標題

MEPC 81 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

2024 年 3 月 18 日から 22 日に国際海事機関（IMO）第 81 回海洋環境保護委員会（MEPC 81）が開催されました。
今般、IMO より MEPC 81 の議事録及び決議並びにサーキュラー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

2023 年 7 月に開催された MEPC 80 では、国際海運からの GHG 排出削減目標を強化するための、2023 年版 IMO GHG 削減戦略が採択されました。今回の MEPC 81 では、強化された削減目標の達成に向けて、燃料消費実績報告制度（IMO DCS, Data Collection System）、就航船のエネルギー効率指標（EEXI, Energy Efficiency Existing Ship Index）関連規制及び CII 燃費実績格付け制度の見直し作業と共に、中期対策及び船舶燃料のライフサイクル評価などの議論が行われました。

(1) 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 IMO DCS 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。前回 MEPC 80 では、IMO DCS で報告すべき項目を追加するための MARPOL 条約附属書 VI 付録 IX の改正案が承認されました。

今回の会合では、前回 MEPC 80 で承認された改正案が採択されました。本改正により、燃料を使用する機器ごとの合計燃料消費量や、航海以外での合計燃料消費量などが IMO DCS の報告項目として追加されます。詳細につきましては下記 4.1 項をご参照ください。

また、これを受け IMO DCS で新たに報告が要求される項目に関連する用語の定義や計測方法について議論され、実貨物量を基に算出する「貨物輸送量」の詳細などを含む「船舶エネルギー効率管理計画書（SEEMP, Ship Energy Efficiency Management Plan）の作成に関するガイドライン」及び「船舶燃料消費量データ及び CII の認証に関するガイドライン」の改正が採択されました。
（添付 2: 決議 MEPC.385(81)、添付 4: 決議 MEPC.388(81)及び添付 5: 決議 MEPC.389(81)参照）

（次頁に続く）

(2) EEXI 規制における出力制限

今回の会合では、2023 年から開始されている EEXI 規制への対策として多くの船舶で採用されている軸出力制限（SHaPoLi）及びエンジン出力制限（EPL）システムの技術要件を示す「軸／エンジン出力制限システムに関するガイドライン」の見直しが行われました。

審議の結果、船舶の航行に関して危険性が想定される場合は、出力制限以上の出力を即座に使用できるよう、予め出力制限を解除してよいことを同ガイドラインに明文化するとともに、エンジンの制御系統から独立した SHaPoLi システムに対する機能要件を新たに追加するガイドラインの改正が採択されました。
（添付 6: 決議 MEPC.390(81)参照）

(3) 重量物運搬船の取扱い

エネルギー効率設計指標（EEDI, Energy Efficiency Design Index）規制、EEXI 規制及び CII 制度の適用から除外される重量物運搬船の定義が新たに作成され、MARPOL 条約附属書 VI 統一解釈の改正として採択されました。
（添付 8: MEPC.1/Circ.795/Rev.9 参照）

(4) GHG 排出削減のための中期対策

2023 年版 IMO GHG 削減戦略では、国際海運における GHG 削減目標を達成するための中期対策として、技術的手法と経済的手法を組み合わせた対策案（Basket of measures）を検討することが掲げられています。技術的手法としては船舶の年間 GHG 排出強度を段階的に強化していく制度（GHG Fuel Standard）等が提案されており、経済的手法としては GHG 排出量に応じた課金制度（Universal Mandatory GHG Levy）や化石燃料船への課金で得られた収入をゼロエミ燃料船へ還付する制度（feebate）等が提案されています。

また、中期対策は 2027 年の発効を目指して次に示す通り作業を進めることが合意されています。

期間	作業内容
2023-2024	中期対策案の各組み合わせについて国際海運及び各国に及ぼす影響の評価（包括的影響評価）を実施し、具体的な中期対策案を最終化
2025	中期対策案の承認及び採択
2027	中期対策の発効

今回の会合では、これまでに提案されている中期対策案に関する意見交換が行われ、船舶の年間 GHG 排出強度の基準値や還付の対象などを含む論点を整理した条約改正の枠組みを示す文書（IMO net-zero framework）が合意され、同文書を用いて各国及び国際団体に対して中期対策案の最終化に向けた議論を進めていくことが要請されました。

（次頁に続く）

包括的影響評価については、実施者である UNCTAD（国連貿易開発会議）などから中間報告が行われ、本年 7 月を目処に最終結果が提出されることが報告されました。また、同結果への理解を深めるための場を設けるべく、専門家ワークショップを MEPC 82 前に開催することが合意されました。
（添付 10 参照）

(5) 船舶燃料のライフサイクル GHG 強度に関するガイドラインの実用化
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などの低/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。

前回の会合では、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全般的な枠組みとして、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。前回の会合にて設置された通信部会では、GHG 強度のデフォルト値開発のためのデータ収集用テンプレートの見直しをはじめ、デフォルト値の検討、土地利用変化に伴う炭素及びメタン漏出、合成燃料の原料としての回収炭素、及び船上 CCS の回収炭素の取り扱い等について議論されました。

今回の会合では、通信部会により提案された LCA ガイドラインの改正を含む 2024 年版 LCA ガイドラインが採択されました。2024 年版 LCA ガイドラインでは、バイオ燃料の生産に関する排出量算定方法の詳細化及びパラメータの数値化がなされた他、燃料の生産に使用する電力に関する GHG 排出強度及び実際の船上での GHG 排出量に関する算定方法が追加されました。

また、通信部会において検討された課題については、多種多様で専門知識が必要なため、通信部会での議論には限界があることから、GESAMP（海洋環境保護の科学的側面に関する合同専門家グループ）に舶用燃料ライフサイクル GHG 強度に関する作業部会を新設することが合意され、作業に向けた付託事項（Terms of Reference）が作成されました。
（添付 7: 決議 MEPC.391(81)参照）

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(6) CO2 以外の GHG の計測及び検証並びに船上 CO2 回収装置

メタンやアンモニアを燃料として使用する場合、燃焼時の漏洩（メタンスリップ）や亜酸化窒素の形成を生じる可能性があり、地球温暖化に与える影響が大きいとされています。そのため、メタン及び亜酸化窒素を含む CO2 以外の GHG の計測及び検証方法について、LCA ガイドラインの更なる実用化に向けて議論されています。

また、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。

今回の会合では、上記に関する議論を進めるべく通信部会が新たに設置され、以下について検討されることが合意されました。

・ CO2 以外の GHG の計測及び検証方法並びに条約での規制枠組み等
・ OCC 技術に関する条約での規制枠組み策定に向けた作業計画

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、前回の会合において優先改正事項を含む条約レビュー計画（CRP, Convention Review Plan）が採択されています。

その後、見直されるべき条約要件の選定作業が通信部会によって実施され、今回の会合において、条約本文、BWMS コード、関連ガイドライン及びガイダンスにおいて改正が必要となる事項のリストが合意されました。同リストにおいては、BWMS の適切な施工及び運転を確認するため、生物殺傷能力及び活性物質排出濃度の確認を、コミッショニング試験だけでなく、中間検査時及び更新検査時にも行うことなどが含まれています。今後、同リストに基づく詳細な検討を進めるため、改めて通信部会が設置され、次回の会合に向けて継続して議論されることとなりました。

(2) 水質に問題がある海域でのバラスト水管理

バラスト水処理装置を運用するにあたり、海水が極端に濁っていて紫外線が透過せず殺菌できない場合や、塩分濃度が低すぎる場合、又は頻繁にフィルターの目詰まりが発生するなど、バラスト水処理装置の正常な連続運転が困難となるような水質（CWQ, Challenging Water Quality）の寄港地におけるバラスト水の搭載について MEPC で審議が行われてきました。

今回の会合では、CWQ に遭遇した際の BWM 条約適用に関する暫定ガイダンスが採択されました。本ガイダンスでは、CWQ の判定基準、CWQ の港湾において BWMS をバイパスしてバラスト水を取水する手順、バイパス取水後のタンク洗浄手順等が規定されています。今後、本暫定ガイダンスの継続的な見直しが行われる見込みです。
（添付 3: 決議 MEPC.387(81)参照）

（次頁に続く）

(3) 処理済み汚水及びグレーウォータの一時貯留

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、それらの港湾においてバラストタンクに処理済み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の作成について議論が行われています。

今回の会合では、処理済み汚水・グレーウォータをバラストタンクへ一時貯留する際のガイダンスが採択されました。同ガイダンスでは、一時貯留後にバラストタンクとしての利用を復旧する際のタンク洗浄に関する要件や、一連の手順のバラスト水管理計画への記載要領及びバラスト水記録簿への記録要領等が規定されています。
（添付 9: BWM.2/Circ.82 参照）

3. 大気汚染防止関連

(1) 窒素酸化物（NOx）並びに硫黄酸化物（SOx）及び粒子状物質（PM）排出規制海域の追加

MARPOL 条約附属書 VI の第 13 規則では、船舶に搭載されているディーゼル機関からの NOx の排出量を規制しています。第 13.6 規則では、NOx 三次規制が適用される排出規制海域（Emission Control Area: 以下 ECA）として、北米沿岸、米国カリブ海海域、バルト海海域及び北海海域が指定されています。

MARPOL 条約附属書 VI の第 14 規則では、SOx 及び PM の排出を抑制するために、2020 年より一般海域で使用する燃料油中の硫黄分濃度が 0.50%以下に制限されています。また、第 14.3 規則では、SOx 及び PM の ECA として北米沿岸、米国カリブ海海域、バルト海海域、北海海域及び地中海海域が指定されており、これらの海域で使用する燃料油中の硫黄分濃度が 0.10%以下に制限されています。

今回の会合では、新たにカナダ北極海域及びノルウェー海域を ECA に指定する提案があり、両海域を ECA に指定する MARPOL 条約附属書 VI の改正案が承認されました。

次回 MEPC 82 において改正案が採択された場合、最短で 2027 年の 2 月より、これらの海域を航行する船舶に対し、燃料油中の硫黄分濃度を 0.10%に制限する規制が適用される見込みです。また、同海域を航行する以下の船舶に NOx 三次規制が適用される予定です。

NOx 三次規制の適用	
カナダ北極海 ECA	・2025 年 1 月 1 日以降に起工または同等の建造段階にある船舶
ノルウェー海 ECA	・2026 年 3 月 1 日以降に建造契約が行われる船舶 ・建造契約がない場合には、2026 年 9 月 1 日以降に起工または同等の建造段階にある船舶 ・2030 年 3 月 1 日以降に引渡しが行われる船舶

（添付 11 及び添付 12 参照）

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(2) NOx 規制対策に関する有効性
NOx 規制対策として採用される選択触媒還元（SCR）や排気ガス再循環（EGR）については、ECA において低出力で運航する際など、排気温度が低い場合や低負荷における補助制御装置（ACD）の作動に伴って、SCR や EGR が十分な効果を発揮していない可能性があることが指摘されています。また、ECA における NOx 排出制限の適用が船舶の起工日に関連付けられていることを含め、NOx 規制の有効性を検討すべきとの提案がありました。

今回の会合では、関係国に対して、この問題に関する調査を継続し、NOx 規制の有効性のレビューに関する新たな提案を、次回以降の会合に提出することが要請されました。

(3) 燃料油の使用における安全性強化の検討
SOx 及び PM に対する排出規制をきっかけとして、燃料油の使用における安全上の問題が検討されています。2023 年 6 月に開催された IMO 第 107 回海上安全委員会（MSC 107）では、SOLAS 条約及び MARPOL 条約において共通の燃料油サンプリング手法を確立するため、既存のガイドライン（決議 MEPC.182(59)）をベースとした、バンカリング時の燃料油サンプリング手法に関する MSC と MEPC の合同ガイドライン案が承認され、MEPC に提出されました。

今回の会合では、合同ガイドライン案で用いられる用語に対して MARPOL 条約との整合をとる作業等が行われ、修正された合同ガイドライン案が承認されました。本ガイドライン案は今後 MSC で改めて承認された後、MSC-MEPC サーキュラーとして発行される予定です。

4. 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。

(1) 燃料消費実績報告制度の見直し
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 の改正が採択されました。
1. 燃料を使用する機器ごとの合計燃料消費量（主機、補機及びボイラ等）
2. 航海以外での合計燃料消費量
3. 航海距離（積荷航海距離をボランタリーで提出可）
4. 貨物輸送量
5. 総陸電供給量
6. エネルギー効率向上のための革新的技術の種類

（添付 2: 決議 MEPC.385(81)参照）

発効日:2025 年 8 月 1 日

なお、本データ報告関連の改正については 2025 年 1 月 1 日より早期適用することが旗国に要請されています。

（次頁に続く）

(2) 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
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（BDN, Bunker Delivery Note）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 の改正が採択されました。
（添付 2: 決議 MEPC.385(81)参照）

発効日：2025 年 8 月 1 日

(3) バラスト水記録簿関連
MEPC 80 で採択され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への参照を含む、バラスト水管理条約 A-1 及び B-2 規則の改正が採択されました。
（添付 1: 決議 MEPC.383(81)参照）

発効日：2025 年 10 月 1 日

MEPC 81 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下さい。
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.383(81): Amendments to Regulations A-1 and B-2 of the International Convention for the Control and Management of Ships' Ballast Water and Sediments, 2004
2. 決議 MEPC.385(81): Amendments to MARPOL Annex VI (Low-flashpoint Fuels and Other Fuel Oil Related Issues, Marine Diesel Engine Replacing Steam System, Accessibility of Data and Inclusion of Data on Transport Work and Enhanced Granularity in the IMO Ship Fuel Consumption Database (IMO DCS))
3. 決議 MEPC.387(81): Interim Guidance on the Application of the BWM Convention to Ships Operating in Challenging Water Quality Conditions
4. 決議 MEPC.388(81): Amendments to the 2022 Guidelines for the Development of a Ship Energy Efficiency Management Plan (SEEMP) (Resolution MEPC.346(78))
5. 決議 MEPC.389(81): Amendments to the 2022 Guidelines for Administration Verification of Ship Fuel Oil Consumption Data and Operational Carbon Intensity (Resolution MEPC.348(78))
6. 決議 MEPC.390(81): Amendments to the 2021 Guidelines on the Shaft/Engine Power Limitation System to Comply with the EEXI Requirements and Use of a Power Reserve (Resolution MEPC.335(76)), as Amended by Resolution MEPC.375(80)
7. 決議 MEPC.391(81): 2024 Guidelines on Life Cycle GHG Intensity of Marine Fuels (2024 LCA Guidelines)
8. MEPC.1/Circ.795/Rev.9: Unified Interpretations to MARPOL Annex VI
9. BWM.2/Circ.82: Guidance for the Temporary Storage of Treated Sewage and/or Grey Water in Ballast Water Tanks
10. Illustration of a Draft Possible Outline of the "IMO Net-zero Framework"
11. Draft Amendments to MARPOL Annex VI (Designation of the Canadian Artic and the Norwegian Sea as Emission Control Areas for Nitrogen Oxides, Sulphur Oxides and Particulate Matter, as Appropriate)
12. カナダ北極海及びノルウェー海 ECA の図示

ANNEX 1

RESOLUTION MEPC.383(81)
(adopted on 22 March 2024)

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

Amendments to regulations A-1 and B-2

(Use of electronic record books)

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 April 2025 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 1October 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

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

(Use of electronic record books)

Regulation A-1
Definitions

1 A new paragraph 9 is inserted after existing paragraph 8, as follows:

"9 Electronic record book means a device or system, approved by the Administration, used to electronically record the entries for each ballast water operation as required under this Convention in lieu of a hard copy record book."

Regulation B-2
Ballast Water Record Book

2 Paragraph 1 is replaced by the following:

"1 Each ship shall have on board a Ballast Water Record Book, that may be an electronic record book, or that may be integrated into another record book or system, and which shall at least contain the information specified in appendix II. Electronic record books shall be approved by the Administration taking into account the guidelines developed by the Organization*."

3 Paragraph 5 is replaced by the following:

"5 Each operation concerning ballast water shall be fully recorded without delay in the Ballast Water Record Book. Each entry shall be signed by the officer in charge of the operation concerned and each completed page shall be signed by the master or, in the case of a group of electronic entries, shall be verified by the master in a timely manner. 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."

***

* Refer to the *Guidelines for the use of electronic record books under the BWM Convention* (resolution MEPC.372(80), as may be amended).

ANNEX 3

RESOLUTION MEPC.385(81)
(adopted on 22 March 2024)

AMENDMENTS TO THE ANNEX OF THE PROTOCOL OF 1997 TO AMEND THE INTERNATIONAL CONVENTION FOR THE PREVENTION OF POLLUTION FROM SHIPS, 1973, AS MODIFIED BY THE PROTOCOL OF 1978 RELATING THERETO

Amendments to MARPOL Annex VI

(Low-flashpoint fuels and other fuel oil related issues, marine diesel engine replacing steam system, accessibility of data and inclusion of data on transport work and enhanced granularity in the IMO Ship Fuel Consumption Database (IMO DCS))

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 16 of the International Convention for the Prevention of Pollution from Ships, 1973, as modified by the Protocols of 1978 and 1997 relating thereto (MARPOL), which specifies the amendment procedure and confers upon the appropriate body of the Organization the function of considering amendments thereto for adoption by the Parties,

HAVING CONSIDERED, at its eighty-first session, proposed amendments to MARPOL Annex VI concerning low-flashpoint fuels and other fuel oil related issues, marine diesel engine replacing a steam system, and accessibility of data and inclusion of data on transport work and enhanced granularity in the IMO Ship Fuel Consumption Database (IMO DCS), which were circulated in accordance with article 16(2)(a) of MARPOL,

1 ADOPTS, in accordance with article 16(2)(d) of MARPOL, amendments to MARPOL Annex VI, the text of which is set out in the annex to the present resolution;

2 DETERMINES, in accordance with article 16(2)(f)(iii) of MARPOL, that the amendments shall be deemed to have been accepted on 1 February 2025 unless prior to that date not less than one third of the Parties or Parties the combined merchant fleets of which constitute not less than 50% of the gross tonnage of the world's merchant fleet have communicated to the Organization their objection to the amendments;

3 INVITES the Parties to note that, in accordance with article 16(2)(g)(ii) of MARPOL, the said amendments shall enter into force on 1 August 2025 upon their acceptance in accordance with paragraph 2 above;

4 ALSO INVITES the Parties to consider the early application of the amendments to appendix IX with regard to information to be submitted to the IMO Ship Fuel Oil Consumption Database from 1 January 2025;

5 REQUESTS the Secretary-General, for the purposes of article 16(2)(e) of MARPOL, to transmit certified copies of the present resolution and the text of the amendments contained in the annex to all Parties to MARPOL;

6 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 MARPOL.

ANNEX

AMENDMENTS TO MARPOL ANNEX VI

(Low-flashpoint fuels and other fuel oil related issues, marine diesel engine replacing steam system, accessibility of data and inclusion of data on transport work and enhanced granularity in the IMO Ship Fuel Consumption Database (IMO DCS))

Regulation 2
Definitions

1 Paragraph 1.14 is replaced by the following:

"1.14 *Fuel oil* means any fuel delivered to and intended for use on board a ship."

2 A new paragraph 1.33 is inserted after existing paragraph 1.32, as follows:

"1.33 *Gas fuel* means a fuel oil with a vapour pressure exceeding 0.28 MPa absolute at a temperature of 37.8°C.*"

* Refer to paragraph 2.2.18 of the *International Code of Safety for Ships using Gases or other Low-flashpoint Fuels (IGF Code)*

Regulation 13
Nitrogen oxides (NO_X)

Major conversion

3 Paragraph 2.2 is replaced by the following:

"2.2 For a major conversion involving the replacement of a marine diesel engine with a non-identical marine diesel engine, or the installation of an additional marine diesel engine, the standards in this regulation at the time of the replacement or addition of the engine shall apply. For the purpose of this regulation, the installation of a marine diesel engine replacing a steam system shall be considered a replacement engine. In the case of replacement engines only, if it is not possible for such a replacement engine to meet the standards set forth in paragraph 5.1.1 of this regulation (Tier III, as applicable), then that replacement engine shall meet the standards set forth in paragraph 4 of this regulation (Tier II), taking into account the guidelines developed by the Organization*. The Administration shall notify the Organization in those instances where a Tier II rather than a Tier III replacement engine has been installed on or after 1 August 2025 in accordance with the provisions of this paragraph.

* Refer to the *2024 Guidelines as required by regulation 13.2.2 of MARPOL Annex VI in respect of non-identical replacement engines not required to meet the Tier III limit* (resolution MEPC.386(81)).

Regulation 14
Sulphur oxides (SO_X) and particulate matter

4 Paragraph 12 is replaced by the following:

"12 The requirements of paragraphs 10 and 11 above are not applicable to a fuel oil service system used for a low-flashpoint fuel or a gas fuel."

Regulation 18
Fuel oil availability and quality

5 The existing chapeau of paragraph 3 is replaced by the following:

"3 Fuel oil delivered to and used on board a ship to which this Annex applies shall meet the following requirements:"

6 The existing chapeau of paragraph 3.2 is replaced by the following:

"3.2 fuel oil derived by methods other than petroleum refining shall not:"

7 Paragraph 4 is replaced by the following:

"4 This regulation does not apply to coal in its solid form or nuclear fuels. Paragraphs 5.1, 8.1 and 8.2 of this regulation do not apply to a low-flashpoint fuel or a gas fuel."

8 Paragraph 5 is replaced by the following new paragraphs 5.1 and 5.2, as follows:

"5.1 For each ship subject to regulations 5 and 6 of this Annex, details of fuel oil delivered to and used on board that ship shall be recorded by means of a bunker delivery note that shall contain at least the information specified in appendix V to this Annex.

5.2 For each ship subject to regulations 5 and 6 of this Annex, details of low-flashpoint fuel or gas fuel delivered to and used on board that ship shall be recorded by means of a bunker delivery note that shall include at least the information specified in items 1 to 6 of appendix V to this Annex, the density as determined by a test method appropriate to the fuel type together with the associated temperature and a declaration signed and certified by the fuel oil supplier's representative that the fuel oil is in conformity with paragraph 3 of this regulation. In addition the sulphur content of a low-flashpoint fuel or a gas fuel delivered to a ship specifically for use on board that ship shall be documented on the bunker delivery note by the supplier in terms of either the actual value as determined by a test method appropriate to the fuel type or, with the agreement of the appropriate authority at the port of supply, a statement that the sulphur content, when tested by such a method, is less than 0.001% m/m."

9 Paragraph 9.2 is replaced by the following:

".2 require local suppliers to provide the bunker delivery note and, if applicable, the MARPOL delivered sample as required by this regulation, certified by the fuel oil supplier that the fuel oil meets the requirements of regulations 14 and 18 of this Annex; "

Regulation 27
Collection and reporting of ship fuel oil consumption data

10 New paragraphs 14 and 15 are added after existing paragraph 13, as follows:

"14 On an ad hoc basis, the Secretary-General of the Organization may share data with analytical consultancies and research entities, under strict confidentiality rules.

15 The Secretary-General of the Organization, on the request of a company, shall grant access to the fuel oil consumption reports of the company's owned ship(s) in a non-anonymized form to the general public."

Appendix I
Form of International Air Pollution Prevention (IAPP) Certificate (regulation 8)

11 Paragraph 2.3.5 is replaced by the following:

"In accordance with regulation 14.12, the requirement for fitting or designating sampling point(s) in accordance with regulation 14.10 or 14.11 is not applicable for a fuel oil service system used for a low-flashpoint fuel or a gas fuel………………□"

Appendix IX
Information to be submitted to the IMO Ship Fuel Oil Consumption Database (regulation 27)

12 Appendix IX is replaced by the following:

" Appendix IX

Information to be submitted to the IMO Ship Fuel Oil Consumption Database (regulation 27)

Identity of the ship

IMO Number……………………………………………………………………………………….

Period of calendar year for which the data is submitted

Start date (dd/mm/yyyy) ………………………………………………………………….

End date (dd/mm/yyyy)…………………………………………………………………

Technical characteristics of the ship

Year of delivery………………………….………………………………………….............................

Ship type, as defined in regulation 2.2 of this Annex or other (to be stated) ………………….

Gross tonnage[1] (GT)……………………………………………………………

Net tonnage (NT)[2] …………………………………………………………………

Deadweight tonnage (DWT)[3] …………………………………………………………….

Power output (rated power)[4] of main and auxiliary reciprocating internal combustion engines over 130 kW (to be stated in kW) …………………………………………..

Attained EEDI[5] (if applicable)…………………… …………………………………………

Attained EEXI[6] (if applicable) ……………………………………………………

Ice class[7] …………………………………………………………………...

Fuel oil consumption data

Total fuel oil consumption by fuel oil type[5] in metric tonnes and methods used for collecting fuel oil consumption data:……………………………………………………… …….

Total fuel oil consumption by fuel oil type[5] per consumer type in metric tonnes and methods used for collecting fuel oil consumption data:

Main Engine(s) …………………………

Auxiliary Engine(s)/Generator(s) ………………………

Oil-fired Boiler(s) …………………………..

Others (specify) …………………………

Fuel oil consumption while the ship is not under way by fuel oil type[5] per consumer type in metric tonnes and methods used for collecting fuel oil consumption data:

Main Engine(s) …………………………

Auxiliary Engine(s)/Generator(s) ………………………

Oil-fired Boiler(s) …………………………..

Others (specify) …………………………

Total distance travelled (nm)…………………………………………………………………

[1] Gross tonnage should be calculated in accordance with the International Convention on Tonnage Measurement of Ships, 1969.

[2] Net tonnage should be calculated in accordance with the International Convention on Tonnage Measurement of Ships, 1969. If not applicable, note "N/A".

[3] DWT means the difference in tonnes between the displacement of a ship in water of relative density of 1,025 kg/m^3 at the summer load draught and the lightweight of the ship. The summer load draught should be taken as the maximum summer draught as certified in the stability booklet approved by the Administration or an organization authorized by it. If not applicable, note "N/A".

[4] Rated power means the maximum continuous rated power as specified on the nameplate of the engine.

[5] Refer to the *2022 Guidelines on the method of calculation of the attained Energy Efficiency Design Index (EEDI) for new ships* (resolution MEPC.364(79)).

[6] Refer to the *2022 Guidelines on the method of calculation of the attained Energy Efficiency Existing Ship Index (EEXI)* (resolution MEPC.350(78)).

[7] Ice class should be consistent with the definition set out in the International Code for Ships Operating in Polar Waters (Polar Code) (resolutions MEPC.264(68) and MSC.385(94)). If not applicable, note "N/A".

Laden distance travelled (nm) (on a voluntary basis) ……………………………………………

Hours under way ……………………………………………………………………………………..

Total amount of onshore power supplied (kWh) ……………………………………………...….

For ships to which regulation 28 of MARPOL Annex VI applies

Total transport work ………………………………………………………………………………….

Applicable CII[8]: ☐ AER ☐ cgDIST

Required annual operational CII[9]…………………………………………………………………...

Attained annual operational CII before any correction[10]……………………………………………

Attained annual operational CII[11]……………………………………………………………...

Installation of innovative technology[12], if applicable: ☐ A ☐ B-1 ☐ B-2 ☐ C-1 ☐ C-2

Operational carbon intensity rating[13]: ☐ A ☐ B ☐ C ☐ D ☐ E

CII for trial purpose (on voluntary basis)[14]:

☐ EEPI (gCO_2/t/nm) …………………………………………………………………………

☐ cbDIST (gCO_2/berth/nm) ……………………………………………………………………

☐ clDIST (gCO_2/m/nm) ………………………………………………………………………..

☐ EEOI (gCO_2/t/nm)[15] ……………………………………………………………………..."

***

8 Refer to the *2022 Guidelines on operational carbon intensity indicators and the calculation methods (CII guidelines, G1)* (resolution MEPC.352(78)).

9 Refer to the *2022 Guidelines on the reference lines for use with operational carbon intensity indicators (CII reference lines guidelines, G2)* (resolution MEPC.353(78)) and *2021 Guidelines on the operational carbon intensity reduction factors relative to reference lines (CII reduction factors guidelines, G3)* (resolution MEPC.338(76)).

10 As calculated in accordance with the *2022 Guidelines on operational carbon intensity indicators and the calculation methods (CII guidelines, G1)* (resolution MEPC.352(78)) before any correction using *Interim guidelines on correction factors and voyage adjustments for CII calculations (G5)* (resolution MEPC.355(78)).

11 As calculated in accordance with the *2022 Guidelines on operational carbon intensity indicators and the calculation methods (CII guidelines, G1)* (resolution MEPC.352(78)) and having been corrected taking into account *Interim guidelines on correction factors and voyage adjustments for CII calculations (G5)* (resolution MEPC.355(78)).

12 Refer to the *2021 Guidance on treatment of innovative energy efficiency technologies for calculation and verification of the attained EEDI and EEXI* (MEPC.1/Circ.896).

13 Refer to the *2022 Guidelines on the operational carbon intensity rating of ships (CII rating guidelines, G4)* (resolution MEPC.354(78)).

14 Refer to the *2022 Guidelines on operational carbon intensity indicators and the calculation methods (CII guidelines, G1)* (resolution MEPC.352(78)).

15 Refer to the *Guidelines for voluntary use of the ship energy efficiency operational indicator (EEOI)* (MEPC.1/Circ.684).

ANNEX 5

RESOLUTION MEPC.387(81)
(adopted on 22 March 2024)

INTERIM GUIDANCE ON THE APPLICATION OF THE BWM CONVENTION TO SHIPS OPERATING IN CHALLENGING WATER QUALITY CONDITIONS

THE MARINE ENVIRONMENT PROTECTION COMMITTEE,

RECALLING Articles 38(a) and 38(b) 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, and its functions for considering appropriate measures to facilitate the enforcement of such conventions,

RECALLING ALSO that resolution MEPC.290(71) established an experience-building phase (EBP) associated with the *International Convention for the Control and Management of Ships' Ballast Water and Sediments, 2004* (BWM Convention), in order to identify aspects of this Convention that are working well and to shed light on issues that require further attention,

RECOGNIZING that properly installed, operated and maintained type-approved ballast water management systems (BWMS) may effectively become temporarily inoperable in the various challenging water quality (CWQ) conditions that exist in a number of global ports and locations,

CONCERNED that bypassing installed BWMS in CWQ, while sometimes necessary as a last resort to permit the continued operation of ports and ships, may contaminate ballast tanks and sediments with harmful aquatic organisms and pathogens that present substantial risks for the environment, human health, property and resources where ballast water is later discharged,

EMPHASIZING its expectation that discharged ballast water meets the performance standard in regulation D-2 of the BWM Convention whenever the Convention requires this to be the case, while recognizing the challenges currently faced by ships encountering CWQ in enclosed and semi-enclosed seas,

DETERMINED to thoroughly address the issue of CWQ through the holistic review of the Convention under the experience-building phase (EBP), the scope of which includes the *Code for Approval of Ballast Water Management Systems* (BWMS Code, resolution MEPC.300(72)) and the *Guidelines for port State control under the BWM Convention* (resolution MEPC.252(67)), and avoid unintended consequences for ships already equipped with BWMS,

CONSIDERING that, in the meantime, ships urgently need guidance on managing CWQ and retaining compliance with the D-2 performance standard in subsequent discharge operations, while also considering that Administrations, BWMS manufacturers and port States would also benefit from guidance on implementing their roles with respect to CWQ,

1 ADOPTS the *Interim guidance on the application of the BWM Convention to ships operating in challenging water quality*, as set out in the annex to the present resolution;

2 REAFFIRMS the conditions for temporary non-penalization agreed in operative paragraph 4 of resolution MEPC.290(71) relating to non-compliance of a ship with the performance standard in regulation D-2 following the use of a BWMS during the EBP;

3 CALLS UPON all relevant entities to maximize the suitability and regular use of BWMS for the management of CWQ in both the short and long term, and calls particularly upon:

.1 BWMS manufacturers to develop performance improvements regarding commonly encountered water quality challenges;

.2 ships and shipyards to invest in the most suitable, robust BWMS where known and available;

.3 ships to treat as much ballast water as practicable in CWQ and use bypass as a last resort;

4 AGREES to keep this interim guidance under review in connection with the EBP.

ANNEX

INTERIM GUIDANCE ON THE APPLICATION OF THE BWM CONVENTION TO SHIPS OPERATING IN CHALLENGING WATER QUALITY (CWQ) CONDITIONS

TABLE OF CONTENTS

INTRODUCTION

Purpose

1 The primary purpose of this Guidance is to assist ships in planning for compliance with the BWM Convention and the D-2 discharge standard when a type-approved ballast water management system (BWMS) that has been properly installed, operated and maintained encounters operational limitations or has difficulty meeting operational demand in challenging water quality (CWQ) conditions. The Guidance may also serve as a practical operational guide for ships and voyage planners in this regard.

2 This Guidance also includes sections intended to guide Administrations, port States and BWMS manufacturers in providing appropriate support and oversight to ships before, during and after CWQ operations.

3 This interim Guidance has been developed while the Committee takes steps through the experience-building phase (EBP) associated with the BWM Convention (resolution MEPC.290(71)) to improve the performance and reliability of BWMS.

4 This Guidance includes recommended steps that can be taken to restore or maintain effective operation of a BWMS when operating in CWQ. These include steps to identify when a system is inoperable owing to CWQ; actions to avoid bypass of the system; steps to recover from bypass including steps to return to compliance with the D-2 discharge standard; and planning, record-keeping and communication principles.

5 This Guidance does not address situations in which a BWMS is inoperable for reasons unrelated to CWQ, or in which inadequate performance is due to installation, operation or maintenance issues. Such situations should be addressed on a case-by-case basis in consultation with the Administration of the ship and implicated port States (see also the *Guidance on contingency measures under the BWM Convention* (BWM.2/Circ.62, as may be revised)).

Principles

6 Ships, supported by BWMS manufacturers, should plan for circumstances where CWQ may be experienced and include procedures informed by this Guidance in their approved Ballast Water Management Plan (BWMP). This Guidance is not intended to reduce the importance of selecting the most suitable BWMS, as known and available, for the circumstances of the ship where appropriate. Relevant stakeholders may, for example, use the INTERTANKO CWQ database[1] until a universal platform becomes available.

7 When operating a BWMS in CWQ, encountering an operational limitation or experiencing a challenge in satisfying operational demand does not indicate a BWMS failure. A BWMS has warnings and alarms to protect the BWMS equipment and/or the ship and the triggering of these set points or flow reductions demonstrates proper BWMS operation as designed.

8 Triggers for implementing CWQ procedures should be included in the BWMP and should be based on the performance and self-monitoring functions of the BWMS. The list of triggers should be developed based on information provided by the BWMS manufacturer in the Operations, Maintenance and Safety Manual (OMSM), based on the BWMS design and operational limitation(s).

[1] See document MEPC 81/4/11 and https://www.intertanko.com/search-article/articleview/pcwq-database

9 CWQ triggers should be assessed on a voyage-by-voyage basis because water quality challenges may vary: from berth to berth, with conditions on board the ship, and with environmental factors such as organism density, tides and seasons.

10 Following a bypass event in a location with CWQ, decontamination to ensure that subsequent discharges meet the D-2 performance standard may include ballast water exchange through a BWMS (BWE+BWT). However, BWE+BWT alone may not be sufficient to meet the standard. This risk may be mitigated by conducting ballast water flushing as described in appendix 1.

11 Bypass should always be considered as the last resort and the BWMS should be used as far as practicable to treat ballast water with CWQ. However, some BWMS are able to treat ballast water at flow rates that are prohibitively low for practical, safe operations.

12 Ports are requested to take CWQ conditions into account and work with ships to plan arrival, departure and berthing times that will accommodate the consistent use of BWMS at expected ballasting rates. When ballasting rates are impacted by CWQ, ports are requested to exercise flexibility and support the ship in using a BWMS as long as operational demand is met (as defined in this Guidance and the ship's approved BWMP).

13 A ship fully applying this Guidance minimizes the risk of non-compliance with the D-2 standard at subsequent discharges. While this Guidance does not limit the rights of a port State in verifying a ship's compliance with the Convention (including sampling), this Guidance should be taken into account when prioritizing compliance verification activities.

14 Administrations and manufacturers of BWMS should collect information to improve the Convention and support the development of BWMS performance improvements regarding commonly encountered CWQ conditions. This information should be shared with the Committee as appropriate.

Application

15 This Guidance is applicable to:

.1 ships that are required to meet the ballast water performance standard in accordance with regulation B-3 of the BWM Convention;

.2 Administrations approving BWMPs in accordance with regulation B-1 and applying articles 13 and 14 of the BWM Convention;

.3 port States applying articles 8 to 10 of the BWM Convention; and

.4 BWMS manufacturers defining troubleshooting procedures in the OMSM in accordance with paragraph 4.8 of the BWMS Code.

Definitions

16 *Challenging water quality* (CWQ) refers to ambient uptake water having quality parameters (including but not limited to high total suspended solids,[2] or turbidity) that cause a properly installed, maintained and operated type-approved BWMS to be temporarily inoperable due to an operational limitation or an inability to meet operational demand. However, temperature and salinity are not parameters that define CWQ.

2 Total suspended solids are defined as solids in water that can be trapped by a filter.

17 *Operational demand* means the minimum BWMS flow rate defined in the BWMP that will permit the ship to continue cargo operations while using the BWMS, which should be no greater than 50% of the BWMS treatment rated capacity (TRC).[3]

18 *Operational limitation* means an automatic shutdown of the BWMS, a critical alarm for which the BWMS OMSM directs a manual shutdown, or a safety-related circumstance that requires the shutdown of the BWMS for the protection of the BWMS equipment, the ship or its crew.[4]

19 *Pre-emptive bypass* means a BWMS bypass undertaken, prior to or during a ballasting operation, in anticipation of reaching an operational limitation or encountering an inability to meet operational demand.

20 *Reactive bypass* means a BWMS bypass undertaken during a ballasting operation upon reaching an operational limitation or encountering an inability to meet operational demand.

GUIDANCE FOR SHIPS OPERATING IN CWQ

21 This part of the guidance is intended to inform the development of Ballast Water Management Plans (BWMP), which should include ship-specific guidance and procedures identified in the conceptual overview provided in figure 1. This planning is intended to facilitate ship operations and efficiency by optimizing the performance of BWMS in CWQ, reducing the need to bypass this environmentally protective equipment and decontaminate ballast tanks.

22 While the focus of this part is on planning, its specific guidance and example process flow charts may also help ship crews reduce risks to the environment, human health, property and resources when operating in CWQ. However, this guidance should be read in conjunction with the ship-specific BWMP and OMSM.

[3] Operational demand pertains to the ship.

[4] Operational limitation pertains to the BWMS.

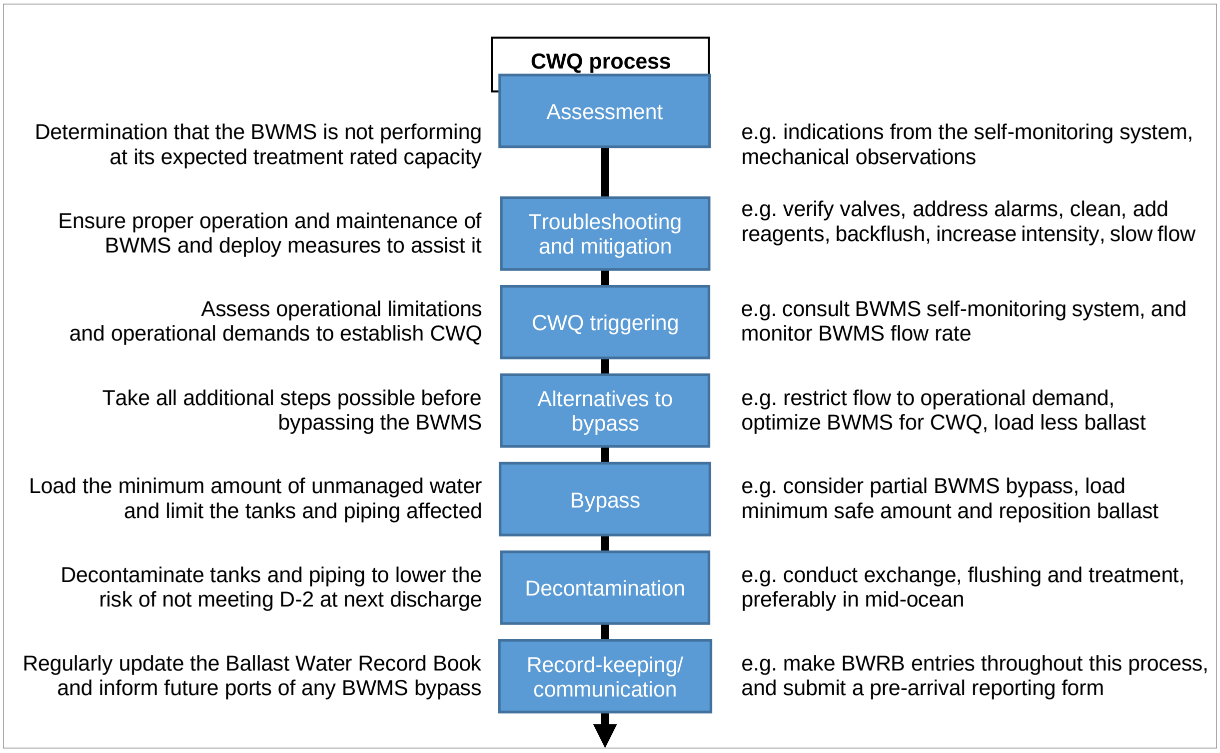


Figure 1: Conceptual overview of the CWQ process

Pre-planning

23 Operations in CWQ will be most efficient when the BWMP includes practical and realistic measures specific to the ship that take into account this Guidance, the BWMS technology installed on board, and specific instructions and procedures from the OMSM.

24 The approved BWMP should include a ship-specific definition of operational demand based on paragraph 17 that identifies the sustained flow rate below which cargo operations cannot practicably be continued by the ship. This flow rate should not be higher than 50% of the treatment rated capacity of the BWMS unless the ship's safety or stability would be affected. For example:

> "On this ship, the operational demand to practicably permit continued cargo operations without affecting the ship's safety or stability while using the BWMS is defined by a sustained flow rate of ___ m^3/h, which is 50% of the treatment rated capacity of the BWMS."

25 Developing ship-specific process flow charts based on the appended samples and manufacturer's guidance is recommended.

26 A detailed plan for at least the following items should be included in the ship-specific BWMP and BWMS operating instructions, taking into account ship safety and the maintenance and operation instructions in the OMSM. Further information and guidance on selected topics from this list are included in the sub-sections below.

.1 Maintenance: Maintenance timetables and checklists for maintaining the system in optimal condition for managing CWQ when it is encountered, including:

.1 crucial maintenance actions, such as those related to inspection, cleaning, calibration, active substance monitoring, etc.; and

.2 ensuring the availability on board of sufficient approved spare parts, Active Substances and neutralizing agents.

.2 Assessment: Indications from the BWMS self-monitoring system or a mechanical observation that the BWMS is not performing at its expected treatment rated capacity.

.3 Troubleshooting and mitigation: Procedures to identify and resolve challenges linked to the operation and maintenance of the BWMS, as well as ship-specific procedures for assisting and optimizing the BWMS in treating CWQ, with a view to completing normal ballast water treatment without bypassing the BWMS, giving consideration to operational demands.

.4 CWQ triggers: In case troubleshooting and mitigation is unsuccessful, a table of critical alarms specific to the BWMS based on the OMSM indicating that an operational limitation has been reached (see paragraph 18). This should include ship-specific procedures to be taken when an alarm is encountered.

.5 Alternatives to bypass: Pre-planned actions, considerations and procedures, taking into account the OMSM, that may clear operational limitations or allow the BWMS to meet operational demands.

.6 Bypass procedure: Steps to be taken to bypass the BWMS, including treatment of a fractional part of the ballast water stream and/or bypassing only the inoperative part of the ballast water treatment process.

.7 Decontamination: Specific procedures for decontaminating ballast tanks and/or piping to reduce the risk of bypassed water, with a view to meeting the D-2 standard at subsequent discharges. Any use of the ballast water exchange plus treatment (BWE+BWT) approach should be clearly detailed in the approved BWMP.

.8 Communication: Procedure for informing the port State(s) that will receive any ballast water discharge impacted by reactive bypass of the BWMS, before arrival of the ship in such State(s).

.9 Record-keeping: How to record CWQ situations in the Ballast Water Record Book (BWRB), in line with the *Guidance on ballast water record-keeping and reporting* (BWM.2/Circ.80, as may be revised). The BWRB should provide a detailed description of the ballast water management method(s) used, as well as location and affected tanks (tank ID).

27 The BWMP should provide that, when a ship encounters CWQ, an evaluation of ship safety should be conducted prior to the application of any steps to manage CWQ as included in this Guidance. Any safety risks identified should be evaluated to determine mitigating actions.

Assessment

28 CWQ may be impacting ballasting operations if the BWMS is not functioning at its expected treatment rated capacity, and alarms indicating an operational limitation arise or the BWMS is not meeting operational demand. A sample process for performing this assessment is set out in process diagram 1 ("Assessment of BWMS operation") in appendix 2.

29 Pre-emptively bypassing the BWMS based on historical CWQ issues experienced at a location is discouraged because water quality conditions may vary by precise location, ship and/or nearby port operations, time of day, tide, weather or seasonality. Through the self-monitoring system, the BWMS is the most suitable and technical method to precisely determine the water quality challenge at any moment and relieves the ship crew of this determination.

30 However, if a pre-emptive bypass is warranted in the case of regular visits to a port or location with known and recurring CWQ, this should be agreed in advance bilaterally between the Administration of the ship and the port State receiving the ballast water (see paragraph 52 below).

Troubleshooting and mitigation

31 If CWQ is impacting ballasting operations, as described in paragraph 28, then the crew should implement ship-specific troubleshooting procedures set out in the BWMP and the OMSM to ensure the system is being operated in accordance with proper procedure and the manufacturer's instructions. For example, this may include steps such as verifying the correct alignment of valves, that the BWMS is in the correct mode, and fully addressing any BWMS warnings and alarms.

32 The crew should also follow ship-specific procedures in the BWMP and the OMSM to verify that the BWMS has been properly maintained. For example, these procedures may include ensuring that any necessary reagents have been introduced into the BWMS, that any cleaning cycles have been run, and that no mechanical or electrical failures are present.

33 If the steps above indicate that the BWMS has been properly operated and maintained, the crew should follow procedures in the BWMP and the OMSM to deploy mitigating measures that assist the system in treating the water successfully. For example, these may include manually operating any backflushing controls, applying suitable backpressure at high differential filter pressures, maximizing UV intensity in the presence of turbid water or low UV transmittance, progressively reducing ballast water flow rate to the point of operational demand or operational limitation.

34 In planning troubleshooting and mitigation, refer to the ship's OMSM and the sample process diagram 2 ("Challenging water quality process") in appendix 2.

CWQ triggers

35 The crew should implement CWQ actions when, despite maximizing all mitigating measures, the BWMS delivers a critical alarm identified in the BWMP signalling that an operational limitation has been reached (see paragraph 18), or the BWMS is not meeting operational demand (see paragraph 17).

36 CWQ triggers relating to operational limitations should be based on the system design limitations of the BWMS as tested during the type approval process, clearly identified in the ship's approved BWMP, and should be developed with reference to the OMSM. CWQ triggers may consist of relevant alarms concerning matters such as:

.1 the required UV transmittance or UV dose of the BWMS;

.2 the maximum allowable differential pressure across the filter to prevent permanent damage to the filter element;

.3 a reduction in flow rate that is below the minimum operating requirements of the BWMS, as identified by the OMSM; and

.4 monitoring data of the BWMS when the self-monitoring system indicates the BWMS is not operating normally owing to issues such as those listed below, and that cannot be remediated through optimization of the BWMS in accordance with the BWMP:

.1 variation of pressure in filters;

.2 UV transmittance or dosage and/or the levels of dissolved organic carbon; and

.3 turbidity and/or total suspended solid that triggers an alarm of the BWMS.

Table 1: Water quality parameters for challenging water

Potential CWQ parameters	Impacts	Types of BWMS affected
Turbidity	Decreased light transfer through water due to deflection from particles/organisms (UV scatter), increased filter differential pressure	UV, filtration
UV transmissivity	Decreased penetration of UV light through seawater	UV
Dissolved organic carbon	Increased consumption of Active Substance, UV absorption	UV, Active Substance
Particulate organic carbon	Increased consumption of Active Substance, UV scatter	UV, Active Substance
Total suspended solids (sediment and/or organism load)	Increased consumption of Active Substance, UV scatter, increased filter differential pressure	UV, filtration, Active Substance

37 The relevant CWQ triggers should be reviewed and amended, as applicable, in the event of any change to the BWMS.

38 The crew should respond with the pre-planned steps in the BWMP and the OMSM for managing any critical alarm or operational demand.

Alternatives to bypass

39 Alternatives should be tried before the ship bypasses a BWMS, because bypass increases the risks ballast water poses to the environment, human health, property and resources. Bypass also increases the operational workload for ship crew to perform alternative management methods and subsequently return the BWMS and ship to normal operations for D-2 compliance.

40 Before the BWMS is bypassed, the officer designated in accordance with regulation B-1.5 should:

.1 ensure that any BWMS alarm that could be ascribed to CWQ is not due to other factors such as malfunction, maintenance, crew familiarity or experience;

.2 ensure that the BWMP and OMSM have been followed in troubleshooting the operation of the BWMS (see paragraph 31), verifying that the BWMS has been properly maintained (see paragraph 32) and ensuring that applicable mitigating measures have been applied (see paragraph 33) to optimize the performance of the BWMS before any bypass;

.3 restrict the flow rate of the BWMS to the minimum level consistent with operational demand (see paragraph 17); and

.4 consider persisting with using the BWMS in the challenging area to load the minimum safe amount of ballast water and complete remaining ballasting at a nearby less challenging location at a later time, taking into account the ship's stability and cargo condition as well as expected weather conditions.

Bypass procedure

41 The sequence of steps for safely bypassing the BWMS in the BWMP and OMSM should be followed. In undertaking an assessment of alternatives to bypassing the BWMS, refer to sample process diagram 3 ("Alternatives to bypass") in appendix 2.

42 The crew should consider that partially managed or unmanaged ballast water loaded through a bypass is likely to contaminate ballast tanks and piping systems with harmful aquatic organisms and pathogens that pose a risk to the environment, human health, property and resources. Therefore:

.1 consideration should be given to limiting the number of ballast tanks that will be exposed to partially treated or unmanaged ballast water;

.2 consideration should be given to treating the greatest possible fraction of the uptake water, by continuing to apply the BWMS to as much of the uptake water stream as practicable;

.3 in cases where only one part of a BWMS treatment process is inoperable, consideration should be given to applying the remainder of the treatment process to the uptake water, if practicable; and

.4 only the minimum safe volume of ballast water should be taken on board through the bypass following which, if necessary and practicable, the ship should proceed to a nearby area where less challenging uptake water may be obtained in order to complete ballasting using the BWMS as usual.

Decontamination

43 When a bypass is undertaken, the ship is still responsible for meeting the D-2 standard at subsequent discharge locations. The density of organisms at the location of uptake may impact the ship's return to D-2 compliance following a bypass. The recovery steps within this Guidance and the BWMP for decontaminating affected ballast tanks and piping should be followed to mitigate risks to the environment, human health, property and resources.

44 The approved BWMP should include a procedure for decontaminating ballast tanks, taking into account the example procedure set out in appendix 1 and the sample process diagram 4 in appendix 2.

45 Regulation B-4.3 does not apply to decontamination following a bypass of a BWMS, in order to restore compliance to regulation D-2.

46 In the case of a ship operating in a sea area where ballast water exchange in accordance with regulations B-4.1 and D-1 is not possible (e.g. an enclosed or semi-enclosed sea) and no ballast water exchange area has been designated, the ship should follow any instructions provided by subsequent port States to reduce the risk of discharging unmanaged or partially unmanaged ballast water and/or residuals. Port States should take into account adjacent or other States that may be affected by such instructions, as well as the safety of ships.

Communication

47 Whenever a full or partial bypass of a BWMS is undertaken, the next State receiving water from affected ballast tanks should be informed of the bypass, such as through a pre-arrival ballast water reporting form[5] when such a form is required. Any deviation from the procedures in this Guidance or the BWMP should be noted in the communication.

Record-keeping

48 In instances when the BWMS has not operated as expected owing to CWQ and may not be treating the water successfully, such circumstances carry greater environmental risk and should be recorded in the Ballast Water Record Book, taking into account the *Guidance on ballast water record-keeping and reporting* (BWM.2/Circ.80, as may be revised).

49 The ship's BWRB should include a description of:

.1 the reason why normal ballasting operations were stopped;

.2 any steps taken to optimize the treatment process and resolve BWMS technical malfunctions;

.3 the operational demands that were not met and/or operational limitations encountered (see paragraphs 17 and 18);

.4 the steps that were taken prior to a bypass being initiated (as relevant);

.5 the tanks which have received bypassed ballast water (tank ID);

.6 the date, time and location where the bypass took place; and

.7 the decontamination steps that were taken to recover from BWMS bypass as per the approved BWMP, including: the start and end locations (GPS coordinates) at which any flushing and/or exchange took place, the start date and time; end date and time, the method of exchange and the volume exchanged and/or flushed.

[5] See the *Guidance on ballast water record-keeping and reporting* (BWM.2/Circ.80, as may be revised).

GUIDANCE FOR ADMINISTRATIONS WITH RESPECT TO BALLAST WATER MANAGEMENT PLANS AND CHALLENGING WATER QUALITY

50 Administrations should ensure that ships are fully prepared to encounter CWQ. Approved BWMPs should be ship-specific, reflect the OMSM of the BWMS, and include at least: equipment maintenance procedures and intervals, predetermined mitigating measures that may preserve and optimize the treatment process in marginal conditions, a table of critical alarms that justify CWQ action, ship-specific alternatives to bypassing the BWMS, safe bypass procedures that minimize the exposure of tanks/piping to unmanaged water, and a decontamination procedure that reflects this Guidance and is safe for the ship and crew. Administrations should also ensure that crew familiarization includes relevant aspects of this Guidance, BWMS operating instructions and the environmental risks of bypassing BWMS and steps to avoid/minimize them.

51 Reactive bypasses (see paragraph 20) may be undertaken by the ship without consulting the Administration or the next port State. Port States receiving water from affected tanks should be notified before arrival (see paragraph 47).

52 Pre-emptive bypass (see paragraph 19) should be discouraged for the reasons set out in paragraph 29. However, in cases where pre-emptive bypass may be appropriate, the Administration should ensure this will not impair or damage the environment, human health, property or resources of other States. In bilaterally agreeing to the pre-emptive bypass, the Administration of the ship and the receiving port State should ensure that the pre-emptive bypass will not impair or damage the environment, human health, property or resources of any State. Pre-emptive bypass arrangements should be specific to voyages between specified ports or locations and should be documented in the ship's approved BWMP and the BWRB.

GUIDANCE FOR PORT STATE CONTROL OFFICERS WITH RESPECT TO SHIPS THAT HAVE ENCOUNTERED CHALLENGING WATER QUALITY

53 When determining compliance with the Convention by a ship that has encountered CWQ, a port State control officer should consult the BWMP, BWRB and crew. In determining that the ship has done all it can to meet the D-2 standard, the officer should use professional judgement in considering:

.1 the nature and degree of the challenge;

.2 whether challenges arose despite proper BWMS operation and maintenance;

.3 whether steps were taken to avoid or limit the bypass of a BWMS, such as efforts to mitigate challenges while continuing to use the BWMS;

.4 whether the ship and crew followed the procedures in the BWMP and recorded this in the BWRB; and

.5 whether decontamination was properly undertaken following any bypass.

54 Port States should consider that a ship fully applying this Guidance is minimizing its risk of non-compliance with the D-2 standard at subsequent discharge locations.

GUIDANCE FOR BWMS MANUFACTURERS WITH RESPECT TO PARTICIPATION IN PRE-PLANNING

55 Manufacturers of BWMS should ensure that the self-monitoring system of the BWMS records and provides clear indications to the crew on the degree of challenge being experienced by the BWMS. Specific CWQ instructions and procedures should be included in the OMSM to assist the ship and Administrations in developing and approving BWMPs, which should include specific, realistic actions the crew can follow to optimize the efficiency and performance of the BWMS. The OMSM should also include a table of unambiguous triggers necessitating actions in CWQ that could compromise the treatment process.

56 Manufacturers of BWMS should support providing appropriate technical information and possible actions to be taken in CWQ scenarios that are appropriate for the installed BWMS for inclusion in the ship-specific BWMP. This may include, but is not limited to:

.1 simple, easy to use operating instructions for the crew to allow prompt identification of BWMS operational issues and an understanding of BWMS alarms and relevant actions to be taken by crew when an alarm arises;

.2 clearly identifying critical alarms in the OMSM and BWMP;

.3 providing clear troubleshooting and mitigation instructions in the OMSM and BWMP for crews to use when CWQ is encountered; and

.4 actions that can be taken pre-emptively to support the BWMS in successfully operating even in CWQ conditions (paragraph 33).

57 Manufacturers of BWMS are encouraged to take efforts to collect relevant information and/or data from ship operators, as available, about BWMS operation in CWQ (including in specific water qualities, and/or at specific ports and locations, if appropriate) for the purposes of informing and guiding relevant stakeholders (e.g. ships, Administrations, port States, IMO) with a view to optimizing the operation of BWMS in CWQ. Ship crews are encouraged to cooperate with BWMS manufacturers to support collection of information and/or data regarding BWMS operations in CWQ.

APPENDIX 1

EXAMPLE DECONTAMINATION PROCEDURE

1 The following steps are intended to promote a return to compliance with regulation D-2 after a BWMS has been bypassed.

2 Having loaded the minimum volume of ballast water, proceed to the first suitable location for the discharge of ballast water from the following list:

.1 a location specified in regulation B-4.1; or

.2 a location specified in regulation B-4.2 by the port State in whose waters the BWMS is bypassed; or

.3 a location specified in regulation B-4.2 by the port State in whose waters the ballast water is to be discharged.

3 Replace the ballast water in each contaminated tank through ballast water exchange (in accordance with the operational and safety provisions of the BWMP), flushing and treatment.

.1 In the case of a ship using the sequential method, which is preferred:

.1 the ballast water should be fully discharged through the neutralization, if applicable, and/or treatment process for the deballasting operation of the BWMS, if technically feasible;

.2 the stripping pump (eductor) should be used to remove residual water from the tank;

.3 the concentration of organisms in remaining residual ballast water and sediments should be reduced by flushing the tank using the following sequential steps, if allowed and/or required by the receiving port State:[6]

.1 the addition of treated water to the ballast tanks (decontamination will be most effective with the addition of as much treated mid-ocean water into the tank as is safe for the ship and crew, at minimum an amount that will cover the entire bottom of the ballast tank);

.2 the mixing, through the motion of the ship, of the added water with the residual ballast water and any sediments that have settled in the tanks; and

.3 the release of the mixed waters; and

[6] The concentration of organisms in unmanaged ballast water (e.g. resulting from a bypass) is expected to exceed the D-2 standard. The purpose of flushing the emptied tanks with treated water is to reduce the concentration of organisms remaining in residual unmanaged ballast water and sediments. This practice has been shown to reduce the risk of subsequent ballast water discharges and can promote a return to D-2 compliance after the tank is refilled with treated water during exchange.

.4 the tank should be refilled with treated ballast water.

.2 The use of the flow-through or dilution method is not recommended. However, in the case of a ship which must use the flow-through or dilution method:

.1 a sufficient volume of treated uptake water should be pumped through to reduce the concentration of organisms in the tank to the standard in regulation D-2, at least 1.66 times the volume specified by regulation D-1.2, if required by the receiving port State;[7] and

.2 to reduce the risk that non-neutralized Active Substances could damage the environment, human health, property or resources, a ship with a BWMS that uses Active Substances should only conduct this exchange in a location described in regulation B-4.1 and in compliance with any precautions in the approved BWMP designed to ensure the safety of the ship and crew.

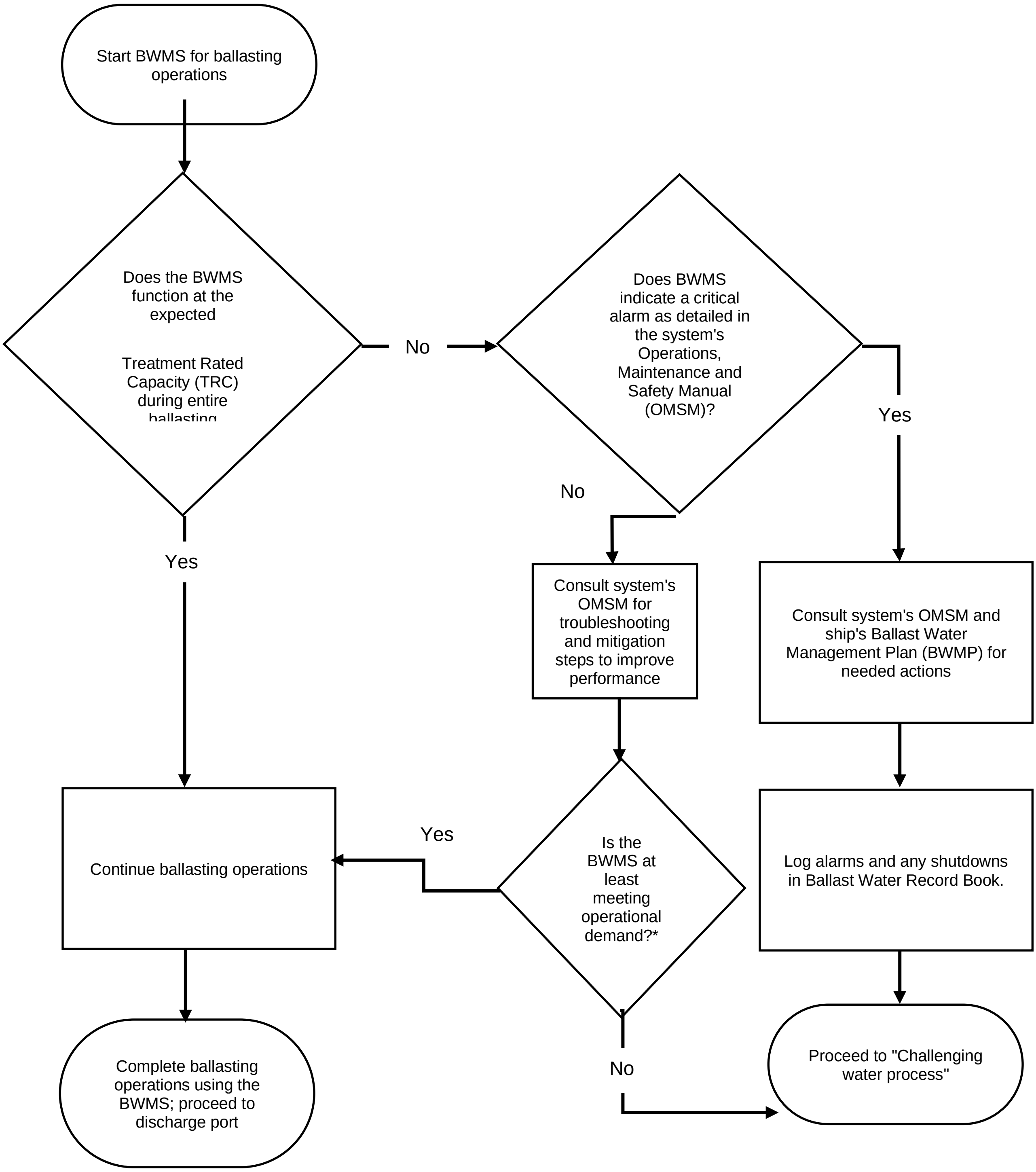
.3 Record the ballast water exchange and flushing operations in the BWRB.

[7] The concentration of organisms in unmanaged ballast water (e.g. resulting from a bypass) is expected to exceed the D-2 standard. Pumping through 1.66 times the normal volume of treated ballast water can promote a return to D-2 compliance by ensuring that a sufficient proportion of the unmanaged water (and the organisms contained within it) has been replaced with the treated water.

APPENDIX 2

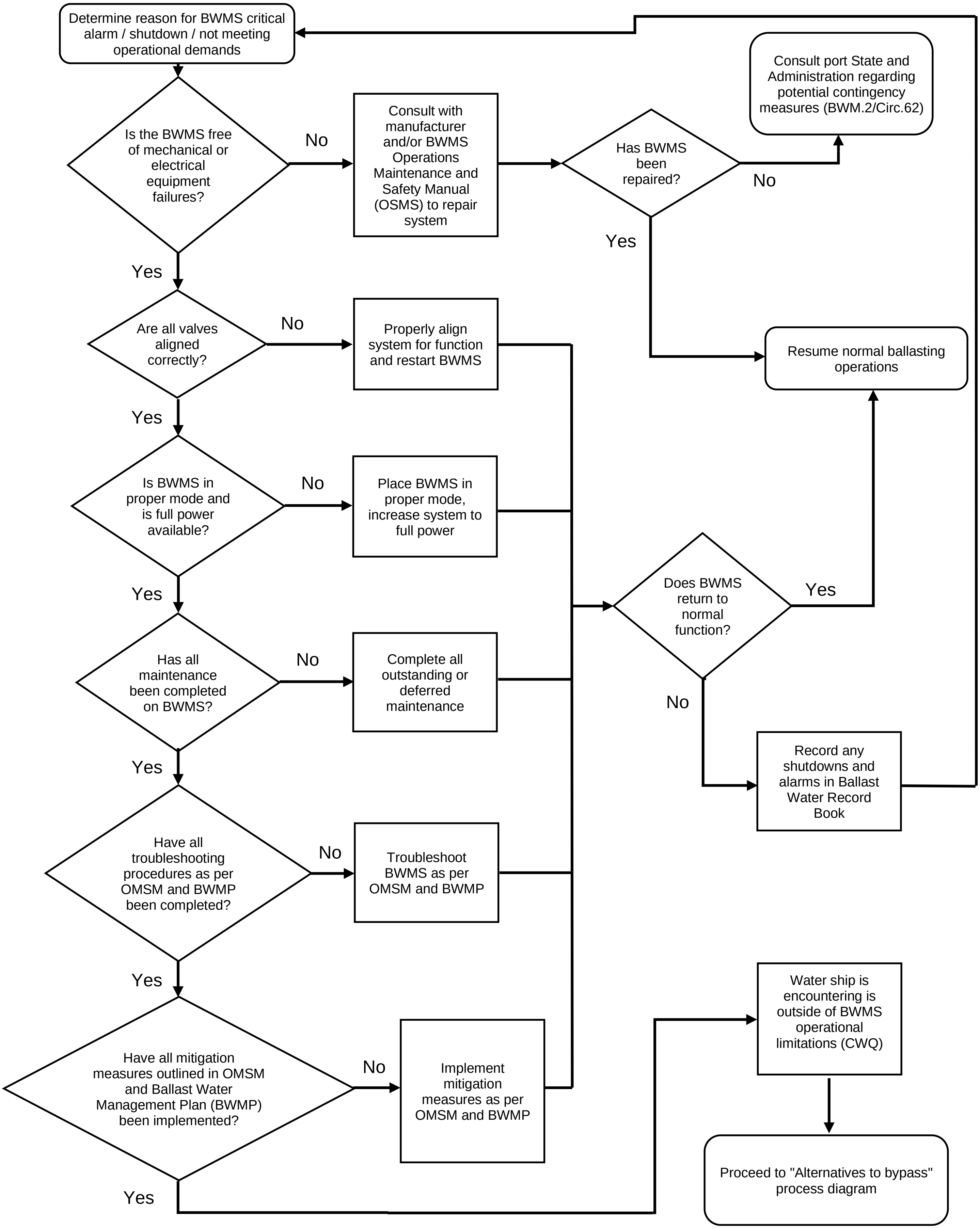
SAMPLE PROCESS DIAGRAMS FOR SHIPS BALLASTING IN AREAS WITH CHALLENGING WATER QUALITY

Process diagram 1: Assessment of BWMS operations

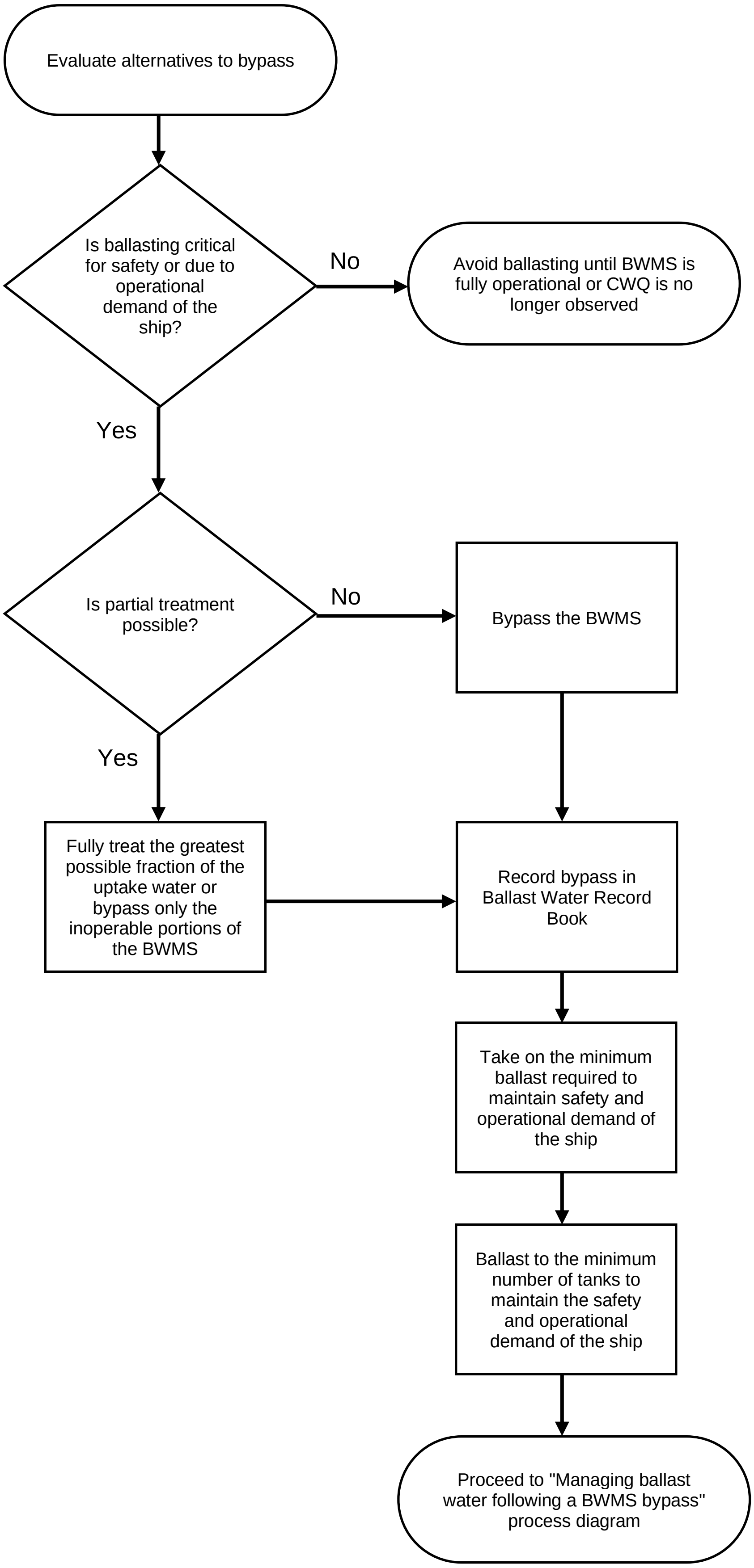


* Operational demand means the minimum BWMS flow rate defined in the approved BWMP that will permit the ship to continue cargo operations while using the BWMS, which should be no greater than 50% of the BWMS treatment rated capacity (TRC).

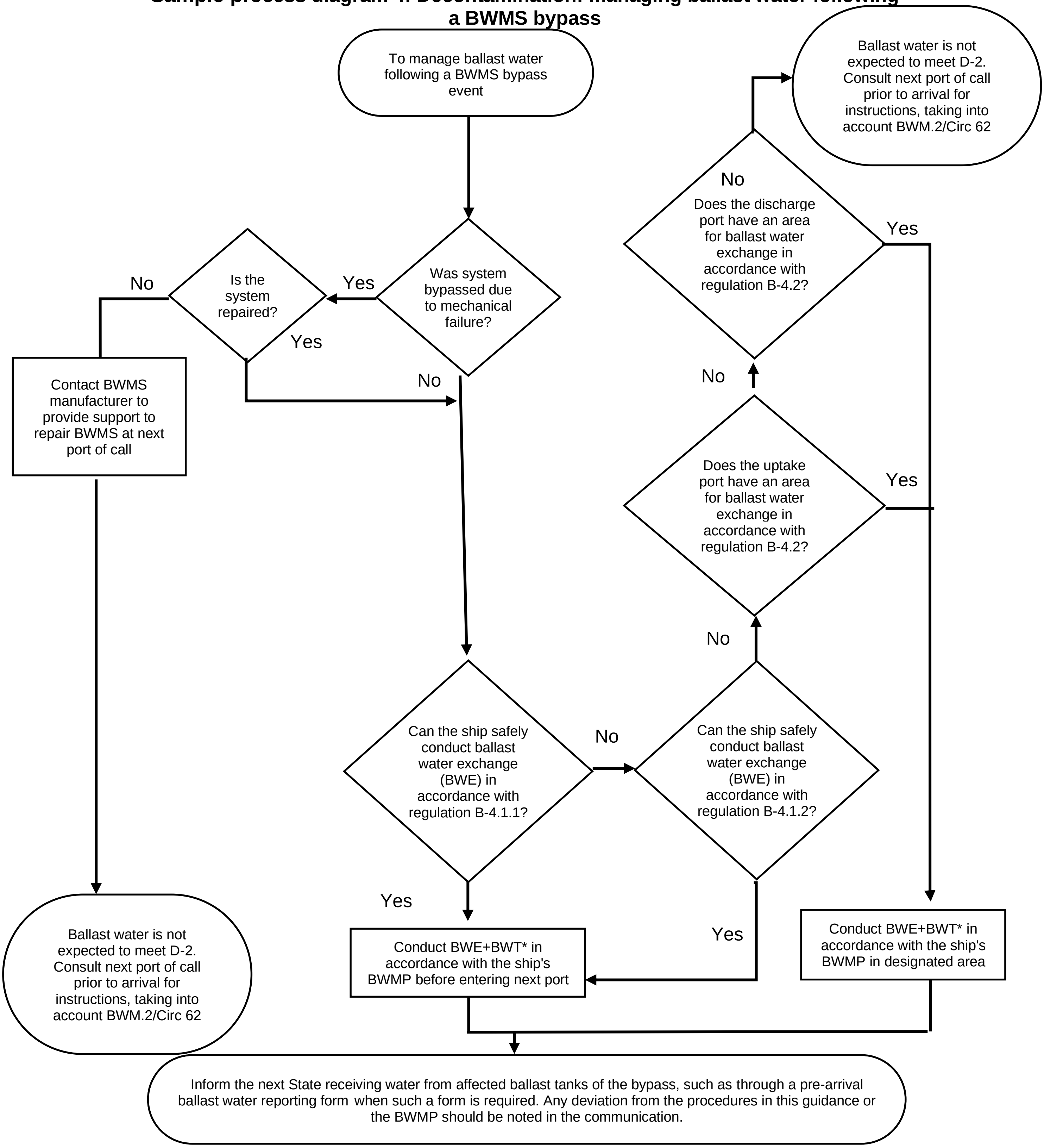
Sample process diagram 2: Challenging water quality process



Sample process diagram 3: Alternatives to bypass



Sample process diagram 4: Decontamination: managing ballast water following a BWMS bypass



* For decontamination purposes, BWE+BWT is to be done in accordance with the OMSM, approved Ballast Water Management Plan, and best practices. For the sequential method, ballast tanks should be emptied, residual ballast water and sediments should be managed (by flushing the tank with treated water, if allowed and/or required by the receiving port State), and then the tank should be refilled with treated water. For non-sequential methods, a sufficient volume of treated uptake water should be pumped through to reduce the concentration of organisms in the tank to the standard in regulation D-2, at least 1.66 times the volume specified by regulation D-1.2, if required by the receiving port State. The BWMS should be used during emptying of contaminated tanks, as well as subsequent uptakes, flushing and discharges during decontamination, if technically feasible. See appendix 1.

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ANNEX 6

RESOLUTION MEPC.388(81)
(adopted on 22 March 2024)

AMENDMENTS TO THE 2022 GUIDELINES FOR THE DEVELOPMENT OF A SHIP ENERGY EFFICIENCY MANAGEMENT PLAN (SEEMP) (RESOLUTION MEPC.346(78))

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,

NOTING that regulation 26 of MARPOL Annex VI requires each ship to keep on board a Ship Energy Efficiency Management Plan (SEEMP), to be developed and reviewed, taking into account the guidelines adopted by the Organization,

NOTING ALSO that, at its seventy-eighth session, it adopted, by resolution MEPC.346(78), the *2022 Guidelines for the development of a Ship Energy Efficiency Management Plan (SEEMP)*,

HAVING CONSIDERED, at its eighty-first session, proposed amendments to the *2022 Guidelines for the development of a Ship Energy Efficiency Management Plan (SEEMP)*,

1 ADOPTS amendments to the *2022 Guidelines for the development of a Ship Energy Efficiency Management Plan (SEEMP)*, the text of which is set out in the annex to the present resolution;

2 REQUESTS the Parties to MARPOL Annex VI and other Member Governments to bring the annexed amendments to the attention of masters, seafarers, shipowners, ship operators and any other interested parties.

ANNEX

AMENDMENTS TO THE 2022 GUIDELINES FOR THE DEVELOPMENT OF A SHIP ENERGY EFFICIENCY MANAGEMENT PLAN (SEEMP) (RESOLUTION MEPC.346(78))

1 A new paragraph 2.5 is added after paragraph 2.4, as follows:

"2.5 *Consumer type* means a type of engine or set of engines, boiler, fuel cell or others used for the same purpose."

2 Section 7 is replaced by the following:

"**7 GUIDANCE ON METHODOLOGY FOR COLLECTING DATA ON FUEL OIL CONSUMPTION, DISTANCE TRAVELLED AND HOURS UNDER WAY AND OTHER ITEMS**

Total annual fuel oil[1] consumption

7.1 Fuel oil consumption should include all the fuel oil consumed on board including but not limited to the fuel oil consumed by the main engines, auxiliary engines, gas turbines, boilers and inert gas generator, for each type of fuel oil consumed, regardless of whether a ship is under way or not. Methods for collecting data on annual fuel oil consumption in metric tonnes include (in no particular order):

.1 method using bunker delivery notes (BDNs):

This method determines the annual total amount of fuel oil used based on BDNs, which are required for fuel oil for combustion purposes delivered to and used on board a ship in accordance with regulation 18 of MARPOL Annex VI; BDNs are required to be retained on board for three years after the fuel oil has been delivered. The Data Collection Plan should set out how the ship will operationalize the summation of BDN information and conduct tank readings. The main components of this approach are as follows:

.1 annual fuel oil consumption would be the total mass of fuel oil used on board the vessel as reflected in the BDNs. In this method, the BDN fuel oil quantities would be used to determine the annual total mass of fuel oil consumption, plus the amount of fuel oil left over from the last calendar year period and less the amount of fuel oil carried over to the next calendar year period;

.2 to determine the difference between the amount of remaining tank oil before and after the period, the tank reading should be carried out at the beginning and the end of the period;

.3 in the case of a voyage that extends across the data reporting period, the tank reading should occur by tank monitoring at the ports of departure and arrival of the voyage and by statistical methods, such as rolling average using voyage days;

[1] Regulation 2.1.14 of MARPOL Annex VI defines "fuel oil" as any fuel delivered to and intended for combustion purposes for propulsion or operation on board a ship, including gas, distillate and residual fuels.

.4 fuel oil tank readings should be carried out by appropriate methods such as automated systems, soundings and dip tapes. The method for tank readings should be specified in the Data Collection Plan;

.5 the amount of any fuel oil offloaded should be subtracted from the fuel oil consumption of that reporting period. This amount should be based on the records of the ship's oil record book; and

.6 any supplemental data used for closing identified difference in bunker quantity should be supported with documentary evidence;

.2 method using flow meters:

This method determines the annual total amount of fuel oil consumption by measuring fuel oil flows on board by using flow meters. In case of the breakdown of flow meters, manual tank readings or other alternative methods will be conducted instead. The Data Collection Plan should set out information about the ship's flow meters and how the data will be collected and summarized, as well as how necessary tank readings should be conducted, as follows:

.1 annual fuel oil consumption may be the sum of daily fuel oil consumption data of all relevant fuel oil consuming processes on board measured by flow meters;

.2 the flow meters applied to monitoring should be located so as to measure all fuel oil consumption on board. The flow meters and their link to specific fuel oil consumers should be described in the Data Collection Plan;

.3 note that it should not be necessary to correct this fuel oil measurement method for sludge if the flow meter is installed after the daily tank as sludge will be removed from the fuel oil prior to the daily tank;

.4 the flow meters applied to monitoring fuel oil flow should be identified in the Data Collection Plan. Any consumer not monitored with a flow meter should be clearly identified, and an alternative fuel oil consumption measurement method should be included; and

.5 calibration of the flow meters should be specified. Calibration and maintenance records should be available on board;

.3 method using bunker fuel oil tank monitoring on board:

.1 to determine the annual fuel oil consumption, the amount of daily fuel oil consumption data measured by tank readings which are carried out by appropriate methods such as automated systems, soundings and dip tapes will be aggregated. The tank readings will normally occur daily when the ship is at sea and each time the ship is bunkering or de-bunkering; and

.2 the summary of monitoring data containing records of measured fuel oil consumption should be available on board;

.4 method using LNG cargo tank monitoring on board:

LNG ships use the Custody Transfer Monitoring System (CTMS) to monitor/record the cargo volumes inside the tanks. When calculating the consumption:

.1 the LNG liquid volume consumed is converted to mass using the methane density of 422 kg/m^3. This is because LNG is transported at methane boiling point, while other heavier hydrocarbons have a higher boiling point and remain at liquid state; and

.2 nitrogen mass content is subtracted for each laden voyage from LNG consumption as it does not contribute to CO_2 emissions;

.5 method using cargo tank monitoring on board for ships using cargo other than LNG as a fuel:

.1 to determine the annual fuel oil consumption, the amount of daily fuel oil consumption data measured by tank readings which are carried out by appropriate methods to the cargo used as a fuel. The method for tank readings should be specified in the SEEMP Data Collection Plan; and

.2 the tank readings will normally occur daily when the ship is at sea and each time the ship is loading or discharging cargo; and the summary of monitoring data containing records of measured fuel oil consumption should be available on board.

7.2 Any corrections, e.g. density, temperature, nitrogen content for LNG, if applied, should be documented.[2]

Fuel oil consumption per consumer type

7.3 For the collection of fuel oil consumption per consumer type (main engines, auxiliaries, boilers and others), the methods can include:

.1 method using flow meters:

[2] For example, ISO 8217 provides a method for liquid fuel.

This method determines the annual fuel oil consumption by measuring fuel oil flows on board by using flow meters. In case of the breakdown of flow meters, manual tank readings or other alternative methods will be conducted instead. The Data Collection Plan should set out information about the ship's flow meters and how the data will be collected and summarized, as well as how necessary tank readings should be conducted, as follows:

.1 annual fuel oil consumption may be the sum of daily fuel oil consumption data of each consumer type on board measured by flow meters;

.2 the flow meters applied to monitoring should be located so as to measure all fuel oil consumption for each consumer type;

.3 note that it should not be necessary to correct this fuel oil measurement method for sludge if the flow meter is installed after the daily tank as sludge will be removed from the fuel oil prior to the daily tank;

.4 the flow meters applied to monitoring fuel oil flow and their link to specific fuel consumer types should be identified in the Data Collection Plan. Any individual consumer of a consumer type not monitored with a flow meter should be clearly identified, and an alternative fuel oil consumption measurement method should be included; and

.5 calibration of the flow meters should be specified. Calibration and maintenance records should be available on board;

.2 method using bunker fuel oil tank monitoring on board:

.1 to determine the annual fuel oil consumption of each consumer type, the amount of daily fuel oil consumption data measured by tank readings which are carried out by appropriate methods such as automated systems, soundings and dip tapes will be aggregated. The tank readings will normally occur daily when the ship is at sea and each time the ship is bunkering or de-bunkering; and

.2 the summary of monitoring data containing records of measured fuel oil consumption should be available on board;

7.4 If there is a consumer type whose fuel oil consumption cannot be determined directly according to one of the methods indicated in paragraphs 7.3.1 and 7.3.2, the annual fuel oil consumption of that consumer type should be determined according to one of the following methods. The method used to determine the annual fuel oil consumption of each consumer type should be described in detail in the Data Collection Plan. Note that each consumer type may use a different method to measure fuel oil consumption.

.1 method using subtraction:

If the fuel consumption for only one of the consumer types is not available, the fuel consumption of this consumer type may be derived by subtracting the fuel consumption of the other consumer types from the total annual fuel oil consumption measured in paragraph 7.1; and

.2 method using estimated fuel oil consumption:

In cases where none of the above methods in paragraphs 7.3.1, 7.3.2 and 7.4.1 can be applied, an alternative method that is to the satisfaction of the Administration or any organization recognized by it may be used to estimate the annual fuel oil consumption of the consumer type, based for example on manufacturer data or actual historic fuel consumption for a specified period.

Conversion factor C_F

7.5 If fuel oils are used that do not fall into one of the categories as described in the *2022 Guidelines on the method of calculation of the attained Energy Efficiency Design Index (EEDI) for new ships* (resolution MEPC.364(79)), and have no C_F-factor assigned (e.g. some "hybrid fuel oils"), the fuel oil supplier should provide a C_F-factor for the respective product supported by documentary evidence.

Distance travelled

7.6 Appendix IX of MARPOL Annex VI specifies that distance travelled should be submitted to the Administration and:

.1 distance travelled over ground in nautical miles should be recorded in the logbook in accordance with SOLAS regulation V/28.1;[3]

.2 the distance travelled while the ship is under way under its own propulsion should be included in the aggregated data of distance travelled for the calendar year; and

.3 other methods to measure distance travelled accepted by the Administration may be applied. In any case, the method applied should be described in detail in the Data Collection Plan.

7.7 Laden distance should be calculated as the distance sailed when the ship is loaded.

Hours under way

7.8 Appendix IX of MARPOL Annex VI specifies that hours under way should be submitted to the Administration. Hours under way should be an aggregated duration while the ship is under way under its own propulsion.

[3] Distance travelled measured using satellite data is distance travelled over the ground.

Data quality

7.9 The Data Collection Plan should include data quality control measures which should be incorporated into the existing safety management system. Additional measures to be considered could include:

.1 the procedure for identification of data gaps and correction thereof; and

.2 the procedure to address data gaps if monitoring data is missing, for example, flow meter malfunctions.

Total amount of onshore power supplied

7.10 Total amount of onshore power supplied should be calculated as the sum of amount of onshore power supplied in kWh. The amount of onshore power supplied should be recorded based on relevant document by power supplier. The document should be stored. This information as shown on the bill from the port or electricity provider could be included in the electronic record.

Total transport work

7.11 Total transport work is the annual sum of each voyage's transport work which is distance sailed multiplied by cargo carried during a voyage. Relevant transport work metrics per ship types are provided in Table 1 below.

Table 1: Transport work to be reported per ship type

Ship type	**Transport work metric**
bulk carriers, tankers, combination carriers, gas carriers, LNG carriers, general cargo ships, ro-ro cargo ships (vehicle carriers), ro-ro cargo ships	$\sum_v (cargo\_mass_v \times distance_v)$
containerships	$\sum_v ((cargo\_mass_v + container\_mass_v) \times distance_v))$ and $\sum_v (No\_of\_TEU_v \times distance_v)$
cruise passenger ships	$\sum_v (No\_of\_passengers_v \times distance_v)$
ro-ro passenger ships	$\sum_v (No\_of\_passengers_v \times distance_v)$ and $\sum_v (cargo\_mass_v \times distance_v)$

A standardized data reporting format

7.12 Regulation 27.3 of MARPOL Annex VI states that the data specified in appendix IX of the Annex are to be communicated electronically using a standardized form developed by the Organization. The collected data should be reported to the Administration in the standardized format shown in appendix 3."

3 Appendix 2, section 4 is replaced by the following:

4 Ship engines and other fuel oil consumers and fuel oil types used

	Engines or other fuel oil consumer type	Power	Fuel oil types
1	Type/model of main engine	(kW)	
2	Type/model of auxiliary engine	(kW)	
3	Boiler	(…)	
4	Inert gas generator	(…)	
5	Others (Specify)	(…)	

4 Appendix 2, sections 6 and 7 are replaced by the following:

"6 Method to measure fuel oil consumption

The applied methods for measurement for each consumer type of this ship are given below. The description explains the procedure for measuring data and calculating annual values, measurement equipment involved, etc.

Engines or other fuel oil consumer type	**Method**	**Description**
Type/model of main engine		
Type/model of auxiliary engine		
Boiler		
Others (Specify)		

7 Method to measure distance travelled including laden distance

Description

"

***

ANNEX 7

RESOLUTION MEPC.389(81)
(adopted on 22 March 2024)

AMENDMENTS TO THE 2022 GUIDELINES FOR ADMINISTRATION VERIFICATION OF SHIP FUEL OIL CONSUMPTION DATA AND OPERATIONAL CARBON INTENSITY (RESOLUTION MEPC.348(78))

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,

NOTING that regulation 27.7 of MARPOL Annex VI requires that ship fuel oil consumption data be verified according to procedures established by the Administration, taking into account guidelines developed by the Organization,

NOTING ALSO that regulation 28.6 of MARPOL Annex VI specifies that the attained annual operational CII shall be documented and verified against the required annual operational CII to determine operational carbon intensity rating, taking into account the guidelines developed by the Organization,

NOTING FURTHER that, at its seventy-eighth session, it adopted, by resolution MEPC.348(78), the *2022 Guidelines for Administration verification of ship fuel oil consumption data and operational carbon intensity*,

HAVING CONSIDERED, at its eighty-first session, proposed amendments to the *2022 Guidelines for Administration verification of ship fuel oil consumption data and operational carbon intensity*,

1 ADOPTS amendments to the *2022 Guidelines for Administration verification of ship fuel oil consumption data and operational carbon intensity*, as set out in the annex to the present resolution;

2 REQUESTS the Parties to MARPOL Annex VI and other Member Governments to bring the annexed amendments to the attention of masters, seafarers, shipowners, ship operators and any other interested parties.

ANNEX

AMENDMENTS TO THE 2022 GUIDELINES FOR ADMINISTRATION VERIFICATION OF SHIP FUEL OIL CONSUMPTION DATA AND OPERATIONAL CARBON INTENSITY (RESOLUTION MEPC.348(78))

1 Paragraph 4.1.5 is replaced by the following:

"4.1.5 copies of documents containing information on the amount of fuel oil consumption, distance travelled, hours under way for the ship's voyages and the other data during the reporting period (e.g. the ship's official logbook, oil record book, BDNs, arrival/noon/departure reports, and from auto-log data files); and"

2 The Table in appendix 2 is replaced by the following:

SAMPLE OF THE COLLECTED DATA SUMMARIES

Date and time from (dd/mm/yyyy; hh:mm UTC)	* Date and time to (dd/mm/yyyy; hh:mm UTC)	Distance travelled (nm)	Hours under way (hh:mm) **	Cargo carried (metric tons)	Cargo carried (TEU)	Cargo carried (Passenger)	(voluntary basis) Laden voyage (Y/N)	***exceptional conditions Specified in regulation 3.1 of MARPOL Annex VI (Y/N)	***Sailing in ice condition (Y/N)	***STS Operation (Y/N) …….	Fuel consumption (metric tons) Main engine(s)			
											HFO****	LFO	MGO	etc.
01/01/2023 00:00	01/01/2023 13:20	150	13:20	1,500			Y	N	N	N				
……	……	……	……	…….				…….	…….	…….				
31/12/2023 00:00	31/12/2023 24:00	290	24:00	1,500			Y	N	N	N				
Annual Total														

(continued from the table above)

Fuel consumption (metric tons)																							
Auxiliary engine(s)				Boiler(s)				Others (Specify)				***mass to be deducted from the total											
												consumed for production of electrical power($FC_{electrical}$)				consumed by oil-fired boiler for cargo heating/discharge on tankers (FC_{boiler})				consumed by stand-alone engine driven cargo pumps during discharge operations on tankers(FC_{others})			
HFO	LFO	MGO	etc.	HFO	LFO	MGO	etc.	HFO	LFO	MGO	etc.	HFO	LFO	MGO	etc.	HFO	LFO	MGO	etc.	HFO	LFO	MGO	etc.

* In the case of daily underlying data, this column would be left blank.

** Hours under way should be equal to the time between the start and end date and time. In case the segment is not under way, it should be left blank.

*** Refer to the *2022 Interim guidelines on correction factors and voyage adjustments for CII calculations (G5)*, adopted by resolution MEPC.355(78). Supporting documentation may be additionally submitted to facilitate the verification when necessary, such as Baplie files where the number of in-use reefer containers on board are recorded. Note that voyages in different sailing or operational conditions should be recorded in separate rows so that the correction factors and voyage adjustments can be duly calculated and verified.

**** Refer to fuel types specified in the *2022 Guidelines on the method of calculation of the attained Energy Efficiency Design Index (EEDI) for new ships* (resolution MEPC.364(79), as may be amended)

Explanatory remarks: If bunker supply/correction data have been recorded in a company's electronic reporting system, the data is acceptable to be submitted in the existing format instead of submitting the data by this format.

***

ANNEX 8

RESOLUTION MEPC.390(81)
(adopted on 22 March 2024)

AMENDMENTS TO THE 2021 GUIDELINES ON THE SHAFT / ENGINE POWER LIMITATION SYSTEM TO COMPLY WITH THE EEXI REQUIREMENTS AND USE OF A POWER RESERVE (RESOLUTION MEPC.335(76)), AS AMENDED BY RESOLUTION MEPC.375(80))

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,

NOTING that the 2021 Revised MARPOL Annex VI, which entered into force on 1 November 2022, contains requirements concerning mandatory goal-based technical and operational measures to reduce carbon intensity of international shipping,

NOTING ALSO that ships may be equipped with a shaft / engine power limitation system in order to comply with regulation 25 of MARPOL Annex VI on the 'Required EEXI',

NOTING FURTHER that, at its seventy-sixth session, it adopted, by resolution MEPC.335(76), the *2021 Guidelines on the shaft/engine power limitation system to comply with the EEXI requirements and use of a power reserve*,

NOTING that, at its eightieth session, the Committee adopted, by resolution MEPC.375(80), amendments to the *2021 Guidelines on the shaft/engine power limitation system to comply with the EEXI requirements and use of a power reserve*.

HAVING CONSIDERED, at its eighty-first session, proposed amendments to the *2021 Guidelines on the shaft/engine power limitation system to comply with the EEXI requirements and use of a power reserve*,

1 ADOPTS amendments to the *2021 Guidelines on the shaft/engine power limitation system to comply with the EEXI requirements and use of a power reserve*, the text of which is set out in the annex to the present resolution;

2 REQUESTS the Parties to MARPOL Annex VI and other Member Governments to bring the annexed amendments to the attention of masters, seafarers, shipowners, ship operators and any other interested parties.

ANNEX

AMENDMENTS TO THE 2021 GUIDELINES ON THE SHAFT / ENGINE POWER LIMITATION SYSTEM TO COMPLY WITH THE EEXI REQUIREMENTS AND USE OF A POWER RESERVE (RESOLUTION MEPC.335(76)), AS AMENDED BY RESOLUTION MEPC.375(80))

1 Paragraph 2.1.1.3 is replaced by the following:

".3 a control unit for calculation and limitation of the power transmitted by the shaft to the propeller(s); if this control unit is independent from the engine automation the following should be satisfied:

.1 override of limitation is indicated by giving an alarm on the bridge, clearly informing the ship's master or OICNW. Acceptance of this alarm by the master or OICNW is the deliberate action referred to in paragraph 2.2.1;

.2 in case of exceedance, the ship's master or OICNW to manually reduce the power within the limit;

.3 in case of deliberate use of power reserve, data recording to commence automatically;

.4 data recording device as defined in section 2.1.1.2; and

.5 in case of short-term unintentional exceedance of the power limit the system may inhibit the initiation of the exceedance alarm for up to a maximum of five (5) minutes."

2 Paragraph 2.2.1 is replaced by the following:

"2.2.1 The SHaPoLi / EPL system should be non-permanent but should require the deliberate action of the ship's master or OICNW to enable the use of unlimited shaft / engine power (power reserve) of the ship. For systems that use a Password/PIN to control access to the power reserve override, attention should be paid to ensure that the necessary Password/PIN is always available when override is required. In a scenario specified in regulation 3.1 of MARPOL Annex VI, which may endanger safe navigation of the ship, immediate use may be achieved by procedural arrangements for pre-emptive un-limiting the SHaPoLi/EPL system."

3 Paragraph 3.3 is replaced by the following:

"3.3 The use of the power reserve should be distinguished from the precautionary un-limiting of a shaft or engine power limitation system. Where an EPL/ShaPoLi override is activated pre-emptively when hazards are anticipated, but the power reserve is not subsequently used, this event should be recorded in the bridge and engine-room logbooks. The engine-room logbook should record power used during the period when the override was activated. The EPL/ShaPoLi should be reset as soon as possible, and details of the reset should also be recorded in the bridge and engine-room logbooks."

4 A new section 6 is added, after existing section 5, as follows:

"**6 Additional information to be provided, as applicable**

The following documents described in the appendices to *Recommendation on the Provision and Display of Manoeuvring Information on Board Ships* (annex, resolution A.601(15)) should be updated to include the manoeuvring characteristics of the ship when the ship has all shaft and engine power available, and when shaft or engine power has been limited:

.1 the Pilot card;

.2 the wheelhouse poster; and

.3 the manoeuvring booklet."

***

ANNEX 10

RESOLUTION MEPC.391(81)
(adopted on 22 March 2024)

2024 GUIDELINES ON LIFE CYCLE GHG INTENSITY OF MARINE FUELS (2024 LCA GUIDELINES)

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

RECALLING FURTHER that, at its eightieth session, it also adopted, by resolution MEPC.376(80), *Guidelines on life cycle GHG intensity of marine fuels* (LCA Guidelines);

NOTING that the 2023 IMO GHG Strategy provides that the levels of ambition and indicative checkpoints set out therein should take into account the well-to-wake GHG emissions of marine fuels as addressed in the LCA Guidelines,

NOTING ALSO that the 2023 IMO GHG 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 LCA Guidelines,

HAVING CONSIDERED, at its eighty-first session, draft 2024 Guidelines on life cycle GHG intensity of marine fuels,

1 ADOPTS the *2024 Guidelines on life cycle GHG intensity of marine fuels (2024 LCA Guidelines)*, as set out in the annex to the present resolution;

2 AGREES that any regulatory application and implications of the 2024 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;

5 REVOKES the LCA Guidelines adopted by resolution MEPC.376(80).

**2024 GUIDELINES ON LIFE CYCLE GHG INTENSITY OF MARINE FUELS
(2024 LCA Guidelines)**

CONTENTS

PART I: GENERAL

1 INTRODUCTION

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 and 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) 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.

---

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.

2.3 Consistent 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 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.

[3] The global warming potential values as given in the *IPCC Fifth Assessment Report* (AR5) are used in the context of these Guidelines.

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.

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.

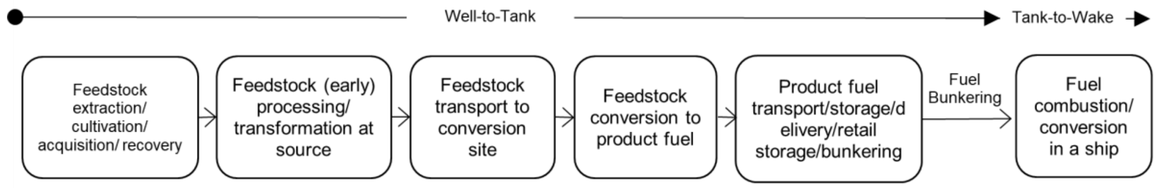

Figure 1: Generic well-to-wake supply chain

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* (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.

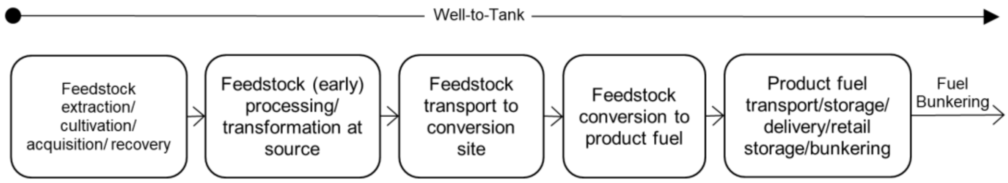

Figure 2: Generic well-to-tank supply chain

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]
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

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
		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. Regarding emissions from bunkering, it is included till the bunker manifold, including emission from the bunker manifold connection.

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, from the bunker manifold up to the energy converter which is leaked, vented or otherwise lost in the system, 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/
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

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.

10 Set at 265 based on IPCC AR5.

$\boldsymbol{Term}$	**Units**	**Explanation**
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
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.

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.

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)

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

<u>Note</u>: 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).

Theme/aspect	Principle/Objective	Metric/Indicator
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 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.

14 Pending further guidance to be developed by the Organization.

Theme/aspect	Principle/Objective	Metric/Indicator
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 paragraph 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); 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.

Theme/aspect	Principle/Objective	Metric/Indicator
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 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.

Theme/aspect	Principle/Objective	Metric/Indicator
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

+

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

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 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;

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

[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.

.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 not 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.

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 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 For the establishment of $e_{l,}$ and following IPCC (2019) and ISO 14067:2018 recommendations, the operators should use the following Equation (5) for the determination of e_l[18], measured as mass (g) of CO_2eq per MJ of energy:

Equation (5): $e_l = ((CS_{R,j} - CS_{A,j}) \times 3.664 + E_{nCO2,j}) \times \frac{1}{n\,x\,P}$

[18] Economic operators are expected to discriminate land types at the appropriate level of detail.

The terms refer to:

$CS_{R,j}$ the carbon stock of the land type j per unit area associated with the reference land-use (measured as mass (g) of carbon per unit area (ha), including both soil and vegetation and dead organic matter). The reference land-use should be the land-use in January 2008 or 20 years before the raw material was obtained, whichever was the later;

$CS_{A,j}$ the carbon stock of the land type j per unit area associated with the actual land-use (measured as mass (g) of carbon per unit area (ha), including both soil and vegetation and dead organic matter). In cases where the carbon stock accumulates over more than one year, the value attributed to CS_A should be the estimated stock per unit area after 20 years or when the crop reaches maturity, whichever the earlier;

3.664 the quotient obtained by dividing the molecular weight of CO_2 (44,010g/mol) by the molecular weight of carbon (12,011g/mol) in gCO_2eq/g C;

n equal to 20, which corresponds to the number of years for amortization of the emissions in the IMO framework;

P the productivity of the crop (measured as MJ of energy per ha per year); and

E_{nCO2j} emission factor for non-CO_2 emissions from biomass burned (measured as gCO_2eq per unit area (ha)), accounted in the equation only if the necessary information on area burned is available. Details of the E_{nCO2j} formula should follow methodology to be defined.

9.6 According to existing standards, the CS_R and CS_A parameters have to be determined by means of direct measurements of soil carbon stocks, or calculated. CS_R and CS_A values, measured as mass (g) of carbon per unit area (ha), are obtained by considering:

$$CS_{R,j\ o\ A,j} = SOC_j + C_{veg,j}$$

9.7 Where C_{veg} is the above and below ground carbon stock of the vegetation, including dead organic matter, measured as mass (g) of carbon per unit area (ha), which shall follow IPCC Guidelines. *SOC* parameter is the amount of soil organic carbon (measured as mass (g) of carbon per unit area (ha)) and consists of four factors, which depend on climate, soil type, management practice and C-input practice: the standard soil organic carbon in the topsoil layer (SOC_{ST}), the land use factor (F_{LU}), the management factor (F_{MG}) and the input factor (F_i).

Where:

$$SOC_j = \left(SOC_{ST,j} * F_{LU,j} * F_{MG,j} * F_{i,j}\right)$$

9.8 Methods not based on measurements could be used as an alternative to calculate *SOC* with standard values, taking into account climate, soil type, land cover, land management and inputs.

9.9 Aggregation of areas: apply the same Equation (5) (e_l) on each type *j* of eligible land (e_{lj}), as follow:

$$e_{lj} = \frac{e_l}{l_j} - e_{bj}$$

$$l_j = \frac{L_j \times y_j}{\sum_j L_j \times y_j}$$

Where:

lj is the land use share of type *j;*

e_b is the specific bonus, measured in terms of gCO_2eq per of energy if biomass is obtained from recovered severely degraded land. This parameter needs to be defined in further discussions and if there is consensus, the specific bonus will be subtracted from the equation;

L_j is the area of each reference type of land *j* converted to feedstock cultivation, measured in hectare; and

y_l is the yield of feedstock for each type of converted land *j*, measured in tons per hectare per year.

9.10 The operators should apply the following formula on all types of eligible land to calculate DLUC, in gCO_2 e/MJ:

$$e_l = \sum_j e_{lj} \times l_j$$

9.11 For the establishment of e_{sca} and following IPCC (2019) and ISO 14067:2018 recommendations, the equation that an operator should use for the determination of e_{sca}, measured as mass (g) of CO_2eq per MJ biofuel, is the following:

Equation (6): $e_{sca} = \left(CS_{A,j} - CS_{R,j}\right) \times 3.664 \times \frac{1}{n\,x\,P}$

The terms refer to:

$CS_{R,j}$ the mass of soil and vegetation carbon stock of the land type *j* per unit area associated with the reference crop management practice in g of C per ha in January 2008 or 20 years before the raw material was obtained;

$CS_{A,j}$ the mass of soil and vegetation estimated carbon stock of the land type *j* per unit area associated with the actual crop management practices after at least 10 years of application in g of C per ha;

3.664 the quotient obtained by dividing the molecular weight of CO_2 (44,010g/mol) by the molecular weight of carbon (12,011g/mol) in g CO_2eq/g C;

n equal to 20, which corresponds to the number of years for amortization of the emissions in the IMO framework; and

P the productivity of the crop (measured as MJ biofuel per ha per year).

The emissions from the increased fertilizers or herbicide use, which may result from the specific agricultural practice, expressed in gCO_2eq per MJ biofuel, have to be properly accounted in the emissions associated with the feedstock extraction / cultivation / acquisition / recovery (e_{fecu}).

9.12 According to existing standards, the CS_R and CS_A parameter have to be determined by means of direct measurements of soil and vegetation carbon stocks or calculated by appropriate tools, accepted in the certification process. the CS_R and CS_A values, measured as mass (g) of carbon per unit area (ha), are obtained by considering:

$$CS_{R,j\ o\ A.j} = SOC_j + C_{veg,j}$$

Where C_{veg} is the above and below ground carbon stock of the vegetation, including dead organic matter, measured as mass (g) of carbon per unit area (ha), according to IPCC Guidelines.

SOC is the amount of soil organic carbon, measured as mass (g) of carbon per unit area (ha).

Appropriate conversion is needed to obtain a final gCO_2eq/MJ of fuel.

9.13 Methods not based on measurements could be used as an alternative to calculate *SOC* with standard values, taking into account climate, soil type, land cover, land management and inputs. The IPCC Guidelines methodology can be applied for calculation of changes in carbon stocks. The adoption of improved agricultural management practices must be addressed under the IPCC "cropland remaining cropland" framework. The parameter consists of four factors, which depend on climate, soil type, management practice and C-input practice: the standard soil organic carbon in the topsoil layer (SOC_{ST}),[19] the land use factor (F_{LU}), the management factor (F_{MG}) and the input factor (F_i). Deeper soil depths (i.e.: 1m or more) can be accepted in case of actual measurements of C stocks soil.

Where:

$$SOC_j = \left(SOC_{ST,j} * F_{LU,j} * F_{MG,j} * F_{i,j}\right)$$

9.14 For aggregation of areas, the same Equation (6) (e_{sca}) should be applied on each type *j* of eligible land ($e_{sca,j}$), as follow:

$$e_{sca,j} = \frac{e_{sca}}{l_j}$$

$$l_j = \frac{L_j \times y_j}{\sum_j L_j \times y_j}$$

Where:

lj is the land use share of type *j;*

L_j is the area of each reference type of land *j* converted to feedstock cultivation, measured in hectare; and

[19] Proper method to assess SOC_{ST} to be agreed with the certification scheme.

y_l is the yield of feedstock for each type of converted land j, measured in tonnes per hectare per year.

9.15 The following formula should be applied on all types of eligible land to calculate e_{sca}, in gCO_2e/MJ:

$$e_{sca} = \sum_j e_{sca,j} \times l_j$$

9.16 A non-exhaustive set of improved agriculture management practices, accepted for the purpose of achieving emission savings from soil carbon accumulation is listed below:

.1 shifting to meaningful reductions in soil tillage;

.2 improved crop/rotation schemes (i.e *SOC* increase);

.3 multicropping, intercropping, and crop rotation;

.4 integration systems of crop, livestock, and forestry;

.5 the use of cover crops, including crop residue management;

.6 the use of organic soil improver (e.g.: compost, digestate, biochar, etc.);

.7 meaningful increase in soil coverage;

.8 no till and reduced till;

.9 sugarcane harvested without burning; and

.10 structural measure to control soil erosion like contour farming.

9.17 TtW default emission factors should be calculated using representative and conservative assumptions, which encompass variable conditions onboard of the ships and performance of energy converters. The reference values used to establish default emission factors should be accompanied by the relevant technical and scientific information (see the template set out in appendix 5) and evaluated against the corresponding information as appropriate, including the agreement between the reference values.

9.18 For the establishment of C_{fCO2} for fuels that can be represented using chemical formula, C_{fCO2} emission factor can be calculated by dividing the molar ratio of carbon to CO_2 by the molar ratio of carbon to the fuel. If fuels cannot be represented using chemical formula, such as biofuels and fossil fuels, the C_{fCO2} factor can be calculated using actual measurement of carbon content according to internationally recognized standards as ASTM D5291 and D6866, etc.

9.19 The C_{fCH4}, C_{fN2O} and C_{slip} emission factors depend on the type of fuel, engine and the engine load. In the case of existing fuels and existing engines, these factors can be obtained using reference values from the *Fourth IMO GHG Study 2020.*[20] However, for other types of fuels and engines, further work is needed to establish measurement procedures.

[20] https://www.imo.org/en/ourwork/Environment/Pages/Fourth-IMO-Greenhouse-Gas-Study-2020.aspx

9.20 Fugitive emissions are difficult to measure but the existing studies state they are very small in comparison to other GHG emissions. C_{fug} should be set as 0 (zero) until further evidence enabling the establishment of a value exists, nevertheless it should be kept as a placeholder for continuous review.

9.21 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 9.17 above may be followed to ensure that these new converters (e.g. fuel cells) may also be associated with a default emission factor.

9.22 For aftertreatment/abatement systems, no default values should be established due to varying performance of this equipment, instead a superior GHG performance can be demonstrated through actual emission factors, subject to verification and certification by a third party.

9.23 For electricity delivered by Onshore Power Supply (OPS) the GHG intensity default value corresponds to the GHG intensity of the national grid. Considering that the GHG intensity national grid are frequently updated this information is not included in these guidelines and the following sources can be used, if the methodology is based in internationally recognized standards: governmental and utility sources, internationally acknowledged public databases, national inventories and national energy regulators.

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[21] and provided in these guidelines. As mentioned in paragraphs 9.19 and 9.22, further work is needed to develop procedures to certify C_{fCH4}, C_{fN2O} and C_{slip} emission factors, and to take in consideration aftertreatment/abatement systems.

10.6 Power Purchase Agreements (PPA) including a GHG intensity for electricity delivered by OPS can be used to certify an actual value if a procedure is in place to establish electricity GHG intensity and a certificate of the Guarantees of Origin, recognized by the Organization.

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

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.

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
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

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

Order	Group	Fuel type	Feedstock structure		Conversion/Production process		Fuel Pathway Code
			Feedstock Type	Nature/Carbon Source	Process Type	Energy used in the process	
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
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[22]	Liquefied Petroleum Gas (Propane)	Crude Oil	Fossil	Standard refinery process and liquefaction	Grid mix electricity	LPG(Propane)_f_SR_gm

22 Regarding LPG, these Guidelines consider the final product form the refineries to be always 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	
12	LPG	Liquefied Petroleum Gas (Propane)	CO_2 + H2	CO_2: Fossil Point Source Carbon Capture H2: Fossil Steam Methane Reformation	Fischer-Tropsch Synthesis and liquefaction	Grid mix electricity	LPG(Propane)_fCO_2_fH2_FT_gm
13	LPG	Liquefied Petroleum Gas (Propane)	CO_2 + H2	CO_2: Fossil Point Source Carbon Capture[23] H2: from Renewable electricity	Fischer-Tropsch Synthesis and liquefaction	Grid mix electricity	LPG(Propane)_fCO_2_rH2_FT_gm
14	LPG	Liquefied Petroleum Gas (Propane)	CO_2 + H2	CO_2: Fossil Point Source Carbon Capture H2: Industrial by-product hydrogen	Fischer-Tropsch Synthesis and liquefaction	Grid mix electricity	LPG(Propane)_fCO_2_ibpH2_FT_gm
15	LPG	Liquefied Petroleum Gas (Propane)	CO_2 + H2	CO_2: Direct Air Capture H2: Fossil Steam Methane Reformation	Fischer-Tropsch Synthesis and liquefaction	Grid mix electricity	LPG(Propane)_rCO_2_fH2_FT_gm

[23] 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	
16	LPG	Liquefied Petroleum Gas (Propane)	CO_2 + H2	CO_2: Direct Air Capture H2: from Renewable electricity	Fischer-Tropsch Synthesis and liquefaction	Grid mix electricity	LPG(Propane)_rCO_2_rH2_FT_gm
17	LPG	Liquefied Petroleum Gas (Propane)	CO_2 + H2	CO_2: Direct Air Capture H2: Industrial by-product hydrogen	Fischer-Tropsch Synthesis and liquefaction	Grid mix electricity	LPG(Propane)_rCO_2_ibpH2_FT_gm
18	LPG	Liquefied Petroleum Gas (Propane)	CO_2 + H2	CO_2: Biogenic Point Source Carbon Capture H2: Fossil Steam Methane Reformation	Fischer-Tropsch Synthesis and liquefaction	Grid mix electricity	LPG(Propane)_bCO_2_fH2_FT_gm
19	LPG	Liquefied Petroleum Gas (Propane)	CO_2 + H2	CO_2: Biogenic Point Source Carbon Capture H2: from Renewable electricity	Fischer-Tropsch Synthesis and liquefaction	Grid mix electricity	LPG(Propane)_bCO_2_rH2_FT_gm
20	LPG	Liquefied Petroleum Gas (Propane)	CO_2 + H2	CO_2: Biogenic Point Source Carbon Capture H2: Industrial by-product hydrogen	Fischer-Tropsch Synthesis and liquefaction	Grid mix electricity	LPG(Propane)_bCO_2_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	
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 + H2	CO_2: Fossil Point Source Carbon Capture H2: Fossil Steam Methane Reformation	Fischer-Tropsch Synthesis and liquefaction	Grid mix electricity	LPG(Butane)_fCO_2_fH2_FT_gm
23	LPG	Liquefied Petroleum Gas (Butane)	CO_2 + H2	CO_2: Fossil Point Source Carbon Capture H2: from Renewable electricity	Fischer-Tropsch Synthesis and liquefaction	Grid mix electricity	LPG(Butane)_fCO_2_rH2_FT_gm
24	LPG	Liquefied Petroleum Gas (Butane)	CO_2 + H2	CO_2: Fossil Point Source Carbon Capture H2: Industrial by-product hydrogen	Fischer-Tropsch Synthesis and liquefaction	Grid mix electricity	LPG(Butane)_fCO_2_ibpH2_FT_gm
25	LPG	Liquefied Petroleum Gas (Butane)	CO_2 + H2	CO_2: Direct Air Capture H2: Fossil Steam Methane Reformation	Fischer-Tropsch Synthesis and liquefaction	Grid mix electricity	LPG(Butane)_rCO_2_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	
26	LPG	Liquefied Petroleum Gas (Butane)	CO_2 + H2	CO_2: Direct Air Capture H2: from Renewable electricity	Fischer-Tropsch Synthesis and liquefaction	Grid mix electricity	LPG(Butane)_rCO_2_rH2_FT_gm
27	LPG	Liquefied Petroleum Gas (Butane)	CO_2 + H2	CO_2: Direct Air Capture H2: Industrial by-product hydrogen	Fischer-Tropsch Synthesis and liquefaction	Grid mix electricity	LPG(Butane)_rCO_2_ibpH2_FT_gm
28	LPG	Liquefied Petroleum Gas (Butane)	CO_2 + H2	CO_2: Biogenic Point Source Carbon Capture H2: Fossil Steam Methane Reformation	Fischer-Tropsch Synthesis and liquefaction	Grid mix electricity	LPG(Butane)_bCO_2_fH2_FT_gm
29	LPG	Liquefied Petroleum Gas (Butane)	CO_2 + H2	CO_2: Biogenic Point Source Carbon Capture H2: from Renewable electricity	Fischer-Tropsch Synthesis and liquefaction	Grid mix electricity	LPG(Butane)_bCO_2_rH2_FT_gm
30	LPG	Liquefied Petroleum Gas (Butane)	CO_2 + H2	CO_2: Biogenic Point Source Carbon Capture H2: Industrial by-product hydrogen	Fischer-Tropsch Synthesis and liquefaction	Grid mix electricity	LPG(Butane)_bCO_2_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	
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
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 + H2	CO_2: Fossil Point Source Carbon Capture H2: Fossil Steam Methane Reformation	Methanation and liquefaction	Grid mix electricity	LNG_fCO_2_fH2_M_gm
36	LNG	Liquefied Natural Gas (Methane)	CO_2 + H2	CO_2: Fossil Point Source Carbon Capture H2: from Renewable electricity	Methanation and liquefaction	Grid mix electricity	LNG_fCO_2_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 + H2	CO_2: Fossil Point Source Carbon Capture H2: Industrial by-product hydrogen	Methanation and liquefaction	Grid mix electricity	LNG_fCO_2_ibpH2_M_gm
38	LNG	Liquefied Natural Gas (Methane)	CO_2 + H2	CO_2: Direct Air Capture H2: Fossil Steam Methane Reformation	Methanation and liquefaction	Grid mix electricity	LNG_rCO_2_fH2_M_gm
39	LNG	Liquefied Natural Gas (Methane)	CO_2 + H2	CO_2: Direct Air Capture H2: from Renewable electricity	Methanation and liquefaction	Grid mix electricity	LNG_rCO_2_rH2_M_gm
40	LNG	Liquefied Natural Gas (Methane)	CO_2 + H2	CO_2: Direct Air Capture H2: Industrial by-product hydrogen	Methanation and liquefaction	Grid mix electricity	LNG_rCO_2_ibpH2_M_gm
41	LNG	Liquefied Natural Gas (Methane)	CO_2 + H2	CO_2: Biogenic Point Source Carbon Capture H2: Fossil Steam Methane Reformation	Methanation and liquefaction	Grid mix electricity	LNG_bCO_2_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 + H2	CO_2: Biogenic Point Source Carbon Capture H2: from Renewable electricity	Methanation and liquefaction	Grid mix electricity	LNG_bCO_2_rH2_M_gm
43	LNG	Liquefied Natural Gas (Methane)	CO_2 + H2	CO_2: Biogenic Point Source Carbon Capture H2: Industrial by-product hydrogen	Methanation and liquefaction	Grid mix electricity	LNG_bCO_2_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 Point Source Carbon Capture (PSCC) and long-term storage and compression	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	
48	CNG	Compressed Natural Gas (Methane)	CO_2 + H2	CO_2: Fossil Point Source Carbon Capture H2: Fossil Steam Methane Reformation	Methanation and compression	Grid mix electricity	CNG_fCO_2_fH2_M_gm
49	CNG	Compressed Natural Gas (Methane)	CO_2 + H2	CO_2: Fossil Point Source Carbon Capture H2: from Renewable electricity	Methanation and compression	Grid mix electricity	CNG_fCO_2_rH2_M_gm
50	CNG	Compressed Natural Gas (Methane)	CO_2 + H2	CO_2: Fossil Point Source Carbon Capture H2: Industrial by-product hydrogen	Methanation and compression	Grid mix electricity	CNG_fCO_2_ibpH2_M_gm
51	CNG	Compressed Natural Gas (Methane)	CO_2 + H2	CO_2: Direct Air Capture H2: Fossil Steam Methane Reformation	Methanation and compression	Grid mix electricity	CNG_rCO_2_fH2_M_gm
52	CNG	Compressed Natural Gas (Methane)	CO_2 + H2	CO_2: Direct Air Capture H2: from Renewable electricity	Methanation and compression	Grid mix electricity	CNG_rCO_2_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	
53	CNG	Compressed Natural Gas (Methane)	CO_2 + H2	CO_2: Direct Air Capture H2: Industrial by-product hydrogen	Methanation and compression	Grid mix electricity	CNG_rCO_2_ibpH2_M_gm
54	CNG	Compressed Natural Gas (Methane)	CO_2 + H2	CO_2: Biogenic Point Source Carbon Capture H2: Fossil Steam Methane Reformation	Methanation and compression	Grid mix electricity	CNG_bCO_2_fH2_M_gm
55	CNG	Compressed Natural Gas (Methane)	CO_2 + H2	CO_2: Biogenic Point Source Carbon Capture H2: from Renewable electricity	Methanation and compression	Grid mix electricity	CNG_bCO_2_rH2_M_gm
56	CNG	Compressed Natural Gas (Methane)	CO_2 + H2	CO_2: Biogenic Point Source Carbon Capture H2: Industrial by-product hydrogen	Methanation and compression	Grid mix electricity	CNG_bCO_2_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

Order	Group	Fuel type	Feedstock structure		Conversion/Production process		Fuel Pathway Code
			Feedstock Type	Nature/Carbon Source	Process Type	Energy used in the process	
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 Fischer-Tropsch Synthesis	Grid mix electricity	FT-Diesel_b_AD_FT_gm
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 + H2	CO_2: Fossil Point Source Carbon Capture H2: Fossil Steam Methane Reformation	Fischer-Tropsch Synthesis	Grid mix electricity	FT-Diesel_fCO₂_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	
68	Diesel	Renewable Diesel (FT-Diesel)	CO_2 + H2	CO_2: Fossil Point Source Carbon Capture H2: from Renewable electricity	Fischer-Tropsch Synthesis	Grid mix electricity	FT-Diesel_fCO_2_rH2_FT_gm
69	Diesel	Renewable Diesel (FT-Diesel)	CO_2 + H2	CO_2: Fossil Point Source Carbon Capture H2: Industrial by-product hydrogen	Fischer-Tropsch Synthesis	Grid mix electricity	FT-Diesel_fCO_2_ibpH2_FT_gm
70	Diesel	Renewable Diesel (FT-Diesel)	CO_2 + H2	CO_2: Direct Air Capture H2: Fossil Steam Methane Reformation	Fischer-Tropsch Synthesis	Grid mix electricity	FT-Diesel_rCO_2_fH2_FT_gm
71	Diesel	Renewable Diesel (FT-Diesel)	CO_2 + H2	CO_2: Direct Air Capture H2: from Renewable electricity	Fischer-Tropsch Synthesis	Grid mix electricity	FT-Diesel_rCO_2_rH2_FT_gm
72	Diesel	Renewable Diesel (FT-Diesel)	CO_2 + H2	CO_2: Direct Air Capture H2: Industrial by-product hydrogen	Fischer-Tropsch Synthesis	Grid mix electricity	FT-Diesel_rCO_2_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	
73	Diesel	Renewable Diesel (FT-Diesel)	CO_2 + H2	CO_2: Biogenic Point Source Carbon Capture H2: Fossil Steam Methane Reformation	Fischer-Tropsch Synthesis	Grid mix electricity	FT-Diesel_bCO_2_fH2_FT_gm
74	Diesel	Renewable Diesel (FT-Diesel)	CO_2 + H2	CO_2: Biogenic Point Source Carbon Capture H2: from Renewable electricity	Fischer-Tropsch Synthesis	Grid mix electricity	FT-Diesel_bCO_2_rH2_FT_gm
75	Diesel	Renewable Diesel (FT-Diesel)	CO_2 + H2	CO_2: Biogenic Point Source Carbon Capture H2: Industrial by-product hydrogen	Fischer-Tropsch Synthesis	Grid mix electricity	FT-Diesel_bCO_2_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_

Order	Group	Fuel type	Feedstock structure		Conversion/Production process		Fuel Pathway Code
			Feedstock Type	Nature/Carbon Source	Process Type	Energy used in the process	
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 DME Synthesis with Point Source Carbon Capture (PSCC) and long-term storage	Grid mix electricity	DME_b_AD_DMES_CCS_gm
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

Order	Group	Fuel type	Feedstock structure		Conversion/Production process		Fuel Pathway Code
			Feedstock Type	Nature/Carbon Source	Process Type	Energy used in the process	
88	Methanol	Methanol	Coal	Fossil	Gasification of Coal and Methanol Synthesis	Grid mix electricity	MeOH_f_G_MS_gm
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 + H2	CO_2: Fossil Point Source Carbon Capture H2: Fossil Steam Methane Reformation	Methanol Synthesis	Grid mix electricity	MeOH_fCO_2_fH2_MS_gm
93	Methanol	Methanol	CO_2 + H2	CO_2: Fossil Point Source Carbon Capture H2: from Renewable electricity	Methanol Synthesis	Grid mix electricity	MeOH_fCO_2_rH2_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	
94	Methanol	Methanol	CO_2 + H2	CO_2: Fossil Point Source Carbon Capture H2: Industrial by-product hydrogen	Methanol Synthesis	Grid mix electricity	MeOH_fCO_2_ibpH2_MS_gm
95	Methanol	Methanol	CO_2 + H2	CO_2: Direct Air Capture H2: Fossil Steam Methane Reformation	Methanol Synthesis	Grid mix electricity	MeOH_rCO_2_fH2_MS_gm
96	Methanol	Methanol	CO_2 + H2	CO_2: Direct Air Capture H2: from Renewable electricity	Methanol Synthesis	Grid mix electricity	MeOH_rCO_2_rH2_MS_gm
97	Methanol	Methanol	CO_2 + H2	CO_2: Direct Air Capture H2: Industrial by-product hydrogen	Methanol Synthesis	Grid mix electricity	MeOH_rCO_2_ibpH2_MS_gm
98	Methanol	Methanol	CO_2 + H2	CO_2: Biogenic Point Source Carbon Capture H2: Fossil Steam Methane Reformation	Methanol Synthesis	Grid mix electricity	MeOH_bCO_2_fH2_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	
99	Methanol	Methanol	CO_2 + H2	CO_2: Biogenic Point Source Carbon Capture H2: from Renewable electricity	Methanol Synthesis	Grid mix electricity	MeOH_bCO₂_rH2_MS_gm
100	Methanol	Methanol	CO_2 + H2	CO_2: Biogenic Point Source Carbon Capture H2: 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_
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

Order	Group	Fuel type	Feedstock structure		Conversion/Production process		Fuel Pathway Code
			Feedstock Type	Nature/Carbon Source	Process Type	Energy used in the process	
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 other Electrolysis and liquefaction	Renewable electricity	LH2_EL_r_Liquefied
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

Order	Group	Fuel type	Feedstock structure		Conversion/Production process		Fuel Pathway Code
			Feedstock Type	Nature/Carbon Source	Process Type	Energy used in the process	
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 Haber Bosch process	Grid mix electricity	NH3_f_SMR_HB_CCS_gm
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	N2 + H2	N2: separated with renewable electricity H2: produced from renewable electricity	Haber Bosch process	Grid mix electricity	NH3_rN2_rH2_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	
121	Ammonia	Ammonia	N2 + H2	N2: separated with renewable electricity H2: Fossil Steam Methane Reformation	Haber Bosch process	Grid mix electricity	NH3_rN2_fH2_HB_gm
122	Ammonia	Ammonia	N2 + H2	N2: separated with renewable electricity H2: Industrial by-product hydrogen	Haber Bosch process	Grid mix electricity	NH3_rN2_ibpH2_HB_gm
123	Ammonia	Ammonia	N2 + H2	N2: separated with grid mix electricity H2: Fossil Steam Methane Reformation	Thermochemical Cycles or Electrolysis	Nuclear	NH3_gmN2_fH2_EL_n
124	Ammonia	Ammonia	N2 + H2	N2: separated with grid mix electricity H2: produced from renewable electricity	Thermochemical Cycles or Electrolysis	Nuclear	NH3_gmN2_rH2_EL_n
125	Ammonia	Ammonia	N2 + H2	N2: separated with grid mix electricity H2: Industrial by-product hydrogen	Thermochemical Cycles or Electrolysis	Nuclear	NH3_gmN2_ibpH2_EL_n
126	Electricity	Electricity		Fossil/Renewable	-	Grid mix electricity	Electricity_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	
127 128	Electricity Wind propulsion	Electricity		Renewable	Dedicated Photovoltaic and/or Wind and/or other	Renewable electricity	Electricity_renewable

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 (gCO_2eq/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	14.1	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 (gCO_2eq/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 (gCO_2eq/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)	2.750						
					LNG Otto (dual fuel slow speed)							
					LNG Diesel (dual fuel slow speed)							
					LBSI (Lean-Burn Spark-Ignited)							
					Steam Turbines and boilers							
62	Diesel (FAME)	FAME_b_TRE_gm_2ndgen	20.8	0.0372	ALL ICEs							
77	Renewable Diesel (HVO)	HVO_b_HD_gm_2ndgen	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 (gCO_2eq/MJ)**	**NOTE**
105	Hydrogen	H2_f_SMR_CCS_gm		0.12	ALL ICEs	0						
					Fuel cell							
121	Ammonia	NH3_rN2_fH2_HB_gm		0.0186	ALL ICEs	0						
					Fuel cell							

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
OPS – Onshore Power Supply

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.

Onshore power supply – the system to supply electricity to ships at berth, at low or high voltage, alternate or direct current, including ship-side and port-side installations, when feeding any of the ship's electrical distribution switchboards for powering hotel and service workloads or charging secondary batteries

APPENDIX 4

TEMPLATE FOR WELL-TO-TANK DEFAULT EMISSION FACTOR SUBMISSION

INTRODUCTION

1 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 according to the methodology of the *2024 Guidelines on Life Cycle GHG Intensity of Marine Fuels (2024 LCA Guidelines)*, adopted on 22 March 2024 through resolution MEPC.391(81).[1] Only one default emission factor should be proposed per template form, i.e. to propose two emission default factors, two separate template forms should be filled. A "default emission factor" represents the quantitative results of the assessed greenhouse gas 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. It is a value describing a feedstock production, collection and transportation for conversion to an average/typical/standard plant, located in a generic region.[24] A default emission factor does not have to capture process improvement, with respect to current production, nor innovative technologies.[25] The goal of default emission factor is, at least, twofold:

.1 allow for fair comparison of GHG intensity among different technologies and fuel conversion pathways, where emissions resulting from some of the parameters in the WtT equation are set at zero by default (i.e. e_{sca}, e_l, e_{ccs}); In other words, allow for a general comparison among different fuel options and technologies;

.2 allow for operators to demonstrate actual life cycle of greenhouse gas emissions compared to the default life cycle emissions for the same feedstock-to-fuel pathway, through a certification process. The period of validity for the certification should be defined along with the rules and procedures of functioning of the certification.

The template provides full coverage of all elements necessary to define a default emission factor. It can be adapted (e.g. by not providing input data to each and every element it comprises) and complemented with additional information.

The LCA Guidelines specify in paragraph 4.4 that the WtT GHG emission factor (gCO_{2eq}/MJ(LCV) fuel or electricity) is calculated according to Equation (1).

Equation (1) $GHG_{WtT} = e_{fecu} + e_l + e_p + e_{td} - e_{\mathrm{sca}} - e_{\mathrm{ccs}}$

while paragraph 9.4 specifies that "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 default emission factors. Similarly, this is the case also for the parameters related to carbon capture and storage (CCS), which require further development." Accordingly, it should be noted that the default emission factors identified through the use of this submission template

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24 Default emission factors reflect the performance of feedstock-fuel pathways across world regions and States. Project-specific values certified according to relevant procedures agreed and adopted at IMO can be used as actual emission factors.

25 In case of immature technologies, literature and modelling sources could be used, limited to the conversion process. However, the principle that this could be used as input data to refine/complete/revise emission factors as a future technology matures should be kept.

will only be partially reflective of WtT emissions attributable to any given "feedstock-to-fuel" pathway and may vary as emissions by sources and/or removals by sinks within the system boundary are taken into account.

2 Once default emission factors fully reflecting WtT GHG emissions are developed in a future iteration of the LCA Guidelines, operators (e.g. fuel producers) that are in a position to prove actual GHG emissions, may seek certification for a project certified "actual value". Certified actual values may also be used for pathways not having a default WtT GHG emission factor listed in appendix 2 of the LCA Guidelines.

3 This template allows indicating a 0 (zero) value for elements of Equation (1) that are temporarily not quantified as explained in paragraph 1 above. Data submitted as required for the calculation of default WtT GHG emission factors, need to ensure quality in terms of: relevance,[26] adequacy,[26] completeness,[27] consistency,[28] reliability,[29] transparency and accessibility.[30] The template can also be partially completed, e.g. by providing data for specific steps of the pathway.

PATHWAY DESCRIPTION

4 This section should clearly present the pathway modelled, intended as the value chain related to the production of a finished fuel, with the aim for providing at least information on inter alia: the type of feedstock used, a description of the technology used for converting such feedstock in the final fuel, and any other relevant information that affects the calculation of emission factors, consistently with the system boundary of the LCA guidelines.

5 The default emission factors are based on the WtT methodology, aiming at evaluating the amount of GHG emissions attributable to the fuel production and distribution. The production steps to be included in the calculation of a WtT emission factor are shown in figure 2 below:

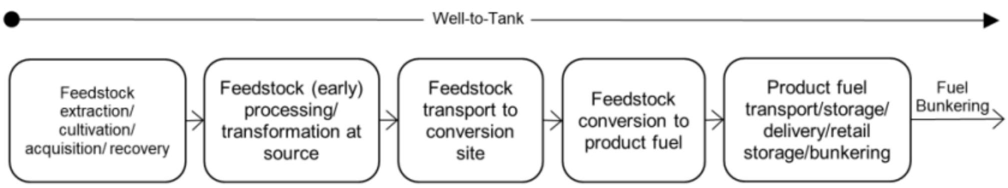

Figure 2 – Generic well-to-tank supply chain

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

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

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26 Is the available data appropriate and reasonable in relation to the goal?

26 Does the data accurately describe the value chain under investigation? Are the uncertainties properly reported?

27 How completely does the data describe the value chain under investigation?

28 Is the data internally consistent? If there are redundant data values, do they have the same value?

29 Is the data regarded as valid/verifiable by the stakeholders?

30 Can the data be accessed and verified by a third party?

INPUT DESCRIPTION

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

7 The source of the data and of the model used should be reported, according to the indications about data quality provided in the LCA Guidelines.

8 Please inform if the LCA calculation has been developed in a particular modelling tool and in case of a positive answer, inform if any background information (information not listed below) has changed with respect to the standard data set and/or methodology used by the tool, and provide adequate justification for such change.

9 In order to provide guidance to fill the template, please see a worked example for a lipid feedstock production and conversion. The worked example is comprised of filled-in tables as necessary to report data, per pathway.

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

				XXXX, per dry kg	Data source/Model used	Observations
	XXX feedstock	Agricultural Inputs	Total N (g)	…	zzz et al. 2010	(explicit the type of N fertilizer, in %. Example: Total N is represented by 50% of Urea, 30% of Ammonium Nitrate, and 20%of..)
e_{fecu}			P_2O_5 (g)	…	ecoinvent	(explicit the type of P_2O_5 fertilizer)
			K_2O (g)	…	GREET	(explicit the type of K_2O fertilizer)
			Diesel (MJ)	…	…	
			Fugitive GHG emissions (e.g. CH_4) at feedstock extraction	…	…	
		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)	…	…	
			Fugitive GHG emissions (e.g. CH_4) at feedstock extraction	…	…	
			…	…	…	
		Oil Extraction Outputs	Co-product, zzz (g)	…	…	
			Protein cake from vegetable oil extraction	…	…	

Additional information:

Table 2: e_p inputs and outputs/losses for XXXX conversion process, 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)[31]	…	…
	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)	**	…
	…	…	…
	Losses, e.g. fugitive CH_4 emissions	**	

*H_2 derived from NG steam reforming is assumed to be default H_2 source, the emission factors of H_2 are modelled based on NG input; ** Inputs after allocation

Additional information:

Table 3: Inputs for regional electricity generation mixes [32]

	US (%)[1]	**EU (%)[2]**	**India[3] (%)**	**xxx (%)[4]**
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, [4] IGES List of Grid Emission Factors

[31] Table 2 allows to detail information on electricity generation (which may be different from the regional mix).

[32] Alternatively, please provide a statement with a clear referenced indication of the Greenhouse gas Intensity of the grid (gCO_{2eq}/kWh or gCO_{2eq}/MJ), and provide the reference used.

Additional information:

Table 4: e_{td} Emissions from Inputs and losses associated with the transportation of feedstock and fuels. 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 [33]	Heavy-duty truck; Train; Ship ; Barge; Rail; Pipeline; etc	
	Share (%)	yy; yy; yyy	
	Fuel Transportation		
	Distance (km)[34]	xxx; xxxx; xx	
	Mode	Heavy-duty truck; Train; Ship; Barge; Rail; Pipeline; etc	
	Share (%)	y; yy; yy	
	Fuel Distribution		
	Distance (km)	xx	
	Mode	Heavy-duty truck; Train; Ship; Barge; Rail; Pipeline; etc	
	Share (%)		
	…	…	
	Any other Transportation, Storage and Distribution emissions, including losses (e.g fugitive CH_4 emissions)		

[33] In case a mode of transport includes more fuels (e.g. diesel and natural gas) or various transport modes (e.g. track and ship), they should be properly reported in the calculation.

[34] Empty back-haul/return voyage(s) should be accounted in the calculation.

MAIN RESULTS

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

Table 5: Fuel identification

Fuel Pathway Code	LCV (MJ/g)	Density (kg/m^3)	C_{fCO2} (gCO_{2eq}/MJ)	Carbon Content (wt%)

Additional information:

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

Fuel Pathway Code	Region	efecu Feedstock cultivation/extraction	etd Feedstock and fuel transportation/storge/distribution	ep Fuel production	(Sum of the terms) Proposed WtT GHG intensity (gCO_{2eq}/MJ) emission factors
	XXXX				

Additional information:

Table 7: Proposed default emission factors for XXX-converted in a YYYY pathway for comparative purposes using GWP20

A CALCULATION USING GLOBAL WARMING POTENTIAL OVER A 20-YEAR HORIZON (GWP20) MAY BE PROVIDED AS INFORMATION FOR COMPARATIVE PURPOSES.

Fuel Pathway Code	Region	e_{fecu} Feedstock cultivation/extraction	e_{td} Feedstock and fuel transportation/storage/distribution	e_p Fuel production	(Sum of the terms) Proposed WtT GHG intensity (gCO_{2eq}/MJ) emission factors
	XXXX				

Additional information:

APPENDIX

11 Brief description of the pathway

12 Brief description of the technology

….

REFERENCES

13 REF (APA format)

APPENDIX 5

TEMPLATE FOR TANK-TO-WAKE DEFAULT EMISSION FACTOR SUBMISSION

SUMMARY

This document presents a template to provide the minimum set of information to submit values for consideration as Tank-to-Wake (TtW) default emission factors.

INTRODUCTION

This template provides the form to submit values for consideration as Tank-to-Wake (TtW) default emission factors, with a minimum set of relevant technical and scientific information to allow the analysis of the adequacy of the proposed values.

TtW default emission factors should be calculated using representative and conservative assumptions, which encompass variable conditions onboard of the ships and performance of energy converters.

The rules to establish TtW default emission factor are described in paragraphs 9.17 and 9.22 of the LCA Guidelines. To establish a TtW default emission factor (with the exception of C_{fCO2}), at least three (3) reference values, from three different representative sources should be considered among the three (or more) values to be 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 and evaluated against the corresponding information as appropriate, including the agreement between the reference values.

The LCA Guidelines allows demonstration of superior GHG performance compared to the default emission factors, trough actual emission factors subject to verification and certification by a third party.

PART A – EMISSION FACTORS FOR COMBUSTED FUEL (C_{fCH4} and C_{fN2O})

This part should contain the data to support proposals for C_{fCH4} and C_{fN2O} as defined in the LCA Guidelines;

Term	Units	Explanation
C_{fCH4}	g_{CH4}/g_{fuel}	CH_4 emission conversion factor ($g_{CH4}/g_{fuel\ delivered\ to\ the\ ship}$) for emissions of the combustion and/or oxidation process of the fuel used by the ship[36]
C_{fN2O}	g_{N2O}/g_{fuel}	N_2O emission conversion factor ($g_{N2O}/g_{fuel\ delivered\ to\ the\ ship}$) for emissions of the combustion and/or oxidation process of the fuel used by the ship

[36] 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.

1 METHODOLOGY

This section should clearly present the methodology for the measurements made and associated uncertainty.

Additional details and relevant information may be added in appendices, such as measurement procedures and equipment used, test-bed/onboard measurement, etc.

2 ENERGY CONVERTER DIFFERENTIATION

This section should clearly present the Energy converter differentiation (general model range)[37] shall be included in the proposed values, and the reasoning to follow such differentiation.

3 MAIN RESULTS

This section should present the results.

Table 1: Proposed values for C_{fCH4} and C_{fN2O}

	Fuel[38]								
	Order	Group	Fuel type	Energy converter[39]	Test Cycle[40]	Measurement Method[41]	$C_{f\,CH4}$ (g_{CH4}/g_{fuel}) [42]	$C_{f\,N2O}$ (g_{N2O}/g_{fuel}) [43]	Uncertainty
Example	5	Marine Diesel/Gas Oil (ISO 8217 Grades DMX, DMA, DMZ and DMB maximum 0.10 % S)	MDO/MGO (ULSFO)_f_SR_gm	Two stroke Low speed Main engine	NTC-E3	Test-bed measurement	x	y	z%

37 Example: ICE/Piston Engines (2-Stroke, SSD/MSD), ICE/Piston Engines (4-Stroke, MSD), ICE/Piston Engines (4-Stroke, HSD), ICE/Gas Turbines (GT), Boilers, Dual Fuel, 4-stroke, Medium Speed, Low Pressure/Otto Cycle (LPMSDF 4-s Otto), Dual Fuel, 4-stroke, Medium Speed, High Pressure/Otto Cycle (HPMSDF 4-s Diesel), Dual Fuel, 2-stroke, Low Speed, Low Pressure/Otto Cycle (LPLSDF 2-s Otto), Dual Fuel (DF), 2-stroke, Low Speed, High Pressure/Diesel Cycle (HPLSDF 2-s Diesel), Gas-only, 4-stroke, Medium Speed, Low Pressure/Otto Cycle (LPMSGas 4-s Otto), Gas-only, 4-stroke, High Speed, Low Pressure/Otto Cycle (LPHSGas 4-s Otto), DF Boilers (DFB), Methane Reformer, (MRCH4), Methanol Reformer (MRCH3OH).

38 Fuel pathways listed in appendix 1 of the LCA guidelines (resolution MEPC.391(81)).

39 The proposal of default values should include a differentiation per energy converter with a technical explanation on how the Energy Converter classes were defined, the make and model of the engine where the emission tests was carried out, including engine design year.

40 It should be detailed the measurements at each load point.

41 For example, a reference to ISO 8178 and NO_x Technical Code 2008. It should include the list of instruments used to measure emissions, test location (lab/onboard).

42 The proposed data should be expressed in $g_{CH4}/g_{\text{fuel consumed by the energy converter}}$. If from the data submitted arises the need to differentiate C_{fCH4} by energy converter, then a C_{fCH4} expressed in $g_{CH4}/g_{\text{fuel delivered to the ship}}$ needs to be calculated trough the weighted average of the different C_{fCH4} taking in consideration the fuel consumed on each energy converter.

43 The proposed data should be expressed in $g_{N2O}/g_{\text{fuel consumed by the energy converter}}$. If from the data submitted arises the need to differentiate C_{fN2O} by energy converter, then a C_{fN2O} expressed in $g_{N2O}/g_{\text{fuel delivered to the ship}}$ needs to be calculated trough the weighted average of the different C_{fN2O} taking in consideration the fuel consumed on each energy converter.

Additional information:

PART B – EMISSION FACTORS FOR FUEL SLIPPAGE (C_{slip})

This part should contain the data to support proposals for C_{slip} as defined in the LCA Guidelines;

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)

1 METHODOLOGY

This section should clearly present the methodology for the measurements made and associated uncertainty.

Additional details and relevant information may be added in appendices, such as measurement procedures and equipment used, test-bed/onboard measurement, etc.

2 ENERGY CONVERTER DIFFERENTIATION

This section should clearly present the Energy converter differentiation (general model range)[44] shall be included in the proposed values, and the reasoning to follow such differentiation.

3 MAIN RESULTS

This section should present the results.

[44] Example: ICE/Piston Engines (2-Stroke, SSD/MSD), ICE/Piston Engines (4-Stroke, MSD), ICE/Piston Engines (4-Stroke, HSD), ICE/Gas Turbines (GT), Boilers, Dual Fuel, 4-stroke, Medium Speed, Low Pressure/Otto Cycle (LPMSDF 4-s Otto), Dual Fuel, 4-stroke, Medium Speed, High Pressure/Otto Cycle (HPMSDF 4-s Diesel), Dual Fuel, 2-stroke, Low Speed, Low Pressure/Otto Cycle (LPLSDF 2-s Otto), Dual Fuel (DF), 2-stroke, Low Speed, High Pressure/Diesel Cycle (HPLSDF 2-s Diesel), Gas-only, 4-stroke, Medium Speed, Low Pressure/Otto Cycle (LPMSGas 4-s Otto), Gas-only, 4-stroke, High Speed, Low Pressure/Otto Cycle (LPHSGas 4-s Otto), DF Boilers (DFB), Methane Reformer, (MRCH4), Methanol Reformer (MRCH3OH).

Table 2: Proposed values for C_{slip}

	Fuel[45]						C_{slip}[46]		
	Order	Group	Fuel type	Energy converter[47]	Test Cycle	Measurement Method[48]	C_{slip} Exhaust 49	C_{slip} Crankcase 49	Uncertainty
Example	31	LNG	Liquefied Natural Gas (Methane)	Low Pressure Four stroke medium speed Auxiliary engine	NTC - D2	Test-bed measurement	x%	y%	z%

Additional information:

PART C – EMISSION FACTORS FOR FUGITIVE EMISSIONS (C_{fug})

This part should contain the data to support proposals for C_{fug} as defined in the LCA Guidelines;

Term	Units	Explanation
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

1 METHODOLOGY

This section should clearly present the methodology for the measurements made and associated uncertainty.

Additional details and relevant information may be added in appendices, such as measurement procedures and equipment used.

2 DEFAULT VALUES DIFFERENTIATION

This section should clearly present the proposed way-forward to differentiate fugitive emissions, for example per energy converter, re-liquefaction equipment or Ship type.

3 MAIN RESULTS

This section should present the results.

45 Fuel pathways listed in appendix 1 of the LCA guidelines (resolution MEPC.391(81)).

46 $C_{slip} = C_{slip\_Exhaust} + C_{slip\_Crankcase}$

47 The proposal of default values should include a differentiation per energy converter with a technical explanation on how the Energy Converter classes were defined, , the make and model of the engine where the emission tests was carried out, including engine design year.

48 For example, a reference to ISO 8178 and NO_x Technical Code 2008. It should include the list of instruments used to measure emissions and test location (lab/onboard).

49 The proposed data should be expressed in $g_{CH4}/g_{\text{fuel consumed by the energy converter}}$.

Table 3: Proposed values for C_{fug}

	Fuel[50]						
	Order	Group	Fuel type	Fugitive Emissions Class[51]	Measurement Method[52]	C_{fug}[53]	Uncertainty
Example	31	LNG	Liquefied Natural Gas (Methane)	LNG Tanker	Onboard measurement	x%	y%

Additional information:

Part D – APPENDIX

Brief description of the procedures to collect data and the data collected used to calculated the proposed values, for example the emissions at each load point of the Test Cycle.

Part E – REFERENCES

REF (APA format)

***

50 Fuel pathways listed in appendix 1 of the LCA guidelines (resolution MEPC.391(81)).

51 A differentiation may be proposed, for example for example per energy converter, re-liquefaction equipment or ship type.

52 For example a reference to ISO 8178 and NO_x Technical Code 2008. It should include the list of instruments used to measure emissions and test location (lab/onboard).

53 Expressed in % of mass of the fuel delivered to the ship.

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MEPC.1/Circ.795/Rev.9
29 April 2024

UNIFIED INTERPRETATIONS TO MARPOL ANNEX VI

1 The Marine Environment Protection Committee, at its eighty-first session (17 to 22 March 2024), approved unified interpretations to regulations 2.2.15 and 2.2.18 of MARPOL Annex VI, in order to provide clarity concerning:

.1 the definition of "heavy load carrier" within the definition of "general cargo ship"; and

.2 the applicable dates for the different ship types for the calculation of the required EEDI under each EEDI Phase.

2 The consolidated text of all existing unified interpretations to MARPOL Annex VI, listed in numerical order of interpreted regulations in MARPOL Annex VI, is set out in the annex.

3 Member Governments are invited to apply the annexed unified interpretations to MARPOL Annex VI, as appropriate, and bring them to the attention of all Parties concerned.

4 This circular revokes MEPC.1/Circ.795/Rev.8.

***

ANNEX

UNIFIED INTERPRETATIONS TO MARPOL ANNEX VI

1 Definition of "heavy load carrier"

Regulation 2
Definitions

Regulation 2.2.15 reads as follows:

> "*General cargo ship* means a ship with a multi-deck or single deck hull designed primarily for the carriage of general cargo. This definition excludes specialized dry cargo ships, which are not included in the calculation of reference lines for general cargo ships, namely livestock carrier, barge carrier, heavy load carrier, yacht carrier, nuclear fuel carrier."

***Interpretation*:**

1.1 The following are considered as a "heavy load carrier":

.1 heavy load deck carriers[1];

.2 semi-submersible project cargo carriers;

.3 semi-submersible heavy load deck carriers (including dock lift ships);

.4 heavy lift multi-purpose ships (see paragraph 1.2 below);

.5 premium project carriers (see paragraph 1.2 below); and

.6 project cargo carriers (see paragraph 1.3 below).

1.2 Heavy lift multi-purpose ships and premium project carriers should fulfil the adapted criterion of "ships engaged in lifting operations" contained in regulation 2.3 of the International Code on Intact Stability, 2008 (2008 IS Code), as amended by resolution MSC.443(99), and comply as follows:

$$\text{SWL} \times \text{Outreach} \geq 0.67 \times \text{Displacement} \times (D - T) / B$$

where:

SWL = maximum safe working load of crane of one single crane;

Outreach = outreach from turning axis of crane;

Displacement = displacement of vessel at draft T;

T = freeboard draft;

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[1] Ships, which do not feature a cargo hold and carry project cargo on a flat deck; not fitted with cargo coamings/chutes/tippers.

B = moulded breadth of the vessel measured amidships at draft *T*;

D = depth for freeboard.

1.3 For project cargo carriers with or without cargo gear, the Administration may base its decision on a design and operation-specific application compiled by the owner/company.

2 Major conversion

Regulation 2
Definitions

Regulation 2.2.17 reads as follows:

"*Major conversion* means in relation to chapter 4 of this Annex a conversion of a ship:

.1 which substantially alters the dimensions, carrying capacity or engine power of the ship; or

.2 which changes the type of the ship; or

.3 the intent of which in the opinion of the Administration is substantially to prolong the life of the ship; or

.4 which otherwise so alters the ship that, if it were a new ship, it would become subject to relevant provisions of the present Convention not applicable to it as an existing ship; or

.5 which substantially alters the energy efficiency of the ship and includes any modifications that could cause the ship to exceed the applicable required EEDI as set out in regulation 24 of this Annex or the applicable required EEXI as set out in regulation 25 of this Annex."

***Interpretation*:**

2.1 For regulation 2.2.17.1, any substantial change in hull dimensions and/or capacity (e.g. change of length between perpendiculars (L_{PP}) or change of assigned freeboard) should be considered a major conversion. Any substantial increase of total engine power for propulsion (e.g. 5% or more) should be considered a major conversion. In any case, it is the Administration's authority to evaluate and decide whether an alteration should be considered a major conversion, consistent with chapter 4.

Note: Notwithstanding paragraph 2.1, assuming no alteration to the ship structure, both decrease of assigned freeboard and temporary increase of assigned freeboard due to the limitation of deadweight or draft at calling port should not be construed as a major conversion. However, an increase of assigned freeboard, except a temporary increase, should be construed as a major conversion.

2.2 Notwithstanding paragraph 2.1, for regulation 2.2.17.5, the effect on Attained EEDI as a result of any change of ships' parameters, particularly any increase in total engine power for propulsion, should be investigated. In any case, it is the Administration's authority to evaluate and decide whether an alteration should be considered a major conversion, consistent with chapter 4.

2.3 A company may, at any time, voluntarily request re-certification of the EEDI, with IEE Certificate reissuance, on the basis of any new improvements to the ships' efficiency that are not considered to be major conversions.

2.4 In regulation 2.2.17.4, the terms "new ship" and "existing ship" should be understood as they are used in MARPOL Annex I, regulation 1.9.1.4, rather than as the defined terms in regulations 2.2.13 and 2.2.18.

2.5 The term "a ship" referred to in regulation 5.4.2 is interpreted as "new ship".

3 Definition of "new ship" for calculation of the required EEDI

Regulation 2
Definitions

Regulation 2.2.18 reads as follows:

"*New ship* means a ship:

.1 for which the building contract is placed on or after 1 January 2013; or

.2 in the absence of a building contract, the keel of which is laid or which is at a similar stage of construction on or after 1 July 2013; or

.3 the delivery of which is on or after 1 July 2015."

Interpretation:

3.1 For the application of the definition "new ship" as specified in regulation 2.2.18 to each Phase specified in table 1 of regulation 24, it should be interpreted as follows:

.1 the date specified in regulation 2.2.18.1 should be replaced with the start date of each Phase;

.2 the date specified in regulation 2.2.18.2 should be replaced with the date six months after the start date and end date of each Phase; and

.3 the date specified in regulation 2.2.18.3 should, for Phases 1, 2 and 3, be replaced with the date 48 months after the start date and end date of each Phase.

3.2 With the above interpretations, the required EEDI of each phase is applied to the following new ship to which chapter 4 is applicable:

.1 the required EEDI of Phase 0 is applied to the following new ship which falls into one of the categories defined in regulations 2.2.5, 2.2.7, 2.2.9, 2.2.14, 2.2.15, 2.2.22 and 2.2.29:

.1 the building contract of which is placed in Phase 0, and the delivery is before 1 January 2019; or

.2 the building contract of which is placed before Phase 0, and the delivery is on or after 1 July 2015 and before 1 January 2019; or

in the absence of a building contract:

.3 the keel of which is laid or which is at a similar stage of construction on or after 1 July 2013 and before 1 July 2015, and the delivery is before 1 January 2019; or

.4 the keel of which is laid or which is at a similar stage of construction before 1 July 2013, and the delivery is on or after 1 July 2015 and before 1 January 2019;

.2 the required EEDI of Phase 1 is applied to the following new ship which falls into one of the categories defined in regulations 2.2.5, 2.2.7, 2.2.9, 2.2.11, 2.2.14, 2.2.15, 2.2.16, 2.2.22, 2.2.26, 2.2.27, 2.2.28 and 2.2.29:

.1 for ship types where Phase 1 commences on 1 January 2015:

.1 the building contract of which is placed in Phase 1, and the delivery is before 1 January 2024; or

.2 the building contract of which is placed before Phase 1, and the delivery is on or after 1 January 2019 and before 1 January 2024; or

in the absence of a building contract:

.3 the keel of which is laid or which is at a similar stage of construction on or after 1 July 2015 and before 1 July 2020, and the delivery is before 1 January 2024; or

.4 the keel of which is laid or which is at a similar stage of construction before 1 July 2015, and the delivery is on or after 1 January 2019 and before 1 January 2024;

.2 for ship types where Phase 1 commences on 1 September 2015:

.1 the building contract of which is placed in Phase 1, and the delivery is before 1 January 2024; or

.2 the building contract of which is placed before Phase 1, and the delivery is on or after 1 September 2019 and before 1 January 2024; or

in the absence of a building contract:

.3 the keel of which is laid or which is at a similar stage of construction on or after 1 March 2016 and before 1 July 2020, and the delivery is before 1 January 2024; or

.4 the keel of which is laid or which is at a similar stage of construction before 1 March 2016, and the delivery is on or after 1 September 2019 and before 1 January 2024;

.3 the required EEDI of Phase 2 is applied to the following new ship which falls into one of the categories defined in regulations 2.2.5, 2.2.7, 2.2.9, 2.2.11, 2.2.14, 2.2.15, 2.2.16, 2.2.22, 2.2.26, 2.2.27, 2.2.28, and 2.2.29:

.1 for ship types where Phase 2 ends on 31 March 2022:

.1 the building contract of which is placed in Phase 2, and the delivery is before 1 April 2026; or

.2 the building contract of which is placed before Phase 2, and the delivery is on or after 1 January 2024 and before 1 April 2026; or

in the absence of a building contract:

.3 the keel of which is laid or which is at a similar stage of construction on or after 1 July 2020 and before 1 October 2022, and the delivery is before 1 April 2026; or

.4 the keel of which is laid or which is at a similar stage of construction before 1 July 2020, and the delivery is on or after 1 January 2024 and before 1 April 2026;

.2 for ship types where Phase 2 ends on 31 December 2024:

.1 the building contract of which is placed in Phase 2, and the delivery is before 1 January 2029; or

.2 the building contract of which is placed before Phase 2, and the delivery is on or after 1 January 2024 and before 1 January 2029; or

in the absence of a building contract:

.3 the keel of which is laid or which is at a similar stage of construction on or after 1 July 2020 and before 1 July 2025, and the delivery is before 1 January 2029; or

.4 the keel of which is laid or which is at a similar stage of construction before 1 July 2020, and the delivery is on or after 1 January 2024 and before 1 January 2029;

.4 the required EEDI of Phase 3 is applied to the following new ship which falls into one of the categories defined in regulations 2.2.5, 2.2.7, 2.2.9, 2.2.11, 2.2.14, 2.2.15, 2.2.16, 2.2.22, 2.2.26, 2.2.27, 2.2.28 and 2.2.29:

.1 for ship types where Phase 3 commences with 1 April 2022 and onwards:

.1 the building contract of which is placed in Phase 3; or

.2 the building contract of which is placed before Phase 3, and the delivery is on or after 1 April 2026; or

in the absence of a building contract:

.3 the keel of which is laid or which is at a similar stage of construction on or after 1 October 2022; or

.4 the keel of which is laid or which is at a similar stage of construction before 1 October 2022 and the delivery of which is on or after 1 April 2026;

.2 for ship types where Phase 3 commences with 1 January 2025 and onwards:

.1 the building contract of which is placed in Phase 3; or

.2 the building contract of which is placed before Phase 3, and the delivery is on or after 1 January 2029; or

in the absence of a building contract:

.3 the keel of which is laid or which is at a similar stage of construction on or after 1 July 2025; or

.4 the keel of which is laid or which is at a similar stage of construction before 1 July 2025 and the delivery of which is on or after 1 January 2029.

4 Ships dedicated to the carriage of fruit juice in refrigerated cargo tanks

Regulation 2
Definitions

Regulation 2.2.22 reads as follows:

"*Refrigerated cargo carrier* means a ship designed exclusively for the carriage of refrigerated cargoes in holds."

***Interpretation*:**

Ships dedicated to the carriage of fruit juice in refrigerated cargo tanks should be categorized as refrigerated cargo carriers.

5 Timing for existing ships to have a SEEMP on board

Regulation 5
Surveys

Regulation 5.4.4 reads as follows:

"For existing ships, the verification of the requirement to have a SEEMP on board according to regulation 26 of this Annex shall take place at the first intermediate or renewal survey identified in paragraph 1 of this regulation, whichever is the first, on or after 1 January 2013."

Regulation 6
Issue or endorsement of Certificates and Statements of Compliance related to fuel oil consumption reporting and operational carbon intensity rating

Regulation 6.4 reads as follows:

> "An International Energy Efficiency Certificate for the ship shall be issued after a survey in accordance with the provisions of regulation 5.4 of this Annex to any ship of 400 gross tonnage and above before that ship may engage in voyages to ports or offshore terminals under the jurisdiction of other Parties."

Regulation 26
Ship Energy Efficiency Management Plan (SEEMP)

Regulation 26.1 reads as follows:

> "Each ship shall keep on board a ship specific Ship Energy Efficiency Management Plan (SEEMP). This may form part of the ship's Safety Management System (SMS)."

Interpretation:

5.1 The International Energy Efficiency Certificate (IEEC) should be issued for both new and existing ships to which chapter 4 applies. Ships which are not required to keep a SEEMP on board are not required to be issued with an IEEC.

5.2 The SEEMP required by regulation 26.1 is not required to be placed on board an existing ship to which this regulation applies until the verification survey specified in regulation 5.4.4 is carried out.

5.3 For existing ships, a SEEMP required in accordance with regulation 26 should be verified on board according to regulation 5.4.4, and an IEEC should be issued, not later than the first intermediate or renewal survey, in accordance with chapter 2, whichever is earlier, on or after 1 January 2013, i.e. a survey connected to an intermediate/renewal survey of the IAPP Certificate.

5.4 The intermediate or renewal survey referenced in paragraph 5.3 relates solely to the timing of the verification of the SEEMP on board, i.e. these IAPP Certificate survey windows will also become the IEEC initial survey date for existing ships. The SEEMP is, however, a survey item solely under chapter 4 and is not a survey item relating to IAPP Certificate surveys.

5.5 In the event that the SEEMP is not available on board during the first intermediate/renewal survey of the IAPP Certificate on or after 1 January 2013, the RO should seek the advice of the Administration concerning the issuance of an IEEC and be guided accordingly. However, the validity of the IAPP Certificate is not impacted by the lack of a SEEMP as the SEEMP is a survey item solely under chapter 4 and not under the IAPP Certificate surveys.

5.6 With respect to ships required to keep on board a SEEMP, such ships exclude platforms (including FPSOs and FSUs) and drilling rigs, regardless of their propulsion, and any other ship without means of propulsion.

5.7 The SEEMP should be written in a working language or languages understood by ships' personnel.

6 Confirmation of compliance for new ships

Regulation 5
Surveys

Regulation 5.4.5 reads as follows:

"The Administration shall ensure that for each ship to which regulation 27 applies, the SEEMP complies with regulation 26.2 of this Annex. This shall be done prior to collecting data under regulation 27 of this Annex in order to ensure the methodology and processes are in place prior to the beginning of the ship's first reporting period. Confirmation of compliance shall be provided to and retained on board the ship."

Regulation 26
Ship Energy Efficiency Management Plan (SEEMP)

Regulation 26.2 reads as follows:

"In the case of a ship of 5,000 gross tonnage and above, the SEEMP shall include a description of the methodology that will be used to collect the data required by regulation 27.1 of this Annex and the processes that will be used to report the data to the ship's Administration."

Interpretation:

Ships should keep on board both a SEEMP that is in compliance with regulation 26.2 and confirmation of compliance as required by regulation 5.4.5.

7 Section 2.3 of the supplement to the IAPP Certificate

Regulation 8
Form of Certificates and Statements of Compliance related to fuel oil consumption reporting and operational carbon intensity rating

Regulation 8.1 reads as follows:

"The International Air Pollution Prevention Certificate shall be drawn up in a form corresponding to the model given in appendix I to this Annex and shall be at least in English, French or Spanish. If an official language of the issuing country is also used, this shall prevail in case of a dispute or discrepancy."

Appendix I
Form of International Air Pollution Prevention (IAPP) Certificate (Regulation 8)

Section 2.3 of the supplement to the International Air Pollution Prevention Certificate reads as follows:

"2.3 Sulphur oxides (SO_x) and particulate matter (regulation 14).

2.3.1 When the ship operates outside of an emission control area specified in regulation 14.3, the ship uses:

.1 fuel oil with a sulphur content as documented by bunker delivery notes that does not exceed the limit value of 0.50% m/m, and/or ………………………...……………………………........................□

.2 an equivalent arrangement approved in accordance with regulation 4.1 as listed in paragraph 2.6 that is at least as effective in terms of SO_x emission reductions as compared to using a fuel oil with a sulphur content limit value of 0.50% m/m …………………...…………..........…………………................□

2.3.2 When the ship operates inside an emission control area specified in regulation 14.3, the ship uses:

.1 fuel oil with a sulphur content as documented by bunker delivery notes that does not exceed the limit value of 0.10% m/m, and/or ……………………………………………...…………………...……□

.2 an equivalent arrangement approved in accordance with regulation 4.1 as listed in paragraph 2.6 that is at least as effective in terms of SO_x emission reductions as compared to using a fuel oil with a sulphur content limit value of 0.10% m/m ………………………………………………………………...………□

2.3.3 For a ship without an equivalent arrangement approved in accordance with regulation 4.1 as listed in paragraph 2.6, the sulphur content of fuel oil carried for use on board the ship shall not exceed 0.50% m/m as documented by bunker delivery notes …………………………………………………………………………...……□"

Interpretation:

Section 2.3 of the Supplement ("as documented by bunker delivery notes") allows for an "x" to be entered in advance of the dates indicated in all of the relevant check boxes recognizing that the bunker delivery notes, required to be retained on board for a minimum period of three years, provide the subsequent means to check that a ship is actually operating in a manner consistent with the intent as given in section 2.3.

8 Inclusion of the annual operational CII and rating in the Statement of Compliance

Regulation 8
Form of Certificates and Statements of Compliance related to fuel oil consumption reporting and operational carbon intensity rating

Regulation 8.3 reads as follows:

"The Statement of Compliance pursuant to regulations 6.6 and 6.7 of this Annex shall be drawn up in a form corresponding to the model given in appendix X to this Annex and shall be at least in English, French or Spanish. If an official language of the issuing Party is also used, this shall prevail in case of a dispute or discrepancy."

Interpretation:

The Statement of Compliance form given in appendix X of MARPOL Annex VI has been updated to include the attained annual operational CII and the rating for ships to which regulation 28 applies. The new form should be used from the entry into force date (1 November 2022); however, the new parts for the attained CII and rating will not be populated until 2024 when the relevant values are available.

9 Identical replacement engines

Regulation 13
Nitrogen oxides (NO_x)

Regulation 13.1.1.2 reads as follows:

> "Each marine diesel engine with a power output of more than 130 kW that undergoes a major conversion on or after 1 January 2000 except when demonstrated to the satisfaction of the Administration that such engine is an identical replacement to the engine that it is replacing and is otherwise not covered under paragraph 1.1.1 of this regulation."

Regulation 13.2.2 reads as follows:

> "For a major conversion involving the replacement of a marine diesel engine with a non-identical marine diesel engine or the installation of an additional marine diesel engine, the standards in this regulation at the time of the replacement or addition of the engine shall apply."

Interpretation:

9.1 In regulation 13.1.1.2, the term "identical" (and hence, by application of the converse, in regulation 13.2.2 the term "non-identical") as applied to engines under regulation 13 should be taken as:

9.2 An "identical engine" is, as compared to the engine being replaced,[2] an engine which is of the same:

.1 design and model;

.2 rated power;

.3 rated speed;

.4 use;

.5 number of cylinders; and

.6 fuel system type (including, if applicable, injection control software):

[2] In those instances where the replaced engine will not be available to be directly compared with the replacing engine at the time of updating the Supplement to the IAPP Certificate reflecting that engine change, it is to be ensured that the necessary records in respect of the replaced engine are available in order that it can be confirmed that the replacing engine represents "an identical engine".

.1 for engines without EIAPP certification, have the same NO_x critical components and settings;[3] or

.2 for engines with EIAPP certification, belonging to the same Engine Group/Engine Family.

10 Time of replacement of an engine

Regulation 13
Nitrogen oxides (NO_x)

Regulation 13.2.2 reads as follows:

> "For a major conversion involving the replacement of a marine diesel engine with a non-identical marine diesel engine, or the installation of an additional marine diesel engine, the standards in this regulation at the time of the replacement or addition of the engine shall apply."

Interpretation:

10.1 The term "time of the replacement or addition" of the engine in regulation 13.2.2 should be taken as the date of:

.1 the contractual delivery date of the engine to the ship;[4] or

.2 in the absence of a contractual delivery date, the actual delivery date of the engine to the ship,[3] provided that the date is confirmed by a delivery receipt; or

.3 in the event the engine is fitted on board and tested for its intended purpose on or after six months from the date specified in sub-paragraphs of regulation 13.5.1.2, as appropriate, the actual date that the engine is tested on board for its intended purpose applies in determining the standards in this regulation in force at the time of the replacement or addition of the engine.

10.2 Entry of the date in paragraph 10.1 above, provided the conditions associated with those dates apply, should be made in item 8.a "Major conversion – According to regulations 13.2.1.1 and 13.2.2" of the Supplement of IAPP Certificate.

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3 For engines without EIAPP Certification there will not be the defining NO_x critical component markings or setting values as usually given in the approved Technical File. Consequently, in these instances, the assessment of "... same NO_x critical components and settings ..." shall be established on the basis that the following components and settings are the same:

Fuel system:

.1 fuel pump model and injection timing; and

.2 injection nozzle model.

Charge air:

.1 configuration and, if applicable, turbocharger model and auxiliary blower specification; and

.2 cooling medium (seawater/freshwater).

4 The engine is to be fitted on board and tested for its intended purpose within six months after the date specified in sub-paragraphs of regulation 13.5.1.2, as appropriate.

10.3 If the engine is not tested within six months after the date specified in the sub-paragraphs of regulation 13.5.1.2, as appropriate due to unforeseen circumstances beyond the control of the shipowner, then the provisions of "unforeseen delay in delivery" may be considered by the Administration in a manner similar to UI4 of MARPOL Annex I.

11 Engine change-over/on-off recording requirements

Regulation 13
Nitrogen oxides (NO_x)

Regulation 13.5.3 reads as follows:

> "The tier and on/off status of marine diesel engines installed on board a ship to which paragraph 5.1 of this regulation applies which are certified to both Tier II and Tier III or which are certified to Tier II only shall be recorded in such logbook or electronic record book as prescribed by the Administration at entry into and exit from a NO_x Tier III emission control area, or when the on/off status changes within such an area, together with the date, time and position of the ship."

Interpretation:

For the application of this regulation:

.1 "marine diesel engines installed on board a ship to which paragraph 5.1 of this regulation applies" includes additional or replaced engines;[5] installed on or after the relevant emission control area takes effect;

.2 "certified to Tier II only" means a Tier II engine that is installed on board a ship which is constructed on or after the emission control area where the ship is operating takes effect;

.3 Tier II engines stipulated under the Tier II requirement of regulation 13.4, i.e. Tier II engines installed on board a ship constructed before the entry into force of the emission control area where the ship is operating, are not considered to be a "Tier II only" engine in the context of record keeping. Such exclusion is extended to Tier II engines replaced after the entry into force of the relevant emission control areas on board ships of this category, if the replacement engines meet resolution MEPC.230(65);

.4 if an engine installed on a ship constructed before the entry into force of the emission control area where the ship is operating has undergone a major conversion as described in regulation 13.2.1, those engines are to be Tier III engines; thus the above interpretation in .1 above applies; and

.5 recording is required for the Tier II engine operation in a NECA under the exemption according to regulation 13.5.4.

[5] Additional or replaced engine: refer to section 10.1 above.

12 Application of sulphur limit to emergency equipment

Regulation 14
Sulphur oxides (SO_x) and particulate matter

Regulation 14.1 reads as follows:

> "The sulphur content of fuel oil used or carried for use on board a ship shall not exceed 0.50% m/m."

Interpretation:

Regulation 14.1 of MARPOL Annex VI for the prohibition on the carriage of non-compliant fuel oil should be applied to the fuel oil of emergency equipment.

13 VOC management plan

Regulation 15
Volatile organic compounds (VOCs)

Regulations 15.6 and 15.7 read as follows:

"6 A tanker carrying crude oil shall have on board and implement a VOC management plan approved by the Administration. Such a plan shall be prepared taking into account the guidelines developed by the Organization. The plan shall be specific to each ship and shall at least:

.1 provide written procedures for minimizing VOC emissions during the loading, sea passage and discharge of cargo;

.2 give consideration to the additional VOC generated by crude oil washing;

.3 identify a person responsible for implementing the plan; and

.4 for ships on international voyages, be written in the working language of the master and officers and, if the working language of the master and officers is not English, French or Spanish, include a translation into one of these languages.

7 This regulation shall also apply to gas carriers only if the types of loading and containment systems allow safe retention of non-methane VOCs on board or their safe return ashore.[6] "

***Interpretation*:**

The requirement for a VOC management plan applies only to a tanker carrying crude oil.

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[6] Resolution MSC.30(61) on *International Code for the Construction and Equipment of Ships Carrying Liquefied Gases in Bulk.*

14 Continuous-feed type shipboard incinerators

Regulation 16
Shipboard incineration

Regulation 16.9 reads as follows:

> "For incinerators installed in accordance with the requirements of paragraph 6.1 of this regulation the combustion chamber gas outlet temperature shall be monitored at all times the unit is in operation. Where that incinerator is of the continuous-feed type, waste shall not be fed into the unit when the combustion chamber gas outlet temperature is below 850°C. Where that incinerator is of the batch-loaded type, the unit shall be designed so that the combustion chamber gas outlet temperature shall reach 600°C within five minutes after start-up and will thereafter stabilize at a temperature not less than 850°C."

***Interpretation*:**

14.1 For the application of this regulation, the term "waste shall not be fed into the unit" should be interpreted as follows:

> For continuous-feed incinerators solid waste shall not be fed into the unit when the combustion chamber flue gas outlet temperature is below 850°C. Sludge oil generated during normal operation of a ship should not be regarded as waste in connection with this regulation, and can be fed into the unit when the required preheat temperature of 650°C in the combustion chamber is achieved.

14.2 For the application of this regulation, the term "the unit shall be designed so that the combustion chamber gas outlet temperature shall reach 600°C within five minutes after start-up" should be interpreted as follows:

> Batch loaded incinerators should be designed so that the temperature in the actual combustion space where the solid waste is combusted should reach 600°C within five minutes after start-up.

15 Application of regulation 18.3 for biofuel and synthetic fuel

Regulation 18
Fuel oil availability and quality

Regulation 18.3 reads as follows:

> "Fuel oil for combustion purposes delivered to and used on board ships to which this Annex applies shall meet the following requirements."

Interpretation:

15.1 A fuel oil which is a blend of not more than 30% by volume of biofuel or synthetic fuel should meet the requirements of regulation 18.3.1 of MARPOL Annex VI. A fuel oil which is a blend of more than 30% by volume of biofuel or synthetic fuel should meet the requirements of regulation 18.3.2 of MARPOL Annex VI. For the purposes of this interpretation, a biofuel is a fuel oil which is derived from biomass and hence includes, but is not limited to, processed used cooking oils, fatty-acid-methyl-esters (FAME) or fatty-acid-ethyl-esters (FAEE), straight vegetable oils (SVO), hydrotreated vegetable oils (HVO), glycerol or other biomass to liquid (BTL) type products. For the purposes of this interpretation, a synthetic fuel is a fuel oil from synthetic or renewable sources similar in composition to petroleum distillate fuels. The Product Name, as entered onto the bunker delivery note, should be of sufficient detail to identify whether, and to what extent, a biofuel or a synthetic fuel is blended into the product as supplied.

Regulation 18.3.2.2 reads as follows:

> "fuel oil for combustion purposes derived by methods other than petroleum refining shall not cause an engine to exceed the applicable NO_x emission limit set forth in paragraphs 3, 4, 5.1.1 and 7.4 of regulation 13."

Interpretation:

15.2 A marine diesel engine certified in accordance with the requirements of regulation 13 of MARPOL Annex VI, which can operate on a biofuel or a synthetic fuel or blends containing these fuels without changes to its NO_x critical components or settings/operating values outside those as given by that engine's approved Technical File, should be permitted to use such a fuel oil without having to undertake the assessment as given by regulation 18.3.2.2 of MARPOL Annex VI. For the purposes of this interpretation, parent engine emissions tests undertaken on DM or RM grade fuels to the ISO 8217:2005 standard, as required by paragraph 5.3.2 of the NO_x Technical Code, should be valid for all DM or RM grade fuels used in operation, or that the engine may be designed for, or capable of operation on, including those meeting ISO 8217 standards superseding ISO 8217:2005.

15.3 Where fuel oils are derived from methods other than petroleum refining, or fuel oil which is a blend of more than 30% by volume of biofuel or synthetic fuel and does not fall under 15.2 of this unified interpretation, or other fuels required to undertake the assessment as given by regulation 18.3.2.2 of MARPOL Annex VI and for which have not been specifically certified in accordance with the regulation 13 limits at test bed for that specific fuel and Engine Group/Family, the following is interpreted as an acceptable route to demonstrate compliance with regulation 18.3.2.2:

> The ship's IAPP Certificate may continue to be issued where the overall NO_x emissions performance has been verified to not cause the specified engine to exceed the applicable NO_x emissions limit when burning said fuels using the onboard simplified measurement method in accordance with 6.3 of the NO_x Technical Code 2008, or the direct measurement and monitoring method in accordance with 6.4 of the NO_x Technical Code 2008, or by reference to relevant test-bed testing. For the purposes of this interpretation and demonstration of compliance with regulation 18.3.2.2 of MARPOL Annex VI, and as applicable to possible deviations when undertaking measurements on board, an allowance of 10% of the applicable limit may be accepted.

16 Applicability of the requirements for a bunker delivery note (BDN)

Regulation 18
Fuel oil availability and quality

Regulation 18.5 reads as follows:

> "For each ship subject to regulations 5 and 6 of this Annex, details of fuel oil for combustion purposes delivered to and used on board shall be recorded by means of a bunker delivery note that shall contain at least the information specified in appendix V to this Annex."

Regulation 18.6 reads as follows:

> "The bunker delivery note shall be kept on board the ship in such a place as to be readily available for inspection at all reasonable times. It shall be retained for a period of three years after the fuel oil has been delivered on board."

Interpretation:

16.1 For the application of these regulations, they should be interpreted as being applicable to all ships of 400 gross tonnage or above and, at the Administration's discretion, to ships of less than 400 gross tonnage.

16.2 The bunker delivery note (BDN) required by regulation 18.5 is acceptable in either hard copy or electronic format provided it contains at least the information specified in appendix V to MARPOL Annex VI and is retained and made available on board in accordance with regulation 18.6. In addition, an electronic BDN should be protected from edits, modifications or revisions and authentication be possible by a verification method such as a tracking number, watermark, date and time stamp, QR code, GPS coordinates or other verification methods.

17 Requirements for reporting attained EEDI and relevant information

Regulation 22
Attained Energy Efficiency Design Index (attained EEDI)

Regulation 22.3 reads as follows:

> "For each ship subject to regulation 24 of this Annex, the Administration or any organization duly authorized by it shall report to the Organization the required and attained EEDI values and relevant information, taking into account the guidelines developed by the Organization, via electronic communication:
>
> .1 within seven months of completing the survey required under regulation 5.4 of this Annex; or
>
> .2 within seven months following 1 April 2022 for a ship delivered prior to 1 April 2022."

Interpretation:

17.1 For new ships that have completed the initial survey required in regulation 5.4.1 of MARPOL Annex VI on or after 1 April 2022, the EEDI data and relevant information shall be submitted within seven months after the completion date of the initial survey (in accordance with regulation 22.3.1).

17.2 For new ships that have completed the initial survey required in regulation 5.4.1 of MARPOL Annex VI prior to 1 April 2022:

.1 if they have not undergone a major conversion specified in regulation 5.4.2 or 5.4.3, the EEDI data and relevant information shall be submitted within seven months after 1 April 2022 (in accordance with regulation 22.3.2);

.2 if they have undergone a major conversion specified in regulation 5.4.2 or 5.4.3 on or after 1 April 2022, the EEDI data and relevant information of the major conversion shall be submitted within seven months after the completion date of general or partial survey required in regulation 5.4.2 or the initial survey required in regulation 5.4.3 (in accordance with regulation 22.3.1); and

.3 if they have completed a major conversion specified in regulation 5.4.2 or 5.4.3 prior to 1 April 2022, the EEDI data and relevant information of the major conversion shall be submitted within seven months after 1 April 2022 (in accordance with regulation 22.3.2).

17.3 For existing ships that have completed the initial survey required in regulation 5.4.3 of MARPOL Annex VI on or after 1 April 2022, the EEDI data and relevant information shall be submitted within seven months after the completion date of the initial survey (in accordance with regulation 22.3.1).

17.4 For existing ships that have completed the initial survey required in regulation 5.4.3 of MARPOL Annex VI prior to 1 April 2022, the EEDI data and relevant information shall be submitted within seven months after 1 April 2022 (in accordance with regulation 22.3.2).

17.5 For ships for which up-to-date EEDI data has already been reported to the Organization prior to 1 April 2022, the reporting of EEDI data and information shall not be required on or after 1 April 2022.

18 Ship Energy Efficiency Management Plan (SEEMP) Part III

Regulation 26
Ship Energy Efficiency Management Plan (SEEMP)

Regulation 26.3.1 reads as follows:

"In the case of a ship of 5,000 gross tonnage and above, which falls into one or more of the categories in regulations 2.2.5, 2.2.7, 2.2.9, 2.2.11, 2.2.14 to 2.2.16, 2.2.22, and 2.2.26 to 2.2.29 of this Annex:

.1 On or before 1 January 2023 the SEEMP shall include:

.1 a description of the methodology that will be used to calculate the ship's attained annual operational CII required by regulation 28 of this Annex and the processes that will be used to report this value to the ship's Administration;

.2 the required annual operational CII, as specified in regulation 28 of this Annex, for the next three years;

.3 an implementation plan documenting how the required annual operational CII will be achieved during the next three years; and

.4 a procedure for self-evaluation and improvement."

Interpretation:

18.1 A ship delivered after 1 January 2023 should comply with regulation 26.3.1 of MARPOL Annex VI at delivery. If delivered on 1 October or later, the following year will then be the first year of the three-year implementation plan and an inferior rating given, in accordance with regulation 28.6 of MARPOL Annex VI, for the remainder of the calendar year of delivery needs not to be counted in for the determination of whether the ship should develop a Corrective Action Plan required by regulation 26.3.2 of MARPOL Annex VI. Nothing in this interpretation relieves any ship of its reporting obligations under regulations 27 and 28 of MARPOL Annex VI.

18.2 A ship changing company, or changing from one Administration to another and from one company to another concurrently, after 1 January 2023 should comply with regulation 26.3.1 at change of company and a new SEEMP III will be required. The year of change should be the first year of the next three-year implementation plan.

18.3 In order to document how the required annual operational CII will be achieved during the next three years, the SEEMP Part III should be a rolling three-year plan, YYYY (first year of implementation plan), YYYY+1 and YYYY+2.

18.4 In the case of updating the SEEMP Part III on the elements in regulation 26.3.1 of MARPOL Annex VI, the original three-year plan may remain.

19 Boil-off gas consumed on board ships

Regulation 2
Definitions

Regulation 2.1.14 reads as follows:

> "*Fuel oil* means any fuel delivered to and intended for combustion purposes for propulsion or operation on board a ship, including gas, distillate and residual fuels."

Regulation 27
Collection and reporting of ship fuel oil consumption data

Regulation 27.1 reads as follows:

> "From calendar year 2019, each ship of 5,000 gross tonnage and above shall collect the data specified in appendix IX to this Annex, for that and each subsequent calendar year or portion thereof, as appropriate, according to the methodology included in the SEEMP."

Appendix IX
Information to be submitted to the IMO Ship Fuel Oil Consumption Database

Appendix IX reads as follows:

> "Fuel oil consumption, by fuel oil type in metric tonnes and methods used for collecting fuel oil consumption data".

Interpretation:

For Data relating to boil-off gas (BOG) consumed on board the ship for propulsion or operation (e.g. BOG used for propulsion, operational needs such as in a boiler, or burnt in a gas combustion unit (GCU) for cargo tank pressure control or other operational purposes) is required to be collected and reported as fuel as part of the Ship Fuel Oil Consumption Data Collection System.

20 Access to the disaggregated data

Regulation 27
Collection and reporting of ship fuel oil consumption data

Regulation 27.8 reads as follows:

> "Except as provided for in paragraphs 4, 5 and 6 of this regulation, the disaggregated data that underlies the reported data noted in appendix IX to this Annex for the previous calendar year shall be readily accessible for a period of not less than 12 months from the end of that calendar year and be made available to the Administration upon request."

Interpretation:

The disaggregated data is not required to be kept on board the ship provided that the disaggregated data can be made available by the Company.

21 Plan of corrective actions to achieve the required annual operational CII

Regulation 28
Operational carbon intensity

Regulation 28.7 reads as follows:

> "A ship rated as D for three consecutive years or rated as E shall develop a plan of corrective actions to achieve the required annual operational CII."

Regulation 28.9 reads as follows:

> "A ship rated as D for three consecutive years or rated as E shall duly undertake the planned corrective actions in accordance with the revised SEEMP."

Interpretation:

In case an inferior rating is given for data collected in calendar year YYYY, the revised SEEMP, including the plan of corrective actions, should be verified in year YYYY+1, and it should be developed to achieve the required annual operational CII for data collected in the calendar year YYYY+2.

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BWM.2/Circ.82
2 April 2024

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

Guidance for the temporary storage of treated sewage and/or grey water in ballast water tanks

1 The Marine Environment Protection Committee, at its eighty-first session (18 to 22 March 2024), approved the *Guidance for the temporary storage of treated sewage and/or grey water in ballast water tanks* to establish a uniform procedure for minimizing the impact on the environment while ensuring practicability on ships, as set out in the annex.

2 Member Governments are invited to bring this Guidance to the attention of all parties concerned.

***

ANNEX

GUIDANCE FOR THE TEMPORARY STORAGE OF TREATED SEWAGE AND/OR GREY WATER IN BALLAST WATER TANKS

Introduction

1 The purpose of this guidance is to provide a procedure for the temporary storage of treated sewage and/or grey water in ballast water tanks.

2 Shipowners, ship operators, masters and officers of ships with temporary storage of treated sewage and/or grey water in ballast water tanks should properly implement this procedure.

3 There are exceptional situations where, to comply with coastal State regulations or inadequate reception facilities at ports, dry-docks and terminals, it may become necessary to store treated sewage and/or grey water in ballast water tanks.

Definitions

4 For the purpose of these guidelines:

.1 "Ballast water" means water with its suspended matter taken on board a ship to control trim, list, draught, stability or stresses of the ship (article 1(2) of the BWM Convention).

.2 "Treated ballast water" means water that is treated by a ballast water management system (BWMS) to comply with regulation D-2 of the BWM Convention.

.3 "Treated sewage (TS)" (effluent) means treated wastewater that is produced by a sewage treatment plant in accordance with regulations 9.1.1 and 9.2.1 of MARPOL Annex IV.

.4 "Grey water (GW)" means drainage from dishwater, galley sink, shower, laundry, bath and washbasin drains and does not include drainage from toilets, urinals, hospitals, and animal spaces, as defined in regulation 1.3 of MARPOL Annex IV, nor drainage from cargo spaces (paragraph 2.7 of resolution MEPC.227(64), as may be amended).

.5 "Ballast water tank (BW tank)" means any tank, hold, or space used for the carriage of ballast water (paragraph 2.2 of Guidelines (G4) (resolution MEPC.127(53) as amended)).

.6 "Ballast water capacity" means the total volumetric capacity of any tanks, spaces or compartments on a ship used for carrying, loading or discharging ballast water, including any multi-use tank, space or compartment designed to allow carriage of ballast water as per regulation A-1.2 of the BWM Convention. Combined tanks are, therefore, regarded as BW tanks for the purposes of the BWM Convention.

General matters for application

5 Temporary storage of TS/GW in BW tanks should only be used as an option in specific ports and areas which restrict the discharge of TS/GW and where the ship does not have dedicated tanks with adequate storage capacity for TS/GW.

6 Mixing ballast water and TS/GW in a BW tank should be avoided.

7 The storage of sewage not meeting the definition in paragraph 4.3 in a BW tank is outside the scope of this guidance.

8 In case a ship stores TS/GW temporarily in its BW tanks, the ship should make periodic inspections for those BW tanks' coatings and take measures to prevent impacts.

General guidance

9 If the use of a particular BW tank is changed for the temporary storage of TS/GW in line with this guidance, such a BW tank should be solely used for storing it. If the use of the BW tank needs to be reverted to storage of ballast water, the ship should follow this guidance again.

10 In case a ship uses BW tank(s) to store TS/GW, when transferring TS/GW to BW tank(s) the ship should take appropriate measures to prevent contamination of the ballast system by TS/GW and to prevent accidental discharge of TS/GW within restricted waters (e.g. closing the valves or using blanks, spectacle flanges and pipeline blinds or using isolated pump and pipeline, dedicated portable hose, and/or using a lockout/tagout).

11 In case a ship changes the use of a BW tank to store TS/GW, the BW tank should be fully emptied, including removal of any residual ballast water, as far as practicable, through the BWMS. The removal and disposal of sediments should be carried out as far as practicable and in line with paragraph 1.3 of part A of Guidelines (G4) (resolution MEPC.127(53) as amended).

12 In case a ship changes the use of a BW tank from TS/GW storage back to ballast water storage, the ship should follow the following procedures:

.1 The contents of the BW tank(s) should be discharged. The BW tank, pipes, and dual-purpose pumps should be flushed with the normal maximum volume of the tank.

.2 Water used to flush the tanks should not be discharged through the BWMS to avoid residue from the TS/GW entering the BWMS as this could potentially harm the BWMS.

.3 Subsequent to the discharge and flushing, the ballast water tank should be reconnected to the ballast system and the tank should be flushed once more with treated ballast water to replace the residual water thus ensuring the tank is ready to return to ballast operations in accordance with the BWM Convention.

13 The hull strength and stability of the ship should not be compromised during the intended duration of the temporary storage of TS/GW in BW tanks including ascertaining that non-availability of a BW tank does not impact ship safety and operational performance.

14 The discharge of ballast water and TS/GW should adhere to the following principles:

.1 the discharge of ballast water and sediments should be in compliance with the BWM Convention; and

.2 the discharge of TS should be in compliance with MARPOL Annex IV where relevant. Any local TS/GW discharge requirements should also be considered.

15 The Ballast Water Management Plan (BWMP) of the ship should include a ship-specific change-over procedure, from ballast water storage to TS/GW storage and back to ballast water storage, including pump and piping associated with the dual-purpose BW tanks, with specific details on how the flushing is conducted. The BW tanks to be used for temporary storage of TS/GW should be identified in the BWMP.

16 The Ballast Water Record Book (BWRB) should have an entry made under the appropriate code related to additional operational procedures and general remarks containing the details as mentioned in examples 22 and 23 in BWM.2/Circ.80.

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ANNEX 12

ILLUSTRATION OF A DRAFT POSSIBLE OUTLINE OF THE "IMO NET-ZERO FRAMEWORK"

Possible amendments to MARPOL Annex VI

Chapter 1 – General

.1 Definitions (regulation 2)

Chapter 2 – Survey, certification and means of control

.2 Surveys (regulation 5)

.3 Certificates and Statements of Compliance (regulation 6)

.4 Form of certificates and Statements of Compliance (regulation 8)

.5 Duration and validity of Certificates and Statements of Compliance (regulation 9)

.6 Port State control (regulation 10)

Chapter 4 – Regulations on the carbon intensity of international shipping

.7 SEEMP (regulation 26)

.8 Data Collection System (regulation 27)

[New Chapter 5 – Regulations on the IMO net-zero framework

.9 ***New Chapter 5.1: Goal-based marine fuel standard regulating the phased reduction of the marine fuel's GHG intensity***

.1 Application (regulation X)

.2 Goal (regulation X)

.3 Functional requirements (regulation X)

.4 Attained GHG fuel intensity (GFI) (regulation X)

.5 Target/Required GFI (regulation X)

.6 GFI data collection and reporting (regulation X)

.7 Alternative compliance approaches (regulation X)

.8 Central GFI Registry (regulation X)

.10 ***New Chapter 5.2: Economic mechanism(s) to incentivize the transition to net-zero***

.1 Application (regulation X)

.2 Calculation of economic contribution by ships (regulation X)

.3 Collection of economic contribution by ships (regulation X)

.4 Flexible compliance mechanism(s) (regulation X)

.5 Central management/oversight of collected revenue (regulation X)

.6 Distribution of revenue (regulation X)

.11 ***Review of the chapter]***

Appendices

.1 Appendix V (BDN)

.2 Appendix IX (DCS)

.3 Appendix X (Statement of Compliance)

+ ***Possible accompanying new guidelines and consequential amendments to existing guidelines***

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ANNEX 13

DRAFT AMENDMENTS TO MARPOL ANNEX VI

(Designation of the Canadian Arctic and the Norwegian Sea as Emission Control Areas for Nitrogen Oxides, Sulphur Oxides and Particulate Matter, as appropriate)

ANNEX VI

REGULATIONS FOR THE PREVENTION OF AIR POLLUTION FROM SHIPS

Regulation 13
Nitrogen oxides (NO_x)

…

Tier III

1 A new sub-paragraph .3 is added to regulation 13.5.1.2 as follows:

".3 1 March 2026 and is operating in the Norwegian Sea Emission Control Area. For the Norwegian Sea Emission Control Area, ship constructed on or after 1 March 2026 means:

.1 for which the building contract is placed on or after 1 March 2026; or

.2 in the absence of a building contract, the keel of which is laid, or which is at a similar stage of construction on or after 1 September 2026; or

.3 the delivery of which is on or after 1 March 2030."

2 At the end of regulation 13.5.1.3, "." is replaced with ":" and a new sub-paragraph .1 is added as follows:

".1 that ship is constructed on or after 1 January 2025 and is operating in the Canadian Arctic Emission Control Area."

Emission control area

3 At the end of sub-paragraph .3 of regulation 13.6, the word "and" is deleted and at the end of sub-paragraph .4, "." is replaced with ";"

4 New sub-paragraphs .5 and .6 are added to regulation 13.6 as follows:

".5 the Canadian Arctic Emission Control Area, which means the area described by the coordinates provided in appendix VII to this Annex; and

.6 the Norwegian Sea as defined in regulation 13.9.4 of Annex II of the present Convention."

Regulation 14
Sulphur oxides (SO_X) and particulate matter
Requirements within emission control areas

5 At the end of sub-paragraph .4 of regulation 14.3, the word "and" is deleted and at the end of sub-paragraph .5, "." is replaced by ";".

6 New sub-paragraphs .6 and .7 of regulation 14.3 as follows:

".6 the Canadian Arctic Emission Control area, which means the area described by the coordinates provided in appendix VII to this Annex; and

.7 the Norwegian Sea as defined in regulation 13.9.4 of Annex II of the present Convention."

Appendix VII
Emission control areas
(regulations 13.6 and 14.3)

7 Paragraph 1 is replaced by the following:

"1 The boundaries of emission control areas designated under regulations 13.6 and 14.3, other than the Baltic Sea, the North Sea, and Norwegian Sea areas, are set forth in this appendix."

8 A new paragraph 5 is added after paragraph 4 as follows:

"5 The Canadian Arctic area comprises two segments starting at the:

.1 Yukon mainland at 68°54'.00 N, 137°0'.00 W; following the coordinates listed below and ending at the north coast of Hans Island at 80°49'.91 N, 66°27'.40 W, connected by geodesic lines connecting the following coordinates in World Geodetic System 1984 (WGS84) datum:

POINT	LATITUDE	LONGITUDE
1	68°54'.00 N	137°0'.00 W
2	72°56'.58 N	137°0'.00 W
3	73°0'.42 N	136°21'.72 W
4	73°21'.72 N	136°20'.46 W
5	73°56'.34 N	136°57'.60 W
6	74°30'.18 N	137°13'.08 W
7	75°3'.42 N	137°7'.20 W
8	75°49'.26 N	136°32'.04 W
9	76°42'.18 N	136°57'.06 W
10	77°28'.26 N	136°34'.74 W
11	78°7'.26 N	135°28'.50 W
12	78°39'.72 N	133°44'.88 W
13	79°29'.58 N	131°24'.96 W
14	79°53'.16 N	129°32'.22 W
15	80°31'.44 N	127°33'.48 W

POINT	**LATITUDE**	**LONGITUDE**
16	81°54'.36 N	118°36'.24 W
17	82°16'.32 N	116°28'.98 W
18	82°52'.86 N	115°29'.46 W
19	83°54'.54 N	112°7'.20 W
20	85°46'.14 N	97°16'.86 W
21	86°9'.78 N	89°14'.46 W
22	86°22'.56 N	78°59'.58 W
23	86°19'.18 N	60°10'.17 W
24	85°38'.92 N	58°10'.58 W
25	85°22'.29 N	57°59'.22 W
26	85°12'.04 N	57°54'.68 W
27	84°49'.56 N	57°13'.28 W
28	84°22'.15 N	56°43'.09 W
29	84°17'.32 N	56°35'.78 W
30	84°11'.05 N	56°29'.53 W
31	83°10'.79 N	57°0'.21 W
32	83°4'.29 N	57°27'.78 W
33	83°0'.95 N	57°32'.72 W
34	82°44'.71 N	58°0'.38 W
35	82°42'.57 N	58°6'.78 W
36	82°40'.69 N	58°11'.74 W
37	82°34'.95 N	58°25'.30 W
38	82°31'.25 N	58°38'.56 W
39	82°27'.52 N	58°50'.12 W
40	82°22'.87 N	59°2'.00 W
41	82°20'.26 N	59°21'.38 W
42	82°18'.54 N	59°32'.25 W
43	82°17'.22 N	59°41'.31 W
44	82°14'.41 N	59°56'.06 W
45	82°12'.06 N	60°2'.23 W
46	81°51'.67 N	62°9'.60 W
47	81°17'.89 N	64°8'.73 W
48	80°50'.48 N	66°15'.33 W
49	80°50'.10 N	66°26'.97 W
50	80°49'.91 N	66°27'.40 W

.2 continuing from the south coast of Hans Island at 80°49'.29 N, 66°27'.04 W, following the coordinates listed below, and ending at the coast of Newfoundland and Labrador at 60°0'.00 N, 64°9'.60 W, connected by geodesic lines connecting the following coordinates in World Geodetic System 1984 (WGS84) datum:

POINT	**LATITUDE**	**LONGITUDE**
51	80°49'.29 N	66°27'.04 W
52	80°49'.19 N	66°26'.57 W

POINT	LATITUDE	LONGITUDE
53	80°45'.43 N	67°3'.99 W
54	80°26'.16 N	68°14'.39 W
55	80°1'.79 N	68°46'.99 W
56	79°40'.38 N	69°4'.68 W
57	78°48'.09 N	72°52'.36 W
58	78°25'.05 N	73°45'.66 W
59	77°30'.83 N	74°38'.24 W
60	76°43'.47 N	74°56'.49 W
61	75°0'.00 N	73°16'.07 W
62	74°50'.67 N	73°2'.71 W
63	74°44'.20 N	72°52'.86 W
64	74°28'.67 N	71°45'.72 W
65	74°24'.02 N	71°25'.67 W
66	74°12'.42 N	70°33'.06 W
67	74°10'.03 N	70°23'.12 W
68	74°7'.50 N	70°12'.16 W
69	74°6'.15 N	70°6'.69 W
70	74°2'.53 N	69°51'.43 W
71	74°2'.25 N	69°50'.33 W
72	73°57'.54 N	69°31'.02 W
73	73°52'.27 N	69°10'.88 W
74	73°46'.73 N	68°51'.14 W
75	73°46'.17 N	68°48'.81 W
76	73°41'.77 N	68°29'.65 W
77	73°37'.91 N	68°12'.34 W
78	73°36'.51 N	68°5'.42 W
79	73°31'.14 N	67°15'.52 W
80	73°25'.90 N	66°24'.99 W
81	73°18'.48 N	66°7'.91 W
82	72°50'.89 N	65°7'.52 W
83	72°47'.70 N	65°0'.63 W
84	72°45'.76 N	64°58'.22 W
85	72°43'.78 N	64°54'.27 W
86	72°36'.40 N	64°38'.74 W
87	72°30'.58 N	64°26'.04 W
88	72°24'.89 N	64°13'.11 W
89	72°10'.96 N	63°40'.55 W
90	72°6'.33 N	63°30'.42 W
91	72°1'.65 N	63°20'.73 W
92	71°52'.98 N	63°3'.86 W
93	71°47'.21 N	62°52'.67 W
94	71°44'.71 N	62°49'.41 W
95	71°32'.90 N	62°33'.35 W
96	71°31'.73 N	62°31'.66 W

POINT	LATITUDE	LONGITUDE
97	71°29'.39 N	62°28'.99 W
98	71°25'.93 N	62°25'.37 W
99	71°18'.98 N	62°17'.45 W
100	71°12'.10 N	62°8'.98 W
101	70°51'.84 N	61°42'.53 W
102	70°48'.17 N	61°37'.62 W
103	70°35'.55 N	61°20'.28 W
104	70°33'.07 N	61°17'.10 W
105	70°13'.48 N	61°10'.49 W
106	70°8'.83 N	61°8'.67 W
107	70°7'.55 N	61°7'.92 W
108	70°1'.68 N	61°4'.08 W
109	69°55'.82 N	60°59'.85 W
110	69°55'.27 N	60°59'.41 W
111	69°49'.82 N	60°57'.99 W
112	69°29'.41 N	60°51'.36 W
113	69°12'.82 N	60°27'.40 W
114	69°10'.24 N	60°23'.47 W
115	69°6'.79 N	60°18'.33 W
116	69°0'.88 N	60°8'.99 W
117	68°56'.83 N	60°2'.21 W
118	68°38'.02 N	59°14'.43 W
119	68°37'.86 N	59°14'.01 W
120	68°34'.02 N	59°4'.46 W
121	68°32'.88 N	59°1'.49 W
122	68°25'.25 N	58°42'.06 W
123	68°21'.67 N	58°38'.64 W
124	68°16'.07 N	58°33'.75 W
125	68°7'.40 N	58°26'.93 W
126	68°6'.87 N	58°26'.58 W
127	68°4'.26 N	58°24'.69 W
128	68°1'.89 N	58°23'.15 W
129	67°56'.94 N	58°19'.62 W
130	67°44'.25 N	58°9'.79 W
131	67°39'.77 N	58°6'.05 W
132	67°35'.33 N	58°2'.07 W
133	67°30'.76 N	57°57'.66 W
134	67°29'.16 N	57°56'.00 W
135	67°28'.21 N	57°55'.01 W
136	67°27'.27 N	57°54'.57 W
137	67°21'.52 N	57°52'.35 W
138	66°49'.47 N	57°42'.84 W
139	66°41'.71 N	57°40'.35 W
140	66°37'.88 N	57°39'.45 W

POINT	LATITUDE	LONGITUDE
141	66°36'.02 N	57°38'.99 W
142	66°30'.27 N	57°38'.04 W
143	66°24'.50 N	57°37'.56 W
144	66°18'.68 N	57°37'.55 W
145	66°12'.84 N	57°38'.01 W
146	66°3'.50 N	57°39'.45 W
147	65°57'.62 N	57°39'.93 W
148	65°57'.50 N	57°39'.93 W
149	65°51'.75 N	57°40'.44 W
150	65°50'.81 N	57°40'.46 W
151	65°37'.59 N	57°41'.74 W
152	65°34'.74 N	57°42'.18 W
153	65°23'.33 N	57°44'.83 W
154	65°18'.08 N	57°45'.70 W
155	65°14'.52 N	57°44'.99 W
156	65°11'.49 N	57°44'.22 W
157	65°8'.79 N	57°43'.69 W
158	65°6'.04 N	57°43'.95 W
159	64°12'.06 N	57°48'.09 W
160	64°4'.20 N	57°49'.01 W
161	63°57'.36 N	57°53'.40 W
162	63°52'.57 N	57°56'.46 W
163	63°50'.05 N	57°57'.01 W
164	63°43'.99 N	57°58'.60 W
165	63°37'.16 N	58°1'.00 W
166	63°35'.02 N	58°1'.86 W
167	63°28'.62 N	57°59'.62 W
168	63°22'.86 N	57°57'.29 W
169	62°47'.14 N	57°40'.83 W
170	62°11'.35 N	57°25'.12 W
171	62°3'.47 N	57°22'.15 W
172	62°2'.23 N	57°21'.62 W
173	62°0'.39 N	57°20'.92 W
174	61°24'.74 N	57°16'.16 W
175	61°10'.14 N	57°38'.70 W
176	60°43'.56 N	57°17'.64 W
177	60°15'.36 N	57°4'.56 W
178	60°0'.00 N	56°43'.02 W
179	60°0'.00 N	64°9'.60 W

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図 1: カナダ北極海 ECA の図示

図 2: ノルウェー海 ECA の図示