Cable Thermal Limits

Real-Time Distribution Cable
Temperature Monitoring

Maria De La Cruz, PE
Austin Energy
Transmission & Distribution Planning and
Regulatory Analysis
Austin Energy at a Glance

- 9th largest municipally-owned electric utility
- 2,600 MW of firm generation
- Electric service area of 437 square miles serving 400,000 customers
- Provide service to
  - City of Austin
  - Travis County
  - Small portion of Williamson County
Discussion Points

- Current Process
- A New Approach - Distributed Temperature Sensing
- Installation Types
- Demonstration Phase
- Full Substation Implementation
- Future???
- Questions
Ampacity Programs

- In-house developed programs
- Software packages
  - CYMCAP
  - ETAP
  - EPRI UT work station
  - PowerAmp
  - USAmp+
  - Others
Parameters

- All conduits 5-inch, PVC schedule 40 with 2 inch spacing (from edges)
- 25°C ambient temperature
- Soil Rho of 90
- Fill Rho of 55
- Average dry soil
- Heavy aggregate fill
- Burial depth of thirty six inches to top of duct bank
Ampacity Study

- Based on NEC Neher-McGrath approach
- Transient Temperature Calculation
- Urban Load Profile
- Normal Rating
  - Uniformly raising loading of all circuits in duct bank until one reaches a temperature of 90°C
- Emergency Rating
  - Loading on the circuit is raised while holding the remaining circuits constant and a temperature of 130°C is reached
Concerns With The Current Process

- How accurate is the existing model?
- Is the existing model too conservative?
  - Assumes all circuits in a given duct are loaded at the same level
- During summer months useable circuit capacity may be reduced
  - Higher temperatures
  - Higher loading on feeders
  - Can loads be safely increased?
Monitoring system that utilizes fiber optic technology to provide real-time temperature data along the entire length of a circuit.
Installation Types

- Power cable with imbedded fiber
- Fiber pulled in adjacent conduit
- Fiber pulled thru already populated conduit

(Not drawn to Scale)
Sample Output
Demonstration Phase - Goals

- Limit the risk of physical cable damage during the installation
- Improve the utilization of available circuit capacity
- Maintain safe cable operating temperature
- Limit the risk of cable damage due to high temperature operation
McNeil Substation

- 12.5 KV substation
- 4 – 30 MVA Transformers
- 8 feeders serving commercial & residential customers
Demo Phase – Fiber Installation

- **Issues/Concerns**
  - Damage to existing power cable
  - 90 degree corners
  - Long vertical runs

- **Worked with vendor on these issues**

- **Installed fiber only in limiting run to minimize risk**
Demonstration Phase

- **MC-07 Feeder Selected**
  - Normal Rating = 490 Amps
  - Overhead feeder
  - Limiting run identified
  - Loading increased above 500 Amps

- **Results**
  - DTS = 58° C
  - Calculated = 61.66° C
Full Substation Implementation

- **Fiber Installation**
  - Took about 2 weeks
  - 3 runs of fiber installed in limiting runs only
  - Fiber runs ranged in length from 800 to 2,400 feet
  - AE crews did installation to minimize # of splices
  - Only splices are located in the control house

- **Rack mounted DTS unit installed in the control house**
Project Status

- **Data being collected**
  - DTS unit holds 1 year of data

- **Preliminary look at data**
  - Calculated results significantly differ from real-time data (WHY???)
Future ???

- Temperature Based Alarm Limits
- Maximize the capacity of the existing infrastructure
- Operation of cable closer to its maximum capacity
- Deferral of projects
- Other ????
Questions?