Western Electricity Coordinating Council
Assuring reliability in the Western Interconnection

Key Activities
- WECC’s “Western Interconnection Synchrophasor Program” is installing more than 300 phasor measurement units (PMUs) and 60 phasor data concentrators (PDCs) across the Western Interconnection.

Aims and Strategies
- Provide grid operators and reliability coordinators with more frequent and time-synchronized system information.
- Better system visibility will help system operators avoid large-scale regional outages, better utilize existing system capacity, and enable greater utilization of intermittent renewable generation resources.

Results and Benefits
- 19 organizations are participating in the project, providing 100% coverage for the Western Interconnection.
- Real-time information and automated controls being deployed will enable grid operators to allow an additional 100 MW of operational capacity on the California-Oregon Intertie (COI). Similar system benefits are possible in other parts of the system.

Facts & Figures
- Total Project Budget: $107,780,000
- Federal Share: $53,890,000
- Project Area: Western Interconnection, 1.8 million square miles
- Project Team: 19 utility organizations
Program Participants

- WECC – Program Awardee
  - Program Director:
    - Linda Perez lperez@wecc.biz
  - Program Manager:
    - Vickie VanZandt vrvanzandt@gmail.com
  - Technical Delivery Manager:
    - Eric Whitley ericwhitley@wecc.biz
  - Technical Architect:
    - Dan Brancaccio dbrancaccio@wecc.biz
  - Participant Liaison:
    - Vic Howell vhowell@wecc.biz
## Program Participants (cont.)

- **Cost Share Participants**
  - Bonneville Power Administration 132 PMUs, 4 PDCs
  - California ISO/CEC 0 PMUs, 2 PDCs
  - Idaho Power Corporation 4 PMUs, 1 PDC
  - NV Energy 14 PMUs, 5 PDCs
  - Pacific Gas & Electric 158 PMUs, 26 PDCs
  - PacifiCorp 3 PMUs, 2 PDCs
  - Salt River Project 21 PMUs, 2 PDCs
  - Southern California Edison 32 PMUs, gateways
  - WECC 6 gateways

**TOTAL** 364 PMUs, 48 PDCs
Program Participants (cont.)

<table>
<thead>
<tr>
<th>10 Additional Participants in WISP</th>
<th>PMUs</th>
<th>PDCs</th>
</tr>
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<tbody>
<tr>
<td>Alberta Electric System Operator</td>
<td>6</td>
<td>1-2</td>
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<tr>
<td>Arizona Public Service</td>
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<td>1-2</td>
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<tr>
<td>British Columbia Hydro</td>
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<td>1-2</td>
</tr>
<tr>
<td>Los Angeles Dept of Water &amp; Power</td>
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<td>1-2</td>
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<tr>
<td>Northwestern Energy</td>
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<td>1-2</td>
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<tr>
<td>Public Service of New Mexico</td>
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<td>1-2</td>
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<tr>
<td>San Diego Gas and Electric</td>
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<tr>
<td>Tri-State G&amp;T</td>
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<td>Tucson Electric</td>
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<tr>
<td>Western Area Power Admin</td>
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<tr>
<td>TOTAL</td>
<td>75</td>
<td>10-20</td>
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</table>
WECC Synchrophasor Infrastructure

Phasor Measurement Units (PMUs) and Phasor Data Concentrators (PDCs) in the Western Interconnection

- PMU locations
- PDC locations
## WISP Milestone Schedule

<table>
<thead>
<tr>
<th>WECC Project Tasks</th>
<th>Start</th>
<th>Finish</th>
<th>2011</th>
<th>2012</th>
<th>2013</th>
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<tr>
<td></td>
<td></td>
<td></td>
<td>Q1</td>
<td>Q2</td>
<td>Q3</td>
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<tr>
<td><strong>WECC Data Center Expansion</strong></td>
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<tr>
<td>Data Center Expansion - Vancouver</td>
<td>Nov-10</td>
<td>Apr-11</td>
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<tr>
<td>Data Center Expansion - Loveland</td>
<td>Mar-11</td>
<td>Oct-11</td>
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<tr>
<td><strong>IT Infrastructure Deployment</strong></td>
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<tr>
<td>IT Test Environment Build (Vancouver, WA)</td>
<td>Mar-11</td>
<td>Jun-11</td>
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<tr>
<td>IT Production Environment Build (Vancouver, WA)</td>
<td>Sep-11</td>
<td>Jul-12</td>
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<td>IT Production Environment Build (Loveland, CO)</td>
<td>May-12</td>
<td>Aug-12</td>
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<td><strong>Wide Area Network Deployment</strong></td>
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<td>WAN Core Network Deployment</td>
<td>Jun-11</td>
<td>Nov-11</td>
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<td>WAN Router Installation &amp; Configuration</td>
<td>Oct-11</td>
<td>Apr-12</td>
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<td>PDC to PDC Communications Testing</td>
<td>Jan-12</td>
<td>Aug-12</td>
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<td><strong>Application Delivery</strong></td>
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<td>Modal Analysis Software (Montana Tech Solution)</td>
<td>Aug-10</td>
<td>Sep-12</td>
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<td>Installation &amp; Acceptance of Alstom Grid / Psymetrix vQ3 2011</td>
<td>Aug-11</td>
<td>Nov-11</td>
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<td>Installation &amp; Acceptance of Alstom Grid / Psymetrix vQ1 2012</td>
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<td>Installation &amp; Acceptance of Alstom Grid / Psymetrix vQ2 2012</td>
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<td>Systems Integration and Testing</td>
<td>Sep-11</td>
<td>Dec-12</td>
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<td><strong>Application Development</strong></td>
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<td>System Prototype Deployment</td>
<td>Jun-10</td>
<td>Apr-11</td>
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<td>WECC RC.Org and PMU Registry</td>
<td>Oct-10</td>
<td>Oct-11</td>
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<td>Historical Data Archive &amp; Reporting</td>
<td>Apr-11</td>
<td>Jun-12</td>
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<td>Wide Area View Application</td>
<td>Aug-11</td>
<td>Jun-12</td>
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<td>NASPInet Phasor Gateway Demonstration</td>
<td>Jan-12</td>
<td>Aug-12</td>
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<tr>
<td><strong>System Acceptance &amp; Cutover</strong></td>
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<tr>
<td>RC and IT Readiness &amp; Training Activities</td>
<td>Jun-12</td>
<td>Dec-12</td>
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<tr>
<td>Business Acceptance &amp; Pre-Operations Test</td>
<td>Oct-12</td>
<td>Mar-13</td>
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<tr>
<td>Final RC Acceptance &amp; Go-Live</td>
<td>Mar-13</td>
<td>Mar-13</td>
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</table>
• 18 Transmission Owners will deploy over 400 PMUs (some outside the WISP grant)
  o Each entity will select its own vendor
• 100% coverage of Western Interconnection
  o Coverage depends on application
• Variety of Types
  o Stand alone
  o DFR
  o Relay-based
\textbf{PMUs (cont.)}

- 244 Substations with PMUs
- Sampling Rate 30-120 sps
- Installation Rate:
  - 2011 Q3 22
  - 2011 EOY 38
  - 2012 EOY 267
  - 2013 Q1 362
## PDCs

- RC centers with PDCs 2
- BA/TO control centers with PDCs 21
- Field PDCs 25
- Archive/database
  - Storage duration and capacity:
    - All Data On-Line – 3 months – 20 TB
    - All Data Off-Line – 15 months – 100 TB
    - Disturbances – forever – TBD
Communications

• Dedicated, private Wide Area Network (WAN)
• Provided by Harris Corporation
  o WAN from RCs up to TOs/ISOs edge routers under contract to WECC
  o Centralized management
  o Core Network Deployment: Nov. 2011
  o PDC to PDC Communications Testing: Aug. 2012
• Enables peer-to-peer communication
• Will facilitate NASPInet phasor gateway pilot – Aug. 2012
PMU/PDC/Signal Registry & Wide Area View (WAV)

• WECC In-house development: Oct. 2011
• Release 1 complete (Agile development, 8 Sprints).
  o Includes initial release of WECCRC.org.
  o PMU Registry – general application layout and styling completed.
  o PMU Registry device element structure and attributes complete.
  o Network security model complete.
PMU/PDC/Signal Registry & Wide Area View (WAV) – (cont.)

• Release 2 complete (Sprint 9).
  o Includes initial release of WAV, PMU Registry map and tree view.
  o Completed WAV high-level requirements.
  o Technology selection for the WAV user interface is complete.
PMU Registry
Demonstration Tomorrow
Major Operational Applications

- Number of TOs/ISOs sharing phasor data: 18
  - Alstom/Psymetrix – General visualization, monitoring, alarming and archiving.
  - Vendor selection underway – Voltage Stability.
Major Operational Applications

• Wide Area View: June 2012
  o WECC in-house development – Telerik mapping, Silverlight display.

• Automated Report Generation: June 2012
  o System performance following events.
  o For baselining, model validation, trending.

• Response-Based Controls: BPA – March 2015
  o Fast reactive switching.
  o Primary and total reactive requirements for wind power plants.
Challenges and lessons learned

• Biggest Technical Challenge
  o Data mining tools for information retrieval.

• Biggest Programmatic/Execution Challenges
  o Took much longer than originally expected:
    ▪ Execute agreements among participants.
    ▪ Finalize contracts for infrastructure and applications.
    ▪ Begin infrastructure construction.
  o Need an additional Data Sharing Agreement
    ▪ To protect source data other than synchrophasors for WAV.
Acknowledgement and Disclaimer

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