American International University- Bangladesh
Department of Electrical and Electronic Engineering
EEE 4227: Power System Protection Laboratory

<u>Title:</u> Study of performance of a simple over current relay

<u>Introduction:</u>

Protection against excess current was naturally the earliest protection system to evolve. From this basic principle, the graded overcurrent system, a discriminative fault protection, has been developed. This should not be confused with ‘overload’ protection, which normally makes use of relays that operate in a time related in some degree to the thermal capability of the plant to be protected. Overcurrent protection, on the other hand, is directed entirely to the clearance of faults, although with the settings usually adopted some measure of overload protection may be obtained.

Figure 4.1

<u>Theory and Methodology:</u>

Protective relay senses the abnormal conditions in any part of a power system and gives an alarm or isolates the faulty part from the healthy system. The relays are compact, self contained devices which respond to abnormal conditions.

The relays distinguish between normal and abnormal condition. Whenever an abnormal condition develops, the relays close its contacts. Thereby the trip circuit of the CB is closed. Then the contacts of the CB is opened and the faulty part is disconnected from the supply.

The functions of a protective relaying include the following:

1) To sound an alarm or close the trip circuit of the CB so as to disconnect a component during an abnormal condition in the component. The abnormal condition include-overload, under voltage, temperature rise, balanced load, reverse power under frequency, short circuit etc.
2) To disconnect the abnormal operating part so as to prevent the subsequent fault.
3) To disconnect the faulty part quickly so as to minimize the damage to the faulty part
4) To localize the effect of fault by disconnecting the faulty part from the healthy part, causing least disturbances to the healthy system
5) To disconnect the faulty part quickly so as to improve the system stability, service continuity and system performance

Over Current Relay Ratings

In order for an over current protective device to operate properly, over current protective device ratings must be properly selected. These ratings include voltage, ampere and interrupting rating. If the interrupting rating is not properly selected, a serious hazard for equipment and personnel will exist. Current limiting can be considered as another over current protective device rating, although not all over current protective devices are required to have these characteristic:

Voltage Rating: The voltage rating of the over current protective device must be at least equal to or greater than the circuit voltage. The over current protective device rating can be higher than the system voltage but never lower.

Ampere Rating: The ampere rating of an over current protecting device normally should not exceed the current carrying capacity of the conductors As a general rule, the ampere rating of an over current protecting device is selected at 130% of the continuous load current.

Pre-Lab Homework:

Co-Ordination Procedure:

Correct overcurrent relay application requires knowledge of the fault current that can flow in each part of the network. Since large-scale tests are normally impracticable, system analysis must be used.

The data required for a relay setting study are:

1) One line diagram of the power system involved showing the type and rating of the protective devices and their associated CTs.
2) Impedances in p.u of all power transformers, rotating machines and feeder circuits.
3) Maximum and minimum values of short circuit currents that are expected to flow through each protective device.
4) Starting current requirements of motors and the starting and stalling times of induction motors.
5) Maximum peak load current through protective devices.
6) Decrement curves showing the rate of decay of the fault current supplied by the generators.
7) Performance curve of CTs.

Apparatus:

1) Electromagnetic relay
2) Two bulbs
3) DC source
4) Clamp Meter

Precautions:

1) Do not touch the bare conductors or connecting junctions.
2) Do not connect/disconnect anything to/from the circuit without turning off main power.

3) Be careful of handling small equipment /instruments inside the relay device.
4) Be careful when power is supplied to the apparatus and any casing is kept open.

Experimental Procedure:

Step1: Connect a variable 12V dc source to the coil between the terminals 13 and 14 of the relay.

Step2: Connect a 230 V 1φ ac source to the terminals 9,1 and 5 of the relay across two 40 watt incandescent bulb as shown in the figure.

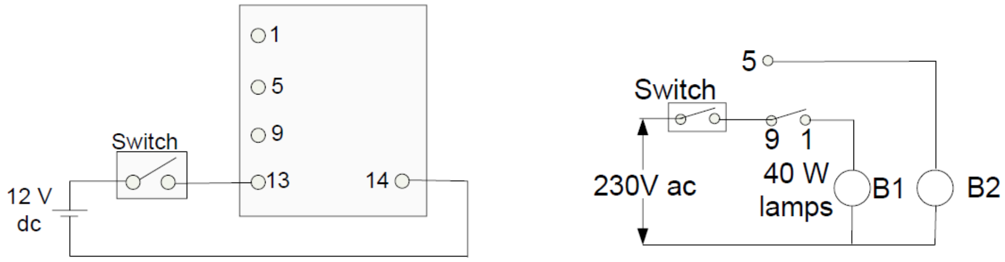

Figure 4.2

Step3: Keeping the variable dc source to zero volt, switch on the source across the relay coil. Then switch the 230V ac supply on to the bulbs. As the contacts 9 and 1 is normally closed, the bulb (B1) across it will glow but not the bulb (B2)
Now, the variable dc source is increased, when the current flow through the relay coil exceeds a certain value the relay activates, then the normally closed contact is opened and consequently the bulb (B1) will be off; and the normally open contact will be closed and consequently the bulb (B2) will glow.

Measurement:

1) Determine the relay current for which relay operate.
2) Suggest a protection scheme for a 10HP motor.
3) Give examples where O/C relays are used.

Discussion and Conclusion:

Interpret the data/findings and determine the extent to which the experiment was successful in complying with the goal that was initially set. Discuss any mistake you might have made while conducting the investigation and describe ways the study could have been improved.

Reference(s):

1) "Electric Power Systems: A Conceptual Introduction" by Alexandra Von Meier
2) "Switchgear Protection and Power Systems" by Sunil S Rao.