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COMMISSION STAFF WORKING DOCUMENT

For the Council Shipping Working Party

IMO – Union submission to be submitted to the 71st session of the Committee on Marine Environment Protection (MEPC 71) of the IMO in London from 3 – 7 July 2017 concerning amendments to the IMO Exhaust Gas Cleaning Guidelines (2015)

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PURPOSE

The document in Annex contains a draft Union submission to the 71st session of the Committee on Marine Environment Protection (MEPC 71) of the IMO concerning amendments to the (2015) IMO Exhaust Gas Cleaning Guidelines. It is hereby submitted to the appropriate technical body of the Council with a view to achieving agreement on transmission of the document to the IMO prior to the required deadline of 31 March 2017[1].

MARPOL Annex VI requirements, with regard to limitation of SOx emissions, are implemented in EU law in Directive (EU) 2016/802 of the European Parliament and of the Council of 11 May 2016 relating to a reduction in the sulphur content of certain liquid fuels[2]. The 2009 Guidelines on Exhaust Gas Cleaning Systems (adopted as Resolution MEPC.184(59)) are referred to in Annex II of Directive 2016/802/EU in relation to conditions for the use of Exhaust Gas Cleaning Systems under that Directive. Furthermore, an amendment of the Guidelines may influence the flexibility Member States have in their choices to achieve the mandatory quality objectives laid down in existing EU rules regulating surface water quality (Directive 2000/60/EC of the European Parliament and of the Council of 23 October 2000 establishing a framework for Community action in the field of water policy (the 'Water Framework Directive') and Directive 2008/56/EC of the European Parliament and of the Council establishing a framework for community action in the field of marine environmental policy (the 'Marine Strategy Framework Directive')) as well as the emissions of priority substances and other pollutants including excess nutrients to water (Water Framework Directive and Directive 2008/105/EC[3] of the European Parliament and of the Council on environmental quality standards in the field of water policy, amending and subsequently repealing Council Directives 82/176/EEC, 83/513/EEC, 84/156/EEC, 84/491/EEC, 86/280/EEC and amending Directive 2000/60/EC of the European Parliament

[1] The submission of proposals or information papers to the IMO, on issues falling under external exclusive EU competence, are acts of external representation. Such submissions are to be made by an EU actor who can represent the Union externally under the Treaty, which for non-CFSP (Common Foreign and Security Policy) issues is the Commission or the EU Delegation in accordance with Article 17(1) TEU and Article 221 TFEU. IMO internal rules make such an arrangement absolutely possible as regards existing agenda and work programme items. This way of proceeding is in line with the General Arrangements for EU statements in multilateral organisations endorsed by COREPER on 24 October 2011.

[2] OJ L 132, 21.5.2016, p. 58.

[3] As amended by Directive 2013/39/EU

and of the Council). In addition, on-board exhaust gas cleaning systems are listed in Commission Implementing Regulation (EU) 2017/306 indicating design, construction and performance requirements and testing standards for marine equipment[4], which refers to IMO Resolution MEPC.259(68), and therefore have to comply with the requirements of Directive 2014/90/EU on marine equipment and repealing Council Directive 96/98/EC[5]. The said draft Union submission therefore falls under EU exclusive competence.

[4] OJ L 48, 24.2.2017, p. 1.

[5] OJ L 257, 28.8.2014, p. 146.

ANNEX

INTERNATIONAL MARITIME ORGANIZATION

E

MARINE ENVIRONMENT PROTECTION COMMITTEE
71st session
Agenda item X

MEPC 71/X/Y
22 February 2017
Original: ENGLISH

REVIEW OF THE 2015 GUIDELINES FOR EXHAUST GAS CLEANING SYSTEMS (RESOLUTION MEPC.259(68))

Proposals for amendments to the 2015 Guidelines for Exhaust Gas Cleaning Systems

Submitted by the European Commission on behalf of the European Union

SUMMARY

Executive summary:	As an equivalent to using fuel oils of sulphur contents as specified in regulation 14, industry has seen an increasing number of Exhaust Gas Cleaning Systems (EGCS), or scrubbers, installed on ships. Technical development of these EGCSs has also advanced rapidly during the past few years. However, in applying the 2009, and the amended 2015, Guidelines for Exhaust Gas Cleaning Systems, it has become apparent that various sections of the guidelines require further technical and editorial clarification in order to ensure their uniform and robust application. For these reasons several proposals are made in this document for amendments to the existing 2015 Guidelines for Exhaust Gas Cleaning Systems (resolution MEPC.259(68)). The intention with this submission is to provide needed clarification regarding the consistency and practicability of the guidelines without weakening the level of protection to the marine environment provided by the existing guidelines.
Strategic direction:	2, 7.2, 7.3, 8, 10
High-level action:	2.0.1, 7.2.2, 7.3.1
Output:	Revision of the 2015 Guidelines for Exhaust Gas Cleaning Systems (resolution MEPC.259(68))
Action to be taken:	Paragraph 81
Related documents:	Resolution MEPC.259(68), 2015 Guidelines for Exhaust Gas Cleaning Systems, MEPC 69/19, MEPC 69/21

Introduction and background

1 The Committee may recall that the latest version of the guidelines was adopted quite recently by resolution MEPC.259(68) at MEPC 68, but the amendments made to the previous version of the guidelines, the 2009 Guidelines for Exhaust Gas Cleaning Systems (resolution MEPC.184(59)), only involved amendments to chapter 6 with regard to emission testing and chapter 10 with regard to application of calculation-based methodologies for verification of compliance with washwater discharge criteria for pH.

2 The 0.10% sulphur limit for fuel oil entered into force in Emission Control Areas on 1 January 2015. As an equivalent to using low sulphur fuel oil, industry has seen an increasing number of Exhaust Gas Cleaning Systems (EGCS), or scrubbers, installed in ships sailing in these areas. This is a fact that can be further confirmed by an increased number of EGCS approvals reported to IMO and continuously updated in the GISIS database (industry reports 360 systems sold to date, but only 90 systems have been reported to GISIS[6]). A recent study on fuel oil availability, submitted to the previous session of MEPC (MEPC 70-INF.6 - Assessment of fuel oil availability - final report (Secretariat)) included as a baseline scenario for analysis an estimate of 3,800 EGCS installations onboard ships worldwide, by January 2020.

3 Technical development of EGCSs has also advanced rapidly during the past years, not only in regard to engineering and arrangement aspects, but also in regard to the mode of operation, functionality and environmental performance. On top of this, it has become apparent that the language in various sections of the guidelines is not sufficiently clear, which has resulted in non-uniform application of the existing guidelines.

4 The proponents of this document proposed at MEPC 69 (see MEPC 69/19) a new output on review of the 2015 Guidelines for Exhaust Gas Cleaning Systems (resolution MEPC.259(68)). The Committee agreed to include a new output on "Review of the 2015 Guidelines for Exhaust Gas Cleaning Systems (resolution MEPC.259(68))" in its post-biennial agenda, with three sessions needed to complete the work.

5 In agreeing to the new output, the Committee also agreed that the scope of the work under the output would be as follows (see section 19.5 of document MEPC 69/21):

> .1 further refinement of the EGCS Guidelines, including clarification of the terms "EGC system" and "EGC unit"; PAH (polycyclic aromatic hydrocarbons) monitoring; emission testing; approval of scrubbers in accordance with Schemes A and B;
>
> .2 development of specific guidance on accidental breakdown, instrument malfunction and perceived temporary non-compliance and transient performance of EGCSs; if appropriate; and
>
> .3 development of consequential amendments to the *2009 Guidelines for port State control under the revised MARPOL Annex VI* (resolution MEPC.181(59)).

6 In this document proposals have been made solely related to 5.1 of the scope of the work given above. In making this submission the proponents are aware that other proposals

[6] Reference for sold EGCS numbers taken from EGCSA (Exhaust Gas Cleaning System Association) and GISIS reported EGCS approvals taken from online consultation of GISIS database 1 March 2017)

may be submitted to this meeting. Hence it is hoped that the draft amendments, as attached to this document, may assist in providing the starting point, allowing other issues to be incorporated as appropriate and as agreed by the Committee.

7 The European Commission has engaged in a set of activities aimed at supporting sustainable shipping in the context of cost-efficient and coherent implementation of the more stringent regulations related to the sulphur content of marine fuel oil in European Emission Control Areas with respect to SOx air emissions. To serve this purpose, the European Sustainable Shipping Forum (ESSF) has been created, bringing together 28 EU Member States and 32 maritime organisations in order to enable, inter alia, a structured dialogue on the monitoring of compliance with the sulphur regulations, on creating the framework conditions for the use of liquefied natural gas (LNG) as a ship fuel, on the increasing use of EGCS technology in shipping, in particular its technical, economic, environmental and operational aspects, on coordinating research and development activities and encouraging innovation, on exploring all available financing opportunities, on considering compatibility with the EU's broader environmental protection objectives (e.g. the effects of the use of EGCSs), and on identifying potential improvements in sustainability and competitiveness. The need to amend the 2015 Guidelines has emerged in the discussions at the ESSF Sub-Group on EGCSs.

The scope of the proposed amendments

8 The scope of this proposal is to revise the 2015 Guidelines for Exhaust Gas Cleaning Systems (resolution MEPC.259(68)) in accordance with the direction given by .1 of paragraph 19.5 of MEPC 69/21.

9 It should also be underlined that in accordance with regulation 4.4 of MARPOL Annex VI the intention of the proponents of this revision of the guidelines is to in no way weaken the level of protection of the marine environment as provided by the current 2015 Guidelines for EGCSs. Rather it is to more clearly detail the various existing requirements in a consistent and practical manner. Clearer language in various sections of the guidelines would result in more uniform application to the general benefit of all those using the document. Notwithstanding the foreseen objective to achieve a more harmonized application of the guidelines, proponents do recall Article 195 of UNCLOS as well as regional or national legislation defining water quality standards, and that coastal States may have to take additional measures necessary to prevent, reduce and control pollution so as to not impair or damage (particular parts of) the marine environment. To this end, the proponents recall that greater attention should be given to the cumulative effect of any pollutant discharges entering the water body per unit time at any location, originating from the EGCS.

Proposals for amendments to the 2015 Guidelines for Exhaust Gas Cleaning Systems

10 In the following sections detailed proposals for amendments of the 2015 Guidelines for EGCSs are explained. In the attached Annex the proposed new text of the guidelines is presented.

Proposals related to several sections of the guidelines

<u>Language used when referring to various sections of the guidelines</u>

11 As a general editorial point it has been noted that the references made to the main sub-divisions of the existing guidelines are not made in a consistent manner, i.e. in 4.4.7 reference is made to 'sections' 7 and 8, in 4.1.4.1 to 'section' 4.1.2 and in 9.2.1.2 to 'paragraph' 4.2.2.1.2.

12 The proposal is to use the word 'section' when reference is made to the main headings of the guidelines (i.e. sections 1 - 10). The next sub-division being 'sub-section' where there is a single point, i.e. 10.1. Thereafter cross references to other paragraphs will be made simply by their number, e.g.'…. As required under 4.4.7 when the …'.

Proposal for a definition for 'Emission Ratio' (sub-section 2.3 and various other sub-sections in the guidelines)

13 The presentation of the ratio SO_2 (ppm) / CO_2 (% v/v) is cumbersome (see e.g. sub-sections 1.2 and 1.3) and the proposal is to define this ratio as the 'Emission Ratio' in the table in sub-section 2.3 and that term would be used hereafter in various sections of the guidelines, relevant headings of tables and appendices to the guidelines.

Clarification of the terms 'EGC system' and EGC unit' (sub-section 2.3 and various other sub-sections in the guidelines)

14 There is inconsistency in the guidelines concerning requirements related to 'EGC system' and 'EGC unit'. 'EGC system' is proposed to by replaced by 'EGCS'. The definitions of these terms have been added in the table in sub-section 2.3 and the text in the guidelines has been changed to correspond to these definitions.

15 The Guidelines to date have always referred to 'washwater' in the context of the control on the condition of the overboard discharge from an EGCS. However, 'washwater' is strictly the water used as cleaning medium within the EGC unit itself – thereafter in an open loop system the washwater drained from the EGC unit will be subject to treatment as required to remove hydrocarbon and other material and also in some instances dilution, as provided for in the Guidelines, prior to overboard discharge. In closed loop systems the washwater is circulated in a closed system with bleed-off water in order to retain the required conditions; that bleed-off water then being subject to treatment and again possible dilution, in order to meet the discharge criteria in the Guidelines, prior to overboard discharge. Consequently the use of the term 'washwater' is not always the most appropriate term to use. Hence the proposal is to focus on the control of 'discharge water' in all instances, retaining the existing distinction as to whether checks are applied to it in its treated state or in its treated and diluted state. The concept of 'washwater' is retained to allow reference to the functional stream, accounting for the scrubbing stage of the EGCS whilst underlining the focus on control of the discharge.

Proposals for amendments to section 1, Introduction

Sub-section 1.2

16 In the existing sub-section 1.2 and in other parts of the existing guidelines reference is made to NOx emission reduction systems and the NOx Technical Code. The Guidelines on EGCS are now well established in their own right and there are no direct parallels between, for example Scheme B of these guidelines and the application of the NOx Technical Code particularly with regard to NOx reduction devices. Hence reference to NOx certification should now be deleted in sub-section 1.2 in order to avoid cross-over arguments between the two different processes.

17 Furthermore, it appears that there is a need to provide a general description of the application of the guidelines to approval of EGCSs. For this reason, sub-section 1.2 has been re-written. It has been explained that the guidelines can be applied to approval of EGCSs which use a wet cleaning medium to reduce the sulphur oxides content of an exhaust gas stream, which operate in either an open loop mode, closed loop mode or as a hybrid system capable of being operated in either mode. The current EGCSs typically use a

wet cleaning medium in direct contact with the exhaust gas to reduce the sulphur dioxide. These wet cleaning systems use various system configurations, but later discharge of sulphur ions overboard is the common denominator.

New sub-section 1.3

18 A new sub-section 1.3 has been added, which states that whenever aspects not covered by these Guidelines need to be controlled, these should be subject to special consideration by the Administration and should be advised to the Organization when submitting the notification required by regulation 4.2 of MARPOL Annex VI.

Sub-section 1.3 and the associated table 1

19 The language of sub-section 1.3 has been improved by making a reference to regulation 14 of MARPOL Annex VI and table 1 of the guidelines. The proposal is also to delete the lines for 4.50% and 1.00% sulphur content of fuel oil, because these sulphur content limits are no longer in force in MARPOL Annex VI regulation 14. The 1.50% sulphur content has been retained in this listing to mesh with the original adoption of the Emission Ratio approach and the basis of that, as given in Appendix 2, which was the demonstration of equivalence between 1.50% sulphur content and an Emission Ratio, as now termed, of 65.

Proposals for amendments to section 2, General

Clarification of the approval of EGCSs in accordance with Schemes A and B (sub-section 2.1)

20 This sub-section has been generally re-written in order to provide an overview of the application of the various sections of the Guidelines.

21 In the discussions with the industry it was apparent that there are different interpretations of the guidelines with regard to approval of an EGCS in accordance with Scheme A and Scheme B concerning exhaust gas emissions. This is an important issue that should be clarified in order to ensure harmonized application of the guidelines. The basis of the proposed clarification is as follows:

- Scheme A requires testing of the whole system against a Certified Value, which results in a certificate (in addition to the approved documentation).
- Scheme B requires approval of the monitoring system and other required documentation supported by measurements following the installation of the system with the EGCS in operation as necessary. Under Scheme B there is no Certified Value or system certificate.

22 Based on this understanding, sub-section 2.1.2 is re-written in order to clarify the difference between approval of EGCSs in accordance with Scheme A and B.

Sub-section 2.2, Application

23 Understanding not only that the very large majority of the EGCSs installed today are of the “wet” type and that the Guidelines we originally intended to focus on wet EGCSs, with provisions specifically drafted for those systems, a new section 2.2.2 is proposed

24 New 2.2.3 has been added indicating that, in the absence of specific guidelines for EGCSs, which use technologies or operate in modes that are not defined in 2.3, these Guidelines may also be applied as appropriate.

Amendments to sub-section 2.3, Definitions and Required Documents

25 Several new definitions have been proposed in this subsection, i.e. definitions for Exhaust Gas Cleaning System (EGCS), open loop mode, closed loop mode, washwater, inlet water, discharge water, bleed-off water, EGCS residue and wet residue. Altogether the existing definitions, with the ones now proposed, are expected by the co-sponsors to clarify some currently used terminology in EGCS technology whilst allowing these to be used in the text of the Guidelines.

26 Since the Certified Value is applicable only to Scheme A that has been added to the definition of 'Certified Value' as given in the table in section 2.3.

27 'Load range' has been defined in the table in sub-section 2.3. The definition does not match the term, but that is effectively already given in the row above, and hence should be deleted since it only repeats.

Proposals for amendments to section 3, Safety note

28 Editorial improvements are proposed to the third sentence of this Section.

Proposals for amendments to section 4, Scheme A – EGC System Approval, Survey and Certification using Parameter and Emission Checks

Proposals for amendments to 4.1.3

29 The paragraph number is added to the paragraph in 4.1.3. Language in 4.1.3.1 has been improved in order to better reflect the duties of the Administration with regard to approval of conformity of production arrangement based on a submission of the equipment manufacturer.

Proposal for amendments to 4.2.2.1.1

30 Additional text is proposed to 4.2.2.1.1 indicating that, if a system contains more than one EGC unit, each EGC unit should be identified in the ETM-A.

Proposal for a new paragraph 4.2.2.1.2.1*bis*

31 Additional text is proposed in the new 4.2.2.1.2.1*bis,* which requires information on the maximum and if applicable, minimum mass flow rate capacity of the EGC unit, to be included in an ETM-A.

Proposal for a new paragraph 4.2.2.1.2.1*ter*

32 Additional text is proposed in the new 4.2.2.1.2.1*ter* to clearly indicate the maximum fuel sulphur content, the EGCS is designed for when approved under Scheme A.

Proposals for amendments to 4.2.2.1.5

33 Additional text is added to 4.2.2.1.5 indicating that corrective actions should also be made, if any of the washwater and discharge criteria are not met.

Proposals for amendments to 4.2.2.1.7

34 Improvements are proposed for the language in 4.2.2.1.7. with the requirement to include the variation of washwater and discharge water characteristics through the operating load range of the fuel oil burning unit(s) connected to the EGCS.

Proposal for amendments to 4.2.2.1.8

35 More detailed language is proposed for 4.2.2.1.8. Whilst the relevant control is considered by the co-sponsors to be intended for the “discharge water”, the relevance of the “washwater” characteristic parameters is also still considered important for inclusion in the ETM-A.

Proposals for editorial improvements to 4.2.3.4

36 Editorial improvements are proposed to 4.2.3.4 with regard to reference to the Supplement of the International Air Pollution Prevention Certificate.

Proposals for amendments to 4.3.1

37 Since the Emission Ratio is the sole criterion of performance, as opposed to the g/kWh basis that was given in regulation 14(4)(b) of Annex VI as adopted in 1997, 4.3.2, 4.3.3, 4.3.4, 4.3.5 & 4.3.7 are redundant and therefore references to these paragraphs should be deleted. The language ‘including fuel oil combustion unit idling’ has been added in order to clarify the reference to ‘at any load point’ in this paragraph.

Proposal to delete 4.3.2 to 4.3.5

38 Paragraphs 4.3.2 to 4.3.5 are redundant and therefore it is proposed to delete them. These paragraphs were first included when the principal criterion for EGCS performance was in terms of grams of SO_2 /kWh – reg. 14(4)(b) of the 1997 Annex. On the basis that EGCSs are to operate at all loads as required and that operation is now assessed solely in terms of the Emission Ratio, these paragraphs are both redundant and potentially misleading in that they could be taken, incorrectly, to imply that operation outside the given load range is not covered, whereas it is.

Proposal to delete 4.3.7

39 Since now the Emission Ratio applies to all loads (including no load idling) this paragraph is redundant and its deletion is proposed.

Proposal for amendments to 4.4.1

40 In addition to editorial improvements, the proposal is also to delete the last two sentences in 4.4.1. What is covered in the 6th sentence onward is whether the EGCS is of the rating required. However no EGCS is simply installed onboard and then presented for survey at which point it is necessary to work out whether it is of the required capacity. In accordance with 9.2.1.2 it needs to be established that the EGCS is of the required rating etc. hence reference to 4.2.2.1.2 is made as part of the review process leading to the approval of the SECP. Hence it is for the EGCS manufacture to propose and the Administration / RO to review and approve, require more information or reject. Therefore in deleting the remainder of 4.4.1 containing these ‘declarations’ nothing is lost – the point is still addressed and would be done so to the satisfaction of the approving party.

Proposals for amendments to 4.4.7

41 For clarity the language ‘against the respective operating limits, or range of operating values’ has been added to 4.4.7.

Proposals for amendments to 4.4.8

42 The existing text in 4.4.8 is vague and subject to differing interpretations. The paragraph has therefore been re-written to make clear the extent of the requirements and what is required in order to provide a robust check of on-going exhaust gas cleaning performance.

Proposal to delete 4.4.9

43 The submitters of this document consider that the language in this paragraph is inappropriate and therefore propose to delete this section.

Proposal for an editorial improvement to 4.4.10

44 In the MARPOL Convention reference is made to ‘ship(s)’ and not to ‘vessel(s)’. Therefore, it is proposed to replace the word ‘vessel’s’ with ‘ship’s’ in the last sentence of this paragraph.

Proposals for amendments to section 5, Scheme B – EGC System Approval, Survey and Certification using Continuous Monitoring of Emission Ratio

Proposals for amendments to sub-sections 5.1, General, 5.2, Approval, and 5.3, Survey and Certification

45 Amendments to clarify the approval of EGCSs in accordance with Scheme B have been proposed in 5.1.1, 5.2.1, 5.3.1 and 5.3.3. These amendments are based on the proposed amendments to sub-section 2.1. The language in 5.3.2 has also been moved to 5.5.1 to improve the section structure.

Heading of sub-section 5.4, Exhaust Gas Monitoring

46 A new heading, ‘Exhaust gas monitoring’, is proposed, which could better reflect the contents of this sub-section compared to the existing heading ‘Calculation of emission rate’.

Proposal for amendments to 5.4.1

47 The Exhaust Gas Monitoring sensor is usually positioned in the scrubbed exhaust gas pipe near the EGC unit exhaust gas outlet after any internal filters, a packing bed and/or droplet separator (which enhances mixing of the exhaust gas thus making it homogeneous mix), but before a possible device for mixing air with exhaust gas to minimize visibility of exhaust gas plume. This sensor position is desirable because at this point the exhaust gas has not been mixed with the air from the de-pluming device. Typically, due to lack of space onboard, it is not possible to meet the sample point requirements of the NOx Technical Code (NTC) (gas exit to atmosphere at least three pipe diameters after the sampling probe). However, the NTC already allows an exception from the requirements “For a short exhaust system that does not have a location that meets both of these specifications, an alternative sample probe location shall be subject to approval by the Administration”, see section 5.9.3.1

of the NTC. Based on these reasons a new sentence is proposed to be added to this paragraph in order to better describe a suitable position for measurement of exhaust gas composition.

Proposal for amendments to 5.4.2

48 In addition to recording SO_2 and CO_2 concentrations the Emission Ratio (see sub-section 1.3) should also be required to be recorded to a precision of at least 1 decimal place. Zero and span check data (i.e. values as initially recorded and values after being reset to the zero and span values) should also be part of the required data to be recorded. It should be given that it is permitted to suspend the recordings required by 5.4.2 during servicing and maintenance of the analysers and as detailed in the OMM. Since the OMM is an approved document, it would act to avoid this provision being abused by over frequent off-line / extended periods. For these reasons section 5.4.2 has been re-written.

Proposal for additional text to 5.5.1

49 Since demonstration of compliance (of an EGCS approved in accordance with Scheme B) is based on information recorded in a data recording system, it has been proposed to add a new sentence to 5.5.1 in order to ensure the availability of the data for the Administration and to port State control.

Proposal for a new paragraph 5.6.1.2.1*bis*

50 Additional text is proposed in the new 5.6.1.2.1*bis* to clearly indicate the maximum fuel sulphur content the EGCS, is designed for.

Proposals for amendments to 5.6.1.4 and 5.6.1.5

51 Editorial improvements are proposed for the language in 5.6.1.4 and 5.6.1.5.

Proposals for amendments to 5.6.1.6

52 More detailed language is proposed for 5.6.1.6.

Proposal for a new sub-section 5.7

53 It is noted that while sub-section 2.3 shows that there is a need for an EGC Record Book, that need is not mentioned in section 5 (or elsewhere) in the same manner as it is for Scheme A – see section 4.4.10. It is therefore proposed that details of this should be added as sub-section 5.7 as a particular element of Scheme B.

Proposals for amendments to section 6, Emission Testing

Proposals for amendments to sub-section 6.1

54 The core problem with the existing text in sub-section 6.1 is the specific reference to Chapter 5 of the NOx Technical Code, which is directed to the ‘one off’ detailed test bed testing of engines for NOx emissions. While it could be seen that Chapter 5 conditions with regard to testing of NOx emissions are comparable to the factory testing of EGCSs under Scheme A it is also accepted that due to engine availability, load requirements, fuel oil sulphur constraints and washwater supply this may actually be undertaken onboard. Generally, it would be preferred that there is a single approach to emission measurement in

these guidelines whether it is Scheme A (system certification with daily spot checks) or Scheme B.

55 As part of the proposals for amendments to these guidelines, sub-sections 6.3, 6.10 and 6.11 have been further developed/created and therefore the language in sub-section 6.1 needs to be considered in line with the proposed amendments to the above mentioned sub-sections – and the rest of Section 6.

56 The basic intent of referencing the NOx Technical Code was to avoid having to repeat in the Guidelines all the test procedure and calculation procedures as given in the Code. The latter was significant since when the first Guidelines were drafted the requirement was against a g/kWh value and hence all the aspects necessary to arrive at such a value had to be covered. Additionally, the first (and second) versions of these Guidelines were against the original (1997) version of the Code which did not include detailed aspects relating to the Direct Measurement and Monitoring procedure now given by 6.4 and Appendix VIII of the Code.

57 Hence, with the EGCS Guidelines written now only in respect to the Emission Ratio, reference to the Code input is not required in regard to the calculation, however it does provide for default positions on other points. Given the above, and the proposed amendments to section 6.3 which follows, it is proposed that the reference to 'chapter 5, and associated appendices' should be deleted in sub-section 6.1.

Proposals for amendments to sub-section 6.3

58 It appears that more detailed language would be required for this sub-section, but in doing so the new text should not be unduly restrictive noting the performance based approach of the Code in general. In particular, it is important to try to avoid 'test bed' type requirements such as 'calibration' is to be undertaken every 3 months. Referring to these considerations and to the comments made to sub-section 6.1 above, new language is proposed for sub-section 6.3.

Proposal for new sub-sections 6.10 and 6.11

59 These new sub-sections cover SO_2 specific aspects, which are not covered in the NO_x Technical Code as that does not provide for SO_2 measurement or continuous monitoring of the type as required by Scheme B. Zero and span check intervals should be set and at these intervals zero / span should be adjusted to correct for any detected drift. SO_2 span gas should be defined as a mixture of SO_2 in nitrogen and to comply with Section 2 of Appendix IV of the NOx Technical Code.

Proposals for amendments to section 7, Data Recording and Processing Device

Proposals for amendments to sub-section 7.2

60 Data required by sub-section 7.2 should be extended to include whether a ship is inside or outside ECA-SOx areas. This shall not only facilitate inspection and verification of compliance, but also allow for more structured information. Data recording as required by 7.2 should also, as a minimum, be capable of:

.1 being automatically set with the Emission Ratio Limit, as appropriate to the ship's area of operation, which it is intended to comply with;

.3 being automatically set, or pre-set, with the applicable overboard pH limit value;

.2 recording instances where the set Emission Ratio Limit value is above that applicable to the area in which the ship is operating;

.5 & .6 being automatically set with the applicable PAH limit value, and recording the aggregated time in excess of 15 minutes over any 12-hour period that the differential PAH value is above the set limit value by more than 100%.

.7 & .8 being pre-set with the applicable turbidity limit value, and recording the aggregated time in excess of 15 minutes over any 12-hour period that the rolling average differential turbidity value is above the set limit value by more than 20%.

Together with corresponding logging of the discharge water data for compliance, and aggregated periods, Sub-section 7.2 has been amended accordingly.

Proposal for a new sub-section 7.6

61 In the guidelines it is not specified in which document the description of the data recording and processing device should be included. It is proposed that greater clarity is provided by including a new sub-section 7.6 in section 7 where reference is made to OMM as a reference document.

Proposals for amendments to section 8, Onboard Monitoring Manual (OMM)

Proposals for amendments to sub-section 8.2

62 Greater clarity in 8.2 should be provided as to what the OMM should cover. It is proposed that the OMM should, as a minimum, include details of:

.1 for extractive sampling systems, the position from which the exhaust gas emission measurement sample is drawn together with details, arrangement and operating values of all necessary ancillary components or requirements including, but not limited to, sampling probe assembly, sample transfer line and sample treatment unit;

.2 for in-situ analysers, the location and arrangement of the analyser in the exhaust duct and all necessary ancillary components or requirements;

.3 the analyser(s) to be used and the scale ranges to be applied;

.4 the service, calibration, inspection, maintenance and adjustment requirements of the monitoring equipment;

.5 analyser zero and span check procedures together with details of the zero and span gases to be used and the frequency of those checks;

.6 where an extractive sample system is used, the sample system leak check procedure;

.7 the data recording system and how it is to be operated, data retained and the types of reports generated. These reports should not simply be a download of the data but rather an effective summary reports from which it can be seen whether the system has or has not operated as required;

.8 guidance as to data or other indications which may signify a malfunction of either the analyser(s) or, if applicable, the extractive sampling system and the necessary fault-finding and corrective actions which should be taken; and

.9 other information or data found relevant to the correct functioning or use of the monitoring system or its use in demonstrating compliance.

Sub-section 8.2 has been amended accordingly.

Proposals for amendments to sub-section 8.3

63 Greater clarity in 8.3 should be provided as to what the OMM should cover in regard to how the monitoring system should be surveyed. The survey should cover the verification that:

.1 the system as installed and used onboard is as approved;
.2 servicing and maintenance has been undertaken as required;
.3 the system is functioning correctly.

In this sub-section it should also be given how those aspects are to be demonstrated. Sub-section 8.3 has been amended accordingly.

Proposals for amendments to section 9, Ship Compliance

64 The core reason to amend this section is that the Emission Ratio is the sole criteria of performance against the requirements as given in the 2008 revision of MARPOL Annex VI, as opposed to the g/kWh basis that was given in regulation 14(4)(b) of Annex VI as adopted in 1997.

Proposals for amendments to sub-section 9.1, SO_x Emissions Compliance Plan (SECP)

65 Editorial improvements are proposed for the language in 9.1.1.

66 The language of this sub-section is proposed to be improved so that in 9.1.2 it is mentioned that the SECP should list each item of oil fuel combustion equipment which may use fuel oil supplied in accordance with the requirements of regulations 14.1 and / or 14.4 of MARPOL Annex VI, i.e. fuel oil combustion equipment which may not be connected to the EGCS.

67 For 9.1.3 new language is proposed where it is mentioned that the SECP should list each item of oil fuel combustion equipment which may use Scheme A and/or B of these Guidelines together with identification of the EGCS to which it is connected and whether this control may be applied continuously or only inside or only outside the Emission Control Areas given by regulation 14.3.

68 It is felt that the issues in 9.1.4 are already covered in sub-section 9.2 and therefore 9.1.4 is proposed to be deleted.

69 The issues in 9.1.5 are covered by the proposed new language in 9.1.2 and therefore 9.1.5 is proposed to be deleted.

Proposals for amendments to sub-section 9.2, Demonstration of compliance

70 The second sentence in 9.2.1.1 refers to ‘maintenance records’ under the SECP which does not appear relevant. Engine room logger system is already given in the first sentence. Reference to electronic records is already inferred in 4.4.10, and in the now proposed 5.7, hence this second sentence should be deleted – as such it is then comparable to 9.2.2.

Proposals for amendments to section 10, Discharge Water and Washwater

Proposals for amendments to sub-section 10.1, Discharge water quality criteria

71 In 10.1.1 the first three sentences are in the wrong place, because they are related to discharge water monitoring. It is proposed to delete these sentences in 10.1.1 and move them to 10.2.1.

72 In the last sentence of 10.1.2.1.2 it is noted that the wording '… to be left to the approval by the Administration…' appears dismissive – and not in accordance with the usual IMO style. It is proposed to write instead '… as agreed by the Administration…'

73 With regard to 10.1.2.1.4 and 10.1.2.1.5 it is noted that the calculation methodology consists in reality of two basic steps. In step 1 a chemical equilibrium model is used to determine the required dilution of the discharge water in the zone 4 meters from the outlet to increase the pH to 6.5. Step 2 is to design and calculate by CFD, other mathematical or formulae the discharge water outlet arrangement. We think it would be helpful to give guidance on the input parameters to these calculations to assist the administrations in their evaluation and approval of the calculations. For these reasons a new Appendix 4 containing an example 'Standard Seawater Titration Curve' supported by some explanatory text has been added.

74 It has been also noted that issues related to PAH, such as the meaning of 'phenanthrene equivalence', its measurement, the onboard verification of the accuracy and responsiveness of measurement, as well as the setting of the PAH limit, require further consideration and clarification. The proponents of this document are planning to submit a document addressing particular PAH related matters not adequately addressed in this submission to a future session in accordance with point 1 of the agreed scope of the output (see section 5 of this document and section 19.5 of document MEPC 69/21).

75 The requirement to monitor PAH in the EGCS discharge water, prior to *any* dilution, has deserved the attention of the proponents. It has been concluded that this requirement is not fully consistent with the existence of the table in 10.1.3.3, where the 50 µg/L limit is normalized for different washwater flow rates. Different washwater flow rates are already the result of *some* dilution, albeit integral to the washwater circuit. The proposal is, therefore, consistent with 10.1.3.3, to introduce the indication "*upstream to any dilution for control of pH*".

76 When considering the requirement to monitor turbidity after water treatment but before any dilution or any reactant dosing, the proponents have identified a possibility for conflict. This could be the case when possible reactants, e.g. flocculants, are used in the water treatment process. With the potential for water treatment reactants to influence the turbidity of the discharge water, the proponents have identified that the second sentence in 10.1.4.2 would be better replaced by a clarification in 10.1.4.1 that the criteria apply after the possible addition of reactants during water treatment, thus safeguarding against possible higher values of turbidity due to that possible addition.

77 In 10.1.4.3, the requirement that all turbidity difference readings should be a rolling average over a 15-minute period is a memory-consuming feature. Therefore, duration shorter than 15 minutes should be acceptable. The proper rolling average period between 0-15 minutes should be based on the EGCS configuration and the performance of the manufacturer's automation and control system. Therefore, it is proposed that the word 'maximum' should be added before '15-minute period' in the third sentence. It is also proposed to add in the end of the third sentence the words 'or NTU' since measurement is

allowed in terms of both FNU and NTU, see the first sentence in 10.1.4.3. In the future it is important that attention be given to the need to link the turbidity criterion to flow rate in the same way as PAH concentration.

78 In 10.1.5, the existing text of the Guidelines allows for a certain level of nitrates in the water at overboard discharge. This is typically due to condensation of the NO_2 content of the NOx present in the exhaust gas due to the temperature lowering effect of the washwater. The NO_2 content of the exhaust gas from a marine diesel engine is typically around 5% of the total NOx.

This requirement applies to all EGCSs. However, the designer of an EGCS, other than one with a specific NOx reduction function, has limited control of the nitrate pick-up by the washwater and hence the presence of nitrates in the discharge water. Additionally, the user has limited settings or operating procedures by which they could control the nitrate content of the discharge water. Furthermore, the nitrate discharge control is applied at the overboard discharge. It is here that a substantial proportion of the flow will be dilution water which did not come in contact with the exhaust gas as it is introduced to control the overboard pH value. It is known that the nitrate content of the seawater itself varies and there is no allowance to account for this nitrate content which, in the case of some coastal waters, could itself be significant.

Added to this, water samples for nitrate analysis are required need to be kept cool and must be transported to a laboratory for prompt analysis. There are also a limited numbers of laboratories that can undertake this type of analysis adding further to the logistic problems associated with the assessment of this parameter.

From the information available to date, the level of nitrate content in the discharge water is negligible, but additional sampling of discharge water should provide more clarity on this.

Considering the above points, it would therefore be brought to the Committee's attention as to whether all the requirements of Section 10.1.5 of the Guidelines should continue to be applied to all EGCSs. Rather it could be considered that most of these provisions should instead be retained solely for those EGCSs which also include a specific NOx reduction function as included in the respective engine's NOx Technical Code 2008 certification. If that were to be the case it would be proposed as part of this submission that a new 10.1.5.1 would be inserted with the existing paragraphs duly renumbered. That new paragraph could read:

> '10.1.5.1 The provisions of this section apply only to an EGCS which incorporates a specific NOx reducing capability and which is included in the respective engine's EIAPP certification, except for the initial measurements that should apply for all systems.'

79 At the beginning of 10.1.5.3 new language is added to indicate that nitrate discharge data should also be made available within the first three months of operation after installation/initial survey of the EGCS.

80 In the last sentence in 10.1.5.3 the proposal is to define the testing method for nitrates to be ISO 13395:1996 or ISO 10304-1:2007 or other internationally accepted equivalent test standard (suitable for seawater). The reason for this proposal is that the method described in Grasshoff *et al.* for nitrate analysis is old-fashioned, and laboratories are trying to avoid the use of that method due to occupational health reasons.

81 A new sentence is proposed to be added to the end of 10.1.6 for the following reasons. Caustic soda consists of sodium (Na^+) and hydroxide (OH^-) ions. There is a high

natural concentration of sodium ions in sea water, and hydroxide ions react with the hydronium ions (H_3O^+) in the washwater to become water.

New 10.1.7, Discharge water from Temporary Storage

82 Discharges of any water from EGCSs, directly from temporary storage tanks, are not covered in the existing 2015 Guidelines. A proposal is made to add this issue in the Guidelines to avoid possible uncontrolled discharges. The discharge criteria proposed for pH, PAH and turbidity are for discharges from any temporary storage.

Proposals for amendments to sub-section 10.2, Washwater Monitoring

83 As explained above the first three sentences in the existing 10.1.1 have been brought to the beginning of 10.2.1. The word 'monitoring' has been added in the end of the third sentence before the word 'equipment', because this sub-section is related to discharge water monitoring. Instead of writing 'recommended' it is proposed to write 'given' in the first sentence of the existing 10.2.1. The second sentence of 10.2.1 is proposed to be deleted since it is redundant.

84 A new paragraph 10.2.2 is proposed to be added to sub-section 10.2. The point in question is to qualify the degree to which the pH, PAH and turbidity sensors should be allowed to deviate from either the zero or the calibration standard value for the reading to still be acceptable. If this is not qualified (as in the NOx Technical Code with respect to test bed and on board exhaust gas testing) then the risk is that any PSC or other entity could interpret any reading which is not exactly zero or the calibration standard value to imply that the sensor is not correctly functioning. It is also proposed that subsequent paragraphs would be duly renumbered.

85 The isolated headings in bold of 'pH', 'PAH' and 'Turbidity' in sub-section 10.2 should be deleted in order to conform to the general guideline style since the respective application (pH etc.) is given in each of the paragraphs that follow.

86 It is proposed to add new text to 10.2.6. Closed loop systems will be able to generate black water. If the water is dark enough, the measuring equipment will not be able to detect scattering (particle reflection) and the turbidity thus becomes 0 NTU, which of course is an improper reading. We propose to implement a control signal, checking the transmittance. If there is high enough transmittance the measurement is valid. If there is not sufficient transmittance the measurement is invalid.

Proposal for new sub-section 10.2 bis, Approval of the Washwater Monitoring System

87 The washwater monitoring system is subject to approval by the Administration. Prior to such approval, assurance must be given that the equipment will monitor correctly and that the sampling represents the intended streams to be monitored before discharge overboard excluding any kind of dilution. A new sub-section 10.2 *bis* is proposed to be added to section 10 to cover these issues.

Proposals for amendments to sub-section 10.3, Washwater Monitoring Data Recording

88 In 10.3.1 the proposal is to improve the language of this section by defining the minimum frequency of the data recording system and by making a reference to paragraph 10.2.1, washwater monitoring instead of the washwater criteria, at the end of this paragraph.

89 It is noted that the issue of recording the zero and span check data should also be addressed in this sub-section, so it is proposed to add a new paragraph 10.3.2 in sub-section 10.3 to address this matter.

Proposal for an amendment to sub-section 10.4, Washwater Residue

90 In 10.4.2 reference is made to an '…EGC log…' for the purposes of recording residues discharged ashore. To avoid the proliferation of records this matter should be included in the already existing EGCS Record Book (see sub-section 2.3) and as required by 4.4.10 (Scheme A) and for Scheme B see the proposed addition above for a new sub-section 5.7 which has also been referenced to in the proposed new sub-section 10.5 below. For these reasons it is proposed to delete the words 'an EGC log' and write instead 'the EGCS Record Book' in 10.4.2.

Proposal for a new sub-section 10.5, Maintenance and Servicing Records

91 The EGCS Record Book (as required by both Scheme A and Scheme B) should also cover the maintenance and servicing of the discharge water monitoring system components. A new sub-section 10.5 is proposed to be added to section 10 to cover this issue.

Proposals for amendments to Appendix 2, Proof of the Emission Ratio Method

92 Appendix 2 has been re-written and has a new heading 'Emission Ratio'. The purpose of this appendix is to explain the background to the use of the Emission Ratio, defined in 2.3 of these Guidelines, as the criteria for the demonstration of equivalency with the fuel oil sulphur limits given in regulation 14 of MARPOL Annex VI. The former version referred to the g SOx/kWh that no longer is relevant. In addition, the basis of the Emission Ratio limit values as given in 1.3 of these Guidelines is also explained.

Proposals for amendments to Appendix 3, Washwater Data Collection

93 In the first sentence in section 2 of Appendix 3 the word 'provide' is proposed to be replaced by the word 'invite', because Administrations are not directly involved with washwater data collection.

94 In the second bullet point in section 2 of Appendix 3 it is proposed to replace the word 'scrubber' with "EGC unit", since the word 'scrubber' is not used elsewhere in the guidelines. In the same bullet point it is proposed to replace the words 'any treatment system' with 'any kind of dilution', since it is considered that taking samples before any treatment system after the EGC unit would not bring any added value for washwater data collection.

95 In section 3 of Appendix 3 pH is one of the parameters currently recommended to be analysed from the washwater. However, the pH of the sample may change in the bottle after the sample is taken due to chemical reaction. Due to this phenomenon, the pH value analysed in the laboratory may be misleading. Therefore, the onboard measurement is recommended instead of analysing the pH of the sample in a laboratory. For this reason, the first bullet point is deleted and language referring to instant onboard measurement of washwater pH is added in the end of this section.

96 In section 3 of Appendix 3 it is also proposed to make a separate bullet point for oil analysis and to add a reference to internationally accepted standards for analysis of oil (detailed GC-MS analysis, e.g. ISO 9377-2 or equivalent methods).

97 In section 5 of Appendix 3 it is proposed improve the language taking into account the proposed amendments to section 2 and 3 of Appendix 3.

Proposal for a new Appendix 4, Standard Seawater Titration Curve

98 Referring to the proposed amendments to 10.1.2.1.4 above, it is proposed to add a new Appendix 4 to the guidelines.

Proposal for a new Appendix 5, Guidance to OMM

99 This new Appendix is proposed as an addition to the clarifications now provided in section 8 of the Guidelines in respect of the objectives and contents of the OMM. In order to assist in the preparation of the OMM in a more uniform manner this Appendix provides templates which may be used as the basis of the descriptions of the exhaust gas and discharge water monitoring systems which are required to be included.

Discussion

100 It must be restated that the intention of the proponents of this revision of the guidelines is to in no way weaken the level of protection of the marine environment as provided by the current 2015 Guidelines for EGCS. Rather it is to more clearly detail the various existing requirements in a consistent and practical manner.

101 The above described and attached draft proposals for amendments to the Guidelines are to be taken into consideration in conjunction with additional proposals in the context of temporary non-compliance, transient exceedance and instrument/equipment malfunction. The co-sponsors are of the opinion that additional guidance on these specific cases is fundamental for the adequate application of the Guidelines, transparency for the technology and to further support Administrations, inspectors and users of EGCSs. The different nature of such provisions, some operational in nature, leads however to the understanding that submission(s) on this matter to PPR 5 will merit more value, in consistency with the scope for the review agreed by the Committee at its 69th session.

102 In relation to 99, above, it is important to emphasise that any such outcome should somehow be clearly reflected in the EGCS Guidelines as it has impact on the EGCS control and alarm system and the statutory documentation described in the EGCS Guidelines.

103 Outstanding issues still remain, especially with regard to the availability of data related to impacts on the water body; issues related to PAH measurements and pH values as well as the prohibition of dilution in water protection policies and nitrates measurement. The proponents of this document intend to try to address these issues in a separate document to be submitted to the PPR 5 meeting.

104 Despite the extensive work undertaken by the proponents of this document it is recognised that there remain a number of outstanding issues on which more data and / or investigation is required. In particular, with respect to PAH measurement; in which a definition of the term ‘phenanthrene equivalence’ remains outstanding, an assessment of the reliability and responsiveness of onboard measurement techniques and the manner of application of the limit to both open and closed loop systems including where multiple units are connected into a single system. Additionally, there remain issues related to overboard pH control especially where dilution is locally prohibited as a measure within the overall management of discharge water. It is intended that these issues be addressed in on-going work still being undertaken, progress on which would be reported to the PPR 5 meeting. In relation to heavy metals, no changes to the current wording of the guidelines have been proposed. However, the results of some sampling trials suggest that additional criteria may be necessary to reinforce the requirement to minimize heavy metals in discharge water.

103 Referring to 10.1.3, in addition to overboard discharges concurrent with the operation of the EGCS it has been noted that some systems incorporate holding tanks or other system process tanks the contents of which may, in some instances, be discharged overboard. In this regard the existing criteria for pH and turbidity can be applied to such discharges irrespective of whether the EGCS is in operation or not. In the case of PAH, it needs to be clarified whether or not the PAH discharged from such tanks while the EGCS is in operation is to be considered as additional or not to the given allowed discharge. Furthermore, in those instances where the EGCS is not in operation, consideration needs to be given to how the PAH limit is to be determined given that the current approach is based on the rated power of the combustion systems while in operation.'

104 In section 76, above, a discussion on the relevance of the current nitrates, related provisions contained in the 2015 Guidelines, is warranted. It is suggested for discussion, and possible consideration, that only EGCSs with an additional NOx reduction functionality should be subject to the provisions in 10.1.5. The Committee is invited to take the elements given for further discussion.

Action requested of the Committee

105 The Committee is invited to consider the proposals to amend the 2015 Guidelines for Exhaust Gas Cleaning Systems (resolution MEPC.259(68)), which are described in sections 11 to 97 and shown in the attached Appendix, and to take action as appropriate.

Appendix
Proposals for amendments to the 2015 Guidelines for Exhaust Gas Cleaning Systems

- *Proposals for existing text to be deleted are struck out and highlighted by grey colour.*
- *Proposals for new text have been highlighted by grey colour.*

2015 GUIDELINES FOR EXHAUST GAS CLEANING SYSTEMS

1 INTRODUCTION

1.1 ~~Regulation 14 of~~ MARPOL 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.~~

1.2 These Guidelines have been developed to allow for the testing, survey, certification, and approval of Exhaust Gas Cleaning Systems (EGCSs) as an alternative compliance method in accordance with Regulation 4 of MARPOL Annex VI.

1.3 To ensure that in operation the EGCS continues to provide at least equivalency with the requirements of regulation 14 of MARPOL Annex VI or in order to meet the requirements of regulation 4.4 of that Annex, whenever aspects not covered by these Guidelines need to be controlled these should be subject to special consideration by the Administration and should be advised to the Organization when submitting the notification required by regulation 4.2 of that Annex.

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

1.~~3~~4 Equivalency with the relevant requirements of regulation 14 to MARPOL Annex VI should be demonstrated in accordance with the requirements of these Guidelines on the basis of compliance with the relevant Emission Ratio limit value as given in Table 1.

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

Fuel oil sulphur content (% m/m)	Emission 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~~ above Emission Ratio limit values is only applicable when using petroleum ~~based~~ derived distillate or residual fuel oils. See appendix ~~II~~ 2 for application of the ~~ratio~~ Emission Ratio method.

1.45 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 EGCSs under regulation 4 of MARPOL Annex VI to ensure that they provide in service, at any operating load point at which they are to operate, including during transient operation, effective equivalence to the requirements of regulations 14.1 and 14.4 of MARPOL Annex VI as applicable.

2.1.2 These guidelines permit two schemes for approval of an EGCS: Scheme A (~~unit~~ system certification with in-service continuous operational parameter monitoring and periodic emission checks) and Scheme B (continuous emission monitoring by means of an approved monitoring system together with periodic operational parameter checks).

2.1.2.1 In Scheme A, the EGCS is subject to approval by the Administration and should be in accordance with section 4 subject to performance tests, sea trials or other similar physical tests that verify that the system in service will result in compliant performance.

2.1.2.2 In Scheme B, the monitoring equipment of the EGCS should be in accordance with section 5 and is subject to approval by the Administration. Approved monitoring equipment will continuously demonstrate whether the EGCS is in compliance.

2.1.3 Emission testing in relation to either Scheme A or Scheme B should be undertaken, as appropriate, in accordance with section 6.

2.1.4 Data recording, retention and the preparation of reports using that data in relation to either Scheme A or Scheme B should be, as appropriate, in accordance with section 7.

2.1.5 Details of the exhaust emissions, operating parameters, washwater and discharge water monitoring systems in relation to either Scheme A or Scheme B should be documented, as appropriate, in accordance with section 8.

2.1.6~~2.1.3~~For ships which are to use an ~~exhaust gas cleaning~~ EGCS in part or in total ~~in order to comply with~~ as an approved equivalent to the requirements of regulations 14.1 and/or 14.4 of MARPOL Annex VI, there should be an approved SO_X Emissions Compliance Plan (SECP) in accordance with section 9.

2.1.7 Discharge water monitoring is equally applicable to Scheme A and Scheme B and should be undertaken in accordance with section 10.

2.2 Application

2.2.1 These guidelines apply to any EGCS ~~unit~~ as connected ~~fitted~~ to fuel oil combustion unit(s), ~~machinery~~ excluding shipboard incinerators, installed on board a ship.

2.2.2 For the purpose of these guidelines, the term 'EGCS' should be generally understood as 'wet EGCS'.

2.2.3 In the absence of specific guidelines for EGCS, which use technologies or operate in modes that are not defined in 2.3, these Guidelines may also be applied as appropriate.

2.3 Definitions and required documents

Bleed-off water	An amount of aqueous solution removed from the washwater of an EGCS operating in closed-loop mode to keep its required operating properties and efficiency
Certified Value	The ~~SO_2/CO_2 ratio~~ Emission Ratio specified by the manufacturer that the EGCS ~~unit~~ is certified as meeting when operating on a continuous basis on the manufacturers specified maximum fuel sulphur content. Applicable to Scheme A only
Closed loop mode	EGCS operating mode in which the washwater is passed several times, through the EGC unit. In order for the washwater to keep its required operating properties and efficiency its pH usually has to be adjusted, e.g. by adding chemicals such as NaOH. In addition, a small amount of washwater is bled, periodically or continuously, from the system. This bleed-off water, unless treated to meet discharge water criteria, is regarded as EGCS residue
CO_2	Carbon dioxide
Discharge water	Any water from an EGCS to be discharged overboard
Emission Ratio	SO_2 expressed in ppm / CO_2 expressed in % v/v
EGC	Exhaust gas cleaning
EGC unit	Device within which exhaust gas and cleaning medium are mixed. An EGC unit may have a single or multiple fuel oil combustion unit(s) connected to it
EGCS Record Book	A record of the EGCS ~~unit~~ in-service operating parameters, component adjustments, maintenance and service records as appropriate
EGCS residue	Material removed from the washwater or the bleed-off water by ~~the~~ a treatment system

ETM-A	EGCS – Technical Manual for Scheme A
ETM-B	EGCS – Technical Manual for Scheme B
Exhaust Gas Cleaning System (EGCS)	A system that includes one or more EGC units and which is based on technology that uses a wet cleaning medium for the reduction of SO_x from an exhaust gas stream from installed fuel oil combustion unit(s), operating in either open loop or closed loop mode. A hybrid EGCS can operate in both open loop mode and closed loop mode. Several EGC units may utilize a common uptake system with a single exhaust gas monitoring device. Several EGC units may utilize a common washwater, water supply, treatment and/or overboard system and discharge water monitoring equipment
Fuel oil combustion unit	Any engine, boiler, gas turbine, or other fuel oil fired equipment, excluding shipboard incinerators
Inlet water	Sea water entering an EGC unit as cleaning medium.
In situ	Sampling directly within an exhaust gas stream
~~Load range~~	~~Maximum rated power of diesel engine or maximum steaming rate of the boiler~~
MCR	Maximum Continuous Rating
OMM	Onboard Monitoring Manual
Open loop mode	EGCS operating mode in which the washwater, typically seawater, is passed through the EGC unit only once before it is being discharged overboard as discharge water
SECP	SO_X Emissions Compliance Plan
SECC	SO_X Emissions Compliance Certificate
SO_X	Sulphur oxides
SO_2	Sulphur dioxide
UTC	Universal Time Co-ordinated
Washwater	Cleaning medium brought into contact with the exhaust gas stream for the reduction of SO_x
Wet residue	Discharge water that does not meet the discharge water criteria

Document	Scheme A	Scheme B
SECP	X	X
SECC	X	
ETM Scheme A	X	
ETM Scheme B		X
OMM	X	X
EGCS 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 the discharge outlet of washwater discharge water used in the EGCS unit, due consideration should be given to the location of the ship's seawater inlet~~. In positioning the EGCS discharge water outlet due consideration should be given to the locations of the existing seawater inlets. 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 – EGCS ~~SYSTEM~~ APPROVAL, SURVEY AND CERTIFICATION USING PARAMETER AND EMISSION CHECKS

4.1 Approval of EGCS ~~systems~~

4.1.1 General

Options under Scheme A of these guidelines provide for:

.1 ~~unit~~ system approval;

.2 serially manufactured ~~units~~ systems; and

.3 production range approval.

4.1.2 ~~Unit~~ System approval

4.1.2.1 An EGCS ~~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~~ system 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 EGCS ~~unit~~ and to demonstrate that the Certified Value can be met if the EGCS ~~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 sub-section 4.3 as appropriate, should be performed. These need not be sequential and could be undertaken on two different, but identical, EGCS ~~units~~.

4.1.2.3 The maximum and, if applicable, minimum exhaust gas mass flow rate of the ~~unit~~ system 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 EGCS ~~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~~ systems

4.1.3.1 In the case of nominally similar EGCSs ~~units~~ of the same mass flow ratings as that certified under 4.1.2, and to avoid the testing of each EGCS ~~unit~~, ~~the equipment~~

~~manufacturer may submit, for acceptance by the Administration, a conformity of production arrangement.~~ the Administration, based on a submission of the equipment manufacturer, should take the necessary measures to verify that adequate arrangements have been made to ensure effective control of the conformity of production arrangement. The certification of each EGCS ~~unit~~ under this arrangement should be subject to such surveys that the Administration ~~may~~ should consider necessary as to assure that each EGCS ~~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 EGCS ~~unit~~ of the same design, but of different maximum exhaust gas mass flow capacities, the Administration may accept, in lieu of tests on an EGCS ~~unit~~ of all capacities in accordance with ~~section~~ 4.1.2, tests of EGCSs ~~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 EGCS ~~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 EGCS ~~unit~~ types.

4.1.4.3 For EGCSs ~~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 EGCS ~~unit~~ capacity on washwater and discharge water 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~~ system, should be submitted to the Administration for approval.

4.2 Survey and certification

4.2.1 Procedures for the certification of an EGCS ~~unit~~

4.2.1.1 In order to meet the requirements of sub-section 4.1 either prior to, or after installation on board, each EGCS ~~unit~~ should be certified as meeting the Certified Value specified by the manufacturer (e.g. the emission level the ~~unit~~ system is capable of achieving on a continuous basis) under the operating conditions and restrictions as given by the EGCS 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 EGCS ~~unit~~ meeting the requirements of ~~paragraph~~ 4.2.1.1 should be issued ~~with~~ an 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 EGCS ~~system~~ manufacturer, shipowner or other party.

4.2.1.5 Any subsequent EGCS ~~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 EGCSs ~~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 EGCSs ~~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 EGCS ~~System~~ Technical Manual "Scheme A" (ETM-A)

4.2.2.1 Each EGCS ~~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~~ system (manufacturer, model/type, serial number and other details as necessary) including a description of the ~~unit~~ system and any required ancillary systems. In case a system contains more than one EGC unit, each EGC unit should be identified;

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

.1 the maximum and, if applicable, minimum mass flow rate of exhaust gas of the connected combustion unit(s);

.1 *bis* the maximum and if applicable, minimum mass flow rate capacity of the EGC unit;

.1 *ter* the maximum fuel sulphur content the EGCS is designed for;

.2 the power, type and other relevant parameters of the fuel oil combustion unit for which the EGCS ~~unit~~ is to be connected to. 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 the maximum and minimum washwater flow rate, inlet pressures and minimum inlet water alkalinity (ISO 9963-1-2:1994);

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

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

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

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

.4 maintenance, service or adjustment requirements in order that the EGCS ~~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 EGCS Record Book;

.5 corrective actions to be applied if ~~in case of~~ exceedances of the applicable maximum allowable ~~SO_2/CO_2 ratio~~ Emission Ratio occurs or the ~~wash water~~ discharge water quality criteria are not met;

.6 a verification procedure to be used during surveys to ensure that the system's performance is maintained and that the ~~unit~~ system is used as required (see sub-section 4.4);

.7 ~~through range performance variation in washwater characteristics;~~ washwater and discharge water characteristics across the operating load range;

.8 ~~design requirements of the washwater system;~~ design requirements for the treatment and monitoring of washwater and control of discharge water, including for example bleed-off water from closed-loop EGCS operation or discharge water temporarily stored within the EGCS;

.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 EGCS ~~unit~~ is ~~fitted~~ installed and should be available for surveys as required.

4.2.2.4 Amendments to the ETM-A which reflect EGCS ~~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 EGCS ~~unit~~ should be subject to survey on installation and at initial, annual/intermediate and renewal surveys by the Administration.

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

4.2.3.3 Prior to use, each EGCS ~~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, sections 2.3 and 2.6 of the Supplement to the ship's International Air Pollution Prevention Certificate should be duly completed.

4.3 Emission limits

4.3.1 Each EGCS ~~unit~~ should be capable of reducing emissions to equal to or less than the Certified Value at any load point, including fuel oil combustion unit idling, when operated in accordance with ~~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 EGCSs 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 EGCSs 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 EGCSs 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 EGCSs 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~~ system is to be certified. One load point should be within ± 5% of the minimum exhaust gas mass flow rate for which the ~~unit~~ system 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 EGCS 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 verification procedures for demonstrating compliance

4.4.1 For each EGCS ~~unit~~, the ETM-A should contain a verification procedure for use ~~at~~ during 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 EGCS ~~unit~~ should be designed in such a way as to facilitate inspection as required. The basis of ~~this~~ the verification procedure is that if all relevant components and operating values or settings are within ~~those as~~ the approved ranges, then the performance of the EGCS ~~system~~ can be assumed to meet the requirements ~~is within that required~~ without the need for actual continuous exhaust emission ~~measurements~~ monitoring. ~~It is also necessary to ensure that the EGCS 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 EGCS ~~unit~~ and its ability to meet the Certified Value.

4.4.3 The verification procedure should be submitted by the EGCS ~~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 EGCS ~~unit~~.

4.4.5 The surveyor should verify that each EGCS ~~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 within the EGCS ~~system,~~ 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 EGCS ~~unit~~ should include means to automatically record when the system is in use. ~~This~~ These means 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~~ machinery load, and exhaust gas temperature before and after the EGC unit against the respective operating limits, or range of operating values. The data recording system should comply with the requirements of sections 7 and 8. In the case of a system ~~unit~~ consuming chemicals at a known rate as documented in ETM-A, recordings of such consumption in the EGCS 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.~~

4.4.8 Under Scheme A, if a continuous exhaust gas monitoring system is not fitted, a daily spot check duration of not less than 5 minutes at a minimum recording frequency of 1 Hz at steady load of the Emission Ratio for each outlet to the atmosphere, should be undertaken to verify compliance in conjunction with the parameter checks stipulated in 4.4.7.

~~4.4.9 If the EGC system manufacturer is unable to provide assurance that the EGC unit system 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 EGCS Record Book should be maintained by the shipowner recording maintenance and service of the ~~unit~~ system including like-for-like replacement. The form of this record should be submitted by the EGCS ~~system~~ manufacturer and approved by the

Administration. This EGCS Record Book should be available ~~at~~ during surveys as required and may be read in conjunction with engine-room log-books and other data as necessary to confirm the correct~~ion~~ operation of the EGCS ~~unit~~. Alternatively, this information ~~should~~ may be recorded in the ~~vessel's~~ ship's planned maintenance record system as approved by the Administration.

5 SCHEME B – EGCS ~~SYSTEM~~ APPROVAL, SURVEY AND CERTIFICATION USING CONTINUOUS MONITORING OF ~~SO_x EMISSIONS~~ EMISSION RATIO

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.~~

5.1.1 Scheme B provides for the approval of the means of continuous Emission Ratio monitoring, supported by daily parameter checks, which will subsequently be used at surveys, and otherwise as required, to demonstrate compliance with the objectives as given in the SECP.

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.~~

5.2.1 The ETM-B~~, OMM and SECP~~, as defined in these Guidelines, should be approved by the Administration.

5.3 Survey and certification

5.3.1 The EGCS's exhaust gas monitoring system ~~of the EGC system~~ should be subject to survey on installation and at initial, annual/intermediate and renewal surveys by the Administration in order to demonstrate that it functions as given in the OMM. The scope of the installation or initial survey should include EGCS operation, as required, in order to demonstrate the functionality of the exhaust gas monitoring system.

~~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,~~ Following the installation survey as required by 5.3.1, section 2.3 and 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~~ Exhaust gas monitoring

5.4.1 Exhaust gas composition in terms of ~~SO_2(ppm)/CO_2(%)~~ Emission Ratio 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. A suitable position could be the upper part of the EGC unit (after all internal structures) or exhaust uptake pipe, but before any possible air mixing with exhaust gas.

~~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.~~

5.4.2 SO_2(ppm) and CO_2(%) and, to not less than one decimal place, Emission Ratio are 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 whenever the EGCS is in operation. This monitoring may be suspended for service and maintenance periods of gas analyser and associated equipment as required by the OMM. All analyser readings from zero and span checks are to be recorded and clearly identifiable as such in the data record.

5.4.3 If more than one analyser is to be used to determine the ~~SO_2/CO_2 ratio~~ Emission 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~~ Emission Ratio is fully representative of the exhaust gas composition.

5.5 Onboard procedures for demonstrating compliance with emission limits

5.5.1 The data recording system should comply with the requirements of sections 7 and 8. Data and the associated reports should be available to the Administration as necessary to demonstrate compliance as required and, in accordance with regulation 10 of MARPOL Annex VI, may also be subject to inspection by port State control.

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

5.6 EGCS ~~System~~ Technical Manual "Scheme B" (ETM-B)

5.6.1 Each EGCS ~~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~~ system (manufacturer, model/type, serial number and other details as necessary) including a description of the ~~unit~~ system and any required ancillary systems; If a system consists of more than one EGC unit, each EGC unit should be identified;

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

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

.1 *bis* the maximum fuel sulphur content for the operational conditions the EGCS is designed for;

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

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

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

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

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

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

.4 corrective actions to be applied if ~~in case of~~ exceedances of the applicable maximum allowable ~~SO_2/CO_2 ratio~~ Emission Ratio occurs or ~~washwater~~ discharge water quality ~~discharge~~ criteria are not met;

.5 ~~through range performance variation in washwater characteristics;~~ washwater and discharge water characteristics across the operating load range; and

.6 design requirements for the washwater and discharge water systems.

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 EGCS ~~unit~~ is fitted. The ETM-B should be available for surveys as required.

5.6.4 Amendments to the ETM-B which reflect EGCS ~~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~~ from the ETM-B as initially approved, they should be retained with the ETM-B and should be considered as part of it.

5.7 An EGCS Record Book should be maintained by the shipowner recording maintenance and servicing of the emission monitoring and ancillary components as given in the OMM including like-for-like replacements. The form of this record book should be approved by the Administration. This EGCS 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 correct operation of the EGCS. Alternatively, this information may be recorded in the ship's planned maintenance record system as approved by the Administration.

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.~~

6.3 The analysing equipment should be installed, operated, maintained, serviced and calibrated in accordance with the requirements as given in the OMM, at a frequency which ensures that the requirements of 1.7 to 1.10 of appendix the NOx Technical Code 2008 are met at all times the equipment is in operation.

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 samplinge systems.

6.6 Extractive exhaust gas samples for SO_2 determination should be maintained at a sufficient temperature to avoid ~~condensed~~ condensation of 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.

6.10 Extractive sample systems should be capable of being verified to be free of ingress leakage in accordance with analysing equipment manufacturers' recommendations as defined in the OMM. It should be verified that the system is free of ingress on initial start-up after installation and after service/maintenance intervals.

6.11 The span gas for the SO_2 analyser should be a mixture of SO_2 and nitrogen at a concentration of more than 80% of the full scale of the measuring range used and should otherwise conform to the requirements of section 2 of appendix IV of the NOx Technical Code 2008. Other equivalent arrangements, as detailed in the OMM, may be accepted by the Administration.

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).~~

7.2 The recording and processing device should record, whenever the EGCS is in operation, the data required by 4.4.7, 5.4.2, and 10.3 as applicable, including overboard discharges from any associated tanks within the system, against UTC and ship's position as given by a Global Navigational Satellite System (GNSS) and whether the ship was inside or outside an Emission Control Area as given by regulation 14.3 at that time. The device should also be capable of:

.1 (Scheme B only) being automatically set, or pre-set, with the Emission Ratio limit value as appropriate to the sea area, in relation to regulation 14.3, where the ship is operating;

.~~3~~2 being automatically set, or pre-set, with the applicable overboard pH limit value;

.~~5~~3 being automatically set with the applicable PAH limit value;

.~~6~~4 recording the aggregated time in excess of 15 minutes over any 12 hour period that the differential PAH value is above the set limit value by more than 100%;

.~~7~~5 being pre-set with the applicable turbidity limit value; and

.~~8~~6 recording the aggregated time in excess of 15 minutes over any 12 hour period that the rolling average differential turbidity value is above the set limit value by more than 20%.

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~~ device 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~~ control as requested.

7.6 A description of the data and processing device should be included in the OMM.

8 ONBOARD MONITORING MANUAL (OMM)

8.1 An OMM should be prepared to cover each EGCS ~~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.~~

.1 for extractive exhaust gas sampling systems, the position from which the gas sample is drawn together with details, arrangement and operating ranges of the analysers and all necessary ancillary components or requirements including, but not limited to, sample probe assembly, sample transfer line and sample treatment unit together with the sample system leak check procedure and the frequency at which that check should be undertaken;

.2 for in-situ exhaust gas analysers, the location and arrangement of the analyser in the exhaust duct, operating ranges and all necessary ancillary components or requirements;

.3 for inlet water and discharge water monitoring, the positions from which the water samples are drawn, the location and arrangement of the analysers together with details of any necessary ancillary services such as sample transfer lines and sample treatment units;

.4 the analysers to be used for monitoring of exhaust gas, inlet water, discharge water, their service, maintenance, and calibration requirements. Templates covering the minimum information, which should be included, are provided in Appendix 5;

.5 the zero and span check procedures of the exhaust gas analysers and calibration of ~~washwater~~ discharge water and inlet water analysers together with reference materials to be used and the required frequency of those checks;

.6 the operating parameter instruments to be used as required by 4.4.7 or 5.5.2;

.7 the installation, operation, adjustment, maintenance, servicing and calibration requirements and procedures of the analysers, associated ancillary equipment and operating parameter measurement instruments;

.8 the data recording system and how it is to be operated, data retained and the types of reports which it can produce;

.9 guidance as to data or other indications which may signify a malfunction of either an analyser, an item of ancillary equipment or an operating parameter sensor together with the fault-finding and corrective actions which should be taken; and

.10 other information or data relevant to the correct functioning or use of the monitoring system or its use in demonstrating compliance;

.11 where the information as required by .1 to .10 above is referring to detailed descriptions of procedures, reference can be made to additional documents (e.g. manufacturer's documentation) which should be considered part of the OMM.

8.3 The OMM should specify how the EGCS, operating parameter measurement instruments and the exhaust gas and discharge water monitoring systems are ~~is~~ to be surveyed in order to verify that:

8.3.1 the EGCS conforms to the ETM-A or ETM-B as applicable;

8.3.2 the operating parameter instruments installed and used onboard are as approved per the OMM;

8.3.3 the exhaust gas and discharge water monitoring systems used onboard are as approved per the OMM;

8.3.4 inspection, maintenance, servicing, calibration and adjustments have been undertaken as required and those actions recorded in the EGCS Record Book as required; and

8.3.5 the operating parameter instruments and the exhaust gas and the discharge water monitoring systems are correctly functioning.

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 EGCS unit , in part or in total, in order to comply with the requirements of regulations 14.1 and 14.4 of MARPOL Annex VI~~ For a ship which is to use an EGCS, in part or in total, as an approved equivalent means to the requirements given by regulation 14.1 or 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~~ may use fuel oil supplied 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.~~

9.1.3 The SECP should list each item of fuel oil combustion equipment which may use Scheme A and/or B of these Guidelines together with identification of the EGCS to which it is connected and whether this control may be applied continuously or only inside or only outside the Emission Control Areas given by regulation 14.3.

~~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, EGCS 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~~ 9.1.3, details should be provided demonstrating that the rating and restrictions for the EGCS ~~unit~~ as approved, ~~paragraph~~ under 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 EGCS is in operation in order to demonstrate compliance.

9.2.2 Scheme B

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

10 ~~WASHWATER~~ DISCHARGE WATER

10.1 ~~Washwater~~ Discharge water quality criteria[7]

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.~~

10.1.1 EGCS discharge water which is to be discharged overboard should comply with the following criteria:

10.1.2 pH criteria

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

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[7] The ~~washwater~~ discharge water quality criteria should be ~~revised~~ reviewed in the future as more data become available, including relevant research and development results, on the ~~contents~~ composition of the washwater and discharge water and its effects, taking into ~~account~~ consideration any advice given by GESAMP and of relevant legislation.

.1 The discharge ~~wash~~water 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~~ a 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 ensure ~~achieve as~~ a minimum ~~a~~ pH no lower than 6.5 at a distance of 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~~ as agreed by the Administration, and in accordance with the following conditions that are 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~~ the maximum sulphur content for which the units are to be certified (Scheme A) or used with (Scheme B);

.2 if a test fuel with lower sulphur content, and/or test load lower than maximum, sufficient for demonstrating the behaviour of the ~~washwater~~ discharge water 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~~ discharge water plume and that the overboard pH discharge limit has been met if the EGCS is operated at the highest fuel sulphur content and load for which the EGCS is certified (Scheme A) or used with (Scheme B);

.3 where the ~~washwater~~ discharge water flow rate is varied in accordance with the EGCS 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 2.2 mmol/litre and pH 8.2[8]; an amended titration curve should be applied where the testing conditions differ from the reference seawater, as agreed by the Administration (example titration curve for reference seawater conditions is presented in Appendix 4); and

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

[8] These values could be revised within two years 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.

10.1.3 PAHs (Polycyclic Aromatic Hydrocarbons)

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

10.1.3.3 The 50 µg/L limit described above is the limit normalized ~~for a washwater flow rate through the EGC unit~~ for a flow rate at the PAH measurement point of 45 t/MWh, where the MW refers to the MCR or 80% of the power rating of the fuel oil combustion unit. Higher limits apply at lower flow rates per MWh, and vice-versa, according to the table below.

Flow rate at the PAH measurement point (t/MWh)	**Discharge concentration limit (µg/L PAH_{phe} equivalents)**	**Measurement technology**
0-1	2250	Ultraviolet light
2.5	900	– " –
5	450	Fluorescence[9]
11.25	200	– " –
22.5	100	– " –
45	50	– " –
90	25	– " –

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 of the discharge water, following treatment, including any reactant dosing, but before any other dilution, should comply with the following requirements. The limit should be recorded in the ETM-A or ETM-B.

10.1.4.2 The ~~washwater~~ discharge water 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~~ the discharge water 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 maximum 15-minute period to a maximum of 25 FNU or NTU. ~~For the purposes of this criteriona the turbidity in the washwater discharge washwater should be measured~~

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

~~downstream of the water treatment equipment but upstream of washwater discharge 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~~ discharge water 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 water flow rate of 45 tons/MWh whichever is the greater, where the MW refers to the MCR or 80% of the power rating of the fuel oil combustion unit.

10.1.5.2 Within the first three months of operation after installation/initial survey and three months prior to each renewal survey a sample of the discharge water from each EGCS must be drawn and analysed for nitrate content and results have to be made available. ~~At each renewal survey nitrate discharge data is are to be available in respect of for sample overboard discharge water drawn sampled from each EGCS system which, in the latter case of renewal surveys, sampled, is to have been drawn with within the previous three months prior to the survey~~. However, the Administration may require an additional sample to be drawn and analysed at its ~~their~~ discretion. The nitrate discharge data and analysis certificate is to be retained on board the ship as part of the EGCS Record Book and to 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~~ discharge water flow normalization. Nitrates discharge data is to be presented as the difference between concentrations in the inlet water and in the discharge water. ~~The test method for the analysis of nitrates should be according to standard seawater analysis as described in Grasshoff et al.~~ The test method for nitrate should be ISO 13395:1996, ISO 10304-1:2007 or other internationally accepted equivalent test standard (suitable for seawater).

~~[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 and d~~D~~ischarge water additives and other substances

Additional ~~An~~ assessment of the ~~washwater~~ discharge water ~~is~~ may be required for those EGCS 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 and/or discharge water quality ~~discharge~~ criteria should be established. If the only chemical used is sodium hydroxide (NaOH, CAS: 001310-73-2) and the discharge water pH does not exceed 8.0, no additional assessment is needed.

10.1.7 Discharge water from Temporary Storage

10.1.7.1. Any discharge water originating from the EGCS and discharged overboard following temporary storage within any tank designed for that purpose and featured in the

ETM-A or ETM-B should meet, independent of any flow rate, the following discharge water criteria:

pH	Section 10.1.2
PAH	Maximum of 50 µg/L PAH_{phe} (phenanthrene equivalence) before any dilution for control of pH,
Turbidity	Not greater than 25 FNU (formazin nephlometric units) or 25 NTU (nephlometric turbidity units) or equivalent units, before any dilution.

10.1.7.2 When demonstration of compliance with the provisions contained within this section is not possible, the water intended for discharge should be considered a wet residue.

10.2 ~~Washwater~~ Discharge water monitoring

10.2.1 When the EGCS is operated in ports, harbours, or estuaries, or during any discharges from temporary storage, the discharge water 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 EGCS is in operation, except for short periods of maintenance, and cleaning of the monitoring equipment as defined in the OMM, pH, oil content (as measured by PAH levels), and turbidity should be continuously monitored and recorded as given in section 7 of these guidelines. Whenever there are overboard discharges from temporary storage within arising from the EGCS operation, no maintenance or cleaning shall take place. ~~The monitoring equipment should also meet the performance criteria described below:~~

10.2.2 The in service permissible deviations of the discharge water monitoring equipment should not exceed the following:

pH	0.2 pH units
PAH	5% of nominal ~~test~~standard test concentration used. That nominal concentration value should be not less than 80% of the scale range used
Turbidity	2 FNU or NTU

Calibration intervals should be such that the above performance requirements are met.

~~pH~~

10.2.~~2~~3 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~~ IEC 60746-2:2003 or other internationally accepted equivalent standard.

~~PAH~~

10.2.~~3~~4 The PAH monitoring equipment should be capable of monitoring 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 by more than 5% in ~~washwater~~ discharge water with turbidity within the working range of the application.

10.2.~~4~~5 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~~6 The turbidity monitoring equipment should meet requirements defined in ISO 7027~~:1999~~-1:2016. ~~or USEPA 180.1.~~ ISO 7027 requires the measurement of turbidity by attenuation at 180° given as FAU, when 40 FNU are exceeded.

10.2 *bis* Approval of the discharge water monitoring systems

10.2 *bis*.1 The discharge water monitoring system is ~~are~~ subject to approval by the Administration. Prior to such approval, assurance must be given that the equipment will monitor correctly and that the sampling represents the intended streams to be monitored before overboard discharge excluding any kind of dilution except for pH monitoring.

10.2 *bis*.2 The discharge water monitoring system should be approved by the Administration.

10.3 ~~Washwater~~ Discharge water monitoring data recording

10.3.1 The data recording system should comply with the requirements of sections 7 and 8 and should continuously record pH, PAH and Turbidity ~~at least at the frequency specified in 5.4.2, and as specified in the washwater criteria in 10.2.1, washwater discharge water monitoring.~~ in accordance with 10.2.1 at a frequency of not less than 0.0111 Hz.

10.3.2 Zero and span check calibration and instrument drift data should, as given in the OMM, be either recorded by the data recording system or manually entered in the EGCS Record Book as appropriate to the means used.

10.4 ~~Washwater~~ Rresidues

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

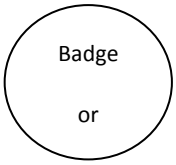
10.4.2 Each ship fitted with an EGCS ~~unit~~ should record the storage and disposal of ~~washwater~~ residues in ~~an EGC log~~ the EGCS Record Book, including the date, time and location of such storage and disposal. ~~The EGCS log may form a part of an existing log-book or electronic recording system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

10.5 Maintenance and servicing records

10.5 The EGCS Record Book as required by either 4.4.10 or 5.7 should also be used to record maintenance and servicing of the washwater and discharge water monitoring systems and ancillary components as given in the OMM including like-for-like replacement.

APPENDIX 1

FORM OF SO_x EMISSION COMPLIANCE CERTIFICATE



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 system (EGCS) ~~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 EGCS ~~unit~~ referred to below:

~~Unit~~ System manufacturer	**Model/ type**	**Serial number**	**EGCS ~~Unit and~~ Technical Manual approval number**

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

This Certificate is valid for the life of the EGCS ~~System unit~~, subject to surveys in accordance with sub-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 EMISSION RATIO METHOD

1 The Emission Ratio (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 sub-section 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 Emission 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 Emission SO_2/CO_2 Ratio considered its use to verify compliance with emissions from 1.5% sulphur fuel. The limit of 65 (ppm[10]/%) 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 Emission SO_2/CO_2 Ratio does not. This indicates that the Emission SO_2/CO_2 Ratio is independent of fuel-to-air ratios. Therefore, Emission 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 Emission 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 Emission 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 other than petroleum derived distillate or residual fuel oils, the appropriate Emission 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.

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[10] 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.

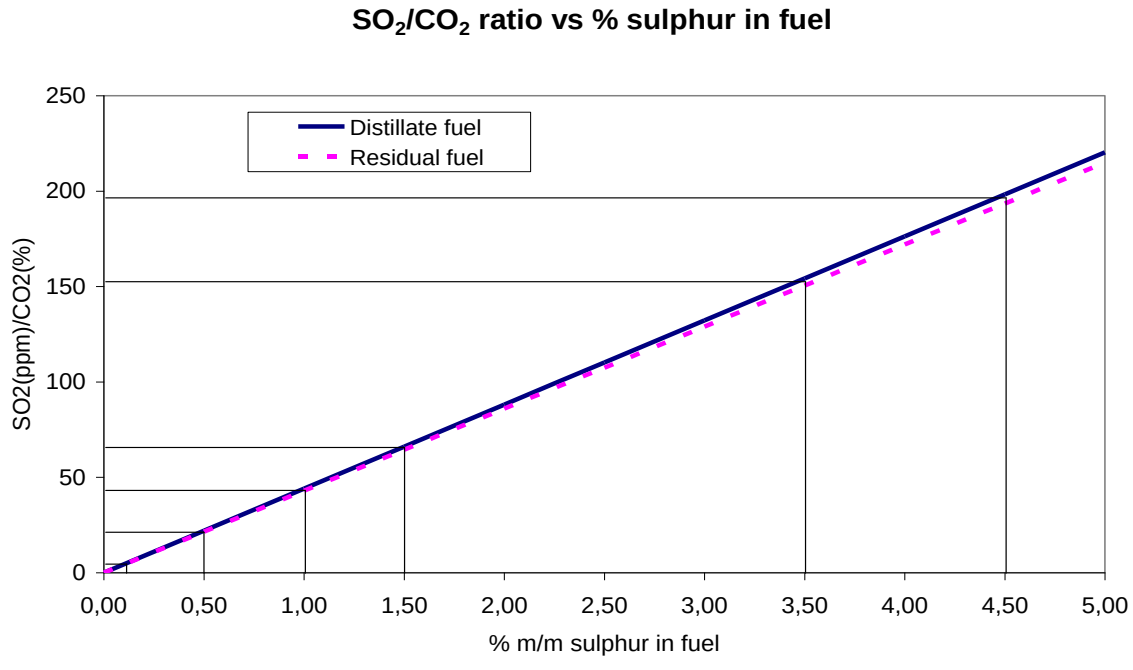
Table 1: Fuel properties for marine distillate and residual fuel*

	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



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:

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

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 system.

.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 2

EMISSION RATIO

This Appendix is included to explain the background to the use of the Emission Ratio, defined in 2.3 of these Guidelines, as the criterion for the demonstration of equivalency with the fuel oil sulphur limits given in regulation 14 of MARPOL Annex VI. In addition, the basis of the Emission Ratio limit values as given in 1.3 of these Guidelines is also explained.

The carbon content of any fuel oil used for power generation combustion exits that system essentially in the form of carbon dioxide (CO_2). While certain amounts of the inflow carbon may form deposits within that system, be incorporated into any direct contact lubricant or exit in the exhaust gas as carbon monoxide or gaseous or particulate hydrocarbons, overall these quantities are not significant in comparison to the flow of CO_2. This applies equally to all combustion systems; internal combustion engines, boilers and gas turbines.

Similarly the sulphur content of a fuel oil used for combustion will exit that system essentially as sulphur dioxide (SO_2) in the hot exhaust gas stream. Again although a certain amount may be retained as sulphur compounds within the system or as other sulphur compounds in the exhaust gas stream, these are not significant in comparison to the flow of SO_2.

Hence although the CO_2 concentration in the exhaust gas will vary in accordance with the excess air ratio applied, the ratio of CO_2 to SO_2 concentrations will be fixed by the carbon / sulphur ratio of the fuel oil used. In those instances where an exhaust gas cleaning system (EGCS) covered by these Guidelines is fitted, the effect will be to reduce the SO_2, but not the CO_2, content of the exhaust gas. Consequently, the SO_2 / CO_2 ratio after the system will reflect the effectiveness of that system in removing SO_2 from the exhaust gas[1]. The post EGCS SO_2 / CO_2 ratio, the Emission Ratio, will largely correspond to that which would otherwise have been obtained if a lower sulphur fuel oil had been used but without the EGCS.

The principal elements present in petroleum derived liquid fuel oils are carbon, hydrogen and sulphur and in some instances also nitrogen and oxygen. The actual proportions differ in each case. In order to derive the Emission Ratios corresponding to different fuel oil sulphur limit values, the fuel oil compositions given in 6.4.11.1.2 (Table 9) of the NO_x Technical Code 2008 are taken as the starting points in Table 1 below. The given compositions for both distillate and residual fuel oils omit sulphur content but these are simply the difference between the summation of the given values and 100% and hence are 0.20% for the distillate example and 2.60% for the residual. In order to estimate the carbon and hydrogen proportions of fuel oils with other sulphur content values the carbon / hydrogen ratio and the 'nitrogen+oxygen' content are assumed to be unchanged for the respective fuel oils. In Table 1 the carbon contents are calculated for fuel oil having a sulphur content for both the distillate and the residual fuel oil of 1.50% as has been used in earlier versions of these Guidelines.

From the derived carbon contents and selected sulphur content value the molar ratio of fuel sulphur to fuel carbon is obtained in Table 2 and from those the corresponding ratios of SO_2 and CO_2. One of the particular features of petroleum derived liquid fuel oils is that despite the wide range of physical properties, such as viscosity and density, between distillates and residuals there is only a very limited range in terms of carbon composition. Hence it is a reasonable proposition to use a single SO_2 / CO_2 ratio in order to represent all such fuel oils; in this instance 65 has been taken to correspond to the Emission Ratio which would be obtained if using a fuel oil of 1.50% sulphur content[2].

From the Emission Ratio corresponding to 1.50% sulphur the Emission Ratios corresponding to the various sulphur limits given in regulation 14 of MARPOL Annex VI are obtained, Table 3.

Table 1: Fuel oil carbon content values

Distillate fuel oil – petroleum derived

Carbon	Given	% m/m	86.2	
	Calculated	% m/m		85.08
Hydrogen	Given	% m/m	13.6	
	Calculated	% m/m		13.42
Sulphur		% m/m	0.2	1.50
Nitrogen + Oxygen		% m/m	0	0
Carbon / Hydrogen ratio			6.338	6.338

Residual fuel oil – petroleum derived

Carbon	Given	% m/m	86.1	
	Calculated	% m/m		87.08
Hydrogen	Given	% m/m	10.9	
	Calculated	% m/m		11.02
Sulphur		% m/m	2.60	1.50
Nitrogen + Oxygen		% m/m	0.40	0.40
Carbon / Hydrogen ratio			7.899	7.899

Table 2: Emission Ratio values for 1.50% sulphur fuel oil

			Distillate	Residual
Fuel	Carbon	% m/m	85.08	87.08
	Sulphur	% m/m	1.50	1.50
	Carbon	mol/kg	70.90	72.57
	Sulphur	mol/kg	0.469	0.469
	S/C ratio	mol/mol	0.00661	0.00646
Exhaust gas Emission Ratio		SO_2 ppm / CO_2 %	66.11	64.60
			65	

Table 3: Emission Ratios corresponding to the regulation 14 sulphur limits[2]

Fuel oil sulphur limits % m/m	Emission Ratio
1.50	65
3.50	151.7
0.50	21.7
0.10	4.3

Note 1. Should treatment systems be developed that also reduce the CO_2 content, the core principle still applies except that in order to assess effectiveness in terms of SO_2 reduction the CO_2 value used would be that before their introduction.

Note 2. The given Emission Ratios only apply where a petroleum derived liquid fuel oil is being used. For other fuel oils specific Emission Ratio values would need to be determined,

and approved by the Administration, based on the particular composition of the fuel oil in question.

APPENDIX 3

~~WASHWATER~~ DISCHARGE WATER DATA COLLECTION

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

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

- inlet water (for background);
- ~~water after the scrubber (but before any treatment system); and~~
- water after the EGC unit (before or after treatment but before any kind of dilution); and
- discharge water after treatment and dilution.

3 This sampling could be conducted 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)~~
- Oil (detailed GC-MS analysis, e.g. ISO 9377-2 or equivalent methods)
- Nitrate
- Nitrite
- Cd
- Cu
- Ni
- Pb
- Zn
- As
- Cr
- V

~~Washwater~~ Discharge water pH should be determined by instant onboard measurements.

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 water flow rates (after treatment, before dilution), dilution of discharge (if applicable), discharge pH 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 a ship that has provided this information to the satisfaction of the Administration should be granted a waiver as regards compliance of the existing installation(s) with possible future stricter ~~washwater~~ discharge water standards whilst still noting the relevance of UNCLOS Article 195 and the fact that restrictions might be in place in certain areas to ensure that environmental quality standards under regional or national water quality legislation are met. The Administration should forward information submitted on this issue to the Organization for dissemination by the appropriate mechanisms.

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APPENDIX 4 (*proposal for a new annex to the guidelines, see 10.1.2.1.2.4*)

STANDARD SEAWATER TITRATION CURVE

1. The following is a description of the chemical equilibrium model and the resulting titration curve shown in the graph below (Figure 1 for pure seawater). The equilibrium model may include the effect of adding an additional alkali to the seawater (e.g. NaOH).

2. The titration curve in Figure 1 is prepared by using a chemical equilibrium model for seawater. The model includes inorganic carbon, boric acid, sulphate, fluoride and dissolved SO_2 equilibria; the equilibrium constants are functions of salinity (ionic strength) and temperature. The apparent pKa values for the equilibrium reactions are found in general oceanography literature, e.g. *An introduction to the chemistry of the sea, Michael E.Q. Pilson, Cambridge University Press (2013),* and in the publication *The Solubility of SO_2 and the dissociation of H2SO3 in NaCl solutions*, F. Millero, P. Hershey, G. Johnson and J. Zhang., Journal of Atmospheric Chemistry, 8 (1989).

   pH is given on the NBS scale.

3. Basis for the computed curve:
   - · Released CO_2 retained in solution, i.e. no forced stripping of CO_2
   - · 10% of dissolved S(IV) oxidized to S(VI) inside EGCS
   - · Seawater alkalinity 2.2 mmol/L
   - · Seawater salinity 35 psu
   - · Seawater pH 8.2
   - · Seawater temperature 32°C

4. Fit equation
   The fit equation for pure seawater is provided based on an empirical equation fit to the EM curve. The equation is

$$pH = 3.84 - 0.2308 * SO_2 + \frac{1.403}{\left(0.0403 + \exp\left(2.966 * \left(SO_2 - 0.189\right)\right)\right)} + \frac{9.947}{\left(4.605 + \exp\left(4.554 * \left(SO_2 - 1.588\right)\right)\right)}$$

   where the variable SO_2 is defined as SO_2 absorbed in mmole/kg seawater.
   The “fit equation” is used for the determination of the dilution factor.

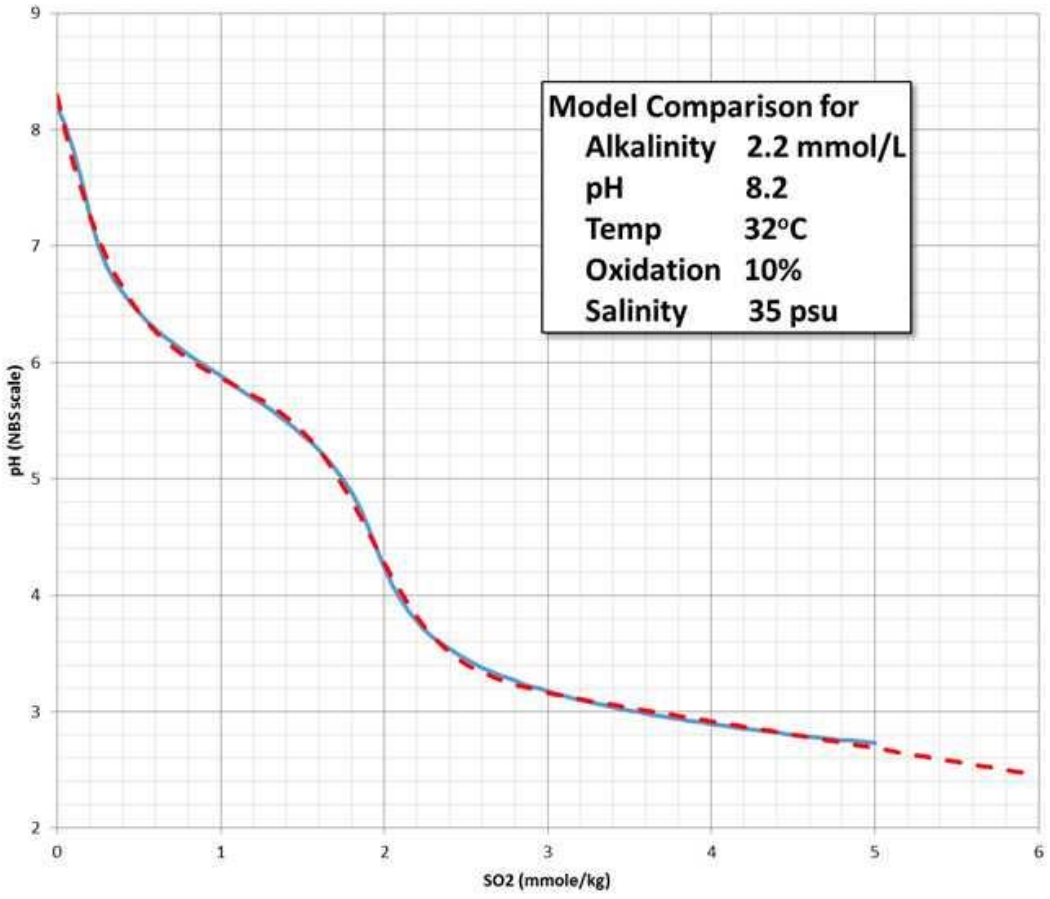
Model Comparison for
Alkalinity 2.2 mmol/L
pH 8.2
Temp 32°C
Oxidation 10%
Salinity 35 psu
pH (NBS scale)
SO2 (mmole/kg)
9
8
7
6
5
4
3
2
0
1
2
3
4
5
6

Figure 1.

APPENDIX 5 (*Proposal for a new appendix to the Guidelines, see 8.2.4*)

Analyser information templates

Under section 8.2 of these Guidelines certain information, as a minimum, should be included in the OMM in order to facilitate surveys and inspections.

Paragraph 8.2.4 requires that information should be given in respect of the exhaust gas and discharge water analysers used in the respective monitoring systems. In order to provide a common approach to the layout and detail which should be included, the following templates are provided and which may be used in the OMM. These templates represent the minimum information which should be given.
Additional information may be required by the Administration.

The use of these templates is voluntary however a standardised layout will assist all users of the OMM.

Exhaust gas

SO_2 / CO_2 measurement Where common so indicate		
Analyser	SO_2	CO_2
Analyser manufacturer		
Model reference		
On-board identification reference		
Arrangement	In situ / extractive	In situ / extractive
Probe location		
Probe description	(ie probe length, single / multiple hole / heated filter / heated pump)	(ie probe length, single / multiple hole / heated filter / heated pump)
Maximum measurement range	ppm	%
Used measurement range(s)	ppm	%
Zero gas specification		
Span gas specification		
Details of: service, maintenance, calibration schedules	Task / interval	Task / interval
Additional information		
Extractive systems only:		
Application	Single or multiple exhaust ducts (if multiple – state which	Single or multiple exhaust ducts (if multiple – state which

	ducts covered and sampling sequence, residence and purge times)	ducts covered and sampling sequence, residence and purge times)
Sample line heated (if yes – maintained temperature ^{o}C)	Yes / No	Yes / No
Sample line details	length, inner diameter	length, inner diameter
Cooler / dryer: Manufacturer Model reference		
Additional information		

Water monitoring

pH / PAH / Turbidity * * delete as applicable	
Application	Sea water inlet / discharge water *
Analyser manufacturer	
Model reference	
On-board identification reference	
Arrangement	In situ / bypass *
Position of sensor	
Maximum measurement range / units	
Used measurement range(s) / units	
Calibration fluid(s) – specification / concentration / units	
Details of: service, maintenance, calibration schedules	Task / interval
Additional information	