Western Electricity Coordinating Council

The Western Interconnection Synchrophasor Program (WISP)

Smart Grid Investment Grant

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Project Overview

- WISP is an interconnection-wide synchrophasor system expected to enable smart grid functionality.
- WISP will deploy:
  - Upgraded or replacement Phasor Measurement Units (PMU)
  - New PMUs
  - Phasor Data Concentrators (PDC) and SuperPDCs
  - Historical data archival systems at the WECC Reliability Offices
  - Network architecture to connect measurement devices

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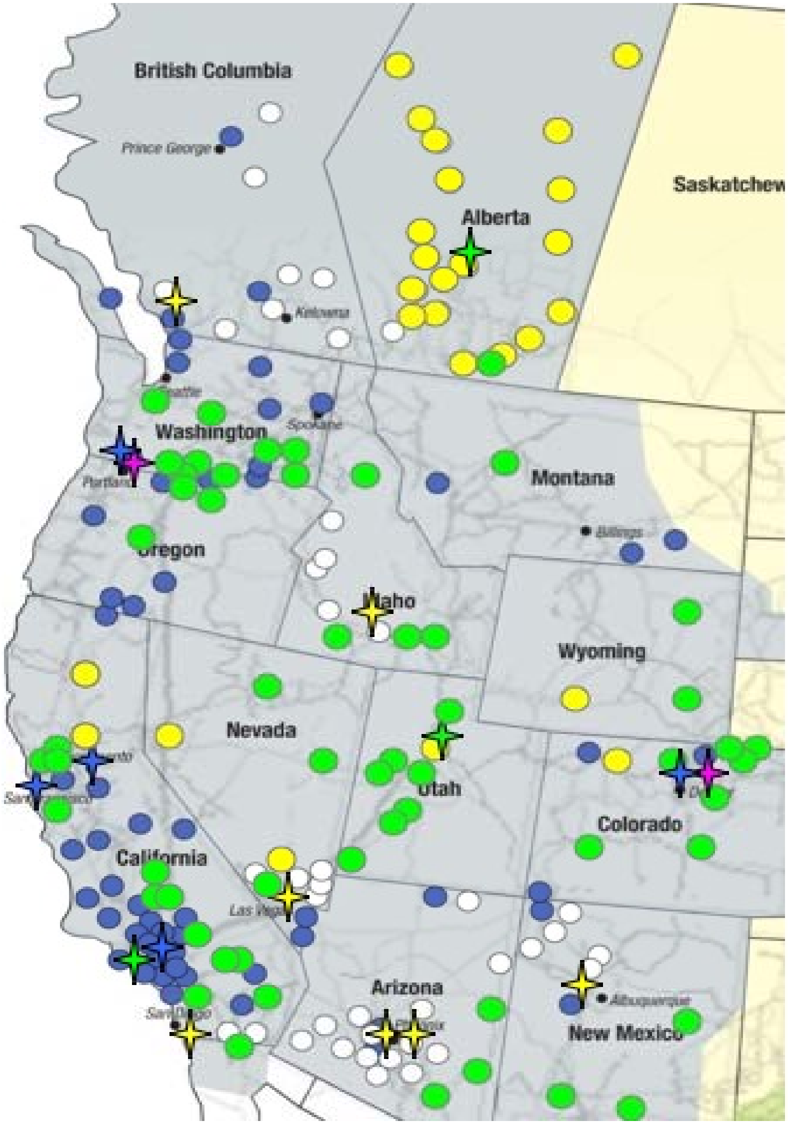
Project Overview

- Real-time and off-line applications for:
  - Situational awareness for operators and reliability coordinators
  - Event and system performance analysis for operations and planning engineers
  - Model validation and improvement
  - Real-time control and protection – including wide-area controls
  - System restoration
- Funding ($54M from DOE and $54M from WISP Partner Entities)

Project Overview



Phasor Measurement Units (PMU) in the Western Interconnection

Legend

- Phasor Data Concentrator (PDC)
- Networked PDC
- Desirable future PDC
- Desirable future Super PDC
- Networked PMU – Multiple PDC
- Networked PMU – Single PDC
- PMU Not Networked
- Desirable future PMU

Project Goals

- WHAT:
  - Significant reliability enhancement
  - Economic growth
  - Job creation through vendor-partner involvement and partner staffing increases
  - Catastrophic event avoidance

Project Goals (continued)

- HOW:
  - Improved integrated system operations
  - More efficient asset use
  - Knowledge-based real-time advanced warning systems
  - Improved market efficiency
  - More reliable and efficient integration of intermittent renewable resources

System Design Elements

- The large-scale deployment of PMUs (250-300) and PDCs throughout the U.S. portion of the Western Interconnection.
- A new private wide-area network backbone that meets:
  - performance, reliability, and security requirements
  - any-to-any communication for real-time phasor data exchange between entities in the Western Interconnection
  - End-to-end design from PMU to Reliability Center to ensure interoperability

System Design Elements *(continued)*

- The planning, design, coordination, and demonstration of WECC's ability to integrate synchrophasor data exchange through NASPInet.
- The expansion of existing WECC Reliability Office data facilities to support new system infrastructure and technology.

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Synchrophasor Applications

- Wide-Area Situational Awareness
  - Trending of interconnection frequency, voltages, path loadings, phase angles, and oscillation energy
  - Phase angle alarming
  - Reactive reserve monitors
  - Voltage instability indicators
  - Mode meter

Synchrophasor Applications (continued)

- Regional Control Schemes
  - Fast reactive switching
  - Primary and total reactive management for wind sites
- System Performance Baselining and Event Analysis
  - Power system performance analysis
  - Data mining tools
- System-Wide Model Validation
  - Generators, HVDC, loads, overall system

This Project is Special Because…

- It is interconnection-wide in scope
- It is the largest of the Smart Grid Investment Grant projects in the Electric Transmission Category
- It has both public and private Partner Entities
- It will deploy visualization of power system oscillations (a particular vulnerability in the West) and will provide decision support for mitigation
- It will demonstrate NASPInet
- It will deploy wide-area response-based controls

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Partner Entities

- Participants in WECC Proposal
  - Southern California Edison
  - Bonneville Power Administration
  - Pacific Gas & Electric
  - California ISO/California Energy Commission
  - Salt River Project
  - PacifiCorp
  - Idaho Power Corporation
  - NV Energy

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Project Participants

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- Key Technical Contributors:

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PMUs and Owners

- 250 – 300 PMUs expected to be deployed.
  - Many of these will be replacements
  - Some will be redundant
  - Some will have local application instead of a West-wide roll up to the WECC Reliability Coordination Offices
- 114 sites are considered higher priority for West-wide applications and ownership extends beyond the WISP Partner Entities. WISP is engaging these parties now.

High Priority PMU Sites and Owners (Preliminary)

Owner	Priority 1 sites	Owner	Priority 1 sites
Alberta Electric System Operator	5	PacifiCorp	7
Arizona Public Service	4	Pacific Gas and Electric	19
Bonneville Power Admin	28	Public Service of New Mexico	3
British Columbia Trans Corp	8	San Diego Gas & Electric	2
El Paso Electric	3	Salt River Project	4
Idaho Power Corp	3	Southern California Edison	6
Los Angeles Dept Water & Power	4	Tri-State G & T	1
Northwestern Energy	2	Tucson Electric	2
NV Energy	5	Western Area Power Admin	8

PMU Location Selection Criteria – 2-5-10 Draft

Category	Requirement	Voltage	Measurements
1. Major Transmission Paths	Transmission paths that have a rating equal to or greater than 800 MW (amount is new)	> 300 kV	- 3-phase bus voltage - 3-phase currents in each line that is a part of the transmission path and meets voltage threshold
2. HVDC lines and links (new)	Lines and links that have a rating equal or greater than 150 MW	>+/- 200 KV	- 3-phase phase bus voltage - 3-phase currents at its terminals
3. Large EHV station (new)	EHV substations that have more than seven transmission elements (lines, transformers) connected	> 300 kV	- 3-phase bus voltage - 3-phase currents in each transmission element
4. Large generating power plants	Substations that have total more than 1000 MW of generating capacity connected	> 200 kV	- 3-phase bus voltage - 3-phase currents in each powerhouse line
5. Individual generating units	Generator units greater than 150 MW (see Note 2)	> 200 kV	- 3-phase bus voltage - 3-phase currents at POI

PMU Location Selection Criteria – 2-5-10 Draft (continued)

Category	Requirement	Voltage	Measurements
6. Intermittent generating units (new)	Generator units greater than 100MW	Any	- 3-phase bus voltage - 3-phase currents at POI
7. Critical generating facilities	Power plants whose outage will reduce a rating of a major transmission path (defined above) by 5% or 100 MW	> 200 kV	- 3-phase bus voltage - 3-phase currents at POI
8. Dynamically Controlled Devices	Synchronous condensers, static VAR compensators and all FACTS devices greater than 100 MVA rating not otherwise included.	> 200 kV	- 3-phase bus voltage - 3-phase currents
9. Large Load Centers	Load serving lines of one or more substations that have a combined served load of greater than 750 MW	> 200 kV	- 3-phase bus voltage, - 3-phase currents in load transformers
10. RAS control elements (new)	A substation where either measurements are taken to initiate a response-based RAS action or a RAS action is applied (including power plants armed for RAS)	> 200 kV	- 3-phase bus voltage - 3-phase current in transmission elements that are a part of a RAS scheme

Security Approach

Physical Security (Adherence to CIP – 006)

- Physical perimeter monitoring and robust physical access control systems and processes
- Current controls to be extended to cover WECC data center expansion at Reliability Coordination Offices in Vancouver, WA and Loveland, CO

Security Approach (continued)

Cyber Security

- Key WECC design principles:
  - Defense in depth
  - Minimize the attack surface
  - Separation of duties
  - Least privileges
  - Use a positive model (deny by default)
  - Assume external systems and services are insecure
- Adherence to NERC CIP 002-1 through 009-1

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Security Approach (continued)

Cyber Security (continued)

- Align with NERC on Risk-based Assessment Approach
  - Risk to Bulk Electric System (BES) assessed based on system/device role and use of output (data) in maintaining reliability of the BES
    - PMUs and PDCs to be assessed based on the USE of the data they provide
  - Risk Assessment and Validation process to be built into each phase of the WISP lifecycle (planning, design, build, test, and implementation)

Security Approach (continued)

Concerns

- Baselining the WECC Security approach to NERC CIP 002-1 through 009-1, which is currently under review for change

Project Timeline

Questions