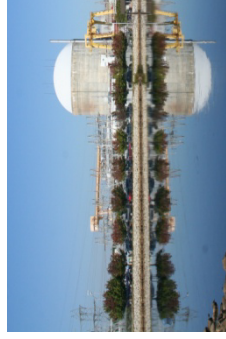
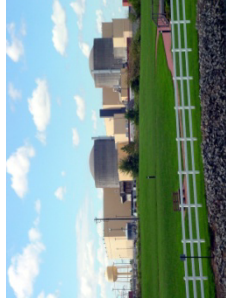
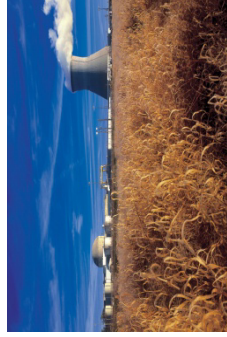
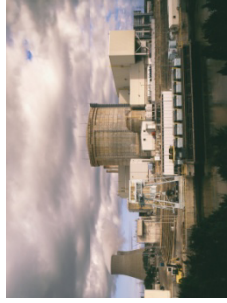




# Open Phase Detection Meter Relay Option

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*Public Meeting To Discuss  
NRC Bulletin 2012-01*

*February 28, 2013*

# Background

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- Duke Energy initiated a design study to identify creative concepts to:
  - Develop a reliable relaying scheme
  - Emphasize simplicity
- Modeling used both PSCAD and ETAP 12 & Version.
- The most viable and advantageous option was chosen for more detailed study
- URS modeling validated phase voltage reconstruction at low load using ETAP & version



## Meter Relay Option

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- A revenue grade meter to monitor the 3 individual phase current magnitudes
- Open phase shows zero (0) current magnitude while other phases are non-zero
- Capable of monitoring down to less than our transformer excitation (no load) current
- Meter contacts can be logically programmed to compare and actuate alarm or trip circuitry



# Meter Relay Option

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## ■ Challenges

- Optimum location for CTs and relaying
- Existing versus new metering CTs
- Noise tolerance
- Single point vulnerability
- Testing
- Risk of spurious operation (– should alarm only?)
- Cost





## Meter Relay Option

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### ■ Pros

- Simple (direct comparison of current magnitude)
- Multiple vendors
- Potentially proactive (no load)
- Switchyard based
- Potentially independent of transformer and ground impedance
- Design and installation can be readily replicated



# Typical Switchyard

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## Plan Going Forward

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- Our current assessment is that this is a viable solution.
- The switchyard location is preferred for its simplicity, independence of transformer and ground impedances, and its ease of replication.
- Our current plan calls for bench testing and field testing (outside the nuclear plants) to further vet the design for application at the Duke Energy sites.