UNIVERSITY - NATIONAL OCEANOGRAPHIC LABORATORY SYSTEM

RESEARCH VESSEL SAFETY STANDARDS

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University-National Oceanographic Laboratory System

UNOLS RVSS – Ninth Edition – March 2009

UNOLS Office
University of Rhode Island – Graduate School of Oceanography
15 South Ferry Road
Narragansett, RI 02882

This edition of the Research Vessel Safety Standards is dedicated to Captain Jim Williams of Scripps Institution of Oceanography, in appreciation for all of his work with the RVOC, UNOLS and in particular for his work on these standards for the academic research fleet.

This edition is also dedicated to Bill Martin of the University of Washington who served as the Chair of RVTEC and as a key member of the Safety Committee, bringing the voice of sea-going marine technicians fully into the process of keeping these Safety Standards current and relevant to the UNOLS Community.

The UNOLS Office and the UNOLS Research Vessel Safety Committee would like to acknowledge the support of the National Science Foundation, Office of Naval Research, National Oceanic and Atmospheric Administration, US Geological Survey, and Minerals Management Service for support of this project.

PREFACE

UNOLS Member Institutions first adopted the Research Vessel Safety Standards (RVSS) in May 1976. Later editions were adopted by members at UNOLS meetings in May 1981, May 1985, October 1989, September 1992, October 1995, July 1999 and March 2003. The UNOLS Council adopted this ninth edition in March 2009. In lieu of published institutional policy, these safety standards are considered the guidelines for UNOLS Research Vessels. For that reason, all UNOLS Members, both Operators and others, should be thoroughly familiar with the contents of this manual and comply with its recommendations as appropriate.

Changes made since last revision (March 2003):

- Overall Organization: Revised the overall structure of the standards to uniformly show those requirements required by laws and regulations, those required by the UNOLS RVSS in addition and any further recommendations, best practices or resources. The chapters were re-ordered.
- Chapter 10: Removed chapter on explosives and inserted relevant information in Chapter 8: Hazardous Materials.
- Chapter 6: Added chapter on Personal Safety with sections covering alcohol and drug policies, sexual harassment and accommodations for persons with disabilities.
- Chapter 12: Added chapter on Human Occupied Vehicle (Submersible) Safety.
- Appendix A: Added UNOLS Rope and Cable Safe Working Load Standards (Revision 1, 07/07/02011)
- Appendix B: Added UNOLS Overboard Load Handling Systems Design (Revision 3, 12/13/2011)
- Appendix E: Added Sexual Harassment Brochure.
- Extensive review and update of references and content throughout the RVSS

RESEARCH VESSEL SAFETY STANDARDS

TABLE OF CONTENTS

1. INTRODUCTION

These safety standards provide guidelines for the operation of oceanographic research vessels owned, operated or chartered by Members of the University-National Oceanographic Laboratory System (UNOLS), to assure that research at sea is conducted to the highest practicable standards of safety and prudence. Each Member Institution is encouraged to comply with them as applicable to all ships and boats under their control. The operators of other research vessels are invited to make use of them as well.

These standards are based in major part on applicable laws and regulations. In addition and where appropriate, they supplement, extend, and assist in the interpretation of the legal requirements. Nothing herein is intended to conflict with the legal standards, but rather to encourage and assist the operator to not only meet, but also go beyond the legal minimums, as may be desirable and practicable. It is recognized that the wide variety of vessel types and sizes, and their diverse operational usage, will necessarily lead to many discretionary interpretations. In such cases, a common-sense application of the principles of good seamanship and sound marine engineering practice will be more effective than attempting to cover all conceivable cases. The absence of a law, regulation or standard covering any particular matter should not be regarded as necessarily lessening the importance of it.

Assistance to operating institutions by providing reference materials, and interpreting the laws, regulations and standards is available through the UNOLS Research Vessel Operators' Committee (RVOC) and the UNOLS Research Vessel Technical Enhancement Committee (RVTEC).

Operators are reminded that in addition to the legal responsibilities and liabilities associated with Federal laws and regulations, and maritime law, safe operation is one of the factors used by Federal science sponsors in evaluating the merit of a ship as a research platform.

These standards do not apply to research submersibles, which are covered by a different, and detailed, set of regulations, however a chapter on handling research submersibles from UNOLS vessels is covered in these standards.

Recognizing that research vessels and ocean research in general should be in the forefront of contributing to maritime safety, research vessels should take every opportunity to participate in innovative research, procedures, and equipment operation evaluations which would enhance the practice of safety at sea.

Institutions are strongly encouraged to make available "Cruise Handbooks" or "User Manuals" incorporating important parts of these standards, plus additional information on their particular ships and any pertinent institutional regulations or procedures. These have been found to be extremely useful both to the scientists and the ship's crew.

This document deals solely with safety standards for craft engaged in oceanographic or limnological research, or related instruction. To avoid constant repetition of the adjective "research," it is to be understood to apply throughout to the terms "ship," "vessel," "boat," "motorboat," etc., unless some other sense is specified.

2. PROCEDURES

2.0 SCOPE

These safety standards are not intended to cover all possible cases, but only those where there is a clear-cut, widespread need for guidance, or to fill a gap not covered by laws and regulations. To the extent possible, these standards are organized as follows:

- Required by Regulations for All Vessels
- Required by Regulations for Certain Vessels
    - Inspected Vessels
    - Classed Vessels
    - SOLAS Vessels
    - Uninspected Vessels
    - Other Regulations
- Required Standards Under RVSS
- Required By RVSS Under Certain Circumstances
- Recommendations And Best Practices

2.1 PROPOSED STANDARDS

Draft standards, or a statement of the need may be proposed by any UNOLS Member, or any other person or group having an interest in the safe operation of academic research vessels. Proposed standards will be referred to the UNOLS Research Vessel Safety Committee to review and make recommendations for action.

2.2 ADOPTION

Standards approved by the Research Vessel Operators' Committee (RVOC) will be transmitted to the UNOLS Council for consideration and adoption under the terms of the UNOLS charter.

2.3 APPLICABILITY

Use of these standards by UNOLS Members shall be as provided for under the terms of the UNOLS charter.

2.4 REFERENCE MATERIAL

The UNOLS Office will maintain and provide to Members pertinent reference materials, circulars, and other information. The RVOC will provide assistance in interpretation of laws, regulations, and standards, and suggest assistance in areas not covered by these standards.

2.5 CHANGES TO RESEARCH VESSEL SAFETY STANDARDS MANUAL

Changes to laws, rules, or regulations, which affect or supplement these standards shall be brought to the attention of the member institutions by the RVOC. Periodically, not later than every three years, the Research Vessel Safety Committee shall review the safety standards to ensure that they are current and complete. Necessary changes shall be submitted by the Chair of the RVOC to the UNOLS Council for approval.

2.6 Record of Revisions to this Edition and Applicable Versions

Chapter	***Title***	***Revision #***	***Effective Date***
One	Introduction	9.0	3/12/2009
Two	Procedures	9.0	3/12/2009
Three	Definitions, Regulations and Documentation	9.0	3/12/2009
Four	Operations	9.0	3/12/2009
Five	Manning	9.0	3/12/2009
Six	Personal Behavior and Individual Safety	9.0	3/12/2009
Seven	Communications	9.0	3/12/2009
Eight	Scientific Support Equipment	9.0	3/12/2009
Nine	Scientific and Shipboard Hazardous Materials	9.0	3/12/2009
Ten	Radioactive Materials	9.0	3/12/2009
Eleven	Diving Operations	9.0	3/12/2009
Twelve	Human Occupied Vehicles	9.0	3/12/2009
Thirteen	Stability	9.0	3/12/2009
Fourteen	Load Lines and Watertight Integrity	9.0	3/12/2009
Fifteen	Electrical and Marine Engineering	9.0	3/12/2009
Sixteen	Firefighting Equipment and Fire Protection	9.0	3/12/2009
Seventeen	Lifesaving Equipment	9.0	3/12/2009
Eighteen	Chartering of Non-Institutional Vessels	9.0	3/12/2009
App A	UNOLS Rope and Cable Safe Working Load Standards	Ed. 9.0 Rev. 1.0	07/07/2011
App B	UNOLS Load Handling System Design Standards	Ed. 9.0 Rev. 3.0	12/13/2011
App C	Safety Inspection Check List for Shipboard Vans	9.0	3/12/2009
App D	Inspection Checklist for Chartering Non-UNOLS vessels	9.0	3/12/2009
App E	Sexual Harassment Brochure	9.0	3/12/2009
App F	List of Acronyms	9.0	3/12/2009

3. DEFINITIONS, REGULATIONS AND DOCUMENTATION

3.0 INTRODUCTION

All seagoing vessels are subject to various requirements for documenting their ownership, occupation, and safety. These requirements, as indicated below, vary greatly, depending on the size and type of vessel, its employment, the area of operations, etc. The language used herein is chosen to convey the sense of the regulations; for the actual legal wording, reference is made to the pertinent parts of the Code of Federal Regulations (CFR), the United States Code (USC), or other sources. References to the CFR and USC generally are cited as the Title Number (e.g. 46) Source (e.g. CFR or USC) and Part Number (e.g. 189) such that 46 CFR 188 would be the reference for the beginning of the regulations regarding Oceanographic Research Vessels.

3.1 REFERENCES

33 CFR - Navigation and Navigable Waters

33 CFR 101 and 104 - International Ship and Port Facility Security Code (ISPS)

33 CFR 138, 33 USC 2702 to 2761 - Oil Pollution Act of 1990 (OPA 90)

33 CFR 151 and 155.70 - International Convention for the Prevention of Pollution from Ships 1973 (MARPOL)

46 CFR - Shipping

46 CFR 188 – 196 Subchapter U - Oceanographic Research Vessels

46 CFR 10 and 15 - International Convention on Standards of Training, Certification and Watch standing for Seafarers (STCW-95)

46 CFR 15.701 - The Seaman’s Competency Act and Officer’s Competency Certificates Convention 1936

46 CFR 15.705 and **46 CFR 15.1111** - respectively - Watches and Rest Periods

46 CFR 188.05-10 - International Convention for Safety of Life at Sea (SOLAS)

46 USC 41 - Motorboat Act

46 USC App 688a - Jones Act

46 USC 32, 33 CFR 96.100 et seq. - International Management Code for the Safe Operations of Ships and Pollution Prevention (ISM)

46 USC 43, 46 CFR 24 - 27 - Federal Boat Safety Act of 1971

46 USC 51 and 46 CFR 42 et seq. - International Load Line Act

Navigation and Vessel Inspection Circulars (NVIC) - Informational material published by the USCG.

NVIC 8-83 - MARPOL 73/78 Annex I, Regulation 9 and 26

NVIC 11-93 Ch. 3 - Applicability Of Tonnage Measurement Systems To U.S. Flag Vessels

Impact of NVIC 11-93, Change 3, on *New Horizon* – Report by Glosten Associates on tonnage applications for intermediate size vessels available on the UNOLS website at: http://unols.org/meetings/2004/200410rvo/reports/200410rvoap21.pdf

3.2 ORGANIZATIONS

AMERICAN BUREAU OF SHIPPING (ABS): A non-profit organization authorized by the Coast Guard to ensure compliance with load line regulations and other related safety factors. The organization provides inspection services to operators for a fee. ABS documents and publications (including Rules for Shipbuilding) are available online at http://www.eagle.org.

AMERICAN BOAT AND YACHT COUNCIL (ABYC): This organization is primarily concerned with private pleasure craft and sets standards for small vessel construction. Some of their standards are referenced in portions of these safety standards and some are incorporated by reference in Coast Guard regulations concerning small craft and commercial fishing vessels. ABYC standards and technical reports are available at http://www.abycinc.org/index.cfm.

U.S. COAST GUARD (USCG): The Federal agency charged with enforcement of many laws and regulations concerning ships and seagoing operations. Information and inspection services are provided either from headquarters in Washington or from several district offices around the country. Operators should always check with their local Coast Guard Sector Office or Officer in Charge of Marine Inspection (OCMI) for interpretation of laws and regulations. For information use the website located at: http://homeport.uscg.mil/mycg/portal/ep/home.do.

FEDERAL COMMUNICATIONS COMMISSION (FCC): Federal agency charged with the regulation of radio communications, including those to, from and between ships. (47 CFR) Contact FCC at http://www.fcc.gov/searchtools.html.

INTERNATIONAL MARITIME ORGANIZATION (IMO): Established during a 1948 United Nations conference, IMO is an international body devoted exclusively to maritime matters. Headquartered in London, IMO consists of various committees and subcommittees. The Maritime Safety Committee (MSC) is the senior committee that carries out the organizations technical work. At a 1960 conference, IMO adopted the International Convention on Safety of Life at Sea (SOLAS). SOLAS is the basic international instrument dealing with matters of marine safety. SOLAS has been amended several times. These amendments cover a variety of issues such as vessel construction and fire safety, Roll On – Roll Off (RO-RO) passenger ship safety, passenger ship safety, GMDSS, tonnage admeasurements, traffic separation schemes, INMARSAT, fishing boat safety, STCW, etc. IMO conventions have also led to adoption of oil pollution policies. These include the 1973 International Convention for the Prevention of Pollution from Ships (MARPOL) and the 1990 International Convention on Oil Pollution Preparedness Response and Cooperation (OPRC). IMO can be contacted at http://www.imo.org.

INTERNATIONAL ORGANIZATION OF STANDARDIZATION (ISO): ISO is a non-government organization that develops various international standards for business, government and society. ISO standards distill an international consensus for standards from a broad base of stakeholders. It is recognized worldwide. Two management systems exist, ISO 9000, which deals with quality management, and ISO 14000, which deals with environmental management. ISO 9000 is the standard that certified auditors for ISM code are trained to meet. To implement ISO 9000, ISO 9001 was developed. It is a series of documents that define the requirements for a Quality Management Safety Standard. Certification under ISO 9001 meets the certification requirements for ISM provided that an alcohol & drug abuse/misuse policy and the handling of contingencies are added to the ISO 9001 standards. ISO does not perform certifications nor are their standards compulsory. However, following ISO 9001 standards as closely as possible will ease the certification process under ISM. Information regarding the standards can be found at http://www.iso.org.

INSTITUTE OF ELECTRICAL AND ELECTRONIC ENGINEERS (IEEE): A professional group, which develops standards in electrical and electronic practices. Many of these standards are incorporated as legal or prudent requirements for ships. Their standards are located at http://www.ieee.org.

UNERWRITERS LABORATORIES (UL): A testing and certification laboratory that provides standards and tests equipment for safety. Some of their standards are used in Coast Guard regulations by reference such as those for smoke detectors and commercial cooking exhaust hoods. UL can be contacted at http://www.ul.com.

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA): A professional organization that sets standards for fire fighting equipment and standards for fire prevention. Some of their standards are included in Coast Guard regulations by reference such as those for a National Electrical Code and for pleasure and commercial motor craft. NFPA is available online at http://www.nfpa.org.

SEAFARERS HEALTH IMPROVEMENT PROGRAM (SHIP): A collaborative group with membership from ship owners/operators, seafarers, shipping associations, U.S. Public Health Service, U.S. Maritime Administration and the U.S. Coast Guard. See NVIC 3-83 for more information. http://www.uscg.mil/hq/g-m/nvic/3_83/n3-83.pdf

3.3 DEFINITIONS

3.3.1 TONNAGE

Other than weight as in displacement, discussed below, other forms of tons and tonnages are arcane descriptors of ship size that may readily be traced back to the *Magna Carta* and beyond. The numbers so derived are used to determine fees and applicability of national and international regulations. For officially determining which version and formula applies and calculating tonnage the services of a professional Naval Architect are required.

REGISTERED TONS: A "registered ton" is a measure of volume, in which one registered ton = 100 ft^3. There are two types of registered tonnages: "Gross" and "Net". Gross Registered Tonnage (GRT) is the total enclosed volume of the vessel, minus certain exempted spaces. Net Registered Tonnage (NRT) is the GRT minus certain deducted spaces. Exempted and deducted spaces are determined according to measurement regulations for U.S., Panama, and Suez tonnage. Tonnage certificates, to the extent required by the vessel's operations, are carried on board with GRT and NRT being permanently affixed to the vessel. (46 CFR 69.107)

CONVENTION TONNAGE: This is tonnage as determined under the International Convention on Tonnage Measurement of Ships, 1969. New documented vessels and new vessels engaged on a foreign voyage that are 79 feet or over are required to be measured under the Convention Measurement system. Existing vessels that undergo a change that substantially affects the gross tonnage and are otherwise required would have to be measured under the Convention Tonnage system. After July 1994 all existing vessels over 79 feet that engage in a foreign voyage have to be measured under the Convention Tonnage System as well as the existing system. (46 CFR 69.11)

NVIC 11-93 Change 3 provides guidelines on applying tonnage measurements to U.S. Vessels and helps to determine how this affects the application of U.S. and International regulations. Convention Tonnage when used to determine application of regulations and treaties will be referred to as Gross Tonnage (GT). Domestic tonnage measurements used for the application of regulations will be referred to as Gross Registered Tonnage (GRT) or Net Registered Tonnage (NRT) as defined above.

DISPLACEMENT: Displacement is the weight of water displaced by a vessel and is equal to the vessel's actual weight. Displacement is used in stability calculations. A "displacement ton" is a measure of weight stated in long tons of 2,240 pounds/ton.

DEADWEIGHT: The "deadweight" of a vessel is its total weight when floating at the load waterline, minus its "lightship weight". Lightship weight includes the vessel's structure, machinery, permanent outfit and so forth. Deadweight may be subdivided into "operating deadweight" and "payload." Operating deadweight includes all items required to operate the vessel, including crew and effects, fuel, lube oil, fresh water and stores. Payload includes all items of deadweight not directly concerned with operations, including non-crew personnel and effects, equipment other than that considered part of the ship, instrumentation not concerned with ship operations, and cargo.

Note that the variations of displacement provide an accurate "weight" of the ship, and are to be used in calculations involving stability, loading, and the like. Registered tonnages are to a large extent artificialities, but they are those, which are involved in many licensing and documenting procedures, rather than the actual displacements.

3.3.2 TYPES OF VESSELS

VESSEL: Any watercraft, other than a seaplane, used as a means of transportation.

SHIP: Often used interchangeably with "vessel," the preferred legal term.

MOTOR VESSEL: A vessel more than 65 feet in length, which is equipped with propulsion machinery. (46 CFR 24.10-1)

MOTOR BOAT: Motorboat includes every vessel propelled by machinery and not more than 65 ft. Excluded are tugboats and towboats propelled by steam, tank vessels, cargo and miscellaneous vessels, and research vessels. Motorboats are classed as; Class A -- less than 16 ft; Class 1 -- 16 ft - 26 ft; Class 2 -- 26 ft - 40 ft; Class 3 -- 40 ft - 65 ft. (46 USC 526 and 46 CFR 24.10-1)

DOCUMENTED VESSEL: A vessel of greater than 5 net tons, which is registered, enrolled or licensed as a "vessel of the United States." This is a requirement for engaging in "trade or commerce." UNOLS research vessels are not ordinarily engaged in "trade or commerce;" commercial vessels ordinarily are.

UNDOCUMENTED VESSEL: Any vessel, which is not required to, and does not, have a marine document issued by the USCG. (46 CFR 188.10-75)

INSPECTED VESSEL: Is one that is inspected and certificated by the USCG. Motor vessels, tank vessels, and the majority of other non-public vessels over 300 GRT are required to be inspected. 46 CFR Table 188.05-1(a) identifies vessels to which the inspection laws apply.

UNINSPECTED VESSEL: A vessel not certificated under the inspection laws or subjected to regular inspections by the USCG. Fishing vessels, recreational motorboats, and oceanographic research vessels less than 300 GRT are examples. Uninspected vessels, however, are still subject to rules about safety and, in some cases, licensed personnel. (46 CFR Subchapter C, 24 et seq.)

VESSEL IN CLASS: A vessel is said to be “in class” when it holds a current certificate of classification issued by a recognized classification society, such as American Bureau of Shipping, Lloyds, Bureau Veritas, and other members of the International Association of Classification Societies (IACS). The certificate of classification signifies conformity with prescribed standards of structural strength, machinery, and equipment, providing for seaworthiness and safety in connection with marine insurance.

OCEANOGRAPHIC RESEARCH VESSEL: A vessel, which the USCG determines is being employed only in instruction in oceanography or limnology, or both, or only in oceanographic or limnological research, including those studies about the sea such as seismic, gravity meter, and magnetic exploration and other marine geophysical or geological surveys, atmospheric research, and biological research. This is a formal designation in writing by the cognizant Coast Guard Marine Safety Office (MSO). (46 CFR 188.10-53, 46 USC 2101(18) and 2113)

NUMBERED VESSEL: A vessel that is numbered under the provisions of the Federal Boat Safety Act of 1971. Oceanographic research vessels not engaged in commerce are not required to be documented, and may therefore become numbered vessels (except for certain federal and state owned vessels). (46 CFR 188.10-49)

PUBLIC VESSEL: Under federal shipping laws (46 USC 2101(24)), a public vessel means a vessel that is owned, or chartered, and operated by the U.S. Government and is not engaged in commercial service. Examples would be USCG and NOAA research vessels.

3.3.3 OPERATIONS

NAUTICAL MILE (nm): The internationally agreed standard sea mile, of 6,076 feet, this is commonly used in laws, regulations and treaties for specifying distance at sea or offshore.

RESEARCH CRUISE: Cruise by vessel primarily for the purpose of conducting marine research at sea. This is commonly defined as commencing on the day of departure, and terminating on the day of return to a port.

TRANSIT: Voyage of a vessel during which little or no research is being carried out; primarily for the purpose of going from one port to another, or to/from a port and an area of research.

LAY DAYS: Days in homeport for purposes of fitting out, cruise preparation, crew rest, and upkeep. May, in rare cases, include similar periods in other ports.

MAINTENANCE DAYS: Days undergoing overhauls, dry-docking, or other scheduled or unscheduled repairs during which the ship is not available for service.

OPERATING DAYS: All days away from homeport in an operating status incident to the scientific mission.

DAYS AT SEA: All days actually at sea incident to the scientific mission.

DAYS OUT OF SERVICE: Periods in which a ship is laid up out of service for an extended period for reasons of economy, unemployment, or unfitness for service.

OCEAN: Used to describe an operating area or route in any ocean or the Gulf of Mexico, more than 20 nm offshore. (46 CFR 188.10-51)

NEAR COASTAL: "The term near coastal means ocean waters not more than 200 nautical miles off a US shore." (46 CFR 10.103)

NEAR COASTAL AS PER STCW REG I/1: "STCW defines near coastal as a voyage in the vicinity of a signatory party. Each signatory party defines its own boundary for near coastal waters. It may not be consistent with 46 CFR 10.103.

COASTWISE: Used to describe a route or operating area, which is not more than 20 nm offshore, on any ocean, Gulf of Mexico, Caribbean Sea, Gulf of Alaska, and such other waters as may be designated. (46 CFR 188.10-15)

DOMESTIC SERVICE: "Domestic Service means a vessel used in trade from one U.S port to another U.S. port, or a voyage to nowhere that returns to the originating port." (NVIC 7-00)

BOUNDARY LINES: "Boundary lines are lines drawn following the general trend of the seaward, high-water shorelines and lines continuing the general trend of the seaward, high-water shorelines across entrances to small bays, inlets, and rivers." (NVIC 7-00 and 46 CFR 7)

INTERNATIONAL VOYAGE: A sea voyage, by a mechanically propelled vessel of 500 gross tons or more, from a country to which SOLAS applies, to a port outside that country, or conversely. Within Subchapter U of 46 CFR, the USCG treats voyages between the continental United States, Hawaii and Alaska as international voyages. NOTE: State numbered vessels in accordance with the Federal Boating Safety Act of 1971, or vessels holding a special exemption issued by the Coast Guard need not comply with regulations applicable to vessels on an international voyage. Such voyages are therefore termed "foreign voyages." (46 CFR 188.05-10, 46 CFR 188.10-35)

FOREIGN VOYAGE: A voyage between two countries or between two territories or possessions of the U.S, by a vessel which is not subject to the SOLAS provisions because of its size, propulsion, or documentation. Vessels engaged in such voyages, if 150 gross tons or over that were built before July 21, 1968 or if 79 feet or greater in length and built on or after July 21, 1968, must comply with load line requirements. After July 1984 existing vessels over 79 feet in length, and engaged in a foreign voyage, must be admeasured under the convention measurement system. (46 CFR 42.03-5, 46 CFR 69.9 & 69.11)

COLREGS: The Rules of the Road - International Regulations for Avoiding Collisions at Sea as well as the Inland Rules for U.S. waters. (USCG COMDTINST M16672.2D)

3.3.4 PERSONNEL

CREW: Personnel involved exclusively or primarily in the navigation and operation of a vessel.

PASSENGER: Every person other than the crew or other persons engaged on board a vessel in the business of the vessel. However, on oceanographic research vessels scientific personnel are not considered to be passengers. Research vessels may not carry passengers for hire, since this would constitute engaging in "trade or commerce." (46 CFR 24.10)

SCIENTIFIC PERSONNEL: "Scientific personnel on oceanographic research vessels are not considered to be seamen or passengers, but are considered as persons when requirements are based on total persons on board." and "Scientific Personnel - This term means those persons who are aboard an oceanographic research vessel solely for the purpose of engaging in scientific research, or in instructing, or receiving instruction, in oceanography or limnology, and shall not be considered seamen under the provisions of Title 46, United States Code." (46 CFR 188.10-71 and 46 CFR 188.05-33)

MASTER: The designated member of the crew of a vessel who is in legal overall charge of the entire operation of the vessel. See section on "Manning" for further discussion. The term "captain" is used almost interchangeably.

CHIEF SCIENTIST: The designated member of the scientific personnel who is in overall charge of the research operations on board ship. See section on "Manning" for further discussion.

PRINCIPAL INVESTIGATOR (PI): The individual in charge of a research grant that is being supported on a research cruise. Research cruises often support more than one PI making it necessary to coordinate cruise planning, safety procedures and science operations for several groups with different goals and from different institutions. This is usually coordinated through the Chief Scientist who may or may not be one of the PIs.

MARINE TECHNICIAN: An employee or representative of the ship operator responsible for at sea operation of oceanographic instrumentation and onboard laboratory facilities. These individuals are legally part of the science party, but are in fact an integral part of the research vessel operator's shipboard personnel supporting the science mission. They are responsible for helping to ensure safety in the laboratories and on deck during science operations and often have key responsibilities during emergency procedures. They serve as a primary point of contact between the scientific party and the ship's crew. Marine Technicians can also be referred to as Resident Technicians, Marine Science Technician or other similar titles.

EXPEDITION LEADER: This is a term that is often applied to the leader of a submersible crew deployed on a research vessel. This individual is responsible for the safe operation of Human Occupied Vehicles (HOV), Remotely Operated Vehicles (ROV) or other submersibles. They are legally part of the science party on a research vessel, but have a key role in helping to ensure the safe operations of submersibles. Other similar titles may be used for this position.

CREDENTIALS FOR MARINERS: Under Title 46 USC, the US Coast Guard is the domestic authority for promulgating requirements and issuing credentials for mariners. Each marine credential has specific requirements as to age, citizenship, physical condition, character, qualifying sea service, assessment and specialized training. The

Coast Guard issues credentials in the form of licenses for deck, engineering and radio officers; Certificate of Registry (CORs) for staff officers; and Merchant Mariner Documents (MMDs) for unlicensed ratings of shipboard deck, engineering and steward departments. Any credential may contain limitations as to vessel type, tonnage, propulsion, horsepower, or water upon which service is authorized. MMDs are issued to unlicensed personnel who support ship operations. Unqualified rating documents are issued to entry-level persons who have little or no sea service. These are ordinary seaman (deck department), wipers (engineering department), or food handler (steward department). Additionally, qualified rating documents are issued based on previous sea service or specialized service, Deck department qualified ratings are able seaman and bosun; for engineering the qualified rating is Qualified Member of the Engineering Department (QMED). Various endorsements or rating are also issued on MMDs to qualified individuals. These include oiler, junior engineer, pumpman, lifeboat man, tankerman, GMDSS at sea maintainer, etc. To serve aboard inspected vessels, an individual must possess a credential but must also hold an STCW certificate. This is a separate document from the credential.

INTERNATIONAL CONVENTION ON STANDARDS OF TRAINING, CERTIFICATION AND WATCHSTANDING FOR SEAFARERS (STCW-95): The convention initially held in 1978 was amended in 1995. It requires comprehensive training and assessment of a mariner's practical skills. These standards were adopted by the USA under 46 CFR Parts 10 and 15 and the STCW code. To obtain an STCW certification, a seafarer must meet the requirements set forth in the regulations. A license or MMD will not be issued if the STCW certification is not presented when applying.

OFFICER COMPETENCY CERTIFICATES AND CONVENTION OF 1936 (46 CFR 15.701): Provisions of the Officer Certificates Convention of 1936 are incorporated into US regulations in this part of the CFRs. It applies to documented vessels 200 GRT and over navigating outside of the boundary line. Public vessels and undocumented vessels less then 300 GRT are exempted. The convention requires masters, mates and engineers to hold licenses.

3.3.5 TYPES OF CERTIFICATION AND DOCUMENTATION

Certification and documentation in the various forms is not in itself a safety standard. Rather, it defines categories of vessels to which certain safety rules and standards apply. In most instances certification and documentation are dictated by the pertinent laws and regulations, with which the operator must comply. In a few cases, there is a choice, owing to the unique nature of research vessel operation. In general the standards set by each category of certification will be adequate for ordinary operations, but prudent operators will often go beyond the legal minimums. Examples of this would be in the case of additional fire extinguishers, or lifesaving equipment. UNOLS operators are urged to recognize the legal requirements as minimums, and take additional steps as the situation may justify in each case.

DOCUMENTATION: Certificates of registry, enrollment, or license are Federal maritime documents required by vessels engaged in trade or commerce. Oceanographic research vessels under 46 USC 2101(18) are not required to be documented, but may be at the option of the operator. If documented, however, the certification should clearly define the vessel's service as "Oceanographic Research." No special advantages accrue, nor are restrictions avoided, by documentation, insofar as research vessel safety is concerned. (46 USC 121 and 46 CFR 67)

NUMBERING: Undocumented research vessels are usually numbered in accordance with the Federal Boat Safety Act (excepting certain federal- or state-owned vessels). Thus, the state-issued “Award of Number” becomes the official certificate identifying the vessel. Most state certificates do not have a routine box to check for “research,” and it is important for the operator to see that this special use is clearly indicated.

OWNER’S CERTIFICATE: The unique and sometimes confusing role of marine research in the context of the U.S. shipping laws and regulations makes it advisable that all research vessels carry a letter, certificate, or plaque stating that the vessel is operated in oceanographic research under the laws of the U.S. This should include an affirmative statement that the vessel is complying with the provisions of 46 USC 2101(18). Such certification will help to avoid difficulties both in the U.S. and abroad.

USCG LETTER OF DESIGNATION AS OCEANOGRAPHIC RESEARCH VESSEL: 46 CFR 3 establishes US Coast Guard procedures for a designation as oceanographic research vessels. The designation is voluntary and is for the purpose of providing relief from otherwise applicable vessel inspection and the “Employment of Seamen” requirements. Such designation is necessary for the vessel to benefit from the exemptions of Subchapter U (46 CFR 188). Without this letter of designation, scientific personnel on board must be considered either crew or passengers. To be designated, a written request should be made to the local USCG officer in charge of marine inspection. The request must contain the information specified by 46 CFR 3.10-1. If the vessel is found to be employed exclusively in oceanographic or limnological research and/or instruction, a designation will usually be granted. For inspected research vessels, designation will be indicated on the certificate of inspection and is valid for the duration of the certificate. For uninspected research vessels a letter of designation will be issued. This letter of designation, which is valid for two years, must be requested by mail 60 days in advance of expiration.

INSPECTION CERTIFICATE: Oceanographic Research Vessels 300 GRT or greater are usually required to be inspected and certificated by the USCG. (46 CFR Subchapter U; 46 CFR 188.05-1)

ABS CLASSIFICATION: ABS classification of both hull and machinery is a detailed survey of the material condition of the vessel. This is not directly safety-related, but obviously bears heavily on the basic safety and operability of the vessel. In most matters of insurance and equity, ABS classification is attractive, and unless there is some strong reason to the contrary, it is recommended.

COURTESY INSPECTION OR UNINSPECTED VESSEL EXAMINATION: The USCG Auxiliary offers courtesy motorboat inspections for vessels that are moored as well as underway. The USCG may board and inspect any U.S. vessel at any time while underway. The annual sticker that is issued by the auxiliary as a result of a satisfactory inspection will be recognized by the USCG as showing the vessel as in compliance with the Boating Safety Act of 1971. Uninspected vessels may request an “Uninspected Vessel Examination” from a local USCG Marine Inspection Office. This service, which is advisory rather than regulatory, depends on the availability of USCG personnel and is not available from all offices. Neither of these “inspections” are mandatory but it is recommended that vessels under 65 ft undergo an auxiliary inspection and large vessels undergo the uninspected vessel examination, if available.

INTERNATIONAL CONVENTION FOR THE PREVENTION OF POLLUTION FROM SHIPS 1973 (33 CFR 151.59 and 33 CFR 155.700) (MARPOL): The provisions of MARPOL and its 1978 modified protocol are incorporated into the US regulations under these CFRs. Designed to minimize pollution of the high seas including the dumping of oil and exhaust pollutions. It contains six annexes. Each addresses a separate area of pollution. Annex 1 - Oil, Annex II - Noxious Liquid Substances carried in bulk, Annex III - Harmful Substances carried in bulk, Annex IV - Sewage, Annex V - Garbage, and Annex VI - Air. Annex I and II are obligatory to parties to the agreement. Annex III to VI are voluntary.

3.4 <u>LAWS AND REGULATIONS</u>

3.4.1 APPLICABLE TO ALL VESSELS

CODE OF FEDERAL REGULATIONS (CFR): A compilation of the rules and regulations made by Federal executive departments and agencies, pursuant to the authority of a Federal law. Most material concerning shipping is contained in Title 46 of the CFR. This is divided into chapters and subchapters, of which Subchapter U contains rules for oceanographic vessels. For example, “46 CFR 192” means Part 192 of Title 46 of the CFR. Not all CFRs apply to all vessels but those that do apply must be followed.

UNITED STATES CODE (USC): A compilation of the laws of the U.S., generally arranged by subject matter under “Titles.” Shipping laws are primarily contained in Title 46 of the code, which contains the Oceanographic Vessels Acts of 1964. Note that the USC contains actual laws from Congress; the CFR contains agency generated regulations. Like the CFRs not all code applies to all vessels but those that do apply must be followed.

INTERNATIONAL CONVENTION FOR THE SAFETY OF LIFE AT SEA (SOLAS): An international treaty, periodically modified, concerning safety at sea. The U.S. follows the provisions of the treaty and incorporates them in U.S. laws and regulations. Undocumented vessels, fishing vessels, vessels under 500 GT and certain others are not subject to the general SOLAS rules. (46 CFR 188.05-10)

JONES ACT (46 USC App 688a): The Jones Act was written to protect seamen injured while working. Under the Jones Act, a seaman is entitled to recover damages if he is injured during employment and they can elect a jury trial to recover damages. If a seaman is killed, a personal representative may bring a Jones Act suit to recover damages. The statue of limitations for a maritime injury suit under the Jones Act is three years. However, the courts have applied either the “time of event” rule or also the “discovery” rule in establishing the start of the statute of limitation. Historically, a Jones Act case has provided a very high cash settlement, compared to Workers Compensation, when either the slightest appearance of negligence or un-seaworthiness of the vessel could be demonstrated. Scientists are not considered seaman for the purposes of the Jones Act. The term seaman as defined by the Jones Act historically has been interpreted broadly. UNOLS vessels must be aware of this when embarking persons who are not part of a science party. (See Workers Compensation below.)

WORKERS COMPENSATION: Workers compensation is a State program that varies widely from state to state. It is traditionally designed to provide medical care, disability payments, and income benefits to employees hurt on the job. Workers Compensation settlements usually provide for lost wages and medical bills. Death benefits generally provide payment for life to a surviving spouse. While some court decisions have ruled that workers compensation may apply in lieu of a Jones Act settlement, this does not prohibit a seaman covered under workers comp from also bringing a Jones Act suit to collect damages nor does it mean he will not receive compensation under the Jones Act. (See Jones Act above.)

IEEE 45: A Standard issued by IEEE titled "Recommended Practices for Electrical Installations on Shipboard." As revised, it is a widely accepted standard for shipboard electrical systems.

3.4.2 APPLICABLE TO INSPECTED VESSELS

46 CFR Subchapter U - Oceanographic Research Vessels. This subchapter defines the regulations for research vessels of 300 GRT or more. They are not all inclusive and further applicable regulations may be found in other parts of the CFRs.

3.4.3 APPLICABLE TO VESSELS BASED ON TONNAGE

3.4.3.1 Vessels 200 GT or greater

INTERNATIONAL SHIP AND PORT FACILITY SECURITY CODE (ISPS): In the wake of the 9/11 attacks on the USA, the ISPS code was developed as part of SOLAS. ISPS is a comprehensive set of measures to cope with perceived threats to enhance the security of ships and port facilities. The purpose of the code is to provide a standardized, consistent framework for evaluating risk, enabling Governments to offset changes in threats with changes in vulnerability for ships and port facilities by determining appropriate security levels and corresponding security measures. It has three different security levels based on threats that contracting countries may implement. It requires facilities and ports to assess the threat and evaluate the risk of potential unlawful acts. Measures to minimize and combat these threats must be developed in a security plan and the plan approved by the contracting state's ISPS certification authority. If a ship's security plan is approved, the ship will be issued an International Ship Security Certificate. Ships not holding a valid security certificate may be detained in port until a certificate is received, may be expelled from a port, or may be refused entry. All ships that visit other ports particularly foreign ports should develop a security plan and obtain a ship security certificate In addition, Automated Information System (AIS), a broadcasting device similar to an aircrafts Identification Friend or Foe (IFF) is required. A Ship Security Alert System (SSAS), an alert system designed to raise the alarm ashore in reaction to security treats or incidents, is being investigated and may become a future requirement.

In the USA, the US Coast Guard reviews and approves ISPS security assessments and plans. It issues security certificates and ensures compliance. It does so under 33 CFR 101 and 104. ISPS code applies to vessels subject to 46 CFR Chapter I Subchapter L. In addition, the Coast Guard enforces the provisions of the Maritime Transport Safety Act of 2003 (MTSA). For this reason, the ISPS code is frequently referred to as ISPS/MTSA. NVIC 04-03 provides guidance in implementing the ISPS/MTSA provisions. Under 33 CFR 401.20 an AIS is required for all commercial vessels over 200 GT and with a length over all of 20 meters or more.

INTERNATIONAL CONVENTION ON STANDARDS OF TRAINING, CERTIFICATION AND WATCHSTANDING FOR SEAFARERS (STCW-95): With few exceptions, STCW applies to mariners employed on vessels 200 GRT or 500 GT that operate seaward of the boundary line specified in 46 CFR 7. Vessels specifically exempted from having STCW qualified mariners aboard are uninspected passenger vessels defined in 46 USC 2101(42), fishing vessels (46 USC 2101(11) 9(a) and (b), and vessels operating exclusively on the Great Lakes.

3.4.3.2 Vessels 300 GRT or greater

46 CFR SUBCHAPTER U - OCEANOGRAPHIC RESEARCH VESSELS: This subchapter defines the regulations for research vessels of 300 GRT or more. They are not all inclusive and further regulations that apply may be found in other parts of the CFRs.

3.4.3.3 Vessels 400GT or greater

MARPOL 73/78 ANNEX I, REGULATION 9 AND 26: Contains requirements for maintaining an oil record log for all vessels over 400 GT, specifies the requirements for maintaining a shipboard oil pollution plan and oil transfer procedures (see NVIC 2-93 change 1 for more information).

OIL POLLUTION ACT OF 1990 (OPA 90) (33 CFR 138, 33 CFR 155.1010, NVIC 03-06/ US MARINE TRANSPORTATION ACT OF 2004 (NVIC 01-05)): *The act established the Oil Spill Liability Trust Fund. It also requires vessels over 400 gross tons to have an Oil Spill Response Plan that is approved by the US Coast Guard in order to sail and vessels over 300 GT to establish and maintain evidence of financial responsibility in the form of a Certificate of Financial Responsibility (COFR) issued by the US Coast Guard.*

OIL SPILL REMOVAL ORGANIZATION (OSRO): A major feature of the National Response System and Marine Transportation Act of 1970 is that vessels over 400 GT are required to ensure the US Coast Guard the availability of response resources to meet their maximum, most probable and worse case discharge of oil into US waters. These resource requirements can be met by private contracts. This requires US Coast Guard approval of the vessel response plan and organization. This requirement is still resolving, however, certain States require these plans when transiting their waters. NVIC 01-05 provides guidance for submission and US Coast Guard approval of these plans.

3.4.3.4 Vessels 500 GT or Greater

INTERNATIONAL MANAGEMENT CODE FOR THE SAFE OPERATIONS OF SHIPS AND POLLUTION PREVENTION (International Safety Management (ISM) Code) (46 USC 32, 33 CFR 96.100 et seq.): *Adopted by IMO in 1978 and amended in 1995, this convention outlines training requirements for personnel serving as crewmembers aboard vessels in order for them to qualify for the required STCW certification. The ISM code establishes safety management objectives and requires a formal, written Safety Management System (SMS) to be implemented onboard certain vessels and at the management company which assumes responsibility for operating these ships. ISM code also requires every vessel over 500 GT to be issued a safety management certificate (SMC) that verifies the company and its shipboard management operate in accordance with the approved safety management system. To obtain and maintain the SMC, the ISM code requires that a US Coast Guard approved external auditing agent approve the initial SMS and that an annual external audit be conducted. It also requires* *internal audits be conducted. The ISM code also established a new position, the Designated Person Ashore (DPA), and the distinct responsibilities of this person are delineated. The DPA is designated in writing by the company and must have direct access to the company's highest level of management. The DPA will ensure the safe operation of the vessel and provide a link between the company and those on board. The DPA must have the responsibility and authority to monitor all safety and pollution prevention aspects of vessel operations and ensure that adequate resources and shore-based support are supplied. It is the responsibility of the company to identify the best candidate to fill the role of the DPA. Within the UNOLS fleet, the Institution operating the vessel is the company and in most instances the Institute will designate its Marine Superintendent as the DPA. This is a new concept in the marine industry where responsibility for safety is now shared between the DPA and vessel's Master. This concept of shared responsibility has yet to be fully tested by the courts.*

3.4.4 APPLICABLE TO UNINSPECTED VESSELS

MOTORBOAT ACT: A federal law enacted originally in 1940 and subsequently amended, which covers many aspects of safety for small craft. (46 USC 41)

FEDERAL BOAT SAFETY ACT OF 1971: Act setting forth certain requirements concerning documentation and safety, principally applicable to small craft (46 USC 43, 46 CFR 24-27). Safety for recreational vessels is contained in 33 CFR Subchapter S, 173 et seq.

3.4.5 APPLICABLE TO VESSELS ON INTERNATIONAL OR FOREIGN VOYAGES

INTERNATIONAL LOAD LINE ACT (46 USC 71 and 46 CFR 42 et seq.): This act concerns stability standards and inspections. It is applicable to certain vessels sailing beyond the Boundary Line. This certificate is issued by ABS for U.S. vessels and is required for most vessels on foreign or international voyages.

3.5 <u>RECOMMENDATIONS</u>

SAFETY STANDARDS FOR SMALL CRAFT: Standards issued by the ABYC concerning safety of small craft (e.g. ABYC E-1-1972).

LOAD LINE CERTIFICATE: Uninspected research vessels, which do not engage in international voyages, are not required to have a load line certificate, but unless there is some strong reason to the contrary, it is recommended.

46 CFR SUBCHAPTER U - OCEANOGRAPHIC RESEARCH VESSELS: While applicable to vessels of 300 GRT or larger, it is prudent for uninspected vessels to comply with these regulations to the maximum extent possible.

4. OPERATIONS

4.0 INTRODUCTION

Basic maritime precautions and procedures naturally apply to all seagoing research vessels in the UNOLS fleet. However, the scientific research element adds a unique dimension to shipboard operations seldom found in other areas of the maritime world. The addition of the Science party to the ship and the unusual nature of the work to be performed make it necessary to integrate added safeguards and procedures not commonly found in other areas of maritime work. Many of these extra precautions are discussed in detail in other sections, such as manning, communications, and hazardous materials. The operational aspects of the research program are potential trouble spots because of the non-standard nature or newness of the work. The participation of non-mariners conducting this work and the element of dual control by the Captain and Chief Scientist are also potential areas for problems. This chapter addresses the principal topics of general operations and some prudent steps to be taken to support the research program.

4.1 REFERENCES

Certain operations for inspected vessels are regulated by 46 CFR 185-196 of Subchapter U and for uninspected vessels by 46 CFR, Part 26 of Subchapter C. Other operations affecting the navigation of vessels, and "rules of the road" are contained in 33 CFR, Chapter I. Recent developments to combat terrorism have added Subchapter H, Maritime Security, to Chapter 1 of 33 CFR; all operators are encouraged to familiarize themselves with parts 101, and 103 thru 106 of this section. To achieve sound operational guidelines, uninspected vessels, insofar as practicable, should use the provisions of 46 CFR 196. In addition to the points mentioned herein, the internal policies set by the operating institution are an essential part of overall operational safety.

4.2 REQUIRED BY REGULATIONS FOR ALL VESSELS

4.2.1 SAFETY ORIENTATION

Before getting underway or as soon as possible afterwards, there should be a formal safety orientation for all embarked Science party members. Participation should be mandatory. Areas to be covered should include as a minimum: stowage and proper donning of lifejackets, type and location of lifesaving devices, the viewing of the RVOC safety movie, and any other instructions relating to safety for the particular vessel. (46 CFR 185-506 and 46 CFR 26.03-1)

4.2.2 EMERGENCY PROCEDURES

Posted instructions for crew and science party to follow in case of emergency are required. (46 CFR 199.80)

4.2.3 CHARTS AND NAUTICAL PUBLICATIONS

Appropriate charts and publications for the voyage shall be carried. They shall be maintained up to date, and of the appropriate scale to facilitate safe navigation at all times. Electronic charting systems supplement but do not replace the requirement to maintain an up to date chart library for the region of vessel operations. (46 CFR 130.330)

4.2.4 VOYAGE PLANS

The Master must prepare a voyage plan that includes a Crew and Science Party list before departure. The usual Passenger List is often presented as "Scientific Crew List" or something similar to clearly distinguish that the Science party members are not "Passengers." (46 CFR 185.503)

4.3 REQUIRED REGULATIONS FOR CERTAIN VESSELS

4.3.1 REQUIRED BASED ON TONNAGE OR SIZE

4.3.1.1 OIL TRANSFER PROCEDURES

All vessels, whether inspected or uninspected, with a fuel capacity of more than 250 barrels (10,500 gallons) of oil are required to have written oil transfer procedures. These procedures must be available during a USCG inspection and must be permanently mounted where the procedures can be easily seen and used by crewmembers engaged in oil transfers. These procedures must apply to both bulk fuel oil transfers to or from another facility and internal transfers between the vessel's tanks. The requirements for these procedures are contained in 33 CFR 155.720 and 33 CFR 155.730.

If there is an ISM system in place, there should be a specific procedure for the guidance of loading and transfer of fuel oil and lube oil.

4.3.1.2 OIL RECORD BOOK

An oil record book (Form CG-4602A) is required to be maintained by all vessels 400 Gross Tons (GT) and above under International Convention for the Prevention of Pollution from Ships (MARPOL) 73/78, Annex I, Chapter II, Regulation 9. Log entries are to be made whenever a vessel discharges ballast or cleaning water from fuel tanks, disposes oily residue (sludge), bunkers, discharges engine room bilge water or has an accidental discharge into the water. Detailed instructions for maintaining the log are contained in the record book.

4.3.1.3 REFUSE RECORD BOOK

33 CFR 151.55 requires that vessels over 40 meters (131 feet) in length maintain a Refuse Record Book in which log entries are made by the Master whenever garbage is transferred to another ship or shore facility, or whenever garbage is incinerated or dumped over-the-side. The log entry is to include the date, position, or port where disposal occurred and the amount in cubic meters. The log must be available to the USCG during a boarding or inspection. The log must also be kept for two years after a logbook is full. A waste management plan and mounted warning placard that prohibits the discharge of prohibited refuse over-the-side is also required.

4.3.2 INSPECTED VESSELS

4.3.2.1 S TABILITY LETTER

If a stability letter is issued in accordance with 46 CFR 170, it shall be posted in the pilothouse. (46 CFR 170.120 and 46 CFR 196.12)

4.3.2.2 STATION BILLS

All research vessels should have posted in conspicuous places station bills setting forth the duties of the crew and scientific personnel under emergency situations. New personnel should be indoctrinated in their duties. (46 CFR 199.80)

4.3.2.3 DRILLS

Drills must, as far as practicable, be conducted as if there were an actual emergency. Every crewmember on board must participate in at least one abandon-ship drill and one fire drill every month. The drills for the crew must take place within 24 hours of the vessel leaving a port if more than 25 percent of the crew have not participated in abandon-ship and fire drills on board that particular vessel in the previous month (46 CFR 199.180). A ship specific training manual should be developed. Conduct of drills should be noted in the deck log.

4.3.2.4 MEDICAL

All research ships and boats, of whatever size, should carry first aid and other medical supplies as appropriate for the size of vessel, number of persons aboard, and operational pattern. In particular, ships on extended voyages, or in areas remote from shore medical assistance should carry fully adequate medical supplies and instructions. Specific guidance as to medical supplies should be obtained from a competent medical support activity. Selected personnel should be trained in basic First Aid and Cardiopulmonary Resuscitation (CPR). Additionally, the Standards of Training, Certification & Watchkeeping (STCW) requires crewmembers to demonstrate competence to undertake listed tasks, duties, and responsibilities. Competency can be demonstrated by successful completion of an STCW approved medical training courses. Vessels on ocean, international, or extended voyages should have firmly established procedures for obtaining medical assistance by satellite phone or radio from a medical support activity, and administering it on board. Support involving radio advisory services, pharmaceuticals, medical supplies, training, evaluation and repatriation are available from commercial sources on a subscription and/or contractual basis. (The U.S. Public Health Service is no longer able to provide such support.) All operators should be familiar with and avail themselves of the current UNOLS medical contractor who provides emergency medical advice at sea and routine medical support activity ashore. (46 CFR 72.20-35 - Hospital Spaces)

The following reference books are valuable sources of information:

- "The Ship's Medicine Chest and Medical Aid at Sea", 2003 Edition. This book has been updated and is available online at: http:www.uscg.mil/hq/g-w/g-wk/wkh/smc/index.htm
- "International Medical Guide for Ships", Second Edition, World Health Organization, Geneva, 1988.

4.3.2.5 LOG BOOKS

A properly kept ship's log is a recognized part of a well-operated vessel. All research vessels, except small boats on day trips, should maintain a formal logbook in which is entered all appropriate records and data. If in doubt, it is much better to log too much than too little. In addition to the purely operational considerations, it is often found that the ship's log is a useful adjunct source of information for the scientific program, and it thus should include sufficient notations of the research operation to permit relating the scientific logbooks to the ship's operational activities. (46 CFR 196.35 and 46 CFR 78.37)

4.3.2.6 CRUISE (VOYAGE) PLANS

Recognizing that planned cruise tracks are often changed between the time a proposal is submitted and the time of the voyage, either the Master or Marine Superintendent of all research vessels shall ensure that a cruise plan is on file with their home office, prior to sailing, which includes the following information:

- The names of all ship's crew (unless recorded elsewhere).
- The names of scientific personnel (including technicians).
- Designation of Master and Chief Scientist.
- Date/time and place of departure.
- Estimated date/time and place of arrival.
- Cruise track and operating areas.
- Capsule summary of science planned.
- Communications instructions to comply with standards as set out in Chapter 6 of these safety standards, and institutional requirements.
- Early and complete information concerning the use of hazardous materials, explosives, and radioactive material. See Chapters 8 and 9 of these standards.
- Other information as appropriate to safe and effective vessel operations.

A copy of the Cruise Plan should be kept at the institutional facility or other designated base, and a copy should be maintained on board. The termination of the cruise or a port arrival should be reported, and it is the responsibility of the Master to see that this is done. The base facility should establish procedures for prompt follow-up action in case of receipt (or non-receipt) of reports.

4.3.2.7 NOTIFICATION OF HAZARDS

The National-Geospatial Agency (NGA) is the point of contact for ship operations that use sonic emitters, towed devices, explosive charges, or deploy moored instrumentation. These items could pose a hazard to the safe navigation and operation of submarines and in some cases to surface vessels, particularly those engaged in fishing, towing or other research work. NGA will disseminate this information through the Notice to Mariners and broadcast warnings as well as directly to appropriate Naval commands. Sending the same information directly to the Aids to Navigation office of the appropriate Coast Guard District and in some cases to local Naval Commanders may improve the level of notification and improve local co-ordination of operations.

To contact NGA to update a chart, or submit a notification:

http://www.nga.mil

Click on "Products and Services" then on the Nautical section on the web site, and then click on the "Maritime Safety Information" http://www.nga.mil/portal/site/maritime/

4.3.2.8 COLLISIONS, CASUALTIES, AND ACCIDENTS

The actions required at the scene of a collision, accident, or casualty, and the follow-up paperwork, vary with the legal requirements. In most cases, submission of United

States Coast Guard (USCG) forms to the USCG Officer in Charge, Marine Inspection (OCMI) is required. As a general rule, if another vessel is involved, the ship is required to render all practicable assistance in addition to identifying itself. Operators and captains should be thoroughly familiar with the particular requirements, which apply, to their vessel since legal and administrative liability will likely be at stake.

In the case of accidents involving injury to personnel, most institutions have very specific requirements for reporting in addition to the USCG requirement noted above. Ship's personnel should be thoroughly familiar with these since they are often crucial to liability or insurance proceedings at the federal, state, or institutional level. Notice of collisions, casualties, and accidents are usually required by the owner of the vessel as part of the Charter Party Agreement.

If the incident qualifies as a "serious marine incident" as defined in 46 CFR 4.03-2, then drug and alcohol testing of the individuals involved, including scientists, is required within twenty four hours and must be reported to the Coast Guard. 46 CFR 4.40

4.3.2.9 SECURIT Y

Research vessels shall follow the new Maritime Security Policies outlined in 33 CFR Subchapter H; parts 101, 104, and 105. Vessels and facilities required by these new regulations shall submit and follow the provisions of a vessel or facility security plan. It is strongly urged that security obligations and requirements be factored into any science expedition.

Marine superintendents and vessel Masters should also consult the NGA web site to download information on piracy and hostile action towards ships. The Office of Naval Intelligence (ONI) "Worldwide threats to shipping report" and the Anti-shipping Activity Messages (ASAM) are useful tools to avoid trouble spots throughout the world. The threat of piracy and terrorist groups attacking ships cannot be underestimated or dismissed as passé.

4.3.3 CLASSED VESSELS

None.

4.3.4 SOLAS VESSELS

None.

4.3.5 UNINSPECTED VESSELS

None.

4.3.6 OTHER REGULATIONS

None.

4.4 REQUIRED STANDARDS UNDER RVSS

4.4.1 BALLAST WATER MANAGEMENT

33 CFR 151.1510 Due to the serious problem of invasive species in US waters, all UNOLS vessels should follow the guidelines established in the USCG Voluntary Ballast Water Management Program. Information can be obtained at: http://www.uscg.mil/hq/gm/mso/mso4/old/estandards.htm.

Vessels over 300 GRT and not owned by the Department of Defense may also have to comply with the EPA regulations regarding Vessel Discharges under the National Pollutant Discharge Elimination System (NPDES). See the EPA web site at: http://cfpub.epa.gov/npdes/home.cfm?program_id=350

4.5 REQUIRED BY RVSS UNDER CERTAIN CIRCUMSTANCES

None.

4.6 RECOMMENDATIONS AND BEST PRACTICES

4.6.1 INSTITUTIONAL POLICIES

Policies of a laboratory or institution operating research vessels regarding their safe operation should be clearly stated in written directives and posted or disseminated as appropriate. As operators implement safety management systems in compliance with International Safety Management (ISM) requirements, these policies will become part of the organization's structure of accountability and will be subjected to regular audits and reviews – both at home and by foreign port state authorities. As a minimum, the following should be covered:

- Preparation, use, and handling of cruise plans.
- Communications instructions.
- Authority and responsibility of the Captain and the Chief Scientist.
- Safe loading standards for equipment and personnel.
- Instructions concerning hazardous materials.
- Responsibilities of base personnel for vessel operations, and procedures for follow-ups in case of overdue vessels or vessels not reporting on schedule.
- A security plan.

4.6.2 VESSEL HANDBOOKS

Research vessel operators should provide cruise handbooks or user manuals with complete information on the ship's capabilities and procedures for use in planning and conducting cruises. These manuals should be kept current and dated so that users can be sure they have the most current version. These manuals can be posted online as well. Principal Investigators and Chief Scientists should make sure that they thoroughly review and use the appropriate manual when they schedule, prepare for, and carry out their cruise.

In addition, the first chapter of the RVOC Safety Training Manual has been published separately as stand-alone safety indoctrination for members of the scientific party and new crewmembers. All members of the science party should read the RESEARCH PARTY SUPPLEMENT, which is available on UNOLS vessels and on the UNOLS web site.

5. MANNING

5.0 INTRODUCTION

By their very nature, oceanographic research vessels have unique manning and crewing requirements, which must satisfy both governmental regulations, and the science mission requirements of each expedition. The regulations put forth by the United States Coast Guard (USCG), Code of Federal Regulations (CFR), United States Code (USC), Standards of Training, Certification, and Watchkeeping, (STCW), International Convention for the Safety of Life at Sea, (SOLAS), International Maritime Organization (IMO), International Convention on Tonnage Measurement of Ships (ITC), Global Maritime Distress and Safety System (GMDSS), as well as local laws, all govern the crew requirements for a particular vessel. In addition to the manning requirements set forth by governmental regulations, the number and type of crew on a particular vessel may also be influenced by the science mission requirements of the ship or a particular cruise. The operating area, over-all experience of the science party, length of the voyage, and complexity of the science plan all impact the number and mix of scientists and technicians needed to successfully carry out the cruise.

The UNOLS fleet represents a diverse and broad spectrum of vessel types, and manning requirements will vary for each type of vessel. There are inspected vessels, uninspected vessels, limited tonnage and unlimited tonnage (Gross tonnage-GT and Gross Registered tonnage-GRT) Regional, Ocean and Global Class ships, and each has its own manning requirements. These crew requirements are addressed in sections below.

The Chief Scientist and/or Principal Investigator determine the make up of the science party for each science mission based on the nature of the work. Although ultimately, the Master of the research vessel is responsible for safety, the Chief Scientist has the responsibility to ensure that each task during the cruise is adequately planned and manned with appropriately trained and experienced scientific personnel.

In general the scientific party is responsible for carrying out the research and the crew is primarily engaged in safe operation of the vessel. In putting together the science team, it is important that factors such as the cruise plan, round-the-clock operations and rest, complexity of over-the-side operations and length of cruise are considered. The total allowable number of personnel (crew, technicians and scientists) will be discussed below in the section on required regulations for all vessels.

There are several terms found in the various regulations, which must be clearly understood in the interpretation of these laws. The following terms affect manning levels and are defined in Chapter 3.

- Oceanographic Vessel (46 CFR 188.10-53)
- Scientific Personnel (46 CFR 188.05-33 and 46 CFR 188.10-71)
- Near Coastal (46 CFR 10.103)
- Near Coastal as per STCW REG I/1
- International Voyage (NVIC 7-00)
- Domestic Service (NVIC 7-00)
- Boundary Lines (NVIC 7-00 and 46 CFR 7)

5.1 REFERENCES

- Code of Federal Regulations (CFR) – 46CFR15 covers manning
- United States Code (USC)
- Navigation and Vessel Inspection Circular (NVIC) in particular 4-97 & 7-00 for guidance on STCW
- United States Coast Guard Marine Safety Manual, Chapters 22-26 http://www.uscg.mil/hq/g-m/nmc/pubs/msm/vol3.htm
- Standards of Training and Certification of Watchkeepers (STCW)
- International Convention for the Safety of Life at Sea (SOLAS), 2004 Ed.
- American Boat and Yacht Council (ABYC)

5.2 REQUIRED BY REGULATIONS FOR ALL VESSELS

Manning regulations are contained in 46 CFR 15. The purpose of the regulations in this part is to set forth uniform minimum requirements for the manning of vessels. In general, they implement, interpret, or apply the specific statutory manning requirements in title 46, USC., parts E & F, implement various international conventions which affect merchant marine personnel, and provide the means for establishing the complement necessary for safe operation of vessels.

The regulations in this part apply to all vessels, which are subject to the manning requirements contained in the navigation, and shipping laws of the United States, including uninspected vessels (46 USC. 7101-9308).

The navigation and shipping laws state that a vessel may not be operated unless certain manning requirements are met. In addition to establishing a minimum of licensed individuals and members of the crew to be carried on board certain vessels, they establish minimum qualifications concerning licenses, citizenship, and conditions of employment. It is the responsibility of the owner, charterer, managing operator, master, or person in charge or command of the vessel to ensure that appropriate personnel are carried to meet the requirements of the applicable navigation and shipping laws and regulations.

46 CFR 15.801 states in part that the Masters or individuals in command of all vessels, whether required to be inspected under 46 USC. 3301 or not, are responsible for properly manning vessels in accordance with the applicable laws, regulations, and international conventions.

5.3 REQUIRED REGULATIONS FOR CERTAIN VESSELS

5.3.1 INSPECTED VESSELS

The Inspected Vessel manning requirements, (composition, billets, total numbers of personnel onboard) are established as part of the Certificate of Inspection issued by the USCG (46 CFR 15.103 & 15.501). For specific details on how the Officer in Charge Marine Inspection (OCMI) determines these numbers see 46 CFR 15.801.

5.3.2 CLASSED VESSELS

None.

5.3.3 SOLAS VESSELS

Applies STCW requirements and documentation to Intermediates and larger (over 500GT) and any vessel going foreign. (See NVIC 4-97 and 7-07) Also SOLAS Chapter V, regulation 14 requires: “vessels engaged in international voyages to be sufficiently and efficiently manned.” See section 5.3.5 – STCW regulations below.

5.3.4 UNINSPECTED VESSELS

The rules, which govern manning requirements on uninspected research vessels, are not well defined. As stated in the USCG Marine Safety Manual, Chapter 26: “there are very few statutory requirements that allow the Coast Guard to regulate uninspected vessels.” The regulations for the uninspected vessel industry focus on towing vessels, motor-propelled yachts, fishing vessels, and uninspected passenger vessels. Most of the regulations that apply to uninspected vessels are applied to Documented vessels.

There is a manning chart in Chapter 26, Figure 26-1, which lists requirements and references for citizenship, manning, and watch requirements that apply to uninspected, documented vessels.

46 CFR 15.701: Implements the Officers Competency Certificate Convention 1936, which applies to each vessel documented under the laws of the US navigating seaward of boundary lines except a vessel of less than 200 GT.

46 CFR 15.805: “There must be an individual holding an appropriate license as Master in command of each of the following vessels:

- Every self-propelled seagoing documented vessel of 200 gross tons and over.
- Every self-propelled inspected vessel of 200 gross tons and over.
- Every vessel documented under the laws of the U.S. other than a vessel with only a recreational endorsement, must be in command of a U.S. citizen”

46 CFR 15.810(c): “An individual in charge of the navigation or maneuvering of a self-propelled, uninspected, documented seagoing vessel of 200 gross tons or over must hold an appropriate license authorizing service as mate.

46 CFR 15.810(f): “The USCG Commandant will consider increases or decreases in the number of mates when special circumstances allowing a vessel to be safely operated can be demonstrated.”

46 CFR 15.820: “There must be an individual holding an appropriate license as Chief Engineer or a license authorizing service as a Chief Engineer on board inspected mechanically propelled seagoing vessels of 200 GT and over.” An individual engaged or employed to perform the duties of Chief Engineer on a mechanically propelled uninspected seagoing documented vessel of 200 GT or over must hold an appropriate license authorizing service as a Chief Engineer.”

46 CFR 15.825: “An individual in charge of an engineer’s watch on a mechanically propelled seagoing documented vessel of 200 GT or over must hold an appropriate license authorizing service as an assistant engineer.

The regulations are mostly silent for un-documented (state numbered) vessels, which include many of the UNOLS research vessels. Because of this it is recommended that operators of these vessels consult directly with the responsible Marine Safety Office for any questions.

On uninspected, undocumented research vessels the total number of crew and scientists is usually governed by the number berths on the vessel. Requirements for life saving equipment should be similar to those of inspected vessels of similar size and operating characteristics. For day trips, availability of lifesaving equipment and the ability of the crew to supervise safe operations will influence the allowable number of people on board.

5.3.5 OTHER REGULATIONS

5.3.5.1 S TCW Regulations

46CFR15.1101 is the beginning of Subpart J of 46 CFR 15 and defines STCW and certain terms relative to STCW. It also describes the applicability of the STCW regulations to U.S. Vessels. Subpart J includes 46CFR15.1101 through 46CFR15.1111. Further STCW guidance is contained in two USCG NVICs. NVIC 4-97 establishes guidelines for applying STCW for companies owning or operating U.S. documented, self-propelled vessels that operate beyond the boundary line (seagoing). The intent is to ensure that U.S. documented seagoing vessels are appropriately manned with personnel fully competent and fit to perform all routine and emergency duties on board. NVIC 7-00 provides clarification regarding the application of STCW to vessels less than 200 GRT.

Subpart J defines STCW to mean the International Convention on Standards of Training, Certification and Watchkeeping for Seafarers, 1978, as amended in 1995 and STCW Code means the Seafarer's Training, Certification and Watchkeeping Code. Also for STCW, Seagoing vessel means a self-propelled vessel in commercial service that operates beyond the Boundary Line established by 46 CFR part 7. It does not include a vessel that navigates exclusively on inland waters.

Rest means a period of time during which the person concerned is off duty, is not performing work (which includes administrative tasks such as chart corrections or preparation of port-entry documents), and is allowed to sleep without being interrupted. Overriding operational conditions means circumstances in which essential shipboard work cannot be delayed for safety or environmental reasons, or could not reasonably have been anticipated at the commencement of the voyage.

Subpart J applies to seagoing vessels subject to STCW. Further clarification in NVIC 7-00 makes it clear that vessels less than 200 GRT on domestic near coastal voyages do not have to comply with STCW requirements. Near Coastal is considered to be within 200 nm of the U.S. shore and within the jurisdiction of the U.S. (see *Domestic Voyages* below). NVIC 7-00 applies STCW to vessels over 200 GRT on "international voyages", which they define more broadly than elsewhere in the CFRs (see *International voyages* below).

A vessel that has on board a valid Safety Management Certificate and a copy of a Document of Compliance issued for that vessel in accordance with 46 U.S.C. 3205 is presumed in compliance with the regulations in subpart J.

STCW Regulation II/4 lists minimum requirements for ratings forming part of a navigational watch for unlicensed mariners working on a seagoing vessel of 500 GT or more.

STCW-95 certificates or endorsements are required as follows on board seagoing vessels operating beyond the boundary line as established by 46 CFR 7:

No person may serve as Master, chief mate, chief engineer, first assistant engineer, officer in charge of the navigating watch or engineering watch unless the person holds an appropriate, valid STCW certificate or endorsement.

On board a seagoing vessel of 500 GT (200 GRT) or more no person may serve in a rating, which forms a part of a navigational watch unless the person holds an appropriate, valid STCW certificate or endorsement.

On board a seagoing vessel driven by main propulsion machinery of 750 kw (1000 hp) propulsion power or more, no person may serve in a rating forming part of a watch in a manned or perform duties in a periodically unmanned engine room except for training or duties of an unskilled nature unless the person holds an appropriate, valid STCW certificate or endorsement. (Note: STCW does not apply to engineering officers serving on a seagoing vessel less than 750 kW (1000hp).

For purposes of these rules 200 Gross Registered Tons (domestic tonnage) is equal to 500 Gross Tons (international tonnage). Specific rules regarding the applicability of STCW for vessels under 200 GRT are summarized below:

5.3.5.2 D omestic Voyages

The Coast Guard, as per NVIC 7-00, has determined that, for certain small vessels on domestic near coast voyages that safety provided through the current licensing, inspection and oversight programs for small vessels delivers a level of safety comparable to STCW. As such the Coast Guard has imposed no new requirements either on mariners serving on passenger vessels of less than 100 GRT inspected under subchapter T or K or on other vessels less than 200 GRT on domestic voyages or on the owners or operators of such vessels.

The Coast Guard considers near coastal voyages to be those within 200 miles of the U.S. shore and within the jurisdiction of the U. S.

As a result, when a Master or other mariner is serving on a vessel of less than 200 GRT on a domestic near coastal voyage, no new training requirements have been imposed beyond the regulations. Holding a suitably endorsed license for service complies with the STCW under domestic law.

An officer operating a vessel on domestic voyages will have an appropriate STCW endorsement automatically placed directly on his or her license. This endorsement is available to any officer on an inspected passenger vessel less than 100 GRT and on any other U. S. vessel less than 200 GRT (500 GT) that is operating exclusively on a domestic voyage, if this mariner does not already hold a STCW certificate. This endorsement should read as follows:

When the holder of this license is serving on an U. S. Vessel of less than 200 gross registered tons (500 gross tonnage) in domestic service, no added STCW endorsement is necessary to meet the U. S. regulations implementing the STCW Convention.

5.3.5.3 In   ternational Voyage

This section uses the terminology found in NVIC 7-00 addressing International voyages. As described in Chapter 3 of the RVSS, International Voyages are made by vessels subject to SOLAS. However NVIC 7-00 seems to cast a broader net regarding “International Voyages”, defined in the NVIC as a voyage from a port in the U.S. to a port in a foreign country. The NVIC also states that these endorsements apply to mariners not engaged on vessels on near coastal voyages and that a license endorsed for near coastal voyages is not valid for international voyages or operations in waters of a foreign country.

Mariners licensed for service on vessels of less than 100 GRT inspected under subchapter T or K and on other vessels less than 200 GRT (500GT), when operating on an international voyages (except for the specific exemptions identified in NVIC 7-00), must meet the training and assessments required by the applicable U. S. and STCW regulations in accordance with 46 CFR 10.202. A mariner seeking a license or certificate valid for international voyages must meet the requirements for training and assessment required by STCW as may be applicable to the license or rating.

Any unlicensed mariner assigned a watch in an engine room or designated to perform duties in a periodically unmanned engine room on a vessel on an international voyage must have an STCW endorsement documenting that he or she meets the competencies of the STCW. This requirement applies only to those vessels driven by machinery of 750kw (1000 hp) or more.

NVIC 7-00 also sets forth a method to issue a STCW certificate to a mariner required to make an occasional international voyage, whose routine operations are domestic voyage.

5.4 <u>REQUIRED STANDARDS UNDER RVSS</u>

All uninspected UNOLS research vessels under 300GRT in addition to inspected vessels over 300GRT shall maintain crews that are trained and organized and whenever possible certified per the regulations established by STCW 95 and NVIC 4-97 & 7-00.

Operators should be guided by 46 CFR 15.1111 which addresses work hours and required rest periods when identifying final crew complement. In general, watch standers must receive a minimum of 10 hours of rest in any 24-hour period. The hours of rest may be divided into not more than two periods, one of which must be at least 6 hours in length.

5.5 <u>REQUIRED BY RVSS UNDER CERTAIN CIRCUMSTANCES</u>

None.

5.6 <u>RECOMMENDATIONS AND BEST PRACTICES</u>

PHYSICAL EVALUATION STANDARDS: Institutions employing personnel as crewmembers not possessing a Coast Guard issued license or merchant marine document should insure these crewmembers meet the physical standards of NVIC 2-98 or an equivalent set of physical standards established by their institution.

MANNING- SCIENTIFIC PERSONNEL: As noted above, the maximum number of scientific personnel is regulated for inspected vessels.

For uninspected vessels, the operator shall determine the maximum number allowable. This must be consistent with the safety and lifesaving equipment available on board the vessel and consistent with crew and science accommodations provided on the vessel. For smaller vessels, which have a labeled boat or raft capacity provided by the manufacturer these ratings shall not be exceeded. This limit should be made known to prospective chief scientists well in advance, so their staffing can be adequately planned. Recommended guidelines in this regard are to be found in manufacturers' specifications, ABYC publications, the Federal Safe Boating Act, and similar sources. (46 CFR 188.05-33; ABYC H-5)

Chief Scientists should ensure that they have adequate numbers of trained personnel to safely carry out their planned science operations. The requirements for crew rest outlined in 46 CFR 15.1111 (described in section 4.4 above) should be used as a guide for marine technicians and scientific personnel engaged in science operations, especially those on deck or in the laboratories when the use of equipment or chemicals might present hazards to personnel. If safety is compromised due to a lack of rest, the Master retains the authority and obligation to suspend operations.

MASTER OF THE VESSEL: The interrelationship of the Master of a vessel and the Chief Scientist is unique. The ship's Master is, in both law and tradition, solely and ultimately responsible for the safety and good conduct of the ship and all persons embarked, including the scientific party. Some specific regulatory requirements concerning the responsibilities of the Master of inspected vessels are found in 46 CFR Subchapter U, and these can be extrapolated to the Master of any vessel. To avoid disputes and misunderstandings, the substance of these regulations and customs should be clearly set forth in the ship's Cruise Handbook or similar publication, since many scientists are not aware of the legal and customary constraints.

Because of these legal responsibilities, the Master is also given full legal authority over all operations and personnel, both on board ship and in foreign ports. However, the primary objective of the Master and the crew is to facilitate carrying out the research in a safe and effective manner. In practice, the Chief Scientist informs the Master what is desired, and unless it is unsafe or illegal, it will be carried out. In case of serious disagreement, the question can be referred to the institution's marine manager, but it must be emphasized that if a decision has to be made quickly, the authority of the Master is absolute. (46 CFR Subchapter U)

CHIEF SCIENTIST: One member of the scientific party shall be designated Chief Scientist. This is to avoid placing conflicting demands from scientists on the Master, and asking the Master to referee disputes on scientific matters. The Chief Scientist is responsible for the coordination and execution of the entire scientific mission, not just his/her own portion of it. By custom, the personal and professional conduct of the scientific party on board ship and ashore is the responsibility of the Chief Scientist, under the overall control of the ship's Master.

In matters of safety, the Chief Scientist must always defer to the Master in case of dispute. In many cases, safety matters are common knowledge, and not unique to research vessels. In other cases there may be safety hazards unique to the research, which the ship's crew may not be aware of. In such instances, the Chief Scientist has a special responsibility to assure safety, and consult with the Master as necessary. (46 CFR 19415-3; 195.09)

6. PERSONAL BEHAVIOR AND INDIVIDUAL SAFETY

6.0 INTRODUCTION

This chapter was established to address aspects of behavior and the physical ability of individuals, which may have an impact on the overall safety of the vessel and other embarked personnel. Though not necessarily regulatory in nature, these items are important to address as part of the RVSS because of the potential impact on safety to others.

6.1 REFERENCES

- American's with Disability Act (ADA) - 42 USC 12101
- ADA Regulatory Guidance - 29 CFR 1630 (primary reference), 1602 (EEOC)
- ADA Title II (State and Local Regulatory Guidance) - 28 CFR 35 (DOJ)
- American Disabilities Act (ADA) Guidelines for UNOLS Vessels, 2008, UNOLS
- Sexual Harassment Regulatory Guidance - 29 CFR 1604.11
- State and Institutional regulations regarding Sexual Harassment
- Drug and Alcohol Testing Regulatory Guidance - 46 CFR 16 and 49 CRF 40
- "Harassment - What is it and what can be done about it?" 2006, Woods Hole Oceanographic Institution Brochure.
- Resolution by UNOLS Council dated October 5, 2006 regarding the ban of alcohol use on board UNOLS vessels at sea.

6.2 REQUIRED BY REGULATIONS FOR ALL VESSELS

All UNOLS Vessels will comply with U.S. Coast Guard regulations related to drug and alcohol testing specified in 46 CFR 16 and 49 CFR 40 in order to minimize the use of intoxicants and to promote a drug free and safe work environment.

6.3 REQUIRED REGULATIONS FOR CERTAIN VESSELS

6.3.1 INSPECTED VESSELS

None.

6.3.2 CLASSED VESSELS

None.

6.3.3 SOLAS VESSELS

None.

6.3.4 UNINSPECTED VESSELS

None.

6.3.5 OTHER REGULATIONS

None.

6.4 <u>REQUIRED STANDARDS UNDER RVSS</u>

6.4.1 ALCOHOL USE ON UNOLS VESSELS

It is the policy of UNOLS, as approved by the UNOLS Council, that all UNOLS vessel operators shall ban the consumption of alcoholic beverages on board UNOLS vessels by crewmembers or embarked members of the scientific party, except as provided below.

Certain exceptions can be approved in writing by institutional management for the purpose of allowing the possession and consumption of alcohol on board UNOLS vessels while in port for receptions, special occasions and entertainment of visiting dignitaries. Participation by ship's crew in these events shall take into consideration scheduled time of sailing and the need for full sobriety at the time of departure.

Possession of alcohol on board UNOLS vessels by crewmembers or embarked members of the scientific party is prohibited, with the exception of transport in bond under the control of the Master as allowed by institutional policies and at the discretion of the Master.

6.4.2 SEXUAL HARASSMENT

Each vessel operator is committed to maintaining a positive working and learning environment, and an environment free of illegal discrimination and harassment according to their own institution's policies. Vessel operators shall consult with the appropriate persons at their institution to ensure they are in compliance regarding crew training, posting of information, and the proper procedures to follow in the event a harassment situation arises on board.

This subject shall be covered in the vessel's Safety Briefing; in particular, the fact the operation is committed to maintaining a harassment free environment, and what resources are available to individuals when at sea. Appendix E of this manual may be printed and made available to the science party, as the operator deems appropriate. Release forms should include information on harassment policies and an indication that the person signing the form has been informed of these policies.

6.5 <u>REQUIRED BY RVSS UNDER CERTAIN CIRCUMSTANCES</u>

None.

6.6 <u>RECOMMENDATIONS AND BEST PRACTICES</u>

6.6.1 AMERICANS WITH DISABILITIES ACT (ADA)

By virtue of the "Oceanographic Research Vessel Act" (ORVA), 46 USC 2101, research vessels are considered under U.S. law to be a special class of sea-going platform. The RVSS contends that research vessels are not "public accommodations" as defined in the Americans with Disabilities Act (ADA) and are therefore exempt from these regulations. However, as in many areas, UNOLS operators should strive to set the example for our industry by making every reasonable accommodation with regard to sailing with disabled crew and scientists as long as safety is not compromised.

Many of the requirements given in shore-based building codes, and even those for Passenger Carrying Vessels are simply not possible on research vessels due to space and cost constraints – particularly on older or smaller vessels. However, many accommodations are reasonable and should be considered by the Federal agencies and the operating institutions as new vessels are brought on line.

UNOLS has developed and approved "*American Disabilities Act (ADA) Guidelines for UNOLS Vessels",* which are available on the UNOLS website. It should be noted that many of the design and outfitting features for the hearing and vision impaired might also improve safety for everyone on board the vessel.

There are many inherent dangers associated with going to sea. Some of the obstacles for the disabled are inherent to the design of the ship. However, most are procedural on the part of the operator – or can be overcome, at relatively reasonable costs, with small modifications or the addition of minor equipment.

The key to making reasonable accommodations is prior planning. The ship's Master and shore-side personnel need the opportunity to consider all of the ramifications and to ensure that adequate procedures can be put in place. It is highly recommended that Pre-Cruise Planning Questionnaires specifically ask about scientists with disabilities – much like asking about special dietary needs.

It is also recommended that the Master or Marine Superintendent be frank in discussing the reality of going to sea and the additional risk that the individual may be accepting. They should also realize that "personal dignity" – though easily maintained ashore -- might have to be sacrificed, because of the physical limitations of the vessel or in an emergency situation. Individuals may not be able to use their own equipment (such as standard wheel chair)s and may have to use equipment more suitable, or specially designed, for the marine environment.

The following is a list of the items that should be considered by the operator when working with a disabled scientist who accepts the personal risk and chooses to go to sea:

- The particular disability: Some, such as the hearing impaired, may be easier to accommodate than a severe mobility disability.
- The particular individual: Overall physical ability, their determination to overcome obstacles, and their own understanding of the inherent risks involved.
- The particular cruise: Operating area, such as exposed offshore waters (vs. inshore) and remote location and/or access to medical assistance. The type of operations – mooring deployment vs. CTD casts. Number in the science party – and the number of scientists available to assist crew with disabled individual's needs.
- The Ship and Facility: Of particular concern are gangways when the vessel is alongside, emergency debarkation facilities when the vessel is underway, wheelchair accessible compartments/decks, and alternate facilities for dining, sleeping, bathing, and toilets.

It is the ultimate responsibility of the vessel's Master to determine if it is safe to embark ANY individual on a scientific mission – regardless of whether or not they are disabled.

The following is a list of recommended procedural solutions for accommodating disabled scientists:

- Establish a "buddy system" for the individual. Do it discretely with the Chief Scientist, and not publicly during the Safety Briefing unless the buddy system is normally instituted for all scientific personnel.
- In emergency procedures, consider the disabled individual as an injured person if necessary and use the same procedures for getting that person to safety.
- Treat this as you would any other special operation on board – develop a plan/procedure.
- Conduct a thorough orientation with the disabled individual. With a visually impaired person, have someone take the time to orient the individual with the layout of the vessel.

The following is a list of simple accommodations, which the operator might find helpful:

- Electric wheel chairs
- Wheel Chair clamps
- "Hearing Impaired Kit"
- Wireless Wigglers
- Minimize obstacles in passageways and decks
- Adequate lighting
- High contrast markings on trip hazards and ladders

7. COMMUNICATIONS

7.0 INTRODUCTION

Adequate radio communications are essential to the safety of a vessel, which operates in the open ocean and must be functional at all times when the vessel is underway. All research vessels should have radio equipment appropriate for the operation, even if not legally required. Certain types of research vessels are required to carry and operate radio communications equipment that meet specific requirements in accordance with references listed below.

In recent years, technological advances have led to substantial changes and increases in communication methods, devices, procedures, rules, and regulations. Specific requirements are too extensive to properly cover in this manual. Operators are strongly encouraged to refer to regulations listed below to ensure a comprehensive understanding of associated requirements.

Communications equipment is usually a mix of required and elective systems on board UNOLS platforms and could include:

- Very High Frequency (VHF) Radio
- Medium Frequency (MF) Radio
- High Frequency (HF) Radio
- Digital Selective Calling (DSC)
- Narrow Band Direct Printing (NBDP) or Simplex Teletype Over Radio (SITOR)
- Cellular Telephone including Iridium
- Satellite Telephone (INMARSAT)
- NAVTEX
- Search And Rescue Transponder (SART)
- Automated Identification System (AIS)

All items listed above except AIS may be components of a Global Maritime Distress & Safety System (GMDSS). GMDSS regulations require that every GMDSS equipped ship shall be capable of the following:

Transmitting ship-to-shore Distress Alerts by at least two separate and independent means, each using a different radio communication service;

Receiving shore-to-ship Distress Alerts; transmitting and receiving ship-to-ship Distress Alerts;

- Transmitting and receiving search and rescue coordinating communications;
- Transmitting and receiving on-scene communications;
- Transmitting and receiving locating signals;
- Receiving maritime safety information;
- Transmitting and receiving general radio communications relating to the management and operation of the vessel;

- Transmitting and receiving bridge-to-bridge communications

AIS is a shipboard broadcast transponder system operating in the VHF maritime band that is capable of sending and receiving ship information such as identification, position, heading, speed, ship length, beam, type, draft and hazardous cargo information, to other ships and to shore.

7.1 REFERENCES

Communication references for rules and regulations include:

- 33 CFR 26 - Vessel Bridge-to-Bridge Radiotelephone Regulations
- 33 CFR 164.46 - Vessel Bridge-to-Bridge Radiotelephone Act 33 U.S.C.
- 46 CFR CHAPTER 1 SUBPART J, PART 25, SUBPART 25.26 - Emergency Position Indicating Radio Beacons (EPIRB)
- 47 CFR CHAPTER 1, SUBCHAPTER D, PART 80 - Stations in the Maritime Services
- SOLAS Chapter IV “Radio communications”
- SOLAS Chapter XI-2 “Special Measures to Enhance Maritime Security”
- The majority of relevant regulations for required communication systems and equipment can be found in 47 CFR 80.

7.2 REQUIRED BY REGULATIONS FOR ALL VESSELS

Most communications regulations are based on vessel size and service; see section 7.3 below.

7.3 REQUIRED REGULATIONS FOR CERTAIN VESSELS

Primary communication regulation requirements can be found in 47 CFR, Part 80. A breakdown according to vessel types follows:

- Subpart C General provisions for ship stations (47CFR80.141)
- Subpart F Equipment Authorization for Compulsory Ships (47CFR80.251)
- Subpart R Radiotelephone Installations for Vessels over 300 Gross Tons (47CFR80.851)
- Subpart T Radiotelephone Installation Required for Vessels on the Great Lakes (47CFR80.951)
- Subpart U Radiotelephone Installations Required by the Bridge-to-Bridge Act applicable for vessels over 20 meters (47CFR80.1001)
- Subpart W Global Maritime Distress and Safety System (GMDSS) (Required for vessels over 300 gross tons) (47CFR80.1065)

Compulsory ship. Any ship which is required to be equipped with radio telecommunication equipment in order to comply with the radio or radio-navigation provisions of a treaty or statute to which the vessel is subject.

AIS Carriage Requirements can be found in 33 CFR 164.46. Self-propelled vessels of 65 feet or more are required to have fully compliant AIS on board.

All ships over 500 gross tons are required to be equipped with a Ship Security Alert System (SSAS), which is capable of discreetly raising the alarm to the relevant authorities and tracking the vessel if the security of the vessel is compromised.

7.3.1 INSPECTED VESSELS

Inspected vessels should adhere to communication regulations per vessel size breakdowns listed in section 7.3.

7.3.2 CLASSED VESSELS

Classed vessels should adhere to communication regulations per vessel size breakdowns listed in section 7.3. In addition, classed vessels should comply with 47 CFR 80.1069, Subpart W, GMDSS, Maritime Sea Areas, for required GMDSS radio equipment, which is dependent on radio frequency and operating areas.

7.3.3 SOLAS VESSELS

SOLAS Chapter IV, Part A, B, & C of the International SOLAS Convention.

7.3.4 UNINSPECTED VESSELS

Uninspected vessels should adhere to communication regulations per vessel size breakdowns listed in section 7.3. There are specific EPIRB requirements for uninspected vessels in 46 CFR CHAPTER 1 SUBPART J, PART 25, SUBPART 25.26: EMERGENCY POSITION INDICATING RADIO BEACONS (EPIRB)

7.3.5 OTHER REGULATIONS

All vessels should adhere to communication requirements listed in 33 CFR 161, VESSEL TRAFFIC MANAGEMENT, when working in areas regulated by Vessel Traffic Service systems.

7.4 REQUIRED STANDARDS UNDER RVSS

7.4.1 REPORTING

All research vessels, while operating, should make the following reports to their home base or other base designated to receive such reports:

- At least once daily when underway on cruises overnight or longer than one day.
- When any change in the cruise plan affects the planned position or Estimated Time of Arrival (ETA) at any previously designated point.
- When any equipment failure adversely affects the capability of the vessel.
- When adverse weather or other factors affect the planned operations of the vessel.
- On arrival and departure from an overnight or other designated stop.
- When an injury occurs to personnel that prohibits them from performing their regularly scheduled duties for 24 hours or more.

7.4.2 LOSS OF RADIO CONTACT

As required by the Maritime Safety Act of 1984 (46 CFR 4.04-3), an operating institution's representative having reason to believe (because of the lack of daily communications for two successive days, 48 hours, or non-appearance of a vessel, or other unusual instance) that the status of a vessel is uncertain or imperiled shall notify the cognizant USCG Rescue Coordination Center (RCC). The operating institution shall continue to use all available means to establish communications with the vessel and determine its status. The person notifying the Coast Guard shall provide complete information concerning the vessel's itinerary, identification, and communication capabilities. The purpose of notification is to make the Coast Guard aware that some uncertainty exists concerning the status of the vessel and to save time if and when it becomes necessary to declare an emergency. A vessel unable to communicate with any station for a period of 60 hours will terminate all operations and proceed to the nearest point where communications can be re-established. Normally, the vessel will proceed to the nearest port having communications capability.

7.5 REQUIRED BY RVSS UNDER CERTAIN CIRCUMSTANCES

None.

7.6 RECOMMENDATIONS AND BEST PRACTICES

None.

8. SCIENTIFIC SUPPORT EQUIPMENT

8.0 INTRODUCTION

Scientific Support Equipment is defined as:

Ship-Owned equipment, such as winches, handling systems, portable vans, sampling instruments, and laboratory equipment that is specifically designed to support scientific operations. It is essentially the equipment suite that separates research vessels from other classes of vessels.

Portable equipment that is owned or obtained by the science party or the ship operator that is brought aboard for a specific mission.

Scientific support equipment carried on board research vessels ranges from the familiar equipment standard on most cruises (Conductivity-Temperature-Depth (CTD) profilers with rosettes or box cores) to one-of-a-kind developmental hardware which is largely unknown to all hands, perhaps even to the scientists who brought it. This raises two safety concerns: first, extreme familiarity may lead to carelessness with gear, which could be inherently dangerous. Second, novel equipment with unknown potential hazards can lead to unpleasant surprises. In either case, both crew and scientific party should exercise prudence and caution when deploying, recovering, or staging scientific equipment.

Although the actual operation of scientific equipment may be delegated to the Chief Scientist or others in the science party, ultimate responsibility for safety lies with the Master of the vessel, and it is assumed that the Master has full knowledge of and has given consent to every operation on board.

8.1 REFERENCES

With very few exceptions, federal laws and regulations do not cover scientific equipment, other than the general requirements embodied in International Safety Management (ISM) code, which requires pro-active safety management of all operations undertaken on board the vessel.

- 46 CFR 189.35 - “Weight Handling Gear”
- 46 CFR 194.15 - “Chemical Laboratories”
- 46 CFR 195.11 - “Portable Vans and Tanks”
- Institute of Electrical and Electronics Engineers (IEEE) publish the IEEE-45, which is a non-regulatory document that provides Underwriters Laboratory (UL) recommendations for the standards of construction and maintenance that should be observed for equipment and materials that are placed in marine service.
- UNOLS Portable Scientific Van Manual: http://www.unols.org/committees/rvoc/vanspec.html

In the majority of cases, the CFRs and other rules delegate the responsibility for safety procedures to the operator, thus placing a heavy burden on those involved. Therefore, it is important that all hands approach research operations with particular care and use the principles of good seamanship, sound marine engineering practices, and common sense.

8.2 REQUIRED BY REGULATIONS FOR ALL VESSELS

None.

8.3 REQUIRED REGULATIONS FOR CERTAIN VESSELS

8.3.1 INSPECTED VESSELS

Though autonomous vehicles and instruments are rapidly becoming more commonplace, most research equipment is still handled over the side on wires and cables. All the handling gear must be installed to meet the manufacturer's specifications and be in compliance with Subchapter U requirements for weight handling gear (46 CFR 189.35). The scientific party is responsible to ensure that their equipment also meets these requirements.

Weight Handling Gear: Inspected research vessels shall comply with 46 CFR 189.35. Where applicable, stress and general design calculations should be performed. 46 CFR 189.35-9 requires that, "The safety factor for all metal structural parts shall be a minimum of 1.5; i.e. the yield strength of the material shall be at least 1.5 times the calculated stresses resulting from application of a load equal to the nominal breaking strength of the strongest section or wire rope to be used. Suitable assumptions for the actual loading conditions shall be used in the design of wet gear. The lead of the wire rope from the head sheave or winch drum shall be considered to vary from the vertical and in azimuth in a manner to represent the most adverse loading condition." These concerns also apply to the means by which equipment is secured to the vessel's deck.

Installation and periodic tests (see 46 CFR 189.35-5): Tests should normally consist of exercising the equipment as a unit with a proof load 25 percent in excess of the equipment's normal working load (125%); however, manufacturer's design limitations should not be exceeded. Examination and testing procedures for weight handling equipment used to deploy scientific equipment over-the-side must be followed, documented and recorded.

The owner or operator shall conduct a safety assessment of weight handling gear. Section 189.35-13 details the Master's responsibilities (listed below) and these may be used as a guide for the operator's safety assessment.

The gear is properly installed and secure.

Suitable safety guards are installed in way of rotating machinery, hazardous cable runs and at other appropriate locations.

Operating limitations are posted in an appropriate manner.

Only qualified operators are permitted to operate the weight handling gear. The master shall designate the operators.

A minimum number of persons, as required to perform the task at hand, are allowed in the immediate area.

The installation does not violate the approved trim and stability information.

A suitable permanent record is maintained on the equipment as appropriate showing such items as inspections, tests, important repairs and casualties experienced. This record shall be made available to the Officer in Charge of Marine Inspection (OCMI), upon request.

Prior to a vessel's departure, an entry shall also be made in the official logbook that the ship's weight handling gear is in compliance with the applicable requirements in this subchapter.

Vans: 46 CFR 188.10-67 provides the definition of a van as science equipment. 46 CFR 195.11 contains the Coast Guard regulations concerning the use of certain vans aboard inspected vessels. These regulations consider only three categories; accommodation vans, power/machinery vans, and chemical storage vans, which are subject to both Coast Guard regulatory plan approval and inspections at a two-year interval. Laboratory vans are NOT considered accommodations vans and are not subject to Coast Guard inspection regulations. More detailed information concerning containers and securing of vans may be found in International Organization for Standardization (ISO) standard 1496 and the American Bureau of Shipping (ABS) Guide for Certification of Container Securing Systems and Certification of Cargo Containers. These regulations are helpful for dimensional details and shipping as containerized cargo. For conversion to portable scientific vans, or for new construction of vans, the UNOLS Portable Scientific Van Manual, which is available in the Publications section of the UNOLS website, should be consulted. Table One of the Van Manual contains a summary of van types and requirements.

Accommodation vans, power/machinery vans, and chemical storage vans designed for use aboard uninspected vessels before the implementation of the UNOLS Scientific Van Standards were not subject to Coast Guard inspection. Therefore, such a van cannot be transferred to an inspected vessel unless the Coast Guard inspects it first.

8.3.2 CLASSED VESSELS

None.

8.3.3 SOLAS VESSELS

None.

8.3.4 UNINSPECTED VESSELS

Operators of uninspected vessels must be aware that a van placed aboard a vessel does count as measurable volume for admeasurement purposes. It is possible for a van to increase tonnage to 300 or more tons, potentially placing the vessel into an inspected status.

8.3.5 OTHER REGULATIONS

None.

8.4 REQUIRED STANDARDS UNDER THE RVSS

Within 18 months of adopting this revision of the RVSS, all vessels shall comply with Appendix A - UNOLS Rope and Cable Safe Working Load Standards.

When Appendix B is adopted, all ship-owned handling systems (winches, davits, frames, etc.) must meet the requirements given in Appendix B - UNOLS Handling System Design Standards.

When Appendix B is adopted, all science-owned handling equipment (winches, davits, frames, etc.) must meet the requirements for portable ship's equipment given in Appendix B - UNOLS Handling System Design Standards.

All ship-owned vans built after January 1, 2002 must meet the requirements given in the UNOLS Portable Scientific Van Manual.

All science-owned vans delivered after January 1, 2010 must meet the requirements given in the UNOLS Portable Scientific Van Manual.

All Vans, including vans delivered prior to January 1, 2010, shall be examined and approved for use based on Appendix C – *Safety Inspection Checklist for Shipboard Vans*.

All science support equipment installations shall be consistent with the approved stability data for the vessel for the entire range of weights and heights through which these are deployed.

8.5 REQUIRED BY RVSS UNDER CERTAIN CIRCUMSTANCES

NONE.

8.6 RECOMMENDATIONS AND BEST PRACTICES

Operators of uninspected vessels, as a matter of best-accepted practices, should follow the requirements of section 8.3.1.

For handling systems, operating limitations should be clearly posted, and operators of winches, cranes, and the like must be qualified in their use or properly certified depending on the system (See Appendix B when it is adopted). Labels giving test information should be placed on the equipment. Since overstresses may degrade the long-term safety factor, records must be maintained of tests, excessive loading, maintenance, alterations, and other factors. It should be noted that as science techniques and equipment evolve, the value of the equipment being lowered increases, and the potential consequential losses arising from equipment failures may extend to delays of the scientific program, immediate hazards to operating personnel, and potential financial liability.

Ship Operators should provide appropriate safety equipment such as tag lines, lifelines, hard hats and communications systems to be used as deemed necessary by the Master for safe deck operations.

The Chief Scientist is responsible for the general operation and safety of the scientific laboratories and storage areas. Periodic inspections of the vessel's laboratory spaces should be made by a scientist and one of the ship's officers to verify safe stowage, securing of equipment, and cleanliness. Particular attention must be paid to the stowage and use of chemicals, flammables, and other hazardous materials; safety labeling; posted standard safety precautions, and common-sense safe operating procedures [See Chapter 8]. Fire extinguishers, ventilation, eyewash facilities, spill kits, and other laboratory safety equipment should be available and marked. Ship's motion is by far the most common cause of damage and personal injury aboard ship, and experienced ship's crew should help the science party to secure laboratory and scientific equipment. Cooperation between the ship's crew and the scientific party is most important since many scientists are not experienced mariners and thus are unfamiliar with even the common problems associated with a moving vessel. It should be remembered that while in practice the Chief Scientist is primarily responsible for safety of the science operations, the ultimate legal responsibility (and authority) lies with the Master of the vessel. (46 CFR 194.15-3)

The carrying of portable science equipment including vans, tanks, special winches, crates of equipment, large sampling gear, and other instrumentation must be carefully checked for conformity with approved stability and load line conditions. It is particularly important that accurate weights be provided for equipment being brought on board. Since such installations are temporary, their design and the selection of materials, especially for weather surfaces and the attachments and hold-downs, should be carefully thought through in light of probable weather conditions and ship's motion likely to be encountered during the voyage. The use of standard-sized hold-down holes at 2-foot spacing on the deck is commonplace throughout the research fleet. With these readily available, all scientific equipment to be embarked should be designed to fit the bolt pattern, and there is no excuse for portable structures coming adrift. While each installation will, of course, be somewhat different, as a basic guide, the van itself and accessory components should be designed and constructed to good marine commercial standards. Electrical and other connections to the permanent ship systems should be to marine standards. Adequate ventilation for the intended use must be provided. Particular attention should be given to van electrical systems since building electrical systems have "grounded neutrals" while ship systems are generally ungrounded. Proper design of van electrical systems, including the provisions to isolate van electrical circuits, is particularly important since it can avoid problems both as shock source and electrolysis. Machinery brought on board should be in good repair and operating condition, because hydraulic leaks and electrical problems pose a safety risk to scientists and crew alike. Acceptable "marine standards" are those standards published by UL for marine service, found in IEEE-45 or Coast Guard regulations.

46 CFR 195.09 Scientific Equipment: All scientific equipment shall be designed to good commercial standards and it is the responsibility of the owner to assure their equipment is free of personnel hazards.

Autonomous equipment: Autonomous science support equipment such as Autonomous Underwater Vehicles (AUVs), gliders, drifters, and Unmanned Airborne Vehicles (UAVs) are becoming more and more common place. Generally speaking, deployment and recovery may not be any more complicated than any other piece of science instrumentation. These systems do, however, present a different legal framework once they are deployed and free from the vessel. The question of who is responsible for incidents caused by an AUV has been raised, but probably won't be settled until some event occurs. Until then, it should be considered like any other piece of science equipment deployed from the vessel. The Master and the Chief Scientist should consult on the details of the particular operation to minimize risk to the instrument itself and outside parties.

9. SCIENTIFIC AND SHIPBOARD HAZARDOUS MATERIALS

9.0 INTRODUCTION

A hazardous material is any substance or combination of substances that, because of quantity, concentration, physical, chemical, radiological, explosive, or infectious characteristics, poses a substantial present or potential danger to humans or the environment. Generally, such materials are classified as:

- Flammable liquids and solids
- Oxidizing materials
- Corrosive materials
- Flammable and non-flammable compressed gases
- Poisons or toxic substances
- Disease-causing agents
- Combustible liquids
- Explosives and blasting agents
- Radioactive materials
- Other Regulated Materials (ORM) (Department of Transportation (DOT) Hazard Class “ORM”), including hazardous wastes

Radioactive materials are covered separately in Chapter 10.

Hazardous materials will be found among both ship and scientific stores and include such items as organic solvents, corrosives, compressed gases, flammable liquids, and toxic or reactive chemicals. Material Safety Data Sheets (MSDS) contain a list of product ingredients, indicating information about the type of hazard; recommended personnel protection and precautions; spill or leak procedures; and fire, explosion, health (including first aid), and reactivity data; and most importantly, an emergency telephone number for assistance in the event of an accident. Employers are required to inform employees of what hazardous materials are present in the work place and train them, with the aid of the MSDS, in their proper use and handling. (29 CFR 1910)

9.1 REFERENCES

- 46 CFR 194 – Subchapter U section on Hazardous Materials
- 29 CFR 1910 – MSDS
- 49 CFR 172 and 105 – Hazardous Materials

9.2 REQUIRED BY REGULATIONS FOR ALL VESSELS

Rules for stowage, labeling, and handling of hazardous materials for all vessels are given in 46 CFR 194.

A Hazardous Material Table can be found in 49 CFR 172.101. This table lists and classifies those materials, which have been designated as hazardous materials, and prescribes the requirements for shipping, labeling, and transporting. Additional regulatory information and guidelines for hazardous waste are in 49 CFR 172.205 and 49 CFR 105.

9.2.1 EXPLOSIVES, PERMITS, AND AUTHORIZATION

Since USCG rules dealing with explosives are stringent and strictly enforced, the Port Captain, USCG Office should be contacted at least 8 weeks prior to the cruise departure date. In addition, Fish and Game Departments, local and state law enforcement agencies, the fire department etc., should be contacted for information on possible restrictions, truck routing, spot assistance and inspections, etc.

The use of explosives, sonic emitters, or towed devices (as well as instrumented moorings) present special hazards to submarine operations and navigation. The National-Geospatial Agency (NGA) (Formerly the National Imagery and Mapping Agency) has agreed to disseminate information concerning underwater hazards as part of the Notice to Mariner system. See chapter 4 (Operations) for details on reporting these hazards.

Rules for carrying, stowage, and labeling of explosives on board inspected ships are given in Subchapter U, CFR. All UNOLS research vessels should follow these rules. In addition, 49 CFR 176 prescribes requirements for all vessels carrying hazardous materials in the domestic waters of the United States, with some exceptions. Magazines and storage areas should be properly labeled and inspected daily, and safety precautions should be posted. (46 CFR 194.05, 194.10, 196.80, 196.85)

9.3 REQUIRED REGULATIONS FOR CERTAIN VESSELS

9.3.1 INSPECTED VESSELS

None.

9.3.2 CLASSED VESSELS

None.

9.3.3 SOLAS VESSELS

The SOLAS- Consolidated Edition 2004, Chapter VI, Carriage of Cargoes governs the carriage of cargoes. Some of these cargoes may present hazards to ships or persons on board and may require special precautions. The following regulations will guide you in the safe handling of these cargoes:

Part A- Regulation 1- Application states: “this chapter may require special precautions in all ships to which the present regulations apply and in cargo ships of less than 500 gross tonnage. However for cargo ships of less than 500 gross tonnage, the Administration (i.e. U.S. Government) if it considers that the sheltered nature and conditions of the voyage are such as to render the application of this chapter unreasonable or unnecessary, may take other effective measures to ensure the required safety for these ships.”

Note: For this ruling UNOLS research vessels are considered cargo ships.

Part A- Regulation 2- Cargo Information.

In this regulation the shipper (i.e. scientist) shall provide the Master or his/her representative with appropriate information on the cargo sufficiently in advance of loading to enable the precautions, which may be necessary for proper stowage and safe carriage.

Scientific supplies, which may include hazardous goods are normally brought aboard research vessels in small quantities in packaged form and not as bulk cargoes. In SOLAS Chapter VII- Carriage of Dangerous Goods guidelines are provided for these instances.

In Part A- Regulation 1, Dangerous goods means the substances, materials, and articles covered by the International Maritime Dangerous Goods (IMDG) Code. Therefore if a chemical is on the IMDG list, the handling of it is governed by these SOLAS regulations.

Note: Regulation 2 states that this part does not apply to ship's stores and equipment. In this case RVSS does not consider scientific cargo as part of the ship's stores.

Regulation 3 states the carriage of dangerous goods shall be in compliance with the IMDG Code.

Regulation 4- Documents- All documents must use the proper shipping name of the goods and a correct description. The transport documents prepared by the shipper must provide certification that the item is properly packaged, marked, labeled or placarded, and in proper condition for carriage.

Regulation 5 governs that the cargo units shall be loaded, stowed, and secured throughout the voyage.

Regulation 6 provides instructions that require the reporting of incidents involving dangerous goods. The master or other person in charge must report without delay when an incident takes place involving the loss or likely loss of dangerous goods into the sea.

9.3.4 UNINSPECTED VESSELS

None.

9.3.5 OTHER REGULATIONS

None.

9.4 REQUIRED STANDARD UNDER RVSS

CRUISE PLANNING: The Chief Scientist will be responsible for providing the following to the ship operator at least 30-days prior to the cruise departure date unless a shorter time is specifically allowed by the ship:

- A list of all hazardous materials by chemical name, common name, UN identification number, type and classification of hazard, quantity (size of containers and number of each size container), user name and contact information
- MSDS sheets for all materials listed above
- A list of the spill response materials and the amount to be brought aboard to address spills or accidents

- The plans for offloading all materials brought aboard at the end of the scheduled cruise.

The ship operator will review the provided material and contact the Chief Scientist if there are any questions or concerns. The ship operator will then forward copies of the required information to the vessel or request that the Chief Scientist carry a copy to the vessel for delivery to the Master.

TRANSPORTATION AND DISPOSAL: The Chief Scientist will be responsible for the proper transportation, shipping and disposal of hazardous materials and waste, including the empty containers, associated with their project. Transportation and disposal must be carried out in accordance with Federal, State and Local regulations. In no case will this responsibility be passed to the ship's crew or operating institution. Each Institution's Shipping Department can provide up-to-date information about regulatory requirements.

SHIPBOARD HAZARDOUS MATERIALS AND POLLUTION: Many of the materials associated with normal operation and maintenance of research vessels are classified as hazardous materials. In addition, waste products and sewage are the subject of pollution control regulations issued by the Coast Guard and other agencies. Research vessel operators have an obligation to ensure that their crews and scientific parties are informed of the hazards associated with these materials and that they are aware of the pollution control regulations so that wastes are not disposed of in violation of the law. Several regulatory documents apply to this area. These are: International Convention for the Prevention of Pollution from Ships 1973 as modified by the Protocol of 1978 (MARPOL 73/78), 46 CFR 131.935 Prevention of Oil Pollution and the Federal Water Pollution Control Act 33 USC-1321.

LITHIUM BATTERIES: Lithium batteries require special fire extinguishing capabilities depending on the type of material used in the manufacturing process. The Chief Scientist is required to notify the ship operator of the use and/or recovery of instruments using lithium batteries and to supply appropriate fire extinguishing equipment and a stowage locker if one is not available from the ship operator.

INCOMPATIBLE MATERIALS: These are materials that should not be stored together. See 49 CFR 176.83 and Table 176.83(b), General Segregation Requirements for Hazardous Materials for information on incompatible materials. The table found in 49 CFR 172.101 is also helpful in this area.

STORAGE CONTAINERS: Material should remain in their original shipping containers (as received from the vendor) with labeling intact. Working quantities in the amount of a one-day supply can be stored inside the ship. Working containers must be marked as follows: Common or trade name, UN identification number (49 CFR 172.101, Hazardous Material Table), the nature of hazard (flammable, acid, poison, etc.), and the contact information (name and work phone number) of the person using the material aboard the vessel.

COMPRESSED GASES: Must be securely held to the ship structure with metal brackets or positive cargo straps to hold them in place. Ropes or other similar lashings must be avoided. All gas cylinders must have their safety cap in place unless they are in use with a regulator. No cylinder should be moved without the cap in place. See 46 CFR 194.05-15, 46 CFR 194.15-17 and 49 CFR 172, 173, 176.

SPILL RESPONSE: Kits or materials to address spills or accidents are supplied by the user, not the ship. The amount of material brought aboard must be sufficient to address a spill of the entire amount of the specific materials being brought aboard. (For example, if you bring 1 liter of Hydrochloric acid, you need to supply spill response material to clean up a spill of 1 liter of Hydrochloric acid.)

SHARPS DISPOSAL: Syringes, sharps, hypodermic needles brought on board should be treated as a safety hazard and proper provisions should be made for safe use and disposal. Safe disposal of other sharp objects such as broken glass, pipettes, etc. should be included in the laboratory safety plan. The science party is responsible for providing the appropriate “Sharps” container(s).

FUME HOODS: A fume hood is ventilation equipment that vents separately from the ship’s heating, ventilation and air conditioning (HVAC) system. The primary means of controlling airborne chemical exposure is a fume hood. Fume hoods should be used when working with toxic compounds or compounds with a boiling point below 120°C. Air flow surveys of fume hoods should be certified at least annually by the owner of the hood with the proper sash height indicated on the fume hood. Fume hoods should be equipped with trays to catch spills and that do not interfere with ventilation.

OSHA CFR 1910.1450, is the federal laboratory standard. It simply states that you must have a chemical hygiene plan for the lab that includes “A requirement that fume hoods and other protective equipment are functioning properly and specific measures that shall be taken to ensure proper and adequate performance of such equipment”

A couple of other industry group standards are the Scientific Equipment & Furniture Association (SEFA 1-2006) which recommends annual testing of fume hoods. For additional testing criteria, refer to AIHA (Laboratory Ventilation Z9.5-2003), ASHRAE (110-1995), and ANSI. Check with the appropriate department at the (or your) Operating Institution for their rules and regulations regarding fume hood use, safety, and testing.

RESPONSIBILITY: Proper storage, labeling, and spill response (clean-up) is the responsibility of the user. Anyone using hazardous material should be trained in proper laboratory safety procedures. The Chief Scientist shall be responsible for ensuring that safe laboratory procedures are followed including use of personal protective equipment, prohibiting the consumption of food and drinks in labs, and other safety precautions as outlined on MSDS and considered standard laboratory procedures.

9.5 REQUIRED BY RVSS UNDER CERTAIN CIRCUMSTANCES

None.

9.6 RECOMMENDATIONS AND BEST PRACTICES

CHECK VESSEL REQUIREMENTS: Individual ship operators may have additional (and more stringent) policies regarding the handling, storage and use of hazardous materials. Users should contact the ship operator as early as possible in the cruise planning process to ensure they comply with the vessel requirements.

10. RADIOACTIVE MATERIALS

10.0 INTRODUCTION

Radioactive materials on board ship pose unique problems not found in shore-based laboratories. It is recommended that all radioisotope work be conducted in a laboratory van set-aside exclusively for this purpose. When this is not possible, radioactive materials can be used at sea in laboratory spaces that will be shared with other researchers. Even if all radioisotope work is conducted in a dedicated van, the potential to inadvertently transport small amounts of isotopes to other areas of the vessel is greater due to the confined nature of research ships. Because of this, research ship operators and scientists have a particular obligation to assure adherence to prudent laboratory procedures; including monitoring, clean-up, and record keeping. These precautions are necessary for the protection of personnel and to ensure the integrity of measurements made by different investigators of environmental levels of natural or artificial radionuclides. In most cases, it is necessary for these programs to measure extremely low levels of ambient radioactive activity. As a result, this work is sensitive to contamination by very small amounts of radioactivity, far below levels having any public health significance. The SWAB program mentioned at the end of this chapter can provide assistance in monitoring and cleaning lab spaces.

10.1 REFERENCES

Activity and quantity of the materials shall not exceed that authorized by the operating institution's Nuclear Regulatory Commission (NRC) Byproduct Material License, or equivalent, which is monitored by that institution's Radioisotope Users Committee, or equivalent. This committee should consist of a Radiation Safety Officer (RSO) and representatives from ship operations and the user community. Provisions of such a license usually apply to a research vessel at sea or away from homeport. The use, storage, transportation, labeling and disposal of such materials shall conform to applicable regulations of the NRC, any state agencies that have jurisdiction, and the operating institution's procedures.

10.2 REQUIRED BY REGULATIONS FOR ALL VESSELS

See below

10.3 REQUIRED REGULATIONS FOR CERTAIN VESSELS

See below

10.3.1 INSPECTED VESSELS

None.

10.3.2 CLASSED VESSELS

None.

10.3.3 SOLAS VESSELS

None.

10.3.4 UNINSPECTED VESSELS

None.

10.3.5 OTHER REGULATIONS

None.

10.4 REQUIRED STANDARD UNDER RVSS

As part of the procedure for obtaining authorization to use radioisotopes at sea, the Chief Scientist must submit an application which includes information on the amount and type of isotope to be used, protocols for the experiments in which these isotopes will be used, and how radioactive waste will be stored or disposed of. The operating institution's Radioisotope Users Committee, RSO, or equivalent, will review and authorize the proposed use of the isotope or isotopes.

Laboratory vans and other work areas designated for isotope use shall conform to minimum standards for such facilities. A properly rated (120 Linear Feet per Minute (LFM) or greater) and vented fume hood must be available for all activities for which there is a potential of airborne radioactivity. It is important to know where this fume hood exhaust exits the ship to make sure that personnel are not exposed directly or indirectly. All working surfaces must be constructed of materials that are nonporous and resistant to corrosion by seawater and radioactive solutions. A refrigerator/freezer capable of being locked must also be available for storage of isotope stocks. No food items may be stored in this appliance with appropriate signage indicating this restriction.

Regulations prohibit the disposal of liquid or solid radioactive waste into the ocean. The scientific user must provide facilities for the safe and secure storage of liquid and solid radioactive waste. The operating institution's RSO or the science user's RSO will approve these containers with proper certification. In order to reduce the possibility of spills, the waste containers must be located in the radiation laboratory van when one is available or in another certified safe storage van/location. The Principal Investigator (PI) assumes all responsibility for the necessary activities and costs to properly dispose of all radioactive materials at the end of the cruise.

It is essential that ship operators be informed of the intent to use radioisotopes as early in the scheduling process as possible. To this end, the following is required:

- The amounts and types of isotopes to be used aboard ship and the name, email address, and telephone number of the RSO from the PI's home institution must be provided on the UNOLS Ship Time Request (STR) form or the ship operators Cruise Planning Documents.
- Upon notification of funding, the PI will be required to initiate the procedure required to obtain authorization to use radioisotopes on UNOLS vessels; i.e. to immediately contact ship operators for instructions and to notify their own RSO.

10.4.1 SCIENCE GROUP

The Chief Scientist must ensure that any PI or other user of radioactive materials has been granted written authority by their home institution's Radiation Safety Committee, RSO, or equivalent, to possess and use radioisotopes. Upon notification of funding, the PI must contact the operating institution and initiate the procedures required to obtain authorization to use radioisotopes on the assigned vessel. The RSO of the PI's home institution must also be notified and requested to verify to the operating institution that the PI is an authorized user.

Once the PI has been authorized to use isotopes by the operating institution, the PI should notify the Chief Scientist and confirm the laboratory space or radioisotope van that will be used and restricted for isotope work. The PI will be responsible for posting the area, monitoring, clean up of spills, and ensuring that the work area is clean upon completion of the isotope work. All users must have personal dosimeters (except when using low energy beta emitters C^{14}, H^3, and S^{35}) and work areas must be surveyed as required by the operating institution. All spills must be reported to the Chief Scientist who will immediately report them to the Master and Marine Technician. Upon completion of the cruise, the PI will report the results of all surveys and the disposition of waste, unused isotopes, and labeled samples to the Chief Scientist. The Chief Scientist must provide this information in a post cruise report to the operating institution and the funding agencies if they require it.

The responsibilities for clean up, disposal and transport of all waste and the associated costs will be borne by the PI.

10.4.2 OPERATING INSTITUTION

Operators must require that the members of the science party using isotopes, including the PI and Chief Scientist, are familiar with NRC procedures as well as specific shipboard rules and regulations. These shipboard regulations must be specific as to the science party's responsibility during the cruise, especially with regard to an isotope spill and the appropriate method for cleanup. These procedures can be found in the ship's cruise planning manual or handbook and should be discussed with the Marine Technician during the cruise planning process.

Of central importance is the establishment of procedures by which a PI may be granted the authority to use radioisotopes at sea. This responsibility rests with the operating institution and its RSO. The information upon which authority is granted should include at least the following:

1. The names of all personnel that will be engaged in the use of isotopes aboard ship, and the quantities and forms of all isotopes to be used.
2. Written verification by the RSO of the PI's home institution that the PI and/or the personnel listed above is currently authorized to possess and use the quantity and type(s) of isotope(s) proposed by the PI.
3. A description of experimental protocol. This should include the proposed location of the work and procedures for storage and manipulation, isolation and control of samples, containment and cleanup of spills, and the disposition of liquid and solid waste.

To ensure the safe and orderly use of radioisotopes at sea, the operating institution should also assume the following responsibilities:

- Provide suitable facilities for use and storage. Such facilities include appropriately designed laboratory space, preferably a laboratory van designated exclusively for radioisotope use, and monitoring equipment (scintillation counter and, when required, personal dosimeters).

- Prior to departure, ship's personnel and the scientific party should be briefed on the types of isotopes to be used, location of van and storage, and potential hazards.
- A member of the ship's complement (i.e. an officer or marine technician) should be trained in basic radiation safety and emergency procedures. This individual, designated as the ship's radiation safety officer, will work with the scientist to ensure that the isotope work is conducted in designated areas that are properly posted and monitored, and that spills are properly cleaned up and reported.

10.5 REQUIRED BY RVSS UNDER CERTAIN CIRCUMSTANCES

None.

10.6 RECOMMENDATIONS AND BEST PRACTICES

10.6.1 Facilities, Instrumentation and Training

The use of laboratory vans restricted for radioisotope use is strongly encouraged; i.e., all operating institutions should have access to at least one laboratory van for this purpose. Appendix C is a checklist for inspecting shipboard vans and contains a reference to the standards to be used in fabricating a van for this purpose. Using this van for other purposes; e.g., storing gear and paints, transporting spares, etc., is prohibited.

In order to ensure proper monitoring of work areas, all UNOLS vessels should be equipped with monitoring equipment such as a liquid scintillation counter, single source counter or Geiger counter with pancake probe. Personal dosimeters should be provided by the scientific user, as appropriate, for the isotopes being used.

Likewise, UNOLS institutions are encouraged to require a member of the ship's complement (could be marine technicians) to be trained in basic radiation safety procedures. At the beginning of each cruise, this person would be responsible for briefing the crew and scientific party on the isotopes to be used, where they are to be used and stored, the disposition of wastes, and potential hazards.

10.6.2 SWAB program

Operators and PI's should be aware of the SWAB team operated by the Tritium Lab at the University of Miami. This group will conduct tests for extremely low levels of radioactivity before and/or after a cruise. This serves as a mechanism for determining when an unreported spill has occurred. SWAB tests can be requested directly from the University of Miami. It is recommended that the scientist perform a SWAB test both immediately before and immediately after a cruise where radioisotopes are used. If logistics prevent personnel from the University of Miami performing the test, a sample collection kit and instructions can be sent to the ship for samples to be collected and returned to the University of Miami for testing. The contact information for the Tritium Lab is: Tritium Laboratory
University of Miami, Rosenstiel School of Marine and Atmospheric Sciences
4600 Rickenbacker Causeway, Miami, Fl 33149
Attn: Jim Happell or Charlene Grall
E-mail: Tritium@rsmas.miami.edu Phone: 305-421-4100

11. DIVING OPERATIONS

11.0 INTRODUCTION

Scientific diving is a normal part of oceanographic research vessel operations. Such diving conducted from a University National Oceanographic Laboratory System (UNOLS) vessel must be under the auspices of a diving program that meets the minimum American Academy of Underwater Sciences' (AAUS) Standards for Scientific Diving Certification and Operation of Scientific Diving Programs. Operators without a program may accommodate scientific diving cruises, which are under the auspices of an institution with such a diving program.

11.1 REFERENCES

The American Academy of Underwater Sciences Standards for Scientific Diving www.aaus.org/downloads/aausstandards.pdf.

11.2 REQUIRED BY REGULATIONS FOR ALL VESSELS

As required by AAUS Standards, a single lead institution's campus diving administration will be designated for all cruises requiring diving. This is usually accomplished by the agreement of all campus diving administrations involved. Items in the AAUS Standards, which refer to the campus diving administration, may be the concern of the Diving Safety Officer according to the practices of the institutions involved. The procedures, rules and regulations that govern the diving operation are those of the designated lead institution, subject to the approval of the operator's Marine Office.

11.3 REQUIRED REGULATIONS FOR CERTAIN VESSELS

11.3.1 INSPECTED VESSELS

See required by RVSS below.

11.3.2 CLASSED VESSELS

None.

11.3.3 SOLAS VESSELS

None.

11.3.4 UNINSPECTED VESSELS

None.

11.3.5 OTHER REGULATIONS

None.

11.4 REQUIRED STANDARD UNDER RVSS

All UNOLS vessels will comply with the AAUS "standard".

11.4.1 CRUISE PLANNING

The Principal Investigator will prepare and supply a cruise dive plan to his or her campus diving administration who will forward the cruise plan, once approved, to the lead institution's campus diving administration and the Chief Scientist. The dive plan, prepared in a standard format, includes: diving credentials for all diving members of the scientific party, detailed operational plans, emergency plans including accident management and emergency evacuation protocols, a list of needed medical supplies, a specified quantity of medical grade oxygen with a positive pressure demand delivery system and required diving support equipment (i.e. small boats and tank racks).

The lead institution's diving administration will, after approving this plan, forward it to the operator's Marine Office one month prior to the cruise.

11.4.2 CRUISE PERSONNEL

The Master has responsibility for the safety of all activities aboard including diving. The Master should ensure that appropriate safety procedures are in place for conducting research diving from the vessel or it's small boats including but not limited to ensuring that high powered acoustics sources are turned off, potentially hazardous over-board discharges are secured, propellers and bow-thrusters are not turning with divers in the vicinity and that proper notifications and signals are made.

The Chief Scientist is responsible for the coordination and execution of the entire scientific mission including the research diving plans and certifications.

The Principal Investigator of the diving project (who may or may not be the Chief Scientist) is responsible for the planning and co-ordination of the research diving operations.

The On-Board Diving Supervisor will be proposed by the Principal Investigator and approved by the lead institution's diving administration. The On-Board Diving Supervisor is responsible for the execution of the research diving operations in accord with the cruise dive plan. He or she has the authority to restrict or suspend diving operations and alter the cruise dive plan in consultation with the Master, Principal Investigator/Chief Scientist and lead Dive Safety Officer when possible. The On-Board Diving Supervisor's responsibilities include:

- Meeting with the Master and Chief Scientist to review the cruise dive plan and emergency procedures prior to diving.
- Remaining in regular communication with the Master on the progress of the research diving operation.
- Assuring that both the lead and operating institution's diving manual are available to the scientists and crew aboard the vessel. The lead institutions manual will take precedence in the event of a conflict unless otherwise agreed to in advance.
- Inspecting high-pressure cylinders and breathing air compressors to assure that they meet the lead institutions' standards.
- Ensure that air used to refill tanks is of proper quality and that all air tanks used by divers have a current hydrostatic test.

11.5 REQUIRED BY RVSS UNDER CERTAIN CIRCUMSTANCES

None.

11.6 RECOMMENDATIONS AND BEST PRACTICES

It is important to ensure that the placement of the air intake for any compressor used for breathable air on board a vessel is made with regards to the location of the vessel's exhaust systems and how it may change with the wind.

Other "in-the-water" research activities such as small boat operations, swimming or snorkeling should be treated similarly to diving operations. At the very least a statement of the qualifications and physical ability to undertake the planned operations and a plan of operations detailing safety precautions should be provided and approved by the ship operator.

Research divers must also recognize their individual responsibility for their safety.

12. HUMAN OCCUPIED VEHICLES

12.0 INTRODUCTION

Marine science researchers have employed submersibles such as the *Alvin*, the two *Johnson Sea-Link* submersibles, the *Clelia*, the *Pisces IV* and *Pisces V* as effective platforms for oceanographic observations, collections and experiments for several decades. In the future, the inventory of Human Occupied Vehicles (HOVs) may change but the concerns for safety will remain. The terms “Human Occupied Vehicles” and “Human Occupied Submersibles” are used interchangeably throughout this chapter.

Safety, both for the personnel embarked aboard the HOV and for those aboard the support ship, is paramount in establishing the operating procedures under which Human Occupied Submersibles support science research missions. Over the years, operating institutions have each developed checklists, personnel training syllabi, testing procedures, maintenance intervals, and safety reviews. Conscientious operators have kept pace with advances in material sciences, metallurgy, composites, hydraulic systems, handling systems, electronics, and science tools and have continually improved their systems in relevance and utility for the science users, training of operational personnel, and in overall safety.

An HOV system consists of three major components: the undersea vehicle, the submersible support surface platform, and the handling system that moves the submersible across the air/water interface. Regulatory agencies and experienced operators worldwide focus on the essential synergy of these three elements to provide an effective and safe tool for undersea research and exploration and the personnel supporting this endeavor. Common Certifying agencies in the U.S. are ABS and NAVSEA. Consideration will be given to foreign certification on a case-by-case basis with ultimate authority to accept such certification lying with the home institution.

12.1 REFERENCES

- UNOLS Safety Standards for Human Occupied Vehicles

12.2 REQUIRED BY REGULATION FOR ALL VESSELS

Regulations based on type and certification of HOV and regulatory status of vessel.

12.3 REQUIRED REGULATIONS FOR CERTAIN VESSELS

12.3.1 INSPECTED VESSELS

None.

12.3.2 CLASSED VESSELS

None.

12.3.3 SOLAS VESSELS

None.

12.3.4 UNINSPECTED VESSELS

None.

12.3.5 OTHER REGULATIONS

None.

12.4 REQUIRED STANDARDS UNDER RVSS

12.4.1 UNOLS HOV SAFETY STANDARDS

Any UNOLS vessel or vessel chartered by a UNOLS institution in accordance with Chapter 18 of these standards will adhere to the UNOLS HOV Safety Standards when conducting any operations involving submersibles designed to carry human occupants.

All HOVs must meet all applicable inspection standards and be currently certified by ABS or the U.S. Navy or other such bodies recognized for that purpose within established regulatory compliance regimes.

12.4.2 SUBMERSIBLE SUPPORT SHIP

The surface support vessel must have the ability to conduct two-way communications with the HOV both on the surface and beneath the surface throughout the design-operating envelope of the vehicle in whatever sea state operations are to be conducted. Typically, this will include VHF radiotelephone communications when the HOV is on the surface, and an acoustic underwater telephone system when the vehicle is submerged. A Loss of Communication Procedure must be provided.

The support ship must have a means for electronic tracking of the position and depth of the HOV.

Transducers for acoustic tracking and communications systems, both on the surface ship and on the submersible, must be mounted so that there are no blocked azimuth angles, and so that the propagation covers maximum horizontal distances and depths expected to be encountered under both normal and emergency operational scenarios

Personnel assigned to operation of the tracking/communications equipment on the ship must be provided with proper training, spare parts, and technical support. The importance of training cannot be over-emphasized. Please see HOV Safety Standards Chapter 7.

The surface support ship must have an adequate suite of depth sounding equipment to determine, with precision and certainty, the depth of the water in which the HOV will be operating. Sufficient spares, backup systems and technical support of these essential components must be provided.

Rescue assets and outside assistance for an entrapped or entangled submersible may, depending upon operating area and environmental conditions, be days away. The surface support ship and/or submersible must be equipped with a self-rescue capability. This may consist of a second HOV, a ROV system, a releasable personnel sphere, or a passive buoy tag-line captive engagement system. The self-rescue system must be operational throughout the depth range at which the submersible is capable of operating. Realistic drills and exercises, simulating a submersible rescue scenario shall be held at regular intervals, no less than once a year, and the results must be documented, to assure the integrity of the rescue equipment and to familiarize the personnel on the surface ship and the HOV with its use. These may include tabletop exercises or comprehensive reviews of safety or rescue plans.

In the event of entrapment, entanglement, or component failure, life support for at least 72 hours should be available in the submersible (i.e. air, water and food).

12.4.3 CHAIN-OF-COMMAND DURING HOV OPERATIONS

As per maritime law and tradition, the Master retains responsibility for and authority over all operations conducted aboard the ship, including the deployment of any off-board vehicles employed by the vessel and its embarked personnel. The Expedition Leader (or other appropriate official title) is responsible for and has authority over the HOV and its embarked personnel. The designated HOV pilot commands his or her vehicle and has responsibility for and authority over its operation. The Chief Scientist, as described elsewhere in this document, is in charge of the mission. Unless accomplishment of the expedition plan is unsafe or illegal, the Master and other key individuals responsible for HOV operations should make every attempt to facilitate science needs.

Four persons have launch veto authority. The Master, the Expedition Leader, the HOV pilot, or the Chief Scientist can make a “no-go” decision. (On occasion, the HOV pilot may also fill the role of Expedition Leader.) The others may not outvote or over-ride such a call. A decision to proceed with a HOV dive should be a consensus decision of these key leadership personnel, but it must be understood that a majority cannot over-rule a “hold” or “no go” determination by any one of these key personnel.

Similarly, a decision to terminate a dive early and to recover the HOV may become necessary due to a change in the weather, mechanical issues on the HOV or the support ship, conflicting traffic, or personnel needs. Again, any one of the key leadership personnel identified in the preceding paragraph can order an early termination of the dive. The final say on the actual timing of the surfacing (unless there is a situation requiring the submersible to make an emergency ascent) is routinely deferred to the Master who will take into account actual surface conditions and the position of the ship with respect to the HOV, maneuvering the ship as required for the recovery procedure.

12.4.4 SUBMERSIBLE SUPPORT SHIP PROCEDURES

Prior to the commencement of HOV launch procedures, the following steps must be taken: (Operators will define step-by-step checklists.)

- Assessment of weather, sea-state, and visibility, forecast out to the anticipated end time of the dive and recovery plus long-range forecasts for the life support capabilities of the HOV in emergency conditions.
- Assessment of the operating area including currents, bottom depth, and the possible presence of seafloor hazards that create an undue risk of damage to or ensnarement of the HOV.
- Assessment of surface traffic, especially in areas of heavy recreational boating and / or fishing activity.
- Establishment of radio and underwater telephone protocol, selection of frequencies and intervals for communications with the HOV, and announcements on the radio guard channels to warn off other shipping.

- Conducting planning meetings, as needed, including the Expedition Leader, the HOV Pilot, the Chief Scientist, and the Scientist(s)/Observer(s) who will be embarking in the HOV, and ship personnel if required.
- Assignment of launch/recovery personnel and the handling system operator. Ensure that all deck personnel are equipped with Personal Floatation Devices (PFDs), hard-hats, and proper footwear and that common signals are understood by all. Verifying clear two-way communications between the deck, the handling system control location, and the bridge watch-keepers.
- Continuous evaluation of conditions and hazards during the dive.
- Establish an unambiguous decision process for an abort of HOV operations and submersible recovery in the event of an emergency, inclement weather, or other unanticipated event.
- Establishment of an area of the deck that is off limits to non-essential personnel.

The institution's Procedures Manual must address unique operations such as multiple simultaneous HOV operations, simultaneous HOV and ROV or AUV operations, submersible rescue drills, and coordination with other research vessels present in the immediate area.

12.4.5 ISM AND SUBMERSIBLE SUPPORT SHIP OPERATIONS

All UNOLS Ocean Class and Global Class ships operate under ongoing safety management systems as per the International Safety Management (ISM) treaty and national implementing laws and regulations. Smaller vessels in the UNOLS fleet are encouraged to comply with ISM to the fullest extent possible.

ISM Procedures for UNOLS vessels already mandate specific written plans for over-the-side science operations, however these may be fairly generic. Ships conducting launch and recovery of HOVs shall also define specific procedures and include them in their reviewed and approved ISM handbooks and other documentation, as required.

- ISM Procedures for HOV operations will include, at a minimum:
- Trained personnel on the support ship required for launch and recovery operations.
- Chain-of-Command and designation of lead personnel during operations.
- Communications between the deck, the handling system control position, the bridge and the HOV.
- Weather and operational safety constraints.

12.4.6 HOV SHIP-MOUNTED HANDLING SYSTEMS

Additional information regarding HOV handling systems is covered in the HOV Safety Standards, Chapter 6.

In general terms, a submersible handling system for the launch and recovery of a HOV is a robust, specially designed piece of precision heavy-lift equipment, built, operated and maintained to exacting standards so that the delicate and human-occupied submersible can be safely and securely hoisted off the deck, placed into the water and recovered after the dive operation--while under full control during the widest possible window of sea-state conditions. The handling system:

- Must meet and be certified under ABS, Naval Sea Systems Command (NAVSEA) system certification, or another appropriate classification society.
- Ship and submersible system operators must make themselves aware of any regulations, promulgated by the USCG or Occupational Safety and Health Administration (OSHA) or classification societies that may require lifting equipment to be “man rated” or “human rated,” and the applicability of such regulations to the anticipated operation and deployment of an HOV.
- Must have operator qualifications and training established by the HOV operating institution.
- The use of a handling system for purposes other than its intended purpose of launching and recovering HOVs requires approval of the certifying authority.

12.5 REQUIRED BY RVSS UNDER CERTAIN CIRCUMSTANCES

None.

12.6 RECOMMENDATIONS AND BEST PRACTICES

12.6.1 ADDITIONAL DESIRABLE CAPABILITIES OF SUPPORT SHIP

A vessel supporting a human occupied submersible should offer adequate space for routine servicing and maintenance of the embarked HOV. This may include such elements as a machine shop, an electronics shop, or a dedicated space on board for these functions. Separate storage space for the submersible’s spare parts should be provided in a secure location where they will not be depleted to meet other routine ship maintenance needs. Since maintenance and battery charging often take place at night, adequate lighting of the HOV work area should be provided. The lighting should be aimed so as to illuminate the submersible while not blinding the bridge watch-keeping personnel.

The ship should be equipped with a multi-beam seafloor sonar mapping system, which can be used to map the operational area before the HOV is deployed. These systems provide data of considerable utility to the science investigators and also enhance safety and security by verifying the depth and topography of the seafloor, the presence of wrecks or other entanglement hazards, and assist in localization of the submersible and positioning of a rescue vehicle during an emergency.

Equipping the vessel with an acoustic Doppler current measuring system is recommended. This sonar can help the operators determine the presence, direction and velocity of undersea currents, before the HOV is launched, and assist the surface vessel in determining environmental factors critical to dynamic-positioning (see next item.)

Dynamic positioning systems will enhance the ability of the support ship to carryout the HOV mission. These systems serve to efficiently keep the vessel within a defined circle of position over the vehicle’s dive site. Some systems permit automatic tracking of the submerged vehicle’s acoustic transponder, moving the surface ship in concert with the submersible. The bridge personnel can thus better dedicate their attention to monitoring systems and watching out for conflicting surface traffic during lengthy dive operations.

12.6.2 TRAINING OF SUBMERSIBLE SUPPORT SHIP PERSONNEL

Submersible support from a surface ship is sufficiently unique as to require specialized training for personnel involved in these operations. This training should include the Master, the bridge watch-keeping officers, the sonar/underwater communications and tracking operators, swimmers (if used), deck personnel, and handling system operators. As required for seagoing personnel under ISM, a syllabus for training shall be established and sign-off documents of training milestones and qualifications shall be maintained.

Emergency exercises and drills shall be held to verify the readiness of the rescue and emergency equipment and the personnel tasked with its employment. Pre-dive briefs and post-dive debriefs along with post exercise critiques are useful practices for advising personnel about performance needs and opportunities for improvements. Institutions operating HOVs are encouraged to share experiences through professional organizations, technical journals and publications, submersible operations sessions at professional meetings.

13. STABILITY

13.0 INTRODUCTION

Stability standards, tests, and information are covered in this section. In each instance, the presentation is divided into a brief background of the subject at hand and its applicability to inspected and/or uninspected oceanographic research vessels on either a required or recommended basis.

A basic understanding of the principals of Ship Stability is essential to the safe operation of any vessel, but particularly so for the operation of a research vessel which can be subject to greatly varying deck loads, towing loads and crane loads, all having an impact on stability. For these reasons it is important that the vessel operators understand the basic concepts of stability and that the operating institutions seek and use the services of a qualified Naval Architect whenever stability questions arise.

A vessel's stability characteristics are based on its hull form, sail area (windage profile), weight (displacement), center of gravity, and free surface of liquids on board. Changes in any of these characteristics will impact the vessel's stability.

Hull form is rarely changed during the life of a vessel. If a hull form change is needed for a particular operation, e.g., addition of a transducer pod, additional sea chests, etc., a naval architect can evaluate potential impacts to stability.

Sail area can change from voyage to voyage, most commonly by the addition of science or equipment vans. Some vessel's stability booklets account for the addition of a van by including an alternate required GM curve based on the additional windage area. If a vessel's existing stability documentation does not account for planned increases in sail area, a naval architect should be consulted to verify that stability criteria can be met.

Weight and center of gravity are typically determined by calculations that add loads to an approved lightship value (determined via stability test). Changes to the lightship weight must be documented in accordance with the guidance given in section 13.3.1 below for inspected research vessels.

Liquids in tanks can reduce a vessel's stability. Stability letters and booklets typically document tank-loading requirements for a specific vessel including the number of tanks that are allowed to be slack at any one time.

Certain aspects of research vessel operations have adverse effects on stability and must be considered in the form of guidance in the Trim and Stability Booklet or by guidance provided by a competent naval architect:

- Over-the-side handling loads if of significant magnitude
- Towing loads, such as from an A-frame or J-frame
- Icing loads

Both required and recommended stability standards should, in general, be viewed as being minimal. In applying them to the design and operation of individual vessels, they should be upgraded as appropriate considering any unique aspects of the vessel's mission requirements and/or design features pertinent to stability.

STABILITY STANDARDS: for the design, construction, and operation of oceanographic research vessels may be placed into one of two categories:

- Standards required for inspected and certain uninspected vessels, and
- Those recommended for the remaining uninspected vessels.

Required standards have been set forth by the USCG and by International Conventions (see next section). Generally these take the form of minimum righting energy requirements, minimum GM, and in the case of larger (inspected) vessels, damage stability requirements.

Additionally, vessels engaged in towing and lifting operations must meet additional criteria. Vessels that operate in areas where ice accretion is possible should meet stability criteria with icing loads.

Uninspected vessels with an assigned load line, although not subject to the requirements of Subchapter S, must still demonstrate adequate stability. The requirements of Subchapter S may be used for guidance. Alternatively, the guidelines for fishing vessels may be used, although these criteria may be more demanding than those outlined for oceanographic research vessels in Subchapter S.

STABILITY TESTS: include formal inclining experiments and, in some cases, rolling period tests. Inclining experiments are conducted to obtain “as inclined” data from which “light ship” displacement and centers of gravity can be derived to define the “light ship condition.” This experiment is normally conducted under the auspices of a qualified Naval Architect, and witnessed by the US Coast Guard or its designee, commonly ABS. Various loadings can then be added to this basic condition to obtain prescribed “service conditions” and associated stability information. This becomes the basis for a “Stability Letter” or “Stability Book”.

STABILITY INFORMATION: includes 1) specific information pertinent to the safe operation of a specific vessel and 2) general information, the understanding of which promotes the safe operation of vessels in a more general sense. Specific information is contained in “Stability Booklets” and “Stability Letters,” or their equivalents, which are carried on board. General information should also be carried on board and made readily available to all personnel on board having duties or functions, which may affect the vessel’s stability.

13.1 <u>REFERENCES</u>

Principal references include Title 46 CFR 170 - Subchapter S, the International Maritime Organization (IMO) Code of Safety For Special Purpose Ships Resolution A.534 (13), and the Commercial Fishing Vessel regulations (46 CFR 28). The last reference concerns commercial fishing vessels but contains much information of value for uninspected oceanographic research vessels.

13.2 <u>REQUIRED BY REGULATIONS FOR ALL VESSELS</u>

Requirements are based on sizes and service.

13.3 REQUIRED REGULATIONS FOR CERTAIN VESSELS

13.3.1 INSPECTED VESSELS

Inspected oceanographic vessels, including motor-driven vessels of 300 and over gross registered tons and steam ships over 65 ft long, must comply with stability criteria set forth in Title 46 CFR, Subchapter S, Parts 170 and 173.

New inspected oceanographic vessels are required to be inclined in accordance with inclining experiment details set forth in 46 CFR, Subchapter S, Part 170, Subpart F.

Any research vessel should be re-inclined any time a significant change in magnitude and/or location of a “light ship” weight occurs or there is a major change in hull shape. For inspected vessels the Coast Guard, in MTN 04-95, requires the following actions based on the amount of aggregate (magnitude of weight removed and weight added) weight change:

- Weight-moment Calculation only when the aggregate weight change does not exceed 2% of the lightship weight and the Longitudinal Center of Gravity (LCG) does not shift by more than 1% of the Length Between Perpendiculars (LBP).
- Deadweight Survey Only when the aggregate weight change is between 2-10% or LCG shifts by more than 1% of LBP
- Full Stability Test when the total aggregate weight change exceeds 10%.

Inspected oceanographic vessels are required to carry the following stability information on board as set forth in Title 46 CFR, Subchapter S, Part 170, Subpart D:

- Stability Booklet (Section 170.110)
- Stability Letter (Section 170.120)
- Lifting information for vessels engaged in lifting operations (Section 170.125)

The above reference does not specify that vessels engaged in towing are required to carry towing information pertinent to stability. Nevertheless, it is recommended that these vessels carry this information.

13.3.2 CLASSED VESSELS

Uninspected oceanographic vessels engaged in international or foreign voyages and subject to load line assignment, as described in Chapter 14, are treated as inspected vessels with regard to stability tests and stability information.

13.3.3 SOLAS VESSELS

An uninspected vessel subject to SOLAS requirements, i.e., over 500 GT Convention Tonnage yet under 300 GRT domestic tonnage will be subject to load line requirements and SOLAS stability requirements. The SOLAS requirements for vessels under 100m (328 ft) in length are not well defined, but compliance with the IMO Code of Safety For Special Purpose Ships would be a reasonable minimum requirement. For a load line, ABS would seek compliance with a “recognized” stability standard such as those outlined in Subchapter S for oceanographic vessels or, alternatively, the requirements contained in IMO’s Code of Safety For Special Purpose Craft.

An inspected vessel subject to SOLAS must meet the stability criteria of Subchapter S.

13.3.4 UNINSPECTED VESSELS

Other uninspected vessels that are not in “class” have no required stability standards unless they have an assigned load line, in which case ABS will require compliance with IMO A167/A206 with A562 or “recognized” criteria suitable to vessel type, such as Subchapter S criteria for oceanographic research vessels. Standards for these vessels under the RVSS are described below.

13.3.5 OTHER REGULATIONS

None.

13.4 REQUIRED UNDER THE RVSS

It shall be the Master‘s responsibility to maintain the vessel in a satisfactory stability condition at all times through control and management of liquid, solid and science loads. It is the Operating Institution‘s responsibility to insure that (1) current stability data are correct and available to the Master, (2) changes to the vessel are controlled and managed to insure compliance with all regulatory requirements and the recommendations of this section.

As a minimum, a deadweight survey shall be performed every five years. If the deadweight survey shows a shift in LCG over 1% and/or a change in weight over 10%, the vessel must undergo a complete stability test (inclining).

Un-classed and uninspected oceanographic vessels, while not required by regulation to undergo inclining experiments, will be inclined and have sufficient data and documentation to determine safe loading. These vessels will carry operators’ directives containing specific stability information equivalent to that required for inspected vessels.

13.5 REQUIRED BY RVSS UNDER CERTAIN CIRCUMSTANCES

NONE.

13.6 RECOMMENDATIONS AND BEST PRACTICES

Uninspected vessels may be divided into two groups: 1) vessels from 79 feet to 328 feet in length, and 2) vessels shorter than 79 feet.

Recommended intact stability standards for group (1) vessels are contained in IMO’s Code of Safety For Special Purpose Craft, which invokes IMO A167/A206 with A562

No firm criteria exist for recommended stability standards applicable to group (2) vessels. Again, criteria set forth in the fishing vessel regulations provide useful guidelines but one must be cautious in their direct use to establish stability standards for these small vessels and it may be necessary to increase IMO Resolution A.168 (ES.IV) criteria. While the basis for this increase has not been established, the practice of some European countries is to increase all criteria by twenty percent.

It is recommended that all uninspected oceanographic vessels carry general stability information on board. Consideration should be given to following the regulations for commercial fishing vessels in 46 CFR 28.

Instructions and data contained in Stability Booklets and Stability Letters, or their equivalents, should be set forth in a clear and concise manner to facilitate stability analysis either by hand or by use of a personal computer. In this regard, it is recommended that vessels be provided with user-friendly stability software for intact and damaged conditions (if feasible) and on board personal computers.

The RVOC Safety Training Manual contains chapters on Stability and on Load Lines and Watertight Integrity that could be used to help in understanding the principals covered by regulations and guidelines. The information provided includes diagrams and example calculations as well as useful safety practices that will minimize or eliminate adverse effects on stability. The North Pacific Fishing Vessel Operators Association (NPFVOA) also publishes a safety manual and a series of videotapes that are excellent training resources with regard to stability on smaller vessels.

13.6.1 RECOMMENDED READING

For those interested in learning more about the basics of vessel stability, the following publications are recommended:

- NPFVOA "Vessel Safety Manual". Available at: http://npfvoa.org/pages/materials.html
- Transport Canada, "A guide To Fishing Vessel Stability". Available at: http://bcseafoodalliance.com/BCSA/SAFETY_TRAINING.html
- "Stability and Trim of Fishing Vessels for Skippers & Second Hands" by J. Anthony Hind, Published by Fishing News (Books) Ltd.

14. LOAD LINES AND WATERTIGHT INTEGRITY

14.0 INTRODUCTION

This chapter provides guidance regarding the requirements for the assignment of load lines as well as the closely related topic of maintenance of watertight integrity. Both items are extremely important to vessel safety in that they are designed to prevent conditions of overloading and/or down flooding that could lead to vessel loss.

Since the assignment of a load line to a vessel is almost universally done as part of the original construction or major conversion of a vessel, the material contained in this chapter serves mainly as background information to the operator. However, it is important that vessel operation conforms to load line restrictions and maintains vessel watertight integrity as identified and discussed herein.

The regulations regarding load lines and watertight integrity vary depending on the type and service of the vessel; however, under USCG requirements, the substantial majority of vessels in the UNOLS system will require a load line.

This chapter also provides information on stability and watertight integrity for vessels not required to have load lines because of their service or size. Such information may be of particular use to institutions chartering smaller, uninspected craft to support oceanographic research operations. A list of references is presented in section 2 of this chapter.

The basics of the load lines requirements are effectively addressed and summarized by a publication of the U.S. Coast Guard's Naval Architecture Division entitled "Load Line Regulations." Significant sections of this article, which is available on the Coast Guard's web site at http://www.uscg.mil/hq/g-m/mse/mse2-loadlines.htm have been reproduced below.

LOAD LINES: Load line marks are affixed to vessel side shell plating amidships and indicate the maximum drafts to which the vessel can be lawfully loaded in several different maritime venues. These load line marks are also related to freeboard. The distance at the side of a vessel measured vertically from the edge of its "freeboard deck" to the upper edge of a particular load line mark represents "statutory freeboard".

LOAD LINE CERTIFICATE: Domestic load line certificates are issued by the American Bureau of Shipping (ABS) on behalf of the Coast Guard.

International load line certificates for U.S. vessels, in accordance with the International Maritime Organization (IMO) International Convention on Load Lines (ICLL), are issued by the American Bureau of Shipping (ABS), or the vessel's classification society (if approved by the Coast Guard).

The Coast Guard itself does not issue load line certificates other than a "single voyage load line exemption certificate." This allows a non-load line vessel to make a "positioning voyage" (transit from one port to another) to relocate to a new place of work or go into a shipyard for an overhaul. The local Coast Guard Marine Safety Office (MSO) at the port of departure issues such exemption certificates. "Round trip" exemptions are not issued; the return voyage requires a new exemption certificate issued by the local MSO.

Load line information is given in the vessel's "Load Lines Certificate." This document certifies to the correctness of the load line marks and that the vessel is in compliance with all applicable requirements. It also provides a diagram of the assigned load line marks and the freeboard deck line, locating the marks with reference to this line in terms of assigned freeboard, as well as stating any conditions, restrictions and exemptions that the vessel shall observe. The validity of these certificates is reviewed annually in load line inspections and every five years in more thorough load line surveys. During these inspections and surveys, ABS is particularly concerned with the following items:

- Freeing ports - Drainage must be adequate from all weather deck areas and not blocked. Particular attention is given to potential water-trapping areas such as wells formed by structure or pockets formed by cargo or equipment.
- Sill heights - Access openings in superstructure and deck houses may have sills that are less than 15 inches, 15 inches, or 23 ½ inches depending on location.
- Vent and hatch coaming heights and fittings above the assigned freeboard deck are carefully checked.
- Watertight doors and fittings - Any penetration of watertight boundaries must be as high and as far inboard as possible. As a minimum, three dogs are required on a circular fitting and four on an oblong fitting.
- Subdivision in general - Subdivision requirements must be met as applicable for vessels being inspected/surveyed. These requirements are the same as for those passenger vessels carrying 400 or fewer passengers and include provisions for a collision bulkhead.

A load line map showing zones and seasonal areas of the world's oceans provides the Master with information regarding the maximum draft amidships to which his vessel can be loaded during various segments of a cruise. The vessel must be loaded at the beginning of a cruise so that at no time during the cruise will the applicable seasonal/zone mark be submerged.

Freeboard is vitally important on smaller vessels not subject to load line requirements. Consequently, these vessels should carry information on board regarding maximum drafts amidships to which they can be loaded safely.

ORIGIN OF LOAD LINES: Historically, the concept of a load line evolved during the 1870s in Great Britain to guard against merchant ships being overloaded. Lloyd's Register established a minimum freeboard requirement for its classed ships, to ensure that a ship had good reserve buoyancy in heavy boarding seas. After considerable persuasive efforts by Samuel Plimsoll, Parliament extended the requirement to all British merchant ships; thus was born the "Plimsoll mark."

Similar load line requirements were adopted by other maritime nations, until they were internationally standardized in the Load Line Convention of 1930. The present International Convention on Load Lines (ICLL) was drawn up in 1966 (in force since 21 July 1968), and modified by the Load Line Protocol of 1988 (in force since 3 February 2000). The Convention is administered by the IMO, a specialized agency of the United Nations. Vessels of countries signatory to the Convention are required to have an ICLL certificate for international voyages. As of April 2005, 155 countries (representing 98.49% of world tonnage) are signatory to the 1966 ICLL, and 74 countries (representing 66.70% of world tonnage) are signatory to the 1988 Load Line Protocol.

The United States is a signatory nation to both the original 1966 ICLL and the 1988 LL Protocol, and therefore load line requirements for U.S. vessels engaged on international voyages are stipulated in the Convention.

Modern load line requirements also ensure the watertight integrity of a vessel below its waterline (i.e. hull penetrations) and the weathertight integrity above its waterline (i.e. critical openings in the superstructure, deckhouses, cargo hatches, etc). The requirements also provide for crew safety on deck by specifying dimensions and locations of guardrails and walkways.

Load line regulations for U.S. vessels operating solely on domestic routes are developed by the Coast Guard, and reflect the less-severe operating environments of coastwise service. Special load line standards apply to vessels operating on the Great Lakes.

MINIMUM STATUTORY FREEBOARD: The minimum “statutory freeboard” is measured to the uppermost load line mark applicable for a specific maritime venue (for example, there are different marks for normal ocean waters vs. fresh waters) taking into account conditions (as discussed below) of 1) reserve buoyancy (buoyancy which can be supplied by the hull and watertight superstructure above the water line) and height of weather deck above this water line, 2) subdivision, and 3) hull strength. In the United States, ABS is the load line assigning authority on behalf of the U.S. Coast Guard.

Condition 1) - reserve buoyancy -- provides for a minimum statutory freeboard by specifying the maximum draft amidships based on the degree of reserve buoyancy and height of weather deck above the waterline which have been found adequate from past experience in providing for vessel and personnel safety. The basic load line mark thus determined, which passes through the center of the load line disk, fixes the “minimum summer freeboard” in salt water. A series of adjacent load line marks above/below this basic mark provide for decreased/increased minimum statutory freeboard when the vessel is operating during seasons and in ocean areas where less/more severe weather-sea conditions are likely to be encountered than assumed in loading the basic mark. Freshwater marks above the basic mark may be authorized for a vessel in ocean service. If such is the case, care must be taken in loading to these marks as these allowances require the vessel to be in virtually fresh water with a specific gravity of 1.000. If the vessel is in brackish water, proportional use of the fresh water allowances must be based on the actual water specific gravity and standard salt-water specific gravity of 1.025.

Condition 2) - subdivision -- concerns vessels whose hulls are subdivided by transverse watertight bulkheads to limit the extent of damage by flooding due to hull penetration -- such damage causing sinkage, trim and reduction of stability. Subdivision of a vessel is either required or made on a voluntary basis -- it being required for inspected oceanographic vessels per reference 3. In design, the location of these bulkheads along the length of the vessel is based on the vessel floating at a specific water line called the “subdivision load line.” The vessel is said to meet a “one compartment standard of subdivision” if subdivision is such that the flooding of any one main compartment can be sustained without submerging the so-called “margin line” just below the freeboard deck while retaining adequate after-damage, or residual, stability, The validity of this or higher standard of subdivision is dependent on the subdivision load line mark being at or above the waterline of the undamaged vessel. A vessel subject to these requirements cannot be loaded deeper than this mark. Note, however, that the subdivision mark has no meaning and is not affixed to the vessel if it lies above other load line marks. Conversely, any marks above the subdivision mark become meaningless and are not affixed to the vessel. In this case, the minimum statutory freeboard is based on the subdivision load line mark.

Condition 3) - hull strength -- refers to the maximum draft amidships to which a vessel can be loaded from a hull strength point of view -- this draft being called the "scantling draft" (scantling being the cross-section dimensions of plates and shapes comprising the hull girders). The authorizing authority must be satisfied that the hull strength is adequate for the minimum freeboard assigned from consideration (1) or (2). If for any reason the scantling draft mark lies below other marks, these marks are meaningless and not affixed to the vessel. In this instance, the minimum statutory freeboard would be the scantling draft freeboard.

In addition to the above considerations, a vessel's freeboard has an important affect on its intact stability curve. As freeboard increases, the freeboard deck edge is immersed at greater angles of inclination, which increases the maximum righting arm and angle of occurrence. The result is increased righting energy and resistance to heeling by wind/wave action. This consideration is extremely important for smaller vessels. In general, vessels with higher freeboards have better performance in stormy weather and are less affected by water on deck.

WATERTIGHT INTEGRITY: The basic concept of watertight integrity is to ensure that the entire vessel does not flood with water and sink. The watertight integrity of a vessel is essential to calculations of required freeboard, stability and subdivision characteristics, so it plays an important role in causing the vessel to remain upright in operation through waves and weather.

During the construction of a vessel, appropriate mechanisms must be incorporated to allow for secure and efficient closure of openings in watertight areas of the vessel such as the hull, watertight bulkheads and sections of the superstructure considered watertight. Examples of such openings include hatches, side openings, and internal watertight doorways.

In order to maintain the watertight integrity of vessels, these watertight closures must be utilized as required, properly operated, and be objects of proper maintenance. It should also be remembered that some watertight doors are set to close automatically under certain conditions and that such doors can close with potentially harmful force.

Watertight integrity is vital to vessel safety -- in December 1978, the charter vessel *M/V Holoholo*, under charter for oceanographic work, was lost with all hands. According to National Transportation Safety Board (NTSB) Report Number: MAR-80-15, the primary reason for this loss was loss of watertight integrity.

14.1 <u>REFERENCES</u>

The following is a list of the documents that were referenced by this chapter, including the regulations and guidance regarding load lines and watertight integrity for various types of vessels. As these documents may be updated or amended periodically care should be taken that the latest edition is used.

Regulations, Standards and Related Information:

- USCG Article, “Load Line Regulations“, http://www.uscg.mil/hq/g-m/mse/mse2-loadlines.htm, accessed August 2006.
- 46 USC Chapter 51.
- IMO International Convention on Load Lines (ICLL), 1966.
- Load Line Protocol of 1988.
- 46 CFR Subchapter E, “Load Lines” (Parts 41 thru 47).
- Navigation & Vessel Inspection Circulars (NVICs) pertaining to Load Lines:
- NVIC 7-94 Guidance on the Passenger Vessel Safety Act of 1993.
- NVIC 8-91 Initial & Subsequent Inspection of Un-certificated Offshore Supply Vessels, Including Liftboats.
- NVIC 1-88 (CH-1) International Load Line Certificates for Small Passenger Vessels Operating Within 20 Miles of the Mouth of a Harbor of Safe Refuge (Change 1).
- NVIC 1-88 International Load Line Certificates for Small Passenger Vessels Operating Within 20 Miles of the Mouth of a Harbor of Safe Refuge.
- NVIC 10-86 Equivalence to Minimum Bow Height Requirements for Load Line Assignment.
- NVIC 8-86 Coast Guard Relationships with Classification Societies for U.S. Flag Vessels.
- USCG Marine Safety Manual, Volume 4, Chapter 6, Section F, “Load Lines”.
- Load Line Technical Manual, USCG-M-1-90, prepared by ABS, 1990 (See also annotated online version with more recent but incomplete updates).
- USCG, Load Line Policy Notes.
- 46 CFR 188.05-35 (from Subchapter U - Oceanographic Vessels).
- 46 CFR 170-174, Subchapter S (Subdivision and Stability).
- American Bureau of Shipping (ABS). “Rules for Building and Classing Steel Vessels”.
- International Convention for the Safety of Life at Sea (SOLAS), 1974 (and see amendments).
- 46 CFR 28 Subpart E (from Subchapter C - Uninspected Vessels).
- 46 CFR 179.210, et seq. (from Subchapter T - Small Passenger Vessels (Under 100 Gross Tons)).
- American Boat and Yacht Council, Inc. (ABYC), “Safety Standards for Small Craft“.
- 33 CFR 183 Subpart C (from Subchapter S - Boating Safety).
- 46 CFR 69.117, (from Subchapter G - Documentation and Measurement of Vessels).
- 46 CFR 72.05 (from Subchapter H - Passenger Vessels).

- 46 CFR 78.15 and 78.17 (from Subchapter H - Passenger Vessels).
- 46 CFR 97.15 (Subchapter I - Cargo and Miscellaneous Vessels).
- 46 CFR 170.248 and 171 (Subchapter S - Subdivision and Stability).
- NTSB Report Number: MAR-80-15. Sinking of the *M/V Holoholo* in the Pacific Ocean, near the Hawaiian Island, December 1978.
- USCG. Marine Safety Manual - Volume 5 - Chapter 7 - "Load Line Investigations".
- "Load Line Assignment" by Cleary and Ritola; Society of Naval Architects and Marine Engineers (SNAME); 1980.
- "Load Line Assignment" by Robert T. Ryan; Principles of Naval Architecture; SNAME; 1967.
- Some additional sources of information on details of watertight integrity include:
- 46 CFR 42.15 (Subchapter E), entitled "Conditions of Assignment of Freeboard," contains details on doors, hatches, machinery space openings, miscellaneous openings, ventilators, air pipes, cargo ports, scuppers, inlets and discharges, side scuttles, and freeing ports.
- 46 CFR 69.117 (Subchapter G) contains information on tonnage openings.
- 46 CFR 72.05 (Subchapter H) contains information on windows and air ports for passenger vessels.
- 46 CFR 78.15 and 78.17 (Subchapter H) contain information on doors to be closed at sea and closing appliances for passenger vessels.
- 46 CFR 97.15 (Subchapter I) contains information on hatches and other openings for cargo and miscellaneous vessels.
- 46 CFR 170.248 and 171 (Subchapter S) contain information on watertight bulkhead doors and vessel subdivision.
- 46 CFR Subchapter C Part 28 Subpart E contains regulations for commercial fishing vessels on stability and watertight integrity.

14.2 <u>REQUIRED BY REGULATIONS FOR ALL VESSELS</u>

There are no regulations regarding load lines or watertight integrity that apply to all vessels.

The U.S. load line regulations are found in 46 CFR Subchapter E, "Load Lines" (parts 41 thru 47). These regulations were originally derived from the Coastwise Load Line Act and the International Voyage Load Line Act, and also incorporate the requirements of the ICLL. The statutory basis for the regulations comes from chapter 51 of Title 46 of the U.S. Code (46 USC chapter 51).

However, some of the regulations have been superseded by the recodification of 46 USC in 1988, which revamped certain load line requirements (particularly vessel applicability and penalties for overloading). Therefore, until the CFR regulations are revised, 46 USC Chapter 51 must also be consulted.

Similarly, the ICLL is subject to periodic amendment via the LL Protocol (the most recent revisions went into force on 1 January 2005). Therefore, the most current revision of the ICLL is applicable for new vessels.

Also, special load line policies have evolved to meet new vessel designs and configurations that did not exist when the original regulations were developed (for example, liftboats). These special situations are addressed in several Navigation & Vessel Inspection Circulars (NVICs) and Chapter 6 of the USCG Marine Safety Manual. (Note: the Marine Safety Manual has not been recently updated; refer to the discussion below concerning the “Load Line Policy Notes”).

In general, most commercial U.S. vessels more than 79 feet (24 m) in length must have a valid load line certificate when venturing outside the U.S. Boundary Line, whether on a domestic or international voyage (even on “voyages to nowhere” that return to the same domestic port of departure). There are a few limited categories of vessels excluded from needing a load line; refer to 46 USC 5102 for specifics.

The design process for new vessel construction or major modification of a vessel should address all applicable load line and watertight integrity requirements.

Masters of oceanographic vessels subject to load line requirements have the responsibility to maintain load line certificates and current survey reports on board their vessels and to comply with all terms and conditions stated in these documents. Further, they should keep logbook records as prescribed in 46 CFR Subchapter E Section 42.07-20.

Masters of other oceanographic vessels not subject to these requirements should comply with load line, or maximum draft amidships, information supplied to the vessels in lieu of load line certificates.

Masters of all oceanographic vessels have the responsibility for maintaining the watertight integrity of these vessels. This responsibility involves the careful maintenance of all watertight closures and associated systems and the assurance that their functions, operation and status in various normal and emergency conditions are clearly understood by members of the crew and science party.

14.3 REQUIRED REGULATIONS FOR CERTAIN VESSELS

14.3.1 INSPECTED RESEARCH VESSELS

Inspected vessels that do not represent special exceptions are subject to the load line requirements as set forth in 46 CFR Subchapter E. Also note that in 46 CFR 188.05-35 (from Subchapter U referring to Oceanographic Research Vessels) it indicates that “Certificated vessels shall be subject to the applicable provisions of the Load Line Acts, and regulations in Subchapter E (Load Lines)”.

Some exceptions are:

- Vessels that do not make foreign or international voyages by sea.
- Vessels that make voyages exclusively on the Great Lakes.

- New vessels of less than 79 feet in length.
- Existing vessels under 150 gross tons, which did not require a load line at the time of construction.

NOTE: *A question often arises as to whether a vessel engaged in oceanographic research upon international waters is on an international voyage if the port of departure, port of return and any intermediate ports are all domestic. Typically, voyages beginning from and terminating at domestic ports are considered domestic voyages, even if international waters are traversed. In certain cases however, the Coast Guard has previously construed voyages to certain ocean dumpsites, offshore weather monitoring stations, etc. to represent arrivals at international destinations, making the voyage an international one. Whether or not some new offshore research area would be considered an international destination should be checked on a case-by-case basis with the Coast Guard office nearest to the departure port.*

Inspected vessels are also subject to watertight subdivision requirements, such as those set forth in reference 46 CFR Subchapter S and some watertight requirements which are included in 46 CFR, Subchapter E, Subpart 42.15, "Conditions of Assignment of Freeboard."

14.3.2 CLASSED VESSELS

U.S. flag vessels will be classed by ABS and, in addition to all other applicable Regulatory Body requirements, must comply with the applicable set of ABS "Rules for Building and Classing Steel Vessels". These Rules contain requirements pertaining to load lines, as well as stability, subdivision and watertight integrity.

14.3.3 SOLAS VESSELS

Regulations from the SOLAS convention (including all current amendments) apply to vessels over 500 GT (international). Vessels less than 500 GT, which do not carry more than 12 passengers, are generally exempt. These Regulations contain requirements pertaining to stability, subdivision and watertight integrity.

14.3.4 UNINSPECTED VESSELS

There are few specific U.S. regulations applicable to watertight integrity for uninspected oceanographic research vessels that are below 500 GT (international). See requirements under RVSS below.

14.3.5 OTHER REGULATIONS

For vessels less than 65 feet in length, all standards relating to capacity or watertight/weathertight integrity in the "Safety Standards for Small Craft" published by ABYC should be met. For watertight/weathertight integrity issues see Sections H-3, H-4, and H-27. Also, applicable safety requirements from the Motorboat Act of 1940, including all current amendments, must be followed.

For boats under 26 feet in length the boat load capacity standards outlined by Section H-5 of the "Safety Standards for Small Craft" published by ABYC should be observed. (See also 33 CFR 183 Subpart C - Safe Loading).

14.4 <u>REQUIRED STANDARDS UNDER RVSS</u>

UNOLS vessels will be designed to and maintained in accordance with the applicable load line and watertight integrity requirements as set forth in US regulations, international conventions and accepted marine standards for the size and operating area of the vessel.

While not legally required for uninspected oceanographic research vessels that are below 500 GT (international), 46 CFR, Part 28, Subpart E (Stability) and 46 CFR 179 (Subdivision, Damage Stability and Watertight Integrity) may provide useful guidance. Vessels chartered to do oceanographic research work should meet, as a minimum, the requirements of 46 CFR Subchapter C, Part 28, Subpart E.

14.5 <u>REQUIRED BY RVSS UNDER CERTAIN CIRCUMSTANCES</u>

NONE.

14.6 <u>RECOMMENDATIONS AND BEST PRACTICES</u>

Operations managers or Marine Superintendents shall oversee and assist the Master in fulfilling the above listed responsibilities.

Uninspected vessels exempted from load line regulations, including those having state boat registration numbers and not sailing in foreign or international waters, should strive to adhere to load line and related requirements given in 46 CFR Subchapter E to the extent feasible for vessels of their size. These vessels should be surveyed in a manner paralleling the annual and five-year periodic surveys made in reviewing the “Conditions of Assignment of Freeboard” for vessels requiring load line assignments.

Further information is provided in:

“LOAD LINE TECHNICAL MANUAL”: The U.S. Coast Guard commissioned the American Bureau of Shipping (ABS) to prepare a report that integrated U.S. load line regulations & policies, ABS and International Association of Classification Societies (IACS)interpretations, IMO circulars, and the International Convention on Load Lines (ICLL) into a single reference document.

The “Load Line Technical Manual” is the result of that effort. It sets forth the technical procedures for evaluating, calculating and assigning ICLL load lines, using USCG and ABS policies where the Convention leaves certain requirements “to the satisfaction of the Administration” or is open to interpretation.

The Technical Manual applies to U.S. vessels seeking an international ICLL assignment or a domestic U.S. load line assignment for unrestricted voyages by sea; it does not cover U.S. load line regulations for other types of domestic voyages (such as coastwise or Great Lakes).

“LOAD LINE POLICY NOTES”: The “Load Line Policy Notes” supplement Chapter 6.F, “Load Lines,” of the Marine Safety Manual (Vol. IV).

The LL Policy Notes encompass all the current USCG load line policies that have evolved since the previous (1990) revision of Marine Safety Manual (MSM) Chapter 6.F.

The LL Policy Notes also include expanded discussions and clarifications for both domestic U.S. and international ICLL load line regimes.

15. ELECTRICAL AND MARINE ENGINEERING

15.0 INTRODUCTION

The intended purpose of this chapter is to address relevant Marine and Electrical Engineering practices on vessels in the UNOLS fleet and certain aspects of these practices as they pertain to setting up and utilizing scientific or science-related equipment on vessels. Scientific or science-related equipment installations on vessels may be unique, non-standard (from a marine environment perspective) and/or temporary. Particular attention should be given to such specialized installations, since the equipment is frequently experimental in nature and the researchers providing and using it are generally not familiar with accepted marine and electrical engineering practices. Such equipment may have been designed for operation in a shore-based environment; whereas, in a shipboard application additional environmental factors may be present, such as: moisture, motion, vibration, temperature variations, and power supply fluctuations. For example, one area of confusion and occasional problems entails equipment designed for use with grounded neutral electrical systems (the norm for office and laboratory equipment) on ships with ungrounded distribution systems.

BASICS OF MARINE ENGINEERING: Marine engineering encompasses the design, operation and maintenance of a vessel's propulsion and auxiliary machinery as well as the mechanical, electrical, fluid (fuel, steam, hydraulic, water, etc.), and control systems aboard a vessel. Additionally, systems engineered for research vessels must support equipment used for research purposes such as electrical and hydraulic distribution systems needed for specialized winches and cranes, and sometimes, special refrigeration equipment used for science purposes.

BASICS OF ELECTRICAL ENGINEERING: The textbook "Marine Engineering" published by the Society of Naval Architects and Marine Engineers (SNAME) includes the following with regard to shipboard electrical systems:

"All ships have an electric power plant similar to a land-based electric utility . . . Electric power is required for propulsion, propulsion system auxiliaries, deck machinery, illumination, heating, ventilation, air conditioning, stores and cargo refrigeration, galley, fresh water and sanitary systems, and safety and casualty control such as fire and bilge systems, fire detection and alarm systems, and remotely operated watertight and firescreen doors. Power must also be supplied for interior communication systems, controls, radio communications, radar, and other electronic aids to navigation and shipboard operation."

The above list of common electrical loads is more applicable to larger vessels. Electrical system requirements for smaller research vessels may be more simply structured to support both the basic needs of the vessel as well as any requirements of the vessel's research mission.

On research vessels, power must also be supplied for scientific work, in addition to all of the above functions. Such "scientific" power must often be especially "clean" and/or delivered from uninterruptible sources. Scientific power may also entail different voltages that must be transformed from those available on the ship's service electrical bus.

15.1 REFERENCES

The following is a list of the documents that are referenced by this chapter, including regulations and guidance regarding Marine and Electrical Engineering practices. These documents are updated or amended periodically, so a check should be made to ensure that the latest edition is used.

- 46 CFR Subchapter F - Marine Engineering
- 46 CFR Subchapter J - Electrical Engineering
- 46 CFR Subchapter H - Passenger Vessels
- 46 CFR Subchapter I - Cargo and Miscellaneous Vessels
- 46 CFR Subchapter U - Oceanographic Research Vessels
- 46 CFR Subchapter D - Tank Vessels
- 46 CFR Subchapter T - Small Passenger Vessels (Under 100 Gross Tons)
- 46 CFR Subchapter C - Uninspected Vessels
- American Bureau of Shipping (ABS). "Rules for Building and Classing Steel Vessels"
- International Convention for the Safety of Life at Sea (SOLAS), 1974 (and all amendments)
- American Boat and Yacht Council, Inc. (ABYC), "Safety Standards for Small Craft"
- Federal Motorboat Act of 1940 (and all amendments)
- 46 CFR 197, Subpart B - Commercial Diving Operations
- Marine Engineering, edited by Harrington, Society of Naval Architects and Marine Engineers, 1992
- UNOLS "RVOC Safety Training Manual" Chapter One, http://www.unols.org/publications/manuals/safe_man.html, accessed January 2008
- Other Relevant Standards (not expressly referenced herein):
- IEEE 45, "Recommended Practice for Electrical Installations on Shipboard"
- National Fire Protection Association, "The National Electrical Code"

15.2 REQUIRED BY REGULATIONS FOR ALL VESSELS

Nearly all UNOLS vessels are subject to marine and/or electrical engineering regulations promulgated by the Coast Guard and other regulatory bodies, as well as possibly classification rules. Due to differences in size, mission and areas of operation, not all the same regulations and rules necessarily apply to all UNOLS vessels. Thus, it is important that a careful analysis be made to ascertain which ones apply to your particular vessel.

All applicable marine and electrical engineering regulations, as well as recommended standards (even if they are not legally binding requirements), must be addressed by the design process for new vessel construction or major modification of a vessel.

For existing vessels, as a general rule, any significant changes to the vessel's machinery or electrical systems must be designed or reviewed for compliance with applicable regulatory and classification requirements by a qualified naval architect and/or marine engineer, preferably one who has relevant experience with research vessels. Operational staff who are not similarly qualified can not assume they understand all the implications and effects of what they may perceive as a simple modification; remember the "rule of unintended consequences."

15.3 REQUIRED REGULATIONS FOR CERTAIN VESSELS

15.3.1 INSPECTED VESSELS

Inspected vessels are generally subject to the marine engineering regulations of 46 CFR Subchapter F – Marine Engineering and electrical engineering regulations of 46 CFR Subchapter J – Electrical Engineering. This is specifically required for vessels regulated by any of the following subchapters:

- 46 CFR Subchapter H - Passenger Vessels,
- 46 CFR Subchapter I - Cargo and Miscellaneous Vessels,
- 46 CFR Subchapter U - Oceanographic Research Vessels, and
- 46 CFR Subchapter D - Tank Vessels (except as specifically modified by that subchapter).

Vessels that are regulated by 46 CFR Subchapter T - Small Passenger Vessels (Under 100 Gross Tons) are subject to the marine and electrical engineering requirements as expressly identified within that chapter.

Oceanographic research vessels, which are subject to 46 CFR Subchapter U, are subject to certain additional regulations. For example, Subchapter U includes some discussion of marine and electrical engineering concerns related to scientific equipment such as the following:

- Subpart 194.15 - Chemistry Laboratory and Scientific Laboratory, and
- Subpart 195.09 - Scientific Equipment, and Subpart 195.11 - Portable Vans and Tanks.

15.3.2 CLASSED VESSELS

U.S. flag vessels in the UNOLS fleet are typically classed by the American Bureau of Shipping ("ABS") and maintained in accordance with associated ABS requirements for their class. In addition to all other applicable Regulatory Body requirements, such classed vessels must comply with the set of ABS "Rules for Building and Classing Steel Vessels" that is appropriate to their size and service. These rules contain numerous requirements pertaining to marine and electrical engineering. Even if a vessel is not "classed," those Rules can provide guidance on good practices.

15.3.3 SOLAS VESSELS

Regulations from the SOLAS convention (including all current amendments) apply to vessels over 500 GT (international). Vessels under 500 GT, which do not carry more than 12 passengers, are generally exempt. These regulations contain requirements pertaining to machinery and electrical installations – see especially Chapter II-1 "Structure, subdivision and stability, machinery and electrical installations".

15.3.4 UNINSPECTED VESSELS

The marine and electrical engineering requirements for uninspected vessels are contained in 46 CFR Subchapter C - Uninspected Vessels. Beyond that which is expressly required by Subchapter C, additional guidance for marine engineering and electrical systems aboard UNOLS vessels can be found by consideration of Subchapter C Part 28 (for fishing vessels) and 46 CFR Subchapter T (for small passenger vessels), as well as 46 CFR Subchapters F and J. There is no prohibition against using the inspected vessel requirements for uninspected vessels; those requirements cited above for inspected vessels should be considered for guidance as well.

15.3.5 OTHER REGULATIONS

For vessels under 65 feet in length, “Safety Standards for Small Craft“ published by American Boat and Yacht Council (ABYC) shall be met. Some examples relating to the mechanical and electrical systems include these ABYC standards:

- A-27 Alternating Current (AC) Generator Sets
- E-11 AC & Direct Current (DC) Electrical Systems on Boats
- H-30 Hydraulic Systems
- H-33 Diesel Fuel Systems

ABYC standards related to the control or documentation of electrical and mechanical systems such as: “T-5, Safety Signs and Labels” shall be adhered to. Also, any and all applicable safety requirements from the Motorboat Act of 1940, including all amendments, must be complied with.

15.4 REQUIRED STANDARDS UNDER THE RVSS

VESSELS: UNOLS vessels will be designed to and maintained in accordance with all applicable marine and electrical engineering requirements as set forth in US regulations, international conventions and accepted marine standards for the size and operating area of the vessel.

PORTABLE SCIENTIFIC EQUIPMENT: Major portable scientific equipment such as winches, seismic air compressors, and laboratory vans or powered sampling equipment may present hazards of injury to personnel or damage to the vessel or vessel systems. Such equipment shall be designed to meet the requirements of 46 CFR Subchapter F and J when applicable. The use of these standards will help in ensuring that the equipment is safe and suitable for use on all vessels.

The following examples demonstrate how the requirements may apply to portable equipment. They do not form a complete list of applicable requirements.

FUEL TANKS: Fuel tanks for portable, engine-driven equipment, see 46 CFR 58.50 - Independent Fuel Tanks.

MACHINERY GUARDS: 46 CFR 58.01-20 requires that “Gears, couplings, flywheels and all machinery capable of injuring personnel shall be provided with adequate covers or guards.” By extension, this includes exposed shafts, which can snag a person’s clothing.

HYDRAULIC AND PNEUMATIC SYSTEMS: For hydraulic and pneumatic systems on winches, portable A-frames and cranes, etc., see 46 CFR 58.30-50 - Requirements for miscellaneous fluid power and control systems.

PRESSURE VESSELS: For pressure vessels, (including hydraulic accumulators which may be part of a winch or over-the-side recovery system), see 46 CFR 54 - Pressure Vessels.

DIVING SUPPORT EQUIPMENT: For diving support equipment including compressors, chambers, etc., see 46 CFR 197, Subpart B – Commercial Diving Operations. Additional information can be found in Chapter 11 (Diving Operations) of this manual.

SYSTEMS IN VANS: Electrical and mechanical systems contained in laboratory vans, machinery vans and chemical storage vans shall meet all applicable requirements of 46 CFR Subchapters F, J, and U. Note especially 46 CFR 195.11 - Portable Vans and Tanks. Additional information can be found in Appendix C of this manual.

GROUNDING OF PORTABLE EQUIPMENT: All portable electric powered equipment must be safely grounded - see 46 CFR 111.05. Specific attention is directed to vans, winches and other equipment connected to the ship's electrical supply by portable cords.

The following guidance for scientific equipment has been taken from the Research Vessel Safety Training manual and made a requirement for safe installation of equipment.

"Most shipboard electrical distribution systems are not grounded, and in that respect are different from household or shore systems. Neither of the two conductors in a shipboard system is grounded, while the potential between them is about 120 volts. If an individual, while grounded, were to touch either of these two conductors, that person would receive a severe shock. All live electrical circuits are always treated as potential hazards."

"Scientific equipment (including power supplies and clean power sources) and the metal racks usually erected for stowage of scientific equipment must be properly grounded. Any discrepancies found must be reported to the Chief Engineer and remedied before such equipment is energized. Temporary electrical cables rigged for scientific equipment shall be arranged to the satisfaction of the Chief Engineer. This includes marking the cable for identification and ensuring the cable is properly supported, free from possibility of chaffing, is properly protected by an overcurrent device, and is of proper size and construction for the application. Further, such cables must be removed after they have served their purpose."

15.5 REQUIRED BY RVSS UNDER CERTAIN CIRCUMSTANCES

None.

15.6 RECOMMENDATIONS AND BEST PRACTICES

The following relevant information has been reproduced from the UNOLS, RVOC Safety Training Manual.

Consider the results of each act. There is absolutely no reason for individuals to take chances that will endanger their lives or the lives of others.

Assume circuits are live. Don't take the word of others. Stored capacitance can be fatal. Take time to test/discharge circuits before starting work.

Test your tester. When testing circuits to see if they are live, test a known voltage source first to see if your tester works.

Heed warning signs. If a sign warns that there may be two sources of power to a cabinet, take time to identify and secure both sources before reaching into the cabinet.

Use your senses. Be alert to smoke, overheating, and an "electrical smell" which are signs that trouble may not be far off.

Authorized personnel only. Only personnel authorized by the Chief Engineer should work on installed shipboard electrical equipment. Researchers should coordinate their requirements with the Chief Engineer before proceeding with work, which may impact a ship's distribution system.

Keep covers closed. Close covers to fuse panels, junction boxes, etc., when not in use. Covers are there to keep moisture and debris out.

Count tools. When working in cabinets or other equipment, count the tools you take in with you and be certain that you remove the same number when you leave.

Beware of dual voltages. Some switchboard panels have both 440/220-volt and 120-volt circuits. If servicing a 120-volt circuit, beware that a higher voltage circuit is close by.

Remove jewelry. Don't wear jewelry when working with electrical equipment or moving machinery. Remove rings, necklaces, and bracelets when you need to work near live components. The jewelry may serve as a path to ground or cause a short circuit, which could be fatal or cause injury. Make sure to avoid contact with metal zippers on clothing.

Tagged-out equipment. The ship's electricians and engineers place equipment out-of-service if it could jeopardize safety of personnel or cause equipment damage if started. Know how to secure all sources of possible power to such equipment. Never violate a tag by energizing that equipment.

- Leave equipment in working order, or tag it out-of-service before you leave.
- Do not service high-voltage equipment alone.

Do not ground yourself. Make sure you are not grounded when adjusting equipment or using measuring equipment. Use only one hand when servicing energized equipment. Keep the other hand behind you or in your pocket.

- Don't energize wet equipment.
- Use only properly grounded power tools.
- Use fuse puller when pulling fuses.
- Examine extension cords and portable cords and remove from service if unsafe.

16. FIRE FIGHTING EQUIPMENT & FIRE PROTECTION

16.0 INTRODUCTION

The intent of this section is to identify practices and standards, which when applied on UNOLS vessels, will help to insure that a vessel is adequately outfitted, that equipment is properly maintained, that proper training is carried out and that adequate plans and procedures for fire safety emergencies exist.

These practices and standards identified herein will not relieve a vessel from complying with existing class standards, Code of Federal Regulations (CFR) requirements, SOLAS requirements or other rules and guidelines, and may in some instances establish or recommend a more stringent standard for the operator of an oceanographic research vessel than contained in the CFR.

This section does not address structural fire protection requirements for any group of vessels.

16.1 REFERENCES

The following documents contain information, rules, and requirements pertaining to fire safety on vessels, which may be applicable. They include:

- 46 CFR Subchapter C-Parts 24-28 Uninspected Vessels
- 46 CFR Subchapter U-Parts188-196 Oceanographic Research Vessels
- American Boat and Yacht Council (ABYC), Project A-4 Standard and Technical Information Reports for Small Craft
- SOLAS-Chapter II-2, Consolidated Edition 2004, International Maritime Organization Note: For classification purposes, the fire and safety measures in the International Convention for the Safety of Life at Sea (1974 SOLAS), as amended are applicable to vessels of type, size and service coming under that convention.
- American Bureau of Shipping, Chapter 4, Part 3, Rules for Building and Classing Vessels Under 90 meters (295 ft) in length (2006)

16.2 REQUIRED BY REGULATION FOR ALL VESSELS

Required fire protection equipment for inspected vessels is prescribed by 46 CFR 193 Subchapter U, and for uninspected vessels by 46 CFR 25.30 Subchapter C. In addition, further practices and standards for them are contained in ABYC's "Safety Standards For Small Craft."

On all vessels, including non-self-propelled vessels of less than 300 gross tons, where fire detecting or extinguishing systems or other equipment are not required but are installed, the system or equipment and its installation shall meet the requirements of 46 CFR 193.

16.3 REQUIRED REGULATIONS FOR CERTAIN VESSELS

16.3.1 INSPECTED VESSELS

16.3.1.1 PORTABLE FIRE EXTINGUISHERS

Inspected vessels over 300 gross tons must follow the requirements of subpart 46 CFR 193.50 for classification, number, size, type, location and spares required.

16.3.1.2 FIXED FIRE EXTINGUISHING SYSTEMS

All inspected research vessels shall have an approved fixed fire extinguisher system installed to protect paint lockers, chemical storerooms, and similar spaces. Machinery spaces containing gasoline engines and machinery spaces containing any internal combustion engines on vessels over 1,000 GRT and total power over 1,000 HP must have fixed CO2 systems installed. (46 CFR 193.05)

Installations must adhere to the details contained in subpart 193.15 and in particular, protected spaces which are normally accessible to personnel while the vessel is underway should be fitted with an approved audible alarm which will sound automatically during a 20 second delay prior to fire suppression materials being discharged into the space. (46 CFR 193.15-30)

16.3.1.3 F IRE PUMPS

Inspected vessels must be equipped with at least one (two if over 1,000 gross tons) independently driven fire pump and the appropriate number of hydrants and hose. If the fire pump is located in an unmanned machinery space, inspected vessels must have the controls for its operation remotely located at a fire control station, on the bridge, or other readily accessible space. (46 CFR 193.10-5)

16.3.1.4 FIRE AXES

All inspected vessels shall carry on board at least the minimum number of fire axes using guidelines set forth in Table 46 CFR 193.60-5(a). The axes should be distributed so as to be most readily available in the event of an emergency. Fire axes shall be located where they maybe readily seen or they should be placed in enclosures together with fire hose, and the enclosure so marked. (46 CFR 193.60)

16.3.1.5 TESTS AND INSPECTIONS

Tests and inspections of portable and fixed fire extinguishing equipment must be conducted at least once every twelve months. Records of these tests shall be maintained and the equipment tagged to indicate that it has been inspected. It is encouraged, where practicable, that such tests and inspections be conducted by a company recommended by the manufacturer and for classed vessels by a company approved by the classification society. Fire hoses shall be tested every 12 months at a pressure equivalent to the maximum pressure they will be subjected to in service, but not less than 100 psi. (46 CFR 189.25-20 and 46 CFR 196.15-60)

16.3.1.6 F IREMAN’S OUTFIT

All inspected vessels must have aboard, in an accessible area, at least two Fireman’s Outfits, each to include: one pressure-demand or positive-pressure self contained breathing apparatus (SCBA), one lifeline with belt, one flashlight, one flame safety lamp or combination oxygen/combustible gas indicator (must be intrinsically safe and UL or Factory Mutual (FM) approved), one spanner wrench, an approved firefighters outfit (to include approved rigid helmet, boots, gloves, coat, trousers and coveralls), and one fire axe. These outfits shall be stored in widely separated, accessible locations. A spare charge is required for each SCBA (46 CFR 195.35, NVIC 12-86 and NVIC 06-01).

16.3.1.7 SELF CONTAINED BREATHING APPARATUS

Two of these appliances are mandatory for inspected vessels as part of a fireman's outfit (46 CFR 195.35).

Consideration should be given to ease of operation and response time in selecting from the list of approved equipment. Lockers and spaces containing the apparatus shall be marked "Self-Contained Breathing Apparatus." (46 CFR 196.37-20) Selected members of the crew should be instructed in its use. Apparatus shall be Mine Safety and Health Administration (MSHA) or National Institute for Occupational Safety and Health (NIOSH) approved for 30 minutes. A spare bottle shall be available for each apparatus and one additional bottle for training. This equipment is not approved for medical use.

16.3.1.8 FIRE AND SMOKE DETECTORS

Fire detecting, manual alarm, and supervised patrol systems are not required on inspected vessels by Subchapter U, but if installed, the systems shall meet the applicable requirements of 46 CFR-part 76 of Subchapter H (Passenger Vessels) (46 CFR 193.05-1).

See 16.3.3 for SOLAS vessel requirements.

16.3.1.9 MARKINGS FOR FIRE EQUIPMENT

Fire equipment for all inspected vessels shall be marked in accordance with the guidelines as set forth in 46 CFR 196.37 if the specified equipment is on board a vessel.

16.3.1.10 FIRE CONTROL PLANS

Fire control plans for inspected vessels must submitted to the Coast Guard for new construction under 46 CFR 189.55-5.

It is required that all manned vessels have available a set of plans which include a general arrangement showing fire retardant bulkheads with particulars of fire-detection, manual alarm and fire extinguishing systems, fire doors, ingress to various compartments, ventilation, location of remote means of stopping fans and identification of sections of ship served by. These requirements are applicable to inspected vessels. When in port, vessels shall have fire control plans immediately available for emergency personnel called to the vessel for fire emergencies. (46 CFR 196.36)

16.3.2 CLASSED VESSELS

None

16.3.3 SOLAS VESSELS

16.3.3.1 GALLEY

SOLAS compliant oceanographic vessels are required to have fixed suppression system in galleys outfitted with a broiler or deep fat fryer (SOLAS Chapter II-2 Part C Regulation 10).

16.3.3.2 FIRE AND SMOKE DETECTORS

For vessels subject to SOLAS, Chapter II-2 Part C Regulation 7 requires that a fixed fire detection and fire alarm system shall be installed in periodically unattended machinery spaces, in machinery spaces where the installation of automatic and remote control systems and equipment has been approved in lieu of continuous manning of the space and in spaces where the main propulsion and associated machinery including sources of the main sources of electrical power, are provided with various degrees of automatic or remote control and are under continuous manned supervision from a control room. Additional requirements call for smoke detection systems in accommodation and service spaces.

16.3.3.3 EMERGENCY ESCAPE BREATHING DEVICE (EEBD)

EEBDs are required on SOLAS ships as of 1 July 2002. The intent of an EEBD is to allow personnel to escape from smoke filled areas as well as areas where a total flooding fire suppression system has been discharged. They are not intended for confined space entry or firefighting purposes. The Coast Guard will accept NIOSH approved EEBDs that have a minimum service time of 10 minutes, are supplied air or oxygen type device, and have a full-face piece or hood. Minimum Coast Guard requirements call for at least two units and one spare unit for the overall crew or passenger living area, and one EEBD for each crewmember normally assigned to continuous or periodic duty in machinery spaces, and at least one spare EEBD such that any person visiting machinery spaces will have access to a unit. Note that compressed air or oxygen cylinders over two inches in diameter will require periodic hydrostatic testing per 49 CFR 173.34.

Training in the use of EEBDs should be part of shipboard familiarization training. (NVIC 06-02)

16.3.4 UNINSPECTED VESSELS

Uninspected vessels requirements for fire-fighting equipment are contained in 46 CFR 25.30 in Subchapter C.

In general, the minimum requirements of Subchapter C are substandard for a research vessel. All uninspected research vessels over 65 ft and less than 300 gross tons shall meet the standards set out in Subchapter U (46 CFR 193) for vessels of their size or to the extent possible when the requirements are stated for large vessels only. Those vessels under 65 ft at a minimum must comply with Subchapter C and with elements of Subchapter U appropriate for vessels of their size. See Section 16.4 below.

16.3.5 OTHER REGULATIONS

Under STCW, mariners with safety-related duties must complete a Basic Safety Training course. Incorporated in this requirement is 16 hours of Basic Fire Fighting. STCW also requires that “Seafarers designated to control fire-fighting operations shall have successfully completed advanced training in techniques for fighting fires, with organizational tactics and command.” This competence must have been demonstrated within the previous five years. Participation and compliance with these training requirements is encouraged; however, the U.S. exempts mariners from STCW requirements who serve on small passenger vessels under subchapters T and K and other vessels of less than 200 Gross tons sailing on near coastal, domestic voyage, that being a voyage that begins and ends in a U.S. port, does not touch at a foreign port or enter foreign waters, and is not more than 200 miles from shore.

16.4 REQUIRED STANDARDS UNDER RVSS

The requirements for firefighting equipment contained in subchapter U (46 CFR 193) provide specifications in many sections for vessels smaller than 300 GT. Because the requirements of Subchapter C are considered substandard for research vessels, UNOLS vessels should usually comply with the requirements appropriate to the size of the vessel.

16.4.1.1 PORTABLE FIRE EXTINGUISHERS

Uninspected vessels less than 300 gross tons and over 65 ft shall comply with the requirements of 46 CFR 193.50 regarding classification, number and location of fire extinguishers. In lieu of carrying spare charges if the vessel when meeting the requirements of 46 CFR 193.50 meets or exceeds the requirements of 46 CFR 25.30-20(c) then no spare charges will be required.

Uninspected vessels under 65 ft are required to follow the requirements in Subchapter C concerning the carriage of portable fire extinguishers. (46 CFR 25.30)

16.4.1.2 FIXED FIRE EXTINGUISHING SYSTEMS

Any uninspected vessel operating beyond the boundary line and with overnight accommodations for science party and crew shall have a fixed fire extinguishing system for spaces containing an internal combustion engine over 50 hp, an oil fired boiler, an incinerator or a gasoline storage tank. Equipment for a fixed system installed on an uninspected vessel must be type-accepted by the Commandant (G-MSE) or the Commanding Officer U. S. Coast Guard Marine Safety Center and installed properly. (46 CFR 25.30-15)

Protected spaces which are normally accessible to personnel while the vessel is underway should be fitted with an approved audible alarm which will sound automatically during a 20 second delay prior to fire suppression materials being discharged into the space. (46 CFR 25.30-15, 46 CFR 193.05-10 and 46 CFR 193.15-30)

16.4.1.3 F IRE PUMPS

Uninspected vessels over 65 ft in length and under 300 gross tons whenever practicable shall be equipped with at least one independently driven fire pump and provided with an appropriate number of 1 1/2 inch-hydrants and hoses complying with table (46 CFR 193.10-5). If the fire pump is located in an unmanned machinery space vessels should, so far as practicable, have the ability to start a fire pump remotely from an accessible space.

For vessels less than 65 ft in length, operated beyond the boundary line with overnight accommodations for crew and science party, a ¾ inch hose (46 CFR 193.10-5) of good commercial grade together with a commercial nozzle may be used. The pump may be hand operated, and the length of hose shall be sufficient to assure coverage of all parts of the vessel.

16.4.1.4 FIRE AXES

All uninspected vessels shall carry on board at least the minimum number of fire axes using guidelines set forth in Table 46 CFR 193.60-5(a). The axes should be distributed so as to be most readily available in the event of an emergency. Fire axes shall be located where they maybe readily seen or they should be placed in enclosures together with fire hose, and the enclosure so marked. (46 CFR 193.60)

16.4.1.5 TESTS AND INSPECTIONS

This section is applicable to all UNOLS research vessels. Tests and inspections of portable and fixed fire extinguishing equipment must be conducted at least once every twelve months. Records of these tests shall be maintained and the equipment tagged to indicate that it has been inspected. It is encouraged, where practicable, that such tests and inspections be conducted by a company recommended by the manufacturer and for classed vessels by a company approved by the classification society. Fire hoses shall be tested every 12 months at a pressure equivalent to the maximum pressure they will be subjected to in service, but not less than 100 psi. (46 CFR 189.25-20 and 46 CFR 196.15-60)

16.4.1.6 GA LLEY

Galley areas in general, and deep fat fryers in particular, are high fire risk areas and merit specialized protection by a smothering system, which can be remotely or automatically activated.

While Coast Guard Regulations do not call for a suppression system on inspected or uninspected vessels, the standards used for other inspected vessels as well as uninspected fishing vessels call for the following: each grease extraction hood must be equipped with a pre-engineered dry or wet chemical fire extinguishing system meeting the applicable sections of NFPA 17 or 17A or other standard set by the Coast Guard and must be listed by an independent lab (46 CFR 28.330 and 46 CFR 181.425) All UNOLS vessels should install remotely or automatically activated systems that at least meet these requirements.

16.4.1.7 F IREMAN'S OUTFIT

Vessels over 65 ft in length and less than 300 gross tons operating beyond the boundary line and providing overnight accommodations for crew and science party shall carry firemen's outfits as required for inspected oceanographic vessels (46 CFR 195.35, NVIC 12-86 and NVIC 06-01).

(a) Each fireman's outfit must consist of one self-contained breathing apparatus, one lifeline with a belt or a suitable harness, one flashlight, one flame safety lamp, one rigid helmet, boots and gloves, protective clothing, and one fire ax.

(b) Every vessel shall carry at least two fireman's outfits. The fireman's outfits must be stored in widely separated, accessible locations.

Vessels less than 65 ft in length are not required to carry a fireman's outfit.

16.4.1.8 SEL F CONTAINED BREATHING APPARATUS

Two of these appliances are required as part of the fireman's outfit (46 CFR 195.35).

Vessels less than 65 ft in length shall consider whether a self-contained breathing apparatus is appropriate.

Consideration should be given to ease of operation and response time in selecting from the list of approved equipment. Lockers and spaces containing the apparatus shall be marked "Self-Contained Breathing Apparatus." (46 CFR 196.37-20) Selected members of the crew should be instructed in its use. Apparatus shall be Mine Safety and Health

Administration (MSHA) or National Institute for Occupational Safety and Health (NIOSH) approved for 30 minutes. A spare bottle shall be available for each apparatus and one additional bottle for training. This equipment is not approved for medical use.

16.4.1.9 FIRE AND SMOKE DETECTORS

All vessels at minimum with accommodations for overnight berthing of crew and science party must be provided with smoke detection devices. Each accommodation space shall be equipped with an independent modular smoke detector or a smoke actuated fire detecting unit installed in accordance with 46 CFR 76, Subpart 76.33. If an independent modular smoke detector is installed, it must meet UL 217 and be listed as a “Single Station Smoke Detector - Also suitable for use in Recreational Vehicles.” (46 CFR 28.325) Further consideration should be given to installation of detection and alarm devices in unattended machinery spaces.

16.4.1.10 M ARKINGS FOR FIRE EQUIPMENT

Fire equipment for uninspected shall be marked in accordance with the guidelines as set forth in 46 CFR 196.37 if the specified equipment is on board a vessel.

16.4.1.11 FIRE CONTROL PLANS

Uninspected vessels 65 ft or over in length and less than 300 gross tons should have a fire plan as provided for in 46 CFR 196.36. In the event such a plan is not available, a general arrangement drawing, at a minimum, shall be readily available for this purpose. When in port, vessels shall have fire control plans immediately available for emergency personnel called to the vessel for fire emergencies.

No requirement exists for vessels less than 65 ft in length; however, it is strongly recommended that a general arrangement drawing of the vessel be readily maintained for emergencies.

16.4.1.12 T RAINING

Vessel crews must receive adequate training to properly operate the fire fighting equipment available aboard their vessel. This should be part of an onboard training program. It is further recommended that all crewmembers, no matter the size of vessel, meet the STCW training requirements for Basic Safety Training and remain current in this training. If possible, the crew should attend as a group.

16.5 REQUIRED BY RVSS UNDER CERTAIN CIRCUMSTANCES

None.

16.6 RECOMMENDATIONS AND BEST PRACTICES

All vessels should consider carrying portable pumps of appropriate size for fire fighting and dewatering.

Vessels less than 65 ft in length shall give due consideration to the benefit of having a fire axe available onboard. In the event a fire axe is carried they shall be located where they maybe readily seen or they should be placed in enclosures together with fire hose and the enclosure so marked

Operators should be aware of hazards posed by specialized spaces or contents of spaces, e.g., labs, spaces with hydraulic oil storage, etc., and insure these specialized hazards are identified and addressed with additional fire fighting systems to accommodate the added potential danger.

Consideration should be given to providing EEBDs as specified for SOLAS vessels in 16.3.3 above on uninspected vessels with the number available taking into account the location and arrangement of berthing spaces as well the science and crew.

For all uninspected vessels there are any number of operational issues, which must be given consideration by the operator when outfitting a vessel. These considerations include the size of the vessel and its capability, area of operation, distance offshore, the number of crewmembers, the training and experience of the crew, and the number of persons in the science party. The standards identified herein are minimum standards.

17. LIFESAVING APPLIANCES

17.0 INTRODUCTION

In general, the minimum standards set out in 46 CFR for inspected vessels are adequate for research vessels. Within SOLAS, oceanographic research vessels fall into a group defined as “Special Purpose Vessels” and are subsequently grouped as “Cargo Vessels.”

However, the minimum standards set forth by 46 CFR 25-28 of Subchapter C for uninspected vessels are substandard for any vessel which operates on coastal or ocean routes unless a vessel is operating well inshore. The RVSS takes the position that research vessels, while operating on ocean routes (20 or more miles offshore), shall meet the general principles and standards set forth by 46 CFR 199 Subchapter W for vessels not subject to SOLAS.

The following definitions apply to this chapter:

- “Survival craft” is a craft capable of sustaining the lives of persons in distress from the time of abandoning the vessel on which the persons were originally carried. This term includes lifeboats, life rafts, buoyant apparatus, and life floats, but does not include rescue boats.
- “Rescue boat” as defined in the CFR‘s means a boat designed to rescue persons in distress and to marshal survival craft. (46 CFR 160.056)
- “Buoyant apparatus“ is floatation equipment, (other than lifeboats, life rafts, and personal floatation devices), designed to support a specified number of persons in the water and of such construction that it retains its shape and properties and requires no adjustment or preparation for use. The types generally in use are of a box float type or peripheral buoyant apparatus. (46 CFR 160.010-2)
- “Inflatable buoyant apparatus” is floatation equipment that depends on inflated compartments for buoyancy and is designed to support a specific number of persons completely out of the water. (46 CFR 160.010-2)
- “Life float” is a buoyant apparatus with a peripheral body designed so that persons are supported only partially submerged with approximately 40 lbs of buoyancy required per person. Each float must have a platform that drops through the center of the float. (46 CFR 160.027)

NVIC 2-92 addresses survival equipment for life rafts. A transition has been in progress, which has resulted in oceangoing vessels replacing “ocean” and “limited” service life rafts. The new life rafts will be “SOLAS A” (equivalent to ocean service), “SOLAS B” (equivalent to limited service) and “coastal” service life rafts. The changes to the SOLAS requirements for A and B Pack rafts include “an efficient radar reflector”, “thermal protective aids ...sufficient for 10% of the number of persons the life raft is permitted”, and being “fitted with retro reflective material”.

17.1 REFERENCES

- Title 46 CFR 199, Subchapter W - Inspected Vessels 199
- Title 46 CFR 25-28, Subchapter C - Uninspected Vessels

- NVIC 2-92 - Survival Equipment for Lifeboats and Liferafts
- SOLAS - Consolidated Edition 2004 or more recent.

17.2 REQUIRED BY REGULATION FOR ALL VESSELS

17.2.1 PERSONAL FLOATATION DEVICES (PFD)

All vessels shall be provided with a USCG approved PFD for each person on board. Vessels over 65 ft and all vessels operating in the open ocean should carry Type 1 PFDs. Vessels under 65 ft operating in protected waters should carry life jackets for their size as prescribed by 46 CFR 25.25-5. Each life preserver must be fitted with a USCG approved light (USCG and SOLAS approved for SOLAS vessels), and retro reflective material of approved type. Lifejackets should be marked with the name of the vessel or operating institution. Details on lifejackets may be found in 46 CFR 199.70 and 46 CFR 25.25.

17.2.2 IMMERSION SUITS

Immersion suits are required for vessels operating north of 32 degrees north and south of 32 degrees south and should be type approved under series 46 CFR 160.171. See 46 CFR 199.70c for details of requirements, markings, stowage, and required attachments and fittings. The immersion suits should be marked and equipped the same as life preservers and stowed in close proximity to working or living areas.

Because immersion suits take longer to don than life preservers, periodic donning drills must be scheduled per CFR for both crew and scientists. 46 CFR 199.180(d)(12) requires all persons other than crew to receive instruction on donning immersion suits monthly. 46 CFR 199.180(d)(11) requires all crewmembers to don an immersion suit every 3 months.

17.2.3 RING LIFE BUOYS

All inspected and uninspected vessels under 328 ft (100m) in length in ocean service shall carry a minimum of eight ring life buoys that shall be stowed, marked, and have attachments per 46 CFR 199.70(a). Life buoys must be stowed so they can be rapidly cast loose, may not be permanently attached to the vessel, and each position must be marked with either the words “LIFEBUOY” or “LIFE BUOY” or the appropriate IMO designated symbol. They must be distributed so they are readily available on either side of the vessel, with at least one near the stern. At least two life buoys fitted with self-activating smoke signals shall be stowed near the bridge where they can be easily released. Life buoys fitted with self-activating smoke shall also be fitted with self-illuminating lights. Each life buoy must be marked in block capital letters with the vessels name and homeport. At least one life buoy on each side shall be fitted with a buoyant lifeline at least 100 ft long. Half the total number of life buoys shall be fitted with approved self-illuminating lights.

For vessels 65 ft or over in length and in services other than ocean (not more than 20 miles offshore), lifebuoys should be stored, marked, and fitted with attachments and fittings as per 46 CFR 199.70(a). For vessels over 65 ft and under 98 ft the minimum number of life buoys to be carried shall be three and for vessels over 98 ft and under 196 ft a minimum of four life rings shall be carried. (46 CFR 199.630) One ring buoy on either side of the vessel shall have 100 ft (30m) of buoyant line attached. All ring buoys shall be marked in capital letters with the name and homeport of the vessel. At least two of the ring buoys with water lights attached shall also be provided with a self-activated smoke signal and capable of quick release from the bridge. While these are not legally required on other voyages, they are strongly recommended minimums.

All uninspected vessels over 26 ft and under 65 ft in services other than ocean (not more than 20 miles off shore) shall be equipped with a minimum of at least one ring life buoys which shall be equipped with a line at least 60 ft in length and shall be placed so as to be readily accessible to the persons on board. The position of the life buoy shall be plainly indicated. (46 CFR 25.25-5)

17.2.4 PYROTECHNIC DISTRESS SIGNALS

All vessels in coastwise or ocean service must carry, in the pilothouse or other suitable location, the following minimum pyrotechnic distress signals: 12 approved rocket, parachute, red flare distress signals contained in an approved portable water-tight container. Each approved signal must have an expiration date marked on it and that date must not be more than 42 months from the date of manufacture. (46 CFR 199.60(c))

17.3 REQUIRED REGULATIONS FOR CERTAIN VESSELS

17.3.1 INSPECTED VESSELS

Rescue Boat: All inspected vessels must have a rescue boat approved under approval series 46 CFR 160.156 and be equipped as specified in table 46 CRF 199.175 and shall comply with requirements for stowage, launch and embarkation. (46 CFR 199.262)

17.3.2 CLASSED VESSELS

None.

17.3.3 SOLAS VESSELS

Survival Craft: SOLAS vessels constructed after July 1, 1986 must be in conformance with the new requirements. Existing SOLAS ships were subject to these requirements July 1, 1991. Older vessels may continue to use life rafts approved for “ocean service” with an “ocean service” equipment pack so long as they remain in good condition. Inspected vessels not required to comply with SOLAS may use the SOLAS A Pack, Ocean Service, or Limited Service (with SOLAS B equipment pack) life rafts as appropriate. “Coastal” service life rafts with a “coastal” equipment pack shall only be used for uninspected vessels operating within 20 miles of the coast.

17.3.4 UNINSPECTED VESSELS

Requirements for Life Preservers and Lifesaving equipment on uninspected vessels in Subchapter C are contained in 46 CFR 25.5. UNOLS Vessels should adhere to the higher standards in this chapter under section 17.4 in addition to the basic requirements in section 17.2.

17.3.5 OTHER REGULATIONS

None.

17.4 REQUIRED STANDARDS UNDER RVSS

17.4.1 PERSONAL FLOATATION DEVICES

UNOLS research vessels shall carry an additional number of life preservers readily accessible for the personnel on watch in the engine room, pilothouse, laboratories, and lookout. Lifejackets should be distributed throughout the crew and scientific quarters and other places accessible to each person on board.

17.4.2 IMMERSION SUITS

In addition to the legal requirements, each UNOLS operator shall carry this equipment, based on local or operational circumstances. Operators especially should consider water temperature in all areas of operations, local or otherwise. 46 CFR 199.70 applies to vessels operating north of 32 degrees north and south of 32 degrees south.

17.4.3 WORK VESTS AND WORK SUITS

The work vest, Type V PFD, is an item of safety apparel and an adequate number of approved work vests must be carried for use by personnel working near or over water. They are not an acceptable substitute for life jackets and shall not be stowed in the same location. Operators shall outfit their work vests with retro reflective material as a minimum, with a PFD light and Global Positioning System (GPS) locators being additional recommendations. Because of the nature of their use, these vests will require replacement more frequently than other lifesaving equipment and frequent inspections are therefore necessary. There are a number of floatation suits and coats available that are recommended when operations take place in a low temperature environment. However, unless these are Coast Guard approved, they may not be substituted for work vests. (46 CFR 26.30 and 46 CFR 196.34)

17.4.4 LIFE BUOYS

All UNOLS research vessels between 65 ft and 98 ft shall comply with the inspected vessel standards.

17.4.5 RESCUE BOAT

All vessels need to maintain a capability to quickly recover a person in the water. On inspected vessels, rescue boats provide this means. All uninspected vessels have a responsibility and should maintain a capability to recover a person in the water. There is no requirement for uninspected vessels to carry rescue boats. However, consideration should be given to types of operations the vessel will be conducting, vessel maneuverability, and vessel freeboard. It is recommended that uninspected vessels have a designated rescue boat when operating in ocean service, coastwise service, or in the Great Lakes. The vessel's workboat may be designated as the rescue boat. In so doing due consideration must be given to the workboats suitability for such purposes and the need to be readily launched, embarked, easily recovered, and suitable for existing conditions (46 CFR 199.640(g)). Since the vessel's workboat may be used for other science support purposes, the vessel operator should decide whether or not the boat should comply with state motorboat registration rules or be marked as a ship's boat.

17.4.6 SURVIVAL CRAFT

Survival Craft needs for uninspected vessels are unclear and inadequate. Therefore, the following minimum standards shall apply for UNOLS Research Vessels:

Inflatable life rafts are the only type of buoyant apparatus acceptable for uninspected vessels operating in the open ocean more than 20 miles from shore. Each vessel shall carry life rafts or a SOLAS A life raft (or equivalent ocean service if they remain in good condition) with an aggregate capacity sufficient to accommodate the total number of persons on board and that are stowed in a position providing for easy side to side transfer at a single open deck level, or with an aggregate capacity on each side of the ship to accommodate the total number of persons on board (46 CFR 199.261 and 46 CFR 199.640). Life raft capacity shall be prominently displayed near each raft. They shall be of a capacity of six persons or more. They shall be stowed and equipped with hydrostatic release or float free link (46 CFR 199.130). Life rafts and releases shall be inspected and serviced at approximately 12-month intervals at a facility approved by the manufacturer and US Coast Guard to service the specific type of life raft

Vessels over 65 ft in length and not operating more than 20 miles beyond shore shall give due consideration to vessels service, operating area, and environmental conditions including water temperature when selecting an appropriate survival craft. Any US Coast Guard approved type buoyant apparatus may be used. The institutional decision to carry equipment must be based on the vessel's service and operating area. When carried, the apparatus should be of a capacity sufficient for all persons on board, or the number of persons on board limited to the capacity of the apparatus. The apparatus shall be mounted so it can be readily launched and, when unlashed, will float free should the vessel sink. Each will be attached to the vessel by a painter and float free link (NVIC 1-83). Each apparatus will be marked as per 46 CFR 199.640(j)(3). Also, each shall be equipped for the service of the vessel and periodically examined for integrity and condition.

Vessels operating in "cold water" where the monthly mean low water temperature is below 59 degrees F (15 degrees C) shall carry an inflatable life raft with a coastal service pack. Cold-water areas are defined in NVIC 7-91. Each vessel shall carry life rafts with an aggregate capacity sufficient to accommodate the total number of persons on board and are stowed in position providing easy side-to-side transfer at a single open deck level, or with an aggregate capacity on each side of the ship to accommodate the total number of persons on board. Each raft shall prominently display life raft capacity. Rafts shall be stowed and equipped with a hydrostatic release or float free link. Life rafts and releases shall be inspected at approximately 12-month intervals at a facility approved by the manufacturer and the U. S. Coast Guard to service the specific type of life raft. If a life raft canister is damaged or the seal broken, the life raft shall be serviced again promptly by an approved facility. Hydrostatic releases shall be provided with stainless steel tags on which is stamped their annual test dates (46 CFR 160.062-4).

Embarkation aids in the form of ladders or other suitable devices and continuous illumination shall be provided at life raft stowage and launching areas. (46 CFR 199.110)

Vessels operating in "warm water" where the monthly mean low water temperature is normally more the 59 degrees F (15 degrees C) may give consideration to carrying inflatable buoyant apparatus. Vessels opting to carry inflatable buoyant apparatus, or life floats shall insure they are stowed, equipped and marked in accordance with guidelines set forth in 46 CFR 199.640(j).

17.4.7 TRAINING AND DRILLS

Inspected vessels shall comply with those requirements for Muster List and Emergency Instructions contained in 46 CFR 199.180. These same requirements shall apply to all vessels in ocean service.

For uninspected vessels, clear instructions must be provided to each person on board a vessel in the event of an emergency. Copies of muster lists shall be posted in conspicuous locations and shall be current for the particular voyage. Each muster list shall include at a minimum, instructions for operating the general emergency alarm system, emergency signals, actions to be taken when an emergency signal is sounded, and duties assigned to members of the ship's crew.

Emergency instructions and illustrations shall be posted in each cabin occupied by personnel on board. The instructions and illustrations shall include fire and emergency signals, muster station, location of lifejackets, and methods of donning lifejackets. As an alternative smaller uninspected research vessels may consider complying with 46 CFR 28.265 for uninspected fishing vessels.

Training and drills for inspected vessels are addressed in 46 CFR 199.180. These same requirements shall apply to all vessels in ocean service. As an alternative uninspected vessels may comply with those requirements for drills and orientation on fishing vessels contained in 46 CFR 28.270.

17.4.8 TETHERS

Vessel operators shall also make available tethers for use as appropriate by persons involved in deck operations. These should be comprised of an easy-release belt or shoulder harness and buoyant line. There is no Coast Guard approval requirement.

17.4.9 RETRO REFLECTIVE MATERIAL

Lifeboats, life rafts, ring life buoys, rescue boats, work boats, life floats, and personal floatation devices shall have retro reflective material which is Coast Guard approved for that application and is approved under 46 CFR 164.018. (46 CFR 25.25-15)

17.4.10 LINE THROWING APPLIANCES

The handling of oceanographic equipment poses a high risk of a person on deck falling overboard, and a vessel with equipment over the side is usually not able to maneuver freely to make a recovery. All UNOLS vessels must maintain a capability to recover a person in the water. Depending on the vessel's operating characteristics and responses to weather and sea conditions this capability may include a line-throwing appliance. Reliability and speed are the main criteria for developing a recovery capability. On the approved equipment list there are two approved line-throwing devices:

- Rocket propelled, canister type, line-throwing appliances are relatively inexpensive to procure and maintain, but the rocket that is used to propel the line must be replaced at its expiration. At least two should be carried to provide back up capability.

- The shoulder gun type has a higher initial cost, and greater maintenance requirements. However, it has the advantage of allowing more than one shot with out having multiple units. One gun can be provided with several projectiles and canisters of line. At least one reload shall be available if this type of appliance is carried.

Training in the use of the line throwing gun or device shall be held quarterly and logged. All vessels should actually fire these devices at a frequency appropriate to maintain proficiency. (46 CFR 199.170 and 46 CFR 199.180(e))

17.4.11 ADDITIONAL LIFESAVING DEVICES

17.4.11.1 L IGHTWEIGHT PERSONAL FLOATATION DEVICES

Vessels equipped with Stearns Ultra 4000 inflatable PFDs (or equivalent) with manual and automatic features and outfitted with the ACR ResQFix™ 406 PERSONAL LOCATION BEACON (PLB) will provide them to scientists and crew while working on the open deck. Should an overboard situation arise, the vest will inflate automatically and the PLB can be activated giving a GPS location while simultaneously transmitting a signal on 121.5 MHz (Search and Rescue (SAR) homing frequency) to assist rescuers once in the general area. NOTE: Some vessels are equipped with Radio Direction Finders that can track on 121.5 MHz

17.4.11.2 R ETRIEVAL DEVICES

Vessels equipped with the MUSTANG SURVIVAL RESCUE STICK or other new water-rescue devices will place them in locations in close proximity to existing throwable life rings. The RESCUE STICK ™ is a throwable personal floatation device that inflates into a horseshoe shape upon contact with the water. The RESCUE STICK can be thrown over 100 feet with good accuracy making it more effective than a standard life ring.

17.5 REQUIRED BY RVSS UNDER CERTAIN CIRCUMSTANCES

None

17.6 RECOMMENDATIONS AND BEST PRACTICES

Lifesaving equipment carried in excess of CFR requirements should still be of a type approved by those regulations and should be maintained in accordance with those regulations.

The Master should determine when activities on deck or circumstances require the wearing of work vests, work suits or inflatable work vests and ensure these requirements are known and followed by all personnel on board.

Care must be used in designating and marking life rafts. Life rafts are approved for service separately from the equipment pack provided.

Immersion suits are expensive and must be ready for use when needed, but must also be used for training, which can damage the suits. To save wear on emergency equipment, operators may want to have some suits marked “not serviceable -- drill only” and separately stowed for this purpose. These suits often tend to crack along fold lines when packed and stored for long periods, and at least quarterly suits should be hung unfolded for a day. Vessels should have available small adult and oversize adult sizes if there will be persons on board under 110 lbs or over 330 lbs. If persons with disabilities are on board, special suits may be required. Immersion suits shall be tagged or marked on the outside of the bag with the date of the last inspection.

When re-stowing life preservers after drills, each shall be checked for condition. At least semi-annually a thorough inspection of each lifejacket shall be made by a qualified crewmember, including a squeeze to ensure floatation pads are still sealed.

Chemiluminescent type lights should be avoided on vessels operating in near-freezing waters.

<u>Litters and Stretchers</u>: Litters or stretchers that are used to evacuate an ill or injured person from a vessel should be equipped with floatation.

<u>Dated Materials</u>: Many items of lifesaving equipment, such as flares, EPIRB batteries and life raft supplies, have a specified, limited service life. Care shall be taken to ensure these items are marked with an expiration date upon being placed into service, and records shall be kept to ensure timely replacement.

<u>Training and Drills</u>: The key to emergency response is training and drills. Therefore uninspected vessels should at minimum:

- Have training materials relating to emergency equipment and procedures readily available on board
- Insure every crewmember on board is familiar with emergency duties before a voyage.
- Provide a safety briefing for special personnel/science party before sailing or immediately after sailing.

<u>Drills shall include</u>:

- One fire and abandon ship drill every month and within 24 hours of leaving port.
- As far as practical, rescue boats should be launched with assigned crew aboard and maneuvered in the water at a minimum of every three months.
- Emergency lighting for muster and abandon ship should be tested at every abandon ship drill.
- Line throwing appliance drills shall be conducted every quarter with actual firing at the Master's discretion.

<u>Every new crewmember shall be provided</u>:

- Onboard training in use of vessels lifesaving appliances, survival craft and fire extinguishing appliances within two weeks of arrival.
- Onboard training in heat, stress, hypothermia and other appropriate first aid.
- Instruction in the use of fire and lifesaving equipment at the same interval as drills.

A record of all training, drills and personnel attending should be maintained on board the vessel. The date, time and type of drill should be documented in the vessel's log.

18. CHARTERING OF NON-INSTITUTION VESSELS

18.0 INTRODUCTION

Many research projects use vessels other than those operated as part of the UNOLS fleet or even by their own institutions. Principal Investigators often need a smaller, local or special purpose vessel for their projects and the only way to obtain the use of these vessels is through charter. There have been several incidents in the past involving scientists employing chartered vessels for their work that have resulted in injury and death. Sometimes, when there is no inspection and qualified personnel have not carefully evaluated the potential for risk, the charters are carried out several times without incident before an accident or near miss finally occurs. The purpose of this chapter and Appendix D is to provide a procedure that will help to mitigate the risks involved with chartering vessels for scientific research and educational projects and that will help to ensure that vessels appropriate to the task are employed. This can be accomplished by ensuring appropriate regulations and provisions of the UNOLS Research Vessel Safety Standards are adhered through inspections and a systematic confirmation of a chartered vessels capabilities, outfitting, material condition and compliance with applicable safety standards and regulations.

18.1 REFERENCES

- UNOLS RVSS
- Appendix D UNOLS RVSS
- NSF/OCE policy regarding charter of non-UNOLS vessels provided through correspondence and included in section 18.4 below

18.2 REQUIRED BY REGULATIONS FOR ALL VESSELS

The chartering institution or their qualified representative must verify that the chartered vessels are in compliance with all applicable federal regulations.

18.2.1 INSPECTED VESSELS

Use the vessel's letter of inspection to help determine suitability for charter.

18.2.2 CLASSED VESSELS

See Below.

18.2.3 SOLAS VESSELS

See Below.

18.2.4 UNINSPECTED VESSELS

See Below.

18.2.5 OTHER REGULATIONS

See Below.

18.3 REQUIRED REGULATIONS FOR CERTAIN VESSELS

Chartered vessels must be able to prove adherence to applicable federal and international regulations.

18.4 REQUIRED STANDARDS UNDER THE RVSS

When a UNOLS institution charters a non-UNOLS vessel for marine research that is not operated by that institution, the guidelines of this chapter must be followed. The Principal Investigator, institution's contracting office and the institution's marine office all have a responsibility to ensure that only vessels that are safe and suitable for a project are chartered. Institutions should establish procedures, utilizing the expertise of marine operations staff, to ensure that all applicable USCG documentation, inspections and licenses to which the vessel is subject are complete and current. Particular attention should be paid to the safety, material condition, and crew competency of vessels chartered for oceanographic research.

When funding support from the National Science Foundation, Division of Ocean Sciences (NSF/OCE) is used for the charter of non-UNOLS vessels, the requirements of the RVSS are mandatory. Projects that use funding support from other NSF Divisions, the Office of Naval Research (ONR), or other federal agencies should follow the requirements of this chapter as a minimum.

This process should take place as early as possible so that any necessary corrections can be made in a timely manner. The correction of any deficiencies should be insisted upon before entering into a charter agreement. The overall goal is to ensure a chartered vessel meets the same safety standards expected of a comparable size UNOLS vessel.

If the marine operations staff does chartering, such factors will be taken care of routinely. The situation becomes more difficult when principal investigators, unfamiliar with marine operations, undertake charters of vessels on their own. It is emphasized that all institutions should set up procedures which will ensure safe, effective operations regardless of who undertakes a charter.

Chartered vessels that possess a current U.S. Coast Guard, SOLAS or U.S. Navy INSURV inspection certificate have been physically inspected by competent marine personnel and such inspections may be used to satisfy the requirements of this chapter. A current inspection is one that has been performed within 12 months of the vessel's charter date. Certain large projects or those involving international cooperation may require a contract inspection by an NSF approved inspection group, or provide evidence that the vessel follows safety standards comparable to the RVSS.

Small vessels that carry less than six scientists and possess a current U.S. Coast Guard safety inspection performed under the Federal Boating Safety Act of 1971 or the Commercial Fishing Industry Vessel Safety Act of 1988 may also satisfy this inspection requirement if these safety requirement are considered sufficient for the expected area of operation and mission by the chartering institution's marine staff.

Any non-inspected vessel that fails to meet the above criteria, should be physically inspected by the chartering institution's Marine Superintendent (or equivalent) or other competent marine personnel such as another member of the marine staff, a marine surveyor, marine architect, etc. that the Marine Superintendent might designate. The purpose of this inspection is to ensure the proposed vessel meets UNOLS Research Vessel Safety Standards and is otherwise suited for the intended purpose. Appendix D provides a set of guidelines to be used in conducting these inspections.

18.4.1 PRE-CHARTER

Collect particulars on the vessel being contemplated for charter so as to have complete data and an understanding of the vessel's safety and capability. Data should include vessel description, radio call sign, owner and operator name and addresses, licenses, inspections, surveys, safety equipment, communications equipment, and navigation equipment. Investigate any information relative to the stability and watertight integrity of the vessel.

Ensure owner has an appropriate Coast Guard Certificate of Inspection or a letter of designation as an Oceanographic Research Vessel or can legally operate as a six-passenger charter vessel. Vessels less than 65 feet in length can carry up to six passengers with a properly licensed master. Vessels 65 feet and over must be inspected to carry even one passenger or have a letter of designation that exempts the vessel from Coast Guard Inspection.

Reserve the right to have the vessel examined by the institution's marine operations personnel and/or a professional marine surveyor if any questions exist as to vessel's condition, stability or general sea worthiness.

Conduct whatever inquiry may be necessary to establish the competency of captain, crew, or operator to provide for a safe voyage, including examination of licenses, etc.

Establish a formal institutional procedure for documenting approvals of charters. Ensure Chief Scientists are aware of these procedures, especially the safety-related terms of the charter.

Ensure that insurance coverage is in accordance with the institution's policy.

If the vessel is not otherwise inspected or certificated (USCG, SOLAS, USN INSURV, NSF, ABS), require a marine survey or, if appropriate, a USCG courtesy examination. If none of the foregoing can be obtained in a timely manner, the marine operations staff of a UNOLS Institution should ensure the vessel is inspected by a qualified person or at their discretion, inspect the vessel themselves prior to charter. RVOC has produced and the UNOLS Council has approved guidelines for the inspection of vessels proposed for charter. See Appendix D for the UNOLS Council approved checklist for chartering non-UNOLS vessels.

Ensure the vessel is equipped with an appropriate EPIRB, and that the vessel's operator is familiar with its purpose and operation.

18.4.2 DURING CHARTER

Require the charterer to prepare a formal cruise plan for each voyage, which shall include, as a minimum, the elements listed in the paragraph regarding cruise/voyage plans in Chapter 3 of these standards.

Require reporting of all significant cruise plan changes to the Institution's shore based contact.

Require the charterer to provide a list of names for all scientific personnel participating in a charter voyage. List should include next of kin, addresses and telephone numbers, and should be filed with designated base personnel.

Require a report of all vessel departures and arrivals. Ensure a return to port notice is received within two hours of scheduled time, or that radio notice of a change in plans has been received if the vessel is to be more than two hours late. If required reports are not received, the charterer's shore-based contact will initiate institutional procedures for notification and action.

For voyages planned to last over 24 hours, a designated shore-based contact should receive daily radio reports of the vessel's present location, and planned movements for the next 24 hours. This report should also include reports of adverse weather, equipment failures or other factors affecting the vessel and its planned operations.

18.5 REQUIRED BY RVSS UNDER CERTAIN CIRCUMSTANCES

None.

18.6 RECOMMENDATIONS AND BEST PRACTICES

None.

APPENDICES

A. UNOLS Rope and Cable Safe Working Load Standards
B. UNOLS Load Handling System Design Standards
C. Safety Inspection Check List for Shipboard Vans
D. Inspection Check List for Chartering Non-UNOLS Vessels
E. Sexual Harassment Brochure
F. List of Acronyms

APPENDIX A (Revision 1 07/07/2011)
UNOLS Rope and Cable Safe Working Load Standards

A.0 DEFINITIONS

A.0.1 WINCH OWNER: The party or their representative who is normally responsible for the operation, inspection, maintenance, and testing of the winch. This could be the vessel operator or the scientific party.

A.0.2 ROPE: A woven, flexible tension member with no internal conductors. It may be made from natural fibers, synthetic fibers, or metal.

A.0.3 CABLE: A woven, flexible tension member with internal conductors or other means of transmitting data such as glass fiber.

A.0.4 TENSION MEMBER: Generic name used to describe a rope or cable in service for over the side work.

A.0.5 ELASTIC LIMIT: The elastic limit or yield point of a material is the stress at which a material begins to deform plastically. Prior to the yield point the material will deform elastically and will return to its original shape when the applied stress is removed. Once the yield point is passed some fraction of the deformation will be permanent and non-reversible. For rope or cable this is the load that causes permanent set, or deformation, of the wires. (See Background Information)

A.0.6 TRANSIENT LOADS: Loads induced which are temporary by nature, including the weight of entrained mud, weight of entrained water, pull out loads, drag due to package characteristics and/or winch speed, etc.

A.0.7 DYNAMIC LOADS: Loads induced due to vessel motion (heave, roll, pitch, etc.)

A.0.8 “g” = The vertical acceleration due to gravity. For normal static loading (no dynamic effect), “g” is equal to 1.0. To take into account dynamic effect due to ship’s motion and package drag, the simple static load is multiplied by a factor higher than 1.0. Under ABS standards, normally 1.75 or 2.0 for vertical accelerations is used depending on the application. “g” is applied to the mass of the package and tension member, not the weight.

A.0.9 “D” = The root diameter of the sheave.

A.0.10 “d” = The outside diameter of the cable or rope.

A.0.11 "d1" = For cable the largest diameter wire in the armor wires. For wire rope the largest of the outer wires.

A.0.12 “w” = The width of the sheave groove supporting the sides of the tension member.

A.0.13 Deleted

A.0.14 NOMINAL BREAKING LOAD (NBL): Manufacturer's minimum published breaking load for a rope or cable.

A.0.15 Deleted

A.0.16 FIXED ENDS (FE) Both ends of the tension member being fixed without the ability to swivel. Most wire rope and cable NBL values are based on FE. An example of a fixed end application is towing a MOCNESS.

A.0.17 FREE TO ROTATE The end of the tension member is free to rotate either because a swivel is at the end of the tension member or the package at the end of the tension member can rotate freely. Tension members used in free to rotate applications typically have a NBL below the fixed end NBL. An example of a free to rotate application is a lowered CTD package.

A.0.18 INDUCED ROTATION Induced rotation occurs when external forces cause torque to be applied to the tension member. An example of an induced rotation situation would be a tow vehicle that spins while being towed but a swivel is not in place to decouple the vehicle from the tension member. This situation could develop if the tail fin of a corer was bent. Induced rotation should never be allowed to occur on a tension member that has not been specifically designed for this purpose.

A.0.19 TESTED BREAKING LOAD (TBL): The actual load required to pull a tension member to destruction as determined by testing. Depending on the intended use of the tension member testing may need to be done under fixed end and free to rotate conditions.

A.0.20 ASSIGNED BREAKING LOAD (ABL): Will be the lowest of the Nominal Breaking Load and Tested Breaking Load. In practice ABL will be equal to NBL used unless testing shows TBL to be less than NBL. An ABL that is greater than the NBL may never be used. Depending on the intended use of the tension member there may be two ABLs for fixed end and free to rotate conditions.

A.0.21 SAFE WORKING LOAD (SWL): The maximum tension that is allowed to be applied to the tension member during normal operation.

A.0.22 Deleted

A.0.23 FACTOR OF SAFETY (FS): For the purpose of this document defined as Assigned Breaking Load / Safe Working Load.

A.0.24 SWL = ABL / FS For the purposes of this standard, FS shall be considered the value selected by the operator. Because there may be two different ABLs (fixed end & free to rotate) there may be two SWLs. Section 6.0 defines the minimum standards that must be met to select specific FS values.

A.0.25 Auto-Render: The capability of the winch to automatically pay out at a pre-set maximum tension in order to prevent the tension member from exceeding the pre-set tension.

A.0.26 Render/Recover: A means of a winch to automatically maintain a pre-set tension by alternately paying-out and hauling back. Generally recovery haul back is limited to the point of the initial rendering.

A.1 REFERENCES

A.1.1 HANDBOOK OF OCEANOGRAPHIC WINCH, WIRE AND CABLE TECHNOLOGY, Third Edition.

A.1.2 Mechanics of Materials, Second Edition, Gere and Timoshenko, 1984

A.1.3 Wires and Cables Deployed Overside of RVS Vessel – Generic Operating Limits, Document Number SE301050, Issue No.: 001, 12/01/00.

A.2 GENERAL

A.2.1 46 CFR 189.35 – "Weight Handling Gear" describes design standards for handling systems aboard inspected oceanographic research vessels. However, this standard does not address FS on the tension members. The purpose of this appendix to the RVSS is to establish safe and effective operating limits for vessels in the UNOLS fleet for tension members loaded beyond traditional shore-side limits.

A.2.2 This standard seeks to define the requirements, which must be adhered to during over-the-side deployments in order to maintain a safe working environment for all personnel aboard. The secondary goal of this standard is to minimize damage to tension members and handling equipment, and the loss of scientific equipment, while still permitting the science objective to be met.

A.2.3 Normal operation beyond the parameters defined in this standard is forbidden. Exceptions to this are an emergency situation declared by the Master or other officer in charge of the vessel.

A.2.4 Loading limitations are expressed in terms of Factor of Safety (FS) on Assigned Breaking Load (ABL) in this document.

A.2.5 The limits in this document may not be used where other regulations are applicable, for example, on cargo cranes. In such cases, the shore-side regulations, which apply, must be adhered to. For example, the Occupational Safety and Health Administration (OSHA) generally require a 5.0 FS on cable breaking strength.

A.2.6 This standard assumes that the tension member is properly used for its intended purpose.

A.2.7 This standard will be complied with no later than 01 June 2011 with the exception of rollers. The addition of rollers to the requirements in tables 6.1 to 6.4 is new and incorporated into the RVSS as part of this revision to Appendix A. Roller diameter shall meet this requirement as soon as the appropriate equipment modifications can be funded and purchased and no later than 01 June 2015. Additionally as part of Revision 1 to Appendix A, Table 6.1 for operating with a FS of 5.0 or greater has been modified to require sheave and roller diameters “as large as practicable” versus equal or greater than the manufacturer’s recommendations.

A.3 INSPECTION, TESTING AND PREVENTATIVE REQUIREMENTS

A.3.1 Cable paths and fairlead arrangements vary widely from ship to ship and change over both the short term (from cruise to cruise) and the life of the vessel. It is impossible to develop a set of standards, which tries to quantify the precise effects on breaking strength, or tension member life, as a result of system design. Instead, each vessel must have a testing program in place, which suits how their tension members are used, and routinely evaluates the status of each. The assumption is that the results of testing will indicate the effect of both the loading and system design on the breaking strength of the tension member.

A.3.2 The testing program followed shall be based on the FS selected by the Owner, which is in turn based on use and the particulars of the handling system employed. The Owner shall have documentation in place specifying the FS for each tension member in use.

A.3.3 Tension member test samples shall be a clean, “representative” length from the end that will be put into future use, not simply the end immediately adjacent to the existing termination. Although this may not be the location of maximum loading during operations, this represents a practical means of determining ABL from an operational standpoint.

A.3.4 The initial ABL shall be assigned through testing by the UNOLS Wire Pool before distribution to the fleet. If the initial test results in an ABL less than the NBL, the Wire Pool shall reject the tension member.

A.3.5 If subsequent testing results in a TBL that is greater than or equal to the initial ABL, the initial ABL shall be used by the Vessel Operation for the purposes of this standard.

A.3.6 If subsequent testing results in a TBL that is less than the initial ABL, then the new TBL shall be used in lieu of the initial ABL by the Vessel Operation for the purposes of this standard.

A.3.7 Method of determining (TBL) – Steel Wires and Cables: ASTM A931-96, “Standard Test Method for Tension Testing of Wire Rope and Strand” (Re-approved 2002) shall be used. Tests shall be done with one end of the tension member free to rotate.

A.3.8 The Vessel Operator shall send samples to a UNOLS-accepted test facility (WHOI Wire Pool) for consistency of testing purposes and maintaining statistics. For steel cables and wire rope, the Operation shall send a five-meter (16 ft.) test sample (as described in Section 4.3) terminated on both ends with the fittings normally used in the field. If the field terminations are found to not develop full breaking strength, a test may be conducted using standard poured epoxy resin terminations.

A.3.9 The Vessel Operator shall also provide a copy of the wire history or wire log information with the sample and, as a minimum, this should include the following:

- UNOLS wire identifier, as described in Chapter 7 UNOLS Winch and Wire Handbook, Third Edition
- Winch and system manufacturer.
- Number and/or duration of deployments since last test.
- Maximum tension of each deployment.
- Maximum payout of each deployment.
- Description of wire train: the number of sheaves between winch and water. Sheave material and values of "D" and "w" for each sheave.

A.3.10 A hard copy and/or electronic copy of the TBL test results and ABL will be provided to the Vessel Operator for each sample tested

A.3.11 Method of determining (TBL) – Synthetic Ropes and Cables: [RESERVED]

A.3.12 Electromagnetic Testing: [RESERVED]

A.3.13 DC Resistance Testing: [RESERVED]

A.3.14 Retirement – Steel Ropes and Cables: Beside obvious physical damage (kinks, bird caging, abrasion, broken strands, excessive corrosion, etc.), a length of tension member shall be removed from service, or cut back so that the unacceptable length is removed, if any of the three following criteria are met:

- If the ABL, with the appropriate FS applied as described above, does not meet future scientific requirements.
- If the ABL deteriorates below 50% of NBL.
- Peak tension over turning sheaves at any time during operations exceeds the Elastic Limit.

A.3.15 Retirement – Synthetic Ropes and Cables: [RESERVED]

A.3.16 Lubrication: As long as these testing and inspection programs are adhered to, lubrication of steel tension members is not expressly required. However, if an operation determines that it is cost effective, and does not affect the quality of the science data collected, lubrication is highly encouraged since it generally extends service life.

A.3.17 Fresh Water Wash Down: While understanding that fresh water is limited at sea, an automatic system that washes the tension member on retrieval is highly encouraged since it greatly extends service life.

A.4 BACKGROUND INFORMATION

A.4.1 Performance Over a Rolling Sheave: When a steel wire rope or cable passes over a rolling sheave, up to a 30% reduction in breaking strength can occur (Ref 1.1 Section 6.4, Pg. 8-22). For a tension member with a nominal breaking load of 10,000 lbs., this would be a reduction in strength of 3,000 lbs. Using a FS of 1.5 in this example, the Safe Working Load equals 6,667 lbs – or a reduction of 3,333 lbs. – just above the reduction in strength anticipated. Since all oceanographic tension members pass over at least one sheave, this is the primary argument for not exceeding a FS of 1.5.

A.4.2 Yield Point and Elastic Limit: "Yield Point" is where continued deformation will occur without adding significantly more load. The "Elastic Limit" is considered to be the load, which induces permanent set or deformation. For steel, the "Yield Point" and "Elastic Limit" are essentially the same for all practical purposes. However, these two points may be quite different for other materials such as synthetics and glass fiber. Since wire rope and cables are made of strands and are not solid bars of steel, the precise Yield Point can be hard to determine by testing. A point on the stress-strain curve known as "0.2% Offset Yield" is used instead. The 0.2% Offset Yield for three-strand wire rope can be found in Section 2.2 (pg 1-5) of Reference 1.

A.4.3 For cables with copper conductors, the yield point generally occurs anywhere from 50-55% of the breaking strength (FS = 1.8) at which point the performance of conductors deteriorates. This is the principle argument for not exceeding a FS of 2.0 for steel cables with copper conductors, the goal being to maintain conductor performance over the life of the cable.

A.4.4 For wire rope, the yield point generally occurs around 75% of the breaking strength (FS = 1.33). This is the other reason for not exceeding a FS of 1.5 on steel wire rope, the goal being to maintain the useful life of the wire rope. This limit matches well with the performance over rolling sheaves above.

A.4.5 When using low FS in oceanographic research, the capabilities of the tension member monitoring system become critical with respect to capturing and displaying dynamic loads. This standard is divided into three primary sections (Tables 6.1 – 6.4) because of this; with each section having increasingly stringent requirements for the monitoring system. If the monitoring system is not capable of reliably capturing peak (or low) dynamic loads, then the chosen FS must keep the tension member below its yield point.

A.4.6 For example, on a tension member with a breaking strength of 20,000 lbs, the approximate yield point would be 20,000 x 0.75 = 15,000 lbs. Using a FS of 2.5, the allowable loading would be 20,000/2.5 = 8,000. If the system is not capable of reliably capturing dynamic effect, then a worst case scenario of 1.75 times static load would have to be assumed (i.e. "g" = 1.75), or 8,000 x 1.75 = 14,000. 14,000 is below the approximate yield strength of 15,000 so the integrity of the tension member would be preserved despite the monitoring system. The graph below illustrates this, and is why a FS of 2.5 is used as the lower limit in Table 6.2

A.4.7 When a tension measuring system is not available which forces using a minimal FS of 5.0, estimates of tension due to "dynamic loading" must be done based on mass not weight. In general, the weight of the package, entrained water and the cable or rope in air is roughly equal to the mass. Do not use weight in water for the dynamic loading estimates.

A.5 WINCHES AND HANDLING SYSTEM DESIGN

A.5.1 All handling systems and winches, whether portable or permanently installed, must be properly designed to an appropriate standard as described in Appendix B of the RVSS.

A.5.2 A calibrated weak link or "Auto-render" may be used by the vessel to ensure the chosen wire FS that best meets operational demand is maintained.

A.5.3 For operations where the weak link itself might be entangled or buried, then Auto-Render shall be the preferred method of strain relief.

A.5.4 Depending on the particular handling system and the type of vessel per Appendix B, when the NBL is at or below the Safe Working Load (SWL) of all components in the handling system, a weak link or Auto-Render may be set to the desired FS that best meets operational demand per Tables 6.1 – 6.4. (See Example 7.4)

A.5.5 Depending on the particular handling system and the type of vessel per Appendix B, when the ABL is higher than the SWL of any component in the handling system then the weak link or Auto-Render may be set equal to or below the SWL of the weakest component. (See Example 7.5)

A.6 REQUIREMENTS

A.6.1 Operating tension members with a Factor of Safety (FS) less than 5.0 results in increasingly higher levels of risk to personnel and equipment. To manage the higher risks so that operations stay within a manageable level, Tables 6.1 to 6.4 were developed. These tables outline the procedures and equipment requirements that must be in place to operate at different ranges of Factor of

Safety. It is the operator's discretion at which FS they choose to operate under as long as they meet the requirements for that FS.

A.6.2 The impact that the diameter of sheaves in the wire path have on tension member service life and safety is significant. For higher loads such as those seen when operating with a FS less than 5.0, having adequately sized sheaves is critical. Further study has shown that the diameter of load carrying rollers has an equally critical impact on tension member service life. For this reason Revision 1 to the RVSS Appendix A now includes load carrying rollers along with sheaves in the requirements of Tables 6.1 to 6.4. Only load carrying rollers are impacted by Revision 1 to Appendix A. A load carrying roller would be any roller in the wire path that serves to change the direction of the loaded tension member.

A.6.3 Examples of rollers where the requirements of Appendix A apply:

- Rollers on a level wind whose function is to ensure a small fleet angle to the level wind sheave is maintained. There is the potential for the tension member to come up hard against one of these rollers and change the direction of the tension member when under load.
- Any level wind that only uses rollers without a sheave has the potential for the tension member to come up hard against one of the rollers and change the direction of the tension member when under load.

A.6.4 Examples of rollers where the requirement of Appendix A do not apply:

- Sense rollers such as what are used on an electro-active level wind that senses when a level wind needs to change direction.
- Capture rollers that are there to help keep the tension member in a sheave groove during no load pre and post deployment periods, but that once the tension member is loaded it is not in contact with the capture rollers.

Table 6.1 - Wire Rope or Cable - Factor of Safety 5.0 or greater	
General	Wire Rope or Cable of steel construction may be operated to a nominal FS = 5.0 on the ABL, including transient and dynamic loads, as long as the following precautions in this section are adhered to.
	When the minimum Factor of Safety of 5.0 is reached, the deployment must be halted, or the next level of standards described in Table 6.2 must be used.
	Sea conditions and the resulting ship motion will affect the transient loads created on the wire. Thus, the trend in prevailing weather should be assessed before committing to a deployment, which could approach the limits specified above.
Tension Monitoring	Tension may be determined by calculation of instrument weight, wire, weight and entrained volume of water, including transient and dynamic loads, as long as the Owner is confident that a FS of 5.0 will not be compromised. If no other precise information is available on package drag and/or vessel accelerations, the Vessel Operator should use the ABS "g" factor of 1.75 as a minimum.
Alarms	None
Sheaves & Load Carrying Rollers	The sheave and roller diameter should be as large as practicable.
Deck Safety	Personnel on deck should follow good safety practices when working in the vicinity of wires and ropes during use
Testing	No routine break testing is required. Wires shall only be tested every two years to the desired SWL, along with the handling system.
Logbooks	At a minimum, the Owner shall maintain logs showing cutbacks, spooling operations, lubrication, wire train description and maximum loading (as determined by monitoring system or by calculation for each cast) for the full service life of the rope or wire. The wire log shall transfer with the wire if it is removed and placed in storage, or transferred to another winch or Owner.
Winch Operator	The Owner and the Master of the vessel must deem competent, in writing, all winch operators. "Deemed Competent" means that both the Owner and the Captain are confident, given the particulars of the winch and the overall operational scenario (weather conditions, equipment being deployed, etc.), that the Winch Operator has the necessary experience to operate the winch safely.

Table 6.2 - Wire Rope or Cable - Factor of Safety From Less Than 5.0 to 2.5	
General	Wire rope or cable of steel construction may be operated to a nominal FS =2.5 on the ABL, including transient and dynamic loads, as long as the following precautions in this section are adhered to.
	When the minimum Factor of Safety of 2.5 is reached, the deployment must be halted, or the next level of standards described in Table 6.3 must be used.
	Sea conditions and the resulting ship motion will affect the transient loads created on the wire. Thus, the trend in prevailing weather should be assessed before committing to a deployment, which could approach the limits specified above.
	Motion-compensation may be used to reduce the dynamic loads below the permissible limit and/or to reduce the chances of a "zero load" condition.
Tension Monitoring	Tension must be monitored at the winch operator's station with a display resolution of at least 3 Hz (every 330 mS). The system must also be capable of logging tension data at a minimum frequency of 3 Hz (every 330 mS). The tension measuring system must be calibrated at a minimum of every 6 months at load equal to the imposed at the selected FS. The tension measuring system must be maintained with an accuracy of 4% of the applied load.
Alarms	The handling system shall be fitted with both audible and visual tension alarms that sound and illuminate prior to a FS=2.8 of a wire's Assigned Breaking Load (ABL). Alarm conditions must automatically be included in the logged data.
Sheaves & Load Carrying Rollers	The D/d ratio must be at least 40:1 or 400d1 (whichever is greater) throughout. Grooving of the sheaves should be as close to "d" as practical, and generally no larger than 1.5d.
Deck Safety	The Operator should identify "Danger Zones" around ropes and wires under tension. To the extent possible, given the nature of operations involved, all personnel should be excluded from these zones such that a sudden failure cannot result in injury.
Testing	Wire Samples from the end closest to the termination shall be sent for testing every two (2) years and generally in conjunction with handling system SWL tests. If a 10% decrease in ABL is detected, then the testing shall be increased to annually. Alternately, the Owner may cut back to and re-test a new representative length
Logbooks	At a minimum, the Owner shall maintain logs showing cutbacks, spooling operations, break tests, lubrication, wire train description and maximum loading (as determined by monitoring system or by calculation for each cast) for the full service life of the rope or wire. The wire log shall transfer with the wire if it is removed and placed in storage, or transferred to another winch or Owner.
Winch Operator	The Winch Owner must certify that all Winch Operators are competent. By "Certified Competent" it is meant that the Owner must have written documentation in place showing that the operator has been through and successfully passed a formal owner/operator developed training program on the winch, handling apparatus, and monitoring system. The system vendor or the Owner, depending on the complexity of the system, may conduct a formal training program. The certification must be renewed annually. The master shall verify certifications and designate the approved winch operators.

Table 6.3 - Wire Rope or Cable - Factor of Safety From Less Than 2.5 to 2.0	
General	Wire rope or cable of steel construction may be operated to a nominal FS =2.0 on the ABL, including transient and dynamic loads, as long as the following precautions in this section are adhered to.
	FOR CABLES -When the minimum Factor of Safety of 2.0 is reached, the deployment must be halted. FOR WIRE ROPE -When the minimum Factor of Safety of 2.0 is reached, the deployment must be halted, or the next level of standards described in Table 6.4 must be used.
	Sea conditions and the resulting ship motion will affect the transient loads created on the wire. Thus, the trend in prevailing weather should be assessed before committing to a deployment, which could approach the limits specified above.
	Motion-compensation may be used to reduce the dynamic loads below the permissible limit and/or to reduce the chances of a "zero load" condition.
Tension Monitoring	Tension must be monitored at the winch operator's station with a display resolution of at least 10 Hz (every 100mS). The system must also be capable of logging tension data at a minimum frequency of 20 Hz (every 50 mS). Tension must be continuously monitored using a "tension trending" graph at the winch operator's station. The tension measuring system must be calibrated at a minimum of every 6 months at load equal to the imposed load at the selected FS. The tension measuring system must be maintained with an accuracy of 3% of the applied load.
Alarms	The handling system shall be fitted with both audible and visual tension alarms that sound and illuminate prior to a FS=2.2 of a wire's Assigned Breaking Load (ABL). Alarm conditions must automatically be included in the logged data.
Sheaves & Load Carrying Rollers	The D/d ratio must be at least 40:1 or 400d1 (whichever is greater) throughout. Grooving shall be per Ref A.1.1, Chapter 1, and Section 11.0 to provide adequate support.
Deck Safety	The Operator should identify "Danger Zones" around ropes and wires under tension. To the extent possible, given the nature of operations involved, all personnel shall be excluded from these zones such that a sudden failure cannot result in injury. Warning notices should be displayed at points of access indicating the danger. Physical and/or visual barriers should be erected as needed. Existing doors and accesses to the area should be secured when possible
Testing	Wire Samples from the end closest to the termination shall be sent for testing annually. If a 10% decrease in ABL is detected, then the testing shall be increased to every six months. Alternately, the Owner may cut back to and re-test a new representative length.
Logbooks	At a minimum, the Owner shall maintain logs showing cutbacks, spooling operations, lubrication, wire train description and maximum loading (as determined by monitoring system for each cast) for the full service life of the rope or wire. The wire log shall transfer with the wire if it is removed and placed in storage, or transferred to another winch or Owner.
Winch Operator	The Winch Owner must certify that all Winch Operators are competent. By "Certified Competent" it is meant that the Owner must have written documentation in place showing that the operator has been through and successfully passed a formal owner/operator developed training program on the winch, handling apparatus, and monitoring system. The system vendor or the Owner, depending on the complexity of the system, may conduct a formal training program. The certification must be renewed annually. The master shall verify qualifications and designate the approved winch operators.

Table 6.4 - Wire Rope - Factor of Safety From Less Than 2.0 to 1.5	
General	Wire rope of steel construction may be operated to a nominal FS =1.5 on the ABL, including transient and dynamic loads, as long as the following precautions in this section are adhered to.
	Once a FS = 2.0 is reached a regular check on wire loading shall be performed. This will require halting a deployment at regular intervals (~ 500 m) and conducting a slow haul until the nominal and peak tensions are established and verified. A decision on whether to proceed must then be based upon the limiting value of SF = 1.5. **The deployment must be halted, when the minimum Factor of Safety of 1.5 is reached.**
	Sea conditions and the resulting ship motion will affect the transient loads created on the wire. Thus, the trend in prevailing weather should be assessed before committing to a deployment, which could approach the limits specified above.
	Motion-compensation may be used to reduce the dynamic loads below the permissible limit and/or to reduce the chances of a "zero load" condition.
Tension Monitoring	Tension must be monitored at the winch operator's station with a display resolution of at least 10 Hz (every 100mS). The system must also be capable of logging tension data at a minimum frequency of 20 Hz (every 50 mS). Tension must be continuously monitored using a "tension trending" graph at the winch operator's station. The tension measuring system must be calibrated at a minimum of every 6 months at load equal to the imposed load at the selected FS. The tension measuring system must be maintained with an accuracy of 3% of the applied load.
Alarms	The handling system shall be fitted with both audible and visual tension alarms that sound and illuminate at prior to a FS=1.7 of a wire's Assigned Breaking Load (ABL). Alarm conditions must automatically be included in the logged data.
Sheaves & Load Carrying Rollers	The D/d ratio must be at least 40:1 or 400d1 (whichever is greater) throughout. Grooving shall be per Ref A.1.1, Chapter 1, and Section 11.0 to provide adequate support.
Deck Safety	The Operator should identify "Danger Zones" around ropes and wires under tension. To the extent possible, given the nature of operations involved, all personnel shall be excluded from these zones such that a sudden failure cannot result in injury. Warning notices should be displayed at points of access indicating the danger. Physical and/or visual barriers should be erected as needed. Existing doors and accesses to the area should be secured when possible
Testing	Wire Samples from the end closest to the termination shall be sent for testing annually. If a 10% decrease in ABL is detected, then the testing shall be increased to every six months. Alternately, the Owner may cut back to and re-test a new representative length.
Logbooks	At a minimum, the Owner shall maintain logs showing cutbacks, spooling operations, lubrication, wire train description and maximum loading (as determined by monitoring system or by calculation for each cast) for the full service life of the rope or wire. The wire log shall transfer with the wire if it is removed and placed in storage, or transferred to another winch or Owner.
Winch Operator	The Winch Owner must certify that all Winch Operators are competent. By "Certified Competent" it is meant that the Owner must have written documentation in place showing that the operator has been through and successfully passed a formal owner/operator developed training program on the winch, handling apparatus, and monitoring system. The system vendor or the Owner, depending on the complexity of the system, may conduct a formal training program. The certification must be renewed annually. The master shall verify qualifications and designate the approved winch operators.

A.6.5 Synthetic Tension Members [Reserved]

A.6.6 Ship operators and their seagoing staff must understand that if, by force of circumstance or by the desire to maintain scientific operations while on a cruise, when they do not meet the operating requirements as described in tables 6.1 through 6.4, they are embarking on a potentially dangerous activity. The consequences of this activity could be loss of valuable equipment, damage to the vessel and its fixed equipment, and, in the worst case, injury to personnel. Operators shall develop a procedure on how, and under what circumstances, the vessel will safely continue operations in the event the operating requirements are not met.

A.7 EXAMPLES

A.7.1 Examples of where a SF of 5 has to be used because a tension measuring system is not available or the sheave/roller diameters are smaller than required.

A grab is planned on 500m of 0.25" 3x19 wire rope using a FS of 5.0.		
Assigned Breaking Load (Free to Rotate)	6,750	
Factor of Safety	5	
Safe Working Load = ABL/FS	1,350	
Weight of Grab (in seawater)	175	
Weight of Sample (in seawater)	25	
Weight of wire rope (in seawater) = 0.284 lbs/m x 500m	142	
Static Total		**342**
Quasi-Static Load (drag)		**35**
Pound-mass of Grab (in air)	200	
Pound-mass of Entrained Mud (in air)	50	
Pound-mass of 500m of wire rope (in air) = 0.327 lbs/m x 500m	164	
Total Mass of System	414	
Dynamic Load (multiply Mass Total by 0.75 for g=1.75)		**310**
Transient Load Pull Out Load	**100**	**100**
Estimated Maximum Load Pounds-force		**787**
Because the estimated maximum load of 787 pounds is less than the SWL of 1,350 pounds it is acceptable to proceed with this grab.		

A CTD cast is planned on 500m of 0.322 cable using FS of 5.0.		
Assigned Breaking Load (Free to Rotate)	10,000	
Factor of Safety	5	
Safe Working Load = ABL/FS	2,000	
Weight of CTD (in seawater)	600	
Weight of Sample (in seawater)	-	
Weight of tension member (in seawater) = 0.474 lbs/m x 500m	237	
Static Total		**837**
Quasi-Static Load (drag)		**300**
Pound-mass of CTD (in air)	1,000	
Pound-mass of Samples (24btls*10liters sea water =240 liters*2.2lb/l)	528	
Pound-mass of 500m of tension member (in air) = 0.573 lbs/m x 500m	287	
Total Mass of System	1,815	
Dynamic Load (multiply Mass Total by 0.75 for g=1.75)		**1,361**
Transient Load		**-**
Estimated Maximum Load Pounds-force		**2,498**
Because the estimated maximum load of 2,498 pounds is more than the SWL of 2,000 pounds it is NOT acceptable to proceed with this CTD cast.		
Vessel Operator must either: know the actual dynamic loading on the package (based on location on vessel, drag, weather conditions, etc.) and/or meet the requirements allowing a lower FS described in Section 6 in order to proceed.		

A.7.2 Example: Estimating the FS Requirements that will need to be met.

A piston core is planned on 4000 m of 9/16" wire rope with an ABL of 32,500 lbs. The winch and frame are both rated for 50,000 lbs.		
Weight of corer (in seawater)	2,000	
Weight of Sample (in seawater)	100	
Weight of 4000 m of wire rope (in seawater) = 1.404 lbs/m x 4000m	5,616	
Static Total		**7,716**
Quasi-Static Load (drag)		**300**
Pound-mass of corer (in air)	2,600	
Pound-mass of mud sample (in air)	350	
Pound-mass of 4000m of cable (in air) = 1.614 lbs/m x 4000 m	6,456	
Total Mass of System	9,406	
Dynamic Load (multiply Mass Total by 0.75 for g=1.75)		**7,055**
Transient Load Pull Out Load		**2,000**
Estimated Maximum Load Pounds-force		**17,071**
FS = Assigned Breaking Load (32,500)/Estimated Maximum Load (17,071)		**1.87**
In order to proceed with this core the requirements in Section 6 for operating at a safety factor (FS) of 1.5 will need to be met.		
Since there is a "substantial risk" of entanglement with this kind of operation, a weak link should be selected by the Vessel Operator to protect the rope.		

A.7.3 Example: Calculating the amount of dynamic loading that can occur before an operation needs to be halted for when the minimum FS of 2 is reached.

A 36-bottle CLIVAR CTD cast deploying 6000 meters of .322-diameter cable is planned. The steel cable has a Free to Rotate ABL of 10,000 lbs. The SWL of the handling system is 10,000 lbs. The minimum FS permitted for E.M. cables is 2.0 per Section 6; therefore the maximum tension allowed on the cable is 5,000 lbs.		
Weight of CTD (in seawater)	1,000	
Weight of Sample (in seawater)	-	
Weight of tension member (in seawater) 0.474 lbs/m x 6000m	2,844	
Static Total		**3,844**
Quasi-Static Load (drag)		**500**
Pound-mass of CTD (in air)	1,500	
Pound-mass of Samples (36btls*10liters sea water =360 liters*2.2lb/l)	572	
Pound-mass of 6000m of cable (in air) = 0.573 lbs/m x 6000 m	3,438	
Total Mass of System	5,510	
Dynamic Load (multiply Mass Total by 0.75 for g=1.75)		**4,133**
Transient Load		**-**
Estimated Maximum Load Pounds-force		**8,477**
FS = Assigned Breaking Load (10,000)/Estimated Maximum Load (8,477)		**1.18**
6,000-meter deployments with a 36-bottle rosette on 0.322 cable easily falls below a FS of 2.0 and can only be accomplished in very calm weather or with motion compensation.		
Note: It is clear that deep CTD operations using 0.322 cable in heavy weather or with a large/heavy CTD will easily exceed an FS of 2.0 and easily could go lower than 1.5. This is below the advisable limit for conductor cable because of the increased potential failure of the internal conductors. If FS is reduced to this level, parting of the cable or decreased cable life due to failure of internal conductors should be anticipated. Operators should do everything possible to reduce ship or deployment system movement. Operators can use a motion compensation package or slow down the rate of winch operation in order to reduce the dynamic loads. As an alternative, a stronger cable could be considered, however most stronger UNOLS Cables also weigh more – see next example		

A CLIVAR CTD cast deploying 6000 meters of 0.680-diameter coax cable is planned. The steel cable has a Free to Rotate ABL of 37,000 lbs. The SWL of the handling system is 45,000 lbs. The minimum FS permitted for E.M. cables is 2.0 per Section 6; therefore the maximum tension allowed on the cable is 18,500 lbs.

The Vessel Operator has chosen to use a FS of 2.0 on the cable under Section 6 above. The Vessel Operator must either know the actual dynamic loading on the package (based on location on vessel, drag, etc.) and/or monitor cable tensions closely as required in Section 5.0, or use motion compensation to reduce dynamic effect.

Weight of CTD (in seawater)	1,000	
Weight of Sample (in seawater)	-	
Weight of tension member (in seawater) 1.814 lbs/m x 6000m	10,884	
Static Total		**11,884**
Quasi-Static Load (drag)		**500**
Pound-mass of CTD (in air)	1,500	
Pound-mass of Samples (36btls*10liters sea water =360 liters*2.2lb/l)	572	
Pound-mass of 6000m of cable (in air) = 2.271 lbs/m x 6000 m	13,626	
Total Mass of System	15,698	
Dynamic Load (multiply Mass Total by 0.75 for g=1.75)		**11,774**
Transient Load		**-**
Estimated Maximum Load Pounds-force		**24,158**
FS = Assigned Breaking Load (37,000)/Estimated Maximum Load (24,158)		**1.53**

6,000 meter deployments with a 36-bottle rosette on 0.680 cable gives a slightly better FS than 0.322 for deep casts. An even greater FS can be achieved with 0.681 F.O. cable that has a breaking strength of around 46,000 and is only slightly heavier than 0.680. A 36 place CTD with all bottles full can be handled at a FS of 2.0 in conditions that yield a "g" factor as high as 1.4.

Note: In all circumstances, a full ocean depth CTD cast will require using the procedures contained in Table 6.3 for FS between 2.0 and 2.5 as long as a steel cable is being used due to the weight and mass of the deployed cable. The level of tension monitoring will allow the operator to use actual dynamic loading to make decisions about whether or not to continue a cast.

APPENDIX B

UNOLS OVERBOARD HANDLING SYSTEMS DESIGN STANDARDS

CRITERIA FOR THE DESIGN AND OPERATIONS OF OVERBOARD HANDLING SYSTEMS

B.0 INTRODUCTION

B.0.1 TABLE OF ACRONYMS

- ABL Assigned Breaking Load (see Appendix A)
- CFR Code of Federal Regulations
- CTD Conductivity, Temperature and Density
- DLT Design Line Tension
- DP Dynamic Positioning
- FS Factor of Safety
- MAOT Maximum Anticipated Operating Tension
- MCD Maximum Capability Document
- MPT Maximum Permissible Tension
- NBL Nominal Breaking Load
- NSF National Science Foundation
- OHDD Overboard Handling Data Document
- OHS Overboard Handling System
- PI Principal Investigator
- QA Quality Assurance
- ROV Remotely Operated Vehicle
- RVSS Research Vessel Safety Standards
- SS Sea State
- SWL Safe Working Load
- UNOLS University-National Oceanographic Laboratory System

B.0.2 OBJECTIVE

The objective of this document is to provide a unified code of practice for the structural design and operating principles of overboard handling systems used on board vessels in the UNOLS Fleet. Attachment A2 provides a flow chart of the process the Operator will use when applying the requirements of Appendix B to overboard handling operations.

Appendix B is not intended to supersede existing regulations. It is intended only to better define the design limits, procedures, documentation, and capabilities of overboard handling systems used specifically for modern oceanographic research.

All UNOLS vessels must comply with Appendix B. UNOLS vessels that are inspected and certificated by USCG under*46 CFR Subchapter U* must comply with Appendix B, as well as the requirements of *46 CFR Subchapter U* (whichever are greater).

B.0.3 SCOPE OF APPLICATION

This document DOES apply to all overboard handling systems and their component parts intended for use on UNOLS vessels. An overboard handling system is defined as a load handling system intended to lift, deploy, and/or recover science packages over the side and into or out of the water.

This document DOES apply to:

- All fixed and portable overboard handling systems
- General purpose, as well as dedicated systems
- Each component of the overboard handling system
- Components include (as applicable):
  - Winches
  - Overboarding appliances (e.g., frames, davits, cranes, booms, etc)
  - Sheaves (or any other device a tension member is lead through)
  - Foundations for all above components – including ship structure
  - Deck tie downs
  - Shackles and other necessary equipment to achieve the task

This document SHALL apply to cranes if they are used to lift, deploy, and/or recover science packages over the side and into or out of the water.

This document DOES NOT apply to the design of winches and overboard handling systems to be used for manned overside operations (e.g., hyperbaric chambers or submersibles). RVSS Chapter 12, *Human Occupied Vehicles* and *UNOLS Safety Standards for Human Occupied Vehicles* provides the applicable guidance for this activity.

The wire ropes and cables used in overboard handling systems are covered under Appendix A as described in Section B.1 below. Throughout Appendix B the wire ropes and cables are generically referred to as the "tension member".

Ship operators and their seagoing staff must understand that if, by force of circumstance or by their wish to maintain scientific operations while on a cruise, they re-configure or use systems outside the bounds of the analyzed capability without undertaking the required study of the new arrangement in accordance with Maximum Capability Document, they are embarking on a potentially dangerous activity. The consequences of this activity could be loss of valuable equipment, damage to the vessel and its fixed equipment, and, in the worst case, injury to personnel.

B.0.4 APPLICABLE DATE

All systems commencing development on or after 07/15/2011 must comply with the requirements of this document.

B.0.5 APPLICABILITY TO EXISTING SYSTEMS

All systems already in existence or to be completed before the applicable date are to be brought into compliance with these standards by 07/15/2014

B.0.6 Application and Responsibilities

It is the responsibility of the Owner of each component of an overboard handling system to ensure that it meets the standards of Appendix B (e.g., a portable winch owner must have documentation that gives that winch's maximum capabilities per Section B.5).

It is the responsibility of the Operator of a UNOLS vessel to ensure that each overboard handling system (including all components either fixed or portable) used on the vessel complies with Appendix B. Each system must have documentation of the system maximum allowable capabilities and configurations per Section B.5. **Component** maximum capability documentation shall be a part of **system** maximum capability documentation. If the Owner of a portable component brought aboard a UNOLS vessel does not have the documentation that provides the maximum capability for the Owner's component, the Operator may reject its use.

When purchasing a new component or system, or retroactively gaining compliance for an existing system, the Owner/Operator must work with the naval architect/engineer and/or the system manufacturer to define all expected uses per Section B.3. If a specific deployment/use is not defined in advance, it will not be part of the component or system maximum capability documentation and thus cannot be approved for a deployment/use without further analysis. An exception to this may be made if it can be shown by the Owner/Operator that the deployment/use is within the parameters of an already defined use.

It is the responsibility of the naval architect/engineer or system manufacturer to apply the described deployment/use loads in the prescribed geometries and determine the maximum capability of the component or system. **The maximum allowed capability shall be described as a maximum permissible tension (MPT) on the tension member along with diagrams of analyzed/approved geometry.** The structural criteria for developing the maximum allowed capability are given in Section B.4.

A flowchart for the process, from development of system deployment information to analysis and development of the maximum allowed capability, is included as Attachment A2.

The naval architect/engineer or system/component manufacturer shall fully share their structural calculations with their client/customer, and these calculations shall be allowed to be reviewed by UNOLS and other government agencies that provide support and/or oversight.

The system/component owner/operator shall comply with operation, maintenance, testing, training, and documentation requirements given in Sections B.6 to B.9.

The details of various tension mitigation devices and systems are given in Section B.10.

B.1 COMPANION STANDARD – RVSS - APPENDIX A

B.1.1 COMPATIBILITY

Appendix B is to be used in conjunction with and its application is to be fully compatible with, Appendix A -*UNOLS Rope and Cable Safe Working Load Standards*.

B.1.2 APPLICATION OF APPENDIX A

The tension member employed is considered part of the overboard handling system for any given deployment scenario. Therefore, the Maximum Permissible Tension (MPT) of the overboard handling system when considered in total must include consideration of the tension member Safe

Working Load (SWL) from Appendix A in addition to the limiting MPT of the components (see Attachment A2).

B.2 DEFINITIONS

B.2.1	Assigned Breaking Load (ABL)	A term defined in Appendix A that is the breaking load for the tension member.
B.2.2	Auto Render	The capability of the Overboard Handling System (OHS) to automatically pay out at a pre-set maximum tension in order to prevent the tension member from exceeding the pre-set tension.
B.2.3	Component	Any part of the OHS. Typically, each component has a load imparted upon it by the tension member either by altering the direction of the tension member or otherwise resisting the tension. This includes, but is not limited to, turning blocks, shackles, overboarding frames, booms or cranes, winches, and the ship's supporting structure.
B.2.4	Design Line Tension (DLT)	This is the value used to design or evaluate the capability of OHS components. Normally the DLT is the Nominal Breaking Load (NBL) of the strongest tension member anticipated to be used with the component(s) to ensure the components do not fail at a line tension less than the tension member NBL. However, the Maximum Anticipated Operating Tension (MAOT), potentially a lesser value than the NBL, may be used where the OHS meets criteria that limit the potential maximum loads.
B.2.5	Factor of Safety (FS)	For components, FS = Yield Load/SWL For tension member, FS = ABL/SWL (see Appendix A).
B.2.6	Fixed System	An OHS that is permanently installed in a specific location permanently attached or integrated to the ship structure or systems.
B.2.7	Hydrodynamic Drag	The force due to the cable and or the payload being pulled through the water encompassing the velocities of a tow, of recovery, of waves, and ship motions.
B.2.8	Lifting Appliance	A reference definition used by classification societies that is any equipment that is involved in supporting an elevated load; this includes OHS components, as well as cranes not handling wet gear.
B.2.9	Load Geometry	The inlet and outlet tension member angles possible for an OHS component.
B.2.10	Maximum Anticipated Operating Tension(MAOT)	A calculated maximum load on the tension member based on the package specifics for weight and the added loads due to dynamic and hydrodynamic effects.

		The vertical acceleration used for calculation of dynamic effects shall be at least 1.75g (per ABS Rules for Building and Classing Underwater Vehicles, Systems and Hyperbaric Facilities, Appendix 3, 9.3.4).
B.2.11	Maximum Capability Document (MCD)	Defines the MPT for a specific component or system, for a given range of load geometries.
B.2.12	Maximum Permissible Tension (MPT)	The maximum line tension that results in the Safe Working Load of a component or of the Overboard Handling System (OHS). This may vary, depending on the arrangement and geometry of the OHS.
B.2.13	Nominal Breaking Load (NBL)	Manufacturer's minimum published breaking load for a tension member. See Appendix A.
B.2.14	Overboard Handling Apparatus	The component of the OHS that launches/retrieves a package directly from the water, or maintains the tension member leading to the water; i.e., A-frame, hydro-boom, etc.
B.2.15	Overboard Handling System (OHS)	All shipboard components that support the tension member, from the point where the tension member attaches to the science package, to the ship supporting structure/foundation for the shipboard termination of the tension member (typically a winch attached to the ship's structure). The combination of components and tension member constitute the "overboard handling system".
B.2.16	Owner	The party or their representative who is responsible for the inspection, maintenance, and testing of the equipment. This could be the vessel operator, a winch pool managing institute, or the science party.
B.2.17	Portable System	An OHS brought aboard the ship and not permanently attached, or an OHS made up of component(s) brought aboard and integrated with shipboard components that work together to form an OHS for a specific use.
B.2.18	Render/Recover	A means of a winch to automatically maintain a pre-set tension by alternately paying-out and hauling back. Generally recovery haul back is limited to the point of initial rendering.
B.2.19	Safe Working Load (SWL)	The maximum total load that is allowed on any given component in an OHS during normal operation. This is determined by the designer of the component and reflects the maximum total force on the component, not the line tension. SWL = Yield Load for the material/FS for components SWL = ABL/FS for the tension member (see Appendix A)
B.2.20	Tension Member	Generic name used to describe a rope or cable in service for over the side work. The Safe Working Load for the tension member is the value determined by compliance with Appendix A (see definition of SWL in Appendix A)

B.2.21	Tension Mitigation Devices	Hardware and or technology employed in the OHS to limit the tension member tension to a pre-set value.
B.2.22	Ultimate Design Load	The load at which the weakest piece of a component reaches the Yield Load of the material.
B.2.23	Wet Weight Handling Gear	46 CFR 189.35-9 (c) (1) term for what Appendix B refers to as “Overboard Handling System” and includes all “gear used to lower apparatus or objects beneath the surface of the water…..”
B.2.24	Yield Load	The load at which the weakest component piece of the OHS reaches the yield stress of that component’s material. This excludes the tension member.

B.3 DEPLOYMENT SCENARIOS AND POTENTIAL FOR APPLIED LOADINGS

B.3.1 OVERALL REQUIREMENTS

For any new system or system component, the information listed in the attached Overboard Handling Data Document (OHDD) shall be developed by the Owner to the extent possible see Section B.3.7). The Designer and/or Vendor shall also provide the Maximum Capability Document (MCD) for each component and/or system (see Section B.5). This information shall be highlighted in the introductory section of the system’s *Operator’s Manual*. The Maximum Capability Document may be either a standalone document provided by the Designer/Vendor that is referenced in the introductory section of the system’s Operator’s Manual, or added to the Operator’s Manual as an addendum.

For any existing system or system component, the Owner shall develop the OHDD and MCD by working closely with the Designer and/or Vendor. This information shall be added to the system Operator’s Manual.

For standard deck hardware such as mounting bolts for deck sockets, shackles, swivels, and turnbuckles that are not custom made, a copy of the manufacturer’s specification sheet for the hardware will fulfil the requirements of Appendix B for the component Overboard Handling Data Document and Maximum Capability Document. The vessel operator shall establish a written procedure for how standard deck hardware is stored and inspected. The written procedure shall document the controls in place to ensure that when standard deck hardware is used, it has the load capability of the hardware components used when the overboard handling system Maximum Capability Document was developed.

B.3.2 PORTABL E SYSTEMS

For Portable Systems, the Owner (of the portable system or the portable components brought aboard and integrated with the vessels components) shall provide to the Operator the Maximum Capability Document information for each component the Owner brings aboard. Once brought aboard a ship, the Operator will develop a new Overboard Handling Data Document for the resulting overboard handling system that is made up of the portable components brought aboard in combination with the components being provided by the vessel. For example, a science party may bring aboard a portable winch and overboarding sheave with shackle that will be mounted on the ship for deployment using the ship’s A-frame. The resulting overboard handling system would be comprised of a combination of portable components provided by the science party and ship components provided by the Operator:

- Portable Components – Winch (with tension member), overboarding sheave, shackle to connect the sheave to the A-frame.
- Ship Components – Deck mounting system (sockets and bolts) and the A-frame.

The resulting portable system is evaluated:

- The Owner provides the Maximum Capability Documents for the three portable components along with the logbook for the tension member (per Appendix A requirements).
- The Operator provides the Maximum Capability Documents for the two shipboard systems.
- The Operator develops the Overboard Handling Data Document for the resulting portable system.
- The Operator utilizes the above information and develops the Maximum Capability Document for the portable system and makes a determination of the Maximum Permissible Tension for the safe use of the portable system.

A new overboard handling system Maximum Capability Document for the portable system shall be generated:

- Each time any of the components are repositioned on board the vessel (system Maximum Capability Document only)
- Each time the system geometry is modified, either alongside or underway. (Overboard Handling Data Document and Maximum Capability Document)
- When the specification of the tension member employed is changed (Overboard Handling Data Document only)

B.3.3 FIXED SYSTEMS

For fixed shipboard systems with a Maximum Capability Document, the Operator shall verify that the currently planned deployment scenario is at or below the existing/original design criteria given in the Maximum Capability Document. A new overboard handling system Overboard Handling Data Document and MCD shall be generated:

- When the specification of the tension member employed is changed
- When there is a modification to any component (geometry or hardware) of the ship's fixed overboard handling system (Maximum Capability Document).

NOTE: An important consideration for both fixed and portable systems are the hydrodynamic characteristics and entrained mass of the science packages and whether or not the induced accelerations from the vessel exceed the requirement of Section B.4 (>1.75g). The impact these characteristics would have on the tension for the overboard handling system must be evaluated and shown to be within the overboard handling system's capability (Maximum Capability Document).

B.3.4 NON-COMPLIANCE WITH MAXIMUM CAPABILITY IN THE MAXIMUM CAPABILITY DOCUMENT

For either Fixed or Portable Systems, if the planned deployment scenario is determined to NOT be within the existing design criteria, then the deployment shall NOT be allowed, or the operator shall take one of the following actions:

- Structural modifications shall be made to bring the components within the bounds of the original design criteria,
- Geometry modifications shall be made to re-configure the system such that it can safely accommodate the new deployment scenario,
- Perform the planned operations with a reduced payload size (lesser package weight, entrained mass, and/or drag).
- A combination of lesser modifications in all three above areas

In all cases above, a new Overboard Handling Data Document and/or Maximum Capability Document are to be prepared for the system.

B.3.5 DEPLOYMENT TYPE

The Deployment Type shall be determined at the beginning of the design and/or system evaluation process that will then allow the Principal, Secondary, and Worst Case loading cases to be defined. The anticipated Worst Case loading shall then determine the Structural Design Criteria to be used in Section B.4.

The following table lists the deployment types for oceanographic operations to be specified for design purposes in the OHDD. The allowable deployment type should also be shown in the MCD.

NOTE: The length of the tension member is used in lieu of the deployed depth to take into consideration a science package settling to the bottom if vessel speed is decreased or lost completely.

	Operation	**Examples**
B.3.5.1	Towing – Surface (Floating or shallow tow)	Towed arrays (e.g., streamers, smart floats) Air gun arrays Towed sonar fish (e.g., PES, 3.5kHz, EK60)
B.3.5.2	Towing - Mid Water (Where the deployed length of the tension member does not exceed 75% of the water depth)	Fisheries Nets (Twin and single wire) Magnetometers, Sonar (e.g., SeaSoar, TriAxis, MVP) MOCNESS
B.3.5.3	Towing - Deep Water (Where the deployed length of the tension member is greater than 75% of the water depth	Deep water fisheries nets (single wire) Sonar, Multidiscipline deep towed platforms Dredges, Bottom trawls, Sledges, Grapnel/Batfish, Camera Sled, SeaSoar, TriAxis.

	with either intentional or high likelihood of bottom contact)	
B.3.5.4	Station Keeping – Surface (Shallow Dips With or without Dynamic Positioning (DP)	Plankton nets Precision Echo Sounders (PES) Hydrophones Free floating buoys Autonomous Underwater Vehicles (AUVs, Gliders Sink and Rise Systems)
B.3.5.5	Station Keeping – Mid Water (Where the deployed length of the tension member does not exceed 75% of the water depth, with or without DP)	Acoustic arrays Conductivity, Temperature, Density (CTD)/water sampler operations
B.3.5.6	Station Keeping – Deep Water (Where the deployed length of the tension member is greater than 75% of the water depth with either intentional or high likelihood of bottom contact, with or without DP)	• Remotely Operated Vehicles (ROVs) • CTD/water sampler operations • Elevators • Standard Wire Coring • Deep Coring (Synthetic Rope) • Multicorer • Rock Drilling • Seabed Laboratory Placement/Retrieval • Steered Bottom Samplers (e.g., HyBIS, ARGO), which differ from ROVs in having no buoyancy. • Moored Buoys

B.3.6 PRINCIP AL, SECONDARY, AND WORST CASE LOADING SCENARIOS

B.3.6.1 Principal Loading

Principal Loading is defined as the tension member loading or loadings and the line(s) of action (vertical, longitudinal and transverse) prevalent at the handling system overboarding sheave during the principal phase or phases of the deployment.

As an example, for a CTD it would include the package weight, tension member weight, dynamic factoring due to ship motion, and hydrodynamic and resistance load during retrieval. Any special requirements of an activity that might have a modifying effect on the loading regime or tension member and equipment lifetime, such a sheave compensation, auto render, or differences between load properties of fixed and free end cables(i.e., use of swivels.) are to be highlighted.

B.3.6.2 Secondary Loading

Secondary Loading is defined as the potential for changes in loading or the primary line(s) of action of the loading.

For example, the vessel, for whatever reason, drifts off station leading to a large tension member angle to the normal nominally vertical case, imparting side loading to the overboarding mechanism. Another example would be for a Track Line Tow when the vessel crabs to maintain its track and imparts a side loading to the towing ‘A’ frame. In this latter case, a similar but much larger angle of the tension member can occur when the vessel executes a turn in order to follow a reciprocal track, or for collision avoidance while maintaining sufficient tow speed to keep the package from dropping to the seabed.

B.3.6.3 Worst Case Loading

Worst Case Loading situations are to be considered and defined in consultation with the operator.

For example, the ship’s machinery suffers a failure while towing a package close to the seabed and the package sinks, risking a hook-up on a rocky seabed, a taut tension member situation, and potential overload of the overboard handling system tension member results as the ship drifts down weather. Or when towing a net at speed near the bottom the net becomes hung-up causing a taut tension member situation and potential overload of the overboard handling system tension member.

The worst case loading situations may also consider the use of mitigation devices.

For example, auto-render with high value packages;e.g., Scanfish or weak links with low value equipment such as a dredge or net.

NOTE: It is important to specify the tension member properties that each piece of equipment is deployed with and the operating FS envelope required. The choice of tension members and their loadings are, as a pre-requisite, to be in accordance with the requirements of RVSS Appendix A.

B.3.7 OVERBOARD HANDLING DATA DOCUMENT (OHDD)

The Overboard Handling Data Document is a standard data sheet that shall be developed for each component that may be used as part of an overboard handling system for both existing systems and new systems equipment. A Maximum Capability Document (see Section B.5) is then developed for each component using the deployment type information in the Overboard Handling Data Document. The owner of the component must work with the Designer/Vendor to complete the data fields on the Overboard Handling Data Document. The owner would provide as many of the data fields in the Overboard Handling Data Document as is known as part of a purchase specification for new equipment (or as part of an engineering analysis specification for existing equipment) with the Designer/Vendor providing the rest. The use of either metric or imperial units should be consistent throughout the document.

Table B.3 is shown below, with examples and explanations regarding completion of the document.

TABLE B.3 — Overboard Handling Data Document

REQUIRED DATA	Operator/Designer Response
Deployment Type	**e.g., “Towing (Surface) – Section B.3.5.1”**
Provide a brief narrative of scientific purpose and the equipment to be deployed. A drawing or drawings of the proposed “system” or “component” architecture is to be appended showing, for example, tension member angles and potential loadings (Principal, Secondary & Worst Case) relative to the various system elements. Provide information on the vessel or vessels (size(s), type(s), UNOLS or not, etc) intended for the system deployment, its/their area(s) of operation and the likely weather conditions to be encountered	e.g., “Portable Deck Winch intended for…” *If this winch were used in a “system” for a particular cruise, a new Table B.3 would be developed using the individual “component” B.3 tables. For example, the stern A-frame would have a B.3 table from the original construction where it was integrated from the fixed trawl winch.* *For portable systems, bolting arrangements (number size and material) are to be defined along with the expected deck loads the system will apply to the vessel*
Provide Primary Deployment Information:	
Package Type	e.g., “Various” for a general purpose system
Maximum Package Weight	
Base Package Mass	
Added Mass to include Captured and Entrained Added Mass (e.g., water/mud)	
Maximum Hydrodynamic Resistance	
Dynamic Factors	
Tension Member Type and Safe Working Tension	e.g., “Various” for a General-Purpose system and/or Manufacturer’s model number
Maximum Tension Member Weight (in water)	
Maximum Tension Member Mass	
Selected Tension Member Factor of Safety per Appendix A	
Maximum Anticipated Depth of Deployment	
Maximum Allowable Depths of Water	

Tension Member Length/Water Depth (%)	*Needed to confirm "Deployment Type"*
Principal Loading	*Verbal Description*
Secondary Loading	*Verbal Description*
Worst Case Loading	*Verbal Description*
Ultimate Design Load	
Load Limiting Equipment	e.g., auto render and/or weak link along with proposed set values, See B.5
Maximum Anticipated Operating Tension (lbs or tons)	e.g., Estimated Maximum Load from Appendix A
Design Line Tension (lbs or tons	e.g., Either Tension Member Breaking strength or Maximum Anticipated Operating Load as applicable.
Other Emergency Means of Package or Tension Member Detachment	e.g., Acoustic release or deck mounted tension member cutter
Other means proposed for package control	e.g., Heave Compensation, state method and excursion limits proposed
Description of Fail Safes in the event of power loss or mechanical/electrical failure of system components	e.g., Connection of electric winch to the ship's emergency generator suitably sized to allow continued winch use. Use of standardized system components, spare parts and redundancies such that failed parts can be replaced

Attachment A1 provides a blank form of Table B.3 for use in the development of equipment proposals.

B.3.8 THE "SYSTEMS DESIGN" APPROACH

The previous sections establish the range and potential loadings applied to the different components that may be utilized in an overboard handling system. It is rare that a single component with its Overboard Handling Data Document and Maximum Capability Document is enough to comprise an overboard handling system since an overboard handling system is normally made up of multiple components (e.g. a winch, load path with necessary sheaves and shackles, and an A-frame). The handling apparatus, intermediate diverter sheaves, winches, ship attachments, ship support structural arrangements, and tension member must also be evaluated as a completely integrated system from the deployed science package through to the foundation structure of the winch taking into account increases in tension member loading due to passage around any sheaves enroute. For shipboard systems, the operator shall also develop Overboard

Handling Data Document's for the standard suite of overboard handling systems that are used aboard their respective ship:

> A ship may be equipped with a hydrographic winch that may be outfitted with either 0.322 EM cable or 3/8" 3x19 rope using interchangeable drums. The load path for the winch may be via a gantry style handling apparatus off the side of the ship, a crane boom with an under slung sheave off the side of the ship, or an A-frame off the fantail. This results in six possible "standard" overboard handling systems that utilize the hydrographic winch, each of which would have an Overboard Handling Data Document developed and a resulting Maximum Capability Document.

Likewise, portable winches are to eventually be incorporated as a component into a completely integrated system through and including, the existing overboarding equipment. Handling apparatus designs (A-frame, gantry, cranes, etc.) need to consider the potential positioning and loads arising from portable systems temporarily mounted on deck and overboarding via the fixed systems.

B.4 <u>STRUCTURAL DESIGN CRITERIA</u>

A flow chart given in Attachment A2 gives the information gathering and decision-making process that allows the appropriate analysis and/or use of an overboard handling system.

The Design Line Tension (DLT) for an overboard handling system shall be the Nominal Breaking Load (NBL) of the tension member used in the system with a minimum factor of safety of 1.5 on the yield of all components in the system, per 46 CFR 189.35 UNLESS the overboard handling system meets <u>any one</u> of the following criteria:

a. It is intended to be used with a deployed tension member length less than 75% of the nominal water depth for any deployment envisioned for that system (except as noted in Section B.0.2).
b. Winches are designed and operated with Auto Render or Render/Recover as described in Section B.10. Tension Member monitoring requirements shall be per Appendix A.
c. Calibrated and tested weak link as described in Section B.10.
d. It can be shown that the ship carrying the overboard handling system cannot develop the thrust or accelerations required to create the full breaking strength of the tension member installed. The calculations must show that the vessel cannot create such loads under power – or in a dead ship or inadvertently anchored situation in Sea State (SS 5/6 (high 5/low 6) wind and sea conditions. Consideration should be given to the added effect of momentum and deceleration of the vessel in the event the payload hangs up on the bottom. It must also be shown that the vessel's stability is adequate to sustain the loads and geometries which might be presented. Based on these calculations, the maximum imparted load on the tension member shall be used in lieu of the breaking strength of the tension member and SS 5/6 shall represent the limiting conditions for operations.

If any one of these conditions is met, then the DLT may be the MAOT in lieu of the NBL of the tension member used in the system and defined as follows:

For B.4 (a):MAOT = The GREATER OF:

[Package Weight (in water) + Tension Member Weight (in water)] +

(Package mass + Tension Member mass+ added mass) x 0.75 + Hydrodynamic drag

or

the maximum imparted load from the vessel

For B.4 (b): MAOT = Adjusted to a lower value with a Render or Render/Recover System to:

Load setting at which winch/system will render (Pay Out)

For B.4(c): MAOT = Adjusted to a lower value with use of a Calibrated Weak Link.

When using a weak link at the payload package, the Calibrated Weak Link load must be reduced by the weight of the maximum amount of tension member anticipated to be deployed and the towing resistance of the tension member, the added mass and other dynamic effects such as strumming.

All UNOLS vessels must comply with Appendix B. UNOLS vessels that are inspected and certificated by USCG under*46 CFR Subchapter U* must comply with Appendix B, as well as the requirements of *46 CFR Subchapter U* (whichever are greater).

B.5 MAXIMUM CAPABILITY DOCUMENT (MCD)

The maximum capability for a component is determined by calculation by a Naval Architect/Engineer (Designer) or component/system manufacturer (Vendor), and will be provided for use in the form of a Maximum Capability Document (MCD). For a fixed component this analysis should include not only that component itself, but also the supporting elements such as foundations and supporting ship's structure. The MCD presents the Maximum Permissible Tension (MPT) coupled with the allowed load geometry for the given Tension for each component in a system. Reactions on ship's structure for fixed components, and the bolting pattern for portable components, should also be given in the MCD based on the MPT.

For components that lend themselves to a single limiting MPT regardless of the geometry, the Maximum Capability Document may simply be a single value MPT that is applicable for all uses of that component. More complex components whose MPT is impacted by geometry may require a more complex Maximum Capability Document to take full advantage of the component capability. Some examples to illustrate this distinction include:

- Shackle – the Maximum Capability Document may be the manufacturer's specification sheet for the shackle with a single value that is the shackle's safe working load.
- Deck Socket – the Maximum Capability Document may be three limits depending on the geometry of how the load is applied; vertically, horizontally, or at an angle.

- A-frame – the Maximum Capability Document may look very similar to the load handling diagram for a crane that has different limits dependent upon the geometry of how the load is applied.

For some components that could have a complex Maximum Capability Document such as an A-frame, the operator may choose to simplify it for ease of use. For instance, a single MPT could be derived that applied to all geometries and modes that component could be used with. In this instance, the engineer would investigate all anticipated uses and modes and return with the LOWEST maximum from their calculations and this single blanket MPT could be stamped on the component. For this approach, it is likely that in some modes a possibly higher MPT is being sacrificed for simplicity during operations. Alternatively, various MPT could be presented for various modes of operation (Towing, Vertical Lift, Luffing) and/or tension member angles. In this instance, all approved geometries would be presented within the Maximum Capability Document.

Attachment A3 is a simplified illustration of how the tension a component sees (in this case an A-frame) is dependent on the geometry of the overboard handling system.

In the ultimate example of a Multiple Capability Document, curves and graphs could be presented that allow for varying MPT based on location of the winch on board, as well as location and angle of science package deployed (similar to a crane's loading diagram).

The engineering costs rise proportionally with the rising complexity of the document as a matter of presentation, rather than the necessity of performing the analysis. Over the life of the vessel and/or the equipment, the added understanding of system capabilities far outweighs the up-front cost.

The Maximum Capability Document shall be presented as a booklet with general information on the system or component, the controlling MPT and the various loading diagrams. Completed Overboard Handling Data Documents shall be attached to the booklet to establish the design criteria from which components were selected or developed.

Each system that uses portable components (for instance, a winch from winch pool) shall have the component maximum capability document included in their documentation as an attachment.

NOTE: The MCD Booklet shall be kept with the component at all times and at least two (2) copies should be delivered with it to the vessel operator; one (1) copy kept on the vessel and one at the marine office for after the vessel departs.

As with the Maximum Capability Document developed for each component based upon the component Overboard Handling Data Document, each overboard handling system will have a Maximum Capability Document developed based upon that overboard handling system's Overboard Handling Data Document and evaluation of the MPT for all the components.

The consolidation of the Overboard Handling Data Document's and Maximum Capability Document's for all components aboard a ship along with the standard suite of overboard handling system documentation results in a complete library of documents that will:

- Provide a permanent record of the basic design data and operational set-up of the components.
- Be incorporated into the equipment Operator's manual for each component.
- Promote consistency of approach.

- Be superseded by subsequent amended versions as and when required by changes made (such as new tension members, changes in system configurations, etc) thus providing a 'life history' of the equipment.
- Provide a record of the installation of portable pieces of equipment on different vessels or, of different positions and configurations on the same vessel, for future reference.

The OHS Operator's Manual and the MCD Component Booklets will also provide the operator with the means to evaluate and determine the Maximum Capability Document for a "new" overboard handling system that has not been previously evaluated. The operator would develop the Overboard Handling Data Document for the "new" overboard handling system and evaluate its capability as a system using the Maximum Capability Documents for each component to determine the Maximum Capability Document for the "new" overboard handling system. This evaluation by the operator would be documented prior to using the "new" overboard handling system.

If the complexities of the "new" overboard handling system are such that the operator is not confident in their ability to properly evaluate the overboard handling system, then it is incumbent upon the operator to have the evaluation done and a Maximum Capability Document prepared by a naval architect/engineer. The availability of the Maximum Capability Documents for each component that makes up the "new" overboard handling system should make this process relatively simple and efficient. This demonstrates the need for early communication between the ship operator and the Principal Investigators (PIs) for each science cruise to ensure "new" overboard handling systems (particularly if portable equipment will be used) can be properly evaluated before use <u>and</u> the necessity for obtaining MCD related information at manufacture.

Attachment A4 (in development) will provide an example Maximum Capability Document for an overboard handling system.

B.6 TESTING AND TEST DOCUMENTATION

Not withstanding the following, all USCG inspected UNOLS vessels must comply with 46 CFR 189.35-5 and as referenced, 189.35-13.

B.6.1 COMPONENT TESTING

Except for tension members and standard deck hardware in good physical condition and previously tested and recorded including those that have a Quality Assurance (QA) data record of manufacturer's testing (shackles, deck bolts, etc.), system components shall be tested to 125% of their MPT at least every two years. If it can be shown that a system test has applied 125% of MPT (for component in question) to that specific component, then that test is acceptable for compliance. Winches and sheaves may be bench tested to comply with this requirement. This requirement ensures that idle gear that may be in a pool or in storage is still tested at a minimum every two years.

Deck bolting sockets are considered components, NOT standard deck hardware and thus are periodically SWL tested on a 2 year testing cycle.

Tension members shall be tested in accordance with Appendix A.

B.6.2 FIXED SYSTEMS

Fixed systems shall be tested every two years to 125% of the system MPT. A fixed system shall be tested in the configuration(s) it will be used in during operations. A test shall consist of all components including winch, diverter sheaves, handling apparatus, and overboarding sheaves.

Each fixed system shall be tested once in each mode it operates in. As an example, an A-frame might lift vertically (1), tow astern (2), or luff inboard (3). This system would need to be tested in each of these modes. However for testing the tow astern it is anticipated that alternative testing as defined in section B.6.5 will be used. As far as geometry (winch location, sheave location, tension member angle) is concerned, the Maximum Capability Document shall identify a worse case geometry for each mode. Only that worst case geometry need be tested. Therefore, the example A-frame would be tested in three modes based on the worst case geometry in each model for a total of three (3) tests every two years. If a component (such as an ancillary winch) is not included in the system test (as it may not be part of worst case geometry) it must be tested on its own.

Auxiliary lifting appendages (lower rated side arms on an A-frame for instance) shall also be tested in their modes of operation at their worst case geometrical configuration. Duplicate appendages of identical design (port/stbd for instance) shall be alternated every two year cycle (year 0 – Port, year 2-Stbd). This does not apply to auxiliary pad eyes in the main lifting section of the apparatus, however – these pad eyes should be tested separately every four years.

B.6.3 PORTABLE SYSTEMS AND COMPONENTS

A complete portable system shall be tested on board the vessel of opportunity after installation and before its first use begins. System shall be tested to 125% of MPT. System shall be tested on every new installation/use. If the system has been used on the subject vessel within previous two years and has been tested on the subject vessel, the testing shall be confined to proper function and shall not require a load test.

A portable component (such as a winch) shall be tested on board the vessel of opportunity after installation on the vessel and before its first use. If the portable component has its own current (< 2 year) test documentation and its MPT and geometry falls within the limits of the vessel's pertinent system's Maximum Capability Document, the system test shall be confined to operational testing. If the component does not have its own stand alone test documentation or if its operation is not within the normal scope of the system's Max Capability document (i.e. new geometry) an in situ load test to 125% of the MPT shall be performed.

This test shall be recorded in both the component and system test logs to avoid unnecessary retesting.

In no case shall the MPT of the host system or the Safe Working Load of the tension member used, be exceeded when using a portable component.

B.6.4 PREFERRED TESTING METHOD

The preferred testing method for a system is to test the system in the configuration it is to be used at sea. A tension member of suitable strength for the test should be used and reeved from the winch through all sheaves, at the worst case angle geometry, through sheave attached to pad eye or lifting point on apparatus and to a “virtual package”. A substitute tension member can be synthetic line of higher strength but approximate diameter as the normally used tension member. The virtual package may consist of a certified test weight hung on a tension member to create the prescribed tension (125% MPT) or it can be a dead ended tension member with the tension provided by hauling back on the system winch. Test tension shall be measured by properly calibrated and verified tension measuring device(s) that are either part of the system or that are introduced for the testing purposes only.

This method of mimicking every aspect of an operation is the most rigorous test method as it tests each component in the exact orientation and loading that will be experienced at sea. This also simultaneously tests the adequacy of standard deck hardware (deck bolts, shackles) for a given system configuration.

Even for towing operations where a handling apparatus can be exposed to loads in both the vertical and horizontal planes simultaneously, testing of the “real life” configuration is the only way to ensure the system can consistently withstand the calculated MPT for that particular operation.

B.6.5 ALTERNATIVE TESTING METHODS

In lieu of testing an entire system in the precise configuration it will be used at sea, an alternative test method can be developed that results in the same effect as 125% of MPT. This alternative test method can separate the testing functions for the various components, and/or resolve real world at sea MPT diagrams into more manageable static load tests alongside.

For instance, a configuration might exist where an A-frame is used at sea with a winch somewhat forward on the deck and a vertically lifted load over the transom with a tension member leading from the winch over a sheave hung on the A-frame to a payload package. In lieu of testing this scenario, a test could be developed that mimicked the resultant load on the A frame and a single calibrated weight could be hung at the appropriate angle from the A-frame. In that case, however, a separate test would still have to be performed on the winch, any fairleads or sheaves in the tension member path as well as the hanging sheave used at the A-frame.

A more logical scenario in which this methodology could be used is for testing the Tow mode. While it is possible that an off center, far astern tow situation could be modelled by reeving a test tension member far astern of a vessel to a fixed point on a pier or to a substantial mooring, the logistics of such a test are complex. In lieu of that, a vertical resultant load could be applied to the overboard handling apparatus as well as additional fore/aft and/or side loads that collectively model a real world tow situation.

B.6.6 TEST PROCEDURE AND RECORDING

A formal test procedure shall be developed for each component and/or the entire system. While this may be done by the operator, it may be best accomplished as part of the scope of work for the naval architect/engineer and/or the system manufacturer. The test procedure shall delineate the real world scenarios and geometry to be tested with reference made to the component or system Maximum Capability Document. The test procedure shall include reeving diagrams, indication of tension member to be used, description of system of tension application (test weight or dead end tension, by system winch or ancillary winch), methods of certification of accuracy of tension (on board tension measuring equipment and that system's calibration, calibrated test weights, calibrated test scale used to weigh miscellaneous weights) and safety precautions. If "alternative" testing method by calculation of equivalent resultant loads is to be used, reference shall be made to these calculations or calculations shall be provided within the test procedure.

Each component and/or the system shall have a Test Log that indicates test dates, test results, test methods (per procedure) and those present. Test logs must be kept aboard the vessel with a shore-side copy maintained at the Marine Office.

The system Test Log shall also incorporate information required by 46 CFR 189.35-13. Specifically, this includes inspections, testing, important repairs and casualties experienced. The Test log shall be kept aboard the vessel and shall be made available to inspectors (regulatory such as USCG and oversight such as NSF or other government agencies as appropriate).

B.6.7 TESTING RESPONSIBILITY

For fixed systems, testing is the responsibility of the vessel Operator.

For portable system components, testing is the responsibility of the component Owner.

For portable systems, testing is the shared responsibility of the component Owner and the vessel Operator. Financial responsibility for setup and conducting the test may be shared with the science user depending on the complexity and availability of documentation (or lack thereof). The ship operator shall assist in making arrangements for all required testing and shall conduct the test with the support of the science user.

B.6.8 TESTING OF LOAD LIMITING DEVICES

Testing of Auto Render, Render/Recovery, and other load limiting devices are as described in Section B.10 below.

B.7 PROCEDURAL AND GENERAL SAFETY REQUIREMENTS

B.7.1 PROCE DURAL REQUIREMENTS

Procedures are to be developed during system design or integration for: Rigging and un-rigging the system, launching and retrieval of packages with emphasis on protection of the handling system, the deployed packages, the vessel, and most importantly, the personnel involved.

These procedures are to be continually reviewed during the design, manufacturing, and/or integration stages to ensure that the process remains valid and safe throughout. Factory acceptance trials and harbor acceptance trials are to be utilized to verify the proposed procedures as far as practicable.

Prior to the first mobilization and sea trial of the system, all the participants are to be rehearsed in the procedures, and a detailed plan prepared of all the tests and trials required to prove the system 'fit for service.'

During the first mobilization and sea trials, the procedures are to be implemented. Where changes become necessary from this experience, they should be incorporated into a revision of the procedure documentation.

On completion of the sea trials, the procedures are to be reviewed, approved for service, and provided along with all other necessary documentation to the Owner/Operator.

B.7.2 GENERAL SAFETY REQUIREMENTS

All moving elements shall be protected by guards or guard rail enclosures to prevent inadvertent contact by personnel in a seaway environment.

All tension member paths shall be protected by wire mesh guards, casings, restraining posts, or safety zones as far as possible to prevent personnel contact in case of failure in accordance with Appendix A.

Where tension members are led from below deck through trunks, due regard must be taken of the potential for down flooding through the open trunks and the requisite coaming heights provided.

Any other penetrations required by the design must also take into account the need for watertight integrity of the hull and superstructure, and be configured accordingly.

Where portable systems are proposed using a vessel's deck bolting system, the equipment weights and tension member loads and directions must be proven not to overstress the bolting system or the deck in which it is incorporated (part of B.3 analysis).

Where permanent systems are proposed, the equipment weight and tension member loads and directions for Principal, Secondary, and Worst Case loadings are to be used in defining the deck and its underdeck support structural designs (part of B.3 analysis).

B.8 TRAINING

Load Handling System and/or component training shall be auditable, comprehensive, and comply with the requirements for winch operator training in Appendix A *UNOLS Rope and Cable Safe Working Load Standards*

B.9 LABELLI NG AND DOCUMENTATION

As a minimum, the system components shall be labelled with the following information:

Maximum Permissible Tension (MPT) XXX

Test Date XX/XX/XXX

MPT Diagram [providing a clear definition of the geometry]

Ref. Drawing: XXXXXX [where MPT diagram alone is inadequate]

While a system might be designed specifically for a particular use and restricted solely to that, on general purpose ships a tension member, and its winch or handing appliance, might be used for a variety of purposes (e.g., coring, dredging, grappling, trawling). Therefore, proper labelling must be carefully considered, comprehensive in its information and based upon the information contained in its Maximum Capability Document.

The labelling of winches capable of handling more than one tension member (e.g., traction types) must be comprehensive in its information and based upon the information pertaining to each configuration contained in its Overboard Handling Data Document and Maximum Capability Document.

On general purpose vessels, a trawl winch and its tension member may be pressed into service to take over from a coring winch in support of a science program or to grapple for a piece of lost equipment. Therefore, such eventualities have to be considered and included in the labelling information. General redundancy to meet these requirements and a wide variety of scientific programs must be understood at the concept stage and their implications carefully considered.

Overboarding appliances can be even more complex by being capable of deploying a number of tension members either individually or simultaneously. For example, a midship frame might be capable of deploying a CTD (vertically), a coring wire (vertically), and a dredging wire (at a towing angle to the vertical). An aft frame might be configured to deploy long cores vertically, but also tow nets, which also impart significant side loads when in a turn. All these activities are to be illustrated in Overboard Handling Data Document and Maximum Capability Document documentation.

Overboarding appliances that come as part of the vessel at delivery generally stay with the vessel for its entire service life. Since this equipment may impose limits on the ship's stability and structural design, the initial design loads should be set recognizing that the vessel overboarding requirements may increase over time.

Ship operators and their seagoing staff must understand that if, by force of circumstance or by their wish to maintain scientific operations while on a cruise, they re-configure or use systems outside the bounds of the labelling information without undertaking the required study of the new arrangement in accordance with Maximum Capability Document, they are embarking on a potentially dangerous activity. The consequences of this activity could be loss of valuable equipment, damage to the vessel and its fixed equipment, and, in the worst case, injury to personnel.

B.10 TENSION MITIGATION DEVICES AND SYSTEMS

Detailed requirements for various tension mitigation devices and systems are given in subsections below.

B.10.1 AUTO RENDER AND RENDER/RECOVERY REQUIREMENTS

Where auto render or render/recovery is specified in order to allow the application of the Maximum Anticipated Operating Tension during design, the Overboard Handling Data Document shall clearly state this along with the specific system capabilities.

Auto render and render/recover shall have the following capabilities:

1. Continually monitor the loading condition of the winch
2. Operate continuously in all modes of winch operation without intervention of the operator
3. Provide rapid response to an overload condition, never allowing the tension member to exceed 100% of Design Line Tension
4. Capable of manual adjustment by the winch operator to enable rendering at any tension between, 10% and 75% of the Design Line Tension.
5. Retain tension at the pre-set load while activated in an overload condition
6. Signal that the system is armed and monitoring with a continuous visual indicator at the control station.
7. Signal that the system is operating in an overload event with a continuously illuminated signal at the control station. The signal shall remain illuminated after the overload event until manually re-set by the operator or until the winch system is powered down.
8. Signal that the system is operating in an overload event with a continuous audible alarm at the control station, winch and working deck areas. The alarm shall stop when the overboard event has passed.
9. Return the winch to full operating capability after the overload event has passed without intervention by the operator.

A means of reliably testing the auto render or render/recover system during winch trials (Factory Acceptance, Harbor Acceptance, Sea Acceptance) and for required periodic load testing shall be described in detail in the Operator's manual.

Note: Render/recover winches can also provide a means of maintaining a constant tension, preventing potential snatch loads after the winch has paid out. The operator should consider the need for an emergency power supply which might be drawn from the ship's emergency generator, in order to keep the winch and its auto render/recovery facility in operation.

B.10.2 WEAK LINKS

Where weak links are specified in order to allow the application of the Maximum Anticipated Operating Tension during design, the Overboard Handling Data Document shall clearly state this along with the design details of the weak link, the calculation of the mechanics of failure and the value of the failure load. The weak link shall be included at the end of the tension member and set to the MPT less the weight of the supported tension member weight and the towing resistance of the tension member, the added mass and other dynamic effects such as strumming.

NOTE: Use of weak links must recognise their limitations when using metallic tension members (as opposed the near neutrally buoyant synthetics) due to the impact of metallic tension member weight on activities such as deep coring. A weak link placed at the package only protects against the package becoming entangled, and if the tension member becomes entangled, it is still possible for the breaking load of the tension member to be generated and transferred to the handling system.

B.10.3 ACOUSTI C RELEASES

In the event a science package may become irretrievable if the tension member parts, an acoustic release device may be considered for inclusion in the system in order to recover either the package and/or a section of the tension member (which could be of very high value).

An acoustic release is not considered a load limiting device for the purposes of designing to MAOT, as it does not automatically prevent the potential overloading of tension members or the overboarding system components. The release is considered a method of last resort if a package is irretrievable.

B.10.4 REMOTELY OPERATED CUTTERS

Where a remotely operated cutting device is installed to sever the tension member, it shall be under the direct control of the vessel's Master who will be the sole arbiter of the necessity and timing of its use.

Load monitoring/alarms as per Appendix A are to be fitted in support.

The cutter should be a stored energy device totally independent of the ship's power system.

Cutters are not considered load limiting device for the purposes of designing to MAOT, as it does not automatically prevent the potential overloading of tension members or the overboarding system components. Cutters are to be used to either release an irretrievable package if an acoustic release is not installed, or if the Captain deems it necessary to cut the tension member to ensure the safety of the vessel.

B.10.5 MOTION COMPENSATION

Motion compensation shall be specified only for the control of the scientific package in the water column to improve scientific data quality (e.g. CTD thermocline following), prevent bottom impact of "low flying" equipment, and/or reduce the dynamic loading per Appendix A. **Motion compensation is not considered a load limiting device for the purposes of designing to MAOT**

NOTE: For motion compensation by winch pay-in/pay-out, the potential for continual working of sections of the tension member over intermediate sheaves and overboarding sheaves must be considered. Sheave diameters and groove profiles should be chosen to minimize possible damage with diameters in excess of the minimum Appendix A requirements fitted if possible.

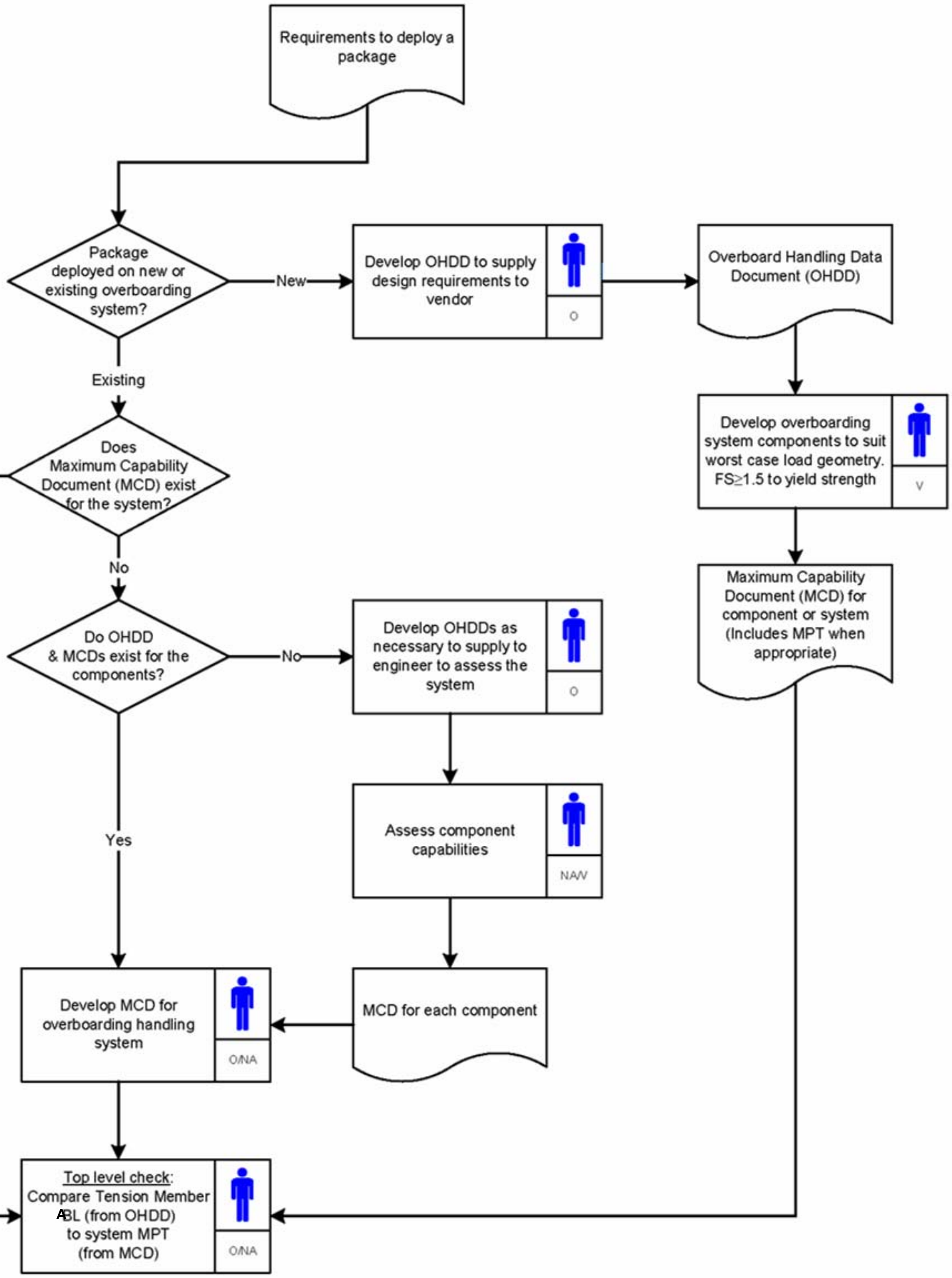
Attachment A1

TABLE B.3 — Overboard Handling Data Document

REQUIRED DATA	Operator/Designer Response
Deployment Type	
Provide a brief narrative of scientific purpose and the equipment to be deployed. A drawing or drawings of the proposed "system" or "component" architecture is to be appended showing, for example, tension member angles and potential loadings (Principal, Secondary & Worst Case) relative to the various system elements. Provide information on the vessel or vessels (size(s), type(s), UNOLS or not, etc.) intended for the system deployment, its/their area(s) of operation and the likely weather conditions to be encountered.	
Provide Primary Deployment Information:	
Package Type	
Maximum Package Weight (lbs.)	
Base Package Mass	
Added Mass to Include Captured and Entrained Added Mass (E.G., Water/Mud)	
Maximum Hydrodynamic Resistance	
Dynamic Factors	
Tension Member Type and Breaking Load	
Maximum Tension Member Weight (In Water)	
Maximum Tension Member Mass	
Selected Tension Member Factor of Safety Per Appendix A	
Maximum Anticipated Depth of Deployment	
Maximum Allowable Depths of Water	
Deployment/Water Depth Ratio	
Principal Loading	
Secondary Loading	
Worst Case Loading	

Ultimate Design Load	
Load Limiting Equipment	
Maximum Anticipated Operating Tension	
Design Line Tension	
Other Emergency Means of Package or Tension Member Detachment	
Other Means Proposed for Package Control	
Description of Fail Safes in the Event of Power Loss or Mechanical/Electrical Failure of System Components	

Attachment A2 Appendix B Flow Chart



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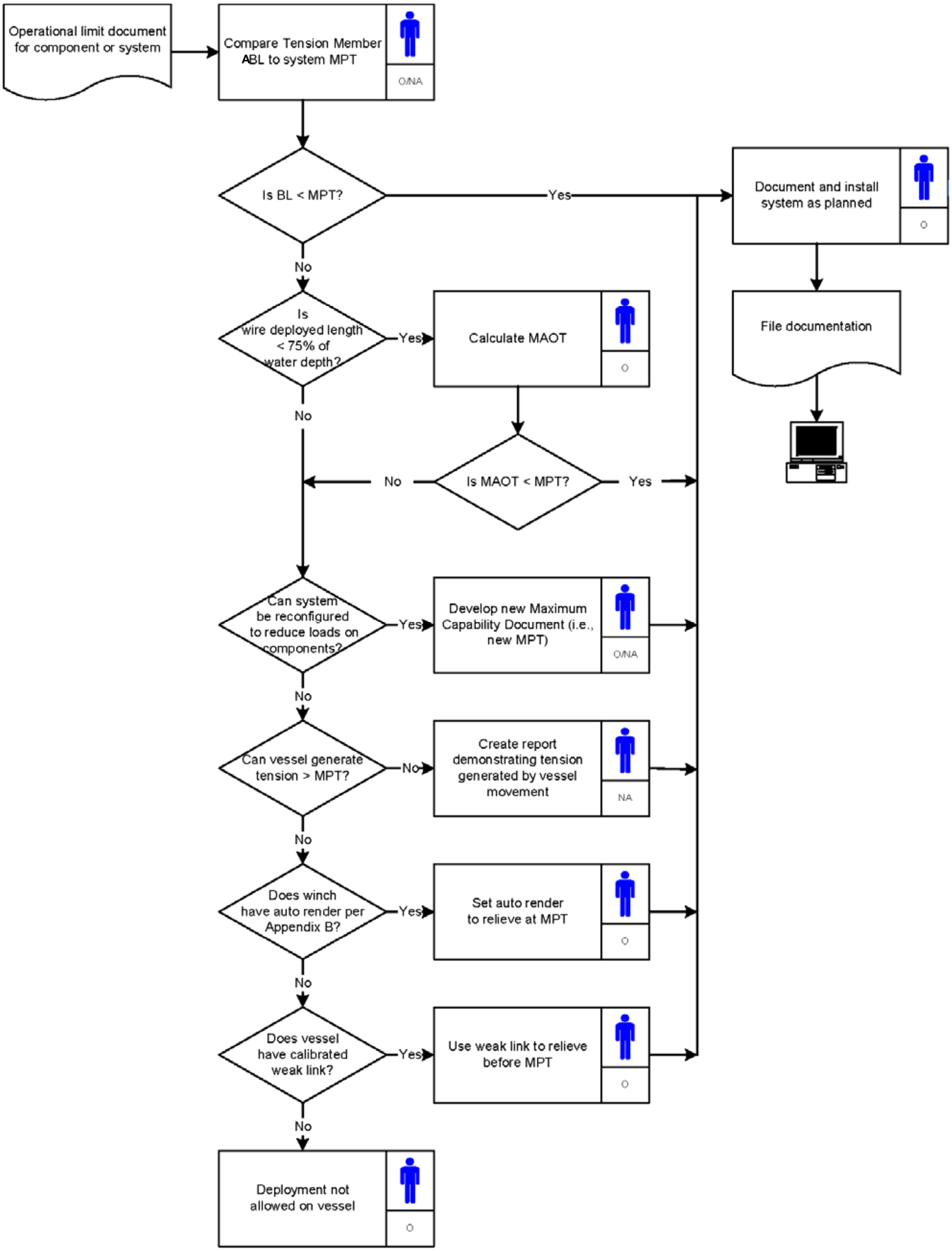
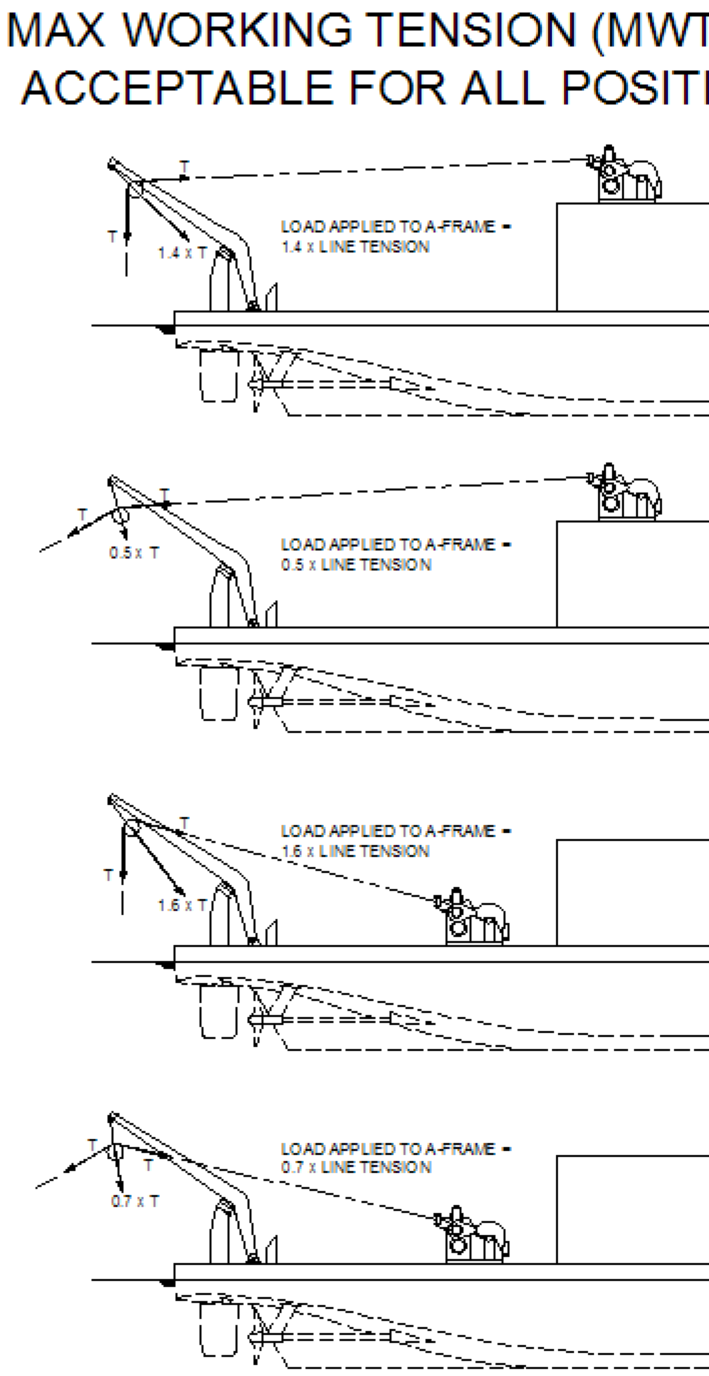

Operational limit document for component or system
Compare Tension Member ABL to system MPT
O/NA
Is BL < MPT?
Yes
Document and install system as planned
O
File documentation
No
Is wire deployed length < 75% of water depth?
Yes
Calculate MAOT
O
No
No
Is MAOT < MPT?
Yes
Can system be reconfigured to reduce loads on components?
Yes
Develop new Maximum Capability Document (i.e., new MPT)
O/NA
No
Can vessel generate tension > MPT?
No
Create report demonstrating tension generated by vessel movement
NA
No
Does winch have auto render per Appendix B?
Yes
Set auto render to relieve at MPT
O
No
Does vessel have calibrated weak link?
Yes
Use weak link to relieve before MPT
O
No
Deployment not allowed on vessel
O

Attachment A3: Example of the impact of the overboard handling system geometry on the tension an A-frame would see.



Attachment A4

Reserved for including an example MCD for an overboard handling system in a later revision to Appendix B.

Attachment A5 Potential Appendix B data structure:

Note: Some of the items will become non-applicable or optional for specific systems and components.

Each Overboard Handling System (OHS):

The potential contents of the OHS Operator's Manual for each OHS:

- Overboard Handling System Data Document (OHDD) for the system
- Maximum Capability Document for the system with "Top Level Check" of the MPTs of each of the components and compared with the tension member Nominal Breaking Load (NBL)
- OHS test logs
- OHS layout and geometries
- Training and operator qualification requirements
- Inspection procedures
- Testing procedures
- Operational and safety precautions
- Emergency procedures

Each Component:

The potential contents of the MCD Component Booklet for each component:

- Maximum Capability Document with proof or analysis of the MPT included.
- Overboard Handling System Data Document (OHDD) for the system (a list of excluded items such as shackles, turning blocks, cleats, tie down bolts and deck foundations, tugger winches will reduce the complexity and the work load.)
    - Footprint and bolt pattern if applicable
    - Attachment loadings
    - Ship system interface requirements such as electrical power, hydraulics, data transfer
    - Component Test Logs
    - Component weight
    - Overall dimensions
    - Equipment Operator's Manual
    - Training and operator qualification requirements
    - Inspection procedures
    - Testing procedures
    - Preventative maintenance
    - Operational and Safety precautions

For portable components additionally:

- Sub-component inventory list
- Delivery check-off list
- Installation instructions

APPENDIX C
Safety Inspection Check List for Shipboard Vans

The attached checklist is intended for use by UNOLS Marine Superintendents and the Masters of vessels in the UNOLS fleet who need to determine if portable laboratory vans brought for use on their ships by Principle Investigators or other scientific personnel are reasonably safe. The placement and use of vans on research vessels is a complex issue involving many regulatory issues as well as common sense and an understanding of the shipboard environment. It is to be particularly noted that the United States Coast Guard and the American Bureau of Shipping regulate portable vans in various ways depending on the vans intended use and the registered tonnage of the vessel (i.e., a van acceptable for use on an “uninspected” vessel, such as the UNOLS “Intermediate” class vessels, may not be suited for a larger inspected vessel such as the UNOLS “Global” class.

Those responsible for inspecting vans as well as scientists planning to use vans should familiarize themselves with the “UNOLS Portable Scientific Vans Manual” (www.unols.org/committees/rvoc/vanspec.html). At the time this is written the manual is still a work in progress but it is an excellent source and is, henceforth, referred to as “the referenced manual.”

In some cases a portable van must meet specific requirements for use; if it does not it may not be used on a vessel. Table 1 in the referenced manual provides an outline of requirements for vans. As an example, a chemical storage, machinery or accommodation van, going on an inspected vessel must have a current USCG Inspection Certificate to be used on the vessel. In many cases, decisions about scientist-supplied vans will be less clear and more subject to judgment.

The attached checklist is intended as a guide. It is not intended to cover accommodation, chemical storage, power/machinery or explosives storage vans which all have specific requirements (see Table 1 in the referenced manual). It need not be used for vans brought on for storage use only. It is intended for laboratory vans of various types that will have scientific personnel working in them during the time the ship is at sea. The goal of the checklist is to reasonably determine if the van is safe for the personnel that will be using the van and that it will not pose an unreasonable hazard to the vessel and embarked personnel.

Safety Inspection Check List for Shipboard Laboratory Vans

Ship:______________ Date: _____________ Inspected by:________________

Van Description: __________________ Van Purpose: ____________________

PI or Owner: ____________________ Cruise(s): ________________________

A. EXTERIOR

Yes	No	
		Does the van appear structurally adequate for the intended use and location (wind, spray, vessel motion, "green water on deck")? See Table 1 in the referenced document for the UNOLS bulkhead stiffening requirements?
		Does the van appear to provide some level of fire boundary between the working space inside the van and the exterior? Will it be located a safe distance from the ship's structure? See Table 1 in the referenced document for the UNOLS Fire Boundary Requirements.
		Is the van constructed of steel, aluminum or other substantial material suitable for marine use?
		Are there suitable attachment points for securing to vessel?
		Is the exterior condition acceptable: holes, obvious structural damage, etc.?
		Are doors equipped with latches to prevent self-releasing from vessel motion?
		Are doors that will be left open during van use equipped with holdbacks?
		Do doors open outward (escape direction)?
		Are external doors and hatches "weather tight?" Are overhead escape hatches "watertight?"
		Is there a label stating the lightweight and gross (tare) weight?
		When applicable, is there a label stating power requirements?
		Are the hook up receptacles (power, water, etc) in good condition?

B. INTERIOR

Yes	No	
		Are there two means of egress that can be opened from both the interior and exterior of the van? (Container doors do not qualify.) (Does not apply to storage vans.)
		If overhead escape hatch, does it open? Test it.
		If fitted with an overhead escape hatch, does it have a unobstructed ladder, footholds, steps or other method for accessing the hatch? Is there a safe method to get down from the top of the van?
		Does the electrical system meet good commercial standards (conduit, GFCI protection, commercial lighting enclosures, grounding)?
		Is the electrical system equipped with adequate and accessible circuit breaker protection?
		Are any internal doors free of locking devices and unblocked (Exterior doors may be fitted with locking devices for security and shipping as long as they remain unlocked while in use)?
		Is there adequate ventilation for the intended purpose?
		Are there suitable fire extinguishers?
		Are there a first aid kit, eyewash, and emergency shower if applicable?
		Is there emergency lighting for egress in the event of a power failure?
		Is there provision for internal communication (intercom, general announcing system, general alarm)?

APPENDIX D
Inspection Check List for Chartering Non-UNOLS Vessels

Vessel Name:	
Owner:	
Address and Contact Information:	
Operator:	
Address and Contact Information:	
Licenses held:	
Vessel Type and General Description:	
Length Overall:	
Displacement:	
Tonnage [GT/GRT/NT] :	
Draft:	
Radio Call Sign	
Number of Passengers/Scientists that can be carried:	
Charterer – PI and Institution	
Dates of planned charter:	
Area of operations:	
Type of operations or activities planned:	
Number in planned science party:	

[Use Reverse Side for additional information]

Inspection Check List for Chartering Non-UNOLS Vessels

Check each category listed below as appropriate for the charter mission and operating area. Ensure necessary equipment is aboard and operates properly.

Bridge and Navigation Equipment:

_____Compass

_____Two GPS Systems

_____Depth Sounder

_____Radar

_____Navigation Lights

_____Ships Bell

_____Whistle or Sound Device

_____Emergency Alarm

_____Pyrotechnics Expiration Date Not Exceeded?__________

_____Navigational Charts and Publications

_____ECDIS or Electronic Charting/Navigation Programs

Communications Equipment:

_____Radios, VHF and/or SSB

_____INMARSAT, Iridium or Other Satellite phone system

_____Cellular Phone

_____Emergency Radio with backup battery or power

_____EPIRBs

_____SART

Documentation:

_____Ensure vessel can be legally chartered based on certificate of inspection, letter of designation or limitation of charter to less than 6 persons.

_____Ensure documentation, ownership, inspection certificate, load line certificate and stability letter are current and appropriate for planned mission.

_____Ensure Master's license is current and appropriate for vessel being chartered.

_____Ensure crew size and credentials are appropriate for charter's mission.

_____Ensure insurance coverage meets chartering Institutes minimum requirements for charter duration.

Inspection Check List for Chartering Non-UNOLS Vessels

Life Saving Equipment:

_____PFDs

_____Immersion Suits

_____Inflatable Life Rafts

_____Life Ring Buoys

_____Rescue Boats

_____Water Lights/Strobes

Exterior Decks and Equipment:

____ Anchors and Associated Equipment

____ Watertight Doors and Hatch Comings

_____Freeing Ports

_____Deck Vents

_____Cargo and Weight Handling Equipment (Safe Work Load posted & tested, 46CFR189.35 requirements, Appendix A requirements if appropriate).

_____Deck Surfaces Non-Skid

_____Life Lines and Safety Chains

Fire Fighting Equipment:

_____Fixed and Portable Fire Extinguishers Inspection Dates Current?_____

_____Smoke and Fire Detectors

_____Fire Stations and Hoses

_____Self Contained Breathing Apparatus

_____Fire and Damage Control Locker

_____Emergency Stations Bill

Inspection Check List for Chartering Non-UNOLS Vessels

Engineering:

_____Gas Engines. Check flame arrestor, vents, gas hoses, no sparking devices in bilges.

_____Diesel Engines. Check oil and exhaust leaks, starting system, maintenance, hours since last overhaul.

_____Inspect overall cleanliness and condition of power sources.

_____Check emergency lights.

_____Check bilge and ballast systems and pumps.

_____Check fueling system and pumps.

_____Check refrigeration systems.

_____Check fire pump.

_____Check engine room fire suppression capability.

_____Check all manifolds for saltwater, fuel, etc.

_____Check condition of switchboards, wiring and auxiliary generators.

Structural:

_____Tank Inspections/Record of Inspections

Miscellaneous:

_____First Aid Kits and Medical Supplies

_____Damage Control Equipment

_____Emergency Steering

_____General Appearance and Cleanliness

_____Oil Pollution Placard and other required notices are posted.

_____Sanitary System Operations

_____Assess vessel's overall stability

_____Assess vessel's overall ability to perform charter mission. Include laboratory and deck space, berthing and feeding capability, scientific equipment and winches, etc.

APPENDIX E
Sexual Harassment Brochure

UNOLS vessel operators are committed to maintaining a positive working and learning environment, and an environment free of illegal discrimination and harassment. Each vessel is obligated to follow the internal policies established by their operating institution. Embarked scientists, ship's crew and technicians, shore-side personnel, and managers ashore, at sea, or in the field should strongly support this effort.

What is harassment?

Harassment includes verbal or physical conduct, whether on or off the premises, which has the intent or effect of unreasonably interfering with any individual's or group's academic or work performance, which significantly affects an individual's ability to participate in the activities of the vessel or field expedition (whether on or off duty), or which creates an intimidating, hostile or offensive educational or work environment, when such conduct is based upon age, race, color, national origin, gender, sexual orientation, religion, creed, disability or status as a Veteran.

What types of behavior constitute harassment?

Harassment can take many forms. It can be blatant or subtle, verbal or physical, printed on paper or communicated electronically. Examples of conduct that can constitute harassment are:

- Outright propositions/improper suggestions or requests for sexual favors
- Threats or promises regarding compliance with sexual behavior
- Sexist, racial or ethnic jokes, slurs or cartoons; lewd or obscene remarks; disparaging remarks relating to gender, race, ethnicity, etc.
- Abuse, insults or jokes concerning sexual orientation, including insinuations or offensive comments about private life or lifestyle
- Sexual or racial innuendoes or offensive sexual or racial statements disguised or presented as humorous
- Unwanted physical contact, including touching, pats, hugs, squeezes, brushing against, putting arm around another person
- Unwelcome advances such as repeatedly asking someone out on a date in spite of past refusals
- Actions or sounds – whistling, cat-calls, suggestive sounds, obscene gestures, display of offensive pictures or graffiti that would be found offensive by a reasonable colleague
- Stalking or following someone in an unacceptably unprofessional fashion
- Imbalance of attention, whether it be positive or negative, towards one employee or student based upon gender or race that has the intent or effect of providing an inequitable work or educational environment
- Any form of assault – sexual or otherwise

Special conditions at sea.

Social conditions in remote locations such as at sea or at an ice camp are very different from those typically faced at work. The close quarters demand utmost consideration of others at all times. Privacy is greatly reduced, and as a result, interactions can become more intense, intentionally or not. When in these situations, anyone may be subject to more excessive personal attention, welcomed or un-welcomed, than might be experienced in a more typical work situation. Sexual awareness and tensions may be heightened, especially if people feel lonely, overtired or homesick and the resulting behavior may be so disruptive as to constitute harassment.

What should you do if you witness or experience an inappropriate or uncomfortable incident or situation?

Speak up: If you believe you may have experienced or witnessed harassment, do not hesitate to speak with the offender. Many situations can be resolved very simply by directly and promptly telling the offending party that his/her behavior is making you feel uncomfortable and asking the person to stop. If you feel uncomfortable speaking with the person privately, approach the individual with a trusted friend or colleague.

Tell someone: In addition or alternatively, it is your right and, especially in the area of sexual harassment, you are strongly encouraged to report the matter to the ship's Captain and/or the Chief Scientist. They are responsible for maintaining a safe working and learning environment, free of harassment and discrimination.

Keep records: Keep notes describing the incidents noting the date, place, time and any witnesses to the behavior.

Seek advice: While speaking directly to the offender or reporting your concerns to the Captain or Chief Scientist are the first options to consider, there may be instances when neither of those is appropriate. In that case, you should seek advice from someone else that is in a position to help, such as the Marine Superintendent who can often be reached by e-mail from the ship at sea.

Resources:

It cannot be emphasized enough that if you are the recipient of unwanted or unwelcome attention or harassment and have not resolved or cannot resolve the situation yourself, you need to speak with someone. For overall or general support, you may want to speak with a friend, colleague, peer or member of the clergy. To address your specific concern it is important that you speak with someone in a position to help. All personnel including those at sea (such as crewmembers, and technicians as well as members of the science party) or in remote field locations, whether they are employees, postdocs or students can access the following resource personnel:

At Sea:

- Chief Scientist or immediate supervisor
- Captain
- Chief Mate
- Marine Superintendent

Note: Verbiage Taken from Wood Hole Oceanographic Institute Brochure, "Harassment; What it is and what can be done about it?", January 2006

APPENDIX F
List of Acronyms

AAUS	American Academy of Underwater Sciences’
ABL	Assigned Breaking Load
ABS	American Bureau of Shipping
ABYC	American Boat and Yacht Council
AC	Alternating Current
ADA	American’s with Disabilities Act
AIS	Automated Identification System
ASAM	Anti-shipping Activity Messages
AUV	Autonomous Underwater Vehicle
CFR	Code of Federal Regulations
COR	Certificate of Registry
CPR	Cardiopulmonary Resuscitation
CTD	Conductivity-Temperature-Depth
DC	Direct Current
DPA	Designated Person Ashore
DSC	Digital Selective Calling
EEBD	Emergency Escape Breathing Device
EPIRB	Emergency Position Indicating Radio Beacons
ETA	Estimated Time of Arrival
FCC	Federal Communications Commission
FM	Factory Mutual
FS	Factor of Safety
GMDSS	Global Maritime Distress and Safety System
GPS	Global Positioning System
GRT	Gross Registered tonnage
GT	Gross tonnage
HF	High Frequency
HOV	Human Occupied Vehicle
IACS	International Association of Classification Societies LTD.
ICLL	International Convention on Load Lines

IEEE	Institute of Electrical and Electronics Engineers
IFF	Identification Friend or Foe
IMDG	International Maritime Dangerous Goods
IMO	International Maritime Organization
INSURV	Inspection and Survey
ISM	International Safety Management
ISO	International Organization for Standardization
ISPS	International Ship and Port Facility Security
ITC	International Convention on Tonnage Measurement of Ships
LBP	Length between perpendiculars
LCG	Location of the Center of Gravity
LFM	Linear Feet per Minute
LL	Load Line
MARPOL	International Convention for the Prevention of Pollution from Ships
MEOL	Maximum Expected Operating Load
MF	Medium Frequency
MMD	Merchant Mariner Document
MSC	Maritime Safety Committee
MSO	Marine Safety Office
MSDS	Material Safety Data Sheets
MSHA	Mine Safety and Health Administration
MSM	Marine Safety Manual
MTSA	Maritime Transport Safety Act
NBDP	Narrow Band Direct Printing
NBL	Nominal Breaking Load
NFPA	National Fire Protection Association
NGA	National-Geospatial Agency
NIOSH	National Institute for Occupational Safety and Health
NOAA	National Oceanic and Atmospheric Administration
NPFVOA	North Pacific Fishing Vessel Operators Association
NRC	Nuclear Regulatory Commission
NRT	Net Registered Tonnage
NSF	National Science Foundation
NTSB	National Transportation Safety Board

NVIC	Navigation and Vessel Inspection Circular
OCMI	Officer in Charge, Marine Inspection
ONI	Office of Naval Intelligence
ONR	Office of Naval Research
OPA	Oil Pollution Act
OPRC	International Convention on Oil Pollution Preparedness Response and Cooperation
ORM	Other Regulated Materials
ORVA	Oceanographic Research Vessel Act
OSHA	Occupational Safety and Health Administration
OSRO	Oil Spill Removal Organization
PFD	Personal Floatation Device
PI	Principal Investigator
PLB	Personal Location Beacon
QMED	Qualified Member of the Engineering Department
RCC	Rescue Coordination Center
RO-RO	Roll On – Roll Off
RSO	Radiation Safety Officer
RVOC	Research Vessel Operators' Committee
RVSS	Research Vessel Safety Standards
SAR	Search And Rescue
SART	Search And Rescue Transponder
SHIP	Seafarers Health Improvement Program
SITOR	Simplex Teletype Over Radio
SMC	Safety Management Certificate
SMS	Safety Management System
SNAME	Society of Naval Architects and Marine Engineers
SOLAS	International Convention for the Safety of Life at Sea
SSAS	Ship Security Alert System
STCW	Standards of Training, Certification & Watchkeeping
STR	Ship Time Request
SWAB	Service offered by the Tritium Lab at the University of Miami to detect very low levels radio activity in shipboard labs and vans..
SWL	Safe Working Load
TBL	Tested Breaking Load

UL	Underwriters Laboratories
UNOLS	University-National Oceanographic Laboratory System
USC	United States Code
USCG	United States Coast Guard
VHF	Very High Frequency

INDEX

NOTES