BIOGRAPHICAL SKETCH

Mr. Chad J. Kiger is the EMC Engineering Manager at Analysis and Measurement Services Corporation (AMS), a nuclear engineering consulting and testing firm headquartered in Knoxville, Tennessee (USA). He has been with AMS since February 2006. In his role as manager of AMS' state-of-the-art electromagnetic compatibility (EMC) testing laboratory, Mr. Kiger is responsible for overseeing the development of EMC and cable testing capabilities, as well as developing the test equipment necessary to perform all facets of EMC and EMI testing for private clients, utilities, and nuclear power plants throughout the world. He is a Professional Engineer in the State of Tennessee, License (# 118572), and currently serves on the Board of Directors for the Knoxville Society of Professional Engineers (KSPE). He is also a Fellow of the International Society of Automation (ISA), a Senior Member of the Institute of Electrical and Electronics Engineers (IEEE), and a member of the American Nuclear Society (ANS). He received the Ted Quinn Early Career Award in 2018 from the American Nuclear Society's Human Factors Instrumentation & Controls Division (HFICD).

EDUCATION

University of Tennessee – Knoxville
BS Electrical Engineering, 2004

University of Tennessee – Knoxville
MS Electrical Engineering, 2005

Tennessee Tech University
PhD Engineering, expected December 2018

College of Engineering

TENNESSEE TECH

The Department of

Electrical & Computer Engineering

Announces the Dissertation Defense

of

Chad Kiger

In Partial Fulfillment of the Requirements

For the degree of

Doctorate of Philosophy

Monday, November 5, 2018 at 10:00 a.m.

Held in

208 Brown Hall
115 West 10th Street
Cookeville, TN
Tennessee Tech University

FIELD OF STUDY

RF Measurements and Signal Analysis

DISSERTATION TOPIC

In-situ Assessment of Aging for Dielectric Cables using Frequency Domain Reflectometry

EXAMINING COMMITTEE

Dr. Satish Mahajan (Committee Chair),
Interim Chair & Professor
Electrical & Computer Engineering

Dr. Wayne Johnson
Professor Emeritus
Electrical & Computer Engineering

Dr. Adam Anderson
Joint Faculty with ORNL & TTU

Dr. Ghadir Radman
Professor
Electrical & Computer Engineering

Dr. Chris Wilson
Chair & Professor
General & Basic Engineering

ABSTRACT

The Nuclear Regulatory Commission (NRC) has granted license extensions to a majority of the nuclear power plants in the United States to operate beyond their original 40 year design life. Most of the original cables installed in the current fleet of U.S. nuclear power plants were qualified by the cable manufacturers for 40 years of use. The nuclear industry is establishing cable condition monitoring and aging management programs to verify these cables can continue to function during normal operation and under accident scenarios. Cable insulation polymers are malleable/ductile when new and become more brittle/stiff as they age. Therefore, cable insulation aging can be determined using mechanical tests such as the elongation at break (EAB) and indenter modulus (IM) tests. However, the EAB test is a destructive laboratory test method and the IM test requires local access to the cable under test. This can be problematic when a utility does not want to damage the subject cable to remove a section for testing or when the cable traverses through differing environments along its length and are inaccessible to plant personnel.

The research and development work performed under this project was conducted to develop a non-destructive method of identifying and trending age related degradation of cable polymers that could be performed remotely and in-situ without affecting the normal operation of a plant. The objective was to design, develop, validate, and demonstrate technology for in-situ testing of polymers to locate and quantify age related degradation for the insulation and jacket material in nuclear power plant cables. The project established the ability to correlate frequency domain reflectometry (FDR) results of aged dielectric cable polymers to industry standard laboratory tests. The results of the correlations were used to develop cable aging criteria for assessing the condition of installed cables to help nuclear power plants determine if the cables will operate properly or if they must be replaced prior to plant life extension.

This project developed preliminary correlations for the two most common cable types in U.S. nuclear power plants which are Ethylene Propylene Rubber (EPR) and Cross-Linked Polyethylene (XLPE). These cables cover a majority of the safety related cables in the nuclear industry. The results have demonstrated that FDR is well suited for identifying and locating cable insulation damage as a result of environmental aging. The research has shown that FDR, as an in-situ non-destructive evaluation (NDE) technique, provides good correlation with Elongation at Break (EAB) results, considered the standard for the assessment of cable aging, and can be correlated to end of life criteria for the most commonly used polymers in nuclear power plant cables.