Federal Energy Regulatory Commission

Technical Conference on Connecticut Infrastructure

Reliability and Operability Committee Update

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Need for the 345 kV Loop

- Without the 345 kV Loop:
  - Bulk system reliability criteria cannot be met
  - Cascading blackouts could occur
  - System operators will need to resort to "pre-cautionary" load shedding to maintain overall grid stability

Inefficiency Costs of Existing Transmission System

- Estimated annual inefficiency costs for Connecticut (2005)
  - RMR Agreements: $240 Million*
  - GAP RFP: $33 Million
  - Congestion: $4 Million
  - Running uneconomic generators: $31 Million
  - Total: $308 Million

* Includes agreements in effect and pending

Reliability and Operability Committee

- Committee Members:
  - ISO New England
  - Project Applicants: Connecticut Light and Power and United Illuminating
- Process:
  - ROC established: June 2004
  - Interim Reports: August 16, October 8
  - Final Report: December 20

Objective

- Determine maximum technological feasible use of 345 kV underground cable
- Meet operability and reliability requirements of the bulk power system in Southwest Connecticut and New England

Scope of Investigation

- An unprecedented amount of technical study conducted on this project due to:
  - Extreme weakness of the Southwest Connecticut system
  - Immediate and pending need for transmission upgrades
- Exhaustive technical analysis conducted
  - Harmonic frequency scans
  - Dynamic voltage analysis
- Multiple lengths of underground cable evaluated

Methods of Investigation

- World-wide experts employed
  - GE, PB Power, Shawnee Power, EnerNex, Teshmont, ABB, EPRI Solutions, and K & R Consulting
- Consulting team designed to work in parallel fashion
  - Engineers and consultants worked thousands of hours to complete necessary studies
  - Provide review of each others' work
  - Expedite study completion

General Findings

- As the length of underground cable increases, so do the variables that must be considered
  - Studies show high sensitivity to load levels, load types, amount of capacitance, etc.
  - Highly volatile and unpredictable results demonstrated
  - Operating in this manner is unprecedented world-wide
- Weakness of the Southwest Connecticut system limits the amount of underground cable that can be used
  - Voltage peaks/durations adversely impact existing system equipment
  - Ability to install new substation capacitor banks to solve local area problems

General Findings, cont.

- ROC has identified solutions that will work:
  - 4 linear miles of underground cable
  - 13 linear miles of underground cable
  - 24 linear miles of underground cable if mitigating measures employed
    - Substitute cable type (XLPE for HPFF) to reduce capacitance and harmonic effects
    - Extensive replacement of substation surge arresters and utilization of higher voltage rated equipment (circuit breakers rated 400 kV rather than 345 kV)
- Maximum use of 345 kV underground cable: 24 linear miles

Other Studies and Determinations

- KEMA
  - KEMA report in October suggested use of C-Type filters to mitigate harmonics issues and add undergrounding
  - Suggested further study to verify results
  - ROC conducted further study and determined C-Type filters help in some cases and hurt in others
  - KEMA approach would not be technologically feasible solution to add 345 kV underground cable

Other Studies and Determinations, cont.

- ABB
  - ABB proposed direct current (DC) project to be embedded in an alternating current (AC) system
  - ROC determined ABB approach would:
    - Not mitigate Southwest Connecticut reliability issues
    - Be a high risk, first of its kind multi-terminal "network" DC application
    - Result in unacceptable complexity
    - Cost nearly double and would be less likely to get any support for regional cost recovery
- The reasons above apply to the multi-terminal installation
  - Another option was for a less complex installation but it did not meet the project objectives

Next Steps

- Cost review for Bethel-Norwalk project (Phase I)
  - Regional vs. local allocation
  - NEPOOL Reliability Committee meeting February 2
  - Stakeholder meeting February 7
- Cost review for Middletown-Norwalk (Phase II)
  - Regional vs. local allocation
  - Stakeholder meetings to be scheduled upon receipt of cost application
- Reliability review of final Phase II design
  - NEPOOL Reliability Committee
  - ISO New England