

標題

MEPC 66 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-0991

発行日 2014年6月26日

各位

2014年3月31日から4月4日にかけて開催されたIMOの第66回海洋環境保護委員会(MEPC 66)での情報及び審議結果について次の通りお知らせいたします。

1. NOx 3次規制の開始時期 (添付 1. Resolution MEPC. 251(66) 参照)

MARPOL 条約附属書 VI において、船舶からの段階的な窒素酸化物(NOx)の排出削減が規定されています。現在、建造中の船舶には、2次規制が適用されています。3次規制は、同規制に対応するNOx削減技術の開発状況等のレビューを2013年までに実施し、開始時期を最終決定することが規定されています。なお、3次規制は、NOx 排出規制海域(ECA:Emission Control Areas)を航行する船舶にのみ適用されます。

前回MEPC 65(2013年5月)において、同レビューの結果、3次規制は予定通り2016年に開始するべきであるとの報告が提出されました。一方、ロシアが開始時期を少なくとも5年延期すべきとの提案を行い、多くの支持を集めたため、開始時期を5年延期して2021年とする条約改正案が承認されました。

今回の会合で同条約改正案の採択に向けた審議を行った結果、NOx 3次規制の適用開始を2021年とするMARPOL条約改正案は、否決されました。一方、将来、NOx 排出規制海域として設定される海域に対して、同海域として指定を受ける際にNOx3次規制の開始日を決定できるMARPOL条約附属書VIの改正が採択されました。

従って、2016年1月1日以降に起工する船舶が、現行のNOx 排出規制海域である北アメリカ海域及び米国カリブ海域を航行する際に、3次規制が適用となります。将来、NOx 排出規制海域に指定される海域では、同海域として指定される際に設定される適用開始日以降に起工する船舶に対して3次規制が適用となります。

2. 温室効果ガス(GHG)関連

温室効果ガス(GHG)の削減を国際的に定めた国連気候変動枠組み条約(UNFCCC)の京都議定書では、外航船舶をその対象外としており、IMOが国際海運からのGHG排出の抑制対策を検討することとされています。

(次頁に続く)

NOTES:

- ClassNK テクニカル・インフォメーションは、あくまで最新情報の提供のみを目的として発行しています。
- ClassNK 及びその役員、職員、代理もしくは委託事業者のいずれも、掲載情報の正確性及びその情報の利用あるいは依存により発生する、いかなる損失及び費用についても責任は負いかねます。
- バックナンバーは ClassNK インターネット・ホームページ(URL: www.classnk.or.jp)においてご覧いただけます。

- (1) EEDI 要件の適用拡大 (添付 1. Resolution MEPC. 251(66) 参照)
 現行の条約で EEDI 規制値又は EEDI 計算の適用対象外となっている以下の船舶に対して、EEDI の関連規則を適用するための MARPOL 条約附属書 VI の改正が採択されました。
- (i) 自動車運搬船、Ro-Ro 貨物船及び Ro-Ro 客船
 - (ii) クルーズ客船 (non-conventional propulsion)
 補足: 客船のうち電気推進等の推進システムを有するクルーズ客船のみが適用対象。
 - (iii) LNG 運搬船
 補足: 現行条約では、直結ディーゼル推進の LNG 運搬船のみが EEDI 規制の対象ですが、直結ディーゼル以外の推進方式を有する LNG 運搬船にも適用対象を拡大するもの。
- 当該条約改正は、以下の船舶に適用されます。
- 2015 年 9 月 1 日以降に建造契約が結ばれる船舶
 - 建造契約がない場合には、2016 年 3 月 1 日以降にキールが据え付けられる船舶又はこれと同様の建造段階にある船舶
 - 2019 年 9 月 1 日以降に引き渡される船舶
- (2) EEDI 計算ガイドラインの改正 (添付 2. Resolution MEPC. 245(66) 参照)
 EEDI 規制の適用拡大に伴い、特定の船種、推進方式に対する EEDI 計算方法が検討されてきました。今回の会合において、主として以下の項目に対する審議が行われ、EEDI 計算ガイドラインの改正が採択されました。
- (i) 二元燃料エンジンを搭載した船舶の EEDI 計算における CO₂ 換算係数(CF)及び燃料消費率(SFC)の取り扱いに関するガイドラインの関連規定の見直し
 - (ii) LNG 運搬船の EEDI 計算方法(直結ディーゼル推進、電気推進及び蒸気タービン推進)
 - (iii) 氷海域を航行する冷凍運搬船に対する出力補正係数(fj)の導入
- (3) EEDI 検査と証書ガイドラインの改正
 LNG 運搬船の EEDI 計算方法が確立されたことを受け、その計算で使用されるパラメータの認証方法についての検討が行われました。特に、電気推進方式を有する LNG 運搬船の推進モーター等の電気効率については、リファレンスライン計算に用いた平均値(91.3%)を既定値とし、それより良い値を使う場合のみ工場又は海上試運転における実測検証を要求することが合意されました。
 EEDI 検査と証書ガイドラインの改正案は基本合意されたものの、詳細について更なるレビューの必要性があるため、MEPC 67(2014 年 10 月)で再審議の上、採択される予定となりました。
- (4) 最低出力ガイドラインの検討
 MEPC 65 において、対象をバルクとタンカーに限定した、フェーズ 0 の期間(2013 年 1 月から 2014 年 12 月)のみ有効な最低出力暫定ガイドラインが策定されました。今回の会合において、フェーズ 1 以降に EEDI 規制値が適用となる 20,000DWT 未満の船舶に対して本ガイドラインを適用することは合理的ではないとの調査結果が示され、今後の最低出力ガイドラインに関する審議において、本調査結果を考慮することになりました。

(次頁に続く)

- (5) 主要な改造に関する統一解釈(添付 3. MEPC.1/Circ.795/Rev.1 参照)
条約で定義される主要な改造に関しては、統一解釈が策定されています。今回の会合において、港における喫水制限のために、船体構造を変更することなく一時的に指定された乾舷を変更する場合は、主要な改造と見なさない(即ち、EEDI の再承認を不要)とする一部改正について合意されました。
- (6) EEDI データベースの構築
MARPOL 条約附属書 VI 第 21.6 規則において、将来の技術開発状況を考慮して EEDI 規制値を見直す(レビュープロセス)ことが規定されています。レビュープロセスのための情報収集を目的とした EEDI データベースの構築について審議が行われ、必要なデータセット、データ収集期間について合意されました。また、当該データベースはレビュープロセスのために IMO におけるレビュー作業にのみ使用されるものであり、公表等を行わないことが確認されました。
- (7) 船舶のエネルギー効率改善についての技術移転・技術協力
MARPOL 条約附属書 VI 第 23 規則により、船舶のエネルギー効率改善について、途上国に対する技術移転及び技術協力を促進することが規定されています。MEPC 65 において同技術移転等を促進するための作業グループの設置等を含む MEPC 決議が採択されました。今回の会合では、同作業グループの作業計画が作成されました。
- (8) 監視・報告・認証(MRV)制度
MEPC 65 において、国際海運からの更なる GHG 排出削減のための技術的及び運航的手法として、現存船を含めた船舶に対し、運航データのモニタリング、報告及び認証を課す燃費報告制度(MRV: Monitoring, Reporting and Verification)を検討することが合意されました。
今回の会合では、米国、日本、ドイツ及び EMSA より提案されている燃費報告制度案について審議が行われ、同制度の規制枠組みに関する検討が開始されました。
提案されている全ての手法について更なる検討が必要なこと、現時点においては手法の絞り込みは行わないことが確認されました。また、燃費報告制度の規制枠組みの策定作業促進のために、通信部会(コレスポndenシスグループ)を設置し、引き続き検討することとなりました。
3. 復原性計算機の搭載義務化 (添付 4. Resolution MEPC.248(66), 249(66), 250(66) 参照)
MSC 83(2007 年 10 月)にて英国より、承認されていない積付状態での運航に対し、乗組員による適切な安全性の検証が実施されていないことが指摘されました。MSC 90(2012 年 5 月)において復原性計算機の搭載義務化の方針が合意され、今回の会合において以下の油タンカー及びケミカルタンカーにその搭載を義務化する MARPOL ANNEX I、IBC 及び BCH Code の改正案が採択されました。
- 新造船:2016 年 1 月 1 日以降に起工する船舶
 - 既存船:2016 年 1 月 1 日以降の最初の更新検査。ただし、2021 年 1 月 1 日までに搭載を要求。

(次頁に続く)

4. バラスト水管理条約関連

船舶のバラスト水の移送による海洋生態系への悪影響を防止する目的のため、バラスト水管理条約が2004年2月に採択されました。

同条約は、30ヶ国以上の批准かつ批准国の合計商船船腹量が世界の商船船腹量の35%以上となった12ヵ月後に発効することとなっています。2014年5月末時点で、批准国数は40ヶ国、合計商船船腹量に対する比率は30.25%となっており、現在未発効です。

同条約の発効と同時に、船舶は沖合におけるバラスト水交換の実施、あるいはバラスト水処理装置を使用したバラスト水交換、のどちらかによってバラスト水の排出を管理することが求められます。その後、条約上定められたスケジュールにしたがい、将来的に全ての船舶においてバラスト水処理装置を使用したバラスト水交換が求められます。

(1) 活性物質を用いたバラスト水処理装置の承認

バラスト水管理条約で規定されるバラスト水処理装置は、IMOのガイドラインに基づいて主管庁による承認(型式承認)が必要とされています。なお、同装置に有害水生生物や病原菌を殺傷・減菌するための「活性物質」が使用される場合は、主管庁による型式承認に先立ち、IMOによる活性物質単体の承認(基本承認)、及び処理装置としての総合的な承認(最終承認)が必要となります。

今回の会合において、活性物質を用いたバラスト水処理装置について、4件の基本承認、及び2件の最終承認が与えられました。この結果、IMOによって最終承認が与えられた装置は、合計33件となりました。

現時点では、主管庁による型式承認を取得し実際に船舶に搭載可能な装置の数は、活性物質を用いない装置も含め、42件です。承認された装置のリストは、IMOのウェブサイトで開催されています。

(<http://www.imo.org/OurWork/Environment/BallastWaterManagement/Pages/BWMTechnologies.aspx>)

(2) バラスト水処理装置の型式承認のためのG8ガイドラインの改正

現行のG8ガイドラインに基づいて型式承認されたバラスト水処理装置が、あらゆる環境下において、バラスト水管理条約D-2規則で規定される排出基準に適合できない可能性があるため、今回の会合において試験内容強化のためのG8ガイドラインの見直しを行うことが提案されました。

審議の結果、バラスト水管理条約D-2規則で規定されるバラスト水排出基準に関し、さらなる調査を行った上で、G8ガイドラインの見直しを検討することとなりました。

(次頁に続く)

5. シップリサイクル条約関連

船舶の安全かつ環境上適正な解撤を目的として、シップリサイクル条約が2009年5月に採択されました。同条約では、船舶に対して有害物質一覧表(インベントリ)を作成・保持すること、及び条約に適合している解撤ヤードにおける船舶の解撤等が要求されています。

同条約は、15カ国以上の批准、批准国の商船船腹量合計が世界商船船腹量の40%以上、かつ批准国の直近10年における最大の年間解体船腹量の合計が批准国の合計商船船腹量の3%以上となった後、24ヶ月後に発効することとなっています。2014年5月末時点、同条約への批准国はノルウェー及びコンゴ共和国であり、合計商船船腹量に対する比率は1.46%です。

(1) インベントリに記載すべき有害物質の閾値の検討

今回の会合では、前回会合に引き続き、「有害物質インベントリ作成ガイドライン」(インベントリガイドライン)に定められている、インベントリに記載すべき物質に関する閾値及び適用除外の見直しについて審議が行われましたが、結論は出ず、MEPC67で引き続き検討を行うこととなりました。

6. 船舶からの廃物に関するガイドライン

MARPOL条約附属書V(船舶からの廃物による汚染防止)の改正が2013年1月1日に発効し、同日以降船舶で発生した廃棄物の海洋への投棄は原則禁止されています。

今回の会合では、MEPC 65に引き続き、条約及び関連ガイドラインにおいて明確になっていないボイラ及び排ガスエコノマイザの洗浄水の取り扱いについて審議が行われましたが、結論は出ず、MEPC 67で引き続き検討を行うこととなりました。

7. 極海コード(Polar Code)

IMOでは、近年の北極航路の開設に向けた国際的な関心の高まりや旅客船等の航行海域が南北に拡大していることに鑑み、北極海及び南極海(「極海」)を航行する船舶の安全確保及び極海的环境保護等を目的とした強制要件の策定について、2009年以降検討を行っています。極海特有の危険性を考慮した復原性、堪航性、防火・救命設備、無線通信及び海洋環境保護等の技術基準を定める極海コードの作成作業を行っています。

同コードのPart Iに安全要件、Part IIに環境要件が規定されており、今回の会合では、Part IIの環境要件及び同コードを強制化するためのMARPOL条約の改正案の審議が行われましたが、最終化には至らず通信部会を設置して、MEPC 67に向けて審議を継続することになりました。

8. 船舶からの水中騒音

船舶から発生する水中騒音がクジラ、イルカ等の海洋生物に悪影響を及ぼす懸念があるため、DE小委員会(現在のSDC小委員会)において「海洋生物への影響を考慮した船舶からの水中騒音低減のための非強制ガイドライン」の案が策定されました。今回の会合において、同ガイドラインが承認されました。

なお、本MEPC 66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)

(次頁に続く)

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。

一般財団法人 日本海事協会 (ClassNK)

本部 管理センター 国際室

住所: 東京都千代田区紀尾井町 4-7 (郵便番号 102-8567)

Tel.: 03-5226-2038

Fax: 03-5226-2024

E-mail: xad@classnk.or.jp

添付:

1. NOx 3 次規制の開始時期/ EEDI 要件の適用拡大 (Resolution MEPC. 251(66))
2. EEDI 計算ガイドラインの改正 (Resolution MEPC. 245(66))
3. 主要な改造に関する統一解釈 (MEPC.1/Circ.795/Rev.1)
4. 復原性計算機の搭載義務化 (Resolution MEPC.248(66), 249(66), 250(66))

ANNEX 12

**RESOLUTION MEPC.251(66)
Adopted on 4 April 2014**

**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 and the NO_x Technical Code 2008

**(Amendments to regulations 2, 13, 19, 20 and 21 and the Supplement to
the IAPP Certificate under MARPOL Annex VI and certification of
dual-fuel engines under the NO_x Technical Code 2008)**

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 (hereinafter referred to as the "1973 Convention"), article VI of the Protocol of 1978 relating to the International Convention for the Prevention of Pollution from Ships, 1973 (hereinafter referred to as the "1978 Protocol") and article 4 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 (hereinafter referred to as the "1997 Protocol"), which together specify the amendment procedure of the 1997 Protocol and confer upon the appropriate body of the Organization the function of considering and adopting amendments to the 1973 Convention, as modified by the 1978 and 1997 Protocols,

NOTING that, by the 1997 Protocol, Annex VI entitled Regulations for the Prevention of Air Pollution from Ships was added to the 1973 Convention (hereinafter referred to as "Annex VI"),

NOTING FURTHER regulation 13 of MARPOL Annex VI which makes the Technical Code on Control of Emission of Nitrogen Oxides from Marine Diesel Engines (NO_x Technical Code 2008) mandatory under that Annex,

NOTING ALSO that both the revised Annex VI, adopted by resolution MEPC.176(58) and the NO_x Technical Code 2008, adopted by resolution MEPC.177(58) entered into force on 1 July 2010,

HAVING CONSIDERED draft amendments to the revised Annex VI and the NO_x Technical Code 2008,

1. ADOPTS, in accordance with article 16(2)(d) of the 1973 Convention, the amendments to Annex VI and the NO_x Technical Code 2008, 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 the 1973 Convention, that the amendments shall be deemed to have been accepted on 1 March 2015, 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 the 1973 Convention, the said amendments shall enter into force on 1 September 2015 upon their acceptance in accordance with paragraph 2 above;

4. REQUESTS the Secretary-General, in conformity with article 16(2)(e) of the 1973 Convention, to transmit to all Parties to the 1973 Convention, as modified by the 1978 and 1997 Protocols, certified copies of the present resolution and the text of the amendments contained in the annex;

5. REQUESTS FURTHER the Secretary-General to transmit to the Members of the Organization which are not Parties to the 1973 Convention, as modified by the 1978 and 1997 Protocols, copies of the present resolution and its annex.

ANNEX

AMENDMENTS TO MARPOL ANNEX VI AND THE NO_x TECHNICAL CODE 2008

AMENDMENTS TO MARPOL ANNEX VI

Chapter 1 – General

Regulation 2 – Definitions

1 Paragraph 26 is amended to read as follows:

"26 *Gas carrier* in relation to chapter 4 of this Annex means a cargo ship, other than an LNG carrier as defined in paragraph 38 of this regulation, constructed or adapted and used for the carriage in bulk of any liquefied gas."

2 New paragraphs 38 to 43 are added after existing paragraph 37 as follows:

"38 *LNG carrier* in relation to chapter 4 of this Annex means a cargo ship constructed or adapted and used for the carriage in bulk of liquefied natural gas (LNG).

39 *Cruise passenger ship* in relation to chapter 4 of this Annex means a passenger ship not having a cargo deck, designed exclusively for commercial transportation of passengers in overnight accommodations on a sea voyage.

40 *Conventional propulsion* in relation to chapter 4 of this Annex means a method of propulsion where a main reciprocating internal combustion engine(s) is the prime mover and coupled to a propulsion shaft either directly or through a gear box.

41 *Non-conventional propulsion* in relation to chapter 4 of this Annex means a method of propulsion, other than conventional propulsion, including diesel-electric propulsion, turbine propulsion, and hybrid propulsion systems.

42 *Cargo ship having ice-breaking capability* in relation to chapter 4 of this Annex means a cargo ship which is designed to break level ice independently with a speed of at least 2 knots when the level ice thickness is 1.0 m or more having ice bending strength of at least 500 kPa.

43 A ship *delivered on or after 1 September 2019* means a ship:

- .1 for which the building contract is placed on or after 1 September 2015; 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 March 2016; or
- .3 the delivery of which is on or after 1 September 2019."

Chapter 2 – Survey, certification and means of control

Regulation 5 – Surveys

3 In the first sentence of paragraph 4.2, the words "a ship" are replaced with the words "a new ship".

Chapter 3 – Requirements for control of emissions from ships

Regulation 13 – Nitrogen oxides (NO_x)

4 Paragraph 2.2 is amended to read 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 at the time of the replacement or addition of the engine shall apply. In the case of replacement engines only, if it is not possible for such a replacement engine to meet the standards set forth in paragraph 5.1.1 of this regulation (Tier III, as applicable), then that replacement engine shall meet the standards set forth in paragraph 4 of this regulation (Tier II), taking into account guidelines developed by the Organization*.

* Refer to the *2013 Guidelines as required by regulation 13.2.2 of MARPOL Annex VI in respect of non-identical replacement engines not required to meet the Tier III limit*, adopted by the MEPC by resolution MEPC.230(65)."

5 Paragraphs 5.1 and 5.2 are amended to read as follows:

"Tier III

5.1 Subject to regulation 3 of this Annex, in an emission control area designated for Tier III NO_x control under paragraph 6 of this regulation, the operation of a marine diesel engine that is installed on a ship:

.1 is prohibited except when the emission of nitrogen oxides (calculated as the total weighted emission of NO_x) from the engine is within the following limits, where n = rated engine speed (crankshaft revolutions per minute):

.1 3.4 g/kWh when n is less than 130 rpm;

.2 $9 \cdot n^{(-0.2)}$ g/kWh when n is 130 or more but less than 2,000 rpm;

.3 2.0 g/kWh when n is 2,000 rpm or more;

when:

.2 that ship is constructed on or after 1 January 2016 and is operating in the North American Emission Control Area or the United States Caribbean Sea Emission Control Area;

when:

- .3 that ship is operating in an emission control area designated for Tier III NO_x control under paragraph 6 of this regulation, other than an emission control area described in paragraph 5.1.2 of this regulation, and is constructed on or after the date of adoption of such an emission control area, or a later date as may be specified in the amendment designating the NO_x Tier III emission control area, whichever is later.

5.2 The standards set forth in paragraph 5.1.1 of this regulation shall not apply to:

- .1 a marine diesel engine installed on a ship with a length (*L*), as defined in regulation 1.19 of Annex I to the present Convention, of less than 24 metres when it has been specifically designed, and is used solely, for recreational purposes; or
- .2 a marine diesel engine installed on a ship with a combined nameplate diesel engine propulsion power of less than 750 kW if it is demonstrated, to the satisfaction of the Administration, that the ship cannot comply with the standards set forth in paragraph 5.1.1 of this regulation because of design or construction limitations of the ship; or
- .3 a marine diesel engine installed on a ship constructed prior to 1 January 2021 of less than 500 gross tonnage, with a length (*L*), as defined in regulation 1.19 of Annex I to the present convention, of 24 m or over when it has been specifically designed, and is used solely, for recreational purposes."

6 Paragraph 10 is deleted.

Chapter 4 – Regulations for energy efficiency of ships

Regulation 19 – Application

7 A new subparagraph 2.2 is added as follows:

- ".2 ships not propelled by mechanical means, and platforms including FPSOs and FSUs and drilling rigs, regardless of their propulsion."

8 Paragraph 3 is amended to read as follows:

- "3 Regulations 20 and 21 of this Annex shall not apply to ships which have non-conventional propulsion, except that regulations 20 and 21 shall apply to cruise passenger ships having non-conventional propulsion and LNG carriers having conventional or non-conventional propulsion, delivered on or after 1 September 2019, as defined in paragraph 43 of regulation 2. Regulations 20 and 21 shall not apply to cargo ships having ice-breaking capability."

Regulation 20 – Attained Energy Efficiency Design Index (attained EEDI)

9 Paragraph 1 is replaced with the following:

- "1 The attained EEDI shall be calculated for:
- .1 each new ship;
 - .2 each new ship which has undergone a major conversion; and
 - .3 each new or existing ship which has undergone a major conversion, that is so extensive that the ship is regarded by the Administration as a newly-constructed ship, which falls into one or more of the categories in regulations 2.25 to 2.35, 2.38 and 2.39 of this Annex. The attained EEDI shall be specific to each ship and shall indicate the estimated performance of the ship in terms of energy efficiency, and be accompanied by the EEDI technical file that contains the information necessary for the calculation of the attained EEDI and that shows the process of calculation. The attained EEDI shall be verified, based on the EEDI technical file, either by the Administration or by any organization duly authorized by it*.

* Refer to *Code for Recognized Organizations (RO Code)*, adopted by the MEPC by resolution MEPC.237(65), as may be amended."

Regulation 21 – Required EEDI

10 Paragraph 1 is replaced with the following:

- "1 For each:
- .1 new ship;
 - .2 new ship which has undergone a major conversion; and
 - .3 new or existing ship which has undergone a major conversion that is so extensive that the ship is regarded by the Administration as a newly-constructed ship, which falls into one of the categories in regulations 2.25 to 2.31, 2.33 to 2.35, 2.38 and 2.39 and to which this chapter is applicable, the attained EEDI shall be as follows:

$$\text{Attained EEDI} \leq \text{Required EEDI} = (1-X/100) \times \text{reference line value}$$

where X is the reduction factor specified in table 1 for the required EEDI compared to the EEDI reference line."

11 New rows are added to table 1 in regulation 2 for ro-ro cargo ships (vehicle carrier), LNG carrier, cruise passenger ship having non-conventional propulsion, ro-ro cargo ships and ro-ro passenger ships, and marks ** and *** and their explanations are added, as follows:

"

Ship Type	Size	Phase 0 1 Jan 2013 – 31 Dec 2014	Phase 1 1 Jan 2015 – 31 Dec 2019	Phase 2 1 Jan 2020 – 31 Dec 2024	Phase 3 1 Jan 2025 and onwards
LNG carrier***	10,000 DWT and above	n/a	10**	20	30
Ro-ro cargo ship (vehicle carrier)***	10,000 DWT and above	n/a	5**	15	30
Ro-ro cargo ship***	2,000 DWT and above	n/a	5**	20	30
	1,000 – 2,000 DWT	n/a	0-5***	0-20*	0-30*
Ro-ro passenger ship***	1000 DWT and above	n/a	5**	20	30
	250 – 1,000 DWT	n/a	0-5***	0-20*	0-30*
Cruise passenger ship*** having non-conventional propulsion	85,000 GT and above	n/a	5**	20	30
	25,000 – 85,000 GT	n/a	0-5***	0-20*	0-30*

* Reduction factor to be linearly interpolated between the two values dependent upon ship size. The lower value of the reduction factor is to be applied to the smaller ship size.

** Phase 1 commences for those ships on 1 September 2015.

*** Reduction factor applies to those ships delivered on or after 1 September 2019, as defined in paragraph 43 of regulation 2.

Note: n/a means that no required EEDI applies."

12 New rows are added to table 2 in paragraph 3 for ro-ro cargo ship (vehicle carrier), LNG carrier, cruise passenger ship having non-conventional propulsion, ro-ro cargo ships and ro-ro passenger ships as follows:

"

Ship type defined in regulation 2	a	b	c
2.33 Ro-ro cargo ship (vehicle carrier)	$(DWT/GT)^{-0.7} \cdot 780.36$ where $DWT/GT < 0.3$ 1812.63 where $DWT/GT \geq 0.3$	DWT of the ship	0.471
2.34 Ro-ro cargo ship	1405.15	DWT of the ship	0.498
2.35 Ro-ro passenger ship	752.16	DWT of the ship	0.381
2.38 LNG carrier	2253.7	DWT of the ship	0.474
2.39 Cruise passenger ship having non-conventional propulsion	170.84	GT of the ship	0.214

"

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

13 The footnote in the Supplement to International Air Pollution Prevention Certificate (IAPP Certificate) is amended to read as follows:

"* Completed only in respect of ships constructed on or after 1 January 2016 that are specially designed, and used solely, for recreational purposes and to which, in accordance with regulation 13.5.2.1 and regulation 13.5.2.3, the NO_x emission limit as given by regulation 13.5.1.1 will not apply."

AMENDMENTS TO THE NO_x TECHNICAL CODE 2008

Abbreviations, subscripts and symbols

14 Table 4 is replaced by the following:

"Table 4 – Symbols for fuel composition

Symbol	Definition	Unit
W_{ALF}^*	H content of fuel	% m/m
W_{BET}^*	C content of fuel	% m/m
W_{GAM}	S content of fuel	% m/m
W_{DEL}^*	N content of fuel	% m/m
W_{EPS}^*	O content of fuel	% m/m
α	Molar ratio (H/C)	1

* Subscripts

"_G" denotes gas-fuel fraction.
"_L" denotes liquid-fuel fraction."

Chapter 1 – General

15 Paragraph 1.3.10 is replaced by the following:

"1.3.10 *Marine diesel engine* means any reciprocating internal combustion engine operating on liquid or dual fuel, to which regulation 13 applies, including booster/compound systems, if applied.

Where an engine is intended to be operated normally in the gas mode, i.e. with the gas fuel as the main fuel and with liquid fuel as the pilot or balance fuel, the requirements of regulation 13 have to be met only for this operation mode. Operation on pure liquid fuel resulting from restricted gas supply in cases of failures shall be exempted for the voyage to the next appropriate port for the repair of the failure."

Chapter 5 – Procedures for NO_x emission measurements on a test bed

16 Existing paragraph 5.3.4 is deleted and new paragraphs 5.3.4, 5.3.5 and 5.3.6 are added after existing paragraph 5.3.3 as follows:

"5.3.4 The selection of gas fuel for testing for dual fuel depends on the aim of tests. In case where an appropriate standard gas fuel is not available, other gas fuels shall be used with the approval of the Administration. A gas fuel sample shall be collected during the test of the parent engine. The gas fuel shall be analysed to give fuel composition and fuel specification.

5.3.5 Gas fuel temperature shall be measured and recorded together with the measurement point position.

5.3.6 Gas mode operation of dual fuel engines using liquid fuel as pilot or balance fuel shall be tested using maximum liquid-to-gas fuel ratio, such maximum ratio means for the different test cycle modes the maximum liquid-to-gas setting certified. The liquid fraction of the fuel shall comply with 5.3.1, 5.3.2 and 5.3.3."

17 A new sentence is added at the end of existing paragraph 5.12.3.3, as follows:

"In case of the use of dual fuel, the calculation shall be in accordance with paragraphs 5.12.3.1 to 5.12.3.3. However, q_{mf} , W_{ALF} , W_{BET} , W_{DEL} , W_{EPS} , f_{iw} values shall be calculated in accordance with the following table:

Factors in the formula (6) (7) (8)		Formula for factors
q_{mf}	=	$q_{mf_G} + q_{mf_L}$
W_{ALF}	=	$\frac{q_{mf_G} \times W_{ALF_G} + q_{mf_L} \times W_{ALF_L}}{q_{mf_G} + q_{mf_L}}$
W_{BET}	=	$\frac{q_{mf_G} \times W_{BET_G} + q_{mf_L} \times W_{BET_L}}{q_{mf_G} + q_{mf_L}}$
W_{DEL}	=	$\frac{q_{mf_G} \times W_{DEL_G} + q_{mf_L} \times W_{DEL_L}}{q_{mf_G} + q_{mf_L}}$
W_{EPS}	=	$\frac{q_{mf_G} \times W_{EPS_G} + q_{mf_L} \times W_{EPS_L}}{q_{mf_G} + q_{mf_L}}$

"

18 In paragraph 5.12.5.1, table 5 is replaced by the following:

"Table 5 – Coefficient u_{gas} and fuel-specific parameters for raw exhaust gas

Gas		NO _x	CO	HC	CO ₂	O ₂
ρ_{gas} kg/m ³		2.053	1.250	*	1.9636	1.4277
	ρ_e †	Coefficient u_{gas} ‡				
Liquid fuel**	1.2943	0.001586	0.000966	0.000479	0.001517	0.001103
Rapeseed Methyl Ester	1.2950	0.001585	0.000965	0.000536	0.001516	0.001102
Methanol	1.2610	0.001628	0.000991	0.001133	0.001557	0.001132
Ethanol	1.2757	0.001609	0.000980	0.000805	0.001539	0.001119
Natural gas	1.2661	0.001621	0.000987	0.000558	0.001551	0.001128
Propane	1.2805	0.001603	0.000976	0.000512	0.001533	0.001115
Butane	1.2832	0.001600	0.000974	0.000505	0.001530	0.001113

- * Depending on fuel.
- ** Petroleum derived.
- † ρ_e is the nominal density of the exhaust gas.
- ‡ At $\lambda = 2$, wet air, 273 K, 101.3 kPa.

Values for u given in table 5 are based on ideal gas properties.
In multiple fuel type operation, the u_{gas} value used shall be determined from the values applicable to those fuels in the table set out above proportioned in accordance with the fuel ratio used."

Chapter 6 – Procedures for demonstrating compliance with NO_x emission limits on board

19 Paragraph 6.3.1.4 is replaced by the following:

"6.3.1.4 In practical cases, it is often impossible to measure the fuel oil consumption once an engine has been installed on board a ship. To simplify the procedure on board, the results of the measurement of the fuel oil consumption from an engine's pre-certification test-bed testing may be accepted. In such cases, especially concerning residual fuel oil operation (RM-grade fuel oil according to ISO 8217:2005) and dual fuel operation, an estimation with a corresponding estimated error shall be made. Since the fuel oil flow rate used in the calculation (q_{mf}) must relate to the fuel oil composition determined in respect of the fuel sample drawn during the test, the measurement of q_{mf} from the test-bed testing shall be corrected for any difference in net calorific values between the test bed and test fuel oils and gases. The consequences of such an error on the final emissions shall be calculated and reported with the results of the emission measurement."

20 In paragraph 6.3.2.1, table 6 is replaced by the following:

"Table 6 – Engine parameters to be measured and recorded

Symbol	Term	Unit
H_a	Absolute humidity (mass of engine intake air water content related to mass of dry air)	g/kg
$n_{d,i}$	Engine speed (at the i^{th} mode during the cycle)	min ⁻¹
$n_{turb,i}$	Turbocharger speed (if applicable) (at the i^{th} mode during the cycle)	min ⁻¹
P_b	Total barometric pressure (in ISO 3046-1:1995: $p_x = P_x =$ site ambient total pressure)	kPa
$P_{c,i}$	Charge air pressure after the charge air cooler (at the i^{th} mode during the cycle)	kPa
P_i	Brake power (at the i^{th} mode during the cycle)	kW
$q_{mf,i}$	Fuel oil (in case of dual fuel engine, it would be fuel oil and gas) (at the i^{th} mode during the cycle)	kg/h
s_i	Fuel rack position (of each cylinder, if applicable) (at the i^{th} mode during the cycle)	
T_a	Intake air temperature at air inlet (in ISO 3046-1:1995: $T_x = TT_x =$ site ambient thermodynamic air temperature)	K
$T_{SC,i}$	Charge air temperature after the charge air cooler (if applicable) (at the i^{th} mode during the cycle)	K
T_{caclin}	Charge air cooler, coolant inlet temperature	°C
$T_{caclout}$	Charge air cooler, coolant outlet temperature	°C
$T_{Exh,i}$	Exhaust gas temperature at the sampling point (at the i^{th} mode during the cycle)	°C
T_{Fuel-L}	Fuel oil temperature before the engine	°C
T_{Sea}	Seawater temperature	°C
T_{Fuel-G}^*	Gas fuel temperature before the engine	°C

* Only for dual-fuel engine."

21 A new paragraph 6.3.4.3 is added after existing paragraph 6.3.4.2 as follows:

"6.3.4.3 In case of a dual fuel engine, the gas fuel used shall be the gas fuel available on board."

22 Paragraph 6.3.11.2 is replaced by the following:

"6.3.11.2 The NO_x emission of an engine may vary depending on the ignition quality of the fuel oil and the fuel-bound nitrogen. If there is insufficient information available on the influence of the ignition quality on the NO_x formation during the combustion process and the fuel-bound nitrogen conversion rate also depends on the engine efficiency, an allowance of 10% may be granted for an on board test run carried out on an RM-grade fuel oil (ISO 8217:2005), except that there will be no allowance for the pre-certification test on board. The fuel oil and gas fuel used shall be analysed for its composition of carbon, hydrogen, nitrogen, sulphur and, to the extent given in (ISO 8217:2005) and (ISO 8178-5:2008), any additional components necessary for a specification of the fuel oil and gas fuel."

23 In paragraph 6.4.11.1, table 9 is replaced by the following:

"Table 9 – Default fuel oil parameters

	Carbon	Hydrogen	Nitrogen	Oxygen
	<i>W_{BET}</i>	<i>W_{ALF}</i>	<i>W_{DEL}</i>	<i>W_{EPS}</i>
Distillate fuel oil (ISO 8217:2005, DM grade)	86.2%	13.6%	0.0%	0.0%
Residual fuel oil (ISO 8217:2005, RM grade)	86.1%	10.9%	0.4%	0.0%
Natural gas	75.0%	25.0%	0.0%	0.0%

For other fuel oils, default value as approved by the Administration."

Appendix VI – Calculation of exhaust gas mass flow (carbon balance method)

24 A new paragraph 2.5 is added after existing paragraph 2.4 as follows:

"2.5 q_{mf} , W_{ALF} , W_{BET} , W_{DEL} , W_{EPS} , f_{fd} parameters, in formula (1), in case of gas mode operation of dual-fuel engine, shall be calculated as follows:

Factors in formula (1)		Formula of factors
q_{mf}	=	$q_{mf_G} + q_{mf_L}$
W_{ALF}	=	$\frac{q_{mf_G} \times W_{ALF_G} + q_{mf_L} \times W_{ALF_L}}{q_{mf_G} + q_{mf_L}}$
W_{BET}	=	$\frac{q_{mf_G} \times W_{BET_G} + q_{mf_L} \times W_{BET_L}}{q_{mf_G} + q_{mf_L}}$
W_{DEL}	=	$\frac{q_{mf_G} \times W_{DEL_G} + q_{mf_L} \times W_{DEL_L}}{q_{mf_G} + q_{mf_L}}$
W_{EPS}	=	$\frac{q_{mf_G} \times W_{EPS_G} + q_{mf_L} \times W_{EPS_L}}{q_{mf_G} + q_{mf_L}}$

ANNEX 5

RESOLUTION MEPC.245(66)

Adopted on 4 April 2014

2014 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, at its sixty-second session, the Committee 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 amendments to MARPOL Annex VI adopted at its sixty-second session by resolution MEPC.203(62), including a new chapter 4 for regulations on energy efficiency for ships in Annex VI, entered into force on 1 January 2013,

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

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

RECOGNIZING that the amendments to MARPOL Annex VI require the adoption of relevant guidelines for the smooth and uniform implementation of the regulations and to provide sufficient lead time for industry to prepare,

HAVING CONSIDERED, at its sixty-sixth session, the *2014 Guidelines on the method of calculation of the attained Energy Efficiency Design Index (EEDI) for new ships*,

1. ADOPTS the *2014 Guidelines on the method of calculation of the attained Energy Efficiency Design Index (EEDI) for new ships*, as set out in the annex to the present resolution;
2. INVITES Administrations to take the annexed Guidelines 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 annexed Guidelines related to the Energy Efficiency Design Index (EEDI) to the attention of shipowners, ship operators, shipbuilders, ship designers and any other interested parties;

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

5. SUPERSEDES 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), as amended by resolution MEPC.224(64).

ANNEX

2014 GUIDELINES ON THE METHOD OF CALCULATION OF THE ATTAINED ENERGY EFFICIENCY DESIGN INDEX (EEDI) FOR NEW SHIPS

CONTENTS

- 1 Definitions
- 2 Energy Efficiency Design Index (EEDI), including equation
 - 2.1 C_F ; conversion factor between fuel consumption and CO₂ emission
 - 2.2 V_{ref} ; ship speed
 - 2.3 *Capacity*
 - 2.3.1 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
 - 2.3.2 Passenger ships and cruise passenger ships
 - 2.3.3 Containerships
 - 2.4 *Deadweight*
 - 2.5 P ; Power of main and auxiliary engines
 - 2.5.1 P_{ME} ; power of main engines
 - 2.5.2 P_{PTO} ; shaft generator
 - 2.5.3 P_{PTI} ; shaft motor
 - 2.5.4 P_{eff} ; output of innovative mechanical energy efficient technology
 - 2.5.5 P_{AEff} ; auxiliary power reduction
 - 2.5.6 P_{AE} ; power of auxiliary engines
 - 2.6 V_{ref} , *Capacity* and P
 - 2.7 SFC ; Specific fuel consumption
 - 2.8 f_j ; Correction factor for ship specific design elements
 - 2.8.1 f_j ; ice-class ships
 - 2.8.2 f_j ; shuttle tankers
 - 2.8.3 f_{jro-ro} ; ro-ro cargo and ro-ro passenger ships
 - 2.8.4 f_j ; general cargo ships
 - 2.8.5 f_j ; other ship types
 - 2.9 f_w ; Weather factor
 - 2.10 f_{eff} ; Availability factor of innovative energy efficiency technology
 - 2.11 f_i ; Capacity factor
 - 2.11.1 f_i ; ice-class ships
 - 2.11.2 f_i ; ship specific voluntary structural enhancement
 - 2.11.3 f_i ; bulk carriers and oil tankers under Common Structural Rules (CSR)
 - 2.11.4 f_i ; other ship types
 - 2.12 f_c ; Cubic capacity correction factor
 - 2.12.1 f_c ; chemical tankers
 - 2.12.2 f_c ; gas carriers
 - 2.12.3 f_{cRoPax} ; ro-ro passenger ships
 - 2.13 L_{pp} ; Length between perpendiculars
 - 2.14 f_i ; Factor for general cargo ships equipped with cranes and other cargo-related gear
 - 2.15 d_s ; Summer load line draught
 - 2.16 B_s ; Breadth
 - 2.17 ∇ ; Volumetric displacement
 - 2.18 g ; gravitational acceleration

- 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 1997 relating 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)

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:

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

* 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 $(SFC_{ME} \cdot C_{FME})$ and $(SFC_{AE} \cdot C_{FAE})$ 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.

Where:

.1 C_F is a non-dimensional conversion factor between fuel consumption measured in g and CO₂ 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 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	Carbon content	C_F (t-CO ₂ /t-Fuel)
1 Diesel/Gas Oil	ISO 8217 Grades DMX through DMB	0.8744	3.206
2 Light Fuel Oil (LFO)	ISO 8217 Grades RMA through RMD	0.8594	3.151
3 Heavy Fuel Oil (HFO)	ISO 8217 Grades RME through RMK	0.8493	3.114
4 Liquefied Petroleum Gas (LPG)	Propane	0.8182	3.000
	Butane	0.8264	3.030
5 Liquefied Natural Gas (LNG)		0.7500	2.750
6 Methanol		0.3750	1.375
7 Ethanol		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.

Example:

$$\begin{aligned} C_{F, Gas} &= 2.750 \\ C_{F, Pilotfuel} &= 3.114 \\ SFC_{ME Pilotfuel} &= 6 \text{ g/kWh} \\ SFC_{ME Gas} &= 160 \text{ g/kWh} \end{aligned}$$

$$\begin{aligned} EEDI &= (P_{ME} \times (C_{F Pilotfuel} \times SFC_{ME Pilotfuel} + C_{F Gas} \times SFC_{ME Gas})) + \dots \\ EEDI &= (P_{ME} \times (3.114 \times 6 + 2.750 \times 160)) + \dots \end{aligned}$$

Calculation examples are set out in appendix 4.

.2 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 2.3.1 and 2.3.3 (in case of passenger ships and cruise passenger ships, this condition should be summer load draught as provided in paragraph 2.4) at the shaft power of the engine(s) as defined in paragraph 2.5 and assuming the weather is calm with no wind and no waves.

.3 *Capacity* is defined as follows:

.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 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*.

.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:

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

.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:

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

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.

.4 *Deadweight* means the difference in tonnes between the displacement of a ship in water of relative density of 1,025 kg/m³ 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.

.5 *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 (*n_{ME}*) (see diagram in appendix 1).

.1 *P_{ME(i)}* is 75% of the rated installed power (MCR*) 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.

η_(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, *η_(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 *η_(i)* should be obtained by measurement and verified by method approved by the verifier.

* 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.

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 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:

Option 1:

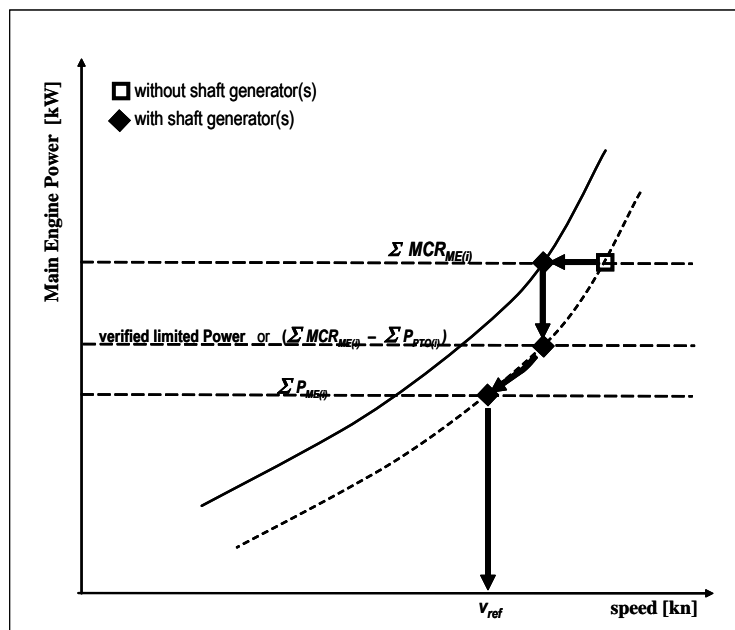
- .1 The maximum allowable deduction for the calculation of $\Sigma P_{ME(i)}$ is to be no more than P_{AE} as defined in paragraph 2.5.6. For this case, $\Sigma P_{ME(i)}$ is calculated as:

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

or

Option 2:

- .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 $\Sigma P_{ME(i)}$:



3 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:

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

Where:

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

η_{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:

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

$\eta_{PTI(i)}$ 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.

- .4 $P_{eff(i)}$ 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 2.1 and 2.7.

- .5 $P_{AEff(i)}$ is the auxiliary power reduction due to innovative electrical energy efficient technology measured at $P_{ME(i)}$.

- .6 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.

- .1 For ships with a total propulsion power $(\sum MCR_{ME(i)} + \frac{\sum P_{PTI(i)}}{0.75})$ of 10,000 kW or above, P_{AE} is defined as:

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

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

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

- .3 For LNG carriers with a reliquefaction 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 1, 2 or 3 as below:

- .1 For ships having re-liquefaction system:

$$+ \text{CargoTankCapacity}_{LNG} \times BOR \times COP_{reliquefy} \times R_{reliquefy}$$

Where:

$\text{CargoTankCapacity}_{LNG}$ 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.

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

$COP_{cooling}$ 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):

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

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

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 $SFC_{SteamTurbine}$.

.4 For ship where the P_{AE} value calculated by paragraphs 2.5.6.1 to 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 table², divided by the average efficiency of the generator(s) weighted by power (see appendix 2).

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

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

¹ 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.

² 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.

- .1 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 2.5.6.1 to 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.

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

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

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 2.5.6 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.
- .8 f_j is a correction factor to account for ship specific design elements:
 - .1 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 25/7³.

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	$\frac{0.308L_{PP}^{1.920}}{\sum_{i=1}^{nME} P_{ME(i)}}$	$0.15L_{PP}^{0.30}$	$0.27L_{PP}^{0.21}$	$0.45L_{PP}^{0.13}$	$0.70L_{PP}^{0.06}$
Bulk carrier	$\frac{0.639L_{PP}^{1.754}}{\sum_{i=1}^{nME} P_{ME(i)}}$	$0.47L_{PP}^{0.09}$	$0.58L_{PP}^{0.07}$	$0.73L_{PP}^{0.04}$	$0.87L_{PP}^{0.02}$
General cargo ship	$\frac{0.0227 \cdot L_{PP}^{2.483}}{\sum_{i=1}^{nME} P_{ME(i)}}$	$0.31L_{PP}^{0.16}$	$0.43L_{PP}^{0.12}$	$0.56L_{PP}^{0.09}$	$0.67L_{PP}^{0.07}$
Refrigerated cargo ships	$\frac{0.639L_{PP}^{1.754}}{\sum_{i=1}^{nME} P_{ME(i)}}$	$0.47L_{PP}^{0.09}$	$0.58L_{PP}^{0.07}$	$0.73L_{PP}^{0.04}$	$0.87L_{PP}^{0.02}$

- .2 The 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

³ HELCOM Recommendation 25/7 may be found at <http://www.helcom.fi>.

twin-propellers need to meet the requirements for dynamic positioning and redundancy propulsion class notation.

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

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

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

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

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

Where

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

and

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

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

- .9 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:

- .1 for the attained EEDI calculated under regulations 20 and 21 of MARPOL Annex VI, f_w is 1.00;
- .2 when f_w is calculated according to the subparagraph .2.1 or .2.2 below, the value for attained EEDI calculated by the formula in

paragraph 2 using the obtained f_w should be referred to as "*attained EEDI_{weather}*";

- .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 Organization⁴ and the method and outcome for an individual ship should be verified by the Administration or an organization recognized by the Administration; and
- .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 Guidelines⁴ 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.

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.

- .10 $f_{eff(i)}$ is the availability factor of each innovative energy efficiency technology. $f_{eff(i)}$ for waste energy recovery system should be one (1.0)⁵.
- .11 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
 - .1 The capacity correction factor, f_i , for ice-classed ships should be taken as the lesser value of f_{i0} and $f_{i,max}$ as tabulated in Table 2, but not less than $f_{i,min} = 1.0$. For further information on approximate correspondence between ice classes, see HELCOM Recommendation 25/7⁶.

Table 2: Capacity correction factor f_i for ice-classed ships

Ship type	f_{i0}	$f_{i,max}$ depending on the ice class			
		IA Super	IA	IB	IC
Tanker	$\frac{0.00138 \cdot L_{pp}^{3.331}}{capacity}$	$2.10L_{pp}^{-0.11}$	$1.71L_{pp}^{-0.08}$	$1.47L_{pp}^{-0.06}$	$1.27L_{pp}^{-0.04}$
Bulk carrier	$\frac{0.00403 \cdot L_{pp}^{3.123}}{capacity}$	$2.10L_{pp}^{-0.11}$	$1.80L_{pp}^{-0.09}$	$1.54L_{pp}^{-0.07}$	$1.31L_{pp}^{-0.05}$

⁴ 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.

⁵ EEDI calculation should be based on the normal seagoing condition outside Emission Control Area designated under regulation 13.6 of MARPOL ANNEX VI.

⁶ HELCOM Recommendation 25/7 may be found at <http://www.helcom.fi>.

Ship type	f_{i0}	$f_{i,max}$ depending on the ice class			
		IA Super	IA	IB	IC
General cargo ship	$\frac{0.0377 \cdot L_{PP}^{2.625}}{capacity}$	$2.18L_{PP}^{-0.11}$	$1.77L_{PP}^{-0.08}$	$1.51L_{PP}^{-0.06}$	$1.28L_{PP}^{-0.04}$
Containership	$\frac{0.1033 \cdot L_{PP}^{2.329}}{capacity}$	$2.10L_{PP}^{-0.11}$	$1.71L_{PP}^{-0.08}$	$1.47L_{PP}^{-0.06}$	$1.27L_{PP}^{-0.04}$
Gas carrier	$\frac{0.0474 \cdot L_{PP}^{2.590}}{capacity}$	1.25	$2.10L_{PP}^{-0.12}$	$1.60L_{PP}^{-0.08}$	$1.25L_{PP}^{-0.04}$

Note: Containership capacity is defined as 70% of the DWT.

- .2 f_{iVSE}^7 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 aluminum alloy to steel) between reference design and enhanced design should not be allowed for the f_{iVSE} 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.

- .3 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:

⁷ 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".

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

Where DWT_{CSR} is the deadweight determined by paragraph 2.4 and LWT_{CSR} is the light weight of the ship.

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

.12 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.

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

$$f_c = R^{-0.7} - 0.014, \text{ where } R \text{ is less than } 0.98$$

or

$$f_c = 1.000, \text{ where } R \text{ is } 0.98 \text{ and above;}$$

where: R is the capacity ratio of the deadweight of the ship (tonnes) as determined by paragraph 2.4 divided by the total cubic capacity of the cargo tanks of the ship (m^3).

.2 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 2.4 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.

.3 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.

.13 *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.

- .14 f_i 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.

$$f_i = f_{cranes} \cdot f_{sideloader} \cdot f_{ro-ro}$$

$$f_{cranes} = 1 \quad \text{If no cranes are present.}$$

$$f_{sideloader} = 1 \quad \text{If no side loaders are present.}$$

$$f_{ro-ro} = 1 \quad \text{If no ro-ro ramp is present.}$$

Definition of f_{cranes} :

$$f_{cranes} = 1 + \frac{\sum_{n=1}^n (0.0519 \cdot SWL_n \cdot Reach_n + 32.11)}{Capacity}$$

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:

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

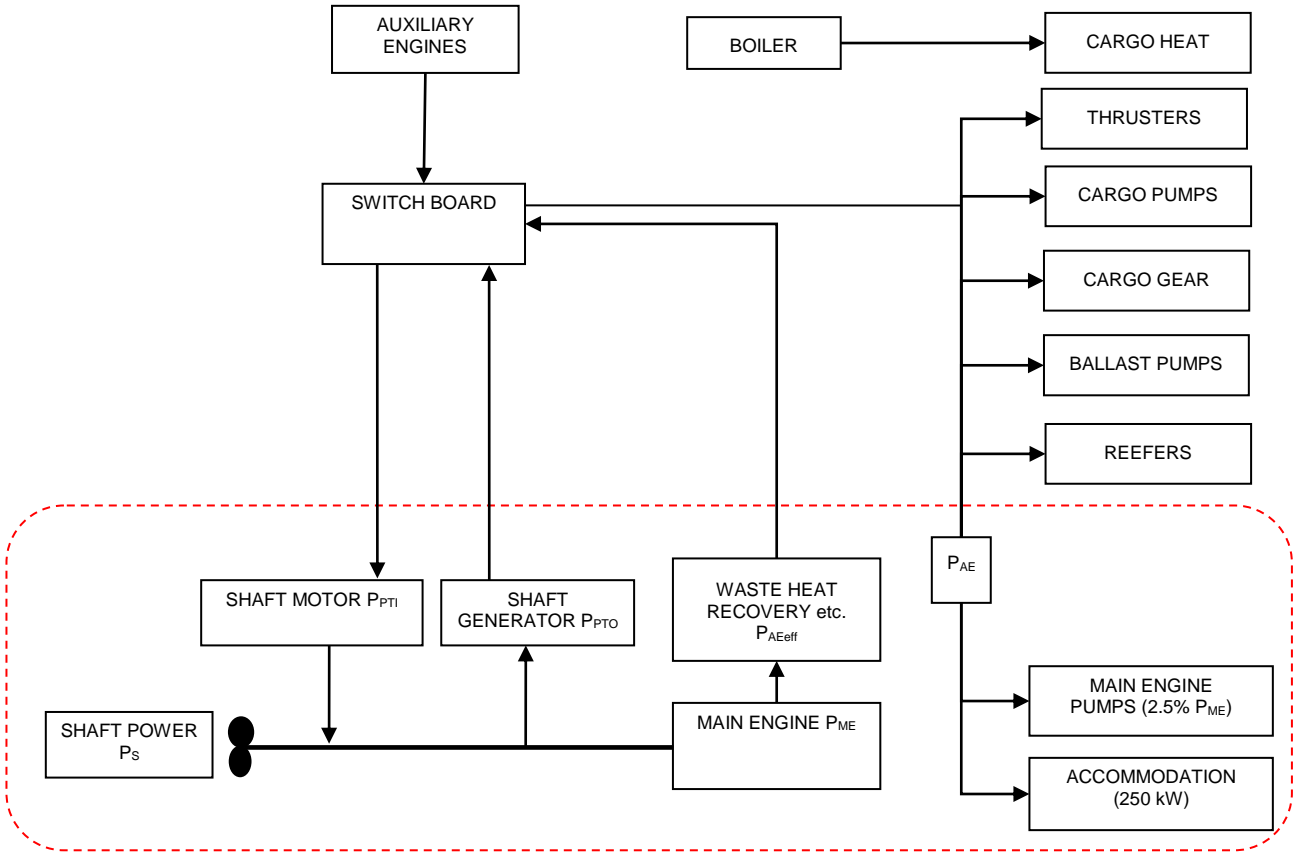
$$f_{RoRo} = \frac{Capacity_{No\ RoRo}}{Capacity_{RoRo}}$$

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} .

- .15 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.
- .16 Breadth, B_s , is the greatest moulded breadth of the ship, in metres, at or below the load line draught, d_s .
- .17 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.
- .18 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 2.5.6 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 " P_m " [kW];
- .6 Load's electric motor rated output power [kW];
- .7 Load's electric motor efficiency " e " [/];
- .8 Load's Rated electric power " P_r " [kW];
- .9 Service factor of load " k_l " [/];
- .10 Service factor of duty " k_d " [/];
- .11 Service factor of time " k_t " [/];
- .12 Service total factor of use " k_u " [/], where $k_u = k_l \cdot k_d \cdot k_t$;
- .13 Load's necessary power " P_{load} " [kW], where $P_{load} = P_r \cdot k_u$;
- .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 PA_{eff} , 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 rows 4 and 5 of paragraph 2.5.6 of the Guidelines, 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 row 5 of paragraph 2.5.6 of the Guidelines;
- .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 " P_m "

4.5 This data is to be indicated in the document only when the 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 " P_r " [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: $P_r = P_m / e$ [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 $\frac{1}{2}$ and $\frac{1}{2}$. When three compressors serves the same circuit and one runs in duty and two in stand-by, then kd is $\frac{1}{3}$, $\frac{1}{3}$ and $\frac{1}{3}$.

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 V_{ref} . 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:
 $ku=kl \cdot kd \cdot kt$.

Loads necessary power "Pload" [kW]

4.13 The individual user contribution to the auxiliary load power is $P_{load}=Pr \cdot ku$.

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.

$$PAE = \sum P_{load}(i) / (\text{average efficiency of the generator(s) weighted by power})$$

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 guideline;
- .4 one Column for the group descriptions as indicated in paragraphs 4.1.1 to 4.1.12 of this guideline;
- .5 one column each for items in paragraphs 4.2 to 4.14 of this guideline (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 guideline; and
- .8 explanatory notes.

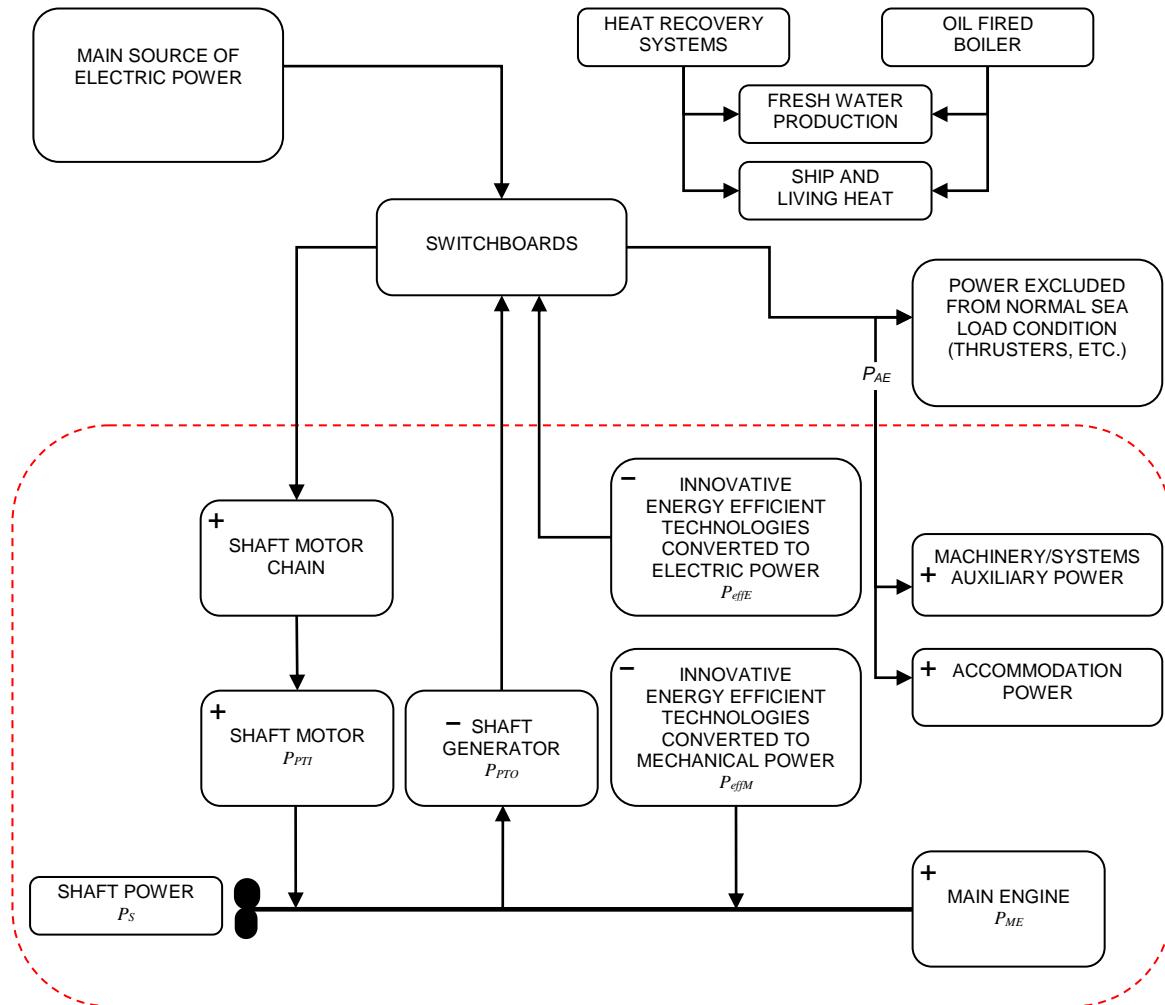
An example of an electric power table for EEDI for a cruise postal ship which transports passengers and has a car garage and reefer holds for fish trade transportation is indicated below. The data indicated and the type of ship is for reference only.

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 D 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 D 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 control 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 circulations 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	1600	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	1600	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	1600	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 explanatory note
51	I	corridors lighthing MVZ3	n.a.	n.a.	n.a.	n.a.	n.a.	10*	1	1	1	1	10.0	* see explanatory 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 explanatory 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 reefer 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=0.22kW)

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 CO₂ contribution to EEDI formula.

APPENDIX 4

EEDI CALCULATION EXAMPLES FOR USE OF DUAL FUEL ENGINES

Standard main engine (HFO), standard auxiliary engines (HFO), no shaft generator:

$$\begin{aligned}
 MCR_{ME} &= 15,000 \text{ kW} \\
 Capacity &= 25,000 \text{ DWT} \\
 C_{FME} &= 3.114 \\
 C_{FAE} &= 3.114 \\
 SFC_{ME} &= 190 \text{ g/kWh} \\
 SFC_{AE} &= 215 \text{ g/kWh} \\
 V_{ref} &= 18 \text{ kn} \\
 P_{ME} &= 0.75 \times MCR_{ME} = 0.75 \times 15,000 \text{ kW} &= 11,250 \text{ kW} \\
 P_{AE} &= (0.025 \times MCR_{ME}) + 250 \text{ kW} &= 625 \text{ kW}
 \end{aligned}$$

$$\begin{aligned}
 EEDI &= [(P_{ME} \times C_{FME} \times SFC_{ME}) + (P_{AE} \times C_{FAE} \times SFC_{AE})] / (V_{ref} \times Capacity) \\
 EEDI &= [(11,250 \times 3.114 \times 190) + (625 \times 3.114 \times 215)] / (18 \times 25,000) \\
 \underline{EEDI} &= \underline{15.721 \text{ gCO}_2/\text{tnm}}
 \end{aligned}$$

Dual-fuel main engine and auxiliary engine (LNG, pilot fuel MDO; no shaft generator), LNG condition for tank capacity and/or operating time is fulfilled:

$$\begin{aligned}
 MCR_{ME} &= 15,000 \text{ kW} \\
 Capacity &= 25,000 \text{ DWT} \\
 C_{F,Gas} &= 2.750 \\
 C_{FPilotfuel} &= 3.206 \\
 SFC_{ME Pilotfuel} &= 6 \text{ g/kWh} \\
 SFC_{ME Gas} &= 160 \text{ g/kWh} \\
 SFC_{AE Pilotfuel} &= 7 \text{ g/kWh} \\
 SFC_{AE Gas} &= 180 \text{ g/kWh} \\
 V_{ref} &= 18 \text{ kn} \\
 P_{ME} &= 0.75 \times MCR_{ME} = 0.75 \times 15,000 \text{ kW} &= 11,250 \text{ kW} \\
 P_{AE} &= (0.025 \times MCR_{ME}) + 250 \text{ kW} &= 625 \text{ kW}
 \end{aligned}$$

$$EEDI = [(P_{ME} \times (C_{FPilotfuel} \times SFC_{ME Pilotfuel} + C_{F,Gas} \times SFC_{ME Gas})) + (P_{AE} \times (C_{FPilotfuel} \times SFC_{AE Pilotfuel} + C_{F,Gas} \times SFC_{AE Gas}))] / (V_{ref} \times Capacity)$$

$$EEDI = [(11,250 \times (3.206 \times 6 + 2.750 \times 160)) + (625 \times (3.206 \times 7 + 2.750 \times 180))] / (18 \times 25,000)$$

$$\underline{EEDI} = \underline{12.200 \text{ gCO}_2/\text{tnm}}$$

Dual-fuel main engine, standard auxiliary engines (HFO), no shaft generator, LNG condition for tank capacity and/or operating time for main engine is fulfilled:

$$\begin{aligned}MCR_{ME} &= 15,000 \text{ kW} \\Capacity &= 25,000 \text{ DWT} \\C_{F \text{ Gas}} &= 2.750 \\C_{F \text{ Pilotfuel}} &= 3.114 \\C_{F \text{ AE}} &= 3.114 \\SFC_{ME \text{ Pilotfuel}} &= 6 \text{ g/kWh} \\SFC_{ME \text{ Gas}} &= 160 \text{ g/kWh} \\SFC_{AE} &= 215 \text{ g/kWh} \\V_{ref} &= 18 \text{ kn} \\P_{ME} &= 0.75 \times MCR_{ME} = 0.75 \times 15,000 \text{ kW} = 11,250 \text{ kW} \\P_{AE} &= (0.025 \times MCR_{ME}) + 250 \text{ kW} = 625 \text{ kW}\end{aligned}$$

$$EEDI = \frac{[(P_{ME} \times (C_{F \text{ Pilotfuel}} \times SFC_{ME \text{ Pilotfuel}} + C_{F \text{ Gas}} \times SFC_{ME \text{ Gas}})) + (P_{AE} \times C_{F, AE} \times SFC_{AE})]}{(V_{ref} \times Capacity)}$$

$$EEDI = \frac{[(11,250 \times (3.114 \times 6 + 2.750 \times 160)) + (625 \times 3.114 \times 215)]}{(18 \times 25,000)}$$

$$\underline{EEDI} = 12.397 \text{ gCO}_2/\text{tnm}$$

4 ALBERT EMBANKMENT
LONDON SE1 7SR
Telephone: +44 (0)20 7735 7611 Fax: +44 (0)20 7587 3210

MEPC.1/Circ.795/Rev.1
21 May 2014

UNIFIED INTERPRETATIONS TO MARPOL ANNEX VI

1 The Marine Environment Protection Committee has approved Unified Interpretations to MARPOL Annex VI as follows:

- .1 at its sixty-first session (27 September to 1 October 2010), Unified Interpretations on scope of application of regulations 15.6 and 15.7 of MARPOL Annex VI (VOC management plan) (MEPC.1/Circ.735);
- .2 at its sixty-fourth session (1 to 5 October 2012), Unified Interpretations to regulations 2, 5, 6, 8, 16 and 22 of MARPOL Annex VI (MEPC.1/Circ.795 and MEPC.1/Circ.795/Corr.1);
- .3 at its sixty-fifth session (13 to 17 May 2013), Unified Interpretations to MARPOL Annex VI on time of replacement of an engine and identical replacement engines (MEPC.1/Cir.812 and MEPC.1/Circ.813), and Unified Interpretations to regulations 5, 6 and 22 of MARPOL Annex VI on Ship Energy Efficiency Management Plan (SEEMP) (MEPC.1/Cir.814); and
- .4 at its sixty-sixth session (31 March to 4 April 2014), amendments to the Unified Interpretation to regulation 2.24 of MARPOL Annex VI on major conversion.

2 MEPC 66 also instructed the Secretariat to issue a consolidated text of the Unified Interpretations to MARPOL Annex VI, incorporating all amendments (MEPC 66/21, paragraph 4.52).

3 Consequently, the Secretariat prepared a consolidated text of all existing Unified Interpretations to MARPOL Annex VI, including those set out in circulars MEPC.1/Circ.735, MEPC.1/Circ.795, MEPC.1/Circ.795/Corr.1, MEPC.1/Circ.812, MEPC.1/Circ.813 and MEPC.1/Circ.814, as set out in the annex to this circular.

4 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.

5 This circular revokes MEPC.1/Circ.735, MEPC.1/Circ.795, MEPC.1/Circ.795/Corr.1, MEPC.1/Circ.812, MEPC.1/Circ.813 and MEPC.1/Circ.814.

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; orin 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; orin 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; orin 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 Certificates

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:

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:

An "identical engine" is, as compared to the engine being replaced¹, 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 settings²; 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 ship³; or
- .2 in the absence of a contractual delivery date, the actual delivery date of the engine to the ship³, 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 16.9

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°C⁴ 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.

ANNEX 9

RESOLUTION MEPC.248(66)
Adopted on 4 April 2014

**AMENDMENTS TO THE ANNEX OF THE PROTOCOL OF 1978 RELATING TO
THE INTERNATIONAL CONVENTION FOR THE PREVENTION OF
POLLUTION FROM SHIPS, 1973**

Amendments to MARPOL Annex I
(Mandatory carriage requirements for a stability instrument)

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 (hereinafter referred to as the "1973 Convention") and article VI of the Protocol of 1978 relating to the International Convention for the Prevention of Pollution from Ships, 1973 (hereinafter referred to as the "1978 Protocol") which together specify the amendment procedure of the 1978 Protocol and confer upon the appropriate body of the Organization the function of considering and adopting amendments to the 1973 Convention, as modified by the 1978 Protocol (MARPOL),

HAVING CONSIDERED proposed amendments to Annex I of MARPOL, developed by the Sub-Committee on Stability and Load Lines and on Fishing Vessels Safety, at its fifty-fifth session,

1. ADOPTS, in accordance with article 16(2)(d) of the 1973 Convention, amendments to Annex I of MARPOL, 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 the 1973 Convention, that the amendments shall be deemed to have been accepted on 1 July 2015 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 the 1973 Convention, the said amendments shall enter into force on 1 January 2016 upon their acceptance in accordance with paragraph 2 above;
4. REQUESTS the Secretary-General, in conformity with article 16(2)(e) of the 1973 Convention, to transmit to all Parties to MARPOL, certified copies of the present resolution and the text of the amendments contained in the annex;
5. REQUESTS FURTHER the Secretary-General to transmit to the Members of the Organization which are not Parties to MARPOL, copies of the present resolution and its annex.

ANNEX

AMENDMENTS TO MARPOL ANNEX I

Chapter 1 – General

Regulation 3 – Exemptions and waivers

1 A new paragraph 6 is inserted, as follows:

"6 The Administration may waive the requirements of regulation 28(6) for the following oil tankers if loaded in accordance with the conditions approved by the Administration taking into account the guidelines developed by the Organization*:

- .1 oil tankers which are on a dedicated service, with a limited number of permutations of loading such that all anticipated conditions have been approved in the stability information provided to the master in accordance with regulation 28(5);
- .2 oil tankers where stability verification is made remotely by a means approved by the Administration;
- .3 oil tankers which are loaded within an approved range of loading conditions; or
- .4 oil tankers constructed before 1 January 2016 provided with approved limiting KG/GM curves covering all applicable intact and damage stability requirements.

* Refer to operational guidance provided in part 2 of the *Guidelines for verification of damage stability requirements for tankers* (MSC.1/Circ.1461)."

Chapter 4 – Requirements for the cargo area of oil tankers

Regulation 28 – Subdivision and damage stability

2 The existing paragraph 6 is renumbered as paragraph 7.

3 A new paragraph 6 is inserted, as follows:

"6 All oil tankers shall be fitted with a stability instrument, capable of verifying compliance with intact and damage stability requirements approved by the Administration having regard to the performance standards recommended by the Organization*:

- .1 oil tankers constructed before 1 January 2016 shall comply with this regulation at the first scheduled renewal survey of the ship after 1 January 2016 but not later than 1 January 2021;
- .2 notwithstanding the requirements of subparagraph .1 a stability instrument fitted on an oil tanker constructed before 1 January 2016 need not be replaced provided it is capable of verifying compliance with intact and damage stability, to the satisfaction of the Administration; and

- .3 for the purposes of control under regulation 11, the Administration shall issue a document of approval for the stability instrument.

* Refer to part B, chapter 4, of the International Code on Intact Stability, 2008 (2008 IS Code), as amended; the *Guidelines for the Approval of Stability Instruments* (MSC.1/Circ.1229), annex, section 4, as amended; and the technical standards defined in part 1 of the *Guidelines for verification of damage stability requirements for tankers* (MSC.1/Circ.1461)."

Appendix II – Form of IOPP Certificate and Supplements, Form B

4 The following new paragraphs 5.7.5 and 5.7.6 are inserted:

- "5.7.5 The ship is provided with an Approved Stability Instrument in accordance with regulation 28(6).....
- 5.7.6 The requirements of regulation 28(6) are waived in respect of the ship in accordance 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)

ANNEX 10

**RESOLUTION MEPC.249(66)
Adopted on 4 April 2014**

**AMENDMENTS TO THE CODE FOR THE CONSTRUCTION AND EQUIPMENT OF SHIPS
CARRYING DANGEROUS CHEMICALS IN BULK (BCH CODE)**

(Cargo containment and Form of Certificate of Fitness)

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 resolution MEPC.20(22) by which the Committee adopted the *Code for the Construction and Equipment of Ships Carrying Dangerous Chemicals in Bulk (BCH Code)*,

NOTING article 16 of the International Convention for the Prevention of Pollution from Ships, 1973 (hereinafter referred to as the "1973 Convention") and article VI of the Protocol of 1978 relating to the International Convention for the Prevention of Pollution from Ships, 1973 (hereinafter referred to as the "1978 Protocol") which together specify the amendment procedure of the 1978 Protocol and confer upon the appropriate body of the Organization the function of considering and adopting amendments to the 1973 Convention, as modified by the 1978 Protocol (MARPOL),

CONSIDERING that it is highly desirable for the provisions of the BCH Code which are mandatory under MARPOL and recommendatory from a safety standpoint, to remain identical, when adopted by the Marine Environment Protection Committee and the Maritime Safety Committee,

HAVING CONSIDERED proposed amendments to the BCH Code, developed by the Sub-Committee on Stability and Load Lines and on Fishing Vessels Safety, at its fifty-fifth session,

1. ADOPTS, in accordance with article 16(2)(b), (c) and (d) of the 1973 Convention, amendments to the BCH Code, 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 the 1973 Convention, that the amendments to the BCH Code shall be deemed to have been accepted on 1 July 2015 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 the 1973 Convention, the amendments to the BCH Code shall enter into force on 1 January 2016 upon their acceptance in accordance with paragraph 2 above;
4. INVITES ALSO the Maritime Safety Committee to note this resolution and take action as appropriate;

5. REQUESTS the Secretary-General, in conformity with article 16(2)(e) of the 1973 Convention, to transmit to all Parties to MARPOL, certified copies of the present resolution and the text of the amendments to the BCH Code contained in the annex;

6. REQUESTS FURTHER the Secretary-General to transmit copies of the present resolution and its annex to the Members of the Organization which are not Parties to MARPOL.

ANNEX

**AMENDMENTS TO THE CODE FOR THE CONSTRUCTION AND EQUIPMENT
OF SHIPS CARRYING DANGEROUS CHEMICALS IN BULK (BCH CODE)**

Chapter II – Cargo containment

Part A – Physical protection (Siting of cargo tanks; ship stability)

1 Existing subparagraph 2.2.1 is replaced by the following:

"2.2.1 General: Ships subject to this Code may be assigned the minimum freeboard permitted by the International Convention on Load Lines, 1966. The additional requirements in paragraph 2.2.4, taking into account any empty or partially filled tank as well as the specific gravities of cargoes to be carried, however, should govern the allowed operating draught for any actual condition of loading.

2.2.1.1 All ships engaged in the transport of chemicals in bulk should be supplied with loading and stability manuals for the information and guidance of the master. These manuals should contain details concerning the loaded conditions of full and empty or partially empty tanks, the position of these tanks in the ship, the specific gravities of the various parcels of cargoes carried, and any ballast arrangements in critical conditions of loading. Provisions for evaluating other conditions of loading should be contained in the manuals.

2.2.1.2 All ships subject to the Code, shall be fitted with a stability instrument, capable of verifying compliance with intact and damage stability requirements approved by the Administration, at the first scheduled renewal survey of the ship after 1 January 2016, but not later than 1 January 2021, having regard to the performance standards recommended by the Organization*:

- .1 notwithstanding the above, a stability instrument fitted on a ship before 1 January 2016 need not be replaced provided it is capable of verifying compliance with intact and damage stability, to the satisfaction of the Administration; and
- .2 for the purposes of control under regulation 16 of MARPOL Annex II, the Administration shall issue a document of approval for the stability instrument.

* Refer to part B, chapter 4, of the International Code on Intact Stability, 2008 (2008 IS Code), as amended; the *Guidelines for the Approval of Stability Instruments* (MSC.1/Circ.1229), annex, section 4, as amended; and the technical standards defined in part 1 of the *Guidelines for verification of damage stability requirements for tankers* (MSC.1/Circ.1461).

2.2.1.3 The Administration may waive the requirements of paragraph 2.2.1.2 for the following ships provided the procedures employed for intact and damage stability verification maintain the same degree of safety as being loaded in accordance with the approved conditions**. Any such waiver shall be duly noted on the Certificate of Fitness referred to in paragraph 1.6.3:

- .1 ships which are on a dedicated service, with a limited number of permutations of loading such that all anticipated conditions have been approved in the stability information provided to the master in accordance with the requirements of paragraph 2.2.1.1;
- .2 ships where stability verification is made remotely by a means approved by the Administration;
- .3 ships which are loaded within an approved range of loading conditions; or
- .4 ships provided with approved limiting KG/GM curves covering all applicable intact and damage stability requirements.

** Refer to operational guidance provided in part 2 of the *Guidelines for verification of damage stability requirements for tankers* (MSC.1/Circ.1461).

Certificate of Fitness

2 Paragraph 6 is replaced with the following:

"6 That the ship must be loaded:

- .1^{***} only in accordance with loading conditions verified compliant with intact and damage stability requirements using the approved stability instrument fitted in accordance with paragraph 2.2.1.2 of the Code;
- .2^{***} where a waiver permitted by paragraph 2.2.1.3 of the Code is granted and the approved stability instrument required by paragraph 2.2.1.2 of the Code is not fitted, loading shall be made in accordance with the following approved methods:
 - (i) in accordance with the loading conditions provided in the approved loading manual, stamped and dated and signed by a responsible officer of the Administration, or of an organization recognized by the Administration; or
 - (ii) in accordance with loading conditions verified remotely using an approved means; or
 - (iii) in accordance with a loading condition which lies within an approved range of conditions defined in the approved loading manual referred to in (i) above; or
 - (iv) in accordance with a loading condition verified using approved critical KG/GM data defined in the approved loading manual referred to in (i) above;

.3^{***} in accordance with the loading limitations appended to this Certificate.

Where it is required to load the ship other than in accordance with the above instruction, then the necessary calculations to justify the proposed loading conditions shall be communicated to the certifying Administration who may authorize in writing the adoption of the proposed loading condition.

*** Delete as appropriate."

ANNEX 11

**RESOLUTION MEPC.250(66)
Adopted on 4 April 2014**

**AMENDMENTS TO THE INTERNATIONAL CODE FOR THE CONSTRUCTION AND
EQUIPMENT OF SHIPS CARRYING DANGEROUS CHEMICALS IN BULK
(IBC CODE)**

**(General, Ship survival capability and location of cargo tanks, Cargo tank venting
and gas-freeing arrangements, Environmental control, Fire protection and
fire extinction, Special requirements, Summary of minimum requirements,
and Form of Certificate of Fitness)**

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 resolution MEPC.19(22) by which the Committee adopted the *International Code for the Construction and Equipment of Ships Carrying Dangerous Chemicals in Bulk (IBC Code)*,

NOTING article 16 of the International Convention for the Prevention of Pollution from Ships, 1973 (hereinafter referred to as the "1973 Convention") and article VI of the Protocol of 1978 relating to the International Convention for the Prevention of Pollution from Ships, 1973 (hereinafter referred to as the "1978 Protocol") which together specify the amendment procedure of the 1978 Protocol and confer upon the appropriate body of the Organization the function of considering and adopting amendments to the 1973 Convention, as modified by the 1978 Protocol (MARPOL),

CONSIDERING that it is highly desirable for the provisions of the IBC Code, which are mandatory under both MARPOL and the 1974 SOLAS Convention, to remain identical,

HAVING CONSIDERED proposed amendments to the IBC Code,

1. ADOPTS, in accordance with article 16(2)(b), (c) and (d) of the 1973 Convention, the amendments to the IBC Code, 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 the 1973 Convention, that the amendments to the IBC Code shall be deemed to have been accepted on 1 July 2015 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 the 1973 Convention, the amendments to the IBC Code shall enter into force on 1 January 2016 upon their acceptance in accordance with paragraph 2 above;

4. REQUESTS the Secretary-General, in conformity with article 16(2)(e) of the 1973 Convention, to transmit to all Parties to MARPOL, certified copies of the present resolution and the text of the amendments to the IBC Code contained in the annex; and

5. REQUESTS FURTHER the Secretary-General to transmit copies of the present resolution and its annex to the Members of the Organization which are not Parties to MARPOL.

ANNEX

**AMENDMENTS TO THE INTERNATIONAL CODE FOR THE CONSTRUCTION AND
EQUIPMENT OF SHIPS CARRYING DANGEROUS CHEMICALS IN BULK
(IBC CODE)**

Chapter 1 – General

- 1 New paragraphs 1.3.37 and 1.3.38 are added as follows:

"1.3.37 *Purging* means the introduction of inert gas into a tank which is already in an inert condition with the object of further reducing the oxygen content; and/or reducing the existing hydrocarbon or other flammable vapours content to a level below which combustion cannot be supported if air is subsequently introduced into the tank.

1.3.38 *Gas-freeing* means the process where a portable or fixed ventilation system is used to introduce fresh air into a tank in order to reduce the concentration of hazardous gases or vapours to a level safe for tank entry."

Chapter 2 – Ship survival capability and location of cargo tanks

2.2 – Freeboard and intact stability

- 2 The title of section 2.2 is amended to read:

"Freeboard and stability"

- 3 A new subparagraph 2.2.6 is added as follows:

"2.2.6 All ships, subject to the Code, shall be fitted with a stability instrument, capable of verifying compliance with intact and damage stability requirements, approved by the Administration having regard to the performance standards recommended by the Organization*:

- .1 ships constructed before 1 January 2016 shall comply with this requirement at the first scheduled renewal survey of the ship after 1 January 2016 but not later than 1 January 2021;
- .2 notwithstanding the requirements of 2.2.6.1, a stability instrument fitted on a ship constructed before 1 January 2016 need not be replaced provided it is capable of verifying compliance with intact and damage stability, to the satisfaction of the Administration; and
- .3 for the purposes of control under regulation 16 of MARPOL Annex II, the Administration shall issue a document of approval for the stability instrument.

* Refer to part B, chapter 4, of the International Code on Intact Stability, 2008 (2008 IS Code), as amended; the *Guidelines for the Approval of Stability Instruments* (MSC.1/Circ.1229), annex, section 4, as amended; and the technical standards defined in part 1 of the *Guidelines for verification of damage stability requirements for tankers* (MSC.1/Circ.1461)."

4 A new subparagraph 2.2.7 is added as follows:

"2.2.7 The Administration may waive the requirements of paragraph 2.2.6 for the following ships provided the procedures employed for intact and damage stability verification maintain the same degree of safety, as being loaded in accordance with the approved conditions*. Any such waiver shall be duly noted on the International Certificate of Fitness referred to in paragraph 1.5.4:

- .1 ships which are on a dedicated service, with a limited number of permutations of loading such that all anticipated conditions have been approved in the stability information provided to the master in accordance with the requirements of paragraph 2.2.5;
- .2 ships where stability verification is made remotely by a means approved by the Administration;
- .3 ships which are loaded within an approved range of loading conditions; or
- .4 ships constructed before 1 January 2016 provided with approved limiting KG/GM curves covering all applicable intact and damage stability requirements.

* Refer to operational guidance provided in part 2 of the *Guidelines for verification of damage stability requirements for tankers* (MSC.1/Circ.1461)."

Chapter 8 – Cargo tank venting and gas-freeing arrangements

5 In paragraph 8.1.5, the references to "SOLAS regulations II-2/4.5.3 and 4.5.6" are replaced by references to "SOLAS regulations II-2/4.5.3, 4.5.6 and 16.3.2".

6 A new paragraph 8.5 is inserted as follows:

"8.5 Cargo tank purging

When the application of inert gas is required by 11.1.1, before gas-freeing, the cargo tanks shall be purged with inert gas through outlet pipes with cross-sectional area such that an exit velocity of at least 20 m/s can be maintained when any three tanks are being simultaneously supplied with inert gas. The outlets shall extend not less than 2 m above the deck level. Purging shall continue until the concentration of hydrocarbon or other flammable vapours in the cargo tanks has been reduced to less than 2% by volume."

7 The existing paragraph 8.5 and subparagraphs 8.5.1, 8.5.2 and 8.5.3 are renumbered as paragraph 8.6 and subparagraphs 8.6.1, 8.6.2 and 8.6.3, respectively.

Chapter 9 – Environmental control

8 The chapeau of paragraph 9.1.3 is replaced by the following:

"9.1.3 Where inerting or padding of cargo tanks is required by this Code in column "h" of chapter 17:"

Chapter 11 – Fire protection and fire extinction*

9 Subparagraph 11.1.1.1 is replaced by the following:

"11.1.1.1 Regulations 10.8 and 10.9 shall not apply;"

Chapter 15 – Special requirements

10 Paragraph 15.13.5 is replaced by the following:

"15.13.5 When a product containing an oxygen-dependent inhibitor is to be carried:

- .1 in a ship for which inerting is required under SOLAS regulation II-2/4.5.5, as amended, the application of inert gas shall not take place before loading or during the voyage, but shall be applied before commencement of unloading*;
- .2 in a ship to which SOLAS regulation II-2/4.5.5, as amended, does not apply, the product may be carried without inertion (in tanks of a size not greater than 3,000 m³). If inertion is to be applied on such a ship, then the application of inert gas shall not take place before loading or during the voyage, but shall be applied before commencement of unloading*.

* Refer to the MSC-MEPC circular on Products requiring oxygen dependent inhibitors."

Chapter 17 – Summary of minimum requirements

11 The explanatory notes for "Tank environment control (column h)" are replaced by the following:

"Tank environmental control (column h)"	Inert: Pad: Dry: Vent: No:	inerting (9.1.2.1) liquid or gas padding (9.1.2.2) drying (9.1.2.3) natural or forced ventilation (9.1.2.4) no special requirements under this Code (inerting may be required under SOLAS)"
--	--	--

Certificate of Fitness

12 Paragraph 6 is replaced with the following:

"6 That the ship must be loaded:

- .1* only in accordance with loading conditions verified compliant with intact and damage stability requirements using the approved stability instrument fitted in accordance with paragraph 2.2.6 of the Code;
- .2* where a waiver permitted by paragraph 2.2.7 of the Code is granted and the approved stability instrument required by paragraph 2.2.6 of the Code is not fitted, loading shall be made in accordance with the following approved methods:

- (i) in accordance with the loading conditions provided in the approved loading manual, stamped and dated and signed by a responsible officer of the Administration, or of an organization recognized by the Administration; or
- (ii) in accordance with loading conditions verified remotely using an approved means; or
- (iii) in accordance with a loading condition which lies within an approved range of conditions defined in the approved loading manual referred to in (i) above; or
- (iv) in accordance with a loading condition verified using approved critical KG/GM data defined in the approved loading manual referred to in (i) above;

.3^{*} in accordance with the loading limitations appended to this Certificate.

Where it is required to load the ship other than in accordance with the above instruction, then the necessary calculations to justify the proposed loading conditions shall be communicated to the certifying Administration who may authorize in writing the adoption of the proposed loading condition.

* Delete as appropriate."
