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Protecting National Security and Sailor Lives at Sea

Providing continuous mobility, power, and thermal management for shipboard combat systems in the presence of major interruptions involving cascading failures is a critical mission within the U.S. defense infrastructure. Electric Shipboard Power Systems (SPSs) supply power to the sophisticated systems for weapons, communication, navigation and operations of warships. During battle, weapons can attack a ship and cause severe damage to the electrical system on the ship. When faults occur as a result of battle damage or material casualty, isolation by protective devices can lead to de-energizing of critical loads on a ship that can eventually decrease a ship's ability to survive the attack. It is very important, therefore, to maintain availability of energy to the loads that keep the power system operational. In present shipboard power systems, the majority of the operations of power restoration to these de-energized loads are performed manually.

However, continuous monitoring of the shipboard electric power system and automated reconfiguration of the SPS before or after battle damage, or material casualty, can help maintain the mission while providing the benefits of reduction in the number of crew required to perform reconfiguration and improved fight-through survivability. Self-healing systems activate control actions to steer the power system to a more secure, less vulnerable operating condition. These strategies include control options that are initiated in a preventive self healing mode or corrective/restorative self healing mode. For the past eight years, researchers in Butler-Purry's research group at Texas A&M University have been developing a self-healing reconfiguration system for shipboard electric power systems that includes two preventive methods and one restorative method. One preventive method operates according to the traditional preventive self-healing definition by determining control solutions to arm the SPS for critical contingencies. The second preventive method, termed 'predictive' by the authors, performs control actions before an incoming weapon hit based on predicted damage to the SPS to reduce the risk of cascading failures when the weapon hits. This self-healing reconfiguration system presents a framework for determining control actions during the preventive and restorative modes of a SPS. The control actions represent the control commands for circuit breakers, and bus transfer and low voltage protection devices.

This presentation will provide an overview of the various functions of the self-healing system and illustrate one of the methods using a computer model of the electric power system on a surface combatant ship.

BIO

Karen Butler-Purry received the B.S. degree from Southern University at Baton Rouge, the M.S. degree from the University of Texas at Austin, and the Ph.D. degree from Howard University, all in electrical engineering.

In 1988-89, Dr. Butler-Purry was a member of Technical Staff at Hughes Aircraft Co. in Culver City, California. Further she spent the summer of 1992 as a researcher at RIKEN National Laboratory in Tokyo, Japan as a part of the 1992 NSF Summer Institute in Japan for Graduate Students in Science and Engineering. Since 1994, Dr. Butler-Purry has been at Texas A&M University in College Station, Texas where she is now a professor and associate head of the electrical and computer engineering department and assistant director of the Power Systems Automation Laboratory. Also she served as Assistant Dean for Graduate Programs for the College of Engineering from 2001-2004. In 2003, she co-founded KBP & Associates, an electrical engineering and construction firm. She was awarded an NSF Faculty Early Career Grant in 1996 and an Office of Naval Research Young Investigator Award in 1999. Further she is a Texas A&M University Center for Teaching Excellence1998 Montague Scholar and 2005 Faculty Associate. In addition, she is a 2005 recipient of Texas A&M University Association of Former Students Distinguished Achievement Awards for Student Relations.

Her research interests focus on Distribution Automation and Management, Fault Diagnosis, Power System Equipment Prognosis, Intelligent Reconfiguration and Restoration; Protection and Control of Power systems; System Modeling and Simulation for Shipboard and Hybrid Vehicles; Real-time Simulation of Large-scale Terrestrial and Isolated Power Systems; and Teaching and Learning Methodologies in Engineering. She is the author of many publications in the areas of power system protection and intelligent systems and has made invited presentations in Nigeria and India. She is an active member of several IEEE technical and education committees. Also she is a registered professional engineer in the States of Louisiana, Texas, and Mississippi.