

EPRI Open-Phase Detection (OPD)

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January 14, 2015



EPRI Research

- Address many of the technical issues associated with detecting an open-phase condition of a station auxiliary transformer (SAT)
 - Studied several types of SATs
 - Identified susceptible transformers.
 - Identified difficulty in detecting event during a low or no-load level state.
 - Identified solution for detecting an event on susceptible transformers during all loading conditions including low or no-load level state.

Released 5 publicly available documents on the open-phase issue since the Byron event.



Successful Field Demonstration

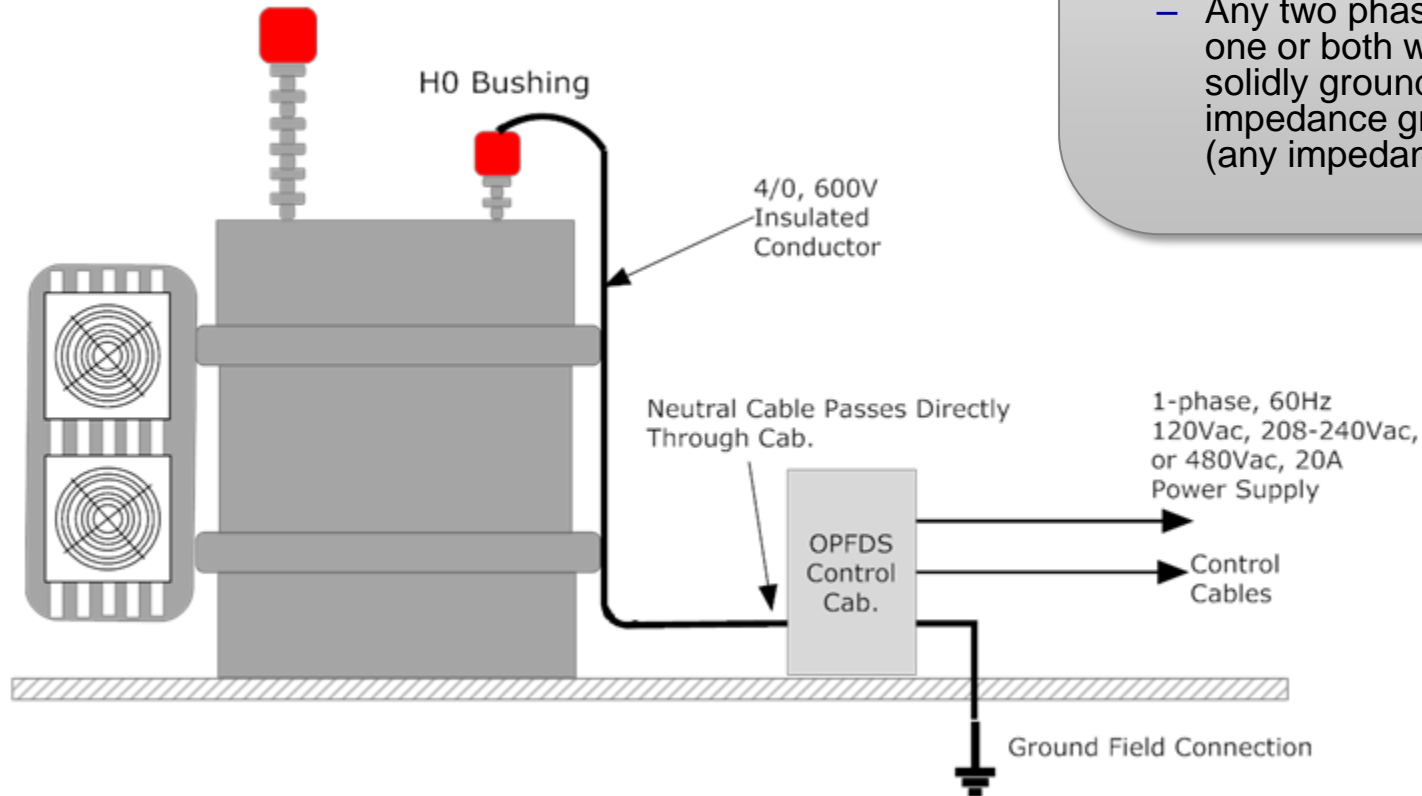
- Conducted at Bellefonte Nuclear Plant in May 2014
- First ever open phase field test
 - TVA opened a 161 kV conductor to a 36 MVA Station Auxiliary Transformer (SAT).
 - Various plant buses were loaded during the test
- Test was witnessed by many
 - TVA Personnel
 - NRC Staff
 - INPO
 - Several AE firms



EPRI Open Phase Detection

- Installation utilizes neutral conductor only.
 - Requires minimal outage time and minimal maintenance
 - Designed for ease of installation

- Design to detect under all loading conditions:
 - Any phase open
 - Any phase opened and solidly grounded or impedance grounded (any impedance)
 - Any two phases opened
 - Any two phases opened, one or both which are solidly grounded or impedance grounded (any impedance)



EPRI Open Phase Detection

- Combined the neutral detection along with neutral injection to provide a robust/secure detection system.
 - Allows for a fail safe and redundant detection design.
 - Allows for a system test scheme to monitor all major system components.
 - Only requires monitoring of a change in signal level.
 - Active protection is the preferred method over passive only protection.
- Design meets all project constraints and goals.
- Uses all commercial-off-the-shelf components.
 - Reduces cost and lead times
 - Minimal maintenance
 - Easily replaced parts to reduce downtime



NRC/NEI Guidelines

- Designed to meet NEI Initiative and NRC functional requirements.
 - Detects open phase events from unloaded conditions to fully loaded conditions via active neutral injection technology combined with passive neutral overcurrent detection.
 - Automatically detects OPC's, and provides dry relay contact outputs for OPC trip, OPC alarm, and System Abnormal alarm.
 - The active neutral injection protection allows for a fail-safe design such that a failure in the device can be detected and an alarm actuated.
 - All the components are COTs and field replaceable with minimal parts list with lead times. Inventorying of these few components would allow for a system failure to be easily repaired.
 - Single channel system uses both the active neutral injection protection and passive overcurrent protection with redundant electromechanical overcurrent relay passive protection.
 - Designed such that a single channel system can be easily expanded to meet to plant specific needs.

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