

# DOE/OE Transmission Reliability Program

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## WECC Frequency Response Tool

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**CERTS**  
CONSORTIUM FOR ELECTRIC RELIABILITY TECHNOLOGY SOLUTIONS

# Project team

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- PNNL
  - Pavel Etingov
  - David Chassin
  - Yu Zhang
- BPA
  - Dmitry Kosterev
  - Steve Yang
- Project is funded by U.S. DOE through American Recovery and Reinvestment Act of 2009 (ARRA)



# Background

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- A set of software tools has been developed in cooperation with BPA, WECC Joint Synchronized Information Subcommittee (JSIS) and Modeling and Validation Work Group (MVWG)
  - Power Plant Model Validation (PPMV) tool
  - Frequency Response Tool (FRT)
  - Load Modeling Data Tool (LMDT)
- The tools are released under open source license
- All tools are stand-alone Windows applications



# Project Objectives (1)

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## Frequency Response Analysis Tool

- Frequency response is a measure of an Interconnection's ability to stabilize frequency immediately following the sudden loss of generation or load.
- NERC developed Frequency Response BAL-003-1 Standard, FERC approved the standard with effective date April 1<sup>st</sup> 2015.
- PNNL was requested by WECC JSIS to develop a tool to automate the analysis of interconnection frequency response:
  - The tool calculates NERC Frequency Response Measure (FRM) using PMU measurements.
  - The tool has advanced visualization capabilities
  - The tool archives the historic events and baselines the system performance.
  - The tool automatically generates reports



# Project Objectives (2)

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## Power Plant Model Validation Tool

- Validation of power system models for power flow and dynamic studies is very important for ensuring that these models are accurate and up to date.
- FERC approved NERC MOD 026/027 Reliability Standard that require verification of excitation and governor models effective date July 1<sup>st</sup> 2014.
- PMU based model validation is acceptable way to meet the standard.
- PNNL was requested by WECC JSIS to develop the tool to automate the process of power plant model validation using disturbance recordings.
  - The tool interacts with GE PSLF
  - The tool uses GE PSLF Play-In Function for generator model validation.
  - Database of projects (model validation studies)
  - Database of the historic events.
  - Database of the power plant
  - The tool has advanced visualization capabilities
  - The tool automatically generates reports



# Project Objectives (3)

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- WECC MVWG completed development of phase one composite load model
- WECC requested PNNL to develop a Load Model Data Tool to create dynamic load model records for GE PSLF and Siemens PTI PSS®E



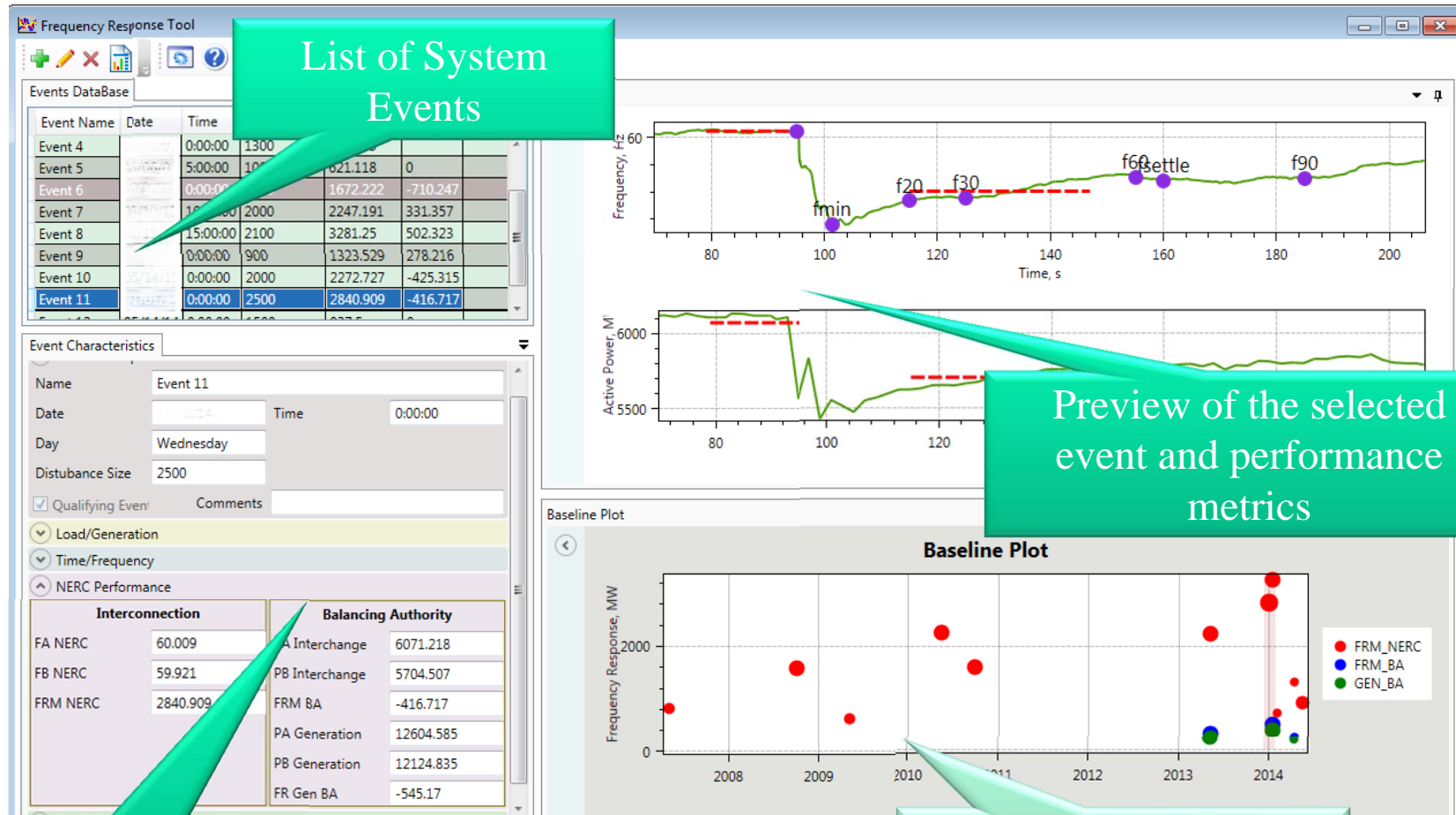
# Past major accomplishments

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- FR, PPMV and LMDT tools are released under open source license
- Developed tools are used by WECC members including BPA, PG&E, SCE, PacificCorp, Northwestern Energy.
- Very positive feedback from the users is received
- BPA is funding development of the “custom” version of the FR tool.
- PNNL developed power plant model calibration methodology using Kalman Filter



# FR Tool version 2.0



Event  
Information

Baseline of system  
performance



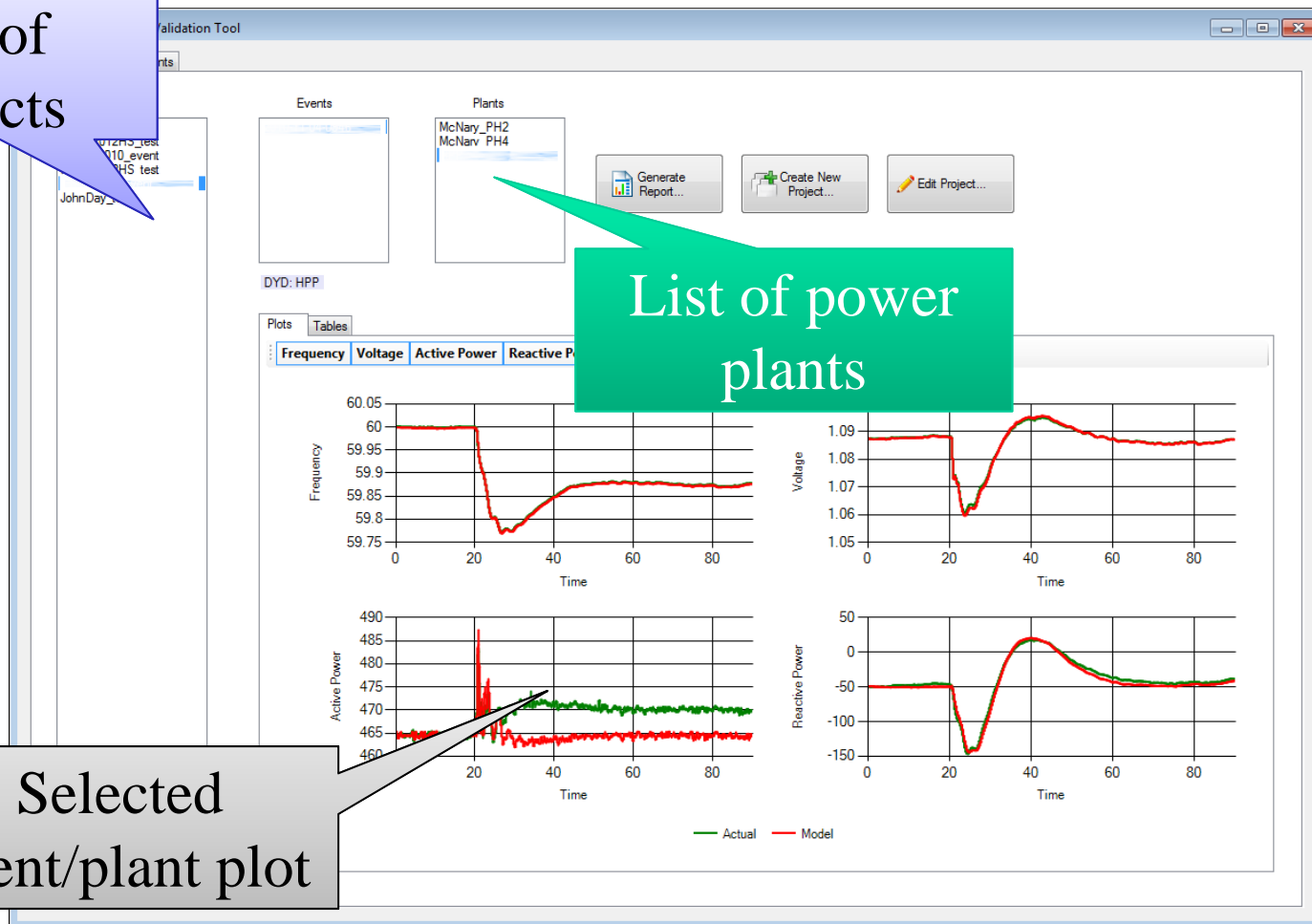


# PPMV Tool (main GUI)

List of  
Projects

Selected  
event/plant plot

List of power  
plants



# PPMV Tool (plants database)

The screenshot displays the PPMV Tool interface with three main sections: 'Power Plants', 'Plant Info', and 'SCADA'. The 'Power Plants' list on the left includes 'Grand\_Coulee\_19', 'Grand\_Coulee\_20', 'JPP', 'John\_Day\_PH1', 'McNary\_PH2', and 'McNary\_PH4'. The 'Plant Info' section shows details for 'McNary\_PH4' with a code of 'MCNPH4'. The 'SCADA' section shows 'Measurements' for 'MCNPH4.1' through 'MCNPH4.4', with 'MCNPH4.1' selected. A green callout box labeled 'List of Plants' points to the 'Power Plants' list. A green callout box labeled 'PMU mapping' points to the 'Measurements' list. A grey callout box labeled 'SCADA mapping' points to the 'SCADA' section. To the right of the interface, text reads: 'Mapping SCADA and PMU measurements with a specific power plant'.

Mapping SCADA and PMU measurements with a specific power plant

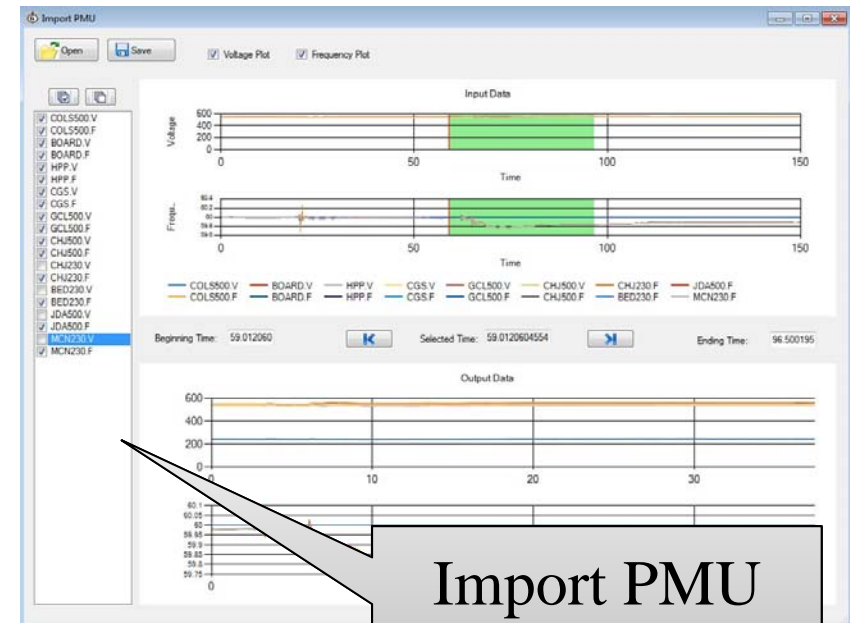
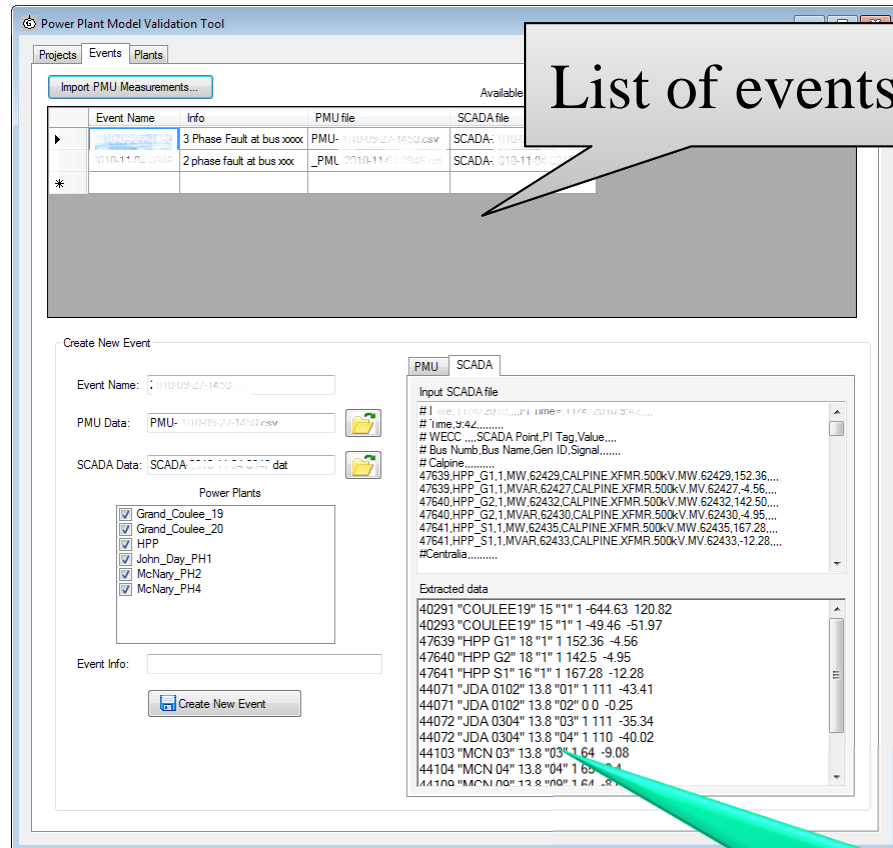
**List of Plants**

**PMU mapping**

**SCADA mapping**



# PPMV Tool (events database)



Extracting and  
Converting SCADA  
data to PSLF format

# PPMV Tool (Create new project)

The screenshot shows the 'Create New Project' dialog box in the PPMV Tool. The 'Project Name' is 'test\_project'. The 'Project Type' is set to 'By Plant'. The 'Events' list shows '2010' and '2010 11-04-09:45'. The 'Plants/dyd' list shows a tree structure of plants including 'Grand\_Coulee\_20', '13hs2', 'HPP', 'John\_Day\_PH1', 'JDAPH1-2012HS', 'McNary\_PH2', 'MCNPH2-2012HS', 'MCNPH2-2013HS-HDR', 'MCNPH2-2013HS-USA', 'MCNPH2-2013HS', 'McNary\_PH4', and 'MCNPH4-2012HS'. The 'Log File' section shows the 'PSLF logs' for the project. A 'PSLF logs' window is also open, displaying the output of the 'plotPSLF18.bat' script, which includes the text 'General Electric International, Inc.', 'Dynamics Plotter V 18.1\_01', 'Running PLOT initialization file plotJavaini.p', 'PLOT: HPP- 09-20-1450 -HPP', 'Plot HPP- 09-20-1450 -HPP.chf', 'Done.', 'PLOT: C:\Users\d3x260\Documents\Visual Studio 2010\Project\orModelTool\bin\Debug\HPP\00-CHF>pause'.

Project type

Events list

Plants list

PSLF logs



# Technical Accomplishments FY14

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- New advanced versions of the PPMV and FR tools will be developed.
- Next version of the FR tool (version 2.0) is under development
  - Completely redesigned GUI
  - New functions including:
    - Support different data source formats.
    - Better reporting features.
    - Analysis of Balancing Authority (BA) Performance (NERC BAL-003-1 Standard).
    - Capability to assess the power plant responses.
    - Impact of renewable resources to the frequency response



# Technical Accomplishments FY14

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- Next version of the PPMV tool will include
  - Completely redesigned GUI
  - Improved visualization
  - Improved reporting features
  - Improved data flow
  - Based on the feedback from the users new functions will be implemented
- Industry Outreach and Technology Transfer
- Presentation of the tools at NASPI, JSIS, MVWG, IEEE workshops



# Deliverables FY14

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- New versions of the Frequency Response and Power Plant Model Validation Tools
  - New analytical functions
  - New advanced user interface
  - New reporting capabilities
  - Support different data sources
  - Software documentation



# Risk factors

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- Risk factors are very low.
- Feedback and guidance from industrial partners are very important for the success of the project.





# Future plans

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- Expanding analytical capabilities to meet user requirements.

