Ship Wide Uninterruptible Power Supply for the DDG-51

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Introduction

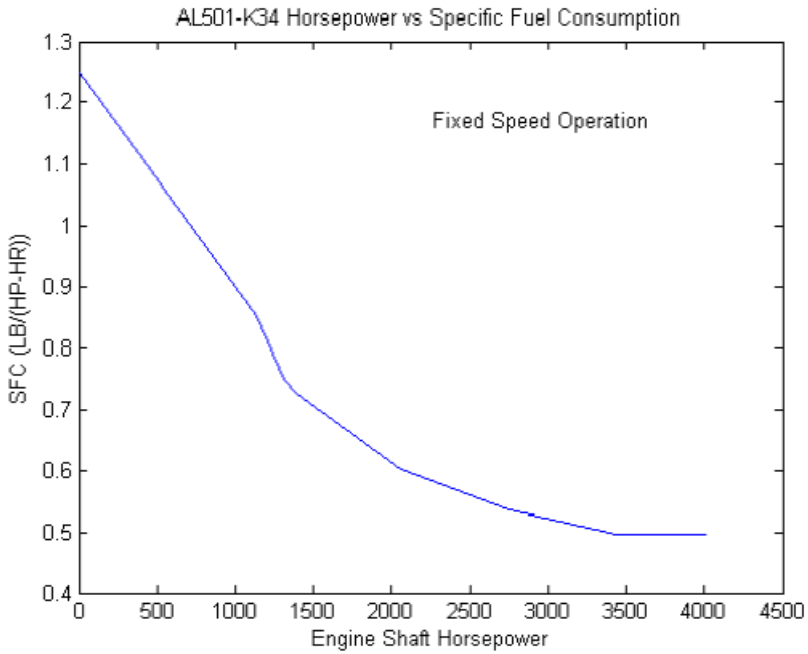
Objective: Save fuel and ancillary costs by enabling single generation operation.

Outline of Presentation:

- Overview of Operational Fuel Usage
- Ship Wide UPS Characteristics
- Shipboard Integration Issues
- Zonal Distribution System and MFM Placement
- Block Diagram of Single UPS Unit
- Battery Bank Characteristics
- Future Benefits

Operational Fuel Usage

- DDG51 uses three Allison 501-K34 for electrical generation; two operational & one in reserve
- GTGs are partially loaded (<50%)
- Enabling single generator operations can save fuel via better loading; over one million gallons/ship/yr
- An additional 19% fuel saved due to reduced refueling requirements
- Reduction of 4,000 hrs/ship/yr of turbine operation; lower maintenance



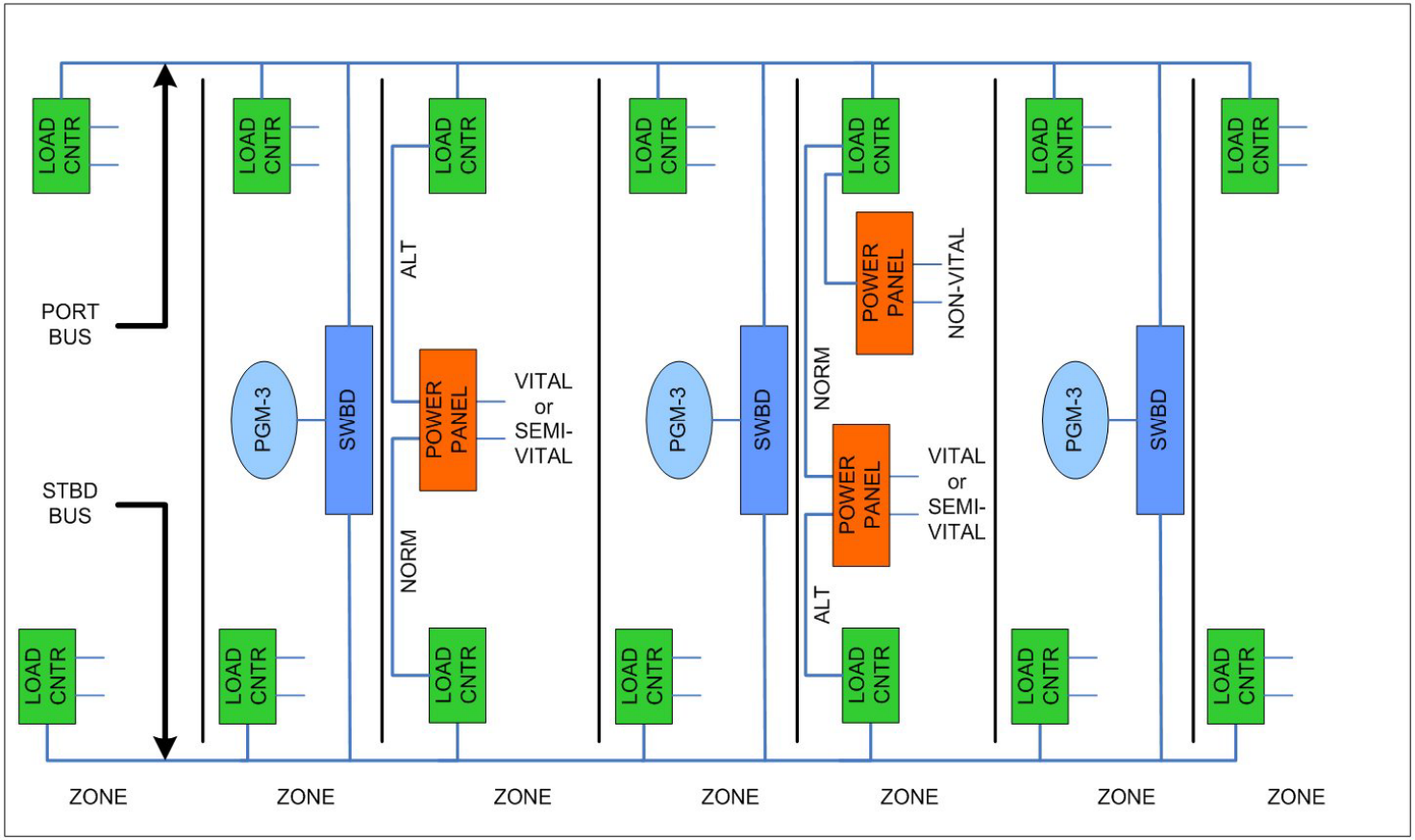
Ship Wide UPS Characteristics

- Total ship distribution system will be sourced (i.e., 2.5MW)
- Multiple units connected at switchboard and/or load center level
- A notional switchboard unit could source 500kW for 10-min with a 117kW-hr battery bank
- Each unit operates autonomously
- High use of modular construction
  - Power Electronic LRU similar to IFTP Inverter
  - Battery Bank LRU will be sized for similar cabinet integration
  - Front panel controller could support communications with ship controller, MFM III controllers and ICAS

Shipboard Integration Issues

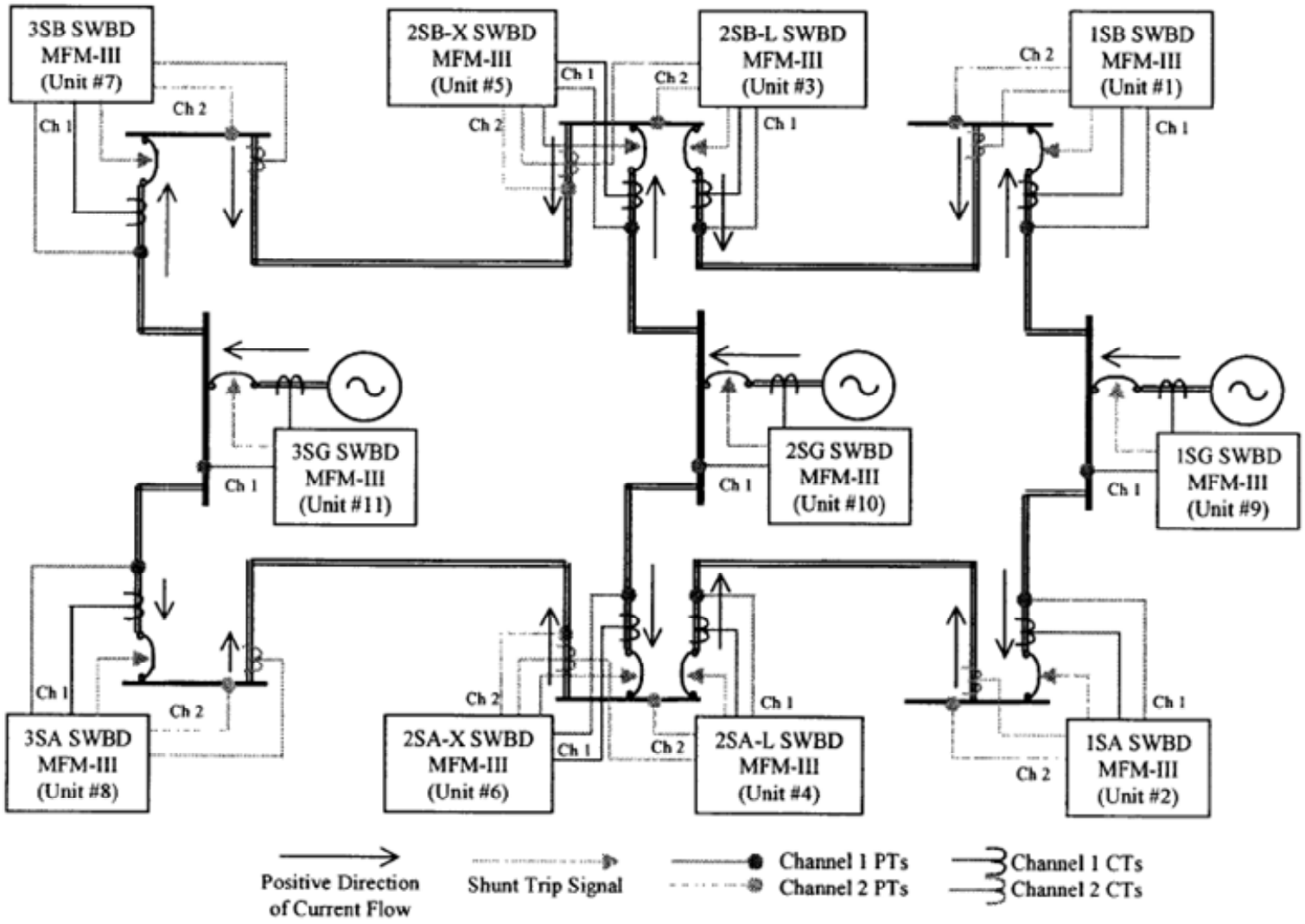
- Mechanical/Geometric
  - Multiple Battery LRUs with a PELRU
  - Ultimate unit size dictated by space availability and electrical load
- Thermal Integration
  - Air or water cooled, dictated by space
  - Anticipated to be minimal unless active rectifier use is expanded
- Electrical Power
  - MIL-STD-1399 power, automatic load pickup
  - Voltage foldback (1pu current feed)
- Controls
  - May interface with local MFM for breaker coordination
  - Should be “smart” enough to evaluate POC and island center if necessary

Zonal Distribution System

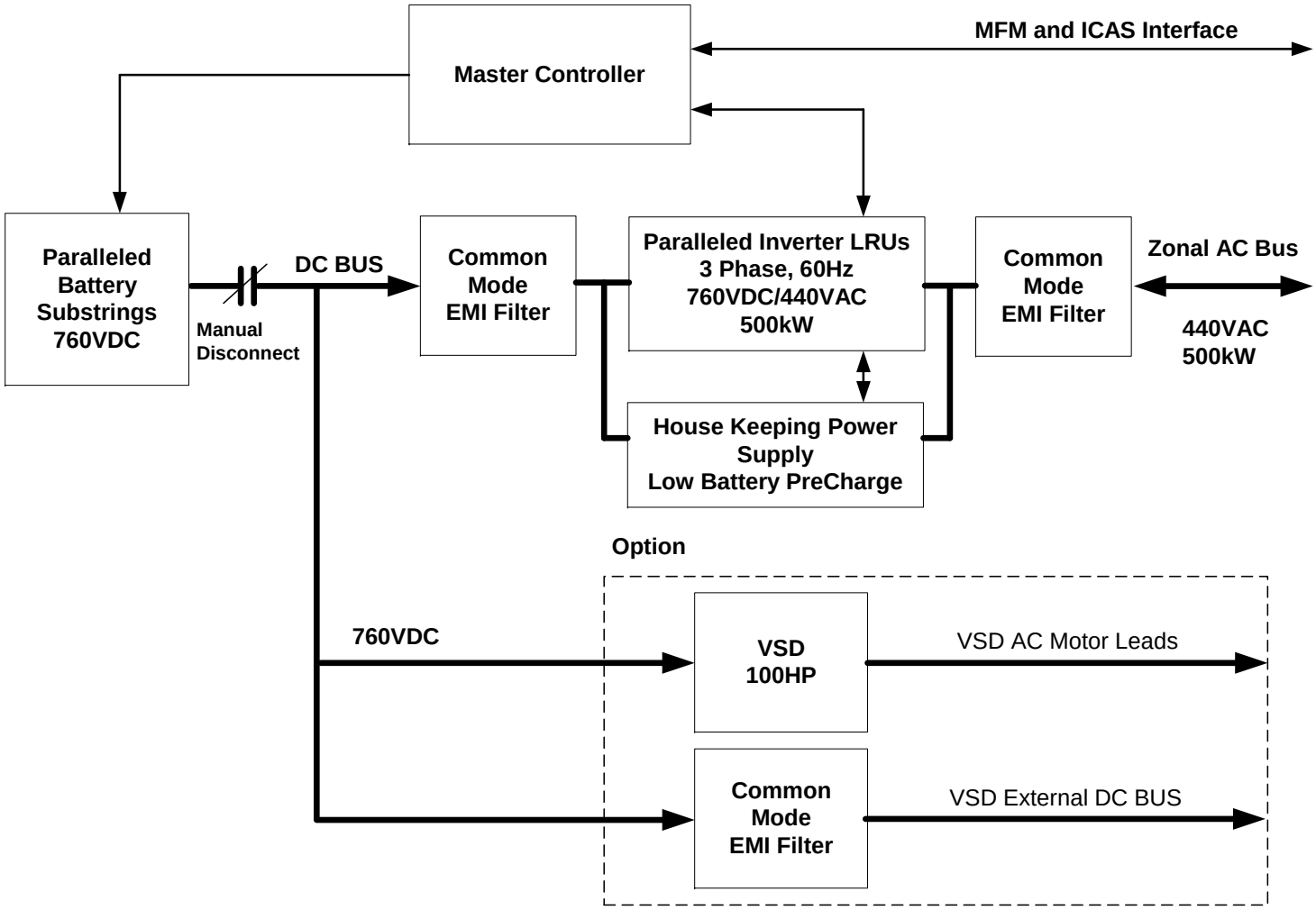


NAVAL SHIPS' TECHNICAL MANUAL, CHAPTER 320, "ELECTRIC POWER DISTRIBUTION SYSTEMS"

MFM Coordination

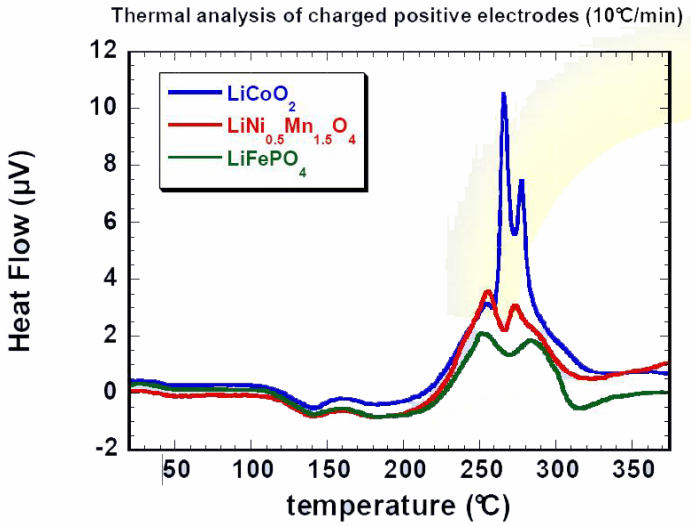


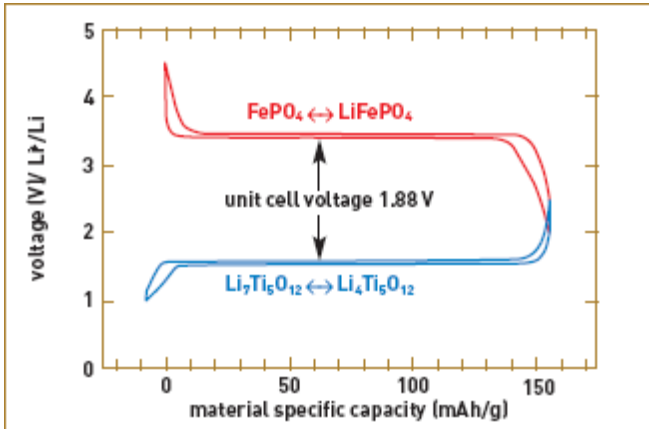
Block Diagram of Unit



Battery Bank Characteristics

- Large format LiIon based system design
- Energy density will be 2-4 times Pb-acid
- High number of cycles for improved LCC
- Must be thermally benign
- Initial design supports full DC bus voltage with flat discharge characteristics





Future Benefits

- Easy introduction of VSD
  - Elimination of large motor start currents from distribution system
  - Partial load control during casualty
- Additional uses of active rectifier
  - Reduction of Reactive Power Flow
  - Harmonic Reduction in Distribution System