June 2021

ClassNK

Guidelines for Hull Monitoring

[English]

Introduction

With the recent improvement of sensing technology, development of communication between ships and shore, and development of technology for big data analysis, efforts to utilize hull monitoring, which is intended to contribute to improving the safety of ships, have been made.

For requirements for hull monitoring, the **Rules for Hull Monitoring Systems**, which was established by ClassNK in 2002, summarized technical requirements that are based on the latest technology of the time for systems that help captain and crew members to make judgment by displaying a hull response obtained from sensors installed on the ship as specific numerical values. However, those systems subject to the rules had limited functions, and therefore, the rules did not necessarily address the latest technologies or the industry's needs.

In the meantime, as its latest effort, ClassNK has commenced "Innovation Endorsement" which is a certification service for innovations that, for example, utilize digital technology, with the aims of conserving the maritime environment, further improving the safety of ships, and supporting sustainable development as raised in the SDGs. As part of this "Innovation Endorsement" ClassNK has published **Guidelines for Digital Smart Ships** and decided to affix a class notation indicating that a ship is provided with digital technology (Digital Smart Ship), such as monitoring, automated operation and so on.

Hence, the Guidelines comprehensively summarize the requirements to be met to achieve functions contributing to improving the safety of the hull structure, while utilizing the hull monitoring, in the light of the trends of latest technologies and the needs of the industry.

The Guidelines consist of a Main Section, Appendix A and Appendix B. The main section stipulates the requirements for individual devices constituting a hull monitoring and for the entire system as well as the procedure of Surveys. Appendix A summarizes the function for evaluating the fatigue strength on the assumption of utilizing it for maintaining and managing the ships, while Appendix B summarizes the function for utilizing measurement data on the assumption of assisting ship operation in the rough condition. Appendixes will be further reviewed at future date to incorporate the growth of technology and the needs of the industry.

ClassNK hopes that this Guidelines will be a positive contribution to current efforts being undertaken worldwide by the maritime industry not only for improving current ship operations but also for furthering the development of innovative technologies.

June 2021
Nippon Kaiji Kyokai(ClassNK)

Contents

Main Section

Guidelines for Hull Monitoring

1. General

1.1 Purpose

-1. This “Guidelines for Hull Monitoring” (hereafter referred to as “the Guidelines”) stipulate the requirements that the hull monitoring system is to satisfy to achieve the intended purpose.
-2. The purpose of the hull monitoring system that the Guidelines assume consists of those intended to contribute to the safety of ships, such as providing support for ship maintenance and management for the hull structure and providing support for ship operation.
-3. The hull monitoring system stipulated in the Guidelines is intended for onboard users such as the captain and crews, hull monitoring system developers, and onshore users who operate the system.
-4. The information provided by such a hull monitoring system is not to be a substitute for the judgment and the responsibility of captain.
-5. Other than the requirements stipulated in the Guidelines, those requirements specified under the related Rules for the Survey and Construction of Steel Ships, international conventions and regulations for the country of ship registration are to be satisfied.

1.2 Application

The Guidelines are applicable to ships that are registered in Nippon Kaiji Kyokai (hereafter referred to as “the Society”), and are equipped with a hull monitoring system, and for which an application for affixing a class notation indicating that the ship is equipped with a hull monitoring system to its classification character has been made.

1.3 Functional Requirements for Hull Monitoring System

-1. Collect necessary information on the hull structure through a means such as monitoring, conduct quantitative analysis based on the collected information, and provide useful information that would contribute to the safety of the ship according to the purpose of the system to the users.
-2. For the functional requirements for providing useful information, those requirements in Appendixes are to be referenced for any purpose in addition to the provisions in the Main Section.

1.4 Class Notations

For ships equipped with a hull monitoring system, a class notation is to be affixed to the classification characters of the ships according to Appendixes A and B.

1.5 Termination of Class Notation

The Society will delete relevant class notation in cases where a smart system in accordance with the Guidelines is not properly maintained. Compliance with the requirements of the Guidelines, however, is optional and not a condition of class maintenance.

1.6 Teams and Definitions

- Hull monitoring system

  This system is intended to collect information through hull monitoring, perform condition monitoring and condition evaluation as specified in the Appendixes. The condition evaluation is to be included onshore ex-post evaluation in addition to onboard evaluation.

2. Requirements for the Hull Monitoring System

2.1 Requirements for the System

2.1.1 General

-1. The functional requirements for the hull monitoring system as stipulated in **1.3** are to be satisfied.
-2. All sensors and components of a hull monitoring system intended to be installed in hazardous areas are to be intrinsically safe type.
-3. If an anomaly is observed in the hull monitoring system, the system is not to be used for analyses or the like as stipulated in the Appendixes.

2.1.2 Stability of the System

-1. The hull monitoring system is to be connected to the main source of electrical power in order to ensure stable power supply.
-2. The hull monitoring system is to be included a function that enables the onboard or onshore user to detect an event where the power supply is lost.
-3. The hull monitoring system is to be included a function that enables the onboard or onshore user to detect an event where the system becomes unable to record data due to failure of the system, sensor and wire, etc.
-4. The hull monitoring system is to be equipped with an uninterruptible power system unit that enables the system to operate for at least ten minutes even if the supply of power stops.
-5. When the supply of power is recovered, the hull monitoring system is to be restarted normal operation without fail.

2.1.3 Incoherence of Signals

If signals of multiple sensors are to be transmitted through the same line, care is to be taken to prevent interference between the sensors.

2.1.4 Functions for Detecting any Anomaly

-1. The hull monitoring system is to be included a function for checking whether the measurement data contains any anomaly (e.g., measurement data omission, drift phenomenon) at least once every 24 hours.
-2. The hull monitoring system is to be included a function for appropriately notifying any detected anomaly on a user interface and recording the log in a data recorder.

2.1.5 Time Synchronization

-1. If multiple systems with different set times are to be used together, time synchronization for the measured data is to be appropriately performed.
-2. The time for synchronization is in general to be the Coordinated Universal Time (UTC).
-3. For the data measured with the hull monitoring system, time synchronization is to be performed with an error not exceeding one second from the UTC.

2.1.6 Storage Function

-1. The system is to be stored the measured data appropriately in the data recorder.
-2. The system is to be included a capacity to sufficiently store measured data.
-3. The system is to be equipped with a data backup function.
-4. If an onboard server compliant with ISO19847/19848 is to be used, data format is to comply with these ISO standards.

2.1.7 Linkage with a Voyage Data Recorder (VDR)

-1. The system is to be included an output port intended to transmit information specified under **IMO Resolution MSC.333(90)** to a voyage data recorder (VDR) in cases where a VDR is directly connected with the hull monitoring system.
-2. The output port described in **-1** above is to be satisfied with **IEC61162**.

2.2 Requirements for the System Components

2.2.1 Strain Gauge

2.2.1.1 General

-1. The strain gauges are to be suitable for measuring target structural responses of hull structures. In cases where measuring longitudinal bending stresses, the effects of other stress components are to be excluded.
-2. If not all the effects of the other stress components are excluded in **-1** above the effects of the other stress components are to be excluded using an appropriate method.
-3. For the sensing element of the sensor, the hysteresis (history effect) for the strain of the hull, long-term stability performance, and environmental resistance performance are to be verified, and the obtained data are to be held.

2.2.1.2 Resolution

The strain gauges are to be capable of measuring strain with accuracy of at least 10 μST. In addition, the measurement range of the strain gauge is to cover the whole range of the expected stress in static water and the fluctuating stress due to waves.

2.2.1.3 Frequency Response Characteristics

The strain gauges are to have frequency response characteristics with which a strain fluctuating in a range from 0 to 5 Hz can be measured.

2.2.1.4 Temperature Characteristics

The strain gauge is to be capable of compensate temperature effects on hull structures.

2.2.1.5 Environmental Resistance

The strain gauges are to be sufficiently durable according to the installation environment.

2.2.2 Accelerometer

2.2.2.1 General

For the sensing element of the sensor, the sensitivity characteristics, long-term stability performance and environmental resistance performance are to be verified, and the obtained data are to be held.

2.2.2.2 Resolution

The accelerometers are to be capable of measuring acceleration with accuracy of at least 0.01 G. In addition, for the measurement range of the accelerometer, it is to be capable of measuring the fluctuating acceleration within a range from -2G to 2G.

2.2.2.3 Frequency Response Characteristics

-1. The accelerometers are to have frequency response characteristics with which an acceleration fluctuating in a range from 0.01 to 5 Hz can be measured.
-2. A vertical-direction accelerator at the bow intended for measurement of slamming are to have frequency response characteristics with which it can measure accelerations from 0.01 to 100 Hz.

2.2.2.4 Environmental Resistance

-1. The accelerometers are to be sufficiently durable according to the installation environment.
-2. The accelerometers are to have impact resistance according to the installation environment.

2.2.3 Signal Processor

2.2.3.1 General

-1. Important programs and data are not to be lost even if the power supply from the outside temporarily stops.
-2. The computer is to be configured so that the power is restored after power supply stops, it can be promptly restored according to the predetermined procedures.

2.2.3.2 Environmental Resistance

-1. The signal processor is to have sufficient durability according to the installation environment.
-2. The signal processor is to be protected from overvoltage that may enter the system from the input/output terminals.

2.2.4 Data Recorder

2.2.4.1 Environmental Resistance

The data recorder is to have sufficient durability according to the installation environment.

2.2.4.2 Protection of Data

The data stored in the data recorder are to be protected from becoming degraded even if the power supply is lost.

2.2.5 Uninterruptible Power System Unit

The uninterruptible power system unit is to have sufficient durability according to the installation environment.

2.2.6 Wiring

The cables used for wiring are to have sufficient durability according to the installation environment.

2.2.7 Other

For the other system components, requirements are to be determined after consultation with the Society.

3. Requirements for Installation

3.1 Installation of the System

3.1.1 Installing Sensors

The influence of the installation method on the sensor's long-term stability performance and environmental resistance performance are to be verified in advance.

3.1.2 Initial Set-up

-1. A strain gauge for measuring the longitudinal bending stress is to be initially set to the stress value corresponding to the result of calculation with a loading computer or a loading manual with a loaded condition as approved by the Society. This setting is to be appropriately corrected for factors such as the influence of sunlight on the temperature.
-2. The initial set-up for the accelerator are to be made in accordance with specifications submitted by the Society.

3.1.3 Installation Location

In installing a sensor, care is to be taken to prevent its location from affecting the functions provided on the ship.

3.2 Operation Test

After installation, system operations are to be tested in order to confirm the hull monitoring system operates well in accordance with the documents specified in **4.2.2-2(2)**.

4. Surveys

4.1 General

4.1.1 Kinds of Surveys

-1. The systems are to be subjected to the following surveys:
(1) Surveys for registration (hereafter referred to as "Registration Surveys")
(2) Surveys for maintaining the registration (hereafter referred to as "Registration Maintenance Surveys"), which are:
  (a) Annual Surveys
  (b) Occasional Surveys

4.1.2 Timing of Surveys

-1. Registration Surveys are to be carried out at the time of application for registration.
-2. Registration Maintenance Surveys are to be carried out at the following intervals:
(1) Annual Surveys are to be carried out at those times stipulated in **1.1.3-1. (1) to (3), Part B of the Rules for the Survey and Construction of Steel Ships.**
(2) Notwithstanding **(1)** above, Occasional Surveys is to be carried out in any of the following cases, independently of the Annual Surveys.
  (a) Any main parts of system have been damaged, repaired or renewed.
  (b) Any systems are modified or altered.
  (c) It is considered necessary by the Society.

4.1.3 Surveys Carried Out in Advance

Annual Surveys may be carried out in advance of their due dates in accordance with the requirements given in **1.1.4, Part B of the Rules for Survey and Construction of Steel Ships**.

4.1.4 Preparations of Surveys

-1. All such preparations considered necessary for surveys are to be made by and are the responsibility of survey applicants. Necessary arrangements are also to be made by survey applicants for persons having knowledge about the requirements of surveys to supervise survey preparation.
-2. Surveyors may suspend surveys as follows:
    (1) In case where necessary preparations have not been made.
    (2) In case where an appropriate attendant is not present.
    (3) In case where Surveyors consider that the safety for survey execution is not ensured.

4.1.5 Disposition when Repairs are Considered Necessary as a Result of Surveys

In cases where repairs are deemed necessary as a result of surveys, Surveyors notify survey applicants of their findings. Survey applicants, upon receiving such notification, are to obtain Surveyor verification after carrying out all necessary repairs.

4.2 Registration Surveys

4.2.1 General

During Registration Surveys, performance, installation and initial set-up of systems are to be examined in detail in order to ascertain that they meet the relevant provisions given in the Guidelines.

4.2.2 Submission of Plans and Documents

-1. In the case of hull monitoring systems to be registered, following plans and documents are to be submitted to confirm that the systems comply with the requirement in **Chapter 2** and **3**.
    (1) Document explaining functions and operation of the hull monitoring system.
    (2) General arrangements and Midship section drawings of ships showing cable arrangements and positions of any strain gauges, accelerometers and main units of systems.
    (3) Block diagram illustrating system operation.
    (4) Document regarding the manufacture names, types, accuracy, measurements, range, frequency response characteristics, temperature characteristics and environmental resistance of sensors.
    (5) Document regarding the data content, recording methods and data storage device capabilities.
    (6) Operation manual for the system.
    (7) Any other documents deemed necessary by the Society.
-2. The following plans and documents are to be submitted in addition to the plans and documents specified in the preceding "**-1**.".
    (1) Document that shows the installing procedures, adjustment method and calibration method for each sensor.
    (2) Document that shows the method for a simulation test for the system.
    (3) Document that shows the procedures for verification of initial set-up in **4.2.4-2(2)**.
    (4) Any other documents deemed necessary by the Society.

4.2.3 Simulation Tests

After installation, processing functions of systems are to be tested in the presence of Surveyors in order to confirm that they are satisfactory. Simulation tests are to be conducted using simulated input signals in accordance with those simulation test procedures submitted prior to such tests. Values produced by systems are to be compared with those values calculated using simulated input signals.

4.2.4 Surveys for Installation and Initial Set-up

-1. After installation, it is to be ascertained, in the presence of a Surveyor, that the sensors and other devices of systems are installed and set up according to plan.
-2. Initial set-up and its verification are to be carried out as follows:
   (1) Strain gauges are to be initially set in ballast conditions or light ship conditions in accordance with the requirements given in **3.1.2-1**.
   (2) Verification of the initial set-up mentioned **(1)** above is to be carried out in conditions at the discretion of the Society. During such verification, stress levels obtained from strain gauges are to be compared with outputs of any loading instruments or calculations using loading manuals. The differences are in general to be 10% of the allowable stress.

4.3 Registration Maintenance Surveys

4.3.1 Annual Surveys

During Annual Surveys, the following examinations and confirmations of systems are to be carried out:

(1) It is to be ascertained that systems are in good order in accordance with those procedures submitted prior to the survey.
(2) It is to be ascertained that current calibration certificates for sensors, including strain gauges, accelerometers and so on are kept on board. In cases where deemed necessary by Surveyors, such sensors are to be re-calibrated.
(3) Operation manuals are to be verified as being on board.

4.3.2 Occasional Surveys

During Occasional Surveys, inspections, tests or investigations are to be carried out on necessary items according to those cases stipulated in **4.1.2-2(2)** in order to ascertain that systems comply with the Guidelines.

Appendix A
Assistance for the Maintenance of the Ships

A1. Purpose

The purpose is to stipulate requirements necessary to have a function for assisting the maintenance of the hull by using fatigue strength evaluation.

A2. Class Notations

For ships which satisfy with the main section and Appendix A in the Guidelines, class notation is to be affixed to the classification characters as shown in the table below.

Target Hull Structural Strength	Class notations and Abbreviation
(A)-1 Hull girder	Digital Smart Ship (Hull Monitoring(Fatigue)) Abbreviation: DSS(HM(F))
(A)-2 Hull girder (with a function for communication to shore)	Digital Smart Ship (Hull Monitoring(Fatigue+Shore)) Abbreviation: DSS(HM(F+S))
(B)-1 Hull girder + local member(s)	Digital Smart Ship (Hull Monitoring(Fatigue+Local)) Abbreviation: DSS(HM(F+L))
(B)-2 Hull girder + local member(s) (with a function for communication to shore)	Digital Smart Ship (Hull Monitoring(Fatigue+Local+Shore)) Abbreviation: DSS(HM(F+LS))

A3. Target Hull Structural Strength

A3.1 Hull Girder

The following locations are generally to be evaluated of hull structural strength.

(1) Strength deck on both sides amidship.
(2) Strength deck on one side in a position 1/4 L from the vertical line of the bow. (L: Length of ship)
(3) Strength deck on one side in a position 1/4 L from the vertical line of the stem. (L: Length of ship)
(4) Other locations are to be at the discretion of the Society.

A3.2 Local Member

-1. Critical areas with high stress concentration.
-2. The locations subject to evaluation are to be determined after contacting with the Society.

A4. Evaluation Method

A4.1 Evaluation of the Measurement Locations

-1. Using measurement data, calculate the cumulative damage in the location subject to evaluation with an appropriate method.

-2. The calculation method specified in **-1** above is to be determined after consultation with the Society based on document **A6.1.1-1(2)**, **A.6.1.1-2(2)**, **A.6.1.1-3(2)** or **A.6.1.1-4(2)** submitted in advance.

A4.2 Evaluation of Non-Measured Location

-1. If a non-measured location is to be evaluated, the cumulative damage is to be estimated through estimation of the stress in the member in a location subject to evaluation other than the monitoring location.
-2. The estimation method specified in **-1** above is to be determined after consultation with the Society based on document **A6.1.1-3(2)** or **A6.1.1-4(2)** submitted in advance.

A5. Requirements

A5.1 Entire System

A5.1.1 Redundancy of the Hull Monitoring System

The hull monitoring system is to have a function for storing a log of a period during which any omission of data measurement occurs.

A5.2 System Components

A5.2.1 Data Recorder

The data recorder is to have a function for recording the following information at least every hour for a period of one year or more.
(1) Date and time (UTC)
(2) Cumulative damage

A5.2.2 Communication to Shore

-1. To acquire an additional notation "DSS(HM(F+S))" the hull monitoring system is to have a function for communicating the evaluation result obtained in section **A4.1** or **A4.2** to shore in an appropriate manner.
-2. The communication function specified in **-1** above is to be determined after consultation with the Society based on document **A6.1.1-2(5)** submitted in advance.
-3. To acquire an additional notation "DSS(HM(F+LS))" the hull monitoring system is to have a function for communicating the evaluation result obtained in section **A4.1** or **A4.2** to shore in an appropriate manner.
-4. The communication function specified in **-3** above is to be determined after consultation with the Society based on document **A6.1.1-4(5)** submitted in advance.

A6. Surveys

A6.1 Registration Surveys

A6.1.1 Documents

-1. For a hull monitoring system that is to undergo Registration Surveys for an additional notation "DSS(HM(F))" of Appendix A, the following documents are to be submitted to confirm that the systems comply with the requirement.
    (1) Document that describes the concept of the system.

(2) Document that describes the method for calculating the cumulative damage in the location subject to evaluation.
(3) Document that describes the adequacy of the method for calculating the cumulative damage in the location subject to evaluation.
(4) Document explaining system functions.
(5) Any other documents deemed necessary by the Society.

-2. For a hull monitoring system that is to undergo Registration Surveys for an additional notation "DSS(HM(F+S))" of Appendix A, the following documents are to be submitted to confirm that the systems comply with the requirement.
(1) Document that describes the concept of the system.
(2) Document that describes the method for calculating the cumulative damage in the location subject to evaluation.
(3) Document that describes the adequacy of the method for calculating the cumulative damage in the location subject to evaluation.
(4) Document explaining system functions.
(5) Document that describes the details of onshore communication function.
(6) Any other documents deemed necessary by the Society.

-3. For a hull monitoring system that is to undergo Registration Surveys for an additional notation "DSS(HM(F+L))" of Appendix A, the following documents are to be submitted to confirm that the systems comply with the requirement.
(1) Document that describes the concept of the system.
(2) Document that describes the method for calculating the cumulative damage in the location subject to evaluation.
(3) Document that describes the adequacy of the method for calculating the cumulative damage in the location subject to evaluation.
(4) Document explaining system functions.
(5) Any other documents deemed necessary by the Society.

-4. For a hull monitoring system that is to undergo Registration Surveys for an additional notation "DSS(HM(F+LS))" of Appendix A, the following documents are to be submitted to confirm that the systems comply with the requirement.
(1) Document that describes the concept of the system.
(2) Document that describes the method for calculating the cumulative damage in the location subject to evaluation.
(3) Document that describes the adequacy of the method for calculating the cumulative damage in the location subject to evaluation.
(4) Document explaining system functions.
(5) Document that describes the details of onshore communication function.
(6) Any other documents deemed necessary by the Society.

A6.2 Registration Maintenance Surveys

A6.2.1 Annual Surveys

Check that the function for Appendix A of the Guidelines operates well in accordance with the procedures submitted in advance.

A6.2.2 Occasional Surveys

In an Occasional Surveys, according to the case in **4.1.2-2.(2)**, an survey, test or investigation on the necessary matters is to be conducted to confirm that the hull monitoring system is in a state where it complies with Appendix A of the Guidelines.

Appendix B
Assistance for the Ship Operation in Rough Condition

B1. Purpose

The purpose is to stipulate requirements necessary to have a function for assisting the ship operation in rough condition by using data on the longitudinal bending strength and acceleration.

B2. Class Notations

For ships which satisfy with the main section and Appendix B in the Guidelines, class notation is to be affixed to the classification characters as shown in the table below.

Functions for assisting the ship operation	Class notations and Abbreviation
(A)-1 Real-time (onboard)	Digital Smart Ship (Hull Monitoring(Operation)) Abbreviation: DSS(HM(O))
(A)-2 Real-time (onboard + shore)	Digital Smart Ship (Hull Monitoring(Operation+Shore)) Abbreviation: DSS(HM(O+S))
(B)-1 Real-time + Forecast (onboard)	Digital Smart Ship (Hull Monitoring(Operation+Prediction)) Abbreviation: DSS(HM(O+P))
(B)-2 Real-time + Forecast (onboard + shore)	Digital Smart Ship (Hull Monitoring(Operation+Prediction+Shore)) Abbreviation: DSS(HM(O+PS))

B3. Functions for Assistance for the Ship Operation

B3.1 Real-time (onboard)

Using measurement data, this function is intended to provide assisting information for ship operation in real-time to the onboard users.

B3.2 Real-time (onboard + shore)

Using measurement data, this function is intended to provide assisting information for ship operation in real-time to the onboard and onshore users.

B3.3 Real-time + Forecast (onboard)

In addition to the function described in **B3.1**, this function is intended to provide assisting information for ship operation based on forecast to the onboard users by using data such as measurement data and wave forecast data.

B3.4 Real-time + Forecast (onboard + shore)

In addition to the function described in **B3.2**, this function is intended to provide assisting information for ship operation based on forecast to the onboard and onshore users by using data such as measurement data and wave forecast data.

B4. Target Hull Structural Strength

B4.1 Strain Gauge

The following locations are generally to be evaluated of hull structural strength.

(1) Strength deck on both sides amidship.
(2) Strength deck on one side in a position 1/4 L from the vertical line of the bow. (L: Length of ship)
(3) Strength deck on one side in a position 1/4 L from the vertical line of the stem. (L: Length of ship)
(4) Other locations are to be at the discretion of the Society.

B4.2 Accelerometer

The following one location is in general to be regarded location subject to evaluation.

(1) One location on the center line of the hull in the range of 0.01 L from the bow (assuming the acceleration in the vertical direction).

B5. Evaluation Method

B5.1 Real-time

-1. The hull monitoring system is to have a function for indicating that the measured stress or acceleration value exceeded the alarming level set in advance.
-2. The alarming index described in **-1** above is to be determined after contacting with the Society based on document **B7.1.1-1(3)**, **B7.1.1-2(3)**, **B7.1.1-3(4)** or **B7.1.1-4(4)** submitted in advance.

B5.2 Forecast

-1. The hull monitoring system is to have a function for assisting the ship operation by forecasting the future stress or acceleration in an appropriate manner, using data such as the measured stress and acceleration and the wave forecast data.
-2. The estimation method described in **-1** above is to be determined after consultation with the Society based on document **B7.1.1-3(2)** or **B7.1.1-4(2)** submitted in advance.

B6. Requirements

B6.1 Display

-1. The system is to appropriately indicate the real-time stress and acceleration values obtained in **B5.1** and the alarm index on the display.
-2. The system is to appropriately indicate the future stress and acceleration values obtained in **B5.2** and the information contributing to assisting the ship operation on the display.

B6.2 Communication to Shore

-1. To acquire an additional notation “DSS(HM(O+S))” the hull monitoring system is to have a function for communicating the evaluation result obtained in **B5.1** to shore in an appropriate manner.
-2. The communication function specified in **-1** above is to be determined after consultation with the Society based on document **B7.1.1-2(5)** submitted in advance.
-3. To acquire an additional notation “DSS(HM(O+PS))” the hull monitoring system is to have a function for communicating the evaluation result obtained in **B5.2** to shore in an appropriate manner.

-4. The communication function specified in **-3** above is to be determined after consultation with the Society based on document **B7.1.1-4(6)** submitted in advance.

B7. Surveys

B7.1 Registration Surveys

B7.1.1 Documents

-1. For a hull monitoring system that is to undergo Registration Surveys for an additional notation "DSS(HM(O))" of Appendix B, the following documents are to be submitted to confirm that the systems comply with the requirement.
   (1) Document that describes the concept of the system.
   (2) Document that describes the method for calculating the stress and acceleration in the measurement location.
   (3) Document that describes the adequacy of the alarm index.
   (4) Document explaining system functions.
   (5) Any other documents deemed necessary by the Society.

-2. For a hull monitoring system that is to undergo Registration Surveys for an additional notation "DSS(HM(O+S))" of Appendix B, the following documents are to be submitted to confirm that the systems comply with the requirement.
   (1) Document that describes the concept of the system.
   (2) Document that describes the method for calculating the stress and acceleration in the measurement location.
   (3) Document that describes the adequacy of the alarm index.
   (4) Document explaining system functions.
   (5) Document that describes the details of onshore communication function.
   (6) Any other documents deemed necessary by the Society.

-3. For a hull monitoring system that is to undergo Registration Surveys for an additional notation "DSS(HM(O+P))" of Appendix B, the following documents are to be submitted to confirm that the systems comply with the requirement.
   (1) Document that describes the concept of the system.
   (2) Document that describes the method for estimating the future stress and acceleration.
   (3) Document that describes a function for assisting the ship operation using the stress and acceleration obtained in **(1)**.
   (4) Document that describes the adequacy of the alarm index.
   (5) Document explaining system functions.
   (6) Any other documents deemed necessary by the Society.

-4. For a hull monitoring system that is to undergo Registration Surveys for an additional notation "DSS(HM(O+PS))" of Appendix B, the following documents are to be submitted to confirm that the systems comply with the requirement.
   (1) Document that describes the concept of the system.
   (2) Document that describes the method for estimating the future stress and acceleration.
   (3) Document that describes a function for assisting the ship operation using the stress and acceleration obtained in **(1)**.
   (4) Document that describes the adequacy of the alarm index.
   (5) Document explaining system functions.
   (6) Document that describes the details of onshore communication function.
   (7) Any other documents deemed necessary by the Society.

B7.2 Registration Maintenance Surveys

B7.2.1 Annual Surveys

Check that the function for Appendix B of the Guidelines operates well in accordance with the procedures submitted in advance.

B7.2.2 Occasional Surveys

In an Occasional Surveys, according to the case in **4.1.2-2.(2)**, an survey, test or investigation on the necessary matters is to be conducted to confirm that the hull monitoring system is in a state where it complies with Appendix B of the Guidelines.

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June 2021