Application Note

Substation Automation and Protection Division

Phase Comparison Relay REL352 Settings

Introduction

This note discusses the settings for the phase comparison section of the REL352 relay. It specifically examines the relationship between the settings : Ikey, ITA2, and LP.

Phase Comparison Theory and Element Definitions

The output of the composite sequence filter is a weighted time varying function called IT. When the instantaneous value of IT exceeds a threshold setting, **Ikey**, IT, (ITR) is sent to the remote terminal in the form of a MARK, and SPACE signal for comparison with an IT developed in a similar fashion at the remote end. Locally, Local Positive, **LP**, and Local Negative, **LN**, signals are developed from local IT, (ITL). When the value of ITL exceeds **LP** a positive square wave signal is developed which stays high until ITL drops below **LP**. Similarly, when the value of ITL drops below (more negative than) **LN**, a negative square wave is developed. The **LP** signal is compared to MARK and the **LN** signal is compared to SPACE for coincidence. If either are coincident for 4 msec, a count occurs which will trip the relay if set for **1CNT**, or trip the relay after two consecutive counts within 24msec if set for **2CNT**. A fault detector **ITA2** which measures the RMS value of ITL supervises the comparison.

Setting Phase Comparison Elements

The instruction Leaflet IL40-201.9B gives some basic considerations for setting the phase comparison elements:

$$\textbf{ITA2} \leq 0.7\ IT_{min\,RMS} \quad \ldots\ldots(1)$$

Where IT_{min} is the minimum rms IT for an internal fault

$$\textbf{IKEY} \geq 1.5 \times I_{charge} \times C1 \quad \ldots\ldots(2)$$

Where I_{charge} is the line charging current and C1 is the positive sequence weighting coefficient

$$\textbf{LP} = \textbf{-LN} = 2 \times \textbf{IKEY} \quad \ldots\ldots(3)$$

There is also a relationship between **IKEY** and IT which results in the width of the square wave. When IT equals **IKEY** the square wave has a width of 4 msec. As IT becomes larger than **IKEY**, the width of the square wave increases. There needs to be a coincidence of 4 msec between ITR and **LP** or **LN** for tripping . Any misalignment of the waveforms due to incorrect channel delays can shrink the coincidence time between the local and remote signals possibly preventing correct operation. For this reason it is suggested that the ratio of IT/**IKEY** be as large as possible.

If strong sources are involved so there is a great deal of fault current, or if the sequence coefficients **C1, C2, C0** are chosen so that IT_{min} is much larger than 0.3 amp, the minimum recommended setting for **IKEY** there is no problem with meeting the above criteria.

If IT_{min} is small, meeting the criteria of a 30% margin of **ITA2** over IT_{min} as expressed in equation (2) will be nearly impossible since the minimum setting of **ITA2** is 0.2 amp. For this case the margin can be reduced thus lowering **ITA2**.

The other option that is employed by some users, is to choose an arbitrary higher IT_{min} that satisfies the equations. **By doing so, the relay will not respond to some low current faults.** Users have justified this because typically another type Directional Comparison relay system such as a permissive overreaching transfer trip system is applied in parallel with the phase comparison system. This system would see the faults that the phase comparison system has been desensitized.

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