis (RCA)
- Troubleshooting Matrix

1-1 OVERVIEW

Troubleshooting is an integral part of signal systems maintenance. The signal maintainer is guided through a process of troubleshooting in order to get to the heart of the reported signals problem so that solutions can be applied quickly and equipment can be safely returned to service in the most efficient way possible.

As part of the Signals Training Consortium series of courses, this course guides the participant through the troubleshooting process by identifying some general strategies, tips, pitfalls, and application procedures. In later courses the participant will apply this general approach while troubleshooting specific areas of the signals system such as track circuits, switches, interlockings, grade crossings, and power distribution by examining common failures and discussion examples.

1-2 THE PROCESS OF TROUBLESHOOTING

Troubleshooting may be defined as a systematic approach to finding the source of a problem in an effort to restore an operation. Troubleshooting is problem-solving in a methodical and organized manner. Sometimes troubleshooting a problem is simple. At other times it may be complex and problems may be difficult to diagnose. Whatever the level of complexity of a signals system, the approach to troubleshooting should be orderly and logical.

The focus of troubleshooting is to find the **root cause** of a problem: that which is initiating a problem. In order to get at the root cause, the troubleshooter would apply **Root Cause Analysis** (**RCA**) which is the collective term that describes the processes or procedures that help guide signal maintainers not only to discover and understand the initiating causes of a problem, but to determine what is needed to prevent recurrence.

In general, there is a series of steps in troubleshooting. There are many descriptions of these steps in the signals industry, but a simple approach involves four steps which we can refer to as the **Four Ds**. They are:

1. **Define**

2. **Decide**

3. **Do**

4. **Document**

1-3 FOUR STEPS IN TROUBLESHOOTING

Figure 1.1 illustrates the four-step method for troubleshooting. Some rail transit authorities may have additional or different steps in approaching troubleshooting but, in general, all the principles are captured in these four steps which can be followed when beginning to troubleshoot a problem within transit signal systems. This list is a basic approach or model that the participant can follow.
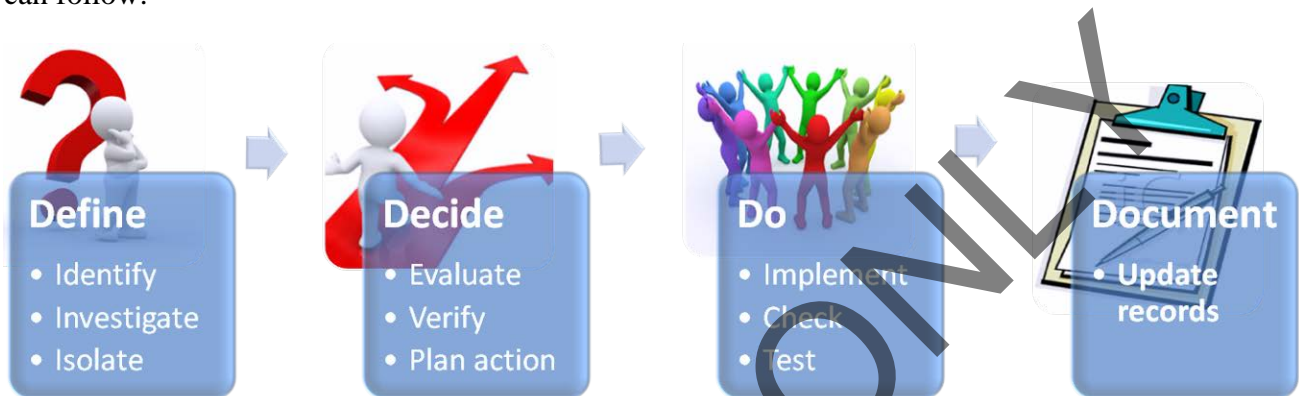

Figure 1.1 The Four Ds: Steps in Troubleshooting Signals Systems

Step 1 - Define

Identify Symptoms, Investigate Situation, Isolate Problem

In order to define the problem, the Signal Maintainer needs to identify the symptoms of the trouble call by collecting as much information as possible on the reported problem. Some questions the Signal Maintainer may ask are:

- Who may have relevant knowledge about the problem?

- What other local equipment is having trouble? Look at broader, larger picture.

- Investigate initial complaints or situation, employ sensory inspection – check the problem out for yourself. Is there an environmental condition that is affecting the equipment performance? Have temperatures dropped too low? Is something overheated? Do you notice any unusual smells or sounds? Do any parts of the system seem unusual to the touch?

- Use your eyes, ears, and nose when possible to get a feel for the problem.

- Check log book for problems with the specific equipment – has the equipment displayed the same symptoms previously? Perhaps the symptoms have been treated but the root cause not identified.

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Module 2

OVERVIEW TO TROUBLESHOOTING AND REPAIR OF CONTROL PANELS

Outline

2-1   Overview

2-2   Typical Problems

2-3   Flow Charts and Schematics Used for Troubleshooting

2-4   Symptoms and Corrective Action

2-5   Scenario-Based Sample Problems

2-6   Summary

Purpose and Objectives

The purpose of this module is to provide the participant with general processes and examples for troubleshooting and repairing typical control panel problems.

Following the completion of this module, the participant should be able to complete the exercises with an accuracy of 70% or greater:

- Replace and/or program a control panel
- Troubleshoot and diagnosis control panel to the component level
- Replace local control panel components
- Read schematics associated with local control panels
- Replace base lamps, push buttons, and control panel tiles
- Reboot HMI display panel
- Check connection and integrity of interfacing cables

Key Words

- Corrective action
- Panel tiles

2-1 OVERVIEW

Module 1 of this course provided the foundation of the overall process of troubleshooting control panels, providing general troubleshooting processes and principles. This module will focus on common failures of control panels, their possible causes and recommended **corrective action**. Also, a review of how to use flow charts and read schematics when troubleshooting typical control panel problems will be provided. A symptom index table (also known as a troubleshooting matrix) which includes symptoms and corrective actions will be provided as well. This module will conclude by giving participants the opportunity to discuss how to troubleshoot and resolve various control panel problems based on real-life scenarios.

As in previous signal courses, this module will use FRA recommendations as guidelines of the minimum standards to follow. However, many agencies have their own policies and procedures regarding control panels troubleshooting, as such signal maintainers must follow their authority's recommendations and policies.

⚠	Agency-Specific Guidelines!
	Regulations and procedures differ between rail authorities. Always refer to your authority for specific guidelines and regulations.

2-2 TYPICAL CONTROL PANEL PROBLEMS

As mentioned the inspection and maintenance control panel course, failures or problems associated with control panels and their components do not occur often. The most common control panel failure is a malfunctioning lamp (Figure 2.1) which usually requires the signal maintainer to simply extract the defective bulb and replace it.

Figure 2.1 Control Panel Lamps

In other systems, the minor failure may simply require a reboot to restore a VMIS screen (Figure 2.2) or the HMI display.
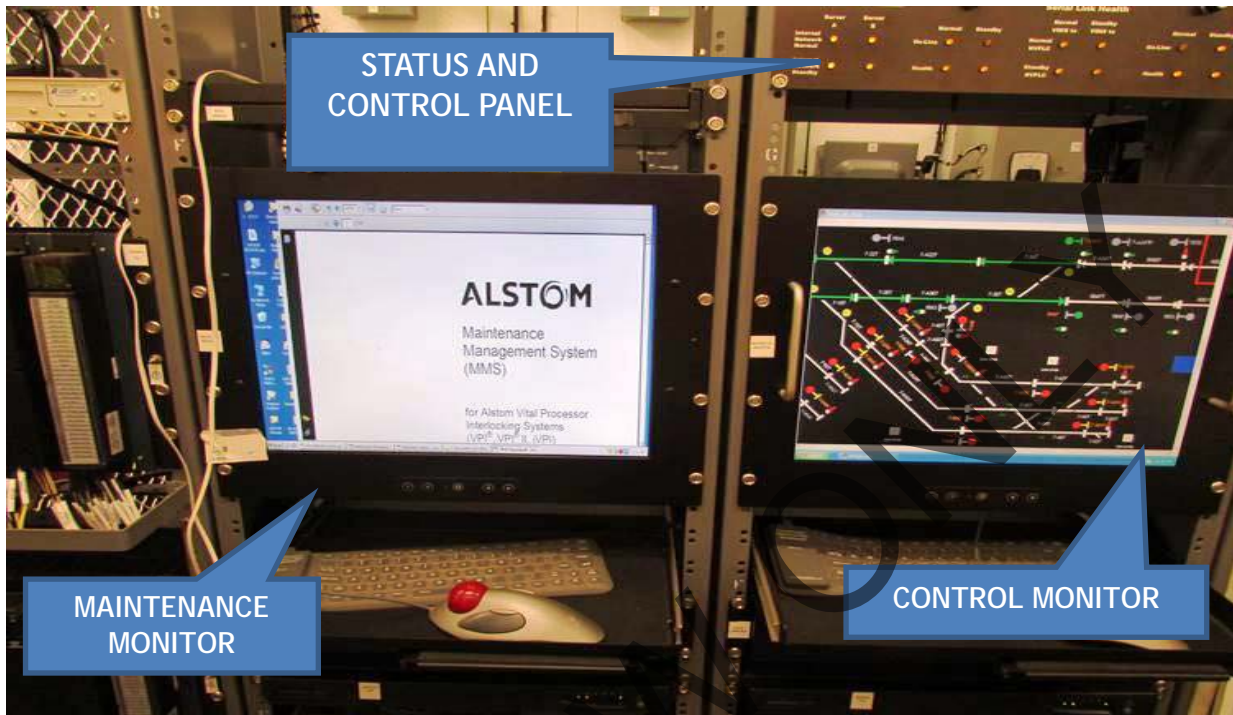

Figure 2.2 Vital Processor Interlockings (VPI) System

Another basic repair that a signal maintainer can expect to perform is replacing missing **panel** tiles (Figure 2.3) on the control panel.

Figure 2.3 Missing Control Panel Tile

2-3 FLOW CHARTS AND SCHEMATICS USED IN TROUBLESHOOTING

An important tool in troubleshooting control panels is the use of flow charts. Various types of diagrams, schematics or flow charts are sometimes included in the service manual to aid signal maintainers in determining the cause of a malfunction so that repairs can be made as quickly as possible. CAUTION: The following are examples only. DO NOT use for actual troubleshooting control panels at your rail authority. As always, follow your authority-specific procedures when troubleshooting.
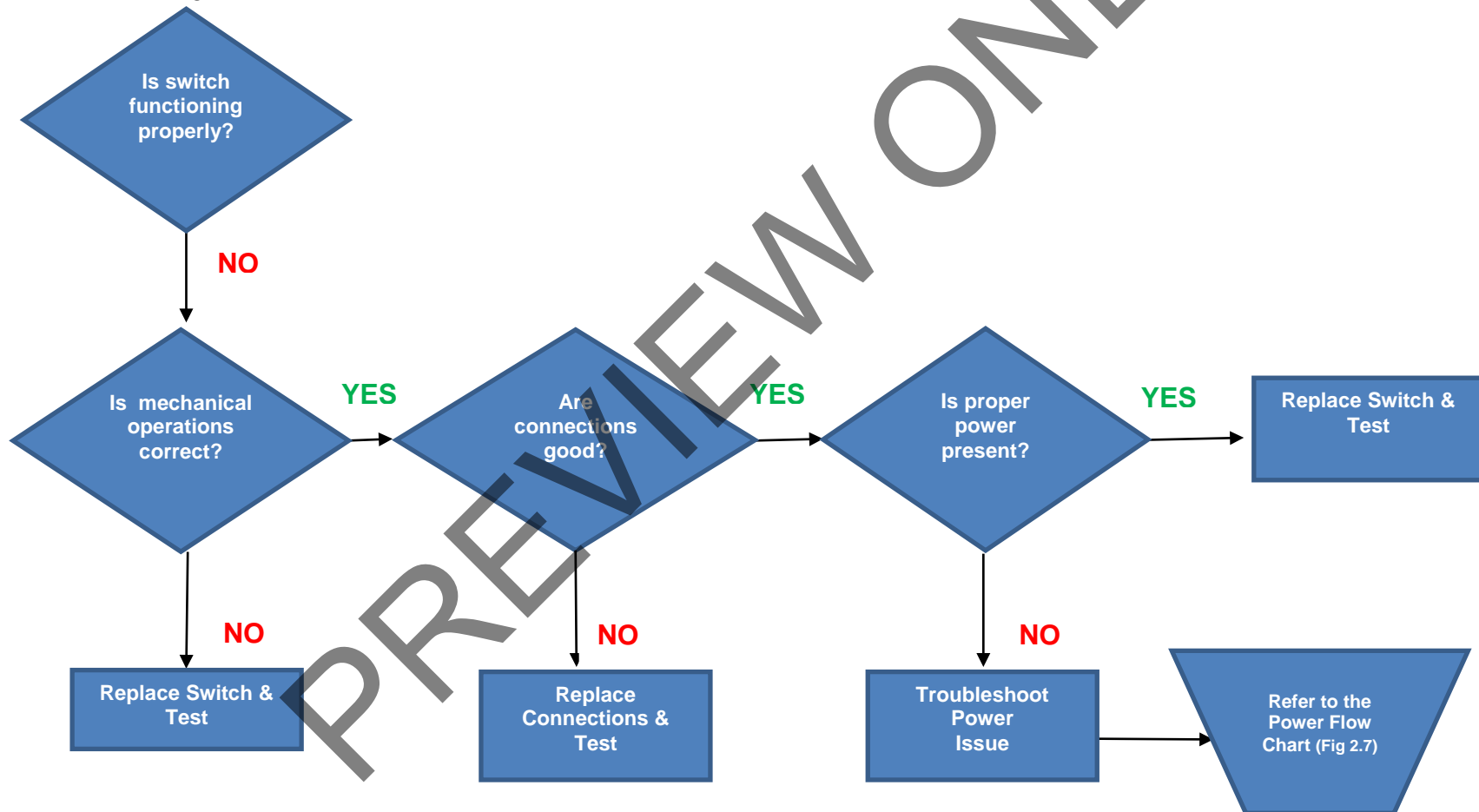
Malfunctioning Control Panel Switch

Figure 2.4 Malfunctioning Control Panel Switch Troubleshooting Flow Chart