Department of Electrical and Electronic Engineering (EEE)
Faculty of Engineering (FE)
American International University- Bangladesh (AIUB)

Laboratory Report

Power System Protection Laboratory

Semester: Summer 2020-21

Experiment No. : 04

Experiment Title : Study of performance of a simple over current relay

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Marking Rubrics for Laboratory Report (to be filled by Faculty)

Objectives	Unsatisfactory (1)	Good (2-3)	Excellent (4-5)	Marks
Theory	The relevant theories are not being described properly.	Part of the relevant theories are described with proper mathematical expression and circuit diagrams (if any)	All the relevant theories are included with proper descriptions, mathematical expressions and circuit diagrams. (if any)	
Simulation circuits & Results	Simulation circuits are not included in this report.	Partial simulation circuit results are included in this report.	All the simulation circuits are included in this report with appropriate results.	
Discussion, Comparison between theoretical and simulation results	Cannot reach meaningful conclusions from experimental data; Cannot summarize or compare findings to expected results	Can extract most of the accurate data. Answers to the report questions are partially correct; Summarize finding in an incomplete way	Can extract all relevant conclusion with appropriate answer to the report questions; Summarize finding in a complete & specific way	
Organization of the report	Report is not prepared as per the instruction.	Report is organized despite of few missing sections as per the recommended structure.	Report is very well organized.	
Comments	Assessed by (Name, Sign, and Date)		Total (out of 20):	

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Title: Study of performance of a simple over current relay

Objective of this experiment:

A protective relay is a relay device designed to trip a circuit breaker when a fault is detected. The first protective relays were electromagnetic devices, relying on coils operating on moving parts to provide detection of abnormal operating conditions such as over-current, overvoltage, reverse power flow, over-frequency, and under-frequency.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. The main objective of this experiment is to familiar with the electromagnetic relay and the performane of it.

Figure 4.1

Theory and Methodology:

Electromechanical protective relays operate by either magnetic attraction, or magnetic induction. Unlike switching type electromechanical relays with fixed and usually ill-defined operating voltage thresholds and operating times, protective relays have well-established, selectable, and adjustable time and current (or other operating parameter) operating characteristics. Protection relays may use arrays of induction disks, shaded-pole,magnets, operating and restraint coils, solenoid-type operators, telephone-relay contacts,clarification needed and phase-shifting networks.

Protective relays can also be classified by the type of measurement they make. A protective relay may respond to the magnitude of a quantity such as voltage or current. Induction relays can respond to the product of two quantities in two field coils, which could for example represent the power in a circuit.It is not practical to make a relay that develops a torque equal to the quotient of two a.c. quantities. This, however is not important; the only significant condition for a relay is its setting and the setting can be made to correspond to a ratio regardless of the component values over a wide range.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

Fig:4.2

Purpose of overcurrent Protection

These are the most important purposes of overcurrent relay:

- Detect abnormal conditions
- Isolate faulty part of the system
- Speed Fast operation to minimize damage and danger
- Discrimination Isolate only the faulty section
- Dependability / reliability
- Security / stability
- Cost of protection / against cost of potential hazard

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.

Overcurrent protection protects against excessive currents or currents beyond the acceptable current ratings, which are resulting from short circuits, ground faults and overload conditions. While, the overload protection protects against the situation where overload current causes overheating of the protected equipment.The overcurrent protection is a bigger concept So that the overload protection can be considered as a subset of overcurrent protection.

Apparatus:

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

Experimental Procedure:

Step1: First we saw the connection and connected a variable 12V dc source to the coil between the terminals 13 and 14 of the relay.

Step2: Then we connected 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.

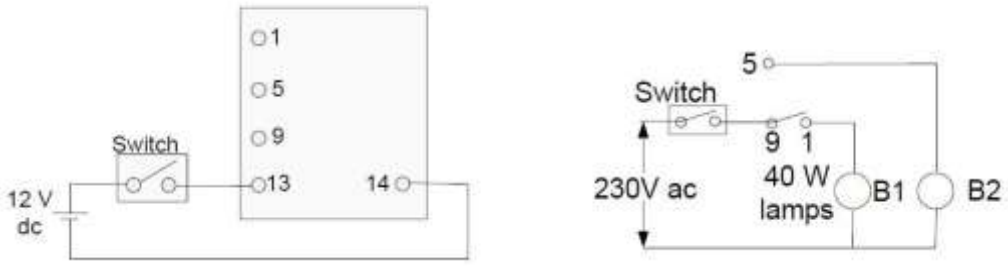

Figure 4.2

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

Measurement:

1) Suggest a protection scheme for a 10HP motor.

Ans. Some suggested schemes for a 10HP motor given below:

1)Instantaneous overcurrent protection.
2.Ground fault protection.
3.Thermal overload protection.
4.Stalling Protection.
5.Phase unbalance protection.

2) Give examples where O/C relays are used.

Ans. Some examples over current relay is used as:

1) Back up protection of distance relay of transmission line with time delay.
2) Back up protection to differential relay of power transformer with time delay.
3) Main protection to outgoing feeders and bus couplers with adjustable time delay setting.

Discussion and Conclusion:

In this experiment, we familiar with the overcurrent relay. We saw an electromagnetic overcurrent relay that had 8 pins and we used 5pins of that to complete the circuit. As we conducted our lab online due to the Covid-19 situation so there was no hardware implementation in the lab. The lab was theory-based and our instructor recorded the implementation of this experiment and showed us how the overcurrent relay actually worked. In the record, we saw that when the voltage exceeds 7 volts the bulb-1 was OFF and the bulb2 was ON. And the process was repeated when the voltage exceeds 7 volts. Our course instructor also discussed different types of relays in an organized way. He also gave us some real-life examples in which purposes the relays are uses. And in the end, we can say that the main purpose of this experiment was successfully achieved.

Reference(s):

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[2]"Switchgear Protection and Power Systems" by Sunil S Rao.

[3]" https://en.wikipedia.org/wiki/Relay ".

[4]"https://electrical-engineering-portal.com/types-and-applications-of-overcurrentrelay-1#:~:text=Overcurrent%20Relay%20Ratings,-In%20order%20for&text=These%20ratings%20include%20voltage%2C%20ampere%20and%20interrupting%20rating.&text=Voltage%20Rating%3A%20The%20voltage%20rating,system%20voltage%20but%20never%20lower. ".