PJM Project Participants

• **PJM Leads:**
  - Project Manager: Bill Walker ([walkew@pjm.com](mailto:walkew@pjm.com))
  - Technical Lead: Mahendra Patel ([patelm3@pjm.com](mailto:patelm3@pjm.com))

• **Vendor Partners:**
  - Electric Power Group (PDC and visualization software)
  - Quanta Technology (engineering/project management)
  - Virginia Tech University (PMU/PDC device testing)

• **Transmission Owners**
  - 12 TO’s streaming phasor data for 81 substations
Installing PMUs at 81 substations; Building support for 150+ substations
SynchroPhasor Applications

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

Deployment Challenge

- Ready to deploy
- Needs moderate development
- Requires more research

1-2 years
2-5 years
>5 years
Philosophy of Training

• Range
  ▪ Awareness through event & role specific

• Focus
  ▪ Built into existing training programs

• Delivery
  ▪ Vendor & PJM Trainers
  ▪ “Lunch & Learn”; lecture; simulation; event analysis
Applications Being Implemented

<table>
<thead>
<tr>
<th>Company</th>
<th>Company Type</th>
<th>Wide Area Frequency Monitoring</th>
<th>Wide Area Angle Monitoring</th>
<th>Oscillation Monitoring</th>
<th>State Estimation Enhancements</th>
<th>Model Validation</th>
<th>Other?</th>
</tr>
</thead>
<tbody>
<tr>
<td>PJM</td>
<td>RTO</td>
<td>RTDMS</td>
<td>RTDMS</td>
<td>RTDMS</td>
<td>TBD</td>
<td>PGDA</td>
<td>IEP</td>
</tr>
</tbody>
</table>

- **Timing**
  - Begin mid 2012 and build into Training cycle
  - Application specific training prior to deployment

- **Approach**
  - Build into Operational training w/ customization

- **Feedback**
  - PJM standard feedback and review process
# Groups Needing Training

## Groups Needing Training Table

<table>
<thead>
<tr>
<th>Comp.</th>
<th>Comp Type</th>
<th>System Ops</th>
<th>Ops Engs</th>
<th>System Planning</th>
<th>Gen Ops</th>
<th>EMS Support</th>
<th>R&amp;D Groups</th>
<th>Perform Comp</th>
<th>Security</th>
<th>IT</th>
</tr>
</thead>
<tbody>
<tr>
<td>PJM</td>
<td>RTO</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
</tbody>
</table>

### Target Groups
- Operations
- Planning
- Performance Compliance
- EMS Support
- IT

### Target Roles
- Administrators
- Power Users
- Users

### Target Hours
- Based on Group
- Based on Roles & App
Basic Phasor Training

• Introduction to Phasors
  – Synchrophasor technologies
  – PMU’s and PDC’s
  – PJM’s PhasorNet
  – PJM deployment
  – PJM Strategy

• Delivery Formats
  – PJM Power Talks
  – Operator Training sessions

• Future Training Options
• Understanding Phasor Data
• What data can it replace/enhance/confirm
• What existing applications can use data
• What new tools are available
Application Based Training

- Detailed Training for each application
- Utilize existing vendor training
- Develop PJM custom training
- Focus on PJM applicability
- Use simulated data
Wide Area Impact Training

- Initial Views
  - Eastern interconnection
  - PJM Footprint
  - Local Regions

- Other RTO Views
  - Review tools and views
  - Major load areas and interconnections
Tools to Support Training

- PJM Power Talks
- Lunch & Learn Sessions
- Recorded Info Sessions
- Hands-On App Training
- Event Simulation Training
Establishment of a Common Communication Language

• Recommend
  – Standard use of acronyms
  – Standard use of terminology
  – Standard colors and visual symbols
Relationship Between Existing Tools vs. New Phasor Based Tools

• Use existing Training methods, facilities and schedules
  – Merge Phasor training into current classes
• Minimize the number of “new” applications
• Reduce the number of screens presented to the operators
• Use data to drive/enhance existing tools
• Use Alerts and Alarms to drive attention and action where needed
Thank You