OTC-24204-MS

Subsea Uninterruptible Power Supplies (UPS) for Local Holdup of Magnetic Levitating Bearings in Subsea Production Hardware

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Abstract

The use of batteries subsea has historically been limited to powering autonomous instrumentation for oceanographic applications with power capacities typically limited to less than a few hundred watt-hours. Over the past decade, engineering design and technology advances in subsea applications have led to an increased focus on battery technology, including increased capacity. In particular, the growth of the autonomous underwater vehicle (AUV) market in the early 2000's lead to regular use of batteries subsea with capacities of up to tens of kilowatt-hours (kWhr).

In order to enhance production and maximize reliability of offshore fields, focus has increased on placing traditional terrestrial equipment subsea and incorporating electrically powered process equipment. Some of these applications have led to the deployment of large battery and UPS modules for subsea deployment. Notable applications include the recent development of 165kWhr battery modules for the Marine Well Containment Company (MWCC) to allow subsea pumping of dispersant from bladder fields to an uncontrolled hydrocarbon leak, and uninterruptible power supplies that have been marinized for holdup of critical equipment on compressors being qualified now for installation on the Ormen Lange oilfield.

This paper focuses on a concept system being developed and qualified for military applications, similar to the MWCC battery system. The focus is on a marinized pressure compensated battery module of 150kWhr, which can be daisy-chained or arranged in a hub configuration for up to 1.5MWhr of holdup capacity. This paper details original analysis on the application of these battery power modules to provide a UPS for dedicated use with magnetic levitating bearings common on subsea compressors and motors on subsea production systems. By providing a localized UPS system to the magnetic levitating bearing controllers, it is possible to provide a redundant power source, mitigating risk from failure of the primary subsea power supply. Coast down times for the magnetic bearings typically take just a few minutes and fit well within the voltage, current, and power supply levels of the UPS design described in this paper. The distributed UPS system design discussed herein utilizes a modular design. The modules discussed can be configured to allow for expansion and enhanced redundancy to be integrated subsea without the need for a unique qualification program.

This paper discusses potential applications of the UPS within subsea production equipment, including interface points, recovery, discharging, charging, and monitoring.