

# INNOVATIVE INTEGRATED POWER SYSTEMS FOR ALL ELECTRIC SHIPS

- Development of power electronics;
- Growth of electrical installations onboard;
- Electric propulsion.

## All Electric Ships (AESs)

- Islanded system with high installed power;
- Generation power comparable with load power;
- High Power Quality needs.

AESs are endowed with an Integrated Power System (IPS): an islanded power system in which a set of generators provide electric power to all the ship's loads (including both propulsion and services) with a single power plant.

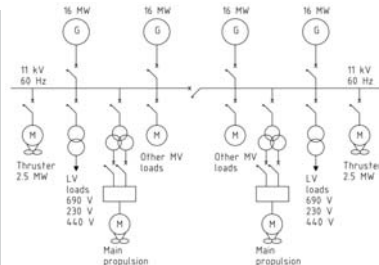
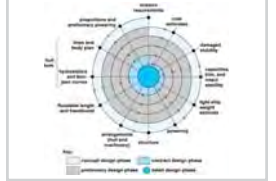


Fig. 1 : Integrated Power System (Cruise Ship)

Conventional ship design: spiral process with sequential design steps, detailing and adapting the single subsystems design at each turn



The aim of the research is to obtain a new design, and an analysis methodology, applicable to the AESs' IPS. This new approach will consider the IPS as a single complex system, designed and managed as a whole.

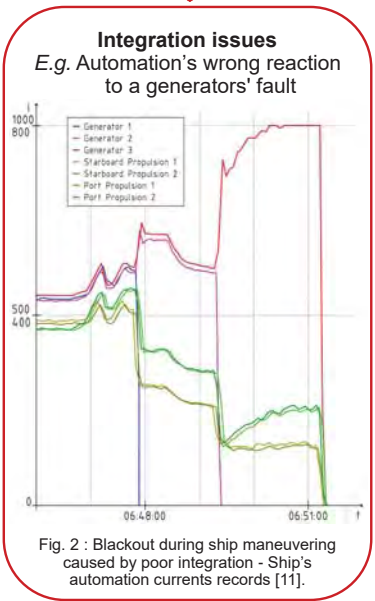


Fig. 2 : Blackout during ship maneuvering caused by poor integration - Ship's automation currents records [11].

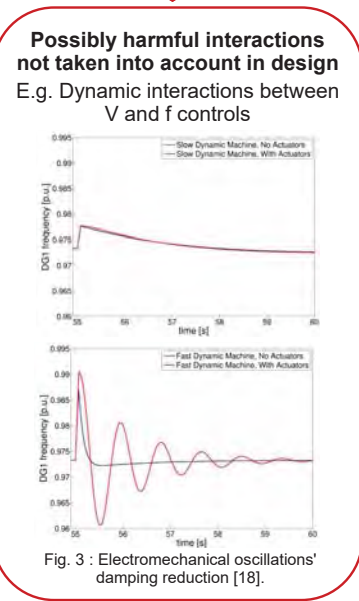


Fig. 3 : Electromechanical oscillations' damping reduction [18].

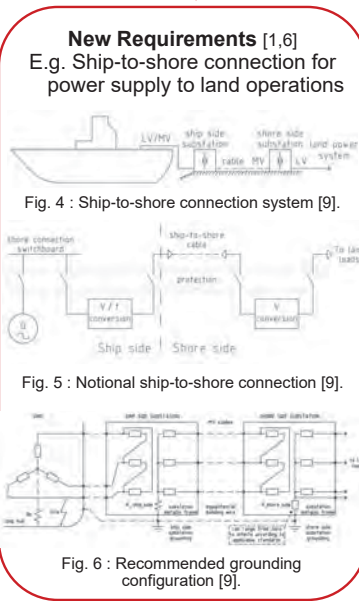


Fig. 4 : Ship-to-shore connection system [9].

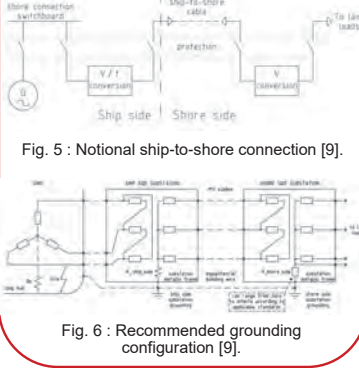


Fig. 5 : Notional ship-to-shore connection [9].

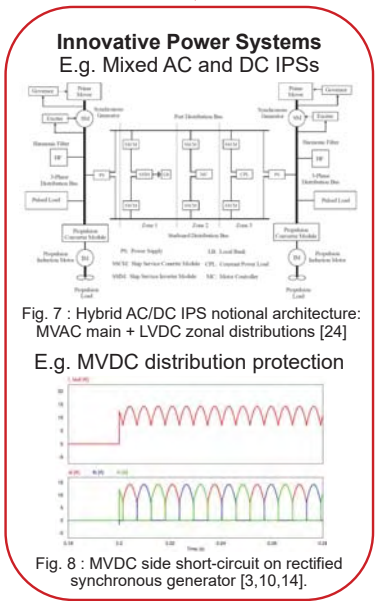


Fig. 7 : Hybrid AC/DC IPS notional architecture: MVAC main + LVDC zonal distributions [24]

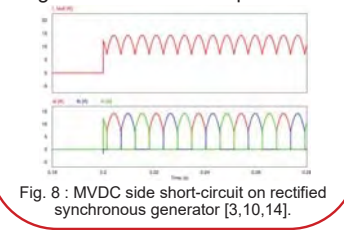


Fig. 8 : MVDC side short-circuit on rectified synchronous generator [3,10,14].

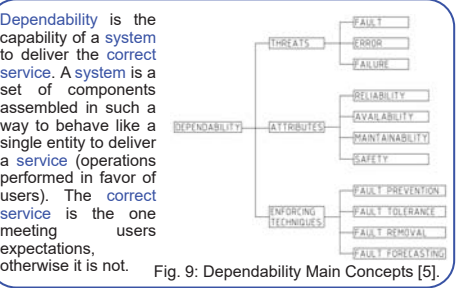
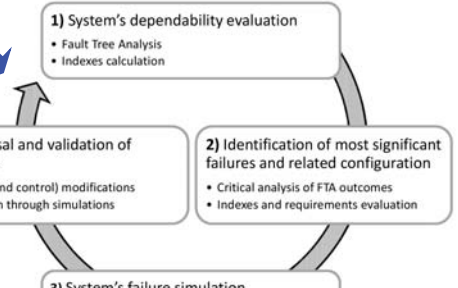
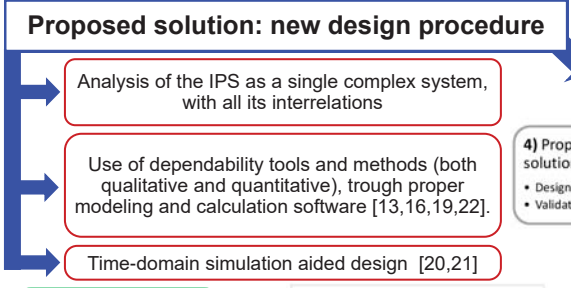
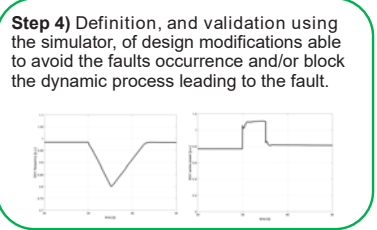
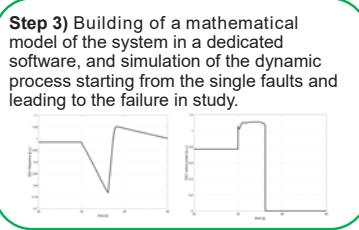
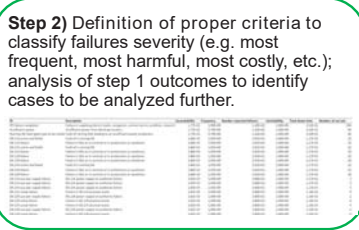
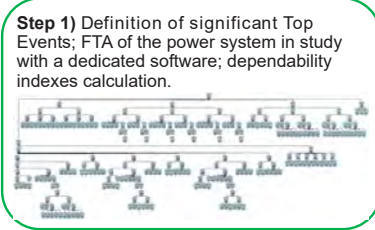


Fig. 9: Dependability Main Concepts [5].

The proposed procedure is already applicable with present data and software tools. It implies a limited additional burden for designers, but leads to significant advantages.



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