VERIFICATION OF FASTBALLAST CMD BY CHELSEA TECHNOLOGIES

Verification Statement - FastBallast Compliance Monitoring Device (CMD)

Chelsea Technologies Ltd.

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Applicable contract(s) governing the provision of this Report:

Short Form Agreement for the Verification of FastBallast CMD by Chelsea Technologies (SFA-A1553812)

Objective:

Verification of FastBallast Compliance Monitoring Device based on IMO Protocol for the verification of ballast water compliance monitoring devices (BWM.2/Circ.78)

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0	2025-12-19	First issue	Michael Lehmann	Qinglan Wu	Martin Olofsson
1	2026-01-12	Inclusion of results from 3rd field test	Michael Lehmann	Qinglan Wu	Martin Olofsson

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1 Executive summary

The FastBallast Compliance Monitoring Device (CMD) manufactured by Chelsea Technologies Ltd. has been tested by the independent testing entity Norwegian Institute for Water Research (NIVA) in accordance with the IMO Protocol for the verification of ballast water compliance monitoring devices (BWM.2/Circ.78).

The FastBallast CMD is a portable chlorophyll fluorometer system designed to allow for the assessment of the density of living phytoplankton cells (i.e. organisms in the size class ≥10 and <50 µm) in discharged ballast water. The FastBallast CMD does not have any limitations regarding the salinity of the ballast water to be tested or regarding treatment technology interactions. However, the FastBallast CMD is not designed to assess compliance with the D-2 performance standard for other organism size classes than the size class ≥10 and <50 µm.

NIVA conducted laboratory testing with the FastBallast CMD at the NIVA laboratory in Oslo. The laboratory testing included testing with prepared challenge water, UV-treated challenge water and challenge water that was treated with the commonly used active substance hypochlorite. Moreover, NIVA conducted field tests with the FastBallast CMD on board three vessels on 23 June, 25 June and 15 December 2025.

DNV has evaluated the test methods and the test results based on the requirements in BWM.2/Circ.78.

DNV was able to confirm that the testing was carried out in accordance with BWM.2/Circ.78 and that the testing entity NIVA has implemented a quality assurance/quality control (QA/QC) programme for the testing that is equivalent to the QA/QC programme for other methods for which NIVA is accredited for ISO/IEC 17025 by Norwegian Accreditation.

DNV finds that the results from the laboratory testing and field testing demonstrate a high level of trueness. The FastBallast CMD matched the reference method (i.e. detailed analyses with CMFDA/FDA) in 71 out of 72 tests and correctly identified compliance during field tests. The precision of the FastBallast CMD was found to be comparable to the precision of the reference method. The FastBallast CMD was also found to have a satisfactory reliability. Therefore, DNV finds that the FastBallast CMD can be considered a reliable CMD for the assessment of the density of living organisms in the size class ≥10 and <50 µm in discharged ballast water for assessing compliance with the D-2 performance standard.

2 Introduction

Chelsea Technologies Ltd. has requested DNV to evaluate the testing of their FastBallast Compliance Monitoring Device (CMD) based on the IMO Protocol for the verification of ballast water compliance monitoring devices (BWM.2/Circ.78) /3/.

The objective of this verification protocol is to provide a framework for the verification of the performance of ballast water CMDs intended for use in the implementation of the BWM Convention and for a variety of purposes: during commissioning testing of ballast water management systems (BWMS), during port State control inspections and during ships' self-monitoring.

The FastBallast CMD is a portable chlorophyll fluorometer system designed to allow for the assessment of the density of living phytoplankton cells (i.e. organisms in the size class ≥10 and <50 µm) in discharged ballast water /1/. The FastBallast CMD does not have any limitations regarding the salinity of the ballast water to be tested or regarding treatment technology interactions. However, the FastBallast CMD is not designed to assess compliance with the D-2 performance standard for other organism size classes than the size class ≥10 and <50 µm. The FastBallast CMD does not allow assessing the density of organisms ≥50 µm or the indicator microbes *Vibrio cholerae*, E*scherichia coli* and Intestinal Enterococci.

The FastBallast CMD measures the variable fluorescence (F_v) generated by living phytoplankton /1/. This is the difference between the maximum saturation fluorescence (F_m), and the origin of variable fluorescence (F_o). The statistical variation in F_m is used to assess cell count and the cell size. The analysis is performed by FBtest, a proprietary Android application that is preinstalled on tablet supplied with the FastBallast unit.

Testing of the FastBallast CMD was carried out by the Norwegian Institute for Water Research (NIVA) /2/. NIVA conducted initial laboratory testing with the FastBallast CMD at the NIVA laboratory in Oslo during June-August 2025. Based on the results of this testing, Chelsea Technologies Ltd. decided to upgrade the software algorithm, and NIVA conducted further laboratory testing in October-November 2025. This report only evaluates the results of the laboratory testing that was conducted in October-November 2025.

The laboratory testing included testing with prepared challenge water, UV-treated challenge water and challenge water treated using the commonly used active substance hypochlorite.

Moreover, NIVA conducted field tests with the FastBallast CMD on board three vessels on 23 June, 25 June and 15 December 2025.

3 Evaluation of Verification Testing of FastBallast CMD

DNV has evaluated the test methods and the test results from testing of the FastBallast CMD based on the requirements in the IMO Protocol for the verification of ballast water compliance monitoring devices (BWM.2/Circ.78).

Both laboratory and field testing of the FastBallast CMD was carried out by the independent testing entity NIVA. NIVA has extensive experience from land-based testing and shipboard testing for the type approval of BWMS and performs BWMS commissioning tests in accordance with BWM.2/Circ.70/Rev.1. DNV was also able to confirm that NIVA has implemented a quality assurance/quality control (QA/QC) programme for the testing that is equivalent to the QA/QC programme for other methods for which NIVA is accredited for ISO 17025 by Norwegian Accreditation.

3.1 Laboratory tests

3.1.1 Test methods

NIVA conducted laboratory testing with the FastBallast CMD at the NIVA laboratory in Oslo. NIVA conducted initial laboratory testing during June-August 2025. Based on the results of this testing, Chelsea Technologies Ltd. decided to upgrade the software algorithm, and NIVA conducted further laboratory testing in October-November 2025. This report only evaluates the results of the laboratory testing that was conducted in October-November 2025 and reported by NIVA in their test report /2/.

DNV was able to confirm that he testing was carried out in accordance with BWM.2/Circ.78. The laboratory testing included testing with prepared challenge water, UV-treated challenge water and challenge water that was treated with the commonly used active substance hypochlorite. No testing with untreated ambient water was performed as the FastBallast CMD is designed to assess organism densities for compliance with the D-2 performance standard for organisms in the size class ≥10 and <50 µm and is not designed to assess ambient organism densities.

Laboratory testing was carried out with the minimum replicate measurements required by BWM.2/Circ.78.

Testing was carried out with ambient water collected from the Oslofjord at NIVA's field station in Solbergstrand or from the lake Holmendammen in the vicinity of NIVA's field station. The test water was as necessary diluted with well water to achieve the required salinity. Moreover, test water was augmented by adding appropriate amounts of lignin, maize flour and kaolin to achieve the dissolved organic carbon (DOC), particulate organic carbon (POC) and total suspended solid (TSS) concentrations for each of the three salinities prescribed in the BWMS Code /4/. The use of these chemicals has earlier been validated by NIVA for the augmentation of test water used for the land-based testing for the type approval of BWMS /6/.

For untreated prepared challenge water with organism densities that bracket densities above (>DS), at (≈DS) and below (<DS) the D-2 performance standard, NIVA decided to use surrogate organisms. This was to ensure a certain diversity of species at such relative low organism densities. Laboratory culture of *Chlamydomonas noctigama* and *Peridinium spp.* were added to fresh water. Three algal culture species (*Tetraselmis suecica*, *Alexandrium minutum*, *Amphidinium spp.*) were added to brackish water. Two algal cultures (*Tetraselmis suecica* and *Alexandrium minutum*) were added to marine water. These use of these algal cultures was previously validated by NIVA for the use in land-based testing for the type approval of BWMS /6/. The algal cultures were taken from NIVA's algal culture collection and cultivated accordingly.

For the evaluation of trueness, the reference method applied by NIVA for enumerating organisms in the size class ≥10 and <50 µm was a detailed analyses with staining by CMFDA/FDA and additionality observing motility /5/. This method is one of the methods that may be used for enumerating living (viable) organisms in the size class ≥10 and <50 µm in accordance with the 2022 Guidance on methodologies that may be used for enumerating viable organisms for type approval of ballast water management systems (BWM.2/Circ.61/Rev.1).

3.1.2 Test results

DNV finds that the results from the laboratory testing demonstrate a high level of trueness. The FastBallast CMD matched the reference method in 71 out of 72 tests. The only test of trueness where the FastBallast CMD did not match the reference method was one of four test in fresh water with an organism density at the D-2 performance standard (≈DS).

The FastBallast CMD was also found to have a satisfactory reliability, and the precision of the FastBallast CMD was found to be comparable to the precision of the reference method.

The FastBallast handbook /1/ claims that the detection limit of the CMD is 1 cell/mL. With measurements of a blank consistently measuring densities well below 1 cell/mL, NIVA's testing also confirmed that this detection limit of 1 cell/mL represents a reasonable claim.

3.2 Field testing

NIVA conducted field tests with the FastBallast CMD on board three vessels on 23 June, 25 June and 15 December 2025 as part of BWMS commissioning tests in accordance with BWM.2/Circ.70/Rev.1.

For the evaluation of trueness, the reference method applied by NIVA for enumerating organisms in the size class ≥10 and <50 µm was a detailed analyses with staining by CMFDA/FDA and observing motility.

DNV finds that the results from the field testing demonstrate a high level of trueness. The FastBallast CMD matched the reference method in both field tests. The precision of the FastBallast CMD was also found to be comparable to the precision of the reference method.

The first two field tests were carried out using a FastBallast CMD applying the previous software algorithm for determining organism densities. However, Chelsea Technologies provided a comparison of the results from the field tests with calculations using the upgraded software algorithm. This comparison showed that the test outcome is the same in all cases and there are no significant differences between the two data sets. The two field tests were thus considered valid tests for the evaluation of the FastBallast CMD even though the software algorithm for the FastBallast CMD was upgraded after the field tests.

The third field test was carried out with the FastBallast CMD applying the upgraded software algorithm.

NIVA was able to confirm all relevant aspects of usability in accordance with the aspects of usability described in BWM.2/Circ.78. Furthermore, NIVA reported that the FastBallast unit was easy to use and requires minimal training.

4 Verification statement

The FastBallast Compliance Monitoring Device (CMD) manufactured Chelsea Technologies Ltd. has been tested by the independent testing entity Norwegian Institute for Water Research (NIVA) in accordance with the IMO Protocol for the verification of ballast water compliance monitoring devices (BWM.2/Circ.78).

DNV has evaluated the test methods and the test results based on the requirements in BWM.2/Circ.78.

DNV was able to confirm that the testing was carried out in accordance with BWM.2/Circ.78 and that the testing entity NIVA has implemented a quality assurance/quality control (QA/QC) programme for the testing that is equivalent to the QA/QC programme for other methods for which NIVA is accredited for ISO/IEC 17025 by Norwegian Accreditation.

DNV finds that the results from the laboratory testing and field testing demonstrate a high level of trueness. The FastBallast CMD matched the reference method (i.e. detailed analyses with CMFDA/FDA) in 71 out of 72 tests and correctly identified compliance during field tests. The precision of the FastBallast CMD was found to be comparable to the precision of the reference method. The FastBallast CMD was also found to have a satisfactory reliability. Therefore, DNV finds that the FastBallast CMD can be considered a reliable CMD for the assessment of the density of living organisms in the size class ≥10 and <50 µm in discharged ballast water for assessing compliance with the D-2 performance standard.

During laboratory and field testing NIVA was also able to confirm relevant aspects of usability of the FastBallast CMD, NIVA reported that the FastBallast unit was easy to use and requires minimal training.

5 References

/1/ Chelsea Technologies, FastBallast System Handbook. Doc No. 2473-100-HB, Issue B

/2/ Norwegian Institute for Water Research (NIVA), Verification of FastBallast as Compliance Monitoring Device (CMD). NVIA report no. 8152-2025 dated 11 December 2025 and amendment to NVIA report no. 8152-2025 dated 8 January 2026

/3/ IMO Circular BWM.2/Circ.78 - Protocol for the verification of ballast water compliance monitoring devices

/4/ IMO Resolution MEPC.300(72) - Code for approval of ballast water management systems (BWMS Code)

/5/ Norwegian Institute for Water Research (NIVA), 17111 Procedure - Enumeration of 10-50 µm organisms with staining method

/6/ Norwegian Institute for Water Research (NIVA), Validation of the test water augmentation

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