



DOE/OE Transmission Reliability Program

Grid Reliability Performance Metrics Using Phasor Data and Model-less Algorithms, Prototype Development and Field Test

Carlos Martinez – Advanced Systems Researchers (ASR)

cmartinez@asresearchers.com

June 27-28 2013

Washington, DC



CERTS
CONSORTIUM FOR ELECTRIC RELIABILITY TECHNOLOGY SOLUTIONS

Project Objective

*LOAD-GENERATION CONTROL
RELIABILITY PERFORMANCE
REALTIME MONITORING*

*GRID RELIABILITY PERFORMANCE
PHASOR BASED AND MODELESS
REALTIME MONITORING*

PROJECT OBJECTIVES

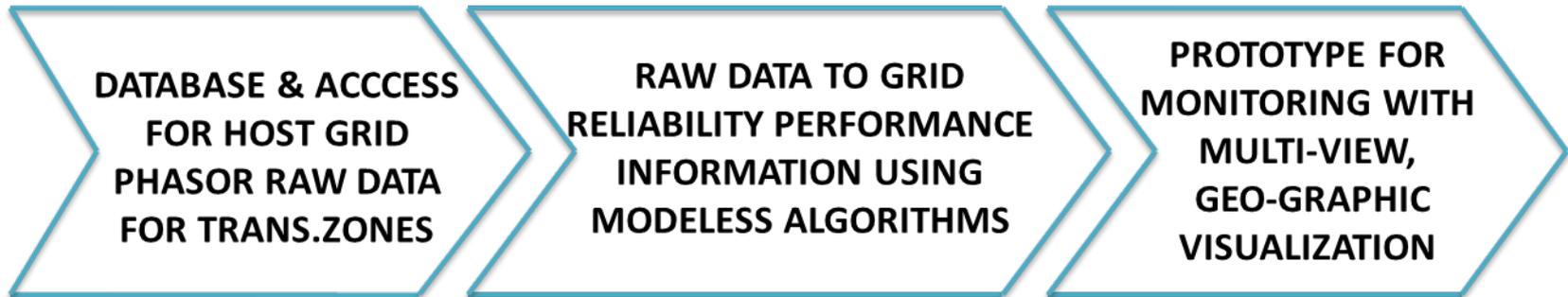
ALL APPLICATIONS IN PRODUCTION



RESEARCH, PROTOTYPE AND FIELD TEST

CERTS
CONSORTIUM FOR ELECTRIC RELIABILITY TECHNOLOGY SOLUTIONS

Project Analytics Approach



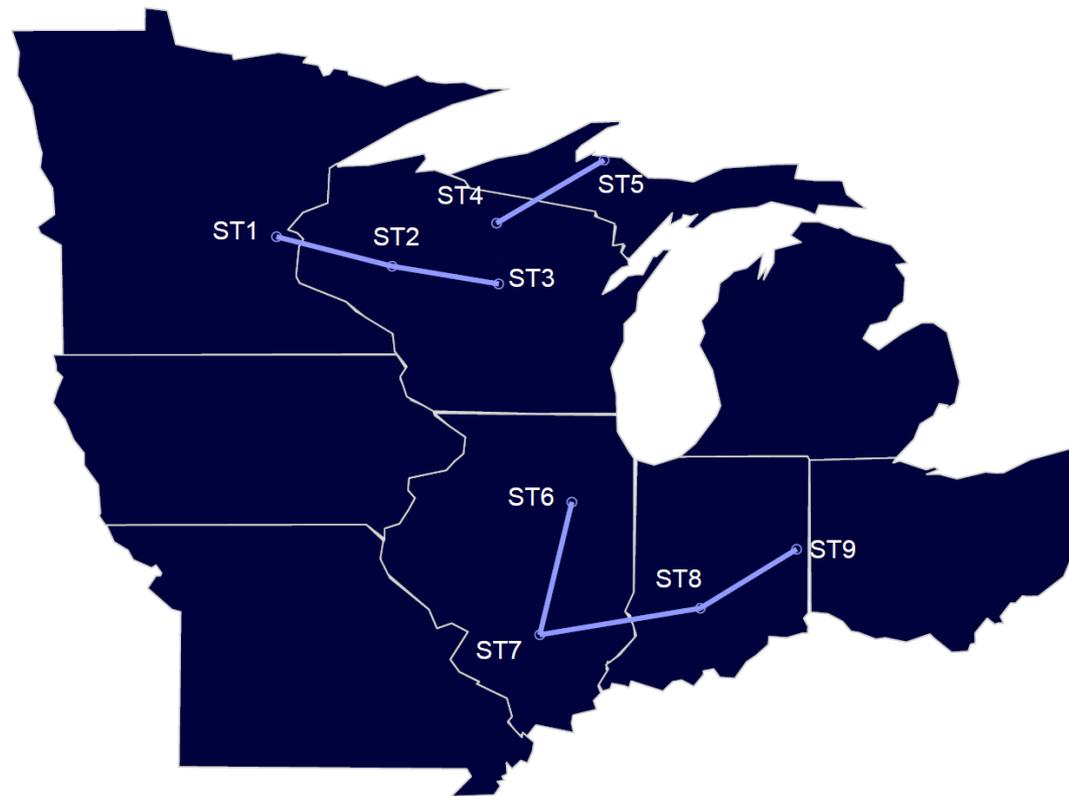
Accomplishments to be Completed in FY 2013

- Deliver to MISO the Extended Prototype Functional Specification
- Complete Research, Test and Validation of Grid Post-Disturbance Reliability Metrics
- Deliver to MISO the Software for Grid Performance Modeless Metrics During Pre and Post Disturbance
- Deliver to MISO the Design, Prototype Software to for Realtime Grid Monitoring Multi-View Visualization
- Deliver to MISO the Prototype Field Test Plan and User Guide



Deliverables Completed in FY2013

COMPLETED: DATABASE AND ACCESS METHODS FOR HANDLING OFF-LINE MISO GRID PHASOR DATA



Note: Stations names are fictitious because of Data Confidentiality

Deliverables Completed in FY2013

COMPLETED: RESEARCH AND DESIGN OF A MULTI-VIEW VISUALIZATION FOR REALTIME GRID MONITORING BY SECURITY COORDINATORS

TRANSMISSION ZONE



All Lines
In Zone

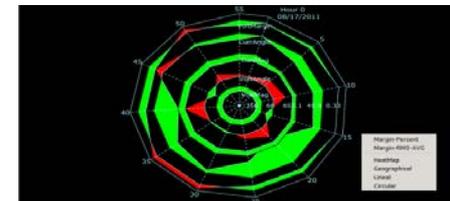
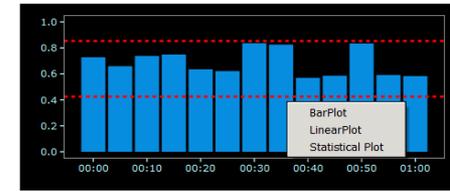
1-Line
in Zone

Voltage Margin

Stability Margin

Thermal Margin

Phasor Voltage and Current Magnitude and Angle



Deliverables Completed in FY2013

- **Completed** — Off-line test and validation of grid reliability performance metrics using model-less pre-contingency algorithms
- **Completed** — Develop model-less post-contingency algorithms
- **Completed** — Initial testing of model-less post-contingency algorithms



Realtime Grid Monitoring Visualization

Multi-View Layout to be Delivered in FY2013

Click Name-Bar to
Expand to Full Display

The screenshot displays a software interface titled "MISO BPS GRID - REALTIME PHASOR BASED MONITORING" with "Revision 0.9" in the top right corner. The interface features a tabbed menu at the top with options: "Voltage Margin", "Stability Margin", "Thermal Margin", and "PostDisturb. Contingencies". The "Voltage Margin" tab is selected, and a blue arrow points to it with the text "Click Name-Bar to Expand to Full Display".

The main content area is divided into several sections:

- Section 1:** A large black area on the left containing the text "GEO-GRAPHIC, HEATMAPS FOR GRID METRICS FOR ALL LINES IN TRANSMISSION ZONE".
- Section 2:** A black area on the top right containing the text "BAR, LINEAL, SPC FOR GRID METRICS FOR USER SELECTED LINE".
- Section 3:** A black area on the bottom right containing the text "STATISTICS FOR GRID METRICS FOR USER SELECTED LINE".
- Section 4:** A large grey area at the bottom center containing the text "TABULAR-TABLE WITH METRICS AND RAW DATA FOR ALL LINES".
- Section 5:** A yellow box on the bottom left containing the text "MARGINS ALARMS".
- Section 6:** A grey box on the bottom right containing the text "DATA REPLAY CONTROLS".

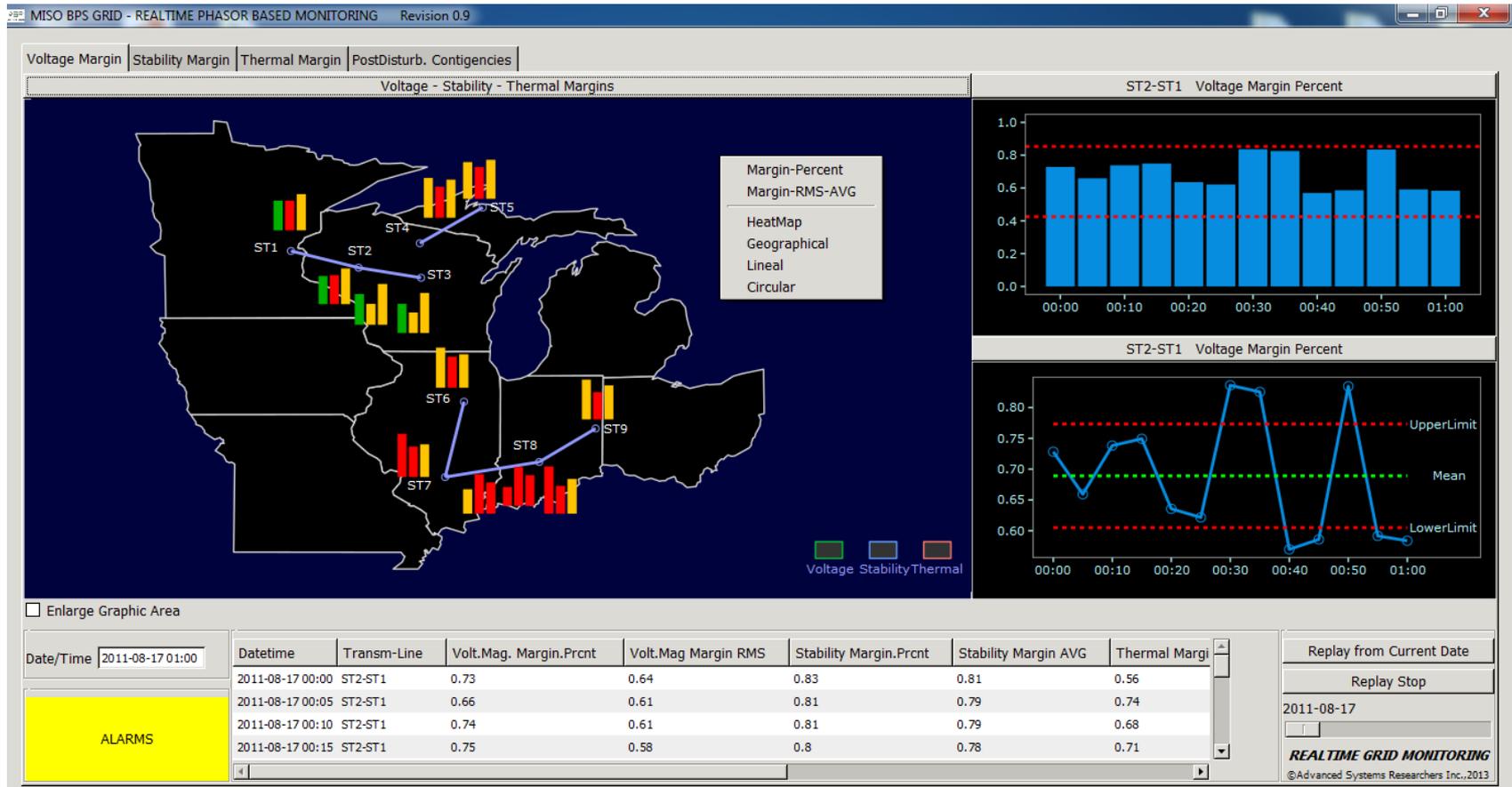
At the bottom left of the interface, there is a checkbox labeled "Enlarge Graphic Area".

Tabs for
Selecting
Margins

Checkbox
to Hide/Show
Tabular-Table

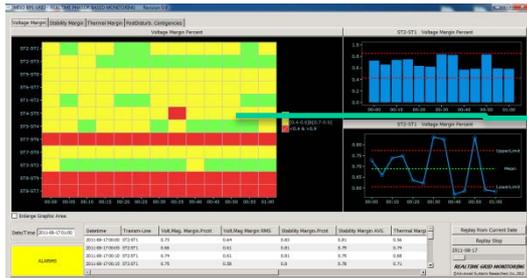


Realtime Grid Monitoring Visualization Prototype to be Delivered in FY2013



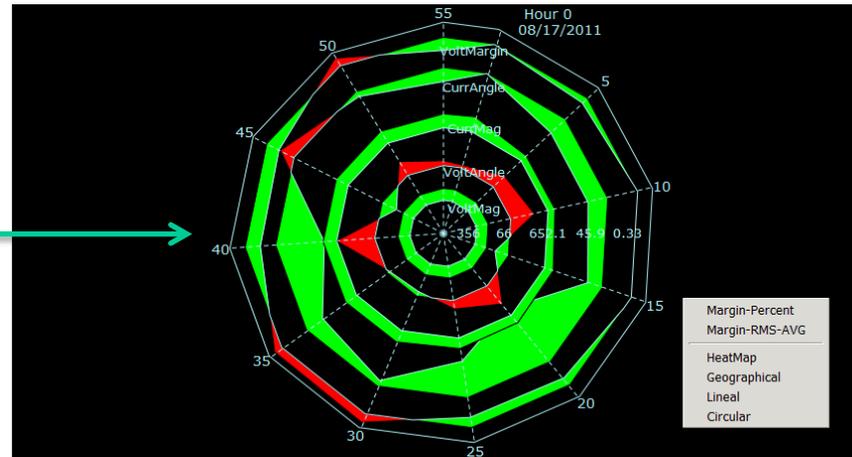
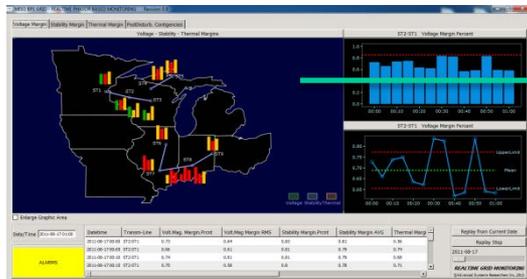
Realtime Grid Monitoring Visualization

Navigation to be Delivered in FY2013



Performance Margins for both terminals of each line

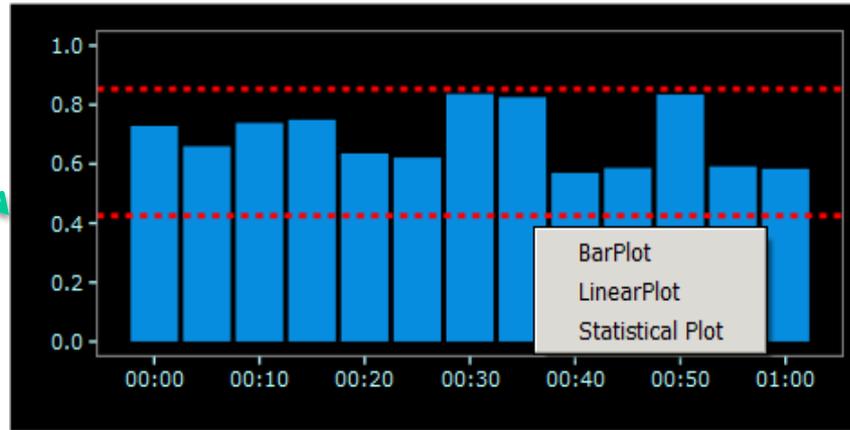
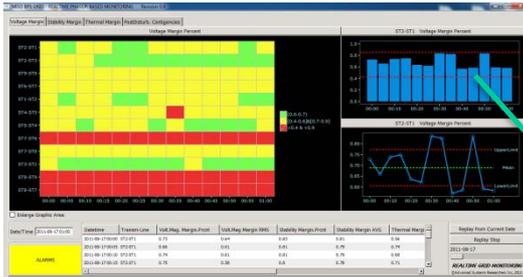
- Margin-Percent
- Margin-RMS-AVG
- HeatMap
- Geographical
- Lineal
- Circular



Voltage-Current phasor data for each line terminal selected by User

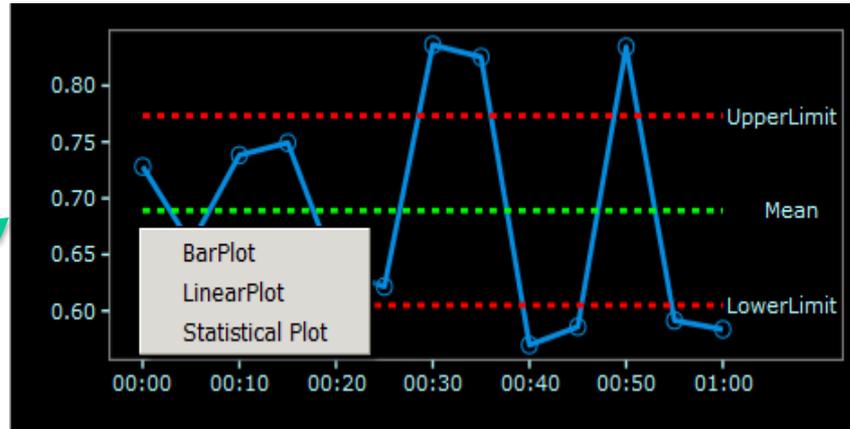
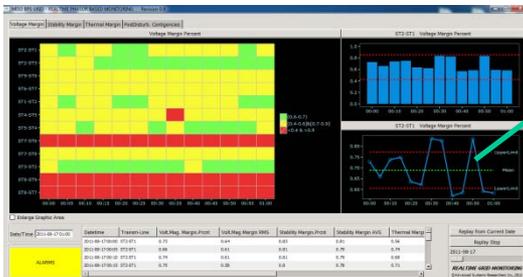


Realtime Grid Monitoring Visualization Navigation to be Delivered in FY2013



Zooming into Margin for User Selected Transmission Line on Heatmap or Map

BarPlot
LinearPlot
Statistical Plot



Zooming into Statistical Pattern for User Selected Transmission Line on Heatmap or Map



Risks Factors Affecting Timely Completion

- **Grid Phasor Data Quality** — Experience using phasor measurements is demonstrating the need for better phasor data quality filters and estimation of grid performance metrics uncertainties
- **Completion of Prototype Deployment at MISO**
MISO personnel and IT Contractors availability
- **Effectiveness of Post-Contingency algorithms**
MISO data and computations will provide important validation results
- **Acceptance of Grid-Metrics and Visualization by MISO Security Coordinators** — Security Coordinators availability for working, testing and give feedback on Prototype



Possible Follow-on Work for FY14 Funding

- Complete the Field Demonstration with MISO for improving models, performance metrics, monitoring visualization, and tracking Automatic Reliability Reports
- Expand realtime monitoring visualization for integrating graphics for Post-Contingency reliability metrics
- Research and develop prototype for Automatic Reliability Reports including Pre and Post Disturbance Grid performance metrics
- Research identification and definition of a grid reliability composite index using this project grid performance metrics and MISO reliability coordinators experience during the Field Test

