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THE NATIONAL SHIPBUILDING RESEARCH PROGRAM

Guide to International Approval Processes for Commercial Ship Construction

U.S. DEPARTMENT OF THE NAVY
CARDEROCK DIVISION,
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NSRP 0505

GUIDE TO INTERNATIONAL APPROVAL PROCESSES FOR COMMERCIAL SHIP CONSTRUCTION

Volume I of World Class U.S. Shipbuilding Standards
NSRP Project 6-94-1
Final report of Task No. 1

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EXECUTIVE SUMMARY
Overview of NSRP Project 6-94-1

You're on a business trip and, in a local store, you see a lamp that will look great in your den. You buy the lamp – but not the light bulb, since you have many. On returning home, you screw a 40W bulb into the lamp, plug the lamp into the wall socket and turn it on. It works perfectly; you are indebted to National Standards.

National Standards not only ensure that lamps work, our shoes fit, and this paper fits the photocopier, they also ensure that ships are built in the most cost effective way possible. National standards become a method of communication, so that a part's specification can be relayed between any vendor, to any engineer in any shipyard with the knowledge that the part is available, functional, and is competitive. NSNRP 6-94-1, "Word Class U.S. Shipbuilding Standards" was dedicated to establishing the framework for developing a set of U.S. National Standards that could compete with those from Japan, Korea, Western Europe and other World Class commercial shipbuilding countries.

The aim of the project was not to create a new National Standards body but to assist those standards bodies, already established in the U.S., in publishing standards that are truly "World Class."

Definition:

> For the purposes of this report, the expression "World Class" means that a shipyard is capable of designing a VLCC (say) in 10 months and completing ship construction in 18 months from contract award – realizing a profit in the process.

NSRP 6-94-1 had several thrust areas: firstly, to assist the industry in understanding the international approval processes for commercial ship construction; secondly, it was important that the project proposed a management plan to effectively implement world class standards within the U.S. This was achieved by first visiting yards in Japan and Denmark to assess <u>how</u> standards are developed and, based on first-hand observations, the "Plan" was developed. The plan focused heavily on adapting or adopting existing standards know to be world class; finally, therefore, the project highlighted priority standards by developing a matrix database of common standards and a cross reference four ship types to standards supporting the desired area (ventilation, electrical, pipe, and structural).

Accordingly, the project was progressed as three tasks. It was originally intended that these tasks be presented as one package; however, the bulk of material has proved too much to be issued under one cover. Therefore, NSRP 6-94-1 will be issued as three volumes as indicated below.

What follows is a brief synopsis of each volume (task) which will be available to readers as three separate NSRP reports:

Volume 1 – Final Report for Task No. 1 (NSRP 0505)
Guide to International Approval Processes for Commercial Ship Construction

To be competitive, U.S. yards must be aware of the standards used in the international commercial market. Shipyards that are fully cognizant of the applicable regulatory requirements and guidance documents will have a significant advantage in the design and construction of commercial vessels. An understanding of these requirements will also permit shipyards to use less expensive commercial alternatives to Milspec requirements where appropriate in naval construction, thus reducing the cost of naval ships.

The purpose of this task was to provide a reference source for shipyard designers. This Guide is intended to present the applicable design requirements for commercial vessels, particularly for the representative products specifically discussed and those in the thirteen prioritized equipment categories analyzed in earlier projects. This Guide discusses:

- The role of standards, including standards-setting organizations, classification societies, and the development of international standards
- Product acceptance criteria including products subject to acceptance, IACS unified requirements, and guidance on international marine products
- ABS product acceptance criteria and approval process for valves, flanges and plastic pipe
- Ongoing domestic regulatory changes, including domestic regulatory reform, the reorganization of the USCG office of marine, safety and environmental protection, The President's regulatory initiatives, Marine Safety Evaluation Program (MSTEP), and the Alternate Compliance Program (ACP).
- Ongoing international regulatory changes including the International maritime Organization (IMO), International Safety Management (ISM), and the International Code for Application of Fire Test Procedures (FTP Code)

This task is the third in a series of studies analyzing international product standards and regulatory issues regarding the acceptability of products in the international market. The initial effort was a Shipbuilder's Council of America (SCA) study, completed by PMC on December 31, 1991, entitled "Evaluation of the Equivalency Process Under U.S. Coast Guard Rules and Regulations." A principal finding of the SCA study was that usable records of the acceptance of foreign equipment for use in U.S. flag vessels were not being kept. The study specifically addressed the use of the USCG equivalency procedures and gave examples of foreign equipment and materials that had been accepted in U.S. flag vessels.

The second project, NSRP Project No. 6-93-1, is entitled "Evaluation of U.S. and International Marine Engineering Standards for Acceptability in U.S. Flag Vessel Applications (NSRP Report No. 0438)". The final report for this second project also presented extensive regulatory summaries for equipment, components, and materials and some piping systems, but with emphasis on USCG regulations rather than classification

society requirements (i.e., ABS requirements), as developed for presentation in this Guide under the current task.

Volume 2 – Final Report for Task No. 2 (NSRP 0506)
The Management Plan to Effectively Implement World Class Standards Within the U.S.

The purpose of this task was to investigate competitive foreign commercial standards for engineering methods, processes and drawings. Specifically, to present a simple and workable approach to producing competitive standards at the National level. Volume 2 includes four deliverables:

- Visit report Odense Steel Shipyard Ltd., Indo, Denmark
- Visit report SHI Shipyard, Yokosuka, Japan
- Visit report IHI Shipyards, Tokyo, Nagoya and Kure, Japan
- The Plan – Processes, phases and criteria

Each visit report includes shipyard information in terms of capacity, ship orders and layout. Trip notes include examples of typical yard standards, standards development processes and organization – with particular emphasis on yard vs. national standards and CAD/CAM interfaces. Detailed question and response matrixes are also included that allow easy comparisons to be made between yard operating methods and philosophies. During the visit process, the team also sought to identify those foreign commercial shipbuilding standards most suitable for acquisition to be used as part of the adopting or adaptation methodology outlined in the Plan.

The Plan section provides a basic description of standards organization and cultures in the visited world class shipyards. It also defines a process that aims to bring the U.S. community and support industries on line to attain World Class Shipbuilding status through the use of competitive standards. The report, which is written in informal tone, embodies six principle elements:

- Selection of Phase one standards
- Establishment of NSRP Panel 6 Technical Point of Contract and supporting coalition
- Shipyard approval/prioritization of Phase 1 standards
- Standards acquisition and distribution to shipyards
- Coordination of “Adopt, Adapt, Develop” review process
- Collection, coordination and processing with existing U.S. standards agencies
- Publishing of lists of U.S. National Shipbuilding Standards

At the heart of the plan is the need for U.S. shipyards to join in the common goal of assisting ASTM, IEEE and other standards organizations in producing standards that are both usable and competitive. Many would argue that this is not the current situation.

Volume 3 – Final Report for Task No. 3 (NSRP 0507)
Catalog of Foreign Standards for Common Systems and Ship Types and Matrix of Equivalencies

The initial purpose of this task was to establish requirements for developing sets of internationally acceptable product procurement standards; this accomplished through Task 2. Task 3, however, extended the work scope to identify international standards that are most applicable to U.S. foreign shipbuilding interests for selected ship types and to identify degrees of commonality between U.S. and foreign standards for high cost process and systems. Task 3 achieved this by studying four specific areas (Ventilation, Electrical, Piping, and Structural) from which a matrix database was developed that cross referenced four ship types (Ro-Ro, LNG, Ferries and Tankers) to standards available from as many foreign national and international standards that were available.

The ventilation area addressed hangers and fittings; the electrical area addressed hangers and tray systems; the piping area studied hangers, firemains and fittings; the structure area focused on components, ladders and handrails. For each of these areas, standards were identified from either an existing paper index or digital database.

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This project was sponsored by the National Shipbuilding Research Program (NSRP) through the Society of Naval Architects and Marine Engineers (SNAME) by its panel on Marine Industry Standards, Panel SP-6. The support of several panel members was essential in carrying out this project and, in many respects, this guide is a compilation of the information provided by them.

NSRP is a cooperative research and development program involving the Maritime Administration (MarAd), U.S. Coast Guard (USCG), Navy, and U.S. and Canadian Shipyards, which seeks to reduce shipbuilding cost and construction time through the implementation of state-of-the-art technology.

NSRP functions through eleven technical panels of the Ship Production Committee of SNAME. These panels identify and undertake programs which lead to productivity improvements within the entire marine industry.

A special note of appreciation is due to the classification society, USCG, and other industry leaders who willingly shared their knowledge of international approval processes to make this guide possible. National Steel and Shipbuilding Company (NASSCO) and Petrochem Marine Consultants, Inc. (PMC) would like to particularly thank:

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CHAPTER 1 - INTRODUCTION

With the end of the Cold War and the reduction in defense spending, U.S. shipyards are moving back into the construction of large commercial ships after more than a decade's absence from this arena. During that time, significant changes have been made to the international requirements, USCG regulations, and classification society rules. In addition, numerous international and national standards bodies have developed standards which are applicable to commercial vessels.

A major opportunity exists in commercial shipbuilding. The Maritime Administration estimates that 7,300 to 9,000 large, oceangoing ships will be built for this international commercial market between 1992 and 2001, with three-quarters of this work after 1996.

To be competitive, U.S. yards must be aware of the standards used in the international commercial market. Shipyards that are fully cognizant of the applicable regulatory requirements and guidance documents will have a significant advantage in the design and construction of commercial vessels. An understanding of these requirements will also permit shipyards to use less expensive commercial alternatives to Milspec requirements where appropriate in naval construction, thus reducing the cost of naval ships.

The purpose of this project is to provide a reference source for shipyard designers. This Guide is intended to present the applicable design requirements for commercial vessels, particularly for the representative products specifically discussed and those in the thirteen prioritized equipment categories analyzed in earlier projects. This Guide discusses:

- Approval lists and catalogs,
- Acceptance processes including first and third party approval systems, case-by-case approvals, and type approval systems,
- Standards including international and domestic standards, and construction versus performance requirements,
- Product requirements, both generally and by specific categories, and
- International versus classification society versus domestic requirements by specific product category including acceptance under recognized standards and alternative procedures.

This project is the third project in a series of studies analyzing international product standards and regulatory issues regarding the acceptability of products in the international market. The initial effort was a Shipbuilder's Council of America (SCA) study, completed by PMC on

December 31, 1991, entitled "Evaluation of the Equivalency Process Under U.S. Coast Guard Rules and Regulations". A principal finding of the SCA study was that usable records of the acceptance of foreign equipment for use in U.S. Flag vessels were not being kept. The study specifically addressed the use of the USCG equivalency procedures and gave examples of foreign equipment and materials that had been accepted in U.S. Flag vessels.

The second project, NSRP Project No. 6-93-1, is entitled "Evaluation of U.S. and International Marine Engineering Standards for Acceptability in U.S. Flag Vessel Applications (NSRP Report No. 0438)". This study was assigned by the NSRP through SNAME Panel SP-6 to NASSCO in conjunction with PMC. The purpose of this project was to recommend improvements to the equivalency process under USCG regulations by demonstrating the comparability and suitability of international and foreign standards for marine equipment. This evaluation included the development of an equipment/standards database which is included in reference (26)[1]. Under this project, detailed analyses and summary reports were also developed showing the comparability and acceptability of international and foreign standards versus U.S. standards for thirteen prioritized equipment categories. The final report for this second project also presented extensive regulatory summaries for equipment, components, and materials and some piping systems, but with emphasis on USCG regulations rather than classification society requirements (i.e., ABS requirements), as developed for presentation in this Guide under the current project.

[1] Numbers in brackets refer to references listed in an appendix at the end of this Guide.

CHAPTER 2 - SUMMARY

o Introduction

The impact of standards on international trade has grown dramatically over the last decade and this trend remains strong. Likewise, the standards that persist and become the standards for international trade depends on global commerce and how these standards are developed.

The Agreement on Technical Barriers to Trade (TBT) was adopted at the conclusion of the Uruguay round of the General Agreement on Tariffs and Trade (GATT) negotiations in 1994 in conjunction with the Agreement establishing the World Trade Organization (WTO). The TBT Agreement promotes the use of international standards, but has led to different positions among governments and standards bodies regarding the nature of technical regulations and standards, and the obligations of signatory governments. The American Society of Mechanical Engineers (ASME) and the American Society for Testing and Materials (ASTM) support the principles of the TBT Agreement, but feel that a common understanding for the use of the term "international standard" is needed.

Many countries believe that the only international standards organizations are the International Organization for Standardization (ISO) and the International Electrotechnical Commission (IEC). They therefore equate international standards to ISO and IEC standards. However, the standards often being used in the industrial sectors of these countries are ASME and ASTM standards.

ASME and ASTM standards are internationally accepted standards developed under processes compatible with the intent and terms of the TBT Agreement. While ISO and IEC provide one avenue for developing international standards, it should be realized that this is not the most effective process for all standards. This is particularly true for standards that facilitate innovation and new technology by continuous revision, and fulfill safety roles by appropriate levels of technical review.

o Purpose

The purpose of this Guide is to provide a reference source for shipyard designers to determine the applicable requirements for commercial vessels being designed, particularly for the representative products specifically discussed and generally for those in the thirteen prioritized equipment categories analyzed in earlier projects. This Guide discusses:

- Standards including international and domestic standards, and construction versus performance requirements,

- Acceptance processes including first and third party approval systems, case-by-case approvals, and type approval systems,

- Product requirements, both generally and by specific categories, including citations for USCG and ABS requirements, and sample ABS approval process diagrams,

- International versus classification society versus domestic requirements by specific product category including acceptance under recognized standards and alternative procedures,

- Product approval lists and catalogs,

- International and domestic standards catalogs,

- International Maritime Organization (IMO) organization, development, Conventions, and Resolutions, and

- Ongoing international and domestic developments, and regulatory reform including Prevention Through People (PTP) and Risk Based Technologies (RBT).

o Standards Development and Approval Processes

The initial chapters provide general background on the role and types of standards, standards-setting organizations, and classification societies. The various general approval and acceptance processes are also introduced. These processes include statutory certification, domestic processes, and classification society processes and procedures including first and third party approval systems, case-by-case approvals, and various type approval systems.

o Product Acceptance Criteria

The chapter on product acceptance criteria provides a reference source for shipyard designers to determine the applicable product requirements for commercial vessels being designed, particularly for products in the thirteen prioritized categories which were analyzed in earlier projects.

The approach used is to present general considerations for functional product groupings and specific requirements for representative product categories. The general requirements are introduced with a summary of the work undertaken in NSRP Project No. 6-93-1. The remainder of the general section includes a listing of regulatory cites (i.e., USCG and ABS) for products generally subject to some degree of approval or acceptance procedures, discussion of the IACS

unified requirements, and general guidance on international marine products.

The remainder of this chapter is devoted to discussion of specific marine engineering product categories. Each product category typically includes a general summary of requirements, a review of the work performed in NSRP Project No. 6-93-1, presentation of the ABS requirements, and a review of the USCG domestic requirements based on the regulations in 46 CFR. The equivalency of these ABS and USCG requirements is discussed and the differences are presented for clarity. These representative categories are typical of the processes that are encountered in the international market. They also show the ramifications that occur when new standards development programs at ISO or IMO are encountered. The specific product categories also demonstrate how standards in the international market can be identified and evaluated to establish their acceptability.

o Standards Evaluation

The general methodology used in NSRP Project No. 6-93-1 within each functional area and specific category continues to provide a basis for evaluating the acceptability of unfamiliar standards. This process includes the following steps:

- Evaluate approval processes and the past use of equivalencies and equipment in the specific category.
- Identify and obtain standards for analysis (ISO, IEC, DIN, or JIS) including second and third tier standards.
- Evaluate the significance of hazard analysis and quality assurance programs on the specific category.
- Develop and provide acceptance recommendations with any limitations including review of international, domestic, and classification society requirements.

o Plastic Piping

Non-metallic piping materials were again used as an illustration of the attempts to develop performance requirements and the ramifications of developing such standards at IMO. The intent is to develop suitable fire resistance and other performance requirements for these "non-metallic" systems so that the suitability of any installation can be judged. This work includes all shipboard piping systems. The requirements agreed upon to date were recently adopted by the IMO Assembly and have been incorporated into the 1997 edition of the ABS Rules for Steel Vessels. Additional work is in progress at IMO regarding requirements for smoke and toxicity.

Issues were uncovered that require USCG consultation. These issues affect the materials testing program and the firestop testing program. For example, the IMO requirements assume Class A-60 as the most severe case and typically anticipate testing with insulation schemes in place. However, for some designs, the lack of insulation in a Class A configuration may cause a more severe or different type of hardship. It was also found that some U.S. manufacturers were unfamiliar with the background relating to the development and goals of these new testing requirements. A significant conclusion is that future product development may require teaming between shipyards and manufacturers.

Finally a test program is outlined and basic cost estimates are provided for each type of testing. The nominal goals are to demonstrate the suitability of some plastic piping materials and some firestops. However, extended goals are also suggested. These include demonstrating the suitability of small scale firestop tests, the implications of different firestop test programs (i.e., deck versus bulkhead or Class A versus Class A-60), and, finally some basic endurance testing.

o Conclusions and Recommendations

The last chapter provides insight into many of the ongoing or planned changes that will affect international and domestic ship construction. The scope and depth of the international technical requirements has been rapidly expanding since the adoption of the tacit amendment procedures introduced into the International Convention for the Safety of Life at Sea (SOLAS), 1974. Additionally, this work is being moved forward by the rapid expansion of ISO and IEC standards to facilitate international trade. This chapter shows the pace of change internationally and domestically, and points to some of the fundamental changes that will impact commercial vessel construction during the turn of the century.

Throughout this report, the development and growth of more extensive technical requirements is shown at IMO, ISO, IEC, ASME, and ASTM. Much of this work has been accelerated by the needs of and growth in international trade. It appears that this rapid pace of standards development will continue into the next century.

Finally, a program is outlined that will further document design requirements and procedures for shipboard systems and their related component products. If undertaken, this work will provide the basis for a Quality Systems Manual for the design of shipboard systems in commercial vessels.

CHAPTER 3 - BACKGROUND

3.1 The Role of Standards

(a) Standards-setting Organizations (1)[1]

The industrial revolution has lead to the development of numerous standards-setting organizations, technical societies, trade associations, and industry groups that bring interested parties together to develop practices, guidelines, technical reports, and standards. The success of such groups depends on several factors. The influence, prestige, and competence of these organizations are essential elements that promote the acceptance and use of their standards. Such factors help to minimize deviations from standards, promote feedback and revision as experience dictates, and provide a robust framework for additional standards work.

The U.S. federal government has had a long standing policy, directed by Executive Order, to support the development of voluntary consensus standards and incorporate relevant standards into national regulations when found suitable. The standards-setting organization must possess high technical competence and consider the views of all interested parties in making its decisions. In cases where participation of groups is denied, such as small business, redress is possible under the Sherman Act. While standards may create certain product restraints, the courts have generally held that the social benefits of having standards outweigh such effects if the standards are reasonable in objective, form, the organization that writes them, and the procedure employed.

The development of standards serves many purposes--

- Promotes commerce
- Promotes safety
- Promotes consistent quality
- Standardizes ratings and sizing
- Standardizes dimensions, particularly interface dimensions
- Promotes usability and interchangability of parts, and reduces the amount of re-working
- Helps to limit liability
- Helps to define the state-of-the-art or good practice
- Saves money
- Saves time

[1] Numbers in brackets refer to references listed in an appendix at the end of this Guide.

Our free enterprise system is generally based on the "prudent owner" model. This model assumes that the shipowner will be able to adequately compete and has the ability to assess a wide range of safety related issues. The owner's actions in building and operating a ship under these conditions constitute an adequate standard provided due regard is given to the safety of passengers and crew, property, and the environment. Early international treaties were pursued on premise of setting standards for crucial emergency equipment to eliminate such aspects from the arena of competition.

Since a wide range of issues must be addressed, a logical way to proceed is to band together to develop a consensus or expert opinion. Such groups have generally been formed by professional societies, trade associations, industry groups, and standards setting organizations. Tables 3-1 and 3-2 show national groups normally involved or associated with the development of standards affecting commercial maritime issues.

Table 3-1

BROAD BASED U.S. STANDARDS-SETTING ORGANIZATIONS/TECHNICAL SOCIETIES INVOLVED IN THE DEVELOPMENT OF MARITIME RELATED STANDARDS

American Boat and Yacht Council (ABYC)
American Bureau of Shipping (ABS)
American Institute of Chemical Engineers (AIChE)
American National Standards Institute (ANSI)
American Society for Nondestructive Testing (ASNT)
American Society of Heating, Refrigerating and Air Conditioning Engineers, Inc. (ASHRAE)
American Society for Testing and Materials (ASTM)
American Society of Mechanical Engineers (ASME)
American Welding Society (AWS)
Fluid Controls Institute, Inc. (FCI)
Illumination Engineering Society (IES)
Institute of Electrical and Electronic Engineers, Inc. (IEEE)
Instrument Society of America (ISA)
International Cargo Gear Bureau
National Cargo Bureau
National Fire Protection Association (NFPA)

National Safety Council
Pressure Vessel Research Committee (PVRC)
Society of Naval Architects and Marine Engineers (SNAME)
Underwriters Laboratories (UL)
Welding Research Council (WRC)

Table 3-2

U.S. TRADE ASSOCIATIONS AND INDUSTRY GROUPS INVOLVED IN THE DEVELOPMENT OF MARITIME RELATED STANDARDS

Air Movement and Control Association (AMCA)
Aluminum Association
American Association of Port Authorities
American Gas Association (AGA)
American Institute of Merchant Shipping (AIMS)
American Iron and Steel Institute (AISI)
American Petroleum Institute (API)
American Shipbuilders Association
American Waterways Operators (AWO)
Boating Industry Association (BIA)
Chlorine Institute
Compressed Gas Association (CGA)
Expansion Joint Manufacturers Association, Inc. (EJMA)
Institute of Makers of Explosives (IME)
Lake Carriers Association
Manufacturing Chemists Association (MCA)
Manufacturers Standardization Society (MSS)
Marine Safety Equipment Manufacturers Association
National Association of Engine and Boat Manufacturers (NAEBM)
National Electrical Manufacturers Association (NEMA)
National Fluid Power Association (NFPA)
National Plant Food Institute
Shipbuilders Council of America (SCA)
Society of Automotive Engineers, Inc. (SAE)
Tubular Exchanger Manufacturers Association (TEMA)

(b) Development of International Standards

During the last two decades, the number and importance of international standards has grown dramatically. A driving force for this has been the increase in international commerce and the general recognition that trade barriers must be removed. Table 3-3 shows the sources of standards that affect the commercial maritime market.

Standards are often traditionally thought of as defining the construction of equipment and components. However, the need to provide flexibility and achieve consensus among a wide range of practices has lead to standards based on performance criteria and testing. This trend allows the manufacturer to pursue a broader range of designs and the international market, and provides the purchaser with more choices. One potential difficulty with such standards is that verification of compliance may be more difficult.

Standards, such as those for piping components, normally contain sections which address:

* Material requirements, heat treatment, and hot/cold working
* Dimensions (including wall thicknesses and tolerances)
* Method of design and stress analysis including factors of safety
* Performance and pressure/temperature ratings
* Welding procedure and welder performance qualification when applicable
* Non-destructive examination, hydrostatic testing, and other sampling or production tests
* Stamping and marking

Table 3-3 - Document Sources and Types for Standards and Requirements in the International Maritime Community

I. International Requirements

A. International Maritime Organization (IMO)

1. Treaties

- International Convention for the Safety of Life at Sea (SOLAS), 1974 as amended
- International Convention for the Prevention of Pollution from Ships (MARPOL 73/78), 1973 as amended
- International Convention on Load Lines (Load Line/LL), 1966
- International Convention on Tonnage Measurement of Ships (Tonnage), 1969; etc.

2. Codes

- International Code of Safety for High-Speed Craft (HSC Code)
- Code for the Construction and Equipment of Mobile Offshore Drilling Units (MODU Code)
- International Code for the Construction and Equipment of Ships Carrying Dangerous Chemical in Bulk (IBC Code)
- International Code for the Construction and Equipment of Ships Carrying Liquefied Gases in Bulk (IGC Code)
- International Maritime Dangerous Goods Code (IMDG Code)
- Code of Safe Practice for Solid Bulk Cargoes (BC Code)
- International Code for the Safe Carriage of Grain in Bulk (International Grain Code); etc.

3. Assembly Resolutions
4. MSC Circulars
5. MEPC Circulars & Resolutions

B. International Labour Organization (ILO)

1. Conventions
2. Cargo Gear

Table 3-3 - Document Sources and Types for Standards and Requirements in the International Maritime Community (cont'd.)

C. World Health Organization (WHO)
   1. Sanitation Requirements
   2. Deratization Requirements

D. International Civil Aviation Organization (ICAO)

E. International Telecommunication Union (ITU)

II. International Consensus Standards

A. International Standards Organization (ISO)
   1. Maritime Specific Standards
   2. Maritime Related Standards

B. International Electrotechnical Commission (IEC)
   1. Maritime Specific Standards
   2. Maritime Related Standards

III. Classification Societies

A. Rules
   - Various rules for societies listed in ASTM F1546

B. Guidance Material

C. Equipment/Material Approval Lists

D. International Standards incorporated in Rules by reference

IV. Domestic Regulations and Guidance Documents

A. U.S. Coast Guard (USCG)
   1. Regulations
      - 46 CFR Shipping
      - 33 CFR Foreign Flag (i.e., All Vessels) Requirements
      - 33 CFR Pollution Prevention
      - Alternative Compliance Program (U.S. Supplement to ABS Rules)
      - Port State Control Verification Programs

Table 3-3 - Document Sources and Types for Standards and Requirements in the International Maritime Community (cont'd.)

2. Guidance Documents
   - Navigation and Vessel Inspection Circulars (NVIC)
   - Marine Safety Manual
   - Other Guidance Materials and Policy Letters
   - Equipment Approval List

B. U.S. Public Health Service (USPHS)
   1. Regulations
   2. Guidance Materials

C. Research and Special Projects Administration (RSPA)
   1. Regulations (49 CFR)

D. Federal Communications Commission FCC)
   1. Regulations (47 CFR)

E. Center for Disease Control (CDC)
   1. Interim Construction Specifications for Passenger Vessels Destined to call in U.S. Ports

F. State Requirements

V. Domestic Consensus Standards

(Note: ASTM F1546 shows standards incorporated by reference into regulations, etc.)

A. American Society for Testing and Materials (ASTM)
B. American National Standards Institute (ANSI)
C. American Society of Mechanical Engineers (ASME)
D. Institute of Electrical and Electronic Engineering (IEEE)
E. National Fire Protection Association (NFPA)
F. Underwriters Laboratories (UL)
G. Manufacturers Standardization Society (MSS)
H. Other documents listed in the NSRP Compendium of Standards or regulations

VI. Foreign Flag and Port State Requirements

(The requirements, guidance, interpretations or supplements issued by various foreign states and signatories to the various international treaties).

Table 3-3 - Document Sources and Types for Standards and Requirements in the International Maritime Community (cont'd.)

VII. Foreign Consensus Standards

(The various national systems of voluntary consensus standards).

A. Deutsches Institute for Normung (DIN)
B. Japanese Industrial Standards (JIS), etc.

Notes: See Appendix 6.1 a listing of standards catalogs
See Appendix 6.3 for a listing of IMO Assembly Resolutions

(c) Classification Societies

The classification society represents a special category of voluntary standards-setting organization. Traditionally, the role of these societies has been to provide technical services as impartial third party experts in support of design, construction, and operation of commercial vessels. Their services have primarily focused on three main maritime areas -classification, statutory services, and ongoing research and development.

Though not required by law, vessel classification for large vessels is essentially mandatory for insurance purposes. It has also been proposed at IMO that all ships be required to be classed. Smaller vessels may be built to class requirements, but the owner sometimes chooses not to continue in class after construction.

Traditional ship classification generally pertains to the construction of commercial ships in accordance with published rules and regulations of a society which, in conjunction with proper care and conduct on the part of the shipowner and operator, provides for:

- the structural strength and related watertight integrity of all essential parts of the hull and appendages,

- the safety and reliability of the propulsion and steering systems, and

- the effectiveness of related features and auxiliary systems which have been built into the ship to facilitate the safe carriage of personnel and cargoes while the ship is at sea, at anchor, or moored in a harbor.

The classification society generally maintains the above provisions by review of the vessel's design, survey of the construction and testing, and periodical survey during operation to ascertain that the vessel complies with its rules and regulations. If significant defects become apparent or damage is sustained, the shipowner and operator is required to inform the society without delay. Similarly, any modification which would affect the vessel's classification must receive prior approval by the society. A ship is said to be "in Class" when the rules and regulations which pertain to it have in the opinion of the society been complied with or a special dispensation from compliance has been granted.

In the past, traditional classification did not generally include matters such as ship's stability, life saving appliances, pollution prevention arrangements, or the actions or movement of personnel about the ship. [2] Such aspects were the prerogative of the

[2] Det Norske Veritas (DNV) has recently modified its rules and regulations to include the normal treaty requirements often delegated to such societies by national authorities.

National Authority of the country the ship is registered with. However, it is the practice of many nations to delegate these responsibilities to classification societies in accordance with agreed procedures. Additionally, coastal states exercise certain verification procedures and other requirements when the ship operates within their waters. In recent times, the role of classification societies has been expanding to embrace within classification such considerations as stability, environmental protection and human factors.

The role of classification societies is also unique because the major societies are able to readily provide their services on a worldwide basis. Several of these societies have banded together to form the International Association of Classification Societies (IACS). By working together, IACS promotes the development of high standards for ship safety and the prevention of marine pollution. IACS also participates in the International Maritime Organization (IMO) providing cooperation and consultation. The Member Societies are bound by the ISO Quality Assurance Standards for Ship Classification and delegated statutory work. One of the goals of this cooperative work is to ensure consistency of class rules from one society to another. The Member Societies are:

Societies

American Bureau of Shipping (ABS)
Bureau Veritas (BV)
China Classification Society (CCS)
Det Norske Veritas (DNV)
Germanischer Lloyd (GL)
Korean Register of Shipping (KR)
Lloyd's Register of Shipping (LR)
Nippon Kaiji Kyokai (NK)

Likewise, the American Bureau of Shipping has increased the scope of its rules to include treaty requirements. Such changes include its recent revisions of its Electrical Engineering requirements, adoption of the SOLAS stability requirements as a condition of class, and general adoption of the SOLAS fire protection requirements with some additional stipulations as deemed necessary.

Societies (cont'd.)

Polski Rejestr Statkow (PRS)
Registro Italiano Navale (RINA)
Register of Shipping (RS)

Associates

Hravatski Registar Brodova (CRS)
Indian Register of Shipping

ASTM F1547, Standard Guide Listing Relevant Standards and Publications for Commercial Shipbuilding, lists the addresses of these societies, pertinent publications, and the countries delegating statutory responsibilities to the various classification societies. A large number of smaller classifications societies do exist. Also, other affiliations between societies do exist, but these groupings are often based on regional considerations.

Figures 3-1 to 3-6 summarize the various rules and regulations for the American Bureau of Shipping, Det Norske Veritas, and Lloyd's Register of Shipping.

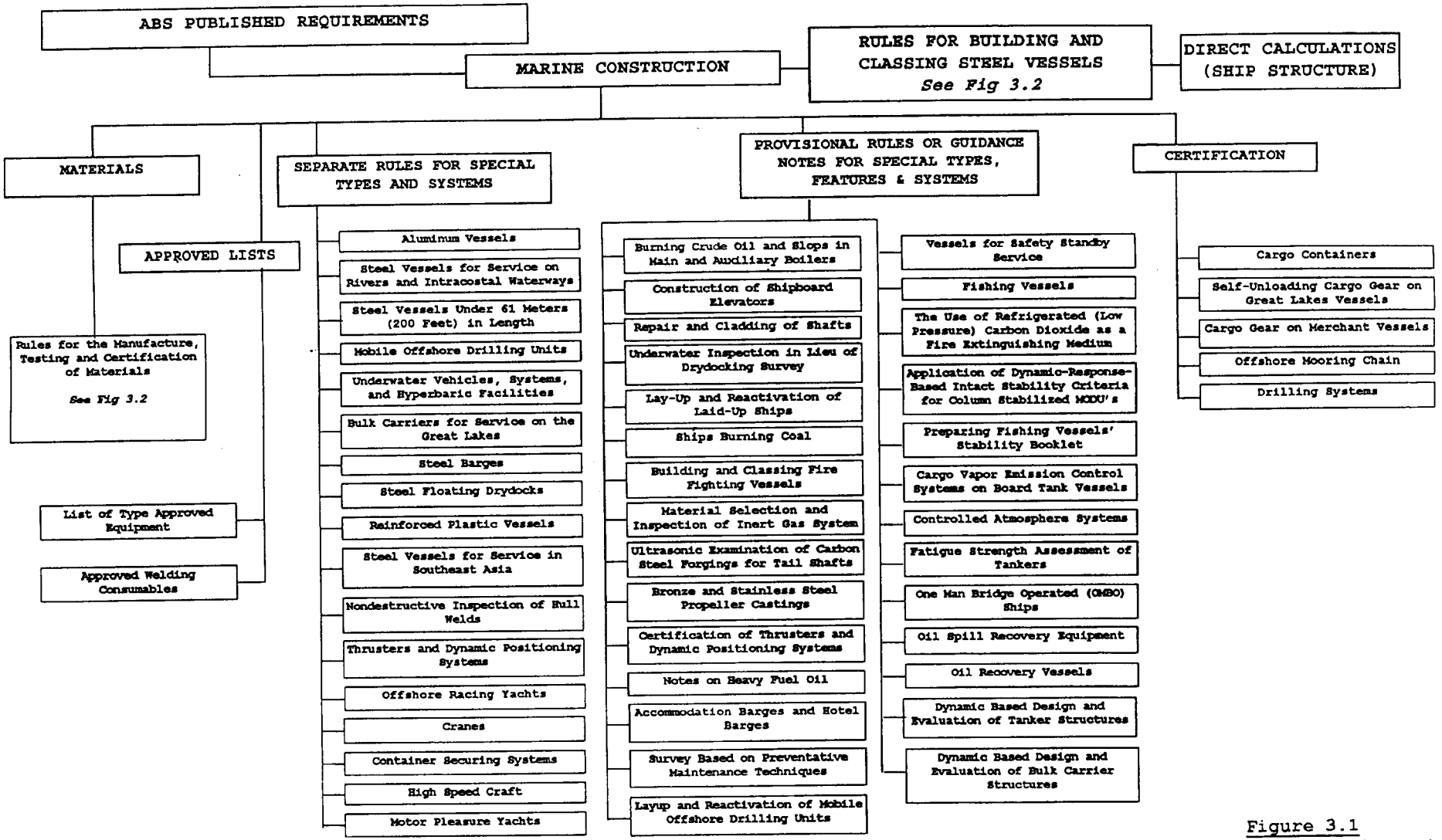

Figure 3.1
ABS Published Requirements

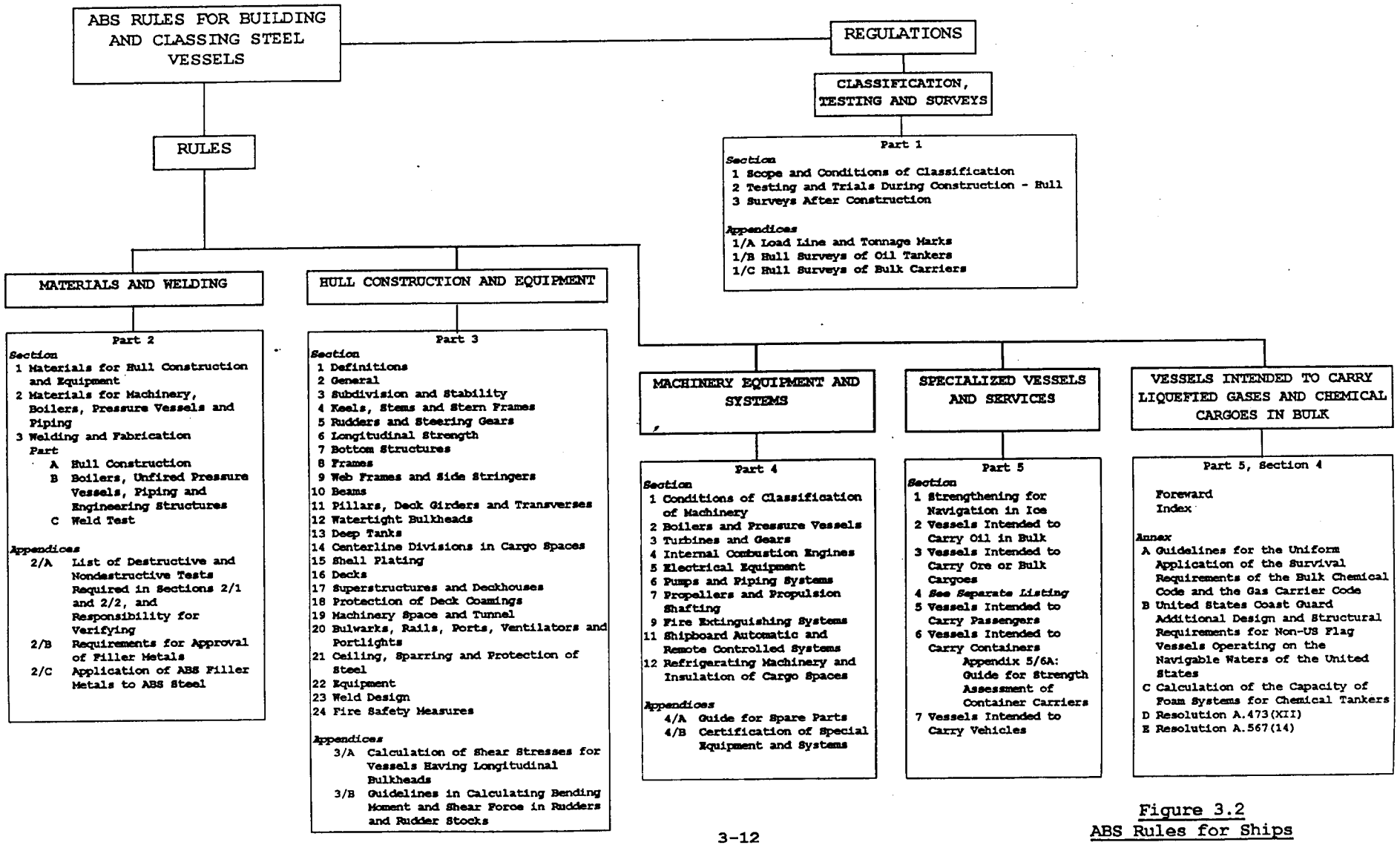

Figure 3.2
ABS Rules for Ships

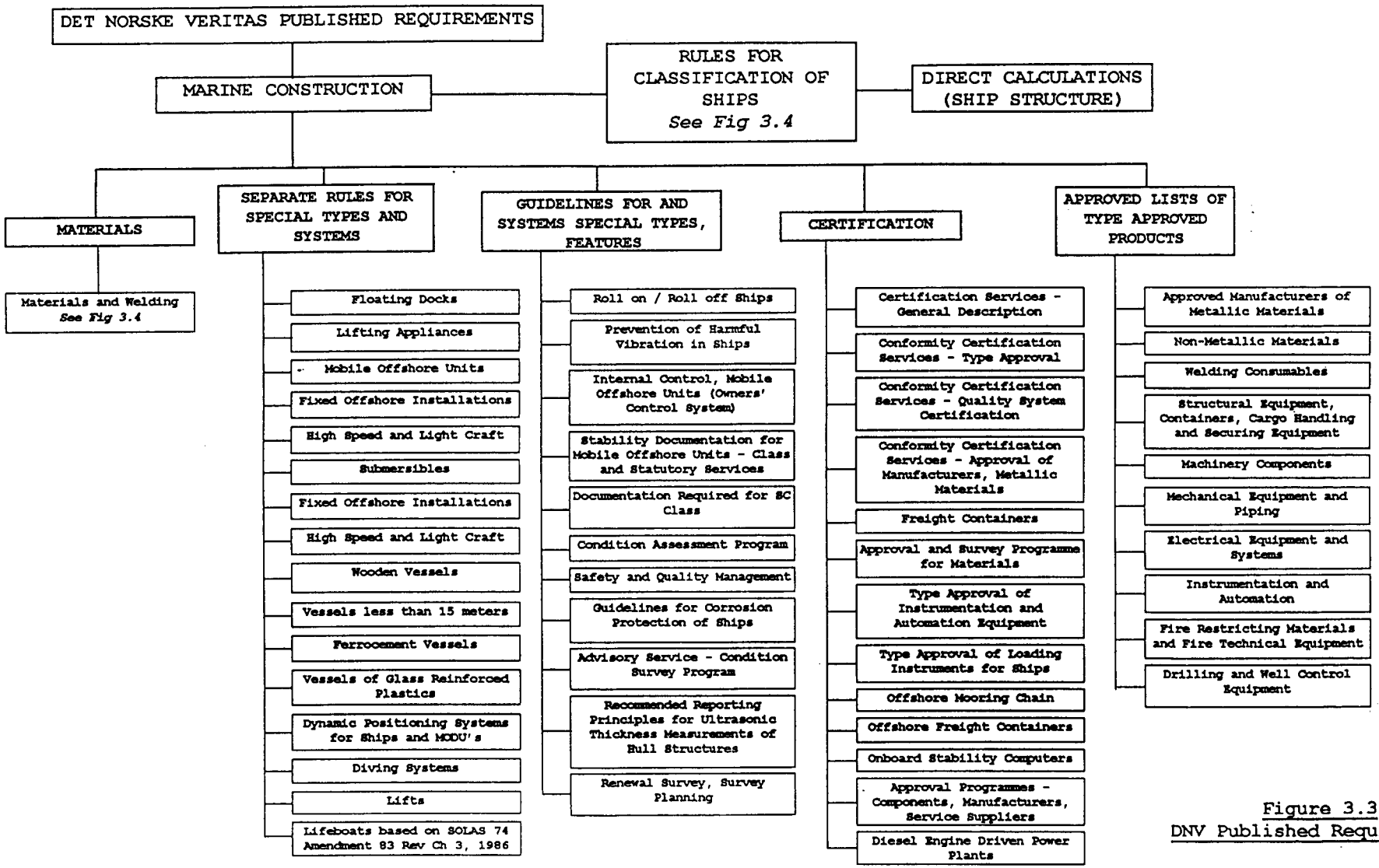

Figure 3.3
DNV Published Requirements

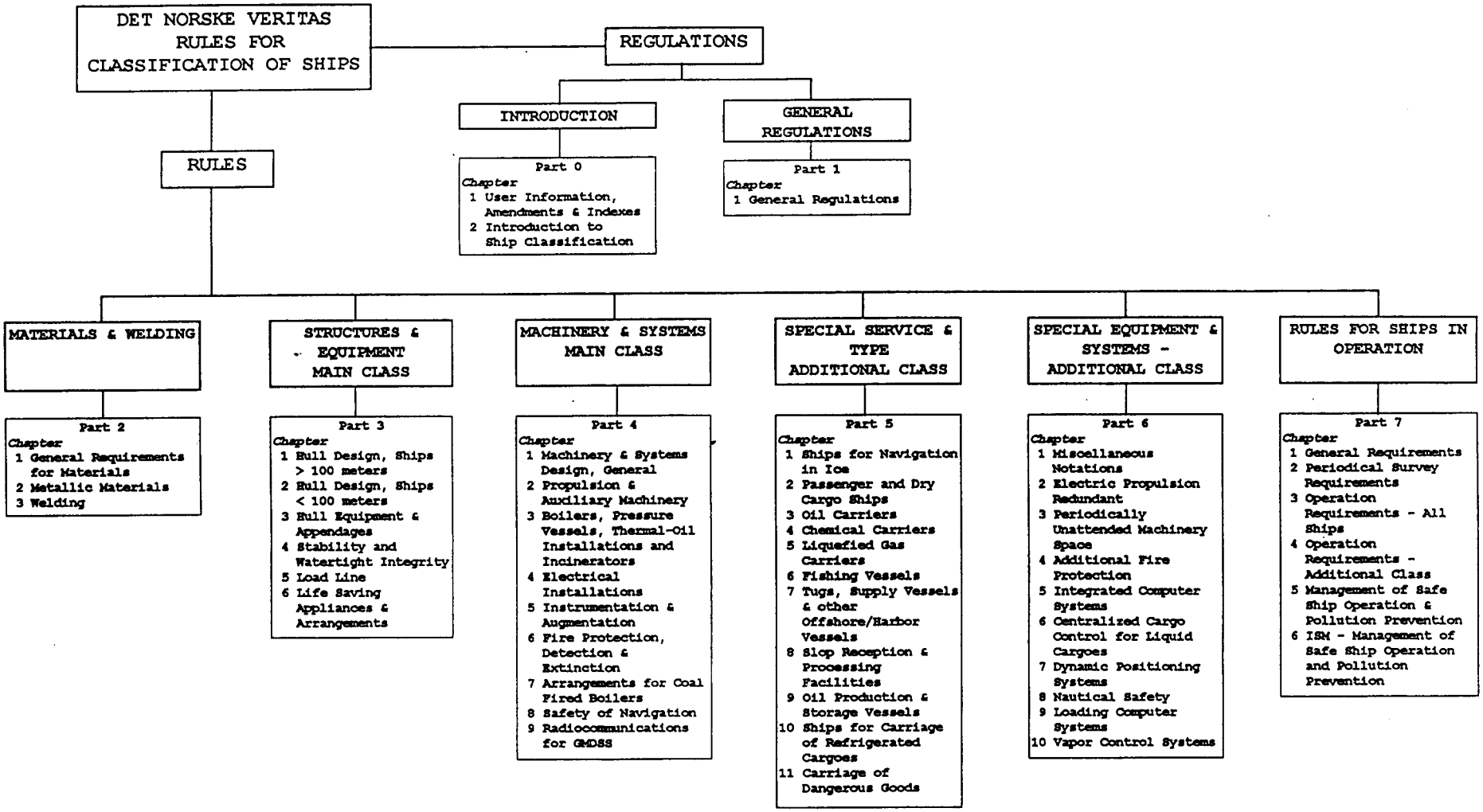

Figure 3.4
DNV Rules for Ships

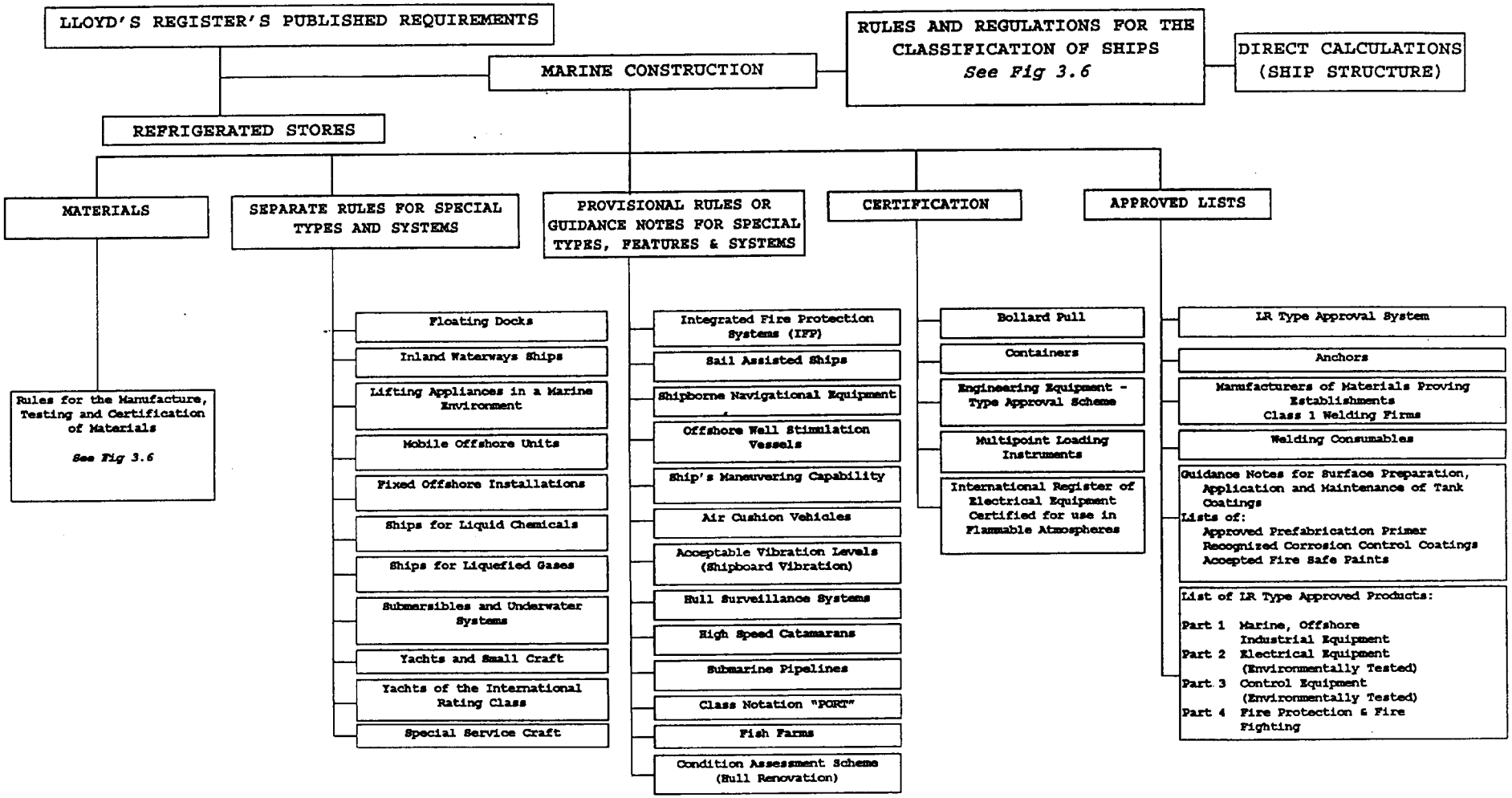

Figure 3.5
Lloyd's Published Requirements

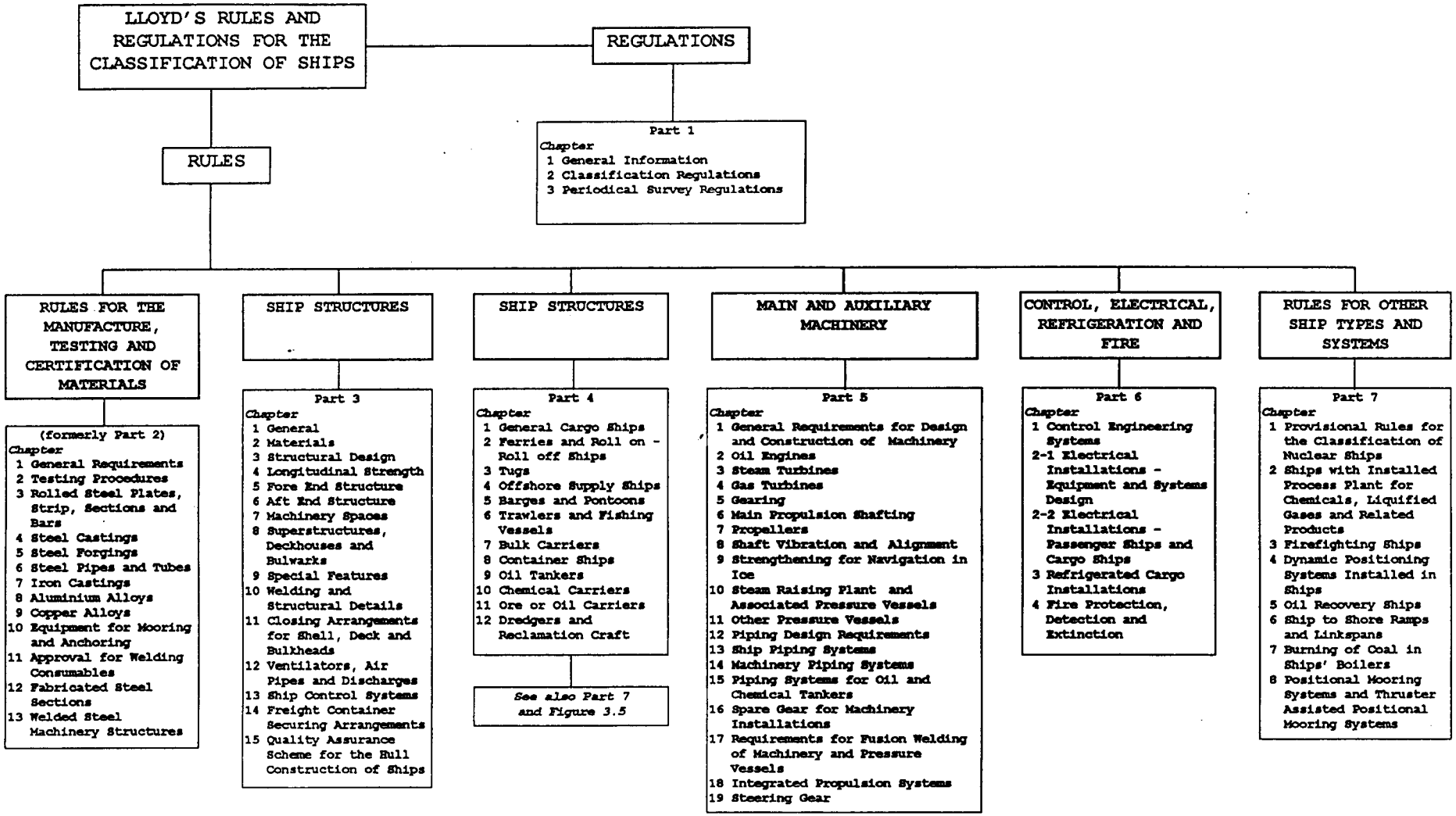

Figure 3.6
Lloyd's Rules for Ships

3.2 Generic Approval/Acceptance Processes

(a) Statutory Certification

While the main thrust of the design review, certification, and survey process is to obtain the required statutory certificates, numerous other approvals, documents, and certificates must be obtained throughout the design and construction period to fulfill all of the various requirements.

The statutory certificates and documents generally include the following, as applicable (see SOLAS, Consolidated Edition, 1997, Appendix with Annexes 1 and 2 in Part 1, and Annex 3 in Part 2):

- International Load Line Certificate
- International Load Line Exemption Certificate
- Passenger Ship Safety Certificate with Form P (Record of Equipment)
- Cargo Ship Safety Construction Certificate
- Cargo Ship Safety Equipment Certificate with Form E (Record of Equipment)
- Cargo Ship Safety Radio Certificate with Form R (Record of Equipment)
- Document of Compliance for the Carriage of Dangerous Goods
- Dangerous Goods manifest or stowage plan
- SOLAS Exemption Certificates
- Certificates pertaining to international codes for special services
- International Oil Pollution Prevention Certificate
- Shipboard Oil Pollution Emergency Plan
- International Pollution Prevention Certificate for the Carriage of Noxious Liquid Substances in Bulk
- Minimum safe manning document
- Certificates for masters, officers or ratings
- Certificate of type test for sewage treatment system (MARPOL Annex IV)
- International Tonnage Certificate
- Cargo Gear Certificates, Registers or plans
- Stability information and booklets
- Cargo Record Book
- Oil Record Book
- Enhanced survey report file (for oil tankers & bulk carriers)
- Noise Survey Report

- o Sanitary Construction Certificate
- o Deratting Exemption Certificate
- o Potable Water Certificate
- o Certificate of Proficiency in Survival Craft (Lifeboatman Certificates)
- o Flag State Certificates (e.g., USCG Certificate of Inspection, Certificate of Registry, Certificate of Financial Responsibility, Safe Manning Certificate, etc.)
- o Port State Requirements, as appropriate (usually without a certificate)

The certification process for the issuance of such certificates often involves plan approval for systems and equipment, design analyses, and various degrees of certification for equipment, components, and materials.

(b) Domestic Approval/Acceptance Processes

These processes were extensively discussed in NSRP Project No. 6-93-1, "Evaluation of U.S. and International Marine Engineering Standards for Acceptability in U.S. Flag Vessel Applications (NSRP Report No. 0438)", either Volume I: Summary Report or Volume II: Final Report. This report particularly discussed the regulatory framework and background for Subchapter F, Marine Engineering Regulations, and Subchapter J, Electrical Engineering Regulations. Volume II of the report also contained an extensive annex discussing the approval or acceptance of systems and equipment for marine and electrical categories, and equipment requiring type approval.

In addition to discussing the framework and background for the regulations, the above reports discussed the expanded use of the equivalency process to address international practices. They included a narrative description of the operation of the equivalency process, as well as a detailed evaluation. Generally, past use of these procedures was limited to specific items of equipment, components, or materials in particular applications. Evaluations based solely on standards were normally not undertaken because of the difficulty encountered in obtaining a complete set of standards including second or third tier standards. These reports presented the results of applying the existing equivalency methods to relatively complete sets of standards for prioritized equipment categories.

For each of the categories undertaken, the report summarizes the detailed results. It also generally discusses historical use, hazards associated with each category,

the method of analysis, presentation of results to the USCG, and associated references. Except for special categories like plastic piping and flanges, each category normally represents at least one comparison of international standards with standards recognized by the USCG. Additionally, where differences are found, an attempt was made to place them in an appropriate perspective. For each category, an overview of the analysis and results is presented to condense the more detailed summary of the work done.

Additional information on approval processes is provided in paragraph (f), "Guidance on Approval Procedures, Plan Review, and Interpretation of Requirements", below, in the equipment categories discussed in Chapter 4, and in Appendix 6.3 of this report.

(c) Classification Society Processes

Classification by a recognized classification society generally involves similar processes including plan approval and acceptance of equipment, components, and materials. While a number of certificates are issued, the two main certificates are the Hull Classification Certificate and Machinery Classification Certificate. The introductory sections in the various technical portions of each classification society's regulations generally state the plans that are required to be submitted for plan approval. Occasionally, ships will receive classification by more than one society. Under such circumstances, some of the survey duties may be shared to reduce redundancy. Such arrangements are not automatic and would be subject to a formal agreement or a case-by-case arrangement between the involved societies.

Classification society rules and regulations provide for the acceptance of equipment, components and materials under different systems ranging from acceptance to type approval. Typical certificates under these systems are:

- Works Certificate or mill certificate (for materials)
- Classification Society Test Report or Test Certificate
- Classification Society Equipment Certificate (in accordance with its rules and regulations)
- Classification Society Type Approval Certificate (in accordance with any of the following -- Society's rules, national/regional requirements, national

standards, industry standards, other government's requirements, or manufacturer's standards).

Additionally, in accordance with international commercial trends, it is often possible to obtain certification from the producer of equipment, components, or materials regarding his conformance with a quality assurance system.

(d) Classification Particulars

Each classification society has a system of letter designations to describe the ratings assigned to each vessel classed by it. The following example describes a hypothetical vessel classed by ABS. Certification to other requirements or standards, such as different ice strengthening criteria, is usually possible upon request.

o ABS Classification and Notations

Example of a vessel classed by ABS:

✠ A1 Ⓔ OilCarrier, ✠ AMS, ✠ ACCU, ✠ APS, OMBO, DLA, SH

In addition, ABS offers nine of its own and four Baltic Sea Ice Class notations in its rules.

The Class designations and symbols are defined as follows:

✠ (Construction)-Symbol:

Denotes that the vessel has been built to the satisfaction of the Surveyors of the American Bureau of Shipping who actually surveyed the vessel during construction.

✠ A1 Oil Carrier-Symbol:

Indicates compliance with the hull requirements of the ABS Rules and that the vessel is designed primarily for the carriage of oil.

Ⓔ Symbol:

Signifies that the mooring equipment consisting of anchors and chain for the vessel is in compliance with requirements of the ABS Rules.

✠ AMS-Symbol:

Indicates that the machinery and boilers have been constructed and installed to the satisfaction of the ABS Surveyors to the full requirements of the ABS Rules.

✠ ACCU-Symbol:

Indicates certification of the Automatic Control System for Unattended Engine Room operation under the requirements of ABS, and assembly and installation under survey by the ABS Surveyor.

✠ APS-Symbol:

Indicate certification and survey of the Athwartships Positioning System (thrusters).

DLA-Symbol:

Indicates that the criteria for calculating and evaluating the behavior of the hull structure under dynamic loading conditions have been fulfilled in addition to full compliance with other requirements of the ABS Rules.

OMBO-Symbol:

Indicates compliance with the ABS requirements for One Man Bridge Operated vessels.

SH-Symbol:

Indicates that this oil carrier has been classed under the SafeHull provisions applicable to all tanker new construction in accordance with ABS Rules for Building and Classing Steel Vessels.

o Required Engineering Analysis

* DLA Analysis - As indicated by the notation above, the owners have chosen to apply the Dynamic Load Approach (DLA) Classification Designation to the subject vessel. The supporting DLA engineering analysis is to be performed in accordance with the ABS "Analysis Procedure Manual for the Dynamic Loading Approach (DLA) for Tankers." Standard ABS Rule analysis may also be carried out as well (either by ABS or the shipyard) to establish Rule minimums.

  The Advanced Analysis Department of ABS Americas will perform the seakeeping, stress evaluation and buckling analyses while the finite element models (entire ship 3-D and required 2-D fine mesh models) are to be provided by the shipyard.

o Other Engineering Analyses

Complementary to the structural analyses described above, the owners may elect to perform other additional optional analyses. These could include:

* Spectral Fatigue Analysis - The shipyard could perform this analysis followed by an ABS review.

* Hull and Superstructure Vibration and Noise Analysis - The shipyard could perform these analyses with ABS review of the results of the vibration analysis. IMO Resolution A.468(XII), Noise Levels Onboard Ships, has been adopted by most maritime nations.

* Thermal Stress Analysis - The shipyard could perform this analysis followed by an ABS review.

* Sloshing Analysis - ABS could independently perform this analysis.

(e) Project Management

Classification societies employ a variety of project management techniques to satisfy the clients needs as well as provide for the internal control of projects. Generally, most societies encourage at least one initial project meeting to discuss the project, any peculiarities or pertinent issues, and the requirements that relate to the intended flag state for the vessel construction. Another important initial milestone is the review of the construction specifications.

Det Norske Veritas was the first society to start providing a formal written project management plan for each individual project. The American Bureau of Shipping will provide clients a similar plan as an optional feature. These plans start with a written description of the scope of work for classification. Such documents include the classification and notations to be made in the vessel record, statutory certifications to be made, issuance of certificates, project management and organization, quality control and record keeping, plan approval and procedures, and certification of material and components. Also, flowcharts are included showing the various stages of project, milestones, related meetings, status reports and follow-up, and delivery with the issuance of certificates. The Det Norske Veritas documentation includes a listing of all the equipment and material certificates that must be submitted for the particular project. Similarly, a list of documentation requirements is provided for the project that shows necessary documentation requirements, which may be a drawing, element of a drawing, or other documentation necessary to support the design. In a sense, this list is similar to the standard distribution of plans list showing regulatory submissions prepared by most shipyards. As the project proceeds, Det Norske Veritas also issues a Quality Assurance Manual pertinent to the project.

The American Bureau of Shipping employs similar procedures for internal control. A Project Manager is assigned to each project to provide coordination and a point of contact for all inquiries by the client. As agreed with the client, the Project Manager compiles and makes progress reports detailing project status. On project completion, a final report is prepared. The Project Manager will also invite the client to comment on where services were or were not effective to provide management with the customer's perspective.

Within the American Bureau of Shipping, plan review and approval is controlled by a well documented Quality Assurance System. All plans are processed and reviewed in accordance with this system. The process begins with logging the

received plans into a plan tracking system. The Project Manager splits plan submissions that require broader distribution and assigns qualified engineers to conduct the review work. Each engineer assigned to carry out a review performs a cursory review of the plans to evaluate submittal completeness. If the information is incomplete, the submitter is advised regarding deficiencies. The review of the plans is then scheduled and the completion goal is normally in four weeks. If the resources cannot be made available to meet the client's requirements, the client is contacted to renegotiate an acceptable reply date. Clients are provided an acknowledgement letter for each submission showing its receipt, what information is missing as applicable, and the point of contact. In the case of split submissions, separate acknowledgement letters are prepared. The review is conducted in accordance with ABS's internal quality assurance procedures and appropriate check-off sheets are used to document the review work. Finally, the review letter is prepared showing pertinent comments and copies of the stamped plans are returned to the client for record purposes.

(f) Guidance on Approval Procedures, Plan Review, and Interpretation of Requirements

References are available that help explain approval procedures, requirements, interpretations, and plan approval requirements and procedures. While many of these documents are domestic, they often contain information generally applicable to international practices. Several of these documents are listed below for reference. Older Navigation and Vessel Inspection Circulars (NVICs) are now available on CD-ROM. The National Maritime Center has a Home Page with items of current information and several reference documents are or will be made available on-line.

- USCG Navigation and Vessel Inspection Circulars (NVICs):

  NVIC 0-96, Index of Navigation and Vessel Inspection Circulars (NVICs)

  NVIC 4-94, Elimination of Coast Guard Plan Review for Non-Critical Engineering Systems and Cargo Barges

  NVIC 8-84, Recommendations for the Submittal of Merchant Vessel Plans and Specifications

  NVIC 2-89, Guide for Electrical Installations on Merchant Vessels and

Mobile Offshore Drilling Units

NVIC 6-80, Guide to Structural Fire Protection Aboard Merchant Vessels

NVIC 6-72, Guide to Fixed Fire-Fighting Equipment Aboard Merchant Vessels; Chg. 1 regarding the use of halon systems is no longer valid

NVIC 6-94, Guidance for Issuing International Oil Pollution Prevention (IOPP) Certificates under Annex I of the International Convention for the Prevention of Pollution from Ships, 1973, as modified by the Protocol of 1978 relating thereto (MARPOL 73/78) (Chg. 1)

NVIC 11-93, Applicability of Tonnage Measurement Systems to U.S. Flag Vessels (Chg. 1)

NVIC 2-95, U.S. Coast Guard's ABS Based Alternative Compliance Program

NVIC 10-92, Coast Guard Recognition of Registered Professional Engineer Certification for Compliance with Coast Guard Requirements (Chg. 1)

NVIC 8-86, Coast Guard Relationships with Classification Societies for U.S. Flag Vessels

NVIC 10-82, Acceptance of Plan Review and Inspection Tasks Performed by the American Bureau of Shipping for New Construction or Major Modifications of U.S. Flag Vessels (Chg. 2)

NVIC 4-93, Subdivision and Damage Stability of Dry Cargo Vessels

NVIC 2-94, Guidance Regarding Voluntary Compliance with the International Management Code for the Safe Operation of Ships and for Pollution Prevention

NVIC 3-94, International Maritime Organization Code for the Safe Carriage of Irradiated Nuclear Fuel, Plutonium and High-Level Radioactive Wastes in Flasks on Board Ships (IMO Resolution A.748(18))

NVIC 5-94, Requirements for Vessels Carrying Bulk Grain Cargo

NVIC 7-94, Guidance on the Passenger Vessel Safety Act of 1993

NVIC 6-95, Maneuvering Standards

NVIC 8-95, Issuance of International Form Required by The STCW to Validate Merchant Mariner Licenses and Documents

- Marine Safety Manual as follows:

USCG Marine Safety Manual, Volume I, Admin./Mgmt. (COMDT INST M16000.9) through Chg. 9

USCG Marine Safety Manual, Volume II, Material Insp. (COMDT INST M16000.9) through Chg. 9

USCG Marine Safety Manual, Volume IV, Technical (COMDT INST M16000.9) through Chg. 2

- Guidance Documents:

United States Coast Guard "Equipment Lists -- Items Approved, Certified or Accepted under Marine Inspection and Navigation Laws", COMDTINST M16714.3E, 15 May 1994 (information on new equipment approvals can be obtained from the local Marine Safety Office)

United States Coast Guard "Load Line Technical Manual" by the American Bureau of Shipping, December 1990

United States Coast Guard SOLAS Guidance Document, Chapter II-2, Parts A and B (Including 1991 Amendments)

NSRP Project 6-93-1 Final Report, "Evaluation of U.S. and International Marine Engineering Standards for Acceptability in U.S. Flag Vessel Applications", December 31, 1994.

ABS's "U.S. Supplement to ABS Rules for Steel Vessels for Vessels on International Voyages", 12 January 1995

ABS Marine Services "Marine Management Supplement"

Working documents of the Sub-Committee on Fire Protection's Working Group on Interpretations of SOLAS 74, Chapter II-2.

Working documents of the Sub-Committee on Fire Protection's Working Group developing the "Code of Fire Test Procedures" that should become mandatory in the 1998 SOLAS amendments

Working documents of the Sub-Committee on Ship Design and Equipment to move the lifesaving appliance requirements from SOLAS to a Lifesaving Appliances Code that should become mandatory in the 1998 SOLAS amendments

USCG Marine Safety Center guidance materials in the form of Merchant Marine Technical Notes

Ship Safety and Pollution Prevention: Ship Management and Port State Control (1992 edition), English, IMO-549E out of print; Resolutions A.680(17) and A.68(17) contained in this publication have been revoked by A.741(18) [ISM Code: see IMO-186E on page 8] and A.742(18).

Code on Intact Stability for All Types of Ships Covered by IMO Instruments, English, IMO-847E (replaces IMO-832E)

GMDSS Handbook (1995 edition); This edition includes amendments up to May 1995 and is published in two forms, as a new 1995 edition and as separate unbound pages to replace the pages of the 1992 edition.

The IMO-VEGA Database (version 3.0)
Version 3.0 adds further important texts, including:

* STCW 1995 Amendments and the 1995 STCW Code
* International Code of Safety for High-Speed Craft (HSC Code)
* 1994 Code of Safe Practice for Solid Bulk Cargoes (BC Code)
* Amendments to SOLAS and MARPOL up to 1995
* More IMO Assembly, MSC and MEPC resolutions and requirements of Panama have also been included in part 2

Lloyd's Register Rulefinder (LR Rules & international requirements)

Lloyd's Register Special Service Craft Rules Package (Class Rules & international requirements)

o Current News Sources & Web Pages:

Marine Safety Newsletter (from the USCG National Maritime Center (NMC))

America Online National Maritime Center Homepage
http://www.dot.gov/dotingo/uscg/hq/g-m/gmhome.htm

USCG Port State Control Information
http://www.dot.gov/dotinfo/uscg/hg/g-m/psc/psc.htm

USCG Proceedings

IMO Newsletter

IMO Publications Catalogue Online
http:\\www.imo.org

IEC Bulletin (News from the International Electrotechnical Commission)

IEC Web Site
http://www.iec.ch

ISO Bulletin (Standardization news, etc.)

Marine Safety Report by the Stamler Publishing Company, phone (800) 422-4121

United States Technical Advisory Group ISO/TC-8 Newsletter

ASTM Web Site
http://www. astm.org
http://www.astm.org/dsearch.htm
(titles and scope of ASTM standards)
National Technical Information Service Web Site
http://www.fedworld.gov/ntis/ntishome.html

Maritime Legal Resources Web Site
http://www.marlegal.com

3.3 Definitions (Generally taken from ISO/IEC Guides)

- Administration - The maritime agency of the Government of the State whose flag the ship is entitled to fly.

- Delegation of Statutory Authority - A formal, mutually agreeable, document or contract whereby an Administration recognizes an organization to provide statutory certification on its behalf.

- Regulation - As used for international purposes, refers to international regulations which an Administration adopts/implements, principally through the forum of the International Maritime Organization (IMO) and, in limited cases, through the International Labor Organization (ILO). International regulation takes the form of a diplomatic Convention or an IMO Resolution, which is usually a non-binding document on member states (see "Resolution").

- Convention - Is an international treaty, that becomes binding, when a State signs a contract (i.e., becomes signatory) and is, therefore, legally obligated to give effect to the Convention's provisions and requirements. The most common Conventions used by maritime nations include SOLAS 74 as amended, MARPOL 73/78, 1966 ICLL, and 1969 Tonnage.

- Resolution - Is a non-binding document, recommendatory in nature. It contains text that "invites" or "urges" States to apply the set of standards contained within the Resolution. As such, specific Instructions from an Administration are necessary in order to determine the applicability of the Resolution's requirements. If the Resolution amends a Convention, then after a certain period of time the Resolution becomes mandatory and therefore equivalent to a Convention, unless before such time, a sufficient number of member States formally reject it. The most common Resolutions used include the 1979 and 1989 IMO MODU Codes, IGC Code, IBC Code, BCH Code and IMDG Codes. Several of these Codes have been made mandatory by other Resolutions that have amended existing Conventions.

  Implementation of non-mandatory resolutions is not uniform. Some

Administrations impose certain resolutions while other Administrations do not require compliance with the same resolutions. See Appendix 6.2 for a list of Assembly Resolutions and the IMO Booklet listing effective resolutions. This later index contains a broad listing including MSC and MEPC resolutions and circulars, some of which are mandatory.

o Categories of Communication

Three levels of communication are used to describe communications and designating responsibilities relative to a classification society's interface with an Administration:

* Instructions - Are considered the highest level of the communication categories. They constitute an Administration's written statement of policy or procedure concerning the implementation and application of Conventions, Codes and Regulations together with decisions rendered relative to exemptions to the Regulations.

* Interpretations - Are specific written decisions that are rendered by an Administration regarding the intent of Regulations. An interpretation clarifies a Regulation and is generally not solely applicable to a specific vessel, piece of equipment, or system/arrangement. Interpretations most commonly clarify qualifying text, such as "sufficient", "suitable", "effective", "satisfactory", "adequate", "equivalent" etc., so as to provide for a quantitative basis for evaluation.

* Advice - Is a communication that is neither an Interpretation nor an Instruction and, therefore, does not address the intent of a Regulation. This category of communication is used to relay established, factual information (such as a Regulation's applicability, relaying of established instructions or interpretations) to facilitate the completion of classification society responsibilities and services. Periodic reporting and notification of vessel-specific class/statutory information (such as survey, certificate status, temporary variances or interim corrective measures to be effected) as is often required under the associated Delegation of Authority, are considered Advice.

o Conformity. The fulfillment by a product, or group of products, of all requirements specified.

- Descriptive provision. A provision for fitness for purpose that concerns the characteristics of a product in terms of design, construction, dimensions and materials.

- Design Analysis. A method of proven reliability to assess that safety and/or performance provisions of a specified standard are fulfilled.

- Design Review. Assessment of a product's relevant design drawings, catalogues, data sheets, design calculations, functional descriptions and test evidence against the descriptive and performance provisions of specified standards.

- Facility. The location where a product is manufactured or service provided as indicated in the quality system description (quality manual), when applicable. In some cases, where certain portions of the manufacturing process are sub-contracted, the sub-contractor's facility may be subject to audit.

- Fitness for purpose. The ability of a product to serve a defined purpose under specific conditions.

- Performance provision. A provision for fitness for purpose that concerns the behavior of a product in or related to use.

- Producer. The organization who either produced the product, abstracted it, or carried out the industrial or other process which gave it its essential attributable characteristics.

- Product. All goods produced either by abstraction, manufacture or a natural, industrial or other process, and includes a product which is comprised in another product, whether by virtue of being a component part, raw material, or otherwise.

  For the purpose of Type Approval, the term product can include a line or group of products produced to the same specified standard(s).

- Product Standard. A document, established by consensus by a recognized body, that specifies the requirements to be fulfilled by a product, or group of products, to establish its fitness for purpose.

- Type Approval Certificate. A document issued under established procedures indicating that adequate confidence is provided that a duly identified product, or group of products, is in conformity with a specific product standard or other

accepted document.

- o Type Testing. A method under which a sample of a product or group of products is tested in order to assess whether the performance provisions of a specified standard are fulfilled, either directly or by simulation of the influencing conditions that may occur in service.

3.4 Product Approval/Acceptance Systems

(a) Background

In terms of broad safety issues, Johnson (2) suggests that there are five levels of safety programs in use today:

1. Less than minimal compliance with regulations.

2. Minimal compliance with enforced regulations.

3. Application of manuals and standards such as the National Safety Council's Accident Prevention Manual for Industrial Operators.

4. Advanced safety programming exemplified by the Nuclear Regulatory Commission and the chemical and petroleum industries.

5. System safety programs, such as those specified by NASA and the military (or the safety system presented by Johnson).

The maritime industry, for the most part, has operated on the second level above, with occasional use of higher or lower level programs. A few designs, such as floating nuclear power plants, barges for transport of nuclear materials, and nuclear-powered vessels, because of special hazards and because applicable regulations did not exist, have had safety programs approaching levels 4 or 5. Also, the design of nuclear submarines has incorporated use of system safety techniques. [3] Other examples include Eberly's (3) assessment of fire risks in open top container holds to support the design of adequate fire safety systems. More recently, the U.S. Coast Guard has embarked on using such techniques through its

[3] Duregger, Leon, and Sample (4) give an excellent description of many of these techniques and their application in the SSN 688 System Safety Program.

developing MSTEP program (Marine SafeTy Evaluation Program) to assess and develop safety criteria for shipboard systems. These techniques have the potential to place specific requirements in a broader safety perspective and to create a system model that will improve with the collection of data.

(b) System Types

A variety of acceptance systems and concepts have been developed to support the use of equipment, components, and materials. The various types of certificates used by classification societies were previously mentioned in paragraph 3.2 (c), but a broader array of acceptance systems exists (i.e., self certification, third party approvals, laboratory approval under recognized listing and labelling systems, plan review and approval, classification society type approval, etc.).

At the most basic level, the acceptance of many products is merely to ensure that their use in a system requiring plan review is suitable. A classic example of this is the review of most piping systems. After the review of such systems for design and arrangement requirements, the bill of materials is normally reviewed to ensure that each component selected is suitable for use in that system.

o Products Not Complying with a Standard (Non-standard Products)

If an unfamiliar component is encountered, it is normal to review its safe use in that system considering at least the following:

* Performance with a view to safety
* Failsafe provisions and failure modes
* Additional safety measures
* Reliability
* Adequate mechanical strength
* Material properties and process of manufacture
* Testing requirements as related to safety
* Past history of the product including successes and failures

Thus, it is common to evaluate all the major characteristics of such items such as construction, environmental criteria, performance rating, pressure rating, temperature rating, material composition, protection, testing, etc., as applicable, to establish the safety, reliability, and fitness for the

intended service.

o Products Complying with a Standard (Standard Products)

When a component in such a system meets a national or industry standard, acceptance of the component is based on reviewing its ratings for use in the particular system. Acceptance based on the producer's compliance with a standard is generally classed as a self certification system -- the producer is certifying that the product conforms to an acceptable standard. These standards usually address the issues mentioned above for products not complying with a standard (non-standard products).

o Third Party Approval Systems

Third party approval systems are available in a variety of forms. Continuing with examples for piping systems, components like boilers and pressure vessels, due to their inherently hazardous nature from stored energy, normally require approval under a third party system. The ASME Boiler and Pressure Vessel Code provides the framework for such certifications. In domestic applications, certification by a National Board Inspector and a professional engineer under the additional provisions of the USCG regulations is sufficient for compliance.

In third party systems, the essential element is that a qualified neutral party, who is independent of the producer and the purchaser, makes the certification. Another example of these systems is the listing and labeling systems of accredited laboratories. In most cases, such laboratories have a published or internal standard that they utilize to evaluate and test the products. These standards normally contain both construction and performance requirements. Domestically, Underwriters Lab (UL) is perhaps the best known laboratory providing these services, particularly for electrical equipment. However, many other recognized laboratories provide product certification services, domestically and internationally.

The classification of ships under published rules and regulations is also a third party system. These rules, guidance materials, and other technical publications often impose additional requirements on important equipment, components, and materials. The classification societies have established their own systems and corresponding certificates to show conformity with these requirements. It is also common for shipowners to

desire additional equipment certifications beyond the minimum requirements stated in the rules. In such cases, the classification societies will issue the desired testing reports or testing certificates just as they would if their rules had required the certifications.

o Type Approval as a Third Party System

For products requiring plan review or specific acceptance under a classification society's rules, guides, or other technical publications, the producers often seek type approval of their products to assure purchasers of their acceptability. Under these design review and certification procedures, the producer submits the required information in accordance with the rules.

This data often includes the following as applicable:

* Calculations (mechanical, electrical, etc.)
* Test Reports (prototype, burst, pressure, electrical, etc.)
* Environmental criteria (automation)
* Component qualification (automation)
* Manufacturer's inspection and acceptance procedures
* Design standard or manufacturer's production standard

In cases where plan review of the shipboard installation is required, such as with switchboards, the plans showing the installation on a particular ship are still required. However, the review of such plans is generally limited to the equipment's arrangement and interconnection with other equipment.

In the above example, the classification society equipment type approval process has taken a general plan approval procedure, which is usually only a case-by-case approval, and has converted it to a general acceptance with a recognized pre-approval of the equipment. Thus, this is an example of the overlap between the general procedures for plan review of important shipboard systems and the requirements for the acceptance of equipment. It again demonstrates the concept that the detailed review (which can also be a case-by-case review) of most products is based on the requirement to determine the performance or acceptability of a shipboard system.

In the international market, the most common application of the various classification society type approval systems is for emergency equipment such as lifesaving appliances and other types of equipment required under treaties like SOLAS and MARPOL. Most countries signatory to these treaties delegate these duties to the classification societies. Sometimes, these countries impose different requirements for prototype testing or materials. To help promote reciprocity between countries, the IMO Subcommittee on Ship Design and Equipment is working to standardize the format for test reports and other required documentation.

(c) Classification Society Systems

Each classification society has a variety of approval/acceptance systems that address marine products applicable to shipboard installations. While the basic systems are generally similar, there are subtle differences relating to design standards or requirements, certification periods, audits, and other procedures. Using the ABS product certification systems as an example of these approval/acceptance systems, the following descriptions are provided:

o ABS Material, Machinery and Equipment Certification (MMEC) Program

This program is designed for the approval of products normally requiring Surveyor attendance during testing under the ABS Rules and higher level quality assurance systems (i.e., Levels I and II are under this program while Level III is used with the type approval program). Under this program, the witnessing of tests may be waived for the following products:

* Diesel Engines, Reduction Gears, Gas Turbines, Turbochargers and Electrical Machinery
* Crankshafts
* Rolled Steel Products (from a manufacturing facility)
* Wrought Aluminum Products (from a manufacturing facility)
* Castings and Forgings
* Container Corner Castings and Refrigeration Machinery and Compressors
* Welding Consumables
* Fiberglass Laminate Material

However, this program cannot be used to waive the witnessing of tests for the following applications -- acrylic viewing ports, mooring chain, secondary sources of materials and equipment, and shipyard hull or offshore construction.

The producer has the choice of seeking certification under one of two quality levels as follows:

* Level I - ISO 9000 (Quality Management) Certification

  The Quality documentation is reviewed and the assessment performed in accordance with ISO 9000 requirements. The Quality Assessment is performed by an ABS auditor in accordance with relevant registration (accreditation) body requirements.

* Level II - Quality Assurance Certification

  Quality documentation is reviewed to a recognized quality standard (i.e., ASME, BSI, ASQC, etc.). The Quality audit is performed by an ABS Surveyor who is certified to conduct audits in accordance with the applicable ABS work instructions.

The facility seeking certification submits its quality manual (prepared along the lines of a standard such as ASQC Z1.15, BS 5750, ISO 9000, MIL-STD 9858A, NS 5801, etc.) along with the necessary product technical data for review by ABS. Following a satisfactory review of the data and manual, an initial quality audit of the facility will be conducted by ABS.

Facilities which demonstrate that they have established and implemented a systematic quality program can have their quality system certified by ABS under the MMEC Program. Generally, for products to be covered under this certification, design approval by the appropriate ABS technical office is also required.

The initial audit will be conducted by an ABS Surveyor from the local ABS port office or other approved ABS representative. If the results are satisfactory, a Quality Assurance Certificate valid for three years will be issued by ABS. Following the initial audit, the local Surveyor will conduct periodic audits on a semi-annual (2 times per year) basis. More frequent

periodic audits may be necessary depending on the nature and volume of production and on non-conformance's discovered during the audits. Renewal of the certification requires a renewal audit at the end of the certificate validity period. Audit non-compliance's are to be corrected within the time period specified by ABS in order to maintain certification.

A new catalog showing approvals under this program should be published in 1996. In the meantime, the local ABS office or ABS Americas in Houston, Texas can provide information about steel mills or other approvals under this program.

ABS publishes annually a list of its approved welding consumables. The book entitled Approved Welding Consumables contains an index of manufacturers by country, listings by type of electrode, requirements for approval of filler metals, use of filler metals meeting AWS Specifications, guidance on application to ABS steels, and a comparison chart of ABS-AWS filler metals.

o ABS Type Approval Program

(1) Introduction (5)

This program is designed for the approval of a broad range of marine products and is particularly effective for small or mass produced products. It generally simplifies the certification of equipment and components. Acceptance into the program is based on a design review of the product and plant surveys that include a quality assessment under a Level III - Quality Control System and annual production visits. The advantages of certification under this system include:

* Wider recognition and product acceptance on a worldwide basis.

* Local surveyor attendance based on the nearest ABS port office.

* Listing in ABS's annual List of Type Approved Equipment.

* Streamlines design review process (versus case-by-case review) for equipment which requires survey during manufacture or individual certification under ABS Rules.

* Confidentiality of the design.

* Optional certification to USCG requirements and corresponding listing notation.

* Optional upgrading of quality assessment from a Level III system to ISO 9000 certification is available.

(2) Significance

Type Approval is a program created by ABS to provide certification of standardized or mass produced marine equipment, components and other products. ABS Type Approval certification is based on design review, prototype testing and annual surveys of the manufacturing facility. It is a worldwide program offered by local ABS ports and technical offices and administered by the Coordinator of ABS Programs in the Houston, Texas office of ABS Americas.

Shipyards and outfitters benefit from Type Approval Certification because it enables them to identify products that conform to an acceptable industry standard or have undergone satisfactory engineering analysis by ABS. For example, once a valve line is approved, models will not need to be individually inspected and approved prior to being placed on board a vessel. The ABS List of Type Approved Equipment provides not only a listing of equipment acceptable to ABS, but also an efficient means of showing supplementary quality audits to a vendor's own program.

For owners and operators, the benefits are time and security. The Type Approval program gives them a means of procuring a consistent product that will not need to be individually inspected and approved prior to being placed on board a vessel.

The program can benefit manufacturers, suppliers, owners, operators and anyone else involved in the specification, use or

procurement of marine components and products. From the manufacturer's point of view, the Type Approval Certificate and subsequent inclusion in the annual ABS List of Type Approved Equipment will aid product marketing. Further, having a product type-approved can eliminate the time and expense necessary for case-by-case product approvals by ABS. On top of it all, the program tells potential purchasers the product has met a known standard of quality.

A further benefit to manufacturers is that Type Approval quality certification can be used as a first step towards ISO-9000 certification - the widely recognized standard for quality management and quality assurance. This can be done through the ABS affiliate, ABS Quality Evaluations, Inc.

(3) The Type Approval Process

A prospective client begins the type approval process with an application form, available at any ABS office. The form requests pertinent information about the product and manufacturer, including details on the standards to which the product is designed and manufactured. The standards listed on the application become the basis of the technical review which will be performed by ABS. Depending upon the product, these may be industry or government standards, ABS Rules or, if no other standards exist, manufacturer's standards. The completed application form and supporting documentation are then submitted to either the local ABS office or directly to a divisional office, along with three copies of any necessary drawings, documentation, test data, etc. (ABS returns one copy of the approved and stamped plans and documentation to the client after completion of the entire type approval process. The other two copies are maintained by the responsible ABS port office and the ABS technical office that performed the review.)

Upon receipt, the completed application package is reviewed for completeness and forwarded to the appropriate ABS technical office. The engineer assigned to the review ensures that the product is designed to the stated standard and verifies ratings, intended service and any service restrictions, while also noting any additional comments relevant to the design review. The assigned

engineer will inform the client if any further information, documentation or testing is required prior to approval. When the design review is completed, the assigned engineer informs by letter both the client and the local ABS port office that the client has be "design review approved" and is ready for a plant survey. The engineer's letter includes the approval wording as it will eventually appear on the Type Approved Certificate. The wording will reference the following:

* Make/Model
* Intended Service
* Description
* Ratings
* Standards
* Service Restrictions
* Comments

Upon receipt of the design approval letter, the plant survey is scheduled by the responsible ABS port office and the client. The plant survey consists of two parts, usually performed by the surveyor during a single visit. As part of ABS's Quality System, the plant survey is performed following a series of check sheets designed to ensure continuity and completeness of the survey visit.

The first part of the survey focuses on the production facility and the procedures and methods used during the manufacturing process. The surveyor will be looking for specific work instructions, procedures and testing at the different phases of the manufacturing process. Any additional testing or witnessing specified in the design review approval letter will also be carried out at this time.

The second part of the plant survey focuses on the quality system in place at the facility. ABS Type Approval is carried out using a standard quality checklist addressing the following areas (a detailed listing of these requirements is provided in the next Section):

* Management
* Receiving Inspection
* Manufacturing Inspection

* Final Inspection
* Testing
* Metrology
* Qualifications
* Drawing/Documentation Control
* Record Keeping

Due to the wide range of products and manufacturing facilities in the Type Approval program, some items on the checklists will not be applicable to all producers. The checklists, therefore, give the surveyor ample room for comments regarding alternate or equivalent quality arrangements that meet the intent of the checklist without meeting the specific wording of each item.

Upon successful completion of the plant survey and all required testing, the client becomes eligible for inclusion in the ABS List of Type Approved Equipment and the associated data base and files maintained in Houston. The responsible ABS port office then issues the client a certificate, valid for five years subject to annual plant surveys. Attached to the certificate will be information on the specific products or models that are type approved by ABS.

Changes to a type approved product line, such as new models added or existing models modified, may require new certificates, depending on the change. Alterations can sometimes be made to the attachments without generating new certificates. Additional design review requirements for accepted products are absolutely necessary in the following cases:

* A change in design or materials;
* A change in standards;
* A change in ratings or intended service;
* The use of certain control and automation equipment, which requires retesting every five years.

The ABS List of Type Approved Equipment is arranged alphabetically by manufacturer and indexed alphabetically by product. This allows for efficient searches for products by either manufacturer or product. The wording incorporated into each client's listing is the same as that on the certificate and attachment

received by the client. This publication is intended to be published and distributed annually, early in the calendar year.

Virtually any marine product may be included in the Type Approval program. Although certain products that require individual testing, witnessing, or surveyor attendance according to the ABS Rules are eligible for inclusion in the program, they do not have any of the Rules requirements waived. Traditional marine products and components such as valves, circuit breakers, control systems and pumps are found in the ABS List of Type Approved Equipment alongside such products as coatings, decking material and fire protection/ detection systems. As third party certification of products continues to be required by owners, operators and administrative bodies, the value of having a product type approved by ABS will continue to increase.

(4) USCG Approvals.

In 1993, ABS was authorized by the USCG to grant type approval on its behalf. This authorization was applicable to products reviewed in the U.S. and excluded certain safety and lifesaving equipment. Products submitted for this particular kind of review must employ a standard acceptable to the USCG. An additional notation on the certificate and in the ABS List of Type Approved Equipment indicates approval on behalf of the USCG.

ABS was authorized in 1995 by the USCG to approve lifesaving, fire-protection and pollution-prevention equipment required to be placed on commercial ships operating in U.S. waters in accordance with 46CFR Subchapter Q. The new approval program is similar to the existing ABS Type Approval program. It is based upon design review, prototype testing and annual surveys of the manufacturing facility.

Manufacturers of lifesaving, fire-protection and pollution-prevention equipment that successfully complete the program's requirements will receive approvals and certificates from both ABS and USCG. Additionally, a special notation will accompany the manufacturer's entry in the annual ABS List of Type Approved Equipment.

In developing the new approval program, ABS and the USCG will work closely together to ensure consistency and establish responsibilities. Later, it is foreseen that the USCG's active involvement will diminish to an oversight rule.

Much of the lifesaving, fire-protection and pollution-prevention equipment specified under Subchapter Q is also required under the provisions of SOLAS and MARPOL. ABS will thus be able to act as a single point of contact for ABS approvals that may be requested in accordance with these two international conventions as well as USCG approval under Subchapter Q.

(5) Level III Quality Control System Requirements

All of the requirements listed are "as applicable" to the product being manufactured.

1.0 Management

* There should be some type of written documentation, detailing to the extent necessary, what the quality system includes as far as controls. This should basically outline and describe the system structure.

* The standard of manufacture and compliance should be described. For example, is the equipment made to some industry standard, in accordance with ABS Rules or simply to a manufacturer's standard.

* A company's management structure should be set up to preclude those responsible for production from also being responsible for quality control or assurance.

* Internal audits should be made of the inspection and test process, and its documentation. These should be performed at least annually and should be done by someone independent of the operation.

2.0 Receiving Inspection

* The company should have procedures for inspection of incoming material and items which are to be used in the manufacturing process for the type approval item. The type of inspection should be specified in these procedures such as sampling or 100%.

* Certificates of incoming material or products should be reviewed and checked prior to being released into the manufacturing system.

* Incoming material should be evaluated and non-conforming material should be identified and/or segregated.

* The company should have an approved vendors list and a system for qualifying these vendors.

* The company should have a procedure for checking the supplier's test reports for conformance of specifications.

3.0 Manufacturing Inspection

* The company should have procedures available at the necessary work locations detailing what inspections are to be performed and, to the degree required, how the inspection is to be done.

* Records of inspections should be maintained.

* The company should have procedures for handling non-conforming product identified during the manufacturing process. There should also be procedures for the accept/reject criteria as well as who has the authority for making this decision.

* The company should have documented procedures for special processes such as heat treating.

* The company should have procedures for welding, qualifying welders, and control of welding electrodes.

4.0 Assembly Inspection

* The company should have procedures to ensure the build orders or assembly instructions are adequate for part identification during assembly.

* The company should identify the critical inspection points and ensure these inspections are performed and records are maintained.

5.0 Final Inspection

* The company should have procedures for inspection and test to ensure the product conforms to the specifications and to verify that all required inspections have been performed.

* The company should establish some type of product identification for traceability.

* The company should have procedures controlling the packaging and identification for shipping.

* The company should have procedures controlling the warehousing and storage of stock material pending delivery.

6.0 Testing

* The company should be written procedures to control any testing required.

* The company should have written procedures addressing the sampling process for testing. For example, each unit or a sample size.

* The company should have procedures for review of testing by either engineering or QA.

7.0 Metrology

* The company should have procedures to ensure inspection and test gauges are calibrated on a regular basis.

* Laboratory test machines should be calibrated on a regular basis.

* Heat treating furnaces should be calibrated on a regular basis.

8.0 Qualifications and Training

* The company should have procedures to ensure operators and technicians are properly trained and qualified.

9.0 Drawing and Documentation Control

* The company should have an effective system for distributing documents which relate to engineering, manufacturing, assembly, inspection and testing.

* The company should have procedures to ensure obsolete or superseded documents are not being used in the process.

* The company should have a written procedure for submitting revisions to approved documents to ABS for approval.

* A company should have procedures for notifying ABS when deviations from the approved specifications are allowed or necessary.

10.0 Record Keeping

* The company should have procedures controlling the maintenance and retention of inspection and test records.

o Other ABS Approval Systems

In addition to the product approval systems mentioned above, the

American Bureau of Shipping has several other special approval systems. These systems are specifically documented in ABS's Quality System Manual with pertinent Procedures and Process Instructions. These systems include:

* Approval of steel mills to produce ABS graded steel.

* Approval of tailshaft facilities to carry out welding repairs to tailshafts and stern tube shafts.

* Approval of tailshaft facilities to carry out cladding of tailshafts and stern tube shafts.

* Approval of chain manufacturers to produce ABS grades 2 and 3 ship anchor chain.

* Approval of chain manufacturers to produce ABS grades of offshore mooring chain.

* Other systems as listed in ABS Guides such as the certification of cranes or shipboard elevators.

CHAPTER 4 - PRODUCT ACCEPTANCE CRITERIA

4.1 General Product Requirements

(a) Introduction

The purpose of this chapter is to provide a reference source for shipyard designers to determine the applicable product requirements for commercial vessels being designed, particularly for products in the thirteen prioritized equipment categories which were analyzed in earlier projects. The previous chapters provided general background on the role and types of standards and standards-setting organizations, classification societies, and the various general approval and acceptance processes. These processes include statutory certification, domestic processes, and classification society processes and procedures including first and third party approval systems, case-by-case approvals, and various type approval systems.

This chapter presents general considerations for functional product groupings and specific requirements for representative product categories. The general requirements are introduced below with a summary of the work undertaken in NSRP Project No. 6-93-1. The remainder of the general section includes a listing of products generally subject to some approval or acceptance procedures, discussion of the IACS unified requirements, and some general guidance on international marine products.

The remainder of the chapter is devoted to discussion of specific product categories arranged in functional groupings. Each product category typically includes a general summary of requirements, a review of the work performed in NSRP Project No. 6-93-1, presentation of the ABS requirements, and a review of the USCG domestic requirements based on the regulations in 46 CFR.

(b) Background (from NSRP Project No. 6-93-1)

As discussed in the last chapter, not all products require regulatory or classification society acceptance. Those products that are subject to acceptance procedures are usually part of a shipboard system that requires plan review. The categories of such products are usually divided along functional lines into marine engineering products, electrical engineering products, or safety and environmental

products (which normally require type approval).

NSRP Project No. 6-93-1 examined a number of prioritized equipment categories to document USCG acceptance procedures and the comparability of domestic and international standards. This project will examine the classification society requirements for these categories more closely to establish the procedures and criteria necessary for use in construction projects under the requirements of other Flag Administrations (i.e., worldwide acceptance criteria, particularly for American Bureau of Shipping acceptance).

The results of NSRP Project 6-93-1 are briefly summarized in Table 4-1 below. The table utilizes the following columns to present information:

- Category. The type of product analyzed.

- Standards. The type of international or national standards examined --

  ISO - standards from the International Standards Organization

  IEC - standards from the International Electrotechnical Commission

  IMO - regulations from the International Maritime Organization

  DIN - standards from the Deutsches Institute for Normung (Germany)

  JIS - Japanese Industrial Standards printed by the Japanese Standards Association (JSA)

  Class Soc. - classification society requirements

TABLE 4-1 SUMMARY OF STANDARD ANALYSES (from NSRP Project 6-93-1)

Category	Standards Analyzed	Type Int.	Type Dom.	Cert. System	Eval. Basis	P.E. Cert.	Comment
Valves Rating	ISO,JIS,DIN	C	C	1	Equiv.	P.E.	Flange
Flanges Case,	ISO, DIN	C	C	1	Policy	Guide	Worst
Plastic Pipe	IMO	P	B	3/1	Policy & Testing	Guide	P.E. Test Program
Fire Dampers/ Fire Doors	IMO, ISO JIS, DIN	B	B	1+	Equiv.	P.E.	New ISO Damper Std.
Electric Cable	DIN	C	B	1	Equiv.	P.E.	Fire Test
Panel Boards	IEC, JIS	P	B	1+	Testing	Guide	IP Code
Transformers Safety	IEC	C	P	1+	Equiv.	P.E.	System
Cir. Breakers	IEC	B	B	1+	Equiv.	Guide	Rating/Short Circuit
Switchboards	IEC	C	C	1+	Equiv.	Guide	Plan Review
Generators	IEC, Class Soc.	C	C	1+	Equiv.	P.E.	Amb. Temp.
Motors/ Controllers	IEC	C	C	1+	Equiv.	P.E.	Amb. Temp.
Lighting Fix.	IEC, JIS	P	B	1+	Testing	Guide	IP Code
Automation	IEC, Class Soc.	P	P	1+	Perform.	Self Cert	Safety Analysis, Equip.Stds.

- Type. Characterization of the type of international and domestic standards analyzed, each respectively characterized by --

  C - generally a construction standard
  P - generally a standard based on performance requirements
  B - standards contain both construction and performance requirements

- Certification System. Characterization of the type of domestic certification system for products in that particular category as follows (See section 3.4 (a) on System Types for further background) --

  1 - generally a self certification system by the producer certifying compliance with a recognized standard.

  1+ - generally a self certification system although third party systems are frequently used or implied (eg., UL standards are often adopted for electrical products, but either demonstration of compliance or utilizing the UL listing and labelling is acceptable).

  3 - generally a third party certification system.

- Evaluation Basis. The general basis for recommending the acceptance of the international standards analyzed based on comparison with domestic standards --

  Equiv. - the international standards analyzed are generally equivalent to the domestic standards

  Policy - policy or guidance material is necessary or would be helpful to purchasing products in this category from the international market

  Testing - Products may be accepted based on equivalent testing

  Perform. - Products or systems may be accepted based on demonstration of equivalent performance.

- P.E. This column is used to show whether, for the purposes of USCG plan approval for domestic acceptance, a professional engineer can certify the product or standard comparisons --

P.E. - a professional engineer or ABS personnel, operating within their area of expertise, can certify the review under NVIC 10-92, Change 1

Guide - additional policy or guidance material would be helpful in making such determinations.

Self Cert. - the regulations require a statement of certification by the producer of the system.

o Comment. This column is used to make brief comments about the standard analyses performed for the product category --

* Valve Category

Flange Rating - ABS has accepted all of the valve standards analyzed within their ratings based on a review of materials and body wall thicknesses. No comment was made about the corresponding proposed equivalent rating under domestic standards.

* Flange Category

Worst Case - guidance concurring that worst case application analysis is reasonable and acceptable would be helpful.

P.E. - professional certification is possible, but additional guidance would be helpful.

* Plastic Pipe

Test Program - a test program is needed identify acceptable piping materials, components, and fire stops. NSRP Project No. 8-95-1 will continue this work. Some manufacturers have begun to certify some materials under these standards.

* Fire Dampers/Fire Doors

New ISO Std. - a new ISO fire damper standard has been finalized and published. It should be evaluated to establish its acceptability.

* Electric Cable

Fire Test - acceptability of the DIN standards analyzed and other foreign cables is generally based on submission of suitable fire test results.

* Panel Boards and Lighting Fixtures

IP Code - acceptance of these products is generally based on the manufacturer's certification of compliance with the IP Code testing requirements and component coding appropriate to the location.

* Transformers

System Safety - transformers are primarily reviewed to insure that their application in a system is safe.

* Circuit Breakers

Rating/Short Circuit - circuit breakers are important safety devices. There acceptance is primarily based on the manufacturer's certification of suitable testing establishing ratings and short circuit characteristics for the required ambient temperature appropriate to the location.

* Switchboards

Plan Review - the acceptability of switchboards is primarily established by plan review. The combination of IEC standards and classification society requirements is generally acceptable for domestic approval.

* Generators and Motors/Controllers

Ambient Temperature - while the use of international standards is acceptable, ratings are generally based on ambient temperatures different than required for marine applications.

* Automation

Safety Analysis - while use of systems procured from the

international market is generally acceptable, the requirement for a safety analysis is generally unique to domestic requirements.

Equipment Stds. - the equipment used must conform to the environmental requirements stipulated for these products.

As noted above, since the completion of Project No. 6-93-1, the American Bureau of Shipping has reviewed the comparisons conducted under the valve category and accepted the standards analyzed. Additionally, ABS has extensively revised its electrical rules in the 1996 edition. This new edition has been written in terms of international standards, and therefore generally adopts the electrical standards comparisons performed in Project No. 6-93-1. In a similar fashion, the USCG has also revised Subchapter J, Electrical Engineering Regulations, to include acceptance of international standards.

In an effort to further describe typical approval processes, ABS has prepared the flow diagrams for representative processes shown in Appendix 6.2. In the process shown for plastic pipe, the diagram is based on the 1997 ABS Rules. These Rules have been updated to include the provisions of the pertinent IMO Resolution.

The database of acceptable standards and equipment developed in Project No. 6-93-1 has been incorporated in the "Standards Database" (26).

(c) Products Subject to Acceptance

As previously stated, products subject to regulatory or classification society acceptance are normally a part of a shipboard system that requires plan review. The degree of design review can vary widely, but normally includes checking that the system application of the product is appropriate, manufacturer's certification and marking (self certification) is adequate, or third party certification requirements are met.

Table 4-2 is a listing of hull and marine engineering, electrical engineering, and safety and environmental product categories that normally require some

degree of regulatory or classification society acceptance. The list is generally compiled from domestic and ABS requirements. It is normal for classification societies to expect that such components meet a recognized national standard. This list only provides basic citations and uses the cargo and miscellaneous vessel regulations as representative of all ship types.

When pursuing the requirements for a particular product, it is good practice to check the latest annual ABS List of Typed Approved Equipment for vendors with approved products. This list shows manufacturers, models, relevant data and restrictions, construction standards, compliance with USCG requirements, etc. Thus, this list can be a useful aid in finding pertinent standards and requirements. An additional source of such information is the new ABS Safe Net network, an on-line life-cycle ship management and information network.

Additionally, Table 1 of ASTM F 1547 contains an extensive list of standards and publications that pertain to marine applications. Where applicable, this list shows the citation for material incorporated into the regulations. The list is sub-divided into nine (9) generic groups.

TABLE 4-2

EQUIPMENT GENERALLY SUBJECT TO REGULATORY APPROVAL

HULL AND MARINE ENGINEERING EQUIPMENT AND OUTFITTING

CATEGORY	USCG 46 CFR CITE	ABS RULE CITE*
Air Compressors	Subpart 58.05	4/4.23.3, 4/11.3.10
Anchor Chain	Subpart 96.07	2/1.13, 3/22
Anchor Windlasses	Subpart 96.07	3/22.11
Anchors	Subpart 96.07	2/1.11, 3/22
Backflow Preventers	USPHS requirements	4/6.
Boilers, Auxiliary	Part 52 or 53	4/2, 4/4.41
Boilers, Exhaust Gas	52.25-20	4/2.
Boilers, Propulsion	Part 52	2/2.15
Boilers, Unfired	Part 52 or 54	4/2.
Cargo Gear and Cranes	Subpart 91.37	ABS Cargo Gear on Merchant Vessels & ABS Cranes
Cargo Handling Systems	Subparts 91.37 & 56.50	4/5B5, 4/6.75, 4/11.27, 4/B
Castings, Bronze	56.60-20	2/2.33
Castings, Ductible Iron	56.60-15	2/2.25, 2/2.31
Castings, Gray Iron	56.60-10	2/2.27
Castings, Hull Steel	92.01-10	2/1.7
Castings, Machinery Steel	Supart 58.05	2/2.3, 2/2.23
Cooler, Keel	Subpart 56.50	4/6.26.2
Couplings, Demountable	Subpart 58.05	4/7.31.4
Deck Covering Compositions	92.07-10	3/16.11
Distillers, Reverse Osmosis	Subpart 58.30	4/2.
Diving Support Systems	56.50-110	ABS Underwater Vehicles
Elevators	Subpart 58.30 & 111. 91-1	4/B, ABS Shipboard Elevators
Extinguisher, Portable	Subpart 95.50	4/9.17
Filler Metals	Subpart 56.70 & Part 57	2/B, 2/C
Filters, Oil	Subpart 56.15	4/4.31.2, 4/6.11
Fire Nozzles	Subpart 95.10	4/9.9.4
Fireman's Outfit	Subpart 96.35	4/9.63
Fittings, Fluid Conditioner	56.15-5	4/6.9.13, 4/6.17
Fittings, Non-metallic Expansion	Subpart 56.30 & 56.35	4/6.9.5
Fittings, Pipe Joining	56.15-1	4/6.17
Fittings, Special Purpose	56.15-10	4/6.17
Fixed Fire Fighting Systems, Carbon Dioxide	Subpart 95.17	4/9.11.2
Fixed Fire Fighting Systems, High Expansion Foam	Subpart 95.17, Special Consideration	4/9.13.1
Fixed Fire Fighting Systems, Low Expansion Foam	Subpart 95.17	4/9.13.2
Fixed Fire Fighting Systems, Pressure Water Spraying	Subpart 76.25, NFPA 13 Special Consideration	4/9.15, IMO Res A. 800
Flanges	56.25 & 56.30-10	4/6.19
Flexible Shaft, Couplings	Subpart 58.05 & 58.10	4/4.19
Fluid Power Systems	Subpart 58.30	4/6.66, 4/11.3.10
Foam Applicator, Portable	Subpart 95.17	4/9.18
Forgings, Hull Steel	92.01-10	2/1.9
Forgings, Machinery Steel	Subpart 58.05	2/2.7, 2/2.11, 2/2.13, 2/2.19
Glasses, Gauge	Subpart 56.50	4/6.41.3
Glasses, Sight Flow	Subpart 56.50	4/6.65.2
Hawsers, Towlines	Subpart 96.07	3/22.9
Heat Exchangers	Part 54	4/2, 4/6.59
Heaters, Hot Water	Part 52, 53 or 54	4/2.
Heaters, Oil	Subpart 54.01	4/4.23.7, 4/6.44.3
Heaters, Thermal Fluid	52.25-15	4/2.
Heating Systems, Cargo	Subpart 56.50	4/6.72.7
Hose, Fire	95.10-10	4/9.9.3

TABLE 4-2(CONT)

EQUIPMENT GENERALLY SUBJECT TO REGULATORY APPROVAL

HULL AND MARINE ENGINEERING EQUIPMENT AND OUTFITTING

CATEGORY	USCG 46 CFR CITE	ABS RULE CITE*
Hose, Marine	56.60-25(c)	4/6.9.14
Hose, Non-metallic Flexible	56.60-25(c)	4/6.9.14
Hydraulic Accumulators	58.30-25	4/2, 4/6.66.6
Hydraulic Components, Shock Tested	58.30-17	4/6.66
Hydraulic Cylinders	58.30-30	4/2, 4/6.22, 4/6.66.7
I.C. Engine Governors	Subpart 58.05 & 58.10	4/4.11.6
I.C. Engines and Turbochargers	Subpart 58.10	4/4, 4/5.21, 4/6.33.3, 4/9.29, 4/11.21
Incinerators	63.25-9, ASTM FI323, TSGS	4/11.15
Industrial Systems	Subpart 58.60	ABS Drilling Systems
Inert Gas Systems	Subpart 32.53, NVIC 1-81 CH-1	4/6.72.11, 4/11.17, ABS Inert Gas Systems
Instruments	56.15-5	4/6.9.13, 4/12.37
International Shore Connection	56.60-1, 95.10	4/9.9.5
Ladders, Accommodation	MSM, CH4	
Machinery, Main Propulsion	Subpart 58.05	4/3, 4/9.29
Manholes & Scuttles	32.60-1	3/18.19, 3/20.5
Oxygen-acetylene Installations, Fixed	Not Permitted	4/6.67
Penetrations, Bulkhead or Deck	Subpart 92.07 & Part 171 Subpart E	4/6.9.6, 4/6.9.7
Pilot Boarding Equipment	Subpart 96.40	
Pipe Vent	Subpart 56.50	4/6.39
Piping Materials, Low Temperature	56.50-105	2/2.9
Piping Materials, Metallic	Subpart 56.60	2/2.29, 4/6.13
Piping Materials, Nonmetallic	56.60-25	2/2, 4 /6.14
Piping Systems	Part 56	2/2.1, 4/6, 4/6.13
Piping, Brass	56.60-20	2/2.37
Piping, Copper	56.60-20	2/2.35
Portlights	32.56-21	3/20.7
Pressure Vessels	Part 54	4/2, 4/6.59
Propellers	92.01-10	4/7, 2/2.33.2, 2/2.34, ABS Propeller Castings
Pumps	Subpart 56.50	4/6, 4/6.12, 4/9.61.2
Pumps, Ballast & General Service	Subpart 56.50	4/6.31, 4/11.23
Pumps, Cargo	Subpart 56.50	4/6.69
Pumps, Circulating Water	Subpart 56.50	4/4.23.6, 4/6.12, 4/6.57
Pumps, Condensate	Subpart 56.50	4/6.55
Pumps, Feed	Subpart 56.50	4/6.51
Pumps, Fire & Bilge	95.10-5 & 56.50-55	4/6.12, 4/6.29, 4/9.5, 4/11.23
Pumps, Fuel Oil	Subpart 56.50	4/4.23.7, 4/6.12
Pumps, Lubricating Oil	Subpart 56.50	4/4.23.5
Refrigeration Machinery, Cargo	Subpart 58.20	4/11.29, 4/12, 4/B
Refrigeration Systems	Subpart 58.20	4/12.
Rudders	92.01-10	3/5.
Steering Gear	Subpart 58.25	3/5.15
Structural Steel	92.01-10	2/1.3, 2/1.5, & 2/1.6
Tail Shaft Bearings	Subpart 58.05	4/7.25
Tail Shaft Liners	Subpart 58.05	4/7.27
Tailshafts and Propulsion Shafting	61.20-15	4/7, ABS Cladding of Shafts
Tanks, Independent Fuel	Subpart 58.50	
Tanks, Portable	90.05-30	
Thrusters and DP Systems	Subpart 58.30	4/1.15, ABS Thrusters, 4/B
Truck, Power Operated Industrial	Subpart 97.70	
Turbines and Gears	Subpart 58.05	4/3, 4/9.29, 4/11.19
Valves	Subpart 56.20	4/6, 4/6.11, 4/6.15, 4/2.19, 4/6.9.8
Venting Systems, Cargo	Subpart 56.50	4/6.72.10

TABLE 4-2(CONT)

EQUIPMENT GENERALLY SUBJECT TO REGULATORY APPROVAL

HULL AND MARINE ENGINEERING EQUIPMENT AND OUTFITTING

CATEGORY	USCG 46 CFR CITE	ABS RULE CITE*
Watertight Sliding Doors	Subpart 111.97, 92.01-13 & Part 170 Subpart H	3/12.9, 4/11.25
Welding Procedures	Part 57	2/3A-Hull, 2/3B-Piping,etc., 3/23

*1996 CFR and 1996 ABS Rules

TABLE 4-2 (CONT)

EQUIPMENT GENERALLY SUBJECT TO REGULATORY APPROVAL

ELECTRICAL ENGINEERING EQUIPMENT

CATEGORY	USCG 46 CFR CITE	ABS RULE CITE*
Alarm System, General Emergency	Subpart 113.25	4/5A9.1
Alarm Systems, Fire & Smoke Detecting	Subpart 113.10	4/5A10.3, 4/9.71
Alarm Systems, Steering Failure	Subpart 113.43	3/5.15
Alarm, Engineer's Assistance Needed	Subpart 113.27	4/1.8, 4/5A9.3, 4/11.9.11
Alarm, Refrigerated Space	Subpart 113.45	4/5A9.5
Appliances, Cooking	111.77-3	
Attachment Plugs and Receptacles	111.79-1	4/5B2.25
Automation (46 CFR Part 62)	Part 62	4/11, 4/2.42 & ABS One Man Bridge Operated
Automation (46 CFR Part 63), Aux. Blr.	Part 63	4/11.13
Batteries	Subpart 111.15 & 112.55	4/5A3.5.3, 4/5A3.9.3, 4/5A5.9, 4/5B2.7, 4/5C3
Battery Chargers (MS)	Subpart 111.15	4/5C4.19
Busways and Associated Fittings	111.30-19, 111.59-1	4/5C4.11
Cabinets and Boxes	111.81-1	4/5C4
Cable	Subpart 111.60	4/5B3, 4/5C7, 4/5D1.9.3, 4/5D1.11.7, 4/5D2.17.12, 4/5E1.9
Circuit Breakers (MS), Molded Case	111.54-1	4/5C6.1
Circuit Breakers, High Voltage	111.54-1	4/5D1.11
Circuit Breakers, Large	111.54-1	4/5C6.1, 4/5D1.11.4
Circuit Breakers, Low Voltage AC	111.54-1	4/5C6.1
Circuit Breakers, Low Voltage DC	111.54-1	4/5C6.1
Computers, Stability	NVIC 3-89	
Control & Monitoring Equipment	Part 62	4/5A3.3.6, 4/5A5.17, 4/5D2.11, 4/5D2.13, 4/8.9.6, 4/8.9.7, 4/11, 4/B
Control and Protective Devices	Subpart 111.50 to 111.57	4/5C4.13
Controls, Propulsion	Part 62	4/5D2.11
Coolers, Drinking Water	111.77-3	
Dishwashers, Commercial	111.77-3	
Dishwashers, Household	111.77-3	
Electric Couplings	Subpart 111.35	4/5D2.17.8
Elevator Door Locking Devices	111.91-1	4/5A9.7
Emergency Stops	Subpart 111.103	4/5A10.1, 4/9.61, 4/11, 4/5D2.11.5, 4/5E3.3.6
Engine Order Telegraph System	Subpart 113.35	4/5A8.1.2
Fire Door Holding & Release Systems	Subpart 111.99	
Flexible cord	111.60-13	4/5C7.5
Fuses	111.53-1	4/5C6.3, 4/5D1.7.4, 4/5D2.17.11
Gas Detection		4/5E1.13.2, 4/5E1.13.3
Generator Sets, Emergency	Subpart 112.50	4/5A3, 4/5A5.3.4, 4/5C2
Generators & Protection, A.C.	Subpart 111.12	4/5A5.5, 4/5C2.19, 4/5D1.7, 4/5D1.11.1
Generators & Protection, D.C.	Subpart 111.12	4/5A5.7, 4/5C2.21, 4/5D1.7, 4/5D1.11.1
Generators, Diesel Engines for	Subpart 112.50	4/5C2.17
Generators, Shaft Driven	Subpart 111.12	4/5A2.3
Generators, Ship Service	111.10-4, Subpart 111.12	4/5A2, 4/5A5.3, 4/5C2, 4/5D3.1, 4/11.31
Generators, Turbines for	Subpart 112.50	4/5C2.15
Gyrocompasses	Subpart 96.17	
Hazardous Area Equipment, Division 1	Subpart 111.105	4/5.3.4, 4/5B7, 4/5E1.5, 4/5E2.3, 4/5E3.5
Hazardous Area Equipment, Division 2	Subpart 111.105	4/5.3.4, 4/5B7, 4/5E1.5, 4/5E2.3, 4/5E3.5
Heaters (MS), Air	111.87-3	4/5B2.19
Heating Equip., Central Air	111.87-3	4/5B2.19
Heating, Baseboard	111.87-3	4/5B2.19
Impressed Current Cathodic Protection		4/5E1.9.3
Indust. Control Equip., High Voltage	111.107-1, 111.30-5 & 111.81-1	4/5D1
Industrial Control Equipment (MS)	111.107-1	

TABLE 4-2 (CONT)

EQUIPMENT GENERALLY SUBJECT TO REGULATORY APPROVAL

ELECTRICAL ENGINEERING EQUIPMENT

CATEGORY	USCG 46 CFR CITE	ABS RULE CITE*
Industrial Systems	Subpart 111.107	ABS Drilling Systems
Instrinsically Safe Systems	111.105-11	4/5.3.7, 4/5B7.3
Lighting Equipment, Emergency	Subpart 112.01	4/5A3.3.2
Lighting Fixtures, Marine	111.75-20	4/5A7.1, 4/5B2.17, 4/5E1.13.3
Lights, Navigation	111.75-17	4/5A3.3, 4/5A7.3
Lights, Signaling	111.75-18	
Machinery, Propulsion	111.35-1	4/5D2, 4/5D2.17.5 & .6
Magnetic Compasses	Subpart 96.17	4/5B2.21
Motor Control Centers	111.70-3	4/5B2.13, 4/5C4.17
Motor Operated Appliances	Subpart 111.25	4/5B2.5
Motors & Controllers	111.25, 111.70	4/5A5.13, 4/5B2.5, 4/5B2.13, 4/5C2, 4/5C4.17, 4/5D2.17.7
Navigational Equipment	33CFR	4/5A7.3
Non-sparking fans	110.15-1	4/5E3.3.3, 4/5B7.7, 4/5.3.10
Outlet Boxes & Fittings (MS)	111.81-1	4/5B3.33, 4/5C6.7
Panelboards (Marine Supplement-MS)	111.40-5	4/5B2.11, 4/5C4
Penetrations, Deck & Bulkhead	Part 92.07, Part 171 Subpart E	3/12.1.2, 4/5B3.13, 4/5B3.27
Portable Equipment & Outlets	35.30-30	4/5B2.23, 4/5B4.7, 4/5C7.5
Propulsion System, Electric	111.35-1	4/5D2
Public Address Systems	Subpart 113.50	
Pump, Emergency Fire	Subpart 112.15	4/5A3.3.4
Pump, Submersible Bilge	Subpart 111.101	
Purged & Pressurized Systems	Subpart 111.05	4/5B7
Radar	Subpart 96.25	
Radio Equipment	47CFR Part 80	4/5A3.3.3
Refrigerators/Freezers, Commercial	111.77-3	
Refrigerators/Freezers, Household	111.77-3	
Rudder Angle Indicator Systems	Subpart 113.40	3/5.15.14
Semicond. Controlled Rectifiers (SCR)	Subpart 111.33	4/5C6.5, 4/5D2.7.5, 4/5D2.15.3, 4/5D2.17.9
Sounding Equipment	Subpart 96.27	4/5E1.9.3
Speed, Shaft Speed & Thrust Indicators	Subpart 113.37	4/5E1.9.3
Sprinkler Systems, Automatic	Subpart 113.20, Part 76.25, NFPA13	4/9.15
Steering Gear	Subpart 111.93	4/5A3.3.5, 4/5A6
Switchboard, Emergency	111.30-29	4/5A3.9, 4/5A8.9, 4/5D3.3.2
Switchboard, Interior Communication	Subpart 113.30	4/5A8.7, 4/11.3.9
Switchboards	Subpart 111.30	4/5C4, 4/5C4.15, 4/11.31, 4/5B2.9, 4/5D3.3.1
Switches (MS), Enclosed	Subpart 111.55	4/5D2.17.11
Switches, Knife	Subpart 111.55	4/5D1.11.4, 4/5D2.17.11
Switches, Snap	Subpart 111.55	4/5D2.17.11
Transformers, Power & Lighting	111.20-15	4/5A5.15, 4/5C5, 4/5D1.7.2, 4/5D1.11.3 & .4, 4/5D2.17.10
Watertight Fixtures and Equipment	111.81-1	4/5.15, 4/5B2.1, 3/12.9, 4/5B2.1.1
Whistle Operations	Subpart 113.65	
Wire Connectors and Soldering Lugs	111.60-17	4/5B4.5, 4/5C4.11.7

*1996 CFR and 1996 ABS Rules

TABLE 4-2 (CONT)

EQUIPMENT GENERALLY SUBJECT TO REGULATORY APPROVAL

SAFETY AND OTHER EQUIPMENT

CATEGORY	USCG 46 CFR CITE	ABS RULE CITE*
MARINE SANITATION DEVICES		
Marine Sanitation Devices	159.015	
LIFESAVING EQUIPMENT		
Life Preservers, Kapok, Adult & Child (Jacket Type)	160.002	
Life Preservers, Fibrous Glass, Adult & Child (Jacket Type)	160.005	
Cleaning Processes for Life Preservers	160.006	
Buoyant Apparatus	160.010	
Gas Masks & Self-Cont. Breathing App.	160.011	
Hatchets (Lifeboat and Liferaft)	160.013	
Compasses, Lifeboat	160.014	
Winches, Lifeboat	160.015	
Lamps, Flame Safety	160.016	
Chain Ladders	160.017	
Life Rafts (Rigid)	160.018	
Sea Anchors, Lifeboat	160.019	
Mirrors, Emergency Signalling	160.020	
Signals, Distress, Hand Red Flare	160.021	
Signals, Distress, Floating Orange Smoke	160.022	
Signals, Distress, Hand Combination Flare and Smoke	160.023	
Signals, Distress, Pistol-Projected Parachute Red Flare	160.024	
Containers, Emergency Provisions & Wate	160.026	
Life Floats	160.027	
Signal Pistols for Parachute Red Flare Distress Signals	160.028	
Line-Throwing Appliances, Shoulder Gun Type (and Equipment)	160.031	
Davits, Lifeboat	160.032	
Mech. Disengaging Apparatus, Lifeboat	160.033	
Hand-Propelling Gear, Lifeboat	160.034	
Lifeboats	160.035	
Lifeboat Diesel Engines	160.035	
Fire Retard. Polyester Laminating Resins	160.035	
Polyurethane Buoyancy Material	160.035	
Signals, Distress, Hand-Held Rocket-Propelled Parachute Red Flare	160.036	
Signals, Distress, Hand Orange Smoke	160.037	
Line-Throwing Appliances, Impulse-Projected Rocket Type (and Equip.)	160.040	
Kits, First-Aid (for Lifeboats)	160.041	
Jackknife (with Can Opener)	160.043	
Pumps, Lifeboat Bilge	160.044	
Emergency Provisions	160.046	
Buoyant Vests, Type II PFDs, Kapok or Fibrous Glass	160.047	
Buoyant Cushions, Kapok or Fibrous Glass, Type IV PFDs	160.048	
Buoyant Cushions, Unicellular Plastic Foam, Type IV PFDs	160.049	
Buoys, Life Ring, Unicellular Plastic Foam, Type IV PFDs	160.050	
Life Rafts, Inflatable	160.051	

TABLE 4-2 (CONT)

EQUIPMENT GENERALLY SUBJECT TO REGULATORY APPROVAL

SAFETY AND OTHER EQUIPMENT

CATEGORY	USCG 46 CFR CITE	ABS RULE CITE*
Inflatable Life Raft Srvcng. Facilities	160.051	
Buoyant Vests, Unicellular Plastic Foam, Type II PFDs	160.052	
Work Vests, Unicellular Plastic Foam, Type V Restricted Use PFDs	160.053	
Kits, First Aid, Inflatable Life Raft	160.054	
Life Preservers, Unicellular Plastic Foam, Adult & Child, Type I or Type V, Restricted Use PFDs	160.055	
Rescue Boats	160.056	
Signals, Distress, Floating Orange Smoke (15 Minute)	160.057	
Desalter Kits, Sea Water	160.058	
Buoyant Vests, Unicellular Polyethylene Foam, Type II PFDs	160.060	
Fishing Tackle Kits, Emergency	160.061	
Hydraulic Release	160.062	
Hydraulic Release Testing Facilities	160.062	
Launching Device for Infl. Life Rafts	160.063	
Marine Buoyant Devices, Type II, III & IV PFDs and Type V Restricted Use PFDs	160.064	
Protecting Cover for Lifeboats	160.065	
Red Aerial Pyrotechnic Flare	160.066	
Automatic Disengaging Devices	160.070	
Exposure Suit	160.071	
Distress Signals for Boats, Orange Flag	160.072	
Float Free Link for Life Floats and Buoyant Apparatus	160.073	
Inflatable Lifejacket	160.076	
Hybrid Inflatable Personal Flotation Device	160.077	
Winches, Lifeboat (SOLAS)	160.115	
Disembarkation Ladders (SOLAS)	160.117	
Life Rafts (Rigid) (SOLAS)	160.118	
Signals, Distr., Hand Red Flare (SOLAS)	160.121	
Signals, Distress, Floating Orange Smoke (SOLAS)	160.122	
Davits, Lifeboat (SOLAS)	160.132	
Release Mechanism, Lifeboat (SOLAS)	160.133	
Lifeboats (SOLAS)	160.135	ABS Reinforced Plastic Vessels
Signals, Distress, Hand-Held Rocket-Propelled Parachute Red Flare (SOLAS)	160.136	
Ring Life Buoys (SOLAS)	160.150	
Life Rafts, Inflatable (SOLAS)	160.151	
Life Jackets (SOLAS)	160.155	
Rescue Boats (SOLAS)	160.156	
Signals, Distress, Floating Orange Smoke (15 Minute) (SOLAS)	160.157	
Hydrostatic Release Units (SOLAS)	160.162	
Launching Device for Inflatable Life Rafts (SOLAS)	160.163	
Automatic Disengaging Devices (SOLAS)	160.170	
Immersion Suit	160.171	
Thermal Protective Aids	160.174	
Marine Escape Slides	160.175	

TABLE 4-2 (CONT)

EQUIPMENT GENERALLY SUBJECT TO REGULATORY APPROVAL

SAFETY AND OTHER EQUIPMENT

CATEGORY	USCG 46 CFR CITE	ABS RULE CITE*
ELECTRICAL EQUIPMENT		
Fire Protective Systems	161.002	
Loudspeaker Systems, Emergency	161.004	
Telephone Systems, Sound Powered	161.005	4/5.16
Searchlight, Motor Lifeboat	161.006	
Flashlights, Electric Hand	161.008	
Floating Electric Water Light	161.010	
EPIRB	161.011	
Personal Flotation Device Light	161.012	
Electric Distress Light for Boats	161.013	
Position Indicating Lights (SOLAS)	161.101	
Personal Flotation Device Light (SOLAS)	161.112	
ENGINEERING EQUIPMENT		
Flame Arresters for Tank Vessels	162.016	4/6.39.4
Valves, Pressure Vacuum Relief	162.017	5/2.1.9
Valves, Safety Relief, Liquified Compressed Gas	162.018	6.37.3
Nozzles, Fire Hose, Combination Solid Stream & Water Spray (1-1/2" & 2-1/2")	162.027	4/9.9
Fire Extinguishers, Portable Marine Type	162.028	4/9.17
Fixed Fire Extinguishing Systems	162.029	4/9.11.2
Fire Extinguishing Systems, Foam Type	162.033	4/9.13.2
Fire Extinguishing Systems, Bromotrifluoromethane Type	162.035	Not permitted(HALON no longer used)
Fire Exting. Systems, Water Spray Type (Sprinkler Systems)	162.036, NVIC 10-93, NFPA13	4/9.15
Water Mist Systems	Special Consideration	4/9.15, Res. A.800
Fire Exting. Sys., Carbon Dioxide Type	162.038	4/9.11.2
Fire Extings., Semiportable Marine Type	162.039	4/9.17
Backfire Flame Control, Gasoline Engines; Flame Arresters	162.041	
Backfire Flame Control, Gasoline Engines; Air & Fuel Induction Systems	162.042	
Oil Pollution Prevention Equipment	162.050	
Oil Water Interface Detectors	162.055	
CONSTRUCTION		
Pilot Hoists	163.002	
Pilot Ladders	163.003	
MATERIALS		
Deck Assemblies	164.005	3/24
Deck Coverings	164.006	3/16.11, 3/24
Structural Insulations	164.007	3/24
Bulkhead Panels	164.008	3/24
Non-Combustible Materials	164.009	3/24
Structural Ceilings	164.010	3/24
Interior Finish	164.012	3/24
Fire Doors	NVIC 6-80	3/24
Fire Dampers	NVIC 6-80	3/24
Retroreflective Material	164.018	

*ABS generally uses SOLAS (1974), as amended, and MARPOL 1973/1978 as the standards that apply. Other IMO Resolutions may also apply. The type approval listings show the standards used in a specific approval.

(d) IACS Unified Requirements

Another force working towards the international harmonization of requirements is the cooperative efforts of the members of the International Association of Classification Societies (IACS). As a part of their collaboration, they have agreed to internal guidelines on many issues to achieve standardized interpretations. One intent of the "Unified Requirements" is that they be incorporated into the rules of the various classification societies.

Where the members of IACS have agreed on unified interpretations, this generally means that their requirements are very similar. In the area of electrical systems, unified requirements have been agreed to for the following items:

- Governing characteristics of generator prime movers
- Electrical installations in double bottoms and duct keels under cargo oil tanks
- General requirements for electrical installations
- Earthing of non-carrying parts
- Definitions
- Protection against electrical shock by earthing
- Methods of earthing, earthing connections, and earthing connections in earthed systems
- Voltage and frequency variations
- Cables and insulated wires
- Starting arrangements of internal combustion engines
- Environmental test specifications for testing procedures for electrical control and instrumentation equipment, marine computers and peripherals covered by classification
- High voltage systems
- Requirements concerning the electrical equipment allowed in paint stores and in the enclosed spaces leading to paint stores.

However, it should be noted that such requirements may not be adopted by individual member societies in their entirety and the individual classification society rules should be consulted when necessary.

For products that are required to be designed and tested in accordance with

classification society rules, it is normally expected that the society classing the vessel will conduct the review and witnessing of tests for approval.[4] Additionally, when electrical equipment is built to shipboard IEC standards, this general conformity does not waive the design review or testing specified in the rules.

In addition to the above, it should be noted that the members of IACS have general reciprocity agreements for vessels changing class. Therefore, when a vessel is being reflagged or changes to another classification society for other reasons, the new society should be consulted regarding their requirements.

(e) Guidance on International Marine Products

Several references are available on international marine products. A number of these were mentioned in NSRP Project No. 6-93-1. A few of the pertinent references are highlighted below.

- Materials. Several guides or listings of similar material specifications are available. Although dated, one of the most useful such comparisons is a USCG sponsored study of materials used in the construction of U.S. Flag vessels overseas. Our experience has been that these basic materials grades still exist even though the specifications have often been updated, revised or reformatted. The study was conducted under rather strict equivalency guidelines, so that some grades used worldwide appear to be rejected in the study. This project was entitled "Analysis of Foreign and Domestic Material Specifications for Ships Components (NBSIR 82-2481)", April 1982 by the National Bureau of Standards.

  Useful tables are found in a variety of sources. Table 4-3 shows a comparison of steel pipes and tubes and was taken from the Marine Stores Guide discussed next.

- Marine Stores. The International Marine Purchasing Association (IMPA) published the second edition of the Marine Stores Guide (6)

[4] Lloyd's Register, in discussing background for this project, stated that they would accept equipment approved by other societies based on the IACS unified requirements.

in 1994. This book is a catalogue of products available under European, Japanese, and United States specifications. This book summarizes basic data on a variety of worldwide marine products.

The basic sections by code number are:

Code	Description
15	Cloth & Linen Products
17	Tableware & Galley Utensils
19	Clothing
21	Rope & Hawsers
23	Rigging Equipment & General Deck Items
25	Marine Paint
27	Painting Equipment
33	Safety Equipment
35	Hose & Couplings
37	Nautical Equipment
39	Medicine
45	Petroleum Products
47	Stationery
49	Hardware
51	Brushes & Mats
53	Lavatory Equipment
55	Cleaning Material & Chemicals
59	Pneumatic & Electrical Tools
61	Hand Tools
63	Cutting Tools
65	Measuring Tools
67	Metal Sheets, Bars, etc.
69	Screws & Nuts
71	Pipes & Tubes
73	Pipe & Tube Fittings
75	Valves & Cocks
77	Bearings
79	Electrical Equipment
81	Packing & Jointing
85	Welding Equipment
87	Machinery Equipment
11	Welfare Items

Comparison Table for Steel Pipes and Tubes of JIS and Foreign Standards

Use for		JIS (1979)	NK KR (RST)	ASTM ASME (SA)	ABS (1977)	LRS (1976)	LRS (1978)	NV (1976)	BV (1977)	GL (1973)
		Classification	World Standards Designation							
Pressure Pipe	Pressure	–	–	A53 G,A	ABS 2	LRS-IIP320N	LRS320P	NVR1-1P	BV P320N	GL G,1-1
		STPG38	KST138			LRS-IIP340N	LRS360P	NVR1-2P	BV P360N	
		STPG42	KST142	A53 G,B	ABS 3	LRS-IIP410N	LRS410P	NVR1-3P	BV P410N	GL G,2-1
		–	–	–	–	–	–		–	
	High Pressure	–	KST235	–	ABS 2 or 4	LRS-IIP340N	LRS320P	–	–	GL G,1-1
		STS38	KST238	–			LRS360P	NVR1-2P	BV P360N	
		STS42	KST242	–	ABS 3 or 5	LRS-IIP410N	LRS410P	NVR1-3P	BV P410N	GL G,2-1
		–	–	–		–	–		–	
	High Temperature	–	–	A106 G,A	ABS 4	LRS-IIP340N	LRS320P	–	–	GL G,1-1 or G,1*
		STPT38	KST338				LRS360P	NVR1-2P	BV P360N	
		STPT42	KST342	A106 G,B	ABS 5	LRS-IIP410N	LRS410P	NVR1-3P	BV P410N	GL G,2-1 or G,2*
		–	–	–	–	–	–		–	
		–	– High Pressure Pipes need the working pressure	–	–	–	Class I · II · III	Test class A · C · D	–	* only Category I-II-III
Boiler Heat-Exchanger, Superheater	Boiler Heat E.	STB33	KSTB33	A179	–	LRS-IIB320N	LRS320B	NVR1-2B	BV B320N	GL G,1 Category I · II · III
		STB35	KSTB35	A192	ABS H	LRS-IIB340N	LRS360B		BV B360N	
		STB42	KSTB42	A210A-1	ABS J	LRS-IIB410N	LRS410B	NVR1-3B	BV B410N	GL G,2 Category I · II · III
		–	(RSTH)	–	–	–	–		–	
	Header or Main Pipe	–	–	A106 G,A	ABS 4	LRS-IIP320N	LRS320P	NVR1-2P	–	GL G,1-1 or G,1
		STPT38	KST338			LRS-IIP340N	LRS360P		BV P360N	
		STPT42	KST342	A106 G,B	ABS 5	LRS-IIP410N	LRS410P	NVR1-3P	BV P410N	GL G,2-1 or G,2
		–		–	–	–			–	
		–		–	–	–		Test class A · C · D	–	Category I · II · III
Low Temperature	Pipe	STPL39	KLPA (–40) KLPB (–50)	A333 G,1	ABS 1L	–	LRS360LT (–40)	NVR1-2P Test class B	–	GL G,1-1
		–	–	A333 G,6	–	–	LRS410LT (–50)	NVR1-3P Test class B	–	GL G,2-1
		–	–	–	–	–				
	Tube	STBL39	KLPA (–40) KLPB (–50)	A334 G,1	ABS 1L	–	LRS360LT (–40)	NVR1-2B Test class B	–	–
		–	–	A334 G,6	–	–	LRS410LT (–50)	NVR1-3B Test class B	–	–
		–	–	–	–	–			–	–

* Classes and Category of Pipes condition of LRS (Lloyd's Register of Shipping), NV (Det Norske Veritas) and GL (Germanischer Lloyd)

LRS (Maximum pressure and temperature condition for class)						
Class	I		II		III	
Piping system	Pressure	Temperature	Pressure	Temperature	Pressure	Temperature
Steam	When all condition exceeds Class II.		kg/cm² 16,3	°C 300	kg/cm² 7,1	°C 170
Fuel oil			16,3	150	7,1	60
Other media			40,8	300	16,3	200

Classification	NV Test Class			GL Category		
Class	A	C	D	I	II	III
Working Pressure	80bar and over	32 ~ 80bar	32bar and under	32 kg/cm² and under	32 ~ 80kg/cm²	80kg/cm² and over
Temperature	450°C and over	400~450°C	400°C and under	400°C and under	400~450°C	450°C and over

* Test class B: Low Temperature

Table 4-3 Comparison of Steel Pipes and Tubes (5)

o Ship Stores. The International Ship Suppliers Association (ISSA) published the Ship Stores Catalogue (7) in 1994. This book is a catalogue of products available on a worldwide basis. This book summarizes basic data on a variety of worldwide marine products. When a particular standard must be met, it must be additionally specified.

The basic sections by code number in Volume 2 are:

Chapter	Description
1-12	Provisions
19-21	Bonded Stores
Part 1	Cabin Stores
25	Catering Equipment
27	Clothing/Linen
29	Brush Ware
31	Cleaning Materials
33	Stationery
35	Medical
37	Hardware
39	Bathroom Equipment
Part 2	Deck Stores
41	Rope & Hawsers
43	Upper Deck Equipment
45	Paint & Painting Equipment
47	Safety Equipment
49	Nautical Equipment
Part 3	Engine Stores
51	Hoses & Couplings
53	Chemicals & Petroleum Products
55	Power Tools
57	Hand Tools
59	Cutting Tools
61	Measuring Instruments
63	Metal Sheets and Bars
65	Fasteners
67	Pipe & Tube Fittings
69	Valves
71	Bearings
73	Electrical Equipment

75	Packing & Jointing
77	Welding

4.2 Marine Engineering Product Requirements

(a) Introduction (8).

Piping systems aboard commercial vessels are subject to requirements reflective of their associated hazards. Piping failure may endanger the vessel, personnel, or the marine environment by:

- Failing to perform an essential function including the loss of --
  - Propulsion
  - Vessel maneuverability
  - Buoyancy or trim
  - Electric power;
- Releasing energy or projecting missiles;
- Releasing harmful substances (hot, very cold, flammable, combustible, toxic, caustic, corroding, polluting, etc.); or
- Allowing the spread of or escalation of fire, explosion, smoke, or flooding.

Piping systems subject to plan review under classification rules are considered to be in one or more of these categories. Other systems are not regarded as being in any of these categories, and need only be safe from an occupational safety viewpoint. Such systems are only expected to meet normal commercial standards, such as being insulated, if hot, or keeping water away from electrical systems. Additionally, if applicable, they should maintain watertight or fire rated boundaries.

In general, many of the treaty and other marine engineering requirements were established for ships of World War II vintage.[5] It is sometimes necessary to

[5] ABS is planning a project to upgrade their marine engineering rules and related type approval system using risk assessment methodologies developed in other industries.

reconsider the application of such requirements. In such cases the existing requirements are used to determine the level of safety intended. The general equivalency provisions are then used in the specific instance to ensure that an equal level of safety, occupational health, environmental protection, etc. is provided.

The general philosophy behind the design of marine piping systems for commercial vessels is different than that for military vessels. Merchant ships do not carry large numbers of trained personnel as do military ships. Therefore, the merchant ship substitute for active "damage control" is passive damage resistance. Piping is not equipped with bulkhead stop valves, jumper lines, and isolation valves in most systems, but is expected to resist noncombatant types of damage without intervention by the crew. Piping systems designed in accordance with classification society rules are assumed to have this resistance because they meet appropriate standards in each case for pressure-temperature rating, safety factors, fire resistance, duplication, shock resistance, etc.

Likewise, the standards for piping components normally contain sections which adress the following:

* Material requirements, heat treatment, and hot/cold working
* Dimensions (including wall thicknesses and tolerances)
* Method of design and stress analysis including factors of safety
* Performance and pressure/temperature ratings
* Welding procedure and welder performance qualification when applicable
* Non-destructive examination, hydrostatic testing, and other sampling or production tests
* Stamping and marking

(b) Valve Category

o General

It is becoming more commonplace to use such techniques to develop system requirements and evaluate alternative arrangements.

The general classification society requirement for valves is that valves meet a recognized standard. ABS, DnV, and LR include valves in their type approval programs. DnV has specific requirements relating to their valve type approval program. The classification society rules also generally incorporate the arrangements and details required under relevant treaties.

Appendix 6.2 shows diagrams of typical acceptance processes for valves in projects worldwide and domestically.

o ABS Valve Requirements

The ABS requirements for valves are basically the same as the USCG's, which are summarized below for reference, except for the USCG's provisions for valves employing resilient seating materials. Since ABS has reviewed the valve standard comparisons performed in NSRP Project No. 6-93-1 for their requirements and USCG requirements, the method and issues presented in that study are suitable for establishing acceptability. However, the general procedure for utilizing a new standard would be to discuss the issue with the ABS project manager first. If ABS is unfamiliar with the standard, it would be appropriate to provide ABS with a copy of the standard and background on its use, as a minimum.

The following are the essential citations and sections regarding ABS valve requirements:

Cite	Description
4/6.5	Material Tests and Inspection
4/6.5.1	- Materials to meet the requirements of Section 2/2 except that tests of materials need not be witnessed. - Where electric welding is used, Section 2/3 also applies. For materials requiring test and inspection by the producer, ABS should be appraised of the purchaser order in duplicate. - Materials not covered by the rules must be specifically approved.

4/6.9 General Installation Details

4/6.9.7 - Collision-bulkhead Penetrations

4/6.9.8 - Sluice Valves and Cocks

4/6.9.9 - Relief Valves

4/6.11 Pumps, Pipes, Valves and Fittings - General

4/6.11.1 - Service Conditions

4/6.11.2 - Recognized standards are American National Standards Institute (ANSI) standards. Other recognized standards will be considered.

4/6.15 Valves

4/6.15.1 General
- a. Standard Valves
- b. Non-Standard Valves

4/6.15.2 Construction

4/6.15.3 Hydrostatic Test and Identification

4/6.21 Material of Valves and Fittings

4/6.21.1 General
- Section 2/2 applies.
- Physical tests of each melt are required (only submitted upon request).

4/6.21.2 Forged or Cast Steel

4/6.21.3 Cast Iron

4/6.21.4 Nonferrous

4/6.21.5 Ductile (Nodular) Iron

4/6.23 Side Valves and Overboard Discharges - Sea Inlets and Overboard Discharges

4/6.23.2 Valve Connections to Shell

4/6.23.3 Materials

4/6.XX Additional requirements for valves based on system[6], location, position, and materials such as plastics.

* Summary - ABS accepts a wide range of valves worldwide based on construction to recognized standards. These standards include ANSI standards, the USCG adopted standards listed below, and the ISO, JIS, and DIN standards analyzed in NSRP Project No. 6-93-1. For reference, these latter standards are summarized in Table 4-4, Valve Standards Analyzed (in NSRP Project No. 6-93-1) and the USCG adopted standards are listed in the summary of their requirements.

Additionally, ABS accepts valves approved under their type approval program. The ABS List of Type Approved Equipment shows manufacturers, models, other relevant data and restrictions, construction standards, compliance with USCG requirements, etc.

[6] ABS requires valves used in firemain systems to be constructed of materials resistant to fire. ABS uses the UK DOT Appendix D as the standard for this determination, although they also accept the Coast Guard requirements for Category A resiliently seated valves as meeting this criteria.

TABLE 4-4

SUMMARY OF VALVE STANDARDS ANALYZED

(In Project No. 6-93-1)

VALVE TYPE	STANDARD	CLASS	EQUIVALENT ANSI	ANSI CLASS
GLOBE	JIS F7319	10K	PN 20	150
	JIS F7313	20K	PN 40	150 < PN40 < 300
	JIS F7315	30K	PN 50	300
	JIS F7317	40K	PN 68	400
ANGLE	JIS F7320	10K	PN 20	150
	JIS F7314	20K	PN 40	150 < PN40 < 300
	JIS F7316	30K	PN 50	300
	JIS F7318	40K	PN 68	400
GLOBE	DIN 86552	100 BAR	PN 125	600 < PN125 < 900
ANGLE	DIN 86552	100 BAR	PN 125	600 < PN125 < 900
GATE	ISO 6002	PN 10 - PN 100	PN 10 - PN 100	150 to 600 with extra DIN Classes
BALL	ISO 7121	PN 10 - PN 100	PN 10 - PN 100	150 to 600 with extra DIN Classes

o USCG Valve Requirements Per 46 CFR

The below requirements are expressed in terms of the Shipping regulations in 46 CFR rather than the procedures allowed when other recognized classification societies are authorized to perform these functions.

The USCG valve regulations generally parallel our conservative domestic power piping practice. However, the requirements for valves employing resilient material originated with naval practices under MilSpec MIL-V-22133. Although SOLAS has been upgraded to address some piping system requirements, it is generally silent on such specific design issues. While the USCG's regulations generally satisfy classification society and other requirements found internationally, the requirements for valves employing resilient materials (Category A, etc.) are unique to the U.S. and the materials requirements often exceed these other practices.

See 46 CFR 56.20-1 for general design requirements for valves, 56.20-5 to -20 for additional specific requirements, 56.60 for adopted standards and materials requirements, and 50.25 for certification requirements.

* The following ANSI and MSS standards are adopted in Table 56.60-1(b):

B16.25	Butt Welding Ends - Pipe, Valves, Flanges & Fittings
B16.34	Valves - Flanged, Threaded and Welding End
SP-6	Finishes - On Flanges, Valves and Fittings
SP-25	Standard Marking System for Valves, Fittings, Flanges and Unions
SP-45	Bypass and Drain Connection
SP-61	Hydrostatic Testing Steel Valves
SP-67	Butterfly Valves
SP-72	Ball Valves with Flanged or Butt-Welding Ends for General Service

Acceptance of these standard valves, made in accordance with the above standards including welded valves used in Class II piping systems, is obtained by listing the adopted industry standard and the applicable material in the bill of materials for plan review by the Marine Safety Center (MSC), and mill certification (material identification only) or component marking, and installation inspection

by the Officer-in-Charge, Marine Inspection (OCMI). The suitability for the intended service of a valve is determined during plan review by verifying the applicable pressure and temperature ratings, service limitations, and material requirements as well as any special system or arrangement requirements.

* Acceptance of nonstandard valves is obtained by following the procedure outlined in 46 CFR 50.25-10 using the requirements in 56.20-1(c). These valves include welded and non-welded valves not complying with an adopted standard and welded valves not used in a Class II system. Plans, calculations, and supporting data are submitted for approval to the MSC and the specific letter of acceptance and approved plans must be available during the installation inspection by the OCMI. As stated above, the suitability for the intended service will also be evaluated during plan review.

* More detailed requirements for valves employing resilient material were recently adopted to clarify previous regulations. Valves employing resilient material are divided into three categories: Category A, Category B, and Positive Shutoff. The three categories are briefly described below:

1) Category A - A Category A valve is required in systems, such as, a fixed fire fighting system or bilge system, that must function efficiently during a fire, but where some leakage is permitted. The leakage, however, must not be substantial. These requirements also apply to overboard shell connections. The maximum leakage permitted through a closed valve with all resilient seating material removed must be less than five percent or 15%/SQRT(NPS), whichever is greater, of the flow rate through the fully open valve with the resilient material intact. In lieu of testing the valve with its resilient seating material removed, the manufacturer has the option of either performing calculations or subjecting the valve to a suitable fire test. See 46 CFR 56.20-15(c)(1).

2) Positive shutoff - A positive shutoff valve is required at the tank in systems subject to internal head pressure from tanks containing flammable, combustible, or hazardous materials to restrict potential leakage. A positive shutoff valve must pass a more restrictive leakage test than a Category A valve. Leakage must be

less than 10 ml/hr of liquid or 3 l/hr of gas per inch Nominal Pipe Size (NPS) after removal of all resilient seating material at full rated pressure. As with a Category A valve, the manufacturer has the option of either performing calculations or subjecting the valve to a fire test. The packing material must be fire resistant. Note that all positive shutoff valves qualify as Category A valves. See 46 CFR 56.20-15(c)(2).

3) Category B - A Category B valve is not required to provide effective closure when the resilient material in the valve is damaged or destroyed as would almost certainly occur when the material is subjected to a fire. A Category B valve is unable to pass one of the tests described in 1) or 2) above. See 46 CFR 56.20-15(c)(4).

* General acceptance is no longer granted for valves employing resilient seats. It is the responsibility of the manufacturer to certify that his resilient seated valve meets one of the above criteria. Identification of the valve in the manufacturer's catalog as meeting one of the criteria is the best method of certification. In the absence of providing the information in the manufacturer's catalog, written certification from the manufacturer must be provided to the USCG prior to acceptance of a Category A or positive shutoff valve (normally, to the MSC during plan review).

(c) Flange Category

o General

The general classification society requirement for flanges is that flanges meet a recognized standard. ABS, DnV, and LR include flanges in their type approval programs. However, because standard flanges are normally supplied in accordance with a recognized standard, no manufacturers have sought to have their flanges listed in the ABS type approval listing.

Additionally, it is generally possible to show the suitability of a flange by a design calculation method. Such calculation procedures are normally found in national boiler and pressure vessel codes. Some stand alone flange calculation procedures were also identified in NSRP Project No. 6-93-1. Also, it is occasionally found practicable to analyze flanges by finite element techniques

and companies specializing in piping design often have computer programs for performing such analysis. The classification societies also offer these services based on direct code calculations or finite element analysis.[7]

Appendix 6.2 shows diagrams of typical acceptance processes for flanges used in projects worldwide and domestically.

o Flange Analysis in NSRP Project No. 6-93-1

The analysis performed in NSRP Project No. 6-93-1 unfortunately has not received detailed review and comment by the USCG or ABS. However, the general analysis, methods and background should be taken to be essentially correct. Much of the study was devoted to evaluation of flanges by ASME Boiler and Pressure Vessel methods, the international program to harmonize flange standards, and the peculiarities of foreign flange analysis under ASME procedures as demonstrated by examples using (high pressure) main diesel engine starting air systems.

The analysis also proposed conservative guidelines, some of which had been used in the past, for quickly judging the ratings of DIN and JIS flanges.

While these guidelines are useful, it is undoubtedly better to discuss the acceptability of standards with the cognizant classification society or technical project manager at the start of a new project. ABS's acceptance of JIS flanged valves, as discussed under the valve category, is an indication that ABS accepts flanges rated under JIS standards. The JIS valve standards analyzed showed body wall thicknesses that are conservatively proportioned, presumably to account for corrosion. Such valves could be used at the proposed ANSI ratings or, in general, at ratings higher than the JIS ratings if a flange calculation demonstrated that the intended flange fit-up would be suitable(the ABS acceptance of these standards previously mentioned was for the JIS ratings only).

In international trade, it is a common practice to obtain material certificates such as mill certificates or, as more commonly known, the works certificate. Normally, there is more than one level of works certificate. The lowest level

[7] In addition to the references provided in NSRP Project No. 6-93-1, also see references (9) and (10).

includes physical and chemical properties, while higher levels including more extensive testing. Other national design practices include obtaining such certificates to confirm the overall suitability of an intended design (i.e., closer attention to material properties allows the use of lower factors of safety). Thus, obtaining material works certificates becomes a practical procurement feature and can help to show the adequacy of intended installations.

Another approach to ensuring the suitability of flanged connections is to have the vendor provide sample calculations for the proposed installation. Such calculations are more common to pressure vessels and heat exchangers, but could be done for other types of equipment procured internationally.

While it may be premature to specify the use of ISO flanges, at some point this approach will be practical. This issue demonstrates the need to monitor the progress of the ISO harmonization program. Periodic feedback on the development of the international flange standards should be sought through the U.S. ISO Technical Advisory Group (TAG). Additionally, such liaison might also produce more background on the technical development of the ISO dimensions.

It is also important to note that the ASME Boiler and Pressure Vessel Code is used worldwide. As a result, international and foreign material grades are gradually being incorporated into this code. These efforts generally make it easier to incorporate international products and materials into designs under domestic standards.

The following sections highlight the background and analysis performed for the flange category in NSRP Project No. 6-93-1.

* Background

  Acceptance of flanges, particularly "non-standard" flanges, has always presented a regulatory dilemma. As with valves, catastrophic failures have not been a problem since designs that leaked would not be acceptable. However, all flange standards have their roots in empirical development. Also, while rational analysis is feasible, exhaustive analysis is not practicable. Additionally, the flange calculation is only one part of a very complex problem -- the other parts being the gasket selection, and the bolt sizing and torquing practice.

Other factors have also influenced attitudes, particularly towards foreign flanges. It has long been known that there are recognized "problems" with DIN flanges, but until the background for the ISO standards was discovered, general knowledge of these problems was poorly understood. Also, the logic of the general reflagging guidance of allowing 75% of the stated rating was never clearly documented -- are other standards based on a factor of safety of 3 to 1, was this based on experience with calculations or high temperature limitations, or is this simply a gross approximate derating to ensure suitability (it's probably the latter). Additionally, this gross rule eliminates the detailed review of 98% of the flange applications on a diesel ship.

As with a couple of the other equipment categories, the work undertaken for this category was very unpredictable and resulted in a dynamic process. Based on experience with both DIN and JIS flanges, there were preconceived ideas about certain issues that needed to be developed. But the discovery of an ISO program to harmonize flange applications worldwide and extensive background on DIN flanges was a complete surprise. This background material includes an extensive review of DIN flanges. Also, in response to criticisms of their flange system, the Germans published a calculation method for flange applications (previously, guidance sections were in their pressure vessel code, as ours is in ASME). This method appears to parallel the American method, but correlation is difficult because we use allowable stresses and they use various applied factors.

In a similar manner, an ASME publication presenting the basic research behind the ASME calculation method rules was obtained. While all of the assumptions behind this calculation method are not clear, the basic method appears to be the most rational method available for making such evaluations. Ironically, all of the references in this research paper are of German origin. Many pertinent references are cited in the NSRP write-up. Addition historical material has more recently been made readily available through the publication of reference (9). Also, reference (10) discusses issues concerning the use of Navy flanges.

* Approach

The approach taken for the flange category is somewhat different than

the other categories studied for a variety of reasons. First, it is always possible to show the suitability of an individual flange by performing calculations. But, exhaustive calculations for standards or applications to various systems are not practicable. Secondly, a serious regulatory problem in past projects is that the USCG has been unwilling to accept a worst case analysis as showing the suitability for a series of flanges. The goal for this category therefore was to highlight issues, develop certain general guidelines, and hopefully show the suitability of worst case application analysis for flanges.

The issues were illustrated by presenting one worst case sample calculation from a past project for the main diesel engine starting air system. The original calculation showed adequacy for operating conditions, but not gasket seating conditions. Prior to this, the USCG had never shown an interest in gasket seating conditions. In fact, acceptance of revisions to ANSI B16.5, "Pipe Flanges and Flanged Fittings" had been based solely on review of operating conditions. While it was intended that this issue be studied, the flaw in the original calculations was discovered. One of the many form factors interpolated from a graph was off by an order of magnitude due to a dislocated decimal point. Thus, two programs for the various factors were developed from published sources and made available. Also, while it was planned to use standardized forms for calculations, it was more productive to develop a similar spreadsheet format. Finally, review of ANSI B16.5 showed that a clear statement of its technical basis is not readily available (i.e., gasket factor assumptions, etc.).

Since there were recently published ISO standards available, the first choice was to try to analyze them. While the international standard for steel flanges basically adopts the American standard, it also preserves the DIN low pressure classes. Additionally, it preserves both systems for rating the respective classes. This ISO standard is interesting for a variety of reasons -- it goes beyond the standard 24 inch pipe size and it often has three different flange thickness columns to reflect different thicknesses for integral flanges. Its not clear how this "scaling" of dimensions was done -- approximate formulas or computer calculations.

In this NSRP study, the flange thickness was used as the principle

strength factor and a crude scaling law for Class 150 flanges was developed. This law appears to be either accurate or conservative for all the studied applications and generally seems to reproduce the slope of all flange thickness versus size graphs for all flange classes. The applicability of using simple formulas obtained by using flat cover plate methods was noted and discussed. Graphs were again found useful for presenting pressure-temperature curves and flange thickness versus size curves. Based on the analysis, various "quick" (conservative) guidelines were proposed for simple rating of flanges that should cover at least 90% of practical applications.

o General Conclusions

From the results of the analysis in NSRP Project No. 6-93-1, a variety of recommendations were made as follows:

* Even though the current ISO standard for steel flanges appears to be only an intermediate step, it could be accepted with certain stipulations. General guidelines, conservative in nature, were proposed. Likewise, DIN steel flange standards could be accepted using similar guidelines. These guidelines assume that the acceptance criteria for a flange is general equivalence to our domestic design standards.

* These same methods could be applied to two other ISO flange standards for other materials. Likewise, applications could be extended to other standards including additional DIN standards, JIS standards, etc.

* Guidance on a variety of issues would be very helpful. Such areas include worst case analysis and their presentation (i.e., graphing flange thickness versus size), gasket seating calculations, analysis based on first principles (computer analysis), and analysis with different facings (i.e., 2 and 3 mm thick facings). Other technical issues such as full face gaskets, moments due to facing contact, and hole spacing could also be addressed.

* Most flange applications can be analyzed by ASME methods. Typically, applications during reflaggings are analyzed by such methods. However, a flat plate type flange application for 250 mm

piping that works well in practice has been analyzed, and clearly does not meet ASME type criteria. Of course, a difficulty with such problems is knowing the gasket properties. As computer usage becomes commonplace, it may be more reasonable to expect the regulatory authority to judge applications not covered by recognized standards as is currently done with piping ratings.

* As with the previous category on valves, graphing data proved to be an extremely useful technique. Acceptance of worst case analysis for a series of flanges appears feasible when the series flange thickness versus size data is also graphed and studied.

o ABS Flange Requirements

The ABS requirements for flanges are stated above under general requirements and are basically the same as the USCG's, which are summarized below for reference. While the general methods, comments, and references cited in NSRP Project No. 6-93-1 are acceptable to ABS, the general procedure for utilizing a new flange standard would be to discuss the issue with the ABS project manager first. If ABS is unfamiliar with the standard, it would be appropriate to provide ABS with a copy of the standard and background on its use, as a minimum. Of course, code calculations or, in rare cases, finite element analysis would also be acceptable when deemed necessary to show acceptability.

The following are the essential citations and sections regarding ABS flange requirements:

Cite	Description
4/6.19	Flanges
4/6.19.1	General - Flanges must be designed and fabricated in accordance with an applicable ANSI standard. - In Group II piping systems, slip-on flanges made from flat plate may be used. - ABS will evaluate flange applications using code or finite

element analysis methods.

4/6.19.2 Group I Piping Flange
- a. Steel Pipe
- b. Nonferrous Pipe

4/6.19.3 Group II Piping Flanges

2/3B.9 Forms of Welded Joints Required

2/3B.9.1 Boilers and Group I Pressure Vessels

2/3B.9.2 Group II Pressure Vessels

2/3B.9.3 Group I Pipe Connections
- a. Pipes over 89mm OD (3 in. NPS)
- b. Pipes 89mm OD and Below
- c. Flanges
  Slip-on flanges
  Socket-type flanges

2/3B.9.4 Group II Pipe Connections

2/3B.9.5 Low-temperature Piping Systems (Below -18°C (0°F))

2/3B.9.6 Engineering Structures

* Summary

ABS accepts a wide range of flanges worldwide based on construction to recognized standards. These standards include ANSI standards, the USCG adopted standards listed below, and common standards used in shipbuilding worldwide such as those mentioned in NSRP Project No. 6-93-1.

Although not a commonly used procedure, ABS will accept and approve flanges under their type approval program. Such approvals would then be shown in the ABS List of Type Approved Equipment issued annually. This approval list shows manufacturers, models,

other relevant data and restrictions, construction standards, compliance with USCG requirements, etc.

o USCG Flange Requirements Per 46 CFR

The below requirements are expressed in terms of the Shipping regulations in 46 CFR rather than the procedures allowed when other recognized classification socities are authorized to perform these functions.

The USCG flange regulations parallel our conservative domestic power piping practice. SOLAS is generally silent on this issue. While the 46 CFR regulations generally satisfy classification society and other requirements found internationally, the materials requirements may exceed these other practices. The suitability of flange connections is normally established by performing flange calculations and/or conformance to a recognized flange standard. Such calculation procedures are normally found in national boiler and pressure vessel codes. Some stand alone flange calculation procedures have been identified and significant international work is underway at ISO to harmonize worldwide flange standards and requirements.

See 46 CFR 56.25 for specific design requirements for flanges, 56.30-10 for additional limitations on use, 56.60 for adopted standards and materials requirements, and 50.25 for certification requirements.

* The following ANSI and MSS standards[8] are adopted in Table 56.60-1(b):

B16.1	C.I. Flanges and Fittings - Classes 125 & 250 Only
B16.5	Steel Pipe Flanges and Flanged Fittings
B16.24	Bronze Pipe Flanges and Flanged Fittings - Class 150 and 300
B16.42	Ductile Iron Pipe Flanges and Fittings
SP-44	Steel Pipe Line Flanges
SP-51	Class 150LW Corrosion Resistant Cast Flanges and Flanged Fittings

[8] The adoption of references (11) to (13) in the Federal Register of May 23, 1996 allows the use of additional coupling methods and related fittings as an alternative to flanges and flanged fittings.

Note: The following ANSI standards shown in the above Table regarding gaskets have been discontinued:

B16.20 Ring Joint Gaskets - Steel Flanges
B16.21 Non-metallic Gaskets for Flanges

Acceptance of these standard flanges, made in accordance with the above standards, is obtained by listing the adopted industry standard and the applicable material in the bill of materials for plan review by the MSC, and mill certification (material identification only) or component marking, and installation inspection by the OCMI. The suitability for the intended service of a flange is determined during plan review by verifying the applicable pressure and temperature ratings, service limitations, and material requirements as well as any specific joint detail requirements appropriate to the specific system.

* Acceptance of nonstandard flanges is obtained by following the procedure outlined in 46 CFR 50.25-10. Calculations in accordance with Appendix 2 of Section VIII, Division 1, of the ASME Boiler and Pressure Vessel Code and supporting data are submitted for approval to the MSC and the specific letter of acceptance and approved plans must be available during the installation inspection by the OCMI. As stated above, the suitability for the intended service will also be evaluated during plan review. Presumably, calculations performed in accordance with Appendix Y, when applicable, would also be acceptable.

(d) Plastic Pipe Category

o General

The low melting point of plastics and many non-ferrous metals and alloys, such as aluminum and aluminum alloys, should be recognized. Such heat sensitive materials must be not be used to convey flammable, combustible, or dangerous fluids, or in vital systems unless the arrangements are acceptable to the Regulatory Authorities.

Plastic piping is used more extensively in Europe and Asia than in the U.S.

Its use has been widely accepted by foreign governments and classification societies. The USCG has been leading an effort at IMO to provide guidelines on the use of all piping materials other than steel in shipboard systems. Except for some flammability issues such as smoke and toxicity, this work was recently completed and adopted at IMO as Resolution A.753(18), "Guidelines for the Application of Plastic Pipes on Ships." These recommended requirements are more stringent than the requirements used previously by other governments and classification societies. The 1997 ABS Rules have been revised to reflect these requirements.

Both the USCG and ABS accept the use of plastic piping for installations complying with Resolution A.753(18). Since this resolution is new, undoubtedly, interpretations will need to be made regarding the application of these requirements. NSRP Project No. 6-93-1 tried to evaluate the potential to use these requirements for deckhouse piping systems and the issues that might arise. One manufacturer has begun to certify conformance with these requirements(14).

Because of the newness of these requirements, it would be best to make a conceptual proposal to the cognizant authorities before proceeding with a specific design. Presumably, other governments and classification societies will accept, if not require, installations under Resolution A.753(18). While IMO has interim standards, clearly the requirements for smoke and toxicity must be clarified in such situations. Reference (15) presents additional commentary on the efforts to finalize the requirements for smoke generation. Reference (16) presents a general summary of the status of IMO work on smoke development and toxicity.

Generally, the ABS Rules for plastic piping are similar to the USCG regulations. The following regulatory provisions are generally considered to exceed the requirements of the ABS Rules:

* Penetrations of bulkheads and decks shall be made in a manner that does not compromise the fire integrity of required divisions.

* Within concealed spaces in accommodation or service areas, plastic piping that does not meet the requirements of Resolution A.753(18) must be installed within ducts or trunks completely surrounded by Class A divisions, or the concealed space must be protected by an approved fire detection system.

* PVC pipe used for potable water service shall bear the seal of approval or NSF mark of the National Sanitation Foundation Testing Laboratory, Inc., School of Public Health, University of Michigan, Ann Arbor, MI 48103.

* It should be noted that even though only small quantities are used, the activating metallic elements in the foreign PVC are typically different than domestic PVC and may be lead. The NSF enforces unofficial guidelines regarding lead content.

Appendix 6.2 shows a diagram of the typical acceptance process for plastic piping and penetrations used in projects worldwide and domestically.

o Plastic Piping Evaluation in NSRP Project Number 6-93-1

The analysis performed in NSRP Project No. 6-93-1 unfortunately has not received detailed review and comment by the USCG or ABS. However, the general analysis, methods and background should be taken to be essentially correct. Much of the study was devoted to evaluation of the current regulatory requirements and the potential for new applications using the new requirements presented in Resolution A.753(18), "Guidelines for the Application of Plastic Pipes in Ships." Potential regulatory issues were discussed. Finally, a test program is outlined and basic cost estimates are provided for each type of testing. The nominal goals are to demonstrate the suitability of some plastic piping materials and some firestops. However, extended goals and testing are also suggested. These include demonstrating the suitability of small scale firestop tests, the implications of different firestop test programs (i.e., deck versus bulkhead or Class A-60 versus Class A, listed in order of possible severity), and conducting some basic L3 endurance testing.

* Plastic Piping Evaluation Overview

Historically, other nations have readily allowed the use of plastic piping within accommodation areas. However, the conservative 46 CFR Subchapter F, Marine Engineering Regulations, requirements have made such installations prohibitive in U.S. Flag vessels. Most vessels presented for reflagging have such systems. These systems have functioned well and show no signs of deterioration. In some

cases these installations are replaced with steel piping, while in others they are preserved by installing smoke detectors in large false ceiling areas.

The USCG has for several years spearheaded an effort at International Maritime Organization (IMO) to develop rational criteria for such systems. The intent is to develop suitable fire resistance and other performance requirements for these "non-metallic" systems so that the suitability of any installation can be judged. This work attempts to include all shipboard systems. The requirements agreed upon to date were recently adopted by the IMO Assembly. Additional work is in progress regarding requirements for smoke and toxicity, and interim guidelines on testing has been suggested. The latest thinking on these requirements will be published in the new Fire Test Procedures Code planned for inclusion in the 1998 SOLAS Amendments.

In the meantime, the application of plastic piping in shoreside applications has become commonplace. Experience and testing regarding the reality of additional toxicity hazards has been gained. Also, numerous creative firestop designs have been developed and UL publishes a booklet of approved firestops. The testing of such penetrations has shifted from large scale panels to more practical small scale tests.

With the above developments in mind, this category was undertaken with a goal of developing new cost saving applications. The intent was to review the new requirements to develop a test program to permit the practical application of plastic piping in accommodation areas. While some background data was readily available, an effort was made to find current information by contacting manufacturers, suppliers, and other sources. This effort provided access to a wide range of current information.

As expected, it appears feasible to use a variety of plastic materials and firestops in these marine applications. CPVC seems to meet the new standards, and PVC and fiberglass products may meet the standard with some modification. PVDF also appears to meet the standard, but its practical application is normally as a substitute for stainless steel because of its cost.

While the need for endurance testing is not significant for applications in accommodations, it seems reasonable that low level endurance requirements (L3 testing) can be met with simple insulation or intumescent coating schemes.

The traditional fire stops have required metallic spool pieces. However, a wide variety of Class A and B bulkhead and deck firestops used in shoreside applications appear feasible. These schemes include passive, semi-active and active designs. Sketches of possible schemes were provided in NSRP Project No. 6-93-1.

A variety of issues were uncovered that require USCG consultation. These issues affect the materials testing program and the firestop testing program. For example, the IMO firestop requirements assume Class A-60 as the most severe case and typically anticipate testing with insulation schemes in place. However, for some designs, the lack of insulation in a Class A configuration may cause a more severe or different type of hardship during the test.

Finally, a test program is outlined and basic cost estimates are provided for each type of testing. The nominal goals are to demonstrate the suitability of some plastic piping materials and some firestops. However, extended goals and testing are also suggested. These include demonstrating the suitability of small scale firestop tests, the implications of different firestop test programs (i.e., deck versus bulkhead or Class A-60 versus Class A), and conducting some basic L3 endurance testing.

* Background

The purpose of this project is to promote the use of plastic or "nonmetallic" piping in shipboard applications. The anticipated benefits of the use of plastic piping are as follows:

- Reduced material costs.

- Simpler and quicker installation.

- Provide new practices competitive with foreign construction practices.

- In many applications, reduced corrosion and contamination problems.

Historically, there has been little use of nonmetallic pipe aboard ships built in the United States. There were no standards or regulatory provisions for nonmetallic pipe use aboard ships until the major rewrite of 46 CFR Subchapter F in 1968 with the addition of §56.60-25, "Nonmetallic materials." Plastic pipe use by U.S. shipyards remained rare or sporadic.

Fiberglass pipe (FGP) was used in some ballast systems, mostly because of the reduced corrosion benefit. The USCG released NVIC 4-83 which was superseded by NVIC 11-86 "Guidelines Governing the Use of Fiberglass Pipe (FGP) on Coast Guard Inspected Vessels." This provided the guidelines or interpretations relative to the most frequently used nonmetallic pipe, FGP, also called glass reinforced plastic pipe (GRP pipe), or fiberglass reinforced plastic pipe (FRP pipe).

Plastic pipe has been accepted by the National Fire Protection Association (NFPA) for automatic sprinkler systems. The USCG released NVIC 10-93 which accepts NFPA Code No. 13, subject to the deletions, modifications and additions contained in the NVIC.

The USCG has been concerned about the potential fire danger posed by piping that could be damaged by or contribute to a fire. Foreign regulatory bodies have been more receptive to using plastic pipe aboard ships, and European shipyard use of plastic pipe has been steadily increasing. Plastic pipe is used extensively in the accommodations for hot and cold potable water, sanitary drain, and vent piping.

Recently, the International Maritime Organization (IMO) passed Resolution A.753(18), "Guidelines for the Application of Plastic Pipe on Ships." The IMO action and the USCG's indicated willingness to follow the IMO guidelines inspired this study of possible applications for plastic piping on U. S. ships.

Use of plastic piping in shoreside structures is very common, and

building codes accommodate its use. Many tests have been conducted to evaluate the flammability of plastic pipe, its behavior in building fires, and various methods of penetrating fire walls with plastic pipe. Some of the bulkhead and deck penetration concepts (fire stops) presented in the NSRP Project No. 6-93-1 reports were adapted from shoreside building practices.

* Regulations

U. S. Coast Guard

46 CFR, Subchapter F

The USCG regulations pertaining to nonmetallic pipe are contained in 46 CFR 56.60-25, (Subchapter F). These regulations deal primarily with PVC pipe, and relevant ASTM specifications are cited. Other materials "may be authorized by the Commandant (G-MTH)." The properties of the material must be submitted. The material must be tested for extent of burning, time of burning, and the minimum oxygen concentration to support candle-like combustion. (Clearly, under IMO Resolution A.753(18), it would be better have IMO flammability testing and related smoke testing.)

The regulations require metallic spool pieces and valves for watertight bulkhead penetrations. Plastic pipe within concealed spaces in the accommodations must be enclosed by Class "A" divisions or protected by an approved smoke detection system. Penetration methods for Class "A" and "B" fire bulkheads are approved on a case by case basis. Plastic pipe used for potable water must have National Sanitation Foundation Testing Laboratory (NSF) approval. Applications in vital systems are required to include duplicate steel piped units.

NVIC 11-86

NVIC 11-86 was issued by the USCG to specifically address the use of fiberglass reinforced plastic pipe. The NVIC lists the systems in which FGP could be used, and the considerations required for each such application. (Generally, this NVIC has been replaced by ASTM F1173, Epoxy Resin Fiberglass Pipe and Fittings to be used for

Marine Applications.)

Prohibited uses are also listed. In order for fiberglass pipe to be considered for a use that is prohibited, the pipe must pass a fire test to prove that it is equivalent to steel. Three sample lengths of pipe are to be tested: one pipe dry, one pipe filled with fluid to a depth of 10% of its diameter, and one pipe full of fluid at service pressure. The test specimens must survive a 1,700°F fire for 60 minutes.

The NVIC addresses the problem of electrostatic charge buildup. Electrical conductive pipe is required in tanks containing flammable or combustible fluids. Fully conductive pipe is required in such tanks next to pump rooms. Maximum electrical resistance to ground values are given as 1 megohm for pipe in tanks and 0.2 megohm for "fully conductive" pipe.

The following statement in the NVIC is of particular significance:

"It has long been recognized that the proper installation of metallic pipe and fittings requires qualified welders following proper welding procedures. The use of FGP requires the same degree of care, with respect to installation procedures and qualification of personnel, as that required for metallic pipe."

This consideration must not be overlooked in the quest to reduce the cost of shipboard piping systems.

NVIC 10-93

NVIC 10-93 accepts National Fire Protection Association's sprinkler system design standard known as NFPA 13 (1991 Edition) for shipboard use. The NVIC contains editorial changes to the NFPA code. In this code CPVC pipe is allowed in sprinkler systems as long as the pipe is above a non-combustible ceiling.

*** International Maritime Organization**

IMO Res. A.753(18)

The Guidelines for the Application of Plastic Pipes on Ships, IMO

Resolution A.753(18), provide material design properties and performance criteria. The following topics are covered:

- Internal Pressure
- External Pressure
- Temperature
- Axial Strength
- Impact Resistance
- Fatigue
- Ageing
- Erosion Resistance
- Fluid Absorption
- Material Compatibility

In addition to basic material flammability testing, the IMO Resolution also provides a Fire Endurance Requirements matrix of piping systems versus area of ship, e.g. Sanitary Drains in Accommodations. The matrix identifies whether plastic pipe can be used in the application, and if so, what the fire endurance requirements are. The entries in the matrix are as follows:

L1 Fire endurance test in the dry condition, 60 minutes of endurance

L2 Fire endurance test in the dry condition, 30 minutes of endurance

L3 Fire endurance test in the wet condition, 30 minutes of endurance

0 No fire endurance test required

NA Not applicable

X Metallic materials having a melting point greater than 925°C (1,697°F) are required

L1 and L2 Fire Endurance Tests

The fire endurance test in the dry condition (no fluid in the piping) is

a furnace test. The specified time-temperature curve reaches 1,098°C (2,008°F) at the end of 30 minutes and 1,100°C (2,012°F) at the end of 60 minutes (to simulate a small oil fire in the bilges). The test specimen is made up with representative joints and fittings and any insulation. The piping is charged with nitrogen at 0.7 bar (~10 psi), and the pressure is monitored to detect any leakage. After cooling, the piping is tested with liquid to its rated pressure and checked for leaks.

The pipe must survive for 60 minutes to receive the "L1" rating and must survive for 30 minutes to receive an "L2" rating.

L3 Fire Endurance Tests

The fire endurance test in the wet condition (piping filled with water) uses a propane fueled multiple burner. The burner is adjusted to produce a heat flux of 113.6 kW/m^2 at 12.5 cm (~5") above the burners (i.e., the location of the bottom of the pipe). A 1.5 m (~5 ft) length of pipe with joints and fittings and any insulation is placed on two V-shaped supports. Only valves and straight joints are to be tested. The pipe ends are closed. One end is connected to a pressurized water supply. The pipe is filled with deaerated water and fitted with a relief valve. During the 30 minute test, only slight weeping through the pipe wall is allowed. After cooling, the piping is tested to its rated pressure with liquid and checked for leaks.

Miscellaneous Additional Requirements

Additional requirements cover flame spread, smoke generation, toxicity and electrical conductivity. Appendix 3 of the IMO Resolution describes the modifications to the flame spread test, or "radiant panel" test of IMO Resolution A.653(16). These modifications relate to the differences in testing round, pipe shaped surfaces versus flat bulkhead lining type surfaces. Reference (17) discusses the development of this test method and reference (18) explores potential applications with intumescent coatings. The details of the test method are described below.

The smoke generation and toxicity criteria are not spelled out in the resolution. Annex 1 of the 30 June 1994, IMO Sub-committee on Fire

Protection, "Formulation of Fire Test Procedures, First report of the working group" contains the draft interim standard for measuring smoke and toxic products of combustion. This interim standard refers to the test procedure in ISO 5659, Part-2, which is in the "Draft International Standard (DIS)" stage.

The electrical conductivity requirements of Resolution A.753(18) are similar to those of NVIC 11-86. Electrically conductive pipe is required for pipe that passes through a hazardous area or contains refined products and distillates. The resistance per unit length of the pipe, bends, elbows, fabricated branch pieces, etc., should not exceed 100 picoohm/meter, and the resistance to earth from any point in the piping system should not exceed 1 megohm.

IMO Resolution A.754(18), "Recommendation on Fire Resistance Tests for "A", "B" and "F" Class Divisions" is adopted for fire testing of penetrations in Class "A" or "B" fire divisions.

Metallic spool pieces and valves are only required in watertight bulkheads that are also fire divisions.

Description of Flammability Test Methods (14)

The IMO/LIFT Method

In the United States, there are two test methods which utilize the same apparatus. ASTM E1321 has become known as the "LIFT" method (for "Lateral Ignition and Flame Travel"), while ASTM E1317, "Standard Test Method for Flammability of Marine Surface Finishes", has become known as the "IMO/LIFT" method because it is based on IMO Resolution A.653(16). This test method was designed for evaluating the ignitability and surface flame spread characteristics (in a lateral direction) of specimens exposed to a variable surface radiant flux fluid. The apparatus requires a 6.1 in. (155 mm) x 31.5 in. (800 mm) specimen mounted vertically, with its long axis extending horizontally. The specimen is positioned at a 15° angle to a gas-fired radiant panel. The radiant panel creates a heat flux at the surface of the specimen ranging from approximately 50 kW/m^2 at the end of the specimen closest to the radiant panel, to near O kW/m^2 at the far end of the specimen. A pilot flame provides a source

of ignition at the hot end. Observations and measurements are made of the time of ignition, the rate at which flame travels laterally across the surface of the specimen, the distance along the centerline of the specimen surface at which the flame self-extinguishes, and the heat released by the specimen (calculated from the temperature rise of the gases in the exhaust duct). Heat flux as a function of distance along the length of the specimen is determined during calibration of the apparatus. Most of the test results are related to the flame travel along the surface of the specimen as a function of this heat flux.

The critical parameters calculated in this method are as follows (taken from ASTM E1317-90):

- Heat for ignition (MJ/m^2) - the product of time from initial specimen exposure until the flame front reaches the 150-mm position and the flux level at this position, the latter obtained in prior calibration of the apparatus.

- Heat for sustained burning (Q_{sb} in MJ/m^2) - the product of time from initial specimen exposure until the arrival of the flame front, and the incident flux level at that same location as measured with a dummy specimen during calibration. The value reported is the average of the values determined for a series of locations along the specimen (i.e., every 50 mm starting at the 150 mm position and continuing for the extent of the flame travel).

- Critical flux at extinction (CFE in kW/m^2) - a flux level at the specimen surface corresponding to the distance of farthest advance and subsequent self-extinguishment of the flame on the centerline of the specimen.

- Peak heat release rate (q_p in kW) and total heat release (Q_t in MJ) - the peak and the area under the curve, respectively, in the observed heat release (vs. time) under the variable flux field imposed on the specimen and measured as defined by this test method (i.e., by the response of a bank of thermocouples in the exhaust stack relative to a series of calibration burns).

- Flux at the 50 mm position (kW/m^2) - this is a calibration check, not a measurement dependent on the specimen to be tested;

however, this value is the maximum flux to which the specimen was exposed.

The IMO acceptability criteria are as follows:

Surface Flammability Criteria

Source	CFE	Q_{sb}	Q_t	q_p
Blkd. req.[9]	≥20.0	≥1.5	≤0.7	≤ 4.0
Floor req.	≥ 7.0	≥0.25	≤1.5	≤10.0

* Promising Applications

Non-vital (Non-essential) Systems

Based on the application matrix of IMO Resolution A.753(18), the most promising cost saving applications for accommodations are those that do not require fire endurance, i.e., applications that have a "0" in the matrix cell. Examples of such systems are as follows:

- Non-essential Seawater Systems
- Non-essential Freshwater Systems, including hot/cold potable water
- Condensate Return
- Internal Deck Drains
- Internal Sanitary Drains
- Sounding and Vent Piping from water tanks or dry spaces

Level 3 Systems

[9] The bulkhead requirements apply to bulkhead, wall and ceiling linings, and have also been adopted as the criteria applicable to plastic piping.

Some of the systems required to meet Level 3 fire endurance may also be good candidates for cost savings. Level 3 is 30 minute endurance for the pipe full of fluid. Two such systems in the accommodations are as follows:

- Fire Sprinklers

- Essential Freshwater Cooling

On cargo vessels the bulkheads in the accommodations are usually "B-0" with some "A-0" bulkheads/decks around stairwells, machinery rooms and large storerooms. Decks are generally required to be of steel although Class "A-0" is not strictly imposed. Class "A-60" bulkheads/decks are required around control stations, around the emergency generator room, and between the main machinery space and the accommodations.

U.S. standard practice extends the Class "B-0" bulkheads from deck to deck, often with a sheet metal steel curtain spanning from the top of the joiner panel to the underside of the deck above. With this arrangement the potable water, sanitary drain and vent piping tend to penetrate a number of Class "B-0" divisions. Figures 1 and 2 in NSRP Project No. 6-93-1 show typical U.S. bulkhead design with sanitary drain piping where the pipes are run down the corridors to minimize the number of penetrations. Actually, the piping would be just below the deck in the overhead of the corridor below.

European standard practice uses Class "B-0" ceiling panels, leaving large open areas above the ceilings. Piping can be run through these open areas with a minimum of penetrations. Full bulkheads are still required at fire zone boundaries. On U.S. vessels that have used this bulkhead and ceiling arrangement and plastic piping, the USCG has required smoke detectors in the ceiling spaces per current regulations. However, this has had only a small impact upon vessel cost partially due to the cost of the extra detectors above the false ceiling.

* Material Selection

The nonmetallic piping materials recommended for testing include those that have already seen some use aboard ship, PVC and fiberglass

reinforced plastic. Also, CPVC and PVDF are considered because of their excellent performance in fire situations.

ABS piping is used in residential sanitary drain and vent systems, but because of its low Limiting Oxygen Index, (LOI = 19), it has not been considered here. Polyethylene pipe is not considered for the same reason, (LOI = 18). Both of these piping materials could be a source for fire and could continue burning on their own, thus spreading the fire.

Polyvinylchloride, (PVC)

PVC is the most common plastic pipe. Its cost is reasonable; it is easy to cut, and the solvent cement welded joints are easy to make-up on board the ship. In general, PVC piping performs well and resists corrosion at ambient temperatures.

PVC has a limiting oxygen index of 40-49 which is double the atmospheric concentration of oxygen. Therefore, when the flame source is removed, PVC will stop burning.

Testing studies have been conducted by the United States and Japan using the IMO Res. A.653(16) / ASTM E1317 test modified for plastic pipe per Appendix 3 of IMO Res. A.753(18). PVC proved to be marginal to slightly deficient in *Total Heat Release*, i.e. values were above the limit (limit: $Q_t \leq 0.7$ MJ) with values that ranged from 0.78 to 1.06 MJ.

In the U.S. study, two of the three PVC pipe samples were deficient in *Critical Flux at Extinguishment*, i.e. values below the limit (limit: CFE $\geq$ 20.0 kW/m^2). However, the lowest value of CFE in the Japanese study was around 36 kW/m^2. Since these test results are measured from a radiant panel test, they may be very sensitive to the surface finish, color, or even surface treatment of the pipe.Also, the wall thickness of the pipe clearly is a significant factor in such tests.

PVC is used shoreside for cold potable water, and most U.S. PVC formulations are approved by NSF. PVC softens at moderate temperatures and is therefore not recommended for hot potable water service. At 110°F PVC's strength is approximately 50% of its

strength at 75°F. At 130°F PVC's strength is approximately 30% of its strength at 75°F.

Chlorinated Polyvinylchloride, (CPVC)

CPVC is suitable for hot potable water service. CPVC can be used for fluid temperatures up into the 170-180°F range. Both samples of CPVC pipe used in the U.S. studies met all of the IMO Res. A.653(16) limits. The 62-67% chlorine content in CPVC makes it more temperature and flame resistant than PVC which only has 53-56% chlorine.

Smoke and toxicity tests to the IMO (Draft MSC) Interim Standard were not found. The Japanese study used the ASTM E662 test as has most of the tests for shoreside applications. Both PVC and CPVC produce smoke when burned including carbon monoxide and hydrogen chloride. However, investigations of smoke and gases in actual shoreside fires indicate that the quantities of smoke and toxic gases found in fires of structures with plastic piping are no different than those found in structures with metallic piping.

Piping in the accommodations area of a ship is usually behind or above some panel. Since most fires in accommodation areas start in the open area of a stateroom, the piping will become involved at a later stage. By then the occupants should be gone from the space, and any firefighting personnel should be equipped with breathing apparatus.

Some specialty CPVC piping has received UL approval for use in sprinkler systems. One such CPVC pipe is BlazeMaster®. It has passed exposed (direct flame) piping tests for shoreside sprinkler systems. BlazeMaster® also has NSF approval for use in potable water systems.

CPVC pipe costs approximately 2.5 times that of PVC. The raw material cost is higher than PVC, and CPVC is more difficult to extrude than PVC. The installation of CPVC is as easy as PVC. The correct (higher temperature) solvent cement must be used.

Fiberglass Reinforced Plastic, (FRP)

FRP pipe (or fiberglass pipe, FGP, or glass reinforced plastic pipe, GRP pipe, etc.) is made from a variety of resins with various structures or layering. The studies conducted by the U.S. and Japan tested fiberglass pipe made from phenolic resin, epoxy resin and vinylester resin. The phenolic resin pipe was the only sample that met all of the IMO Res. A.653(16) limits. The phenolic resin pipe used in the Japanese study failed to meet *Total Heat Release* and *Critical Flux at Extinguishment* limits. Reference (14) discusses recent developments that allow compliance with the L3 endurance criteria as well as the flame spread and smoke requirements.

Since FRP pipe is "built up" in the manufacturing process, the structure or layering of FRP pipe varies widely. Some FRP pipe constructions are fully wound from glass fiber and resin. Some have a gel and fiberglass mat interior with wound glass fiber and resin exterior. Some have a PVC liner. The exterior is usually wound glass fiber and resin. The winding is performed by machine and is patterned to produce tangential and lengthwise strength.

Conductive materials can be incorporated into the FRP pipe as layers on the inside or outside or mixed in with the windings.

Polyvinylidenefluoride, (PVDF)

PVDF is virtually non-flammable and has a UL 94 test rating of V-0. Pipe made of PVDF maintains a high proportion of its strength throughout a temperature range of -40^{o}F to 280^{o}F. PVDF is resistant to most chemicals. These qualities are desirable for all shipboard applications. However, high price, difficulty of joining, and lack of application experience are drawbacks.

Fittings must be joined using the socket fusion method conforming to ASTM D2657. This requires a heating tool to heat the pipe and fitting to melting temperature. The two are then quickly forced together, and they fuse.

At present PVDF piping is very expensive (but less than stainless steel) and is used primarily in applications requiring high purity, such as laboratory piping. PVDF may become a viable candidate for

shipboard use, if widespread shoreside use brings the price down and shows that the socket fusion method of joining can be easily accomplished "in the field."

Additives in General

The properties of plastics can be modified by adding other substances to the mix before extrusion or forming. Usually, an additive that improves one quality of the plastic will have a negative effect on some other quality. A additive that improves fire resistance may lower tensile strength or reduce impact resistance. An additive that makes the plastic easier to extrude may reduce the temperature tolerance or fire resistance.

For piping that is to be used in potable water systems, the variety of additives is restricted to those that are not harmful to humans. Even the pigment that gives the plastic a desirable color may be a dangerous substance that leaches into the water flowing through the pipe.

Manufacturers are reluctant to produce specialty formulations unless there is a large market for plastic with those properties. However, future development and testing may find a superior additive that makes a certain type of plastic the ideal material for pipe aboard ship. See references (58) through (61) in the original study for further information.

* Insulation Schemes

Two insulation schemes have been used with plastic or fiberglass reinforced plastic pipe. One scheme wraps the pipe with a mineral fiber blanket. The other coats the pipe with an intumescent substance. An intumescent substance expands and chars when subjected to high heat or flame. The increased thickness and char insulate the surface underneath (Note: Insulation materials must meet 46 CFR 164.007 or 164.009 requirements). New developments with intumescent coatings and spray-on insulation may accelerate the feasibility of non-vital and vital system applications. See references (18) and (19) for further information.

Mineral Fiber Blanket

The FireMaster® Plastic Pipe System wraps the entire length of plastic pipe with up to three inches of FireMaster® blanket. Using the ASTM E119 test, three inches thickness gives a one hour fire rating for dry pipe and two hour rating for wet pipe. The insulating blanket is easy to install -- similar to the thermal insulation on exhaust piping in the engine room. The insulation does make the pipe very bulky.

Intumescent Coating

Bondstrand® Series 2000M-FP fiberglass pipe and fittings use a 5 mm to 8 mm coat of Pitt-Char® intumescent coating. Series 2000M-FP pipe can withstand a 2,000^{o}F hydrocarbon fire for 10 minutes in the dry condition, and for up to 6 hours in the full-flow wet condition.

* Fire Stops

Fire stop designs range from passive to active types. Passive designs use insulation of the pipe at the penetration, a metal sleeve (sometimes with insulation), or manufactured transits. Active designs include a spring loaded guillotine to cut off the heat softened pipe or a falling plug that is released at high temperature. Intermediate types employ intumescent wraps or coatings. The use of fire stops at the fire bulkhead or deck only implies that the plastic pipe on the side with the fire is expendable.

Passive Fire Stops

On cargo vessels, Class "A" bulkheads need to keep out flame and smoke for one hour and Class "B" bulkheads must keep out flame for 30 minutes. Class "B" bulkhead integrity can be maintained with just thick insulation around the pipe at the penetration. Adding a metal sleeve that encircles the pipe for sufficient distance either side of the bulkhead can upgrade the fire stop to Class "A". These systems rely upon the plastic pipe remaining intact at the penetration and on the unexposed side, i.e. the pipe must be insulated sufficiently that it does not burn or melt away leaving a hole.

Manufactured transits have a metal frame which is welded to the

bulkhead and rubber blocks which are molded to fit around electrical cable or pipe. There is usually a screw down clamping arrangement that compresses the blocks tightly around the electrical cable or pipe. Such transits have been approved by the USCG for use with electrical cable. The rubber blocking material tends to char during a fire, but maintains the seal around the cable. When applied to plastic pipe, two such transits may have to be used back-to-back with insulation between them. This is to preserve the plastic pipe on the unexposed side to keep the hole closed. However, at least one manufacturer claims that his standard transits are suitable for plastic pipe.

Semi-active Fire Stop Designs

An intumescent coating or wrap between the plastic pipe and a metal sleeve can be used to completely close off the pipe during a fire. The outer metal sleeve forces the intumescent material to expand inward only. The expanding intumescent material squeezes the heat softened plastic pipe and closes off any path for flame and smoke.

Perhaps something as simple as a high temperature cloth furnace screen can be used for Class "B" bulkhead penetrations. In laboratories and pottery shops, such screens prevent the heat from furnaces or kilns from spreading out into the lab or shop. Furnace screens usually hang by gravity, and vessel list or trim may reduce their effectiveness.

Active Fire Stop Designs

The spring loaded guillotine is mounted in a metal frame that is welded to the bulkhead. A fusible link releases the spring which forces the blade through the fire softened plastic pipe. The blade closes off the opening formerly occupied by the pipe. Installation of these devices may require strict safety measures, because the spring is strong and the blade is sharp.

The ProSet® falling plug design works best with vertical through-deck penetrations. A 45° degree wye lateral is fitted just above the deck. In the branch of the wye a cast iron plug is suspended in a

temperature sensitive polyethylene harness. When the heat melts the polyethylene harness, the plug falls into the pipe. The section of plastic pipe that penetrates the deck is lined with a cast iron sleeve -- on the inside. This reduces the corrosion resistance advantage of using plastic pipe. The effects of list and trim would also have to be considered.

Fire Stop Testing

Some fire stop designs incorporate a combination of the above concepts, and new ideas for fire stops appear frequently, particularly for shoreside applications.

Under IMO Resolution A.754(18), testing of a fire stop design requires testing with the fire stop installed in a standard Class "A-60" bulkhead or deck. The standard bulkhead is approximately 8 ft by 8 ft, and the standard deck is approximately 8 ft by 10 ft. Testing each fire stop design in such a large panel is quite expensive. The conceptual ideas for fire stops are so varied and numerous that there should be a less expensive test that could evaluate the effectiveness of a bulkhead or deck fire stop. Shoreside testing of fire stops now use the ASTM E814 test which uses a smaller section of panel. Also, the need to test bulkhead firestops that pass deck firestop testing seems questionable.

The bulkheads and decks in the accommodations are usually Class "A-0", "B-0", or "B-15". Some of the fire stop designs rely on the plastic pipe surviving on the unexposed side to keep the bulkhead or deck sealed. Plastic pipe loses all strength and melts at 300-400° F. A Class "A-60" bulkhead or deck limits the temperature rise on the unexposed side; a Class "A-0" bulkhead does not. Therefore, testing a fire stop in a standard Class "A-60" bulkhead may not be the most realistic or worst case test for the fire stop design.

* Conclusions

At least three plastic piping materials appear to be usable aboard ship. PVC is the least expensive plastic pipe material, but PVC may have difficulty passing some of the IMO fire test requirements. CPVC satisfies all fire test requirements; it is in common use; and CPVC can

be easily joined. PVDF is great from a flammability stand point, but high cost, little experience and special joining methods are drawbacks.

Additionally, one to three fiberglass pipe constructions are candidates for use aboard ship. Phenolic resin fiberglass pipe passes the fire test requirements, but manufacturing difficulties make it scarce. Epoxy resin and vinylester resin fiberglass pipe fails the fire tests, but addition of insulation or an intumescent coating may solve this deficiency. Improved phenolic resin designs have recently passed the basic flammability and smoke requirements as well as the L3 endurance testing requirements.

Mineral fiber blanket insulation, sprayed-on fireproofing, and intumescent coatings are viable insulation schemes where basic flammability or fire endurance may be needed.

Fire stops for plastic pipe penetrations of Class "A" and "B" bulkheads and decks need to be tested to the IMO standards. Innovative designs should be examined, and if found practical, they should be tested. In order to reduce costs, testing in smaller bulkhead/deck panels is recommended. Practical test sequences need to be determined to ensure that the worst case scenarios are included. In general, effective deck penetrations are more difficult to design than bulkhead penetrations, because the underside of the deck is bathed in trapped, hot gasses. The need to retest bulkhead penetrations that have passed the deck penetration test should be evaluated.

The next section briefly outlines a test program to further promote the use of plastic piping within accommodation areas aboard ship. Before undertaking such a program, the USCG should be consulted to obtain guidance on the following issues:

Material Tests

1. Smoke and Toxicity Testing -- Should the "Draft MSC Resolution Interim Standard for Measuring Smoke and Toxic Products of Combustion" be followed for the smoke and toxicity testing? Is the ASTM E662 test an acceptable alternative?

   (Note: References (15) and (16) provide background and data on

these questions. Also see the draft Fire Test Procedures Code.)

2. Can insulation or intumescent coatings be used to help pass the radiant panel fire test? (While the answer should be "Yes", arrangement of the sample or other issues may need to be discussed.)

3. Are there any guidelines for the testing of different piping wall thicknesses?

Fire Stop Tests

4. The existing UL deck furnace accommodates a 7.5 ft by 8.5 ft panel. The IMO Res. A.754(18) requires a standard deck panel of 2.420 m by 3.020 m (7.94 ft by 9.91 ft). Can the present UL deck furnace be used to show compliance with IMO, or must it be modified to provide a larger opening? The modification will cost on the order of $30,000 to $35,000.

5. Will the USCG accept small panel, deck and bulkhead fire stop tests, as is done in shoreside practice? Must a correlation be proven between full panel and small panel tests?

6. What type of testing should be done for fire stops to show that the worst case is covered? Is testing in an "A-60" bulkhead/deck always the worst case? If not, what range of tests must be done to include Class A-O, etc. For fire stop designs that are intended for installation in either deck or bulkhead, would acceptable performance in a deck fire stop test be sufficient to obtain approval for use as a bulkhead fire stop?

* <u>Recommendations</u>

The goal of the following outlined test program is to develop, as a minimum, some practical, approved plastic piping materials and suitable bulkhead/deck penetration fire stops to permit U.S. shipyards to utilize plastic piping for non-essential systems in accommodation areas.

Promising materials are PVC, CPVC, PVDF and phenolic resin

fiberglass pipe. Other type resin fiberglass pipe may be acceptable with additives, insulation, or coating. Several plausible fire stop arrangements are available.

Related issues that could be explored include the relationship between large panel and small panel fire stop tests, and the worst case scenario for various fire stop ratings. The testing scope could be extended to include L3 fire endurance tests to allow a broader range of piping systems in the testing program.

Materials

IMO Res. A.653(16) as modified by IMO Res. A.753(18) Appendix 3 - Radiant Panel Tests:

Testing of PVC should be continued. Manufacturers should be asked to recommend different formulations (additives) to be considered. PVC pipe with different pigments or with a reflective coating (aluminum paint?) should also be tested. The wall thickness of the piping sample is probably a key factor in passing these tests. Flat substrates may test differently than samples made from pipe.

Testing of CPVC and phenolic resin fiberglass should be repeated, unless the USCG is willing to accept the previous tests as proving suitability of these materials.

PVDF should be added to the testing program, if sufficient funding is available.

Estimates from Underwriters Laboratories for IMO Resolution A.653(16) tests, three tests per series, are: $800 for first series, $300 for each additional series, plus, $95 per series for materials.

ISO 5659, Part 2 (Draft MSC Resolution Interim Standard for Measuring Smoke and Toxic Products of Combustion):

PVC, CPVC, PVDF and other materials passing the above radiant panel tests should be tested. Any additives or coatings should be included in the tests. The need for toxicity testing, which is very expensive, should be discussed with the USCG.

Estimates from Underwriters Laboratories for ISO 5659 tests, nine tests per series, are: $1,350 for first series, $720 for each additional series, plus, $100 per series for materials.

Fire Stops

New innovative fire stop designs should be developed. The UL Fire Resistance Directory, Volume II and the sketches included as Figures 3 through 11 of NSRP Project No. 6-93-1 can be used as a starting point for developing new fire stop designs. Many of these designs use metal sleeves, insulation and metal sleeve combinations, or sleeves surrounding intumescent materials.

Existing fire stop designs that have been approved for shoreside use or for shipboard electrical cable use should be tested. These include the Orion Impeder™, the ProSet™ Code Red Firestop Devices, and the ROX System cable transit, and similar devices.

Small Panel Tests

Preliminary small panel fire tests approximating the IMO Resolution A.754(18) full panel tests should be run to cull out unworkable fire stop systems. UL's new vertical panel furnace is about the size needed for such tests. The shoreside fire stop testing standard, ASTM E814 (ANSI/UL 1479), should be used for guidance.

Estimates from Underwriters Laboratories for small deck type panel tests are: $5,000-$6,000 per test for set-up, plus, $1,500 for materials and $500 for a steel plate to hold the penetration.

IMO Resolution A.754(18) - Large Panel Tests

If the USCG does not feel that the small panel tests are equivalent, then successful fire stop systems can be tested using the IMO full panel test. More than one fire stop arrangement can be tested at a time, but failure of any one fire stop may influence the test results or lead to stopping the test. Both bulkhead panel tests and deck panel tests should be conducted. For actual shipboard applications, bulkhead testing may need to be given priority.

Estimates from Underwriters Laboratories for large panel tests are: $10,000-$15,000 per test for set-up, plus, $5,000 for materials. If the furnace opening has to be enlarged for the IMO deck tests, an additional $30,000-$35,000 will be required.

Insulation

IMO Resolution A.753(18) Appendix 2 - L3 Fire Endurance Tests:

Insulation schemes such as mineral fiber blankets, sprayed-on fireproofing, and intumescent coatings should be tested with all of the piping materials passing the flammability and smoke tests. These tests should determine insulation/coating thicknesses required to meet the IMO L3 fire endurance level.

Rough estimates from Underwriters Laboratories for the L3 fire endurance tests from IMO Resolution A.753(18) Appendix 2 are: $300 per pipe, $400 for the report, plus, $1,600 to $2,000 for the burner assembly and set-up. This does not include the cost of the test samples: the plastic pipe, end caps, insulation/coating, etc.

o ABS Plastic Piping Requirements

The ABS requirements for plastic piping and penetrations are summarized above under general requirements. They are basically the same as the USCG's requirements, which are summarized below for reference. As shown in the ABS Rules outlined below, ABS is willing to accept installations in accordance with IMO Resolution A.753(18), "Guidelines for the Application of Plastic Pipes on Ships". The 1997 edition of the ABS Rules was revised to include these new requirements.

Although ABS has not reviewed the final report in NSRP Project No. 6-93-1 in detail, the general methods, comments, references, etc. should be acceptable to ABS since this presentation primarily dealt with Resolution A.753(18). If ABS is unfamiliar with a proposed standard, it would be appropriate to provide ABS with a copy of the standard and background on its use, as a minimum. Such issues should be discussed with the ABS project manager.

Appendix 6.2 shows flow diagrams of typical acceptance processes for plastic piping in projects worldwide and domestically.

The following are the essential citations and sections regarding ABS plastic piping and penetration requirements:

Cite	Description
4/6.14	Plastic Pipes
4/6.14.1	General

- Pipes and piping components made of thermoplastic or thermosetting plastic materials, with or without reinforcement, may be used in piping systems referred to in Table 4/6.4.

- "Plastic" means both thermoplastic and thermosetting plastic materials, with or without reinforcement, such as polyvinyl chloride (PVC) and fiber reinforced plastics (FRP).

4/6.14.2 Specification

- Rigid plastic pipes are to be in accordance with a recognized national or international standard acceptable to the Bureau.

- Plastic piping specifications must be submitted for review including thermal and mechanical properties, chemical resistance, and piping support spacing.

4/6.14.3 Design

- a. Internal Pressure
  - * The maximum internal pressure, P_{int}, for a pipe is to be the lesser of the following:
    $P_{int} = P_{sth}/4$ or $P_{int} = P_{lth}/2.5$
    P_{sth} = short-term hydrostatic test failure pressure
    P_{lth} = long-term hydrostatic test failure pressure (>100,000 hours)

  - * The hydrostatic test failure pressure may be verified experimentally or determined by a combination of testing and calculation methods, which are to be

submitted to the Bureau for approval.

- b. External Pressure
  - * A pipe is to be designed for an external pressure not less than the sum of the pressure imposed by the maximum potential head of liquid outside the pipe plus full vacuum, 1 bar (1 kgf/cm^2, 14.5 psi), inside the pipe.

- c. Axial Strength
  - * The sum of the longitudinal stresses due to pressure, weight, and other dynamic and sustained loads is not to exceed the allowable stress in the longitudinal direction.

  - * For fiber reinforced plastic pipes, the sum of the longitudinal stresses is not to exceed one-half of the nominal circumferential stress derived from the maximum internal pressure.

- d. Temperature
  - * The maximum allowable working temperature of a pipe is to be in accordance with the manufacturer's recommendations.

  - * It is to be at least 20 C (36F) lower than the minimum heat distortion temperature of the pipe material determined according to ISO 75 method A.

- e. Impact Resistance
  - * Plastic pipes and joints are to have a minimum resistance to impact in accordance with a recognized national or international standard such as ASTM D2444 or equivalent.

  - * After the impact resistance is tested, the specimen is to be subjected to hydrostatic pressure equal to 2.5 times the design pressure for at least one hour.

- f. Fire Endurance
  - * Table 4/6.4 specifies fire endurance requirements for

pipes based upon system and location. Where a fire protective coating for pipes and fittings is necessary for achieving the fire endurance standard required, the following requirements apply.

- o Pipes are generally to be delivered from the manufacturer with the protective coating applied, with on-site application limited to that necessary for installation purposes (i.e., joints).

- o It is to be demonstrated that the coating is resistant to products likely to come in contact with the piping.

- o In considering fire protection coatings, such characteristics as thermal expansion, restistance against vibration, and elasticity are to be taken into account.

- o The fire protection coatings are to have sufficient resistance to impact to retain their integrity.

- g. Flame Spread
  - * All pipes, except those fitted on open decks and within tanks, cofferdams, void spaces, pipe tunnels and ducts are to have low flame spread characteristics.

  - * The test procedures in IMO Resolution A.653(16) are to be used for determining the flame spread characteristics. Piping materials giving average values for all of the surface flammability criteria not exceeding the values listed in Resolution A.653(16) (surface flammability criteria of bulkhead, wall and ceiling linings) are considered to meet the requirements for low flame spread.

  - * Alternatively, flame spread testing in accordance with ASTM D635 may be used in lieu of the IMO flame spread testing provided such tests are acceptable to the

Administration.

* Using the Self-Extinguishing Testing test procedure in ASTM D635, this requirement is satisfied if none of the ten or no more than one in twenty specimens burn to the 100 mm mark.

- h. Electrical Conductivity
  * Piping conveying fluids with a conductivity less than 1000 pico siemens per meter are to be electrically conductive.

  * Regardless of the fluid being conveyed, plastic pipes are to be electrically conductive if the piping passes through a hazardous area.

  * Where electrically conductive pipe is required, the resistance per unit length of the pipes and fittings is not to exceed 1×10^5 Ohm/m (3×10^4 Ohm/ft).

  * If the pipes and fittings are not homogeneously conductive, the conductive layers are to be protected against the possibility of spark damage to the pipe wall.

- i. Marking
  * Identification is to include pressure ratings, the design standard that the pipe or fitting is manufactured in accordance with, and the material with which the pipe or fitting is made.

4/6.14.4 Installation of Plastic Pipes

- a. Supports
  * Selection and spacing of pipe supports in shipboard systems are to be determined as a function of allowable stresses and maximum deflection criteria. Support spacing is not to be greater than the pipe manufacturer's recommended spacing.

- b. External Loads
    * Allowances are to include at least the force exerted by a load (person) of 980 N (100 kgf, 220 lbf) at mid- span on any pipe more than 100 mm (4 in.) nominal diameter.

    * Pipes are to be protected from mechanical damage where necessary.

- c. Plastic Pipe Connections
    * The strength of fittings and joints is not to be less than that of the piping they connect.

    * Joining techniques are to be in accordance with manufacturer's installation guidelines.

- d. Electrical Conductivity
    * Where electrically conductive pipe is required by 4/6.14.3h, installation of the pipe is to be in accordance with the following:
        o The resistance to earth (ground) from any point in the system is not to exceed 1 megohm.

        o Where used, earthing wires or bonding straps are to be accessible for inspection.

- e. Shell Connection
    * Where plastic pipes are permitted in systems connected to the shell of the vessel, the valves and the pipe connection to the shell are to be metallic. The side shell valves are to be arranged for remote control from outside the space in which the valves are located.

- f. Bulkhead and Deck Penetrations
    * The integrity of watertight bulkheads and decks is to be maintained where plastic pipes pass through them.

    * Where plastic pipes pass through "A" or "B" class divisions, arrangements are to be made to ensure that the fire endurance is not impaired. These arrangements

are to be tested in accordance with IMO Resolution A 754 (18), Recommendation on Fire Resistance Tests for "A", "B" and "F" Class Divisions.

* If the bulkhead or deck is also a fire division and destruction by fire of plastic pipes may cause inflow of liquid from a tank, a metallic shut-off valve operable from above the bulkhead deck is to be fitted at the bulkhead or deck.

- g. Application of Fire Protection Coatings
  * Fire protection coatings are to be applied on the joints, where necessary for meeting the required fire endurance criteria, after performing hydrostatic pressure tests of the piping system.

4/6.14.5 Manufacturing of Plastic Pipes

- Preferably, the manufacturer is to have a quality system and be certified in accordance with 4/1.2 or ISO 9001.

- Samples of pipe are to be tested to determine the short-term and long-term hydrostatic design strength.

- For piping required to be electrically conductive, representative samples of pipe are to be tested to determine electrical resistance per unit length.

- Samples of pipe are to be tested to determine the adhesion qualities of the coating to the pipe.

- Each length of pipe is to be tested at the manufacturer's production facility to a hydrostatic pressure not less than 1.5 times the maximum allowable internal pressure of the pipe.

4/6.14.6 Plastic Pipe Bonding Procedure Qualification

- a. Procedure Qualification Requirements

- b. Procedure Qualification Testing

4/6.14.7 Tests by the Manufacturer-Fire Endurance Testing of Plastic Piping in the Dry Condition (For Level 1 and Level 2)

- a. Test Method
- b. Test Specimen
- c. Test Condition
- d. Acceptance Criteria

4/6.14.8 Test by Manufacturer-Fire Endurance Testing of Water-Filled Plastic Piping (For Level 3)

- a. Test Method
- b. Test Specimen
- c. Test Conditions
- d. Acceptance Criteria

4/6.14.9 Tests by Manufacturer-Flame Spread

- a. Test Method

4/6.14.10 Testing On Board After Installation

- Piping systems are to be subjected to a hydrostatic test pressure of not less than 1.5 times the design pressure.
- For piping required to be electrically conductive, earthing is to be checked and random resistance testing is to be conducted.

Table 4/6.4 Fire Endurance Requirements Matrix (1997)

* Summary

ABS accepts a wide range of plastic piping systems, components,

materials, and penetrations based on international and domestic standards. These standards include the pertinent IMO Resolution, ASTM standards, the USCG adopted standards listed below, and common standards used in shipbuilding worldwide such as those mentioned in NSRP Project No. 6-93-1.

ABS will accept and approve plastic piping and components under their type approval program. Such approvals would then be shown in the ABS List of Type Approved Equipment issued annually. This approval list shows manufacturers, models, other relevant data and restrictions, construction standards, compliance with USCG requirements, etc.

o USCG Plastic Piping and Penetration Requirements Per 46 CFR

The below requirements are expressed in terms of the Shipping regulations in 46 CFR rather than the procedures allowed when other recognized classification societies are authorized to perform these functions.

46 CFR 50.25 discusses procedures and 56.60-25 states specific requirements for plastic and FGP piping and fittings, and flexible hose; NVIC 11-86 expands use of FGP; NVIC 10-93 addresses sprinkler systems; plan review and inspection approval and acceptance procedures are by listing in the bill of materials (MSC), and mill certification, component marking, or letter of approval, and installation inspection (OCMI).

In addition to the above regulatory requirements and interpretations, the USCG is willing to accept installation on the basis of IMO Resolution A.753(18), "Guidelines for the Application of Plastic Pipe on Ships". Since this is a new standard and work at IMO and ISO regarding smoke development and toxicity is ongoing, the best procedure would be to seek conceptual approval first for any proposed application.

With respect to structural fire protection and the use of plastic pipe, emphasis is placed on:

1) minimizing the plastic's contribution to flame spread during the early stages of fire growth, and

2) maintaining the boundary integrity at the penetrations.

In addition, prudent use of this heat sensitive material should ensure that failure does not add fluids or gases to the fire, hinder the performance of needed systems, or create a hazard for personnel during egress or firefighting operations.

46 CFR 56.60-25(a) (3) only permits the use of plastic pipe in concealed spaces of accommodation and service spaces if such piping is within ducts or trunks of Class A construction. This requirement is in addition to the requirement that the surface of the plastic pipe be of low flame spread as described below. Other methods of protecting the pipe may be considered including structural insulation or intumescent coverings.

As an alternative outlined in USCG regulations and policy, the concealed space can be fitted with an addressable smoke detection system meeting 46 CFR 76.27. In this case, plastic pipe, still meeting the low surface flame spread requirements, may be used with the concealed spaces without being enclosed within ducting or a trunk. This option focuses on early detection of the fire under the assumption that evacuation will begin promptly and manual fire suppression will be effective.

46 CFR 56.60-25(a)(2) specifically states that penetrations of Class A and Class B divisions by plastic pipe is prohibited without special precautions being taken to insure that the fire integrity of the divisions is not compromised. Common methods of penetration are discussed below.

Testing methods (flame/smoke/fire endurance):

The USCG policy on the use of plastic pipe is similar to IMO/MSC Circular 580 which has been adopted as IMO Resolution A.753(18) "Guidelines for the Application of Plastic Pipe on Ships". Nonvital pipe must pass the surface flame spread and smoke generation criteria (i.e., see references (15) and (16)) outlined in this document. Vital plastic piping must meet the low surface flame spread and smoke generation requirements and, in addition, pass the fire endurance test as described below.

System Classification:

The classification of the piping system as vital or non-vital should be made by the MSC during initial plan review. As general guidance, vital systems are those which are central to the safe operation of the vessel including damage control operations like firefighting or dewatering. Systems whose failure may create a hazard to personnel or add to existing damage may also be considered vital. Examples of vital systems

include main machinery cooling/control/lubrication, flammable liquid transfer, firemain, ballast, or bilge. Examples of non-vital systems include drainage, grey water, sewage, and potable water.

Fire Endurance Test:

This requirement is intended to ensure that the pipe does not fail prematurely during a fire and is not intended to evaluate the contribution of the plastic pipe to the fire. The test procedure involves a section of pipe supported above a row of gas burners providing direct flame impingement (L3 endurance test) and is described in IMO Resolution A.753(18). A standard fire test may also be used with certain limitations. Nonvital systems need not be tested for fire endurance.

Flame Spread and Smoke Generation Test(s):

These tests are intended to evaluate the piping surface's propensity to ignite and spread flame along its surface, thus adding to the fire hazard in the early stages of fire growth.

The criteria for low surface flame spread and smoke generation may be met by any of the following methods (also see references (15) and (16)):

- 46 CFR 56.60-25
- 46 CFR 164.012 (i.e., ASTM E 84 type testing)
- IMO Resolution A.653(18)
- IMO Resolution A.753(18)
- ISO 5659, Part 2
- ASTM E 662
- ASTM E 1354
- ISO 5660 Part 3 (under development)

The above test methods were not originally designed for testing plastic pipe and thus the cylindrical geometry presents a slight problem. The IMO recommendation is to cut the pipe into strips and attach these strips to the test apparatus. This may be done in ASTM E 84, but will require some time. The effects of using these procedures are somewhat unknown and will at best be used as a screening tool. It is recommended that manufacturers consider producing flat specimens for testing and approval purposes. Obviously, wall thickness is also a factor in some of these tests.

As a possible substitute to the above surface flame spread requirements, the piping

may be covered with approved insulation, intumescent coating, or a noncombustible material. This equivalency shall include proof that the covering will be maintained and perform adequately under all conditions.

Associated components such as vibration dampeners and bracing sleeves need not meet the above requirements. However, pipe hangers, bracing, and load bearing components shall be steel or equivalent material and shall not be heat sensitive.

Piping Penetrations
Ref: 46 CFR 72.05, 56.60-25
Tests: ASTM E 814, UL 1479, MIL-P-24705,
IMO Resolution A.754(18)

Piping penetrations shall not degrade the integrity of fire rated bulkheads or decks, and notice should be taken of Subchapter F, specifically 46 CFR 56.50-1, dealing with plastic pipe and other materials considered to be heat sensitive. All installations shall employ good marine practice which may include design aspects other than fire integrity. Some specific requirements include:

- Piping made from heat sensitive materials (meaning they melt at or below 927° C for Class A construction or 821° C for B Class construction) shall not penetrate Class A or Class B divisions unless performance can be proven.

- Steel pipe in steel bulkheads and aluminum pipe in aluminum bulkheads should preferably be welded continuously on one side for Class A penetrations. Class B penetrations shall be close fitting. Class C penetrations shall reasonably allow the penetration of the pipe without making the clearance unnecessarily large.

- Piping penetrations through smoke tight Class C barriers for type 5A spaces should be mechanically supported and smoke tight as generally defined for Class A construction.

- Piping is required to be insulated to the same level of performance (thickness) as required for the bulkhead. This insulation shall be applied for a distance of 30 cm on the side of the bulkhead that is insulated.

Pipe penetrations must be fitted as described in current USCG NVICs. However, bolted connections are not permitted for pipe penetrations in any bulkhead or deck.

If the piping is constructed of heat sensitive materials such as plastic, copper alloys, or aluminum, then spool pieces of steel or equivalent material shall be used for the actual penetration. Such spool pieces should preferably be welded and shall extend at least 30 cm on each side of the division. Other arrangements shall be proven in the standard fire test.

Penetrations shall be properly supported with bolted or welded bracing. Heat sensitive materials are not permitted to be used for structural support of piping because of the possibility of failure during a fire.

In cases when the bulkhead is required to be watertight, other requirements may apply. In general, watertight bulkheads and associated penetrations will easily meet the minimum requirements of Class A construction.

CHAPTER 5 - ONGOING DOMESTIC AND INTERNATIONAL REGULATORY CHANGES, CONCLUSIONS, AND RECOMMENDATIONS

5.1 Introduction

The purpose of this chapter is to provide insight into many of the ongoing or planned changes that will affect international and domestic ship construction. The scope and depth of the international technical requirements has been rapidly expanding since the adoption of the tacit amendment procedures introduced into SOLAS (1974). Additionally, this work is being moved forward by the rapid expansion of ISO and IEC standards to facilitate international trade.

In conclusion, a program is outlined that will further document design requirements and procedures for shipboard systems and their related component products. If undertaken, this work will provide the bases for a Quality Systems Manual for the design of shipboard systems in commercial vessels.

The initial chapters of this Guide provide general background on the role and types of standards, standards-setting organizations, and classification societies. The various general approval and acceptance processes are also introduced. These processes include statutory certification, domestic processes, and classification society processes and procedures including first and third party approval systems, case-by-case approvals, and various type approval systems.

The last chapter provides a reference source for shipyard designers to determine the applicable product requirements for commercial vessels being designed, particularly for products in the thirteen prioritized equipment categories which were analyzed in earlier projects.

The approach used is to present general considerations for functional product groupings and specific requirements for representative product categories. The general requirements are introduced with a summary of the work undertaken in NSRP Project No. 6-93-1. The remainder of the general section includes a listing of and regulatory cites for products generally subject to some degree of approval or acceptance procedures, discussion of the IACS unified requirements, and general guidance on international marine products.

The remainder of the last chapter is devoted to discussion of specific product categories. Each product category typically includes a general summary of requirements, a review of the work performed in NSRP Project No. 6-93-1, presentation of the ABS requirements, and a review of the USCG domestic requirements based on the regulations in 46 CFR.

The equivalency of these requirements is discussed and the differences are presented for clarity. These representative categories are typical of the processes that are encountered in the international market. They also show the ramifications that occur when new standards development programs at ISO or IMO are encountered. The specific product categories also demonstrate how standards in the international market can be identified and evaluated to establish their acceptability.

5.2 Domestic Regulatory Reform

The USCG is in the midst of an aggressive campaign to work with the international maritime community to create, alter, and eliminate rules and regulations in order to streamline processes for shipowners. Over the past few years the pace of regulatory reform has increased and the programs that are evolving show real economic promise and financial return to both industry and the USCG. The groundwork has been developed domestically and internationally for some very important program and regulatory changes.

(a) Reorganization of the USCG Office of Marine Safety and Environmental Protection

The structure of the USCG's Office of Marine Safety and Environmental Protection was reorganized as part of a USCG wide streamlining program. The new title of the Admiral responsible for this program is the Assistant Commandant for Marine Safety and Environmental Protection (G-M). The main principles of this reorganization were:

- The "nature" of the organization was redeveloped along functional lines, with Directorates established for Field Activities, Standards, and Resources. A separate headquarters unit, the National Maritime Center (NMC), was also created.

- No division was moved intact from the old to the new organization; therefore, direct "mapping" of previous vs. new functions is not possible.

- The component divisions and branches were dramatically reduced in number and retitled as offices and divisions.

The new directorates were established as follows:

- Standards Directorate (G-MS): Serves the marine community by

developing standards and regulations for marine transportation. It will be the primary source for articulating public policy flowing from legislation, administration and congressional priorities, and advisory group recommendations. This Directorate focuses on standards for the improvement of safety for personnel, operations, ship structures, cargo systems, and equipment; the transport of hazardous materials (HAZMAT); and the protection of the environment. They also lead in formulating and implementing a focus on the role of the human element (Prevention-Through-People: PTP).

- Field Activities Directorate (G-MO): Focuses primarily on interaction with USCG field customers. They consolidate and focus operational policy and support for field prevention response and investigation by implementing the standards developed in G-MS.

- Resource Management Directorate (G-MR): Serves the Office and other directorates by providing leadership in planning, budgeting, and program analysis. Their primary goal is to provide the resources and services needed by the Standards and Field Activities Directorates, by acquiring, allocating and managing program funds, information, and people.

- National Maritime Center (NMC): As part of this reorganization, a new National Maritime Center (NMC) was established as the means to serve the private sector and provide support to the USCG's marine safety field offices. The NMC consists of the once self-standing Marine Safety Center, which does plan review of new U.S. ships and foreign passenger ships having U.S. ports of call; a centralized National Vessel Documentation Center, which is a consolidation of the regional vessel documentation system; an Office of Marine Personnel Administration to handle licensing, personnel, training and certification issues; an Office of Shipbuilding, Design and Operations Facilitation to help promote competitiveness of the U.S. maritime industry; and finally, a publications staff to produce the Marine Safety Manual, Navigation and Vessel Inspection Circulars (NVICs), the Proceedings magazine and the Marine Safety Newsletter.

  The NMC is an independent USCG headquarters unit responsible for initiation and execution of marine safety activities and services at the national and international levels. The NMC maintains an active public and

industry awareness outreach program aimed at communicating USCG regulatory activities and policy quidelines.

The NMC consists of several programs:

* The Shipbuilding, Design and Operations Facilitation Division promotes a globally competitive U.S. maritime industry by fostering partnerships between industry, academia, and government. The Division works with affected customers to identify and resolve ship production and operations problems and promote innovative marine research, design, construction and repair, and operations to achieve established levels of safety/reliability while minimizing any regulatory burden. Division activities include application of cost/benefit assessment as an element of risk management. This provides a decision maker with an objective tool to evaluate the cost of various options and benefits.

* The Container Inspection Training and Assistance Team works with USCG field units and other federal, state and local agencies, and assists shippers to enhance their capability to comply with the Hazardous Materials Regulations and the Safety Approval of Cargo Containers Regulations. The Team coordinates USCG participation in local hazardous materials enforcement "Strike Force" joint inspections. Team activities entail inspections of internodal freight containers and portable tanks for compliance with the Hazardous Materials Regulations and the Safety Approval of Cargo Containers Regulations.

* The Marine Safety Center (MSC) under the direction of the NMC continues to provide technical services in review and approval of plans for the design, construction, alteration and repair of U.S. commercial vessels and marine structures subject to the marine inspection laws; issue safety certificates and exemption certificates in accordance with the currently effective International Convention for Safety of Life at Sea (SOLAS); and administers the provisions of the International Convention on Tonnage Measurement of Ships, 1969. The MSC provides direct support to the USCG On Scene Commander (OSC) during a pollution incident response. Additionally, in support of the NMC maritime industry facilitation

mission, the MSC provides technical support to USCG/industry problem solving teams.

* The Marine Personnel Division maintains central records for merchant marine personnel. It also administers programs for merchant mariner documentation, and examination and licensing of merchant marine personnel.

* The Publications and Information Staff provides the public and maritime industry with pertinent information that is easy to access. Publications under the domain of the publications staff that either already exist or are being developed include: the Proceedings of the Marine Safety Council, Marine Safety Newsletter, the Marine Safety Manual, the Merchant Marine Exam Questions Publication, Navigation and Vessel Inspection Circulars, the World Wide Web, the "M" Phone Book (available in an updated online version at http://www.dot.gov/dotinfo/uscg/hq/g-m/nmc/gendoc/), the Key Word Index, the Marine Safety Mailing List, and the Merchant Vessels of the United States. Using state-of-the-art technology, the Division obtains and incorporates all available sources of information and makes it readily available to the maritime public.

* The National Vessel Documentation Center plans and administers a central system for the documentation of U.S. vessels and ensures proper recordation of vessel transactions. The centralization of the vessel documentation services allows USCG to provide more efficient and effective service by enhancing uniformity, specialization, and expertise of the documentation staff.

* The Marine Safety Laboratory provides forensic oil analysis and expert testimony in support of oil pollution law enforcement efforts for USCG field investigators, districts, hearing officers, National Pollution Fund Center, Department of Justice, and other federal agencies. The lab also plans and conducts research and tests in specific areas identified by Program Managers and approved by the NMC in support of USCG regulatory and international goals.

(b) The President's regulatory initiatives and the U.S. shipbuilding industry

On March 4, 1995, President Clinton issued a memorandum announcing plans for further reform of all federal regulatory programs. In this initiative, he stressed that all Americans must still be able to expect the benefits of effective regulation: clean water; safe work places; wholesome food; and sound financial institutions. The expectation for a safe and environmentally sound maritime industry also remains unchanged. Accordingly, he described four steps that are to be an integral part of a total and ongoing regulatory reform process.

- o Step One is to cut obsolete regulations. Agencies are to consider the following for each of their regulations:

- o Step Two is to reward results, not "red tape." This has forced agencies to shift resource allocations from "enforcement" activities to compliance-driven programs.

- o Step Three is to get out of Washington and create "grassroots" partnerships. The goal is to have front-line regulators talking directly to the regulated public.

- o Step Four is to negotiate rules, not dictate them. The President has directed agencies to substantially expand their efforts to promote consensual rulemaking. Thus, the USCG Marine Safety & Environmental Program has placed new emphasis on partnerships with industry.

In support of the President's initiative, the USCG has developed a plan to implement regulatory reform in a three phase process.

- o In the first phase, the USCG is eliminating regulations that are completely obsolete, and where no public comment is expected. Included are regulations for nuclear vessels, incinerator vessels, and ocean thermal energy conversion facilities and plantships.

- o In the second phase, the USCG is eliminating regulations that are nearly as obsolete as those regulations deleted in the first phase, except these requirements are a little more technical and will require a public comment period. Examples in the second phase include requirements for hand leads, a box of sand in the engine room, marking of the vessel's name on equipment that doesn't float, and other regulations that don't make sense

on a modern vessel.

- In the third and final phase, the USCG will be eliminating differences between our domestic regulations and the combination of international and classification society rules that generate additional cost without improving safety or environmental protection. Achieving this consistency will enable vessels flying the U.S. flag to be more globally competitive.

As a part of this third phase, the President signed Public Law 104-324, the Coast Guard Authorization Act of 1996, on October 19, 1996. Title VI on Regulatory Reform sets forth the following provisions:

- Mandates regulations establishing a safety management system for specified persons and vessels, including: (1) a safety and environmental protection policy; (2) instructions and procedures to ensure safe operation of those vessels and protection of the environment in compliance with international and U.S. law; (3) defines levels of authority and lines of communication between and among personnel on shore and on the vessel; and (4) procedures for reporting accidents and nonconformities with this title, preparing for and responding to emergency situations, and internal audits and management reviews of the system.

- Requires regulations prescribed to be consistent with the International Safety Management Code with respect to vessels engaged on a foreign voyage.

- Sets forth provisions regarding: (1) implementation of the safety management system; and (2) certification and enforcement.

- Mandates a study and report to the Congress on the methods that may be used to implement and enforce the International Management Code for the Safe Operation of Ships and for Pollution Prevention under the Annex to the International Convention for the Safety of Life at Sea, 1974.

- Authorizes the head of the department in which the Coast Guard is operating to rely, as evidence of compliance with this title, on reports, documents, and records of other persons and on other methods determined by the head of that department to be reliable.

- Revises provisions regarding: (1) equipment approval; (2) frequency of

inspection (5 years); (3) certificates of inspection; and (4) delegation of authority of the head of that department to classification societies.

- The new equipment provisions allow the Secretary to accept equipment or materials approved by a foreign government when:

  * The design standards and testing procedures meet SOLAS (1974),

  * Such products secure the safety of U.S. vessels,

  * The foreign government has given equivalent treatment to U.S. approved lifesaving equipment, and

  * Lifesaving equipment approved by the U.S. may be used on vessels under the laws of that country.

  The Secretary and other Federal Agencies will work to seek acceptance of U.S. approved equipment internationally.

- The Secretary may delegate to ABS and other recognized classification societies the authority to:

  * Review and approve required plans,

  * Conduct inspections and examinations, and

  * Issue certificates and other documents.

  For foreign classification societies, there must be reciprocity and the society must have offices and records in the U.S.

(c) Marine Safety Evaluation Program (MSTEP)

In order to reach these historic new objectives, there is an obvious need to develop new tools to meet the needs of the future. One of these tools is risk-based technology (RBT), which provides a means to evaluate and manage safety and environmental hazards. For years, the USCG experience in making determinations in design equivalency has pointed to a need for using RBT. Unfortunately, such presentations were considered to be the responsibility of the submitter.

As part of the USCG's new technical-regulatory paradigm, the USCG is joining forces with other U.S. and international interests to better define, and refine RBT in order to make risk-based approaches useful marine safety and environmental protection management tools.

The USCG's Marine Safety Evaluation Program, called "M-STEP," is a cooperative effort involving the U.S. Navy, academia, global RBT experts, and other leaders in the international maritime community to advance the science and utility of RBT in maritime applications.

To demonstrate the utility of the MSTEP risk based approach for determining alternative regulatory compliance, various candidate systems were considered for proof-of-concept. The basic selection criteria for a candidate system was that the system have a high cost-to-safety ratio, and also be a good representative of other applicable systems. The MSTEP team chose the cargo hold lighting system installed aboard U.S. Maritime Administration (MarAd) reflagged "Cape H" and "Cape W" RoRo vessels. This system was chosen because of its high refit cost for compliance with federal regulations and classification society rules.

The analysis of the cargo hold lighting system set out to answer two essential questions: (1) was the current hazardous location classification of the cargo spaces consistent with the true safety risks; and, (2) were installed lighting fixtures adequate if the cargo space was reclassified?

o Risk-Based Technology (RBT)

MSTEP proposes to use RBT to evaluate the safety risks of complex ship systems. RBT uses a top-down approach to define hazards and accident scenarios, and is based on answering three fundamentals: what can go wrong (s_i); what is its likelihood (l_i); and what are the consequences(x_i)? A rank-ordered list of major risk contributors is developed, and thereafter, efforts and resources are expended on systems with the highest consequences and frequency of failure.

o Proof-Of-Concept

In the present proof-of-concept, a team of safety analysts and ship systems experts performed a Preliminary Hazards Analysis (PrHA) to demonstrate the RBT application. The decision-making process used for

deciding whether to retain or replace lights currently installed on AFP RoRo ships was then executed.

o PrHA Results

Over the course of the evaluation, the team documented more than 50 potential accident scenarios that had unfavorable consequences. As a part of the analysis, these hazards were rank ordered on the basis of frequency and severity.

o Conclusions

The evaluation concluded that there is a risk of personal injury due to inadequate emergency lighting for safety inspections, and the likelihood of an explosion (with current lights providing an ignition source) is low. This is based on the amount of fuel that is required to be spilled and its ability to reach lower explosive limits at the location of the current lights. Thus, reclassification of the compartments in order to retain the current lights is appropriate.

The MarAd lighting system analysis resulted in a savings of more than $7 million for five ships. Operational, intrinsic design, and other risk mitigating features were given credit and provided the basis for the decision to retain the existing lights. Reference (24) summarizes the results of this program. Reference (25) reports on a USCG sponsored workshop on RBT where these results were presented and the application of RBT methods to commercial vessels was discussed.

(d) Alternate Compliance Program (ACP)

In addition to updating and aligning technical aspects of the regulations, the USCG is streamlining and re-engineering the regulatory process itself. For instance, the USCG is implementing a program called the Alternate Compliance Program (ACP). Initial application of these concepts were started in a pilot program to test the implementation of this approach.

The ACP provides owners and operators of cargo ships and tank ships in international service with an alternative to the traditional way of demonstrating compliance with applicable laws and regulations.

Under this program, the USCG recognizes the combination of applicable international conventions and rules of approved classification societies as equivalent to U.S. rules. Therefore, vessels which comply with these international conventions and approved classification society rules will be considered to be in compliance with applicable U.S. Laws and regulations. The Alternate Compliance Program also eliminates areas of duplication where the USCG and the classification society check the same plans and inspect the same systems, thereby promoting greater efficiency in the vessel design, construction and inspection processes. ACP is just one of a "family" of new approaches to achieving marine safety and environmental protection at less cost and greater efficiency.

An Interim Rule was published in the Federal Register on 27 December 1996. It contains extensive background and information on this new regulatory alternative compliance scheme. Enrollment in this program is optional. Appendix 6.2 contains further details on the operation of this program.

(e) Streamlined Inspection Program (SIP)

Another alternative approach is being pursued on a pilot basis by USCG field units in partnership with selected industry groups. This optional new program is called the Streamlined Inspection Program (SIP).

In SIP, vessel operators who develop a safety management system designed to keep their fleets in continuous regulatory compliance may enter into a safety partnership with the USCG. As safety partners, qualified company personnel use USCG-approved test procedures to perform their vessels' scheduled inspections on their own, rather than in the presence of a USCG marine inspector. In SIP, the USCG adopts an "audit" culture; USCG SIP inspections involve checking company records, doing limited spot checks on critical safety systems, and assessing the crew's ability to deal with shipboard emergency situations.

This approach returns the balance to more closely reflect what was envisioned when the regulations were written, i.e., the ship company does a number of safety functions on a routine periodic basis and the USCG inspector serves to assure that these critical safety tasks are being performed. The USCG expects that participating vessels will continuously meet a higher level of safety and inspection readiness throughout the inspection cycle.

A Notice of Proposed Rulemaking was published in the Federal Register on 8 April 1997. It contains extensive background, information and process diagrams on this new regulatory alternative compliance scheme. As with other new programs, enrollment and participation are optional.

Vessels participating in a prototype program have had much as a 50 percent reduction in the time it takes USCG to perform an onboard inspection. Other benefits include cost savings due to fewer personnel injuries and insurance claims, fewer major vessel repairs, and reduced maintenance expenses. In addition, participating companies cited more rapid professional growth experienced by unlicensed crew, improved vessel working environment, more complete maintenance records, and better communication with USCG.

Over the next three years, USCG projects that enrollment in SIP will include 352 small passenger vessels, 48 large passenger vessels, 131 offshore supply vessels, 4 tank ships, and 942 tank barges or oil spill response vessels.

(f) USCG Electrical Engineering Regulations
(46 CFR Subchapter J)

As part of the President's Regulatory Reinvention Initiative, the USCG is amending its electrical engineering regulations to reduce the regulatory burden on the marine industry, purge obsolete and out-of-date regulations, and eliminate requirements that create an unwarranted differential between domestic rules and international standards. This rulemaking harmonizes, where possible, the electrical engineering regulations with recent amendments to the International Convention for the Safety of Life at Sea, 1974, as amended. Additionally, this rulemaking dramatically revises certain prescriptive electrical equipment design, specification, and approval requirements and replaces them with performance-based requirements that incorporate international standards. The revisions also clarify and condense, in technically correct language, the requirements applicable to USCG certificated vessels. Included in the revisions are amendments to Subchapter Q regarding fire protective systems and emergency loudspeaker systems.

An interim rule was published in the Federal Register on 4 June 1996 and the final rule, completing this round of revisions, was published on 1 May 1997. The USCG stated that they may consider the following items for a subsequent rulemaking:

- Incorporation of the new Institute of Electronic and Electrical Engineers (IEEE) Std 45, when approved by the IEEE standards board and published;
- Addition of a requirement that all manufacturer's conducting self-certification should be International Organization for Standardization (ISO) 9001 registered;
- Incorporation of performance-based inclination criteria into § 111.01-19;
- Consideration of requirements for high impedance grounding systems to be added to § 111.05-19;
- Establishing a new subpart that would address the necessary supply of clean, uninterrupted power for modern AC-powered, solid-state equipment, which would complement the requirements of §§ 111.15-3 and 111.20-1;
- Addition of a ventilation alarm requirement to § 111.35-1.
- Prohibition of screw-in, porcelain or glass-cap fuses in subpart 111.53;
- Incorporation of new standards that provide guidance for high voltage cable in § 111.60-1(e);
- Incorporation of the Canadian Standards Association (CSA) flame test CSA FT-4 either as another option or in place of American National Standards Institute/ Underwriters Laboratories (ANSI/UL) 1581 test VW-1 in §§ 111.60-2 and 111.30-19(b)(4);
- Incorporation of Underwriters Laboratories (UL) 2225 into § 111.60-23(h) to provide guidance on the use of metal-clad (Type MC) cable in hazardous (classified) locations;
- Incorporation of Illuminating Engineers Society (IES) Recommended Practice (RP) 12 for marine lighting in § 111.75-15(c);
- Permission of third-party testing for lighting, appliances, oil immersion heaters, and electric heaters in §§ 111.75-20, 111.85-1, and 111.87-3;
- Incorporation of International Electrotechnical Commission (IEC) 1892 in § 111.105-5 for electrical installations aboard mobile offshore drilling units (MODU's) and floating platforms;
- Incorporation of pump room ventilation and monitoring requirements of American Bureau of Shipping (ABS), Rules for Building and Classing Steel Vessels, section 4/5.151.6 into § 111.105-31;
- Replacing IEC 332-3, Category A flame test with IEC 332-3, Category A/F in § 111.107-1;
- Restricting the color red for general emergency or fire alarms only in § 113.25-10;
- Application of the cable routing and fire testing requirement of § 113.30-

25(i) to all safety related circuits in part 113;

- o Incorporation of additional requirements in § 113.50-20 to align the regulations with the International Maritime Organization (IMO) Code of Alarms and Indicators; and
- o Establishing a new subpart 113.70 for gas detection systems.

(g) NFPA 301, Code for Safety to Life from Fire on Merchant Vessel

In line with the regulatory reform initiatives, the USCG has been working closely with the National Fire Protection Association (NFPA) to develop a marine Life Safety Code similar to NFPA 101, the shoreside Life Safety Code. A complete draft has been finalized and is in the comment and balloting process. The final standard (23) should be published in mid 1998 or shortly thereafter. The development of this standard should allow the USCG to simplify the fire protection regulations by incorporating the standard by reference. An additional advantage to industry is that the standard promotes consideration of alternatives and flexibility by use of hazard analysis and risk assessment methods.

In the same regard, the USCG has been working to develop revised structural fire protection guidance to replace NVIC 6-80, "Guide to Structural Fire Protection Aboard Merchant Vessels." A fifth draft revision is available for public comment. This document also represents preparations for a regulatory project to simplify and clarify these structural fire protection requirements.

(h) Prevention Through People (PTP)

- o Introduction

Human error causes more than 80 percent of marine casualties. These human error causes have not been addressed directly; the majority of maritime safety resources focus on eliminating accidents by reducing material failures and systems problems. The Office of Marine Safety, Security and Environmental Protection (G-M) in partnership with the Office of Navigation Safety and Waterway Services (G-N) chartered a Prevention Through People (PTP) Quality Action Team (QAT) to develop a long-term strategy to rebalance the safety equation by refocusing prevention efforts on casualties caused by human error.

The report of the PTP QAT's work is presented in reference (21). The report examines the extent of human error in the maritime transportation system; identifies candidate, high-risk industries where human error prevails; examines the reasons why human error persists; offers a strategy to refocus prevention efforts on human error, root causes of marine casualties; and recommends an implementation plan to create a participatory, systematic approach to reduce human error-related loss of life, injury, and pollution.

o Background

Historically, the international maritime community has approached maritime safety from a predominantly technical perspective. The conventional wisdom applied engineering and technological solutions to promote safety and minimize the risks and consequences of marine casualties. Accordingly, international standards address equipment requirements, such as the type and amount of lifesaving and firefighting apparatus required on board vessels. Adopting design requirements such as protectively located segregated ballast tanks, double hulls, and improved steering gear standards make operating tankers safer, and minimize the extent of pollution in the event of a casualty. All these technical standards help to improve quality and reliability throughout the maritime industry. Despite the industry's innovations, marine casualties persist.

o Approach

The PTP QAT used the Focus, Analyze, Develop, and Execute (FADE) problem solving process, depicted in the Coast Guard's Process Improvement Guide, to develop a PTP philosophy and program. The PTP QAT formed two sub-teams. These teams addressed data analysis and examined operations from a maritime systems perspective that included an assessment of vessels, facilities, and waterways. The output of these efforts formed the basis to develop the strategy and to create an implementation plan for the PTP philosophy and program.

o Key Findings - Human Error Identified

Almost all the studies reviewed showed that human error was a major cause of marine casualties, accounting for between 75 and 96 percent of

marine casualties. The predominant human errors were classified into five groups:

* Management: (For example, faulty standards and legislation and inadequate communications or coordination.)

* Operator Status: (For example, inattention or carelessness, fatigue.)

* Working Environment: (For example, poor equipment design, hazardous natural environment.)

* Knowledge: (For example, inadequate general technical knowledge, inadequate knowledge of shipboard operations.)

* Decision-making: (For example, poor judgement, inadequate information.)

The three largest specific problems were fatigue, inadequate pilot-bridge crew coordination, and inadequate technical knowledge (especially of radar). These problems were general to the entire maritime industry and not specific to any one segment.

The following table shows a broad summary of human error cited in the analyses review. The percentage of cites from this variety of sources is identified.

Category	Times Cited:
Management	30%
Operator Status	22%
Working Environment	20%
Knowledge	14%
Decision Making	14%

o High-Risk Industries

Towing vessel/barge, tankship, fishing vessel, passenger vessel, and offshore supply vessel operations were found to have the highest risk for

fatalities, injuries, and pollution. The following matrix shows the distribution as a percentage of the total fatalities and oil spills. Industry selection was based on the results of a comprehensive analysis of marine casualty data.

Industry	Fatalities	Oil Spills
Towing vessel/ barge operations	11%	23%
Tankship operations	3%	60%
Fishing operations	42%	3%
Passenger vessel operations	10%	-
Offshore supply vessel operations	3%	-
Total	69%	86%

o Maritime Casualties Persist

Why do maritime casualties persist? The analysis concludes the following factors contribute to the persistence of maritime casualties and pollution:

* Lack of conducting root cause investigations of marine casualties, and thereby unable to identify the specific human error problems that cause casualties;

* Lack of identifying and systematically analyzing high-risk operations;

* Lack of identifying, developing, and implementing effective measures to prevent the specific human error problems that

dominate casualties; and

* Lack of the collective marine industry to analyze problems, share analyses, and share lessons learned.

o Strategy

The PTP strategy incorporates a comprehensive and balanced safety system approach to human error prevention. The PTP QAT developed a strategy that includes the following four key elements:

* Collaboration by government agencies, mariner organizations, classification societies, and the maritime industry, internationally and nationally, to address human error from an overall systems perspective;

* Use of risk management tools to identify root causes and cost-effective preventive measures for casualties and near-miss events;

* Employment of human error detection, assessment, and prevention techniques as part of USCG marine safety activities of boardings, examinations, and inspections; and

* Improvement of investigative methods, data collection, analyses, and feedback.

o Initial PTP Candidates

The following high-risk industries are recommended as candidates to employ the PTP strategy. These candidates are ideal for initial PTP work because they offer the greatest potential to reduce maritime fatalities, injuries, and pollution.

* Towing vessel/barge operations;

* Tankship operations;

* Fishing operations;

* Passenger vessel operations; and

* Offshore supply vessel operations.

The PTP QAT recommends that early PTP work group efforts closely examine the following high-risk processes to improve them:

* Towing operations: (Specifically, fleeting and tow make-up);

* Tankship operations: (Specifically, restricted waterway transits); and

* Tankship/barge operations: (Specifically, ballasting and topping-off tanks).

o Implementation Plan

Prevention Through People (PTP) is a strategic, long-term initiative. Reference (22) presents a detailed plan for implementing this initiative. Both the maritime industry and governments have spent the last 40 years attempting to redesign ships and marine facilities to reduce casualties. Attention must turn to address the human-related issues. To initiate participatory, systematic PTP efforts, both the USCG and the maritime industry must first undergo a cultural change. Working in joint USCG/industry partnerships to manage maritime risk through a systematic, non-regulatory approach represents a departure from traditional practice. Implementing such a dramatic change requires a major commitment from both the USCG and industry. Owners, operators, masters, pilots, engineers, persons-in-charge, and USCG field commanders must be convinced that safety pays and risk management is their inherent responsibility and the proper course to take. Risk management is a shared responsibility between government, industry, classification societies, and the mariner. All must work in tandem to manage maritime risk systematically. Successful implementation of the PTP initiative hinges on the participation of the following entities:

* USCG Leadership: Create an environment for cultural change and modify organizational structures. Continue to lead the International Maritime Organization (IMO) in developing a systematic approach to detecting, examining, and measuring the effectiveness of mariners, owners and operators, and governments in maintaining an

acceptable level of safety aboard vessels;

* USCG Human Element Coordinating Branch: Coordinate national and international activities including collect and distribute data, track cost savings, distribute success stories, facilitate USCG and industry training, and establish a forum to leverage USCG resources; sponsor and coordinate human error training for all USCG Headquarters personnel;

* National Steering Committees: Form national work groups in candidate industries that include mariner organizations to establish long-term strategies, milestones, and objectives for PTP efforts;

* Regional/Local Industries & USCG Field Units: Establish, effect, and measure risk regionally and locally by working in work groups and port area committees to address local high-risk maritime operations and identify root causes of casualties;

* Other USCG Headquarters Divisions: Learn about human factors and human error; develop human error detection, assessment, and prevention methods in areas of responsibility;

* USCG Research and Development (R&D) Center: Focus R&D efforts to address human error and risk management in maritime operations, and be responsive to national steering committees; work jointly with other USCG and maritime industry personnel on R&D efforts; and

* USCG Reserve Training Center: Redesign investigation, inspection, and boarding officer training to equip trainees with an understanding of human error, the ability to recognize situations where human-related causal factors are present, and use standard data collection techniques. Also train the trainer in risk model application.

o Next Steps

The following steps will ensure a smooth transition from the concept phase to the implementation of the participatory culture necessary to implement the PTP strategy.

* Hold public meetings to share the PTP approach and strategy with interested parties and to obtain their feedback;

* Meet with industry leaders to test and validate the PTP approach and strategy;

* Select at least three high-risk processes in the high-risks industries for in-depth analysis by initial PTP work groups; and

* Conduct orientation training on the PTP approach and strategy for Headquarters and field personnel.

o Conclusion

Our 200-year-old safety system has been one of promoting safety through developing and enforcing engineering and technological standards. Typical examples include specifying the type and amount of lifesaving and firefighting apparatus on board vessels and designs of segregated ballast tanks, double hulls, and steering gears. These standards establish useful criteria to ensure vessels, facilities, and systems can properly and safely function and meet operational demands. However, human error causes over 80 percent of maritime casualties. While it is important to maintain the current level of maritime safety and pollution prevention achieved by past technological and engineering innovations, removing human error will yield the greatest safety and pollution prevention results in the years ahead.

The partnerships which evolve from PTP will eliminate risks by taking a systems approach to managing safety performance and balancing the critical factors that influence people's performance. Four critical components affecting people's performance include management, behavior, work environment, and technology. The QAT concluded that each of these components affects people's ability to perform maritime operations safely. Safe and profitable operations require continuous and balanced interactions between the four components to manage risk and prevent maritime disasters.

The USCG's PTP initiative represents a breakthrough in maritime safety. By taking a systematic approach to the human element in maritime safety,

government, industry, mariners, and classification societies will be able to continually assess and maintain the necessary balance in the safety system. This balance will be achieved by (1) deliberately detecting, assessing, and predicting human error in maritime operations, (2) identifying the root causes in maritime casualties, (3) collectively developing and implementing preventive solutions to root causes, and (4) collectively sharing analyses, best practices, and lessons-learned.

5.3 International Regulatory Changes

(a) International Maritime Organization (IMO)

When the establishment of a specialized agency of the United Nations dealing with maritime affairs was first proposed, the main concern was to develop international machinery to improve safety at sea. Because of the international nature of the shipping industry, it had been thought that action to improve safety in maritime operations would be more effective if carried out at an international level rather than by individual countries acting unilaterally. Although a number of important international agreements had already been adopted, many States believed that there was a need for a permanent body which would be able to coordinate and promote further measures on a more regular basis. With this goal in mind, a conference held by the United Nations in 1948 adopted a convention establishing the International Maritime Organization (IMO) to serve as a permanent international body devoted exclusively to maritime matters.

In the ten-year period between the adoption of the Convention and its entry into force in 1958, other problems relating to safety but requiring slightly different emphasis had attracted international attention. One of the most important of these was the threat of marine pollution from ships, particularly pollution by oil carried in tankers. An international convention on this subject had been adopted in 1954, four years before IMO came into existence, and responsibility for administering and promoting this convention was assumed by IMO in January 1959. From the very beginning, improvement of maritime safety and prevention of marine pollution have been IMO's most important objectives.

The Organization is based at 4 Albert Embankment, London, and is the only United Nations specialized agency to have its headquarters in the United Kingdom. Its governing body is the Assembly, which meets once every two years. It consists of all 137 Member States and two Associate Members.

Between these sessions, a Council consisting of 32 Member Governments elected by the Assembly acts as IMO's governing body.

o The Committees

IMO is a technical organization and most of its work is carried out in a number of committees and subcommittees.

The Maritime Safety Committee (MSC) is the most senior of the committees that carry out the Organization's technical work. It has a number of subcommittees whose titles indicate the subjects they deal with: Safety of Navigation; Radio communications; Life-Saving, Search and Rescue; Training and Watchkeeping; Carriage of Dangerous Goods; Ship Design and Equipment; Fire Protection; Stability and Load Lines, and Fishing Vessel Safety; Containers and Cargoes; and Bulk Chemicals.

The Marine Environment Protection Committee (MEPC) was established by the Assembly in November 1973. It is responsible for coordinating IMO's activities in the prevention and control of pollution of the marine environment from ships. The Sub-Committee on Bulk Chemicals is also a subcommittee of the MEPC as far as pollution is concerned.

The Legal Committee was originally established to deal with the legal problems arising from the TORRY CANYON accident of 1967, but was subsequently made a permanent committee. It is responsible for considering any legal matters within the scope of the Organization.

The Technical Cooperation Committee is responsible for coordinating the work to provide technical assistance in the maritime field, in particular to the developing countries. The importance of technical assistance in IMO's work is shown by the fact that it is the first organization in the United Nations system to formally recognize a Technical Cooperation Committee in its Convention.

The Facilitation Committee is responsible for IMO's activities and functions relating to the facilition of international maritime traffic. These efforts are aimed at reducing the formalities and simplifying the documentation required for ships entering or leaving ports or other terminals.

All the committees of IMO are open to participation by all Member Governments on an equal basis.

- The Secretariat

The secretariat is headed by the Secretary-General, who is assisted by a staff of some 300 international civil servants. The Secretary-General is appointed by the Council with the approval of the Assembly.

- IMO's Conventions

In order to achieve its objectives, IMO has promoted the adoption of some 30 conventions and protocols, and adopted over 700 codes and recommendations concerning maritime safety, the prevention of pollution, and related matters in the last 30 years.

The initial work on a convention is normally done by a committee or subcommittee; a draft instrument is the product which is submitted to a conference. Delegations from all States within the United Nations system, including States which may not be IMO Members, are invited. The conference adopts a final text, which is submitted to Governments for ratification.

An instrument so adopted comes into force after fulfilling certain requirements, which always include ratification by a specified number of countries. Generally speaking, the more important the convention the more stringent are the requirements for entry into force. Implementation of the requirements of a convention is mandatory on countries which are parties to it. Codes and recommendations which are adopted by the IMO Assembly are not binding on Governments. However, their contents can be just as important, and in most cases they are implemented by Governments through incorporation into domestic legislation. Also, a new trend in promulgating technical requirements is to adopt codes in SOLAS by reference which contain the pertinent technical requirements.

More information about IMO and its conventions is available on-line at the National Maritime Center Web Site (see page 3-24). The remaining discussion focuses on SOLAS (1974), as amended.

o SOLAS (1974), As Amended

Of all the international conventions dealing with maritime safety, the most important is the International Convention for the Safety of Life at Sea (SOLAS). It is also one of the oldest conventions, the first version having been adopted at a conference held in London in 1914. The incident which led to the convening of the 1914 Conference on Safety of Life at Sea was the sinking of the TITANIC on her maiden voyage in April 1912, when more than 1,500 passengers and crew died.

Since then there have been four further versions of SOLAS: the second was adopted in 1929 and entered into force in 1933; the third was adopted in 1948 and entered into force in 1952; the fourth was adopted (under the auspices of IMO) in 1960 and entered into force in 1965; and the present version was adopted in 1974 and entered into force in 1980. SOLAS 1974 is unlikely to be replaced by a new instrument because it can be easily amended by the new "tacit amendment" procedure included in article VIII.

A series of accidents involving oil tankers in the winter of 1976/77 led to increasing pressure for further international action. As a result, early in 1978 IMO convened the International Conference on Tanker Safety and Pollution Prevention. It adopted a number of important modifications to the SOLAS Convention (the Protocol of 1978 relating to SOLAS 1974/SOLAS Protocol 1978), as well as to the International Convention for the Prevention of Pollution from Ships (MARPOL), 1973.

SOLAS 1974 was further amended in 1981 and 1983. These amendments extensively revised the machinery and electrical, fire protection, and life saving equipment technical requirements. The 1983 amendments also made the International Code for the Construction and Equipment of Ships Carrying Dangerous Chemicals in Bulk (IBC Code) and the International Code for the Construction and Equipment of Ships Carrying Liquefied Gases in Bulk (IGC Code) mandatory by adoption in the Convention. The IBC Code was itself amended in 1987.

Additional amendments to SOLAS 1974 concerning ro-ro ferries; standards of residual damage stability for passenger ships; changes in chapters II-1, II-2, III, IV, V and VII; and the global maritime distress and safety system

were adopted in 1988 and 1989.

Amendments adopted in 1990 define subdivision and stability requirements (based on the probabilistic concept of survivability) for cargo ships over 100 meters in length. The 1991 amendments cover fire protection, fire drills, shipboard emergencies, pilot transfer operations, and documentation of dangerous goods and reports of their loss; they also replace chapter VI with expanded provisions covering all potentially dangerous cargoes and make mandatory the new International Code for the Safe Carriage of Grain in Bulk (International Grain Code).

Further amendments were made in 1992 to improve fire safety measures on passenger ships and add provisions on survivability for ro-ro passenger ferries, as well as various measures relating to fire protection requirements, electrical power, access to cargo areas of oil tankers, and on-board communications. Chapters II-1, II-2, III, and IV were affected.

In 1994 additional amendments relating to fire safety (chapter II-2) were adopted; there were also some amendments in chapters V, VI and VII. The Conference of Contracting Governments to the 1974 SOLAS Convention, held in the same year, added three new chapters to the Convention - chapters IX (Management for the Safe Operation of Ships), X (Safety Measures for High-Speed Craft), and XI (Special Measures to Enhance Maritime Safety). Thus the new International Code of Safety for High-Speed Craft (HSC Code) and the International Management Code for the Safe Operation of Ships (ISM Code) were made mandatory under SOLAS.

1995 saw the introduction of new provisions on ships' routeing, as well as the Conference of Contracting Governments to the International Convention, which adopted a number of resolutions related to the Convention and made amendments on passenger ships, especially ro-ro ferries, in chapters II-1, II-2, III, IV, and V.

o Contents of SOLAS (Consolidated edition, 1997)

The 1997 consolidated edition incorporates all amendments up to and including those adopted by the 1995 SOLAS Conference. Its contents include:

Part 1

* Articles of SOLAS 1974;
* Articles of the Protocol of 1978 relating to SOLAS 1974;
* Consolidated text of the annex to SOLAS 1974 and the 1978 Protocol relating thereto:

Chapter		Title
I	-	General provisions
II-1	-	Construction: Subdivisdion and stability, machinery and electrical installations
II-2	-	Construction: Fire protection, fire detection and fire extinction
III	-	Life-saving appliances and arrangements
IV	-	Radiocommunications
V	-	Safety of navigation
VI	-	Carriage of grain
VII	-	Carriage of dangerous goods
VIII	-	Nuclear ships
IX	-	Management for the safe operation of ships
X	-	Safety measures for high-speed craft
XI	-	Special measures to enhance maritime safety

Part 2

* Resolution A.718 (17) of the IMO Assembly and resolutions of the 1994 and 1995 SOLAS Conferences
* List of certificates required to be carried on board

(b) Implementation of the ISM Code

U.S. companies and their vessels that engage in international voyages will have to implement a safety management system that meets International Maritime Organization (IMO) requirements under the International Safety Management (ISM) Code. A USCG notice of proposed rulemaking published on 1 May 1997 proposes to implement regulations that parallel requirements set by the International Convention for the Safety of Life at Sea (SOLAS), 1974, as amended, which adopts the ISM Code.

The USCG plans to use existing industry and international standards as much as possible. Safety management system requirements will include development, documentation, auditing, certification, and enforcement of approved corporate and vessel safety system management programs. The Coast Guard Authorization Act of 1996 requires adoption of these regulations.

Compliance with the ISM Code is required by July 1, 1998, for oceangoing passenger vessels transporting more than 12 passengers, tankers, bulk freighters, and high-speed freighters of at least 500 gross tons. By 1 July 2002, oceangoing freight vessels and self-propelled mobile offshore drilling units of at least 500 gross tons must also comply. Companies and vessels that are not subject to SOLAS requirements may voluntarily meet these standards. Guidelines for implementation and certification are provided in NVIC 2-94. International references include Resolutions A.741 (18) and A.788 (19).

The ISM Code is intended to change the maritime industry's passive compliance with government-issued regulations to more aggressive self-monitoring and correction. The code also addresses the role of the human element in preventing marine casualties.

Implementation of the ISM Code will harmonize U.S. regulations with international standards, allowing U.S. ships to engage in international trade without interruption.

Companies that implement safety management systems should see reductions in insurance costs and claims, crew injuries, pollution incidents, ship casualties, and cargo damage claims. For more information, call Robert M. Gauvin, Vessel and Facility Operating Standards Division, (202) 267-1053.

(c) International Code for Application of Fire Test Procedures (FTP Code)

For over 30 years, IMO has been publishing and updating a variety of fire test procedures to support the requirements in SOLAS (1974), as amended. In recent sessions of the Maritime Safety Committee (MSC) and the Sub-Committee on Fire Protection (FP), work has been under way to consolidate these procedures into a technical code, and make them mandatory with the 1998 SOLAS amendments. This work was finalized at the 41st session of the FP Sub-Committee and the FTP Code was adopted at the 67th session of the MSC as Resolution MSC.61 (67) - (adopted on 5 December 1996). The implementation date coincides with the 1998 SOLAS amendments on 1 July 1998. The amendments to SOLAS will make the provisions of the FTP Code mandatory for new vessels subject to SOLAS.

Originally, most of the IMO Resolutions on fire test procedures were similar to the U.S. domestic requirements. However, as European countries became more involved and increased their own requirements to facilitate trade within their community, these test procedures evolved. In many cases, the effective resolutions are more stringent than current domestic requirements found in 46 CFR. The mandatory implementation of these requirements will cause manufacturers to have to retest their products. In some cases, these changes will force shipyards to rely more heavily on foreign products to meet the new international requirements when domestic manufacturers choose not to upgrade their approvals.

U.S. flag vessels requiring SOLAS certificates will need to comply with the requirements of chapter II-2 of SOLAS for structural fire protection in lieu of 46 CFR. For the purpose of type approved materials under SOLAS, the FTP Code is the controlling document under these new requirements. The details of the approval process are outlined in paragraph 5 of the FTP Code. While such materials can be tested domestically or in foreign laboratories, presumably many of these approvals will be based on testing conducted elsewhere. The USCG's procedures for recognition of laboratories, including foreign laboratories, are in 46 CFR 159. The FP Subcommittee is compiling a list of such laboratories recognized by various nations.

(d) Structural Fire Protection Comprehensive Review

IMO is supporting the adoption of risk based technology (RBT) to provide for flexibility and technology development in the fire protection requirements. This work is ongoing in the Subcommittee on Fire Protection (FP) under an agenda item providing for a functional reorganization and review of SOLAS (1974), as amended, Chapter II-2. The work also includes the development of an International Code for Fire Safety Systems (Fire Safety Systems Code) to separate the text from SOLAS for these supporting system requirements. The work in the FP Subcommittee is scheduled for completion in the year 2000 to allow these revisions to be adopted in the amendments scheduled for 2002.

The proposed outline for this revised SOLAS chapter is as follows:

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The proposed outline for the new Fire Safety Systems Code is as follows:

INTERNATIONAL CODE FOR FIRE SAFETY SYSTEMS (MARCH 1996)
(Fire Safety Systems Code)

Preamble

Chapter	Title
1	General
1.1	Application
1.2	Definitions

1.3	Modern technology
2	International shore connections
3	Fire fighter's outfits
4	Fire extinguisher
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Part F of the revised Chapter II-2 will provide the guidance on the use of risk based technology. The current proposal in the working group is to adopt a series of standards on this subject under development at ISO. These standards are at the committee draft stage within ISO/TC92/SC4. These new standards are devoted to Fire Safety Engineering in a complimentary series of documents.

These series of Technical Reports outline the important aspects which need to be considered in making a fundamental approach to the provision of fire safety in buildings. The approach ignores any constraints which might apply as a consequence of regulations or codes; following the approach will not, therefore, necessarily mean compliance with national regulations.

The complimentary documents in the series on Fire Safety Engineering are:

ISO CD 13387	The application of fire performance concepts to design objectives
ISO CD 13388	Design fire scenarios and design fires
ISO CD 13389	Assessment and verification of mathematical fire models
ISO CD 13390	Initiation and development of fires and fire effluents
ISO CD 13391	Movement of fire effluents
ISO CD 13392	Fire spread beyond the enclosure of origin
ISO CD 13393	Detection, activation and suppression
ISO CD 13394	Life safety

Several documents, which have been produced in ISO/TC21, ISO/TC61, ISO/TC92, and IEC/TC89, provide data and information which are supportive and complimentary to the fundamental approach given in the above Technical Reports. It is anticipated that, in the future, the number of subsystems will be increased to cover Property loss, Business interruption, Contamination of the environment, and Destruction of heritage.

5.4 Additional Proposed Work to Document Regulatory Procedures

During the development of this Guide, it became apparent that these same methods being applied to equipment, components and materials and the evaluation of their related standards (i.e., the methods in NSRP Project Nos. 6-93-1 and 6-94-1 Task No.1), could be applied to shipboard systems. As such, an expanded and completed design guide would become part of the shipyard's Quality Systems Manual to ensure the suitability and completeness of shipboard system design and the products used in them.

Each shipboard system could have its design process summarized by a document presenting its purpose, scope, responsibilities, procedures, technical criteria and references, regulatory requirements, technical attachments, and an appropriate check-off list ensuring compliance with the steps in the design process.

The extension envisioned above for this current work program is summarized in the below proposed project description:

TITLE:

"Guide to International and Domestic Regulatory Requirements and Approval Processes for Commercial Ship Construction"

BACKGROUND:

After concentrating on U.S. Navy ship design for the more than a decade, U.S. marine design engineers are not knowledgeable in the procedures, rules, regulations, and standards for the international or rapidly changing domestic commercial markets. Understanding the regulatory framework and how to choose and apply the correct rules, regulations, and standards can have a major impact on design manhours, material costs, and ultimate ship cost.

Industry has recognized that a key to becoming competitive is compliance with international

requirements. Additionally, domestic laws to promote regulatory reform and new programs, such as the Alternative Compliance Program, have changed the domestic framework. Recognition of additional classification societies, such as Lloyd's Register and Det Norske Veritas, has created the need to become familiar with their rules and procedures. The Government has recognized that over-regulation is a hindrance to competitive pricing.

The proposed project would bring together the above factors in a manner to provide focus and a baseline for future projects. This study should expand NSRP Project 6-94-1, Task No. 1, (Guide to International Approval Processes for Commercial Ship Construction) to include new USCG procedures, the Alternative Compliance Program, and newly recognized classification society rules and procedures. Additionally, this project will expand the number of equipment categories addressed, including those affected by the new mandatory Fire Test Code under the 1998 SOLAS Amendments, and provide new sections on system requirements for essential shipboard systems including mechanical, electrical, environmental, and traditional safety systems.

This project will be built on a number of regulatory and standard evaluation projects already conducted or planned by Panel SP-6. They include:

- NSRP Project Report #0438, "Evaluation of U.S. and International Marine Engineering Standards for Acceptability in U. S. Flag Applications",

- The Ship Designers Handbook - Cross Reference of Requirements, and,

- Task No.1 under NSRP Project 6-94-1 (mentioned above).

A phased approach is necessary due to the magnitude of addressing all major equipment categories and essential systems common to most ships. Each phase will provide useful expanded and updated information as the project progresses. The accomplishment of all phases is expected to take approximately 3 years. The end product will be a comprehensive guide to the regulatory requirements for shipboard systems and equipment, components, and materials including mechanical, electrical, environmental, and traditional safety systems.

OBJECTIVE:

To develop a reference manual setting forth the requirements and procedures for international and domestic approval of essential shipboard systems and equipment, components, and materials.

TECHNICAL APPROACH:

The end result of this multi-year effort will be the development of a comprehensive reference manual addressing shipboard systems and equipment, components, and materials. Each phase is envisioned as being approximately the same size and the work will proceed on a priority basis with the approval of the Technical Overseeing Committee (TOC).* For both shipboard systems and equipment, components and materials, the reference manual will include appropriate functional categories including mechanical, electrical, environmental, and traditional safety groupings.

TASK OUTLINE

1. Develop a broad outline of requirements and proposed inclusion of equipment and system categories as a strawman document. Include proposed priorities for review by shipyards and the TOC.

2. Present the strawman outline to the TOC, design agents, and shipyards to obtain confirmation on which regulatory bodies and classification societies should be included as a minimum and in which order the project should proceed.

3. Using the shipyard and other responses, produce a revised project outline for approval by the TOC which will determine the scope and order of work.

4. Contact regulatory bodies and classification societies to be included for their input and suggestions. As much as possible, indicate the desired scope and format of material.

5. Develop the reference manual parts envisioned for phase 1 and provide a preliminary draft to the regulatory bodies, classification societies, and the TOC for review, suggestions and comments.

6. Incorporate comments and complete the final reference manual due under phase 1.

EXAMPLE OF PHASED PROJECT PROGRESS (3 years)

Phase 1: PRODUCT ACCEPTANCE CRITERIA (first year)

(Note: See Table 4-2 of NSRP Project No. 6-94-1, Task No. 1, for a complete listing of equipment, components, and materials requiring some degree of Regulatory Body approval).

A. General Acceptance Requirements

Introduction
Background
Products Subject to Acceptance
IACS Unified Requirements
Guidance on International Marine Products

B. Marine Engineering Product Requirements

Introduction
General Requirements
Piping Systems & Appurtances
Fluid Power & Control Systems
Refrigeration Machinery & Piping
Metallic Piping Materials Category
Nonmetallic Piping Materials Category
Pipe Joining Fittings Category
Fluid Conditioner Fittings Category
Special Purpose Fittings Category
Valves Category
Flanges Category

C. Electrical Engineering Product Requirements

Introduction
General Requirements
Electric Cable Category
Panel Board Category
Transformer Category
Circuit Breaker Category
Switchboard Category
Generator Category
Motors/Controller Category
Motor Control Centers Category
Lighting Fixture Category
Navigation Lights Category
Automation Category
Fire Detection and Alarm Systems
General Alarm Systems

Equipment for Hazardous Areas

D. Structural Fire Protection, Safety & Environmental Systems

Non-combustible Materials
Interior Finishes
Structural Insulations
Bulkhead Panels
Deck Assemblies
Fire Doors
Fire Dampers
Fire Stops
Oil & Bilge Monitoring Systems

Phase 2: MECHANICAL SYSTEMS (second year)

Piping System General Practices
Firemain & Foam Systems
Fixed Fire Extinguishment Systems
Bilge Systems
Sprinkler Systems
Internal Combustion Engines
Fuel Oil Piping Systems
Cargo Oil Piping Systems
Lubricating Oil Systems
Hazardous Chemical Systems
Steam Piping Systems
Pressure Vessels

Phase 3: ELECTRICAL SYSTEMS (third year)

One Line Diagrams
Short Circuit Analysis
Switchboard Installations
Coordination Analysis
Emergency Power and Lighting Systems
Suitability of Electrical Equipment
Battery Installations
Motor Control Centers
Propulsion Control

Remote Control & Monitoring Systems
Hazardous Areas
Fire Detection & Alarm Systems
General Alarm Systems
Steering Gear Systems

SCHEDULE:

Completion of phase 1 in 12 months, and each succeeding phase in 12 months for a total of approximately 3 years.

COSTS:

The funding for phase 1 of this project is not to exceed $150,000.00, and following phases should require approximately the same resources. The budgetary breakdown is:

o	Labor (2500 hrs) x $55.00/hr	$137,500.00
o	Regulatory/class.soc. visits (7 trips) x ($1000/trip)	$ 7,000.00
o	SP-6 Panel Meetings (3 trips) x ($1000/trip)	$ 3,000.00
o	Materials	$ 2,500.00
	Total	$150.000.00

BENEFITS:
This project supports the NSRP goals to "actively support the capability to build ships to international standards and specifications", "reduce the overall design, acquisition, construction and repair times", and "reduce the cost of design, build and/or repair of ships".

The project phases will contribute to the reduction of rework and elimination of unanticipated costs by better access to regulatory information and choices regarding regulatory systems, shipboard systems and equipment, components and materials, and reduced misuse or misapplication of regulatory requirements and existing standards. It will also facilitate the transition of design personnel from U.S. Navy work to commercial work. These benefits include:

A. Estimating and engineering time will be shortened by having a single source for ship design information on regulatory requirements for shipboard systems and equipment.

B. Preliminary design time will be shortened by having a single reference for guidance on regulations and procedures regarding system requirements for shipboard systems and

essential equipment categories.

C. Shipyards will use the information to decide on which alternative procedures and regulations are the most competitive in international markets and to better design shipboard systems and choose equipment, components, and materials.

D. Specification writing agencies will use the information to choose between alternatives and decide if there are overlapping areas of regulation.

E. Regulatory agencies may use the information to determine if differences or conflicts in international requirements or domestic regulations exist.

F. Design agencies will use the information to decide which regulations they need to satisfy without an expensive search of many different documents.

DELIVERABLES:

1. The new reference manual for distribution to NSRP SP-6 Panel members, etc. The reference manual may be either hard copy and/or disk.

2. Proposed scope of work for the other project phases and the recommended priorities for inclusion of topics and order of work.

3. Quarterly Progress Reports and related reports to Panel SP-6 and the TOC.

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* The technical performance of the proposed effort will be monitored by a Technical Overseeing Committee (TOC) established within Panel SP-6, Marine Industry Standards. Reports on the technical effort will be made at each SP-6 meeting (3 per year) during the period of performance.

APPENDIX 6.1 - LIST OF REFERENCES

1. R.J. Bosnak, "Development of Maritime Safety Standards for Vessels and Equipment Construction by the U.S. Coast Guard", SNAME Spring Meeting, Washington, D.C., April 1970.

2. William G. Johnson, MORT: The Management Oversight and Risk Tree, a study for the Energy Research and Development Administration, Division of Operational Safety, Contract No. AT(04-3)-821, Government Printing Office, Washington, D.C., 1973.

3. Randall Eberly, P.E., "Evaluation of Fire Risks in the Open Top Container Holds-SS MAUI and SS KAUAI", Events Analysis, Inc., Oakton, VA, July 2, 1992.

4. R.A. Duregger, E. Leon, and J.R. Sample, "System Safety Analysis Techniques as Applied to Shipboard Systems", SNAME Spring Meeting, Williamsburg, Virginia, May, 1972.

5. Gerald Nielsen, "The ABS Type Approval Program", Surveyor Magazine, ABS Americas, Houston, TX, March 1994.

6. Marine Stores Guide by International Marine Purchasing Association (IMPA), P.O. Box 2, Stratford St. Mary, Suffolk C07 6JS, England, Tel: (+44) (0)206-322822, Second Edition, April 1994.

7. Ship Stores Catalogue, Volume 2, by International Ship Suppliers Association, 235 The Broadway, Wimbeldon, London SW19 1SD, England, Tel: (+44) (0)81-5439161.

8. USCG Marine Safety Manual, Volume IV, Technical, (COMDT INST M16000.9) through Chg. 2.

9. Pressure Vessel and Piping Design - Collected Papers 1927-1959 by ASME, United Engineering Center, New York, New York reprinted in 1994.

10. NSRP Study No. 0358, "Navy Document Conversion Program Project: Pipe Flanges" by George G. Sharp, Inc., May 2, 1990.

11. ASTM F 1387-93 "Standard Specification for Performance of Mechanically Attached Fittings", including supplementary requirements and annex -- See 46 CFR 56.30-25.

12. ASTM F 1476-93 "Standard Specification for Performance of Gasketed Mechanical Couplings for Use in Piping Applications" including annex -- See 46 CFR 56.30-35.

13. ASTM F 1548-94 "Standard Specification for Performance of Fittings for Use with Gasketed Mechanical Couplings for Use in Piping Applications -- See 46 CFR 56.30-35.

14. Ameron Fiberglass Pipe Division, Summary Report "Bondstrand PSX Piping for Offshore Jet Fire (PSX-JF) and IMO Level 3 (PSX-L3) Fire Service", May 6, 1996

15. IMO Working Paper FP 41/INF.12 on "Formulation of Fire Test Procedures, Test Method for Measuring Smoke," by the United States, 1 May 1996

16. IMO Working Paper FP 41/6 on "Formulation of Fire Test Procedures, Smoke and Toxicity", by the United Kingdom dated 10 April 1996

17. U.S. Coast Guard Research and Development Center, Mr. William H. McLain, CG Technical Report CG-D-20-92, "An Investigation of the IMO Spread of Flame Test Method" dated March 1992

18. Omega Point Laboratories, "Innovative Fire Resistant Coatings for Use on Composite Products Aboard U.S. Commercial Ships", dated June 3, 1993 for DOT Program SBIR-1992 Phase I

19. D.C. Miller, American Sprayed Fibers, Inc. USA, Paper No. 12, "Approval for Sprayed Insulation" presented at the International Conference on "Lightweight Materials in Naval Architecture" dated 28 & 29 February 1996, Southampton, UK (1-800-453-8393)

20. NSRP Report No. 0438, "Evaluation of U.S. and International Marine Engineering Standards for Acceptability in U.S. Flag Vessel Applications(NSRP Project No. 6-93-1)"

21. Prevention Through People, Quality Action Team Report, U.S. Coast Guard, July 15, 1995

22. Prevention Through People, United States Coast Guard Implementation Plan, revised 01/31/97

23. NFPA 301, Code for Safety to Life from Fire on Merchant Vessels, 1998 Edition

24. "Report on Preliminary Hazards Analysis (PrHA) of RO/RO Afloat Preposition Ship Cargo Hold Lighting System -- Safety Analysis Report (Executive Summary)", January 1996, by the USCG National Maritime Center, Arlington, VA

25. Applications of Risk-Based Technologies to U.S. Coast Guard Systems: Workshop Proceedings, 1997, CRTD-Vol. 44, American Society of Mechanical Engineers

Standard's Catalogs

26. International Maritime Organization Publications Catalogue, 199X

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28. International Organization for Standardization, Technical Programme, 199X

29. International Organization for Standardization, Catalogue, 199X

30. KWIC Index of International Standards, Sixth Edition, 1993

31. "Computerized Compendium of Standards", Final Report NSRP 0361, December 18, 1992, by H.M. Bunch et al, University of Michigan

32. "Standards Database Maintenance", Final Report NSRP 0456, February 20, 1996, by Richard C. Moore et al, Marine Systems Division, University of Michigan Transportation Research Institute.

33. 199X Catalogue of IEC Publications, World Standards for Electrical and Electronic Engineering

34. JIS Industrial Standards Yearbook, 199X

35. VDE-Vorschriftenwerk, Katalog der Normen, 1994, List of VDE Specifications & Guidelines issued by the Association of German Electrical Engineers (VDE) (available from ANSI)

36. DIN Catalogue of Technical Rules, 1993, with Supplement & Translations (available from ANSI)

37. Underwriters Laboratories Inc., Standards for Safety Catalog, February 199X

38. Underwriters Laboratories Inc., Standards for Safety Product Index, December 199X

39. Underwriters Laboratories Inc. Directory, "Marine Products, Part I - Listed and Classified Marine Products, Part II - Recognized Marine Components", 199X

40. 199X Annual Book of ASTM Standards - Iron and Steel Products, Volume 01.07, Shipbuilding

41. Quick Reference to IEEE Standards, 199X

42. American National Standards, 199X Catalog

APPENDIX 6.2 - FLOW DIAGRAMS FOR TYPICAL APPROVAL PROCESSES

This Appendix presents representative approval process diagrams developed by ABS. The diagrams address different classification society and regulatory programs and include processes for valves, flanges, plastic piping, motors, controllers, and motor control centers.

The following process diagrams are enclosed:

- Approval of Metallic Gate, Globe, Ball, & Butterfly Valves for ABS, ABS Type Approval, and Alternative Compliance Program (ACP) Requirements with one (1) page of notes

- Approval of Metallic Gate, Globe, Ball, & Butterfly Valves for USCG Requirements (under NVIC 10-82,Chg.2 and other approval programs) with one (1) page of notes

- Approval of Butt Weld, Socket Weld & Slip-On Flanges for ABS, ABS Type Approval, and ACP Requirements

- Approval of Butt Weld, Socket Weld & Slip-On Flanges for USCG Requirements (under NVIC 10-82, Chg.2 and other approval programs)

- Approval of Plastic Pipes for ABS, ABS Type Approval, and ACP Requirements using the 1997 ABS Rules with one (1) page of notes

- Approval of Motors, Controllers and Motor Control Centers for ABS, ABS Type Approval, ACP, USCG Requirements (under NVIC 10-82, Chg.2 and other approval programs) and USCG Type Approval Requirements

While the above diagrams are intended as stand alone items, additional information is available in the appropriate sections of this report for valves, flanges, and plastic piping and for all of the above equipment categories in reference (20).

The following is a brief description of the different classification society and regulatory approval programs portrayed in the process diagrams below:

° **Classification Society Approval Programs**

* ABS Classification - a case-by-case approval for a specific project. See section 3.2 (c), Classification Society Processes, on page 3-19 and section 3.4(b), System Types, on page 3-34.

  ABS Type Approval - a program that provides a general acceptance or recognized pre-approval of equipment. A specific certificate is issued identifying the equipment, approval conditions, limitations, standards, etc. See section 3.4(b), System types, on page 3-34 and specifically "Type Approval as a Third Party System" on page 3-36. Also, the remaining sections in Chapter 3 apply.

° **Regulatory Approval Programs**

See section 3.2 (f), Guidance on Approval Procedures, Plan Review, and Interpretation of Requirements, on page 3-25 for further guidance and a listing of pertinent NVIC titles.

* NVIC No.10-92, Chg.1 (P.E.NVIC)- provides a system of self-certification of drawings and materials that must be approved. The certifications can be made by registered professional engineers or ABS personnel. The submissions are audited by USCG personnel except as authorized by NVIC 4-94.

* NVIC No.10-82, Chg. 2 - provides a system of delegation of authority to ABS to perform inspection and plan review functions on behalf of USCG under current regulations in the CFR.

* USCG Type Approval by ABS - in 1995 the USCG authorized ABS to grant type approvals on its behalf under 46 CFR Subchapter Q. Many of these specifications are for lifesaving, fire fighting, and pollution equipment required under SOLAS and MARPOL. Thus, a manufacturer can work with a single point of contact when seeking these domestic and international approvals. See discussion in section 3.4(c)(4) under USCG Approvals on page 3-45.

* USCG/ABS Alternate Compliance Program (ACP) - the USCG's ABS based ACP is a cooperative effort. Its purpose is to increase the international competitiveness of the U.S. maritime industry by reducing

burdensome national regulations and eliminating duplication of the tasks conducted by the USCG and ABS in the process of verifying vessel safety. The program is based upon the USCG's determination that ABS Classification Rules, International Convention Regulations, and the requirements provided in a jointly developed U.S. Supplement to ABS Rules for Steel Vessels for Vessels on International Voyages, 21 October 1996 (U.S. Supplement) are equivalent to the requirements for inspected vessels in the CFR.

The ACP has been implemented by the USCG and ABS as an optional, alternative approach for the U.S. maritime community to comply with all of the various regulatory requirements concerning ship design, plan review, construction and inspection. ACP was developed in recognition of a series of factors that were constraining U.S. shipbuilders and operators in their efforts to become internationally competitive in terms of costs and the latest technologies being offered. These factors include the significant overlap in requirements between USCG regulations, as embodied in the CFR, and international regulatory conventions and ABS Rules; overlapping and redundant inspections, during both ship construction and operation; the presence of outdated requirements in the CFR that inhibit technological advance; and the unwillingness of major international equipment and system suppliers to go through the substantial efforts needed to qualify their products with the USCG for a very small U.S. shipbuilding market.

ACP is only available to ships classed by ABS although the USCG Authorization Act signed in 1996 allows extension to other classification societies. Enrollment in the ACP is at the option of the shipbuilder and/or ship owner.

ABS and USCG collaborated to do a careful comparison of the existing U.S. regulations against current, internationally-recognized regulatory conventions and requirements--specifically, IMO SOLAS 74, MARPOL 73/78, and the ABS Rules. This resulted in the development of the U.S. Supplement, which identifies requirements that are still needed either because ABS and the international conventions fail to address safety issues of concern to the USCG, or where the international conventions rely on interpretations provided by the flag authority. The Commandant has issued a determination that the ABS Rules, SOLAS and MARPOL, in conjunction with the U.S. Supplement, are equivalent to the U.S. merchant vessel safety regulations.

Under this program, the USCG has expanded the scope of plan review and inspection activities delegated to ABS. Vessels designed, constructed, equipped and surveyed in accordance with applicable ABS Rules, International Convention Regulations and the U.S. Supplement are deemed to be in compliance with applicable domestic laws and regulations, and can be issued Certificates of Inspection by the USCG. An oversight program, based in part on the ABS Quality Systems, has been developed to ensure that vessels participating in this program maintain a level of safety equivalent to that experienced by vessels inspected under the traditional process. A pilot program to introduce the ACP, involving a limited number of volunteer companies and ships, began in early 1995.

ACP is a positive step forward in the promotion of safety of life at sea and the protection of the marine environment. It provides the maritime industry greater flexibility in complying with regulatory requirements. It also allows the USCG to focus resources on those vessels which pose the greatest safety and environmental risks, and those human factors largely responsible for marine casualties.

Shipyards and owners will benefit from enrollment in the ACP. During design and construction, streamlined drawing approvals and inspections will reduce schedule risk and administrative costs. Use of ABS Rules, SOLAS, MARPOL and the U.S. Supplement, in lieu of the CFR, will provide a clearer set of requirements for all involved, reducing conflicts over rule interpretations. It will provide more flexibility in system design and equipment selection and will better enable shipyards to take full advantage of technological advances in the international marine industries, as well as from other industries. In addition to the ship acquisition cost savings, owners will continue to achieve operating cost savings over the life of the ship, through streamlined inspections and approvals.

In addition to the new regulations found in 46 CFR Part 8, five (5) documents have been developed to provide the foundation for the ACP. These documents will be amended as necessary to incorporate the lessons learned during the pilot program. These documents are:

(1) Memorandum of Understanding (MOU): The MOU delegates authority and sets forth guidelines for cooperation between USCG and ABS concerning initial and subsequent inspections for certification and plan review. Significant terms and conditions in

the MOU stipulate requirements for information exchange, program oversight, points of contacts in the respective organizations, and qualifications for the ABS personnel involved in carrying out the program.

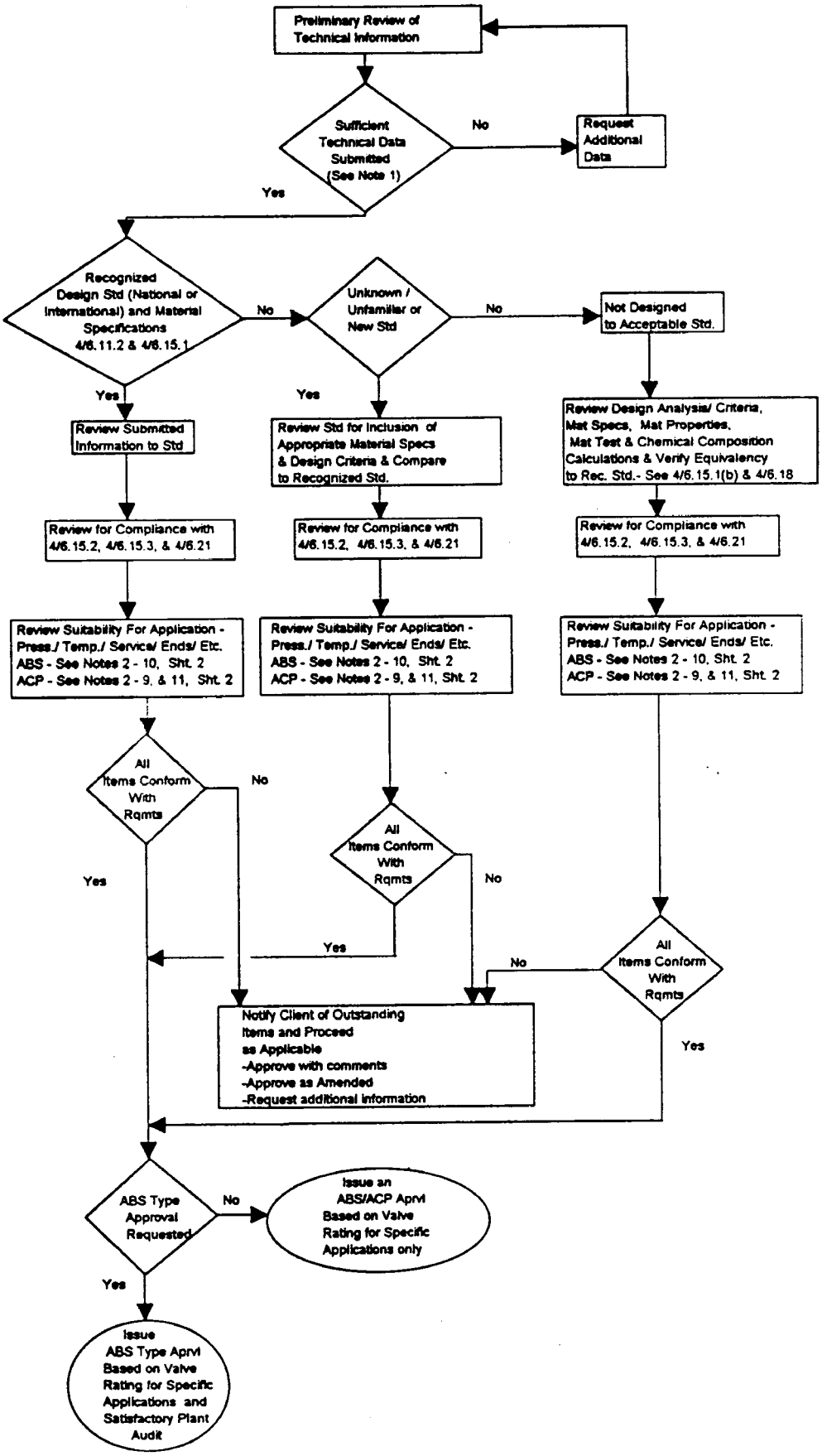
(2) U.S. Supplement to ABS Classification Rules (U.S. Supplement): The U.S. Supplement addresses those areas which the USCG has determined are not covered by ABS Rules and International Convention Regulations, or which International Convention Regulations have left to the interpretation of the flag administration.

(3) ACP Navigation and Vessel Inspection Circular (NVIC No. 2-95): This NVIC introduces the program to the maritime communtiy. It provides an overall description of the program, identifies the conditions for enrollment, and describes the duties and responsibilities of participating vessel owners and operators, ABS and the USCG.

(4) ACP Procedures Commandant Instruction (COMDTINST): This COMDTINST provides the procedures for issuing Certificates of Inspection to vessels enrolled in the program. It designates the USCG's ABS Liaison Officer as Program Manager; defines the terms developed specifically for this program; provides guidance concerning the inspection and certification process for vessels enrolled in the program; and outlines the duties and responsibilities of the Officer-in-Charge, Marine Inspection (OCMI) and the Program Manager.

(5) Oversight COMDTINST: This COMDTINST describes the oversight procedures which have been developed to ensure the USCG meets its statutory responsibilities and the ACP is being properly carried out. This instruction describes the ABS Quality System, and the specific procedures necessary to assess the effectiveness of ABS surveys and overall compliance with established processes. The instruction also describes the routine and non-routine oversight procedures. Specific duties and responsibilities of OCMIs and the Program Manager are identified.

Approval of Metallic Gate, Globe, Ball, & Butterfly Valves for ABS, ABS Type Approval, and ACP

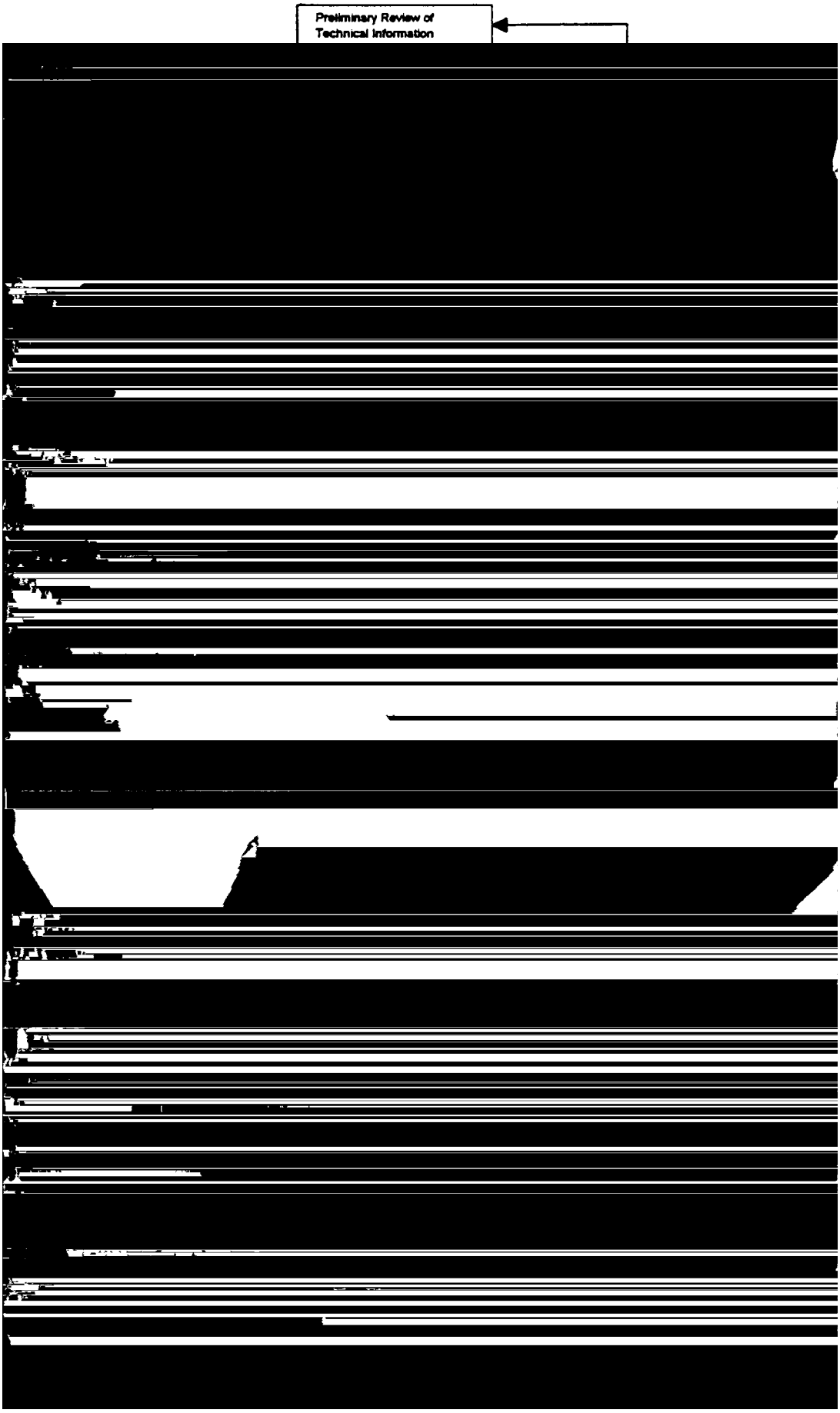


Approval of Metallic Gate, Globe, Ball, & Butterfly Valves for ABS, ABS Type Approval, and ACP (cont.)

Notes:

1. Submitted information should include the following as a minimum:
   a. Valve details/ drawings, as necessary, to verify compliance with Rule requirements,
   b. Standard of construction or design criteria,
   c. Complete material specifications for all components,
   d. Identification of application/ service with maximum pressures & temperatures,
   e. Where valve is not designed to a recognized standard, additional information identifying design, material, testing & marking requirements would be required.
   f. Test results for resiliently seated valves, as applicable,
   g. Welding Details/ Procedures, as applicable, and
   h. Other technical information/ details, as necessary, to verify compliance with applicable Rule requirements.
2. End Connection Application Restrictions - See 2/3B.9.3(a), 4/6.15.2, 4/6.17.1 & 4/6.66.4 of the Rules.
3. Shell Valves - See 4/6.23.2, 4/6.23.3, & 4/6.24.1 of the Rules.
4. Fuel Oil & Lube Oil Tank Shut off Valves - See 4/6.45.5 of the Rules.
5. Boiler Mounting Valves - See 4/2.19, 4/2.21, 4/2.25, & 4/2.27.
6. Collision Bulkhead Valves - See 4/6.9.7 of the Rules.
7. Keel Cooler Valves -See 4/6.26 of the Rules.
8. Bilge Manifold Valves - See 4/6.35.4(a) of the Rules.
9. Oil Tank Sounding Tube Valves - See 4/6.41.2(a) of the Rules.
10. ABS - Valves employing resilient material and utilized in fire fighting systems, for fuel oil tank shut-off valves, and in oil tank valve remote closing systems are not to be rendered ineffective by heat. Valves employing resilient material in such services are to be tested and certified as passing an ABS recognized fire test.
11. ACP Vessels - Valves employing resilient material - See 4/6.15 of ACP-U.S. Supplement for testing requirements & application restrictions.

Approval of Metallic Gate, Globe, Ball, & Butterfly Valves for USCG NVIC 10-82

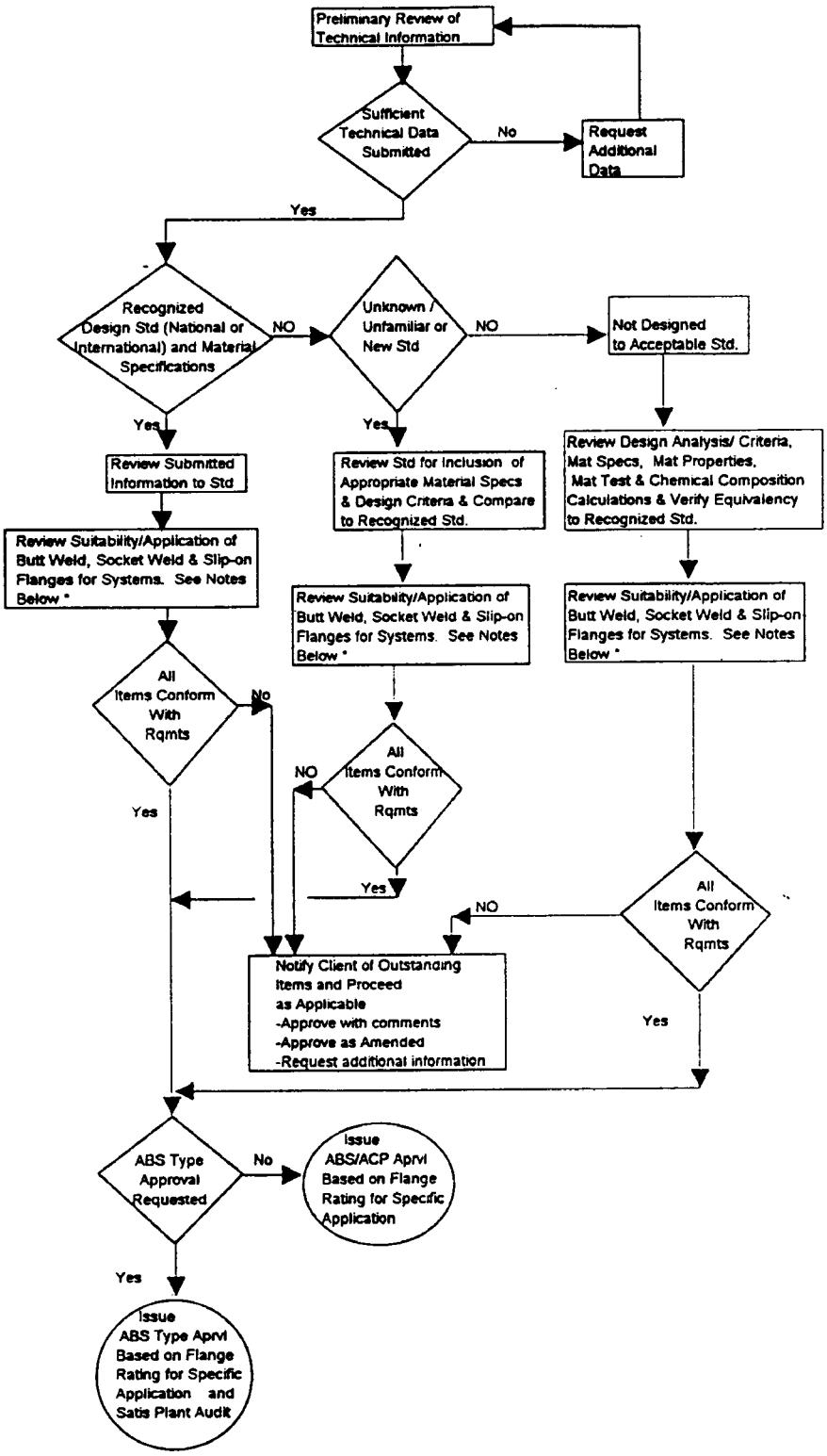


Approval of Metallic Gate, Globe, Ball, & Butterfly Valves for USCG NVIC 10-82 (cont.)

Notes:

1. Submitted information should include the following as a minimum:
   a. Valve details/ drawings, as necessary, to verify compliance with CFR requirements,
   b. Standard of construction or design criteria,
   c. Complete material specifications for all components,
   d. Identification of application/ service with maximum pressures & temperatures,
   e. Where valve is not designed to a recognized standard, additional information identifying design, material, testing & marking requirements would be required.
   f. Welding Details/ Procedures, as applicable,
   g. Test results for resiliently seated valves, as applicable, and
   h. Other technical information/ details, as necessary, to verify compliance with applicable CFR requirements.
2. Valve Pressure Ratings in Class I, Class I-L, and Class II-L Systems to be limited to 80% Allowable Stress Valve unless Ship Motion Dynamic Effects Analysis and NDT Performed - See 46CFR 56.07-10(c) as per 46CFR 56.20-1(b).
3. End connection Restrictions - See 46CFR 56.30.
4. General Material Restrictions - See 46CFR 56.60-3, 56.60-5, 56.60-10, 56.60-15, 56.60-20.
5. Material Certification Requirements - See 46CFR 50.25-1(a) & (b), 50.25-3, 50.25-5 & 50.25-7.
6. Valves employing resilient material - See 46CFR 56.20-15 for testing requirements and application restrictions.
7. Collision Bulkhead Valves - See 46CFR 56.50-01(b).
8. Misc. Bulkhead Valves - See 46CFR 56.50-1(c).
9. Boiler Steam, Feed & Blowdown Valves - See 46CFR 52.01-105, 56.50-15(c), 56.50-30(a)(3) & 56.50-40(d).
10. Bilge Manifold Valves - See 46CFR 56.50-50(c)(1).
11. Misc. Fuel System Valves - See 46CFR 56.50-60(f) & (g).
12. Oil Tank Shut off Valves - See 46CFR56.50-60(d), 56.50-70(c), 56.50-75(b)(4).
13. Burner Fuel Systems - See 46CFR 56.50-65(d) & (f).
14. Gasoline Fuel Systems - See 46CFR 56.50-70(a)(4).
15. Oil Tank Sounding Tube Valves - See 46CFR 56.50-90(b).
16. Shell Valves - See 46CFR 56.50-95(f).
17. Keel Cooler Valves -See 46CFR 56.50-96(a).
18. Low Temperature Applications - See 46CFR 56.50-105.
19. Hydraulic Systems - See 46CFR 58.30-15 and 50.25-1(e).
20. Please note that the approval process above for valves not constructed to a standard recognized in 46CFR 56.60-1 is based upon USCG's guidance to ABS for acceptance of foreign material specifications and standards by their letter of 3 March 1995.

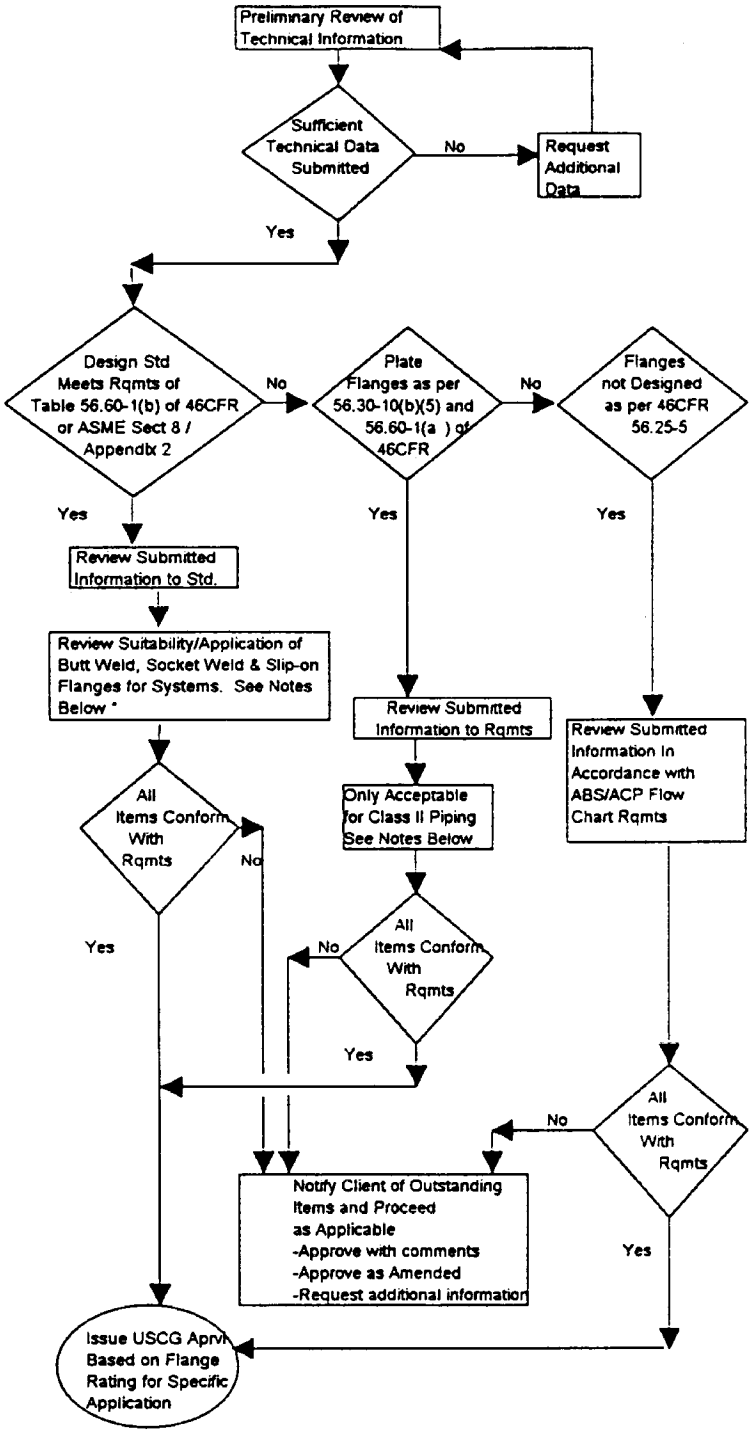
Approval of Butt Weld, Socket Weld & Slip-On Flanges for ABS & ACP



Notes:

1. Butt Weld Flanges may be used in all Group I & II applications
2. Socket Weld Flanges upto & including ANSI 600 Class may be used in piping 3 in NPS or less & upto & inclu. the ANSI 1500 Class in piping 2.5 in NPS or less
3. Slip-on Flanges may be used for applications with service rating no higher than ANSI 300 Class. For boiler external piping Slip-on flanges limited to sizes not exceeding 4in NPS (OD). See 2/3B.9.3c of the Rules
4. Plate Slip-on Flanges acceptable in Group II piping only. See 4/6.19.1 of the Rules
5. Please note that the subject flow chart includes changes in ACP proposed by USCG by their letter of 9 October 1996

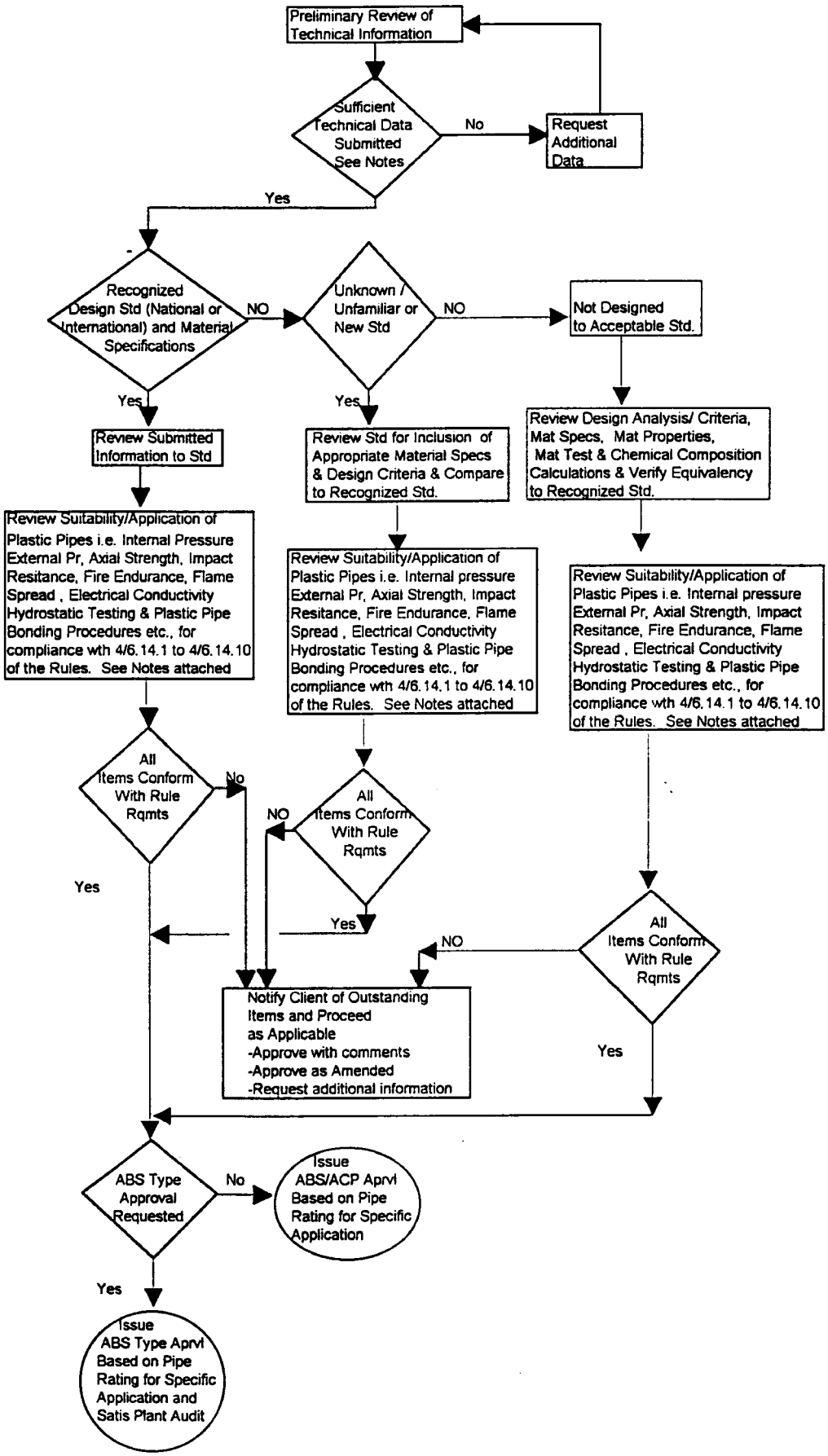
Approval of Butt Weld, Socket Weld & Slip-On Flanges for USCG Under NVIC 10-82 Ch-2



Notes:

1. Butt Weld Flanges may be used in all Group I & II applications
2. Socket Weld Flanges may be used in Class I or II-L systems not exceeding 3 in NPS for Class 600 and lower Class flanges and 2 1/2 in NPS for Class 900 & Class 1500 flanges within the specified rating. Use of socket weld flanges is further not permitted if 100% radiography is required as per 46CFR56.95-10
3. Slip-on Flanges may be used for applications with service rating no higher than ANSI 300 Class. Slip-on flanges limited to sizes not exceeding 4in NPS in Class I & Class II-L piping. See 46CFR 56.30-10(b)(3). Use of Slip-on flanges is further not permitted if 100% radiography is required as per 46CFR56.95-10
4. Plate Flanges acceptable in Group II piping for pressures not exceeding 150psi & temp not exceeding 450 F. Plate flanges must conform at least to ANSI Class 150 flange dimension. See 46CFR 56.30-10(b)(5)
5. Please note that the approval process for the flanges not designed as per 46CFR 56.25-5 is based on USCG's guidance to ABS for acceptance of foreign material specs & standards by their letter of 3 March 1995

Approval of Plastic Pipes for ABS & ACP



Approval of Plastic Pipes for ABS, ABS Type Approval & ACP

1. Submitted information should include the following as a minimum.

   a. Details of piping components i.e. material specifications, standard of construction, pressure ratings, hydrostatic testing, bonding procedures, electrical conductivity, suitability of internal & external pressures. Additionally fire endurance test & flame spread test as applicable.

   b. Where components are not designed to recognized standard, further information identifying design, materials, testing & drawings etc. would be required in addition to item (a) above.

   c. Identification of application /service with maximum pressures and temperatures.

   d. Other technical information/ details as necessary to verify compliance with applicable Rule requirements.

2. Please note that the subject flow chart is based on 1997 Rules.

3. Plastic pipes may be used in Group I & II applications in accordance with attached sheet.

4. Installation of plastic pipes, penetration of deck and bulkheads and shell connections are to be in accordance with 4/6.14 of the Rules.

5. Please note that the for the purpose of the Rules, "Plastic" means both thermoplastic & thermosetting plastic materials with or without reinforcement i.e. polyvinyl chloride (PVC) and fiber reinforced plastics (FRP).

Motor/Controller Review Process
(Motor Control Center)

Preliminary review of technical information to confirm that, as applicable, submitted documents include plans listed on 4/5B1 of ABS Rules and USCG 46 CFR 110.25-1. Submittal is to include:

- Placement, location, MCC construction, assembly of enclosure, standards, inclinations
- As applicable, details of Bus Bars and Wiring, rating and setting of Circuit Breakers, Over Load Relays, rating of Magnetic Starters, etc. Also as applicable, details and settings for Steering Gear system.

Sufficient Technical Data Submitted? — No → **Request Additional Data**

Yes

ABS 1996/ Alternative Compliance Program (ACP)

1 — Review: Location Details (as applicable)

ABS Rules		ACP
4/5B2.1	General Considerations	As per ABS Rules
4/5B2.13	Motor Controllers and Control Centers	

3 — Review: Panel Construction Details (as applicable)

ABS Rules		ACP
4/5C4.9	MCC construction and assembly	As per ABS Rules
4/5C4.11	Bus Bars, Wiring and Contacts	
4/5C4.17	Enclosure and Assemblies	

5 — Review: Electrical Performance (as applicable)

ABS Rules		ACP
4/5A5	Circuit Protection System	As per ABS Rules
4/5C4.1.1	Switchboards and MCCs'	
4/1.13	Inclinations	

7 — Review: Inspections and Tests (as applicable)

ABS Rules		ACP
4/5C4.3(c)	MCC testing and inspections.	As per ABS Rules
4/5C4.5	Insulation test	
4/5C4.7	Dielectric Test	
	(Type Approval) Review Tests Reports and Independent Laboratory Certification.	

9 — Review: Control of Steering Motors (as applicable)

ABS Rules		ACP
4/5A6	System for Steering Gear	As per ABS Rules

USCG NVIC 10-82, 1995

2 — Review: Location Details (as applicable)

USCG 46 CFR	
111-01	Placement of Equipment, Protection from Bilge Water, Accessibility, Watertight and Corrosion

4 — Review: Panel Construction Details (as applicable)

USCG 46 CFR	
111-70-3	Motor Controllers and Motor Control Centers. (Also UL 508 Including Marine Supplement, UL 845) (UL 347 if above 600 VAC)
111.01-9	Watertight, waterproof and driproof equipment
111.30-19	Buses and Wiring (Also IEEE Table A27 and NEC 384-26)

6 — Review: Electrical Performance (as applicable)

USCG 46 CFR	
111-70-1	Motor Circuits, Controllers and Protection (Also NEC 430)

8 — Review: Inspections and Tests (as applicable)

USCG 46 CFR	
110.30-1	Testing and Inspections
	(Type Approval) Review Tests Reports and USCG Recognized Laboratory Certification.

10 — Review: Control of Steering Motors (as applicable)

USCG 46 CFR	
58.25-55	Overcurrent Protection for Steering-Gear Systems.

All Items Conform with ABS/ACP? — No → **Notify submitter of engineering outstanding items. As applicable proceed to:**
- Approve with comments
- Approve as amended
- Request additional information
- Reject, resubmitting required

All Items Conform with 46 CFR? — No → Notify submitter of engineering outstanding items. As applicable proceed to:

Yes

ABS Type Approval Requested — Yes → **Issue ABS Type Approval**

Type Approval Requested on Behalf of USCG — Yes → **Issue Type Approval on Behalf of U.S.C.G.**

No

Issue Approval for ABS Class & USA Flag

APPENDIX 6.3 - LIST OF INTERNATIONAL MARITIME ORGANIZATION (IMO) ASSEMBLY RESOLUTIONS (BY SESSION)

IMO Resolutions are promulgated by the various constituent bodies and include the following types of resolutions:

ASSEMBLY Resolutions
COUNCIL Resolutions
MARITIME SAFETY COMMITTEE (MSC) Resolutions
MARINE ENVIRONMENT PROTECTION COMMITTEE (MEPC) Resolutions
LONDON (DUMPING) CONVENTION (LDC/LC) Resolutions

The effective resolutions are listed in the Comprehensive Index of Valid Technical Guidelines and Recommendations (as of 1 January 1992) published by IMO. A full index is also published as Index of IMO Resolutions (sales number: IMO-126E). CD ROM listings are also available.

Summary of Assembly Resolutions

Standard Abbreviations

The below abbreviations are often used for the following documents:

Abbreviation	Title
BC Code	Code of Safe Practice for Solid Bulk Cargoes
BCH Code	Code for the Construction and Equipment of Ships Carrying Dangerous Chemicals in Bulk
IBC Code	International Code for the Construction and Equipment of Ships Carrying Dangerous Chemicals in Bulk
IGC Code	International Code for the Construction and Equipment of Ships Carrying Liquified Gases in Bulk
MARPOL 1973	International Convention for the Prevention of Pollution from Ships, 1973
MARPOL 73/78	International Convention for the Prevention of Pollution from Ships, 1973, as modified by the Protocol of 1978 relating thereto
MODU Code	Code for the Construction and Equipment of Mobile Offshore Drilling Units
SOLAS	International Convention for the Safety of Life at Sea
STCW	International Convention on Standards of Training, Certification and Watchkeeping for Seafarers

IMO Assembly Resolutions
1st Session
1959

Number	Title
A.1(1)	Approval of the appointment of the Secretary-General by the Council
A.2(1)	Acceptance of duties under the International Convention for the Safety of Life at Sea (1948)-revision of the Regulations for Preventing Collisions at Sea (1948)
A.3(1)	Acceptance of duties in connection with the International Code of Signals
A.4(1)	Acceptance of duties in connection with the establishment of the Group of Experts on the Unification of Maritime Tonnage Measurement
A.5(1)	Status of the Convention on IMCO
A.6(1)	Report of the Credentials Committee
A.7(1)	Agreement on relationship with the United Nations
A.8(1)	Acceptance of duties under the International Convention for the Prevention of Pollution of the Sea by Oil (1954)
A.9(1)	Election of members of the Maritime Safety Committee, as provided in Article 28 of the Convention
A.10(1)	Report of the Assembly on the final text of the Annex to the General Convention on the Privileges and Immunities of the Specialized Agencies
A.11(1)	Relationship with other specialized agencies and other international organizations
A.12(1)	Election of Members of the Maritime Safety Committee
A.13(1)	Adoption of Rules of Procedure for subsequent sessions of the Assembly
A.14(1)	Financial Regulations of the Inter-Governmental Maritime Consultative Organization

IMO Assembly Resolutions
1st Session
1959

Number	Title
A.15(1)	Staff Regulations of the Inter-Governmental Maritime Consultative Organization
A.16(1)	Review of expenditures and approval of accounts of the Preparatory Committee
A.17(1)	Dissolution of the Preparatory Committee
A.18(1)	Staff establishment and adoption of the budget for the first financial period
A.19(1)	Staff establishment and adoption of the budget for the first financial period. Resolution relating to the Working Capital Fund
A.20(1)	Apportionment of expenses among Member States

IMO Assembly Resolutions
2nd Session
1961

Number	Title
A.21(2)	Report on request by the first Assembly for an Advisory Opinion of the International Court of Justice on the constitution of the Maritime Safety Committee
A.22(2)	Presentation of the report of the Council in accordance with Article 24 of the Convention
A.23(2)	Approval of appointment of External Auditor
A.24(2)	Programme appraisal in the economic, social and human rights fields
A.25(2)	General Convention on Privileges and Immunities of the Specialized Agencies
A.26(2)	Admission of new Member States-the Islamic Republic of Mauritania
A.27(2)	Adoption of the Rules of Procedure
A.28(2)	Participation in the United Nations expanded programme of technical assistance
A.29(2)	Facilitation of travel and transport
A.30(2)	Consideration of Agreement between International Atomic Energy Agency and Inter-Governmental Maritime Organization
A.31(2)	Approval of the Rules for the admission to consultative status of non-governmental international organizations
A.32(2)	Amendment to the Financial Regulations

IMO Assembly Resolutions
2nd Session
1961

Number	Title
A.33(2)	Work programme of the Organization
A.34(2)	Staff establishment and adoption of the budget for the second financial period 1962/63
A.35(2)	Staff establishment and adoption of the budget for the second financial period 1962/63-amendment to the Staff Regulations
A.36(2)	Staff establishment and adoption of the budget for the first financial period-supplementary estimates for 1961
A.37(2)	Staff establishment and adoption of the budget for the second financial period 1962/63-Working Capital Fund
A.38(2)	Apportionment of expenses among Member States
A.39(2)	United Nations Joint Staff Pension Fund
A.40(2)	Report on request by the first Assembly for an Advisory Opinion of the International Court of Justice on the constitution of the Maritime Safety Committee
A.41(2)	Presentation of the report of the Maritime Safety Committee transmitted by the Council
A.42(2)	Approval of the provisional consultative status granted to non-governmental international organizations
A.43(2)	Determination of date and place of the third session of the Assembly in 1963

IMO Assembly Resolutions
1st Extraordinary Session & 3rd Session
1963

Number	Title
A.44(3)	Approval of the appointment of the Secretary-General by the Council
A.45(3)	Banning of nuclear tests in the atmosphere, in outer space and under water
A.46(3)	Approval of the appointment of the External Auditor
A.47(3)	Red Sea lights
A.48(3)	Approval of the recommendations of the Maritime Safety Committee on treatment of shelter-deck and other "open" spaces
A.49(3)	Approval of the recommendations of the Maritime Safety Committee on stability information for ships carrying grain
A.50(3)	Approval of the recommendations of the Maritime Safety Committee on marking of oceanographic stations
A.51(3)	Acceptance by the Organization of additional duties consequent upon the International Conference on Prevention of Pollution of the Sea by Oil, 1962
A.52(3)	Intact stability of fishing vessels
A.53(3)	Convening of the International Conference on Load Lines
A.54(3)	Adoption of the reports of the Maritime Safety Committee
A.55(3)	General Convention on Privileges and Immunities of the Specialized Agencies
A.56(3)	Relations with the host State
A.57(3)	Relationship with the UN, specialized agencies, IAEA and other internationalorganizations

IMO Assembly Resolutions
1st Extraordinary Session & 3rd Session
1963

Number	Title
A.58(3)	Relations with the non-governmental international organizations; review of the list of non-governmental international organizations in consultative status; etc.
A.59(3)	Amendment to the Financial Regulations
A.60(3)	Review of expenditures and approval of accounts
A.61(3)	IMCO Headquarters accommodation
A.62(3)	Participation in the United Nations expanded programme of technical assistance
A.63(3)	Facilitation of travel and transport
A.64(3)	Work programme of the Organization
A.65(3)	Staff establishment and adoption of the budget for the third financial period 1964/65
A.66(3)	Staff establishment and adoption of the budget for third financial period 1964/65; Working Capital Fund
A.67(3)	Apportionment of expenses among Member States
A.68(3)	Determination of date and place of the third session of the Assembly in 1965

IMO Assembly Resolutions
2nd Extraordinary Session & 4th Session
1964 & 1965

Number	Title
A.69(ES.II)	Amendments to Articles 17, 18 and 28 of the IMCO Convention
A.70(4)	Amendment to Article 28 of the Convention on the Inter-Governmental Maritime Consultative Organization
A.71(4)	Amendments to the Rules of Procedure of the Assembly consequent upon amendments to Articles 17, 18 and 28 of the IMCO Convention
A.72(4)	Amendment to rule 3 and rule 9 of the Rules of Procedure of the Assembly
A.73(4)	Presentation of the final accounts and audit report for the second financial period
A.74(4)	Working Capital Fund
A.75(4)	Amendment to the Financial Regulations
A.76(4)	Apportionment of expenses among Member States
A.77(4)	Arrears of contributions
A.78(4)	Facilitation of travel and transport
A.79(4)	Arrangements for an International Conference on Load Lines in 1966
A.80(4)	International Code of Signals
A.81(4)	Approval of the International Maritime Dangerous Goods Code
A.82(4)	Approval of the Code of Safe Practice for Bulk Cargoes
A.83(4)	Acceptance of the International Convention for the Safety of Life at Sea, 1960, and of the International Regulations for Preventing Collisions at Sea, 1960
A.84(4)	Prevention of pollution of the sea by oil

IMO Assembly Resolutions
2nd Extraordinary Session & 4th Session
1964 & 1965

Number	Title
A.85(4)	Prevention of pollution of the sea by agents other than oil
A.86(4)	Implementation of the recommendations on treatment of shelter-deck and other "open" spaces and acceptance of tonnage certificates
A.87(4)	Convening of an International Conference on Tonnage Measurement
A.88(4)	Intact stability of fishing vessels
A.89(4)	Training of seafarers
A.90(4)	Navigation in the Strait of Dover
A.91(4)	Emergency Position-Indicating Radio Beacons
A.92(4)	Radiocommunication requirements for the Ocean Data Service of the Inter-governmental Oceanographic Commission
A.93(4)	Lights and shapes for dracones
A.94(4)	Nuclear ships
A.95(4)	Weather messages in oceanic areas
A.96(4)	Red Sea lights
A.97(4)	Adoption of the report of the Maritime Safety Committee
A.98(4)	Work Programme
A.99(4)	Work Programme of the Organization
A.100(4)	Printing Fund
A.101(4)	Budget for the fourth financial period 1966/67; staff establishment

IMO Assembly Resolutions
2nd Extraordinary Session & 4th Session
1964 & 1965

Number	Title
A.102(4)	Participation in the United Nations expanded programme of technical assistance
A.103(4)	Agreement between FAO and IMCO
A.104(4)	Relations with the host State
A.105(4)	Relations with non-governmental organizations
A.106(4)	Status of the IMCO Convention
A.107(4)	Broadcasts from stations outside territorial waters

IMO Assembly Resolutions
3rd Extraordinary Session & 5th Session
1966 & 1967

Number	Title
A.108(ES.III)	Amendments to Chapter II of the International Convention for the Safety of Life at Sea, 1960
A.109(ES.III)	Recommendation to put fire safety measures into effect
A.110(ES.III)	Recommendations for fire safety measures for all passenger ships
A.111(5)	Amendments to Articles 17, 18 and 28 of the Convention; consequential amendments to the Rules of Procedure of the Assembly
A.112(5)	Approval of the appointment of the Secretary-General by the Council
A.113(5)	Revised International Code of Signals
A.114(5)	Implementation of the recommendations on treatment of shelter-deck and other "open" spaces and acceptance of tonnage certificates
A.115(5)	Recommendation on the treatment of spaces on board ships for the separation, clarification or purification, and the carriage of slop oil
A.116(5)	Arrangements with the Food and Agriculture Organization of the United Nations (FAO) and the International Labour Organization (ILO)
A.117(5)	Broadcasts from stations outside territorial waters
A.118(5)	Maritime World Administrative Radio Conference
A.119(5)	Prevention of pollution of the sea by oil
A.120(5)	International Maritime Dangerous Goods Code
A.121(5)	Examination of the reports submitted to the Organization under Regulation 19 of Chapter I of the International Convention for the Safety of Life at Sea, 1960

IMO Assembly Resolutions
3rd Extraordinary Session & 5th Session
1966 & 1967

Number	Title
A.122(5)	Amendments to the International Convention for the Safety of Life at Sea, 1960
A.123(5)	Recommendation on fixed fire-extinguishing systems for special category spaces
A.124(5)	Recommendation on crew training
A.125(5)	Recommendation on periodical inspection of musters
A.126(5)	Recommendation on life-saving appliances for hyrdofoil boats
A.127(5)	Recommendation on signals by Emergency Position-Indicating Radio Beacons
A.128(5)	Recommendation on VHF radiotelephone stations
A.129(5)	Recommendation on emergency radiotelegraph transmitters on vessels of less than 1,600 tons gross when on transoceanic voyages
A.130(5)	Recommendation on pilot ladders on fishing vessels and vessels of less than 500 tons gross
A.131(5)	Recommendation on the application of certain rules of the International Regulations for Preventing Collisions at Sea, 1960
A.132(5)	Recommendation on additional signals to be used by vessels fishing in close proximity
A.133(5)	International Conference on Load Lines, 1966
A.134(5)	International Conference on Tonnage Measurement
A.135(5)	Adoption of the reports of the Maritime-Safety Committee
A.136(5)	Facilitation of travel and transport: Standardized forms of documents

IMO Assembly Resolutions
3rd Extraordinary Session & 5th Session
1966 & 1967

Number	Title
A.137(5)	Working Capital Fund
A.138(5)	Appointment of an External Auditor
A.139(5)	World weather watch
A.140(5)	Participation of the Inter-Governmental Maritime Consultative Organization in the United Nations Development Programme
A.141(5)	Presentation of the final accounts and audit report for the third financial period
A.142(5)	Work programme and budget for the fifth financial period 1968/69
A.143(5)	Relations with the non-governmental organizations
A.144(5)	Simla Rules
A.145(5)	Appreciation of the services of M. Jean Georges Roullier to the Organization

IMO Assembly Resolutions
4th Extraordinary Session & 6th Session
1968 & 1969

Number	Title
A.146(ES.IV)	Amendments to the International Convention for the Safety of Life at Sea, 1960
A.147(ES.IV)	Reports on accidents involving significant spillages of oil
A.148(ES.IV)	National arrangements for dealing with significant spillages of oil
A.149(ES.IV)	Regional co-operation in dealing with significant spillages of oil
A.150(ES.IV)	Research and exchange of information on methods for disposal of oil in cases of significant spillages
A.151(ES.IV)	Detection of offences against and enforcement of the International Convention for the Prevention of Pollution of the Sea by Oil, 1954
A.152(ES.IV)	Discharge of oily mixtures resulting from tank cleaning and ballasting into the sea
A.153(ES.IV)	Penalties for unlawful discharge of oil into the sea
A.154(ES.IV)	Oil reception facilities
A.155(ES.IV)	Prevention of pollution of the sea by oil outside the prohibited zones
A.156(ES.IV)	Recommendation on the carriage of electronic position-fixing equipment
A.157(ES.IV)	Recommendation on the use of testing of shipborne navigational equipment
A.158(ES.IV)	Recommendation of port advisory services
A.159(ES.IV)	Recommendation of pilotage
A.160(ES.IV)	Recommendation on data concerning manoeuvring capabilities and stopping distances of ships
A.161(ES.IV)	Recommendation on establishing traffic separation schemes and areas to be avoided by ships of certain classes

IMO Assembly Resolutions
4th Extraordinary Session & 6th Session
1968 & 1969

Number	Title
A.162(ES.IV)	Recommendation on additional signals for deep-draught ships in narrow channels
A.163(ES.IV)	Recommendation for fire test procedures for "A" and "B" class divisions
A.164(ES.IV)	Recommendation concerning checking the constancy of the properties of materials
A.165(ES.IV)	Provisional guidelines on test procedures for deck coverings
A.166(ES.IV)	Guidelines on the evaluation of fire hazard properties of materials
A.167(ES.IV)	Recommendation on intact stability for passenger and cargo ships under 100 metres in length
A.168(ES.IV)	Recommendation on intact stability of fishing vessels
A.169(ES.IV)	Recommendation for testing life-jackets
A.170(ES.IV)	Recommendation on life-saving appliances for air-cushion vehicles
A.171(ES.IV)	Convening of a conference on "Torrey Canyon" matters
A.172(ES.IV)	Recommendation for uniform application and interpretation of Regulation 27 of the International Convention on Load Lines, 1966
A.173(ES.IV)	Participation in official inquiries into maritime casualties
A.174(6)	Amendments to the International Convention for the Safety of Life at Sea, 1960
A.175(6)	Amendments to the International Convention for the Prevention of Pollution of the Sea by Oil, 1954
A.176(6)	Marine pollution

IMO Assembly Resolutions
4th Extraordinary Session & 6th Session
1968 & 1969

Number	Title
A.177(6)	Recommendation on recommended practices for navigation lights
A.178(6)	Recommendation on positioning of navigation lights
A.179(6)	Recommendations on establishment of fairways through offshore exploration areas
A.180(6)	Recommendation on dissemination of information, charting and manning of drilling rigs and production platforms
A.181(6)	Instructions on survival in liferafts
A.182(6)	Safety radio communication requirements for drilling and production platforms and similar units
A.183(6)	Recommendation on fire safety measures for hydrofoil boats
A.184(6)	Adoption of grain regulations as an equivalent to Chapter VI of the International Convention for the Safety of Life at Sea, 1960
A.185(6)	Application grain regulations to cargo ships of less than 500 tons gross tonnage
A.186(6)	Recommendation on establishing additional traffic separation schemes and areas to be avoided by ships of certain classes
A.187(6)	Procedure for amending and bringing up to date the International Code of Signals
A.188(6)	Training of masters, officers and crew
A.189(6)	Voluntary reports on spillages of oil
A.190(6)	Adoption of the reports of the Maritime Safety Committee
A.191(6)	International Conference on Tonnage Measurements of Ships, 1969

IMO Assembly Resolutions
4th Extraordinary Session & 6th Session
1968 & 1969

Number	Title
A.192(6)	Revision of the Regulations for Preventing Collisions at Sea, 1960
A.193(6)	International Conference on Container Traffic
A.194(6)	Recommendation on wider implementation of facilitation measures in maritime travel and transport
A.195(6)	Review of the Organization's methods of work and the total financial burden falling upon Member States
A.196(6)	Working Capital Fund
A.197(6)	Presentation of the final accounts and audit report for the fourth financial period
A.198(6)	Work programme and budget for the sixth financial period 1970/71
A.199(6)	Relations with the non-governmental organizations
A.200(6)	Printing Fund
A.201(6)	International Labour Organization

IMO Assembly Resolutions
7th Session
1971

Number	Title
A.202(7)	International Conference on Special Trade Passenger Ships, 1971
A.203(7)	Recommendation on the conclusion of agreements and arrangements between States on the question of access and employment of foreign sea-borne salvage equipment in territorial waters
A.204(7)	Appreciation of the services of Mr. Hjalmar R. Bardarson
A.205(7)	Amendments to the International Convention for the Safety of Life at Sea, 1960
A.206(7)	Amendments to the recommendation on intact stability for passenger and cargo ships under 100 meters in length (Resolution A.167(ES.IV)) with respect to ships carrying deck cargoes
A.207(7)	Recommendation for an interim simplified criterion for decked fishing vessels under 30 meters in length
A.208(7)	Recommendation on construction of fishing vessels affecting the vessel's stability and crew safety
A.209(7)	Recommendation on information to be included in the manoeuvring booklets
A.210(7)	Recommendation on steering gear for large ships
A.211(7)	Recommendation on safety measures for periodically unattended machinery spaces of cargo ship additional to those normally considered necessary for an attended machinery
A.212(7)	Code for the Construction and Equipment of Ships Carrying Dangerous Chemicals in Bulk
A.213(7)	Recommendation on fire safety requirements for construction and equipment of new tankers

IMO Assembly Resolutions
7th Session
1971

Number	Title
A.214(7)	Improved provisional guidelines on test procedures for primary deck coverings
A.215(7)	Correction to the text of the recommendation for fire test procedures for "A" and "B" class divisions (Resolution A.163(ES.IV))
A.216(7)	Instruction for action in survival craft
A.217(7)	Measures for strengthening and improving the maritime distress system
A.218(7)	Safety radiocommunication requirements for novel types of craft
A.219(7)	Unification of performance specifications
A.220(7)	Introduction of selective calling (SSFC) system
A.221(7)	Radio equipment for homing
A.222(7)	Performance standards for navigational radar equipment
A.223(7)	Performance standards for radio direction-finding systems
A.224(7)	Performance standards for echo-sounding equipment
A.225(7)	Homing capability of search and rescue (SAR) aircraft
A.226(7)	Traffic separation schemes
A.227(7)	System of traffic separation schemes in the Dover Strait and adjacent areas
A.228(7)	Observance of traffic separation schemes
A.229(7)	Merchant Ship Search and Rescue Manual (MERSAR)
A.230(7)	Adoption of the International Maritime Dangerous Goods Code
A.231(7)	Amendments to the International Convention on Load Lines, 1966

IMO Assembly Resolutions
7th Session
1971

Number	Title
A.232(7)	Amendments to the International Convention for the Prevention of Pollution of the Sea by Oil, 1954 (as amended in 1969), concerning the protection of the Great Barrier Reef
A.233(7)	Recommendation on international performance specifications for oily-water separating equipment and oil content meters
A.234(7)	Disposal of oily bilge and ballast water from ships in ports (excluding effluent from cargo/ballast tanks in tankers)
A.235(7)	Facilities in ports for the reception of oil residues
A.236(7)	Implementation of the 1969 amendments to the International Convention for the Prevention of Pollution of the Sea by Oil, 1954
A.237(7)	Acceleration of the Marine Safety Committee's work programme
A.238(7)	Adoption of the reports of the Maritime Safety Committee
A.239(7)	Recommendation on facilitation in maritime travel and transport
A.240(7)	Working Capital Fund
A.241(7)	International Conference on Marine Pollution, 1973
A.242(7)	Preparations for the United Nations Conference on the Human Environment (Stockholm, 5-6 June 1972)
A.243(7)	International Convention on Ocean Data Acquisition Systems (ODAS)
A.244(7)	Co-operation with the Inter-governmental Oceanographic Commission
A.245(7)	United Nations/IMCO Conference on International Container Traffic, 1972

IMO Assembly Resolutions
7th Session
1971

Number	Title
A.246(7)	Amendments to the International Convention for the Prevention of Pollution of the Sea by Oil, 1954 concerning tank arrangements and limitation of tank size
A.247(7)	Recommendation to put into effect requirements relating to tank arrangements and to the limitation of tank size from the point of view of minimizing pollution of the sea by oil
A.248(7)	Long-term work programme of the Organization
A.249(7)	Amendment procedures in conventions for which IMCO is depositary
A.250(7)	Implementation of United Nations General Assembly resolutions on apartheid and on the Declaration of the Granting of Independence to Colonial Countries and People
A.251(7)	Relations with non-governmental international organizations
A.252(7)	Presentation of the final accounts and audit report for the fifth financial period
A.253(7)	Amendment to the Financial Regulations
A.254(7)	Supplementary estimates for 1971
A.255(7)	Work programme and budget for the seventh financial period 1972/73
A.256(7)	Continuation of the Joint Inspection Unit
A.257(7)	Appointment of External Auditor
A.258(7)	Approval of the appointment of the Secretary-General by the Council

IMO Assembly Resolutions
8th Session
1973

Number	Title
A.259(8)	Convention on the International Regulations for Preventing Collisions at Sea, 1972
A.260(8)	International Convention for Safe Containers (CSC), 1972
A.261(8)	International Conference on Space Requirements for Special Trade Passenger Ships, 1973
A.262(8)	Approval of the appointment of the Secretary-General by the Council
A.263(8)	Amendments to Chapters II, III, IV and V of the International Convention for the Safety of Life at Sea, 1960
A.264(8)	Amendments to Chapter VI of the International Convention for the Safety of Life at Sea, 1960
A.265(8)	Regulations on subdivision and stability of passenger ships as an equivalent to Part B of Chapter II of the International Convention for the Safety of Life at Sea, 1960
A.266(8)	Recommendation on a standard method for establishing compliance with the requirements for cross-flooding arrangements in passenger ships
A.267(8)	Code of practice concerning the accuracy of stability information for fishing vessels
A.268(8)	Amendments to recommendation on intact stability of fishing vessels Appendix V - recommended practice on portable fish-hold divisions (Resolution A.168(ES.IV))
A.269(8)	Recommendation for skippers of fishing vessels on ensuring a vessel's endurance in conditions of ice formation
A.270(8)	Recommendation on test method for qualifying marine construction materials as non-combustible

IMO Assembly Resolutions
8th Session
1973

Number	Title
A.271(8)	Recommendation to put fire safety measures for tankers and combination carriers into effect
A.272(8)	Recommendation on safe access to and working in large tanks, and recommendation on safe access to and working in large cargo holds of bulk carriers
A.273(8)	Survey of inflatable liferafts
A.274(8)	Recommendation on retro-reflective tapes on life-saving appliances
A.275(8)	Recommendation on performance standards for mechanical pilot hoists
A.276(8)	Recommendation on the number of persons allowed on board existing passenger ships resulting from an increase in liferaft capacity
A.277(8)	Recommendation of performance standards for radar reflectors
A.278(8)	Supplement to the recommendation on performance standards for navigational radar equipment (Resolution A.222(VII))
A.279(8)	Recommendation on Emergency Position-Indicating Radio Beacons
A.280(8)	Recommendation on performance standards for gyro-compasses
A.281(8)	Recommendation on general requirements for electronic navigational aids
A.282(8)	Recommendation on the installation and use of manoeuvering lights
A.283(8)	Recommendation on the development of the maritime distress system
A.284(8)	Routing systems
A.285(8)	Recommendations on basic principles and operational guidance relating to navigational watchkeeping

IMO Assembly Resolutions
8th Session
1973

Number	Title
A.286(8)	Recommendation on training and qualifications of officers and crews of ships carrying hazardous or noxious chemicals in bulk
A.287(8)	Code of Safe Practice for Ships Carrying Timber Deck Cargoes
A.288(8)	Recommendation on the safe stowage and securing of containers on deck on vessels which are not specifically designed and fitted for the purpose of carrying containers
A.289(8)	Recommendation on safe practice on dangerous goods in ports and harbours
A.290(8)	Adoption of the reports of the Maritime Safety Committee
A.291(8)	Arrears of contributions
A.292(8)	Working Capital Fund
A.293(8)	Amendment procedures in conventions of which IMCO is depositary
A.294(8)	Voting rights on proposed amendments to conventions of which IMCO is depositary
A.295(8)	Appreciation of the services of Mr. Colin Goad to the Organization
A.296(8)	International Conference on Marine Pollution, 1973
A.297(8)	Establishment of a Marine Environment Protection Committee
A.298(8)	Facilitation measures in maritime travel and transport
A.299(8)	Classification and labelling of dangerous or hazardous cargo
A.300(8)	Presentation of the final accounts and audit report for the sixth financial period

IMO Assembly Resolutions
8th Session
1973

Number	Title
A.301(8)	Amendment to the Financial Regulations
A.302(8)	Supplementary estimates for 1973
A.303(8)	Long-term work programme of the Organization
A.304(8)	International Conference on Safety of Life at Sea, 1974
A.305(8)	International Conference on the Establishment of an International Maritime Satellite System
A.306(8)	Work programme and budget for eighth financial period 1974/75
A.307(8)	Printing Fund
A.308(8)	Headquarters facilities and accommodation
A.309(8)	International Civil Service Commission
A.310(8)	Exclusion of the Governments of Portugal and South Africa from the Assembly and all conferences and meetings of IMCO
A.311(8)	Safety of maritime navigation
A.312(8)	Relations with non-governmental international organizations
A.313(8)	Continuation of the Joint Inspection Unit
A.314(8)	Convening of an extraordinary session of the Assembly

IMO Assembly Resolutions
5th Extraordinary Session & 9th Session
1974 & 1975

Number	Title
A.315(9)	Amendments to the IMCO Convention
A.316(9)	Wider representation in the Council
A.317(9)	Establishment of an ad hoc working group
A.318(9)	Adoption of the reports of the Maritime Safety Committee
A.319(9)	Amendment to the International Convention on Load Lines, 1966
A.320(9)	Regulation equivalent to Regulation 27 of the International Convention on Load Lines, 1966
A.321(9)	Procedures for the control of ships
A.322(9)	The conduct of investigations into casualities
A.323(9)	Recommendation to ensure uniform treatment of ships designed for the carriage of vehicles involved in the international road transport of goods
A.324(9)	Recommendation on position of collision bulkheads in cargo ships
A.325(9)	Recommendation concerning regulations for machinery and electrical installations in passenger and cargo ships
A.326(9)	Amendments to the draft regulations concerning fire safety measures for tankers and combination carriers annexed to Resolution A.271(VIII)
A.327(9)	Recommendation concerning fire safety requirements for cargo ships
A.328(9)	Code for the Construction and Equipment of Ships Carrying Liquefied Gases in Bulk
A.329(9)	Recommendations concerning ships not covered by the Code for the Construction and Equipment of Ships Carrying Liquified Gases in Bulk (Resolution A.328(IX))

IMO Assembly Resolutions
5th Extraordinary Session & 9th Session
1974 & 1975

Number	Title
A.330(9)	Amendment to the recommendation on safe access to and working in large tanks (Resolution A.272(VIII), Annex I) to include large water ballast tanks
A.331(9)	Recommendation on longitudinal rubbing bands
A.332(9)	Recommendation on arrangements for embarking and disembarking pilots in very large ships
A.333(9)	Recommendation on the conditions for the approval of servicing stations for inflatable liferafts
A.334(9)	Recommendation on operational standards for radiotelephone transmitters and receivers
A.335(9)	Recommendations related to Chapter IV of the International Convention for the Safety of Life at Sea
A.336(9)	Recommendation on the carriage of VHF radiotelephone stations
A.337(9)	Recommendation on principles and operational guidance for deck officers in charge of a watch in port
A.338(9)	Routing systems
A.339(9)	Recommendation on navigation through the entrance to the Baltic Sea
A.340(9)	Recommendation on establishment of fairways through offshore exploration areas
A.341(9)	Recommendation on dissemination of information, charting and manning of drilling rigs, production platforms and other similar structures
A.342(9)	Recommendation on performance standards for automatic pilots
A.343(9)	Recommendation on methods of measuring noise levels at listening posts

IMO Assembly Resolutions
5th Extraordinary Session & 9th Session
1974 & 1975

Number	Title
A.344(9)	Recommendation on search and rescue signals between aircraft and ships
A.345(9)	Recommendation on marking and labelling of dangerous goods
A.346(9)	Approval of the reports of the Marine Environment Protection Committee
A.347(9)	Entry into force of the 1969 amendments to the International Convention for the Prevention of Pollution of the Sea by Oil, 1954 and of the International Convention for the Prevention of Pollution from Ships, 1973
A.348(9)	Provision of reception facilities for oil residues and wastes under the International Convention for the Prevention of Pollution from Ships, 1973
A.349(9)	Technical assistance in the field of marine pollution
A.350(9)	International Convention for the Safety of Life at Sea, 1974
A.351(9)	Use of metric units in the SI system in the International Convention for the Safety of Life at Sea, 1974, and other future instruments
A.352(9)	Acceptance of the 1974 amendments to the IMCO Convention
A.353(9)	Co-operation between IMCO and the ILO on the subject of sub-standard ships
A.354(9)	Progressive use of Spanish as a working language of the Organization
A.355(9)	Appointment of the External Auditor
A.356(9)	Application of Article 42 of the IMCO Convention
A.357(9)	Amendment to Article VII of the Convention on Facilitation of International Maritime Traffic, 1965
A.358(9)	Amendments to the IMCO Convention

IMO Assembly Resolutions
5th Extraordinary Session & 9th Session
1974 & 1975

Number	Title
A.359(9)	Establishment of an ad hoc working group
A.360(9)	Institutionalization of the Committee on Technical Co-operation
A.361(9)	Interpretation of the IMCO Convention concerning voting rights in the Maritime Safety Committee
A.362(9)	Headquarters facilities and accommodation
A.363(9)	Working Capital Fund
A.364(9)	Amendment to Financial Regulations
A.365(9)	Presentation of accounts and audit report
A.366(9)	Supplementary estimates, 1975
A.367(9)	Long-term work program of the Organization (1978-1982)
A.368(9)	Currency of the IMCO budget
A.369(9)	Work program and budget for the ninth financial period 1976/77
A.370(9)	Relations with non-governmental international organizations

IMO Assembly Resolutions
10th Session
1977

Number	Title
A.371(10)	Correction of Assembly resolution A.358(IX)
A.372(10)	Recommendation concerning fire safety requirements for passenger ships carrying not more than 36 passengers
A.373(10)	Code of Safety for Dynamically Supported Craft
A.374(10)	Routing systems
A.375(10)	Navigation through the Straits of Malacca and Singapore
A.376(10)	Procedure for adoption of traffic separation schemes for the purposes of the International Regulations for Preventing Collisions at Sea, 1972
A.377(10)	Procedure for adoption and amendment of routing systems other than traffic separation schemes
A.378(10)	General provisions on ships' routing
A.379(10)	Establishment of safety zones and fairways or routing systems in offshore exploration areas
A.380(10)	Standard Marine Navigational Vocabulary
A.381(10)	Plan for the establishment of a world-wide navigational warning system
A.382(10)	Magnetic compasses: carriage and performance standards
A.383(10)	Operational standards for radiotelephone watch receivers
A.384(10)	Performance standards for radar reflectors
A.385(10)	Operational standards for VHF radiotelephone installations
A.386(10)	Application of section 9(b) of Annex 1 to the International Regulations for Preventing Collisions at Sea, 1972

IMO Assembly Resolutions
10th Session
1977

Number	Title
A.387(10)	Procedure for amending and bringing up to date the Merchant Ship Search and Rescue Manual (MERSAR)
A.388(10)	Recommendation concerning tonnage measurement of ballast spaces in segregated ballast oil tankers
A.389(10)	Interim scheme for tonnage measurement for certain ships
A.390(10)	Procedures for the control of ships under the International Convention for the Safety of Life at Sea, 1960 and the International Convention on Load Lines, 1966
A.391(10)	Procedures for the control of discharges under the International Convention for the Prevention of Pollution of the Sea by Oil, 1954
A.392(10)	Reports of the Inter-Governmental Maritime Consultative Organization on contraventions of the International Convention for the Prevention of Pollution of the Sea by Oil, 1954
A.393(10)	Recommendation on International Performance and Test Specifications for Oily-Water Separating Equipment and Oil Content Meters
A.394(10)	Recommendation on prohibition of the bulk carriage of polychlorinated biphenyls
A.395(10)	Acceptance of duties under the Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter, 1972
A.396(10)	Contract of the Secretary-General
A.397(10)	Acceptance of the Convention on the International Maritime Satellite Organization (Inmarsat)
A.398(10)	Approval of reports of committees

IMO Assembly Resolutions
10th Session
1977

Number	Title
A.399(10)	Recommendation on the issue by Governments of information on documentary requirements and other formalities applicable to the arrival, stay and departure of ships engaged in international voyages
A.400(10)	Amendments to the Convention on the Inter-Governmental Maritime Consultative Organization
A.401(10)	Establishment of an ad hoc working group
A.402(10)	Headquarters facilities and accommodation
A.403(10)	Arrears of contributions and the Working Capital Fund
A.404(10)	Presentation of accounts and audit reports
A.405(10)	Long-term work programme of the Organization
A.406(10)	Work programme and budget for the tenth financial period 1978/79
A.407(10)	Review of the list of non-governmental organizations in consultative status
A.408(10)	Statute of the Joint Inspection Unit
A.409(10)	Disposition of cash surpluses for 1976 and 1977

IMO Assembly Resolutions
11th Session
1979

Number	Title
A.410(11)	Ratification of the 1975 amendments to the International Convention on Load Lines, 1966
A.411(11)	Amendment to the International Convention on Load Lines, 1966
A.412(11)	Acceptance and enforcement of international instruments relating to maritime safety and marine environmental protection
A.413(11)	Guidelines on surveys and inspections under the Protocol of 1978 relating to the International Convention for the Safety of Life at Sea, 1974, and under the Protocol of 1978
A.414(11)	Code for the Construction and Equipment of Mobile Offshore Drilling Units (MODU Code)
A.415(11)	Improved steering gear standards for passenger and cargo ships
A.416(11)	Examination of steering gears on existing tankers
A.417(11)	Improved fire safety standards for ships
A.418(11)	Revised Regulation 62 of Chapter II-2 of the International Convention for the Safety of Life at Sea, 1974
A.419(11)	World-wide navigational warning service
A.420(11)	Development of the maritime distress and safety system
A.421(11)	Operational standards for radiotelephone alarm signal generators
A.422(11)	Performance standards for Automatic Radar Plotting Aids (ARPA)
A.423(11)	Radar beacons and transponders
A.424(11)	Performance standards for gyro-compasses

IMO Assembly Resolutions
11th Session
1979

Number	Title
A.425(11)	Performance standards for differential Omega correction transmitting stations
A.426(11)	Arrangements for embarking and disembarking pilots in very large ships
A.427(11)	Recommendation on the use pilotage services in the Sound
A.428(11)	General provisions on the ships' routeing
A.429(11)	Routing systems
A.430(11)	Navigation in the Strait of Bonifacio
A.431(11)	Recommendation concerning vessels restricted in their ability to manoeuvre when engaged in an operation for the maintenance of safety of navigation in a traffic separation scheme
A.432(11)	Compliance with the Convention on the International Regulations for Preventing Collisions at Sea, 1972
A.433(11)	Resolutions to be revoked as a result of the entry into force of the International Regulations for Preventing Collisions at Sea, 1972
A.434(11)	Code of Safe Practice for Solid Bulk Cargoes
A.435(11)	Safe transport, handling and storage of dangerous goods in port areas
A.436(11)	Harmonized interpretation and implementation of the International Convention for Safe Containers
A.437(11)	Training of crews in fire-fighting
A.438(11)	Training and qualification of persons in charge of medical care aboard ship
A.439(11)	IMCO Search and Rescue Manual

IMO Assembly Resolutions
11th Session
1979

Number	Title
A.440(11)	Exchange of information for investigations into marine casualties
A.441(11)	Control by the flag State over the owner of a ship
A.442(11)	Personnel and material resource needs of Administrations for the investigation of casualties and contraventions of conventions
A.443(11)	Decisions of the shipmaster with regard to maritime safety and marine environment protection
A.444(11)	Recommendation concerning the installation of oily-water separating equipment under the International Convention for the Prevention of Pollution from Ships, 1973, as amended by the Protocol of 1978
A.445(11)	Oil discharge monitoring and control systems for oil tankers
A.446(11)	Revised specifications for the design, operation and control of crude oil washing systems
A.447(11)	Interim guidelines for reporting incidents involving harmful substances
A.448(11)	Regional arrangements for combating major incidents or threats of marine pollution
A.449(11)	Improved methods and procedures for communication between the Secretary-General and Member Governments
A.450(11)	Amendments to the Convention on the Inter-Governmental Maritime Consultative Organization
A.451(11)	Acceptance of the amendment to article VII of the Convention on Facilitation of International Maritime Traffic, 1965
A.452(11)	Application of Automatic Data Processing (ADP) as provided for in the Convention on Facilitation of International Maritime Traffic, 1965

IMO Assembly Resolutions
11th Session
1979

Number	Title
A.453(11)	Arrears of contributions and the Working Capital Fund
A.454(11)	Presentation of accounts and audit reports
A.455(11)	Budgetary deficit for 1979
A.456(11)	Long-term work programme of the Organization
A.457(11)	Relations with non-governmental international organizations
A.458(11)	Work programme and budget for the eleventh financial period 1980/81
A.459(11)	Rate of exchange for estimating the budget and assessments for 1981
A.460(11)	Loans for financing installation costs in the new Headquarters building
A.461(11)	Barratry and unlawful seizure of ships and their cargoes
A.462(11)	Appointment of the External Auditor

IMO Assembly Resolutions
12th Session
1981

Number	Title
A.463(12)	Contract of the Secretary-General
A.464(12)	Amendments to the International Regulations for Preventing Collisions at Sea, 1972
A.465(12)	Amendments to the guidelines on mandatory annual surveys, unscheduled inspections of all cargo ships as well as intermediate surveys on tankers of ten years of age and older
A.466(12)	Procedures for the control of ships
A.467(12)	Guidelines for acceptance of non-duplicated rudder actuators for tankers, chemical tankers and gas carriers of 10,000 tons gross tonnage and above but less than 100,000 tonnes deadweight
A.468(12)	Code on Noise Levels on Board Ships
A.469(12)	Guidelines for the Design and Construction of Offhsore Supply Vessels
A.470(12)	International shore connection (shore side)
A.471(12)	Recommendation on test method for determining the resistance to flame of vertically supported textiles and films
A.472(12)	Improved recommendation on test method for qualifying marine construction materials as non-combustible
A.473(12)	Interim regulation for inert gas systems on chemical tankers carrying petroleum products
A.474(12)	Proper use of VHF channels at sea
A.475(12)	Ships' routing
A.476(12)	Navigation through the Straits of Malacca and Singapore

IMO Assembly Resolutions
12th Session
1981

Number	Title
A.477(12)	Performance standards for radar equipment
A.478(12)	Performance standards for devices to indicate speed and distance
A.479(12)	Performance standards for shipborne receivers for use with differential Omega
A.480(12)	Recommendation on the use of adequately qualified deep-sea pilots in the Baltic
A.481(12)	Principles of safe manning
A.482(12)	Training in the use of Automatic Radar Plotting Aids (ARPA)
A.483(12)	Training of radar observation and plotting
A.484(12)	Basic principles to be observed in keeping a navigational watch on board fishing vessels
A.485(12)	Training, qualifications and operational procedures for maritime pilots other than deep-sea pilots
A.486(12)	Recommendation on the use of adequately qualified deep-sea pilots in the North Sea, English Channel and Skagerrak
A.487(12)	Participation in the AMVER system
A.488(12)	Use of the Standard Marine Navigational Vocabulary
A.489(12)	Safe stowage and securing of cargo units and other entities in ships other than cellular container ships
A.490(12)	Revision of the Code for the Construction and Equipment of Ships Carrying Dangerous Chemicals in Bulk
A.491(12)	Code of Safety for Nuclear Merchant Ships

IMO Assembly Resolutions
12th Session
1981

Number	Title
A.492(12)	Application of the International Convention on Tonnage Measurement of Ships, 1969
A.493(12)	Use of the term "gross tonnage" in lieu of "tons gross tonnage"
A.494(12)	Revised interim scheme for tonnage measurement for certain ships
A.495(12)	Revised specifications for oil tankers with dedicated clean ballast tanks
A.496(12)	Guidelines and specifications for oil discharge monitoring and control systems for oil tankers
A.497(12)	Amendments to the revised specifications for the design, operation and control of crude oil washing systems
A.498(12)	Difficulties encountered by ships in carrying out crude oil washing
A.499(12)	Penalties for violations of convention requirements relating to the prevention of marine pollution from ships
A.500(12)	Objectives of the Organization in the 1980's
A.501(12)	Establishment of a high-level world Maritime university at Malmo, Sweden
A.502(12)	IMCO's technical co-operation program
A.503(12)	Acceptance of the amendment to article VII of the Convention on Facilitation of International Maritime Traffic, 1965
A.504(12)	Barratry, unlawful seizure of ships and their cargoes and other forms of maritime fraud
A.505(12)	Establishment of permanent missions by Member Governments

IMO Assembly Resolutions
12th Session
1981

Number	Title
A.506(12)	Headquarters facilities and accommodation
A.507(12)	Arrears of contributions
A.508(12)	Working Capital Fund
A.509(12)	Presentation of accounts and audit reports
A.510(12)	Long-term work program of the Organization
A.511(12)	Work program and budget for the twelfth financial period 1982/83
A.512(12)	Relations with non-governmental international organizations

IMO Assembly Resolutions
13th Session
1983

Number	Title
A.513(13)	Amendments to the International Convention on Load Lines, 1966
A.514(13)	Amendments to the Regulations Equivalent to Regulation 27 of the International Convention on Load Lines, 1966
A.515(13)	Future amendments to the International Convention for the Safety of Life at Sea, 1974
A.516(13)	Recommendation on fire test procedures for surface flammability of bulkhead and deck finish materials
A.517(13)	Recommendation on fire test procedures for "A", "B", and "F" class divisions
A.518(13)	Guidelines for marine portable fire extinguishers
A.519(13)	Standards for devices to prevent the passage of flame into cargo tanks
A.520(13)	Code of Practice for the Evaluation, Testing and Acceptance of Prototype Novel Life-Saving Appliances and Arrangements
A.521(13)	Recommendation on testing life-saving appliances
A.522(13)	Recommendation on carriage of Emergency Position-Indicating Radio Beacons
A.523(13)	Charges for distress, urgency and safety messages through the Inmarsat system
A.524(13)	Performance standards for VHF multiple watch facilities
A.525(13)	Performance standards for narrow-band direct-printing telegraph equipment for the reception of navigational and meteorological warnings and urgent information to ships

IMO Assembly Resolutions
13th Session
1983

Number	Title
A.526(13)	Performance standards for rate-of-turn indicators
A.527(13)	Ships' routing
A.528(13)	Recommendation on weather routing
A.529(13)	Accuracy standards for navigation
A.530(13)	Use of radar transponders for search and rescue purposes
A.531(13)	General principles for ship reporting systems
A.532(13)	Collecting and forwarding hydrographic data
A.533(13)	Elements to be taken into account when considering the safe stowage and securing of cargo units and vehicles in ships
A.534(13)	Code of Safety for Special Purpose Ships
A.535(13)	Recommendation on emergency towing requirements for tankers
A.536(13)	Code of Safety for Diving Systems
A.537(13)	Training of officers and ratings responsible for cargo handling on ships carrying dangerous and hazardous substances in solid form in bulk or in packaged form
A.538(13)	Maritime safety training of personnel on mobile offshore units
A.539(13)	Certification of skippers and officers in charge of a navigational watch on fishing vessels of 24 meters in length and over
A.540(13)	Tonnage measurement of certain ships relevant to the International Convention on Standards of Training, Certification and Watchkeeping for Seafarers, 1978

IMO Assembly Resolutions
13th Session
1983

Number	Title
A.541(13)	Interim scheme for tonnage measurement for certain ships for the purposes of the International Convention for the Prevention of Pollution from Ships, 1973, as modified by the Protocol of 1978
A.542(13)	Procedures for the control of ships and discharges under Annex I of the International Convention for the Prevention of Pollution from Ships, 1973, as modified by the Protocol of 1978
A.543(13)	Accuracy of oil content meters
A.544(13)	Standards for procedures and arrangements called for by Annex II of the International Convention for the Prevention of Pollution from Ships, 1973, as modified by the Protocol of 1978
A.545(13)	Measures to prevent acts of piracy and armed robbery against ships
A.546(13)	Appeal to the United Nations Development Programme, other international agencies and donor countries for support of IMO's technical co-operation programme
A.547(13)	Headquarters facilities and accommodation
A.548(13)	Guidelines for hire of conference facilities at IMO Headquarters
A.549(13)	Report on the establishment of the World Maritime University
A.550(13)	Apportionment of expenses among Member States
A.551(13)	Arrears of contributions
A.552(13)	Working Capital Fund
A.553(13)	Presentation of accounts and audit reports
A.554(13)	Long-term work programme of the Organization (up to 1990)

IMO Assembly Resolutions
13th Session
1983

Number	Title
A.555(13)	Work programme and budget for the thirteenth financial period 1984-1985
A.556(13)	Relations with non-governmental international organizations
A.557(13)	Appointment of the External Auditor

IMO Assembly Resolutions
14th Session
1985

Number	Title
A.558(14)	Contract of the Secretary-General
A.559(14)	The World Maritime University
A.560(14)	Guidelines on surveys required by the 1978 SOLAS Protocol, the International Bulk Chemical Code (IBC Code) and the International Gas Carrier Code (IGC Code)
A.561(14)	Translation of the text of certificates
A.562(14)	Recommendation on a severe wind and rolling criterion (weather criterion) for the intact stability of passenger and cargo ships of 24 meters in length and over
A.563(14)	Amendments to the recommendation on test method for determining the resistance to flame of vertically supported textiles and films (resolution A.471(XII))
A.564(14)	Revised recommendation on fire test procedures for surface flammability of bulkhead and deck finish materials
A.565(14)	Recommended procedures to prevent the illegal or accidental use of low flashpoint cargo oil as fuel
A.566(14)	Draft amendment to regulation II-2/55.5 of the International Convention for the Safety of Life at Sea, 1974, as amended
A.567(14)	Regulation for inert gas systems on chemical tankers
A.568(14)	Use of the COSPAS-SARSAT low polar orbiting satellite EPIRB system
A.569(14)	General requirements for shipborne radio equipment forming part of the future global maritime distress and safety system
A.570(14)	Type approval of ship earth stations

IMO Assembly Resolutions
14th Session
1985

Number	Title
A.571(14)	Testing of the automatic device for generating the radiotelephone alarm signal
A.572(14)	General provisions on ships' routing
A.573(14)	Ships' routing
A.574(14)	Recommendation on general requirements for electronic navigational aids
A.575(14)	Unification of performance standards for navigational equipment
A.576(14)	Standards for skippers and officers in charge of a navigational watch on fishing vessels of less than 24 meters in length operating in unlimited and limited waters
A.577(14)	Operational status of electronic position-fixing systems
A.578(14)	Guidelines for vessel traffic services
A.579(14)	Use of pilotage services in the Sound
A.580(14)	Regional hydrographic commissions and regional charting groups
A.581(14)	Guidelines for securing arrangements for the transport of road vehicles on ro-ro ships
A.582(14)	Guidelines for the construction and equipment of ships carrying hazardous liquid wastes in bulk for the purpose of dumping at sea
A.583(14)	Amendments to the Code of Safety for Diving Systems (resolution A.536(13))
A.584(14)	Measures to prevent unlawful acts which threaten the safety of ships and the security of their passengers and crews
A.585(14)	Provision of facilities in ports for the reception of oily wastes from ships

IMO Assembly Resolutions
14th Session
1985

Number	Title
A.586(14)	Revised guidelines and specifications for oil discharge monitoring and control systems for oil tankers
A.587(14)	Arrangements for combating major incidents of marine pollution
A.588(14)	Arrears of contributions
A.589(14)	Working Capital Fund
A.590(14)	Presentation of accounts and audit reports
A.591(14)	Long-term work programme of the Organization (up to 1992)
A.592(14)	Budget for 1985
A.593(14)	Work programme and budget for the fourteenth financial period 1986-1987
A.594(14)	Contribution of IMO to the programme for the International Year of Peace 1986
A.595(14)	Relations with non-governmental international organizations

IMO Assembly Resolutions
15th Session
1987

Number	Title
A.596(15)	Safety of passengers ro-ro ferries
A.597(15)	Amendments to the procedures for the control of ships
A.598(15)	General principles for ship reporting systems and ship reporting requirements
A.599(15)	Avoidance by submerged submarines of fishing vessels and their fishing gear
A.600(15)	IMO ship identification number scheme
A.601(15)	Provision and display of manoeuvering information on board ships
A.602(15)	Revised guidelines for marine portable fire extinguishers
A.603(15)	Symbols related to life-saving appliances and arrangements
A.604(15)	Performance standards for survival craft radar transponders for use in search and rescue operations
A.605(15)	Performance standards for survival craft two-way VHF radiotelephone apparatus
A.606(15)	Review and evaluation of the Global Maritime Distress and Safety System (GMDSS)
A.607(15)	Administrative, financial and operational arrangements related to the Global Maritime Distress and Safety System (GMDSS)
A.608(15)	Performance standards for ship earth stations capable of two-way communications
A.609(15)	Performance standards for shipborne VHF radio installations capable of voice communication and digital selective calling

IMO Assembly Resolutions
15th Session
1987

Number	Title
A.610(15)	Performance standards for shipborne MF radio installations capable of voice communication and digital selective calling
A.611(15)	Performance standards for float-free satellite Emergency Position-Indicating Radio Beacons operating on 406 MHz
A.612(15)	Performance standards for float-free VHF Emergency Position-Indicating Radio Beacons
A.613(15)	Performance standards for shipborne MF/HF radio installations capable of voice communication, narrow-band direct-printing and digital selective calling
A.614(15)	Carriage of radar operating in the frequency band 9300-9500 MHz
A.615(15)	Radar beacons and transponders
A.616(15)	Search and rescue homing capability
A.617(15)	Implementation of the NAVTEX system as a component of the world-wide navigational warning service
A.618(15)	Ships' routing
A.619(15)	Use of pilotage services in the Torres Strait and Great Barrier Reef area
A.620(15)	Navigation through the entrances to the Baltic Sea
A.621(15)	Measures to prevent infringement of safety zones around offshore installations or structures
A.622(15)	Basic principles to be observed in keeping an engineering watch on board fishing vessels

IMO Assembly Resolutions
15th Session
1987

Number	Title
A.623(15)	Minimum requirements for certification of chief engineer officers and second engineer officers of fishing vessels powered by main propulsion machinery of 750 kW propulsion power or more
A.624(15)	Guidelines on training for the purpose of launching lifeboats and rescue boats from ships making headway through the water
A.625(15)	Arrangements for the entry and clearance of marine pollution response resources during emergency situations
A.626(15)	Amendments to the International Regulations for Preventing Collisions at Sea, 1972
A.627(15)	Appointment of the External Auditor
A.628(15)	Application of automatic data processing (ADP) as provided for in the Convention on Facilitation of International Maritime Traffic, 1965, as amended
A.629(15)	Arrears of contributions
A.630(15)	Presentation of accounts and audit reports
A.631(15)	Long-term work programme of the Organization (up to 1994)
A.632(15)	Denomination of the currency of the IMO regular budget and assessments
A.633(15)	Work programme and budget for the fifteenth financial period 1988-1989
A.634(15)	Co-operation for Central America
A.635(15)	Relations with non-governmental international organizations

IMO Assembly Resolutions
16th Session
1989

Number	Title
A.636(16)	Approval of the appointment of the Secretary-General by the Council
A.637(16)	Co-operations in maritime casualty investigations
A.638(16)	Unique consignment identifier (UCI)
A.639(16)	Undesirability of HIV screening of crews and passengers of ships
A.640(16)	Institutionalization of the Facilitation Committee
A.641(16)	Arrears of contributions
A.642(16)	Presentation of accounts and audit reports
A.643(16)	Long-term work programme of the Organization (up to 1996)
A.644(16)	Work programme and budget for the sixteenth financial period 1990-1991
A.645(16)	Relations with non-governmental international organizations
A.646(16)	Safety of fisherman at sea
A.647(16)	IMO guidelines on management for the safe operation of ships and for pollution prevention
A.648(16)	General principles for ship reporting systems and ship reporting requirements, including guidelines for reporting incidents involving dangerous goods, harmful substances and/or marine pollutants
A.649(16)	Code for the Construction and Equipment of Mobile Offshore Drilling Units, 1989
A.650(16)	An example of alternative intact stability criteria for twin-pontoon column-stabilized semi-submersible units

IMO Assembly Resolutions
16th Session
1989

Number	Title
A.651(16)	An example of alternative stability criteria for a range of positive stability after damage or flooding for column-stabilized semi-submersible units
A.652(16)	Recommendation on fire test procedures for upholstered furniture
A.653(16)	Recommendation on improved fire test procedures for surface flammability of bulkhead, ceiling and deck finishing materials
A.654(16)	Graphic symbols for fire control plans
A.655(16)	Use of halons as fire-extinguishing media on board ships
A.656(16)	Fast rescue boats
A.657(16)	Instructions for action in survival craft
A.658(16)	Use of fitting of retro-reflective material on life-saving appliances
A.659(16)	Provision of radio services for the global maritime distress and safety system
A.660(16)	Carriage of satellite Emergency Position-Indicating Radio Beacons (EPIRBs)
A.661(16)	Performance standards for float-free satellite Emergency Position-Indicating Radio Beacons operating through the geostationary Inmarsat satellite system on 1.6 GHz
A.662(16)	Performance standards for float-free release and activation arrangements for emergency radio equipment
A.663(16)	Performance standards for Inmarsat Standard-C ship earth stations capable of transmitting and receiving direct-printing communications
A.664(16)	Performance standards for enhanced group call equipment
A.665(16)	Performance standards for radio direction-finding systems

IMO Assembly Resolutions
16th Session
1989

Number	Title
A.666(16)	World-wide Radionavigation System
A.667(16)	Pilot transfer arrangements
A.668(16)	Use of pilotage services in the Euro-Channel and IJ-Channel
A.669(16)	Ships' routing
A.670(16)	Navigation in the Strait of Bonifacio
A.671(16)	Safety zones and safety of navigation around offshore installations and structures
A.672(16)	Guidelines and standards for the removal of offshore installations and structures on the continental shelf and in the exclusive economic zone
A.673(16)	Guidelines for the transport and handling of limited amounts of hazardous and noxious liquid substances in bulk in offshore support vessels
A.674(16)	International co-operation on oil pollution preparedness and response
A.675(16)	Prevention of oil pollution
A.676(16)	Transboundary movement of hazardous wastes
A.677(16)	Technical assistance in the field of protection of the marine environment
A.678(16)	Amendments to the International Regulations for Preventing Collisions at Sea, 1972
A.679(16)	Appreciation of the services to the Organization of Mr. C.P. Srivastava

IMO Assembly Resolutions
17th Session
1991

Number	Title
A.680(17)	IMO Guidelines on Management for the Safe Operation of Ships and for Pollution Prevention
A.681(17)	Procedures for the control of operational requirements related to the safety of ships and pollution prevention
A.682(17)	Regional co-operation in the control of ships and discharges
A.683(17)	Prevention and suppression of acts of piracy and armed robbery against ships
A.684(17)	Explanatory notes to the SOLAS regulations on subdivision and damage stability of cargo ships of 100 meters in length and over
A.685(17)	Weather criterion for fishing vessels of 24 meters in length and over
A.686(17)	Code on Alarms and Indicators
A.687(17)	Fire test procedures for ignitability of primary deck coverings
A.688(17)	Fire test procedures for ignitability of bedding components
A.689(17)	Recommendations on testing of life-saving appliances
A.690(17)	Periodical inspections of abandon ship and fire drills on passenger ships
A.691(17)	Safety instructions to passengers
A.692(17)	Guidelines and specifications for hyberbaric evacuation systems
A.693(17)	Conditions for the approval of servicing stations for inflatable liferafts
A.694(17)	General requirements for shipborne radio equipment forming part of the Global Maritime Distress and Safety System (GMDSS) and for electronic navigational aids

IMO Assembly Resolutions
17th Session
1991

Number	Title
A.695(17)	Performance standards for float-free satellite Emergency Position-Indicating Radio Beacons (EPIRBs) operating on 406 MHz
A.696(17)	Type approval of satellite Emergency Position-Indicating Radio Beacons (EPIRBs) operating in the COSPAS-SARSAT system
A.697(17)	Performance standards for survival craft radar transponders for use in search and rescue operations
A.698(17)	Performance standards for ship earth stations capable of two-way communications
A.699(17)	System performance standard for the promulgation and co-ordination of maritime safety information using high-frequency Narrow-Band Direct Printing (NBDP)
A.700(17)	Performance standards for narrow-band direct printing telegraph equipment for the reception of navigational and meteorological warnings and urgent information (MSI) by HF
A.701(17)	Carriage of Inmarsat enhanced group call SafetyNET receivers under the Global Maritime Distress and Safety System (GMDSS)
A.702(17)	Radio maintenance guidelines for the Global Maritime Distress and Safety System (GMDSS) related to sea areas A3 and A4
A.703(17)	Training of radio personnel in the Global Maritime Distress and Safety System (GMDSS)
A.704(17)	Provision of radio services for the Global Maritime Distress and Safety System (GMDSS)
A.705(17)	Promulgation of maritime safety information
A.706(17)	World-wide navigational warning service

IMO Assembly Resolutions
17th Session
1991

Number	Title
A.707(17)	Changes for distress, urgency and safety messages through the Inmarsat system
A.708(17)	Navigation bridge visibility and functions
A.709(17)	Avoidance by submerged submarines of fishing vessels and their fishing gear
A.710(17)	Use of pilotage services in the Torres Strait and the Great North East Channel
A.711(17)	Ships' routing
A.712(17)	Recommended standards of specialized training, qualifications and certification of key personnel assigned responsibility for essential marine functions on Mobile Offshore Units (MOUs)
A.713(17)	Safety of ships carrying solid bulk cargoes
A.714(17)	Code of Safe Practice for Cargo Stowage and Securing
A.715(17)	Code of Safe Practice for Ships Carrying Timber Deck Cargoes, 1991
A.716(17)	The International Maritime Dangerous Goods Code (IMDG Code)
A.717(17)	Co-ordination in matters relating to dangerous goods and hazardous substances
A.718(17)	Early implementation of the harmonized system of survey and certification
A.719(17)	Prevention of air pollution from ships
A.720(17)	Guidelines for the designation of special areas and the identification of particularly sensitive areas

IMO Assembly Resolutions
17th Session
1991

Number	Title
A.721(17)	Development of the new tanker designs for the prevention of oil pollution
A.722(17)	Recommendation concerning the application of tonnage measurement of ballast spaces in segregated ballast oil tankers
A.723(17)	Appointment of the External Auditor
A.724(17)	Amendments to the Convention on the International Maritime Organization (Institutionalization of the Facilitation Committee)
A.725(17)	Arrears of contributions
A.726(17)	Apportionment of expenses among Member States and amendments to the Rules of Procedure of the Assembly
A.727(17)	Presentation of accounts and audit reports
A.728(17)	Long-term work programme of the Organization (up to 1998)
A.729(17)	Future development of the intergovernmental oil pollution liability and compensation system based on the International Convention on Civil Liability for Oil Pollution
A.730(17)	Work programme and budget for the seventeenth financial period 1992-1993
A.731(17)	United Nations Conference on Environment and Development, 1992
A.732(17)	Relations with non-governmental international organizations

IMO Assembly Resolutions
18th Session
1993

Number	Title
A.733(18)	Appointment of the Secretary-General
A.734(18)	Relations with non-governmental international organizations
A.735(18)	Amendments to the Convention on the International Maritime Organization
A.736(18)	Amendments to the International Regulations for Preventing Collisions at Sea, 1972
A.737(18)	Amendments to the International Convention for Safe Containers (CSC), 1972
A.738(18)	Measures to prevent and suppress piracy and armed robbery against ships
A.739(18	Guidelines for the authorization of organizations acting on behalf of the Administration
A.740(18)	Interim Guidelines to assist Flag States
A.741(18)	International Management Code for the Safe Operation of Ships and for Pollution Prevention (International Safety Management (ISM) Code)
A.742(18)	Procedures for the control of operational requirements related to the safety of ships and pollution prevention
A.743(18)	Oil tanker safety and marine environmental protection
A.744(18)	Guidelines on the enhanced programme of inspections during surveys of bulk carriers and oil tankers
A.745(18)	Early implementation of the harmonized system of survey and certification
A.746(18)	Survey guidelines under the harmonized system of survey and certification
A.747(18)	Application of tonnage measurement of segregated ballast tanks in oil tankers

IMO Assembly Resolutions
18th Session
1993

Number	Title
A.748(18)	Code for the Safe Carriage of Irradiated Nuclear Fuel, Plutonium and High-level Radioactive Wastes in Flasks on Board Ships
A.749(18)	Code on Intact Stability for All Types of Ships Covered by IMO Instruments
A.750(18)	Damage stability standard for existing ro-ro passenger ships
A.751(18)	Interim standards for ship maneuverability
A.752(18)	Guidelines for the evaluation, testing and application of low-location lighting on passenger ships
A.753(18)	Guidelines for the application of plastic pipes on ships
A.754(18)	Recommendation on fire resistance tests for "A", "B" and "F" class divisions
A.755(18)	Guidelines for approval of sprinkler systems equivalent to that referred to in SOLAS regulation II-2/12
A.756(18)	Guidelines on the information to be provided with fire control plans and booklets required by SOLAS regulations II-2/20 and 41-2
A.757(18)	Standards for the calculation of the width of stairways forming means of escape on passenger ships
A.758(18)	Application of Recommendation 2 of the International Conference on Tonnage Measurement of Ships, 1969
A.759(18)	Marking of inflatable liferafts
A.760(18)	Symbols related to life-saving appliances and arrangements

IMO Assembly Resolutions
18th Session
1993

Number	Title
A.761(18)	Recommendation on conditions for the approval of servicing stations for inflatable liferafts
A.762(18)	Performance standards for survival craft two-way VHF radiotelephone apparatus
A.763(18)	Performance standards for float-free satellite emergency position-indicating radio beacons (EPIRBs) operating on 406 MHz
A.764(18)	Establishment, updating and retrieval of the information contained in the registration databases of satellite EPIRBs
A.765(18)	Guidelines on the safety of towed ships and other floating objects, including installations, structures and platforms at sea
A.766(18)	Navigation in the Strait of Bonifacio
A.767(18)	Amended traffic separation scheme "Off Finisterre"
A.768(18)	Ships' routing
A.769(18)	Procedures and arrangements for issuing GMDSS certificates to holders of non-GMDSS certificates
A.770(18)	Minimum training requirements for personnel nominated to assist passengers in emergency situations on passenger ships
A.771(18)	Training requirements for crews of fast rescue boats
A.772(18)	Fatigue factors in manning and safety
A.773(18)	Enhancement of safety of life at sea by the prevention and suppression of unsafe practices associated with alien smuggling by ships
A.774(18)	Guidelines for preventing the introduction of unwanted aquatic organisms and pathogens from ships' ballast water and sediment discharges

IMO Assembly Resolutions
18th Session
1993

Number	Title
A.775(18)	Arrears of contributions
A.776(18)	Presentation of accounts and audit reports
A.777(18)	Work methods and organization of work in committees and their subsidiary bodies
A.778(18)	Work programme and budget for the eighteenth financial period 1994-1995
A.779(18)	Long-term work plan of the Organization (up to 2000)

IMO Assembly Resolutions
19th Session
1995

Number	Title
A.780(19)	Amendments to the Rules of Procedure of the Assembly consequent upon the introduction of electronic counting of votes for election of council members
A.781(19)	Amendments to Rules 56bis and 56ter of the Rules of Procedure of the Assembly
A.782(19)	Relations with non-governmental organizations
A.783(19)	Appointment of the External Auditor
A.784(19)	Amendments to the International Convention on Load Lines, 1966
A.785(19)	Contribution of the World Maritime University (WMU) in the achievement of Enhanced Standards of Maritime Training
A.786(19)	Strategy for Ship/Port interface
A.787(19)	Procedures for Port State control
A.788(19)	Guidelines on implementation of the International Safety Management (ISM) Code by Administrations
A.789(19)	Specifications on the survey and certification functions of recognized organizations acting on behalf of the Administration
A.790(19)	Review of the Code for the Safe Carriage of Irradiated Nuclear Fuel, Plutonium and High-level Radioactive Wastes in Flasks On Board Ships
A.791(19)	Application of the International Convention on Tonnage Measurement of Ships, 1969, to existing ships

IMO Assembly Resolutions
19th Session
1995

Number	Title
A.792(19)	Safety Culture in and around passengers ships
A.793(19)	Strength and securing and locking arrangements of shell doors on ro-ro passenger ships
A.794(19)	Surveys and Inspections of Ro-Ro Passenger Ships
A.795(19)	Navigational guidance and information scheme for ro-ro ferry operations
A.796(19)	Recommendations on a decision-support system for masters on passenger ships
A.797(19)	Safety of Ships Carrying Solid Bulk Cargoes
A.798(19)	Guidelines for the selection, application and maintenance of corrosion prevention systems of dedicated seawater ballast tanks
A.799(19)	Revised recommendation on test methods for qualifying marine construction materials as non-combustible
A.800(19)	Revised guidelines for approval of sprinkler systems equivalent to that referred to in SOLAS Regulation II-2/12
A.801(19)	Provision of radio services for the Global Maritime Distress and Safety System (GMDSS)
A.802(19)	Performance standards for survival craft radar transponders for use in search and rescue operations
A.803(19)	Performance standards for Shipborne VHF Radio Installations capable of Voice Communication and Digital Selective Calling
A.804(19)	Performance standards for Shipborne MF Radio Installations capable of Voice Communication and Digital Selective Calling

IMO Assembly Resolutions
19th Session
1995

Number	Title
A.805(19)	Performance standards for Float-free VHF Emergency Position-Indicating Radio Beacons
A.806(19)	Performance standards for shipborne MF/HF Radio Installation capable of Voice Communication, Narrow-band Direct-printing and Digital Selective Calling
A.807(19)	Performance standards for INMARSAT-C Ship Earth Stations capable of transmitting and receiving Direct-printing Communications
A.808(19)	Performance standards for Ship Earth Stations capable of Two-way Communications
A.809(19)	Performance standards for Survival Craft Two-way VHF Radiotelephone Apparatus
A.810(19)	Performance standards for Float-free Satellite Emergency Position-Indicating Radio Beacons (EPRIBs) operating on 406 MHz
A.811(19)	Performance standards for a shipborne Integrated Radiocommunication System (IRCS) when used in the GMDSS
A.812(19)	Performance standards for float-free satellite Emergency Position-Indicating Radio Beacons operating through the geostationary INMARSAT satellite system in 1.6 GHz
A.813(19)	General requirements for electromagnetic compatibility (EMC) for all electrical and electronic ship's equipment
A.814(19)	Guidelines for the avoidance of false distress alerts
A.815(19)	World-wide radionavigation system
A.816(19)	Performance standards for shipborne Decca Navigator Receivers
A.817(19)	Performance standards for Electronic Chart Display and Information Systems (ECDIS)

IMO Assembly Resolutions
19th Session
1995

Number	Title
A.818(19)	Performance standards for shipborne LORAN-C and CHAYKA Receivers
A.819(19)	Performance standards for shipborne Global Positioning System (GPS) Receiver Equipment
A.820(19)	Performance standards for Navigational Radar Equipment for High-Speed Craft
A.821(19)	Performance standards for Gyro-compasses for High-Speed Craft
A.822(19)	Performance standards for Automatic Steering Aids (Automatic Pilots) for High-Speed Craft
A.823(19)	Performance standards for Automatic Radar Plotting Aids (ARPAs)
A.824(19)	Performance standards for devices to indicate speed and distance
A.825(19)	Procedures for adoption and amendment of performance standards for radio and navigational equipment
A.826(19)	Procedure for adoption and amendment of traffic separation schemes, routing measures other than traffic separation schemes and ship reporting systems.
A.827(19)	Ships' routing
A.828(19)	Recommendations on maritime safety and emergency preparedness training for all personnel working on MODUs
A.829(19)	Guidelines for the evaluation of the adequacy of Type C Tank Vent Systems
A.830(19)	Code on Alarms and Indicators, 1995
A.831(19)	Code of Safety for Diving Systems, 1995
A.832(19)	Follow-up action to the United Nations Conference on Environment and Development, 1992

IMO Assembly Resolutions
19th Session
1995

Number	Title
A.833(19)	Headquarters facilities and accommodation
A.834(19)	Arrears of contributions
A.835(19)	Presentation of accounts and audit reports
A.836(19)	Long-term work plan of the Organization (up to 2002)
A.837(19)	Work programme and budget for the nineteenth financial period 1996-1997
A.838(19)	Integrated technical co-operation programme transfer of funds from the surplus of the printing fund