Substation Relay Protection Overview NWPPA E&O Conference 2016

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Presentation Overview

- Faults
- Relays
- Instrument Transformers
- Correlation to Drawings
  - One Lines
  - AC Schematics
  - DC Schematics
- Other Types of Protection
- Coordination of Relays
Protect Personnel

Protect Equipment

Isolate Fault to Smallest Affected Area
1) Trip during fault
2) Trip during overload
3) Trip during over/under voltage
4) Trip during over/under frequency
5) Don’t trip during inrush
6) Don’t trip during cold load restoration
7) Don’t trip during “normal” conditions
How do Relays Recognize Faults?

- Abnormal Current
- Abnormal Voltage
- Abnormal Frequency
- Combination of any of the Above
What does a fault look like to a Relay?
Pre Fault Breaker Opens

AØ Fault

Breaker Opens
Types of Typical Faults

- Single Line to Ground
- Two-Line to Ground
- 3-Phase
Cause of Faults

- Grounding Cables
- Trees
- Splices
- Terminations
- Weather
Simplified Overall System Schematic
(Radial System)

FAULT CURRENT CONTRIBUTION

SOURCE (UTILITY)

SUBSTATION TRANSFORMER

FEEDER BREAKER-1

FEEDER BREAKER-2

FAULT
Looped System
What is a Relay

- Continuously Monitors Power System
- Sends a signal to Trip Circuit Breaker or Recloser during abnormal conditions (faults)
Common Types of Relays Located in Substation

- Line (Distance and Differential)
- Transformer (Differential)
- Bus (Differential)
- Feeder (Overcurrent)
Relay Testing
How to Measure Current, Voltage and Frequency:

Instrument Transformers

- PTs
- CTs
Analog Inputs
Voltage & Current

Relay

Digital Outputs
(one or zero)

Signal to trip
circuit breaker
Correlation to Drawings

One-line Diagrams
Primary vs. Secondary
Transformer Differential
Correlation to Drawings

DC Schematics
Other Types of Substation/Feeder Protection

- Transformer Fuses
- Reclosers
- Sectionalizers
Transformer Fuse Protection
Recloser
Recloser Controller
Recloser
Time Current Curves
Questions?