

# Open Phase Detection System

## COSI Digital Instrument Transformers with P40 Agile Protection

### Optical | Precise | Dependable: Open Phase Detection for the most critical standby power supplies

OPD monitors the availability and health of standby power supplies. Due to the criticality of the circuits supplied, nuclear plant operators are assured that the standby supply will be available to serve the demand should switchover occur.

GE's Open Phase Detection (OPD) system is a fully integrated solution to a problem that has vexed the nuclear power industry: how to best provide open-circuit protection for off-site auxiliary power transformers serving nuclear generating stations. GE's OPD schemes are capable of detecting such scenarios and isolating the power transformers when required, in both unloaded and loaded conditions.

The problem solved is to detect the loss of a single phase in the supply path to power transformers caused by incorrect switching operations or an unintentionally open or grounded conductor. This requires that the scheme is sensitive enough to measure the transformer magnetizing current on two phases, and its absence on a third phase.

The extremely low current levels to be measured mean that conventional current transformers would not be sensitive enough. GE's COSI-CT digital instrument transformers prove to be perfect for the task, using optical measurement technology to directly measure the magnetizing current. The measurements are published via Ethernet using IEC 61850-9-2LE, with MiCOM Agile P645 process bus relays providing the protection.

### Overview

While numerous approaches have been tried by others, only GE's OPD system offers this unique combination of attributes:

#### Safety

GE's OPD system eliminates the need for conventional current transformers (CT). While analog CTs have been an industry workhorse for years, their usage comes with a significant risk: an improperly isolated CT circuit that's opened can result in physical harm to equipment and personnel. When open-circuited, a CT can develop high voltage that results in arcing, associated heat, and burning. By employing an optical sensor instead of a traditional CT, GE's OPD system enhances operational safety by eliminating the risk of inadvertently open-circuiting an energized CT.



### Key Benefits

- Safety – no wired cross-site CT circuits
- Optical technology sensitive to measure magnetizing current as low as 10 mA primary
- Slip-over optical CT for easy retrofitting of an existing installation
- Fully standards-compliant IEC 61850 solution, nothing is proprietary
- Secondary engineering in minimum panel footprint



## Reliability

GE's OPD system is dependable. It can be counted on to successfully operate when it should operate.

The system has been battle-tested both in the lab and where it counts, in the field.

## Security

GE's OPD system design is guided by the philosophy that avoiding false operation is just as critical as flawless performance during legitimate open-circuit conditions. GE's solution only initiates equipment isolation when necessary to remove an open-phase fault, not for faults outside the zone of coverage. Line faults, inrush currents, and high load transfer conditions will not initiate operation.

## Selectivity

GE's OPD system offers reliable and secure system operation because, uniquely, it integrates inputs like circuit breaker status, over/under current, neutral current, negative sequence current, and single pole logic with independent phase settings. Processing such inputs helps to overcome the challenges associated with the significant variance of current magnitudes in a properly functioning power transformer. These can range from tens of milliamps in each phase (and unequal because of the core geometry) when a power transformer is energized but unloaded, to thousands of amps when the transformer is fully loaded. Another design element is "time discrimination" – the coordination between the OPD system and the neighboring line, transformer, voltage, and/or motor relays.

## Convenience

GE's OPD system incorporates two independent OPD functions inside a single housing. This ensures that OPD is provided (1) for an unloaded transformer, and (2) for a loaded transformer.

Additionally, the digital nature of the system eases testing and maintenance. No test switches are required to prevent disconnection of wires during testing, as all equipment requiring isolation is connected through a fiber network.

To ease diagnostic work, safe, digital, test signals can be injected into the process bus.

## Cost-effectiveness

GE's OPD system is a fully-digital solution, meaning that minimum equipment and circuitry is required for each installation. Ease of application, installation, testing and maintenance contribute further to savings. Finally, GE's OPD systems are configurable to each unique application. The days of one-size-fits-all, off-the-shelf solutions are gone, along with their costs and risks.



P645 process-bus protection relay in half-rack 8 inch case

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