

An Overview of Hybrid Power Systems and their Architecture



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Abstract:

As technology evolves and regulatory complexities increase, the marine industry is faced with the reality of both complying with environmental requirements and meeting operational demands. To deal with these challenges, owners and operators are turning to more non-conventional sources of energy to power and propel vessels. As the industry moves ahead, hybrid electric power systems will play a key role in meeting the regulatory and operational demands placed on vessels.

Other industries, like electric utilities and aerospace, are already applying renewable energy technologies to their end products and finding innovative ways to reduce their environmental footprint while still maintaining their competitive edge. It is critical that lessons learned and experiences in the adaptation of hybrid electric power in other sectors are considered as the marine industry examines their various options. The evaluating the potential advantages and disadvantages, challenges and level of readiness for the primary hybrid electric power systems and components that are most suited for marine applications is being carried out in this paper. Modern electric propulsion systems are being enhanced by the incorporation of new technology. One example is the incorporation of alternative electrical power sources such as fuel cells, solar panels and wind turbines. Other designs employ one or more methods of energy storage such as batteries, super-capacitors and flywheels to supply and/or supplement the electrical power needs of the vessel. Vessels with such arrangements also incorporate power management systems that extend well beyond the standard electrical control systems. These types of systems are considered to fall under the new and developing category of hybrid electric power systems.

For the context of this paper, hybrid electrical power systems incorporate multiple sources of power, usually a combination of both non-traditional sources (batteries, capacitors, fuel cells, etc.) and traditional sources (diesel gen sets). This Paper offers an overview on hybrid electric power systems, the current status of the component technologies, the advantages and challenges of each, along with some of the applications in the marine and offshore industry. The primary component technologies have been divided into two broad categories, namely energy storage technologies and energy generation technologies.

The energy storage technologies covered include batteries (with a focus on Lithium-ion batteries), capacitors (with a focus on supercapacitors and hybrid capacitors) and flywheel energy storage. The energy generation technologies covered in this Paper include fuel cells, solar and wind power.