

Grid Stability Awareness System (GSAS)

- A Software Suite for Stability Monitoring and Analysis (DOE-OE0000700)

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Project Overview

Objectives

- Develop a suite of production level software applications (named Grid Stability Awareness System - GSAS) for power grid real-time monitoring and analysis of oscillation stability, voltage stability and transient stability.
- Deploy the software suite to one of Southern Company's control centers

Project Duration

- 10/1/2014 12/31/2016
- Funding
 - DOE Funds: \$1,458,181 (48.6% of total budget)
 - Recipient cost share: \$1,541,936 (51.4% of total budget)
- Partners
 - Southern Company
 - Washington State University
 - Grid Protection Alliance





Project Achievements

Developed a software suite: Grid Stability Awareness System -GSAS

- Oscillation monitoring tool
- Voltage stability monitoring tool
- Angle instability monitoring tool
- Angle difference monitoring tool
- Event detection tool

Deployed the software suite on Southern Company's real-time synchrophasor facilities

- Release 1 (11/18/2015), Dashboard, oscillation tool, voltage stability tool
- Release 2 (3/9/2016), Event detection and alarm triggers and archival
- Release 3 (7/27/2016), Angle instability tool, angle difference monitoring tool
- Release 3.1 (8/31/2016), Final release





Project Achievements (cont.)

Performed extensive offline validation of analytical engines

- Using transmission planning model
- PSSE simulation of known events
- Validating based on different stability category

Performed comprehensive evaluation of software on-line performance

- Bi-weekly WebEx demo to demonstrate software performance based on real-time data
- Receive feedbacks from all stakeholders at the on-line demo
- Address feedbacks quickly

Training materials and training sessions

- Facilitated by off-line validation effort
- For different user groups





GSAS Design Considerations

- Operator view oriented
 - Real-time data streams
 - Event triggers
- Scalable for larger numbers of PMUs
- Extensible framework for new functionality
 - Stability monitoring
 - Dynamic response validation
 - Wide-area awareness
- Server / Client structure



GSAS Modules Implemented





Oscillation Monitoring

- Mode frequency, damping ratio, mode energy, confidence level, mode shape for each mode
- Playback of historical alarm data







Voltage Stability Monitoring

- Local/remote voltage stability index and confidence level for each line
- User selectable signals based on locations and voltage levels
- Playback of historical alarm data

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Angle Difference Monitoring

- Angle difference for each user-defined angle difference pair
- Playback of historical alarm data

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GSAS Alarm Mechanisms

Oscillation Stability Alarming	 Real time modal analysis (damping ratio, mode frequency, mode shape, mode energy) User-configurable damping ratio limit and confidence thresholds
Voltage Stability Alarming	 Real time voltage stability index based on deltaQ/deltaV sensitivity User-configurable voltage stability limits and confidence thresholds
Transient Stability Alarming	 Real time angle separation after transient event User-configurable generator clusters
Angle Difference Alarming	 Real time phase angle difference User-configurable phase angle difference limits
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GSAS Alarming Dashboard

- Real-time status of system stability
- Historical (last 24 hours) status of system stability
- User clickable event/alarm retrieval

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Event/alarm log and acknowledgements



Historical Alarm Playback

- Alarms captured for playback mode (configurable)
- Alarm logs and operator acknowledgements
- Alarm filtering, grouping, and report generation
- Post-event replay and analysis

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Actual Oscillation Event Detected

Event Date: June 17, 2016

This event occurred outside of Southern Company's footprint...



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Project Progress

Key Milestones (as of October, 2016)

Milestones	Estimated Completion				
Project Kick-off meeting at Southern Company	Complete				
An on-site interview meeting at Southern Company	Complete				
Draft software requirement specifications	Complete				
Define software roadmap and plans for development and deployment	Complete				
Develop and refine analytical tools (engines)	Complete				
Release 1 of GSAS	Complete				
Release 2 of GSAS	Complete				
Release 3 of GSAS	Complete				
Complete training materials and user manuals	On going				
Complete grid operator training sessions	On going				
Complete topical report on software off-line validation	On going				
Complete topical report on evaluation of software on-line performance	On going				







Contact

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