



ELECTRIC POWER
RESEARCH INSTITUTE

NRC Public Meeting – Open-Phase Design Vulnerability

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EPRI's Involvement

- EPRI has been a contributor to the analysis and detection of the open-phase condition as of the Byron event.
- EPRI's technical staff has previous experience in transformer modeling for all protection issues.
- Developed two reports related to this issue in 2012
 - *EPRI 1025772, Analysis of Station Auxiliary Transformer Response to Open Phase Conditions*
 - *EPRI 1026484, Development and Analysis of an Open-Phase Detection Scheme*
- EPRI has two additional projects for 2013 relate to this issue

EPRI 1025772, Analysis of Station Auxiliary Transformer Response to Open Phase Conditions

- Addresses technical issues associated with detecting an open-phase condition of a station auxiliary transformer (SAT) or start up transformer
 - Modeled variations of three-legged, core-form, wye-wye transformers
 - Developed multiple transformer models for use in the analysis
- Research results
 - Little to no effect on voltage signals at light or no-load conditions due to transformer core construction.
 - Detection method will necessarily include current monitoring of some type.

EPRI 1026484, Development and Analysis of an Open-Phase Detection Scheme

- Project addressed detecting open-phase condition at one customer specific location
 - Determined the system response during open-phase conditions.
 - Determined the signature of an open-phase condition in order to develop a protection scheme.
- This analysis can be used to aid in the development of system protection schemes to detect such conditions for other facilities.
 - Requires plant electrical system modeling.

New Research – Follow on Project

- Model/analyze station auxiliary transformer types (SAT) that were not included in the initial EPRI study (1025772)
 - Document responses of transformer types other than wye-wye, three-legged core form transformers that are used as SATs
 - This information can be used to determine if present voltage relaying will respond to loss-of-phase.

New Research – Additional Project

- Address many of the technical issues associated with detecting an open-phase condition of a station auxiliary transformer (SAT) during a low or no-load level state.
- Low and no-load condition is the prevalent condition for most SATs.
- Investigate detecting at lower current levels.
- Several methods are presently under investigation
- Initial simulations look promising
- Investigate active monitoring of the circuit conditions at all times independent of load.



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