標題

MEPC 73 の審議結果の紹介

ClassNK
テクニカル
インフォメーション

No. TEC-1175
発行日 2019 年 2 月 8 日

各位

2018 年 10 月 22 日から 26 日にかけて、IMO（英国・ロンドン）において第 73 回海洋環境保護委員会（MEPC 73）が開催されました。今般、IMO より MEPC 73 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

国際海運からの温室効果ガス（GHG）排出の抑制対策は IMO にて検討が進められており、現在までにエネルギー効率設計指標（EEDI）、エネルギー効率管理計画（SEEMP）による規制、及び燃料消費実績報告制度（DCS）が導入されています。
また、2018 年 4 月に開催された MEPC 72 では、GHG 削減目標と GHG 排出削減策の候補を盛り込んだ IMO GHG 削減戦略が採択されました。

(1) EEDI 規制に関する技術開発状況レビュー

MARPOL 条約 附属書 VI 第 21.6 規則で、フェーズ 1 の開始時点及びフェーズ 2 の中間期において、EEDI の改善に寄与する技術の開発動向をレビューし、要すればフェーズの開始時期、関連船種のリファレンスライン算定パラメータ及び削減率を見直すことが規定されています。MEPC 71 では、フェーズ 3 の早期実施やフェーズ 4 導入の必要性を検討するために、日本をコーディネータとする通信部会が設置されました。通信部会は MEPC 73 に暫定報告書を、MEPC 74 に最終報告書を提出することになっています。
今回の会合では通信部会からの暫定報告書について検討を行い、以下について合意をしました。この合意事項を元に、通信部会で更に審議を継続する運びとなります。

タンカー及びばら積み貨物船：
- フェーズ 3 の開始時期は 2025 年を維持
- フェーズ 3 の削減率は 30%を維持
- リファレンスラインは、基準値の算定パラメータを保持

コンテナ船：
- フェーズ 3 の開始時期は 2025 年から 2022 年に前倒し
- フェーズ 3 の削減率を原則 40%に強化
- リファレンスラインは、基準値の算定パラメータを保持

一般貨物船：
- 適用開始を 2025 年から 2022 年に前倒し、削減率は 30%を維持

その他の船種：
- データの不足などの理由から、合意事項なし

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また、耐氷構造船の補正係数を修正した EEDI 計算ガイドラインの改正が採択され、Polar Code の A 類に該当する（いわゆる 1A Super を超える）耐氷構造船の EEDI 規制を適用外とする MARPOL 条約 附属書 VI の改正案が承認されました。
（添付 4 : MEPC.308(73) 参照）

(2) EEDI 規制と最低推進出力規制
EEDI 規制への適合が要求される船舶の荒天下における操船性を維持するため、MEPC 65 において暫定の最低推進出力ガイドラインが策定されました。さらに MEPC 71 では、ガイドラインが改正されるまでの措置として、暫定ガイドラインの適用期間をフェーズ 2 まで延長することが合意されています。
一方、この最低推進出力規制により一定の出力を確保する必要がある反面、フェーズ 3 への対応がさらに困難になることが懸念されていました。
今回の会合では、EEDI 規制と最低推進出力規制の両方を満足するために、通常航海時には機関の出力を制限し、非常時（荒天時）には出力制限を解除することを認める EEDI 計算ガイドラインの改正が提案されました。審議の結果、不正防止や出力の制限手法などについて更に検討が必要となることから、本件を継続して審議すること、また現在の最低推進出力規制は維持することが合意されました。

(3) EEDI 検査認証ガイドラインの改正
EEDI の算出にあたっては、海上速力試験の結果を踏まえた平水中速力の計算が必要となります。海上公試時の外乱（風、波浪、潮流、浅水、排水量、水温）の影響を排除した速力を求めるための解析・計算方法について、現行の EEDI 検査認証ガイドラインでは、「ISO 15016:2015」と「2014 年版 ITTC ガイドライン」のいずれかの基準に従うことが規定されています。
2017 年に ITTC ガイドラインが改正されたため、EEDI 検査認証ガイドラインで参照されている当該規定について審議を行った結果、改正された「2017 年版 ITTC ガイドライン」を参照することが合意され、EEDI 検査認証ガイドラインの改正が採択されました。
（添付 9 : MEPC.1/Circ.855/Rev.2 参照）

(4) 燃料消費実績報告制度（DCS）
DCS を導入するための MARPOL 条約 附属書 VI の改正が 2018 年 3 月に発効し、国際航海に従事する 5,000GT 以上の船舶に対し 2019 年 1 月より燃料消費量等に関するデータ収集が義務付けられます。
今回の会合では、DCS 規則の実施において一部取扱いが不明瞭であった事項について、以下の内容の統一解釈が MEPC サーキュラーとして承認されました。
（添付 8 : MEPC.1-Circ.795-Rev.3 参照）

- 2019 年 1 月 1 日以降に引渡しされる新造船は、完工時に SEEMP パート 2 及び Confirmation of Compliance （COC）の保持が要求される
- LNG 運搬船から排出されるボイルオフガスを船舶の推進又は運航のために使用する場合、その消費量もデータ収集・報告の対象となる
- 合算前データは、会社にて利用可能であれば、本船上に保管する必要はない

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(5) IMO GHG 排出削減戦略

2015 年に採択されたパリ協定では、世界の平均気温上昇を産業革命以前から 2 度以内に抑えるというGHGの排出削減目標が世界的に共有されました。これを受け、MEPC 72 では、2030 年までの短期削減目標と 2050 年までの中期削減目標、及び各目標達成のための削減方策の候補を盛り込んだ IMO GHG 削減戦略が採択されています。

今回の会合では、2018 年 10 月 15 日から 19 日にかけて開催された中間会合に引き続き、IMO GHG 削減目標を達成するための下記の内容を含む作業工程表が合意されました。本件については、MPEC 74 の直前に中間会合を開催し、削減策の具体的な検討が開始される予定となっています。

- 各国は MEPC 74 に短期的削減策の具体的な提案を行う。
- 短期的削減策について、EEDI など既存の規制で行うもの（Group A）、DCS などのデータの分析が必要となる速度の最適化などの新規規制（Group B）、燃費改善に関する調査研究や代替燃料の使用などの新規枠組み（Group C）に分類して検討を行う。
- 各国は、MEPC74 及び MEPC 75 に対して、中長期の削減方策について提案を行う。

2. 大気汚染関連

(1) 燃料油の硫黄分濃度規制

一般海域で使用する燃料油の硫黄分濃度の規制値が、2020 年 1 月 1 日から 0.5%に強化されます。

今回の会合では、硫黄分濃度 0.5%を上回る燃料油を使用する目的で船上に搭載することを禁止する MARPOL 条約 附属書 VI 第 14 規則、及び IAPP 証書の追補様式の改正が採択されました。 また、0.5%規制に対する船側の準備の一環として「船舶実施計画」の作成を推奨する非強制の指針が承認されました。

（添付 1 : MEPC.305(73)、及び添付 10 : MEPC.1/Circ.878 参照）

(2) 低硫黄燃料油の経験蓄積期間

硫黄分濃度の 0.5%規制の導入により、これまでに実績の無い性状の燃料油が広く出回ることが予想されており、予期できない問題が発生することが懸念されています。

今回の会合では、0.5%規制の実施状況や、新規燃料油の使用により発生した安全、環境上の課題を情報収集し、課題の解消を図るための経験蓄積期間を設けることが提案されました。提案国からは、この経験蓄積期間は、0.5%規制の円滑な実施を目指したもので、規制の先送りを意図したものではないことが表明されましたが、十分な支持は得られませんでした。0.5%規制の円滑な実施のために各国間で情報共有を強化する枠組みを構築するために、関係国に対して次回の会合に具体的な提案を行うよう要請されています。

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(3) 排ガス再循環装置（EGR）からの排水に関するガイドライン
NOx 三次規制への適合のため、エンジンからの排気ガスを再度燃焼室に送り込むことで燃焼温度を下げ、NOx の生成を低減する排ガス再循環装置（exhaust gas recirculation, EGR）が開発されています。EGR では燃焼室に送り込む排気ガスを洗浄するためにスクラバが設置されており、洗浄に使用した水の船外排出が必要となる場合があります。この洗浄水の扱いについては、排出基準が規定されていなかったことから、汚染防止・対応小委員会（PPR 小委員会）にて、洗浄水の排出基準の他、必要となる図書や検査手順を規定した EGR からの排水に関するガイドライン案を作成しました。
今回の会合では、2019 年 6 月以降に EIAPP 証書が発行される EGR 月エンジンにガイドラインを適用すること、Polar Code に規定する極海域での排水は認められないことを盛り込んで、当該ガイドラインを採択しました。（添付 3 : MEPC.307(73) 参照）

3. バラスト水管理条約関連

(1) バラスト水処理装置の性能確認
2017 年に開催された IMO 第 30 回総会（Assembly 30）にて、条約検査の検査項目を明記した HSSC 検査ガイドラインに BWM 条約暫定検査ガイドライン（BWM.2/Circ.7）を取り入れる改正が採択されました(A.1120(30))。この改正では、バラスト水管理条約の初回検査において、バラスト水処理装置 (BWMS) の性能確認のためにバラスト水のサンプリング分析を含めた搭載時の試験を行うことが規定されています。この規定について MEPC 72 では、根拠となる条約要件が存在せず、サンプリング分析の試験手順が確立されていない旨の指摘があり、サンプリング分析手順を策定する方針が合意されました。
今回の会合で審議を行った結果、バラスト水処理装置の搭載時におけるサンプリング分析の手順をまとめた指針が承認され、次回の会合に強制化のための条約等の改正案を提案することが関心国に要請されました。（添付 12 : BWM.2/Circ.70 参照）

(2) 恒久的バラスト水の管理
バラスト水管理条約では、排出することの無い封密タンクに保持する恒久的バラスト水は条約の適用外とされています。この規定に関し、運行中はフランジ等を用いて絶縁し、修繕時のみバラスト水の入れ替えを行うバラストタンクの扱いについて、適用を明確化すべきとの提案がありました。
審議の結果、汚染防止・対応小委員会（PPR 小委員会）にて本件を明確化する統一解釈を検討することが合意されました。

(3) システム設計制限 (SDL)
2020 年 10 月 28 日以降に搭載されるバラスト水処理装置は、MEPC 72 にて採択された BWMS コード (MEPC.300(72))に適合する必要があります。この承認基準では、バラスト水処理装置が正常に機能する水質や運転条件などのシステム設計制限（system design limitations, SDL）を明確に指定し、SDL の範囲内で運転する手段を講じる事が規定されています。
今回の会合では、SDL の指定や運転状態を監視するための手順を示す指針が承認されました。（添付 11 : BWM.2/Circ.69 参照）

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(4) 緊急対応方法（C/M）
MEPC 71 では、本条約に定める排出基準を満足することができない不適合事態が発生した場合に、船舶及び港湾当局が講じる緊急対応方法（contingency measures, C/M) を決定するためのガイダンスが承認されました (BWM.2/Circ.62）。
今回の会合では、バラスト水管理計画書（BWMP）に C/M に関する手順を任意情報として記載できるよう、バラスト水管理及びバラスト水管理計画作成のためのガイドライン (G4) の改正が採択されました。（添付 2 : MEPC.306(73) 参照）

4. その他の議題
(1) 電子記録簿
MARPOL 条約 附属書 I に規定される油記録簿等、MARPOL 条約では船舶にて使用、または発生する汚染物質を管理するために、各種の記録簿を備えることを要求しています。昨今、管理維持の利便性より記録簿の電子化が進んでいることから、電子記録簿の利用基準を定める必要があり、PPR 小委員会にて電子記録簿に関するガイドライン案を作成しました。
今回の会合では、PPR 5 から報告されたガイドライン案、当該ガイドラインを強制化するための MARPOL 条約、及び NOx テクニカルコードの改正案が承認されました。これらは 2019 年 5 月に開催される MEPC 74 にて採択される予定です。条約の改正後、紙媒体による記録簿の代わりに電子記録簿を使用する場合、電子記録簿はガイドラインに従って承認を受ける必要があります。

(2) 海洋プラスチック廃棄物
近年問題となっているプラスチックごみの海洋投棄については、2013 年に発効した MARPOL 条約 附属書 V の改正により、全ての船舶からのプラスチックごみの排出が禁止されています。しかしながら、国連の調査によれば、未だ船舶に由来するプラスチックごみの排出が継続していることが報告されています。この問題に対応する為、MEPC 72 では船舶から排出される海洋プラスチックごみの影響評価、及び MARPOL 条約の強化について検討を行うことが合意されています。
今回の会合では、今後、検討を行うべき項目を記載した作業計画を作成しました。同作業計画では、海洋プラスチックゴミに関する調査（IMO Study）を実施する等の計画が記載されています。また IMO Study の調査対象・調査方法等を検討するためのコレスポンデンス・グループを設置することも合意されました。

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

(1) 高硫黄燃料油の使用目的での保持禁止 （2.(1) 項参照）
2020 年 1 月 1 日から一般海域で使用する燃料油の硫黄分濃度の規制値が 0.5%に強化されることに合わせ、非適合油を使用する目的で保持することを禁止する MARPOL 条約 附属書 VI 第 14 規則、及び IAPP 証書の追補様式の改正が採択されました。

発効日 : 2020 年 3 月 1 日

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(2) 排ガス再循環装置（EGR）からの排水 （2.(3) 項参照）
EGR に用いた洗浄水の船外排出基準等を定めたガイドラインが採択されました。

(3) EEDI 計算ガイドラインの改正 （1.(1) 項参照）
耐氷構造船の補正係数を修正した EEDI 計算ガイドラインの改正が採択されました。

(4) EEDI 検査認証ガイドラインの改正 （1.(3) 項参照）
最新の ITTC ガイドラインを参照するため、EEDI 検査証書ガイドラインの改正が採択されました。

(5) 浮体式海洋設備に対する MARPOL 附属書 I の適用
油の流出による海洋汚染を防止する為に、MARPOL 附属書 I では油タンカーに対し規則を設けています。一方、浮体式海洋石油生産貯蔵積出設備 (FPSO) 及び、浮体式海洋石油貯蔵積出設備 (FSU) は規則の適用対象となっていないことから、MEPC 53 において FPSO・FSU に適用する要件を示すガイドラインが採択されています。
今会合では、当該ガイドライン策定後に新設された要件の取入れと、復元性計算機の設置を推奨する同ガイドラインの改正案が承認されました。（添付 7 : MEPC.311(73) 参照）

MEPC 73 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。
http://www.imo.org/MediaCentre/MeetingSummaries/MEPC/Pages/Default.aspx

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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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8. MEPC.1/Circ.795/Rev.3
9. MEPC.1/Circ.855/Rev.2
10. MEPC.1/Circ.878
11. BWM.2/Circ.69
12. BWM.2/Circ.70

ANNEX 1

RESOLUTION MEPC.305(73)
(adopted on 26 October 2018)

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

(Prohibition on the carriage of non-compliant fuel oil for combustion purposes for propulsion or operation on board a ship)

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 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 seventy-third session, proposed amendments to MARPOL Annex VI concerning the prohibition on the carriage of non-compliant fuel oil for combustion purposes for propulsion or operation on board a ship,

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 September 2019 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 March 2020 upon their acceptance in accordance with paragraph 2 above;

4 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;

5 REQUESTS FURTHER 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

(Prohibition on the carriage of non-compliant fuel oil for combustion purposes for propulsion or operation on board a ship)

ANNEX VI

REGULATIONS FOR THE PREVENTION OF AIR POLLUTION FROM SHIPS

Regulation 14
Sulphur oxides (SO_X) and particulate matter

General requirements

1 Paragraph 1 is replaced by the following:

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

Requirements within emission control areas

2 Paragraph 3 is replaced by the following:

"3 For the purpose of this regulation, an emission control area shall be any sea area, including any port area, designated by the Organization in accordance with the criteria and procedures set forth in appendix III to this Annex. The emission control areas under this regulation are:

.1 the Baltic Sea area as defined in regulation 1.11.2 of Annex I of the present Convention;

.2 the North Sea area as defined in regulation 1.14.6 of Annex V of the present Convention;

.3 the North American Emission Control Area, which means the area described by the coordinates provided in appendix VII to this Annex; and

.4 the United States Caribbean Sea Emission Control Area, which means the area described by the coordinates provided in appendix VII to this Annex."

3 Paragraph 4 is replaced by the following:

"4 While a ship is operating within an emission control area, the sulphur content of fuel oil used on board that ship shall not exceed 0.10% m/m."

4 The subtitle "Review provision" and paragraphs 8, 9 and 10 are deleted.

Appendix I

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

Supplement to International Air Pollution Prevention Certificate (IAPP Certificate)

5 Paragraphs 2.3.1 and 2.3.2 are replaced by the following and a new paragraph 2.3.3 is added as follows:

"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
……..……☐"

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ANNEX 2

RESOLUTION MEPC.306(73)
(adopted on 26 October 2018)

AMENDMENTS TO THE GUIDELINES FOR BALLAST WATER MANAGEMENT AND DEVELOPMENT OF BALLAST WATER MANAGEMENT PLANS (G4) (RESOLUTION MEPC.127(53))

THE MARINE ENVIRONMENT PROTECTION COMMITTEE,

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

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

NOTING that regulation A-2 of the Ballast Water Management Convention requires that discharge of ballast water shall only be conducted through ballast water management in accordance with the provisions of the Annex to the Convention,

NOTING FURTHER that regulation B-1 of the Annex to the Ballast Water Management Convention provides that each ship shall have on board and implement a ballast water management plan approved by the Administration, taking into account Guidelines developed by the Organization,

NOTING FURTHER that, at its fifty-third session, the Committee adopted, by resolution MEPC.127(53), the *Guidelines for ballast water management and development of ballast water management plans* (G4),

HAVING CONSIDERED, at its seventy-third session, proposed amendments to the Guidelines (G4),

1 ADOPTS amendments to the *Guidelines for ballast water management and development of ballast water management plans*, as set out in the annex to the present resolution;

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

3 AGREES to keep the Guidelines, as amended, under review.

ANNEX

AMENDMENTS TO THE GUIDELINES FOR BALLAST WATER MANAGEMENT AND DEVELOPMENT OF BALLAST WATER MANAGEMENT PLANS (G4)

1 Paragraph 4.3 is added in part B:

"4.3 The ballast water management plan may include contingency measures developed taking into account guidelines developed by the Organization*."

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* Refer to the *Guidance on contingency measures under the BWM Convention* (BWM.2/Circ.62, as may be amended).

ANNEX 3

RESOLUTION MEPC 307(73)
(adopted on 26 October 2018)

2018 GUIDELINES FOR THE DISCHARGE OF EXHAUST GAS RECIRCULATION (EGR) BLEED-OFF WATER

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 (the Committee) conferred upon it by international conventions for the prevention and control of marine pollution from ships,

RECALLING ALSO that, at its fifty-eighth session, it adopted, by resolution MEPC.176(58), a revised MARPOL Annex VI (hereinafter referred to as "MARPOL Annex VI") and, by resolution MEPC.177(58), a revised Technical Code on Control of Emission of Nitrogen Oxides from Marine Diesel Engines (hereinafter referred to as the "NO_X Technical Code 2008"),

NOTING regulation 13 of MARPOL Annex VI which makes the NO_X Technical Code 2008 mandatory under that Annex,

NOTING ALSO that the use of NO_X-reducing devices is envisaged in the NO_X Technical Code 2008 and that exhaust gas recirculation (EGR) systems are such NO_X-reducing devices for compliance with the Tier II and/or Tier III NO_X limit,

RECOGNIZING the need to develop guidelines for the discharge of EGR bleed-off water,

HAVING CONSIDERED, at its seventy-third session, draft guidelines for the discharge of EGR bleed-off water, prepared by the Sub-Committee on Pollution Prevention and Response, at its fifth session,

1 ADOPTS the *2018 Guidelines for the discharge of exhaust gas recirculation (EGR) bleed-off water*, as set out at annex to the present resolution;

2 INVITES Administrations to take the annexed Guidelines into account in developing provisions for regulating the discharge of EGR bleed-off water;

3 REQUESTS Parties to MARPOL Annex VI and other Member Governments to bring the annexed Guidelines to the attention of shipowners, ship operators, shipbuilders, marine diesel engine manufacturers and any other interested parties;

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

ANNEX

2018 GUIDELINES FOR THE DISCHARGE OF EXHAUST GAS RECIRCULATION (EGR) BLEED-OFF WATER

1 INTRODUCTION

1.1 Regulation 13.5 of MARPOL Annex VI requires marine diesel engines to meet the Tier III NO_X emission levels when operating in a NO_X Tier III emission control area in accordance with the provisions in regulations 13.5.1 and 13.5.2.

1.2 One method for reducing NO_X emissions is to use Exhaust Gas Recirculation (EGR), which is an internal engine process resulting in a NO_X reduction which will meet the requirements of the regulation. By means of this process, condensate of exhaust gas will be generated and discharged as bleed-off water, which should be handled differently depending on the fuel oil sulphur content. EGR may also be used as a Tier II compliance option.

1.3 These Guidelines cover the discharge of EGR bleed-off water. They are recommendatory in nature; however, the Administrations are invited to base their implementation on these Guidelines.

2 GENERAL

2.1 Purpose

The purpose of these Guidelines is to specify requirements for the discharge to the sea of bleed-off water when using EGR.

2.2 Application

These Guidelines should apply to a marine diesel engine fitted with an EGR device having a bleed-off water discharge arrangement, for which the EIAPP Certificate is first issued on or after 1 June 2019. It should be noted that any discharge of oil or oily mixtures into polar waters is prohibited by the Polar Code (see also paragraphs 3.1 and 3.2 of these Guidelines).

2.3 Definitions

2.3.1 "Bleed-off water" means water to be discharged directly, or via a holding tank, to the sea from an EGR water treatment system.

2.3.2 "EGC" means exhaust gas cleaning.

2.3.3 "EGCS Guidelines" means the *2015 Guidelines for exhaust gas cleaning systems* (resolution MEPC.259(68), as may be amended).

2.3.4 "EGR record book" means a record of the maintenance and servicing of the monitoring equipment required by these Guidelines. This may be met by following the relevant requirements of the EGCS Guidelines. This record would include the date, time, location and quantity of residues delivered ashore from the EGR water treatment system or may be recorded in the EGCS Record Book.

2.3.5 "Manual for EGR bleed-off discharge system" means the manual containing the system description, discharge limits and the relevant items required for Onboard Monitoring Manual (OMM) in the EGCS Guidelines or the Revised Guidelines.

2.4 Required documents

The EGR record book and manual for EGR bleed-off discharge system should be approved by the Administration. The following documents should be retained on board the ship as appropriate and should be available for surveys as required:

.1 manual for EGR bleed-off discharge system;

.2 certificates for type approval of oil content meters (15 ppm alarm);

.3 operating and maintenance manuals of oil content meters (15 ppm alarm); and

.4 EGR record book.

3 DISCHARGE OF EGR BLEED-OFF WATER INTO THE SEA

3.1 Bleed-off water when using fuel oil not complying with the relevant limit value in regulation 14 of MARPOL Annex VI

3.1.1 The bleed-off water discharged to the sea from an EGR water treatment system may or may not be combined with the discharge water from an EGC system. In either case, this discharge to the sea should be documented, monitored and recorded, as appropriate, in accordance with the relevant requirements of the EGCS Guidelines. Upon request, the Administration should be provided with bleed-off water samples according to appendix 3 of the EGCS Guidelines, as applicable.

3.1.2 Bleed-off water which is retained onboard in a holding tank should not be discharged to the sea, except when:

.1 the ship is en route[1] and outside polar waters,[2] ports, harbours or estuaries; and

.2 the bleed-off water discharged meets the provisions of paragraph 3.1.1.

3.2 Bleed-off water when using fuel oil complying with the relevant limit value in regulation 14 of MARPOL Annex VI

3.2.1 In case the EGR system is in operation and the sulphur content of the fuel oil used for the engine complies with regulation 14 of MARPOL Annex VI, the discharge of bleed-off water should meet the requirements of paragraph 3.1, unless the following conditions are satisfied:

.1 the ship is en route[1] outside polar waters,[2] ports, harbours or estuaries;

.2 the sulphur content of the fuel oil used for the engine when the EGR system is in operation complies with the relevant requirements of regulation 14 of MARPOL Annex VI;

.3 the oil content meter is type approved in accordance with the annex of resolution MEPC.107(49), as amended;

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[1] Refer to Unified Interpretation to regulation 15.2.1 of the revised MARPOL Annex I (MEPC 55/23, annex 18).

[2] Refer to the *International Code for Ships Operating in Polar Waters* (Polar Code) (resolutions MEPC.264(68) and MSC.385(94)).

.4 the oil content of the bleed-off water discharge and 15 ppm alarm is continuously monitored and recorded; and

.5 the oil content of the discharge does not exceed 15 ppm.

3.2.2 When the EGR system is operated in polar waters,[2] ports, harbours or estuaries, the discharge of bleed-off water to the sea should comply with section 3.1.

3.2.3 Bleed-off water which is retained on board in a holding tank should not be discharged to the sea, except when:

.1 the ship is en route[1] and outside polar waters,[2] ports, harbours or estuaries; and

.2 the bleed-off water discharged meets the provisions of paragraph 3.2.1.

4 RESIDUES FROM EGR WATER TREATMENT SYSTEMS

4.1 Residues from EGR water treatment systems should be delivered ashore to adequate reception facilities. Such residues should not be discharged to the sea or incinerated on board.

4.2 Each ship fitted with an EGR unit should record the storage and disposal of bleed-off water residues in an EGR record book, including the date, time and location of such storage and disposal.

5 BLEED-OFF WATER ADDITIVES

5.1 In case additives are used for enhancing the bleed-off water quality, an assessment of the additive should be performed and documented unless the below substances are used and documented with a Material Safety Data Sheet:

.1 neutralization agent (caustic substance), such as Sodium Hydroxide (NaOH) or Sodium Carbonate (Na_2CO_3); and

.2 flocculants, which are used for marine approved oily-water separating equipment.

5.2 For those technologies which make use of chemicals, additives, preparations or create relevant chemicals, not including those in paragraph 5.1, in situ, there should be an assessment of the bleed-off water additives. The assessment could take into account relevant guidelines such as the *Procedure for approval of ballast water management systems that make use of active substances (G9)* (resolution MEPC.169(57)), and, if necessary, additional bleed-off water discharge criteria should be established.

6 SURVEY AND CERTIFICATION

The bleed-off discharge system and the EGR record book should be subject to survey on installation and at initial, annual/intermediate and renewal surveys by the Administration. The bleed-off discharge system and the EGR record book may also be subject to inspection by port State control.

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ANNEX 5

RESOLUTION MEPC.308(73)
(adopted on 26 October 2018)

2018 GUIDELINES ON THE METHOD OF CALCULATION OF THE ATTAINED ENERGY EFFICIENCY DESIGN INDEX (EEDI) FOR NEW SHIPS

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 (the Committee) conferred upon it by international conventions for the prevention and control of marine pollution from ships,

RECALLING ALSO that it adopted, by resolution MEPC.203(62), 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 (inclusion of regulations on energy efficiency for ships in MARPOL Annex VI),

NOTING that the aforementioned amendments to MARPOL Annex VI entered into force on 1 January 2013,

NOTING ALSO that regulation 20 (Attained Energy Efficiency Design Index (attained EEDI)) of MARPOL Annex VI, as amended, requires that the EEDI shall be calculated taking into account the guidelines developed by the Organization,

NOTING FURTHER that the *2012 Guidelines on the method of calculation of the attained Energy Efficiency Design Index (EEDI) for new ships*, adopted by resolution MEPC.212(63), and, the amendments thereto, adopted by resolution MEPC.224(64),

NOTING FURTHER that it adopted, by resolution MEPC.245(66), the *2014 Guidelines on the method of calculation of the attained Energy Efficiency Design Index (EEDI) for new ships*, and by resolutions MEPC.263(68) and MEPC.281(70), amendments thereto,

RECOGNIZING that the aforementioned amendments to MARPOL Annex VI require relevant guidelines for the smooth and uniform implementation of the regulations,

HAVING CONSIDERED, at its seventy-third session, proposed *2018 Guidelines on the method of calculation of the attained Energy Efficiency Design Index (EEDI) for new ships,*

1 ADOPTS the *2018 Guidelines on the method of calculation of the attained Energy Efficiency Design Index (EEDI) for new ships, as amended*, as set out in the annex to the present resolution;

2 INVITES Administrations to take the aforementioned amendments into account when developing and enacting national laws which give force to and implement provisions set forth in regulation 20 of MARPOL Annex VI, as amended;

3 REQUESTS the Parties to MARPOL Annex VI and other Member Governments to bring the amendments to the attention of shipowners, ship operators, shipbuilders, ship designers and any other interested parties;

4 AGREES to keep these Guidelines, as amended, under review, in the light of experience gained with their implementation;

5 SUPERSEDES the *2014 Guidelines on the method of calculation of the attained Energy Efficiency Design Index (EEDI) for new ships* adopted by resolution MEPC.245(66), as amended by resolutions MEPC.263(66) and MEPC.281(70), and MEPC.1/Circ.866.

ANNEX

2018 GUIDELINES ON THE METHOD OF CALCULATION OF THE ATTAINED ENERGY EFFICIENCY DESIGN INDEX (EEDI) FOR NEW SHIPS

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APPENDIX 1 A generic and simplified power plant

APPENDIX 2 Guidelines for the development of electric power tables for EEDI (EPT-EEDI)

APPENDIX 3 A generic and simplified marine power plant for a cruise passenger ship having non-conventional propulsion

APPENDIX 4 EEDI calculation examples for use of dual fuel engines

1 Definitions

1.1 MARPOL means the International Convention for the Prevention of Pollution from Ships, 1973, as modified by the Protocols of 1978 and 1997relating thereto, as amended.

1.2 For the purpose of these Guidelines, the definitions in chapter 4 of MARPOL Annex VI, as amended, apply.

2 Energy Efficiency Design Index (EEDI)

2.1 EEDI Formula

The attained new ship Energy Efficiency Design Index (EEDI) is a measure of ships' energy efficiency (g/t · nm) and calculated by the following formula:

$$\frac{\left(\prod_{j=1}^{n} f_j\right)\left(\sum_{i=1}^{nME} P_{ME(i)} \cdot C_{FME(i)} \cdot SFC_{ME(i)}\right) + \left(P_{AE} \cdot C_{FAE} \cdot SFC_{AE}\,*\right) + \left(\left(\prod_{j=1}^{n} f_j \cdot \sum_{i=1}^{nPTI} P_{PTI(i)} - \sum_{i=1}^{neff} f_{eff(i)} \cdot P_{AEeff(i)}\right) C_{FAE} \cdot SFC_{AE}\right) - \left(\sum_{i=1}^{neff} f_{eff(i)} \cdot P_{eff(i)} \cdot C_{FME} \cdot SFC_{ME}\,**\right)}{f_i \cdot f_c \cdot f_l \cdot Capacity \cdot f_w \cdot V_{ref}}$$

* If part of the Normal Maximum Sea Load is provided by shaft generators, SFC_{ME} and C_{FME} may – for that part of the power – be used instead of SFC_{AE} and C_{FAE}

** In case of $P_{PTI(i)} > 0$, the average weighted value of (SFC_{ME} · C_{FME}) and (SFC_{AE} · C_{FAE}) to be used for calculation of P_{eff}

Note: This formula may not be applicable to a ship having diesel-electric propulsion, turbine propulsion or hybrid propulsion system, except for cruise passenger ships and LNG carriers.

2.2 Parameters

For the calculation of EEDI by the formula in paragraph 2.1, following parameters apply.

2.2.1 C_F ; Conversion factor between fuel consumption and CO_2 emission

C_F is a non-dimensional conversion factor between fuel consumption measured in g and CO_2 emission also measured in g based on carbon content. The subscripts $_{ME(i)}$ and $_{AE(i)}$ refer to the main and auxiliary engine(s) respectively. C_F corresponds to the fuel used when determining *SFC* listed in the applicable test report included in a Technical File as defined in paragraph 1.3.15 of the NO_X Technical Code ("test report included in a NO_X technical file" hereafter). The value of C_F is as follows:

Type of fuel	Reference	Lower calorific value (kJ/kg)	Carbon content	C_F (t-CO_2/t-Fuel)
1 Diesel/Gas Oil	ISO 8217 Grades DMX through DMB	42,700	0.8744	3.206
2 Light Fuel Oil (LFO)	ISO 8217 Grades RMA through RMD	41,200	0.8594	3.151
3 Heavy Fuel Oil (HFO)	ISO 8217 Grades RME through RMK	40,200	0.8493	3.114
4 Liquefied Petroleum Gas (LPG)	Propane	46,300	0.8182	3.000
	Butane	45,700	0.8264	3.030

5 Liquefied Natural Gas (LNG)		48,000	0.7500	2.750
6 Methanol		19,900	0.3750	1.375
7 Ethanol		26,800	0.5217	1.913

In case of a ship equipped with a dual-fuel main or auxiliary engine, the C_F-factor for gas fuel and the C_F-factor for fuel oil should apply and be multiplied with the specific fuel oil consumption of each fuel at the relevant EEDI load point. Meanwhile, gas fuel should be identified whether it is regarded as the "primary fuel" in accordance with the formula below:

$$f_{DFgas} = \frac{\sum_{i=1}^{ntotal} P_{total(i)}}{\sum_{i=1}^{ngasfuel} P_{gasfuel(i)}} \times \frac{V_{gas} \times \rho_{gas} \times LCV_{gas} \times K_{gas}}{\left(\sum_{i=1}^{nLiquid} V_{liquid(i)} \times \rho_{liquid(i)} \times LCV_{liquid(i)} \times K_{liquid(i)} \right) + V_{gas} \times \rho_{gas} \times LCV_{gas} \times K_{gas}}$$

$f_{DFliquid} = 1 - f_{DFgas}$

where,

f_{DFgas} is the fuel availability ratio of gas fuel corrected for the power ratio of gas engines to total engines, f_{DFgas} should not be greater than 1;

V_{gas} is the total net gas fuel capacity on board in m^3. If other arrangements, like exchangeable (specialized) LNG tank-containers and/or arrangements allowing frequent gas refuelling are used, the capacity of the whole LNG fuelling system should be used for V_{gas}. The boil-off rate (BOR) of gas cargo tanks can be calculated and included to V_{gas} if it is connected to the fuel gas supply system (FGSS);

V_{liquid} is the total net liquid fuel capacity on board in m^3 of liquid fuel tanks permanently connected to the ship's fuel system. If one fuel tank is disconnected by permanent sealing valves, V_{liquid} of the fuel tank can be ignored;

ρ_{gas} is the density of gas fuel in kg/m^3;

ρ_{liquid} is the density of each liquid fuel in kg/m^3;

LCV_{gas} is the low calorific value of gas fuel in kJ/kg;

LCV_{liquid} is the low calorific value of liquid fuel in kJ/kg;

K_{gas} is the filling rate for gas fuel tanks;

K_{liquid} is the filling rate for liquid fuel tanks;

P_{total} *is* the total installed engine power, P_{ME} *and* P_{AE} in kW;

$P_{gasfuel}$ *is* the dual fuel engine installed power, P_{ME} *and* P_{AE} in kW;

.1 If the total gas fuel capacity is at least 50% of the fuel capacity dedicated to the dual fuel engines , namely $f_{DFgas} \geq 0.5$, then gas fuel is regarded as the "Primary fuel," and $f_{DFgas} = 1$ and $f_{DFliquid} = 0$ for each dual fuel engine.

.2 If $f_{DFgas} < 0.5$, gas fuel is not regarded as the "primary fuel." The C_F and *SFC* in the EEDI calculation for each dual fuel engine (both main and auxiliary engines) should be calculated as the weighted average of C_F and *SFC* for liquid and gas mode, according to f_{DFgas} and $f_{DFliquid}$, such as the original item of $P_{ME(i)} \cdot C_{FME(i)} \cdot SFC_{ME(i)}$ in the EEDI calculation is to be replaced by the formula below.

$$P_{ME(i)} \cdot (f_{DFgas(i)} \cdot (C_{FME\ pilot\ fuel(i)} \cdot SFC_{ME\ pilot\ fuel(i)} + C_{FME\ gas(i)} \cdot SFC_{ME\ gas(i)}) + f_{DFliquid(i)} \cdot C_{FME\ liquid(i)} \cdot SFC_{ME\ liquid(i)})$$

2.2.2 V_{ref} ; Ship speed

V_{ref} is the ship speed, measured in nautical miles per hour (knot), on deep water in the condition corresponding to the *capacity* as defined in paragraphs 2.2.3.1 and 2.2.3.3 (in case of passenger ships and cruise passenger ships, this condition should be summer load draught as provided in paragraph 2.2.4) at the shaft power of the engine(s) as defined in paragraph 2.2.5 and assuming the weather is calm with no wind and no waves.

2.2.3 *Capacity*

Capacity is defined as follows.

2.2.3.1 For bulk carriers, tankers, gas carriers, LNG carriers, ro-ro cargo ships (vehicle carriers), ro-ro cargo ships, ro-ro passenger ships, general cargo ships, refrigerated cargo carrier and combination carriers, deadweight should be used as *capacity*.

2.2.3.2 For passenger ships and cruise passenger ships, gross tonnage in accordance with the International Convention of Tonnage Measurement of Ships 1969, annex I, regulation 3, should be used as *capacity*.

2.2.3.3 For containerships, 70% of the deadweight (DWT) should be used as *capacity*. EEDI values for containerships are calculated as follows:

.1 attained EEDI is calculated in accordance with the EEDI formula using 70% deadweight for *capacity*.

.2 estimated index value in the Guidelines for calculation of the reference line is calculated using 70% deadweight as:

$$Estimated\ \ Index\ Value = 3.1144 \cdot \frac{190 \cdot \sum_{i=1}^{NME} P_{MEi} + 215 \cdot P_{AE}}{70\%\mathrm{DWT} \cdot V_{ref}}$$

.3 parameters a and c for containerships in table 2 of regulation 21 of MARPOL Annex VI are determined by plotting the estimated index value against 100% deadweight i.e. a = 174.22 and c=0.201 were determined.

.4 required EEDI for a new containership is calculated using 100% deadweight as:

$$\text{Required EEDI} = (1\text{-}X/100) \cdot a \cdot 100\%\ \text{deadweight}^{-c}$$

where X is the reduction factor (in percentage) in accordance with table 1 in regulation 21 of MARPOL Annex VI relating to the applicable phase and size of new containership.

2.2.4 *Deadweight*

Deadweight 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 recognized by it.

2.2.5 *P ;* Power of main and auxiliary engines

P is the power of the main and auxiliary engines, measured in kW. The subscripts $_{ME(i)}$ and $_{AE(i)}$ refer to the main and auxiliary engine(s), respectively. The summation on *i* is for all engines with the number of engines ($_{nME}$) (see diagram in appendix 1).

2.2.5.1 $P_{ME(i)}$; Power of main engines

$P_{ME(i)}$ is 75% of the rated installed power (MCR[1]) for each main engine (*i*).

For LNG carriers having diesel electric propulsion system, $P_{ME(i)}$ should be calculated by the following formula:

$$P_{ME(i)} = 0.83 \times \frac{MPP_{Motor(i)}}{\eta_{(i)}}$$

Where:

$MPP_{Motor(i)}$ is the rated output of motor specified in the certified document.

$\eta_{(i)}$ is to be taken as the product of electrical efficiency of generator, transformer, converter and motor, taking into consideration the weighted average as necessary.

The electrical efficiency, $\eta_{(i)}$, should be taken as 91.3% for the purpose of calculating attained EEDI. Alternatively, if the value more than 91.3% is to be applied, the $\eta_{(i)}$ should be obtained by measurement and verified by method approved by the verifier.

For LNG carriers having steam turbine propulsion systems, $P_{ME(i)}$ is 83% of the rated installed power ($MCR_{SteamTurbine}$) for each steam turbine$_{(i)}$.

The influence of additional shaft power take off or shaft power take in is defined in the following paragraphs.

2.2.5.2 $P_{PTO(i)}$; Shaft generator

In case where shaft generator(s) are installed, $P_{PTO(i)}$ is 75% of the rated electrical output power of each shaft generator. In case that shaft generator(s) are installed to steam turbine, $P_{PTO(i)}$ is 83% of the rated electrical output power and the factor of 0.75 should be replaced to 0.83.

For calculation of the effect of shaft generators two options are available:

[1] The value of MCR specified on the EIAPP certificate should be used for calculation. If the main engines are not required to have an EIAPP certificate, the MCR on the nameplate should be used.

Option 1:

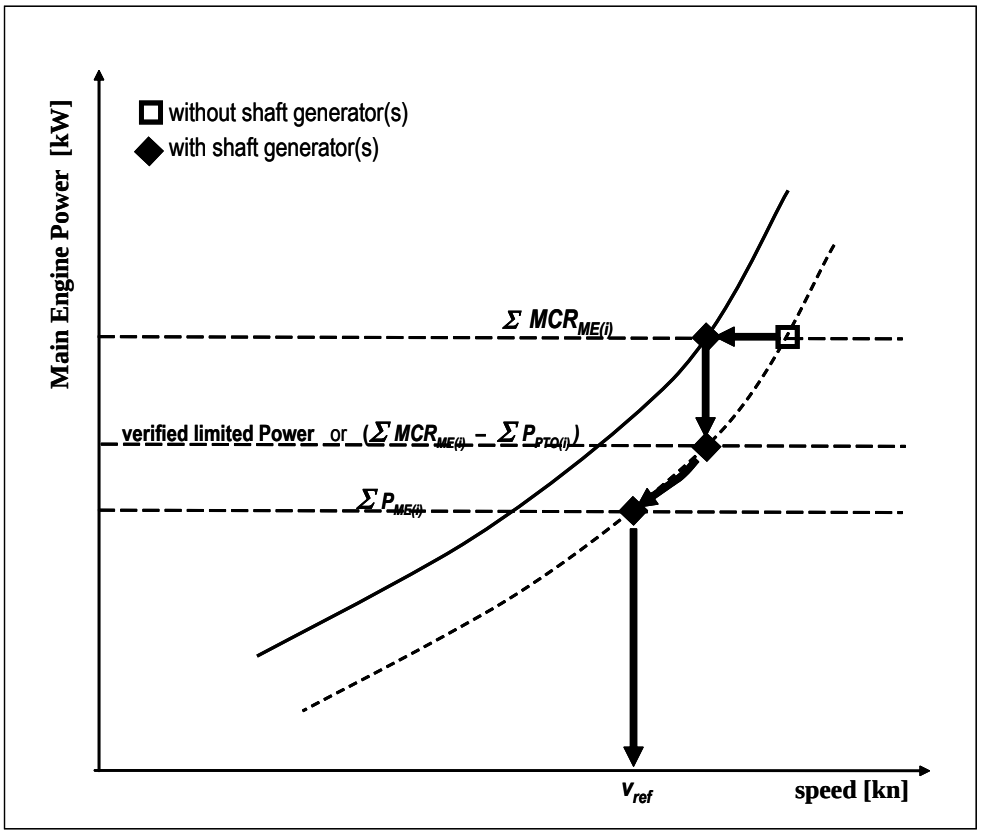
The maximum allowable deduction for the calculation of $\Sigma P_{ME(i)}$ is to be no more than P_{AE} as defined in paragraph 2.2.5.6. For this case, $\Sigma P_{ME(i)}$ is calculated as:

$$\sum_{i=1}^{nME} P_{ME(i)} = 0.75 \times \left(\sum MCR_{ME(i)} - \sum P_{PTO(i)} \right) \quad with \;\; 0.75 \times \sum P_{PTO(i)} \le P_{AE}$$

or

Option 2:

Where an engine is installed with a higher rated power output than that which the propulsion system is limited to by verified technical means, then the value of $\Sigma P_{ME(i)}$ is 75% of that limited power for determining the reference speed, V_{ref} and for EEDI calculation. The following figure gives guidance for determination of $\Sigma P_{ME(i)}$:



2.2.5.3 $P_{PTI(i)}$; Shaft motor

In case where shaft motor(s) are installed, $P_{PTI(i)}$ is 75% of the rated power consumption of each shaft motor divided by the weighted average efficiency of the generator(s), as follows:

$$\sum P_{PTI(i)} = \frac{\sum \left(0.75 \cdot P_{SM,\max(i)} \right)}{\eta_{\overline{Gen}}}$$

Where:

$P_{SM,\max(i)}$ is the rated power consumption of each shaft motor

$\eta_{\overline{Gen}}$ is the weighted average efficiency of the generator(s)

In case that shaft motor(s) are installed to steam turbine, $P_{PTI(i)}$ is 83% of the rated power consumption and the factor of 0.75 should be replaced to 0.83.

The propulsion power at which V_{ref} is measured, is:

$$\sum P_{ME(i)} + \sum P_{PTI(i),Shaft}$$

Where:

$$\sum P_{PTI(i),Shaft} = \sum \left(0.75 \cdot P_{SM,\max(i)} \cdot \eta_{PTI(i)}\right)$$

$\eta_{PTI(i)}$ is the efficiency of each shaft motor installed

Where the total propulsion power as defined above is higher than 75% of the power the propulsion system is limited to by verified technical means, then 75% of the limited power is to be used as the total propulsion power for determining the reference speed, V_{ref} and for EEDI calculation.

In case of combined PTI/PTO, the normal operational mode at sea will determine which of these to be used in the calculation.

Note: The shaft motor's chain efficiency may be taken into consideration to account for the energy losses in the equipment from the switchboard to the shaft motor, if the chain efficiency of the shaft motor is given in a verified document.

2.2.5.4 $P_{eff(i)}$; Innovative mechanical energy efficient technology for main engine

$P_{eff(i)}$ is the output of the innovative mechanical energy efficient technology for propulsion at 75% main engine power.

Mechanical recovered waste energy directly coupled to shafts need not be measured, since the effect of the technology is directly reflected in the V_{ref}.

In case of a ship equipped with a number of engines, the C_F and *SFC* should be the power weighted average of all the main engines.

In case of a ship equipped with dual-fuel engine(s), the C_F and *SFC* should be calculated in accordance with paragraphs 2.2.1 and 2.2.7.

2.2.5.5 P_{AEeff} ; Innovative mechanical energy efficient technology for auxiliary engine

$P_{AEeff\ (i)}$ is the auxiliary power reduction due to innovative electrical energy efficient technology measured at $P_{ME(i)}$.

2.2.5.6 P_{AE} ; Auxiliary engine power

P_{AE} is the required auxiliary engine power to supply normal maximum sea load including necessary power for propulsion machinery/systems and accommodation, e.g. main engine pumps, navigational systems and equipment and living on board, but excluding the power not for propulsion machinery/systems, e.g. thrusters, cargo pumps, cargo gear, ballast pumps, maintaining cargo, e.g. reefers and cargo hold fans, in the condition where the ship engaged in voyage at the speed (V_{ref}) under the condition as mentioned in paragraph 2.2.2.

2.2.5.6.1 For ships which total propulsion power ($\sum MCR_{ME(i)} + \frac{\sum P_{PTI(i)}}{0.75}$) is 10,000 kW or above, P_{AE} is defined as:

$$P_{AE\ (\Sigma MCR_{ME(i)} \geq 10,000kW)} = \left(0.025 \times \left(\sum_{i=1}^{nME} MCR_{ME(i)} + \frac{\sum_{i=1}^{nPTI} P_{PTI(i)}}{0.75} \right) \right) + 250$$

2.2.5.6.2 For ships which total propulsion power ($\sum MCR_{ME(i)} + \frac{\sum P_{PTI(i)}}{0.75}$) is below 10,000 kW, P_{AE} is defined as:

$$P_{AE\ (\Sigma MCR_{ME(i)} < 10,000kW)} = \left(0.05 \times \left(\sum_{i=1}^{nME} MCR_{ME(i)} + \frac{\sum_{i=1}^{nPTI} P_{PTI(i)}}{0.75} \right) \right)$$

2.2.5.6.3 For LNG carriers with a reliquiefaction system or compressor(s), designed to be used in normal operation and essential to maintain the LNG cargo tank pressure below the maximum allowable relief valve setting of a cargo tank in normal operation, the following terms should be added to above P_{AE} formula in accordance with 2.2.5.6.3.1, 2.2.5.6.3.2 or 2.2.5.6.3.3 as below:

.1 For ships having re-liquefaction system:

$$+ CargoTankCapacity_{LNG} \times BOR \times COP_{reliquefy} \times R_{reliquefy}$$

Where:

CargoTankCapacity$_{LNG}$ is the LNG Cargo Tank Capacity in m^3.

BOR is the design rate of boil-off gas of entire ship per day, which is specified in the specification of the building contract.

COP$_{reliquefy}$ is the coefficient of design power performance for reliquefying boil-off gas per unit volume, as follows:

$$COP_{reliquefy} = \frac{425\,(kg/m^3) \times 511\,(kJ/kg)}{24\,(h) \times 3600\,(\text{sec}) \times COP_{cooling}}$$

COP$_{cooling}$ is the coefficient of design performance of reliquefaction and 0.166 should be used. Another value calculated by the manufacturer and verified by the Administration or an organization recognized by the Administration may be used.

$R_{reliquefy}$ is the ratio of boil-off gas (BOG) to be re-liquefied to entire BOG, calculated as follows:

$$R_{reliquefy} = \frac{BOG_{reliquefy}}{BOG_{total}}$$

.2 For LNG carriers with direct diesel driven propulsion system or diesel electric propulsion system, having compressor(s) which are used for supplying high-pressured gas derived from boil-off gas to the installed engines (typically intended for 2-stroke dual fuel engines):

$$+ COP_{comp} \times \sum_{i=1}^{nME} SFC_{ME(i),gasmode} \times \frac{P_{ME(i)}}{1000}$$

Where:

COP_{comp} is the design power performance of compressor and 0.33 (kWh/kg) should be used. Another value calculated by the manufacturer and verified by the Administration or an organization recognized by the Administration may be used.

.3 For LNG carriers with direct diesel driven propulsion system or diesel electric propulsion system, having compressor(s) which are used for supplying low-pressured gas derived from boil-off gas to the installed engines (typically intended for 4-stroke dual fuel engines):

$$+ 0.02 \times \sum_{i=1}^{nME} P_{ME(i)}$$ [2]

2.2.5.6.4 For LNG carriers having diesel electric propulsion system, $MPP_{Motor(i)}$ should be used instead $MCR_{ME(i)}$ for P_{AE} calculation.

2.2.5.6.5 For LNG carriers having steam turbine propulsion system and of which electric power is primarily supplied by turbine generator closely integrated into the steam and feed water systems, P_{AE} may be treated as 0(zero) instead of taking into account electric load in calculating $SFC_{SteamTurbine}$.

2.2.5.7 Use of electric power table

For ship where the P_{AE} value calculated by paragraphs 2.2.5.6.1 to 2.2.5.6.3 is significantly different from the total power used at normal seagoing, e.g. in cases of passenger ships (see NOTE under the formula of EEDI), the P_{AE} value should be estimated by the consumed electric power (excluding propulsion) in conditions when the ship is engaged in a voyage at reference speed (V_{ref}) as given in the electric power table,[3] divided by the average efficiency of the generator(s) weighted by power (see appendix 2).

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[2] With regard to the factor of 0.02, it is assumed that the additional energy needed to compress BOG for supplying to a 4-stroke dual fuel engine is approximately equal to 2% of $P_{ME,}$ compared to the energy needed to compress BOG for supplying to a steam turbine.

[3] The electric power table should be examined and validated by the verifier. Where ambient conditions affect any electrical load in the power table, such as that for heating ventilation and air conditioning systems, the contractual ambient conditions leading to the maximum design electrical load of the installed system for the ship in general should apply.

2.2.6 Consistency of parameters V_{ref}, *Capacity* and *P*

V_{ref}, *Capacity* and *P* should be consistent with each other. As for LNG carries having diesel electric or steam turbine propulsion systems, V_{ref} is the relevant speed at 83% of MPP_{Motor} or $MCR_{SteamTubine}$ respectively.

2.2.7 *SFC;* Certified specific fuel consumption

SFC is the certified specific fuel consumption, measured in g/kWh, of the engines or steam turbines.

2.2.7.1 *SFC* for main and auxiliary engines

The subscripts $_{ME(i)}$ and $_{AE(i)}$ refer to the main and auxiliary engine(s), respectively. For engines certified to the E2 or E3 test cycles of the NO_X Technical Code 2008, the engine Specific Fuel Consumption ($SFC_{ME(i)}$) is that recorded in the test report included in a NO_X technical file for the engine(s) at 75% of MCR power of its torque rating. For engines certified to the D2 or C1 test cycles of the NO_X Technical Code 2008, the engine Specific Fuel Consumption ($SFC_{AE(i)}$) is that recorded on the test report included in a NO_X technical file at the engine(s) 50% of MCR power or torque rating. If gas fuel is used as primary fuel in accordance with paragraph 4.2.3 of the *Guidelines on survey and certification of the energy efficiency design index (EEDI)*, *SFC* in gas mode should be used. In case that installed engine(s) have no approved NO_X Technical File tested in gas mode, the *SFC* of gas mode should be submitted by the manufacturer and confirmed by the verifier.

The *SFC* should be corrected to the value corresponding to the ISO standard reference conditions using the standard lower calorific value of the fuel oil (42,700kJ/kg), referring to ISO 15550:2002 and ISO 3046-1:2002.

For ships where the P_{AE} value calculated by paragraphs 2.2.5.6.1 to 2.2.5.6.3 is significantly different from the total power used at normal seagoing, e.g. conventional passenger ships, the Specific Fuel Consumption (SFC_{AE}) of the auxiliary generators is that recorded in the test report included in a NO_X technical file for the engine(s) at 75% of MCR power of its torque rating.

SFC_{AE} is the power-weighted average among $SFC_{AE(i)}$ of the respective engines *i*.

For those engines which do not have a test report included in a NO_X technical file because its power is below 130 kW, the *SFC* specified by the manufacturer and endorsed by a competent authority should be used.

At the design stage, in case of unavailability of test report in the NO_X file, the *SFC* specified by the manufacturer and endorsed by a competent authority should be used.

For LNG driven engines of which *SFC* is measured in kJ/kWh should be corrected to the *SFC* value of g/kWh using the standard lower calorific value of the LNG (48,000 kJ/kg), referring to the 2006 IPCC Guidelines.

Reference lower calorific values of additional fuels are given in the table in paragraph 2.2.1 of these Guidelines. The reference lower calorific value corresponding to the conversion factor of the respective fuel should be used for calculation.

2.2.7.2 *SFC* for steam turbines ($SFC_{SteamTurbine}$)

The $SFC_{SteamTurbine}$ should be calculated by manufacturer and verified by the Administration or an organization recognized by the Administration as follows:

$$SFC_{SteamTurbine} = \frac{FuelConsumption}{\sum_{i=1}^{nME} P_{ME(i)}}$$

Where:

.1 *Fuel consumption* is fuel consumption of boiler per hour (g/h). For ships of which electric power is primarily supplied by Turbine Generator closely integrated into the steam and feed water systems, not only P_{ME} but also *electric loads* corresponding to paragraph 2.2.5.6 should be taken into account.

.2 The *SFC* should be corrected to the value of LNG using the standard lower calorific value of the LNG (48,000 kJ/kg) at SNAME Condition (condition standard; air temperature 24°C , inlet temperature of fan 38°C, sea water temperature 24°C).

.3 In this correction, the difference of the boiler efficiency based on lower calorific value between test fuel and LNG should be taken into account.

2.2.8 f_j ; Ship specific design elements

f_j is a correction factor to account for ship specific design elements:

2.2.8.1 Power correction factor for ice-classed ships

The power correction factor, f_j, for ice-classed ships should be taken as the greater value of f_{j0} and $f_{j,min}$ as tabulated in table 1 but not greater than $f_{j,max}$ = 1.0.

For further information on approximate correspondence between ice classes, see HELCOM Recommendation 25/7[4].

Table 1: Correction factor for power f_j for ice-classed ships

Ship type	f_{j0}	$f_{j,min}$ depending on the ice class			
		IA Super	IA	IB	IC
Tanker	$\frac{17.444 \cdot DWT^{0.5766}}{\sum_{i=1}^{nME} MCR_{ME(i)}}$	$0.2488 \cdot DWT^{0.0903}$	$0.4541 \cdot DWT^{0.0524}$	$0.7783 \cdot DWT^{0.0145}$	$0.8741 \cdot DWT^{0.0079}$
Bulk carrier	$\frac{17.207 \cdot DWT^{0.5705}}{\sum_{i=1}^{nME} MCR_{ME(i)}}$	$0.2515 \cdot DWT^{0.0851}$	$0.3918 \cdot DWT^{0.0556}$	$0.8075 \cdot DWT^{0.0071}$	$0.8573 \cdot DWT^{0.0087}$
General cargo ship	$\frac{1.974 \cdot DWT^{0.7987}}{\sum_{i=1}^{nME} MCR_{ME(i)}}$	$0.1381 \cdot DWT^{0.1435}$	$0.1574 \cdot DWT^{0.144}$	$0.3256 \cdot DWT^{0.0922}$	$0.4966 \cdot DWT^{0.0583}$
Refrigerated cargo ship	$\frac{5.598 \cdot DWT^{0.696}}{\sum_{i=1}^{nME} MCR_{ME(i)}}$	$0.5254 \cdot DWT^{0.0357}$	$0.6325 \cdot DWT^{0.0278}$	$0.7670 \cdot DWT^{0.0159}$	$0.8918 \cdot DWT^{0.0079}$

4 HELCOM Recommendation 25/7 may be found at http://www.helcom.fi

Alternatively, if an ice-class ship is designed and constructed based on an open water ship with same shape and size of hull with EEDI certification, the power correction factor, f_j, for ice-classed ships can be calculated by using propulsion power of the new ice-class ship required by ice-class regulations, $P_{ice\ class}$, and the existing open water ship, P_{ow}, as follows:

$$f_j = \frac{P_{ow}}{P_{ice\ class}}$$

In this case, V_{ref} should be measured at the shaft power of the engine(s) installed on the existing open water ship as defined in paragraph 2.2.5.

2.2.8.2 Power correction factor for shuttle tankers with propulsion redundancy

The power correction factor f_j, for shuttle tankers with propulsion redundancy should be $f_j = 0.77$. This correction factors applies to shuttle tankers with propulsion redundancy between 80,000 and 160,000 dwt. Shuttle tankers with propulsion redundancy are tankers used for loading of crude oil from offshore installations equipped with dual-engine and twin-propellers need to meet the requirements for dynamic positioning and redundancy propulsion class notation.

2.2.8.3 Correction factor for ro-ro cargo and ro-ro passenger ships (f_{jRoRo})

For ro-ro cargo and ro-ro passenger ships f_{jRoRo} is calculated as follows:

$$f_{jRoRo} = \frac{1}{F_{n_L}^{\alpha} \cdot \left(\frac{L_{pp}}{B_s}\right)^{\beta} \cdot \left(\frac{B_s}{d_s}\right)^{\gamma} \cdot \left(\frac{L_{pp}}{\nabla^{1/3}}\right)^{\delta}} \quad ; \quad \text{If } f_{jRoRo} > 1 \text{ then } f_j = 1$$

where the Froude number, F_{n_L}, is defined as:

$$F_{n_L} = \frac{0.5144 \cdot V_{ref}}{\sqrt{L_{pp} \cdot g}}$$

and the exponents α, β, γ and δ are defined as follows:

Ship type	Exponent:			
	α	β	γ	δ
Ro-ro cargo ship	2.00	0.50	0.75	1.00
Ro-ro passenger ship	2.50	0.75	0.75	1.00

2.2.8.4 Correction factor for general cargo ships

The factor f_j for general cargo ships is calculated as follows:

$$f_j = \frac{0.174}{Fn_{\nabla}{}^{2.3} \cdot C_b{}^{0.3}} \quad ; \quad \text{If } f_j > 1 \text{ then } f_j = 1$$

Where

$$Fn_{\nabla} = \frac{0.5144 \cdot V_{ref}}{\sqrt{g \cdot \nabla^{\frac{1}{3}}}} \quad ; \quad \text{If } Fn_{\nabla} > 0.6 \text{ then } Fn_{\nabla} = 0.6$$

and

$$C_b = \frac{\nabla}{L_{pp} \cdot B_s \cdot d_s}$$

2.2.8.5 Correction factor for other ship types

For other ship types, f_j should be taken as 1.0.

2.2.9 f_w ; Factor for speed reduction at sea

f_w is a non-dimensional coefficient indicating the decrease of speed in representative sea conditions of wave height, wave frequency and wind speed (e.g. Beaufort Scale 6), and is determined as follows:

2.2.9.1 for the attained EEDI calculated under regulations 20 and 21 of MARPOL Annex VI, f_w is 1.00;

2.2.9.2 when f_w is calculated according to the subparagraph 2.2.9.2.1 or 2.2.9.2.2 below, the value for attained EEDI calculated by the formula in paragraph 2.1 using the obtained f_w should be referred to as "*attained EEDI*$_{weather}$";

2.2.9.2.1 f_w can be determined by conducting the ship specific simulation on its performance at representative sea conditions. The simulation methodology should be based on the Guidelines developed by the Organization[4] and the method and outcome for an individual ship should be verified by the Administration or an organization recognized by the Administration; and

2.2.9.2.2 In cases where a simulation is not conducted, f_w should be taken from the "Standard f_w " table/curve. A "Standard f_w " table/curve is provided in the Guidelines[5] for each ship type defined in regulation 2 of MARPOL Annex VI, and expressed as a function of capacity (e.g. deadweight). The "Standard f_w " table/curve is based on data of actual speed reduction of as many existing ships as possible under the representative sea condition.

2.2.9.3 f_w and *attained EEDI*$_{weather}$, if calculated, with the representative sea conditions under which those values are determined, should be indicated in the EEDI Technical File to distinguish it from the attained EEDI calculated under regulations 20 and 21 of MARPOL Annex VI.

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5 Refer to *Interim Guidelines for the calculation of the coefficient f_w for decrease in ship speed in a representative sea condition for trial use*, approved by the Organization and circulated by MEPC.1/Circ.796.

2.2.10 $f_{eff(i)}$; Factor of each innovative energy efficiency technology

$f_{eff(i)}$ is the availability factor of each innovative energy efficiency technology. $f_{eff(i)}$ for waste energy recovery system should be one (1.0)[6].

2.2.11 f_i ; Capacity factor for technical/regulatory limitation on capacity

f_i is the capacity factor for any technical/regulatory limitation on capacity, and should be assumed to be one (1.0) if no necessity of the factor is granted.

2.2.11.1 Capacity correction factor for ice-classed ships

The capacity correction factor, fi, for ice-classed ships having DWT as the measure of capacity should be calculated as follows:

$$f_i = f_{i(ice\ class)} \cdot f_{iC_b},$$

where $f_{i(ice\ class)}$ is the capacity correction factor for ice-strengthening of the ship, which can be obtained from Table 2 and f_{iC_b} is the capacity correction factor for improved ice-going capability, which should not be less than 1.0 and which should be calculated as follows:

$$f_{iC_b} = \frac{C_{b\ reference\ design}}{C_b},$$

where $C_{b\ reference\ design}$ is the average block coefficient for the ship type, which can be obtained from Table 3 for bulk carriers, tankers and general cargo ships, and C_b is the block coefficient of the ship. For ship types other than bulk carriers, tankers and general cargo ships,

$f_{iC_b} = 1.0.$

[6] EEDI calculation should be based on the normal seagoing condition outside Emission Control Area designated under regulation 13.6 of MARPOL ANNEX VI.

Table 2: Capacity correction factor for ice-strengthening of the hull

Ice class[7]	$f_{i(ice\ class)}$
IC	$f_{i(IC)}$ = 1.0041 + 58.5/*DWT*
IB	$f_{i(IB)}$ = 1.0067 + 62.7/*DWT*
IA	$f_{i(IA)}$ = 1.0099 + 95.1/*DWT*
IA Super	$f_{i(IAS)}$ = 1.0151 + 228.7/*DWT*

Table 3: Average block coefficients $C_{b\ reference\ design}$ for bulk carriers, tankers and general cargo ships

	Size categories				
Ship type	below 10,000 DWT	10,000 – 25,000 DWT	25,000 – 55,000 DWT	55,000 – 75,000 DWT	above 75,000 DWT
Bulk carrier	0.78	0.80	0.82	0.86	0.86
Tanker	0.78	0.78	0.80	0.83	0.83
General cargo ship	0.80				

Alternatively, the capacity correction factor for ice-strengthening of the ship ($f_{i(ice\ class)}$) can be calculated by using the formula given for the ship specific voluntary enhancement correction coefficient ($f_{i\ VSE}$) in paragraph 2.2.11.2. This formula can also be used for other ice classes than those given in Table 2.

2.2.11.2 $f_{i\ VSE}$[8] ; Ship specific voluntary structural enhancement

$f_{i\ VSE}$ for ship specific voluntary structural enhancement is expressed by the following formula:

$$f_{iVSE} = \frac{DWT_{referencedesign}}{DWT_{enhanceddesign}}$$

where:

$$DWT_{referencedesign} = \Delta_{ship} - lightweight_{referencedesign}$$

$$DWT_{enhanceddesign} = \Delta_{ship} - lightweight_{enhanceddesign}$$

For this calculation the same displacement (Δ) for reference and enhanced design should be taken.

DWT before enhancements ($DWT_{reference\ design}$) is the deadweight prior to application of the structural enhancements. DWT after enhancements ($DWT_{enhanced\ design}$) is the deadweight following the application of voluntary structural enhancement. A change of material (e.g. from

[7] For further information on approximate correspondence between ice classes, see HELCOM Recommendation 25/7, which can be found at http://www.helcom.fi

[8] Structural and/or additional class notations such as, but not limited to, "strengthened for discharge with grabs" and "strengthened bottom for loading/unloading aground", which result in a loss of deadweight of the ship, are also seen as examples of "voluntary structural enhancements".

aluminum alloy to steel) between reference design and enhanced design should not be allowed for the $f_{i\ VSE}$ calculation. A change in grade of the same material (e.g. in steel type, grades, properties and condition) should also not be allowed.

In each case, two sets of structural plans of the ship should be submitted to the verifier for assessment. One set for the ship without voluntary structural enhancement; the other set for the same ship with voluntary structural enhancement (alternatively, one set of structural plans of the reference design with annotations of voluntary structural enhancement should also be acceptable). Both sets of structural plans should comply with the applicable regulations for the ship type and intended trade.

2.2.11.3 f_{iCSR} ; Ships under the Common Structural Rules (CSR)

For bulk carriers and oil tankers, built in accordance with the Common Structural Rules (CSR) of the classification societies and assigned the class notation CSR, the following capacity correction factor f_{iCSR} should apply:

$$f_{iCSR} = 1 + (0.08 \cdot LWT_{CSR} / DWT_{CSR})$$

Where DWT_{CSR} is the deadweight determined by paragraph 2.2.4 and LWT_{CSR} is the light weight of the ship.

2.2.11.4 f_i for other ship types

For other ship types, f_i should be taken as one (1.0).

2.2.12 f_c ; Cubic capacity correction factor

f_c is the cubic capacity correction factor and should be assumed to be one (1.0) if no necessity of the factor is granted.

2.2.12.1 f_c for chemical tankers

For chemical tankers, as defined in regulation 1.16.1 of MARPOL Annex II, the following cubic capacity correction factor f_c should apply:

$f_c = R^{-0.7} - 0.014$, where R is less than 0.98
or
$f_c = 1.000$, where R is 0.98 and above;

where: R is the capacity ratio of the deadweight of the ship (tonnes) as determined by paragraph 2.2.4 divided by the total cubic capacity of the cargo tanks of the ship (m^3).

2.2.12.2 f_c for gas carriers

for gas carriers having direct diesel driven propulsion system constructed or adapted and used for the carriage in bulk of liquefied natural gas, the following cubic capacity correction factor f_{cLNG} should apply:

$$f_{cLNG} = R^{-0.56}$$

where: R is the capacity ratio of the deadweight of the ship (tonnes) as determined by paragraph 2.2.4 divided by the total cubic capacity of the cargo tanks of the ship (m^3).

Note: This factor is applicable to LNG carriers defined as gas carriers in regulation 2.26 of MARPOL Annex VI and should not be applied to LNG carriers defined in regulation 2.38 of MARPOL Annex VI.

2.2.12.3 f_c for ro-ro passenger ships (f_{cRoPax})

For ro-ro passenger ships having a DWT/GT-ratio of less than 0.25, the following cubic capacity correction factor, f_{cRoPax}, should apply:

$$f_{cRoPax} = \left(\frac{(DWT/GT)}{0.25}\right)^{-0.8}$$

Where DWT is the Capacity and GT is the gross tonnage in accordance with the International Convention of Tonnage Measurement of Ships 1969, annex I, regulation 3.

2.2.12.4 f_c for bulk carriers having R of less than 0.55 ($f_{c\ bulk\ carriers\ designed\ to\ carry\ light\ cargoes}$)

For bulk carriers having R of less than 0.55 (e.g. wood chip carriers), the following cubic capacity correction factor, $f_{c\ bulk\ carriers\ designed\ to\ carry\ light\ cargoes}$, should apply:

$$f_{c\ bulk\ carriers\ designed\ to\ carry\ light\ cargoes} = R^{-0.15}$$

where R is the capacity ratio of the deadweight of the ship (tonnes) as determined by paragraph 2.2.4 divided by the total cubic capacity of the cargo holds of the ship (m^3).

2.2.13 L_{pp} ; Length between perpendiculars

Length between perpendiculars, L_{pp}, means 96% of the total length on a waterline at 85% of the least moulded depth measured from the top of the keel, or the length from the foreside of the stem to the axis of the rudder stock on that waterline, if that were greater. In ships designed with a rake of keel the waterline on which this length is measured should be parallel to the designed waterline. L_{pp} should be measured in metres.

2.2.14 f_l ; Factor for general cargo ships equipped with cranes and cargo-related gear

f_l is the factor for general cargo ships equipped with cranes and other cargo-related gear to compensate in a loss of deadweight of the ship.

$$f_l = f_{cranes} \cdot f_{sideloader} \cdot f_{roro}$$

f_{cranes}	= 1	If no cranes are present.
$f_{sideloader}$	= 1	If no side loaders are present.
f_{roro}	= 1	If no ro-ro ramp is present.

Definition of f_{cranes}:

$$f_{cranes} = 1 + \frac{\sum_{n=1}^{n}\left(0.0519 \cdot SWL_n \cdot \mathrm{Re}ach_n + 32.11\right)}{Capacity}$$

where:

SWL = Safe Working Load, as specified by crane manufacturer in metric tonnes

Reach = Reach at which the Safe Working Load can be applied in metres
N = Number of cranes

For other cargo gear such as side loaders and ro-ro ramps, the factor should be defined as follows:

$$f_{sideloader} = \frac{Capacity_{No\ sideloades}}{Capacity_{sideloades}}$$

$$f_{RoRo} = \frac{Capacity_{No\ RoRo}}{Capacity_{RoRo}}$$

The weight of the side loaders and ro-ro ramps should be based on a direct calculation, in analogy to the calculations as made for factor f_{ivse}.

2.2.15 d_s ; Summer load line draught

Summer load line draught, d_s is the vertical distance, in metres, from the moulded baseline at mid-length to the waterline corresponding to the summer freeboard draught to be assigned to the ship.

2.2.16 B_s ; Breadth

Breadth, B_s, is the greatest moulded breadth of the ship, in metres, at or below the load line draught, d_s.

2.2.17 ∇ ; Volumetric displacement

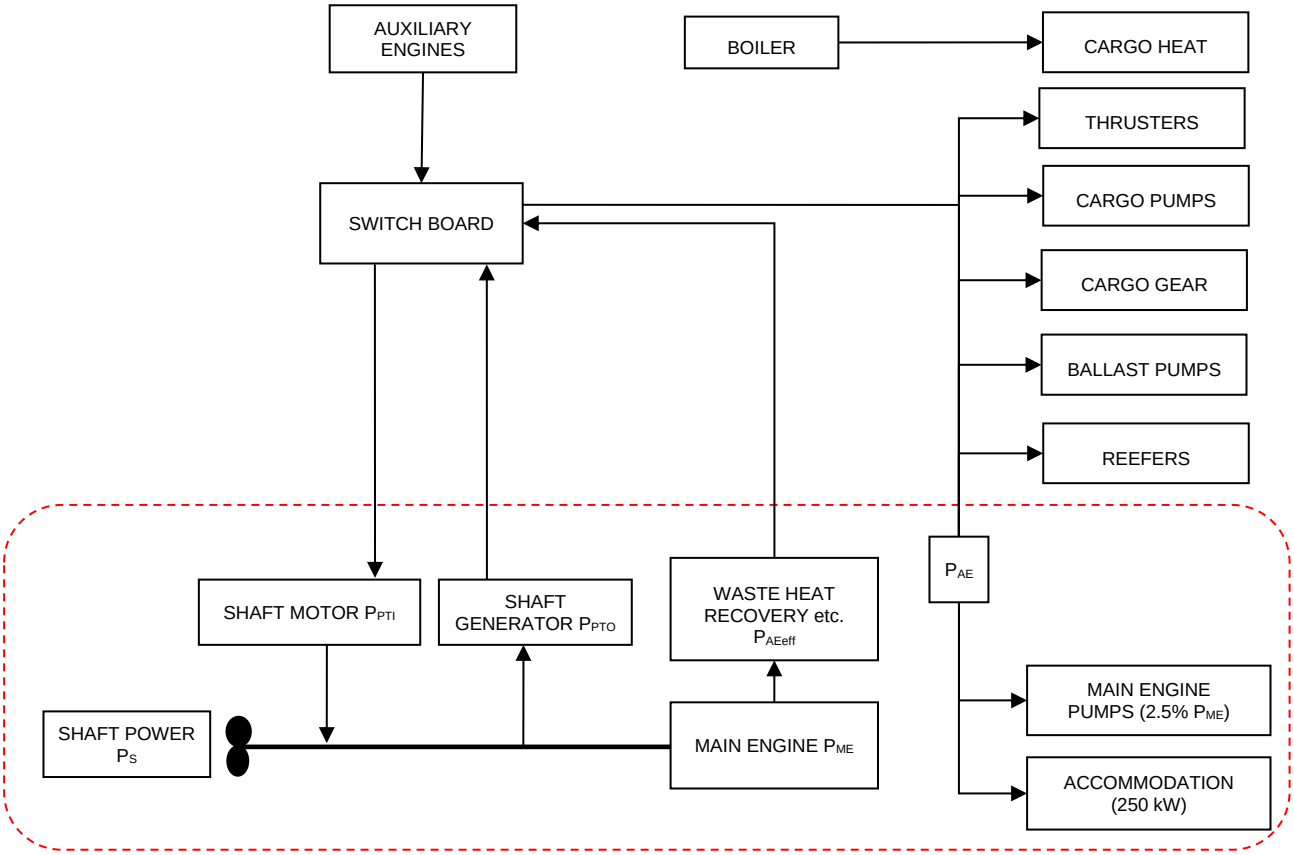
Volumetric displacement, ∇, in cubic metres (m^3), is the volume of the moulded displacement of the ship, excluding appendages, in a ship with a metal shell, and is the volume of displacement to the outer surface of the hull in a ship with a shell of any other material, both taken at the summer load line draught, d_s, as stated in the approved stability booklet/loading manual.

2.2.18 g ; Gravitational acceleration

g is the gravitational acceleration, 9.81m/s^2.

APPENDIX 1

A GENERIC AND SIMPLIFIED MARINE POWER PLANT



Note 1: Mechanical recovered waste energy directly coupled to shafts need not be measured, since the effect of the technology is directly reflected in the V_{ref} .

Note 2: In case of combined PTI/PTO, the normal operational mode at sea will determine which of these to be used in the calculation.

APPENDIX 2

GUIDELINES FOR THE DEVELOPMENT OF ELECTRIC POWER TABLES FOR EEDI (EPT-EEDI)

1 Introduction

This appendix contains a guideline for the document "Electric power table for EEDI" which is similar to the actual shipyards' load balance document, utilizing well defined criteria, providing standard format, clear loads definition and grouping, standard load factors, etc. A number of new definitions (in particular the "groups") are introduced, giving an apparent greater complexity to the calculation process. However, this intermediate step to the final calculation of P_{AE} stimulates all the parties to a deep investigation through the global figure of the auxiliary load, allowing comparisons between different ships and technologies and eventually identifying potential efficiencies improvements.

2 Auxiliary load power definition

P_{AE} is to be calculated as indicated in paragraph 2.2.5.6 of the Guidelines, together with the following additional three conditions:

.1 non-emergency situations (e.g. "no fire", "no flood", "no blackout", "no partial blackout");

.2 evaluation time frame of 24 hours (to account loads with intermittent use); and

.3 ship fully loaded with passengers and/or cargo and crew.

3 Definition of the data to be included in the electric power table for EEDI

The electric power table for EEDI calculation should contain the following data elements, as appropriate:

.1 Load's group;
.2 Load's description;
.3 Load's identification tag;
.4 Load's electric circuit Identification;
.5 Load's mechanical rated power "*Pm*" (*kW*);
.6 Load's electric motor rated output power (*kW*);
.7 Load's electric motor efficiency "*e*" (*/*);
.8 Load's Rated electric power "*Pr*" (*kW*);
.9 Service factor of load "*kl*" (*/*);
.10 Service factor of duty "*kd*" (*/*);
.11 Service factor of time "*kt*" (*/*);
.12 Service total factor of use "*ku*" (*/*), where *ku=kl·kd·kt;*
.13 Load's necessary power "*Pload*" (*kW*), where *Pload=Pr·ku;*
.14 Notes;
.15 Group's necessary power (*kW*); and
.16 Auxiliaries load's power P_{AE} (*kW*).

4 Data to be included in the electric power table for EEDI

Load groups

4.1 The loads are divided into defined groups, allowing a proper breakdown of the auxiliaries. This eases the verification process and makes it possible to identify those areas where load reductions might be possible. The groups are listed below:

.1 A – Hull, deck, navigation and safety services;
.2 B – Propulsion service auxiliaries;
.3 C – Auxiliary engine and main engine services;
.4 D – Ship's general services;
.5 E – Ventilation for engine-rooms and auxiliaries room;
.6 F – Air conditioning services;
.7 G – Galleys, refrigeration and laundries services;
.8 H – Accommodation services;
.9 I – Lighting and socket services;
.10 L – Entertainment services;
.11 N – Cargo loads; and
.12 M – Miscellaneous.

All the ship's loads should be delineated in the document, excluding only P_{AEeff}, the shaft motors and shaft motors chain (while the propulsion services auxiliaries are partially included below in paragraph 4.1.2 B). Some loads (i.e. thrusters, cargo pumps, cargo gear, ballast pumps, maintaining cargo, reefers and cargo hold fans) still are included in the group for sake of transparency, however their service factor is zero in order to comply with paragraph 2.2.5.6 of the Guidelines (see rows 4 and 5 of the electric power table contained in this appendix), therefore making it easier to verify that all the loads have been considered in the document and there are no loads left out of the measurement.

4.1.1 A – Hull, deck, navigation and safety services

.1 loads included in the hull services typically are: ICCP systems, mooring equipment, various doors, ballasting systems, bilge systems, stabilizing equipment, etc. Ballasting systems are indicated with service factor equal to zero to comply with paragraph 2.5.6 of the Guidelines (see row 5 of the electric power table contained in this appendix);

.2 loads included in the deck services typically are: deck and balcony washing systems, rescue systems, cranes, etc.;

.3 loads included in the navigation services typically are: navigation systems, navigation's external and internal communication systems, steering systems, etc.; and

.4 loads included in the safety services typically are: active and passive fire systems, emergency shutdown systems, public address systems, etc.

4.1.2 B – Propulsion service auxiliaries

This group typically includes: propulsion secondary cooling systems such as LT cooling pumps dedicated to shaft motors, LT cooling pumps dedicated to propulsion converters, propulsion UPSs, etc. Propulsion service loads do not include shaft motors (*PTI(i)*) and the auxiliaries

which are part of them (shaft motor own cooling fans and pump, etc.) and the shaft motor chain losses and auxiliaries which are part of them (i.e. shaft motor converters including relevant auxiliaries such as converter own cooling fans and pumps, shaft motor transformers including relevant auxiliaries losses such as propulsion transformer own cooling fans and pumps, shaft motor harmonic filter including relevant auxiliaries losses, shaft motor excitation system including the relevant auxiliaries consumed power, etc.). Propulsion service auxiliaries include manoeuvring propulsion equipment such as manoeuvring thrusters and their auxiliaries whose service factor is to be set to zero.

4.1.3 C – Auxiliary engine and main engine services

This group includes: cooling systems, i.e. pumps and fans for cooling circuits dedicated to alternators or propulsion shaft engines (seawater, technical water dedicated pumps, etc.), lubricating and fuel systems feeding, transfer, treatment and storage, ventilation system for combustion air supply, etc.

4.1.4 D – Ship's general services

This group includes loads which provide general services which can be shared between shaft motor, auxiliary engines and main engine and accommodation support systems. Loads typically included in this group are: cooling systems, i.e. pumping seawater, technical water main circuits, compressed air systems, fresh water generators, automation systems, etc.

4.1.5 E – Ventilation for engine-rooms and auxiliaries room

This group includes all fans providing ventilation for engine-rooms and auxiliary rooms that typically are: engine-rooms cooling supply-exhaust fans, auxiliary rooms supply and exhaust fans. All the fans serving accommodation areas or supplying combustion air are not included in this group. This group does not include cargo hold fans and garage supply and exhaust fans.

4.1.6 F – Air conditioning services

All loads that make up the air conditioning service that typically are: air conditioning chillers, air conditioning cooling and heating fluids transfer and treatment, air conditioning's air handling units ventilation, air conditioning re-heating systems with associated pumping, etc. The air conditioning chillers service factor of load, service factor of time and service factor of duty are to be set as 1 (*kl=1, kt*=1 and *kd*=1) in order to avoid the detailed validation of the heat load dissipation document (i.e. the chiller's electric motor rated power is to be used). However, *kd* is to represent the use of spare chillers (e.g. four chillers are installed and one out four is spare then *kd=0* for the spare chiller and *kd*=1 for the remaining three chillers), but only when the number of spare chillers is clearly demonstrated via the heat load dissipation document.

4.1.7 G – Galleys, refrigeration and laundries services

All loads related to the galleys, pantries refrigeration and laundry services that typically are: galleys various machines, cooking appliances, galleys' cleaning machines, galleys auxiliaries, refrigerated room systems including refrigeration compressors with auxiliaries, air coolers, etc.

4.1.8 H – Accommodation services

All loads related to the accommodation services of passengers and crew that typically are: crew and passengers' transportation systems, i.e. lifts, escalators, etc. environmental services, i.e. black and grey water collecting, transfer, treatment, storage, discharge, waste systems including collecting, transfer, treatment, storage, etc. accommodation fluids transfers, i.e. sanitary hot and cold water pumping, etc., treatment units, pools systems, saunas, gym equipment, etc.

4.1.9 I – Lighting and socket services

All loads related to the lighting, entertainment and socket services. As the quantity of lighting circuits and sockets within the ship may be significantly high, it is not practically feasible to list all the lighting circuits and points in the EPT for EEDI. Therefore circuits should be grouped into subgroups aimed to identify possible improvements of efficient use of power. The subgroups are:

.1 Lighting for 1) cabins, 2) corridors, 3) technical rooms/stairs, 4) public spaces/stairs, 5) engine-rooms and auxiliaries' room, 6) external areas, 7) garages and 8) cargo spaces. All should be divided by main vertical zones; and

.2 Power sockets for 1) cabins, 2) corridors, 3) technical rooms/stairs, 4) public spaces/stairs, 5) engine-rooms and auxiliaries' room, 6) garages and 7) cargo spaces. All should be divided by main vertical zones.

The calculation criteria for complex groups (e.g. cabin lighting and power sockets) subgroups are to be included via an explanatory note, indicating the load composition (e.g. lights of typical cabins, TV, hair dryer, fridge, etc., typical cabins).

4.1.10 L – Entertainment services

This group includes all loads related to entertainment services, typically: public spaces audio and video equipment, theatre stage equipment, IT systems for offices, video games, etc.

4.1.11 N – Cargo loads

This group will contain all cargo loads such as cargo pumps, cargo gear, maintaining cargo, cargo reefers loads, cargo hold fans and garage fans for sake of transparency. However, the service factor of this group is to be set to zero.

4.1.12 M – Miscellaneous

This group will contain all loads which have not been associated to the above-mentioned groups but still are contributing to the overall load calculation of the normal maximum sea load.

Loads description

4.2 This identifies the loads (for example "seawater pump").

Loads identification tag

4.3 This tag identifies the loads according to the shipyard's standards tagging system. For example, the "PTI1 fresh water pump" identification tag is "SYYIA/C" for an example ship and shipyard. This data provides a unique identifier for each load.

Loads electric circuit Identification

4.4 This is the tag of the electric circuit supplying the load. Such information allows the data validation process.

***Loads mechanical rated power* "*Pm*"**

4.5 This data is to be indicated in the document only when th electric load is made by an electric motor driving a mechanical load (for example a fan, a pump, etc.). This is the rated power of the mechanical device driven by an electric motor.

Loads electric motor rated output power (kW)

4.6 The output power of the electric motor as per maker's name plate or technical specification. This data does not take part of the calculation but is useful to highlight potential over rating of the combination motor-mechanical load.

Loads electric motor efficiency "e" (/)

4.7 This data is to be entered in the document only when the electric load is made by an electric motor driving a mechanical load.

Loads rated electric power "Pr" (kW)

4.8 Typically the maximum electric power absorbed at the load electric terminals at which the load has been designed for its service, as indicated on the maker's name plate and/or maker's technical specification. When the electric load is made by an electric motor driving a mechanical load the load's rated electric power is: *Pr=Pm/e (kW).*

Service factor of load "kl" (/)

4.9 Provides the reduction from the loads rated electric power to loads necessary electric power that is to be made when the load absorb less power than its rated power. For example, in case of electric motor driving a mechanical load, a fan could be designed with some power margin, leading to the fact that the fan rated mechanical power exceeds the power requested by the duct system it serves. Another example is when a pump rated power exceed the power needed for pumping in its delivery fluid circuit. Another example in case of electric self-regulating semi-conductors electric heating system is oversized and the rated power exceeds the power absorbed, according a factor *kl.*

Service factor of duty "kd" (/)

4.10 Factor of duty is to be used when a function is provided by more than one load. As all loads are to be included in the EPT for EEDI, this factor provides a correct summation of the loads. For example when two pumps serve the same circuit and they run in duty/stand-by their *Kd* factor will be ½ and ½. When three compressors serves the same circuit and one runs in duty and two in stand-by, then *kd* is 1/3, 1/3 and 1/3.

Service factor of time "kt" (/)

4.11 A factor of time based on the shipyard's evaluation about the load duty along 24 hours of ship's navigation as defined at paragraph 3. For example the Entertainment loads operate at their power for a limited period of time, 4 hours out 24 hours; as a consequence *kt=4/24.* For example, the seawater cooling pumps operate at their power all the time during the navigation at *Vref*. As a consequence *kt=1*.

Service total factor of use "ku" (/)

4.12 The total factor of use that takes into consideration all the service factors: *ku=kl·kd·kt.*

Loads necessary power "Pload" (kW)

4.13 The individual user contribution to the auxiliary load power is *Pload=Pr·ku.*

Notes

4.14 A note, as free text, could be included in the document to provide explanations to the verifier.

Groups necessary power (kW)

4.15 The summation of the "Loads necessary power" from group A to N. This is an intermediate step which is not strictly necessary for the calculation of *PAE*. However, it is useful to allow a quantitative analysis of the *PAE*, providing a standard breakdown for analysis and potential improvements of energy saving.

Auxiliaries load's power PAE (kW)

4.16 Auxiliaries load's power *PAE* is the summation of the "Load's necessary power" of all the loads divided by the average efficiency of the generator(s) weighted by power.

PAE=ΣPload(i)/(average efficiency of the generator(s) weighted by power)

Layout and organization of the data indicated in the electric power table for EEDI

5 The document "Electric power table for EEDI" is to include general information (i.e. ship's name, project name, document references, etc.) and a table with:

.1 one row containing column titles;

.2 one Column for table row ID;

.3 one Column for the groups identification ("A", "B", etc.) as indicated in paragraphs 4.1.1 to 4.1.12 of this appendix;

.4 one Column for the group descriptions as indicated in paragraphs 4.1.1 to 4.1.12 of this appendix;

.5 one column each for items in paragraphs 4.2 to 4.14 of this appendix (e.g. "load tag", etc.);

.6 one row dedicated to each individual load;

.7 the summation results (i.e. summation of powers) including data from paragraphs 4.15 to 4.16 of this appendix; and

.8 explanatory notes.

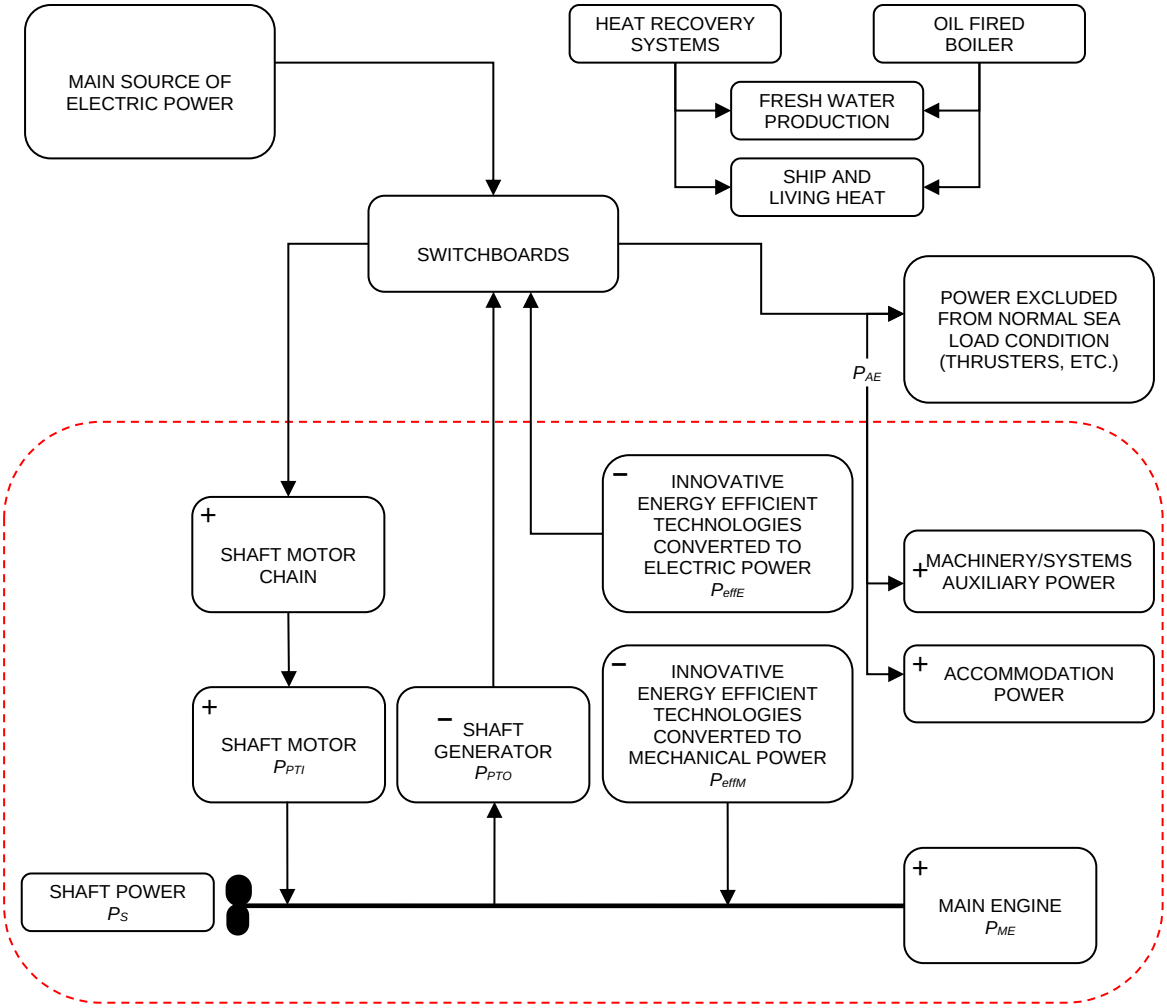
An example of an electric power table for EEDI for a cruise postal ship which transports passengers and has a car garage and reefer holds for fish trade transportation is indicated below. The data indicated and the type of ship is for reference only.

ELECTRIC POWER TABLE FOR EEDI			HULL "EXAMPLE"	PROJECT "EXAMPLE"										(NMSL=Normal Maximun Sea Load)
id	Load group	Load description	Load identification tag	Load electric circuit identification	Load mechanical rated power "Pm" [kW]	Load electric motor rated output power [kW]	Load electric motor efficiency "e" []	Load Rated electric power "Pr" [kW]	service factor of load "kl" []	service factor of duty "kd" []	service factor of time "kt" []	service total factor of use "ku" []	Load necessary power "Pload" [kW]	Note
1	A	Hull cathodic protection Fwd	xxx	yyy	n.a.	n.a.	n.a.	5.2	1	1	1*	1	5.2	*in use 24hours/day
2	A	Hull cathodic protection mid	xxx	yyy	n.a.	n.a.	n.a.	7.0	1	1	1*	1	7	*in use 24hours/day
3	A	Hull cathodic protection aft	xxx	yyy	n.a.	n.a.	n.a.	4.8	1	1	1*	1	4.8	*in use 24hours/day
4	A	Ballast pump 3	xxx	yyy	30	36	0.92	32.6	0.9	0.5	1	0*	0	*not in use at **NMSL** see para 2.5.6 of Circ.681
5	A	Fwd Stb mooring winch motor n.1	xxx	yyy	90	150	0.92	97.8	0.8	1	0*	0*	0	*not in use at **NMSL** see para 2.5.6 of Circ.681
6	A	WTDs system main control panel	xxx	yyy	n.a.	n.a.	n.a.	0.5	1	1	1*	1	0.5	*in use 24hours/day
7	A	WTD 1, deck 0 frame 150	xxx	yyy	1.2	3	0.91	1.3	0.7	1	0.104*	0.0728	0.096	*180 secs to open/close x 100 opening a day
8	A	WTD 5, deck 0 frame 210	xxx	yyy	1.2	3	0.91	1.3	0.7	1	0.156*	0.1092	0.14	*180 secs to open/close x 150 opening a day
9	A	Stabilisers control unit	xxx	yyy	n.a.	n.a.	n.a.	0.7	1	1	1*	1	0.7	*in use 24hours/day
10	A	Stabilisers Hydraulic pack power pump 1	xxx	yyy	80	90	0.9	88.9	0.9	1	0*	0	0	*NMSL=> calm sea,=> stabiliser not in use
11	A	S-band Radar 1 controller	xxx	yyy	n.a.	n.a.	n.a.	0.4	1	1	1*	1	0.4	*in use 24hours/day
12	A	S-band Radar 1 motor	xxx	yyy	0.8	1	0.92	0.9	1	1	1*	1	0.9	*in use 24hours/day
13	A	Fire detection system bridge main unit	xxx	yyy	n.a.	n.a.	n.a.	1.5	1	1	1*	1	1.5	*in use 24hours/day
14	A	Fire detection system ECR unit	xxx	yyy	n.a.	n.a.	n.a.	0.9	1	1	1*	1	0.9	*in use 24hours/day
15	A	High pressure water fog contol unit	xxx	yyy	n.a.	n.a.	n.a.	1.2	1	1	1*	1	1.2	*in use 24hours/day
16	A	High pressure water fog engines rooms pump 1a	xxx	yyy	25	30	0.93	26.9	0.9	0.5	0*	0	0	*NMSL=> not emergency =>Load not in use
17	A	High pressure water fog engines rooms pump 1b	xxx	yyy	25	30	0.93	26.9	0.9	0.5	0*	0	0	* not emergency situations
18	B	PTi port fresh water pump 1	xxx	yyy	30	36	0.92	32.6	0.9	0.5*	1	0.45	14.7	* pump1,2 one is duty and one is stand-by
19	B	PTi port fresh water pump 2	xxx	yyy	30	36	0.92	32.6	0.9	0.5*	1	0.45	14.7	* pump1,2 one is duty and one is stand-by
20	B	Thrusters control system	xxx	yyy	n.a.	n.a.	n.a.	0.5	1	1	1*	1	0.5	in use 24hours/day (even if thruster motor isn't)
21	B	Bow thruster 1	xxx	yyy	3000	3000	0.96	3125.0	1	1	0*	0	0	*NMSL=>thrusters motor are not in use
22	B	PEM port cooling fan 1	xxx	yyy	20	25	0.93	21.5	0.9	1	n.a.	n.a	n.a.*	*this load is included in the propulsion chain data
23	C	HT circulation pump 1 DG 3	xxx	yyy	8	10	0.92	8.7	0.9	0.5*	1	0.45	3.9	* pump1,2 one is duty and one is stand-by
24	C	HT circulation pump 2 DG 3	xxx	yyy	8	10	0.92	8.7	0.9	0.5*	1	0.45	3.9	* pump1,2 one is duty and one is stand-by
25	C	DG3 combustion air fan	xxx	yyy	28	35	0.92	30.4	0.9	1	1*	0.9	27.4	*in use 24hours/day
26	C	DG3 exhaust gas boiler circulating pump	xxx	yyy	6	8	0.93	6.5	0.8	1	1*	0.8	5.2	*in use 24hours/day
27	C	Alternator 3 external cooling fan	xxx	yyy	3	5	0.93	3.2	0.8	1	1*	0.8	2.75	*in use 24hours/day
28	C	fuel feed fwd booster pump a	xxx	yyy	7	9	0.92	7.6	0.9	0.5*	1	0.45	3.4	* pump1,2 one is duty and one is stand-by
29	C	fuel feed fwd booster pump b	xxx	yyy	7	9	0.92	7.6	0.9	0.5*	1	0.45	3.4	* pump1,2 one is duty and one is stand-by
30	D	Fwd main LT cooling pump 1	xxx	yyy	120	150	0.95	126.3	0.9	0.5*	1	0.45	56.8	* pump1,2 one is duty and one is stand-by
31	D	Fwd main LT cooling pump 2	xxx	yyy	120	150	0.95	126.3	0.9	0.5*	1	0.45	56.8	* pump1,2 one is duty and one is stand-by
32	E	FWD engine room supply fan 1	xxx	yyy	87.8	110	0.93	94.4	0.95	1	1*	0.95	89.7	*in use 24hours/day
33	E	FWD engine room exhaust fan 1	xxx	yyy	75	86	0.93	80.6	0.96	1	1*	0.96	77.4	*in use 24hours/day
34	E	purifier room supply fan 1	xxx	yyy	60	70	0.93	64.5	0.96	0.5	1*	0.48	31.0	*in use 24hours/day
35	E	purifier room supply fan 2	xxx	yyy	60	70	0.93	64.5	0.96	0.5	1*	0.48	31.0	*in use 24hours/day
36	F	HVAC chiller a	xxx	yyy	1450	1800	0.95	1526.3	1	2/3*	1	0.66	1007.4	*1 Chiller is spare; see heat load dissipation doc.
37	F	HVAC chiller b	xxx	yyy	1450	1800	0.95	1526.3	1	2/3*	1	0.66	1007.4	*1 Chiller is spare; see heat load dissipation doc.
38	F	HVAC chiller C	xxx	yyy	1450	1800	0.95	1526.3	1	2/3*	1	0.66	1007.4	*1 Chiller is spare; see heat load dissipation doc.
39	F	A.H.U. Ac station 5.4 supply fan	xxx	yyy	50	60	0.93	53.8	0.9	1	1*	0.9	48.4	*in use 24hours/day
40	F	A.H.U. Ac station 5.4 exhaust fan	xxx	yyy	45	55	0.93	48.4	0.9	1	1*	0.9	43.5	*in use 24hours/day
41	F	Chilled water pump a	xxx	yyy	80	90	0.93	86.0	0.88	0.5*	1	0.44	37.8	* pump1,2 one is duty and one is stand-by
42	F	Chilled water pump b	xxx	yyy	80	90	0.93	86.0	0.88	0.5*	1	0.44	37.8	* pump1,2 one is duty and one is stand-by
43	G	Italian's espresso coffee machine	xxx	yyy	n.a.	n.a.	n.a.	7.0	0.9	1	0.2*	0.18	1.3	*in use 4.8hours/day
44	G	deep freezer machine	xxx	yyy	n.a.	n.a.	n.a.	20.0	0.8	1	0.16*	0.128	3.2	*in use 4hours/day
45	G	washing machine 1	xxx	yyy	n.a.	n.a.	n.a.	8.0	0.8	1	0.33*	0.264	3.2	*in use 8hours/day
46	H	lift pax mid 4	xxx	yyy	30	40	0.93	32.3	0.5	1	0.175*	0.0875	0.9	*in use 4hours/day
47	H	vacuum collecting system 4 pump a	xxx	yyy	10	13	0.92	10.9	0.9	1	1*	0.9	8.7	*in use 24hours/day
48	H	sewage treatmet system 1 pump 1	xxx	yyy	15	17	0.93	16.1	0.9	1	1*	0.9	8.7	*in use 24hours/day
49	H	Gym running machine	xxx	yyy	n.a.	n.a.	n.a.	2.5	1	1	0.3*	0.3	0.8	*in use 7.2hours/day
50	I	Cabin's lighting MVZ3	n.a.	n.a.	n.a.	n.a.	n.a.	80*	1	1	1	1	80.0	* see explainatory note
51	I	corridors lighting MVZ3	n.a.	n.a.	n.a.	n.a.	n.a.	10*	1	1	1	1	10.0	* see explainatory note
52	I	Cabin's sockets MVZ3	n.a.	n.a.	n.a.	n.a.	n.a.	5*	1	1	1	1	5.0	* see explainatory note
53	L	Main Theatre audio booster amplifier	xxx	yyy	n.a.	n.a.	n.a.	15.0	1	1	0.3*	0.3	4.5	*in use 7.2hours/day
54	L	Video wall atrium	xxx	yyy	n.a.	n.a.	n.a.	2.0	1	1	0.3*	0.3	0.6	*in use 7.2hours/day
55	M	Car Garage supply fan1	xxx	yyy	28	35	0.92	30.4	0.9	1	1*	0*	0	*not in use at **NMSL** see para 2.5.6 of Circ.681
56	M	Fish transportation refeer hold n.2	xxx	yyy	25	30	0.93	26.9	0.9	0.5	0*	0*	0	*not in use at **NMSL** see para 2.5.6 of Circ.681
57	N	Sliding glass roof	xxx	yyy	30	40	0.93	32.3	0.9	1	0.3*	0.27	0.2	*in use 7.2hours/day
											ΣPload(i)=		3764	

***PAE* =3764/(weighted average efficiency of generator(s)) [kW]** Group's necessary power (group A=22.9kW, B=29.8kW,C=49.9kW, D=113.7kW, E=229kW , F=3189kW, G=7.6kW, H=19kW, I=95kW, L=5.1kW, M=0kW, N=6.22kW)

APPENDIX 3

A GENERIC AND SIMPLIFIED MARINE POWER PLANT FOR A CRUISE PASSENGER SHIPS HAVING NON-CONVENTIONAL PROPULSION

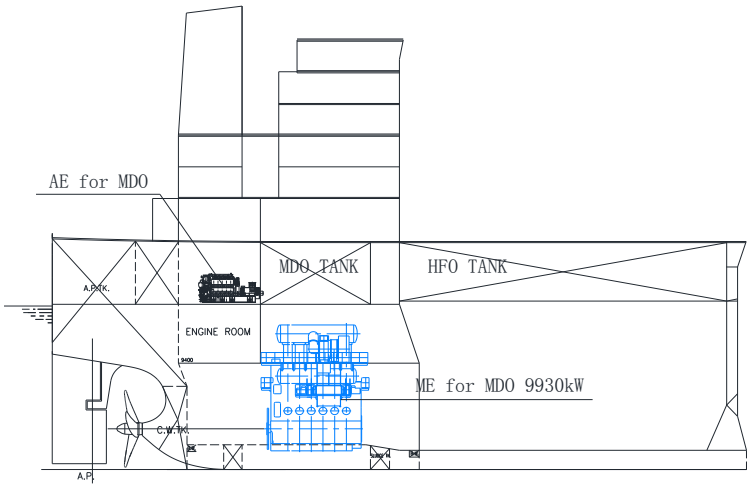


Note: Symbols for plus (+) and minus (−) indicate CO_2 contribution to EEDI formula.

APPENDIX 4

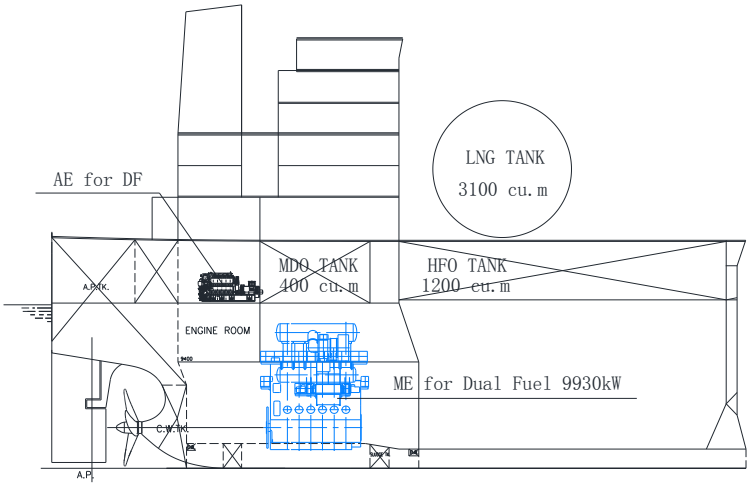
EEDI CALCULATION EXAMPLES FOR USE OF DUAL FUEL ENGINES

Case 1: Standard Kamsarmax ship, one main engine (MDO), standard auxiliary engines (MDO), no shaft generator:



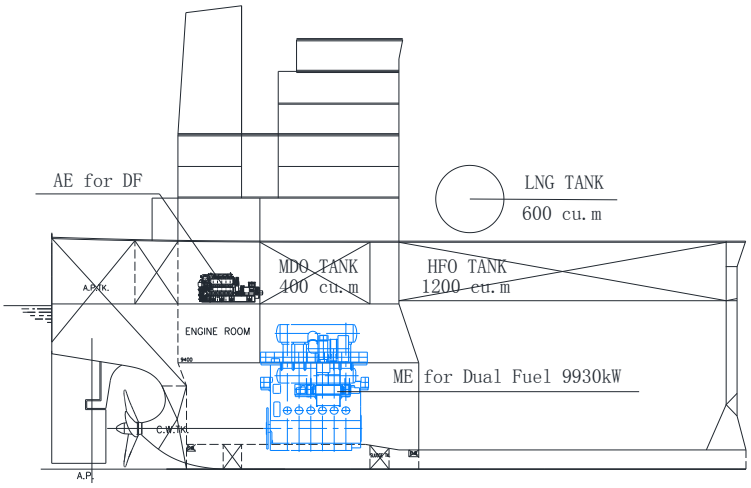
S/N	Parameter	Formula or Source	Unit	Value
1	MCR_{ME}	MCR rating of main engine	kW	9930
2	Capacity	Deadweight of the ship at summer load draft	DWT	81200
3	V_{ref}	Ships speed as defined in EEDI regulation	kn	14
4	P_{ME}	0.75 x MCR_{ME}	kW	7447.5
5	P_{AE}	0.05 x MCR_{ME}	kW	496.5
6	C_{FME}	C_F factor of Main engine using MDO	-	3.206
7	C_{FAE}	C_F factor of Auxiliary engine using MDO	-	3.206
8	SFC_{ME}	Specific fuel consumption of at P_{ME}	g/kWh	165
9	SFC_{AE}	Specific fuel consumption of at P_{AE}	g/kWh	210
10	EEDI	$((P_{ME} \times C_{F\,ME} \times SFC_{ME})+(P_{AE} \times C_{FAE} \times SFC_{AE})) / (V_{ref} \times Capacity)$	gCO_2/tnm	3.76

Case 2: LNG is regarded as the "primary fuel" if dual-fuel main engine and dual-fuel auxiliary engine (LNG, pilot fuel MDO; no shaft generator) are equipped with bigger LNG tanks:



S/N	Parameter	Formula or Source	Unit	Value
1	MCR_{ME}	MCR rating of main engine	kW	9930
2	Capacity	Deadweight of the ship at summer load draft	DWT	81200
3	V_{ref}	Ships speed as defined in EEDI regulation	kn	14
4	P_{ME}	0.75 x MCR_{ME}	kW	7447.5
5	P_{AE}	0.05 x MCR_{ME}	kW	496.5
6	$CF_{Pilotfuel}$	C_F factor of pilot fuel for dual fuel ME using MDO	-	3.206
7	$CF_{AE\ Plilotfuel}$	C_F factor of pilot fuel for Auxiliary engine using MDO	-	3.206
8	CF_{LNG}	C_F factor of dual fuel engine using LNG	-	2.75
9	$SFC_{MEPilotfuel}$	Specific fuel consumption of pilot fuel for dual fuel ME at P_{ME}	g/kWh	6
10	$SFC_{AE\ Pilotfuel}$	Specific fuel consumption of pilot fuel for dual fuel AE at P_{AE}	g/kWh	7
11	$SFC_{ME\ LNG}$	Specific fuel consumption of ME using LNG at P_{ME}	g/kWh	136
12	$SFC_{AE\ LNG}$	Specific fuel consumption of AE using LNG at P_{AE}	g/kWh	160
13	V_{LNG}	LNG tank capacity on board	m^3	3100
14	V_{HFO}	Heavy fuel oil tank capacity on board	m^3	1200
15	V_{MDO}	Marine diesel oil tank capacity on board	m^3	400
16	ρ_{LNG}	Density of LNG	kg/m^3	450
17	ρ_{HFO}	Density of heavy fuel oil	kg/m^3	991
18	ρ_{MDO}	Density of Marine diesel oil	kg/m^3	900
19	LCV_{LNG}	Low calorific value of LNG	kJ/kg	48000
20	LCV_{HFO}	Low calorific value of heavy fuel oil	kJ/kg	40200
21	LCV_{MDO}	Low calorific value of marine diesel oil	kJ/kg	42700
22	K_{LNG}	Filling rate of LNG tank	-	0.95
23	K_{HFO}	Filling rate of heavy fuel tank	-	0.98
24	K_{MDO}	Filling rate of marine diesel tank	-	0.98
25	f_{DFgas}	$\frac{P_{ME}+P_{AE}}{P_{ME}+P_{AE}} \times \frac{V_{LNG} \times \rho_{LNG} \times LCV_{LNG} \times K_{LNG}}{V_{HFO} \times \rho_{HFO} \times LCV_{HFO} \times K_{HFO} + V_{MDO} \times \rho_{MDO} \times LCV_{MDO} \times K_{MDO} + V_{LNG} \times \rho_{LNG} \times LCV_{LNG} \times K_{LNG}}$	-	0.5068
26	EEDI	(P_{ME} x ($C_{F\ Pilotfuel}$ x $SFC_{ME\ Pilotfuel}$ + $C_{F\ LNG}$ x $SFC_{ME\ LNG}$) + P_{AE} x ($C_{F\ Pilotfuel}$ x $SFC_{AE\ Pilotfuel}$ + $C_{F\ LNG}$ x $SFC_{AE\ LNG}$)) / (V_{ref} x *Capacity*)	gCO_2/tnm	2.78

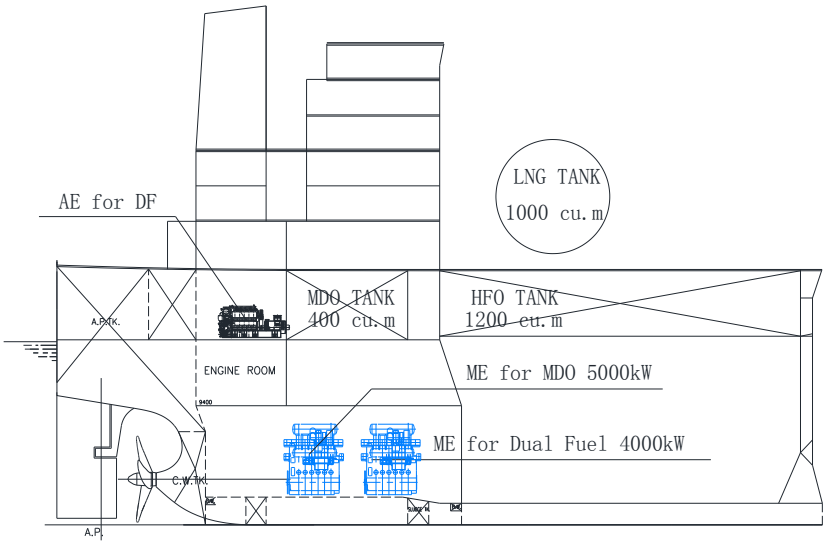
Case 3: LNG is not regarded as the "primary fuel" if dual-fuel main engine and dual-fuel auxiliary engine (LNG, pilot fuel MDO; no shaft generator) are equipped with smaller LNG tanks:



S/N	Parameter	Formula or Source	Unit	Value
1	MCR_{ME}	MCR rating of main engine	kW	9930
2	Capacity	Deadweight of the ship at summer load draft	DWT	81200
3	V_{ref}	Ships speed as defined in EEDI regulation	kn	14
4	P_{ME}	0.75 x MCR_{ME}	kW	7447.5
5	P_{AE}	0.05 x MCR_{ME}	kW	496.5
6	$C_{FPilotfuel}$	C_F factor of pilot fuel for dual fuel ME using MDO	-	3.206
7	$C_{FAE\ Plilotfuel}$	C_F factor of pilot fuel for Auxiliary engine using MDO	-	3.206
8	C_{FLNG}	C_F factor of dual fuel engine using LNG	-	2.75
9	C_{FMDO}	C_F factor of dual fuel ME/AE engine using MDO	-	3.206
10	$SFC_{MEPilotfuel}$	Specific fuel consumption of pilot fuel for dual fuel ME at P_{ME}	g/kWh	6
11	$SFC_{AE\ Pilotfuel}$	Specific fuel consumption of pilot fuel for dual fuel AE at P_{AE}	g/kWh	7
12	$SFC_{ME\ LNG}$	Specific fuel consumption of ME using LNG at P_{ME}	g/kWh	136
13	$SFC_{AE\ LNG}$	Specific fuel consumption of AE using LNG at P_{AE}	g/kWh	160
14	$SFC_{ME\ MDO}$	Specific fuel consumption of dual fuel ME using MDO at P_{ME}	g/kWh	165
15	$SFC_{AE\ MDO}$	Specific fuel consumption of dual fuel AE using MDO at P_{AE}	g/kWh	187
16	V_{LNG}	LNG tank capacity on board	m^3	600
17	V_{HFO}	Heavy fuel oil tank capacity on board	m^3	1800
18	V_{MDO}	Marine diesel oil tank capacity on board	m^3	400
19	ρ_{LNG}	Density of LNG	kg/m^3	450
20	ρ_{HFO}	Density of heavy fuel oil	kg/m^3	991
21	ρ_{MDO}	Density of Marine diesel oil	kg/m^3	900
22	LCV_{LNG}	Low calorific value of LNG	kJ/kg	48000
24	LCV_{HFO}	Low calorific value of heavy fuel oil	kJ/kg	40200
25	LCV_{MDO}	Low calorific value of marine diesel oil	kJ/kg	42700
26	K_{LNG}	Filling rate of LNG tank	-	0.95
27	K_{HFO}	Filling rate of heavy fuel tank	-	0.98

S/N	Parameter	Formula or Source	Unit	Value
28	K_{MDO}	Filling rate of marine diesel tank	-	0.98
29	f_{DFgas}	$\frac{P_{ME}+P_{AE}}{P_{ME}+P_{AE}} \times \frac{V_{LNG} \times \rho_{LNG} \times LCV_{LNG} \times K_{LNG}}{V_{HFO} \times \rho_{HFO} \times LCV_{HFO} \times K_{HFO} + V_{MDO} \times \rho_{MDO} \times LCV_{MDO} \times K_{MDO} + V_{LNG} \times \rho_{LNG} \times LCV_{LNG} \times K_{LNG}}$	-	0.1261
30	$f_{DFliquid}$	1- f_{DFgas}	-	0.8739
31	EEDI	(P_{ME} x (f_{DFgas} x ($C_{F\ Pilotfuel}$ x $SFC_{ME\ Pilotfuel}$ + $C_{F\ LNG}$ x $SFC_{ME\ LNG}$) + $f_{DFliquid}$ x C_{FMDO} x $SFC_{ME\ MDO}$) + P_{AE} x (f_{DFgas} x ($C_{FAE\ Pilotfuel}$ x $SFC_{AE\ Pilotfuel}$ + $C_{F\ LNG}$ x $SFC_{AE\ LNG}$)+ $f_{DFliquid}$ x C_{FMDO} x $SFC_{AE\ MDO}$)) / (V_{ref} x *Capacity*)	gCO_2/tnm	3.61

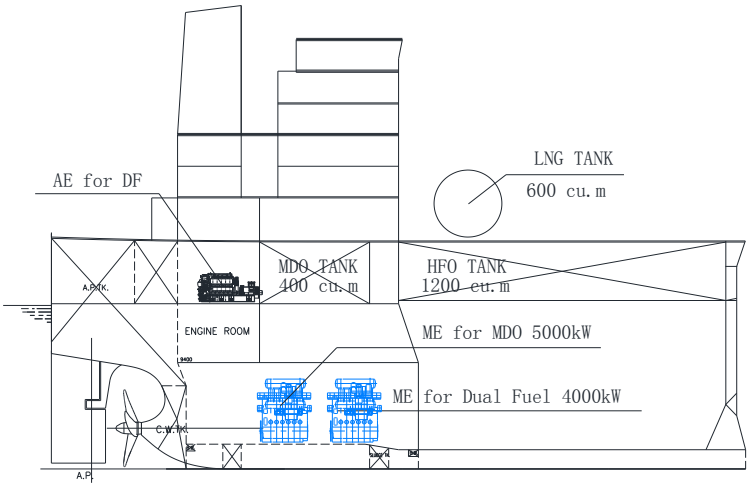
Case 4: One dual-fuel main engine (LNG, pilot fuel MDO) and one main engine (MDO) and dual-fuel auxiliary engine (LNG, pilot fuel MDO, no shaft generator) which LNG could be regarded as "primary fuel" only for the dual-fuel main engine:



S/N	Parameter	Formula or Source	Unit	Value
1	MCR_{MEMDO}	MCR rating of main engine using only MDO	kW	5000
2	MCR_{MELNG}	MCR rating of main engine using dual fuel	kW	4000
3	Capacity	Deadweight of the ship at summer load draft	DWT	81200
4	V_{ref}	Ships speed	kn	14
5	P_{MEMDO}	0.75 x MCR_{MEMDO}	kW	3750
6	P_{MELNG}	0.75 x MCR_{MELNG}	kW	3000
7	P_{AE}	0.05 x (MCR_{MEMDO} + MCR_{MELNG})	kW	450
8	$C_{FPilotfuel}$	C_F factor of pilot fuel for dual fuel ME using MDO	-	3.206
9	$C_{FAE\ Plilotfuel}$	C_F factor of pilot fuel for Auxiliary engine using MDO	-	3.206
10	C_{FLNG}	C_F factor of dual fuel engine using LNG	-	2.75
11	C_{FMDO}	C_F factor of dual fuel ME/AE engine using MDO	-	3.206
12	$SFC_{MEPilotfuel}$	Specific fuel consumption of pilot fuel for dual fuel ME at P_{ME}	g/kWh	6
13	$SFC_{AE\ Pilotfuel}$	Specific fuel consumption of pilot fuel for dual fuel AE at P_{AE}	g/kWh	7
14	$SFC_{DF\ LNG}$	Specific fuel consumption of dual fuel ME using LNG at P_{ME}	g/kWh	158
15	$SFC_{AE\ LNG}$	Specific fuel consumption of AE using LNG at P_{AE}	g/kWh	160
16	$SFC_{ME\ MDO}$	Specific fuel consumption of single fuel ME at P_{ME}	g/kWh	180
17	V_{LNG}	LNG tank capacity on board	m^3	1000
18	V_{HFO}	Heavy fuel oil tank capacity on board	m^3	1200

S/N	Parameter	Formula or Source	Unit	Value
19	V_{MDO}	Marine diesel oil tank capacity on board	m^3	400
20	ρ_{LNG}	Density of LNG	kg/m^3	450
21	ρ_{HFO}	Density of heavy fuel oil	kg/m^3	991
22	ρ_{MDO}	Density of Marine diesel oil	kg/m^3	900
23	LCV_{LNG}	Low calorific value of LNG	kJ/kg	48000
24	LCV_{HFO}	Low calorific value of heavy fuel oil	kJ/kg	40200
25	LCV_{MDO}	Low calorific value of marine diesel oil	kJ/kg	42700
26	K_{LNG}	Filling rate of LNG tank	-	0.95
27	K_{HFO}	Filling rate of heavy fuel tank	-	0.98
28	K_{MDO}	Filling rate of marine diesel tank	-	0.98
29	f_{DFgas}	$\frac{P_{MEMDO}+P_{MELNG}+P_{AE}}{P_{MELNG}+P_{AE}} \times \frac{V_{LNG}\times\rho_{LNG}\times LCV_{LNG}\times K_{LNG}}{V_{HFO}\times\rho_{HFO}\times LCV_{HFO}\times K_{HFO}+V_{MDO}\times\rho_{MDO}\times LCV_{MDO}\times K_{MDO}+V_{LNG}\times\rho_{LNG}\times LCV_{LNG}\times K_{LNG}}$	-	0.5195
30	EEDI	(P_{MELNG} x ($C_{F\ Pilotfuel}$ x $SFC_{ME\ Pilotfuel}$ + $C_{F\ LNG}$ x $SFC_{DF\ LNG}$) + P_{MEMDO} x $C_{F\ MDO}$ x $SFC_{ME\ MDO}$ + P_{AE} x ($C_{FAE\ Pilotfuel}$ x $SFC_{AE\ Pilotfuel}$ + $C_{F\ LNG}$ x $SFC_{AE\ LNG}$)) / (V_{ref} x $Capacity$)	gCO_2/tnm	3.28

Case 5: One dual-fuel main engine (LNG, pilot fuel MDO) and one main engine (MDO) and dual-fuel auxiliary engine (LNG, pilot fuel MDO, no shaft generator) which LNG could not be regarded as "primary fuel" for the dual- fuel main engine:



S/N	Parameter	Formula or Source	Unit	Value
1	MCR_{MEMDO}	MCR rating of main engine using only MDO	kW	5000
2	MCR_{MELNG}	MCR rating of main engine using dual fuel	kW	4000
3	Capacity	Deadweight of the ship at summer load draft	DWT	81200
4	V_{ref}	Ships speed	kn	14
5	P_{MEMDO}	0.75 x MCR_{MEMDO}	kW	3750
6	P_{MELNG}	0.75 x MCR_{MELNG}	kW	3000
7	P_{AE}	0.05 x (MCR_{MEMDO} + MCR_{MELNG})	kW	450
8	$C_{FPilotfuel}$	C_F factor of pilot fuel for dual fuel ME using MDO	-	3.206
9	$C_{FAE\ Plilotfuel}$	C_F factor of pilot fuel for Auxiliary engine using MDO	-	3.206
10	C_{FLNG}	C_F factor of dual fuel engine using LNG	-	2.75
11	C_{FMDO}	C_F factor of dual fuel ME/AE engine using MDO	-	2.75
12	$SFC_{MEPilotfuel}$	Specific fuel consumption of pilot fuel for dual fuel ME at P_{ME}	g/kWh	6

S/N	Parameter	Formula or Source	Unit	Value
13	$SFC_{AE\ Pilotfuel}$	Specific fuel consumption of pilot fuel for dual fuel AE at P_{AE}	g/kWh	7
14	$SFC_{DF\ LNG}$	Specific fuel consumption of dual fuel ME using LNG at P_{ME}	g/kWh	158
15	$SFC_{AE\ LNG}$	Specific fuel consumption of AE using LNG at P_{AE}	g/kWh	160
16	$SFC_{DF\ MDO}$	Specific fuel consumption of dual fuel ME using MDO at P_{ME}	g/kWh	185
17	$SFC_{ME\ MDO}$	Specific fuel consumption of single fuel ME at P_{ME}	g/kWh	180
18	$SFC_{AE\ MDO}$	Specific fuel consumption of AE using MDO at P_{AE}	g/kWh	187
19	V_{LNG}	LNG tank capacity on board	m^3	600
20	V_{HFO}	Heavy fuel oil tank capacity on board	m^3	1200
21	V_{MDO}	Marine diesel oil tank capacity on board	m^3	400
22	ρ_{LNG}	Density of LNG	kg/m^3	450
23	ρ_{HFO}	Density of heavy fuel oil	kg/m^3	991
24	ρ_{MDO}	Density of Marine diesel oil	kg/m^3	900
25	LCV_{LNG}	Low calorific value of LNG	kJ/kg	48000
26	LCV_{HFO}	Low calorific value of heavy fuel oil	kJ/kg	40200
27	LCV_{MDO}	Low calorific value of marine diesel oil	kJ/kg	42700
28	K_{LNG}	Filling rate of LNG tank	-	0.95
29	K_{HFO}	Filling rate of heavy fuel tank	-	0.98
30	K_{MDO}	Filling rate of marine diesel tank	-	0.98
31	f_{DFgas}	$\frac{P_{MEMDO}+P_{MELNG}+P_{AE}}{P_{MELNG}+P_{AE}} \times \frac{V_{LNG} \times \rho_{LNG} \times LCV_{LNG} \times K_{LNG}}{V_{HFO} \times \rho_{HFO} \times LCV_{HFO} \times K_{HFO} + V_{MDO} \times \rho_{MDO} \times LCV_{MDO} \times K_{MDO} + V_{LNG} \times \rho_{LNG} \times LCV_{LNG} \times K_{LNG}}$	-	0.3462
32	$f_{DFliquid}$	$1- f_{DFgas}$	-	0.6538
33	EEDI	$(P_{MELNG}$ x (f_{DFgas} x ($C_{F\ Pilotfuel}$ x $SFC_{ME\ Pilotfuel}$ + $C_{F\ LNG}$ x $SFC_{DF\ LNG}$) + $f_{DFliquid}$ x C_{FMDO} x $SFC_{DF\ MDO}$))+ P_{MEMDO} x $C_{F\ MDO}$ x $SFC_{ME\ MDO}$ + P_{AE} x (f_{DFgas} x ($C_{FAE\ Pilotfuel}$ x $SFC_{AE\ Pilotfuel}$ + $C_{F\ LNG}$ x $SFC_{AE\ LNG}$) + $f_{DFliquid}$ x C_{FMDO} x $SFC_{AE\ MDO}$)) / (V_{ref} x *Capacity*)	gCO_2/tnm	3.54

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ANNEX 7

RESOLUTION MEPC.309(73)
(adopted on 26 October 2018)

AMENDMENTS TO THE 2014 GUIDELINES ON SURVEY AND CERTIFICATION OF THE ENERGY EFFICIENCY DESIGN INDEX (EEDI) (RESOLUTION MEPC.254(67), AS AMENDED BY RESOLUTION MEPC.261(68))

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 it adopted, by resolution MEPC.203(62), 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 (inclusion of regulations on energy efficiency for ships in MARPOL Annex VI),

NOTING that the aforementioned amendments to MARPOL Annex VI entered into force on 1 January 2013,

NOTING ALSO that regulation 5 (Surveys) of MARPOL Annex VI, as amended, requires ships to which chapter 4 applies shall also be subject to survey and certification taking into account guidelines developed by the Organization,

NOTING FURTHER that it adopted, by resolution MEPC.214(63), the *2012 Guidelines on survey and certification of the Energy Efficiency Design Index (EEDI)*, and, by resolution MEPC.234(65), the amendments thereto,

NOTING FURTHER that it adopted, by resolution MEPC.254(67), the *2014 Guidelines on survey and certification of the Energy Efficiency Design Index (EEDI)*, and by resolution MEPC.261(68), amendments thereto,

RECOGNIZING that the aforementioned amendments to MARPOL Annex VI require relevant guidelines for the smooth and uniform implementation of the regulations,

HAVING CONSIDERED, at its seventy-third session, proposed amendments to the *2014 Guidelines on survey and certification of the Energy Efficiency Design Index (EEDI)*, as amended,

1 ADOPTS amendments to the *2014 Guidelines on survey and certification of the Energy Efficiency Design Index (EEDI)*, as set out in the annex to the present resolution;

2 INVITES Administrations to take the aforementioned amendments into account when developing and enacting national laws which give force to and implement provisions set forth in regulation 5 of MARPOL Annex VI, as amended;

3 REQUESTS the Parties to MARPOL Annex VI and other Member Governments to bring the amendments to the attention of shipowners, ship operators shipbuilders, ship designers and any other interested groups;

4 AGREES to keep these Guidelines, as amended, under review, in light of the experience gained with their application.

ANNEX

AMENDMENTS TO THE 2014 GUIDELINES ON SURVEY AND CERTIFICATION OF THE ENERGY EFFICIENCY DESIGN INDEX (EEDI) (RESOLUTION MEPC.254(67), AS AMENDED BY RESOLUTION MEPC.261(68))

1 Footnote for the title of section 2 is replaced by the following:

"**2 DEFINITIONS**[1]

1 Other terms used in these guidelines have the same meaning as those defined in the *2018 Guidelines on the method of calculation of the attained EEDI for new ships* (resolution MEPC.308(73))."

2 Paragraph 4.1.1 is replaced by the following:

"4.1.1 The attained EEDI should be calculated in accordance with regulation 20 of MARPOL Annex VI and the *2018 Guidelines on the method of calculation of the attained Energy Efficiency Design Index (EEDI) for new ships* (resolution MEPC.308(73)) (EEDI Calculation Guidelines). Survey and certification of the EEDI should be conducted in two stages: preliminary verification at the design stage and final verification at the sea trial. The basic flow of the survey and certification process is presented in figure 1."

3 Paragraphs 4.2.2.1 and 4.2.2.2 are replaced by the following:

".1 deadweight (DWT) or gross tonnage (GT) for passenger and ro-ro passenger ships, the maximum continuous rating (MCR) of the main and auxiliary engines, the ship speed (V_{ref}), as specified in paragraph 2.2.2 of the EEDI Calculation Guidelines, type of fuel, the specific fuel consumption (*SFC*) of the main engine at 75% of MCR power, the *SFC* of the auxiliary engines at 50% MCR power, and the electric power table for certain ship types, as necessary, as defined in the EEDI Calculation Guidelines;

.2 power curve(s) (kW – knot) estimated at design stage under the condition as specified in paragraph 2.2.2 of the EEDI Calculation Guidelines, and, in the event that the sea trial is carried out in a condition other than the above condition, also a power curve estimated under the sea trial condition;"

4 Paragraph 4.2.8.2 is replaced by the following:

".2 LNG cargo tank capacity in m^3 and BOR as defined in paragraph 2.2.5.6.3 of the EEDI Calculation Guidelines;"

5 Paragraph 4.2.8.5 is replaced by the following:

".5 $SFC_{SteamTurbine}$ for steam turbine, as specified in paragraph 2.2.7 of the EEDI Calculation Guidelines."

6 Paragraph 4.2.5 is replaced by the following:

"4.2.5 For ships to which regulation 21 of MARPOL Annex VI applies, the power curves used for the preliminary verification at the design stage should be based on reliable results of tank tests. A tank test for an individual ship may be omitted based

on technical justifications such as availability of the results of tank tests for ships of the same type. In addition, the omission of tank tests is acceptable for a ship for which sea trials will be carried out under the condition as specified in paragraph 2.2.2 of the EEDI Calculation Guidelines, upon agreement of the shipowner and shipbuilder and with the approval of the verifier. To ensure the quality of tank tests, the ITTC quality system should be taken into account. Model tank tests should be witnessed by the verifier."

7 Paragraph 4.2.7.4 is replaced by the following:

".4 detailed report on the method and results of the tank test; this should include at least the tank test results at sea trial condition and under the condition as specified in paragraph 2.2.2 of the EEDI Calculation Guidelines;"

8 Paragraph 4.3.1 is replaced by the following:

"4.3.1 Sea trial conditions should be set as the conditions specified in paragraph 2.2.2 of the EEDI Calculation Guidelines, if possible."

9 Paragraph 4.3.5 is replaced by the following:

"4.3.5 Sea conditions should be measured in accordance with ITTC Recommended Procedure 7.5-04-01-01.1 Speed and Power Trials 2017 or ISO 15016:2015."

10 Paragraph 4.3.6 is replaced by the following:

"4.3.6 Ship speed should be measured in accordance with ITTC Recommended Procedure 7.5-04-01-01.1 Speed and Power Trials 2017 or ISO 15016:2015, and at more than two points of which range includes the power of the main engine as specified in paragraph 2.2.5 of the EEDI Calculation Guidelines."

11 Paragraph 4.3.8 is replaced by the following:

"4.3.8 The submitter should develop power curves based on the measured ship speed and the measured output of the main engine at sea trial. For the development of the power curves, the submitter should calibrate the measured ship speed, if necessary, by taking into account the effects of wind, current, waves, shallow water, displacement, water temperature and water density in accordance with ITTC Recommended Procedure 7.5-04-01-01.1 Speed and Power Trials 2017 or ISO 15016:2015. Upon agreement with the shipowner, the submitter should submit a report on the speed trials including details of the power curve development to the verifier for verification."

12 Paragraphs 4.3.9.1 and 4.3.9.2 are replaced by the following:

".1 for ships for which sea trial is conducted under the condition as specified in paragraph 2.2.2 of the EEDI Calculation Guidelines: the attained EEDI should be recalculated using the measured ship speed at sea trial at the power of the main engine as specified in paragraph 2.2.5 of the EEDI Calculation Guidelines; and

.2 for ships for which sea trial cannot be conducted under the condition as specified in paragraph 2.2.2 of the EEDI Calculation Guidelines: if the measured ship speed at the power of the main engine as specified in

paragraph 2.2.5 of the EEDI Calculation Guidelines at the sea trial conditions is different from the expected ship speed on the power curve at the corresponding condition, the shipbuilder should recalculate the attained EEDI by adjusting ship speed under the condition as specified in paragraph 2.2.2 of the EEDI Calculation Guidelines by an appropriate correction method that is agreed by the verifier."

13 Paragraph 4.3.13 is replaced by the following:

"4.3.13 The EEDI Technical File should be revised, as necessary, by taking into account the results of sea trials. Such revision should include, as applicable, the adjusted power curve based on the results of sea trials (namely, modified ship speed under the condition as specified in paragraph 2.2.2 of the EEDI Calculation Guidelines), the finally determined deadweight/gross tonnage, η for LNG carriers having diesel electric propulsion system and *SFC* described in the approved NO_X Technical File, and the recalculated attained EEDI based on these modifications."

14 Section 2 of appendix 2 is replaced by the following:

"These guidelines provide a framework for the uniform application of the EPT-EEDI validation process for ships for which required auxiliary engine power is calculated under paragraph 2.2.5.7 of the EEDI Calculation Guidelines."

15 Paragraph 3.5 of appendix 2 is replaced by the following:

"3.5 P_{AE} herein is defined as per the definition in paragraph 2.2.5.6 of the EEDI Calculation Guidelines."

16 Paragraph 4.1 of appendix 2 is replaced by the following:

"4.1 These guidelines are applicable to ships as stipulated in paragraph 2.2.5.7 of the EEDI Calculation Guidelines."

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ANNEX 10

RESOLUTION MEPC.310(73)
(adopted on 26 October 2018)

ACTION PLAN TO ADDRESS MARINE PLASTIC LITTER FROM SHIPS

THE MARINE ENVIRONMENT PROTECTION COMMITTEE

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

ACKNOWLEDGING that work to prevent pollution by garbage from ships has been undertaken by the Organization since the adoption of MARPOL Annex V,

ACKNOWLEDGING ALSO the relevance of the work on marine plastic litter undertaken by the Parties to the Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter 1972 and its 1996 Protocol, including the adoption in 2016 of a "Recommendation to Encourage Action to Combat Marine Litter",

ACKNOWLEDGING FURTHER the relevant work of other international organizations in relation to marine plastic litter, in particular FAO and UN Environment, and the importance of existing cooperation mechanisms, including GESAMP, the Joint FAO/IMO Ad Hoc Working Group on IUU fishing and related matters, and the Global Partnership for Marine Litter,

RECALLING the United Nations 2030 Agenda for Sustainable Development, in particular Sustainable Development Goal (SDG) 14: Conserve and sustainably use the oceans, seas and marine resources for sustainable development,

RECALLING ALSO that the Assembly, at its thirtieth session, in December 2017, recognized the ongoing problem of marine plastic pollution, as addressed in MARPOL Annex V, which required further consideration as part of a global solution within the framework of ocean governance, in pursuance of the target of Sustainable Development Goal 14 to prevent and significantly reduce marine pollution of all kinds by 2025,

1 ADOPTS the Action Plan to address marine plastic litter from ships (hereinafter the Action Plan) as set out in the annex to the present resolution;

2 NOTES the application of the Action Plan to all ships, incuding fishing vessels;

3 INVITES the Secretary-General of the Organization to make adequate provisions in the Integrated Technical Cooperation Programme (ITCP) to support relevant follow-up actions of the Action Plan;

4 AGREES to keep the Action Plan under review, with a view to assessing, in 2023, the effectiveness of the actions within the Action Plan against the intended outcomes.

ANNEX

ACTION PLAN TO ADDRESS MARINE PLASTIC LITTER FROM SHIPS

1 Background

1.1 Marine plastic litter enters the marine environment as a result of a wide range of land- and sea-based activities. Both macroplastics (e.g. large plastic items such as plastic bags, water bottles and fishing gear) and microplastics (small plastic particles generally five millimetres or less in size) persist in the marine environment and result in harmful effects on marine life and biodiversity, as well as negative impacts on human health. In addition, marine plastic litter negatively impacts on activities such as tourism, fisheries and shipping. This plastic material has the potential to be brought back into the economy by means of reuse or recycling. Studies demonstrate that despite the existing regulatory framework to prevent marine plastic litter from ships discharges into the sea continue to occur.

1.2 IMO has recognized the importance of preventing pollution by garbage, including plastics, from ships since the adoption of MARPOL Annex V, as well as the dumping of various types of waste, including plastics, into the sea through the Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter 1972 (London Convention or LC) and its 1996 Protocol (London Protocol or LP). This commitment was reinforced by the IMO Assembly, at its thirtieth session, in December 2017, recognizing the ongoing problem of marine plastic pollution, as addressed in MARPOL Annex V, which required further consideration as part of a global solution within the framework of ocean governance, in pursuance of the target of Sustainable Development Goal 14 to prevent and significantly reduce marine pollution of all kinds by 2025.

1.3 IMO has committed to working closely with a number of partners to address the issue of marine plastic litter including, but not limited to:

.1 FAO through the Joint FAO/IMO Ad Hoc Working Group on IUU Fishing and Related Matters (JWG);

.2 the Joint Group of Experts on the Scientific Aspects of Marine Environmental Protection (GESAMP);

.3 the UN Environment-managed Global Partnership on Marine Litter (GPML);

.4 the United Nations Open-ended Informal Consultative Process on Oceans and the Law of the Sea (ICP); and

.5 the United Nations Environment Assembly (UNEA).

1.4 IMO recognizes the importance of continued action to manage this global issue with the development of an Action Plan to address marine plastic litter from ships. In addition, the thirty-eighth Consultative Meeting of Contracting Parties to the London Convention and the eleventh Meeting of Contracting Parties to the London Protocol adopted a "Recommendation to Encourage Action to Combat Marine Litter".

2 Objective

The Action Plan to address marine plastic litter from ships has been developed to contribute to the global solution for preventing marine plastic litter entering the oceans through ship-based activities. This Action Plan provides IMO with a mechanism to identify specific

outcomes, and actions to achieve these outcomes, in a way that is meaningful and measureable. The Action Plan builds on existing policy and regulatory frameworks, and identifies opportunities to enhance these frameworks and introduce new supporting measures to address the issue of marine plastic litter from ships.

3 Time frames

3.1 In line with the time frames provided in Sustainable Development Goal 14, the measures within this Action Plan should be completed by 2025.

3.2 Priority actions under this plan, to be pursued upon adoption of this plan, have been identified in the below table of actions. Further specific time frames for individual measures should be evaluated during the annual review and evaluation process by the Marine Environment Protection Committee.

4 Actions

	Outcome	Measures	Parent Organ	Coordinating/ Associated Organ	Priority	Associated partners
1.	**Reduction of marine plastic litter generated from, and retrieved by, fishing vessels**	Consider making the IMO Ship Identification Number Scheme mandatory for all fishing vessels over 24 metres in length through an amendment to the Cape Town Agreement once it enters into force. Encourage the ratification of the Cape Town agreement	MSC / MEPC			
2.		Consider making mandatory, through an appropriate IMO instrument (e.g. MARPOL Annex V), the marking of fishing gear with the IMO Ship Identification Number, in cooperation with the Food and Agriculture Organization of the United Nations (FAO)	MEPC	PPR / III (JWG)		FAO
3.		Further investigate logging of the identification number for each item of fishing gear on board a fishing vessel	MEPC	PPR / III		FAO
4.		Preparation of a circular reminding IMO Member States to collect information from their registered fishing vessels regarding any discharge or accidental loss of fishing gear	MEPC	PPR		
5.		Consider the development of best management practice to facilitate incentives for fishing vessels to retrieve derelict fishing gear and deliver it to port reception facilities, in collaboration with FAO	MEPC / MSC	PPR / III (JWG) / SDC		FAO

	Outcome	Measures	Parent Organ	Coordinating/ Associated Organ	Priority	Associated partners
6.		Consider the issue of waste that has been collected during fishing operations building on experience gathered from established projects	MEPC	PPR		
7.		Review the application of placards, garbage management plans and garbage record-keeping (regulation 10, MARPOL Annex V), for example making the Garbage Record Book mandatory for ships of 100 GT and above	MEPC	PPR		
8.		Preparation of a circular reminding Member States to enforce MARPOL Annex V on fishing vessels through PSC measures. Encourage port State control MoUs to develop PSC procedures that include fishing vessels	MEPC	PPR / III		
9.	**Reduction of shipping's contribution to marine plastic litter**	Review the application of placards, garbage management plans and garbage record-keeping (regulation 10, MARPOL Annex V), for example making the Garbage Record Book mandatory for ships of 100 GT and above	MEPC	PPR		
10		Consider the establishment of a compulsory system of formatted declarations of the loss of containers and the means on board to easily identify the exact number of losses Also, consider establishing an obligation to report through a standardized procedure the loss of containers	MSC / MEPC		X	

	Outcome	Measures	Parent Organ	Coordinating/ Associated Organ	Priority	Associated partners
11		Consider ways to communicate the location of containers lost overboard based on additional information to be provided by interested parties	MEPC			
12		Consider the most appropriate instrument to address the responsibility and liability for plastic consumer goods lost at sea from ships	LEG / MEPC	PPR		
13		Consider enhancing the enforcement of MARPOL Annex V, including, where possible, through a risk-based approach	MEPC	PPR / III		
14	**Improvement of the effectiveness of port reception and facilities and treatment in reducing marine plastic litter**	Consider the requirement for port reception facilities to provide for separate garbage collection for plastic waste from ships, including fishing gear to facilitate reuse or recycling	MEPC	PPR		
15		Consider mechanisms to enhance the enforcement of MARPOL Annex V requirements for the delivery of garbage to reception facilities	MEPC	PPR		

	Outcome	Measures	Parent Organ	Coordinating/ Associated Organ	Priority	Associated partners
16		Consider the development of tools to support the implementation of cost frameworks associated with port reception facilities, taking into account the need to not create disincentives for the use of port reception facilities, the potential benefits of cost incentives that provide no additional fees based on volume and identifying waste types that can be reduced, reused or recycled through schemes that identify waste revenue	MEPC	PPR		
17		IMO to encourage Member States to effectively implement their obligation to provide adequate facilities at ports and terminals for the reception of garbage, as required by regulation 8 of MARPOL Annex V Consider facilitating the mandatory use of port waste management plans to ensure the provision of adequate waste reception facilities Encourage Member States to address the entire process of plastic garbage handling and ensure that landed garbage is managed in a sustainable manner ashore Identify information from the port waste management plans that can be shared via the Global Integrated Shipping Information System (GISIS) Take into consideration work being undertaken under the Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter 1972	MEPC	PPR / III		

	Outcome	Measures	Parent Organ	Coordinating/ Associated Organ	Priority	Associated partners
		(London Convention or LC) and its 1996 Protocol (London Protocol or LP) (LC/LP) on this issue				
18		Further consider the impact on Small Island Developing States and on remote locations such as polar regions when planning for the disposal of waste to land-based facilities	MEPC	PPR		
19	**Enhanced public awareness, education and seafarer training**	Consider ways to promote the work of IMO to address marine plastic litter generated from ships	MEPC	PPR		
20		Consider tasking the HTW Sub-Committee with reviewing chapter III of STCW-F (Basic safety training for all fishing vessel personnel) to ensure that all fishing vessel personnel, before being assigned any shipboard duties, receive basic training on marine environment awareness oriented on marine plastic litter including abandoned, lost or otherwise discarded fishing gear (ALDFG)	MEPC	HTW		
21		Consider how the model course "Marine Environmental Awareness 1.38" could be amended/revised to specifically address marine plastic litter Further consider how to ensure familiarization of all seafarers within the existing STCW (International Convention on Standards and Training, Certification and Watch keeping for Seafarers) minimum requirements and taking into account existing best practice, guidelines and programmes	MEPC	HTW / PPR		

	Outcome	Measures	Parent Organ	Coordinating/ Associated Organ	Priority	Associated partners
22	**Improved understanding of the contribution of ships to marine plastic litter**	Consider extending the reporting requirement in regulation 10.6 of MARPOL Annex V to include reporting data on discharge or accidental loss of fishing gear by the flag State to IMO via GISIS or other means if appropriate	MEPC	PPR / III		
23		Encourage Member States and international organizations that have conducted any scientific research related to marine litter to share the results of such research, including any information on the areas contaminated by marine litter from ships	MEPC	PPR	X	
24		Conduct a study on marine plastic litter, including macro and microplastics, from all ships	MEPC LC/LP	PPR	X	GESAMP, FAO, UN Environment, RFMOs, World Oceans Assessment, Regional Seas Conventions
25		Invite Member States and international organizations to undertake studies to better understand microplastics from ships			X	

	Outcome	Measures	Parent Organ	Coordinating/ Associated Organ	Priority	Associated partners
26	**Improved understanding of the regulatory framework associated with marine plastic litter from ships**	Consider the development of a regulatory framework matrix for the purpose of a gap analysis	MEPC	PPR / III	X	
27	**Strengthened international cooperation**	Make information available to the United Nations Environment Assembly (UNEA)	MEPC LC/LP	PPR		
28		Continue work with other United Nations bodies and agencies, as well as with international fora, which are active in the matter of marine plastic litter from shipping, such as through the Global Partnership on Marine Litter (GPML)	MEPC LC/LP	PPR	X	
29	**Targeted technical cooperation and capacity-building**	Address implementation issues related to the action plan to address marine plastic litter from ships in the context of IMO technical cooperation and capacity-building activities	MEPC TCC	PPR / III		
30		Consider the establishment of externally funded major projects under the auspices of IMO in support of the action plan to address marine plastic litter from ships	MEPC	PPR		

5 Review and Evaluation

5.1 This Action Plan will be reviewed periodically to ensure that it continues to deliver against the objective and outcomes identified within the plan. Periodic review and evaluation of the plan will facilitate assessing the effectiveness of the actions within the plan, updating the plan with new information and incorporating new actions identified based on the implementation of the Action Plan or as a result of new information.

5.2 IMO will undertake a review of the Action Plan (i.e. assess the need for updating actions and/or incorporating new actions to the plan) annually and a comprehensive review (i.e. assessing the effectiveness of the actions within the plan against the objective and outcomes identified within the plan) after five years.

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ANNEX 14

RESOLUTION MEPC.311(73)
(adopted on 26 October 2018)

2018 GUIDELINES FOR THE APPLICATION OF MARPOL ANNEX I REQUIREMENTS TO FLOATING PRODUCTION, STORAGE AND OFFLOADING FACILITIES (FPSOs) AND FLOATING STORAGE UNITS (FSUs)

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 fifty-third session, it adopted , by resolution MEPC.139(53), the *Guidelines for the application of the revised MARPOL Annex I requirements to floating production, storage and offloading facilities (FPSOs) and floating storage units (FSUs)* (Guidelines), which were further amended by resolution MEPC.142(54),

RECOGNIZING the need to align the relevant provisions of the Guidelines with the amendments to MARPOL Annex I adopted since MEPC 54.

HAVING CONSIDERED, at its seventy-third session, draft 2018 Guidelines for the application of MARPOL Annex I requirements to floating production, storage and offloading facilities (FPSOs) and floating storage units (FSUs) prepared by the Sub-Committee on Pollution Prevention and Response, at its fifth session,

1 ADOPTS the *2018 Guidelines for the application of MARPOL Annex I requirements to floating production, storage and offloading facilities (FPSOs) and floating storage units (FSUs)*;

2 INVITES Governments to take the 2018 Guidelines into account when applying the relevant requirements of MARPOL Annex I to FPSOs and FSUs;

3 AGREES to keep the 2018 Guidelines under review in light of experience gained;

4 REVOKES the *Guidelines for the application of the revised MARPOL Annex I requirements to floating production, storage and offloading facilities (FPSOs) and floating storage units (FSUs)* (resolution MEPC.139(53), as amended by resolution MEPC.142(54)).

ANNEX

2018 GUIDELINES FOR THE APPLICATION OF MARPOL ANNEX I REQUIREMENTS TO FLOATING PRODUCTION, STORAGE AND OFFLOADING FACILITIES (FPSOs) AND FLOATING STORAGE UNITS (FSUs)

1 The Marine Environment Protection Committee, at its forty-ninth session (14 to 18 July 2003), recognizing the necessity to provide appropriate guidance for the application of MARPOL Annex I requirements to floating production, storage and offloading facilities (FPSOs) used for the offshore production and storage of oil, and floating storage units (FSUs) used for the offshore storage of produced oil, approved the Guidelines for application of MARPOL Annex I requirements to FPSOs and FSUs. The Guidelines were issued as MEPC/Circ.406 on 10 November 2003.

2 The Marine Environment Protection Committee, at its fifty-third session, adopted, by resolution MEPC.139(53), *the Guidelines for the application of the revised MARPOL Annex I requirements to floating production, storage and offloading facilities (FPSOs) and floating storage units (FSUs)* to replace MEPC/Circ.406 and update the Guidelines' references to the requirements of MARPOL Annex I as amended by resolution MEPC.117(52).

3 The Marine Environment Protection Committee, at its seventy-third session, recognizing that similar revision would be needed for the Guidelines, agreed to the adoption of these Guidelines to replace resolution MEPC.139(53), as amended, with a view to updating the Guidelines to address the application of all new MARPOL Annex I amendments up to resolution MEPC.276(70).

4 The purpose of these Guidelines is to provide for uniform application of MARPOL Annex I requirements to FPSOs and FSUs that are used for the offshore production and storage or for the offshore storage of produced oil.

5 The Committee noted the complex issues involved in applying the requirements of MARPOL Annex I to FPSOs and FSUs, whose arrangements, functions and operations fall under the over-riding control of coastal States.

6 In addition, the Committee found that the role of FPSOs and FSUs in operation does not include transport of oil. Accordingly, FPSOs and FSUs are a form of floating platform and do not lie within the definition of *oil tanker* in regulation 1.5 of MARPOL Annex I. They are therefore subject to the provisions of MARPOL Annex I that relate to fixed and floating platforms, including regulation 39.

7 The Committee noted that the environmental hazards associated with the quantities of produced oil stored on board operational FPSOs and FSUs are similar to some of the hazards related to oil tankers, and that relevant requirements of MARPOL Annex I in relation to *oil tankers* could be adapted to address those hazards in an appropriate manner. Based on the above and recognizing that these floating platforms are stationary when operating, the Committee recommends that coastal States, flag States and others associated with the design, construction and operation of FPSOs and FSUs apply the relevant MARPOL Annex I regulations referred to in annex 1 to the Guidelines. References contained in annex 1 relate to MARPOL Annex I up to and including the amendments contained in resolution MEPC.276(70).

8 These Guidelines have been prepared with a view to providing the necessary guidance and interpretation information which may be specifically applicable to FPSOs and FSUs, and accordingly represent a single document describing the application of MARPOL Annex I to these floating platforms.

9 The provisions of these Guidelines are for application to FPSOs and FSUs when located at their operating station. However they also take into account the abnormal and rare circumstances of:

.1 voyages for drydocking, repair or maintenance work; or

.2 disconnection of the platform in extreme environmental or emergency conditions.

In either case, the FPSO/FSU should not transport oil to a port or terminal except with the specific agreement of the flag and relevant coastal States, obtained on a single voyage basis. When undertaking any voyage away from the operating station, for whatever purpose, FPSOs and FSUs will be required to comply with the discharge provisions of MARPOL Annex I for *oil tankers*.

10 In order to avoid development of an entire new text from MARPOL Annex I attending to such terminology matters and notwithstanding the basis for these Guidelines outlined above, in any regulation indicated to apply to FPSOs and FSUs by the Guidelines at annex 1, the following interpretation of terminology should be used:

.1 "oil tanker" should be read as "FPSO or FSU";

.2 "carry" should be read as "hold";

.3 "cargo" should be read as "produced oil and oily mixtures"; and

.4 "voyage" should be read to include "operations".

11 Oil tanker requirements that are extended by the Guidelines to apply to FPSOs/FSUs are identified through the phrase "recommend application" or similar, while "applies" is used for requirements to be implemented irrespective of the contents of these Guidelines.

12 The requirement for oil tankers to undergo enhanced surveys is contained in SOLAS regulation XI-1/2. Since SOLAS does not apply to the vast majority of FPSOs and FSUs, which are permanently moored at their operating stations, the relevant oil tanker requirements of resolution A.1049(27) (2011 ESP Code) have been included as one of the provisions of the Guidelines in order to ensure a satisfactory standard of structural integrity for FPSOs and FSUs. Reflecting the operational characteristics of FPSOs and FSUs, the Guidelines also make provision for limited departure from resolution A.1049(27) in respect of acceptance of in-water surveys under conditions which do not compromise safety and pollution prevention.

13 In implementing the provisions of these Guidelines, Member Governments are invited to use and recognize the Record of Construction and Equipment for FPSOs and FSUs at annex 2 in place of Forms A and B appended to MARPOL Annex I.

14 The Committee noted that most operations of FPSOs and FSUs are different from other ships covered by MARPOL Annex I and, recognizing that the coastal State has jurisdiction over fixed and floating platforms operating in waters under its jurisdiction, Member Governments may find it necessary to depart from the provisions of these Guidelines. Accordingly, Member Governments are invited to advise the Organization of their experience in applying these Guidelines so that it can be taken into account if future amendments to these Guidelines are deemed necessary.

ANNEX 1

RECOMMENDED PROVISIONS OF MARPOL ANNEX I FOR APPLICATION TO FPSOs AND FSUs

Article	Subject	Basis of Application
Art. 2(3)(b)(ii)	Def. *Discharge*	In accordance with Reg. 39 and UI 67, produced water, offshore processing drainage and displacement water are not included in the meaning of *discharge.*
Art. 2(4)	Def. *Ship*	FPSOs/FSUs are "fixed or floating platforms" and are therefore included in this definition.

Regulation	Subject	Basis of Application
1.1 to 1.4	Defs. *Oil, Crude Oil, Oily mixture, Oil fuel*	Apply.
1.5	Def. *Oil tanker*	FPSOs/FSUs are adapted primarily for a purpose other than to carry (transport) oil and are therefore excluded from this definition.
1.6 and 1.7	Defs. *Crude Oil tanker, Products carrier*	Not applicable.
1.8	Def. *Combination carrier*	Not applicable for same reasons as 1.5.
1.9	Def. *Major conversion*	Conversion of an *oil tanker* or *combination carrier* to an FPSO/FSU and *vice versa* should be considered to be a *major conversion.* Alterations or modifications required for an existing FPSO/FSU to move to another field should not be considered a *major conversion*.
1.10 and 1.11	Defs. *Nearest land, Special area*	Apply.
1.12	Def. *Instantaneous rate of discharge of oil*	Not applicable to FPSO/FSU at operating station as this definition applies when the ship is under way (refer regs. 34.1.4 and 31.2, 31.3 and 36.6).
1.13 to 1.26	Defs. *Various*	Apply.
1.27	Def. *Anniversary date*	Applies.
1.28.1, 1.28.2 and 1.28.9	Defs. *Ship age groups*	Apply.
1.28.3 to 1.28.8	Defs. *Oil tanker age groups*	Not applicable.
1.29 to 1.38	Defs. *Various*	Apply.
2.1	Application	Applies.

Regulation	Subject	Basis of Application
2.2 and 2.3	Application	Not applicable as the scope of application of these Guidelines is for FPSOs and FSUs when located at their normal operational station, including where appropriate temporary disconnection from the riser at the operating station for the minimum period necessary to ensure the safety of the vessel in extreme environmental or emergency conditions.
2.4	Application	Not applicable.
2.5 and 2.6	Existing tankers engaged in specific trades	Not applicable.
3.1 to 3.3	Exemptions and waivers	Any Administration using this clause in relation to FPSOs/FSUs would need to justify such use in relation to the terms of paragraph .1 and in accordance with the requirements of paragraph .3.
3.4 and 3.5	Exemptions and waivers	Recommend application in order to sanction the waiver arrangements outlined in 31.2, e.g. for operations within special areas (3.5.2.1) in compliance with 3.5.2.4 to 3.5.2.7. Transfer of oily mixtures to offload tankers for discharge ashore is acceptable within this waiver.
3.6	Exemptions and waivers	Recommend application.[1]
4	Exceptions	Applies.
5	Equivalents	Applies.
6	Surveys and inspections	Applies. Notwithstanding whether SOLAS 74 applies to an FPSO/FSU, surveys of FPSOs and FSUs should be conducted to the standard specified for *oil tankers* in SOLAS 74 regulation XI-1/2, except for the provisions of 2.2 of Annex B, Parts A and B, to resolution A.1049(27) (2011 ESP Code), as amended in relation to dry-dock survey. The coastal and flag States may accept bottom survey of the ship afloat instead of in dry-dock when the conditions are satisfactory and the proper equipment and suitably qualified personnel are available.
7	Issue of certificate	IOPP Certificate should be issued unless flag and coastal States have other means of certificating/documenting compliance.
8	Issue of certificate by another Government	Applicable.
9	Form of certificate	Applicable. When completing the IOPP certificate, FPSOs'/FSUs' "type of ship" should be shown as "ship other than any of the above" and this entry should be annotated with "FPSO" or "FSU" together with details of operational location. Record of Construction and Equipment for FPSOs and FSUs given at Annex 2 should be used for the IOPP Supplement. Where this is done, Form A or Form B required by the Convention need not be provided.

[1] If an Administration decides to apply these provisions to FPSOs and FSUs, it is invited to notify all parties involved so that a sufficient amount of time is allowed for the provisions to be complied with, which should be at least one year from the date of notification.

Regulation	Subject	Basis of Application
10	Duration of certificate	Applicable.
11	Port State control on operational requirements	Applies to FPSO/FSU at its operating station, recognizing that under Art. 2(5) and UNCLOS Arts. 56 and 60, the coastal State exercises sovereign rights for the purposes of exploration and exploitation of their natural resources. However, port State control powers are applicable at other times such as if the FPSO/FSU voyages to a port in another State for maintenance purposes.
12	Tanks for oil residues (sludge)	Applicable.
12A	Oil fuel tank protection	Applies to new purpose built FPSOs and FSUs only excluding the requirements of paragraph 6. However, when undertaking any voyage away from the operating station for whatever purpose, the double bottom oil fuel tanks are to be empty unless they are in compliance with the requirements of paragraph 6.
13	Standard discharge connection	Applicable.
14	Oil filtering equipment	Applicable subject to applicable provisions of Reg. 15 and 34. For reasons of practicality, the equipment need not be fitted provided the machinery space discharges are disposed of in accordance with options a, b, d or e in relation to regulation 15.2. A waiver may be issued under 14.5.3, where all oily mixtures are discharged either ashore or into production stream.
15A	Discharges outside special areas	In accordance with Reg. 39 and UI 67, applies only to machinery space discharges and contaminated sea water from operational purposes such as produced oil tank cleaning water, produced oil tank hydrostatic testing water, water from ballasting of produced oil tank to carry out inspection by rafting. Since FPSOs/FSUs and other fixed and floating platforms cannot comply with 15.2.1 when operating on station then these oils and oily mixtures may, with the agreement of the coastal State: a. be sent ashore; b. be incinerated; c. have water separated and discharged if not exceeding 15 ppm oil content under 34.2; d. be discharged in accordance with this clause subject to waiver of the *en route* requirement; e. be added to the production stream; or f. be treated using a combination of these methods.
15B	Discharges in special areas	Applicable, but FPSOs/FSUs cannot comply with 15.3.1 when operating on station. This requirement should be handled consistent with 15A above. Coastal State may issue dispensation from 15.3.1 where satisfied that this dispensation does not prejudice the environment.

Regulation	Subject	Basis of Application
15C and 15D	Requirements for ships <400 GT and general req.	Apply.
16.1, 16.2 and 16.4	Segregation of oil and water ballast and carriage of oil in forepeak tanks	Apply. The principles of 16.3 should be extended to all other FPSOs and FSUs.
16.3	"	Applies to FPSOs/FSUs which are capable of disconnecting from the riser at the operating station as collision bulkhead requirement is in SOLAS rather than MARPOL. This principle is also relevant to stern collision as per 19.7.
17	Oil Record Book Part I	Applies.
18.1 to 18.9	Segregated ballast tanks	Recommend application subject to the conditions listed for 18.2 and 18.3.
18.2	"	Not applicable, but FPSO/FSU should have sufficient ballast capacity to meet stability and strength requirements in design and operational conditions of loading.
18.3	"	Recommend application, noting that there should normally be separation between ballast and produced oil (crude) tanks and pumping systems, but temporary cross-connection may be permitted for the duration of transfer operations. In such exceptional cases where sea water is introduced into produced oil tanks for the operational purposes listed above in relation to 15.2, it should be dealt with as provided for under that clause.
18.8.1 to 18.8.4	Requirements for oil tankers with dedicated clean ballast tanks	Recommend application similar to 18.1 to 18.9.
18.10.1	Existing oil tankers having special ballast arrangements	Recommend application to meet 18.2 and 18.3 as modified by these Guidelines.
18.10.2	"	Recommended application consistent with 18.3 and 35.2 as modified by these Guidelines.
18.10.3	"	Not applicable.
18.11	SBT for oil tankers >=70,000 DWT delivered after 31.12.79	Recommend application, subject to the conditions listed for 18.2 and 18.3.
18.12 to 18.15	Protective location of segregated ballast spaces	Not applicable. Refer to 19.3.1 for corresponding provisions in relation to both new purpose-built FPSOs/FSUs and other non-purpose-built FPSOs/FSUs.

Regulation	Subject	Basis of Application
19	Double hull and double bottom requirements for oil tankers delivered on or after 6.07.96	Not applicable, except as detailed below.
19.3.1 and 19.3.6	"	Recommend application to new purpose-built FPSOs/FSUs so as to provide protection against relatively low-energy collision. (NOTE: Appropriate measures should also be taken for other FPSOs/FSUs to address this collision hazard).
19.5	"	Applicable to the extent that the Guidelines referred to can be used to demonstrate equivalency with 19.3.1 and 19.3.6 as modified above.
19.7	"	Recommend application to new construction purpose-built FPSOs/FSUs and other FPSOs/FSUs which are arranged with a fore peak or collision bulkhead. Similarly, oil should not be held in integral tanks located at the stern in FPSOs/FSUs which may offload to a tanker moored astern or alongside of the FPSO/FSU.
19.8	"	Recommend application to new construction purpose built FPSOs/FSUs and other FPSOs/FSUs which may be modified to meet this regulation.
20 (as amended by resolution MEPC.111(50))	Double hull and double bottom requirements for oil tankers delivered before 6.07.96	Not applicable.
21	Prevention of pollution from oil tankers carrying heavy grade oil as cargo	Not applicable.
22	Pump-room bottom protection	Not applicable.
23	Accidental oil outflow performance	Not applicable.
24	Damage assumptions	Recommend application with regard to side damage only. It is recommended that protective measures, such as fendering, be used to minimize side impact damage such as that which might be experienced during offloading and supply vessel berthing operations. Such protection, however, should not be considered to reduce the minimum transverse extent of side penetration damage.
25	Hypothetical outflow of oil	Recommend application for side damages only in accordance with 24 above.
26	Limitation of size and arrangement of cargo tanks	Recommend application based on 24 and 25 above.

Regulation	Subject	Basis of Application
27	Intact stability	Recommend application.
28.1 to 28.5	Subdivision and damage stability	Recommend application only in respect of side damage in accordance with 24 above.
28.6	Stability instrument	Recommend application.[2]
28.7	Damage assumptions for oil tankers >=20,000 DWT delivered on or after 6.07.96	Not applicable.
29	Slop tanks	Applies.
30.1	Pumping, piping and discharge arrangement	Applies, except that manifold is to be provided in at least one position on the FPSO/FSU.
30.2	"	Not applicable for FPSOs.
30.3 to 30.7	"	Recommend application, particularly for management of contaminated sea as per Reg.18.3.
31	Oil discharge monitoring and control system	Applies only to tank cleanings and contaminated sea water (refer Art. 2(3)(b)(ii), Reg. 39 and UI 67) and should be read in light of Reg. 34. Not required where all oily mixtures are discharged to shore.
32	Oil/water interface detector	Applies only to tank cleanings and contaminated sea water (refer Art. 2(3)(b)(ii), Reg. 39 and UI 67) and should be read in light of Reg. 34. Not required where all oily mixtures are discharged to shore.
33	Crude oil washing requirements	COW system should be fitted unless produced oil characteristics are not suitable for COW.
34	Control of discharge of oil	Applicable as detailed below.
34.1	Discharges outside special areas	Recommended application whenever the FPSO/FSU is not at its operating station.
34.2	"	Applies.
34.3 to 34.5	Discharges in special areas	Apply.
34.6	Oil tankers <150 GT	Recommend application if FPSO/FSU is less than 150 GT.
34.7 to 34.9	General requirements	Apply.
35	Crude oil washing operations	Recommended application to any produced oil tanks used for water ballast as water ballast is subject to different discharge requirements than produced water. COW O&E Manual is to be provided for any COW system fitted.
36	Oil Record Book Part II	Part II should be applied in principle as part of oil production management system when on station, noting that this function must be complied with on voyage.

[2] If an Administration decides to apply these provisions to FPSOs and FSUs, it is invited to notify all parties involved so that a sufficient amount of time is allowed for the provisions to be complied with, which should be at least one year from the date of notification.

Regulation	Subject	Basis of Application
37.1 to 37.3	SOPEP	Applies in respect of SOPEP. However, contingency plan in accordance with requirements of OPRC Art 3(2) may be accepted under UI 48 as meeting this requirement. In such cases a separate SOPEP in accordance with the MARPOL format is not required. This acceptance of the contingency plan does not apply to a disconnectable FPSO/FSU unless that plan remains applicable when the FPSO/FSU is not connected to the riser.
37.4	Access to stability and residual strength calculation programmes	Applicable.
38	Reception facilities	FPSOs/FSUs should not be considered as offshore terminals and should not receive dirty ballast or slops from offload tankers.
39	Special requirements for fixed or floating platforms	Applies, subject to UI 67.
40	Scope of application (for chapter 8 – Prevention of pollution during transfer of oil cargo between oil tankers at sea)	The regulations contained in this chapter shall not apply to oil transfer operations associated with fixed or floating platforms including drilling rigs; floating production, storage and offloading facilities (FPSOs) used for the offshore production and storage of oil; and floating storage units (FSUs) used for the offshore storage of produced oil.
41	General rules on safety and environmental protection	Not applicable (in chapter 8).
42	Notification (for chapter 8)	Not applicable (in chapter 8).
43	Special requirements for the use or carriage of oils in the Antarctic area	Applies.
44	Application (for chapter 10 – Verification of compliance with the provisions of this Convention)	Applies.
45	Verification of compliance	Applies.

Regulation	Subject	Basis of Application
46	Definitions (for chapter 11 – International Code for ships operating in polar waters)	Applies.
47	Application and requirements	Applies.

ANNEX 2

RECORD OF CONSTRUCTION AND EQUIPMENT FOR FPSOs AND FSUs

In respect of the provisions of resolution MEPC.311(73) "Guidelines for the application of MARPOL Annex I[3] requirements to FPSOs and FSUs", hereafter referred to as the "Guidelines".

Notes:

1 This form should be used for Floating Production Storage and Offloading facilities (FPSOs) and Floating Storage Units (FSUs) to which regulation 39 of Annex I of the Convention applies.

2 This Record should be permanently attached to the IOPP Certificate. The IOPP Certificate should be available on board the ship at all times.

3 If the language of the original Record is neither English nor French nor Spanish, the text should include a translation into one of these languages.

4 Entries in boxes shall be made by inserting either a cross (x) for the answers "yes" and "applicable" or a dash (-) for the answers "no" and "not applicable" as appropriate.

5 Unless otherwise stated, regulations mentioned in this Record refer to regulations of the revised Annex I of the Convention as implemented under the Guidelines and resolutions refer to those adopted by the International Maritime Organization.

1. Particulars of ship

1.1 Name of ship
.....

1.2 Distinctive number or letters
.....

1.3 IMO number (if applicable)
.....

1.4 Port of registry (if applicable)
.....

1.5 Gross tonnage (if applicable)
.....

1.6 Produced liquids holding capacity of ship ..... (m^3)

1.7 Deadweight of ship .....(tonnes) (regulation 1.23)

1.8 Length of ship ..... (m) (regulation 1.19)

1.9 Operating station (lat/long)
.....

1.10 Coastal State
.....

[3] Annex I of International Convention for the Prevention of Pollution from Ships, 1973, as modified by the Protocol of 1978 relating thereto, hereafter referred to as the "Convention".

1.11 Date of build:

1.11.1 Date of building contract .....

1.11.2 Date on which keel was laid or ship was at a similar stage of construction .....

1.11.3 Date of delivery .....

1.12 Conversion to FPSO/FSU (if applicable):

1.12.1 Date of conversion contract .....

1.12.2 Date on which conversion was commenced .....

2. Equipment for the control of oil discharge from machinery space bilges and oil fuel tanks (regulations 14, 15 and 34)

2.1 Carriage of ballast water in oil fuel tanks:

2.1.1 The ship may under normal conditions carry ballast water in oil fuel tanks □

2.2 Type of oil filtering equipment fitted:

2.2.1 Oil filtering (15 ppm) equipment (regulation 14.6) □

2.2.2 Oil filtering (15 ppm) equipment with alarm and automatic stopping device (regulation 14.7) □

2.3 Approval standards:[4]

2.3.1 The separating/filtering equipment:

.1 has been approved in accordance with resolution A.393(X); □

.2 has been approved in accordance with resolution MEPC.60(33); □

.3 has been approved in accordance with resolution MEPC.107(49); □

.4 has been approved in accordance with resolution A.233(VII); □

.5 has been approved in accordance with national standards not based upon resolutions A.393(X) or A.233(VII); □

.6 has not been approved; □

[4] Refer to *the Recommendation on international performance and test specifications of oily-water separating equipment and oil content meters* adopted by the Organization on 14 November 1977 by resolution A.393(X), which superseded resolution A.233(VII). Further reference is made to the *Guidelines and specifications for pollution prevention equipment for machinery space bilges* adopted by the Marine Environment Protection Committee of the Organization by resolution MEPC.60(33), which, effective on 6 July 1993, superseded resolutions A.393(X) and A.444(XI) and the revised *Guidelines and specifications for pollution prevention equipment for machinery spaces of ships* adopted by the Marine Environment Protection Committee of the Organization by resolution MEPC.107(49) which, effectively on 1 January 2005, superseded resolutions MEPC.60(33), A.393(X) and A.444(XI).

2.3.2 The process unit has been approved in accordance with resolution A.444(XI) □

2.3.3 The oil content meter:

.1 has been approved in accordance with resolution A.393(X); □

.2 has been approved in accordance with resolution MEPC.60(33); □

.3 has been approved in accordance with resolution MEPC.107(49); □

2.4 Maximum throughput of the system is ..... m^3/h

2.5 Waiver of regulation 14:

2.5.1 The requirements of regulations 14.1 and 14.2 are waived in respect of the ship:

.1 As the ship is provided with adequate means for disposal of oily residues in accordance with the Guidelines □

.2 In accordance with regulation 14.5.1 the ship is engaged exclusively in operations within special area(s): □
Name of special area(s)

2.5.2 The ship is fitted with holding tank(s) for the total retention on board of all oily bilge water as follows: □

Tank identification	**Tank location**		**Volume (m^3)**
	Frames (from) - (to)	Lateral position	
		Total volume: .....……..m^3	

3. Means for retention and disposal of oil residues (sludge) (regulation 12) and oily bilge water holding tank(s)[5]

3.1 The ship is provided with oil residue (sludge) tanks for retention of oil residues (sludge) on board as follows:

Tank identification	**Tank location**		**Volume (m^3)**
	Frames (from) – (to)	Lateral position	
		Total volume: .....……..m^3	

[5] Oily bilge water holding tank(s) are not required by the Convention, if such tank(s) are provided they should be listed in table 3.3.

3.2 Means for the disposal of oil residues (sludge) retained in oil residue (sludge) tanks:

3.2.1 Incinerator for oil residues (sludge) ……..... □

3.2.2 Auxiliary boiler suitable for burning oil residues (sludge) □

3.2.3 Facility for adding oil residues to production stream □

3.2.4 Other acceptable means, state which …….. □

3.3 The ship is provided with holding tank(s) for the retention on board of oily bilge water as follows:

Tank identification	**Tank location**		**Volume (m^3)**
	Frames (from) – (to)	Lateral position	
		Total volume: .....……..m^3	

3A. Oil fuel tank protection (regulation 12A)

3A.1 The ship is required to be constructed according to regulation 12A and complies with the requirements of:

.1 Paragraph 7 or 8 (double side construction) □

.2 Paragraphs 6 and either 7 or 8 (double hull construction) □

.3 Paragraph 11 (accidental oil fuel outflow performance) □

3A.2 The ship is not required to comply with the requirements of regulation 12A □

4. Standard discharge connection
(regulation 13)

4.1 The ship is provided with a pipeline for the discharge of residues from machinery bilges and sludges to reception facilities, fitted with a discharge connection □

5. Construction
(regulations 18, 26 and 28)

5.1 In relation to the application of regulation 18, the ship is:

5.1.1 Provided with SBT □

5.1.2 Provided with COW □

5.1.3 Provided with sufficient ballast capacity to meet stability and strength requirements □

5.1.4 Provided with CBT

5.2 Segregated ballast tanks (SBT): □

5.2.1 The ship is provided with SBT consistent with regulation 18 □

5.2.2 The ship is provided with SBT which includes tanks or spaces not used for oil outboard of all produced oil tanks □

5.2.3 SBT are distributed as follows:

Tank	**Volume (m^3)**	**Tank**	**Volume (m^3)**
		Total volume ..... m^3	

5.3 Dedicated clean ballast tanks (CBT):

5.3.1 The ship is provided with CBT consistent with regulation 18.8 □

5.3.2 CBT are distributed as follows:

Tank	**Volume (m^3)**	**Tank**	**Volume (m^3)**
		Total volume ..... m^3	

5.3.3 The ship has been supplied with a valid Dedicated Clean Ballast Tank Operation Manual, which is dated ……...…… □

5.3.4 The ship has common piping and pumping arrangements for ballasting the CBT and handling produced oil □

5.3.5 The ship has separate independent piping and pumping arrangements for ballasting the CBT □

5.4 Crude oil washing (COW):

5.4.1 The ship is equipped with a COW system □

5.4.2 The ship is equipped with a COW system consistent with regulations 33 and 35 □

5.4.3 The ship has been supplied with a valid Crude Oil Washing Operations and Equipment Manual which is dated …… □

5.5 Limitation of size and arrangements of produced oil tanks (regulation 26):

5.5.1 The ship is constructed according to the provisions of regulation 26 □

5.6 Subdivision and stability (regulation 28):

5.6.1 The ship is constructed consistent with regulation 28 □

5.6.2 Information and data required under regulation 28.5 have been supplied to the ship in an approved form □

5.6.3 The ship is constructed consistent with regulation 27 □

5.6.4 The ship is provided with an Approved Stability Instrument consistent with regulation 28.6 □

5.6.5 In place of an Approved Stability Instrument, consistent with regulation 3.6 stability is verified by the following means:

.1 loading only to approved conditions defined in the stability information provided to the master in accordance with regulation 28.5 □

.2 verification is made remotely by a means approved by the Administration □

.3 loading within an approved range of loading conditions defined in the stability information provided to the master in accordance with regulation 28.5 □

.4 loading in accordance with approved limiting KG/GM curves covering all applicable intact and damage stability requirements defined in the stability information provided to the master in accordance with regulation 28.5 □

5.7 Double-hull/side construction:

5.7.1 The ship is constructed consistent with regulation 19 as follows:

.1 paragraph 3 (double-hull construction) □

.2 paragraphs 3.1 and 3.6 (double sides) □

.3 paragraph .5 (alternative method approved by the Marine Environment Protection Committee) □

5.7.2 The ship is constructed consistent with regulation 19.6 □

6. Retention of oil on board (regulations 29, 31 and 32)

6.1 Oil discharge monitoring and control system:

6.1.1 The ship comes under category ..... oil tanker as defined in resolution A.496(XII) or A.586(14)[6] *(delete as appropriate)* □

6.1.2 The system comprises:

.1 control unit □

.2 computing unit □

.3 calculating unit □

6.1.3 The system is:

.1 fitted with a starting interlock □

.2 fitted with automatic stopping device □

6.1.4 The oil content meter is approved under the terms of resolution A.393(X) or A.586(14) or MEPC.108(49) [7]*(delete as appropriate)* suitable for crude oil □

6.1.5 The ship has been supplied with an operations manual for the oil discharge monitoring and control system □

6.2 Slop tanks:

6.2.1 The ship is provided with ..... dedicated slop tank(s) with the total capacity of ..... m^3, which is. .... % of the oil carrying capacity, in accordance with:

.1 regulation 29.2.3 □

.2 regulation 29.2.3.1 □

.3 regulation 29.2.3.2 □

.4 regulation 29.2.3.3 □

6.2.2 Produced oil tanks have been designated as slop tanks □

6.3 Oil/water interface detectors:

6.3.1 The ship is provided with oil/water interface detectors approved under the terms of resolution MEPC.5(XIII) □

---

6 FPSOs and FSUs the keels of which are laid, or which are at a similar stage of construction, on or after 2 October 1986, should be fitted with a system approved under resolution A.586(14).

7 For oil content meters installed on tankers built prior to 2 October 1986, refer to the *Recommendation on international performance and test specifications for oily-water separating equipment and oil content meters* adopted by the Organization by resolution A.393(X). For oil content meters as part of discharge monitoring and control systems installed on tankers built on or after 2 October 1986, refer to the *Guidelines and specifications for oil discharge monitoring and control systems for oil tankers* adopted by the Organization by resolution A.586(14). For oil content meters as part of discharge monitoring and control systems installed on oil tankers built on or after 1 January 2005, refer to the revised *Guidelines and specifications for oil discharge monitoring and control systems for oil tankers* adopted by the Organization by resolution MEPC.108(49).

6.4 Waiver of regulation:

6.4.1 The requirements of regulations 31 and 32 are waived in respect of the ship as follows:

.1 The ship is engaged exclusively in operations within special area(s) (regulation 3.5) □

Name of special area(s)……

.2 The ship is provided with adequate means of disposal of contaminated sea water

a. sent ashore □

b. incinerated □

c. added to the production stream □

7. Pumping, piping and discharge arrangements
(regulation 30)

7.1 The overboard discharge outlets for segregated ballast are located:

7.1.1 Above the waterline □

7.1.2 Below the waterline □

7.2 The overboard discharge outlets, other than the discharge manifold, for clean ballast are located:[8]

7.2.1 Above the waterline □

7.2.2 Below the waterline □

7.3 The overboard discharge outlets, other than the discharge manifold, for dirty ballast water or oil-contaminated water from produced oil tank areas are located:

7.3.1 Above the waterline □

7.3.2 Below the waterline in conjunction with the part flow arrangements consistent with regulation 30.6.5 □

7.3.3 Below the waterline □

[8] Only those outlets which can be monitored are to be indicated.

7.4 Discharge of oil from produced oil pumps and oil lines (regulations 30.4 and 30.5):

7.4.1 Means to drain all produced oil pumps and oil lines at the completion of produced oil discharge:

.1 drainings capable of being discharged to a produced oil tank or slop tank □

.2 for discharge a special small-diameter line is provided □

8. Shipboard oil pollution emergency plan
(regulation 37)

8.1 The ship is provided with a shipboard oil pollution emergency plan in compliance with regulation 37.1 □

8.2 The ship is provided with an oil pollution emergency plan approved in accordance with procedures established by …..…… as the coastal State in compliance with the unified interpretation of regulation 37.1 □

8.3 The ship is provided with a contingency plan in accordance with requirements of OPRC Art. 3(2) accepted in accordance with regulation 37 □

9. Surveys

9.1 Records of surveys in accordance with resolution A.1049(27), as amended maintained on board □

9.2 In-water surveys in lieu of dry-docking authorized as per documentation …… □

10. Equivalents

10.1 Equivalents have been approved by the Administration for certain requirements of the guidelines on those items listed under paragraph(s) ……. ……..……. of this Record □

11. Compliance with part II-A – chapter 1 of the Polar Code

11.1 The ship is in compliance with additional requirements in the environment-related provisions of the introduction and section 1.2 of chapter 1 of part II-A of the Polar Code □

THIS IS TO CERTIFY that this Record is correct in all respects.
Issued at ……

(Place of issue of the Record)

…… ……
(Signature of duly authorized official issuing the Record)

(Seal or stamp of the issuing authority, as appropriate)

***

INTERNATIONAL MARITIME ORGANIZATION

E

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MEPC.1/Circ.795/Rev.3
9 November 2018

UNIFIED INTERPRETATIONS TO MARPOL ANNEX VI

1 The Marine Environment Protection Committee, at its seventy-third session (22 to 26 October 2018), approved unified interpretations to MARPOL Annex VI concerning the data collection system for fuel oil consumption of ships.

2 The updated consolidated text of all existing unified interpretations to MARPOL Annex VI, including those set out in circular MEPC.1/Circ.795/Rev.2, 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 supersedes MEPC.1/Circ.795/Rev.2.

***

ANNEX

UNIFIED INTERPRETATIONS TO MARPOL ANNEX VI

1 Definition of "new ship"

Regulation 2
Definitions

Regulation 2.23 reads as follows:

"23 *New ship* means a ship:

.1 for which 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*:**

1.1 For the application of the definition "new ship" as specified in regulation 2.23 to each Phase specified in table 1 of regulation 21, it should be interpreted as follows:

.1 the date specified in regulation 2.23.1 should be replaced with the start date of each Phase;

.2 the date specified in regulation 2.23.2 should be replaced with the date six months after the start date of each Phase; and

.3 the date specified in regulation 2.23.3 should, for Phase 1, 2 and 3, be replaced with the date 48 months after the start date of each Phase.

1.2 With the above interpretations, the required EEDI of each Phase is applied to the following new ship which falls into one of the categories defined in regulations 2.25 to 2.31 and to which chapter 4 is applicable:

.1 the required EEDI of Phase 0 is applied to the following new ship:

.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:

.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.

.3 the required EEDI of Phase 2 is applied to the following new ship:

.1 the building of which contract 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:

.1 the building of which contract is placed in Phase 3; 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 2025; or

.3 the delivery of which is on or after 1 January 2029.

2 Major conversion

Regulation 2.24 reads as follows:

> "24 *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 21 of this Annex."

***Interpretation*:**

2.1 For regulation 2.24.1, 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 as 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 2.24.5, 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 as 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 2.24.4, 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 2.22 and 2.23.

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

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

Regulation 2.30 reads as follows:

> "30 *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 carrier.

4 Timing for existing ships to have on board a SEEMP

Regulation 5
Surveys

Regulation 5.4.4 reads as follows:

> ".4 For existing ships, the verification of the requirement to have a SEEMP on board according to regulation 22 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 a Certificate

Regulation 6.4 reads as follows:

> "4 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 22
Ship Energy Efficiency Management Plan (SEEMP)

Regulation 22.1 reads as follows:

> "1 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*:**

4.1 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 an SEEMP on board are not required to be issued with an IECC.

4.2 The SEEMP required by regulation 22.1 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.

4.3 For existing ships, a SEEMP required in accordance with regulation 22 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.

4.4 The intermediate or renewal survey referenced in paragraph 4.3 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.

4.5 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.

4.6 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.

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

5 Section 2.3 of the supplement to the IAPP Certificate

Regulation 8
Form of Certificates

Regulation 8.1 reads as follows:

> "1 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 1
Form of International Air Pollution Prevention (IAPP) Certificate (Regulation 8)

Section 2.3 of the supplement to 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:

- 4.50% m/m (not applicable on or after 1 January 2012); or ☐
- 3.50% m/m (not applicable on or after 1 January 2020); or ☐
- 0.50% m/m, and/or ☐

.2 an equivalent arrangement approved in accordance with regulation 4.1 as listed in 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:

- 4.50% m/m (not applicable on or after 1 January 2012); or ☐
- 3.50% m/m (not applicable on or after 1 January 2020); or ☐
- 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:

- 1.00% m/m (not applicable on or after 1 January 2015); or ☐
- 0.10% m/m, and/or ☐

.2 an equivalent arrangement approved in accordance with regulation 4.1 as listed in 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:

- 1.00% m/m (not applicable on or after 1 January 2015); or ☐
- 0.10% m/m ☐

***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.

6 Identical replacement engines

Regulation 13
Nitrogen oxides (NO_x)

Regulation 13.1.1.2 reads as follows:

".2 each marine diesel engine with a power output of more than 130 kW which 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 which it is replacing and is otherwise not covered under paragraph 1.1.1 of this regulation."

Regulation 13.2.2 reads as follows:

> "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 in force at the time of the replacement or addition of the engine shall apply."

Interpretation:

6.1 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:

6.2 An "identical engine" is, as compared to the engine being replaced[1], 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):

.1 for engines without EIAPP certification, have the same NO_x critical components and settings[2]; or

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

---

1 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".

2 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).

7 Time of replacement of an engine

Regulation 13.2.2 reads as follows:

> "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 in force at the time of the replacement or addition of the engine shall apply."

Interpretation:

7.1 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[3]; 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 1 July 2016, 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.

7.2 The date in paragraph 7.1 above, provided the conditions associated with those dates apply, is the "Date of major conversion – According to regulation 13.2.2" to be entered in the Supplement of IAPP Certificate. In this case, the "Date of installation", which applies only for identical replacement engines, should be filled in with "N.A.".

7.3 If the engine is delivered in accordance with either paragraphs 7.1.1 or 7.1.2 above before 1 January 2016, but not tested before 1 July 2016 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.

8 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

[3] The engine is to be fitted on board and tested for its intended purpose before 1 July 2016.

.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.[†]"

***Interpretation*:**

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

9 Continuous-feed type shipboard incinerators

Regulation 16
Shipboard incineration

Regulation 16.9 reads as follows:

"9 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*:**

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

The introduction of sludge oil, generated during normal operation of a ship, into a continuous-feed type incinerator during the warm-up process at combustion chamber temperatures above 500°C[4] in order to achieve the normal operation combustion chamber temperature of 850°C is allowed. The combustion chamber flue gas outlet temperature should reach 850°C within the period of time specified in the manufacturer's operations manual but should not be more than five minutes.

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

[4] For the introduction of sludge oil into the incinerator, two conditions need to be fulfilled to secure smokeless and complete combustion:

.1 the combustion chamber flue gas outlet temperature has to be above 850°C as required by regulation 16.9 of MARPOL Annex VI to ensure smokeless combustion; and

.2 the combustion chamber temperature (material temperature of the fire brickwork) has to be above 500°C to ensure a sufficient evaporation of the burnable components of the sludge oil.

10 Applicability of the requirements for a bunker delivery note

Regulation 18
Fuel oil availability and quality

Regulation 18.5 reads as follows:

> "5 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:

> "6 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:

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.

11 Confirmation of compliance for new ships

Regulation 5
Surveys

Regulation 5.4.5 reads as follows:

> ".5 The Administration shall ensure that for each ship to which regulation 22A applies, the SEEMP complies with regulation 22.2 of this Annex. This shall be done prior to collecting data under regulation 22A 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 22
Ship Energy Efficiency Management Plan (SEEMP)

Regulation 22.2 reads as follows:

> "2 On or before 31 December 2018, 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 22A.1 of this Annex and the processes that will be used to report the data to the ship's Administration."

Regulation 22.3 reads as follows:

> "3 The SEEMP shall be developed taking into account guidelines adopted by the Organization."

Interpretation:

Ships that are delivered on or after 1 January 2019 should keep on board both a SEEMP that is in compliance with regulation 22.2 and confirmation of compliance as required by regulation 5.4.5.

12 Boil-off gas consumed on board ships

Regulation 2
Definitions

Regulation 2.9 reads as follows:

> "9 *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 22A
Collection and reporting of ship fuel oil consumption data

Regulation 22A.1 reads as follows:

> "1 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
Collection and reporting of ship fuel oil consumption data

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:

Data relating to Boil-off Gas (BOG) consumed on board the ship for propulsion or operation is required to be collected and reported as fuel as part of the Data Collection System for fuel oil consumption of ships.

13 Access to the disaggregated data

Regulation 22A
Collection and reporting of ship fuel oil consumption data

Regulation 22A.8 reads as follows:

> "8 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 onboard the ship provided that the disaggregated data can be made available by the Company.

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MEPC.1/Circ.855/Rev.2
14 January 2019

2014 GUIDELINES ON SURVEY AND CERTIFICATION OF THE ENERGY EFFICIENCY DESIGN INDEX (EEDI), AS AMENDED (RESOLUTION MEPC.254(67), AS AMENDED BY RESOLUTION MEPC.261(68) AND RESOLUTION MEPC.309(73))

1 The Marine Environment Protection Committee, at its seventy-third session (22 to 26 October 2018), adopted, by resolution MEPC.309(73), amendments to the *2014 Guidelines on survey and certification of the Energy Efficiency Design Index (EEDI)* (resolution MEPC.254(67), as amended by resolution MEPC.261(68)). A revised consolidated text of the Guidelines, as requested by the Committee (MEPC 73/19, paragraph 5.87), is set out in the annex.

2 Member Governments are invited to bring the annexed *2014 Guidelines on survey and certification of the Energy Efficiency Design Index (EEDI)*, as amended, to the attention of Administrations, industry, relevant shipping organizations, shipping companies and other stakeholders concerned.

3 This circular revokes MEPC.1/Circ.855/Rev.1.

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ANNEX

2014 GUIDELINES ON SURVEY AND CERTIFICATION OF THE ENERGY EFFICIENCY DESIGN INDEX (EEDI), AS AMENDED (RESOLUTION MEPC.254(67), AS AMENDED BY RESOLUTION MEPC.261(68) AND RESOLUTION MEPC.309(73))

Table of contents

1 GENERAL

The purpose of these guidelines is to assist verifiers of the Energy Efficiency Design Index (EEDI) of ships in conducting the survey and certification of the EEDI, in accordance with regulations 5, 6, 7, 8 and 9 of MARPOL Annex VI, and assist shipowners, shipbuilders, manufacturers and other interested parties in understanding the procedures for the survey and certification of the EEDI.

2 DEFINITIONS[1]

2.1 *Verifier* means an Administration, or organization duly authorized by it, which conducts the survey and certification of the EEDI in accordance with regulations 5, 6, 7, 8 and 9 of MARPOL Annex VI and these Guidelines.

2.2 *Ship of the same type* means a ship the hull form (expressed in the lines such as sheer plan and body plan), excluding additional hull features such as fins, and principal particulars of which are identical to that of the base ship.

2.3 *Tank test* means model towing tests, model self-propulsion tests and model propeller open water tests. Numerical calculations may be accepted as equivalent to model propeller open water tests or used to complement the tank tests conducted (e.g. to evaluate the effect of additional hull features such as fins, etc. on ships' performance) with the approval of the verifier.

3 APPLICATION

These guidelines should be applied to new ships for which an application for an initial survey or an additional survey specified in regulation 5 of MARPOL Annex VI has been submitted to a verifier.

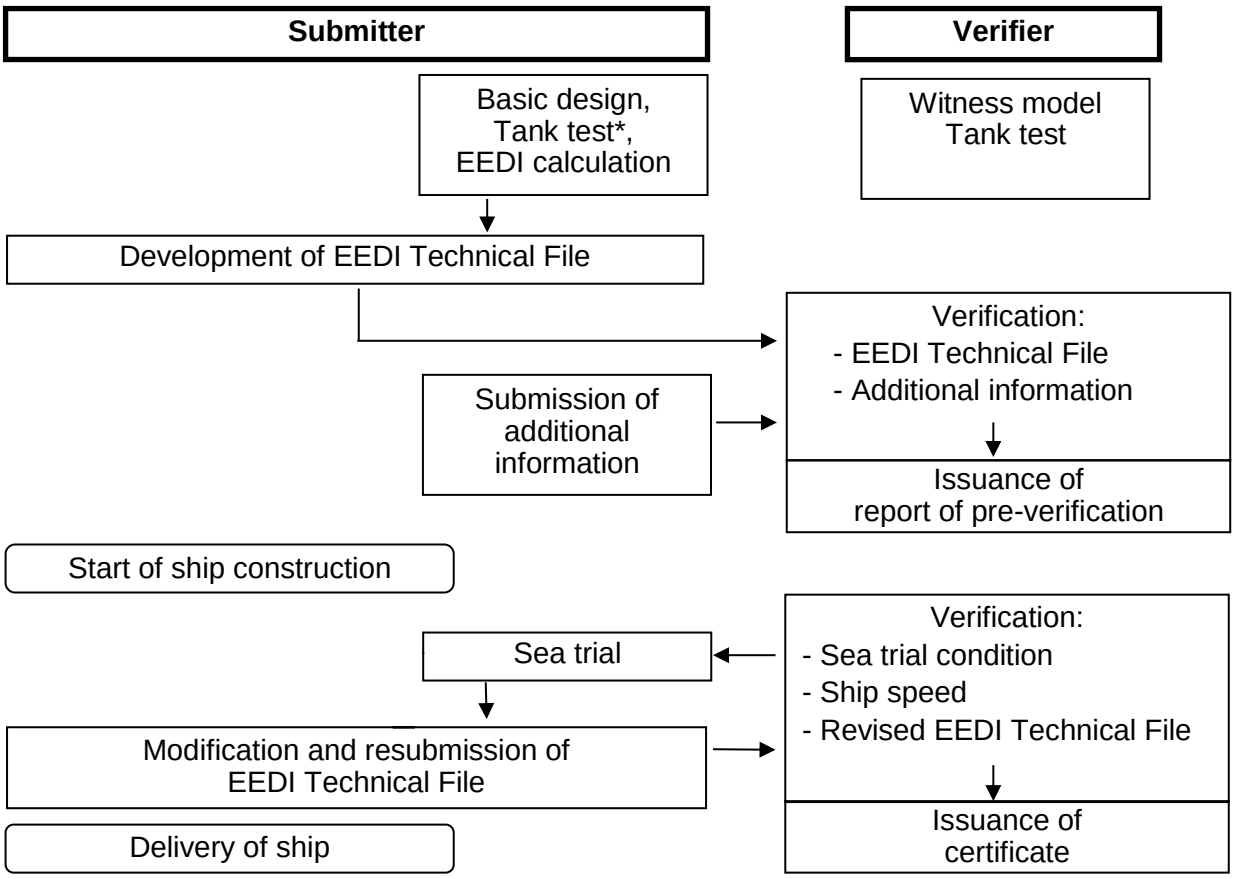
4 PROCEDURES FOR SURVEY AND CERTIFICATION

4.1 General

4.1.1 The attained EEDI should be calculated in accordance with regulation 20 of MARPOL Annex VI and the *2018 Guidelines on the method of calculation of the attained Energy Efficiency Design Index (EEDI) for new ships* (resolution MEPC.308(73)) (EEDI Calculation Guidelines). Survey and certification of the EEDI should be conducted in two stages: preliminary verification at the design stage and final verification at the sea trial. The basic flow of the survey and certification process is presented in figure 1.

4.1.2 The information used in the verification process may contain confidential information of submitters which requires Intellectual Property Rights (IPR) protection. In the case where the submitter wants a non-disclosure agreement with the verifier, the additional information should be provided to the verifier upon mutually agreed terms and conditions.

[1] Other terms used in these guidelines have the same meaning as those defined in the *2018 Guidelines on the method of calculation of the attained EEDI for new ships* (resolution MEPC.308(73)).



* To be conducted by a test organization or a submitter.

Figure 1: Basic flow of survey and certification process

4.2 Preliminary verification of the attained EEDI at the design stage

4.2.1 For the preliminary verification at the design stage, an application for an initial survey and an EEDI Technical File containing the necessary information for the verification and other relevant background documents should be submitted to a verifier.

4.2.2 The EEDI Technical File should be written at least in English. The EEDI Technical File should include as a minimum, but not limited to:

.1 deadweight (DWT) or gross tonnage (GT) for passenger and ro-ro passenger ships, the maximum continuous rating (MCR) of the main and auxiliary engines, the ship speed (V_{ref}), as specified in paragraph 2.2.2 of the EEDI Calculation Guidelines, type of fuel, the specific fuel consumption (*SFC*) of the main engine at 75% of MCR power, the *SFC* of the auxiliary engines at 50% MCR power, and the electric power table[2] for certain ship types, as necessary, as defined in the EEDI Calculation Guidelines;

[2] Electric power tables should be validated separately, taking into account the guidelines set out in appendix 2.

.2 power curve(s) (kW – knot) estimated at design stage under the condition as specified in paragraph 2.2.2 of the EEDI Calculation Guidelines, and, in the event that the sea trial is carried out in a condition other than the above condition, also a power curve estimated under the sea trial condition;

.3 principal particulars, ship type and the relevant information to classify the ship as such a ship type, classification notations and an overview of the propulsion system and electricity supply system on board;

.4 estimation process and methodology of the power curves at design stage;

.5 description of energy saving equipment;

.6 calculated value of the attained EEDI, including the calculation summary, which should contain, at a minimum, each value of the calculation parameters and the calculation process used to determine the attained EEDI;

.7 calculated values of the attained $EEDI_{weather}$ and f_w value (not equal to 1.0), if those values are calculated, based on the EEDI Calculation Guidelines; and

.8 for LNG carriers:

.1 type and outline of propulsion systems (such as direct drive diesel, diesel electric, steam turbine);

.2 LNG cargo tank capacity in m^3 and BOR as defined in paragraph 2.2.5.6.3 of the EEDI Calculation Guidelines;

.3 shaft power of the propeller shaft after transmission gear at 100% of the rated output of motor (MPP_{Motor}) and $\eta_{(i)}$ for diesel electric;

.4 maximum continuous rated power ($MCR_{SteamTurbine}$) for steam turbine; and

.5 $SFC_{SteamTurbine}$ for steam turbine, as specified in paragraph 2.2.7.2 of the EEDI Calculation Guidelines.

A sample of an EEDI Technical File is provided in appendix 1.

4.2.3 For ships equipped with dual-fuel engine(s) using LNG and fuel oil, the C_F-factor for gas (LNG) and the specific fuel consumption (*SFC*) of gas fuel should be used by applying the following criteria as a basis for the guidance of the Administration:

.1 final decision on the primary fuel rests with the Administration;

.2 the ratio of calorific value of gas fuel (LNG) to total marine fuels (HFO/MGO), including gas fuel (LNG) at design conditions should be equal to or larger than 50% in accordance with the formula below. However, the Administration can accept a lower value of the percentage taking into account the intended voyages:

$$\frac{V_{gas} \times \rho_{gas} \times LCV_{gas} \times K_{gas}}{\left(\sum_{i=1}^{nLiquid} V_{liquid(i)} \times \rho_{liquid(i)} \times LCV_{liquid(i)} \times K_{liquid(i)} \right) + V_{gas} \times \rho_{gas} \times LCV_{gas} \times K_{gas}} \geq 50\%$$

whereby:

V_{gas} is the total net tank volume of gas fuel on board in m^3;

V_{liquid} is the total net tank volume of every liquid fuel on board in m^3;

ρ_{gas} is the density of gas fuel in kg/m^3;

ρ_{liquid} is the density of every liquid fuel in kg/m^3;

LCV_{gas} is the low calorific value of gas fuel in kJ/kg;

LCV_{liquid} is the low calorific value of liquid fuel in kJ/kg;

K_{gas} is the filling rate for gas fuel tanks;

K_{liquid} is the filling rate for liquid fuel tanks.

Normal density, Low Calorific Value and filling rate for tanks of different kinds of fuel are listed below.

Type of fuel	Density (kg/m^3)	Low Calorific Value (kJ/kg)	Filling rate for tanks
Diesel/Gas Oil	900	42700	0.98
Heavy Fuel Oil	991	40200	0.98
Liquefied Natural Gas (LNG)	450	48000	0.95*

* Subject to verification of tank filling limit.

.3 in case the ship is not fully equipped with dual-fuel engines, the CF-factor for gas (LNG) should apply only for those installed engines that are of dual-fuel type and sufficient gas fuel supply should be available for such engines; and

.4 LNG fuelling solutions with exchangeable (specialized) LNG tank-containers should also fall under the terms of LNG as primary fuel.

4.2.4 The *SFC* of the main and auxiliary engines should be quoted from the approved NO_X Technical File and should be corrected to the value corresponding to the ISO standard reference conditions using the standard lower calorific value of the fuel oil (42,700 kJ/kg), referring to ISO 15550:2002 and ISO 3046-1:2002. For the confirmation of the *SFC*, a copy of the approved NO_X Technical File and documented summary of the correction calculations should be submitted to the verifier. In cases where the NO_X Technical File has not been approved at the time of the application for initial survey, the test reports provided by manufacturers should be used. In this case, at the time of the sea trial verification, a copy of

the approved NO_X Technical File and documented summary of the correction calculations should be submitted to the verifier. In the case that gas fuel is determined as primary fuel in accordance with paragraph 4.2.3 and that installed engine(s) have no approved NO_X Technical File tested in gas mode, the *SFC* of gas mode should be submitted by the manufacturer and confirmed by the verifier.

> **Note:** *SFC* in the NO_X Technical File are the values of a parent engine, and the use of such value of *SFC* for the EEDI calculation for member engines may have the following technical issues for further consideration:
>
> .1 the definition of "member engines" given in the NO_X Technical File is broad and specification of engines belonging to the same group/family may vary; and
>
> .2 the rate of NO_X emission of the parent engine is the highest in the group/family – i.e. CO_2 emission, which is in the trade-off relationship with NO_X emission, can be lower than the other engines in the group/family.

4.2.5 For ships to which regulation 21 of MARPOL Annex VI applies, the power curves used for the preliminary verification at the design stage should be based on reliable results of tank tests. A tank test for an individual ship may be omitted based on technical justifications such as availability of the results of tank tests for ships of the same type. In addition, the omission of tank tests is acceptable for a ship for which sea trials will be carried out under the condition as specified in paragraph 2.2.2 of the EEDI Calculation Guidelines, upon agreement of the shipowner and shipbuilder and with the approval of the verifier. To ensure the quality of tank tests, the ITTC quality system should be taken into account. Model tank tests should be witnessed by the verifier.

> **Note:** It would be desirable in the future that an organization conducting a tank test be authorized.

4.2.6 The verifier may request further information from the submitter, in addition to that contained in the EEDI Technical File, as necessary, to examine the calculation process of the attained EEDI. For the estimation of the ship speed at the design stage much depends on each shipbuilder's experience, and it may not be practicable for any person/organization other than the shipbuilder to fully examine the technical aspects of experience-based parameters, such as the roughness coefficient and wake scaling coefficient. Therefore, the preliminary verification should focus on the calculation process of the attained EEDI to ensure that it is technically sound and reasonable and follows regulation 20 of MARPOL Annex VI and the EEDI Calculation Guidelines.

> **Note 1:** A possible way forward for more robust verification is to establish a standard methodology of deriving the ship speed from the outcome of tank tests, by setting standard values for experience-based correction factors such as roughness coefficient and wake scaling coefficient. In this way, ship-by-ship performance comparisons could be made more objectively by excluding the possibility of arbitrary setting of experience-based parameters. If such standardization is sought, this would have an implication on how the ship speed adjustment based on sea trial results should be conducted, in accordance with paragraph 4.3.8 of these Guidelines.
>
> **Note 2:** A joint industry standard to support the method and role of the verifier is expected to be developed.

4.2.7 Additional information that the verifier may request the submitter to provide includes, but is not limited to:

.1 descriptions of a tank test facility; this should include the name of the facility, the particulars of tanks and towing equipment, and the records of calibration of each monitoring equipment;

.2 lines of a model ship and an actual ship for the verification of the appropriateness of the tank test; the lines (sheer plan, body plan and half-breadth plan) should be detailed enough to demonstrate the similarity between the model ship and the actual ship;

.3 lightweight of the ship and displacement table for the verification of the deadweight;

.4 detailed report on the method and results of the tank test; this should include at least the tank test results at sea trial condition and under the condition as specified in paragraph 2.2.2 of the EEDI Calculation Guidelines;

.5 detailed calculation process of the ship speed, which should include the basis for the estimation of experience-based parameters such as roughness coefficient and wake scaling coefficient;

.6 reasons for exempting a tank test, if applicable; this should include lines and tank test results of ships of the same type, and the comparison of the principal particulars of such ships and the ship in question. Appropriate technical justification should be provided, explaining why the tank test is unnecessary; and

.7 for LNG carriers, detailed calculation process of P_{AE} and $SFC_{SteamTurbine}$.

4.2.8 The verifier should issue the report on the Preliminary Verification of the EEDI after it has verified the attained EEDI at the design stage, in accordance with paragraphs 4.1 and 4.2 of these Guidelines.

4.3 Final verification of the attained EEDI at sea trial

4.3.1 Sea trial conditions should be set as the conditions specified in paragraph 2.2.2 of the EEDI Calculation Guidelines, if possible.

4.3.2 Prior to the sea trial, the following documents should be submitted to the verifier: a description of the test procedure to be used for the speed trial, the final displacement table and the measured lightweight, or a copy of the survey report of deadweight, as well as a copy of the NO_X Technical File, as necessary. The test procedure should include, as a minimum, descriptions of all necessary items to be measured and corresponding measurement methods to be used for developing power curves under the sea trial condition.

4.3.3 The verifier should attend the sea trial and confirm:

.1 propulsion and power supply system, particulars of the engines or steam turbines, and other relevant items described in the EEDI Technical File;

.2 draught and trim;

.3 sea conditions;

.4 ship speed; and

.5 shaft power and RPM.

4.3.4 Draught and trim should be confirmed by the draught measurements taken prior to the sea trial. The draught and trim should be as close as practical to those at the assumed conditions used for estimating the power curves.

4.3.5 Sea conditions should be measured in accordance with ITTC Recommended Procedure 7.5-04-01-01.1 Speed and Power Trials 2017 or ISO 15016:2015.

4.3.6 Ship speed should be measured in accordance with ITTC Recommended Procedure 7.5-04-01-01.1 Speed and Power Trials 2017 or ISO 15016:2015, and at more than two points of which range includes the power of the main engine as specified in paragraph 2.2.5 of the EEDI Calculation Guidelines.

4.3.7 The main engine output, shaft power of propeller shaft (for LNG carriers having diesel electric propulsion system) or steam turbine output (for LNG carrier having steam turbine propulsion system) should be measured by shaft power meter or a method which the engine manufacturer recommends and the verifier approves. Other methods may be acceptable upon agreement of the shipowner and shipbuilder and with the approval of the verifier.

4.3.8 The submitter should develop power curves based on the measured ship speed and the measured output of the main engine at sea trial. For the development of the power curves, the submitter should calibrate the measured ship speed, if necessary, by taking into account the effects of wind, current, waves, shallow water, displacement, water temperature and water density in accordance with ITTC Recommended Procedure 7.5-04-01-01.2 Speed and Power Trials 2017 or ISO 15016:2015. Upon agreement with the shipowner, the submitter should submit a report on the speed trials including details of the power curve development to the verifier for verification.

4.3.9 The submitter should compare the power curves obtained as a result of the sea trial and the estimated power curves at the design stage. In case differences are observed, the attained EEDI should be recalculated, as necessary, in accordance with the following:

.1 for ships for which sea trial is conducted under the condition as specified in paragraph 2.2.2 of the EEDI Calculation Guidelines: the attained EEDI should be recalculated using the measured ship speed at sea trial at the power of the main engine as specified in paragraph 2.2.5 of the EEDI Calculation Guidelines; and

.2 for ships for which sea trial cannot be conducted under the condition as specified in paragraph 2.2.2 of the EEDI Calculation Guidelines: if the measured ship speed at the power of the main engine as specified in paragraph 2.2.5 of the EEDI Calculation Guidelines at the sea trial conditions is different from the expected ship speed on the power curve at the corresponding condition, the shipbuilder should recalculate the attained EEDI by adjusting ship speed under the condition as specified in paragraph 2.2.2 of the EEDI Calculation Guidelines by an appropriate correction method that is agreed by the verifier.

.3 An example of the scheme of conversion from trial condition to EEDI condition at EEDI power is given as follows:

V_{ref} is obtained from the results of the sea trials at trial condition using the speed-power curves predicted by the tank tests. The tank tests shall be carried out at both draughts: trial condition corresponding to that of the S/P trials and EEDI condition. For trial conditions the power ratio α_P between model test prediction and sea trial result is calculated for constant ship speed. Ship speed from model test prediction for EEDI condition at EEDI power multiplied with α_P is V_{ref}.

$$\alpha_P = \frac{P_{Trial,P}}{P_{Trial,S}}$$

where:

$P_{Trial,P}$: power at trial condition predicted by the tank tests

$P_{Trial,S}$: power at trial condition obtained by the S/P trials

α_P: power ratio

.4 Figure 2 shows an example of the scheme of conversion to derive the resulting ship speed at EEDI condition (V_{ref}) at EEDI power.

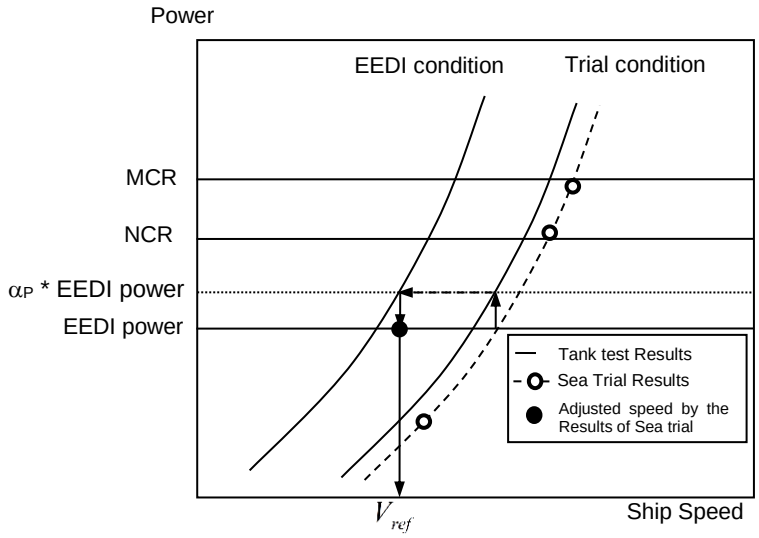


Figure 2: An example of scheme of conversion from trial condition to EEDI condition at EEDI power

Note: Further consideration would be necessary for speed adjustment methodology in paragraphs 4.3.9.2 to 4.3.9.4 of these Guidelines. One of the concerns relates to a possible situation where the power curve for sea trial condition is estimated in an excessively conservative manner (i.e. power curve is shifted in a leftward direction) with the intention to get an upward adjustment of the ship speed by making the measured ship speed at sea trial easily exceed the lower-estimated speed for sea trial condition at design stage.

4.3.10 In cases where the finally determined deadweight/gross tonnage differs from the designed deadweight/gross tonnage used in the EEDI calculation during the preliminary verification, the submitter should recalculate the attained EEDI using the finally determined deadweight/gross tonnage. The finally determined gross tonnage should be confirmed in the Tonnage Certificate of the ship.

4.3.11 The electrical efficiency $\eta_{(i)}$ should be taken as 91.3% for the purpose of calculating the attained EEDI. Alternatively, if a value of more than 91.3% is to be applied, $\eta_{(i)}$ should be obtained by measurement and verified by a method approved by the verifier.

4.3.12 In case where the attained EEDI is calculated at the preliminary verification by using *SFC* based on the manufacturer's test report, due to the non-availability at that time of the approved NO_X Technical File, the EEDI should be recalculated by using *SFC* in the approved NO_X Technical File. Also, for steam turbines, the EEDI should be recalculated by using *SFC* confirmed by the Administration, or an organization recognized by the Administration, at the sea trial.

4.3.13 The EEDI Technical File should be revised, as necessary, by taking into account the results of sea trials. Such revision should include, as applicable, the adjusted power curve based on the results of sea trials (namely, modified ship speed under the condition as specified in paragraph 2.2.2 of the EEDI Calculation Guidelines), the finally determined deadweight/gross tonnage, η for LNG carriers having diesel electric propulsion system and *SFC* described in the approved NO_X Technical File, and the recalculated attained EEDI based on these modifications.

4.3.14 The EEDI Technical File, if revised, should be submitted to the verifier for confirmation that the (revised) attained EEDI is calculated in accordance with regulation 20 of MARPOL Annex VI and the EEDI Calculation Guidelines.

4.4 Verification of the attained EEDI in case of major conversion

4.4.1 In cases of a major conversion of a ship, the shipowner should submit to a verifier an application for an additional survey with the EEDI Technical File duly revised, based on the conversion made and other relevant background documents.

4.4.2 The background documents should include as a minimum, but are not limited to:

.1 details of the conversion;

.2 EEDI parameters changed after the conversion and the technical justifications for each respective parameter;

.3 reasons for other changes made in the EEDI Technical File, if any; and

.4 calculated value of the attained EEDI with the calculation summary, which should contain, as a minimum, each value of the calculation parameters and the calculation process used to determine the attained EEDI after the conversion.

4.4.3 The verifier should review the revised EEDI Technical File and other documents submitted and verify the calculation process of the attained EEDI to ensure that it is technically sound and reasonable and follows regulation 20 of MARPOL Annex VI and the EEDI Calculation Guidelines.

4.4.4 For verification of the attained EEDI after a conversion, speed trials of the ship are required, as necessary.

APPENDIX 1

SAMPLE OF EEDI TECHNICAL FILE

1 Data

1.1 General information

Shipbuilder	JAPAN Shipbuilding Company
Hull no.	12345
IMO no.	94111XX
Ship type	Bulk carrier

1.2 Principal particulars

Length overall	250.0 m
Length between perpendiculars	240.0 m
Breadth, moulded	40.0 m
Depth, moulded	20.0 m
Summer load line draught, moulded	14.0 m
Deadweight at summer load line draught	150,000 tons

1.3 Main engine

Manufacturer	JAPAN Heavy Industries Ltd.
Type	6J70A
Maximum continuous rating (MCR)	15,000 kW x 80 rpm
SFC at 75% MCR	165.0 g/kWh
Number of sets	1
Fuel type	Diesel Oil

1.4 Auxiliary engine

Manufacturer	JAPAN Diesel Ltd.
Type	5J-200
Maximum continuous rating (MCR)	600 kW x 900 rpm
SFC at 50% MCR	220.0 g/kWh
Number of sets	3
Fuel type	Diesel Oil

1.5 Ship speed

Ship speed in deep water at summer load line draught at 75% of MCR	14.25 knots

2 Power curves

The power curves estimated at the design stage and modified after the speed trials are shown in figure 2.1.

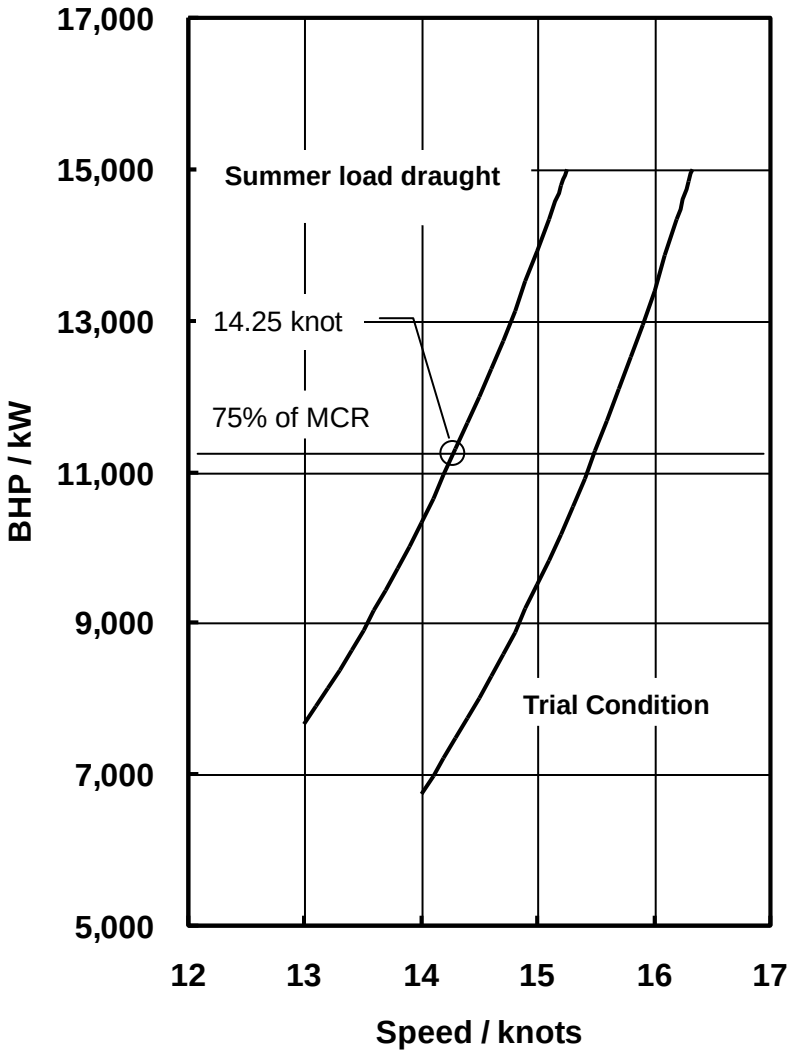


Figure 2.1: Power curves

3 Overview of propulsion system and electric power supply system

3.1 Propulsion system

3.1.1 Main engine
Refer to paragraph 1.3 of this appendix.

3.1.2 Propeller

Type	Fixed pitch propeller
Diameter	7.0 m
Number of blades	4
Number of sets	1

3.2 Electric power supply system

3.2.1 Auxiliary engines
Refer to paragraph 1.4 of this appendix.

3.2.2 Main generators

Manufacturer	JAPAN Electric
Rated output	560 kW (700 kVA) x 900 rpm
Voltage	AC 450 V
Number of sets	3

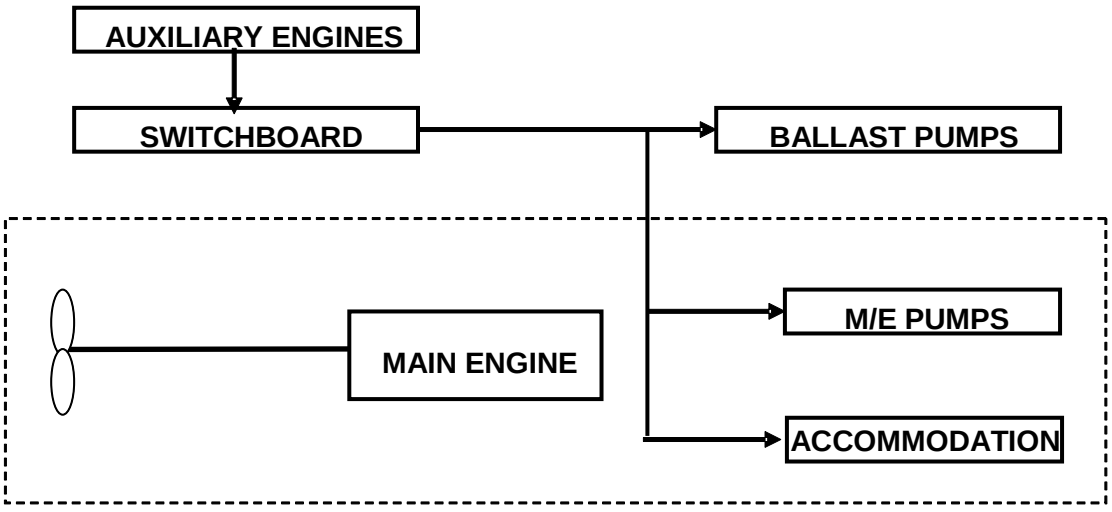


Figure 3.1: Schematic figure of propulsion and electric power supply system

4 Estimation process of power curves at design stage

Power curves are estimated based on model test results. The flow of the estimation process is shown below.

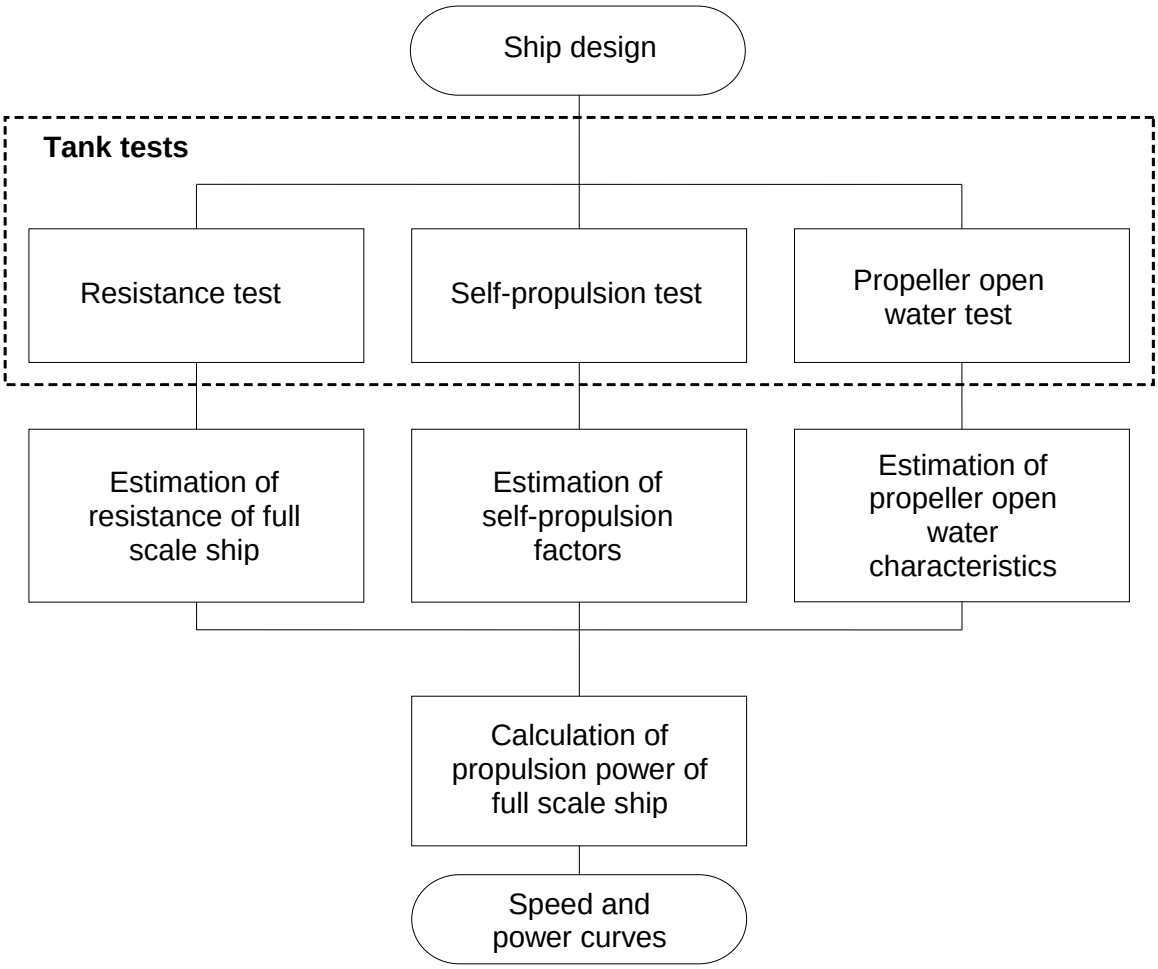


Figure 4.1: Flow-chart of process for estimating power curves

5 Description of energy saving equipment

5.1 Energy saving equipment the effects of which are expressed as $P_{AEeff(i)}$ and/or $P_{eff(i)}$ in the EEDI calculation formula

N/A

5.2 Other energy saving equipment

(Example)

5.2.1 Rudder fins

5.2.2 Propeller boss cap fins

(Specifications, schematic figures and/or photos, etc. for each piece of equipment or device should be indicated. Alternatively, attachment of a commercial catalogue may be acceptable.)

6 Calculated value of attained EEDI

6.1 Basic data

Type of ship	Capacity DWT	Speed V_{ref} (knots)
Bulk Carrier	150,000	14.25

6.2 Main engine

MCR_{ME} (kW)	Shaft gen.	P_{ME} (kW)	Type of fuel	C_{FME}	SFC_{ME} (g/kWh)
15,000	N/A	11,250	Diesel Oil	3.206	165.0

6.3 Auxiliary engines

P_{AE} (kW)	Type of fuel	C_{FAE}	SFC_{AE} (g/kWh)
625	Diesel Oil	3.206	220.0

6.4 Ice class

N/A

6.5 Innovative electrical energy efficient technology

N/A

6.6 Innovative mechanical energy efficient technology

N/A

6.7 Cubic capacity correction factor

N/A

6.8 Calculated value of attained EEDI

$$EEDI = \frac{\left(\prod_{j=1}^{M} f_j\right)\left(\sum_{i=1}^{nME} P_{ME(i)} \cdot C_{FME(i)} \cdot SFC_{ME(i)}\right) + \left(P_{AE} \cdot C_{FAE} \cdot SFC_{AE}\right)}{f_i \cdot f_c \cdot Capacity \cdot f_w \cdot V_{ref}}$$

$$+ \frac{\left\{\left(\prod_{j=1}^{M} f_j \cdot \sum_{i=1}^{nPTI} P_{PTI(i)} - \sum_{i=1}^{neff} f_{eff(i)} \cdot P_{AEeff(i)}\right) C_{FAE} \cdot SFC_{AE}\right\} - \left(\sum_{i=1}^{neff} f_{eff(i)} \cdot P_{eff(i)} \cdot C_{FME} \cdot SFC_{ME}\right)}{f_i \cdot f_c \cdot Capacity \cdot f_w \cdot V_{ref}}$$

$$= \frac{1 \times (11250 \times 3.206 \times 165.0) + (625 \times 3.206 \times 220.0) + 0 - 0}{1 \cdot 1 \cdot 150000 \cdot 1 \cdot 14.25}$$

$$= 2.99 \quad (\mathrm{g - CO_2/ton \cdot mile})$$

attained EEDI: 2.99 g-CO_2/ton mile

7 Calculated value of attained $EEDI_{weather}$

7.1 Representative sea conditions

	Mean wind speed	Mean wind direction	Significant wave height	Mean wave period	Mean wave direction
BF6	12.6 (m/s)	0 (deg.)*	3.0 (m)	6.7 (s)	0 (deg.)*

* Heading direction of wind/wave in relation to the ship's heading, i.e. 0 (deg.) means the ship is heading directly into the wind.

7.2 Calculated weather factor, f_w

f_w	0.900

7.3 Calculated value of attained $EEDI_{weather}$

attained $EEDI_{weather}$: 3.32 g-CO_2/ton mile

APPENDIX 2

GUIDELINES FOR VALIDATION OF ELECTRIC POWER TABLES FOR EEDI (EPT-EEDI)

1 INTRODUCTION

The purpose of these Guidelines is to assist recognized organizations in the validation of Electric Power Tables (EPT) for the calculation of the Energy Efficiency Design Index (EEDI) for ships. As such, these Guidelines support the implementation of the EEDI Calculation Guidelines and the *Guidelines on survey and certification of the Energy Efficiency Design Index (EEDI)*. These Guidelines will also assist shipowners, shipbuilders, ship designers and manufacturers in relation to aspects of the development of more energy efficient ships and also in understanding the procedures for the EPT-EEDI validation.

2 OBJECTIVES

These Guidelines provide a framework for the uniform application of the EPT-EEDI validation process for ships for which required auxiliary engine power is calculated under paragraph 2.2.5.7 of the EEDI Calculation Guidelines.

3 DEFINITIONS

3.1 *Applicant* means an organization, primarily a shipbuilder or a ship designer, which requests the EPT-EEDI validation in accordance with these Guidelines.

3.2 *Validator* means a recognized organization which conducts the EPT-EEDI validation in accordance with these Guidelines.

3.3 *Validation* for the purpose of these Guidelines means review of submitted documents and survey during construction and sea trials.

3.4 *Standard EPT-EEDI-Form* refers to the layout given in appendix 3, containing the EPT-EEDI results that will be the subject of validation. Other supporting documents submitted for this purpose will be used as reference only and will not be subject to validation.

3.5 P_{AE} herein is defined as per the definition in paragraph 2.2.5.6 of the EEDI Calculation Guidelines.

3.6 *Ship service and engine-room loads* refer to all the load groups which are needed for the hull, deck, navigation and safety services, propulsion and auxiliary engine services, engine-room ventilation and auxiliaries and ship's general services.

3.7 *Diversity factor* is the ratio of the "total installed load power" and the "actual load power" for continuous loads and intermittent loads. This factor is equivalent to the product of service factors for load, duty and time.

4 APPLICATION

4.1 These Guidelines are applicable to ships as stipulated in paragraph 2.2.5.7 of the EEDI Calculation Guidelines.

4.2 These Guidelines should be applied to new ships for which an application for an EPT-EEDI validation has been submitted to a validator.

4.3 The steps of the validation process include:

.1 review of documents during the design stage:

.1 check if all relevant loads are listed in the EPT;

.2 check if reasonable service factors are used; and

.3 check the correctness of the P_{AE} calculation based on the data given in the EPT;

.2 survey of installed systems and components during construction stage:

.1 check if a randomly selected set of installed systems and components are correctly listed with their characteristics in the EPT; and

.3 survey of sea trials:

.1 check if selected units/loads specified in EPT are observed.

5 SUPPORTING DOCUMENTS

5.1 The applicant should provide as a minimum the ship electric balance load analysis.

5.2 Such information may contain shipbuilders' confidential information. Therefore, after the validation, the validator should return all or part of such information to the applicant at the applicant's request.

5.3 A special EEDI condition during sea trials may be needed and defined for each ship and included in the sea trial schedule. For this condition, a special column should be inserted into the EPT.

6 PROCEDURES FOR VALIDATION

6.1 General

P_{AE} should be calculated in accordance with the EPT-EEDI Calculation Guidelines. EPT-EEDI validation should be conducted in two stages: preliminary validation at the design stage and final validation during sea trials. The validation process is presented in figure 6.1.

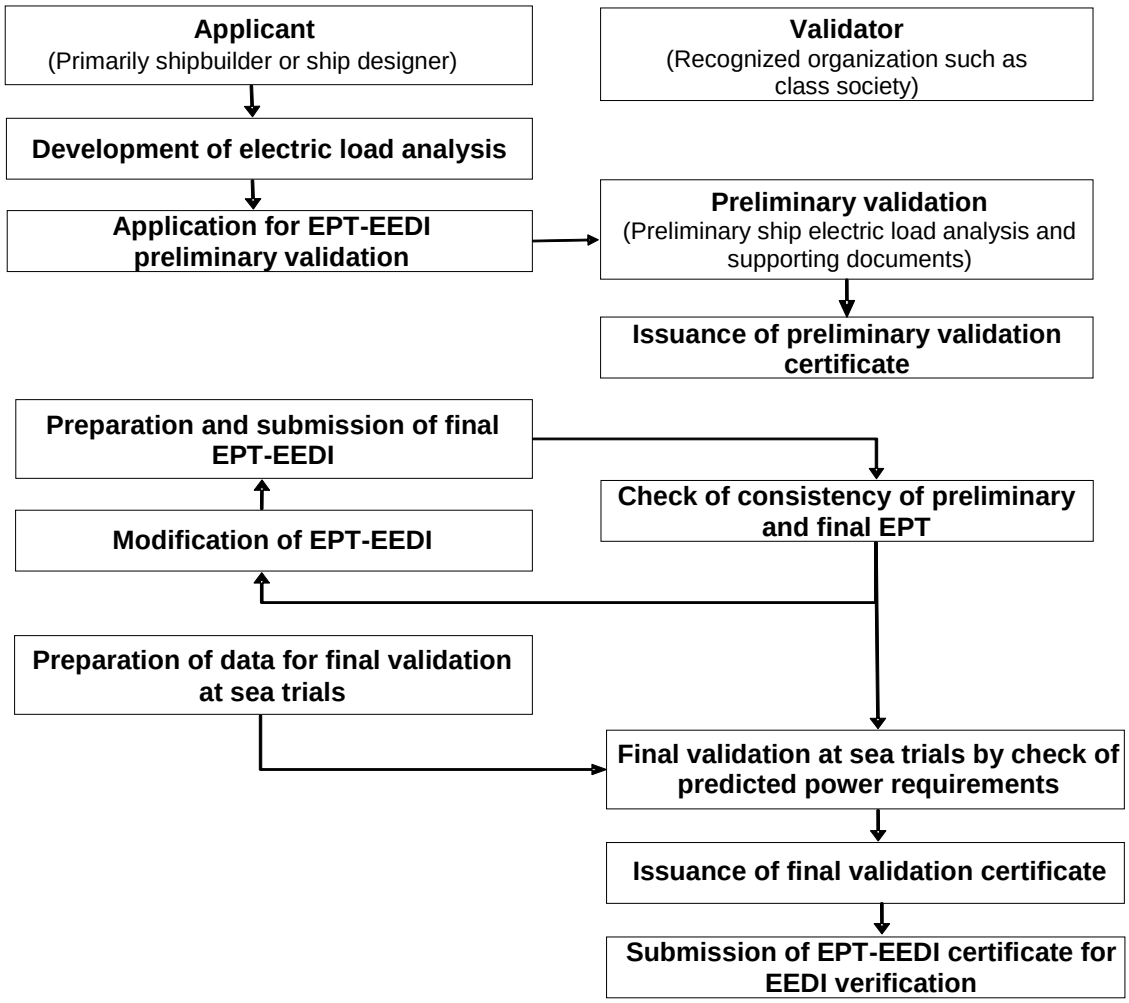


Figure 6.1: Basic flow of EPT-EEDI validation process

6.2 Preliminary validation at the design stage

6.2.1 For the preliminary validation at the design stage, the applicant should submit to a validator an application for the validation of EPT-EEDI, inclusive of the EPT-EEDI Form, and all the relevant and necessary information for the validation as supporting documents.

6.2.2 The applicant should supply as a minimum the supporting data and information, as specified in appendix A (to be developed).

6.2.3 The validator may request from the applicant additional information to that contained in these Guidelines, as necessary, to enable the validator to examine the calculation process of the EPT-EEDI. The estimation of the ship EPT-EEDI at the design stage depends on each applicant's experience, and it may not be practicable to fully examine the technical aspects and details of each machinery component. Therefore, the preliminary validation should focus on the calculation process of the EPT-EEDI that should follow best marine practices.

> **Note:** A possible way forward for more robust validation is to establish a standard methodology of deriving the ship EPT by setting standard formats as agreed and used by industry.

6.3 Final validation

6.3.1 The final validation process should as a minimum include a check of the ship electric load analysis to ensure that all electric consumers are listed. Their specific data and the calculations in the power table itself are correct and are supported by sea trial results. If necessary, additional information has to be requested.

6.3.2 For the final validation, the applicant should revise the EPT-EEDI Form and supporting documents as necessary, by taking into account the characteristics of the machinery and other electrical loads actually installed on board the ship. The EEDI condition at sea trials should be defined and the expected power requirements in these conditions documented in the EPT. Any changes within the EPT from design stage to construction stage should be highlighted by the shipyard.

6.3.3 The preparation for the final validation includes a desk top check comprising:

.1 consistency of preliminary and final EPT;

.2 changes of service factors (compared to the preliminary validation);

.3 all electric consumers are listed;

.4 their specific data and the calculations in the power table itself are correct; and

.5 in case of doubt, component specification data is checked in addition.

6.3.4 A survey prior to sea trials is performed to ensure that machinery characteristics and data as well as other electric loads comply with those recorded in the supporting documents. This survey does not cover the complete installation but selects randomly a number of samples.

6.3.5 For the purpose of sea trial validation, the surveyor will check the data of selected systems and/or components given in the special column added to the EPT for this purpose or the predicted overall value of electric load by means of practicable measurements with the installed measurement devices.

7 ISSUANCE OF THE EPT-EEDI STATEMENT OF VALIDATION

7.1 The validator should stamp the EPT-EEDI Form as "Noted" having validated the EPT-EEDI in the preliminary validation stage, in accordance with these Guidelines.

7.2 The validator should stamp the EPT-EEDI Form as "Endorsed" having validated the final EPT-EEDI in the final validation stage in accordance with these Guidelines.

APPENDIX 3

ELECTRIC POWER TABLE FORM FOR ENERGY EFFICIENCY DESIGN INDEX (EPT-EEDI FORM) AND STATEMENT OF VALIDATION

Ship ID:
IMO no.: _____
Ship's name: _____
Shipyard: _____
Hull no.: _____

Applicant:

Name: _____
Address: _____
_____

Validation stage:

☐ Preliminary validation

☐ Final validation

Summary results of EPT-EEDI

Load group	Seagoing condition EEDI Calculation guidelines		Remarks
	Continuous load (kW)	Intermittent load (kW)	
Ship service and engine-room loads			
Accommodation and cargo loads			
Total installed load			
Diversity factor			
Normal seagoing load			
Weighted average efficiency of generators			
P_{AE}			

Supporting documents

Title	ID or remarks

Validator details:
Organization: _____
Address: _____
_____

This is to certify that the above-mentioned electrical loads and supporting documents have been reviewed in accordance with EPT-EEDI Validation Guidelines and the review shows a reasonable confidence for use of the above P_{AE} in EEDI calculations.

Date of review: _____ Statement of validation no. _____

This statement is valid on condition that the electric power characteristics of the ship do not change.

Signature of Validator

_____
Printed name:

_____

INTERNATIONAL MARITIME ORGANIZATION

E

4 ALBERT EMBANKMENT
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MEPC.1/Circ.878
9 November 2018

GUIDANCE ON THE DEVELOPMENT OF A SHIP IMPLEMENTATION PLAN FOR THE CONSISTENT IMPLEMENTATION OF THE 0.50% SULPHUR LIMIT UNDER MARPOL ANNEX VI

1 The Marine Environment Protection Committee, at its seventy-third session (22 to 26 October 2018), approved the *Guidance on the development of a ship implementation plan for the consistent implementation of the 0.50% sulphur limit under MARPOL Annex VI*, as set out in the annex.

2 Member Governments are invited to bring the annexed Guidance to the attention of their Administration, industry, relevant shipping organizations, shipping companies and other stakeholders concerned.

***

ANNEX

GUIDANCE ON THE DEVELOPMENT OF A SHIP IMPLEMENTATION PLAN FOR THE CONSISTENT IMPLEMENTATION OF THE 0.50% SULPHUR LIMIT UNDER MARPOL ANNEX VI

Introduction

1 MEPC 70 agreed to "1 January 2020" as the effective date of implementation for ships to comply with global 0.50% m/m sulphur content of fuel oil requirement and adopted resolution MEPC.280(70) on the *Effective date of implementation of the fuel oil standard in regulation 14.1.3 of MARPOL Annex VI*[1].

2 In this context, MEPC 73 agreed that Administrations should encourage ships flying their flag to develop implementation plans, outlining how the ship may prepare in order to comply with the required sulphur content limit of 0.50% by 1 January 2020. The plan could be complemented with a record of actions taken by the ship in order to be compliant by the applicable date.

3 Regulation 18.2.3 of MARPOL Annex VI requires a Party to take into account all relevant circumstances and the evidence presented to determine the action to take, including not taking control measures. Administrations and port State control authorities may take into account the implementation plan when verifying compliance with the 0.50% sulphur limit requirement.

4 A ship implementation plan is not a mandatory requirement. A lack of a ship implementation plan or an incomplete ship implementation plan should not be considered as "clear grounds" for a more detailed inspection.

Ship implementation plan for the consistent implementation of 0.50% sulphur limit under MARPOL Annex VI

5 The ship implementation plan for 2020 could cover various items relevant for the specific ship, including, as appropriate, but not limited to:

.1 risk assessment and mitigation plan (impact of new fuels);

.2 fuel oil system modifications and tank cleaning (if needed);

.3 fuel oil capacity and segregation capability;

.4 procurement of compliant fuel;

.5 fuel oil changeover plan (conventional residual fuel oils to 0.50% sulphur compliant fuel oil); and

.6 documentation and reporting.

[1] Amendments to regulation 14.1.3 of MARPOL Annex VI were adopted by MEPC 73 (October 2018).

Issues relating to use of sulphur compliant fuel oil

6 All fuel oil supplied to a ship shall comply with regulation 18.3 of MARPOL Annex VI and chapter II/2 of SOLAS. Furthermore, ship operators could consider ordering fuel oil specified in accordance with the ISO 8217 marine fuel standard. The following potential fuel-related issues may need to be assessed and addressed by ships in preparation for and implementation of the 0.50% sulphur limit requirement:

.1 technical capability of ships to handle different types of fuel (e.g. suitability of fuel pumps to handle both higher and lower viscosity fuels, restrictions on fuels suitable for use in a ship's boilers, particularly the use of distillate fuels in large marine boilers);

.2 compatibility of different types of fuels e.g. when paraffinic and aromatic fuels containing asphaltenes are commingled in bunkering or fuel oil changeover;

.3 handling sulphur non-compliant fuels in the event of non-availability of sulphur compliant fuels; and

.4 crew preparedness including possible training with changeover procedures during fuel switching from residual fuel oil to 0.50% compliant fuel oils.

7 The ship implementation plan could be used as the appropriate tool to identify any specific safety risks related to sulphur compliant fuel oil, as may be relevant to the ship, and to develop an appropriate action plan for the Company to address and mitigate the concerns identified. Examples should include:

.1 procedures to segregate different types of fuel and fuels from different sources;

.2 detailed procedures for compatibility testing and segregating fuels from different sources until compatibility can be confirmed;

.3 procedures to changeover from one type of fuel to another or a fuel oil that is known to be incompatible with another fuel oil;

.4 plans to address any mechanical constraints with respect to handling specific fuels, including ensuring that minimum/maximum characteristics of fuel oil as identified in ISO 8217 can be safely handled on board the ship; and

.5 procedures to verify machinery performance on fuel oil with characteristics with which the ship does not have prior experience.

8 A ship implementation plan for the consistent implementation of the 0.50% sulphur limit under MARPOL Annex VI is recommended to be developed based on the indicative example as set out in appendix 1.

9 The plan could take into account the issues identified in:

.1 appendix 2: additional guidance on development of ship implementation plan (impact on machinery systems); and

.2 appendix 3: additional guidance on development of ship implementation plan (tank cleaning).

APPENDIX 1

INDICATIVE EXAMPLE FOR SHIP IMPLEMENTATION PLAN FOR ACHIEVING COMPLIANCE WITH THE 0.50% SULPHUR LIMIT ENTERING INTO FORCE ON 1 JANUARY 2020 USING COMPLIANT FUEL OIL ONLY

Particulars of ship

1. Name of ship:

2. Distinctive number or letters:

3. IMO Number:

Planning and preparation (before 1 January 2020)

1 Risk assessment and mitigation plan

1.1 Risk assessment (impact of new fuels): YES/NO
1.2 Linked to onboard SMS YES/NO

2 Fuel oil system modifications and tank cleaning (if needed)

2.1 Schedule for meeting with manufacturers and/or classification societies:

2.2 Structural Modifications (installation of fuel oil systems/tankage) required: YES/NO/NOT APPLICABLE

If YES, then:

2.2.1 Fuel oil storage system:

Description of modification:

Details of yard booking (as applicable), time schedules etc.:

Estimated date of completion of modification:

2.2.2 Fuel transfer, filtration and delivery systems:

Description of modification:

Details of yard booking (as applicable), time schedules etc.:

Estimated date of completion of modification:

2.2.3 Combustion equipment:

Description of modification:

Details of yard booking (as applicable), time schedules etc.:

Estimated date of completion of modification:

2.3 Tank cleaning required: YES/NO/NOT APPLICABLE

If YES, then:

Details of cleaning schedule (including, yard booking, time schedules etc., if applicable):

Estimated date of completion of cleaning:

3 Fuel oil capacity and segregation capability:

Following any required modifications as per Section 2:

3.1 Expected number of bunker tanks designated to store 0.50% sulphur compliant fuel oil:

3.2 Expected total storage capacity (m^3) for 0.50% sulphur compliant fuel oil:

3.3 Expected number of bunker tanks designated to store 0.10% sulphur compliant fuel oil:

3.4 Expected total storage capacity (m^3) for 0.10% sulphur compliant fuel oil:

3.5 Approximate total fuel oil content (m^3) in the fuel oil transfer, purification and delivery systems:

4 Procurement of compliant fuel oil

4.1 Details of fuel purchasing procedure to source compliant fuels, including procedures in cases where compliant fuel oil is not readily available:

4.2 Estimated date for bunkering compliant fuel oil, not later than 24:00hrs 31 December 2019:

4.3 If fuel arranged by charterer, is there an intention to accept charter party contracts that do not have a specified obligation to provide compliant fuel oil after 1 June 2019 or other date to be identified: YES/NO

If YES, then:

Details of alternate steps taken to ensure that the charter party provides timely delivery of compliant fuel:

4.4 Is there confirmation from bunker supplier(s) to provide compliant fuel oil on the specified date: YES/NO

If NO, then:
Details of alternate steps taken to ensure timely availability of compliant fuel oil:

4.5 Details of arrangements (if any planned) to dispose of any remaining non-compliant fuel oil:

5 Fuel oil changeover plan

5.1 Consider whether a ship-specific fuel changeover plan is to be made available. The plan should include measures to offload or consume any remaining non-compliant fuel oil. The plan should also demonstrate how the ship intends to ensure that all its combustion units will be using compliant fuel oil no later than 1 January 2020.

5.2 As per the ship-specific fuel changeover plan, the maximum time period required to changeover the ship's fuel oil system to use compliant fuel oil at all combustion units:

5.3 Expected date and approximate time of completion of the above-mentioned changeover procedure:

5.4 Consider availability of adequately trained officers and crew familiar with the ship's fuel system and fuel changeover procedures to carry out the fuel oil changeover procedure. If this cannot be confirmed, then consider whether there is a sufficient amount of time dedicated for ship-specific familiarization and training of new officers and crew.

6 Documentation and reporting

6.1 If there are modifications planned as per section 2, related documents including the shipboard fuel oil tank management plans and stability and trim booklets should be consequently updated.

6.2 The implementation plan could be kept on board and updated as applicable.

6.3 If when following the implementation plan the ship has to bunker and use non-compliant fuel oil due to unavailability of compliant fuel oil safe for use on board the ship, steps to limit the impact of using non-compliant fuel oil could be:

6.4 The ship should have a procedure for Fuel Oil Non-Availability Reporting (FONAR). The master and chief engineer should be conversant about when and how FONAR should be used and who it should be reported to.

APPENDIX 2

ADDITIONAL GUIDANCE FOR DEVELOPMENT OF THE SHIP IMPLEMENTATION PLAN (IMPACT ON MACHINERY SYSTEMS)

1 Ships are advised to assess potential impact on machinery systems with the use of distillates and fuel oil blends and prepare ships in consultation with chief engineers, equipment manufacturers and suppliers.

2 The ship tank configuration and fuel system may require adjustments. A fully segregated fuel system for distillate fuels and blended fuels is recommended because they may require special attention. Ship tank configuration and segregated fuel system will also allow for better management of potentially incompatible fuels.

Distillates

3 If distillates have been chosen as the option for compliance the following may be considered:

.1 a decrease in fuel oil viscosity may cause an increase in fuel oil leakage between the fuel pump plunger and barrel of diesel engines. Internal leakages in the fuel injection system may result in reduced fuel pressure to the engine, which may have consequences for the engine performance (e.g. starting of the engine). Equipment makers' recommendations should be consulted, and adequate testing, maintenance and possible installation of coolers etc. may be performed;

.2 shipowners may also consider installing fuel pumps and injection nozzles, suitable to fuel oil with low viscosity. Fuel oil with too low viscosity may lead to increased wear or seizure of fuel oil pumps. Engine and boilermakers should be consulted to ensure its safe and efficient operation. Implications for validity of NO_X certification (EIAPP Certificate) should be considered;

.3 while some compliant fuels may not require heating, others, including some distillates, will require heating. It would therefore be prudent to review heating arrangements for distillate fuels on board and, where appropriate, maintain the existing heating arrangements; and

.4 in some locations, bunker suppliers may only be able to offer automotive diesel fuel containing biodiesel (FAME) in accordance with the ISO 8217-2017 Standard which provides a marine biodiesel specification (DFA/DFB) with up to 7.0% by volume of FAME. CIMAC has provided a "Guideline for Ship Owners and Operators on Managing Distillate Fuels up to 7.0 % v/v Fame (Biodiesel)".[2]

4 In view of paragraph 3.3 manufacturers of engines and equipment such as oily water separators, overboard discharge monitors, filters and coalescers, etc. need to be consulted to confirm ability to handle biodiesel blends up to 7% v/v.

5 Also, some parts of the fuel oil supply system, i.e. fuel pumps, pipefittings and gaskets may need to be overhauled to ensure integrity.

[2] https://www.cimac.com/cms/upload/workinggroups/WG7/CIMAC_WG7_Guideline_for_Ship_Owners_and_Operators_on_Managing_Distillate_Fuels_May_2013.pdf

Blended residual fuels

6 New blended 0.50% sulphur fuel oil as and when offered could provide an alternative to conventional distillate fuel such as Marine Distillate Fuel.

7 When using such new blended sulphur fuel oils, the technical specification of such fuels are (a) either within the limits specified by ISO 8217 or are (b) issued with formal documentation indicating no objection to its use by the engine/boiler makers.

8 Before purchasing a new fuel oil product, operators should carefully consider the specific technical and operational challenges that this type of fuel oil may have and, where necessary, contact the fuel oil supplier or Original Equipment Manufacturer (OEM) for the considerations to be made to ensure safe operation.

9 Densities of these fuel oils are in general lower than conventional residual fuel oils. This may require adjustment of centrifuges to ensure adequate cleaning of the fuel oil.

Cold flow

10 Since most distillate fuels do not require heating (in fact, typically, heating is not recommended due to the low viscosity of these products), the fuel's cold flow properties become a potential handling/storage challenge, especially when operating in colder regions.

11 It is however possible to successfully manage cold flow properties through good fuel management, from procurement to technical operation, by considering the following:

.1 where the ship will be operating;

.2 where the risk is higher of getting fuels with poor cold flow properties;

.3 can the required cold flow properties be specified in the fuel contract;

.4 what is the actual low-temperature flow properties of the bunkered fuel; and

.5 which actions have to be taken in order to safely consume the bunkered fuel (e.g. tank and filter heating).

APPENDIX 3

ADDITIONAL GUIDANCE FOR DEVELOPMENT OF THE SHIP IMPLEMENTATION PLAN (TANK CLEANING)

Introduction

1 Most ships will have been using high viscosity high sulphur fuel oil (HSFO) based primarily on residual fuel oils. Such fuels tend to adhere to the inside of fuel tanks forming layers of semi-solid substances containing sediments and asphaltenic sludge; such residues will also typically have solidified and settled in various parts of the fuel oil service system including pipelines, settling and service tanks.

2 The ship operator may choose to clean the fuel oil tanks of these residues before loading compliant fuel prior to 1 January 2020 based on the following considerations.

3 Some of the fuels complying with the 0.50% sulphur limit are expected to be very paraffinic due to crude sources of blending components and also a high content of distillate components. If such fuels are loaded into HSFO fuel tanks that have not been cleaned, there is a possibility that they could dissolve and dislodge sediments and asphaltenic sludge in storage tanks, settling tanks and pipelines, potentially leading to purifier and filter operational issues and in extreme cases fuel starvation resulting in loss of power.

4 Alternatively, ships have been using ship specific changeover procedures to effectively and safely load on top of existing fuel oil and gradually flushing through the fuel system until the sulphur content in the fuel oil is at a compliant level.

5 Should the ship operator determine it is appropriate to clean the ship's fuel oil tanks and system, the following considerations may need to be taken into account when making arrangements for tank cleaning.

Options for tank cleaning, approximate timelines and considerations

6 Fuel oil tanks are normally cleaned on a regular basis on ships to remove built-up sediments and sludge, usually during dry docking and whenever inspections of the fuel tanks are due. However, leading up to 1 January 2020, it would not be practicable for the majority of the global fleet that has been running on HSFO and decided to opt for tank cleaning to undergo dry docking during a very short period. Hence, other options for cleaning tanks and fuel oil systems during service may need to be considered.

7 The time and work involved in cleaning HSFO tanks cannot be defined precisely, as it will vary depending on how long it has been since the last time the tanks were cleaned, the condition of the tank coating and the effectiveness of the cleaning process itself. The estimates in this document may err on the side of caution as it is almost impossible to pinpoint at what stage the ship's fuel oil system is sufficiently clean to guarantee compliance.

Manual cleaning during dry docking

8 Time required varies; it can be done in 2 to 4 days per tank. In addition to cleaning tanks, all of the pipework in the fuel oil service system needs to be flushed through. Overall, it may take 1 to 2 weeks.

9 A ship that has had all its fuel oil tanks and fuel system cleaned can start loading compliant fuels and expect to be fully compliant right away.

10 However, if only the tanks have been cleaned in dry dock, it could take 2 to 5 days to flush through the pipework in the fuel oil service system to ensure full compliance with the 0.50% sulphur limit.

Manual cleaning during service

11 If tanks are to be cleaned manually during service, risk assessment and safety measures are paramount; refer to IMO resolution A.1050(27) on *Revised recommendations for entering enclosed spaces aboard ships*.

12 Time required will vary depending on tank size and the number of tanks, how long it has been since the last tank cleaning and the number of crew available to perform safe and complete tank cleaning operations. Tank cleaning can be performed by the ship's crew and/or by employing a riding crew for this purpose. It is always good practice to inspect the tank once cleaned to check its condition and to inspect heating coils, conduct pressure tests and undertake repairs as necessary.

13 If the cleaning is done by the ship's existing crew, it would likely take a minimum of 4 days per tank. For an average tank, a week should be allowed. If employing a riding crew to clean the tanks, if working in shifts, it would likely take a minimum of 2 days to clean a tank, but 4 days per tank should be allowed.

14 Tanks need to be empty before they can be cleaned, hence the time needed to drain tanks needs to be taken into account when estimating the overall time required.

15 In addition to cleaning tanks, all of the pipework in the fuel oil service system needs to be flushed. Flushing the remaining pipework and fuel oil service system after all tanks have been cleaned could take another 1 to 2 days.

16 The residues from tank cleaning should be retained on board until they can be disposed of correctly or disposed to shore reception facilities.

Cleaning tanks in service with specialized additives

17 As an alternative to manual cleaning, consideration can be given to gradually cleaning the sediments and asphaltenic sludge from HSFO tanks and fuel systems by dosing additives. There are successful examples of this approach for ships that needed to reallocate HSFO tanks to fuels complying with the 0.10% sulphur limit that took effect in ECAs in 2015.

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BWM.2/Circ.69
1 November 2018

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

Guidance on System Design Limitations of ballast water management systems and their monitoring

1 The Marine Environment Protection Committee (MEPC), at its seventy-third session (22 to 26 October 2018), approved the *Guidance on System Design Limitations of ballast water management systems and their monitoring* developed by the PPR Sub-Committee at its fifth session (5 to 9 February 2018), as set out in the annex.

2 Member Governments and international organizations are invited to bring the annexed Guidance to the attention of all parties concerned.

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ANNEX

**GUIDANCE ON SYSTEM DESIGN LIMITATIONS
OF BALLAST WATER MANAGEMENT SYSTEMS AND THEIR MONITORING**

1 The purpose of this document is to expand on the information provided in the Code for approval of ballast water management systems (BWMS Code) concerning the inclusion of System Design Limitations (SDL) on the Type Approval Certificates of ballast water management systems (BWMS).

2 With a view to increasing global consistency in the application of SDL and the implementation of self-monitoring, this document also provides recommendations to Administrations and manufacturers of BWMS concerning:

.1 potential SDL for the various types of technologies used in BWMS; and

.2 self-monitoring parameters that may be associated with these SDL.

System Design Limitations approach

3 BWMS used to comply with the Convention are approved by the Administration taking into account the BWMS Code. This Code include standardized tests (e.g. specifying salinity ranges and other challenge water parameters) that are designed to demonstrate the proper function of BWMS in these conditions, and thereby screen out those systems that would not meet the ballast water performance standard described in regulation D-2.

4 However, an approved BWMS might not be appropriate for all ships or all situations. Also, some ships need assurances that BWMS will be capable of operating in conditions that are more challenging than those included in the standardized tests. The SDL approach is intended to complement the standardized tests in the BWMS Code by providing validated information on the conditions for which an individual BWMS is designed. This information is communicated transparently on the Type Approval Certificate to stakeholders, such as the shipowners who are required by the Convention to meet the D-2 standard during every ballast water discharge and crew members who will operate BWMS.

5 SDLs should be identified and validated for each specific BWMS presented for approval. The SDL approach provides a process to identify and provide information to the end user on performance expectations for the system. The SDL approach has two objectives:

.1 to ensure that the performance of the BWMS has been transparently assessed with respect to the known water quality and/or operational parameters that are important to its proper function, including those that may not otherwise be provided for in the Code;

.2 to provide transparent oversight of manufacturer's BWMS performance claims that may go beyond the specific criteria in the Code.

6 The term "System Design Limitations" refers to the physical and/or operational limitations inherent in the design of the BWMS itself, as opposed to the minimum criteria within the BWMS Code. The term does not refer to regulatory restrictions on when the BWMS may or may not be used.

7 The SDL approach unfolds through the following steps:

.1 the manufacturer identifies the parameters to which the BWMS is sensitive and that are important to the proper operation of the BWMS, together with claimed high and/or low values for which the BWMS is capable of achieving the D-2 standard, and the proposed methods for validating these claims (paragraph 1.3.5 of the annex to the BWMS Code;

.2 the Administration evaluates the basis for the manufacturer's claims and the suitability and reliability of the methods proposed to validate the claims (paragraphs 1.14 to 1.15 of the annex to the BWMS Code;

.3 the Administration oversees the validation of the manufacturer's claimed SDLs through a rigorous evidence-based assessment, which may include testing integrated with the specific tests identified in the BWMS Code and/or the use of existing data and/or models (part 6 of the annex to the BWMS Code);

.4 the Administration includes SDLs on the Type Approval Certificate, listed under the heading "*This equipment has been designed for operation in the following conditions*" (paragraph 7.1.6 of the annex to the BWMS Code), and the manufacturer integrates the SDLs into the self-monitoring system of the BWMS where appropriate and practical (paragraph 4.17 of the body of the BWMS Code); and

.5 the Administration includes all documentation associated with the validation of applicable SDLs in the type approval report of the BWMS (paragraph 6.6 of the annex to the BWMS Code).

8 On the model Type Approval Certificate shown in the appendix to the BWMS Code, the heading "*This equipment has been designed for operation in the following conditions*" is distinct from the headings pertaining to "Limiting Operational Conditions" and "other restrictions." If no other restriction is to be imposed, the Administration should write the word "nil" in the "other restrictions" sections in order to clearly indicate that SDLs do not directly constitute a restriction.

System Design Limitations identification

9 Essentially, SDLs are the BWMS-specific water quality parameters (environmental factors) and/or operational parameters (arising from the BWMS design) that are important to the operation of the system and for which the BWMS is designed to achieve the D-2 standard.

10 SDLs should be developed using measures and units that are as accessible as possible to the end user, that are relevant to the operation of ships, and that may be displayed, monitored, recorded and alarmed by the BWMS self-monitoring system.

11 While SDLs should be specific to each BWMS, potential SDLs for various types of ballast water management technologies are provided in the annex to this document in order to provide guidance to BWMS manufacturers and Administrations. They are given as examples of what has been used during type approval of BWMS. This annex should be updated based on the experience gained in the implementation of the BWMS Code by Administrations. As experience is gained, the potential SDL applicable to different technology may also change.

12 For each SDL, a low and/or high value should be claimed by the manufacturer and validated by the Administration to provide information on the range in which the BWMS is designed to work properly. These values are reported on the Type Approval Certificate. As BWMS manufacturers may include a margin of error in claiming System Design Limitations, the SDL should not necessarily be interpreted as the exact parameter values beyond which the BWMS is incapable of operation. The Administration should take this into account in considering whether to include any additional restrictions on the Type Approval Certificate in connection with the validation of System Design Limitations.

13 In the case of SDL parameters that are also subject to specific criteria in part 2 of the annex to the BWMS Code, the procedure set out in part 2 shall be followed. For such parameters, the SDL approach may be used only to the extent that the performance claim goes beyond the specific criteria in part 2.

14 In claiming and validating SDLs, manufacturers and Administrations are advised to bear in mind that the SDLs will be communicated to the end user of the equipment for information under the heading "*This equipment has been designed for operation in the following conditions*." It is therefore advisable that the list focuses only on the key parameters that are most important to the proper operation of the BWMS.

15 In selecting SDLs, parameters that are important to the operation of the system should be included even if such parameters are also assessed specifically by the BWMS Code. This can provide information on the ability (or non-ability) of the system to operate in conditions more challenging than the standardized tests in the BWMS Code. For example, a BWMS that depends on the salinity of ballast water should have an SDL for salinity, for which the manufacturer might claim performance beyond the minimum required under the BWMS Code. The Administration would validate any such claim before including the information on the Type Approval Certificate.

16 It is recommended to only claim SDL which are relevant to the specific technology and that can be measured (directly or indirectly) and be used for regulating or controlling the performance and/or functioning of the BWMS. This is because if no measurement is available, the SDL cannot be verified during test or operation and consequently is not relevant for BWMS operation by the end user.

17 Correlations and potential interactions between parameters do exist. Administrations and BWMS manufacturers are encouraged to report on these correlations to the Organization. SDLs affected by any known or applicable interactions should be identified.

Self-monitoring of System Design Limitations

18 The BWMS Code stipulates that control equipment of a BWMS should incorporate a continuous self-monitoring function during the period in which the system is in operation. The monitoring equipment should record and produce a report of the proper functioning or failure of the ballast water management system in accordance with part 5 of the annex to the BWMS Code (resolution MEPC.300(72)).

19 The self-monitoring function of the BWMS should make the data pertaining to the SDL readily accessible to the end user. The monitoring parameters may be measured directly or indirectly. It is preferable to use direct measurements when feasible. Sensors should be appropriately located to provide a representative reading of the functioning of the BWMS.

20 Potential control and monitoring parameters associated with SDL are provided in the annex to this document. Self-monitoring parameters are given as examples of what has been observed in type-approved BWMS.

21 The BWMS Code also provides that any additional parameters that are necessary to ascertain BWMS performance and safety should be determined by the Administration and stored in the system.

ANNEX

POTENTIAL CONTROL AND MONITORING PARAMETERS ASSOCIATED WITH SYSTEM DESIGN LIMITATIONS

1 The table below sets out information about the technologies commonly used in ballast water management, together with potential SDLs and control and monitoring parameters that the Administration may wish to take into account in connection with the BWMS Code (resolution MEPC.300(72)).

2 The table does not include all potential factors or interactions, nor all self-monitoring parameters as detailed in part 5 of the BWMS Code, but instead is intended to identify known parameters that can be monitored and may be important to the operation of the BWMS.

3 The table is not intended to be exhaustive. It is intended that this remain a living document and that information be added based on experience gained. In particular, more experience is needed on parameters that cannot currently be monitored directly (e.g. suspended solids in the case of filtration).

Table: List of potential System Design Limitations and related self-monitoring parameters

Technology	Principles	Potential SDL		Control and monitoring parameters seen in BWMS	Design elements / related information
		Environmental / water quality parameters	Technical / operational parameters		
Filtration	- Removal of particles and organisms greater than the filter mesh size (disk, basket, candle, etc.) - Automatic cleaning	- Suspended solids (size, quality, quantity) - Salinity and temperature	- Maximum flow rate - Minimum backwash pressure	- Flow rate - Inlet/outlet pressure or differential pressure (dP) - Minimum backwash pressure	- Mesh size or retention threshold (nominal or absolute) - Filtration capacity (flow rate) - Cleaning capacity (backflush) - Number or frequency of backwashes or cleaning cycles
Hydrocyclone	- Gravitational separation of particles by centrifugal force (removal of organisms)	- Suspended solids (specific gravity, quantity) - Salinity and temperature	- Minimum and maximum flow rate	- Flow rate - Inlet/outlet pressure	- Capacity - Separation percentage
Ultraviolet (UV) irradiation	- UV irradiation (low pressure / medium pressure) damages cells	- UVT - Salinity and temperature	- UVI - Minimum and maximum flow rate - Minimum holding time	- UVI, UVT, and/or UV dose - Power, or current and voltage - Minimum and maximum flow rate	- UV dose

Technology	Principles	Potential SDL		Control and monitoring parameters seen in BWMS	Design elements / related information
		Environmental / water quality parameters	Technical / operational parameters		
Electro-chlorination	- Generation of Active Substance through electrolysis of seawater (electric current)	- Salinity and temperature, or conductivity, of the electrolytic feedwater and/or the ambient water to be treated	- Active Substance dose (quantity or concentration) - Maximum flow rate - Minimum holding time	- Power, or current and voltage - Active Substance dose, TRO, and/or ORP - Feedwater (side stream, or full flow) conductivity, or salinity and temperature - Flow rate - Holding time	- Active Substance production rate
	- Neutralizing agent may be used (as per Procedure (G9) requirements)	- Salinity and temperature	- Neutralization dose - Maximum flow rate	- Neutralizing agent flow rate or quantity - Flow rate - Active Substance - Concentration at discharge	- Neutralizing agent storage quantity and dosing rate
Chemical injection (e.g. ozone, sodium hypochlorite, ClO_2, etc.)	- Storage or generation of Active Substance and injection of the created biocide in ballast water	- Salinity and temperature	- Active Substance dose (quantity or concentration) - Maximum flow rate - Minimum holding time	- Power, or current and voltage - Temperature of ozone generator - Active Substance dose - Salinity and/or water conductivity - Water temperature - Flow rate - Holding time	- Active substance production rate, storage quantity, and/or dosing rate
	- Neutralizing agent may be used (as per Procedure (G9) requirements)	- Salinity and temperature	- Neutralization dose - Maximum flow rate	- Neutralizing agent flow rate or quantity - Flow rate - Active Substance concentration at discharge	- Neutralizing agent storage quantity and dosing rate

Technology	Principles	Potential SDL		Control and monitoring parameters seen in BWMS	Design elements / related information
		Environmental / water quality parameters	Technical / operational parameters		
Heat	- Disruption of chemical bonds, denaturing of enzymes and structures through heat energy	- Salinity and temperature	- Temperature range and minimum holding time - Maximum flow rate	- Temperature and holding time - Flow rate	- Heating capacity
Cavitation	- Cell membrane is damaged by shear forces	- Salinity and temperature	- Minimum differential pressure - Inlet and outlet pressure - Maximum flow rate	- Differential pressure - Flow rate	- Available differential pressure
Ultrasound	- Ultrasound waves generate cavitation bubbles in water resulting in intense shear forces and high stress to cell membranes	- Salinity and temperature	- Minimum ultrasound power - Maximum flow rate - Minimum exposure time	- Power, or current and voltage - Flow rate	- Frequency, amplitude and exposure time of ultrasound delivery
Deoxygenation	- Inert gas injection or creation (e.g. CO_2 or N_2) to reduce the available oxygen for organisms in water	- Salinity and temperature	- Minimum inert gas purity (in %) - Minimum injection rate - Minimum holding time	- Dissolved oxygen content - Inert gas purity (%) - Injection rate - Holding time	- Inert gas production rate and purity - Rate of gas injection and mixing
In tank treatment systems – chemicals	- Application of Active Substance into ballast water tanks	- Salinity and temperature - As appropriate for the Active Substance in use	- Minimum uniformity of tank mixing - Minimum holding time per tank	- Active Substance dose or concentration in tank - Holding time	- Mixing device placement - Circulation flow rate/volume - Holding time

Technology	Principles	Potential SDL		Control and monitoring parameters seen in BWMS	Design elements / related information
		Environmental / water quality parameters	Technical / operational parameters		
	- Neutralizing agent may be used (as per Procedure (G9) requirements)	- Salinity and temperature	- Neutralization dose	- Neutralizing agent flow rate or quantity - Active Substance - Concentration in ballast tank	- Neutralizer storage quantity and dosing rate
In tank treatment systems – non-chemicals	- Application of mechanism into ballast water tanks	- Salinity and temperature - As appropriate for the treatment mechanism in use	- Fraction of the tank water being circulated - Minimum uniformity of mechanism application - Minimum holding time per tank	- Measurement of mechanism to the ballast tank or in the ballast tank - Holding time	- Mixing device placement - Circulation flow rate/volume - Holding time

Note: all parameters refer to properties of the ballast water unless otherwise noted (e.g. feedwater).

Legend for the table:
ORP = Oxidant Reduction Potential
TRO = Total Residual Oxidant
UVI = UV intensity
UVT = UV transmittance
The heading "principles" means a summary of the main process used by the technology to manage the ballast water.
The heading "technical/operational parameters" means design parameters of the BWMS that impact or define its performance and/or operation.
The heading "environmental/water quality parameters" means external factors (e.g. water quality) that may directly impact the functioning of the system.
The heading "control and monitoring parameters seen in BWMS" means parameters that may be monitored/logged by BWMS in relation to the SDL. The intention is to give a list of examples, not to prescribe certain kind of measurements that must be included. These examples come from observed control and monitoring parameters in approved BWMS.

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BWM.2/Circ.70
1 November 2018

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

Guidance for the commissioning testing of ballast water management systems

1 The Marine Environment Protection Committee (MEPC), at its seventy-third session (22 to 26 October 2018), approved *Guidance for the commissioning testing of ballast water management systems*, as set out in the annex.

2 Member Governments and international organizations are invited to bring the annexed Guidance to the attention of all parties concerned.

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ANNEX

GUIDANCE FOR THE COMMISSIONING TESTING OF BALLAST WATER MANAGEMENT SYSTEMS

Context

1 The purpose of commissioning testing is to validate the installation of a ballast water management system (BWMS) by demonstrating that its mechanical, physical, chemical and biological processes are working properly. Commissioning testing is not intended to validate the design of type-approved BWMS that are approved by the Administration.

2 The following Guidance for the commissioning testing of BWMS has been developed for use by persons fitting and verifying the installation of BWMS in accordance with:

.1 regulation E-1.1.1 of the Convention, which requires, inter alia, that an initial survey verify that any structure, equipment, systems, fitting, arrangements, material or processes comply fully with the requirements of the Convention;

.2 regulation E-1.1.5 of the Convention which requires, inter alia, that an additional survey be made after a change, replacement, or significant repair of the structure, equipment, systems, fittings, arrangements and material necessary to achieve full compliance with the Convention;

.3 paragraph 8.2.5 of the BWMS Code, which requires that the Administration issuing the International Ballast Water Management Certificate verify that installation commissioning procedures are on board the ship in a suitable format;

.4 paragraph 8.3.6 of the BWMS Code, which requires that the installation commissioning procedures have been completed;

.5 paragraph 1.18 of resolution MEPC.174(58), which provides that, when a type-approved ballast water management system is installed on board, an installation survey according to section 8 should be carried out; and

.6 paragraph 1.1.2.19 of annex 4 of the HSSC Guidelines (resolution A.1120(30)), which includes, "verifying that an operational test of the ballast water management system was carried out based on the installation commissioning procedures and that documented evidence is provided which shows compliance of the treated discharge ballast water during the above mentioned test with regulation D-2 through sampling and analysis based on applicable guidelines developed by the Organization."

3 For the purposes of this Guidance, commissioning testing refers to an operational test of the ballast water management system carried out based on the installation commissioning procedures referred to in paragraph 2.6.

Validating compliance

4 The following steps should be undertaken following installation of the BWMS on board the ship, and after all ballasting equipment (e.g. pumps and piping) has been fully installed and tested as appropriate:

.1 a sample should be collected during a ballast water uptake to characterize the ambient water, by any means practical (e.g. in-line sample port or direct harbour sample). The ambient water should be accepted for testing regardless of the level of challenge it poses to the BWMS;

.2 a sample should be collected during the corresponding ballast water discharge after the full treatment has been applied. Samples should be taken in accordance with the *Guidelines on ballast water sampling* (G2);

.3 the representative samples should be analysed for all size classes included in the D-2 standard using indicative analysis methods listed in table 3 of BWM.2/Circ.42/Rev.1; and

.4 the applicable self-monitoring parameters (e.g. flow rate, pressure, TRO, UV intensity, etc.) of the BWMS should also be assessed, taking into account the System Design Limitations of the BWMS, and the correct operation of all sensors and related equipment should be confirmed.

5 The validation is successful if the analysis indicates that the discharge sample does not exceed the D-2 standard and the self-monitoring equipment indicates correct operation.

6 In the case that the ambient water is not appropriate for the operational testing during the commissioning of the BWMS (e.g. salinity of ambient water is outside the SDL of the BWMS), testing should be evaluated to the satisfaction of the Administration.

Documentation

7 A written report including methods and detailed results of the commissioning testing should be provided to the Administration.