

Impact of CT Errors on Protective Relays – Case Studies and Analysis

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Current transformers (CTs) are the basic interconnection between the power system and almost all measurement devices such as protective relays. CTs step the primary current down to a nominal secondary level for use by protective relays, meters, and other monitoring devices. One of the practical concerns for the protection engineer is the actual ability of a CT to replicate the primary current.

CTs perform reasonably in most operating scenarios, faithfully reproducing primary current as a secondary current, with little distortion or error. In practice, modern C-class CTs have an error of 1% to 2%, and keep this high level of accuracy over their operating life. However, there are scenarios where CTs can be expected to not perform well, and can have a negative impact on the performance of the protection system. The protection engineer must consider these scenarios when designing the protection system, and relay suppliers must consider these scenarios when designing relays.

The following discussion describes how CT replication error impacts protective relay performance by presenting three actual examples. These examples specifically describe the operation of a line differential relay at a dual-breaker line terminal line, the operation of a generator differential relay, and the operation of a low-impedance bus differential relay. Oscillography data and event logs retrieved from the protective relays are used to explain the undesirable operation of the relay due to CT saturation. The interest in these three examples is that the mode of CT saturation was different for each. The first example is really about different CT saturation rates using paralleled CTs. The second example is about the impact of DC offset and saturation of CTs at low current levels. And the final example describes how a CT saturated due to the secondary voltage drop across the CT. Since, the root cause of the relay operation is response to CT saturation is different for each case, the appropriate solution to prevent undesirable relay operation is different for each. The paper will suggest some solutions for each example.

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