

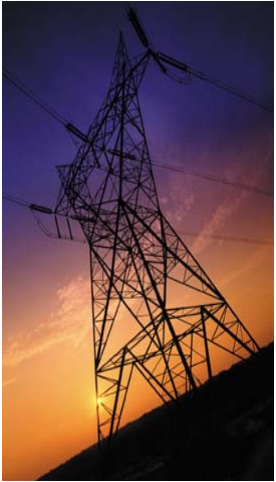


Dominion's Application of Pseudo-Measurements to Aid in State Estimation

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Dominion Virginia Power

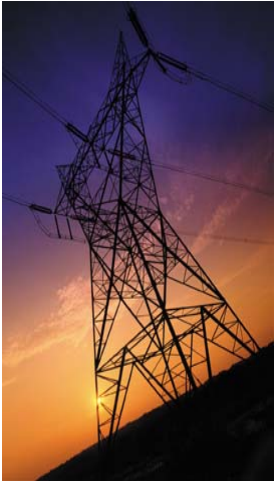


Dominion[®]



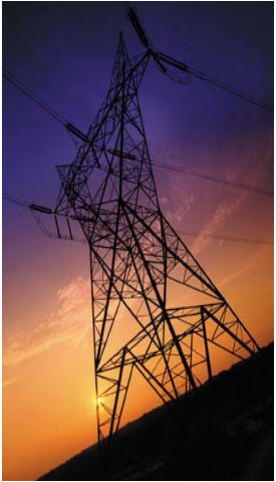
Dominion Virginia Power

- **28,200 megawatts of generation**
- **6,300 miles of high-voltage transmission lines, up to 500kV**
- **54,000 miles of distribution lines**
- **2.4 million franchise electric retail customer accounts in VA and NC**



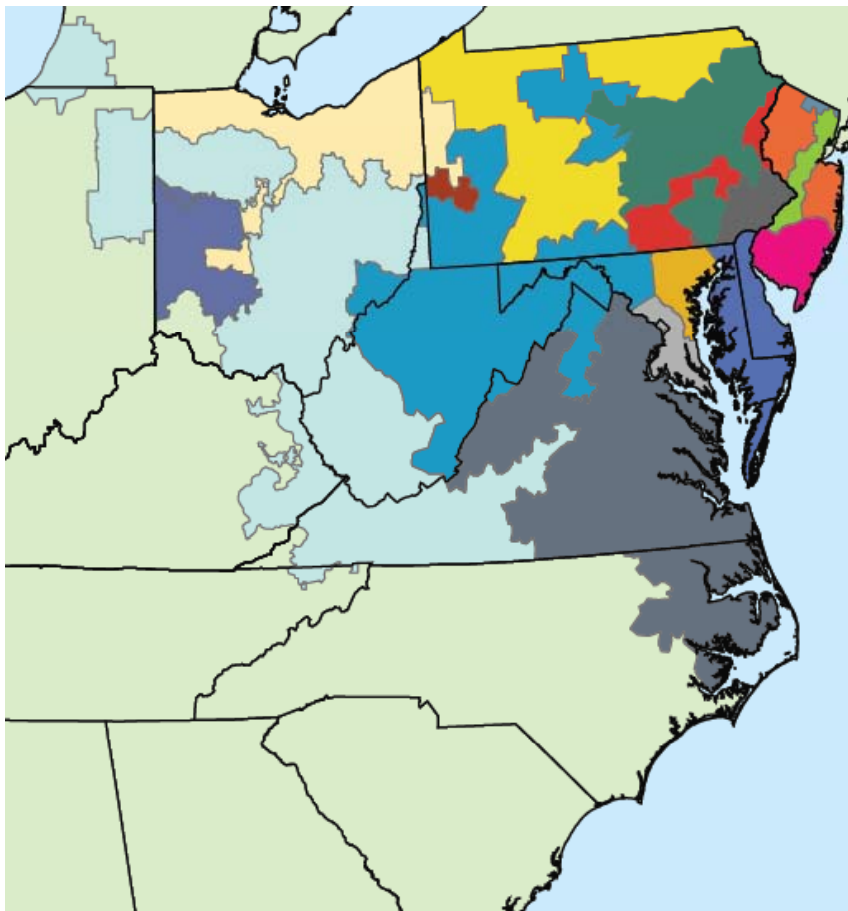
State Estimator at Dominion

- **Operates on a version of Alstom's "e-terraplatform"**
- **Over 4,000 buses**
- **Coverage**
 - Internal area: MW and MVAR
 - External area: MW only
- **State Estimation Philosophy**
 - High accuracy for internal buses
 - Focus on the accuracy in solving the MW power flow for external buses
 - Less effort is spent toward the accuracy in solving the MVAR power flow for external buses

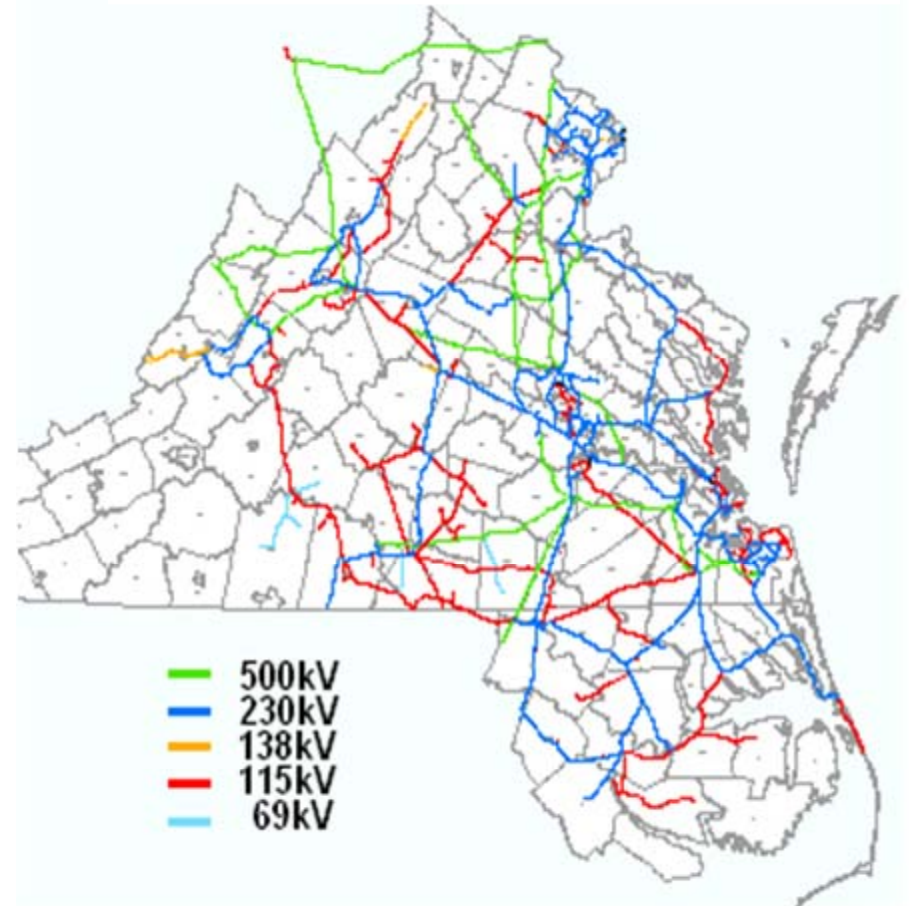


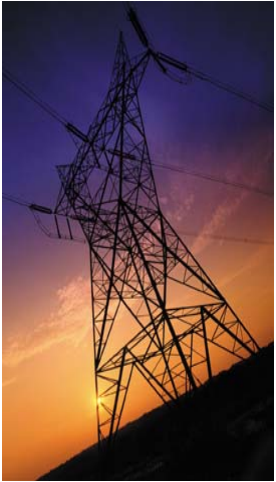
State Estimation Network Model

PJM



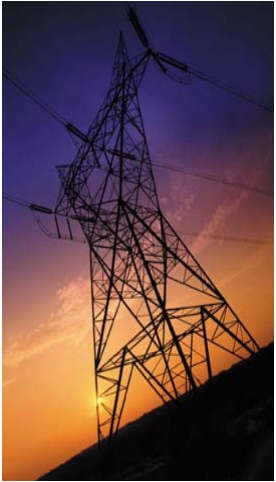
DOM Service Area





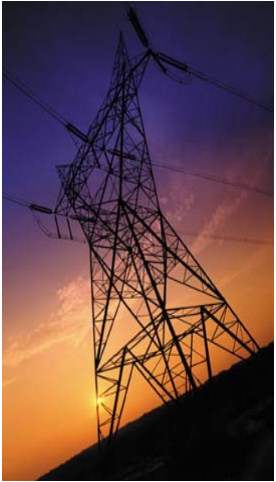
State Estimation Network Model

- **4,975 injections**
 - 863 units (90% of units have MW measurements)
 - 4,112 loads (64% of loads have MW measurements and 18% have MVAR measurements)
- **SCADA measurements**
 - Weights are determined by the assigned accuracy class



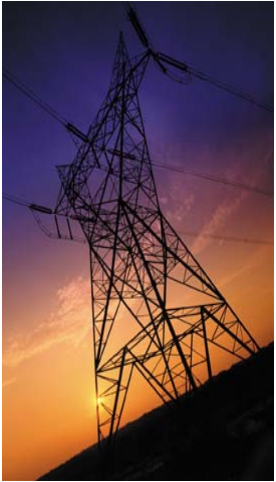
Pseudo-measurements

- **Pseudo-measurements apply when:**
 - No measurement is modeled in SCADA
 - Telemetry failure
- **Pseudo-measurement weight:**
 - An assigned accuracy class that determines the weight



Pseudo-measurement Value

- **Model value of unit MW output**
 - Area Watt Regulation (AWR) Mode
respect area transactions
 - Free Flow Mode
respect total island load



Pseudo-measurement Value

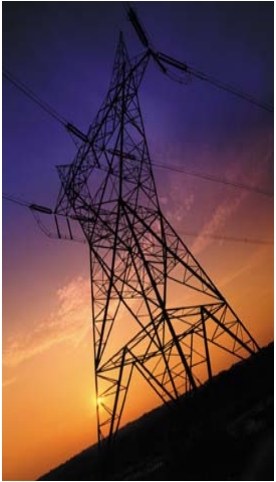
■ Model value of load:

– MW model value:

- Load → load area → associated schedule with a base and parent fraction value for every hour
- load hierarchy:
 - Internal: Load → station load area → division load area → load area
 - External: Load → division load area → load area

– MVAR model value:

- Calculated from MW model value and model power factor



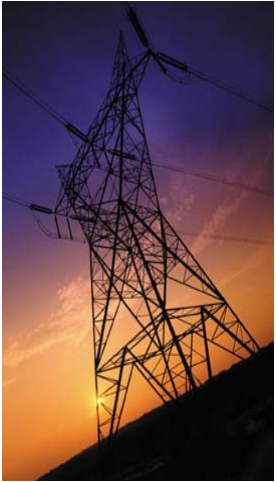
Dominion Pseudo-Measurements

- **Problem:**

- Automatically assign the same weight to MW and MVAR pseudo-measurements
- Competing between real measurements and pseudo-measurements

- **Solution:**

- Separately weight the MW and MVAR pseudo-measurements



Cautions and Possibilities for Enhanced Use of Pseudo-Measurements

- **Non-redundant measurements**
 - Do not help with bad data identification and detection
 - Bias is absorbed completely
 - Carefully calculating/forecasting the value of pseudo-measurements
- **Misidentifying bad data with highly weighted biased pseudo-measurements**
 - Assign smaller weights to pseudo-measurements
 - Check the estimation results against the real measurements

Questions?



Dominion®