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GOAL-BASED NEW SHIP CONSTRUCTION STANDARDS

Requirements for regular review of the GBS North Atlantic wave data

Submitted by ICS and INTERCARGO

SUMMARY

Executive summary:	This document proposes amendments to the *Revised guidelines for verification of conformity with goal-based ship construction standards for bulk carriers and oil tankers* (resolution MSC.454(100)), which governs the verification of conformity with Goal-Based Ship Construction Standards (GBS) for Bulk Carriers and Oil Tankers. Recognizing the importance of ensuring the North Atlantic wave data remain representative of long-term operating conditions, the document proposes periodic review requirements for the environmental data that underpin structural design load assumptions.
Strategic direction, if applicable:	7
Output:	7.24
Action to be taken:	Paragraph 11
Related documents:	Resolution MSC.454(100); MSC.1/Circ.1627 and MSC 96/5

Introduction

1 The co-sponsors note MSC 111's invitation for interested delegations to submit proposals for improving the GBS audit process. This submission is intended to contribute to that discussion by proposing requirements for regular review of the GBS wave data that underpin the Common Structural Rules for Bulk Carriers and Oil Tankers (CSR).

Background

2 The North Atlantic wave data is not only used for the development of the CSR, it is widely used for the development of many other class rules. Test tanks and research institutions also utilize it and the IMO Second Generation Intact Stability Criteria (MSC.1/Circ.1627) reference it. Hence this wave data is of fundamental importance to the design of ships.

3 Document MSC 96/5 recorded the outcome of a 2014 GBS audit of the CSR. The auditors′ observation IACS/2015/FR1-8/OB/02 confirmed the following:

.1 there had been no evidence of monitoring of the North Atlantic Wave Data since its adoption;

.2 no ongoing plan to further assess North Atlantic conditions had been submitted, and;

.3 the audit had not found sufficient justification that the wave data used in the rules properly represent North Atlantic conditions.

4 The observation initiated a review of the wave data which resulted in its revision and adoption as IACS Recommendation 34 Rev.2 in December 2022.

5 Section 2.3 of the *Revised guidelines for verification of conformity with goal-based ship construction standards for bulk carriers and oil tankers* (resolution MSC.454(100)) (GBS Verification Guidelines), provides evaluation criteria for the environmental conditions, and paragraph 2.3.1 requires confirmation of the following:

> ″Does the wave data properly represent North Atlantic conditions and include the regions where the most severe conditions are expected?″

Potential impact of global warming

6 Recently published studies note the potential for North Atlantic extreme wave heights to increase as a result of global warming. For example, (Lobeto, 2021) [1]:

> "An increase in Hs return values and a decrease in annual mean Hs is found in the SE Indian, NW Atlantic and NE Pacific. Therefore, an extrapolation of the expected change in mean wave conditions to extremes in regions presenting such divergences should be adopted with caution, since it may lead to misinterpretation when used for the design of marine structures or in the evaluation of coastal flooding and erosion."

> And (Bricheno, 2025)[2]:

> "The most severe waves could increase in height by 2100 under a high-emissions scenario, but there could be an overall reduction in mean significant wave height in the North Atlantic. Wave heights are expected to decrease in the mean but experience increased frequency and intensity of extreme events."

7 There is also the possibility of other sea areas becoming more onerous than the North Atlantic and therefore might in the future become the appropriate basis for ship design for worldwide operation.

8 The co-sponsors note section 2.3.1 of the GBS Verification Guidelines provides an expectation that the validity of the wave data should be reviewed, but in practice this has not automatically initiated such reviews and to date only one such formal review has occurred.

9 The rate and severity of global warming, and its impact on wave heights is very difficult to predict and therefore a formalized requirement for regular and more frequent review of the wave data is an appropriate mitigation.

10 The amendments within the annex to this document are proposed as a feasible option to address the concerns highlighted in paragraphs 2 to 9. Nevertheless, the co-sponsors

1 Lobeto, H. (2021). Future behavior of wind wave extremes due to climate change. *Scientific Reports*, 12.

2 Bricheno, L. (2025). Climate Change Impacts on Storms and Waves Relevant to the UK and Ireland. *Marine Climate Change Impacts Partnership*, 24.

remain open to further discussions within MSC, a sub-committee, or an associated working group, that may lead to alternative solutions that address the same issues.

Action requested of the Committee

11 The Committee is invited to note the information and to:

.1 consider the proposed amendments to resolution MSC.454(100) contained in the annex, noting paragraph 10 and;

.2 include consideration of these proposals within the terms of reference of the planned MSC 112 GBS Working Group.

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ANNEX

Proposed changes to resolution MSC.454(100) - IMO Revised Guidelines for Verification of Conformity with Goal-Based Ship Construction Standards (GBS) for Bulk Carriers and Oil Tankers

2 Environmental conditions

2.1 Statement of intent

Confirm that the wave data and associated ship motions and loads are developed on the basis of North Atlantic environmental conditions and the relevant long-term sea state scatter diagrams for the specified design life.

2.2 Information and documentation requirements

2.2.1 Source of sea state data (scatter diagrams, etc.) including method and date of data collection and geographical location represented by the data.

2.2.2 Justification that sea state data and predictions used to develop motions and loads are representative of North Atlantic environmental conditions.

2.2.3 Justification of the methodology used to develop ship motions and loads, including assumptions related to speed, distribution of headings, number of cycles of wave encounters, probability of exceedance of design values, sea states, wave spectral shapes, hull form and other relevant parameters. Clearly define limits of applicability and provide guidance for assessment when outside this range.

2.2.4 Description of how the methodology used to develop ship motions and loads has been validated against experimental or service history data.

2.3 Evaluation criteria

2.3.1 Does the wave data properly represent North Atlantic conditions and include the regions where the most severe conditions are expected?

2.3.2 Do the rules specify the wave spectrum and statistical analysis methods used to obtain the design extreme value, including its probability of exceedance?

2.3.3 Are the design extreme motions and loads based on appropriate number of cycles of wave encounters corresponding to at least a 25-year design life?

2.3.4 Are the ship speeds and headings used for assessment of ship motions and loads based upon speeds and headings that can be expected in the sea states under consideration?

2.3.5 Do the rules properly specify the range of applicability of ship motions and loads, and when further analysis, such as direct seakeeping analysis or model testing, is required? Do the rules clearly state the assumptions used in the methodologies to develop ship motions and loads?

2.3.6 Are the methodologies used to develop ship motions and loads validated by experimental or service history data?

2.4 Periodic review

2.4.1 At intervals of not less than [10] years, the validity of the adopted wave data shall be subject to a detailed review by the Submitter. The review shall include a comparison with published data from direct observations, e.g. as provided by:

- European Centre for Medium-Range Weather Forecasts (ECMWF) ERA 5 data.
- National Oceanic and Atmospheric Administration (NOAA)
- Copernicus Marine Service

Authoritative assessments of wave height shall also be considered, e.g. as provided by:

- The Intergovernmental Panel on Climate Change (IPCC);
- Coordinated Ocean Wave Climate Project (COWCLiP)

Based on the findings of the detailed review, the Submitter shall confirm whether the existing wave data continues to represent the most onerous conditions experienced by ships designed for worldwide operation.