標題

MEPC 80 の審議結果の紹介

ClassNK
テクニカル
インフォメーション

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各位

2023 年 7 月 3 日から 7 日に国際海事機関（IMO）第 80 回海洋環境保護委員会（MEPC 80）が開催されました。
今般、IMO より MEPC 80 の議事録及び決議並びにサーキュラが発行されたことから、次の通り同会合の情報及び審議結果をお知らせ致します。

1. 温室効果ガス（GHG）関連
   (1) 2023 年版 IMO GHG 削減戦略
   2023 年版 IMO GHG 削減戦略が採択されました。

   2018 年に採択された IMO GHG 削減初期戦略では、下表に示す国際海運における GHG 削減目標を掲げると共に、同内容を 5 年ごとに見直すことが規定されていました。

目標年	GHG 削減目標（2018 年版）
2030 年 （2008 年比）	・ 輸送効率最低 40%改善
2050 年 （2008 年比）	・ 輸送効率最低 70%改善 ・ GHG 総排出量の最低 50%削減
今世紀中	・ GHG 排出ゼロ

   今回の会合では、国際海運からの GHG 排出削減目標を下表の通り強化することが合意され、2023 年版 IMO GHG 削減戦略として採択されました。

目標年	GHG 削減目標（2023 年版）
2030 年 （2008 年比）	・ 輸送効率最低 40%改善 ・ GHG 総排出量の最低 20%削減（30%削減を目指す） ・ ゼロエミッション燃料等の最低 5%普及（10%普及を目指す）
2040 年 （2008 年比）	・ GHG 総排出量の最低 70%削減（80%削減を目指す）
2050 年	・ 遅くとも 2050 年頃までに GHG 排出ネットゼロ

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2023 年版 IMO GHG 削減戦略では、燃料の燃焼等による船上からの GHG 排出（Tank-to-Wake）に限ることなく、燃料の原料採取から製造、輸送及び貯蔵等までの GHG 排出（Well-to-Tank）を含めた燃料のライフサイクル全体における GHG 排出（Well-to-Wake）に対する削減目標が掲げられています。なお、2030 年及び 2040 年の年間 GHG 総排出量については、2050 年目標を達成するためのチェックポイントとして合意されました。

今回採択された 2023 年版 IMO GHG 削減戦略は、2028 年を目処に見直すことが予定されています。
（添付 4: 決議 MEPC.377(80)参照）

(2) 舶用燃料のライフサイクル GHG 強度に関するガイドラインの採択
船舶の脱炭素化に向けて今後普及が予想される水素やアンモニア、バイオマスを原料とした燃料等の低/ゼロ炭素燃料については、それら燃料の製造や流通過程において排出される GHG にも関心が高まっています。また、メタン（CH4）や亜酸化窒素（N2O）といった CO2 以外の GHG についても、地球温暖化に与える影響が大きいことから注目されています。このような背景から、IMO では、船舶で使用される燃料の原料採取から製造、流通、及び船上での使用を通じたライフサイクル全体における GHG 排出強度（単位エネルギー当たりの GHG 排出量）を総合的に評価するための LCA（Life Cycle Assessment）ガイドラインの策定作業が進められてきました。

今回の会合では、CO2、CH4 及び N2O を含む GHG 排出強度の計算方法、燃料ライフサイクルラベル（燃料ごとの特性に関する情報の統一表記）の様式、排出強度のデフォルト値（各燃料の代表的な GHG 排出強度の値）の指定方法及び第三者による認証項目等について全般的な枠組みを示す、舶用燃料のライフサイクル GHG 強度に関するガイドライン（LCA ガイドライン）が採択されました。一方、本ガイドラインでは、資源作物の栽培に伴う土地利用変化（森林から耕地への変化等）による CO2 排出量、合成燃料の原料として回収された CO2、及び船上で回収された CO2 等の取り扱いをはじめ、燃料の認証方法や GHG 排出強度のデフォルト値の指定等についてさらなる検討開発が必要なため、今後、通信部会や専門家ワークショップを通じて本ガイドラインの実用化に向けた作業を実施していくことが合意されました。
（添付 3: 決議 MEPC.376(80)参照）

(3) GHG 排出削減のための中期対策
今回の会合では、2023 年版 IMO GHG 削減戦略における GHG 削減目標を達成する対策を今後どのように検討してくか等について審議が行われました。

審議の結果、GHG 排出削減のための中期対策として、技術的な要素と経済的な要素の両方から構成される対策案（basket of measures）の検討を進めていくこと、及び当該検討のスケジュール等が合意されました。

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具体的には、船舶の年間 GHG 排出強度を段階的に強化していく制度（GHG Fuel Standard）、GHG 排出量に応じた課金制度（Levy）や化石燃料船への課金とゼロエミ燃料船への還付を組み合わせた制度（Feebate）等について、各々が含む技術的な要素と経済的な要素を組み合わせた対策案を検討し、その対策案が各国に及ぼす影響を評価（包括的影響評価）した上で最終化することが合意されました。

また、中期対策については、2025 年中に採択し、2027 年中に発効を目指すスケジュールが合意され、2023 年版 IMO GHG 削減戦略に盛り込まれました。

(4) 燃料消費実績報告制度の見直し

2019 年より燃料消費量等の運航データの収集及び報告が義務付けられている燃料消費実績報告制度（IMO DCS, Data Collection System）について、主に報告データの粒度の強化及び報告する項目を拡充するための見直し作業が 2022 年より進められてきました。

今回の会合では、IMO DCS で報告が要求される以下の項目の修正及び追加を含む MARPOL 条約附属書 VI 付録 IX の改正案が承認されました。

(i) 燃料を使用する機器ごとの燃料消費量（主機、補機及びボイラ等）
(ii) 航海以外での燃料消費量
(iii) 航海距離（積荷航海距離をボランタリーで提出可）
(iv) 貨物輸送量
(v) 総陸電供給量
(vi) エネルギー効率向上のための革新的技術の種類

本改正案は次回の MEPC 81 で採択される見込みです。なお、「貨物輸送量」に関しては実貨物量を基に算出することも併せて合意されており、その詳細等も含め、次回 MEPC 81 にて関連ガイドラインの修正について検討されることとなりました。

(5) バイオ燃料の CO2 換算係数

GHG 排出削減の観点から代替燃料への切り替えが検討されている中、従来設計の船舶においてドロップイン燃料としての使用が比較的容易なバイオ燃料の利用に関する議論が IMO で行われてきました。

今回の会合では、LCA ガイドラインでバイオ燃料の取り扱いが明確化されるまでの暫定措置として、IMO DCS 及び燃費実績格付け制度（CII, Carbon Intensity Indicator）においてバイオ燃料のライフサイクル（Well-to-Wake）の GHG 排出量を考慮した CO2 換算係数を採用できること等を盛り込んだ暫定ガイダンスが採択されました。国際的な認証スキームにより使用するバイオ燃料の持続可能性が認証されており、ライフサイクル GHG 排出強度が 33 gCO2eq/MJ より低い場合は、その数値を使用することが可能となりました。
（添付 7: MEPC.1/Circ.905 参照）

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(6) EEDI 規制における非常用出力

エネルギー効率設計指標（EEDI, Energy Efficiency Design Index）と最低推進出力規制の両方を満足するために、通常航海時には機関出力を制限し、非常時（荒天時）には出力制限を解除することを認めるコンセプトを導入することについて、これまでの会合において合意されていました。

今回の会合では、本コンセプトの導入に向けて EEDI 計算における主機出力（P_{ME}）の定義、NOx 認証において参照すべき連続最大出力（MCR）、及び NOx テクニカルコードへの影響について審議されました。特に P_{ME} の定義については、EEDI 規制の制限最大出力（MCR_{lim}）の 75%を基準とするか、MCR_{lim} の 83%と MCR の 75%のいずれか小さい方の値を基準とすべきかについて各国で意見が分かれるところとなりましたが、本件を含め合意には至らなかったことから、次回 MEPC 81 以降に継続して審議されることとなりました。

(7) 船上 CO2 回収装置

船舶の排ガスから CO2 を分離･回収することで、船舶から排出される GHG を削減する船上 CO2 回収（OCC, Onboard Carbon Capture）技術が開発･検証され始めています。前回の会合において、OCC 装置を搭載している場合、回収される CO2 量を EEDI、就航船のエネルギー効率指標（EEXI, Energy Efficiency Existing Ship Index）及び CII の計算において考慮すべき、との提案がありました。

今回の会合では、OCC 装置の使用を認めるための規制枠組みを検討するため、温室効果ガスに関する中間作業部会（ISWG-GHG）において新規議題を設置することが合意されました。

2. バラスト水管理条約関連

(1) バラスト水管理条約の見直し

バラスト水管理条約が発効した 2017 年以降、同条約の履行状況を評価し条約要件の見直しを検討するための経験蓄積期間（EBP, Experience Building Phase）が設けられており、これまで条約レビュー計画（CRP, Convention Review Plan）の策定作業が通信部会によって進められてきました。

今回の会合では、条約要件の見直しに向けた優先改正事項を含む CRP が採択されました。今後、改めて通信部会が設置され、次回 MEPC 81 に向けて条約要件の見直し作業が継続されることとなりました。なお、条約要件の改正案は MEPC 84（2026 年春）を目処に承認され、MEPC 85（2026 年秋）を目処に採択される見通しとなっています。

（添付 10: BWM.2/Circ.79 参照）

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(2) 水質に問題がある海域でのバラスト水管理並びに処理済み汚水及びグレーウォータの一時貯留
バラスト水処理装置（BWMS, Ballast Water Management Systems）の正常な連続運転が困難となるような水質（CWQ, Challenging Water Quality）の港湾があることを受け、そのような港湾では BWMS を通さないバイパス処理によってバラスト水を取水し、処理装置が正常に運転できる海域においてバラスト水交換（BWE, Ballast Water Exchange）及びバラスト水処理（BWT, Ballast Water Treatment）を行うための暫定ガイダンスが提案されています。今回の会合では、バイパス処理を開始すべき時期や、通常の運転を再開すべき時期等に関する意見がありましたが、全般的な合意が得られなかったため、次回 MEPC 81 にて引き続き議論が行われることとなりました。

また、特定の港湾において処理済みの汚水やグレーウォータの排出が禁止されていることから、該当する港湾においてバラストタンクに汚水やグレーウォータを一時貯留する際に実施すべき措置等を示すガイダンスが提案されています。今回の会合では複数のガイダンス案について議論されましたが、時間の制約上、次回 MEPC 81 までにガイダンス案を統合する作業を実施した上で改めて議論が行われることとなりました。

(3) バラスト水適合監視装置の試験手順
バラスト水管理条約では、船外排出されるバラスト水に要求される体積当たりの生物含有数が規定されています。この規定への適合性を確認するため、バラスト水のサンプルを採取し分析するバラスト水適合監視装置が利用されており、同装置に対する試験手順を作成すべく、汚染防止・対応小委員会（PPR）において検討が進められていました。

今回の会合では、バラスト水適合監視装置を検証するための試験手順が採択されました。本試験手順に従って承認された適合監視装置は、PSC サンプリング時や船上モニタリングにおいて利用されることが期待されます。
（添付 9: BWM.2/Circ.78 参照）

(4) バラスト水管理条約証書様式の統一解釈
主要な改造を受けた船舶に対する、バラスト水管理条約の証書様式上における建造日の取り扱いを明確化する統一解釈案が PPR で作成され、今回の会合において採択されました。
（添付 8: BWM.2/Circ.66/Rev.5 参照）

（次頁に続く）

(5) バラスト水記録簿関連
今回の会合で採択された強制要件であるバラスト水記録簿（BWRB, Ballast Water Record Book）の書式の改正に関連し、BWRB の記録例を示すガイダンスが採択されました。また、バラスト水電子記録簿の利用促進を目的としたガイドラインが採択され、関連するバラスト水管理条約 A-1 及び B-2 規則の改正案が承認されました。同条約改正案は次回 MEPC 81 にて採択される見込みです。
（添付 2: 決議 MEPC.372(80)及び添付 11: BWM.2/Circ.80 参照）

3. 大気汚染防止関連
(1) 低引火点燃料油及びガス燃料に対する燃料油供給証明書関連要件の改正
前回の会合において、安全上の観点から燃料油供給証明書（BDN, Bunker Delivery Note）に燃料油の引火点を記載するよう MARPOL 条約附属書 VI の改正が採択されました。一方で、低引火点燃料及びガス燃料に対する BDN 関連要件の適用に関する明確化が求められていました。

今回の会合では、低引火点燃料油及びガス燃料に対する BDN の所持及び記載事項等に関する要求を明確化した MARPOL 条約附属書 VI の改正案が承認されました。本改正案は次回 MEPC 81 で採択される見込みです。

4. その他の審議事項
(1) 船体付着生物の越境移動の抑制
2011 年に採択された船体付着生物管理ガイドライン（決議 MEPC.207(62)）について、その実用性及び有効性の評価による見直し作業が 2020 年より行われていました。

今回の会合では、船体防汚システム（AFS, Anti-Fouling System）の適用に応じた船体の部分ごとの点検頻度及び同点検結果に基づく船体清掃の推奨方法等に関する要件を盛り込んだ船体付着生物管理ガイドラインの改正版が採択されました。今後 2025 年にかけて、船体水中洗浄におけるバイオマスや粒子の回収率要件等に関するガイドラインの検討を行うことが合意されました。
（添付 5: 決議 MEPC.378(80)参照）

(2) 有害物質インベントリ作成ガイドラインの改正
2023 年 1 月より船体防汚塗料としてのシブトリンの使用が制限されていることを受け、「2009 年の船舶の安全かつ環境上適正な再生利用のための香港国際条約（通称シップリサイクル条約）」において作成が要求される有害物質インベントリ（IHM）に記載すべき有害物質としてシブトリンを追加する、有害物質インベントリ作成ガイドライン（決議 MEPC.269(68)）の改正版が採択されました。
（添付 6: 決議 MEPC.379(80)参照）

5. 採択された強制要件
今回の会合で採択された主な強制要件は以下の通りです。

（次頁に続く）

(1) バラスト水記録簿の書式
バラスト水管理条約の付録 II に定められているバラスト水記録簿（BWRB）の書式について、これまで記録する事項を「項目」（数字）のみで指定する形式とされていましたが、油記録簿（Oil Record Book）と同様に、記録すべき事項を「コード」（アルファベット）と「項目」（数字）に分けて指定する形式とする改正が採択されました。
（添付 1: 決議 MEPC.369(80)参照）

発効日: 2025 年 2 月 1 日

MEPC 80 の審議概要につきましては IMO ホームページにも掲載されていますのでご参照ください。
https://www.imo.org/en/MediaCentre/MeetingSummaries/Pages/MEPC-default.aspx

なお、本件に関してご不明な点は、以下の部署にお問い合わせください。

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添付:

1.	決議 MEPC.369(80):	Amendments to Appendix II of the International Convention for the Control and Management of Ships' Ballast Water and Sediments, 2004
2.	決議 MEPC.372(80):	Guidelines for the Use of Electronic Record Books under the Ballast Water Management Convention
3.	決議 MEPC.376(80):	Guidelines on Life Cycle GHG Intensity of Marine Fuels (LCA Guidelines)
4.	決議 MEPC.377(80):	2023 IMO Strategy on Reduction of GHG Emissions from Ships
5.	決議 MEPC.378(80):	2023 Guidelines for the Control and Management of Ships' Biofouling to Minimize the Transfer of Invasive Aquatic Species
6.	決議 MEPC.379(80):	2023 Guidelines for the Development of the Inventory of Hazardous Materials
7.	MEPC.1/Circ.905:	Interim Guidance on the Use of Biofuels under Regulations 26, 27 and 28 of MARPOL Annex VI (DCS and CII)
8.	BWM.2/Circ.66/Rev.5:	Unified Interpretations to the BWM Convention and the BWMS Code
9.	BWM.2/Circ.78:	Protocol for the Verification of Ballast Water Compliance Monitoring Devices
10.	BWM.2/Circ.79:	Convention Review Plan for the Experience-building Phase Associated with the BWM Convention
11.	BWM.2/Circ.80:	Guidance on Ballast Water Record-keeping and Reporting

ANNEX 2

RESOLUTION MEPC.369(80)
(adopted on 7 July 2023)

AMENDMENTS TO THE INTERNATIONAL CONVENTION FOR THE CONTROL AND MANAGEMENT OF SHIPS' BALLAST WATER AND SEDIMENTS, 2004

Amendments to appendix II

(Form of Ballast Water Record Book)

THE MARINE ENVIRONMENT PROTECTION COMMITTEE,

RECALLING Article 38(a) of the Convention on the International Maritime Organization concerning the functions of the Marine Environment Protection Committee conferred upon it by international conventions for the prevention and control of marine pollution from ships,

RECALLING ALSO article 19 of the International Convention for the Control and Management of Ships' Ballast Water and Sediments, 2004 (the BWM Convention), which specifies the amendment procedure and confers upon the Marine Environment Protection Committee of the Organization the function of considering amendments thereto for adoption by the Parties,

HAVING CONSIDERED, at its eightieth session, proposed amendments to appendix II of the BWM Convention regarding the form of Ballast Water Record Book,

1 ADOPTS, in accordance with article 19(2)(c) of the BWM Convention, amendments to appendix II, the text of which is set out in the annex to the present resolution;

2 DETERMINES, in accordance with article 19(2)(e)(ii) of the BWM Convention, that the amendments shall be deemed to have been accepted on 1 August 2024 unless, prior to that date, more than one third of the Parties have notified the Secretary-General that they object to the amendments;

3 INVITES the Parties to note that, in accordance with article 19(2)(f)(ii) of the BWM Convention, the said amendments shall enter into force on 1 February 2025 upon their acceptance in accordance with paragraph 2 above;

4 REQUESTS the Secretary-General, for the purposes of article 19(2)(d) of the BWM Convention, to transmit certified copies of the present resolution and the text of the amendments contained in the annex to all Parties to the BWM Convention;

5 ALSO REQUESTS the Secretary-General to transmit copies of the present resolution and its annex to Members of the Organization which are not Parties to the BWM Convention;

6 FURTHER REQUESTS the Secretary-General to prepare a consolidated certified text of the BWM Convention.

ANNEX

AMENDMENTS TO THE INTERNATIONAL CONVENTION FOR THE CONTROL AND MANAGEMENT OF SHIPS' BALLAST WATER AND SEDIMENTS

Appendix II
Form of Ballast Water Record Book

1 Appendix II is replaced by the following:

"**BALLAST WATER RECORD BOOK**

INTERNATIONAL CONVENTION FOR THE CONTROL AND MANAGEMENT OF

SHIPS' BALLAST WATER AND SEDIMENTS

Name of ship: ……..……....

IMO number, distinctive numbers or letters: ….……...…

Gross tonnage: ……

Flag: ……..…

Total ballast water capacity (in cubic metres): …….

Number of the International Ballast Water Management Certificate: ……..……

Period From: ….……. To: ……

A diagram identifying the ballast tanks of the ship, corresponding to the Ballast Water Management Plan, including any multi-use tank, space or compartment designed to allow carriage of ballast water, is integral to and shall be a part of this Ballast Water Record Book.

Introduction

In accordance with regulation B-2 of the annex to the International Convention for the Control and Management of Ships' Ballast Water and Sediments, a record is to be kept of each ballast water operation. This includes discharges at sea and to reception facilities.

"Ballast water" means water with its suspended matter taken on board a ship to control trim, list, draught, stability, or stresses of a ship. Management of ballast water shall be in accordance with an approved Ballast Water Management Plan and taking into account guidelines developed by the Organization.

The Ballast Water Record Book entries should be completed taking into account any guidelines to be developed by the Organization.

The volume of ballast water on board should be estimated in cubic metres. It is recognized that the accuracy of estimating volumes of ballast is left to interpretation.

ENTRIES IN THE BALLAST WATER RECORD BOOK

Entries in the Ballast Water Record Book shall be made on each of the following occasions:

(A) When ballast water is taken on board from the aquatic environment (ballasting operation)

.1 Start time and location (port of uptake or latitude/longitude)

.2 Completion time and location (port of uptake or latitude/longitude and minimum depth of water during uptake)

.3 The identity of the tanks affected

.4 Estimated volume of uptake and final total quantity retained in cubic metres

.5 Whether conducted in accordance with the approved Ballast Water Management Plan

.6 Ballast water treatment method

(B) When ballast water is discharged into the aquatic environment (deballasting operation)

.1 Start time and location (port of discharge or latitude/longitude)

.2 Completion time and location (port of discharge or latitude/longitude and minimum depth of water during discharge)

.3 The identity of the tanks affected

.4 Estimated volume of discharge and final total quantity retained in cubic metres

.5 Whether conducted in accordance with the approved Ballast Water Management Plan

.6 Ballast water treatment method

(C) Whenever ballast water is exchanged, treated through internal circulation or treated in tank

1 Ballast water exchange

.1 Start time and location (latitude/longitude)

.2 Completion time and location (latitude/longitude)

.3 Minimum distance from the nearest land and minimum depth of water during the exchange or, if applicable, identify the designated exchange area in accordance with regulation B-4.2

.4 Whether conducted in accordance with the Ballast Water Management Plan and state the ballast water exchange method (Sequential or Flow-through or Dilution) used

.5 The identity of the tanks affected

.6 Total quantity exchanged and final total quantity on board in cubic metres

.7 Treatment method for the incoming ballast water

2 Ballast water internal circulation for treatment or in-tank treatment

.1 Start time

.2 Completion time

.3 The identity of the tanks affected (identifying source and destination tanks if applicable)

.4 Total quantity treated (through circulation or in tank) in cubic metres

.5 Ballast water treatment method

(D) Uptake or discharge of ballast water from/to a port-based or reception facility

.1 Start time and location of uptake/discharge (state facility name)

.2 Completion time

.3 Operation carried out (whether uptake or discharge)

.4 The identity of the tanks affected

.5 Total quantity in cubic metres and final quantity retained on board

.6 Whether conducted in accordance with the approved Ballast Water Management Plan

.7 Onboard ballast water treatment method

(E) Accidental discharge/ingress or other exceptional uptake or discharge of ballast water

.1 Start time and location of ingress/uptake/discharge (port name or latitude/longitude)

.2 Completion time

.3 Operation carried out (whether ingress, uptake or discharge)

.4 The identity of the tanks affected

.5 Total quantity of ballast water in cubic metres

.6 State the circumstances of ingress, uptake, discharge or loss, the reason thereof, any treatment method used and general remarks

(F) Failures and inoperabilities* of the ballast water management system

.1 Time and location (port name or latitude/longitude) of failure of the ballast water management system

.2 Operation carried out (state whether uptake or discharge)

.3 Description of the issue (e.g. kind of alarm or other description of circumstances)

.4 Time and location (port name or latitude/longitude) when the ballast water management system has been made operational

(G) Ballast tank cleaning/flushing, removal and disposal of sediments

.1 Time and ship's location on commencement of ballast tank cleaning/flushing, removal or disposal of sediments (port name or latitude/longitude)

.2 Time and ship's location on completion of ballast tank cleaning/flushing, removal or disposal of sediments (port name or latitude/longitude)

.3 Tank(s) identification (name of the ballast tanks as per the Ballast Water Management Plan)

.4 Discharge or disposal to a reception facility (state quantity in cubic metres and name of the facility)

.5 Disposal or discharge to the aquatic environment as per Ballast Water Management Plan (state quantity in cubic metres, minimum distance from the nearest land in nm and minimum depth of water in metres)

* Failures and inoperabilities include malfunctions, shutdowns or critical alarms indicating a failure of the ballast water management system which may indicate non-compliance with the D-2 standard (except routine information and warnings).

(H) Additional operational procedures and general remarks

Sample Ballast Water Record Book Page

Name of ship: ……

IMO number, distinctive numbers or letters: ……

Date	Code (letter)	Item (number)	Record of operations / signature of officer in charge

Signature of the master ……"

***

ANNEX 6

RESOLUTION MEPC.372(80)
(adopted on 7 July 2023)

GUIDELINES FOR THE USE OF ELECTRONIC RECORD BOOKS UNDER THE BWM CONVENTION

THE MARINE ENVIRONMENT PROTECTION COMMITTEE,

RECALLING Article 38(a) of the Convention on the International Maritime Organization concerning the functions of the Marine Environment Protection Committee conferred upon it by international conventions for the prevention and control of marine pollution from ships,

RECALLING ALSO that the International Conference on Ballast Water Management for Ships held in February 2004 adopted the International Convention for the Control and Management of Ships' Ballast Water and Sediments, 2004 (the BWM Convention) together with four Conference resolutions,

NOTING that regulation B-2 of the BWM Convention enables the use of electronic record books,

RECOGNIZING the need to develop guidance for the use of electronic record books under the BWM Convention,

HAVING CONSIDERED, at its eightieth session, draft Guidelines for the use of electronic record books under the BWM Convention,

1 ADOPTS the *Guidelines for the use of electronic record books under the BWM Convention*, the text of which is set out in the annex to this resolution;

2 INVITES Governments to apply the Guidelines as soon as possible;

3 AGREES to keep the Guidelines under review in light of experience gained.

ANNEX

GUIDELINES FOR THE USE OF ELECTRONIC RECORD BOOKS UNDER THE BWM CONVENTION

1 INTRODUCTION

1.1 A key element of the International Convention for the Control and Management of Ships' Ballast Water and Sediments, 2004 (BWM Convention) regulations is the recording of ballast water operations from ships.

1.2 The format for the recording of ballast water operations under the BWM Convention is provided in appendix II to the BWM Convention.

1.3 As companies and shipowners increasingly focus on ways to operate in an environmentally responsible manner and aim to reduce the heavy burden associated with paperwork through electronic means, the concept of operational logs in an electronic format has become a popular consideration. It is considered that this approach to recording and reporting should be encouraged as it may have many benefits for the retention of records by companies, crew and officers.

1.4 It is expected that, as companies and shipowners increasingly explore electronic record-keeping, flag State Administrations will be requested to approve electronic recording systems (henceforth referred to as an electronic record book). This guidance aims to provide standardized information on approving an electronic record book to ensure the obligations of the BWM Convention are met and that there is a consistent approach to approving such systems.

2 APPLICATION

2.1 These Guidelines are only applicable to the use of electronic record books on board to meet the requirements of the Ballast Water Record Books and recording requirements under the BWM Convention.

2.2 The use of an electronic record book to record operational logs is an alternative method to a hard copy record book. The electronic record book may allow ships to utilize their technology to reduce administrative burdens and contribute to on board environmental initiatives, e.g. reduction of paper use.

2.3 These Guidelines do not provide information on the management of electronic access to, or electronic versions of, certificates and other documents that do not log continuous operations of a ship.

2.4 These Guidelines do not address the exchange of information from a ship to a company headquarters or other body, as this exchange is not a requirement of record books under the BWM Convention.

2.5 If a shipowner decides to use an electronic record book to record operational logs, instead of a hard copy record book, the following guidance should be taken into consideration by the Administration when approving the electronic record book for use.

3 DEFINITIONS

For the purposes of these Guidelines, the following definitions apply to the extent consistent with the BWM Convention:

.1 **Administration:** means the Government of the State under whose authority the ship is operating. With respect to a ship entitled to fly a flag of any State, the Administration is the Government of that State. With respect to fixed or floating platforms engaged in exploration and exploitation of the seabed and subsoil thereof adjacent to the coast over which the coastal State exercises sovereign rights for the purposes of exploration and exploitation of their natural resources, the Administration is the Government of the coastal State concerned.

.2 **Audit logging:** means logs recording user activities, exceptions and information security events, where logs are kept for an agreed period to assist in future investigations and access control monitoring (ISO/IEC 27001:2006). The time and date for the log should be in Coordinated Universal Time (UTC) and the Ship Mean Time.

.3 **Backup:** means to make a duplicate copy of a file, programme, etc., as a safeguard against loss or corruption of the original. The specific properties of the backup such as its format, frequency, storage location, retention period, are unique to each business organization and should be defined in accordance with a business continuity plan.

.4 **Business continuity plan:** means a collection of procedures and information that is developed, compiled and maintained in readiness for use in the event of an emergency or disaster.

.5 **Company:** means the owner of the ship or any other organization or person such as the manager or the bareboat charterer, who has assumed the responsibility for the operation of the ship from the shipowner and who on assuming such responsibility has agreed to take over all the duties and responsibility imposed.

.6 **Credentials:** means data that is transferred to establish the claimed identity of an entity (ISO 7498-2). Examples of credentials include a unique code/password, electronic key, digital certificate, hardware key, biometric data (e.g. fingerprint).

.7 **Cryptography:** means the discipline which embodies principles, means and methods for the transformation of data in order to hide its information content, prevent its undetected modification and/or prevent its unauthorized use (ISO 7498-2).

.8 **Data:** means a re-interpretable representation of information in a formalized manner suitable for communication, interpretation or processing (ISO/IEC 2382-1).

.9 **Digital certificate:** means a cryptographic transformation (see "cryptography") of a data unit in an asymmetric (public key) cryptosystem, using a digital signature to unite an identity with a public key.

.10 **Digital signature:** means data appended to, or a cryptographic transformation (see "cryptography") of, a data unit that allows a recipient of the data unit to prove the source and integrity of the data unit and protect against forgery e.g. by the recipient (ISO 7498-2).

.11 **Document:** means books, manuals, plans, instructions and similar media that are not certificates and are used to convey a ship's information.

.12 **Electronic record book:** means a device or system used to electronically record the entries for discharges, transfers and other operations as required under the BWM Convention.

.13 **Functional unit:** means an entity of hardware, software, or both, capable of accomplishing a specified purpose (ISO/IEC 2382-1:1993 Information technology – Vocabulary - Part 1: Fundamental terms, definition 10.01.40).

.14 **Graphic character:** means a character, other than a control character, that has a visual representation and is normally produced by writing, printing or displaying (ISO 2382-4).

.15 **IEC 60092 (series):** means standards published by the International Electrotechnical Commission (IEC) on Electrical Installations on Ships.

.16 **IEC 60533:** means standard published by the International Electrotechnical Commission (IEC) on Electrical and Electronic Installations on Ships – Electromagnetic Compatibility.

.17 **Offline:** means usage #1. Pertaining to the operation of a functional unit when not under the direct control of the system with which it is associated. Offline units are not available for immediate use on demand by the system. Offline units may be independently operated. Usage #2. Pertaining to equipment that is disconnected from a system, is not in operation, and usually has its main power source disconnected or turned off.

.18 **Portable Document Format (PDF):** means a digital form for representing documents that enables users to exchange and view electronic documents easily and reliably, independent of the environment in which they were created and the environment in which they are viewed or printed (ISO 32000).

.19 **Port:** means any port, terminal, offshore terminal, ship and repair yard or roadstead which is normally used for the loading, unloading, repair and anchoring of ships, or any other place at which a ship can call.

.20 **Key:** means a sequence of symbols that controls the operation of encipherment and decipherment (see "cryptography").

.21 **Private key:** means (in a public key cryptosystem) that key of a user's key pair which is known only by that user (ISO/IEC 9594-8).

.22 **Public key:** means (in a public key cryptosystem) that key of a user's key pair which is publicly known (ISO/IEC 9594-8).

.23 **Role-based access control (RBAC):** means a control mechanism that provides different access levels to guarantee that individuals and devices can only gain access to and perform operations on network elements, stored information, and information flows for which they are authorized (ISO/IEC 27033-2:2012).

.24 **Shipowner:** means one who owns or operates a ship, whether a person, a corporation or other legal entity, and any person acting on behalf of the owner or operator.

.25 **Signature:** means the handwritten means of identifying the signer of a document or an electronic equivalent which is uniquely and securely linked to an individual.

.26 **Standardized:** means the prescription of an authoritative rule, principle, means of judgement or estimation, criterion, measure of correctness, measure of perfection or some definite degree of any quality that determines what is adequate for a purpose.

.27 **Storage (device):** means a functional unit into which data can be placed, in which they can be retained, and from which they can be retrieved (ISO/IEC 2382-1:1993 Information technology – Vocabulary – Part 1: Fundamental terms).

4 SYSTEM SPECIFICATIONS

4.1 Ability of the electronic record book to meet regulations under the BWM Convention.

4.1.1 The use and output presentation of any electronic record book approved by an Administration should satisfy the requirements of all relevant regulations under the BWM Convention.

4.1.2 As the BWM Convention specifies the recording of a range of information for specific circumstances, an approved system should only allow a complete entry to be saved for verification by the master. For example, when ballast water is discharged into the sea, the entry should not be able to be saved without the entry of the latitude and longitude of the discharge. It is suggested that, where possible, technology which can automatically input required data be installed to ensure accuracy. In the case of equipment failure, manual input should be allowed and the change of the source of data recorded. The automatic data value inputs should be protected by measures aimed at preventing attempts at manipulation or falsification. The system should automatically record any attempts to manipulate or falsify any data.

4.1.3 To assist with consistent recording of data such as dates and positions, the system should be developed to display entry fields and request data formats that are as consistent as possible with other electronic reporting required by IMO and other shipboard systems. Electronic record books should be presented in the form as specified in the BWM Convention in order to assist the smooth transition from hard copy record books to electronic ones.

4.1.4 In order to comply with the BWM Convention's requirements, an electronic record book should have the capability to retain all records made for the minimum period as specified in the BWM Convention. The capability to produce a hard copy of verified records for the master to certify as a true copy, upon request from relevant authorities, should also be provided.

4.2 Updates to the electronic record book

As the BWM Convention continues to evolve, it is essential that all approved electronic record books are reviewed and appropriately updated to ensure relevant BWM Convention amendments are incorporated in the electronic record book. Any updates should not cause loss of existing records, nor make them unreadable, and the system should continue to present all records in the form specified by the BWM Convention. Updates to the system should be completed prior to the entry into force of the relevant BWM Convention amendments.

4.3 Security and accountability of the electronic record book

4.3.1 To ensure the security of an electronic record book, it is critical that the system implements role-based access control. At a minimum, all access to the application should use a unique personal login identifier and password for each user. This level of security ensures that the user making entries into the application is accountable for any false entries or omissions.

4.3.2 The BWM Convention requires the signature of the relevant officer entering a record. As such, the electronic record book should implement audit logging. Audit logging should record a user code, identifying symbol, such as a graphic character, or an equivalent identifier against each entry to uniquely identify the user and whether the user provided, accessed or amended an entry.

4.3.3 Electronic signatures applied to an electronic record book should meet authentication standards, as adopted by the Administration.

4.3.4 Records and entries should be protected by measures aimed at preventing and detecting attempts at unauthorized deletion, destruction or amendment. After an entry is saved by the user, the system should secure the information against unauthorized or untraceable changes. Any change(s) to the entry by the same user or a different user should be automatically recorded and made visible both in the system and in any output presentation or printed versions of the electronic record book. The entry should appear in the list of entries in a format that makes it clear that the entry has been amended. To create transparency of changes to saved or verified entries, it is essential that the system is designed to retain both the original entry and the amendment(s).

4.3.5 If an entry requires amendment, it is recommended that the reason and user identifier, for the officer making the amendment, be recorded for verification by the master. The original entries and all amendments should be retained and visible.

4.3.6 The BWM Convention also requires that information in the record book be verified (e.g. regulation B-2.5 of the BWM Convention requires that each page of the Ballast Water Record Book be signed by the master of the ship). For verification of a single or series of saved entries by the master, the electronic record book should have an additional authentication factor to allow verification. This additional authentication factor should be in the form of additional credentials supplied by the master at the time of verification.

4.3.7 The electronic record book should also be able to log and identify the entries made, amended or verified by time. This will assist in identifying those situations where actions requiring an entry are undertaken over days or weeks and all entered at one time, where such an approach to making entries is consistent with the BWM Convention (e.g. regulation B-2.5 requires that each operation concerning ballast water shall be fully recorded without delay in the Ballast Water Record Book).

4.3.8 To provide for different stages of the data entry and approval process, the electronic record book should provide a status field for each entry that clearly determines the verification stage of the entry. For example, when an entry has been saved in the system by the user, the entry should reflect a term such as "pending" or "awaiting verification". Once the master has verified an entry, a term such as "verified" should be automatically reflected.

4.3.9 If an entry is amended after the master has verified it, the electronic record book should automatically return the entry to "pending" or "re-verification" notifying the master that the entry requires re-verification.

4.3.10 To ensure that entries are verified in a timely manner, the system should provide a reminder that verification by the master is required. Verifications should occur weekly or prior to arrival in-port (as appropriate). Entries not verified should be accompanied by comments advising of the reason for non-verification.

4.3.11 If a recorded entry correlates with a receipt for services (such as a receipt received when ballast water is discharged to a reception facility), or the endorsement provided during regulatory surveys or inspections (such as endorsement of the Cargo Record Book), the electronic record book should allow this receipt or endorsement to be identified or attached to the relevant entry in the system. This receipt can be referenced in the system with a hard copy receipt or endorsement made available upon request. Alternatively, the receipt or endorsement can be attached to the entry in any form deemed acceptable by the Administration (such as a scanned copy of the original in PDF), and the original retained.

4.4 Storage of data recorded in the electronic record book

4.4.1 To create the same level of confidence as a hard copy record book, any electronic record book should form part of the Information Technology Business Continuity Plan. This includes having an appropriate method for backing up data and data recovery if the system were to fail or not be available from the ships' network. Consideration should also be given to alternate power supplies to ensure consistent access to the system. Both data recovery and power sources are essential to allow ongoing entries to be made and facilitate port State control (PSC) inspections.

4.4.2 The electronic record book should have the capability to allow automatic backup of data in the system to offline storage. Backups should ensure the offline record is updated automatically every time changes are made to entries to ensure the backing up process is not forgotten by the user.

4.4.3 The recorded data stored in the offline space should be:

.1 developed using cryptography so that unauthorized access to the information is not possible, and so that once the data has been saved it is in a read-only format with no amendments able to be made to the record (unless done so through the application or by a user with the appropriate level of authorization);

.2 in a format that can be transferred from the point of record to another storage location. Examples include a local (removable) storage peripheral device, local and remote network storage;

.3 maintained in a format that ensures the longevity and integrity of the record; and

.4 in a format that allows output presentation and printing of the record.

4.4.4 This offline record may be provided in any format deemed appropriate by the Administration and should be digitally signed by the master. The properties of the digital signature need to appear on the offline record, including the title; full name of the signer; and date and time of signing. It is recommended that the document be presented in PDF; however, an alternative format may be used. Alternative formats should allow the exchange and view of electronic documents independent of the environment in which they were created and the environment in which they are viewed or printed, in a simple way and with fidelity.

4.4.5 An electronic record book and infrastructure related to the system, including computers and peripherals, should be installed in compliance with IEC 60092 and IEC 60533, where applicable.

5 DECLARATION

5.1 Any electronic system deemed to meet the above criteria should be provided with written confirmation by the Administration and carried on board the ship for the purpose of regulatory surveys or inspections. An example of a declaration can be seen in the appendix.

5.2 Delegating the assessment of the electronic record book against these Guidelines and the issuing of a declaration on behalf of the Administration by recognized organizations (ROs) is at the discretion of the Administration.

6 BWM CONVENTION INSPECTION AND ENFORCEMENT

6.1 Inspection

6.1.1 An electronic record book should have the ability to meet the company verification/audit requirements (such as integration with the ship's safety management system (International Safety Management Code)). The record book should also have the ability to meet all flag State and survey requirements. In addition, an electronic record book should meet all control provisions as set out in the BWM Convention. Such a system should also meet any general requirements set out in the *Procedures for port State control, 2021* (resolution A.1155(32))), as amended, as well as support the detection of violations and enforcement of the Convention as outlined in article 10 of the BWM Convention.

6.1.2 The use of and reliance upon electronic record books in no way relieves shipowners of their existing duty to accurately maintain and produce records during an inspection, as required by the BWM Convention. It is recommended that, if a ship cannot produce the electronic record book or a declaration provided by the Administration during the PSC inspection, the PSC officer should request to view an alternative verified copy of the records or a hard copy record book for verification.

6.2 Equipment requirements during an inspection

As the electronic record book will be presented using the ships' onboard equipment, it should not be necessary for officers to carry additional equipment (e.g. electronic devices to view the records) during inspections. Officers may choose to carry additional equipment on board to aid in the verification process if the ships' onboard equipment is unavailable.

6.3 Prosecution

To accommodate current procedures when investigating illegal discharges under the BWM Convention, the electronic record book should allow for the specific entry, relevant page, pages or the entirety of the electronic record book to be printed at the time of an investigation and each printed page physically signed by the master to certify it as a "true copy". All printed pages should provide the following details in addition to those required under the BWM Convention for record books:

.1 the title and full name of the person that entered the record (in addition to the person's unique username and/or ID in the electronic record book);

.2 any changes that were made to the entries;

.3 the date and time of printing;

.4 the name and version number of the electronic record book from which the true copy was produced; and

.5 page numbering and number of pages to ensure the report is complete.

APPENDIX

EXAMPLE DECLARATION

DECLARATION OF BWM CONVENTION ELECTRONIC RECORD BOOK

Issued under the authority of the Government of:
……
(full designation of the country)

In reference to the requirements set out in the
International Convention for the Control and Management of Ships' Ballast Water and Sediments, 2004 (BWM Convention)

Name of ship……

IMO number ……

Flag State of ship…….

Gross tonnage……..

This is to declare that the electronic system designed to record entries in accordance with the BWM Convention installed on board the ship listed above has been assessed by this Administration to meet the relevant requirements as set out in the BWM Convention and is consistent with the Guidelines developed by the International Maritime Organization (IMO).

Electronic Record Book Manufacturer	
Electronic Record Book Supplier	
Electronic Record Book Installer	
Electronic Record Book Software Name/Version	
Electronic Record Book is in accordance with MEPC resolution/s	
Date of installation (dd/mm/yy)	

A copy of this declaration should be carried on board a ship fitted with this Electronic Record Book at all times.

……..	……	……
NAME	SIGNATURE	DATE (dd/mm/yy)

Seal or stamp of the Authority, as appropriate

***

ANNEX 14

RESOLUTION MEPC.376(80)
(adopted on 7 July 2023)

GUIDELINES ON LIFE CYCLE GHG INTENSITY OF MARINE FUELS
(LCA GUIDELINES)

THE MARINE ENVIRONMENT PROTECTION COMMITTEE,

RECALLING Article 38(a) of the Convention on the International Maritime Organization (the Committee) concerning the functions of the Marine Environment Protection Committee conferred upon it by international conventions for the prevention and control of marine pollution from ships,

RECALLING ALSO that at its seventy-second session, the Committee adopted resolution MEPC.304(72) on *Initial IMO Strategy on Reduction of GHG Emissions from Ships* (Initial Strategy),

NOTING that the Initial Strategy calls for the development of robust life cycle GHG/carbon intensity guidelines for all types of fuels, in order to prepare for an implementation programme for effective uptake of alternative low-carbon and zero-carbon fuels,

NOTING ALSO that at its eightieth session, the Committee adopted resolution MEPC.377(80) on the *2023 IMO Strategy on Reduction of GHG Emissions from Ships* (2023 IMO Strategy) setting out the levels of ambition for the international shipping sector in reducing GHG emissions,

NOTING FURTHER that the 2023 IMO Strategy provides that the levels of ambition and indicative checkpoints should take into account the well-to-wake GHG emissions of marine fuels as addressed in the guidelines on life cycle GHG intensity of marine fuels developed by the Organization,

NOTING that the 2023 IMO Strategy provides that the basket of candidate mid-term GHG reduction measures should take into account the well-to-wake GHG emissions of marine fuels as addressed in the guidelines on life cycle GHG intensity of marine fuels developed by the Organization,

HAVING CONSIDERED, at its eightieth session, the draft guidelines on life cycle GHG intensity of marine fuels (LCA Guidelines),

1 ADOPTS the *Guidelines on life cycle GHG intensity of marine fuels (LCA Guidelines)*, as set out in the annex to the present resolution;

2 AGREES that any regulatory application and implications of the LCA Guidelines should be determined by the Committee in the process of developing regulatory provisions,

3 REQUESTS Member Governments to bring the annexed Guidelines to the attention of shipowners, ship operators, shipbuilders, ship designers, energy companies, fuel producers, bunkering companies, engine manufacturers and any other interested parties;

4 AGREES to keep these Guidelines under review in light of experience gained with their implementation.

GUIDELINES ON LIFE CYCLE GHG INTENSITY OF MARINE FUELS

(LCA Guidelines)

CONTENTS

PART I: GENERAL

1 INTRODUCTION

1.1 These guidelines provide guidance on life cycle GHG intensity assessment for all fuels and other energy carriers (e.g. electricity) used on board a ship. These guidelines aim at covering the whole fuel life cycle (with specific boundaries), from feedstock extraction/cultivation/ recovery, feedstock conversion to a fuel product, transportation as well as distribution/bunkering, and fuel utilization on board a ship. These guidelines also specify sustainability themes/aspects for marine fuels and define a Fuel Lifecycle Label (FLL), which carries information about fuel type, feedstock (feedstock type and feedstock nature/carbon source), conversion/production process (process type and energy used in the process), GHG emission factors, information on fuel blends and sustainability themes/aspects. These guidelines specify the elements of FLL subject to verification/certification and include a general procedure on how the certification scheme/standards could be identified.

2 SCOPE

2.1 The scope of these guidelines is to address well-to-tank (WtT), tank-to wake (TtW), and well-to-wake (WtW) greenhouse gases (GHG) intensity and sustainability themes/aspects related to marine fuels/energy carriers (e.g. electricity for shore power) used for ship propulsion and power generation onboard. The relevant GHGs included are carbon dioxide (CO_2), methane (CH_4) and nitrous oxide (N_2O). These guidelines are not intended to provide guidance for a complete IMO GHG inventory for international shipping. Emissions from cargo (e.g. volatile organic compounds (VOC)), or use of refrigerants are not included; other short-lived climate forcers and precursors such as non-methane volatile organic compounds (NMVOC), sulphur oxides (SO_x), carbon monoxide (CO), particulate matter (PM) and Black Carbon are not part of the scope of these LCA guidelines.

2.2 The system boundaries of the WtW GHG emission factors calculation, in the context of these guidelines span the life cycle of fuels from their sourcing to production, conversion, transport, distribution, and eventually their use on board ships based on an attributional approach.[1] The possibility to expand the system boundaries for specific pathways in which the feedstock is displaced from present use(s) will be assessed on a case-by-case basis.[2] As such, emissions associated with the following life cycle stages of the fuel life cycle chain will be accounted for:

.1 feedstock extraction/cultivation/acquisition/recovery;
.2 feedstock (early) processing/ transformation at source;
.3 feedstock transport to conversion site;
.4 feedstock conversion to product fuel;
.5 product fuel transport/storage/delivery/retail storage/bunkering; and
.6 fuel utilization on board a ship.

2.3 Consistently with the attributional approach and using best available scientific evidence, the WtT emissions calculations (i.e. emissions related to the fuel sourcing, production, conversion, transport and delivery) are assessed regardless of the final use of

[1] Attributional Life Cycle Assessment (LCA): LCA aiming to describe the environmentally relevant physical flows to and from a system and its subsystems over their life cycle; Consequential Life cycle Analysis (LCA): LCA aiming to describe how environmentally relevant flows will change in response to possible decisions. (Finnveden G, Hauschild MZ, Ekvall T, Guinée J, Heijungs R, Hellweg S, et al. "Recent developments in life cycle assessment". *Journal of Environmental Management*. 2009;91(1):1-21).

[2] Such as for captured CO_2 transportation and storage.

fuels/energy carriers, and the TtW emissions (i.e. emissions related to the fuel use) are quantified regardless of the sourcing/production/conversion/transport and delivery steps of the fuel/energy carrier. WtW emissions are given by the sum of the two parts, providing the full emission performance associated with the fuel production and use of a certain fuel/energy in a specific converter onboard.

2.4 The GHG emissions are calculated as CO_2-equivalent (CO_{2eq}), using the Global Warming Potential over a 100-year time-horizon (GWP100) to convert emissions of other gases than CO_2, as given in the fifth IPCC Assessment Report,[3] for CO_2, CH_4 and N_2O, as follows:

- $g_{CO_{2eq}(100y)} = GWP_{CO_2(100y)} \times g_{CO_2} + GWP_{CH_{4(}100y)} \times g_{CH_4} + GWP_{N_2O\,(100y)} \times g_{N_2O}$

(CO_2 1; CH_4 28; N_2O 265), this would read as:

- $g_{CO_{2eq}(100y)} = 1 \times gCO_2 + 28 \times gCH_4 + 265 \times gN_2O)$

These GWP100 values should be used for the purpose of quantifying the GHG intensity in accordance with these guidelines.

A calculation using a Global Warming Potential over a 20-year horizon (GWP20) may be provided as information for comparative purposes, as follows:

- $g_{CO_{2eq}(20y)} = GWP_{CO_2(20y)} \times g_{CO_2} + GWP_{CH_4(20y)} \times g_{CH_4} + GWP_{N_2O\,(20y)} \times g_{N_2O}$

(CO_2 1; CH_4 84; N_2O 264), this would read as:

- $g_{CO_{2eq}(20y)} = 1 \times gCO_2 + 84 \times gCH_4 + 264 \times gN_2O$

2.5 These guidelines provide:

.1 WtW GHG emission factors based on a life cycle attributional methodology, expressing the GHG profile of each representative fuel using on Global Warming Potential (GWP) values over a 100-year time-horizon of included GHG (CO_2, CH_4 and N_2O);

.2 WtT GHG emission factors (CO_2, CH_4 and N_2O) quantified consistently with the attributional approach;

.3 TtW GHG emission factors (CO_2, CH_4 and N_2O); and

.4 sustainability themes/aspects for marine fuels.

2.6 These guidelines define a FLL that carries information about fuel type, feedstock used, fuel production pathway, GHG emission factors, information on fuel blends and sustainability themes/aspects.

[3] The Global Warming Potential values as given in the IPCC Fifth Assessment Report (AR5) are used in the context of these guidelines.

2.7 The figure below shows a generic WtW supply chain for a fuel. The bunkering marks the last step in the WtT phase before the TtW phase starts.

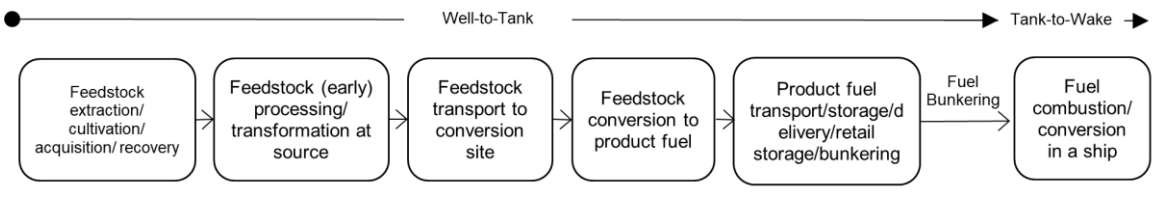

Figure 1: Generic well-to-wake supply chain

2.8 These guidelines include an initial non-exhaustive list of fuels in appendix 1 depicting the main current and expected future marine fuels.

PART II: METHODOLOGY

3 GENERAL APPROACH

3.1 A Life Cycle Assessment (LCA) based approach provides a holistic assessment of the product/service/system from well-to-wake using data specific to the activity considered. The LCA methodology follows the marine fuel from feedstock sourcing to its utilization onboard ships and assesses its life cycle GHG intensity. This approach, applied within the boundaries of the WtW GHG emissions quantification, is applicable across all geographical regions, where emissions occur and allows for quantifying the GHG intensity over the entire fuel/energy supply chain.

3.2 General principles and methodology can be found in ISO 14044:2006 *Environmental management — Lifecycle assessment — Requirements and guidelines*. ISO 14040:2006 *Environmental management — Lifecycle assessment — Principles and framework* sets the framework for the LCA, for the quantification of the environmental impact of products, processes and services in the supply chain. On this basis, a specific LCA methodology can be tailored for its application to marine fuels.

3.3 WtT emissions represent GHG emissions resulting from growing or extracting raw materials, producing and transporting the fuel up to the point of use, including bunkering.

3.4 TtW emissions represent GHG emissions resulting from fuel utilization onboard (e.g. combustion), including potential leaks (fugitive emissions and slip), when relevant for the GHG assessment.

3.5 WtW emissions are the sum of the WtT and TtW emissions and quantify the full life cycle GHG emissions for a given fuel and fuel pathway, used in a given energy converter on board.

3.6 The attributional approach considers all processes along the supply chain of fuel/energy carrier pathways, allowing the quantification of contributions per segment to the overall GHG intensity of the final fuel/energy product used on board a ship. The expansion of the system boundaries for specific pathways, in which the feedstock or intermediate products are diverted from existing use(s), may be considered on a case-by-case basis.

3.7 As regards the expansion of the system boundaries, with consequential elements such as Indirect Land Usage Change (ILUC), concerns with respect to uncertainties and the risk of arbitrariness suggest that the feedstocks with associated ILUC should only be assessed through a risk-based approach, in the framework of sustainability themes/aspects, as part of these guidelines.

3.8 When more than one product results from a conversion process, emissions related to the fuel production should be allocated between main product and co-products. Within such conversion processes, emissions are allocated using their energy content, the so-called "energy allocation" approach. Where co-products allocation cannot be performed based on their energy content (e.g. Oxygen resulting from water electrolysis for H_2 production), other methods such as mass allocation, market revenue allocation (also known as "economic allocation"), could be considered on a case-by-case basis.

3.9 A *co-product* is defined as "an outcome of a production process, which has economic value and elastic supply (intended as the existence of a clear evidence of the causal link between feedstock market value and the quantity of feedstock that can be produced)".

3.10 This definition applies also when a raw material used to produce the fuels is a waste (no economic value) or a residue (unavoidably produced and with negligible economic value, needing further processing to be used in the main conversion process). In case the feedstock is a waste, a residue or a by-product, emissions considered as WtT start at the feedstock collection point onwards until the point of use of the final fuel/energy product.

3.11 According to the *IPCC Guidelines for National Greenhouse Gas Inventories* ("the IPCC Guidelines"),[4] any carbon in the fuel derived from biomass should be reported as an information item and not included in the sectoral or national totals to avoid double counting, since the net emissions from biomass are already accounted for in the Agriculture Forestry and Other Land Use (AFOLU) sector at a national level.

3.12 The scope of the IMO LCA guidelines does not affect or change the IPCC Guidelines. According to the IPCC Guidelines, international waterborne navigation (international bunkers) is grouped under "Mobile combustion" under the Energy sector, but emissions from fuel used by ships in international transport should not be included in national totals in national GHG inventories.

3.13 A fuel batch may be a mix of fuels made from various feedstocks and sources (e.g. by blending 20% biodiesel into fossil MGO) and/or through different production pathways. The calculation should be done using the weighted averages of the energy of the various fuel components. Relevant information should accompany each component fuel in the FLL. Blended fuels should be included in the certification schemes and relevant GHG default or actual emission factors (gCO_2/MJ) determined in proportion to the energy of each fuel part of the blend.

4 WELL-TO-TANK (WtT)

4.1 The pathway of each relevant marine fuel should be clearly described and the GHG emissions during each step of the fuel pathway should be calculated. Specific GHG emissions of a specific non-conventional and non-fossil fuel's pathway may take into account different characteristics across geographic regions, where feedstock production and/or conversion occurs, as appropriate.

[4] *2006 IPCC Guidelines for National Greenhouse Gas Inventories*

4.2 Any further reference in this document to a "fuel pathway" should be understood to include the feedstock structure (the so-called nature/carbon source and feedstock type pair) and the production or conversion process (noting that the same feedstock and fuel type pair can have a different production or conversion process).

4.3 The aim of the WtT methodology is to quantify and evaluate the GHG intensity of fuel production, including all steps mentioned in figure 2. The carbon feedstock and production pathway of a fuel should be identified in order to apply the methodology and is included as part of the FLL. The production steps to be included in the WtT are presented in figure 2.

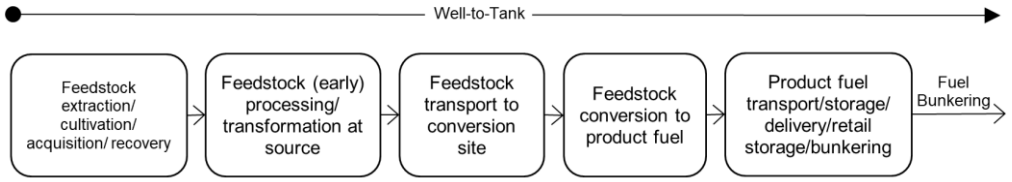

Figure 2: Generic well-to-tank supply chain

4.4 The WtT GHG emission factor ($gCO_{2eq}/MJ_{(LCV)}$ fuel or electricity) is calculated according to Equation (1).

Equation (1)

$$GHG_{WtT} = e_{fecu} + e_l + e_p + e_{td} - e_{sca} - e_{ccs}$$

Term	Units	Explanation
e_{fecu}	gCO_{2eq} / $MJ_{(LCV)}$	Emissions associated with the feedstock extraction/cultivation/acquisition/recovery
e_l	gCO_{2eq} / $MJ_{(LCV)}$	Emissions (annualized emissions (over 20 years) from carbon stock changes caused by direct land-use change)[5]
e_p	gCO_{2eq} / $MJ_{(LCV)}$	Emissions associated with the feedstock processing and/or transformation at source and emissions associated with the conversion of the feedstock to the final fuel product, including electricity generation
e_{td}	gCO_{2eq} / $MJ_{(LCV)}$	Emissions associated with the feedstock transport to conversion plant, and the emissions associated with the finished fuel transport and storage, local delivery, retail storage and bunkering
e_{sca}	gCO_{2eq} / $MJ_{(LCV)}$	Emissions (annualized emission savings (over 20 years) from soil carbon accumulation via improved agricultural management)[6]

5 Pending further methodological guidance to be developed by the Organization, the value of parameter e_l should be set to zero.

6 Pending further methodological guidance to be developed by the Organization, the value of parameter e_{sca} should be set to zero.

Term	Units	Explanation
e_{ccs}	gCO_{2eq} / $MJ_{(LCV)}$	Emissions credit from carbon capture and storage (e_{ccs}), that have not already been accounted for in e_p. This should properly account the avoided emissions through the capture and sequestration of emitted CO_2, related to the extraction, transport, processing and distribution of fuel (c_{sc}). From the above-mentioned emission credit, all the emissions resulting from the process of capturing (e_{cc}) and transporting (e_t) the CO_2 up to the final storage (including the emissions related to the injection, etc.) need to be deducted. This element should be calculated with the following formula: $e_{CCS} = c_{SC} - e_{cc} - e_t - e_{st} - e_x$
c_{sc}	g CO_2 stored / $MJ_{(LCV)}$	Emissions credit equivalent to the net CO_2 captured and stored (long-term: 100 years)
e_{cc}	gCO_{2eq} / $MJ_{(LCV)}$	Emissions associated with the process of capturing, compression and/or cooling and temporary storage of the CO_2
e_t	gCO_{2eq} / $MJ_{(LCV)}$	Emissions associated with transport to a long-term storage site
e_{st}	gCO_{2eq} / $MJ_{(LCV)}$	Any emissions associated with the process of storing (long-term: 100 years) the captured CO_2 (including fugitive emissions that may happen during long-term storage and/or the injection of CO_2 into the storage)
e_x	gCO_{2eq} / $MJ_{(LCV)}$	Any additional emissions related to the CCS

4.5 The WtT emissions in Equation (1) include emissions associated with raw materials extraction or cultivation, primary energy sources used for production of goods and utilities such as energy carriers (e.g. fuels and electricity), transport and distribution (including bunkering), direct land use change and changes in carbon stocks (soil carbon accumulation).

4.6 Processing incorporates all steps and operations needed for the extraction, capture or cultivation of the primary energy source. Process includes basic transformation at source and operations needed to make the resource transportable to the marketplace (e.g. drying, chemical/physical upgrade such as gas-to-liquid, etc.).

4.7 Transportation, processing and distribution include transportation of the products in the fuel pathway to the place of transformation, conditioning (such as compression, cooling), distribution to the marketplace (i.e. bunkering) and eventual leakages, as well as fugitive emissions at any of these stages.

4.8 Allocation of emissions to co-products based on their energy content should be used, as the most appropriate and reliable methodology considering the establishment of an appropriate certification method using values that are predictable, reproducible and stable.

4.9 Land use (direct and indirect) for the production of biofuels may lead to land use change (LUC). LUC can be classified as direct LUC (DLUC) and indirect LUC (ILUC).

4.10 The DLUC definition is based on ISO 14067:2018 described as a change in the use or management of land within the product system being assessed. The DLUC impacts comprises the emissions and sequestration resulting from carbon stock changes in biomass, dead organic matter and soil organic matters, evaluated in accordance with the IPCC Guidelines. When available, sector or country-specific data on carbon stocks may be used; otherwise, IPCC's Tier 1 default emission factors may be considered. Two terms in the WtT Equation (1) capture respectively emissions resulting from direct land use change, i.e. e_l, and sequestration or otherwise increase in the content of soil organic carbon: e_{sca}.

4.11 The ILUC definition is based on ISO 14067:2018, described as a change in the use or management of land, which is a consequence of direct land use change, but which occurs outside the product system being assessed. ILUC occurs as a result of the economic impacts induced by increased biofuel demand on commodity prices with resulting shifts in demand and supply across economic sectors, including primarily food and feed production. ILUC cannot be directly measured and is projected with economic models instead.

4.12 Owing to the variability of assumptions underlying the evaluation of indirect effects, quantitative assessment of GHG effects of ILUC is subject to uncertainty, high quantitative variability and to the risk of arbitrary conclusions. For these reasons, ILUC should be at this stage addressed using a risk-based approach, meaning that quantitative values will not be calculated and assigned to each fuel pathway. The ILUC emissions, as well as the spatial dimension of the ILUC effects, are dependent on a variety of factors such as local/regional conditions and practices for agriculture, current and expected food import demand, national current accounts, the type of feedstock, the alternative economic uses of the same feedstock, etc.

4.13 A qualitative risk-based approach to ILUC includes consideration on the following:

.1 *Low-ILUC risk* qualifies and characterizes biofuel production projects that supply additional feedstock without disrupting existing land uses. When productivity is increased on an area which is in agricultural production, only additional yields should be considered as low-ILUC rather than the entire production; and

.2 *High-ILUC risk* qualifies and characterizes biofuel production projects based on, or displacing, food and feed crops resulting in a significant expansion of the feedstock production area shifting into land with high-carbon stock.

4.14 WtT default emission factors are provided in appendix 2 of these guidelines.

5 TANK-TO-WAKE (TtW)

5.1 The aim of the TtW methodology is to quantify and evaluate the intensity of CO_2, CH_4 and N_2O emitted on board a ship related to the fuel usage, including combustion/conversion and all relevant fugitive emissions with a Global Warming Potential.

5.2 The TtW GHG emission factors should be calculated using Equation (2):

Equation (2)

$$GHG_{TtW} = \frac{1}{LCV}\left(\begin{array}{c}\left(1-\frac{1}{100}\left(C_{slip\_ship}+C_{fug}\right)\right)\times\left(C_{fCO_2}\times GWP_{CO_2}+C_{fCH_4}\times GWP_{CH_4}+C_{fN_2O}\times GWP_{N_2O}\right)+\\ +\left(\frac{1}{100}\left(C_{slip\_ship}+C_{fug}\right)\times C_{sfx}\times GWP_{fuelx}\right)-S_{Fc}\times e_c-S_{Fccu}\times e_{ccu}-e_{OCCS}\end{array}\right)$$

Note: terms S_{Fccu}, e_{ccu} and e_{occs} are pending further methodological guidance to be developed by the Organization. For more details refer to footnotes 11 to 13.

Term	Units	Explanation
C_{slip_ship}	% of total fuel mass	Factor accounting for fuel (expressed in % of total fuel mass delivered to the ship) which escapes from the energy converter without being oxidized (including fuel that escapes from combustion chamber/oxidation process and from crankcase, as appropriate) $C_{slip\_ship} = C_{slip} * (1 - C_{fug}/100)$
C_{slip}	% of total fuel mass	Factor accounting for fuel (expressed in % of total fuel mass consumed in the energy converter) which escapes from the energy converter without being oxidized (including fuel that escapes from combustion chamber/oxidation process and from crankcase, as appropriate)
C_{fug}	% of fuel mass	Factor accounting for the fuel (expressed in % of mass of the fuel delivered to the ship) which escapes between the tanks up to the energy converter which is leaked, vented or otherwise lost in the system[7]
C_{sfx}	gGHG/g fuel	Factor accounting for the share of GHG in the components of the fuel (expressed in g GHG/g fuel) Example: for LNG this value is 1
C_{fCO2}	gCO_2/g fuel	CO_2 emission conversion factor (gCO_2/g fuel completely combusted) for emissions of the combustion and/or oxidation process of the fuel used by the ship
C_{fCH4}	gCH_4/g fuel	CH_4 emission conversion factor (gCH_4/g fuel delivered to the ship) for emissions of the combustion and/or oxidation process of the fuel used by the ship[8]
C_{fN2O}	gN_2O/g fuel	N_2O emission conversion factor (gN_2O/g fuel delivered to the ship) for emissions of the combustion and/or oxidation process of the fuel used by the ship
GWP_{CH4}	gCO_{2eq}/g CH_4	Global Warming Potential of CH_4 over 100 years (based on the fifth IPCC Assessment Report 5)[9] Definition as per https://www.ipcc.ch/assessment-report/ar5/

7 Pending further methodological guidance to be developed by the Organization to determine appropriate factor(s), the value of C_{fug} should be set to zero.

8 For LNG/CNG fuel, the C_{slip_engine} is covering the role of C_{fCH4}, so C_{fCH4} is set to zero for these fuels.

9 Set at 28 based on IPCC AR5.

Term	Units	Explanation
GWP_{N2O}	$gCO_{2eq}/g\ N_2O$	Global Warming Potential of N_2O over 100 years (based on the fifth IPCC Assessment Report 5).[10] Definition as per https://www.ipcc.ch/assessment-report/ar5/
GWP_{fuelx}	gCO_{2eq}/g GHG	Global Warming Potential of GHG in the components of the fuel over 100 years (based on the fifth IPCC scientific Assessment Report)
S_{Fc}	0 or 1	Carbon source factor to determine whether the emissions credits generated by biomass growth are accounted for in the calculation of the TtW value
e_c	gCO_{2eq}/g fuel	Emissions credits generated by biomass growth
e_{ccu}[11]	gCO_{2eq}/g fuel	Emission credits from the used captured CO_2 as carbon stock to produce synthetic fuels in the fuel production process and utilization (that was not accounted under e_{fecu} and e_p)
S_{Fccu}[12]	0 or 1	Carbon source factor to determine whether the emissions credits from the used captured CO_2 as carbon stock to produce synthetic fuels in the fuel production process are accounted for in the calculation of the TtW value
e_{occs}[13]	gCO_{2eq} / g fuel	Emission credit from carbon capture and storage (e_{occs}), where capture of CO_2 occurs onboard. This should properly account for the emissions avoided through the capture and sequestration of emitted CO_2, if CCS occurs on board. From the above-mentioned emission credit, all the emissions resulting from the process of capturing (e_{cc}), and transporting (e_t) the CO_2 up to the final storage (including the emissions related to the injection, etc.) need to be deducted. This element should be calculated with the following formula: $$e_{OCCS} = c_{SC} - e_{cc} - e_t - e_{st} - e_x$$
c_{sc}	gCO_2 / g fuel	Credit equivalent to the CO_2 captured and stored (long-term: 100 years)
e_{cc}	gCO_{2eq} / g fuel	Any emission associated with the process of capturing, compress and temporarily store on board the CO_2

10 Set at 265 based on IPCC AR5.

11 Pending further methodological guidance to be developed by the Organization, the value of the multiplication $S_{Fccu} \times e_{ccu}$ should be set to zero.

12 Pending further methodological guidance to be developed by the Organization, the value of the multiplication $S_{Fccu} \times e_{ccu}$ should be set to zero.

13 Pending further methodological guidance to be developed by the Organization, the value of e_{occs} should be set to zero.

Term	Units	Explanation
e_t	gCO_{2eq} / g fuel	Emissions associated with transport to long-term storage site
e_{st}	gCO_{2eq} / g fuel	Any emission associated with the process of storing (long-term: 100 years) the captured CO_2 (including fugitive emissions that may happen during long-term storage and/or the injection of CO_2 into the storage)
e_x	gCO_{2eq} / g fuel	Any additional emission related to the CCS
LCV	MJ/g	Lower Calorific Value is the amount of heat that would be released by the complete combustion of a specified fuel

5.3 In order to have LCA guidelines that will allow for their clear, robust and consistent application to any possible measure, the methodology allows to calculate two TtW values as follows:

.1 TtW GHG intensity value 1: calculated regardless of the carbon source, therefore the e_c and e_{ccu} parameters should not be taken into account and the S_{Fc} and S_{Fccu} value should be always 0; and

.2 TtW GHG intensity value 2: calculated taking into account the carbon source for fuels of biogenic origins or made from captured carbon, therefore the e_c and e_{ccu} parameters should be taken into account and the S_{Fc} and S_{Fccu} values should be always 1.

5.4 The actual GHG intensity depends both on the properties of the fuel and on the efficiency of the energy conversion. For CO_2, the emission factors are based on the molar ratio of carbon to oxygen multiplied with the carbon mass of the fuel, assuming that all the carbon in the fuel is oxidized (stoichiometric combustion). The CH_4 and N_2O emissions factors are dependent on the combustion and/or conversion process in the energy converter.

5.5 For future use of, for example, fuel cells with a reforming unit, also electro-chemical reactions forming GHGs can be taken into account by this TtW methodology.

5.6 TtW default emission factors are provided in appendix 2 of these guidelines.

6 WELL-TO-WAKE (WtW)

6.1 The aim of the WtW methodology is to integrate WtT and TtW parts, to quantify the full life cycle emissions related to the production and use of a fuel.

6.2 The WtW GHG emission factor (gCO_{2eq}/MJ_{LCV} fuel or electricity) is calculated as follows:

Equation (3)

$$GHG_{WtW} = GHG_{WtT} + GHG_{TtW}$$

where:

Term	Units	Explanation
GHG_{WtW}	$gCO_{2eq}/MJ_{(LCV)}$	Total well-to-wake GHG emissions per energy unit from the use of the fuel or electricity in a consumer on board the ship
GHG_{WtT}	$gCO_{2eq}/MJ_{(LCV)}$	Total well-to-tank GHG upstream emissions per energy unit of the fuel provided to the ship
GHG_{TtW}	$gCO_{2eq}/MJ_{(LCV)}$	Total tank-to-wake GHG downstream emissions per energy unit from the use of the fuel or electricity in a consumer on board the ship

Equation (4)

$$GHG_{WtW} = e_{fecu} + e_l + e_p + e_{td} - e_{sca} - e_{ccs} + \frac{1}{LCV}\left(\begin{array}{c}\left(1 - \frac{1}{100}\left(C_{slip\_ship} + C_{fug}\right)\right) \times \left(C_{fCO_2} \times GWP_{CO_2} + C_{fCH_4} \times GWP_{CH_4} + C_{fN_2O} \times GWP_{N_2O}\right) + \\ \left(\frac{1}{100}\left(C_{slip_{ship}} + C_{fug}\right) \times C_{sfx} \times GWP_{fuelx}\right) - S_{Fc} \times e_c - S_{Fccu} \times e_{ccu} - e_{OCCS}\end{array}\right)$$

Note: terms S_{Fccu}, e_{ccu} and e_{occs} are pending further methodological guidance to be developed by the Organization. For more details refer to section 5.2.

6.3 For the purpose of calculating WtW, the TtW value 2 as calculated in accordance with paragraph 5.3.2 should be used.

7 SUSTAINABILITY

7.1 The sustainability of marine fuels should be assessed considering the following themes/aspects on a life cycle basis:

.1 greenhouse gases (GHG);
.2 carbon source;
.3 source of electricity/energy;
.4 carbon stock – direct land use change (DLUC);
.5 carbon stock – indirect land use change (ILUC);
.6 water;
.7 air;
.8 soil;
.9 waste and chemicals; and
.10 conservation.

Other social and economic sustainability themes/aspects may be considered at a later stage.

7.2 The principle/objective in conjunction with the associated metrics/indicators of each of the sustainability theme/aspect are specified below.

Table 1: Sustainability themes/aspects

Theme/aspect	Principle/Objective	Metric/Indicator
1. Greenhouse Gases (GHG)	Sustainable marine fuels generate lower GHG emissions than conventional marine fuels (energy-based weighted average of liquid petroleum products on 3 specific years of DCS data) on a life cycle basis.	1. GHG intensity in gCO_{2eq}/MJ (GWP100); and GHG intensity in gCO_{2eq}/MJ (GWP20) for comparative purposes.
2. Carbon source	Sustainable marine fuels do not increase GHG intensity from the use of fossil energy sources and the permanence of captured and stored carbon is ensured while also avoiding double counting across economic sectors.	1. Carbon source indicator, including its content (in %) and origin in feedstock used to produce final fuel product, i.e. Fossil, Biogenic, Captured Carbon (including direct air capture (DAC), point source fossil (PSF) and point source biogenic (PSB)), and Others (including mixture of sources).
3. Source of electricity/energy	Sustainable marine fuels requiring significant electricity input during WtT phase and electricity delivered directly to ships are produced by using electricity/energy from renewable, nuclear or biogenic sources, which are additional to current or long-standing demand levels, or by using surplus electricity during off-peak hours.	1. The GHG intensity of electricity used in the production of marine fuels or delivered directly to ships (annual average, expressed in g CO_{2eq}/kWh based on total emissions and actual hours of production.
4. Carbon stock – direct land use change (DLUC)	Sustainable marine fuels are not made from biomass obtained from land with high carbon stock; production of sustainable marine fuels minimizes emissions resulting from Direct Land Use Change.	1. Sustainable marine fuel feedstock does not include biomass obtained from land with high carbon stock (e.g. primary forests, wetlands, or peat lands referred to a specific cut-off date for conversion), or a sustainable land management plan and reporting schedule are in

Theme/aspect	Principle/Objective	Metric/Indicator
		place to ensure that the biomass is obtained from activities or ecosystem services that do not negatively impact the soil carbon stock; 2. The production of sustainable marine fuels does not occur in lands converted from primary forest, forestland, grassland or legally protected land, taking (1 January 2008)[14] as the cut-off date; and 3. Direct land-use change (DLUC) indicator, expressed in GHG (including CO_2, CH_4 and N_2O emissions) intensity, i.e. mass of CO_2 equivalent / MJ of production or yield of feedstock.
5. Carbon stock – indirect land use change (ILUC)	Cultivation of feedstock of sustainable marine fuels minimizes inducing negative changes in the use or management of land which occurs outside the product system being assessed.	1. Indirect carbon stock risk associated with cultivation of feedstock for sustainable marine fuels (see para. 4.13).
6. Water	Production of sustainable marine fuels maintain or enhance water quality and availability.	1. Operational practices are in place to (1) maintain water quality; and (2) use water efficiently and to avoid the depletion of water resources (including surface water, renewable water and fossil/underground water) beyond replenishment capacities; 2. Respect of decision-making of local population on water management; 3. Water environment impact (weighted water consumption on water scarcity);

[14] Pending further guidance to be developed by the Organization.

Theme/aspect	Principle/Objective	Metric/Indicator
		4. Water Use Indicator expressed in m^3/year per MJ or production or yield of feedstock; 5. Freshwater eutrophication indicator, e.g. expressed in kg of phosphorus equivalent (P_{eq}) and kg of nitrogen equivalent (N_{eq}) released to fresh water/kg of feedstock produced or per MJ respectively; and 6. Marine eutrophication indicator, e.g. expressed in kg of phosphorus equivalent (P_{eq}) and kg of nitrogen equivalent (N_{eq}) released to marine water/kg of feedstock produced or per MJ respectively.
7. Air	Production of sustainable marine fuels minimizes negative impacts on air quality.	1. The marine fuel is made in a facility that fully complies with all local, national and regional air pollution laws and regulations.
8. Soil	Production of sustainable marine fuels maintain or enhance soil health.	1. Agricultural and forestry best management practices for feedstock production or residue collection have been implemented to maintain or enhance soil health, such as physical, chemical and biological conditions; and 2. The marine fuel is made in a facility that fully complies with all local, national and regional laws and regulations about soil health.
9. Waste and chemicals	Production of sustainable marine fuels maintain or enhance responsible management of waste and use of chemicals.	1. Operational practices are implemented to ensure that waste arising from, and chemicals used in, production processes are minimized at storage, handling and disposal steps. Reuse or recycling of chemicals and waste is

Theme/aspect	Principle/Objective	Metric/Indicator
		encouraged. 2. Procedures are in place to minimize the use of materials that are neither recyclable nor biodegradable; 3. Average (in tonnes) of hazardous wastes generated per MJ of fuel produced; and 4. Average (in tonnes) of specified industrial chemicals consumed per MJ of fuel produced.
10. Conservation	Production of sustainable marine fuels maintain or enhance biodiversity and ecosystems, or conservation services.	1. The marine fuel is not made from feedstock obtained from areas that due to their biodiversity, conservation value, or ecosystem services, are protected by the State having jurisdiction over the area. Evidence is provided that the activity does not interfere with the protection purposes; and 2. Low invasive-risk feedstock is selected for cultivation and appropriate controls are adopted with the intention of preventing the uncontrolled spread of cultivated alien species and modified microorganisms.

8 FUEL LIFECYCLE LABEL (FLL)

8.1 The FLL is a technical tool to collect and convey the information relevant for the life cycle assessment of marine fuels and energy carriers (e.g. electricity for shore power) used for ship propulsion and power generation onboard in the context of these guidelines.

8.2 The FLL consists of five main parts, as illustrated below:

Part A-1	**Part A-2**	**Part A-3**	**Part A-4**	**Part A-5**
Fuel type (blend)	Fuel Pathway Code	Lower Calorific Value (LCV, MJ/g)	share in fuel blend (%$MJ_{(LCV)}$ / $MJ_{(LCV)}$)	WtT GHG emission factor (GWP100, $gCO_{2eq}/MJ_{(LCV)}$)

+

Part B-1	**(Part B-2)**[15]
Emissions credits related to biogenic carbon source (e_c, in gCO_2/g fuel based on GWP100)	Emissions credits related to source of captured carbon (e_{ccu}, in gCO_2/g fuel based on GWP100)

+

Part C-1	**Part C-2**	**Part C-3**
Value 1 (carbon source NOT taken into account): TtW GHG emission factor (GWP100, $gCO_{2eq}/MJ_{(LCV)}$)	Value 2 (carbon source taken into account): TtW GHG emission factor (GWP100, $gCO_{2eq}/MJ_{(LCV)}$)	Energy Converter

+

Part D	**Part E**
WtW GHG emission factor (GWP100, $gCO_{2eq}/MJ_{(LCV)}$) Note: Part D = Part A-5 + Part C-2	Sustainability (Certification)[16]

8.3 Different parties (fuel suppliers, owners/operators, Administration/RO, etc.) may use different parts of the FLL for different purposes along the fuel pathway. As such, each interested party may use those parts of the FLL as relevant to their activities and purposes rather than the complete, integrated document.

8.4 The five main parts of the FLL are explained below.

.1 **Part A** of the FLL indicates:

.1 fuel type (Part A-1);

.2 fuel pathway code (Part A-2);

.3 lower calorific value (Part A-3, in MJ/g); and

.4 WtT GHG emission factor (Part A-5, in $gCO_{2eq}/MJ_{(LCV)}$ calculated on GWP100).

Part A-4 is only applicable when a fuel batch is supplied to the ship as a blend of fuels with different fuel pathway code (hereinafter referred to as the "fuel blend") and indicates the share of each blend component in the fuel

[15] Pending further methodological guidance to be developed by the Organization (see section 5).

[16] Pending further guidance to be developed by the Organization.

blend (in %$MJ_{(LCV)}$/$MJ_{(LCV)}$). If fuel blends are denoted on volume-basis, a re-calculation on energy basis based on the LCV values of the blend components is required;

For the fuel blend supplied to a ship, the information on fuel type for the mixture is presented under Part A-1 on top of its components, named by percentual order of composition in the fuel, e.g. X (70%), Y (20%), Z (10%). Part A-5, Part C-1, Part C-2 and Part D are the average value weighted on energy share (% $MJ_{(LCV)}$) /$MJ_{(LCV)}$)) of each fuel component, while Part A-2 to A-4, Part B and Part E are kept blank. Each component of the fuel blend with a specific fuel pathways code is presented in a separate row below the row for the fuel blend;

.2 **Part B** of the FLL indicates the carbon credits related to the carbon source, including:

.1 e_c (Part B-1, in gCO_2 / g fuel calculated on GWP100); (and

.2 e_{ccu} (Part B-2, in gCO_2/g fuel calculated on GWP100)),[17]

as defined in section 5 of these guidelines;

.3 **Part C** of the FLL indicates the TtW GHG emission factor of the fuel type in conjunction with the energy converter(s) on board the ship (Part C-3). The TtW GHG emission factor of the fuel type is further categorized as:

.1 Value 1 where carbon source is <u>not</u> taken into account (Part C-1, in gCO_{2eq}/$MJ_{(LCV)}$ calculated on GWP100); and

.2 Value 2 where carbon source is taken into account (Part C-2, in gCO_{2eq}/$MJ_{(LCV)}$ calculated on GWP100),

as defined in section 5 of these guidelines;

.4 **Part D** of the FLL indicates the WtW GHG emission factor of the fuel type (in gCO_{2eq}/$MJ_{(LCV)}$ calculated on GWP100), which is always the sum of Part A-5 and Part C-2; and

.5 **Part E** of the FLL indicates the sustainability performance of the fuel as per Section 7 of these guidelines.

PART III: DEFAULT EMISSION FACTORS AND ACTUAL VALUES

9 DEFAULT EMISSION FACTORS

9.1 The principles and the procedure described for the determination of default emission factors under this section 9 have been used for the establishment of default emission factors and should remain valid for the factors that will be established.

[17] Pending further methodological guidance to be developed by the Organization. For more details on the e_{ccu} parameter and Part B-2 of the FLL, refer to sections 5.2 and 8.2, respectively.

9.2 WtT default emission factors should be calculated using representative and conservative assumptions, which encompass variable performance of feedstock-fuel pathways across world regions and States.

9.3 To establish a WtT default emission factor, at least three reference values from three different, representative, sources should be considered. Among the three (or more) values considered, the upper emission value should be selected as default, and the range of available emission factors should be provided for informative purposes. The reference values should be accompanied by the relevant technical and scientific information (see Template set out in appendix 4) and evaluated against the corresponding information as appropriate, including the agreement between the reference values.

9.4 Emissions related to carbon stock changes caused by direct land-use change (DLUC) (e_l) and emissions savings from soil carbon accumulation via improved agricultural management (e_{sca}) are considered as zero for the establishment of the initial default emission factors. Similarly, this is the case also for the parameters related to carbon capture and storage (ccs), which require further development.

9.5 TtW default emission factors, including slip factors per fuel type and per converter types, are set out in appendix 2 (for those fuels and converters for which such factors are available in resolution MEPC.364(79) on the *2022 Guidelines on the method of calculation of the attained energy efficiency design index (EEDI) for new ships* and the *Fourth IMO GHG Study 2020*). Further TtW default emission factors (with the exception of C_{fCO2} provided in resolution MEPC.364(79)) may be established by following the same rules as for the WtT default emission factors described in paragraph 9.3. No default emission factors are provided for the use of onboard CCS (e_{occs}), and the amount of captured carbon per unit of fuel mass should be specifically certified. The parameters related to emission credits from the used captured CO_2 as carbon stock to produce synthetic fuels (e_{ccu}) requires further development.

9.6 As the definition of C_{fug} factors is considered a difficult parameter to be measured, C_{fug} factors should be established by the best existing knowledge and will be dealt with at a later stage. Until C_{fug} factors are defined, C_{fug} should be set as 0.

9.7 In case additional categories of energy converters (not listed in appendix 2) are proposed, the rules to establish TtW default emission factors as described in paragraph 9.5 above may be followed to ensure that these new converters (e.g. fuel cells) may also be associated with a default emission factor.

10 ACTUAL EMISSION FACTORS

10.1 The aim of actual emission factors is to allow demonstration of superior GHG performance compared to the default emission factors, subject to verification and certification by a third party.

10.2 WtT and TtW emission factors should be based on methodologies established in these guidelines. Actual values provide the WtW (WtT and TtW) GHG intensity for the specific fuel over the life cycle (from fuel production to its use on board).

10.3 For the pathways contained in appendix 1, the description and the calculation method for providing WtT actual emission factors should be provided. In addition, for the pathways not contained in appendix 1, a detailed description of the pathway should be provided.

10.4 The use of actual WtT emission factors is not applicable to purely fossil pathways. However, for fuels which are produced from captured carbon of fossil origin and for fossil fuels where the technology of CCS/CCUS is applied, actual values are allowed. For the fossil component of a blended fuel, fossil fuel default emission factors should be used.

10.5 Actual TtW emission factors are allowed for all fuel pathways[18] and provided in these guidelines.

PART IV: VERIFICATION AND CERTIFICATION

11 ELEMENTS SUBJECT TO VERIFICATION/CERTIFICATION

11.1 When used as evidence for performances, the FLL needs to be verified and certified by a third party, taking into account further guidance to be developed by the Organization.

11.2 The verification and certification of Part A, Part B, Part C, and Part E of the FLL may be carried out separately by different verification bodies. The verification and certification of Part D of the FLL needs to be based on the verified Part A, Part B and Part C.

11.3 For fuel types with a specific fuel pathway code and which will be consumed in a specified energy converter, the default emission factors for Part A-5, Part C-1, Part C-2 and Part D of the FLL are provided in appendix 2. As long as Part A-1 to Part A-4 and Part C-3 of the FLL have been duly verified, the default emission factors contained in these guidelines can be consequently applied without further verification.

11.4 In the case where lower emission factors are claimed compared to the default emission factors for Part A-5, Part C-1, Part C-2 and/or Part D, the actual emission factors can be used only after the verification and certification by a third party, taking into account further guidance referred to in paragraph 11.1.

12 IDENTIFICATION OF CERTIFICATION SCHEMES/STANDARDS

12.1 The verification and certification of individual parts of the FLL will use relevant certification schemes/standards. Different parts of the FLL may be verified using different certification schemes/standards as applicable, while a specific part of the FLL may be addressed by multiple certification schemes/standards with similar scopes.

12.2 The certification schemes/standards used for the purposes specified in paragraph 12.1 above should be recognized by the Committee, taking into account guidance to be developed by the Organization. The list of recognized certification schemes/standards should be publicly available and kept under review.

12.3 Proposals to recognize international certification schemes/standards should be submitted to the Committee for consideration, including an assessment of a set of predetermined criteria which will be further developed for this purpose.

12.4 The framework, criteria and procedures leading to the recognition of certification schemes should be implemented uniformly to guarantee the quality, reliability and robustness of the IMO framework as a whole and to ensure a level playing field among certification schemes.

[18] Verification and certification methodologies would need further work to be established.

PART V: REVIEW

13 CONTINUOUS REVIEW PROCESS

13.1 To ensure that new technological advances and scientific knowledge are taken into account, these guidelines should be kept under continuous technical review taking into account emerging and evolving technologies.

13.2 In particular, the following elements should be kept under review:

.1 WtT, TtW and WtW default emission factors as specified in appendix 2; and

.2 new proposed fuel pathways and the corresponding default emission factors in addition to those specified in appendix 1.

APPENDIX 1

FUEL LIST WITH FUEL PATHWAY CODES

Order	Group	Fuel type	Feedstock structure		Conversion/Production process		Fuel Pathway Code
			Feedstock Type	Nature/Carbon Source	Process Type	Energy used in the process	
1	HFO (VLSFO)	Heavy Fuel Oil (ISO 8217 Grades RME, RMG and RMK, 0.10 < S ≤ 0.50%)	Crude Oil	Fossil	Standard refinery process	Grid mix electricity	HFO(VLSFO)_f_SR_gm
2	HFO (HSHFO)	Heavy Fuel Oil (ISO 8217 Grades RME, RMG and RMK exceeding 0.50% S)	Crude Oil	Fossil	Standard refinery process	Grid mix electricity	HFO(HSHFO)_f_SR_gm
3	LFO (ULSFO)	Light Fuel Oil (ISO 8217 Grades RMA, RMB and RMD maximum 0.10% S)	Crude Oil	Fossil	Standard refinery process	Grid mix electricity	LFO(ULSFO)_f_SR_gm

Order	Group	Fuel type	Feedstock structure		Conversion/Production process		Fuel Pathway Code
			Feedstock Type	Nature/Carbon Source	Process Type	Energy used in the process	
4	LFO (VLSFO)	Light Fuel Oil (ISO 8217 Grades RMA, RMB and RMD, 0.10 < S ≤ 0.50%)	Crude Oil	Fossil	Standard refinery process	Grid mix electricity	LFO(VLSFO)_f_SR_gm
5	Diesel/Gas oil (ULSFO)	Marine Diesel/Gas Oil (ISO 8217 Grades DMX, DMA, DMZ and DMB maximum 0.10 % S)	Crude Oil	Fossil	Standard refinery process	Grid mix electricity	MDO/MGO(ULSFO)_f_SR_gm
6	Diesel/Gas oil (VLSFO)	Marine Diesel/Gas Oil (ISO 8217 Grades DMX, DMA, DMZ and DMB, 0.10 < S ≤ 0.50%)	Crude Oil	Fossil	Standard refinery process	Grid mix electricity	MDO/MGO(VLSFO)_f_SR_gm

Order	Group	Fuel type	Feedstock structure		Conversion/Production process		Fuel Pathway Code
			Feedstock Type	Nature/Carbon Source	Process Type	Energy used in the process	
7	Diesel/Gas oil (ULSFO)	Bio co-processed marine fuel (ISO 8217 Grades DMX, DMA, DMZ and DMB maximum 0.10 % S)	Crude Oil + mixed biomass	Fossil/Biogenic	CoProcessing (CP) in refinery	Grid mix electricity	MDO/MGO(ULSFO)_f_b_CP_gm
8	Diesel/Gas oil (VLSFO)	Bio co-processed marine fuel (ISO 8217 Grades DMX, DMA, DMZ and DMB, 0.10 < S ≤ 0.50%)	Crude Oil + mixed biomass	Fossil/Biogenic	CoProcessing (CP) in refinery	Grid mix electricity	MDO/MGO(VLSFO)_f_b_CP_gm
9	Diesel/Gas oil (ULSFO)	Co-processed marine fuel (ISO 8217 Grades DMX, DMA, DMZ and DMB maximum 0.10 % S)	Crude Oil + recycled carbon	Fossil/Recycled carbon	CoProcessing (CP) in refinery	Grid mix electricity	MDO/MGO(ULSFO)_f_r_CP_gm

Order	Group	Fuel type	Feedstock structure		Conversion/Production process		Fuel Pathway Code
			Feedstock Type	Nature/Carbon Source	Process Type	Energy used in the process	
10	Diesel/Gas oil (VLSFO)	Co-processed marine fuel (ISO 8217 Grades DMX, DMA, DMZ and DMB, 0.10 < S ≤ 0.50%)	Crude Oil + recycled carbon	Fossil/Recycled carbon	CoProcessing (CP) in refinery	Grid mix electricity	MDO/MGO(VLSFO)_f_r_CP_gm
11	LPG[19]	Liquefied Petroleum Gas (Propane)	Crude Oil	Fossil	Standard refinery process and liquefaction	Grid mix electricity	LPG(Propane)_f_SR_gm
12	LPG	Liquefied Petroleum Gas (Propane)	CO_2 + H_2	CO_2: Fossil Point Source Carbon Capture H_2: Fossil Steam Methane Reformation	Fischer-Tropsch Synthesis and liquefaction	Grid mix electricity	LPG(Propane)_fCO2_fH2_FT_gm
13	LPG	Liquefied Petroleum Gas (Propane)	CO_2 + H_2	CO_2: Fossil Point Source Carbon Capture[20] H_2: from Renewable electricity	Fischer-Tropsch Synthesis and liquefaction	Grid mix electricity	LPG(Propane)_fCO2_rH2_FT_gm

19 Regarding LPG, these guidelines consider the final product form the refineries to be always liquefied.

20 CO_2: Fossil Point Source Carbon Capture includes captured CO_2 stemming from fuel combustion and captured CO_2 stemming from extraction of resources underground.

Order	Group	Fuel type	Feedstock structure		Conversion/Production process		Fuel Pathway Code
			Feedstock Type	Nature/Carbon Source	Process Type	Energy used in the process	
14	LPG	Liquefied Petroleum Gas (Propane)	$CO_2 + H_2$	CO_2: Fossil Point Source Carbon Capture H_2: Industrial by-product hydrogen	Fischer-Tropsch Synthesis and liquefaction	Grid mix electricity	LPG(Propane)_fCO2_ibpH2_FT_gm
15	LPG	Liquefied Petroleum Gas (Propane)	$CO_2 + H_2$	CO_2: Direct Air Capture H_2: Fossil Steam Methane Reformation	Fischer-Tropsch Synthesis and liquefaction	Grid mix electricity	LPG(Propane)_rCO2_fH2_FT_gm
16	LPG	Liquefied Petroleum Gas (Propane)	$CO_2 + H_2$	CO_2: Direct Air Capture H_2: from Renewable electricity	Fischer-Tropsch Synthesis and liquefaction	Grid mix electricity	LPG(Propane)_rCO2_rH2_FT_gm
17	LPG	Liquefied Petroleum Gas (Propane)	$CO_2 + H_2$	CO_2: Direct Air Capture H_2: Industrial by-product hydrogen	Fischer-Tropsch Synthesis and liquefaction	Grid mix electricity	LPG(Propane)_rCO2_ibpH2_FT_gm
18	LPG	Liquefied Petroleum Gas (Propane)	$CO_2 + H_2$	CO_2: Biogenic Point Source Carbon Capture H_2: Fossil Steam Methane Reformation	Fischer-Tropsch Synthesis and liquefaction	Grid mix electricity	LPG(Propane)_bCO2_fH2_FT_gm

Order	Group	Fuel type	Feedstock structure		Conversion/Production process		Fuel Pathway Code
			Feedstock Type	Nature/Carbon Source	Process Type	Energy used in the process	
19	LPG	Liquefied Petroleum Gas (Propane)	$CO_2 + H_2$	CO_2: Biogenic Point Source Carbon Capture H_2: from Renewable electricity	Fischer-Tropsch Synthesis and liquefaction	Grid mix electricity	LPG(Propane)_bCO2_rH2_FT_gm
20	LPG	Liquefied Petroleum Gas (Propane)	$CO_2 + H_2$	CO_2: Biogenic Point Source Carbon Capture H_2: Industrial by-product hydrogen	Fischer-Tropsch Synthesis and liquefaction	Grid mix electricity	LPG(Propane)_bCO2_ibpH2_FT_gm
21	LPG	Liquefied Petroleum Gas (Butane)	Crude Oil	Fossil	Standard refinery process and liquefaction	Grid mix electricity	LPG(Butane)_f_SR_gm
22	LPG	Liquefied Petroleum Gas (Butane)	$CO_2 + H_2$	CO_2: Fossil Point Source Carbon Capture H_2: Fossil Steam Methane Reformation	Fischer-Tropsch Synthesis and liquefaction	Grid mix electricity	LPG(Butane)_fCO2_fH2_FT_gm
23	LPG	Liquefied Petroleum Gas (Butane)	$CO_2 + H_2$	CO_2: Fossil Point Source Carbon Capture H_2: from	Fischer-Tropsch Synthesis and liquefaction	Grid mix electricity	LPG(Butane)_fCO2_rH2_FT_gm

Order	Group	Fuel type	Feedstock structure		Conversion/Production process		Fuel Pathway Code
			Feedstock Type	Nature/Carbon Source	Process Type	Energy used in the process	
				Renewable electricity			
24	LPG	Liquefied Petroleum Gas (Butane)	$CO_2 + H_2$	CO_2: Fossil Point Source Carbon Capture H_2: Industrial by-product hydrogen	Fischer-Tropsch Synthesis and liquefaction	Grid mix electricity	LPG(Butane)_fCO2_ibpH2_FT_gm
25	LPG	Liquefied Petroleum Gas (Butane)	$CO_2 + H_2$	CO_2: Direct Air Capture H_2: Fossil Steam Methane Reformation	Fischer-Tropsch Synthesis and liquefaction	Grid mix electricity	LPG(Butane)_rCO2_fH2_FT_gm
26	LPG	Liquefied Petroleum Gas (Butane)	$CO_2 + H_2$	CO_2: Direct Air Capture H_2: from Renewable electricity	Fischer-Tropsch Synthesis and liquefaction	Grid mix electricity	LPG(Butane)_rCO2_rH2_FT_gm
27	LPG	Liquefied Petroleum Gas (Butane)	$CO_2 + H_2$	CO_2: Direct Air Capture H_2: Industrial by-product hydrogen	Fischer-Tropsch Synthesis and liquefaction	Grid mix electricity	LPG(Butane)_rCO2_ibpH2_FT_gm

Order	Group	Fuel type	Feedstock structure		Conversion/Production process		Fuel Pathway Code
			Feedstock Type	Nature/Carbon Source	Process Type	Energy used in the process	
28	LPG	Liquefied Petroleum Gas (Butane)	CO_2 + H_2	CO_2: Biogenic Point Source Carbon Capture H_2: Fossil Steam Methane Reformation	Fischer-Tropsch Synthesis and liquefaction	Grid mix electricity	LPG(Butane)_bCO2_fH2_FT_gm
29	LPG	Liquefied Petroleum Gas (Butane)	CO_2 + H_2	CO_2: Biogenic Point Source Carbon Capture H_2: from Renewable electricity	Fischer-Tropsch Synthesis and liquefaction	Grid mix electricity	LPG(Butane)_bCO2_rH2_FT_gm
30	LPG	Liquefied Petroleum Gas (Butane)	CO_2 + H_2	CO_2: Biogenic Point Source Carbon Capture H_2: Industrial by-product hydrogen	Fischer-Tropsch Synthesis and liquefaction	Grid mix electricity	LPG(Butane)_bCO2_ibpH2_FT_gm
31	LNG	Liquefied Natural Gas (Methane)	Natural Gas	Fossil	Standard LNG production including liquefaction	Grid mix electricity	LNG_f_SLP_gm
32	LNG	Liquefied Natural Gas (Methane)	Mixed 1st, 2nd and 3rd Gen. feedstock	Biogenic	Thermochemical gasification followed by methanation and liquefaction	Grid mix electricity	LNG_b_G_M_gm

Order	Group	Fuel type	Feedstock structure		Conversion/Production process		Fuel Pathway Code
			Feedstock Type	Nature/Carbon Source	Process Type	Energy used in the process	
33	LNG	Liquefied Natural Gas (Methane)	Mixed 1st, 2nd and 3rd Gen. feedstock	Biogenic	Bio-derived LNG via Anaerobic Digestion, separation and liquefaction	Grid mix electricity	LNG_b_AD_gm
34	LNG	Liquefied Natural Gas (Methane)	Mixed 1st, 2nd and 3rd Gen. feedstock	Biogenic	Bio-derived LNG via Anaerobic Digestion, separation with Point Source Carbon Capture (PSCC) and long-term storage and liquefaction	Grid mix electricity	LNG_b_AD_CCS_gm
35	LNG	Liquefied Natural Gas (Methane)	CO_2 + H_2	CO_2: Fossil Point Source Carbon Capture H_2: Fossil Steam Methane Reformation	Methanation and liquefaction	Grid mix electricity	LNG_fCO2_fH2_M_gm
36	LNG	Liquefied Natural Gas (Methane)	CO_2 + H_2	CO_2: Fossil Point Source Carbon Capture H_2: from Renewable electricity	Methanation and liquefaction	Grid mix electricity	LNG_fCO2_rH2_M_gm

Order	Group	Fuel type	Feedstock structure		Conversion/Production process		Fuel Pathway Code
			Feedstock Type	Nature/Carbon Source	Process Type	Energy used in the process	
37	LNG	Liquefied Natural Gas (Methane)	CO_2 + H_2	CO_2: Fossil Point Source Carbon Capture H_2: Industrial by-product hydrogen	Methanation and liquefaction	Grid mix electricity	LNG_fCO2_ibpH2_M_gm
38	LNG	Liquefied Natural Gas (Methane)	CO_2 + H_2	CO_2: Direct Air Capture H_2: Fossil Steam Methane Reformation	Methanation and liquefaction	Grid mix electricity	LNG_rCO2_fH2_M_gm
39	LNG	Liquefied Natural Gas (Methane)	CO_2 + H_2	CO_2: Direct Air Capture H_2: from Renewable electricity	Methanation and liquefaction	Grid mix electricity	LNG_rCO2_rH2_M_gm
40	LNG	Liquefied Natural Gas (Methane)	CO_2 + H_2	CO_2: Direct Air Capture H_2: Industrial by-product hydrogen	Methanation and liquefaction	Grid mix electricity	LNG_rCO2_ibpH2_M_gm
41	LNG	Liquefied Natural Gas (Methane)	CO_2 + H_2	CO_2: Biogenic Point Source Carbon Capture H_2: Fossil Steam Methane Reformation	Methanation and liquefaction	Grid mix electricity	LNG_bCO2_fH2_M_gm

Order	Group	Fuel type	Feedstock structure		Conversion/Production process		Fuel Pathway Code
			Feedstock Type	Nature/Carbon Source	Process Type	Energy used in the process	
42	LNG	Liquefied Natural Gas (Methane)	CO_2 + H_2	CO_2: Biogenic Point Source Carbon Capture H_2: from Renewable electricity	Methanation and liquefaction	Grid mix electricity	LNG_bCO2_rH2_M_gm
43	LNG	Liquefied Natural Gas (Methane)	CO_2 + H_2	CO_2: Biogenic Point Source Carbon Capture H_2: Industrial by-product hydrogen	Methanation and liquefaction	Grid mix electricity	LNG_bCO2_ibpH2_M_gm
44	CNG	Compressed Natural Gas (Methane)	Natural Gas	Fossil	Standard refinery process and compression	Grid mix electricity	CNG_f_SR_gm
45	CNG	Compressed Natural Gas (Methane)	Mixed 1st, 2nd and 3rd Gen. feedstock	Biogenic	Thermochemical gasification followed by methanation and compression	Grid mix electricity	CNG_b_G_M_gm
46	CNG	Compressed Natural Gas (Methane)	Mixed 1st, 2nd and 3rd Gen. feedstock	Biogenic	Bio-derived LNG via Anaerobic Digestion and separation and compression	Grid mix electricity	CNG_b_AD_gm
47	CNG	Compressed Natural Gas (Methane)	Mixed 1st, 2nd and 3rd Gen. feedstock	Biogenic	Bio-derived LNG via Anaerobic Digestion, separation with	Grid mix electricity	CNG_b_AD_CCS_gm

Order	Group	Fuel type	Feedstock structure		Conversion/Production process		Fuel Pathway Code
			Feedstock Type	Nature/Carbon Source	Process Type	Energy used in the process	
					Point Source Carbon Capture (PSCC) and long-term storage and compression		
48	CNG	Compressed Natural Gas (Methane)	$CO_2 + H_2$	CO_2: Fossil Point Source Carbon Capture H_2: Fossil Steam Methane Reformation	Methanation and compression	Grid mix electricity	CNG_fCO2_fH2_M_gm
49	CNG	Compressed Natural Gas (Methane)	$CO_2 + H_2$	CO_2: Fossil Point Source Carbon Capture H_2: from Renewable electricity	Methanation and compression	Grid mix electricity	CNG_fCO2_rH2_M_gm
50	CNG	Compressed Natural Gas (Methane)	$CO_2 + H_2$	CO_2: Fossil Point Source Carbon Capture H_2: Industrial by-product hydrogen	Methanation and compression	Grid mix electricity	CNG_fCO2_ibpH2_M_gm
51	CNG	Compressed Natural Gas (Methane)	$CO_2 + H_2$	CO_2: Direct Air Capture H_2: Fossil Steam	Methanation and compression	Grid mix electricity	CNG_rCO2_fH2_M_gm

Order	Group	Fuel type	Feedstock structure		Conversion/Production process		Fuel Pathway Code
			Feedstock Type	Nature/Carbon Source	Process Type	Energy used in the process	
				Methane Reformation			
52	CNG	Compressed Natural Gas (Methane)	$CO_2 + H_2$	CO_2: Direct Air Capture H_2: from Renewable electricity	Methanation and compression	Grid mix electricity	CNG_rCO2_rH2_M_gm
53	CNG	Compressed Natural Gas (Methane)	$CO_2 + H_2$	CO_2: Direct Air Capture H_2: Industrial by-product hydrogen	Methanation and compression	Grid mix electricity	CNG_rCO2_ibpH2_M_gm
54	CNG	Compressed Natural Gas (Methane)	$CO_2 + H_2$	CO_2: Biogenic Point Source Carbon Capture H_2: Fossil Steam Methane Reformation	Methanation and compression	Grid mix electricity	CNG_bCO2_fH2_M_gm
55	CNG	Compressed Natural Gas (Methane)	$CO_2 + H_2$	CO_2: Biogenic Point Source Carbon Capture H_2: from Renewable electricity	Methanation and compression	Grid mix electricity	CNG_bCO2_rH2_M_gm

Order	Group	Fuel type	Feedstock structure		Conversion/Production process		Fuel Pathway Code
			Feedstock Type	Nature/Carbon Source	Process Type	Energy used in the process	
56	CNG	Compressed Natural Gas (Methane)	CO_2 + H_2	CO_2: Biogenic Point Source Carbon Capture H_2: Industrial by-product hydrogen	Methanation and compression	Grid mix electricity	CNG_bCO2_ibpH2_M_gm
57	Ethane	Ethane	Natural Gas	Fossil	Standard refinery process	Grid mix electricity	Ethane_f_SR_gm
58	Vegetable oil-based fuel	Straight Vegetable Oil	1st Gen. feedstock	Biogenic	Extraction and purification	Grid mix electricity	SVO_b_EP _1stgen_gm
59	Vegetable oil-based fuel	Used oils and fats	2nd Gen. feedstock	Biogenic	Extraction and purification	Grid mix electricity	UOF_b_EP _2ndgen_gm
60	Vegetable oil-based fuel	Algae oil	3rd Gen. feedstock	Biogenic	Extraction and purification	Grid mix electricity	AO_b_EP _3rdgen_gm
61	Diesel	Diesel (FAME)	1st Gen. feedstock	Biogenic	Transesterification	Grid mix electricity	FAME_b_TRE_1stgen_gm_
62	Diesel	Diesel (FAME)	2nd Gen. feedstock	Biogenic	Transesterification	Grid mix electricity	FAME_b_TRE_2ndgen_gm_
63	Diesel	Diesel (FAME)	3rd Gen. feedstock	Biogenic	Transesterification	Grid mix electricity	FAME_b_TRE_3rdgen_gm_
64	Diesel	Renewable Diesel (Bio FT-Diesel)	1st Gen. feedstock	Biogenic	Gasification and Fischer-Tropsch Synthesis	Grid mix electricity	FT-Diesel_b_G_FT_1stgen_gm_
65	Diesel	Renewable Diesel (Bio FT-Diesel)	Mixed 1st, 2nd and 3rd Gen. feedstock	Biogenic	Anaerobic digestion and methane separation and	Grid mix electricity	FT-Diesel_b_AD_FT_gm

Order	Group	Fuel type	Feedstock structure		Conversion/Production process		Fuel Pathway Code
			Feedstock Type	Nature/Carbon Source	Process Type	Energy used in the process	
					Fischer-Tropsch Synthesis		
66	Diesel	Renewable Diesel (Bio FT-Diesel)	Mixed 1st, 2nd and 3rd Gen. feedstock	Biogenic	Anaerobic digestion and methane separation and Fischer-Tropsch Synthesis with Point Source Carbon Capture (PSCC) and long-term storage	Grid mix electricity	FT-Diesel_b_AD_FT_CCS_gm
67	Diesel	Renewable Diesel (FT-Diesel)	CO_2 + H_2	CO_2: Fossil Point Source Carbon Capture H_2: Fossil Steam Methane Reformation	Fischer-Tropsch Synthesis	Grid mix electricity	FT-Diesel_fCO2_fH2_FT_gm
68	Diesel	Renewable Diesel (FT-Diesel)	CO_2 + H_2	CO_2: Fossil Point Source Carbon Capture H_2: from Renewable electricity	Fischer-Tropsch Synthesis	Grid mix electricity	FT-Diesel_fCO2_rH2_FT_gm
69	Diesel	Renewable Diesel (FT-Diesel)	CO_2 + H_2	CO_2: Fossil Point Source Carbon Capture	Fischer-Tropsch Synthesis	Grid mix electricity	FT-Diesel_fCO2_ibpH2_FT_gm

Order	Group	Fuel type	Feedstock structure		Conversion/Production process		Fuel Pathway Code
			Feedstock Type	Nature/Carbon Source	Process Type	Energy used in the process	
				H_2: Industrial by-product hydrogen			
70	Diesel	Renewable Diesel (FT-Diesel)	$CO_2 + H_2$	CO_2: Direct Air Capture H_2: Fossil Steam Methane Reformation	Fischer-Tropsch Synthesis	Grid mix electricity	FT-Diesel_rCO2_fH2_FT_gm
71	Diesel	Renewable Diesel (FT-Diesel)	$CO_2 + H_2$	CO_2: Direct Air Capture H_2: from Renewable electricity	Fischer-Tropsch Synthesis	Grid mix electricity	FT-Diesel_rCO2_rH2_FT_gm
72	Diesel	Renewable Diesel (FT-Diesel)	$CO_2 + H_2$	CO_2: Direct Air Capture H_2: Industrial by-product hydrogen	Fischer-Tropsch Synthesis	Grid mix electricity	FT-Diesel_rCO2_ibpH2_FT_gm
73	Diesel	Renewable Diesel (FT-Diesel)	$CO_2 + H_2$	CO_2: Biogenic Point Source Carbon Capture H_2: Fossil Steam Methane Reformation	Fischer-Tropsch Synthesis	Grid mix electricity	FT-Diesel_bCO2_fH2_FT_gm
74	Diesel	Renewable Diesel (FT-Diesel)	$CO_2 + H_2$	CO_2: Biogenic Point Source Carbon Capture	Fischer-Tropsch Synthesis	Grid mix electricity	FT-Diesel_bCO2_rH2_FT_gm

Order	Group	Fuel type	Feedstock structure		Conversion/Production process		Fuel Pathway Code
			Feedstock Type	Nature/Carbon Source	Process Type	Energy used in the process	
				H_2: from Renewable electricity			
75	Diesel	Renewable Diesel (FT-Diesel)	CO_2 + H_2	CO_2: Biogenic Point Source Carbon Capture H_2: Industrial by-product hydrogen	Fischer-Tropsch Synthesis	Grid mix electricity	FT-Diesel_bCO2_ibpH2_FT_gm
76	Diesel	Renewable Diesel (HVO)	1st Gen. feedstock	Biogenic	Hydrogenation	Grid mix electricity	HVO_b_HD_1stgen_gm_
77	Diesel	Renewable Diesel (HVO)	2nd Gen. feedstock	Biogenic	Hydrogenation	Grid mix electricity	HVO_b_HD_2ndgen_gm_
78	Diesel	Renewable Diesel (HVO)	3rd Gen. feedstock	Biogenic	Hydrogenation	Grid mix electricity	HVO_b_HD_3rdgen_gm_
79	DME	Dimethyl Ether (DME)	1st Gen. feedstock	Biogenic	Gasification and DME Synthesis	Grid mix electricity	DME_b_G_DMES_1stgen_gm_
80	DME	Dimethyl Ether (DME)	2nd Gen. feedstock	Biogenic	Gasification and DME Synthesis	Grid mix electricity	DME-b-G-DMES_2ndgen_gm_
81	DME	Dimethyl Ether (DME)	Mixed 1st, 2nd and 3rd Gen. feedstock	Biogenic	Anaerobic digestion and methane separation and DME Synthesis	Grid mix electricity	DME_b_AD_DMES_gm
82	DME	Dimethyl Ether (DME)	Mixed 1st, 2nd and 3rd Gen. feedstock	Biogenic	Anaerobic digestion and methane separation and	Grid mix electricity	DME_b_AD_DMES_CCS_gm

Order	Group	Fuel type	Feedstock structure		Conversion/Production process		Fuel Pathway Code
			Feedstock Type	Nature/Carbon Source	Process Type	Energy used in the process	
					DME Synthesis with Point Source Carbon Capture (PSCC) and long-term storage		
83	DME	Dimethyl Ether (DME)	Natural Gas	Fossil	Gasification and DME Synthesis	Grid mix electricity	DME_f_G_DMES_gm
84	Diesel	Upgraded Pyrolysis Oil	2nd Gen. feedstock	Biogenic	Pyrolysis, Fast Pyrolysis, and/or Catalytic Fast Pyrolysis and upgrading	Grid mix electricity	UPO_b_UPO_2ndgen_gm_
85	Diesel	Hydrothermal Liquefaction (HTL) Oil	2nd Gen. feedstock	Biogenic	Hydrothermal liquefaction and upgrading	Grid mix electricity	HTL_b_HTL_2ndgen_gm_
86	Methanol	Methanol	Natural Gas	Fossil	Steam Methane Reformation of Natural Gas and Methanol Synthesis	Grid mix electricity	MeOH_f_SMR_gm
87	Methanol	Methanol	Natural Gas	Fossil	Steam Methane Reformation of Natural Gas with Carbon Capture & Storage and Methanol Synthesis	Grid mix electricity	MeOH_f_SMR_CCS_gm
88	Methanol	Methanol	Coal	Fossil	Gasification of Coal and Methanol Synthesis	Grid mix electricity	MeOH_f_G_MS_gm

Order	Group	Fuel type	Feedstock structure		Conversion/Production process		Fuel Pathway Code
			Feedstock Type	Nature/Carbon Source	Process Type	Energy used in the process	
89	Methanol	Methanol	Coal	Fossil	Gasification of Coal with Carbon Capture & Storage and Methanol Synthesis	Grid mix electricity	MeOH_f_G_MS_CCS _gm
90	Methanol	Methanol	2nd and 3rd Gen. feedstock	Biogenic	Gasification of Biomass and Methanol Synthesis	Grid mix electricity	MeOH_b_G_MS_gm
91	Methanol	Methanol	Mixed 1st, 2nd and 3rd Gen. feedstock	Biogenic	Reforming of Renewable Natural Gas (biomethane from Anaerobic Digestion) and Methanol Synthesis	Grid mix electricity	MeOH_b_AD_MS_gm
92	Methanol	Methanol	CO_2 + H_2	CO_2: Fossil Point Source Carbon Capture H_2: Fossil Steam Methane Reformation	Methanol Synthesis	Grid mix electricity	MeOH_fCO2_fH2_MS_gm
93	Methanol	Methanol	CO_2 + H_2	CO_2: Fossil Point Source Carbon Capture H_2: from Renewable electricity	Methanol Synthesis	Grid mix electricity	MeOH_fCO2_rH2_MS_g m

Order	Group	Fuel type	Feedstock structure		Conversion/Production process		Fuel Pathway Code
			Feedstock Type	Nature/Carbon Source	Process Type	Energy used in the process	
94	Methanol	Methanol	$CO_2 + H_2$	CO_2: Fossil Point Source Carbon Capture H_2: Industrial by-product hydrogen	Methanol Synthesis	Grid mix electricity	MeOH_fCO2_ibpH2_MS_gm
95	Methanol	Methanol	$CO_2 + H_2$	CO_2: Direct Air Capture H_2: Fossil Steam Methane Reformation	Methanol Synthesis	Grid mix electricity	MeOH_rCO2_fH2_MS_gm
96	Methanol	Methanol	$CO_2 + H_2$	CO_2: Direct Air Capture H_2: from Renewable electricity	Methanol Synthesis	Grid mix electricity	MeOH_rCO2_rH2_MS_gm
97	Methanol	Methanol	$CO_2 + H_2$	CO_2: Direct Air Capture H_2: Industrial by-product hydrogen	Methanol Synthesis	Grid mix electricity	MeOH_rCO2_ibpH2_MS_gm

Order	Group	Fuel type	Feedstock structure		Conversion/Production process		Fuel Pathway Code
			Feedstock Type	Nature/Carbon Source	Process Type	Energy used in the process	
98	Methanol	Methanol	CO_2 + H_2	CO_2: Biogenic Point Source Carbon Capture H_2: Fossil Steam Methane Reformation	Methanol Synthesis	Grid mix electricity	MeOH_bCO2_fH2_MS_gm
99	Methanol	Methanol	CO_2 + H_2	CO_2: Biogenic Point Source Carbon Capture H_2: from Renewable electricity	Methanol Synthesis	Grid mix electricity	MeOH_bCO2_rH2_MS_gm
100	Methanol	Methanol	CO_2 + H_2	CO_2: Biogenic Point Source Carbon Capture H_2: Industrial by-product hydrogen	Methanol Synthesis	Grid mix electricity	MeOH_bCO2_ibpH2_MS_gm
101	Ethanol	Ethanol	1st Gen. feedstock	Biogenic	Fermentation	Grid mix electricity	EtOH_b_FR_1stgen_gm_
102	Ethanol	Ethanol	2nd Gen. feedstock	Biogenic	Pretreatment/hydrolysis step and Fermentation	Grid mix electricity	EtOH_b_FR_2ndgen_gm_
103	Ethanol	Ethanol	3rd Gen. feedstock	Biogenic	Fermentation	Grid mix electricity	EtOH_b_FR_3rdgen_gm_

Order	Group	Fuel type	Feedstock structure		Conversion/Production process		Fuel Pathway Code
			Feedstock Type	Nature/Carbon Source	Process Type	Energy used in the process	
104	Hydrogen	Hydrogen	Natural Gas	Fossil	Steam Methane Reformation of Natural Gas	Grid mix electricity	H2_f_SMR_gm
105	Hydrogen	Hydrogen	Natural Gas	Fossil	Steam Methane Reformation of Natural Gas with Carbon Capture and long-term storage	Grid mix electricity	H2_f_SMR_CCS_gm
106	Hydrogen	Hydrogen	Natural Gas	Fossil	Methane Pyrolysis into carbon and hydrogen	Grid mix electricity	H2_f_MPO_gm
107	Hydrogen	Hydrogen	Coal	Fossil	Gasification or Carbonization of Coal	Grid mix electricity	H2_f_G_gm
108	Hydrogen	Hydrogen	Coal	Fossil	Gasification or Carbonization of Coal with Carbon Capture and long-term storage	Grid mix electricity	H2_f_G_CCS _gm
109	Hydrogen	Hydrogen	2nd Gen. feedstock	Biogenic	Gasification of biomass and Syngas separation with Point Source Carbon Capture (PSCC) and long-term storage	Grid mix electricity	H2_b_G_SS_CCS_2ndgen_gm_
110	Hydrogen	Hydrogen	Water + Electricity	Renewable	Dedicated Photovoltaic and/or Wind and/or	Renewable electricity	LH2_EL_r_Liquefied

Order	Group	Fuel type	Feedstock structure		Conversion/Production process		Fuel Pathway Code
			Feedstock Type	Nature/Carbon Source	Process Type	Energy used in the process	
					other Electrolysis and liquefaction		
111	Hydrogen	Hydrogen	Water + Electricity	Fossil/Renewable	Electrolysis and liquefaction	Grid mix electricity	LH2_EL_gm_Liquefied
112	Hydrogen	Hydrogen	Water + Electricity	Nuclear	Thermochemical Cycles or Electrolysis and liquefaction	Nuclear	LH2_EL_n_Liquefied
113	Hydrogen	Hydrogen		Industrial by-product hydrogen		Grid mix electricity	LH2_ _ibp_gm _Liquefied
114	Ammonia	Ammonia	Natural Gas	Fossil	Methane Pyrolysis into pure carbon and hydrogen and Haber Bosch process	Grid mix electricity	NH3_f_MPO_HB_gm
115	Ammonia	Ammonia	Natural Gas	Fossil	Steam Methane Reformation of Natural Gas and Haber Bosch process	Grid mix electricity	NH3_f_SMR_HB_gm
116	Ammonia	Ammonia	Natural Gas	Fossil	Steam Methane Reformation of Natural Gas with Point Source Carbon Capture (PSCC) and long-term storage and	Grid mix electricity	NH3_f_SMR_HB_CCS_gm

Order	Group	Fuel type	Feedstock structure		Conversion/Production process		Fuel Pathway Code
			Feedstock Type	Nature/Carbon Source	Process Type	Energy used in the process	
					Haber Bosch process		
117	Ammonia	Ammonia	Coal	Fossil	Gasification of Coal and Haber Bosch process	Grid mix electricity	NH3_f_G_HB_gm
118	Ammonia	Ammonia	Coal	Fossil	Gasification of Coal with Carbon Capture and long-term storage and Haber Bosch process	Grid mix electricity	NH3_f_G_HB_CCS_gm
119	Ammonia	Ammonia	2nd Gen. feedstock	Biogenic	Gasification	Grid mix electricity	NH3_b_G_2ndgen_gm_
120	Ammonia	Ammonia	N_2 + H_2	N_2: separated with renewable electricity H_2: produced from renewable electricity	Haber Bosch process	Grid mix electricity	NH3_rN2_rH2_HB_gm
121	Ammonia	Ammonia	N_2 + H_2	N_2: separated with renewable electricity H_2: Fossil Steam Methane Reformation	Haber Bosch process	Grid mix electricity	NH3_rN2_fH2_HB_gm

Order	Group	Fuel type	Feedstock structure		Conversion/Production process		Fuel Pathway Code
			Feedstock Type	Nature/Carbon Source	Process Type	Energy used in the process	
122	Ammonia	Ammonia	N_2 + H_2	N_2: separated with renewable electricity H_2: Industrial by-product hydrogen	Haber Bosch process	Grid mix electricity	NH3_rN2_ibpH2_HB_gm
123	Ammonia	Ammonia	N_2 + H_2	N_2: separated with grid mix electricity H_2: Fossil Steam Methane Reformation	Thermochemical Cycles or Electrolysis	Nuclear	NH3_gmN2_fH2_EL_n
124	Ammonia	Ammonia	N_2 + H_2	N_2: separated with grid mix electricity H_2: produced from renewable electricity	Thermochemical Cycles or Electrolysis	Nuclear	NH3_gmN2_rH2_EL_n
125	Ammonia	Ammonia	N_2 + H_2	N_2: separated with grid mix electricity H_2: Industrial by-product hydrogen	Thermochemical Cycles or Electrolysis	Nuclear	NH3_gmN2_ibpH2_EL_n
126	Electricity	Electricity		Fossil/Renewable	-	Grid mix electricity	Electricity_gm
127	Electricity	Electricity		Renewable	Dedicated Photovoltaic and/or Wind and/or other	Renewable electricity	Electricity_renewable

Order	Group	Fuel type	Feedstock structure		Conversion/Production process		Fuel Pathway Code
			Feedstock Type	Nature/Carbon Source	Process Type	Energy used in the process	
128	Wind propulsion						

APPENDIX 2

INITIAL DEFAULT EMISSION FACTORS PER FUEL PATHWAY CODE

Order	Fuel type	Fuel Pathway Code	WtT GHG intensity (gCO_{2eq}/MJ)	LCV (MJ/g)	Energy Converter	C_f CO_2 (gCO_2/g fuel)	C_f CH_4 (gCH_4/g fuel)	C_f N_2O (gN_2O/g fuel)	C_{slip}/C_{fug} (mass %)	e_c gCO_{2eq}/g fuel	TtW GHG intensity (gCO2eq/MJ)	NOTE
1	Heavy Fuel Oil (ISO 8217 Grades RME, RMG and RMK, 0.10 < S ≤ 0.50%)	HFO(VLSFO)_f_SR_gm	16.8	0.0402	ALL ICEs	3.114	0.00005	0.00018				Resolution MEPC.364(79) Fourth IMO GHG study
2	Heavy Fuel Oil (ISO 8217 Grades RME, RMG and RMK exceeding 0.50% S)	HFO(HSHFO)_f_SR_gm	14.9	0.0402	ALL ICEs	3.114	0.00005	0.00018				Resolution MEPC.364(79) Fourth IMO GHG study
3	Light Fuel Oil (ISO 8217 Grades RMA, RMB and RMD maximum 0.10% S)	LFO(ULSFO)_f_SR_gm		0.0412	ALL ICEs	3.151	0.00005	0.00018				Resolution MEPC.364(79) Fourth IMO GHG study
4	Light Fuel Oil (ISO 8217 Grades RMA, RMB and RMD, 0.10 < S ≤ 0.50%)	LFO(VLSFO)_f_SR_gm		0.0412	ALL ICEs	3.151	0.00005	0.00018				Resolution MEPC.364(79) Fourth IMO GHG study

Order	Fuel type	Fuel Pathway Code	WtT GHG intensity (gCO_{2eq}/MJ)	LCV (MJ/g)	Energy Converter	C_f CO_2 (gCO_2/g fuel)	C_f CH_4 (gCH_4/g fuel)	C_f N_2O (gN_2O/g fuel)	C_{slip}/C_{fug} (mass %)	e_c gCO_{2eq}/g fuel	TtW GHG intensity (gCO2eq/MJ)	NOTE
5	Marine Diesel/Gas Oil (ISO 8217 Grades DMX, DMA, DMZ and DMB maximum 0.10 % S)	MDO/MGO(ULSFO)_f_SR_gm	17.7	0.0427	ALL ICEs	3.206	0.00005	0.00018				Resolution MEPC.364(79) Fourth IMO GHG study
6	Marine Diesel/Gas Oil (ISO 8217 Grades DMX, DMA, DMZ and DMB, 0.10 < S ≤ 0.50%)	MDO/MGO(VLSFO)_f_SR_gm		0.0427	ALL ICEs	3.206	0.00005	0.00018				Resolution MEPC.364(79) Fourth IMO GHG study
11	Liquefied Petroleum Gas (Propane)	LPG(Propane)_f_SR_gm		0.0463	ALL ICEs	3.000	0.00005	0.00018				Resolution MEPC.364(79) Fourth IMO GHG study
21	Liquefied Petroleum Gas (Butane)	LPG(Butane)_f_SR_gm		0.0457	ALL ICEs	3.030	0.00005	0.00018				Resolution MEPC.364(79) Fourth IMO GHG study

Order	Fuel type	Fuel Pathway Code	WtT GHG intensity (gCO_{2eq}/MJ)	LCV (MJ/g)	Energy Converter	C_f CO_2 (gCO_2/g fuel)	C_f CH_4 (gCH_4/g fuel)	C_f N_2O (gN_2O/g fuel)	C_{slip}/C_{fug} (mass %)	e_c gCO_{2eq}/g fuel	TtW GHG intensity (gCO2eq/MJ)	NOTE
31	Liquefied Natural Gas (Methane)	LNG_f_SLP_gm		0.0480	LNG Otto (dual fuel medium speed)	2.750	0	0.00011	3.5/-			Resolution MEPC.364(79) Fourth IMO GHG study
					LNG Otto (dual fuel slow speed)				1.7/-			
					LNG Diesel (dual fuel slow speed)				0.15/-			
					LBSI (Lean-Burn Spark-Ignited)				2.6/-			
					Steam Turbines and boilers				0.01/-			

Order	Fuel type	Fuel Pathway Code	WtT GHG intensity (gCO_{2eq}/MJ)	LCV (MJ/g)	Energy Converter	C_f CO_2 (gCO_2/g fuel)	C_f CH_4 (gCH_4/g fuel)	C_f N_2O (gN_2O/g fuel)	C_{slip} /C_{fug} (mass %)	e_c gCO_{2eq}/g fuel	TtW GHG intensity (gCO_{2eq}/MJ)	NOTE
33	Liquefied Natural Gas (Methane)	LNG_b_AD_gm			LNG Otto (dual fuel medium speed) LNG Otto (dual fuel slow speed) LNG Diesel (dual fuel slow speed) LBSI (Lean-Burn Spark-Ignited) Steam Turbines and boilers	2.750						
62	Diesel (FAME)	FAME_b_TRE_gm_2ndgen	20.8	0.0372	ALL ICEs							
77	Renewable Diesel (HVO)	HVO_b_HD_gm_1stgen	14.9	0.044	ALL ICEs							

Order	Fuel type	Fuel Pathway Code	WtT GHG intensity (gCO_{2eq}/MJ)	LCV (MJ/g)	Energy Converter	C_f CO_2 (gCO_2/g fuel)	C_f CH_4 (gCH_4/g fuel)	C_f N_2O (gN_2O/g fuel)	C_{slip}/C_{fug} (mass %)	e_c gCO_{2eq}/g fuel	TtW GHG intensity (gCO2eq/MJ)	NOTE
105	Hydrogen	H2_f_SMR_CCS_gm		0.12	ALL ICEs Fuel cell	0						
121	Ammonia	NH3_rN2_fH2_HB_gm		0.0186	ALL ICEs Fuel cell	0						

APPENDIX 3

ABBREVIATIONS AND GLOSSARY

Abbreviations

AR – IPCC Assessment Report
BDN – Bunkering Delivery Note
C_f – Emission conversion factors $C_{fCO2/CH4/N2O}$ (g GHG (CO_2/CH_4/N_2O)/g fuel) for emissions of the combustion and/or oxidation process, including the fuel with relevant GWP effect resulting from the combustion energy conversion
CH_4 – Methane
CO_2 – Carbon dioxide
CO_{2eq} – Carbon dioxide equivalent
CCS – Carbon Capture and Storage
CCU – Carbon Capture and Utilization
DAC – Direct Air Capture
DCS – IMO ship fuel oil consumption Data Collection System
DLUC – Direct Land Use Change
FLL – Fuel Lifecycle Label
GHG – Greenhouse gas
GWP – Global Warming Potential
ILUC – Indirect Land Use Change
IPCC – Intergovernmental Panel on Climate Change
LCA – Life Cycle Assessment
LCV – Lower Calorific Value (MJ/g fuel)
NMVOC – Non-Methane Volatile Organic Compounds
N_2O – Nitrous oxide
NTC – NO_x Technical Code
RFNBO – Renewable Fuels of Non-Biological Origin
SLCF – Short-Lived Climate Forcers
TtW – Tank-to-Wake
WtT – Well-to-Tank
WtW – Well-to-Wake
VOC – Volatile Organic Compounds

Glossary

Co-product – an outcome of a production process, which has a relevant economic value and elastic supply (intended as the existence of a clear evidence of the causal link between feedstock market value and the quantity of feedstock that can be produced).

Biomass – Biomass is renewable organic material that comes from plants and animals.

Renewables – any form of energy from solar, geophysical or biological sources that is replenished by natural processes at a rate that equals or exceeds its rate of use. Renewables are obtained from the continuing or repetitive flows of energy occurring in the natural environment and includes low-carbon technologies such as solar energy, hydropower, wind, tide and waves and ocean thermal energy, as well as renewable fuels such as biomass.

Global Warming Potential – Global Warming Potential indicates the potential of a greenhouse gas to trap extra heat in the atmosphere over time in relation to carbon dioxide. The enhanced heat trapping in the atmosphere (i.e. the "greenhouse effect") is caused by the absorption of infrared radiation by a given gas. The GWP also depends on the atmospheric lifetime of a gas, and the

time-horizon considered (for example, GWP20 is based on the energy absorbed over 20 years, whereas GWP100 is based on the energy absorbed over 100 years. Each greenhouse gas has a specific global warming potential which is used to calculate the CO_2-equivalent (CO_{2eq}).

Land Use Change - Production of bio-based fuels leads to land use change (LUC). LUC can be classified as direct LUC (DLUC) and indirect LUC (ILUC).

Life Cycle Assessment (LCA) framework – Life Cycle Assessment determines the potential environmental impacts of products, processes or services from cradle to grave, e.g. from acquisition/extraction of raw materials through to processing, transport, use and disposal.

System boundaries – The system boundary determines which entities (unit processes) are inside the system and which are outside. It essentially determines which life cycle/supply chain stages and processes are included in the assessment and need to be in accordance with the goal and scope of the study.

System expansion – ISO 14040 recommends the use of system expansion whenever possible. System expansion is part of the consequential LCA method that seeks to capture change in environmental impact as a consequence of a certain activity.

Well-to-Wake - WtW studies estimate the energy requirements and the resulting greenhouse gas (GHG) emissions in the production of a fuel and its use in a ship, based on the broader Life Cycle Assessment (LCA) methodology. The term 'Well' is used for fuels from all sources, because although the term is most applicable to conventional crude oil resources, it is widely used and understood.

APPENDIX 4

TEMPLATE FOR WELL-TO-TANK DEFAULT EMISSION FACTOR SUBMISSION

1 ***Explanatory remarks on the general scope of the template:*** *This template aims at collecting and presenting in a clear and structured manner the input data used to calculate a "default emission factor" for a specific "feedstock-to-fuel" pathway. A "default emission factor" aims as representing the quantitative results of a high-level assessment about the carbon intensity (gCO_{2eq}/MJ) of a feedstock-to-fuel value chain. The default emission factor is not meant to represent the best available way to produce a fuel, rather a value potentially describing a feedstock production then converted in a standard plant, located in a generic region. A default emission factor does not have to capture process improvement, with respect to current production, nor innovative technologies. The goal of default emission factor is, at least, twofold:*

.1 allow for a carbon intensity comparison among different technologies;

.2 allow for operators to demonstrate lower core life cycle emissions compared to the default core life cycle, thought a certification process.

2 Operators (e.g. fuel producers) can ask for being certified, in order to prove better performances than the default emission factor (that cannot therefore be the representation of the best available technology), obtain a certified "actual value". Actual values may also be used when the fuel producer has defined a new pathway that does not have a default core life cycle emission factor.

3 This template allows presenting the minimum set of data required for the calculation of default core LCA emission factors, ensuring quality in terms of data relevance, adequacy, quality, transparency and accessibility.

PATHWAY DESCRIPTION

4 This section should clearly present the pathway modelled, with the aim for providing at least information on: the type of feedstock used, a description of the technology used for converting such feedstock in the final fuel, and any other relevant information, consistently with the system boundary of the LCA guidelines.

5 ***Explanatory remarks on the pathway description:*** *The default emission factors are based on the WtT methodology, aiming at evaluating the amount of GHG emissions for the fuel production and distribution. The production steps to be included in the WtT are:*

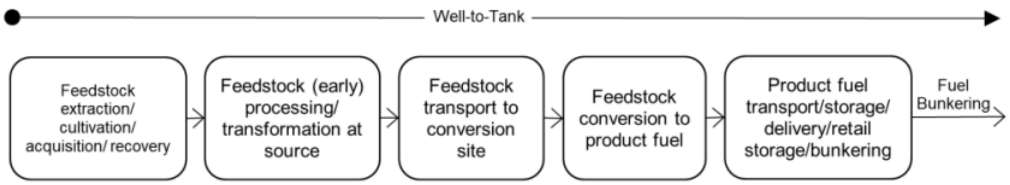

Figure 2 – Generic well-to-tank supply chain

The system boundaries defined for describing a specific feedstock-to-fuel pathway shall be in line with the definitions contained in the guidelines.

Additional details and relevant information may be added in appendices, such as location, production capacity, age of production facility or facilities.

INPUT DESCRIPTION

6 This section should clearly present the input used for the modelling exercise.

7 Source of the data and of the used model should be reported.

8 ***Explanatory remarks on the input description****: In order to provide guidance to fill the template, please see below some tables aiming at presenting the data that should be reported, per pathway (example based on a lipid feedstock production and conversion). As, in practical terms, the tables are "pathway specific", please adapt when needed.*

Table 1: e_{fecu} inputs and outputs for XXX feedstock

				XXXX, per dry kg	**Data source/Model used**
	XXX feedstock	Agricultural Inputs	Total N (g)	…	zzz et al. 2010
e_{fecu}			P_2O_5 (g)	…	ecoinvent
			K_2O (g)	…	GREET
			Diesel (MJ)	…	…
			…	…	…
		per kg XXXX oil			
		Oil Extraction Inputs		Values	Data source/ Model used
			Feedstock (g, dry)	…	zzz et al. 2010
			NG (MJ)	…	ecoinvent
			N-Hexane (MJ)	…	GREET
			Electricity (MJ)	…	…
			Electricity (MJ)	…	…
			…	…	…
			Co-product, zzz(g)	…	…
			Co-product, zzz (g)	…	…
		Oil Extraction Outputs	Co-product, zzz (g)	…	…
			…	…	…

Table 2: e_p Inputs and outputs for XXXX conversion process *Explanatory remark: including all the needed steps to pre-treat the feedstock in order to be able to convert it into the fuel, via the selected conversion process.*

	per MJ fuel		
		Values	**Data source/model used**
Inputs	Feedstock (g oil)	…	zzz et al. 2010
	NG (MJ)	…	ecoinvent
	H_2 (MJ)	*	GREET
	Electricity (MJ)	…	…
	Explanatory remark: *placeholder for key material inputs (e.g. chemicals, etc.)*	…	…
Outputs	Co-product, propane mix (MJ)	**	…
	Co-product, naphtha (MJ)	**	…
	Co-product, xxxx (MJ)	…	…
	…	…	…

*H_2 derived from NG steam reforming, included in NG input; ** Inputs after allocation

Table 3: Inputs for regional electricity generation mixes

	US (%)[1]	**EU (%)[2]**	**India[3] (%)**	**Xxx (%)**
Residual oil	…	…	…	…
Natural gas	…	…	…	…
Coal	…	…	…	…
Nuclear power	…	…	…	…
Biomass	…	…	…	…
Hydroelectric	…	…	…	…
Geothermal	…	…	…	…
Wind	…	…	…	…
Solar PV	…	…	…	…
Others	…	…	…	…

[1] GREET 20xx, [2] EEA, 20xx (EU electricity mix 20xx), [3]International Energy Agency 20xx.

Table 4: e_{td} Inputs for transportation of feedstock and fuels *Explanatory remark: in filling the table, please add the fuel used - In the "Data source/model used" please specify the type of fuel, the specific efficiency and energy converter, if available*.

	Feedstock Transportation		Data source/model used
e_{td} Inputs for Transport and Distribution	Distance (km)	xxx; xxx	
	Mode	Heavy-duty truck; Train; Ship	
	Share (%)	yy; yy; yyy	
	Fuel Transportation		
	Distance (km)	xxx; xxxx; xx	
	Mode	Barge; Rail; Heavy-duty truck	
	Share (%)	y; yy; yy	
	Fuel Distribution		
	Distance (km)	xx	
	Mode	Heavy-duty truck	
	Share (%)		
	…	…	
	Any other Transportation and Distribution		

MAIN RESULTS

9 This section should present the results of the modelled pathway.

Table 5: Fuel identification

Fuel Pathway Code	LCV (MJ/g)	Density (kg/m^3)	$CfCO_2$

Table 6: Proposed default emission factors for XXX-converted in a YYYY pathway

Region	efecu Feedstock cultivation/extraction	etd Feedstock transportation	ep Fuel production	(Sum of the terms) Proposed WtT GHG intensity (gCO_{2eq}/MJ) emission factors
ZZZZ				
AAAA				
BBBB				
…				

APPENDIX

10 Brief description of the pathway

11 Brief description of the technology

….

REFERENCES

12 REF (APA format)

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ANNEX 15

RESOLUTION MEPC.377(80)
(adopted on 7 July 2023)

2023 IMO STRATEGY ON REDUCTION OF GHG EMISSIONS FROM SHIPS

THE MARINE ENVIRONMENT PROTECTION COMMITTEE,

RECALLING Article 38(e) of the Convention on the International Maritime Organization concerning the functions of the Marine Environment Protection Committee (the Committee) to consider and take appropriate action with respect to any other matters falling within the scope of the Organization which would contribute to the prevention and control of marine pollution from ships,

ACKNOWLEDGING that work to address greenhouse gas (GHG) emissions from ships has been undertaken by the Organization continuously since the adoption of Conference resolution 8 on *CO_2 emissions from ships* in September 1997, in particular, through the adoption of global mandatory technical and operational energy efficiency measures for ships under MARPOL Annex VI,

ACKNOWLEDGING ALSO the decisions of the Assembly at its thirtieth and thirty-second sessions in December 2017 and December 2021, respectively, that approved for the Organization a strategic direction to "Respond to climate change",

RECALLING that the Committee at its seventy-second session (MEPC 72) in April 2018 adopted, by resolution MEPC.304(72), the *Initial IMO Strategy on Reduction of GHG Emissions from Ships* (Initial IMO GHG Strategy),

NOTING that the Initial IMO GHG Strategy foresees that a revised IMO GHG Strategy should be adopted in 2023,

RECALLING the United Nations 2030 Agenda for Sustainable Development,

RECALLING ALSO the Paris Agreement adopted at the UN Climate Change Conference (COP 21), which identifies the long-term goal to hold the increase in the global average temperature to well below 2°C above pre-industrial levels and to pursue efforts to limit the temperature increase to 1.5°C above pre-industrial levels, recognizing that this would significantly reduce the risks and impacts of climate change, as was also reaffirmed in the Glasgow Climate Pact at COP 26 and in the Sharm el-Sheikh Implementation Plan at COP 27,

RECALLING FURTHER IMO Assembly resolution A.998(25) on the need to develop capacity-building for the development and implementation of new instruments and amendments to existing instruments,

RECALLING that the Maritime Safety Committee at its 107th session decided to initiate work on the "Development of a safety regulatory framework to support the reduction of GHG emissions from ships using new technologies and alternative fuels",

HAVING CONSIDERED, at its eightieth session, the draft 2023 IMO strategy on reduction of GHG emissions from ships,

1 ADOPTS the *2023 IMO Strategy on Reduction of GHG Emissions from Ships* (2023 IMO GHG Strategy) as set out in the annex to the present resolution;

2 ACKNOWLEDGES the challenges that developing countries, in particular least developed countries (LDCs) and small island developing States (SIDS), may face in the implementation of the 2023 IMO GHG Strategy;

3 ALSO ACKNOWLEDGES the importance of addressing the human element, including the impact on seafarers and other maritime professionals, in the safe implementation of the 2023 IMO GHG Strategy;

4 INVITES the Secretary-General to make adequate provisions in the Integrated Technical Cooperation Programme (ITCP), the IMO GHG TC-Trust Fund and any other means of support related to follow-up actions to the 2023 IMO GHG Strategy that may be further decided by the Committee and undertaken by developing countries, in particular LDCs and SIDS;

5 AGREES to keep the 2023 IMO GHG Strategy under review with a view to the adoption of a revised IMO GHG Strategy in 2028;

6 ALSO AGREES that the 2023 IMO GHG Strategy revokes the 2018 Initial IMO GHG Strategy, as from this date.

ANNEX

2023 IMO STRATEGY ON REDUCTION OF GHG EMISSIONS FROM SHIPS

Contents

1 INTRODUCTION

1.1 The International Maritime Organization (IMO or the Organization) is the United Nations specialized agency responsible for safe, secure and efficient shipping and the prevention of pollution from ships.

1.2 The *2023 IMO Strategy on Reduction of GHG Emissions from Ships* (the 2023 IMO GHG Strategy) represents the continuation of work by IMO as the appropriate international body to address greenhouse gas (GHG) emissions from international shipping. This work includes Assembly resolution A.963(23) on *IMO policies and practices related to the reduction of greenhouse gas emissions from ships*, adopted on 5 December 2003, urging the Marine Environment Protection Committee (MEPC or the Committee) to identify and develop the mechanisms needed to achieve the limitation or reduction of GHG emissions from international shipping.

1.3 In response to the Assembly's request, work to address GHG emissions from ships has been undertaken by the Organization, as summarized in appendix 1.

1.4 The *Initial IMO Strategy on Reduction of GHG Emissions from Ships* (resolution MEPC.304(72)) was the first milestone set out in the *Road map for developing a comprehensive IMO strategy on reduction of GHG emissions from ships* (the Road Map) approved at MEPC 70. The Road Map identified that a revised strategy was to be adopted in 2023.

1.5 The adoption of the 2023 IMO GHG Strategy is the latest milestone set out in the Road Map. The 2023 IMO GHG Strategy also sustains the momentum and represents the continuation of work by IMO as the appropriate international body to address GHG emissions from international shipping.

Context

1.6 The 2023 IMO GHG Strategy falls within a broader context that includes:

.1 other existing instruments related to the law of the sea, including UNCLOS, and to climate change, including the UNFCCC and its related legal instruments, including the Paris Agreement;

2 the leading role of the Organization in the development, adoption and assistance in implementation of environmental regulations applicable to international shipping;

.3 the decision of the thirty-second session of the Assembly (A 32) in December 2021 that adopted for the Organization a strategic direction entitled "Respond to climate change"; and

.4 the United Nations 2030 Agenda for Sustainable Development.

Emissions and emission scenarios

1.7 The Third IMO GHG Study 2014 estimated that GHG emissions from international shipping in 2012 accounted for some 2.2% of anthropogenic CO_2 emissions and that such emissions could grow by between 50% and 250% by 2050.

1.8 The Fourth IMO GHG Study 2020 estimated that GHG emissions from shipping in 2018 accounted for some 2.89% of global anthropogenic GHG emissions and that such emissions could represent between 90% and 130% of 2008 emissions by 2050.

1.9 Future annual IMO emission and carbon intensity estimates using the available data from the IMO Ship Fuel Oil Consumption Database (IMO DCS) and other relevant sources would help reduce the uncertainties associated with these emission estimates and scenarios.

Objectives of the 2023 IMO GHG Strategy

1.10 The 2023 IMO GHG Strategy is aimed at:

.1 enhancing IMO's contribution to global efforts by addressing GHG emissions from international shipping. International efforts in addressing GHG emissions include the Paris Agreement and its goals and the United Nations 2030 Agenda for Sustainable Development and its SDG 13: *"Take urgent action to combat climate change and its impacts"*;

.2 identifying actions to be implemented by the international shipping sector, as appropriate, while addressing impacts on States and recognizing the critical role of international shipping in supporting the continued development of global trade and maritime transport services; and

.3 identifying actions and measures, as appropriate, to help achieve the above objectives, including incentives for research and development and monitoring of GHG emissions from international shipping.

2 VISION

IMO remains committed to reducing GHG emissions from international shipping and, as a matter of urgency, aims to phase them out as soon as possible, while promoting, in the context of this Strategy, a just and equitable transition.

3 LEVELS OF AMBITION, INDICATIVE CHECKPOINTS, AND GUIDING PRINCIPLES

Levels of ambition

3.1 Subject to amendment depending on reviews to be conducted by the Organization in accordance with section 7, the 2023 IMO GHG Strategy identifies levels of ambition for the international shipping sector noting that technological innovation and the global introduction and availability of zero or near-zero GHG emission technologies, fuels and/or energy sources for international shipping will be integral to achieving the overall level of ambition.

3.2 The levels of ambition and indicative checkpoints should take into account the well-to-wake GHG emissions of marine fuels as addressed in the *Guidelines on life cycle GHG intensity of marine fuels* (LCA guidelines) developed by the Organization[1] with the overall objective of reducing GHG emissions within the boundaries of the energy system of international shipping and preventing a shift of emissions to other sectors.

[1] Resolution MEPC.376(80)

3.3 Levels of ambition directing the 2023 IMO GHG Strategy are as follows:

.1 carbon intensity of the ship to decline through further improvement of the energy efficiency for new ships

to review with the aim of strengthening the energy efficiency design requirements for ships;

.2 carbon intensity of international shipping to decline

to reduce CO_2 emissions per transport work, as an average across international shipping, by at least 40% by 2030, compared to 2008;

.3 uptake of zero or near-zero GHG emission technologies, fuels and/or energy sources to increase

uptake of zero or near-zero GHG emission technologies, fuels and/or energy sources to represent at least 5%, striving for 10%, of the energy used by international shipping by 2030; and

.4 GHG emissions from international shipping to reach net zero

to peak GHG emissions from international shipping as soon as possible and to reach net-zero GHG emissions by or around, i.e. close to, 2050, taking into account different national circumstances, whilst pursuing efforts towards phasing them out as called for in the Vision consistent with the long-term temperature goal set out in Article 2 of the Paris Agreement.

Indicative checkpoints

3.4 Indicative checkpoints to reach net-zero GHG emissions from international shipping:

.1 to reduce the total annual GHG emissions from international shipping by at least 20%, striving for 30%, by 2030, compared to 2008; and

.2 to reduce the total annual GHG emissions from international shipping by at least 70%, striving for 80%, by 2040, compared to 2008.

Guiding principles

3.5 The principles guiding the 2023 IMO GHG Strategy include:

.1 the need to be cognizant of the principles enshrined in instruments already developed, such as:

.1 the principle of non-discrimination and the principle of no more favourable treatment, enshrined in MARPOL and other IMO conventions; and

.2 the principle of common but differentiated responsibilities and respective capabilities, in the light of different national circumstances, enshrined in UNFCCC, its Kyoto Protocol and the Paris Agreement;

.2 the requirement for all ships to give full and complete effect, regardless of flag, to implementing mandatory measures to ensure the effective implementation of this Strategy;

.3 the need to consider the impacts of measures on States, including developing countries, in particular on LDCs and SIDS, and their specific emerging needs, as recognized in the Revised Strategic Plan for the Organization (resolution A.1149(32)); and

.4 the need for evidence-based decision-making balanced with the precautionary approach as set out in resolution MEPC.67(37).

4 CANDIDATE SHORT-, MID- AND LONG-TERM GHG REDUCTION MEASURES WITH POSSIBLE TIMELINES AND THEIR IMPACTS ON STATES

Timelines

4.1 Candidate measures set out in this 2023 IMO GHG Strategy should be consistent with the following timelines:

.1 short-term GHG reduction measures are the measures finalized and agreed by the Committee between 2018 and 2023, as included in appendix 1;

.2 the basket of mid-term GHG reduction measures should be finalized and agreed by the Committee by 2025. Dates of entry into force and when the measure(s) can effectively start to reduce GHG emissions could be defined for the basket or for each measure individually;

.3 other candidate mid-term GHG reduction measures could be finalized and agreed by the Committee between 2023 and 2030. Dates of entry into force and when the measure can effectively start to reduce GHG emissions would be defined for each measure individually; and

.4 possible long-term measures could be measures finalized and agreed by the Committee beyond 2030, to be developed as part of the 2028 review of the IMO GHG Strategy.

4.2 The list of candidate measures is non-exhaustive and is without prejudice to measures the Organization may further consider and adopt.

Short-term GHG reduction measures

4.3 In accordance with regulations 25.3 and 28.11 of MARPOL Annex VI, a review of the mandatory goal-based technical and operational measures to reduce carbon intensity of international shipping (the "short-term GHG reduction measures") shall be completed by 1 January 2026.

4.4 The Committee may decide to initiate a review of the other short-term measure(s) as included in appendix 1.

Basket of candidate mid-term GHG reduction measures

4.5 In accordance with the timelines set out in this Strategy and the Work Plan, a basket of candidate measure(s), delivering on the reduction targets, should be developed and finalized comprised of both:

.1 a technical element, namely a goal-based marine fuel standard regulating the phased reduction of the marine fuel's GHG intensity; and

.2 an economic element, on the basis of a maritime GHG emissions pricing mechanism.

The candidate economic elements will be assessed observing specific criteria to be considered in the comprehensive impact assessment, with a view to facilitating the finalization of the basket of measures.

The mid-term GHG reduction measures should effectively promote the energy transition of shipping and provide the world fleet with a needed incentive while contributing to a level playing field and a just and equitable transition.

4.6 In accordance with Phase III of the Work Plan, the measure(s) in the basket should be developed and adopted, along with the assessments of impacts on States.

4.7 The development of the basket of candidate mid-term GHG reduction measures should take into account the well-to-wake GHG emissions of marine fuels as addressed in the LCA guidelines developed by the Organization with the overall objective of reducing GHG emissions within the boundaries of the energy system of international shipping and preventing a shift of emissions to other sectors.

Synergies with existing measures

4.8 In addition, the potential synergies with other existing measures such as the Carbon Intensity Indicator (CII) will be considered, in particular regarding incentives for energy efficiency and for the adoption of better operational practices in the shipping value chain or other technologies to reduce emissions from ships.

Other candidate mid-term GHG reduction measures

4.9 In addition to the basket of candidate mid-term GHG reduction measures, the Organization should continue to develop other mid-term GHG reduction measures to reduce GHG emissions from ships. All the following candidate mid-term measures represent possible mid-term further action by the Organization on matters related to the reduction of GHG emissions from ships:

Informed policymaking:

.1 the Secretariat to undertake annual IMO GHG emission and carbon intensity estimates using the available data from the IMO DCS and other relevant sources; and other studies to inform policy decisions;

.2 development of a feedback mechanism to enable lessons learned on implementation of measures to be collated and shared through a possible information exchange on best practice;

Supporting global availability and uptake of zero or near-zero GHG emission technologies, fuels and/or energy sources:

.3 further development of the LCA guidelines;

.4 undertake a regulatory assessment of safety aspects associated with reducing GHG emissions in accordance with this Strategy and develop a road map to support the safe delivery of the Strategy;

.5 consider and analyse measures to address emissions of methane and nitrous oxide and further enhance measures to address emissions of volatile organic compounds;

.6 incentives for first movers to develop and take up new technologies; and

.7 consider and analyse measures to both encourage port developments and activities globally to facilitate reduction of GHG emissions from shipping, including provision of ship and shoreside/onshore power supply from renewable sources, and infrastructure to support supply of zero or near-zero GHG emission fuels and/or energy sources, and to further optimize the logistic chain and its planning, including ports.

Impacts on States

4.10 The impacts on States of a measure/combination of measures should be assessed and taken into account as appropriate before adoption of the measure(s) in accordance with the *Revised procedure for assessing impacts on States of candidate measures.*[2] Particular attention should be paid to the needs of developing countries, in particular LDCs and SIDS.

4.11 The Committee should consider the comprehensive impact assessment in order to inform further consideration of the proposed measure(s), and take action as appropriate.

4.12 When assessing impacts on States, the impact of (a) measure(s) should be considered, as appropriate, inter alia, in the following terms:

.1 geographic remoteness of and connectivity to main markets;
.2 cargo value and type;
.3 transport dependency;
.4 transport costs;
.5 food security;
.6 disaster response;
.7 cost-effectiveness; and
.8 socio-economic progress and development.

4.13 Once the comprehensive impact assessment is completed, and disproportionately negative impacts assessed and addressed, as appropriate, the measure(s) may be considered for adoption.

4.14 Once a measure is adopted and enacted, the Committee should keep its implementation and impacts under review, upon request by Member States, so that any necessary adjustments may be made.

5 BARRIERS AND SUPPORTIVE ACTIONS, CAPACITY-BUILDING AND TECHNICAL COOPERATION, AND R&D

5.1 The Committee recognizes that developing countries, in particular LDCs and SIDS, have special needs with regard to capacity-building and technical cooperation.

[2] MEPC.1/Circ.885/Rev.1

5.2 The Committee recognizes the challenges that some delegations of developing countries, in particular LDCs and SIDS, may face in participating in the work of the Organization, in particular on GHG-related matters. In this regard, the Organization should periodically assess the provision of financial resources through the Voluntary Multi-Donor Trust Fund established by the Organization for the purpose of assisting developing countries, in particular LDCs and SIDS, in attending the meetings of MEPC and the Intersessional Working Group on Reduction of GHG Emissions (ISWG-GHG).

5.3 When developing candidate mid- and long-term GHG reduction measures, due account should be taken to ensure a just and equitable transition that leaves no country behind, including supportive measures.

5.4 The Committee acknowledges that developing and making globally available zero and near-zero GHG emission technologies, fuels and/or energy sources, and developing the necessary associated port infrastructure could be specific barriers to the implementation of possible measures.

5.5 The Committee recognizes the need for a broad approach to regulating safety of ships using zero or near-zero GHG emission technologies, fuels and/or energy sources, including addressing the human element, to ensure the safe implementation of this Strategy.

5.6 Recognizing the impact this Strategy will have on seafarers and other maritime professionals, the Organization is further requested to assess its instruments, guidance and training standards to help ensure a just transition for seafarers and other maritime workforce that leaves no one behind.

Continue and enhance partnerships, technical cooperation, capacity-building activities and technology cooperation

5.7 The Committee could assist the efforts to promote zero and near-zero GHG emission technologies, fuels and/or energy sources by facilitating public-private partnerships and information exchange.

5.8 The Committee should continue to provide mechanisms for facilitating information sharing, technology transfer, capacity-building and technical cooperation, taking into account resolution MEPC.229(65) on *Promotion of technical co-operation and transfer of technology relating to the improvement of energy efficiency of ships*.

5.9 The Committee recognizes that the decarbonization of shipping should be possible for all IMO Member States and may create new opportunities also for developing countries, including LDCs and SIDS, to take part in the value chain of the production and distribution of zero and near-zero GHG emission technologies, fuels and/or energy sources for international shipping.

5.10 The Organization should assess periodically the provision of financial and technological resources and capacity-building to implement the Revised Strategy through the Integrated Technical Cooperation Programme (ITCP), the IMO GHG TC-Trust Fund and other initiatives, including both IMO and Member States-sponsored programmes, as listed in appendix 2.

5.11 In addition, the Organization may:

.1 develop a seafarers' training and skills programme to support the reduction of GHG emissions from ships;

.2 initiate R&D activities and pilots addressing marine propulsion, zero or near-zero GHG emission technologies, fuels and/or energy sources to further enhance the energy efficiency of ships and supporting the global availability and uptake of low-carbon and zero-carbon fuels and technologies;

.3 support, including through partnerships and provision of financial and technological resources, enhanced technical cooperation, capacity-building activities and technology cooperation, the implementation of the existing short-term GHG reduction measures; and

.4 initiate efforts to explore renewable fuel production opportunities to be made available to international shipping, notably in developing countries, including LDCs and SIDS.

6 FOLLOW-UP ACTIONS

6.1 A programme of follow-up actions for the 2023 IMO GHG Strategy should be developed.

6.2 The key stages towards the adoption of a 2028 IMO GHG Strategy are as follows:

Target dates	**Milestones**		
	Comprehensive impact assessment of the basket of candidate mid-term measures	**Development of candidate mid-term measures**	**Other milestones**
MEPC 80 (Summer 2023)	Initiation of CIA	Initiate Phase III of the Work Plan on the development of mid-term measures	
MEPC 81 (Spring 2024)	Interim report	Finalization of basket of measures	
MEPC 82 (Autumn 2024)	Finalized report		
MEPC 83 (Spring 2025)		Approval of measures	Review of the short-term measure to be completed by 1 January 2026
Extraordinary one or two-day MEPC (six months after MEPC 83 in Autumn 2025)		Adoption of measures	
MEPC 84 (Spring 2026)			
MEPC 85 (Autumn 2026)			
16 months after adoption (2027)		Entry into force of measures	

Target dates	Milestones		
	Comprehensive impact assessment of the basket of candidate mid-term measures	**Development of candidate mid-term measures**	**Other milestones**
MEPC 86 (Summer 2027)			Initiate the review of the 2023 IMO GHG Strategy
MEPC 87 (Spring 2028)			
MEPC 88 (Autumn 2028)			Finalization of the review of the 2023 IMO GHG Strategy with a view to adoption of the 2028 IMO GHG Strategy

6.3 The Marginal Abatement Cost Curve (MACC) for each measure, as appropriate, should be ascertained and updated, and then evaluated on a regular basis.

7 PERIODIC REVIEW OF THE STRATEGY

7.1 The IMO GHG Strategy should be subject to a five-yearly review with the first review due in 2028.

7.2 The Committee should undertake the review including defining the scope of the review and its terms of reference.

7.3 The reviews of the levels of ambition should take into account updated emission estimates, emission reduction options and availability for international shipping, and the reports of the Intergovernmental Panel on Climate Change (IPCC), and future IMO GHG inventories and studies, as relevant, to assess progress towards reaching net-zero GHG emissions of international shipping. The reviews should also take into account available data on the impact on States of any measure(s) applied, including information provided by the States or by international organizations or institutions, so that any necessary adjustments may be made as provided for in the *Revised procedure for assessing impacts on States of candidate measures* (MEPC.1/Circ.885/Rev.1).

APPENDIX 1

OVERVIEW OF PREVIOUS WORK UNDERTAKEN BY THE ORGANIZATION TO ADDRESS GHG EMISSIONS FROM SHIPS

An overview of IMO work undertaken to address GHG emissions from ships is provided below:

.1 MEPC 62 (July 2011) adopted resolution MEPC.203(62) on *Inclusion of regulations on energy efficiency for ships in MARPOL Annex VI* introducing mandatory technical (EEDI) and operational (SEEMP) measures for the energy efficiency of ships;

.2 MEPC 65 (May 2013) adopted resolution MEPC.229(65) on *Promotion of technical co-operation and transfer of technology relating to the improvement of energy efficiency of ships*, to provide technical assistance to Member States to enable cooperation in the transfer of energy efficient technologies, in particular to developing countries;

.3 MEPC 67 (October 2014) approved the Third IMO GHG Study 2014, estimating that GHG emissions from international shipping in 2012 accounted for some 2.2% of anthropogenic CO_2 emissions and that such emissions could grow by between 50% and 250% by 2050;

.4 MEPC 70 (October 2016) adopted, by resolution MEPC.278(70), amendments to MARPOL Annex VI to introduce the data collection system for fuel oil consumption of ships, containing mandatory requirements for ships to record and report their fuel oil consumption, and also adopted the *Road map for developing a comprehensive IMO strategy on reduction of GHG emissions from ships* (the Road Map). Ships of 5,000 gross tonnage and above (representing approximately 85% of the total GHG emissions from international shipping) are required to collect consumption data for each type of fuel oil they use, as well as other, additional, specified data including proxies for "transport work";

.5 MEPC 72 (April 2018) adopted, by resolution MEPC.304(72), the *Initial IMO Strategy on Reduction of GHG Emissions from Ships*, setting out a vision which confirmed IMO's commitment to reducing GHG emissions from international shipping and to phasing them out as soon as possible, and agreed to keep the Initial Strategy under review, with a view to adoption of a Revised Strategy in 2023;

.6 MEPC 73 (October 2018) approved the *Programme of follow-up actions of the Initial IMO Strategy*, intended to be used as a planning tool in meeting the timelines identified in the Initial IMO Strategy;

.7 MEPC 74 (May 2019) approved MEPC.1/Circ.855 on *Procedure for assessing the impacts on States of candidate measures*; adopted resolution MEPC.323(74) on *Inviting Member States to encourage voluntary cooperation between the port and shipping sectors to contribute to reducing GHG emissions from ships,* as revised by MEPC 79 by resolution MEPC.366(79); and agreed to establish a voluntary multi-donor trust fund ("GHG TC-Trust Fund"), to provide a dedicated source of financial support for technical cooperation and capacity development activities to support the implementation of the Initial IMO Strategy on Reduction of GHG Emissions from Ships;

.8 MEPC 75 (November 2020) adopted resolution MEPC.327(75) on *Encouraging Member States to develop and submit voluntary National Action Plans to address GHG emissions from ships,* as revised by MEPC 79 by resolution MEPC.367(79); approved the Fourth IMO GHG Study 2020; and adopted, by resolution MEPC.324(75), amendments to MARPOL Annex VI advancing and strengthening EEDI Phase 3 requirements for several ship types;

.9 MEPC 76 (June 2021) adopted, by resolution MEPC. 328(76), amendments to MARPOL Annex VI introducing the short-term GHG reduction measure containing a technical Energy Efficiency Existing Ship Index (EEXI), an operational Carbon Intensity Indicator (CII) and an enhanced Ship Energy Efficiency Management Plan (SEEMP); adopted a series of seven technical guidelines supporting the EEXI and CII frameworks; approved a *Work plan to progress development of mid- and long-term GHG reduction measures in line with the Initial IMO Strategy on Reduction of GHG Emissions from Ships and its Programme of follow-up actions*;

.10 MEPC 77 (November 2021) agreed to initiate the revision of the *Initial IMO Strategy on Reduction of GHG Emissions from Ships*, recognizing the need to strengthen the ambition during the revision process; and adopted resolution MEPC.342(77) on *Protecting the Arctic from shipping Black Carbon emissions* recognizing that Black Carbon was a potent short-lived contributor to climate warming; and

.11 MEPC 78 (June 2022) adopted a series of 10 technical guidelines to support the implementation of the short-term GHG reduction measure;

.12 Council 128 (November 2022) endorsed the finalized terms of reference of a Voluntary Multi-Donor Trust Fund to Facilitate the Participation of Developing Countries, Especially Small Island Developing States (SIDS) and Least Developed Countries (LDCs) in IMO GHG Meetings, and agreed to review the terms of reference, based on the experience of the first full year of operations of the Fund, no later than at the 130th session of the Council;

.13 MEPC 79 (December 2022) adopted amendments to MARPOL Annex VI to revise the data collection system for fuel oil consumption for the implementation of the EEXI and the CII framework, approved a *Revised procedure for assessing the impacts on States of candidate measures* (MEPC.1/Circ.885/Rev.1) and adopted resolutions MEPC.366(79) and MEPC.367(79) on *Invitation to Member States to encourage voluntary cooperation between the port and the shipping sectors to contribute to reducing GHG emissions from ships* and *Encouragement of Member States to develop and submit voluntary National Action Plans (NAPs) to address GHG emissions from ships*, respectively; and

.14 MEPC 80 (July 2023) adopted resolution MEPC.376(80) on *Guidelines on life cycle GHG intensity of marine fuels* (LCA guidelines); initiated the comprehensive impact assessment of the basket of candidate mid-term measures; and adopted resolution MEPC.377(80) on *2023 IMO Strategy on Reduction of GHG Emissions from Ships* (2023 IMO GHG Strategy).

APPENDIX 2

OVERVIEW OF RELEVANT INITIATIVES BY THE ORGANIZATION SUPPORTING THE REDUCTION OF GHG EMISSIONS FROM SHIPS

An overview of relevant IMO initiatives supporting the reduction of GHG emissions from ships is provided below:

.1 The **Integrated Technical Cooperation Programme (ITCP)** is designed to assist Governments which lack the technical knowledge and resources that are needed to operate a shipping industry safely and efficiently. Support for IMO's GHG-related activities under the ITCP is a clear priority for the Organization. For 2022-2023, a dedicated global programme "Reducing atmospheric emissions from ships and in ports and effective implementation of MARPOL Annex VI and the Initial IMO GHG Strategy" was designed to assist Member States with the implementation of the Initial IMO Strategy, thereby increasing energy efficiency measures for ships, as well as reducing atmospheric pollution from ships, including when in ports.

.2 MEPC 74 (May 2019) agreed to establish a **voluntary multi-donor trust fund ("GHG TC-Trust Fund")**, to provide a dedicated source of financial support for technical cooperation and capacity development activities to support the implementation of the *Initial IMO Strategy on Reduction of GHG Emissions from Ships* (MEPC 74/18/Add.1, annex 17). The resources of the Trust Fund include voluntary contributions from IMO Member States, UN agencies, international organizations and other entities who have expressed support for the Initial IMO Strategy.

.3 With support from the European Union, the **Global Maritime Technologies Cooperation Centres (MTCC) Network (GMN)** project (approximately $11 million, 2016-2022) established five MTCCs in China (MTCC Asia), Fiji (MTCC Pacific), Kenya (MTCC Africa), Panama (MTCC Latin America) and Trinidad and Tobago (MTCC Caribbean). Plans are now being finalized for a GMN Phase II project for the five MTCCs to continue their work to support maritime decarbonization in the respective regions and to be linked to other IMO projects and initiatives. Phase II is to pay particular attention to the delivery of smaller scale (for example, ships retrofitting) pilot demonstration projects, with a focus on the needs of developing countries, in particular LDCs and SIDS.

.4 With support from Norway, the **Green Voyage 2050** project (approximately $7.1 million, 2019-2023) is currently supporting countries to undertake assessments of maritime emissions in the national context, develop policy frameworks and National Action Plans (NAPs) to address GHG emissions from ships, and draft legislation to implement MARPOL Annex VI into national law. Partnering countries are also supported in identifying and implementing of low- and zero-carbon pilot projects on board ships and in ports. Phase 1 of the project is expected to terminate in December 2023 and a new phase envisioned to ensure that efforts can be further continued both in relation to scaled-up pilot projects and NAP development.

.5 The **GHG-SMART Programme** (Sustainable Maritime Transport Training Programme to Support the Implementation of the GHG Strategy) project ($2.5 million, 2020-2025), funded by the Republic of Korea, is a training

programme to support the implementation of the *Initial IMO Strategy on Reduction of GHG Emissions from Ships* by developing capacity in LDCs and SIDS. This is a series of annual training programmes consisting of comprehensive training online, followed by individual training plans, and a practical training and study visit, combined with an opportunity for two trainees (one female and one male) to further benefit from a World Maritime University (WMU) scholarship.

.6 The **GloFouling Partnerships** project (approximately $7 million, 2018-2025) is part of the wider efforts by IMO, in collaboration with UNDP and GEF, to improve biofouling management and protect marine ecosystems from the negative effects of invasive aquatic species . By supporting the implementation of the IMO *2011 Guidelines for the control and management of ships' biofouling to minimize the transfer of invasive aquatic species*, this project also contributes to the reduction of GHG emissions from ships. The project has developed and published in 2022 a study entitled *Analysing the Impact of Marine Biofouling on the Energy Efficiency of Ships and the GHG Abatement Potential of Biofouling Management Measures*.

.7 The **TEST Biofouling** (Transfer of Environmentally Sound Technologies) project ($4 million, 2022-2025), funded by Norway, aims to assist developing countries to build their knowledge on control and management of biofouling and showcase effective approaches to biofouling management and the mitigation of environmental risks associated with the transfer of invasive aquatic species through biofouling by means of demonstration projects at both regional and country levels. The project focuses on testing novel technologies and new sustainable methods of biofouling management, which, in line with the above study, indirectly contributes to reducing GHG emissions.

.8 The **IMO CARES** (Coordinated Actions to Reduce Emissions from Shipping) Foundation Project, project (approximately $1.5 million, 2022-2024), funded by Saudi Arabia, started its implementation phase in early 2023, with the ultimate objective to help link the global North and global South for the identification and trial of ready for market technology solutions, technology transfer, technology diffusion and uptake activities, pilot demonstration projects and green financing initiatives. This project will assist the maritime sector in developing countries in their transition towards a low-carbon future with key involvement of the MTCCs at a regional level.

.9 The Future Fuels and Technology for Low- and Zero-carbon Shipping Project (**FFT project**) (approximately $1.2 million, 2022-2024) is a partnership project between the Republic of Korea and IMO, designed to support GHG reduction from international shipping by providing technical analysis to the Organization in support of policy discussions held in the Marine Environment Protection Committee (MEPC).

.10 The **IMO-UNEP-Norway Innovation Forum** (approximately $650,000, 2020-2023) identified as championing innovation to accelerate the transition of the marine sector towards a zero- and low-emission future. Its aim is to promote innovation by providing a global platform to exchange best practices and fill necessary gaps by gathering ideas and latest developments from all competent international policy makers.

The second Innovation Forum was held in a hybrid format on 28 and 29 September 2022 and was linked to the IMO World Maritime Day (WMD) theme 2022 "New Technologies for Greener Shipping". It was attended by a total of 1,900 in-person and virtual participants.

The 2023 session will be held in conjunction with WMD, under the theme "MARPOL at 50 — Our commitment goes on", celebrating the fiftieth anniversary of the MARPOL Convention, continuing to support the global South and the green transition of the maritime sector into a sustainable future.

.11 The IMO-EBRD-World Bank co-led **Financing Sustainable Maritime Transport (FIN-SMART) Roundtable** initiative has been providing a platform among Member State representatives, international financial institutions, representatives of private banks and other key maritime stakeholders to identify maritime decarbonization investment risks, opportunities and potential financial solutions and innovative financial instruments to address financing needs and investment opportunities in developing countries, in particular LDCs and SIDS.

The third FIN-SMART roundtable in June 2023, through concrete examples of maritime decarbonization projects resulting in investment or having the potential to become bankable projects in developing countries, aims to highlight concrete success factors and the role of the various actors in achieving investment in maritime decarbonization. It also showcases to the financial community the investment opportunity in more concrete terms, as developing countries may have large unused sustainable resources (for example, wind or solar energy) that could be used for the production of green fuels that the maritime industry requires to accelerate decarbonization.

.12 The **NextGEN** (Green and Efficient Navigation) portal, which was launched by IMO and the Maritime and Port Authority of Singapore (MPA) in September 2021, is an online platform to support information sharing and collaboration on decarbonization initiatives and projects in the field of maritime, presenting an opportunity to provide an online platform of collaboration across the maritime value chain. The next phase of the NextGEN initiative was launched in 2022 as the NextGEN Connect Project, the new phase of which supports a pilot route-based action in the Asia-Pacific region to reduce emissions from international shipping.

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ANNEX 17

RESOLUTION MEPC.378(80)
(adopted on 7 July 2023)

2023 GUIDELINES FOR THE CONTROL AND MANAGEMENT OF SHIPS' BIOFOULING TO MINIMIZE THE TRANSFER OF INVASIVE AQUATIC SPECIES

THE MARINE ENVIRONMENT PROTECTION COMMITTEE,

RECALLING Article 38 of the Convention on the International Maritime Organization concerning the functions of the Marine Environment Protection Committee relating to any matter within the scope of the Organization concerned with the prevention and control of marine pollution from ships,

RECALLING ALSO that Member States of the International Maritime Organization made a clear commitment to minimizing the transfer of invasive aquatic species by shipping in adopting the International Convention for the Control and Management of Ships' Ballast Water and Sediments, 2004,

RECALLING FURTHER that studies have shown biofouling on ships to be an important means of transferring invasive aquatic species which, if established in new ecosystems, may pose threats to the environment, human health, property and resources,

NOTING the objectives of the Convention on Biological Diversity, 1992, and that the Kunming-Montreal Global Biodiversity Framework includes a target to eliminate, minimize, reduce and/or mitigate the impacts of invasive alien species on biodiversity and ecosystem services by identifying and managing pathways of the introduction of alien species,

NOTING ALSO that the transfer and introduction of invasive aquatic species through ships' biofouling threatens the conservation and sustainable use of biological diversity, and implementing practices to control and manage ships' biofouling can greatly assist in reducing the risk of the transfer of invasive aquatic species,

NOTING FURTHER that this issue, being of worldwide concern, demands a globally consistent approach to the management of biofouling,

RECALLING that, at its sixty-second session, it had adopted, by resolution MEPC.207(62), the *2011 Guidelines for the control and management of ships' biofouling to minimize the transfer of invasive aquatic species* (Biofouling Guidelines), developed by the Sub-Committee on Bulk Liquids and Gases,

RECALLING ALSO that, at its seventy-second session, it had agreed to review the Biofouling Guidelines, with a view to amending the Guidelines, if required,

HAVING CONSIDERED, at its eightieth session, the draft revised *Guidelines for the control and management of ships' biofouling to minimize the transfer of invasive aquatic species*, developed by the Sub-Committee on Pollution Prevention and Response,

1 ADOPTS the *2023 Guidelines for the control and management of ships' biofouling to minimize the transfer of invasive aquatic species*, as set out in the annex to the present resolution;

2 REQUESTS Member States to take urgent action in applying these Guidelines, including the dissemination thereof to the shipping industry and other interested parties, taking these Guidelines into account when adopting measures to minimize the risk of introducing invasive aquatic species via biofouling, and reporting to MEPC on any experience gained in their implementation;

3 AGREES to keep these Guidelines under review in light of the experience gained;

4 REVOKES resolution MEPC.207(62).

2023 GUIDELINES FOR THE CONTROL AND MANAGEMENT OF SHIPS' BIOFOULING TO MINIMIZE THE TRANSFER OF INVASIVE AQUATIC SPECIES

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1 INTRODUCTION

1.1 MEPC 62 adopted the 2011 *Guidelines for the control and management of ships' biofouling to minimize the transfer of invasive aquatic species* (the Guidelines) through resolution MEPC.207(62). The aim of the Guidelines was to provide a globally consistent approach to managing biofouling by providing useful recommendations of general measures to reduce the risk associated with biofouling for all types of ships.

1.2 Member States of the International Maritime Organization (IMO) decided at MEPC 72 to review the Guidelines in order to assess the uptake and effectiveness of the Guidelines and identify any required action.

1.3 Studies have shown that biofouling can be a significant vector for the transfer of invasive aquatic species. Biofouling on ships entering the waters of States may result in the establishment of invasive aquatic species, which may pose threats to human, animal and plant life, economic and cultural activities, and the aquatic environment.

1.4 Invasive aquatic species have been recognized as one of the major threats for the well-being of the oceans by, inter alia, the Convention on Biological Diversity, several UNEP Regional Seas Conventions, the Asia Pacific Economic Cooperation forum and the Secretariat of the Pacific Region Environmental Programme.

1.5 Prediction of risk of introducing invasive species is complex, hence these Guidelines have the intention to minimize the accumulation of biofouling on ships. Biofouling may include invasive species while a clean hull and niche areas significantly reduce this risk. Studies have shown that the biofouling process begins within the first few hours of a ship's immersion in water. The biofouling pressure on a specific ship is influenced by a range of factors, starting with design and construction of the ship hull and niche areas, followed by operating profile of the ship and maintenance history.

1.6 These Guidelines describe recommended biofouling management practices, as illustrated in figure 1. Attention during initial ship design and construction may provide effective and sustainable means to reduce ship biofouling risks, supplemented by anti-fouling systems (AFS) for all types of ships' submerged or otherwise wetted surface areas, including hull and niche areas. Although these Guidelines focus on ships using AFS, these biofouling management practices are equally recommended for ships using coatings or surfaces that are not used to control or prevent attachment of organisms, as may be applicable.

1.7 The need for inspection and biofouling management may depend on the use of AFS, cleaning regime, and the overall risk of biofouling on the hull and in niche areas. By conducting ship-specific monitoring of risk parameters, identifying potential higher risk for biofouling, an optimized regime for biofouling management can be determined. Cleaning is an important measure to remove biofouling from the hull and niche areas but, when conducted in-water, it poses a risk of releasing invasive aquatic species into the water. Waste substances which are dislodged from the ship during the cleaning operation should therefore be collected. The Guidelines provide guidance for cleaning actions based on a fouling rating number with an overall aim to minimize the risk of transfer of invasive aquatic species. Maintenance and ship recycling should also be conducted with sufficient preventative measures to avoid release of any invasive aquatic species into the water. When conducting biofouling management, potential release of harmful waste substances should also be considered.

1.8 In addition to the Biofouling Guidelines, the following frameworks are relevant for minimizing the transfer of invasive aquatic species:

.1 the International Convention for the Control and Management of Ships' Ballast Water and Sediments, 2004 (BWM Convention), which aims to minimize the transfer of invasive aquatic species through ships' ballast water and sediments; and

.2 the International Convention on the Control of Harmful Anti-fouling Systems on Ships, 2001 (AFS Convention), which addresses anti-fouling systems on ships and focuses on the prevention of adverse impacts from the use of anti-fouling systems and the biocides they may contain.

1.9 Biofouling management practices may also improve a ship's hydrodynamic performance and can be effective at enhancing energy efficiency and reducing air emissions from ships. This concept has been identified by IMO in the 2022 *Guidelines for the development of a ship energy efficiency management* plan *(SEEMP)* (resolution MEPC.346(78)). These Guidelines further support the *2023 IMO Strategy for the reduction of green house gases from ships* (resolution MEPC.377(80)).

1.10 A GEF-UNDP-IMO GloFouling Partnerships Project was conducted as part of wider efforts by IMO, in collaboration with the United Nations Development Programme (UNDP) and the Global Environment Facility (GEF), to protect marine ecosystems from the negative effects of invasive aquatic species. The aim of the GloFouling Partnerships Project was to build capacity in developing countries for implementing the IMO Biofouling Guidelines and other relevant guidelines to minimize the transboundary introduction of invasive aquatic species, with additional benefits in the reduction of greenhouse gas emissions from global shipping.

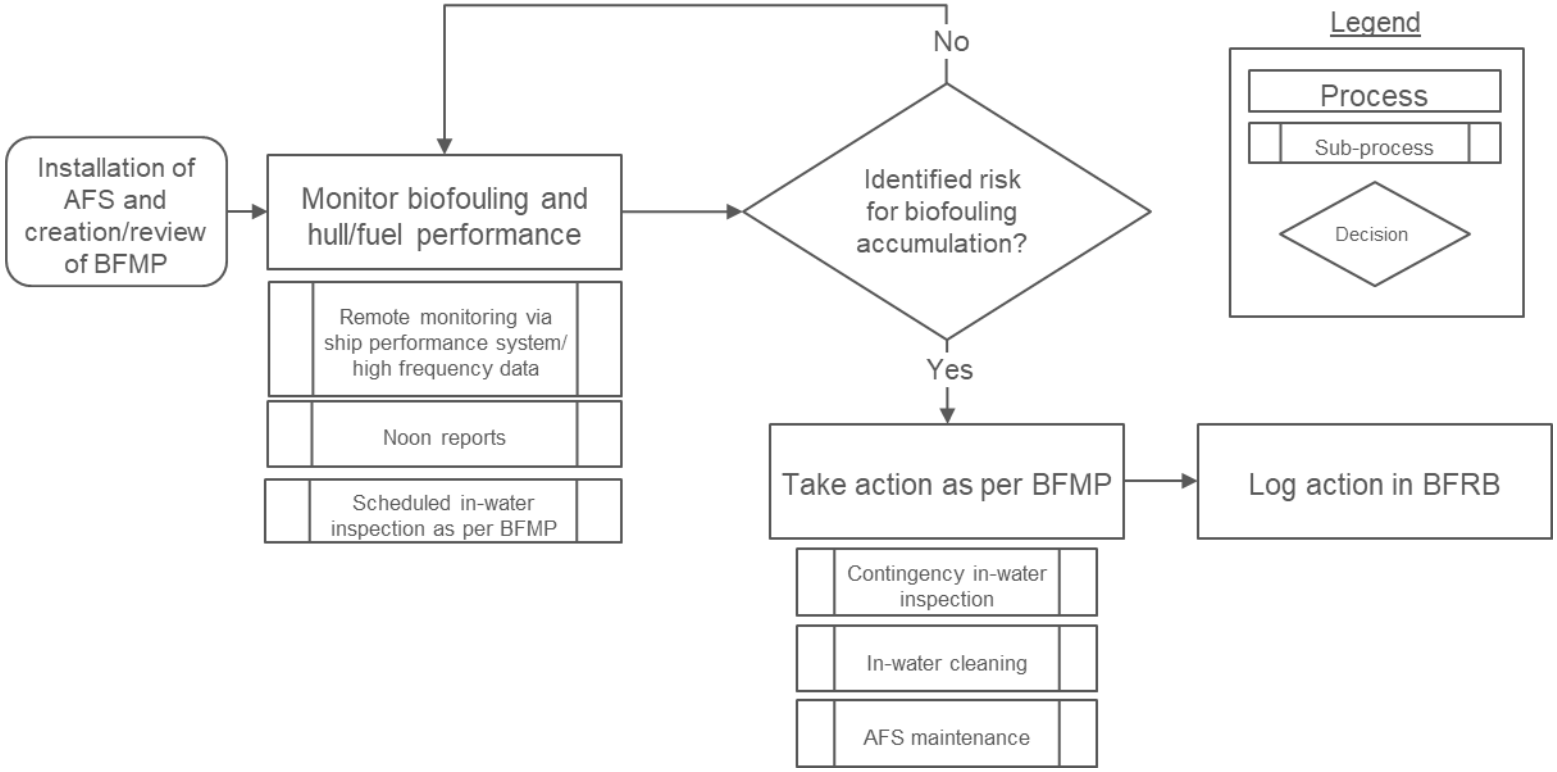


Figure 1: Simplified flow chart visualizing the biofouling management activities of a ship

2 DEFINITIONS

2.1 For the purposes of these Guidelines, the following definitions apply:

Anti-fouling system (AFS) means a coating, paint, surface treatment, surface or device that is used on a ship to control or prevent attachment of organisms.

Anti-fouling coating (AFC) means a surface coating or paint designed to prevent, repel or facilitate the detachment of biofouling from hull and niche areas that are typically or occasionally submerged.

Biofouling is the accumulation of aquatic organisms such as microorganisms, plants and animals on surfaces and structures immersed in or exposed to the aquatic environment. Biofouling can include pathogens. For microfouling and macrofouling, see definitions below.

Biofouling pressure means the biofouling accumulation rate, which differs regionally and seasonally. High biofouling pressure means the development of dense biofouling within a short period of time.

Capture is the process of containment, collection and removal of biofouling material and waste substances detached from submerged surfaces during cleaning in water or in dry dock.

Cleaning system is the equipment used for, or the process of, removal of biofouling from the ship surface, with or without capture.

Dry-dock cleaning refers to the cleaning of the submerged areas when the ship is out of water.

Fouling rating is the allocation of a number for a defined inspection area of the ship surface based on a visual assessment, including description of biofouling present and percentage of macrofouling coverage.

In-water cleaning is the removal of biofouling from a ship's hull and niche areas while in the water.

Invasive aquatic species are non-native species to a particular ecosystem which may pose threats to human, animal and plant life, economic and cultural activities and the aquatic environment.

Macrofouling is biofouling caused by the attachment and subsequent growth of visible plants and animals on structures and ships exposed to water. Macrofouling is large, distinct multicellular individual or colonial organisms visible to the human eye such as barnacles, tubeworms, mussels, fronds/filaments of algae, bryozoans, sea squirts and other large attached, encrusting or mobile organisms.

Marine growth prevention system (MGPS) is an AFS used for the prevention of biofouling accumulation in niche areas or other surface areas but may also include methods which apply surface treatments.

Member States means States that are Members of the International Maritime Organization.

Microfouling is biofouling caused by bacteria, fungi, microalgae, protozoans and other microscopic organisms that creates a biofilm also called a slime layer.

Niche areas are a subset of the submerged surface areas on a ship that may be more susceptible to biofouling than the main hull owing to structural complexity, different or variable hydrodynamic forces, susceptibility to AFC wear or damage, or inadequate or no protection by AFS.

Organization means the International Maritime Organization.

Port State authority means any official or organization authorized by the Government of a port State to verify the compliance and enforcement of standards and regulations relevant to the implementation of national and international shipping control measures.

Proactive cleaning is the periodic removal of microfouling on ships' hulls to prevent or minimize attachment of macrofouling.

Reactive cleaning is a corrective action during which biofouling is removed from a ship's hull and niche areas either in water with capture or in dry dock.

Ship means a vessel of any type whatsoever operating in the aquatic environment and includes hydrofoil boats, air-cushion vehicles, submersibles, floating craft, fixed or floating platforms, floating storage units and floating production storage and off-loading units.

States means coastal, port, flag or Member States, as appropriate.

Waste substances are dissolved and particulate materials that may be released or produced during cleaning or maintenance, and may include biocides, metals, organic substances, removed biofouling, pigments, microplastics or other contaminants that could have a negative impact on the environment.

3 APPLICATION

3.1 The Guidelines are intended to provide useful recommendations for measures to minimize biofouling for all types of ships. The Guidelines are directed at various stakeholders, such as ship designers, shipbuilders, anti-fouling paint manufacturers and suppliers, States, including environmental and regulatory agencies, classification societies, shipowners, ship operators, charterers, shipmasters, port authorities, ship cleaning and maintenance operators, inspection organizations, ship repair, dry-docking and recycling facilities, and any other interested parties.

3.2 Alternative procedures, methods or actions taken to meet the objectives of these Guidelines which are not described should be reported to the Organization by Members of the Organization and their representatives and be taken into account in future reviews of the Guidelines as appropriate.

3.3 A separate guidance document, based on these Guidelines, provides advice relevant to owners and/or operators of recreational craft less than 24 metres in length, using terminology appropriate for that sector (*Guidance for minimizing the transfer of invasive aquatic species as biofouling (hull fouling) for recreational craft* (MEPC.1/Circ.792)).

3.4 The Guidelines may not be relevant to ships which operate only in the same waters in which the biofouling was accumulated. Although operation in the same waters leads to no risk of introducing invasive aquatic species, measures to avoid discharge of harmful waste substances during cleaning may still be relevant.

3.5 An inspection regime as defined in paragraphs 8.4 to 8.6 may not be relevant to a ship when idle for a longer period. To maintain the anti-fouling effect of an AFS, inspection and reactive cleaning may be needed before the ship is reactivated to reduce the risk of biofouling.

4 OBJECTIVES

4.1 The objective of these Guidelines is to minimize the transfer of invasive aquatic species through biofouling on ships.

4.2 Procedures, methods and actions taken in line with these Guidelines should safeguard the obligation under the United Nations Convention on the Law of the Sea (UNCLOS), article 194, to prevent, reduce and control pollution of the marine environment. This includes ensuring not to transfer, directly or indirectly, damage or hazards from one area to another, or transform one type of pollution into another (ref. UNCLOS article 195), as well as preventing the intentional or accidental introduction of species, alien or new, to a particular part of the marine environment (ref. UNCLOS article 196).

4.3 The objective of these Guidelines is pursued by providing a globally consistent approach to stakeholders on the control and management of biofouling, which will contribute to minimizing the risk of transferring invasive aquatic species from biofouling on ships. An additional effect of good biofouling management can be a reduction in emissions to air from ships, due to lower fuel demand in operation as a result of a clean hull.

5 DESIGN AND CONSTRUCTION

5.1 Initial ship design and construction offers the most comprehensive, effective and long-lasting means to minimize ship biofouling risks. In the design and construction of a ship, or when a ship is being significantly modified, the following items, not exhaustive, should be taken into consideration:

.1 small niches and sheltered areas should be avoided as far as practical, e.g. flush mounting pipes in sea chests (where not practical, these should be designed so that they may be easily accessed for inspection, cleaning and application of AFS like marine growth prevention systems (MGPS));

.2 rounding and/or bevelling of corners, gratings and protrusions to promote more effective coverage of AFC and hinging of gratings to enable diver access;

.3 providing the capacity to block off the sea chest and other areas, such as moon pools, floodable docks and other free-flood spaces, for cleaning and treatment, if applicable and appropriate; and

.4 internal seawater cooling systems should be designed with a minimum number of bends and flanges. The design should be made of appropriate material to minimize biofouling, and be compatible with MGPS, if any. Dead ends, as can be found between different systems like cross-over piping between cooling and general service systems, should be avoided. Standby pumps and piping should be fully integrated into the systems to avoid stagnant water.

6 ANTI-FOULING SYSTEM INSTALLATION AND MAINTENANCE

6.1 AFS are effective means to minimize biofouling on ships' submerged surfaces, including the hull and niche areas.

6.2 Restrictions on the use of certain substances in the AFC are regulated by the AFS Convention.

Choosing an AFS

6.3 It is recommended to install AFS in all submerged surfaces on a ship where biofouling may attach. Various AFS are designed for different ship operating profiles, some suitable for hull and some for niche areas and therefore will require different maintenance activities. Thus, it is essential that shipowners, ship operators and shipbuilders obtain appropriate technical advice. AFS manufacturers are best suited to provide advice to ensure a suitable system is applied, reapplied, installed or renewed. As biofouling may typically be found at higher abundance in niche areas, where flow characteristics change as the ship moves through the water, it is recommended to choose a combination of AFC and MGPS, suitable for different submerged areas. If an appropriate AFS is not applied, biofouling accumulation may increase, and more frequent inspections may be necessary. Some factors to consider when choosing an AFS include the following:

.1 **Ship design and construction:** Where possible and appropriate upon the recommendation of AFS manufacturers, targeted installation of AFS may be employed for different areas of the ship. AFS for the hull may include specific AFC, paint and/or surface treatment. Installation of any proactive cleaning measures should be in accordance with the recommendations from the AFC provider and should not damage the AFC. Different AFS are designed to optimize their performance for specific ship speeds. For niche areas, the selected AFS should be optimized for conditions of the niche area, e.g. an AFC may be recommended for use in combination with effective MGPS to minimize biofouling. AFC selection should be based on expected wear, abrasion and water flow rates.

.2 **Active ingredients of AFC:** Environmental impact assessment of the selected AFC with respect to the release of harmful substances should be considered. The limitations of an AFC to minimize biofouling should be known and may include operating profile, aquatic environment, ship design and life cycle of AFC. Decision makers should be aware of the limitations of each AFC and the recommended in-water cleaning methods in order to minimize potential environmental impacts and damage to the system. Depending on the type of AFC, various types of waste substances may be released when cleaning. Some waste substances may easily be captured but others are fine particles or dissolved substances that may be released into the water. Therefore, not all AFC types are designed for frequent cleaning. The AFC manufacturers should provide key information on any biocides used and coating types on publicly available safety and technical datasheets. Frequent cleaning may impact the effectiveness of a specific AFC, and it is therefore recommended that the AFC manufacturers provide relevant guidance. In-water cleaning service providers and manufacturers of cleaning methods/equipment should provide guidance considering compatibility with AFC type.

.3 **Operating profile:** Patterns of use, operating routes, ship activity levels and periods of inactivity may influence the rate of biofouling accumulation and thus the effectiveness of the AFS. Inactivity may cause higher accumulation of biofouling. Biofouling may attach more easily on slow-moving ships.

.4 **Aquatic environment:** Biofouling pressure differs between areas, depending on temperature, salinity and nutrient conditions. Biofouling grows more slowly, but is not prevented, in low temperature waters. Ships operating in ice conditions should consider special AFC. Different organisms grow in different salinity waters and, if a ship operates in all salinity ranges, the anti-fouling system should target a wide range of organisms causing fouling. The benthic (seabed) environment should also be considered. Increasing depth of water and distance from shore may decrease susceptibility for biofouling. Additionally, higher content of nutrients in the water may increase algal blooms and susceptibility to biofouling.

.5 **Cleaning method:** Although cleaning system manufacturers are encouraged to find technological solutions that allow them to clean a wide variety of AFC, not all AFC can be cleaned by every cleaning system. When selecting the AFC, the available cleaning technologies and techniques and their suitability for the specific AFC should be considered. Therefore, AFC manufacturers should provide key information on any biocides used and coating types. The choice of AFC should be compatible with the cleaning technologies available to ensure both minimum biofouling growth as well as reducing the risk of damage to the AFC and the potential release of harmful waste substances to the environment.

.6 **Maintenance:** The lifespan of an AFS should be considered in combination with dry-docking schedules. AFC lifespan and lifetime of MGPS (e.g. anodes) should exceed the period between dry-dockings.

.7 **Legal requirements:** In addition to the AFS Convention, any national or regional regulatory requirements, if relevant, should be considered in the selection of AFS. This may apply to release of chemicals from MGPS and the AFS.

Installing the AFS

6.4 Installing an AFS in hull and niche areas should be in accordance with the manufacturer's guidance.

6.5 Niche areas are particularly susceptible to biofouling growth. Care should be taken in surface preparation and application of any AFC to ensure adequate adhesion and coating thickness. Particular attention should be paid to corners, edges, pipes, holding brackets and bars of gratings. Corners, edges and welded joints should be smooth and coated with adequate coating thickness to optimize system effectiveness. Additionally, for such areas, it is recommended to apply a touch up to ensure film thickness or a higher-grade AFC.

6.6 A non-exhaustive list of recommended measures for installation of an AFS in niche areas is as follows:

.1 **Sea chest:** Internal surfaces and inlet gratings of sea chests should be protected by an AFS that is suitable for the flow conditions of the area over the gratings and through the sea chest.

.2 **Bow and stern thrusters:** Free-flooding spaces which may exist around the thruster tunnel require special attention. The housings/recesses and retractable fittings such as stabilizers and thruster bodies should have an AFC of adequate thickness for optimal effectiveness.

.3 **Rudder hinges and stabilizer fin apertures:** Rudders and stabilizer fins should be moved through their full range of motion during the coating process to ensure that all surfaces are correctly coated to the specification of the AFC. Rudders, rudder fittings and the hull areas around them should also be adequately coated to withstand the increased wear rates experienced in these areas.

.4 **Propeller and shaft:** Propellers and immersed propeller shafts are generally not coated but polished. Fouling release coatings or other suitable coatings may be applied where possible and appropriate to maintain efficiency.

.5 **Stern tube seal assemblies and the internal surfaces of rope guards:** Exposed sections of stern tube seal assemblies and the internal surfaces of rope guards should be carefully painted with AFC appropriate to the degree of water movement over and around these surfaces.

.6 **Cathodic protection anodes:** Biofouling can be minimized in niche areas if anodes are flush-fitted to the hull, a rubber backing pad is inserted between the anode and the hull or the gap is caulked. Caulking the gap will make the seam or joint watertight. If not flush-fitted, the hull surface under the anode and the anode strap should be coated with an AFC suitable for low water flow to prevent biofouling accumulation. If anodes are attached by bolts recessed into the anode surface, the recess should be caulked to remove a potential niche.

.7 **Pitot tubes:** Where retractable pitot tubes are fitted, the housing should be internally coated with an AFC suitable for static conditions.

.8 **Sea inlet pipes and overboard discharges:** Pipe openings and accessible internal areas should be protected by an AFS as far as practicable. Any anti-corrosive or primer coating used should be appropriate for the specific pipe material and area requirements. Care should be taken in surface preparation and coating application to ensure good adhesion and coating thickness.

6.7 Details for performance monitoring of the AFS should be included in the ship-specific Biofouling Management Plan (BFMP) and be based on recommendations from the manufacturer of the AFS. Necessary measures to ensure that the AFS remains effective over the specified docking interval, plus any recommendations on how to return the AFS to optimal performance, should be included.

6.8 Manufacturers of AFS are also encouraged to provide information on appropriate cleaning methods, details of maintenance or upgrade protocols specific to the AFS and details on inspection and repair to ensure the effectiveness of their products. Such details are encouraged to be included in the ship-specific BFMP.

Reinstalling, reapplying or repairing the AFS

6.9 Reinstalling, reapplying or repairing the AFS should be in accordance with manufacturer's guidance that includes measures for surface preparation to facilitate good adhesion and durability.

6.10 Positions of dry-docking blocks and supports should be varied at each dry-docking, or alternative arrangements made to ensure that areas under blocks are painted with an AFC, at least at alternate dry-dockings. Where it is not possible to alternate the position of dry-docking support strips, these areas should be specially considered and managed by other means, e.g. the application of specialized coatings or procedures or measures for such areas based on the past arrangement of dry-docking support strips to shift their position step by step for each docking.

6.11 Reinstalling or repairing the MGPS in niche areas should be in accordance with manufacturer's guidance.

6.12 When reinstalling, reapplying or repairing AFS in niche areas, the list of recommended items in paragraph 6.6 should be considered. A non-exhaustive list of some additional recommended measures for reinstallation or reapplication of an AFS in niche areas is as follows:

.1 bow and stern thrusters – the body and area around bow, stern and any other thrusters prone to coating damage should be routinely maintained during dry-dockings;

.2 recesses within rudder hinges and behind stabilizer fins need to be carefully and effectively cleaned and recoated during maintenance dry-dockings; and

.3 gratings located in sea chests may require a major-refurbishment type of surface preparation at each dry-docking to ensure coating durability.

7 CONTINGENCY ACTION PLANS

7.1 A ship-specific contingency action plan based on specific triggers from monitoring of biofouling parameters should be described in the BFMP.

7.2 As presented in figure 1, monitoring of hull/fuel performance during ship operation should identify whether there may be an increased risk of biofouling accumulation. When monitoring identifies a possible increase in biofouling accumulation, the ship is at a higher risk level which should lead to contingency actions. A contingency action plan may involve inspection of submerged surfaces in line with chapter 8.

7.3 A contingency action plan may include measures which are ship-specific and relevant for the monitoring parameters. In general, a contingency action plan could include the following aspects:

.1 proactive actions can be implemented to lower the risk of biofouling accumulation if a higher biofouling risk may be predicted owing to planned operational changes;

.2 corrective actions to operating profile, maintenance or other repair plans, if the monitoring identifies an early indication of elevated risk; and

.3 inspection may be necessary to determine biofouling accumulation if the monitoring of biofouling parameters identifies an indication of prolonged elevated risk. The inspection should be in line with chapter 8.

7.4 Depending on the relevant biofouling risk parameters, the contingency action plan should trigger a reaction to be conducted in line with the BFMP.

7.5 If an inspection is conducted and biofouling is identified, cleaning actions should be conducted as described in table 1.

7.6 Monitoring of risk parameters may also identify and trigger a need for maintenance of MGPS or AFC.

8 INSPECTION

8.1 Inspections should be carried out:

.1 by organizations, crew or personnel competent to undertake inspections following these guidelines and competent to use relevant inspection methods or equipment to determine the level of biofouling and the condition of the AFS;

.2 for the purpose of fixed schedule inspections, by inspection organizations or personnel able to provide impartial inspection; and

.3 for the purpose of inspections as part of contingency actions, by organizations, crew or personnel competent for such inspections.

8.2 The fixed schedule of inspections should be carried out in line with the minimum frequencies as described in paragraphs 8.4 to 8.6.

8.3 Inspection frequency or inspection dates (or date ranges) for in-water inspections during the in-service period of the ship should be based on the ship-specific biofouling risk profile (see appendix 1), including inspection as a contingency action, and specified in the BFMP. The BFMP should also specify management actions to be taken when biofouling is identified during inspections (e.g. cleaning), including changes to inspection frequency.

8.4 For ships not undertaking performance monitoring, the first inspection date should be within 12 months of application, reapplication, installation or renewal of AFS to confirm their effective operation.

8.5 Where monitoring indicates that the AFS is not performing effectively soon after application, reapplication, installation or renewal (e.g. increased fuel consumption), an inspection should be carried out to confirm the condition of the AFS and level of biofouling as soon as practical or possible, in line with the BFMP and contingency action plan. If adequate performance of the AFS is observed through monitoring, the inspection could be conducted up to 18 months after application, reapplication, installation or renewal, noting that such monitoring may not reflect the level of biofouling in all niche areas.

8.6 Subsequent inspections should occur at least every 12 to 18 months and may need to increase to confirm the continued effectiveness of ageing or damaged AFS. In-water inspections should seek to coincide with existing subsea operations (e.g. underwater inspections in lieu of dry-dock or any other in-water inspections), including any unscheduled subsea operations. If no AFS are installed in areas of a ship and no other measures are undertaken such as in-water cleaning or propeller polishing, then inspections should occur more frequently (<12 months) to manage the risk of biofouling accumulation.

8.7 In-water inspections should assess biofouling across the entirety of a ship's hull and niche areas. If high levels of biofouling are identified during an inspection and there are reasons to suspect issues with the AFS's effectiveness, actions should be taken to manage the biofouling and subsequent inspections should occur more frequently, for example biannually until dry-docking and recoating of AFC.

8.8 In-water inspections should determine the level of biofouling of the hull and niche areas and the condition of the AFS. The inspection areas should be subdivided into appropriate sections as listed in tables 4 and 5 of appendix 2. The fouling rating for each area on the ship should be the highest rating identified in the inspected areas.

8.9 The following should be investigated during the inspection:

.1 rating of the type and approximate extent of biofouling in line with the definitions in table 1 below;

.2 condition of the AFC on the hull and in niche areas as described in paragraph 8.7 using definitions in table 4; and

.3 functionality of the MGPS in niche areas.

Extent of biofouling and recommended actions

8.10 During an inspection, niche areas in the ship-specific BFMP should be inspected as a priority. All inspected areas should be allocated a fouling rating number in line with the extent of fouling as defined in table 1 below.

Table 1: Rating scale to assess the extent of fouling on inspection areas

Rating	Description	Macrofouling cover of area inspected (visual estimate)	Recommended cleaning
0	**No fouling** Surface entirely clean. No visible biofouling on surfaces.	-	-
1	**Microfouling** Submerged areas partially or entirely covered in microfouling. Metal and painted surface may be visible beneath the fouling.	-	Proactive cleaning may be recommended as further specified in paragraph 9.4.
2	**Light macrofouling** Presence of microfouling and multiple macrofouling patches. Fouling species cannot be easily wiped off by hand.	1-15% of surface	Cleaning with capture is recommended as further specified in paragraph 9.9. It is recommended to shorten the interval until the next inspection. If the AFS is significantly deteriorated, dry-docking with maintenance and reapplication of the AFS is recommended.
3	**Medium macrofouling** Presence of microfouling and multiple macrofouling patches.	16-40% of surface	
4	**Heavy macrofouling** Large patches or submerged areas entirely covered in macrofouling.	41-100% of surface	

Condition of the AFS

8.11 The condition of the AFS on the hull and in niche areas should be observed during the inspection and reported. Recommended action and relevant procedures for inspection of the AFS are described in tables 4 and 5.

Inspection report

8.12 An inspection report should be prepared and a copy should be available on board and listed/linked in the Biofouling Record Book (BFRB). For details on reporting on biofouling levels and AFS condition inspections, see appendix 2, tables 4 to 6.

9 CLEANING AND MAINTENANCE

9.1 Cleaning is an important measure to remove biofouling from the hull and niche areas, but may physically damage the AFC, shorten coating service lifetime and release harmful waste substances and invasive aquatic species into the environment.

9.2 Comprehensive testing of cleaning systems or processes is necessary to understand the cleaning performance, capture efficiency or any release of harmful waste substances as well as improve knowledge concerning the prevention of release of viable fragments, spores and other parts of biofouling organisms that have the potential to be invasive.

9.3 In-water cleaning is a complex activity to manage appropriately and international standards for the management of in-water cleaning may continue to be developed and published in a stand-alone document to the Guidelines.

Procedures for proactive cleaning

9.4 Proactive cleaning is the periodic removal of microfouling on ships' hull and niche areas or other submerged surfaces as relevant prior to macrofouling growth and can be conducted with or without capture. Proactive cleaning without capture should:

.1 not be conducted on biofouling with rating ≥2 in line with table 1; and
.2 be performed in an area accepted by the relevant authority for this activity.

9.5 Operators undertaking proactive cleaning should be aware of any local regulations or requirements. Regulations regarding the discharge of biofouling and waste substances into the marine environment and the location of sensitive areas (such as Marine Protected Areas) may be relevant.

9.6 Procedures for proactive cleaning and frequency should be described in the BFMP. All proactive cleaning, and any determination of biofouling level prior to the cleaning, should be entered in the BFRB.

Procedures for reactive cleaning

9.7 Reactive cleaning systems physically remove micro- and macrofouling from the hull and niche areas. There are various reactive cleaning methods available and more under development.

9.8 Reactive cleaning should be conducted based on the inspection results and contingency actions as outlined in table 1, though cleaning with capture may be used to manage any rating level.

9.9 The reactive cleaning should:

.1 use a reactive cleaning system that is compatible with the AFC in order to minimize damage of the AFC;

.2 be conducted with the aim of achieving a fouling rating ≤1 for the cleaned area in line with table 1;

.3 strive for effective collection and safe disposal of all biofouling material and waste substances when reactive cleaning is performed in water or at dry dock; and

.4 be performed in an area accepted by the relevant authority for this activity.

9.10 Biofouling management in niche areas should include the following or similar adequate measures:

.1 maintenance of any MGPS installed to ensure they operate effectively to prevent accumulation of biofouling in relevant niche areas;

.2 regular polishing (with capture of debris) of uncoated propellers to maintain operational efficiency and minimize macrofouling accumulation;

.3 appropriate treatment of internal seawater cooling systems and discharge of any treated water in accordance with applicable regulations; and

.4 minimizing the use of any soap, cleaner or detergent used on surfaces and ensuring they are toxic- and phosphate-free, biodegradable and non-hazardous to the marine environment.

9.11 Operators undertaking in-water reactive cleaning should be aware of any regulations or requirements. Regulations regarding the discharge of biofouling and waste substances into the marine environment and the location of sensitive areas (such as Marine Protected Areas) may be relevant.

9.12 Captured biological waste and waste substances should be disposed of and treated in a safe and environmentally sound manner, in accordance with local requirements.

9.13 A report on the cleaning should be prepared by the operators undertaking reactive cleaning. The report should have the content as described in appendix 2 and describe the cleaning outcome.

9.14 A copy of the cleaning report or similar outcome in a digital tool should be available on board and the activity entered in the BFRB.

Procedures for recycling facilities

9.15 Ship recycling facilities should adopt measures (consistent with applicable national and local laws and regulations) to ensure that biofouling organisms or waste substances are not released into the local aquatic environment.

9.16 Ship recycling facilities should develop a plan to minimize release of biofouling organisms and/or waste substances. If relevant, it is recommended that hull and niche areas be cleaned prior to recycling to avoid release of viable biofouling organisms or waste substances.

10 BIOFOULING MANAGEMENT PLAN

10.1 It is recommended that every ship have a ship-specific BFMP under the responsibility of shipowners, ship operators and shipmasters. A BFMP may require information from ship designers, shipbuilders, shipowners, AFC and MGPS manufacturers, recognized organizations and suppliers.

10.2 An effective BFMP should contribute to the aim of maintaining a recommended fouling rating ≤1, as described in chapter 8.

10.3 The ship-specific BFMP should include, but not necessarily be limited to, the following:

.1 identification of the officer, or the position (e.g. chief engineer), responsible for the BFMP, ensuring that the plan is properly implemented;

.2 details of the AFS installed and where it is installed;

.3 details of the recommended operating conditions which are suitable for the selected AFS to avoid deterioration of AFC, including recommended conditions such as temperature, salinity, speed;

.4 details of expected AFC efficacy throughout AFC lifetime including the need for inspection or maintenance, if relevant;

.5 description of monitoring on biofouling risk parameters;

.6 regime for cleaning, if any;

.7 details of hull and niche areas where biofouling may accumulate;

.8 schedule for fixed inspections of areas;

.9 procedures for reactive cleaning actions that should be performed if triggered by inspection results;

.10 contingency action plan based on specific triggers from monitoring of biofouling risk parameters;

.11 regime for repairs, maintenance and renewal of AFS, when relevant, in accordance with the manufacturer's instructions;

.12 process for monitoring and maintenance of MGPS as per the manufacturer's instructions to ensure their effectiveness in minimizing biofouling; and

.13 details of the documentation/reports required to document biofouling activities.

Continuous improvements

10.4 Information should be gathered to plan and facilitate efficient and sustainable biofouling management, allowing the evaluation and comparison of the cost-effectiveness of alternative strategies. The optimal solution is case-specific and should be considered in the light of several aspects.

10.5 Monitoring of the hull and the biofouling risk parameters may determine a risk of biofouling to be higher than predicted in the BFMP and therefore trigger more frequent inspections.

10.6 Inspection results may be shared in agreement with stakeholders involved if they are relevant for improvement purposes. To increase the efficiency of biofouling management and inspections, inspection organizations are encouraged to share inspection results with AFS manufacturers.

10.7 The effectiveness of the management actions in place should be reviewed following inspections and cleaning. The BFMP should be updated if the management actions in place are ineffective or deficient. Efficacy of the following items should be evaluated:

.1 ability to minimize biofouling by use of proactive cleaning methods;
.2 biofouling inspections schedule;
.3 ability to minimize biofouling by MGPS;
.4 AFS performance; and
.5 outcome of reactive biofouling management procedures:

.1 efficacy of the biofouling removal (i.e. no areas are missed); and
.2 accessibility for reactive cleaning in niche areas.

10.8 A form of a BFMP is set out in appendix 3 to these Guidelines.

11 BIOFOULING RECORD BOOK

11.1 The overall record-keeping of ship-specific biofouling management activities in a BFRB is the responsibility of shipowners, ship operators and/or shipmasters. The ship-specific BFRB should include information on biofouling management actions with input from AFS manufacturers and suppliers, ship cleaning and maintenance operators, inspection organizations, and ship repair and dry-docking facilities when relevant.

11.2 It is recommended that the BFRB be retained on board for the life of the ship. The book should record details and reports of all inspection and maintenance activities to be undertaken for all hull and niche areas. The BFRB may be maintained physically or electronically, and could be a stand-alone document, or integrated in part or fully into the existing ships' operational and procedural manuals and/or planned maintenance systems.

11.3 The BFRB should assist the shipowner and operator to evaluate the efficacy of the specific AFS and biofouling management measures on the ship.

11.4 All biofouling management activities should be recorded in a BFRB, including the following:

.1 details of repair and maintenance to the AFS including date, location and areas of the ship affected, including the percentage of the ship that was recoated with AFC – this is in addition to recordings in the International Anti-fouling System Certificate;

.2 details of repair and maintenance to the MGPS, including date, location and areas of the ship affected;

.3 the initial date, final date, duration in hours/days and location of in-water inspections, including the inspection report;

.4 the initial date, final date, duration in hours/days and location of cleaning (in water or in dry dock), including a cleaning report;

.5 details of when the ship has been operating outside its normal operating profile including any details of when the ship was laid up or inactive for extended periods of time;

.6 details of relevant performance monitoring parameters used to determine inspection intervals;

.7 a copy of the cleaning report including the information set out in appendix 2, if applicable; and

.8 description of contingency actions taken, including date, time and location.

11.5 A form of a BFRB is set out in appendix 4 to these Guidelines.

12 DOCUMENTATION AND DISSEMINATION OF INFORMATION

12.1 Documentation which is recommended in these Guidelines, such as relevant plans and reports, can be developed, maintained and kept in an electronic format.

12.2 States are encouraged to provide information on the location and the terms of use of proactive cleaning, inspection, reactive cleaning services and facilities to comply with these Guidelines. States requiring inspection or cleaning prior to arrival in their territory should inform the Organization. Member States or other relevant stakeholders are encouraged to communicate the outcome of testing of cleaning systems and applicable test standards to relevant stakeholders via https://bwema.org.

12.3 States are also encouraged to provide technical and research information to the Organization, including any studies on the impact and control of invasive aquatic species in ships' biofouling, information on local biofouling pressure, databases on regional biofouling management options, tools for the choice of AFS, and on the efficacy and practicality of in-water cleaning technologies, risk assessment tools and inspection reporting tools.

12.4 State authorities should provide ships with timely, clear and concise information on biofouling management measures and cleaning requirements that are being applied to shipping and ensure these are widely distributed. Shipowners and operators should endeavour to become familiar with all requirements related to biofouling by requesting such information from their port or shipping agents or competent authorities (i.e. State authorities).

12.5 Organizations or shipping agents representing shipowners and operators should be familiar with the requirements of State authorities with respect to biofouling cleaning and management procedures, including information that will be needed to obtain entry clearance. Verification and detailed information concerning State requirements should be obtained by the ship prior to arrival.

12.6 To monitor the effectiveness of these Guidelines as part of the evaluation process, States are encouraged to provide the Organization with records describing reasons why ships could not apply these Guidelines, e.g. design, construction or operation of a ship, particularly from the viewpoint of ships' safety, or lack of information concerning the Guidelines.

13 TRAINING AND EDUCATION

13.1 Training for ships' masters and crew, in-water cleaning or maintenance facility operators and those surveying or inspecting ships as appropriate should include instructions on the application of biofouling cleaning and management procedures, based upon the information contained in these Guidelines. Instruction should also be provided on the following:

.1 maintenance of appropriate records and logs;

.2 impacts of invasive aquatic species from ships' biofouling;

.3 benefits to the ship of managing biofouling and the threats posed by not applying management procedures;

.4 biofouling management measures and associated safety procedures; and

.5 relevant health and safety issues.

13.2 States and industry organizations should ensure that relevant marine training organizations are aware of these Guidelines and include them in their syllabuses as appropriate.

14 OTHER MEASURES

14.1 To the extent practical, States and port authorities should aim to ensure a smooth flow of ships going in and out of their ports to avoid ships waiting offshore, so that AFS can operate as effectively as possible.

14.2 States may apply other measures to ships within their jurisdiction for the purpose of providing additional protection for their marine environment, or in emergency situations. When managing emergency situations for biofouling, States may find the guidance document for ballast water emergency situations (BWM.2/Circ.17, as may be amended) also relevant to biofouling management.

14.3 States should consider these Guidelines when developing other measures and/or restrictions for managing ships' biofouling.

14.4 Where other measures are being applied, States should notify the Organization of the specific requirements, with supporting documentation, for dissemination to other States and non-governmental agencies where appropriate.

14.5 The application of other measures by States should not place the safety of the ship and crew at risk.

LIST OF APPENDICES

ABBREVIATIONS

AFS	Anti-fouling system
AFC	Anti-fouling coating
BFMP	Biofouling Management Plan
BFRB	Biofouling Record Book
IMO	International Maritime Organization
MGPS	Marine growth prevention system

APPENDIX 1

ASSESSMENT OF BIOFOULING RISK

1 Introduction

The Guidelines recommend taking a proactive approach to biofouling through assessment of biofouling risk profiles for hull and niche areas and by monitoring various risk parameters during operation. An assigned risk profile is dependent on AFS type and protection and should be ship-specific. Definition of risk monitoring parameters and trigger points for actions should also be ship-specific.

Monitoring various risk parameters during operation will lead to a holistic approach to biofouling management in line with a risk-based approach.

2 Identification of risk areas

Typical niche areas and other areas susceptible to biofouling on the hull are indicated in figure 2, but other niche areas may be relevant.

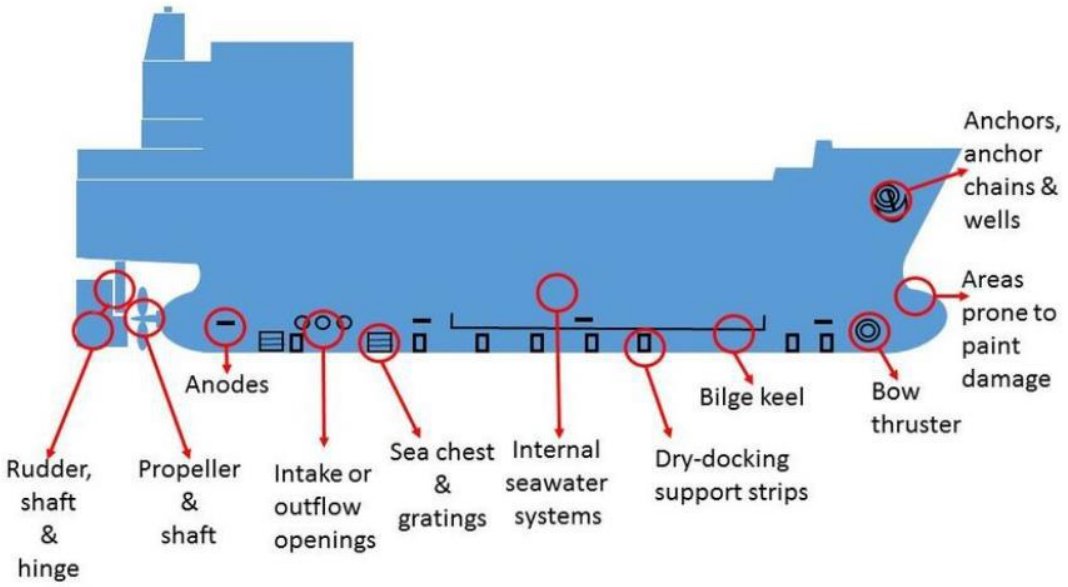


Figure 2: Hull with typical niche areas susceptible to biofouling (source: *Eugene, Conduct of land-based biofouling surveys for domestic vessels)*

3 Relevant parameters to be considered in the risk assessment

A ship-specific assessment should be established based on the possibility for biofouling accumulation. If any ship areas have no AFS installed, there is typically a higher risk of biofouling accumulation. If all ship areas have an AFS installed which is compatible with the ship's operating profile, the ship has an overall lower risk profile.

Based on the risk profile, an inspection regime should be determined and described in the BFMP. If the assessment determines that an area has a high risk for biofouling accumulation, an inspection regime with short intervals between inspections is recommended. Further, the areas with a low risk profile may follow the inspection regime with longer fixed intervals as specified in chapter 8 of the Guidelines.

The risk profile indicates the possibility of accumulating biofouling and increases as a function of biofouling pressure versus biofouling protection over time. The biofouling risk parameters given in table 2 should be monitored as the risk of biofouling accumulation may increase over time. When higher risk is identified, recommended actions in the form of inspection, reactive cleaning and/or maintenance of AFS should be performed as described in the BFMP. Inspection as a contingency action, if completed by an inspection organization in line with chapter 8, can be treated as a starting point to define the interval for the next inspection.

A hull performance monitoring system can be used to assess the changes in the propulsion power and fuel consumption of the ship. Such changes may indicate a degradation of hull or propeller condition due to biofouling.

The results from the hull performance monitoring may indicate biofouling growth on the hull and propeller; however, growth in niche areas will not necessarily be detected with this monitoring method.

Digital tools may be applied for monitoring of biofouling risk parameters. Monitoring of parameters should be as thorough as practicable.

In table 2 below, various biofouling risk parameters are presented with a description of possible risk impact.

Table 2: Biofouling risk parameters

	Examples of biofouling risk parameters	Description and evaluation guidance
1	**Deviation from AFS specifications (e.g. speed, salinity, temperature)**	An AFS/AFC can typically work well within a specific range of operating parameters. The relevant parameters and acceptable ranges for each parameter should be described in the manufacturer's specification and included in the BFMP. Specifications typically include operation routes, ship activity level, speed, water salinity and temperature and cleaning requirements. Specifications may vary depending on the technology of the AFS used. Ship operations should be in accordance with the recommendations from the AFC manufacturer. Deviation from the specification of the ship's AFC may increase the deterioration of the AFC or reduce its efficacy and change the biofouling risk. Incidental deviations should be evaluated for potential biofouling impact. Continuous or regular deviations, or deviations not rectified, would lead to an elevated risk profile and more frequent inspection should be part of the contingency plan.
2	**Deviation from AFS maintenance/service regime**	Regular maintenance and service (e.g. calibration or adjustment of treatment dosages for an MGPS) may be necessary actions for proper protection by the AFS. If the maintenance and service time is exceeded, as specified by the manufacturer, the risk profile is elevated. For maintenance of AFC, see item 7. Missing maintenance and/or service should be evaluated as part of the contingency plan for potential biofouling impact.
3	**Deviation from regular proactive cleaning or necessary reactive cleaning**	When proactive cleaning is part of the ship-specific BFMP, deviation from regular use as specified in the BFMP may lead to increased risk of biofouling growth onto relevant areas. The impact should be evaluated as part of the contingency action plan for potential biofouling impact until the missing proactive cleaning is back in regular operation. Ships should be aware of possible macrofouling accumulation and, if fouling rating is >1, cleaning with capture is the recommended cleaning action. If reactive cleaning is not conducted when inspection has determined cleaning is necessary, it will increase the risk of spreading organisms to new locations. This risk should be evaluated as part of the contingency plan until the next cleaning event is undertaken.
4	**Extended ship idle time**	Biofouling accumulation starts immediately when a ship is idle, but the rate depends on AFS type and biofouling pressure (temperature, distance to coast). To avoid risk of biofouling, the operating profile should only allow short periods in port or at anchorage or at least not exceed the recommendation by the AFS manufacturer. Acceptable idle time should be specified in the ship's BFMP. Idle time is often defined in charter party contracts and typically ranges between 18 to 30 days. If the idle time is longer than specified in the BFMP, the risk profile changes. If the number of consecutive idle days is still within what is specified as acceptable as per AFS supplier's guarantee and/or idling takes place in an area far from shore (>200 nm and >200 m depth), the risk may still be considered low. If the number of consecutive idle days is beyond what is specified as acceptable as per AFS supplier's guarantee, the risk may be considered very high if the ship is subject to biofouling pressure. For these cases, the contingency action plan should include immediate actions before the next voyage.

	Examples of biofouling risk parameters	Description and evaluation guidance
5	**Performance loss as per PMS**	Performance monitoring of fuel consumption may give indication on possible biofouling accumulation on the hull. Performance monitoring is mainly for hull monitoring (not niche areas) and may include the following methods: .1 Sensors and collecting high frequency data. .2 Semi-automatic or manual calculations using data collected by ship's crew (e.g. noon reports). .3 Speed trials and comparing the performance data with previous speed trial reports. Note that PMS is often a lagging indicator and may depend on many factors, therefore additional measures may be necessary before it can be used to determine biofouling accumulation. For some ships, a speed loss between 1% and 3% or increased fuel consumption of 3-9% may indicate light biofouling while a speed loss >3% or fuel consumption increase by >9% may indicate higher biofouling risk (examples taken from ISO 19030-2:2016).
6	**AFS damage**	Failure caused by mechanical damage to the AFS may result in higher risk of biofouling in the areas affected, if not rectified within reasonable time. Failures and damage should be recorded in the BFRB. As part of the contingency action plan, the impact from the damage should be evaluated for potential biofouling accumulation and relevant actions should be implemented until a repair is undertaken.
7	**Downtime/malfunction of MGPS, proactive cleaning or other AFS**	Observed downtime of an MGPS, proactive cleaning or other AFS has a direct impact on risk of biofouling accumulation. The impact on the area impacted will be affected depending on the duration of malfunction. The impact should be evaluated as part of the contingency action plan for potential biofouling impact until the missing MGPS/proactive cleaning/other AFS is back in operation. Reduced operation time of proactive cleaning, i.e. longer intervals between cleaning than specified in the BFMP, is defined as downtime and may increase biofouling accumulation particularly in those areas where it is not applied as specified in the BFMP. The impact on the area affected depends on the duration of malfunction and the trading conditions during that time. The evaluation of impact and potential reactions should be part of the contingency action plan. If proactive cleaning without capture is irregular, ships should be aware of possible macrofouling accumulation and take actions to avoid spread of macrofouling. If fouling growth exceeds fouling rating 1, cleaning with capture is recommended.
8	**Exceeding expected lifetime of AFS**	Once an AFS has exceeded its lifetime, as specified by the manufacturer, the biofouling risk profile is elevated. Inspection and cleaning should be performed more often and 1-2 months interval between inspections is recommended. Additionally, the efficacy of the AFS may be reduced as it approaches the end of its lifetime. If macrofouling has been removed in a previous cleaning event, the strong forces needed for removing the fouling can have compromised the lifetime of the AFC. The performance of the AFS, and any necessary change in maintenance or inspection schedule, as given by the AFS manufacturer, should be part of the contingency action plan specified in the BFMP.

4 Flow chart visualizing biofouling management

An example of a flow chart for visualizing biofouling management risk profile and monitoring of parameters is shown in figure 3.

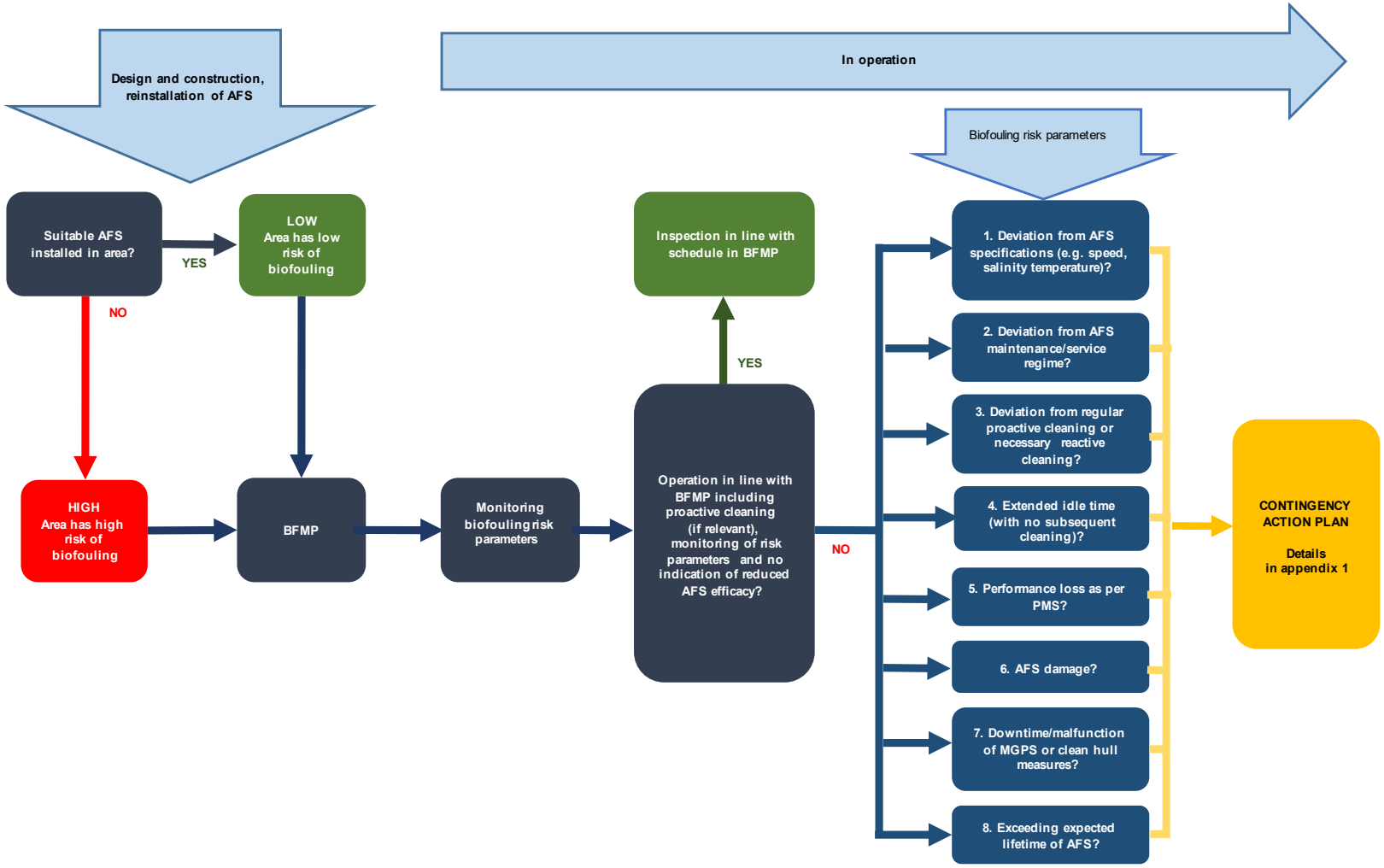


Figure 3: **Flow chart visualizing the biofouling management risk profile and monitoring parameters**

APPENDIX 2 INSPECTION AND CLEANING REPORTS

1 Introduction

The Guidelines recommend that a report should be prepared after an inspection and/or cleaning operation. The report should record the details of the biofouling management actions undertaken on the ship. The inspection report should be prepared by the inspection provider. It may also be relevant to prepare a report after an inspection carried out by ship's crew as part of contingency actions.

The cleaning report should be prepared by either the cleaning operators or the inspection provider as part of a combined cleaning and inspection report.

Digital tools may be applied for the reporting and/or assessment of results. The conclusions from the reports should be recorded in the BFRB including reference to the detailed report/assessment.

2 Entries in the report after a biofouling inspection

The following information should be recorded in the inspection report:

- Ship particulars:
  - Ship name
  - IMO number
- Date and place of inspection
- Name of inspection/cleaning company
- List of all inspected hull and niche areas
- Inspection equipment used (including list of divers/ROV operators participating in the operation)
- Inspection conditions (i.e. duration, estimated visibility underwater)
- Signature of authorized person of the inspection/cleaning company
- Inspection start and end times
- Results:
  - Type of biofouling as per the rating in table 1
  - Quantitative assessments of biofouling cover of area inspected (i.e. estimates of per cent cover) as per table 1
- AFC condition
  - The condition of the AFC should be observed during the inspection and reported. The condition is recommended to be categorized in line with table 4
- MGPS condition
  - The condition of the MGPS should be observed during the inspection and reported. The condition is recommended to be categorized in line with table 5
- Photos/videos
  - Photos and videos submitted or used in a digital assessment tool as evidence of hull fouling

SAMPLE OF INSPECTION REPORT

Name of ship: .....

IMO number: .....

Date: .....

Location/port: ……

Inspection organization/responsible officer: ……

Inspection conditions: ……..

Inspection equipment used: ……..…….

Divers/ROV operators participating: ……

Quantitative assessment of biofouling cover is summarized in table 3 (in line with the ratings in table 1)

Table 3: Quantitative assessment of biofouling cover

For each transect and niche area surveyed, the mode of the fouling rating (most frequent rating) and the range (lowest and highest rating) should be recorded. An average should not be used. If more than one of the same type of area is assessed, these should be recorded separately and each be given their own fouling rating.

Areas	**Fouling rating** (0-4)			**Macrofouling cover** (%)
	Lowest rating	Highest rating	Most frequent rating	
Hull below the waterline				
Port vertical side				
1 m wide belt				
1 m wide belt of subsection X				
1 m wide belt of subsection X				
Starboard vertical side				
1 m wide belt				
1 m wide belt of subsection X				
1 m wide belt of subsection X				
Flat bottom front				
1 m wide belt				
1 m wide belt of subsection X				
Flat bottom mid				
1 m wide belt				
1 m wide belt of subsection X				
Flat bottom aft				

Areas	**Fouling rating** (0-4)			**Macrofouling cover** (%)
	Lowest rating	Highest rating	Most frequent rating	
Hull below the waterline				
1 m wide belt				
1 m wide belt of subsection X				
Niche areas				
Bow subsection X				
Bow subsection X				
Bow thruster				
Bilge keels				
Sea chest gratings				
Location 1				
Location 2				
Stern				
Propeller and its shaft				
Rudder and rudder shaft				
Discharge pipes				
Rope guards				
Sounders/instruments				
Sacrificial anodes				
Internal seawater systems				
…..				
…..				

An area should be assigned a fouling rating equal to the highest rated 1 m^2 identified along the subdivided areas.

The inspection should be as comprehensive as practicable. The more subdivided areas that are inspected, the greater the certainty that the biofouling for the area is realistic. It is recommended that the identified niche areas should be in line with the BFMP.

The condition of the AFC and MGPS should be observed during the inspection and reported. The condition is recommended to be categorized in line with tables 4 and 5, respectively. If the condition of the AFC could only be thoroughly assessed after reactive cleaning, table 4 should be part of the cleaning report.

Table 4: The condition of the AFC

AFC condition								
Areas	**Intact and effective in preventing biofouling**	**Failure of adhesion between a coating and a metallic surface**	**Blistering in coating**	**Cracks in the coatings**	**Cold flow resulting in irregular coating thickness**	**Delamination / peeling / detachment between coatings**	**Polishing off coating during the ship's operation (beyond specifications)**	**Grounding / general damage to coating**
Hull below the waterline								
Port vertical side								
subsection X								
Starboard vertical side								
subsection X								
Flat bottom front								
subsection X								
Flat bottom mid								
subsection X								
Flat bottom aft								
subsection X								
Bow								
Bow thruster								
Bilge keels								
Sea chest gratings								
Location X								
Location X								
Stern								
Propeller and its shaft								
Rudder and rudder shaft								
Discharge pipes								
Rope guards								
Sounders/instruments								
Sacrificial anodes								
…								
…								

Table 5: The condition of the MGPS

Areas examples (typical niche areas)	Condition of MGPS		
	Intact and effective in preventing biofouling	Calibration/maintenance required	Non-effective to prevent biofouling
Bow			
Bow thruster			
Bilge keels			
Sea chest gratings			
Location 1			
Location 2			
Stern			
Propeller and its shaft			
Rudder and rudder shaft			
Discharge pipes			
Rope guards			
Sounders/instruments			

Comments: ……..……

Reference to supporting photos/videos for fouling inspection and assessment of AFC/MGPS: ……

Signature of inspection organization or competent ship crew: ……..……...…….

3 Entries in the report after biofouling management (reactive cleaning)

The following information should be recorded in the cleaning report:

- Ship particulars:
  - Ship name
  - IMO number
- Date and place of inspection
- Name of cleaning company
- All hull and niche areas cleaned/treated specified and documented in the report, including also areas not cleaned/treated
- Cleaning equipment used for hull
- Cleaning equipment used for niche areas
- Inspection equipment used (including list of divers/ROV operators participating in the operation)
- Conditions during cleaning inspection (i.e. duration, estimated visibility underwater)
- Signature of authorized person of the cleaning company
- Cleaning start and end times
- Results:
  - Type of biofouling after reactive cleaning (as per the ratings in table 1)
  - Quantitative assessments of biofouling cover after cleaning (as per table 1)
- AFC condition (unless assessed during inspection)
  - The condition of the AFC should be observed during the cleaning activity and reported using the conditions as categorized in table 4
- Photos/videos
  - Photos and videos submitted or used in a digital assessment tool as evidence of hull cleaning
- Capture
  - Description of capture method
  - Supporting evidence that dislodged material (by mass) has been captured as described in chapter 9

  (Reference to equipment specification and validation test report may be sufficient)
- Treatment* and/or disposal of waste material captured during cleaning should be described in the report. Evidence of delivery to waste management facility or facilities should be attached to the cleaning report. The biofouling waste should be disposed of and/or treated in a safe and environmentally sound manner, in accordance with local regulations, and ensure that the main objective of the Guidelines, to minimize the spread of invasive aquatic species, is safeguarded.

* Treatment is any process designed to remove or deactivate any biofouling material and particulate or dissolved waste substances captured or produced during any stages of cleaning.

SAMPLE OF A BIOFOULING CLEANING REPORT

Name of ship: .....

IMO number: .....

Date: .....

Location/port: …….

Cleaning company: ……...

In-water conditions: ……..

Technologies used for reactive cleaning of hull and niche areas:
……
……

Table 6: Summary of the operations

Areas examples	**New fouling rating after performed cleaning**		
	Lowest rating	Highest rating	Most frequent rating
Hull below the waterline			
Port vertical side			
subsection X			
subsection X			
subsection X			
Starboard vertical side			
subsection X			
subsection X			
subsection X			
Flat bottom front			
subsection X			
subsection X			
Flat bottom mid			
subsection X			
subsection X			
Flat bottom aft			
subsection X			
subsection X			
Niche areas			
Bow			
Bow thruster			
Bilge keels			
Sea chest gratings			
Location 1			
Location 2			
Stern			
Propeller and its shaft			
Rudder and rudder shaft			
Discharge pipes			
Rope guards			
Sounders/instruments			
Sacrificial anodes			
Internal seawater systems			
….			
….			

Description of activity and reference to supporting evidence (photos/videos):

Description of capture and reference to supporting evidence:

Description of treatment and/or biofouling waste disposal with supporting evidence (e.g. receipts):

Description of any problems encountered during cleaning including details of any damage to the AFS that may have occurred:

Comments:

Signature of cleaning organization: ……...……

APPENDIX 3

EXAMPLE FORM OF BIOFOULING MANAGEMENT PLAN

INTRODUCTION

Biofouling on ships can be a significant vector for the transfer of invasive aquatic species. Biofouling management practices may also improve a ship's hydrodynamic performance and can be effective at enhancing energy efficiency, hence reducing air emissions from ships as well as fuel costs.

This Biofouling Management Plan (BFMP) should assist the ship crew in conducting biofouling management and is specific to this ship.

SHIP PARTICULARS

Name of ship	
IMO number	
Date of construction	
Ship type	
Gross tonnage	
Beam or ship's breadth	
Length overall	
Maximum and minimum draughts	

RECORD OF REVISION OF THE BFMP

This plan describes the biofouling management for the period between two scheduled dry-dockings which include application, reapplication, installation or renewal of the AFS. The plan should be re-evaluated and, if necessary, updated after a dry-docking and/or if any changes are made that have an impact on the anticipated biofouling.

	Date:
Most recent scheduled dry-docking	
The next scheduled dry-docking	

The following revisions have been made:

Date/timeline	**Developed by**	**Implemented by/ responsible person**	**Updated parts**

INDEX

<A table of contents should be included.>

PURPOSE

The purpose of the BFMP is to outline measures for the control and management of the ship's biofouling to minimize the spread of invasive aquatic species.

DESCRIPTION OF OPERATING PROFILE

The ship's operating profile is described below and is the basis for the selection of the ship's anti-fouling systems (AFS) and operational practices.

Typical operating speed	
Typical trading areas	<EXAMPLE> <Domestic, great coasting, North Sea and Baltic trade, European trade, short international voyage, international voyage, overseas voyage or unrestricted voyages>
Typical operating areas, including climate zones in which the ship will operate	<EXAMPLE> <Temperate, semi-temperate, tropical and/or arctic>
Typical salinities of operating areas in which the ship will operate	<EXAMPLE> <Fresh water, brackish water and/or marine water>
AFS installed are suitable for typical operating profile (Y/N)	

DESCRIPTION OF HULL AND NICHE AREAS WHERE BIOFOULING MAY ACCUMULATE

The hull and niche areas where biofouling may accumulate are described below.

Areas on hull	<EXAMPLE> <flat-bottom- front flat-bottom- mid flat-bottom- aft bow dome boot top vertical sides – port side vertical sides – starboard side vertical side – aft transom or others>
Niche areas (including quantity where relevant)	<EXAMPLE> <Sea chests bow dome bow thruster tunnel tunnel grates cathodic protection anodes bilge keels anchor chain chain locker stabilizer fins rudder dock block positions A-brackets/stern tube cathodic protection anodes and systems draft internal pipework ballast uptake system inlet gratings sea inlet pipes stern thruster thruster body velocity probes propeller propeller shaft stern tube seal echo sounders rope guards box coolers moon pools free-flood spaces/voids engine cooling system fire-fighting system auxiliary service system or others>

LOCATION OF AREAS WHERE BIOFOULING MAY ACCUMULATE ON THE SHIP

<A diagram of both side and bottom of the ship identifying the location of each area that may accumulate biofouling should be included.>

DESCRIPTION OF APPLIED ANTI-FOULING SYSTEM

The selected AFS that are applied, reapplied, installed or renewed on the ship are described below. When more than one type of anti-fouling coating (AFC) or marine growth prevention system (MGPS) are applied, reapplied, installed or renewed, each AFS should be described individually and in accordance with each manufacturer's instructions.

Prior to a scheduled dry-docking, an evaluation of qualitative observations regarding the ship's biofouling should be made with the purpose of a potential improvement of the AFS selection. Previous reports on the performance of the ship's AFS should be part of the evaluation.

Manufacturer(s) and type(s) of AFC	<EXAMPLE> <Hard coating, self-polishing or fouling release, etc.>
Biocides in AFC	<EXAMPLE> <Copper oxide, zineb, etc.>
Dry film thickness	
Expected lifetime and, if any, expected reduction of efficiency of AFC	
Operating profiles which are suitable for the AFC including temperature, salinity, speed, periods of inactivity	
Recommended regime for repairs, maintenance and/or renewal to receive the AFC optimal performance	<EXAMPLE> <Regime for repairs> <Regime for maintenance> <Regime for renewal> <N/A>
Cleaning methods recommended for AFC	
Cleaning methods not appropriate for AFC, if any	
IAFS Certificate	

Manufacturer(s), models and type(s) of MGPS	<EXAMPLE> <Anode, ultrasound, electrode, electrolysis, ultraviolet radiation or other>

Type(s) of harmful discharge from MGPS	<EXAMPLE> <Chlorine, noise or other>
Operating conditions/frequency of use	<EXAMPLE> <dosing frequency temperature, salinity, speed>
Required maintenance and frequency	
Service life of MGPS	

Manufacturer(s), models and type(s) of other AFS	
Type(s) of harmful discharge from other AFS	
Operating conditions/frequency	
Required maintenance and frequency	
Service life and expiry date of AFS	

INSTALLATION OF ANTI-FOULING SYSTEM

The areas on the ship which are protected with the selected AFS are described below. If necessary, the individual AFS could be identified as A and B, respectively. Areas with no protection are also described.

AFS applied	Areas on ship where AFS is applied	Date of application	Recommended cleaning technique
<EXAMPLE> <AFC (A)>	<EXAMPLE> <flat-bottom- front, flat-bottom- mid, flat-bottom- aft, bow dome, boot top, vertical sides – port side, vertical sides – starboard side, vertical side – aft, transom, or others>		<EXAMPLE> <soft brush, blades, metal brushes or water jet>
<EXAMPLE> <MGPS (A)>	<EXAMPLE> <Sea chests, internal pipework, ballast uptake system, inlet gratings>		<EXAMPLE> <Steaming>
<EXAMPLE> <Other AFS>			

<EXAMPLE> <No AFS>			

INSPECTION SCHEDULE OF HULL AND NICHE AREAS

An inspection will be carried out by organizations or personnel competent to undertake inspections in line with the fixed intervals described below:

Inspection areas	Initial inspection	Subsequent inspections
<EXAMPLE> <Areas installed with AFS and operating within the profile>	<EXAMPLE> <Inspection within 12 months> <When utilizing a performance monitoring system that indicates adequate performance of the AFS, an inspection will be conducted within 18 months. If the monitoring indicates that the AFS is not performing effectively, an inspection should be carried out as soon as possible.>	<EXAMPLE> <If rating 0-1 in previous inspection, then inspection every 12-18 months If rating 2, 3 or 4 in previous inspection, then more frequent inspections>
<EXAMPLE> <Areas with no AFS and no other measures>	<EXAMPLE> <Inspection within 12 months>	<EXAMPLE> <Inspection more frequent>

CLEANING

Reactive cleaning should be performed as a result of any inspection with a fouling rating ≥2. It should be performed in line with procedures of the ship cleaning operator or the dry-dock facilities used, and the cleaning practices should be conducted in accordance with the jurisdiction's policies or regulations of the relevant authority. Preferred cleaning methods and procedures that can be used are described below. The methods and cleaning operator used in each cleaning occasion should be recorded in the BFRB.

Reactive cleaning method(s)	**Areas where cleaning method will be applied**	**Operating condition when cleaning method will be applied**	**Cleaning schedule**
<EXAMPLE> <Water jet and suction with capture in line with <name of the standard>>	<EXAMPLE> <flat-bottom-front, flat-bottom-mid, flat-bottom-aft, bow dome, boot top, vertical sides – port side, vertical sides – starboard side, vertical side – aft, transom, or others>	<EXAMPLE> <moored in harbour, drifting in open sea, on anchorage in coastal waters, on voyage>	<EXAMPLE> <When recommended based on monitoring of biofouling parameters and/or in case unforeseen biofouling levels are detected on hull or in niche areas>
<EXAMPLE> <Steaming with capture performed in line with <name of the standard>>	<EXAMPLE> <Sea chests, internal pipework, ballast uptake system, inlet gratings>	<EXAMPLE> <in dry dock>	<EXAMPLE> <When recommended based on monitoring of biofouling parameters and/or in case unforeseen biofouling levels are detected in niche areas>
Possible harmful discharge from cleaning with reactive cleaning method			
Manufacturer and model of ship-specific reactive cleaning device, if applicable			
Reactive cleaning method suitable for AFC			

Reactive cleaning method(s)	Areas where cleaning method will be applied	Operating condition when cleaning method will be applied	Cleaning schedule
Required maintenance and frequency, as applicable			
Reactive cleaning suitable for typical operating profile, i.e. is the ship expected to stay enough time in locations where reactive cleaning can be carried out			
Reactive cleaning device tested in line with <name of the standard> (Y/N), if applicable			

Proactive cleaning should take into account recommendations from the AFS manufacturer listed in this BFMP. Description of proactive cleaning activities which are planned on a regular basis, if any, are listed below.

Proactive cleaning method(s)	Areas where cleaning method will be applied	Operating condition when cleaning method will be applied	Cleaning schedule
<EXAMPLE> <ROV with water jet, ROV with soft brush,	<EXAMPLE> <flat-bottom-front, flat-bottom-mid, flat-bottom-	<EXAMPLE> <moored in harbour, drifting in open	<EXAMPLE> <every <XX> days when operating in temperate waters;

Proactive cleaning method(s)	Areas where cleaning method will be applied	Operating condition when cleaning method will be applied	Cleaning schedule
manual device with soft brush or other>	aft, bow dome, boot top, vertical sides – port side, vertical sides – starboard side, vertical side – aft, transom, or others>	sea, on anchorage in coastal waters, on voyage>	every <XX> days when operating in tropical/semi-tropical waters; when recommended based on monitoring of biofouling parameters; and in case of unforeseen biofouling levels defined as rating 1 are detected on hull or in niche areas>
Possible harmful discharge from cleaning with proactive cleaning method		<EXAMPLE> <AFC biocides, biofouling, particles or other>	
Manufacturer and model of ship-specific proactive cleaning device, if applicable			
Proactive cleaning method suitable for AFC			
Required maintenance and frequency, as applicable			
Proactive cleaning suitable for typical operating profile, i.e. is the ship expected to stay enough time in locations where proactive cleaning can be carried out			
Description of how to avoid biofouling cleaning and discharge of macrofouling, if possible			
Proactive cleaning device tested in line with <name of the standard> (Y/N), if applicable			

MONITORING OF BIOFOULING RISK PARAMETERS AND CONTINGENCY ACTIONS

Relevant digital tools applied for monitoring of biofouling risk parameters and/or digitalized real-data input are <describe the tools and data used for this ship>.

The biofouling risk parameters given below should be monitored when the ship is in operation. When a parameter goes beyond the deviation limit, the risk of biofouling is increased, and the recommended contingency actions should be used as described.

Biofouling risk parameters to monitor	Evaluation of a deviation including deviation limit of the risk parameter	Contingency actions	Long-term actions
<EXAMPLE> <Deviation from speed specifications acceptable for the AFS>	<EXAMPLE> <Incidental deviations should be evaluated for potential biofouling impact. Continuous or regular deviations, or deviations not rectified, should lead to contingency actions>.	<EXAMPLE> <Shorter inspection interval with inspection every 4 months. When recommended by the AFS manufacturer, more frequent proactive cleaning activities could be implemented between inspections.>	<EXAMPLE> <Evaluate the need for a potential improvement of the AFS selection prior to the next dry-docking.>
<EXAMPLE> <Deviation from salinity specifications acceptable for the AFS>	<EXAMPLE> <Incidental deviations should be evaluated for potential biofouling impact. Continuous or regular deviations, or deviations not rectified, should lead to contingency actions.>	<EXAMPLE> <Shorter inspection interval with inspection every 4 months. When recommended by the AFS manufacturer, more frequent proactive cleaning activities could be implemented between inspections.>	<EXAMPLE> <Evaluate the need for a potential improvement of the AFS selection prior to the next dry-docking.>
<EXAMPLE> <Deviation from temperature range specifications acceptable for the AFS>	<EXAMPLE> <Incidental deviations should be evaluated for potential biofouling impact. Continuous or regular deviations, or deviations not rectified, should lead to contingency actions.>	<EXAMPLE> <Shorter inspection interval with inspection every 4 months. When recommended by the AFS manufacturer, more frequent proactive cleaning activities could be implemented between inspections.>	<EXAMPLE> <Evaluate the need for a potential improvement of the AFS selection prior to the next dry-docking.>

Biofouling risk parameters to monitor	Evaluation of a deviation including deviation limit of the risk parameter	Contingency actions	Long-term actions
<EXAMPLE> <Deviation from the maintenance/service regime of the AFC>	<EXAMPLE> <If the maintenance and service time, specified by the manufacturer, is exceeded, the risk of biofouling is elevated, and contingency actions should be implemented>.	<EXAMPLE> <An inspection should be carried out for the relevant area. Maintenance or repair should be performed at earliest possible opportunity.>	<EXAMPLE> <Regular maintenance and repair (e.g.) may be necessary actions for proper protection by the AFC. Evaluate the need to update maintenance programme.>
<EXAMPLE> <AFC damage>	<EXAMPLE> <Failure caused by mechanical damage to the AFC may result in higher risk of biofouling in the areas affected, if not rectified within reasonable time. The damage should be evaluated for potential biofouling accumulation.>	<EXAMPLE> <An inspection should be carried out for the relevant area. Repair should be performed at earliest opportunity. More frequent inspections of damaged area should be implemented until a repair is undertaken.>	
<EXAMPLE> <Deviation from the maintenance/service regime of the MGPS>	<EXAMPLE> <If the maintenance and service time, specified by the manufacturer, is exceeded, the risk of biofouling is elevated, and contingency actions should be implemented.>	<EXAMPLE> <An inspection should be carried out for the relevant niche area where MGPS is installed. Maintenance, calibration, or adjustment of treatment dosages for a MGPS should be performed at earliest possible opportunity.>	<EXAMPLE> <Regular maintenance and service (e.g.) may be necessary actions for proper protection by the AFS. Evaluate the need to update maintenance programme>

Biofouling risk parameters to monitor	Evaluation of a deviation including deviation limit of the risk parameter	Contingency actions	Long-term actions
<EXAMPLE> <Downtime/malfunction of MGPS>	<EXAMPLE> <Observed downtime of an MGPS could have a direct impact on risk of biofouling accumulation. The impact will depend on the duration of malfunction and operating areas (coastal area).>	<EXAMPLE> <More frequent inspections of relevant area should be implemented until the MGPS is back in operation.>	
<EXAMPLE> <Downtime/malfunction of other AFS>	<EXAMPLE> <Reduced operation time of other AFS may increase biofouling accumulation in areas where it is usually applied.>	<EXAMPLE> <More frequent inspections of relevant area should be implemented until the AFS is back in operation.>	
<EXAMPLE> <Exceeding expected lifetime of AFS>	<EXAMPLE> <Once an AFS has exceeded its lifetime, as specified by the manufacturer, the biofouling risk is increased.>	<EXAMPLE> <More frequent inspections should be implemented until the AFS is back in operation.>	<EXAMPLE> <The performance of the AFS, and any necessary change in maintenance or inspection schedule, based on experience, should be included in the next update of this BWMP.>
<EXAMPLE> <Deviation from regular proactive cleaning>	<EXAMPLE> <When proactive cleaning is implemented as part of the AFS, deviation from regular use could lead to increased risk of biofouling growth onto relevant submerged areas.>	<EXAMPLE> <An inspection should be carried out. If there is macrofouling (fouling rating ≥2) in the relevant area, reactive cleaning with capture should be performed before	<EXAMPLE> <Regular maintenance and repair (e.g.) may be necessary actions for proper protection by the proactive cleaning.

Biofouling risk parameters to monitor	Evaluation of a deviation including deviation limit of the risk parameter	Contingency actions	Long-term actions
		proactive cleaning is used again. Maintenance or repair should be performed at earliest possible opportunity. More frequent inspections should be implemented until the missing proactive cleaning is in regular use.>	Evaluate the need to update maintenance programme.>
<EXAMPLE> <Deviation from necessary reactive cleaning>	<EXAMPLE> <If reactive cleaning is not conducted as scheduled or after an inspection has determined that reactive cleaning is necessary, it will increase the risk of spreading organisms to new locations.>	<EXAMPLE> <Prior to departure reactive cleaning should be performed, to avoid risk of spreading invasive aquatic species. If no reactive cleaning is performed prior to departure, a reactive cleaning activity should be scheduled at earliest possible opportunity. If no reactive cleaning is performed, an acceptance could be required to arrive in the next port. Contact next port for further advice.>	<EXAMPLE> <More frequent reactive cleaning may be necessary actions for proper biofouling management. Evaluate the need to update the cleaning schedule.>
<EXAMPLE> <Extended ship idle time (berthed, anchored, moored)>	<EXAMPLE> <If the idle time is longer than estimated in the ship's operating profile, it could lead to	<EXAMPLE> <If the idle time is within the guarantee of the AFS supplier, a short voyage with speed as specified for the AFS could be	EXAMPLE> <Evaluate the need for a potential improvement of the AFS selection prior

Biofouling risk parameters to monitor	Evaluation of a deviation including deviation limit of the risk parameter	Contingency actions	Long-term actions
	an elevated risk of biofouling. If the idle time is beyond the guarantee of the AFS supplier, the risk of biofouling accumulation increases. The risk also depends on biofouling pressure, e.g. temperature and distance to the coastline. If the ship is idle in an area far from shore (>200 nm and >200 m depth) and far from other installations, the risk may still be considered low.>	conducted, sea chests could be blanked off or, when recommended by the AFS manufacturer, more frequent proactive cleaning activities could be implemented. If the idle time is beyond the guarantee of the AFS supplier, an inspection should be carried out.>	to the next dry-docking.>
<EXAMPLE> <Performance loss as per Performance Monitoring System>	<EXAMPLE> <Performance monitoring may detect biofouling growth on the hull, but not necessarily in niche areas. Performance monitoring of fuel consumption may give indication on possible biofouling accumulation on the hull and may include the following methods: .1 Sensors and collecting high-frequency data. .2 Semi-automatic or manual	<EXAMPLE> <When the data show a trend in performance loss over time, the time since last cleaning activity in combination with operating profile should be evaluated to determine if an inspection should be carried out.>	<EXAMPLE> <Experience from fuel consumption and cleaning activity over time may lead to optimization and changes to the cleaning schedule.>

Biofouling risk parameters to monitor	Evaluation of a deviation including deviation limit of the risk parameter	Contingency actions	Long-term actions
	calculations using data collected from ship's crew (e.g. noon reports). .3 Speed trials and comparing the performance data with previous speed trial reports. <Percentage of the speed loss and percentage of increased fuel consumption, that may indicate light biofouling on the ship>.>		
<EXAMPLE> <Downtime/malfunction of proactive cleaning >	<EXAMPLE> <When proactive cleaning is implemented as part of the AFS, long periods of downtime could lead to increased risk of biofouling growth.>	<EXAMPLE> <More frequent inspections of relevant areas should be implemented until the proactive cleaning is back in operation. Maintenance or repair should be performed at earliest possible opportunity. If macrofouling accumulation is found (fouling rating ≥2), reactive cleaning with capture should be conducted before the proactive cleaning is put into service again.>	<EXAMPLE> <Regular maintenance and repair (e.g.) may be necessary actions for proper protection by the proactive cleaning. Evaluate the need to update maintenance programme.>

CAPTURE AND DISPOSAL OF WASTE

In-water reactive cleaning companies should arrange for capture of debris during cleaning. The biofouling waste should be disposed of and/or treated in a safe and environmentally sound manner, in accordance with local regulations, to ensure that the main objective of the Guidelines, to minimize the transfer of invasive aquatic species, is safeguarded.

Documenting evidence of collection/delivery of the wastes (a receipt) will be appended to the BFRB.

SAFETY PROCEDURES FOR THE SHIP AND THE CREW

<Details of specific operational or safety restrictions associated with the AFC or MGPS systems that affect the ship and/or the crew.

Details of specific safety procedures to be followed during ship inspections and cleaning operations.>

CREW TRAINING AND FAMILIARIZATION

<Information on the provision of crew training and familiarization on biofouling management.

Detailed description of how inspections are to be carried out by ship crew as part of contingency actions.>

APPENDIX 4

EXAMPLE FORM OF BIOFOULING RECORD BOOK

PART I – Biofouling management activities

Name of ship: .....

IMO number, distinctive numbers or letters:.....

Gross tonnage: .....

Period from:..... to: .....

Note:

Biofouling Record Book Part I should be provided to every ship with a Biofouling Management Plan (BFMP), to record relevant biofouling activities such as inspections, maintenance and cleaning activities. Biofouling Record Book Part II should also be provided to record when the ship has a higher risk of biofouling accumulation and related contingency actions.

1 Introduction

The following pages of this section show a comprehensive list of items of biofouling management activities which are, when appropriate, to be recorded in Biofouling Record Book Part I. Management of biofouling should be in line with an approved Biofouling Management Plan (BFMP) and take into account guidelines developed by the Organization. The items have been grouped into operational sections, each of which is denoted by a letter code.

When making entries in Biofouling Record Book Part I, the date, operational code and item number should be inserted in the appropriate columns and the required particulars should be recorded chronologically in the blank spaces. Each completed operation should be signed for and dated by the officer or officers in charge. The master of the ship should sign each completed page.

The use of an electronic record book to record activities is an alternative method to a hard copy record book. Electronic recording and reporting should be encouraged as it may have many benefits and may allow ships to utilize their technology to reduce administrative burdens and contribute to onboard environmental initiatives, e.g. reduction of paper use. In case electronic recording is to be used, resolution MEPC.312(74) may be used for guidance.

Biofouling Record Book Part I contains many references to observations regarding fouling rating. These observations may be included in separate reports including observations of subsections and corresponding photos/video. The entries in Biofouling Record Book Part I may be a summary only including a conclusion on whether the activity is in line with the BFMP. Biofouling Record Book Part I should be kept on board the ship in a place where it is readily available for inspection at all reasonable times and for the life of the ship. Any inspection of Biofouling Record Book Part I should be performed as expeditiously as possible without causing the ship to be unduly delayed.

LIST OF ITEMS TO BE RECORDED

(A) Proactive cleaning

1 Date and location of ship when proactive cleaning occurred.

2 General observations with regard to biofouling prior to cleaning, if any (i.e. extent of microfouling and macrofouling in line with the defined ratings).

3 Records of permits required to undertake in-water proactive cleaning, if applicable.

4 Details of hull and niche areas cleaned.

5 General observations with regard to biofouling after the cleaning, if any (i.e. extent of microfouling and macrofouling in line with the defined ratings).

6 Reference to any supporting evidence/reports of the cleaning (e.g. report from supplier, photographs/videos and/or receipts), if any.

7 Method, manufacturer and model of proactive cleaning method used, if not given in BFMP.

8 Reference to test standard for which the method has been tested, if not given in BFMP.

9 Name, position and signature of the person in charge of the activity.

(B) Inspection

1 Date and location of inspection.

2 Methods used for inspection (including inspection tools/devices).

3 Areas inspected of the ship.

4 Observations with regard to biofouling (extent of microfouling and macrofouling in line with the defined fouling rates).

5 Observations with regard to anti-fouling system (AFS) condition.

6 Reference to any supporting evidence/reports of the inspection.

7 Name, position and signature of the person in charge of the activity.

(C) Reactive cleaning

1 Date and location of ship when cleaning occurred.

2 Records of permits required to undertake in-water cleaning, if applicable.

3 Description of hull and niche areas cleaned.

4 Methods of reactive cleaning used.

5 Estimation of overall biofouling after cleaning in line with the defined fouling rates.

6 Reference to any supporting evidence/reports of the activity.

7 Receipt or other documenting evidence of collection/delivery of the wastes.

8 Name, position and signature of the person in charge of the activity.

9 Manufacturer and model of cleaning and capture device as well as cleaning company executing the cleaning.

10 Reference to test standard for which the method has been tested, if relevant.

(D) Additional operational procedures and general remarks

Name of ship .....

IMO number, distinctive numbers or letters .....

BIOFOULING MANAGEMENT ACTIVITIES

Date	Code (letter)	Item (number)	Record of activity / signature of officer in charge

Signature of master .....

PART II – Monitoring of biofouling risk parameters

Name of ship: .....

IMO number, distinctive numbers or letters:.....

Gross tonnage: .....

Period from:..... to: .....

Note:

Biofouling Record Book Part II should be provided to every ship with a Biofouling Management Plan, to record when the ship is at higher risk of biofouling accumulation given by monitoring of biofouling risk parameters. Relevant contingency actions should also be recorded.

1 Introduction

The following pages of this section show a comprehensive list of risk parameters to be monitored and recorded in Biofouling Record Book Part II whenever the risk is increased according to the BFMP. The items have been grouped into sections, each of which is denoted by a letter code.

When making entries in Biofouling Record Book Part II, the date, code and item number should be inserted in the appropriate columns and the required particulars should be recorded chronologically in the blank spaces. Each completed operation should be signed for and dated by the officer or officers in charge. The master of the ship should sign each completed page.

The use of an electronic record book to record when the ship is subject to higher risk of biofouling accumulation is an alternative method to a hard copy record book. Electronic recording and reporting should be encouraged as it may have many benefits and may allow ships to utilize technology to monitor the risk parameters as defined in the BFMP. This may reduce administrative burdens and contribute to better surveillance of potential risk. In case electronic recording is to be used whenever the ship has higher risk, resolution MEPC.312(74) may be used for guidance.

Biofouling Record Book Part II may contain many references to contingency actions. When actions include inspection, maintenance and/or cleaning, these may be recorded in Biofouling Record Book Part I.

Biofouling Record Book Part II should be kept on board the ship in a place where it is readily available for inspection at all reasonable times and for the life of the ship.

Any inspection of Biofouling Record Book Part II should be performed as expeditiously as possible without causing the ship to be unduly delayed.

LIST OF ITEMS TO BE RECORDED

(A) When the ship operates outside the expected operating profile specified in the BFMP (e.g. speed, temperature or salinity)

1 Duration and dates when ship is not operating in line with its BFMP.

2 Reason for departure from normal operation.

3 Contingency actions taken to minimize biofouling accumulation (e.g. more frequent inspections) taken in the period when the ship is operating outside the expected operating profile.

4 Time and location (port name or latitude/longitude) when the ship operates again as specified in the BFMP.

(B) Maintenance/service or damage to AFC

1 Date/period and description of any observed reduction of the efficacy, damage or deviation from maintenance/service to anti-fouling coating (AFC) during its lifetime.

2 Date/period and description of any operation beyond expected lifetime.

3 Contingency actions taken to minimize biofouling accumulation (e.g. more frequent inspections).

4 Date/period and location where any AFC maintenance or repair was performed (e.g. in dry dock).

5 Description of any AFC, including patch repairs, that was applied during maintenance. Detail the type of AFC, the area and locations it was applied to (including the location of dry-dock support blocks if relevant), an estimated percentage cover of reapplication of the AFC, the coating thickness achieved and any surface preparation work undertaken (e.g. complete removal of underlying AFC or application of new AFC over the top of existing AFC).

6 Reference to any supporting data for AFC maintenance (e.g. AFC technical file).

7 Name, position and signature of the person in charge of the activity.

(C) Maintenance/service or downtime/malfunction of MGPS

1 Date/period and description of any observed reduction of the efficacy, downtime, malfunction or deviation from maintenance/service of marine growth prevention system (MGPS) during its lifetime.

2 Date/period and description of operation beyond the expected lifetime.

3 Date and location of any instances when the system was not operating in line with the BFMP.

4 Records of maintenance (including regularly monitoring the electrical and mechanical functions of the systems, calibration, or adjustment of treatment dosages).

5 Contingency actions taken to minimize biofouling accumulation (e.g. more frequent inspections).

6 Name, position and signature of the person in charge of the activity.

(D) Maintenance/service or downtime/malfunction of other AFS

1 Date/period and description of any observed reduction of the efficacy, downtime, malfunction or deviation from maintenance/service of other AFS during its lifetime.

2 Date/period and description of operation beyond expected lifetime.

3 Date and location of any instances when the system was not operating in line with the Biofouling Management Plan.

4 Records of maintenance.

5 Contingency actions taken to minimize biofouling accumulation (e.g. more frequent inspections).

(E) Deviation from regular use of expected proactive cleaning as specified in the BFMP

1 Date and location where ship did not conduct proactive cleaning as specified.

2 Contingency actions taken to minimize biofouling accumulation (e.g. inspections of biofouling and/or reactive cleaning before return to proactive cleaning activity).

3 Records of maintenance, if any.

4 Date when ship returned to normal activities with proactive cleaning.

(F) Deviation from necessary reactive cleaning as specified in the BFMP

1 Date and location where ship was inspected and reactive cleaning found necessary.

2 Contingency actions taken until reactive cleaning, including scheduling of reactive cleaning activity.

3 Date when ship completed the reactive cleaning and reference to relevant recording in Part I.

(G) When the ship is idle (berthed, anchored, moored) for a longer period

1 Date and location where ship was laid up, including general description of biofouling pressure, e.g. temperature and distance to the coastline.

2 Contingency actions taken to minimize biofouling accumulation (e.g. inspections, sea chests blanked off or short voyages taken prior to and following the period laid up).

3 Precautions taken to minimize biofouling accumulation (e.g. short voyage).

4 Date when ship returned to normal operations.

(H) When the ship has performance loss as per Performance Monitoring System for a period beyond the expected period as specified in the BFMP

1 Date and location where ship started with performance loss beyond the expectations.

2 Inspections or biofouling management actions taken prior to and following the period with performance loss.

3 Contingency actions taken to minimize biofouling accumulation.

4 Date when ship returned to normal performance.

(I) Other deviations

Name of ship .....

IMO number, distinctive number or letters .....

BIOFOULING MANAGEMENT ACTIVITIES

Date	Code (letter)	Item (number)	Record of risk / signature of officer in charge

Signature of master .....

***

ANNEX 18

RESOLUTION MEPC.379(80)
(adopted on 7 July 2023)

2023 GUIDELINES FOR THE DEVELOPMENT OF THE INVENTORY OF HAZARDOUS MATERIALS

THE MARINE ENVIRONMENT PROTECTION COMMITTEE,

RECALLING Article 38(a) of the Convention on the International Maritime Organization concerning the functions of the Marine Environment Protection Committee conferred upon it by international conventions for the prevention and control of marine pollution from ships,

RECALLING ALSO that the International Conference on the Safe and Environmentally Sound Recycling of Ships held in May 2009 adopted the Hong Kong International Convention for the Safe and Environmentally Sound Recycling of Ships, 2009 (the Hong Kong Convention) together with six Conference resolutions,

NOTING that regulations 5.1 and 5.2 of the annex to the Hong Kong Convention require that ships shall have on board an Inventory of Hazardous Materials which shall be prepared and verified taking into account guidelines, including any threshold values and exemptions contained in those guidelines, developed by the Organization,

NOTING ALSO that, at its sixty-second session, it adopted, by resolution MEPC.197(62), the *Guidelines for the development of the Inventory of Hazardous Materials*,

NOTING FURTHER that, at its sixty-eighth session, it adopted, by resolution MEPC.269(68), the *2015 Guidelines for the development of the Inventory of Hazardous Materials*, which superseded the Guidelines adopted through resolution MEPC.197(62), to improve the guidance on threshold values and exemptions,

RECOGNIZING the need for a consequential revision of the Guidelines associated with amendments to Annex 1 to the *International Convention on the Control of Harmful Anti-fouling Systems on Ships, 2001* (AFS Convention) (resolution MEPC.331(76)), which introduced controls on cybutryne and entered into force on 1 January 2023,

HAVING CONSIDERED, at its eightieth session, the recommendation made by the Sub-Committee on Pollution Prevention and Response at its tenth session,

1 ADOPTS the *2023 Guidelines for the development of the Inventory of Hazardous Materials* as set out in the annex to this resolution;

2 INVITES Member Governments to apply the 2023 Guidelines as soon as possible, or at the latest when the Convention enters into force;

3 AGREES to keep the 2023 Guidelines under review in the light of experience gained with their application;

4 AGREES ALSO that the 2023 Guidelines supersede the guidelines adopted by resolution MEPC.269(68).

ANNEX

2023 GUIDELINES FOR THE DEVELOPMENT OF THE INVENTORY OF HAZARDOUS MATERIALS

1 INTRODUCTION

1.1 Objectives

These guidelines provide recommendations for developing the Inventory of Hazardous Materials (hereinafter referred to as "the Inventory" or "the IHM") to assist compliance with regulation 5 (Inventory of Hazardous Materials) of the Hong Kong International Convention for the Safe and Environmentally Sound Recycling of Ships, 2009 (hereinafter referred to as "the Convention").

1.2 Application

These guidelines have been developed to provide relevant stakeholders (e.g. shipbuilders, equipment suppliers, repairers, shipowners and ship management companies) with the essential requirements for the practical and logical development of the Inventory.

1.3 Objectives

The objectives of the Inventory are to provide ship-specific information on the actual hazardous materials present on board, in order to protect health and safety and to prevent environmental pollution at ship recycling facilities. This information will be used by the ship recycling facilities to decide how to manage the types and amounts of materials identified in the Inventory of Hazardous Materials (regulation 9 of the Convention).

2 DEFINITIONS

The terms used in these guidelines have the same meaning as those defined in the Convention, with the following additional definitions which apply to these guidelines only.

2.1 *Exemption* (as referred to in regulation 5 of the Convention) means materials specified in paragraph 3.3 in these guidelines that do not need to be listed on the IHM, even if such materials or items exceed the IHM threshold values.

2.2 *Fixed* means the conditions that equipment or materials are securely fitted with the ship, such as by welding or with bolts, riveted or cemented, and used at their position, including electrical cables and gaskets.

2.3 *Homogeneous material* means a material of uniform composition throughout that cannot be mechanically disjointed into different materials, meaning that the materials cannot, in principle, be separated by mechanical actions such as unscrewing, cutting, crushing, grinding and abrasive processes.

2.4 *Loosely fitted equipment* means equipment or materials present on board the ship by the conditions other than "fixed", such as fire extinguishers, distress flares and lifebuoys.

2.5 *Product* means machinery, equipment, materials and applied coatings on board a ship.

2.6 *Supplier* means a company which provides products; it may be a manufacturer, trader or agency.

2.7 *Supply chain* means the series of entities involved in the supply and purchase of materials and goods, from raw materials to final product.

2.8 *Threshold value* is defined as the concentration value in homogeneous materials.

3 REQUIREMENTS FOR THE INVENTORY

3.1 Scope of the Inventory

The Inventory consists of:

Part I: Materials contained in ship structure or equipment;

Part II: Operationally generated wastes; and

Part III: Stores.

3.2 Materials to be listed in the Inventory

3.2.1 Appendix 1 of these guidelines (Items to be listed in the Inventory of Hazardous Materials), provides information on the hazardous materials that may be found on board a ship. Materials set out in appendix 1 should be listed in the Inventory. Each item in appendix 1 of these guidelines is classified under tables A, B, C or D, according to its properties:

.1 table A comprises the materials listed in appendix 1 of the Convention;

.2 table B comprises the materials listed in appendix 2 of the Convention;

.3 table C (Potentially hazardous items) comprises items which are potentially hazardous to the environment and human health at ship recycling facilities; and

.4 table D (Regular consumable goods potentially containing hazardous materials) comprises goods which are not integral to a ship and are unlikely to be dismantled or treated at a ship recycling facility.

3.2.2 Tables A and B correspond to part I of the Inventory. Table C corresponds to parts II and III and table D corresponds to part III.

3.2.3 For loosely fitted equipment, there is no need to list this in part I of the Inventory. Such equipment which remains on board when the ship is recycled should be listed in part III.

3.2.4 Those batteries containing lead acid or other hazardous materials that are fixed in place should be listed in part I of the Inventory. Batteries that are loosely fitted, which include consumer batteries and batteries in stores, should be listed in part III of the Inventory.

3.2.5 Similar materials or items that contain hazardous materials that potentially exceed the threshold value can be listed together (not individually) on the IHM with their general location and approximate amount specified there (hereinafter referred to as "bulk listing"). An example of how to list those materials and items is shown in row 3 of table 1 of appendix 3.

3.3 Exemptions – Materials not required to be listed in the Inventory

3.3.1 Materials listed in table B that are inherent in solid metals or metal alloys, such as steels, aluminium, brasses, bronzes, plating and solders, provided they are used in general construction, such as hull, superstructure, pipes or housings for equipment and machinery, are not required to be listed in the Inventory.

3.3.2 Although electrical and electronic equipment is required to be listed in the Inventory, the amount of hazardous materials potentially contained in printed wiring boards (printed circuit boards) installed in the equipment does not need to be reported in the Inventory.

3.4 Standard format of the Inventory of Hazardous Materials

The Inventory should be developed on the basis of the standard format set out in appendix 2 of these guidelines: Standard format of the Inventory of Hazardous Materials. Examples of how to complete the Inventory are provided for guidance purposes only.

3.5 Revision of threshold values

Revised threshold values in tables A and B of appendix 1 should be used for IHMs developed or updated after the adoption of the revised values and need not be applied to existing IHMs and IHMs under development. However, when materials are added to the IHM, such as during maintenance, the revised threshold values should be applied and recorded in the IHM.

4 REQUIREMENTS FOR DEVELOPMENT OF THE INVENTORY

4.1 Development of part I of the Inventory for new ships[1]

4.1.1 Part I of the Inventory for new ships should be developed at the design and construction stage.

4.1.2 *Checking of materials listed in table A*

During the development of the Inventory (part I), the presence of materials listed in table A of appendix 1 should be checked and confirmed; the quantity and location of table A materials should be listed in part I of the Inventory. If such materials are used in compliance with the Convention, they should be listed in part I of the Inventory. Any spare parts containing materials listed in table A are required to be listed in part III of the Inventory.

[1] In ascertaining whether a ship is a "new ship" or an "existing ship" according to the Convention, the term "a similar stage of construction" in regulation 1.4.2 of the annex to the Convention means the stage at which:

.1 construction identifiable with a specific ship begins; and

.2 assembly of that ship has commenced comprising at least 50 tonnes or 1% of the estimated mass of all structural material, whichever is less.

4.1.3 *Checking of materials listed in table B*

If materials listed in table B of appendix 1 are present in products above the threshold values provided in table B, the quantity and location of the products and the contents of the materials present in them should be listed in part I of the Inventory. Any spare parts containing materials listed in table B are required to be listed in part III of the Inventory.

4.1.4 *Process for checking of materials*

The checking of materials as provided in paragraphs 4.1.2 and 4.1.3 above should be based on the Material Declaration furnished by the suppliers in the shipbuilding supply chain (e.g. equipment suppliers, parts suppliers, material suppliers).

4.2 Development of part I of the Inventory for existing ships

4.2.1 In order to achieve comparable results for existing ships with respect to part I of the Inventory, the following procedure should be followed:

.1 collection of necessary information;
.2 assessment of collected information;
.3 preparation of visual/sampling check plan;
.4 onboard visual check and sampling check; and
.5 preparation of part I of the Inventory and related documentation.

4.2.2 The determination of hazardous materials present on board existing ships should, as far as practicable, be conducted as prescribed for new ships, including the procedures described in sections 6 and 7 of these guidelines. Alternatively, the procedures described in this section may be applied for existing ships, but these procedures should not be used for any new installation resulting from the conversion or repair of existing ships after the initial preparation of the Inventory.

4.2.3 The procedures described in this section should be carried out by the shipowner, who may draw upon expert assistance. Such an expert or expert party should not be the same as the person or organization authorized by the Administration to approve the Inventory).

4.2.4 Reference is made to appendix 4 (Flow diagram for developing part I of the Inventory for existing ships) and appendix 5 (Example of development process for part I of the Inventory for existing ships).

4.2.5 *Collection of necessary information (step 1)*

The shipowner should identify, research, request and procure all reasonably available documentation regarding the ship. Information that will be useful includes maintenance, conversion and repair documents; certificates, manuals, ship's plans, drawings and technical specifications; product information data sheets (such as Material Declarations); and hazardous material inventories or recycling information from sister ships. Potential sources of information could include previous shipowners, the shipbuilder, historical societies, classification society records and ship recycling facilities with experience working with similar ships.

4.2.6 *Assessment of collected information (step 2)*

The information collected in step 1 above should be assessed. The assessment should cover all materials listed in table A of appendix 1; materials listed in table B should be assessed as far as practicable. The results of the assessment should be reflected in the visual/sampling check plan.

4.2.7 *Preparation of visual/sampling check plan (step 3)*

4.2.7.1 To specify the materials listed in appendix 1 of these guidelines, a visual/sampling check plan should be prepared taking into account the collated information and any appropriate expertise. The visual/sampling check plan should be based on the following three lists:

.1 List of equipment, system and/or area for visual check (any equipment, system and/or area specified regarding the presence of the materials listed in appendix 1 by document analysis should be entered in the List of equipment, system and/or area for visual check);

.2 List of equipment, system and/or area for sampling check (any equipment, system and/or area which cannot be specified regarding the presence of the materials listed in appendix 1 by document or visual analysis should be entered in the List of equipment, system and/or area as requiring sampling check. A sampling check is the taking of samples to identify the presence or absence of hazardous material contained in the equipment, systems and/or areas, by suitable and generally accepted methods such as laboratory analysis); and

.3 List of equipment, system and/or area classed as "potentially containing hazardous material" (any equipment, system and/or area which cannot be specified regarding the presence of the materials listed in appendix 1 by document analysis may be entered in the List of equipment, system and/or area classed as "potentially containing hazardous material" without the sampling check. The prerequisite for this classification is a comprehensible justification such as the impossibility of conducting sampling without compromising the safety of the ship and its operational efficiency).

4.2.7.2 Visual/sampling checkpoints should be all points where:

.1 the presence of materials to be considered for the Inventory part I as listed in appendix 1 is likely;

.2 the documentation is not specific; or

.3 materials of uncertain composition were used.

4.2.8 *Onboard visual/sampling check (step 4)*

4.2.8.1 The onboard visual/sampling check should be carried out in accordance with the visual/sampling check plan. When a sampling check is carried out, samples should be taken and the sample points should be clearly marked on the ship plan and the sample results should be referenced. Materials of the same kind may be sampled in a representative manner. Such materials are to be checked to ensure that they are of the same kind. The sampling check should be carried out drawing upon expert assistance.

4.2.8.2 Any uncertainty regarding the presence of hazardous materials should be clarified by a visual/sampling check. Checkpoints should be documented in the ship's plan and may be supported by photographs.

4.2.8.3 If the equipment, system and/or area of the ship are not accessible for a visual check or sampling check, they should be classified as "potentially containing hazardous material". The prerequisite for such classification should be the same prerequisite as in section 4.2.7. Any equipment, system and/or area classed as "potentially containing Hazardous Material" may be investigated or subjected to a sampling check at the request of the shipowner during a later survey (e.g. during repair, refit or conversion).

4.2.9 *Preparation of part I of the Inventory and related documentation (step 5)*

If any equipment, system and/or area is classed as either "containing hazardous material" or "potentially containing hazardous material", their approximate quantity and location should be listed in part I of the Inventory. These two categories should be indicated separately in the "Remarks" column of the Inventory.

4.2.10 *Testing methods*

4.2.10.1 Samples may be tested by a variety of methods. "Indicative" or "field tests" may be used when:

.1 the likelihood of a hazard is high;

.2 the test is expected to indicate that the hazard exists; and

.3 the sample is being tested by "specific testing" to show that the hazard is present.

4.2.10.2 Indicative or field tests are quick, inexpensive and useful on board the ship or on-site, but they cannot be accurately reproduced or repeated, and cannot identify the hazard specifically, and therefore cannot be relied upon except as "indicators".

4.2.10.3 In all other cases, and in order to avoid dispute, "specific testing" should be used. Specific tests are repeatable, reliable and can demonstrate definitively whether a hazard exists or not. They will also provide a known type of the hazard. The methods indicated are found qualitative and quantitative appropriate and only testing methods to the same effect can be used. Specific tests are to be carried out by a suitably accredited laboratory, working to international standards[2] or equivalent, which will provide a written report that can be relied upon by all parties.

4.2.10.4 Specific test methods for appendix 1 materials are provided in appendix 9.

4.2.11 *Diagram of the location of hazardous materials on board a ship*

Preparation of a diagram showing the location of the materials listed in table A is recommended in order to help ship recycling facilities gain a visual understanding of the Inventory.

[2] For example ISO 17025.

4.3 Maintaining and updating part I of the Inventory during operations

4.3.1 Part I of the Inventory should be appropriately maintained and updated, especially after any repair or conversion or sale of a ship.

4.3.2 *Updating of part I of the Inventory in the event of new installation*

If any machinery or equipment is added to, removed or replaced or the hull coating is renewed, part I of the Inventory should be updated according to the requirements for new ships as stipulated in paragraphs 4.1.2 to 4.1.4. Updating is not required if identical parts or coatings are installed or applied.

4.3.3 *Continuity of part I of the Inventory*

Part I of the Inventory should belong to the ship and the continuity and conformity of the information it contains should be confirmed, especially if the flag, owner or operator of the ship changes.

4.4 Development of part II of the Inventory (operationally generated waste)

4.4.1 Once the decision to recycle a ship has been taken, part II of the Inventory should be developed before the final survey, taking into account that a ship destined to be recycled shall conduct operations in the period prior to entering the ship recycling facility in a manner that minimizes the amount of cargo residues, fuel oil and wastes remaining on board (regulation 8.2 of the Convention).

4.4.2 *Operationally generated wastes to be listed in the Inventory*

If the wastes listed in part II of the Inventory provided in table C (Potentially hazardous items) of appendix 1 are intended for delivery with the ship to a ship recycling facility, the quantity of the operationally generated wastes should be estimated and their approximate quantities and locations should be listed in part II of the Inventory.

4.5 Development of part III of the Inventory (stores)

4.5.1 Once the decision to recycle has been taken, part III of the Inventory should be developed before the final survey, taking into account the fact that a ship destined to be recycled shall minimize the wastes remaining on board (regulation 8.2 of the Convention). Each item listed in part III should correspond to the ship's operations during its last voyage.

4.5.2 *Stores to be listed in the Inventory*

If the stores to be listed in part III of the Inventory provided in table C of appendix 1 are to be delivered with the ship to a ship recycling facility, the unit (e.g. capacity of cans and cylinders), quantity and location of the stores should be listed in part III of the Inventory.

4.5.3 *Liquids and gases sealed in ship's machinery and equipment to be listed in the Inventory*

If any liquids and gases listed in table C of appendix 1 are integral in machinery and equipment on board a ship, their approximate quantity and location should be listed in part III of the Inventory. However, small amounts of lubricating oil, anti-seize compounds and grease which are applied to or injected into machinery and equipment to maintain normal performance do not fall within the scope of this provision. For subsequent completion of part III of the Inventory

during the recycling preparation processes, the quantity of liquids and gases listed in table C of appendix 1 required for normal operation, including the related pipe system volumes, should be prepared and documented at the design and construction stage. This information belongs to the ship, and continuity of this information should be maintained if the flag, owner or operator of the ship changes.

4.5.4 *Regular consumable goods to be listed in the Inventory*

Regular consumable goods, as provided in table D of appendix 1 should not be listed in part I or part II but should be listed in part III of the Inventory if they are to be delivered with the ship to a ship recycling facility. A general description including the name of item (e.g. TV set), manufacturer, quantity and location should be entered in part III of the Inventory. The check on materials provided for in paragraphs 4.1.2 and 4.1.3 of these guidelines does not apply to regular consumable goods.

4.6 Description of location of hazardous materials on board

The locations of hazardous materials on board should be described and identified using the name of location (e.g. second floor of engine-room, bridge DK, APT, No.1 cargo tank, frame number) given in the plans (e.g. general arrangement, fire and safety plan, machinery arrangement or tank arrangement).

4.7 Description of approximate quantity of hazardous materials

In order to identify the approximate quantity of hazardous materials, the standard unit used for hazardous materials should be kg, unless other units (e.g. m^3 for materials of liquid or gases, m^2 for materials used in floors or walls) are considered more appropriate. An approximate quantity should be rounded up to at least two significant figures.

5 REQUIREMENTS FOR ASCERTAINING THE CONFORMITY OF THE INVENTORY

5.1 Design and construction stage

The conformity of part I of the Inventory at the design and construction stage should be ascertained by reference to the collected Supplier's Declaration of Conformity described in section 7 and the related Material Declarations collected from suppliers.

5.2 Operational stage

Shipowners should implement the following measures in order to ensure the conformity of part I of the Inventory:

.1 to designate a person as responsible for maintaining and updating the Inventory (the designated person may be employed ashore or on board);

.2 the designated person, in order to implement paragraph 4.3.2, should establish and supervise a system to ensure the necessary updating of the Inventory in the event of new installation;

.3 to maintain the Inventory including dates of changes or new deleted entries and the signature of the designated person; and

.4 to provide related documents as required for the survey or sale of the ship.

6 MATERIAL DECLARATION

6.1 General

Suppliers to the shipbuilding industry should identify and declare whether or not the materials listed in table A or table B are present above the threshold value specified in appendix 1 of these guidelines. However, this provision does not apply to chemicals which do not constitute a part of the finished product.

6.2 Information required in the declaration

6.2.1 At a minimum the following information is required in the Material Declaration:

.1 date of declaration;

.2 Material Declaration identification number;

.3 supplier's name;

.4 product name (common product name or name used by manufacturer);

.5 product number (for identification by manufacturer);

.6 declaration of whether or not the materials listed in table A and table B of appendix 1 of these guidelines are present in the product above the threshold value stipulated in appendix 1 of these guidelines; and

.7 mass of each constituent material listed in table A and/or table B of appendix 1 of these guidelines if present above threshold value.

6.2.2 An example of the Material Declaration is shown in appendix 6.

7 SUPPLIER'S DECLARATION OF CONFORMITY

7.1 Purpose and scope

7.1.1 The purpose of the Supplier's Declaration of Conformity is to provide assurance that the related Material Declaration conforms to section 6.2, and to identify the responsible entity.

7.1.2 The Supplier's Declaration of Conformity remains valid as long as the products are present on board.

7.1.3 The supplier compiling the Supplier's Declaration of Conformity should establish a company policy.[3] The company policy on the management of the chemical substances in products which the supplier manufactures or sells should cover:

.1 Compliance with law:

The regulations and requirements governing the management of chemical substances in products should be clearly described in documents which should be kept and maintained; and

[3] A recognized quality management system may be utilized.

.2 Obtaining of information on chemical substance content:

In procuring raw materials for components and products, suppliers should be selected following an evaluation, and the information on the chemical substances they supply should be obtained.

7.2 Contents and format

7.2.1 The Supplier's Declaration of Conformity should contain the following:

.1 unique identification number;

.2 name and contact address of the issuer;

.3 identification of the subject of the Declaration of Conformity (e.g. name, type, model number, and/or other relevant supplementary information);

.4 statement of conformity;

.5 date and place of issue; and

.6 signature (or equivalent sign of validation), name and function of the authorized person(s) acting on behalf of the issuer.

7.2.2 An example of the Supplier's Declaration of Conformity is shown in appendix 7.

8 LIST OF APPENDICES

Appendix 1: Items to be listed in the Inventory of Hazardous Materials

Appendix 2: Standard format of the Inventory of Hazardous Materials

Appendix 3: Example of the development process for part I of the Inventory for new ships

Appendix 4: Flow diagram for developing part I of the Inventory for existing ships

Appendix 5: Example of the development process for part I of the Inventory for existing ships

Appendix 6: Form of Material Declaration

Appendix 7: Form of Supplier's Declaration of Conformity

Appendix 8: Examples of table A and table B materials of appendix 1 with CAS-numbers

Appendix 9: Specific test methods

Appendix 10: Examples of radioactive sources

APPENDIX 1

ITEMS TO BE LISTED IN THE INVENTORY OF HAZARDOUS MATERIALS

Table A – Materials listed in appendix 1 of the Annex to the Convention

No.	Materials		Inventory			Threshold value
			Part I	Part II	Part III	
A-1	Asbestos		x			0.1%[4]
A-2	Polychlorinated biphenyls (PCBs)		x			50 mg/kg[5]
A-3	Ozone-depleting substances	CFCs	x			no threshold value[6]
		Halons	x			
		Other fully halogenated CFCs	x			
		Carbon tetrachloride	x			
		1,1,1-Trichloroethane (Methyl chloroform)	x			
		Hydrochlorofluorocarbons	x			
		Hydrobromofluorocarbons	x			
		Methyl bromide	x			
		Bromochloromethane	x			
A-4	Anti-fouling systems containing organotin compounds as a biocide		x			2,500 mg total tin/kg[7]
	Anti-fouling systems containing cybutryne		x			1,000 mg/kg[8]

[4] In accordance with regulation 4 of the Convention, for all ships, new installation of materials which contain asbestos shall be prohibited. According to the UN recommendation "Globally Harmonized System of Classification and Labelling of Chemicals (GHS)" adopted by the United Nations Economic and Social Council's Sub-Committee of Experts on the Globally Harmonized System of Classification and Labelling of Chemicals (UNSCEGHS), the UN's Sub-Committee of Experts, in 2002 (published in 2003), carcinogenic mixtures classified as Category 1A (including asbestos mixtures) under the GHS are required to be labelled as carcinogenic if the ratio is more than 0.1%. However, if 1% is applied, this threshold value should be recorded in the Inventory and, if available, the Material Declaration and can be applied not later than five years after the entry into force of the Convention. The threshold value of 0.1% need not be retroactively applied to those Inventories and Material Declarations.

[5] In accordance with regulation 4 of the Convention, for all ships, new installation of materials which contain PCBs shall be prohibited. The Organization set 50 mg/kg as the threshold value referring to the concentration level at which wastes, substances and articles containing, consisting of or contaminated with PCB are characterized as hazardous under the Basel Convention.

[6] "No threshold value" is in accordance with the Montreal Protocol for reporting ODS. Unintentional trace contaminants should not be listed in the Material Declarations and in the Inventory.

[7] This threshold value is based on the *2022 Guidelines for brief sampling of anti-fouling systems on ships* (resolution MEPC.356(78)).

[8] When samples are directly taken from the hull, average values of cybutryne should not be present above 1,000 mg of cybutryne per kilogram of dry paint.

Table B – Materials listed in appendix 2 of the annex to the Convention

No.	Materials	Inventory			Threshold value
		Part I	Part II	Part III	
B-1	Cadmium and cadmium compounds	x			100 mg/kg[9]
B-2	Hexavalent chromium and hexavalent chromium compounds	x			1,000 mg/kg[8]
B-3	Lead and lead compounds	x			1,000 mg/kg[8]
B-4	Mercury and mercury compounds	x			1,000 mg/kg[8]
B-5	Polybrominated biphenyl (PBBs)	x			50 mg/kg[10]
B-6	Polybrominated diphenyl ethers (PBDEs)	x			1,000 mg/kg[8]
B-7	Polychlorinated naphthalenes (more than 3 chlorine atoms)	x			50mg/kg[11]
B-8	Radioactive substances	x			no threshold value[12]
B-9	Certain short-chain chlorinated paraffins (alkanes, C10-C13, chloro)	x			1%[13]

9 The Organization set this as the threshold value referring to the Restriction of Hazardous Substances (RoHS Directive 2011/65/EU, Annex II).

10 The Organization set 50 mg/kg as the threshold value referring to the concentration level at which wastes, substances and articles containing, consisting of or contaminated with PBB are characterized as hazardous under the Basel Convention.

11 The Organization set 50 mg/kg as the threshold value referring to the concentration level at which wastes, substances and articles containing, consisting of or contaminated with PCN are characterized as hazardous under the Basel Convention.

12 All radioactive sources should be included in the Material Declaration and in the Inventory. *Radioactive source* means radioactive material permanently sealed in a capsule or closely bonded and in a solid form that is used as a source of radiation. This includes consumer products and industrial gauges with radioactive materials. Examples are listed in appendix 10.

13 The Organization set 1% as the threshold value referring to the EU legislation that restricts chlorinated paraffins from being placed on the market for use as substances or as constituents of other substances or preparations in concentrations higher than 1% (EU Regulation 1907/2006, Annex XVII Entry 42 and Regulation 519/2012).

Table C – Potentially hazardous items

No.	Properties		Goods	Inventory		
				Part I	Part II	Part III
C-1	Liquid	Oiliness	Kerosene			x
C-2			White spirit			x
C-3			Lubricating oil			x
C-4			Hydraulic oil			x
C-5			Anti-seize compounds			x
C-6			Fuel additive			x
C-7			Engine coolant additives			x
C-8			Antifreeze fluids			x
C-9			Boiler and feed water treatment and test re-agents			x
C-10			De-ionizer regenerating chemicals			x
C-11			Evaporator dosing and descaling acids			x
C-12			Paint stabilizers/rust stabilizers			x
C-13			Solvents/thinners			x
C-14			Paints			x
C-15			Chemical refrigerants			x
C-16			Battery electrolyte			x
C-17			Alcohol, methylated spirits			x
C-18	Gas	Explosives/ inflammables	Acetylene			x
C-19			Propane			x
C-20			Butane			x
C-21			Oxygen			x
C-22		Green House Gases	CO_2			x
C-23			Perfluorocarbons (PFCs)			x
C-24			Methane			x
C-25			Hydrofluorocarbon (HFCs)			x
C-27			Nitrous oxide (N_2O)			x
C-28			Sulphur hexafluoride (SF_6)			x
C-29	Liquid	Oiliness	Bunkers: fuel oil			x
C-30			Grease			x
C-31			Waste oil (sludge)		x	
C-32			Bilge and/or wastewater generated by the after-treatment systems fitted on machineries		x	
C-33			Oily liquid cargo tank residues		x	
C-34			Ballast water		x	
C-35			Raw sewage		x	
C-36			Treated sewage		x	
C-37			Non-oily liquid cargo residues		x	
C-38	Gas	Explosibility/ inflammability	Fuel gas			x

No.	Properties	Goods	Inventory		
			Part I	Part II	Part III
C-39	Solid	Dry cargo residues		x	
C-40		Medical waste/infectious waste		x	
C-41		Incinerator ash[14]		x	
C-42		Garbage		x	
C-43		Fuel tank residues		x	
C-44		Oily solid cargo tank residues		x	
C-45		Oily or chemical contaminated rags		x	
C-46		Batteries (incl. lead acid batteries)			x
C-47		Pesticides/insecticide sprays			x
C-48		Extinguishers			x
C-49		Chemical cleaner (incl. electrical equipment cleaner, carbon remover)			x
C-50		Detergent/bleacher (could be a liquid)			x
C-51		Miscellaneous medicines			x
C-52		Fire-fighting clothing and personal protective equipment			x
C-53		Dry tank residues		x	
C-54		Cargo residues		x	
C-55		Spare parts which contain materials listed in table A or table B			x

Table D – Regular consumable goods potentially containing hazardous materials*[15]*

No.	Properties	Example	Inventory		
			Part I	Part II	Part III
D-1	Electrical and electronic equipment	Computers, refrigerators, printers, scanners, television sets, radio sets, video cameras, video recorders, telephones, consumer batteries, fluorescent lamps, filament bulbs, lamps			x
D-2	Lighting equipment	Fluorescent lamps, filament bulbs, lamps			x
D-3	Non-ship-specific furniture, interior and similar equipment	Chairs, sofas, tables, beds, curtains, carpets, garbage bins, bed-linen, pillows, towels, mattresses, storage racks, decoration, bathroom installations, toys, not structurally relevant or integrated artwork			x

[14] Definition of garbage is identical to that in MARPOL Annex V. However, incinerator ash is classified separately because it may include hazardous substances or heavy metals.

[15] This table does not include ship-specific equipment integral to ship operations, which has to be listed in part I of the inventory.

APPENDIX 2

STANDARD FORMAT OF THE INVENTORY OF HAZARDOUS MATERIALS[16]

Part I

Hazardous materials contained in the ship's structure and equipment

I-1 – Paints and coating systems containing materials listed in table A and table B of appendix 1 of these guidelines

No.	Application of paint	Name of paint	Location	Materials (classification in appendix 1)	Approximate quantity		Remarks
1	Anti-drumming compound	Primer, xx Co., xx primer #300	Hull part	Lead	35.00	kg	
2	Anti-fouling	xx Co., xx coat #100	Underwater parts	TBT	120.00	kg	

16 Examples of how to complete the Inventory are provided for guidance purposes only in accordance with paragraph 3.4 of the Guidelines.

I-2 – Equipment and machinery containing materials listed in table A and table B of appendix 1 of these guidelines

No.	Name of equipment and machinery	Location	Materials (classification in appendix 1)	Parts where used	Approximate quantity		Remarks
1	Switchboard	Engine control room	Cadmium	Housing coating	0.02	kg	
			Mercury	Heat gauge	<0.01	kg	less than 0.01kg
2	~~Diesel engine, xx Co., xx #150~~	~~Engine room~~	~~LeadCadmium~~	~~BearingStarter for blower~~	~~0.02~~	~~kg~~	
3	Diesel engine, xx Co., xx #200	Engine-room	Lead	Starter for blower	0.01	kg	revised by XXX on Oct. XX, 2008 (revoking No.2)
4	Diesel generator (x 3)	Engine-room	Lead	Ingredient of copper compounds	0.01	kg	
5	Radioactive level gauge	No. 1 Cargo tank	Radioactive substances	Gauge	5 (1.8E+11)	Ci (Bq)	Radionuclides: ^{60}Co

I-3 - Structure and hull containing materials listed in table A and table B of appendix 1 of these guidelines

No.	Name of structural element	Location	Materials (classification in appendix 1)	Parts where used	Approximate quantity		Remarks
1	Wall panel	Accommodation	Asbestos	Insulation	2,500.00	kg	
2	Wall insulation	Engine control room	Lead	Perforated plate	0.01	kg	cover for insulation material
			Asbestos	Insulation	25.00	kg	under perforated plates
3							

Part II
Operationally generated waste

No.	Location[1]	Name of item (classification in appendix 1) and detail (if any) of the item	Approximate quantity		Remarks
1	Garbage locker	Garbage (food waste)	35.00	kg	
2	Bilge tank	Bilgewater	15.00	m^3	
3	No.1 cargo hold	Dry cargo residues (iron ore)	110.00	kg	
4	No.2 cargo hold	Waste oil (sludge) (crude)	120.00	kg	
5	No.1 ballast tank	Ballast water	2,500.00	m^3	
		Sediments	250.00	kg	

[1] The location of a part II or part III item should be entered in order based on its location, from a lower level to an upper level and from a fore part to an aft part. The location of part I items is recommended to be described similarly, as far as practicable.

Part III
Stores

III-1 - *Stores*

No.	Location[1]	Name of item (classification in appendix 1)	Unit quantity		Figure		Approximate quantity		Remarks[2)]
								m^3	
								kg	
								kg	
									Details are shown in the attached list.
5	Paint stores	Paint, xx Co., #600	20.00	kg	5	pcs	100.00	kg	Cadmium containing.

1 The location of a part II or part III item should be entered in order based on its location, from a lower level to an upper level and from a fore part to an aft part. The location of part I items is recommended to be described similarly, as far as practicable.

2 In column "Remarks" for part III items, if hazardous materials are integrated in products, the approximate amount of the contents should be shown as far as possible.

III-2 – Liquids sealed in ship's machinery and equipment

No.	Type of liquids (classification in appendix 1)	Name of machinery or equipment	Location	Approximate quantity		Remarks
1	Hydraulic oil	Deck crane hydraulic oil system	Upper deck	15.00	m^3	
		Deck machinery hydraulic oil system	Upper deck and bosun store	200.00	m^3	
		Steering gear hydraulic oil system	Steering gear room	0.55	m^3	
2	Lubricating oil	Main engine system	Engine-room	0.45	m^3	
3	Boiler water treatment	Boiler	Engine-room	0.20	m^3	

III-3 – Gases sealed in ship's machinery and equipment

No.	Type of gases (classification in appendix 1)	Name of machinery or equipment	Location	Approximate quantity		Remarks
1	HFC	AC system	AC room	100.00	kg	
2	HFC	Refrigerated provision chamber machine	AC room	50.00	kg	

III-4 – Regular consumable goods potentially containing hazardous materials

No.	Location[17]	Name of item	Quantity	Remarks
1	Accommodation	Refrigerators	1	
2	Accommodation	Personal computers	2	

[17] The location of a part II or part III item should be entered in order based on its location, from a lower level to an upper level and from a fore part to an aft part. The location of part I items is recommended to be described similarly, as far as practicable.

APPENDIX 3

EXAMPLE OF THE DEVELOPMENT PROCESS FOR PART I OF THE INVENTORY FOR NEW SHIPS

1 OBJECTIVE OF THE TYPICAL EXAMPLE

This example has been developed to give guidance and to facilitate understanding of the development process for part I of the Inventory of Hazardous Materials for new ships.

2 DEVELOPMENT FLOW FOR PART I OF THE INVENTORY

Part I of the Inventory should be developed using the following three steps. However, the order of these steps is flexible and can be changed depending on the schedule of shipbuilding:

.1 collection of hazardous materials information;
.2 utilization of hazardous materials information; and
.3 preparation of the Inventory (by filling out standard format).

3 COLLECTION OF HAZARDOUS MATERIALS INFORMATION

3.1 Data-collection process for hazardous materials

Materials Declaration (MD) and Supplier's Declaration of Conformity (SDoC) for products from suppliers (tier 1 suppliers) should be requested and collected by the shipbuilding yard. Tier 1 suppliers may request from their suppliers (tier 2 suppliers) the relevant information if they cannot develop the MD based on the information available. Thus the collection of data on hazardous materials may involve the entire shipbuilding supply chain (figure 1).

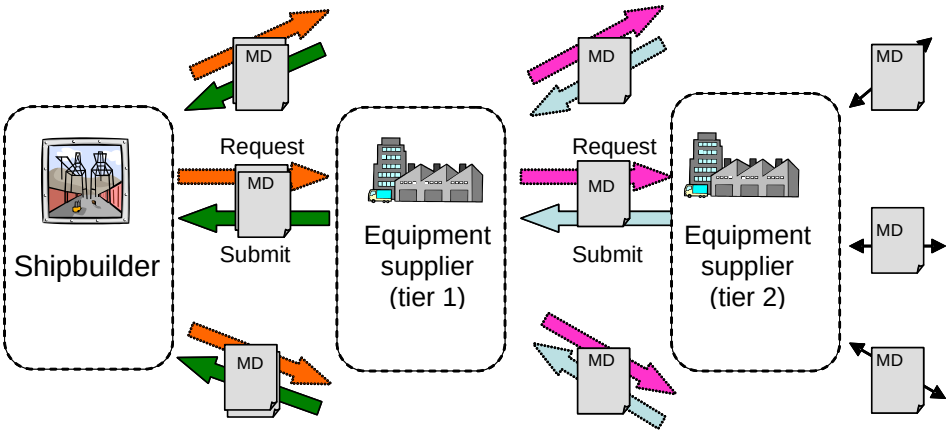


Figure 1 – Process of MD (and SDoC) collection showing involvement of supply chain

3.2 Declaration of hazardous materials

Suppliers should declare whether or not the hazardous materials listed in table A and table B in the MD are present in concentrations above the threshold values specified for each homogeneous material in a product.

3.2.1 *Materials listed in table A*

If one or more materials listed in table A are found to be present in concentrations above the specified threshold value according to the MD, the products which contain these materials shall not be installed on a ship. However, if the materials are used in a product in accordance with an exemption specified by the Convention (e.g. new installations containing hydrochlorofluorocarbons (HCFCs) before 1 January 2020), the product should be listed in the Inventory.

3.2.2 *Materials listed in table B*

If one or more materials listed in table B are found to be present in concentrations above the specified threshold value according to the MD, the products should be listed in the Inventory.

3.3 Example of homogeneous materials

Figure 2 shows an example of four homogeneous materials which constitute a cable. In this case, sheath, intervention, insulator and conductor are all individual homogeneous materials.

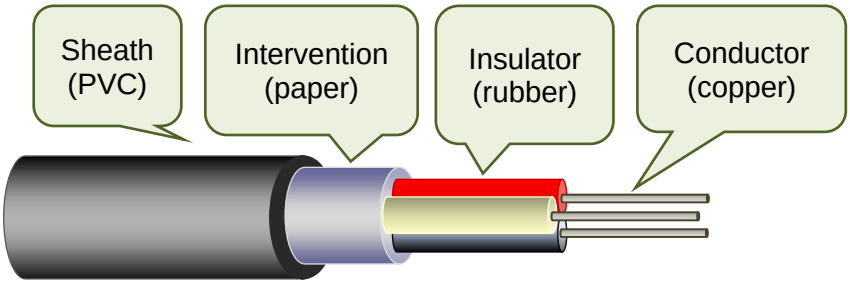


Figure 2 – *Example of homogeneous materials (cable)*

4 UTILIZATION OF HAZARDOUS MATERIALS INFORMATION

Products which contain hazardous materials in concentrations above the specified threshold values should be clearly identified in the MD. The approximate quantity of the hazardous materials should be calculated if the mass data for hazardous materials are declared in the MD using a unit which cannot be directly utilized in the Inventory.

5 PREPARATION OF INVENTORY (BY FILLING OUT STANDARD FORMAT)

The information received for the Inventory, as contained in table A and table B of appendix 1 of these guidelines, ought to be structured and utilized according to the following categorization for part I of the Inventory:

Part I-1 Paints and coating systems;

Part I-2 Equipment and machinery; and

Part I-3 Structure and hull.

5.1 "Name of equipment and machinery" column

5.1.1 *Equipment and machinery*

5.1.1.1 The name of each item of equipment or machinery should be entered in this column. If more than one hazardous material is present in the equipment or machinery, the row relating to that equipment or machinery should be appropriately divided such that all of the hazardous materials contained in the piece of equipment or machinery are entered. If more than one item of equipment or machinery is situated in one location, both name and quantity of the equipment or machinery should be entered in the column. Examples are shown in rows 1 and 2 of table 1.

5.1.1.2 For identical or common items, such as but not limited to bolts, nuts and valves, there is no need to list each item individually (see Bulk Listing in paragraph 3.2 of the guidelines). An example is shown in row 3 of table 1.

Table 1 – Example showing more than one item of equipment or machinery situated in one location

No.	Name of equipment and machinery	Location	Materials (classification in appendix 1)	Parts where used	Approximate quantity		Remarks
1	Main engine	Engine-room	Lead	Piston pin bush	0.75	kg	
			Mercury	Thermometer charge air temperature	0.01	kg	
2	Diesel generator (x 3)	Engine-room	Mercury	Thermometer	0.03	kg	
3	FC valve (x 100)	Throughout the ship	Lead and lead compounds		20.5	kg	

5.1.2 *Pipes and cables*

The names of pipes and of systems, including electric cables, which are often situated in more than one compartment of a ship, should be described using the name of the system concerned. A reference to the compartments where these systems are located is not necessary as long as the system is clearly identified and properly named.

5.2 "Approximate quantity" column

The standard unit for approximate quantity of solid hazardous materials should be kg. If the hazardous materials are liquids or gases, the standard unit should be either m^3 or kg. An approximate quantity should be rounded up to at least two significant figures. If the hazardous material is less than 10 g, the description of the quantity should read "<0.01 kg".

Table 2 – Example of a switchboard

No.	Name of equipment and machinery	Location	Materials (classification in appendix 1)	Parts where used	Approximate quantity		Remarks
	Switchboard	Engine control room	Cadmium	Housing coating	0.02	kg	
			Mercury	Heat gauge	<0.01	kg	less than 0.01 kg

5.3 "Location" column

5.3.1 *Example of a location list*

It is recommended to prepare a location list which covers all compartments of a ship based on the ship's plans (e.g. general arrangement, engine-room arrangement, accommodation and tank plan) and on other documentation on board, including certificates or spare parts lists. The description of the location should be based on a location such as a deck or room to enable easy identification. The name of the location should correspond to the ship's plans so as to ensure consistency between the Inventory and the ship's plans. Examples of names of locations are shown in table 3. For bulk listings, the locations of the items or materials may be generalized. For example, the location may only include the primary classification such as "Throughout the ship" as shown in the table 3 below.

Table 3 – Examples of location names

(A) Primary classification	(B) Secondary classification	(C) Name of location
Throughout the ship		
Hull part	Fore part	Bosun store
		…
	Cargo part	No.1 cargo hold/tank
		No.1 garage deck
		…
	Tank part	Fore peak tank
		No.1 WBT
		No.1 FOT
		…
		Aft Peak Tank
	Aft part	Steering gear room
		Emergency fire pump space
		…
	Superstructure	Accommodation
		Compass deck
		Nav. bridge deck
		…
		Wheel house
		Engine control room
		Cargo control room
		…
	Deck house	Deck house
		…
(A) Primary classification	(B) Secondary classification	(C) Name of location
Machinery part	Engine-room	Engine-room
		Main floor
		2nd floor
		…
		Generator space/room
		Purifier space/room
		Shaft space/room
		Engine casing
		Funnel
		Engine control room
		…
	Pump-room	Pump-room
		…
Exterior part	Superstructure	Superstructure
	Upper deck	Upper deck
	Hull shell	Hull shell
		bottom
		under waterline
		…

5.3.2 *Description of location of pipes and electrical systems*

5.3.2.1 Locations of pipes and systems, including electrical systems and cables situated in more than one compartment of a ship, should be described for each system concerned. If they are situated in a number of compartments, the most practical of the following two options should be used:

.1 listing of all components in the column; or

.2 description of the location of the system using an expression such as those shown under "primary classification" and "secondary classification" in table 3.

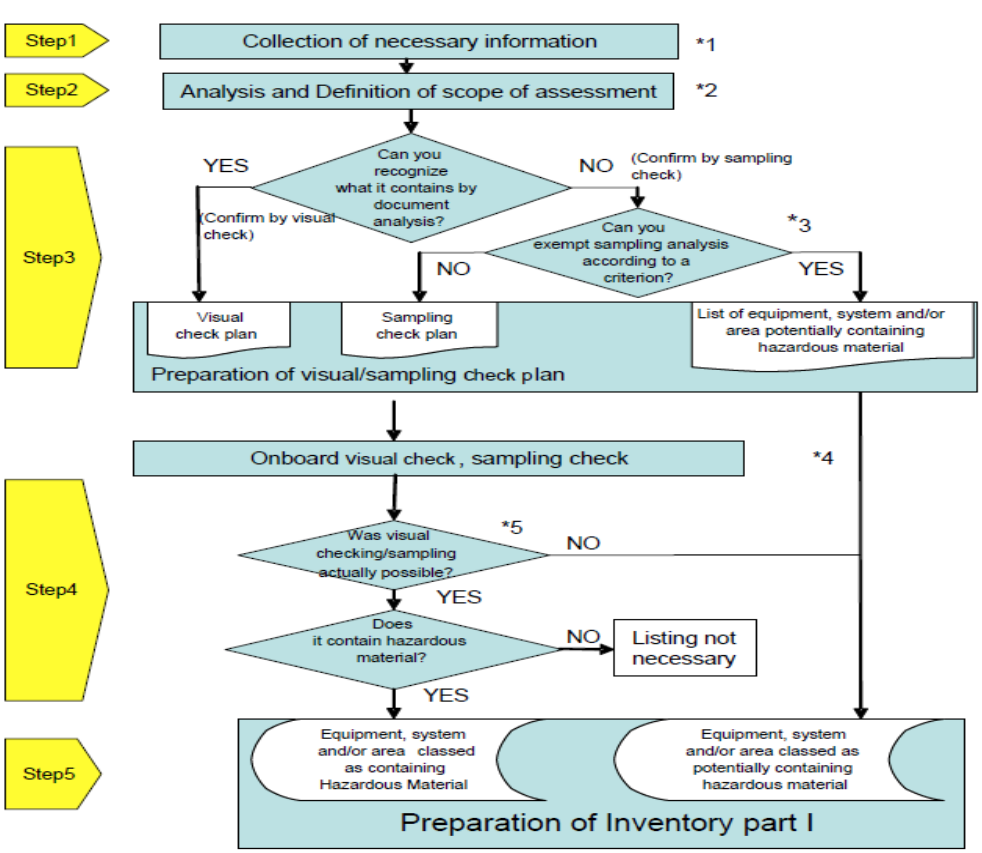
5.3.2.2 A typical description of a pipe system is shown in table 4.

Table 4 – Example of description of a pipe system

No.	Name of equipment and machinery	Location	Materials (classification in appendix 1)	Parts where used	Approximate quantity		Remarks
	Ballast water system	Engine-room, Hold parts					

APPENDIX 4

FLOW DIAGRAM FOR DEVELOPING PART I OF THE INVENTORY FOR EXISTING SHIPS



*1 : Documents may include any certificates, manuals, ship's plans drawings, technical specifications and information from sister and/or similar ships.

*2 : The assessment should cover all materials listed in table A of appendix 1 of the Guideline; the materials listed in table B should be listed as far as practicable.
It is impossible to assess all equipment and areas including those which are assumed not to contain hazardous materials described above.
Using analysis of available documents based on knowledge and experience, it must be made clear which equipment and/or area should be included in the scope of the assessment.

*3 : Equipment, system and/or areas which cannot be specified as containing materials listed in appendix 1 of these guidelines on the basis of documents can be listed in the List of equipment, system and/or area classed as "potentially containing hazardous material" without the sampling check. The prerequisite for this classification is a comprehensible justification of the conclusion, such as the impossibility to conduct samplings without compromising ship safety and operational efficiency.

*4 : Sampling check. This means sampling and identification of hazardous material contained in the equipment, systems, and/or areas, by laboratory analysis. The sampling check should be applied where the presence of prohibited and restricted hazardous material is assumed but cannot be recognized by analysis of the available documentation.

*5 : When equipment, systems and/or areas of a ship are not accessible for visual check or sampling check, this equipment, system and/or area is classified as "potentially containing hazardous material".

APPENDIX 5

EXAMPLE OF THE DEVELOPMENT PROCESS FOR PART I OF THE INVENTORY FOR EXISTING SHIPS

1 INTRODUCTION

1.1 In order to develop part I of the Inventory of Hazardous Materials for existing ships, documents of the individual ship as well as the knowledge and experience of specialist personnel (experts) is required. An example of the development process for part I of the Inventory of Hazardous Materials for existing ships is useful to understand the basic steps as laid out in the guidelines and to ensure a unified application. However, attention should be paid to variations in different types of ships.[18]

1.2 Compilation of part I of the Inventory of Hazardous Material for existing ships involves the following five steps which are described in paragraph 4.2 and appendix 4 of these guidelines.

Step 1: Collection of necessary information;

Step 2: Assessment of collected information;

Step 3: Preparation of visual/sampling check plan;

Step 4: Onboard visual/sampling check; and

Step 5: Preparation of part I of the Inventory and related documentation.

2 STEP 1 – COLLECTION OF NECESSARY INFORMATION

2.1 Sighting of available documents

A practical first step is to collect detailed documents for the ship. The shipowner should try to collate documents normally retained on board the ship or by the shipping company as well as relevant documents that the shipyard, manufacturers or classification society may have. The following documents should be used when available:

.1 Ship's specification

.2 General Arrangement

.3 Machinery Arrangement

.4 Spare Parts and Tools List

.5 Piping Arrangement

.6 Accommodation Plan

.7 Fire-Control Plan

.8 Fire Protection Plan

.9 Insulation Plan (Hull and Machinery)

[18] The example of a 28,000 gross tonnage bulk carrier constructed in 1985 is used in this appendix.

.10 International Anti-Fouling System Certificate

.11 Related manuals and drawings

.12 Information from other inventories and/or sister or similar ships, machinery, equipment, materials and coatings

.13 Results of previous visual/sampling checks and other analysis

2.1.2 If the ship has undergone conversions or major repair work, it is necessary to identify as far as possible the modifications from the initial design and specification of the ship.

2.2 Indicative list

2.2.1 It is impossible to check all equipment, systems and/or areas on board the ship to determine the presence or absence of hazardous materials. The total number of parts on board may exceed several thousand. In order to take a practical approach, an indicative list should be prepared that identifies the equipment, system and/or area on board that is presumed to contain hazardous materials. Field interviews with the shipyard and suppliers may be necessary to prepare such lists. A typical example of an indicative list is shown below.

2.2.2 *Materials to be checked and documented*

Hazardous Materials, as identified in appendix 1 of these guidelines, should be listed in part I of the Inventory for existing ships. Appendix 1 of the guidelines contains all the materials concerned. Table A shows those which are required to be listed and table B shows those which should be listed as far as practicable.

2.2.3 *Materials listed in table A*

2.2.3.1 Table A lists the following four materials:

.1 Asbestos

.2 Polychlorinated biphenyls (PCBs)

.3 Ozone-depleting substances

.4 Anti-fouling systems containing organotin compounds as a biocide or cybutryne

2.2.3.2 *Asbestos*

Field interviews were conducted with over 200 Japanese shipyards and suppliers regarding the use of asbestos in production. Indicative lists for asbestos developed on the basis of this research are shown below:

Structure and/or equipment	Component
Propeller shafting	Packing with low pressure hydraulic piping flange
	Packing with casing
	Clutch
	Brake lining
	Synthetic stern tubes

Structure and/or equipment	Component
Diesel engine	Packing with piping flange
	Lagging material for fuel pipe
	Lagging material for exhaust pipe
	Lagging material turbocharger
Turbine engine	Lagging material for casing
	Packing with flange of piping and valve for steam line, exhaust line and drain line
	Lagging material for piping and valve of steam line, exhaust line and drain line

Structure and/or equipment	**Component**
Structure and/or equipment	Component
Boiler	Insulation in combustion chamber
	Packing for casing door
	Lagging material for exhaust pipe
	Gasket for manhole
	Gasket for hand hole
	Gas shield packing for soot blower and other hole
	Packing with flange of piping and valve for steam line, exhaust line, fuel line and drain line
	Lagging material for piping and valve of steam line, exhaust line, fuel line and drain line
Exhaust gas economizer	Packing for casing door
	Packing with manhole
	Packing with hand hole
	Gas shield packing for soot blower
	Packing with flange of piping and valve for steam line, exhaust line, fuel line and drain line
	Lagging material for piping and valve of steam line, exhaust line, fuel line and drain line
Incinerator	Packing for casing door
	Packing with manhole
	Packing with hand hole
	Lagging material for exhaust pipe
Auxiliary machinery (pump, compressor, oil purifier, crane)	Packing for casing door and valve
	Gland packing
	Brake lining
Heat exchanger	Packing with casing
	Gland packing for valve
	Lagging material and insulation
Valve	Gland packing with valve, sheet packing with piping flange
	Gasket with flange of high pressure and/or high temperature
Pipe, duct	Lagging material and insulation
Tank (fuel tank, hot water, tank, condenser), other equipment (fuel strainer, lubricant oil strainer)	Lagging material and insulation
Electric equipment	Insulation material
Airborne asbestos	Wall, ceiling
Ceiling, floor and wall in accommodation area	Ceiling, floor, wall
Fire door	Packing, construction and insulation of the fire door
Inert gas system	Packing for casing, etc.
Air conditioning system	Sheet packing, lagging material for piping and flexible joint

Structure and/or equipment	Component
Miscellaneous	Ropes
	Thermal insulating materials
	Fire shields/fire proofing
	Space/duct insulation
	Electrical cable materials
	Brake linings
	Floor tiles/deck underlay
	Steam/water/vent flange gaskets
	Adhesives/mastics/fillers
	Sound damping
	Moulded plastic products
	Sealing putty
	Shaft/valve packing
	Electrical bulkhead penetration packing
	Circuit breaker arc chutes
	Pipe hanger inserts
	Weld shop protectors/burn covers
	Fire-fighting blankets/clothing/equipment
	Concrete ballast

2.2.3.3 *Polychlorinated biphenyl (PCBs)*

Worldwide restriction of PCBs began on 17 May 2004 as a result of the implementation of the Stockholm Convention, which aims to eliminate or restrict the production and use of persistent organic pollutants. In Japan, domestic control began in 1973, with the prohibition of all activities relating to the production, use and import of PCBs. Japanese suppliers can provide accurate information concerning their products. The indicative list of PCBs has been developed as shown below:

Equipment	**Component of equipment**
Transformer	Insulating oil
Condenser	Insulating oil
Fuel heater	Heating medium
Electric cable	Covering, insulating tape
Lubricating oil	
Heat oil	Thermometers, sensors, indicators
Rubber/felt gaskets	
Rubber hose	
Plastic foam insulation	
Thermal insulating materials	
Voltage regulators	
Switches/reclosers/bushings	
Electromagnets	
Adhesives/tapes	
Surface contamination of machinery	
Oil-based paint	
Caulking	
Rubber isolation mounts	
Pipe hangers	

Equipment	Component of equipment
Light ballasts (component within fluorescent light fixtures)	
Plasticizers	
Felt under septum plates on top of hull bottom	

2.2.3.4 *Ozone-depleting substances*

The indicative list for ozone-depleting substances is shown below. Ozone-depleting substances have been controlled according to the Montreal Protocol and MARPOL Convention. Although almost all substances have been banned since 1996, HCFC can still be used until 2020.

Materials	Component of equipment	Period for use of ODS in Japan
CFCs (R11, R12)	Refrigerant for refrigerators	Until 1996
CFCs	Urethane formed material	Until 1996
	Blowing agent for insulation of LNG carriers	Until 1996
Halons	Extinguishing agent	Until 1994
Other fully halogenated CFCs	The possibility of usage in ships is low	Until 1996
Carbon tetrachloride	The possibility of usage in ships is low	Until 1996
1,1,1-Trichloroethane (methyl chloroform)	The possibility of usage in ships is low	Until 1996
HCFC (R22, R141b)	Refrigerant for refrigerating machine	It is possible to use it until 2020
HBFC	The possibility of usage in ships is low	Until 1996
Methyl bromide	The possibility of usage in ships is low	Until 2005

2.2.3.5 *Organotin compounds*

Organotin compounds include tributyl tins (TBT), triphenyl tins (TPT) and tributyl tin oxide (TBTO). Organotin compounds have been used as anti-fouling paint on ships' bottoms, and the International Convention on the Control of Harmful Anti-fouling Systems on Ships (AFS Convention, as amended) stipulates that all ships shall not apply or reapply organotin compounds after 1 January 2003, and that, after 1 January 2008, all ships shall either not bear such compounds on their hulls or shall bear a coating that forms a barrier preventing such compounds from leaching into the sea. The above-mentioned dates may have been extended by permission of the Administration bearing in mind that the AFS Convention entered into force on 17 September 2008.

2.2.3.6 *Cybutryne*

Cybutryne has been used as biocide in anti-fouling systems, and the International Convention on the Control of Harmful Anti-fouling Systems on Ships (AFS Convention, as amended) stipulates that all ships shall not apply or reapply cybutryne after 1 January 2023, and that ships bearing an anti-fouling system that contains this substance in the external coating layer of their hulls or external parts or surfaces on 1 January 2023 shall either remove the anti-fouling system or apply a coating that forms a barrier to this substance leaching from the underlying non-compliant anti-fouling system at the next scheduled renewal of the anti-fouling system after 1 January 2023, but no later than 60 months following the last application to the ship of an anti-fouling system containing cybutryne.

2.2.4 *Materials listed in table B*

For existing ships it is not obligatory for materials listed in table B to be listed in part I of the Inventory. However, if they can be identified in a practical way, they should be listed in the Inventory, because the information will be used to support ship recycling processes. The Indicative list of materials listed in table B is shown below:

Materials	Component of equipment
Cadmium and cadmium compounds	Plating film, bearing
Hexavalent chromium compounds	Plating film
Mercury and mercury compounds	Fluorescent light, mercury lamp, mercury cell, liquid-level switch, gyro compass, thermometer, measuring tool, manganese cell, pressure sensors, light fittings, electrical switches, fire detectors
Lead and lead compounds	Corrosion resistant primer, solder (almost all electric appliances contain solder), paints, preservative coatings, cable insulation, lead ballast, generators
Polybrominated biphenyls (PBBs)	Non-flammable plastics
Polybrominated diphenyl ethers (PBDE)	Non-flammable plastics
Polychlorinated naphthalenes	Paint, lubricating oil
Radioactive substances	Refer to appendix 10
Certain short-chain chlorinated paraffins	Non-flammable plastics

3 STEP 2 – ASSESSMENT OF COLLECTED INFORMATION

Preparation of a checklist is an efficient method for developing the Inventory for existing ships in order to clarify the results of each step. Based on collected information including the indicative list mentioned in step 1, all equipment, systems and/or areas on board assumed to contain hazardous materials listed in tables A and B should be included in the checklist. Each listed equipment, system and/or area on board should be analysed and assessed for its hazardous materials content.

The existence and volume of hazardous materials may be judged and calculated from the Spare parts and tools list and the maker's drawings. The existence of asbestos contained in floors, ceilings and walls may be identified from Fire Protection Plans, while the existence of TBT in coatings can be identified from the International Anti-Fouling System Certificate, Coating scheme and the History of Paint.

Example of weight calculation

No.	Hazardous Materials	Location/equipment/ component	Reference	Calculation
1.1-2	TBT	Flat bottom/paint	History of coatings	
1.2-1	Asbestos	Main engine/ exh. pipe packing	Spare parts and tools list	250 g x 14 sheet = 3.50 kg
1.2-3	HCFC	Ref. provision plant	Maker's drawings	20 kg x 1 cylinder = 20 kg
1.2-4	Lead	Batteries	Maker's drawings	6kg x 16 unit = 96 kg
1.3-1	Asbestos	Engine-room ceiling	Accommodation plan	

When a component or coating is determined to contain hazardous materials, a "Y" should be entered in the column for "Result of document analysis" in the checklist, to denote "Contained". Likewise, when an item is determined not to contain hazardous materials, the entry "N" should be made in the column to denote "Not contained". When a determination cannot be made as to the hazardous materials content, the column should be completed with the entry "Unknown".

Checklist (step 2)

Analysis and definition of scope of assessment for "Sample Ship"

No.	Table A/B	Hazardous materials *1	Location	Name of equipment	Component	Quantity			Manufacturer/brand name	Result of documents analysis *2	Procedure of check *3	Result of check *4	Reference/DWG No.
						Unit (kg)	No.	Total (kg)					
[Inventory part I-1.1]													
1	A	TBT	Top side	Painting and coating	A/F Paints			NIL	Paints Co./marine P1000	N			・On Aug., 200X, Sealer Coat applied to all over submerged area before tin-free coating.
2	A	TBT	Flat Bottom				3000m²		Unknown AF	Unknown			
[Inventory part I-1.2]													
1	A	Asbestos	Lower deck	Main engine	Exh. pipe packing	0.25	14		Diesel Co.	Y			M-100
2	A	Asbestos	3rd deck	Aux.boiler	Lagging		12		Unknown lagging	Unknown			M-300
3	A	Asbestos	Engine room	Piping/flange	Packing					PCHM			
4	A	HCFC	2nd deck	Ref. provision plant	Refrigerant(R22)	20.00	1		Reito Co.	Y			Maker's dwg
5	B	Lead	Nav. Br. deck	Batteries		6	16		Denchi Co.	Y			E-300
[Inventory part I-1.3]													
1	A	Asbestos	Upper deck	Back deck ceilings	Engine room ceiling		20m²		Unknown ceiling	Unknown			O-25

Notes

*1 Hazardous materirials: material classification

*2 Result of documents analysis: Y=Contained, N=Not contained, Unknown, PCHM=Potentially containing hazardous material

*3 Procedure of Check:. V=Visual check, S=Sampling check

*4 Result of Check: Y=Contained, N=Not contained, PCHM=Potentially containing hazardous material

4 STEP 3 – PREPARATION OF VISUAL/SAMPLING CHECK PLAN

4.1 Each item classified as "Contained" or "Not contained" in step 2 should be subjected to a visual check on board, and the entry "V" should be made in the "Check procedure" column to denote "Visual check".

4.2 For each item categorized as "unknown", a decision should be made as to whether to apply a sampling check. However, any item categorized as "unknown" may be classed as "potentially containing hazardous material" provided comprehensive justification is given, or if it can be assumed that there will be little or no effect on disassembly as a unit and later ship recycling and disposal operations. For example, in the following checklist, in order to carry out a sampling check for "Packing with aux. boiler" the shipowner needs to disassemble the auxiliary boiler in a repair yard. The costs of this check are significantly higher than the later disposal costs at a ship recycling facility. In this case, therefore, the classification as "potentially containing hazardous material" is justifiable.

Checklist (step 3)

Analysis and definition of scope of assessment for "Sample Ship"

No.	Table A/B	Hazardous materials *1	Location	Name of equipment	Component	Quantity			Manufacturer/brand name	Result of documents analysis *2	Procedure of check *3	Result of check *4	Reference/DWG No.
						Unit (kg)	No.	Total (kg)					
[Inventory part I-1.1]													
1	A	TBT	Top side	Painting & Coating	A/F Paints			NIL	Paints Co./marine P1000	N	V		・On Aug., 200X, Sealer Coat applied to all over submerged area before tin-free coating.
2	A	TBT	Flat bottom				3000m^2		Unknown AF	Unknown	S		
[Inventory Part I-1.2]													
1	A	Asbestos	Lower deck	Main engine	Exh. pipe packing	0.25	14		Diesel Co.	Y	V		M-100
2	A	Asbestos	3rd deck	Aux.boiler	Lagging		12		Unknown lagging	Unknown	S		M-300
3	A	Asbestos	Engine room	Piping/flange	Packing					PCHM	V		
4	A	HCFC	2nd deck	Ref. provision plant	Refrigerant(R22)	20.00	1		Reito Co.	Y	V		Maker's dwg
5	B	Lead	Nav. Br. deck	Batteries		6	16		Denchi Co.	Y	V		E-300
[Inventory Part I-1.3]													
1	A	Asbestos	Upper deck	Back deck ceilings	Engine room ceiling		20m^2		Unknown ceiling	Unknown	S		O-25

Notes

*1 Hazardous materirials: material classification

*2 Result of documents analysis: Y=Contained, N=Not contained, Unknown, PCHM=Potentially containing hazardous material

*3 Procedure of check:. V=Visual check, S=Sampling check

*4 Result of check: Y=Contained, N=Not contained, PCHM=Potentially containing hazardous material

4.3 Before any visual/sampling check on board is conducted, a "visual/sampling check plan" should be prepared. An example of such a plan is shown below.

4.4 To prevent any incidents during the visual/sampling check, a schedule should be established to eliminate interference with other ongoing work on board. To prevent potential exposure to hazardous materials during the visual/sampling check, safety precautions should be in place on board. For example, sampling of potential asbestos containing materials could release fibres into the atmosphere. Therefore, appropriate personnel safety and containment procedures should be implemented prior to sampling.

4.5 Items listed in the visual/sampling check should be arranged in sequence so that the onboard check is conducted in a structured manner (e.g. from a lower level to an upper level and from a fore part to an aft part).

Example of visual/sampling check plan

Name of ship	XXXXXXXXXX
IMO number	XXXXXXXXXX
Gross tonnage	28,000 GT
L x B x D	xxx.xx × xx.xx × xx.xx m
Date of delivery	dd.mm.1987
Shipowner	XXXXXXXXXX
Contact point (Address, Telephone, Fax, Email)	XXXXXXXXXX Tel: XXXX-XXXX Fax: XXXX-XXXX Email: abcdefg@hijk.co.net
Check schedule	Visual check： dd, mm, 20XX Sampling check：dd, mm, 20XX
Site of check	XX shipyard, No. Dock
In charge of check	XXXX XXXX
Check engineer	XXXX XXXX, YYYY YYYY, ZZZZ ZZZZ
Sampling engineer	Person with specialized knowledge of sampling
Sampling method and anti-scattering measure for asbestos	Wet the sampling location prior to cutting and allow it to harden after cutting to prevent scatter. Notes: Workers performing sampling activities shall wear protective equipment.
Sampling of fragments of paints	Paints suspected to contain TBT should be collected and analysed from load line, directly under bilge keel and flat bottom near amidships.
Laboratory	QQQQ QQQQ
Chemical analysis method	Method by ISO/DIS 22262-1 Bulk materials – Part 1: Sampling and qualitative determination of asbestos in commercial bulk materials and ISO/CD 22262-2 Bulk materials – Part 2: Quantitative determination of asbestos by gravimetric and microscopic methods. ICP Luminous analysis (TBT)
Location of visual/sampling check	Refer to lists for visual/sampling check

Listing for equipment, system and/or area for visual check
See attached "Analysis and definition of scope of investigation for sample ship"

List of equipment, system and/or area for sampling check				
Location	**Equipment, machinery and/or zone**	**Name of parts**	**Materials**	**Result of doc. checking**
Upper deck	Back deck ceilings	Engine-room ceiling	Asbestos	Unknown
Engine-room	Exhaust gas pipe	Insulation	Asbestos	Unknown
Engine-room	Pipe/flange	Gasket	Asbestos	Unknown
Refer to attached "Analysis and definition of scope of investigation for sample ship" and "Location plan of hazardous materials for sample ship"				

List of equipment, system and/or area classed as PCHM				
Location	**Equipment, machinery and/or zone**	**Name of part**	**Material**	**Result of doc. checking**
Floor	Propeller cap	Gasket	Asbestos	PCHM
Engine-room	Air operated shut-off valve	Gland packing	Asbestos	PCHM
Refer to attached "Analysis and definition of scope of investigation for sample ship" and "Location plan of hazardous materials for sample ship"				

This plan is established in accordance with the guidelines for the development of the Inventory of Hazardous Materials

・Document check・date/place：
dd, mm, 20XX at XX Lines Co. Ltd.

・Preparation date of plan：dd. mm, 20XX

5 STEP 4 – ONBOARD VISUAL/SAMPLING CHECK

5.1 The visual/sampling check should be conducted according to the plan. Checkpoints should be marked in the ship's plan or recorded with photographs.

5.2 A person taking samples should be protected by the appropriate safety equipment relevant to the suspected type of hazardous materials encountered. Appropriate safety precautions should also be in place for passengers, crew members and other persons on board, to minimize the potential exposure to hazardous materials. Safety precautions could include the posting of signs or other verbal or written notification for personnel to avoid such areas during sampling. The personnel taking samples should ensure compliance with relevant national regulations.

5.3 The results of visual/sampling checks should be recorded in the checklist. Any equipment, systems and/or areas of the ship that cannot be accessed for checks should be classified as "potentially containing hazardous material". In this case, the entry in the "Result of check" column should be "PCHM".

6 STEP 5 – PREPARATION OF PART I OF THE INVENTORY AND RELATED DOCUMENTATION

6.1 *Development of part I of the Inventory*

The results of the check and the estimated quantity of hazardous materials should be recorded on the checklist. Part I of the Inventory should be developed with reference to the checklist.

6.2 *Development of location diagram of hazardous materials*

With respect to part I of the Inventory, the development of a location diagram of hazardous materials is recommended in order to help the ship recycling facility gain a visual understanding of the Inventory.

Checklist (step 4 and step 5)

Analysis and definition of scope of assessment for "Sample Ship"

No.	Table A/B	Hazardous materials *1	Location	Name of equipment	Component	Quantity			Manufacturer/brand name	Result of documents analysis *2	Procedure of check *3	Result of check *4	Reference/DWG No.
						Unit (kg)	No.	Total (kg)					
[Inventory part I-1.1]													
1	A	TBT	Top side	Painting & Coating	A/F Paints			NIL	Paints Co./marine P1000	N	V	N	・On Aug., 200X, Sealer Coat applied to all over submerged area before tin-free coating.
2	A	TBT	Flat Bottom			0.02	3000m^2	60.00	Unknown AF	Unknown	S	Y	
[Inventory part I-1.2]													
1	A	Asbestos	Lower deck	Main engine	Exh. pipe packing	0.25	14	3.50	Diesel Co.	Y	V	Y	M-100
2	A	Asbestos	3rd deck	Aux. boiler	Lagging		12		Unknown lagging	Unknown	S	N	M-300
3	A	Asbestos	Engine room	Piping/flange	Packing					PCHM	V	PCHM	
4	A	HCFC	2nd deck	Ref. provision plant	Refrigerant(R22)	20.00	1	20.00	Reito Co.	Y	V	Y	Maker's dwg
5	B	Lead	Nav. Br. deck	Batteries		6	16	96.00	Denchi Co.	Y	V	Y	E-300
[Inventory part I-1.3]													
1	A	Asbestos	Upp.deck	Back deck ceilings	Engine room ceiling	0.19	20m^2	3.80	Unknown ceiling	Unknown	S	Y	O-25

Notes

*1 Hazardous materirials: material classification

*2 Result of documents analysis: Y=Contained, N=Not contained, Unknown, PCHM=Potentially containing hazardous material

*3 Procedure of check:. V=Visual check, S=Sampling check

*4 Result of check: Y=Contained, N=Not contained, PCHM=Potentially containing hazardous material

Example of the Inventory for existing ships

Inventory of Hazardous Materials for "Sample Ship"

Particulars of the "Sample Ship"

Distinctive number or letters	XXXXNNN
Port of registry	Port of World
Type of vessel	Bulk carrier
Gross tonnage	28,000 GT
IMO number	NNNNNNN
Name of shipbuilder	xx Shipbuilding Co. Ltd
Name of shipowner	yy Maritime SA
Date of delivery	MM/DD/1988

This inventory was developed in accordance with the guidelines for the development of the Inventory of Hazardous Materials.

Attachment:

1: Inventory of Hazardous Materials

2: Assessment of collected information

3: Location diagram of hazardous materials

Prepared by XYZ (Name & address) (dd/mm/20XX)

Inventory of Hazardous Materials: "Sample Ship"

Part I – *Hazardous materials contained in the ship's structure and equipment*

I-1 Paints and coating systems containing materials listed in table A and table B of appendix 1 of the guidelines

No.	Application of paint	Name of paint	Location*	Materials (classification in appendix 1)	Approximate quantity		Remarks
1	AF paint	Unknown paints	Flat bottom	TBT	60.00	kg	Confirmed by sampling
2							
3							

I-2 Equipment and machinery containing materials listed in table A and table B of appendix 1 of the guidelines

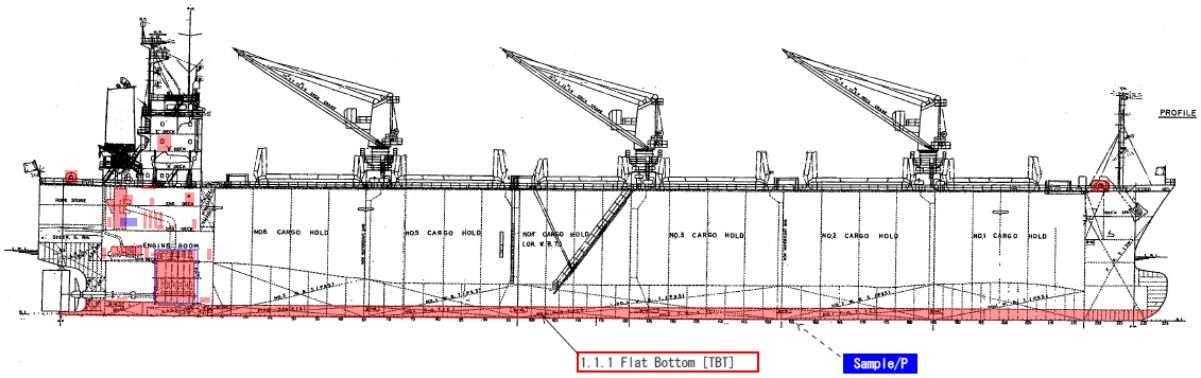
No.	Name of equipment and machinery	Location *1	Materials (classification in appendix 1)	Parts where used	Approximate quantity		Remarks
1	Main engine	Lower floor	Asbestos	Exh. pipe packing	3.50	kg	
2	Aux. boiler	3rd deck	Asbestos	Unknown packing	10.00	kg	PCHM (potentially containing hazardous material)
3	Piping/flange	Engine-room	Asbestos	Packing	50.00	kg	PCHM
4	Ref. provision plant	2nd deck	HCFC	Refrigerant (R22)	20.00	kg	
5	Batteries	Navig. bridge deck	Lead		96.00	kg	

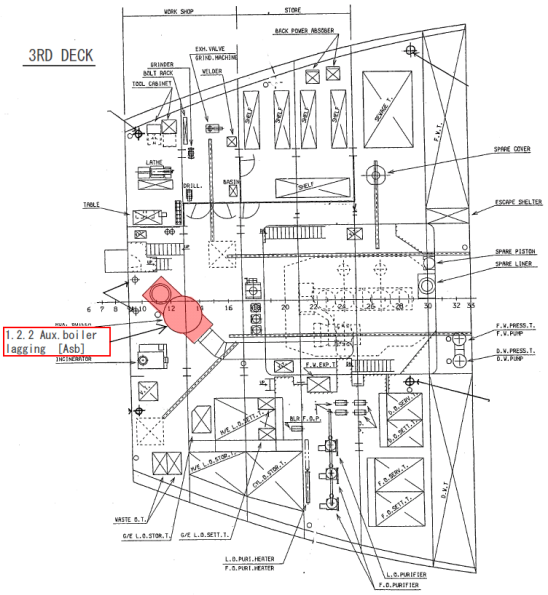
I-3 Structure and hull containing materials listed in table A and table B of appendix 1 of the guidelines

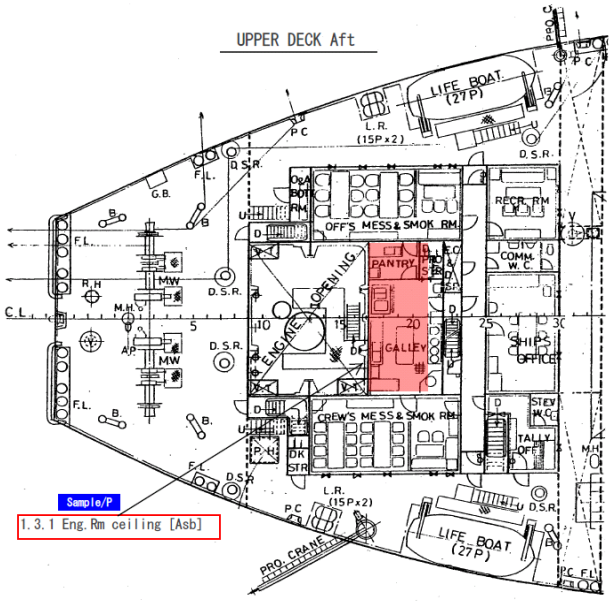
No.	Name of structural element	Location *1	Materials (classification in appendix 1)	Parts where used	Approximate quantity		Remarks
1	Back deck ceiling	Upper deck	Asbestos	Engine-room ceiling (A class)	3.80	kg	Confirmed by sampling
2							
3							

* Each item should be entered in order based on its location, from a lower level to an upper level and from a fore part to an aft part.

Example of location diagram of hazardous materials







APPENDIX 6

FORM OF MATERIAL DECLARATION

<Date of declaration>

Date	

<MD ID number>

MD- ID No.	

<Other information>

Remark 1	
Remark 2	
Remark 3	

<Supplier (respondent) information>

Company name	
Division name	
Address	
Contact person	
Telephone number	
Fax number	
Email address	
SDoC ID no.	

<Product information>

Product name	Product number	Delivered unit			Product information
		Amount	Unit		

<Materials information>

	Unit
This materials information shows the amount of hazardous materials contained in 1	(unit: piece, kg, m, m^2, m^3, etc.) of the product.

Table	Material name		Threshold value	Present above threshold value	If yes, material mass		If yes, information on where it is used
				Yes / No	Mass	Unit	
Table A (materials listed in appendix 1 of the Convention)	Asbestos	Asbestos	0.1%[19]				
	Polychlorinated biphenyls (PCBs)	Polychlorinated biphenyls (PCBs)	50 mg/kg				
	Ozone-depleting substance	Chlorofluorocaobons (CFCs)	no threshold value				
		Halons					
		Other fully halogenated CFCs					
		Carbon tetrachloride					
		1,1,1-Trichloroethane					
		Hydrochlorofluorocaobons					
		Hydrobromofluorocaobons					
		Methyl bromide					
		Bromochloromethane					
	Anti-fouling systems containing organotin compounds as a biocide		2,500 mg total tin/kg				
	Anti-fouling systems containing cybutryne		1,000 mg/kg[20]				

19 In accordance with regulation 4 of the Convention, for all ships, new installation of materials which contain asbestos shall be prohibited. According to the UN recommendation "Globally Harmonized System of Classification and Labelling of Chemicals (GHS)" adopted by the United Nations Economic and Social Council's Sub-Committee of Experts on the Globally Harmonized System of Classification and Labelling of Chemicals (UNSCEGHS), the UN'S Sub-Committee of Experts, in 2002 (published in 2003), carcinogenic mixtures classified as Category 1A (including asbestos mixtures) under the GHS are required to be labelled as carcinogenic if the ratio is more than 0.1%. However, if 1% is applied, this threshold value should be recorded in the Inventory and, if available, the Material Declaration and can be applied not later than five years after the entry into force of the Convention. The threshold value of 0.1% need not be retroactively applied to those Inventories and Material Declarations.

20 When samples are directly taken from the hull, average values of cybutryne should not be present above 1,000 mg of cybutryne per kilogram of dry paint.

Table	Material name	Threshold value	Present above threshold value	If yes, material mass		If yes, information on where it is used
			Yes / No	Mass	Unit	
Table B (materials listed in appendix 2 of the Convention)	Cadmium and cadmium compounds	100 mg/kg				
	Hexavalent chromium and hexavalent chromium compounds	1,000 mg/kg				
	Lead and lead compounds	1,000 mg/kg				
	Mercury and mercury compounds	1,000 mg/kg				
	Polybrominated biphenyl (PBBs)	50 mg/kg				
	Polybrominated dephenyl ethers (PBDEs)	1,000 mg/kg				
	Polychloronaphthalenes (Cl >= 3)	50 mg/kg				
	Radioactive substances	no threshold value				
	Certain short-chain chlorinated paraffins	1%				

APPENDIX 7

FORM OF SUPPLIER'S DECLARATION OF CONFORMITY

SUPPLIER'S DECLARATION OF CONFORMITY FOR MATERIAL DECLARATION MANAGEMENT

1 Identification number _____

2 Issuer's name _____

Issuer's address _____

3 Object(s) of the declaration _____

_____

_____

4 The object(s) of the declaration described above is in conformity with the following documents :

	Document No.	Title	Edition/date of issue
5	_____	_____	_____
	_____	_____	_____
	_____	_____	_____

6 Additional information _____

_____

Signed for and on behalf of

_____

_____

(place and date of issue)

7 _____ _____

(name, function) *(signature)*

APPENDIX 8

EXAMPLES OF TABLE A AND TABLE B MATERIALS OF APPENDIX 1 WITH CAS NUMBERS

This list was developed with reference to Joint Industry Guide No.101. This list is not exhaustive; it represents examples of chemicals with known CAS numbers and may require periodical updating.

Table	Material Category	Substances	CAS Numbers
Table A (materials listed in appendix 1 of the Convention)	Asbestos	Asbestos	1332-21-4
		Actinolite	77536-66-4
		Amosite (Grunerite)	12172-73-5
		Anthophyllite	77536-67-5
		Chrysotile	12001-29-5
		Crocidolite	12001-28-4
		Tremolite	77536-68-6
	Polychlorinated biphenyls (PCBs)	Polychlorinated biphenyls	1336-36-3
		Aroclor	12767-79-2
		Chlorodiphenyl (Aroclor 1260)	11096-82-5
		Kanechlor 500	27323-18-8
		Aroclor 1254	11097-69-1
	Ozone-depleting substances/ isomers (they may contain isomers that are not listed here)	Trichlorofluoromethane (CFC11)	75-69-4
		Dichlorodifluoromethane (CFC12)	75-71-8
		Chlorotrifluoromethane (CFC 13)	75-72-9
		Pentachlorofluoroethane (CFC 111)	354-56-3
		Tetrachlorodifluoroethane (CFC 112)	76-12-0
		Trichlorotrifluoroethane (CFC 113)	354-58-5
		1,1,2 Trichloro-1,2,2 trifluoroethane	76-13-1
		Dichlorotetrafluoroethane (CFC 114)	76-14-2
		Monochloropentafluoroethane (CFC 115)	76-15-3
		Heptachlorofluoropropane (CFC 211)	422-78-6
			135401-87-5
		Hexachlorodifluoropropane (CFC 212)	3182-26-1
		Pentachlorotrifluoropropane (CFC 213)	2354-06-5
			134237-31-3
		Tetrachlorotetrafluoropropane (CFC 214) 1,1,1,3-Tetrachlorotetrafluoropropane	29255-31-0 2268-46-4
		Trichloropentafluoropropane (CFC 215) 1,1,1-Trichloropentafluoropropane 1,2,3-Trichloropentafluoropropane	1599-41-3 4259-43-2 76-17-5
		Dichlorohexafluoropropane (CFC 216)	661-97-2
		Monochloroheptafluoropropane (CFC 217)	422-86-6
		Bromochlorodifluoromethane (Halon 1211)	353-59-3
		Bromotrifluoromethane (Halon 1301)	75-63-8
		Dibromotetrafluoroethane (Halon 2402)	124-73-2
		Carbon tetrachloride (Tetrachloromethane)	56-23-5
		1,1,1, - Trichloroethane (methyl chloroform) and its isomers except 1,1,2-trichloroethane	71-55-6
		Bromomethane (Methyl bromide)	74-83-9
		Bromodifluoromethane and isomers (HBFC's)	1511-62-2
		Dichlorofluoromethane (HCFC 21)	75-43-4
		Chlorodifluoromethane (HCFC 22)	75-45-6
		Chlorofluoromethane (HCFC 31)	593-70-4

Table	Material Category	Substances	CAS Numbers
		Tetrachlorofluoroethane (121) HCFC 1,1,1,2-tetrachloro-2-fluoroethane (HCFC 121a) 1,1,2,2-tetracloro-1-fluoroethane	134237-32-4 354-11-0 354-14-3
		Trichlorodifluoroethane (HCFC 122) 1,2,2-trichloro-1,1-difluoroethane	41834-16-6 354-21-2
		Dichlorotrifluoroethane(HCFC 123) Dichloro-1,1,2-trifluoroethane 2,2-dichloro-1,1,1-trifluroethane 1,2-dichloro-1,1,2-trifluroethane (HCFC-123a) 1,1-dichloro-1,2,2-trifluroethane (HCFC-123b) 2,2-dichloro-1,1,2-trifluroethane (HCFC-123b)	34077-87-7 90454-18-5 306-83-2 354-23-4 812-04-4 812-04-4
		Chlorotetrafluoroethane (HCFC 124) 2-chloro-1,1,1,2-tetrafluoroethane 1-chloro-1,1,2,2-tetrafluoroethane (HCFC 124a)	63938-10-3 2837-89-0 354-25-6
		Trichlorofluoroethane (HCFC 131) 1-Fluoro-1,2,2-trichloroethane 1,1,1-trichloro-2-fluoroethane (HCFC131b)	27154-33-2; (134237-34-6) 359-28-4 811-95-0
		Dichlorodifluoroethane (HCFC 132) 1,2-dichloro-1,1-difluoroethane (HCFC 132b) 1,1-dichloro-1,2-difluoroethane (HFCF 132c) 1,1-dichloro-2,2-difluoroethane 1,2-dichloro-1,2-difluoroethane	25915-78-0 1649-08-7 1842-05-3 471-43-2 431-06-1
		Chlorotrifluoroethane (HCFC 133) 1-chloro-1,2,2-trifluoroethane 2-chloro-1,1,1-trifluoroethane (HCFC-133a)	1330-45-6 1330-45-6 75-88-7
		Dichlorofluoroethane(HCFC 141) 1,1-dichloro-1-fluoroethane (HCFC-141b) 1,2-dichloro-1-fluoroethane	1717-00-6; (25167-88-8) 1717-00-6 430-57-9
		Chlorodifluoroethane (HCFC 142) 1-chloro-1,1-difluoroethane (HCFC142b) 1-chloro-1,2-difluoroethane (HCFC142a)	25497-29-4 75-68-3 25497-29-4
		Hexachlorofluoropropane (HCFC 221)	134237-35-7
		Pentachlorodifluoropropane (HCFC 222)	134237-36-8
		Tetrachlorotrifluropropane (HCFC 223)	134237-37-9
		Trichlorotetrafluoropropane (HCFC 224)	134237-38-0
		Dichloropentafluoropropane, (Ethyne, fluoro-) (HCFC 225)	127564-92-5; (2713-09-9)
		2,2-Dichloro-1,1,1,3,3-pentafluoropropane(HCFC 225aa)	128903-21-9
		2,3-Dichloro-1,1,1,2,3-pentafluoropropane (HCFC 225ba)	422-48-0
		1,2-Dichloro-1,1,2,3,3-pentafluoropropane (HCFC 225bb)	422-44-6
		3,3-Dichloro-1,1,1,2,2-pentafluoropropane (HCFC 225ca)	422-56-0
		1,3-Dichloro-1,1,2,2,3-pentafluoropropane (HCFC 225cb)	507-55-1
		1,1-Dichloro-1,2,2,3,3-pentafluoropropane(HCFC 225cc)	13474-88-9
		1,2-Dichloro-1,1,3,3,3-pentafluoropropane (HCFC 225da)	431-86-7
		1,3-Dichloro-1,1,2,3,3-pentafluoropropane (HCFC 225ea)	136013-79-1
		1,1-Dichloro-1,2,3,3,3-pentafluoropropane(HCFC 225eb)	111512-56-2
		Chlorohexafluoropropane (HCFC 226)	134308-72-8
		Pentachlorofluoropropane (HCFC 231)	134190-48-0
		Tetrachlorodifluoropropane (HCFC 232)	134237-39-1
		Trichlorotrifluoropropane (HCFC 233) 1,1,1-Trichloro-3,3,3-trifluoropropane	134237-40-4 7125-83-9
		Dichlorotetrafluoropropane (HCFC 234)	127564-83-4
		Chloropentafluoropropane (HCFC 235) 1-Chloro-1,1,3,3,3-pentafluoropropane	134237-41-5 460-92-4
		Tetrachlorofluoropropane (HCFC 241)	134190-49-1
		Trichlorodifluoropropane (HCFC 242)	134237-42-6
		Dichlorotrifluoropropane (HCFC 243) 1,1-dichloro-1,2,2-trifluoropropane 2,3-dichloro-1,1,1-trifluoropropane 3,3-Dichloro-1,1,1-trifluoropropane	134237-43-7 7125-99-7 338-75-0 460-69-5
		Chlorotetrafluoropropane (HCFC 244)	134190-50-4

Table	Material Category	Substances	CAS Numbers
		3-chloro-1,1,2,2-tetrafluoropropane	679-85-6
		Trichlorofluoropropane (HCFC 251)	134190-51-5
		1,1,3-trichloro-1-fluoropropane	818-99-5
		Dichlorodifluoropropane (HCFC 252)	134190-52-6
		Chlorotrifluoropropane (HCFC 253)	134237-44-8
		3-chloro-1,1,1-trifluoropropane (HCFC 253fb)	460-35-5
		Dichlorofluoropropane (HCFC 261)	134237-45-9
		1,1-dichloro-1-fluoropropane	7799-56-6
		Chlorodifluoropropane (HCFC 262)	134190-53-7
		2-chloro-1,3-difluoropropane	102738-79-4
		Chlorofluoropropane (HCFC 271)	134190-54-8
		2-chloro-2-fluoropropane	420-44-0
	Organotin compounds (tributyl tin, triphenyl tin, tributyl tin oxide)	Bis(tri-n-butyltin) oxide	56-35-9
		Triphenyltin N,N'-dimethyldithiocarbamate	1803-12-9
		Triphenyltin fluoride	379-52-2
		Triphenyltin acetate	900-95-8
		Triphenyltin chloride	639-58-7
		Triphenyltin hydroxide	76-87-9
		Triphenyltin fatty acid salts (C=9-11)	47672-31-1
		Triphenyltin chloroacetate	7094-94-2
		Tributyltin methacrylate	2155-70-6
		Bis(tributyltin) fumarate	6454-35-9
		Tributyltin fluoride	1983-10-4
		Bis(tributyltin) 2,3-dibromosuccinate	31732-71-5
		Tributyltin acetate	56-36-0
		Tributyltin laurate	3090-36-6
		Bis(tributyltin) phthalate	4782-29-0
		Copolymer of alkyl acrylate, methyl methacrylate and tributyltin methacrylate(alkyl; C=8)	-
		Tributyltin sulfamate	6517-25-5
		Bis(tributyltin) maleate	14275-57-1
		Tributyltin chloride	1461-22-9
		Mixture of tributyltin cyclopentanecarboxylate and its analogues (Tributyltin naphthenate)	-
		Mixture of tributyltin 1,2,3,4,4a, 4b, 5,6,10,10adecahydro-7-isopropyl-1, 4a-dimethyl-1-phenanthlenecarboxylate and its analogues (Tributyltin rosin salt)	-
		Other tributyl tins & triphenyl tins	-
	Anti-fouling systems containing cybutryne	Cybutryne	28159-98-0
Table B (Materials listed in appendix 2 of the Convention)	Cadmium/ cadmium compounds	Cadmium	7440-43-9
		Cadmium oxide	1306-19-0
		Cadmium sulfide	1306-23-6
		Cadmium chloride	10108-64-2
		Cadmium sulfate	10124-36-4
		Other cadmium compounds	-
	Chromium VI compounds	Chromium (VI) oxide	1333-82-0
		Barium chromate	10294-40-3
		Calcium chromate	13765-19-0
		Chromium trioxide	1333-82-0
		Lead (II) chromate	7758-97-6
		Sodium chromate	7775-11-3
		Sodium dichromate	10588-01-9
		Strontium chromate	7789-06-2
		Potassium dichromate	7778-50-9
		Potassium chromate	7789-00-6
		Zinc chromate	13530-65-9

Table	Material Category	Substances	CAS Numbers
		Other hexavalent chromium compounds	-
	Lead/lead compounds	Lead	7439-92-1
		Lead (II) sulfate	7446-14-2
		Lead (II) carbonate	598-63-0
		Lead hydrocarbonate	1319-46-6
		Lead acetate	301-04-2
		Lead (II) acetate, trihydrate	6080-56-4
		Lead phosphate	7446-27-7
		Lead selenide	12069-00-0
		Lead (IV) oxide	1309-60-0
		Lead (II,IV) oxide	1314-41-6
		Lead (II) sulfide	1314-87-0
		Lead (II) oxide	1317-36-8
		Lead (II) carbonate basic	1319-46-6
		Lead hydroxidcarbonate	1344-36-1
		Lead (II) phosphate	7446-27-7
		Lead (II) chromate	7758-97-6
		Lead (II) titanate	12060-00-3
		Lead sulfate, sulphuric acid, lead salt	15739-80-7
		Lead sulphate, tribasic	12202-17-4
		Lead stearate	1072-35-1
		Other lead compounds	-
	Mercury/ mercury compounds	Mercury	7439-97-6
		Mercuric chloride	33631-63-9
		Mercury (II) chloride	7487-94-7
		Mercuric sulfate	7783-35-9
		Mercuric nitrate	10045-94-0
		Mercuric (II) oxide	21908-53-2
		Mercuric sulfide	1344-48-5
		Other mercury compounds	-
	Polybrominated biphenyls (PBBs) and polybrominated diphenyl ethers (PBDEs)	Bromobiphenyl and its ethers	2052-07-5 (2-Bromobiphenyl)
			2113-57-7 (3-Bromobiphenyl)
			92-66-0 (4-Bromobiphenyl)
			101-55-3 (ether)
		Decabromobiphenyl and its ethers	13654-09-6
			1163-19-5 (ether)
		Dibromobiphenyl and its ethers	92-86-4
			2050-47-7 (ether)
		Heptabromobiphenylether	68928-80-3
		Hexabromobiphenyl and its ethers	59080-40-9
			36355-01-8 (hexabromo-1,1'-biphenyl)
			67774-32-7 (Firemaster FF-1)
			36483-60-0 (ether)
		Nonabromobiphenylether	63936-56-1
		Octabromobiphenyl and its ethers	61288-13-9
			32536-52-0 (ether)
		Pentabromobidphenyl ether (note: commercially available PeBDPO is a complex reaction mixture containing a variety of brominated diphenyloxides)	32534-81-9 (CAS number used for commercial grades of PeBDPO)
		Polybrominated biphenyls	59536-65-1
		Tetrabromobiphenyl and its ethers	40088-45-7
			40088-47-9 (ether)
		Tribromobiphenyl ether	49690-94-0
	Polychlorinated naphthalenes	Polychlorinated naphthalenes	70776-03-3
		Other polychlorinated naphthalenes	-
	Radioactive substances	Uranium	-
		Plutonium	-
		Radon	-

Table	Material Category	Substances	CAS Numbers
		Americium	-
		Thorium	-
		Caesium	7440-46-2
		Strontium	7440-24-6
		Other radioactive substances	-
	Certain short-chain chlorinated paraffins (with carbon length of 10-13 atoms)	Chlorinated paraffins (C10-13)	85535-84-8
		Other short-chain chlorinated paraffins	-

APPENDIX 9

SPECIFIC TEST METHODS

1 Asbestos

Types to test for: Actinolite CAS 77536-66-4 Amosite (Grunerite) CAS 12172-73-5 Anthophyllite CAS 77536-67-5 Chrysotile CAS 12001-29-5 Crocidolite CAS 12001-28-4 Asbestos Tremolite CAS 77536-68-6.

Specific testing techniques: Polarized Light Microscopy, electron microscope techniques and/or X-Ray Diffraction (XRD) as applicable.

Specific reporting information: The presence/no presence of asbestos, indicate the concentration range, and state the type when necessary.

Notes: .1 The suggested three kinds of testing techniques are most commonly used methods when analysing asbestos and each of them has its limitation. Laboratories should choose the most suitable methods to determine, and in most cases, two or more techniques should be utilized together.

.2 The quantification of asbestos is difficult at this stage, although the XRD technique is applicable. Only a few laboratories conduct the quantification rather than the qualification, especially when a precise number is required. Considering the demand from the operators and ship recycling parties, the precise concentration is not strictly required. Thereby, the concentration range is recommended to report, and the recommended range division according to standard VDI 3866 is as follows:

- Asbestos not detected
- Traces of asbestos detected
- Asbestos content approx. 1% to 15% by mass
- Asbestos content approx. 15% to 40% by mass
- Asbestos content greater than 40% by mass

Results that specified more precisely must be provided with a reasoned statement on the uncertainty.

.3 As to the asbestos types, to distinguish all six different types is time-consuming and in some cases not feasible by current techniques; while on the practical side, the treatment of different types of asbestos is the same. Therefore, it is suggested to report the type when necessary.

2 Polychlorinated biphenyls (PCBs)

Note: There are 209 different congeners (forms) of PCB of it is impracticable to test for all. Various organizations have developed lists of PCBs to test for as indicators. In this instance two alternative approaches are recommended. Method 1 identifies the seven congeners used by the International Council for the Exploration of the Sea (ICES). Method 2 identifies 19 congeners and seven types of aroclor (PCB mixtures commonly found in solid shipboard materials containing PCBs). Laboratories should be familiar with the requirements and consequences for each of these lists.

Types to test for: Method 1: ICES7 congeners (28, 52, 101, 118, 138, 153, 180). Method 2: 19 congeners and seven types of aroclor, using the US EPA 8082a test.

Specific testing technique: GC-MS (congener specific) or GC-ECD or GC-ELCD for applicable mixtures such as aroclors. Note: standard samples must be used for each type.

Sample Preparation: It is important to properly prepare PCB samples prior to testing. For solid materials (cables, rubber, paint, etc.), it is especially critical to select the proper extraction procedure in order to release PCBs since they are chemically bound within the product.

Specific reporting information: PCB congener, ppm per congener in sample, and for Method 2, ppm per aroclor in sample should also be reported.

Notes:

.1 Certain field or indicator tests are suitable for detecting PCBs in liquids or surfaces. However, there are currently no such tests that can accurately identify PCBs in solid shipboard materials. It is also noted that many of these tests rely on the identification of free chlorine ions and are thus highly susceptible to chlorine contamination and false readings in a marine environment where all surfaces are highly contaminated with chlorine ions from the seawater and atmosphere.

.2 Several congeners are tested for as "indicator" congeners. They are used because their presence often indicates the likelihood of other congeners in greater quantities (many PCBs are mixes, many mixes use a limited number of PCBs in small quantities, therefore the presence of these small quantities indicates the potential for a mix containing far higher quantities of other PCBs).

.3 Many reports refer to "total PCB", which is often a scaled figure to represent likely total PCBs based on the sample and the common ratios of PCB mixes. Where this is done the exact scaling technique must be stated, and is for information only and does not form part of the specific technique.

3 Ozone-depleting substances

Types to test for: as per appendix 8 of these guidelines all the listed CFCs, Halons, HCFCs and other listed substance as required by Montreal Protocol.

Specific testing technique: Gas Chromatography-Mass Spectrometry (GC-MS), coupled Electron Capture Detectors (GC-ECD) and Electrolytic Conductivity Detectors (GC-ELCD).

Specific reporting information: Type and concentration of ODS.

4 Anti-fouling systems containing organotin compounds as a biocide and/or cybutryne

4.1 Anti-fouling systems containing organotin compounds as a biocide

Types to test for: Anti-fouling compounds and systems regulated under annex I to the International Convention on the Control of Harmful Anti-fouling Systems on Ships, 2001 (AFS Convention, as amended), including: tributyl tins (TBT), triphenyl tins (TPT) and tributyl tin oxide (TBTO).

Specific testing technique: As per resolution MEPC.356(78) (*2022 Guidelines for brief sampling of anti-fouling systems on ships*), adopted on 10 June 2022, using ICPOES, ICP, AAS, XRF, GC-MS as applicable.

Specific reporting information: Type and concentration of organotin compound.

Note: For "field" or "indicative" testing it may be acceptable to simply identify presence of tin, owing to the expected good documentation on anti-fouling systems.

4.2 Anti-fouling systems containing cybutryne

Types to test for: Anti-fouling systems containing cybutryne regulated under Annex 1 to the International Convention on the Control of Harmful Anti-fouling Systems on Ships, 2001 (AFS Convention, as amended).

Specific testing technique: As per resolution MEPC.356(78) (*2022 Guidelines for brief sampling of anti-fouling systems on ships*), adopted on 10 June 2022, using GC-MS.

Specific reporting information: Concentration of cybutryne.

4.3 Simplified approach to detect organotin compounds or cybutryne

Types to test for: Anti-fouling systems containing organotin compounds as biocides and/or cybutryne regulated under Annex 1 to the International Convention on the Control of Harmful Anti-fouling Systems on Ships, 2001 (AFS Convention, as amended).

Specific testing technique: As per resolution MEPC.356(78) (*2022 Guidelines for brief sampling of anti-fouling systems on ships*), adopted on 10 June 2022, using GC-MS.

Specific reporting information: Concentration of organotin compound and/or cybutryne.

APPENDIX 10

EXAMPLES OF RADIOACTIVE SOURCES

The following list contains examples of radioactive sources that should be included in the Inventory, regardless of the number, the amount of radioactivity or the type of radionuclide.

Examples of consumer products with radioactive materials

Ionization chamber smoke detectors (typical radionuclides ^{241}Am; ^{226}Ra)
Instruments/signs containing gaseous tritium light sources (^{3}H)
Instruments/signs containing radioactive painting (typical radionuclide ^{226}Ra)
High intensity discharge lamps (typical radionuclides ^{85}Kr; ^{232}Th)
Radioactive lighting rods (typical radionuclides ^{241}Am; ^{226}Ra)

Examples of industrial gauges with radioactive materials

Radioactive level gauges
Radioactive dredger gauges[21]
Radioactive conveyor gauges[21]
Radioactive spinning pipe gauges[21]

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[21] Typical radionuclides: ^{241}Am; ^{241}Am/Be; ^{252}Cf; ^{244}Cm; ^{60}Co; ^{137}Cs; ^{153}Gd; ^{192}Ir; ^{147}Pm; ^{238}Pu; ^{239}Pu/Be; ^{226}Ra; ^{75}S; ^{90}Sr (^{90}Y); ^{170}Tm; ^{169}Yb

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MEPC.1/Circ.905
24 July 2023

INTERIM GUIDANCE ON THE USE OF BIOFUELS UNDER REGULATIONS 26, 27 AND 28 OF MARPOL ANNEX VI (DCS AND CII)

1 The Marine Environment Protection Committee, at its eightieth session (3 to 7 July 2023), approved the *Interim guidance on the use of biofuels under regulations 26, 27 and 28 of MARPOL Annex VI (DCS and CII)*, as set out in the annex.

2 Member Governments are invited to bring the annexed Interim Guidance to the attention of their Administrations, shipowners, ship operators, fuel oil suppliers and any other interested relevant stakeholders concerned for application as of 1 October 2023.

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ANNEX

INTERIM GUIDANCE ON THE USE OF BIOFUELS UNDER REGULATIONS 26, 27 AND 28 OF MARPOL ANNEX VI (DCS AND CII)

1 The *2022 Guidelines on operational carbon intensity indicators and the calculation methods* (resolution MEPC.352(78) CII Guidelines, G1) provide the possibility for the CO_2 Emission Conversion Factor (C_f) to be obtained from the fuel oil supplier, supported by documentary evidence, in case the type of the fuel oil is not covered by the relevant guidelines.

2 Pending the development of the comprehensive method to account for well-to-wake GHG emissions and removals based on the *Guidelines on life cycle GHG intensity of marine fuels (LCA Guidelines)* (resolution MEPC 376(80)), biofuels that have been certified by an international certification scheme,* meeting its sustainability criteria, and that provide a well-to-wake GHG emissions reduction of at least 65% compared to the well-to-wake emissions of fossil MGO of 94 gCO_2e/MJ (i.e. achieving an emissions intensity not exceeding 33 gCO_2e/MJ) according to that certification, may be assigned a C_f equal to the value of the well-to-wake GHG emissions of the fuel according to the certificate (expressed in gCO_2eq/MJ) multiplied by its lower calorific value (LCV, expressed in MJ/g) for the purpose of regulations 26, 27 and 28 of MARPOL Annex VI for the corresponding amount of fuels consumed by the ship. In any case, the C_f value of a biofuel cannot be less than 0. For blends, the C_f should be based on the weighted average of the C_f for the respective amount of fuels by energy.

3 A Proof of Sustainability or similar documentation from a recognized scheme should be provided along with the Bunker Delivery Note, to facilitate the verification of the reported biofuel consumption.

4 Biofuels not certified as "sustainable" or not fulfilling the well-to-wake emission factor criterion above should be assigned a C_f equal to the C_f of the equivalent fossil fuel type.

5 This guidance should be considered as an interim simplified method until a more comprehensive method is developed to calculate a fuel's Emission Conversion Factor reflecting its well-to-wake GHG emissions and removals based on the LCA Guidelines. This guidance does not intend to prejudge or delay the process of developing such a comprehensive method.

6 This Interim Guidance will be rescinded immediately upon operationalization of a well-to-wake GHG methodology through the LCA Guidelines.

7 Administrations are invited to inform the Committee on which international certification schemes have been used when applying this guidance.

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* Refer to ICAO's Approved Sustainability Certification Schemes and the CORSIA Sustainability Criteria (chapter 2) for CORSIA Eligible Fuels

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BWM.2/Circ.66/Rev.5
13 July 2023

INTERNATIONAL CONVENTION FOR THE CONTROL AND MANAGEMENT OF SHIPS' BALLAST WATER AND SEDIMENTS, 2004

Unified interpretations to the BWM Convention and the BWMS Code

1 The Marine Environment Protection Committee, at its eightieth session (3 to 7 July 2023), approved unified interpretations to regulations B-3.5 and B-3.10 of the BWM Convention and the Form of the International Ballast Water Management Certificate, concerning the "date of construction" for a ship which has undergone a major conversion in order to implement the BWM Convention.

2 The updated consolidated text of all existing unified interpretations to the BWM Convention and the BWMS Code, including those set out in BWM.2/Circ.66/Rev.4, is set out in annexes 1 and 2, respectively.

3 Member Governments and international organizations are invited to apply the annexed unified interpretations to the BWM Convention and the BWMS Code and bring them to the attention of all parties concerned.

4 This circular revokes BWM.2/Circ.66/Rev.4.

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ANNEX 1

UNIFIED INTERPRETATIONS TO THE BWM CONVENTION

1 Date to meet the standard in regulation D-2 in accordance with resolution MEPC.297(72)

Regulation B-3
Ballast water management for ships

Regulations B-3.5 and B-3.10 read as follows:

"5 A ship constructed on or after 8 September 2017 shall conduct ballast water management that at least meets the standard described in regulation D-2.

10 Notwithstanding regulation E-1.1.2, the renewal survey referred to in paragraphs 1.1, 1.2, 2 and 4 is:

.1 the first renewal survey, as determined by the Committee*, on or after 8 September 2017 if:

.1 this survey is completed on or after 8 September 2019; or

.2 a renewal survey is completed on or after 8 September 2014 but prior to 8 September 2017; and

.2 the second renewal survey, as determined by the Committee,* on or after 8 September 2017 if the first renewal survey on or after 8 September 2017 is completed prior to 8 September 2019, provided that the conditions of paragraph 10.1.2 are not met."

Interpretation:

1.1 A ship constructed before 8 September 2017 which has undergone a major conversion on or after 8 September 2017 should be deemed as a ship constructed on or after 8 September 2017 and comply with regulation B-3.5. If the major conversion has occurred before the renewal survey specified in regulation B-3.10, the said ship should meet the D-2 standard from the date of completion of the major conversion. If the major conversion has occurred after the renewal survey specified in regulation B-3.10, the said ship should meet the D-2 standard from the date of completion of the renewal survey specified in regulation B-3.10.

2 Date to be used for determining the implementation of mandatory commissioning testing of individual ballast water management systems in accordance with resolution MEPC.325(75)

Regulation E-1
Surveys

Regulations E-1.1.1 and E-1.1.5 read as follows:

"1 An initial survey before the ship is put in service or before the Certificate required under regulation E-2 or E-3 is issued for the first time. This survey shall verify

that the ballast water management plan required by regulation B-1 and any associated structure, equipment, systems, fittings, arrangements and material or processes comply fully with the requirements of this Convention. This survey shall confirm that a commissioning test has been conducted to validate the installation of any ballast water management system by demonstrating that its mechanical, physical, chemical and biological processes are working properly, taking into account the guidelines developed by the Organization.*

5 An additional survey, either general or partial, according to the circumstances, shall be made after a change, replacement, or significant repair of the structure, equipment, systems, fittings, arrangements and material necessary to achieve full compliance with this Convention. The survey shall be such as to ensure that any such change, replacement or significant repair has been effectively made, so that the ship complies with the requirements of this Convention. When an additional survey is undertaken for the installation of any ballast water management system, this survey shall confirm that a commissioning test has been conducted to validate the installation of the system by demonstrating that its mechanical, physical, chemical and biological processes are working properly, taking into account the guidelines developed by the Organization.*

* Refer to the *2020 Guidance for the commissioning testing of ballast water management systems* (BWM.2/Circ.70/Rev.1), as amended."

Interpretation:

2.1 Irrespective of new ships under construction subject to regulation E-1.1.1 or existing ships retrofitting ballast water management system(s) (BWMS) on board subject to regulation E-1.1.5, the commissioning testing of individual BWMS taking into account the guidelines developed by the Organization* should be conducted if the initial or additional survey is completed on or after 1 June 2022. If the initial or additional survey is completed before 1 June 2022, the commissioning testing of individual BWMS remains subject to the specific requirements of the Administration(s).

2.2 In case an installed BWMS on board a ship undergoes an upgrade or change to a major component as defined under paragraph 3.9 of the BWMS Code, the BWMS should be regarded as a newly installed BWMS. A commissioning test should be conducted in accordance with regulation E-1.1.5 of the BWM Convention and an International Ballast Water Management Certificate (IBWMC) for that ship should be re-issued accordingly.

* Refer to the *2020 Guidance for the commissioning testing of ballast water management systems* (BWM.2/Circ.70/Rev.1), as amended.

3 "Date of construction" for a ship which has undergone a major conversion

Appendix I
Form of International Ballast Water Management Certificate

The following information regarding "Date of construction" and "Date of major conversion" is to be provided on the certificate:

"Date of construction ....."

Interpretation:

3.1 For the International Ballast Water Management Certificate for a ship that has undergone a major conversion, the date of the commencement of the major conversion should be filled in the item "Date of construction".

4 "Date installed" in relation to "Method of ballast water management used"

Appendix I
Form of the International Ballast Water Management Certificate

The following information regarding "Details of ballast water management method(s) used" is to be provided on the certificate:

"Method of ballast water management used .....
Date installed (if applicable) (dd/mm/yyyy) .....
Name of manufacturer (if applicable) ....."

Interpretation:

4.1 For the purpose of completing the International Ballast Water Management Certificate, the date when the latest commissioning has been completed in accordance with section 8 of the BWMS Code (resolution MEPC.300(72)) should be used.

4.2 Notwithstanding the above, it should be noted that, with regard to the deadline for installing a ballast water management system, operative paragraph 5 of resolution MEPC.300(72) (*Code for Approval of Ballast Water Management Systems*) is as follows:

> "5 RESOLVES that, for the purpose of operative paragraph 4 of this resolution, the word "installed" means the contractual date of delivery of the ballast water management system to the ship. In the absence of such a date, the word "installed" means the actual date of delivery of the ballast water management system to the ship;"

4.3 Consequently, two dates, i.e. the contractual date of delivery or the actual date of delivery, and the date following the latest commissioning and operation, may exist in relation to installing a ballast water management system.

5 Principal ballast water management method(s) employed on the ship

Appendix I
Form of the International Ballast Water Management Certificate

Appendix I of the BWM Convention reads as follows:

"…Method of ballast water management used .....
Date installed (if applicable) (dd/mm/yyyy) .....
Name of manufacturer (if applicable) .....

The principal ballast water management method(s) employed on this ship is/are:
☐ in accordance with regulation D-1
☐ in accordance with regulation D-2
(describe) .....
☐ the ship is subject to regulation D-4
☐ other approach in accordance with regulation....."

Interpretation:

5.1 For a ship which is occasionally engaged in an international voyage and is not intending to discharge ballast water back to the original location, having been granted an exemption by its Administration, taking into account BWM.2/Circ.52/Rev.1, on the condition that the ship implements the D-1 standard in lieu of the D-2 standard, the principal ballast water management method(s) employed is:

"☒ other approach in accordance with regulation D-1 taking into account BWM.2/Circ.52/Rev.1."

5.2 For a ship granted an exemption in accordance with regulation A-4 of the BWM Convention, the principal ballast water management method employed on the ship is:

"☒ other approach in accordance with regulation A-4 ."

5.3 For a ship which is fitted with a BWMS on board and is certified in accordance with the D-2 standard, even if the ship will also use other ballast water management methods as contingency measures, as reflected in its Ballast Water Management Plan, the principal ballast water management method employed on this ship is:

"☒ in accordance with regulation D-2
(describe) ..... "

5.4 For a ship which has employed an "other approach" in accordance with regulation B-3.6 or B-3.7 of the BWM Convention, the Ballast Water Management Plan should describe the other approach that has been approved for the ship.

5.5 In the case of an Administration that requires its ships which are subject to equivalent compliance under regulation A-5 to carry International Ballast Water Management Certificates, those certificates should refer to regulation A-5 in the item "other approach" as their principal ballast water management method employed.

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ANNEX 2

UNIFIED INTERPRETATIONS TO THE BWMS CODE

1 Requirements for the calibration of the BWMS components that take measurements

Chapter 4
Technical specifications

Paragraph 4.10 reads as follows:

> "4.10 Facilities shall be provided for checking, at the renewal surveys and according to the manufacturer's instructions, the performance of the BWMS components that take measurements. A calibration certificate certifying the date of the last calibration check shall be retained on board for inspection purposes. Only the manufacturer or persons authorized by the manufacturer shall perform the accuracy checks."

Interpretation:

1.1 For BWMS components that take measurements, the interval for an accuracy check/calibration (or replacement of a sensor in case it cannot be calibrated) should not be mandatorily linked to the survey scheme for the BWMS, even though a validity check of calibration certificates should be conducted at BWM annual/intermediate/renewal surveys. The accuracy check/calibration of BWMS components that take measurements should be performed in accordance with the calibration procedure at intervals specified in the manufacturer's instructions.

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BWM.2/Circ.78
14 July 2023

INTERNATIONAL CONVENTION FOR THE CONTROL AND MANAGEMENT OF SHIPS' BALLAST WATER AND SEDIMENTS, 2004

Protocol for the verification of ballast water compliance monitoring devices

1 The Marine Environment Protection Committee (MEPC), at its eightieth session (3 to 7 July 2023), approved the *Protocol for the verification of ballast water compliance monitoring devices* to provide a framework that can be used to verify the ability of a compliance monitoring device to assess non-compliance with the standard described in regulation D-2 of the BWM Convention, as set out in the annex.

2 Member Governments and international organizations are invited to bring this Protocol to the attention of all parties concerned.

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ANNEX

PROTOCOL FOR THE VERIFICATION OF BALLAST WATER COMPLIANCE MONITORING DEVICES

1 Purpose

1.1 The goal of this protocol is to provide a framework that can be used to verify the ability of a compliance monitoring device (CMD) to assess non-compliance with the standard described in regulation D-2 (the D-2 standard) of the *International Convention for the Control and Management of Ships' Ballast Water and Sediments*, 2004 (the BWM Convention), and its ability to operate, as claimed by the manufacturer, with regard to the degree or level of non-compliance that can be detected and with regard to the stated intended use of the device. This protocol is intended to support effective implementation of the BWM Convention by enabling the use of ballast water CMDs that satisfy a common level of quality.

2 Definitions

2.1 Compliance monitoring device (CMD): an instrument and its associated indicative analytical methodology typically used as a rapid assessment of the concentration of viable (or living) organisms in treated ballast water for the purpose of determining compliance or non-compliance with a discharge standard.

2.2 Ambient challenge water: ambient water that meets the challenge water criteria without augmentation or concentration.

2.3 Ambient water: water from a natural, local source.

2.4 Challenge water: water used to test a CMD which meets specific criteria for water quality and organism diversity as described in paragraphs 6.9 to 6.16 of this protocol.

2.5 False negative: a test result declared negative, where it is in fact positive.

2.6 False positive: a test result declared positive, where it is in fact negative.

2.7 Field test: a practicability test to assess the ability of the device to work under real-life conditions, including a demonstration of producing accurate and reliable results in an onboard environment or the location of the intended use of the device. It is designed around the intended use of the device. Parameters included within the field test are assessed within a shipboard environment and/or at locations appropriate to the stated intended use and application of the device.

2.8 Negative control: any well-characterized material or substance that, when tested by a specific procedure, demonstrates the suitability of the procedure to yield a reproducible, appropriately negative, non-reactive or minimal response in the test system.

2.9 Positive control: any well-characterized material or substance that, when tested by a specific procedure, demonstrates the suitability of the procedure to yield a reproducible, appropriately positive or reactive response in the test system.

2.10 Prepared challenge water: water (from any source) that is augmented to meet the challenge water criteria.

2.11 Calibration standard: sample containing the analyte of interest at a known concentration either purchased from an external source or prepared in-house from materials of known purity or concentration, or both, and used to calibrate the measurement system.

2.12 Treated water: water that has been processed by a type-approved ballast water management system (BWMS) or by a process that replicates, as close as possible, the processes undertaken by a type-approved BWMS.

3 Introduction

3.1 The objective of this 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. These devices may be used for a variety of purposes: during commissioning testing of ballast water management systems, during port State control inspections, and during ships' self-monitoring. The protocol relies on laboratory and field tests conducted in accordance with standard test procedures such as those under development or published by the International Organization for Standardization; additional tests (e.g. vibration, humidity) may be carried out when applicable.

3.2 This protocol is applicable to the two designated size classes prescribed by the D-2 standard (organisms ≥ 50 µm; organisms ≥ 10 µm and < 50 µm) and to the group of specified indicator microbes (toxicogenic *Vibrio cholerae* (O1 and O139), *Escherichia coli* and intestinal enterococci). For consistency and brevity, these three items (i.e. the two-size classes and indicator microbes) are hereinafter called "groups of organisms".

3.3 CMDs can include various sensors, instruments, kits, methods and assays designed to measure the concentrations of organisms in ballast water to determine compliance with regulation D-2. Following collection, samples can be analysed in the laboratory, in the field (e.g. dockside), on board ships (e.g. hand-held or mobile units brought on board or that reside on board), or by in-line units integrated directly into a ship's ballast system or BWMS.

3.4 Any acknowledged or suspected chemical or physical factors affecting the device's efficacy, including any interactions due to the treatment technologies used to treat the ballast water (e.g. flow, bubbles) should be assessed and addressed as appropriate.

3.5 This protocol primarily intends to validate the device's ability to measure groups of organisms in ballast water, including, when such claims are made by the manufacturer, the ability to distinguish between viable and non-viable organisms. CMDs may consist of their own components and apparatus for preparing the sample for measurement, including, but not limited to, sample collection, filtering, sieving, incubation. Additional validation may be required for those functions if they are not integral to the CMD and sold as part of the device.

3.6 Depending on the intended use of the device, the manufacturers' claims and specifications may vary; as such CMDs may not measure all groups of organisms as described in paragraph 3.2, and may use differing measurement approaches (i.e. direct measurement comparable to the D-2 standard, indirect measurement not directly comparable to the performance standard or a binary "pass/fail" designation). This protocol is designed to determine devices' data quality, as well as the ability of devices to operate effectively within the environment they have been designed for use in. A CMD should be verified following this protocol only for the group(s) of organisms it is intended to quantify, as per the manufacturer's specifications. Likewise, if the manufacturer of a CMD indicates there are restrictions on its use (for example, it is intended only for use in fresh water), the device should be tested under the stated limiting conditions. Otherwise, it should be tested in accordance with the full matrix of laboratory and field testing, as described in sections 4 to 6 and shown in tables 1 and 2.

3.7 The diverse biological communities and water quality conditions required for BWMS certification testing should also be used to verify the performance of these devices. However, if specific variables are known or suspected to affect the performance of a device (e.g. water temperature, the ship's electrical noise or residual chemicals in ballast water), they should also be included as test parameters in verification testing.

3.8 All verifications of ballast water CMDs should be conducted by an independent, third-party testing entity (having implemented a rigorous quality assurance/quality control programme, e.g. in accordance with ISO/IEC 17025 or equivalent, that is approved, certified and audited by an independent accreditation body) and include expert review of specific test plans. The expert should be independent of the team involved in the verification of the CMD and have documented competences and experiences with knowledge and understanding of the enumeration of biological parameters and of the quality assurance approval of detailed analysis procedures being used as referenced in this protocol. The specific test plans/protocols and final reports should be approved by the testing entity.

3.9 For a given make and model of CMD, one unit should be randomly selected for testing, and the same unit should be used in all verification testing (laboratory and field), which should take place over several weeks to months.

3.10 BWMS that make use of ultraviolet irradiation (UV) or Active Substances have been identified as the two dominant technology types. These technology types are referred to throughout this protocol as the basis for ensuring the suitability of the CMD for use against the range of BWMS that may be encountered. It is acknowledged that new and novel BWMS technology types may be developed and as such consideration should be given to these new technologies when verifying a CMD for use with water treated by BWMS. The principles outlined within this protocol should be applied and any methods utilized to assess water treated by a novel BWMS technology type should be consistent with the aims and purpose of this protocol.

3.11 When considering the verification of a novel CMD, benchmarking against standard reference methods (direct counts), similar to the approach detailed in the *Procedure for approving other methods of ballast water management in accordance with regulation B-3.7 of the BWM Convention* (resolution MEPC.206(62), as may be amended), should be adopted. Any deviation from this protocol should be described and an equivalent level of confidence in the verification of the CMD ensured based on the parameters outlined in section 4.

3.12 Where the protocol references a standard that is not directly related to the verification of compliance monitoring devices, those undertaking the verification should refer only to the sections of the referenced standard that are relevant to the process or methodology that is being referred to in this protocol. It should be noted that a range of standards may be relevant to the methods in this protocol and could be considered appropriate for use. Where this protocol references a standard, other equivalent standards may be used or referred to in place of the referenced document.

4 Verification testing parameters

4.1 This protocol is designed to evaluate the performance or capability of a CMD to detect non-compliance with the performance standard within the performance claims of the device manufacturer. The CMD is evaluated as suitable or appropriate for its final use (i.e. detection of non-compliance with the performance standard) if the verification criteria listed in paragraph 8.4 are fulfilled.

4.2 At a minimum, the performance of a given make and model of a CMD should be verified based on measures of the following parameters under varying conditions that represent the device's intended use. The minimum parameters are described in this section and in tables 1 and 2.

4.3 Trueness – A measure of the closeness of agreement between a value obtained from a series of test results and an agreed reference standard value under multiple salinities, communities and concentrations of organisms, and other water quality parameters that may influence device performance (e.g. temperature, optical clarity). For these verifications, the trueness of the CMD should be determined in controlled laboratory tests and field tests. Repeated comparisons between a device's measurements and a reference standard (described below) should be completed; a minimum of three replicate test measurements at each test condition type, or the appropriate level of replication to ensure statistical confidence, are needed.

4.4 Precision – A measure of the repeatability of a measurement. The precision of an individual device should be determined under controlled laboratory tests. The standard deviation should be calculated from a minimum of 10 consecutive measurements of a reference solution under stable conditions (or the appropriate level of replication to ensure statistical confidence). This process should be repeated for multiple relevant conditions. For example, if the CMD claims to measure concentrations of organisms at the D-2 standard, then precision should be measured at a concentration similar to the performance standard.

4.5 Detection limits (also known as quantification limits) – The instrument or method detection limit of an individual device is the lowest (and, if applicable, the highest) value that can be detected with an acceptable level of confidence. Detection limits should be determined in controlled laboratory tests by quantifying the signal-to-noise ratio. Here, repeated (minimum of three, or the appropriate level of replication to ensure statistical confidence) measurements are made at low concentrations (at and below the D-2 standard) and of blanks (known zero), and the minimum concentration at which the known value can be quantified with a signal-to-noise ratio of 10:1 is determined.

4.6 Reliability – The ability to maintain integrity or stability of the CMD and data collection over time. Reliability of instruments should be determined in two ways from the data collected during all laboratory and field tests. First, comparisons should be made of the percentage of data points collected as a proportion of the data that the device was intended to have collected over a set period of time. Second, the percentage of time, and total number of times, that the device operated/functioned as designed without interruption or non-scheduled maintenance, calibration or repair should be reported. Comments on the physical condition of the device (e.g. physical damage, flooding, corrosion, battery failure, etc.) should also be recorded. Instruments should be tested and used in accordance with the manufacturers' instructions for calibration, operation and maintenance, and the reliability should be determined considering these time periods. When applicable, e.g. for in-line devices in continuous use, direct measures to assess drift over time should be collected.

4.7 Aspects of usability/vulnerability – the degree to which the CMD is fit for its intended use within the environments it is likely to encounter. Table 2 outlines the parameters that may form a part of the usability and vulnerability assessments which may be determined through field and laboratory testing. Unless the CMD is being verified against usability claims made by the manufacturer, the assessment is subjective in its nature and as such qualitative assessments of the CMD's performance can be used to provide an indication of the usability of the device.

5 Reference standard and verification protocol

5.1 While the true concentration of viable organisms in discharged ballast water is often unknown, accepted detailed analysis methods for quantifying viable organism concentrations are available. Methods used in type approving BWMS and identified in the *Code for Approval of Ballast Water Management Systems* (BWMS Code, resolution MEPC.300(72), as may be amended) and the *Guidance on methodologies that may be used for enumerating viable organisms* (BWM.2/Circ.61/Rev.1, as may be amended) should be used. When determining a suitable reference standard for use in verifying the performance of the CMD, consideration should be given to those identified within the BWMS Code. There is a range of available reference standards, each with associated uncertainties, and not all reference standards will be applicable to every device.

5.2 To maximize both the value and the harmonization of device testing, individual verification protocols should:

.1 be drafted separately for each specific type, or make and model, of CMD (e.g. to enumerate the group(s) of organisms the device is intended to quantify);

.2 be based on existing and accepted practices for instrument and method testing; and

.3 include independent expert review of test protocols.

6 Experimental design

6.1 Tests should be conducted in laboratory and field settings. All tests should be conducted (1) with sample volumes consistent with those required by the CMD and (2) with representative samples of the group(s) of organisms intended to be quantified by the device.

6.2 The range of tests undertaken should be designed to verify the ability of the CMD, taking into consideration the claims made by the manufacturer, including any limitations to the scope of the device's operation, to assess non-compliance with regulation D-2 of the BWM Convention. The experimental design should assess any claims made by the manufacturer with regard to interactions between the device and the treatment technologies being used to produce the treated water.

6.3 The laboratory tests should consist of tests using both treated and untreated water, such that the CMD is tested against samples with high and low organism concentrations, including a mixture of live and dead individuals in the same sample. The samples used for laboratory tests should be collected from a natural water source, containing a mix of ambient aquatic organisms (natural assemblages). The untreated test water should meet the salinity, dissolved organic carbon (DOC), particulate organic carbon (POC) and total suspended solid (TSS) thresholds for each of the three salinities (as prescribed in the BWMS Code) in which the device is to be verified (table 1). Where ambient water is unable to meet the set challenge criteria, the ambient water can be concentrated or augmented to achieve the minimum criteria, at which point the challenge water becomes "prepared challenge water"; therefore, ambient challenge water can only be used if it meets the set challenge criteria without concentration or augmentation. The organism concentrations may be adjusted to ensure a robust mix of species and an adequate range of organism concentrations to bracket the D-2 standard (described below).

6.4 The device should be tested as per the manufacturer's claims; however, where no claims are stated with regard to treatment technology interactions or suitability to address potential interferences caused by the treatment technology, the device should be tested with UV-treated challenge water and with challenge water treated using the most commonly used active substance. The treated water used should reflect typical treatment dosages as used in type-approved, commercially available BWMS. If no manufacturer claims are made and the previously mentioned testing is completed, the use of UV and most common active substance should be clearly stated in the CMD test report.

6.5 The field tests are practicability tests undertaken to assess the ability of the device to work under real-life conditions, including a demonstration of producing true and reliable results in an onboard environment or at the location of the intended use of the device. They should be designed around the intended use of the device. The parameters against which the CMD is assessed should include, but not be limited to, those detailed in table 2, as is appropriate to the intended use of the device. Field tests are undertaken within a shipboard environment and/or at locations appropriate to the stated intended use and application of the device. During field tests, treated discharged water from a functioning BWMS (with no manipulation or augmentation) should be tested. Where the intended use of the CMD does not include a shipboard environment, treated water, appropriate to the environment associated with the intended use of the CMD, should be tested.

6.6 During both laboratory and field tests any treated water used should be produced by a type-approved BWMS and the provenance (type of treatment, holding times, dosages, etc.) of the treated water should be documented. If a type-approved BWMS is not used to produce the treated water used during testing, reasons for this should be explained and the treatment of the water should replicate, as close as possible, the processes undertaken by a BWMS.

Reference standards

6.7 In all tests (laboratory and field), the results of the CMD should be compared to an accepted reference method using direct counts for enumerating viable organisms that is relevant to the device being tested, as described in section 5.

6.8 For each analysis day or group of analyses, the results of the CMD should be validated by a positive control (ISO 10993-10:2010) or a calibration through a calibration standard (ASTM D1129), and a negative control (ISO 10993-10:2010).

Laboratory tests using prepared challenge water

6.9 The use of local ambient organisms is favoured but laboratory cultures of organisms of the appropriate size and species variety and diversity may be used in order to ensure the appropriate level of organism concentration and "challenge" or to improve the diversity of organisms present. The addition of cultured organisms is also considered acceptable when the number of organisms present, before and/or after the treatment of the prepared challenge water, is close to the detection limits or standard thresholds of the device. For consistency at a given laboratory, healthy ambient or cultures of organisms (e.g. phytoplankton cultures in exponential growth phase) should be used, and a minimum of three diverse species (e.g. from three higher taxa) should be tested together in a mixture.

6.10 In order to ensure a sufficient level of challenge, when using cultured organisms, the following should be considered: (i) diversity of species used (minimum three species), representing all groups of organisms that the CMD is designed for; (ii) the resistance of organisms to treatment; (iii) organism concentrations; and (iv) whether the ratio of organisms

should reflect natural/harbour waters. The BWMS Code requirements for challenge water should be referred to. If cultured test organisms are used, local applicable quarantine regulations should be taken into consideration during culturing and discharge.

6.11 It is appreciated that laboratory testing with cultures of toxicogenic strains of *Vibrio cholerae* is challenging and requires specific safety and handling conditions and procedures. However, if the CMD is designed to quantify toxicogenic *V. cholerae*, prepared challenge water laboratory testing is critical, since toxicogenic *V. cholerae* are rarely found in ambient waters or during shipboard type approval testing.

6.12 For each group of organisms, a dilution series should be created using filtered seawater or fresh water with the appropriate salinity. The dilution process should be completed following an internationally accepted standard. Each dilution series should have at least three, but preferably five, concentrations of organisms, with the concentrations created by diluting or concentrating the organism mix so that the dilution series brackets above and below the discharge standard. This step, and all other steps in preparing the challenge water, should be done carefully to minimize organism mortality and loss. The highest concentration of organisms should be at least 5x greater than the discharge standard (to ensure linearity measurements for devices that do not have pass/fail outputs). The verification report should state all organism concentrations tested.

6.13 The DOC, POC and TSS should be adjusted in the challenge water to meet the minimum thresholds in the BWMS Code for a given salinity. Temperature should not be manipulated, but it should be measured and reported.

6.14 The treated water should be prepared from the challenge water, as described above. If testing with two treatment technology types, as opposed to testing against the claims made by the manufacturer, if it is not possible to test one of those two treatment types in the laboratory, the treatment type not tested in the laboratory should be tested during field tests.

Laboratory tests using ambient challenge water

6.15 Ambient challenge water should not be manipulated to dilute or concentrate organisms, or manipulate temperature, salinity, DOC, POC and TSS. While these parameters should be measured and reported, ambient challenge water should simply be natural concentrations of organisms and natural conditions of physical and chemical parameters.

6.16 To characterize the ambient challenge water, it should be analysed for the concentration and taxonomic composition of organisms. That is, species should be identified to the lowest possible taxonomic level, e.g. species, genus or family. Recognizing that devices may have species-specific biases, the purpose of this step is to demonstrate the diversity of organisms that are quantified by the CMD by using waters containing various organisms. This step should be done using an accepted method or microscopy; it is not intended to be performed with the CMD.

Field tests

6.17 When verifying trueness and reliability during field tests:

.1 at least three tests should be conducted with treated discharged water from a functioning and type-approved BWMS (the type of treatment should be reported) (see paragraph 2.7 for definition or paragraph 6.5 for field test criteria). The three tests should be conducted on separate ballast water

samples having variability in water quality parameters (e.g. different salinity or organism assemblages). In this type of testing, measurements of intake water are not required;

.2 the treated discharged water should be analysed for the concentration and taxonomic composition of organisms as in paragraph 6.16 and the reliability of the CMD should be evaluated for use under real-world conditions; and

.3 in the three field tests, only trueness (table 2) and reliability (paragraph 6.7) should be quantified, under conditions of the device's intended use.

6.18 To assess the practicability of the CMD, field tests should ensure that the device is able to operate in the static and dynamic conditions that may be experienced on board a ship or, as appropriate, the location of the intended use of the device. To assess the suitability of the device, the aspects of usability parameters that form the field test should be identified depending on whether the device is designed to be portable or to be a permanent installation. Parameters may be tested in situ on board a ship or, as appropriate, at the location of the intended use of the device, e.g. operability and readability of the device in a real-life situation, or within a laboratory, e.g. intrinsic safety, vibration testing, waterproof testing. The matrix of field test parameters (table 2) may be used as a basis for identifying parameters that should be assessed.

6.19 Where applicable, field test parameters should be assessed against any success criteria set and/or claims made by the manufacturer.

6.20 When assessing aspects of usability, it is acknowledged that some are subjective assessments of the device's practicability for use within its intended environment. These subjective assessments should only be used as an indicator for the practicability of the device's use as different users will have differing needs with regard to the usability aspects of a device, for example the need for two people to carry the equipment should not necessarily lead to a "fail".

6.21 When reporting on the outcome of these tests, the environmental conditions under which the tests were conducted should be recorded and commented on within the test report. The report should also include problems that occurred, along with any maintenance/repair information to help assess reliability and usability.

6.22 The results of this assessment should be used in order to provide an indication of the device's suitability within the location of the intended use of the device.

Ancillary data

6.23 At a minimum, water temperature, salinity (or conductance), pH and TSS should be measured in all laboratory and field tests. If possible, DOC and POC should be measured, as well as any other additional water quality parameters that are suspected to influence the performance of the CMD.

6.24 If the CMD performance claims are limited to monitoring treated water from specific BWMS technology types, this should be specified.

6.25 The evaluation of treated discharges should consider the effect of chemical/physical interferences, as applicable.

6.26 Verification testing should include evaluation of false positives and/or negatives.

Trueness, precision and detection limits

6.27 For these three parameters, the conditions for the laboratory tests and field tests are shown in tables 1 and 2 below. In all cases, the measurement/assessment of organism concentration that is collected by the CMD should be compared to the reference standard, and the appropriate statistical analysis should be conducted. Note that, if the manufacturer claims the CMD can measure concentrations well below the discharge standard, additional dilutions may be needed.

6.28 The measurements used to determine precision and detection limits (the last two rows of table 1) may be taken from the samples prepared for trueness testing, thereby reducing the total number of tests.

6.29 The applicable ISO standards should be used when determining trueness and precision.

Reliability tests

6.30 The reliability of the CMD should be determined as in paragraph 4.6 using data collected in all tests and specifically under the conditions of intended use (e.g. controlled laboratory bench top, field conditions on board a ship). First, reliability should be calculated as the percentage of data points collected as a proportion of the data that the device was intended to have collected over a given period of time. Second, reliability should also be calculated as the percentage of time, and total number of times, that the device operated as designed for each sample tested without interruption or requiring non-scheduled maintenance, calibration or repair. Third, the physical condition of the device (e.g. any physical damage, flooding, corrosion, battery failure) should be documented (e.g. with notes and photographs) and reported.

6.31 An applicable internationally recognized standard should be used when determining reliability.

Testing for viable/non-viable organisms

6.32 If a manufacturer claims that the CMD is able to distinguish between viable and non-viable organisms, this should be assessed using the appropriate methodology for the device being tested. Methods that may be employed to quantify viable organism concentrations have been provided within the BWMS Code.

Additional tests

6.33 The research and development stage of the device design should have ensured the suitability of the equipment for the environment in which its use is intended. Assessment or verification of product design considerations, including standard principles when considering the use of a piece of equipment for the shipboard environment, i.e. intrinsic safety, waterproofing, temperature tolerance, vibration, humidity, power supply consistency, robustness/durability of the CMD, etc., is required.

Parameter	Test type	Salinity	Minimum replicate measurements per group of organisms								
			Microbes			≥ 10 and < 50 µm			≥ 50 µm		
Trueness	Untreated prepared challenge water	Fresh	<DS n≥3	≈DS n≥3	>DS n≥3	<DS n≥3	≈DS n≥3	>DS n≥3	<DS n≥3	≈DS n≥3	>DS n≥3
		Brackish	<DS n≥3	≈DS n≥3	>DS n≥3	<DS n≥3	≈DS n≥3	>DS n≥3	<DS n≥3	≈DS n≥3	>DS n≥3
		Marine	<DS n≥3	≈DS n≥3	>DS n≥3	<DS n≥3	≈DS n≥3	>DS n≥3	<DS n≥3	≈DS n≥3	>DS n≥3
	Untreated ambient challenge water	Fresh	n≥3			n≥3			n≥3		
		Brackish	n≥3			n≥3			n≥3		
		Marine	n≥3			n≥3			n≥3		
	Treated water (for each tested technology type)	Fresh	n≥3			n≥3			n≥3		
		Brackish	n≥3			n≥3			n≥3		
		Marine	n≥3			n≥3			n≥3		
Precision	Prepared challenge water (treated and untreated)	1 salinity (different from the detection limits test)	Against the manufacturer's claims n≥10								
Detection limits	Prepared challenge water (treated and untreated)	1 salinity (different from the precision test)	Against the manufacturer's minimum and maximum claims n≥3								

Table 1: Matrix of verification tests for ballast water compliance monitoring devices

Note 1: The range of tests undertaken should reflect any claims made by the manufacturer; the full suite of tests represented by this table is only needed for a device that claims to (1) quantify all groups of organisms in the D-2 performance standard and (2) operate in all three salinities.

Note 2: Trueness testing is only needed for either prepared or ambient challenge water (as applicable) and treated water.

Note 3: The table indicates the minimum recommended level of replication that is needed for a statistically robust analysis.

Note 4: For the tests to calculate trueness and detection limits, the bracketing of the performance (discharge) standard is represented by <DS, ≈DS, and >DS to indicate below, approximately equal to, and above the discharge standard, respectively.

Note 5: Salinity ranges are to be as follows: fresh (<1 PSU), brackish (10-20 PSU), marine (28-36 PSU).

Table 2: Field test parameter matrix

Location of intended use / **Parameter**	On board a ship		Other
	Portable	Permanently installed	
Trueness according to the claim of the manufacturer, ≥3 replicates	✓	✓	✓
Reliability according to the claim of the manufacturer, ≥3 replicates	✓	✓	✓
Aspects of usability			
Is the device easy to set up for taking a measurement?	✓	-	(✓)
Can the display be easily read (with respect to light conditions, contrast, brightness, reflections, vibrations and temperature)?	✓	(✓)	✓
Is the device easy to transport to the location of use (weight, size, shape, volume)?	✓	-	(✓)
Is the device easy to operate (buttons, menu dialogues, command dialogues, user guidance)?	✓	✓	✓
Does the device have adequate power supply for taking measurements at the location of use (battery conditions, power consumption, battery life)?	✓	✓	✓
Other usability aspects	(✓)	(✓)	(✓)
Are the measurement outputs tamper-proof?	✓	✓	✓
Is the device easy to maintain?	✓	✓	✓
Vulnerability with respect to environmental aspects			
Humidity (display failure, electrical fault, etc.)	✓*	✓	(✓)
Vibrations (electrical fault, etc.)	✓*	✓	(✓)
Air temperature (result drift, display failure, battery life, etc.)	✓*	✓	(✓)

✓ = General requirement (✓) = If applicable - = Not applicable
* = Required but results from the research and development stage of the device design (paragraph 6.33) may be substituted

7 Data and quality management

7.1 The independent testing entity should follow standard/accepted data management and analysis procedures. For example, data logs should be recorded throughout testing, copied, or duplicated and archived daily. The datasheets should be signed by the analyst upon completion, verified by a quality officer and stored until the data are manually logged into a

digital file. Data reported by the CMD should be manually transcribed on formatted data sheets and, if applicable, logged by the device itself. Additionally, data from other analyses should be recorded in standard formats, such as data-collection forms, bound and paginated laboratory and field notebooks, spreadsheets and electronic data files.

7.2 Specific data analyses should be conducted as prescribed in individual device test plans. For example, trueness should be measured relative to the reference method using a standard approach (e.g. per cent difference), and precision should be measured as the variation among replicate readings and subsamples.

7.3 All testing should occur at facilities with a rigorous quality assurance/quality control programme for laboratory activities (such as ISO/IEC 17025) that has been approved, certified and audited by an independent accreditation body. A test plan and standard operating procedures should be followed while conducting all tests.

7.4 The test plan should include procedures to ensure quality results, as appropriate.

7.5 For at least one randomly chosen subsample per test, two analysts should aliquot, distribute, process and analyse the same sample using the CMD. Readings differing by ≤ 25% are considered within typical variation. Likewise, the variation of the reference method used should be quantified and reported in this manner.

8 Reporting

Test report

8.1 The test report should:

.1 include the following elements:

.1 a statement of verification;

.2 an executive summary;

.3 a description of the technology undergoing verification;

.4 details of the test design for laboratory and field tests (as applicable); and

.5 annexes to provide additional information or data;

.2 include the specific information, where applicable, outlined in the example verification reporting format in the annex to this protocol;

.3 follow the format provided in the annex to this protocol; and

.4 be made available to the public.

8.2 A list of CMDs that have been verified in accordance with this protocol can be found at https://bwema.org. Any CMD manufacturers who wish their verified equipment to be included in this list should provide the relevant information via the URL above.

Verification criteria

8.3 A CMD being verified as a valid CMD by this testing protocol should assure the end users that the CMD is able to function as claimed. If performance is poor, troubleshooting may be required.

8.4 For this purpose, a list of verification success criteria should be provided by the manufacturer and agreed as appropriate by the testing facility. This list should include, as a minimum, the criteria below, which the CMD should, as a minimum, be able to meet:

.1 precision (repeatability): it might be assessed as the coefficient of variance (CV). A CV of less than 25% is considered as acceptable, while a CV of less than 10% indicates excellent repeatability;

.2 reliability: it might be assessed as the percentage of data recovered compared to the data that the device was intended to have collected over a set period of time. A per cent value >90% is considered as acceptable. Comments on the physical condition of the device (e.g. physical damage, flooding, corrosion, battery failure) should also be recorded. Instruments should be tested and used in accordance with the manufacturers' instructions for calibration, operation and maintenance; and

.3 agreement between CMD results and detailed analysis results: at least 80% of the CMD results should be in agreement with the conclusion given by the corresponding detailed analysis results regarding the results being in compliance or not with the D-2 discharge standard.

8.5 The measurement uncertainty (ISO TS 21748:2010) for both detailed and indicative analysis should be quantified, reported and taken into consideration for the comparison.

9 References

ASTM D1129 Standard Terminology Relating to Water

BWM.2/Circ.61/Rev.1 *2022 Guidance on methodologies that may be used for enumerating viable organisms*

International Convention for the Control and Management of Ships' Ballast Water and Sediments, 2004

ISO/IEC 17025 Testing and calibration laboratories

ISO 10993-10:2010 Tests for irritation and skin sensitization

ISO 21748:2010 Guidance for the use of repeatability, reproducibility and trueness estimates in measurement uncertainty estimation

MEPC.206(62) *Procedure for approving other methods of ballast water management in accordance with regulation B-3.7 of the BWM Convention*

MEPC.300(72) *Code for Approval of Ballast Water Management Systems*

ANNEX

VERIFICATION REPORT

The verification report should include, as applicable, the following information:

1 Statement of verification

A clear statement declaring whether or not the device passed (or failed) all verification tests to the agreed standard, including the type of evaluation(s) undertaken (laboratory, field testing or both) and any limitations of the device and its operation.

This section should also include:

- the name of the organization or individual making the statement of verification;
- the date and location at which verification was confirmed;
- the name of the organization providing testing facilities (if different than the organization making the statement);
- a description (manufacturer name, make and model) of the device that has been verified;
- details of any limitations of the verification (BWMS technology, organism sizes, deviations from verification criteria in paragraph 8.4); and
- a statement that the report is freely available to the public.

2 Executive summary

A high-level overview of the verification criteria tests undertaken, the objectives of the tests, the results gained and conclusions drawn.

3 Description of technology

Details of the device undergoing verification. This should include:

- manufacturer;
- model, including serial number and software version number (as applicable);
- operational claims made by the manufacturer; and
- limitations declared by the manufacturer.

4 Test design

This section should outline the objectives of the tests undertaken and include details of the criteria, including any claims made by the manufacturer, against which the device was tested. The experimental design and methodologies used should be described and relevant information provided as required to indicate adherence to this protocol. The following information is required:

- **Laboratory testing**

  - Name of testing organization(s) and any lead or primary personnel
  - Test facility accreditation status and standards, quality assurance and quality control programme(s) as a list and/or table of contents
  - Details of the calibration status of equipment used during testing, including details of certificates and calibration intervals
  - Location and dates of tests
  - Details of the tests undertaken, including descriptions of all verification criteria used and levels of replication
  - Information regarding challenge and ambient water used for testing, including:
    - Source and location of ambient water
    - Volumes used for testing
    - Water quality parameters analysed (including water temperature, salinity, DOC, POC, TSS and any other additional water quality parameters identified in the experimental design)
    - Description of biological community in the test water (organism size, diversity and relative abundances)
    - Details of any augmentation or concentration methods, including any natural organism assemblages (i.e. ≥50 µm or ≥10 to <50 µm) or cultured organisms added (i.e. species used)

  - Details of treated water
    - BWMS make and model or process used to produce treated water (as applicable)
    - Treatment type, including details of active substance type, as applicable
    - Water quality parameters analysed (including water temperature, salinity, DOC, POC, TSS and any other additional water quality parameters identified in the experimental design)
    - Applied treatment doses

  - Sample collection and processing methods in line with paragraph 6.1 of this protocol, including volumes collected, handling prior to analysis (i.e. condition of transportation and holding times) and volumes of samples used for analysis
  - Details of reference methods used
  - References to any applied standards
  - Details of failures or unexpected results or scenarios and actions taken
  - Results / outcomes for parameters as required by the protocol or claimed by the manufacturer
  - Discussion, including any implications of any findings
  - Conclusions

- **Field testing**

  - Name of testing organization(s) and any lead or primary personnel
  - Details of facility accreditation status and standards, quality assurance and quality control programme(s) as a list and/or table of contents
  - Details of the calibration status of equipment used during testing
  - Location(s), date(s) and ship(s) from which samples were taken
  - Location, date and time that tests were undertaken
  - Details of ballast water origin, including
    - Source location

        - Details of the BWMS type and model
        - Whether or not ballast water exchange has taken place
        - Description of biological community in the sample(s) (organism size, diversity and relative abundances)
        - Water quality parameters analysed (including water temperature, salinity, DOC, POC, TSS and any other additional water quality parameters identified in the experimental design)
    - Sample collection and processing methods, in line with paragraph 6.1 of this protocol, including volumes collected, handling prior to analysis (i.e. condition of transportation, storage conditions such as temperature and light shielding property and holding times) and volumes of samples used for analysis
    - Details of the tests undertaken, including descriptions of all verification criteria used and levels of replication
    - Details of reference methods used
    - References to any applied standards
    - Treated water quality parameters (e.g. temperature, salinity, DOC, POC, TSS, organisms present)
    - Environmental conditions including air temperature, water temperature, humidity, vibration, salinity, pH, TSS and any other additional water quality parameters that are suspected to influence the performance of the CMD
    - An assessment of the aspects of usability and vulnerability of the device, including any operational or technological factors as detailed in the protocol, including photographs
    - Details of failures, unexpected results or scenarios, or deviations from standard operating procedures and actions taken
    - Condition of the device, including any damage, wear and tear, battery status, software failures or any notable observations resulting from use of the device during field tests (including photographic evidence)
    - Results/outcomes for parameters as required by the protocol or claimed by the manufacturer
    - Discussion, including any implications of any findings
    - Conclusions

Annexes

Additional information to support the detail provided within the body of the verification report should include:

- Quality assurance/quality control documentation as a list and including details of how documentation can be accessed; this should include a URL that provides direct access to the documentation
- Standard operating procedures, either in full or as a list of documents that can be provided upon request
- Details of the calibration of the CMD
- Raw data
- Data logged by the device (as applicable)
- Any sample and sample handling guidelines
- Instructions/operating manual for device use, as provided by the manufacturer

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BWM.2/Circ.79
14 July 2023

INTERNATIONAL CONVENTION FOR THE CONTROL AND MANAGEMENT OF SHIPS' BALLAST WATER AND SEDIMENTS, 2004

Convention Review Plan for the experience-building phase associated with the BWM Convention

1 The Marine Environment Protection Committee (MEPC), at its seventy-first session (3 to 7 July 2017), adopted resolution MEPC.290(71), establishing the experience-building phase associated with the BWM Convention (EBP), to allow the Marine Environment Protection Committee to monitor and improve the *International Convention for the Control and Management of Ships' Ballast Water and Sediments, 2004*, in three stages: data gathering, data analysis and Convention review.

2 MEPC 72 (9 to 13 April 2018) approved the *Data gathering and analysis plan for the experience-building phase associated with the BWM Convention* (BWM.2/Circ.67), and MEPC 74 (13 to 17 May 2019) approved a revision of the plan (BWM.2/Circ.67/Rev.1).

3 MEPC 78 (6 to 10 June 2022), having considered the data analysis report on the EBP and a proposal to develop a Convention Review Plan, agreed in principle to develop a BWM Convention Review Plan (CRP) and established a Correspondence Group to finalize the CRP.

4 MEPC 80 (3 to 7 July 2023), having considered the report of the Correspondence Group, approved the BWM Convention Review Plan as set out in the annex.

5 Member Governments and international organizations are encouraged to use the annexed plan to guide the holistic review of the BWM Convention which was agreed as part of the EBP.

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ANNEX

CONVENTION REVIEW PLAN FOR THE EXPERIENCE-BUILDING PHASE ASSOCIATED WITH THE BWM CONVENTION

1 Overview of the experience-building phase

1.1 On 7 July 2017, the Marine Environment Protection Committee (the Committee) established the experience-building phase associated with the BWM Convention (EBP) through resolution MEPC.290(71). The annex to this resolution set out the structure of the EBP, whose purpose is to allow the Committee to monitor and improve the *International Convention for the Control and Management of Ships' Ballast Water and Sediments, 2004* (the Convention).

1.2 The EBP consists of a data gathering stage, a data analysis stage and a Convention review stage. The EBP began with the entry into force of the Convention and ends with the entry into force of a package of priority amendments. The priority amendments are those that implement improvements to the Convention needed before the end of non-penalization measures specific to the EBP that are set out in resolution MEPC.290(71). Aside from these non-penalization measures, the EBP does not alter the basic roles, responsibilities, obligations and recommendations under the Convention, its guidelines and relevant guidance.

1.3 The Committee subsequently adopted BWM.2/Circ.67/Rev.1 containing a data gathering and analysis plan (DGAP) for the EBP. The circular set out specific arrangements for data gathering, as well as principles and organizational arrangements for analysing the data collected. With the submission of the data analysis report (MEPC 78/4/1) the data gathering and analysis stages of the EBP have been completed.

1.4 This Convention Review Plan (CRP) picks up where the DGAP left off by laying out the Committee's work plan for the remainder of the EBP. It includes a revised timeline that reflects the challenges posed by the COVID-19 pandemic and the heavy workload of the Committee relating to other matters of importance to the marine environment. Although the DGAP has been completed, it is still considered appropriate for any further information and data to be submitted to the Committee for consideration during the Convention review stage of the EBP.

2 Organizational arrangements

2.1 The Ballast Water Review Group (BWRG) should meet at each session of the Committee during the EBP. The BWRG will consider the analysis report and will be the primary forum for discussion during the Convention review stage, preparing the necessary materials and recommendations for the Committee's consideration. The BWRG should also continue to undertake reviews in accordance with regulation D-5 of the Convention during the EBP.

2.2 Recognizing the significant time constraints faced by the Committee due to its heavy workload, and the uncertain timing of returning to in-person meetings due to the COVID-19 pandemic, the work of the BWRG should be supported by a correspondence group (CG), preferably coordinated by the BWRG Chair.

3 Conducting the Convention review

3.1 The purpose of the Convention review stage is for the Committee to recommend to the Parties a package of amendments to the Convention and its instruments. The Convention review stage will develop amendments through a systematic and evidence-based approach, based on the data gathering and analysis report developed earlier in the EBP, and ensure that amendments are developed holistically, taking into account any inconsistencies or ambiguities, through an objective, transparent and inclusive approach. In addition to the data gathering and analysis report, the review may consider any further information or data submitted to the Committee and as such interested parties are encouraged to collect and submit such information, provided that any such submission is in line with the timeline proposed in section 6.

3.2 General steps for the Convention review were set out in paragraph 18 of resolution MEPC.290(71). More specifically, the Convention review should proceed through the following sequence:

.1 finalization of this Convention Review Plan, including agreed principles for the review, and the evidence-based list of issues with the Convention, highlighting those priority issues that need to be addressed before the end of the EBP (and its associated non-penalization arrangements);

.2 discussion of approaches to resolving priority issues on a holistic basis, guided by the principles for the review, resulting in agreement to objectives for amending specific Convention provisions and/or instruments, if appropriate;

.3 determination of whether any amendments to Convention provisions should be adopted under article 19(2) or 19(3), taking into account the scope of amendments and the workload of the Committee, and stocktaking of the timeline as appropriate;

.4 drafting of the package of specific amendments to Convention provisions and instruments in line with the objectives agreed at step 2; and

.5 recommendation of the package of amendments to the Committee for approval, as well as the proposed approach for addressing any remaining non-priority issues following the conclusion of the EBP.

3.3 An anticipated timeline for the Convention review is set out in section 6.

Trial period for reviewing, improving and standardizing guidance for ballast water sampling and analysis

3.4 Recognizing a lack of agreed standard methods and/or accepted procedures for sampling and analysing ballast water for compliance, MEPC adopted certain methods and approaches for trial use* with a view to eventual incorporation into the port State control (PSC) guidelines (resolution MEPC.252(67)). The EBP includes this trial, with the goal of developing a suite of accepted procedures that can be used for sampling and analysing ballast water in a globally consistent way.

* Reference is made to the *Guidance on ballast water sampling and analysis for trial use in accordance with the BWM Convention and Guidelines (G2)* (circular BWM.2/Circ.42/Rev.2, as may be revised) and to the agreement in principle of MEPC with respect to the trial period (paragraph 2.43.2 of document MEPC 65/22).

3.5 The DGAP envisioned the finalization of these procedures during the Convention review stage, based on the EBP's data gathering and analysis. At least one agreed standard method for indicative and detailed analysis of organisms at each size class is desired.

3.6 In developing the list of priority issues for the Convention review (section 5), the BWRG will consider the results of the trial period and implementation experience gained, recalling the Committee's agreement that the PSC guidelines be kept under review after the trial period and in the light of experience gained with their application (see operative paragraph 3 of resolution MEPC.252(67)).

4 Principles for the Convention review

4.1 In reviewing the Convention, the Committee decided through resolution MEPC.290(71) to give due consideration to matters such as the policy goals of the Convention, any challenges identified in its implementation and the considerations outlined in regulation D-5 of the Convention.

4.2 Furthermore, in identifying and addressing issues during the Convention review, the following principles should also be taken into account:

.1 the review should continue the development of the Convention and its instruments, in line with article 2(5), to prevent, minimize and ultimately eliminate the transfer of harmful aquatic organisms and pathogens through the control and management of ships' ballast water and sediments, and article 2(6), to endeavour not to impair or damage the environment, human health, property or resources;

.2 the Convention and its instruments should continue to promote the development of suitable methods for the management of ballast water and sediments, including the development of robust ballast water management systems (BWMS) suitable for challenging conditions in worldwide operations;

.3 with respect to ships that opt to meet the performance standard by using a BWMS, the Convention and its instruments should continue to encourage and promote the development, selection, installation, operation and maintenance of BWMS appropriate and suitable to the operational profile of the ship;

.4 while the objectives of the Convention cannot be met without impact to ship operations, the review should be undertaken with a view to minimizing unintended consequences and impacts;

.5 the principle of proportionality (e.g. the number of ships affected by challenges) and the considerations in regulation D-5.2 should inform the review of the Convention and its instruments; and

.6 the review presents an opportunity to rationalize and improve key control points, with a view to improving the clarity and effectiveness of the Convention.

5 Prioritization of issues to be addressed through the Convention review

5.1 The table in the annex lists the identified issues, including priority issues that should be addressed before the end of the non-penalization measures specific to the EBP. Non-priority issues may be addressed during the EBP, if time frames and resources allow, or after the EBP. Issues have been identified based upon the principles outlined in section 4.

5.2 Priority issues are those that need to be addressed before the non-penalization measures specific to the EBP end. When determining if an issue should be considered as 'priority', the principles of the Convention review (section 4) and the following points should be taken into consideration:

.1 has the issue been identified by the report of the data gathering and analysis phase of the EBP (MEPC 78/4/1) or otherwise been evidenced and identified to the Committee (e.g. MEPC 78/4/10 and MEPC 78/4/11)?

.2 does the identified issue impact upon a mandatory requirement of the Convention (the legal status (or lack of) of the issue) and/or whether there is the need for existing instruments or proposed solutions to be made mandatory?

.3 the extent to which any actions taken in response to the issue may facilitate compliance with the Convention while adhering to the aims and intent of the Convention;

.4 any evidence or experience of the scale, impact and/or consequences (to the environment, human health, property or resources) if the issue is not resolved or of the proposed action(s);

.5 any evidence or experience of the scale, impact and/or consequences of the issue on ship operations if it remains unresolved; and

.6 whether the issue can be addressed as a part of a holistic approach to amending the Convention (issues that may be addressed in isolation may be given a lower priority and addressed outside of the EBP).

5.3 The contents of the table in the annex may be amended during the Convention review process on the basis of new developments, information or data or on direction by the Committee. The form of the table used to propose additional issues to the Committee is shown as table 1.

Table 1: Form of the table for proposing additional issues

	Issue	Relevant provisions and instruments	Relevant IMO documents	Priority issue? (Y/N)	Justification for prioritization
1.	Issue A	- Regulation V - Guideline W - Guidance X - Resolution Y - Circular Z	-	YES / NO	
	…	…			…

6 Timeline for the Convention review

Meeting	Time frame	Activity
MEPC 80	Summer 2023	- targeted policy discussions as recommended by the CG - adopt the final CRP, including principles and priority issues - holistic discussion of approaches to resolving priority issues - re-establish the CG to define specific objectives for changes to identified Convention provisions and/or instruments
MEPC 81	Spring 2024	- holistic discussion of approaches to resolving priority issues - targeted policy discussions as recommended by the CG - adopt objectives for changes to specific Convention provisions and/or instruments, or agree to the need for new provisions and/or instruments, to address the issues in the annex - re-establish the CG to begin drafting text of amendments
MEPC 82	Autumn 2024	- targeted discussions as recommended by the CG - determine if any amendments should be adopted under article 19(2) or 19(3), and revise timeline if needed - continued work by the CG with a view to drafting of amendments to provisions and/or instruments
MEPC 83	Spring 2025	- targeted discussions as recommended by the CG - re-establish the CG with a view to completing drafting of priority amendments, and to developing an approach to addressing any remaining non-priority issues after the EBP
MEPC 84	Spring 2026	- targeted discussions as recommended by the CG - approval of the package of amendments - determine approach to addressing any remaining non-priority issues
MEPC 85	Autumn 2026	- drafting group - adoption of amendments to provisions and/or instruments

ANNEX

TABLE OF ISSUES TO BE ADDRESSED

Issue number	Issue	Priority issue (Y/N)
1	How to improve the performance and reliability of BWMS to increase compliance to the D-2 standard	Y
2	Lack of approved sampling and analysis methods usable in a PSC context limits the ability of the port State in establishing whether ships are in compliance with the D-2 standard	Y
3	Verification of the performance of BWMS outside of PSC is inconsistent	Y
4	How should crossover / confusion / overlap issues between Conventions be addressed?	N
5	Mechanisms for ship compliance in circumstances in which a BWMS installed on a ship may not be suitable for the intended specific voyage or operations to be undertaken	Y
6	Mechanisms for ship compliance in cases of BWMS failure need to be agreed to ensure the aims of the Convention are maintained in all situations	Y
7	Mechanisms for ship compliance in situations other than BWMS failure or challenging water quality need to be agreed to ensure the aims of the Convention are maintained in all situations	Y
8	BWMS may become temporarily inoperable when encountering challenging water quality	Y
9	The current type approval process does not support modifications to BWMS	Y
10	Mechanisms within the Convention for ensuring that a BWMS is kept in working order should be improved	Y
11	Sampling of ballast water discharges managed by in-service BWMS indicates that the discharges do not consistently meet the D-2 standard	Y
12	The Convention's minimum requirements for Ballast Water Management Plans do not cover all items necessary for smooth implementation and compliance (e.g. contingency measures, including ballast water exchange) and there is no requirement to keep the plan up to date	Y
13	Sampling of ballast water discharges managed by in-service BWMS that use active substances indicates that the discharges do not consistently meet the maximum allowable discharge concentrations allowed under Procedure (G9)	Y
14	Operational challenges, maintenance challenges, or preventable BWMS failures are occurring owing to a lack of familiarity with the equipment	Y

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INTERNATIONAL CONVENTION FOR THE CONTROL AND MANAGEMENT OF SHIPS' BALLAST WATER AND SEDIMENTS, 2004

Guidance on ballast water record-keeping and reporting

1 The Marine Environment Protection Committee, at its eightieth session (3 to 7 July 2023) approved the *Guidance on ballast water record-keeping and reporting* to assist in bringing clarity to the record-keeping and reporting process under the BWM Convention, including guidance on completing the Ballast Water Record Book, an updated example ballast water reporting form and an example form for voluntary tank-by-tank logging of ballast water operations, as set out in the annex.

2 Member Governments are invited to bring this Guidance to the attention of all parties concerned.

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ANNEX

GUIDANCE ON BALLAST WATER RECORD-KEEPING AND REPORTING

Table of contents

1 Purpose

1.1 The first part of this document (section 2, Ballast Water Record Book), which is intended for ship crews, explains how ballast water operations should be recorded by making mandatory entries in the Ballast Water Record Book (BWRB). These records are required by the Convention. These records may also assist the ship in properly implementing its Ballast Water Management Plan and in operating and maintaining any ballast water management system (BWMS) that is being used.

1.2 The second part (section 3, Ballast water reporting form), intended for ship crews and port States, contains an example ballast water reporting form (BWRF) together with instructions for completing it. A BWRF may be submitted prior to entry into a port State that requires specific information regarding the management of ballast water on ships bound for its ports, offshore terminals or anchorage areas.

1.3 The third part (section 4, Voluntary tank-by-tank log), intended for ship crews, explains how to maintain voluntary tank-by-tank records of ballast water operations that may facilitate completion of a BWRF by allowing the crew to efficiently track the contents of each tank and hold that carries ballast water. Maintaining these voluntary records may also assist the ship in documenting and demonstrating that the requirements of the Convention have been met.

2 Ballast Water Record Book

2.1 Introduction

2.1.1 Regulation B-2 of the BWM Convention establishes mandatory requirements for maintaining a BWRB on board the ship, and appendix II of the Annex to the Convention specifies the information that must be included.

2.1.2 The BWRB may be inspected in the port or offshore terminal of a Party by officers duly authorized to inspect the ship for the purpose of determining compliance with the Convention.

2.1.3 The following sections explain when to record operations in the BWRB, how to record these operations (including standardized formats that should be used for smooth record-keeping and inspections) and how the records should be stored. Example entries are provided in appendix 1 to demonstrate how various ballast water operations and circumstances should be recorded in the BWRB.

2.2 When to record operations in the Ballast Water Record Book

2.2.1 Each operation concerning ballast water shall be fully recorded chronologically as per completion without delay in the Ballast Water Record Book (regulation B-2.5).

2.2.2 In the event of the discharge of ballast water pursuant to regulations A-3 (exceptions), A-4 (exemptions), B-3.6 (ballast water discharged to a reception facility) or B-3.7 (other methods of ballast water management that are approved in principle by the Committee) or in the event of other accidental discharge/ingress or other exceptional uptake or discharge of ballast water not otherwise exempted by this Convention, an entry shall be made in the Ballast Water Record Book describing the circumstances of, and the reason for, the discharge.

2.2.3 If ballast water exchange is not undertaken for the reasons in regulation B-4 this shall be recorded, in accordance with regulation B-4.5.

2.2.4 Record all failures or inoperabilities of the ballast water management system in the Ballast Water Record Book under Code F. If the failure or inoperability is not immediately resolved, a second Code F entry should later be recorded when the BWMS is rectified and made operational.

2.2.5 Exemptions granted under regulation A-4 and any additional measures under regulation C-1 shall be recorded in the Ballast Water Record Book under item Code H. (regulation A-4.4)

2.2.6 For tankers, ballast taken into heavy weather Cargo Oil Tanks is considered as exceptional ballast as described in regulation 18.3 of MARPOL Annex I and would be recorded in both the Oil Record Book part II and in the Ballast Water Record Book.

2.2.7 Ships should take the following guidance into account in selecting code letters to reflect ballasting operations:

.1 During a typical uptake or discharge operation, any ballast water treatment should be noted under Code A or Code B as appropriate. It is not necessary to enter Codes C1 or C2 to reflect this treatment.

.2 A ballast water exchange operation should be entered using Code C1 (noting any ballast water treatment applied). It is not necessary to enter Codes A and B in conjunction with ballast water exchange.

.3 Code C2 should be used when treatment occurs independently from an uptake or discharge (e.g. in-tank treatment, or treatment during circulation between tanks).

.4 Ballast water internal transfer operations for the purpose of list/trim/stability of the ship involving similarly managed water should be recorded under Code H in the Ballast Water Record Book as the quantity in the tanks have changed.

2.3 How to record operations in the Ballast Water Record Book

2.3.1 When making entries, write the date in dd-MMM-yyyy format (e.g. 01-JUN-2022). If the operations cross over the dates, then the entry should be made after completion of the operation and the start date can be mentioned as: - Start 1900 hrs (UTC) (hhmm SMT) on 01-JAN-2023 and Completion at 0100 hrs (UTC) (hhmm SMT) on 02-JAN-2023.

2.3.2 Enter the appropriate code and item number in the respective columns.

2.3.3 Enter all times using the Coordinated Universal Time (UTC) and Ship's Mean Time (SMT).

2.3.4 Record the ballast tank nomenclature as per the diagram corresponding to the Ballast Water Management Plan that forms a part of the Ballast Water Record Book.

2.3.5 Enter the port names using the proper standardized UN/LOCODE. If the UN/LOCODE is not available, or an offshore terminal or anchorage area is entered, write out Port Name and Country in full. No abbreviation should be used.

2.3.6 Enter the location position in the degrees, minutes and seconds format (example: Lat: 00 00.00 N/S, Long: 000 00.00 E/W).

2.3.7 Under the item "Ballast water treatment method" enter any treatment applied to the water during the specific operation being recorded. No prior treatment or intended future treatment should be recorded. If more than one method applies (e.g. partial treatment) then multiple entries should be made, each pertaining to the relevant volume. The following notations should be used:

.1 "Approved BWMS";

.2 "Prototype BWMS"; and

.3 "Regulation B-3.7", in the case of other methods of ballast water management approved in principle by the Committee in accordance with that regulation.

2.3.8 "None. (regulation A-4)", in the case of exemptions granted in accordance with that regulation.

2.3.9 "None, as per BWMS design", in the case no treatment is necessary during uptake or discharge because of the design of the BWMS (e.g. a BWMS that does not treat during discharge, or a BWMS where the treatment takes place in the tank).
2.3.10 "None. (regulation B-3)" if the ship is not yet required to meet the standard in regulation D-2.

2.3.11 "None" and specify the reason, in other cases where no treatment is performed (e.g. BWMS bypass).

2.3.12 There should not be blank lines between successive entries.

2.3.13 In the case of a ship subject to equivalent compliance under regulation A-5 that is required by its Administration to keep records of each ballast water operation, the information specified in this guidance should be taken into account.

2.3.14 The entries in the Ballast Water Record Book shall be in a working language of the ship. If that language is not English, French or Spanish, the entries shall contain a translation into one of those languages. When entries in an official national language of the State whose flag the ship is entitled to fly are also used, these shall prevail in case of a dispute or discrepancy. (regulation B-2.5)

2.3.15 Each entry shall be signed by the officer in charge of the operation concerned and each completed page shall be signed by the master. (regulation B-2.5)

2.3.16 Incorrect entries should be struck through with a single line in such a way that the wrong entry is still legible. The incorrect entry should be signed and dated and followed by the correct entry.

2.3.17 Entries pertaining to an earlier missed operation should be completed as per example 25.

2.4 Storage of information

2.4.1 The Ballast Water Record Book shall be maintained on board the ship for a minimum period of two years after the last entry has been made and thereafter in the Company's control for a minimum period of three years. (regulation B-2.2)

2.4.2 The Ballast Water Record Book shall be kept readily available for inspection at all reasonable times and, in the case of an unmanned ship under tow, may be kept on the towing ship. (regulation B-2.4)

2.4.3 In addition to the Ballast Water Record Book, further tank-wise entries can be made in the ballast water log voluntarily to complement it accordingly. Keeping tank-by-tank records of ballast water operations may assist the ship crews in completing any ballast water reporting form that may be required by a port State, demonstrating that entries in the Ballast Water Record Book reflect the actual ballast water situation during any inspection, and implementing the Ballast Water Management Plan more efficiently through more specific knowledge of current tank contents.

2.4.4 Officers duly authorized by a Party may inspect the Ballast Water Record Book on board any ship to which this regulation applies while the ship is in its port or offshore terminal, and may make a copy of any entry, and require the master to certify that the copy is a true copy. Any copy so certified shall be admissible in any judicial proceeding as evidence of the

facts stated in the entry. The inspection of a Ballast Water Record Book and the taking of a certified copy shall be performed as expeditiously as possible without causing the ship to be unduly delayed. (regulation B-2.6)

3 Ballast water reporting form

3.1 Introduction

3.1.1 As noted above, a BWRF may be submitted prior to entry into a port State that requires specific information regarding the management of ballast water on ships bound for its ports, offshore terminals, or anchorage areas.

3.1.2 Although individual port State forms may vary owing to national requirements and circumstances, port States are invited to align their forms with the example BWRF set out in appendix 2 as much as possible. Doing so will reduce the administrative burden on ships. Port States are also invited to use fillable PDF forms or online reporting systems to facilitate the submission of BWRFs.

3.1.3 The example form allows for the collection and transmission of relevant information that will assist the port State and the ship in efficiently and effectively communicating the situation on board, as well as the ship's intentions. A completed form will:

.1 positively identify the ship, the owner, the ISM Company, the agent and the officer on board completing the report, to facilitate communications with port State authorities;

.2 convey relevant voyage information, including the ship's intended arrival port and date, as well as the last port and future ports, if known;

.3 summarize the current ballast water situation on board the ship relative to its ballast water capacity, including ballast tanks and any holds that may be in use for ballasting purposes;

.4 summarize the ship's ballast water management approach, including management actions taken on water to be discharged, any available contingency methods (should they be needed), and key information on the ship's status with respect to survey and certification to assist the port State in assessing the status of the ship; and

.5 include an appendix identifying the origin, management and discharge intentions for each tank to allow the port State to assess the risk posed by the water.

3.1.4 Ships that regularly submit BWRFs to port States may find it practical and efficient to maintain records of ballast water operations on a tank-by-tank basis. A form to facilitate this record-keeping is provided in appendix 3 and discussed in section 4 of this guidance.

3.2 Completing the example ballast water reporting form

3.2.1 Write dates in the dd-MMM-yyyy format (e.g. 01-JUN-2022).

3.2.2 Enter times using Coordinated Universal Time (UTC).

3.2.3 Section 1. Ship information:

.1 Ship name: Enter the name of the ship. In case of tug and barge operation (pull, push, sideway or an articulated tug and barge), enter both ship names, separated by a hyphen (-). Do not add prefixes or suffixes such as "M/V" (Motor Vessel), "M/S" (Motor Ship) or "T/S" (Tanker Ship / Tall Ship);

.2 Flag: Enter the full name of the State or Territory whose flag the ship is flying at the time of the BWRF submission. Do not use abbreviation;

.3 MMSI Number: Enter the ship's Maritime Mobile Service Identify (MMSI number);

.4 Distinctive Numbers/Letters or Call Sign: Enter the ship's Official Number or Call Sign. If no Official Number exists for the ship, enter other identification number;

.5 Owner: Enter the name of the registered owner(s) of the ship. If under charter, enter the name of the operator;

.6 ISM Company name and number: Enter the name of the Company as defined under the *International Convention for the Safety of Life at Sea*, chapter IX-1, and *International Safety Management Code* and its Identification Number, conforming to the IMO Unique Company and Registered Owner Identification Number Scheme;

.7 Gross tonnage: Enter the gross tonnage of the ship as established under the *International Convention on Tonnage Measurement of Ships, 1969* or any successor Convention. In case of tug and barge combinations, enter the gross tonnage of each ship, separated by a hyphen (-); and

.8 Date of construction: Enter the date of construction as defined in regulation A-1.

3.2.4 Section 2. Voyage Information:

.1 Enter ports using the proper UN/LOCODE for standardization and to avoid errors (https://unece.org/trade/cefact/unlocode-code-list-country-and-territory). If UN/LOCODE is not available, write out port, State/province, and country in full. No abbreviation should be used.

3.2.5 Section 3. Ballast water usage and capacity:

.1 Enter the total volume of ballast water on board and the number of ballast tanks and cargo holds with ballast water upon arrival at the "Arrival port" indicated in section 2; and

.2 Enter the total ballast water capacity as per the ship's Ballast Water Management Plan including the maximum volume of ballast water which can be carried and the number of tanks and cargo holds designed to carry ballast water.

3.2.6 Section 4. Ballast water management:

.1 Indicate the principal ballast water management method(s) employed on the ship. "In accordance with regulation D-1" refers to the exchange of ballast water to meet the ballast water exchange standard. "In accordance with regulation D-2" refers to the treatment of ballast water using an IMO-approved ballast water management system to meet the ballast water performance standard. "Subjected to regulation D-4" refers to the use of a prototype ballast water treatment technology approved by the Administration under regulation D-4. If an "other method" of ballast water management approved in principle by the Committee is used in accordance with regulation B-3.7, describe the method. Multiple items may be checked off, if applicable;

.2 Enter the number of tanks and holds with ballast water that will be discharged for the current planned trip by ballast water management method. If other ballast water management method has been used, describe the method and state the reason;

.3 If the ship is equipped with a ballast water management system, provide the name of the manufacturer and the model of the system. Indicate whether the ballast water management system was fully operational during the management of all treated ballast tanks/holds. Indicate when the ballast water management system was last partially or fully bypassed by entering the last bypass date, if any;

.4 If ballast water has not been exchanged or treated in accordance with regulation B-3, state the reason. For countries that use an electronic form, a drop-down list with the following options may be used:

.1 regulation A-4 exemption;

.2 equipment failure;

.3 regulatory exemption;

.4 ship design limit;

.5 adverse weather; and

.6 other (describe);

.5 Provide information on the Ballast Water Management Plan, including any contingency measures(s) in the appropriate fields. Provide descriptions if a contingency measure other than ballast water exchange in accordance with regulation D-1 is planned. Multiple items may be checked off, if applicable;

.6 Indicate if an interface is available on the ship for coupling to a ballast water reception facility as a contingency measure;

.7 Provide information on the Ballast Water Record Book and the International Ballast Water Management Certificate or equivalent document in the appropriate fields;

.8 Provide the name of the authority (e.g. flag State authority or recognized organization) that issued the International Ballast Water Management Certificate or equivalent document;

.9 Provide the date of the last intermediate, annual, or any other additional endorsement as per the Convention; and

.10 Provide the name of the authority (e.g. flag State authority or recognized organization) that performed the last survey.

3.2.7 Section 5 and appendix. Ballast water history:

.1 Enter the name and the identifier of the ship as well as the arrival date in case the page gets separated from the previous page of the form in a printed copy;

.2 Record information for each ballast water tank/hold across the page listing the original source(s) of the ballast water under "BW source" prior to any ballast water management, all management events under "BW management practices", and all planned discharge events under "Proposed BW discharge";

.3 Tanks/holds: List all ballast tanks and holds separately (e.g. port and starboard tanks should be on separate rows). Use tank codes as indicated on the form. List multiple ballast water sources for the same tank on separate lines. Include empty tanks/holds and those containing only residual ballast water and sediments*;

.4 Current volume: Enter the volume of ballast water in tank on arrival at the "Arrival port" indicated in section 2;

.5 Under "BW management practices", complete columns with an asterisk (*) only if exchange or saltwater flushing has been conducted as per regulation B-4 and paragraph 1.3.2 of part A of the Guidelines (G4), respectively;

.6 % Exchange: If exchange or saltwater flushing has been conducted, calculate the percentage of tanks volumetric capacity used to exchange. % Exchange can be calculated by dividing the total volume of water moved by "Sequential" or "Flow-through" or used in "Saltwater flushing" by the capacity of ballast tank or hold, then multiply by 100;

.7 Min. depth (m): If exchange or saltwater flushing has been conducted, enter the minimum depth in metres during the ballast water exchange or flushing;

.8 Indicate the ballast water management method(s) used. For countries that use an electronic form, a drop-down list with the following options may be used:

.1 DE = Dilution exchange;

.2 SE = Sequential exchange;

.3 FE = Flow-through exchange;

* Residual ballast water and sediments refers to any ballast water and sediments that cannot be removed from a ballast tank using the equipment installed on the ship for that purpose.

.4 SWF = Saltwater flushing;

.5 OT = Onboard treatment;

.6 PBU = Uptake from port-based facility;

.7 PRF = Discharge to port reception facility; and

.8 NM = No management; and

.9 If no discharges are planned for the current trip, fields under "Proposed BW discharge" are to remain blank.

3.2.8 Section 6. Responsible officer

.1 Provide information on the responsible officer, including name, title, and contact information.

4 Voluntary tank-by-tank log

4.1 Introduction

4.1.1 Tank-by-tank logs are not required by the Convention. However, keeping tank-by-tank logs is recommended as a best practice to assist in:

.1 completing any BWRF that may be required by a port State;

.2 demonstrating that entries in the BWRB reflect the actual ballast water situation on board during any inspection; and

.3 implementing the Ballast Water Management Plan more efficiently through more specific knowledge of current tank contents.

4.1.2 The tank-by-tank log format in appendix 3 has been developed to efficiently capture the essential information needed to complete the example BWRF set out in this guidance.

4.2 Completing the tank-by-tank log

4.2.1 Complete a ballast water log for each tank.

4.2.2 Enter ports using the proper UN/LOCODE for standardization and to avoid errors (https://unece.org/trade/cefact/unlocode-code-list-country-and-territory). If UN/LOCODE is not available, write out port, State/province, and country in full. No abbreviation should be used.

4.2.3 Write dates in the dd-MMM-yyyy format (e.g. 01-JUN-2022).

4.2.4 Enter times using Coordinated Universal Time (UTC).

4.2.5 Enter ship name, ship identifier, tank identifier and tank capacity in the appropriate fields.

4.2.6 Record information for each ballast water operation across the page listing the date, location or position, start time, minimum depth (if operations took place outside of port), all applicable volumes under "Volume" in cubic metres, end time, the salinity of the ballast water after ballast operation was completed in PSU, ballast water management method(s) used, and any remarks.

4.2.7 Record one operation per row in chronological order. Record all applicable volumes associated with one operation in a single row. For example, if approximately 1,000 cubic metres of ballast water are loaded into an empty tank and treated in a single operation then enter a single row with 0 for the initial content, 1,000 for the estimated uptake from the sea, 1,000 for the estimated volume treated and 1,000 for the final content.

APPENDIX 1

GUIDANCE FOR COMPLETING THE BALLAST WATER RECORD BOOK

SAMPLE ENTRIES IN THE BALLAST WATER RECORD BOOK

Code A - When ballast water is taken on board (ballasting operation)

(A) When ballast water is taken on board from the aquatic environment (ballasting operation)

.1 Start time and location (port of uptake or latitude/longitude)

.2 Completion time and location (port of uptake or latitude/longitude and minimum depth of water during uptake)

.3 The identity of the tanks affected

.4 Estimated volume of uptake and final total quantity retained in cubic metres

.5 Whether conducted in accordance with the approved Ballast Water Management Plan

.6 Ballast water treatment method

Example 1: When ballast water is taken on board (ballasting operation) – at port

Date	Code (letter)	Item (number)	Record of operations/signature of officer in charge
02-JAN-2023	A	1	Start - 0900 hrs (UTC) (hhmm SMT) on 01-JAN-2023 at BE ANR (UN/LOCODE or port name)
		2	Completion - 0600 hrs (UTC) (hhmm SMT) on 02-JAN-2023 at BE ANR
		3	3P, 3S, 4P and 4S BW tanks
		4	Uptake 6800 m3. Final quantity retained: 7200 m3
		5	Yes. Ballasting as per BWMP for D-2 compliance
		6	Approved BWMS
			Signed---------- Name ----------Rank----------

Example 2: When ballast water is taken on board (ballasting operation) – at sea

Date	Code (letter)	Item (number)	Record of operations / signature of officer in charge
01-JAN-2023	A	1	Start - 0900 hrs (UTC) (hhmm SMT) at Lat xx xx.xx N / Long yyy yy.yy E
		2	Completion - 1800 hrs (UTC) (hhmm SMT) at Lat xx xx.xx N / Long yyy yy.yy E at 350 m minimum depth
		3	3P, 3S, 4P and 4S
		4	Uptake 6800 m3. Final quantity retained: 7200 m3
		5	Yes. Ballasting as per BWMP for D-2 compliance
		6	Approved BWMS
			Signed---------- Name ----------Rank----------

Notes for examples 1 and 2:

1. A ship required to meet the D-1 standard that loads ballast water without treatment in accordance with the BWMP should record "Yes. Ballasting done as per the BWMP for D-1 compliance" in item 5 and "None" in item 6. When the ship later carries out a ballast water exchange, this should be recorded under code C.

2. The examples 1 and 2 consider the new intake water of 6,800 m^3 taken in tanks having existing treated water of 400 m^3. Mixing of treated water with untreated water will result in the full load being considered as unmanaged.

3. In case the ship has to take in unmanaged ballast water, item 5 should state "No", item 6 should state "None" and the reason should be given.

Example 3: When ballast water is taken on board (ballasting operation) – at port (or sea) on board ships employing in-tank or in-voyage treatment in accordance with the approved Ballast Water Management Plan

Date	Code (letter)	Item (number)	Record of operations/signature of officer in charge
02-JAN-2023	A	1	Start - 0900 hrs (UTC) (hhmm SMT) on 01-JAN-2023 at UN/LOCODE or port name or Lat/Long
		2	Completion - 0600 hrs (UTC) (hhmm SMT) on 02-JAN-2023 at UN/LOCODE or port name or Lat / Long
		3	3P, 3S, 4P and 4S
		4	Uptake 6800 m3. Final quantity retained: 7200 m3
		5	Yes. Ballasting as per BWMP for D-2 compliance
		6	None. As per BWMS design
			Signed---------- Name ----------Rank----------

Notes for example 3:

.1 BWMS employing "in-tank" treatment load in ballast directly into the tank without any treatment. At the point of uptake, entry to be made as per example 3. Item 6 must state "None. As per BWMS design".

.2 Subsequently the ship must make entry as per example 10 when carrying out the in-tank or circulation using code C 2

Code B

(B) When ballast water is discharged into the aquatic environment (deballasting operation)

.1 Start time and location (port of discharge or latitude/longitude)

.2 Completion time and location (port of discharge or latitude/longitude and minimum depth of water during discharge)

.3 The identity of the tanks affected

.4 Estimated volume of discharge and final total quantity retained in cubic metres

.5 Whether conducted in accordance with the approved Ballast Water Management Plan

.6 Ballast water treatment method

Example 4: When ballast water is discharged into the port (aquatic environment)

Date	Code (letter)	Item (number)	Record of operations / signature of officer in charge
01-JAN-2023	B	1	Start - 09:00 hrs (UTC) (hhmm SMT) at UN/LOCODE or port name
		2	Completion - 1800 hrs (UTC) (hhmm SMT) at UN/LOCODE or port name
		3	3P, 3S, 4P and 4S
		4	Discharged 6800 m3. Final quantity retained: 400 m3
		5	Yes. Deballasting as per BWMP for D-2 compliance
		6	Approved BWMS
			Signed---------- Name ----------Rank----------

Example 5: When ballast water managed as per BWMP is discharged into the sea (aquatic environment)

Date	Code (letter)	Item (number)	Record of operations/signature of officer in charge
01-JAN-2023	B	1	Start - 09:00 hrs (UTC) (hhmm SMT) at Lat /Long

Date	Code (letter)	Item (number)	Record of operations/signature of officer in charge
		2	Completion - 1800 hrs (UTC) (hhmm SMT) Lat /Long at minimum depth of 400 metres
		3	3P, 3S, 4P and 4S
		4	Discharged 6800 m3. Final quantity retained: 400 m3
		5	Yes. Deballasting as per BWMP for D-2 compliance
		6	Approved BWMS
			Signed---------- Name ----------Rank----------

Notes for examples 4 and 5

.1 For a D-1 certified ship, item 5 to be entered as "Yes. D-1 compliant" and item 6 to be entered as "No".

.2 Ships employing single pass treatment system (only on uptake) with no treatment during deballasting are to record "None, as per BWMS design" in item 6.

.3 Ships deballasting water managed under the contingency plan of the approved BWMP to record as per example 7.

Example 6: When ballast water not managed as per BWMP is discharged into the sea (aquatic environment)

Date	Code (letter)	Item (number)	Record of operations/signature of officer in charge
01-JAN-2023	B	1	Start - 09:00 hrs (UTC) (hhmm SMT) at Lat / Long
		2	Completion - 1800 hrs (UTC) (hhmm SMT) at Lat /Long at minimum depth of 400 metres
		3	3P, 3S, 4P and 4S
		4	Discharged 6800 m3. Final quantity retained: 400 m3
		5	No.
		6	None. State the reasons
			Signed---------- Name ----------Rank----------

Notes for example 6:

.1 For a D-1 certified ship, in case the ship has not carried out the exchange, item 5 to be recorded as "No." and item 6 as "None. [regulation B-3]".

.2 For a D-2 certified ship, in the event of discharge of semi / untreated water where the approved BWMP process is not followed, the deballasting event must be recorded with item 5 entered "No." and item 6 entered as "None" and state the reasons.

.3 Further, entry using code (F) or code (H) is required to be made (as applicable) preceding the above example 6 entry, stating the conditions leading to non-compliant discharge.

Example 7: When ballast water is discharged into the aquatic environment (e.g. at a port) which has been managed as per the contingency plan in the approved BWMP

Date	Code (letter)	Item (number)	Record of operations / signature of officer in charge
01-JAN-2023	B	1	Start - 0900 hrs (UTC) (hhmm SMT) at Lat /Long
		2	Completion - 1800 hrs (UTC) (hhmm SMT) at Lat /Long at minimum depth of 400 metres
		3	3P, 3S, 4P and 4S
		4	Discharged 6800 m3. Final quantity retained: 400 m3
		5	Yes. As per approved contingency plan
		6	Approved BWMS
			Signed---------- Name ----------Rank----------

Note for example 7:

.1 For a D-2 certified ship, only in case the ship has implemented contingency plan as per approved BWMP, item 5 to be recorded as "Yes. As per approved contingency plan" and item 6 as "Approved BWMS" (if applicable to the contingency plan procedure adopted).

Code C

(C) Whenever ballast water is exchanged, or treated in-tank or treated through internal circulation

1 Ballast water exchange

.1 Start time and location (latitude/longitude)

.2 Completion time and location (latitude/longitude)

.3 Minimum distance from the nearest land and minimum depth of water during the exchange or, if applicable, identify the designated exchange area in accordance with regulation B-4.2

.4 Whether conducted in accordance with the Ballast Water Management Plan and state the ballast water exchange method (sequential or flow-through or dilution) used

.5 The identity of the tanks affected

.6 Total quantity exchanged and final total quantity on board in cubic metres

.7 Treatment method for the incoming ballast water

Example 8: Whenever ballast water is exchanged (without any treatment)

Date	Code (letter)	Item (number)	Record of operations/signature of officer in charge
01-JAN-2023	C	1.1	Start - 0900 hrs (UTC) (hhmm SMT) at Lat /Long
		1.2	Completion - 1800 hrs (UTC) (hhmm SMT) at Lat /Long
		1.3	Minimum distance 840 nm and minimum depth 6500 metres
		1.4	Yes. Sequential method as approved in the BWMP
		1.5	2P, 2S, 3P, 3S, 4P and 4S
		1.6	Exchanged 7200 m3. Final quantity retained 7200 m3
		1.7	None
			Signed---------- Name ----------Rank----------

Example 9: Whenever ballast water is exchanged along with treatment using approved BWMS

Date	Code (letter)	Item (number)	Record of operations/signature of officer in charge
01-JAN-2023	C	1.1	Start - 0900 hrs (UTC) (hhmm SMT) at Lat /Long
		1.2	Completion - 1800 hrs (UTC) (hhmm SMT) at Lat /Long
		1.3	Minimum distance 840 nm and minimum depth 6500 metres
		1.4	Yes. Sequential method (as approved in the BWMP)
		1.5	2P, 2S, 3P, 3S, 4P and 4S
		1.6	Exchanged 7200 m3. Final quantity retained 7200 m3
		1.7	Approved BWMS
			Signed---------- Name ----------Rank----------

Notes for examples 8 and 9:

.1 The stated exchange method (dilution/sequential/flow-through) must be as per the approved Ballast Water Management Plan.

.2 The exchange along with treatment (BWE+BWT), if carried out as per the approved BWMP contingency plan, must be recorded using example 9 and if applicable reported to the concerned authorities prior to discharge of this water.

.3 In case of carrying out exchange at a designated area, state the "area name or Lat / Long" under item 1.3 and enter "designated area in accordance with regulation B-4.2" under item 1.4.

.4 In the event the ship is unable to carry out exchange owing to safety or operational issues, entry has to be made as per example 26.

.5 In case of a flow-through or dilution ballast water exchange as per approved Ballast Water Management Plan item 1.4 should state "yes flow-through or dilution (as appropriate) method (as approved in Ballast Water Management Plan)" and under 1.6 enter the total quantity exchanged and final quantity retained (example: "exchanged 22000 m^3 retained 7200m^3")

(C) 2 Ballast water internal circulation for treatment or in-tank treatment

.1 Start time

.2 Completion time

.3 The identity of the tanks affected (identifying source and destination tanks if applicable)

.4 Total quantity treated (through circulation or in tank) in cubic metres

.5 Ballast water treatment method

Example 10: Ballast water internal circulation for treatment using approved BWMS

Date	Code (letter)	Item (number)	Record of operations/signature of officer in charge
02-JAN-2023	C	2.1	Start - 0900 hrs (UTC) (hhmm SMT) on 01-JAN-2023
		2.2	Completion - 1800 hrs (UTC) (hhmm SMT) on 02-JAN-2023
		2.3	3P, 3S, 4P and 4S
		2.4	6800 m3 treated through circulation
		2.5	Approved BWMS
			Signed---------- Name ----------Rank----------

Notes for example 10:

.1 The above entry is applicable to the ships which circulate the water in the ballast tanks through the BWMS to achieve treatment. In such case there is no fresh intake or release of ballast water.

.2 Ships taking in water directly (bypassing BWMS) and subsequently carrying out treatment in tank or in voyage as per BWMP, are required to make entry as per example 3 after uptake and as per example 10 when the treatment of this water is carried out.

.3 Anti-heeling tank automatic operations of transfers of water for the purpose of list correction are not to be recorded under code C.

.4 The internal transfers between a set of ballast tanks having same quality of water (either managed or unmanaged) for which entries have already been made under code A or managed under code C are not to be recorded.

.5 In case of water being transferred into a tank not accounted under A 3 , C 1.5 or C 2.3, entry is required to be made under code C 2 with C 2.3 capturing the required details.

Code D

(D) Uptake or discharge of ballast water from/to a port-based or reception facility

.1 Start time and location of uptake/discharge (state facility name)

.2 Completion time

.3 Operation carried out (whether uptake or discharge)

.4 The identity of the tanks affected

.5 Total quantity in cubic metres and final quantity retained on board

.6 Whether conducted in accordance with the approved Ballast Water Management Plan

.7 Onboard ballast water treatment method

Example 11: Uptake of ballast water from a port-based or reception facility

Date	Code (letter)	Item (number)	Record of operations/signature of officer in charge
01-JAN-2023	D	1	Start - 0900 hrs (UTC) (hhmm SMT) from "facility / terminal name" at the Port of (insert UN/LOCODE)
		2	Completion - 1800 hrs (UTC) (hhmm SMT)
		3	Uptake
		4	1DB(P), 1DB(S), 2TST (P), 2TST (S) and Aft Peak Tank
		5	6800 m3. Final quantity retained 6800 m3
		6	Yes. Treated ballast water intake as per BWMP
		7	None.
			Signed---------- Name ----------Rank----------

Example 12: Discharge of ballast water to a port-based or reception facility

Date	Code (letter)	Item (number)	Record of operations/signature of officer in charge
01-JAN-2023	D	1	Start - 0900 hrs (UTC) (hhmm SMT) from "port-based/reception facility" at the Port of (insert UN/LOCODE)
		2	Stop - 1800 hrs SMT (UTC) (hhmm SMT)
		3	Discharge
		4	1DB(P), 1DB(S), 2TST (P), 2TST (S) and Aft Peak Tank
		5	6800 m^3. Total retained 0 m^3
		6	Yes. Discharged to port reception facility.
		7	None.
			Signed---------- Name ----------Rank----------

Notes for examples 11 and 12:

.1 The ship taking in ballast water from the port facility which is treated by the onboard BWMS prior to filling the ballast tanks is to enter item 7 as "Yes, approved BWMS" in example 11.

.2 The documents concerning the uptake / discharge of ballast water provided by the port-based or reception facility must be attached to the BWRB and must be readily available for inspection.

Code E

(E) Accidental discharge/ingress or other exceptional uptake or discharge of ballast water

.1 Start time and location of ingress/uptake/discharge (port name or latitude/longitude)

.2 Completion time

.3 Operation carried out (whether ingress, uptake or discharge)

.4 The identity of the tanks affected

.5 Total quantity of ballast water in cubic metres

.6 State the circumstances of ingress, uptake, discharge or loss, the reason thereof, any treatment method used and general remarks

Example 13: Accidental ingress of ballast water

Date	Code (letter)	Item (number)	Record of operations/signature of officer in charge
01-JAN-2023	E	1	Start - 0900 hrs (UTC) (hhmm SMT) at (insert port name / location)
		2	Completion - 1800 hrs (UTC) (hhmm SMT)
		3	Ingress of water into ballast tank
		4	Fore Peak Tank (FPT)
		5	450 m3
		6	Accidental ingress of water in forepeak ballast tank due to hull breach as a result of collision
			Signed---------- Name ----------Rank----------

Example 14: Accidental discharge of ballast water

Date	Code (letter)	Item (number)	Record of operations/signature of officer in charge
01-JAN-2023	E	1	Start - 0900 hrs (UTC) (hhmm SMT) at _____ (insert port name/location)
		2	Completion - 1000 hrs (UTC) (hhmm SMT)
		3	Discharge of water from ballast tank
		4	Fore Peak Tank (FPT)
		5	450 m^3

		6	Accidental discharge of water in forepeak ballast tank due to hull breach as a result of collision
			Signed---------- Name ----------Rank----------

Example 15: Exceptional uptake of ballast water

Date	Code (letter)	Item (number)	Record of operations/signature of officer in charge
01-JAN-2023	E	1	Start - 0900 hrs (UTC) (hhmm SMT) at _(insert port name/ location)
		2	Completion - 1200 hrs (UTC) (hhmm SMT)
		3	Uptake of water into ballast tank
		4	Aft Peak tank
		5	400 m^3
		6	Water taken into aft peak ballast tank to adjust trim, following an oil spill on deck
			Signed---------- Name ----------Rank----------

Notes for examples 13, 14 and 15:

.1 Accidental ingress or discharges are occurrences without human initiation. Water ingress or discharge (escape) due to collision, grounding, structural failures, valve or machinery failures are to be recorded under code E.

.2 Exceptional uptake or discharge are human initiated procedures undertaken in exceptional circumstances for the safety of the ship and prevention of pollution.

.3 Intake of shore-supplied untreated water into ballast tanks at a dry dock facility for the purpose of undocking of a ship should be considered as exceptional circumstance and entry recorded under code E.

Code F

(F) Failures and inoperabilities of the ballast water management system

.1 Time and location (port name or latitude/longitude) of failure of the ballast water management system

.2 Operation carried out (state whether uptake or discharge)

.3 Description of the issue (e.g. kind of alarm or other description of circumstances)

.4 Time and location (port name or latitude/longitude) when the ballast water management system has been made operational

Example 16: Failures of the ballast water management system that are repaired immediately

Date	Code (letter)	Item (number)	Record of operations/signature of officer in charge
01-JAN-2023	F	1	1100 hrs (UTC) (hhmm SMT) at the port of _____

		2	Uptake
		3	Xxxxxx sensor failure and BWMS plant shut down
		4	1500 hrs (UTC) (hhmm SMT) at the port of _____ the BWMS made operational
			Signed---------- Name ----------Rank----------

Example 17: Inoperabilities of the ballast water management system

Date	Code (letter)	Item (number)	Record of operations/signature of officer in charge
01-JAN-2023	F	1	1100 hrs (UTC) (hhmm SMT) at the Port of (UNLOCODE)
		2	Uptake
		3	Filter choked and high differential pressure trip due to muddy water
		4	No repair required
			Signed---------- Name ----------Rank----------

Notes for examples 16 and 17:

.1 Failures and inoperabilities include malfunctions, shutdowns or critical alarms indicating a failure of the ballast water management system which may indicate non-compliance with the D-2 standard (except routine information and warnings).

.2 In case the BWMS failure is not rectified immediately, the entry using code F / item 4 is to be made on the date when the BWMS is made operational.

.3 In the event of failure of the BWMS during ballasting or deballasting, the entry under code A or code B must be followed up by code F entry as per example 17.

.4 Inoperability of the BWMS due to challenging water conditions is required to be recorded under code F items 1, 2 and 3 with remark in item 3 clearly stating the alarms which are triggered owing to challenging water conditions.

Code G

(G) Ballast tank cleaning/flushing, removal and disposal of sediments

.1 Time and ship's location on commencement of ballast tank cleaning/flushing, removal or disposal of sediments (port name or latitude/longitude)

.2 Time and ship's location on completion of ballast tank cleaning/flushing, removal or disposal of sediments (port name or latitude/longitude)

.3 Tank(s) identification (name of the ballast tanks as per the Ballast Water Management Plan)

.4 Discharge or disposal to a reception facility (state quantity in cubic metres and name of the facility)

.5 Disposal or discharge to the aquatic environment as per Ballast Water Management Plan (state quantity in cubic metres, minimum distance from the nearest land in nm and minimum depth of water in metres)

Example 18: Ballast tank cleaning and discharge of sediments to reception facility / dry dock

Date	Code (letter)	Item (number)	Record of operations/signature of officer in charge
01-JAN-2023	G	1	1100 hrs (UTC) (hhmm SMT) at Port of (UN/LOCODE)
		2	1500 hrs (UTC) (hhmm SMT) at Port of (UN/LOCODE)
		3	1P, 1S, 2P, 2S, 3P and 3S
		4	10 m3 sediments disposed to "insert name" reception facility
			Signed---------- Name ----------Rank----------

Example 19: Ballast tank cleaning/flushing and disposal of sediments to aquatic environment (at sea)

Date	Code (letter)	Item (number)	Record of operations/signature of officer in charge
01-JAN-2023	G	1	1100 hrs (UTC) (hhmm SMT) at Lat xx xx.xx N / Long yyy yy.yy E
		2	1500 hrs (UTC) (hhmm SMT) at Lat xx xx.xx N / Long yyy yy.yy E
		3	3P and 3S
		5	100 m3 of tank flushing including sediments discharged to sea at minimum distance of 350 nm and minimum depth of 2800 m
			Signed---------- Name ----------Rank----------

Notes for examples 18 and 19:

.1 Sediment disposal receipt provided by shore/port reception facility or dry dock facility must be attached to the BWRB and must be available for inspections.

.2 In case of flushing of a tank with treated water, operation to be recorded under code G items 1, 2, 3 and 5 with comments in 5 stating that treated water was used to flush the tank.

Code H

(H) Additional operational procedures and general remarks

Example 20: Internal tank-to-tank ballast water transfers

Date	Code (letter)	Item (number)	Record of operations/signature of officer in charge
01-JAN-2023	H		200 m3 of ballast water transferred from 1P and 1S to 2P and 2S

			Signed---------- Name ----------Rank----------

Example 21: Sampling of ballast water during discharging

Date	Code (letter)	Item (number)	Record of operations/signature of officer in charge
01-JAN-2023	H		Ballast water sample taken during discharge operation at the port of "UN/LOCODE" by PSC
			Signed---------- Name ----------Rank----------

Example 22: Use of ballast water tank for non-ballast water purpose: taking out of operation

Date	Code (letter)	Item (number)	Record of operations/signature of officer in charge
01-JAN-2023	H		Aft peak ballast tank emptied and isolated from the ballast water pipe system for use of non-ballast purpose in accordance with BWMP. Valve # 123 sealed.
			Signed---------- Name ----------Rank----------

Example 23: Use of ballast water tank for non ballast water purpose: taking into operation

Date	Code (letter)	Item (number)	Record of operations/signature of officer in charge
01-JAN-2023	H		Aft Peak ballast tank cleaned / flushed and reconnected to ballast water system pipeline in accordance with BWMP. Valve # 123 unsealed
			Signed---------- Name ----------Rank----------

Example 24: Reporting to flag or port State of a failure of the BWMS

Date	Code (letter)	Item (number)	Record of operations/signature of officer in charge
01-JAN-2023	H		BWMS failure at hhmm (UTC) (hhmm SMT) on dd-MMM-yyyy informed flag State
			Signed---------- Name ----------Rank----------

Note for example 24:

.1 BWMS failures are recorded under code F. In case of reporting to flag or port State, above entry to be recorded and, if operations subsequently carried out as per contingency plan or as per advice from port/flag State, same to be recorded under applicable code/item.

Example 25: Entry pertaining to an earlier missed operational entry

Date	Code (letter)	Item (number)	Record of operations/signature of officer in charge
xx-MON-yyyy (Date 1)	H		Entry pertaining to an earlier missed operational entry

			Signed---------- Name ----------Rank----------
xx-MON-yyyy (Date 2)			(record the correct entry here)
			Signed---------- Name ----------Rank----------

Note for example 25:

.1 This entry is to be followed by the entry pertaining to the missed operation. The date 1 to be entered corresponding to the original date of operation and subsequent entry date 2 to be the current date.

Example 26: Ship unable to perform ballast water exchange owing to safety reasons, e.g. bad weather

Date	Code (letter)	Item (number)	Record of operations/signature of officer in charge
01-JAN-2023	H		Ship unable carry out BWE owing to …… (state reason)
			Port of call (Name port / country) informed
			Signed---------- Name ----------Rank----------

Note for example 26:

.1 This entry is to be made for safety (bad weather) or operational related issues (e.g. ship's route does not pass through areas where distance from nearest land is always more than 50 nm and / or 200 m depth or a designated BWE area).

Example 27 : Scenarios for making sequential entries in the ballast water record book

Scenario 1: Uptake and discharge of ballast water for a ship subject to regulation D-2

Date	Code (letter)	Item (number)	Record of operations/signature of officer in charge
01-JAN-2023	A	1	Start - 0900 hrs (UTC)(hhmm SMT) at BE ANR
		2	Completion – 1800 hrs (UTC) (hhmm SMT) at BE ANR
		3	3P, 3S, 4P and 4S
		4	Uptake 6800 m3. Final quantity retained: 7200 m3
		5	Yes. Ballasting as per BWMP for D-2 compliance
		6	Approved BWMS
			Signed---------- Name ----------Rank----------

07-JAN-2023	B	1	Start - 09:00 hrs (UTC) (hhmm SMT) at FR LEH
		2	Completion – 1800 hrs (UTC) (hhmm SMT) at FR LEH
		3	3P, 3S, 4P and 4S
		4	Discharged 6800 m3. Final quantity retained: 400 m3
		5	Yes. Deballasting as per BWMP for D-2 compliance

		6	Approved BWMS
			Signed---------- Name ----------Rank----------

Scenario 2: Uptake, exchange and discharge of ballast water for a ship subject to regulation D-1

Date	Code (letter)	Item (number)	Record of operations/signature of officer in charge
01-JAN-2023	A	1	Start - 0900 hrs (UTC) (hhmm SMT) at BE ANR
		2	Completion – 1800 hrs (UTC) (hhmm SMT) at BE ANR
		3	3P, 3S, 4P and 4S
		4	Uptake 6800 m3. Final quantity retained: 7200 m3
		5	Yes. Ballasting as per BWMP for D-1 compliance
		6	None
			Signed---------- Name ----------Rank----------

03-JAN-2023	C	1.1	Start – 0900 hrs (UTC) (hhmm SMT) at Lat / Long
		1.2	Completion –1800 hr (UTC) (hhmm SMT) at Lat / Long
		1.3	Minimum distance 840 nm and minimum depth 6500 metres
		1.4	Yes. Sequential method as approved in the BWMP
		1.5	3P, 3S, 4P and 4S
		1.6	Exchanged 7200 m3. Final quantity retained 7200 m3.
		1.7	None
			Signed---------- Name ----------Rank----------

07-JAN-2023	B	1	Start – 09:00 hrs (UTC) (hhmm SMT) at FR LEH
		2	Completion – 1800 hrs (UTC) (hhmm SMT) at FR LEH
		3	3P, 3S, 4P and 4S
		4	Discharged 6800 m3. Final quantity retained: 400 m3
		5	Yes. Deballasting as per BWMP for D-1 compliance
		6	None
			Signed---------- Name ----------Rank----------

APPENDIX 2

EXAMPLE BALLAST WATER REPORTING FORM

Date of submission (dd/MMM/yyyy): _____ Time of submission (24:00 UTC): _____ **Report type:** □ **New** □ **Amended**

1. SHIP INFORMATION		**2. VOYAGE INFORMATION**	**3. BALLAST WATER USAGE AND CAPACITY**			
Ship name:	Flag:	Arrival port UN/LOCODE (or port, State/province and country):				
IMO Number:	MMSI Number:	Arrival date (dd/MMM/yyyy):	Total ballast water on board:			
Distinctive Numbers/Letters or Call Sign:		Agent:	Volume	Units	No. of tanks in ballast	No. of holds in ballast
Owner:		Last port UN/LOCODE (or port, State/province and country):		m^3		
ISM Company name and number:		Next port UN/LOCODE (or port, State/province and country):	Total ballast water capacity:			
Type:	GT:	Next port (2) UN/LOCODE (or port, State/province and country):	Volume	Units	Total no. of ballast tanks	Total no. of holds
Date of construction (dd/MMM/yyyy):		Next port (3) UN/LOCODE (or port, State/province and country):		m^3		

4. BALLAST WATER MANAGEMENT

The principal ballast water management method(s) employed on this ship is/are:
□ in accordance with regulation D-1 □ in accordance with regulation D-2 (describe): _____
□ subject to regulation D-4 □ other approach in accordance with regulation (describe): _____

Total no. of ballast water tanks/holds to be discharged: ____

Of tanks/holds to be discharged, how many were managed in accordance with: Regulation D-1 ____ Regulation D-2 ____ Both regulations D-1 and D-2 ____
other method ____ (describe and state reason) _____ not managed ____

If any tanks/holds not managed, state reason(s) why not: _____

BWMS used, if any: Manufacturer: _____ Model: _____ Fully operational? □ Yes □ No Last bypass date (dd/MMM/yyyy): _____

Approved Ballast Water Management Plan on board? □ Yes □ No Ballast Water Management Plan implemented? □ Yes □ No

Contingency measure(s) included in the Ballast Water Management Plan? □ None □ D-1 □ Other (describe): _____

Contingency measure(s) deployed? □ Yes □ No Interface available on ship for coupling to ballast water reception facility? □ Yes □ No

Ballast Water Record Book on board? □ Yes □ No

Does ship carry an International Ballast Water Management Certificate: □ Yes □ No Authority that issued Certificate: _____

Date of issue (dd/MMM/yyyy): _____ Expiry date (dd/MMM/yyyy): _____ Place of issue: _____

Last survey/endorsement date (dd/MMM/yyyy): _____ Surveying authority: _____

5. BALLAST WATER HISTORY: In the appendix, RECORD ALL TANKS/HOLDS that may contain water taken on board to control trim, list, draught, stability or stresses of the ship, regardless of ballast water discharge intentions, including empty tanks/holds. Note: BW sources are the last BW uptakes prior to any ballast water management practices.

6. RESPONSIBLE OFFICER'S NAME AND TITLE: _____ Email: _____ Phone number: _____

APPENDIX: BALLAST WATER HISTORY

Ship name:				IMO Number (if not applicable, Distinctive Numbers / Letters, Call Sign or MMSI):								Arrival date (dd/MMM/yyyy):		
Tanks/Holds List multiple sources/ tanks separately	**Tank capacity (m^3)**	**BW sources**		**Current volume** (m^3)	**BW MANAGEMENT PRACTICES**							**PROPOSED BW DISCHARGE**		
		Date (dd/MMM/ yyyy)	UN/LOCODE or Lat. Long		Date (dd/MMM/yyyy)	Start point* Lat./Long.	End point* Lat./Long.	Min. depth* (m)	Volume used* (m^3)	% Exchange*	Method(s) (DE, SE, FE, SWF, OT, PBU, PRF, NM)	Date (dd/MMM/yyyy)	UN/LOCODE or Lat./Long.	Volume (m^3)

Ballast water tank codes: Forepeak = FP, Aftpeak = AP, Double bottom = DB, Wing = WT, Topside = TS, Cargo hold = CH, Other = O.
Enter positions in degrees, minutes and seconds in the format: 00 00 000 N or 00 00 000 S (latitude) and 000 00 000 W or 000 00 000 E (longitude).
Methods: DE = Dilution exchange, SE = Sequential exchange, FE = Flow-through exchange, SWF = Saltwater flushing, OT = Onboard treatment, PBU = Uptake from port-based facility, PRF = Discharge to port reception facility, NM = No management
Complete columns with (*) only if exchange or flushing was conducted.

APPENDIX 3

EXAMPLE TANK-BY-TANK LOG FORM

Ballast Water Log														
Ship name:		This voluntary log allows for tank-by-tank recording of all operations concerning ballast water in order to facilitate the completion of the ballast water report form that may be requested by port States. Further information on completing this log is available in the Guidance on ballast water record-keeping and reporting of the International Maritime Organization.						**Tank ID:**						
IMO Number: (if not applicable, Distinctive Numbers / Letters, Call Sign or MMSI):								Tank capacity:						
Date (dd/MMM/yyyy)	**Record of operations**													
	Location / Position (Port UN/LOCODE or Lat./Long. at sea)	Time started (UTC)	Minimum depth in metres (if outside port)*	Volume (m^3)							Time completed (UTC)	Any BW management method(s) (DE, SE, FE, SWF, OT, PBU, PRF, NM)	Remarks
				Initial content	Estimated uptake from sea, where applicable	Estimated intake from reception facility, where applicable	Estimated circulated or treated, where applicable*	Estimated discharged into sea, where applicable	Estimated discharged to port reception facility, where applicable	Final content			
Enter positions in degrees, minutes and seconds in the format: 00 00 000 N or 00 00 000 S (latitude) and 000 00 000 W or 000 00 000 E (longitude). **Methods: DE = Dilution exchange, SE = Sequential exchange, FE = Flow-through exchange, SWF = Saltwater flushing, OT = Onboard treatment, PBU = Uptake from port-based facility, PRF = Discharge to port reception facility, NM = No management** **Complete columns with (*) only if exchange or flushing was conducted.**														