Faults per Feeder Mile

Presented by
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In the Past All We Needed

Cost

Reliability
A Utility System Today

Reliability

Measurement

Cost

Power Quality
Power Quality vs. Reliability

• System Reliability Issues (Outages > 1 minute)
  – Human interface is required to restore the system

• System Power Quality
  – Events less than one minute
  – Voltage regulation
  – Harmonics
  – Most all of the reliability events will cause a power quality event

• Faults on system cause most of the Power Quality and Reliability issues
Reliability- Minutes Out

- Reliability
- Number of Customer
  - Customer Minutes Out
- Type (some sensitive some not)
  - Industrial
  - Commercial
  - Residential
- Location
  - Urban
  - Rural

![Reliability Triangle Diagram]
Cost - Cents per kWh

- Cost to Customer
- Revenue
- kW Demand
  - Large
  - Medium
  - Small
- Load Factor
- kWh
  - Total Energy Delivered

Reliability
USAP
Cost $/kWh
Power Quality

CP&L
A Progress Energy Company
System - Faults/Feeder Mile

- Power Quality
- Events
  - Number of Faults
- Miles of Conductor
  - Transmission
  - Distribution
- Type (some sensitive some not)
  - Industrial
  - Commercial
  - Residential
- Location
  - Urban
  - Rural

Reliability

Cost

USAP

FFM

Power Quality

CP&L
A Progress Energy Company
How We Measure Our System

- Customer Minutes Out
- Reliability
- Cents per KWH
- COST
- Faults/Feeder Mile
- Power Quality
- Average
- SAIDI, FFM, kWh$
Using new technologies engineers at CP&L are now able to put the distribution system under the magnifying glass to see how it is reacting to system disturbances.
Distribution Automation Communications

1. Substation Power Quality and Load Monitoring with dial-up access
2. Capacitor Control
3. 2-Way Communications w/Alarms
4. Supervisory Control (remote operation of feeder breaker)

Distribution Substation

- Alarm Monitors
- Event Monitor, Planning, Info., PQ
- RTU
- Modem
- CAP OCB
- FDR OCB
- Switch
- Communications Network
- PQM Server
- Dial-up Telephone
- Dedicated Telephone or V-sat

Communications Network

- DSCADA CPU
- DLC CPU
- Dispatcher Console
- CSC
- EMS CPU
- Skaale ECC
- Summary Alarms from all T/D Subs

Distribution Substation Power Quality and Load Monitoring with dial-up access, Capacitor Control, 2-Way Communications w/Alarms, and Supervisory Control (remote operation of feeder breaker) are shown in the diagram.
Monitoring Equipment

Substation RTU
Using the FMS

“Live” Connection
Events on the System

Power Quality Monitoring

Ability to monitor faults on every substation and feeder
FMS Screen
Phase To Ground Fault Event
Estimating Fault Location Based On Fault Current

![Microsoft Excel - Fault Current Program](image)
FieldView Map - Fault Location

Blumenthal 23kV Feeder - Snake On Arrester

Circuit Distance
9,540 Feet
1.807 Miles
Snake On Arrester
Snake On Arrester
Types of Faults

Phase To Ground Fault

Phase To Phase Fault

Three Phase Fault

Multiple Fault
Other Variable in Faults

Fault vs Magnetizing Current

Time Aggregation of One Minute
## Faults per Feeder Mile (FFM)

### Apr-01

<table>
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<tr>
<th>Region</th>
<th>UG Miles</th>
<th>OH Miles</th>
<th>Faults</th>
<th>Average</th>
<th>Totals</th>
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### YTD 2001 totals FFM

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Conclusion
Faults per Feeder Mile

- Most all power quality events on the utility systems are caused by a fault
- Exposure is a big factor for utilities
  - Rural vs Urban on line length
- Easy for linemen and others in the utility industry to understand
- Easy to count less variables
- Good comparison to other utility systems for power quality events