Control interaction with mission systems

Shipboard Power System Fundamentals

Revision of 6 February 2026

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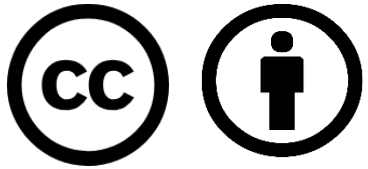

Essential Questions

When should mission systems and the power systems controls communicate?	Understand
What are examples of mission system - power system communication?	Remember
How are mission system – power system control interfaces implemented?	Understand
What are potential design issues with respect to mission system – power system communications?	Understand

Reserve Power

- Shipboard power systems are designed to supply the operating load at all times.
- Reserve power is online generation capacity and energy storage capacity in excess of the operating load that may be used for powering additional loads.
- To minimize fuel consumption, a ship may operate with less reserve power then needed to cover every contingency for additional loads.
  - Control interaction between the mission systems and the power system controls enable the power system to have sufficient online generation capacity to serve the operating loads
    - May require loads to delay increasing their power consumption.
    - May require the power system to shed long-term interrupt loads while additional generation capacity is brought online.

Examples

- Large Load
  - When operating at maximum power, a large load may require more than 20% of the online power capacity.
  - Example: Propulsion motors.
    - The maximum power used by a propulsion motor may be limited by the power system to prevent overloading the generator sets.
    - If more propulsion power is needed, the propulsion motor requests additional power and the power system brings online additional generator sets (power system control may shed long term interrupt loads while additional generator sets are brought online). The propulsion motor may not use the additional power until given permission to do so by the power system controls.
  - Example: Large exhaust fans on a mechanical drive roll-on-roll off (RORO) ship
    - Fans must gain permission to start from the control system before starting.
- Pulsed Load
  - If unconstrained, the power and current waveforms of a pulsed load may be such that the power system cannot provide a voltage waveform within interface standards.
  - Negotiations between the pulsed load and the power system may be employed so that the voltage waveforms are within interface standards while the pulsed load draws the negotiated power and current waveforms.
    - Control mode of generator sets may change from fuel economy to responsiveness.
- Load Shedding
  - Commanding loads to enter a reduced power consumption state may be preferable to shutting off power to them completely; the recovery time could be considerably shorter.
  - The load may have multiple power limit levels corresponding to different levels of capability.

Implementation

- The interface between the mission system equipment and power system controls should include definitions for all seven layers of the Open Systems Interconnection (OSI) Model.
  - Physical Layer
  - Data Link Layer
  - Network Layer
  - Transport Layer
  - Session Layer
  - Presentation Layer
  - Application Layer
- A simple command-response application layer protocol could be …
  - Load request for use of power from power system
  - Power system grants request or commands to stand by
  - Load acknowledges power system response and behaves accordingly
    - If load commanded to standby, power system grants request when the power system is ready
    - Load acknowledges power system response
- Behavior of the load and power system if the protocol is not completed within a specified time should be clearly defined.
- Protocol should be described in the Interface Control Document (ICD).