Health Monitoring of Digital I&C Systems using Online Electromagnetic Measurements

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Morgan Berg
EMC Engineer, AMS, Knoxville, TN

Phase II SBIR R&D Project Related to Digital I&C Testing

Health Monitoring of Digital I&C Systems using Online Electromagnetic Measurements

Goal: Develop a system that monitors EM emissions to characterize digital I&C device health during operation.

Health Monitoring of Digital I&C Systems using Online Electromagnetic Measurements

OVERVIEW

Purpose:
Develop a commercial system that uses established correlations between EM emissions and device health to monitor digital I&C systems in real time during operation.

Objectives:
- Build a database of typical device EM emission "signatures" and correlate with common failure modes.
- Create a data acquisition system to continuously monitor device EM emissions and identify potential device failures during operation.

IMPACT

Logical Path:
1. Identify simple, common digital devices that have known failures.
2. Perform accelerated aging on identified devices while continuously recording the device EM emissions.
3. Create a database of EM emission signatures and correlated device failures.
4. Create a design for a real time monitoring system.
5. Build, test, and demonstrate real time monitoring system.

Outcomes:
The effort of this work resulted in a commercial system to perform passive monitoring of digital I&C equipment in its installed environment. The device monitors and records EM emissions of devices and uses known correlations of EM signatures and device failures to produce an early warning of possible equipment failures.

DETAILS

Principal Investigator: Chad Kiger

Institution: Analysis and Measurement Services Corporation (AMS) www.ams-corp.com

Collaborators: N/A

Duration: 36 Months (24 Months + 12 Month No-Cost Extension)

Funding: $999,851 (FY2019 $499,876; FY2020/2021 $499,975)

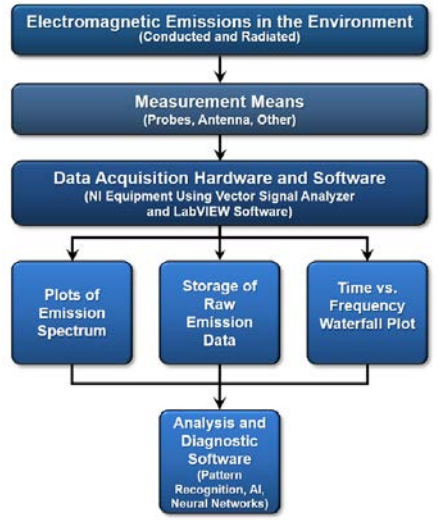
TPOC (Technical Point of Contact): Chad Kiger

Federal Manager: Daniel Nichols

PICS:NE Workpackage: DOE Award Number DE-SC0018865

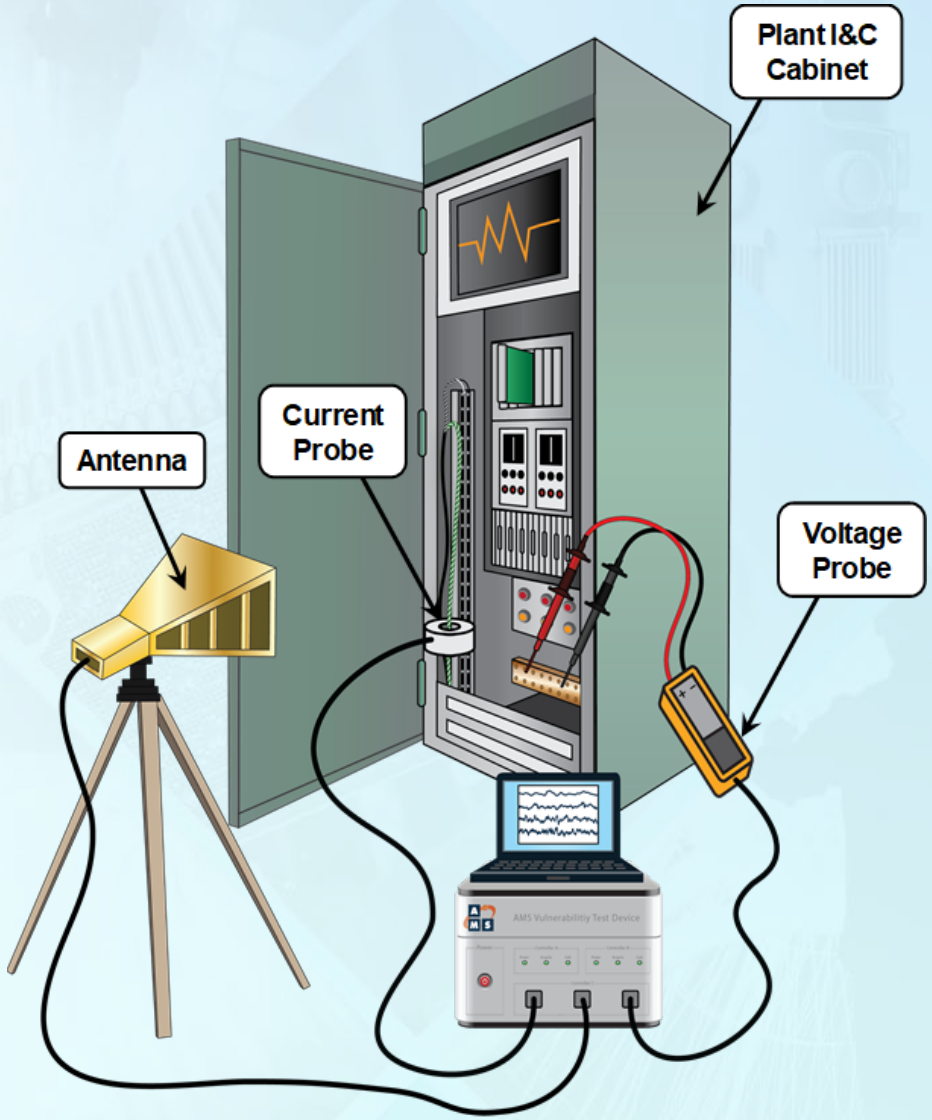
RESULTS

Accomplishments:
1. Performed research to characterize digital I&C failure EM signatures and correlate with failure mode.
2. Development of a commercial system architecture.
3. Development of prototype software system for real time EM monitoring
4. Development and testing of the individual components of the commercial system

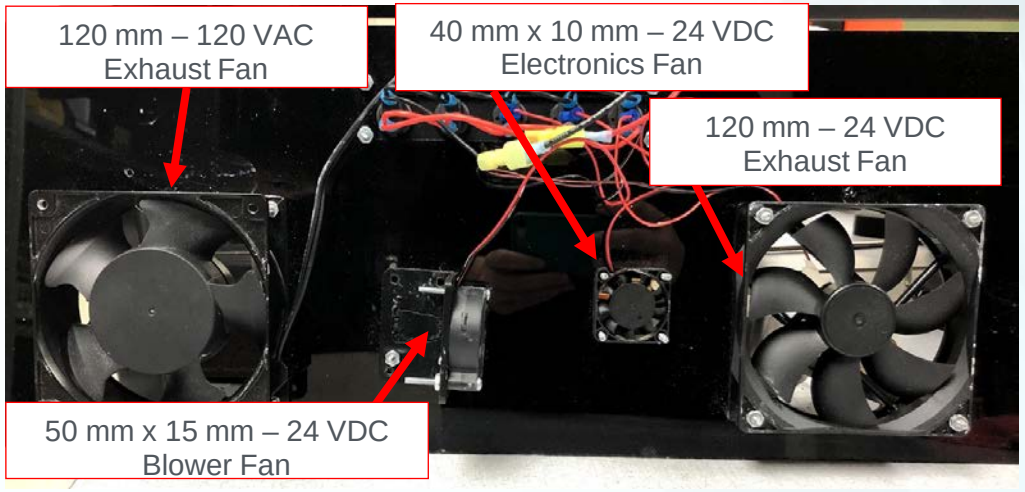


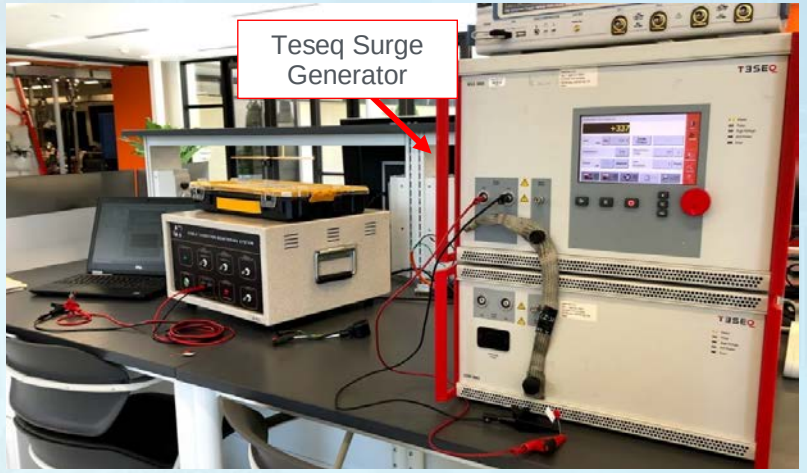
Project Summary

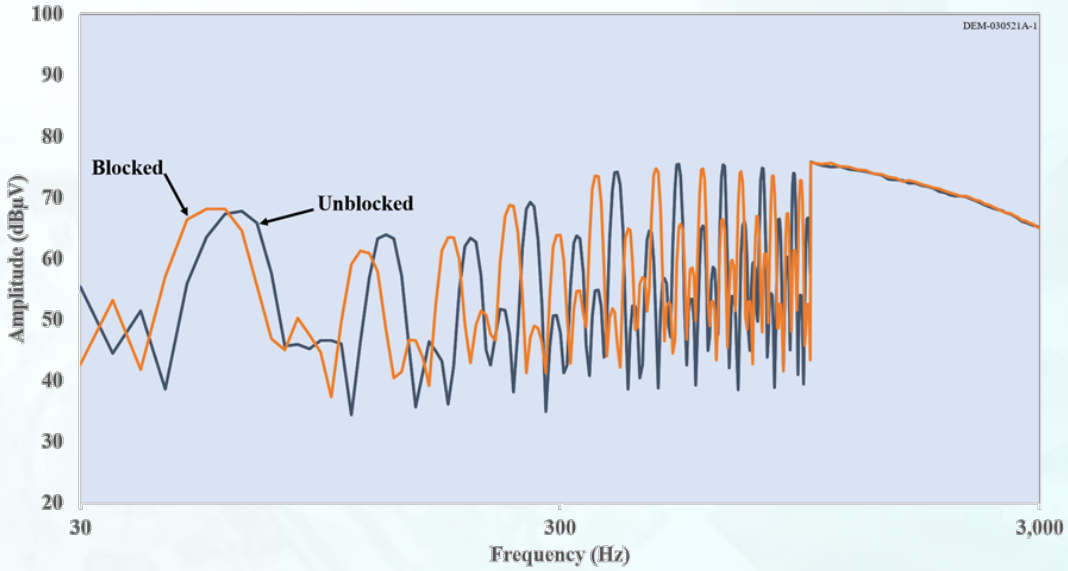
- Design and build a condition monitoring system
  - Capable of collecting and analyzing emissions measurements
  - Designed for both predictive maintenance and RF environment characterization
- Measure emissions from I&C equipment and components as they are artificially degraded

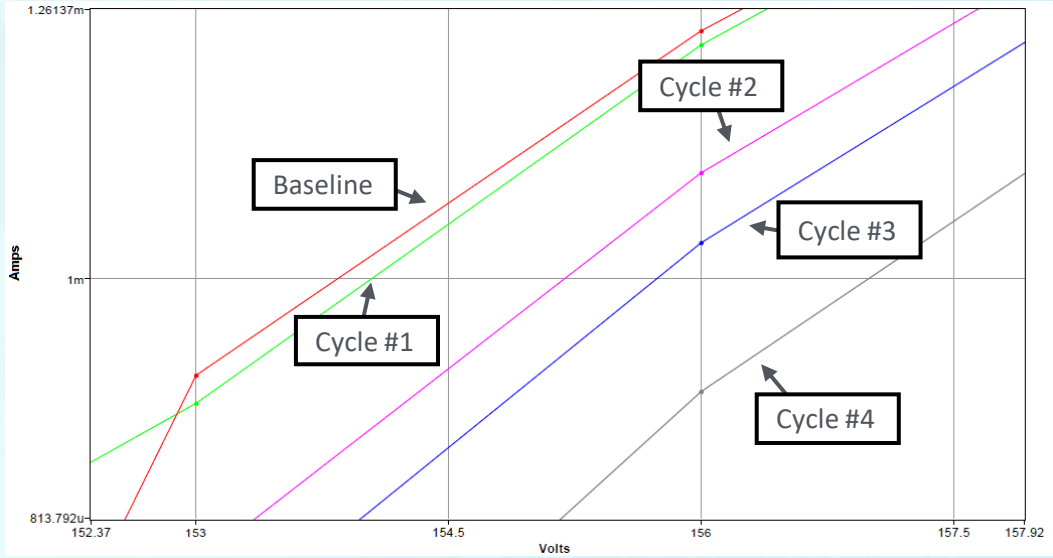


Technical Highlights









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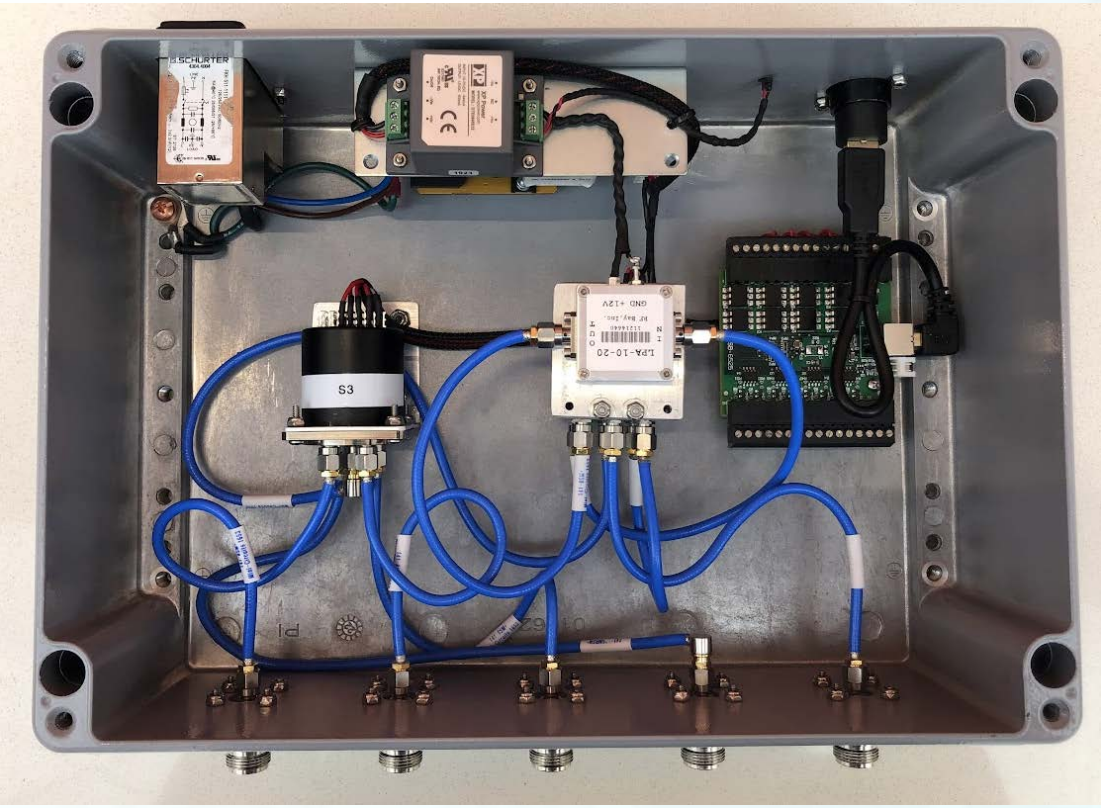

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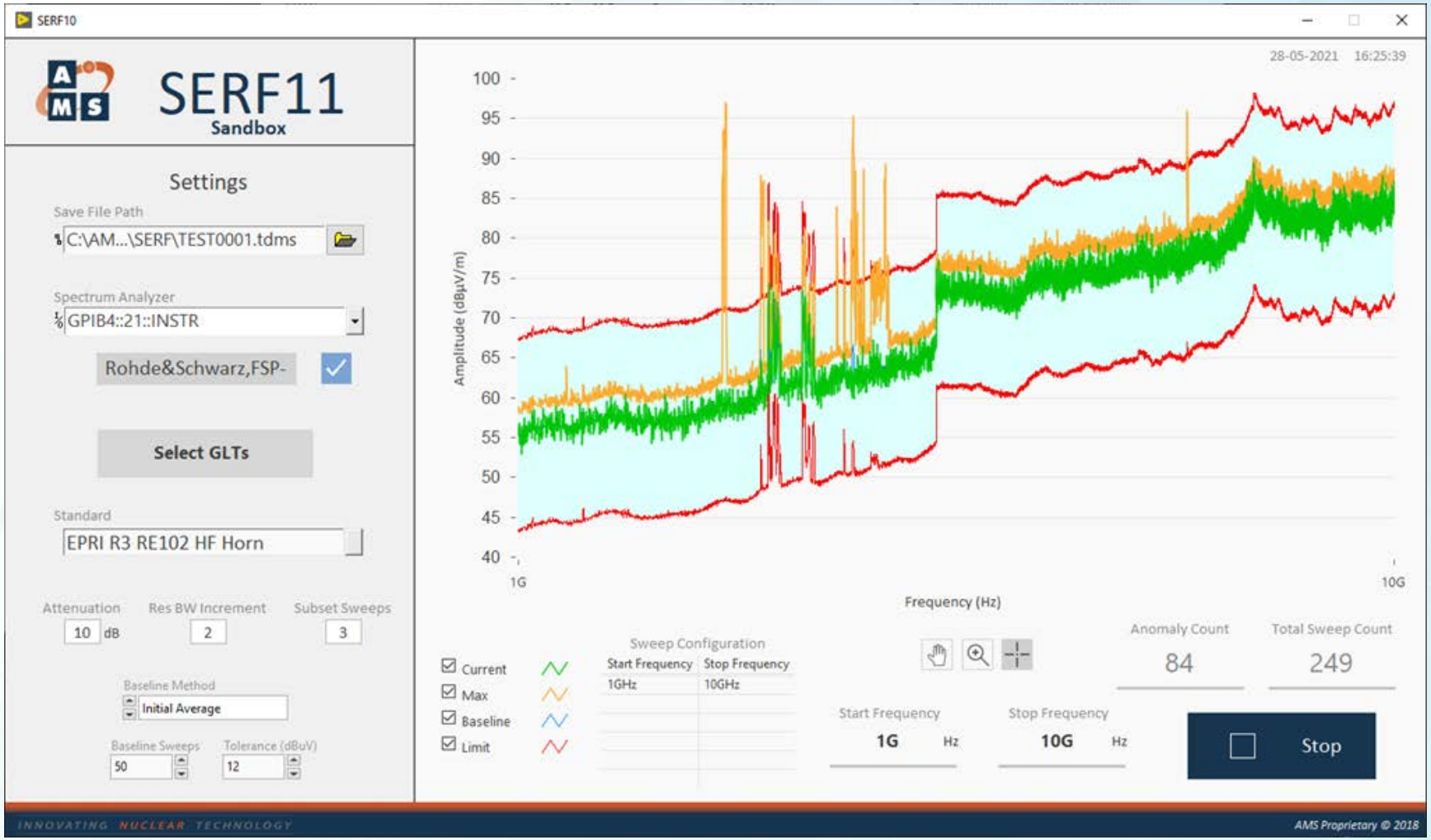

Publications & Conferences

Health Monitoring of Digital I&C Systems using Online Electronic Measurements

B.D. Shumaker, C.J. Kiger, D.E. McCarter

12th Nuclear Plant Instrumentation, Control and Human-Machine Interface Technologies Conference, June 14-17, 2021

Automated System to Characterize Electromagnetic Environments in Nuclear Power Plants

M.F. Berg, C.J. Kiger

ANS Winter Meeting and Technology Expo, November 30 – December 3, 2021

Characterizing the Electromagnetic Environment within Nuclear Power Plants

C. Kiger, M. Berg, R. Kettle, W. Kirby

ANS Annual Meeting, June 12-16, 2022

Morgan Berg
EMC Engineer (AMS)
morgan@ams-corp.com

Thank You