

Article Overview

Opening the secondary of a current transformer (CT) while energized can generate dangerously high voltages, potentially damaging the CT, relay, or surrounding equipment, and protective devices like CT open-circuit protectors (OCPs) are used to mitigate this risk.

Hazards of CT Secondary Opening

When a CT secondary is open-circuited while the primary is energized, the secondary voltage can rise dramatically, sometimes from 400 V to over 6 kV, depending on the CT ratio and primary current, far exceeding the insulation rating of the secondary leads or terminals (typically 600 V class) and creating a fire or arcing hazard. This can damage the CT winding insulation, cause high eddy currents in the core, and lead to relay misoperation or failure. Open circuits can occur due to wiring errors, maintenance mistakes, rodent damage, or loose connections in vibrating equipment .

Impact on Relay Protection

Protective relays rely on accurate CT secondary currents to detect faults. An open CT secondary can result in zero current readings, causing relays to fail to operate or operate incorrectly. High transient voltages can also damage relay inputs or distort measurements, compromising the protection system . Therefore, never open a CT secondary while the primary is energized; always short or load the secondary during maintenance .

Protective Measures

- o CT Open-Circuit Protectors (OCPs): These devices monitor the CT secondary voltage and, if it exceeds a set clamp voltage, trigger a back-to-back SCR to reduce the voltage to safe levels (typically 2-35 V) within a fraction of an AC cycle. OCPs protect both halves of the AC waveform and prevent insulation damage without affecting CT accuracy or relay operation under normal conditions .
- o Voltage Limiting Devices: Varistor-based CT Protection Units (CTPUs) act as passive loads under normal operation and actively limit voltage during open-circuit conditions. They dissipate energy safely and can remain in place without immediate replacement after an abnormal event .
- o Installation Practices: Use ring lugs, proper torque nuts, and dedicated conduits for CT secondary leads to prevent accidental disconnections. Low-power CTs or Rogowski coils can be used where compatible, as they pose no risk if open-circuited .
- o Monitoring and Alarms: Some relays or meters can detect current unbalance or zero-phase current conditions, alerting operators to a potential open CT, although this is less effective if all three phases are lost .

Summary

CT secondary opening is a serious hazard in relay protection systems, capable of generating high voltages that

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can damage CTs, relays, and insulation. CT open-circuit protectors, varistor-based devices, and careful installation practices are essential to safeguard equipment and ensure reliable relay operation. Proper maintenance, testing, and adherence to IEEE C57.13 standards are critical to prevent misoperation and ensure system safety .

OVERCURRENT PROTECTION FUNDAMENTALS Relay protection against high current was the earliest relay protection

Eaton's protective relays provide you with unique microprocessor-based devices that eliminate

The greater the number of secondary turns, the less flux that is required to force the

A differential protection monitors an area limited by CTs which measure incoming and outgoing currents. Now, let's

Restricted earth fault protection is a form of differential protection, typically applied to transformers.

CT Sizing for Generator and Transformer Protective Relays Ritwik Chowdhury, Dale Finney, and Normann Fischer Schweitzer

Apart from wiring mistake and accidents, another cause of open circuit CT is rodent activity in

tello, Schweitzer Engineering Laboratories, Inc. Abstract--A wire crimping error caused a current transformer (CT) to become open

And with a typical CT you would be running the CT to a parallel current meter or have a low impedance external shunt.

Protective relays are arguably the least understood component of medium voltage (MV) circuit protection. In fact, some believe that

Will the saturation cause the relay to fail to operate? Doesn't matter how saturated if the relay still does its job. Why

Plug setting multiplier of relay is referred as ratio of fault current in the relay to its pick up current. Suppose we have

This comparison summarize characteristics of all protection relay types described in previously published technical

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CT failure detection for differential protection applications 61 st Annual Conference for Protective Relay Engineers

Metrosil offers unrivalled current transformer protection. Our CTPUs protect current transformers from damage under open-circuit

The paper then describes several field events of undesired or unexpected protection system performance due to improper CT or VT

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