Director’s Message
By Xinsheng Lou, PhD

Thank you all for your kind support to ISA POWID throughout 2018. As 2019 is underway, ISA is introducing a series of changes for the Society and the technical divisions. Through all of these changes, our vision stays the same: to create a better world through automation.

One of the new initiatives from ISA is to host a joint power and water event in 2019. This is aimed at creating synergies between the two industrial communities that share the same technical interests and achievements on instrumentation and controls, cyber security, and plant operating efficiency, reliability and safety, etc. The information for this forthcoming event is included in this newsletter.

In our last issue, I emphasized power plant and power grid operating safety. While we continue to advocate operating safety with no compromise, we invite you to ponder the evolving demands for operating flexibility. The power system itself needs more flexibility, while renewable power has increased its share in the overall power generation industry. Fossil fuel fired thermal power plants have been pushed to operate with more cycles and low load conditions. Thermal and electrical energy storage solutions have been introduced to the power markets. How will nuclear power respond to the increasing need for operating flexibility? Let’s keep an eye on these trends throughout the year and prepare to share our observations and visions at the upcoming event.

Please join Power Industry Group on LinkedIn.

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Editor’s Message

We would like to thank those of you who contributed to this edition of our newsletter. We appreciate you sharing your knowledge and experience. We also appreciate those who recruited others to join ISA and the Power Industry Division (POWID).

We always need more contributors. I invite you to consider providing articles for our next newsletter. Technical content that is specific to the automation side of the power industry is most useful to our readers. We are also interested in historical items and items of general technical interest.

If you have questions or want to submit something, please email me. (limit attachments to 5MB). If you email an article and do not get a response, it did not get through to me. Please keep in mind that articles need to be non-commercial.

We hope you enjoy this edition and look forward to hearing from you.

Beth Clarkin
Southern Company
epclarki@southernco.com

ISA Energy and Water Automation Conference

Mark your calendar for 7–8 August at the Omni Hotel in Orlando, Florida, USA

For the first time, ISA is combining its popular power and municipal water programs into a single, two-day event with additional content on industrial water applications.

Our volunteer committee, led by Josh Long of Bechtel and Manoj Yegnaraman of Carollo Engineers, is hard at work mapping out the session topics and identifying industry thought-leaders to chair interactive panel discussions. Areas of interest include data analytics, IIOT, the Smart Cities Initiative, and cybersecurity.

Infrastructure supporting power generation and municipal water systems are at the heart of “Smart City” initiatives. Such automated solutions increase productivity and efficiency, but vulnerabilities through HMI and connected devices create cyber security and safety issues.

Many forms of power generation rely on industrial water sourcing, transportation, handling, remediation, recycling, and disposal. This alignment will bring municipal and industrial water and energy sessions under the same umbrella event to create synergy through application and experience sharing. The novel approach offers a more robust technical scope and encourages experts from varied, but related, backgrounds to share experiences and identify solutions to complex problems. We open the door to a variety of related growth industries such as upstream/midstream oil & gas, wind, and solar while retaining content for refining and power generation specialists.

Share your expertise. Submit an abstract for consideration by 1 April.

A New year...A New Strategic Direction for ISA

ISA is heading in a new strategic direction to better serve you as well as the entire automation community. This includes a new vision, mission, and values. Over the next 3–5 years, ISA will work to transform itself to bring more value than ever to the automation community. These videos will help you understand the pieces and parts of ISA’s Strategic Plan.

As this direction continues to take shape, our Division will develop plans that align and support ISA’s objectives.
**Large-Scale Simulation of Modern Electric Power Systems**

**Author:** Dr. Hantao Cui  
**Advisor:** Dr. Fangxing (Fran) Li  
**Department:** Electrical Engineering and Computer Science  
**University:** University of Tennessee, Knoxville  

**Abstract:** Computer simulation techniques are essential to electric power system studies to reduce risks and improve reliability. Modern power systems are undergoing significant changes with better monitoring and communication capabilities, higher levels of renewable penetration, and a considerable number of connected power electronics devices. There arises a pressing need for a testbed with structural and functional representations of modern power systems, including wide-area measurement, energy management, communication, and measurement-based control.

The topic of the dissertation, Large-Scale Simulation of Modern Electric Power Systems, is broad. This dissertation will cover two aspects of the topic. The first aspect is the design and implementation of a communication network enabled large-scale testbed (LTB) for wide-area measurement-based control verification. The second aspect is the modeling and control of voltage source converter (VSC) based multi-terminal dc (MTDC) networks.

In detail, the LTB section introduces the concepts and techniques that are being used in the current implementation. A proposal of a cyber-physical system (CPS) design for the next-generation LTB follows. The VSC MT-HVDC part covers a) the steady-state power flow analysis of ac/dc hybrid systems, b) positive-sequence transient dynamics models of VSC with inertia emulation and frequency response capability, and c) an application of multi-terminal dc for integrating offshore wind generation with inertial and frequency support.

The outcome in the testbed section includes an implementation of the CURENT LTB. A decoupled architecture enabled by distributed messaging environment allows for building up a simulation environment with modules for simulation, communication, energy management, and wide-area control. The LTB also features module interchangeability by adopting a unified communication format that makes the modules agnostic of each other. The testbed has successfully demonstrated state estimations, frequency control and damping control on the CURENT test systems.

In the VSC-based MTDC modeling section, the power flow model is able to handle systems with more than 10,000 buses at a calculation speed faster than MATLAB-based open-source packages. The transient models of the VSCs and the dc network demonstrate power transfer capability for inertial response and frequency control in a single grid and a multi-area grid with offshore wind generations.

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**Energy Storage System Sizing Using The Conti-Varlet And Disutility Optimization**

**Author:** Paulo Alberto Viana Vieira  
**Advisor:** Dr. Edson Bortoni  
**Institute:** Institute of Electrical Systems and Energy (ISEE)  
**University:** Itajubá Federal University, Brazil  

**Abstract:** Nowadays, the transition from conventional fossil fuel based and centralized energy generation to distributed renewables is increasing rapidly, due to the environmental concerns and political incentives. Wind and solar power generation offer carbon dioxide neutral electricity but also present some integration difficulties for energy system operators and planners due to intermittent power output. A promising way of dealing with the intermittency from renewables is energy storage. Many types of energy storage have been under development and study. Therefore, a battery energy storage system has been implemented mainly in residential applications to utility power grids. Battery energy storage can allow higher amounts of renewable electricity generation to be integrated by smoothening power output, and time shifting generated energy to follow demand and increase hosting capacities through peak shaving. Power quality related issues due to intermittency can be mitigated by controlling the storage’s charging patterns to respond to grid variables. For optimal utilization and maximum storage value, several applications should be within the operational repertoire of the storage unit. Other applications including arbitrage, grid investment deferral, and load following are discussed. This thesis proposes a study and analysis of the Conti-Varlet approach or stretched-thread method (STM) a powerful graphical based technique used to partial flow regularization for hydropower plants to provide auxiliary service regularization considering a battery energy storage system (BESS). The proposal is maintaining the power more stable and constant as possible, mitigating the PV intermittence. A one-year analysis is performed for each BESS size, ranging from 10% to 90%. A cost for each scenario and an optimal BESS is presented to reduce the disutility. The changing of the consumption costs is defined as disutility.
Evaluating Distributed Antenna Systems for Nuclear Power Plants

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KEYWORDS

Distributed Antenna System (DAS), Electromagnetic Compatibility (EMC), Electromagnetic Interference (EMI), Radio Frequency Interference (RFI), EMI/RFI, Radiating Cables, Nuclear Power Plant, Wireless

ABSTRACT

The successful implementation of a Distributed Antenna System (DAS), in an operating nuclear power plant (NPP), enables wireless voice and data communications over a wide range of frequencies. This can facilitate the deployment of wireless condition monitoring sensors, electronic work packages, wireless dosimetry, and other innovations that reduce operations and maintenance costs while increasing plant efficiency and safety. However, the impact of electromagnetic and radio interference (EMI/RFI) on plant equipment and the degradation mechanisms of DAS components have not been fully investigated. Research is being conducted by Analysis and Measurement Services (AMS) to determine and overcome the technical challenges associated with the installation and operation of a DAS within an NPP. This research consists of evaluating state-of-the-art DAS technologies, characterizing the radio frequency (RF) performance of DAS equipment, determining degradation and aging mechanisms of radiating cables, and overcoming EMI/RFI challenges in a plant environment. The findings from this research will aid the nuclear industry in addressing possible issues with DAS technologies prior to installation and overcoming issues encountered after implementation.

In support of this research, five radiating cables were acquired from several equipment manufacturers for testing. Baseline RF performance for each cable was established, and subsequently, the cables were degraded using a variety of degradation methods, such as accelerated thermal aging and conductor and shield deformation, to determine the effect of wear and age on RF performance. Additionally, a commercial grade DAS unit was set up in an Electromagnetic Compatibility (EMC) laboratory alongside nuclear grade process sensors in order to simulate installation in a sensitive nuclear plant environment and measure the impact of a DAS on the sensor output signals. As a result of this research potential concerns and barriers have been identified and best practices have been determined for the implementation of DAS technologies in the nuclear industry.
INTRODUCTION

Wireless technologies are already known to benefit the nuclear industry in many areas such as equipment condition monitoring, collection of operational information (wireless connected tablets for operators to use on their rounds), field work (electronic work packages and troubleshooting), monitoring and reducing radiation dose (real-time wireless dosimetry), improved plant communications (plant-wide use of cell phones), and video monitoring (both outage and operational use of wireless cameras) [1, 2]. These applications are a main driving force and have become even more attractive with a recent initiative of the Nuclear Energy Institute (NEI) that is referred to as “Delivering the Nuclear Promise,” or DNP. The DNP seeks to drive the nuclear industry to reduce operation and maintenance costs to keep nuclear power competitive, while increasing efficiency and maintaining the highest level of safety [3]. In the United States, most of the approximately 100 licensed and operating nuclear power units will likely implement some form of wireless technology in the next 10 years to further assist in reducing operating costs, thus helping meet the Nuclear Promise even after the program is complete in 2018.

Although wireless technology can provide significant benefits, roadblocks still exist in its implementation path in nuclear facilities. One of the roadblocks is the poor propagation of high frequency wireless signals throughout the plant environment. To overcome this, the industry along with EPRI is looking to extend coverage of wireless networks to all areas of nuclear power plants (NPPs) using Distributed Antenna System (DAS) technology [4]. As with all wireless technologies, EMI/RFI is a main area of concern for utilities [5, 6]. Research is being conducted to help establish the feasibility of deploying a DAS in an NPP. This research aims to address obstacles related to electromagnetic and radio frequency interference (EMI/RFI), installation and implementation concerns, and environmental and aging effects on wireless signal performance associated with the use of DAS technology.

DAS RADIATING CABLES

Radiating cables or “leaky coax” are used in conjunction with a DAS to provide propagation of signals along its entire cable length as opposed to a normal antenna which is a fixed point radiator. Radiating cables have a proven history in harsh environments and are commonly used in mines to provide data and communications to miners and operations throughout many miles of tunnels. Another example is in Transit tunnels which use leaky coax cables to provide customers with cellular communication. In a nuclear plant, using a leaky coax system may provide better coverage than a traditional antenna system using only Access Points (AP). As a cable, it can be routed around corners and in other restricted spaces where normal wave propagation would be hindered. As such, radiating cables would be ideal in a nuclear plant where most areas are disconnected, and walls are typically made of concrete. Radiating cables could be routed along a main corridor to provide coverage to adjacent areas. This type of coverage would be difficult with traditional APs as the signals would be radiated from a single point and be significantly attenuated by the surrounding structures.

The research conducted under this project aims to aid the nuclear industry in implementing DAS technology by identifying the unique concerns and obstacles to installation in the nuclear environment.
In support of this research, five radiating cables from several equipment manufacturers were acquired and their characteristics are listed in Table 1.

<table>
<thead>
<tr>
<th>Manufacturer &amp; Model</th>
<th>Dia. (in.)</th>
<th>Frequency (MHz)</th>
<th>Length Acquired (ft.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Radio Frequency Systems (RFS) (Model: RADIAFLEX RCF12-50JFL)</td>
<td>1/2</td>
<td>30 – 6000</td>
<td>100</td>
</tr>
<tr>
<td>Times Microwave Systems (TMS) (Model: T-RAD-600-PVC)</td>
<td>1/2</td>
<td>150 – 2500</td>
<td>140</td>
</tr>
<tr>
<td>Trilogy Communications (Model: AR012J50)</td>
<td>1/2</td>
<td>150 – 11000</td>
<td>50</td>
</tr>
<tr>
<td>Trilogy Communications (Model: AR078FV50)</td>
<td>7/8</td>
<td>150 – 1000</td>
<td>100</td>
</tr>
<tr>
<td>Siemens (Model: 6XV18752A)</td>
<td>1/2</td>
<td>2400 – 2485</td>
<td>65</td>
</tr>
</tbody>
</table>

**PERFORMANCE EVALUATION AND BASELINE METRICS**

The evaluation of a DAS and/or radiating cable can be done using a variety of methods. Each evaluation method is used to highlight unique aspects of the electrical characteristics of the DAS and cable. By combining and evaluating the results of each of these evaluation methods, the overall performance of DAS technology can be determined. The methods were chosen based upon their ability to monitor the change in the electromagnetic signatures from the cables. Initially, baseline data was taken for each cable under test, and then the cable was subjected to individual degradation mechanisms after which new data was taken for comparison. Following are brief descriptions of each test method with examples of the observable effects that can be seen.

**NEAR FIELD RADIO FREQUENCY (RF) PROPAGATION**

Near field RF measurements are used in order to determine the radiation pattern in close proximity to a radiating cable and how it might change during testing, as well as to determine signal attenuation at various frequencies. For the near field measurements, a near field probe is attached as close as possible to the cable to measure the RF energy radiated from the cable at a specific frequency using a spectrum analyzer. Initially, the DAS cable radiation patterns were evaluated using near field scanning techniques, which demonstrated two separate and distinct standing wave patterns. The “global pattern” was related to impedance mismatches at the feed point and end termination of the cables, and the “local pattern” was related to the wavelength of the signal being propagated through the cables as displayed in Figure 1. Prior to testing the cable samples, baseline RF measurements were made in the near-field in order to help identify any gross changes in the cables radiation pattern after being exposed to various degradation mechanisms.
Figure 1. Near Field Radio Frequency (RF) Propagation

Similar to near field RF measurements, far field RF measurements were used to determine the radiation patterns from the cables. Unlike near field measurements, far field measurements are taken at further distances from the cable and are used to show RF propagation through free space. Far field RF measurements use a receiving antenna that is physically larger than a near field probe and thus is better suited to determine the overall RF pattern of the radiating cables.

The far field RF signal was measured along the length of the cables with an antenna at a separation distance of 1 meter, where it was expected that the cable’s radiation pattern would exhibit little wavelength-dependent variation, as was present in near field measurements. At 1 meter from the cable, the radiation pattern was fairly uniform across its entire length with no “global” pattern variation as evident in Figure 2.

Figure 2. Example of far-field RF Pattern from DAS Cable

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TIME DOMAIN REFLECTOMETRY (TDR)

Time Domain Reflectometry (TDR) is used to measure the reflection within a cable resulting from a pulse input and can be used to determine the distance to impedance changes in the cables. TDR measurements can detect shorts, opens, faulty connectors, and insulation leakage due to moisture absorption.

TDR data was acquired during the accelerated aging process to identify, locate, and monitor faults in cable connections caused by exposure to elevated temperatures. Figure 3 shows an example TDR plot, where a change in the vertical axis (Rho) indicates a change in the characteristic impedance of the cable caused by faulty connections.

![Figure 3. Baseline TDR Data for Two DAS Cable Samples with Faulty Connections](image)

THERMAL AGING AND EFFECTS ON PERFORMANCE

As cables age, the polymers of the jacket and insulation material can break down and degrade. This degradation can lead to changes in the overall performance of the cable. To determine the extent of this degradation, a variety of cable evaluation techniques were used. This testing can be performed on cables samples harvested from the plant that have been exposed to a harsh environment or on cable samples that have undergone accelerated aging in a laboratory. Descriptions of the two main tests that were performed on the DAS radiating cables are provided in Table 2.

<table>
<thead>
<tr>
<th>Test Method</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Elongation at Break (EAB)</td>
<td>Destructive mechanical test performed by pulling a sample in tension until failure and calculating the % elongation. 50% absolute EAB is commonly used as the end of life condition for cable insulations. This serves as the primary benchmark test for monitoring cable insulation degradation.</td>
</tr>
<tr>
<td>Indenter Modulus (IM)</td>
<td>Non-destructive mechanical test used to assess the hardness of cable polymers. IM can be used to assess localized degradation of cable samples. These tests would be performed to establish the correlation between IM and EAB and monitor degradation in the insulation materials.</td>
</tr>
</tbody>
</table>

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ACCELERATED AGING OF RADIATING CABLES

All cable samples were subjected to accelerated aging for 1500 hours at a temperature of 110°C and an additional 345 hours at a temperature of 135°C. The results of the Elongation at Break testing showed there was little change between the baseline data taken at zero, 500, and 1500 hour marks. However, the data does indicate that the radiating cable polymers have severe degradation after 1845 hours of accelerated aging. This is due to the increased embrittlement of the polymers after aging the cables at a higher temperature. The cables, excluding the TMS-RAD-600-PVC radiating cable, did not exhibit any change in the Indenter Modulus results, as the baseline data taken at zero hours and the data at 500, 1500 and 1845 hours were all very similar. However, the TMS-RAD-600-PVC cable showed a significant increase in age degradation at the higher aging temperature for the last 345 hours due to the hardening of the polymer. In addition, near field propagation testing, as described earlier, was performed on each cable at the 500 and 1500 hour marks and there was no significant or observable effect on the near-field RF performance as a result of the thermal aging.

PHYSICAL DAMAGE AND DEGRADATION

In addition to thermal aging of the radiating cables, there are other physical stressors that can impact their performance. These stressors can include movement, abrasion, deformation, or any other physical force exerted on small or large sections of cable. Since the radiating cables are not installed in conduit or cable trays, they are more vulnerable to physical damage that may result due to these stressors. If these stressors are severe enough they can lead to component wear, failure, or complete breakage.

A sample of the radiating cable was tested by being bent at several angles between 0 and 180°. A sample of the results from the cable bend experiments can be found in Figure 4. It can be seen that the RF propagation pattern from the radiating cable was significantly affected at the bend location when bent at a 180° angle; no significant changes were observed at lesser angles. Although bending the cable to such an extreme degree did not render the cable inoperable, it would cause a significant change in the performance further down the cable.

Figure 4. DAS Cable Bend Testing at 180° Angle
Cuts and abrasions can be superficial and only affect the cable’s outer jacket or can be more significant and cause damage to the shielding or center conductor of the cable. To determine the impact this type of damage can have on a radiating cable, cable samples were intentionally cut to expose and subsequently damage the inner components of the cable (i.e. the outer conductor shield, insulation dielectric material, and center conductor) in order to characterize the effect on RF performance and to evaluate the capability of cable condition monitoring technologies, like TDR, to identify gross cable damage. Figure 5 illustrates the various stages of the RADIAFLEX RCF-12-50JFL cable after: (a) the jacket material was removed to expose a section of the cable, (b) the outer conductor shield slots were cut to create a large slot, (c) half of the outer conductor shield was removed, (d) all of the outer conductor shield was removed, and (e) the insulation dielectric material was removed, leaving the center conductor fully exposed.

As a result of the cuts to the cable’s inner components, the near-field global and local RF propagation patterns were affected. In Figure 6, an example of the effects that the severe damage had on the cable can be seen from the data collected for the RADIAFLEX RCF-12-50JFL cable at 900 MHz. In particular, when the outer shield and insulation/dielectric material are removed there is a sharp change in amplitude at the point of damage. As additional portions of the shield were removed, the measured amplitude decreased by as much as 18 dB at the point of the shield removal meaning that more of the signal was radiating at adjacent points as shown in the figure. This increase in radiated energy could lead to the susceptibility of nearby equipment.

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Another problem that may be experienced in an NPP is moisture intrusion into the cables. Due to the harsh environment, cracks may form in the jacket and insulation of a cable creating a pathway for moisture to infiltrate. When moisture enters a cable, the dielectric constant of the insulation material is affected; consequently, the cable may fail to function as intended. In the case of a radiating cable, the cable may not be able to effectively transmit a signal. An experiment was performed by submerging a short section (~ 8 inches) of cable in water to evaluate the effects of moisture intrusion. The submerged section was tested with the cable jacket removed, outer conductor removed, and dielectric/insulation material removed. Testing was conducted on several cables under similar conditions. Cables that were tested included the Times Microwave Systems T-RAD-600-PVC, RADIAFLEX RCF-12-50JFL, and the Trilogy Communications AR012F50. The TDR data collected on all of the cables were very similar, and the data clearly indicates the location of the submerged section. Figure 7 is an example TDR plot for the RADIAFLEX cable showing the submergence at a distance of 7 feet along the length of the cable.

![Figure 7. TDR Data Plot of RADIAFLEX RCF-12-50JFL Cable – Baseline vs. Submerged](image)

In general, an intact cable jacket provides protection from moisture intrusion. However, cuts to the jacket or severe damage to the cable presents the potential for moisture-related failures in the radiating cables. Plant personnel must consider the environmental conditions and the consequences of moisture intrusion prior to installation of the cable in the plant. Furthermore, TDR testing of the installed cables has successfully been demonstrated to accurately and consistently identify moisture intrusion in radiating cables.

**EMC AND WIRELESS COEXISTENCE**

One of the practical considerations that exists when installing new equipment in an NPP is the concern of electromagnetic compatibility [7]. This becomes even more important when considering intentional wireless transmitters such as a DAS. The goal is to ensure that the new equipment will not interfere with existing plant equipment and vice versa. One of the most vulnerable pieces of equipment that have been identified in NPPs are pressure, level, and flow transmitters that are used to monitor both safety-related and non-safety-related systems. Laboratory testing of a DAS radiating cable located near a Barton 764 pressure transmitter was performed to determine the possibility and severity of interference caused by radiating cables.

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For this experiment, a RADIAFLEX RCF12-50JFL radiating cable was routed alongside the Barton 764 in two different orientations as shown in Figure 8. For test configuration #1, the radiating cable was routed along the front face of the Barton 764. For test configuration #2, the cable was routed above the Barton 764 close to its lead wires. The lead wires receive the power for the transmitter and also carry the output signal from the transmitter. Testing shows that the lead wires are the most vulnerable point of the transmitter since EMI/RFI can couple to the wires and be carried into the transmitter where it can affect the internal components. This was due to configuration #2 presenting a more direct path for the radiating cable to propagate and couple onto the lead wires relative to configuration #1 where the metal housing provides physical separation and sufficient shielding of the lead cables.

![Figure 8. EMC Susceptibility Testing of Barton Transmitter](image)

The output of the Barton 764 transmitter was recorded as the sensor was provided with a constant pressure source to establish a baseline measurement. Subsequently, changes in the Barton transmitter output relative to baseline were recorded as the radiating cable transmitted signals at several common cellular and Wi-Fi frequencies: 742 MHz (3.7 W), 944 MHz (4.6 W), and 2.4 GHz (3.2 W).

Generally speaking, increasing the physical separation between the transmitter and the radiating source is the most practical means of reducing undesirable EMI/RFI effects. This drop off can be approximated by using the electric field strength formula below and solving for distance. The formula can be used since the dominating factor for approximating the drop off of power is distance and the influence of all other factors (i.e. antenna size) have a negligible effect.

\[
E = \frac{\sqrt{30P_tG_t}}{D}
\]

Where:
- \( E \) – Electric Field (V/m)
- \( P_t \) – Transmitter Power (W)
- \( G_t \) – Antenna Gain (dimensionless)
- \( D \) – Distance to Antenna (m)

For all test frequencies of configuration #1, the percent difference in pressure with respect to baseline was very small as a result of the EMI/RFI introduced by the radiating cable as shown in Figure 9. Even
for small separation distances, the percent difference was less than 2.5%. For configuration #2, a large percent difference was observed for the 742 MHz test at extremely short separation distances (< 5 cm) as shown in the right side of Figure 9. For distances of 10 cm or greater, the impact was relatively low. For both test configurations, the impact on the transmitter was greater as the frequency decreased. Expanding on this observation, additional testing of the EMI/RFI effects was performed at a lower frequency, 400 MHz, which is a common Radio and Public Safety frequency.

![Figure 9. DAS Radiating Cable EMI Test on Barton 764 – Configuration 1 (Left) and Configuration 2 (Right)](image)

For the testing at 400 MHz, a constant separation distance of 300 cm was maintained parallel to the face of the transmitter (configuration #1). The amplitude of the signal was incrementally increased from 10 to 400 mW, and the output of the Barton transmitter was measured and compared to the baseline data as shown in Figure 10. For high-power, low-frequency signals, there is a significant impact on the output of the Barton 764 transmitter. Therefore, when installing a DAS radiating cable in the vicinity of sensitive equipment, plant personnel must be cautious with respect to the distance between the cable and the transmitter, the transmission frequency, as well as the power of the signals propagated over the radiating cable. On-site EMC testing and evaluation can be performed prior to installing radiating cables to establish operational limits for the DAS radiating cable or determine an exclusion zone for wireless devices.

![Figure 10. DAS Radiating Cable EMI Test on Barton 764 – Configuration 1 (400 MHz)](image)
CONCLUSIONS

The applications for wireless technology will continue to expand in the nuclear power industry leading to time and cost savings that further assists in “Delivering the Nuclear Promise”. DAS technology is one enabling technology that can help accomplish these goals by providing a wireless infrastructure for numerous different wireless protocols across a wide range of frequencies, thereby, allowing plants to implement wireless sensors and data communications efficiently and effectively.

The research conducted in this paper aids in addressing some of the challenges and concerns associated with deploying DAS technology in an NPP including EMI/RFI, installation practices, and maintenance programs. These challenges were addressed by evaluating the most likely failure mechanisms associated with cables and the unique concerns specific to intentionally radiating DAS cables.

Through testing it was shown that physical damage of cables and shield, such as sharp bends, can lead to increased radiating energy in the vicinity of the damaged section and diminished performance further along the length of the cable. This increase in energy could lead to increased interference of nearby equipment. Therefore, EMC evaluations and testing are recommended, prior to installation, to establish operational limits for the DAS radiating cables and to determine exclusion zones for wireless devices. Unlike physically damaging the radiating cables, testing showed no significant changes in performance after being subjected to accelerated aging at 110°C for over 1500 hours. However, due to the brevity of this testing, further research is suggested to fully evaluate the effects of aging on the long-term performance of radiating cables.

ACKNOWLEDGMENTS

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REFERENCES


MEMBER RECOGNITION

John Sorge Named Engineer of the Year

Contributed by Dale Evely, Southern Company (retired) and ISA Life Fellow

In February, John Sorge was named 2018 Engineer of the Year by the Engineering Council of Birmingham, Inc. (ECOB). John was nominated for this award by the ISA Birmingham (Alabama) Section. As an ISA POWID member, John most recently served as Program Chair for our 2018 symposium.

ECOB was founded in the 1950s to coordinate activities and communications among local engineering societies in the Birmingham area. The council has a diverse group of societies that include educational, professional, and specialty trade associations. They are all related in some way to the fields of engineering, technology, construction, consulting, as well as promotion and education of students for these related fields.

John, who retired in December after a long career with Southern Company, was recognized by ECOB primarily for his work at Southern Company as a Research Engineer where he focused on automation, diagnostics and prognostics. He also managed DOE Clean-Coal projects on NOx control, providing guidance to EPA regulations. In addition, he was a contributor to standing up two Southern Company Monitoring and Diagnostic Centers. John is a Senior Member of ISA and also a member of ASME and IEEE. John holds a BS in Mechanical Engineering and a MS in Engineering Mechanics from the University of Alabama and a MS in Electrical Engineering from the University of Alabama in Birmingham. John is a licensed Professional Engineer in the State of Alabama.

Please congratulate John on this recognition of his career accomplishments.

Update From Standards & Practices

ISA77
The ISA77 committee last held a meeting on 31 October 2018. You can find the ISA77 meeting minutes posted on the committee website. A few of the working group chairs reported that they have held meetings to work on revising documents. As a result, the status of new/revision documents are as follows:

- ISA77.00.01 Definitions and Basic Control Concepts (Ballot submitted Nov. 7)
- ISA77.13 Turbine Steam Bypass Systems (in revision and still in progress)
- ISA77.14.01 Steam Turbine Controls (in revision and ready to be balloted)
- ISA77.22.01 Power Plant Automation (new document and still in progress)
- ISA77.42.01 Feedwater Control (in revision and ready to be balloted)
- ISA77.44.01 Steam Temperature (in revision and still in progress)

Recently, both Robert Eng (Mitsubishi Hitachi Power Systems) and Dale Evely (Southern Company) have retired and stepped down as members of ISA 77 committee. We thank both Robert and Dale for their many years of support to the ISA 77 standards work and wish them well on their retirement plans.

If you have an interest in joining the ISA77 committee or any of its working groups, please contact Daniel Lee.

ISA67
ISA67 is the standards committee organized to support the development and maintenance of consensus standards supporting the nuclear power industry. This is a promising time for nuclear. Construction of the Vogtle units 3 & 4 continue. NuScale’s Small Modular Reactor technology has passed the first phase of the Nuclear Regulatory Commission’s licensing process and entered the first phases of the manufacturing process with plans to have their Idaho pilot plant finished by 2026.

Conceptual design of a versatile test reactor is moving forward. If approved the unit would allow for testing of fuels and materials for advanced reactor technologies. Nuclear energy has a tremendous ability to produce large quantities of clean energy.

With the progression of nuclear technology, the need to further develop standards and best practices continues. As a consensus standard group, we rely on the knowledge and experience of volunteers willing to participate in the process. Involvement will enhance your own understanding of industry codes and good engineering practices. In addition, you build your network with other committee members.

If you have an interest in joining the ISA67 committee, please contact Daniel Steik.
Welcome Members
(February through June 2018)

Welcome new members and students. We hope you will take advantage of everything ISA and POWID have to offer for your career, especially the opportunity to network with power industry professional colleagues across the globe.

Our goal is to provide a means for information exchange among engineers, scientists, technicians, and managers involved in instrumentation, control and automation related to the production of power. We also support the development of industry standards and training. We hope you will get involved in our activities, writing papers for our newsletter, website or ISA conferences, or volunteering your time within our management structure.

Chethan Acharya, Southern Company Services, Principal Engineer
Amir Ahmadi, Advanced Process Automation Technologies Inc., CEO
Eisa Alblooshi, ADNOC Benard Alejandria, Ser2hate Inc., Director Sales and Marketing
Jonathan Allcock, Energy Innovators Ltd, Director
Peter Nosike Amadike Puay Lun Ang, AVF Solutions (M) Sdn Bhd, Sales & Marketing Director
Prasad Aslekar, Emerson Export Engineering Centre, Sr. Project Manager
Craig Battles, Rimkus Consulting Group, Inc., Consultant, Electrical Jon Beach Deepramak BHOWMICK, Mitsubishi Hitachi Power Systems, I&C Lead Engineer
Jaime Marcelo Cedeño, I&Cl Senior Engineer
Tin Soong Chan, Automation & Controls Systems SDN BHD, Business Development Director
Rongmin Chen, China Datang Corporation

Robert Cleghorn, Gemma Power Systems, I&C Commissioning Lead Tech
Michel Compere, Tractebel SA, Chief Engineer
Behnam Daftary Besheli, LAWI Engineering GmbH., I&C Department Manager
Tyrone De Wet, Instruments South Africa, Managing Director
Steve Dodyk, Corix Control Solutions, Sales Engineer
Jeffrey C. Downen, CCST, CSTIT
L A E Fernandez, Bharat Heavy Electricals Limited, General Manager
Eric M. Fornshell, Control Systems
Raul Garcia Bada, CTAI Ingenieria
Lisa Gentry
Renji George
Gustaw Golinski
Francis X. Hanley, PCT Plant Controls Technician
Sherif Hassan, Fapco, Lead C&I Engineer
Guilermo J. Hernandez Martinez, Cargil De Mexico, Supervisor Electrico
Marlon Hodge
Ravinda Krishna Holivale, Reliance Industries Ltd, AVP
Aidan Hollier
Mithch Impey, SE Holding A/S
Samson Ingomovwe
Aasif Iqbal, Dubai Electricity and Water Authority

Milind Kadam, Steam Equipments Pvt Ltd, Director Sales
Robert Kamp, Kansas City Kansas Board of Public Utilities, Sr Project Manager
Julian Kryemadhi, Covanta, Sr. Manager, IT Security & Risk Management
Fabian Lara
Orbin Lopez, Lakeland Electric
Jose Antonio Lucus Martinez, Araner, Project I&C Manager
Tingyan Lyu, China Datang Corporation, Vice President
Tariq Mahmood, GE Power, Engineering Manager
Binny Mathews, ESB, C&I Engineer
Tom McKevitt, Duncan Company, Director Business Development
Amanulla Baig Mizra, Dubai Electricity Water Authority
Peter Mulholland, ESB, EC & I Team Leader
Mazhar Nawaz
Cofie Penrose, Prairie View A&M University, Engineer
Sheraz Pervaiz
Michael Allan Queen, Charlotte Water, Engineering Division Manager
Jamin Quinn
Pradeep Ramakrishnan, OG&E, ICE Technician
Ross Edward Ritter, Manager - East Region
Sreeram S
Milana Santos
Colleen M. Scholl, HDR, Senior Vice President
Nathan Sparks, Idaho Nation Laboratory
Kathy Staudt, The Vibration Guys, LLC, Director
Daniel R. Steik, Cognizant Team Leader
Ken Yokoyama

Jonathan A. Whitten, Senior Project Manager
Mahmoud Zain Elabdin
Elsayed, Almashariq Co, Sr. Systems Engineer
Anthony Zamore, Pricewaterhousecoopers, Director
Carlos Antonio Zarco
Garnero, MABREX, Gerente General

Students
Majid Alsuwaidi
Vladimir Alvarenga
Nicolas Amaraibi
Saba Anjum
Durga Kumar Appikonda
Mohan Jorge Luis Ayala Molina
Dhruvi Bhatt
Pawan Challa
Jacques Coetzee
Hantao Cui
Cody Dickinson
Nalini Duraisamy
Katlyn Farness
Jenna Garcia
José Alexander García Rodriguez
Jeff Gross
Sakaria Indongo
Chetan Kansagara
Kasidi Kavan
Ryan Kelly
Sharmila Devi Kumaravel
Andrew Mchvor
Ian Mossman
Jorge Murguetio
Rahul Nair
Amethyst O’Connell
Juan Camilo Pabon Meneses
Dan Azle Paglomutan
Jann Tristan Ramos
Gerson Ivan Rivera
Argumedo
Mark Runge
Revathi S
Fredy Josué Sánchez
J Sczesny
Johnathan Sinnathamby
Bhagoji Bapurao Sule
Colton Tucker
Justin Walker
Xu Wongzhe
Ken Yokoyama