

Subject

Amendment to the ClassNK Rules and Guidance related to computer based systems

ClassNK

Technical Information

No. TEC-1235
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To whom it may concern

ClassNK has informed the requirements related to computer based systems by ClassNK Technical Information TEC-1114 issued on 16 June 2017 (revoked) and TEC-1145 issued on 28 February 2018. In view of the recent situation, ClassNK reviewed the contents of the Technical Information TEC-1145 and has issued TEC-1235 alternatively.

ClassNK Technical Information TEC-1145 is revoked by this Technical Information.

IACS UR E22 (Rev.1) specified requirements related to configuration and function of computer based systems used for systems such as control, alarm, and safety systems. These requirements have already been incorporated in Rules and Guidance of NIPPON KAIJI KYOKAI (hereinafter referred as "the Society"). Furthermore, IACS has focused on the importance of quality control of computer based system software and has reviewed the unified requirement. As a result, IACS adopted UR E22 (Rev.2) in June 2016 in order to clarify the roles of stakeholders regarding computer based systems used on vessels and the requirements for quality control of the life cycles of software (hereinafter referred to as "SW") and hardware (hereinafter referred to as "HW") to be used in computer based systems.

Accordingly, relevant requirements in the Society's Rules and Guidance were amended and have been applied to vessels, machinery/systems. However, in view of the application of these rules so far, and in correspondence to diversifying computer based systems and inquiries from manufacturers and shipyards, ClassNK Technical Information TEC-1145 is amended.

[Summary of Rules]

The Rules apply to SW and HW for computer based systems used on vessels, as stipulated in Annex D18.1.1, Part D of Guidance for the Survey and Construction for Steel Ships. The computer based systems are assigned to three system categories according to the degree of these failure impact. The Rules apply to the SW and HW for computer based systems according to the system categories.

Furthermore, responsibilities and roles of the owner, system integrator, and suppliers to comply with the Rules are specified. In particular, the system integrator is a newly defined in stakeholder and shall take a responsibility only when an integrated system is installed. The "integrated system" means a system in which several machineries and/or systems are connected and mutually controlled, or there is a upstream system that integrates several systems, such as IAS (Integrated Automation System) that controls cargo control and monitoring system, gas fuel supply control system, and gas reliquefaction system on a liquefied gas carrier.

(To be continued)

NOTES:

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1. System Categories

The computer based systems shall be assigned to system category III, II or I in accordance with 2.2.2 and Table 2.1 of Annex D18.1.1, Part D of Guidance for the Survey and Construction for Steel Ships.

Table 2.1 System categories in Annex D18.1.1, Part D of Guidance for the Survey and Construction of Steel Ships

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 or 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 systems - 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 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

The following are typical examples of machinery/systems belongs to system category III and II, but the exact system category is in accordance with the results of risk assessment for all operational scenarios.

Category III

System	Examples of detailed machinery/systems
Main propulsion systems	Engine control system, Engine remote control system, Main boiler control system, CPP control system, Electric propulsion control system, Gas combustion control system
Steering system control systems	Steering system, Azimuth thruster control system
Electric power systems	Generator engine control system (including power management system), Electric power converter (for electric propulsion ship, etc.)

(To be continued)

Safety systems	Emergency shutdown system and other safety systems Safety system for integrated control of fire detection and fighting, flooding detection and fighting, evacuation, lifesaving and etc.
Other systems	Dynamic positioning system (IMO MSC/Circ.645 Class2 or Class3), Drilling system

Category II

System	Examples of detailed machinery/systems
Alarm and monitoring systems for main propulsion systems	Machinery alarm and monitoring system (including data logger)
Liquid cargo transfer control systems	Cargo control and/or monitoring system, Ballast transfer valve remote control system, Gas reliquefaction system / Inert gas generator, and other systems for cargo control
Fuel oil treatment systems	Fuel transfer system (in cases where functions are integrated into the cargo control and monitoring system) Gas fuel supply control system
Stabilization and ride control systems	Fin stabilizer control system, Hydrofoil control system

The above mentioned machinery/systems are examples, and some machinery/systems not listed that use computer based systems may also be subject to the Rules based on the basic concept of IACS UR E22 (Rev.2).

In cases where several machinery/systems or functions are integrated into one computer based system, the system category of the one with the highest impact in the event of failure shall be applied to the entire system.

If the function and performance of the machinery/systems have been approved by the Organization such as Flag State, the necessity and conditions for application of the Rules will be individually examined by the Society after confirming the details approved by the Organization.

(To be continued)

2. Roles of Stakeholders

In this Technical Information, stakeholders are defined as listed below, and responsibilities, roles, and others are specified for each stakeholder. The detailed role and responsibility of each stakeholder shall be as described in Paragraph 2.1 through Paragraph 2.3 in principle.

- Owner (before delivery/after delivery of the vessel)
- Shipyard (construction shipyard of the vessel)
- Shipowner
- System integrator (only if equipped with an integrated system)
- Supplier (machinery/system manufacturer)

2.1 Owner

In general, the shipyard is the owner before vessel delivery (during construction), and the shipowner is the owner after vessel delivery. After vessel delivery, the owner may delegate part of the responsibility to the operator of the vessel.

Before or after vessel delivery, the owner is responsible for contracting with each supplier and/or system integrator that provide HW and SW that meet the owner's specifications

2.1.1 Shipyard

In general, the shipyard is the owner before vessel delivery (during construction). The shipyard is required to contract with each supplier and take the following actions as the owner:

- To confirm and assign the system category for machinery/systems that use computer based systems installed on board
- To give instructions to suppliers of category II and III machinery/systems on the application of relevant Rules
- To submit documents listed in the attached table
- To hand over the necessary documents and information (e.g., the list of computer based systems installed onboard and risk assessment reports) to the owner (after vessel delivery)

In particular, the necessity of applying the Rules related to computer based systems shall be instructed to suppliers by the shipyard.

In addition, a list of computer based systems installed on board shall be prepared for each vessel by confirming the specifications of machinery/systems with suppliers, and submitted to the Society. The list shall specify the system category of each machinery/system after confirming with each supplier.

In cases where an integrated system is installed onboard, the shipyard or an assigned engineering party (e.g., supplier of the integrated system) is required to take actions described in Paragraph 2.2 as the system integrator.

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2.1.2 Shipowner

The shipowner is the owner after vessel delivery. The shipowner is requested to take over the necessary documents and information such as risk assessment reports from the shipyard, the owner (before vessel delivery), or the system integrator (before vessel delivery).

In addition, in cases where the integrated system is installed on board, the shipowner is required as the owner, to assign the system integrator at replacement and/or modification of the integrated system. The system integrator may be assigned at each system replacement or modification.

2.2 System Integrator

The system integrator means to an engineering party that integrates and provides several machinery/systems constituting of an integrated system to a vessel and is responsible for system integration.

The "integrated system" means a system in which several machineries and /or systems are connected and mutually controlled, or there is a upstream system that integrates several systems, such as IAS that controls cargo monitoring system, gas fuel supply system, and gas reliquefaction system on a liquefied gas carrier.

Before vessel delivery, the owner (before vessel delivery) is the system integrator or appoints the engineering party (e.g., supplier of the integration system) as the system integrator. The system integrator (before vessel delivery) is required to take the following actions in addition to the actions as the owner (before vessel delivery) in Paragraph 2.1 and as the shipyard in Paragraph 2.1.1.

- To coordinate between suppliers, submit test procedures, and carry out final onboard integration tests (and simulation tests before the installation on board, if necessary)

In cases where any computer based systems in the integrated system are completely replaced or the specifications of the control system are significantly changed, the conducted risk assessment and functional tests during construction period may be invalid. The system integrator is requested to coordinate with suppliers and take the following actions:

- To submit documents and test procedure listed in the attached table (after consultation with the Society for details)
- To carry out onboard tests in final integrated environment

For vessels without integrated systems, it is not necessary to appoint the system integrator.

2.3 Supplier

As mentioned in Paragraph 1., some machinery/systems belong to system category III or II are required to obtain document approval by the Society and to be shop tested (the factory acceptance test) in the presence of the Surveyor according to the Rules, even though the HW of computer based system have not been required shop test in the presence of the Surveyor by the Rules other than computer based systems.

(To be continued)

The suppliers of machinery/systems belong to system category III or II are required to take the following actions:

- To submit documents and test procedure listed in the attached table
- To carry out shop test of computer based systems in the presence of the Surveyor
- To carry out simulation tests of integrated systems before the final onboard integration (simulation tests at the shop or on board to check safe interaction with other systems on board before integration with such other systems, if necessary)

If the type approval of use of computer based systems for the subject machinery/systems has been obtained by the supplier, the submission of the above mentioned documents and test procedure as well as the attendance of the Surveyor at the shop tests can be omitted. For details, refer to Paragraph 5..

The submission of the above documents and the attendance of the Surveyor at shop tests are not required to machinery/systems in system category I. Therefore, no action is necessary in principle.

Machinery/systems belong to system category III or II in table of Paragraph 1. are not be allowed to be re-assigned to other system categories in principle after the issuance of this Technical Information. If the supplier determines the effect level of machinery/systems as system category I based on a result of risk assessment of control details and failure impact, the supplier is requested to submit a report of risk assessment for all operational scenarios and other documents (e.g., machinery drawings/specifications, instruction manuals) for each vessel. The effect level may be accepted as equivalent to system category I by the Society based on the submitted report and documents.

It is noted that the machinery/system is re-assigned to the system categories in accordance with the table of Paragraph 1. after issuance of this Technical information, even though the impact level of the machinery/system has been accepted as equivalent to system category I by the Society before.

3. Exemption from Submission of Documents

In cases where the same machinery/systems are installed on several vessels and the documents are not changed from the previously approved ones, the submission of documents for approval may be exempted from the second vessels. The supplier is requested to submit an application for exemption from submission of documents including the following information. It is noted that this application is to be approved by the Society.

- Information of the first vessel (reference vessel) for which relevant documents have been previously approved
- SW version information of machinery/systems for the reference vessel and the subject vessel. If SW version for the subject vessel is upgraded from the reference vessel, the version history is required.
- List of all specification differences between the reference vessel and the subject vessel
- Names of documents which will be exempted to submit

(To be continued)

It is noted that the application described in this Paragraph is applied for computer based systems, not to machinery or equipment which have already been required by the Rules other than computer based systems.

4. Exemption from Attendance of Surveyor at Shop Tests

As for the shop tests of computer based systems required by the Rules, an application of exemption from the attendance of the Surveyor at shop tests may be submitted for each vessel. This application is submitted with documents showing that the system configuration and the function/control specifications are the same as those at the shop tests previously conducted in the attendance of the Surveyor, and that the test results are the same. It is noted that this application is to be approved by the Society.

The following information shall be included in this application.

- Information of the first vessel (reference vessel) for which shop tests in the attendance of the Surveyor was carried out
- SW version information of machinery/systems for the reference vessel and the subject vessel. If SW version for the subject vessel is upgraded from the reference vessel, the version history is required.
- List of all specification differences between the reference vessel and the subject vessel

Submission of one application including the contents described in Paragraph 3 and Paragraph 4 for each vessel may be acceptable. It is noted that this application in this Paragraph is applied for the computer based systems, not to machinery or equipment which have already been required by the Rules other than computer based systems.

5. Type Approval of Use of Computer Based Systems

If the type approval of use of computer based systems for the subject machinery/systems was obtained by the supplier, the submission of documents for approval and the attendance of the Surveyor at shop tests for computer based systems can be omitted. For details of the type approval of use, refer to Chapter 8 of Part 7 of Guidance for the Approval and Type Approval of Materials and Equipment for Marine Use.

After obtaining the type approval of use, the supplier is requested to submit an application for exemption from the submission of documents and exemption from the attendance of the Surveyor at shop tests of computer based systems for each vessel with copies of the certificate of the type approval in addition to the documents described in Paragraph 3. and Paragraph 4. .

It is noted that the application described in this Paragraph is applied for the computer based systems, not to machinery or equipment which have already been required by the rules other than computer based systems.

(To be continued)

	Type Approval of use of computer based systems		Note
	Not obtained	Obtained	
Submission of drawings and documents			
- 18.1.3, Part D of the Rules	Required	Required	
- Annex D18.1.1, 1.2, Part D of Guidance and Rules	Required*	Exemptable	*) Exemptable, if an application for exemption from submission of documents are approved. (Refer to Paragraph 3.)
Attendance of Surveyor at shop tests			
- 18.7.1, Part D of the Rules	Required	Required	
- Annex D18.1.1, 3.1.3, Part D of Guidance and Rules	Required*	Exemptable	*) Exemptable, if an application for exemption from the attendance of the Surveyor at shop test is approved. (Refer to Paragraph 4.)

(To be continued)

Table. Documents to be submitted

Document	Contents and Notes	Stakeholder in charge
(For approval)		
Documents of conformity of a quality assurance system	An appropriate quality assurance system shall be in operation at the supplier (machinery/system manufacturers) that manufactures the subject machinery/systems. That is, it shall be confirmed that a quality assurance system such as ISO 9001 is applied, and it is certified by an authorized organization with accreditation under a national accreditation scheme. The subject machinery/ systems shall be within the scope of the certified quality assurance system.	Supplier
Quality plan (machinery/systems)	<p>The following shall be specified in the company's quality plan.</p> <ul style="list-style-type: none"> - Company's quality policy - Definition of the entire organization in the company and definition of the scope of work and responsibility of each organization such as department - Definition of each work processes (product development, build-to-order product production, etc.) - Document management and work record keeping - Details of qualifications and management of qualified personnel (qualified personnel system in each work) <p>In addition, it is required that quality control of the subject machinery/systems is conducted based on the quality assurance system and that they are appropriately designed and manufactured as products. The following work processes shall be defined for the subject machinery/systems.</p> <ul style="list-style-type: none"> - Order receipt (finalization of required specifications) - Design (design procedures, work standards, approval management) - Procurement management of HW and SW (outsourcing, etc.) - Production flow and work procedures of HW and SW 	Supplier

(To be continued)

	<ul style="list-style-type: none"> - Test procedure and pass/fail criteria at shop tests - Change management and SW version management including post-shipment change management <p>(Supplement)</p> <p>In cases where the work process is different between the basic part (common specifications for all vessels) and individualized part (individual vessel specifications) in SW configuration of the computer based system, it is necessary to clearly define each work process and prepare a quality plan for each.</p>	
Quality plan (integrated system)	<p>The system integrator (before vessel delivery) is required to prepare a quality plan for the entire integrated system.</p> <p>The following shall be specified in the quality plan.</p> <ul style="list-style-type: none"> - Quality policy for the integrated system - Overall configuration diagram of the integrated system - Planning, design, and manufacturing systems of the integrated system and the definition of the role (scope of work and responsibility) of each supplier - Definition of the specification setting process for the integrated system - Risk assessment report for the integrated system 	System integrator
Security policy documents	<p>System security shall be addressed from the following two points.</p> <p>(a) Management during product development and production</p> <p>During the development and production of machinery/systems, it is necessary that SW and HW are properly managed to prevent unauthorized SW from entering the system, and that malware contamination, virus infection, and others are inspected at appropriate timings.</p> <p>(b) Security function in products</p> <p>Machinery/systems shall have function to prevent unauthorized access, unexpected SW changes, etc. .</p>	Supplier

(To be continued)

Test procedure for functional tests and failure tests at the shop	<p>The functional tests and failure tests of the computer based system are to be carried out at the shop to check the following:</p> <ul style="list-style-type: none"> - SW version - Whether SW functions properly - Whether SW and HW interact and function properly - Whether SW reacts appropriately in case of failure <p>The following shall be specified in the test procedure to confirm the functions and performance of the machinery/systems.</p> <ul style="list-style-type: none"> - The SW version - For functional tests, test conditions, test items/ procedures, and pass/fail criteria shall be specified for each function that constitutes the machinery/systems. - For failure tests, detection, notification (alarm), and response actions shall be specified for system abnormalities listed in the risk assessment. 	Supplier
Simulation test procedure before installation on board (integrated system)	Simulation test shall be carried out before final onboard integration (at shop or on board) to check safe interaction with all onboard systems	Supplier or system integrator
Test procedure for final onboard integration test (integrated system)	<p>The following shall be checked in final integrated environment in which all systems interact each other by operating actual machinery/systems.</p> <ul style="list-style-type: none"> - To function as designed - To react safely in case of failures caused internally or by external systems - To interact safely among all onboard systems 	System integrator
Approval for HW of computer based systems	Environmental test stipulated in 18.7.1 (1), Part D of the Rules or type approval of use in accordance with Chapter 1 of Part 7 of Guidance for the Approval and Type Approval of Material and equipment for Marine Use is required to HW of computer based system.	Supplier

(To be continued)

	<p>In the Rules, HW constituting the computer based system means itself, including CPU, I/O, communication I/F, and HMI. Other components and sensors that are physically separated from the system do not need to be covered.</p> <p>It is noted that sensors for which environmental tests are to be required in accordance with Table 18.7.1-1, Part D of Guidance for the Survey and Construction of Steel Ships are to be handled as same as before.</p> <p>If HW and SW of computer based systems has already been type approved at the same time and both have been described in one type approval certificate, it is not necessary to obtain the type approval for HW of computer based systems again.</p> <p>In case HW including computer based systems has already been type approved, a copy of the certificate of the type approval is to be submitted with the drawings and documents for each vessel.</p> <p>If HW constituting computer based systems are carried out environmental tests for each vessel without obtaining the type approval of HW, the test records are to be submitted.</p>	
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(To be continued)

(For reference)		
List of computer based systems	A list showing computer based systems (including information of the system categories) described in Paragraph 2.1.1.	Shipyards / system integrator
Risk assessment report (machinery/systems)	<p>A risk assessment report is to be submitted.</p> <p>The risk assessment shall evaluate the impact to the operation of objects (plant) which are controlled by the machinery/systems in case of an abnormality in part or all of the computer based system. The abnormality of the computer based system itself and peripheral components such as power supplies and external interfaces shall be assumed.</p> <p>The evaluation method is not specified, but FMEA is generally used.</p> <p>The following shall be evaluated properly and described to that effect in the risk assessment report.</p> <ul style="list-style-type: none"> - All items to be evaluated and their configuration shall be defined. - The pass/fail criteria for evaluation results shall be defined. (The events to be avoided shall be defined.) - All the risks (failure modes) shall be defined. Not only component stoppage, but also HW and SW abnormality/failure, power supply failure, communication system failure communication data abnormality, I/O data abnormality, and other failures shall be defined for each component. - For each risk, the behavior of the machinery/systems at occurrence of the risk, the impact of the failure to the operation of controlled objects (plant), the detection of abnormalities, and notification shall be analyzed and evaluated. 	Supplier
Risk assessment report (integrated system)	Additional risk assessment report with new risks as a result of integrating the systems is to be submitted.	System integrator
SW documents	In addition to the functional specifications (functional description) for the machinery/system, the following documents are to be submitted to confirm the specifications for the computer based system used.	Supplier

(To be continued)

	<ul style="list-style-type: none"> - HW configuration diagram (clearly defining CPU, I/O, HMI, communication I/F, power supply, and connection system, etc.) - SW architecture (functional structure) and function assignment to HW - Overview of functional specifications for each SW module - Internal data structure - Communication I/F specifications (protocol, data, communication control, etc.) <p>(Supplement) For the functional system and internal data structure of SW, the basic part (common specifications for all vessels) and individualized part (individual vessel specifications) shall be clearly defined. Each SW shall be designed, created, and tested according to each work processes specified in the quality plan.</p>	
Interfaces between systems	<p>If there is communication between the machinery/systems and other external systems, the communication specifications are to be submitted.</p> <p>In addition to the communication protocol and communication data list (data specifications), this specification shall specify the detection of communication abnormalities and the functional specification in case of abnormalities based on the risk assessment.</p>	Supplier
List of SW and their versions	<p>A list of SW including version information is to be submitted.</p> <p>That version management shall be implemented according to the quality plan. If there are different specifications or functional settings for each vessel, it is necessary to manage the SW version for each vessel.</p> <p>(Supplement) The above is required to all SW constituting the machinery/systems (purchased SW shall also be managed).</p>	Supplier

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	<p>The basic part (common specifications for all vessels) and individualized part (individual vessel specifications) shall also be managed individually.</p>	
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For any questions about the above, please contact:

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