Safety Bulletin for Vessels Operating in Australian Waters

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Safety Bulletin for Vessels Operating in Australian Waters - No.100 - Using exhaust gas cleaning systems (EGCS) in Australian waters

1. Background & Purpose

The Australian Maritime Safety Authority (AMSA) has recently issued Marine Notice 2025/04. This is the fourth AMSA Marine Notice on EGCS requirements following 2019/05, 2021/02 and 2022/12. The 2025/04 notice supersedes Marine Notice 2022/12, is more operationally focused, and sets out clearer, more detailed requirements.

This advisory summarizes the key points and operational requirements of 2025/04 to help owners/managers/crew use EGCS compliantly in Australian waters, maintain proper records, handle discharges correctly and respond to malfunctions promptly—reducing PSC risk and supporting safe, compliant operations.

2. Relevant Conventions and Regulatory

- MARPOL Annex VI — low Sulphur fuel requirements
- Protection of the Sea (Prevention of Pollution from Ships) Act 1983, section 26 FEGA (Australia)
- Marine Order 97 (Marine pollution prevention — air pollution)
- 2021 Guidelines for Exhaust Gas Cleaning Systems (MEPC.340(77))

3. General Requirements

- EGCS can be used as an alternative way to comply with the low Sulphur fuel requirements under MARPOL Annex VI.
- EGCS must currently be approved by the vessel's flag State Administration, or a Recognized Organization appointed by the flag State.
- EGCS must currently be operated in accordance with International Maritime Organization (IMO) requirements, including the 2021 Guidelines for Exhaust Gas Cleaning Systems (resolution MEPC.340(77)).

4. Discharge Water Requirements

All EGCS types (open-loop, closed-loop, hybrid) operated in Australian waters are subject to the same discharge water standards.
You may release discharge water from EGCS in Australian waters. All discharges must meet the discharge water quality criteria in the IMO Guidelines, and as amended from time to time.
This includes discharges in waters within:

- Australia's Particularly Sensitive Sea Area (PSSA)
- areas within the MARPOL 'nearest land' boundary, including the Great Barrier Reef Marine Park.

Some port authorities may encourage vessels not to release discharge water within port limits. You should contact the specific port Authority prior to discharge.

5. Sludge and residue disposal

EGCS residues must be delivered to shore reception facilities, and:

- must not be discharged at sea;
- must not be incinerated onboard.

6. Operation & Records

For shipboard EGCS operation, ensure that:

crew are familiar with correct EGCS operation requirements;

the EGCS is well maintained and kept in good working order;

monitoring devices are fully functional;

the following records are kept onboard and ready for PSCO inspection:

- EGCS approval documents;
- EGCS operation and maintenance records.

7. EGCS Malfunctions & Non-Compliance Handling

If your EGCS malfunctions, you must take immediate action and may need to report it.

Step 1: try to fix the malfunction

Identify and fix the issue as soon as possible.

If it's a one-off malfunction and you can fix it within one hour, you don't need to report it.

Step 2: switch to compliant fuel oil and report the malfunction

If the EGCS malfunction lasts more than one hour or happens repeatedly, you must:

- change over to compliant fuel oil
- report the malfunction to the vessel's flag State Administration and the Competent Authority of the port State of the vessel's destination.

Your report should explain the steps you are taking to address the issue.

Step 3: if you don't have enough compliant fuel oil

If the vessel doesn't have sufficient compliant fuel oil to reach the port of destination, you must:

- include this in your report
- outline the vessel's proposed course of action for agreement by the flag State Administration and Competent Authority for their agreement, which might include:
  -bunkering compliant fuel oil at the next port, or
  -carrying out repairs
- where this occurs on an Australian vessel or a foreign vessel within Australian waters, you must email the report to reports@amsa.gov.au.
- Any EGCS that does not comply with IMO Guidelines in any respect (including but not limited to the discharge water quality criteria) may be prohibited from use in Australian waters.

Attachment

2025-04-Marine-Notice-Using-exhaust-gas-cleaning-systems-Australian-waters

MEPC340(77) - 2021 GUIDELINES FOR EXHAUST GAS CLEANING SYSTEMS

CCS Australian Office

August 26, 2025

Disclaimer:
1. The purpose of this document is to assist shipping companies in promptly understanding AMSA inspection requirements and better complying with relevant regulations in Australian waters.
2. For detailed information, please visit the AMSA website at www.amsa.gov.au or the CCS website at www.ccs.org.cn.
3. The content of this document does not replace any provisions of CCS rules, applicable conventions, AMSA regulations, or those of other competent authorities.

Australian Government
Australian Maritime Safety Authority

Using exhaust gas cleaning systems in Australian waters

Marine notice 2025/04

Supersedes Marine Notice 2022/12

Guidance for

- vessel owners
- operators
- masters.

Purpose

This marine notice provides guidance on using an exhaust gas cleaning system (EGCS) to support compliance with the sulphur limit of 0.50 mass per cent concentration (m/m) in fuel oil.

The sulphur limit is required by the International Convention for the Prevention of Pollution from Ships (MARPOL) Annex VI and Australia's domestic law.

General guidance only

This notice should be read in conjunction with MARPOL Annex VI and associated guidelines, relevant Acts, and Marine Orders. It does not constitute legal advice and is not a substitute for independent professional advice.

Use and operational standards

You may use an EGCS as an alternative way to comply with the low sulphur fuel requirements under MARPOL Annex VI.

In Australia, this is allowed under section 26FEGA of the *Protection of the Sea (Prevention of Pollution from Ships) Act 1983*.

To comply, your EGCS must currently be:

- approved by the vessel's flag State Administration, or a Recognised Organisation appointed by the flag State
- operated in accordance with International Maritime Organization (IMO) requirements, including the 2021 Guidelines for Exhaust Gas Cleaning Systems (resolution MEPC.340(77)). (IMO Guidelines).

Discharge water standards

All EGCS types (open-loop, closed-loop, hybrid) operated in Australian waters are subject to the same discharge water standards.

You may release discharge water from EGCS in Australian waters. All discharges must meet the discharge water quality criteria in the IMO Guidelines, and as amended from time to time.

This includes discharges in waters within:

- Australia's Particularly Sensitive Sea Area (PSSA)
- areas within the MARPOL 'nearest land' boundary, including the Great Barrier Reef Marine Park.

Some port authorities may encourage vessels not to release discharge water within port limits. You should contact the specific port Authority prior to discharge.

Sludge and residue disposal

EGCS sludge and residues must be disposed of at port reception facilities. They:

- **must not be** discharged at sea
- **must not be** incinerated onboard.

Operational requirements

When operating an EGCS, you must ensure:

- crew members are familiar with correct operation of EGCS
- the system is kept in good working order and maintenance is up to date
- monitoring devices are fully functional
- records are available for inspection, including:
  - EGCS approval documents
  - operational and maintenance records for the EGCS.

Records must be kept onboard the vessel and provided on request of a Port State Control Officer (PSCO).

EGCS malfunctions

If your EGCS malfunctions[2], you must take immediate action and may need to report it.

Step 1: try to fix the malfunction

Identify and fix the issue as soon as possible.

If it's a one-off malfunction and you can fix it within one hour, you don't need to report it.

Step 2: switch to compliant fuel oil and report the malfunction

If the EGCS malfunction lasts more than one hour or happens repeatedly, you must:

- change over to compliant fuel oil

- report the malfunction to:
  - the vessel's flag State Administration
  - the Competent Authority of the port State of the vessel's destination.

Your report should explain the steps you are taking to address the issue.

Step 3: if you don't have enough compliant fuel oil

If the vessel doesn't have sufficient compliant fuel oil to reach the port of destination, you must:

- include this in your report
- outline the vessel's proposed course of action for agreement by the flag State Administration and Competent Authority for their agreement, which might include:
  - bunkering compliant fuel oil at the next port, or
  - carrying out repairs
- where this occurs on an Australian vessel or a foreign vessel within Australian waters, you must email the report to reports@amsa.gov.au.

Non-compliance consequences

Any EGCS that does not comply with IMO Guidelines in any respect (including but not limited to the discharge water quality criteria) may be prohibited from use in Australian waters.

Further information

- MARPOL Annex VI
- *Protection of the Sea (Prevention of Pollution from Ships) Act 1983*
- *Marine Order 97 (Marine pollution prevention – air pollution)*.

Footnotes

[1] Refer to resolution MEPC.340(77) for further information.
[2] Refer to resolution MEPC.1/Circ.883/Rev.1 for further information.

ANNEX 1

RESOLUTION MEPC.340(77)
(adopted on 26 November 2021)

2021 GUIDELINES FOR EXHAUST GAS CLEANING SYSTEMS

THE MARINE ENVIRONMENT PROTECTION COMMITTEE,

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

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

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

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

RECALLING ALSO that, at its sixty-eighth session, the Committee adopted, by resolution MEPC.259(68), the *2015 Guidelines for exhaust gas cleaning systems* (hereinafter referred to as the "2015 EGCS Guidelines"),

RECOGNIZING the need to update the 2015 EGCS Guidelines,

HAVING CONSIDERED, at its seventy-seventh session, draft amendments to the 2015 EGCS Guidelines, prepared by the Sub-Committee on Pollution Prevention and Response at its seventh session,

1 ADOPTS the *2021 Guidelines for exhaust gas cleaning systems* (hereinafter referred to as the "2021 EGCS Guidelines"), as set out in the annex to the present resolution;

2 INVITES Administrations to implement the 2021 EGCS Guidelines and apply them to exhaust gas cleaning systems installed on ships the keels of which are laid or which are at a similar stage of construction on or after 1 June 2022; or exhaust gas cleaning systems installed on ships the keels of which are laid or which are at a similar stage of construction before 1 June 2022 which have a contractual delivery date of EGCS to the ship on or after 1 June 2022 or, in the absence of a contractual delivery date, the actual delivery of the exhaust gas cleaning system to the ship on or after 1 June 2022; or amendments, as those specified in paragraphs 4.2.2.4 or 5.6.3 of the 2021 EGCS Guidelines, to existing exhaust gas cleaning systems undertaken on or after 1 June 2022, when allowing the use of an exhaust gas cleaning system in accordance with regulation 4 of MARPOL Annex VI;

3 REQUESTS Parties to MARPOL Annex VI and other Member Governments to bring the 2021 EGCS Guidelines to the attention of shipowners, ship operators, shipbuilders, marine diesel engine manufacturers and any other interested groups;

4 INVITES Administrations to provide for discharge water data collection as described in appendix 3 of these Guidelines, and to also apply that appendix when undertaking related sampling from exhaust gas cleaning systems that have been approved in accordance with the earlier versions of the EGCS Guidelines;

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

6 ALSO AGREES that these Guidelines supersede the 2015 EGCS Guidelines adopted by resolution MEPC.259(68).

ANNEX

2021 GUIDELINES FOR EXHAUST GAS CLEANING SYSTEMS

1 INTRODUCTION

1.1 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 These Guidelines have been developed to allow for the testing, survey, certification, and approval of Exhaust Gas Cleaning Systems (EGCSs) in accordance with regulation 4 of MARPOL Annex VI.

1.3 Equivalency with the relevant requirements of regulation 14 of MARPOL Annex VI should be demonstrated by using these Guidelines as a basis of compliance with the relevant Emission Ratio limit value as given in table 1. Where the design or operation of an EGCS requires controls in addition to those given in these Guidelines in order to meet the requirements of regulation 4.4 of the above-mentioned Annex, they should be subject to special consideration by the Administration and should be communicated to the Organization when submitting the notification required by regulation 4.2 of MARPOL Annex VI.

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

Fuel oil sulphur content (% m/m)	Emission Ratio SO_2(ppm)/CO_2(% v/v)
0.50	21.7
0.10	4.3

Note: The use of the above Emission Ratio limit values is only applicable when using petroleum-derived distillate or residual fuel oils. See appendix 2 for the assumptions and rationale which form the basis of the Emission Ratio method.

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

2 GENERAL

2.1 Purpose

2.1.1 The purpose of these Guidelines is to specify the criteria 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 or 14.4 of MARPOL Annex VI, as applicable.

2.1.2 These Guidelines describe two schemes for approval of an EGCS: Scheme A (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):

.1 in Scheme A, the EGCS is subject to approval by the Administration and should be as given in section 4 subject to performance tests, sea trials or other similar physical tests that verify that the system in service will result in the intended performance; and

.2 in Scheme B, the exhaust gas monitoring system of the EGCS is subject to approval by the Administration and should be as given in section 5. Approved exhaust gas monitoring system should continuously indicate the Emission Ratio while the EGCS is in operation, allowing verification against the applicable limit.

2.1.3 Emission testing in relation to either Scheme A or Scheme B should be undertaken, as appropriate, as given in 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, as given in section 7.

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

2.1.6 For ships which are to use an EGCS in part or in total 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) as given in section 9.

2.1.7 Discharge water monitoring which is equally applicable to Scheme A and Scheme B should be undertaken as given in section 10.

2.2 Application

2.2.1 These Guidelines apply to any EGCS as applied to fuel oil combustion unit(s), excluding shipboard incinerators, installed on board a ship.

2.2.2 For the purpose of these Guidelines, the term "EGCS" should be generally, but not exclusively (see 2.2.3), understood as "wet EGCS".

2.2.3 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.

2.2.4 These Guidelines apply to:

.1 EGCSs installed on ships the keels of which are laid or which are at a similar stage of construction on or after 1 June 2022; or

.2 EGCSs installed on ships the keels of which are laid or which are at a similar stage of construction before 1 June 2022 which have a contractual delivery date of EGCS to the ship on or after 1 June 2022 or, in the absence of a contractual delivery date, the actual delivery of the EGCS to the ship on or after 1 June 2022; or

.3 amendments as those specified in 4.2.2.4 or 5.6.3 to existing EGCSs undertaken on or after 1 June 2022.

2.3 Abbreviations, definitions and required documents

2.3.1 Abbreviations as given in table 2 and definitions as given in table 3 are applied in these Guidelines.

Table 2: Abbreviations

CL	Closed-Loop
CO_2	Carbon dioxide
EGC	Exhaust gas cleaning
EGCS	Exhaust gas cleaning system
ETM-A	EGCS – Technical Manual for Scheme A
ETM-B	EGCS – Technical Manual for Scheme B
MCR	Maximum Continuous Rating
SECP	SO_X Emissions Compliance Plan
SECC	SO_X Emissions Compliance Certificate
SO_2	Sulphur dioxide
SO_X	Sulphur oxides
OL	Open-Loop
OMM	Onboard Monitoring Manual
PAH	Polycyclic Aromatic Hydrocarbons
PAH_{phe}	Polycyclic Aromatic Hydrocarbons as phenanthrene equivalents (see table 3)
UTC	Universal Time Coordinated

Table 3: Definitions

12-hour period	A period of 12 consecutive hours determined on a rolling basis with new 12-hour periods beginning past each hour of EGCS operation.
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 Emission Ratio specified by the manufacturer that the EGCS is certified as meeting when operating on a continuous basis on the manufacturer-specified maximum fuel sulphur content and within the specified operational parameters. 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 meeting discharge water criteria, needs to be treated to meet discharge water criteria, or is regarded as EGCS residue.
Continuous monitoring	Process and technology used for evaluation of EGCS compliance through representative measurement, at a specified frequency, for selected parameters.
Discharge water	Any water from an EGCS to be discharged overboard.
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 Electronic Data Recording, or Electronic Logging System	Automatic record of the EGCS in service operating parameters. The record of parameters does not involve any user input.
EGCS Record Book (or Electronic Record Book)	A user-input record of the EGCS, component adjustments, corrective and planned maintenance and service records as appropriate. It can have an electronic format.
EGCS residue	Material removed from the washwater or the bleed-off water by a treatment system or discharge water that does not meet the discharge criterion, or other residue material removed from the EGCS.
Emission Ratio	SO_2 expressed in ppm/CO_2 expressed in % v/v.
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 system. Several EGC units may utilize a common washwater, water supply, treatment and/or overboard system and discharge water monitoring equipment.
Extractive sampling system	System which extracts a sample flow from the exhaust gas stream and transfers it by heated lines to the measurement instrument.
Fuel oil combustion unit	Any engine, boiler, gas turbine, or other fuel oil fired equipment, excluding shipboard incinerators.
Inlet water	Water entering the ship as a cleaning medium for an EGC unit.
In situ	Measuring directly within an exhaust gas stream.

Load range	Interval ranging from minimum practicable to maximum rated power of diesel engine or maximum steaming rate of the boiler.
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.
Phenanthrene equivalent	It corresponds to the signal produced by a PAH monitor with excitation wavelengths between 244 nm and 264 nm (254±10 nm) and detection wavelengths between 310 nm and 410 nm (360±50 nm) calibrated against a known set of phenanthrene concentrations within the expected measurement range when exposed to EGCS discharge water containing a range of different PAH species.
Washwater	Cleaning medium brought into contact with the exhaust gas stream for the reduction of SO_X.
Wet EGCS	EGCS using liquid cleaning medium.

2.3.2 Relevant documents for EGCSs approved in accordance with Scheme A and Scheme B are listed in table 4.

Table 4: Relevant documents for Scheme A and Scheme B

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 Record Book	X	X

3 SAFETY NOTE

3.1 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. For positioning the EGCS discharge water outlet, due consideration should be given to the locations of the existing seawater inlets. In all operating conditions the design of the EGCS should take into consideration the necessary balance between low pH water discharge and the anti-corrosive resistance of the surfaces in contact with that discharge stream. To avoid premature failure of sea chests, discharge pipework and hull penetration finishes, due care should be taken in the preparation of surfaces and the correct selection and application of protective coatings to withstand the corrosive effects of low pH discharge water.

3.2 In cases where exhaust gas duct bypass lines are arranged on board, appropriate measures should be taken to prevent leakage of exhaust gases from the damper to bypass lines.

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

4.1 Approval of EGCSs

4.1.1 General

Options under Scheme A of these Guidelines provide for:

.1 individual EGCS approval;

.2 serially manufactured systems; and

.3 production range approval.

4.1.2 Individual EGCS approval

4.1.2.1 An EGCS should be certified as capable of meeting the Emission Ratio value, the Certified Value, specified by the manufacturer (e.g. the Emission Ratio value the 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 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 allowed. The two fuels selected should have a difference in % m/m sulphur content sufficient to demonstrate the operational behaviour of the EGCS and to demonstrate that the Certified Value can be met if the EGCS 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 subsection 4.3 as appropriate, should be performed. These tests need not be sequential and could be undertaken on two different, but identical, EGCSs.

4.1.2.3 The maximum and, if applicable, minimum exhaust gas mass flow rate of the system should be stated. The effect of variation of the other parameters defined in 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 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 systems

4.1.3.1 In the case of nominally similar EGCSs of the same mass flow ratings as that certified under 4.1.2, and to avoid the testing of each EGCS, 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 under this arrangement should be subject to such surveys that the Administration should consider necessary as to assure that each EGCS has an Emission Ratio value of not more than the Certified Value when operated in accordance with the parameters defined in 4.2.2.1.2.

4.1.4 Product range approval

4.1.4.1 In the case of an EGCS of the same design, but of different maximum exhaust gas mass flow capacities, the Administration may accept, in lieu of tests on an EGCS of all capacities in accordance with 4.1.2, tests of EGCSs 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 EGCSs 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 types.

4.1.4.3 For EGCSs 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 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 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 system, should be submitted to the Administration for approval.

4.2 Survey and certification

4.2.1 Procedures for the certification of an EGCS

4.2.1.1 In order to meet the criterion of subsection 4.1 either prior to, or after installation on board, each EGCS should be certified as meeting the Certified Value specified by the manufacturer (e.g. the Emission Ratio the 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 take into account the provisions of these Guidelines.

4.2.1.3 Each EGCS meeting the criterion of 4.2.1.1 should be issued 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 manufacturer, shipowner or other party.

4.2.1.5 Any subsequent EGCS of the same design and rating as that certified under 4.2.1.1 may be issued with an SECC by the Administration without the need for testing taking into account 4.2.1.1 subject to 4.1.3 of these Guidelines.

4.2.1.6 EGCSs of the same design, but with ratings different from that certified under 4.2.1.1 may be accepted by the Administration subject to 4.1.4 of these Guidelines.

4.2.1.7 EGCSs 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 the overall Emission Ratio value of the exhaust gas downstream of the system is no more than the Certified Value.

4.2.2 EGCS Technical Manual "Scheme A" (ETM-A)

4.2.2.1 Each EGCS 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 system (manufacturer, model/type, serial number and other details as necessary) including a description of the 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;

.2 the maximum and, if applicable, minimum exhaust gas mass flow rate capacity of the EGC unit;

.3 the maximum fuel oil sulphur content the EGCS is certified for;

.4 the Certified Value;

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

.6 the maximum and minimum washwater flow rate, inlet pressures and minimum inlet water alkalinity (ISO 9963-1-2:1994);

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

.8 the maximum exhaust gas differential pressure across the EGC unit and the maximum exhaust gas inlet pressure;

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

.10 other factors concerning the design and operation of the EGCS relevant to achieving a maximum Emission Ratio value no higher than the Certified Value;

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

.4 maintenance, service or adjustment requirements in order that the EGCS can continue to achieve a maximum Emission Ratio 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 the following occurs or is expected to occur: operating conditions are outside approved ranges or limits; the discharge water quality criteria are not met; or exceedances of the Certified Value;

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

.7 washwater and discharge water characteristics across the operating load range;

.8 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; and

.9 detail the procedure to produce reports regarding operation in a non-compliant condition, or in a condition where the ongoing compliance would be temporary indicated in accordance with 8.2.8.

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 is installed and should be available for surveys as required.

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

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

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

4.2.3.4 Following the installation survey given in 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 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 4.2.2.1.2.

4.3.2 In order to demonstrate performance, emission measurements should be undertaken, with the agreement of the Administration, at a minimum of four load points. One load point should be at 95% to 100% of the maximum exhaust gas mass flow rate for which the unit is to be certified. One load point should be within ± 5% of the minimum exhaust gas mass flow rate

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

4.4 Onboard verification procedures for demonstrating compliance

4.4.1 For each EGCS, the ETM-A should contain a verification procedure for use 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 should be designed in such a way as to facilitate inspection as required. The basis of the verification procedure is that if all relevant components and operating values or settings are within the approved ranges, then the performance of the EGCS can be assumed to meet the requirements without the need for actual continuous exhaust emission monitoring.

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 and its ability to meet the Certified Value.

4.4.3 The verification procedure should be provided by the EGCS 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.

4.4.5 The surveyor should verify that each EGCS 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, 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 should include means to automatically record when the system is in use. These means should automatically record, at least at the frequency specified in 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 each EGC unit, fuel oil combustion unit 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 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, a daily spot check of the Emission Ratio for a duration of not less than five minutes at a minimum recording frequency of 0.1 Hz at normal working condition for each outlet to the atmosphere should be undertaken to verify compliance in conjunction with the continuous monitoring of the parameters stipulated in 4.4.7. The exhaust gas readings should be allowed to stabilize before

commencing recording. Readings from the calibration procedure should be automatically recorded or noted in a calibration protocol. Emission values, which are used to determine the Emission Ratio, obtained after stabilization should be recorded. If a continuous exhaust gas monitoring system is fitted, only daily spot checks of the parameters listed in paragraph 4.4.7 would be needed to verify proper operation of the EGC unit.

4.4.9 An EGCS Record Book should be maintained on board the ship recording maintenance and service of the system including like-for-like replacement. This EGCS Record Book should be available during surveys as required and may be read in conjunction with engine-room logbooks and other data, as necessary, to confirm the correct operation of the EGCS. The form of this record should be provided by the EGCS manufacturer and approved by the Administration. Alternatively, this information may be recorded in the ship's planned maintenance record system as approved by the Administration. Alternatively, this information may be recorded in an Electronic Record Book as approved by the Administration. The EGCS Record Book entries should be maintained on board the ship for a minimum period of three years after the last entry has been made.

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

5.1 General

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

5.2.1 The ETM-B, 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 should be subject to survey on installation and at initial, annual/intermediate and renewals 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 Following the installation survey given in 5.3.1 and approval of documents as listed in 2.3.2, sections 2.3 and 2.6 of the Supplement to the ship's International Air Pollution Prevention Certificate should be duly completed.

5.4 Exhaust gas monitoring

5.4.1 The exhaust gas composition of the Emission Ratio should be measured at an appropriate position after the EGC unit and that measurement should be as given in section 6 as applicable. A suitable position could be downstream of the EGC unit, but before any possible mixing of outside ambient air or other additional air or gases with the exhaust gas.

5.4.2 SO_2(ppm) and CO_2(%) and, to not less than one decimal place, the Emission Ratio should be continuously monitored and recorded against the applicable Emission Ratio limit 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. 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.

5.4.3 If more than one analyser is to be used to determine the Emission Ratio, these should have similar sampling and measurement times and the data outputs aligned to ensure that the Emission Ratio is fully representative of the exhaust gas composition.

5.5 Onboard verification procedures for demonstrating compliance with emission limits

5.5.1 The data recording system should be as given in 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 4.4.7 are needed to verify proper operation of the EGCS and should be recorded in the EGCS Record Book or in the engine-room logger system.

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

5.6.1 Each EGCS 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 system (manufacturer, model/type, serial number and other details as necessary) including a description of the 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 system is designed. These should, as a minimum, include:

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

.2 the advised maximum fuel sulphur content for the operational conditions the EGCS is designed for (Note: higher sulphur content fuel oils may be used provided the relevant Emission Ratio value is not exceeded);

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

.4 the maximum and minimum washwater flow rate, inlet pressures and minimum inlet water alkalinity (ISO 9963-1-2:1994);

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

.6 the maximum exhaust gas differential pressure across the EGC unit and the maximum exhaust gas inlet pressure;

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

.8 other parameters as necessary concerning the operation of the EGCS;

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

.4 corrective actions to be applied if the following occurs or is expected to occur: operating conditions are outside approved ranges or limits; the discharge water quality criteria are not met; or exceedances of the maximum allowable Emission Ratio;

.5 washwater and discharge water characteristics across the operating load range;

.6 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; and

.7 detail the procedure for producing reports regarding operation in a non-compliant condition, or in a condition where the ongoing compliance would be temporary indicated in accordance with 8.2.8.

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

5.6.3 Amendments to the ETM-B which reflect EGCS 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 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 Onboard procedures for demonstrating compliance

5.7.1 An EGCS Record Book should be maintained on board the ship 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 logbooks 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. Alternatively, this information may be recorded in an Electronic Record Book as approved by the Administration. The EGCS Record Book entries should be maintained on board the ship for a minimum period of three years after the last entry has been made.

6 EMISSION TESTING

6.1 Emission testing should follow the requirements of the NO_X Technical Code 2008 except as provided for in these Guidelines.

6.2 CO_2 should be measured using an analyser operating on the non-dispersive infrared (NDIR) principle and with additional equipment such as dryers as necessary. SO_2 should be measured using analysers operating on 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 than 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 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 III of the NO_X 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 sampling systems.

6.6 Extractive exhaust gas samples for SO_2 determination should be maintained at a sufficient temperature to avoid 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 verified to be free of ingress leakage in accordance with the analysing equipment manufacturers' recommendations at intervals as defined in the OMM. It should be verified that the system is free of ingress on initial start-up and as given in the OMM with the findings from those checks recorded in the EGCS Record Book.

6.11 The span gases for the SO_2 and CO_2 analyser should be a mixture of SO_2 and/or CO_2 and nitrogen at a concentration of more than 80% of the full scale of the measuring range used. The span gas for the CO_2 should conform to the requirements of section 2 of appendix IV of the NO_X 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, whenever the EGCS is in operation, the data described in 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;

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

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

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

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

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

.7 recording preset and set limit values.

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 device is changed over that period, it should be ensured that the required data is retained on board and available as required for inspection.

7.5 The device should be capable of downloading a copy of the recorded data and reports in a readily useable format clearly indicating periods of non-compliance. Such copy of the data and reports should be available to the Administration or port State control as requested.

8 ONBOARD MONITORING MANUAL (OMM)

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

8.2 The OMM should, as a minimum, include:

.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;

.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 described in 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 means by which ongoing compliance would be temporarily indicated in the case of the failure of a single monitoring device, taking into account that transitory periods of emission exceedances and/or isolated spikes in the recorded output in the Emissions Ratio do not necessarily mean non-compliant exceedance of emissions and should therefore not be considered as a breach of the requirements;

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

.10 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;

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

.12 where the information described in .1 to .11 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 to be surveyed in order to verify that:

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

.2 the operating parameter instruments installed and used on board are as approved per the OMM;

.3 the exhaust gas and discharge water monitoring systems used on board are as approved per the OMM;

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

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

8.4 Under scheme B, where operation of the EGCS is required in order to demonstrate the functionality of the monitoring system during installation or initial surveys, the OMM should describe the operational condition(s) which demonstrate the operational behaviour of the monitoring system and which should be used when surveying in accordance with paragraph 5.3.1. The description of operational condition(s) may include:

.1 the connected fuel oil combustion unit load point(s); and

.2 the minimum operating time at a given load point.

8.5 The OMM should be:

.1 approved by the Administration; and

.2 retained on board the ship onto which the EGCS is installed and should be available for surveys as required.

9 SHIP COMPLIANCE

9.1 SO_X Emissions Compliance Plan (SECP)

9.1.1 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 fuel oil combustion unit which 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 The SECP should list each fuel oil combustion unit 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 of MARPOL Annex VI.

9.1.4 The SECP should advise that records should be kept of actions initiated to meet the requirement of these Guidelines in case of breakdown of the EGCS or associated equipment, and that the relevant flag and port State's Administration should be notified, in accordance with MEPC.1/Circ.883/Rev.1.

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.

9.2.1.2 For all fuel oil combustion units listed under 9.1.3, details should be provided demonstrating that the rating and restrictions for the EGCS as approved, under 4.2.2.1.2, are complied with.

9.2.1.3 Required parameters should be monitored and recorded as described in 4.4.7 when the EGCS is in operation in order to demonstrate compliance.

9.2.2 Scheme B

9.2.2.1 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 DISCHARGE WATER

10.1 Discharge water quality criteria[1]

10.1.1 EGCS discharge water should comply with the following criteria prior to being discharged into the sea:

10.1.2 pH criteria

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

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

.2 The pH discharge limit, at the overboard monitoring position, is the value that will ensure a pH no lower than 6.5 at a distance of 4 m from the overboard discharge point with the ship stationary, and 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) as agreed by the Administration, and in accordance with the following conditions to be recorded in the ETM-A or ETM-B:

[1] The discharge water quality criteria should be reviewed in the future as more data become available, including relevant research and development results, on the content of discharge water and its effects, taking into consideration any advice given by GESAMP. Guidance for voluntary discharge water data collection is included in appendix 3.

.1 all EGC units connected to the same outlets are operating at their full loads (or highest practicable load) and with fuel oil of 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 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 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 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 seawater alkalinity of 2.2 mmol/L and pH 8.2;[2] an amended titration curve should be applied where the testing conditions differ from the reference seawater, as agreed by the Administration (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, discharge water flow rates, designated pH values at both the discharge and 4 m location, titration and dilution data.

10.1.3 PAHs (Polycyclic Aromatic Hydrocarbons)

10.1.3.1 The discharge water PAH should meet the criteria below. The appropriate limit should be specified in the ETM-A or ETM-B.

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

10.1.3.3 The 50 µg/L limit described above is normalized for a discharge flow rate, before any dilution for pH control, of 45 t/MWh where the MW refers to the aggregated MCR of all those fuel oil combustion units whose EGCS discharge water PAH is being monitored at that point. In cases where sensors are installed in a separate measurement cell, the PAH limit applies to the flow in the main discharge pipe from which the water is bypassed. This limit would have to be adjusted upward for lower washwater flow rates (t/h) per MW, and vice versa, according to the table below.

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

Table 5: Criteria for discharge water PAH concentration

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

*Alternative measurement technologies may be used with the agreement of the Administration.

10.1.3.4 For an aggregated 15-minute period in any rolling 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 particulate matter

10.1.4.1 The discharge water treatment system should be designed to minimize suspended particulate matter, including heavy metals and ash. The turbidity of the discharge water, following treatment equipment, including any reactant dosing, but upstream of any other dilution unit, if used, should meet the criteria below. The limit should be recorded in the ETM-A or ETM-B.

10.1.4.2 The maximum continuous turbidity in 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.

10.1.4.3 For an aggregated 15-minute period in any rolling 12-hour period, the continuous turbidity discharge limit may be exceeded by 20%.

10.1.5 Nitrates

10.1.5.1 The 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 discharge water flow rate of 45 t/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 should be drawn and analysed for nitrate content and results should be made available

[3] For any flow rate > 2.5 t/MWh fluorescence technology should be used.

to the Administration. However, the Administration may require an additional sample to be drawn and analysed at its 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. Criteria 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 10.1.5.1, which specifies the need for 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 nitrate should be ISO 13395:1996, ISO 10304-1:2007, US EPA 353.2 or other internationally accepted equivalent test standard (suitable for seawater).

10.1.5.3 Data on discharge water nitrate concentrations gathered from EGCSs of similar design could be used as an alternative to the sampling, analysis and quantification requirements of 10.1.5.2 with the agreement of the Administration based on an engineering analysis which demonstrates the design similarities in respect of nitrate concentrations in the discharge water.

10.1.6 Washwater and discharge water additives and other substances

10.1.6.1 Additional assessment of the discharge water may be required for those EGCS technologies which make use of chemicals, additives, preparations or create relevant chemicals in situ. The assessment may take into account relevant guidelines, such as the *Procedure for approval of ballast water management systems that make use of active substances (G9)* (resolution MEPC.169(57)), to determine if additional discharge water quality criteria are appropriate. If only the following chemicals are used and the discharge water pH does not exceed 8.0, no additional assessment is needed**:**

.1 neutralization agent (caustic substance), such as sodium hydroxide (NaOH) or sodium carbonate (Na_2CO_3); and

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

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 be monitored/recorded in accordance with 10.2.1, and meet, independent of any flow rate, the following discharge water criteria:

pH	See paragraph 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 for pH control

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 EGCS residue.

10.2 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. Whenever there are overboard discharges of discharge water from temporary onboard storage, no maintenance or cleaning of the monitoring equipment should take place. Those EGCS which apply degassing of the sampled discharge water for the purpose of turbidity monitoring should ensure that particles do not settle during degassing, as this would underestimate the real turbidity value.

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

pH	0.2 pH units
PAH	5% of nominal 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. Calibration and calibration checks should be done according to the manufacturer's specification.

10.2.3 The pH electrode and pH meter should have a resolution of 0.1 pH units and temperature compensation. The electrode performance and accuracy should at least comply with the requirements defined in BS 2586 or ASTM D1293-18 and the meter should meet or exceed IEC 60746-2:2003 or other internationally accepted equivalent standards. pH electrodes or pH meters which comply with another accepted standard or technical specification which is in force are deemed to be the equivalent of the equipment, provided these standards or technical specifications conform to standards BS 2586 or ASTM D1293-18 or IEC 60746-2:2003, and ensure at least a like-for-like level of requirements.

10.2.4 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 more than 5% in discharge water with turbidity within the working range of the application.

10.2.5 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.

10.2.6 The turbidity monitoring equipment should meet requirements defined in ISO 7027. The turbidimeter should identify when the turbidity is unable to be reliably quantified.

10.3 Approval of the discharge water monitoring systems

10.3.1 The discharge water monitoring system should be approved by the Administration.

10.4 Water monitoring data recording

10.4.1 The data recording system should comply with the requirements of sections 7 and 8 and should continuously record pH, PAH and turbidity in accordance with 10.2.1 at a frequency of not less than 0.0111 Hz.

10.4.2 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.

10.5 EGCS Residues

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

10.5.2 Each ship fitted with an EGCS should record the storage and disposal of EGCS residues in the EGCS Record Book, including the date, time and location of such storage and disposal.

10.6 Maintenance and servicing records

10.6.1 The EGCS Record Book as required by either 4.4.9 or 5.7.1 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.

10.7 Design guidance for water sampling points/valves

10.7.1 Each sampling point should be installed at a location that is representative of the main washwater or discharge water stream and accessible to personnel. The sampling extraction point should be open in the direction of the water flow.

APPENDIX 1

FORM OF SO_X EMISSION COMPLIANCE CERTIFICATE

Badge or Cipher

NAME OF ADMINISTRATION

SO_X EMISSION COMPLIANCE CERTIFICATE

CERTIFICATE OF APPROVAL FOR EXHAUST GAS CLEANING SYSTEMS

Issued under the provisions of the Protocol of 1997, as amended, to amend the International Convention for the Prevention of Pollution from Ships, 1973, as modified by the Protocol of 1978 relating 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) listed below has been surveyed in accordance with the specifications contained under Scheme A in the *20XX Guidelines for exhaust gas cleaning systems* adopted by resolution MEPC.YYY(ZZ).

This Certificate is valid only for the EGCS referred to below:

System manufacturer	**Model/ type**	**Serial number**	**This EGCS is certified as providing following equivalency:**		**EGCS – Technical Manual for Scheme A (ETM-A) approval reference**
			Fuel oil sulphur limit values:	**Maximum sulphur content of fuel oils to be used:**	
			0.10%	**_____% / n/a***	
			0.50%	**_____%**	

* delete as applicable

A copy of this Certificate should be carried on board the ship fitted with this EGCS at all times.

This Certificate is valid for the life of the EGCS, subject to surveys in accordance with subsection 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)

Date dd/mm/yyyy

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

(Seal or Stamp of the authority, as appropriate)

APPENDIX 2

EMISSION RATIO

1 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.

2 The carbon content of any fuel oil used for power generation by 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.

3 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.

4 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.

5 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.

6 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] The value of 1.50% sulphur content was used as the basis of these calculations as that was the original limit value for Emission Control Areas as given by the MARPOL Annex VI text as adopted in 1997, and which has been subsequently amended.

7 From the Emission Ratio corresponding to 1.50% sulphur the Emission Ratios corresponding to the various sulphur limits now given in regulation 14 of MARPOL Annex VI are obtained (see 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 %	66.12	64.60
			65	

Table 3: Emission Ratios corresponding to fuel oil sulphur content[2]

Fuel oil sulphur content % m/m	Emission Ratio
1.50	65
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 prior to that reduction i.e. CO_2 being measured at a point upstream of that treatment device.

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

DISCHARGE WATER DATA COLLECTION

1 Introduction

1.1 The discharge water quality criteria are intended to act as initial guidance for implementing EGCS designs. The criteria should be reviewed 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.

1.2 Administrations should therefore invite the collection of relevant data. To this end, shipowners in conjunction with the EGCS manufacturer are invited to sample and analyse samples of EGCSs, taking into account section 2 and section 3 of this appendix, as appropriate.

1.3 The sampling could be conducted during approval testing or shortly after commissioning and at about 12-monthly intervals.

2 Recommended procedure for sampling

2.1 In order to evaluate the contents of the discharge water and its effects, it is recommended that samples be analysed for the parameters listed under paragraph 2.4.1 of this appendix.

2.1 Preparation

2.1.1 This section describes preparations recommended prior to any sampling.

2.1.2 The EGCS should be equipped with sampling points for sampling of the following water streams:

.1 inlet water (for background);

.2 water after the EGC unit after treatment (if applicable) but before any kind of dilution; and

.3 discharge water after treatment and dilution.

2.1.3 Preparation for sampling, handling and transport

2.1.3.1 Sampling equipment

The sampling equipment and pre-prepared sample containers should be made ready prior to sampling. The equipment can be ordered from the laboratory performing the analysis. The equipment should be ordered well before the sampling takes place, taking into consideration the itinerary of the ship.

The table below lists the recommended physical properties of the sampling bottles needed. It takes ISO 5667-3 and the appropriate analytical standard into account, but other equivalent standards can also be used. The table furthermore informs how the samples should be stored when drawn and when at the latest they need to reach the laboratory for analysis.

Parameter	Bottle material	Volume	Method specifying sampling bottle requirements	Preservative	Storage temperature	Maximum time until analysis
NO_2^-/NO_3^-	PE	250 mL	ISO 10304-1	No preservative	Frozen (≤ -18°C)	8 days
Total Metals	PE	500 mL	ISO 17294-2	HNO_3 Acid	Cooled (4°C) / dark	1 month
Dissolved Metals	PE	500 mL	ISO 17294-2	No preservative	Cooled (4°C) / dark	1 month
PAHs	Amber-glass with PTFE seal	2 L (OL), 1 L (CL)	DIN EN 16691 or EPA 8270	No preservative	Cooled (4°C) / dark	7 days
Hydrocarbon oil index (GC-FID analysis)	Glass	1L	ISO 9377-2	Mineral acid pH<2	Cooled (4°C) / dark	4 days

It is practical to label sampling bottles before sampling. Identify each bottle such that it can be tracked back to sampling point, sampling parameter, EGCS operation mode and EGCS load.

2.1.3.2 Preparation for storage and holding of samples

To ensure proper storage and holding, crew need to appoint an appropriate space on board for samples and ice packs, preferably in an enclosed container in a cool space without direct sunlight.

2.1.3.3 Preparation for transport

If samples need to be transported with ice packs, the ice packs should be deep-frozen at least 48 h prior to sampling.

It is recommended to arrange shipping of the samples in advance with the port agent of the destination port.

2.1.3.4 Preparation of personnel conducting the sampling

To ensure the health and safety of the personnel, it is recommended to wear the following equipment:

2.1.3.4.1 Protective eyeglasses/goggles, ear protection, gloves, protective clothing and safety shoes

2.1.3.5 Personnel qualifications and responsibilities.

It is important that the personnel taking the samples are well trained. They should be aware of:

.1 how the system is working and where the sampling points are located; and

.2 how to dispose of the flushing water collected during flushing.

The personnel should be competent in drawing samples and should know the location of the sampling points and how to safely dispose of the collected flushing water.

2.1.3.6 Information prior to sampling

It is recommended to complete the templates under 3.1 prior to sampling.

2.2 Collection

2.2.1 Sample time schedule

It is recommended to prepare a sampling time plan in advance in agreement with the crew, considering when at the latest the samples need to be analysed at laboratory. The sampling plan should contain information that can identify which bottle contains which water (OL/CL, inlet/outlet, etc.) and at which hour the sample was drawn. In this manner, continuous recorded EGCS control parameters can be retrieved at a later stage. Sampling should be undertaken with the EGCS operating above 50% of maximum exhaust gas flow (4.2.2.1.2.1 / 5.6.1.2.1).

2.2.2 Filling the sampling bottle

To prevent contamination during sampling, the following practices are recommended:

.1 use sampling bottles prepared by the laboratory;

.2 the water flow and thus the engine load(s) should be steady before and during sampling;

.3 the sampling valve should be flushed with a minimum of 10 litres of sampling water before samples are taken and it should not be closed or touched after flushing or before the sampling is done;

.4 if more than one bottle is filled, the sampling valve should not be closed in between;

.5 the use of any hydrocarbon-based cleaning agents at the sampling point should be avoided; and

.6 fill the sampling bottles to the brim and close firmly to avoid air in the bottles.

2.2.3 Information while sampling

It is recommended to complete the template under 3.2 while sampling.

2.3 Transportation

Sampling equipment to be used during transportation should meet provisions under 2.1.3.1 above.

2.3.1 Transportation container

For transportation an insulated and leak-proof container should be used. The transportation container should be provided by the laboratory. It should be able to hold a sufficient quantity of ice packs.

2.3.2 Shipping to the laboratory

Samples should be shipped to the laboratory as fast as possible. The transportation container should be labelled in accordance with local requirements for shipping and handling of water samples.

Immediately before handing over the samples to the port agent, the ice packs should be put into the box.

2.3.3 Chain of custody

A formal chain of custody process is required, with records.

Usually it is not necessary to include a customs declaration as these are water samples of zero commercial value.

2.3.4 Information from the laboratory

Take into consideration any information provided by the laboratory.

2.4 Sample preparation and analysis

Analysis should be undertaken by ISO 17025-accredited laboratories using EPA, ISO or equivalent test procedures. Methods used in the laboratories need to be within the scope of ISO 17025 accreditation of the laboratory.

2.4.1 To ensure comparability of laboratory results, the following methods are recommended:

Parameter	Recommended method for sample analysis	Recommended method for sample preparation
Polycyclic Aromatic Hydrocarbons (PAH): 16 EPA PAHs: Acenaphthene Acenaphthylene Anthracene Benzo-a-anthracene Benzo-a-pyrene Benzo-b-fluoranthene Benzo-g,h,i-perylene Benzo-k-fluoranthene Chrysene Dibenzo-a,h-anthracene Fluoranthene Fluorene Indeno-1,2,3-pyrene Naphthalene Phenanthrene Pyrene Sum of 16 PAHs	EN 16691:2015 or ISO 28540:2011 (recognizing EN 16691 as ISO is currently under consideration) or EPA 8270	* * EPA 3510; or EPA 3511; or EPA 3520.
Oil detailed GC FID analysis	ISO 9377-2:2000	*

Determination of Hydrocarbons Oil Index		
Nitrate and nitrite (NO_3-/NO_2-)	ISO 10304-1:2007 or ISO 15923-1:2013 or ISO 13395:1996 or EPA 353.2	* * * *
Total Metals: - Cd - Cu - Ni - Pb - Zn - As - Cr - V - Se	ISO 17294-2:2016 or EPA 200.8 or EPA 200.9	ISO 15587-1:2002 * *
Dissolved Metals: - Cd - Cu - Ni - Pb - Zn - As - Cr - V - Se	ISO 17294-2:2016 or EPA 200.8 or EPA 200.9	ISO 17294-2:2016 and filtration on 0.45 µm + HNO_3 EPA 200.8 and filtration on 0.45 µm + HNO_3 EPA 200.9 and filtration on 0.45 µm + HNO_3
Discharge water pH should be determined by instant onboard measurements	Record pH immediately on board	Record pH immediately on board

* Preparation method is included in the analytical method.

3 Recommended template for submitting sampling data

When submitting sampling data to the Administration, the data should include information according to paragraphs 1 and 2 as well as the results from the analyses as described under paragraph 2.4.

When submitting sampling data to the Administration, the following template is recommended.

3.1 Data Template Part 1 **Information prior to sampling**		
Parameter	Value	Unit
3.1.1 Ship information		
Ship's name		
IMO number		
Ship build date		dd.mm.yyyy
3.1.2 Combustion unit(s) details Engine questions should be answered for every fuel-burning facility connected to the EGCS		

Number of combustion units connected to EGCS		
Combustion unit(s) manufacturer(s)		
Type of combustion unit(s) (ME, AE, 2/4-stroke, boiler)		
EGCS capacity in MW		
3.1.3 EGCS general		
Name of manufacturer		
Name of system		
Number of streams	single/multiple	
System operation mode	open/closed/hybrid	
Type of washwater treatment		
EGCS retrofit or new building		
Installation date		
ETM scheme A or B approval		
Additional notes:		

3.2 Information in conjunction with sampling for each operation mode (OL and/or CL)		
Parameter	Value	Unit
3.2.1 Ship information during sampling		
Cruise speed		knots
Start of sampling date and time		UTC
Stop of sampling date and time		UTC
Ship's position start of sampling		GPS
Ship's position end of sampling		GPS
Weather conditions (during sampling)		calm/rough
3.2.2 EGCS operation		
Approx. EGCS load		%
System operation mode	open/closed	
Type of washwater treatment, if any		
Added chemicals for treatment		Name
Dosage rate of added chemicals for treatment during sampling		l/m³
Average washwater flow rate to EGCS during sampling period		m³/h
Average dilution water flow rate during sampling period, if given or relevant		m³/h
3.2.3 Combustion unit(s) operation		
Approx. total combustion unit(s) load to EGCS		MW
Total fuel consumption		t/h
Fuel sulphur content (according BDN)		
Fuel viscosity if available		
Additional notes:		

3.2.4 Online monitoring readings during sampling, for each sampling point			
Monitoring unit	pH	PAH_{phe} µg/L or ppb	Turbidity FNU or NTU
Inlet (if available), average during sampling period			
Discharge point, average during sampling period (outlet)		NA	NA
Before dilution, average during sampling period	NA		

3.2.5 Results to be reported by the laboratory				
Question	Answer		Comments	
Satisfactory temperature at arrival	Yes/No			
Sampling bottles and transportation container prepared by laboratory	Yes/No			
Methods within the scope of ISO 17025 accreditation of the laboratory	Yes/No			
Date and time samples arrived at laboratory				
Date and time of analyses				
Parameter	Bottle ID	Preparation method	Analytical method	Result + unit
Polycyclic Aromatic Hydrocarbons (PAH): 16 EPA PAHs: Acenaphthene Acenaphthylene Anthracene Benzo-a-anthracene Benzo-a-pyrene Benzo-b-fluoranthene Benzo-g,h,i-perylene Benzo-k-fluoranthene Chrysene Dibenzo-a,h-anthracene Fluoranthene Fluorene Indeno-1,2,3-c,d-pyrene Naphthalene Phenanthrene Pyrene				
Hydrocarbon Oil Index GC-FID analysis				
Nitrate and nitrite (NO_3^-/NO_2^-)				

Total Metals: - Cd - Cu - Ni - Pb - Zn - As - Cr - V - Se				
Dissolved Metals: - Cd - Cu - Ni - Pb - Zn - As - Cr - V - Se				

3.2.6 List of bottle IDs or chain of custody (COC)

Sampling point	Parameter PAH	Parameter Metals	Parameter X
Inlet	Bottle #1 + time stamp	Bottle #2 + time stamp	Etc.
discharge point	Bottle # + time stamp	Bottle # + time stamp	Etc.
Etc.	Etc.	Etc.	Etc.

APPENDIX 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 H_2SO_3 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:

.1 Released CO_2 retained in solution, i.e. no forced stripping of CO_2;

.2 10% of dissolved S(IV) oxidized to S(VI) inside EGCS;

.3 Seawater alkalinity 2.2 mmol/L;

.4 Seawater salinity 35 psu;

.5 Seawater pH 8.2; and

.6 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:

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

where the variable SO_2 is defined as SO_2 absorbed in mmol/kg seawater.

The "fit equation" is used for the determination of the dilution factor.

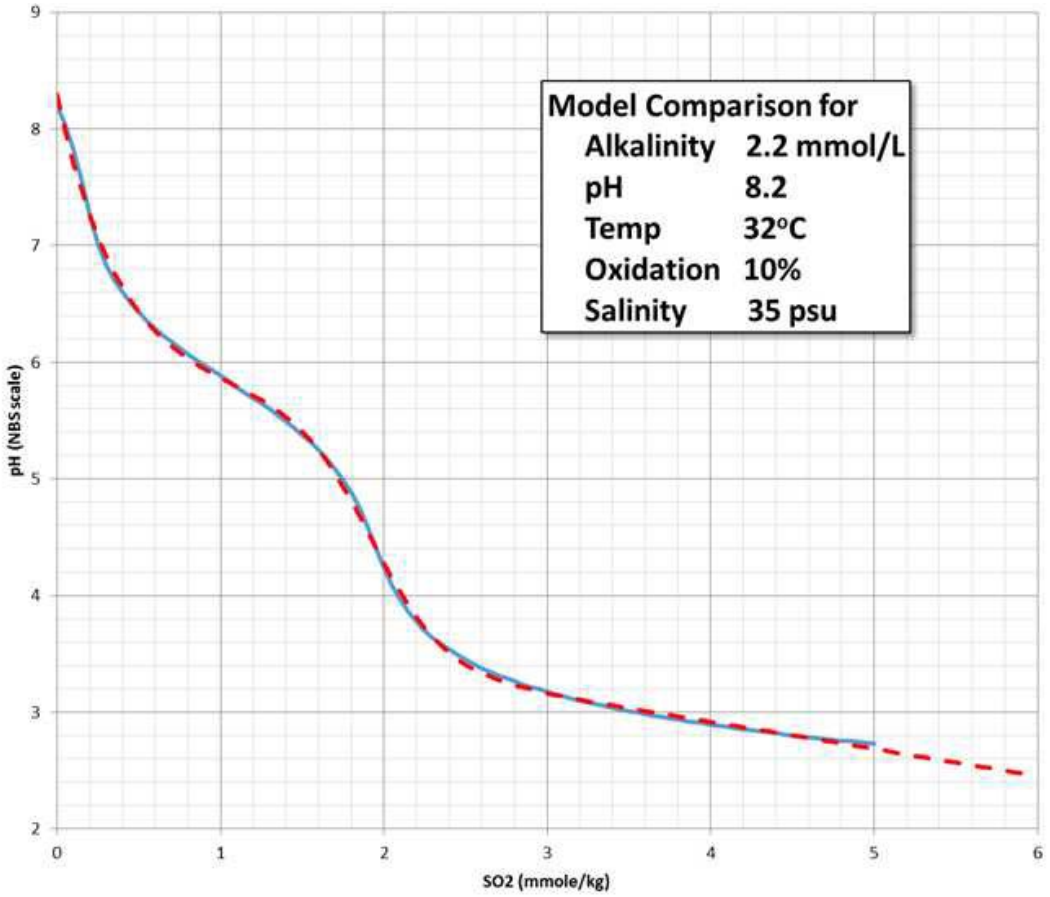


Figure 1 – pure seawater titration curve

APPENDIX 5

ANALYSER INFORMATION TEMPLATES

Under subsection 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 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 standardized 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		
Onboard identification reference		
Arrangement	In situ/extractive	In situ/extractive
Probe location		
Probe description	(i.e. probe length, single/multiple hole/heated filter/heated pump)	(i.e. 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 ducts covered and sampling sequence, residence and purge times)	Single or multiple exhaust ducts (if multiple – state which ducts covered and sampling sequence, residence and purge times)

Sample line heated (if yes – maintained temperature ºC)	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	Seawater inlet/discharge water*
Analyser manufacturer	
Model reference	
Onboard 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	

***