

# Electric Propulsion and Power Generation for ships

## Indian perspective

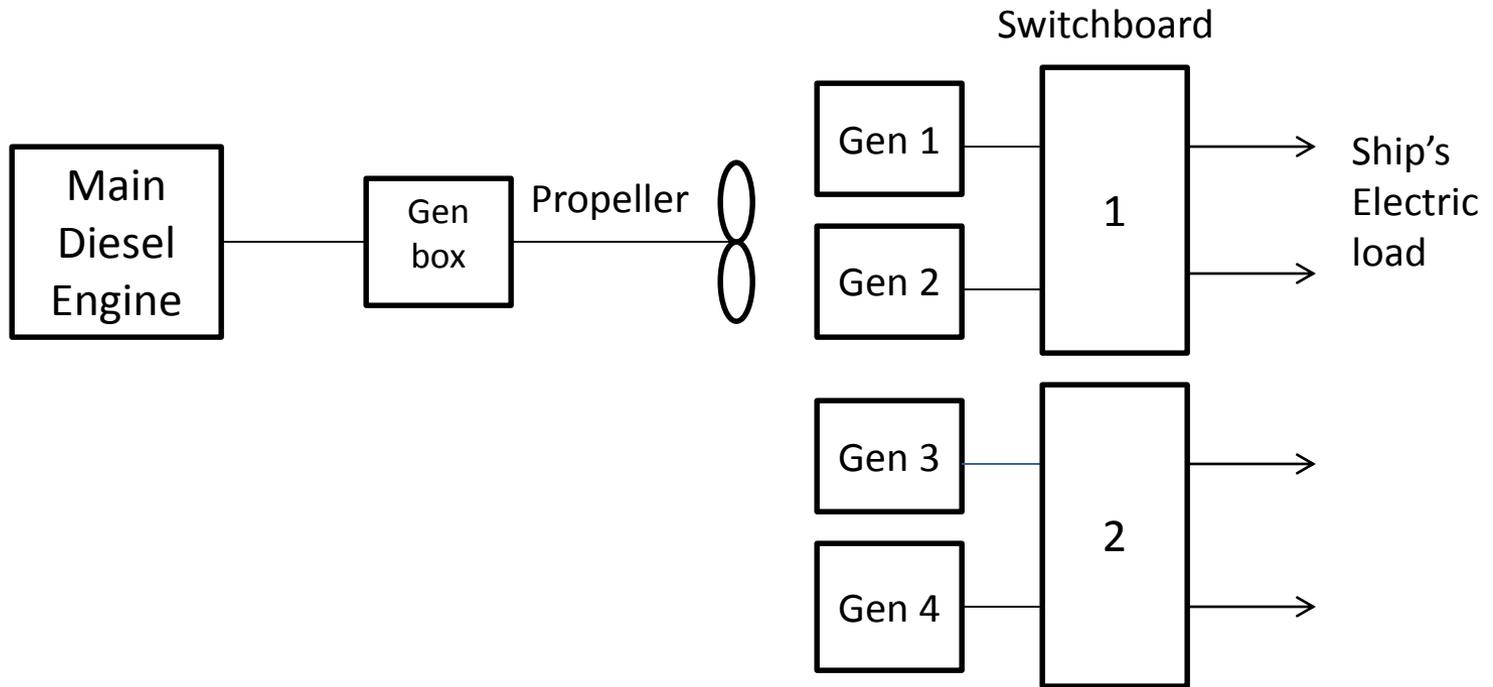
By

**R S. Mahajan**



- ❖ **Introduction – Direct drive, geared drive and electric propulsion**
- ❖ **Integrated Electric Propulsion (IEP)**
- ❖ **Elements and Approach**
- ❖ **Advantages of IEP**
- ❖ **Disadvantages of IEP**
- ❖ **Specific application to Naval Ships. Environment, Operational Philosophy, Medium voltage Generation**
- ❖ **Preparedness of Indian Industry - Issues to be addressed**
- ❖ **Way ahead**

# Ship Propulsion System – Direct Drive



Conventional Propulsion

**Fig.1**

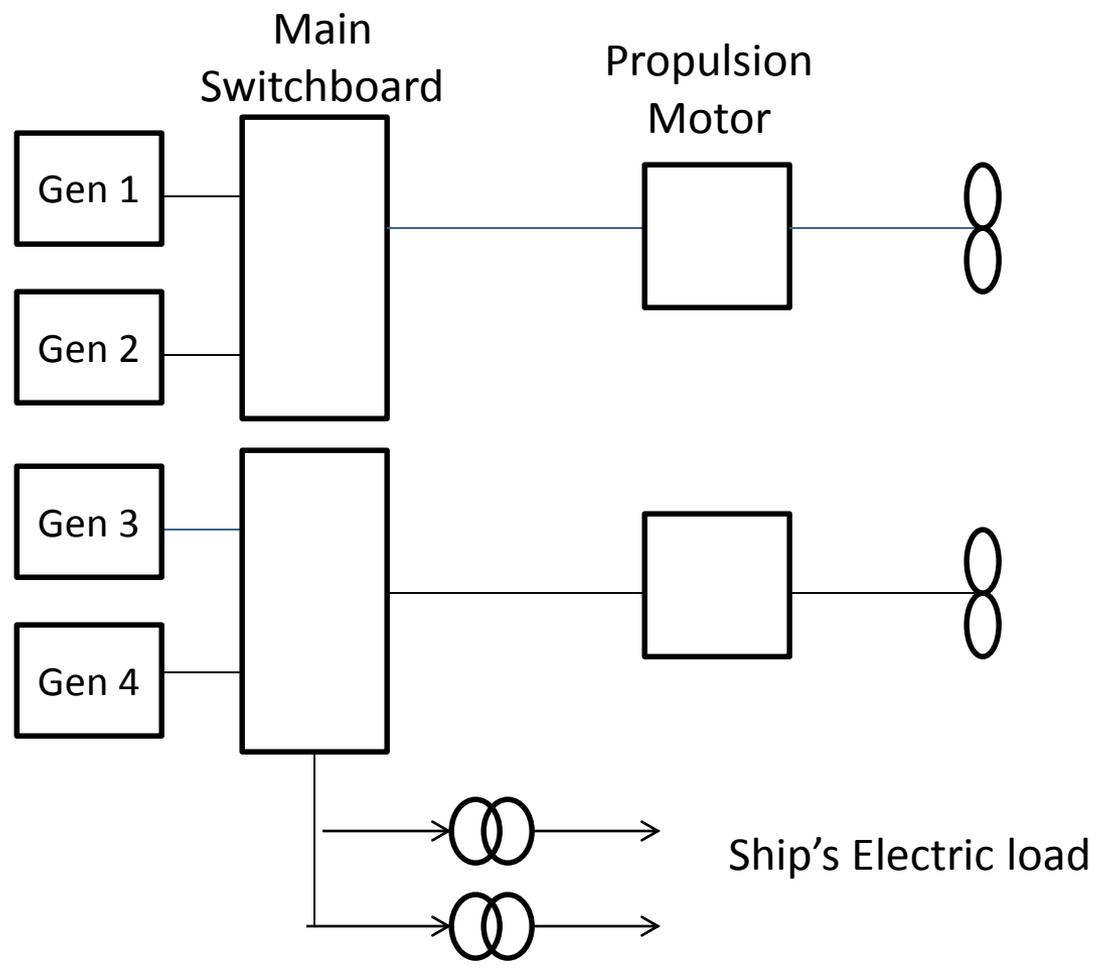
- ❖ **Most commonly used**
- ❖ **Used by Ships plying in confined waters**
- ❖ **Propulsion System & Power Generation are independent systems**

# Ship Propulsion System – Geared Drive

- ❖ System can be associated with all kind of prime movers
- ❖ Used to derive maximum propeller efficiency
- ❖ Used to connect one shaft to two prime movers or share one prime mover between two shafts or to connect shaft alternator to the propeller



# Ship Propulsion System – Electric Propulsion

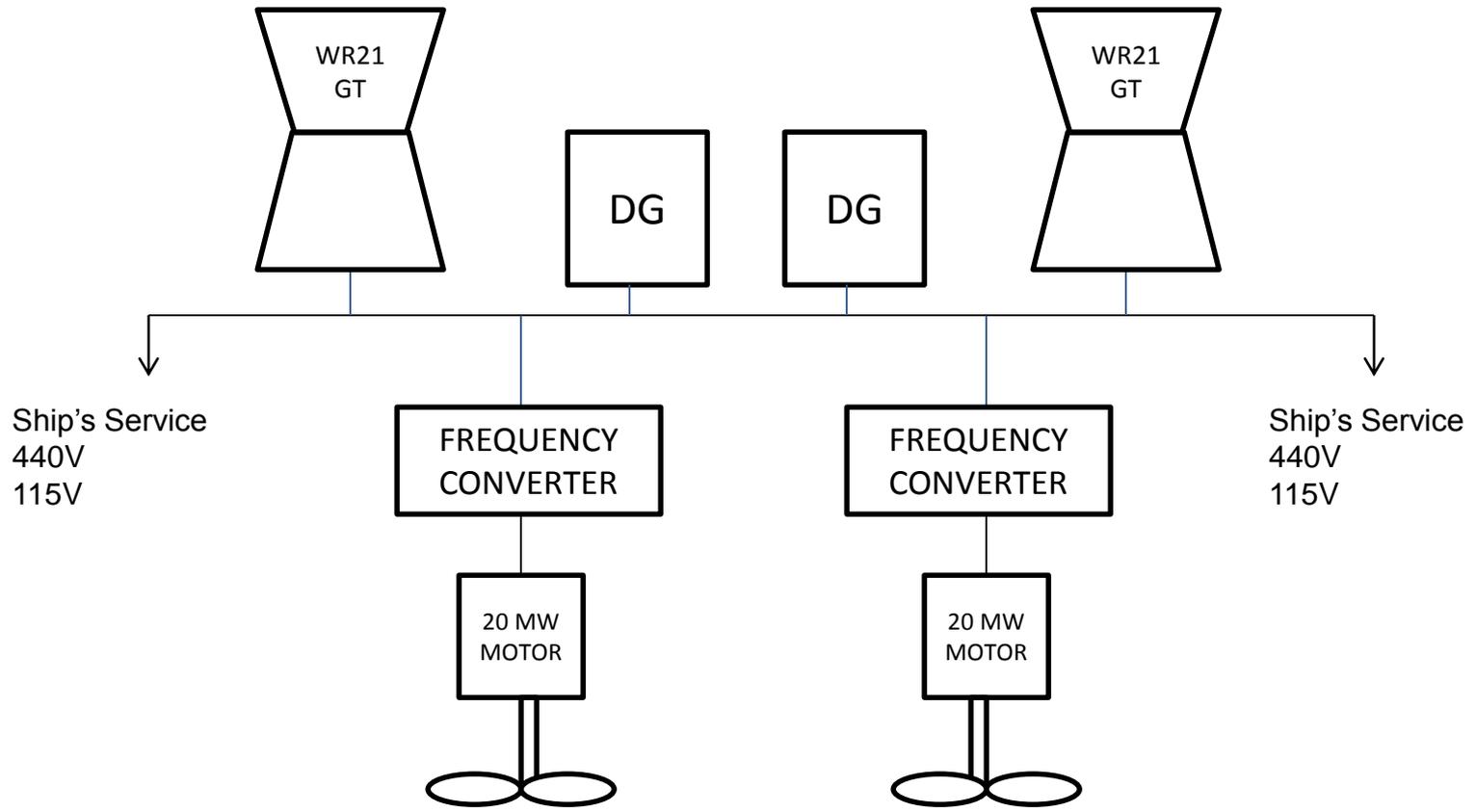


**Diesel Electric Propulsion**

**Fig. 2**



# Integrated Electric Propulsion - IEP



Integrated Electric Propulsion  
High Voltage Power Generation and Propulsion (4.16kV)

**Fig. 3**

# Integrated Electric Propulsion - IEP

- ❖ **Power generated by Gas Turbines or Diesel Generators used to drive ships propellers using Electric motors**
- ❖ **Eliminates clutches and gear boxes**
- ❖ **Gas turbines offer lower weight, smaller size and much less noise and vibration**
- ❖ **For low power requirement, combination with diesel generators offer operational efficiency**

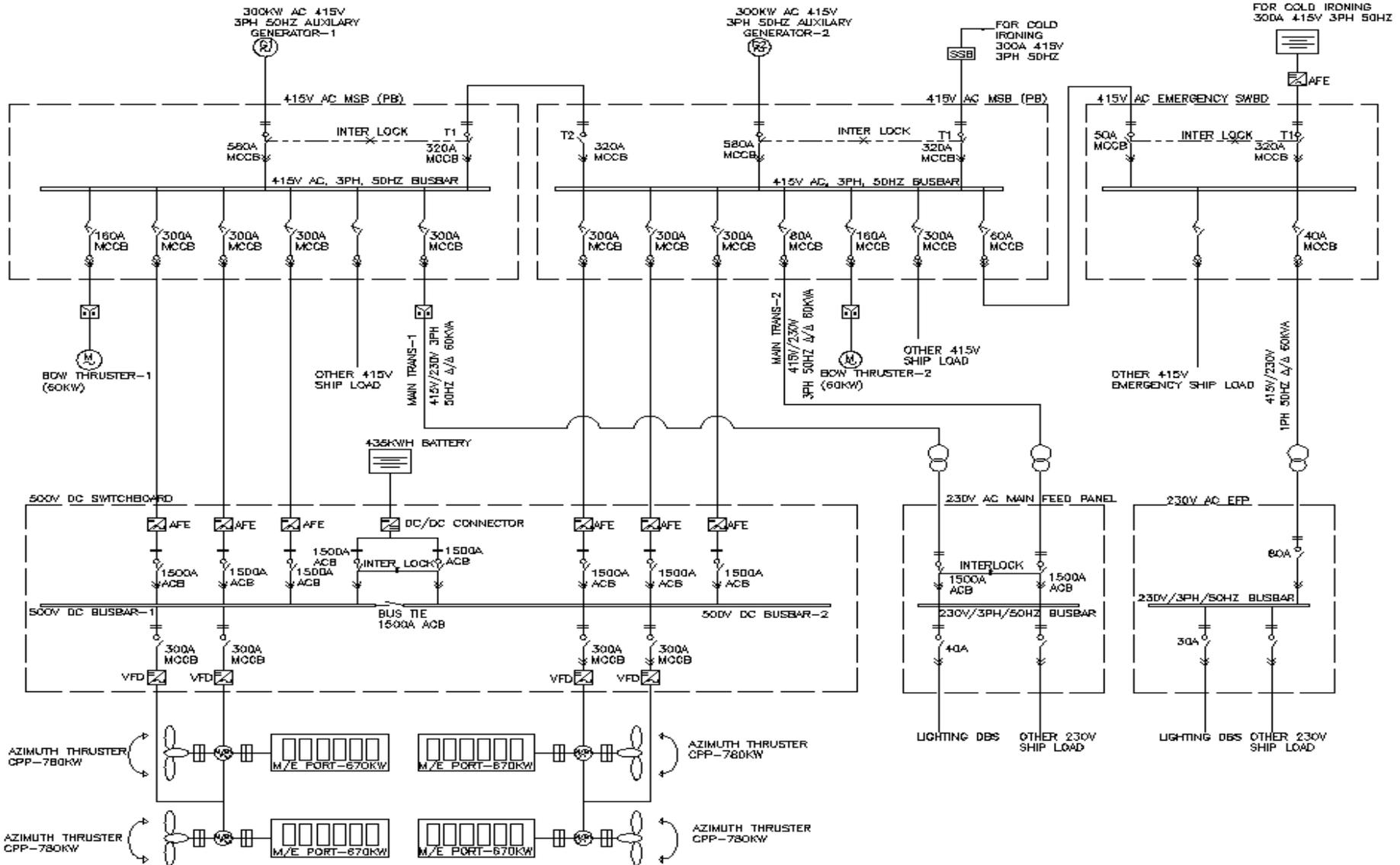


# Integrated Electric Propulsion - IEP

- ❖ **Application of permanent magnetic motors on shaft offer significant fuel saving**
- ❖ **Direction of rotation of propeller is controlled by changing phase sequence of the electric supply**
- ❖ **Speed control is achieved by variable speed drive**
- ❖ **Efficient and reliable power management systems is integral part of electric propulsion**



# Single Line Diagram – Hybrid Propulsion



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# Advantages of IEP

- ❖ Freedom to place engines
- ❖ Simplified in-ship system
- ❖ Increased space for cargo
- ❖ Maximum torque at zero speed
- ❖ Ease of maneuverability with precise control
- ❖ Less fuel consumption and maintenance cost
- ❖ Increased comfort due to low vibration, low noise
- ❖ Reduction in weight and volume
- ❖ Reduction in marine pollution



# Advantages of IEP

- ❖ **Excess power generated can be used for ship utilities**
- ❖ **Low capital and maintenance cost due to reduced number of engines**



# Disadvantages of IEP

- ❖ Higher installation cost of Electric Propulsion plant.
- ❖ Involves major automation. Ship's staff requires different and focused training.



- ❖ **Issues to be addressed – Ship environment**
  - **Shock & Vibration proof devices**
  - **Electromagnetic interference**
  - **Power electronics to handle large power**
  - **Building reliability & redundancy**

# Naval Application - Issues to be addressed

## ❖ Operational philosophy

- Shaft Generators paralleling with Diesel Generators
- Use of VFD for controlling thrusters

## ❖ Medium voltage generation and distribution

- Generation at 3.3 / 6.6 KV
- Demands higher level of safety, different operational considerations
- Precaution in equipment location, cable routing



- ❖ **Indian Navy plans to build ships with IEP**
- ❖ **Indian industry approach:**
  - **Collaboration with technology leaders and technology transfer**
  - **Indigenous life cycle support**
  - **Skill building**
  - **Develop home grown products through R&D efforts**

- ❖ LV, MV switchboards; Transformers; Power management systems are indigenized. MV generators, motors, active front end drives are imported
- ❖ Indigenizing large rotating machines and power electronics require assured volumes to make investment attractive
- ❖ More projects, quick turnaround are essential for capital investment and developing competent technical engineers
- ❖ Export oriented manufacturing in India catering to global requirements of the technology provider offers the solution.
- ❖ “Make in India” approach holds the answer



# Industry Perspective – Proposed way ahead

- ❖ **Form a Consortium of Technology provider and Indian industrial house**
- ❖ **Indian Navy to select the Industrial house. Considerations:**
  - **Proven track record for technology absorption**
  - **Investment in R&D**
  - **Manufacturing capacity and capability**
  - **Financial Longevity of business in India**
  - **Stability.**
- ❖ **The investment model can be based on the lines of USA or UK MOD - Industry partnership**
- ❖ **Reach global quality benchmark by exporting the indigenized system**



# THANK YOU



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