Rules for the Classification of Steel Ships

(Development Review : For external opinion inquiry)

Part 6 Electrical Equipment and Control Systems

2023. 9.

KR
KOREAN REGISTER

Machinery Rule Development Team

Effective Date：1 January 2024

(The contract date for ship construction)

Present	Amendment	Remark

CHAPTER 1 〈same as the present Rules〉
 	
CHAPTER 2 CONTROL SYSTEMS
 	
Section 1 〈same as the present Rules〉
 	
Section 2 System and Control
 	
201. – 203. 〈same as the present Rules〉
 	
204. Control system of electric generating sets
 	
1. 〈same as the present Rules〉
 	
2. <u>Emergency Source of Electric Power</u>
 	
  <u>Automatic or remote control devices for diesel engines to drive emergency generators are to be complied with the following requirements: *(2020)*</u>
 	
  (1) <u>Alarm devices to be activated in the event of the abnormal conditions given in **Table 6.2.1** are to be provided.</u>
 	
  (2) – (4) 〈same as the present Rules〉
 	
  <u>(5)</u> The silencing of the audible alarms from the control positions is not to cause the silencing of the audible alarm at local position.
	CHAPTER 1 〈same as the present Rules〉
	
	CHAPTER 2 CONTROL SYSTEMS
	
	Section 1 〈same as the present Rules〉
	
	Section 2 System and Control
	
	201. – 203. 〈same as the present Rules〉
	
	204. Control system of electric generating sets
	
	1. 〈same as the present Rules〉
	
	2. ~~Emergency Source of Electric Power~~ <u>Alarms and safeguards for emergency reciprocating I.C. engines *(2024)*</u>
	
	  ~~Automatic or remote control devices for diesel engines to drive emergency generators are to be complied with the following requirements: *(2020)*~~ <u>These requirements apply to reciprocating I.C. engines, which use distillate marine fuels covered by ISO 8217:2017, required to be immediately available in an emergency and capable of being controlled remotely or automatically operated.</u>
	
	  (1) ~~Alarm devices to be activated in the event of the abnormal conditions given in **Table 6.2.1** are to be provided.~~ <u>Alarms and safeguards are to be fitted in accordance with **Table 6.2.1**.</u>
	
	  (2) – (4) 〈same as the present Rules〉
	  <u>(5) In addition to the fuel oil control from outside the space, a local means of engine shutdown is to be provided.</u>
	  ~~(5)~~<u>(6)</u> The silencing of the audible alarms from the control positions is not to cause the silencing of the audible alarm at local position.
		(Amended)
		– In accordance with IACS UR M63 (Rev.1), the requirements for alarms and safeguards for emergency reciprocating I.C. engines have been amended.

〈Present〉

Table 6.2.1 Alarms for diesel engines to drive emergency generators *(2021)*

Monitored parameters [H=High L=Low O=Abnormal status]			AA	Auto Shut down with alarm	Notes [AA=Alarm Activation ●=apply]
Temp.	Lub. oil inlet	H	●		For engines having a power of 220 kW or over
	Cooling water(or cooling air) outlet	H	●		
Press.	Lub. oil inlet	L	●		
	Pressure or flow of cooling water inlet	L	●		For engines having a power of 220 kW or over
Others	Oil mist concentration in crankcase(H) or main & connecting rod bearing temp. (or oil outlet temp.)(H) or an equivalent device	H	●		For engines having a power of more than 2250 kW, or a cylinder bore of more than 300 mm An equivalent device could be interpreted as measures applied to high speed engines where specific design features to preclude the risk of crankcase explosions are incorporated.[1]
	Fuel oil leakage from high pressure pipes	O	●		
	Overspeed	O	●	●	For engines having a power of 220 kW or over
(NOTE) (1) Oil mist detection system is to be of the approved type by the Society, tested by **Ch 3, Sec. 10** of **the Guidance for Approval of Manufacturing Process and Type Approval, Etc.** and applied to **Pt.5 Ch 2, 203.**					

〈Amendments〉

Table 6.2.1 Alarms and safeguards for emergency reciprocating I.C. engines *(2024)*

Parameter		Alarm activation	Auto Shutdown
Fuel oil leakage from high pressure pipes (fuel injection pipes and common rails)		O	
Lubricating oil temperature[1]	High	O	
Lubricating oil pressure	Low	O	
Activation of oil mist detection arrangements (or activation of the temperature monitoring systems or equivalent devices of: - the engine main and crank bearing oil outlet; or - the engine main and crank bearing)[2][3]		O	
Pressure or flow of cooling water[1]	Low	O	
Temperature of cooling water (or cooling air)	High	O	
Overspeed activated[1]		O	O
(NOTE) (1) For engines having a power of or more than 220 kW. (2) For engines having a power of more than 2250 kW or a cylinder bore of more than 300 mm. (3) Oil mist detection system is to be of the approved type by the Society, tested by **Ch 3, Sec. 10** of **the Guidance for Approval of Manufacturing Process and Type Approval, Etc.** and applied to **Pt.5 Ch 2, 203.**			

Effective Date：1 July 2024

(The contract date for ship construction)

Present	Amendment	Remark
# CHAPTER 1 ELECTRICAL EQUIPMENT Section 1 – 2 〈same as the present Rules〉 Section 3 Rotating Machinery 301. – 305. 〈same as the present Rules〉 306. Ship's service a.c. generator 1. – 3. 〈same as the present Rules〉 **4. Load sharing of _a.c._ generators** (1) <u>When _a.c._ generators are run in parallel, each generator is to be stable in running and the load on any generator is not to differ by more than (A) or (B), whichever is the less, from its proportionate share, based on the generator ratings, of the combined load for any steady-state condition in the combined load between 20 % and 100 % of the sum of the rated loads of all the generators.</u> The starting point for the test is to be at 75 % load with each generator carrying its proportionate share. (A) 15% of the rated <u>output</u> of the largest <u>generator,</u> (B) 25% of the rated <u>output</u> of <u>each generator.</u> (2) \<same as the present Rules\> 307. – 308. 〈same as the present Rules〉	# CHAPTER 1 ELECTRICAL EQUIPMENT Section 1 – 2 〈same as the present Rules〉 Section 3 Rotating Machinery 301. – 305. 〈same as the present Rules〉 306. Ship's service a.c. generator 1. – 3. 〈same as the present Rules〉 **4. Load sharing of _a.c._ generators** (1) ~~When _a.c._ generators are run in parallel, each generator is to be stable in running and the load on any generator is not to differ by more than (A) or (B), whichever is the less, from its proportionate share, based on the generator ratings, of the combined load for any steady-state condition in the combined load between 20 % and 100 % of the sum of the rated loads of all the generators.~~ <u>For a.c. generating sets operating in parallel,</u> generators <u>shall be such that within the limits of 20% and 100% total load, the load on any generating set will not normally differ from its proportionate share of the total load by more than (A) or (B), whichever is the less.</u> The starting point for the test is to be at 75 % load with each generator carrying its proportionate share. (A) 15% of the rated ~~output~~ <u>power</u> of the largest ~~generator,~~ <u>machine</u> (B) 25% of the rated ~~output~~ <u>power</u> of ~~each generator.~~ <u>the individual machine in question</u> (2) \<same as the present Rules\> 307. – 308. 〈same as the present Rules〉	(Amended) – Requirements for load sharing of a.c. generators have been amended to conform to IACS UR M3.

Present	Amendment	Remark

309. Testing and inspection
 	
  1. – 15. 〈same as the present Rules〉
 	
  16. Tests
 	
    The tests of rotating machinery are as following table according to its kinds.
	309. Testing and inspection
	
	  1. – 15. 〈same as the present Rules〉
	
	  16. Tests
	
	    The tests of rotating machinery are as following table according to its kinds. *(2024)*
		(Amended)
		- Tables for testing of rotating machinery have been amended to conform to IACS UR E13.

〈Present〉

No.	Tests	a.c. Generator		a.c. Motors		d.c. Machines	
		Type test*	Routine test[(1)]	Type test*	Routine test[(1)]	Type test*	Routine test[(1)]
1	Drawing approval[(9)]	X	X	X	X	X	X
2	Visual inspection	X	X	X	X	X	X
3	Material test of shaft	X[(2)]	X[(2)]	X[(2)]	X[(2)]	X[(2)]	X[(2)]
4	Temperature test	X	X[(8)]	X	X[(8)]	X	X[(8)]
5	Overcurrent or excess torque test	X	X[(3)]	X	X[(3)]	X	X[(3)]
6	Overspeed test	X	X	X[(4)]	X[(4)]	X[(4)]	X[(4)]
7	Insulation resistance test	X	X	X	X	X	X
8	High voltage test	X	X	X	X	X	X
9	Voltage regulation test	X	X[(5)]				
10	Winding resistance measurement	X	X	X	X	X	X
11	Commutation test					X[(6)]	
12	Verification of steady short-circuit condition [(7)]	X	X[(8)]				
13	No load test	X	X	X	X	X	X
14	Verification of bearings	X	X	X	X	X	X
15	Verification of degree of protection	X[(8)]	X[(8)]	X[(8)]	X[(8)]	X[(8)]	X[(8)]

(Notes)

* Type tests on prototype machine or tests on at least the first batch of machines.

(1) Test report of machines routine tested is to contain the manufacturer's serial number of the machine which has been type tested and the test result.

(2) Only applicable for rotating machines of 100kW(100 kVA for Generator) and more (except emergency generators).

(3) Only applicable for rotating machines of essential services rated 100kW(100 kVA for Generator) and more.

(4) Not applicable for squirrel cage motors.

(5) Only functional test of voltage regular system.

(6) Only applicable for rotating machines with commutators.

(7) Only applicable for synchronous generators.

(8) Where accepted by the Society, test may be omitted. *(2020)* 【See Guidance】

(9) Only applicable for rotating machines of 100kW(100 kVA for Generator) and more. And where accepted by the Society, drawing approval may be omitted. 【See Guidance】

〈Amendments〉

No.	Tests	a.c. Generator Type test*(1)	a.c. Generator Routine test(1)(2)	a.c. Motors Type test*(1)	a.c. Motors Routine test(1)(2)	d.c. Machines Type test*(1)	d.c. Machines Routine test(1)(2)
1	Drawing approval(9)(10)	X	X	X	X	X	X
2	Visual inspection	X	X	X	X	X	X
3	Material test of shaft	X(2)(3)	X(2)(3)	X(2)(3)	X(2)(3)	X(2)(3)	X(2)(3)
4	Temperature test	X	X(8)(9)	X	X(8)(9)	X	X(8)(9)
5	Overcurrent or excess torque test	X	X(3)(4)	X	X(3)(4)	X	X(3)(4)
6	Overspeed test	X	X	X(4)(5)	X(4)(5)	X(4)(5)	X(4)(5)
7	Insulation resistance test	X	X	X	X	X	X
8	High voltage test	X	X	X	X	X	X
9	Voltage regulation test	X	X(5)(6)				
10	Winding resistance measurement	X	X	X	X	X	X
11	Commutation test					X(6)(7)	
12	Verification of steady short-circuit condition(7)(8)	X	X(8)(9)				
13	No load test	X	X	X	X	X	X
14	Verification of bearings	X	X	X	X	X	X
15	Verification of degree of protection	X(8)(9)	X(8)(9)	X(8)(9)	X(8)(9)	X(8)(9)	X(8)(9)

(Notes)
*(1) Type tests on prototype machine or tests on at least the first batch of machines.

(1)(2) Test report of machines routine tested is to contain the manufacturer's serial number of the machine which has been type tested and the test result.

(2)(3) Only applicable for rotating machines of 100kW(100 kVA for Generator) and more (except emergency generators).

(3)(4) Only applicable for rotating machines of essential services rated 100kW(100 kVA for Generator) and more.

(4)(5) Not applicable for squirrel cage motors.

(5)(6) Only functional test of voltage regular system.

(6)(7) Only applicable for rotating machines with commutators.

(7)(8) Only applicable for synchronous generators.

(8)(9) Where accepted by the Society, test may be omitted. *(2020)* 【See Guidance】

(9)(10) Only applicable for rotating machines of 100kW(100 kVA for Generator) and more. And where accepted by the Society, drawing approval may be omitted. 【See Guidance】

Present	Amendment	Remark

Section 4 Switchboards, Section Boards and Distribution Boards
 	
401. - 405. 〈same as the present Rules〉
 	
406. Testing and inspection
 	
  1. 〈same as the present Rules〉
 	
  2. Temperature test 【See Guidance】
 	
    The temperature rises of switchboards are not to exceed the values given in **Table 6.1.10** under the specified current and/or rated voltage, except these provided in the relevant Sections of this Chapter.
    (1) - (2) 〈newly added〉
 	
  3. 〈same as the presnet Rules〉
 	
  4. High voltage test 【See Guidance】
 	
    Switchboards with all components are to withstand the high voltage by applying the following voltage at commercial frequency for 1 minute between all current-carrying parts connected together and earth and between current-carrying parts of opposite polarity of phase. Instruments and auxiliary apparatus may be disconnected during the highvoltage test:
 	
    Rated voltage up to 60^V : 500 ^{V}
 	
    Rated voltage exceeding 60^V : 1,000^V + twice the rated voltage (min. 1,500^V)
	Section 4 Switchboards, Section Boards and Distribution Boards
	
	401. - 405. 〈same as the present Rules〉
	
	406. Testing and inspection
	
	  1. 〈same as the present Rules〉
	
	  2. Temperature test 【See Guidance】
	
	    ~~The temperature rises of switchboards are not to exceed the values given in~~ **~~Table 6.1.10~~** ~~under the specified current and/or rated voltage, except these provided in the relevant Sections of this Chapter.~~
	    (1) The temperature rises of switchboards are not to exceed the values given in **Table 6.1.10** under the specified current and/or rated voltage, except these provided in the relevant Sections of this Chapter.
	    (2) The temperature rises of high voltage switchboards are to comply with **1506. 4.**
	
	  3. 〈same as the presnet Rules〉
	
	  4. High voltage test 【See Guidance】
	
	    ~~Switchboards with all components are to withstand the high voltage by applying the following voltage at commercial frequency for 1 minute between all current-carrying parts connected together and earth and between current-carrying parts of opposite polarity of phase. Instruments and auxiliary apparatus may be disconnected during the highvoltage test:~~
	
	    ~~Rated voltage up to 60^V : 500 ^{V}~~
	
	    ~~Rated voltage exceeding 60^V : 1,000^V + twice the rated voltage (min. 1,500^V)~~
		(Amended)
		- It has been amended to specify temperature rises of high voltage switchboard separately.

Present	Amendment	Remark
(1) - (2) 〈newly added〉	(1) Switchboards with all components are to withstand the high voltage by applying the following voltage at commercial frequency for 1 minute between all current-carrying parts connected together and earth and between current-carrying parts of opposite polarity of phase. Instruments and auxiliary apparatus may be disconnected during the highvoltage test: Rated voltage up to 60^V : 500 ^{V} Rated voltage exceeding 60^V : 1,000^V + twice the rated voltage (min. 1,500^V) 【See Guidance】 (2) The high voltage tests of high voltage switchboards are to comply with **1506. 4.**	(Amended) - It has been amended to specify high voltage tests of high voltage switchboard separately.
5. 〈same as the presnet Rules〉	5. 〈same as the presnet Rules〉	
Section 5 Cables	**Section 5 Cables**	
501. - 510. 〈same as the present Rules〉	501. - 510. 〈same as the present Rules〉	
511. Joints and branch circuits	511. Joints and branch circuits	
1. - 4. 〈same as the present Rules〉	1. - 4. 〈same as the present Rules〉	
5. Cable termination	5. Cable termination	
Cables stripped of moisture-resistant insulation are to be sealed against the admission of moisture by methods such as taping in combination with insulating compound or sealing devices. Cable conductors for connection to terminals are to be fitted with crimp lugs of corresponding current rating, or equivalent. Soldered lugs are permitted for conductors up to 2.5$^{mm^2}$ only. Cables are to be secured to the terminal box or other sturdy structure in such a manner that stresses are not transmitted to the terminal. Where applicable, other properties of the cable, e.g., flame retarding, fire resistant, etc. are to be retained through to the terminal box.	Cables stripped of moisture-resistant insulation are to be sealed against the admission of moisture by methods such as taping in combination with , insulating compound or, sealing devices or other thinngs. Cable conductors for connection to terminals are to be fitted with crimp lugs of corresponding current rating, or equivalent. Soldered lugs are permitted for conductors up to 2.5$^{mm^2}$ only. Cables are to be secured to the terminal box or other sturdy structure in such a manner that stresses are not transmitted to the terminal. Where applicable, other properties of the cable, e.g., flame retarding, fire resistant, etc. are to be retained through to the terminal box.	
512. 〈same as the present Rules〉		
Section 6 - 14 〈same as the present Rules〉	**Section 6 - 14 〈same as the present Rules〉**	

Present	Amendment	Remark
Section 15　High Voltage Electrical Installations	Section 15　High Voltage Electrical Installations	
1501. – 1505. 〈same as the present Rules〉	1501. – 1505. 〈same as the present Rules〉	
1506. Switchgear and controlgear assemblies	1506. Switchgear and controlgear assemblies	
1. General *(2022)*	1. General *(2022)*	(Amended) – It has been added to test requirements of IEC.
Switchgear and controlgear assemblies are to be constructed according to IEC 62271-200:2011 and **1506. 2, 3,** and **4** of the Rules.	Switchgear and controlgear assemblies are to be constructed according to IEC 62271-200:2011 and **1506. 2, 3,** ~~and~~ ,**4 and 6** of the Rules.	
2. – 3. 〈same as the presnet Rules〉	2. – 3. 〈same as the presnet Rules〉	
4. High voltage test *(2022)* 【See Guidance】	4. ~~High voltage test *(2022)*~~ Testing and inspection *(2024)* 【See Guidance】	(Amended) – It has been amended to testing and inspection. – It has been newly added to temperature rise test and see guidance for detail.
A power-frequency voltage test is to be carried out on any switchgear and controlgear assemblies. The test voltages are to be in accordance with the following **Table 6.1.24** and the test procedure is to be in accordance with the IEC 62271-200:2011 Sec 7 Routine tests.	~~A power-frequency voltage test is to be carried out on any switchgear and controlgear assemblies. The test voltages are to be in accordance with the following~~ **Table 6.1.24** ~~and the test procedure is to be in accordance with the IEC 62271-200:2011 Sec 7 Routine tests.~~ (1) Temperature test Where accepted by the Society, test may be exempted. (2) High voltage test A power-frequency voltage test is to be carried out on any switchgear and controlgear assemblies. The test voltages are to be in accordance with the following **Table 6.1.24** and the test procedure is to be in accordance with the IEC 62271-200:2011 Sec 7 Routine tests.	
1507. 〈same as the present Rules〉	1507. 〈same as the present Rules〉	
Section 16 – 18 〈same as the present Rules〉	Section 16 – 18 〈same as the present Rules〉	

Present	Amendment	Remark
# CHAPTER 2 CONTROL SYSTEMS Section 1 – 3 〈same as the presnet Rules〉 Section 4 Computer Based Systems *(2017)* **401. Introduction** 1. Scope The requirements of this Section apply to design, construction, commissioning and maintenance of computer based systems where they depend on software for the proper achievement of their functions. <u>The requirements focus on the functionality of the software and on the hardware supporting the software.</u> The requirements of this Section apply to <u>the use of computer based systems which provide control, alarm, monitoring, safety or internal communication functions which</u> are subject to classification requirements. 2. Exclusion Navigation systems required by SOLAS Chapter V, Radio-communication systems required by SOLAS Chapter IV, and vessel loading instrument/stability computer are not in the scope of this requirement. <u>(1) – (2) 〈newly added〉</u>	# CHAPTER 2 CONTROL SYSTEMS Section 1 – 3 〈same as the presnet Rules〉 Section 4 Computer Based Systems *(2024)* **401. Introduction** 1. Scope <u>(1)</u> The requirements of this Section apply to design, construction, commissioning and maintenance of computer based systems where they depend on software for the proper achievement of their functions. ~~The requirements focus on the functionality of the software and on the hardware supporting the software.~~ <u>(2)</u> The requirements of this Section apply to ~~the use of computer based systems which provide control, alarm, monitoring, safety or internal communication functions which~~ <u>systems which provide control, alarm, monitoring, safety, or internal vessel communication functions that</u> are subject to classification requirements. 2. Exclusion ~~Navigation systems required by SOLAS Chapter V, Radio-communication systems required by SOLAS Chapter IV, and vessel loading instrument/stability computer are not in the scope of this requirement.~~ <u>(1) Computer based systems that are covered by statutory regulations are excluded from the requirements of this Section.</u> ~~(2) Guidance:~~ <u>Examples of such systems are navigation systems and radio communication system required by SOLAS chapter V and IV, and vessel loading instrument/stability computer.</u> <u>(2) For loading instrument/stability computer, IACS recommendation no. 48 may be considered.</u>	(Amended) – UR E22(Rev.3) has been applied.

Present	Amendment	Remark
3. References For the purpose of application of the requirements of this Section, the following identified standards can be used for the development of hardware/software of computer based systems. Other industry standards may be considered: (1) – (2) 〈newly added〉 (1) IEC 61508: Functional safety of electrical/electronic/programmable electronic safety-related systems (2) ISO/IEC 12207: Systems and software engineering – Software life cycle processes (3) ISO 9001:2008 Quality Management Systems – Requirements (4) ISO/IEC 90003: Software engineering – Guidelines for the application of ISO 9001:2008 to computer software (5) IEC 60092-504: Electrical installations in ships – Part 504: Special features – Control and instrumentation (6) ISO/IEC 25000: Systems and software engineering – Systems and software Quality Requirements and Evaluation (SQuaRE) – Guide to SQuaRE	3. References For the purpose of application of the requirements of this Section, the following identified standards can be used for the development of hardware/software of computer based systems. Other industry standards may be considered: (1) Normative standards For the purposes of this Section, the following standards are normative: (A) Ch 3, Sec 23 of the **Guidance for Approval of Manufacturing Process and Type Approval, Etc.** (B) IACS UR E26, Cyber resilience of ships (C) IACS UR E27, Cyber resilience of on-board systems and equipment (2) Informative standards For the purposes of this Section, the following standards are listed for information and may be used for the development of hardware/software of computer based systems: (1) (A) IEC 61508:2010, Functional safety of electrical/electronic/programmable electronic safety-related systems (2) (B) SO/IEC 12207:2017, Systems and software engineering – Software life cycle processes (3) (C) ISO 9001:20082015, Quality Management Systems – Requirements (4) (D) ISO/IEC 90003:2018, Software engineering – Guidelines for the application of ISO 9001:2008 to computer software (5) (E) IEC 60092-504:2016, Electrical installations in ships – Part 504: Special features – Control and instrumentation (6) (F) ISO/IEC 25000:2014, Systems and software engineering – Systems and software Quality Requirements and Evaluation (SQuaRE) – Guide to SQuaRE	(Amended) – UR E22(Rev.3) has been applied.

Present	Amendment	Remark
(7) ISO/IEC 25041: Systems and software engineering – Systems and software Quality Requirements and Evaluation (SQuaRE) – Evaluation guide for developers, acquirers and independent evaluators (8) IEC 61511: Functional safety – Safety instrumented systems for the process industry sector (9) ISO/IEC 15288: Systems and software engineering – system life cycle process	(7) (G) 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) (H) IEC 61511:2016, Functional safety – Safety instrumented systems for the process industry sector (9) (I) ISO/IEC 15288:2015, Systems and software engineering – system life cycle process (J) ISO 90007:2017 Quality management – Guidelines for configuration management (K) ISO 24060:2021 Ships and marine technology – Ship software logging system for operational technology Other industry standards may also be considered.	(Amended) – UR E22(Rev.3) has been applied.
4. – 5. 〈newly added〉	4. Structure (1) The general certification requirements for computer based systems and the relation to type approval is described in **402.** The requirements and extent of verification of a computer based system depends on its categorization into one of three categories. The categories are described in **403.** (2) The requirements of this section cover the lifecycle of computer based system from design through operations. The requirements are split into groups representing the different phases of the life cycle and the roles responsible for fulfilling the requirements. The activities related to the development and delivery of a computer based system is described in **404.**, while the activities related to the maintenance in the operational phase are described in **405.** (3) Management of changes to software and systems is given special attention in this Section, and the main aspects of a management of change process are described in **406.**	

Present	Amendment	Remark
	(4) Most requirements in this Section are related to the way of working, and thus focus on activities to be performed, but it also contains some technical requirements. The technical requirements on computer based systems have been gathered in **407.** (5) Each activity contains a requirement part which describes the minimum requirements on the role in question, and a part which describes the Society's verification of the activity in question. **5. Definition of abbreviations and terminology** (1) Abbreviations Table 6.2.1 Abbreviations	(Amended) - UR E22(Rev.3) has been applied.

Table 6.2.1 Abbreviations

Abbreviation:	Expansion:
Cat I	Category one systems as defined in **403. 1**
Cat II	Category two systems as defined in **403. 1**
Cat III	Category three systems as defined in **403. 1**
COTS	Commercial off-the-shelf
FAT	Factory acceptance test
FMEA	Failure mode and effect analysis
IT	Information technology
OT	Operational technology
PMS	Planned maintenance system
SAT	System acceptance test
SOST	System of systems test
SSLS	Ship software logging system
UR	Unified requirement

Present	Amendment	Remark
	(2) Terminology **Table 6.2.2 Terminology**	(Amended) - UR E22(Rev.3) has been applied.

Term:	Definition:
Black-box description	A description of a system's functionality and behaviour and performance as observed from outside the system in question
Black-box test methods	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/component under test in order to achieve the desired level of verification.
Computer based system (CBS)	A programmable electronic device, or interoperable set of programmable electronic devices, organized to achieve one or more specified purposes such as collection, processing, maintenance, use, sharing, dissemination, or disposition of information. CBSs onboard include IT and OT systems. A CBS may be a combination of subsystems connected via network. Onboard CBSs may be connected directly or via public means of communications (e.g. Internet) to ashore CBSs, other vessels' CBSs and/or other facilities.
Failure mode description	A document describing the effects due to failures in the system, not failures in the equipment supported by the system, and includes the following along with a list of failures to be evaluated. - list of failures which are subject to assessment, with - description of the system response to each of the above failures - comments to the consequence of each of these failures
Owner	The organization or person which orders the vessel in the construction phase or the organization which owns or manages the vessel in service. In the context of this UR this is a defined role with specific responsibilities.
Parameterization	To configure and tune system and software functionality by changing parameters. It does not usually require-computer programming and is normally done by the system supplier or a service provider, not the operator or end-user.
Programmable device	Physical component where software is installed
Robustness	The ability to respond to abnormal inputs and conditions
Service supplier	A person or company, not employed by an IACS Member, 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 which are used by surveyors in making decisions affecting classification or statutory certification and services

Present	Amendment		Remark
	Simulation test	Monitoring, control, or safety system testing where the equipment under control is partly or fully replaced with simulation tools, or where parts of the communication network and lines are replaced with simulation tools.	(Amended) – UR E22(Rev.3) has been applied.
	Society Certificate	Compliance document issued by the Society certifies the following: – conformity with applicable Classification Technical Rules and requirements. – the tests and inspections have been carried out on the finished certified component itself or, when applicable, on samples taken from earlier stages in the production of the component. – the inspection and tests were performed in the presence of the Surveyor or in accordance with special agreements.	
	Software component	A standalone piece of code that provides specific and closely coupled functionality.	
	Software master files	The computer-files that constitutes the original source of the software. For custom made software this may be readable source- code files, and for COTS software it may be different forms of binary files.	
	Software-structure	Overview of how the different software components interact and is commonly referred to as the Software Architecture, or Software Hierarchy	
	Sub-system	Identifiable part of a system, which may perform a specific function or set of functions.	
	Supplier	A generic term used for any organisation or person that is a contracted or a subcontracted provider of services, system components, or software.	
	System	A combination of components, equipment and logic which has a defined purpose, functionality, and performance. In the context of this section, a specific system is delivered by one system supplier.	
	System of systems	A system which is made up of several systems. In the context of this section, the system of systems encompasses all monitoring, control and safety systems delivered from the Shipyard as a part of a vessel.	
	System supplier	An organisation or person that is contracted or a subcontracted provider of system components or software under the coordination of the Systems integrator. In the context of this UR this is a defined role with specific responsibilities.	

Present	Amendment	Remark
	<table><tr><td>Systems integrator</td><td>Single organization or a person coordinating interaction between suppliers of systems and sub-systems on 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 of the computer based systems. In the context of this UR this is a defined role with specific responsibilities. During the design and delivery phase the Shipyard is the default Systems integrator, during operations phase the Owner is the default.</td></tr><tr><td>Type approval Certificate</td><td>Compliance document issued by the Society by which the Society declares that a product design meets a minimum set of technical requirements.</td></tr><tr><td>Vessel</td><td>Ship or offshore unit where the computer based system is to be installed.</td></tr></table>	(Amended) - UR E22(Rev.3) has been applied.

Present	Amendment	Remark

402. Definitions
 	
1. Stakeholders
  (1) Owner
    (A) The Owner is responsible for contracting the system integrator and/or suppliers to provide a hardware system including software according to the owner's specification.
    (B) The Owner could be the Ship Builder Integrator (Builder or Shipyard) during initial construction. After vessel delivery, the owner may delegate some responsibilities to the vessel operating company.
  (2) System integrator
    (A) The role of system integrator is to be taken by the yard unless an alternative organisation is specifically contracted/assigned this responsibility. The system integrator is responsible for the integration of systems and products provided by suppliers into the system invoked by the requirements specified herein and for providing the integrated system. The system integrator may also be responsible for integration of systems in the vessel.
    (B) If there are multiple parties performing system integration at any one time a single party is to be responsible for overall system integration and coordinating the integration activities. If there are multiple stages of integration different System Integrators may be responsible for specific stages of integration but a single party is to be responsible for defining and coordinating all of the stages of integration.
	402. Definitions
	
	1. Stakeholders
	  (1) Owner
	    (A) The Owner is responsible for contracting the system integrator and/or suppliers to provide a hardware system including software according to the owner's specification.
	    (B) The Owner could be the Ship Builder Integrator (Builder or Shipyard) during initial construction. After vessel delivery, the owner may delegate some responsibilities to the vessel operating company.
	  (2) System integrator
	    (A) The role of system integrator is to be taken by the yard unless an alternative organisation is specifically contracted/assigned this responsibility. The system integrator is responsible for the integration of systems and products provided by suppliers into the system invoked by the requirements specified herein and for providing the integrated system. The system integrator may also be responsible for integration of systems in the vessel.
	    (B) If there are multiple parties performing system integration at any one time a single party is to be responsible for overall system integration and coordinating the integration activities. If there are multiple stages of integration different System Integrators may be responsible for specific stages of integration but a single party is to be responsible for defining and coordinating all of the stages of integration.
		(Amended)
		- UR E22(Rev.3) has been applied.

Present	Amendment	Remark
(3) Supplier 　(A) The Supplier is any contracted or subcontracted provider of system components or software under the coordination of the System Integrator or Shipyard. The supplier is responsible for providing programmable devices, sub-systems or systems to the system integrator. 　(B) The supplier provides a description of the software functionality that meets the Owner's specification, applicable international and national standards, and the requirements specified herein. 2. Objects 　Fig 6.2.1 shows the hierarchy and relationships of a typical computer based system. 　　　　Fig 6.2.1 〈same as the presnet Rules〉 (1) Object definitions 　(A) System 　　Combination of interacting programmable devices and/or sub-systems organized to achieve one or more specified purposes. 　(B) Sub-system 　　Identifiable part of a system, which may perform a specific function or set of functions. 　(C) Programmable device 　　Physical component where software is installed. 　(D) Software module 　　A module is a standalone piece of code that provides specific and closely coupled functionality. 402. 〈newly added〉	(3) Supplier 　(A) The Supplier is any contracted or subcontracted provider of system components or software under the coordination of the System Integrator or Shipyard. The supplier is responsible for providing programmable devices, sub-systems or systems to the system integrator. 　(B) The supplier provides a description of the software functionality that meets the Owner's specification, applicable international and national standards, and the requirements specified herein. 2. Objects 　Fig 6.2.1 shows the hierarchy and relationships of a typical computer based system. 　　　　Fig 6.2.1 〈same as the presnet Rules〉 (1) Object definitions 　(A) System 　　Combination of interacting programmable devices and/or sub-systems organized to achieve one or more specified purposes. 　(B) Sub-system 　　Identifiable part of a system, which may perform a specific function or set of functions. 　(C) Programmable device 　　Physical component where software is installed. 　(D) Software module 　　A module is a standalone piece of code that provides specific and closely coupled functionality. 402. Approval of systems and components 1. System certification	(Amended) - UR E22(Rev.3) has been applied.

Present	Amendment	Remark
	(1) Computer based systems that are necessary to accomplish vessel-functions of category II or category III (as defined in **403. 1** below) shall be delivered with a vessel-specific Society certificate. The objective of the vessel-specific system certification is to confirm that design and manufacturing of the system has been completed and that the system complies with applicable rules of the Society. (2) Vessel-specific system certification consist of two main verification activities: (A) Assessment of vessel-specific documentation (see **404. 2** and **406.**) (B) Survey and testing of the system to be delivered to the vessel (see **404. 2 (7)**) (3) The Society may accept Alternative Certification Scheme (ACS) provided that the requirements are met, and that the system is provided with a vessel-specific certificate. **2. Type approval of computer based systems** (1) Computer based systems that are routinely manufactured and include standardized software functions may be type approved in accordance with specified rules of the Society. Hardware shall be documented according to the requirement in **404. 2 (4)**. (2) The type approval consist of two main verification activities: (A) Assessment of type-specific documentation (B) Survey and testing of the standardized functions (3) Type approval will normally not yield exemption from vessel-specific system certification since vessel-specific functions, parameter configurations and installation elements demand vessel-specific verification.	(Amended) - UR E22(Rev.3) has been applied.
403. 〈newly added〉 3. System categories	403. System categories ~~3. System categories~~	

Present	Amendment	Remark
(1) **Table 6.2.2** shows how to assign system categories based on their effects on system functionality.	(1) ~~Table 6.2.2 shows how to assign system categories based on their effects on system functionality.~~	(Amended) − UR E22(Rev.3) has been applied.
	1. System category definitions	
	(1) The categorization of a system in this section is based on the potential severity of the consequences if the system serving the function fails. **Table 6.2.3** provides the definitions of the categories.	

Table 6.2.2 System categories

Category	Effects	Typical System functionality
I	Those systems, failure of which will not lead to dangerous situations for human safety, safety of the vessel and/or threat to the environment.	− Monitoring function for informational / administrative tasks
II	Those systems, failure of which could eventually lead to dangerous situations for human safety, safety of the vessel and/or threat to the environment.	− Alarm and monitoring functions − Control functions which are necessary to maintain the ship in its normal operational and habitable conditions
III	Those systems, failure of which could immediately lead to dangerous situations for human safety, safety of the vessel and/or threat to the environment.	− Control functions for maintaining the vessel's propulsion and steering − Vessel safety functions

Table ~~6.2.2~~ 6.2.3 System categories

Category	Effects	Typical System functionality
I	Those systems, failure of which will not lead to dangerous situations for human safety, safety of the vessel and/or threat to the environment.	− ~~Monitoring function for informational/administrative tasks~~ − Monitoring, informational and administrative functions
II	Those systems, failure of which could eventually lead to dangerous situations for human safety, safety of the vessel and/or threat to the environment.	− ~~Alarm and monitoring functions~~ − ~~Control functions which are necessary to maintain the ship in its normal operational and habitable conditions~~ − Vessel alarm, monitoring and control functions which are necessary to maintain the vessel in its normal operational and habitable conditions
III	Those systems, failure of which could immediately lead to dangerous or catastrophic ~~situations~~ for human safety, safety of the vessel and/or threat to the environment.	− Control functions for maintaining the vessel's propulsion and steering − Vessel safety functions

Present	Amendment	Remark
	2. Class Societies' scope (1) Category I systems are normally not subject to verification by the Society, as failure of these systems shall not lead to dangerous situations. However, information pertinent to category I systems shall be required upon request to determine the correct category or ensure that they do not influence the operation of systems in category II and category III. **3. System category examples** (1) The category of a system shall always be evaluated in the context of the specific vessel in question; thus, the categorization of a system may vary from one vessel to the next. This means that the examples of categories below are given as guidance only. For determining the categorization of systems for a specific vessel, see **404. 3 (3).**	(Amended) - UR E22(Rev.3) has been applied.
(2) The following systems typically belong to Category III, the exact category being dependent on the risk assessment for all operational scenarios: (A) Propulsion system of a ship, meaning the means to generate and control mechanical thrust in order to move the ship (devices used only during manoeuvring are not in the scope of this requirement such as bow tunnel thrusters) (B) Steering system control system (C) Electric power system (including power management system) (D) Ship safety systems covering fire detection and fighting, flooding detection and fighting, internal communication systems involved in evacuation phases, ship systems involved in operation of life saving appliances equipment (E) Dynamic positioning system of equipment classes DPS(2) and DPS(3) according to IMO MSC/Circ.645 (F) Drilling systems	(2) ~~The following systems typically belong to Category III, the exact category being dependent on the risk assessment for all operational scenarios:~~ (A) ~~Propulsion system of a ship, meaning the means to generate and control mechanical thrust in order to move the ship (devices used only during manoeuvring are not in the scope of this requirement such as bow tunnel thrusters)~~ (B) ~~Steering system control system~~ (C) ~~Electric power system (including power management system)~~ (D) ~~Ship safety systems covering fire detection and fighting, flooding detection and fighting, internal communication systems involved in evacuation phases, ship systems involved in operation of life saving appliances equipment~~ (E) ~~Dynamic positioning system of equipment classes DPS(2) and DPS(3) according to IMO MSC/Circ.645~~ (F) ~~Drilling systems~~	

Present	Amendment	Remark
(3) The following systems typically belong to Category II, the exact category being dependent on the risk assessment for all operational scenarios: (A) Liquid cargo transfer control system (B) Bilge level detection and associated control of pumps (C) Fuel oil treatment system (D) Ballast transfer valve remote control system (E) Stabilization and ride control systems (F) Alarm and monitoring systems for propulsion systems (4) The example systems are not exhaustive. (2) – (5) ⟨newly added⟩	(3) The following systems typically belong to Category II, the exact category being dependent on the risk assessment for all operational scenarios: (A) Liquid cargo transfer control system (B) Bilge level detection and associated control of pumps (C) Fuel oil treatment system (D) Ballast transfer valve remote control system (E) Stabilization and ride control systems (F) Alarm and monitoring systems for propulsion systems (4) The example systems are not exhaustive. (2) Examples of category I systems: Fuel monitoring system, maintenance support system, diagnostics and troubleshooting system, closed circuit television, cabin security, entertainment system, fish detection system. (3) Examples of category II systems: Fuel oil treatment system, alarm monitoring and safety systems for propulsion and auxiliary machinery, Inert gas system, control, monitoring and safety system for cargo containment system. (4) Examples of category III systems: Propulsion control system, steering gear control system, electric power system (including power management system), dynamic positioning system (IMO classes 2 and 3). (5) The list of example systems is not exhaustive.	(Amended) - UR E22(Rev.3) has been applied.

4. Other terminology
 	
(1) Simulation tests
  Control system testing where the equipment under control is partly or fully replaced with simulation tools, or where parts of the communication network and lines are replaced with simulation tools.
	4. Other terminology
	
	(1) Simulation tests
	  Control system testing where the equipment under control is partly or fully replaced with simulation tools, or where parts of the communication network and lines are replaced with simulation tools.	

Present	Amendment	Remark
403. Systems requirements 1. General (1) Program and memory data To preclude the possible loss or corruption of data as a result of power disruption, programs and associated memory data considered to be essential for the operation of the specific system are to be stored in non-volatile memory. (2) Start-up after power failure The system's software and hardware is to be designed so that upon restoration of power supply after power failure, automatic or remote control and monitoring capabilities can immediately be available after the pre-established computer control access (sign-in) procedure has been completed. (3) Self monitoring Computer-based systems are to be self-monitoring and any incorrect operation or abnormal condition is to be alarmed at the computer workstation. (4) Power supply The power supply is to be monitored for voltage failure and protected for short circuit. Where redundant computer systems are provided to satisfy (5), they are to be separately fed. (5) System independence Control, monitoring and safety systems are to be arranged such that a single failure or malfunction of the computer equipment will not affect more than one of these system functions.	403. Systems requirements 1. General (1) Program and memory data To preclude the possible loss or corruption of data as a result of power disruption, programs and associated memory data considered to be essential for the operation of the specific system are to be stored in non-volatile memory. (2) Start-up after power failure The system's software and hardware is to be designed so that upon restoration of power supply after power failure, automatic or remote control and monitoring capabilities can immediately be available after the pre-established computer control access (sign-in) procedure has been completed. (3) Self monitoring Computer-based systems are to be self-monitoring and any incorrect operation or abnormal condition is to be alarmed at the computer workstation. (4) Power supply The power supply is to be monitored for voltage failure and protected for short circuit. Where redundant computer systems are provided to satisfy (5), they are to be separately fed. (5) System independence Control, monitoring and safety systems are to be arranged such that a single failure or malfunction of the computer equipment will not affect more than one of these system functions.	(Amended) - UR E22(Rev.3) has been applied.

Present	Amendment	Remark
(6) Response time Computer system's memory is to be of sufficient capacity to handle the operation of all computer programs as configured in the computer system. The time response for processing and transmitting data is to be such that an undesirable chain of events may not arise as a result of unacceptable data delay or response time during the computer system's worst data overload operating condition. For propulsion related system applications, the time limit on response delays for safety and alarm displays is not to exceed two(2) seconds. The response delay is to be taken as the time between detection of an alarm or safety critical condition and the display of the alarm or actuation of the safety system. (7) Fail-safe Computer-based system is to be designed such that failure of any of the system's components will not cause unsafe operation of the process or the equipment it controls. FMEA is to be used to determine that any component failure will not result in the complete loss of control, the shutdown of the process or equipment, or other undesirable consequences.	~~(6) Response time~~ ~~Computer system's memory is to be of sufficient capacity to handle the operation of all computer programs as configured in the computer system. The time response for processing and transmitting data is to be such that an undesirable chain of events may not arise as a result of unacceptable data delay or response time during the computer system's worst data overload operating condition. For propulsion related system applications, the time limit on response delays for safety and alarm displays is not to exceed two(2) seconds. The response delay is to be taken as the time between detection of an alarm or safety critical condition and the display of the alarm or actuation of the safety system.~~ ~~(7) Fail-safe~~ ~~Computer-based system is to be designed such that failure of any of the system's components will not cause unsafe operation of the process or the equipment it controls. FMEA is to be used to determine that any component failure will not result in the complete loss of control, the shutdown of the process or equipment, or other undesirable consequences.~~	(Amended) - UR E22(Rev.3) has been applied.
2. Additional requirements for integrated systems (1) General Common hardware in an integrated system serving many subsystems, e.g., monitor, keyboard, microprocessor, etc., is to be duplicated or otherwise provided with a means of backup. (2) Component independence Failure of one part (individual module, equipment or subsystem) of the integrated system is not to affect the functionality of other parts, except for those functions directly dependent upon information from the defective part.	~~2. Additional requirements for integrated systems~~ ~~(1) General~~ ~~Common hardware in an integrated system serving many subsystems, e.g., monitor, keyboard, microprocessor, etc., is to be duplicated or otherwise provided with a means of backup.~~ ~~(2) Component independence~~ ~~Failure of one part (individual module, equipment or subsystem) of the integrated system is not to affect the functionality of other parts, except for those functions directly dependent upon information from the defective part.~~	

Present	Amendment	Remark

(3) Data communication
(A) Data link
    (a) Any detected abnormal condition is to be alarmed at the centralized control station and on the navigation bridge.
    (b) Safeguards are to be provided to prevent unacceptable data transmission delays (overloading of network).
    (c) Alarm is to be activated prior to a critical data overload condition.
(B) Duplicated data link
    (a) When the same data link is used for two or more essential functions (e.g., propulsion control and generator control), this link is to be duplicated, and each is to be routed as far apart from the other as practical.
    (b) The duplicate link is for standby purpose only and not to be used to reduce traffic in the online link.
    (c) Duplicated data link is to be arranged so that upon the failure of the on-line link, the standby link is automatically connected to the system. Switching between duplicated links is not to disturb data communication or continuous functioning of the system.
    (d) The failure of one link is to be alarmed at the centralized control station and on the navigation bridge.
(C) Connection failure
    (a) A complete failure in connectivity between component systems and the data highway is not to affect individual functionality of the component systems.
 	
3. Expert system
 	
The expert system software is not to be implemented on a computer linked with essential functions and is not to be used for direct control or operation.
	(3) Data communication
	(A) Data link
	    (a) Any detected abnormal condition is to be alarmed at the centralized control station and on the navigation bridge.
	    (b) Safeguards are to be provided to prevent unacceptable data transmission delays (overloading of network).
	    (c) Alarm is to be activated prior to a critical data overload condition.
	(B) Duplicated data link
	    (a) When the same data link is used for two or more essential functions (e.g., propulsion control and generator control), this link is to be duplicated, and each is to be routed as far apart from the other as practical.
	    (b) The duplicate link is for standby purpose only and not to be used to reduce traffic in the online link.
	    (c) Duplicated data link is to be arranged so that upon the failure of the on-line link, the standby link is automatically connected to the system. Switching between duplicated links is not to disturb data communication or continuous functioning of the system.
	    (d) The failure of one link is to be alarmed at the centralized control station and on the navigation bridge.
	(C) Connection failure
	    (a) A complete failure in connectivity between component systems and the data highway is not to affect individual functionality of the component systems.
	
	3. Expert system
	
	The expert system software is not to be implemented on a computer linked with essential functions and is not to be used for direct control or operation.
		(Amended)
		- UR E22(Rev.3) has been applied.

Present	Amendment	Remark

4. Hardware
 	
(1) Design for ease of maintenance
  (A) The design and layout of the hardware is to ensure ease of access to interchangeable parts for repairs and maintenance.
  (B) Each replaceable part is to be simple to replace and is to be constructed for easy and safe handling.
  (C) All replaceable parts are to be so designed that it is not possible to connect them incorrectly or to use incorrect replacements. Where this is not practicable, the replaceable parts and their mounting location, including their means of electrical connection, are to be clearly marked.
(2) User interface and input devices
  (A) General
  Input devices are to have clearly marked functions and, as far as practicable, are to be arranged to avoid conceivable inadvertent errors in their operations.
  (B) Security
  Input devices, such as keyboard, which can be used to effect changes to equipment or processes under control, are to be provided with security arrangement, such as password, so as to limit access to authorized personnel only.
  Where a single action of, for example, pressing of a key is able to cause dangerous operating conditions or malfunctions, measures such as use of two or more keys are to be taken to prevent execution by a single action.
  (C) Control Status
  Where control action can be effected from more than one station, conflicting control station actions are to be prevented by means of interlock or warning. Control status is to be indicated at all stations.
	4. Hardware
	
	(1) Design for ease of maintenance
	  (A) The design and layout of the hardware is to ensure ease of access to interchangeable parts for repairs and maintenance.
	  (B) Each replaceable part is to be simple to replace and is to be constructed for easy and safe handling.
	  (C) All replaceable parts are to be so designed that it is not possible to connect them incorrectly or to use incorrect replacements. Where this is not practicable, the replaceable parts and their mounting location, including their means of electrical connection, are to be clearly marked.
	(2) User interface and input devices
	  (A) General
	  Input devices are to have clearly marked functions and, as far as practicable, are to be arranged to avoid conceivable inadvertent errors in their operations.
	  (B) Security
	  Input devices, such as keyboard, which can be used to effect changes to equipment or processes under control, are to be provided with security arrangement, such as password, so as to limit access to authorized personnel only.
	  Where a single action of, for example, pressing of a key is able to cause dangerous operating conditions or malfunctions, measures such as use of two or more keys are to be taken to prevent execution by a single action.
	  (C) Control Status
	  Where control action can be effected from more than one station, conflicting control station actions are to be prevented by means of interlock or warning. Control status is to be indicated at all stations.
		(Amended)
		- UR E22(Rev.3) has been applied.

Present	Amendment	Remark
(3) Visual display unit (A) General The size, color and density of text and graphic information displayed on a visual display unit are to be such that it may be easily read from the normal operator position under all operational lighting conditions. The brightness and contrast are to be capable of being adjusted. (B) Alarm display Where alarms are displayed by means of visual display unit, they are to appear in the sequence as the incoming signals are received. Alarming of the incoming fault signals is to appear on the screen, regardless of the mode the computer or the visual display unit is in. (C) Propulsion monitoring Where visual display unit is used to display monitored parameters, unless other display means are provided capable of displaying the same information, the centralized control station is to be provided with at least two computer monitors. (D) Color monitor The failure of a primary color is not to prevent an alarm from being distinctly indicated. (4) Graphical display (A) General Information is to be presented clearly and intelligibly, according to its functional relations. Display presentations are to be restricted to the data which is directly relevant for the user. (B) Alarms Alarms are to be clearly distinguishable from other information and are to be visually and audibly presented with priority over other information, regardless of the mode the computer or the visual display unit is in.	(3) Visual display unit (A) General The size, color and density of text and graphic information displayed on a visual display unit are to be such that it may be easily read from the normal operator position under all operational lighting conditions. The brightness and contrast are to be capable of being adjusted. (B) Alarm display Where alarms are displayed by means of visual display unit, they are to appear in the sequence as the incoming signals are received. Alarming of the incoming fault signals is to appear on the screen, regardless of the mode the computer or the visual display unit is in. (C) Propulsion monitoring Where visual display unit is used to display monitored parameters, unless other display means are provided capable of displaying the same information, the centralized control station is to be provided with at least two computer monitors. (D) Color monitor The failure of a primary color is not to prevent an alarm from being distinctly indicated. (4) Graphical display (A) General Information is to be presented clearly and intelligibly, according to its functional relations. Display presentations are to be restricted to the data which is directly relevant for the user. (B) Alarms Alarms are to be clearly distinguishable from other information and are to be visually and audibly presented with priority over other information, regardless of the mode the computer or the visual display unit is in.	(Amended) - UR E22(Rev.3) has been applied.

Present	Amendment	Remark
404. Requirements for software and supporting hardware	404. ~~Requirements for software and supporting hardware~~ Requirements on development and certification of computer based systems	(Amended) - UR E22(Rev.3) has been applied.
1. Life cycle approach	1. ~~Life cycle approach~~ General requirements	
~~A global top to bottom approach is to be undertaken regarding software and the integration in a system, spanning the software lifecycle. This approach is to be accomplished according to software development standards as listed herein or other standards recognized by the Class Society.~~	~~A global top to bottom approach is to be undertaken regarding software and the integration in a system, spanning the software lifecycle. This approach is to be accomplished according to software development standards as listed herein or other standards recognized by the Class Society.~~	
(1) ⟨newly added⟩	(1) Life cycle approach with appropriate standards (A) Requirement: A global top-down approach shall 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 lifecycle. This approach shall be based on the standards as listed herein or other standards recognized by the Society. (B) Class Society's verification: It is verified by the Society as a part of the quality management system verification described in (2).	
(1) Quality system (A) System integrators and suppliers is to operate a quality system regarding software development and testing and associated hardware such as ISO 9001 taking into account ISO 90003.	~~(1)~~ (2) Quality management system ~~(A) System integrators and suppliers is to operate a quality system regarding software development and testing and associated hardware such as ISO 9001 taking into account ISO 90003.~~ (A) Systems integrators and system suppliers shall, in the development of computer based systems for category II and category III, comply to a recognised quality standard such as ISO 9001; also incorporating principles of IEC/ISO 90003. (B) The quality management system shall as a minimum include the **Table 6.2.4**, applicable for both category II and category III systems:	

Present	Amendment	Remark

Present — **Amendment** — **Remark**

Table 6.2.4 Quality management system

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

(Amended)
- UR E22(Rev.3) has been applied.

Present	Amendment	Remark
(B) Satisfaction of this requirement is to be demonstrated by either: (a) The quality system being certified as compliant to the recognized standard by an organisation with accreditation under a national accreditation scheme, or (b) The Society confirming compliance to the standard through a specific assessment. (C) This quality system is to include: (a) Relevant procedures regarding responsibilities, system documentation, configuration management and competent staff. (b) Relevant procedures regarding software lifecycle and associated hardware: (i) Organization set in place for acquisition of related hardware and software from suppliers (ii) Organization set in place for software code writing and verification (iii) Organization set in place for system validation before integration in the vessel (c) Minimum requirements for approval of Quality system: (i) Having a specific procedure for verification of software code of Category II and III at the level of systems, sub-systems and programmable devices and modules	(B) Satisfaction of this requirement is to be demonstrated by either: (a) The quality system being certified as compliant to the recognized standard by an organisation with accreditation under a national accreditation scheme, or (b) The Society confirming compliance to the standard through a specific assessment. (C) Class Society's verification: The quality management system may be verified by two alternative means: (a) The Society confirming that the quality management system is certified as compliant to a recognized standard by an organisation with accreditation under a national accreditation scheme. (b) The Society confirming compliance to a standard through a specific assessment of the quality management system. The documentation requirements will be defined per case. (C) This quality system is to include: (a) Relevant procedures regarding responsibilities, system documentation, configuration management and competent staff. (b) Relevant procedures regarding software lifecycle and associated hardware: (i) Organization set in place for acquisition of related hardware and software from suppliers (ii) Organization set in place for software code writing and verification (iii) Organization set in place for system validation before integration in the vessel (c) Minimum requirements for approval of Quality system: (i) Having a specific procedure for verification of software code of Category II and III at the level of systems, sub-systems and programmable devices and modules	(Amended) - UR E22(Rev.3) has been applied.

Present	Amendment	Remark

(ii) Having check points for the Society for Category II and III systems (see **Table 6.2.3** for the minimum check points). Examples of check points can be a required submittal of documentation, a test event, a technical design review meeting, or peer review meeting.
(iii) Having a specific procedure for software modification and installation on board the vessel defining interactions with owners
(d) Quality Plan
A document, referred to herein as a Quality Plan, is to be produced that records how the quality management system will be applied for the specific computer based system and that includes, as a minimum, all of material required by (a) to (c) inclusively.
 	
2. ~ 3. 〈newly added〉
	(ii) ~~Having check points for the Society for Category II and III systems (see~~ **Table 6.2.3** ~~for the minimum check points). Examples of check points can be a required submittal of documentation, a test event, a technical design review meeting, or peer review meeting.~~
	(iii) ~~Having a specific procedure for software modification and installation on board the vessel defining interactions with owners~~
	~~(d) Quality Plan~~
	~~A document, referred to herein as a Quality Plan, is to be produced that records how the quality management system will be applied for the specific computer based system and that includes, as a minimum, all of material required by (a) to (c) inclusively.~~
	
	2. Requirements on the system supplier
	
	(1) Define and follow a quality plan
	  (A) Requirement:
	    (a) The system supplier shall document that the quality management system is applied for the design, construction, delivery, and maintenance of the specific system to be delivered.
	    (b) All applicable items described in 1 (2) (for the system supplier role) shall be demonstrated to exist and being followed, as relevant.
	  (B) Class Society's verification:
	    (a) Category I: No documentation required
	    (b) Category II and III: The quality plan shall be available during survey (FAT) or submitted for information upon request (FI).
	(2) Unique identification of systems and software
	  (A) Requirement:
		(Amended)
		- UR E22(Rev.3) has been applied.

Present	Amendment	Remark
	(a) A method for unique identification of a system, its different software components and different revisions of the same software component shall be applied. The method shall be applied throughout the lifecycle of the system and the software. (b) See also **407. 1** for related technical requirements on the system in question. The documentation of the method is typically a part of the quality management system, see 1 (2). (B) Class Society's verification: (a) Category I: Not required (b) Category II and III: Application of the identification system is verified as a part of the FAT (2 (7)) and SAT (3 (6)). (3) System description (A) Requirement: (a) The system's specification and design shall be determined and documented in a system description. In addition to serve as a specification for the detailed design and implementation, the purpose of the system description is to document that the entire system-delivery is according to the specifications and in compliance with applicable rules and regulations. (b) The system description shall contain information of the following: (ⅰ) Purpose and main functions, including any safety aspects (ⅱ) System category as defined (ⅲ) Key performance characteristics (ⅳ) Compliance with the technical requirements and the Society rules (ⅴ) User interfaces/mimics (ⅵ) Communication and Interface aspects 　　－ Identification and description of interfaces to other vessel systems	(Amended) － UR E22(Rev.3) has been applied.

Present	Amendment	Remark
	(vii) Hardware-arrangement related aspects: 　- Network-architecture/topology, including all network components like switches, routers, gateways, firewalls etc. 　- 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 etc) 　- I/O allocation (mapping of field devices to channel, communication link, hardware unit, logic function) 　- Power supply arrangement 　- Failure mode description (c) The information listed above is in this section collectively referred to as the system description. It may however be divided into a number of different documents and models. (B) Class Society's verification: (a) Category I: The system description documentation shall upon request be submitted for information (FI). (b) Category II and III: The system description documentation shall be submitted for approval (AP). (4) Environmental compliance of hardware components (A) Requirement: (a) Evidence of environmental type testing according to **Ch 3, Sec 23** of the **Guidance for Approval of Manufacturing Process and Type Approval, Etc.** regarding hardware elements included in the system and sub-systems shall be submitted to the Society.	(Amended) - UR E22(Rev.3) has been applied.

Present	Amendment	Remark

	(B) Class Society's verification:
	  (a) Category I: This requirement is not mandatory for category I systems. Reference to Type approval certificate or other evidence of type testing shall upon request be submitted for information (FI), see 403. 2.
	  (b) Category II and III: Reference to Type approval certificate or other evidence of type testing shall be submitted for information (FI).
	(5) Software code creation, parameterization, and testing
	  (A) Requirement:
	    (a) The software created, changed, or configured for the delivery project shall be developed and have the quality assurance activities assessed according to the selected standard(s) as described in the quality plan.
	    (b) The quality assurance activities may be performed on several levels of the software-structure and shall include both custom-made software and configured components (e.g. software libraries) as appropriate.
	    (c) The verification of the software shall as a minimum verify the following aspects based on black-box methods:
	      (ⅰ) Correctness, completeness and consistency of any parameterization and configuration of software components
	      (ⅱ) Intended functionality
	      (ⅲ) Intended robustness
	    (d) For components in systems of Category II and III, the scope, purpose, and results of all performed reviews, analyses, tests, and other verification activities shall be documented in test reports.
		(Amended)
		- UR E22(Rev.3) has been applied.

Present	Amendment	Remark
	(e) Some of the methods utilized in this activity are sometimes referred to as "software unit test" or "developer test" and may also include verification methods like code-reviews and static- or dynamic code analysis. (B) Class Society's verification: (a) Category I: No documentation required (b) Category II and III: Software test reports shall upon request be submitted for information (FI). (6) Internal system testing before FAT (A) Requirement: (a) The system shall as far as practicable be tested before the FAT. The main purpose of the system test is for the system supplier to verify that the entire system delivery is according to the specifications, approved documentation and in compliance with applicable rules and regulations; and further, that the system is completed and ready for the FAT. (b) The testing shall at least verify the following aspects of the system: (ⅰ) Functionality (ⅱ) Effect of faults and failures (including diagnostic functions, detection, alerts response) (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 utilizing simulators and replica hardware.	(Amended) - UR E22(Rev.3) has been applied.

Present	Amendment	Remark
	(e) The test-environment shall be documented, including a description of any simulators, emulators, test-stubs, test-management tools, or other tools affecting the test environment and its limitations. (f) Test cases and test results shall be documented in test programs and test reports respectively. (B) Class Society's verification: (a) Category I: No documentation required (b) Category II and III: Internal system test report shall be made available during FAT or submitted upon request (FI). (7) Factory acceptance testing (FAT) before installation on board (A) Requirement: (a) A factory acceptance test (FAT) shall be arranged for the system in question. The main purpose of the FAT is to demonstrate to the Society that the system is completed and compliant with applicable classification rules, thus enabling issuance of a Society Certificate for the system. (b) The FAT test program shall cover a representative selection of the test items from the internal system test (described in (6)), including normal system functionality and response to failures. (c) For category II and III systems, network testing to verify the network resilience requirements in **407. 2 (1)** shall be performed. If agreed by all parties, the network testing may be performed as a part of the system test onboard the vessel. (d) The FAT shall as a rule be performed with the 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 with the Society.	(Amended) - UR E22(Rev.3) has been applied.

Present	Amendment	Remark
	(e) For each test-case it shall be noted if the test passed or failed, and the test-results shall be documented in a test report. The test report shall also contain a list of the software (including software versions) that were installed in the system when the test was executed. (f) 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. (B) Class Society's verification: (a) Category I: FAT not required (b) Category II and III: The FAT program shall be approved (AP) before the test is executed. （ⅰ）The FAT execution shall be witnessed by the Society. （ⅱ）The FAT report shall be submitted for information (FI). （ⅲ）Additional FAT documentation including e.g., user manuals and internal system test report shall be made available during FAT or submitted upon request for information (FI). (8) Secure and controlled software installation on the vessel (A) Requirement: (a) The initial installation and subsequent updates of the software components of the system shall be done according to a management of change procedure which has been agreed between the system supplier and the systems integrator. (b) The management of change procedure shall comply with the requirements in **406.** (c) Cyber security measures shall be observed as described in **Guidance for Cyber Resilience**.	(Amended) - UR E22(Rev.3) has been applied.

Present	Amendment	Remark

	(B) Class Society's verification:
	  (a) Category I: Not required
	  (b) Category II and III: The management of change procedure shall upon request be submitted for information (FI).
	
	3. Requirements on the systems integrator
	
	(1) Responsibilities
	  For the purposes of this section, the Shipyard is considered as the systems integrator in the development and delivery phase unless another organization or person is explicitly appointed by the Shipyard.
	(2) Define and follow a quality plan
	  (A) Requirement:
	    (a) The systems integrator shall document that the quality management system is applied for the installation, integration, completion, and maintenance of the systems to be installed on board. All applicable items described in **1** (2) (for the systems integrator role) shall be demonstrated to exist and being followed, as relevant.
	  (B) Class Society's verification:
	    (a) Category I: No documentation required
	    (b) Category II and III: The quality plan shall be made available during survey (at SAT/SOST) or upon request submitted for information (FI).
	(3) Determining the category of the system in question
	  (A) Requirement:
	    (a) For each system delivery to a particular vessel, it shall be decided which category the system falls under based on the failure effects of the system (as defined in **403.**). The category for a specific system must be conveyed to the relevant system supplier. The Society may decide that a risk-assessment is needed to verify the proper system category.
		(Amended)
		- UR E22(Rev.3) has been applied.

Present	Amendment	Remark
(2) Design phase (A) Risk assessment of system (a) This step is to be undertaken to determine the risk to the system throughout the lifecycle by identifying and evaluating the hazards associated with each function of the system. A risk assessment report is to upon request be submitted to the Society. (b) This document is normally to be submitted by the System Integrator or the Supplier, including data coming from other suppliers. (c) IEC/ISO31010 "Risk management – Risk assessment techniques" may be applied in order to determine method of risk assessment. The method of risk assessment is to be agreed by the Society. (d) Based on the risk assessment, a revised system category might need to be agreed between the Society and the system supplier. (e) Where the risks associated with a computer based system are well understood, it is permissible for the risk assessment to be omitted, however in such cases the supplier or the system integrator is to provide a justification for the omission. The justification is to give consideration to: (i) How the risks are known (ii) The equivalence of the context of use of the current computer based system and the computer based system initially used to determine the risks (iii) The adequacy of existing control measures in the current context of use	(B) Class Society's verification: (a) Category I, II and III: The category for the different systems shall upon request be documented and submitted for approval (AP). (2) Design phase (A) Risk assessment of system (a) This step is to be undertaken to determine the risk to the system throughout the lifecycle by identifying and evaluating the hazards associated with each function of the system. A risk assessment report is to upon request be submitted to the Society. (b) This document is normally to be submitted by the System Integrator or the Supplier, including data coming from other suppliers. (c) IEC/ISO31010 "Risk management – Risk assessment techniques" may be applied in order to determine method of risk assessment. The method of risk assessment is to be agreed by the Society. (d) Based on the risk assessment, a revised system category might need to be agreed between the Society and the system supplier. (e) Where the risks associated with a computer based system are well understood, it is permissible for the risk assessment to be omitted, however in such cases the supplier or the system integrator is to provide a justification for the omission. The justification is to give consideration to: (i) How the risks are known (ii) The equivalence of the context of use of the current computer based system and the computer based system initially used to determine the risks (iii) The adequacy of existing control measures in the current context of use	(Amended) – UR E22(Rev.3) has been applied.

Present	Amendment	Remark
(B) Code production and testing (a) The following documentation is to be provided to the Society for Category II and III systems: (i) Software modules functional description and associated hardware description for programmable devices. This is to be provided by Supplier and System Integrator. (ii) Evidence of verification (detection and correction of software errors) for software modules, in accordance with the selected software development standard. Evidence requirements of the selected software standard might differ depending on how critical the correct operation of the software is to the function it performs (i.e. IEC 61508 has different requirements depending on SILs, similar approaches are taken by other recognized standard). This is to be supplied by the Supplier and System Integrator. (iii) Evidence of functional tests for programmable devices at the software module, sub-system, and system level. This is to be supplied by the Supplier via the System Integrator. 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. (4) – (8) ⟨newly added⟩	(B) Code production and testing (a) The following documentation is to be provided to the Society for Category II and III systems: (i) Software modules functional description and associated hardware description for programmable devices. This is to be provided by Supplier and System Integrator. (ii) Evidence of verification (detection and correction of software errors) for software modules, in accordance with the selected software development standard. Evidence requirements of the selected software standard might differ depending on how critical the correct operation of the software is to the function it performs (i.e. IEC 61508 has different requirements depending on SILs, similar approaches are taken by other recognized standard). This is to be supplied by the Supplier and System Integrator. (iii) Evidence of functional tests for programmable devices at the software module, sub-system, and system level. This is to be supplied by the Supplier via the System Integrator. 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. (4) Risk assessment of the system (A) Requirement: (a) If requested by the Society, a risk assessment of a specific system in context of the specific vessel in question shall be performed and documented in order to determine the applicable category for the system.	(Amended) – UR E22(Rev.3) has been applied.

Present	Amendment	Remark

	(b) IEC/ISO31010 "Risk management – Risk assessment techniques" may be used as guidance in order to determine method of risk assessment.
	(B) Class Society's verification:
	   (a) Category I, II and III: The risk assessment report shall upon request be submitted for approval (AP).
	(5) Define the vessel's system-architecture
	(A) Requirement:
	   (a) The system of systems (SoS) shall be specified and documented. This architecture specification provides the basis for category determination and development of the different integrated systems by allocating functionality to individual systems and by identifying the main interfaces between the systems. It shall also serve as a basis for the testing of the integrated systems on the vessel level (see **3** (7)).
	   (b) The vessel's system architecture shall at least contain description of:
	     (ⅰ) Overview of the total systems architecture (the system of systems)
	     (ⅱ) Each system's purpose and main functionality
	     (ⅲ) Communication and interface aspects between different systems
	   (c) See also **Ch.1 of Guidance for Cyber Resilience** for diagram of security zones and conduits
	(B) Class Society's verification:
	   (a) Category I, II and III: The vessel's system architecture shall upon request be submitted for information (FI).
		(Amended)
		– UR E22(Rev.3) has been applied.

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Present	Amendment	Remark

	(6) System acceptance test (SAT) onboard the vessel
	(A) Requirement:
	  (a) A system acceptance test shall be arranged onboard the vessel. The main purpose of the system acceptance test (SAT) is to verify the system functionality, after installation and integration with the applicable machinery/electrical/process systems on board including possible interfaces with other control and monitoring systems.
	  (b) For each test-case it shall be noted if the test passed or failed, and the test-results shall be documented in a test report. The test report shall also contain a list of the software (including software versions) that were installed in the system when the test was executed.
	(B) Class Society's verification:
	  (a) Category I: Not required
	  (b) Category II and III: The SAT program shall be submitted for approval (AP) before the test is executed.
	    (ⅰ) The SAT execution shall be witnessed by the Society.
	    (ⅱ) The SAT report shall be submitted for information (FI).
	(7) Testing of integrated systems on vessel-level (SOST)
	(A) Requirement:
	  (a) Integration tests shall be conducted after installation and integration of the different systems in its final environment on board. The purpose of the 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.
		(Amended)
		– UR E22(Rev.3) has been applied.

Present	Amendment	Remark
	(b) The testing shall at least verify the following aspects of the system of systems: 　(ⅰ) The overall functionality of the interacting systems as a whole 　(ⅱ) Failure response between systems 　(ⅲ) Performance 　(ⅳ) Human-machine interfaces 　(ⅴ) Interfaces between the different systems (c) For complex systems there may be a large difference in scope between the "System acceptance test (SAT) onboard the vessel" activity and the SOST, 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. (B) Class Society's verification: (a) Category I: Not required (b) Category II and III: The SOST program shall submitted for approval (AP) before the test is executed. 　(ⅰ) The SOST execution shall be witnessed by the Society. 　(ⅱ) The SOST report shall be submitted for information (FI). (8) Change management (A) Requirement: (a) The systems integrator shall follow procedures for management of change to the system as described in **406.** (B) Class Society's verification: (a) Category I: No documentation requirements (b) Category II and III: The management of change procedure shall upon request be submitted for information (FI).	(Amended) - UR E22(Rev.3) has been applied.

Present	Amendment	Remark

(3) Integration testing before installation on board
  (A) Intra-system integration testing is to be done between system and sub-system software modules before being integrated on board. The objective is to check that software functions are properly executed, that the software and the hardware it controls interact and function properly together and that software systems react properly in case of failures. 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. Functional and failure testing can be demonstrated by simulation tests.
  (B) For Category II and III systems:
    (a) Test programs and procedures for functional tests and failure tests are to be submitted to the Society. An FMEA may be requested by the Society in order to support containment of failure tests programs.
    (b) Factory acceptance test including functional and failure tests are to be witnessed by the Society.
    (c) Following documentation is to be provided:
      (i) Functional description of software
      (ii) List and versions of software installed in system
      (iii) User manual including instructions for use during software maintenance
      (iv) List of interfaces between system and other ship systems
      (v) List of standards used for data links
      (vi) Additional documentation as requested by the Society which might include an FMEA or equivalent to demonstrate the adequacy of failure test case applied
	(3) Integration testing before installation on board
	  (A) Intra-system integration testing is to be done between system and sub-system software modules before being integrated on board. The objective is to check that software functions are properly executed, that the software and the hardware it controls interact and function properly together and that software systems react properly in case of failures. 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. Functional and failure testing can be demonstrated by simulation tests.
	  (B) For Category II and III systems:
	    (a) Test programs and procedures for functional tests and failure tests are to be submitted to the Society. An FMEA may be requested by the Society in order to support containment of failure tests programs.
	    (b) Factory acceptance test including functional and failure tests are to be witnessed by the Society.
	    (c) Following documentation is to be provided:
	      (i) Functional description of software
	      (ii) List and versions of software installed in system
	      (iii) User manual including instructions for use during software maintenance
	      (iv) List of interfaces between system and other ship systems
	      (v) List of standards used for data links
	      (vi) Additional documentation as requested by the Society which might include an FMEA or equivalent to demonstrate the adequacy of failure test case applied
		(Amended)
		- UR E22(Rev.3) has been applied.

Present	Amendment	Remark
(4) Approval of programmable devices for Category II and III systems Approval of programmable devices integrated inside a system is to be delivered to the system integrator or supplier. Approval can be granted on case by case basis, or as part of a product type approval, so long as above mentioned documents have been reviewed/approved (as per **Table 6.2.3**) and the required tests have been witnessed by the Society (also see **405.** regarding hardware environmental type tests). Documentation is to address the compatibility of the programmable device in the ship's application, the necessity to have on board tests during ship integration and is to identify the components of system using the approved programmable devices. (5) Final integration and on board testing (A) Simulation tests are to be undertaken before installation, when it is found necessary to check safe interaction with other computerized systems and functions that could not be tested previously. (B) On board tests are to check that a computer based system in its final environment, integrated with all other systems with which it interacts is: (a) Performing functions it was designed for (b) Reacting safely in case of failures originated internally or by devices external to the system (c) Interacting safely with other systems implemented on board vessel (c) For final integration and on board testing of Category II and III systems: (a) Test specifications are to be submitted to the Society for approval. (b) The tests are to be witnessed by the Society.	(4) Approval of programmable devices for Category II and III systems Approval of programmable devices integrated inside a system is to be delivered to the system integrator or supplier. Approval can be granted on case by case basis, or as part of a product type approval, so long as above mentioned documents have been reviewed/approved (as per **Table 6.2.3**) and the required tests have been witnessed by the Society (also see **405.** regarding hardware environmental type tests). Documentation is to address the compatibility of the programmable device in the ship's application, the necessity to have on board tests during ship integration and is to identify the components of system using the approved programmable devices. (5) Final integration and on board testing (A) Simulation tests are to be undertaken before installation, when it is found necessary to check safe interaction with other computerized systems and functions that could not be tested previously. (B) On board tests are to check that a computer based system in its final environment, integrated with all other systems with which it interacts is: (a) Performing functions it was designed for (b) Reacting safely in case of failures originated internally or by devices external to the system (c) Interacting safely with other systems implemented on board vessel (c) For final integration and on board testing of Category II and III systems: (a) Test specifications are to be submitted to the Society for approval. (b) The tests are to be witnessed by the Society.	(Amended) - UR E22(Rev.3) has been applied.

Present	Amendment	Remark
2. Limited approval (1) Sub-systems and programmable devices may be approved for limited applications with service restrictions by the Society when the ship system where they will be integrated is not known. In this case, requirements about Quality systems under **1** (1) might need to be fulfilled as required by the Society. Additional drawings, details, tests reports and surveys related to the Standard declared by the Supplier may be required by the Society upon request. (2) Sub-systems and programmable devices may in this case be granted with a limited approval mentioning the required checks and tests performed. 3. Modifications during operation (1) Responsibilities (A) Organizations in charge of software modifications are to be clearly declared by Owner to the Society. A System integrator is to be designated by the Owner and shall fulfil requirements mentioned in **1**. Limited life cycle steps may be considered for modifications already considered and accepted in the scope of initial approval. The level of documentation needed to be provided for the modification is to be determined by the Society. (B) At the vessel level, it is the responsibility of Owner to manage traceability of these modifications; the achievement of this responsibility is to be supported by system integrators updating the Software Registry. This Software Registry is to contain: (a) List and versions of software installed in systems required in **1** (3) (b) Results of security scans as described in **4**	2. Limited approval (1) Sub-systems and programmable devices may be approved for limited applications with service restrictions by the Society when the ship system where they will be integrated is not known. In this case, requirements about Quality systems under **1** (1) might need to be fulfilled as required by the Society. Additional drawings, details, tests reports and surveys related to the Standard declared by the Supplier may be required by the Society upon request. (2) Sub-systems and programmable devices may in this case be granted with a limited approval mentioning the required checks and tests performed. 3. Modifications during operation (1) Responsibilities (A) Organizations in charge of software modifications are to be clearly declared by Owner to the Society. A System integrator is to be designated by the Owner and shall fulfil requirements mentioned in **1**. Limited life cycle steps may be considered for modifications already considered and accepted in the scope of initial approval. The level of documentation needed to be provided for the modification is to be determined by the Society. (B) At the vessel level, it is the responsibility of Owner to manage traceability of these modifications; the achievement of this responsibility is to be supported by system integrators updating the Software Registry. This Software Registry is to contain: (a) List and versions of software installed in systems required in **1** (3) (b) Results of security scans as described in **4**	(Amended) - UR E22(Rev.3) has been applied.

Present	Amendment	Remark

(2) Change management
  The owner is to ensure that necessary procedures for software and hardware change management exist on board, and that any software modification/upgrade are performed according to the procedure. All changes to computer based systems in the operational phase are to be recorded and be traceable.
 	
4. System security
 	
(1) Owner, system integrator and suppliers are to adopt security policies and include these in their quality systems and procedures.
(2) For Category I, II, and III systems, 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.
(3) Prior to installation, all artefacts, software code, executables and the physical medium used for installation on the vessel are to be scanned for viruses and malicious software. Results of the scan are to be documented and kept with the Software Registry.
 	
405. Requirements for hardware regarding environment
 	
Evidence of environmental type testing according to UR E10 regarding hardware elements included in the system and sub-systems is to be submitted to the Society for Category I, II and III computer based systems. This requirement is not mandatory for Category I computer based systems not considered by the Society.
	(2) Change management
	  ~~The owner is to ensure that necessary procedures for software and hardware change management exist on board, and that any software modification/upgrade are performed according to the procedure. All changes to computer based systems in the operational phase are to be recorded and be traceable.~~
	
	~~4. System security~~
	
	~~(1) Owner, system integrator and suppliers are to adopt security policies and include these in their quality systems and procedures.~~
	~~(2) For Category I, II, and III systems, 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.~~
	~~(3) Prior to installation, all artefacts, software code, executables and the physical medium used for installation on the vessel are to be scanned for viruses and malicious software. Results of the scan are to be documented and kept with the Software Registry.~~
	
	~~405. Requirements for hardware regarding environment~~
	
	~~Evidence of environmental type testing according to UR E10 regarding hardware elements included in the system and sub-systems is to be submitted to the Society for Category I, II and III computer based systems. This requirement is not mandatory for Category I computer based systems not considered by the Society.~~
		(Amended)
		- UR E22(Rev.3) has been applied.

Present	Amendment	Remark
405. 〈newly added〉	405. Requirements on maintenance of computer based systems 1. Requirements on the Vessel Owner (1) Responsibilities (A) For the purposes of this section, the vessel owner is considered to be the systems integrator in the operations phase unless another organization or person is explicitly appointed by the owner. (B) Accordingly, the Society shall in a timely manner be informed by the owner about the appointed systems integrator which is responsible for implementing any changes to the systems in conjunction with system supplier(s). 2. Requirements on the Systems integrator (1) Change management (A) Requirement: (a) The systems integrator shall ensure that necessary procedures for software and hardware change management exist on board, and that any software modification/upgrade are performed according to the procedure(s). For details about change management please see **406.** (b) Changes to computer based systems in the operational phase shall be recorded. (c) The records shall contain information about the relevant software versions and other relevant information as described in **406. 11.** (B) Class Society's verification: (a) Category I: No documentation requirements (b) Category II and III: See **406. 12.**	(Amended) - UR E22(Rev.3) has been applied.

Present	Amendment	Remark
	3. Requirements on the System Supplier (1) Change management (A) Requirement: (a) The system supplier shall follow procedures for maintenance of the system including procedures for management of change as described in **406.** (B) Class Society's verification: (a) Category I: No documentation requirements (b) Category II and III: See **406. 12**. (2) Testing of changes before installation onboard (A) Requirement: (a) The system supplier shall make sure that the planned changes to a system have passed relevant in-house tests before the change is made to systems on board. (B) Class Society's verification: (a) Category I: No documentation requirements (b) Category II and III: See **406. 12**.	(Amended) - UR E22(Rev.3) has been applied.
406. Requirements for data links for Category II and III systems 1. General requirements (1) Loss of a data link is to be specifically addressed in risk assessment analysis. (2) A single failure in data link hardware is to be automatically treated in order to restore proper working of system. For Category III systems a single failure in data link hardware is not to influence the proper working of the system. (3) Characteristics of data link are to prevent overloading in any operational condition of system. (4) Data link is to be self-checking, detecting failures on the link itself and data communication failures on nodes connected to the link. Detected failures are to initiate an alarm.	~~406. Requirements for data links for Category II and III systems~~ ~~1. General requirements~~ ~~(1) Loss of a data link is to be specifically addressed in risk assessment analysis.~~ ~~(2) A single failure in data link hardware is to be automatically treated in order to restore proper working of system. For Category III systems a single failure in data link hardware is not to influence the proper working of the system.~~ ~~(3) Characteristics of data link are to prevent overloading in any operational condition of system.~~ ~~(4) Data link is to be self-checking, detecting failures on the link itself and data communication failures on nodes connected to the link. Detected failures are to initiate an alarm.~~	

Present	Amendment	Remark
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) Other categories of systems may use wireless data links with following requirements: (A) Recognised international wireless communication system protocols are to be employed, incorporating: (a) Message integrity. Fault prevention, detection, diagnosis, and correction so that the received message is not corrupted or altered when compared to the transmitted message. (b) Configuration and device authentication. Shall only permit connection of devices that are included in the system design. (c) Message encryption. Protection of the confidentiality and or criticality of the data content. (d) Security management. Protection of network assets, prevention of unauthorized access to network assets. (B) The internal wireless system within the vessel is to comply with the radio frequency and power level requirements of International Telecommunication Union and flag state requirements. Consideration is to be given to system operation in the event of port state and local regulations that pertain to the use of radio-frequency transmission prohibiting the operation of a wireless data communication link due to frequency and power level restrictions.	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) Other categories of systems may use wireless data links with following requirements: (A) Recognised international wireless communication system protocols are to be employed, incorporating: (a) Message integrity. Fault prevention, detection, diagnosis, and correction so that the received message is not corrupted or altered when compared to the transmitted message. (b) Configuration and device authentication. Shall only permit connection of devices that are included in the system design. (c) Message encryption. Protection of the confidentiality and or criticality of the data content. (d) Security management. Protection of network assets, prevention of unauthorized access to network assets. (B) The internal wireless system within the vessel is to comply with the radio frequency and power level requirements of International Telecommunication Union and flag state requirements. Consideration is to be given to system operation in the event of port state and local regulations that pertain to the use of radio-frequency transmission prohibiting the operation of a wireless data communication link due to frequency and power level restrictions.	(Amended) - UR E22(Rev.3) has been applied.

Present	Amendment	Remark
(C) For wireless data communication equipment, tests during harbour and sea trials are to be conducted to demonstrate that radio-frequency transmission does not cause failure of any equipment and does not its self-fail as a result of electromagnetic interference during expected operating conditions.	(C) For wireless data communication equipment, tests during harbour and sea trials are to be conducted to demonstrate that radio-frequency transmission does not cause failure of any equipment and does not its self-fail as a result of electromagnetic interference during expected operating conditions.	(Amended) - UR E22(Rev.3) has been applied.
406. 〈newly added〉	406. Management of change 1. General (1) **406.** provides requirements for the management of change throughout the lifecycle of a computer based system. (2) Different procedures for the management of change may be defined for specific phases in a system's lifecycle as the different phases typically involve different stakeholders. (3) The Society's verification is described in **12**. 2. Documented change management procedures (1) Requirement: (A) The organization in question shall have defined and documented change management procedures applicable for the computer based system in question covering both hardware and software. (B) After FAT, the system supplier shall 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. (C) The procedure(s) shall at least describe the activities listed in **3** through **11**. (D) The outcome of the impact analysis in **406. 8** will determine to what extent the activities in **3** to **12** shall be performed. (E) Change records (described in **11**) shall always be produced.	

Present	Amendment	Remark

	3. Agreement between relevant stakeholders
	
	(1) Requirement:
	    (A) The management of change process shall be coordinated and agreed between the relevant stakeholders along the different stages of the lifecycle of the computer based system.
	    (B) Typically, the management of change address at least three different stages:
	        (a) Development and internal verification before FAT; involving the system supplier and sub-suppliers
	        (b) From FAT to handover of the vessel to the owner; involving the system supplier, the systems integrator, the Society, and the owner
	        (c) In operation; involving the system supplier, service suppliers, the owner, and the Society
	
	4. Approved software shall be under change management
	
	(1) Requirement: If changes are required to a system after it has been approved by applicable stakeholders (typically the systems integrator and the Society at FAT) the modifications shall follow defined change management procedures.
	
	5. Unique identification of system and software versions
	
	(1) Requirement: The system supplier shall make sure that each system and software version is uniquely identifiable, see **404. 2 (2).**
	
	6. Handling of software master files
	
	(1) Requirement: There shall be defined mechanisms for handling of the files that constitutes the master-files for a software component. Personnel authorities shall be clearly defined along with the tools and mechanisms used to ensure the integrity of the master files.
		(Amended)
		- UR E22(Rev.3) has been applied.

Present	Amendment	Remark
	7. Backup and restoration of onboard software (1) Requirement: It shall be clearly defined how to perform backup and restoration of the software components of a computer based system onboard the vessel. **8. Impact analysis before change is made** (1) Requirement: Before a change to the system is made, an impact analysis shall be performed in order to: (A) Determine the criticality of the change. (B) Determine the impact on existing documentation. (C) Determine the needed verification and test activities. (D) Determine the need to inform other stakeholders about the change. (E) Determine the need to obtain approval from other stakeholders (e.g. the Society and/or Owner) before the change is made. **9. Roll-back in case of failed software changes** (1) Requirement: (A) When maintenance includes installation of new versions of the software in the system, it shall be possible to perform a rollback of the software to the previous installed version with the purpose of returning the system to a known, stable state. (B) Roll-backs shall be documented and analysed to find and eliminate the root cause. **10. Verification and validation of system changes** (1) Requirement: (A) To the largest degree practically possible, modifications shall be verified before being installed onboard. (B) After installation, the modification(s) shall be verified onboard according to a documented verification program containing: (a) Verification that the new functionalities and/or improvements have had the intended effect.	(Amended) - UR E22(Rev.3) has been applied.

Present	Amendment	Remark
	(b) Regression test to verify that the modification has not had any negative effects on functionality or capabilities that was not expected to be affected. **11. Change records** (1) Changes to systems and software shall be documented in change records to allow for visibility and traceability of the changes. The change records shall contain at least the following items: (A) The purpose for a change (B) A description of the changes and modifications (C) The main conclusions from the impact analysis (see **8**) (D) The identity and version of any new system or software version(s) (see **5**) (E) Test reports or tests summaries (see **10**) (2) Documentation of the changes to software may be recorded in the planned maintenance system (PMS), in a software registry or equivalent. **12. Verification of change management by the Society** (1) In operation phase (existing ship) (A) The verification by the Society regarding the management of change in operation is generally performed during the annual survey of the vessel. Procedures for management of change and relevant change records (see **11**) shall be made available at the time of survey. (B) In the cases where the change requires approval from the Society up front, the relevant procedures and documentation for the change in question may be verified at that time.	(Amended) - UR E22(Rev.3) has been applied.

Present	Amendment	Remark
	(2) During newbuilding (new building ship) (A) The verification of management of change in the newbuilding phase is divided into two; Procedures are verified as a part of the verification of the quality management system (**404. 1** (2)), while project specific implementation of the procedures are verified during FAT (**404. 2** (7)) and after FAT (**406. 12** (1)).	(Amended) - UR E22(Rev.3) has been applied.

407. 〈newly added〉	**407. Technical requirements on computer based systems**
	
	The paragraphs below contain technical requirements on computer based systems. The compliance to these requirements shall be documented in the design documentation (see **404. 2** (3)) and verified through the verification activities described in this section.
	
	1. Reporting of system and software identification and version
	
	(1) System identification
	  (A) The system shall provide means to identify its name, version, identifier, and manufacturer. It is recommended that the system can automatically report the status of its software to a ship software logging system (SSLS) as specified in the international standard ISO 24060.
	
	2. Data links
	
	(1) General requirements for category II and III systems
	Loss of a data link shall be specifically addressed in risk assessment analysis/FMEA. See **404. 2** (3).
	  (A) A single failure in data link shall not cause loss of vessel- functions of category III. Any effect of such failures shall meet the principle of fail-to-safe for the vessel-function(s) being served.
	  (B) For vessel-functions of category II and III, any loss of functionality in the remote control system shall be compensated for by local/manual means.	

Present	Amendment	Remark

	(C) The data link shall have means to prevent or cope with excessive communication rates.
	(D) Data links shall be self-checking, detecting failures or performance issues on the link itself and data communication failures on nodes connected to the link.
	(E) Detected failures shall initiate an alarm.
	(2) Specific requirements for wireless data links
	  (A) Category III systems shall not 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.
	  (B) Category I and II systems may use wireless data links with the following requirements.
	    (a) Recognised international wireless communication system protocols shall be employed, incorporating:
	      (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. Shall only permit connection of devices that are included in the system design.
	      (iii) Message encryption. Protection of the confidentiality and or criticality of the data content.
	      (iv) Security management. Protection of network assets, prevention of unauthorized access to network assets.
	    (b) The internal wireless system within the vessel shall comply with the radio frequency and power level requirements of International Telecommunication Union and flag state requirements.
		(Amended)
		– UR E22(Rev.3) has been applied.

Present	Amendment	Remark
	(c) Consideration should be given to system operation in the event of port state and local regulations that pertain to the use of radio-frequency transmission prohibiting the operation of a wireless data communication link due to frequency and power level restrictions. (d) For wireless data communication equipment, tests during harbour and sea trials are to be conducted to demonstrate that radio-frequency transmission does not cause failure of any equipment and does not self-fail as a result of electromagnetic interference during expected operating conditions. **3. Verification of technical requirements by the Society** (1) The implementation of the technical requirements provided in **407.** is verified by the Society as part of the system description (**404. 2** (3)), FAT (**404. 2** (7)) and SAT (**404. 3** (6)) described above.	(Amended) - UR E22(Rev.3) has been applied.

Present	Amendment	Remark
~~**1.1.1.1. 407. Documents for the Society and test attendance for Computer based systems**~~	**407. Documents for the Society and test attendance for Computer based systems**	(Amended)
~~Documents for the Society and test attendance for computer based systems are to comply with the **Table 6.2.3**.~~ ~~(1) Computer hardware~~ ~~The documentation to be submitted is to include followings:~~ ~~(A) Hardware information of importance for the application and a list of documents that apply to the system~~ ~~(B) The supply circuit diagram~~ ~~(C) A description of hardware and software tools for equipment configuration~~ ~~(D) The information to activate the system~~ ~~(E) General information for trouble shooting and repair when the system is in operation~~ ~~(2) System reliability analysis~~ ~~The documentation to be submitted is to demonstrate the reliability of the system by means of appropriate analysis such as:~~ ~~(A) A failure mode analysis describing the effects due to failures leading to the destruction of the automation system, In addition, this documentation is to show the consequences on other systems, if any.~~ ~~(B) Mean time between failures(MTBF) calculation~~ ~~(C) Any other documentation demonstrating the reliability of the system~~ ~~(3) User interface description~~ ~~The documentation is to contain:~~ ~~(A) A description of the functions allocated to each operator interface(keyboard/screen or equivalent)~~ ~~(B) A description of individual screen views(schematics, colour photos, etc.)~~ ~~(C) A description of how menus are operated(tree presentation)~~ ~~(D) An operator manual providing necessary information for installation and use.~~	~~Documents for the Society and test attendance for computer based systems are to comply with the **Table 6.2.3**.~~ ~~(1) Computer hardware~~ ~~The documentation to be submitted is to include followings:~~ ~~(A) Hardware information of importance for the application and a list of documents that apply to the system~~ ~~(B) The supply circuit diagram~~ ~~(C) A description of hardware and software tools for equipment configuration~~ ~~(D) The information to activate the system~~ ~~(E) General information for trouble shooting and repair when the system is in operation~~ ~~(2) System reliability analysis~~ ~~The documentation to be submitted is to demonstrate the reliability of the system by means of appropriate analysis such as:~~ ~~(A) A failure mode analysis describing the effects due to failures leading to the destruction of the automation system, In addition, this documentation is to show the consequences on other systems, if any.~~ ~~(B) Mean time between failures(MTBF) calculation~~ ~~(C) Any other documentation demonstrating the reliability of the system~~ ~~(3) User interface description~~ ~~The documentation is to contain:~~ ~~(A) A description of the functions allocated to each operator interface(keyboard/screen or equivalent)~~ ~~(B) A description of individual screen views(schematics, colour photos, etc.)~~ ~~(C) A description of how menus are operated(tree presentation)~~ ~~(D) An operator manual providing necessary information for installation and use.~~	– UR E22(Rev.3) has been applied.

Present	Amendment	Remark
(4) Test programs The following test program are to be submitted: (A) System validation test (B) On-board test Each test program is to include: (a) A description of each test item (b) A description of the acceptance criteria for each tests. (5) When alternative design or arrangement is intended to be used, an engineering analysis is to be submitted.	(4) Test programs The following test program are to be submitted: (A) System validation test (B) On-board test Each test program is to include: (a) A description of each test item (b) A description of the acceptance criteria for each tests. (5) When alternative design or arrangement is intended to be used, an engineering analysis is to be submitted.	(Amended) - UR E22(Rev.3) has been applied.

〈Present〉

Table 6.2.3 Documents for the Society and test attendance

Requirement	Supplier involved	System Integrator Involved	Owner Involved	System Category		
				I[1]	II	III
Quality Plan	X	X	_	A[2]	A	A
Risk assessment report	_	X	_	I[2]	I[2]	I[2]
Software modules functional description and associated hardware description	X (if necessary)	X	_	_	I	I
Evidence of verification of software code	X (if necessary)	X	_	_	I	I
Evidence of functional tests for elements included in systems of Category II and III at the level of software module, sub-system and system	X	X	_	_	I	I
Test programs and procedures for functional tests and failure tests including a supporting FMEA or equivalent, at the request of the Class Society	_	X	_	_	A	A
Factory acceptance test event including functional and failure tests	X	X	_	_	W	W
Test program for simulation tests for final integration	_	X	_	_	A	A
Simulation tests for final integration	_	X	_	_	W	W
Test program for on board tests (includes wireless network testing)	_	X	_	_	A	A
On board integration tests (includes wireless network testing)	_	X	_	_	W	W
- List and versions of software installed in system - Functional description of software - User manual including instructions during software maintenance - List of interfaces between system and other ship systems	_	X	_	_	I	I
Updated Software Registry	_	X	X	_	I	I
Procedures and documentation related to Security Policy	_	_	_	_	I	I
Test reports according to UR E10 requirements	X	X	_	A[3]	A	A

(NOTE)
A: Submitted for Approval
I : Provided for Information
W: Witness
[1] Additional documentation may be required upon request
[2] Upon request
[3] If in the scope of Class requirement

〈Amendments〉

Table 6.2.3 Documents for the Society and test attendance

Requirement	Supplier involved	System Integrator Involved	Owner Involved	System Category I[1]	II	III
Quality Plan	X	X	–	A[2]	A	A
Risk assessment report	–	X	–	I[2]	I[2]	I[2]
Software modules functional description and associated hardware description	X (if necessary)	X	–	–	I	I
Evidence of verification of software code	X (if necessary)	X	–	–	I	I
Evidence of functional tests for elements included in systems of Category II and III at the level of software module, sub-system and system	X	X	–	–	I	I
Test programs and procedures for functional tests and failure tests including a supporting FMEA or equivalent, at the request of the Class Society	–	X	–	–	A	A
Factory acceptance test event including functional and failure tests	X	X	–	–	W	W
Test program for simulation tests for final integration	–	X	–	–	A	A
Simulation tests for final integration	–	X	–	–	W	W
Test program for on board tests (includes wireless network testing)	–	X	–	–	A	A
On board integration tests (includes wireless network testing)	–	X	–	–	W	W
– List and versions of software installed in system – Functional description of software – User manual including instructions during software maintenance – List of interfaces between system and other ship systems	–	X	–	–	I	I
Updated Software Registry	–	X	X	–	I	I
Procedures and documentation related to Security Policy	–	–	–	–	I	I
Test reports according to UR E10 requirements	X	X	–	A[3]	A	A

(NOTE)
A: Submitted for Approval
I : Provided for Information
W: Witness
[1] Additional documentation may be required upon request
[2] Upon request
[3] If in the scope of Class requirement

Present	Amendment	Remark
408. 〈newly added〉	408. SUMMARY OF DOCUMENTATION SUBMITTAL **Table 6.2.5** and **Table 6.2.6** below summarise the documentation to be submitted to the Society. Table 6.2.5 Summary of documentation submittal by the system supplier	(Amended) – UR E22(Rev.3) has been applied.

Table 6.2.5 Summary of documentation submittal by the system supplier

Item		System category		
Paragraph reference	Document	Cat I	Cat II	Cat III
404. 2 (1)	Quality plan	–	FI on req.	FI on req.
404. 2 (3)	System description	FI on req.	AP	AP
404. 2 (4)	Environmental compliance	FI on req.	FI	FI
404. 2 (5)	Software test reports	–	FI on req.	FI on req.
404. 2 (6)	System test report	–	FI on req.	FI on req.
404. 2 (7)	FAT program	–	AP	AP
404. 2 (7)	FAT report	–	FI	FI
404. 2 (7)	Additional FAT docs. (e.g. user manual, etc)	–	FI on req.	FI on req.
404. 2 (8)	Management of change procedure	–	FI on req.	FI on req.

(Legend)
AP = Approval, FI = For Information, "–" = No requirement, on req. = Upon request from the Society

Present	Amendment	Remark
	Table 6.2.6 Summary of documentation submittal by the system integrator	(Amended) - UR E22(Rev.3) has been applied.

Table 6.2.6 Summary of documentation submittal by the system integrator

Item		System category		
Paragraph reference	Document	Cat I	Cat II	Cat III
404. 3 (2)	Quality plan	–	FI on req.	FI on req.
404. 3 (3)	List of system categorizations	AP on req.	AP on req.	AP on req.
404. 3 (4)	Risk assessment report	AP on req.	AP on req.	AP on req.
404. 3 (5)	Vessel's system architecture	FI on req.	FI on req.	FI on req.
404. 3 (6)	SAT program	–	AP	AP
404. 3 (6)	SAT report	–	FI	FI
404. 3 (7)	SOST program	–	AP	AP
404. 3 (7)	SOST report	–	FI	FI
404. 3 (8)	Change management procedure for software	–	FI on req.	FI on req.

(Legend)
AP = Approval, FI = For Information, "–" = No requirement, on req. = Upon request from the Society

Present	Amendment	Remark
409. 〈newly added〉	409. Summary of test witnessing and survey **Table 6.2.7** below summarises the activities that shall be witnessed or surveyed by the Society. The responsible role shall facilitate the activity of the Surveyor. Table 6.2.7 Summary of test witnessing and survey	(Amended) – UR E22(Rev.3) has been applied.

Table 6.2.7 Summary of test witnessing and survey

Item		Responsible role	System category		
Paragraph reference	Activity		Cat I	Cat II	Cat III
404. 2 (7)	FAT witnessing	System supplier	–	X	X
404. 3 (6)	SAT witnessing	System integrator	–	X	X
404. 3 (7)	SOST witnessing	System integrator	–	X	X
406. 12	Verification of changes	System integrator	–	X	X

(Legend)
"x" = Witnessing required, "–" = Witnessing not required

Amendments of Guidance Relating to the Rules for the Classification of Steel Ships

(Development Review : For external opinion inquiry)

Part 6 Electrical Equipment and Control Systems

2023. 9.

Machinery Rule Development Team

Effective Date：1 July 2024

(The contract date for ship construction)

Present	Amendment	Note
# CHAPTER 1 ELECTRICAL EQUIPMENT ## Section 1 – 14 ⟨same as the previous Rules⟩ ## Section 15 High Voltage Electrical Installations **1506. Switchgear and controlgear assemblies 【See Rule】** 1. In application to **1506. 4** of the Rules, the high voltage test procedure is to be in accordance with the IEC <u>62271-200</u>, or equivalent and <u>above</u>, data proving that the assembly will withstand an internal arc is to be submitted to the Society for information service.(e.g. testing in accordance with Appendix <u>A</u> of <u>IEC 62271-200</u>)	# CHAPTER 1 ELECTRICAL EQUIPMENT ## Section 1 – 14 ⟨same as the previous Rules⟩ ## Section 15 High Voltage Electrical Installations **1506. Switchgear and controlgear assemblies 【See Rule】** 1. In application to **1506. 4** of the Rules, the high voltage test procedure is to be in accordance with the IEC 62271-200<u>:2011</u>, or equivalent and ~~above~~ <u>higher standards</u>, data proving that the assembly will withstand temperature rise(e.g testing in accordance with 6.5 of IEC62271-200:2011) and an <u>internal arc</u>.(e.g. testing in accordance with Appendix <u>AA</u> of IEC 62271-200<u>:2011</u>) is to be submitted to the Society for information service	(Amended) - Check if the temperature rise test for switch gear and controlgear assemblies for high voltage have been passed (generally, if 랫 feasible during FAT, it is accepted to substitute with a Test report from the same type to which is has been applied)

Amendments of the Guidance Relating to the Rules for the Classification of Steel Ships

(Development Review : For external opinion inquiry)

Part 6 Electrical Equipment and Control Systems

2024. 2.

Machinery Rule Development Team

Effective Date：1 July 2024

(The contract date for ship construction)

Present	Amendment	Note
# CHAPTER 1 ELECTRICAL EQUIPMENT ## Section 1 General **101. General** **1. Application** (1) – (4) ⟨same as the present Rules⟩ (5) Electrical equipment on board the ships specified in (4) above are to be in accordance with (1) through (3) above, and the following: (A) Ships specified in (4) (A) above (a) – (g) ⟨same as the present Rules⟩ (h) In application to **202.** and **1601. 3** of the Rules, a gen-erator may be provided with 1 set, except ships having class notation UMA and ships with coastal and the farther service. *(2019)* (i) ⟨same as the present Rules⟩ (j) The requirements in **203.** of the Rules do not apply. However emergency source of electrical power capable of supplying simultaneously the following services at least for <u>3</u> hours (for a period of 30 minutes with continuous operation for the below (iv) & (v) system), is to be provided. <u>Notwithstanding these requirements, ships subject to Korean Ship Safety Act are to comply with the relevant requirements of the Korean Ship Safety Act. (2018)</u> (i) All communication equipment required in an emergency (ii) Navigation lights and signal lights (not under command lights, anchor lights) (iii) Emergency lights installed in the following station ① Embarkation station of life boats, life rafts, etc. and over the sides ② Accommodation alleyways, stairways and exits ③ Machinery spaces and spaces installed emergency source of electrical power ④ Control stations for main engine	# CHAPTER 1 ELECTRICAL EQUIPMENT ## Section 1 General **101. General** **1. Application** (1) – (4) ⟨same as the present Rules⟩ (5) Electrical equipment on board the ships specified in (4) above are to be in accordance with (1) through (3) above, and the following: (A) Ships specified in (4) (A) above (a) – (g) ⟨same as the present Rules⟩ (h) In application to **202.** and **1601. 3** of the Rules, a gen-erator<u>, transformer and converter</u> may be provided with 1 set, except ships having class notation UMA and ships with coastal and the farther service. *(2024)* (i) ⟨same as the present Rules⟩ (j) The requirements in **203.** of the Rules do not apply. However emergency source of electrical power capable of supplying simultaneously the following services at least for 3 <u>6</u> hours (for a period of 30 minutes with continuous operation for the below (iv) & (v) system), is to be provided. ~~Notwithstanding these requirements, ships subject to Korean Ship Safety Act are to comply with the relevant requirements of the Korean Ship Safety Act.~~ *(2024)* (i) All communication equipment required in an emergency (ii) Navigation lights and signal lights (not under command lights, anchor lights) (iii) Emergency lights installed in the following station ① Embarkation station of life boats, life rafts, etc. and over the sides ② Accommodation alleyways, stairways and exits ③ Machinery spaces and spaces installed emergency source of electrical power ④ Control stations for main engine	(Amended) – It has been ame nded to expand t he scope to tran mers and convert ers for main sour ce, (Deleted) – It has been deleted for electrical equipment of the Rules to comply with Korean Ships Safety Act (Refer to No.73 of the Korean Ships Safety Act and No.4/94 of the Enforcement rule of Korean Ships Safety Act

Present	Amendment	Note
(iv) Intermittent operation of the daylight signalling lamp, the ship's whistle, and all internal signals that are required in an emergency. (v) The fire detection system and manually operated call point. (k) – (q) 〈same as the present Rules〉 (B) – (D) 〈same as the present Rules〉 (6) – (10) 〈same as the present Rules〉 2. – 3. 〈same as the present Rules〉 102. – 103. 〈same as the present Rules〉 **Section 2 System design** 201. General 1. Construction and installation (1) 〈same as the present Rules〉 (2) Installation and protective enclosure (A) In a case where the characteristic letter IP showing the protection type of enclosures in accordance with the IEC 60529 is used for the protective enclosures of electrical equipment, the following requirements are to be complied with. (a) – (b) 〈same as the present Rules〉 (c) Application of degree of protection As a guide for the selection of degree of protection for the electrical equipment on the basis of the circumstances of the place of installation, the requirements given in **Table 6.1.6** of the Guidance are to be taken into consideration. (3) 〈same as the present Rules〉 2. – 4. 〈same as the present Rules〉 202. – 205. 〈same as the present Rules〉 **Section 3 – 18 〈same as the previous Rules〉**	(iv) Intermittent operation of the daylight signalling lamp, the ship's whistle, and all internal signals that are required in an emergency. (v) The fire detection system and manually operated call point. (k) – (q) 〈same as the present Rules〉 (B) – (D) 〈same as the present Rules〉 (6) – (10) 〈same as the present Rules〉 2. – 3. 〈same as the present Rules〉 102. – 103. 〈same as the present Rules〉 **Section 2 System design** 201. General 1. Construction and installation (1) 〈same as the present Rules〉 (2) Installation and protective enclosure (A) In a case where the characteristic letter IP showing the protection type of enclosures in accordance with the IEC 60529 is used for the protective enclosures of electrical equipment, the following requirements are to be complied with. (a) – (b) 〈same as the present Rules〉 (c) Application of degree of protection As a guide for the selection of degree of protection for the electrical equipment on the basis of the circumstances of the place of installation, the requirements given in **Table 6.1.6** of the Guidance are to be taken into consideration. **Table 6.1.6 〈see the next page〉** (3) 〈same as the present Rules〉 2. – 4. 〈same as the present Rules〉 202. – 205. 〈same as the present Rules〉 **Section 3 – 18 〈same as the previous Rules〉**	(Amended) – It has been amended for the selection of the degree for the electrical equipment installed the area to comply with the Pt 8 of the Guidance which has been applied to UR 20.

〈Present〉

Table 6.1.6 Application of Degree of Protection *(2020)*

Example of location	Condition of location	Switchboard, etc[1]	Generators	Motors	Transformers[7], Converters	Lighting fixtures	Heating appliances	Accessories[2]
		〈same as the present Rules〉						
Engine rooms and boiler rooms above floor plates[5]	Danger of dripping water and(or) moderate mechanical damage	IP 22	IP 22	IP 22	IP 22	IP 22	IP 22	IP 44
		〈same as the present Rules〉						

(NOTES)
  (1) – (4) 〈same as the present Rules〉
  (5) Where the equipment is located within areas protected by local fixed pressure water spraying or water-mist fire extinguishing system and its adjacent <u>areas.</u>
  (6) – (7) 〈same ase the present Rules〉

〈Amendments〉

Table 6.1.6 Application of Degree of Protection *(2024)*

Example of location	Condition of location	Switchboard, etc[1]	Generators	Motors	Transformers[7], Converters	Lighting fixtures	Heating appliances	Accessories[2]
		〈same as the present Rules〉						
Engine rooms and boiler rooms above floor plates[5]	Danger of dripping water and(or) moderate mechanical damage	IP 22	IP 22	IP 22	IP 22	IP 22	IP 22	IP 44
		〈same as the present Rules〉						

(NOTES)
  (1) – (4) 〈same as the present Rules〉
  (5) Where the equipment is located within areas protected by local fixed pressure water spraying or water-mist fire extinguishing system and its adjacent ~~areas.~~ <u>areas, it is to be complied with **Pt 8 Ch 8 406. 3** of the Guidance.</u>
  (6) – (7) 〈same as the present Rules〉