Computer-Based Systems

Established and Amended Rules and Guidance

Rules for the Survey and Construction of Steel Ships Part X (Establishment)
Guidance for the Survey and Construction of Steel Ships Part X (Establishment)
Rules for the Survey and Construction of Steel Ships Parts B and D
Rules for Automatic and Remote Control Systems
Rules for High Speed Craft
Rules for the Survey and Construction of Inland Waterway Ships
Guidance for the Survey and Construction of Steel Ships Parts B, D, and P
Guidance for Automatic and Remote Control Systems
Guidance for the Survey and Construction of Inland Waterway Ships
Guidance for the Approval and Type Approval of Materials and Equipment for Marine Use

Reason for Establishment and Amendment

IACS Unified Requirement (UR) E22(Rev.2) (adopted June in 2016) specifies requirements related to stakeholder responsibilities and management procedure changes with respect to software for computer-based systems. These requirements have already been incorporated into the NK Rules.

As the use of general-purpose computers and full-fledged programming languages in ship systems has become more common in recent years, the dependence of such systems on the software they use has also correspondingly increased. At the same time, automated systems are becoming more complex and such systems are becoming increasingly more interconnected. Since several years had passed since the adoption of UR E22(Rev.2), IACS decided to review the UR to make sure it still reflected the current situation. As a result of this review, IACS adopted UR E22(Rev.3) in June 2023 to further clarify requirements for each phase (i.e. design, construction, testing and maintenance) of computer-based system development and use. In addition, IACS also revised UR E26 (“Cyber resilience of ships”) and UR E27 (“Cyber resilience of on-board systems and equipment”) that it adopted in April 2022.

In light of the above, the Society decided to add a new part to its Rules for the Survey and Construction of Steel Ships to not only establish requirements corresponding to UR E22, UR E26 and UR E27 but also to respond to the growing importance of computer-based systems and their use on board ships. Accordingly, the Rules for the Survey and Construction of Steel Ships Part X for computer-based systems is established and relevant requirements are amended in accordance with UR E22(Rev.3).

Outline of Establishment and Amendment

The main details of the establishment and amendment are as follows:

(1) Transfers requirements related to computer-based systems from Annex 18.1.1 Part D of the Rules to the newly established Part X of the Rules.
(2) Clarifies requirements according to the life cycle of computer-based systems (i.e. from design to operation) for each stakeholder role (system supplier, systems integrator, etc.)
(3) Specifies requirements related to quality management in manufacturing processes and change management after manufacturing for computer-based systems.
(4) Amends requirements related to the approval of use of computer-based systems specified in Chapter 8, Part 7 of the Guidance for the Approval and Type Approval of Materials and Equipment for Marine Use so that they correspond to Part X of the Rules.

“Rules for the survey and construction of steel ships” has been partly amended as follows:

Part X has been added as follows.

Part X COMPUTER-BASED SYSTEMS

Chapter 1 INTRODUCTION

1.1 General

1.1.1 Scope

This Part applies to computer-based systems, including the hardware and software which constitute such systems.

1.1.2 Equivalency

Computer-based systems which do not comply with this Part may be accepted provided that they are deemed by the Society to be equivalent to those specified in this Part.

Chapter 2 PLANS, DOCUMENTS AND TESTS

2.1 Submission of Plans and Documents

2.1.1 Submission of Plans and Documents

The following drawings and data are, in principle, to be submitted.

(1) Plans and documents for approval:

(a) Plans and documents for computer-based systems subject to **Chapter 3** that are required to be submitted for approval purposes are specified in **2.2.1** and **2.2.2** according to system category. Summaries of said plans and documents are shown in **Tables X2.1** and **X2.2**. However, submission of plans and documents may be omitted in accordance with **2.1.2-6, Part B** for computer-based systems approved for use in accordance with **Chapter 8, Part 7 of the Guidance for the Approval and Type Approval of Materials and Equipment for Marine Use**.

(b) Other plans and documents considered necessary by the Society

(2) Plans and documents for reference:

(a) Plans and documents for computer-based systems subject to **Chapter 3** that are required to be submitted for reference purposes are specified in **2.2.1** and **2.2.2** according to system category. Summaries of said plans and documents are shown in **Tables X2.1** and **X2.2**. However, submission of plans and documents may be omitted in accordance with **2.1.2-6, Part B** for computer-based systems approved for use in accordance with **Chapter 8, Part 7 of the Guidance for the Approval and Type Approval of Materials and Equipment for Marine Use,** except for the "list of system categorisations" specified in **2.2.2-3**.

(b) Other plans and documents considered necessary by the Society

Table X2.1 Plans and Documents to be Submitted by System Suppliers

Referenced requirements	Plans and documents	Category I		Categories II and III	
		Reference	Approval	Reference	Approval
2.2.1-1 and **3.4.2-1**	Quality plan (and quality manual)	-	-	-	○
2.2.1-3 and **3.4.2-3**	System descriptions (System specification and design)	○*	-	-	○
2.2.1-4 and **3.4.2-4**	Environmental compliance	○*	-	○	-
2.2.1-5 and **3.4.2-5**	Software test report	-	-	○*	-
2.2.1-6 and **3.4.2-6**	System test report	-	-	○*	-
2.2.1-7 and **3.4.2-7**	FAT program	-	-	-	○
2.2.1-7 and **3.4.2-7**	FAT report	-	-	○	-
2.2.1-7 and **3.4.2-7**	Additional FAT documentation (e.g. user manuals)	-	-	○*	-
2.2.1-8 and **3.4.2-8**	Change management procedure	-	-	-	○

(Notes)

Approval: Plans and documents to be submitted for approval

Reference: Plans and documents to be submitted for reference

○ : Submission required

○*: Submission required only when deemed necessary by the Society or its surveyor

See **3.3.1** for information on system categories

Table X2.2 Plans and Documents to be Submitted by Systems Integrators

Referenced requirements	Plans and documents	Category I		Categories II and III	
		Reference	Approval	Reference	Approval
2.2.2-2 and 3.4.3-2	Quality plan	-	-	-	○*
2.2.2-3 and 3.4.3-3	List of system categorisations	For reference (regardless of category) ○			
2.2.2-4 and 3.4.3-4	Risk assessment report (For determining system category)	For reference (regardless of category) ○*			
2.2.2-5 and 3.4.3-5	Vessel's system architecture	○*	-	○*	-
2.2.2-6 and 3.4.3-6	SAT program	-	-	-	○
2.2.2-6 and 3.4.3-6	SAT report	-	-	○	-
2.2.2-7 and 3.4.3-7	SOST program	-	-	-	○
2.2.2-7 and 3.4.3-7	SOST report	-	-	○	-
2.2.2-8 and 3.4.3-8	Change management procedure	-	-	-	○*

(Notes)
Approval: Plans and documents to be submitted for approval
Reference: Plans and documents to be submitted for reference
○ : Submission required
○*: Submission required only when deemed necessary by the Society or its surveyor
See **3.3.1** for information on system categories

2.2 Tests

Computer-based systems subject to **Chapter 3** are to be verified by the Society in accordance with **2.2.1** and **2.2.2** based on their system category. A summary of the tests to be witnessed and verified by Society surveyors are shown in **Table X2.3**.

Table X2.3 Test Witnessing and Verifying

Referenced requirements	Verification details	Responsible party	Category I	Category II	Category III
2.2.1-7 and 3.4.2-7	Witness FAT	System supplier	-	○	○
2.2.2-6 and 3.4.3-6	Witness SAT	Systems integrator	-	○	○
2.2.2-7 and 3.4.3-7	Witness SOST	Systems integrator	-	○	○
3.6.12	Verification of changes	Systems integrator	-	○	○

(Notes)
○: Test required to be witnessed and verified by a Society surveyor
See **3.3.1** for information on system categories

2.2.1 Verification Items for System Suppliers

1 Quality plan (and quality manual) (see **3.4.2-1**)
(1) Category I: This requirement is not applicable. (hereafter referred to as "N/A" in this Chapter)
(2) Categories II and III:
(a) Quality plan (and quality manual) are to be submitted for approval.
(b) Quality plan (and quality manual) are to be made available during FAT.
2 Unique identification of systems and software (see **3.4.2-2**)

(1) Category I: N/A
(2) Categories II and III: Application of the identification system is verified as a part of the FAT (see **3.4.2-7**) and SAT (see **3.4.3-6**)

3 System description (System specification and design) (see **3.4.2-3**)
(1) Category I: The system description documentation is to be submitted for reference when deemed necessary by the Society.
(2) Categories II and III: Application of the identification system is verified as a part of the FAT (see **3.4.2-7**) and SAT (see **3.4.3-6**)

4 Environmental compliance of hardware components (see **3.4.2-4**)
(1) Category I: Environmental tests may be omitted. However, certificates issued in accordance with **Chapter 1, Part 7 of the Guidance for the Approval and Type Approval of Materials and Equipment for Marine Use** or documents proving the passing of the environmental tests specified in **18.7.1(1), Part D** are to be submitted for reference when deemed necessary by Society (see **3.3.2**).
(2) Categories II and III: Certificates issued in accordance with **Chapter 1, Part 7 of the Guidance for the Approval and Type Approval of Materials and Equipment for Marine Use** or documents proving the passing of the environmental tests specified in **18.7.1(1), Part D** are to be submitted for reference.

5 Software code creation, parameterisation, and testing (see **3.4.2-5**)
(1) Category I: N/A
(2) Categories II and III: Software test report is to be submitted for reference when deemed necessary by the Surveyor.

6 Internal system testing before FAT (see **3.4.2-6**)
(1) Category I: N/A
(2) Categories II and III:
  (a) Internal system test report is to be available during survey (FAT).
  (b) Internal system test report is to be submitted for reference when deemed necessary by the Surveyor.

7 FAT before installation on board (see **3.4.2-7**)
(1) Category I: N/A
(2) Categories II and III:
  (a) The FAT program is to be submitted for approval before the test.
  (b) The FAT is to be witnessed by the Surveyor.
  (c) The FAT report is to be submitted to the Society branch office in charge for reference.
  (d) Additional FAT documentation (e.g. user manuals and internal system test reports specified in **-6**) is to be made available during the FAT.
  (e) Additional FAT documentation (e.g. user manuals and internal system test reports specified in **-6**) is to be submitted for reference when deemed necessary by the Surveyor.

8 Secure and controlled software installation on the vessel (see **3.4.2-8**)
(1) Category I: N/A
(2) Categories II and III: The change management procedure is to be submitted for approval. The change management procedure may be included in quality plan (and quality manual).

2.2.2 Verification Items for Systems Integrators

1 Appointed systems integrator (see **3.5.1-1**)
The Society is to be informed in a timely manner by owners about the systems integrators appointed to be responsible for implementing any changes to the systems in conjunction with system suppliers.

2 Quality plan (see **3.4.3-2**)
(1) Category I: N/A
(2) Categories II and III:

(a) Quality plan is to be made available for verification by the Surveyor during surveys (SAT/SOST).

(b) Quality plan is to be submitted for the approval when deemed necessary by the Society.

3 Determining the category of the system in question (see **3.4.3-3**)

The categories for the different systems are to be documented in the list of system categorisations and submitted for reference.

4 Risk assessment of the system (see **3.4.3-4**)

Risk assessment report is to be submitted for approval when deemed necessary by the Society.

5 Define the vessel's system architecture (see **3.4.3-5**)

The vessel's system architecture is to be submitted for reference when deemed necessary by the Society.

6 System acceptance test (SAT) on board the vessel (see **3.4.3-6**)

(1) Category I: N/A

(2) Categories II and III:

(a) The SAT program is to be submitted to the Surveyor for approval before the test.

(b) The SAT is to be witnessed by the Surveyor.

(c) The SAT report is to be submitted to the Surveyor for reference.

7 SOST at the vessel level (see **3.4.3-7**)

(1) Category I: N/A

(2) Categories II and III:

(a) The SOST program is to be submitted to the Surveyor for approval before the test.

(b) The SOST is to be witnessed by the Surveyor.

(c) The SOST report is to be submitted to the Surveyor for reference.

8 Change management (see **3.4.3-8**)

(1) Category I: N/A

(2) Categories II and III: The change management procedure is to be submitted for approval when deemed necessary by the Society.

Chapter 3 COMPUTER-BASED SYSTEMS

3.1 General

3.1.1 Scope

This chapter applies to the design, construction, testing and maintenance of computer-based systems that are subject to classification requirements, including the hardware and software which constitute such systems. However, this chapter does not apply to computer-based systems subject to statutory regulation such as the following **(1)** to **(4)**.

(1) the navigating equipment specified in the **Rules for Safety Equipment**,
(2) the radio installations specified in the **Rules for Radio Installations**,
(3) stability computers, and
(4) loading computers.

3.1.2 References

The following identified standards may be used for the development of hardware / software of computer-based systems. Other industry standards, however, may also be considered.

(1) *IEC* 61508:2010 Functional safety of electrical/electronic/programmable electronic safety-related systems
(2) *ISO/IEC* 12207:2017 Systems and software engineering - Software life cycle processes
(3) *ISO* 9001:2015 Quality Management Systems – Requirements
(4) *ISO/IEC* 90003:2018 Software engineering - Guidelines for the application of ISO 9001:2015 to computer software
(5) *IEC* 60092-504:2016 Electrical installations in ships - Part 504: Special features - Control and instrumentation
(6) *ISO/IEC* 25000:2014 Systems and software engineering - Systems and software Quality Requirements and Evaluation (SQuaRE) - Guide to SQuaRE
(7) *ISO/IEC* 25041:2012 Systems and software engineering - Systems and software Quality Requirements and Evaluation (SQuaRE) - Evaluation guide for developers, acquirers and independent evaluators
(8) *IEC* 61511:2016 Functional safety - Safety instrumented systems for the process industry sector
(9) *ISO/IEC* 15288:2015 Systems and software engineering - System life cycle process
(10) *ISO* 90007:2017 Quality management - Guidelines for configuration management
(11) *ISO* 24060:2021 Ships and marine technology - Ship software logging system for operational technology

3.1.3 Structure

1 General certification requirements for computer-based systems and their relationship to approval of use are described in **3.2**.

2 The requirements and extent of verification for a computer-based system depends on its categorisation. There are three categories, and they are described in **3.3**.

3 Activities related to the development and delivery of computer-based system are described in **3.4**, while activities related to maintenance in the operational phase are described in **3.5**. This Chapter covers the life cycle of computer-based systems from design through operations. The requirements are split into groups representing the different phases of the life cycle and the parties responsible for meeting said requirements.

4 Change management for software and systems is given special attention in this Chapter and the main aspects of a change management process are described in **3.6**.

5 This Chapter mainly focuses on the activities to be performed, but it also contains some technical requirements, and these requirements are described in **3.7**.

6 The plans and documents to be submitted, and the tests required to be carried out are described in **Chapter 2**.

3.1.4 Terminology

The terms used in this Chapter are defined as follows.

(1) "Black-box description" means a description of a system's functionality and behaviour and performance as observed from outside the system in question.

(2) "Black-box test methods" means verification of the functionality, performance and robustness of a system, sub-system or component by only manipulating the inputs and observing the outputs. This does not require any knowledge of the system's inner workings and focuses only on the observable behaviour of the system or component being tested in order to achieve the desired level of verification.

(3) "Computer-based system" means a programmable electronic device, or interoperable set of programmable electronic devices, organised to achieve one or more specified purposes such as collection, processing, maintenance, use, sharing, dissemination or disposition of information. Onboard computer-based systems include Information Technology (IT) and Operational Technology (OT) systems, and may be a combination of sub-systems connected via network. Onboard computer-based systems may be connected directly or via public means of communications (e.g. the Internet) to on-shore computer-based systems, other vessels' computer-based systems or other facilities.

(4) "Failure mode description" means a document describing the effects due to failures in the system, not failures in the equipment supported by the system. The following aspects are to be covered:
   (a) A list of failures which are subject to assessment.
   (b) A description of the system response to each failure.
   (c) Comments on the consequences of each failure.

(5) "Owner" means the organisation or person which orders the vessel in the construction phase or the organisation which owns or manages the vessel in service.

(6) "Parameterisation" means the configuration and tuning of a system and software functionality by changing parameters. It does not usually require computer programming and is normally done by system suppliers or service providers, not operators or end-users.

(7) "Programmable device" means the physical component in which software is installed.

(8) "Robustness" means the ability to respond to abnormal inputs and conditions.

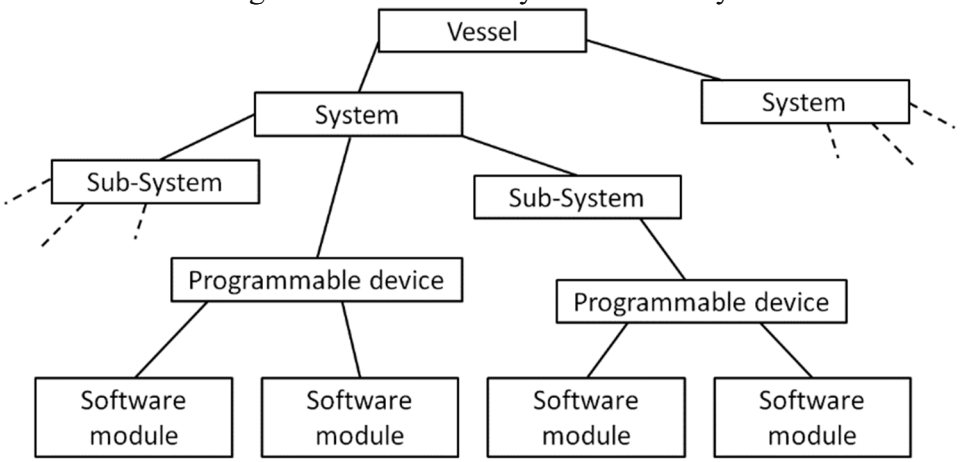
(9) "Service supplier" means a person or company, not employed by the Society, who at the request of an equipment manufacturer, shipyard, vessel's owner or other client acts in connection with inspection work and provides services for a ship or a mobile offshore unit such as measurements, tests or maintenance of safety systems and equipment. The results of these services are then used by the Surveyors in making decisions affecting classification or statutory certification and services.

(10) "Simulation test" means monitoring, control or safety system testing in which the equipment under control is either partly or fully replaced with simulation tools, or in which parts of the communication network and lines are replaced with simulation tools.

(11) "Vessel-specific certificate" means compliance document issued by the Society stating the following:
   (a) Conformity with applicable rules and requirements.
   (b) That tests and inspections have been carried out on either the finished certified component itself or on samples taken from earlier stages in the production of the component, when applicable.
   (c) That tests and inspections were carried out either in the presence of a Society surveyor or in accordance with the **Rules for Approval of Manufacturers and Service Suppliers**.

(12) “Software component” means a standalone piece of code that provides specific and closely coupled functionality.
(13) “Software master files” means computer-files that constitute the original source of software. For custom made software this may be readable source-code files, and for commercial-off-the-shelf (COTS) software it may be different forms of binary files.
(14) “Software-structure” means overview of how the different software components interact and is commonly referred to as the software architecture or software hierarchy.
(15) “Sub-system” means an identifiable part of a system, which may perform a specific function or set of functions.
(16) “Supplier” means a generic term used for any organisation or person that is a contracted or a subcontracted provider of services, system components or software.
(17) “System” means a combination of components, equipment and logic which has a defined purpose, functionality and performance. In the context of this Chapter, a specific system is delivered by one system supplier. An illustrative system hierarchy is shown in **Fig. X3.1**.
(18) “System of systems” means a system which is made up of several systems. In the context of this Chapter, a system of systems encompasses all monitoring, control and safety systems delivered from the shipyard as a part of a vessel.
(19) “System supplier” means an organisation or person that is a contracted or a subcontracted provider of system components or software under the coordination of the systems integrator.
(20) “Systems integrator” means single organisation or a person coordinating interaction between Suppliers of systems and sub-systems at all stages of life cycle of computer-based systems in order to integrate them into a verified vessel-wide system of systems and to provide proper operation and maintenance for the computer-based systems. The shipyard is the default systems integrator during the design and delivery phases, while the owner is the default systems integrator during the operations phase.
(21) “Vessel” means ship or offshore unit where the computer-based system is to be installed.
(22) “FAT” means factory acceptance test before installation on board in accordance with **3.4.2-7.**
(23) “SAT” means system acceptance test onboard the vessel in accordance with **3.4.3-6.**
(24) “SOST” means system of systems (SoS) test at the vessel level in accordance with **3.4.3-7.**

Fig. X3.1 Illustrative System Hierarchy



3.2 Approval of Systems and Components

3.2.1 System Certification*

1 Computer-based systems that are needed to accomplish vessel functions of Category II or Category III (as defined in **3.3.1**) are to be delivered with a vessel-specific certificate. The objective of vessel-specific system certification is to confirm that the design and manufacturing of a system has been completed and that the system complies with applicable requirements of the Society. Vessel-specific system certification consists of two main verification activities:

(1) Assessment of vessel-specific documentation (see **3.4.2** and **3.6**)

(2) Survey and testing of the system to be delivered to the vessel (see **3.4.2-7**)

2 The Society may apply the **Rules for Approval of Manufacturers and Service Suppliers** as the requirements specified otherwise by the Society to the confirmation and issuance of vessel-specific certificates specified in **-1** above.

3.2.2 Approval of Use for Computer-based Systems

1 Computer-based systems that are routinely manufactured and include standardised software functions may be approved in accordance with **Chapter 8, Part 7 of the Guidance for the Approval and Type Approval of Materials and Equipment for Marine Use**. Hardware is to be documented according to **2.2.1-4.** The approval of use consists of two main verification activities:

(1) assessment of type-specific documentation, and

(2) survey and testing of the standardised functions.

2 In principle, vessel-specific system certification is required as specified in **3.2.1** even if the approval of use is acquired for computer-based systems. However, for such computer systems, submitted drawings may be omitted subject to **2.1.1(1)(a)** and **(2)(a)**, and tests may be subject to **3.2.1-2.**

3.3 System Categories

3.3.1 Definitions

The categorisation of a system in the context of this Chapter is based on the potential severity of the consequences if the system serving the function fails. **Table X3.1** provides the definitions of the categories.

Table X3.1 System Categories

Category	Failure effects	Typical system functionality
I	Those systems whose failure will not lead to dangerous situations for human safety, vessel safety or a threat to the environment.	Monitoring, informational and administrative functions
II	Those systems whose failure could eventually lead to dangerous situations for human safety, vessel safety or a threat to the environment.	Vessel alarm, monitoring and control functions that are necessary to maintain the vessel in its normal operational and habitable conditions
III	Those systems whose failure could immediately lead to dangerous or catastrophic situations for human safety, vessel safety or a threat to the environment.	- Control functions for maintaining vessel propulsion and steering - Vessel safety functions

3.3.2 Scope of Application

Category I systems are normally not subject to verification by the Society since a failure of such systems does not lead to dangerous situations. However, information pertinent to Category I systems is to be provided upon request to determine the correct category and ensure that they do not influence the operation of Category II and III systems.

3.3.3 Examples*

The category of a system is always to be evaluated in the context of the specific vessel in question; thus, the categorisation of a system may vary from one vessel to the next. This means that the examples of categories below are not exhaustive but only being given for reference. For determining the categorisation of systems for a specific vessel, see **3.4.3-3.**

(1) Examples of Category I systems
- (a) Fuel monitoring system
- (b) Maintenance support system
- (c) Diagnostics and troubleshooting system
- (d) Closed circuit television (CCTV)
- (e) Cabin security
- (f) Entertainment system
- (g) Fish detection system

(2) Examples of Category II systems
- (a) Fuel control system
- (b) Alarm monitoring and safety systems for propulsion and auxiliary machinery
- (c) Inert gas system
- (d) Control, monitoring and safety system for cargo containment system

(3) Examples of Category III systems
- (a) Propulsion control system
- (b) Steering gear control system
- (c) Electric power system (including power management system)
- (d) Dynamic positioning system (Classes 2 and 3)

3.4 Requirements for Development and Certification of Computer-based Systems

3.4.1 General Requirements

1 Life cycle approach with appropriate standards

A global top-down approach is to be undertaken in the design and development of both hardware and software, and the integration in sub-systems, systems, and system of systems, spanning the complete system life cycle. This approach is to be based on the standards listed herein or other standards recognised by the Society. This is to be verified by the Society as a part of the quality management system verification described in **-2 below.**

2 Quality management systems

Systems integrators and system suppliers are to comply with a recognised quality standard (e.g. *ISO* 9001 incorporating principles of *IEC*/*ISO* 90003) with respect to the quality management of Category II and III computer-based systems. Quality management systems for Category II and III systems are to as a minimum include the items specified in **Table X3.2**. In addition, quality management systems are to be verified by following **(1)** or **(2)**.

(1) The Society confirms that the quality management system is certified as compliant with a recognised standard by an organisation with accreditation under a national accreditation scheme.

(2) The Society confirms that the quality management system complies with a standard through a specific assessment of the quality management system. The documentation requirements for this method will be defined on a per case basis.

Table X3.2 Quality Management Systems

Area		Role	
#	Topic	System supplier	Systems integrator
1	Responsibilities and competency of the staff	×	×
2	The complete life cycle of the delivered software and associated hardware	×	×
3	Specific procedure for unique identification of a computer-based system, its components and versions	×	-
4	Creation and update of the vessel's system architecture	-	×
5	Organisation set in place for the acquisition of software and related hardware from suppliers	×	×
6	Organisation set in place for software code writing and verification	×	-
7	Organisation set in place for system validation before integration in the vessel	×	-
8	Specific procedure for conducting and approving of systems at FAT and SAT	×	×
9	Creation and update of system documentation	×	-
10	Specific procedure for software modification and installation on board the vessel, including interactions with shipyards and owners	×	×
11	Specific procedures for verification of software code	×	-
12	Procedures for integrating systems with other systems, and testing of the system of systems for the vessel	×	×
13	Procedures for managing changes to software and configurations before FAT	×	-
14	Procedures for managing and documenting changes to software and configurations after FAT	×	×
15	Checkpoints for the organization's own follow-up of adherence to its quality management system	×	×

(Note)
×: To be included in the quality management system

3.4.2 Requirements for System Suppliers*

1 Define and follow a quality plan supplemented by quality manual as necessary (hereinafter referred to as "quality plan and quality manual")

(1) System suppliers are to document that the quality management system is being applied to the design, construction, delivery, and maintenance of the specific system to be delivered.

(2) All applicable items described in **Table X3.2** (for system suppliers) are to be demonstrated to exist and to be being followed, as relevant.

2 Unique identification of systems and software

A method for uniquely identifying a system, its different software components and different revisions of the same software component is to be applied. Said method is to be applied throughout the life cycle of the system and its software. Relevant technical requirements for the system in question are specified in **3.7.1.** The documentation of the method is, in general, considered to be part of the quality management system specified in **3.4.1-2.**

3 System description (System specification and design)

(1) The system's specification and design are to be determined and documented in a system description. In addition to serving as a specification for the detailed design and implementation of the system, the purpose of the system description is to document that the entire system-delivery is in accordance with the specifications and in compliance with applicable requirements and restrictions.

(2) System descriptions are to include the following information.
- (a) Purpose and main functions, including any safety aspects
- (b) System category, as defined
- (c) Key performance characteristics
- (d) Compliance with the technical requirements and the Society's Rules

(e) User interfaces / mimics
(f) Communication and interface aspects
Identification and description of interfaces to other vessel systems
(g) Hardware-arrangement related aspects
i) Network-architecture / topology, including all network components like switches, routers, gateways, firewalls, etc.
ii) Internal structure with regards to all interfaces and hardware nodes in the system (e.g. operator stations, displays, computers, programmable devices, sensors, actuators, I/O modules)
iii) I/O allocation (mapping of field devices to channel, communication link, hardware unit, logic function)
iv) Power supply arrangements
(h) Risk assessment report by FMEA (failure mode effect analysis) or justification for the omission of risk assessment

4 Environmental compliance of hardware components

Environmental tests for hardware, which includes systems and sub-systems, are to comply with **18.7.1(1), Part D**.

5 Software code creation, parameterisation, and testing

(1) Software created, changed or configured for the project is to be developed and have quality assurance activities assessed in accordance with selected standards, as described in the quality plan (and quality manual).
(2) Quality assurance activities may be performed on several levels of the software structure and are to include both custom-made software and configured components (e.g. software libraries), as appropriate.
(3) Verification of the software is, at a minimum, to verify the following aspects based on black-box methods:
(a) correctness, completeness and consistency of any parameterisation and configuration of software components;
(b) intended functionality; and
(c) intended robustness.
(4) For Category II and III system components, the scope, purpose and results of all performed reviews, analyses, tests and other verification activities are to be documented in test reports.

6 Internal system testing before FAT

(1) Systems are, as far as practicable, to be tested before FAT. The main purpose of such testing is for system suppliers to verify that the entire system is in accordance with specifications and approved documentation, in compliance with applicable rules and regulations, and, furthermore, is complete and ready for FAT.
(2) Testing is, at a minimum, to verify the following aspects of the system.
(a) Functionality
(b) Effect of faults and failures (including diagnostic functions, detection, alert responses)
(c) Performance
(d) Integration between software and hardware components
(e) Human-machine interfaces
(f) Interfaces to other systems
(3) Faults are to be simulated as realistically as possible to demonstrate appropriate system fault detection and system response.
(4) Some of the testing may be performed by utilising simulators and replica hardware.
(5) The test environment is to be documented, including a description of any simulators, emulators, test-stubs, test-management tools, or other tools affecting the test environment and its

limitations.

(6) Test cases and test results are to be documented in test programs and test reports, respectively.

7 Factory acceptance test (FAT) before installation on board

(1) FAT is to be carried out for each product or when the computer-based system acquires approval of use in accordance with **Chapter 8, Part 7 of the Guidance for the Approval and Type Approval of Materials and Equipment for Marine Use**. The main purpose of FAT is to demonstrate to the Society that the system is complete and compliant with applicable requirements, thus enabling issuance of a vessel-specific certificate for the system.

(2) FAT test programs are to cover a representative selection of test items from internal system tests (see **3.4.2-6**), including normal system functionality and response to failures.

(3) For Category II and III systems, network testing to verify the network resilience required by **3.7.2-1** is to be performed. If agreed to by all parties, such testing may be performed as part of system tests on board the vessel.

(4) FAT is, in principle, to be performed with project specific software operating on the actual hardware components to be installed on board, with necessary means for simulation of functions and failure responses. However, other solutions such as replica hardware or simulated hardware (emulators) may be agreed upon with the Society.

(5) For each test case, it is to be noted whether the test was passed or failed, and test results are to be documented in test reports. Such test reports are to also contain a list of the software (including software versions) that were installed in the system when the test was performed.

8 Secure and controlled software installation on board vessels

(1) The initial installation and subsequent updates of the software components of a system are to be carried out in accordance with a change management procedure which has been agreed upon between the system supplier and the systems integrator.

(2) The change management procedure is to comply with **3.6.**

(3) Cyber security measures are to be deemed appropriate by the Society.

3.4.3 Requirements for Systems Integrators*

1 Responsibilities

For the purposes of this Chapter, the shipyard is considered to be the systems integrator for the development and delivery phases unless another organisation or person is explicitly appointed as such by the shipyard.

2 Define and follow a quality plan

(1) Systems integrators are to document that quality management systems are being applied to the installation, integration, completion and maintenance of the systems to be installed on board.

(2) All applicable items described in **Table X3.2** (for systems integrators) are to be demonstrated to exist and to be being followed, as relevant.

3 Determining the category of the system in question

(1) For each system delivery to a particular vessel, it is to be decided which category the system falls under based on the failure effects of the system (as defined in **3.3**).

(2) The category for a specific system is to be conveyed to the relevant system supplier.

(3) The Society may decide that a risk assessment is needed to verify the proper system category.

4 Risk assessment of the system

(1) If requested by the Society, a risk assessment of a specific system in context of the specific vessel in question is to be performed and documented in order to determine the applicable category for the system.

(2) The method of risk assessment is to be agreed to by the Society.

5 Define the vessel's system architecture

(1) The system of systems is to be specified and documented. This architecture specification provides the basis for category determination and development of the different interconnected

systems by allocating functionality to individual systems and by identifying the main interfaces between the systems.

(2) It is also to serve as a basis for the SOST at the vessel level (see **3.4.3-7**).

(3) The vessel's system architecture is to include at least the following information.

(a) Overview of the total system architecture (the system of systems)

(b) Each system's purpose and main functionality

(c) Communication and interface aspects between different systems

(d) Risk assessment report for the system of systems

6 System acceptance test (SAT) on board vessels

(1) SAT is to be performed on board the vessel. The main purpose of the SAT is to verify system functionality after installation and integration with the applicable machinery / electrical / process systems on board (including possible interfaces with other control and monitoring systems).

(2) For each testcase, it is to be noted whether the test was passed or failed, and the test results are to be documented in a test report. Such test reports are to also contain a list of the software (including software versions) that were installed in the system when the test was performed.

7 SOST at the vessel level

(1) Integration tests are to be conducted after the installation and integration of different systems in their final environment on board. The purpose of such tests is to verify the functionality of the complete installation (system of systems) including all interfaces and inter-dependencies in compliance with requirements and specifications.

(2) Testing is, at a minimum, to verify the following aspects of the system of systems.

(a) Overall functionality of the interacting systems as a whole

(b) Failure response between systems

(c) Performance

(d) Human-machine interfaces

(e) Interfaces between the different systems

8 Change management

Systems integrators are to follow the procedures for change management described in **3.6**.

3.5 Requirements for Maintenance of Computer-based Systems

3.5.1 Requirements for Vessel Owners

For the purposes of this Chapter, the vessel owner is considered to be the systems integrator in the operations phase unless another organisation or person is explicitly appointed by the owner. When a systems integrator, which is responsible for implementing any changes to the systems in conjunction with system suppliers, is appointed, this information is to be given to the Society in a timely manner.

3.5.2 Requirements for Systems Integrators

Change management is to comply with following requirements. In addition, it is to be noted that the verification specified in **3.6.12** is required in annual survey in accordance with **Chapter 3, Part B** for computer-based systems of categories II and III.

(1) Systems integrators are to ensure that necessary procedures for software and hardware change management exist on board, and that any software modifications or upgrades are performed according to such procedures. For details about change management, see **3.6** below.

(2) Changes to computer-based systems in the operational phase are to be recorded. Such records are to include information about the relevant software versions and other relevant information described in **3.6.11**.

3.5.3 Requirements for System Suppliers

1 Regarding change management, system suppliers are to follow procedures for maintenance of the system including procedures for change management described in **3.6**.

2 System suppliers are to make sure that the planned changes to a system have passed relevant in-house tests before the change is made to systems on board.

3 It is to be noted that the verification specified in **3.6.12** is required in annual survey in accordance with **Chapter 3, Part B** for computer-based systems of categories II and III.

3.6 Change Management

3.6.1 General

This **3.6** specifies requirements for the change management throughout the lifecycle of a computer-based system. Different procedures for the change management may be defined for specific phases in a system's lifecycle as the different phases typically involve different stakeholders. The Society's verification is described in **3.6.12**.

3.6.2 Documented Change Management Procedures

The organisation in question is to have defined and documented change management procedures applicable for the computer-based system in question covering both hardware and software. After FAT, the system supplier is to manage all changes to the system in accordance with the procedure. Examples could be qualification of new versions of acquired software, new hardware, modified control logic, changes to configurable parameters. The procedures are to at least describe the activities listed in **3.6.3** through **3.6.11**. The outcome of the impact analysis in **3.6.8** will determine to what extent the activities in **3.6.3** to **3.6.12** are to be performed. Change records (see **3.6.11**) are always to be produced.

3.6.3 Agreement between Relevant Stakeholders*

The change management process is to be coordinated and agreed upon between relevant stakeholders along the different stages of the life cycle of the computer-based system.

3.6.4 Approved Software is to be Under Change Management

If changes are required to a system after it has been approved by applicable stakeholders (typically the systems integrator and the Society at FAT), such modifications are to follow defined change management procedures.

3.6.5 Unique Identification of System and Software Versions

System suppliers are to make sure that each system and software version is uniquely identifiable (see **3.4.2-2**).

3.6.6 Handling of Software Master Files

There are to be defined mechanisms for the handling of files that constitute master-files for a software component. Personnel authorities are to be clearly defined along with the tools and mechanisms used to ensure the integrity of master files.

3.6.7 Backup and Restoration of Onboard Software

It is to be clearly defined how to perform backup and restoration of the software components of a computer-based system on board the vessel.

3.6.8 Impact Analysis before Change is Made

Before a change to a system is made, an impact analysis is to be performed in order to determine the following:

(1) the criticality of the change,

(2) the impact on existing documentation,

(3) the needed verification and test activities,
(4) the need to inform other stakeholders about the change, and
(5) the need to obtain approval from other stakeholders (e.g. The Society or owner) before the change is made.

3.6.9 Roll-back in Case of Failed Software Changes

When maintenance includes installation of new versions of software in a system, it is to be possible to perform a roll-back of the software to the previous installed version with the purpose of returning the system to a known, stable state. Roll-backs are to be documented and analysed to find and eliminate the root cause.

3.6.10 Verification and Validation of System Changes

To the largest degree practically possible, modifications are to be verified before being installed on board. After installation, the modifications are to be verified on board according to a documented verification program containing the following:
(1) Verification that the new functionalities or improvements have had the intended effect.
(2) Regression test to verify that the modification has not had any negative effects on functionality or capabilities that was not expected to be affected.

3.6.11 Change Records

1 Changes to systems and software are to be documented in change records to allow for visibility and traceability of the changes. The change records are to contain at least the following items:
(1) the purpose for a change,
(2) a description of the changes and modifications,
(3) the main conclusions from the impact analysis (see **3.6.8**),
(4) the identity and version of any new system or software versions (see **3.6.5**), and
(5) test reports or tests summaries (see **3.6.10**).

2 Documentation of the changes to software may be recorded in the planned maintenance system, in a software registry or in the equivalent thereto.

3.6.12 Verification of Change Management by the Society

1 Operational (vessel in service) phase

The verification by the Society of the change management in operation is generally performed during annual surveys of the vessel. Procedures for change management and relevant change records (see **3.6.11**) are to be made available at the times of such surveys.

In the cases where the change requires approval from the Society in advance, the relevant procedures and documentation for the change in question may be verified at that time.

2 During newbuilding

The verification of change management during the newbuilding phase is divided into two parts: procedures are verified as a part of the verification of the quality management system (see **3.4.1-2**), while project specific implementation of the procedures are verified during FAT (see **3.4.2-7**) and after FAT (see **3.6.12-1**)

3.7 Technical Requirements for Computer-based Systems

This **3.7** specifies technical requirements for computer-based systems. Compliance with these requirements is to be documented in the design documentation (see **3.4.2-3**) and verified through the verification activities described in this Chapter.

3.7.1 Reporting of System and Software Identification and Version

Systems are to provide means to identify their names, versions, identifiers, and manufacturers.

It is recommended that systems be capable of automatically reporting the status of their software to a ship software logging system (SSLS) as specified in the international standard *ISO* 24060.

3.7.2 Data Links

1 General requirements of data links for Category II and III systems

Data links are to comply with following **(1)** to **(5)**. In addition, loss of a data link is to be specifically addressed in risk assessment analysis / FMEA (see **3.4.2-3).**

(1) A single data link failure is not to cause loss of vessel functions of Category III. The effects of such failures are to meet the principle of fail-to-safe for the vessel functions being served.

(2) For vessel functions of Categories II and III, any loss of functionality in remote control systems is to be compensated for by local or manual means.

(3) Data links are to be provided with means for preventing or coping with excessive communication rates.

(4) Data links are to be self-checking so as to detect failures or performance issues on the links themselves and data communication failures on nodes connected to the links.

(5) Detected failures are to initiate alarms.

2 Specific requirements for wireless data links

(1) Category III systems are not to use wireless data links unless specifically considered by the Society on the basis of an engineering analysis carried out in accordance with an international or national standard acceptable to the Society.

(2) Systems of other categories may use wireless data links on the condition they satisfy the following **(a)** to **(d)**:

(a) Recognised international wireless communication system protocols incorporating the following **i)** to **iv)** are to be complied with.

i) Message integrity
Fault prevention, detection, diagnosis and correction so that the received message is not corrupted or altered when compared to the transmitted message.

ii) Configuration and device authentication
Only permit the connection of devices that are included in the system design.

iii) Message encryption
Protect the confidentiality and criticality of data content.

iv) Security management
Protect network assets and prevent unauthorised access to such assets.

(b) Internal wireless systems within vessels are to comply with the radio frequency and power level requirements of the International Telecommunication Union (ITU) and the requirements of flag states.

(c) Consideration is to be given to system operation in the event of port state and local restrictions that pertain to the use of radio-frequency transmission and prohibit the operation of wireless data communication links due to frequency and power level restrictions.

(d) For wireless data communication equipment, tests during harbour and sea trials are to be performed to demonstrate the following **i)** and **ii)**:

i) Radio-frequency transmission does not cause failure of any equipment during expected operating conditions.

ii) Radio-frequency transmission does not cause itself to fail as a result of electromagnetic interference during expected operating conditions.

3.7.3 Verification of Technical Requirements by the Society

The implementation of the technical requirements in **3.7** is to be verified by the Society as part of the system description (**3.4.2-3**), FAT (**3.4.2-7**) and SAT (**3.4.3-6**) described above.

Part BCLASS SURVEYS

Chapter 2 CLASSIFICATION SURVEYS

2.1 Classification Survey during Construction

2.1.2 Submission of Plans and Documents for Approval*

Sub-paragraph -1(2) has been amended as follows.

1 When it is intended to build a ship for classification by the Society, the following plans and documents are to be submitted for the approval by the Society before the work is commenced. The plans and documents may be submitted for examination by the Society prior to making an application for the classification of the ship as stipulated otherwise by the Society.
((1) is omitted.)
(2) Machinery
((a) to (n) are omitted.)
(o) Computer-based systems
Plans and data specified in **2.1.1(1), Part X**
((3) to (7) are omitted.)

2.1.3 Submission of Other Plans and Documents

Sub-paragraph -1(7) has been amended as follows.

1 When it is intended to build a ship to the classification with the Society the following plans and documents are to be submitted, in addition to those required in **2.1.2**:
((1) to (6) are omitted.)
(7) The following plans and documents related to machinery:
((a) to (g) are omitted.)
(h) Computer-based systems:
Plans and data specified in **2.1.1(2), Part X**
((8) to (17) are omitted.)

2.1.4 Presence of Surveyor*

Sub-paragraph -2(2) has been amended as follows.

2 The presence of a surveyor is required at the following stages of the work in relation to machinery. To implement surveys of items specified otherwise by the Society, in lieu of traditional ordinary surveys where a surveyor is in attendance, the Society may approve other survey methods which it considers to be appropriate in the following cases.
((1) is omitted.)
(2) Main parts of machinery
(a) When the tests stipulated in either **Part D** or **Part H** (according to the kind of machinery) and **Part X** are carried out.
((b) to (e) are omitted.)
((3) to (6) are omitted.)

Chapter 3 ANNUAL SURVEYS

Table B3.1 has been amended as follows.

Table B3.1 Examination of Plans and Documents

Items	Examination
(Omitted)	
15 Procedures for software and hardware change management and relevant change records	(1) Confirmation that the procedures for software and hardware change management are kept on board in accordance with **3.6.12-1, Part X.** (2) Confirmation that the change records are updated in accordance with **3.6.11** and **3.6.12-1, Part X.**

Part D MACHINERY INSTALLATIONS

Chapter 18 AUTOMATIC AND REMOTE CONTROL

Section 18.1 has been amended as follows.

18.1 General

18.1.1 Scope*

1 The requirements in this chapter apply to automatic or remote control systems which are used to control the following machinery and equipment:

(1) Main propulsion machinery (in this chapter, propulsion generating sets in electric propulsion ships are excluded),
(2) Controllable pitch propeller
(3) Steam generating sets
(4) Electric generating sets (in this chapter, propulsion generating sets in electric propulsion ships are included)
(5) Auxiliary machinery associated with the machinery and equipment listed in **(1)** to **(4)**
(6) Fuel oil systems
(7) Bilge systems
(8) Deck machinery

2 In cases where considered necessary by the Society, the requirements in this chapter are correspondingly applied to those automatic or remote control systems which are used for controlling machinery and equipment not listed in **-1(1)** to **(8)**.

3 Computer-based systems, including the hardware and software which constitute such systems, are to be in accordance with ~~**Annex 18.1.1**~~**Chapters 1, 2** and **3, Part X** in addition to those specified in **-1** and **-2** above and throughout the rest of this chapter for design, construction, commissioning, maintenance, etc.

~~**4 The requirement in -3 above is not applicable to equipment mentioned below:**~~
~~**(1) navigating equipment specified in the Rules for Safety Equipment,**~~
~~**(2) radio installations specified in the Rules for Radio Installations,**~~
~~**(3) stability instruments, and**~~
~~**(4) loading computers.**~~

18.1.2 Terminology*

Terms used in this chapter are defined as follows:

((1) to (9) are omitted.)

~~(10) A system is defined as a combination of interacting programmable devices and/or sub-systems organized to achieve one or more specified purposes.~~
~~(11) A computer based system is defined as a system which provides control, alarm, monitoring, safety or internal communication functions and depends upon software for the proper achievement of these functions.~~
~~(12) A sub-system is defined as an identifiable part of a system, which may perform a specific function or set of functions.~~
~~(13) A programmable device is defined as a physical component where software is installed.~~
~~(14)~~(10) A safety system is defined as a system which operates automatically, in order to prevent damage to machinery and equipment in cases where serious impediments to functioning should occur during their operation so that one of the following actions will take place:

(a) Starting of stand-by machinery or equipment
(b) Reduction of output of machinery or equipment
(c) Shutting off fuel or power supplies, thereby stopping the machinery or equipment

18.1.3 Drawings and Data

Drawings and data to be submitted are generally as follows. ~~In cases where the Society deems it to be necessary, the submission of drawings and data other than those specified below may be requested.~~

(1) Drawings and data for approval
((a) to (e) are omitted.)
(f) ~~Drawings and data listed in **1.2(1), Annex 18.1.1** for computer based systems specified in **18.1.1-3.** With respect to computer based systems which have been already approved by the Society in accordance with **Chapter 8, Part 7 of the Guidance for the Approval and Type Approval of Materials and Equipment for Marine Use**, only drawings and data on parts that differ from ship to ship need to be submitted.~~ Other drawings and data deemed necessary by the Society.

(2) Drawings and data for reference
~~Drawings and data listed in **1.2(2), Annex 18.1.1** for computer based systems specified in **18.1.1-3.** With respect to computer based systems which have been already approved by the Society in accordance with **Chapter 8, Part 7 of the Guidance for the Approval and Type Approval of Materials and Equipment for Marine Use**, only drawings and data on parts that differ from ship to ship need to be submitted; this, however, excludes those specified in **1.2(2)(a)** of the Annex.~~ Other drawings and data deemed necessary by the Society.

18.3 Automatic and Remote Control of Main Propulsion Machinery or Controllable Pitch Propellers

18.3.3 Bridge Control Devices*

Bridge control devices are to comply with the following **(1)** through **(4)** as well as requirements in **18.3.2**.
((1) and (2) are omitted.)

Sub-paragraphs (3) and (4) have been amended as follows.

(3) Bridge control devices are to be provided with visual and audible alarms which give the officer in charge of the navigational watch enough time to assess navigational circumstances in an emergency before the safety systems of main propulsion machinery specified in **18.1.2(~~1~~4~~1~~10) (b)** or **(c)** go into effect.
(4) Bridge control devices are to be provided with an override arrangement specified in **18.2.6-3** for the following safety systems of main propulsion machinery:
(a) Safety systems which perform as specified in **18.1.2(~~1~~4~~1~~10)(b)**
(b) Safety systems which perform as specified in **18.1.2(~~1~~4~~1~~10)(c)** (except in cases where the total failure of main propulsion machinery will occur within a short period of time.)

Annex 18.1.1 has been deleted.

~~**Annex 18.1.1 COMPUTER BASED SYSTEMS**~~

~~**(Omitted)**~~

“Rules for automatic and remote control systems” has been partly amended as follows:

Chapter 1 GENERAL

1.2 System Design

1.2.1 System Design*

Sub-paragraph (2) has been amended as follows.

System design is to comply with the following requirements in addition to those specified in **18.2.1, Part D of the Rules for the Survey and Construction of Steel Ships**.

((1) is omitted.)

(2) Safety systems intended for those functions specified in **18.1.2(~~14~~10)(c), Part D of the Rules for the Survey and Construction of Steel Ships** are to be, in all cases, independent of the other systems.

((3) is omitted.)

"Rules for high speed craft" has been partly amended as follows:

Part 9 MACHINERY INSTALLATIONS

Chapter 12 AUTOMATIC AND REMOTE CONTROL

Section 12.1 has been amended as follows.

12.1 General

12.1.1 Scope*

1 The requirements in this chapter apply to the systems of automatic or remote control which are used to control the following machinery and equipment.

(1) Main propulsion machinery (in this chapter, propulsion generating set in electric propulsion ships are excluded),
(2) Controllable pitch propeller
(3) Steam generating set
(4) Electric generating set (in this chapter, propulsion generating set in electric propulsion ships are included)
(5) Auxiliary machinery associated with machinery and equipment listed in **(1)** to **(4)**
(6) Fuel oil systems
(7) Bilge systems
(8) Deck machinery

2 Where considered necessary by the Society, the requirements in this chapter are correspondingly applied to the systems of automatic or remote control which are used for controlling machinery and equipment not listed in **-1(1)** to **(8)**.

3 Computer based systems, including the hardware and software which constitute such systems, are to be in accordance with ~~**Annex 18.1.1**~~ **Chapters 1, 2** and **3, Part ~~D~~ X of the Rules for the Survey and Construction of Steel Ships** in addition to those specified in **-1** and **-2** above and throughout the rest of this chapter for design, construction, commissioning, maintenance, etc.

~~**4 The requirement in -3 above is not applicable to equipment mentioned below:**~~
~~(1) navigating equipment specified in the **Rules for Safety Equipment,**~~
~~(2) radio installations specified in the **Rules for Radio Installations,**~~
~~(3) stability instruments, and~~
~~(4) loading computers.~~

12.1.2 Terminology

Terms used in this chapter are defined as the requirements specified in **18.1.2, Part D of the Rules for the Survey and Construction of Steel Ships**.

12.1.3 Drawings and Data*

Drawings and data to be submitted are generally as follows. ~~In cases where the Society deems it to be necessary, the submission of drawings and data other than those specified below may be requested.~~

(1) Drawings and data for approval
((a) to (e) are omitted.)
(f) ~~Drawings and data listed in **1.2(1), Annex 18.1.1, Part D of the Rules for the Survey and Construction of Steel Ships** for computer based systems specified in **12.1.1-3**. With~~

~~respect to computer-based systems which have been already approved by the Society in accordance with **Chapter 8, Part 7 of the Guidance for the Approval and Type Approval of Materials and Equipment for Marine Use**, only drawings and data on parts that differ from ship to ship need to be submitted.~~ Other drawings and data deemed necessary by the Society.

(2) Drawings and data for reference

~~Drawings and data listed in **1.2(2), Annex 18.1.1, Part D of the Rules for the Survey and Construction of Steel Ships** for computer based systems specified in **12.1.1-3.** With respect to computer based systems which have been already approved by the Society in accordance with **Chapter 8, Part 7 of the Guidance for the Approval and Type Approval of Materials and Equipment for Marine Use**, only drawings and data on parts that differ from ship to ship need to be submitted; this, however, excludes those specified in **1.2(2)(a)** of the Annex.~~ Other drawings and data deemed necessary by the Society.

"Rules for the survey and construction of inland waterway ships" has been partly amended as follows:

Part 2 CLASS SURVEYS

Chapter 2 CLASSIFICATION SURVEYS

2.1 Classification Survey during Construction

2.1.2 Submission of Plans and Documents for Approval*

Sub-paragraph -1(2) has been amended as follows.

1 When it is intended to build a ship for classification by the Society, the following plans and documents are to be submitted for the approval by the Society before the work is commenced. The plans and documents may be submitted for examination by the Society prior to making an application for the classification of the ship as stipulated otherwise by the Society.
((1) is omitted.)
(2) Machinery
((a) to (m) are omitted.)
(n) Computer-based systems:
Plans and data specified in **2.1.1(1), Part X of the Rules for the Survey and Construction of Steel Ships**
((3) to (5) are omitted.)

2.1.3 Submission of Other Plans and Documents

Sub-paragraph -1(7) has been amended as follows.

1 When it is intended to build a ship to the classification with the Society the following plans and documents are to be submitted, in addition to those required in **2.1.2**:
((1) to (6) are omitted.)
(7) The following plans and documents related to machinery:
((a) to (f) are omitted.)
(g) Computer-based systems:
Plans and data specified in **2.1.1(2), Part X of the Rules for the Survey and Construction of Steel Ships**
((8) to (9) are omitted.)

2.1.4 Presence of Surveyor*

Sub-paragraph -2(2) has been amended as follows.

2 The presence of the Surveyor is required at the following stages of the work in relation to machinery:
((1) is omitted.)
(2) Main parts of machinery
(a) When the tests stipulated in either **Part 7** or **Part 8** (according to the kind of machinery) and **Part X of the Rules for the Survey and Construction of Steel Ships** are carried out.
((b) to (e) are omitted.)

((3) to (6) are omitted.)

Chapter 3 ANNUAL SURVEYS

Table 2.3.1 has been amended as follows.

Table 2.3.1 Examination of Plans and Documents

Items	Examination
1 Loading Manual	・ For ships required to have the manual on board in accordance with the requirements of **10.2.4, Part 4**, confirmation that the manual is kept on board is to be made.
2 Stability Information Booklet	・ Confirmation as to whether the booklet is kept on board is to be made.
3 Fire Control Plan	・ Confirmation that the fire control plan is provided on board is to be made.
4 Procedures for software and hardware change management and relevant change records	(1) Confirmation that the procedures for software and hardware change management are kept on board in accordance with **3.6.12-1, Part X of the Rules for the Survey and Construction of Steel Ships.** (2) Confirmation that the change records are updated in accordance with **3.6.11** and **3.6.12-1, Part X of the Rules for the Survey and Construction of Steel Ships.**

Part 7 MACHINERY INSTALLATIONS

Chapter 14 AUTOMATIC AND REMOTE CONTROL

Section 14.1 has been amended as follows.

14.1 General

14.1.1 Scope*

1 The requirements in this Chapter apply to automatic or remote control systems which are used to control the following machinery and equipment:

(1) Main propulsion machinery (in this Chapter, propulsion generating sets in electric propulsion ships are excluded)
(2) Controllable pitch propeller
(3) Steam generating sets
(4) Electric generating sets (in this Chapter, propulsion generating sets in electric propulsion ships are included)
(5) Auxiliary machinery associated with the machinery and equipment listed in **(1)** to **(4)**
(6) Fuel oil systems
(7) Bilge systems
(8) Deck machinery

2 In cases where considered necessary by the Society, the requirements in this Chapter are correspondingly applied to those automatic or remote control systems which are used for controlling machinery and equipment not listed in **-1(1)** to **(8)**.

3 Computer based systems, including the hardware and software which constitute such systems, are to be in accordance with ~~**Annex 18.1.1**~~ **Chapters 1, 2** and **3, Part ~~D~~ X of the Rules for the Survey and Construction of Steel Ships** in addition to those specified in **-1** and **-2** above and throughout the rest of this chapter for design, construction, commissioning, maintenance, etc.

~~**4 The requirement in -3 above is not applicable to equipment mentioned below:**~~
~~**(1) navigating equipment specified in the Rules for Safety Equipment,**~~
~~**(2) radio installations specified in the Rules for Radio Installations,**~~
~~**(3) stability instruments, and**~~
~~**(4) loading computers.**~~

14.1.2 Terminology*

Terms used in this Chapter are defined as follows:

((1) to (9) are omitted.)

~~(10) A system is defined as a combination of interacting programmable devices and/or sub-systems organized to achieve one or more specified purposes.~~
~~(11) A computer based system is defined as a system which provides control, alarm, monitoring, safety or internal communication functions and depends upon software for the proper achievement of these functions.~~
~~(12) A sub-system is defined as an identifiable part of a system, which may perform a specific function or set of functions.~~
~~(13) A programmable device is defined as a physical component where software is installed.~~

(~~14~~10) A safety system is defined as a system which operates automatically, in order to prevent damage to machinery and equipment in cases where serious impediments to functioning should occur during their operation so that one of the following actions will take place:

(a) Starting of stand-by machinery or equipment
(b) Reduction of output of machinery or equipment
(c) Shutting off fuel or power supplies, thereby stopping the machinery or equipment

14.1.3 Drawings and Data*

Drawings and data to be submitted are generally as follows. ~~However, other drawings and data may be required in cases where deemed necessary by the Society.~~

(1) Drawings and data for approval:
((a) to (e) are omitted.)
(f) ~~Drawings and data listed in 1.2(1), Annex 18.1.1, Part D of the Rules for the Survey and Construction of Steel Ships for computer based systems specified in 14.1.1-3. With respect to computer based systems which have been already approved by the Society in accordance with Chapter 8, Part 7 of the Guidance for the Approval and Type Approval of Materials and Equipment for Marine Use, only drawings and data on parts that differ from ship to ship need to be submitted.~~ Other drawings and data deemed necessary by the Society.

(2) Drawings and data for reference:
~~Drawings and data listed in 1.2(2), Annex 18.1.1, Part D of the Rules for the Survey and Construction of Steel Ships for computer based systems specified in 14.1.1-3. With respect to computer based systems which have been already approved by the Society in accordance with Chapter 8, Part 7 of the Guidance for the Approval and Type Approval of Materials and Equipment for Marine Use, only drawings and data on parts that differ from ship to ship need to be submitted; this, however, excludes those specified in 1.2(2)(a) of the Annex.~~ Other drawings and data deemed necessary by the Society.

14.3 Automatic and Remote Control of Main Propulsion Machinery or Controllable Pitch Propellers

14.3.3 Bridge Control Devices*

Bridge control devices are to comply with the following **(1)** through **(4)** as well as requirements in **14.3.2**.
((1) and (2) are omitted.)

Sub-paragraphs (3) and (4) have been amended as follows.

(3) Bridge control devices are to be provided with visual and audible alarms which give the officer in charge of the navigational watch enough time to assess navigational circumstances in an emergency before the safety systems of main propulsion machinery specified in **14.1.2(~~14~~10)(b)** or **(c)** go into effect.
(4) Bridge control devices are to be provided with an override arrangement specified in **14.2.6-3** for the following safety systems of main propulsion machinery:
(a) Safety systems which perform as specified in **14.1.2(~~14~~10)(b)**
(b) Safety systems which perform as specified in **14.1.2(~~14~~10)(c)** (except in cases where the total failure of main propulsion machinery will occur within a short period of time)

"Guidance for the survey and construction of steel ships" has been partly amended as follows:

Part X has been added as follows.

Part X COMPUTER-BASED SYSTEMS

X3 COMPUTER-BASED SYSTEMS

X3.2 Approval of Systems and Components

X3.2.1 System Certification

The wording "requirements specified otherwise by the Society" in **3.2.1-2, Part X of the Rules**, means confirmation of the following when assessments are carried out based on the **Rules for Approval of Manufacturers and Service Suppliers.**

(1) The computer-based system in question is to acquire the approval of use (including the approval of quality plan (and quality manual) specified in **2.2.1-1, Part X of the Rules**) specified in **3.2.2, Part X of the Rules.** Tests for approval of use may be carried out at the same time as an assessment based on the **Rules for Approval of Manufacturers and Service Suppliers.**

(2) The manufacturers in question perform quality management based on the quality plan (and quality manual) specified in **2.2.1-1, Part X of the Rules**.

X3.3 System Categories

X3.3.3 System Category Examples

The wording "diagnostics and troubleshooting systems" in **3.3.3(1)(c), Part X of the Rules**, does not means the "condition monitoring system" specified in **B9.1.4-5(2), Part B**.

X3.4 Requirements on Development and Certification of Computer-based Systems

X3.4.2 Requirements for System Suppliers

1 The wording "system description (System specification and design)" in **3.4.2-3, Part X of the Rules** means the information listed in **3.4.2-3(2)(a)** to **(h)**. It may, however, be divided into a number of different documents and models.

2 Some of the methods utilised in the activities listed to in **3.4.2-5, Part X of the Rules** are sometimes referred to as "software unit tests" or "developer tests" and may also include verification methods like code-reviews and static or dynamic code analysis.

3 The wording "factory acceptance test (FAT) before installation on board" in **3.4.2-7, Part X of the Rules** means only those tests carried out for computer-based systems in accordance with this Chapter. Therefore, it does not mean "shop test" in accordance with other requirements in other Parts. For complex systems, there may be a large differences in scope between "internal system testing before FAT" activity and the FAT, while for some systems the scope may be identical.

X3.4.3 Requirements for Systems Integrators

1 With respect to **3.4.3-4, Part X of the Rules**, *IEC/ISO* 31010 "Risk management – Risk assessment techniques" may be used as guidance in order to determine the risk assessment method.

2 For the SAT and SOST activities specified respectively in **3.4.3-6 and 3.4.3-7, Part X of the Rules**, there may be a large difference in scope on board the vessel for complex systems, while for some systems the scope may be overlapping or identical. It is possible to combine the two activities

into one when the test scope is similar. In addition, test programs and test reports may be allowed to be made common.

X3.6 Change Management

X3.6.3 Agreement between Relevant Stakeholders

The change management specified in **3.6.3, Part X of the Rules** is, in principle, to address at least three different stages:

(1) The “development and internal verification before FAT” stage involving system suppliers and sub-suppliers.

(2) The “from FAT to the handing over of the vessel to its owner” stage involving system suppliers, systems integrators, the Society and owners.

(3) The “in operation” stage involving system suppliers, service suppliers, owners, and the Society.

Part B CLASS SURVEYS

B9 PLANNED MACHINERY SURVEYS

B9.1 Planned Machinery Surveys

B9.1.4 Condition Based Maintenance Scheme (CBM)

Sub-paragraph -5(2) has been amended as follows.

5 Approval of CBM

Conditions for approval of CBM are as follows:

((1) is omitted.)

(2) Condition monitoring system

The condition monitoring system is to satisfy the following requirements specified in **(a)** to **(h)**. In cases where this system is modified, that modification is to be approved by the Society.

((a) is omitted.)

(b) The hardware and software of the computer is to comply with **B9.1.3-4(5)(a)** to **(e)** and ~~**Annex 18.1.1**~~ **Chapters 1**, **2** and **3**, **Part ~~D~~X of the Rules**.

((c) to (h) are omitted.)

((3) to (7) are omitted.)

Part D MACHINERY INSTALLATIONS

D18 AUTOMATIC AND REMOTE CONTROL

D18.1 General

D18.1.2 has been deleted.

~~**D18.1.2 Terminology**~~

~~The computer based system referred to in **18.1.2(11), Part D of the Rules** includes a system which contains programmable controllers such as sequencers.~~

Part P MOBILE OFFSHORE DRILLING UNITS AND SPECIAL PURPOSE BARGES

P10 POSITIONING SYSTEMS

P10.7 Dynamic Positioning Systems

Paragraph P10.7.6 has been amended as follows.

P10.7.6 Computer Systems

Computer systems installed on Class 2 DPS and Class 3 DPS are to comply with ~~**Annex D18.1.1, Part D of the Guidance "COMPUTER BASED SYSTEMS"**~~ **Chapters 1, 2** and **3, Part X of the Rules**.

"Guidance for automatic and remote control systems" has been partly amended as follows:

Chapter 2 SURVEYS OF AUTOMATIC AND REMOTE CONTROL SYSTEMS

2.2 Registration Surveys

2.2.1 Drawings and Data

Sub-paragraph -2 has been amended as follows.

2 In applying **2.2.1(1)(a)** and **(2)(a) of the Rules**, in cases where the automatic and remote control system includes computer based systems subject to **18.1.1-3, Part D of the Rules for the Survey and Construction of Steel Ships**, the drawings and data stipulated in ~~**1.2, Annex 18.1.1**~~ **2.1.1**, **Part ~~D~~X of the Rules for the Survey and Construction of Steel Ships** are to be submitted. However, for computer based systems which have been already approved by the Society in accordance with **Chapter 8, Part 7 of the Guidance for the Approval and Type Approval of Materials and Equipment for Marine Use**, only drawings and data on parts that differ from ship to ship need to be submitted; this, however, excludes those specified in ~~**1.2(2)(a) of the said Annex**~~ **2.2.2-3, Part X of the Rules for the Survey and Construction of Steel Ships**.

"Guidance for the survey and construction of inland waterway ships" has been partly amended as follows:

Part 2 CLASS SURVEYS

Chapter 9 PLANNED MACHINERY SURVEYS

9.1 Planned Machinery Surveys

9.1.4 Condition Based Maintenance Scheme (CBM)

Sub-paragraph-5(2) has been amended as follows.

5 Approval of CBM

Conditions for approval of CBM are as follows:

((1) is omitted.)

(2) Condition monitoring system

The condition monitoring system is to satisfy the following requirements specified in **(a)** to **(h)**. In cases where this system is modified, that modification is to be approved by the Society.

((a) is omitted.)

(b) The hardware and software of the computer is to comply with **9.1.3-4(5)(a)** ~~**€**~~**(e)** and ~~**Annex D18.1.1 "COMPUTER-BASED SYSTEMS"**~~ **Chapters 1, 2** and **3, Part** ~~**D**~~**X of the** ~~**Guidance**~~ **Rules for the Survey and Construction of Steel Ships**.

((c) to (h) are omitted.)

((3) to (7) are omitted.)

"Guidance for the approval and type approval of materials and equipment for marine use" has been partly amended as follows:

Part 7 CONTROL AND INSTRUMENTATION EQUIPMENT AND ELECTRICAL INSTALLATIONS

Chapter 1 APPROVAL OF USE OF AUTOMATIC DEVICES AND EQUIPMENT

Table 7.1-1 has been amended as follows.

Table 7.1-1 Environmental Test Items, Testing Conditions, Methods, and Criteria

<table>
<tr><td>Test Item</td><td colspan="3">Testing condition and method</td><td>Criteria</td></tr>
<tr><td colspan="5">(Omitted)</td></tr>
<tr><td rowspan="6">Radiated radio frequency immunity test</td><td colspan="3">- Check the operation of the equipment when the radiated radio frequency immunity test is carried out according to the following condition.</td><td rowspan="6">- Performance Criterion A(*1)</td></tr>
<tr><td>Frequency range</td><td colspan="2">8– MHz - 6 GHz</td></tr>
<tr><td>Modulation</td><td colspan="2">80% AM at 1 kHz</td></tr>
<tr><td>Field strength</td><td colspan="2">10 V/m</td></tr>
<tr><td>Frequency sweep rate</td><td colspan="2">≤1.5×10⁻³decades/sec.
(or 1% / 3sec.)</td></tr>
<tr><td colspan="3">- If for tests of equipment an input signal with a modulation frequency of 1 kHz is necessary a modulation frequency of 400 Hz may be chosen.
- If equipment is intended to receive radio signals for the purpose of radio communication (e.g. wifi router, remote radio controller), then the immunity limits at its communication frequency do not apply, subject to the provisions in <s>5.2 of Annex D18.1.1</s> <u>3.7.2-2</u>, Part <s>D</s> <u>X</u> of the <s>Guidance</s> <u>Rules</u> for the Survey and Construction of Steel Ships.
- Detailed test methods are according to Level 3 of IEC 61000-4-3:2020.</td></tr>
<tr><td colspan="5">(Omitted)</td></tr>
<tr><td>Test Item</td><td colspan="3">Testing condition and method</td><td>Criteria</td></tr>
<tr><td rowspan="5">Radiated emission test</td><td colspan="3">- Radiated emission test is to be carried out according to the following.</td><td rowspan="5">- Radiated emission is to be within limits in the table.</td></tr>
<tr><td colspan="3">(Omitted)</td></tr>
<tr><td rowspan="3">Frequency range: Above 1 GHz</td><td>Frequency range</td><td>Average limit (dB μ V/m)</td></tr>
<tr><td>– GHz - 6 GHz</td><td>54</td></tr>
<tr><td colspan="2">- Distance between equipment and antenna is to be 3 m.
- Equipment intended to transmit radio signals for the purpose of radio communication (e.g. wifi router, remote radio controller) may be exempted from limits, within its communication frequency range, subject to the provisions in <s>5.2 of Annex D18.1.1</s> <u>3.7.2-2</u>, Part <s>D</s><u>X</u> of the <s>Guidance</s> <u>Rules</u> for the Survey and Construction of Steel Ships.
- Detailed test methods are according to CISPR 16-2-3:2016.</td></tr>
<tr><td colspan="5">(Omitted)</td></tr>
</table>

Chapter 8 APPROVAL OF USE OF COMPUTER BASED SYSTEMS

Section 8.1 has been amended as follows.

8.1 General

8.1.1 Scope

1 The requirements in this chapter apply to tests and inspection for "approval of use" of computer based systems belong to Category II or III specified in ~~**2.2.2**~~ **3.3.1**, ~~**Annex 18.1.1,**~~ **Part ~~D~~ X of the Rules for the Survey and Construction of Steel Ships** ~~(hereinafter referred to as "the Annex" in this chapter)~~ in accordance with **18.1.3, Part D** and **3.2.2, Part X of the Rules for the Survey and Construction of Steel Ships**, **2.2.1-2 of the Guidance for Automatic and Remote Control System**, **12.1.3, Part 9 of the Rules for High Speed Craft** and **14.1.3, Part 7 of the Rules for the Survey and Construction of Inland Waterway Ships** ~~and **3.1.3-1** the Annex of the Rules for the Survey and Construction of Steel Ships~~.

2 Programmable devices installed into a computer based system which receives approval of use in accordance with requirements of this chapter are to be subject to the environmental tests specified in **Table 7.1-1**. However, for programmable devices which have already received approval of use from the Society, a part of or all environmental tests may be omitted.

8.1.2 Definitions

The definitions of terms which appear in this chapter are as specified in ~~**Chapter 2 of the Annex**~~ **3.1.4, Part X of the Rules for the Survey and Construction Steel Ships** unless otherwise specified.

8.2 Application

Paragraph 8.2.2 has been amended as follows.

8.2.2 Documents to be Submitted

1 Three copies each of the following documents are to be submitted to the Society with the application form specified in **8.2.1**. Summaries of said drawings and data are shown in **Table 7.8-1**.

(1) Drawings and data for approval:
~~The following drawings and data specified in **1.2(1)** of the Annex:~~
   (a) ~~Documents related to quality management:~~ Quality plan (and quality manual)
   ~~i) Documents showing satisfaction of a quality system~~
   ~~ii) Quality plan~~
   ~~iii) Documents related to security policies~~
   (b) ~~Test programs and procedures for intra-system integration testing~~ System description (System specification and design)
   (c) ~~Test reports of environmental tests according to **Table7.1-1** or a certificate issued in accordance with **Chapter 1**~~ FAT program
   (d) Change management procedure
   (~~d~~e) Other drawings and data deemed necessary by the Society

(2) Drawings and data for reference:
~~The following drawings and data specified in **1.2(2)** of the Annex~~:
   (a) ~~Risk assessment report~~ A certificate issued in accordance with **Chapter 1, Part 7** or documents proving satisfaction with environmental tests specified in **7.1-1**.
   (b) ~~Documents related to software code creation and testing, etc.:~~ Software test report

~~i) Software module functional descriptions and associated hardware descriptions for programmable devices~~

~~ii) Evidence of verification (detection and correction of software errors) for software modules in accordance with the selected software development standard~~

~~iii) Evidence of functional tests for programmable devices at the software module, subsystem, and system levels (The functional testing is to be designed to test the provisions of features used by the software but provided by the operating system, function libraries, customized layer of software and any set of parameters.)~~

~~iv) Functional description of software~~

~~v) List and versions of software installed in system~~

(c) ~~Other drawings and data concerning systems such as the following:~~ System test report

~~i) User manual including instructions for use during software maintenance~~

~~ii) List of interfaces between system and other vessel systems~~

~~iii) List of standards used for data links~~

(d) ~~Where approval has already been granted by other classification societies, documentation of such approval tests performed~~ FAT report

(e) Additional FAT documentation (e.g. user manuals)

(~~e~~f) Other drawings and data deemed necessary by the Society

2 Notwithstanding the requirements in **-1**, where the documents are duplicated by the ones at the previous approval for other computer based systems, part or all of the documents may be omitted. However, test programs and procedures specified in **-1(1)(~~b~~c)** are not ~~be~~ exempted from submission.

Table 7.8-1 Drawings and Data to be Submitted by System Suppliers

Referenced requirements in **Part X of the Rules for the Survey and Construction of Steel Ships**	Drawings and data	Category I		Categories II and III	
		Reference	Approval	Reference	Approval
2.2.1-1 and **3.4.2-1**	Quality plan (and quality manual)	-	-	-	○
2.2.1-3 and **3.4.2-3**	System descriptions (System specification and design)	○*	-	-	○
2.2.1-4 and **3.4.2-4**	Environmental compliance	○*	-	○	-
2.2.1-5 and **3.4.2-5**	Software test report	-	-	○*	-
2.2.1-6 and **3.4.2-6**	System test report	-	-	○*	-
2.2.1-7 and **3.4.2-7**	FAT program	-	-	-	○
2.2.1-7 and **3.4.2-7**	FAT report	-	-	○	-
2.2.1-7 and **3.4.2-7**	Additional FAT documentation (e.g. user manuals)	-	-	○*	-
2.2.1-8 and **3.4.2-8**	Change management procedure	-	-	-	○

(Notes)

Approval : Drawings and data to be submitted for approval

Reference: Drawings and data to be submitted for reference

○ : Submission required

○*: Submission required only when deemed necessary by the Society

Section 8.3 has been amended as follows.

8.3 Preliminary Examination

8.3.1 Confirmation of Quality Management System, Design, etc.

Prior to tests specified in **8.4**, the Society examines documents submitted in accordance with the requirements in **8.2.2** (except test programs and procedures specified in **8.2.2-1(1)(~~b~~c)**), and confirms that quality system of the manufacturer, design of the computer based system, etc. comply with the following **(1)** to **(~~4~~5)**.

(1) ~~Life cycle approach~~ Quality Plan (and Quality Manual) for the specific product
~~A global top-to-bottom approach is to be undertaken regarding software and its integration into a system, spanning the software lifecycle. This approach is to be accomplished according to software development standards as listed in the Annex or other standards recognized by the Society.~~ System suppliers are to comply with a recognised quality standard (e.g. *ISO* 9001 incorporating principles of *IEC*/*ISO* 90003) with respect to the quality management of Category II and III computer-based systems. Quality management systems for Category II and III systems are to as a minimum include the items specified in **Table 7.8-2**. System suppliers are to document that the quality management system is being applied to the design, construction, delivery, and maintenance of the specific system to be delivered.

(2) ~~Quality system~~ System description (System specification and design)

(a) ~~A quality system regarding software development and testing and associated hardware such as *ISO* 9001 taking into account *ISO* 90003 is to be operated.~~ The system's specification and design are to be determined and documented in a system description. In addition to serving as a specification for the detailed design and implementation of the system, the purpose of the system description is to document that the entire system-delivery is in accordance with said specifications and in compliance with applicable requirements and restrictions.

(b) ~~Satisfaction of the requirement specified in (a) above is to be demonstrated through either of the following i) or ii):~~System descriptions are to include the following information.

i) ~~The quality system being certified as compliant to the recognized standard by an organization with accreditation under a national accreditation scheme, or~~ Purpose and main functions, including any safety aspects

ii) ~~The quality system being confirmed compliance with a recognized standard by the Society through a specific assessment.~~ System category, as defined

iii) Key performance characteristics

iv) Compliance with the technical requirements and the Society's Rules

v) User interfaces / mimics

vi) Communication and interface aspects
Identification and description of interfaces to other vessel systems

vii) Hardware-arrangement related aspects

1) Network-architecture / topology, including all network components like switches, routers, gateways, firewalls, etc.

2) Internal structure with regards to all interfaces and hardware nodes in the system (e.g. operator stations, displays, computers, programmable devices, sensors, actuators, I/O modules)

3) I/O allocation (mapping of field devices to channel, communication link, hardware unit, logic function)

4) Power supply arrangements

viii) Risk assessment reports by FMEA (failure mode effect analysis) or justification for

the omission of risk assessment

(c) ~~The quality system specified in (a) above is to include a quality plan documenting the items listed in the following i) to iv):~~ The wording "system description (System specification and design)" referred to in this Chapter means the information listed collectively in **(b) i)** to **viii)** above. It may, however, be divided into a number of different documents and models.

~~i) Relevant procedures regarding responsibilities, system documentation, configuration management and competent staff;~~

~~ii) Relevant procedures regarding software lifecycle and associated hardware including the following 1) to 3):~~

~~1) The organization set in place for acquisition of related hardware and software from suppliers;~~

~~2) the organization set in place for software code writing and verification; and~~

~~3) the organization set in place for system validation before integration in the vessel.~~

~~iii) The information specified in the following 1) to 3):~~

~~1) Specific procedures for verification of software code at the level of systems, sub-systems and programmable devices and modules;~~

~~2) Drawings and data submitted for the Society and tests witnessed by the Surveyor; and~~

~~3) Specific procedures for software modification and installation on board the vessel defining interactions with owners.~~

~~iv) Relevant procedures regarding application of the quality management system for the specific computer based system.~~

~~(d) The manufacturer of computer based system is to adopt security policies and include these in its quality systems and procedures.~~

(3) ~~Design~~ Software code creation, parameterisation and testing

(a) ~~Risk assessments of systems are to be according to the following i) to ii):~~ Software created, changed, or configured for the project is to be developed and have quality assurance activities assessed in accordance with selected standards, as described in the quality plan (and quality manual).

~~i) Risk assessments of systems is to be undertaken to determine the risks to the system throughout its lifecycle by identifying and evaluating the hazards associated with each function of the system; and~~

~~ii) *IEC/ISO* 31010 "Risk management – Risk assessment techniques" may be applied in order to determine the method of risk assessment. The method of risk assessment is to be agreed to by the Society.~~

(b) ~~Physical and logical security measures are to be in place to prevent unauthorized or unintentional modification of software, whether undertaken at the physical system or remotely.~~ Quality assurance activities may be performed on several levels of the software structure and are to include both custom-made software and configured components (e.g. software libraries), as appropriate.

(c) The verification of the software is, at a minimum, to verify the following aspects based on black-box methods:

i) correctness, completeness and consistency of any parameterisation and configuration of software components;

ii) intended functionality; and

iii) intended robustness.

(d) For Category II and III system components, the scope, purpose, and results of all performed reviews, analyses, tests and other verification activities are to be documented in test reports.

(e) Some of the methods utilised in this activities are sometimes referred to as "software unit

tests" or "developer tests" and may also include verification methods like code-reviews and static or dynamic code analysis.

(4) ~~Requirements for data links~~ Internal system testing before FAT

~~Data links are to satisfy the requirements specified in **Chapter 5** except **5.2.2(3)** of the Annex.~~

(a) Systems are, as far as practicable, to be tested before FAT. The main purpose of such testing is for system suppliers to verify that the entire system is in accordance with specifications and approved documentation, in compliance with applicable rules and regulations, and, furthermore, is complete and ready for FAT.

(b) Testing is, at a minimum, to verify the following aspects of the system.

i) Functionality

ii) Effect of faults and failures (including diagnostic functions, detection, alert responses)

iii) Performance

iv) Integration between software and hardware components

v) Human-machine interfaces

vi) Interfaces to other systems

(c) Faults are to be simulated as realistically as possible to demonstrate appropriate system fault detection and system response.

(d) Some of the testing may be performed by utilising simulators and replica hardware.

(e) The test environment is to be documented, including a description of any simulators, emulators, test-stubs, test-management tools, or other tools affecting the test environmental and its limitations.

(f) Test cases and test results are to be documented in test programs and test reports, respectively.

(5) Data links

(a) General requirements of data links for Category II and III systems

Data links are to comply with following **i)** to **v)**. In addition, loss of a data link is to be specifically addressed in risk assessment analysis / FMEA (see **8.3.1(2)**)

i) A single data link failure is not to cause loss of vessel functions of Category III. The effects of such failures are to meet the principle of fail-to-safe for the vessel functions being served.

ii) For vessel functions of Categories II and III, any loss of functionality in remote control systems is to be compensated for by local or manual means.

iii) Data links are to be provided with means for preventing or coping with excessive communication rates.

iv) Data links are to be self-checking so as to detect failures or performance issues on the links themselves and data communication failures on nodes connected to the links.

v) Detected failures are to initiate alarms.

(b) Specific requirements for wireless data links

i) Category III systems are not to use wireless data links unless specifically considered by the Society on the basis of an engineering analysis carried out in accordance with international or national standards acceptable to the Society. Systems of other categories may use wireless data links on the condition that they satisfy the following **ii)** to **v)**:

ii) Recognised international wireless communication system protocols incorporating the following **1)** to **4)** are to be complied with.

1) Message integrity

Fault prevention, detection, diagnosis and correction so that the received message is not corrupted or altered when compared to the transmitted message.

2) Configuration and device authentication

Only permit the connection of devices that are included in the system design.

3) Message encryption
Protect the confidentiality and criticality of data content.

4) Security management
Protect network assets and prevent unauthorised access to such assets.

iii) Internal wireless systems within vessels are to comply with the radio frequency and power level requirements of the International Telecommunication Union (ITU) and the requirements of flag states.

iv) Consideration is to be given to system operation in the event of port state and local restrictions that pertain to the use of radio-frequency transmission and prohibit the operation of wireless data communication links due to frequency and power level restrictions.

v) For wireless data communication equipment, tests during harbour and sea trials are to be performed to demonstrate the following **1)** and **2)**:

1) Radio-frequency transmission does not cause failure of any equipment during expected operations.

2) Radio-frequency transmission does not cause itself to fail as a result of electromagnetic interference during expected operating conditions during expected operations.

Table 7.8-2 Quality Management Systems

Area	
#	Topic
1	Responsibilities and competency of the staff
2	The complete life cycle of the delivered software and associated hardware
3	Specific procedure for unique identification of a computer-based system, its components and versions
4	Organisation set in place for the acquisition of software and related hardware from suppliers
5	Organisation set in place for software code writing and verification
6	Organisation set in place for system validation before integration in the vessel
7	Specific procedure for conducting and approving of systems at FAT
8	Creation and update of system documentation
9	Specific procedure for software modification and installation on board the vessel, including interactions with shipyards and owners
10	Specific procedures for verification of software code
11	Procedures for integrating systems with other systems, and testing of the system of systems for the vessel
12	Procedures for managing changes to software and configurations before FAT
13	Procedures for managing and documenting changes to software and configurations after FAT
14	Checkpoints for the organization's own follow-up of adherence to its quality management system

8.3.2 Approval of Test Programs and Procedures

Prior to approval tests specified in **8.4**, the Society examines test programs and procedures submitted in accordance with the requirements in **8.2.2-1(1)(~~b~~c)** and approves them where deemed appropriate.

8.4 Approval Test

Paragraph 8.4.1 has been amended as follows.

8.4.1 ~~Intra-system Integration Testing~~ Factory acceptance test (FAT) before installation on board

~~**1** Intra-system integration testing is to be done between system and sub-system software modules in order to check the following (1) to (3). This testing may be demonstrated by simulation tests.~~
~~(1) The software functions are properly executed.~~
~~(2) The software and the hardware it controls interact and function properly together.~~
~~(3) The software systems react properly in the case of failures.~~
~~**2** Faults are to be simulated as realistically as possible to demonstrate appropriate system fault detection and system response. The results of any required failure analysis are to be observed.~~

(1) FAT is to be carried out for the system in question. The main purpose of the FAT is to demonstrate to the Society that the system is complete and compliant with applicable classification rules, thus enabling issuance of a Society Certificate for the system.

(2) The FAT test program is to cover a representative selection of the test items from the internal system test (see **8.3.1(4)**), including normal system functionality and response to failures.

(3) For Category II and III systems, network testing to verify the network resilience required by in **3.7.2-1, Part X of the Rules for the Survey and Construction of Steel Ships** is to be performed. If agreed to by all parties, such testing may be performed as part of the system tests on board the vessel.

(4) FAT is, in principle, to be performed with project specific software operating on the actual hardware components to be installed on board, with necessary means for simulation of functions and failure responses. However, other solutions such as replica hardware or simulated hardware (emulators) may be agreed upon with the Society.

(5) For each test case, it is to be noted whether the test was passed or failed, and test results are to be documented in test reports. Such test reports are to also contain a list of the software (including software versions) that were installed in the system when the test was performed.

(6) For complex systems, there may be a large difference in scope between the “internal system testing before FAT” activity and the FAT, while for some systems the scope may be identical.

(7) Quality plan (and quality manual) are to be made available during FAT. All applicable items described in **Table 7.8-2** are to be demonstrated to exist and to be being followed, as relevant.