標題

MEPC 68 の審議結果の紹介

ClassNK
テクニカル
インフォメーション

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2015 年 5 月 11 日から 15 日にかけて開催された IMO の第 68 回海洋環境保護委員会（MEPC 68）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. 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ため、バラスト水管理条約が 2004 年に採択されています。同条約では、船舶に対して沖合におけるバラスト水交換を実施するか、バラスト水排出基準を満足するバラスト水処理装置を使用したバラスト水交換が要求されています。

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。

(1) 条約の批准状況

MEPC 67（2014 年 10 月）以降、新たに条約を批准した国はグルジアだけであり、同条約の批准国数は 44 ヶ国、合計商船船腹量に対する比率は 32.86%になりましたが、依然未発効となっています。

(2) バラスト水処理装置の承認

同条約で規定されるバラスト水処理装置は、IMO のガイドラインに従っ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・滅菌するための「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。

今回の会合では、活性物質を用いたバラスト水処理装置について、5 件の基本承認、及び 1 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 37 件となりました。

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 57 件です。承認された装置のリストは、IMO のウェブサイトで公開されます。

http://www.imo.org/OurWork/Environment/BallastWaterManagement/Pages/BWMTechnologies.aspx

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(3) 活性物質を使用するバラスト水管理システムの承認手順（G9）の改正
G9ガイドラインでは、基本承認又は最終承認をIMOに申請する前に、主管庁はGESAMPにおいて作成された基準（メソドロジー）に従って申請内容を確認することが規定されています。
今回の会合において、GESAMP で見直されたメソドロジーの改訂案（添付 10. BWM.2/Circ.13/Rev.3）が承認され、MEPC 71 以降の承認申請から適用することが合意されました。

(4) バラスト水処理装置の型式承認のための G8 ガイラインの改正
現行の G8 ガイドラインに従って型式承認されたバラスト水処理装置が、使用環境によっては基準値以上の値が検出される可能性があることから、通信部会を設置して G8 ガイドラインの見直しを行うことについて、MEPC 66（2014 年 4 月）より審議が行われています。
今回の会合では、試験水の塩分濃度・温度・浮遊物質に対する条件、タンク保持期間、試験生物の標準化、試験機関によって作成される試験報告書の記載内容の強化などについて審議を行った結果、通信部会を再び設置して、G8 ガイドラインの見直し作業を継続することが合意されました。

(5) 条約施行に向けた課題の検討
前回の会合において、上記（4）の見直し作業の結果G8ガイドラインを改正することとなった場合、現行の G8 ガイドラインに基づいて承認されたバラスト水処理装置を搭載した船舶が不利益を被ることがない措置を講じることを明記した MEPC 決議が採択されました。
今回の会合では、先行してバラスト水処理装置を搭載した船主への保護策及び条約の円滑な実施に向けた今後の作業計画に関する審議が行われました。審議の結果、船主の保護策に関しては、MEPC67 で採択された決議内容を踏まえ、
(i) 現行の G8 ガイドラインに基づいて承認されたバラスト水処理装置を先行して搭載している船舶に対し、今後、ガイドラインが改正されても、改正ガイドラインに基づいて承認されたバラスト処理装置への換装を要求しないこと
(ii) 船主が、現行の G8 ガイドラインに基づいて承認されたバラスト水処理装置に対し、以下の条件にて運用しているにも関わらず、条約が定める排出基準値以上の生物を含むバラスト水が排出されていることが確認された場合、当該船舶に対し、拘留等の処罰を行わないこと。
- 承認されたバラスト水管理計画を遵守していること
- 製造者の指示に従って適切に保守されていること
- 自己監視装置の正常な作動の下で稼働していること

に合意するとともに、
(i) 基準値以上の排出が確認された場合の緊急対処方策に関するガイダンスの策定
(ii) 条約発効後、2～3 年間実施することが決定しているサンプリング・分析法に関する検証のための試行期間を、D2 基準を満足しない処理方法、及びその原因について情報収集を行うために、必要な期間延長すること

等を内容とする条約の発効・実施に向けた今後の作業計画を策定しました。

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(6) バラスト水処理装置の搭載時期見直しに関する条約改正案
2013 年に開催された第 28 回 IMO 総会において、現存船に対するバラスト水処理装置の搭載義務期限について、最大 5 年間の延長などを定めた総会決議 A.1088(28)が採択されました。また、条約発効後、速やかに本決議に基づく B-3 規則の改正を行うことが勧告されています。
今回の会合では、決議 A.1088(28)の内容を反映するための条約改正案を作成し、次回の会合において、法律面から更なる検討を行うことが合意されました。

(7) バラストサンプリングに関するガイダンス
バラスト水管理条約第 9 条において、PSC におけるバラスト水サンプリングについて規定されています。また、MEPC 65（2013 年 5 月）において、バラスト水のサンプリング・分析方法についてのガイダンスが BWM.2/Circ.42 として承認されています。
今回の会合では、PPR 2（2015 年 1 月）にて合意された新たな簡易分析手法（Pulse Counting fluorescein diacetate（FDA））を同ガイダンスに追加する改正案（添付 11. BWM.2/Circ.42/Rev.1）が承認されました。

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。
2011 年 7 月に開催された MEPC 62 において、エネルギー効率設計指標（EEDI）及び船舶エネルギー効率管理計画（SEEMP）の船舶への備え付け等を義務化する MARPOL 条約 附属書 VI の改正が採択され、2013 年 1 月 1 日に発効しました。また、MEPC 66（2014 年 4 月）では、EEDI 規制の適用を ro-ro 船、LNG 運搬船、クルーズ客船に拡大する MARPOL 条約附属書 VI の改正が採択され、2015 年 9 月 1 日に発効する予定です。

(1) EEDI 検査・証書ガイドラインの改正
海上速力試験解析法の ISO 規格（ISO15016:2002）の改正作業が ISO と国際水槽試験会議（ITTC）により行われ、「ISO15016:2015」が 2015 年 4 月 1 日に発行されました。
今回の会合において、EEDI 検査・証書ガイドラインで引用されている当該 ISO 規格等を修正するための一部改正が採択されました（添付 4. resolution MEPC.261(68)参照）。また、ISO15016:2015 は、2015 年 9 月 1 日以降に海上試運転を実施する船舶から適用されることが合意されました。
これにより、速力試験の解析方法が変更になるだけでなく、速力試験の実施方法が強化されることになります。例えば、航走計測時間が 10 分間以上要求されるようになると共に、新設計船の場合には航走回数が少なくとも 1 往復追加されることになります。なお、本件に関してテクニカル・インフォメーション No.1030 を発行していますので、詳細につきましては、そちらをご確認下さい。

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(2) 最低推進出力ガイドラインの改正

MEPC 67（2014 年 10 月）において、適用対象船舶及び評価手法（レベル 1、レベル 2）を維持したまま、最低推進出力暫定ガイドラインをフェーズ 1 の期間まで延長適用することが合意されました。一方で、同ガイドラインの要件を強化するギリシャ提案について、今後の MEPC で検討することも合意されました。

審議の結果、レベル 1 の要件を以下の通り強化することが合意され、同ガイドラインの一部改正が採択されました（添付 5. resolution MEPC.262(68)参照）。レベル 2 の評価については、欧州と日本で現在実施されている研究開発プロジェクトの成果が報告される 2016 年後半以降に、当該要件の原則事項をレビューすることが再確認されました。

2015 年 11 月 16 日以降に建造契約が結ばれる船舶に対する Level 1 最低推進出力ライン

船　種	最低推進出力 (kW)
ばら積貨物船 (20,000 ≤ DWT < 145,000)	0.0763 x DWT + 3374.3
ばら積貨物船 (145,000 ≤ DWT)	0.0490 x DWT + 7329.0
タンカー及び兼用船 (20,000 ≤ DWT)	0.0652 x DWT + 5960.2

現行の Level 1 最低推進出力ライン

船　種	最低推進出力 (kW)
ばら積貨物船 (20,000 ≤ DWT)	0.0687 x DWT + 2924.4
タンカー及び兼用船 (20,000 ≤ DWT)	0.0689 x DWT + 3253.0

改正ガイドラインの適用期日について、採択後 6 か月の導入期間を設けることが合意され、2015 年 11 月 16 日以降に建造契約が結ばれる船舶に適用されることとなりました。なお、本件に関してテクニカル・インフォメーション No.1039 を発行していますので、詳細につきましては、そちらをご確認下さい。

(3) EEDI 規制に関する技術開発状況レビュー

MARPOL 条約 附属書 VI 第 21.6 規則で、フェーズ 1 の開始時点及びフェーズ 2 の中間点において EEDI の改善に寄与する技術の開発動向をレビューし、要すれば、フェーズの開始時期、関連船種のリファレンスライン算定パラメータ及び削減率を改正することが規定されています。MEPC 67（2014 年 10 月）において、日本をコーディネータとする通信部会が設置され、今回の会合にその進捗報告が提出されました。

審議の結果、MEPC 67（2014 年 10 月）で合意された付託事項に従って作業を継続することが合意されました。次回 MEPC 69（2016 年 4 月）に中間報告、MEPC 70（2016 年 10 月）で最終報告が提出される予定です。

(4) 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 規則において、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 66（2014 年 4 月）において、特別作業部会が設置され、技術移転・協力のための具体的な活動及びスケジュールを定めた作業計画を作成し、MEPC 69（2016 年 4 月）においてその成果を報告することが合意されました。

今回の会合では、同作業部会の進捗状況が報告されました。

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(5) 燃費報告制度（MRV）

MEPC 65（2013 年 5 月）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）を検討することが合意され、MEPC 66（2014 年 4 月）から本格的な審議が開始されました。

今回の会合では、MEPC 67 で設置された通信部会における検討結果が報告されました。審議の結果、Confidentiality の確保を前提とした 3 ステップアプローチ（①データ収集、②データ分析・指標の検討、③規制の検討・決定）について、大勢が支持しました。一方で、燃費報告制度を義務要件（mandatory）、または、任意要件（voluntary）とするかの決定については次回以降に持ち越されました。

また、通信部会の検討結果を基に、データ収集のための燃費報告制度の枠組み案が基本合意されました。実貨物量、航行距離、海上滞在時間等の「トランスポートワーク」に関連したデータ収集については、「データの秘匿性」、「一貫性があること」及び「シンプルであること」の三原則を基本として、今後更に検討されることとなりました。

燃費報告制度に必要なガイドライン策定等の技術的な詳細検討を進めるために、中間作業会合を 2015 年 9 月 9 日～11 日に開催することが合意されました。

(6) 船舶からの GHG 排出削減目標の設定

今回の会合では、マーシャル諸島から IMO による国際海運部門の GHG 排出削減目標の設定、及び排出削減目標の実現に必要な措置の策定を進めることが提案されました。

審議の結果、マーシャル諸島の提案が重要であることを認識した上で、現在 IMO において喫緊の課題である船舶のエネルギー効率改善の追及（EEDI、SEEMP）と燃費報告制度（MRV）の規制枠組みの策定を早急に進める必要があることが合意されました。

3. 大気汚染防止関連

(1) 排ガス浄化装置ガイドライン（EGCS ガイドライン）

MARPOL 条約附属書 VI 第 14 規則では、船舶から排出される硫黄酸化物（SOx）を削減するために，硫黄分濃度規制値を満たす燃料油の使用が義務付けられています。また、代替措置として同附属書の第 4 規則では、主管庁によって承認された同等措置による対応が認められています。その同等措置の一つとして排ガス浄化装置の使用があり，同装置の技術基準及び認証方法を定めた「2009 年排ガス浄化装置ガイドライン」が MEPC59（2009 年 7 月）で承認されました。

今回の会合では、PPR 2（2015 年 1 月）で審議が行われた同ガイドラインの改正案を審議した結果、以下の手法を導入するための「2015 年排ガス浄化装置ガイドライン」が承認されました（添付 1. resolution MEPC.259(68)参照）。

(i) 湿り状態における排ガス中の CO2 計測方法

(ii) EGCS の排水口から 4m 先における海水中 pH の基準の計算による適合検証

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(2) 硫黄分濃度規制値における燃料油供給可能性のレビュー
MARPOL 条約 附属書 VI 第 14.8 規則において、燃料油中の硫黄分濃度規制値を 2020 年より 0.5%に強化する前に、規制値に適合した低硫黄燃料油が十分に供給可能であるかをレビューすることが規定されています。同レビューは 2018 年までに完了し、レビューの結果によっては、規制強化の時期を 2020 年から 2025 年まで延期することとされています。
今回の会合では、レビューの開始時期及び手法について検討を行うための通信部会の審議結果が報告されました。審議の結果、レビュー実施のための運営委員会を設立しレビューを開始すること及びレビュー結果の最終報告を MEPC 70（2016 年 10 月）に提出することが合意されました。

(3) 燃料油の品質管理
MARPOL 条約 附属書 VI 第 18 規則では、有害な添加物の含有禁止等、船舶に供給される燃料油の品質が規定されており、前回の会合では燃料油の品質を確保するためのガイダンスの作成及び現行条約の規制内容を検討するための通信部会が設置されました。
今回の会合で通信部会の審議結果を審議した結果、燃料油品質確保のための現行条約の枠組みは不十分であること及びガイダンス案について更なる審議が必要との意見が多くあったことから、今回の会合での審議結果を踏まえて、引き続き通信部会での審議を継続することとなりました。

(4) 燃料油の船上サンプリング
今回の会合において、デンマーク及びノルウェーより、船上における燃料油のサンプリングとその硫黄含有率の検証に関するガイドラインの策定などを提案する文書が提出されました。
審議の結果、船内で使用されている燃料油のサンプリング及びその分析を安全で一貫した方法で行う必要があることから、同ガイドラインの策定を新規作業計画として承認し、PPR 3（2016 年 2 月）にて審議を行うこととなりました。

(5) MARPOL 条約附属書 VI 及び NOx テクニカルコードの改正
MEPC 67（2014 年 10 月）において、ガス専焼エンジンを NOx 規制の対象とする MARPOL 条約附属書 VI の改正が採択されました。
今回の会合では、ガス専焼エンジンの NOx 認証の要件（二元燃料エンジンにも適用される要件も一部含む）を追加する NOx テクニカルコードの改正案が承認されました（添付 3. Draft amendments to NOx Technical Code 2008 参照）。
また、NOx 排出規制海域（NOx ECA）内において NOx 3 次規制値に適合したエンジンのみが運転されていることを示すために、NOx ECA 出入時及び NOx ECA 内におけるエンジンの始動及び停止時に、本船に搭載のエンジンの運転状態を航海日誌に記録する要件を追加する MARPOL 条約附属書 VI の改正案が承認されました（添付 2. draft amendments to MARPOL Annex VI 参照）。
これらの改正案は、MEPC 69（2016 年 4 月）にて採択される見込みです。

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(6) NOx 排出規制海域内における二元燃料エンジンの油モード運転に関するガイダンス
二元燃料エンジン及びガス専焼エンジンに対する NOx 3 次規制適用に関するガイダンスが承認されました（添付 12. MEPC.1/Circ.854）。同ガイダンスでは、NOx 排出規制海域内において、二元燃料機関が油燃焼モードでの運転を余儀なくされる以下のケースの取り扱いが示されています。
(i) 故障によるガス供給制限時
(ii) 建造直後、ドライドック及び修理・保守の際のガスフリー時
(iii) エンジンの始動・停止時、低負荷時、操船・逆転時

4. 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 ヶ国以上の批准、批准国の船腹量合計が世界船腹量の 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。2015 年 7 月末時点の、同条約への批准国はノルウェー、コンゴ共和国及びフランスの 3 ヶ国です。
(1) インベントリに記載すべき有害物質の閾値の検討
2015 年 2 月に開催された第 2 回汚染防止・対応小委員会（PPR 2）において、インベントリに記載すべき有害物質の閾値について見直しを行った所、アスベストの閾値は 0.1%を基本とし、1%を採用する場合にはその旨をインベントリに記載することが合意されました。
(2) 今回の会合では、PPR 2 において作成された有害物質インベントリガイドラインの改正が承認されました（添付 9. resolution MEPC.269(68)参照）。

5. 極海コード（Polar Code）
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の環境保護等を目的とした極海コードについて、2009 年以降検討を行ってきました。同コードの Part I には、極海特有の危険性を考慮した復原性、耐航性、防火・救命設備、無線通信などの安全要件、Part II に油や汚水などによる海洋汚染防止のための環境保護要件が規定されています。昨年 11 月に開催された MSC 94 において、Part I の安全要件及び同コードを強制化する SOLAS 条約 XIV 章の改正が採択されました。
今回の会合では、Part II の環境保護要件（添付 6. Resolution MEPC.264(68)）及び同コードを強制化するための MARPOL 条約の改正（添付 7. Resolution MEPC.265(68)）が採択されました。また、Polar Code の施行により改訂が必要となる MARPOL 関連の証書、P&A マニュアル、廃物記録簿の様式に関するガイダンス（添付 13. MEPC.1/Circ.856）が承認されました。

（次頁に続く）

6. 採択された強制要件
今回の会合で採択された強制要件は以下の通りです。
(1) 極海コードの環境保護要件
極海コード及び同コードを強制化するための MARPOL 条約附属書 I、II、IV、V の改正（5 項を参照）

発効日:2017 年 1 月 1 日

(2) 機関室ビルジ及びスラッジタンクに関する要件の明確化
MARPOL 条約付属書 I 第 12 規則に関する既存の統一解釈を取り入れて、要件を明確化するための MARPOL 条約附属書 I 第 12 規則の改正（添付 8. resolution MEPC.266(68) 参照）

発効日:2017 年 1 月 1 日

本 MEPC 68 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

なお、本件に関してご不明な点は、以下の部署にお問い合わせください。

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添付:

1. resolution MEPC.259(68)
2. draft amendments to MARPOL Annex VI
3. draft amendments to the NOx Technical Code 2008
4. resolution MEPC.261(68)
5. resolution MEPC.262(68)
6. resolution MEPC.264(68)
7. resolution MEPC.265(68)
8. resolution MEPC.266(68)
9. resolution MEPC.269(68)
10. BWM.2/Circ.13/Rev.3
11. BWM.2/Circ.42/Rev.1
12. MEPC.1/Circ.854
13. MEPC.1/Circ.856

ANNEX 1

RESOLUTION MEPC.259(68)
(adopted on 15 May 2015)

2015 GUIDELINES FOR EXHAUST GAS CLEANING SYSTEMS

THE MARINE ENVIRONMENT PROTECTION COMMITTEE,

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

RECALLING ALSO that, at its fifty-eighth session, the Committee adopted, by resolution MEPC.176(58), a revised MARPOL Annex VI which significantly strengthens the emission limits for sulphur oxides (SO_X),

RECALLING FURTHER that, at its fifty-ninth session, the Committee adopted, by resolution MEPC.184(59), the *2009 Guidelines for exhaust gas cleaning systems* (hereinafter referred to as "2009 EGCS Guidelines"),

NOTING that the revised MARPOL Annex VI entered into force on 1 July 2010,

NOTING ALSO that regulation 4 of MARPOL Annex VI allows the use of an alternative compliance method at least as effective in terms of emission reductions as that required by MARPOL Annex VI, including any of the standards set forth in regulation 14, taking into account guidelines developed by the Organization,

RECOGNIZING the need to update the 2009 EGCS Guidelines accordingly,

HAVING CONSIDERED, at its sixty-eighth session, draft amendments to the 2009 EGCS Guidelines, prepared by the Sub-Committee on Pollution Prevention and Response, at its second session,

1 ADOPTS the *2015 Guidelines for exhaust gas cleaning systems*, as set out in the annex to the present resolution;

2 INVITES Administrations to take these Guidelines into account when allowing the use of an exhaust gas cleaning system in accordance with regulation 4 of MARPOL Annex VI;

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

4 INVITES Administrations to provide for collection of data as described in appendix 3 of these Guidelines;

5 AGREES to keep these Guidelines under review in the light of experience gained with their application;

6 SUPERSEDES the 2009 EGCS Guidelines adopted by resolution MEPC.184(59).

ANNEX

2015 GUIDELINES FOR EXHAUST GAS CLEANING SYSTEMS

1 INTRODUCTION

1.1 Regulation 14 of Annex VI requires ships to use fuel oil with a sulphur content not exceeding that stipulated in regulations 14.1 or 14.4. Regulation 4 allows, with the approval of the Administration, the use of an alternative compliance method at least as effective in terms of emission reductions as that required by the Annex, including the standards set forth in regulation 14. The Administration of a Party should take into account any relevant guidelines developed by the Organization pertaining to alternatives provided for in regulation 4.

1.2 Similar to a NO_X emission reduction system, an exhaust gas cleaning (EGC) unit may be approved subject to periodic parameter and emission checks or the system may be equipped with a continuous emission monitoring system. These guidelines have been developed with the intention of being objective and performance oriented. Furthermore, use of the SO_2(ppm)/CO_2(%) ratio method will simplify the monitoring of SO_X emission and facilitate approval of an EGC unit. See appendix II for the rationale explaining the use of SO_2(ppm)/CO_2(%) as the basis for system monitoring.

1.3 Compliance should be demonstrated on the basis of the SO_2(ppm)/CO_2(% v/v) ratio values.

Table 1: Fuel oil sulphur limits recorded in regulations 14.1 and 14.4 and corresponding emissions values

Fuel oil sulphur content (% m/m)	Ratio emission SO_2(ppm)/CO_2(% v/v)
4.50	195.0
3.50	151.7
1.50	65.0
1.00	43.3
0.50	21.7
0.10	4.3

Note: The use of the ratio emissions limits is only applicable when using petroleum based distillate or residual fuel oils. See appendix II for application of the ratio method.

1.4 These guidelines are recommendatory in nature, however, Administrations are invited to base the implementation of the relevant requirements of regulation 4 of MARPOL Annex VI on them.

2 GENERAL

2.1 Purpose

2.1.1 The purpose of these guidelines is to specify the requirements for the testing, survey certification and verification of EGC systems under regulation 4 of MARPOL Annex VI to ensure that they provide effective equivalence to the requirements of regulations 14.1 and 14.4 of MARPOL Annex VI.

2.1.2 These guidelines permit two schemes: Scheme A (unit certification with parameter and emission checks and Scheme B (continuous emission monitoring with parameter checks).

2.1.3 For ships which are to use an exhaust gas cleaning system in part or in total in order to comply with regulations 14.1 and/or 14.4 of MARPOL Annex VI, there should be an approved SO_X Emissions Compliance Plan (SECP).

2.2 Application

2.2.1 These guidelines apply to any EGC unit as fitted to fuel oil combustion machinery, excluding shipboard incinerators, installed on board a ship.

2.3 Definitions and required documents

Fuel oil combustion unit	Any engine, boiler, gas turbine, or other fuel oil fired equipment, excluding shipboard incinerators
EGC	Exhaust gas cleaning
SO_X	Sulphur oxides
SO_2	Sulphur dioxide
CO_2	Carbon dioxide
UTC	Universal Time Co-ordinated
Certified Value	The SO_2/CO_2 ratio specified by the manufacturer that the EGC unit is certified as meeting when operating on a continuous basis on the manufacturers specified maximum fuel sulphur content
In situ	Sampling directly within an exhaust gas stream
MCR	Maximum Continuous Rating
Load range	Maximum rated power of diesel engine or maximum steaming rate of the boiler
SECP	SO_X Emissions Compliance Plan
SECC	SO_X Emissions Compliance Certificate
ETM-A	EGC system – Technical Manual for Scheme A
ETM-B	EGC system – Technical Manual for Scheme B
OMM	Onboard Monitoring Manual
EGC Record Book	A record of the EGC unit in-service operating parameters, component adjustments, maintenance and service records as appropriate

Document	Scheme A	Scheme B
SECP	X	X
SECC	X	
ETM Scheme A	X	
ETM Scheme B		X
OMM	X	X
EGC Record Book or Electronic Logging System	X	X

3 SAFETY NOTE

Due attention is to be given to the safety implications related to the handling and proximity of exhaust gases, the measurement equipment and the storage and use of pressurized containers of pure and calibration gases. Sampling positions and permanent access platforms should be such that this monitoring may be performed safely. In locating discharge outlet of washwater used in the EGC unit, due consideration should be given to the location of the

ship's seawater inlet. In all operating conditions the pH should be maintained at a level that avoids damage to the vessel's anti-fouling system, the propeller, rudder and other components that may be vulnerable to acidic discharges, potentially causing accelerated corrosion of critical metal components.

4 SCHEME A – EGC SYSTEM APPROVAL, SURVEY AND CERTIFICATION USING PARAMETER AND EMISSION CHECKS

4.1 Approval of EGC systems

4.1.1 General

Options under Scheme A of these guidelines provide for:

.1 unit approval;

.2 serially manufactured units; and

.3 production range approval.

4.1.2 Unit approval

4.1.2.1 An EGC unit should be certified as capable of meeting the limit value, (the Certified Value), specified by the manufacturer (e.g. the emission level the unit is capable of achieving on a continuous basis) with fuel oils of the manufacturer's specified maximum % m/m sulphur content and for the range of operating parameters, as listed in paragraph 4.2.2.1.2, for which they are to be approved. The Certified Value should at least be suitable for ship operations under requirements given by MARPOL Annex VI regulations 14.1 and/or 14.4.

4.1.2.2 Where testing is not to be undertaken with fuel oils of the manufacturer's specified maximum % m/m sulphur content, the use of two test fuels with a lower % m/m sulphur content is permitted. The two fuels selected should have a difference in % m/m sulphur content sufficient to demonstrate the operational behaviour of the EGC unit and to demonstrate that the Certified Value can be met if the EGC unit were to be operated with a fuel of the manufacturer's specified maximum % m/m sulphur content. In such cases a minimum of two tests, in accordance with section 4.3 as appropriate, should be performed. These need not be sequential and could be undertaken on two different, but identical, EGC units.

4.1.2.3 The maximum and, if applicable, minimum exhaust gas mass flow rate of the unit should be stated. The effect of variation of the other parameters defined in paragraph 4.2.2.1.2 should be justified by the equipment manufacturer. The effect of variations in these factors should be assessed by testing or otherwise as appropriate. No variation in these factors, or combination of variations in these factors, should be such that the emission value of the EGC unit would be in excess of the Certified Value.

4.1.2.4 Data obtained in accordance with this section should be submitted to the Administration for approval together with the ETM-A.

4.1.3 Serially manufactured units

In the case of nominally similar EGC units of the same mass flow ratings as that certified under 4.1.2, and to avoid the testing of each EGC unit, the equipment manufacturer may submit, for acceptance by the Administration, a conformity of production arrangement. The

certification of each EGC unit under this arrangement should be subject to such surveys that the Administration may consider necessary as to assure that each EGC unit has an emission value of not more than the Certified Value when operated in accordance with the parameters defined in paragraph 4.2.2.1.2.

4.1.4 Product range approval

4.1.4.1 In the case of an EGC unit of the same design, but of different maximum exhaust gas mass flow capacities, the Administration may accept, in lieu of tests on an EGC unit of all capacities in accordance with section 4.1.2, tests of EGC systems of three different capacities provided that the three tests are performed at intervals including the highest, lowest and one intermediate capacity rating within the range.

4.1.4.2 Where there are significant differences in the design of EGC units of different capacities, this procedure should not be applied unless it can be shown, to the satisfaction of the Administration, that in practice those differences do not materially alter the performance between the various EGC unit types.

4.1.4.3 For EGC units of different capacities, the sensitivity to variations in the type of combustion machinery to which they are fitted should be detailed together with sensitivity to the variations in the parameters listed in paragraph 4.2.2.1.2. This should be on the basis of testing, or other data as appropriate.

4.1.4.4 The effect of changes of EGC unit capacity on washwater characteristics should be detailed.

4.1.4.5 All supporting data obtained in accordance with this section, together with the ETM-A for each capacity unit, should be submitted to the Administration for approval.

4.2 Survey and certification

4.2.1 Procedures for the certification of an EGC unit

4.2.1.1 In order to meet the requirements of section 4.1 either prior to, or after installation on board, each EGC unit should be certified as meeting the Certified Value specified by the manufacturer (e.g. the emission level the unit is capable of achieving on a continuous basis) under the operating conditions and restrictions as given by the EGC Technical Manual (ETM-A) as approved by the Administration.

4.2.1.2 Determination of the Certified Value should be in accordance with the provisions of these guidelines.

4.2.1.3 Each EGC unit meeting the requirements of paragraph 4.2.1.1 should be issued with a SECC by the Administration. The form of the SECC is given in appendix 1.

4.2.1.4 Application for an SECC should be made by the EGC system manufacturer, shipowner or other party.

4.2.1.5 Any subsequent EGC units of the same design and rating as that certified under paragraph 4.2.1.1 may be issued with an SECC by the Administration without the need for testing in accordance with paragraph 4.2.1.1 subject to section 4.1.3 of these guidelines.

4.2.1.6 EGC units of the same design, but with ratings different from that certified under paragraph 4.2.1.1 may be accepted by the Administration subject to section 4.1.4 of these guidelines.

4.2.1.7 EGC units which treat only part of the exhaust gas flow of the uptake in which they are fitted should be subject to special consideration by the Administration to ensure that under all defined operating conditions that the overall emission value of the exhaust gas downstream of the system is no more than the Certified Value.

4.2.2 EGC System Technical Manual "*Scheme A*" *(ETM-A)*

4.2.2.1 Each EGC unit should be supplied with an ETM-A provided by the manufacturer. This ETM-A should, as a minimum, contain the following information:

.1 the identification of the unit (manufacturer, model/type, serial number and other details as necessary) including a description of the unit and any required ancillary systems;

.2 the operating limits, or range of operating values, for which the unit is certified. These should, as a minimum, include:

.1 maximum and, if applicable, minimum mass flow rate of exhaust gas;

.2 the power, type and other relevant parameters of the fuel oil combustion unit for which the EGC unit is to be fitted. In the cases of boilers, the maximum air/fuel ratio at 100% load should also be given. In the cases of diesel engines whether the engine is of 2 or 4-stroke cycle;

.3 maximum and minimum washwater flow rate, inlet pressures and minimum inlet water alkalinity (ISO 9963-1-2);

.4 exhaust gas inlet temperature ranges and maximum and minimum exhaust gas outlet temperature with the EGC unit in operation;

.5 exhaust gas differential pressure range and the maximum exhaust gas inlet pressure with the fuel oil combustion unit operating at MCR or 80% of power rating whichever is appropriate;

.6 salinity levels or fresh water elements necessary to provide adequate neutralizing agents; and

.7 other factors concerning the design and operation of the EGC unit relevant to achieving a maximum emission value no higher than the Certified Value;

.3 any requirements or restrictions applicable to the EGC unit or associated equipment necessary to enable the unit to achieve a maximum emission value no higher than the Certified Value;

.4 maintenance, service or adjustment requirements in order that the EGC unit can continue to achieve a maximum emission value no higher than the Certified Value. The maintenance, servicing and adjustments should be recorded in the EGC Record Book;

.5 corrective actions in case of exceedances of the applicable maximum allowable SO_2/CO_2 ratio, or wash water discharge criteria;

.6 a verification procedure to be used at surveys to ensure that its performance is maintained and that the unit is used as required (see section 4.4);

.7 through range performance variation in washwater characteristics;

.8 design requirements of the washwater system; and

.9 the SECC.

4.2.2.2 The ETM-A should be approved by the Administration.

4.2.2.3 The ETM-A should be retained on board the ship onto which the EGC unit is fitted and should be available for surveys as required.

4.2.2.4 Amendments to the ETM-A which reflect EGC unit changes that affect performance with respect to emissions to air and/or water should be approved by the Administration. Where additions, deletions or amendments to the ETM-A are separate to the ETM-A as initially approved, they should be retained with the ETM-A and should be considered as part of it.

4.2.3 In-service surveys

4.2.3.1 The EGC unit should be subject to survey on installation and at initial, annual/intermediate and renewals surveys by the Administration.

4.2.3.2 In accordance with regulation 10 of MARPOL Annex VI, EGC units may also be subject to inspection by port State control.

4.2.3.3 Prior to use, each EGC unit should be issued with an SECC by the Administration.

4.2.3.4 Following the installation survey as required by paragraph 4.2.3.1, section 2.6 of the Supplement to the ship's International Air Pollution Certificate should be duly completed.

4.3 Emission limits

4.3.1 Each EGC unit should be capable of reducing emissions to equal to or less than the Certified Value at any load point when operated in accordance with the criteria as given in paragraph 4.2.2.1.2, as specified in paragraphs 4.3.2 to 4.3.5 of these guidelines, and as excepted in paragraph 4.3.7.

4.3.2 EGC units fitted to main propulsion diesel engines should meet the requirements of paragraph 4.3.1 at all loads between 25 to 100% of the load range of the engines to which they are fitted.

4.3.3 EGC units fitted to auxiliary diesel engines should meet the requirements of paragraph 4.3.1 at all loads between 10 to 100% of the load range of the engines to which they are fitted.

4.3.4 EGC units fitted to diesel engines which supply power for both main propulsion and auxiliary purposes should meet the requirements of paragraph 4.3.3.

4.3.5 EGC units fitted to boilers should meet the requirements of paragraph 4.3.1 at all loads between 10 to 100% of the load range (steaming rates) or, if the turn down ratio is smaller, over the actual load range of the boilers to which they are fitted.

4.3.6 In order to demonstrate performance, emission measurements should be undertaken, with the agreement of the Administration, at a minimum of four load points. One load point should be at 95 to 100% of the maximum exhaust gas mass flow rate for which the unit is to be certified. One load point should be within ± 5% of the minimum exhaust gas mass flow rate for which the unit is to be certified. The other two load points should be equally spaced between the maximum and minimum exhaust gas mass flow rates. Where there are discontinuities in the operation of the system the number of load points should be increased, with the agreement of the Administration, so that it is demonstrated that the required performance over the stated exhaust gas mass flow rate range is retained. Additional intermediate load points should be tested if there is evidence of an emission peak below the maximum exhaust gas mass flow rate and above, if applicable, the minimum exhaust gas flow rate. These additional tests should be sufficient number as to establish the emission peak value.

4.3.7 For loads below those specified in paragraphs 4.3.2 to 4.3.5, the EGC unit should continue in operation. In those cases where the fuel oil combustion equipment may be required to operate under idling conditions, the SO_2 emission concentration (ppm) at standardized O_2 concentration (15.0% diesel engines, 3.0% boilers) should not exceed 50 ppm.

4.4 Onboard procedures for demonstrating compliance

4.4.1 For each EGC unit, the ETM-A should contain a verification procedure for use at surveys as required. This procedure should not require specialized equipment or an in-depth knowledge of the system. Where particular devices are required they should be provided and maintained as part of the system. The EGC unit should be designed in such a way as to facilitate inspection as required. The basis of this verification procedure is that if all relevant components and operating values or settings are within those as approved, then the performance of the EGC system is within that required without the need for actual exhaust emission measurements. It is also necessary to ensure that the EGC unit is fitted to a fuel oil combustion unit for which it is rated – this forms part of the SECP. A Technical File related to an EIAPP certificate, if available, or an Exhaust Gas Declaration issued by the engine maker or designer or another competent party or a Flue Gas Declaration issued by the boiler maker or designer or another competent party serves this purpose to the satisfaction of the Administration.

4.4.2 Included in the verification procedure should be all components and operating values or settings which may affect the operation of the EGC unit and its ability to meet the Certified Value.

4.4.3 The verification procedure should be submitted by the EGC system manufacturer and approved by the Administration.

4.4.4 The verification procedure should cover both a documentation check and a physical check of the EGC unit.

4.4.5 The surveyor should verify that each EGC unit is installed in accordance with the ETM-A and has an SECC as required.

4.4.6 At the discretion of the Administration, the surveyor should have the option of checking one or all of the identified components, operating values or settings. Where there is more than one EGC unit, the Administration may, at its discretion, abbreviate or reduce the extent of the survey on board, however, the entire survey should be completed for at least one of each type of EGC unit on board provided that it is expected that the other EGC units perform in the same manner.

4.4.7 The EGC unit should include means to automatically record when the system is in use. This should automatically record, at least at the frequency specified in paragraph 5.4.2, as a minimum, washwater pressure and flow rate at the EGC unit's inlet connection, exhaust gas pressure before and pressure drop across the EGC unit, fuel oil combustion equipment load, and exhaust gas temperature before and after the EGC unit. The data recording system should comply with the requirements of sections 7 and 8. In case of a unit consuming chemicals at a known rate as documented in ETM-A, records of such consumption in the EGC Record Book also serves this purpose.

4.4.8 Under Scheme A, if a continuous exhaust gas monitoring system is not fitted, it is recommended that a daily spot check of the exhaust gas quality in terms of SO_2(ppm)/CO_2(%) ratio, is used to verify compliance in conjunction with parameter checks stipulated in paragraph 4.4.7. If a continuous exhaust gas monitoring system is fitted, only daily spot checks of the parameters listed in paragraph 4.4.7 would be needed to verify proper operation of the EGC unit.

4.4.9 If the EGC system manufacturer is unable to provide assurance that the EGC unit will meet the Certified Value or below between surveys, by means of the verification procedure stipulated in paragraph 4.4.1, or if this requires specialist equipment or in-depth knowledge, it is recommended that continuous exhaust gas monitoring of each EGC unit be used, Scheme B, to assure compliance with regulations 14.1 and/or 14.4 of MARPOL Annex VI.

4.4.10 An EGC Record Book should be maintained by the shipowner recording maintenance and service of the unit including like-for-like replacement. The form of this record should be submitted by the EGC system manufacturer and approved by the Administration. This EGC Record Book should be available at surveys as required and may be read in conjunction with engine-room log-books and other data as necessary to confirm the correction operation of the EGC unit. Alternatively, this information should be recorded in the vessel's planned maintenance record system as approved by the Administration.

5 SCHEME B – EGC SYSTEM APPROVAL, SURVEY AND CERTIFICATION USING CONTINUOUS MONITORING OF SO_X EMISSIONS

5.1 General

This Scheme should be used to demonstrate that the emissions from a fuel oil combustion unit fitted with an EGC will, with that system in operation, result in the required emission value (e.g. as stated in the SECP) or below at any load point, including during transient operation and thus compliance with the requirements of regulations 14.1 and/or 14.4 of MARPOL Annex VI.

5.2 Approval

Compliance demonstrated in service by continuous exhaust gas monitoring. Monitoring system should be approved by the Administration and the results of that monitoring available to the Administration as necessary to demonstrate compliance as required.

5.3 Survey and certification

5.3.1 The monitoring system of the EGC system should be subject to survey on installation and at initial, annual/intermediate and renewals surveys by the Administration.

5.3.2 In accordance with regulation 10 of MARPOL Annex VI, monitoring systems of EGC units may also be subject to inspection by port State control.

5.3.3 In those instances where an EGC system is installed, section 2.6 of the Supplement to the ship's International Air Pollution Prevention Certificate should be duly completed.

5.4 Calculation of emission rate

5.4.1 Exhaust gas composition in terms of SO_2(ppm)/CO_2(%) should be measured at an appropriate position after the EGC unit and that measurement should be in accordance with the requirements of section 6 as applicable.

5.4.2 SO_2(ppm) and CO_2(%) to be continuously monitored and recorded onto a data recording and processing device at a rate which should not be less than 0.0035 Hz.

5.4.3 If more than one analyser is to be used to determine the SO_2/CO_2 ratio, these should be tuned to have similar sampling and measurement times and the data outputs aligned so that the SO_2/CO_2 ratio is fully representative of the exhaust gas composition.

5.5 Onboard procedures for demonstrating compliance with emission limit

5.5.1 The data recording system should comply with the requirements of sections 7 and 8.

5.5.2 Daily spot checks of the parameters listed in paragraph 4.4.7 are needed to verify proper operation of the EGC unit and should be recorded in the EGC Record Book or in the engine-room logger system.

5.6 EGC System Technical Manual "Scheme B" (ETM-B)

5.6.1 Each EGC unit should be supplied with an ETM-B provided by the manufacturer. This ETM-B should, as a minimum, contain the following information:

.1 the identification of the unit (manufacturer, model/type, serial number and other details as necessary) including a description of the unit and any required ancillary systems;

.2 the operating limits, or range of operating values, for which the unit is certified. These should, as a minimum, include:

.1 maximum and, if applicable, minimum mass flow rate of exhaust gas;

.2 the power, type and other relevant parameters of the fuel oil combustion unit for which the EGC unit is to be fitted. In the cases of boilers, the maximum air/fuel ratio at 100% load should also be given. In the cases of diesel engines whether the engine is of 2 or 4-stroke cycle;

.3 maximum and minimum washwater flow rate, inlet pressures and minimum inlet water alkalinity (ISO 9963-1-2);

.4 exhaust gas inlet temperature ranges and maximum and minimum exhaust gas outlet temperature with the EGC unit in operation;

.5 exhaust gas differential pressure range and the maximum exhaust gas inlet pressure with the fuel oil combustion unit operating at MCR or 80% of power rating whichever is appropriate;

.6 salinity levels or fresh water elements necessary to provide adequate neutralizing agents; and

.7 other parameters as necessary concerning the operation of the EGC unit;

.3 any requirements or restrictions applicable to the EGC unit or associated equipment;

.4 corrective actions in case of exceedances of the applicable maximum allowable SO_2/CO_2 ratio, or washwater discharge criteria;

.5 through range performance variation in washwater characteristics;

.6 design requirements of the washwater system.

5.6.2 The ETM-B should be approved by the Administration.

5.6.3 The ETM-B should be retained on board the ship onto which the EGC unit is fitted. The ETM-B should be available for surveys as required.

5.6.4 Amendments to the ETM-B which reflect EGC unit changes that affect performance with respect to emissions to air and/or water should be approved by the Administration. Where additions, deletions or amendments to the ETM-B are separate to the ETM-B as initially approved, they should be retained with the ETM-B and should be considered as part of it.

6 EMISSION TESTING

6.1 Emission testing should follow the requirements of the NO_X Technical Code 2008, chapter 5, and associated appendices, except as provided for in these guidelines.

6.2 CO_2 should be measured using an analyser operating on non-dispersive infrared (NDIR) principle and with additional equipment such as dryers as necessary. SO_2 should be measured using analysers operating on non-dispersive infrared (NDIR) or non-dispersive ultra-violet (NDUV) principles and with additional equipment such as dryers as necessary. Other systems or analyser principles may be accepted, subject to the approval of the Administration, provided they yield equivalent or better results to those of the equipment referenced above. For acceptance of other CO_2 systems or analyser principles, the reference method should be in accordance with the requirements of appendix III of the NO_X Technical Code 2008.

6.3 Analyser performance should be in accordance with the requirements of sections 1.6 to 1.10 of appendix III of the NO_X Technical Code 2008.

6.4 An exhaust gas sample for SO_2 should be obtained from a representative sampling point downstream of the EGC unit.

6.5 SO_2 and CO_2 should be monitored using either in situ or extractive sample systems.

6.6 Extractive exhaust gas samples for SO_2 determination should be maintained at a sufficient temperature to avoid condensed water in the sampling system and hence loss of SO_2.

6.7 If an extractive exhaust gas sample for determination needs to be dried prior to analysis it should be done in a manner that does not result in loss of SO_2 in the sample as analysed.

6.8 The SO_2 and CO_2 values should be compared on the basis of the same residual water content (e.g. dry or with the same wetness fraction).

6.9 In justified cases where the CO_2 concentration is reduced by the EGC unit, the CO_2 concentration can be measured at the EGC unit inlet, provided that the correctness of such a methodology can be clearly demonstrated. In such cases the SO_2 and CO_2 values should be compared on a dry basis. If measured on a wet basis the water content in the exhaust gas stream at those points should also be determined in order to correct the readings to dry basis values. For calculation of the CO_2 value on a dry basis, the dry/wet correction factor may be calculated in accordance with paragraph 5.12.3.2.2 of the NO_X Technical Code 2008.

7 DATA RECORDING AND PROCESSING DEVICE

7.1 The recording and processing device should be of robust, tamper-proof design with read-only capability.

7.2 The recording and processing device should record the data required by sections 4.4.7, 5.4.2, and 10.3 against UTC and ships position by a Global Navigational Satellite System (GNSS).

7.3 The recording and processing device should be capable of preparing reports over specified time periods.

7.4 Data should be retained for a period of not less than 18 months from the date of recording. If the unit is changed over that period, the shipowner should ensure that the required data is retained on board and available as required.

7.5 The device should be capable of downloading a copy of the recorded data and reports in a readily useable format. Such copy of the data and reports should be available to the Administration or port State authority as requested.

8 ONBOARD MONITORING MANUAL (OMM)

8.1 An OMM should be prepared to cover each EGC unit installed in conjunction with fuel oil combustion equipment, which should be identified, for which compliance is to be demonstrated.

8.2 The OMM should, as a minimum, include:

.1 the sensors to be used in evaluating EGC system performance and washwater monitoring, their service, maintenance and calibration requirements;

.2 the positions from which exhaust emission measurements and washwater monitoring are to be taken together with details of any necessary ancillary services such as sample transfer lines and sample treatment units and any related service or maintenance requirements;

.3 the analysers to be used, their service, maintenance, and calibration requirements;

.4 analyser zero and span check procedures; and

.5 other information or data relevant to the correct functioning of the monitoring systems or its use in demonstrating compliance.

8.3 The OMM should specify how the monitoring is to be surveyed.

8.4 The OMM should be approved by the Administration.

9 SHIP COMPLIANCE

9.1 SO_X Emissions Compliance Plan (SECP)

9.1.1 For all ships which are to use an EGC unit, in part or in total, in order to comply with the requirements of regulations 14.1 and 14.4 of MARPOL Annex VI there should be an SECP for the ship, approved by the Administration.

9.1.2 The SECP should list each item of fuel oil combustion equipment which is to meet the requirements for operating in accordance with the requirements of regulations 14.1 and/or 14.4 of MARPOL Annex VI.

9.1.3 Under Scheme A, the SECP should present how continuous monitoring data will demonstrate that the parameters in paragraph 4.4.7 are maintained within the manufacturer's recommended specifications. Under Scheme B, this would be demonstrated using daily recordings of key parameters.

9.1.4 Under Scheme B, the SECP should present how continuous exhaust gas emissions monitoring will demonstrate that the ship total SO_2(ppm)/CO_2(%) ratio is comparable to the requirements of regulation 14.1 and/or 14.4 of MARPOL Annex VI or below as prescribed in paragraph 1.3. Under Scheme A, this would be demonstrated using daily exhaust gas emission recordings.

9.1.5 There may be some equipment such as small engines and boilers to which the fitting of EGC units would not be practical, particularly where such equipment is located in a position remote from the main machinery spaces. All such fuel oil combustion units should be listed in the SECP. For these fuel oil combustion units which are not to be fitted with EGC units, compliance may be achieved by means of regulations 14.1 and/or 14.4 of MARPOL Annex VI.

9.2 Demonstration of compliance

9.2.1 Scheme A

9.2.1.1 The SECP should refer to, not reproduce, the ETM-A, EGC Record Book or Engine-Room logger system and OMM as specified under Scheme A. It should be noted that as an alternative, the maintenance records may be recorded in the ship's planned maintenance record system, as allowed by the Administration.

9.2.1.2 For all fuel oil combustion equipment listed under paragraph 9.1.2, details should be provided demonstrating that the rating and restrictions for the EGC unit as approved, paragraph 4.2.2.1.2, are complied with.

9.2.1.3 Required parameters should be monitored and recorded as required under paragraph 4.4.7 when the EGC is in operation in order to demonstrate compliance.

9.2.2 Scheme B

The SECP should refer to, not reproduce, the ETM-B, EGC Record Book or Engine-Room logger system and OMM as specified under Scheme B.

10 WASHWATER

10.1 Washwater discharge criteria[1]

10.1.1 When the EGC system is operated in ports, harbours, or estuaries, the washwater monitoring and recording should be continuous. The values monitored and recorded should include pH, PAH, turbidity and temperature. In other areas the continuous monitoring and recording equipment should also be in operation, whenever the EGC system is in operation, except for short periods of maintenance and cleaning of the equipment. The discharge water should comply with the following limits.

10.1.2 pH criteria

10.1.2.1 The washwater pH should comply with one of the following requirements which should be recorded in the ETM-A or ETM-B as applicable:

.1 The discharge washwater should have a pH of no less than 6.5 measured at the ship's overboard discharge with the exception that during manoeuvring and transit, the maximum difference between inlet and outlet of 2 pH units is allowed measured at the ship's inlet and overboard discharge.

.2 The pH discharge limit, at the overboard monitoring position, is the value that will achieve as a minimum pH 6.5 at 4 m from the overboard discharge point with the ship stationary, and which is to be recorded as the overboard pH discharge limit in the ETM-A or ETM-B. The overboard pH discharge limit can be determined either by means of direct measurement, or by using a calculation-based methodology (computational fluid dynamics or other equally scientifically established empirical formulae) to be left to the approval by the Administration, and in accordance with the following conditions to be recorded in the ETM-A or ETM-B:

.1 all EGC units connected to the same outlets are operating at their full loads (or highest practicable load) and with the fuel oil of a maximum sulphur content for which the units are to be certified (Scheme A) or used with (Scheme B);

[1] The washwater discharge criteria should be revised in the future as more data becomes available on the contents of the discharge and its effects, taking into account any advice given by GESAMP.

.2 if a test fuel with lower sulphur content, and/or test load lower than maximum, sufficient for demonstrating the behaviour of the washwater plume is used, the plume's mixing ratio must be established based on the titration curve of seawater. The mixing ratio would be used to demonstrate the behaviour of the washwater plume and that the overboard pH discharge limit has been met if the EGC system is operated at the highest fuel sulphur content and load for which the EGC system is certified (Scheme A) or used with (Scheme B);

.3 where the washwater flow rate is varied in accordance with the EGC system gas flow rate, the implications of this for the part load performance should also be evaluated to ensure that the overboard pH discharge limit is met under any load;

.4 reference should be made to a sea-water alkalinity of 2,200 µmol/litre and pH 8.2[2]; an amended titration curve should be applied where the testing conditions differ from the reference seawater, as agreed by the Administration; and

.5 if a calculation-based methodology is to be used, details to allow its verification such as but not limited to supporting scientific formulae, discharge point specification, washwater discharge flow rates, designed pH values at both the discharge and 4 m location, titration and dilution data should be submitted.

10.1.3 PAHs (Polycyclic Aromatic Hydrocarbons)

10.1.3.1 The washwater PAH should comply with the following requirements. The appropriate limit should be specified in the ETM-A or ETM-B.

10.1.3.2 The maximum continuous PAH concentration in the washwater should not be greater than 50 µg/L PAH_{phe} (phenanthrene equivalence) above the inlet water PAH concentration. For the purposes of this criteria, the PAH concentration in the washwater should be measured downstream of the water treatment equipment, but upstream of any washwater dilution or other reactant dosing unit, if used, prior to discharge.

10.1.3.3 The 50 µg/L limit described above is normalized for a washwater flow rate through the EGC unit of 45 t/MWh where the MW refers to the MCR or 80% of the power rating of the fuel oil combustion unit. This limit would have to be adjusted upward for lower washwater flow rates per MWh, and vice-versa, according to the table below.

Flow rate (t/MWh)	Discharge concentration limit (µg/L PAH_{phe} equivalents)	Measurement technology
0-1	2250	Ultraviolet light
2.5	900	– " –
5	450	Fluorescence[3]
11.25	200	– " –
22.5	100	– " –
45	50	– " –
90	25	– " –

[2] These values could be revised within two years for new installations following the adoption of these amended guidelines upon further inputs on the physical state of the seas resulting from the use of exhaust gas cleaning systems.

[3] For any Flow Rate > 2.5 t/MWh Fluorescence technology should be used.

10.1.3.4 For a 15-minute period in any 12-hour period, the continuous PAH_{phe} concentration limit may exceed the limit described above by up to 100%. This would allow for an abnormal start-up of the EGC unit.

10.1.4 Turbidity/Suspended Particle Matter

10.1.4.1 The washwater turbidity should comply with the following requirements. The limit should be recorded in the ETM-A or ETM-B.

10.1.4.2 The washwater treatment system should be designed to minimize suspended particulate matter, including heavy metals and ash.

10.1.4.3 The maximum continuous turbidity in washwater should not be greater than 25 FNU (formazin nephlometric units) or 25 NTU (nephlometric turbidity units) or equivalent units, above the inlet water turbidity. However, during periods of high inlet turbidity, the precision of the measurement device and the time lapse between inlet measurement and outlet measurement are such that the use of a difference limit is unreliable. Therefore all turbidity difference readings should be a rolling average over a 15-minute period to a maximum of 25 FNU. For the purposes of this criteria the turbidity in the washwater should be measured downstream of the water treatment equipment but upstream of washwater dilution (or other reactant dosing) prior to discharge.

10.1.4.4 For a 15-minute period in any 12-hour period, the continuous turbidity discharge limit may be exceeded by 20%.

10.1.5 Nitrates

10.1.5.1 The washwater treatment system should prevent the discharge of nitrates beyond that associated with a 12% removal of NO_X from the exhaust, or beyond 60 mg/l normalized for washwater discharge rate of 45 tons/MWh whichever is greater.

10.1.5.2 At each renewal survey nitrate discharge data is to be available in respect of sample overboard discharge drawn from each EGC system with the previous three months prior to the survey. However, the Administration may require an additional sample to be drawn and analysed at their discretion. The nitrate discharge data and analysis certificate is to be retained on board the ship as part of the EGC Record Book and be available for inspection as required by port State control or other parties. Requirements in respect of sampling, storage, handling and analysis should be detailed in the ETM-A or ETM-B as applicable. To assure comparable nitrate discharge rate assessment, the sampling procedures should take into account paragraph 10.1.5.1, which specifies the need for washwater flow normalization. The test method for the analysis of nitrates should be according to standard seawater analysis as described in Grasshoff et al.

10.1.5.3 All systems should be tested for nitrates in the discharge water. If typical nitrate amounts are above 80% of the upper limit, it should be recorded in the ETM-A or ETM-B.

10.1.6 Washwater additives and other substances

An assessment of the washwater is required for those EGC technologies which make use of chemicals, additives, preparations or create relevant chemicals in situ. The assessment could take into account relevant guidelines such as the *Procedure for approval of ballast water management systems that make use of active substances (G9)* (resolution MEPC.126(53)), and, if necessary, additional washwater discharge criteria should be established.

10.2 Washwater monitoring

10.2.1 pH, oil content (as measured by PAH levels), and turbidity should be continuously monitored and recorded as recommended in section 7 of these guidelines. The monitoring equipment should also meet the performance criteria described below:

pH

10.2.2 The pH electrode and pH meter should have a resolution of 0.1 pH units and temperature compensation. The electrode should comply with the requirements defined in BS 2586 or of equivalent or better performance and the meter should meet or exceed BS EN ISO 60746-2:2003.

PAH

10.2.3 The PAH monitoring equipment should be capable to monitor PAH in water in a range to at least twice the discharge concentration limit given in the table above. The equipment should be demonstrated to operate correctly and not deviate more than 5% in washwater with turbidity within the working range of the application.

10.2.4 For those applications discharging at lower flow rates and higher PAH concentrations, ultraviolet light monitoring technology or equivalent, should be used due to its reliable operating range.

Turbidity

10.2.5 The turbidity monitoring equipment should meet requirements defined in ISO 7027:1999 or USEPA 180.1.

10.3 Washwater monitoring data recording

The data recording system should comply with the requirements of sections 7 and 8 and should continuously record pH, PAH and Turbidity as specified in the washwater criteria.

10.4 Washwater residue

10.4.1 Residues generated by the EGC unit should be delivered ashore to adequate reception facilities. Such residues should not be discharged to the sea or incinerated on board.

10.4.2 Each ship fitted with an EGC unit should record the storage and disposal of washwater residues in an EGC log, including the date, time and location of such storage and disposal. The EGC log may form a part of an existing log-book or electronic recording system as approved by the Administration.

APPENDIX 1

FORM OF SO_X EMISSION COMPLIANCE CERTIFICATE

Badge or Cipher

NAME OF ADMINISTRATION

SO_X EMISSION COMPLIANCE CERTIFICATE

CERTIFICATE OF UNIT APPROVAL FOR EXHAUST GAS CLEANING SYSTEMS

Issued under the provisions of the Protocol of 1997, as amended by resolution MEPC.176(58) in 2008, to amend the International Convention for the Prevention of Pollution from Ships, 1973, as modified by the Protocol of 1978 related thereto under the authority of the Government of:

.....
(full designation of the country)

by.....
(full designation of the competent person or organization authorized under the provisions of the Convention)

This is to certify that the exhaust gas cleaning (EGC) unit listed below has been surveyed in accordance with the requirements of the specifications contained under Scheme A in the *2015 Guidelines for exhaust gas cleaning systems* adopted by resolution MEPC.259(68).

This Certificate is valid only for the EGC unit referred to below:

Unit manufacturer	Model/ type	Serial number	EGC System Unit and Technical Manual approval number

A copy of this Certificate, together with the EGC System Technical Manual, shall be carried on board the ship fitted with this EGC System unit at all times.

This Certificate is valid for the life of the EGC System unit, subject to surveys in accordance with section 4.2 of the guidelines and regulation 5 of MARPOL Annex VI, installed in ships under the authority of this Government.

Issued at .....
(place of issue of certificate)

dd/mm/yyyy

....
(date of issue) (*signature of duly authorized official issuing the certificate)*

(Seal or Stamp of the authority, as appropriate)

APPENDIX 2

PROOF OF THE SO_2/CO_2 RATIO METHOD

1 The SO_2/CO_2 ratio method enables direct monitoring of exhaust gas emissions to verify compliance with emissions limits set out in table 1 in paragraph 1.3 of these guidelines. In the case of EGC systems that absorb CO_2 during the exhaust gas cleaning process it is necessary to measure the CO_2 prior to the cleaning process and use the CO_2 concentration before cleaning with the SO_2 concentration after cleaning. For conventional low alkali cleaning systems virtually no CO_2 is absorbed during exhaust gas cleaning and therefore monitoring of both gases can be undertaken after the cleaning process.

2 Correspondence between the SO_2/CO_2 ratio can be determined by simple inspection of the respective carbon contents per unit mass of distillate and residual fuel. For this group of hydrocarbon fuels the carbon content as a percentage of mass remains closely similar, whereas the hydrogen content differs. Thus it can be concluded that for a given carbon consumption by combustion there will be a consumption of sulphur in proportion to the sulphur content of the fuel, or in other words a constant ratio between carbon and sulphur adjusted for the molecular weight of oxygen from combustion.

3 The first development of the SO_2/CO_2 ratio considered its use to verify compliance with emissions from 1.5% sulphur fuel. The limit of 65 (ppm[4]/%) SO_2/CO_2 for 1.5% sulphur in fuel can be demonstrated by first calculating the mass ratio of fuel sulphur to fuel carbon, which is tabulated in table 1 in this appendix for various fuels and fuel sulphur contents; including 1.5% sulphur for both distillate and residual fuels. These ratios were used to solve for the corresponding SO_2 and CO_2 concentrations in exhaust, which are tabulated in table 2 of this appendix. Molecular weights (MW) were taken into account to convert mass fractions to mole fractions. For the 1.5% sulphur fuels in table 2, the amount of CO_2 is set first at 8% and then changed to 0.5% to show that there is no effect due to changes in excess air. As expected, the absolute SO_2 concentration changes, but the SO_2/CO_2 ratio does not. This indicates that the SO_2/CO_2 ratio is independent of fuel-to-air ratios. Therefore, SO_2/CO_2 ratio can be used robustly at any point of operation, including operation where no brake power is produced.

3.1 Note that the SO_2/CO_2 ratio varies slightly from distillate to residual fuel. This occurs because of the very different atomic hydrogen-to-carbon ratios (H:C) of the two fuels. Figure 1 illustrates the extent of the SO_2/CO_2 ratios' sensitivity to H:C over a broad range of H:C and fuel sulphur concentrations. From Figure 1, it can be concluded that for fuel sulphur levels less than 3.0% sulphur, the difference in S/C ratios for distillate and residual fuel is less than 5.0%.

3.2 In the case of using non-petroleum fuel oils, the appropriate SO_2/CO_2 ratio applicable to the values given in regulations 14.1 and/or 14.4 of MARPOL Annex VI will be subject to approval by the Administration.

[4] ppm means "parts per million". It is assumed that ppm is measured by gas analysers on a molar basis, assuming ideal gas behaviour. The technically correct units are actually micro-moles of substance per mole of total amount (μmol/mol), but ppm is used in order to be consistent with units in the NO_x Technical Code.

Table 1: Fuel properties for marine distillate and residual fuel*

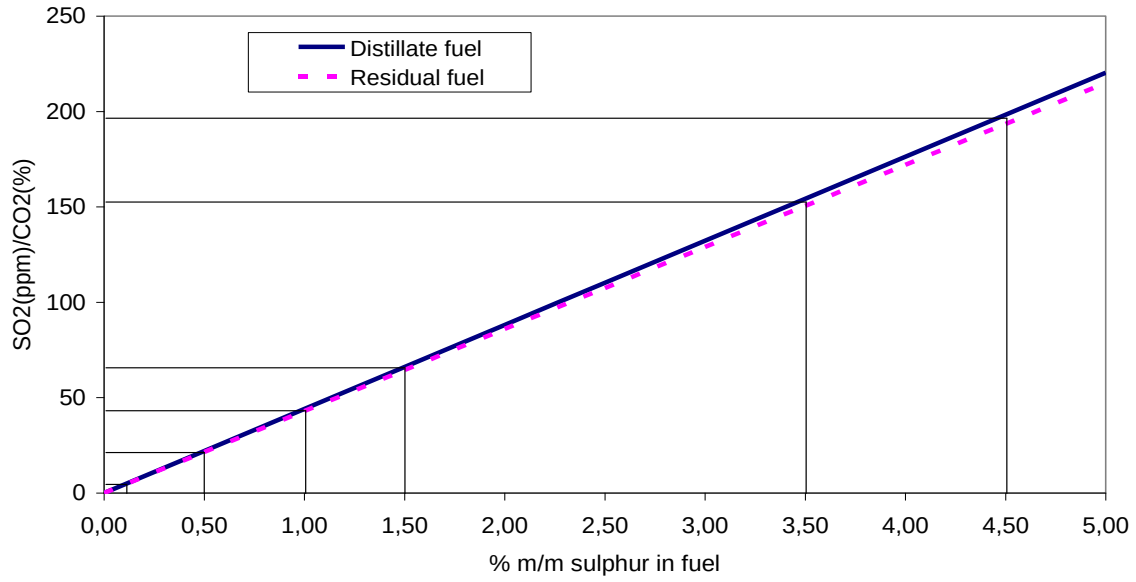
	Carbon	Hydrogen	Sulphur	Other	C	H	S	Fuel S/C	Exh SO_2/CO_2
Fuel Type	%(m/m)	%(m/m)	%(m/m)	%(m/m)	mol/kg	mol/kg	mol/kg	mol/mol	ppm/%(v/v)
Distillate	86.20	13.60	0.17	0.03	71.8333	136	0.0531	0.00074	7.39559
Residual	86.10	10.90	2.70	0.30	71.7500	109	0.8438	0.01176	117.5958
Distillate	85.05	13.42	1.50	0.03	70.8750	134.2	0.4688	0.006614	66.1376
Residual	87.17	11.03	1.50	0.30	72.6417	110.3	0.4688	0.006453	64.5291

* Based on properties in the IMO NO_x Monitoring Guidelines, resolution MEPC.103(49).

Table 2: Emissions calculations corresponding to 1.5 % fuel sulphur

	CO_2	SO_2	Exh SO_2/CO_2	Exh S/C
	%	ppm[4]	ppm[4]/%	m/m
Distillate 0.17% S	8	59.1	7.4	0.00197
Residual 2.70% S	8	939.7	117.5	0.03136
Distillate 1.5% S	8	528.5	66.1	0.01764
Residual 1.5% S	8	515.7	64.5	0.01721
Distillate 1.5% S	0.5	33.0	66.1	0.01764
Residual 1.5% S	0.5	32.2	64.5	0.01721

SO_2/CO_2 ratio vs % sulphur in fuel



4 Correspondence between 65 (ppm[4]/%) SO_2/CO_2 and 6.0 g/kWh is demonstrated by showing that their S/C ratios are similar. This requires the additional assumption of a brake-specified fuel consumption value of 200 g/kWh. This is an appropriate average for marine diesel engines. The calculation is as follows:

$$S/C_{fuel} = \frac{\text{brake-specific } SO_2 \times (MW_S / MW_{SO2})}{\text{BSFC} \times (\%\text{ carbon in fuel} / 100)}$$

brake-specific SO_2 = 6.0 g/kW-hr

MW_S = 32.065 g/mol

MW_{SO2} = 64.064 g/mol

BSFC = 200 g/kW-hr

% carbon in 1.5% sulphur fuel (from table 1) = 85.05% (distillate) or 87.17% (residual)

$$S/C_{residual\ fuel} = \frac{6.0 \times (32.065 / 64.064)}{200 \times (87.17\% / 100)} = 0.01723$$

$$S/C_{distillate\ fuel} = \frac{6.0 \times (32.065 / 64.064)}{200 \times (85.05\% / 100)} = 0.01765$$

Note 1: The S/C mass ratios calculated above, based on 6.0 g/kWh and 200 g/kWh BSFC, are both within 0.10% of the S/C mass ratios in the emissions table (Table 2). Therefore, 65 (ppm[4]/%) SO_2/CO_2 corresponds well to 6.0 g/kWh.

Note 2: The value of 6.0 g/kWh, hence the 200g/kWh brake-specified fuel consumption is taken from MARPOL Annex VI as adopted by the 1997 MARPOL Conference.

5 Thus, the working formulas are as follows:

$$\text{For complete combustion} = \frac{SO_2\ (ppm^*)}{CO_2\ (\%^*)} \leq 65$$

$$\text{For complete combustion} = \frac{SO_2\ (ppm^*)}{CO_2\ (\%^*) + (CO(ppm^*)/10000) + (THC(ppm^*)/10000)} \leq 65$$

* Note: gas concentrations must be sampled or converted to the same residual water content (e.g., fully wet, fully dry).

6 The following is the basis of using the (ppm[4]/%) SO_2/CO_2 as the limit for determining compliance with regulation 14.1 or 14.4 of MARPOL Annex VI:

.1 This limit can be used to determine compliance from fuel oil burners that do not produce mechanical power.

.2 This limit can be used to determine compliance at any power output, including idle.

.3 This limit only requires two gas concentration measurements at one sampling location.

.4 There is no need to measure any engine parameters such as engine speed, engine torque, engine exhaust flow, or engine fuel flow.

.5 If both gas concentration measurements are made at the same residual water content in the sample (e.g., fully wet, fully dry), no dry-to-wet conversion factors are required in the calculation.

.6 This limit completely decouples the thermal efficiency of the fuel oil combustion unit from the EGC unit.

.7 No fuel properties need to be known.

.8 Because only two measurements are made at a single location, transient engine or EGCS unit effects can be minimized by aligning signals from just these two analysers. (Note that the most appropriate points to align are the points where each analyser responds to a step change in emissions at the sample probe by 50% of the steady-state value.)

.9 This limit is independent of the amount of exhaust gas dilution. Dilution may occur due to evaporation of water in an EGC unit, and as part of an exhaust sampler's preconditioning system.

APPENDIX 3

WASHWATER DATA COLLECTION

1 The washwater discharge criteria are intended to act as initial guidance for implementing EGC system designs. The criteria should be revised in the future as more data becomes available on the contents of the discharge and its effects, taking into account any advice given by GESAMP.

2 Administrations should therefore provide for collection of relevant data. To this end, shipowners in conjunction with the EGC manufacturer are requested to sample and analyse samples of:

- inlet water (for background);
- water after the scrubber (but before any treatment system); and
- discharge water.

3 This sampling could be made during approval testing or shortly after commissioning and at about twelve-month intervals for a period of two years of operation (minimum of three samples). Sampling guidance and analysis should be undertaken by laboratories using EPA or ISO test procedures for the following parameters:

- pH
- PAH and oil (detailed GC-MS analysis)
- Nitrate
- Nitrite
- Cd
- Cu
- Ni
- Pb
- Zn
- As
- Cr
- V

4 The extent of laboratory testing may be varied or enhanced in the light of developing knowledge.

5 When submitting sample data to the Administration, information should also be included on washwater discharge flow rates, dilution of discharge, if applicable, and engine power should be included as well as specifications of the fuel used from the bunker delivery note as a minimum.

6 It is recommended that the ship that has provided this information to the satisfaction of the Administration should be granted a waiver for compliance of the existing installation(s) to possible future stricter washwater discharge standards. The Administration should forward information submitted on this issue to the Organization for dissemination by the appropriate mechanisms.

***

ANNEX 4

DRAFT AMENDMENTS TO MARPOL ANNEX VI
(Record requirements for operational compliance with NO_X Tier III emission control areas)

Regulation 13 – Nitrogen oxides (NO_x)

A new paragraph 5.3 is added after existing paragraph 5.2, as follows:

> "5.3 The tier and on/off status of marine diesel engines installed on board a ship to which paragraph 5.1 of this regulation applies which are certified to both Tier II and Tier III or which are certified to Tier II only shall be recorded in such logbook as prescribed by the Administration at entry into and exit from an emission control area designated under paragraph 6 of this regulation, or when the on/off status changes within such an area, together with the date, time and position of the ship."

***

ANNEX 3

DRAFT AMENDMENTS TO THE NO_X TECHNICAL CODE 2008
(Testing of gas-fuelled and dual fuel engines for NO_X Tier III strategy)

Abbreviations, subscripts and symbols

1 In subparagraphs .1 and .2 and in the title of table 2, the word "marine" is added before the word "diesel".

2 In table 2, row 4 is replaced with the following:

"

(H)FID	(Heated) flame ionization detector

"

Chapter 1 – General

3 In paragraph 1.3.10, the following new sentence is inserted after the first sentence:

"In addition, a gas-fuelled engine installed on a ship constructed on or after 1 March 2016 or a gas-fuelled additional or non-identical replacement engine installed on or after that date is also considered as a marine diesel engine."

Chapter 4 – Approval for serially manufactured engines: engine family and engine group concepts

4 In paragraph 4.3.8.2.6, after the existing bullet point "– dual fuel", a new bullet point is added as follows:

"– gas fuel"

5 After existing paragraph 4.3.8.2.10, a new paragraph 4.3.8.2.11 is added as follows:

".11 ignition methods:
– compression ignition
– ignition by pilot injection
– ignition by spark plug or other external ignition device"

6 In paragraph 4.4.6.2.5, after the words "injection cam", the words "or gas valve" are inserted.

7 In the first and second bullet points under paragraph 4.4.7.2.1, after the word "injection", the words "or ignition" are inserted, respectively.

8 In paragraph 4.4.7.2.2, after the existing bullet point "– combustion chamber", a new bullet point is added as follows:

"– gas valve specification."

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

9 In paragraph 5.2.1.2, after the word "engines", the words "operating on liquid or dual fuel" are inserted.

10 The existing paragraph 5.2.1.3 is renumbered as 5.2.1.3.1 and in the renumbered paragraph 5.2.1.3.1, after the word "engines", the words "operating on liquid or dual fuel" are inserted.

11 A new paragraph 5.2.1.3.2 is added after the renumbered paragraph 5.2.1.3.1 as follows:

"5.2.1.3.2 For engines to be tested with gas fuel only with or without cooling of the intake air the parameter f_a shall be determined according to the following:

$$f_a = \left(\frac{99}{p_s}\right)^{1.2} \cdot \left(\frac{T_a}{298}\right)^{0.6} \qquad (2a)$$ "

12 In the second sentence of paragraph 5.3.3, the words "fuel injection pump" are replaced with the word "engine".

13 In the first sentence of paragraph 5.3.4, the words "for dual fuel" are deleted.

14 In the second sentence of paragraph 5.4.2, before the word "diesel", the word "marine" is inserted.

15 A new paragraph 5.12.3.2.3 is added as follows:

".3 The calculation shall be in accordance with paragraphs 5.12.3.1 to 5.12.3.2. However, q_{mf}, w_{ALF}, w_{BET}, w_{DEL}, w_{EPS}, f_{fw} 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}	=	$\frac{q_{mf\_G} \times w_{EPS\_G} + q_{mf\_L} \times w_{EPS\_L}}{q_{mf\_G} + q_{mf\_L}}$

"

16 Paragraph 5.12.3.3 is replaced with the following:

"5.12.3.3 For the intake air:

$$k_{wa} = 1 - k_{w2} \quad (15)"$$

17 Paragraph 5.12.4.1 is replaced with the following:

"5.12.4.1 As the NO_X emission depends on ambient air conditions, the NO_X concentration shall be corrected for ambient air temperature and humidity with the factors in accordance with 5.12.4.5, 5.12.4.6 or 5.12.4.7 as applicable."

18 In paragraph 5.12.4.6, the last sentence is replaced with the following:

"However if $H_a \geq H_{SC}$, then H_{SC} shall be used in place of H_a in formula (17) or (17a)."

19 A new paragraph 5.12.4.7 is added after existing paragraph 5.12.4.6 as follows:

"5.12.4.7 For engines to be tested with gas fuel only:

$$k_{\mathrm{hd}} = 0.6272 + 44.030 \times 10^{-3} \times H_{\mathrm{a}} - 0.862 \times 10^{-3} \times {H_{\mathrm{a}}}^2 \quad (17a)$$

where:

H_a is the humidity of the intake air at the inlet to the air filter in g water per kg dry air."

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

20 In the first sentence of paragraph 6.2.1.2, before the word "diesel", the word "marine" is inserted.

21 Subparagraph 6.2.2.3.1 is replaced with the following:

".1 injection or ignition timing,"

22 In subparagraph 6.2.2.3.14, the word "or" is deleted.

23 At the end of subparagraph 6.2.2.3.15, the word "or" is added.

24 A new subparagraph 6.2.2.3.16 is added as follows:

".16 gas valve."

25 In the third sentence of paragraph 6.3.1.4[1], the word "dual" is replaced with the word "gas".

26 The footnote of table 6[1] is replaced with the following:

"* Only for engines to be tested with gas fuel."

27 Paragraph 6.3.4.1 is replaced with the following:

"6.3.4.1 Generally all emission measurements with liquid fuel shall be carried out with the engine running on marine diesel fuel oil of an ISO 8217:2005, DM grade. Generally all emission measurements with gas fuel shall be carried out with the engine running on gas fuel equivalent to ISO 8178-5:2008."

28 In paragraph 6.3.4.3[1], before the word "engine", the words "or gas-fuelled" are inserted.

Appendix III – Specifications for analysers to be used in the determination of gaseous components of marine diesel engine emissions

29 Subparagraph 1.2.12 is replaced with the following:

".12 O_2 – Oxygen analyser

Paramagnetic detector (PMD), zirconium dioxide (ZRDO) or electrochemical sensor (ECS). ZRDO shall not be used for dual fuel or gas-fuelled engines."

30 At the end of paragraph 3.3, a new sentence is added as follows:

"Optionally, for gas-fuelled engines (without liquid pilot injection), the hydrocarbon analyser may be of the non-heated flame ionization detector (FID) type."

31 At the end of paragraph 3.5, a new sentence is added as follows:

"ZRDO shall not be used for dual fuel or gas-fuelled engines."

Appendix IV – Calibration of the analytical and measurement instruments

32 In paragraphs 5.3, 5.4.2, 8, 8.1.1, 8.2.2 and 8.3.2.10, the symbol "FID" is replaced with the symbol "(H)FID", respectively.

Appendix V – Parent engine test report and test data

Section 1 – Parent engine test report

33 Rows 10, 11 and 12 of sheet 1/5 are replaced with the following:

"

Static injection or ignition timing		deg CA BTDC
Electronic injection or ignition control	No:	Yes:
Variable injection or ignition control	No:	Yes:

"

34 Rows 6 and 27 of sheet 2/5 are replaced, respectively, and a new row is inserted after row 6 as follows:

"

Fuel type to be used on board	Distillate/distillate or heavy fuel/dual fuel or gas fuel
Ignition methods	Compression ignition / ignition by pilot injection / ignition by spark plug or other external ignition device

Injection or ignition timing (range)					

"

35 The title of the table under sheet 3/5 is replaced with the following:

"Liquid fuel characteristics"

36 A new table is added below the table of fuel characteristics under sheet 3/5 as follows:

"**Gas fuel characteristics**

Fuel type				
Fuel properties			Fuel elemental analysis	
Methane number	prEN16726: 2014	/	Carbon	% m/m
Lower heating value		MJ/kg	Hydrogen	% m/m
Boiling point		°C	Nitrogen	% m/m
Density at boiling point		kg/m³	Oxygen	% m/m
Pressure at boiling point		bar (abs)	Sulphur	% m/m
			Methane, CH_4	mol%
			Ethane, C_2H_6	mol%
			Propane, C_3H_8	mol%
			Isobutane, i C_4H_{10}	mol%
			N-Butane, n C_4H_{10}	mol%
			Pentane, C_5H_{12}	mol%
			C6+	mol%
			CO_2	mol%

"

37 Row 11 of sheet 5/5 is replaced and a footnote is added as follows:

"

Fuel rack/gas admission duration** mm/sec											

** Only for engines to be tested with gas fuel"

Section 2 – Parent engine test data to be included in the technical file

38 Row 9 is replaced, new rows are inserted after row 15 and a footnote is added as follows:

"

ISO 8217: 2005 grade (DM or RM), ISO 8178-5:2008 (natural gas)		
Carbon	% m/m	
Hydrogen	% m/m	
Sulphur	% m/m	
Nitrogen	% m/m	
Oxygen	% m/m	
Water	% V/V	
Methane, CH_4**	mol%	
Ethane, C_2H_6**	mol%	
Propane, C_3H_8**	mol%	
Isobutane, i C_4H_{10}**	mol%	
N-Butane, n C_4H_{10}**	mol%	
Pentane, C_5H_{12}**	mol%	
C6+**	mol%	
CO_2**	mol%	

** Only for engines to be tested with gas fuel"

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

39 In paragraph 2.5, the words "in case of gas mode operation of dual-fuel engine," are deleted.

Appendix VII – Checklist for an engine parameter check method

40 The chapeau of paragraph 1.1 is replaced with the following:

".1 parameter 'injection timing and ignition timing': "

41 At the end of subparagraph 1.1.4, the word "and" is added.

42 A new subparagraph 1.1.5 is added as follows:

".5 timing indicator or timing light."

Appendix VIII – Implementation of the direct measurement and monitoring method

43 At the end of paragraph 2.1.1.4, a new sentence added as follows:

"Optionally, for gas-fuelled engines (without liquid pilot injection), the hydrocarbon analyser may be of the non-heated flame ionization detector (FID) type."

44 At the end of paragraph 2.1.1.5, a new sentence is added as follows:

"ZRDO shall not be used for dual fuel or gas-fuelled engines."

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ANNEX 6

RESOLUTION MEPC.261(68)
(adopted on 15 May 2015)

AMENDMENTS TO THE 2014 GUIDELINES ON SURVEY AND CERTIFICATION OF THE ENERGY EFFICIENCY DESIGN INDEX (EEDI) (RESOLUTION MEPC.254(67))

THE MARINE ENVIRONMENT PROTECTION COMMITTEE,

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

RECALLING ALSO that, at its sixty-second session, it adopted, by resolution MEPC.203(62), *Amendments to the Annex of the Protocol of 1997 to amend the International Convention for the Prevention of Pollution from Ships, 1973, as modified by the Protocol of 1978 relating thereto* (inclusion of regulations on energy efficiency for ships in MARPOL Annex VI),

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

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

NOTING FURTHER that, at its sixty-third session, it adopted, by resolution MEPC.214(63), *2012 Guidelines on survey and certification of the Energy Efficiency Design Index (EEDI)*, which were further amended at its sixty-fifth session, by resolution MEPC.234(65),

NOTING FURTHER that, at its sixty-seventh session, it adopted, by resolution MEPC.254(67), *2014 Guidelines on survey and certification of the Energy Efficiency Design Index (EEDI)*,

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-eighth session, draft amendments to the *2014 Guidelines on survey and certification of the Energy Efficiency Design Index (EEDI)*,

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

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

3 ENDORSES the use of ISO standard 15016:2105 for ships for which the sea trial is conducted on or after 1 September 2015 and encourages the application of the standard prior to that date;

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

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

ANNEX

AMENDMENTS TO THE 2014 GUIDELINES ON SURVEY AND CERTIFICATION OF THE ENERGY EFFICIENCY DESIGN INDEX (EEDI) (RESOLUTION MEPC.254(67))

1 Paragraphs 4.3.5 and 4.3.6 are replaced with the following:

"4.3.5 Sea conditions should be measured in accordance with ITTC Recommended Procedure 7.5-04-01-01.1 Speed and Power Trials Part 1; 2014 or ISO 15016:2015."

4.3.6 Ship speed should be measured in accordance with ITTC Recommended Procedure 7.5-04-01-01.1 Speed and Power Trials Part 1; 2014 or ISO 15016:2015, and at more than two points of which range includes the power of the main engine as specified in paragraph 2.5 of the EEDI Calculation Guidelines."

2 Paragraphs 4.3.8 and 4.3.9 are replaced with the following:

"4.3.8 The submitter should develop power curves based on the measured ship speed and the measured output of the main engine at sea trial. For the development of the power curves, the submitter should calibrate the measured ship speed, if necessary, by taking into account the effects of wind, current, waves, shallow water, displacement, water temperature and water density in accordance with ITTC Recommended Procedure 7.5-04-01-01.2 Speed and Power Trials Part 2; 2014 or ISO 15016:2015. Upon agreement with the shipowner, the submitter should submit a report on the speed trials including details of the power curve development to the verifier for verification.

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

.1 for ships for which sea trial is conducted under the condition as specified in paragraph 2.2 of the EEDI Calculation Guidelines: the attained EEDI should be recalculated using the measured ship speed at sea trial at the power of the main engine as specified in paragraph 2.5 of the EEDI Calculation Guidelines; and

.2 for ships for which sea trial cannot be conducted under the condition as specified in paragraph 2.2 of the EEDI Calculation Guidelines: if the measured ship speed at the power of the main engine as specified in paragraph 2.5 of the EEDI Calculation Guidelines at the sea trial conditions is different from the expected ship speed on the power curve at the corresponding condition, the shipbuilder should recalculate the attained EEDI by adjusting ship speed under the condition as specified in paragraph 2.2 of the EEDI Calculation Guidelines by an appropriate correction method that is agreed by the verifier.

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

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

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

where:

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

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

α_p: power ratio

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

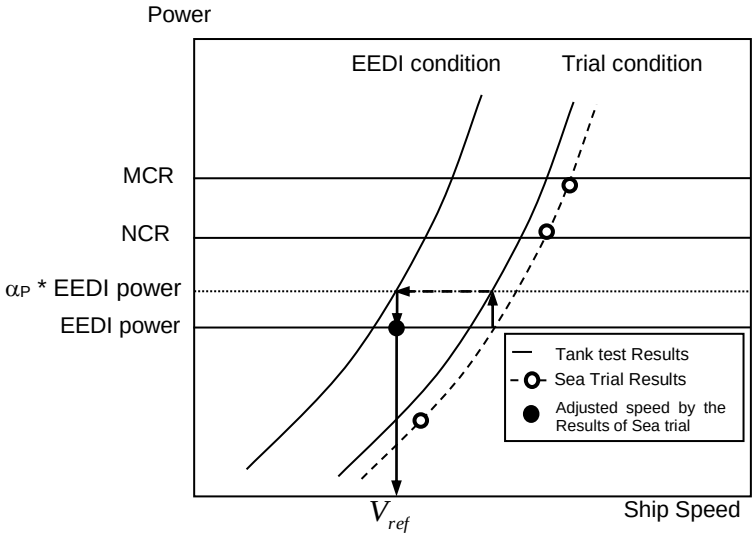

Figure 2: An example of scheme of conversion from trial condition to EEDI condition at EEDI power

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

***

ANNEX 7

RESOLUTION MEPC.262(68)
(adopted on 15 May 2015)

AMENDMENTS TO THE 2013 INTERIM GUIDELINES FOR DETERMINING MINIMUM PROPULSION POWER TO MAINTAIN THE MANOEUVRABILITY OF SHIPS IN ADVERSE CONDITIONS (RESOLUTION MEPC.232(65), AS AMENDED BY RESOLUTION MEPC.255(67))

THE MARINE ENVIRONMENT PROTECTION COMMITTEE,

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

RECALLING ALSO that, at its sixty-second session, it adopted, by resolution MEPC.203(62), Amendments to the annex of the Protocol of 1997 to amend the International Convention for the Prevention of Pollution from Ships, 1973, as modified by the Protocol of 1978 relating thereto (inclusion of regulations on energy efficiency for ships in MARPOL Annex VI),

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

NOTING ALSO that regulation 21.5 of MARPOL Annex VI, as amended, requires that the installed propulsion power shall not be less than the propulsion power needed to maintain the manoeuvrability of the ship under adverse conditions as defined in guidelines to be developed by the Organization,

NOTING FURTHER that, at its sixty-fifth session, it adopted, by resolution MEPC.232(65), the *2013 Interim guidelines for determining minimum propulsion power to maintain the manoeuvrability of ships in adverse conditions* (the interim guidelines) and, at its sixty-seventh session, by resolution MEPC.255(67), amendments thereto,

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-eighth session, proposed amendments to the interim guidelines,

1 ADOPTS amendments to the *2013 Interim guidelines for determining minimum propulsion power to maintain the manoeuvrability of ships in adverse conditions*, as amended, as set out in the annex to the present resolution;

2 INVITES Administrations to take the aforementioned amendments into account when developing and enacting national laws which give force to and implement provisions set forth in regulation 21.5 of MARPOL Annex VI, as amended;

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

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

ANNEX

AMENDMENTS TO THE 2013 INTERIM GUIDELINES FOR DETERMINING MINIMUM PROPULSION POWER TO MAINTAIN THE MANOEUVRABILITY OF SHIPS IN ADVERSE CONDITIONS (RESOLUTION MEPC.232(65), AS AMENDED BY RESOLUTION MEPC.255(67))

Appendix – Assessment procedures to maintain the manoeuvrability under adverse conditions, applicable during phase 0 and phase 1 of the EEDI implementation

Table 1 in paragraph 2 is replaced as follows:

"

Table 1: Parameters a and b for determination of the minimum power line values for the different ship types

Ship type	**a**	**b**
Bulk carrier which DWT is less than 145,000	0.0763	3374.3
Bulk carrier which DWT is 145,000 and over	0.0490	7329.0
Tanker	0.0652	5960.2
Combination Carrier	see tanker above	

"

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ANNEX 10

RESOLUTION MEPC.264(68)
(adopted on 15 May 2015)

INTERNATIONAL CODE FOR SHIPS OPERATING IN POLAR WATERS (POLAR CODE)

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,

RECOGNIZING the need to provide a mandatory framework for ships operating in polar waters due to the additional demands for the protection of the marine environment, which go beyond the existing requirements contained in the International Convention for the Prevention of Pollution from Ships, 1973, as modified by the Protocol of 1978 relating thereto as amended by the 1997 Protocol (MARPOL) and other relevant binding IMO instruments,

NOTING resolution MEPC.265(68), by which it adopted, inter alia, amendments to MARPOL Annexes I, II, IV and V to make use of the environment-related provisions of the International Code for Ships Operating in Polar Waters (Polar Code) mandatory,

NOTING ALSO that the Maritime Safety Committee, at its ninety-fourth session, adopted, by resolution MSC.385(94), the Introduction, as it relates to safety, and parts I-A and I-B of the Polar Code and, by resolution MSC.386(94), amendments to the 1974 SOLAS Convention to make use of the safety-related provisions of the Polar Code mandatory,

HAVING CONSIDERED, at its sixty-eighth session, the draft International Code for Ships Operating in Polar Waters,

1 ADOPTS the environment-related provisions of the Introduction, and the whole of parts II-A and II-B of the Polar Code, the text of which is set out in the annex to the present resolution;

2 AGREES that amendments to the Introduction of the Polar Code that address both safety and environmental protection shall be adopted in consultation with the Maritime Safety Committee;

3 INVITES Parties to note that the Polar Code will take effect on 1 January 2017 upon entry into force of the associated amendments to MARPOL Annexes I, II, IV and V;

4 INVITES ALSO Parties to consider the voluntary application of the Polar Code, as far as practicable, to ships not covered by the Polar Code and operating in polar waters;

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

6 REQUESTS ALSO the Secretary-General to transmit copies of the present resolution and the text of the Polar Code contained in the annex to Members of the Organization which are not Parties to MARPOL;

7 REQUESTS FURTHER the Secretary-General to prepare a consolidated certified text of the Polar Code.

ANNEX

INTERNATIONAL CODE FOR SHIPS OPERATING IN POLAR WATERS (POLAR CODE)

Contents

PREAMBLE

1 The International Code for Ships Operating in Polar Waters has been developed to supplement existing IMO instruments in order to increase the safety of ships' operation and mitigate the impact on the people and environment in the remote, vulnerable and potentially harsh polar waters.

2 The Code acknowledges that polar water operation may impose additional demands on ships, their systems and operation beyond the existing requirements of the International Convention for the Safety of Life at Sea (SOLAS), 1974, the International Convention for the Prevention of Pollution from Ships, 1973, as modified by the Protocol of 1978 relating thereto as amended by the 1997 Protocol, and other relevant binding IMO instruments.

3 The Code acknowledges that the polar waters impose additional navigational demands beyond those normally encountered. In many areas, the chart coverage may not currently be adequate for coastal navigation. It is recognized even existing charts may be subject to unsurveyed and uncharted shoals.

4 The Code also acknowledges that coastal communities in the Arctic could be, and that polar ecosystems are, vulnerable to human activities, such as ship operation.

5 The relationship between the additional safety measures and the protection of the environment is acknowledged as any safety measure taken to reduce the probability of an accident, will largely benefit the environment.

6 While Arctic and Antarctic waters have similarities, there are also significant differences. Hence, although the Code is intended to apply as a whole to both Arctic and Antarctic, the legal and geographical differences between the two areas have been taken into account.

7 The key principles for developing the Polar Code have been to use a risk-based approach in determining scope and to adopt a holistic approach in reducing identified risks.

INTRODUCTION

1 Goal

The goal of this Code is to provide for safe ship operation and the protection of the polar environment by addressing risks present in polar waters and not adequately mitigated by other instruments of the Organization.

2 Definitions

For the purpose of this Code, the terms used have the meanings defined in the following paragraphs. Terms used in part I-A, but not defined in this section shall have the same meaning as defined in SOLAS. Terms used in part II-A, but not defined in this section shall have the same meaning as defined in article 2 of MARPOL and the relevant MARPOL Annexes.

2.1 *Category A ship* means a ship designed for operation in polar waters in at least medium first-year ice, which may include old ice inclusions.

2.2 *Category B ship* means a ship not included in category A, designed for operation in polar waters in at least thin first-year ice, which may include old ice inclusions.

2.3 *Category C ship* means a ship designed to operate in open water or in ice conditions less severe than those included in categories A and B.

2.4 *First-year ice* means sea ice of not more than one winter growth developing from young ice with thickness from 0.3 m to 2.0 m[1].

2.5 *Ice free waters* means no ice present. If ice of any kind is present this term shall not be used[1].

2.6 *Ice of land origin* means ice formed on land or in an ice shelf, found floating in water[1].

2.7 *MARPOL* means the International Convention for the Prevention of Pollution from Ships, 1973, as modified by the Protocol of 1978 relating thereto as amended by the 1997 Protocol.

2.8 *Medium first-year ice* means first-year ice of 70 cm to 120 cm thickness[1].

2.9 *Old ice* means sea ice which has survived at least one summer's melt; typical thickness up to 3 m or more. It is subdivided into residual first-year ice, second-year ice and multi-year ice[1].

2.10 *Open water* means a large area of freely navigable water in which sea ice is present in concentrations less than 1/10. No ice of land origin is present[1].

2.11 *Organization* means the International Maritime Organization.

2.12 *Sea ice* means any form of ice found at sea which has originated from the freezing of sea water[1].

2.13 *SOLAS* means the International Convention for the Safety of Life at Sea, 1974, as amended.

2.14 *STCW Convention* means the International Convention on Standards of Training, Certification and Watchkeeping for Seafarers, 1978, as amended.

2.15 *Thin first-year ice* means first-year ice 30 cm to 70 cm thick.

3 Sources of hazards

3.1 The Polar Code considers hazards which may lead to elevated levels of risk due to increased probability of occurrence, more severe consequences, or both:

.1 Ice, as it may affect hull structure, stability characteristics, machinery systems, navigation, the outdoor working environment, maintenance and emergency preparedness tasks and malfunction of safety equipment and systems;

.2 experiencing topside icing, with potential reduction of stability and equipment functionality;

[1] Refer to the WMO Sea Ice Nomenclature.

.3 low temperature, as it affects the working environment and human performance, maintenance and emergency preparedness tasks, material properties and equipment efficiency, survival time and performance of safety equipment and systems;

.4 extended periods of darkness or daylight as it may affect navigation and human performance;

.5 high latitude, as it affects navigation systems, communication systems and the quality of ice imagery information;

.6 remoteness and possible lack of accurate and complete hydrographic data and information, reduced availability of navigational aids and seamarks with increased potential for groundings compounded by remoteness, limited readily deployable SAR facilities, delays in emergency response and limited communications capability, with the potential to affect incident response;

.7 potential lack of ship crew experience in polar operations, with potential for human error;

.8 potential lack of suitable emergency response equipment, with the potential for limiting the effectiveness of mitigation measures;

.9 rapidly changing and severe weather conditions, with the potential for escalation of incidents; and

.10 the environment with respect to sensitivity to harmful substances and other environmental impacts and its need for longer restoration.

3.2 The risk level within polar waters may differ depending on the geographical location, time of the year with respect to daylight, ice-coverage, etc. Thus, the mitigating measures required to address the above specific hazards may vary within polar waters and may be different in Arctic and Antarctic waters.

4 Structure of the Code

This Code consists of Introduction, parts I and II. The Introduction contains mandatory provisions applicable to both parts I and II. Part I is subdivided into part I-A, which contains mandatory provisions on safety measures, and part I-B containing recommendations on safety. Part II is subdivided into part II-A, which contains mandatory provisions on pollution prevention, and part II-B containing recommendations on pollution prevention.

Figures illustrating the Antarctic area and Arctic waters, as defined in SOLAS regulations XIV/1.2 and XIV/1.3, respectively, and MARPOL Annex I, regulations 1.11.7 and 46.2; Annex II, regulations 13.8.1 and 21.2; Annex IV, regulations 17.2 and 17.3; and Annex V, regulations 1.14.7 and 13.2

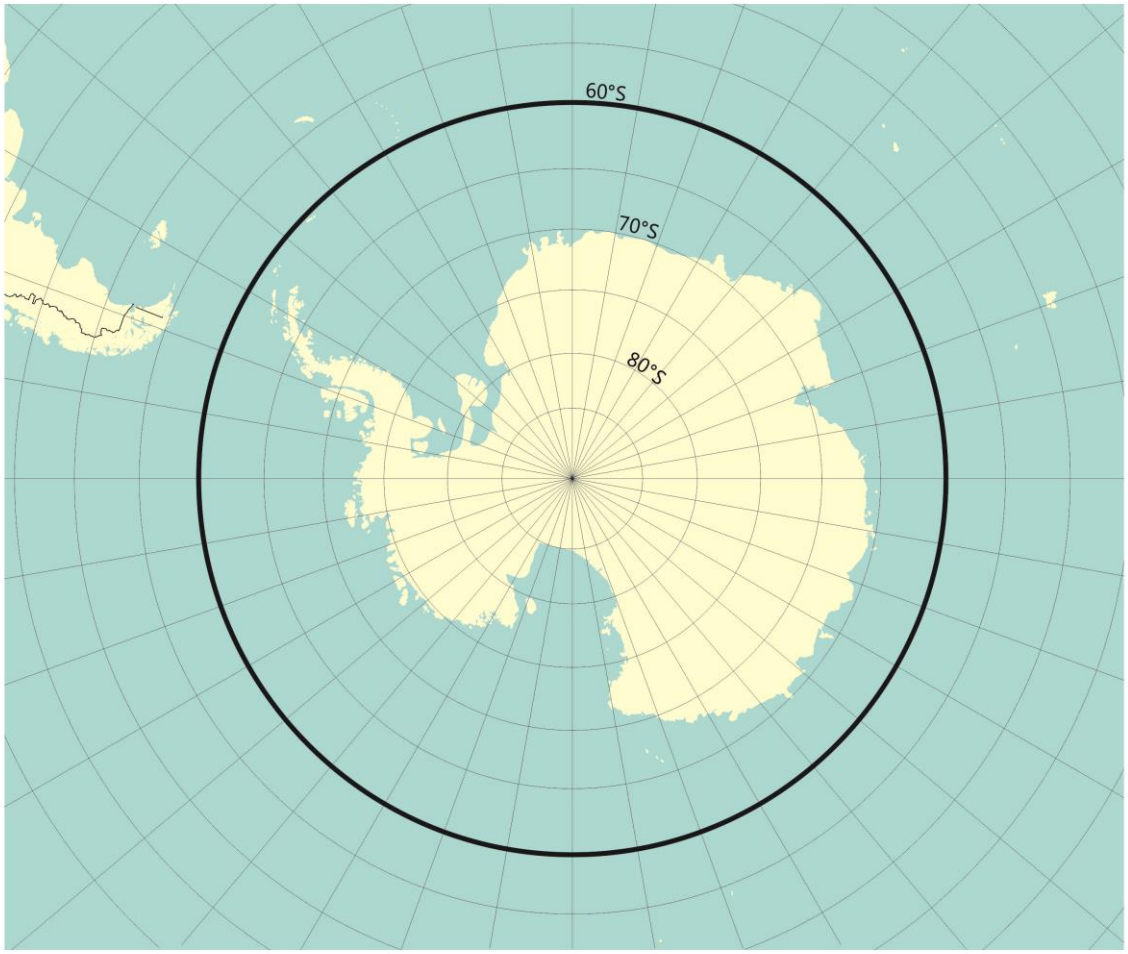


Figure 1 – Maximum extent of Antarctic area application[2]

[2] It should be noted that this figure is for illustrative purposes only.

Figure 2 – Maximum extent of Arctic waters application[3]

[3] It should be noted that this figure is for illustrative purposes only.

PART I-A

SAFETY MEASURES

CHAPTER 1 – GENERAL

1.1 Structure of this part

Each chapter in this part consists of the overall goal of the chapter, functional requirements to fulfil the goal, and regulations. A ship shall be considered to meet a functional requirement set out in this part when either:

.1 the ship's design and arrangements comply with all the regulations associated with that functional requirement; or

.2 part(s) or all of the ship's relevant design and arrangements have been reviewed and approved in accordance with regulation 4 of SOLAS chapter XIV, and any remaining parts of the ship comply with the relevant regulations.

1.2 Definitions

In addition to the definitions included in the relevant SOLAS chapters and the introduction of this Code, the following definitions are applicable to this part.

1.2.1 *Bergy waters* mean an area of freely navigable water in which ice of land origin is present in concentrations less than 1/10. There may be *sea ice* present, although the total concentration of all ice shall not exceed 1/10.

1.2.2 *Escort* means any ship with superior ice capability in transit with another ship.

1.2.3 *Escorted operation* means any operation in which a ship's movement is facilitated through the intervention of an escort.

1.2.4 *Habitable environment* means a ventilated environment that will protect against hypothermia.

1.2.5 *Icebreaker* means any ship whose operational profile may include escort or ice management functions, whose powering and dimensions allow it to undertake aggressive operations in ice-covered waters.

1.2.6 *Ice Class* means the notation assigned to the ship by the Administration or by an organization recognized by the Administration showing that the ship has been designed for navigation in sea-ice conditions.

1.2.7 *Maximum expected time of rescue* means the time adopted for the design of equipment and system that provide survival support. It shall never be less than 5 days.

1.2.8 *Machinery Installations* means equipment and machinery and its associated piping and cabling, which is necessary for the safe operation of the ship.

1.2.9 *Mean Daily Low Temperature* (MDLT) means the mean value of the daily low temperature for each day of the year over a minimum 10 year period. A data set acceptable to the Administration may be used if 10 years of data is not available[4].

1.2.10 *Polar Class (PC)* means the ice class assigned to the ship by the Administration or by an organization recognized by the Administration based upon IACS Unified Requirements.

1.2.11 *Polar Service Temperature (PST) means* a temperature specified for a ship which is intended to operate in low air temperature, which shall be set at least 10^0C below the lowest MDLT for the intended area and season of operation in polar waters.

1.2.12 *Ship intended to operate in low air temperature* means a ship which is intended to undertake voyages to or through areas where the lowest Mean Daily Low Temperature (MDLT) is below -10^0C.

1.2.13 *Tankers* mean oil tankers as defined in SOLAS regulation II-1/2.22, chemical tankers as defined in SOLAS regulation II-1/3.19 and gas carriers as defined in SOLAS regulation VII/11.2.

1.2.14 *Upper ice waterline* means the waterline defined by the maximum draughts forward and aft for operation in ice.

1.3 Certificate and survey

1.3.1 Every ship to which this Code applies shall have on board a valid Polar Ship Certificate.

1.3.2 Except as provided for in paragraph 1.3.3, the Polar Ship Certificate shall be issued after an initial or renewal survey to a ship which complies with the relevant requirements of this Code.

1.3.3 For category C cargo ships, if the result of the assessment in paragraph 1.5 is that no additional equipment or structural modification is required to comply with the Polar Code, the Polar Ship Certificate may be issued based upon documented verification that the ship complies with all relevant requirements of the Polar Code. In this case, for continued validity of the certificate, an onboard survey should be undertaken at the next scheduled survey.

1.3.4 The certificate referred to in this regulation shall be issued either by the Administration or by any person or organization recognized by it in accordance with SOLAS regulation XI-1/1. In every case, that Administration assumes full responsibility for the certificate.

1.3.5 The Polar Ship Certificate shall be drawn up in the form corresponding to the model given in appendix 1 to this Code. If the language used is neither English, nor French nor Spanish, the text shall include a translation into one of these languages.

1.3.6 Polar Ship Certificate validity, survey dates and endorsements shall be harmonized with the relevant SOLAS certificates in accordance with the provisions of regulation I/14 of the SOLAS Convention. The certificate shall include a supplement recording equipment required by the Code.

[4] Refer also to additional guidance in part I-B.

1.3.7 Where applicable, the certificate shall reference a methodology to assess operational capabilities and limitations in ice to the satisfaction of the Administration, taking into account the guidelines developed by the Organization[5].

1.4 Performance standards

1.4.1 Unless expressly provided otherwise, ship systems and equipment addressed in this Code shall satisfy at least the same performance standards referred to in SOLAS.

1.4 2 For ships operating in low air temperature, a polar service temperature (PST) shall be specified and shall be at least 10^0C below the lowest MDLT for the intended area and season of operation in polar waters. Systems and equipment required by this Code shall be fully functional at the polar service temperature.

1.4.3 For ships operating in low air temperature, survival systems and equipment shall be fully operational at the polar service temperature during the maximum expected rescue time.

1.5 Operational assessment

In order to establish procedures or operational limitations, an assessment of the ship and its equipment shall be carried out, taking into consideration the following:

.1 the anticipated range of operating and environmental conditions, such as:

.1 operation in low air temperature;

.2 operation in ice;

.3 operation in high latitude; and

.4 potential for abandonment onto ice or land;

.2 hazards, as listed in section 3 of the Introduction, as applicable; and

.3 additional hazards, if identified.

CHAPTER 2 – POLAR WATER OPERATIONAL MANUAL (PWOM)

2.1 Goal

The goal of this chapter is to provide the owner, operator, master and crew with sufficient information regarding the ship's operational capabilities and limitations in order to support their decision-making process.

2.2 Functional requirements

2.2.1 In order to achieve the goal set out in paragraph 2.1 above, the following functional requirements are embodied in the regulations of this chapter.

2.2.2 The Manual shall include information on the ship-specific capabilities and limitations in relation to the assessment required under paragraph 1.5.

[5] Refer to guidance to be developed by the Organization.

2.2.3 The Manual shall include or refer to specific procedures to be followed in normal operations and in order to avoid encountering conditions that exceed the ship's capabilities.

2.2.4 The Manual shall include or refer to specific procedures to be followed in the event of incidents in polar waters.

2.2.5 The Manual shall include or refer to specific procedures to be followed in the event that conditions are encountered which exceed the ship's specific capabilities and limitations in paragraph 2.2.2.

2.2.6 The Manual shall include or refer to procedures to be followed when using icebreaker assistance, as applicable.

2.3 Regulations

2.3.1 In order to comply with the functional requirements of paragraphs 2.2.1 to 2.2.6, the Manual shall be carried on board.

2.3.2 In order to comply with the functional requirements of paragraph 2.2.2, the Manual shall contain, where applicable, the methodology used to determine capabilities and limitations in ice.

2.3.3 In order to comply with the functional requirements of paragraph 2.2.3, the Manual shall include risk-based procedures for the following:

.1 voyage planning to avoid ice and/or temperatures that exceed the ship's design capabilities or limitations;

.2 arrangements for receiving forecasts of the environmental conditions;

.3 means of addressing any limitations of the hydrographic, meteorological and navigational information available;

.4 operation of equipment required under other chapters of this Code; and

.5 implementation of special measures to maintain equipment and system functionality under low temperatures, topside icing and the presence of sea ice, as applicable.

2.3.4 In order to comply with the functional requirements of paragraph 2.2.4, the Manual shall include risk-based procedures to be followed for:

.1 contacting emergency response providers for salvage, search and rescue (SAR), spill response, etc., as applicable; and

.2 in the case of ships ice strengthened in accordance with chapter 3, procedures for maintaining life support and ship integrity in the event of prolonged entrapment by ice.

2.3.5 In order to comply with the functional requirements of paragraph 2.2.5, the Manual shall include risk-based procedures to be followed for measures to be taken in the event of encountering ice and/or temperatures which exceed the ship's design capabilities or limitations.

2.3.6 In order to comply with the functional requirements of paragraph 2.2.6, the Manual shall include risk-based procedures for monitoring and maintaining safety during operations in ice, as applicable, including any requirements for escort operations or icebreaker assistance. Different operational limitations may apply depending on whether the ship is operating independently or with icebreaker escort. Where appropriate, the PWOM should specify both options.

CHAPTER 3 – SHIP STRUCTURE

3.1 Goal

The goal of this chapter is to provide that the material and scantlings of the structure retain their structural integrity based on global and local response due to environmental loads and conditions.

3.2 Functional requirements

In order to achieve the goal set out in paragraph 3.1 above, the following functional requirements are embodied in the regulations of this chapter:

.1 for ships intended to operate in low air temperature, materials used shall be suitable for operation at the ships polar service temperature; and

.2 in ice strengthened ships, the structure of the ship shall be designed to resist both global and local structural loads anticipated under the foreseen ice conditions.

3.3 Regulations

3.3.1 In order to comply with the functional requirements of paragraph 3.2.1 above, materials of exposed structures in ships shall be approved by the Administration, or a recognized organization accepted by it, taking into account standards acceptable to the Organization[6] or other standards offering an equivalent level of safety based on the polar service temperature.

3.3.2 In order to comply with the functional requirements of paragraph 3.2.2 above, the following apply:

.1 scantlings of category A ships shall be approved by the Administration, or a recognized organization accepted by it, taking into account standards acceptable to the Organization[7] or other standards offering an equivalent level of safety;

.2 scantlings of category B ships shall be approved by the Administration, or a recognized organization accepted by it, taking into account standards acceptable to the Organization[8] or other standards offering an equivalent level of safety;

6 Refer to IACS UR S6 Use of Steel Grades for Various Hull Members – Ships of 90 m in Length and Above (latest version) or IACS URI Requirements concerning Polar Class (latest version), as applicable.

7 Refer to Polar Class 1-5 of IACS URI Requirements concerning Polar Class (latest version).

8 Refer to Polar Class 6-7 of IACS URI Requirements concerning Polar Class (latest version).

.3 scantlings of ice strengthened category C ships shall be approved by the Administration, or a recognized organization accepted by it, taking into account acceptable standards adequate for the ice types and concentrations encountered in the area of operation; and

.4 a category C ship need not be ice strengthened if, in the opinion of the Administration, the ship's structure is adequate for its intended operation.

CHAPTER 4 –SUBDIVISION AND STABILITY

4.1 Goal

The goal of this chapter is to ensure adequate subdivision and stability in both intact and damaged conditions.

4.2 Functional requirements

In order to achieve the goal set out in paragraph 4.1 above, the following functional requirements are embodied in the regulations of this chapter:

.1 ships shall have sufficient stability in intact conditions when subject to ice accretion; and

.2 ships of category A and B, constructed on or after 1 January 2017, shall have sufficient residual stability to sustain ice-related damages.

4.3 Regulations

4.3.1 Stability in intact conditions

4.3.1.1 In order to comply with the functional requirement of paragraph 4.2.1, for ships operating in areas and during periods where ice accretion is likely to occur, the following icing allowance shall be made in the stability calculations:

.1 30 kg/m^2 on exposed weather decks and gangways;

.2 7.5 kg/m^2 for the projected lateral area of each side of the ship above the water plane; and

.3 the projected lateral area of discontinuous surfaces of rail, sundry booms, spars (except masts) and rigging of ships having no sails and the projected lateral area of other small objects shall be computed by increasing the total projected area of continuous surfaces by 5% and the static moments of this area by 10%.

4.3.1.2 Ships operating in areas and during periods where ice accretion is likely to occur shall be:

.1 designed to minimize the accretion of ice; and

.2 equipped with such means for removing ice as the Administration may require; for example, electrical and pneumatic devices, and/or special tools such as axes or wooden clubs for removing ice from bulwarks, rails and erections.

4.3.1.3 Information on the icing allowance included in the stability calculations shall be given in the PWOM.

4.3.1.4 Ice accretion shall be monitored and appropriate measures taken to ensure that the ice accretion does not exceed the values given in the PWOM.

4.3.2 Stability in damaged conditions

4.3.2.1 In order to comply with the functional requirements of paragraph 4.2.2, ships of categories A and B, constructed on or after 1 January 2017, shall be able to withstand flooding resulting from hull penetration due to ice impact. The residual stability following ice damage shall be such that the factor s_i, as defined in SOLAS regulations II-1/7-2.2 and II-1/7-2.3, is equal to one for all loading conditions used to calculate the attained subdivision index in SOLAS regulation II-1/7. However, for cargo ships that comply with subdivision and damage stability regulations in another instrument developed by the Organization, as provided by SOLAS regulation II-1/4.1, the residual stability criteria of that instrument shall be met for each loading condition.

4.3.2.2 The ice damage extents to be assumed when demonstrating compliance with paragraph 4.3.2.1 shall be such that:

.1 the longitudinal extent is 4.5% of the upper ice waterline length if centred forward of the maximum breadth on the upper ice waterline, and 1.5% of upper ice waterline length otherwise, and shall be assumed at any longitudinal position along the ship's length;

.2 the transverse penetration extent is 760 mm, measured normal to the shell over the full extent of the damage; and

.3 the vertical extent is the lesser of 20% of the upper ice waterline draught or the longitudinal extent, and shall be assumed at any vertical position between the keel and 120% of the upper ice waterline draught.

CHAPTER 5 – WATERTIGHT AND WEATHERTIGHT INTEGRITY

5.1 Goal

The goal of this chapter is to provide measures to maintain watertight and weathertight integrity.

5.2 Functional requirements

In order to achieve the goal set out in paragraph 5.1 above, all closing appliances and doors relevant to watertight and weathertight integrity of the ship shall be operable.

5.3 Regulations

In order to comply with the functional requirements of paragraph 5.2 above, the following apply:

.1 for ships operating in areas and during periods where ice accretion is likely to occur, means shall be provided to remove or prevent ice and snow accretion around hatches and doors; and

.2 in addition, for ships intended to operate in low air temperature the following apply:

.1 if the hatches or doors are hydraulically operated, means shall be provided to prevent freezing or excessive viscosity of liquids; and

.2 watertight and weathertight doors, hatches and closing devices which are not within an habitable environment and require access while at sea shall be designed to be operated by personnel wearing heavy winter clothing including thick mittens.

CHAPTER 6 – MACHINERY INSTALLATIONS

6.1 Goal

The goal of this chapter is to ensure that, machinery installations are capable of delivering the required functionality necessary for safe operation of ships.

6.2 Functional requirements

6.2.1 In order to achieve the goal set out in paragraph 6.1 above, the following functional requirements are embodied in the regulations of this chapter.

6.2.1.1 Machinery installations shall provide functionality under the anticipated environmental conditions, taking into account:

.1 ice accretion and/or snow accumulation;

.2 ice ingestion from seawater;

.3 freezing and increased viscosity of liquids;

.4 seawater intake temperature; and

.5 snow ingestion.

6.2.1.2 In addition, for ships intended to operate in low air temperatures:

.1 machinery installations shall provide functionality under the anticipated environmental conditions, also taking into account:

.1 cold and dense inlet air; and

.2 loss of performance of battery or other stored energy device; and

.2 materials used shall be suitable for operation at the ships polar service temperature.

6.2.1.3 In addition, for ships ice strengthened in accordance with chapter 3, machinery installations shall provide functionality under the anticipated environmental conditions, taking into account loads imposed directly by ice interaction.

6.3 Regulations

6.3.1 In order to comply with the functional requirement of paragraph 6.2.1.1 above, taking into account the anticipated environmental conditions, the following apply:

.1 machinery installations and associated equipment shall be protected against the effect of ice accretion and/or snow accumulation, ice ingestion from sea water, freezing and increased viscosity of liquids, seawater intake temperature and snow ingestion;

.2 working liquids shall be maintained in a viscosity range that ensures operation of the machinery; and

.3 seawater supplies for machinery systems shall be designed to prevent ingestion of ice,[9] or otherwise arranged to ensure functionality.

6.3.2 In addition, for ships intended to operate in low air temperatures, the following apply:

.1 in order to comply with the functional requirement of paragraph 6.2.1.2 above, exposed machinery and electrical installation and appliances shall function at the polar service temperature;

.2 in order to comply with the functional requirement of paragraph 6.2.1.2.1 above, means shall be provided to ensure that combustion air for internal combustion engines driving essential machinery is maintained at a temperature in compliance with the criteria provided by the engine manufacturer; and

.3 in order to comply with the functional requirements of paragraph 6.2.1.2.2 above, materials of exposed machinery and foundations shall be approved by the Administration, or a recognized organization accepted by it, taking into account standards acceptable to the Organization[10, 11] or other standards offering an equivalent level of safety based on the polar service temperature.

6.3.3 In addition, for ships ice strengthened in accordance with chapter 3, in order to comply with the functional requirements of paragraph 6.2.1.3 above, the following apply:

.1 scantlings of propeller blades, propulsion line, steering equipment and other appendages of category A ships shall be approved by the Administration, or a recognized organization accepted by it, taking into account standards acceptable to the Organization[10]or other standards offering an equivalent level of safety;

.2 scantlings of propeller blades, propulsion line, steering equipment and other appendages of category B ships shall be approved by the Administration, or a recognized organization accepted by it, taking into account standards acceptable to the Organization[11] or other standards offering an equivalent level of safety; and

.3 scantlings of propeller blades, propulsion line, steering equipment and other appendages of ice-strengthened category C ships shall be approved by the Administration, or a recognized organization accepted by it, taking into account acceptable standards adequate with the ice types and concentration encountered in the area of operation.

9 Refer to MSC/Circ.504, *Guidance on design and construction of sea inlets under slush ice conditions.*

10 Refer to Polar Class 1–5 of IACS URI Requirements concerning Polar Class (2011).

11 Refer to Polar Class 6–7 of IACS URI Requirements concerning Polar Class (2011).

CHAPTER 7 – FIRE SAFETY/PROTECTION

7.1 Goal

The goal of this chapter is to ensure that fire safety systems and appliances are effective and operable, and that means of escape remain available so that persons on board can safely and swiftly escape to the lifeboat and liferaft embarkation deck under the expected environmental conditions.

7.2 Functional requirements

7.2.1 In order to achieve the goal set out in paragraph 7.1 above, the following functional requirements are embodied in the regulations of this chapter:

.1 all components of fire safety systems and appliances if installed in exposed positions shall be protected from ice accretion and snow accumulation;

.2 local equipment and machinery controls shall be arranged so as to avoid freezing, snow accumulation and ice accretion and their location to remain accessible at all time;

.3 the design of fire safety systems and appliances shall take into consideration the need for persons to wear bulky and cumbersome cold weather gear, where appropriate;

.4 means shall be provided to remove or prevent ice and snow accretion from accesses; and

.5 extinguishing media shall be suitable for intended operation.

7.2.2 In addition, for ships intended to operate in low air temperature, the following apply:

.1 all components of fire safety systems and appliances shall be designed to ensure availability and effectiveness under the polar service temperature; and

.2 materials used in exposed fire safety systems shall be suitable for operation at the polar service temperature.

7.3 Regulations

7.3.1 In order to comply with the requirement of paragraph 7.2.1.1, the following apply:

.1 isolating and pressure/vacuum valves in exposed locations are to be protected from ice accretion and remain accessible at all time; and

.2 all two-way portable radio communication equipment shall be operable at the polar service temperature.

7.3.2 In order to comply with the requirement of paragraph 7.2.1.2, the following apply:

.1 fire pumps including emergency fire pumps, water mist and water spray pumps shall be located in compartments maintained above freezing;

.2 the fire main is to be arranged so that exposed sections can be isolated and means of draining of exposed sections shall be provided. Fire hoses and nozzles need not be connected to the fire main at all times, and may be stored in protected locations near the hydrants;

.3 firefighter's outfits shall be stored in warm locations on the ship; and

.4 where fixed water-based firefighting systems are located in a space separate from the main fire pumps and use their own independent sea suction, this sea suction is to be also capable of being cleared of ice accumulation.

7.3.3 In addition, for ships intended to operate in low air temperature, the following apply:

.1 In order to comply with the requirement of paragraph 7.2.2.1, portable and semi-portable extinguishers shall be located in positions protected from freezing temperatures, as far as practical. Locations subject to freezing are to be provided with extinguishers capable of operation under the polar service temperature.

.2 In order to comply with the functional requirements of paragraph 7.2.2.2 above, materials of exposed fire safety systems shall be approved by the Administration, or a recognized organization accepted by it, taking into account standards acceptable to the Organization[12] or other standards offering an equivalent level of safety based on the polar service temperature.

CHAPTER 8 – LIFE-SAVING APPLIANCES AND ARRANGEMENTS

8.1 Goal

The goal of this chapter is to provide for safe escape, evacuation and survival.

8.2 Functional requirements

In order to achieve the goal set out in paragraph 8.1 above, the following functional requirements are embodied in the regulations of this chapter:

8.2.1 *Escape*

8.2.1.1 Exposed escape routes shall remain accessible and safe, taking into consideration the potential icing of structures and snow accumulation.

8.2.1.2 Survival craft and muster and embarkation arrangements shall provide safe abandonment of ship, taking into consideration the possible adverse environmental conditions during an emergency.

8.2.2 *Evacuation*

All life-saving appliances and associated equipment shall provide safe evacuation and be functional under the possible adverse environmental conditions during the maximum expected time of rescue.

8.2.3 *Survival*

8.2.3.1 Adequate thermal protection shall be provided for all persons on board, taking into account the intended voyage, the anticipated weather conditions (cold and wind), and the potential for immersion in polar water, where applicable.

[12] Refer to IACS UR S6 Use of Steel Grades for Various Hull Members – Ships of 90 m in Length and Above (2013) or IACS URI Requirements concerning Polar Class (2011).

8.2.3.2 Life-saving appliances and associated equipment shall take account of the potential of operation in long periods of darkness, taking into consideration the intended voyage.

8.2.3.3 Taking into account the presence of any hazards, as identified in the assessment in chapter 1, resources shall be provided to support survival following abandoning ship, whether to the water, to ice or to land, for the maximum expected time of rescue. These resources shall provide:

.1 a habitable environment;

.2 protection of persons from the effects of cold, wind and sun;

.3 space to accommodate persons equipped with thermal protection adequate for the environment;

.4 means to provide sustenance;

.5 safe access and exit points; and

.6 means to communicate with rescue assets.

8.3 Regulations

8.3.1 *Escape*

In order to comply with the functional requirements of paragraphs 8.2.1.1 and 8.2.1.2 above, the following apply:

.1 for ships exposed to ice accretion, means shall be provided to remove or prevent ice and snow accretion from escape routes, muster stations, embarkation areas, survival craft, its launching appliances and access to survival craft;

.2 in addition, for ships constructed on or after 1 January 2017, exposed escape routes shall be arranged so as not to hinder passage by persons wearing suitable polar clothing; and

.3 in addition, for ships intended to operate in low air temperatures, adequacy of embarkation arrangements shall be assessed, having full regard to any effect of persons wearing additional polar clothing.

8.3.2 *Evacuation*

In order to comply with the functional requirement of paragraph 8.2.2 above, the following apply:

.1 ships shall have means to ensure safe evacuation of persons, including safe deployment of survival equipment, when operating in ice-covered waters, or directly onto the ice, as applicable; and

.2 where the regulations of this chapter are achieved by means of adding devices requiring a source of power, this source shall be able to operate independently of the ship's main source of power.

8.3.3 *Survival*

8.3.3.1 In order to comply with the functional requirement of paragraph 8.2.3.1 above, the following apply:

.1 for passenger ships, a proper sized immersion suit or a thermal protective aid shall be provided for each person on board; and

.2 where immersion suits are required, they shall be of the insulated type.

8.3.3.2 In addition, for ships intended to operate in extended periods of darkness, in order to comply with the functional requirements of paragraph 8.2.3.2 above, searchlights suitable for continuous use to facilitate identification of ice shall be provided for each lifeboat.

8.3.3.3 In order to comply with the functional requirement of paragraph 8.2.3.3 above, the following apply:

.1 no lifeboat shall be of any type other than partially or totally enclosed type;

.2 taking into account the assessment referred to in chapter 1, appropriate survival resources, which address both individual (personal survival equipment) and shared (group survival equipment) needs, shall be provided, as follows:

.1 life-saving appliances and group survival equipment that provide effective protection against direct wind chill for all persons on board;

.2 personal survival equipment in combination with life-saving appliances or group survival equipment that provide sufficient thermal insulation to maintain the core temperature of persons; and

.3 personal survival equipment that provide sufficient protection to prevent frostbite of all extremities; and

.3 in addition, whenever the assessment required under paragraph 1.5 identifies a potential of abandonment onto ice or land, the following apply:

.1 group survival equipment shall be carried, unless an equivalent level of functionality for survival is provided by the ship's normal life-saving appliances;

.2 when required, personal and group survival equipment sufficient for 110% of the persons on board shall be stowed in easily accessible locations, as close as practical to the muster or embarkation stations;

.3 containers for group survival equipment shall be designed to be easily movable over the ice and be floatable;

.4 whenever the assessment identifies the need to carry personal and group survival equipment, means shall be identified of ensuring that this equipment is accessible following abandonment;

.5 if carried in addition to persons, in the survival craft, the survival craft and launching appliances shall have sufficient capacity to accommodate the additional equipment;

.6 passengers shall be instructed in the use of the personal survival equipment and the action to take in an emergency; and

.7 the crew shall be trained in the use of the personal survival equipment and group survival equipment.

8.3.3.4 In order to comply with the functional requirement of paragraph 8.2.3.3.4 above, adequate emergency rations shall be provided, for the maximum expected time of rescue.

CHAPTER 9 – SAFETY OF NAVIGATION

9.1 Goal

The goal of this chapter is to provide for safe navigation.

9.2 Functional requirements

In order to achieve the goal set out in paragraph 9.1 above, the following functional requirements are embodied in the regulations of this chapter.

9.2.1 *Nautical information*

Ships shall have the ability to receive up-to-date information including ice information for safe navigation.

9.2.2 *Navigational equipment functionality*

9.2.2.1 The navigational equipment and systems shall be designed, constructed, and installed to retain their functionality under the expected environmental conditions in the area of operation.

9.2.2.2 Systems for providing reference headings and position fixing shall be suitable for the intended areas.

9.2.3 *Additional navigational equipment*

9.2.3.1 Ships shall have the ability to visually detect ice when operating in darkness.

9.2.3.2 Ships involved in operations with an icebreaker escort shall have suitable means to indicate when the ship is stopped.

9.3 Regulations

9.3.1 *Nautical information*

In order to comply with the functional requirement of paragraph 9.2.1 above, ships shall have means of receiving and displaying current information on ice conditions in the area of operation.

9.3.2 *Navigational equipment functionality*

9.3.2.1 In order to comply with the functional requirement of paragraph 9.2.2.1 above, the following apply:

.1 ships constructed on or after 1 January 2017, ice strengthened in accordance with chapter 3, shall have either two independent echo-sounding devices or one echo-sounding device with two separate independent transducers;

.2 ships shall comply with SOLAS regulation V/22.1.9.4, irrespective of the date of construction and the size and, depending on the bridge configuration, a clear view astern;

.3 for ships operating in areas, and during periods, where ice accretion is likely to occur, means to prevent the accumulation of ice on antennas required for navigation and communication shall be provided; and

.4 in addition, for ships ice strengthened in accordance with chapter 3, the following apply:

.1 where equipment required by SOLAS chapter V or this chapter have sensors that project below the hull, such sensors shall be protected against ice; and

.2 in category A and B ships constructed on or after 1 January 2017, the bridge wings shall be enclosed or designed to protect navigational equipment and operating personnel.

9.3.2.2 In order to comply with the functional requirement of paragraph 9.2.2.2 above, the following apply:

.1 ships shall have two non-magnetic means to determine and display their heading. Both means shall be independent and shall be connected to the ship's main and emergency source of power; and

.2 ships proceeding to latitudes over 80 degrees shall be fitted with at least one GNSS compass or equivalent, which shall be connected to the ship's main and emergency source of power.

9.3.3 *Additional navigational equipment*

9.3.3.1 In order to comply with the functional requirement of paragraph 9.2.3.1 ships, with the exception of those solely operating in areas with 24 hours daylight, shall be equipped with two remotely rotatable, narrow-beam search lights controllable from the bridge to provide lighting over an arc of 360 degrees, or other means to visually detect ice.

9.3.3.2 In order to comply with the functional requirement of paragraph 9.2.3.2, ships involved in operations with an icebreaker escort shall be equipped with a manually initiated flashing red light visible from astern to indicate when the ship is stopped. This light shall have a range of visibility of at least two nautical miles, and the horizontal and vertical arcs of visibility shall conform to the stern light specifications required by the International Regulations for Preventing Collisions at Sea.

CHAPTER 10 – COMMUNICATION

10.1 Goal

The goal of this chapter is to provide for effective communication for ships and survival craft during normal operation and in emergency situations.

10.2 Functional requirements

In order to achieve the goal set out in paragraph 10.1 above, the following functional requirements are embodied in the regulations of this chapter.

10.2.1 *Ship communication*

10.2.1.1 Two-way voice and/or data communications ship-to-ship and ship-to-shore shall be available at all points along the intended operating routes.

10.2.1.2 Suitable means of communications shall be provided where escort and convoy operations are expected.

10.2.1.3 Means for two-way on-scene and SAR coordination communications for search and rescue purposes including aeronautical frequencies shall be provided.

10.2.1.4 Appropriate communication equipment to enable telemedical assistance in polar areas shall be provided.

10.2.2 *Survival craft and rescue boat communications capabilities*

10.2.2.1 For ships intended to operate in low air temperature, all rescue boats and lifeboats, whenever released for evacuation, shall maintain capability for distress alerting, locating and on-scene communications.

10.2.2.2 For ships intended to operate in low air temperature, all other survival craft, whenever released, shall maintain capability for transmitting signals for location and for communication.

10.2.2.3 Mandatory communication equipment for use in survival craft, including liferafts, and rescue boats shall be capable of operation during the maximum expected time of rescue.

10.3 Regulations

10.3.1 *Ship communication*

10.3.1.1 In order to comply with the functional requirements of paragraph 10.2.1.1 above, communication equipment on board shall have the capabilities for ship-to-ship and ship-to-shore communication, taking into account the limitations of communications systems in high latitudes and the anticipated low temperature.

10.3.1.2 In order to comply with the functional requirements of paragraph 10.2.1.2 above, ships intended to provide icebreaking escort shall be equipped with a sound signaling system mounted to face astern to indicate escort and emergency manoeuvres to following ships as described in the International Code of Signals.

10.3.1.3 In order to comply with the functional requirements of paragraph 10.2.1.3 above, two-way on-scene and SAR coordination communication capability in ships shall include:

.1 voice and/or data communications with relevant rescue coordination centres; and

.2 equipment for voice communications with aircraft on 121.5 and 123.1 MHz.

10.3.1.4 In order to comply with the functional requirements of paragraph 10.2.1.4 above, the communication equipment shall provide for two-way voice and data communication with a Telemedical Assistance Service (TMAS).

10.3.2 *Survival craft and rescue boat communications capabilities*

10.3.2.1 For ships intended to operate in low air temperature, in order to comply with the functional requirements of paragraph 10.2.2.1 above, all rescue boats and lifeboats, whenever released for evacuation, shall:

.1 for distress alerting, carry one device for transmitting ship to shore alerts;

.2 in order to be located, carry one device for transmitting signals for location; and

.3 for on-scene communications, carry one device for transmitting and receiving on-scene communications.

10.3.2.2 For ships intended to operate in low air temperature, in order to comply with the functional requirements of paragraph 10.2.2.2 above, all other survival craft shall:

.1 in order to be located, carry one device for transmitting signals for location; and

.2 for on-scene communications, carry one device for transmitting and receiving on-scene communications.

10.3.2.3 In order to comply with the functional requirements of paragraph 10.2.2.3 above, recognizing the limitations arising from battery life, procedures shall be developed and implemented such that mandatory communication equipment for use in survival craft, including liferafts, and rescue boats are available for operation during the maximum expected time of rescue.

CHAPTER 11 – VOYAGE PLANNING

11.1 Goal

The goal of this chapter is to ensure that the Company, master and crew are provided with sufficient information to enable operations to be conducted with due consideration to safety of ship and persons on board and, as appropriate, environmental protection.

11.2 Functional requirement

In order to achieve the goal set out in paragraph 11.1 above, the voyage plan shall take into account the potential hazards of the intended voyage.

11.3 Requirements

In order to comply with the functional requirement of paragraph 11.2 above, the master shall consider a route through polar waters, taking into account the following:

.1 the procedures required by the PWOM;

.2 any limitations of the hydrographic information and aids to navigation available;

.3 current information on the extent and type of ice and icebergs in the vicinity of the intended route;

.4 statistical information on ice and temperatures from former years;

.5 places of refuge;

.6 current information and measures to be taken when marine mammals are encountered relating to known areas with densities of marine mammals, including seasonal migration areas;[13]

.7 current information on relevant ships' routing systems, speed recommendations and vessel traffic services relating to known areas with densities of marine mammals, including seasonal migration areas;[14]

.8 national and international designated protected areas along the route; and

.9 operation in areas remote from search and rescue (SAR) capabilities.[15]

CHAPTER 12 –MANNING AND TRAINING

12.1 Goal

The goal of this chapter is to ensure that ships operating in polar waters are appropriately manned by adequately qualified, trained and experienced personnel.

12.2 Functional requirements

In order to achieve the goal set out in paragraph 12.1 above, companies shall ensure that masters, chief mates and officers in charge of a navigational watch on board ships operating in polar waters shall have completed training to attain the abilities that are appropriate to the capacity to be filled and duties and responsibilities to be taken up, taking into account the provisions of the STCW Convention and the STCW Code, as amended.

12.3 Regulations

12.3.1 In order to meet the functional requirement of paragraph 12.2 above while operating in polar waters, masters, chief mates and officers in charge of a navigational watch shall be qualified in accordance with chapter V of the STCW Convention and the STCW Code, as amended, as follows:

Ice conditions	Tankers	Passenger ships	Other
Ice Free	Not applicable	Not applicable	Not applicable
Open waters	Basic training for master, chief mate and officers in charge of a navigational watch	Basic training for master, chief mate and officers in charge of a navigational watch	Not applicable

13 Refer to MEPC/Circ.674 on *Guidance document for minimizing the risk of ship strikes with cetaceans*.

14 Refer to MEPC/Circ.674 on *Guidance document for minimizing the risk of ship strikes with cetaceans*.

15 Refer to MSC.1/Circ.1184 on *Enhanced contingency planning guidance for passenger ships operating in areas remote from SAR facilities* and resolution A.999(25) *on Guidelines on voyage planning for passenger ships operating in remote areas.*

Ice conditions	Tankers	Passenger ships	Other
Ice Free	Not applicable	Not applicable	Not applicable
Other waters	Advanced training for master and chief mate. Basic training for officers in charge of a navigational watch	Advanced training for master and chief mate. Basic training for officers in charge of a navigational watch	Advanced training for master and chief mate. Basic training for officers in charge of a navigational watch.

12.3.2 The Administration may allow the use of a person(s) other than the master, chief mate or officers of the navigational watch to satisfy the requirements for training, as required by paragraph 12.3.1, provided that:

.1 this person(s) shall be qualified and certified in accordance with regulation II/2 of the STCW Convention and section A-II/2 of the STCW Code, and meets the advance training requirements noted in the above table;

.2 while operating in polar waters the ship has sufficient number of persons meeting the appropriate training requirements for polar waters to cover all watches;

.3 this person(s) is subject to the Administration's minimum hours of rest requirements at all times;

.4 when operating in waters other than open waters or bergy waters, the master, chief mate and officers in charge of a navigational watch on passenger ships and tankers shall meet the applicable basic training requirements noted in the above table; and

.5 when operating in waters with ice concentration of more than 2/10, the master, chief mate and officers in charge of a navigational watch on cargo ships other than tankers shall meet the applicable basic training requirements noted in the above table.

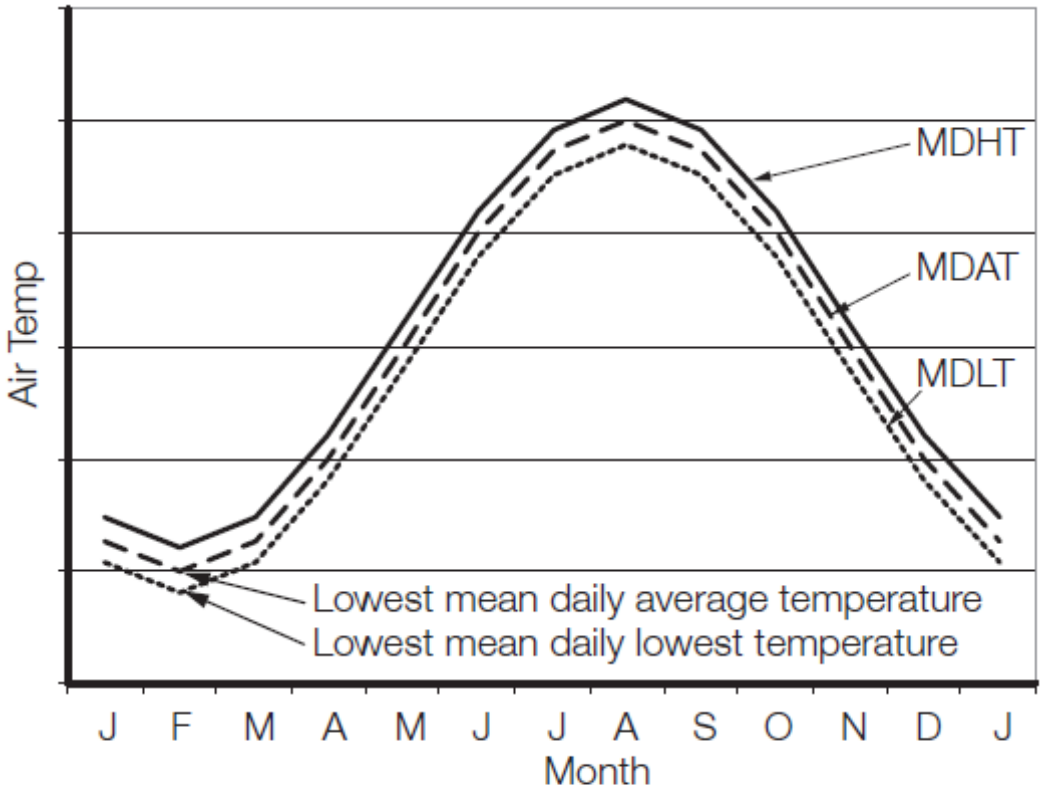
12.3.3 The use of a person other than the officer of the navigational watch to satisfy the requirements for training does not relieve the master or officer of the navigational watch from their duties and obligations for the safety of the ship.

12.3.4 Every crew member shall be made familiar with the procedures and equipment contained or referenced in the PWOM relevant to their assigned duties.

PART I-B

ADDITIONAL GUIDANCE REGARDING THE PROVISIONS OF THE INTRODUCTION AND PART I-A

1 ADDITIONAL GUIDANCE TO SECTION 2 (DEFINITIONS) OF THE INTRODUCTION



Definitions used in the figure above

MDHT – Mean Daily High Temperature

MDAT – Mean Daily Average Temperature

MDLT – Mean Daily Low Temperature

Guidance instructions for determining MDLT:

1 Determine the daily low temperature for each day for a 10 year period.

2 Determine the average of the values over the 10 year period for each day.

3 Plot the daily averages over the year.

4 Take the lowest of the averages for the season of operation.

2 ADDITIONAL GUIDANCE TO CHAPTER 1 (GENERAL)

1 Limitations for operating in ice

1.1 Limitations for operation in ice can be determined using systems, tools or analysis that evaluate the risks posed by the anticipated ice conditions to the ship, taking into account factors such as its ice class, seasonal changing of ice strength, icebreaker support, ice type, thickness and concentration. The ship's structural capacity to resist ice load and the ship's planned operations should be considered. The limitations should be incorporated into an ice operational decision support system.

1.2 Limitations for operating in ice should be determined using an appropriate methodology, such methodologies exist, have been in use for a number of years and have been validated with service experience. Existing methodologies and other systems may be acceptable to the Administration.

1.3 Operation in ice should take into account any operational limitations of the ship; extended information on the ice operational methodology contained in the PWOM; the condition of the ship and ship's systems, historical weather/ice data and weather/ice forecasts for the intended area of operation, current conditions including visual ice observations, sea state, visibility and the judgment of qualified personnel.

2 Operational assessment

2.1 This guidance is intended to support shipowners carrying out, and Administrations reviewing, the assessment required in part I-A, section 1.5, for operational limitations and procedures for the Polar Ship Certificate.

2.2 Steps for an operational assessment:

.1 identify relevant hazards from section 3 of the Introduction and other hazards based on a review of the intended operations;

.2 develop a model[16] to analyse risks considering:

.1 development of accident scenarios;

.2 probability of events in each accident scenario; and

.3 consequence of end states in each scenario;

.3 assess risks and determine acceptability:

.1 estimate risk levels in accordance with the selected modelling approach; and

.2 assess whether risk levels are acceptable; and

[16] Reference is made to the techniques in appendix 3 of the *Revised guidelines for Formal Safety Assessment (FSA) for use in the IMO Rule-Making Process* (MSC-MEPC.2/Circ.12) and standard IEC/ISO 31010 "Risk management – Risk assessment techniques".

.4 in the event that risk levels determined in steps 1 to 3 are considered to be too high, identify current or develop new risk control options that aim to achieve one or more of the following:

.1 reduce the frequency of failures through better design, procedures, training, etc.;

.2 mitigate the effect of failures in order to prevent accidents;

.3 limit the circumstances in which failures may occur; or

.4 mitigate consequences of accidents; and

.5 incorporate risk control options for design, procedures, training and limitations, as applicable.

3 Performance standards

A system previously accepted based on manufacturer certifications, classification society certifications and/or satisfactory service of existing systems may be acceptable for installation on new and existing ships if no performance or testing standards are accepted by the Organization.

3 ADDITIONAL GUIDANCE TO CHAPTER 2 (POLAR WATER OPERATIONAL MANUAL (PWOM))

3.1 Recommendation on the content of the Polar Water Operational Manual

The Polar Water Operational Manual (PWOM) is intended to address all aspects of operations addressed by chapter 2 of part I-A. When appropriate information, procedures or plans exist elsewhere in a ship's documentation, the PWOM itself does not need to replicate this material, but may instead cross-reference the relevant reference document.

A model Table of Contents is found in appendix 2.

The model follows the general structure of chapter 2. Not every section outlined below will be applicable to every polar ship. Many category C ships that undertake occasional or limit polar voyages will not need to have procedures for situations with a very low probability of occurrence. However, it may still be advisable to retain a common structure for the PWOM as a reminder that if assumptions change then the contents of the manual may also need to be updated. Noting an aspect as "not applicable" also indicates to the Administration that this aspect has been considered and not merely omitted.

3.2 Guidance on navigation with icebreaker assistance

With respect to navigation with icebreaker assistance, the following should be considered:

.1 while approaching the starting point of the ice convoy to follow an icebreaker/icebreakers or in the case of escorting by icebreaker of one ship to the point of meeting with the icebreaker, ships should establish radio communication on the VHF channel 16 and act in compliance with the icebreaker's instructions;

.2 the icebreaker rendering the icebreaker assistance of ship ice convoy should command ships in the ice convoy;

.3 position of a ship in the ice convoy should be determined by the icebreaker rendering the assistance;

.4 ship within the ice convoy, in accordance with the instructions of the icebreaker rendering the assistance, should establish communication with the icebreaker by VHF channel indicated by the icebreaker;

.5 the ship, while navigating in the ice convoy, should ensure compliance with the instructions of the icebreaker;

.6 position in the ice convoy, speed and distance to a ship ahead should be as instructed by the icebreaker;

.7 the ship should immediately notify the icebreaker of any difficulties to maintain the position within the ice convoy, speed and/or distance to any other ship in the ice convoy; and

.8 the ship should immediately report to the icebreaker of any damage.

3.3 Guidance on the development of contingency plans

In developing the ship's contingency plans ships should consider damage control measures arrangements for emergency transfer of liquids and access to tanks and spaces during salvage operations.

See also additional guidance to chapter 9.

4 ADDITIONAL GUIDANCE TO CHAPTER 3 (SHIP STRUCTURE)

Method for determining equivalent ice class

1 The guidance presented below is intended to assist in determining equivalency with standards acceptable to the Organization, as referenced in chapters 3 and 6 of the Code. The methodology is consistent with guidance developed by the Organization[17] while allowing for the use of a simplified approach.

2 The basic approach for considering equivalency for categories A and B ships can be the same for both new and existing ships. It involves comparing other ice classes to the IACS Polar Classes. For ice classes under category C, additional information on comparisons of strengthening levels is available for the guidance of owners and Administrations.[18] The responsibility for generating the equivalency request and supporting information required should rest with the owner/operator. Review/approval of any equivalency request should be undertaken by the flag State Administration, or by a recognized organization acting on its behalf under the provisions of the Code for Recognized Organizations (RO Code). Several classification societies have developed easy-to-use tools for determination of compliance with the IACS Polar Class structural requirements, as have some Administrations and other third parties.

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17 Refer to the G*uidelines for the approval of alternatives and equivalents as provided for in various IMO instruments* (MSC.1/Circ.1455).

18 Refer to the annex to HELCOM Recommendation 25/7, Safety of Winter Navigation in the Baltic Sea Area, available at www.helcom.fi

3 The scope of a simplified equivalency assessment (referring to paragraphs 6.1 to 6.3 below) is expected to be limited to materials selection, structural strength of the hull and propulsion machinery.

4 If there is not full and direct compliance, then an equivalent level of risk can be accepted in accordance with guidance provided by the Organization. An increase in the probability of an event can be balanced by a reduction in its consequences. Alternatively, a reduction in probability could potentially allow acceptance of more serious consequences. Using a hull area example, a local shortfall in strength level or material grade could be accepted if the internal compartment is a void space, for which local damage will not put the overall safety of the ship at risk or lead to any release of pollutants.

5 For existing ships, service experience can assist in risk assessment. As an example, for an existing ship with a record of polar ice operations a shortfall in the extent of the ice belt (hull areas) may be acceptable if there is no record of damage to the deficient area; i.e. a ship that would generally meet PC 5 requirements but in limited areas is only PC 7 could still be considered as a category A, PC 5 ship. In all such cases, the ship's documentation should make clear the nature and scope of any deficiencies.

6 The process includes the following stages of assessment:

.1 select the target Polar Class for equivalency;

.2 compare materials used in the design with minimum requirements under the IACS Polar Class URs; identify any shortfalls; and

.3 compare strength levels of hull and machinery components design with requirements under the IACS Polar Class URs; quantify levels of compliance.

7 Where gaps in compliance are identified in steps 1 to 3, additional steps should be necessary to demonstrate equivalency, as outlined below:

.4 identify any risk mitigation measures incorporated in the design of the ship (over and above the requirements of the Code and IACS URs);

.5 where applicable, provide documentation of service experience of existing ships, in conditions relevant to the target ice class for equivalency; and

.6 undertake an assessment, taking into account information from steps 1 to 5, as applicable, and on the principles outlined in paragraphs 2 to 6 above.

8 Documentation provided with an application for equivalency should identify each stage that has been undertaken, and sufficient supporting information to validate assessments.

9 Where a ship in categories A or B is provided with an equivalency for ice class by its flag State, this should be noted in its Polar Ship Certificate.

5 ADDITIONAL GUIDANCE TO CHAPTER 4 (SUBDIVISION AND STABILITY)

No additional guidance

6 ADDITIONAL GUIDANCE TO CHAPTER 5 (WATERTIGHT AND WEATHERTIGHT INTEGRITY)

No additional guidance.

7 ADDITIONAL GUIDANCE TO CHAPTER 6 (MACHINERY INSTALLATIONS)

Refer to additional guidance to chapter 3.

8 ADDITIONAL GUIDANCE TO CHAPTER 7 (FIRE SAFETY/PROTECTION)

No additional guidance.

9 ADDITIONAL GUIDANCE TO CHAPTER 8 (LIFE-SAVING APPLIANCES AND ARRANGEMENTS)

9.1 Sample personal survival equipment

When considering resources to be included with the personal survival equipment, the following should be taken into account:

Suggested equipment
Protective clothing (hat, gloves, socks, face and neck protection, etc.)
Skin protection cream
Thermal protective aid
Sunglasses
Whistle
Drinking mug
Penknife
Polar survival guidance
Emergency food
Carrying bag

9.2 Sample group survival equipment

When considering resources to be included in the group survival equipment, the following should be taken into account:

Suggested equipment
Shelter – tents or storm shelters or equivalent – sufficient for maximum number of persons
Thermal protective aids or similar – sufficient for maximum number of persons
Sleeping bags – sufficient for at least one between two persons
Foam sleeping mats or similar – sufficient for at least one between two persons
Shovels – at least 2
Sanitation (e.g. toilet paper)
Stove and fuel – sufficient for maximum number of persons ashore and maximum anticipated time of rescue

Suggested equipment
Emergency food – sufficient for maximum number of persons ashore and maximum anticipated time of rescue
Flashlights – one per shelter
Waterproof and windproof matches – two boxes per shelter
Whistle
Signal mirror
Water containers & water purification tablets
Spare set of personal survival equipment
Group survival equipment container (waterproof and floatable)

10 ADDITIONAL GUIDANCE TO CHAPTER 9 (SAFETY OF NAVIGATION)

10.1 Radars equipped with enhanced ice detection capability should be promoted used, in particular, in shallow waters.

10.2 As the chart coverage of polar waters in many areas may not currently be adequate for coastal navigation, navigational officers should:

.1 exercise care to plan and monitor their voyage accordingly, taking due account of the information and guidance in the appropriate nautical publications;

.2 be familiar with the status of hydrographic surveys and the availability and quality of chart information for the areas in which they intend to operate;

.3 be aware of potential chart datum discrepancies with GNSS positioning; and

.4 aim to plan their route through charted areas and well clear of known shoal depths, following established routes whenever possible.

10.3 Any deviations from the planned route should be undertaken with particular caution. For example, and when operating on the continental shelf:

.1 the echo-sounder should be working and monitored to detect any sign of unexpected depth variation, especially when the chart is not based on a full search of the sea floor; and

.2 independent cross-checking of positioning information (e.g. visual and radar fixing and GNSS) should be undertaken at every opportunity. Mariners should ensure to report to the relevant charting authority (Hydrographic Office) any information that might contribute to improving the nautical charts and publications.

10.4 Ships should be fitted with:

.1 a suitable means to de-ice sufficient conning position windows to provide unimpaired forward and astern vision from conning positions; and

.2 an efficient means of clearing melted ice, freezing rain, snow, mist and spray from outside and accumulated condensation from inside. A mechanical means to clear moisture from the outside face of a window should have operating mechanisms protected from freezing or the accumulation of ice that would impair effective operation.

11 ADDITIONAL GUIDANCE TO CHAPTER 10 (COMMUNICATION)

11.1 Limitations of communication systems in high latitude

11.1.1 Current maritime digital communication systems were not designed to cover Polar waters.

11.1.2 VHF is still largely used for communication at sea, but only over short distances (line of sight) and normally only for voice communication. HF and MF are also used for emergency situations. Digital VHF, mobile phone systems and other types of wireless technology offer enough digital capacity for many maritime applications, but only to ships within sight of shore-based stations, and are, therefore, not generally available in polar waters. AIS could also be used for low data-rate communication, but there are very few base stations, and the satellite-based AIS system is designed for data reception only.

11.1.3 The theoretical limit of coverage for GEO systems is 81.3° north or south, but instability and signal dropouts can occur at latitudes as low as 70° north or south under certain conditions. Many factors influence the quality of service offered by GEO systems, and they have different effects depending on the system design.

11.1.4 Non-GMDSS systems may be available and may be effective for communication in polar waters.

11.2 Advice for the operation of multiple alerting and communication devices in the event of an incident

A procedure should be developed to ensure that when survival craft are in close proximity, not more than two alerting or locating devices are activated (as required by regulation 10.3.2) at the same time. This is to:

.1 preserve battery life;

.2 enable extended periods of time for the transmission of alerting or locating signals; and

.3 avoid potential interference.

11.3 For satellite distress beacons, although multiple beacon transmissions can be detected successfully by the satellite system, it is not recommended to activate multiple beacons, unless the survival craft operating the beacons are widely dispersed, as this can cause interference on direction-finding equipment.

11.4 Advice on location and communication equipment to be carried by rescue boats and survival craft

In determining the equipment to be carried for transmitting signals for location, the capabilities of the search and rescue resources likely to respond should be borne in mind. Responding ships and aircraft may not be able to home to 406/121.5 MHz, in which case other locating devices (e.g. AIS-SART) should be considered.

12 ADDITIONAL GUIDANCE TO CHAPTER 11 (VOYAGE PLANNING)

In developing and executing a voyage plan ships should consider the following:

.1 in the event that marine mammals are encountered, any existing best practices should be considered to minimize unnecessary disturbance; and

.2 planning to minimize the impact of the ship's voyage where ships are trafficking near areas of cultural heritage and cultural significance.

See also additional guidance to chapter 9.

13 ADDITIONAL GUIDANCE TO CHAPTER 12 (MANNING AND TRAINING)

No additional guidance.

PART II-A
POLLUTION PREVENTION MEASURES

CHAPTER 1 – PREVENTION OF POLLUTION BY OIL

1.1 Operational requirements

1.1.1 In Arctic waters any discharge into the sea of oil or oily mixtures from any ship shall be prohibited.

1.1.2 The provisions of paragraph 1.1.1 shall not apply to the discharge of clean or segregated ballast.

1.1.3 Subject to the approval of the Administration, a category A ship constructed before 1 January 2017 that cannot comply with paragraph 1.1.1 for oil or oily mixtures from machinery spaces and is operating continuously in Arctic waters for more than 30 days shall comply with paragraph 1.1.1 not later than the first intermediate or renewal survey, whichever comes first, one year after 1 January 2017. Until such date these ships shall comply with the discharge requirements of MARPOL Annex I regulation 15.3.

1.1.4 Operation in polar waters shall be taken into account, as appropriate, in the Oil Record Books, manuals and the shipboard oil pollution emergency plan or the shipboard marine pollution emergency plan as required by MARPOL Annex I.

1.2 Structural requirements

1.2.1 For category A and B ships constructed on or after 1 January 2017 with an aggregate oil fuel capacity of less than 600 m^3, all oil fuel tanks shall be separated from the outer shell by a distance of not less than 0.76 m. This provision does not apply to small oil fuel tanks with a maximum individual capacity not greater than 30 m^3.

1.2.2 For category A and B ships other than oil tankers constructed on or after 1 January 2017, all cargo tanks constructed and utilized to carry oil shall be separated from the outer shell by a distance of not less than 0.76 m.

1.2.3 For category A and B oil tankers of less than 5,000 tonnes deadweight constructed on or after 1 January 2017, the entire cargo tank length shall be protected with:

.1 double bottom tanks or spaces complying with the applicable requirements of regulation 19.6.1 of MARPOL Annex I; and

.2 wing tanks or spaces arranged in accordance with regulation 19.3.1 of MARPOL Annex I and complying with the applicable requirements for distance referred to in regulation 19.6.2 of MARPOL Annex I.

1.2.4 For category A and B ships constructed on or after 1 January 2017 all oil residue (sludge) tanks and oily bilge water holding tanks shall be separated from the outer shell by a distance of not less than 0.76 m. This provision does not apply to small tanks with a maximum individual capacity not greater than 30 m^3.

CHAPTER 2 – CONTROL OF POLLUTION BY NOXIOUS LIQUID SUBSTANCES IN BULK

2.1 Operational requirements

2.1.1 In Arctic waters any discharge into the sea of noxious liquid substances (NLS), or mixtures containing such substances, shall be prohibited.

2.1.2 Operation in polar waters shall be taken into account, as appropriate, in the Cargo Record Book, the Manual and the shipboard marine pollution emergency plan for noxious liquid substances or the shipboard marine pollution emergency plan as required by MARPOL Annex II.

2.1.3 For category A and B ships constructed on or after 1 January 2017, the carriage of NLS identified in chapter 17, column e, as ship type 3 or identified as NLS in chapter 18 of the International Code for the Construction and Equipment of Ships Carrying Dangerous Chemicals in Bulk in cargo tanks of type 3 ships shall be subject to the approval of the Administration. The results shall be reflected on the International Pollution Prevention Certificate for the Carriage of Noxious Liquid Substances in Bulk or Certificate of Fitness identifying the operation in polar waters.

CHAPTER 3 –PREVENTION OF POLLUTION BY HARMFUL SUBSTANCES CARRIED BY SEA IN PACKAGED FORM

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CHAPTER 4 –PREVENTION OF POLLUTION BY SEWAGE FROM SHIPS

4.1 Definitions

4.1.1 *Constructed* means a ship the keel of which is laid or which is at a similar stage of construction.

4.1.2 *Ice-shelf* means a floating ice sheet of considerable thickness showing 2 to 50 m or more above sea-level, attached to the coast.[19]

4.1.3 *Fast ice* means sea ice which forms and remains fast along the coast, where it is attached to the shore, to an ice wall, to an ice front, between shoals or grounded icebergs.[19]

4.2 Operational requirements

4.2.1 Discharges of sewage within polar waters are prohibited except when performed in accordance with MARPOL Annex IV and the following requirements:

.1 the ship is discharging comminuted and disinfected sewage in accordance with regulation 11.1.1 of MARPOL Annex IV at a distance of more than 3 nautical miles from any ice-shelf or fast ice and shall be as far as practicable from areas of ice concentration exceeding 1/10; or

.2 the ship is discharging sewage that is not comminuted or disinfected in accordance with regulation 11.1.1 of MARPOL Annex IV and at a distance of more than 12 nautical miles from any ice-shelf or fast ice and shall be as far as practicable from areas of ice concentration exceeding 1/10; or

[19] Refer to the WMO Sea-Ice Nomenclature.

.3 the ship has in operation an approved sewage treatment plant[20] certified by the Administration to meet the operational requirements in either regulation 9.1.1 or 9.2.1 of MARPOL Annex IV, and discharges sewage in accordance with regulation 11.1.2 of Annex IV and shall be as far as practicable from the nearest land, any ice-shelf, fast ice or areas of ice concentration exceeding 1/10.

4.2.2 Discharge of sewage into the sea is prohibited from category A and B ships constructed on or after 1 January 2017 and all passenger ships constructed on or after 1 January 2017, except when such discharges are in compliance with paragraph 4.2.1.3 of this chapter.

4.2.3 Notwithstanding the requirements of paragraph 4.2.1, category A and B ships that operate in areas of ice concentrations exceeding 1/10 for extended periods of time, may only discharge sewage using an approved sewage treatment plant certified by the Administration to meet the operational requirements in either regulation 9.1.1 or 9.2.1 of MARPOL Annex IV. Such discharges shall be subject to the approval by the Administration.

CHAPTER 5 – PREVENTION OF POLLUTION BY GARBAGE FROM SHIPS

5.1 Definitions

5.1.1 *Ice-shelf* means a floating ice sheet of considerable thickness showing 2 to 50 m or more above sea-level, attached to the coast[21].

5.1.2 *Fast ice* means sea ice which forms and remains fast along the coast, where it is attached to the shore, to an ice wall, to an ice front, between shoals or grounded icebergs[21]

5.2 Operational requirements

5.2.1 In Arctic waters, discharge of garbage into the sea permitted in accordance with regulation 4 of MARPOL Annex V, shall meet the following additional requirements:

.1 discharge into the sea of food wastes is only permitted when the ship is as far as practicable from areas of ice concentration exceeding 1/10, but in any case not less than 12 nautical miles from the nearest land, nearest ice-shelf, or nearest fast ice;

.2 food wastes shall be comminuted or ground and shall be capable of passing through a screen with openings no greater than 25 mm. Food wastes shall not be contaminated by any other garbage type;

.3 food wastes shall not be discharged onto the ice;

.4 discharge of animal carcasses is prohibited; and

.5 discharge of cargo residues that cannot be recovered using commonly available methods for unloading shall only be permitted while the ship is en route and where all the following conditions are satisfied:

.1 cargo residues, cleaning agents or additives, contained in hold washing water do not include any substances classified as harmful to the marine environment, taking into account guidelines developed by the Organization;

[20] Refer to resolution MEPC.2(VI), resolution MEPC.159(55) or resolution MEPC.227(64) as applicable.

[21] Refer to the WMO Sea-Ice Nomenclature.

.2 both the port of departure and the next port of destination are within Arctic waters and the ship will not transit outside Arctic waters between those ports;

.3 no adequate reception facilities are available at those ports taking into account guidelines developed by the Organization; and

.4 where the conditions of subparagraphs 5.2.1.5.1, 5.2.1.5.2 and 5.2.1.5.3 of this paragraph have been fulfilled, discharge of cargo hold washing water containing residues shall be made as far as practicable from areas of ice concentration exceeding 1/10, but in any case not less than 12 nautical miles from the nearest land, nearest ice shelf, or nearest fast ice.

5.2.2 In the Antarctic area, discharge of garbage into the sea permitted in accordance with regulation 6 of MARPOL Annex V, shall meet the following additional requirements:

.1 discharges under regulation 6.1 of MARPOL Annex V shall be as far as practicable from areas of ice concentration exceeding 1/10, but in any case not less than 12 nautical miles from the nearest fast ice; and

.2 food waste shall not be discharged onto ice.

5.2.3 Operation in polar waters shall be taken into account, as appropriate, in the Garbage Record Book, Garbage Management Plan and the placards as required by MARPOL Annex V.

PART II-B

ADDITIONAL GUIDANCE REGARDING THE PROVISIONS OF THE INTRODUCTION AND PART II-A

1 Additional guidance to chapter 1

1.1 Ships are encouraged to apply regulation 43 of MARPOL Annex I when operating in Arctic waters.

1.2 Non-toxic biodegradable lubricants or water-based systems should be considered in lubricated components located outside the underwater hull with direct seawater interfaces, like shaft seals and slewing seals.

2 Additional guidance to chapter 2

Category A and B ships, constructed on or after 1 January 2017 and certified to carry noxious liquid substances (NLS), are encouraged to carry NLS identified in chapter 17, column e, as ship type 3 or identified as NLS in chapter 18 of the *International Code for the Construction and Equipment of Ships Carrying Dangerous Chemicals in Bulk*, in tanks separated from the outer shell by a distance of not less than 760 mm.

3 Additional guidance to chapter 5

In order to minimize the risks associated with animal cargo mortalities, consideration should be given to how animal carcasses will be managed, treated, and stored on board when ships carrying such cargo are operating in polar waters. Reference is made in particular to the *2012 Guidelines for the implementation of MARPOL Annex V* (resolution MEPC.219(63), as amended by resolution MEPC.239(65)) and the *2012 Guidelines for the development of garbage management plans* (resolution MEPC.220(63)).

4 Additional guidance under other environmental conventions and guidelines

4.1 Until the *International Convention for the Control and Management of Ships' Ballast Water and Sediments* enters into force, the ballast water management provisions of the ballast water exchange standard, set out in regulation D-1, or the ballast water performance standard, set out in regulation D-2 of the Convention should be considered as appropriate. The provisions of the *Guidelines for ballast water exchange in the Antarctic treaty area* (resolution MEPC.163(56)) should be taken into consideration along with other relevant guidelines developed by the Organization.

4.2 In selecting the ballast water management system, attention should be paid to limiting conditions specified in the appendix of the Type Approval Certificate and the temperature under which the system has been tested, in order to ensure its suitability and effectiveness in polar waters.

4.3 In order to minimize the risk of invasive aquatic species transfers via biofouling, measures should be considered to minimize the risk of more rapid degradation of anti-fouling coatings associated with polar ice operations. Reference is made in particular to the *2011 Guidelines for the control and management of ships' biofouling to minimize the transfer of invasive aquatic species* (resolution MEPC.207(62)).

Table: Example of matters related to anti-fouling systems taken into consideration by some ice-going ships
(this table is used by some operators of ice-going ships)

	Hull	**Sea chest**
Year round operation in ice-covered polar waters		• Abrasion resistant coating. • Compliant with the AFS Convention. Thickness of anti-fouling system to be decided by shipowner.
Intermittent operation in ice-covered polar waters	• Abrasion resistant low friction ice coating. • In sides, above bilge keel, max thickness of anti-fouling system 75 µm, to protect hull between application of anti-fouling system and next anticipated voyage to ice-covered waters. In bottom area thickness to be decided by shipowner. Composition of anti-fouling system should also be decided by the shipowner.	• Compliant with the AFS Convention. Thickness of anti-fouling system to be decided by shipowner.
Category B and C vessels	• Compliant with the AFS Convention. Thickness of anti-fouling system to be decided by shipowner.	• Compliant with the AFS Convention. Thickness of anti-fouling system to be decided by shipowner.

APPENDIX 1

Form of Certificate for Ships operating in Polar Waters

POLAR SHIP CERTIFICATE

This Certificate shall be supplemented by a Record of Equipment for the Polar Ship Certificate

(Official seal)

(State)

Issued under the provisions of the

International Convention for the Safety of Life at Sea, 1974, as amended

under the authority of the Government of

(name of the State)

by _____
(person or organization authorized)

Particulars of ship[22]

Name of ship……
Distinctive number or letters……..
Port of registry……..
Gross tonnage……..
IMO Number[23]…….....

[22] Alternatively, the particulars of the ship may be placed horizontally in boxes.

[23] In accordance with *IMO ship identification number scheme* adopted by the Organization by resolution A.1078(28).

THIS IS TO CERTIFY:

1 That the ship has been surveyed in accordance with the applicable safety-related provisions of the International Code for Ships Operating in Polar Waters.

2 That the survey[24] showed that the structure, equipment, fittings, radio station arrangements, and materials of the ship and the condition thereof are in all respects satisfactory and that the ship complies with the relevant provisions of the Code.

Category A/B/C[25] ship as follows:

Ice Class and Ice Strengthened Draft Range

Ice class	**Maximum draft**		**Minimum draft**	
	Aft	Fwd	Aft	Fwd

2.1 Ship type: tanker/passenger ship/other[4]

2.2 Ship restricted to operate in ice free waters/open waters/other ice conditions[4]

2.3 Ship intended to operate in low air temperature: Yes/No[4]

2.3.1 Polar Service Temperature: ……..°C/Not Applicable[4]

2.4 Maximum expected time of rescue …….days

3 The ship was/was not[4] subjected to an alternative design and arrangements in pursuance of regulation(s) XIV/4 of the International Convention for the Safety of Life at Sea, 1974, as amended.

4 A Document of approval of alternative design and arrangements for structure, machinery and electrical installations/fire protection/life-saving appliances and arrangements[4] is/is not[4] appended to this Certificate.

5 Operational limitations

The ship has been assigned the following limitations for operation in polar waters:

5.1 Ice conditions: .....

.....

5.2 Temperature: .....

5.3 High latitudes: .....

[24] Subject to regulation 1.3 of the International Code for Ships Operating in Polar Waters.

[25] Delete as appropriate.

This certificate is valid until . . . . subject to the annual/periodical/intermediate surveys in accordance with section 1.3 of the Code[26]

Completion date of the survey on which this certificate is based:. . . . .
(dd/mm/yyyy)

Issued at . . . .
(Place of issue of certificate)

. . . .

(*Date of issue)* *(Signature of authorized official issuing the certificate)*

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

Endorsement for annual, periodical and intermediate surveys[6]

THIS IS TO CERTIFY that, at a survey required by regulation 1.3 of the Code, the ship was found to comply with the relevant requirements of the Code.

Annual survey:

Signed: ……………………………………………
(Signature of authorized official)

Place: ……………………………………………

Date: ……………………………………………
(Seal or stamp of the authority, as appropriate)

Annual/Periodical/Intermediate[27] survey:

Signed: ……………………………………………
(Signature of authorized official)

Place: ……………………………………………

Date: ……………………………………………
(Seal or stamp of the authority, as appropriate)

Annual/Periodical/Intermediate[6] survey:

Signed: ……………………………………………
(Signature of authorized official)

Place: ……………………………………………

Date: ……………………………………………
(Seal or stamp of the authority, as appropriate)

26 Delete as applicable.

27 Delete as appropriate.

Annual survey:

Signed: …….
(Signature of authorized official)

Place: …….

Date: …….
(Seal or stamp of the authority, as appropriate)

Endorsement to extend the certificate if valid for less than 5 years where regulation I/14(c) of the Convention applies[28]

The ship complies with the relevant requirements of the Convention, and this certificate shall, in accordance with regulation I/14(c) of the Convention, be accepted as valid until.....

Signed: .....
(Signature of authorized official)

Place: .....

Date: .....
(Seal or stamp of the authority, as appropriate)

Endorsement where the renewal survey has been completed and regulation I/14(d) of the Convention applies[7]

The ship complies with the relevant requirements of the Convention, and this certificate shall, in accordance with regulation I/14(d) of the Convention, be accepted as valid until.....

Signed: .....
(Signature of authorized official)

Place: .....

Date: .....
(Seal or stamp of the authority, as appropriate)

Endorsement to extend the validity of the certificate until reaching the port of survey or for a period of grace where regulation I/14(e) or I/14(f) of the Convention applies[7]

This certificate shall, in accordance with regulation I/14(e)/I/14(f)[7] of the Convention, be accepted as valid until.....

Signed: .....
(Signature of authorized official)

Place: .....

Date: .....
(Seal or stamp of the authority, as appropriate)

[28] Delete as appropriate.

Endorsement for advancement of anniversary date where regulation I/14(h) of the Convention applies[29]

In accordance with regulation I/14(h) of the Convention, the new anniversary date is .....

Signed: .....
(Signature of authorized official)

Place: .....

Date: .....
(Seal or stamp of the authority, as appropriate)

In accordance with regulation I/14(h) of the Convention, the new anniversary date is .....

Signed: .....
(Signature of authorized official)

Place: .....

Date: .....
(Seal or stamp of the authority, as appropriate)

[29] Delete as appropriate.

Record of Equipment for the Polar Ship Certificate

This record shall be permanently attached to the
Polar Ships Certificate

RECORD OF EQUIPMENT FOR COMPLIANCE WITH THE INTERNATIONAL CODE
FOR SHIPS OPERATING IN POLAR WATERS

1 Particulars of ship:

Name of ship:……
Distinctive number or letters:……..

2 Record of equipment

2.1 *Life-saving appliances*

1	Total number of immersion suits with insulation:	.....
1.1	for crew	.....
1.2	for passengers	.....
2	Total number of thermal protective aids	.....
3	Personal and Group Survival Equipment	.....
3.1	Personal survival equipment – for number of persons	.....
3.2	Group survival equipment – for number persons	.....
3.3	Total capacity of liferafts in compliance with chapter 8 of the Polar Code	.....
3.4	Total capacity of lifeboats in compliance with chapter 8 of the Polar Code	.....

2.2 *Navigation equipment*

1	Two independent echo-sounding devices or a device with two separate independent transducers	.....
2	Remotely rotatable, narrow-beam search lights controllable from the bridge or other means to visually detect ice	.....
3	Manually initiated flashing red light visible from astern (for ships involved in icebreaking operations)	.....
4	Two or more non-magnetic independent means to determine and display heading	.....
5	GNSS compass or equivalent (for ships proceeding to latitudes over 80 degrees)	.....

2.3 *Communication equipment*

1	Sound signaling system mounted to face astern to indicate escort and emergency manoeuvres to following ships as described in the International Code of Signals (for ships intended to provide ice breaking escort).	……..
2	Voice and/or data communications with relevant rescue coordination centres.	.....
3	Equipment for voice communications with aircraft on 121.5 and 123.1 MHz.	.....
4	Two-way voice and data communication with a Telemedical Assistance Service (TMAS).	.....
5	All rescue boats and lifeboats, whenever released for evacuation, have a device (for ships certified to operate in low air temperature):	
5.1	for transmitting vessel to shore alerts;	.....
5.2	for transmitting signals for location;	.....
5.3	for transmitting and receiving on-scene communications.	……..
6	All other survival craft have a device:	
6.1	for transmitting signals for location; and	.....
6.2	for transmitting and receiving on-scene communications.	……

THIS IS TO CERTIFY that this Record is correct in all respects

Issued at……
(Place of issue of the Record)

…….. ……..
(Date of issue) *(Signature of duly authorized official issuing the Record)*

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

APPENDIX 2

Model table of contents for the Polar Water Operational Manual (PWOM)

SAFETY MEASURES

1 – Operational capabilities and limitations

Chapter 1 Operation in ice

1.1 Operator guidance for safe operation

Guidance: The PWOM should establish the means by which decisions as to whether ice conditions exceed the ship's design limits should be made, taking into account the operational limitations on the Polar Ship Certificate. An appropriate decision support system, such as the Canada's Arctic Ice Regime Shipping System, and/or the Russian Ice Certificate as described in the Rules of Navigation on the water area of the Northern Sea Route, can be used... Bridge personnel should be trained in the proper use of the system to be utilized. For ships that will operate only in ice-free waters, procedures to ensure that will keep the ship from encountering ice should be established.

1.2 Icebreaking capabilities

Guidance: The PWOM should provide information on the ice conditions in which the ship can be expected to make continuous progress. This may be drawn, for example from numerical analysis, model test or from ice trials. Information on the influence of ice strength for new or decayed ice and of snow cover may be included.

1.3 Manoeuvring in ice

1.4 Special features

Guidance: Where applicable, the PWOM should include the results of any equivalency analyses made to determine Polar Ship category/ice class. The manual should also provide information on the use of any specialized systems fitted to assist in ice operations.

Chapter 2 Operation in low air temperatures

2.1 System design

Guidance: The PWOM should list all ship systems susceptible to damage or loss of functionality by exposure to low temperatures, and the measures to be adopted to avoid malfunction.

Chapter 3 Communication and navigation capabilities in high latitudes

Guidance: The PWOM should identify any restrictions to operational effectiveness of communications and navigational equipment that may result from operating in high latitudes.

Chapter 4 Voyage duration

Guidance: The PWOM should provide information on any limitations on ship endurance such as fuel tankage, fresh water capacity, provision stores, etc. This will normally only be a significant consideration for smaller ships, or for ships planning to spend extended periods in ice.

Division 2 – Ship operations

Chapter 1 Strategic planning

Assumptions used in conducting the analyses referred to below should be included in the Manual.

1.1 Avoidance of hazardous ice

Guidance: For ships operating frequently in polar waters, the PWOM should provide information with respect to periods during which the ship should be able to operate for intended areas of operation. Areas that pose particular problems, e.g. chokepoints, ridging, as well as worst recorded ice conditions should be noted. Where the available information is limited or of uncertain quality, this should be recognized and noted as a risk for voyage planning.

1.2 Avoidance of hazardous temperatures

Guidance: For ships operating frequently in polar waters, the PWOM should provide information with respect to, the daily mean daily low temperature as well as the minimum recorded temperature for each of the days during the intended operating period. Where the available information is limited or of uncertain quality, this should be recognized as a risk for voyage planning.

1.3 Voyage duration and endurance

Guidance: Procedures to establish requirements for supplies should be established, and appropriate safety levels for safety margins determined taking into account various scenarios, e.g. slower than expected steaming, course alterations, adverse ice conditions, places of refuge and access to provisions. Sources for and availability of fuel types should be established, taking into account long lead times required for deliveries.

1.4 Human resources management

Guidance: The PWOM should provide guidance for the human resources management, taking into account the anticipated ice conditions and requirements for ice navigation, increased levels of watch keeping, hours of rest, fatigue and a process that ensures that these requirements will be met.

Chapter 2 Arrangements for receiving forecasts of environmental conditions

Guidance: The PWOM should set out the means and frequency for provision of ice and weather information. Where a ship is intended to operate in or in the presence of ice, the manual should set out when weather and ice information is required and the format for the information.

When available, the information should include both global and localized forecasts that will identify weather and ice patterns/regimes that could expose the ship to adverse conditions.

The frequency of updates should provide enough advance notice that the ship can take refuge or use other methods of avoiding the hazard if the conditions are forecast to exceed its capabilities.

The PWOM may include use of a land-based support information provider an effective method of sorting through available information, thereby providing the ship only with information that is relevant, reducing demands on the ship's communications systems. The manual may also indicate instances in which additional images should be obtained and analysed, as well as where such additional information may be obtained.

2.1 Ice information

Guidance: The PWOM should include or refer to guidance on how radar should be used to identify ice floes, how to tune the radar to be most effective, instructions on how to interpret radar images, etc. If other technologies are to be used to provide ice information, their use should also be described.

2.2 Meteorological information

Chapter 3 Verification of hydrographic, meteorological and navigational information

Guidance: The PWOM should provide guidance on the use of hydrographic information as further described in the additional guidance to chapter 10.

Chapter 4 Operation of Special Equipment

4.1 Navigation systems

4.2 Communications systems

Chapter 5 Procedures to maintain equipment and system functionality

5.1 Icing prevention and de-icing

Guidance: The PWOM should provide guidance on how to prevent or mitigate icing by operational means, how to monitor and assess ice accretion, how to conduct de-icing using equipment available on the ship, and how to maintain the safety of the ship and its crew during all of these aspects of the operation.

5.2 Operation of seawater systems

Guidance: The PWOM should provide guidance on how to monitor, prevent or mitigate ice ingestion by seawater systems when operating in ice or in low water temperatures. This may include recirculation, use of low rather than high suctions, etc.

5.3 Procedures for low temperature operations

Guidance: The PWOM should provide guidance on maintaining and monitoring any systems and equipment that are required to be kept active in order to ensure functionality; e.g. by trace heating or continuous working fluid circulation.

Division 3 – Risk management

Chapter 1 Risk mitigation in limiting environmental condition

1.1 Measures to be considered in adverse ice conditions

Guidance: The PWOM should contain guidance for the use of low speeds in the presence of hazardous ice. Procedures should also be set for enhanced watchkeeping and lookout manning in situations with high risks from ice, e.g. in proximity to icebergs, operation at night, and other situations of low visibility. When possibilities for contact with hazardous ice exist, procedures should address regular monitoring, e.g. soundings/inspections of compartments and tanks below the waterline.

1.2 Measures to be considered in adverse temperature conditions

Guidance: The PWOM should contain guidance on operational restrictions in the event that temperatures below the ships polar service temperature are encountered or forecast. These may include delaying the ship, postponing the conduct of certain types of operation, using temporary heating, and other risk mitigation measures.

Chapter 2 Emergency response

Guidance: In general, where the possibility of encountering low air temperatures, sea ice, and other hazards is present, the PWOM should provide guidance on procedures that will increase the effectiveness of emergency response measures.

2.1 Damage control

Guidance: the PWOM should consider damage control measures arrangements for emergency transfer of liquids and access to tanks and spaces during salvage operations.

2.2 Firefighting

2.3 Escape and evacuation

Guidance: Where supplementary or specialized lifesaving equipment is carried to address the possibilities of prolonged durations prior to rescue, abandonment onto ice or adjacent land, or other aspects specific to polar operations, the PWOM should contain guidance on the use of the equipment and provision for appropriate training and drills.

Chapter 3 Coordination with emergency response services

3.1 Ship emergency response

Guidance: The PWOM should include procedures to be followed in preparing for a voyage and in the event of an incident arising.

3.2 Salvage

Guidance: The PWOM should include procedures to be followed in preparing for a voyage and in the event of an incident arising.

3.3 Search and rescue

Guidance: The PWOM should contain information on identifying relevant Rescue Coordination Centres for any intended routes, and should require that contact information and procedures be verified and updated as required as part of any voyage plan.

Chapter 4 Procedures for maintaining life support and ship integrity in the event of prolonged entrapment by ice.

Guidance: Where any ship incorporates special features to mitigate safety or environmental risks due to prolonged entrapment by ice, the PWOM should provide information on how these are to be set up and operated. This may include, for example, adding additional equipment to be run from emergency switchboards, draining systems at risk of damage through freezing, isolating parts of HVAC systems, etc.

4.1 System configuration

4.2 System operation

Division 4 – Joint operations

Chapter 1 Escorted operations

Guidance: The PWOM should contain or reference information on the rules and procedures set out by coastal States who require or offer icebreaking escort services. The manual should also emphasize the need for the master to take account of the ship's limitations in agreeing on the conduct of escort operations.

Chapter 2 Convoy operations

***

ANNEX 11

RESOLUTION MEPC.265(68)
(adopted on15 May 2015)

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 Annexes I, II, IV and V
(Making the use of the environment-related provisions of the Polar Code mandatory)

THE MARINE ENVIRONMENT PROTECTION COMMITTEE,

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

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

RECOGNIZING the need to provide a mandatory framework for ships operating in polar waters due to the additional demands on ships, their systems and operation, which go beyond the existing requirements of MARPOL, and other relevant binding IMO instruments,

NOTING resolution MEPC.264(68), by which it adopted the International Code for Ships Operating in Polar Waters (Polar Code) with respect to its environment-related provisions,

NOTING ALSO that the Maritime Safety Committee, at its ninety-fourth session, adopted, by resolution MSC.385(94), the International Code for Ships Operating in Polar Waters with respect to its safety-related provisions, and, by resolution MSC.386(94), amendments to the 1974 SOLAS Convention to make the safety-related provisions of the Polar Code mandatory,

HAVING CONSIDERED proposed amendments to MARPOL Annexes I, II, IV and V to make the environment-related provisions of the Polar Code mandatory,

1 ADOPTS, in accordance with article 16(2)(d) of MARPOL, amendments to Annexes I, II, IV and V, the text of which is set out in the annex to the present resolution;

2 DETERMINES, in accordance with article 16(2)(f)(iii) of MARPOL, that the amendments shall be deemed to have been accepted on 1 July 2016, unless, prior to that date, not less than one third of the Parties or Parties the combined merchant fleets of which constitute not less than 50% of the gross tonnage of the world's merchant fleet, have communicated to the Organization their objection to the amendments;

3 INVITES the Parties to note that, in accordance with article 16(2)(g)(ii) of MARPOL, the said amendments shall enter into force on 1 January 2017 upon their acceptance in accordance with paragraph 2 above;

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

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

ANNEX

AMENDMENTS TO MARPOL ANNEXES I, II, IV AND V

ANNEX I
REGULATIONS FOR THE PREVENTION OF POLLUTION BY OIL

Chapter 1
General

Regulation 3 – Exemptions and waivers

1 In paragraph 1, the words "or section 1.2 of part II-A of the Polar Code" are inserted between "chapters 3 and 4 of this Annex" and "relating to construction".

2 A new paragraph 5.2.2 is added as follows:

".2 voyages within Arctic waters; or"

3 The existing paragraphs 5.2.2 to 5.2.6 are renumbered as paragraphs 5.2.3 to 5.2.7 and the subparagraphs are renumbered accordingly. In the renumbered paragraphs 5.2.5 and 5.2.6, the referenced paragraph numbers "5.2.2" and "5.2.2.2" are replaced by "5.2.3" and "5.2.3.2", respectively.

4 The chapeau of the renumbered paragraph 5.2.3 is replaced with the following:

".3 voyages within 50 nautical miles from the nearest land outside special areas or Arctic waters where the tanker is engaged in:"

Regulation 4 – Exceptions

5 The chapeau is replaced with the following:

"Regulations 15 and 34 of this Annex and paragraph 1.1.1 of part II-A of the Polar Code shall not apply to:"

Chapter 3
Requirements for machinery spaces of all ships

Part B
Equipment

Regulation 14 – Oil filtering equipment

6 Paragraph 5.1 is replaced with the following:

".1 any ship engaged exclusively on voyages within special areas or Arctic waters, or"

7 In paragraph 5.3.4, between the words "within special areas" and "or has been accepted", the words "or Arctic waters" are inserted.

Part C
Control of discharge of oil

Regulation 15 – Control of discharge of oil

8 At the end of the title for section A, the words "except in Arctic waters" are added.

9 At the end of the title for section C, the words "and Arctic waters" are added.

Chapter 4
Requirements for the cargo area of oil tankers

Part C
Control of operational discharges of oil

Regulation 34 – Control of discharge of oil

10 At the end of the title for section A, the words "except in Arctic waters" are added.

Chapter 6
Reception facilities

Regulation 38 – Reception facilities

11 In paragraph 2.5, the words "and paragraph 1.1.1 of part II-A of the Polar Code" are added after the words "regulations 15 and 34 of this Annex".

12 In paragraph 3.5, the words "and paragraph 1.1.1 of part II-A of the Polar Code" are added after the words "regulation 15 of this Annex".

Chapter 11
International Code for Ships Operating in Polar Waters

13 A new chapter 11 is added after existing chapter 10 as follows:

"**Chapter 11 – International Code for Ships Operating in Polar Waters**

Regulation 46 – Definitions

For the purpose of this Annex,

1 Polar Code means the International Code for Ships Operating in Polar Waters, consisting of an introduction, parts I-A and II-A and parts I-B and II-B, adopted by resolutions MSC.385(94) and MEPC.264(68), as may be amended, provided that:

.1 amendments to the environment-related provisions of the introduction and chapter 1 of part II-A of the Polar Code are adopted, brought into force and take effect in accordance with the provisions of article 16 of the present Convention concerning the amendment procedures applicable to an appendix to an annex; and

.2 amendments to part II-B of the Polar Code are adopted by the Marine Environment Protection Committee in accordance with its Rules of Procedure.

2 *Arctic waters* means those waters which are located north of a line from the latitude 58º00´.0 N and longitude 042º00´.0 W to latitude 64º37´.0 N, longitude 035º27´.0 W and thence by a rhumb line to latitude 67º03´.9 N, longitude 026º33´.4 W and thence by a rhumb line to the latitude 70º49´.56 N and longitude 008º59´.61 W (Sørkapp, Jan Mayen) and by the southern shore of Jan Mayen to 73º31'.6 N and 019º01'.0 E by the Island of Bjørnøya, and thence by a great circle line to the latitude 68º38´.29 N and longitude 043º23´.08 E (Cap Kanin Nos) and hence by the northern shore of the Asian Continent eastward to the Bering Strait and thence from the Bering Strait westward to latitude 60º N as far as Il'pyrskiy and following the 60th North parallel eastward as far as and including Etolin Strait and thence by the northern shore of the North American continent as far south as latitude 60º N and thence eastward along parallel of latitude 60º N, to longitude 056º37´.1 W and thence to the latitude 58º00´.0 N, longitude 042º00´.0 W.

3 *Polar waters* means Arctic waters and/or the Antarctic area.

Regulation 47 – Application and requirements

1 This chapter applies to all ships operating in polar waters.

2 Unless expressly provided otherwise, any ship covered by paragraph 1 of this regulation shall comply with the environment-related provisions of the introduction and with chapter 1 of part II-A of the Polar Code, in addition to any other applicable requirements of this Annex.

3 In applying chapter 1 of part II-A of the Polar Code, consideration should be given to the additional guidance in part II-B of the Polar Code."

Appendix II
Form of IOPP Certificate and Supplements

Appendix

Supplement to the international Oil Pollution Prevention Certificate (IOPP Certificate) – Form A

14 A new section 8 is added after existing section 7 as follows:

"8 Compliance with part II-A – chapter 1 of the Polar Code

8.1 The ship is in compliance with additional requirements in the environment-related provisions of the Introduction and section 1.2 of chapter 1 of part II-A of the Polar Code..... "

Supplement to the international Oil Pollution Prevention Certificate (IOPP Certificate) – Form B

15 A new section 11 is added after existing section 10 as follows:

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

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

ANNEX II
REGULATIONS FOR THE CONTROL OF POLLUTION OF NOXIOUS LIQUID SUBSTANCES IN BULK

Chapter 1
General

Regulation 3 – Exceptions

1 In the chapeau of paragraph 1, between the words "this Annex" and "shall not apply", the words "and chapter 2 of part II-A of the Polar Code" are inserted.

Chapter 6
Measures of control by port States

Regulation 16 – Measures of control

2 In paragraph 3, the reference to "regulation 13 and of this regulation" is replaced with "regulation 13 and of this regulation, and chapter 2 of part II-A of the Polar Code when the ship is operating in Arctic waters,"

Chapter 10
International Code for Ships Operating in Polar Waters

3 A new chapter 10 is added after existing chapter 9 as follows:

"**Chapter 10 – International Code for International Code for Ships Operating in Polar Waters**

Regulation 21 – Definitions

For the purpose of this Annex,

1 *Polar Code* means the International Code for Ships Operating in Polar Waters, consisting of an introduction, part I-A and part II-A and parts I-B and II-B, as adopted by resolutions MSC.385(94) and MEPC.264(68), as may be amended, provided that:

.1 amendments to the environment-related provisions of the introduction and chapter 2 of part II-A of the Polar Code are adopted, brought into force and take effect in accordance with the provisions of article 16 of the present Convention concerning the amendment procedures applicable to an appendix to an annex; and

.2 amendments to part II-B of the Polar Code are adopted by the Marine Environment Protection Committee in accordance with its Rules of Procedure.

2 *Arctic waters* means those waters which are located north of a line from the latitude 58º00´.0 N and longitude 042º00´.0 W to latitude 64º37´.0 N, longitude 035º27´.0 W and thence by a rhumb line to latitude 67º03´.9 N, longitude 026º33´.4 W and thence by a rhumb line to the latitude 70º49´.56 N and longitude 008º59´.61 W (Sørkapp, Jan Mayen) and by the southern shore of Jan

Mayen to 73º31'.6 N and 019º01'.0 E by the Island of Bjørnøya, and thence by a great circle line to the latitude 68º38´.29 N and longitude 043º23´.08 E (Cap Kanin Nos) and hence by the northern shore of the Asian Continent eastward to the Bering Strait and thence from the Bering Strait westward to latitude 60º N as far as Il'pyrskiy and following the 60th North parallel eastward as far as and including Etolin Strait and thence by the northern shore of the North American continent as far south as latitude 60º N and thence eastward along parallel of latitude 60º N, to longitude 056º37´.1 W and thence to the latitude 58º00´.0 N, longitude 042º00´.0 W.

3 *Polar waters* means Arctic waters and/or the Antarctic area.

Regulation 22 – Application and requirements

1 This chapter applies to all ships certified to carry noxious liquid substances in bulk, operating in polar waters.

2 Unless expressly provided otherwise, any ship covered by paragraph 1 of this regulation shall comply with the environment-related provisions of the introduction and with chapter 2 of part II-A of the Polar Code, in addition to any other applicable requirements of this Annex.

3 In applying chapter 2 of part II-A of the Polar Code, consideration should be given to the additional guidance in part II-B of the Polar Code."

Appendix IV
Standard format for the Procedures and Arrangements Manual

Section 1 – Main features of MARPOL Annex II

4 At the end of paragraph 1.3, the following sentence is added:

"In addition, under chapter 2 of part II-A of the Polar Code, more stringent discharge criteria apply in Arctic waters."

Section 4 – Procedures relating to the cleaning of cargo tanks, the discharge of residues, ballasting and deballasting

5 In paragraph 4.4.3, the words "Antarctic area (the sea area south of latitude 60º S)" are replaced with the words "polar waters".

ANNEX IV
REGULATIONS FOR THE PREVENTION OF POLLUTION BY SEWAGE FROM SHIPS

Chapter 1
General

Regulation 3 – Exceptions

1 The chapeau of paragraph 1 is replaced with the following:

"1 Regulation 11 of this Annex and section 4.2 of chapter 4 of part II-A of the Polar Code, shall not apply to:"

Chapter 7
International Code for Ships Operating in Polar Waters

2 A new chapter 7 is added after existing chapter 6 as follows:

"**Chapter 7 – International Code for Ships Operating in Polar Waters**

Regulation 17 – Definitions

For the purpose of this Annex,

1 *Polar Code* means the International Code for ships operating in polar waters, consisting of an introduction, part I-A and part II-A and parts I-B and II-B, as adopted by resolutions MSC.385(94) and MEPC.264(68), as may be amended, provided that:

.1 amendments to the environment-related provisions of the introduction and chapter 4 of part II-A of the Polar Code are adopted, brought into force and take effect in accordance with the provisions of article 16 of the present Convention concerning the amendment procedures applicable to an appendix to an annex; and

.2 amendments to part II-B of the Polar Code are adopted by the Marine Environment Protection Committee in accordance with its Rules of Procedure.

2 *Antarctic area* means the sea area south of latitude 60º S.

3 *Arctic waters* means those waters which are located north of a line from the latitude 58º00´.0 N and longitude 042º00´.0 W to latitude 64º37´.0 N, longitude 035º27´.0 W and thence by a rhumb line to latitude 67º03´.9 N, longitude 026º33´.4 W and thence by a rhumb line to the latitude 70º49´.56 N and longitude 008º59´.61 W (Sørkapp, Jan Mayen) and by the southern shore of Jan Mayen to 73º31'.6 N and 019º01'.0 E by the Island of Bjørnøya, and thence by a great circle line to the latitude 68º38´.29 N and longitude 043º23´.08 E (Cap Kanin Nos) and hence by the northern shore of the Asian Continent eastward to the Bering Strait and thence from the Bering Strait westward to latitude 60º N as far as Il'pyrskiy and following the 60th North parallel eastward as far as and including Etolin Strait and thence by the northern shore of the North American continent as far south as latitude 60º N and thence eastward along parallel of latitude 60º N, to longitude 056º37´.1 W and thence to the latitude 58º00´.0 N, longitude 042º00´.0 W.

4 *Polar waters* means Arctic waters and/or the Antarctic area.

Regulation 18 – Application and requirements

1 This chapter applies to all ships certified in accordance with this Annex operating in polar waters.

2 Unless expressly provided otherwise, any ship covered by paragraph 1 of this regulation shall comply with the environment-related provisions of the introduction and with chapter 4 of part II-A of the Polar Code, in addition to any other applicable requirements of this Annex."

ANNEX V
REGULATIONS FOR THE PREVENTION OF POLLUTION BY GARBAGE FROM SHIPS

Chapter 1
General

Regulation 3 – General prohibition on discharge of garbage into the sea

1 In paragraph 1, the reference to "regulation 4, 5, 6 and 7 of this Annex" is replaced with "regulation 4, 5, 6 and 7 of this Annex and section 5.2 of part II-A of the Polar Code, as defined in regulation 13.1 of this Annex."

Regulation 7 – Exceptions

2 The chapeau of paragraph 1 is replaced with the following:

"1 Regulations 3, 4, 5 and 6 of this Annex and section 5.2 of chapter 5 of part II-A of the Polar Code shall not apply to:"

3 Paragraph 2.1 is replaced with the following:

".1 The en route requirements of regulations 4 and 6 of this Annex and chapter 5 of part II-A of the Polar Code shall not apply to the discharge of food wastes where it is clear the retention on board of these food wastes presents an imminent health risk to the people on board."

Regulation 10 – Placards, garbage management plans and garbage record keeping

4 In paragraph 1.1, the words "and section 5.2 of part II-A of the Polar Code" are added after the references to "regulations 3, 4, 5 and 6 of this Annex".

Chapter 3
International Code for Ships Operating in Polar Waters

5 A new chapter 3 is added as follows:

"**Chapter 3 – International Code for Ships Operating in Polar Waters**
Regulation 13 – Definitions

For the purpose of this Annex,

1 *Polar Code* means the International Code for Ships Operating in Polar Waters, consisting of an introduction, part I-A and part II-A and parts I-B and II-B, as adopted by resolutions MSC.385(94) and MEPC.264(68), as may be amended, provided that:

.1 amendments to the environment-related provisions of the introduction and chapter 5 of part II-A of the Polar Code are adopted, brought into force and take effect in accordance with the provisions of article 16 of the present Convention concerning the amendment procedures applicable to an appendix to an annex; and

.2 amendments to part II-B of the Polar Code are adopted by the Marine Environment Protection Committee in accordance with its Rules of Procedure.

2 *Arctic waters* means those waters which are located north of a line from the latitude 58º00´.0 N and longitude 042º00´.0 W to latitude 64º37´.0 N, longitude 035º27´.0 W and thence by a rhumb line to latitude 67º03´.9 N, longitude 026º33´.4 W and thence by a rhumb line to the latitude 70º49´.56 N and longitude 008º59´.61 W (Sørkapp, Jan Mayen) and by the southern shore of Jan Mayen to 73º31'.6 N and 019º01'.0 E by the Island of Bjørnøya, and thence by a great circle line to the latitude 68º38´.29 N and longitude 043º23´.08 E (Cap Kanin Nos) and hence by the northern shore of the Asian Continent eastward to the Bering Strait and thence from the Bering Strait westward to latitude 60º N as far as Il'pyrskiy and following the 60th North parallel eastward as far as and including Etolin Strait and thence by the northern shore of the North American continent as far south as latitude 60º N and thence eastward along parallel of latitude 60º N, to longitude 056º37´.1 W and thence to the latitude 58º00´.0 N, longitude 042º00´.0 W.

3 *Polar waters* means Arctic waters and/or the Antarctic area.

Regulation 14 – Application and requirements

1 This chapter applies to all ships to which this Annex applies, operating in polar waters.

2 Unless expressly provided otherwise, any ship covered by paragraph 1 of this regulation shall comply with the environment-related provisions of the introduction and with chapter 5 of part II-A of the Polar Code, in addition to any other applicable requirements of this Annex.

3 In applying chapter 5 of part II-A of the Polar Code, consideration should be given to the additional guidance in part II-B of the Polar Code."

Appendix
Form of Garbage Record Book

6 The chapeau of section 4.1.3 is replaced with the following:

"4.1.3 When garbage is discharged into the sea in accordance with regulations 4, 5 or 6 of MARPOL Annex V or chapter 5 of part II-A of the Polar Code:"

***

ANNEX 12

RESOLUTION MEPC.266(68)
(adopted on 15 May 2015)

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

Amendments to regulation 12 of MARPOL Annex I

THE MARINE ENVIRONMENT PROTECTION COMMITTEE,

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

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

HAVING CONSIDERED, at its sixty-eight session, proposed amendments to MARPOL Annex I concerning requirements for machinery spaces of all ships,

1 ADOPTS, in accordance with article 16(2)(d) of the 1973 Convention, amendments to regulation 12 of Annex I, the text of which is set out in the annex to the present resolution;

2 DETERMINES, in accordance with article 16(2)(f)(iii) of MARPOL, that the amendments shall be deemed to have been accepted on 1 July 2016 unless prior to that date, not less than one third of the Parties or Parties the combined merchant fleets of which constitute not less than 50% of the gross tonnage of the world's merchant fleet, have communicated to the Organization their objection to the amendments;

3 INVITES the Parties to note that, in accordance with article 16(2)(g)(ii) of MARPOL, the said amendments shall enter into force on 1 January 2017 upon their acceptance in accordance with paragraph 2 above;

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

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

ANNEX

AMENDMENTS TO MARPOL ANNEX I

Chapter 3
Requirements for machinery spaces of all ships

Part A
Construction

Regulation 12 – Tanks for oil residues (sludge)

Paragraphs 1 to 4 of regulation 12 are replaced by the following:

"1 Unless indicated otherwise, this regulation applies to every ship of 400 gross tonnage and above except that paragraph 3.5 of this regulation need only be applied as far as is reasonable and practicable to ships delivered on or before 31 December 1979, as defined in regulation 1.28.1.

2 Oil residue (sludge) may be disposed of directly from the oil residue (sludge) tank(s) to reception facilities through the standard discharge connection referred to in regulation 13, or to any other approved means of disposal of oil residue (sludge), such as an incinerator, auxiliary boiler suitable for burning oil residues (sludge) or other acceptable means which shall be annotated in item 3.2 of the Supplement to IOPP Certificate Form A or B.

3 Oil residue (sludge) tank(s) shall be provided and:

.1 shall be of adequate capacity, having regard to the type of machinery and length of voyage, to receive the oil residues (sludge) which cannot be dealt with otherwise in accordance with the requirements of this Annex;

.2 shall be provided with a designated pump that is capable of taking suction from the oil residue (sludge) tank(s) for disposal of oil residue (sludge) by means as described in regulation 12.2;

.3 shall have no discharge connections to the bilge system, oily bilge water holding tank(s), tank top or oily water separators, except that:

.1 the tank(s) may be fitted with drains, with manually operated self-closing valves and arrangements for subsequent visual monitoring of the settled water, that lead to an oily bilge water holding tank or bilge well, or an alternative arrangement, provided such arrangement does not connect directly to the bilge discharge piping system; and

.2 the sludge tank discharge piping and bilge-water piping may be connected to a common piping leading to the standard discharge connection referred to in regulation 13; the connection of both systems to the possible common

piping leading to the standard discharge connection referred to in regulation 13 shall not allow for the transfer of sludge to the bilge system;

.4 shall not be arranged with any piping that has direct connection overboard, other than the standard discharge connection referred to in regulation 13; and

.5 shall be designed and constructed so as to facilitate their cleaning and the discharge of residues to reception facilities.

4 Ships constructed before 1 January 2017 shall be arranged to comply with paragraph 3.3 of this regulation not later than the first renewal survey carried out on or after 1 January 2017."

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ANNEX 17

RESOLUTION MEPC.269(68)
(adopted on 15 May 2015)

2015 GUIDELINES FOR THE DEVELOPMENT OF THE INVENTORY OF HAZARDOUS MATERIALS

THE MARINE ENVIRONMENT PROTECTION COMMITTEE,

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

RECALLING ALSO that the International Conference on the Safe and Environmentally Sound Recycling of Ships held in May 2009 adopted the Hong Kong International Convention for the Safe and Environmentally Sound Recycling of Ships, 2009 (the Hong Kong Convention) together with six Conference resolutions,

NOTING that regulations 5.1 and 5.2 of the annex to the Hong Kong Convention require that ships shall have on board an Inventory of Hazardous Materials which shall be prepared and verified taking into account guidelines, including any threshold values and exemptions contained in those guidelines, developed by the Organization,

NOTING ALSO resolution MEPC.197(62) by which it adopted *Guidelines for the development of the Inventory of Hazardous Materials* (the guidelines) and resolved to keep them under review,

RECOGNIZING the need to improve the guidance on threshold values and exemptions, as contained in the aforementioned guidelines,

HAVING CONSIDERED, at its sixty-eighth session, the recommendation made by the Sub-Committee on Pollution Prevention and Response, at its second session,

1 ADOPTS the *2015 Guidelines for the development of the Inventory of Hazardous Materials* as set out in the annex to this resolution;

2 INVITES Member Governments to apply the 2015 Guidelines as soon as possible, or latest when the Convention enters into force;

3 AGREES to keep the 2015 Guidelines under review in the light of experience gained with their application;

4 SUPERSEDES the guidelines adopted by resolution MEPC.197(62).

ANNEX

2015 GUIDELINES FOR THE DEVELOPMENT OF THE INVENTORY OF HAZARDOUS MATERIALS

1 INTRODUCTION

1.1 Objectives

These guidelines provide recommendations for developing the Inventory of Hazardous Materials (hereinafter referred to as "the Inventory" or "the IHM") to assist compliance with regulation 5 (Inventory of Hazardous Materials) of the Hong Kong International Convention for the Safe and Environmentally Sound Recycling of Ships, 2009 (hereinafter referred to as "the Convention").

1.2 Application

These guidelines have been developed to provide relevant stakeholders (e.g. shipbuilders, equipment suppliers, repairers, shipowners and ship management companies) with the essential requirements for the practical and logical development of the Inventory.

1.3 Objectives

The objectives of the Inventory are to provide ship-specific information on the actual hazardous materials present on board, in order to protect health and safety and to prevent environmental pollution at ship recycling facilities. This information will be used by the ship recycling facilities in order to decide how to manage the types and amounts of materials identified in the Inventory of Hazardous Materials (regulation 9 of the Convention).

2 DEFINITIONS

The terms used in these guidelines have the same meaning as those defined in the Convention, with the following additional definitions which apply to these guidelines only.

2.1 *Exemption* (as referred to in regulation 5 of the Convention) means materials specified in paragraph 3.3 in these guidelines that do not need to be listed on the IHM, even if such materials or items exceed the IHM threshold values.

2.2 *Fixed* means the conditions that equipment or materials are securely fitted with the ship, such as by welding or with bolts, riveted or cemented, and used at their position, including electrical cables and gaskets.

2.3 *Homogeneous material* means a material of uniform composition throughout that cannot be mechanically disjointed into different materials, meaning that the materials cannot, in principle, be separated by mechanical actions such as unscrewing, cutting, crushing, grinding and abrasive processes.

2.4 *Loosely fitted equipment* means equipment or materials present on board the ship by the conditions other than "fixed", such as fire extinguishers, distress flares, and lifebuoys.

2.5 *Product* means machinery, equipment, materials and applied coatings on board a ship.

2.6 *Supplier* means a company which provides products; which may be a manufacturer, trader or agency.

2.7 *Supply chain* means the series of entities involved in the supply and purchase of materials and goods, from raw materials to final product.

2.8 *Threshold value* is defined as the concentration value in homogeneous materials.

3 REQUIREMENTS FOR THE INVENTORY

3.1 Scope of the Inventory

The Inventory consists of:

Part I: Materials contained in ship structure or equipment;

Part II: Operationally generated wastes; and

Part III: Stores.

3.2 Materials to be listed in the Inventory

3.2.1 Appendix 1 of these guidelines (Items to be listed in the Inventory of Hazardous Materials), provides information on the hazardous materials that may be found on board a ship. Materials set out in appendix 1 should be listed in the Inventory. Each item in appendix 1 of these guidelines is classified under tables A, B, C or D, according to its properties:

.1 table A comprises the materials listed in appendix 1 of the Convention;

.2 table B comprises the materials listed in appendix 2 of the Convention;

.3 table C (Potentially hazardous items) comprises items which are potentially hazardous to the environment and human health at ship recycling facilities; and

.4 table D (Regular consumable goods potentially containing hazardous materials) comprises goods which are not integral to a ship and are unlikely to be dismantled or treated at a ship recycling facility.

3.2.2 Tables A and B correspond to part I of the Inventory. Table C corresponds to parts II and III and table D corresponds to part III.

3.2.3 For loosely fitted equipment, there is no need to list this in part I of the Inventory. Such equipment which remains on board when the ship is recycled should be listed in part III.

3.2.4 Those batteries containing lead acid or other hazardous materials that are fixed in place should be listed in part I of the Inventory. Batteries that are loosely fitted, which includes consumer batteries and batteries in stores, should be listed in part III of the Inventory.

3.2.5 Similar materials or items that contain hazardous materials that potentially exceed the threshold value can be listed together (not individually) on the IHM with their general location and approximate amount specified there (hereinafter referred to as "bulk listing"). An example of how to list those materials and items is shown in row 3 of table 1 of appendix 3.

3.3 Exemptions – Materials not required to be listed in the Inventory

3.3.1 Materials listed in Table B that are inherent in solid metals or metal alloys, such as steels, aluminium, brasses, bronzes, plating and solders, provided they are used in general construction, such as hull, superstructure, pipes or housings for equipment and machinery, are not required to be listed in the Inventory.

3.3.2 Although electrical and electronic equipment is required to be listed in the Inventory, the amount of hazardous materials potentially contained in printed wiring boards (printed circuit boards) installed in the equipment does not need to be reported in the Inventory.

3.4 Standard format of the Inventory of Hazardous Materials

The Inventory should be developed on the basis of the standard format set out in appendix 2 of these guidelines: Standard format of the Inventory of Hazardous Materials. Examples of how to complete the Inventory are provided for guidance purposes only.

3.5 Revision to threshold values

Revised threshold values in tables A and B of appendix 1 should be used for IHMs developed or updated after the adoption of the revised values and need not be applied to existing IHMs and IHMs under development. However, when materials are added to the IHM, such as during maintenance, the revised threshold values should be applied and recorded in the IHM.

4 REQUIREMENTS FOR DEVELOPMENT OF THE INVENTORY

4.1 Development of part I of the Inventory for new ships[1]

4.1.1 Part I of the Inventory for new ships should be developed at the design and construction stage.

4.1.2 *Checking of materials listed in table A*

During the development of the Inventory (part I), the presence of materials listed in table A of appendix 1 should be checked and confirmed; the quantity and location of table A materials should be listed in part I of the Inventory. If such materials are used in compliance with the Convention, they should be listed in part I of the Inventory. Any spare parts containing materials listed in table A are required to be listed in part III of the Inventory.

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[1] In ascertaining whether a ship is a "new ship" or an "existing ship" according to the Convention, the term "a similar stage of construction" in regulation 1.4.2 of the annex to the Convention means the stage at which:

.1 construction identifiable with a specific ship begins: and
.2 assembly of that ship has commenced comprising at least 50 tonnes or 1% of the estimated mass of all structural material, whichever is less.

4.1.3 *Checking of materials listed in table B*

If materials listed in table B of appendix 1 are present in products above the threshold values provided in table B, the quantity and location of the products and the contents of the materials present in them should be listed in part I of the Inventory. Any spare parts containing materials listed in table B are required to be listed in part III of the Inventory.

4.1.4 *Process for checking of materials*

The checking of materials as provided in paragraphs 4.1.2 and 4.1.3 above should be based on the Material Declaration furnished by the suppliers in the shipbuilding supply chain (e.g. equipment suppliers, parts suppliers, material suppliers).

4.2 Development of part I of the Inventory for existing ships

4.2.1 In order to achieve comparable results for existing ships with respect to part I of the Inventory, the following procedure should be followed:

.1 collection of necessary information;

.2 assessment of collected information;

.3 preparation of visual/sampling check plan;

.4 onboard visual check and sampling check; and

.5 preparation of part I of the Inventory and related documentation.

4.2.2 The determination of hazardous materials present on board existing ships should, as far as practicable, be conducted as prescribed for new ships, including the procedures described in sections 6 and 7 of these guidelines. Alternatively, the procedures described in this section may be applied for existing ships, but these procedures should not be used for any new installation resulting from the conversion or repair of existing ships after the initial preparation of the Inventory.

4.2.3 The procedures described in this section should be carried out by the shipowner, who may draw upon expert assistance. Such an expert or expert party should not be the same as the person or organization authorized by the Administration to approve the Inventory).

4.2.4 Reference is made to appendix 4 (Flow diagram for developing part I of the Inventory for existing ships) and appendix 5 (Example of development process for part I of the Inventory for existing ships.

4.2.5 *Collection of necessary information (step 1)*

The shipowner should identify, research, request and procure all reasonably available documentation regarding the ship. Information that will be useful includes maintenance, conversion and repair documents; certificates, manuals, ship's plans, drawings and technical specifications; product information data sheets (such as Material Declarations); and hazardous material inventories or recycling information from sister ships. Potential sources of information could include previous shipowners, the ship builder, historical societies, classification society records and ship recycling facilities with experience working with similar ships.

4.2.6 *Assessment of collected information (step 2)*

The information collected in step 1 above should be assessed. The assessment should cover all materials listed in table A of appendix 1; materials listed in table B should be assessed as far as practicable. The results of the assessment should be reflected in the visual/sampling check plan.

4.2.7 *Preparation of visual/sampling check plan (step 3)*

4.2.7.1 To specify the materials listed in appendix 1 of these guidelines, a visual/sampling check plan should be prepared taking into account the collated information and any appropriate expertise. The visual/sampling check plan should be based on the following three lists:

.1 List of equipment, system and/or area for visual check (any equipment, system and/or area specified regarding the presence of the materials listed in appendix 1 by document analysis should be entered in the List of equipment, system and/or area for visual check);

.2 List of equipment, system and/or area for sampling check (any equipment, system and/or area which cannot be specified regarding the presence of the materials listed in appendix 1 by document or visual analysis should be entered in the List of equipment, system and/or area as requiring sampling check. A sampling check is the taking of samples to identify the presence or absence of hazardous material contained in the equipment, systems, and/or areas, by suitable and generally accepted methods such as laboratory analysis); and

.3 List of equipment, system and/or area classed as "potentially containing hazardous material" (any equipment, system and/or area which cannot be specified regarding the presence of the materials listed in appendix 1 by document analysis may be entered in the List of equipment, system and/or area classed as "potentially containing hazardous material" without the sampling check. The prerequisite for this classification is a comprehensible justification such as the impossibility of conducting sampling without compromising the safety of the ship and its operational efficiency).

4.2.7.2 Visual/sampling checkpoints should be all points where:

.1 the presence of materials to be considered for the Inventory part I as listed in appendix 1 is likely;

.2 the documentation is not specific; or

.3 materials of uncertain composition were used.

4.2.8 *Onboard visual/sampling check (step 4)*

4.2.8.1 The onboard visual/sampling check should be carried out in accordance with the visual/sampling check plan. When a sampling check is carried out, samples should be taken and the sample points should be clearly marked on the ship plan and the sample results should be referenced. Materials of the same kind may be sampled in a representative manner. Such materials are to be checked to ensure that they are of the same kind. The sampling check should be carried out drawing upon expert assistance.

4.2.8.2 Any uncertainty regarding the presence of hazardous materials should be clarified by a visual/sampling check. Checkpoints should be documented in the ship's plan and may be supported by photographs.

4.2.8.3 If the equipment, system and/or area of the ship are not accessible for a visual check or sampling check, they should be classified as "potentially containing hazardous material". The prerequisite for such classification should be the same prerequisite as in section 4.2.7. Any equipment, system and/or area classed as "potentially containing Hazardous Material" may be investigated or subjected to a sampling check at the request of the shipowner during a later survey (e.g. during repair, refit or conversion).

4.2.9 *Preparation of part I of the Inventory and related documentation (step 5)*

If any equipment, system and/or area is classed as either "containing hazardous material" or "potentially containing hazardous material", their approximate quantity and location should be listed in part I of the Inventory. These two categories should be indicated separately in the "Remarks" column of the Inventory.

4.2.10 *Testing methods*

4.2.10.1 Samples may be tested by a variety of methods. "Indicative" or "field tests" may be used when:

.1 the likelihood of a hazard is high;

.2 the test is expected to indicate that the hazard exists; and

.3 the sample is being tested by "specific testing" to show that the hazard is present.

4.2.10.2 Indicative or field tests are quick, inexpensive and useful on board the ship or on site, but they cannot be accurately reproduced or repeated, and cannot identify the hazard specifically, and therefore cannot be relied upon except as "indicators".

4.2.10.3 In all other cases, and in order to avoid dispute, "specific testing" should be used. Specific tests are repeatable, reliable and can demonstrate definitively whether a hazard exists or not. They will also provide a known type of the hazard. The methods indicated are found qualitative and quantitative appropriate and only testing methods to the same effect can be used. Specific tests are to be carried out by a suitably accredited laboratory, working to international standards[2] or equivalent, which will provide a written report that can be relied upon by all parties.

4.2.10.4 Specific test methods for appendix 1 materials are provided in appendix 9.

4.2.11 *Diagram of the location of hazardous materials on board a ship*

Preparation of a diagram showing the location of the materials listed in table A is recommended in order to help ship recycling facilities gain a visual understanding of the Inventory.

[2] For example ISO 17025.

4.3 Maintaining and updating part I of the Inventory during operations

4.3.1 Part I of the Inventory should be appropriately maintained and updated, especially after any repair or conversion or sale of a ship.

4.3.2 *Updating of part I of the Inventory in the event of new installation*

If any machinery or equipment is added to, removed or replaced or the hull coating is renewed, part I of the Inventory should be updated according to the requirements for new ships as stipulated in paragraphs 4.1.2 to 4.1.4. Updating is not required if identical parts or coatings are installed or applied.

4.3.3 *Continuity of part I of the Inventory*

Part I of the Inventory should belong to the ship and the continuity and conformity of the information it contains should be confirmed, especially if the flag, owner or operator of the ship changes.

4.4 Development of part II of the Inventory (operationally generated waste)

4.4.1 Once the decision to recycle a ship has been taken, part II of the Inventory should be developed before the final survey, taking into account that a ship destined to be recycled shall conduct operations in the period prior to entering the Ship Recycling Facility in a manner that minimizes the amount of cargo residues, fuel oil and wastes remaining on board (regulation 8.2 of the Convention).

4.4.2 *Operationally generated wastes to be listed in the Inventory*

If the wastes listed in part II of the Inventory provided in table C (Potentially hazardous items) of appendix 1 are intended for delivery with the ship to a ship recycling facility, the quantity of the operationally generated wastes should be estimated and their approximate quantities and locations should be listed in part II of the Inventory.

4.5 Development of part III of the Inventory (stores)

4.5.1 Once the decision to recycle has been taken, part III of the Inventory should be developed before the final survey, taking into account the fact that a ship destined to be recycled shall minimize the wastes remaining on board (regulation 8.2 of the Convention). Each item listed in part III should correspond to the ship's operations during its last voyage.

4.5.2 *Stores to be listed in the Inventory*

If the stores to be listed in part III of the Inventory provided in table C of appendix 1 are to be delivered with the ship to a ship recycling facility, the unit (e.g. capacity of cans and cylinders), quantity and location of the stores should be listed in part III of the Inventory.

4.5.3 *Liquids and gases sealed in ship's machinery and equipment to be listed in the Inventory*

If any liquids and gases listed in table C of appendix 1 are integral in machinery and equipment on board a ship, their approximate quantity and location should be listed in part III of the Inventory. However, small amounts of lubricating oil, anti-seize compounds and grease which are applied to or injected into machinery and equipment to maintain normal performance do not fall within the scope of this provision. For subsequent completion of

part III of the Inventory during the recycling preparation processes, the quantity of liquids and gases listed in table C of appendix 1 required for normal operation, including the related pipe system volumes, should be prepared and documented at the design and construction stage. This information belongs to the ship, and continuity of this information should be maintained if the flag, owner or operator of the ship changes.

4.5.4 *Regular consumable goods to be listed in the Inventory*

Regular consumable goods, as provided in table D of appendix 1 should not be listed in part I or part II but should be listed in part III of the Inventory if they are to be delivered with the ship to a Ship Recycling Facility. A general description including the name of item (e.g. TV set), manufacturer, quantity and location should be entered in part III of the Inventory. The check on materials provided for in paragraphs 4.1.2 and 4.1.3 of these guidelines does not apply to regular consumable goods.

4.6 Description of location of hazardous materials on board

The locations of hazardous materials on board should be described and identified using the name of location (e.g. second floor of engine-room, bridge DK, APT, No.1 cargo tank, frame number) given in the plans (e.g. general arrangement, fire and safety plan, machinery arrangement or tank arrangement).

4.7 Description of approximate quantity of hazardous materials

In order to identify the approximate quantity of hazardous materials, the standard unit used for hazardous materials should be kg, unless other units (e.g. m^3 for materials of liquid or gases, m^2 for materials used in floors or walls) are considered more appropriate. An approximate quantity should be rounded up to at least two significant figures.

5 REQUIREMENTS FOR ASCERTAINING THE CONFORMITY OF THE INVENTORY

5.1 Design and construction stage

The conformity of part I of the Inventory at the design and construction stage should be ascertained by reference to the collected Supplier's Declaration of Conformity described in section 7 and the related Material Declarations collected from suppliers.

5.2 Operational stage

Shipowners should implement the following measures in order to ensure the conformity of part I of the Inventory:

.1 to designate a person as responsible for maintaining and updating the Inventory (the designated person may be employed ashore or on board);

.2 the designated person, in order to implement paragraph 4.3.2, should establish and supervise a system to ensure the necessary updating of the Inventory in the event of new installation;

.3 to maintain the Inventory including dates of changes or new deleted entries and the signature of the designated person; and

.4 to provide related documents as required for the survey or sale of the ship.

6 MATERIAL DECLARATION

6.1 General

Suppliers to the shipbuilding industry should identify and declare whether or not the materials listed in table A or table B are present above the threshold value specified in appendix 1 of these guidelines. However, this provision does not apply to chemicals which do not constitute a part of the finished product.

6.2 Information required in the declaration

6.2.1 At a minimum the following information is required in the Material Declaration:

.1 date of declaration;

.2 Material Declaration identification number;

.3 supplier's name;

.4 product name (common product name or name used by manufacturer);

.5 product number (for identification by manufacturer);

.6 declaration of whether or not the materials listed in table A and table B of appendix 1 of these guidelines are present in the product above the threshold value stipulated in appendix 1 of these guidelines; and

.7 mass of each constituent material listed in table A and/or table B of appendix 1 of these guidelines if present above threshold value.

6.2.2 An example of the Material Declaration is shown in appendix 6.

7 SUPPLIER'S DECLARATION OF CONFORMITY

7.1 Purpose and scope

7.1.1 The purpose of the Supplier's Declaration of Conformity is to provide assurance that the related Material Declaration conforms to section 6.2, and to identify the responsible entity.

7.1.2 The Supplier's Declaration of Conformity remains valid as long as the products are present on board.

7.1.3 The supplier compiling the Supplier's Declaration of Conformity should establish a company policy[3]. The company policy on the management of the chemical substances in products which the supplier manufactures or sells should cover:

.1 Compliance with law:

The regulations and requirements governing the management of chemical substances in products should be clearly described in documents which should be kept and maintained; and

[3] A recognized quality management system may be utilized.

.2 Obtaining of information on chemical substance content:

In procuring raw materials for components and products, suppliers should be selected following an evaluation, and the information on the chemical substances they supply should be obtained.

7.2 Contents and format

7.2.1 The Supplier's Declaration of Conformity should contain the following:

.1 unique identification number;

.2 name and contact address of the issuer;

.3 identification of the subject of the Declaration of Conformity (e.g. name, type, model number, and/or other relevant supplementary information);

.4 statement of conformity;

.5 date and place of issue; and

.6 signature (or equivalent sign of validation), name and function of the authorized person(s) acting on behalf of the issuer.

7.2.2 An example of the Supplier's Declaration of Conformity is shown in appendix 7.

8 LIST OF APPENDICES

Appendix 1: Items to be listed in the Inventory of Hazardous Materials

Appendix 2: Standard format of the Inventory of Hazardous Materials

Appendix 3: Example of the development process for part I of the Inventory for new ships

Appendix 4: Flow diagram for developing part I of the Inventory for existing ships

Appendix 5: Example of the development process for part I of the Inventory for existing ships

Appendix 6: Form of Material Declaration

Appendix 7: Form of Supplier's Declaration of Conformity

Appendix 8: Examples of table A and table B materials of appendix 1 with CAS-numbers

Appendix 9: Specific test methods

Appendix 10: Examples of radioactive sources

APPENDIX 1

ITEMS TO BE LISTED IN THE INVENTORY OF HAZARDOUS MATERIALS

Table A – Materials listed in appendix 1 of the Annex to the Convention

No.	Materials		Inventory			Threshold value
			Part I	Part II	Part III	
A-1	Asbestos		x			0.1%[4]
A-2	Polychlorinated biphenyls (PCBs)		x			50 mg/kg[5]
A-3	Ozone depleting substances	CFCs	x			no threshold value[6]
		Halons	x			
		Other fully halogenated CFCs	x			
		Carbon tetrachloride	x			
		1,1,1-Trichloroethane (Methyl chloroform)	x			
		Hydrochlorofluorocarbons	x			
		Hydrobromofluorocarbons	x			
		Methyl bromide	x			
		Bromochloromethane	x			
A-4	Anti-fouling systems containing organotin compounds as a biocide		x			2,500 mg total tin/kg[7]

[4] In accordance with regulation 4 of the Convention, for all ships, new installation of materials which contain asbestos shall be prohibited. According to the UN recommendation "Globally Harmonized System of Classification and Labelling of Chemicals (GHS)" adopted by the United Nations Economic and Social Council's Sub-Committee of Experts on the Globally Harmonized System of Classification and Labelling of Chemicals (UNSCEGHS), the UN's Sub-Committee of Experts, in 2002 (published in 2003), carcinogenic mixtures classified as Category 1A (including asbestos mixtures) under the GHS are required to be labelled as carcinogenic if the ratio is more than 0.1%. However, if 1% is applied, this threshold value should be recorded in the Inventory and, if available, the Material Declaration and can be applied not later than five years after the entry into force of the Convention. The threshold value of 0.1% need not be retroactively applied to those Inventories and Material Declarations.

[5] In accordance with regulation 4 of the Convention, for all ships, new installation of materials which contain PCBs shall be prohibited. The Organization set 50 mg/kg as the threshold value referring to the concentration level at which wastes, substances and articles containing, consisting of or contaminated with PCB are characterized as hazardous under the Basel Convention.

[6] "No threshold value" is in accordance with the Montreal Protocol for reporting ODS. Unintentional trace contaminants should not be listed in the Material Declarations and in the Inventory.

[7] This threshold value is based on the *Guidelines for brief sampling of anti-fouling systems on ships* (resolution MEPC.104(49)).

Table B – Materials listed in appendix 2 of the Annex to the Convention

No.	Materials	Inventory			Threshold value
		Part I	Part II	Part III	
B-1	Cadmium and cadmium compounds	x			100 mg/kg[8]
B-2	Hexavalent chromium and hexavalent chromium compounds	x			1,000 mg/kg[8]
B-3	Lead and lead compounds	x			1,000 mg/kg[8]
B-4	Mercury and mercury compounds	x			1,000 mg/kg[8]
B-5	Polybrominated biphenyl (PBBs)	x			50 mg/kg[9]
B-6	Polybrominated diphenyl ethers (PBDEs)	x			1,000 mg/kg[8]
B-7	Polychlorinated naphthalenes (more than 3 chlorine atoms)	x			50mg/kg[10]
B-8	Radioactive substances	x			no threshold value[11]
B-9	Certain shortchain chlorinated paraffins (Alkanes, C10-C13, chloro)	x			1%[12]

8 The Organization set this as the threshold value referring to the Restriction of Hazardous Substances (RoHS Directive 2011/65/EU, Annex II).

9 The Organization set 50 mg/kg as the threshold value referring to the concentration level at which wastes, substances and articles containing, consisting of or contaminated with PBB are characterized as hazardous under the Basel Convention.

10 The Organization set 50 mg/kg as the threshold value referring to the concentration level at which wastes, substances and articles containing, consisting of or contaminated with PCN are characterized as hazardous under the Basel Convention.

11 All radioactive sources should be included in the Material Declaration and in the Inventory. *Radioactive source* means radioactive material permanently sealed in a capsule or closely bonded and in a solid form that is used as a source of radiation. This includes consumer products and industrial gauges with radioactive materials. Examples are listed in appendix 10.

12 The Organization set 1% as the threshold value referring to the EU legislation that restricts Chlorinated Paraffins from being placed on the market for use as substances or as constituents of other substances or preparations in concentrations higher than 1% (EU Regulation 1907/2006, Annex XVII Entry 42 and Regulation 519/2012).

Table C – Potentially hazardous items

No.	Properties		Goods	Inventory		
				Part I	Part II	Part III
C-1	Liquid	Oiliness	Kerosene			x
C-2			White spirit			x
C-3			Lubricating oil			x
C-4			Hydraulic oil			x
C-5			Anti-seize compounds			x
C-6			Fuel additive			x
C-7			Engine coolant additives			x
C-8			Antifreeze fluids			x
C-9			Boiler and feed water treatment and test re-agents			x
C-10			De-ioniser regenerating chemicals			x
C-11			Evaporator dosing and descaling acids			x
C-12			Paint stabilizers/rust stabilizers			x
C-13			Solvents/thinners			x
C-14			Paints			x
C-15			Chemical refrigerants			x
C-16			Battery electrolyte			x
C-17			Alcohol, methylated spirits			x
C-18	Gas	Explosives/ inflammables	Acetylene			x
C-19			Propane			x
C-20			Butane			x
C-21			Oxygen			x
C-22		Green House Gases	CO_2			x
C-23			Perfluorocarbons (PFCs)			x
C-24			Methane			x
C-25			Hydrofluorocarbon (HFCs)			x
C-27			Nitrous oxide (N_2O)			x
C-28			Sulfur hexafluoride (SF_6)			x
C-29	Liquid	Oiliness	Bunkers: fuel oil			x
C-30			Grease			x
C-31			Waste oil (sludge)		x	
C-32			Bilge and/or waste water generated by the after-treatment systems fitted on machineries		x	
C-33			Oily liquid cargo tank residues		x	
C-34			Ballast water		x	
C-35			Raw sewage		x	
C-36			Treated sewage		x	
C-37			Non-oily liquid cargo residues		x	
C-38	Gas	Explosibility/ inflammability	Fuel gas			x

No.	Properties	Goods	Inventory		
			Part I	Part II	Part III
C-39	Solid	Dry cargo residues		x	
C-40		Medical waste/infectious waste		x	
C-41		Incinerator ash[13]		x	
C-42		Garbage		x	
C-43		Fuel tank residues		x	
C-44		Oily solid cargo tank residues		x	
C-45		Oily or chemical contaminated rags		x	
C-46		Batteries (incl. lead acid batteries)			x
C-47		Pesticides/insecticide sprays			x
C-48		Extinguishers			x
C-49		Chemical cleaner (incl. electrical equipment cleaner, carbon remover)			x
C-50		Detergent/bleacher (could be a liquid)			x
C-51		Miscellaneous medicines			x
C-52		Fire fighting clothing and Personal protective equipment			x
C-53		Dry tank residues		x	
C-54		Cargo residues		x	
C-55		Spare parts which contain materials listed in Table A or Table B			x

Table D – Regular consumable goods potentially containing hazardous materials[14]

No.	Properties	Example	Inventory		
			Part I	Part II	Part III
D-1	Electrical and electronic equipment	Computers, refrigerators, printers, scanners, television sets, radio sets, video cameras, video recorders, telephones, consumer batteries, fluorescent lamps, filament bulbs, lamps			x
D-2	Lighting equipment	Fluorescent lamps, filament bulbs, lamps			x
D-3	Non ship-specific furniture, interior and similar equipment	Chairs, sofas, tables, beds, curtains, carpets, garbage bins, bed-linen, pillows, towels, mattresses, storage racks, decoration, bathroom installations, toys, not structurally relevant or integrated artwork			x

13 Definition of garbage is identical to that in MARPOL Annex V. However, incinerator ash is classified separately because it may include hazardous substances or heavy metals.

14 This table does not include ship-specific equipment integral to ship operations, which has to be listed in part I of the inventory.

APPENDIX 2

STANDARD FORMAT OF THE INVENTORY OF HAZARDOUS MATERIALS[15]

Part I
Hazardous materials contained in the ship's structure and equipment

I-1 – Paints and coating systems containing materials listed in table A and table B of appendix 1 of these guidelines

No.	Application of paint	Name of paint	Location	Materials (classification in appendix 1)	Approximate quantity		Remarks
1	Anti-drumming compound	Primer, xx Co., xx primer #300	Hull part	Lead	35.00	kg	
2	Anti-fouling	xx Co., xx coat #100	Underwater parts	TBT	120.00	kg	

[15] Examples of how to complete the Inventory are provided for guidance purposes only in accordance with paragraph 3.4 of the guidelines.

I-2 – Equipment and machinery containing materials listed in table A and table B of appendix 1 of these guidelines

No.	Name of equipment and machinery	Location	Materials (classification in appendix 1)	Parts where used	Approximate quantity		Remarks
1	Switch board	Engine control room	Cadmium	Housing coating	0.02	kg	
			Mercury	Heat gauge	<0.01	kg	less than 0.01kg
2	~~Diesel engine, xx Co., xx #150~~	~~Engine room~~	~~LeadCadmium~~	~~BearingStarter for blower~~	~~0.02~~	~~kg~~	
3	Diesel engine, xx Co., xx #200	Engine-room	Lead	Starter for blower	0.01	kg	Revised by XXX on Oct. XX, 2008 (revoking No.2)
4	Diesel generator (x 3)	Engine-room	Lead	Ingredient of copper compounds	0.01	kg	
5	Radioactive level gauge	No. 1 Cargo tank	Radioactive substances	Gauge	5 (1.8E+11)	Ci (Bq)	Radionuclides: ^{60}Co

I-3 - Structure and hull containing materials listed in table A and table B of appendix 1 of these guidelines

No.	Name of structural element	Location	Materials (classification in appendix 1)	Parts where used	Approximate quantity		Remarks
1	Wall panel	Accommodation	Asbestos	Insulation	2,500.00	kg	
2	Wall insulation	Engine control room	Lead	Perforated plate	0.01	kg	cover for insulation material
			Asbestos	Insulation	25.00	kg	under perforated plates
3							

Part II
Operationally generated waste

No.	Location[1]	Name of item (classification in appendix 1) and detail (if any) of the item	Approximate quantity		Remarks
1	Garbage locker	Garbage (food waste)	35.00	kg	
2	Bilge tank	Bilgewater	15.00	m^3	
3	No.1 cargo hold	Dry cargo residues (iron ore)	110.00	kg	
4	No.2 cargo hold	Waste oil (sludge) (crude)	120.00	kg	
5	No.1 ballast tank	Ballast water	2,500.00	m^3	
		Sediments	250.00	kg	

[1] The location of a part II or part III item should be entered in order based on its location, from a lower level to an upper level and from a fore part to an aft part. The location of part I items is recommended to be described similarly, as far as practicable.

Part III
Stores

III-1 - *Stores*

No.	Location[1]	Name of item (classification in appendix 1)	Unit quantity		Figure		Approximate quantity		Remarks[2)]
								m^3	
								kg	
								kg	
									Details are shown in the attached list.
5	Paint stores	Paint, xx Co., #600	20.00	kg	5	pcs	100.00	kg	Cadmium containing.

1 The location of a part II or part III item should be entered in order based on its location, from a lower level to an upper level and from a fore part to an aft part. The location of part I items is recommended to be described similarly, as far as practicable.

2 In column "Remarks" for part III items, if hazardous materials are integrated in products, the approximate amount of the contents should be shown as far as possible.

III-2 – Liquids sealed in ship's machinery and equipment

No.	Type of liquids (classification in appendix 1)	Name of machinery or equipment	Location	Approximate quantity		Remarks
1	Hydraulic oil	Deck crane hydraulic oil system	Upper deck	15.00	m^3	
		Deck machinery hydraulic oil system	Upper deck and bosun store	200.00	m^3	
		Steering gear hydraulic oil system	Steering gear room	0.55	m^3	
2	Lubricating oil	Main engine system	Engine-room	0.45	m^3	
3	Boiler water treatment	Boiler	Engine-room	0.20	m^3	

III-3 – Gases sealed in ship's machinery and equipment

No.	Type of gases (classification in appendix 1)	Name of machinery or equipment	Location	Approximate quantity		Remarks
1	HFC	AC system	AC room	100.00	kg	
2	HFC	Refrigerated provision chamber machine	AC room	50.00	kg	

III-4 – Regular consumable goods potentially containing hazardous materials

No.	Location[16]	Name of item	Quantity	Remarks
1	Accommodation	Refrigerators	1	
2	Accommodation	Personal computers	2	

[16] The location of a part II or part III item should be entered in order based on its location, from a lower level to an upper level and from a fore part to an aft part. The location of part I items is recommended to be described similarly, as far as practicable.

APPENDIX 3

EXAMPLE OF THE DEVELOPMENT PROCESS FOR PART I OF THE INVENTORY FOR NEW SHIPS

1 OBJECTIVE OF THE TYPICAL EXAMPLE

This example has been developed to give guidance and to facilitate understanding of the development process for part I of the Inventory of Hazardous Materials for new ships.

2 DEVELOPMENT FLOW FOR PART I OF THE INVENTORY

Part I of the Inventory should be developed using the following three steps. However, the order of these steps is flexible and can be changed depending on the schedule of shipbuilding:

.1 collection of hazardous materials information;

.2 utilization of hazardous materials information; and

.3 preparation of the Inventory (by filling out standard format).

3 COLLECTION OF HAZARDOUS MATERIALS INFORMATION

3.1 Data collection process for hazardous materials

Materials Declaration (MD) and Supplier's Declaration of Conformity (SDoC) for products from suppliers (tier 1 suppliers) should be requested and collected by the shipbuilding yard. Tier 1 suppliers may request from their suppliers (tier 2 suppliers) the relevant information if they cannot develop the MD based on the information available. Thus the collection of data on hazardous materials may involve the entire shipbuilding supply chain (Figure 1).

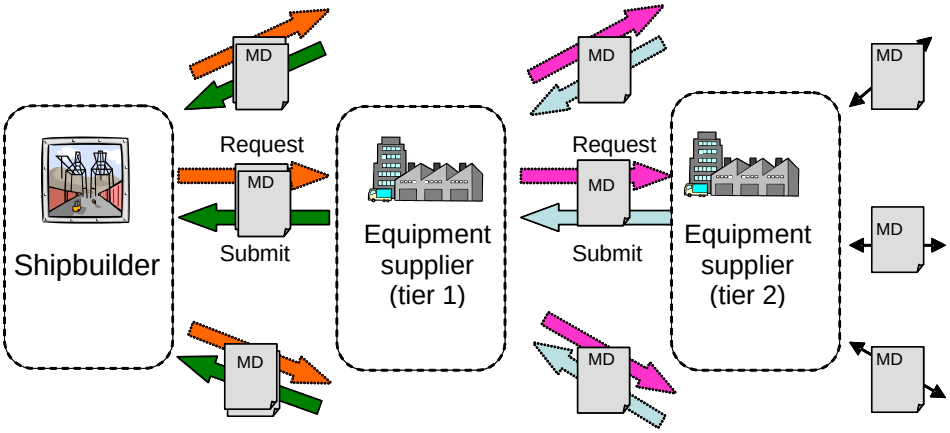


Figure 1 – Process of MD (and SDoC) collection showing involvement of supply chain

3.2 Declaration of hazardous materials

Suppliers should declare whether or not the hazardous materials listed in table A and table B in the MD are present in concentrations above the threshold values specified for each homogeneous material in a product.

3.2.1 *Materials listed in table A*

If one or more materials listed in table A are found to be present in concentrations above the specified threshold value according to the MD, the products which contain these materials shall not be installed on a ship. However, if the materials are used in a product in accordance with an exemption specified by the Convention (e.g. new installations containing hydrochlorofluorocarbons (HCFCs) before 1 January 2020), the product should be listed in the Inventory.

3.2.2 *Materials listed in table B*

If one or more materials listed in table B are found to be present in concentrations above the specified threshold value according to the MD, the products should be listed in the Inventory.

3.3 Example of homogeneous materials

Figure 2 shows an example of four homogeneous materials which constitute a cable. In this case, sheath, intervention, insulator and conductor are all individual homogeneous materials.

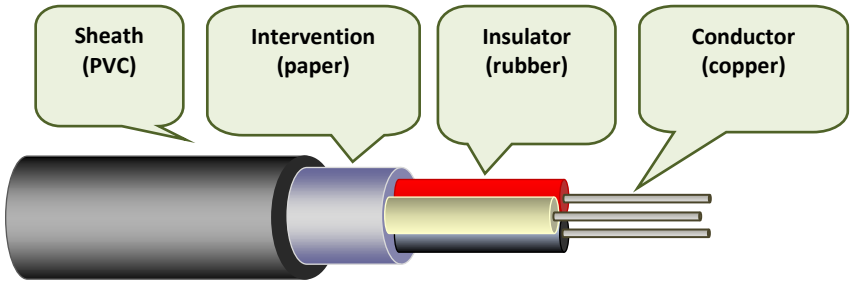


Figure 2 – *Example of homogeneous materials (cable)*

4 UTILIZATION OF HAZARDOUS MATERIALS INFORMATION

Products which contain hazardous materials in concentrations above the specified threshold values should be clearly identified in the MD. The approximate quantity of the hazardous materials should be calculated if the mass data for hazardous materials are declared in the MD using a unit which cannot be directly utilized in the Inventory.

5 PREPARATION OF INVENTORY (BY FILLING OUT STANDARD FORMAT)

The information received for the Inventory, as contained in table A and table B of appendix 1 of these guidelines, ought to be structured and utilized according to the following categorization for part I of the Inventory:

Part I-1 Paints and coating systems;

Part I-2 Equipment and machinery; and

Part I-3 Structure and hull.

5.1 "Name of equipment and machinery" column

5.1.1 *Equipment and machinery*

5.1.1.1 The name of each item of equipment or machinery should be entered in this column. If more than one hazardous material is present in the equipment or machinery, the row relating to that equipment or machinery should be appropriately divided such that all of the hazardous materials contained in the piece of equipment or machinery are entered. If more than one item of equipment or machinery is situated in one location, both name and quantity of the equipment or machinery should be entered in the column. Examples are shown in rows 1 and 2 of table 1

5.1.1.2 For identical or common items, such as but not limited to bolts, nuts and valves, there is no need to list each item individually (see Bulk Listing in paragraph 3.2 of the guidelines). An example is shown in row 3 of table 1.

Table 1 – Example showing more than one item of equipment or machinery situated in one location

No.	Name of equipment and machinery	Location	Materials (classification in appendix 1)	Parts where used	Approximate quantity		Remarks
1	Main engine	Engine-room	Lead	Piston pin bush	0.75	kg	
			Mercury	Thermometer charge air temperature	0.01	kg	
2	Diesel generator (x 3)	Engine-room	Mercury	Thermometer	0.03	kg	
3	FC valve (x 100)	Througout the ship	Lead and lead compounds		20.5	kg	

5.1.2 *Pipes and cables*

The names of pipes and of systems, including electric cables, which are often situated in more than one compartment of a ship, should be described using the name of the system concerned. A reference to the compartments where these systems are located is not necessary as long as the system is clearly identified and properly named.

5.2 "Approximate quantity" column

The standard unit for approximate quantity of solid hazardous materials should be kg. If the hazardous materials are liquids or gases, the standard unit should be either m^3 or kg. An approximate quantity should be rounded up to at least two significant figures. If the hazardous material is less than 10 g, the description of the quantity should read "<0.01 kg".

Table 2 – Example of a switchboard

No.	Name of equipment and machinery	Location	Materials (classification in appendix 1)	Parts where used	Approximate quantity		Remarks
	Switchboard	Engine control room	Cadmium	Housing coating	0.02	kg	
			Mercury	Heat gauge	<0.01	kg	less than 0.01 kg

5.3 "Location" column

5.3.1 *Example of a location list*

It is recommended to prepare a location list which covers all compartments of a ship based on the ship's plans (e.g. general arrangement, engine-room arrangement, accommodation and tank plan) and on other documentation on board, including certificates or spare parts' lists. The description of the location should be based on a location such as a deck or room to enable easy identification. The name of the location should correspond to the ship's plans so as to ensure consistency between the Inventory and the ship's plans. Examples of names of locations are shown in table 3. For bulk listings, the locations of the items or materials may be generalized. For example, the location may only include the primary classification such as "Throughout the ship" as shown in the table 3 below.

Table 3 – Examples of location names

(A) Primary classification	(B) Secondary classification	(C) Name of location
Throughout the ship		
Hull part	Fore part	Bosun store
		…
	Cargo part	No.1 cargo hold/tank
		No.1 garage deck
		…
	Tank part	Fore peak tank
		No.1 WBT
		No.1 FOT
		…
		Aft Peak Tank
	Aft part	Steering gear room
		Emergency fire pump space
		…
	Superstructure	Accommodation
		Compass deck
		Nav. bridge deck
		…
		Wheel house
		Engine control room
		Cargo control room
		…
	Deck house	Deck house
		…
(A) Primary classification	(B) Secondary classification	(C) Name of location
Machinery part	Engine-room	Engine-room
		Main floor
		2nd floor
		…
		Generator space/room
		Purifier space/room
		Shaft space/room
		Engine casing
		Funnel
		Engine control room
		…
	Pump-room	Pump-room
		…
Exterior part	Superstructure	Superstructure
	Upper deck	Upper deck
	Hull shell	Hull shell
		bottom
		under waterline
		…

5.3.2 *Description of location of pipes and electrical systems*

5.3.2.1 Locations of pipes and systems, including electrical systems and cables situated in more than one compartment of a ship, should be described for each system concerned. If they are situated in a number of compartments, the most practical of the following two options should be used:

.1 listing of all components in the column; or

.2 description of the location of the system using an expression such as those shown under "primary classification" and "secondary classification" in Table 3.

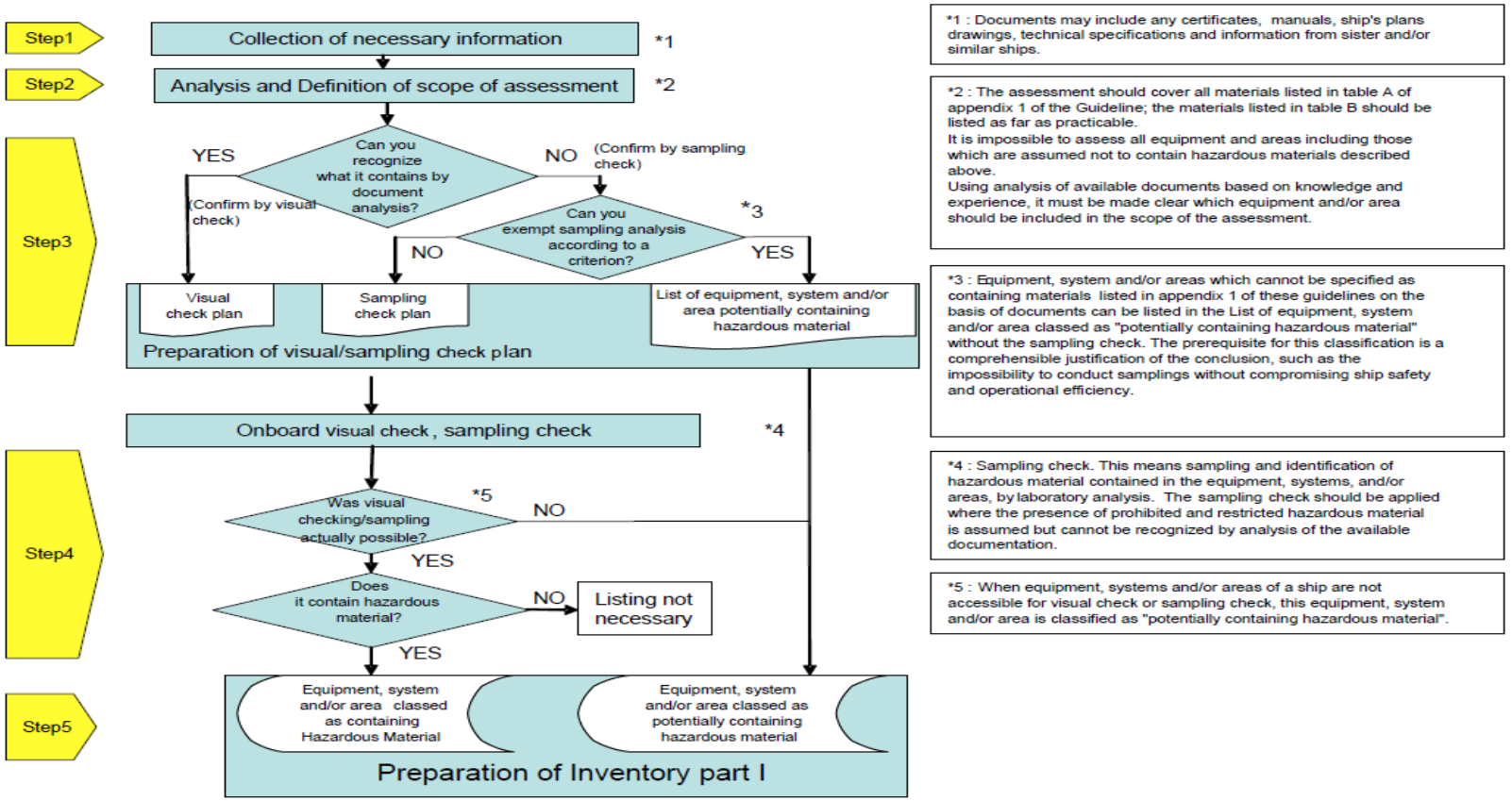
5.3.2.2 A typical description of a pipe system is shown in table 4.

Table 4 – Example of description of a pipe system

No.	Name of equipment and machinery	Location	Materials (classification in appendix 1)	Parts where used	Approximate quantity		Remarks
	Ballast water system	Engine-room, Hold parts					

APPENDIX 4

FLOW DIAGRAM FOR DEVELOPING PART I OF THE INVENTORY FOR EXISTING SHIPS



*1 : Documents may include any certificates, manuals, ship's plans drawings, technical specifications and information from sister and/or similar ships.

*2 : The assessment should cover all materials listed in table A of appendix 1 of the Guideline; the materials listed in table B should be listed as far as practicable.
It is impossible to assess all equipment and areas including those which are assumed not to contain hazardous materials described above.
Using analysis of available documents based on knowledge and experience, it must be made clear which equipment and/or area should be included in the scope of the assessment.

*3 : Equipment, system and/or areas which cannot be specified as containing materials listed in appendix 1 of these guidelines on the basis of documents can be listed in the List of equipment, system and/or area classed as "potentially containing hazardous material" without the sampling check. The prerequisite for this classification is a comprehensible justification of the conclusion, such as the impossibility to conduct samplings without compromising ship safety and operational efficiency.

*4 : Sampling check. This means sampling and identification of hazardous material contained in the equipment, systems, and/or areas, by laboratory analysis. The sampling check should be applied where the presence of prohibited and restricted hazardous material is assumed but cannot be recognized by analysis of the available documentation.

*5 : When equipment, systems and/or areas of a ship are not accessible for visual check or sampling check, this equipment, system and/or area is classified as "potentially containing hazardous material".

APPENDIX 5

EXAMPLE OF THE DEVELOPMENT PROCESS FOR PART I OF THE INVENTORY FOR EXISTING SHIPS

1 INTRODUCTION

1.1 In order to develop part I of the Inventory of Hazardous Materials for existing ships, documents of the individual ship as well as the knowledge and experience of specialist personnel (experts) is required. An example of the development process for Part I of the Inventory of Hazardous Materials for existing ships is useful to understand the basic steps as laid out in the guidelines and to ensure a unified application. However, attention should be paid to variations in different types of ships[17].

1.2 Compilation of part I of the Inventory of Hazardous Material for existing ships involves the following five steps which are described in paragraph 4.2 and appendix 4 of these guidelines.

Step 1: Collection of necessary information;

Step 2: Assessment of collected information;

Step 3: Preparation of visual/sampling check plan;

Step 4: Onboard visual/sampling check; and

Step 5: Preparation of part I of the Inventory and related documentation.

2 STEP 1 – COLLECTION OF NECESSARY INFORMATION

2.1 Sighting of available documents

A practical first step is to collect detailed documents for the ship. The shipowner should try to collate documents normally retained on board the ship or by the shipping company as well as relevant documents that the shipyard, manufacturers, or classification society may have. The following documents should be used when available:

.1 Ship's specification
.2 General Arrangement
.3 Machinery Arrangement
.4 Spare Parts and Tools List
.5 Piping Arrangement
.6 Accommodation Plan
.7 Fire Control Plan
.8 Fire Protection Plan
.9 Insulation Plan (Hull and Machinery)
.10 International Anti-Fouling System Certificate
.11 Related manuals and drawings
.12 Information from other inventories and/or sister or similar ships, machinery, equipment, materials and coatings
.13 Results of previous visual/sampling checks and other analysis

[17] The example of a 28,000 gross tonnage bulk carrier constructed in 1985 is used in this appendix.

2.1.2 If the ship has undergone conversions or major repair work, it is necessary to identify as far as possible the modifications from the initial design and specification of the ship.

2.2 Indicative list

2.2.1 It is impossible to check all equipment, systems, and/or areas on board the ship to determine the presence or absence of hazardous materials. The total number of parts on board may exceed several thousand. In order to take a practical approach, an indicative list should be prepared that identifies the equipment, system, and/or area on board that is presumed to contain hazardous materials. Field interviews with the shipyard and suppliers may be necessary to prepare such lists. A typical example of an indicative list is shown below.

2.2.2 *Materials to be checked and documented*

Hazardous Materials, as identified in appendix 1 of these guidelines, should be listed in part I of the Inventory for existing ships. Appendix 1 of the guidelines contains all the materials concerned. Table A shows those which are required to be listed and table B shows those which should be listed as far as practicable.

2.2.3 *Materials listed in table A*

2.2.3.1 Table A lists the following four materials:

.1 Asbestos
.2 Polychlorinated biphenyls (PCBs)
.3 Ozone depleting substances
.4 Anti-fouling systems containing organotin compounds as a biocide

2.2.3.2 *Asbestos*

Field interviews were conducted with over 200 Japanese shipyards and suppliers regarding the use of asbestos in production. Indicative lists for asbestos developed on the basis of this research are shown below:

Structure and/or equipment	Component
Propeller shafting	Packing with low pressure hydraulic piping flange
	Packing with casing
	Clutch
	Brake lining
	Synthetic stern tubes
Diesel engine	Packing with piping flange
	Lagging material for fuel pipe
	Lagging material for exhaust pipe
	Lagging material turbocharger
Turbine engine	Lagging material for casing
	Packing with flange of piping and valve for steam line, exhaust line and drain line
	Lagging material for piping and valve of steam line, exhaust line and drain line

Structure and/or equipment	Component
Boiler	Insulation in combustion chamber
	Packing for casing door
	Lagging material for exhaust pipe
	Gasket for manhole
	Gasket for hand hole
	Gas shield packing for soot blower and other hole
	Packing with flange of piping and valve for steam line, exhaust line, fuel line and drain line
	Lagging material for piping and valve of steam line, exhaust line, fuel line and drain line
Exhaust gas economizer	Packing for casing door
	Packing with manhole
	Packing with hand hole
	Gas shield packing for soot blower
	Packing with flange of piping and valve for steam line, exhaust line, fuel line and drain line
	Lagging material for piping and valve of steam line, exhaust line, fuel line and drain line
Incinerator	Packing for casing door
	Packing with manhole
	Packing with hand hole
	Lagging material for exhaust pipe
Auxiliary machinery (pump, compressor, oil purifier, crane)	Packing for casing door and valve
	Gland packing
	Brake lining
Heat exchanger	Packing with casing
	Gland packing for valve
	Lagging material and insulation
Valve	Gland packing with valve, sheet packing with piping flange
	Gasket with flange of high pressure and/or high temperature
Pipe, duct	Lagging material and insulation
Tank (fuel tank, hot water, tank, condenser), other equipment (fuel strainer, lubricant oil strainer)	Lagging material and insulation
Electric equipment	Insulation material
Airborne asbestos	Wall, ceiling
Ceiling, floor and wall in accommodation area	Ceiling, floor, wall
Fire door	Packing, construction and insulation of the fire door
Inert gas system	Packing for casing, etc.
Air-conditioning system	Sheet packing, lagging material for piping and flexible joint

Structure and/or equipment	Component
Miscellaneous	Ropes
	Thermal insulating materials
	Fire shields/fire proofing
	Space/duct insulation
	Electrical cable materials
	Brake linings
	Floor tiles/deck underlay
	Steam/water/vent flange gaskets
	Adhesives/mastics/fillers
	Sound damping
	Moulded plastic products
	Sealing putty
	Shaft/valve packing
	Electrical bulkhead penetration packing
	Circuit breaker arc chutes
	Pipe hanger inserts
	Weld shop protectors/burn covers
	Fire-fighting blankets/clothing/equipment
	Concrete ballast

2.2.3.3 *Polychlorinated biphenyl (PCBs)*

Worldwide restriction of PCBs began on 17 May 2004 as a result of the implementation of the Stockholm Convention, which aims to eliminate or restrict the production and use of persistent organic pollutants. In Japan, domestic control began in 1973, with the prohibition of all activities relating to the production, use and import of PCBs. Japanese suppliers can provide accurate information concerning their products. The indicative list of PCBs has been developed as shown below:

Equipment	**Component of equipment**
Transformer	Insulating oil
Condenser	Insulating oil
Fuel heater	Heating medium
Electric cable	Covering, insulating tape
Lubricating oil	
Heat oil	Thermometers, sensors, indicators
Rubber/felt gaskets	
Rubber hose	
Plastic foam insulation	
Thermal insulating materials	
Voltage regulators	
Switches/reclosers/bushings	
Electromagnets	
Adhesives/tapes	
Surface contamination of machinery	
Oil-based paint	
Caulking	
Rubber isolation mounts	
Pipe hangers	

Equipment	Component of equipment
Light ballasts (component within fluorescent light fixtures)	
Plasticizers	
Felt under septum plates on top of hull bottom	

2.2.3.4 *Ozone depleting substances*

The indicative list for ozone depleting substances is shown below. Ozone depleting substances have been controlled according to the Montreal Protocol and MARPOL Convention. Although almost all substances have been banned since 1996, HCFC can still be used until 2020.

Materials	Component of equipment	Period for use of ODS in Japan
CFCs (R11, R12)	Refrigerant for refrigerators	Until 1996
CFCs	Urethane formed material	Until 1996
	Blowing agent for insulation of LNG carriers	Until 1996
Halons	Extinguishing agent	Until 1994
Other fully halogenated CFCs	The possibility of usage in ships is low	Until 1996
Carbon tetrachloride	The possibility of usage in ships is low	Until 1996
1,1,1-Trichloroethane (methyl chloroform)	The possibility of usage in ships is low	Until 1996
HCFC (R22, R141b)	Refrigerant for refrigerating machine	It is possible to use it until 2020
HBFC	The possibility of usage in ships is low	Until 1996
Methyl bromide	The possibility of usage in ships is low	Until 2005

2.2.3.5 *Organotin compounds*

Organotin compounds include tributyl tins (TBT), triphenyl tins (TPT) and tributyl tin oxide (TBTO). Organotin compounds have been used as anti-fouling paint on ships' bottoms and the International Convention on the Control of Harmful Anti-Fouling Systems on Ships (AFS Convention) stipulates that all ships shall not apply or re-apply organotin compounds after 1 January 2003, and that, after 1 January 2008, all ships shall either not bear such compounds on their hulls or shall bear a coating that forms a barrier preventing such compounds from leaching into the sea. The above-mentioned dates may have been extended by permission of the Administration bearing in mind that the AFS Convention entered into force on 17 September 2008.

2.2.4 ***Materials listed in table B***

For existing ships it is not obligatory for materials listed in table B to be listed in part I of the Inventory. However, if they can be identified in a practical way, they should be listed in the Inventory, because the information will be used to support ship recycling processes. The Indicative list of materials listed in table B is shown below:

Materials	Component of equipment
Cadmium and cadmium compounds	Plating film, bearing
Hexavalent chromium compounds	Plating film
Mercury and mercury compounds	Fluorescent light, mercury lamp, mercury cell, liquid-level switch, gyro compass, thermometer, measuring tool, manganese cell, pressure sensors, light fittings, electrical switches, fire detectors
Lead and lead compounds	Corrosion resistant primer, solder (almost all electric appliances contain solder), paints, preservative coatings, cable insulation, lead ballast, generators
Polybrominated biphenyls (PBBs)	Non-flammable plastics
Polybrominated diphenyl ethers (PBDE)	Non-flammable plastics
Polychlorinated naphthalenes	Paint, lubricating oil
Radioactive substances	Refer to appendix 10
Certain shortchain chlorinated paraffins	Non-flammable plastics

3 STEP 2 – ASSESSMENT OF COLLECTED INFORMATION

Preparation of a checklist is an efficient method for developing the Inventory for existing ships in order to clarify the results of each step. Based on collected information including the indicative list mentioned in step 1, all equipment, systems, and/or areas on board assumed to contain hazardous materials listed in tables A and B should be included in the checklist. Each listed equipment, system, and/or area on board should be analysed and assessed for its hazardous materials content.

The existence and volume of hazardous materials may be judged and calculated from the Spare parts and tools list and the maker's drawings. The existence of asbestos contained in floors, ceilings and walls may be identified from Fire Protection Plans, while the existence of TBT in coatings can be identified from the International Anti-Fouling System Certificate, Coating scheme and the History of Paint.

Example of weight calculation

No.	Hazardous Materials	Location/equipment/ component	Reference	Calculation
1.1-2	TBT	Flat bottom/paint	History of coatings	
1.2-1	Asbestos	Main engine/ exh. pipe packing	Spare parts and tools list	250 g x 14 sheet = 3.50 kg
1.2-3	HCFC	Ref. provision plant	Maker's drawings	20 kg x 1 cylinder = 20 kg
1.2-4	Lead	Batteries	Maker's drawings	6kg x 16 unit = 96 kg
1.3-1	Asbestos	Engine-room ceiling	Accommodation plan	

When a component or coating is determined to contain hazardous materials, a "Y" should be entered in the column for "Result of document analysis" in the checklist, to denote "Contained". Likewise, when an item is determined not to contain Hazardous Materials, the entry "N" should be made in the column to denote "Not contained". When a determination cannot be made as to the hazardous materials content, the column should be completed with the entry "Unknown".

Checklist (step 2)

Analysis and definition of scope of assessment for "Sample Ship"

No.	Table A/B	Hazardous materials *1	Location	Name of equipment	Component	Quantity			Manufacturer/brand name	Result of documents analysis *2	Procedure of check *3	Result of check *4	Reference/DWG No.
						Unit (kg)	No.	Total (kg)					
[Inventory part I-1.1]													
1	A	TBT	Top side	Painting and coating	A/F Paints			NIL	Paints Co./marine P1000	N			・On Aug., 200X, Sealer Coat applied to all over submerged area before tin-free coating.
2	A	TBT	Flat Bottom				3000m^2		Unknown AF	Unknown			
[Inventory part I-1.2]													
1	A	Asbestos	Lower deck	Main engine	Exh. pipe packing	0.25	14		Diesel Co.	Y			M-100
2	A	Asbestos	3rd deck	Aux.boiler	Lagging		12		Unknown lagging	Unknown			M-300
3	A	Asbestos	Engine room	Piping/flange	Packing					PCHM			
4	A	HCFC	2nd deck	Ref. provision plant	Refrigerant(R22)	20.00	1		Reito Co.	Y			Maker's dwg
5	B	Lead	Nav. Br. deck	Batteries		6	16		Denchi Co.	Y			E-300
[Inventory part I-1.3]													
1	A	Asbestos	Upper deck	Back deck ceilings	Engine room ceiling		20m^2		Unknown ceiling	Unknown			O-25

Notes

*1 Hazardous materirials: material classification

*2 Result of documents analysis: Y=Contained, N=Not contained, Unknown, PCHM=Potentially containing hazardous material

*3 Procedure of Check:. V=Visual check, S=Sampling check

*4 Result of Check: Y=Contained, N=Not contained, PCHM=Potentially containing hazardous material

4 STEP 3 – PREPARATION OF VISUAL/SAMPLING CHECK PLAN

4.1 Each item classified as "Contained" or "Not contained" in step 2 should be subjected to a visual check on board, and the entry "V" should be made in the "Check procedure" column to denote "Visual check".

4.2 For each item categorized as "unknown", a decision should be made as to whether to apply a sampling check. However, any item categorized as "unknown" may be classed as "potentially containing hazardous material" provided comprehensive justification is given, or if it can be assumed that there will be little or no effect on disassembly as a unit and later ship recycling and disposal operations. For example, in the following checklist, in order to carry out a sampling check for "Packing with aux. boiler" the shipowner needs to disassemble the auxiliary boiler in a repair yard. The costs of this check are significantly higher than the later disposal costs at a ship recycling facility. In this case, therefore, the classification as "potentially containing hazardous material" is justifiable.

Checklist (step 3)

Analysis and definition of scope of assessment for "Sample Ship"

No.	Table A/B	Hazardous materials *1	Location	Name of equipment	Component	Quantity			Manufacturer/brand name	Result of documents analysis *2	Procedure of check *3	Result of check *4	Reference/DWG No.
						Unit (kg)	No.	Total (kg)					
[Inventory part I-1.1]													
1	A	TBT	Top side	Painting & Coating	A/F Paints			NIL	Paints Co./marine P1000	N	V		・On Aug., 200X, Sealer Coat applied to all over submerged area before tin-free coating.
2	A	TBT	Flat bottom				3000m^2		Unknown AF	Unknown	S		
[Inventory Part I-1.2]													
1	A	Asbestos	Lower deck	Main engine	Exh. pipe packing	0.25	14		Diesel Co.	Y	V		M-100
2	A	Asbestos	3rd deck	Aux.boiler	Lagging		12		Unknown lagging	Unknown	S		M-300
3	A	Asbestos	Engine room	Piping/flange	Packing					PCHM	V		
4	A	HCFC	2nd deck	Ref. provision plant	Refrigerant(R22)	20.00	1		Reito Co.	Y	V		Maker's dwg
5	B	Lead	Nav. Br. deck	Batteries		6	16		Denchi Co.	Y	V		E-300
[Inventory Part I-1.3]													
1	A	Asbestos	Upper deck	Back deck ceilings	Engine room ceiling		20m^2		Unknown ceiling	Unknown	S		O-25

Notes

*1 Hazardous materirials: material classification

*2 Result of documents analysis: Y=Contained, N=Not contained, Unknown, PCHM=Potentially containing hazardous material

*3 Procedure of check:. V=Visual check, S=Sampling check

*4 Result of check: Y=Contained, N=Not contained, PCHM=Potentially containing hazardous material

4.3 Before any visual/sampling check on board is conducted, a "visual/sampling check plan" should be prepared. An example of such a plan is shown below.

4.4 To prevent any incidents during the visual/sampling check, a schedule should be established to eliminate interference with other ongoing work on board. To prevent potential exposure to Hazardous Materials during the visual/sampling check, safety precautions should be in place on board. For example, sampling of potential asbestos containing materials could release fibres into the atmosphere. Therefore, appropriate personnel safety and containment procedures should be implemented prior to sampling.

4.5 Items listed in the visual/sampling check should be arranged in sequence so that the onboard check is conducted in a structured manner (e.g. from a lower level to an upper level and from a fore part to an aft part).

Example of visual/sampling check plan

Name of ship	XXXXXXXXXX
IMO Number	XXXXXXXXXX
Gross Tonnage	28,000 GT
L x B x D	xxx.xx × xx.xx × xx.xx m
Date of delivery	dd.mm.1987
Shipowner	XXXXXXXXXX
Contact point (Address, Telephone, Fax, Email)	XXXXXXXXXX Tel: XXXX-XXXX Fax: XXXX-XXXX Email: abcdefg@hijk.co.net
Check schedule	Visual check： dd, mm, 20XX Sampling check：dd, mm, 20XX
Site of check	XX shipyard, No. Dock
In charge of check	XXXX XXXX
Check engineer	XXXX XXXX, YYYY YYYY, ZZZZ ZZZZ
Sampling engineer	Person with specialized knowledge of sampling
Sampling method and anti-scattering measure for asbestos	Wet the sampling location prior to cutting and allow it to harden after cutting to prevent scatter. Notes: Workers performing sampling activities shall wear protective equipment.
Sampling of fragments of paints	Paints suspected to contain TBT should be collected and analysed from load line, directly under bilge keel and flat bottom near amidships.
Laboratory	QQQQ QQQQ
Chemical analysis method	Method by ISO/DIS 22262-1 Bulk materials – Part 1: Sampling and qualitative determination of asbestos in commercial bulk materials and ISO/CD 22262-2 Bulk materials – Part 2: Quantitative determination of asbestos by gravimetric and microscopic methods. ICP Luminous analysis (TBT)
Location of visual/sampling check	Refer to lists for visual/sampling check

Listing for equipment, system and/or area for visual check
See attached "Analysis and definition of scope of investigation for sample ship"

List of equipment, system and/or area for sampling check				
Location	**Equipment, machinery and/or zone**	**Name of parts**	**Materials**	**Result of doc. checking**
Upper Deck	Back deck ceilings	Engine-room ceiling	Asbestos	Unknown
Engine-room	Exhaust gas pipe	Insulation	Asbestos	Unknown
Engine-room	Pipe/flange	Gasket	Asbestos	Unknown
Refer to attached "Analysis and definition of scope of investigation for sample ship" and "Location plan of hazardous materials for sample ship"				

List of equipment, system and/or area classed as PCHM				
Location	**Equipment, machinery and/or zone**	**Name of part**	**Material**	**Result of doc. checking**
Floor	Propeller cap	Gasket	Asbestos	PCHM
Engine-room	Air operated shut-off valve	Gland packing	Asbestos	PCHM
Refer to attached "Analysis and definition of scope of investigation for sample ship" and "Location plan of hazardous materials for sample ship"				

This plan is established in accordance with the guidelines for the development of the Inventory of Hazardous Materials

Prepared by： XXXX XXXX

Tel.： YYYY-YYYY

Email： XXXX@ZZZZ.co.net

・Document check・date/place：
dd, mm, 20XX at XX Lines Co. Ltd.

・Preparation date of plan：dd. mm, 20XX

5 STEP 4 – ONBOARD VISUAL/SAMPLING CHECK

5.1 The visual/sampling check should be conducted according to the plan. Check points should be marked in the ship's plan or recorded with photographs.

5.2 A person taking samples should be protected by the appropriate safety equipment relevant to the suspected type of hazardous materials encountered. Appropriate safety precautions should also be in place for passengers, crewmembers and other persons on board, to minimize the potential exposure to hazardous materials. Safety precautions could include the posting of signs or other verbal or written notification for personnel to avoid such areas during sampling. The personnel taking samples should ensure compliance with relevant national regulations.

5.3 The results of visual/sampling checks should be recorded in the checklist. Any equipment, systems and/or areas of the ship that cannot be accessed for checks should be classified as "potentially containing hazardous material". In this case, the entry in the "Result of check" column should be "PCHM".

6 STEP 5 – PREPARATION OF PART I OF THE INVENTORY AND RELATED DOCUMENTATION

6.1 *Development of part I of the Inventory*

The results of the check and the estimated quantity of hazardous materials should be recorded on the checklist. Part I of the Inventory should be developed with reference to the checklist.

6.2 *Development of location diagram of hazardous materials*

With respect to part I of the Inventory, the development of a location diagram of hazardous materials is recommended in order to help the ship recycling facility gain a visual understanding of the Inventory.

Checklist (step 4 and step 5)

Analysis and definition of scope of assessment for "Sample Ship"

No.	Table A/B	Hazardous materials *1	Location	Name of equipment	Component	Quantity			Manufacturer/brand name	Result of documents analysis *2	Procedure of check *3	Result of check *4	Reference/DWG No.
						Unit (kg)	No.	Total (kg)					
[Inventory part I-1.1]													
1	A	TBT	Top side	Painting & Coating	A/F Paints			NIL	Paints Co./marine P1000	N	V	N	・On Aug., 200X, Sealer Coat applied to all over submerged area before tin-free coating.
2	A	TBT	Flat Bottom			0.02	3000m^2	60.00	Unknown AF	Unknown	S	Y	
[Inventory part I-1.2]													
1	A	Asbestos	Lower deck	Main engine	Exh. pipe packing	0.25	14	3.50	Diesel Co.	Y	V	Y	M-100
2	A	Asbestos	3rd deck	Aux. boiler	Lagging		12		Unknown lagging	Unknown	S	N	M-300
3	A	Asbestos	Engine room	Piping/flange	Packing					PCHM	V	PCHM	
4	A	HCFC	2nd deck	Ref. provision plant	Refrigerant(R22)	20.00	1	20.00	Reito Co.	Y	V	Y	Maker's dwg
5	B	Lead	Nav. Br. deck	Batteries		6	16	96.00	Denchi Co.	Y	V	Y	E-300
[Inventory part I-1.3]													
1	A	Asbestos	Upp.deck	Back deck ceilings	Engine room ceiling	0.19	20m^2	3.80	Unknown ceiling	Unknown	S	Y	O-25

Notes

*1 Hazardous materirials: material classification

*2 Result of documents analysis: Y=Contained, N=Not contained, Unknown, PCHM=Potentially containing hazardous material

*3 Procedure of check:. V=Visual check, S=Sampling check

*4 Result of check: Y=Contained, N=Not contained, PCHM=Potentially containing hazardous material

Example of the Inventory for existing ships

Inventory of Hazardous Materials for "Sample Ship"

Particulars of the "Sample Ship"

Distinctive number or letters	XXXXNNN
Port of registry	Port of World
Type of vessel	Bulk carrier
Gross Tonnage	28,000 GT
IMO number	NNNNNNN
Name of shipbuilder	xx Shipbuilding Co. Ltd
Name of shipowner	yy Maritime SA
Date of delivery	MM/DD/1988

This inventory was developed in accordance with the guidelines for the development of the Inventory of Hazardous Materials.

Attachment:

1: Inventory of Hazardous Materials

2: Assessment of collected information

3: Location diagram of Hazardous Materials

Prepared by XYZ (Name & address) (dd/mm/20XX)

Inventory of Hazardous Materials: "Sample Ship"

Part I – *hazardous materials contained in the ship's structure and equipment*

I-1 Paints and coating systems containing materials listed in Table A and Table B of appendix 1 of the guidelines

No.	Application of paint	Name of paint	Location*	Materials (classification in appendix 1)	Approximate quantity		Remarks
1	AF paint	Unknown paints	Flat bottom	TBT	60.00	kg	Confirmed by sampling
2							
3							

I-2 Equipment and machinery containing materials listed in Table A and Table B of appendix 1 of the guidelines

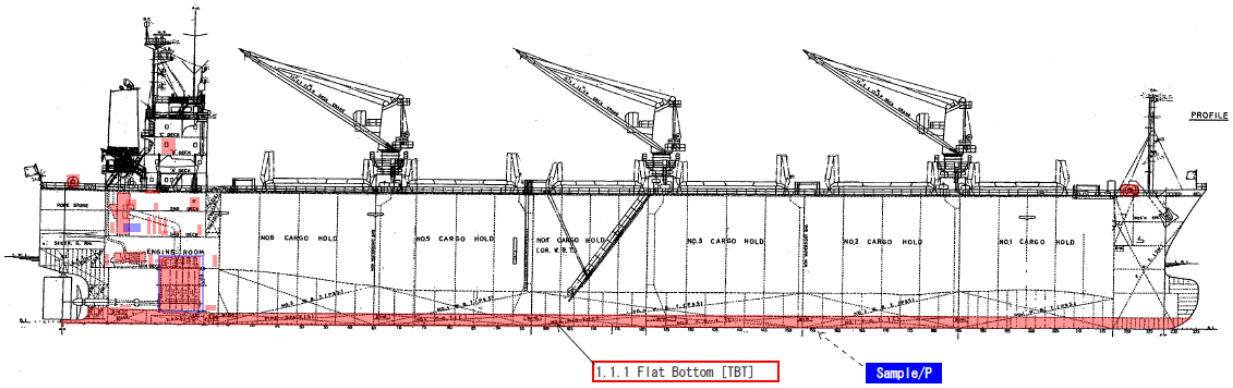
No.	Name of equipment and machinery	Location *1	Materials (classification in appendix 1)	Parts where used	Approximate quantity		Remarks
1	Main engine	Lower floor	Asbestos	Exh. pipe packing	3.50	kg	
2	Aux. boiler	3rd deck	Asbestos	Unknown packing	10.00	kg	PCHM (potentially containing Hazardous Material)
3	Piping/flange	Engine-room	Asbestos	Packing	50.00	kg	PCHM
4	Ref. provision plant	2nd deck	HCFC	Refrigerant (R22)	20.00	kg	
5	Batteries	Navig. Bridge deck	Lead		96.00	kg	

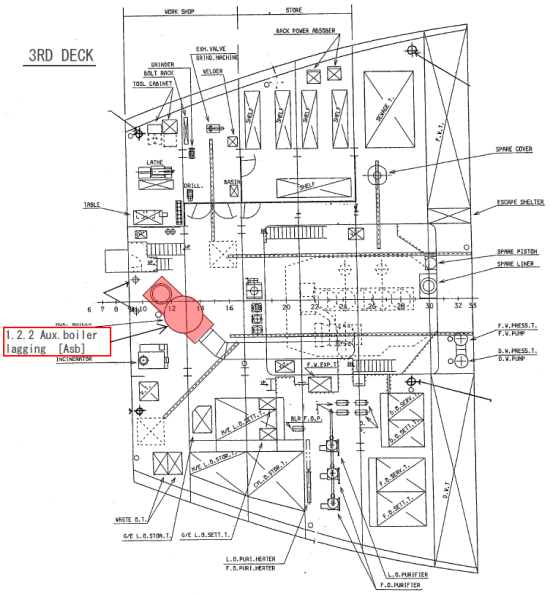
I-3 Structure and hull containing materials listed in Table A and Table B of appendix 1 of the guidelines

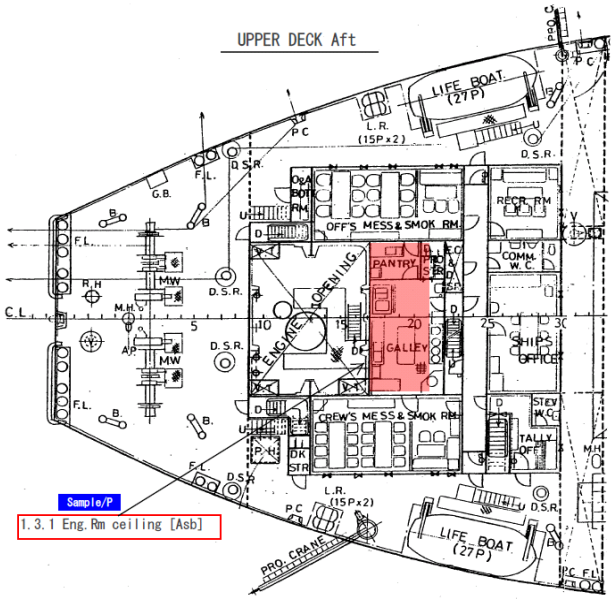
No.	Name of structural element	Location *1	Materials (classification in appendix 1)	Parts where used	Approximate quantity		Remarks
1	Back deck ceiling	Upper deck	Asbestos	Engine-room ceiling (A class)	3.80	kg	Confirmed by sampling
2							
3							

* Each item should be entered in order based on its location, from a lower level to an upper level and from a fore part to an aft part.

Example of location diagram of hazardous materials







APPENDIX 6

FORM OF MATERIAL DECLARATION

<Date of declaration>

Date	

<MD ID number>

MD- ID-No.	

<Other information>

Remark 1	
Remark 2	
Remark 3	

<Supplier (respondent) information>

Company name	
Division name	
Address	
Contact person	
Telephone number	
Fax number	
Email address	
SDoC ID no.	

<Product information>

Product name	Product number	Delivered unit			Product information
		Amount	Unit		

<Materials information>

		Unit	
This materials information shows the amount of hazardous materials contained in	1		(unit: piece, kg, m, m^2, m^3, etc.) of the product.

Table	Material name		Threshold value	Present above threshold value	If yes, material mass		If yes, information on where it is used
				Yes / No	Mass	Unit	
Table A (materials listed in appendix 1 of the Convention)	Asbestos	Asbestos	0.1%[18]				
	Polychlorinated biphenyls (PCBs)	Polychlorinated biphenyls (PCBs)	50 mg/kg				
	Ozone depleting substance	Chlorofluorocaobons (CFCs)	no threshold value				
		Halons					
		Other fully halogenated CFCs					
		Carbon tetrachloride					
		1,1,1-Trichloroethane					
		Hydrochlorofluorocaobons					
		Hydrobromofluorocaobons					
		Methyl bromide					
		Bromochloromethane					
	Anti-fouling systems containing organotin compounds as a biocide		2,500 mg total tin/kg				

[18] In accordance with regulation 4 of the Convention, for all ships, new installation of materials which contain asbestos shall be prohibited. According to the UN recommendation "Globally Harmonized System of Classification and Labelling of Chemicals (GHS)" adopted by the United Nations Economic and Social Council's Sub-Committee of Experts on the Globally Harmonized System of Classification and Labelling of Chemicals (UNSCEGHS), the UN'S Sub-Committee of Experts, in 2002 (published in 2003), carcinogenic mixtures classified as Category 1A (including asbestos mixtures) under the GHS are required to be labelled as carcinogenic if the ratio is more than 0.1%. However, if 1% is applied, this threshold value should be recorded in the Inventory and, if available, the Material Declaration and can be applied not later than five years after the entry into force of the Convention. The threshold value of 0.1% need not be retroactively applied to those Inventories and Material Declarations.

Table	Material name	Threshold value	Present above threshold value	If yes, material mass		If yes, information on where it is used
			Yes / No	Mass	Unit	
Table B (materials listed in appendix 2 of the Convention)	Cadmium and cadmium compounds	100 mg/kg				
	Hexavalent chromium and hexavalent chromium compounds	1,000 mg/kg				
	Lead and lead compounds	1,000 mg/kg				
	Mercury and mercury compounds	1,000 mg/kg				
	Polybrominated biphenyl (PBBs)	50 mg/kg				
	Polybrominated dephenyl ethers (PBDEs)	1,000 mg/kg				
	Polychloronaphthalenes (Cl >= 3)	50 mg/kg				
	Radioactive substances	no threshold value				
	Certain shortchain chlorinated paraffins	1%				

APPENDIX 7

FORM OF SUPPLIER'S DECLARATION OF CONFORMITY

SUPPLIER'S DECLARATION OF CONFORMITY FOR MATERIAL DECLARATION MANAGEMENT

1 Identification number _____

2 Issuer's name _____

Issuer's address _____

3 Object(s) of the declaration _____

_____

_____

4 The object(s) of the declaration described above is in conformity with the following documents :

	Document No.	Title	Edition/date of issue
5	_____	_____	_____
	_____	_____	_____
	_____	_____	_____

6 Additional information _____

_____

Signed for and on behalf of

_____

_____

(place and date of issue)

7 _____ _____

(name, function) *(signature)*

APPENDIX 8

EXAMPLES OF TABLE A AND TABLE B MATERIALS OF APPENDIX 1 WITH CAS NUMBERS

This list was developed with reference to Joint Industry Guide No.101. This list is not exhaustive; it represents examples of chemicals with known CAS numbers and may require periodical updating.

Table	Material Category	Substances	CAS Numbers
Table A (materials listed in appendix 1 of the Convention)	Asbestos	Asbestos	1332-21-4
		Actinolite	77536-66-4
		Amosite (Grunerite)	12172-73-5
		Anthophyllite	77536-67-5
		Chrysotile	12001-29-5
		Crocidolite	12001-28-4
		Tremolite	77536-68-6
	Polychlorinated biphenyls (PCBs)	Polychlorinated biphenyls	1336-36-3
		Aroclor	12767-79-2
		Chlorodiphenyl (Aroclor 1260)	11096-82-5
		Kanechlor 500	27323-18-8
		Aroclor 1254	11097-69-1
	Ozone depleting substances/ isomers (they may contain isomers that are not listed here)	Trichlorofluoromethane (CFC11)	75-69-4
		Dichlorodifluoromethane (CFC12)	75-71-8
		Chlorotrifluoromethane (CFC 13)	75-72-9
		Pentachlorofluoroethane (CFC 111)	354-56-3
		Tetrachlorodifluoroethane (CFC 112)	76-12-0
		Trichlorotrifluoroethane (CFC 113)	354-58-5
		1,1,2 Trichloro-1,2,2 trifluoroethane	76-13-1
		Dichlorotetrafluoroethane (CFC 114)	76-14-2
		Monochloropentafluoroethane (CFC 115)	76-15-3
		Heptachlorofluoropropane (CFC 211)	422-78-6
			135401-87-5
		Hexachlorodifluoropropane (CFC 212)	3182-26-1
		Pentachlorotrifluoropropane (CFC 213)	2354-06-5
			134237-31-3
		Tetrachlorotetrafluoropropane (CFC 214) 1,1,1,3-Tetrachlorotetrafluoropropane	29255-31-0 2268-46-4
		Trichloropentafluoropropane (CFC 215) 1,1,1-Trichloropentafluoropropane 1,2,3-Trichloropentafluoropropane	1599-41-3 4259-43-2 76-17-5
		Dichlorohexafluoropropane (CFC 216)	661-97-2
		Monochloroheptafluoropropane (CFC 217)	422-86-6
		Bromochlorodifluoromethane (Halon 1211)	353-59-3
		Bromotrifluoromethane (Halon 1301)	75-63-8
		Dibromotetrafluoroethane (Halon 2402)	124-73-2
		Carbon tetrachloride (Tetrachloromethane)	56-23-5
		1,1,1, - Trichloroethane (methyl chloroform) and its isomers except 1,1,2-trichloroethane	71-55-6
		Bromomethane (Methyl bromide)	74-83-9
		Bromodifluoromethane and isomers (HBFC's)	1511-62-2
		Dichlorofluoromethane (HCFC 21)	75-43-4
		Chlorodifluoromethane (HCFC 22)	75-45-6
		Chlorofluoromethane (HCFC 31)	593-70-4

Table	Material Category	Substances	CAS Numbers
		Tetrachlorofluoroethane (121) HCFC 1,1,1,2-tetrachloro-2-fluoroethane (HCFC 121a) 1,1,2,2-tetracloro-1-fluoroethane	134237-32-4 354-11-0 354-14-3
		Trichlorodifluoroethane (HCFC 122) 1,2,2-trichloro-1,1-difluoroethane	41834-16-6 354-21-2
		Dichlorotrifluoroethane(HCFC 123) Dichloro-1,1,2-trifluoroethane 2,2-dichloro-1,1,1-trifluroethane 1,2-dichloro-1,1,2-trifluroethane (HCFC-123a) 1,1-dichloro-1,2,2-trifluroethane (HCFC-123b) 2,2-dichloro-1,1,2-trifluroethane (HCFC-123b)	34077-87-7 90454-18-5 306-83-2 354-23-4 812-04-4 812-04-4
		Chlorotetrafluoroethane (HCFC 124) 2-chloro-1,1,1,2-tetrafluoroethane 1-chloro-1,1,2,2-tetrafluoroethane (HCFC 124a)	63938-10-3 2837-89-0 354-25-6
		Trichlorofluoroethane (HCFC 131) 1-Fluoro-1,2,2-trichloroethane 1,1,1-trichloro-2-fluoroethane (HCFC131b)	27154-33-2; (134237-34-6) 359-28-4 811-95-0
		Dichlorodifluoroethane (HCFC 132) 1,2-dichloro-1,1-difluoroethane (HCFC 132b) 1,1-dichloro-1,2-difluoroethane (HFCF 132c) 1,1-dichloro-2,2-difluoroethane 1,2-dichloro-1,2-difluoroethane	25915-78-0 1649-08-7 1842-05-3 471-43-2 431-06-1
		Chlorotrifluoroethane (HCFC 133) 1-chloro-1,2,2-trifluoroethane 2-chloro-1,1,1-trifluoroethane (HCFC-133a)	1330-45-6 1330-45-6 75-88-7
		Dichlorofluoroethane(HCFC 141) 1,1-dichloro-1-fluoroethane (HCFC-141b) 1,2-dichloro-1-fluoroethane	1717-00-6; (25167-88-8) 1717-00-6 430-57-9
		Chlorodifluoroethane (HCFC 142) 1-chloro-1,1-difluoroethane (HCFC142b) 1-chloro-1,2-difluoroethane (HCFC142a)	25497-29-4 75-68-3 25497-29-4
		Hexachlorofluoropropane (HCFC 221)	134237-35-7
		Pentachlorodifluoropropane (HCFC 222)	134237-36-8
		Tetrachlorotrifluropropane (HCFC 223)	134237-37-9
		Trichlorotetrafluoropropane (HCFC 224)	134237-38-0
		Dichloropentafluoropropane, (Ethyne, fluoro-) (HCFC 225)	127564-92-5; (2713-09-9)
		2,2-Dichloro-1,1,1,3,3-pentafluoropropane(HCFC 225aa)	128903-21-9
		2,3-Dichloro-1,1,1,2,3-pentafluoropropane (HCFC 225ba)	422-48-0
		1,2-Dichloro-1,1,2,3,3-pentafluoropropane (HCFC 225bb)	422-44-6
		3,3-Dichloro-1,1,1,2,2-pentafluoropropane (HCFC 225ca)	422-56-0
		1,3-Dichloro-1,1,2,2,3-pentafluoropropane (HCFC 225cb)	507-55-1
		1,1-Dichloro-1,2,2,3,3-pentafluoropropane(HCFC 225cc)	13474-88-9
		1,2-Dichloro-1,1,3,3,3-pentafluoropropane (HCFC 225da)	431-86-7
		1,3-Dichloro-1,1,2,3,3-pentafluoropropane (HCFC 225ea)	136013-79-1
		1,1-Dichloro-1,2,3,3,3-pentafluoropropane(HCFC 225eb)	111512-56-2
		Chlorohexafluoropropane (HCFC 226)	134308-72-8
		Pentachlorofluoropropane (HCFC 231)	134190-48-0
		Tetrachlorodifluoropropane (HCFC 232)	134237-39-1
		Trichlorotrifluoropropane (HCFC 233) 1,1,1-Trichloro-3,3,3-trifluoropropane	134237-40-4 7125-83-9
		Dichlorotetrafluoropropane (HCFC 234)	127564-83-4
		Chloropentafluoropropane (HCFC 235) 1-Chloro-1,1,3,3,3-pentafluoropropane	134237-41-5 460-92-4
		Tetrachlorofluoropropane (HCFC 241)	134190-49-1
		Trichlorodifluoropropane (HCFC 242)	134237-42-6
		Dichlorotrifluoropropane (HCFC 243) 1,1-dichloro-1,2,2-trifluoropropane 2,3-dichloro-1,1,1-trifluoropropane 3,3-Dichloro-1,1,1-trifluoropropane	134237-43-7 7125-99-7 338-75-0 460-69-5
		Chlorotetrafluoropropane (HCFC 244)	134190-50-4

Table	Material Category	Substances	CAS Numbers
		3-chloro-1,1,2,2-tetrafluoropropane	679-85-6
		Trichlorofluoropropane (HCFC 251)	134190-51-5
		1,1,3-trichloro-1-fluoropropane	818-99-5
		Dichlorodifluoropropane (HCFC 252)	134190-52-6
		Chlorotrifluoropropane (HCFC 253)	134237-44-8
		3-chloro-1,1,1-trifluoropropane (HCFC 253fb)	460-35-5
		Dichlorofluoropropane (HCFC 261)	134237-45-9
		1,1-dichloro-1-fluoropropane	7799-56-6
		Chlorodifluoropropane (HCFC 262)	134190-53-7
		2-chloro-1,3-difluoropropane	102738-79-4
		Chlorofluoropropane (HCFC 271)	134190-54-8
		2-chloro-2-fluoropropane	420-44-0
	Organotin compounds (tributyl tin, triphenyl tin, tributyl tin oxide)	Bis(tri-n-butyltin) oxide	56-35-9
		Triphenyltin N,N'-dimethyldithiocarbamate	1803-12-9
		Triphenyltin fluoride	379-52-2
		Triphenyltin acetate	900-95-8
		Triphenyltin chloride	639-58-7
		Triphenyltin hydroxide	76-87-9
		Triphenyltin fatty acid salts (C=9-11)	47672-31-1
		Triphenyltin chloroacetate	7094-94-2
		Tributyltin methacrylate	2155-70-6
		Bis(tributyltin) fumarate	6454-35-9
		Tributyltin fluoride	1983-10-4
		Bis(tributyltin) 2,3-dibromosuccinate	31732-71-5
		Tributyltin acetate	56-36-0
		Tributyltin laurate	3090-36-6
		Bis(tributyltin) phthalate	4782-29-0
		Copolymer of alkyl acrylate, methyl methacrylate and tributyltin methacrylate(alkyl; C=8)	-
		Tributyltin sulfamate	6517-25-5
		Bis(tributyltin) maleate	14275-57-1
		Tributyltin chloride	1461-22-9
		Mixture of tributyltin cyclopentanecarboxylate and its analogs (Tributyltin naphthenate)	-
		Mixture of tributyltin 1,2,3,4,4a, 4b, 5,6,10,10adecahydro-7-isopropyl-1, 4a-dimethyl-1-phenanthlenecarboxylate and its analogs (Tributyltin rosin salt)	-
		Other tributyl tins & triphenyl tins	-
Table B (Materials listed in appendix 2 of the Convention)	Cadmium/ cadmium compounds	Cadmium	7440-43-9
		Cadmium oxide	1306-19-0
		Cadmium sulfide	1306-23-6
		Cadmium chloride	10108-64-2
		Cadmium sulfate	10124-36-4
		Other cadmium compounds	-
	Chromium VI compounds	Chromium (VI) oxide	1333-82-0
		Barium chromate	10294-40-3
		Calcium chromate	13765-19-0
		Chromium trioxide	1333-82-0
		Lead (II) chromate	7758-97-6
		Sodium chromate	7775-11-3
		Sodium dichromate	10588-01-9
		Strontium chromate	7789-06-2
		Potassium dichromate	7778-50-9
		Potassium chromate	7789-00-6
		Zinc chromate	13530-65-9
		Other hexavalent chromium compounds	-
	Lead/lead compounds	Lead	7439-92-1
		Lead (II) sulfate	7446-14-2
		Lead (II) carbonate	598-63-0

Table	Material Category	Substances	CAS Numbers
		Lead hydrocarbonate	1319-46-6
		Lead acetate	301-04-2
		Lead (II) acetate, trihydrate	6080-56-4
		Lead phosphate	7446-27-7
		Lead selenide	12069-00-0
		Lead (IV) oxide	1309-60-0
		Lead (II,IV) oxide	1314-41-6
		Lead (II) sulfide	1314-87-0
		Lead (II) oxide	1317-36-8
		Lead (II) carbonate basic	1319-46-6
		Lead hydroxidcarbonate	1344-36-1
		Lead (II) phosphate	7446-27-7
		Lead (II) chromate	7758-97-6
		Lead (II) titanate	12060-00-3
		Lead sulfate, sulphuric acid, lead salt	15739-80-7
		Lead sulphate, tribasic	12202-17-4
		Lead stearate	1072-35-1
		Other lead compounds	-
	Mercury/ mercury compounds	Mercury	7439-97-6
		Mercuric chloride	33631-63-9
		Mercury (II) chloride	7487-94-7
		Mercuric sulfate	7783-35-9
		Mercuric nitrate	10045-94-0
		Mercuric (II) oxide	21908-53-2
		Mercuric sulfide	1344-48-5
		Other mercury compounds	-
	Polybrominated biphenyls (PBBs) and polybrominated diphenyl ethers (PBDEs)	Bromobiphenyl and its ethers	2052-07-5 (2-Bromobiphenyl)
			2113-57-7 (3-Bromobiphenyl
			92-66-0 (4-Bromobiphenyl)
			101-55-3 (ether)
		Decabromobiphenyl and its ethers	13654-09-6
			1163-19-5 (ether)
		Dibromobiphenyl and its ethers	92-86-4
			2050-47-7 (ether)
		Heptabromobiphenylether	68928-80-3
		Hexabromobiphenyl and its ethers	59080-40-9
			36355-01-8 (hexabromo-1,1'-biphenyl)
			67774-32-7 (Firemaster FF-1)
			36483-60-0 (ether)
		Nonabromobiphenylether	63936-56-1
		Octabromobiphenyl and its ethers	61288-13-9
			32536-52-0 (ether)
		Pentabromobidphenyl ether (note: commercially available PeBDPO is a complex reaction mixture containing a variety of brominated diphenyloxides.	32534-81-9 (CAS number used for commercial grades of PeBDPO)
		Polybrominated biphenyls	59536-65-1
		Tetrabromobiphenyl and its ethers	40088-45-7
			40088-47-9 (ether)
		Tribromobiphenyl ether	49690-94-0
	Polychlorinated naphthalenes	Polychlorinated naphthalenes	70776-03-3
		Other polychlorinated naphthalenes	-
	Radioactive substances	Uranium	-
		Plutonium	-
		Radon	-
		Americium	-
		Thorium	-
		Cesium	7440-46-2
		Strontium	7440-24-6

Table	Material Category	Substances	CAS Numbers
		Other radioactive substances	-
	Certain shortchain chlorinated paraffins (with carbon length of 10-13 atoms)	Chlorinated paraffins (C10-13)	85535-84-8
		Other short chain chlorinated paraffins	-

APPENDIX 9

SPECIFIC TEST METHODS

1 Asbestos

Types to test for: as per resolution MEPC.179(59); Actinolite CAS 77536-66-4 Amosite (Grunerite) CAS 12172-73-5 Anthophyllite CAS 77536-67-5 Chrysotile CAS 12001-29-5 Crocidolite CAS 12001-28-4 Asbestos Tremolite CAS 77536-68-6.

Specific testing techniques: Polarized Light Microscopy (PLM), electron microscope techniques and/or X-Ray Diffraction (XRD) as applicable.

Specific reporting information: The presence/no presence of asbestos, indicate the concentration range, and state the type when necessary.

Notes: .1 The suggested three kinds of testing techniques are most commonly used methods when analysing asbestos and each of them has its limitation. Laboratories should choose the most suitable methods to determine, and in most cases, two or more techniques should be utilized together.

.2 The quantification of asbestos is difficult at this stage, although the XRD technique is applicable. Only a few laboratories conduct the quantification rather than the qualification, especially when a precise number is required. Considering the demand from the operators and ship recycling parties, the precise concentration is not strictly required. Thereby, the concentration range is recommended to report, and the recommended range division according to standard VDI 3866 is as follows:

- Asbestos not detected
- Traces of asbestos detected
- Asbestos content approx. 1% to 15% by mass
- Asbestos content approx. 15% to 40% by mass
- Asbestos content greater than 40% by mass

Results that specified more precisely must be provided with a reasoned statement on the uncertainty.

.3 As to the asbestos types, to distinguish all six different types is time consuming and in some cases not feasible by current techniques; while on the practical side, the treatment of different types of asbestos is the same. Therefore, it is suggested to report the type when necessary.

2 Polychlorinated biphenyls (PCBs)

Note: There are 209 different congeners (forms) of PCB of it is impracticable to test for all. Various organizations have developed lists of PCBs to test for as indicators. In this instance two alternative approaches are recommended. Method 1 identifies the seven congeners used by the International Council for the Exploration of the Sea (ICES). Method 2 identifies 19 congeners and seven types of aroclor (PCB mixtures commonly found in solid shipboard materials containing PCBs). Laboratories should be familiar with the requirements and consequences for each of these lists.

Types to test for: Method 1: ICES7 congeners (28, 52, 101, 118, 138, 153, 180). Method 2: 19 congeners and seven types of aroclor, using the US EPA 8082a test.

Specific testing technique: GC-MS (congener specific) or GC-ECD or GC-ELCD for applicable mixtures such as aroclors. Note: standard samples must be used for each type.

Sample Preparation: It is important to properly prepare PCB samples prior to testing. For solid materials (cables, rubber, paint, etc.), it is especially critical to select the proper extraction procedure in order to release PCBs since they are chemically bound within the product.

Specific reporting information: PCB congener, ppm per congener in sample, and for Method 2, ppm per aroclor in sample should also be reported.

Notes:

.1 Certain field or indicator tests are suitable for detecting PCBs in liquids or surfaces. However, there are currently no such tests that can accurately identify PCBs in solid shipboard materials. It is also noted that many of these tests rely on the identification of free chlorine ions and are thus highly susceptible to chlorine contamination and false readings in a marine environment where all surfaces are highly contaminated with chlorine ions from the sea water and atmosphere.

.2 Several congeners are tested for as "indicator" congeners. They are used because their presence often indicates the likelihood of other congeners in greater quantities (many PCBs are mixes, many mixes use a limited number of PCBs in small quantities, therefore the presence of these small quantities indicates the potential for a mix containing far higher quantities of other PCBs).

.3 Many reports refer to "total PCB", which is often a scaled figure to represent likely total PCBs based on the sample and the common ratios of PCB mixes. Where this is done the exact scaling technique must be stated, and is for information only and does not form part of the specific technique.

3 Ozone depleting substances

Types to test for: as per appendix 8 of these guidelines all the listed CFCs, Halons, HCFCs and other listed substance as required by Montreal Protocol.

Specific testing technique: Gas Chromatography-Mass Spectrometry (GC-MS), coupled Electron Capture Detectors (GC-ECD) and Electrolytic Conductivity Detectors (GC-ELCD).

Specific reporting information: Type and concentration of ODS.

4 Anti-fouling systems containing organotin compounds as a biocide

Types to test for: Anti-fouling compounds and systems regulated under annex I to the International Convention on the Control of Harmful Anti-fouling Systems on Ships, 2001 (AFS Convention), including: tributyl tins (TBT), triphenyl tins (TPT) and tributyl tin oxide (TBTO).

Specific testing technique: As per resolution MEPC.104(49) (*Guidelines for Brief Sampling of Anti-Fouling Systems on Ships*), adopted 18 July 2003, using ICPOES, ICP, AAS, XRF, GC-MS as applicable.
Specific reporting information: Type and concentration of organotin compound.

Note: For "field" or "indicative" testing it may be acceptable to simply identify presence of tin, due to the expected good documentation on anti-fouling systems.

APPENDIX 10

EXAMPLES OF RADIOACTIVE SOURCES

The following list contains examples of radioactive sources that should be included in the Inventory, regardless of the number, the amount of radioactivity or the type of radionuclide.

Examples of consumer products with radioactive materials

Ionization chamber smoke detectors (typical radionuclides ^{241}Am; ^{226}Ra)
Instruments/signs containing gaseous tritium light sources (^{3}H)
Instruments/signs containing radioactive painting (typical radionuclide ^{226}Ra)
High intensity discharge lamps (typical radionuclides ^{85}Kr; ^{232}Th)
Radioactive lighting rods (typical radionuclides ^{241}Am; ^{226}Ra)

Examples of industrial gauges with radioactive materials

Radioactive level gauges
Radioactive dredger gauges[19]
Radioactive conveyor gauges[56]
Radioactive spinning pipe gauges[56]

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[19] Typical radionuclides: ^{241}Am; $^{241}Am/Be$; ^{252}Cf; ^{244}Cm; ^{60}Co; ^{137}Cs; ^{153}Gd; ^{192}Ir; ^{147}Pm; ^{238}Pu; $^{239}Pu/Be$; ^{226}Ra; ^{75}S; ^{90}Sr (^{90}Y); ^{170}Tm; ^{169}Yb

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BWM.2/Circ.13/Rev.3
28 May 2015

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

Methodology for information gathering and conduct of work of the GESAMP*-BWWG

1 Regulation D-3 of the Ballast Water Management Convention provides that ballast water management systems which make use of Active Substances shall be approved by the Organization. The Marine Environment Protection Committee (MEPC), at its fifty-third session (July 2005), adopted the *Procedure for approval of ballast water management systems that make use of Active Substances (G9)* by resolution MEPC.126(53), and agreed with the establishment of a Technical Group under the auspices of GESAMP, to evaluate such systems and advise the Committee accordingly. At the same session the GESAMP-Ballast Water Working Group was also requested to develop a Methodology for information gathering and conduct of its work (the Methodology).

2 MEPC, at its fifty-sixth session (July 2007), having recognized that the Methodology is a living document, which may be further refined taking into account the best practices and lessons learned during the evaluation process, agreed that the Methodology, as drafted at that time, should be suitable for use as technical guidance by applicants submitting applications for approval of ballast water management systems.

3 Having adopted resolution MEPC.169(57), which revokes resolution MEPC.126(53) and contains the revised *Procedure for approval of ballast water management systems that make use of Active Substances (G9)*, MEPC 57 requested the GESAMP-BWWG to update its Methodology in accordance with the revised Procedure (G9). The updated Methodology was subsequently circulated by means of BWM.2/Circ.13.

4 Taking into account the lessons learned and the experience gained, the GESAMP-BWWG carried out a thorough review of the Methodology and prepared a revised version which was approved by the GESAMP, endorsed by MEPC 63 and circulated as BWM.2/Circ.13/Rev.1. Another version was endorsed by MEPC 66 and subsequently circulated as BWM.2/Circ.13/Rev.2.

5 The GESAMP-BWWG further revised the Methodology at its Sixth Stocktaking Workshop in July 2014, clarifying identified inconsistencies related mainly to the circulation of Derived No-Effect Levels (DNEL) and taking into account lessons learned and experience

* GESAMP stands for "IMO/FAO/UNESCO-IOC/WMO/IAEA/UN/UNDP/UNEP/UNIDO Joint Group of Experts on the Scientific Aspects of Marine Environmental Protection".

gained. MEPC, at its sixty-eighth session (May 2015), endorsed the revised Methodology for information gathering and conduct of work of the GESAMP-BWWG, as set out in the annex, and agreed to disseminate it as BWM.2/Circ.13.Rev.3 to supersede BWM.2/Circ.13/Rev.2.

6 MEPC 68 further agreed that the revised Methodology should be applied to all submissions for Basic Approval of ballast water management systems to MEPC 71 and subsequent sessions and to the submissions for Final Approval of those systems.

7 Member Governments are invited to bring the revised Methodology to the attention of all parties concerned and, in particular, manufacturers of ballast water management systems that make use of Active Substances.

8 This circular supersedes circular BWM.2/Circ.13/Rev.2.

***

ANNEX

REVISED METHODOLOGY FOR INFORMATION GATHERING AND CONDUCT OF WORK OF THE GESAMP-BWWG

Endorsed by MEPC 68 on 15 May 2015

1 INTRODUCTION

This document contains the Methodology for information gathering and conduct of work of the GESAMP-BWWG when undertaking technical evaluations in accordance with the *Procedure for approval of ballast water management systems that make use of Active Substances (G9)*, as revised (adopted by resolution MEPC.169(57)).

1.1 Terms and definitions

For the purpose of this Methodology, these definitions are intended to supplement those in the Ballast Water Management Convention to facilitate a consistent evaluation of submissions:

.1 **Ballast Water Management Convention** (the Convention) means the International Convention for the Control and Management of Ships' Ballast Water and Sediments, 2004.

.2 **Ballast Water Management** means mechanical, physical, chemical and biological processes – either singularly or in combination – to remove, render harmless, or avoid the uptake or discharge of harmful aquatic organisms and pathogens within ballast water and sediments.

.3 **Preparation** means any commercial formulation containing one or more Active Substances including any additives. This term also includes any Active Substances generated on board for purposes of ballast water management and any Relevant Chemicals formed in the ballast water management system that makes use of Active Substances to comply with the Convention.

.4 **Active Substance** (AS) means a substance or organism, including a virus or a fungus, that has a general or specific action (chemical or biological) on or against harmful aquatic organisms and pathogens.

.5 **Relevant Chemical** (RC) means transformation or reaction product that is produced during and after employment of the ballast water management system in the ballast water or in the receiving environment and that may be of concern to the ship's safety, aquatic environment and/or human health.

.6 **Other Chemical** (OC) means any other substance, other than the Active Substance(s) or Relevant Chemicals, potentially associated with the system either intentionally or resulting from the treatment of ballast water.

.7 **Basic Approval** (BA) means the preliminary approval of Active Substances and the ballast water management system that uses them in order to comply with the Ballast Water Management Convention. Basic Approval should confirm that the available information does not indicate possible unacceptable adverse effects or a potential for unreasonable risk to environment, human health, property or resources. This should include consideration of potential risks associated with the Active Substance during full-scale deployment on commercial ships when possible.

.8 **Final Approval** (FA) means the approval of a ballast water management system using an Active Substance or Preparation to comply with the Convention and includes an evaluation of the whole effluent toxicity (WET) tests performed as part of the land-based Type Approval process in

accordance with the Guidelines for approval of ballast water management systems (G8). The review does not include the re-evaluation of efficacy testing results conducted by Administrations under the Guidelines (G8). The Final Approval should confirm that previous evaluations of risks to ship, crew and the environment including storage, handling and application of Active Substances or Preparations remain valid and the concerns expressed during the Basic Approval process have been addressed, as well as that the residual toxicity of the discharge conforms to the evaluation undertaken for Basic Approval.

.9 **GESAMP-Ballast Water Working Group (GESAMP-BWWG)**, also being referred to as the Group, means the Technical Group consisting of independent experts acting in their individual capacity that review the proposals for approval of ballast water management systems that make use of Active Substances submitted by the Administration and report, through the GESAMP, to MEPC. When reviewing the proposals, the Group should take account of any other relevant data as well as other relevant information submitted to it, or the Group is aware of, because of its members' expertise.

.10 **GESAMP** is the IMO/FAO/UNESCO-IOC/WMO/IAEA/UN/UNDP/UNEP/UNIDO Joint Group of Experts on the Scientific Aspects of Marine Environmental Protection, an advisory and multi-disciplinary body consisting of specialized experts nominated by the sponsoring agencies. Experts working for the GESAMP act independently in their individual capacity.

1.2 Abbreviations used in the text

ABBREVIATIONS

<	less than
≦	less than or equal to
>	greater than
≧	greater than or equal to
µg	microgram
AS	Active Substance
ASF	interspecies allometric scaling factor
ASTM	American Society for Testing and Materials
BA	Basic Approval
BCF	bioconcentration factor
BIO_{inh}	bioavailability factor for inhalation
BMD	benchmark dose
b.p.	boiling point
bw	body weight
BWMS	ballast water management system
°C	degree Celsius (Centigrade)
CAS	Chemical Abstracts Service
cc	cubic centimeter
CEC	cation exchange capacity
CF_{abs}	correction factor for absorption
CF_{dr}	correction factor for dose regime
CMR	carcinogenicity, mutagenicity and reproductive toxicity

ABBREVIATIONS

d	day(s)
DNEL	Derived No-Effect Level
DMEL	Derived Minimal Effect Level
DOC	dissolved organic carbon
DT_{50}	half-life of a substance
EC_{50}	effect concentration, 50% (median effective concentration)
EHC	environmental health criteria
EHS	Evaluation of Hazardous Substances
ESF	observed effect scaling factor
EU	European Union
FA	Final Approval
g	gram
G9	*Procedure for approval of ballast water management systems that make use of Active Substances (G9)*, as revised, adopted by resolution MEPC.169(57) in April 2008
GESAMP	IMO/FAO/UNESCO-IOC/WMO/IAEA/UN/UNDP/UNEP/UNIDO Joint Group of Experts on the Scientific Aspects of Marine Environmental Protection
GESAMP-BWWG	GESAMP-Ballast Water Working Group
GHS	Globally Harmonized System
GLP	good laboratory practice
h	hour(s)
HES	human exposure scenario
IARC	International Agency for Research on Cancer
IC_{50}	inhibition concentration, 50%
IMO	International Maritime Organization
IR	ingestion rate
ISF	intraspecies differences factor
ISO	International Organization for Standardization
IUPAC	International Union of Pure and Applied Chemistry
K_d	sorption coefficient
kg	kilogram
K_{oc}	organic carbon-water partition coefficient
K_{ow}	octanol/water partitioning coefficient (also P_{ow})
K_p	sorption coefficient for ionic substances
L	litre
LC_{50}	lethal concentration, 50%
LD_{50}	lethal dose, 50%
LLNA	local lymph node assay
LOAEL	lowest observed adverse effect level
LOD	Limit of Detection
LOEL	lowest observed effect level
Log P_{ow}	logarithm of the octanol/water partition coefficient
MADC	Maximum Allowable Discharge Concentration

ABBREVIATIONS

MAMPEC	Marine antifoulant model for PEC calculation
MAMPEC-BW	Marine antifoulant model for PEC calculation for ballast water
MARPOL	International Convention for the Prevention of Pollution from Ships
MEPC	Marine Environment Protection Committee
mg	milligram
mL	millilitre
m.p.	melting point
ng	nanogram
NOAEC	No Observed Adverse Effect Concentration
NOEC	No Observed Effect Concentration
NOAEL	No-Observed-Adverse-Effect Level
NOEL	No-Observed-Effect Level
NTP	National Toxicological Programme
OC	Other Chemical
OECD	Organisation for Economic Co-operation and Development
Organization	the International Maritime Organization
OSF	other interspecies scaling factor
PBT	Persistence, Bioaccumulation and Toxicity
PEC	Predicted Environmental Concentration
PNEC	Predicted No Effect Concentration
POC	Particulate organic carbon
POEM	UK Predictive Operator Exposure Model
P_{ow}	Octanol/water partition coefficient (also K_{ow})
PPE	protective personal equipment
QAPP	Quality Assurance Project Plan
QA/QC	Quality Assurance/Quality Control
QFC	quantity of fish consumed
QSAR	Quantitative Structure-Activity Relationship
RC	Relevant Chemical
RCR	Risk Characterization Ratio
SF_{dur}	scaling factor for exposure duration
SOLAS	The International Convention for the Safety of Life at Sea
TLV	threshold limit value
TOC	Total Organic Carbon
TRC	total residual chlorine
TRO	total residual oxidant
US EPA	United States Environmental Protection Agency
WET	whole effluent toxicity test
WHO	World Health Organization
wt	Weight

2 GENERAL

2.1 Legal provision

Regulation D-3.2 of the International Convention for the Control and Management of Ships' Ballast Water and Sediments, 2004, stipulates that ballast water management systems (BWMS) that make use of Active Substances to comply with the Convention shall be approved by the Organization. During its fifty-third session, the Marine Environment Protection Committee (MEPC) adopted the *Procedure for approval of ballast water management systems that make use of Active Substances (G9)* through resolution MEPC.126(53). Resolution MEPC.169(57) revoked the initial Procedure and provided a revised version of it.

2.2 Principles of acceptability of BWMS that make use of Active Substances

2.2.1 A ballast water management system that makes use of Active Substances accomplishes its intended purpose through action on potentially harmful aquatic organisms and pathogens in ships' ballast water and sediments. However, if the ballast water is still toxic at the time of discharge into the environment, the organisms in the receiving water may suffer unacceptable harm. Both the Active Substance itself or the Preparation, as well as the treated ballast water, should be subjected to toxicity testing in order to determine if an Active Substance or Preparation can be used and under which conditions the potential for harming the receiving environment or human health is acceptably low (G9: 3.2).

2.2.2 Any system that makes use of, or generates, Active Substances, Relevant Chemicals or free radicals during the treatment process to eliminate harmful organisms and pathogens in order to comply with the Convention should be subject to Procedure (G9) (G9: 3.3).

2.2.3 Ballast water management systems that make use of Active Substances and Preparations must be safe in terms of the ship, its equipment and the personnel to comply with the Convention (G9: 3.4).

2.3 Submission of an application for approval

2.3.1 The manufacturer should evaluate the system, the Active Substances or Preparations and the potential discharge in accordance with the approval criteria specified in the *Procedure for approval of ballast water management systems that make use of Active Substances (G9)*.

2.3.2 Upon completion of the evaluation the manufacturer should prepare an application on the system that makes use of Active Substances or Preparations and submit it to the Member of the Organization concerned. An application should only be made when the ballast water management system using Active Substance or Preparations has been sufficiently designed, developed and tested to provide the full data necessary for Basic or Final Approval as appropriate (G9: 8.1.2.2).

2.3.3 For systems that have previously received Basic Approval, the provisions of the "Framework for determining when a Basic Approval granted to one BWMS may be applied to another system that uses the same Active Substance or Preparation" should apply (see BWM.2/Circ.27).

2.3.4 Upon receipt of an application, the concerned Administration should conduct a careful completeness check to ensure that the application satisfies all the provisions contained in Procedure (G9) and that it is presented in the format recommended in this Methodology. Administrations should check the quality and completeness of any application against the latest version of the Methodology for information gathering and conduct of work of the GESAMP-BWWG, agreed by the Organization, prior to its submission to the MEPC. For Final Approval applications, the Administration should ensure that all the recommendations given by the GESAMP-BWWG during the Basic Approval process have been addressed to its complete satisfaction.

2.3.5 When the Administration is satisfied with the application received in accordance with paragraph 3.6 of Procedure (G9), it should submit a proposal for approval to the Organization consisting of the following:

.1 a description of the ballast water management system containing the non-confidential data in the usual format for dissemination as an MEPC document (preferably less than 50 pages). Administrations should aim at submitting the non-confidential descriptions of their ballast water management systems at the MEPC session, which precedes the MEPC session expected to decide on the approval of the systems. If this is not possible, the non-confidential description should be submitted at the earliest opportunity to the MEPC session expected to decide on the approval of the systems, but not later than the 28-week deadline established as indicated in paragraph 2.3.7 below. Documents containing non-confidential descriptions of BWMS, which contain more than 20 pages, will not be translated into all working languages in their entirety. They should include, for translation purposes, a summary of the document not longer than four pages, with the technical content submitted as an annex in the language (e.g. English) that may be needed, for example, by working groups. Proponents seeking approval of BWMS that use Active Substances should thoroughly observe the provisions of paragraph 8.1.1 of Procedure (G9), bearing in mind that failure to provide the non-confidential information could result in Member States having insufficient data to approve the proposals when requested by the Committee. INF documents could be used in conjunction with proposals for approval to ensure that all safety and environmental protection data are made available;

.2 a Letter of Agreement concerning the arrangements between IMO and the submitting Administrations for the evaluation of the respective system. A template of such a letter is provided in appendix 1;

.3 the complete application dossier in accordance with Procedure (G9) consisting of the full description of the system, tests results, study reports, references and copies of the literature referenced and any other information relevant to that system. A summary of the key data should be provided in a tabular format. The complete application dossier should contain a list of contents indicating the location of the information in the application. Pursuant to paragraphs 4.2.2, 8.1.1 and 8.1.2.7 of Procedure (G9), the information mentioned above will be treated as confidential. It should be noted, however, that all information related to safety and environmental protection, including physical/chemical properties, environmental fate and toxicity, will be treated as non-confidential; and

.4 the assessment report in accordance with paragraph 4.3 of Procedure (G9).

2.3.6 Proposals for approval of ballast water management systems that make use of Active Substances that need to be evaluated by the GESAMP-BWWG should be addressed to:

Marine Environment Division
International Maritime Organization
4 Albert Embankment
London SE1 7SR
United Kingdom

2.3.7 A non-refundable registration fee to cover the costs related to the services provided by the GESAMP-BWWG should be paid upon receipt of the invoice issued by the Organization in this respect. It should be noted that the evaluation of a proposal for approval cannot be initiated before the payment of the fee mentioned above.

2.3.8 The GESAMP-BWWG aims to hold its meetings 20 weeks before the MEPC session expected to decide on the approval of the proposals made by the Member Governments. Consequently, a 28-week deadline has been established for the submission of the proposal for approval (including the complete application dossier). This allows eight weeks for the preparation of the meeting and enables interested parties to provide information that is relevant to the evaluation in accordance with the provisions of paragraph 8.1.2.6 of Procedure (G9). A timetable used for planning the activities related to the GESAMP-BWWG meetings is shown in appendix 2.

2.3.9 When due to the time constraints the GESAMP-BWWG is not able to evaluate all the proposals for approval submitted before the deadline established as indicated in paragraph 2.3.8 above, an extraordinary meeting of the GESAMP-BWWG may be convened, subject to the availability of the Group and with the authorization of the Secretary-General of the Organization.

2.3.10 The GESAMP-BWWG will endeavour to evaluate as many proposals for approval as possible received before the deadline described in paragraph 2.3.8 above. When due to the time limitations between two consecutive sessions of the MEPC, the GESAMP-BWWG is not able to evaluate all the proposals for approval received before the above deadline, the remaining proposals will be evaluated on a "priority basis", in accordance with the order of submission during the subsequent meetings of the GESAMP-BWWG. Proposals for approval received after the established deadline will be referred to the MEPC session following the session used to establish the deadline and will be considered after any priority proposals not considered at previous meetings.

2.3.11 Upon receipt of a complete proposal for approval, the Organization will issue a confirmation letter indicating the date and the time the proposal has been received. In order to ensure complete transparency and a fair and impartial treatment of all the submissions, the proposals for approval are evaluated in the chronological order of their receipt.

2.3.12 Face-to-face meetings between the GESAMP-BWWG and applicants/ Administrations should be conducted at the request of the Administrations prior to the meeting and solely during Final Approval evaluations. Face-to-face meeting should be limited to one hour per Final Approval application.

2.3.13 Clarification of certain aspects identified during the preparation for, or in the process of, an evaluation of a proposal for approval may be requested by the GESAMP-BWWG, if it becomes evident that clarification is found to be necessary in order to finalize the evaluation. The clarifications should be received in a timely manner so that the GESAMP-BWWG is able to take the information into account during its evaluation of the system. A time limit for

response to any request for clarifications should not exceed 12 hours unless otherwise agreed with the GESAMP-BWWG. Applicants may wish to designate a technical representative to provide clarifications on request during the Group's meeting.

2.3.14 After completion of the GESAMP-BWWG report, relevant annexes containing the results of the evaluation will be forwarded to the respective Administrations for confirmation that no confidential data are being disclosed. Unless the Administration advises otherwise before the deadline indicated in the request for confirmation (normally one week), the Secretariat will assume that the respective evaluation does not contain confidential data and will process the report according to the timetable shown in appendix 2.

2.3.15 If after the revision of the draft report of the GESAMP-BWWG the GESAMP provides comments on the findings of the Group, the Chair of the GESAMP-BWWG, in consultation with the members of the Group, as appropriate, will address the respective comments. The GESAMP provides confirmation of peer review and approval to the Organization for the information of the MEPC.

2.3.16 In case an Administration that has submitted a proposal for approval disagrees with the recommendations of the GESAMP-BWWG, such an Administration should be given the option to submit a document indicating the reasons for disagreement to the session of the MEPC expected to decide on the respective proposal. The explanatory document should be considered by the Committee in conjunction with the GESAMP-BWWG report.

2.3.17 Any supplementary data regarding a proposal not recommended for approval that was provided to the GESAMP-BWWG after the completion of its meeting will be considered as a new proposal, subject to a new deadline for evaluation according to the procedure described in this Methodology and subject to a new registration fee.

2.3.18 The Secretariat will endeavour to forward all the requests for clarification regarding the published reports of the GESAMP-BWWG received from the Administrations concerned to the Chairman of the GESAMP-BWWG and to the IMO consultant responsible for the respective meeting for response as appropriate.

2.4 Confidentiality and data protection

The confidential information in the submitted documents should clearly be identified. All information related to safety and environmental protection, including physical/chemical properties, environmental fate and toxicity, will be treated as non-confidential with the understanding that original proprietary test reports and studies, with the exception of the summary of the results and test conditions to be prepared by the applicant and validated by the GESAMP-BWWG, are considered confidential (G9: 8.1.1). Once an approval procedure is completed and the system using the Active Substance is approved, the following data should not be regarded as confidential:

.1 the name and address of the Administration;

.2 the names and addresses of the Administrations of the Active Substance and/or the Preparation (if different);

.3 the names and amount of the Active Substance(s) in the Preparations and the name of the Preparation;

.4 the names of other components of Preparations, in particular those that are regarded as dangerous according to the UN GHS or relevant IMO regulations and contribute to the hazard documentation of the Preparation;

.5 the names of Relevant Chemicals that may be formed during or after application of the BWMS and that may be of concern for the receiving environment or human health;

.1 the names of other chemicals that may be formed during or after the application of the BWMS with a technical justification as to why they should not be treated as Relevant Chemicals;

.6 methods of chemical analysis, including the Limit of Detection (LOD);

.7 physical and chemical data concerning the Active Substance, the Preparation and its components and Relevant Chemicals;

.8 a summary of the results of the tests conducted pursuant to section 4.2 of the Procedure (G9) to establish the effects of the substance(s) or Preparation(s) on humans and the environment;

.9 a summary of the results of the tests conducted on the treated ballast water pursuant to section 5.2 of Procedure (G9);

.10 recommended methods and precautions against dangers resulting from handling, storage, transport and fire;

.11 any means of rendering the Active Substance or Preparation harmless;

.12 methods of disposal of the product and of its packaging;

.13 procedures to be followed and measures to be taken in the case of spillage or leakage;

.14 first aid and medical advice to be given in the case of injury to persons;

.15 Safety Data Sheets, which should contain the information required of items .7 to .14;

.16 all results of the Persistence, Bioaccumulation and Toxicity (PBT) assessment and the risk characterization pursuant to sections 5.1 and 5.3 of Procedure (G9); and

.17 the uncertainty analysis specified in paragraph 6.4.3 of Procedure (G9).

2.5 Test methods

2.5.1 Tests, which are described in 3.3.2, 3.3.3 and 6.1.3., should be carried out under internationally recognized guidelines (preferably OECD or equivalent) (G9: 4.2.3), and according to an internationally recognized quality assurance system (G9: 4.2.4) (e.g. Good Laboratory Practice (GLP)). Information may be derived from existing data where an acceptable justification is provided. Full copies of sources of data (e.g. literature papers) and relevant documents for QA/QC (i.e. QAPP) should be provided electronically and in hard copy. The relevant document should include validity criteria for all tests.

2.5.2 Care should be taken to provide full supporting references and copies of the appropriate test laboratory reports in support of each application electronically and in hard copy. If submissions are lacking relevant information, it may not be possible for the GESAMP-BWWG to conduct its risk assessment.

2.5.3 Many substances have acquired large databases for many of the hazards concerned and a weight of evidence approach has become necessary to ensure that the rating reflects the body of data rather than simply using the most conservative value. This, however, means that the submission of all available end-point data for Active Substances and Relevant Chemicals is necessary to enable a review.

2.6 Alternatives to testing and non-submission of data

2.6.1 Alternative methods to testing on live organisms, e.g. *in vitro* testing methods, Quantitative Structure-Activity Relationship (QSAR), extrapolation by analogy to known chemicals, or grouping of similar substances, may be used whenever justified. Sufficient documentation or references to documentation on the validity of the method should be provided, as well as documentation that the substance or Preparation lies within the applicability domain of the method.

2.6.2 Information that is not necessary, owing to the nature of the substance, need not be supplied. The same applies where it is not scientifically justified or technically feasible to supply the information. In such cases, a justification for not supplying such information should be submitted.

2.7 Additional data

2.7.1 If, in the course of the review by the GESAMP-BWWG, the Group considers that additional data are found to be necessary to finalize the evaluation, the Group may, in exceptional circumstances, request that such data are provided to facilitate the review.

2.7.2 The applicant should not submit any additional data after the dossier has been submitted to the Organization for evaluation unless such data have been requested by the Group.

2.8 Retrospective requirement

Once a ballast water management system has received Final Approval under this procedure, then the respective applicant should not have to retrospectively submit new data in accordance with this revised Methodology.

3 APPLICATION DATA-SET

3.1 General

3.1.1 The dossier should contain the information specified in Procedure (G9). In cases where information requested in accordance with Procedure (G9) has not been submitted and no justification for non-submission is provided, the GESAMP-BWWG may not be able to judge the reasons for not submitting the information that may influence its evaluation and development of recommendations. A model for the presentation of the application data-set is given in appendix 3.

3.1.2 For Active Substances and/or Preparations, including any of its components as appropriate, data on properties should be included. For Relevant Chemicals, data should be provided as well.

3.1.3 Fate and effect testing should be performed in the laboratory with Active Substances and Preparations (G9: 5.3.1). However, the GESAMP-BWWG notes that normally assessment of fate (including degradation, bioaccumulation) is not feasible for Preparations, but only for individual substances. Therefore, degradation and fate testing of Preparations may not be appropriate. However, fate of individual substances of the Preparation should be demonstrated.

3.1.4 For treated ballast water, the Administration should provide both acute and chronic toxicity data (G9: 5.2.2) at Basic Approval application. The discharge toxicity tests at Final Approval should include acute and chronic toxicity test methods and results performed as part of the land-based type approval process with test species (fish, crustacea and algae). The results should include acute LC_{50} values and chronic NOECs (G9: 5.2.5). One hundred per cent concentrations of samples of ballast water discharge should be tested (G9: 5.2.6), if appropriate.

3.1.5 Any reference to specific test methods in the following is indicative with the purpose of providing guidance to an Administration on possible methods that may be considered. Any other internationally recognized test method may be used as well.

3.2 Identification of the substance or Preparation (G9: 4.1)

3.2.1 Preparations

3.2.1.1 For each Preparation, the application should include the following information (G9: 4.2.2):

.1 the Trade name;

.2 compositional information of the Preparation; including:

.1 the chemical (IUPAC) name of each component;

.2 the concentration of each component (liquids in g/L; solids in %w/w; gases in %v/v);

.3 the CAS number of each component;

.4 the UN number and proper shipping name of each component (where relevant);

.5 an indication of whether the component is an Active Substance or an additive, e.g. stabilizer or inhibitor or solvent, etc.; and

.6 particle size distribution, if in powder and/or granular form, as smaller particles (< 10 µm) present a greater hazard in potential cases of inhalation.

3.2.2 Active Substances

3.2.2.1 For each Active Substance, the applicant should provide the following information:

.1 the Trade name (where relevant);

.2 the chemical (IUPAC) name;

.3 the CAS number;

.4 the UN number and proper shipping name (where relevant);

.5 the molecular mass;

.6 the empirical formula;

.7 the structural formula;

.8 the classification in accordance with the UN GHS system;

.9 the purity of the technical material and identification of impurities (chemical name and CAS-numbers, etc.); and

.10 the identity of any stabilizers or necessary additives.

3.2.3 Relevant Chemicals (G9: 2.1.4)

3.2.3.1 Chemical analysis results should be accompanied by a specification of the applied Active Substance concentration, test conditions, characteristics of the test water (temperature, pH, salinity, TOC, DOC, TSS), sampling time, handling and storage of samples before analysis, and analytical method.

3.2.3.2 If chemical analyses were performed during more than one test run, the number of test runs should be stated and results should be reported in the form of individual measurements for each test run. Analytical results should be provided for both treated and control samples.

3.2.3.4 Reasoning should be provided, based on the documented state of knowledge, on which basis the selection of substances for inclusion in the chemical analysis was made, taking into account the chemical reactivity of the Active Substance and other components of the respective system.

3.2.3.5 Where the process might produce by-products when reacting with ballast water, the applicant should provide the following information for those products deemed to be Relevant Chemicals:

.1 the Chemical (IUPAC) name;

.2 the CAS number;

.3 the molecular mass;

.4 the empirical formula;

.5 the structural formula; and

.6 the classification in accordance with the GHS system.

3.2.4 Other Chemical

Unless a justification can be provided for not doing so, the following information should be supplied for Other Chemicals:

.1 the Chemical (IUPAC) name;

.2 the CAS number;

.3 the molecular mass;

.4 the empirical formula;

.5 the structural formula;

.6 the classification in accordance with the GHS system; and

.7 if relevant particle size distribution, if in powder and/or granular form, as smaller particles (< 10 µm) present a greater hazard in potential cases of inhalation exposure.

3.3 Data on effects on aquatic plants, invertebrates and fish, and other biota, including sensitive and representative organisms (G9: 4.2.1.1)

3.3.1 General

For every Active Substance or Preparation including any of its components, data should be presented and discussed either on the basis of toxicological tests or published toxicological knowledge for each end point listed.

3.3.2 Acute aquatic toxicity

3.3.2.1 Short-term $L(E)C_{50}$ from freshwater or saltwater representatives of three taxa (algae, crustacea and fish) representing three trophic levels by internationally standardized tests, e.g. OECD guidelines 201 (Algae, Growth Inhibition Test), 202 (*Daphnia* sp. Acute Immobilization Test), 203 (Fish, Acute Toxicity Test), USEPA 850.1035 (Mysid shrimp acute toxicity test), and Mysid shrimp acute toxicity test (USEPA 850.1035) should be accepted. To reduce further any remaining uncertainty, applicants should, preferably, also submit data for two additional marine taxa (e.g. echinoderms, molluscs), ISO 10253 (Micro algae), ISO 7346-2, ISO 7346-3 (fish), and ISO 10706 (Daphnia).

3.3.2.2 Such acute aquatic toxicity data should be provided for:

.1 Preparations including any of its components;

.2 Active Substances;

.3 Relevant Chemicals; and

.4 discharged ballast water (G9: 5.2.3).

3.3.2.3 For algal toxicity testing, it is recommended that:

.1 two species of algae be used in toxicity tested testing at Basic Approval and Final Approval;

.2 *Skeletonema costatum* be used as one of the test species;

.3 the second test species is not a diatom; and

.4 *Phaeodactylum tricornutum* not be used as a test species.

3.3.3 Chronic aquatic toxicity

3.3.3.1 Long-term NOECs or EC_{10} from three freshwater or saltwater species (normally algae and/or crustacea and/or fish), representing three trophic levels by internationally standardized tests, e.g. OECD guidelines 210, 215, or 212 (fish), and OECD guideline 211 (*Daphnia*), should be acceptable. To reduce any further remaining uncertainty, applicants should preferably also submit two long-term NOECs from additional marine taxa (e.g. echinoderms, molluscs), ISO 10253 (micro algae), ISO 20666 (rotifer), and ISO 10229 (fish).

3.3.3.2 Short-term methods by US EPA and ISO for estimating the chronic toxicity of substances and discharge provide acceptable alternatives, since the identification of the sensitive sub-lethal endpoints and vulnerable life stages is the ultimate aim of the long-term testing.

3.3.3.3 Such chronic aquatic toxicity data should be provided for:

.1 Preparations including any of its components;

.2 Active Substances;

.3 Relevant Chemicals; and

.4 discharged ballast water (fish, invertebrate, plant) (G9: 5.2.3).

3.3.3.4 For the chronic aquatic toxicity testing using discharged ballast water (paragraph 3.1.4), based on the experience gained in the evaluation process of BWMS, it has been shown that, where BWMS using electrolysis and/or ozonation are concerned, there is no need to evaluate the results of chronic ecotoxicity testing using discharged ballast water . This is because the levels of Relevant Chemicals, such as THMs and HAAs, have been found to remain in similar concentration ranges that lead to PEC/PNEC ratios < 1. It is also recognized that with these types of BWMS, Relevant Chemicals other than the range of well-known chlorinated and brominated low molecular weight substances are not produced. Therefore, it is considered appropriate that such BWMS could fully be evaluated at Basic Approval without the results of chronic ecotoxicity testing. It should be emphasized that this waiver would not apply to BWMSs other than those systems mentioned and this waiver does not extend to Final Approval.

3.3.4 Endocrine disruption

3.3.4.1 Regarding the risks connected to endocrine disruption, non-standardized *in vivo* as well as *in vitro* tests may be conducted as long as no internationally standardized tests are available (e.g. full-life-cycle test on fish or amphibian metamorphosis assay).

When substantial evidence on such effects is available, this should be taken into account on a case-by-case basis and in the effect assessment for each compartment of relevance. If there is no indication for endocrine disruption – e.g. due to the structure of the substance or results of other available studies – these tests may be waived.

3.3.4.2 Such information on endocrine disruption should be provided for:

.1 Preparations including any of its components;

.2 Active Substances; and

.3 Relevant Chemicals.

3.3.5 Sediment toxicity

3.3.5.1 Substances that are potentially capable of depositing on or adsorbing to sediments to a significant extent should be assessed for toxicity to sediment-dwelling organisms. Testing is considered relevant only if log K_{ow} > 3 or if there is similar adsorption behaviour and should include a maximum of three long-term tests with species representing different living and feeding conditions, e.g. *Chironomus* sp. (OECD 218), *Lumbriculus variegates,* including a minimum of two tests with marine species. If sediment toxicity tests are not available, toxicity should be assessed using established internationally recognized methods such as the equilibrium partitioning method (EPM) according to the "Technical Guidance Document on Risk Assessment" (TGD) to the European Biocides Regulation 1107/2009/EC.

3.3.5.2 For substances that are persistent in marine waters or may accumulate in sediments, a specific marine sediment assessment is necessary.

3.3.5.3 Such information on sediment toxicity should be provided for:

.1 Preparations including any of its components;

.2 Active Substances;

.3 Relevant Chemicals; and

.4 discharged ballast water.

3.3.6 Food web/population effects

3.3.6.1 The biomagnification and persistence in the food web should be discussed based on the results from aquatic toxicity testing, mammalian toxicity evaluation and bioaccumulation and biodegradation data.

3.3.6.2 An assessment of secondary poisoning is redundant if, for the substance of concern, the absence of bioaccumulation potential can be demonstrated (BCF < 500 L/kg wet weight for the whole organism at 5% fat). If not, testing should include:

.1 one long-term NOEC based on reproduction studies with a bird species; and

.2 two NOECs from long-term studies with two mammalian species (from section 3.4 below).

3.3.6.3 Such information related to the food web/population effects should be provided for:

.1 Active Substances; and

.2 Relevant Chemicals.

3.4 Data on mammalian toxicity (G9: 4.2.1.2)

3.4.1 General

3.4.1.1 Information that is deemed to be scientifically not justified or technically not feasible need not be supplied. However, in such cases, a scientific justification should be submitted in order to explain why the data have not been provided. In general, testing with vertebrate animals should be avoided if another type of information is available that allows an assessment of hazards and risks to humans. Such alternative information may be obtained by validated *in vitro* methods, Quantitative Structure Activity Relationships (QSAR), and grouping or read-across with similar substances. If available, human cases or epidemiological evidence should be presented and discussed.

3.4.1.2 In general, information should be provided on the Active Substance and the Preparation, including any of its components, as appropriate. Information on Relevant Chemicals formed during or after application of the BWMS should be provided as well.

3.4.2 Acute toxicity

3.4.2.1 The acute toxicity data should be known for at least two routes of exposure, one of which should be the oral route. Active Substances or Preparations that are gases should be assessed in terms of inhalation toxicity.

3.4.2.2 The submission of dermal and/or inhalation studies instead of or in addition to oral studies may be requested depending on the physico-chemical properties of the substance, the proposed or potential application of the substance/products.

3.4.2.3 Such information on acute toxicity should be provided for:

.1 Preparations including any of its components;

.2 Active Substances; and

.3 Relevant Chemicals.

3.4.3 Effects on skin and eye

3.4.3.1 Data should provide information on the degree and nature of skin, eye and associated mucous membrane irritation, especially with regard to the reversibility of responses. Data should provide sufficient information to assess the potential to cause skin sensitization reactions. Submitted data should concern testing with the Active Substance(s) or Preparation(s).

3.4.3.2 Data should include available information concerning a study on acute dermal irritation/corrosion and a study on acute eye irritation/corrosion. The recommended tests are OECD guidelines 404 (Acute Dermal Irritation/Corrosion) and 405 (Acute Eye Irritation/Corrosion). Results from validated *in vitro* test methods may be submitted.

3.4.3.3 The recommended test guideline for Skin Sensitization is OECD guideline 406. While the guinea-pig Maximization test is considered to be the preferred adjuvant technique in certain cases, there may be good reasons for choosing the Buehler test or OECD TG 442A the Local Lymph Node Assay (LLNA) and OECD TG 442B (Lymph Node Assay: BrdU-ELISA). However, scientific justification should be given when either of the two latter mentioned is used. Information regarding hazard classification as a sensitizer should be submitted, if available.

3.4.3.4 Such information related to the effects on skin and eyes should be provided for:

.1 Preparations including any of its components;

.2 Active Substances; and

.3 Relevant Chemicals.

3.4.4 Repeated-dose toxicity

3.4.4.1 Repeated-dose toxicity should be assessed based on data from a sub-chronic toxicity study (90-day) in two species, one rodent and one other mammalian species, using the oral route unless another one is more appropriate.

3.4.4.2 Such information on repeated-dose toxicity should be provided for:

.1 Preparation including any of its components;

.2 Active Substances; and

.3 Relevant Chemicals.

3.4.5 Chronic toxicity

3.4.5.1 There is a need for a chronic toxicity assessment based on a study of a minimum duration of 12 months in two species – one rodent and one other mammalian species – unless a full justification demonstrates that this test is not necessary.

3.4.5.2 Any chronic study can be combined with a carcinogenicity study.

3.4.5.3 Such information on chronic toxicity should be provided for:

.1 Preparation including any of its components;

.2 Active Substances; and

.3 Relevant Chemicals.

3.4.6 Developmental and reproductive toxicity

3.4.6.1 Data should include information from:

.1 a two-generation reproduction and fertility study (OECD guideline 416 – Two-Generation Reproduction Toxicity Study); and

.2 a prenatal developmental toxicity (teratogenicity) study in two species (OECD guideline 414 – Prenatal Developmental Toxicity).

3.4.6.2 However, this information can be waived provided that an argument is submitted based on structural relationships with a known reproductive toxicant, the results of other toxicity studies (including toxicokinetics), and concerns for endocrine disruption. Such information on developmental and reproductive toxicity should be provided for:

.1 Preparation including any of its components;

.2 Active Substances; and

.3 Relevant Chemicals.

3.4.7 Carcinogenicity

3.4.7.1 Carcinogenicity data should be submitted based on studies performed with one rodent and one other mammalian species. In case this information is not provided, a scientific justification should be submitted.

3.4.7.2 Such information on carcinogenicity should be provided for:

.1 Preparations including any of its components;

.2 Active Substances; and

.3 Relevant Chemicals.

3.4.8 Mutagenicity/genotoxicity

3.4.8.1 This information should address at least three tests: a bacterial gene mutation test, an *in vitro* mammalian cell cytogenicity study and an *in vitro* mammalian cell gene mutation assay. In case of positive or equivocal results, further *in vivo* mutagenicity data are necessary i.e. bone marrow assay for chromosomal damage or a micronucleus test. In case this information is not provided, a scientific justification should be submitted.

3.4.8.2 Such information on mutagenicity and genotoxicity should be provided for:

.1 Preparations including any of its components;

.2 Active Substances; and

.3 Relevant Chemicals.

3.4.9 Toxicokinetics

3.4.9.1 Basic data on the toxicokinetics of Active Substances and other components of a Preparation as well as Relevant Chemicals should be included. Information on absorption, distribution, metabolism and elimination (e.g. OECD guideline 417) should be presented, if available, to allow better understanding of toxic effects and a reduction of animal testing. The potential for dermal absorption should be evaluated preferably *in vitro* or by physico-chemical data to reduce the need for any specific dermal toxicity testing.

3.5 Data on environmental fate and effect under aerobic and anaerobic conditions (G9: 4.2.1.3)

3.5.1 General

3.5.1.1 The rate and route of abiotic and biotic degradation of the Active Substances, components of a Preparation and Relevant Chemicals under aerobic and anaerobic conditions should be assessed, resulting in the identification of relevant metabolites in the relevant media (ballast water, marine and fresh waters) (G9: 5.3.4).

3.5.1.2 The solids-water partition coefficient (K_d) and/or organic carbon normalized distribution coefficient (K_{oc}) of the Active Substances, components of a Preparation and Relevant Chemicals should be determined (G9: 5.3.6).

3.5.1.3 The data submitted in accordance with this paragraph should clarify, in addition to the degradation of the substance, other relevant routes of dispersion in and from water, such as volatilization, adsorption, sedimentation and transformation into bound residues. Accordingly, the exposure of organisms living in water and the sediment should be established.

3.5.2 Modes of degradation (biotic; abiotic)

3.5.2.1 Testing should include:

.1 a study on hydrolysis at pH 5, 7, and 9 under aerobic conditions according to OECD guideline 111;

.2 a study on ready biodegradability according to OECD guideline 301 (Ready Biodegradability) or equivalent guidelines if the Active Substance is discharged only into fresh water;

.3 a study on ready biodegradability according to OECD guideline 306 (Biodegradability in Seawater) or equivalent guidelines if the Active Substance is discharged only into marine water;

.4 studies on ready biodegradability according to OECD guideline 301 (or equivalent guidelines) and OECD guideline 306 (or equivalent guidelines) if the Active Substance is discharged into estuarine water (e.g. inland harbour with contact to seawater); and

.5 it is recommended to evaluate the fate of Active Substances and Relevant Chemicals in fresh water (PSU < 3) and in marine water (PSU > 32) each at low temperatures (5°C) and higher temperatures (> 25°C).

3.5.2.2 If the Active Substance is not readily biodegradable, then the following higher tier studies should be conducted:

.1 a study on aerobic and anaerobic transformation in aquatic sediment systems according to OECD guideline 308 (Aerobic and Anaerobic Transformation in Aquatic Sediment Systems) or equivalent guidelines if K_{oc} > 500 L/kg, using fresh or marine water depending on the kind of aquatic ecosystem where discharge is intended. At least one system with high organic matter/nutrient content and one with low organic matter/nutrient content should be tested;

.2 a study on aerobic transformation of low concentrations of organic contaminants according to OECD guideline 309 (Aerobic Mineralization in Surface Water – Simulation Biodegradation Test) or equivalent guidelines, using fresh or marine water depending on the kind of aquatic ecosystem where discharge is intended; and

.3 where relevant, a study on photo-transformation in water, e.g. US EPA OPPTS 835.2210 (1998) and/or OECD Guidance document on photo-transformation in water (1997).

3.5.2.3 Such information on the modes of degradation should be provided for:

.1 Active Substances;

.2 any other components of Preparations; and

.3 Relevant Chemicals.

3.5.3 Persistence and identification of the main metabolites in the relevant media (ballast water, marine and fresh waters)

3.5.3.1 The route of degradation in the higher tier simulation tests specified under section 3.5.2 of this Methodology should be characterized based on a mass balance, including mineralization and formation of bound residues. Reaction or transformation products formed that may be considered as Relevant Chemicals should be identified.

3.5.3.2 Such information on persistence and metabolites should be provided for:

.1 Active Substances;

.2 any components of Preparations; and

.3 Relevant Chemicals.

3.5.4 Bioaccumulation, partition coefficient, octanol/water partition coefficient

3.5.4.1 Data should include:

.1 information on bioconcentration and biomagnification, which have already been detailed earlier in this Methodolgy;

.2 a study into the log P_{ow} according to OECD guideline 107 (Partition Coefficient (n-octanol/water): Shake Flask Method), OECD guideline 117 (Partition coefficient – n-octanol/water HPLC Method) or equivalent test guidelines. For very hydrophobic compounds, a slow stirring method is appropriate (e.g. OECD 123 (Partition coefficient – Slow Stirring Method)); and

.3 the partition coefficient between solids and liquids should be determined, e.g. according to EU Technical Guidance Document on Risk Assessment (2003) for at least three inocula, including fresh water sediment, marine sediment, and particulate matter (sludge) (OECD 106). If no measured data are available for a specific adsorbing material, it is assumed that all adsorption can be related to the organic matter of the

medium, viz. standardization to K_{oc}. This is only valid for non-ionic substances. For ionic substances, the K_p values and the test characteristics (% clay, CEC, % o.c., pH) should be reported.

3.5.4.2 Such information on bioaccumulation and partition coefficients should be provided for:

.1 Active Substances;

.2 any other components of Preparations; and

.3 Relevant Chemicals.

3.5.5 Bioavailability/biomagnification/bioconcentration

3.5.5.1 If log P_{ow} >3, testing of the bioaccumulation potential should be considered taking into account the following points:

.1 one bioconcentration factor (BCF) determined in a bioconcentration study (at two dosing levels) with fish (e.g. OECD 305) or bivalves. The BCF should be based on uptake/elimination kinetics (k_1/k_2). The half-life for elimination should be reported. Fat content in marine fish typically ranges between 0.5 and 15% of the whole body weight. BCF should be normalized to 5% fat. The BCF, could e.g. be calculated with formulae 74 and 75 of the TGD (see 3.3.5) using the log K_{ow};

.2 the biomagnification and persistence in the food web should be discussed based on the results from aquatic toxicity testing, mammalian toxicity evaluation and bioaccumulation and biodegradation data; and

.3 there are no data provisions on bioavailability since it is considered that the bioavailability in the toxicity test systems is equivalent to the conditions under assessment. If the bioavailability of the Active Substance or Relevant Chemical in the discharge or the receiving environment is to be assessed, consequently, the bioavailability in the toxicity testing is to be reconsidered.

3.5.5.2 Such information on bioavailability/biomagnification/bioconcentration should be provided for:

.1 Active Substances;

.2 any components of a Preparation; and

.3 Relevant Chemicals.

3.5.6 Reaction with organic matter

3.5.6.1 The reaction of radicals produced by the action of Active Substances with organic matter should be addressed qualitatively as to identify products of concern to the environment and, where possible, quantitatively as to identify environmental concentrations. In cases where this information is not available, a scientific justification should be submitted.

3.5.6.2 Radical producing chemicals are capable of forming halogenated (chlorinated, brominated) hydrocarbons that may be of concern to environment or human health, in the presence of organic matter. For these substances, the freely and otherwise reasonably available information should be presented and discussed in relation to the proposed manner of application, since they are subject to the decision making criteria.

3.5.6.3 Such information on the reaction with organic matter should be provided for:

.1 Active Substances; and

.2 Relevant Chemicals.

3.5.7 Potential physical effects on wildlife and benthic habitats

3.5.7.1 Data requirements consisting of physical/chemical properties are also required under other headings. Further guidance can be found in the MEPC-approved hazard evaluation procedure published as GESAMP Reports and Studies No.64. In cases where this information is not available, a scientific justification should be submitted.

3.5.7.2 Such data on the potential physical effects on wildlife and benthic habitats should be provided for:

.1 Preparations including any of its components;

.2 Active Substances;

.3 Relevant Chemicals; and

.4 discharged ballast water.

3.5.8 Potential residues in seafood

3.5.8.1 As appropriate, data should be submitted to assess the potential presence of residues of the Active Substance in seafood, the possible impact on consumer safety, and the level of residues that may be tolerated in seafood. Any available monitoring data on residues of the substance in seafood should be submitted.

3.5.8.2 Such data on potential residues in seafood should be provided for:

.1 Preparations including any of its components;

.2 Active Substances; and

.3 Relevant Chemicals.

3.5.9 Any known interactive effects

3.5.9.1 Any knowledge (or absence of this knowledge) on interactive effects of the substances identified with the ballast water, with other Preparations to be used in ballast water, with other physical or chemical management of the ballast water, or with the receiving environment, should be reported. In cases where this information is not available, a scientific justification should be submitted.

3.5.9.2 Such information on known interactive effects should be provided for:

.1 Preparations including any of its components;

.2 Active Substances; and

.3 Relevant Chemicals.

3.6 Physical and chemical properties for the Active Substances and preparations and treated ballast water, if applicable (G9: 4.2.1.4)

3.6.1 General

Data should be submitted for the Active Substances, Preparations including any of its components, the treated ballast water on board and the Relevant Chemicals to allow for the identification of hazards to the crew, the ship and the environment.

3.6.2 Melting point

Data on the melting point should be provided for Active Substances.

3.6.3 Boiling point

Data on the boiling point should be provided for Active Substances.

3.6.4 Flammability (flash point)

Data on the flash point should be provided for:

.1 Active Substances; and

.2 Relevant Chemicals.

3.6.5 Density (relative density)

Data on the density should be provided for:

.1 Active Substances; and

.2 discharged ballast water.

3.6.6 Vapour pressure, vapour density

Data on the vapour pressure and vapour density should be provided for:

.1 Active Substances; and

.2 Relevant Chemicals.

3.6.7 Water solubility/dissociation constant

Data on the water solubility and dissociation constant should be provided for:

.1 Active Substances; and

.2 Relevant Chemicals.

3.6.8 Oxidation/reduction potential

Data on the oxidation/reduction potentials should be provided for:

.1 Preparations including any of its components;

.2 Active Substances;

.3 Relevant Chemicals; and

.4 discharged ballast water.

3.6.9 Corrosivity and chemical influence on the materials or equipment of normal ship construction

3.6.9.1 For the dataset, at least the corrosivity and chemical influence to low carbon steel and other metals (e.g. stainless steel, Cu alloys and Ni alloys) and non-metals (e.g. gasket, coatings and seal materials) as may be found in a ship's seawater piping, fittings and structures that will be exposed to the Active Substance and Relevant Chemicals should be provided.

Data required for Basic Approval

3.6.9.2 For Basic Approval it is sufficient that the data from publicly available sources are submitted.

Data required for Final Approval

3.6.9.3 For Final Approval evaluation, the risk to the Safety of Ships should be assessed (see chapter 7.1).

3.6.10 Auto-ignition temperature

Data on the auto-ignition temperature should be provided for:

.1 Active Substances; and

.2 Relevant Chemicals.

3.6.11 Explosive properties

Data on the explosive properties should be provided for:

.1 Active Substance; and

.2 Relevant Chemicals.

3.6.12 Oxidizing properties

Data on the oxidizing properties should be provided for:

.1 Active Substances; and

.2 Relevant Chemicals.

3.6.13 Surface tension

Data on the surface tension should be provided for:

.1 Active Substances; and

.2 Relevant Chemicals.

3.6.14 Viscosity

Data on the viscosity should be provided for:

.1 Active Substances; and

.2 Relevant Chemicals.

3.6.15 Thermal stability and identity of relevant breakdown products

Data on thermal stability and identity of relevant breakdown products should be provided for Active Substances.

3.6.16 Reactivity towards materials

Data on the reactivity towards materials, e.g. piping, gaskets and containers, should be provided for:

.1 Preparations

.2 Active Substances; and

.3 Relevant Chemicals.

3.6.17 pH

Since the pH of test waters can influence the formation of disinfection by-products, all chemical analysis results relating to the investigation of by-product formation should be accompanied by a specification of the pH. Data on the pH should be provided for uptake water and discharged water.

3.6.18 Salinity

Since the salinity of test waters can influence the formation of disinfection by products, all chemical analysis results relating to the investigation of by-product formation should be accompanied by a specification of the salinity. If water of different sources was mixed or any additives were added to natural test water to achieve the given salinity, this should be specified. Data on the salinity should be provided for uptake water and discharged water.

3.6.19 TOC, DOC, percentage of particulate matter

Since the organic carbon and particulate matter content of test waters can influence the formation of disinfection by-products, all chemical analysis results relating to the investigation of by-product formation should be accompanied by a specification of TOC, DOC, and total suspended solids (TSS). If any additives were added to natural test water at Basic Approval or Final Approval to achieve the given concentrations, these should be specified. Data on the TOC, DOC and percentage of particulate matter should be provided for uptake water and discharged water.

3.6.20 Other known relevant physical or chemical hazards

Data on the any other known relevant physical or chemical hazards should be provided for:

.1 Active Substances;

.2 Relevant Chemicals; and

.3 discharged ballast water.

3.7 Analytical methods at environmentally relevant concentrations (G9: 4.2.1.5)

3.7.1 Recognizing that some methods may only cover a range of chemicals, e.g. TRO, analytical methods at environmentally relevant concentrations should be provided for:

.1 Active Substance; and

.2 Relevant Chemicals.

3.7.2 If the BWMS needs any monitoring system for Active Substance, the analytical methods and product name of the monitoring equipment should be provided.

4 USE OF THE ACTIVE SUBSTANCE OR THE PREPARATION

4.1 The manner of application

4.1.1 The proposal for Basic Approval and Final Approval should include the intended minimum and maximum dosage and maximum allowable discharge concentrations of Active Substances, if applicable.

4.1.2 The proposal should also include the manner of application of the Active Substance or the Preparation by the BWMS to ensure the dosage and concentrations mentioned in paragraph 4.1.1 above.

4.1.3 In relation to section 7 of Procedure (G9), the dossier should contain the necessary data addressing the following items:

.1 the technical manual or instructions by the Administration, including the product specification, process description, operational instructions, details of the major components and materials used, technical installation specifications, system limitations, and routine maintenance should be provided. The technical manual should also clearly specify the dosage to be added to ballast water and the maximum discharge concentration of the Active Substance therein;

.2 recommended methods and precautions concerning handling, use, storage, and transport;

.3 procedures to be followed in case of fire, and the nature of reaction products, combustion gases, etc.;

.4 emergency measures in case of an accident;

.5 an indication of the possibility of destruction or decontamination following emergency release in the marine environment;

.6 procedures for the management of wastes that may be generated during the operation of the BWMS;

.7 the manner or procedure of reuse or recycling of Active Substances or Preparations, if applicable;

.8 the possibility of neutralization;

.9 conditions for controlled discharge;

.10 minimum retention time of treated water on board before discharge;

.11 the amount of substance on board ship; and

.12 if an Active Substance is used that is convertible to TRO, the dose should be expressed as mg/L as Cl_2.

4.1.4 Appropriate risk management measures (e.g. for neutralization of the Active Substance in case of emergency or if PEC/PNEC at discharge > 1) should be described. These management measures are an integral part of the ballast water management system and should be evaluated in the assessment.

4.1.5 The risk management measures proposed should be evaluated in respect to the hazards to ship, personnel and the environment.

5 RISK CHARACTERIZATION – HUMAN HEALTH

5.1 In risk characterization for human health, the procedure is to compare the exposure levels to which the target groups are exposed or likely to be exposed with those levels at which no toxic effects from the chemicals are expected to occur.

5.2 A quantitative risk assessment is an iterative process and normally includes four steps:

.1 **Hazard identification** – what are the substances of concern and what are their effects?

.2 **Dose (concentration)** – response (effect) relation – what is the relationship between the dose and the severity or the frequency of the effect?

.3 **Exposure assessment** – what is the intensity, and the duration or frequency of exposure to an agent?

.4 **Risk characterization** – how to quantify the risk from the above data?

5.3 In assessing an acceptable level of a particular substance, the procedure usually follows moving from animal experiments or preferably human data (e.g. epidemiological studies) giving a No Observed Adverse Effect Level (NOAEL) or a Lowest Observed Adverse Effect Level (LOAEL) to derive an exposure limit above, which humans should not be exposed to (Derived No Effect Level - DNELs). Taking into account the critical health effect that can be exerted by a threshold mode of action, the lowest DNEL for each exposure route should be established by dividing the value of the critical dose descriptor, e.g. N(L)OAEL, by an assessment factor (AF) to allow for extrapolation from experimental data to real human exposure situations. Comparison of this exposure limit with a measured or estimated exposure level is then used to judge whether the situation is satisfactory or whether risk management measures are required.

5.4 Based on the most suitable N(L)OAEL, a DNEL for further risk assessment is derived. Generally, the DNEL is determined by applying an Assessment Factor (AF) according to the formula:

DNEL = N(L)OAEL/AF

5.5 Two groups of potentially exposed persons are distinguished as follows:

.1 workers (crew and port State control officers); and

.2 general public.

5.6 Particularly in case of occupational exposure, it is of primary importance to fully understand the processes and unit operations in which exposure occurs, and the actual activities resulting in exposure (potentially exposed individuals, frequency and duration of the routes of concern, what personal protective equipment and control measures are used to reduce or mitigate exposure, and how effective they are).

5.7 Where data are of an unsatisfactory quality, it is useful to conduct an assessment using "worst-case" assumptions. If this indicates a risk of no concern, the assessment needs no further refinement.

5.8 Exposure should always be assessed in the first instance for the unprotected worker and, if appropriate, a second assessment, should be made taking personal protective equipment (PPE) into account.

5.9 In the risk characterization, these estimates are combined with the results of the effects assessment and conclusions are drawn whether or not there is a concern for any scenarios assessed (Risk Characterization Ratio (RCR) = Exposure/DNEL).

5.10 When a risk assessment results in the conclusion that there is an unacceptable risk (RCR > 1), a second tier assessment should be performed by considering specific risk control measures in order to lower this risk to acceptable levels (protective clothing, respirators and self-contained breathing apparatus, crew training, good operational practices, etc.).

5.11 The effect assessment of the Active Substances, Preparations and Relevant Chemicals should include a screening on carcinogenic, mutagenic and endocrine disruptive properties, taking into account available information. There is no requirement for additional testing. If the screening results give rise to concerns, this should give rise to a further assessment.

5.12 As a general rule, exposure in the workplace must be avoided or minimized as far as technically feasible. In addition, a risk for the general public from secondary exposure to a non-threshold carcinogenic substance is also unacceptable.

5.13 Carcinogens can have a threshold or non-threshold mode of action. When it comes to threshold carcinogens, these can be assessed by using a Derived No-Effect Level (DNEL) approach, however in the case of the non-threshold carcinogens a different approach to risk assessment is recommended. In these cases, a Derived Minimal Effect Level (DMEL) should be determined.

5.14 Cancer risk levels between 10^{-4} to 10^{-6} are normally seen as indicative tolerable risk levels when setting DMELs. Where these values are available from internationally recognized bodies, they can be used to set DMELs for risk assessment purposes.

5.15 The assessment of the carcinogenicity, mutagenicity and reproductive toxicity properties of the Active Substance and the Relevant Chemicals takes place as part of the PBT assessment (see 6.1 of this Methodology).

5.16 The procedure followed is described in more detail in appendix 4.

6 RISK CHARACTERIZATION – ENVIRONMENT

The environmental risk assessment approach is set up according to the following principles:

.1 **Hazard identification** – what are the substances of concern and what are their effects?

.2 **Dose (concentration)** – response (effect) relation – what is the relationship between the dose and the severity or the frequency of the effect?

.3 **Exposure assessment** – what is the intensity, and the duration or frequency of exposure to an agent?

.4 **Risk characterization** – how to quantify the risk from the above data?

6.1 Screening for persistence, bioaccumulation and toxicity (G9: 5.1)

6.1.1 Persistence (G9: 5.1.1.1)

6.1.1.1 Persistence is preferably assessed in simulation test systems to determine the half-life under relevant conditions. Biodegradation screening tests may be used to show that the substances are readily biodegradable. The determination of the half-life should include assessment of Relevant Chemicals.

6.1.1.2 For persistence and degradation data, see sections 3.5.2 and 3.5.4 of this Methodology.

6.1.2 Bioaccumulation (G9: 5.1.1.2)

6.1.2.1 The assessment of the bioaccumulation potential should use measured bioconcentration factors in marine (or freshwater organisms). Where test results are not available, the assessment of the bioaccumulation potential of an organic substance may be based on the log P_{ow}.

6.1.2.2 For bioaccumulation data, see sections 3.3.6 and 3.5.3 of this Methodology.

6.1.3 Toxicity tests (G9: 5.1.2.3)

6.1.3.1 Acute and/or chronic ecotoxicity data, ideally covering the sensitive life stages, should be used for the assessment of the toxicity criterion.

6.1.3.2 For ecotoxicity data, see section 3.3 of this Methodology.

6.1.3.3 It is necessary to consider, whether an effect assessment based on tests in freshwater species offers sufficient certainty that sensitive marine species will be covered by any risk assessment.

6.1.4 Does the Active Substance and/or Preparation meet all three criteria for PBT?

Table 1: Criteria for identification of PBT Substances

Criterion	**PBT criteria**
Persistence	Half-life: > 60 days in marine water, or > 40 days in fresh water,* or > 180 days in marine sediments, or > 120 days in freshwater sediments
Bioaccumulation	Experimentally determined BCF > 2,000, or if no experimental BCF has been determined, Log P_{ow} ≥ 3
Toxicity (environment) Toxicity (human health, CMR)	Chronic NOEC < 0.01 mg/L carcinogenic (category 1A or 1B), mutagenic (category 1A or 1B) or toxic for reproduction (category 1A, 1B or 2) According to GHS classification.

* For the purpose of marine environmental risk assessment, half-life data in fresh water and freshwater sediment can be overruled by data obtained under marine conditions.

See also table 1 in Procedure (G9).

6.1.4.1 Active Substances, Relevant Chemicals or Preparations identified as PBT substances will not be recommended for approval in accordance with paragraph 6.4.1 of Procedure (G9).

6.1.4.2 The CMR assessment is based on new regulations in several jurisdictions as part of the PBT assessment. This is a new development in the risk assessment methods as applied by jurisdictions to register pesticides, biocides and industrial chemicals. Therefore, it is considered appropriate that including CMR into the methodology of the evaluation of BWMS is necessary to be in line with these jurisdictions.

6.1.4.3 Based on the appropriate toxicological studies on carcinogenicity, mutagenicity and reproductive toxicity, the Relevant Chemicals should be scored on these three items, using 1 (one) if the substance showed the hazard under consideration and 0 (zero) if the substance did not show the hazard under consideration.

6.1.4.4 For any Relevant Chemical showing at least one of the hazards, carcinogenicity, mutagenicity or reproductive toxicity, exposure should be avoided or relevant risk mitigation measures should be proposed to minimize exposure to an acceptable level using appropriate extrapolation methods.

6.2 Evaluation of the discharged ballast water (G9: 5.2)

6.2.1 General

6.2.1.1 The advantage of toxicity testing on the ballast water discharge is that it integrates and addresses the potential aquatic toxicity of the Active Substance, Preparation including any of its components and Relevant Chemicals formed during and after application of the BWMS.

6.2.1.2 For ecotoxicity data, see sections 3.3.2 and 3.3.3 of this Methodology.

6.2.1.3 The validity criteria should be clearly established during planning and the results of the validation should be stated in the report.

6.2.1.4 For the acute and chronic test using algae, the following three criteria should be taken into account:

.1 The biomass should increase exponentially by a factor of at least 16 within the 72-hour test period. This corresponds to a specific growth rate of 0.92 d^{-1}.

.2 The mean coefficient of variation for section-by-section specific growth rates (days 0-1, 1-2 and 2-3, for 72-hour tests) must not exceed 35% (OECD 201).

.3 The coefficient of variation of average specific growth rates in the replicates during the whole test period must not exceed 7% (ISO10253) or 10% (OECD 201).

6.2.2 Basic Approval

6.2.2.1 Testing should be performed in the laboratory using a sample prepared by simulation of the BWMS (G9: 5.2.1).

6.2.2.2 It is required that the residual toxicity of treated ballast water is assessed in marine, brackish and fresh water to provide certainty as to acceptability when the treated water is discharged because discharge of ballast water may occur in all three salinities and, therefore, risk assessment in three salinities is needed. Any limitations as to environmental acceptability should be clearly indicated in the submission.

6.2.3 Final Approval

6.2.3.1 Toxicity tests (Whole Effluent Toxicity test) with samples of ballast water treated with the BWMS from the land-based test set-up should be conducted (G9: 5.2.1.2, 5.2.2 and 5.2.3).

6.2.3.2 From a pragmatic standpoint, the following information would provide adequate safeguards for the environment and may replace the requirement of the submission of chronic toxicity data on the full-scale WET tests:

.1 acute toxicity testing using algae (or plants), invertebrates and fish; or

.2 chemical analysis demonstrating that there are no significant increases in the concentrations of chemical by-products during at least a five-day tank holding time or a holding time in accordance with the sampling scheme under the Guidelines (G8); or

.3 both chemical analysis and acute aquatic toxicity testing; immediately after treatment and after 24 or 48 hours.

6.2.3.3 Recently gained experience on the data availability of a full chemical analysis of the treated and/or neutralized ballast water in combination with the acute toxicity testing of the WET test would reveal, based on expert judgment, that unacceptable effects on the receiving aquatic environment are not to be expected. In this way, expensive chronic ecotoxicity testing may be avoided with sufficient safety on the potential effects on aquatic organisms.

6.2.4 Comparison of effect assessment with discharge toxicity

The results of the effect assessment of the substances that are likely to be present in the treated ballast water at discharge are compared to the results of the toxicity testing of the treated ballast water. Any unpredicted results (e.g. lack of toxicity or unexpected toxicity in the treated ballast water at discharge) should give rise to a further elaboration on the effect assessment (G9: 5.3.14).

6.2.5 Determination of holding time

6.2.5.1 The test data should be used to determine the no adverse-effect concentration upon discharge, i.e. the necessary dilution of the treated ballast water. The half-life, decay and dosage rates, system parameters and toxicity should be used to determine the amount of time needed to hold the treated ballast water before discharge (G9: 5.2.7). An indication of the uncertainty of the holding time should be given, taking into account different variables (e.g. temperature, pH, salinity and sediment loading).

6.3 Risk characterization and analysis

6.3.1 Prediction of discharge and environmental concentrations

6.3.1.1 Based on measured data of the Active Substances, Preparations including any of its components, and Relevant Chemicals, the worst-case concentration at discharge should be established.

6.3.1.2 Environmental concentrations after discharge of treated ballast water under controlled conditions during development and type approval tests should be estimated and provided in the application dossier for Basic Approval.

6.3.1.3 Environmental concentrations, under suitable emission scenarios developed describing typical full-scale use and discharge situations, should also be estimated for treated ballast water, Active Substances, Relevant Chemicals and other components of Preparations, as appropriate.

6.3.1.4 MAMPEC-BW, latest available version, should be used to calculate PEC values with its standard settings. All information about MAMPEC-BW can be found through the information given in appendix 5.

6.3.1.5 The MAMPEC-BW, latest available version, will calculate the stationary concentration in the harbour after discharge of ballast water. To account for local effects, near the ship at discharge, the local concentration at near ship is estimated using the formulae suggested in Zipperle et al., 2011 (Zipperle, A., Gils J. van, Heise S., Hattum B. van, Guidance for a harmonized Emission Scenario Document (ESD) on Ballast Water discharge, 2011):

$$C_{\max} = \frac{C_{BW} + (S-1) \cdot C_{mean}}{S}$$

where:

C_{max}	=	the maximum concentration due to near ship exposure (µg/L)
C_{BW}	=	the concentration found in the discharged ballast water (µg/L)
S	=	dilution factor based on sensitivity analysis with a higher tier model, default value = 5
C_{mean}	=	the mean concentration as output from MAMPEC-BW

6.3.1.6 The concentration calculated with this formula will be compared to acute toxicity data for the Active Substances and Relevant Chemicals to evaluate the short-term effects on aquatic organisms.

6.3.1.7 It is further recommended that the effect of cold and/or fresh water to the natural degradation process of the Active Substances and Relevant Chemicals is considered.

6.3.1.8 It is not necessary to undertake further assessment of temperature effects on the degradation rate of Active Substances and Relevant Chemicals if the PEC/PNEC ratio is found to be acceptable assuming no degradation.

6.3.1.9 If the PEC/PNEC ratio is not found to be acceptable assuming no degradation, further analysis is required. In the literature, the degradation rate of the Active Substance and Relevant Chemicals is typically determined at 20°C. Because the degradation rate is slower in cold environments, the risk should be assessed at temperatures of 1°C.

6.3.1.10 Extrapolation of the temperature effect for a difference less than or equal to 10°C is generally scientifically accepted when assessed by application of the Arrhenius equation according to the Q10 approach. Extrapolation of the temperature effect for a difference greater than 10°C should also be undertaken as a best estimate using the Arrhenius equation.

6.3.2 Effects assessment

6.3.2.1 The effect assessment of the Active Substances, Preparations including any of its components, and Relevant Chemicals is initially based on a data-set of acute and/or chronic ecotoxicity data for aquatic organisms, being primary producers (e.g. algae), consumers (e.g. crustacea), and predators (e.g. fish) (G9: 5.3.9).

6.3.2.2 An effect assessment could also be prepared on secondary poisoning to mammalian and avian top-predators where relevant. Only toxicity studies reporting on dietary and oral exposure are relevant, as the pathway for secondary poisoning refers exclusively to the uptake of chemicals through the food chain. It might be necessary to extrapolate threshold levels for marine species from terrestrial species assuming there are interspecies correlations between laboratory bird species and marine predatory bird species and between laboratory mammals (e.g. rats) and the considerably larger marine predatory mammals. An assessment of secondary poisoning is redundant if the substance of concern demonstrates a lack of bioaccumulation potential (e.g. BCF < 500 L/kg wet weight for the whole organism at 5% fat) (G9: 5.3.10).

6.3.2.3 An assessment of effects to sediment species should be conducted unless the potential of the substance of concern to partition into the sediment is low (e.g. K_{oc} < 500 L/kg) (G9: 5.3.11).

6.3.2.4 The effect assessment of the Active Substances, Preparations and Relevant Chemicals, taking the indicated information into account, should be based on internationally recognized guidance (e.g. OECD) (G9: 5.3.13).

6.3.3 Effects on aquatic organisms

6.3.3.1 For assessment of effects to the aquatic environment, appropriate Predicted No-Effect Concentrations (PNEC) should be derived. A PNEC is typically derived at a level that, when not exceeded, protects the aquatic ecosystem against toxic effects of long-term exposures. However, for situations where only short-term exposures are expected, an additional PNEC for short-term (or near ship) exposure may be useful. PNEC values are

normally derived from acute and/or chronic aquatic toxicity results for relevant aquatic species by dividing the lowest available effect concentration with an appropriate assessment factor. For the aquatic effect assessment, the assessment factors, given in table 2, should provide guidance although these may be altered on a case-by-case basis based on expert judgment. In cases where a comprehensive data-set is available, the PNEC may be derived with a mathematical model of the sensitivity distribution among species.

Table 2: Assignment of Assessment Factors (AF) used for deriving PNEC values

Data-set	Assessment Factor		Rule number
	PNEC general	PNEC near ship	
Lowest* short-term L(E)C_{50} from freshwater or marine species representing one or two trophic levels	10,000	1,000	1
Lowest* short-term L(E)C_{50} from three freshwater or marine species representing three trophic levels	1,000	100	2
Lowest* short-term L(E)C_{50} from three freshwater or marine species representing three trophic levels + at least two short-term L(E)C_{50} from additional marine taxonomic groups	100	10	3
Lowest* chronic NOEC from one freshwater or marine species representing one trophic level, but not including micro-algae	100		4
Lowest* chronic NOEC from two freshwater or marine species representing two trophic levels, which may include micro-algae	50		5
Lowest* chronic NOEC from three freshwater or marine species representing three trophic levels, which may include micro-algae	10		6

Notes: *.1 If the lowest value is not used, based on expert judgement, a scientific rationale should be submitted.

.2 AF assigned to chronic data may be lowered if sufficient (for instance three different trophic levels) acute values are available.

.3 See section 3.3.3 of this Methodology for information on suitable chronic testing.

.4 For the determination of the assessment factor for the NOEC values in table 2 micro-algae have been excluded because of the short duration of the chronic test for algae (4 days) and, therefore, it is not considered by some jurisdictions as a real chronic test.

.5 The rule numbers refer to the GESAMP-BWWG Database containing the 43 substances as indicated in appendix 6 to this Methodology and indicates the relevant Assessment Factors as used for these 43 substances.

6.3.3.2 In some cases, the $PNEC_{near\ ship}$ may be substantially lower than the $PNEC_{harbour}$ due to insufficient availability of acute ecotoxicity data. In such cases, the $PNEC_{near\ ship}$ should be set equal to the $PNEC_{harbour}$. This would still be considered a worst-case PNEC.

6.3.3.3 PNEC values should be derived for any substances that may be found in treated ballast water in concentrations that may be of concern for the aquatic environment. The relevance of deriving PNEC values for Active Substances, any other components of Preparations and/or Relevant Chemicals should thus be considered.

6.3.3.4 Currently there is no compelling physiological or empirical proof that marine organisms are more sensitive than freshwater organisms or vice versa and therefore, an additional assessment factor is not applied. Should this, however, be demonstrated for the substance under consideration, an additional assessment factor should be taken into account.

6.3.3.5 Where data are available for additional marine taxa, for example, rotifers, echinoderms or molluscs, the uncertainties in the extrapolation are reduced and the magnitude of the assessment factor applied to a data-set can be lowered.

6.3.3.6 Because sediment constitutes an important compartment of ecosystems, it may be important to perform an effects assessment for the sediment compartment for those substances that are likely to transfer substantially into the sediment.

6.3.4 Comparison of effect assessment with discharge toxicity

The results of the effect assessment of the substances that are likely to be present in the treated ballast water at discharge are compared to the results of the toxicity testing of the treated ballast water. Any unpredicted results (e.g. lack of toxicity or unexpected toxicity in the treated ballast water at discharge) should give rise to a further elaboration on the effect assessment (G9: 5.3.14).

7 RISK ASSESSMENT

7.1 Risk to safety of ship

7.1.1 The potential risk to the safety of the ship and crew raised by the operation of the BWMS should be assessed, taking into account the identified risk mitigation measures to be applied and any relevant legislative requirements such as provided in SOLAS and MARPOL. Potential risks to the ship/crew may include, inter alia:

.1 increased corrosion;

.2 fire and explosion;

.3 storage and handling of the substances;

.4 contact with, or inhalation of, process products; and

.5 noise.

7.1.2 The BWMS that make use of an Active Substance (such as hypochlorite electrolysis, chlorine dioxide, sodium hypochlorite, peroxyacetic acid or ozone) may have a direct effect on organic material like epoxy tank coatings. Depending on the dose and degradation rate of Active Substance there could be an impact on the coating system. Particularly, for a BWMS with a TRO dose ≥ 10 mg/L, expressed as TRO as Cl_2 mg/L, compatibility is validated against a coated surface by test described in paragraph 7.1.3.

7.1.3 Testing should be conducted with two series of test panels and the coating shall be applied in accordance with table 1 of the *Performance standard for protective coatings for dedicated seawater ballast tanks in all types of ships and double-side skin spaces of bulk carriers* (PSPC) (resolution MSC.215(82)). Each test should be carried out in duplicate. One set of panels should be exposed to untreated ballast water and the other to treated ballast water. Other test conditions are described in the table below.

Parameters	Quantification	Reference[1]/Remark
The size of each test panel	200 mm x 400 mm x 3 mm	NACE standard TM0112-2012
Depth of immerse	250 ± 10 mm	NACE standard TM0112-2012
Water temperature in tanks for exposure	> 35 ± 2 °C	NACE standard TM0112-2012
The total test duration	More than 6 months	NACE standard TM0112-2012
Ballast water	Natural seawater (> 32 PSU)	Preferred by GESAMP/BWWG but artificial seawater is accepted
Active Substance Dose	At maximum dose, which is evaluated by the Group at Basic Approval	Modified from NACE standard TM0112-2012
Renewal frequency	Every 7 days	Modified from NACE standard TM0112-2012

1 NACE International has as a point of policy that when one of its standards are made mandatory by a major International governing body then that standard will be available at no cost to the general public by placement on its website outside the firewall. This would apply to NACE standard TM0112-2012 for Ballast Tank Coating evaluation.

7.1.4 Testing of corrosion should take place in the laboratory, but it is recommended to make use of the full-scale BWMS which is to be used for efficacy testing in accordance with Guidelines (G8), for the preparation of treated ballast water for this purpose. However, if it is impractical to maintain the renewal frequency described in the table, ballast water may be prepared by a separate treatment using an identical BWMS.

7.1.5 After the exposure duration, adhesion, blistering, cracking, delamination and corrosion around a scribe should be determined, scored and reported.

Acceptance criteria

7.1.6 In order to determine whether the BWMS has influenced the coating's properties as evaluated according to ISO 4624 and 4628, the principles and acceptance criteria mentioned in 7.1.7 should be employed. Paint coatings evaluation should be made as direct comparisons between samples subject to treated and untreated ballast water, respectively. Only the difference should be used for the final assessment. Paint coatings for BWMS compliance testing will normally be PSPC approved, and the present evaluation should not be a re-evaluation of approved products. "Pass/Fail" is judged by comparison with the "untreated" sample, i.e. the sample that has been exposed to untreated ballast water in parallel with the ballast water management system.

7.1.7 For the BWMS to be found suitable for Final Approval, it should not fail in any test evaluation as specified below:

.1 ISO 4624: Adhesion: "Fail" if adhesion at treated panel is below 5 MPa and treated panel shows more than 20% reduction compared to untreated panel;

.2 ISO 4628-2: Blistering: "Fail" if blisters occur;

.3 ISO 4628-4: Cracking: "Fail" if the density and/or size and/or depth in crease with three or more units from the one exposed by the untreated ballast water; and

.4 ISO 4628-8: Delamination and corrosion around a scribe: "Fail" if the difference between treated and untreated is greater than 3 mm.

7.1.8 It is recommended that these Pass/Fail criteria be reviewed no later than one year after the implementation of this new chapter to the Methodology (BWM.2/Circ.13/Rev.2).

7.2 Risks to human health

7.2.1 General

7.2.1.1 The human health risk assessment should follow generally accepted guidelines including acute/short-term and long-term exposure situations. The risk assessment should entail hazard identification and, as appropriate, dose (concentration) – response (effect) assessment, exposure assessment and risk characterization as indicated in section 5.2 of this Methodology. The population groups deemed to be at risk and so to be examined should include crew, passengers and all personnel, including the public, in ports. Potential health risks connected to the exposure of consumers via seafood or persons at the coast (e.g. beach) after discharge should be evaluated. Special attention should be given to service and repair of the system by technicians and accidental situations on board (e.g. specific personal protection equipment). The evaluation of the risks to human health should include risk reduction (risk management) by specific measures proposed by the manufacturer and of the ballast water management system.

7.2.2 Health effects in humans

The effect assessment of the Active Substances, Preparations and Relevant Chemicals should include a screening on carcinogenic, mutagenic and reproductive toxic properties. If the screening results give rise to concerns, this should give rise to a further effect assessment (G9: 5.3.12) (see also section 6.1.4 of this Methodology).

7.2.3 Human Exposure Scenario

7.2.3.1 A Human Exposure Scenario (HES) should be provided by the applicant as part of the risk assessment procedure for ballast water management systems, using the guidance contained in appendix 4 of this Methodology (G9: 6.3.3).

7.2.3.2 The risk assessment should include a description of the ballast water treatment process associated with the system as a set of unit operations, i.e. in doing so, identifying clearly which individual system components of a BWMS are likely to lead to human exposure to Active Substances, Relevant Substances and by-products. For each system component, including connecting piping, a description of such exposures needs to be provided, e.g. chemical storage, chemical application, processing of treated ballast water, ballast tank operations, including associated piping, as well as discharge operations and maintenance. The risk assessment should also include the risk reduction measures envisaged for all of the above-defined unit operations, i.e. stating clear Personal Protective Equipment (PPE) requirements for each step in the process.

7.2.3.3 Equipment failure and accident situations should be considered separately from conditions of normal operation.

7.2.3.4 In cases where an exposure/DNEL or exposure/DMEL ratio is not less than 1, then, to demonstrate that there is no unacceptable risk, the applicant should provide scientific justification, which may include potential risk mitigation measures.

7.3 Risks to the aquatic environment

7.3.1 The potential risks to the aquatic environment should be assessed for both Basic and Final Approval.

7.3.2 When no aquatic toxicity of the treated ballast water at discharge is found either through direct testing of the treated ballast water or if the estimated ratios between predicted concentrations of the Active Substance, components of Preparations or Relevant Chemicals, described in 6.3.3 and the respective PEC/PNEC ratios are less than 1, no further assessment of direct toxic effects to the aquatic environment is necessary.

7.3.3 In cases where a PEC/PNEC ratio is not less than 1, then, to demonstrate that there is no unacceptable risk, the applicant should provide scientific justification, which may include potential risk mitigation measures.

8 ASSESSMENT REPORT (G9: 4.3)

The Assessment Report referred to in section 4.3 of Procedure (G9) should be presented by the concerned Administration and should at least provide:

.1 an overview of the data and endpoints on which the risk characterization according to section 6 of Procedure (G9) is based, including a description of the quality of test reports;

.2 an assessment of risks to the safety of ships, human health (crew and the general public), the environment and resources in accordance with section 6 of Procedure (G9);

.3 if any monitoring has been conducted, a summary of the results of that monitoring, including information on the analytical methodology used, ship movements and a general description of the area monitored;

.4 a summary of the available data on environmental exposure and any estimates of environmental concentrations developed through the application of mathematical models, using all available environmental fate parameters, preferably those that were determined experimentally, along with an identification or description of the modeling methodology;

.5 an evaluation of the association between the ballast water management system making use of Active Substances or Preparations containing one or more Active Substances to comply with the Convention in question, the related adverse effects and the environmental concentrations, either observed or expected, based on the risk assessment and the effluent testing;

.6 a qualitative statement of the level of uncertainty in the evaluation referred to under the preceding paragraph; and

.7 a detailed description of risk management possibilities, e.g. for neutralization of the Active Substance in case of emergency or if PEC/PNEC at discharge > 1. These management measures are an integral part of the ballast water management system.

9 MODIFICATION TO THE APPLICATION

9.1 Manufacturers should report any modifications in names, including trade and technical name, composition or use of the Active Substances and Preparations in the ballast water management systems approved by the Organization, to the Member of the Organization. The Member of the Organization should inform the Organization accordingly (G9: 8.4.1).

9.2 Manufacturers intending to significantly change any part of a ballast water management system that has been approved by the Organization or the Active Substances and Preparations used in it should submit a new application (G9: 8.4.2).

10 FINAL APPROVAL

10.1 In accordance with paragraph 5.2.1 of Procedure (G9) for Final Approval, the discharge testing should be performed as part of the land-based type approval process using the treated ballast water discharge.

10.2 In order to obtain Final Approval in accordance with section 8.2 of Procedure (G9), the following criteria have to be met:

.1 Basic Approval has to be granted first;

.2 the Member of the Organization submitting an application should conduct the Type Approval tests in accordance with the Guidelines for approval of ballast water management systems (G8). The results should be conveyed to the Organization for confirmation that the residual toxicity of the discharge conforms to the evaluation undertaken for Basic Approval. This would result in Final Approval of the ballast water management system in accordance with regulation D-3.2. Active Substances or Preparations that have received Basic Approval by the Organization may be used for evaluation of ballast water management systems using Active Substances or Preparations for Final Approval (G9: 8.2.1) in accordance with the provisions of the framework "For determining when a Basic Approval granted to one BWMS may be applied to another system that uses the same Active Substance or Preparation";

.3 it is to be noted that from the Guidelines (G8), paragraph 2.3, on land-based testing, only the results of the residual toxicity tests should be included in the proposal for Final Approval in accordance with Procedure (G9). All other Guidelines (G8) testing remains for the assessment and attention of the Administration. Although Basic Approval under Procedure (G9) should not be a pre-requisite for Type Approval testing, as an Administration can regulate discharges from its own ships in its own jurisdiction, Basic Approval should still be required when the technology is used on ships trading in other States' jurisdiction (G9: 8.2.2);

.4 it should be noted that once a system has received Final Approval under Procedure (G9), the respective applicant should not have to retrospectively submit new data if there is a change in the Methodology agreed by the Organization (G9: 8.2.3);

.5 toxicity testing should be done on two types of water at two appropriate time intervals after treatment (preferably immediately after treatment and

after a 24- or 48-hour interval), and organisms normally found in the selected types of water should be used in the toxicity testing. Dependent upon recommendations made at Basic Approval, in many cases only acute toxicity testing will be needed for Final Approval;

.6 all information related to Total Residual Oxidants (TROs), Total Residual Chlorine (TRC) and the chemicals included in such groupings, including their concentrations, should be provided to the GESAMP-BWWG for Final Approval when requested as part of its evaluation for Basic Approval;

.7 in addition to the basic data-set needed for the treated ballast water and the individual chemicals produced by the system – as identified in the Methodology for Basic Approval – a generated meaningful PEC/PNEC ratio would be required for Final Approval; and

.8 the application for Final Approval should address the concerns identified during the consideration for Basic Approval.

APPENDIX 1

LETTER OF AGREEMENT

relating to a ballast water management system that makes use of Active Substances proposed for approval in accordance with regulation D-3, paragraph 2, of the Ballast Water Management Convention

Having received a satisfactory application on **[please insert the name of the ballast water management system]** produced by **[please insert the name of the manufacturer]**, the undersigned hereby confirms, on behalf of the maritime Administration of **[please insert the name of the submitting country]**, that the application dossier regarding the ballast water management system that makes use of Active Substance(s) mentioned above is subject to the following conditions:

1. **Financial arrangements:** The fee paid in connection with this proposal for approval is based on the recovery of costs incurred by the International Maritime Organization (Organization) in respect of the services provided by the GESAMP-Ballast Water Working Group. Fees will be invoiced in up to three tranches:

   - US$50,000 immediately following receipt of this Letter of Agreement by the Organization;

   - an additional US$50,000 immediately following the deadline for submissions, if only one submission has been made; and/or

   - a final invoice to recover costs over the initial cost estimate, if required.

   All fees paid as described above will be retained in a Trust Fund established for this purpose.

2. **Intellectual Property Rights:** The Organization and the members of the GESAMP-Ballast Water Working Group will make every reasonable effort to prevent the disclosure of information which is clearly and prominently identified as being subject to an intellectual property right, subject to the condition that sufficient detail must be provided to the Marine Environment Protection Committee (MEPC) of the Organization to enable that body to perform its functions under resolution MEPC.169(57) and, in particular, to approve the proposed ballast water management systems that make use of Active Substances. In this respect the members of the Group will be required to sign a declaration concerning the confidentiality of information acquired as a result of their affiliation with the Group. In any case, neither the Organization nor the members of the GESAMP-Ballast Water Working Group can accept liability for damage or loss, which may result from disclosure of such information in the exercise of their responsibilities.

3. **Settlement of disputes:** The submitting Administration, the Organization, and the GESAMP-Ballast Water Working Group shall use their best efforts to settle amicably any dispute, controversy or claim arising out of, or relating to the process established for reviewing Active Substances used for the management of ballast water or this Letter of Agreement, or the

breach, termination or invalidity thereof. Where these parties wish to seek such an amicable settlement through conciliation, the conciliation shall take place in accordance with the UNCITRAL Conciliation Rules then pertaining, or according to such other procedure as may be agreed between the parties. Any dispute, controversy or claim, which is not settled amicably, shall be referred to arbitration in accordance with the UNCITRAL Arbitration Rules then pertaining. The place of the arbitration will be London, England.

4. **Privileges and immunities:** Nothing in or relating to the process established for reviewing Active Substances used for the management of ballast water or this Letter of Agreement shall be deemed a waiver, express or implied, of any of the privileges and immunities of the International Maritime Organization, including its officers, experts or subsidiary organizations or of the privileges and immunities to which the Administration is entitled under international law.

   Members of the GESAMP-Ballast Water Working Group, when performing functions in connection with the terms of reference of the Group, shall be considered to be experts of the Organization pursuant to Annex XII of the Convention on Privileges and Immunities of the Specialized Agencies of the United Nations.

Authorized signature on behalf of the maritime Administration:

_____

Typed/Printed name: _____

Title/Position/Organization/Country: _____

Date of signature: _____

Name and address for fees invoicing: _____

_____

_____

APPENDIX 2

TIMETABLE FOR ACTIVITIES RELATED TO THE GESAMP-BWWG MEETINGS

Timeline	Activity
28 weeks before MEPC	Deadline for submission of application dossiers and related documents to be reviewed by the GESAMP-BWWG
(8 weeks)	Preparation of the meeting, including circulation of any relevant information provided by other delegations
20 weeks before MEPC	GESAMP-BWWG meeting
(1 week)	Editing and completion of the draft report of the meeting
(3 weeks)	Review and approval of the report by the GESAMP including response/clarification by the working group
(1 week)	Administrations confirm that no confidential data are contained in the report
(1 week)	Produce the final report addressing the comments by the GESAMP
13 weeks before MEPC	Submission of the report of the meeting of the GESAMP-BWWG in accordance with the 13-week deadline (bulk documents) for MEPC

APPENDIX 3

MODEL DOCUMENT FOR THE ANNEX ON NON-CONFIDENTIAL DOSSIER OF AN APPLICATION FOR BASIC APPROVAL AND/OR FINAL APPROVAL OF A BALLAST WATER MANAGEMENT SYSTEM (BWMS)

1 INTRODUCTION

This section should include:

.1 a brief history of any previous applications; and

.2 the results of any previous evaluations with references to any pertinent documents;

2 DESCRIPTION OF THE SYSTEM

This section should include:

.1 a list of all the relevant parts of the BWMS, e.g. filtration, treatment (e.g. U.V. or electrolysis or chemicals), neutralization and any feedback controls;

.2 a schematic representation of the system showing the component parts; and

.3 a general description of how the BWMS works and how all the component parts are integrated.

3 CHEMICALS ASSOCIATED WITH THE SYSTEM

3.1 Chemical reactions associated with the system

This section should describe the anticipated chemical reactions associated with the particular system involved and residual chemicals expected to be discharged to the sea.

3.2 Identification of chemicals associated with the ballast water management system

3.2.1 This section should include all Active Substances (AS), Relevant Chemicals (RC) and any Other Chemicals (OC) potentially associated with the system either intentionally or as by-products resulting from the treatment.

3.2.2 A summary of all chemicals analysed in the treated ballast water should be presented in a table, as shown below, including those not actually detected. Where a chemical could not be detected, a less than value (< x mg/L) should be associated with it to indicate the detection limits of the analysis.

Chemical analysis of treated ballast water

Chemical	Concentration in treated ballast water (µg/L)	AS, RC or OC
A		
B		
C		
D		

3.3 For each chemical measured above the detection limits of the system (and above the control levels of untreated ballast water), a separate data sheet (as shown at the end of this appendix) should be included in the application where the chemical has not been evaluated by the GESAMP-EHS or the GESAMP-BWWG and listed in appendix 6 to this Methodology.

Table: Chemical analysis of treated ballast water in different salinities as reported by the applicant

Chemical	Detection limit (µg/L)	Brackish water			Seawater		
		Maximum value (µg/L)	Mean value (µg/L)	Standard deviation (µg/L)	Maximum value (µg/L)	Mean value (µg/L)	Standard deviation (µg/L)
A							
B							
C							
D							

3.4 Unless the applicant disagrees with these data, in which case the applicant should provide reasons for disagreeing and supported replacement data for consideration.

3.5 For the further risk assessment for human health and the environment, the Group selects only the substances that have been detected in a concentration above the detection limit from the table listing all of the potential by-products produced in ballast water. These substances should be considered the Relevant Chemicals for the BWMS. If the detection limit for a substance is determined to be unreasonably high, the substance will be included in the further risk assessment with a value corresponding to the detection limit.

Table: Selected Relevant Chemicals and the concentrations for further risk assessment (RA)

Relevant Chemicals	Concentration in ballast water used in the RA (µg/L)
A	
B	
C	

3.6 The operation of the BWMS is preferably highly automated. A compact description of the control system is to be provided.

4 CONSIDERATION OF CONCERNS EXPRESSED BY THE GROUP DURING ITS PREVIOUS REVIEW

This section should include a copy of each concern raised by the GESAMP-BWWG with an appropriate response from the applicant (valid in case an earlier submission was denied Basic Approval (BA) or Final approval (FA), or in case of an FA submission following a BA approval).

5 HAZARD PROFILE DATA AND EXPOSURE OF CHEMICALS ASSOCIATED WITH THE BWMS

5.1 This section should contain a summary of the hazards to mammals and the environment associated with each chemical associated with or generated by the BWMS. Such a summary should be shown in appendix 1 to this Methodology. Where possible, references have been added.

5.2 The hazards identified will be used to perform a risk assessment of the BWMS on the environment, the ships' crews and the general public.

5.3 In order to assist applicants in providing these summary data, the GESAMP Evaluation of Hazardous Substances Working Group (EHS) and the GESAMP-Ballast Water Working Group (BWWG) have evaluated some of the chemicals commonly associated with Ballast Water Management Systems (BWMS). This means that for the substances indicated in appendix 6, no additional properties on physico-chemistry, ecotoxicology and toxicology have to be submitted, unless the applicant has other, scientifically more relevant data available.

5.4 The reason for this approach is to:

.1 provide a consistent set of data for all applications;

.2 assist applicants in collating the data associated with their BWMS; and

.3 streamline the work of the GESAMP-BWWG in assessing applications.

5.5 The following endpoints should be recorded:

.1 The proposed PNEC based on the available ecotoxicological data, including the final assessment factor to establish the PNEC. This value will be used in the environmental risk assessment.

5.5.1 Predicted No Effect Concentrations (PNEC)

Table: PNEC values of Chemicals associated with the BWMS and included in the GESAMP-BWWG Database

Relevant Chemicals	Harbour	Near ship
	PNEC (µg/L)	PNEC (µg/L)
A		
B		
C		

Table: PNEC values of Chemicals associated with the BWMS, not included in the GESAMP-BWWG Database

Relevant Chemicals	Harbour			Near ship		
	AF	PNEC (µg/L)	Rule No.	AF	PNEC (µg/L)	Rule No.
A						
B						
C						

.1 The proposed DNEL and/or DMEL based on the available toxicological data, including the final assessment factor to establish the DNEL and / DMEL to be used in the human risk assessment.

5.5.2 Derived No Effect Levels (DNEL) and/or Derived Minimum Effect Level (DMEL)

Table: CMR properties for selected Relevant Chemicals

	Carcinogenic	Mutagenic	Reprotoxicity	CMR
A	Yes/No	Yes/No	Yes/No	Yes/No
B	Yes/No	Yes/No	Yes/No	Yes/No
C	Yes/No	Yes/No	Yes/No	Yes/No

Table: DNELs and DMELs to be used in the risk assessment for humans

Chemical	DNEL (mg/kg bw/d) Crew	DNEL (µg/kg bw/d) General public	DMEL (µg/kg bw/d)
A			
B			
C			

5.6 Exposure

5.6.1 In order to perform a risk assessment related to both the environment and those people who may be exposed to any chemicals associated with the BWMS, it is necessary to estimate the concentration of such chemicals in:

.1 the air space in the ship's ballast water tank;

.2 the atmosphere surrounding the ship;

.3 leakages and spills when operating the system; and

.4 in the harbour water.

5.6.2 It is recognized that there are various computer models which can be used to fulfil this requirement and that such models can produce differing results depending on a range of input parameters which can be used. So, in order to provide some standardization and a mechanism for comparing the various systems, it is recommended that applicants use the model of paragraph 5.6.3 associated with the standard inputs described in appendix 5 resulting in a Predicted Environmental Concentration for the Active Substance, all Relevant Chemicals and relevant disinfection by-products.

5.6.3 Predicted Environmental Concentration (PEC)

The Predicted Environmental Concentration (PEC) should be calculated using the MAMPEC-BW 3.0 model or latest available version with the appropriate environment definition and emission input. The results of these calculations should be used to estimate the risk to the crew, port State control, the general public and the environment. See the guidance in appendix 4 for the risk assessment for humans and appendix 5 for the risk assessment for the aquatic ecosystem.

Table: PEC from MAMPEC modelling results from the GESAMP-BWWG Model Harbour

Chemical name	PEC (µg/L)	
	Maximum	Near ship
A		
B		
C		

5.6.4 Concentration of Chemicals associated with the BWMS in the atmosphere

An inventory should be made of the ways humans (crew, port State control and the general public) may be exposed to Relevant Chemicals due to the ballasting and deballasting processes. Guidance to the potential exposure routes is given in appendix 4, together with calculation tools to estimate the worst-case exposure concentration. These resulting concentrations should be used in the risk assessment for humans and reported here.

Table: Resulting concentrations to be used in the risk assessment for humans

Chemical	Crew		General public	
	Concentration in tank (µg/L)	Concentration in air (mg/m^3)	Concentration MAMPEC (µg/L)	Concentration in air (mg/m^3)
A				
B				
C				

6 WHOLE EFFLUENT TESTING (WET) – (LABORATORY TEST FOR BASIC APPROVAL AND LAND-BASED TEST OR ON-BOARD TEST FOR FINAL APPROVAL)

This section should include:

.1 a description of the tests carried out; and

.2 a table of the results, e.g. as shown below:

	Species	Endpoint			Comments
		NOEC*		EC_{50}*	
Algae		50%		83%	
Crustacea		> 100%		> 100%	
Fish		> 100%		> 100%	

* The values indicated are examples.

7 RISKS TO SHIP SAFETY

This section covers damage to the structure of the ship which might be caused by various effects including:

.1 explosion;

.2 fire; and

.3 corrosion.

8 RISKS TO THE CREW

Risks to the crew may be assumed to be associated with:

.1 delivery, loading, mixing or adding chemicals to the BWMS;

.2 ballast water sampling;

.3 periodic cleaning of ballast tanks;

.4 ballast tank inspections; and

.5 normal work on deck.

These situations are covered in the guidance in appendix 4.

8.1 Mixing and Loading/Ballast water sampling/Periodic cleaning of ballast tanks

8.1.1 When considering various work operations, it should be assumed that the exposure routes of concern for the crew and/or port State workers will be inhalation and dermal. In this respect, it is assumed that the crew will be exposed by inhalation to the highest concentration of each chemical in the atmosphere above the treated ballast water at equilibrium and by dermal uptake to the highest concentration of each chemical in the treated ballast water. These approaches are described in appendix 4.

8.1.2 The result from the calculations may be presented as shown in the tables below:

Table: Crew, scenario 1: delivery, loading, mixing or adding chemicals to the BWMS

Chemical	AS concentration	Dermal exposure (mg/kg bw/d)	DNEL (mg/kg bw/d)	RCR
Al				
B				
C				

Table: Crew/Port State control, scenarios 2–5

Chemical	Scenario (mg/kg bw/d)		Aggregated exposure (mg/kg bw/d)	DNEL (mg/kg bw/d)	RCR
	Dermal	Inhalation			
A					
B					
C					

Table: Crew/Port State control, scenario: – DMEL approach

Chemical	Scenario (mg/kg bw/d)		Aggregated exposure (mg/kg bw/d)	DMEL (mg/kg bw/d)	RCR
	Dermal	Inhalation			
A					
B					
C					

9 RISKS TO THE GENERAL PUBLIC

Risks to the general public are most likely to occur as a result of:

.1 ingestion of seafood which has been exposed to chemical by-products in the treated ballast water; and

.2 swimming in seawater contaminated with treated ballast water where exposure may be via ingestion (accidental swallowing), inhalation and dermal contact.

9.1 The risk to the general public from the oral, dermal and inhalatory exposure of chemical by-products may be calculated according to the guidance in appendix 4.

Table: General public scenario: swimming and consumption of seafood

Chemical	Scenario 10.1.1 and 10.1.2 (µg/kg bw/d)				Aggregated exposure (µg/kg bw/d)	DNEL (µg/kg bw/d)	RCR
	Swimming			Consumption of seafood			
	Oral	Dermal	Inhalation	Oral			
A							
B							
C							

9.2 An indicative risk level may be used to calculate an indicative RCR regarding potential cancer risk. These values can be used to estimate a risk dose based on the probability of increased cancer incidence over a lifetime (10^{-6}) and may be regarded as a DMEL for the general public.

Table: General public scenario: swimming and consumption of seafood – DMEL approach

Chemical	Aggregated exposure (µg/kg bw/d)	DMEL (µg/kg bw/d)	Indicative RCR
A			
B			
C			

10 RISKS TO THE ENVIRONMENT

10.1 Assessment of Persistence (P), Bioaccumulation (B) and Toxicity (T)

Based on the half-life, BCF or Log K_{ow} and the chronic NOEC values for each chemical (Procedure (G9), paragraph 6.4), the PBT properties of each chemical should be reflected in a table with the justification in parentheses as shown below:

Chemical by-product	Persistence (P) (Yes/No)	Bioaccumulation (B) (Yes/No)	Toxicity (T) (Yes/No)	PBT (Yes/No)
A	Yes/No	Yes/No	Yes/No	
B	Yes/No	Yes/No	Yes/No	
C	Yes/No	Yes/No	Yes/No	

10.1 Calculation of PEC/PNEC ratios

10.1.1 The ratio of PEC/PNEC is a measure of the risk that each chemical is deemed to present to the environment.

10.1.2 For each chemical the estimation of the PEC/PNEC ratio should be summarized as shown in the table below:

Table: PEC/PNEC ratios [according to the Group]

Chemical name	Maximum/Harbour			Near ship		
	PEC	PNEC	PEC/ PNEC	PEC	PNEC	PEC/ PNEC
	(µg/L)	(µg/L)	(-)	(µg/L)	(µg/L)	(-)
A						
B						
C						

11 ADDITIONAL HEADINGS

11.1 As part of the report to be made by the Group during its evaluations, the following parts also appear:

11.1.1 CONCLUSIONS AND RECOMMENDATIONS

11.1.1.1 Risks to ship safety

11.1.1.2 Risks to the crew and the general public

11.1.1.3 Risks to the environment

11.1.1.4 Recommendation

DATA ON EACH COMPONENT OF THE PREPARATION AND BY-PRODUCT PRODUCED IN BALLAST WATER

Chemical Name ……

Where the applicant considers that it is not necessary to complete the data form for a given chemical, a full justification should be given (e.g. the ½-life of the chemical is only a few seconds and so will have disappeared by the time the ballast water is discharged into the sea).

2 EFFECTS ON AQUATIC ORGANISMS

2.1 Acute aquatic toxicity data

	Species	duration*-LC_{50} (mg/L)	Reference/comments/justification for missing data
Fish			
Crustacea			
Algae			

* The duration is given in hours (h) or days (d), e.g. 96h-LC_{50} or 7d-NOEC.

2.2 Chronic aquatic toxicity data

	Species	duration*-LC_{50} (mg/L) or duration*-NOEC (mg/L)	Reference/comments/justification for missing data
Fish			
Crustacea			
Algae			

* The duration is given in hours (h) or days (d), e.g. 96h-LC_{50} or 7d-NOEC.

2.3 Information on endocrine disruption

	Species	Information	Reference/comments/justification for missing data
Fish			
Crustacea			
Algae			

2.4 Sediment toxicity

	Species	Information	Reference/comments/justification for missing data
Fish			
Crustacea			
Algae			

2.5 Bioavailability/biomagnification/bioconcentration

	Value	Reference/comments/justification for missing data
Log P_{ow}		
BCF		

2.6 Food web/population effects

2.6.1 A description of potential food web and population effects should be provided supported by a full justification.

3 MAMMALIAN TOXICITY

3.1 Acute toxicity

	Value	Species	Reference/comments/justification for missing data
Oral LD_{50} (mg/L)			
Dermal LD_{50} (mg/kg bw)			
Inhalation 4h-LC_{50} (mg/L)			

3.2 Corrosion/irritation

	Species	Method	Results (including scores where available)	Reference/comments/justification for missing data
Skin				
Eye				

3.3 Sensitization

	Species	Method (e.g. Buehler, M&K)	Results (Sensitizer Y/N)	Reference/comments/justification for missing data
Skin				
Inhalation				

3.4 Repeated-dose toxicity

Exposure route	
Exposure duration	
Exposure dose	
Species	
Method	
Results	
NOAEL	
NOEL	
Reference/comments/justification for missing data	

3.5 Development and reproductive toxicity

Exposure route	
Exposure duration	
Exposure dose	
Species	
Method	
Results	
NOAEL	
NOEL	
Reference/comments/justification for missing data	

3.6 Carcinogenicity

Exposure route	
Exposure duration	
Exposure dose	
Species	
Method	
Results	
NOAEL	
NOEL	
Reference/comments/justification for missing data	

3.7 Mutagenicity

	Method	**Dose range**	**Results**	**Reference/comments/ justification for missing data**
Bacterial gene mutation				
Mammalian cytogenicity				
Mammalian gene mutation				

3.8 Carcinogenicity/mutagenicity/reproductive toxicity (CMR)

	Results	**Reference/comments/justification for missing data**
Carcinogenicity		
Mutagenicity		
Reproductive toxicity		

4 ENVIRONMENTAL FATE AND EFFECT UNDER AEROBIC AND ANAEROBIC CONDITIONS

4.1 Modes of degradation (biotic and abiotic)

	Seawater or fresh water	**Test duration**	**Results**	**Breakdown products**	**Reference/comments/ justification for missing data**
Hydrolysis at pH 5					
Hydrolysis at pH 7					
Hydrolysis at pH 9					
Biodegradation					
DT_{50}					

4.2 Partition coefficients

	Method	Results	Reference/comments/justification for missing data
Log P_{ow}			
K_{oc}			

4.3 Persistence and identification of main metabolites

	Method	Results	Reference/comments/justification for missing data
Persistence (d)			

4.4 Reaction with organic matter

4.5 Potential physical effects on wildlife and benthic habitats

4.6 Potential Residues in seafood

4.7 Any known interactive effects

5 PHYSICAL AND CHEMICAL PROPERTIES FOR THE ACTIVE SUBSTANCES, PREPARATIONS AND TREATED BALLAST WATER, IF APPLICABLE

Property*	Value	Reference/comments/ justification for missing data
Melting point (°C)		
Boiling point (°C)		
Flammability (flashpoint for liquids; °C)		
Density (20°C; kg/m^3)		
Vapour pressure (Pa at 20°C)		
Relative vapour density (expressed as a ratio by that of air as 1.293 kg/m^3 at 0°C and 10^5 Pa)		
Water solubility (mg/L, temp; effect of pH)		
pH in solution (under the intended concentration for AS)		
Dissociation constant (pK_a)		
Oxidation-reduction potential (V)		
Corrosivity to material or equipment (for AS see paragraph 3.6.9)		
Reactivity to container material (only for AS, which needs storage on board)		
Auto-ignition temperature, also flash point if applicable (°C)		
Explosive properties (narrative)		
Oxidizing properties (narrative)		
Surface tension (N/m)		
Viscosity Viscosity (Pa·s), Kinetic viscosity (m^2/s) is also accepted		
Thermal stability and identity of breakdown products (narrative)		
Other physical or chemical properties (narrative)		

* If units are indicated for the property, then these should be considered the preferred unit.

6 OTHER INFORMATION

6.1 Analytical methods for measuring the concentration at environmentally relevant concentrations

Method	
Applicability	
Sensitivity	
Reference/comments/justification for missing data	

6.2 Material Safety Data Sheet provided (Yes/No)

6.3 GHS classification …….

6.4 Risk characterization

Persistent (y/n)	Bioaccumulative (y/n)	Toxic (y/n)	Reference/comments/justification for missing data

APPENDIX 4

HUMAN RISK ASSESSMENT OF BALLAST WATER CHEMICALS

1 INTRODUCTION

1.1 In risk characterization for human health, the procedure is to compare the exposure levels to which the target groups are exposed or likely to be exposed with those levels at which no toxic effects from the chemicals are expected to occur. There are normally four stages when carrying out a quantitative risk assessment:

.1 **Hazard identification** – what are the substances of concern and what are their effects?

.2 **Dose (concentration)** – **response (effect) relation** – what is the relationship between the dose and the severity or the frequency of the effect?

.3 **Exposure assessment** – what is the intensity, and the duration or frequency of exposure to an agent.

.4 **Risk characterization** – how to quantify the risk from the above data.

1.2 It is proposed to apply a tiered approach when assessing the risk of the chemicals associated with the BWMS.

1.3 In the first tier, the level of exposure to the substance below which no adverse effects are expected to occur should be derived for the relevant systemic effects. This level of exposure above, which humans should not be exposed to, is designated as the Derived No Effect Level (DNEL). Risks are regarded to be controlled when the estimated exposure levels do not exceed the predicted no effect levels (DNEL).

1.4 A DNEL is a derived level of exposure because it is normally calculated on the basis of available dose descriptors from animal studies such as No Observed Adverse Effect Levels (NOAELs) or benchmark doses (BMDs).

1.5 The DNEL can be considered as an "overall" No-Effect-Level for a given exposure (route, duration, frequency), accounting for uncertainties/variability in these data and the human population exposed by using appropriate Assessment Factors (AFs).

1.6 If an unacceptable level of risk is identified for any of the scenarios in the first tier, a refinement of the exposure assessment and/or the assessment factors might be performed in the second tier giving special attention to route-specific contributions and protection measures.

1.7 In order to determine the risks with chemicals associated with the treatment of ballast water, it is necessary to determine several parameters:

.1 concentration of each chemical in the ballast water tank (and in the air phase above the water);

.2 concentration of chemicals after discharging in the sea;

.3 concentration of chemicals which may be transferred from the aquatic environment into the atmosphere; and

.4 potential uptake of chemicals by humans through the various routes of exposure.

1.8 For the worker exposure situation in the ballast water tank (while performing sampling or cleaning), it is important to estimate the air concentrations in the ballast tank. The concentration of each chemical in the atmosphere above the water may be calculated using the Henry's Law Constant.

1.9 For the exposure situation regarding the general public (whilst swimming in the sea or consuming seafood), the calculated concentration of each chemical in the discharged treated ballast water needs to be used. These can be determined using environmental models and the MAMPEC-BW model version 3.0.1 or latest available version written for this purpose is the one preferred. It is normal practice to use the highest values obtained from this model which is the concentration anticipated in the harbour area.

1.10 It is important to note that the methodologies described in this document generally apply to DNELs of chemicals with a systemic and threshold related property, and do not apply to chemicals producing local effects, such as irritation. However, in some cases it is considered appropriate to derive a DNEL for a local effect when a reliable NOAEL is available. For chemicals with a non-threshold effect (i.e. cancer), a DMEL should be used.

1.11 No account has been taken of the naturally occurring background levels of contaminants in seawater, which, it is recognized, will be different in different parts of the world.

1.12 The approach described in this documentation takes into account the EU REACH guidance described in ECHA Guidance on information requirements and chemical safety assessment.

2 HUMAN EXPOSURE ASSESSMENT

2.1 Occupational

2.1.1 The exposure assessment is carried out through an evaluation of different exposure scenarios. An exposure scenario is the set of information and/or assumptions that describes how the contact between the worker and the substance takes place. It is based on the most important characteristics of the substance in view of occupational exposure, e.g. the physico-chemical properties, pattern of use, processes, tasks and controls. An exposure scenario will therefore describe a specific use of the treatment product with a set of specific parameters. Exposure estimates are intended to be used as a screening tool. The following situations have been identified as likely exposure scenarios for workers:

Table 1. Summary of occupational exposure scenarios

Operations involving the crew and/or port state workers			
Operation	**Exposure**	**Frequency/duration/quantity**	**Approach described in:**
Delivery, loading, mixing or adding chemicals to the	Potential dermal exposure and inhalation from	Solids, dermal: scenario to be developed Liquids, dermal: 0.05-	2.1.2

Operations involving the crew and/or port state workers			
Operation	**Exposure**	**Frequency/duration/quantity**	**Approach described in:**
BWMS	leakages and spills.	0.1 mL/container handled Gases/vapours/dusts, inhalation: scenario to be developed	
Ballast water sampling at the sampling facility	Inhalation of air released	2 hours/day for 5 days/week; 45 weeks/year	2.1.3.1
	Dermal exposure to primarily hands	2 hours/day for 5 days/week; 45 weeks/year	2.1.3.4
Periodic cleaning of ballast tanks	Inhalation of air in the ballast water tank	8 hours/day for 5 days/week; 1 event/year	2.1.4.1
	Dermal exposure to the whole body	8 hours/day for 5 days/week; 1 event/year	2.1.4.3
Ballast tank inspections	Inhalation of air in the ballast water tank	3 hours/day for 1 day/month	2.1.5
Normal operations carried out by the crew on BWMS			
Normal work on deck unrelated to any of the above	Inhalation of air released from vents	1 hour/day for 6 months/year	2.1.6

Note: Whilst the above situations have been identified as typical exposure scenarios, it is recognized that there will be other situations when exposure of workers may be greater or less and due consideration should be given to such situations.

2.1.2 Delivery, loading, mixing or adding chemicals to the BWMS

2.1.2.1 There is potential for exposure to chemical substances during transfer of concentrated formulations in containers or within closed systems. It is considered that the risks are dealt with through the use of appropriate chemical protective clothing, in particular gloves. The applicant should provide details of the intended methods to be used to transfer Active Substances, Preparations or Other Chemicals, e.g. neutralizers, to the on-board storage and propose the appropriate personal protective equipment to prevent exposure arising from any loss of containment or through contact with contaminated plant and equipment.

2.1.2.2 Dilution of concentrated chemical products is often referred to as mixing and loading. On smaller vessels this process may be performed manually. Exposure through inhalation is considered unlikely for non-volatile or water-based chemical formulations. Potential dermal exposure of the hands can be estimated by several available models. It is recommended to use the UK Predictive Operator Exposure Model (POEM) for this estimation. In this model, the daily level of exposure during the handling of containers depends on the properties of the container (capacity and diameter of the opening) and the number of containers handled per day. Containers with narrow openings (< 45 mm) are not considered for this scenario.

Principal equation:

$$Dose = (1 - f_{RMM}) \cdot \frac{C \cdot N \cdot E \cdot f_{derm} \cdot f_{pen}}{BW}$$

Dose	=	skin exposure (mg/kg bw/d)
f_{RMM}	=	risk mitigation factor (tier 1 = 0, tier 2 = 0.95)
C	=	concentration of Active Substance (mg/L)
N	=	number of containers handled, to be determined according to the total volume needed for the specific BWMS (d^{-1})
E	=	contamination per container handled (tier 1 = 0.1 mL, tier 2 = 0.05 mL)
f_{derm}	=	dermal absorption factor (default = 1)
f_{pen}	=	penetration factor (default = 1)
BW	=	body weight (default = 60 kg)

The tier 1 assessment is based on the handling of containers with an opening diameter of 45 mm and a volume of 10 L. For this case, UK POEM predicts a hand exposure of 0.1 mL fluid per container handled. The number of containers handled depends on the total volume of liquid that needs to be transferred. The tier 2 assessment is based on the handling of containers with an opening diameter of 63 mm and a volume of 20 L. For this case, UK POEM predicts a hand contamination of 0.05 mL for each container. The total volume handled should be the same as in tier 1, i.e. the number of containers handled is half of that in tier 1. The exposure estimation can be further refined by the use of substance-specific values for the dermal absorption factor or the penetration factor, if available. Exposure can be reduced by the use of gloves. According to UK POEM, suitable gloves will reduce exposure to 5% of the original value. This value is used as a default for tier 2.

2.1.2.3 On larger vessels, transfer of chemicals will more likely occur through closed transfer systems. These systems do not necessarily result in reduced levels of operation exposure. The connection and removal of adaptors may result in similar levels of exposure as those from open pouring operations. Therefore, calculation of exposure by the above equation is recommended also for these systems.

2.1.2.4 Measures to safeguard installations against unintended release of chemicals should be discussed under "Risks to the safety of the ship" (see chapter 7.1 of the Methodology).

2.1.3 Ballast water sampling

2.1.3.1 There is a potential risk for inhalation of chemicals that have evaporated into the air phase while performing the task of taking samples of the ballast water from the sampling facility. The worst concentration of chemicals in the air may theoretically be calculated using the Henry's Law Constant in the equation presented below:

$$C_{air} = \frac{H}{R \cdot T} \cdot C_{water}$$

where:

C_{air}	=	concentration in air (mg/m^3)
H	=	Henry's Law Constant (Pa m^3/mole)
R	=	gas constant (8.314 Pa m^3/mole K)
T	=	absolute temperature (K)
C_{water}	=	measured concentration in ballast water (µg/L)

2.1.3.2 If the applicant proposes that the sampling facility be placed in the engine room, a dilution factor of 100 may be introduced to estimate the concentration in the air surrounding test facilities. This is based on the assumption that any air released from the sampling facilities will be diluted by the surrounding air

2.1.3.3 Once a concentration of a volatile component has been estimated, a simple tier 1 exposure assessment can be performed.

$$Dose_{Tier1} = \frac{C_{air} \times ET \times IR}{BW}$$

where:

$Dose_{Tier1}$	=	inhaled dose (mg/kg bw/d)
C_{air}	=	concentration of volatile component in air (mg/m^3)
ET	=	exposure time (2 h/d)
IR	=	inhalation rate (default = 1.25 m^3/h)
BW	=	body weight (default = 60 kg)

2.1.3.4 There is also a potential risk for dermal uptake of chemicals from the ballast water while taking samples from the sampling facility. The dermal uptake may be calculated using the equation below:

$$U_{sd} = \frac{A_{hands} \cdot TH_{dermal} \cdot C_{water} \cdot BIO_{derm}}{BW}$$

where:

U_{sd}	=	dermal uptake (mg/kg bw/d)
A_{hands}	=	surface area of two hands (0.084 m^2)
TH_{dermal}	=	thickness of the product area on the skin (0.0001 m)
C_{water}	=	concentration of chemical in treated ballast (µg/L)
BIO_{derm}	=	dermal bioavailability (default = 1)
BW	=	body weight (default = 60 kg)

2.1.3.5 The aggregated uptake, that is the sum of the inhaled dose and the dermal dose, is then compared with the DNEL to assess whether the risk is acceptable or not.

2.1.3.6 If the tier 1 risk assessment indicates an unacceptable risk, a tier 2 exposure assessment can be performed by averaging the short-term daily exposure over an extended period of time, in accordance with a methodology developed by the U.S. EPA[1]. For this purpose, employment duration of 20 years is assumed.

$$Dose_{Tier2} = (1 - f_{RMM}) \frac{C_{air} \times IR \times ET \times EF \times ED}{BW \times AT}$$

[1] U.S. Environmental Protection Agency, 2002. Supplemental guidance for developing soil screening levels for superfund sites. http://www.epa.gov/superfund/health/conmedia/soil/pdfs/ssg_main.pdf

where:

$Dose_{Tier2}$	=	inhaled dose (mg/kg bw/d)
f_{RMM}	=	risk mitigation factor
C_{air}	=	concentration of volatile component in air (mg/m^3)
IR	=	inhalation rate (default = 1.25 m^3/h)
ET	=	exposure time (2 h/d)
EF	=	exposure frequency (225 d/y)
ED	=	exposure duration (20 y)
BW	=	body weight (default = 60 kg)
AT	=	averaging time (7,300 d (= exposure duration) for non-carcinogenic effects; 25,550 d (= life expectancy) for carcinogenic effects)

The dermal exposure is modified in an analogous manner.

2.1.3.7 For further refinement, the effect of risk mitigation measures may be taken into account using a system-specific risk mitigation factor.

2.1.4 Periodic cleaning of ballast water tanks

2.1.4.1 In this scenario a worker works in the emptied ballast tank, where he may be exposed to volatile components arising from treatment of the ballast water that have remained in the tank atmosphere after discharge of the treated ballast water. The concentration of chemicals in the air phase may be calculated in the same manner as in 2.1.3.1. A dilution factor of 10 is introduced based on the assumption that the ballast tank was previously filled to 90 percent capacity and so the air from the headspace will be diluted as the ballast water is discharged and fresh air is drawn in.

2.1.4.2 Once a concentration of a volatile component has been estimated, the tier 1 exposure assessment can be performed as described in 2.1.3.3, using an exposure time of 8 hours/day (see table 1).

2.1.4.3 The dermal uptake of chemicals from the sediment and sludge in the ballast tank may be calculated in the same manner as in 2.1.3.4 taking into account possible exposure to more parts of the body apart from the hands.

2.1.4.4 For risk assessment, the aggregated exposure is calculated according to 2.1.3.5.

2.1.4.5 If necessary, a tier 2 exposure assessment can be performed as described in 2.1.3.6, using an exposure frequency of 5 days/year (see table 1).

2.1.4.6 For this scenario effects of risk mitigation measures may be taken into account as described in the following. The data underlying the UK POEM model suggest that for higher levels of challenge, it is reasonable to assume that impermeable protective coveralls provide 90% protection against aqueous challenge. Protective gloves, for this type of work, are considered to always have the potential to get wet inside and the high-end default value is used as a measure of hand exposure even for the tier 2 assessment (exposure occurs owing to water entering via the cuff). For boots, a lower default value may be selected to represent the worker wearing appropriate impermeable boots.

2.1.5 Ballast tank inspections

2.1.5.1 In this scenario a crew member or a port state inspector enters the emptied ballast tank and may be exposed to volatile components arising from treatment of the ballast water. The concentration of chemicals in the air phase may be calculated in the same manner as in 2.1.3.1, using a dilution factor of 10 to account for the dilution by fresh air drawn into the emptied ballast tank.

2.1.5.2 Once a concentration of a volatile component has been estimated, the tier 1 exposure assessment can be performed as described in 2.1.3.3. Exposure time in this scenario is 3 hours/day (see table 1).

2.1.5.3 No dermal exposure is assumed for this scenario, and the calculated inhaled dose can be directly used for risk assessment.

2.1.5.4 If necessary, a tier 2 exposure assessment can be performed as described in 2.1.3.6, using an exposure frequency of 12 days/year (see table 1).

2.1.5.5 For further refinement, the effect of system-specific risk mitigation measures may be taken into account.

2.1.6 Crew carrying out normal work on deck unrelated to any of the above

2.1.6.1 Exposure in this scenario is through inhalation of air released from the air vents on deck. The concentration of chemicals in the atmosphere surrounding the air vents may be calculated as detailed in 2.1.3.1 and 2.1.3.3, taking into account a dilution factor of 100 for the dilution by the surrounding atmosphere..

2.1.6.2 Once a concentration of a volatile component has been estimated, the tier 1 exposure assessment can be performed as described in 2.1.3.3. Exposure time in this scenario is 1 hour/day (see table 1).

2.1.6.3 No dermal exposure is assumed for this scenario, and the calculated inhaled dose can be directly used for risk assessment.

2.1.6.4 If necessary, a tier 2 exposure assessment can be performed as described in 2.1.3.6, using an exposure frequency of 180 days/year (see table 1).

2.1.6.5 For further refinement, the effect of system-specific risk mitigation measures may be taken into account.

2.2 General public

2.2.1 Indirect exposure of humans via the environment where treated ballast water is discharged may occur by consumption of seafood and swimming in the surrounding area.

2.2.2 The following situations have been identified as likely exposure scenarios for the general public:

Table 2: Summary of exposure scenarios for the general public

Situations in which the general public might be exposed to treated ballast water containing chemical by-products			
Situation	**Exposure**	**Duration/quantity**	**Approach described in:**
Recreational activities in the sea	Inhalation of chemicals partitioning into the air above the sea	5 events of 0.5 hours/day for 14 days of the year	2.2.3.1
	Dermal exposure to chemicals whilst swimming in the sea	5 events/day for 14 days of the year	2.2.3.2
	Swallowing of seawater contaminated with treated ballast water	5 events of 0.5 hours/day for 14 days of the year	2.2.3.3
Eating seafood exposed to treated ballast water	Oral consumption	Once or twice/day equivalent to 0.188 kg/day	2.2.4
Aggregated exposure (through swimming and consumption of seafood)			2.2.5

Note: Whilst the above situations have been identified as typical worst-case exposure scenarios, it is recognized that there will be other situations when exposure of the general public may be greater or less and due consideration should be given to such situations.

In addition, the consumer exposure (general public) is normally assessed as chronic/lifetime risk in order to protect the most vulnerable population groups taking also into account that they would not use protective equipment when exposed to chemicals.

2.2.3 Recreational activities (swimming) in the sea

2.2.3.1 **Inhalation of chemicals partitioning into the air above the sea**

2.2.3.1.1 Exposure in this scenario is through inhalation of air above the sea while swimming. The concentration of chemicals in the air may be calculated while using the Henry's Law Constant as already described in 2.1.3.1. However in this case the concentration in the water is the PEC harbour value as calculated by MAMPEC, and taking into account a dilution factor of 100 (due to wind, turbulence and insufficient time for the chemical to reach equilibrium).

2.2.3.1.2 The inhaled dose may be estimated using the equation below, while taking into account various assumptions (number of swims, etc.):

$$U_{si} = \frac{C_{air} \cdot IR \cdot n \cdot D \cdot BIO_{inh}}{BW}$$

where:

U_{si}	=	inhalation intake of chemical during swimming (mg/kg bw/d)
C_{air}	=	concentration in air (mg/m^3)
IR	=	inhalation rate – light activity assumed (1.25 m^3/h)
n	=	number of swims per day (5/d)
D	=	duration of each swim (0.5 h)
BIO_{inh}	=	fraction of chemical absorbed through the lungs (1)
BW	=	body weight (default = 60 kg)

2.2.3.2 Dermal exposure to chemicals whilst swimming in the sea

Exposure in this scenario is via dermal uptake of chemicals when swimming, while using the following equation:

$$U_{sd} = \frac{C_w \times TH_{dermal} \times n_{swim} \times A_{skin} \times BIO_{dermal}}{BW}$$

where:

U_{sd}	=	dermal uptake per day during swimming (mg/kg bw/d)
C_w	=	concentration in the water, i.e. PEC_{MAMPEC} (µg/L)
TH_{dermal}	=	thickness of the product layer on the skin (0.0001 m)
n_{swim}	=	number of events (5/d)
A_{skin}	=	surface area of whole body being exposed to water (1.94 m^2)
BIO_{dermal}	=	bioavailability for dermal intake (default= 1)
BW	=	body weight (kg)

2.2.3.3 Swallowing of seawater contaminated with treated ballast water

The oral uptake via swimming is calculated according to the following:

$$U_{so} = \frac{C_w \cdot IR_{swim} \cdot n_{swim} \cdot Dur_{swim} \cdot BIO_{oral}}{BW}$$

where:

U_{so}	=	amount of chemical swallowed (µg/kg bw/d)
C_w	=	concentration in the water, i.e. PEC_{MAMPEC} (µg/L)
IR_{swim}	=	ingestion rate of water while swimming (0.025 L/h)
n_{swim}	=	number of swims per day (5/d)
Dur_{swim}	=	duration of each swim (0.5 h)
BIO_{oral}	=	bioavailability for oral intake (default = 1)
BW	=	body weight (default = 60 kg)

2.2.4 Eating seafood exposed to treated ballast water

2.2.4.1 The concentration of chemicals in the seafood that is being consumed is calculated in this way:

$$C_{fish} = BCF \cdot PEC_{mampec}$$

where:

C_{fish}	=	concentration in fish (µg/kg)
BCF	=	bioconcentration factor (L/kg)
PEC_{mampec}	=	concentration of chemical in water derived from MAMPEC (µg/L)

2.2.4.2 While taking into account the assumption that people in the area only eat fish that is being caught locally (worst-case scenario), the daily intake may be calculated in the following way:

$$U_{fish} = \frac{QFC \cdot C_{fish} \cdot BIO_{oral}}{BW}$$

where:

U_{fish}	=	uptake of chemical from eating fish (µg/kg bw/d)
QFC	=	quantity of fish consumed/day (= 0.188 kg/d (FAO, Japan))
C_{fish}	=	concentration of chemical in fish (µg/kg)
BIO_{oral}	=	bioavailability for oral intake (default = 1)
BW	=	body weight (default = 60 kg)

2.2.5 Aggregated exposure (through swimming and consumption of seafood)

The total exposure to the general public whilst swimming in the sea and eating fish is the sum of the amount of chemical absorbed through eating fish plus the oral intake, dermal absorption and inhalation absorption whilst swimming.

Swimming (inhalation)	:	µg/kg/d
Swimming (dermal)	:	µg/kg/d
Swimming (oral)	:	µg/kg/d
Eating fish	:	µg/kg/d
Total	:	µg/kg/d

Note: Make sure all values are in the same units.

2.2.6 Concluding remarks

2.2.6.1 It should be noted that whilst the above situations have been identified as typical worst-case exposure scenarios, it is recognized that there will be other situations when exposure of the general public may be greater or less. Due consideration should be given to such situations.

2.2.6.2 In addition, the consumer exposure (general public) is normally assessed as chronic/lifetime risk in order to protect the most vulnerable population groups taking also into account that they would not use protective equipment when exposed to chemicals.

3 CALCULATION OF DERIVED NO-EFFECT LEVELS (DNELS)

3.1 The next step of the risk assessment process includes the definition of toxicologically significant endpoints for comparison with the calculated aggregated exposure doses. These endpoints, for example No Observed Adverse Effect Levels (NOAELs), Lowest Observed Adverse Effect Levels (LOAELs) or Benchmark Doses (BMDs) from experimental animal studies, are then further transformed to Derived No-effect Levels (DNELs) or Derived Minimal Effect Levels (DMELs) for the characterization of toxicological risks to humans.

3.2 The DNEL can be considered as an 'overall' No-Effect-Level for a given exposure (route, duration, frequency). Uncertainties/variability in these data and the human population exposed are taken into account by using appropriate Assessment Factors (AFs) according to this equation:

$$DNEL = \frac{Dose_{descriptor}}{Assessment\ Factor}$$

4 DNELS FOR THE WORKER POPULATION

4.1 For the exposure at the workplace, the following DNELs may be calculated:

.1 DNEL, short-term exposure (mg/kg bw): the dose descriptor might be an LD_{50} from an oral or dermal study or an LC_{50} from an inhalation study.

.2 DNEL, long-term exposure (mg/kg bw/d): the dose descriptor might be a NOAEL or LOAEL from a sub-acute, sub-chronic or chronic oral or dermal study or a NOAEC or LOAEC from an inhalation study.

4.2 It is also possible to derive DNELs for local effects. This is relevant for instance for corrosive/irritant substances that can produce immediate severe effects at the first site of contact (skin, eyes and/or respiratory tract).

5 DNELS FOR THE GENERAL PUBLIC

5.1 The exposure of the general public is normally assessed as chronic/lifetime risk in order to protect the most vulnerable population groups, taking also into account that they would not use protective equipment when exposed to chemicals.

5.2 Therefore, for the exposure of the general public via swimming or consumption of seafood, only one DNEL is calculated:

.1 DNEL, general public: (mg/kg bw/d): the dose descriptor might be a NOAEL or LOAEL from a sub-acute, sub-chronic or chronic oral or dermal study or a NOAEC or LOAEC from an inhalation study.

6 DNEL CALCULATION FROM MAMMALIAN TOXICOLOGY ENDPOINTS

6.1 The DNEL may be calculated in accordance with the following equation:

$$DNEL = \frac{Dose_{descriptor} \cdot CF_{dr}}{ASF \cdot OSF \cdot ISF \cdot ESF \cdot SF_{dur} \cdot CF_{abs}}$$

where:

$Dose_{descriptor}$	=	see 6.3
CF_{dr}	=	experimental dosing regime, see 6.4
ASF	=	interspecies allometric factor, see 6.5
OSF	=	other interspecies scaling factor, see 6.6
ISF	=	intraspecies scaling factor, see 6.7
ESF	=	observed effect scaling factors, see 6.8
SF_{dur}	=	duration scaling factors, see 6.9
CF_{abs}	=	differential absorption factors, see 6.10

6.2 It should be noted that the DNEL is only appropriate for chemicals which cause a threshold systemic effect and is not appropriate for such effects as carcinogenicity for which a **Derived Minimal Effect Level (DMEL)** should be determined (see 7).

6.3 Dose descriptor

6.3.1 If the dose descriptor is a NOAEC or LOAEC from an inhalation study, expressed e.g. as mg/m^3, the internal exposure, expressed as mg/kg bw/d, can be calculated using the standard respiratory volume (sRV) of the test species:

$$NOAEL = \frac{NOAEC}{sRV_{animal}}$$

For the rat the sRV is 1.15 m^3/kg bw/d
For the mouse the sRV is 1.03 m^3/kg bw/d

6.4 Experimental dosing regime (CF_{dr})

6.4.1 This factor is needed to correct the dose value when the dosing regime in an experimental animal study differs from the exposure pattern anticipated for the human population under consideration.

For example:

.1 Starting NOAEL/NOAEC adjusted for treatment schedule (if dosing 5 days/week then a factor of 5/7 is applied)

6.5 Interspecies Allometric Scaling Factor (ASF)

6.5.1 Allometric scaling extrapolates doses according to an overall assumption that equitoxic doses (expressed in mg/kg/d) are related to, though not directly proportional to, the body weight of the animals concerned.

6.5.2 The following Allometric Scaling Factors are recommended for use in determining DNELs:

Species	Body Weight (kg)	ASF
Rat	0.25	4
Mouse	0.03	7
Hamster	0.11	5
Guinea pig	0.80	3
Rabbit	2.00	2.4
Monkey	4.00	2
Dog	18.00	1.4

6.6 Other Interspecies Scaling Factor (OSF)

6.6.1 If no substance-specific data are available, the standard procedure for threshold effects would be, as a default, to correct for differences in metabolic rate (allometric scaling) and to apply an additional factor of 2.5 for other interspecies differences, i.e. toxicokinetic differences not related to metabolic rate (small part) and toxicodynamic differences

(larger part). In case substance-specific information shows specific susceptibility differences between species, which are not related to differences in basal metabolic rate, the default additional factor of 2.5 for "remaining differences" should be modified to reflect the additional information available.

6.7 Intraspecies scaling factor for the general population (ISF_{gp}) and workers (ISF_w)

6.7.1 Humans differ in sensitivity to exposure to toxic substances owing to a multitude of biological factors such as genetic polymorphism, affecting e.g. toxicokinetics/metabolism, age, gender, health and nutritional status. These differences, as the result of genetic and/or environmental influences, are greater in humans than in the more uniform inbred experimental animal population. Therefore, "intraspecies" in this context refers only to humans, which are divided into the following groups:

.1 **workers**, which are considered to be reasonably fit and of working age. As a result, the variation in the effect of a chemical on this group is considered to be relatively small, hence:

.1 the scaling factor for **workers (ISF_w)** = 5

.2 **the general population**, which are considered to include children, the elderly as well as the unfit and unwell. As a result, the variation in the effect of a chemical on this group is considered to be greater than that of workers, hence:

.1 the scaling factor for the **general population (ISF_{gp})** = 10

6.8 Observed effect scaling factors (ESF)

6.8.1 For the dose-response relationship, consideration should be given to the uncertainties in the dose descriptor (NOAEL, benchmark dose) as the surrogate for the true no-adverse-effect-level (NAEL), as well as to the extrapolation of the LOAEL to the NAEL (in cases where only a LOAEL is available or where a LOAEL is considered a more appropriate starting point).

6.8.2 The size of an assessment factor should take into account the dose spacing in the experiment (in recent study designs generally spacing of 2-4 fold), the shape and slope of the dose-response curve, and the extent and severity of the effect seen at the LOAEL.

6.8.3 When the starting point for the DNEL calculation is a LOAEL, it is suggested to use an assessment factor of 3. However, the benchmark dose (BMD) approach is, when possible, preferred over the LOAEL-NAEL extrapolation.

6.9 Duration scaling factors (SF_{dur})

6.9.1 In order to end up with the most conservative DNEL for repeated dose toxicity, chronic exposure is the 'worst case'. Thus, if an adequate chronic toxicity study is available, this is the preferred starting point and no assessment factor for duration extrapolation is needed. If only a sub-acute or sub-chronic toxicity study is available, the following default assessment factors are to be applied, as a standard procedure:

Duration	Scaling Factor (SF_{dur})
Sub-chronic to chronic	2
Sub-acute to chronic	6
Sub-acute to sub-chronic	3

"sub-acute" usually refers to a 28 day study
"sub-chronic" usually refers to a 90 day study
"chronic" usually refers to a 1.2-2 year study (for rodents)

6.10 Differential Absorption Factors (CF_{abs})

6.10.1 It is recognized that route-to-route extrapolation is associated with a high degree of uncertainty and should be conducted with caution relying on expert judgement.

6.10.2 For simplicity 100% absorption for the oral and the inhalation route for animals and humans is assumed. On the assumption that, in general, dermal absorption will not be higher than oral absorption, no default factor (i.e. factor 1) should be introduced when performing oral-to-dermal extrapolation.

7 CALCULATION OF DMELS – HOW TO DEAL WITH NON-THRESHOLD CARCINOGENS?

7.1 Background

According to Procedure (G9), paragraph 5.3.12, the effect assessment of the Active Substances, Preparations and Relevant Chemicals should include a screening on carcinogenic, mutagenic and endocrine disruptive properties. If the screening results give rise to concerns, this should give rise to a further assessment.

7.2 The Linearized approach and the Large Assessment Factor approach

7.2.1 Carcinogens can have a threshold or non-threshold mode of action. When it comes to the threshold carcinogens these can be assessed by using a DNEL approach, however, in the case of the non-threshold carcinogens (i.e. with mutagenic potential) a different approach to risk assessment is recommended.

7.2.2 As a general rule, exposure in the workplace must be avoided or minimized as far as technically feasible. In addition, a risk for the general public from secondary exposure to a non-threshold carcinogenic substance is also unacceptable. However, calculation of an exposure level corresponding to a defined low risk is possible based on a semi-quantitative approach, i.e. a derived minimal effect level (DMEL). In contrast to a DNEL, a DMEL does not represent a safe level of exposure. It is a risk-related reference value that should be used to better target risk management measures.

7.2.3 At the present status of knowledge there are two methodologies which can be applied for deriving a DMEL. The "**Linearized**" approach essentially results in DMEL values representing a lifetime cancer risk considered to be of very low concern and the "**Large Assessment Factor**" approach similarly results in DMEL values representing a low concern from a public health point of view. If data allow, more sophisticated methodologies for deriving a DMEL may be applied. The choice of such alternative methodologies should be justified.

7.2.4 Cancer risk levels between 10^{-4} to 10^{-6} are normally seen as indicative tolerable risk levels when setting DMELs. Where these values are available from internationally recognized bodies, they can be used to set DMELs for risk assessment purposes.

8 RISK CHARACTERIZATION

8.1 General approach

8.1.1 The Risk Characterization Ratios (RCR) compares the exposure levels to various DNELs or DMELs. The RCR is calculated according to the following formula:

$$RCR = \frac{Exposure}{DNEL\,/\,DMEL}$$

8.2 Occupational health risks

8.2.1 While considering ballast water sampling and tank cleaning operations, it should be assumed that the exposure routes of concern for Port State control officers and the crew will be inhalation and dermal exposure. The assumption being that the exposure will include inhalation to the highest concentration of each chemical in the atmosphere above the treated ballast water at equilibrium and the dermal uptake to the highest concentration of each chemical in the treated ballast water.

8.2.2 In the other two scenarios, ballast tank inspection and normal work on deck, only inhalation is taken into consideration.

8.3 Health risks for the general public

8.3.1 In the two scenarios applicable for general public, swimming in seawater contaminated with treated ballast water and ingestion of seafood which has been exposed to treated ballast water are taken into consideration.

8.4 Conclusion

8.4.1 If the RCR < 1, the exposure is deemed to be safe.

8.4.2 However, risks are regarded not to be controlled when the estimated exposure levels exceed the DNEL and/or the DMEL, that is, if the RCR ≥ 1.

8.4.3 If the treated ballast water contains two or more chemicals with the same toxicological effect, these should be evaluated as an 'assessment group'. The RCR for an assessment group is calculated by addition of all RCRs of the individual components:

$$RCR_{group} = RCR_A + RCR_B + RCR_C + \cdots.$$

For the group RCR the same conclusions apply as described above.

8.4.4 If an unacceptable level of risk is identified for any of the scenarios in the first tier, the second tier is applied. If still an unacceptable risk is identified further refinement of the exposure assessment and/or the assessment factors might be performed giving special attention to route-specific contributions and additional RMM.

APPENDIX 5

MAMPEC 3.0 INFORMATION

1 GENERAL

The model Marine Antifoulant Model for PEC calculation for Ballast Water (MAMPEC BW 3.0) or latest available version may be downloaded from the website of Deltares in the Netherlands. The website is:

http://www.deltares.nl/en/software/1039844/mampec/1232321

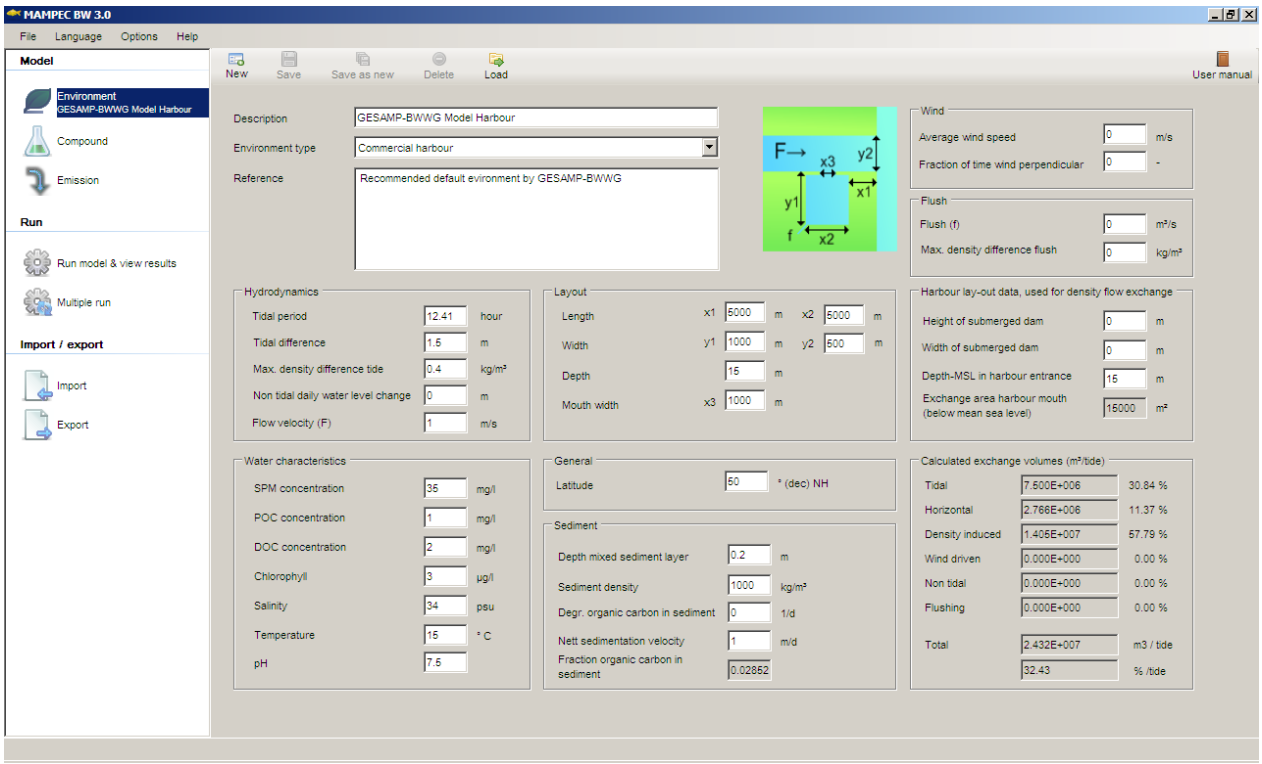
Follow the installation instructions and run the model.

2 CALCULATION OF THE PREDICTED ENVIRONMENTAL CONCENTRATION (PEC)

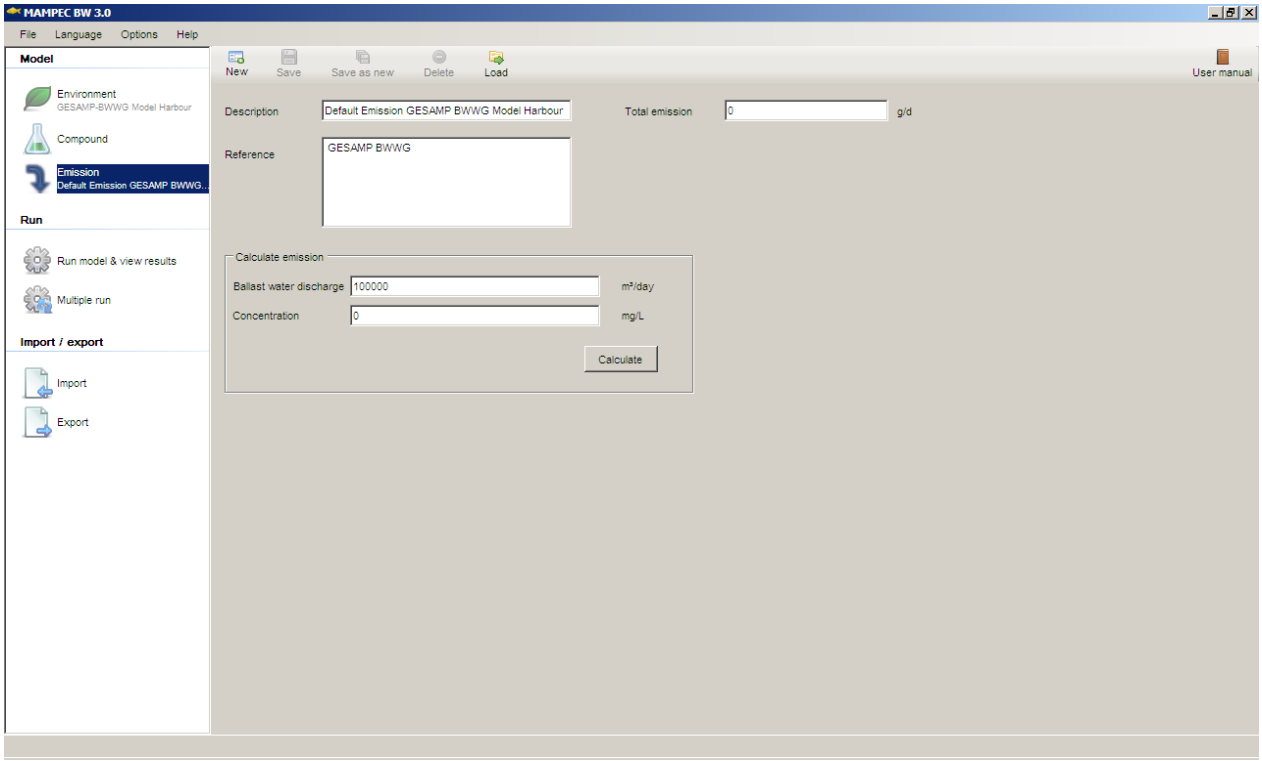
2.1 This procedure is important for carrying out a risk assessment to the environment.

2.2 In order to provide a standard approach, it is recommended that the MAMPEC-BW 3.0 or latest available version is used to determine the PEC for each chemical identified.

2.3 When this model is used, the following the GESAMP-BWWG Harbour Environment should be selected from the options available:



2.4 In addition to the GESAMP-BWWG Harbour Environment shown above, the following standard GESAMP-BWWG emission data need to be included as part of the GESAMP-BWWG Standard model:



2.5 The results of carrying out this procedure for each of the chemicals associated with the BWMS will be a series of PEC values, which should be included in a table with the Predicted No Effect Concentration (PNEC) and the appropriate assessment factor (AF). As a first assessment, the maximum value from the MAMPEC-BW 3.0 or latest available version calculations should be used. If this comparison results in PEC/PNEC ratios above 1.0, the 95%-ile may be used. If the PEC/PNEC ratio is still above 1.0, additional mitigation measures or a scientific reasoning may be proposed for discussion in the GESAMP-BWWG.

2.6 The resulting table should be reported in the main document of the submission.

3 CALCULATION OF THE PEC IN THE VICINITY OF THE SHIP ($PEC_{NEAR\ SHIP}$)

3.1 The MAMPEC-BW, latest available version, will calculate the stationary concentration in the harbour after discharge of ballast water. To account for local effects, near the ship at discharge, the local concentration at near ship is estimated using the formulae suggested in Zipperle et al., 2011 (Zipperle, A., Gils J. van, Heise S., Hattum B. van, Guidance for a harmonized Emission Scenario Document (ESD) on Ballast Water discharge, 2011):

$$C_{\max} = \frac{C_{BW} + (S-1) \cdot C_{mean}}{S}$$

where:

C_{max} = the maximum concentration due to near ship exposure (µg/L) = $PEC_{near\ ship}$
C_{BW} = the concentration found in the discharged ballast water (µg/L)
S = dilution factor based on sensitivity analysis with a higher tier model, default value = 5
C_{mean} = the mean concentration as output from MAMPEC-BW = called average in the MAMPEC results calculated.

3.2 The concentration calculated with this formula will be compared to acute toxicity data for the Active Substances and Relevant Chemicals to evaluate the short-term effects on aquatic organisms according to the ratio:

$$PEC_{near\ ship}/\ PNEC_{near\ ship}.$$

APPENDIX 6

DATABASE OF CHEMICALS MOST COMMONLY ASSOCIATED WITH TREATED BALLAST WATER

For the 43 chemicals presented below, the GESAMP-BWWG holds sufficient information from the literature on physico-chemical, ecotoxicological and toxicological properties and no additional supporting information needs to be submitted by applicants. It is recommended that applicants make use of the latest version of the Database, as published by MEPC when preparing their application dossiers.

Substance	CAS-number
Acetaldehyde	75-07-0
Bromate ion	15541-45-4
Bromochloroacetic acid	5589-96-8
Bromochloroacetonitrile	83463-62-1
Chloral hydrate	302-17-0
Chloropicrin	76-06-2
Dalapon	75-99-0
1,2-dibromo-3-chloropropane	96-12-8
Dibromoacetic acid	631-64-1
Dibromoacetonitrile	3252-43-5
Dibromochloroacetic acid	5278-95-5
Dibromochloromethane	124-48-1
1,1-dichloroethane	75-34-3
1,1-dibromoethane	557-91-5
Dibromomethane	74-95-3
Dichloroacetic acid	79-43-6
Dichloroacetonitrile	3018-12-0
Dichlorobromoacetic acid	71133-14-7
Dichlorobromomethane	75-27-4
1,2-dichloroethane	107-06-2
Dichloromethane	75-09-2
1,2-dichloropropane	78-87-5
Formaldehyde	50-00-0
Monobromoacetic acid	79-08-3
Monobromoacetonitrile	590-17-0
Monochloroacetic acid	79-11-8
Monochloroacetonitrile	107-14-2
Monochloroamine	10599-90-3
Potassium bromate	7758-01-2

Substance	CAS-number
Sodium bromate	7789-38-0
Sodium hypochlorite	7681-52-9
Sodium thiosulphate	7772-98-7
Tetrachloromethane	56-23-5
Tribromoacetic acid	75-96-7
Tribromomethane	75-25-2
2,4,6-tribromophenol	118-79-6
Trichloroacetic acid	76-03-9
Trichloroacetonitrile	545-06-2
Trichloroethene	79-01-6
1,1,1-trichloroethane	71-55-6
1,1,2-trichloroethane	79-00-5
Trichloromethane	67-66-3
Trichloropropane	96-18-4

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BWM.2/Circ.42/Rev.1
28 May 2015

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

Guidance on ballast water sampling and analysis for trial use in accordance with the BWM Convention and Guidelines (G2)

1 The Marine Environment Protection Committee, at its fifty-eighth session (October 2008), following the adoption of the *Guidelines for ballast water sampling (G2)* (resolution MEPC.173(58)), instructed the Sub-Committee on Bulk Liquids and Gases (BLG) to develop, as a matter of high priority, a circular to provide sampling and analysis guidance.

2 MEPC 65 (13 to 17 May 2013) approved BWM.2/Circ.42 on *Guidance on ballast water sampling and analysis for trial use in accordance with the BWM Convention and Guidelines (G2)*, as agreed by BLG 17 (4 to 8 February 2013).

3 MEPC 66 (31 March to 4 April 2014) had invited Member Governments and international organizations to submit further information and proposals related to ballast water sampling, analysis and contingency measures to the Sub-Committee on Pollution Prevention and Response (PPR), with a view to further developing and improving the relevant guidance documents and guidelines.

4 MEPC 68 (11 to 15 May 2015) approved the revised *Guidance on ballast water sampling and analysis for trial use in accordance with the BWM Convention and Guidelines (G2),* as agreed by PPR 2 (19 to 23 January 2015), set out in the annex.

5 Member Governments are invited to bring the annexed Guidance to the attention of all parties concerned.

6 This circular supersedes BWM.2/Circ.42.

***

ANNEX 1

GUIDANCE ON BALLAST WATER SAMPLING AND ANALYSIS FOR TRIAL USE IN ACCORDANCE WITH THE BWM CONVENTION AND GUIDELINES (G2)

1 INTRODUCTION

1.1 The purpose of this guidance is to provide general recommendations on methodologies and approaches to sampling and analysis to test for compliance with the standards described in regulations D-1 and D-2 of the International Convention for the Control and Management of Ships' Ballast Water and Sediments, 2004 (BWM Convention). This guidance is an updated version of the guidance contained in document BLG 16/WP.4, taking into account advances in research since the document was first drafted, and should be read in conjunction with the BWM Convention, the *Guidelines for port State control under the BWM Convention* (resolution MEPC.259(67)) and the *Guidelines for ballast water sampling (G2)* (resolution MEPC.173(58)). Furthermore, and as instructed by MEPC 64, the sampling and analysis procedures to be used for enforcement of the BWM Convention should result in no more stringent requirements than what is required for Type Approval of ballast water management systems (BWMS).

1.2 This guidance consists of two parts,

.1 a discussion of the principles of sampling, accompanied by a list of recommended methods and approaches for analysis and sampling protocols available for compliance testing to the D-1 and D-2 standards in section 5; and

.2 background information on sampling and analysis methodologies and approaches, set out in the annex.

1.3 Sampling and analysis for compliance testing is a complex issue. According to the *Guidelines for ballast water sampling (G2)*, testing for compliance can be performed in two steps. As a first step, prior to a detailed analysis for compliance, an indicative analysis of ballast water discharge may be undertaken to establish whether a ship is potentially in compliance with the Convention.

1.4 When testing for compliance, the sampling protocol used should result in a representative sample of the whole discharge of the ballast water from any single tank or any combination of tanks being discharged.

2 DEFINITIONS

For the purpose of this guidance, the definitions in the BWM Convention apply and:

.1 A *sample* means a relatively small quantity intended to show what the larger volume of interest is like.

.2 *Representative sampling* reflects the relative concentrations and composition of the populations (organisms and/or chemicals) in the volume of interest. Samples should be taken in accordance with the annex, part 1 and/or part 2 of the *Guidelines on ballast water sampling (G2)*.

.3 *Analysis* means the process of measuring and determining the concentrations and composition of the populations of interest (organisms and/or chemicals) within the sample.

.4 An *indicative analysis* means a compliance test that is a relatively quick indirect or direct measurement of a representative sample of the ballast water volume of interest:

.1 an indirect, indicative analysis may include measurements whose parameters do not provide a value directly comparable to the D-2 standard, including biological, chemical, or physical parameters (e.g. dissolved oxygen levels, residual chlorine levels, Adenosine triphosphate (ATP), nucleic acid, *chlorophyll a*, and that by variable fluorescence, etc. The practicalities, applicability and limitations of these methods should be understood before they are used in compliance testing;

.2 a direct measurement, which is directly comparable to the D-2 standard (i.e. the determination of the number of viable organisms per volume) may also be indicative if it has:

.1 a large confidence interval, or

.2 high-detection limits; and

.3 an indicative analysis is an analysis performed in accordance with sections 4.1 and 4.2.

.5 A *detailed analysis* means a compliance test that is likely to be more complex than indicative analysis and is a direct measurement of a representative sample used to determine the viable organism concentration of a ballast water volume of interest. The result of such measurement:

.1 should provide a direct measurement of viable organism concentration in the ballast water discharge which is directly comparable to the D-2 standard (number of viable organisms per volume);

.2 should be of sufficient quality and quantity to provide a precise measurement of organism concentration (+/- [X] organisms per volume) for the size category(ies) in the D-2 standard being tested for; and

.3 should use a measurement method with an adequate detection limit for the purpose for which it is being applied.

A detailed analysis is an analysis performed in accordance with the methods and approaches in sections 4.3 and 4.4. Detailed analysis should usually be undertaken on a sample taken in accordance with the procedures in section 4.4.

.6 *Testing for compliance* using indicative analysis and detailed analysis can employ a range of general approaches or standard methods. These approaches or methods are divided into those that sample a small proportion of the volume of interest to indicate or confirm compliance or a larger proportion of the volume of interest that can be utilized to indicate and confirm compliance. Those that provide a wide confidence interval should not be used to confirm compliance unless the result and confidence limit are demonstrably over the D-2 standard as measured directly or indirectly. Approaches/Standards are highlighted in sections 4.1, 4.2 and 4.4 for indicative analysis and sections 4.3 and 4.4 for detailed analysis.

.7 *Method* means a detailed step-by-step analysis procedure (for indicative or detailed analysis) or sampling methodology, which the laboratory or organization undertaking the work can follow, be audited against and be accredited to.

.8 *Approach* means a detailed step-by-step analysis procedure (for indicative or detailed analysis) or sampling methodology, which the laboratory or organization undertaking the work can follow. These procedures will not have been validated by an international or national standards organization.

.9 *General approach* means a conceptual description or broad methodology of sample collection or analysis.

.10 *The precision* of a measurement system is the degree to which repeated measurements under unchanged conditions show the same results.

.11 *The detection limit* is the lowest concentration level that can be determined to be statistically different from a blank sample within a stated confidence interval. Limits of detection are method and analysis specific.

.12 *Plankton* means *phytoplankton* (e.g. diatoms or dinoflagellates) and *zooplankton* (e.g. bivalve larvae or copepods) that live in the water column and are incapable of swimming against a current.

.13 *Confidence interval* means a statistical measure of the number of times out of 100 that test results can be expected to be within a specified range. For example, a confidence level of 95% means that the result of an action will probably meet expectations 95% of the time.

.14 *Operational indicator* means a parameter used to monitor and control the operation of the BWMS as defined during testing for Type Approval, e.g. limit values of physical or chemical parameters such as flow rates, dose, etc.

.15 *Performance indicator* means a biological parameter (e.g. ATP, *chlorophyll a*, direct counts) used to estimate or measure the performance of the BWMS in achieving the D-2 standard.

3 PRINCIPLES FOR SAMPLING AND ANALYSIS FOR BALLAST WATER DISCHARGES

3.1 All samples and analysis carried out to determine whether a ship is in compliance with the BWM Convention should be performed under reliable and verified QA/QC procedures (note that any method, approach or sampling procedure should be rigorously validated and practicability should be assessed).

3.2 The first premise of any sampling and/or any analysis protocol is to identify the purpose of the protocol, i.e. to prove whether the discharge of a ship is meeting the D-1 standard or meeting the D-2 standard. There are many ways in which this can be done; however, they are limited by:

.1 the requirements of the methodologies available for sampling the ballast water discharge;

.2 the methods of analysis of samples being collected;

.3 the methods involved in statistically processing the results of these analyses;

.4 the specific operation of the ballast water management system (including when the treatment is applied during the ballast cycle and the type of treatment used); and

.5 the practicalities of sampling a very large volume of water and analysing it for very low concentrations of organisms.

3.3 Successful sampling and analysis is also based on identifying the viable biological population being sampled and its variability. If this population is homogenous, it is much easier to sample than one that is known to be heterogeneous. In the case of ballast water, the sample is drawn from a discharge with a population that can vary significantly. Consequently, the samples collected for indicative or detailed analysis should be representative samples.

3.4 Sampling a ballast water discharge is restricted even further when parts of the ballast water may have already been discharged. Very few inferences can be made on the quality of that ballast water already discharged based on sampling the remaining discharge as it happens. The challenge is to determine the volume of interest and how to sample it.

3.5 The qualitative difference between indicative analysis and detailed analysis often relies on the level of statistical confidence, which, in detailed analysis may be superior.

3.6 Indicative analysis (using operational or performance indicators) can be undertaken at any time throughout the discharge. In cases where indicative analysis identifies that a system is grossly exceeding the D-2 standard, it may be sufficient to establish non-compliance, however, the practicalities, application and limitations of the methodology being used for indicative analysis need to be understood fully.

3.7 Based on the discussion in paragraph 3.3, two different potential detailed sampling approaches can therefore be considered:

.1 sampling the entire discharge from a vessel during a port visit. During this approach:

.1 it will be impossible, by definition, for vessels to discharge prior to sampling;

.2 large numbers of samples are likely to be required over a long period of time;

.3 large sample volumes may be required over a long period of time; and

.4 sampling personnel would be required on the vessel over a significant period of time; and

.2 collecting a representative sample of the ballast water being discharged during some chosen period of time, e.g. one sample or a sequence of samples. During this approach:

.1 the sampling can be developed to fit the situation on board the vessel; and

.2 a representative sample of the discharge can be taken, and that volume can be selected in many ways, providing the opportunity for identifying and sampling specific volumes of the discharge if appropriate, e.g. choosing a percentage of the discharge or sampling duration.

3.8 The D-2 standard expresses a low concentration of organisms to identify in the analysis. The confidence in the result of any sampling and analysis depends on the error inherent in the sampling method and on the error inherent in the method used for analysing the sample. The cumulative error of both must be taken into account when evaluating the result.

3.9 The tables in sections 4.1, 4.2 and 4.3 set out the range of methodologies and approaches, currently identified for use to analyse ballast water discharges and how they relate to the specific sampling protocols in section 4.4. These methodologies and approaches are stand-alone techniques that need to be combined with specific sampling protocols. These protocols should recognize the limitations of each methodology, its inherent sampling requirements, and how it can fit into a comprehensive sampling protocol for compliance testing.

3.10 Although some methodologies and approaches used in type approval testing may also be applicable in compliance testing, the latter, especially indicative sampling, may also require other approaches.

Table 1

Definition and differences between indicative and detailed analysis for the D-2 standard

	Indicative analysis	**Detailed analysis**
Purpose	To provide a quick, rough estimate of the number of viable organisms	To provide a robust, direct measurement of the number of viable organisms
Sampling		
Volume	Small or large depending on specific analysis	Small or large depending on specific analysis
Representative sampling	Yes, representative of volume of interest	Yes, representative of volume of interest
Analysis method		
Analysis parameters	Operational (chemical, physical) and/or performance indicators (biological)	Direct counts (biological)
Time-consuming	Lower	Higher
Required skill	Lower	Higher
Accuracy of numeric organism counts	Poorer	Better
Confidence with respect to D-2	Lower	Higher

4 METHODOLOGIES FOR COMPLIANCE TESTING UNDER THE BWM CONVENTION

4.1 Table 2: Analysis methods that may provide an indication of compliance with the D-1 standard[1]

Indicator	General approach	Standard method	Notes	Level of confidence or detection limit and citation for validation studies
Salinity	Conductivity meter to monitor salinity.	No international standard for ballast water analysis at this time although standard methods for measuring salinity do exist.	External elements can affect the salinity.	To be determined.
Salinity	Refractometer to monitor salinity.	No international standard for ballast water analysis at this time although standard methods for measuring salinity do exist.	Temperature can affect the readings.	To be determined.
Types of organisms in discharge – oceanic, coastal, estuarine or fresh water	Visual identification.	No international standard for ballast water analysis at this time.	Expensive, time-consuming, needs extensively trained personnel; may produce false results if encysted organisms from previous ballasting operations hatch.	To be determined.
Turbidity	Portable turbidity sensors.	No international standard for ballast water analysis at this time.	Requires understanding of turbidity characteristics in relation to the distance from shore.	To be determined.
Dissolved Inorganic and Organic constituents (Nutrients, metals coloured dissolved organic matter (CDOM))	Portable nutrient sensors.	No international standard for ballast water analysis at this time.	Requires understanding of inorganic or organic constituent characteristics in relation to the distance from shore.	To be determined.

[1] Additional information can be found in document BLG 16/4.

4.2 **Table 3: Indicative analysis methods for use when testing for potential compliance with the D-2 standard[2]**

Indicator	General approach	Standard method	Notes	Level of confidence or detection limit and citation for validation studies
Viable organisms ≥ 50 µm	Visual counts or stereo-microscopy.	No international standard for ballast water analysis at this time.	Can be expensive and time-consuming, needs moderately trained personnel. (Note that OECD Test Guideline for Testing of Chemicals 202, "*Daphnia* sp. Acute immobilization test and reproduction test" could be used as basis for standard methodology.)	To be determined.
Viable organisms ≥ 50 µm	Visual inspection.	No international standard for ballast water analysis at this time.	Visual inspection is likely to only register organisms bigger than 1,000 micro-metres in minimum dimension.	To be determined.
Viable organisms ≥ 10 µm and < 50 µm	Variable fluorometry.	No international standard for ballast water analysis at this time.	Only monitors photosynthetic phytoplankton and thus may significantly underestimate other planktonic organisms in this size fraction.	To be determined.
Viable organisms ≥ 50 µm and ≥ 10 µm and < 50 µm	Photometry, nucleic acid, ATP, bulk fluorescein diacetate (FDA), *chlorophyll a.*	No international standard for ballast water analysis at this time.	Semi-quantitative results can be obtained. However, some of these organic compounds can survive for various lengths of time in aqueous solution outside the cell, potentially leading to false positives. Welschmeyer and Maurer (2012).	To be determined.

[2] Additional information can be found in document BLG 15/5/4.

Indicator	General approach	Standard method	Notes	Level of confidence or detection limit and citation for validation studies
Viable organisms ≥ 50 µm and ≥ 10 µm and < 50 µm	Flow cytometry.	No international standard for ballast water analysis at this time.	Very expensive.	To be determined.
Enterococci	Fluorometric diagnostic kit.	No international standard for ballast water analysis at this time.	Minimum incubation time 6 h. Semi-quantitative results from portable methods (see paragraph 2.2.2 of annex 1).	To be determined.
Escherichia coli	Fluorometric diagnostic kit.	No international standard for ballast water analysis at this time.	Minimum incubation time 6 h. Semi-quantitative results from portable methods (see paragraph 2.2.2 of annex 1).	To be determined.
Vibrio cholerae (O1 and O139)	Test kits.	No international standard for ballast water analysis at this time.	Relatively rapid indicative test methods are available.	To be determined.
Viable organisms ≥ 50 µm and ≥ 10 µm and < 50 µm	Pulse counting fluorescein diacetate (FDA).	No international standard for ballast water analysis at this time.	Sampling kit can be larger than that for bulk fluorescein diacetate (FDA).	To be determined.

4.3 **Table 4: Detailed analysis methods for use when testing for compliance with the D-2 standard**

Indicator	General approach	Standard method	IMO citation	Notes	Level of confidence or detection limit and citation for validation studies
Viable organisms ≥ 50 µm and ≥ 10 µm and < 50 µm	Visual counts or stereo-microscopy examination. May be used with vital stains in conjunction with fluorescence + movement.	No international standard for ballast water analysis at this time, but see US EPA ETV Protocol, v. 5.1	BLG 15/5/5 and BLG 15/5/6 BLG 15/INF.6	Can be expensive and time-consuming, needs trained personnel. (Note that OECD Test Guideline for Testing of Chemicals 202, "*Daphnia* sp. Acute immobilization test and reproduction test" could be used as basis for standard methodology.)	To be determined.
Viable organisms ≥ 10 µm and < 50 µm	Visual counts with use of vital stains.	No international standard for ballast water analysis at this time, but see US EPA ETV Protocol, v. 5.1	BLG 15/5/10 (method) BLG 15/5/5 and BLG 15/5/6 (approach) MEPC 58 /INF.10	Requires specific knowledge to operate them. It should be noted that there may be limitations using vital stains with certain technologies.	To be determined. Steinberg et al., 2011
Viable organisms ≥ 10 µm and < 50 µm	Flow cytometers (based on *chlorophyll a* and vital stains).	No international standard for ballast water analysis at this time.	BLG 15/5/5 and BLG 15/5/6	Expensive and require specific knowledge to operate them. It should be noted that there may be limitation using vital stains with certain technologies.	To be determined

Indicator	General approach	Standard method	IMO citation	Notes	Level of confidence or detection limit and citation for validation studies
Viable organisms ≥ 50 µm and Viable organisms ≥ 10 µm and < 50 µm	Flow cameras (based on *chlorophyll a* and vital stains).	No international standard for ballast water analysis at this time.	BLG 15/5/5 and BLG 15/5/6	Expensive and require specific knowledge to operate them. It should be noted that there may be limitations using vital stains with certain ballast water management systems.	To be determined
Viable organisms ≥ 50 µm and Viable organisms ≥ 10 µm and < 50 µm	Culture methods for recovery, regrowth and maturation.	No international standard for ballast water analysis at this time.	BLG 15/5/5 and BLG 15/5/6	Require specific knowledge to conduct them. Densities are expressed as Most Probable Numbers (the MPN method). Most species do not manage to grow using this method therefore cannot be used alone. 2-3 weeks incubation time needed.	To be determined
Enterococci	Culture methods.	ISO 7899-1 or ISO 7899-2	BLG 15/5/5 and BLG 15/5/6	Requires specific knowledge to conduct them. At least 44-h incubation time. EPA Standard Method 9230	To be determined.
Escherichia coli	Culture methods.	ISO 9308-3 or ISO 9308-1	BLG 15/5/5 and BLG 15/5/6	Requires specific knowledge to conduct them. At least 24-h incubation time. EPA Standard Method 9213D	To be determined.

Indicator	General approach	Standard method	IMO citation	Notes	Level of confidence or detection limit and citation for validation studies
Vibrio cholerae (O1 and O139)	Culture and molecular biological or fluorescence methods.	ISO/TS 21872-1/13/	BLG 15/5/5 and BLG 15/5/6	Requires specific knowledge to conduct them. 24-48 h incubation time. US EPA ETV Fykse et al., 2012 (semi-quantitative pass/fail-test) Samples should only be cultured in a specialized laboratory.	To be determined.
Enterococci, *Escherichia coli, Vibrio cholerae (O1 and O139)*	Culture with 11holera11ence-in-situ hybridization (FISH)	No international standard for ballast water analysis at this time.		Requires specific knowledge to conduct them. Quantitative and qualitative results after 8 h. Samples should only be cultured in a specialized laboratory.	To be determined.
Viable organisms ≥ 50 µm and viable organisms ≥ 10 µm and < 50 µm	Visual counts using stereo-microscopy examination and flow cytometry.	No international Standard for ballast water analysis at this time.	BLG 17/INF.15	A Sampling Protocol that identifies whether a system is broken or not working and producing a discharge that is significantly above the D-2 standard. Designed to detect gross non-compliance with 99.9% confidence. Needs to be Validated.	To be determined.

4.4 **Table 5: General approaches for sampling use when testing for compliance with the BWM Convention**

General approaches for sampling	Discharge line or BW tank	Citation for validation study or use	Sample error and detection limit	Relative sample error amongst approaches
Filter skid + isokinetic sampling	Discharge line	Drake et al., 201First et al., 2012 (land-based testing); shipboard validation underway, Prototype 01, SGS	To be determined	Lower
Cylinder containing plankton net + isokinetic sampling	Discharge line	MEPC 57/INF.17	To be determined	Lower
Sampling tub containing plankton net + isokinetic sampling	Discharge line	Gollasch, 2006 and Gollasch et al., 2007 Cangelosi et al., 2011	To be determined	Lower
Continuous drip sampler + isokinetic sampling	Discharge line	Gollasch and David, 2010, 2013	To be determined	Lower
Grab sample	BW tank	David and Perkovic, 2004; David et al. 2007, BLG14/INF.6	To be determined	Higher

4.5 **Table 6: Sampling and analysis methods/approaches for use when testing compliance with the BWM Convention. A checkmark indicates an appropriate combination of sampling and analysis.**

Analysis type size class or indicator microbe analysis method/approach	**Filter skid + isokinetic sampling**[3]	**Plankton net + isokinetic sampling**	**Continuous drip sampler + isokinetic sampling**	**Grab sample**
Indicative Analysis ≥ 50 µm Visual inspection Stereomicroscopy counts Flow cytometry Nucleic acid ATP *Chlorophyll a,* Bulk *FDA*	✓	✓		
Indicative Analysis < 50 µm and ≥ 10 µm variable fluorometry Flow cytometry Nucleic acid ATP *Chlorophyll a,* bulkBulk *FDA*			✓	✓

[3] Methods other than using an isokinetic approach as defined in Guidelines (G2) for acquiring a representative sample may be used in certain circumstances. Such methods should be validated prior to use.

Analysis type size class or indicator microbe analysis method/approach	**Filter skid + isokinetic sampling**[3]	**Plankton net + isokinetic sampling**	**Continuous drip sampler + isokinetic sampling**	**Grab sample**
Indicative Analysis Enterococci, *E. coli* Fluorometric diagnostics			✓	✓
Indicative Analysis *Vibrio 14holera* Test kits Culture methods + microscopy			✓	✓
Detailed Analysis ≥ 50 µm Stereomicroscopy counts Flow cytometry/Flow camera	✓	✓		
Detailed Analysis < 50 µm and ≥ 10 µm Visual counts + vital stain(s) Flow cytometry/Flow camera Culture methods			✓	
Detailed Analysis Enterococci, *E. coli* Culture methods FISH with pre-cultivation			✓	
Detailed Analysis *Vibrio 14holera* Culture methods FISH with pre-cultivation			✓	

4.6 References

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ANNEX 2

TECHNICAL DISCUSSION FOR THE GUIDANCE TO BALLAST WATER SAMPLING AND ANALYSIS IN ACCORDANCE WITH THE BWM CONVENTION AND GUIDELINES (G2)

1 INTRODUCTION

1.1 The purpose of this annex is to provide background information on:

.1 the development and use of methodologies for both indicative and detailed analysis and appropriate sampling; and

.2 analysis of the sample at an accredited laboratory.

1.2 This annex highlights the advantages, disadvantages and limitations of many different measures. Although recommendations are given in this document on what methodologies may be used, there are distinct benefits in using certain technologies at certain times. This should not stop the use of any of the methodologies, as long as the limitations are taken into account.

1.3 Any methods for analysis used for assessing compliance with the BWM Convention should be carefully validated under a range of operating conditions.

2 INDICATIVE ANALYSIS: METHODOLOGY AND APPROACHES

2.1 The D-1 standard

2.1.1 The D-1 standard requires the vessel to exchange its ballast water 200 nm from the coastline in waters 200 m deep, or if this cannot be achieved for safety reasons, 50 nm from the coastline in waters of the same depth. Therefore, the water in exchanged ballast water should have a similar salinity to that of mid-ocean water.

2.1.2 Indicative analysis for the D-1 standard of the BWM Convention could rely on the chemical parameters (e.g. salinity) of the water in the ballast water discharge, or on an estimate of species present. However, the latter might need trained personnel. If the ballast water discharge being tested has a salinity significantly less than that of 30 PSU, then it is likely that the ballast water has not been exchanged en route under the conditions required in the D-1 standard, or that the exchange has not been completed successfully.

2.1.3 Two exceptions to this are:

.1 when ballast water is taken up in port areas that are located in high-salinity environments, above 30 PSU. In such a case ballast water with a PSU of 30 may not originate from mid-ocean waters and therefore the ship may not be compliant with the D-1 standard; or

.2 when ballast water has been exchanged in designated ballast water exchange areas within 50 nm from the coastline in waters that may be of less salinity than the mid-ocean water. In this case the ballast water exchange would be compliant.

Therefore, the origin of the last ballast water exchange should be known before interpreting the results of salinity analysis.

2.1.4 Checking salinity could be backed up by further analysis of the organisms in the ballast water discharge to determine the origin of the ballast water; however, this would take time and need experienced staff. This can be done in line with the visual analysis methodologies outlined in paragraph 2.4.3 below. However, it should be noted that there are many external factors that could affect the salinity and the organisms in the ballast water, such as wet sediments in the ballast tanks, the state of the tide in the port concerned during its uptake and the fact that exchange may not remove all coastal organisms.

2.1.5 There are many ways to quickly and easily monitor the salinity of water on the market, and generic salinity measures should be used for indicative analysis.

2.2 Bacteria levels in the D-2 standard

2.2.1 Bacterial levels could be tested by a wealth of available portable methods. However, as the D-2 standard for bacteria is measured in colony forming units (CFU), the systems utilized may have to include a specific incubation time of the samples, which for commercially available systems is never shorter than four hours. Therefore, the time it takes for incubation limits the use of such systems for indicative analysis.

2.2.2 Advances in fluorometric diagnostics have resulted in a methodology that identifies the presence or absence of bacteria in a sample of the ballast water discharge. This methodology is based upon the detection of enzymes produced by the target bacteria in unconcentrated fresh water or marine samples and presently easily portable test kits for E. coli and Enterococci are available. This method can identify low levels of bacteria in water samples in less than 10 minutes, but the results are only semi-quantitative, i.e. a low level reading equates to a low level of bacteria. However, although the presence of bacteria can be shown, whether or not these organisms are living (i.e. form colonies) cannot be proven with this method at the present time. These diagnostic methods could be used in indicative analysis if very large numbers of organisms are identified.

2.3 Organisms of less than 50 micrometres and greater than or equal to 10 micrometres in minimum dimension[4] in the D-2 standard

2.3.1 Methods to measure the organisms in this category of the D-2 standard can be divided into two categories as follows:

.1 the use of biological indicators for organisms:

.1 nucleic acid;

.2 adenosine triphosphate (ATP), a coenzyme used as the main energy storage and transfer molecule in the cells of all known organisms; and

.3 indicators for the presence of organisms, such as *chlorophyll a*;

.2 the use of direct counts of living organisms (coupling a means to determine viability and manual or automatic counting of individual organisms).

[4] The "Minimum Dimension" means the minimum dimension of an organism based upon the dimensions of that organism's body, ignoring e.g. the size of spines, flagellae or antenna. The minimum dimension should therefore be the smallest part of the "body", i.e. the smallest dimension between main body surfaces of an individual when looked at from all perspectives. For spherical shaped organisms, the minimum dimension should be the spherical diameter. For colony forming species, the individual should be measured as it is the smallest unit able to reproduce that needs to be tested in viability tests. This should be considered whenever size is discussed in this document.

2.3.2 The presence of nucleic acid or ATP in a sample may be taken as an indication of life, but it should be noted that this nucleic acid or ATP could come from any living organism of any size within the sample. There are no definitive methods available to correlate the amount of nucleic acid or ATP with the amount, or viability of organisms in the sample and, therefore, the presence of these chemicals are limited as an indicative analysis methodology. However, zero measurements of these chemicals may indicate that no organisms are in the sample, i.e. the treatment process was successful and in the D-2 standard is being met. Additionally, if nested filters are used to isolate specific size groups, then ATP, which degrades relatively quickly, can provide an indication of the potential presence of a large concentration of organisms in one size class. If linked to thresholds of ATP concentrations, this can be used to indicate samples which are highly likely to be above the standard.

2.3.3 The same problems occur when using other bio-chemical indicators to monitor the number of organisms in this category. As many of the organisms in this size range are likely to be phytoplankton, an obvious step would be to measure the level of *chlorophyll a*, a photosynthetic pigment which is essential for photosynthesis in the sample. Zero concentrations may indicate that there is no phytoplankton in the sample and chlorophyll *a* may also be a good indicator as to whether a BWMS using an oxidizing process was working to design dosages, as it might be expected to bleach such pigments. However, caution has to be exercised as:

.1 *chlorophyll a* can persist in seawater outside of a cell, therefore, sampling should only be limited to the particulate phase. However, nucleic acid and ATP can exist in dead organisms, detrital material, senescent or dead cells, decomposing macroalgae, plant detritus from terrestrial ecosystems and other non-living particles, etc.;

.2 there may be zooplankton in the sample being analysed;

.3 no cell count can be directly measured from a *chlorophyll a* measurement, as many small cells may provide a similar signal strength to that of fewer bigger cells; and

.4 no size distinction can be made and the *chlorophyll a* could derive from phytoplankton in the larger size category of the D-2 standard.

As a consequence, direct concentration measurements of this chemical would be difficult to use in indicative analysis. A wealth of portable tools exists to document the *chlorophyll* a content in seawater.

2.3.4 One potential exception is the Pulse-Amplitude Modulated Fluorometer (PAM) which measures the *chlorophyll a* fluorescence in living cells by exciting *chlorophyll a* molecules and registering the subsequent fluorescent signal. Such a response is only available in living cells and it should be noted that this method only provides an indirect measurement of those phytoplankton that use *chlorophyll a* in the sample, in both size categories of the D-2 standard. Testing this methodology on ballast water discharges suggests that there is a correlation between the ratio of variable and maximum fluorescence and the number of phytoplankton in this size category. However, the relationship between fluorescence signals and mixed assemblages of phytoplankton from different locations needs to be validated.

2.3.5 For analysis of organisms above 10 microns in minimum dimension, a flow cytometer may also be used. A common element of these systems is that they automatically count objects, including organisms, per size class in a fluid. The more simplified systems cannot separate organisms from sediment and detritus, or living from dead organisms. More

sophisticated systems can also assess organism viability for phytoplankton by using organism stains together with flow cytometry. The separation of living phytoplankton from detrital material and zooplankton is based on the presence of auto chlorophyll fluorescence of phytoplankton cells. It should be noted, however, that using *chlorophyll a* fluorescence as an indicator of living organisms may result in over counting, as the molecule can remain intact for a significant amount of time as has been proved in preparing fixed (dead) samples. The practicability to use such devices on board a ship should be carefully assessed before use. To make a stable stream to produce adequate size of water particles, the device should be set in perfectly horizontal. Also any vibration should be isolated for accurate measurement.

2.3.6 Systems using flow cytometry deliver automated results promptly and may be used to assess the number of living phytoplankton in a sample after treatment with a viability stain. However, readings provided by the flow cytometer should also be examined manually to verify the automated readings. Concerns have been raised by users that the viability of smaller algae may not always be categorized correctly in these systems, as the viability signal may be too low for detection. Other concerns include the efficiency of portable versions and the limited ability of some of them to monitor organisms greater than or equal to 50 micrometres in minimum dimension. Although these systems may become a major tool in the future, there are elements, such as the reliability of portable versions of the systems that limit their use at the present time, which is especially the case for organisms greater than or equal to 50 micrometres in minimum dimension. Also, it is not clear if the time to analyse a sample is greater than can be allotted in compliance testing. These can be overcome by taking the sample off the ship and using a fixed or mobile system near to the ship or the port.

2.3.7 Visual inspection could be another method of indicative analysis that is a quick and simple way to justify the need for detailed analysis. Taking an appropriate sample, concentrating it if necessary, and visually inspecting it against the light may show living organisms in the sample, but it should be noted that without magnification a visual inspection is likely to result in only organisms greater than or equal to 1,000 micrometres in minimum dimension being detected, unless chains or clumps are formed by colony forming organisms or the density of organisms is sufficiently large to colour the water. An assessment of the viability in such an inspection is limited to complete body movements of the organisms as organ activity and antennae or flagella movements may not be seen. As samples from BWMS that are not compliant are likely to contain organism levels that are orders of magnitude above the D-2 performance standard, visual inspections could be used in indicative analysis. However, it is assumed that only organisms bigger than 1,000 micrometres in minimum dimension may be determined in such way, therefore, its use for this size category is limited.

2.3.8 Visual inspection can also be undertaken using a field stereomicroscope with a low magnification (e.g. x 10). However, this methodology may require concentration of the sample and may need analysis by a trained operator to detect viable organisms. It should also be noted that this methodology would be more efficient and practicable for organisms greater than or equal to 50 micrometres in minimum dimension.

2.4 Organisms greater than or equal to 50 micrometres in minimum dimension in the D-2 standard

2.4.1 Many of the methodologies for monitoring organisms less than 50 micrometres and greater than or equal to 10 micrometres in minimum dimension may also be valid for monitoring organism levels in this category. However, nucleic acid and ATP methodologies encounter the same problems as outlined in paragraphs 2.3.2 and 2.3.3; and monitoring *chlorophyll a* levels, through fluorometers or the PAM methodology described above, has limited value for this size category of the D-2 standard, as the majority of organisms in this category are likely to be zooplankton.

2.4.2 Visual inspections may significantly underestimate the number of organisms in this size category due to the issues described in paragraph 2.3.8. However, the method may be robust enough to determine whether the BWMS is working at orders of magnitude above the D-2 standard based on a simple extrapolation from the sample to the D-2 standard. Detailed analysis may be needed to confirm this, especially when levels near the D-2 standard are encountered.

2.4.3 Additionally, stereomicroscopy can also be used to identify viable organisms greater than or equal to 50 micrometres in minimum dimension. The sample should be concentrated appropriately. Viability assessment should be based on movements of intact organisms. This movement may be stimulated. In addition, organ activity should be observed and fully intact non-moving organisms which show organ activity should be counted as living. Stains might also be used to help in viability determination – though methods are still under development. The viable organism numbers should be recorded and the numbers extrapolated up to the total volume of water filtered.

2.4.4 If the results in paragraphs 2.4.2 and 2.4.3 show elevated levels of organisms, then this result will indicate that the D-2 standard is not being met.

2.4.5 Further research must be encouraged; innovative methods for assessing for D-2 compliance, preferably based on in situ, automatic sampling and analytical procedures, should facilitate the most uniform implementation of the BWM Convention.

2.5 Operational indicators

Other indirect parameters and indicators could be used to indicate whether a BWMS is meeting the D-2 standard. These include, but are not limited to, indicators from the electronic self-monitoring of the BWMS and residual chemicals (or lack of) from the BWMS, such as dissolved oxygen levels, residual chlorine, etc.

3 DETAILED ANALYSIS METHODOLOGIES AND APPROACHES

Once detailed analysis has been instigated by the port State, they should be prepared to undertake full analysis of the sample at an appropriate laboratory.

3.2 Bacteria

3.2.1 There are already international standards in place to analyse for the bacteriological indicators contained within the D-2 standard.

3.2.2 For Enterococci, ISO 7899-1 or 7899-2; or Standard Method 9230 (in the United States) should be used, and ISO 9308-3, ISO 9308-1 or Standard Method 9213D (in the United States) are appropriate for Escherichia coli. The methods used should be quantitative and based on a 95-percentile statistical evaluation. The number of laboratory samples should be sufficient to define the mean and standard deviation of Log 10 bacterial enumerations.

3.2.3 For *Vibrio cholerae* ISO/TS 21872-1/13 is appropriate. 100 ml of ballast water should be filtered and incubated according to ISO/TS 21872-1. Analysis needs to be undertaken in a specialist laboratory.

3.3 Organisms of less than 50 micrometres and greater than or equal to 10 micrometres in minimum dimension

3.3.1 Many of the analysis methods used to ascertain the numbers of organisms within this category have already been discussed in section 2. However, section 2 focuses on indicative analysis, rather than the more detailed analysis. Therefore, the following sections examine these methodologies in more detail. Some of these methodologies discussed here also relate to organisms greater than or equal to 50 micrometres in minimum dimension.

3.3.2 Simple upright and inverted microscopes are very useful for the enumeration of morphologically healthy organisms and motile organisms, as well as for measuring the size of organisms. Using this technology needs some skill and experience to evaluate the health of the individual organisms in the sample. However, this technology and experience should be available globally.

3.3.3 Fluorescence generated from photosynthetic pigments can be used for more detailed analysis of the morphological health of organisms and for the evaluation of stained organisms and a microscope with fluorescence capabilities is needed. However, this methodology only identifies phytoplankton (both living and dead) in the sample and makes no size differentiation. Zooplankton should be analysed through the methods highlighted in section 3.4.

3.3.4 Fluorescein di-acetate (FDA), chloromethylfluorescein diacetate (CMFDA) and Calcein-AM vital stains have both been used to determine viability. When non-specific esterases (enzymes found in live cells) are present, they cleave the acetate groups from the stains, and the resultant fluorescein molecules fluoresce green when illuminated with a blue light from an epi-fluorescence microscope. This method works best with live samples. Microscopes with a fluorescence capability and operators with skills and experience of analysis should be available at universities and research laboratories worldwide. However, it should be noted that these stains do not always work on all species or at all salinities and further research to validate this approach may be needed to support the use of these stains for this type of analysis.

3.3.5 Flow cytometers are advanced technologies which can be used in a laboratory to determine size, and viability of organisms in ballast water when a reliable vital stain(s) is (are) used to indicate organism viability. Cytometer detected particles, including organisms, can be processed visually or by a computer to quantify viable organisms in that sample. These systems reduce manual labour, but require specific knowledge to operate them. High particle loads in ballast water may reduce the detection limits of these methodologies and the volume of samples analysed. At present, portable versions of these technologies have not fully been proven for use on ballast water discharges, however, samples could be taken off the ship and analysed using a fixed or mobile system near to the ship or the port.

3.3.6 Regrowth experiments, in which the visual appearance of photosynthetic organisms in a sample is followed by a specific period in order to quantify the Most Probable Number (MPN), are methods to evaluate the number of organisms in a sample. However, these are slow and are work intensive. In addition, a major drawback of this methodology may be that specific growth factors during the incubation may not be fulfilled, giving a risk of bias. Regrowth and reproduction may be seasonably variable, giving different results at different times. Further, a viable organism may be in good health and reproducing rapidly, or in poor health, not reproducing until health has improved. Finally, this is likely to be time-consuming.

3.3.7 Bulk parameter measurements, such as photosynthetic activity, are also not suitable for detailed analysis (please see paragraphs 2.3.2 and 2.3.3), but can be used as supporting data for other methods used to determine the number of viable organisms in the ballast water samples.

3.3.8 Planktonic organisms may be fragile and samples may need to be concentrated further to aid the accurate quantification of organisms. There are many methods to achieve this, however, care has to be taken to reduce physical stress as this may result in reduced viability levels. A simple, rapid, flexible and cautious method for concentrating plankton cells is the use of transparent membrane filters. If the sample analysis is performed on board the sample can be filtered directly on to this membrane, which can subsequently be placed directly under a microscope for examination. The sample volume to be analysed would need to be adjusted depending on the cell density, however, live, vital stained and fixed organisms within this size category can be evaluated on these filters. If the representative analysis is performed at a laboratory, this process for concentration should be performed at the laboratory just before starting the staining process to avoid under-estimate of viable organisms. Importantly, the loss (if any) of organisms (i.e. those cells passing through the filter and recovered in the filtrate) would need to be determined. Alternatively, a filter mesh may be used to concentrate the sample and the concentrated organisms may, after filtration, be transferred into an observation chamber. Again, the loss of organisms through damage must be quantified.

3.4 Organisms greater than or equal to 50 micrometres in minimum dimension in the D-2 standard

3.4.1 Paragraphs 3.3.2 to 3.3.8 are also applicable to the analysis of organisms in this size category.

3.4.2 In addition, the following issues need to be considered when developing a methodology for analysing organism numbers in this size category:

.1 testing the sample for movement and response to different stimuli are simple techniques for the examination of viable/dead zooplankton under a stereomicroscope. The observation for organ activity, such as heartbeats, may also contribute to the viability assessment. The use of a filtering mesh (e.g. 50 microns in diagonal dimension) under the Petri dish of the stereomicroscope, or the addition of 50 micron micro beads to the sample, may help with size calculations and vital stains may also add value to these methodologies. Separate guidelines on this issue are being developed through the land-based facilities and the ETV protocol in the United States;

.2 methods using a combination of flow cytometry and microscopy have the disadvantage of high complexity, high price and small sample sizes, which means the ballast water samples would have to be concentrated further; and

.3 the storage condition and time before analysis is likely to be critical to reduce mortality in the sample.

3.4.3 It is therefore recommended that simple microscopic examination of organisms in this size category is used for compliance monitoring. The microscopic examination of organisms is a robust, simple and cheap methodology which can be completed in laboratories worldwide.

4 SOURCES OF ERROR

4.1 The ideal method for compliance monitoring is a procedure that:

.1 detects organisms in the ballast water discharge;

.2 has an appropriate limit of detection;

.3 is precise;

.4 is accurate;

.5 is economical;

.6 is quick;

.7 can be carried out with minimal technical expertise; and

.8 can be obtained in all parts of the world.

However, any result obtained would have to include confidence limits based on both the sampling error and analytical error.

4.2 Sources of error include, but are not limited to, errors arising within:

.1 sampling, including:

.1 sample loss (e.g. during filtration);

.2 incorrect use of equipment;

.3 day-to-day variations in the conditions in which the sampling is taking place; and

.4 the experience of the technicians;

.2 processing the sample, including:

.1 incorrect use of equipment;

.2 day-to-day variations in the conditions in which the sampling is taking place; and

.3 the experience [and fatigue] of the technicians;

.3 analysis of the sample:

.1 incorrect use of equipment;

.2 the experience [and fatigue] of the technicians;

.3 day-to-day variations in the conditions in which the sampling is taking place;

.4 the number of organisms counted. The distribution of organisms in a range of samples usually follows the Poisson distribution and higher numbers of samples give a lower relative variation and sample error;

.5 the inherent variation and errors arising from the methods used for analysis. This is especially so when the evaluation of organism numbers in a sample is based on manual counting methods due to human error. For example, although the definition of the minimum dimension of an organism in Guidelines (G2) is quite detailed,

analytical results may be influenced by practical issues. These include situations when the size of an organism is determined on a two dimensional microscope, which cannot view the organism "from all perspectives"; and

.6 poor harmonization between laboratories and quality control within the laboratory. In the field of chemical analysis, inter-laboratory calibration occurs and is tested. Inter-laboratory calibration of biological samples is also common practice, but the difficulty in the compliance monitoring context is that the viability of the organisms needs to be documented and the viability may be impaired by the mode and duration of sample shipments to different laboratories. Therefore, laboratories should be well managed, and uncertainty limits (the analysis variation) should be calculated for each laboratory. This should be achieved in conjunction with ISO 17025, which provides a standard for the general requirements needed by laboratories to prove they are competent to carry out tests and/or calibrations, including sampling.

4.3 The variation arising from sampling should be added to that from analysis to determine the confidence limits within which the true value of the organism number lies. This has an important bearing on how the result can be used for enforcement of the BWM Convention.

4.4 The sampling uncertainty can be obtained by setting up a null–hypothesis, that is a general or default position that is expected in the results, e.g. the average concentration of organisms is equal to the D-2 standard at a selected level of significance and then the data would be analysed using one of the following tests:

Table 1: Statistical handling of the results

Distribution of the results	Test	Notes
Normal distribution	t-test	It is unlikely this test will be used, as it is not used with "rare" populations, i.e. the expected population of organisms in treated ballast water
A distribution that is not normal	Non-parametric Wilcoxon rank test	Not normal due to the small number of samples
Poisson distribution	Chi-square test	Used when the analytical results are treated as one sample (i.e. the numbers of organisms over the entire volume are very rare [low] and combined).

Ideally, an analysis of the distribution should be performed before the data are statistically evaluated.

4.5 There has been much discussion within IMO on whether the results of the analysis should be averaged to assess compliance or that every result should have to meet the D-2 standard. This is a unique debate at IMO due to the biological nature of the subject

matter being analysed, and different States have significantly different views on this issue. Therefore, it will be very difficult to arrive at a conclusion as in the case of non-compliance the results of the analysis are likely to be used in the legal jurisdictions of each IMO Member State, and each of those States may require different evidence to support any enforcement action.

4.6 If the results of detailed analysis are to be averaged, then both the sample variation and the analysis variation need to be calculated and applied to the result. However, some analysis of the sample variation may be needed, as it may be unacceptably high. For example, for five treated ballast water samples, viable organism number results of 9,9,9,9 and 9 will provide the same average as 0,0,0,0 and 45. Both systems would pass the D-2 standard, if averaged; however, the variation is considerably bigger for the second set of results and may prove to be unacceptable because of the one large value.

4.7 If each of the results is treated as an individual value that has to meet the D-2 standard, then again the confidence limits would have to be calculated from the sampling and analytical errors. Here if all results are less than the D-2 standard, then the sampling has proved that the BWMS is meeting the standard.

4.8 The basic difference between instantaneous and average approaches is that the results of the average approach describe the variations of the concentration of organisms during the deballasting event, whereas the results of the instantaneous approach describes the variation based on the assumptions of the Poisson distribution. However, the average approach, based on the results of a few samples, has the disadvantage that the variation may be too high, is unacceptable and needs to be improved, which could invalidate the evaluation and lead to inconclusive results.

4.9 The instantaneous approach has the disadvantage that variations in the organism levels at different times of the discharge are not taken into account, which should not be a problem if all the samples meet the D-2 standard. If the discharge is not always under the D-2 standard, the problem can be mitigated by using a flow-integrated sample over set periods of time, which, if taken properly, represents an average of the organisms in the treated ballast water over that time when presented with variance estimates and confidence intervals. This constitutes a better representation of the ballast water quality than separate samples. In addition, a lower variation should be obtained because a larger sample is being analysed. The average approach is likely to have the same disadvantages unless the samples are very large and collected over most of the discharge.

4.10 The differences between applying an instantaneous sampling regime or an average sampling regime to the result are less extreme when taking numerous flow-integrated samples. This is because for each discharge there will be a number of results arising from samples that have been averaged over a specific time.

5 DETAILED ANALYSIS: THE SAMPLE PROTOCOL

5.1 Sample protocols for discharges of treated ballast water through a distinct discharge point fall into two categories, the first based on specified and replicated volumes and the second based on flow integration over a specified time. The first entails taking a specific number of set volumes of the ballast water discharge, whilst the second takes a continuous sample over a set time period. The flow integration sampling protocol can be achieved by either continuously sub-sampling a small amount throughout the entire duration of the discharge, therefore, collecting one sample over time, or taking multiple sub-samples over a specific time scale (i.e. 5 minutes, 10 minutes or 15 minutes) repeatedly throughout the discharge, providing a result for each sub-sample.

5.2 However, for sampling protocols based on specified and replicated volumes, defining both the number of samples and their volume to ensure representativeness, takes time. As a representative sampling procedure is needed to ensure compliance with the BWM Convention, then the flow integration protocols based on set times should be implemented.

5.3 Using a sampling protocol that continuously sub-samples small amounts throughout the entire duration of the discharge, may significantly underestimate the amount of larger organisms (i.e. organisms greater than or equal to 50 micrometres in minimum dimension) in the sample due to damage to the organisms held in the cod-end of the filter. If such a system is used then a protocol for replacing the cod end needs to be developed.

5.4 The arrangements for detailed analysis should take into account the requirements of the methods and/or approaches they intend to use for detailed and/or indicative analysis. Special consideration should be given and contingencies arranged for sampling in remote ports, where it is likely to take time to mobilize samplers and sampling resources.

6 DETAILED METHODOLOGY

6.1 As described in paragraph 5.1, there are two distinct ballast water sampling protocols, one based on flow integration and one based on the use of specified and replicated volumes. As they both use filtration and concentration of the sample the following section can apply to both methods.

6.2 For in-line sampling, a sampling system should be set up which:

.1 collects organisms greater or equal to 50 µm;

.2 allows samples of the ballast water to be taken and filtered;

.3 enables the amount of ballast water sampled to be measured to allow for extrapolation of the results; and

.4 allows the filtered ballast water to be discharged safely without affecting the stability and safety of the ship, its crew and the samplers or other discharges from the vessel such as bilge water.

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GUIDANCE ON THE APPLICATION OF REGULATION 13 OF MARPOL ANNEX VI TIER III REQUIREMENTS TO DUAL FUEL AND GAS-FUELLED ENGINES

1 The Marine Environment Protection Committee, at its sixty-eighth session (11 to 15 May 2015), recognizing the need for uniform application of regulation 13 of MARPOL Annex VI Tier III requirements to dual fuel and gas-fuelled engines, approved the *Guidance on the application of regulation 13 of MARPOL Annex VI Tier III requirements to dual fuel and gas-fuelled engines*, as set out in the annex.

2 Member Governments are invited to bring the annexed guidance to the attention of Administrations, industry, relevant shipping organizations, shipping companies and other stakeholders concerned.

3 Member Governments and international organizations are also invited to provide information on the outcome and experience gained in applying the guidance to a future session of the Committee.

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ANNEX

GUIDANCE ON THE APPLICATION OF REGULATION 13 OF MARPOL ANNEX VI TIER III REQUIREMENTS TO DUAL FUEL AND GAS-FUELLED ENGINES

1 The NO_X certification requirements of regulation 13 of MARPOL Annex VI include dual fuel engines (those which can simultaneously use both liquid and gas fuels). MEPC 66 adopted amendments to the NO_X Technical Code 2008 in order to specifically cover certain specific aspects related to the NO_X certification of those engines.

2 MEPC 67 adopted amendments to MARPOL Annex VI which extend the scope of the definition of a marine diesel engine as given by regulation 2.14 to include gas-fuelled engines installed on ships constructed on or after 1 March 2016 and also such engines installed as additional or non-identical replacement engines on or after that date. PPR 2 considered further amendments to the NO_X Technical Code 2008 relating to the certification of gas-fuelled engines which were subsequently approved by MEPC 68. As such, these steps may be seen as complementary to the *International Code of Safety for Ships using Gases or other Low-flashpoint Fuels (IGF Code)*, adopted by MSC 95 in June 2015 (resolution MSC.391(95)).

3 Therefore, the procedures for the certification of engines which use gas as a fuel, typically natural gas, but also other gases, have now been finalized.

4 Gas-fuelled engines, where ignition is initiated by a spark plug or another external ignition device, are generally expected to readily meet the Tier III NO_X emission limits and therefore it is possible that engine builders will seek only Tier III certification for such engines, irrespective of whether they are to be installed on ships which operate outside or inside Emission Control Areas (ECA) for NO_X as described in regulation 13.6 of MARPOL Annex VI, currently the North American ECA and the United States Caribbean Sea ECA, both of which will take effect from 1 January 2016.

5 In the case of dual fuel engines, those engines which use gas fuel in a pre-mix combustion process with the liquid fuel as the pilot ignition source (as opposed to gas-diesel engines which use high pressure gas injection directly into the combustion chamber) are expected to be certified to the Tier III NO_X standards when operating in that arrangement. Consequently, the Technical Files for such engines will include the restriction that, when operating in the Tier III condition, the liquid fuel rate will be limited to the certified maximum liquid pilot fuel rate and those engines will undergo their Tier III Parent Engine test on that basis.[1] These engines are expected to be certified to the Tier II NO_X standards when operating on liquid fuel oil only. In these cases, the EIAPP Certificate would be completed for both Tier II (liquid fuel only) and Tier III (gas fuel with pilot fuel), with a single Technical File giving two different modes of operation.

6 In terms of the applied Onboard NO_X Verification Procedure, virtually all engines use the Parameter Check Method. In this, the Technical Files will provide that all replacements and adjustments to the listed components and settings which affect NO_X emissions are to be recorded in a Record Book of Engine Parameters. This is also the case for engines certified to both Tier II and Tier III, with replacements and adjustments for both operating conditions being listed. In addition, amendments to regulation 13 of MARPOL Annex VI approved at MEPC 68 also require that the tier and on/off status of an engine certified to both Tier II and Tier III or only Tier II on ships subject to regulation 13.5.1 of MARPOL Annex VI should be recorded

[1] The sulphur limit of the fuel used in these engines, in Tier II and Tier III configuration, is subject to MARPOL Annex VI regulation 14 requirements regardless.

together with the date, time and ship's position at entry into and exit from an ECA under regulation 13.6 of MARPOL Annex VI or when the on/off status changes within such designated area. It should be noted that prior to entry into an ECA, sufficient time must be allowed for the tier changeover, to ensure Tier III compliance upon entry into the ECA, and the Technical File should include a written procedure showing how the tier change-over is to be done. The ship must also log the fuel oil change-over as required under regulation 14.6 of MARPOL Annex VI.

7 NO_X emissions during operation on pure liquid fuel resulting from restricted gas supply in cases of failure under paragraph 1.3.10 of the NO_X Technical Code 2008 should follow regulation 3.1.2 of MARPOL Annex VI. This would indicate that if such failure prevents operation on gas fuel, the ship should take reasonable precautions to minimize emissions by operating at Tier II NO_X levels, if feasible. It should be noted that non-availability of gas fuel under regulation 18 of MARPOL Annex VI is not regarded as a failure in this provision.

8 A particular issue for gas or dual fuel engines, including those engines on gas tankers where boil-off from the cargo tanks is the only source of gas fuel on board, is the situation immediately following building, before or after dry docking, or when repairs or maintenance are done on board the ship, when a ship is required to not have gas fuel or gas cargo on board due to safety requirements. In these particular situations, a coastal/port State would have discretion with respect to how the ship would proceed through the ECA. For example, the coastal/port State may allow the ship to proceed to and/or from the dry dock or repair or maintenance location or from the shipyard using liquid fuel, without associated Tier III NO_X controls, provided the fuel is SO_X ECA-compliant or, alternatively, it may specify some other conditions for that limited voyage.

9 It is possible that certain auxiliary control devices (ACD), as mentioned in regulation 13.9 and defined in regulation 2.4 of MARPOL Annex VI, respectively, may be used on dual fuel and gas-fuelled engines, covering starting and stopping, low load operation and manoeuvring and reversing operation. During this type of operation, the amount of liquid fuel used may exceed the maximum amount that the engine was operated on when certified to the test cycles in appendix II of MARPOL Annex VI, resulting in higher NO_X emissions. These ACDs should be disclosed at the time of Tier III certification and denoted in the engine's Technical File.

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GUIDANCE FOR ISSUING REVISED CERTIFICATES, MANUALS AND RECORD BOOKS UNDER ANNEXES I, II AND V OF MARPOL FOR COMPLIANCE WITH ENVIRONMENT-RELATED REQUIREMENTS OF THE POLAR CODE

1 The Marine Environment Protection Committee at its sixty-eight session (11 to 15 May 2015) approved the *Guidance for issuing revised certificates, manuals and record books under Annexes I, II and V of MARPOL for compliance with environment-related requirements of the Polar Code*, as set out in the annex.

2 Member Governments are invited to bring the attached guidance to the attention of Administrations, recognized organizations, port authorities, shipowners, ship operators and other parties concerned.

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ANNEX

GUIDANCE FOR ISSUING REVISED CERTIFICATES, MANUALS AND RECORD BOOKS UNDER ANNEXES I, II AND V OF MARPOL FOR COMPLIANCE WITH ENVIRONMENT-RELATED REQUIREMENTS OF THE POLAR CODE

Introduction

1 The Marine Environment Protection Committee (the Committee), at its sixty-eight session (11 to 15 May 2015), adopted, by resolution MEPC….(68), the environment-related provisions of the International Code for Ships Operating in Polar Waters (Polar Code), together with amendments to MARPOL Annexes I, II and V to make the Introduction and corresponding chapters of part II-A of the Polar Code mandatory (resolution MEPC….(68). The Polar Code is expected to take effect on 1 January 2017, upon entry into force of the associated MARPOL amendments.

2 In accordance with the Committee's decision that compliance with the environment-related requirements of the Polar Code should be reflected in the existing certificates, manuals and record books under the relevant Annexes to MARPOL, amendments have been introduced to the following certificates, manuals and record books:

.1 Supplement to the International Oil Pollution Prevention Certificate (IOPP Certificate) – Forms A and B;

.2 Standard format for the Procedures and Arrangements Manual; and

.3 Form of Garbage Record Book.

3 This guidance advises on the revision of certificates, manuals and record books under Annexes I, II and V of MARPOL for compliance with the environment-related requirements of the Polar Code.

International Oil Pollution Prevention Certificate (IOPP Certificate)

4 Amendments have been introduced to the Supplement to the IOPP Certificate (Forms A and B) to certify that category A and B ships constructed on or after 1 January 2017 are in compliance with the additional structural requirements on tank protection, as set out in section 1.2 of chapter 1 of part II-A of the Polar Code.

5 In this regard, the *Guidance on the timing of replacement of existing certificates by the certificates issued after the entry into force of amendments to certificates in IMO instruments* (MSC-MEPC.5/Circ.6) provides, inter alia, that in cases where the ship has not to comply with new requirements, the certificate (and its supplement, if any) is not reissued until its expiry.

6 In addition, in cases where the ship has to comply with new requirements, the certificate (and its supplement, if any) is reissued at the first opportunity of the survey related to the new requirement, occurring after the date of entry into force of the amendments.

7 In view of the guidance quoted in paragraph 5, it is recommended that ships built before 1 January 2017, operating in polar waters, should be allowed to use the existing IOPP certificate until its expiry, as there are no additional structural requirements for existing ships.

8 Paragraph 1.1.3 of chapter 1 of part II-A of the Polar Code requires that, subject to the approval of the Administration, a category A ship constructed before 1 January 2017 that cannot comply with paragraph 1.1.1 for oil or oily mixtures from machinery spaces and is operating continuously in Arctic waters for more than 30 days shall comply with paragraph 1.1.1 not later than the first intermediate or renewal survey, whichever comes first, one year after 1 January 2017.

9 It is recommended that the approval of existing category A ships could be achieved through a letter of approval issued by the Administration, using the phase-in provision of paragraph 1.1.3 of chapter 1 of part II-A of the Polar Code, instead of reflecting the approval on the IOPP certificate.

International Pollution Prevention Certificate for the Carriage of Noxious Liquid Substances in Bulk or Certificate of Fitness

10 Paragraph 2.1.3 of chapter 2 of part II-A of the Polar Code requires that, for category A and B ships constructed on or after 1 January 2017, the carriage of noxious liquid substances (NLS) identified in chapter 17, column e, as ship type 3 or identified as NLS in chapter 18 of the International Code for the Construction and Equipment of Ships Carrying Dangerous Chemicals in Bulk (IBC Code) in cargo tanks of type 3 ships, shall be subject to the approval of the Administration. The results shall be reflected on the International Pollution Prevention Certificate for the Carriage of Noxious Liquid Substances in Bulk or Certificate of Fitness identifying the operation in polar waters.

11 The Committee agreed that there is no need for amendments to the NLS Certificate or the Certificate of Fitness and further recommended the following with regard to the approval referred to in paragraph 2.1.3 of chapter 2 of part II-A: when considering the approval of the carriage of NLS identified in chapter 17, column e, as ship type 3 or identified as NLS in chapter 18 of the IBC Code, the carriage conditions for voyages in polar waters may be noted in the column "Conditions of carriage" or in the general remarks related to the certificate. This applies to both the NLS Certificate and Certificate of Fitness.

Standard format for the Procedures and Arrangements Manual

12 Amendments have been introduced to paragraphs 1.3 and 4.4 of the standard format for the Procedures and Arrangements Manual, to make reference to the requirements of chapter 2 of part II-A of the Polar Code. The amendments to the manual are to be made prior to entering polar waters on or after 1 January 2017.

13 It is recommended that prior approval of the Administration, in accordance with paragraph 8 of the introduction part of the Procedures and Arrangements Manual, may be given automatically for ships introducing modifications to paragraphs 1.3 and 4.4 of the manuals, as set out in resolution MEPC….(68). Where such an automatic approval has been given, this approval remains valid until the first scheduled survey related to the NLS Certificate or the Certificate of Fitness.

Form of Garbage Record Book

14 Amendments have been introduced to the chapeau of section 4.1.3 of the Form of Garbage Record Book to make reference to the provisions of chapter 5 of part II-A of the Polar Code.

15 It is recommended that no approval is needed for ships introducing modifications to section 4.1.3 of the Form of Garbage Record Book, as set out in resolution MEPC.265(68).