

DEVELOPMENT OF NAVAL SHIP RULES FOR SAFETY EQUIPMENT AND ARRANGEMENTS

BY

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ABSTRACT

This article reviews the process and philosophy by which Lloyd's Register and its industry partners have developed proposals for a new set of Rules for the Classification of Safety Equipment and Arrangements on Naval Ships.

Those responsible for the procurement, design and operation of warships are increasingly seeking to adopt practices and standards that are consistent with those used in merchant ships. The International Maritime Organisation's Conventions, which are applicable to merchant ships, contain good safety engineering practice that with suitable adaptation can also be applied to naval ships.

This article provides an explanation of the rationale behind developing such Rules and discusses the challenges and peculiarities overcome in the process. The article also details how the Rules are to be applied, and how they effect other aspects of Naval Ship Classification.

Introduction

Navies are generally self-regulating and are, by and large, exempt from the legislation applicable to merchant ships. To satisfy their own safety requirements, navies have traditionally sought to mitigate the risks to their personnel and equipment through the application of prescriptive requirements for the arrangement of safety equipment and through high levels of personnel training.

The design and build of warships is increasingly becoming a performance driven process with the end user making demands on designers to be flexible and to harness new technology. Traditional prescriptive standards for the performance, technical and safety aspects of naval ships can be restrictive to the designer when exploiting new technology or exploring innovative design solutions. In such circumstances there is potential for a designer or regulating body to adapt the prescriptive standard to suit their needs without actually realizing the underlying intent of the regulation, and thereby creating a possible unsafe situation.

Navies are becoming aware of these issues and are looking at merchant ship safety standards, as laid down in the International Maritime Organization (IMO) International Conventions, to address the issue. In particular, navies and government departments alike are calling on the expertise and experience of Lloyd's Register in the application of IMO requirements.

During Lloyd's Register's Naval Ship Technical Committee meeting in November 1999 an action was placed on Lloyd's Register to produce a discussion document on statutory equivalence in naval ships. The paper was presented at the 2000 Naval Ship Technical Committee. The feedback from the paper¹ and the

development of the British Government's Ship Safety Management Document JSP430² led to the formulation of proposed new Naval Ship Rules.

Based on the concepts discussed in the paper,¹ Lloyd's Register, in conjunction with designers, owners, operators and statutory bodies, has used its knowledge in the application and development of International Conventions to develop a set of Rules for Safety Equipment and Arrangements on Naval Ships.

These new Rules aim to provide for levels of safety on naval ships that can be considered to be as far as reasonably practicable in accord with the applicable IMO International Conventions but take due cognisance of military application.

The proposed new Rules were approved with amendments agreed by correspondence and discussions at Lloyd's Register's Naval Ship Technical Committee meeting on 4 November 2002 and will be effective from July 2003.

The conventions of the IMO

The IMO aims to provide an institutional means of ensuring achievement of its objectives of safer shipping and cleaner oceans, while maintaining flexibility to meet unforeseen contingencies.

In order to achieve its objectives, IMO has promoted the adoption of some 40 conventions and protocols and adopted well over 800 codes and recommendations concerning maritime safety, the prevention of pollution and related matters.³

The principal conventions of IMO are The International Convention for the Safety of Life at Sea (SOLAS) and The International Convention for the Prevention of Pollution from Ships (MARPOL). SOLAS, 1974, as amended,⁴ contains requirements for:

- Subdivision and stability.
- Machinery and electrical installations.
- Fire protection, detection and extinction.
- Life-saving appliances and arrangements.
- Radio-communications.
- Safety of navigation.
- Carriage of different types of cargoes and dangerous goods.
- Nuclear ships.

The 2000 amendments to SOLAS Chapter II-2, adopts a new approach of Fire Engineering Analysis which can better accommodate the way port and flag states and ship designers deal with fire safety issues in new ships to be constructed in the future. The new structure focuses on the 'fire scenario' process rather than on ship type as had previously been the case. The new SOLAS regulations start with requirements for the prevention, detection and extinction all the way through to escape. In addition the technical requirements have been removed from SOLAS and incorporated into the Fire Safety Systems Code and each regulation now has a high level purpose statement and functional requirements associated with it to assist in resolving matters which may not be fully addressed in the prescriptive requirements. This approach is discussed in greater detail below.

IMO also publish *Code of Safety for Special Purpose Ships*⁵ which recognizes that additional/alternative safety standards supplementing those of SOLAS may be required for special purpose ships. (Special purpose ships are those ships where persons are specially needed for particular operational duties and are additional to those persons required for the normal operation of the ship). Although this Code

is not applicable to naval ships, there are parallels when assessing how the SOLAS requirements can be applied to naval ships.

MARPOL⁶ is another IMO International Convention that mandates requirements aimed at ensuring that merchant ships do not pollute the environment. In particular it contains requirements for the prevention of pollution by oil, noxious liquid substances, dangerous goods, sewage, garbage and exhaust gas emissions.

The relationship of classification and IMO

It will be useful at this point to take a little time to explain the relationship of Classification and IMO, as this will aid the understanding for the need to develop Safety Equipment and Arrangement Rules for Naval Ships.

Lloyd's Register's current involvement in the Classification of Naval Ships is generally restricted to hull structures and machinery systems. This mirrors approach taken by the civilian Rules and Regulations for the Classification of Ships since matters such as tonnage measurement, subdivision and stability, fire protection, detection and extinction, life saving, radio communications, safety of navigation and the prevention of pollution are the concern of the Flag Administration who are responsible for ensuring the IMO requirements are applied.

Lloyd's Register is authorized, by many Flag Administrations, such as the Maritime Coastguard Agency in the UK, to conduct surveys and issue certificates in accordance with IMO international conventions. The Rules of Lloyd's Register for merchant ships do not address all matters of concern to the IMO but it is important to note that SOLAS regulations require the ship to be designed, constructed and maintained in compliance with the structural, mechanical and electrical requirements of a classification recognized by the Flag Administration responsible for the regulation of a particular ship.

Compliance with the statutory requirements for merchant ships as stipulated by Flag Administrations is a classification requirement of Lloyd's Register. It should be noted the IMO requirements for safety and pollution prevention have not been developed with the intent of being applicable to naval ships and this has been the driving force in the development of the new Rules to be applicable to naval ships.

Amongst other duties, the Flag Administrations have the responsibility of keeping owners, operators and designers up to date with current legislation which otherwise may go unnoticed. This function is missing in the naval ship regulatory regime at present, and although the legislation is not applicable to naval ships, the new Rules will have the advantage of keeping naval bodies abreast of current legislation should they choose to adopt the classification processes. This is certainly one advantage that the UK Ministry of Defence sees in the development of these Rules.

The new Rules

The new Rules define requirements for the design and through life operation of safety equipment and arrangements and for pollution prevention. They are designed to provide a method of assessment that demonstrates that the levels of safety and pollution prevention on board a naval ship are to a standard that is acceptable to the Owner of the ship and to Lloyd's Register. The new Rules aim to provide a standard that can be considered to be in accord with the applicable IMO International Conventions taking due cognisance of military functions. The new Rules also provide a methodology for assessing designs that deviate from the generally accepted practice.

It should be noted that these Rules are not a mandatory part of Naval Ship Classification and are an optional provision that an owner may choose to apply.

New Rule topics

The new Rules cover Fire Protection, Escape, Emergency Access, Evacuation, Rescue, Navigation, Communication and Pollution Prevention. Consistent with current classification practices in the application of non-mandatory Rules such as these, a Class Notation can be assigned or a Certificate of Compliance issued. Being assigned either a Class Notation or issued with a Certificate of Compliance demonstrates conformance with the Rules.

(a) **Certificate of Compliance.**

This is issued where the design has been assessed against applicable Lloyd's Register Rules, which may refer to alternative acceptable standards, and the arrangements on board are found acceptable to Lloyd's Register's surveyors.

(b) **Class Notations.**

These may be assigned where in addition to the requirements for Certificate of Compliance a periodical survey regime has been established for the life of the ship.

It is recognized that the different areas of ship safety complement each other but for clarity the Rules have been arranged in six Chapters. Chapter 1 details the general requirements and guidance on application of the Rules and the other five chapters deal with particular safety and pollution prevention measures. The Rules have been arranged to reflect the categorization in the IMO SOLAS and MARPOL publications.

New Rules and Regulations for the Classification of Naval Ships, Volume 3, Part 3:

Chapter 1	General Requirements (EER)
Chapter 2	Fire Protection (FIRE)
Chapter 3	Escape and Emergency Access (ESC)
Chapter 4	Life-Saving and Evacuation Arrangements (LSAE)
Chapter 5	Safety of Navigation and Communication (SNC)
Chapter 6	Pollution Prevention (POL)

Each of the Chapters has a Class Notation attributed to it as shown in the brackets. All of the Class Notations may be endorsed by a Star (*) where the arrangements are in accordance with the applicable requirements of a particular National Administration.

The Chapter headings identify with those of International Conventions however some changes have been necessary to reflect naval practices. One major difference between naval and merchant practices that has led to the Chapter titles being as they are, recognizes that it is a usual naval requirement for personnel to gain access back into the ship compartments during emergency situations for the purposes of damage limitation and recovery, hence Chapter 3 refers to Escape and Emergency Access. Other peculiarities of naval design that have effected the development of these Rules are described later.

New Rule Philosophies

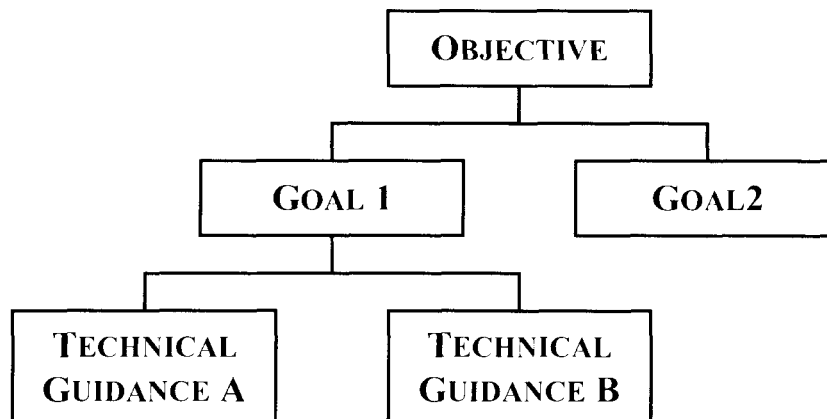
As mentioned in the introduction, prescriptive requirements can cause problems for innovative designers and may lead to hazardous situations if guidance is not given on the underlying intent of the requirement. For this reason the new Rules do not provide designers strict requirements which must be satisfied, but rather identify risks which must be addressed and mitigated and give guidance as to how the suitability of the design is to be justified.

Lloyd's Register is not alone in adopting such an approach and this has been recognized by the IMO for some time. This has been discussed above with SOLAS becoming a more performance-based standard rather than prescriptive which was the traditional methodology.

The new Rules elaborate this performance-based approach and identify a clear objective to be met by all designs requiring a particular Class Notation or Certificate of Compliance. These objectives represent the highest level of abstraction of a purely technical requirement. As such, they are of limited use to the designer seeking guidance on an acceptable design, and are therefore supported by more detailed requirements and ultimately pure technical requirements.

Although these statements provide limited guidance to the designer, they underpin the intent of the Rules and are extremely useful in deciding whether a design that deviates from the norm is acceptable.

In the new Rules, these high level statements are referred to as Objectives and the more detailed requirements are Goals. There is usually more than one goal stemming from each objective, and in turn, several references to technical guidance stemming from each goal.



Lloyd's Register has used its experience and expertise in the development and application of the International Conventions to formulate the Objectives that underpin the intent of the applicable sections of SOLAS and MARPOL.

Objectives – Underpinning the new Rules

The Objectives, as stated in the new Rules Are described below.

Fire Protection Objectives. (Chapter 2).

- (a) Fire Prevention Objective
Every Ship is to be designed and equipped so as to prevent the occurrence of fire and explosion, taking due account of its civil and military operational role.
- (b) Fire Detection Objective
Every ship is to be designed and equipped, as far as is practicable, to detect any potentially hazardous fire or explosion.
- (c) Fire Extinguishing Objective
Every ship is to be equipped, so far as is practicable, so that all detected fires can be safely and effectively extinguished.
- (d) Containment Objective
Every ship is to be arranged, so far as is practicable, to limit the spread of fire, smoke and toxic by-products from the zone of origin.
- (e) Personnel Hazard Objective
All reasonable measures are to be taken to prevent hazards to personnel as a result of fire or explosion.
- (f) System Interaction Objective
The possibility of fire protection measures or systems causing fire related or non-fire related hazards is to be kept to a level that is as low as is reasonably practicable.
- (g) Command and Control Objective
Suitable means are to be provided to ensure any active fire control measures can be safely and effectively orchestrated.
- (h) Structural Integrity Objective
Sufficient structural integrity is to be maintained following a fire so as to prevent whole or partial collapse for the ship's structures due to strength deterioration by heat.

Escape of Personnel and Emergency Access Arrangements Objectives. (Chapter 3).

- (a) Escape of Personnel Objective
Every ship is to be arranged so that all spaces have means of safe and effective escape for personnel to a designated place of safety, during anticipated emergency situations.
- (b) Emergency Access Objective
Every ship is to be arranged so that personnel can access all areas with necessary equipment, for damage control and fire fighting purposes.

Life-Saving and Evacuation Arrangements Objectives. (Chapter 4).

- (a) Evacuation Objective
Arrangements are to be provided to enable personnel to evacuate the ship safely and in a time acceptable to the naval authority.
- (b) Personnel Protection Objective
Evacuated personnel are to be kept protected until such time as they can be rescued from the survival craft.
- (c) Rescue Objective
Every ship is to be suitably equipped to rescue personnel from the water.
- (d) Command and Control Objective
Every ship is to be equipped and manned so that command of all evacuation and life-saving situations can be maintained.

Safety of Navigation and Communication Objectives. (Chapter 5).

- (a) Communication Objective
Every ship is to be capable of communication to avert unnecessary danger to itself and other ships in the vicinity during normal and emergency conditions.
- (b) Safety of Navigation Objective
Every ship is to be arranged with the necessary equipment to facilitate safe and effective navigation.
- (c) Equipment Arrangements Objective
All navigation and communications equipment is to be arranged to allow safe and effective task performance.

MARPOL is a very prescriptive document that does not lend itself to interpretation. In short, the requirements for pollution prevention as stated in MARPOL must be complied with in full for Rule application and compliance purposes. As such, the need for objectives is obviated and they have not been included in Chapter 6 of the new Rules.

Military distinction notations

The new Rules provide for a minimum basic level of safety equipment arrangements that will provide suitable personnel and equipment protection for the majority of incidents that are likely to occur during daily duties.

However, the Rules are not intended to deal with direct military threats. In line with current Lloyd's Register Naval Ship Classification practice, the Rules offer a Military Distinction (MD) notation where a navy requests that the design is such that it deals with a predefined military threat. For example, fire protection systems may be required to be such that the ship will survive for 96 hours following an internal blast generated by 30kgs of explosives in the forward accommodation space. Lloyd's Register has the capability to review simulations to verify that designs are capable of withstanding defined threats.

For obvious reasons the details of MD notations are strictly confidential and even a surveyor attending the vessel will not know why the arrangements are such as they are, but the MD notation will bring their attention to that fact that some novel

arrangements will be found, and are to be in accordance with the survey information received from the design appraisal office.

Lloyd's Register Naval Survey Guidance (NSG)

The NSG document contains detailed engineering survey information on Classification items covering such items as primary hull structures and watertight integrity. As the title suggests, it primarily contains information about what is to be achieved during survey. The document highlights areas of particular concern and common problems the surveyors should be aware of.

In the case of the safety and pollution prevention arrangements, as well as containing the usual survey criteria, the NSG will provide information on the formulation of an Alternative Design Justification Report. It will also contain information on generally acceptable designs and on the use of simulation techniques for the assessment of design.

Conclusion of New Rule structure

It may appear at first that the new Rules as developed provide limited help to designers when they try to meet the requirements of an Owner. However the next section of the article aims to explain why purely prescriptive requirements are simply not an option, and will demonstrate how the Rules are to be applied and how they provide benefit to the design process.

Military considerations

There are differences between military and civilian ship operation that have been considered during the development of these Rules. Whilst the new Rules have been based on goal setting objectives we have recognized the need to consider actual scenarios that the designer may have to address to ensure that the Rules are usable. This Section looks at some of the design considerations that are currently used in naval ships and discusses how these compare to those that would be generally acceptable to a National Administration applying an IMO Convention requirements.

In civilian shipping, active fire fighting systems whilst still a requirement, are being substituted with passive systems such as automated sprinkler and water mist systems. However in naval ships, fire fighting is still currently heavily reliant on trained fire crews and ready availability of fire fighting means.

Escape and evacuation procedures in merchant shipping are considered in International Conventions to be two separate acts whereby personnel escape from inside the ship on one signal, and then evacuate the ship completely on another signal. This is because the priority here is to save the personnel so they are therefore mustered ready to evacuate in the eventuality that it is not tenable to stay on the ship. On a naval ship the priorities are somewhat different as saving the vessel is of the highest priority. If the vessel is to be lost, evacuation is a last resort and is not through organized mustering into lifeboats, but typically by wet shod procedures that is a far speedier, if not more dangerous.

Also, it should be recognized that SOLAS is formulated with a wide range of ships in mind with for instance a cargo vessel the size of a destroyer or frigate having a crew in the region of 20-30 people, mainly concentrated in machinery and accommodation spaces.

Where SOLAS requirements are applicable to a passenger ship, they assume a core competent crew and a body of passengers with little or no knowledge of the ship procedures. What's more, the body of passengers is assumed to be from a

cross section of society, ranging from infants to the elderly and disabled. This is in stark contrast to the situation on a typical frigate where the compliment would consist of 160 to 180 highly trained personnel, or on an assault ship that may carry hundreds of fit and disciplined marines for example.

It is obvious, just from these few differences between civilian and military practices, that the merchant ship statute requirements are not strictly applicable to naval ships in their current form. Furthermore, it should also be apparent that the nature and roles of naval ships is so diverse that to develop prescriptive Rules would be a hugely time consuming task particularly given the usefulness of prescriptive requirements as outlined earlier.

It is also evident that it is not acceptable to mix and match merchant requirements to naval applications, and a radically different approach is needed. As with any new approach, there are going to be problems in application until experience is gained, however the routes for demonstrating compliance have been given careful consideration to minimize the potential for misinterpretation of the Rules. Details of this are provided in the next Section.

Application of the new Rules – demonstrating compliance

Acceptance Criteria

Acceptance of a system installed on a ship for the purposes for safety or pollution prevention is dependent on the system being acceptable at defined points in its life cycle, namely:

- Design.
- Construction.
- Installation/testing.
- Trials.
- Through life operations.
- Modifications.

Where a Certificate of Compliance is requested, through life operations and modifications are not subject to review. The acceptance criteria are again fairly subjective and to ensure that they are met, the new Rules provide routes to conformance to ensure that the criteria are achieved at each stage of the life cycle.

Routes to conformance

The routes to demonstrating conformance with the different Rule requirements are through defined processes and procedures. These cover Design, Construction, Installation, Trials, In Service Survey and Modifications.

(a) Design

Plans are required to be appraised by Lloyd's Register when required by the Rules and where the Owner has requested a MD notation.

(b) Construction

Systems are to be built under survey by Lloyd's Register's surveyors as required by the Rules.

(c) Installation

Systems are to be installed under survey in accordance with plans appraised by Lloyd's Register and Rule requirements.

(d) Trials

Systems are to be tested under normal working conditions to the satisfaction of Lloyd's Register Surveyors.

(e) In Service

Systems will be subject to survey where required by the Rules or Regulations or where requested by the Owner or Naval Authority. (Applicable only where Class Notations are assigned)

(f) Modifications

Details of any modifications are to be appraised and construction, installation and trials are to be carried out under survey when required by the Rules. (Applicable only where Class Notations are assigned)

At each stage of the process there are likely to be occasions where specific requirements cannot be met. Where the reasons for non-compliance have a military justification, conformance will be managed through a Concession or an Alternative Design Justification Report.

(a) Concession

A concession may be granted at the discretion of an authorised Lloyd's Register Surveyor. The concession is only granted where the Surveyor considers the deviation not to effect the overall design philosophy of the Rules. The concession will be recorded as an annex to the Certificate of Compliance or Classification Records as applicable.

(b) Alternative Design Justification Report

An alternative design justification report is required to be developed in accordance with the Naval Survey Guidance where an authorized Lloyd's Register Surveyor considers the deviation from a specific Rule requirement to be of a critical or significant nature such that it cannot be assessed on their judgement alone. Following a satisfactory review of the report, Lloyd's Register will issue a statement of acceptance. The statement of acceptance and principal details from the report will be recorded in an annex to a Certificate of Compliance or Classification Records as applicable.

Concluding remarks

A need has been identified to develop new Rules for the arrangement of safety equipment on naval ships to a standard, which is in accord with that found on a merchant ship. Due to the diverse roles of naval ships and also due to the rapid advances in technology, a set of prescriptive Rules was not considered to be suitable for these purposes. Instead, a performance based set of Rules has been formulated based the underlying principles of the IMO international conventions, but suitably adapted to take account of military application.

To support the new Rules, the Naval Survey Guidance is being developed to offer more detailed guidance to designers on arrangements that will be acceptable for the majority of naval ship applications.

Lloyd's Register's Naval Ship Technical Committee has approved the proposed new Rules and the next stage will involve their application. It is envisaged that the application of the Rules to actual installations will lead to refinement of the requirements in common to the development of other Lloyd's Register Rules. The new Rules as developed will provide a means that will enable naval ships to

demonstrate that they have levels of safety and environmental protection which are in accord with that found on merchant ships.

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