

ELECTRIFICATION TECHNOLOGIES AND VESSEL INTEGRATION



FLEXSHIP

Halil Can YORGANCI

R&D Engineer

halil.yorganci@elkon-tr.com

ELECTRIFICATION OF MARINE VESSELS

- Power Generation (Shore Charging, Carbon-based, Hydrogen Cell, Solar, Nuclear)
- Energy Storage Units (Batteries, Hydrogen, Nuclear, Carbon-fuel)
- Grids (DC, AC, Low Voltage)
- Switchboards
- Breakers
- Power Management System
- Inverters/Converters/Rectifiers



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Power Sources in FLEXSHIP

- 2 x 750 kW Diesel Generator & Diesel Fuel Tanks
- 3 MWh 550V-820V Battery Energy Storage System (BESS)
- Backup Generator
- Multiple Uninterruptable Power Supplies (UPS)
- Onshore Power Supply (OPS) to charge the BESS



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VESSEL INTEGRATION

- Data communication between subsystems
- Physical & Signalling connections
- Alarm & Monitoring
- HMI
- System Redundancy
- Marine Standards
- Simulations & Tests



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Main Subsystems of the FLEXSHIP Project

- Power Management System (PMS)
- Battery Management System (BMS)
- DC Switchboard
- Battery Thermal Management System (BTMS)
- Battery Energy Storage System (BESS)
- Alarm & Monitoring



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Power Management System (PMS) Device: Beckhoff CX5140

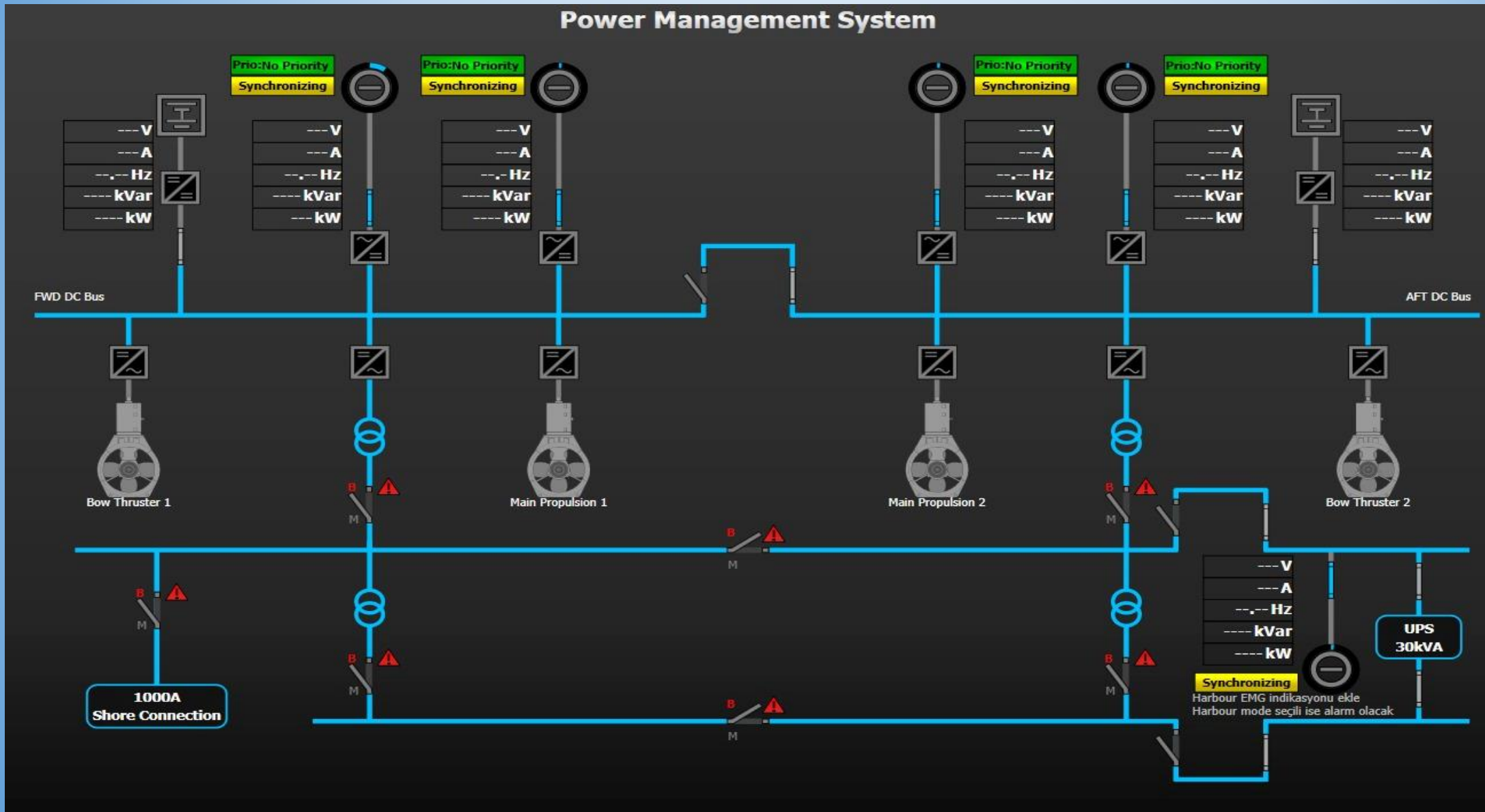
- Has both PC and PLC capabilities
- Windows OS
- Governs the Energy Management System (EMS) software
- System power control hub
- Controls breakers, drives, all management systems
- Main communication hub of the system
- Communication: EtherCAT & Hardwired
- Does not have native CAN support
- Will employ an HMI
- Manages operation modes
- Marine standard compliant
- Has a dedicated UPS



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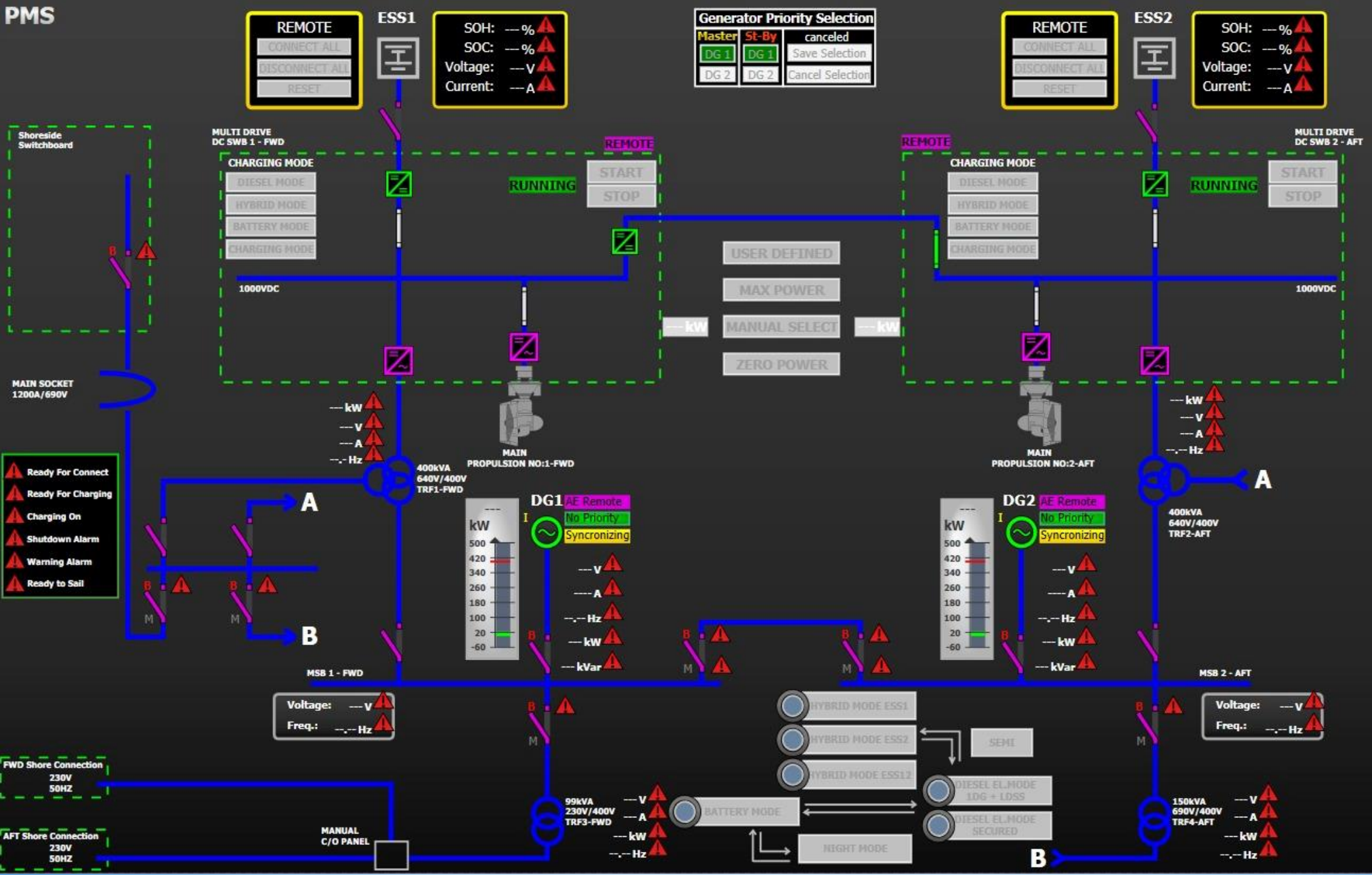
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PMS HMI Example



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Communication Gateway Device: Beckhoff EL6751

- Comms Gateway : EtherCAT $\leftrightarrow$ Standard CAN (CAN 2.0A/B)
- Provides seamless communication between PMS, BMS and the DC Switchboard



Battery Management System (BMS) by FHG

- Communication: CAN2.0A/B & Hardwired
- BMS master communicates with PMS & controls BMS slaves
- BMS slaves control battery packs of the BESS



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DC Switchboard by WABTEC

- Communication: CAN J1939 & Hardwired
- DC Switchboard Management System communicates with the PMS
- Ship's main 750V DC Grid Connection Center
- Has bidirectional DC/DC Convertors (developed by WABTEC)
- Governs power flow between BESS $\leftrightarrow$ DC Grid



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Battery Thermal Management System (BTMS) by ABEE

- Communication Protocol: CAN & Hardwired
- Communicates with the PMS
- Controls & Monitors BESS temperature
- Has dedicated sensors



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Battery Energy Storage System (BESS) by ABEE

- Connected to the BMS
- Cells controlled and monitored by the BMS Slaves



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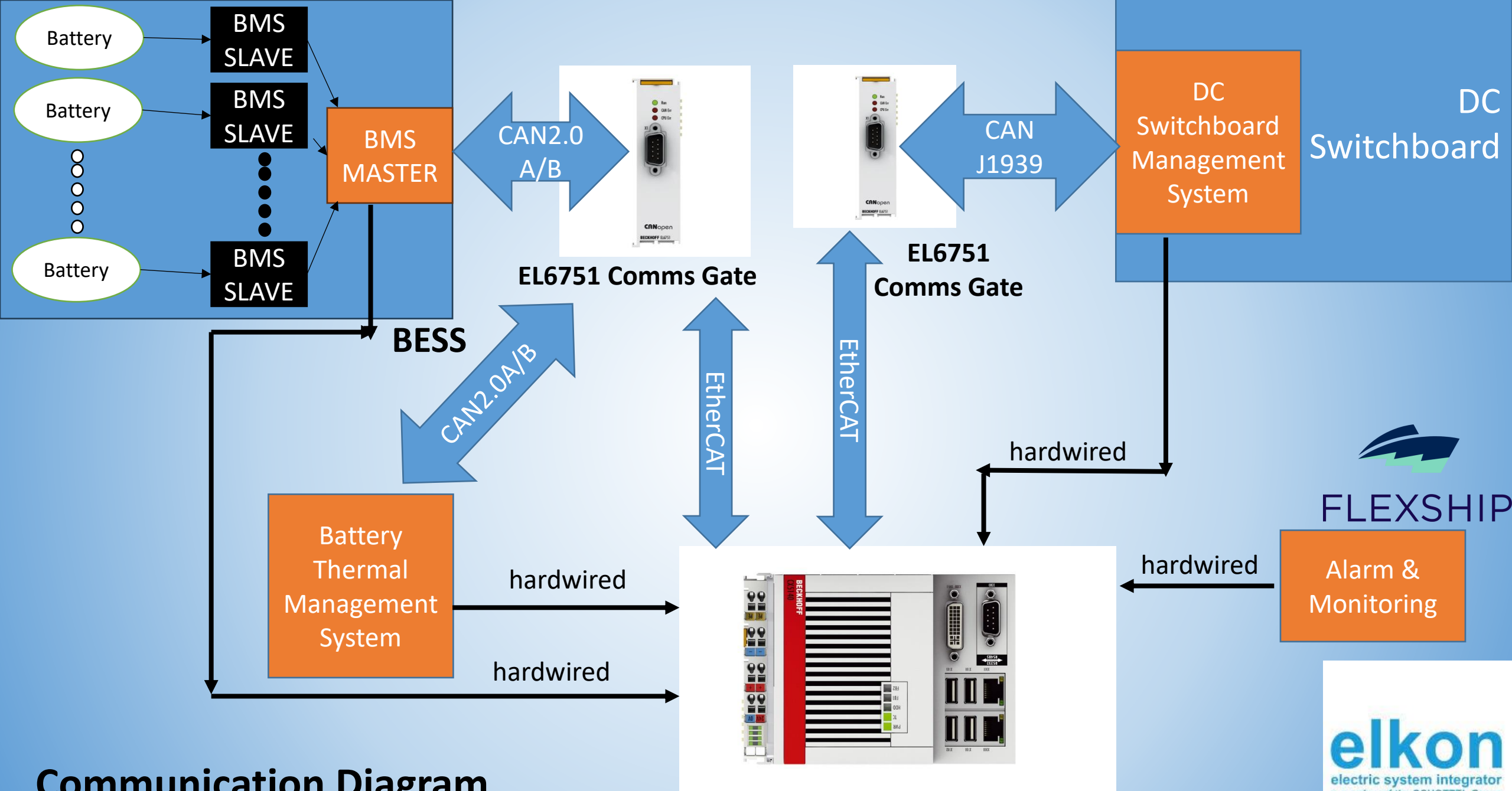
Alarm and Monitoring

- Communicates with the BMS
- Has dedicated alarm sequences
- Different alarm modes for different errors



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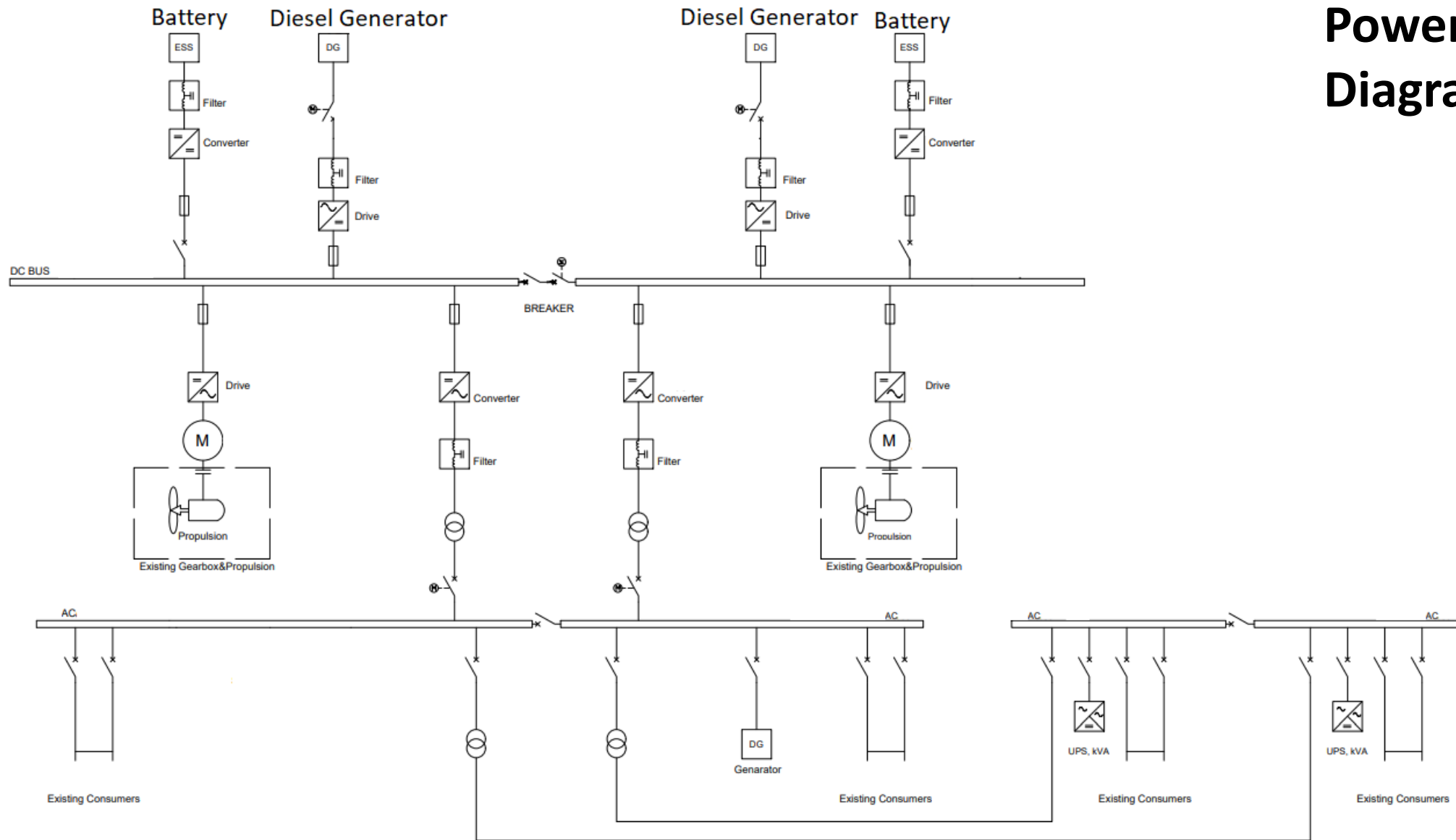
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Communication Diagram

PMS - CX5140

Power Diagram



QUESTIONS



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