

Extended power plant protection

The functionality of the DGMS extends that of the normal protection functions from the relays. Because the DGMS can be installed as a stand-alone system, it is well suited for both newbuilds and existing vessels as a functional upgrade to the current power generation protection and monitoring system.

Generator monitoring functions

DGMS monitoring functions are designed to detect abnormal behavior of the generator set, which indicates a fault. An alarm is issued to the IAS whenever a fault condition is present.

DGMS provides the following monitoring functions:

- Correlation algorithms are used to monitor each generator individually and detect over-/under-fueling and over-/under-excitation
- Voting algorithms are used to group and compare generators running in parallel. If the load on one generator deviates excessively from the others, it is identified as faulty. Voting algorithms are provided for both reactive (excitation) and active (fueling) power.
- With fuel rack position monitoring, the position of the engine's fuel rack is compared to the active power output of the generator.
- Excitation current monitoring compares the excitation current produced by the AVR to the reactive power output of the generator.

The DGMS provides several additional monitoring functions as a back-up for the protection functions described above.



Drilling rigs and FPSO's are typical applications that can benefit from DGMS.

Tripping functionality

Each DGMS is able to trip the generator which it monitors as well as the busties connecting its switchboard section to other sections. If the monitoring functions detect a fault, which then deteriorates until the remaining healthy generators are in danger of being tripped, the appropriate trip sequence will be initiated. In the case of a fault on the same bus section, the DGMS will trip the affected generator. If the fault lies on another section, the DGMS may trip busties to isolate the fault.

Tripping functionality includes:

- Send pre-trip to PMS
- Stop engine and close fuel valve
- De-excite
- Open circuit breaker when power falls to zero

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Marine Automation

Diesel Generator Monitoring System (DGMS) A reliable safeguard against blackout

The Diesel Generator Monitoring System (DGMS) is an important tool for assuring efficient operations for vessels and offshore facilities. By proactively monitoring the vessel's diesel-electric generators, the DGMS mitigates potential onboard power plant problems and failures before they occur.

A problem source for blackouts

Power generation is the most important part of the design of diesel-electric power plants for marine and offshore applications. The basic protection of the power plant against abnormal behavior and blackouts has traditionally been to split the power plant into several independent units and install dedicated protection relays for each generator. These relays continuously monitor the voltage and current at each feeder in the switchboards. If exposed to electrical failures or abnormal behavior such as short circuits, over/under voltage or overloads, the relays disconnect the exposed generator(s) from the switchboard.

However, certain types of faults of the automatic voltage regulators or engine governors are not necessarily detectable by monitoring only the faulty generator. Such faults may in fact cause the other healthy units to behave abnormally in an attempt to maintain acceptable voltage and frequency. This can lead to a cascade fault in which all the healthy units are disconnected, leaving only the faulty unit running. Without the healthy units to maintain the frequency and voltage, the faulty unit will then also be tripped, resulting in a complete blackout of the affected switchboard.



The DGMS solution

The Diesel Generator Monitoring System (DGMS) addresses this issue by monitoring all connected generators simultaneously for fault types that typically cause disconnection of healthy generators. These faults include over/under fueling of the diesel engines and over/under excitation of the generators.

By checking that each generator behaves according to the control mode selected by the PMS and governor, the DGMS can correctly identify a faulty unit and automatically disconnect it from the switchboard before a cascade fault can occur.

DGMS response to generator faults includes:

- Detecting failure
- Creating alarms
- Starting standby diesel engines
- Isolating faulty engines before a blackout condition occurs (only if system crosses pre-set trip limits)
- Isolating faulty switchboard section (only if isolation of faulty engine fails)

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Maintaining the integrity and safety of the power plant through intelligent generator monitoring

Advanced process control technology

The DGMS is based on the ABB Compact Products 800 automation concept, which utilizes ABB AC 800M process controllers and S800 I/O modules.

The DGMS is a modular system that is designed for use on power systems with up to 8 generators and 8 switch-board splits. The system uses one cabinet per generator, with each cabinet including an AC 800M process controller with corresponding S800 I/O modules and power supply. Each cabinet interfaces with its assigned generator, Automatic Voltage Regulator (AVR), switchboard, engine and governor.

All DGMS cabinets are linked by a fiber optic Ethernet network. The network is configured as a ring, which provides cable redundancy and allows the systems to share data efficiently. Each DGMS reads the status of the generators monitored by all the other DGMSs, and uses this data to aid identification and location of faults, thus providing good protection against faults occurring both locally and on other bus sections.

Local operator panel

A local operator panel is provided in the door of each DGMS cabinet. This panel displays mimics which give an overview of the state of the power plant. An alarm list is provided showing a detailed description of any active alarms. An event list is also provided.

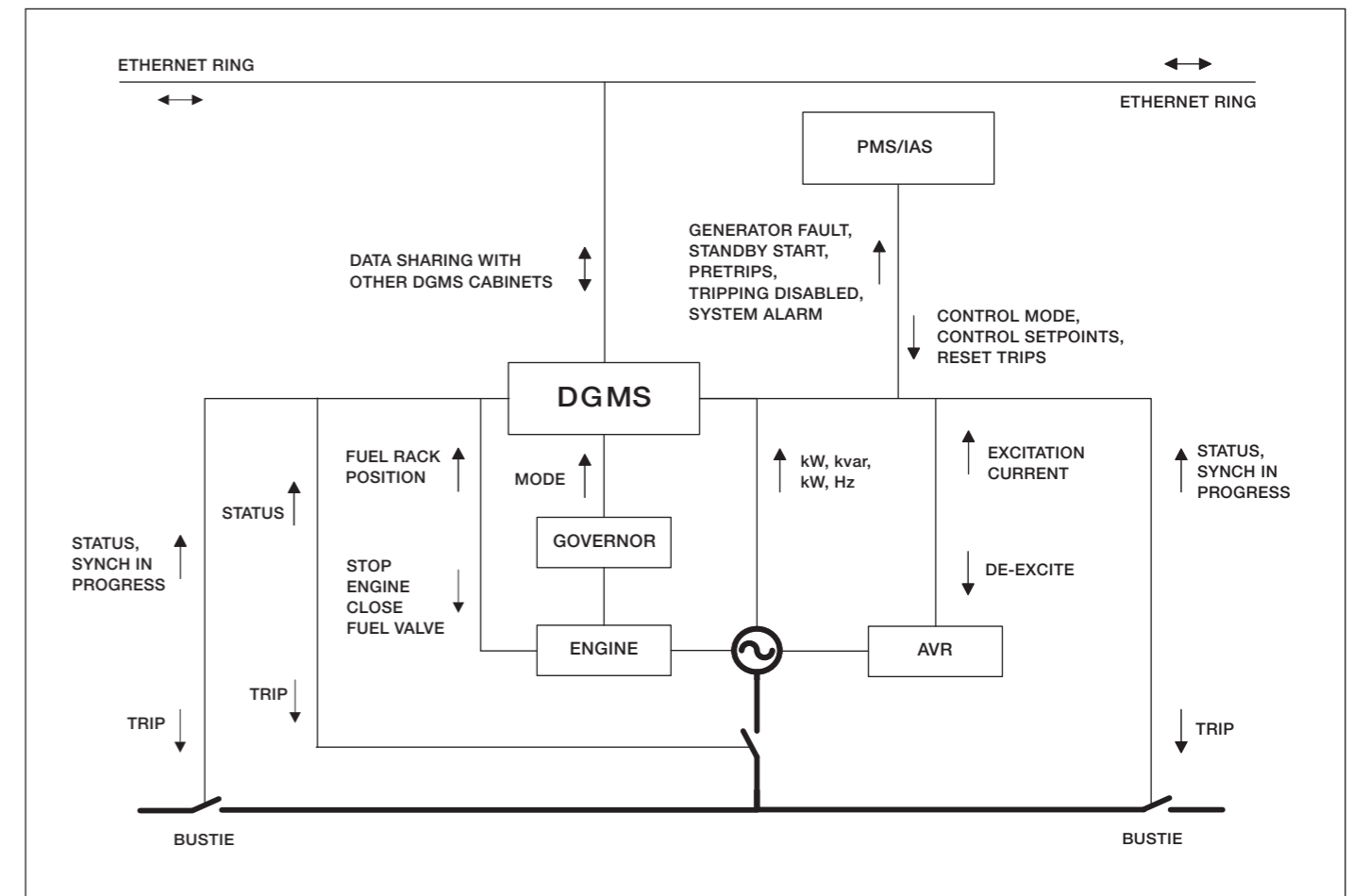
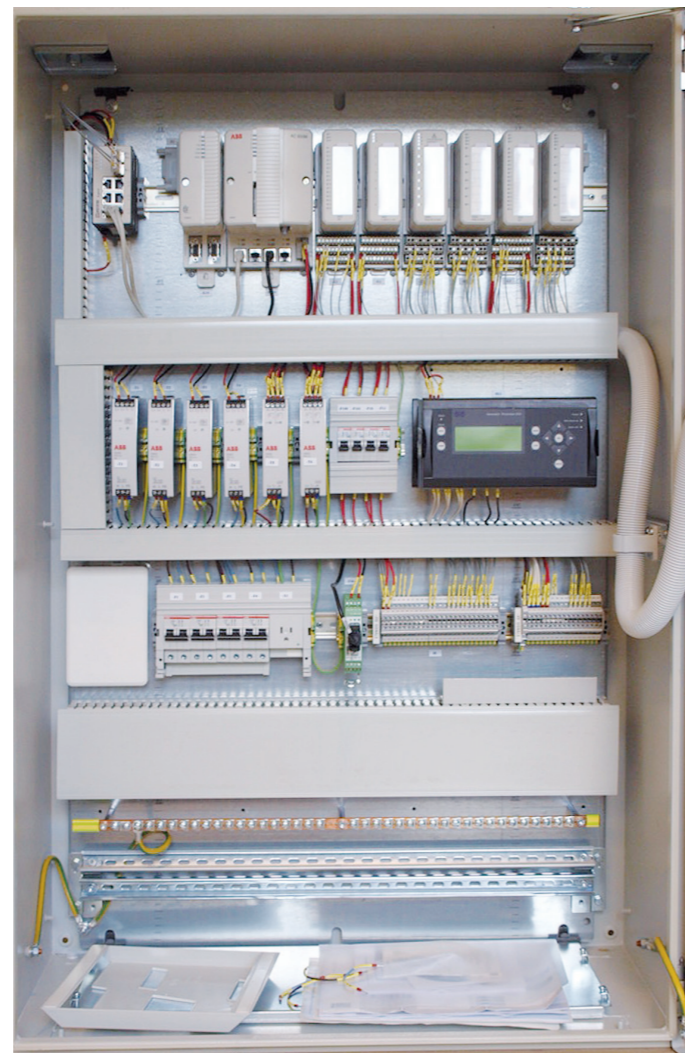
By ensuring reliable generator performance and providing effective protection against blackouts, the DGMS is a powerful tool for enhancing safety and optimizing vessel operations.

DGMS system features

The DGMS system includes:

- Real time data collection via high performance transducers
- Data logging with playback function (separate cabinet)
- Time synchronization with ship clock or GPS
- Power supply and data network redundancy
- Stand-alone cabinets for flexible mounting and easy retrofitting.
- Available in isochronous, droop and base load mode
- Scalable for any power system configuration, up to 8 generators and 8 switchboards
- Compliance with all major marine classification societies

Shown below is the DGMS cabinet.



Overview of DGMS interface

System self-monitoring

The DGMS includes a system self-monitoring function.

The following system conditions result in alarms:

- Warning from the Ethernet switch
- Missing memory backup card in the PLC
- Mismatch between the running PLC application version and the version on the memory backup card
- Failure of one of the two power sources (main or backup) or one of the redundant power supplies for the internal hardware or field
- Failure of the local operator panel
- Lack of response to any trip command issued by the DGMS
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- Lack of response to any trip command issued by the DGMS

The alarm signal for the IAS is made by a normally-open contact, which is closed when no alarms are present. The contact will thus open and generate an alarm in the event of failure of the PLC.

The 24V field power supply to all digital inputs is monitored by the digital input module. If the power supply fails, an alarm is given for each affected signal, and any tripping functions which depend on the affected signals are disabled.