Session – New Applications

Title: **DP Power Plant Open Bus Redundancy with Closed Bus Operations**

Authors: **Saurabh Shah** and **Kamal Garg,** *Schweitzer Engineering Laboratories, Inc.*

Abstract

Closed bus-tie operation of power plants provides superior tolerance for dynamic positioning (DP) power plant faults. However, a vessel operating with closed bus-tie breakers is not guaranteed to retain thrusters during certain types of power system failures. In these situations, rapid recovery of equipment is critical for meeting DP2 and DP3 minimum requirements of stationkeeping.

Open bus ties are often used when rapid recovery is inadequate to meet operational needs and retention of thrusters is necessary. Operating with open bus ties reduces overall power plant reliability but maintains availability of thrusters during any equipment fault.

This paper presents a design that can provide the desired reliability of closed bus-tie operation while providing nearly the same thruster retention capability as open bus-tie operation. Using advanced fault detection and plant management techniques, faults that would typically result in the loss of all thrusters on a closed bus-tie power plant can now be handled such that sufficient thrusters remain operational to continue DP operations even after the fault.

Power plant reliability is critical for the operation of DP vessels. DP vessel power plants are islanded power systems with four to eight generators operating in droop modes with total load demands commonly exceeding 50 MW. There are several common failure modes of the engine, synchronous machine, governor, and exciter systems that cause a complete blackout of the onboard power system. In the past, the offshore drilling industry has experienced single undesirable electrical system outages (blackouts) that have resulted in revenue losses of millions of dollars.

This makes a reliable electrical power system protection and control package critically important for offshore vessels. This paper explains several critical protection areas for offshore vessels and the failure modes currently affecting these vessels, including failure or misoperation of generator exciters and governors, islanding of defective generators, and fast fault detection and clearing in electrical machinery. The criticality of designing complete systems for simplicity, robustness, maintainability, testability, local support, ease of commissioning, longevity, and availability is also explained. This paper concludes with a design discussion of a protection and control system for offshore vessels using the latest technology and development in the area of protection and control. This includes a detailed design discussion of a proposed system for a DP vessel. A discussion of improving the reliability of a power plant, including an overview of the communications architecture, hardware designs, and visualization system, is also provided.

Additionally, the paper discusses the enhancement of the system design and many additional technological enhancements previously unavailable, such as real-time system monitoring, harmonic analysis, advanced visualization, ultrahigh- speed protection, IEC 61131 programming, synchrophasors, IEC 61850, and modern communications protocols. This paper also addresses the importance of reliability.

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