Use of Synchrophasors and FNET at Dominion

Kyle Thomas
ET Operations Engineering
Dominion Virginia Power

October 14, 2015
Dominion Electric Transmission System

Over 6,490+ miles of transmission line

- 6,490+ miles of electric transmission lines:
  - 500kV – 1,275 miles
  - 230kV – 2,775 miles
  - 115kV – 2,275 miles
  - 138kV – 65 miles
  - 69kV – 90 miles

- 400+ transmission substations
- Dominion geographic footprint covers:
  - Major load centers
  - Government agencies
  - Military bases
  - Data centers

350-mile 500kV Loop
Synchrophasor Deployment

Initial focus on Transmission system

• **DOE SGIG Projects**
  • 80 PMUs
  • 21 500kV substations
  • Sharing with PJM
  • Advanced applications

• **Standardization in 2013**
  • 300+ PMUs installed
  • 230kV and 115kV systems
  • < 0.5% of Total CapEx
Synchrophasor Data & Applications
Across the business unit

- Data available to all Electric Transmission departments
  - Transmission Planning
  - Protection & Control
  - Operations & Engineering

- Visualizations
  - Deployed across all Electric Transmission
Synchrophasor Data & Applications

Across the business unit

- As transmission events occur, group responsibilities and responses are supported with synchrophasors

- Transmission Planning
  - Generator activity
  - Stability analysis
  - Model validation

- Operations & Engineering
  - Event analysis
  - Root cause investigation
Main question always asked:
- Why did generators swing?

Any activity on Transmission system?
- System faults
- Transmission breakers opening
- Activity in neighbor’s system
- DFR and other devices triggered?

Any similar activity on Distribution system?
• Instances occur where nothing occurred inside Dominion territory

• Faults far away are not typically observed, especially if cleared high speed

• Large frequency excursions are observed
Use of UTK FNET/GridEye

Application used to identify grid disturbances

- A network of Frequency Disturbance Recorders (FDRs) installed throughout the world
- Measures the voltage phasor from an electrical outlet
- Voltage magnitude, angle, and frequency is synchronized by GPS time reference
  - Produces voltage synchrophasors
- Data transmitted to servers at UTK and ORNL
Use of UTK FNET/GridEye

Application used to identify grid disturbances
Use of UTK FNET/GridEye

Automatic event disturbance detection

1700MW EI Generator Trip at 16:39:38 UTC, on mm/dd/yyyy near *name* Power Plant
(city, state, zip; Latitude: 38.3661, Longitude: -76.4346)
Use of UTK FNET/GridEye

Immediate information to support many parties

- FNET processes data, detects events, and sends notification emails within 1-2 minutes of actual event
- Allows for immediate verification of observations seen in other data, such as synchrophasor and SCADA data
- When these large events occur, can quickly provide information to grid operators and plant operators
- Creates a database of significant grid events to use for further study
  - Generator model validation
  - FACTs model validation