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ECE 525

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Lab 2 Report

# Purpose:

This lab was designed to cover the basics of applying inverse-time-overcurrent (TOC) protective elements in a standard microprocessor relay. The goal of using these TOC elements in the lab was to apply effective protection coordination between devices, and to illustrate some of the pitfalls in application.

# Lab Procedure:

This lab was composed of two parts, the first being the basic application of zone-1 TOC elements, and the second being focused more around the pitfalls associated with such elements, and mitigation techniques that would help to solve such issues.

As mentioned, the first part of the lab focused primarily on application of the standard TOC elements, which included 51P1, 51G1, and 51Q. However, this presented a pitfall. Applying these pickup elements directly to the trip equation in the relay caused a major issue in that they asserted instantaneously. Only the 51x1T elements applied the appropriate TOC inverse delay, as a result, we initially perceived what appeared to be instantaneous operation. This was interesting in that it demonstrated that even a relay whose instantaneous element limit has been reached can be used with more levels of protection by applying the pickup elements instead of the timed elements.

After correction of this issue, application of the elements became quite simple, and illustration of the elements’ effectiveness in coordination became evident. The SEL-351S relay was coordinated with an SEL-411L line protection relay. When a fault occurred downstream of both relays, the 411L was responsible for tripping, as it was nearest the fault. However, if the 411L did not trip for any reason, the 351S picked up its slack and took action into its own hands.

The second part of the lab consisted of various tests related to reverse faults and inappropriate tripping. Such actions would occur if a fault occurred upstream of a protective device, but the device took action by mistake. We made a few attempts to illustrate this error, but as was found, the 351S was in a position that could not reasonably show the faulted situation. Due to this shortcoming, we instead discussed the applications of such issues, and how they could adversely affect the grid. It was clear that “protecting” a line or system out of zone could cause some major issues for the greater grid.

Although testing was not fully successful, we were able to illustrate the usefulness of directional elements by applying them as supervisory logic in the trip equation. This illustrated one method of securing trip operations.

# Event Record Analysis:

Here, like in Lab 1, it was very useful to open an event record and view the results as oscillographic data and make interpretations based on the data. In addition to seeing the information, it was useful to confirm that pickup was reached some time delay before trip, from this information, it may be possible to confirm relay operation meeting specification or otherwise better coordinate protection between devices.

# Conclusion:

This lab was very useful in understanding the basics of relay settings application and validation. It was useful to see how coordination could be applied to radial systems through usage of TOC elements, but it was even more useful to see how some of the pitfalls may occur, or how they may come about.