

# LLOYD'S REGISTER'S APPROACH TO NAVAL SHIP CLASSIFICATION

BY

EUR ING R.V. POMEROY, MA, CENG, FIMECHE, FIMAREST  
(Lloyd's Register of Shipping)

*This is an edited version of the paper that was first published by the Royal Institute of Naval Architects at the International Conference on Safety Regulation and Naval Class held in London 5 to 6 November 2002.*

## ABSTRACT

Although there has been considerable co-operation between classification societies and navies, particularly in times of major conflicts, the adoption of classification has, essentially, been limited to auxiliary ships of merchant ship types and smaller ships, such as patrol boats. This article outlines the historical experience of Lloyd's Register with the application of the merchant ship classification regime to naval ships. This experience identifies areas where a fundamentally different approach is required to meet the requirements of navies, whilst retaining the same basic principles.

The development of a classification regime that is specific to naval ships is described, identifying how this regime supports the naval ship designer, constructor and operator. The result, supported by recent experience with application of both the naval ship regime and the merchant ship regime to naval ships, is shown to be a rapidly maturing scheme that is finding considerable interest within the military community.

The article also explores the fundamental requirement for safety assurance, the relation to other technical safety regimes and the standards role that is played by classification.

## Introduction

In recent years there has been considerable interest within the defence community in the adoption of commercial standards, primarily in an attempt to reduce the cost of procurement and support by excluding a 'defence premium'. In the naval sector this has promoted interest in the adoption of the classification regime that is routinely applied to merchant shipping. Before describing the position of Lloyd's Register and the development of a naval ship classification approach it seems useful to set out a short historical background. This shows that there has been previous experience of co-operation between Lloyd's Register and various navies, particularly the Royal Navy, but there has also been something of a parallel existence that has left some established viewpoints that are challenged by the new approach.

Lloyd's Register continued to survey merchant shipping during the war years but also worked closely with the Admiralty, particularly on the construction of auxiliary vessels, frigates and corvettes.<sup>1</sup> Heavy tank landing craft and other landing ships were constructed to the requirements of Lloyd's Register,<sup>2</sup> although the idea of applying classification to the regulation of the materiel state of naval ships lay a long time in the future.

The well-established merchant ship classification regime continues to be used as the basis of design, construction and survey in operation for naval auxiliaries. However, as described later, this rule set is of limited value when applied to a ship with extensive military capability.

In his text on ship structural design,<sup>3</sup> CHALMERS refers to the use of so-called commercial standards in warships, drawing the conclusion that this would imply use of the Rules of a classification society. Although he refers to specific elements from the Rules and Regulations for the Classification of Ships, published by Lloyd's Register, within his book he concludes that this proposition of adopting commercial standards is not possible.

“As there are no classification society Rules for warships but only for ship types, such as trawlers and Ro-Ro ferries which may be construed as being similar to warship style.”

He notes, quite correctly that use of a naval ship is different to a merchant ship, and cites driving the ship hard in heavy weather to satisfy a military objective. This article returns later to the subject of differences in operational use. CHALMERS also states very clearly that.

“Consequently in a well designed warship, ‘commercial standards’ are unlikely themselves to save much if any money while pursuing the idea of a commercial hull in preference to warlike standards will considerably increase the risk both of loss of the ship in war and loss of operational availability in peacetime.”

The remainder of this article sets out to present the rationale that has been used to develop an independent set of standards, the Rules and Regulations for the Classification of Naval Ships, by Lloyd's Register.<sup>4</sup> The development has involved considerable input from navies, designers, ship builders and equipment suppliers from a number of nations.

### **Naval ship safety in perspective**

The safety of naval ships is of very high standard, with ships of good design and construction, well maintained and manned by well trained crews. Nevertheless, there are incidents in peacetime when questions regarding naval ship safety are raised and many major navies have looked carefully at their safety management regimes, seeking to establish that they are following best industry practices as far as these are compatible with a military operation.

In the Foreword of the first issue of JSP 430 the then Secretary of State for Defence wrote.

“I require that where the MoD has been granted exemption from specific regulations, health and safety standards and arrangements will be, as far as reasonably practicable, at least as good as those required by statute.”

Similar statements of intention have been made for other defence forces. Any ship safety management system that aims to provide demonstration that the level of safety is at least as good as that required by statute needs some benchmark for comparison. By implication this benchmark must be the equivalent civilian sector where safety is subject of statutory regulation, and merchant shipping is a sector with international regulation enforced by national statute. The development of safety management systems for naval ships in a number of defence forces has introduced approaches that will be familiar to a number of hazardous civil applications. More recently, typified by the UK MoD publication JSP 430,<sup>5</sup> there has been a greater recognition of the need for a regulation process that provides demonstration of the intention.

The safety case, which is now widely accepted in safety management systems, can be written from first principles but in practical terms demonstration of appropriate risk control relies on selection of standards, which are accepted industry practice. Of course, for a naval ship the safety case must include a considerable volume devoted to weapons systems and munitions. Classification can provide a suitable

benchmark for the platform at design, during construction and in service provided the Rules that are applied are appropriate for the ship type and where specific Rules have been derived for naval ships the equivalence in safety terms can be determined.

#### Experience with merchant ship Rules

Further consideration of the involvement of Lloyd's Register with naval ship building programmes using the merchant ship Rules indicates that in times of national emergency the shortcomings in this approach are outweighed by the benefits. The relationships established result in a continued application of these Rules to naval ship particularly those of similar type to current merchant ships.

During the First World War Lloyd's Register was engaged to supervise the construction of auxiliary ships in Building Yards that were not familiar with naval ship construction. In addition to steel ships this programme of work included a reversion to building in wood and a small number of ferro-cement vessels. During the Second World War the services of the staffs of Lloyd's Register and the British Corporation (which was later absorbed into Lloyd's Register) were enlisted by the Admiralty to augment its own overseeing staff. As a result a large number of naval ships were built during the war years to the requirements of the classification societies, including the RIVER and LOCH class frigates, the FLOWER and CASTLE class corvettes, minesweepers, landing craft and all manner of smaller vessels. In total some 2,139 auxiliary naval ships were built to class in the UK with a further 241 being built in Canada.<sup>1</sup> Some of these wartime construction programmes relied heavily on commercial designs, not least the essential convoy escorts, the corvettes, which were based on a whale catcher designed by Smith's Dock.<sup>6</sup>

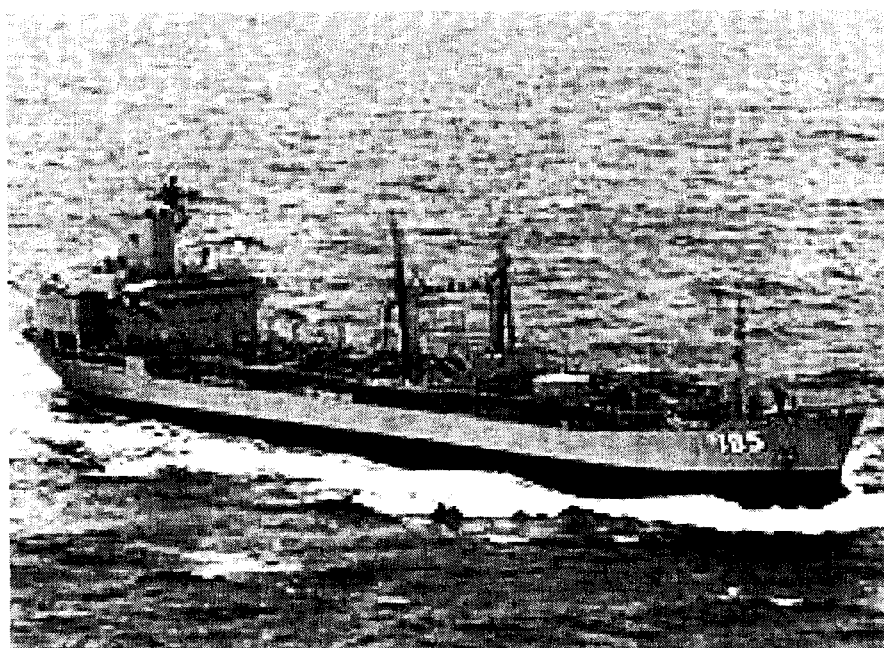


FIG.1 HMAS WESTRALIA, ROYAL AUSTRALIAN NAVY

Subsequently, the Rules and Regulations for the Classification of Ships have continued to be selected as the standards for design, construction and maintenance

in operation for a wide range of naval ships. The majority of ships have been the replenishment and refuelling ships that are similar in design to commercial oil tankers and cargo ships (FIG.1). However, even in these cases critical naval operational demands are not covered by the Rules, such as replenishment at sea and the storage of hazardous materials in close proximity to each other.

The Rules have also been used, with many years of experience, in connection with landing craft, landing ships, landing platforms. This general grouping of ship types includes involvement with the LSLs of the SIR LANCELOT class from the time of build in 1967/8. More recent application of the merchant ship Rules has involved ships of increasing military profile including:

- LPD(R) HMS *Albion* and *Bulwark* for the Royal Navy.
- LPD *Rotterdam* for the Royal Netherlands Navy.
- LPD *Galicja* and *Castilla* for the Spanish Navy.
- LSD(A) BAY class (ALSL) for the Royal Navy.
- LCU and LCVP for the Royal Navy.
- LPH HMS *Ocean* for the Royal Navy.

For these ships, and for the large number of patrol vessels and larger naval units, that have been designed and constructed (and in some cases maintained) in accordance with the merchant ship classification regime it has become increasingly apparent that this approach, whilst offering an alternative standards set to the naval sector, has limitations. The classification of the larger units such as HMS *Ocean* (FIG.2) and the LPDs, along with a CVS built in Spain for the Thai Navy, moved classification back into ships with a very significant military role, fitted with the systems to support the required capability. The merchant ship Rules cover adequately many of the ship features but the scope is limited and the interface with other standards that are applied to complete the picture are not necessarily coherent, and therefore the advantage of using a 'commercial approach' is not realized in full.

The experience of recent years has been instrumental in driving the development of the Rules and Regulations for the Classification of Naval Ships.<sup>4</sup> In particular, the construction of HMS *Ocean* and the classification of this major naval ship by Lloyd's Register provided clear indication that the recognition of classification by a major navy was a reality and that to meet the expectations of the naval customer the classification regime would benefit from changes. Discussions with other naval customers reinforced these indications.

Nevertheless continued use is being made of the merchant ship approach, particularly where the designers and builders have familiarity with this commercial practice.

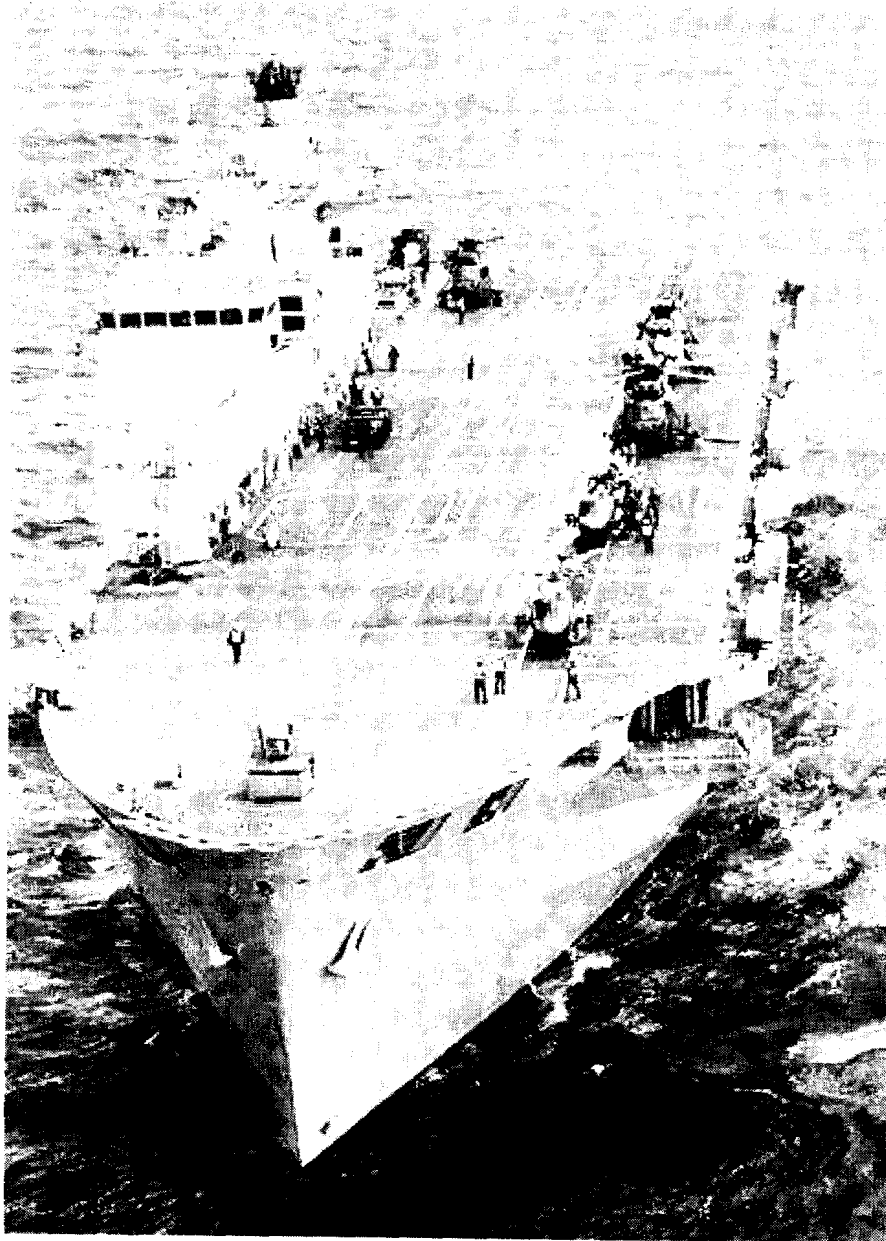


FIG.2 HMS OCEAN

### **Role of Standards**

The Rules published by classification societies form, together with the requirements set down in the various International Conventions of the International Maritime Organization and the marine legislation of the flag states, a comprehensive and coherent set of standards for:

- Design.

- Construction
- Maintenance in operation of ships.

Without this standards set an owner wishing to purchase a new merchant ship would have to develop a similarly comprehensive set of requirements as part of his specification. Nevertheless, the owner will always include his specific requirements, covering details of his performance and capacity needs and any matters of choice. Some experiences with the defence sector applying 'commercial standards' by relying on classification have been of limited success because the scope of classification as a set of standards was not fully appreciated and the necessary requirements of the owner were not clearly defined. In effect reliance was placed on a scheme of limited scope without recognizing the limitations.

For merchant ships the Rules have been developed over a long period, with Lloyd's Register first publishing its Rules in 1855.<sup>7</sup> The Regulations covering the conditions of classification and surveys have their origins in the earliest days of classification, preceding the publication of Rules for design and construction by over a century. The Rules have been developed with active input from industry and so represent accepted good practice. Development takes account of changes in technology, both in terms of advances in ship and equipment design methods and of the introduction of new ideas and concepts. Feedback from operation is an essential part of the Rules calibration process, with information routinely extracted from surveyors' reports.

There is, of course, a large body of defence standards in existence, covering most aspects of naval ship design. Within this available material there exists a number of standards that cover similar aspects to those covered in the Rules for Classification, including:

- Materials.
- Hull structure.
- Machinery and electrical engineering systems.

Some naval engineering standards also cover subjects that, for a merchant ship, are covered by International Conventions, notably Safety Of Life At Sea (SOLAS) and MARPOL. In many cases there is considerable similarity between the naval engineering standards and the merchant ship standards set, but there are key differences that reflect the military application.

In setting out to develop the Rules for the Classification of Naval Ships, Lloyd's Register decided that there was a clear need for a comprehensive and consistent set of standards, similar to those for merchant ships but:

- Covering additional systems that are specific to naval ships.
- Using the merchant ship requirements wherever this does not conflict with the military demand to encourage the selection of commercial of the shelf equipment and materials.
- Including Rules for items that are covered by International Conventions, but interpreted for the naval situation.
- Recognized that naval ships are exempted from compliance with International Conventions and merchant shipping statutes and, hence, a naval ship regulatory regime could be freed from following the survey cycles employed for commercial shipping, if appropriate.

Standards that are recognized as representing good industry practice and that reflect the essential requirements for safety will always form the basis of ship procurement. When a safety case regime is implemented it is necessary to

demonstrate that appropriate risk control is exercised for all identified hazards. In many instances it is useful to demonstrate that risk is controlled by verification of compliance with an appropriate standard. In a naval environment, where safety cases are increasingly used to support safety management, a coherent and consistent set of standards covering the ship with the exception of the weapons systems is valuable, although the standards will only support the procurement specification, which must include the definition of required capability and any specific requirements of the owner and operator.

#### **Development of an approach to naval ship classification by Lloyd's Register**

In this section of the article reference to the Rules refers specifically to the Rules and Regulations for the Classification of Naval Ships, developed and published by Lloyd's Register.<sup>4</sup>

Lloyd's Register developed the Rules with support from the UK Ministry of Defence and active international contribution from naval staffs, industry and the research community. This international support focused initially on the structure of the ship and subsequently on mechanical and electrical systems. The Rules were published in provisional form in July 1999 and, after approval by the Naval Ship Technical Committee, as full Rules in January 2000. Subsequent amendments and extensions have been made. The membership of the Naval Ship Technical Committee has recently been enlarged and extended with the election of representatives of more navies and ship builders.

Classification is a system for controlling or regulating the materiel state of the ship, component or feature to which it is applied. This is achieved by verifying through review, audit and inspection that an appropriate set of Rules is complied with. The classification process is applied to all stages throughout the life of a ship as illustrated in (FIG.3). In this respect the regime developed by Lloyd's Register for the classification of naval ships mirrors that well established in the commercial field.

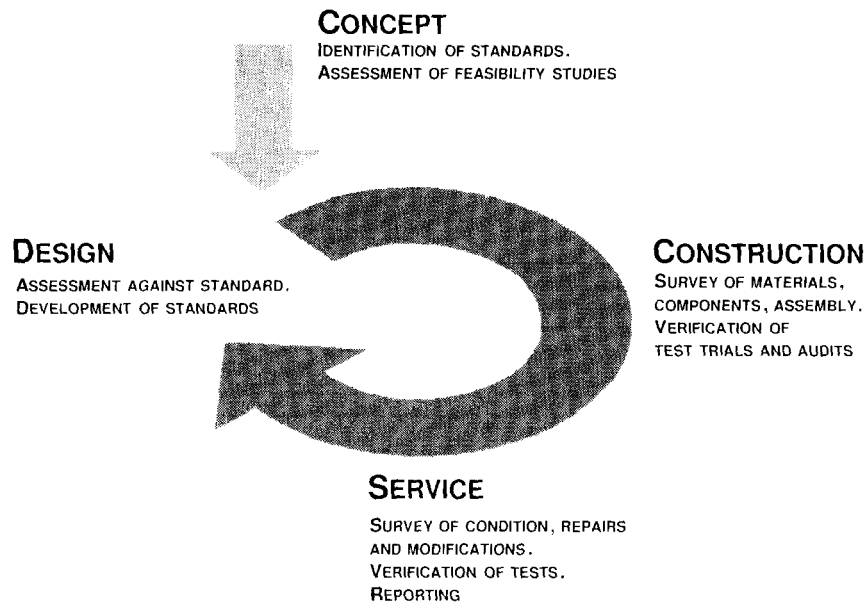


FIG.3 THE CLASSIFICATION PROCESS

In the conceptual or feasibility stage, before the design is commenced, an appropriate rule set or assessment method is selected. In the design stage, the ship and its component parts are assessed against the requirements of the nominated standard in a process referred to as design appraisal. Survey during the construction or fabrication stages of each component ensures that the original design assumptions are met and that the relevant manufacturing standards are complied with. Survey throughout the in-service life of a ship is carried out to ensure that changes to the component do not compromise the requirements of classification. These changes may occur as a result of modifications, repairs or degradation of the component. Through life survey may also draw upon the service experience from similar components or features in other ships.

This involvement in the whole life of a component is shown in FIG.3 and it can be seen how the Rules used in the classification process benefit from the results of in-service experience. Lloyd's Register uses the feedback from service experience, gathered from surveys, in the development of Rules and standards to ensure that they remain valid and take account of any failures occurring in service.

The provisions of classification are:

- The structural strength and the watertight integrity of all essential parts of the hull and its appendages; this includes compliance with suitable stability standards acceptable to the Naval Authority.
- The operation and functioning of systems installed for operational requirements relating to the ship type.
- The effectiveness of other defined features and systems that have been built into the ship in order to establish and maintain basic conditions on board whereby appropriate stores, fuels, equipment and personnel can be safely carried whilst the ship is at sea, at anchor, or moored in harbour.



The main differences between naval and merchant ship classification are in the following areas:

- Scope of classification.
- Military distinctions.
- The survey regimes permitted by the Regulations and the use of the classification process by the navy.

### **Scope of Naval Classification**

A naval ship is not bound by international legislation to have classification and hence unlike a merchant ship, the scope of classification is not so rigidly defined. A navy may choose to have as much or as little of a ship covered by a classification regime as they wish. As a minimum, the hull structure must be covered. Class notations are used to define the selected scope for a particular ship from the available Rules set.

A naval ship has a different role and function to that of a merchant ship and as such different standards are usually applied. The Rules have been developed by Lloyd's Register to meet this need for appropriate standards. Rules have been introduced for a range of operating conditions, features and systems that are not found in the Rules for merchant ships, such as:

- Engineering systems for chilled water, HP air, aviation fuelling.
- Operations such as replenishment at sea and opening of ramps for operations at sea.

However, care has been taken in the development of the Rules to ensure that there remains maximum compatibility with the merchant ship regime to allow procurement of commercial of the shelf materials and equipment.

Within the requirements of naval classification some additional definitions regarding regulatory authorities have been incorporated. It is important to determine who these authorities are in an organization so that the appropriate decisions can be taken to define the requirement and the appropriate class notations and standards.

#### *Owner*

Generally, this will be the government department responsible for naval procurement and support. In certain circumstances, the Navy may operate ships chartered from their owners, in which case the Owner is to be agreed with Lloyd's Register on a case by case basis.

#### *Navy*

The operator of the ship. The Navy may also be the Owner.

#### *Naval Authority*

Authorities nominated by the Owner responsible for providing regulation associated with procurement and support of the ship. The Naval Authority may also be responsible for identifying appropriate standards, auditing and certification. The Naval Authority could be a government department, a Statutory Authority, Lloyd's Register or an independent organization with appropriate standing.

### **Military Distinctions**

Whilst classification is usually associated with provision of an assurance of the safety of a ship, a similar approach can be adopted to help assure performance attributes of the design. Military Distinctions have been introduced into the Rules

and Regulations for the Classification of Naval Ships to provide standards relating to the survivability of the ship, when exposed to defined threats. The application of the classification process requires an appropriate standard and this has been developed by Lloyd's Register within the Rules drawing upon the expertise of the UK's defence research establishments, now Defence Science and Technology Laboratories and QinetiQ, for the military aspects.

The primary benefit in adopting classification principles will be to help ensure that the original design intent and vulnerability policy, as far as the ship structure is concerned, is built into the ship and maintained through the life. By establishing a clear framework of class Military Distinction notations the specification and procurement process is made more straightforward as the options available to a designer are presented in a simple form.

Military Distinctions are related to survivability. Survivability is defined as the probability that a ship can remain operational following an attack and consists of three main aspects:

- Susceptibility.
- Vulnerability.
- Recoverability.

(Fig.4) shows the definition of survivability used by in the Rules relating to Military Distinctions.

#### *Susceptibility*

The probability of a threat acquiring, reaching and detonating on a ship. It is dependent on the capability of the threat, the ship's signatures and the effectiveness of the ship's defensive systems. The weapons systems are not covered by classification. The Rules recognize that susceptibility features will have an impact on ship design and need to be considered throughout the design and in service life of a ship. Currently the Rules go no further than some simple guidance to remind the structural designer of how structural design can influence signatures.

#### *Vulnerability*

The probability that a ship will be able to survive and operate at a prescribed level immediately following damage from the detonation of a threat. The exact meaning of 'remaining' operational must be clearly defined. The vulnerability of a ship can be improved by 'hardening' it against specific threats and it is this hardening of a ship that is considered in the Rules.

#### *Recoverability*

A measure of the ability of the ship to reach a particular level of operation, higher than that immediately following a hit. It is dependent on crew training and capability as well as system design and duplication. The following can all contribute to recoverability:

- Good design of the ship in terms of access and layout.
- Provision of cross and counter flooding arrangements.
- Consideration of damaged water levels for systems and structure.
- Salvage systems.
- Damage control procedures.
- Provision of damage tolerant systems.

The Rules currently consider some of these aspects and there is an intention to address other aspects in future releases.

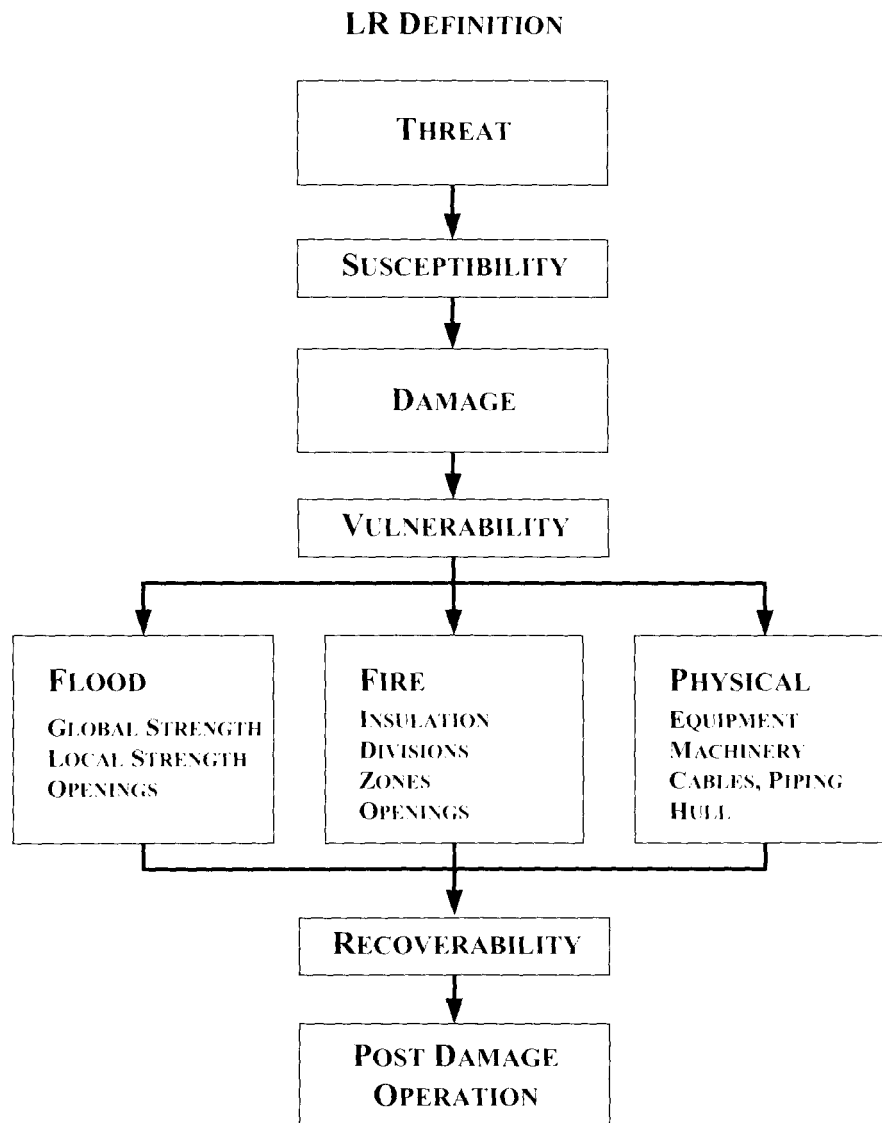


FIG.4 CONCEPTS OF SURVIVABILITY

The Rules use notations to determine what hardening is required for particular threats. These identify the vulnerability requirements and inform surveyors about the features that are installed in the ship. Table 1 lists the current notations with a brief description of each.

TABLE 1 Military distinction notations

Threat effect	Area affected	Notation	Summary
External blast	All structure above waterline	<b>EB1</b>	Structural assessment using empirical Rule equations.
		<b>EB2</b>	Structural assessment using elasto-plastic structural response.
		<b>EB3</b>	Structural assessment using 2D non-linear analysis methods.
		<b>EB4</b>	Structural assessment using 3D non-linear analysis methods.
Internal blast	Zone boundaries and Watertight bulkheads	<b>IB1</b>	General internal blast capability achieved by adopting rule bulkheads at zone or watertight boundaries.
		<b>IB2</b>	Specific internal blast capability for designated locations based on testing and analysis.
Fragmentation protection	Critical compartments	<b>FP1</b>	Assessment using Rule thickness.
		<b>FP2</b>	Assessment based on analysis or trials.
Small arms protection	Critical Compartments	<b>SA</b>	Assessment of design to ensure compliance with navy specified requirement.
Shock	All under water structure	<b>SH1</b>	Structural response to be below threshold determined from trials and testing.
		<b>SH2</b>	Structural assessment by linear finite elements analysis. Detail design requirements. Shock trial and equipment assessment.
		<b>SH3</b>	Structural assessment by non-linear finite elements analysis. Detail design requirements. Shock trial and equipment assessment.
Whipping	Globally effective structure	<b>WH1</b>	Global assessment of sections based on simplified rule procedures. Whipping response generated by 2D code.
		<b>WH2</b>	Global assessment of sections based on ultimate strength procedures. Whipping response generated by 2D code.
		<b>WH3</b>	Global assessment of sections based on FE analysis. Whipping response generated by 3D code.
Residual strength	Globally effective structure	<b>RSA1</b>	Global assessment of sections based on simplified rule procedures.
		<b>RSA2</b>	Global assessment of sections based on ultimate strength procedures.
		<b>RSA3</b>	Global assessment of sections based on FE analysis.

The number associated with each notation describes the analysis method, in general level 1 methods are a direct application of the formulations presented in the Rules and the higher levels require special analysis methods. In some cases procedures need to be agreed between the designer and Lloyd's Register to ensure that the required capability can be demonstrated. In addition to levels of analysis that are contained in the notation e.g. **IB1**, levels of performance are also specified. Level 1 is a relatively low-level threat, which can in most cases be sustained by

normal ship structure built to resist sea loads. Levels 2 and 3 will usually require specific hardening or protection to be arranged.

Obviously the assessment of vulnerability is highly sensitive and the selection of notations will be treated in accordance with security classification requirements of the navy concerned. Only the principal notations \*MD or MD are declared.

The design assessment look in detail at the hardening measures used to improve the vulnerability of the ship. It identifies features that exceed the usual structural requirement, for example reinforcing of penetrations on blast strengthened bulkheads. The assessment phase also verifies that the arrangement will perform satisfactorily when subjected to the various effects of a threat. The verification of a particular capability may be through testing, analysis, a combination of both or through direct application of the Rules which for simple low level threats will give an adequate level of protection. The manner in which the Rules address these effects is summarized in Table.2.

TABLE.2 Current naval ship rule coverage of vulnerability aspects

Threat effects	Structure and layout		Equipment and systems	
	Risk reduction measure	Rule requirement	Risk reduction measure	Role requirement
Blast	Adequate local strength	<b>IB</b> Notation or <b>EB</b> Notation	Equipment armour Redundancy	
Fragmentation Small arms	Adequate local strength	<b>FP</b> Notation <b>SA</b> Notation	Equipment armour Redundancy	
Shock	Adequate local strength	<b>SH</b> Notation	Equipment shock capability. Mounting plus installation Redundancy	
Whipping	Adequate global strength	<b>WH</b> Notation	Equipment shock capability. Mounting plus installation Redundancy	
Flooding	Define intact and damage stability criteria. Define watertight integrity requirements Local strength using 'damage head'	Pt 3 Ch 2. 1.3 Pt 3 Ch 2. 1.3 Pt 3 Ch 4 Pt 5 Ch 3. 5.7	Isolation valves Cross flooding Pumping systems Redundancy	
Hull girder damage	Adequate global strength	<b>RSA</b> Notation	NA	NA
Fire	Zone policy ( <i>see note 1</i> ) Structural fire protection Smoke, fire boundaries	Pt 4 Ch 1.7 <b>FS</b> Notation	Fire detection, protection and extinction systems Redundancy Operational procedures	<b>FS</b> Notation
Sympathetic reaction	Magazine structure and location	Pt 4 Ch 1.6	Magazine equipment and systems	Pt 4 Ch 1.6
Contaminants	NBCD Zone Policy	Pt 4 Ch 1.7	NBCD Zone Policy	Pt 4 Ch 1.7
Note (1) An effective zone policy will assist both NBCD risk reduction and fire protection.				

In the classification regime survey during the life of the ship is equally important to the design assessment. It is clear that the same emphasis must be placed on ensuring that the military capability that has been designed into the ships is built in and maintained through life. After some years service the military capability of a ship must not have become degraded by corrosion, repairs or modifications. Therefore, the introduction of the classification regime to military aspects is providing a new approach to continued assurance of capability, which is still fundamentally linked to the safety of the ship and its crew.

Normally only the MD or \*MD Notation is specified in the register book and unclassified survey information. The surveyor does not need to know the threat or threat level to perform a survey, just the areas protected and what that protection is. In general the size of the threat will have not have an effect on the survey requirements. It is essential that any modifications or repairs be made using the correct material as indicated on the approved plans.

By establishing a clear framework and notations the specification and procurement process should be eased as the variety of options available to a designer can be presented in a relatively simple and succinct form. This standardization of structural military requirements should make it easier to assess different bids and will reassure the designer that they are quoting for the same requirements as other tenders.

### **Survey regimes**

The survey regime for naval ships is not constrained by the requirements of the International Conventions and established merchant ship practice. The opportunity was taken to create a more flexible regime to allow for the operational demands placed on naval ships and for the refit cycles. The fundamental period for Special Surveys was set at six years, compared with five years used for merchant ships.

The regime includes Annual, Intermediate, Special and Docking surveys, following merchant ship practice. For surveys of engineering systems it is expected that greater use will be made of condition monitoring and reliability centred maintenance schemes than is found in the commercial sector, since these concepts are better developed in naval circles. Schemes are included for acceptance, subject to audit, of surveys of engineering systems and hull items by qualified naval staff, particularly the Marine Engineering Officer and shore based technical staff. In this way recognition is given to work carried out within the maintenance regime with monitoring by classification surveyors.

The demand for the survey regime to fit around operational deployments, often involving unscheduled events, is recognized. A flexible but rigorous approach is required and the Rules and Regulations for the Classification of Naval Ships provide a suitable scheme.

### **Experience with new and existing ships**

#### *Design and Construction*

With any new Rules it is important that these are calibrated against designs that are known to perform well, and to check that where problems are known to occur that the Rules would have indicated the need for a design change. During the development process a number of model ship types were assessed and this work formed the basis of evaluation for subsequently taking those classes of existing ships into class. The work on the Royal navy's CVS and Type 23 frigate established the credence of the Rules for a range of ship sizes.

The application of the Rules for both the existing ship types and for major new projects has not indicated any significant shortcomings for the hull design sections. The engineering systems Rules are less mature but these have recently been endorsed as an acceptable alternative for specification for naval ships, when amplified by the essential input of the requirements of the owner.<sup>8</sup>

The Rules are now being used within the UK Type 45 and CVF programmes and for a variety of other major naval ship projects for other navies.

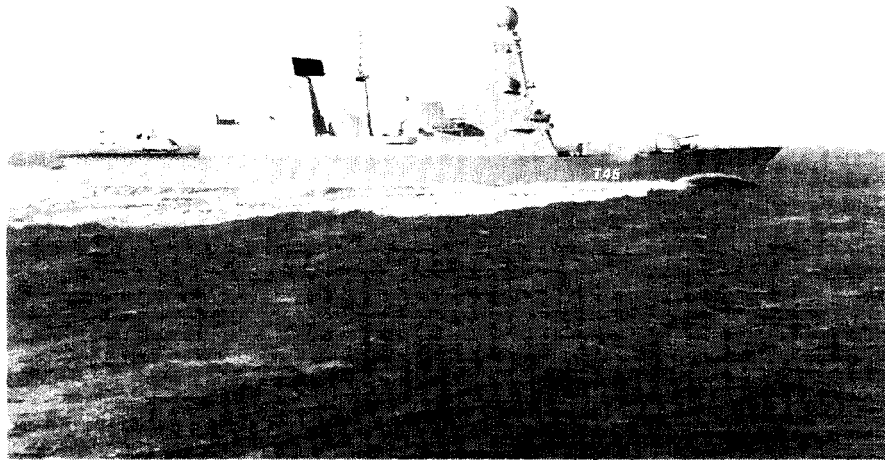


FIG.5 TYPE 45 FOR THE ROYAL NAVY

Meanwhile construction of naval ships to the requirements of Classification is progressing, with some new units expected to transfer to the naval ship regime on completion. The current programme will result in the classification by Lloyd's Register of:

- Destroyers and frigates.
- Corvettes.
- Landing platforms, dock.
- Landing ships.
- Survey ships.
- Patrol boats.

#### *Ships in Service*

Experience with the application of the Regulations pertaining to the maintenance of class is being built up following the entry into the naval ship classification regime of a number of existing naval ships. This will include the transfer of some new ships on completion, including HMS *Albion* and *Bulwark*, and after initial service, such as HMS *Ocean*. These ships were ordered under the merchant ship classification regime, prior to the development of the Rules and Regulations for the Classification of Naval Ships.

Further experience has been gained by the entry into class, after a review of the design and a thorough survey of a number of Type 23 frigates (Fig.6), and the CVS *Ark Royal*. It is expected that *Illustrious* will follow her sister during refit. Other ships such as the heavy landing craft and HMAS *Tobruk* of the Royal Australian Navy have also entered naval class. The experience provided by conducting surveys on existing naval ships, during major refits and alongside for annual surveys has been a valuable demonstration of the classification regime. Further transfers of existing ships into the regime are anticipated as the benefits in terms of providing an auditable support to ship safety management are realized.



FIG.6 TYPE 23 FRIGATE

Lloyd's Register also continues to provide assistance to naval customers by carrying out investigations into failures and technical advice to ship managers.

#### **Further developments**

The development by Lloyd's Register of the regime for the classification for naval ships continues. The Naval Ship Technical Committee will have met immediately prior to this conference to consider new proposals for extending and amending the Rules, taking account from feedback from application to design and ships in operation.

Among the forthcoming developments of particular significance are:

- The development of Rules covering those aspects that are dealt with in the SOLAS convention for merchant ships, including requirements for escape and evacuation.
- The extension of the Rules to cover additional hull forms, notably using information acquired from the trimaran demonstrator, RV *Triton*, to assist the exploitation of the trimaran concept.



### Concluding remarks

The development of a classification regime that would be appropriate to naval ships provided a very considerable challenge. The initial resistance in some quarters to the adoption of a different approach to regulation of the materiel state of a naval ship has been largely dispelled and the naval community is increasingly receptive.

This new business sector has also provided a challenge to Lloyd's Register, as a new customer community brings new ideas, demands and expectations. The decision to produce an entirely free-standing set of Rules and regulations has been vindicated. Of course, wherever it makes sense changes in one rule set will be used to amend others in a similar way to that used by Lloyd's Register with its other publications. Naval ships are different in concept and in application and the principles of classification can be applied beneficially to contribute to effective safety management but only if the fundamental differences are recognized within the Rules and Regulations.

As Lloyd's Register gains experience from application of the Rules and Regulations further developments will be made to meet the expectations of the naval sector.

#### References

1. BLAKE G. 'Lloyd's Register of Shipping 1760-1960.' *Lloyd's Register of Shipping, 1960*.
2. BAKER R. 'Ships of the Invasion Fleet', in 'Selected Papers on British Warship Design in World War II' from Transactions of the Royal Institution of Naval Architects. *Comway Press, 1983*.
3. CHALMERS D.W. 'Design of Ship Structures.' *IIMSO, 1993*.
4. 'Rules and Regulations for the Classification of Naval Ships.' *Lloyd's Register of Shipping*.
5. 'MoD Ship Safety Management: Part I. Policy, Issue 2.' *JSP430. Ship Safety Management Office, MoD, 2002*.
6. WALSON A.W. 'Corvettes and frigates' in 'Selected Papers on British Warship Design in World War II' from Transactions of the Royal Institution of Naval Architects. *Comway Press, 1983*.
7. MURRAY J.M. 'A hundred years of Lloyd's Register ship Rules.' Transactions of the Royal Institution of Naval Architects, 1955.
8. 'Annual Report of the Director Marine Engineering.' *MoD DLO, 2002*.