



Next Steps: Taking Synchrophasor Technology to ERCOT Operations

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**INTERNATIONAL SYNCHROPHASOR SYMPOSIUM
MARCH 22-24, 2016, Atlanta, Georgia, USA**

The ERCOT Synchrophasor (PMU) Project

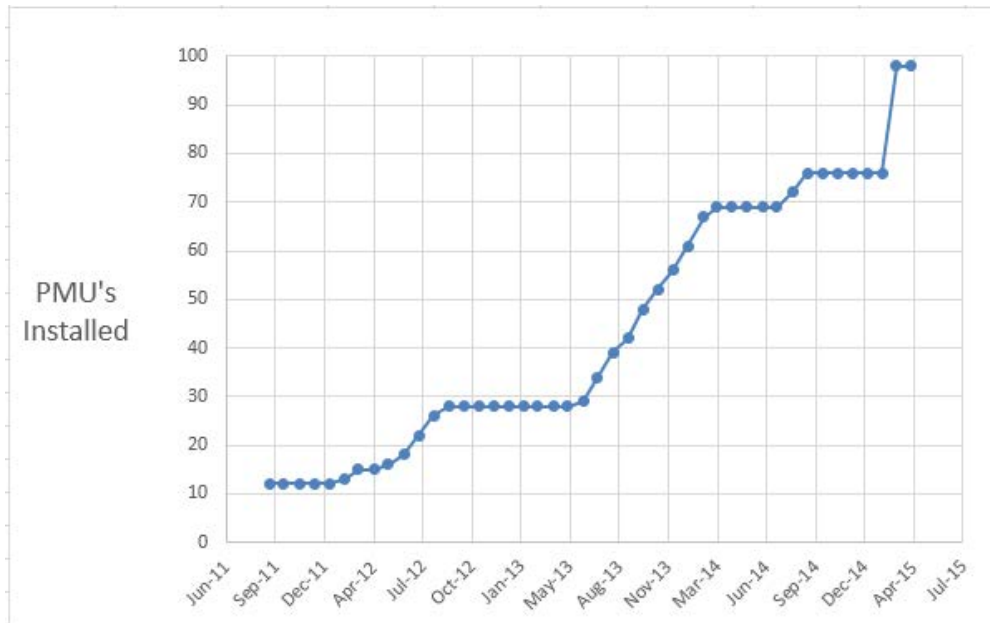
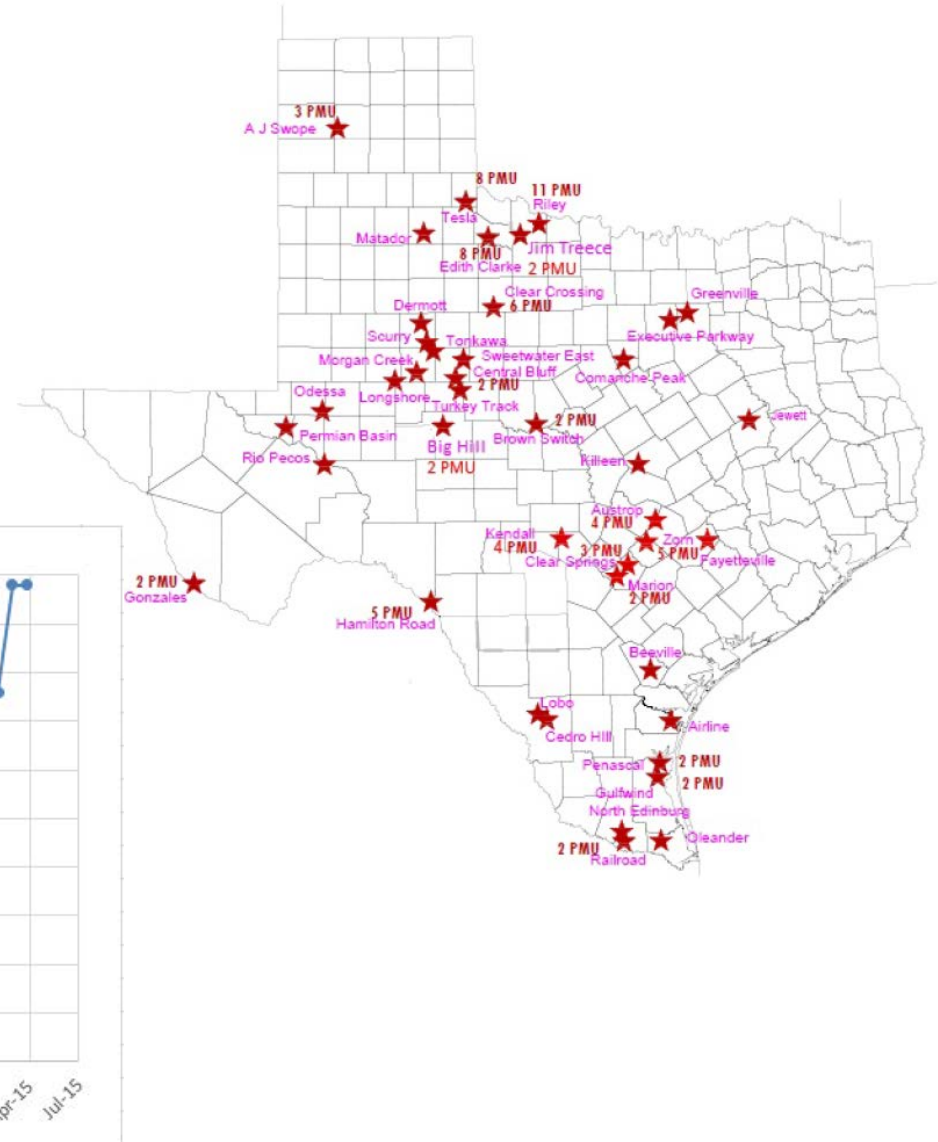
- **Awarded to CCET** - Texas 501(c)6 non-profit formed in 2005
- **CCET Members and Mission:** 21 corporate members and 5 university cooperators. Mission - enhance the safety, reliability, security, and efficiency of the Texas electric transmission and distribution system through research, development and commercialization of emerging technologies (<http://www.electrictchnologycenter.com>)
- **Awarded Jan 4, 2010:** DE-OE-0000194; Value \$27 million (DOE 50%); 17 participants; 3 Components – Synchrophasors, Smart Meter Texas Portal, and Smart Grid Community of the Future; 3 phases – Planning, Design, Demonstration
- **Title:** *Discovery Across Texas: Technology Solutions for Wind Integration in ERCOT*
- **Goal:** Demonstrate a synergistic approach to managing fluctuations in wind power (currently 8 GW increasing to 18 GW) in the ERCOT transmission grid through better system monitoring capabilities, enhanced operator visualization, and improved load management
- **Synchrophasor Project Participants:** ERCOT, TOs, Electric Power Group – Lead for Synchrophasor portion of the project
- **Project ended in Dec 2014**
- **Reports submitted to DOE**
- **Some presentations available on NASPI website (www.NASPI.org)**

[Details: http://www.ercot.com/gridinfo/etts/ccet/index.html](http://www.ercot.com/gridinfo/etts/ccet/index.html)

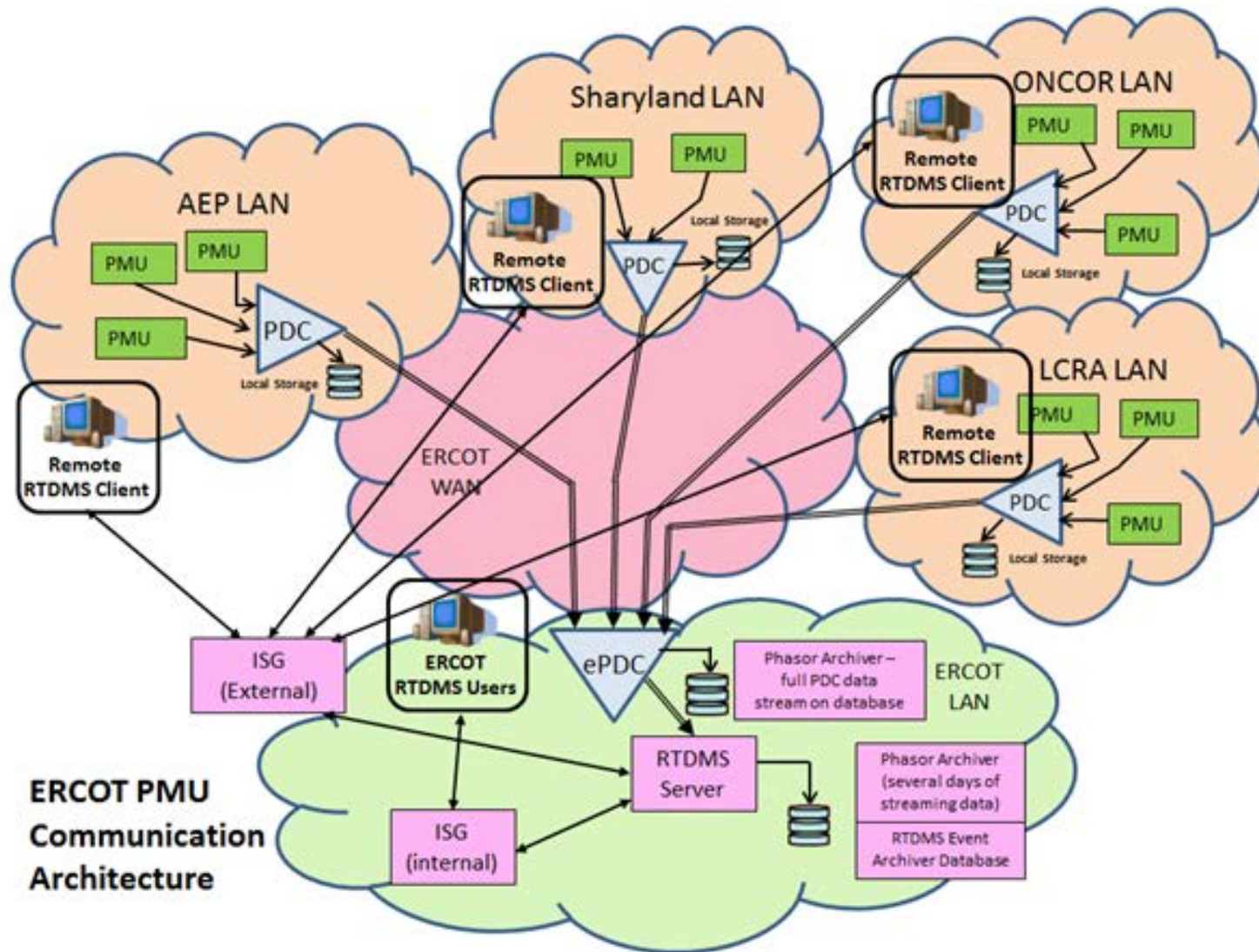
Number of PMUs in CCET Project (as on Dec 2015)

- **Total 98 PMUs @ 42 Locations**

- AEP: 55
- ONCOR: 17
- Sharyland: 5
- LCRA: 21 (Not part of DOE Project)



The Synchrophasor Data Communication Network



**ERCOT PMU
Communication
Architecture**

ERCOT ROS Synchrophasor Task Force

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PHASOR MEASUREMENT TASK FORCE

The purpose of the PMTF is to formalize a framework of requirements and criteria associated with the provision of phasor measurement data to ERCOT through the initiation of appropriate Protocol and Guide changes after consideration of the capabilities of the technology, the expected and required uses of the data, and the relevant policy considerations.

Contact Information
Chair: [Kristian Koellner](#)
Vice Chair: [Bill Blevins](#)

Send an email to this group: pmtf@lists.ercot.com
([Subscribe](#) to this email list.)

Scheduled Meetings and Meeting Details

January 08, 2014	February 05, 2014	March 07, 2014
April 09, 2014	May 14, 2014	June 04, 2014
June 11, 2014	July 09, 2014	August 06, 2014
September 03, 2014	October 01, 2014	October 29, 2014
December 03, 2014		

([Subscribe to calendar and receive meeting updates.](#) [Get help](#) with calendar subscription.)

Key Documents

- [ERCOT PMTF 2014 Roster](#) (03/18/2014, xls, 45 KB)
- [Phasor Measurement Task Force Scope ROS Approved March 6 2014](#) (03/06/2014, doc, 46 KB)
- [PMTF Issues List 030714](#) (03/18/2014, doc, 52 KB)

All information is posted as Public in accordance with the ERCOT Websites Content Management Corporate Standard.

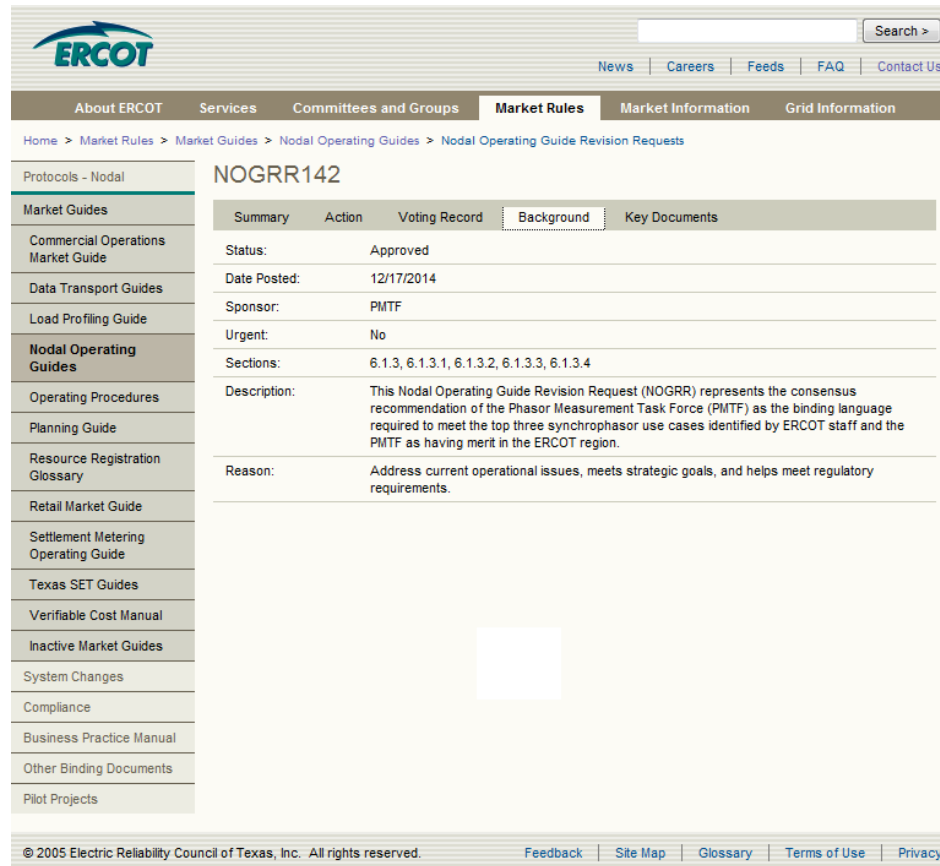
Archives
[2013 Archives](#)

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- Synchrophasor Technology Assessment
 - Addresses the major questions posed to the PMTF by ROS
 - Includes an overall summary of key recommendations
- Synchrophasor Communication Handbook
 - Provides guidance for connecting new PMUs to ERCOT's network
- Draft Nodal Operating Guide Section 6 language
 - Recommends language to formalize the placement and usage of PMUs within ERCOT
- ERCOT's NOGRR142
 - Approved on May 28, 2015 and effective from June 1, 2015
 - <http://www.ercot.com/mktrules/issues/NOGRR142#summary>

Details of ERCOT's NOGRR142

- Approved on May 28, 2015 and effective date: June 1, 2015
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Protocols - Nodal

Market Guides

Commercial Operations Market Guide

Data Transport Guides

Load Profiling Guide

Nodal Operating Guides

Operating Procedures

Planning Guide

Resource Registration Glossary

Retail Market Guide

Settlement Metering Operating Guide

Texas SET Guides

Verifiable Cost Manual

Inactive Market Guides

System Changes

Compliance

Business Practice Manual

Other Binding Documents

Pilot Projects

NOGRR142

Summary	Action	Voting Record	Background	Key Documents
Status:	Approved			
Date Posted:	12/17/2014			
Sponsor:	PMTF			
Urgent:	No			
Sections:	6.1.3, 6.1.3.1, 6.1.3.2, 6.1.3.3, 6.1.3.4			
Description:	This Nodal Operating Guide Revision Request (NOGRR) represents the consensus recommendation of the Phasor Measurement Task Force (PMTF) as the binding language required to meet the top three synchrophasor use cases identified by ERCOT staff and the PMTF as having merit in the ERCOT region.			
Reason:	Address current operational issues, meets strategic goals, and helps meet regulatory requirements.			

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Details of ERCOT's NOGRR142 (Contd.)

■ Sections of Protocol

➤ 6.1.3 Dynamic Disturbance Recording Equipment

✓ 6.1.3.1 Recording Requirements (new)

- Sampling rate, format, transmitted or locally stored

✓ 6.1.3.2 Location Requirements (new)

- FACT devices, GTCs, new generating sites $\geq 20\text{MVA}$

✓ 6.1.3.3 Data Recording and Redundancy Requirements (new)

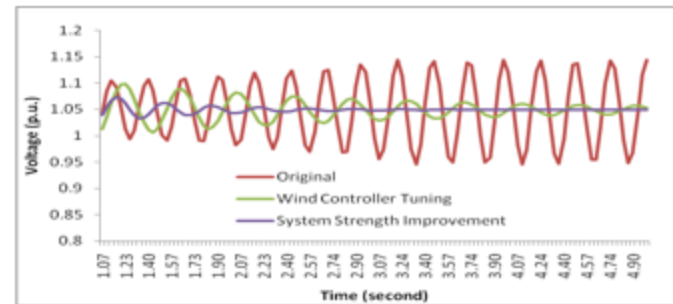
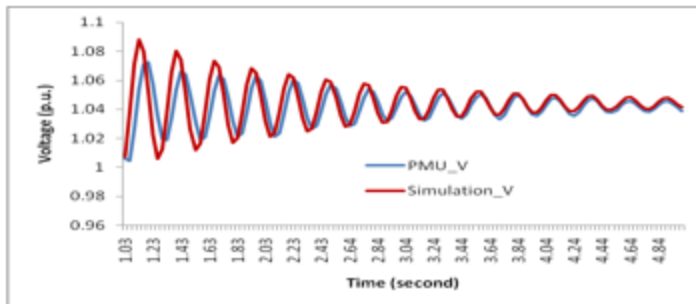
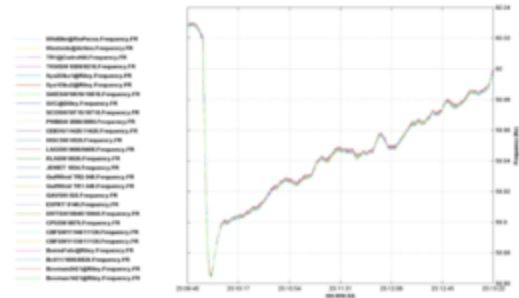
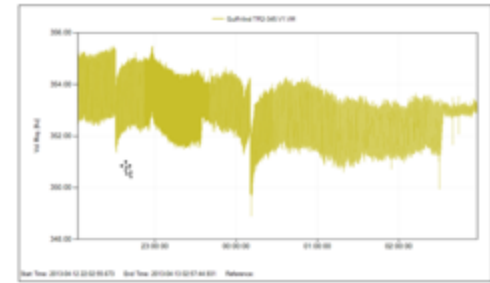
- Voltage, current, frequency, df/dt

✓ 6.1.3.4 Data Retention and Reporting Requirements (new)

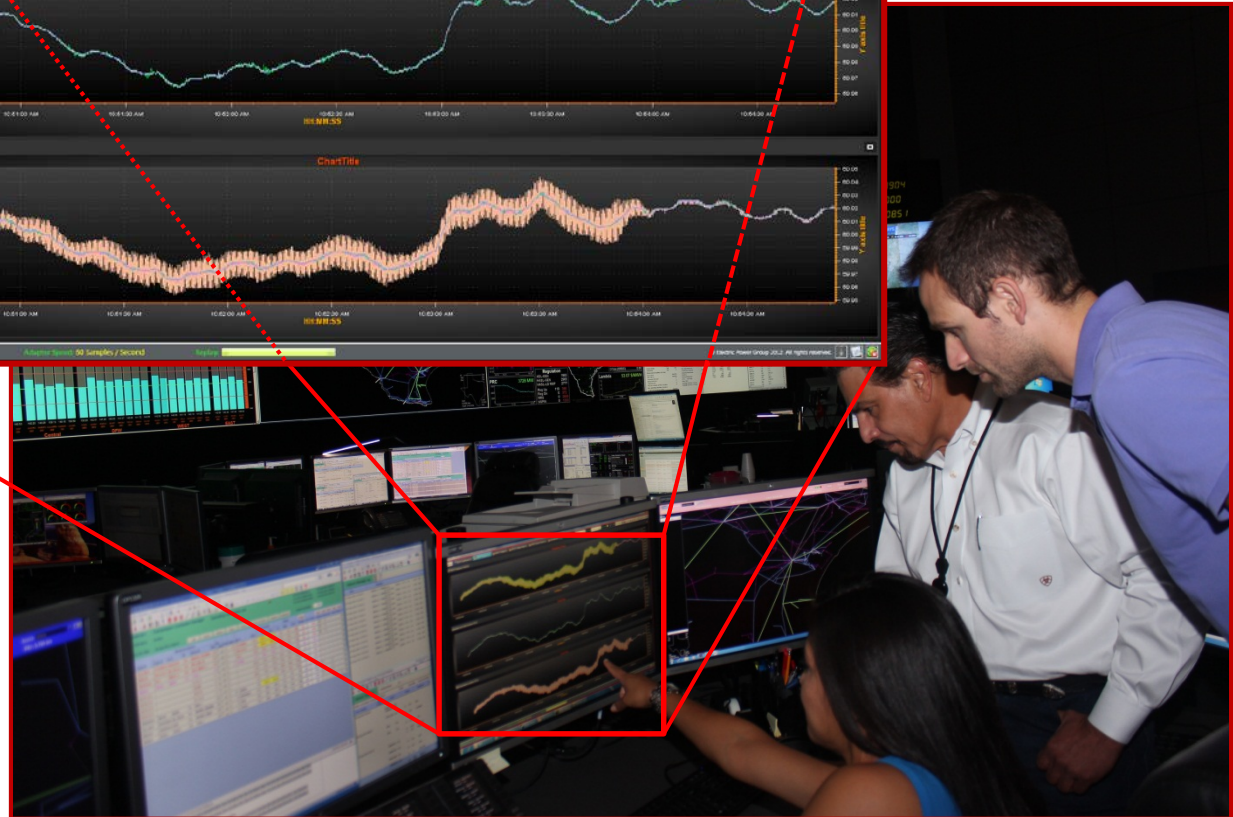
- 10 day for all data, 3 year for event data

How Synchrophasor Data Is Being Used

- **System Oscillations**
- **Event Analysis**
- **Generator Model Validation/Tuning**



Synchrophasor technology in ERCOT Control Center



PSOT Project

PHASOR SIMULATION FOR OPERATOR TRAINING (PSOT)

Event Libraries and Integration with TSAT and RTDS for Real Time Simulations



DOE Grant Award DE-OE0000702

NASPI Presentation

Cost Share Partners- Bill Blevins, ERCOT and Frank Ashrafi, SCE

Prime Contractor – Jim Dyer, EPG

March 24, 2015

PSOT Project (Cont'd)

PSOT Project Participants

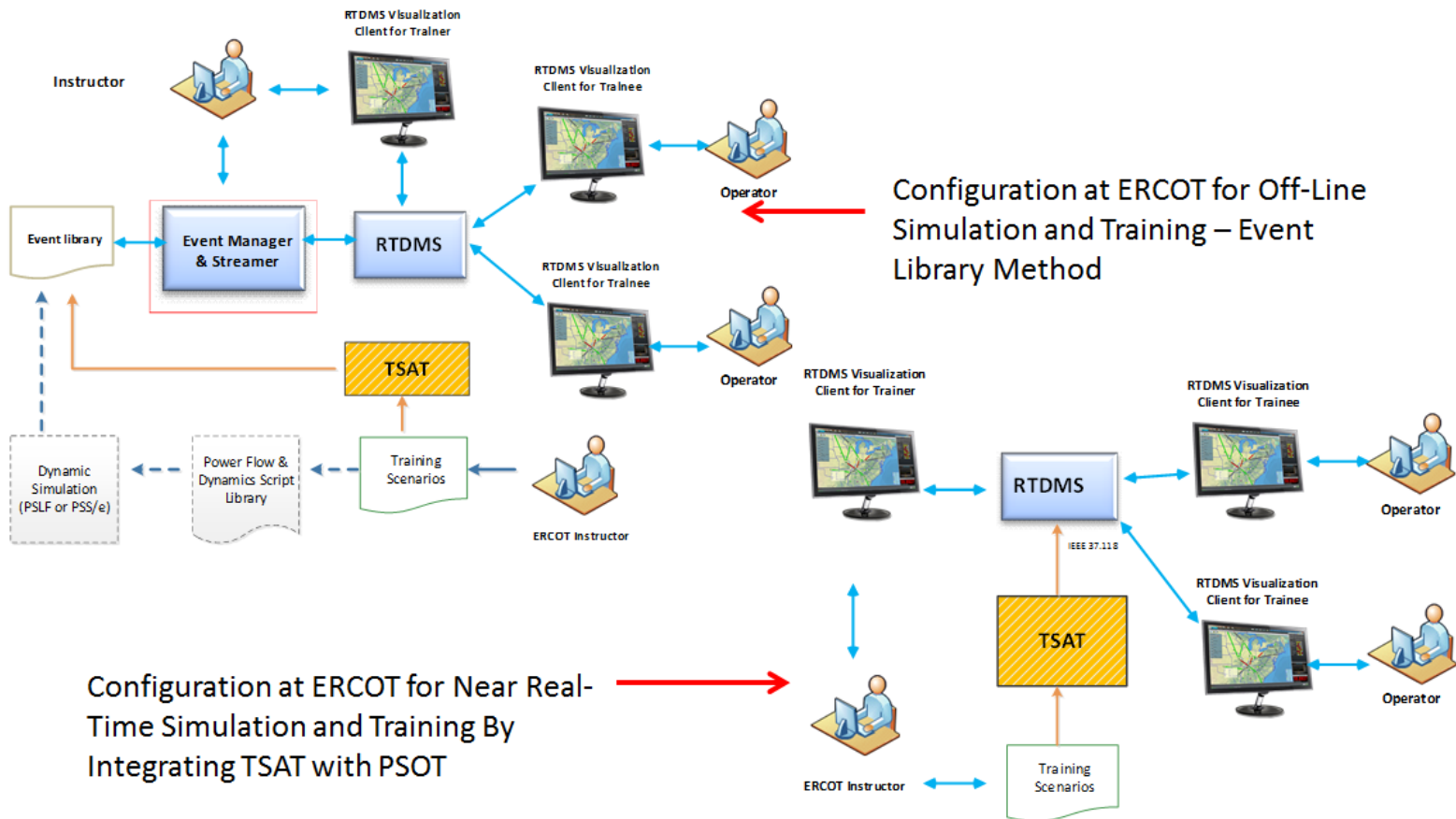
- **Southern California Edison (SCE)** – Cost Share Participant
 - Project Manager/Alternate - Frank Ashrafi/Nagy Abed
- **Electric Reliability Council of Texas (ERCOT)** - Cost Share Participant
 - Project Manager/Alternate - Bill Blevins/ Sarma (NDR) Nuthalapati
- **Dominion Virginia Power** (Dominion)
 - Adviser/Observer - Matt Gardner
- **Electric Power Group, LLC** – Prime Contractor
 - Project Manager - Jim Dyer
 - Key Project Personnel – Bharat Bhargava, Prashant Palayam, Simon Mo, Iknoor Singh
- **Powertech Labs Inc.** – Added to Project for Real Time Simulations with TSAT
 - Project Management - Lie Wang and George (Gang) Zheng

PSOT Project Objectives & Goals

- Research, design, develop and demonstrate a pre-commercial phasor-based training simulator to train power system operators on the use of synchrophasor technology
- Designed for operators to:
 - Understand phasor technology
 - Get familiar with dynamic metrics
 - Enable operators to visualize events using simulations
 - Utilize a library of events, both generic and utility specific, for use in training sessions
 - Test different actions and their effectiveness using simulations
 - Gain a wide area perspective, early warning indications and situational awareness of the interconnected grid

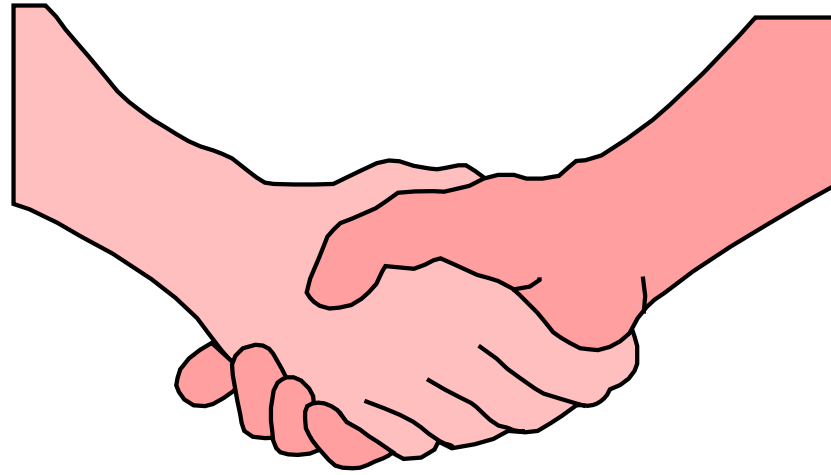
PSOT Project (Cont'd)

PSOT Flow Diagram for ERCOT



Future (Next To Next) Steps

- **Develop redundant RTDMS Systems in ERCOT Control Centers**
- **Provide Training to Operators using PSOT system**
- **Develop procedures for the operators in the control center**
- **Incorporate in Blackstart training**
- **Include in new EMS state estimator**
- **Potential linear state estimator for specific interfaces as a backup**
- **Add to existing Operator displays such as PI displays**
- **Add to Macomber Map**



Thank You !!