



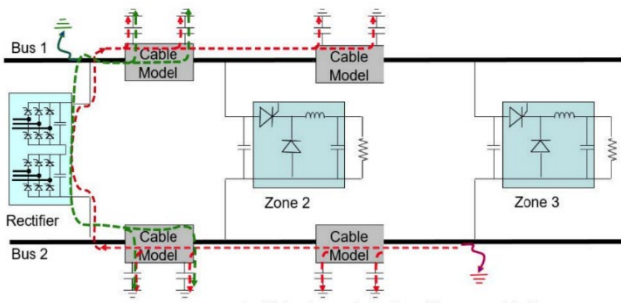
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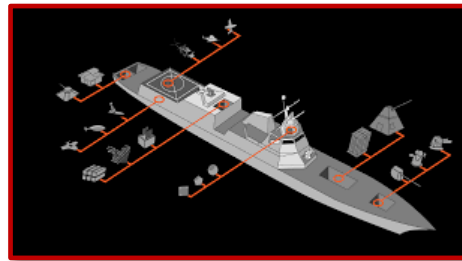
TECHNOLOGY FACT SHEET – Medium Voltage Direct Current

TECHNICAL CHALLENGE

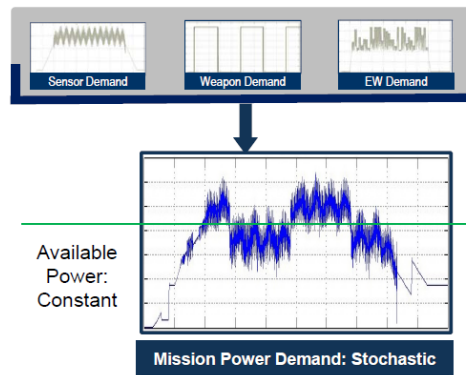
- Medium Voltage Direct Current (MVDC) circuit protection and fault management are increasingly difficult over AC systems
- Anticipated pulsed and stochastic shipboard loads requires power quality management
- Stray electrical hull currents from shipboard power distribution system cause corrosion damage to hull and equipment
- Faults must be located quickly for isolation, repair, and recovery



Ground current loops for positive and negative rail faults

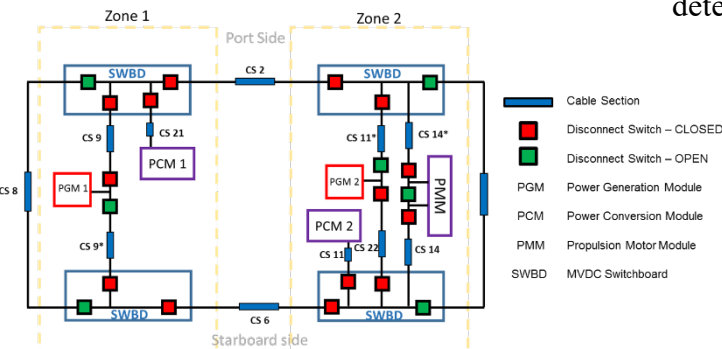


NEW CAPABILITIES DEMAND PULSE AND STOCHASTIC POWER



BENEFIT TO THE WARSHIP

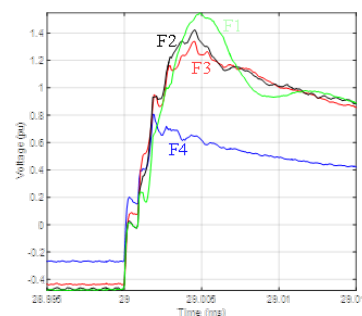
- Enables dynamic high-power demands
- Increased operational efficiency due to a decoupling of prime movers from the power quality on the DC bus
- Increased system power density
- Heightened control over fault currents with power electronics
- Simpler paralleling of generators



Notional multi-zonal MVDC shipboard power distribution

TECHNOLOGY OVERVIEW

- Commercial marine MVDC systems exist, primarily motivated by efficiency and power quality benefits
- Grounding methodology provides protection and fault ride through
- Developing noise pattern analysis-based fault localization, passively monitoring inherent system noise to determine a given fault case location



Fault Transient Voltage Characteristics per Location

6

Technology Readiness Level for Navy Shipboard MVDC Distribution

“Integrated Power and Energy System development is currently focused on a medium voltage direct current (MVDC) system evolved from the DDG 1000 1kVDC Integrated-Fight-Through-Power system” Stephen Markle Naval Power and Energy Systems Technology Development Roadmap

