PJM Interconnection
Smart Grid Investment Grant Update

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PJM Project Participants

• **PJM Leads:**
  – Project Manager: Bill Walker (walkew@pjm.com)
  – SynchroPhasor Technical Lead: Mahendra Patel (patelm3@pjm.com)

• **Vendor Partners:**
  – Electric Power Group (PDC and visualization software)
  – Quanta Technology (engineering/project management)
  – Virginia Tech University (PMU/PDC device testing)
## PJM’s Participating Transmission Owners

<table>
<thead>
<tr>
<th>Transmission Owner</th>
<th># of Substations with PMU Installations</th>
<th># of Central PDCs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Allegheny Power</td>
<td>8</td>
<td>0</td>
</tr>
<tr>
<td>American Electric Power</td>
<td>15</td>
<td>1</td>
</tr>
<tr>
<td>Baltimore Gas &amp; Electric</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Commonwealth Edison</td>
<td>4</td>
<td>1</td>
</tr>
<tr>
<td>Duquesne Light</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>FirstEnergy Services</td>
<td>7</td>
<td>2</td>
</tr>
<tr>
<td>PECO Energy</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>PEPCO Holdings Inc.</td>
<td>4</td>
<td>2</td>
</tr>
<tr>
<td>PPL Electric Utilities</td>
<td>12</td>
<td>2</td>
</tr>
<tr>
<td>Public Service Electric &amp; Gas</td>
<td>12</td>
<td>2</td>
</tr>
<tr>
<td>Rockland Electric</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>VA Electric &amp; Power (Dominion)</td>
<td>11</td>
<td>2</td>
</tr>
</tbody>
</table>
Installing PMUs at 81 substations; Building support for 150+ substations
Activated first PDC in August 2011
   - Receiving measurements from three (3) phasor units
Installed T1 telecommunication lines at four (4) Transmission Owner sites; three (3) in progress
Targeting six (6) additional TO connections by end of 4th quarter 2011
PJM receiving phasor data from MISO
• 12 Transmission Owners installing measurement devices at 81 substations
  – TO’s selecting their own vendors
• Transmission Elements Monitored
  – 64 > 345kv; 17 < 345kv
• Approx. 20% of regional footprint monitored
• Installing PMU’s, Relays, DFRs, DDRs
• Installation rate
  – 24 as of 09/2011; 47 by EOY 2011
  – 81 by EOY 2012
PDCs and Communications

• PDCs
  – 11 TO Control Centers with Central PDC
  – Archive Database Status
    • Storage Size - TBD
    • Data retention
      – 90 days real-time; 1 year near-real-time; 7 year archive

• Communication System
  – 11 dedicated links to TOs (T1 lines)
  – 2 dedicated MPLS Clouds; 1 Verizon and 1 AT&T
SynchroPhasor Applications

- Voltage Stability Monitoring
- Determination of Accurate Operating Limits
- Inter-area Oscillation Detection & Analysis
- Disturbance Analysis
- Angle & Frequency Monitoring
- Wide Area Monitoring
- Model Derivation & Validation
- Improve State Estimation
- System Restoration
- Real-time Control of corridors
- Real-time Control of wide-area network
- Detection of imminent Cascading

Deployment Challenge:
- Requires more research
- Needs moderate development
- Included in Project

Timeframe:
- 1-2 Years
- 2-5 Years
- >5 Years
• High-level Project Challenges
  – Evolving standards, technologies, & security guidelines
  – Coordination of all project stakeholders
    • TOs, Vendors, ISO/RTOs, DOE
  – TO Installation Schedule Changes
  – Estimated cost vs. actual cost spending gaps
  – Expanding scope to use available funds
    • Installing additional PMU’s
    • Data Exchange with neighboring RTO/ISO’s
    • Developing additional software applications
  – R&D approach vs. “touch it once” approach
• Architecture, Design, & Communication
  – Confidence in performance of PMU/PDC equipment
  – Ensuring the architecture is scalable
    • Add more PMU’s in the future
    • Database sizing and format
  – Complexities of sharing data between RTO/ISO, etc.
  – Internal IT architecture design
    • High-availability
    • Software limitations
    • Latency and throughput
    • UDP vs. TCP Communications
DOE Site Visit Results

• DOE Site Visit June 2011

• Recommendations
  – Update Project Execution Plan w/ schedule adjustments
  – Update Cyber Security Plan to show coordination with TO plans
  – Provide more detail on monthly reporting
  – Match invoice categories to original budget

• All related action items completed
• Other Project Updates
  – PJM and MISO currently sharing data
    • Continue to expand data sharing
  – Working with other RTO/ISO’s to create data sharing requirements
  – Talking to additional vendors on using SynchroPhasor data in existing applications
Thank You