Hardware Model of a Shipboard Zonal Electrical Distribution System (ZEDS):
Alternating Current/Direct Current (AC/DC)

by

Chad N. Tidd

Submitted to the Department of Mechanical Engineering on May 7, 2010 in Partial Fulfillment of the Requirements for the Degrees of Naval Engineer and Masters of Science in Engineering Management

ABSTRACT

A hardware model of a shipboard electrical distribution system based on aspects of the DDG 51 Flight IIA, Arleigh Burke class, 60Hz Alternating Current (AC) and the future direct current (DC), zonal electrical distribution system (ZEDS). These distribution boards were designed and built for the purpose of testing electrical system components at the Massachusetts Institute of Technology's Laboratory for Electromagnetic and Electronic Systems (LEES).

The combination of existing electrical generators and the newly created electrical distribution boards will provide a hereto unattained level of access for testing and evaluating a number of research topics currently being worked on at LEES. The level of reality inherent in this system will enable the user to refine experimental hardware and software in a safe and controlled environment. The user will benefit from a quicker product development process. Additionally, the ability to easily produce verifiable records to demonstrate the effectiveness/applicability of their individual experiments will help to progress research at LEES along the product development path.

Two 5 kW generators serve as electrical generation for the ZEDS benchtop emulator boards. The hardware models support experimentation with AC and DC ZEDS power loading and protection. The hardware models reflect the AC ZEDS architecture employed on the DDG-51 class destroyers. The emulator is a three phase electrical system with both port and starboard buses, a computer interface to control the generators and contactors or solid state relays through a graphic user interface (GUI). The system is capable of being configured and operated in a split plant, parallel or single generator plant configuration.

Thesis Supervisor: Steven B. Leeb
Title: Professor of Electrical Engineering and Computer Science & Mechanical Engineering