ACQUISITION OF ALBION AND BULWARK

LESSONS LEARNT

BY

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ABSTRACT

With HMS *Albion* now in service and HMS *Bulwark* due to enter service in 2005, it is perhaps opportune to look at some of the lessons we can take forward to other platform procurement projects. The two new ships offer significant enhancements to the capabilities offered in HM Ships *Fearless* and *Intrepid* and are indeed the first RN manned warship to adopt Integrated Electrical Propulsion (IEP) and widespread use of a Platform Management System (PMS). The article will assess at a high level a range of related issues, including:

- Standards.
- Design.
- IEP.
- PMS.
- Construction.
- Damage Control.
- Fire-fighting.
- Training.
- Support.

Introduction

The Replacement Landing Platform Dock (LPD(R)) Project has replaced the two decommissioned amphibious ships (LPDs) HM Ships *Fearless* and *Intrepid* with HM Ships *Albion* and *Bulwark*. The ship's primary function is to embark and transport, and to deploy and recover by air and surface means, troops, their equipment, vehicles and miscellaneous cargo forming part of an Amphibious Assault Force. The ship is also to act as the afloat command platform for the Commander Amphibious Task Force (CATF) which includes duties of naval Task Group Commander (CTG) and Commander Landing Force (CLF) while embarked. Major improvements over the replaced ships include more extensive command, control and communications and higher off load speed due to improved troop handling arrangements.

The contract for Design, Build and Initial Support of the 2 LPD(R)s was placed with VSEL (now BAE SYSTEMS Marine Ltd) in July 1996. The LPD(R)s are the first large surface ships for the Royal Navy to be built at Barrow since the completion of HMS *Invincible* in 1978, and the first warships to be dynamically launched from the berths since HMS *Talent* in 1988.

HMS *Albion* has already demonstrated that she is a very capable platform with many extremely good design features. The use of an IEP system and Platform Management System (PMS) is a great leap forward. The recognition that we have to keep up with technology in transition must continue in future classes. To list but a few:

- A dry spray system for communal and accommodation areas.
- Essential chilled water plants for specific weapon and sensor systems backed up by cross connections with non-essential plants.
- Lifts for victuals, bulk stores and magazines.
- The layout of the assault routes.
- No propulsion gearboxes.

Some of the shortcomings discussed in this article were caused by late changes to the design but if just a few of the points made in this article are taken forward we can expect an even better product next time.

Principal characteristics

Each ship will provide a military lift of over 300 troops (with over 400 additional troops in overload) together with a payload of main battle tanks and high and low vehicles, with four RO-RO Landing Craft Utility (LCUs) and four Landing Craft Vehicle and Personnel (LCVPs). A two-spot flight deck will support the operation of two medium support helicopters.

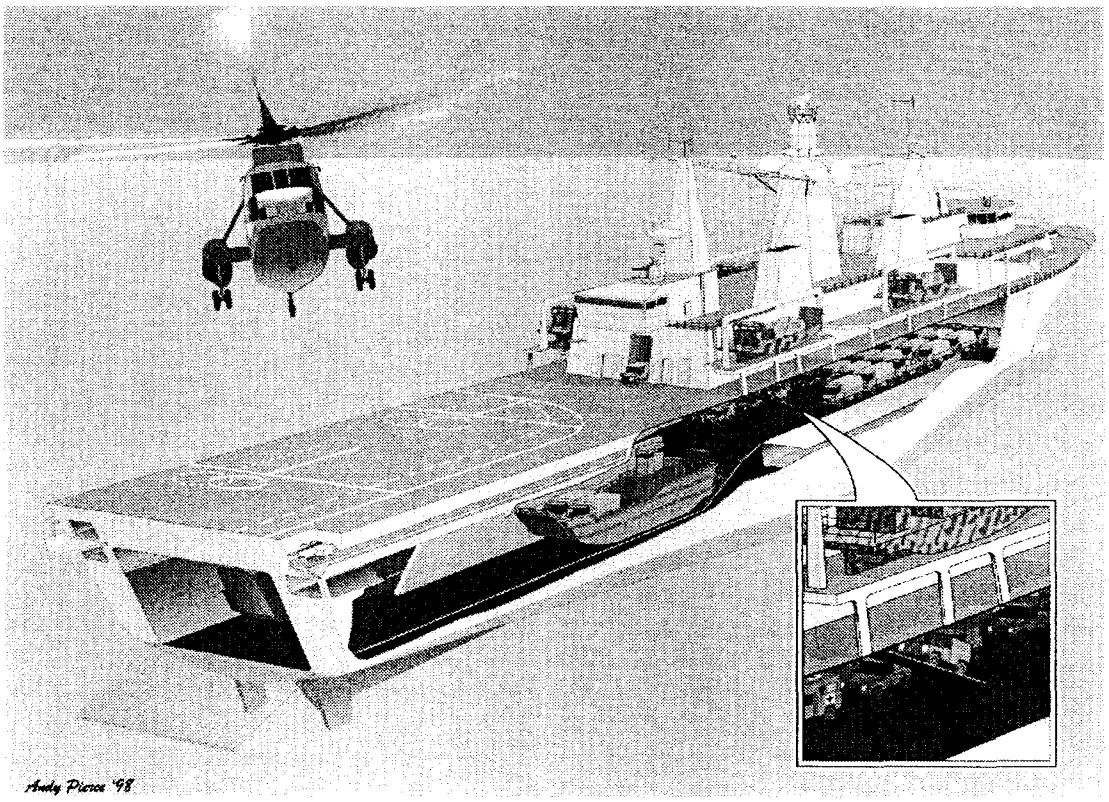

FIG.1 – GENERAL ARRANGEMENT OF THE LPD(R).

(FIG.1) shows the general arrangement of the LPD(R). The superstructure contains the Command and Control areas with some accommodation. The vehicle deck is forward with a dock aft. The ship can therefore be best described as 'Polo' shaped in cross section, with one large void down the middle of the vessel from transom to bridge screen. Stores, offices and ballast tanks are located to either side of the vehicle deck and the dock with a deck above which is predominantly accommodation for the Ship's Company and Embarked Forces with some office space and the galley. The compartments beneath the vehicle deck and dock consist primarily of machinery spaces, stores and tanks.

Standards

A number of the problems encountered by the shipbuilder during build and indeed a significant number of minor defects, which the WSA will now have to rectify, could have been prevented by using DefStans or other suitable standards. DefStans reflect best practice and lessons learnt, often the hard way:

- The joints in the small bore pipework needed much rework and are not supportable at sea.
- The HP air compressors and their compartment layout does not meet latest DefStans standards, which required considerable design rework to change the compressors to achieve clean air certification.

Hence DefStans are an extremely important part of the acquisition and support processes, providing the "owner's requirements' to maintain effective integration, coherence, minimum design standards and minimum characteristics of Defence Systems. It is accepted that the move to Smarter processes has removed a significant amount of over-regulation in the specification, design and acceptance of maritime platforms, with the trend away from DefStans. In many cases DefStans were a mixture of standards, advice and guidance, often without sponsors and in need of review and it was generally accepted that the blanket application of standards was unaffordable. Recent equipment and platform experience has however shown that Commercial and Regulatory standards (predominantly focussed on safety, reliability and legislation) do not meet the Defence need and DefStans should now be used and applied in an informed and effective manner by Industry and the MoD.

If the use of DefStans is not appropriate then equivalent standards should be applied and that the QA process must bears close scrutiny. Extensive use of subcontractors in modern shipbuilding needs tight contracts and close supervision. Poor lagging and cabling in some areas shows how this can go drastically wrong. The use of Naval Authorities providing certification may provide a means to enforce customer requirements and will therefore require the use of Defstans/NESs/Policy documents/owner's requirements; call them what you will.

The Safety Case based on JSP 430 is a key element of any acquisition project but is not enough in itself to ensure that the final product is operable in a warship environment and not just safe. The ship's High Voltage system is an example of this.

Therefore:

Do

- **Use Owners requirements.**

Don't

- **Rely solely on JSP 430 to get an operationally capable platform.**

Design

The design strategy was supported by the use of state of a Computer Aided Design (CAD) 3 dimensional computer system. An example of one compartment, the Forward Auxiliary Machinery Room (FAMR) is shown in (FIG.2).

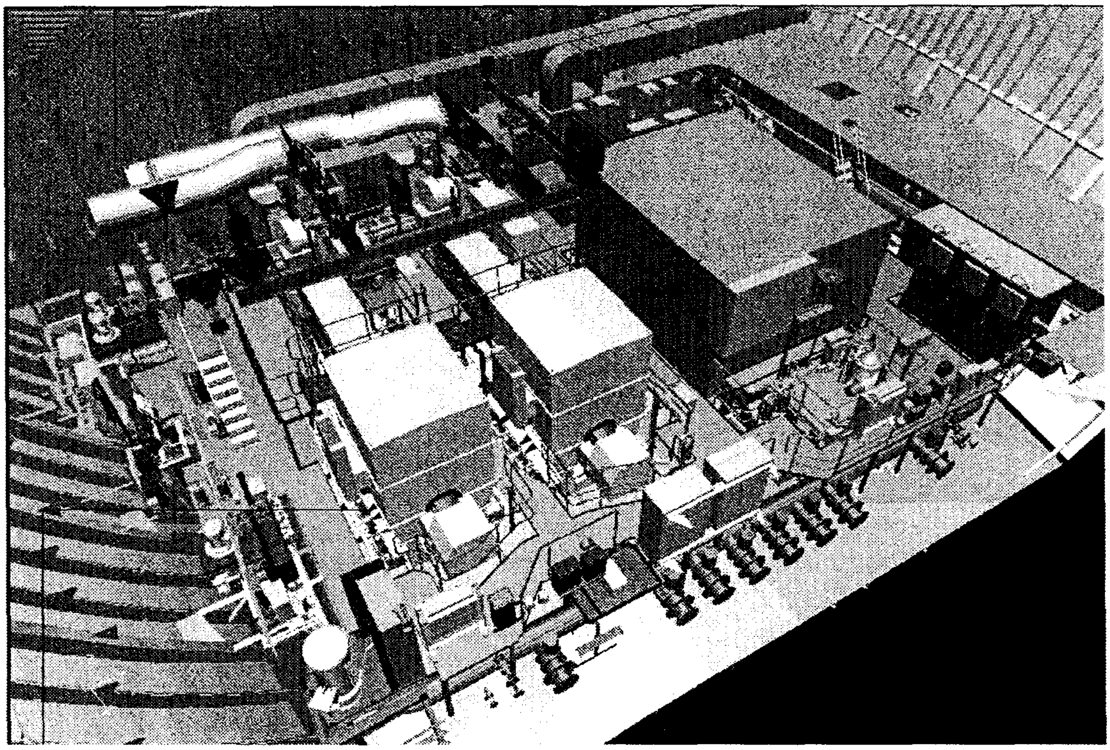

FIG.2 – FORWARD AUXILIARY MACHINERY ROOM CAD MODEL

Once the design was completed using the CAD package, the build commenced with construction of large blocks, partially outfitted, weighing up to 2,400 tonnes. The blocks were then transported to the berth where the blocks were welded together before launch. Final outfitting of HMS *Albion* took place afloat within the Buccleuch dock area (Fig.3).

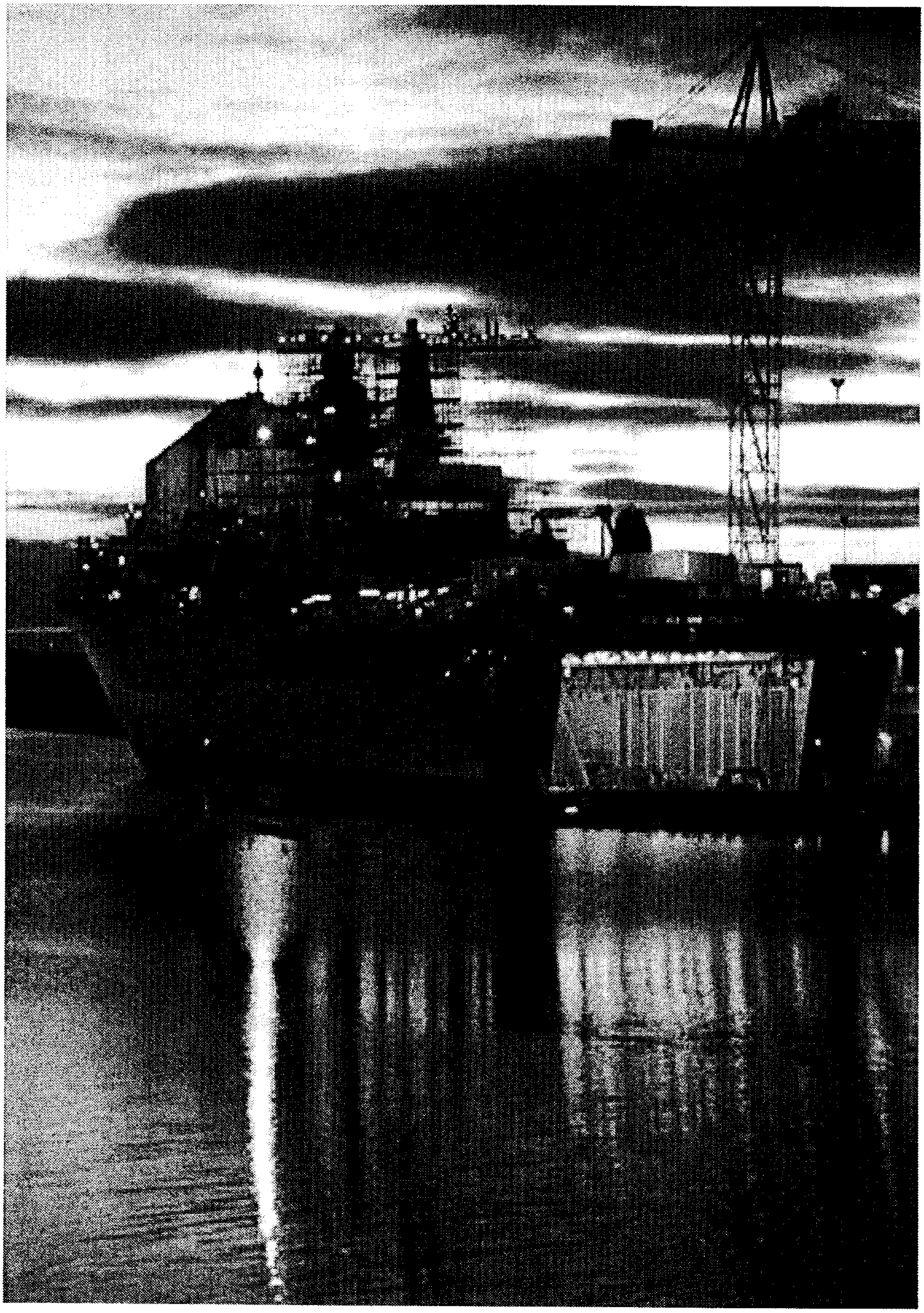

FIG.3 – HMS ALBION FITTING OUT

She arrived in Devonport in March 2003 (FIG.4).

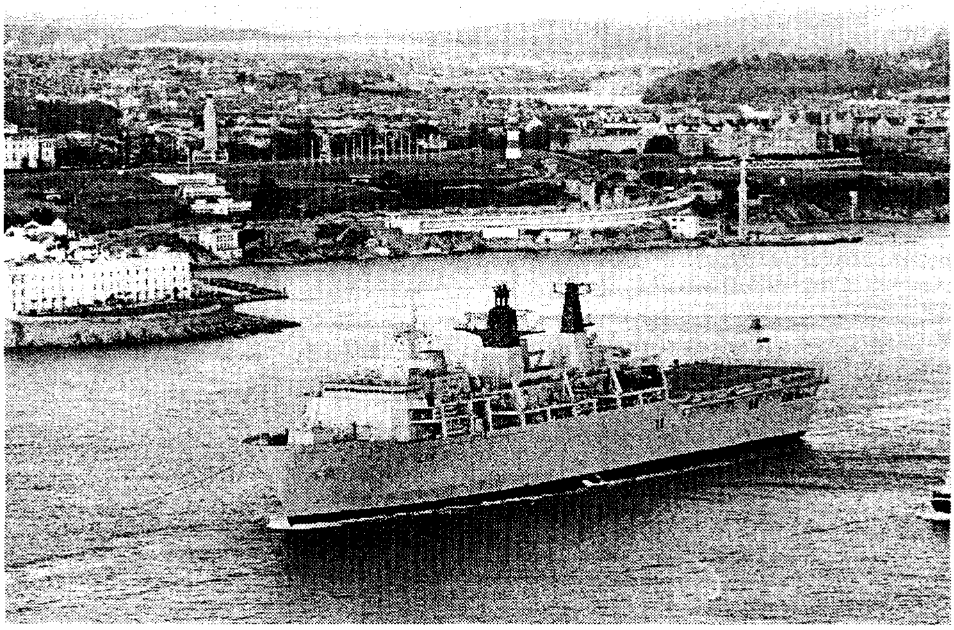

FIG. 4 – HMS ALBION ARRIVING IN DEVONPORT.

CAD is a very powerful design tool but beware at Formal Plan Approval stage that maintenance envelopes don't give a false idea of the accessibility, maintainability or operability of the equipment selected. The design is only as good as the draftsmen employed and the system and compartment layouts need to be carefully scrutinized by engineers in three phases concentrating on equipment, system and compartment.

Probably the worst area of the design is the attention paid to ship's husbandry, in particular the upper deck and layout of internal passageways. For instance:

- The number of rustraisers on the weatherdecks should be reduced.
- There are too many doors (reduce by a minimum of 50% by having a single door into a lobby area).
- There are insufficient drains (more drains).
- The quarterdeck areas are festooned with drains and conduits (need to change internal layout of bathrooms).
- The upperdeck fittings use inappropriate materials (use composite conduit, pipes and connection boxes on upper deck).

The use of composite superstructure should be considered where possible and the number of inaccessible pipes, brackets, vents, brackets for walkways, which will produce rust streaks, should be designed out. The overboard discharges should be in boot topping area to reduce rust streaks down ship's side.

Therefore:

Do

- **Minimize upperdeck fittings, openings.**
- **Use non-metallic fittings where possible.**

Don't

- **Ignore the systems approach to compartment approval.**
- **Underestimate the lack of ship borne engineering knowledge of CAD draftsmen.**

IEP

Integrated Electric Propulsion (IEP) is now a reality in the Naval Service and has been discussed in a plethora of papers and seminars. The reality however brings to the fore a number of issues, for the design, support, operations and training communities; the main focus of which is the implication of High Voltage equipment and systems. In facing these challenges, the Naval community have sought to embrace the requirements of classification societies, operating experience, legislative bodies and best practice from the commercial sector. In doing so a High Voltage document has been produced which aims to capture a set of Naval 'Owner's Requirements'.

Originally designed as a direct drive mechanical propulsion system, IEP was introduced as the most effective power and propulsion design solution during the final stages of design premised on the inability of the mechanical solution to meet the performance requirements of the vessel, notably the loiter requirement and the cost of ownership benefits of the IEP configuration. The use of a common power system for both propulsion and ship's services is now an accepted norm for the commercial marine and offshore markets. Electric Propulsion brings together efficiency, flexibility, survivability and, perhaps most importantly, reductions in cost of ownership. Captured simply – reduced numbers of prime movers, integrated systems, flexibility in layout and proven commercial precedent make it a credible solution to the requirement. Whilst successful in the commercial sector, the exacting demands of the Naval environment mean that systems need to be survivable and have flexibility to operate in both peacetime and wartime scenarios. It is this framework of commercial solution, the Naval environment and legislative requirement, which bounds the successful introduction of IEP. As a result of the design studies and investment appraisal, the diesel electric IEP option was adopted for the LPDs but owner's requirements were not fully considered or appreciated at the time.

The LPD(R) main propulsion and power system (FIGs 5 and 6) was re-designed from an original diesel mechanical solution and hence was already subject to many design constraints. The power system was restricted to being sized and located such that it could be accommodated in the original footprint for machinery spaces and associated switchboard compartments. The design also specified that the main propulsion should consist of two independent shaft sets and the project itself was subject to severe timescale constraints, which dictated the use of readily available equipment.

The management system introduced has taken industry best practice with a degree of pragmatism to make a safe but manageable system. As with any new technology and the associated management processes associated with its introduction there will need to be a period of running, probably until both ships have undertaken BOST, after which FLEET will review the Safe System of Work introduced with the key stakeholders. The review will commence with a Ship Administration Check (E) (SAC(E)) HV inspection and small changes are likely to include the passes, QM's brief, etc.

Therefore:

Do

- **Use IP 56 equipment if located in Main Machinery Space (MMS).**

Don't

- **Locate in MMS unless absolutely necessary.**

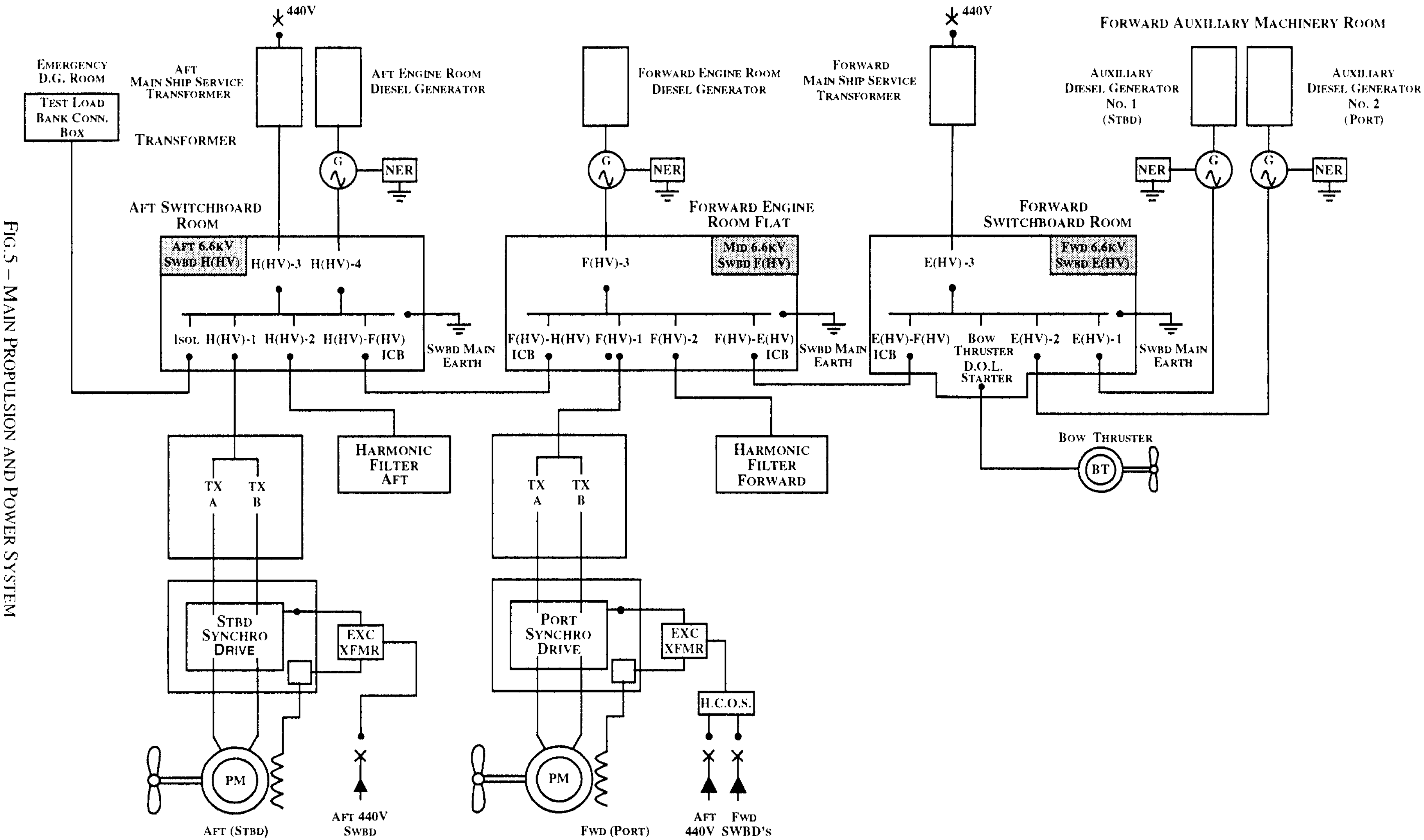

Fig.5 – Main Propulsion and Power System