Progress Energy
15kV Cable Failure Discussion

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Background – Harris Plant Cable System

- Medium Voltage – 6.9kV
- Anaconda Unishield
  - Original cable installation; 25 years of service
  - 15kV class cable; 3-1/C 350kcmil; black EPR
  - 1300 ft run; no splices
- First Tan Delta Test for Cable
- Cable Feeds:
  - Water Treatment Building
  - Mostly Non-Power Block Loads
- Included in Cable Aging Management Program population
Cable History

● **Original Testing**
  - Testing performed on 3/21/2011
  - HV Diagnostics Tan Delta Test
  - Performed per Fleet Procedures
  - ‘A’ Phase Tan Delta – 63E-3 (max recorded @ 2Vo)
  - ‘B’ & ‘C’ Phase cables - ~12E-3
  - Megger Readings:
    - ‘A’ Phase – Before 3.72 G-ohm; After 0.57 G-ohm
    - ‘B’ Phase – Before 24.4 G-ohm; After 24.2 G-ohm
    - ‘C’ Phase – Before 24.4 G-ohm; After 24.2 G-ohm
  - Cable declared Operable based upon megger
Actions following Tan Delta Test
- Work Request/Work Order generated for replacement
- NCR generated to document results

Multiple Ground Fault alarms received by MCR
- Started occurring ~7 months after test
- Alarms occurred over a week period
- Temp power connected to impacted loads

Prior to securing cable, fault occurred. Damage localized to cable
Cable Fault Actions

- Cable De-Energized
- Loads were powered from Temp Power
- Cable was quarantined for forensics
- Replacement cable was deployed
  - Original Uni-Shield left from construction
- Sections of cable sent to CTL for analysis
3 – 60 foot Sections sent to CTL; included faulted section

CTL performed standard evaluations:
- Visual Exam
- Insulation Resistance
- 0.1Hz Dissipation Factor
- Tan Delta
- Partial Discharge
- AC Breakdown
- Water Content assessment
Installed condition
Pictures of Fault
Pictures of Fault
Results of Analysis

- Significant water present near failure
- AC Breakdown for ‘B’ & ‘C’ phases
  - 43kv (~11x Vo)
- Confirmation of field readings/assessment of ‘A’ phase
- “Water related degradation of a 20 foot section a ‘A’ phase” was the primary conclusion.
Summary

- Correlation between Tan Delta and IR readings
- Ground fault alarms can be leading indicator of pending failure
- End of life still not predictable
- Corrective Actions should consider plant risk for timeliness
- Testing identified the problem; wasn’t remedied before failure