Open Circuit Protectors for Current Transformers

April 10, 1996

Current transformers should never be operated with an open secondary circuit. If the secondary of a CT carrying primary current is open circuited, a high voltage can be developed across the CT terminals. Depending of the characteristics of the particular CT, this voltage may be several hundred volts if the primary current is high enough. This voltage may be dangerous to personnel servicing the equipment and damaging to the CT itself or to devices connected to the CT. To guard against this possibility, devices used in CT secondary circuits are designed to prevent open circuits. For instance, ammeter switches have overlapping contacts so that the circuit is never opened as the ammeter is transferred from phase to phase, and drawout relay cases have shorting contacts in current circuits so that the CT circuits are shorted before the relay coil is removed from the circuit. Also, CT secondary circuits are often wired to special terminal blocks which allow a short circuit to be placed on the CT secondary if it is necessary to service the secondary circuit.

For those users who wish even further protection against the possibility of an accidental open circuit in a CT secondary, open circuit protectors are available. These are useful especially where the CT secondary leads are long and subject to possible damage, such as in substations where CT leads from high voltage circuit breakers or transformers may runs as much as several hundred feet to reach the secondary devices. Some users require these devices in metal-enclosed switchgear, but only about 5% or less of the switchgear we build has these protectors.

There are two basic types of protectors available - variable resistance and electronic. They both work by limiting the CT secondary voltage, but in very different ways. The variable resistance type carries enough current to limit the voltage across the protector, much in the manner of an MOV or a surge arrester. However, in order to protect itself, this device includes a heater element in series with the variable resistor and a bimetallic contact which will short out the CT secondary before the variable resistor element is damaged. The electronic type monitors instantaneous voltage, and shorts the CT secondary through an SCR if the instantaneous voltage exceeds the set point. This short remains for the rest of the half-cycle of the voltage wave on which it occurs, and is then removed. Each half cycle is separately monitored and acted upon.

Both types of protector come in several voltage classes. It is very important when applying these protectors that the proper voltage class be chosen, and coordinated with the operation of the relays at maximum fault current. This is especially important for CTs connected to high impedance bus differential relays, which are normally voltage actuated. The protector must operate for a true open circuit, but must not operate to short circuit the CTs under fault conditions, preventing desired relay operation.

Baldwin Bridger, P.E.
Technical Director