Pit Distribution Troubleshooting Exercise

Problem Booklet

Instructions

Read the problem situation described on the next page. Then study Figure 1. Next answer each of the 5 questions. Do them one at a time. Don't jump ahead but you may look back to earlier questions and your answers.

After you have selected a choice to a question look up the number for that choice on the answer sheet. Select your answer to the questions by rubbing the developing pen between the brackets on the answer sheet. A hidden message will appear and tell you if you are right or wrong and why. The best score is obtained by selecting the one correct answer for each question. However, if you select a wrong answer, try again. This will help you learn the correct answer to each question. When you finish you will learn how to score your performance.

Background

The mine is a surface mine located in hilly country with two operating pits. Utility power is brought to the mine at 138 KV and reduced to 25 KV for primary pit distribution. Further reductions are made to 4,160 volts to power smaller equipment such as drills.

You are an electrician assigned to the south pit area. You have 12 years total electrical experience with 8 of those years at this mine.

The weather has been bad for the past three months with quite a bit of rain. Winter is approaching and temperatures have been cold enough recently to produce frost in the mornings.

You completed electrical retraining in June and this year had an excellent class in troubleshooting.

Problem

In your pit 25 KV power feeds a large dragline. A substation located on the south end of the pit drops the line voltage to 4,160 to power a drill. Power leaves the portable substation and goes through two boxes before reaching the drill. We'll call these boxes "A" and "B". The system has a good past history with few problems. All boxes in this pit were recently tested and calibrated to give a good coordinated distribution system.

Two weeks ago a ground fault occurred in the system and tripped box "A". The flag was reset and the system held. Then the ground monitor tripped box "B". After the monitor was reset the system held for a few days. During the past week box "A" has tripped at least two more times, also because of a ground fault. Study Figure 1 on page 4, then answer the first question.

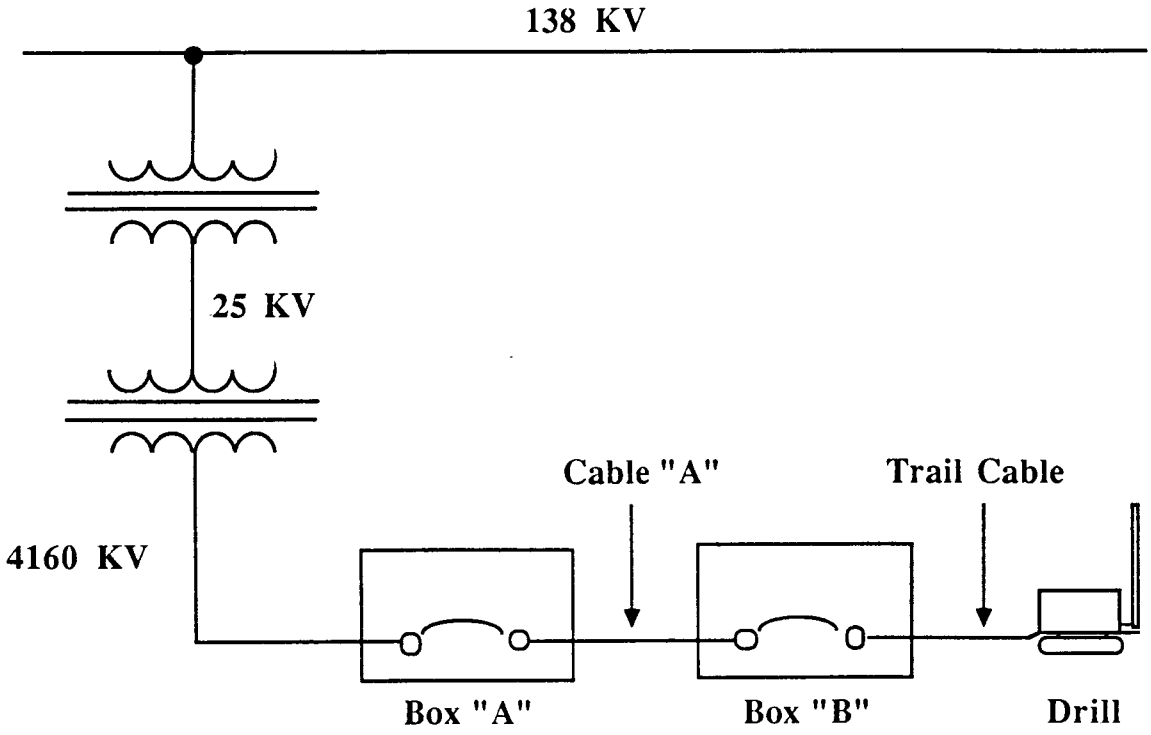

Figure 1: Schematic showing power distribution to the drill

Question A

A possible cause of these trips could be: (Choose only ONE unless you are told to "Try Again!")

1. Fault in the distribution system.
2. Poor ground connection at the 4160 volt substation.
3. Open grounding resistor at the 4160 volt substation.
4. Ground fault in the drill.

Question B

This week the ground fault tripping in box A has become so frequent that some action is needed to correct the problem. At 10:30, box "A" trips out again and you are assigned the task of fixing the problem. A possible action you might take is: (Choose only ONE unless you are told to "Try Again!")

5. Ask the machine operator if he was doing anything unusual when the power tripped off.

6. Assume that the problem is in the trailing cable feeding the drill, as it usually is, change it out, and hope for the best.

7. Walk out the cables from box "A" to the drill and look for damage.

8. Break for lunch, and hope something else comes up so second shift will have to worry about it.

Question C

You have walked out the cables and found no serious damage. There was one place in the trailing cable feeding the drill where the cable jacket had been cut by a rock, but it didn't look serious enough to cause this problem. You taped the cut and went on.

You decide that testing the system is the best approach and get your ohm meter from the truck. Next you lock-out and tag the oil circuit breaker (OCB), disconnect the cable feeding out of box "A", discharge any voltages from the cable and then check each phase-to-ground. All phases seem to be okay.

You remember seeing a megger in the truck and decide to give it one more test in hopes of finding the problem.

The megger is set to the highest voltage scale, 1000 volts, and each phase is tested. This time you find leakage to ground on all three phases, with resistance readings much lower than they should be.

Your next action might be: (Choose only ONE unless you are told to "Try Again!")

9. Go ahead and replace the drill cable, since it had a cut in it and is probably the problem.

10. Turn the power back on and kick the trailing cable at the location where the cut was located.

11. Try to isolate more parts of the system and find the problem, even though this will take more time.

12. Go back to the cut in the trailing cable, open the cable at that point, and look for trouble.

Question D

From past experience you feel that the cut in the trailing cable is the source of the problem. Isolating various parts of the system and testing them is the logical next step. You unplug the trailing cable at both ends and again use the megger. Much to your surprise, all three phases read okay to ground. The system is now broken into three parts; the trailing cable that you just tested, the drill itself, and cable "A" and box "B" connected together. You decide to start over at the beginning of cable "A" since box "A" had tripped most of the time. This time the megger reads lower on two phases to ground than it does on the third phase.

Your next step is to: (Choose only ONE unless you are told to "Try Again!")

13. Change-out cable "A".

14. Unplug cable "A" and check both cable ends for dirt, moisture, or damage.

15. Carefully walk-out cable "A", again looking for damage.

16. Unplug cable "A" and again use the megger to check it.

Question E

You have unplugged both ends of the cable and checked for dirt and moisture. Everything looks good so you connect the megger to the cable and find all three phases check okay. This is a surprise, but one final check will tell the story. You go to box "B" and use the megger on the input connector. Here you again find two phases that read lower than the third.

Some possible causes of this are: (Choose only ONE unless you are told to "Try Again!")

17. A current transformer (CT) has shorted it's secondary winding to ground, thus reflecting this low resistance to the phase wires.

18. One fuse has probably blown on the potential transformer (PT) primary, thus giving a higher reading on one phase.

19. The OCB has one phase open thus giving a higher reading on that phase.

20. The control power transformer (CPT) may be defective causing a high amount of leakage from its input terminals to ground.

Scoring your performance

1. Count the total number of responses you colored in that were marked "correct". Write this number in the first blank on the answer sheet.

2. Count the total number of incorrect responses you colored in. Subtract this number from 15. Write the difference in the second blank on the answer sheet.

3. Add the numbers on the first and second blanks. This is your score.

The highest possible score is 20.