



CHINA CLASSIFICATION SOCIETY

RULES FOR INTELLIGENT SHIPS

AMENDMENTS

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Chapter 1 General

1.3 Alterations and repairs

1.3.1 A ship assigned Intelligent Ship class notation, which has undergone any alteration or repair of its equipment or system (hereinafter referred to as 'Intelligent System') in association with intelligent ship functions, is to be subject to a survey, as appropriate, for confirming compliance with the technical requirements for the existing notation.

1.4 Class notation for intelligent ships

1.4.4 Class memorandum is to be given for ships to which CCS Intelligent Ship class notation is assigned for the first time and the implementation survey is to be carried out by CCS surveyor no earlier than 6 months after installation survey and no later than the first annual/intermediate/special survey after 6 months (whichever is the earlier). During the implementation survey, the following is to be verified by a surveyor:

- (1) relevant intelligent systems have been operated effectively according to the approval documentation, and pre-designed functions are achieved, including a comparison with baseline data;
- (2) implementation report of intelligent system (refer to annual report), including relevant survey and testing reports;
- (3) relevant personnel are familiar with operating the scheme;
- (4) detailed working records of intelligent system, including records of any limiting parameters (alarms and warnings) that have been modified during operation of the scheme;
- (5) records of any failures and repair of the ship together with the equipment and systems are reviewed to ensure that relevant intelligent systems are effective.

The survey unit is to report to the Headquarters if the ship is found to fail to satisfy the requirements during the implementation of survey, and the Headquarters is to put forward a written reminder to request the shipowner or ship management company to rectify within the specified time limit, otherwise, relevant Intelligent Ship class notation will be canceled.

1.4.45 The assignment, maintenance, suspension, cancellation and reinstatement of Intelligent Ship class notation are to be in accordance with the requirements of Section 9, Chapter 2 of PART ONE of CCS Rules for Classification of Sea-Going Steel Ships.

1.6 Personnel requirements

1.6.2 Relevant operating personnel are to ~~receive pre-post training, obtain qualification, and be familiar with~~ and competent for the operation and maintenance of intelligent system.

1.7 Cyber security requirements

~~1.7.1—Ships assigned with notations as specified in the Rules for Intelligent Ships are to take measures to minimize the risks of cyber security during ship design and operation, in compliance with the requirements of CCS Guidelines for Cyber Security Requirements and Safety Assessment, and obtain notation of Cyber Security (S):~~

1.7.1 The cyber security of the Intelligent System is to comply with the requirements of Chapter 4 of CCS Guidelines for Requirements and Security Assessment of Ship Cyber System.

1.7.2 If requirements of 1.7.1 may not be met, a risk assessment is to be carried out with the method specified in Appendix 1 to CCS Guidelines for Requirements and Security Assessment of Ship Cyber System or that specified in the standard accepted by CCS^①, and measures are to be taken to lower the cyber security risk of the Intelligent System to the acceptable level. Cyber security risk assessment report is to be submitted for information. For risk assessment, the following elements are at least to be considered:

- (1) System vulnerabilities, including vulnerabilities in respect of communications, operation system and application program;
- (2) Threats, including unauthorized operation and mis-operation of both internal and external personnel, such as hackers, third party, crew, etc.;
- (3) Possibility of cyber security incidents;
- (4) Potential impacts of cyber security incidents on human safety, safety of the vessel and/or threat to the marine environment;
- (5) System connectivity, including physical and logical connectivity, such as integration of systems, interfaces among systems, including systems not onboard (e.g. if remote access to onboard systems is

^① IEC/ISO 31010 "Risk management – Risk assessment techniques" or other equivalent standards.

provided).

1.7.3 If substantial change of the Intelligent System occurred in the whole life cycle of the ship, the risk assessment is to be carried out again and relevant control measures are to be taken.

1.7.4 Plans and documents are to be submitted according to 4.2.1 of Chapter 4 of CCS Guidelines for Requirements and Security Assessment of Ship Cyber System.

1.8 Security system

1.8.1 For ships with remote control or autonomous operations (with Ri or Ai functional notations), their security systems are to, in addition to the applicable requirements of the Administration, comply with the following requirements of 1.8.2 to 1.8.4:

~~(1) Access control;~~

~~(2) Detection, surveillance and alarms;~~

~~(3) Security communication;~~

~~(4) Identity Recognition.~~

1.8.2 Access control

1.8.2.1 The number of external openings ~~in the external boundaries~~ of hull, superstructures and deck house for access are to be minimized to meet the minimum requirements of the intended usage. ~~The door to any means of access in the ship is to be capable of automatic closing. The locking arrangement of doors and access (e.g. small hatchways) is to be so designed that they can be only opened or closed by a authorized person, and can be remotely opened or closed by the remote control station.~~

1.8.2.2 The door to any means of access in the ship is to be capable of automatic closing. The locking arrangement of doors and access (e.g. small hatchways) is to be so designed that they can be remotely operated by the remote control station and opened or closed by authorized personnel.

1.8.2.3 For ships applying for R1 class notation (see definition in 8.1.3 of Chapter 8 of the Rules), requirements for access control are to be determined considering specific ship manning and responsibilities. If the ship manning and responsibilities meet the minimum manning requirements of conventional ship, requirements of 1.8.2.2 may be exempted.

1.8.3 Detection, surveillance and alarms

1.8.3.1 The range of onboard detection and surveillance systems is to cover overboard surrounding areas, means of access to the ship and restricted areas onboard. The detection capacity is to be such that a suspected object around the ship, as well as its direction of movement and speed, can be identified.

1.8.3.2 The ship and its security system are to meet the following requirements:

(1) The detection system fitted on the ship is to be able to automatically send a warning to the remote control station and onboard control station (if applicable) once detecting the approach of a suspected object.

① If the ship is not provided with crew, remote control station is to take appropriate actions according to the actual situation, such as sending security warning to the Administration or ship company, once the early warning is received;

② If the ship is provided with crew, the crew is to activate security warning system according the actual situation to send warning to the Administration, ship company and remote control station.

(2) Onboard spaces and means of access are to be provided with adequate lighting. Detection, surveillance and lighting equipment is able to be controlled by the remote control station and/or onboard control station (if applicable).

1.8.3.3 For remote control ships provided with crew members (R1), requirements for detecting, monitoring and alarming are to be determined according to specific ship manning and responsibilities. If the ship manning and responsibilities meet the minimum manning requirements of conventional ship, requirements of 1.8.3.1, 1.8.3.2(1)①, 1.8.3.2(2) may be exempted.

~~1.8.4 The ship is to be installed with a security alert system as required by SOLAS Regulation XI-2/6. Where the ship is manned, alarms will be sent by the personnel onboard according practical situation to the Administration, ship owner and the remote control station. Where the ship is unmanned, once a suspicious security incident is detected, the remote control station will be notified and take further action according to the practical situation.~~

1.8.4 Security communication

1.8.4.1 The communication systems of the ship and the remote control station are to be capable of keeping ship security communication, information and equipment smooth and unimpeded at all times, and security communication records are to be ~~maintained~~stored onboard the ship and in the remote control station at the same time.

1.9 Operating manual

1.9.1 Operating manuals for relevant intelligent systems are to be provided onboard the ship to specify procedures and descriptions in respect of system operation, inspection, maintenance and security.

1.9.2 Operating manual for Intelligent System is to be submitted to CCS for information. In general, the operating manual is to include:

- (1) procedures and descriptions in respect of system operation, inspection, testing and maintenance;
- (2) working conditions and limits in respect of system operation;
- (3) emergency procedures.

1.9.3 Corresponding emergency procedures are to be established against the potential failure of intelligent system during use, specifying the operation procedures and responsible person in the event of emergency, so as to minimize the effect on the safe operation of the ship and relevant equipment as far as possible.

Chapter 2 Intelligent Navigation

2.3 Functional requirements

2.3.1 Route and speed design and optimization (N)

2.3.1.8 Route and speed design and optimization is to achieve one or more of the following ~~functions goals~~ in the highest sea scale for the set voyage ~~and under the restriction of the navigation time period of the voyage~~:

- (1) Optimization of navigation period, including fixed time of arrival and shortest time of arrival ;
- (2) Optimization of fuel oil consumption;
- (3) Optimization of total cost.

~~2.3.1.11 Ship's propulsion and steering capability is to be taken into consideration in route and speed design optimization. Turning point and speed of the optimized route should match the propulsion and steering performance of the ship.~~

2.3.1.12~~1~~ The following route and speed design and optimization results are to be output and displayed: route, turning point and speed of each voyage segment.

2.3.1.13~~2~~ The ship is to be able to store the result of route and speed design and optimization and the actual navigational condition of the ship, for analysis and assessment of the optimized result.

2.3.2 Autonomous navigation in open water (No)

2.3.2.5 The ship autonomously navigating in open waters is to be capable of fusing the data and information, at least the perceived data and information specified in 2.3.2.4(1) to (6), so as to eliminate the perceptual errors from single source.

2.3.2.7~~8~~ When the failure of the situation awareness system and the autonomous navigation system finally leads to the damage of autonomous navigation capability of the ship, an alarm is to be activated and the personnel onboard are to intervene and take over the operation of navigation of the ship.

2.3.2.8~~9~~ The ship is to be provided with data server for the storage of information on condition and operation of the equipment and system related to navigation. The capacity of the data server is to be such that at least the data generated by a single voyage but not less than 30 days can be continuously stored. When the server capacity reaches its limit, the oldest data can be replaced by the latest data.

2.3.2.9~~10~~ Where the design or equipment selection related to the autonomous navigation control and situation awareness function fails to meet the requirements of this Chapter, alternative or equivalent design may be accepted by CCS, provided that any risk existing in the design of intelligent navigation system in all autonomous scenarios is fully identified and analyzed by means of risk assessment method (e.g. FMEA), the risk control measure is proposed and the design of system is improved upon verification.

2.5 Survey and test requirements

2.5.2 Initial survey

2.5.2.3 Confirming, for different intelligent navigation functions, that a navigation officer ~~has finished corresponding training~~ is already familiar with the operation and maintenance of intelligent system and is competent to properly perform his duty.

Chapter 3 Intelligent Hull

3.3 Hull maintenance

3.3.8 Survey and test

3.3.8.1 ~~Prior to completion of construction of ship,~~ †The initial survey at least includes the following items:

- (1) Examining the approval certificate of system software.
- (2) The systems for hull and deck machinery inspection and maintenance schemes have been installed on board the ship and operate normally.
- (3) General inspection items, critical areas and inspection interval of hull inspection and maintenance scheme satisfy requirements.
- (4) Personnel carrying out hull and deck machinery inspection and maintenance on board the ship ~~have been trained by CCS or an organization accepted by CCS~~ are already familiar with the operation and maintenance of intelligent hull system.

3.3.8.2 The annual/intermediate/special survey is at least to include the following items:

- (1) The information specified by 3.3.7.2 is to be kept on board the ship.
- (2) The thickness data of structural members and renewal history recorded in the hull database are consistent with practical conditions.
- (3) The analysis report of hull thickness measurement data satisfies the requirements of 3.3.5.3.
- (4) Personnel carrying out hull and deck machinery inspection and maintenance on board the ship ~~have been trained by CCS or an organization accepted by CCS~~ are already familiar with the operation and maintenance of intelligent hull system.
- (5) Witnessed by the surveyor, personnel on board the ship randomly select at least two ballast tanks for internal inspection, correctly determine the coating and structural conditions of the structural area under inspection and correctly enter the identified problem and assessed grade into the computer system.
- (6) The records in the computer system of hull and deck machinery inspection and maintenance scheme are complete and consistent with practical conditions.

3.4 Hull monitoring and assistant decision-making

3.4.5 Survey and tests

3.4.5.1 ~~Prior to completion of construction of the ship,~~ †The initial survey for hull monitoring and assistant decision-making system is at least to include the following items:

- (1) Confirming that relevant plans have been examined;
- (2) Confirming that system hardwares (including sensors) are furnished with relevant certificates;
- (3) Confirming that software systems are approved;
- (4) After completion of installation of the system and equipment, survey and test are to be carried out in accordance with testing procedures to verify system function and effectiveness.

Chapter 4 Intelligent Machinery

4.1 General requirements

4.1.7 For a ship directly propelled by conventional main propulsion diesel engine applying for intelligent machinery functional notation M, at least the following equipment and systems shown in Table 4.1.7 is to be monitored:

List of equipment and systems being monitored

Table 4.1.7

No.	Name of equipment /systems	Monitoring Scope (e.g. equipment/parts/performance, etc.	Monitoring Purpose (e.g. condition, function, performance, etc.)
1	Main diesel engine (direct propulsion)		
1.1		Cylinder combustion	Combustion condition
1.2		Cylinder liner	Sealing, heat transfer
1.3		Piston head (including piston ring)	Sealing, heat transfer
1.4		Cylinder cover (including intake valve and exhaust valve)	Sealing, heat transfer
1.5		Fuel nozzle/valve	Injection, atomization
1.6		Friction parts, e.g. main bearings, crankpin bearings, crosshead bearings (if fitted) and camshaft bearings, etc.	Wear, lubrication condition
1.7		Crankcase	Explosion-proof
1.8		Turbocharger	Turbocharging performance
2	Diesel engine for propulsion and/or auxiliary power generation		
2.1		Cylinder cover (including intake valve and exhaust valve)	Sealing, heat transfer
2.2		Cylinder liner	Sealing, heat transfer
2.3		Fuel nozzle/valve	Injection, atomization
2.4		Friction parts, e.g. main bearings	Wear, lubrication
2.5		Turbocharger	Turbocharging performance
3	Shafting for propulsion		
3.1		Gearbox (if any), e.g. bearings	Wear
3.2		Shaft and bearings	Wear, sealing condition
4	Auxiliary system		
4.1	Fuel (oil) system (including the pilot fuel system of dual fuel engine)		
4.1.1		Fuel (oil) pump	Fuel (oil) supply capacity
4.1.2		Filter	Filtering of impurities
4.1.3		Heat exchanger (if fitted)	Heat exchange performance
4.2	Lubricating oil system		
4.2.1		Lubricating oil pump	Oil supply capacity
4.2.2		Filter	Filtering of impurities
4.2.3		Heat exchanger	Heat exchange performance
4.3	Cooling system		
4.3.1		Pump	Cooling medium supply capacity
4.3.2		Heat exchanger	Heat exchange performance
4.3.3		Filter	Filtering of impurities
4.4	Hydraulic (servo) oil system		
4.4.1		Hydraulic oil pump	Oil supply capacity
4.4.2		Filter	Filtering of impurities
4.5	Starting and control air system		Air supply capacity
4.6	Air intake (four-stroke)/Scavenging (two-stroke) system		quality of cylinder combustion air
4.7	Exhaust gas system		Exhaust performance
4.8	Power supply for control-safety-alarm system (electrical, pneumatic, hydraulic)		Power supply capacity

4.1.8 For an AC electric propelled ship ~~applying for intelligent machinery functional notation M, the diesel engine for propulsion or auxiliary power generation as well the auxiliary systems are to be monitored according to the applicable requirements specified in Table 4.1.7. In addition, the monitoring requirements in Table 4.1.8 are to be met in addition to the monitoring of the applicable equipment and systems specified in Table 4.1.7.~~ following equipment and systems shown in Table 4.1.8 are to be monitored:

List of equipment and systems being monitored

Table 4.1.8

No.	Name of equipment / systems	Monitoring Scope (e.g. equipment/parts/performance, etc.)	Monitoring Purpose (e.g. condition, function, performance, etc.)
1	Generator		Overall working condition
1.1		Stator	Condition of stator, e.g. winding inter-turn insulation
1.2		Rotor	Condition of rotor, e.g. rotor balance, inter-turn condition, eccentricity condition
1.3		Bearing	Wearing condition
1.4		Excitation and AVR	Excitation and voltage regulating condition
2	Switchboard		Overall working condition Quality of power supply Insulation status
2.1		Main bus bar and circuit breaker	Order of circuit break switching on/off, condition of circuit breaker switching on/off and bus bar overcurrent capacity etc.
<u>2.2</u>		<u>Main bus bar</u>	<u>Quality of system power supply , including voltage, current, power, harmonic wave, etc. Insulation status of system</u>
3	Transformer		
3.1		Winding	Working condition of winding
4	Motor driver		
4.1		Power electronics	Overall working condition
4.2		Braking resistance	Overload condition
5	Propulsion motor		
5.1		Stator	Condition of stator, e.g. winding inter-turn insulation
5.2		Rotor	Condition of rotor, e.g. inter-turn condition (synchronous motor), balance condition, eccentricity condition, broken rotor (induction motor)
5.3		Bearing	Wearing condition
6	Auxiliary system		
6.1		Cooling system (water-cooling, air-cooling)	Cooling condition
7	Propeller		
7.1		Sealing device	Sealing condition
7.2		Bearing device	Wearing condition

4.1.9 For a gas fuelled ship, additional monitoring requirements specified in Table 4.1.9 are to be met in addition to the monitoring of the applicable equipment and systems specified in Table 4.1.7.

List of gas-fule-related equipment and systems being monitored

Table 4.1.9

<u>No.</u>	<u>Name of equipment / systems</u>	<u>Monitoring Scope (e.g. equipment/parts/performance, etc.)</u>	<u>Monitoring Purpose (e.g. condition, function, performance, etc.)</u>
<u>1</u>	<u>Gas fuel engine for propulsion</u>		
<u>1.1</u>		<u>Pilot fuel nozzle</u>	<u>Ignition ability</u>
<u>1.2</u>		<u>Ignition device (gas fuel only engine)</u>	<u>Ignition ability</u>
<u>1.3</u>		<u>Piston underside space of two stroke gas fuel engine(if applicable)</u>	<u>Explosion-proof</u>
<u>2</u>	<u>Gas fuel engine for power generation (including electric propulsion)</u>		
<u>2.1</u>		<u>Cylinder combustion</u>	<u>Combustion condition (e.g. misfire, knocking, unsteady combustion, etc.)</u>
<u>2.2</u>		<u>Pilot fuel nozzle (applicable to dual fuel engine)</u>	<u>Ignition ability</u>
<u>2.3</u>		<u>Ignition device (applicable to gas fuel only engine)</u>	<u>Ignition ability</u>
<u>2.4</u>		<u>Crankcase (applicable to trunk piston type gas fuel engine)</u>	<u>Explosion-proof</u>
<u>2.5</u>		<u>piston underside space (applicable to crosshead type gas fuel engine)</u>	<u>Explosion-proof</u>
<u>3</u>	<u>Auxiliary system</u>		
<u>3.1</u>	<u>Gas fuel system</u>		
<u>3.1.1</u>		<u>Ventilated double wall gas fuel piping</u>	<u>Ventilation and air change capacity, leakage of gas fuel</u>
<u>3.1.2</u>		<u>Pressurized inert gas double wall gas fuel piping</u>	<u>Inerting capacity, leakage of gas fuel</u>
<u>3.2</u>	<u>Lubricating oil system</u>		
<u>3.2.1</u>		<u>Lubricating oil piping</u>	<u>Leakage of gas fuel</u>
<u>3.3</u>	<u>Cooling system</u>		
<u>3.3.1</u>		<u>Cooling water piping</u>	<u>Leakage of gas fuel</u>

4.3 Plans and documents

4.3.1 For ships applying for the functional notation for intelligent machinery, the following applicable plans and documents are to be submitted:

- (1) Condition monitoring and health assessment system diagram;
- (2) Onboard installation and arrangement of main equipment of the condition monitoring and health assessment system
- (3) List and description of monitored equipment and systems, at least including the following information of each equipment and part:
 - ① monitoring purpose (condition, function, performance, etc.)~~condition and/or fault~~, e.g. combustion condition in the cylinder, wear condition of bearing and performance of turbocharger;
 - ② monitoring parameters and normal range, e.g. temperature, pressure, flow and vibration;
 - ③ monitoring devices/sensors;

- ④ monitoring procedures;
- ⑤ condition analysis/assessment method;
- ⑥ acceptance criteria.

Note: If acceptance criteria may not be provided before the condition monitoring and health assessment systems are installed onboard the ship, the designer is to provide detailed plan for measuring/acquiring acceptance criteria, including measurement methods, time to establish acceptance criteria and method for assessing the effectiveness of acceptance criteria, etc..

(4) Detailed information on condition monitoring and health assessment system, generally including the following:

- ① system principle, functions, operating and maintenance description;
- ② system hardware description, e.g. sensor, data acquisition device, data storage/backup device;
- ③ software description, e.g. data processing and analysis method, fault diagnosis method and condition assessment method;
- ④ type and content of output data/information.

Note: If data/information relating to condition monitoring and health assessment is uniformly acquired through ship integration platform, relevant hardware such as sensors and data acquisition devices may be described in the plans and documents of integration platform.

(5) List and descriptions of systems and equipment subject to condition-based maintenance (applicable to functional notation Mx);

(6) Procedures and schedules related to implementation of condition monitoring, health assessment and auxiliary decision-making, including:

- ① onboard testing procedures;
- ② procedures and schedules for data collection;
- ③ procedures and schedules for data storage/backup;
- ④ procedures and schedules for data analysis;
- ⑤ output of assessment result/report;
- ⑥ procedures and schedules for calibration of monitoring devices.

(7) Relevant information on the company (if applicable), at least including:

- ① structure diagram of relevant posts (responsibilities) of company;
- ② working flow, including goal, method and strategy;
- ③ training plan and qualification requirements for relevant personnel carrying out assistant decision making and condition-based maintenance.

(8) Other plans and documents deemed necessary by CCS.

Chapter 5 Intelligent Energy Efficiency Management

5.1 General requirements

5.1.1 The requirements of this Chapter apply to ships for which CCS functional notation for intelligent energy efficiency management is requested.

5.1.2 Intelligent energy efficiency management means to evaluate ship energy efficiency condition, navigation and loading condition based on the monitoring data and information on ship navigational condition and energy-consuming condition, and provide evaluation results and solutions for speed optimization and optimal stowage based on trim optimization, so as to realize real-time monitoring, evaluation and optimization of ship energy efficiency, and continuously improve level of energy efficiency management of ship.

5.1.3 Intelligent energy efficiency management is to have following basic functions:

- (1) Online monitoring and automatic data collection of ship navigational condition, energy efficiency and energy-consuming condition;
- (2) Providing evaluation, report and alarm on ship energy efficiency and energy-consuming condition;
- (3) Providing assistant decision-making recommendations for energy efficiency management according to analysis and evaluation results.

5.1.4 In addition to basic functions specified in 5.1.3, intelligent energy efficiency management may also have following additional functions:

- (1) Providing speed optimization plan based on different objectives and in combination with evaluation results of route characteristics, fuel consumption and cost effectiveness;
- (2) Providing optimal stowage plan based on trim optimization according to initial loading and ship's optimal navigation state analysis.

5.1.5 If the intelligent energy efficiency management functions provided in the above 5.1.3 and 5.1.4 do not apply to some ships not engaged in transport of cargoes, designers may consult CCS to agree on the functions and associated requirements for intelligent energy efficiency management.

5.1.6 Ships for which functional notation for intelligent energy efficiency management is requested are to comply with relevant requirements of CCS Guidelines for Surveys of Intelligent Energy Efficiency Management of Ships in addition to the requirements of this Chapter.

5.1.67 Relevant definitions and abbreviations in this Chapter are as follows:

(1) Calendar year means the period from 1 January until 31 December inclusive;

(2) Annual Transport Work means the product by multiplying the distance travelled by the ship with a ship's capacity expressed by the deadweight tonnage or gross tonnage^① in a given calendar year;

(3) Annual Operational Carbon Intensity Indicator (CII) means ratio of the total mass of CO₂ (M) emitted to the total transport work (W) undertaken in a given calendar year;

(44) Ship Energy Efficiency Operational Indicator (EEOI) means ~~ship's energy efficiency operation index, i.e.~~ the ratio of mass of CO₂ emitted per unit of transport work;

(25) MRV (Monitoring Reporting and Verification) means monitoring, reporting and verification of CO₂ emissions from maritime transport.

(36) Emission control area (ECA) means the area requiring special compulsory measures to be taken to ship emission so as to prevent, reduce and control atmospheric pollution due to NO_x or SO_x and particulate matters or all three emission types, which will then cause adverse effect on human health and environment.

(47) Main energy-consuming equipment means main energy-consuming equipment including main engine, auxiliary diesel engine for power generation, boiler and gas turbine and inert gas generator, etc.

(58) Transportation work means product by multiplying the distance travelled by the ship with the amount of cargo carried.

5.3 Plans and documents

5.3.1 The following plans and documents are to be submitted to CCS:

(1) Composition and explanation of energy efficiency on-line monitoring system, which is to include the following information:

- ① explanation of equipment composition;
- ② monitoring method and parameters;
- ③ special explanation on installation processes and positions of monitoring equipment (if necessary);

① According to IMO resolution MEPC.336(76) on 2021 Guidelines on Operational Carbon Intensity Indicators and Calculation Methods (CII Guidelines, G1), for cruise passenger ships, ro-ro cargo ships (vehicle carriers) and ro-ro passenger ships, gross tonnage (GT) is to be used for calculating annual transport work.

- ④ method for analyzing and evaluating energy efficiency/energy consumption;
 - ⑤ (initial) set value of energy efficiency/energy consumption evaluation criteria;
 - ⑥ type and contents of output data/information.
- (2) Electrical system plan of energy efficiency on-line monitoring system (including system power supply, system input and output signal circuit and parameter list) [and equipment arrangement plan](#);
- (3) Electrical system plan and arrangement plan of shaft power measurement device (if fitted);
- (4) Arrangement plan of fuel flowmeter;
- (5) Procedure and plan, including:
- ① Procedure and plan for data collection/storage;
 - ② Procedure and plan for relevant evaluation results/report output;
 - ③ Plan for calibration of monitoring device;
- (6) Principle, function and instructions of speed optimization system ([applicable to functional notation Es](#));
- (7) Principle, function and instructions of optimal stowage system based on trim optimization ([applicable to functional notation Et](#));
- (8) Test program of energy efficiency management system-;
- [\(9\) Other plans and documents deemed necessary by CCS.](#)

5.4 Ship energy efficiency on-line intelligent monitoring

5.4.1 General requirements

5.4.1.1 Energy efficiency on-line intelligent monitoring is to be able to monitor main energy-consuming equipment and ship navigational condition, collect, transmit, store and analyze data, and carry out evaluation and alarm on relevant technical index such as ship's energy efficiency and energy consumption.

5.4.1.2 It is to be able to carry out periodic general evaluation on ship's energy efficiency condition and provide assistant decision-making recommendations on energy efficiency optimization and improvement.

5.4.1.3 It is to be able to provide relevant data or analysis evaluation report according to demand and based on the results of monitoring, analysis and evaluation of energy efficiency and energy consumption data.

[5.4.1.4 It is to be able to easily inquire the results of monitoring, analysis and evaluation of energy efficiency data and assistant decision-making recommendations.](#)

[5.4.1.45](#) Computer system of energy efficiency on-line intelligence monitoring is to satisfy requirements for category I computer system, and monitoring ~~device and~~ system are to be approved by CCS.

5.4.2 Monitoring and measurement

5.4.2.1 It is to be able to carry out real-time collection of relevant data of main energy-consuming equipment, shaft power measurement device (if fitted), electronic fuel flowmeter, wind speed and direction indicator, global positioning system, log, electronic clinometer, sounding instrument and ship draft measuring equipment, etc.

Note: The above equipment may be adjusted based on ship types and ship propulsion types.

5.4.2.2 Monitoring parameters of ship's main energy-consuming equipment, metering equipment and navigational equipment include, but not limited to:

(1) ~~Parameter of p~~Power, pressure and temperature, etc. of main energy-consuming equipment, [for details, see provisions of Chapter 9 of CCS Guidelines for Surveys of Intelligent Energy Efficiency Management of Ships](#);

(2) ~~Parameter of f~~Fuel consumption of main energy-consuming equipment;

(3) ~~Parameter of m~~Main engine shaft power[Ⓢ];

(4) ~~Parameter of w~~Wind speed and direction;

(5) ~~Parameters of s~~Ship position, course and speed;

(6) ~~Parameter of s~~Speed through the water;

(7) Ship inclination angle;

(8) Water depth value;

(9) Ship draft value.

[Note[Ⓢ]: Output power of generators for propulsion and/or auxiliary power generation is permitted to be obtained by alternative methods.](#)

5.4.3 Data transmission and storage

5.4.3.1 The system may receive and store equipment parameter data periodically, and the receiving period may be adjusted according to minimum period set of the equipment and management demands.

5.4.4 Energy efficiency and energy consumption calculation

5.4.4.1 The system is to be able to calculate following energy efficiency and emission index automatically:

(1) EEOI;

(2) Fuel consumption per sea mile;

① [Output power of generators for propulsion and/or auxiliary power generation is permitted to be obtained by alternative methods.](#)

- (3) Fuel consumption per transport work;
- (4) CO₂ emission per sea mile;
- (5) CO₂ emission per transport unit.

Note: The above indexes may be adjusted based on ship types and ship propulsion types.

5.4.4.2 The system is to be able to calculate following index of main energy-consuming equipment automatically:

- (1) Fuel consumption per hour;
- (2) Fuel consumption per day;
- (3) Summary of fuel consumption per voyage (leg).

5.4.4.3 The system is to be able to calculate the following carbon intensity indicators and relevant parameters automatically:

- (1) CII;
- (2) annual total fuel consumption;
- (3) annual total CO₂ emission.

Note: Above indicators and data are to be calculated according to IMO resolution MEPC.336(76) on 2021 Guidelines on Operational Carbon Intensity Indicators and the Calculation Methods (CII Guidelines, G1).

5.4.5 Energy efficiency and energy consumption evaluation

5.4.5.1 Real-time evaluation of energy consumption of main energy-consuming equipment

- (1) Automatically judging ship's navigational status such as mooring, maneuvering navigation and constant speed navigation according to actual operational condition of ship equipment;
- (2) Using real-time data of ship's energy consumption, carrying out comparison and analysis according to set energy consumption evaluation method and criteria, automatically judging energy-consuming condition and outputting evaluation conclusion.

5.4.5.2 Evaluation of ship energy efficiency and emission index

(1) It is to be able to carry out automatic real-time monitoring of energy efficiency and emission indexes specified in 5.4.4.1. These evaluation indexes may be adjusted based on ship types and comparative analysis with energy efficiency evaluation criteria can be carried out.

(2) It is to be able to automatically generate yearly, quarterly, monthly and voyage-related index data report according to demands and carry out inquiry when necessary.

(3) It is to be able to predict the potential attained carbon intensity indicator (CII) which can be achieved according to the monitoring data of energy efficiency and emission indexes.

(4) It is to be able to rate the operational carbon intensity of the ship according the CII specified in 5.4.4.3 and relevant data calculation results, and automatically generate and output the annual report for audit, inspection and inquiry according to demands.

Note: Reference may be taken to the following documents for CII reference line calculation, CII reduction factors and CII rating:

- (1) IMO resolution MEPC.337(76) on 2021 Guidelines on the Reference Lines for Use with Operational Carbon Intensity Indicators (CII Reference Lines Guidelines, G2);
- (2) IMO resolution MEPC.338(76) on 2021 Guidelines on the Operational Carbon Intensity Reduction Factors Relative to Reference Lines (CII Reduction Factors Guidelines, G3);
- (3) IMO resolution MEPC.339(76) on 2021 Guidelines on the Operational Carbon Intensity Rating of Ships (CII Rating Guidelines, G4).

5.4.5.3 Ship's energy consumption distribution analysis

(1) It is to be able to obtain energy consumption distribution proportion and energy utilization efficiency of main energy-consuming equipment by analysis and according to ship's design parameters and relevant plans and information or real ship navigation data;

(2) It is to be able to output energy consumption distribution data and analysis result of energy utilization efficiency.

5.4.5.4 Reminding that index exceeds limit

(1) If ~~real-time value of~~ ship's energy efficiency ~~and~~, energy consumption and carbon intensity index exceeds set value, the system is to give alarm or remind that the index exceeds limit.

5.4.6 Assistant decision-making on energy efficiency management

5.4.6.1 General evaluation on ship's energy efficiency and energy consumption condition may be carried out according to voyage and natural period (not exceeding one year). In addition, a comprehensive evaluation of the operational carbon intensity of the ship is to be carried out after the end of each calendar year.

5.4.6.2 It is to be able to propose assistant decision-making recommendations on energy efficiency optimization and improvement according to results of comprehensive evaluation.

5.4.7 Assistant management of energy efficiency

5.4.7.1 Carbon emission monitoring and reporting required by MRV: system is able to monitor carbon emission data required by MRV, and generate relevant report and evidence satisfying verification requirements.

5.4.7.2 Emission control area (ECA) early warning (if applicable): system is able to provide early

warning for residual nautical miles and residual time within certain area away from ECA according to current ship voyage plan.

5.4.7.3 Fuel information management: management of fuel replacement during fuel bunkering and navigation, including information management on [fuel bunkering and types of bunkered fuel oil and types of fuel oils before and after](#) fuel replacement.

5.5 Speed optimization

5.5.1 General requirements

5.5.1.1 It is to be able to provide speed optimization plan based on different objectives according to voyage plan, fuel consumption and general cost effectiveness analysis.

5.5.1.2 Speed optimization analysis is to generate speed optimization plan according to ship's navigational data and in combination with voyage plan, route characteristics and ship efficiency, fuel consumption evaluation results, etc., as well as with navigational cost accounting and analysis results.

5.5.1.3 Speed optimization function based on different objectives is to include speed optimization based on voyage plan and speed optimization based on cost effectiveness.

5.5.1.4 Computer system of speed optimization is to satisfy requirements for Category I computer system.

5.5.2 Speed optimization based on voyage plan

5.5.2.1 It is to automatically calculate navigated distance and navigated time based on voyage and leg management functions and according to information including ship's departure port, destination port, departure time, and predicted navigation distance, etc., and forecast arrival time according to residual voyage and current speed.

5.5.2.2 It is to automatically calculate specific fuel consumption under current speed according to parameters such as speed, main propulsion equipment power and fuel consumption, calculate fuel consumption according to current speed and residual navigation distance and calculate fuel consumption for navigated miles and fuel necessary for residual miles.

5.5.2.3 It is to evaluate effect on speed according to set indexes which can reflect ship performance and efficiency during operation and considering the factors such as weather and sea conditions.

5.5.2.4 During navigation, it is able to provide speed optimization plan according to the analysis of fuel consumption rate, ship efficiency, etc.

Chapter 7 Intelligent Integration Platform

7.1 General requirements

7.1.1 The requirements of this Chapter apply to ships for which CCS functional notation for intelligent integration platform is requested.

7.1.2 ~~If a ship is assigned with the functional notation for i~~Intelligent integration platform, ~~is to be able to provide~~ support ~~is to be provided~~ to ~~at least two systems among~~ intelligent navigation, intelligent hull, intelligent machinery, intelligent energy efficiency management ~~and~~, intelligent cargo management, ship remote control and autonomous operation in order to form unified integration platform of data acquisition/collection, storage, integration, interaction, sharing and demonstration and control command transmission (where applicable). Integration platform is to be open and be cable to integrate existing information management system on board ship and subsequent newly-added system to realize all-round monitor, control and intelligent management for ship as well as data exchange with shore base.

7.3 Illustrations for System layer

7.3.1 Overall structure of system

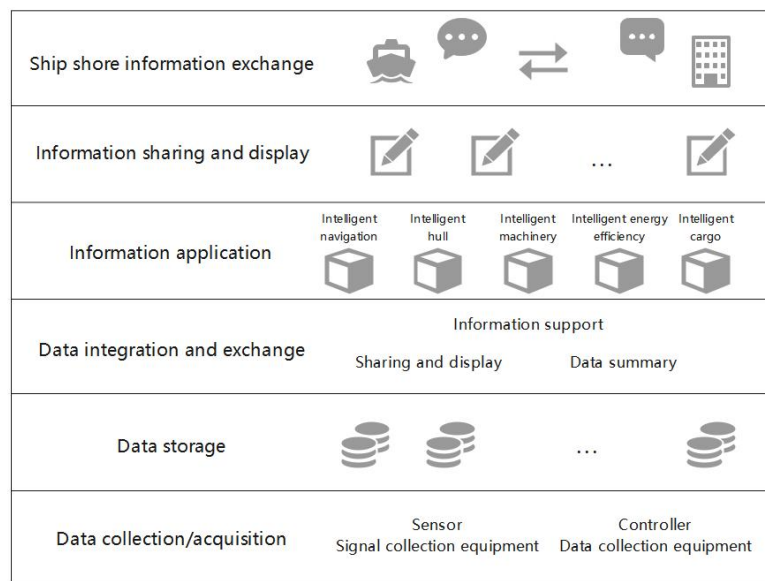


Figure 7.3.1 Illustration of Overall Structure of System

(1) Data collection/acquisition, i.e. using sensing equipment (e.g. sensor), control, signal collecting equipment and data collecting equipment to collect required data; ~~collecting data, defining data standard, including standard relating to data definition, data description, data quality, data transmission and data handling, and realizing data traceability~~

(2) Data storage, i.e. establishing ~~subject-oriented, integrated and stable~~ data set to be kept during acquisition and processing process; ~~supporting decision-making and management process and reflecting historical change, carrying out evaluation management for data collected to ensure accuracy, integrity and availability of data; in case of single failure, the data stored on board will not be lost~~

(3) Data integration and exchange, i.e. carrying out system processing, aggregation, analysis integration and exchange based on necessary selection and cleaning of existing data, using multi-dimensional analysis method, analyzing and comparing from different aspects, and extracting information hidden within data to provide information supporting for service application and assistant decision-making as well as play a role of information integration;

(4) Ship shore information exchange, i.e. realizing the sending and receiving of ship shore information exchange through communication equipment; ~~to achieve remote failure diagnosis and data mining~~

(5) Information application, i.e. providing support for other intelligent applications;

(5) Information sharing and display, i.e. realizing visualized display of data and information exchange and sharing. ~~By~~ means of human-computer interaction and according to customization, providing ~~excavating~~ results of relevant data, expressing failure cause in proper form and providing prediction and early warning for user's operational decision-making by using data trend.

(6) Standard rules system, which is to be observed during system integration process.

(7) Information security system, i.e. based on requirements for information security (information confidentiality, authenticity, integrity, unauthorized copy and security of parasitic system) and from computer operation system, security agreement and mechanism (digital signature, message authentication and data encryption) to safety system, proposing design thinking and protection strategy to ensure continuous, reliable and normal operation of system and uninterrupted information service to achieve final continuity of service.

7.4 System requirements

7.4.1 General requirements

7.4.1.1 Intelligent integration system is generally to be designed according to the requirements of Chapter 1 to Chapter 4 of CCS Guidelines for Verification of Digital Systems of Ships and Offshore Installations.

7.4.1.1 System integration is to adopt unified input and output standard.

7.4.1.2 Stable and reliable communication agreement and system data transmission mechanism is to be adopted for communication between ship and shore.

7.4.1.3 Data collection is to have fault tolerant mechanism.

7.4.1.4 Database of integration platform is to have valid integration process, i.e. screening necessary data according to data quality of each system and functional requirements for integration platform.

7.4.1.5 The system is to support multi-terminal (PC and mobile device) access.

7.4.1.6 The system is to provide external data transmission interface and have capability of sharing data with relevant parties.

7.4.1.7 The system is to realize multi-department and multi-user cooperative management according to company's relevant requirements for management system.

7.4.1.8 A redundant design is to be used for the network providing data communication for different nodes, i.e. the failure of any node or network will not affect the communication between other nodes.

7.4.1.9 A redundant design is to be used for the data storage and hot backup is to be achieved to ensure the continuity of functions.

7.4.1.10 Where the integration platform has the function of transmitting control commands, it is to ensure the timeliness and accuracy of the transmission of commands.

7.4.1.11 Log management function is to be provided so that users with authorization for log maintenance may carry out the maintenance of log.

7.4.1.12 The integration platform providing support for assistant decision-making is to comply with the requirements for category II computer system, and the integration platform providing support for control is to comply with the requirements for category III computer system, as well as satisfying applicable requirements of Chapter 2, PART SEVEN of CCS Rules for Classification of Sea-going Steel Ships.

7.4.2 System integration requirements

7.4.2.1 Intelligent integration platform is to integrate existing information resource of intelligent system on board ship. Data collected through intelligent system can be stored in integration platform database, or establish effective call relation with it.

7.4.2.2 Intelligent integration platform can integrate functions relating to ship information management system and realize management for relevant ship information by ship and company, e.g. equipment maintenance management, crew delivery and basic information management, security management, system management, cost management and electronic management of maritime information.

7.4.2.3 Intelligent integration platform is to be able to integrate newly-added system (e.g. video monitoring system, integrated navigation system) according to conventions, regulations, rules as well as company management and operation needs. The system is to have certain expandability and complete data interface plan to facilitate access of other newly-added system. Data collected through newly-added system may be stored in intelligent integration platform database, or establish effective call relation with it.

7.4.3 Data collection/acquisition

7.4.3.1 Normalized data standards are to be established for collected/acquired data, including standards relating to data definition, data description, data quality, data transmission and data processing, so as to realize data traceability.

7.4.3.2 Validation check is to be carried out during data collection by deleting repeated data and error data, initially completing missing data and giving effective reminding of error data.

7.4.3.3 General data exchange, data transmission agreement and framework are recommended for data collection.

7.4.3.4 Data collection is to have fault-tolerant mechanism.

7.4.4 Data storage

7.4.4.1 A redundant design is to be used for data storage and backup is to be achieved to ensure the

continuity of functions.

7.4.4.2 Data kept in the integration platform is to satisfy the expected application demands and quality requirements.

7.4.4.3 Periodical evaluation is to be carried out for collected data to ensure the accuracy, integrity and availability of data.

7.4.5 Data integration and exchange

7.4.5.1 Integration platform is to be capable of data integrating, i.e. screening necessary data according to the expected application demands.

7.4.6 Ship shore information exchange

7.4.6.1 Stable and reliable communication agreement and data transmission mechanism is to be adopted for communication between ship and shore.

7.4.7 Information sharing and display

7.4.7.1 The system is to adopt general data exchange agreement to provide external data transmission and have capability of sharing data with relevant parties.

7.4.7.2 The system is to be able to provide the results of data analysis as request by the user, display in proper form and provide prediction and early warning for user's operational decision-making by using data trend.

7.5 Plans and documents

7.5.1 Detailed information on intelligent integration platform system generally includes following contents:

(1) Technical specification of the product, which is to specify the general performance requirements as well as general design requirements for the product, applicable parts of the following are to be included as a minimum:

- ① environmental conditions, system principles and descriptions of product functions as well as its use and maintenance;
- ② hardware description, e.g. technical specification of hardware and peripheral configuration, main hardware configuration, input and output devices and power supply equipment, etc.;
- ③ software description, e.g. software configuration, soft data processing and analysis method, fault diagnosis method, condition evaluation method, etc.;
- ④ categories and contents of output data/information.

(2) Wiring connection diagram of intelligent integration platform system, applicable parts of the following are to be included as a minimum:

- ① power supply arrangement: showing power supply arrangement of the system;
- ② circuit diagram of important hardware circuit, such as emergency operation and interlock, details of input and output devices, power supply condition of each circuit.

(3) User interface description

Applicable part of the following is to be included as a minimum:

- ① function distribution of each work station and operation station as well as description of control changeover among stations;
- ② layout of equipment and description of functions.

(4) Description of the operation and use of system (for information)

7.5.2 For ships applying for functional notation for intelligent integration platform, the following applicable plans and documents are to be provided:

- (1) arrangement of system and main equipment;
- (2) system schematic (including power supply);
- (3) other plans and documents deemed necessary by CCS.

7.56 Survey

7.56.1 Initial survey

7.56.1.1 It is to be confirmed that plans have been examined.

7.6.1.2 It is to be confirmed that the system has relevant product certificates.

7.56.1.23 ~~Ships applying for the functional notation for intelligent integration platform is to be subject to initial survey to verify following Survey~~ items:

- (1) confirming the completeness of the installation of ~~that~~ intelligent integration platform ~~has relevant certificates~~;
- (2) confirming that process of data collection, storage, transmission, display and application of intelligent

integration platform is implemented properly;

(3) ~~inspecting~~testing relevant functions ~~according to requirements for~~ of each integration system-;

(4) verifying data integration capacity of the platform.

7.56.2 Survey after construction

7.56.2.1 Following items are to be examined at annual survey, intermediate survey and special survey:

(1) examining that no substantial change of intelligent integration platform occurred since last survey;

(2) examining former service condition record of intelligent integration platform and confirming normal operation of intelligent integration platform;

(3) system data can be exchanged normally between ship and shore, and conforming historical record of data exchange;

(4) checking system backup record randomly and confirming system has implemented effective backup;

(5) ~~inspecting relevant functions according to requirements for each integration system~~verifying the data integration capacity of the platform.

7.6.2.2 If the equipment and system are repaired or renewed, verification of functions is to be carried out again, and the test is to be carried out again if necessary.

Chapter 8 Remote Control Ships

8.3 Radio communication and signal equipment

8.3.2 Functional requirements

~~8.3.2.2 — The signal equipment of the ship is to be able to operate automatically or at the remote control station, and give the audible, visual and shape signals according to IMO International Regulations for Preventing Collisions at Sea, 1972.~~

8.3.3 Equipment and requirements for communication

~~8.3.3.6 — The communication equipment is to be supplied by two sources of electrical power from different sections of main switchboards, and to realize automatic change over in the event of failure of one power supply. In addition, the communication equipment is to be equipped with a dedicated standby power which provides power supply for at least an hour.~~

8.3.3.76 The installation position of communication equipment is to be fit for the function of equipment and is to be installed outside the engine room.

8.3.4 Equipment and requirements for signal

~~8.3.4.4 — Each signal equipment is to be supplied by the independent branch of the signal equipment control board. The signal equipment control board is to be supplied by two sources of electrical power from different sections of main switchboards, and to realize automatic change over in the event of failure of one power supply.~~

8.3.4.54 The states of all signal equipment are to be transferred to the remote control station and can autonomously operate or be remotely controlled by the remote control station in accordance with the function provided on the ship.

8.3.4.65 The performance of signal equipment is to comply with the technical requirements of IMO International Regulations for Preventing Collisions at Sea, 1972 and adapts to the environmental conditions of the ship.

8.3.4.76 When the ship passes through a special channel such as a canal, it is to be equipped with a specified signal according to the requirements of the canal authority or port State authority. The signal light is to be operated remotely from the remote control station.

8.3.4.87 The arrangement of the signal light is to comply with IMO International Regulations for Preventing Collisions at Sea, 1972 and relevant administrations.

8.4 Additional requirements for R1 functional notation

8.4.1 Navigation requirements

8.4.1.2 Design requirements

8.4.1.2.6 When the remote control function is affected due to the failure of the ship or failure of system of the remote control station, the ship's personnel are to transfer control from the remote control station to the ship's control station. Meanwhile, transfer warnings are to be generated onboard ship and at the remote control station. †The failure is to be checked in time to restore the remote control function of the ship as soon as possible.

8.4.2 Machinery installations

8.4.2.4 Condition monitoring and health assessment

8.4.2.4.1 Condition monitoring, health assessment, assistant decision-making ~~(including condition based maintenance)~~ of engine room machinery installations and systems are to comply with provisions relevant requirements for functional notation M for

[intelligent machinery in Chapter 4 of the Rules.](#)

[8.4.2.4.2 Where condition-based maintenance of machinery equipment and system is necessary to be carried out taking into account design arrangement of machinery equipment and system, the provision and responsibilities of onboard personnel and maintenance demands, it is to comply with relevant requirements for functional notation Mx for intelligent machinery in Chapter 4 of the Rules.](#)

8.5 Additional requirements for R2 functional notation

8.5.2 Machinery installations

8.5.2.9 Protection against flooding

8.5.2.9.1 In addition to the following provisions, protection against flooding of engine room is to satisfy the applicable requirements of CCS Rules for Classification of Sea-going Steel Ships:

(1) any valve serving a sea inlet, a discharge below the waterline or a bilge injection system, for controlling flooding upon damage is to ~~be act~~ automatically ~~closed~~ [to control flooding upon damage](#) in case of alarm of [high bilge](#) water level as specified in [Section 9 of Chapter 3 of PART SEVEN](#) of CCS Rules for Classification of Sea-going Steel Ships;

(2) bilge pumps are to be operated automatically in accordance with specified procedures. The operational conditions of bilge pumps are to be indicated at the remote control station. In case the influx of liquid is greater than the pump capacity or the pump is operating more frequently than would normally be expected, timely feedback is to be sent to the remote control station for making decisions on repair.

Chapter 9 Autonomous Operation Ships

9.1 General requirements

9.1.1 The requirements of this Chapter apply to ships for which CCS functional notation for autonomous operation is requested.

9.1.2 Autonomous operation ship means a ship is capable of fully autonomous operation in open waters or during the entire voyage, normally without seafarers to operate on board.

9.2 Additional requirements for A1 functional notation

9.2.1 Navigation requirements

9.2.1.2 Design requirements

9.2.1.2.1 The design of A1 ship is to satisfy the requirements in 8.5.1.2.1 to 8.5.1.2.4 of the Rules.

9.2.1.2.2 The autonomous navigation system is to be connected to the situation awareness system, communication and signal system, machinery installations, anchoring and mooring system, electrical system, hull safety system, fire safety system, environmental protection system and security system through a redundant network (or equivalent measure).

9.2.1.2.3 When redundant system and equipment are connected to the autonomous navigation system, the interfaces are to be independent from each other.

9.2.1.2.4 The autonomous navigation system is to obtain the information on the failure of a connected system. Upon receiving the failure, it is to evaluate the seaworthiness of the ship to decide the control strategy at the next step.

9.2.1.2.5 The ship is to have a fail-safe mode. If the seaworthiness of the ship is severely affected due to equipment failure and it is impossible to carry out remote control or autonomous navigation, it is to ~~enter~~adopt the an appropriate safe mode to ensure the safety of the ship and prevent pollution as far as possible. Analysis and assessment of the fail-safe mode suitable for the ship are to be carried out taking into account factors such as the failure mode of ship, the intended function, manning, location, surroundings, weather and sea condition, depth of water and residual navigation capacity of the ship.