ADDITIONAL CLASS NOTATION SMART

NR675 - JANUARY 2024

BUREAU VERITAS
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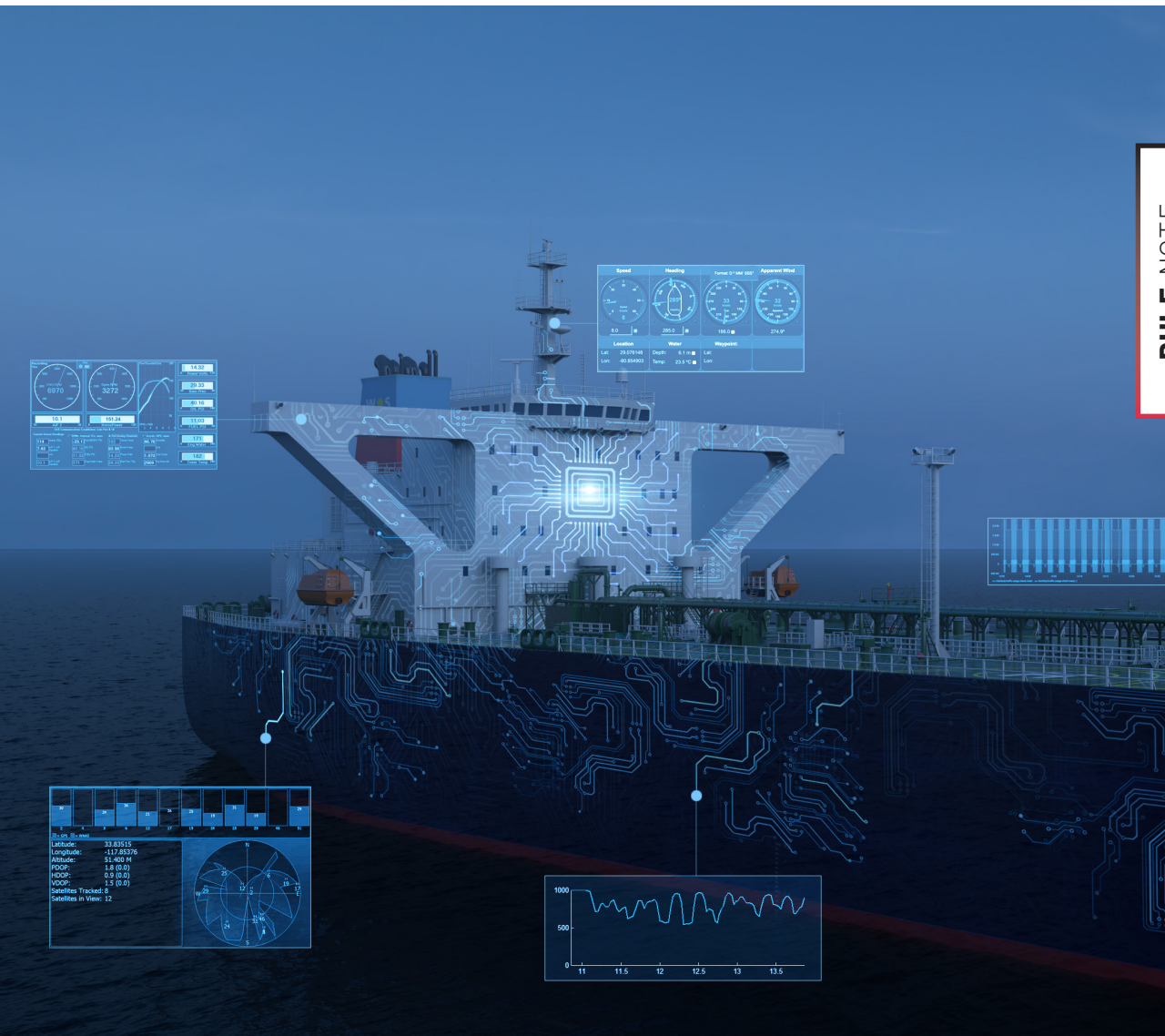
BUREAU VERITAS

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RULES, RULE NOTES
AND GUIDANCE NOTES

NR675 DT R03 January 2024 takes precedence over previous revision.

The PDF electronic version of this document available on the Bureau Veritas Marine & Offshore website https://marine-offshore.bureauveritas.com/ is the official version and shall prevail if there are any inconsistencies between the PDF version and any other available version.

These rules are provided within the scope of the Bureau Veritas Marine & Offshore General Conditions, enclosed at the end of Part A of NR467, Rules for the Classification of Steel Ships. The latest version of these General Conditions is available on the Bureau Veritas Marine & Offshore website.

NR675

ADDITIONAL CLASS NOTATION SMART

January 2024

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Section 1 General Requirements

1 General

1.1 Purpose

1.1.1 Smart systems are digital solutions designed to process ship's data and support sustainable, efficient and safe operation. Such digital solutions depend on two components:

a) Supporting data infrastructure which enables collecting data, providing accessibility of the data to multiple consumers and maintaining data traffic control

b) Software designed to perform a smart function optimising the use of the existing onboard systems with algorithms based on physics-based, data-driven and hybrid models.

1.2 Definitions

1.2.1 The following definitions are used in this Rule Note:

- Data-driven model: model based on statistical methods and/or machine learning applied to extended historical datasets

- Decision support: aid to decision-making with specific actions recommended to the users, e.g. intervention into a process, spare part replacement, route modification.

- Digital solution: computer based system that incorporates functions for collection, transmission, analysis and visualisation of data

- Event records: collection of time-stamped messages produced by a monitoring function of a system, e.g. alarms, alerts, notifications

- Expert-in-the-loop service: service in which a digital solution needs a regular input from a shore operator, other than the intended user of the smart function, to produce conclusive results.

- Function: defined objective or characteristic action of a system or component (ISO/IEC/IEEE 24765:2017 Systems and software engineering - Vocabulary)

- Hardware: physical elements of a device, system or equipment which support the computation and/or data access for the software; hardware is a component of a smart system. Examples include computers, display units, alarm and monitoring units, miscellaneous electronic devices (switches, PLC, data loggers, routers, ship's server, etc.), purposely installed sensors.

- Hybrid model: model based on a combination of physics-based and data-driven approaches

- Non-essential consumer: onboard energy consumer other than consumers contributing to the provision of functions essential for propulsion, steering, safety of life and safety of the ship

- Onboard Digital Solution (ODS): digital solution available for users on board

- Permanent data acquisition: automatic collection of data from sensors, monitoring devices, control systems and collection systems which are permanently installed on board and connected to a smart system

- Physics-based model: model employing explicit analytical expressions for physical principles describing a process

- Raw data: data acquired directly from its source and existing in its original form before subsequent processing (ISO 5127:2017 Information and documentation - Foundation and vocabulary); in the present Rule Note, raw data is the original input into the smart system before subsequent processing, e.g. data directly transmitted from sensors

- Remote monitoring: provision of data descriptive of the state of a system, equipment or a device to a data consumer which is not located on board for checking the measured or calculated states against a specific reference.

- Smart function: characteristic function of a smart system.

- Smart service centre: location remote from the ship that can support smart functions of the ship, including, but not limited to, remote monitoring, e.g. data monitoring centre.

- Software: program code with associated data stored and executed in the hardware; software is a component of a smart system.

- Shore Digital Solution (SDS): digital solution available for users on shore to monitor the status of smart systems on board and to obtain the decision support relevant for managing the ship from the shore

- Time series: time-stamped states of a system indexed in time order.

1.3 Application

1.3.1 Ships fitted with a smart system and assigned an additional class notation **SMART( )** as defined in NR467, Pt A, Ch 1, Sec 2, [6.23] are to comply with the requirements of this Rule Note.

Note 1: NR467 refers to the Rules for the Classification of Steel Ships.

1.3.2 The additional class notation **SMART( )** is to be completed between brackets by at least one of the notations in Tab 1 indicating the scope of application of the smart function, where **x** indicates the smart group designation and can take one of the values in Tab 2. The structure of the smart notations is given in Fig 1.

1.3.3 Each smart system with a smart function may be assigned the smart group **1**, **2** or **3**.

Examples:

SMART(H1) which indicates compliance with the smart group 1 for the smart function Hull;

SMART(MH2,N1,EnE3-LIT) which indicates compliance with both smart groups 1 and 2 for the smart function Machinery Health monitoring, compliance with the smart group 1 for the smart function Navigation and compliance with both smart groups 1 and 3 for the smart function Energy Efficiency;

SMART(MH2, N1, EnE1-LIT, EnE3-LIT) which indicates compliance with both smart groups 1 and 2 for the smart function Machinery Health monitoring, compliance with the smart group 1 for the smart function Navigation and compliance with both smart groups 1 and 3 for the smart function Energy Efficiency.

1.3.4 Smart groups **1** and **3** do not cover cyber security for which reference is made to NR659 "Rules on cyber security for the classification of marine units".

1.4   Applicable requirements

1.4.1 The general requirements for assignment of the additional class notation **SMART( )** are defined in Article [2].

1.4.2 Additional requirements are given in Tab 1.

Table 1 : Notations and applicable additional requirements

Notations	Requirements additional to Sec 1
Hx for Hull	Sec 2
Mx for Machinery	Sec 3, [1]
MHx for Machinery Health Monitoring	Sec 3, [2]
Nx for Navigation	Sec 4
EnEx for Energy Efficiency **(1)**	Sec 5
Lx for Electronic Logbook	Sec 6
Xx for Special	Sec 7
(1) The notation **EnEx** may be complemented by one or by a combination of the following complementary notations, as defined in Sec 5: **-Em**, **-T**, **-LIT**, **-S**, **-W** and **-CII**.	

Figure 1 : Structure of smart notations
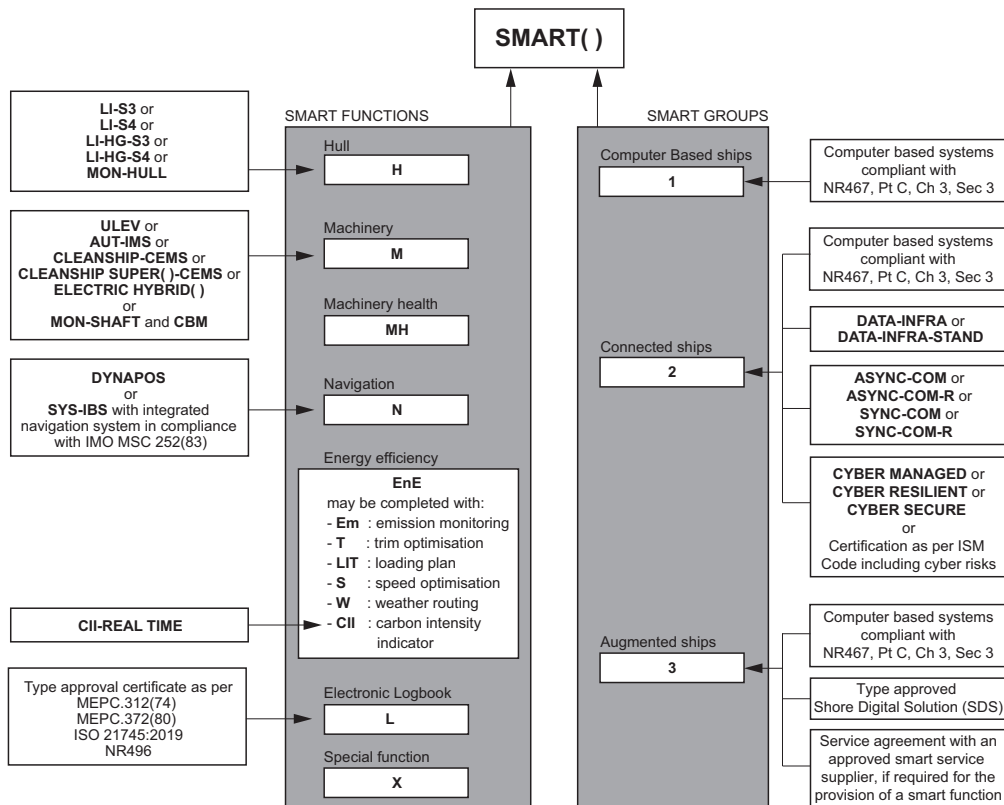
Table 2 : Smart groups

Smart group	Name	Description
1	Computer Based ships	• for ships equipped with at least one smart system, which is in accordance with the requirements related to computer based systems and smart functions as specified in Sec 1 to Sec 7
2	Connected ships	• for ships equipped with at least one smart system, which is in accordance with the requirements of smart group **1**, and • with the additional requirements related to data infrastructures, ship-shore data communication and cyber security as specified in Sec 1 to Sec 7
3	Augmented ships	• for ships equipped with at least one smart system, which is in accordance with the requirements of smart group **1**, and • with the additional requirements related to Shore Digital Solutions (SDS) as specified in [2.6], • and which may be supported by a smart service supplier approved according to the Rule Note NR533 "Approval of service suppliers" as specified in Sec 1 to Sec 7

2   General requirements for the additional class notations SMART( )

2.1   Documentation to be submitted

2.1.1 The documentation listed in Tab 3 are to be submitted.

2.1.2 Additional documents may be required according to the notations intended to be assigned. Reference is to be made to Sec 2 to Sec 7.

Table 3 : Documentation to be submitted

No.	A/I **(1)**	Description
1	I	List of computer based systems involved in smart functions. For each system the list is to include: a) functional designation b) supplier
2	A/I	Documentation as required in NR467, Pt C, Ch 3, Sec 3 for the computer based systems forming the smart system
3	A	For Cat III Computer Based Systems defined in NR467, Pt C, Ch 3, Sec 3, which are designed to demonstrate redundancy: Analysis of consequences of single failures in the form of a Failure Mode and Effect Analysis (FMEA)
(1) A = to be submitted for approval; I = to be submitted for information		

2.2   Computer based systems

2.2.1 The design, construction, commissioning and maintenance of computer based systems where they depend on software for the proper achievement of the smart functions are to be in accordance with the requirements of NR467, Pt C, Ch 3, Sec 3 and are to comply at least to the requirements for Category I systems.

2.2.2 Onboard functional tests of the software modules are to be witnessed by the Surveyor.

2.3   Components

2.3.1 Software components forming a part of the smart system are to be type approved as per Tab 4.

2.3.2 Hardware components forming a part of the smart system on board are to be type approved as per Tab 4 with a reference to NR467, Pt C, Ch 2, Sec 15, [2] and in compliance with the requirements of the pre-requisite notations.

Note 1: Only the hardware installed on board the ship is considered in the scope of the present Rule Note.

2.3.3 Case by case approval of hardware and software may also be granted at the discretion of the Society, based on submission of adequate documentation and subject to the satisfactory outcome of any required tests.

2.4   Electromagnetic susceptibility

2.4.1 Electronic type components of a smart system are to comply with the requirements covering electromagnetic susceptibility as defined in NR467, Pt C, Ch 2, Sec 2, [3].

2.5   Hardware Testing

2.5.1 Before a new installation, or before any alteration or addition to an existing installation is put into service, the electrical equipment of a smart system is to be tested in accordance with the requirements as defined in NR467, Pt C, Ch 2, Sec 15 to the satisfaction of the Surveyor, where the type approval for components is required as per Tab 4.

2.5.2 Onboard integration tests (including wireless network testing) tests are to be witnessed by the Surveyor.

2.5.3 Hardware type approval of a smart system is obtained subject to the successful outcome of the tests as defined in NR467, Pt C, Ch 3, Sec 6, [2], where the type approval is required as per Tab 4.

Table 4 : Applicability of the requirement to provide the type approved components to each notation

SMART function or SMART group	Pre-requisite notations described in NR467	Type Approved components are required	
		Hardware	Software
H	**LI-S3** or **LI-S4** or **LI-HG-S3** or **LI-HG-S4**	No	No
	MON-HULL	Yes	No
M	**ULEV**	No	No
	AUT-IMS	Yes	Yes
	CLEANSHIP-CEMS	Yes	Yes
	CLEANSHIP SUPER( )-CEMS	Yes	Yes
	CBM	Yes	Yes
	ELECTRIC HYBRID()	Yes	Yes
N	**DYNAPOS**	Yes	Yes
	SYS-IBS	Yes	Yes
MH	–	No	No
EnE completed by **-CII**	**CII-REALTIME**	No	Yes
EnE completed by: **-Em**, **-T**, **-LIT**, **-S** or **-W**	–	No	Yes
L	–	No	Yes
X	–	No	No
Smart group **2**	**DATA-INFRA** or **DATA-INFRA-STAND**	Yes	Yes
	ASYNC-COM or **ASYNC-COM-R**	Yes	No
	SYNC-COM or **SYNC-COM-R**	Yes	No
Smart group **3**	–	No	Yes

2.6   Shore Digital Solution (SDS)

2.6.1 In addition to [2.1], additional documents required for notations of smart group **3** are listed in Tab 5.

2.6.2 If a SDS (Shore Digital Solution) is provided for the smart function, the SDS is to comply with the visualisation and reporting requirements of the corresponding ODS (Onboard Digital Solution).

2.6.3 For Category I Computer Based Systems defined in NR467, Pt C, Ch 3, Sec 3, the digital user interface may be available in SDS only.

Note 1: For example, the digital user interface of the SDS may be sufficient for the notations **SMART(MH3)** and **SMART(EnE3)**.

2.6.4 If a SDS requires a regular input from an expert on shore, other than the intended user of the smart function, the service supplier providing the expert-in-the-loop services is to be certified as an approved smart service supplier as per the Rule Note NR533 "Approval of service suppliers". The regular input does not include the provision of the software updates.

2.6.5 The software of the SDS is to be type approved in accordance with the Society's type approval scheme described in the Rule Note NR320 "Certification scheme of materials and equipment for the classification of marine units".

2.6.6 During an initial test witnessed by a Surveyor, the user manual is to be provided and the SDS is to be operated by a representative of the Shipowner to demonstrate

• transfer of data between the ODS and the SDS, checking the results in the interface of SDS

• visualisation and reporting features as per [2.6.2].

Table 5 : Additional documents to be submitted for notations of smart group 3

No.	A/I **(1)**	Description
1	I	List of the decision support functions provided by SDS on shore
2	I	Software Type Approval Certificate of the SDS
3	I	Description of the SDS with functional diagrams, data flow, process description, location of the hosting servers
4	I	Description of the communication between the ODS and the SDS including the data transfer procedures
5	I	Table listing the types of user accounts with corresponding access rights
6	A	Templates of dashboards and reports generated by SDS
7	I	List of alerts and notifications generated for onboard and shore users
8	I	Service agreement between the Applicant and the approved smart service supplier for the provision of services required for the functioning of SDS, if applicable
(1)	A = to be submitted for approval; I = to be submitted for information	

Section 2   Hull SMART Functions

1   Notations Hx

1.1   Additional documentation to be submitted

1.1.1 In addition to Sec 1, [2.1] and to the documents to be submitted for the assignment of the notations as mentioned in [1.2.1] and [1.3.1], additional documents required for the additional class notations of this Section are listed in Tab 1.

Table 1 : Additional documents to be submitted for notations SMART(Hx)

No.	A/I **(1)**	Description
1	A	List of components of the monitoring system, including sensors, as applicable a) for hull strains and acceleration, or b) for the draught and loading status
(1)		A = to be submitted for approval; I = to be submitted for information

1.2   Class notation SMART(H1)

1.2.1 The additional class notation **SMART(H1)** may be assigned when the ship complies with the requirements for granting at least one of the following notations defined in NR467:

a) hull smart functions dedicated to operation:
   LI-S3, **LI-S4**, **LI-HG-S3** or **LI-HG-S4**

b) hull smart functions dedicated to hull maintenance:
   MON-HULL

1.3   Class notation SMART(H2)

1.3.1 The additional class notation **SMART(H2)** may be assigned when, in addition to the requirements defined in [1.2] and Sec 1, [2] for the additional class notation **SMART(H1)**, the smart system uses data infrastructure, ship-shore data communication capabilities, and the ship complies with:

a) The requirements for assigning one of the following additional class notations: **CYBER MANAGED**, **CYBER RESILIENT** or **CYBER SECURE**. As an alternative to the assignment of these additional class notations, the demonstration of the compliance with the requirements of IMO.MSC.428(98) "Maritime cyber risk management in safety management systems" may be accepted.

b) The requirements for assigning one of the following additional class notations: **DATA-INFRA** or **DATA-INFRA-STAND** for data infrastructure as per NR467.

c) The requirements for assigning one of the following additional class notations: **ASYNC-COM** or **ASYNC-COM-R** or **SYNC-COM** or **SYNC-COM-R** for ship-shore communication as per NR467.

1.4   Class notation SMART(H3)

1.4.1 The additional class notation **SMART(H3)** may be assigned when, in addition to the requirements defined in [1.2] and Sec 1, [2] for the additional class notation **SMART(H1)**, the smart system uses SDS compliant with the requirements of Sec 1, [2.6].

Section 3   Machinery SMART Functions

1   Notations Mx

1.1   Additional documentation to be submitted

1.1.1 In addition to Sec 1, [2.1] and to the documents to be submitted for the assignment of the notations as mentioned in [1.2.1] and [1.3.1], the documents required for the additional class notation **SMART(Mx)** are listed in Tab 1.

Table 1 : Additional documents to be submitted for notations SMART(Mx)

No.	A/I **(1)**	Description
1	I	Approval certificate of the Computerised Maintenance Management System (CMMS), when applicable
2	A	List of machinery items surveyed under a Condition Based Maintenance scheme, when applicable
(1)		A = to be submitted for approval; I = to be submitted for information

1.2   Class notation SMART(M1)

1.2.1 The additional class notation **SMART(M1)** may be assigned when the ship complies with the requirements for assigning at least one of the following notations defined in NR467:

a) machinery smart functions dedicated to operation:

   AUT-IMS

   or

   ULEV in the case of electronically controlled engines

   or

   CLEANSHIP-CEMS or **CLEANSHIP SUPER()-CEMS**

b) machinery smart functions dedicated to machinery maintenance:

   MON-SHAFT and **CBM**

c) machinery smart functions dedicated to energy storage systems (ESS):

   ELECTRIC HYBRID()

1.2.2 For ships for which the additional service feature **CBM** is assigned, the following additional requirements are to be complied with:

a) the Computerised Maintenance Management System (CMMS) used to program and maintain the Planned Maintenance System (PMS) is to be approved by the Society in accordance with the requirements of the Rule Note NR496 "Approval of Computerized Maintenance Management Systems used on board Ships".

1.2.3 For ships for which the additional class notations **ELECTRIC HYBRID()** are assigned, the following additional requirements are to be complied with:

a) smart system is to include a digital user interface for monitoring at least 1 year of the operational data for the ESS including state of charge (SOC), state of health (SOH) and cell health status;

b) smart system is to provide recommendations for optimising the use of the ESS to meet the target battery lifetime.

1.3   Class notation SMART(M2)

1.3.1 The additional class notation **SMART(M2)** may be assigned when, in addition to the requirements defined in Sec 1, [2] and [1.2] for the additional class notation **SMART(M1)**, the smart system uses data infrastructure, ship-shore data communication capabilities and the ship complies with:

a) The requirements for assigning one of the following additional class notations: **CYBER MANAGED**, **CYBER RESILIENT** or **CYBER SECURE**. As an alternative to the assignment of these additional class notations, the demonstration of the compliance with the requirements of IMO.MSC.428(98) "Maritime cyber risk management in safety management systems" may be accepted.

b) The requirements for assigning one of the following additional class notations: **DATA-INFRA** or **DATA-INFRA-STAND** for data infrastructure as per NR467.

c) The requirements for assigning one of the following additional class notations: **ASYNC-COM** or **ASYNC-COM-R** or **SYNC-COM** or **SYNC-COM-R** for ship-shore communication as per NR467.

1.4 Class notation SMART(M3)

1.4.1 The additional class notation **SMART(M3)** may be assigned when, in addition to the requirements defined in [1.2] and Sec 1, [2] for the additional class notation **SMART(M1)**, the smart system uses SDS compliant with the requirements of Sec 1, [2.6].

2 Notations MHx

2.1 Additional documentation to be submitted

2.1.1 In addition to Sec 1, [2.1] and to the documents to be submitted for the assignment of the notations as mentioned in [2.6], additional documents required for the additional class notation **SMART(MHx)** are listed in Tab 2.

Table 2 : Additional documents to be submitted for notations SMART(MHx)

No.	A/I **(1)**	Description
1	I	Diagrams and functional schemes describing the equipment covered by the smart system
2	I	Description of the machinery health monitoring functionality with the principles of the algorithm and data manipulation
3	I	Description of the measured parameters including: a) characteristics of time series including the source equipment ID, value ranges, units of measurement b) ID, characteristics and location of sensors, if any, or other means of permanent data acquisition
4	I	Description of alarm and event data, if received by the smart system from the machinery, including: a) typical message format b) message text template c) description of the triggering conditions d) priority, limits, deadband
(1)	A = to be submitted for approval; I = to be submitted for information	

2.2 Class notation SMART(MH1)

2.2.1 The additional class notation **SMART(MH1)** may be assigned when the ship is fitted with a smart system that provides monitoring of the state of health and operating conditions of machines and onboard systems in compliance with the requirements in [2.4], [2.5] and Sec 1, [2].

2.2.2 The list of equipment to be considered in the scope of the additional class notation **SMART(MH1)**, with the list of the corresponding parameters monitored by the smart system are to be specified by the Applicant in the documents submitted as described in Tab 2.

2.2.3 The assessment for granting the additional class notation **SMART(MH1)** is to be considered as separate from the assessment for granting the additional service feature **CBM**. The output and functionalities covered by the additional class notation **SMART(MH1)** is not to be used to influence the scope and/or frequency of in-service surveys.

2.3 Definitions

2.3.1 The following definitions are used in the present Article:

- Failure: termination of the ability of an item to perform a required function.

- Parameter: a characteristic value describing a state of a system.

- Descriptor: data item derived from raw or processed parameters or from event records.

- Baseline data: descriptor or group of descriptors which provide a criterion of the normal behavior of equipment under various process states.

2.4 Required functionalities

2.4.1 The smart system is to provide a digital user interface for the management of:

a) descriptors including a visualisation of historical trends

b) baseline data.

2.4.2 The digital user interface is to provide dashboards for equipment health parameters presented with:

a) measured or calculated values

b) baseline value ranges

c) safe operational ranges

d) distinctive colour coding for values within and exceeding the relevant ranges.

2.4.3 The smart system is to generate condition reports. The condition report is to include:

• a summary of the equipment status;

• results of anomaly detection or diagnostics in the sense of ISO 13372:2012 Condition monitoring and diagnostics of machines - Vocabulary

• running hours (if available).

2.4.4 Means of testing the health monitoring functionality are to be provided, such as a software test mode with a simulated introduction of incipient failures. Such simulations are to be related to the results pre-calculated by the manufacturer of the smart system as a test case. The test is to result in an alert generated within the digital user interface.

Note 1: The test cases should focus on the early detectable degradation, i.e. the manifestations occurring within the first 25% of the mean time span between the potentially detectable fault and the functional failure of the equipment as per the recommendations from the OEM (Original Equipment Manufacturer).

2.4.5 The smart system is to generate alerts based on the data where the equipment is running outside of the safe operational limits.

2.4.6 The raw data time series, alarm and event records from equipment are to be stored for a minimum period of 30 days.

2.4.7 The time series derived from the raw data and event records produced by the smart system are to be automatically recorded and stored for at least 5 years. The storage may be on board or on shore if the onshore storage is accessible for the smart system on board.

2.5   Onboard testing

2.5.1 During the onboard test witnessed by a Surveyor, the user manual is to be provided and the smart system is to be operated to:

a) generate a list of time series with uptime history metrics, identification of the source equipment, status of the sensors calibration, if the calibration is required by the manufacturer of the sensor or of the smart system

b) generate a report providing statistics of equipment alarms received by the smart system, if any

c) generate a condition report for the list of equipment considered in the scope of the notation

d) generate a condition report in a test mode with a simulated introduction of incipient failures and compare the results to the corresponding test case

e) compare the consistency of parameter trends with the recent operation of the equipment by demonstrating alarm-based descriptors and baseline data acquired during the equipment commission tests.

2.6   Class notation SMART(MH2)

2.6.1 The additional class notation **SMART(MH2)** may be assigned when, in addition to the requirements defined in [2.2], [2.3], [2.4], [2.5] and Sec 1, [2] for the additional class notation **SMART(MH1)**, the smart system uses data infrastructure, ship-shore data communication capabilities, and the ship complies with:

a) The requirements for assigning one of the following additional class notations: **CYBER MANAGED**, **CYBER RESILIENT** or **CYBER SECURE**. As an alternative to the assignment of these additional class notations, the demonstration of the compliance with the requirements of IMO.MSC.428(98) "Maritime cyber risk management in safety management systems" may be accepted.

b) The requirements for assigning one of the following additional class notations: **DATA-INFRA** or **DATA-INFRA-STAND** for data infrastructure as per NR467.

c) The requirements for assigning one of the following additional class notations: **ASYNC-COM** or **ASYNC-COM-R** or **SYNC-COM** or **SYNC-COM-R** for ship-shore communication as per NR467.

2.7   Class notation SMART(MH3)

2.7.1 The additional class notation **SMART(MH3)** may be assigned when, in addition to the requirements defined in [1.2] and Sec 1, [2] for the additional class notation **SMART(MH1)**, the smart system uses SDS compliant with the requirements of Sec 1, [2.6].

Section 4   Navigation SMART Functions

1   Notations Nx

1.1   Additional documentation to be submitted

1.1.1 In addition to Sec 1, [2.1] and to the documents to be submitted for the assignment of the notations as mentioned in [1.2.1] and [1.3.1], additional documents required for the additional class notations of this Section are listed in Tab 1.

Table 1 : Additional documents to be submitted for notations SMART(Nx)

N°	A/I **(1)**	Description
1	A	Description of the Integrated Navigation System, when applicable
(1)	A = to be submitted for approval; I = to be submitted for information	

1.2   Class notation SMART(N1)

1.2.1 The additional class notation **SMART(N1)** may be assigned when the ship complies with the requirements for assigning at least one of the following notations defined in NR467:

a) **DYNAPOS** (DP Class 1, 2 or 3)

b) **SYS-IBS**

    and

    the ship is equipped with an Integrated Navigation System (INS) in accordance with the requirements of IMO.MSC.252(83) "Adoption of the revised performance standards for Integrated Navigation Systems (INS)".

1.3   Class notation SMART(N2)

1.3.1 The additional class notation **SMART(N2)** may be assigned when, in addition to the requirements defined in [1.2] and Sec 1, [2] for the additional class notation **SMART(N1)**, the smart system uses data infrastructure, ship-shore data communication capabilities and the ship complies with:

a) The requirements for assigning one of the following additional class notations: **CYBER MANAGED**, **CYBER RESILIENT** or **CYBER SECURE**. As an alternative to the assignment of these additional class notations, the demonstration of the compliance with the requirements of IMO.MSC.428(98) "Maritime cyber risk management in safety management systems" may be accepted.

b) The requirements for assigning one of the following additional class notations: **DATA-INFRA** or **DATA-INFRA-STAND** for data infrastructure as per NR467.

c) The requirements for assigning one of the following additional class notations: **ASYNC-COM** or **ASYNC-COM-R** or **SYNC-COM** or **SYNC-COM-R** for ship-shore communication as per NR467.

1.4   Class notation SMART(N3)

1.4.1 The additional class notation **SMART(N3)** may be assigned when, in addition to the requirements defined in [1.2] and Sec 1, [2] for the additional class notation **SMART(N1)**, the smart system uses SDS compliant with the requirements of Sec 1, [2.6].

Section 5   Energy Efficiency SMART Functions

1   Documentation

1.1   Additional documentation to be submitted

1.1.1 In addition to Sec 1, [2.1] and to the documents to be submitted for the assignment of the notations as mentioned in [8] and [9.1.1], additional documents required for the additional class notation **SMART(EnEx)** and for the complementary notations **-Em**, **-T**, **-LIT**, **-S**, **-W** and **-CII** are listed in Tab 1.

2   Class notation SMART(EnE1)

2.1   Application

2.1.1 The additional class notation **SMART(EnE1)** may be assigned when the ship is equipped with a smart system that provides monitoring of energy consumption and emissions in relation to the operating conditions of the ship and to the geographical area. The relevant data acquisition and reporting may include, but is not limited to, the operational status of the ship and its onboard consumers. The smart system is to comply with the requirements of this Section and Sec 1, [2].

2.2   Data inputs

2.2.1 Means of monitoring and recording the following data are to be available on board with inputs to the smart system:

a) Operational parameters of the active propulsion directly impacting the forces applied on the hull, e.g. pitch, rpm, rudder angle

b) Propulsion power

c) Engine speed and shaft torque

d) Fuel intakes for engines, oil-fired boilers

e) State of charge of Energy Storage Systems (ESS), if fitted.

2.2.2 Means of monitoring and recording the following navigation related data are to be available on board with inputs to the smart system:

a) Ship's geographic position

b) Speed Over The Ground

c) Speed Through the Water

d) Wind direction and speed

e) Underkeel clearance from echo sounder

f) Ship's heading.

2.2.3 Where the inputs listed in [2.2.1] and [2.2.2] are not automatic, a manual entry interface may be accepted at the discretion of the Society, e.g. electronic log entries.

2.2.4 Where wind propulsion systems, as described in NR206, or other energy saving systems are available, means of monitoring and recording the available effective power delivered by the specified system are to be provided on board with inputs to the smart system.

Note 1: NR206 refers to the Rules for the Wind Propulsion Systems.

2.2.5 Where a shore power supply is intended to be regularly used to sustain operations, means of monitoring and recording the power consumed from the shore grid are to be available on board with inputs to the smart system.

2.2.6 Means of monitoring and recording the electric current per group of non-essential consumers are to be available on board with inputs to the smart system, if all the items below are applicable:

a) Electrical load balance tables indicate at least one set of non-essential consumers

b) The sets of consumers are defined by the grouping in the electrical distribution system to distinct switchboard elements, and more than a single group can be identified

c) The total maximum electrical load from the non-essential consumer(s) is above 30% of the total power plant output.

Table 1 : Additional documents to be submitted for notations SMART(EnEx)

Notation	No.	A/I (1)	Description
SMART(EnEx)	1	I	For the measured parameters the following information is to be provided: a) characteristics of time series including the source equipment ID, value ranges, units of measurement b) ID, characteristics and location of sensors, if any
	2	I	Templates of reports generated as in [2.4.1] a, b and c in consistency with SEEMP and Engine International air pollution prevention Certificate (EIAPP)
	3	I	Power balance taking into account the achievable configurations for energy production and distribution
SMART(EnEx-Em)	4	I	Templates of reports generated as in [3.2.1]
	5	I	Description of the methods used for calculating the emissions
SMART(EnEx-T)	6	I	Pre-calculated report with the tabulated data for the trim related propulsion power demands is to be provided. The trim and draughts are to cover the loading conditions as given in the loading manual and the operational range in ballast and laden voyage loading conditions
SMART(EnEx-LIT)	7	I	Pre-calculated report containing optimized stowage plan for all loading conditions listed in the loading manual
	8	I	If the smart system automatically transfers the optimized stowage plan to the ship's Loading Instrument (LI) a) Description of the interaction between the LI and the smart system: data exchange protocols, direction of the data flow, regularity of the communication when an optimized stowage plan is produced and transferred to the LI. The information can be provided as a part of the software and hardware module descriptions required in Sec 1, [2.1] b) Extract from the risk assessment of cyber security performed in compliance with IMO.MSC.428(98), and being part of ISM Code certification, or from the risk assessment for additional cyber security class notation defined in NR467, as applicable. The extract is to cover the risks and mitigations pertaining to the connectivity between the LI and the smart system
SMART(EnEx-S)	9	I	If the smart system automatically transfers the route plan to the ship's Electronic Chart Display and Information System (ECDIS): a) Description of the interaction between the ECDIS and the smart system: data exchange protocols, direction of the data flow, regularity of the communication when a route plan is produced and transferred to the ECDIS. The information can be provided as a part of the software and hardware module descriptions required in Sec 1, [2.1] b) Extract from the risk assessment of cyber security performed in compliance with IMO.MSC.428(98), and being part of ISM Code certification, or from the risk assessment for additional cyber security class notation defined in NR467, as applicable. The extract is to cover the risks and mitigations pertaining to the connectivity between the ECDIS and the smart system
SMART(EnEx-W)	10	I	Procedure for managing the weather routing information on board
	11	I	If the smart system automatically transfers the route plan to the ship's ECDIS: a) Description of the interaction between the ECDIS, the smart system and the means of receiving the meteorological information: data exchange protocols, direction of the data flow, regularity of the communication when a route plan is produced and transferred to the ECDIS. The information can be provided as a part of the software and hardware module descriptions required in Sec 1, [2.1] b) Extract from the risk assessment of cyber security performed in compliance with IMO.MSC.428(98), and being part of ISM Code certification, or from the risk assessment for additional cyber security class notation defined in NR467, as applicable. The extract is to cover the risks and mitigations pertaining to the connectivity between the ECDIS, the smart system and the means of receiving the meteorological information
SMART(EnEx-CII)	12	I	List of manual data entries in the interface of the CII ODS
	13	A	Description of the methods used for calculating the Continuous CII and models used to estimate the fuel consumption based on the automatic inputs
	14	I	Description of the CII ODS and CII SDS architectures with functional diagrams, data flow, process description, location of the hosting servers in regard of the automatic data acquisition
	15	I	List of alerts generated for onboard and shore users based on the automatic inputs
(1) A = to be submitted for approval; I = to be submitted for information			

2.3 Calculated parameters

2.3.1 The smart system is to calculate and record the following information:

a) CO2 emissions

b) Hull resistance

c) Ship's draught

d) Operational status of the ship (ocean transit, moored, manoeuvring, etc.)

e) Equipment operational status, e.g. running, stopped

f) Fuel consumption based on the manufacturer's design information, e.g. Specific Fuel Oil Consumption, if applicable

g) Steam consumption in heaters, evaporators, accommodation heating, based on heat transfer equations

h) Energy transfer within waste heat recovery systems, if fitted, based on heat transfer equations

i) Active power per group of consumers.

2.4 Required functionalities

2.4.1 The smart system is to present functionalities for database management, continuous analytical processing, visualisation and reporting to generate:

a) Reports of the Energy Efficiency Operational Indicator (EEOI) and Carbon Intensity Indicator (CII), as applicable according to the Ship Energy Efficiency Management Plan (SEEMP) as estimated for voyages, regular intervals and user defined periods

b) Estimated performance profiles for the ship for typical and representative ship's operating configurations based on the collected data

c) Recommended performance profiles for the ship based on typical operating configurations

d) Alerts for exceeding selected performance ranges for energy consumption

e) Simulations of energy consumption for the ship based on typical operating configurations.

2.4.2 The raw data time series are to be stored for a period of at least 30 days.

2.4.3 The time series derived from the raw data are to be automatically recorded and stored for at least 5 years. The storage may be on board or on shore if the onshore storage is accessible for the smart system on board.

2.5 Onboard testing

2.5.1 During the onboard test witnessed by a Surveyor, the smart system is to be operated to:

a) generate reports as in [2.4.1] items a), b) and c) in consistency with SEEMP, Power Balance report and EIAPP certificates

b) generate a list of time series with uptime history metrics, identification of the source equipment, status of the sensors calibration, if the calibration is required by the manufacturer of the sensor or of the smart system

c) generate recommended performance profile for realistic conditions, e.g. a laden voyage typical for the ship's trade

d) simulate energy consumption for the typical operational configurations, including at least an ocean passage and a loading or unloading activity in port.

3 Additional requirements for notation -Em

3.1 Application

3.1.1 The additional class notation **SMART(EnE1)** may be complemented by the notation **-Em** when, in addition to compliance with the requirements given in [2] the ship is fitted with a smart system that provides an estimation of the emissions.

3.1.2 The smart system is to evaluate and record the following information:

a) SO_x emissions

b) NO_x emissions

c) Greenhouse gas (GHG) emissions, including CO_2, CH_4 and N_2O, or carbon dioxide equivalent CO_2e

d) Georeferenced emission performance with respect to the Emission Control Areas (ECAs).

3.2 Required functionalities

3.2.1 The smart system is to present functionalities for database management, continuous analytical processing, visualisation and reporting to generate:

a) Reports with performance indicators for GHG, SO_x and NO_x emissions related to the geographic area of operation

b) Estimated emission profiles for the ship for typical and representative ship's operating configurations based on the collected data

c) Recommended emission profiles for the ship based on typical operating configurations

d) Alerts for exceeding selected performance ranges for emissions

e) Simulations of emissions for groups of consumers based on typical operating configurations, if the corresponding inputs are available as per [2.2.6].

3.3 Onboard testing

3.3.1 During the onboard test witnessed by a Surveyor, the user manual is to be provided and the smart system is to be operated to:

a) generate reports as in [3.2.1] in consistency with the characteristics of the fuel on board or intended for the next voyage

b) generate recommended emission profile for realistic conditions, e.g. a laden voyage typical for the ship's trade

c) simulate emissions for the typical operational configurations and conditions, including at least an ocean passage and a loading or unloading activity in port.

4 Additional requirements for notation -T

4.1 Application

4.1.1 The additional class notation **SMART(EnE1)** may be complemented by the notation **-T** when, in addition to the compliance with the requirements given in [2] the ship is fitted with a smart system that provides a decision support for trim optimization by graphically plotting the recommended trim for a selected displacement and a voyage speed.

4.2 Required functionalities

4.2.1 The smart system is to display draught and trim combinations corresponding to energy consumption and propulsion power demand. The graphic presentation is to unambiguously demonstrate the change in the corresponding energy efficiency for a trim variation.

4.3 Onboard testing

4.3.1 During the onboard test witnessed by a Surveyor, the smart system is to be operated to:

a) calculate the energy consumption relevant to the ship's actual loading condition in transit

b) compare for consistency the estimated power demand and the relevant data in the report defined in Tab 1 for **SMART(EnEx-T)**.

5 Additional requirements for notation -LIT

5.1 Application

5.1.1 The additional class notation **SMART(EnE1)** may be complemented by the notation **-LIT** when, in addition to the compliance with the requirements given in [2] and [4], the ship is fitted with a smart system that provides a decision support for trim optimization by generating a stowage plan for intact stability.

5.2 Required functionalities

5.2.1 The ship is to be equipped with a Loading Instrument (LI) which is to be approved by the Society for hull girder and intact stability calculations.

5.2.2 The smart system is to generate a stowage plan, which is optimized for energy efficiency on the pre-calculated set of the draught and trim combinations.

5.2.3 The optimized stowage plan is only to result in loading conditions that meet intact stability and hull girder criteria applicable to the ship concerned.

5.2.4 If the smart system automatically transfers the optimized stowage plan to the ship's LI, the proposed stowage plan is to be subject to an automatic check by the algorithms based on the LI intact stability and hull girder criteria. The output of the automatic check is to be provided to the crew for a manual acknowledgement.

5.3 Onboard testing

5.3.1 During the onboard test witnessed by a Surveyor in addition to the scope of the tests described in [4.3.1], the smart system is to be operated to generate an optimized stowage plan for one of the loading conditions given in the loading manual. The optimized stowage plan is to comply with the stability and hull girder criteria.

6 Additional requirements for notation -S

6.1 Application

6.1.1 The additional class notation **SMART(EnE1)** may be complemented by the notation **-S** when, in addition to compliance with the requirements given in [2] the ship is fitted with a smart system that provides a decision support for voyage plan optimization including a recommended speed profile.

6.2 Required functionalities

6.2.1 The smart system is to be able to use Electronic Navigational Charts (ENCs), Emission Control Area (ECA) positions, sea current and tidal predictions, fuel type and navigational route information.

6.2.2 During the route planning, the smart system is to be able to calculate optimal speed profiles for the minimum energy consumption and for the minimum greenhouse gas (GHG) emissions. The smart system is to provide a waypoint optimization with route and schedule alternatives.

6.2.3 During the route execution, the smart system is to provide a decision support with a recommended speed setpoint, energy consumption and emission status.

6.2.4 If the smart system automatically transfers the optimised route to the ship's Electronic Chart Display and Information System (ECDIS), the proposed route is to be subject to an automatic check by the algorithms based on the ECDIS safety contour. The output of the automatic check is to be provided to the crew for a manual acknowledgement.

6.3 Onboard testing

6.3.1 During the onboard test witnessed by the Surveyor, the smart system is to be operated to generate a voyage plan report which includes the speed profiles, energy consumption and GHG emissions. A new voyage plan for an ocean transit is to be generated and optimized for the energy efficiency.

6.3.2 If the smart system automatically transfers the route to the ship's ECDIS, the Surveyor is to witness a functional test for the automatic display of the optimized voyage plan in ECDIS in both planning mode and voyage execution mode. The test is to include an examination of the safety contour alerts produced by the ECDIS in relation to the route.

7 Additional requirements for notation -W

7.1 Application

7.1.1 The additional class notation **SMART(EnE1)** may be complemented by the notation **-W** when, in addition to compliance with the requirements given in [2] the ship is fitted with a smart system providing a decision support for voyage plan optimization based on the meteorological information, i.e. weather routing.

7.2 Required functionalities

7.2.1 The smart system is to be able to use Electronic Navigation Charts (ENCs), electronic surface weather analysis reports and navigational route information.

7.2.2 The smart system is to provide a digital user interface with an overlay of the surface weather analysis charts on the plotted voyage plan as selected from the routing alternatives calculated by the smart system.

7.2.3 A weather routing function is to alert the user in the event of meteorological dangers to navigation requiring an alteration of the initial voyage plan, e.g. tropical storm.

7.2.4 The surface weather analysis reports relevant for the areas where the routes are plotted are to be stored for 1 year.

7.2.5 If the smart system automatically transfers the route to the ship's Electronic Chart Display and Information System (ECDIS), the proposed route is to be subject to an automatic check by the algorithms based on the ECDIS safety contour. The output of the automatic check is to be provided to the crew for a manual acknowledgement.

7.3 Onboard testing

7.3.1 During the onboard test witnessed by a Surveyor, the smart system is to be operated to

a) Generate a report for an optimized voyage plan which takes into account the meteorological conditions. The report is to provide a new voyage plan for an ocean transit. The relevant information from the surface weather analysis is to be incorporated in the report.

b) Import and display the latest surface weather analysis chart information for the local area.

7.3.2 If the smart system automatically transfers the route to the ship's ECDIS, the Surveyor is to witness a functional test for the automatic display of the optimized voyage plan in ECDIS in both planning mode and voyage execution mode. The test is to include an examination of the safety contour alerts produced by the ECDIS in relation to the route.

8 Additional requirements for notation -CII

8.1 Definitions

8.1.1 The following definitions are used in the present article:

- Carbon Intensity Indicator (CII): a ship's performance indicator by which it is possible to measure the carbon intensity of the ship for a calendar year, as defined in the IMO Guidelines on operational carbon intensity indicators and the calculation methods (CII Guidelines, G1).

- Continuous CII: a ship's carbon intensity indicator which is calculated for a period of time between the commencement of a calendar year and the exact time defined by the system or the operator. Continuous CII is based on available IMO DCS data without extrapolation.

- CII Onboard Digital Solution (CII ODS): an onboard computer based system performing on board the collection of data necessary for the calculation of the Continuous CII. CII ODS is to be available for the onboard users to monitor regularly the Continuous CII and to obtain a relevant decision-support.

- CII Shore Digital Solution (CII SDS): a shore digital solution available for the shore users to monitor regularly the Continuous CII and to obtain a relevant decision support based on the data received from the CII ODS.

8.2 Application

8.2.1 The additional class notation **SMART(EnE1)** may be complemented by the notation **-CII** when, in addition to the compliance with the requirements given in [2]:

a) requirements for granting the additional class notation **CII-REALTIME** as per NR467

b) CII ODS uses the means of permanent automatic data acquisition as inputs in addition to the manual inputs

c) CII ODS and CII SDS comply with the requirements of [8.3].

8.3 Required functionalities

8.3.1 The CII ODS and CII SDS are to comply with the requirements for granting the additional class notation **CII-REALTIME** as per NR467. In case of a failure of the permanent automatic data acquisition, the smart system is to produce a notification to the operator on board and is to provide as a fall-back at least the functionalities related to the manual inputs described in the requirements for granting the additional class notation **CII-REALTIME**.

8.3.2 The fuel intake sensor data required as per [2.2.1] can be substituted by the inputs from the fuel tank sounding sensors.

8.3.3 Direct CO_2 emission measurement sensors can be used to calculate the CO_2 emissions. If available, the digital interfaces of the CII ODS and CII SDS are to include a comparative trending view of the emissions calculated from the exhaust sensor time series and from other inputs.

8.3.4 Where applicable, the fields for manual entries are to be automatically pre-filled with the values which are calculated from the permanent automatic data acquisition inputs. Such pre-filled entries are to be further modified or digitally signed off "as is" by an onboard user upon verification.

8.3.5 Sensor measurement data and other inputs from the permanent automatic data acquisition are to be sampled and logged at least daily. The sensor measurement data is to be stored for a minimum of 1 year.

8.3.6 The CII ODS and CII SDS are to generate notifications for the discrepancies between the fuel quantities which are estimated from the permanent automatic data acquisition time series and the fuel quantities which are based on the manually reported values.

8.3.7 The digital interfaces of the CII ODS and CII SDS are to include a comparative trending view for the fuel quantities calculated from the permanent automatic data acquisition time series and from the manual input for

a)   the total amount of fuel on board

b)   amount in each tank monitored, if fuel tank sounding sensors are used

c)   amount transferred to a consumer or to a group of consumers, if flowmeters are used.

8.4   Onboard testing

8.4.1   During the onboard test witnessed by a Surveyor, the CII ODS is to be operated to:

a)   check the trending view as described in [8.3.7]

b)   complete other actions as per the testing scope of the additional class notation **CII-REALTIME**.

8.5   Remote testing

8.5.1   During the remote test witnessed by a Surveyor, the CII SDS is to be accessed by means of external Internet connection to:

a)   check the trending view as described in [8.3.7]

b)   complete other actions as per the testing scope of the additional class notation **CII-REALTIME**.

9   Class notation SMART(EnE2)

9.1   Additional requirements

9.1.1   The additional class notation **SMART(EnE2)** may be assigned when, in addition to the requirements defined in [2] and Sec 1, [2] for the additional class notation **SMART(EnE1)**, and Articles [3], [4], [5], [6], [7] and [8], as applicable for the notations **-Em**, **-T**, **-LIT**, **-S**, **-W** and **-CII**, the smart system uses data infrastructure, ship-shore data communication capabilities, and the ship complies with:

a)   The requirements for assigning one of the following additional class notations: **CYBER MANAGED**, **CYBER RESILIENT** or **CYBER SECURE**. As an alternative to the assignment of these additional class notations, the demonstration of the compliance with the requirements of IMO.MSC.428(98) "Maritime cyber risk management in safety management systems" may be accepted.

b)   The requirements for assigning one of the following additional class notations: **DATA-INFRA** or **DATA-INFRA-STAND** for data infrastructure as per NR467.

c)   The requirements for assigning one of the following additional class notations: **ASYNC-COM** or **ASYNC-COM-R** or **SYNC-COM** or **SYNC-COM-R** for ship-shore communication as per NR467.

10   Class notation SMART(EnE3)

10.1   Additional requirements

10.1.1   The additional class notation **SMART(EnE3)** may be assigned when, in addition to the requirements defined in [2] and Sec 1, [2] for the additional class notation **SMART(EnE1)**, and Articles [3], [4], [5], [6], [7] and [8], as applicable for the notations **-Em**, **-T**, **-LIT**, **-S**, **-W** and **-CII**, the smart system uses SDS compliant with the requirements of Sec 1, [2.6].

Section 6   Electronic Logbook SMART Functions

1   Documentation

1.1   Additional documentation to be submitted

1.1.1 In addition to Sec 1, [2.1] and to the documents to be submitted for the assignment of the notations as mentioned in [3.1.1], the documents for assigning the additional class notation **SMART(Lx)** are provided in Tab 1.

Table 1 : Additional documents to be submitted for notations SMART(Lx)

No.	A/I	Description
1	I	Type approval certificate of the smart system with regards to the references listed in [2.1.1]
2	I	List of the relevant inputs including digital and analogue interfaces and manual entries
3	I	List of the outputs including digital user interfaces, application programming interfaces (API) and reports relevant for the onboard process supported by the smart system
4	I	Description of the onboard process supported by the special smart function with a reference to its interfaces and the operational procedures
(1)	A: to be submitted for approval; I: to be submitted for information	

2   Class notation SMART(L1)

2.1   Application

2.1.1 The additional class notation **SMART(L1)** may be assigned to ships equipped with a type approved smart system for electronic record keeping such as:

a)   Computerized Maintenance Management System (CMMS) as per the requirements of the Rule Note NR496 "Approval of Computerized Maintenance Management Systems used on board Ships".

b)   electronic record book as per the resolution MEPC.312(74) under the International Convention for the Prevention of Pollution from Ships (MARPOL)

c)   electronic record book as per the resolution MEPC.372(80) under the International Convention for the Control and Management of Ships' Ballast Water and Sediments (BWM Convention)

d)   electronic logbook as per a set of requirements of ISO 21745:2019 selected by the Applicant

Note 1: Where the smart system is type approved as per a set of the ISO 21745:2019 requirements, the smart system may be used for a variety of electronic record keeping purposes, including, but not limited to, operational noon reports, bridge and engine logbooks. The set of requirements of ISO 21745:2019 selected by the Applicant is to be specified in the type approval certificate.

Note 2: The manual entries may provide the input in the smart system where no measurements can be made automatically.

2.1.2 The additional class notation **SMART(L1)** may be assigned on a case-by-case basis for electronic record keeping systems which are not in the scope of Sec 7, [2.1.1] at the discretion of the Society.

2.2   Onboard testing

2.2.1 During the onboard test witnessed by the Surveyor, the user manual is to be provided and the system is to be operated to:

a)   generate records on board

b)   check the availability of the newly created records in primary and backup storage

c)   confirm the availability of automatic inputs, if any

d)   check that the list of the authorised users on board is consistent with the Role Based Access Control defined in the user manual.

3 Class notation SMART(L2)

3.1   Additional requirements

3.1.1 The additional class notation **SMART(L2)** may be assigned when, in addition to the requirements defined in [2] and Sec 1, [2.1] for the additional class notation **SMART(L1)**, the smart system uses data infrastructure, ship-shore data communication capabilities, and the ship complies with:

a) The requirements for assigning one of the following additional class notations: **CYBER MANAGED**, **CYBER RESILIENT** or **CYBER SECURE**. As an alternative to the assignment of these additional class notations, the demonstration of the compliance with the requirements of IMO.MSC.428(98) "Maritime cyber risk management in safety management systems" may be accepted.

b) The requirements for assigning one of the following additional class notations: **DATA-INFRA** or **DATA-INFRA-STAND** for data infrastructure as per NR467.

c) The requirements for assigning one of the following additional class notations: **ASYNC-COM** or **ASYNC-COM-R** or **SYNC-COM** or **SYNC-COM-R** for ship-shore communication as per NR467.

4 Class notation SMART(L3)

4.1   Additional requirements

4.1.1 The additional class notation **SMART(L3)** may be assigned when, in addition to the requirements defined in [2] and Sec 1, [2.1] for the additional class notation **SMART(L1)**, the smart system uses SDS compliant with the requirements of Sec 1, [2.6].

Section 7   Special SMART Functions

1   Documentation

1.1   Additional documentation to be submitted

1.1.1 In addition to Sec 1, [2.1] and to the documents to be submitted for the assignment of the notations as mentioned in [3.1.1], the documents for assigning the additional class notation **SMART(Xx)** are provided in Tab 1.

Table 1 : Additional documents to be submitted for notations SMART(Xx)

No.	A/I **(1)**	Description
1	I	List of the relevant inputs including digital and analogue interfaces and manual entries
2	I	List of the outputs including digital user interfaces, application programming interfaces (API) and reports relevant for the onboard process supported by the digital solution
3	I	Description of the performance indicators which drive the improvement of the process enhanced with the special smart function
4	A	Description of the onboard process supported by the special smart function with a reference to its interfaces and the operational procedures
(1) A = to be submitted for approval; I = to be submitted for information		

2   Class notation SMART(X1)

2.1   Application

2.1.1 The additional class notation **SMART(X1)** may be assigned to ships equipped with a smart system providing a dedicated smart function other than the ones covered by Sec 2 to Sec 6, and complying with the requirements of this Section.

2.1.2 The additional class notation **SMART(X1)** may be assigned on a case by case basis, subject to the Society agreement and the demonstration by the Applicant that the dedicated smart function is beyond the existing scopes covered by Sec 2 to Sec 6.

2.1.3 The notation **X** is to be replaced by the name of the smart function which is to be covered by the additional class notation **SMART(X1)**, e.g. **SMART(Sloshing 1)**.

2.1.4 The application of the notation **X** is to be limited to Category I systems as described in NR467, Ch 3, Sec 3, [2.3.1].

2.1.5 When granting the additional class notation **SMART(X1)**, a memorandum is to be endorsed in order to record the list of equipment covered and an overview of the dedicated smart function.

2.1.6 The loss of the smart function which is to be covered by the additional class notation **SMART(X1)** is not to lead to dangerous situations for human safety, safety of the ship and/or threat to the environment.

2.2   Data inputs

2.2.1 Monitoring and recording equipment for the relevant time series is to be available on board the ship as inputs to the smart system.

2.3   Onboard testing

2.3.1 During the onboard test witnessed by a Surveyor, the user manual is to be provided and the system is to be operated to:

a) generate a report on data availability with uptime metrics and including identification of the source equipment, according to the list of inputs required in Tab 1

b) status of the sensors calibration, if the calibration is required by the manufacturer of the sensor or of the smart system

c) generate the output consistent with the list defined in Tab 1 including reports, if applicable.

3 Class notation SMART(X2)

3.1 Additional requirements

3.1.1 The additional class notation **SMART(X2)** may be assigned when, in addition to the requirements defined in [2] and Sec 1, [2.1] for the additional class notation **SMART(X1)**, the smart system uses data infrastructure, ship-shore data communication capabilities, and the ship complies with:

a) The requirements for assigning one of the following additional class notations: **CYBER MANAGED**, **CYBER RESILIENT** or **CYBER SECURE**. As an alternative to the assignment of these additional class notations, the demonstration of the compliance with the requirements of IMO.MSC.428(98) "Maritime cyber risk management in safety management systems" may be accepted.

b) The requirements for assigning one of the following additional class notations: **DATA-INFRA** or **DATA-INFRA-STAND** for data infrastructure as per NR467.

c) The requirements for assigning one of the following additional class notations: **ASYNC-COM** or **ASYNC-COM-R** or **SYNC-COM** or **SYNC-COM-R** for ship-shore communication as per NR467.

4 Class notation SMART(X3)

4.1 Additional requirements

4.1.1 The additional class notation **SMART(X3)** may be assigned when, in addition to the requirements defined in [2] and Sec 1, [2.1] for the additional class notation **SMART(X1)**, the smart system uses SDS compliant with the requirements of Sec 1, [2.6].

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