PROGRAM INTRODUCTION

Program Description

Switching is the act of transferring, isolating, paralleling, or interrupting current and voltage by the use of mechanical or electrical devices, including the following:

- gang-operated air-break switches
- single-blade disconnects
- fused cutouts
- sectionalizers
- substation oil circuit-breakers
- oil circuit-reclosers
- disconnect switches in live-front transformers
- loadbreak elbows in dead-front transformers
- loadbreak elbows in junction boxes
- Mark II switchgear

This program addresses the full range of safety policies, safety practices, technical information, theory, and operating procedures that can be involved in the wide range of switching situations encountered by journeymen lineworkers in the field.

Program Outline

This Program is composed of a total of twelve stand-alone Modules, as follows:

1. Apply Communication Practices
2. Interpret Local Operating Orders
3. Install Overhead Equipotential Grounding
4. Install Underground Equipotential Grounding

5. Install or Replace Overhead Fuses
6. Apply Safety Protection Guarantees
7. Perform URD Switching
8. Perform Overhead Switching
9. Perform Station Switching
10. Perform Circuit Parallels
11. Perform Dual Radial Switching
12. Perform Network System Switching

Program Goals and Objectives

Goal: The goal of the Field Switching Course is to enable lineworker journeymen and apprentices to perform switching operations in a safe and efficient manner.

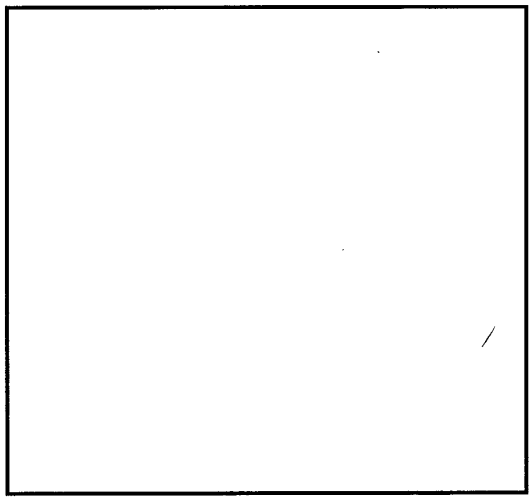
Objective: Upon successful completion of this course, you will be able to perform switching operations in the field according to B.C. Hydro Safety Practice Regulations and Workers' Compensation regulations.

Resources

There are two main types of resources for the *Field Switching Program*—print materials and videotapes. These resources should be used in conjuction with the modules. All of the materials listed on the following pages are available through Trades Training and Development.

Print Materials

- *Safety Practice Regulations* (*SPR*) Sections 300, 400, and 500
- *Power System Safety Protection* (PSSP) *System Operating Orders*
- Your PSSP Local Component information and Local Operating Orders



Section 3-1

EQUIPOTENTIAL GROUNDING PRINCIPLES

EQUIPOTENTIAL GROUNDING PRINCIPLES

Introduction

Portable grounds installed to de-energize an isolated circuit do not give complete protection against electrocution. Fault current will flow to ground mostly through the ground leads, but some current will still flow through you, possibly enough to be fatal. Therefore the equipotential method of safety grounding must be used to ensure that no current can flow through your immediate work area.

Upon successful completion of this Section, you will be able to explain the purpose and importance of equipotential grounding, describe the requirements for setting up an equipotential zone, and identify the equipotential zone on a grounding simulator board.

Sources of Hazardous Energy

Energized lines can fall directly onto the isolated circuit. This kind of accident is relatively rare compared to induction.

Induction from adjacent live lines can be present throughout a work procedure. The magnetic field generated by the current in another line can induce current in the isolated line you are working on, especially if the other live line becomes involved in a ground fault. You should anticipate induced current whenever you are working in the vicinity of 500 KV lines or if the line you are to work on runs parallel to a lower voltage line (e.g. 287 KV) for several kilometers. Known hazardous induction situations are marked on Control Center mimic boards and in power district linerooms.

Static electricity (caused by wind, dust storms, or capacitance), and lightning (either directly or by induction) can also energize the line you are working on.

The Principles of Safety Grounding and Bonding

1. Installing portable ground leads onto the overhead lines provides a low resistance path for fault or induction currents, which in turn will trip the protection relays.

2. The low resistance path of these ground leads minimizes the proportion of the current that will flow through you, since your resistance is much higher. With

only this grounding, however, some current would still flow through you, since you would still be across a potential difference and in parallel with the other current carriers.

3. Bonding together everything in your immediate work area to a conductor on the pole just below your feet (the pole band) keeps you inside a zone of equal potential. Since there can then be no difference in voltage between the overhead power lines and your feet, no current will flow if a fault energizes the line -- and you along with it -- to a high voltage. Safety is assured within the equipotential zone.

4. Finally, tying all three phases together causes any balanced system to have zero voltage to ground if energized. In addition, relays operate more quickly on phase-to-phase faults. This bonding does not protect against an unbalanced system, a single phase being energized, or induced currents.

General Practices for Equipotential Grounding

The ground rod is placed 5 to 10 meters away from the base of the pole so that when on the ground you can work in the clear of any touch or step potentials. Such voltage gradients can exist because any voltage that builds up at the ground rod drops off rapidly away from the rod.

The ground lead is jumpered to a pole band just below where you stand on the pole. The pole band is jumpered to the neutral line and to the center overhead phase of a three phase pole. The center phase is itself jumpered to the other two phases. The power lines, neutral, and pole band are then said to be bonded. Bonding should be performed on any existing or impending opening of any high voltage conductor. The conductors are all grounded by way of the pole band.

The *SPR* sections 501.7, 510, and 511 state the general rules for safety grounding, including equipotential grounding.

Portable Grounding Mats

If you are about to operate a pole switch handle at ground level but you suspect the reliability of an installed, below-ground grounding grid or counterpoise, use a portable ground mat. The preferred work practice is to use a portable ground mat in all cases of operating pole switch handles at ground level. For switch handles that require climbing the pole, a ground mat is not needed.

By standing on the ground mat and connecting the ground mat by a jumper to the pole switch handle, you create an equipotential zone from the ground to the handle, exactly as described above for working on overhead line switches.

Ground mats must also be used in all bad step potential areas. The area must be covered with a ground mat and tied into the field ground system, providing a platform from which to work at ground level.