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Joint Group of Experts on the Scientific Aspects of Marine Environmental Protection

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Agenda item 4

**PLANNING OF GESAMP ACTIVITIES:
REVIEW OF APPLICATIONS FOR 'ACTIVE SUBSTANCES' TO BE USED IN BALLAST WATER MANAGEMENT SYSTEMS**

Report of the GESAMP Ballast Water Working Group (Working Group 34)

Background and introduction

1 The International Convention for the Control and Management of Ships' Ballast Water and Sediments, (hereafter referred to as the BWM Convention) was adopted at IMO on 13 February 2004, in response to the increasing concern of the international community with regard to the transfer of invasive species in ships' ballast water. On 8 September 2016, Finland deposited its accession to the BWM Convention. The accession brought the combined tonnage of contracting States to the treaty to 35.14%, with 52 contracting Parties. The convention stipulates that it will enter into force 12 months after ratification by a minimum of 30 States, representing 35% of world merchant shipping tonnage. Therefore, the Ballast Water Management Convention will enter into force on 8 September 2017. Since then, Panama has also acceded to the Convention bringing the number of contracting Parties to 53, representing 53.28% of the world tonnage.

2 Within this framework, an approval procedure has been set up for those ballast water management systems which make use of an Active Substance or Preparation to comply with the Convention. The procedure consists of a two-step approach for granting Basic Approval and Final Approval. The approval is granted by the Marine Environment Protection Committee (MEPC) based on the advice provided by the Ballast Water Working Group of the GESAMP (WG 34). There is a third step, the type approval, but that is outside the remit of WG 34.

3 The more general outline, scope and aim of the BWM Convention have been addressed in the report to the GESAMP 35 (see document GESAMP 35/5/1) and will only be referred to here. The Terms of Reference of WG 34 have been added as annex 1 to this report. As the terms of reference of WG 34 have not changed, several parts of this report have been kept unchanged. For the sake of completeness and readability, these sections have been kept in the report, with apologies to the experienced reader.

4 This report focuses on the main activities of WG 34, which consist of the evaluation of several ballast water management systems (hereafter BWMS) and the further development of the Methodology of the group, which has been accepted as a 'living' document. This means that the Methodology will be a discussion item at (almost) each meeting of the group and changes and improvements are made, as appropriate (see further below).

'Active Substances'

5 'Active Substances' are defined by the Convention as "substances or organisms, including a virus or a fungus that have a general or specific action on or against harmful aquatic organisms and pathogens" and the approval of BWMS using such substances is described in resolution MEPC.169(57) adopted in 2008. However, not only 'Active Substances' are evaluated by the WG 34. Also all other substances considered relevant are taken into account in the

evaluation report. The Procedure for approval of ballast water management systems that make use of Active Substances (G9) contained in resolution MEPC.169(57) under the BWM Convention distinguishes also 'Relevant Chemicals' and 'Other Chemicals'.

6 Therefore, WG 34's task is to evaluate the risks for the crew, the ships' safety, the risk for the public at large and the environmental safety of the BWMS. It is furthermore the intention of WG 34 to perform these evaluations in a consequent, consistent and transparent manner, which helps Administrations to prepare a concise dossier, containing all the necessary data. The Methodology, as developed by WG 34 in the course of its work process, serves as guidance in the evaluation.

7 WG 34 convened two times since GESAMP 42 to evaluate proposed BWMS. Furthermore the WG is holding regular stocktaking workshops to discuss items related to the Methodology; the 7th stocktaking workshop was held the week after GESAMP 42 and therefore will be reported to GESAMP 43 as well. During the two WG 34 meetings five BWMS were discussed and evaluated. Of these BWMS, one received a recommendation for Basic Approval and four received a recommendation for Final Approval. During its meetings in April and October 2016, MEPC agreed with the recommendations of WG 34 in all cases and granted the approvals accordingly. An overview of the BWMS evaluated in these meetings is presented in annex 2 to this report.

8 WG 34 was able to clear the whole stock of BWMS submitted for evaluation before the meeting of MEPC for which the evaluation was requested. The group recognized that the number of BWMS presented to the group have been less than in other reporting periods. It is expected that this has close relation to the ongoing process in IMO to modify Guidelines (G8) for receiving type approval from Administration (see paragraph 11).

Methodology for information gathering and the conduct of work of WG 34

9 The evaluation Methodology of WG 34 has been determined to be a living document based on increasing experience in the evaluation of BWMS. During six Stocktaking Workshops WG 34 further developed the Methodology by adding 1) quantitative methods for the evaluation of human risk assessment including exposure assessment for professionals and the general public, 2) quantitative assessment of the environmental effects by using a specific ballast water model, MAMPEC-BW 3.0.1 and 3) finalization of the second version of the database for 41 specific chemicals, including AS and neutralizer frequently used in BWMSs and disinfection by-products (DBP) frequently observed in which the physico-chemical data, the toxicological data and the environmental fate and effect data are included. For these 41 substances the applicants of BWMS do not have to submit the data mentioned to IMO anymore as the group is of the opinion that all and sufficient, relevant information is already available. All physico-chemical data of 41 chemicals has already been included in the MAMPEC-BW, version 3.0.1.

10 The group also developed an electronic tool for the calculation of several risk quotients, e.g. for human health and the environment, to support the work of the group. This tool, originally developed in Microsoft Access, has now been transposed to the IMO toolbox GISIS (Global Integrated Shipping Information System) with the intention to make it available for all stakeholders. The group is currently testing the new tool in the new environment.

11 In 2014, MEPC had started its work to review the Guidelines for approval of ballast water management systems (G8) (resolution MEPC.174(58)), which is used for evaluating biological efficacy and granting type approval by National Administrations. This is the second amendment of Guidelines (G8), which may include the changes of test water conditions (salinity, DOC, POC and TSS), tank holding times (less than 5 days may be accepted) and evaluation of efficacy under extreme conditions. Although, the purpose of the review is to seek more accuracy on the evaluation of biological efficacy in ballast water treated by BWMS, the test water and treated water will be also used for evaluation in accordance with Procedure (G9). Therefore, there is a need to develop a uniform approach across the Guidelines (G8) and the Methodology in several areas. WG 34 has been formally attending the correspondence group for the review of Guidelines (G8) in order to contribute to achieving such a uniform approach.

12 With respect to aiming at achieving a uniform approach the group identified 2 areas where the further discussion will focus upon:

.1 tank holding time; according to a decision of MEPC 69, the tank holding time for the evaluation of the biological efficacy may be variable, whilst for the determination of the worst-case concentration of disinfection by-products a storage time of 5 days should be more appropriate.

.2 safety aspects; WG34 favours a risk assessment approach for all relevant chemicals that are commonly associated with BWMS, *e.g.* the chemicals in the GESAMP-BWWG database, referred to under point 9. However, in the most recent proposals of the correspondence group, a hazard approach is preferred if relevant Administrations assess risks on safety. In such an approach the exposure to the chemicals is not considered, only the hazard.

13 WG 34 held its 7th STW from 7 to 10 September 2015 at IMO Headquarters in London, which was one week after GESAMP 42. Therefore, it was not possible, to report at GESAMP 42. The report of the workshop has been attached to this report as annex 3.

14 Considering paragraph 12, WG34 spent some time in the preparation of its position papers related to the main 2 discussion points. The final position papers are attached to this report as annexes 4 and 5.

15 The group had to decide based on the heavy agenda at IMO with respect to several meetings that it was not opportune to organise STW8 during 2016 but to postpone it to 2017. A draft agenda is not yet available.

Planning ahead

16 The deadline for the submission of proposals for approval of BWMS to MEPC 71 was on 21 October 2016 and 3 applications were received. WG 34 scheduled a meeting to accommodate those applications: BWWG 34 from 5 to 9 December 2016. In addition, due to a number of requests by the MEPC for the Group to consider specific matters urgently and report to MEPC 71, the Group scheduled its 8th Stocktaking Workshop from 6 to 10 February 2017. Both meetings (BWWG 34 and STW8) are foreseen to be held at IMO Headquarters in London.

Acknowledgement

17 WG 34 is very thankful to all the members of GESAMP that took the time to critically review the work of WG 34. The quality of the work has been improved as a result from this peer review process and the comments made were brought to the attention of the consultant involved in the drafting of the reports.

Action requested of GESAMP

18 GESAMP is invited to review this document and comment, as it deems appropriate.

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ANNEX 1

TERMS OF REFERENCE FOR THE TECHNICAL GROUP (GESAMP-BWWG/ WG 34)

1 Consideration of development of necessary methodologies and information requirements in accordance with the "Procedure for approval of ballast water management systems that make use of Active Substances (G9)" (adopted by resolution MEPC 169(57)) for consideration by MEPC 65.

2 For Basic Approval, the group should review the comprehensive proposal submitted by the Member of the Organization along with any additional data submitted as well as other relevant information available to the group and report to the Organization.

In particular, the group should undertake:

.1 scientific evaluation of the data set in the proposal for approval (see paragraphs 4.2, 6.1, 8.1.2.3, 8.1.2.4 of Procedure (G9));

.2 scientific evaluation of the assessment report contained in the proposal for approval (see paragraph 4.3.1 of Procedure (G9));

.3 scientific evaluation of the risks to the ship and personnel to include consideration of the storage, handling and application of the Active Substance (see paragraph 6.3 of Procedure (G9));

.4 scientific evaluation of any further information submitted (see paragraph 8.1.2.6 of Procedure (G9));

.5 scientific review of the risk characterization and analysis contained in the proposal for approval (see paragraph 5.3 of Procedure (G9));

.6 scientific recommendations on whether the proposal has demonstrated a potential for unreasonable risk to the environment, human health, property or resources (see paragraph 8.1.2.8 of Procedure (G9)); and

.7 preparation of a report addressing the above-mentioned aspects for consideration by MEPC (see paragraph 8.1.2.10 of Procedure (G9)).

3 For Final Approval, the group should review the discharge testing (field) data and confirm that the residual toxicity of the discharge conforms to the evaluation undertaken for Basic Approval and that the previous evaluation of the risks to the ship and personnel including consideration of the storage, handling and application of the Active Substance remains valid. The evaluation will be reported to the MEPC (see paragraph 8.2 of Procedure (G9)).

4 The group should keep confidential all data, the disclosure of which would undermine protection of the commercial interests of the applicant, including intellectual property.

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ANNEX 2

LIST OF BALLAST WATER MANAGEMENT SYSTEMS THAT MAKE USE OF ACTIVE SUBSTANCES IN ACCORDANCE WITH PROCEDURE (G9) SINCE GESAMP 41

Name of the System/Manufacturer	Brief description of the System	Date of Approval	Specifications
1. ECS-HYCHLOR™ System	Combination of filtration followed by in situ electrolysis of a side stream of the ballast water uptake to produce a concentrated stream of the Active Substance sodium hypochlorite and neutralization of the remaining Active Substance with sodium thiosulfate during discharge. This system requires the storage of chemicals on-board.	Final Approval, Granted, April 2016	The Flag State Administration was invited to ensure that the recommendations presented in annex 4 of the report of the GESAMP-BWWG 32 were fully addressed during the further development of the ballast water management systems. The recommendations mainly focus on the reassessment of the system limitations for salinity and temperature and the performance of a corrosion test..
2. NK-Cl BlueBallast System	Treatment with the Preparation sodium dichloroisocyanurate dehydrate (NaDCC) which is immediately converted to sodium hypochlorite by dissolving in water.	Final Approval, Granted, April 2016	The Flag State Administration was invited to ensure that the recommendations presented in annex 5 of the report of the GESAMP-BWWG 32 were fully addressed during the further development of the ballast water management systems. The recommendations mainly focus on the use of adequate respiratory devices during ballast water sampling.
3. ATPS-BLUEsys BWMS	Disinfection with Active Substance sodium hypochlorite formed by in situ electrolysis, followed by neutralization with sodium thiosulfate. This system requires	Final Approval, Granted, April 2016	The Flag State Administration was invited to ensure that the recommendations provided in annex 6 of the report of the GESAMP-BWWG 32 meeting were fully addressed during the

Name of the System/Manufacturer	Brief description of the System	Date of Approval	Specifications
	the storage of the neutraliser on board.		further development of the ballast water management systems. The recommendations mainly relate to potential measurement problems of TRO in aerated water and the prevention of manual operation by the crew.
4. ClearBal Ballast Water Management System	Disinfection with a solution of two Active Substances, Brilliant Green (BG) and cetyltrimethyl ammonium bromide (CTAB). A detoxification system is operating on discharge.	Basic Approval, Granted, October 2016	The Flag State Administration was invited to ensure that the recommendations provided in annex 4 of the report of the GESAMP-BWWG 33 meeting were fulfilled prior to submission for Final Approval. The recommendations focus on the development of a suitable measuring device for the control of the Active Substances.
5. ECS-HYCHEM^{TM} System	Combination of filtration followed by treatment with the Preparation sodium dichloroisocyanurate dehydrate (NaDCC) which is immediately converted to sodium hypochlorite by dissolving in water.	Final Approval, Granted, October 2016	The Flag State Administration was invited to ensure that the recommendations presented in annex 5 of the report of the GESAMP-BWWG 33 were verified prior to the further development of the system. The recommendations mainly focus on keeping the MADC at the required level.

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ANNEX 3

INTERNATIONAL MARITIME ORGANIZATION

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MARINE ENVIRONMENT PROTECTION COMMITTEE
69th session
Agenda item 4

MEPC 69/4/3
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HARMFUL AQUATIC ORGANISMS IN BALLAST WATER

Seventh Stocktaking Workshop on the activity of the GESAMP-Ballast Water Working Group

Note by the Secretariat

SUMMARY

Executive summary:	This document provides a summary of the outcome of the Seventh Stocktaking Workshop on the activity of the GESAMP-Ballast Water Working Group[1]
Strategic direction:	7.1
High-level action:	7.1.2
Output:	7.1.2.4
Action to be taken:	Paragraph 60
Related documents:	MEPC 62/24 and BWM.2/Circ.13/Rev.3

Introduction

1 Regulation D-3.2 of the Ballast Water Management Convention (BWM Convention) provides that ballast water management systems (BWMS) which make use of Active Substances to comply with the Convention shall be approved by IMO in accordance with the *Procedure for approval of ballast water management systems that make use of active substances* (G9) (resolution MEPC.169(57)). Since 2006, this task of approval has been performed by the Marine Environment Protection Committee based on the independent advice provided by the GESAMP-Ballast Water Working Group (GESAMP-BWWG).

2 MEPC 58 agreed that additional time should be allocated to the GESAMP-BWWG to take stock of the experience achieved and to discuss the lessons learned and the general aspects related to the evaluation process, without the pressure of having to review specific submissions. Such stocktaking workshops were conducted in January and October 2009, in April 2011, in August 2012, in September 2013 and in July 2014, their outcome being reported to MEPC 59, MEPC 60, MEPC 62, MEPC 65, MEPC 66 and MEPC 68, respectively.

1 Following the decision of MEPC 58, only the main body of the GESAMP-BWWG report is translated in all three working languages with the annexes being submitted in English only.

3 In considering the report of the Third Stocktaking Workshop, MEPC 62 noted the outcome of the Workshop contained in document MEPC 62/2/14 (Secretariat) and endorsed the proposal of the GESAMP-BWWG to conduct the stocktaking meetings on a yearly basis.

Seventh Stocktaking Workshop on the activity of the GESAMP-Ballast Water Working Group

4 The Seventh Stocktaking Workshop on the activity of the GESAMP-BWWG (hereafter the Group) was held at IMO Headquarters in London from 7 to 10 September 2015 under the chairmanship of Mr. Jan Linders. Dr. Michael Huber represented the GESAMP and made a presentation providing background information on the purpose, structure and current work of the GESAMP, demonstrating the context in which the Group carries out its work, primarily for the benefit of members who joined the Group recently. A brief overview of the 42nd session of the GESAMP was also provided by the Group's Vice Chairman, Mrs. Annette Dock, who had attended that meeting. The agenda, as adopted by the Workshop, is set out in annex 1. A summary report of the Workshop is provided below.

Review of the Guidelines for approval of ballast water management systems (G8)

Introduction

5 Treated ballast water, required for testing the acceptability of BWMS making use of Active Substances (hereafter AS) in accordance with Procedure (G9), is prepared in conjunction with the tests required under Guidelines (G8). Therefore, there is a link between the two documents as well as implications that need to be assessed by the Group.

6 Among the numerous issues being considered by the Correspondence Group on the review of Guidelines (G8), which mainly relate to biological efficacy and robustness of BWMS operation, several are also related to Procedure (G9). Due to this link the Group has participated in the correspondence group, providing advice and suggestions.

7 The Workshop recalled the contributions that the Group had already made to the correspondence group, which had been captured in its report to MEPC 68 (MEPC 68/2/12, paragraphs 15 and 92 to 95), and discussed the Group's further contributions in the ongoing deliberations of the correspondence group, in view of the correspondence group's report to be submitted to MEPC 69. During the discussions in the correspondence group some additional issues related to both Guidelines (G8) and Procedure (G9) were recognized. Therefore, corresponding points were added under agenda item 3 to be considered at this Workshop (see annex 1). A summary of the Workshop's discussions and decisions on these points is provided in the following sections (paragraphs 8 to 37).

Environmental acceptability of the use of Active Substances in BWMS

8 In the correspondence group, concerns have been expressed about the environmental acceptability of the use of AS, particularly under extreme conditions (e.g. cold water) since all chemical reaction rates are temperature dependent. These concerns were related to the maximum allowable discharge concentration (hereafter MADC), which may not be guaranteed under extreme conditions since the reaction rate between AS and the neutralizer will be slowed down due to the lower temperature, and to the fate of AS in receiving water at lower temperatures even if the MADC is guaranteed. For BWMS that make use of TRO as AS, the Group consistently recommends to install a neutralization process, which takes temperature into account, to guarantee the MADC.

9 The Workshop considered that three functions in the neutralization process are crucial for an appropriate control scheme aimed at maintaining the MADC effectively in the full-scale BWMS at all times:

.1 an initial overdose of neutralizer against stoichiometric demands calculated from an accurate monitoring of TRO concentration prior to the neutralization process;

.2 an additional overdose of neutralizer above the one referred to in .1, to be used under extreme conditions; and

.3 an automatic shutdown of ballast water discharge, if the MADC is exceeded.

10 In conclusion, the Workshop considered that the MADC of AS can be guaranteed for the BWMS, for which MEPC has granted Final Approval, provided that all the recommendations made by the Group are taken into account in the final development of the BWMS. The Workshop recalled that, following a recommendation made by the Group at its Sixth Stocktaking Workshop (MEPC 68/2/8, paragraph 30.2), MEPC had agreed that the value of MADC for TRO should be changed from 0.2 to 0.1 mg/L expressed as Cl_2 (MEPC 68/21, paragraph 2.41). With the new MADC, the Workshop concluded that the environmental acceptability can be ensured even under extreme low temperatures.

11 The Workshop also considered the concerns raised in the correspondence group with regard to efficacy at higher temperatures, for example regarding the efficacy of ozonation, which could be lower in such conditions. However, from an environmental acceptability point of view, i.e. completion of the neutralization process, the Workshop could not find any negative effects caused by higher temperature on the behaviour of AS.

12 The Workshop concluded that the following general recommendation should be made at Basic Approval for all BWMS with a neutralization process:

> "The Group recommended that for the further development of the BWMS the applicant should ensure that the control scheme could maintain the TRO dose and the MADC effectively in the full-scale BWMS at all times and in particular to avoid unacceptable TRO levels at the beginning of discharge and under extreme low temperatures. The Group is of the opinion that, in order to achieve the MADC, an initial overdose against stoichiometric demand is needed, during a limited period of time. Also, an additional overdosing will be needed at extreme low temperatures."

13 To verify the reliability and completion of the control scheme of the neutralizer together with TRO monitoring, the Workshop recommended that at Basic Approval applicants should perform a simulation of discharge immediately after treatment (when the maximum amount of neutralizer will be needed). The raw monitored data shown below should be provided in the application:

.1 TRO concentration at, prior to and after the neutralization process;

.2 calculated overdose ratio against the stoichiometric demand;

.3 dose of the neutralization; and

.4 measurement results on TRO and on the residual concentration of the neutralizer discharged by using manual methods.

Five-day period for Relevant Chemicals determination under Procedure (G9)

14 The Workshop recalled that MEPC 68 had agreed that, for the purpose of Procedure (G9), a five-day storage period for the determination of Relevant Chemicals (RCs) in treated ballast water should be maintained, while the required tank holding time (THT) for the

purpose of Guidelines (G8) should be made flexible and this would be further considered in the context of the review of the Guidelines (G8) (MEPC 68/21, paragraph 2.42, and MEPC 68/WP.8, paragraphs 10 and 17). To avoid confusion, in this document the term "tank holding time (THT)" refers to Guidelines (G8), whilst the term "storage period" refers to Procedure (G9). The Workshop considered the scientific background regarding the multiple sampling timings during the storage period, together with recommendations on how applicants could implement this in conjunction with the anticipated revised requirements in Guidelines (G8).

15 In order to establish worst–case concentrations of RCs, most applicants perform sampling and chemical analysis at multiple timings and conditions. In total 12 chemical analyses (combinations of timings and conditions) may be performed, including for example three salinities (seawater, brackish water, fresh water), two sample timings (e.g. 24 and/or 48 hours, 120 hours) and two treatment stages (prior to and after neutralization); the number may increase if more than one temperatures are applied, which is however not required.

16 With respect to multiple sample timings, the Group has concluded that the concentrations of most RCs are still increasing in treated ballast water even after a 5-day tank holding time or storage period, while some chemicals reach their worst-case concentrations earlier. Therefore, the Group is of the position that multiple sampling times, including five days, will be needed. As for neutralization, the Group has recommended to analyse the RC concentrations both prior to and after the neutralization process. Furthermore, it should be quantitatively verified whether each individual RC can be neutralized or not. Finally, the Group has accepted the raw concentrations of RCs without any adjustment with regard to temperature, which can vary significantly. Data from past applications indicate that the variation of concentrations for RCs in relation to temperature is not clear. For the selection of the worst-case concentrations of RCs, the current practice of the Group is to select the highest concentration for each RC amongst all water samples.

17 Following discussion, the Workshop agreed on the following points (see also the explanatory figure in annex 2), noting that new text, which will be developed following the finalization of the review of the Guidelines (G8), should be added to the Methodology for information gathering and conduct of work of the GESAMP-BWWG (hereafter the Methodology) to reflect these points:

.1 the total storage period should be five days, irrespective of any flexible tank holding times used for Guidelines (G8);

.2 for Basic Approval the applicant should prepare additional treated ballast water in a separate tank used for testing under Procedure (G9), together with tests for Guidelines (G8);

.3 for Final Approval the same concept may be applied. However, as the volume of the tank used for testing under Procedure (G9) should be smaller than that for Guidelines (G8) purposes, it may be difficult to perform the neutralization process using the full scale BWMS. From a pragmatic viewpoint, the Group could accept a single sample timing, which would then be the same as the THT under Guidelines (G8). However, since the details of flexible THT for Guidelines (G8) are still under discussion, the Group may reconsider this approach for Final Approval at a later stage; and

.4 for both Basic and Final Approval any post-treatment prior to discharge should be verified using the BWMS that is used for the biological efficacy tests under Guidelines (G8).

18 In addition, the Workshop agreed to accept the use of a tank for testing under Procedure (G9), where the treated ballast water is to be kept for five days, also for Final Approval. In this case, the Workshop concluded to accept the RC identification on the

sample water without neutralization, due to the fact that most RCs do not react with the neutralizer. Therefore, the concentrations in the non-neutralized water may be identified as representing a worst case.

19 Applicants may also propose two worst-case concentrations, one for human health assessment (in a ballast water tank) and the other for environmental risk assessment (in the discharged ballast water), if they can provide scientific background information demonstrating how their post-treatment procedure may affect the concentrations in the ballast water tanks.

Five-day period for ecotoxicity and WET tests under Procedure (G9)

20 The ecotoxicity of the discharged ballast water is directly linked to the concentration of RCs in the water. Hence, the storage period for ecotoxicity and whole effluent toxicity (WET) tests is directly related to that required for the chemical analysis of the RCs (paragraphs 14 to 19 above) and some of the main relevant considerations and conclusions of the Workshop are similar and linked to those in paragraphs 16 and 17 above.

21 The Workshop recognized the complex nature of aquatic toxicity, which may be the result of any reaction between AS and various organic matter sources to result in any given RC, and recalled that at Final Approval the Group has been giving more weight to the results of WET tests than to the PEC/PNEC assessment, which is based only on the chemical analysis. The Workshop also recognized that, while it is generally expected that higher concentrations of RCs in the discharged water will lead to higher aquatic toxicity, the most adverse ecotoxicological effects may not only result from the highest concentrations but from a combination of different RCs. In comparison with the human risk assessment, where the concentration of RCs before neutralization will also be of interest, for the environmental risk assessment in total six chemical analyses (combinations of timings and conditions) may be performed, as there is no need to test the ballast water prior to neutralization.

22 Based on data from past applications, there is an observed trend of higher aquatic toxicity in discharged ballast water with a storage period of five days, compared for example to day 1 in the algal growth inhibition test. Therefore, the Workshop was of the position that multiple sampling timings, including five days, will also be needed in this context, as was the case with RC identification, see paragraph 16 above. Moreover, the observations on the effects of temperature in that paragraph are also applicable here.

23 After discussion, the Workshop agreed on the following points, noting that new text, which will be developed following the finalization of the review of the Guidelines (G8), should be added to the Methodology to reflect these points:

.1 the numbers and time of sampling for aquatic toxicity tests should be defined based on practicability and test results for the applications for Basic as well as Final Approval;

.2 for Basic Approval, consistent with RC identification, the test water should be sampled at least twice, at day 1 or 2 and at day 5. All the recommendations on sampling for the identification of RCs (paragraph 17) should also be applied to ecotoxicity and WET tests; and

.3 for Final Approval, similarly to RC identification, from a pragmatic point of view the Group may accept that the test water may be sampled only at the end of the THT applied for Guidelines (G8). However, due to potential changes in Guidelines (G8), the Group may revisit its position on this issue when the review of Guidelines (G8) is finalized.

24 The Workshop recalled that a waiver of chronic toxicity tests at Basic and Final Approval has been implemented and agreed that this waiver may be continued

for Basic Approval, since the Group has no new information to alter its expert judgement at this moment. Thus the scientific justification already provided to the Committee still holds. With respect to WET tests at Final Approval, due to potential changes in Guidelines (G8) the Workshop concluded that the Group may reserve its position until further experience with the reviewed Guidelines (G8) has been gained.

Evaluation of ship safety under both Guidelines (G8) and Procedure (G9)

25 The Workshop discussed the fact that, as the evaluations under Procedure (G9) are carried out based on land-based test results, there are certain areas at that point in the type approval process where the applicant may not have been able to fully develop information on ship-specific installation and operational use issues. The Group can therefore only consider the information presented to it in the context of the requirements of the Methodology but it may make recommendations to the Administration relating to areas requiring attention when the BWMS is taken through the final stages of the type approval process. It was also understood that, as part of the review of Guidelines (G8), an enquiry had been raised on whether it was possible for the Procedure (G9) to ask applicants to identify and quantify the type and quantities of dangerous gasses or liquids produced by their BWMS at the land-based testing stage.

26 The Workshop entered into a detailed debate regarding this subject and identified that, whilst it was not seen as necessary to amend the Methodology in this respect, the question of hydrogen gas (H_2) production rates in the electrochemical cell of a BWMS was worthy of examination. To this end, the Group looked into this phenomenon in detail and considered its response based on the projected volumes of hydrogen gas generated by such systems at different flow rates of ballast water treatment.

27 Using the results of this indicative work, the Workshop was able to determine that the quantities of hydrogen gas production against selected TRO and ballast water flow rates could be readily assessed for a system utilising an electrochemical AS generator. The Workshop was consequently of the opinion that this data need not be actively sought for an individual BWMS via a formal amendment of the Methodology. It was also noted that gas production for BWMS with a side stream could be lower than that of a BWMS employing full-flow electrolysis. Further to this, the information generated by this work was considered by the Workshop to be most useful as it would allow for a better future evaluation of the ship safety factors reported to be in place by an applicant when utilising an electrochemical process to produce AS.

Upgrading BWMS during land-based and shipboard tests based on recommendations by the GESAMP-BWWG

28 The Workshop recalled the view expressed in the correspondence group that during type approval testing upgrades or changes to major components of BWMS should not take place. Major components were considered to be those that directly affect the ability of the system to meet the D-2 standard. The Group has, however, made recommendations at Final Approval (at which stage the type approval testing is already finished) on the aspects shown below:

.1 changing the proposed MADC;

.2 improving the control scheme on the dose of AS;

.3 improving the control scheme on the dose of the neutralizer;

.4 changing the TRO monitoring scheme and equipment used; and

.5 changing the location of AS and neutralizer injection and monitoring points.

29 The Workshop concluded that an upgrading of the neutralization control scheme and relevant equipment should not be classified as a change of major components, since those changes do not affect the biological efficacy of the BWMS but only mitigate the effects of RCs. Therefore, the recommendations at the Final Approval stage will not be in conflict with the Guidelines (G8) if amended in accordance with the correspondence group's above-mentioned view. However, to avoid any confusion after the granting of Final Approval by the Committee, the Workshop identified the need for an additional paragraph in Guidelines (G8) to allow upgrading of BWMS, in accordance with recommendations under Procedure (G9), even after the land-based or shipboard tests conducted under Guidelines (G8). The Group has provided the required relevant input to the correspondence group.

30 The Workshop further concluded that, in conjunction with any future recommendations made by the Committee when granting Final Approval, the Group should only re-evaluate those BWMS for which the proposed changes have been determined to be major, as discussed above. If, however, a modification of the control of the neutralization process would not be allowed by Guidelines (G8), then the Group may not be able to recommend the granting of Final Approvals in the same manner as it has been doing until now.

Additives for preparation of test water for the worst-case concentration of RCs

31 The Workshop recalled that Guidelines (G8) do not include any quantitative provisions for the quality of the test water with respect to the concentrations of total suspended solids (TSS) and particulate and dissolved organic carbon (POC and DOC). The main purpose of such criteria is to be able to reproduce the worst cases of TSS, POC and DOC as they would appear in natural water, for the verification of the efficacy of the BWMS under extreme conditions. Testing facilities may use additives to attain the criteria for these parameters in the test water. From the viewpoint of Procedure (G9), using such additives may have an effect on the degradation rate of the AS and on RC production during the storage period. This is confirmed both by information from testing facilities and by the Group's evaluation of several proposals for approval of BWMS, in which a change in the concentration of RCs between Basic and Final Approval appeared to be the result of changes in the additives to increase the DOC content.

32 One member of the GloBal TestNet kindly provided the Workshop with test results of RC identification using different additives. From these data, the Workshop concluded that it is probable that additional production of RCs during tank holding time may be affected by the specification of the additives selected by testing facilities. The Workshop also concluded that, while the use of additives may cause effects on the degradation rate of the AS, this does not have any fundamental impact on the MADC, provided that it is controlled by a well-designed neutralization process.

33 The Methodology requires that all chemical analysis results relating to the investigation of by-product formation should be accompanied by a specification of total organic carbon (TOC), DOC and TSS, including a request to specify additives for DOC. However, the Group has not yet recommended the use of any specific additive and the Workshop discussed this possibility. The Workshop noted that Specific UV Absorbance at 254 nm may indicate the aromatic character of dissolved organic matter, however further assessment will be needed with regard to this method's applicability to test water with a rich content of DOC. The Workshop also made an attempt to recommend the use of a specific additive, such as dissolved corn starch as a non-aromatic DOC, however, the Workshop was of the position that it was premature to come to any conclusions on a preferred additive for DOC at this stage.

34 In conclusion, the Workshop was not able to recommend a standardized DOC additive to be specified in the Methodology, as more research in this area was considered necessary.

The Workshop also identified that further assessment will be needed with regard to establishing a suitable level at which to adjust DOC, in comparison with representative natural DOC. Therefore, it was decided to continue this task at a future Stocktaking Workshop. For this important task, it is crucial to collect information not only from future applicants but also from the testing facilities involved in testing under Guidelines (G8) and Procedure (G9). Therefore, the Workshop agreed to invite the Committee to encourage Member Governments and international organizations to submit any information on the results of measuring Specific UV Absorbance at 254 nm both on natural water and test water.

Guidelines (G8) as mandatory guidance

35 The Workshop recalled that the Committee had supported, in principle, the view that the Guidelines (G8) should provide mandatory guidance and had agreed that the review of the Guidelines should be finalized before deciding on their possible mandatory status (MEPC 68/21, paragraph 2.22). The Workshop discussed this issue and concluded that, if such a decision is made, the Committee may wish to consider categorizing Procedure (G9) as a mandatory document as well, in order to have the same status as Guidelines (G8).

Ballast water discharge during shipboard tests

36 The Workshop recalled that, in considering the concerns raised with regard to certain Administrations not allowing the discharge of treated ballast water from ships during the shipboard testing period, MEPC 68 had invited Member Governments and international organizations to submit relevant proposals to MEPC 69 for an MEPC resolution urging Member States to allow such discharges (MEPC 68/21, paragraph 2.45).

37 As shipboard tests may be performed upon obtaining Basic Approval, the control scheme of the neutralizer may not be fully developed. In such cases any additional neutralizer overdose required under extreme conditions may not have been implemented on the BWMS used for shipboard testing. However, as the number of ships involved with such BWMS testing is quite limited (usually only a single ship), the Workshop considered that the standard scenario to determine the Predicted Environmental Concentrations (PEC) is not applicable for this situation and only the near ship scenario should be considered. Moreover, if an automatic stop on ballast water discharge using a TRO monitor is implemented, then the risk can be avoided. The Workshop therefore agreed that, under such circumstances, the risk of discharging ballast water with AS in excess of the proposed MADC would be negligible for a single ship and could moreover be mitigated.

Evaluation of new corrosion criteria

38 The Workshop recalled that the International Paint and Printing Ink Council (IPPIC) and NACE International had made recommendations for changes to the Methodology, including revised test and acceptance criteria for ballast tank coatings exposed to BWMS (BLG 17/6). It was highlighted that, as a result of consequential changes to the Methodology adopted at MEPC 66, which included an overhaul of the previous corrosion testing regime through the introduction of new paragraphs 7.1.1 to 7.1.8 in the Methodology, the latest revisions of the Methodology (BWM.2/Circ.13/Rev.2 and Rev.3) include some approval criteria for ballast tank coating tests that are in excess of the commonly applied *Performance standard for protective coatings for dedicated seawater ballast tanks in all types of ships and double-side skin spaces of bulk carriers* (resolution MSC.215(82)), hereafter "PSPC".

39 The implications of these increased requirements for BWMS applications were discussed. In addition, results of investigative work carried out into several previous applicants' corrosion test reports were presented. This study indicated that, whilst all the presented coating systems met the PSPC criteria, several had not met the current requirements in the Methodology. This was particularly noticeable in the case of the paint adhesion tests where

many systems had reported values compliant with PSPC but below that of the current requirement under the Methodology.

40 It was noted that, as these new standards could be called into question by future applicants, it was important to establish the background reasoning for their application. In order to determine this and as part of the investigative work, both IPPIC and NACE International had been formally asked to research their records to identify the origin of the enhanced criteria limits so that the Methodology guidance could be validated. The Workshop was informed that, as a result of these requests, both organizations had raised this subject at recent internal meetings but could not identify the source of the enhanced testing requirement or provide evidence to support these increases. Further to this, neither organization stated that it supported the increased adhesion criteria.

41 As a result of this, the Workshop concluded that the current corrosion criteria requirements in the Methodology, which require levels above the PSPC standards, were unsubstantiated and that the next revision of the Methodology should be altered to remove ambiguity and bring the corrosion testing and evaluation requirements into line with the PSPC values. Due to the delay until that revision may be effected, the Group agreed to immediately start applying the PSPC criteria instead of the current criteria in the Methodology (BWM.2/Circ.13/Rev.2 and 3) in its evaluation of proposals for approval of BWMS. In addition, the Workshop agreed that paragraph 7.1.2 of the Methodology could be worded in a slightly different manner to clarify when applicants are required to carry out corrosion testing. The proposed changes to section 7.1 of the Methodology are set out in annex 3.

Neutralization of TRO and overdosing of neutralizer

42 The Workshop recalled that, while most BWMS use sodium thiosulfate ($Na_2S_2O_3$, hereafter STS) or sodium sulfite (Na_2SO_3, hereafter SSI) to neutralize TRO, it has been shown that a stoichiometric amount of STS or SSI may not completely neutralize TRO. Therefore, excess addition of STS and SSI may be necessary to ensure a complete neutralization of TRO in treated ballast water. The Workshop noted that, although such excess addition is necessary to increase TRO neutralization, it remains clear that excess unreacted STS will be discharged overboard with neutralized ballast water. Depending on the quantities discharged, this may result in adverse effects related to oxygen (O_2) depletion, especially in coastal areas with low dissolved O_2 concentration, and STS may also promote *Thiobacillus* bacteria growth. At TRO concentrations above 10 mg Cl_2/L, the total quantity of STS released may be up to 4 tons for a single ship with very large ballast tanks (≥ 100,000 m^3). Excess SSI quantities discharged with neutralized ballast water are three times higher compared to STS and the total quantity released may be up to 14 tons for a similar ship.

43 Considering the above, the Workshop recommended that applicants optimize the dose of STS and SSI used for the neutralization of TRO, including quantities in excess, in order to avoid unnecessary release of these chemicals. The STS/TRO ratio used should be assessed against the factors that may influence TRO reduction, such as pH, temperature and reaction time. This issue is expected to be considered again at a future Workshop in light of further experience that may be gained by the Group from the evaluation of BWMS that apply high neutralizer overdoses.

Assessment of risk mitigation measures

44 The assessment of risk mitigation measures (RMM) had been discussed during the Sixth Stocktaking Workshop and a proposed template had been agreed upon in terms of its usefulness for the refinement of the exposure assessment as part of the Methodology (BWM.2/Circ.13/Rev.3). Further consideration by the Workshop was undertaken in order to agree on how to implement the template in practical terms, including the technical features of

the protective equipment (PPE/RPE) used in the BWMS occupational exposure scenarios (crew and port State control officers).

45 While recognizing that the PPE/RPE is the last line of defence and that users must be trained to use it correctly, the Workshop agreed that whenever PPE/RPE is mentioned in the application dossier the applicant is requested to include specific information, as part of the operation manual and the safety datasheets (SDS), to unequivocally identify the equipment in use. The submitted information should include the international mark and corresponding digit code that identifies the body responsible for checking manufacturing quality and, in case of RPE, the type and class categorized by an assigned protection factor (APF).

Appropriate detection limits for different Relevant Chemicals

46 The Workshop was of the view that detection limits should be based on RC concentrations in ballast water, which are higher and easier to detect, rather than environmental concentrations, which are generally low and may necessitate very sensitive and costly analytical methodologies. The Workshop discussed the concepts of the critical values for RC concentrations in ballast water, i.e. those that lead to a PEC/PNEC ratio or risk characterization ratio (RCR) above 1, and the relative sensitivity of analytical methods used to quantify RC, defined as the ratio between the critical value and the detection limit. If the relative sensitivity is above 1 for both PEC/PNEC and RCR, the analytical method used can be deemed as satisfactory in first approximation.

47 Relative sensitivities were calculated for the chemicals in the GESAMP-BWWG Database of chemicals most commonly found in treated ballast water (hereafter the Database) and most were found to be well above 1000, with only one below 1 and two between 1 and 3. In the opinion of the Workshop, relative sensitivity values in the range of 10 to 50 are sufficient to ensure the quality of the evaluation of proposals for approval of BWMS. Since relative sensitivities were found to be much higher for most chemicals listed in the Database, very low detection limits may be unnecessary. Based on a conservative relative sensitivity value of 50, new detection limits are suggested by the Workshop, which are set out in annex 4. An effort was made to harmonize the suggested detection limits for chemicals belonging to the same family. Improved detection limits appear to be required for three chemicals, due either to a very low critical value or a relatively high current detection limit.

48 The Workshop recommended the acceptance of the suggested detection limits set out in annex 4 as a guide for applicants. These are also expected to be included in the next revision of the Methodology, possibly as a new appendix. Though analytical methods with lower detection limits have been developed, the Workshop considered that the suitability of such low detection limits should be further assessed before formal acceptance, taking into account factors such as cost, relevance, practicability and acceptance by applicants.

New BWMS that employ chlorinated potable water as ballast

49 One new technology for ballast water management uses very low levels of AS and discharges pure water into the environment, using on-board potable water generators (PWGs) to make potable water for use as ballast. The Workshop conducted a review of such BWMS based on PWGs, including where these systems may be used. The Workshop also reviewed the toxicity and disinfection by-product (DBP) profile of treated ballast water discharged from a full-scale operational PWG. Furthermore, a review of how these systems fit into the approval process in accordance with Procedure (G9) was conducted with reference to past BWMS applications and previous MEPC documents that have focused on drinking water from land-based systems.

50 PWGs are typically comprised of two subsystems, consisting of filtration or distillation followed by disinfection primarily by either an AS, UV, or a combination of the two. A case study

of a PWG system employing reverse osmosis (RO) and chlorination subsystems was presented to the Workshop. Discharged treated ballast water had very low levels of chlorate and tribromomethane only, while WET tests showed no chronic toxicity to fish, but did show effects on crustacean reproduction and algal growth. Based on this, the Workshop concluded that ecotoxicity testing of treated ballast water was not appropriate for these systems because of the purity of the water, which could lead to toxicity at TRO levels well below what is considered acceptable for release into the environment. At these extremely low TRO levels, all residual oxidants would be consumed immediately when discharged into the receiving water.

51 Operationally, PWG systems may dose Active Substance in a variety of forms and methods, making them similar to other BWMS. The Group has reviewed only one BWMS that uses chlorinated RO (land-based production) to produce ballast water (MEPC 65/2/9, annex 6). In that specific case Basic Approval was granted with no further need to review an application for Final Approval.

52 The Workshop concluded that BWMS based on PWG technology that use AS to produce ballast water should be submitted to the Administration to decide on the necessity for review under Procedure (G9).

Further quality assessment and finalization of the data in the GESAMP-BWWG Database

53 The Sixth Stocktaking Workshop of the GESAMP-BWWG (STW 6) had considered that toxicity studies should have enough detail available to confirm that the study followed consistent QA/QC standards and that data meet all relevant toxicity test criteria established by the Group or required by the relevant test methodologies. STW 6 had concluded that some ecotoxicity values in the GESAMP-BWWG Database were obtained from sources that did not have supporting research details and had agreed that PNECs would not be changed because of the lack of study details until there was an attempt by the Group to obtain the required details of the study in question.

54 This Workshop conducted a review of new ecotoxicity data for inclusion in the Database as well as the identification of specific ecotoxicity data that needs supporting study details. The Workshop agreed that it was necessary to obtain more information on studies conducted by the Japanese Ministry of Environment where ecotoxicity values were obtained from the Chemical Risk Information Platform (CHRIP) online database. Study details were requested and received from the Japanese Ministry of Environment for a number of substances[2]. It was confirmed by the Workshop that all QA/QC standards and toxicity test acceptability criteria were met, these data will therefore appear in the Database.

55 The Workshop agreed to introduce certain changes to the Database using new ecotoxicity data available from studies published in peer-reviewed journals, as set out in annex 5.

Publication of the Methodology as a GESAMP R&S document

56 After consulting with the GESAMP representative, Dr. Michael Huber, the Workshop agreed to prepare a GESAMP Reports and Studies series (R&S) publication using relevant information from the Methodology (BWM.2/Circ.13/Rev.3). The main focus will be on the evaluation of risks to human health and the environment, therefore drawing primarily from appendix 4 (Human risk assessment of ballast water chemicals) and appendix 5 (MAMPEC-BW information), as well as other relevant parts of the Methodology. This publication aims to reflect the Group's way of working and the expertise gained during approximately ten years of activity, as a result of the scientific evaluation of the BWMS application dossiers, in terms of environmental and human health risk assessments. The publication will be prepared by the Group with a target of submitting it to the GESAMP in 2016 or 2017.

2 Existing Chemicals Survey Program Conducted by the Japanese Government (2007).

Dissemination of GESAMP-BWWG information

57 During the normal course of its work the Group makes recommendations, both during the regular meetings and during the Stocktaking Workshops. After discussing what type of information would be most beneficial to compile and publish, the Workshop concluded that it would be helpful to list both the action points from the MEPC reports and some of the decisions made by the Group that are not specifically referenced in the general part of the reports or reflected as action points. Furthermore, the Workshop made a short list of the type of information that would be part of a dissemination report (e.g. introduction of new PNEC values); however, due to time constraints the Workshop was not able to finalize the dissemination document and it was decided that this task should be added to the agenda of the next Stocktaking Workshop.

Previous STW discussion papers - how to structure the existing information

58 The Workshop discussed how existing information and material from previous Stocktaking Workshop documents could be made more readily available for the reference of existing and new Group members in an organized manner. It was agreed that some Group members will collate and compile relevant materials for the use of the Group. A critical review of the decisions made during the previous Stocktaking Workshops will be carried out with the aim to collect the relevant outputs in a summarised factsheet format per Stocktaking Workshop. To support this activity, the Secretariat provided to the Group the complete record of material and reports from all previous Stocktaking Workshops.

Future activities

59 The Workshop tentatively agreed that the Eighth Stocktaking Workshop should be held in November 2016, for the consideration of the several important items that have been identified to require further discussion and any other aspects related to the Methodology for information gathering and conduct of work of the GESAMP-BWWG.

Action requested of the Committee

60 The Committee is invited to note the outcome of the Seventh Stocktaking Workshop of the GESAMP-BWWG and in particular to:

.1 endorse the Workshop's recommendations regarding the neutralization process and control scheme aimed at maintaining the MADC effectively in the full-scale BWMS at all times, including under extreme conditions (paragraphs 12 and 13);

.2 endorse the Workshop's recommendations regarding testing arrangements for Basic and Final Approval in conjunction with the anticipated amendments to tank holding time requirements under Guidelines (G8) and note the Group's intention to prepare corresponding amendments to the Methodology (BWM.2/Circ.13/Rev.3) for its next revision, which will be carried out following the finalization of the revision of the Guidelines (G8) (paragraphs 17 and 23);

.3 note the Workshop's decision to use the sample water without neutralization as a worst case for the identification of Relevant Chemicals (RCs), due to the fact that most RCs do not react with the neutralizer (paragraph 18);

.4 agree that applicants may propose two worst-case concentrations of Relevant Chemicals, one for human health assessment, taken from the

ballast water tank, and the other for environmental risk assessment, taken from the discharged ballast water (paragraph 19);

.5 note the Workshop's view that upgrades of BWMS, which are recommended by the Committee when granting Final Approval under Procedure (G9), may be allowed prior to type approval (paragraphs 28 and 30);

.6 note the importance of a unified approach aiming at recommending additives for preparation of test water and the Group's intention to consider this further at a future Stocktaking Workshop, and encourage Member Governments and international organizations to submit any information on the results of measuring Specific UV Absorbance at 254 nm both on natural water and test water (paragraph 34);

.7 consider categorizing Procedure (G9) as a mandatory document, if such a decision is made for Guidelines (G8), and take the necessary action to that end (paragraph 35);

.8 note the Workshop's view that, if an automatic shutdown function is installed on a BWMS used for shipboard tests, the risk of discharging ballast water with Active Substances in excess of the proposed MADC during such tests could be mitigated, and that the risk of a single ship would be negligible (paragraph 37);

.9 approve in principle the proposed amendments to section 7.1 of the Methodology (BWM.2/Circ.13/Rev.3), set out in annex 3, to be incorporated into the next revision of the Methodology (paragraph 41);

.10 note the Group's intention to immediately start applying the PSPC criteria for corrosion testing instead of the higher criteria in the current Methodology (BWM.2/Circ.13/Rev.3) in its evaluation of proposals for approval of BWMS making use of Active Substances (paragraph 41);

.11 endorse the Workshop's recommendation to require applicants to include specific information on protective equipment as part of the application dossier, to unequivocally identify the equipment in use (paragraph 45);

.12 endorse the Workshop's recommendation that applicants use the suggested detection limits for Relevant Chemicals set out in annex 4 as a guide (paragraph 48);

.13 agree that BWMS based on potable water generation technology that use Active Substances to produce ballast water should be submitted to the Administration to decide on the necessity for review under Procedure (G9) (paragraph 52); and

.14 note the changes to the GESAMP-BWWG Database, set out in annex 5 (paragraph 55).

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ANNEX 1

SEVENTH STOCKTAKING WORKSHOP ON THE ACTIVITY OF THE GESAMP-BALLAST WATER WORKING GROUP

7 to 10 September 2015, IMO, London, United Kingdom

AGENDA

1 Adoption of the agenda

2 Introduction and ways of working during the Workshop, housekeeping, timetable and GESAMP presentation

3 Review of the Guidelines for approval of ballast water management systems (G8)

.1 Environmental acceptability of the use of Active Substances in BWMS

.2 Five-day period for Relevant Chemicals determination under Procedure (G9)

.3 Five-day period for ecotoxicity and WET tests under Procedure (G9)

.4 Evaluation of ship safety under both Guidelines (G8) and Procedure (G9)

.5 Upgrading BWMS during land-based and shipboard tests based on recommendations by the GESAMP-BWWG

.6 Other issues

4 Evaluation of new corrosion criteria

5 Neutralization of TRO and overdosing of neutralizer

6 Assessment of risk mitigation measures (RMM)

7 Appropriate detection limits for different Relevant Chemicals

8 New BWMS that employ chlorinated potable water as ballast

9 Further quality assessment and finalization of the data in the GESAMP-BWWG Database

10 Publication of the Methodology as a GESAMP R&S document

11 Dissemination of GESAMP-BWWG information

12 Previous STW discussion papers - how to structure the existing information

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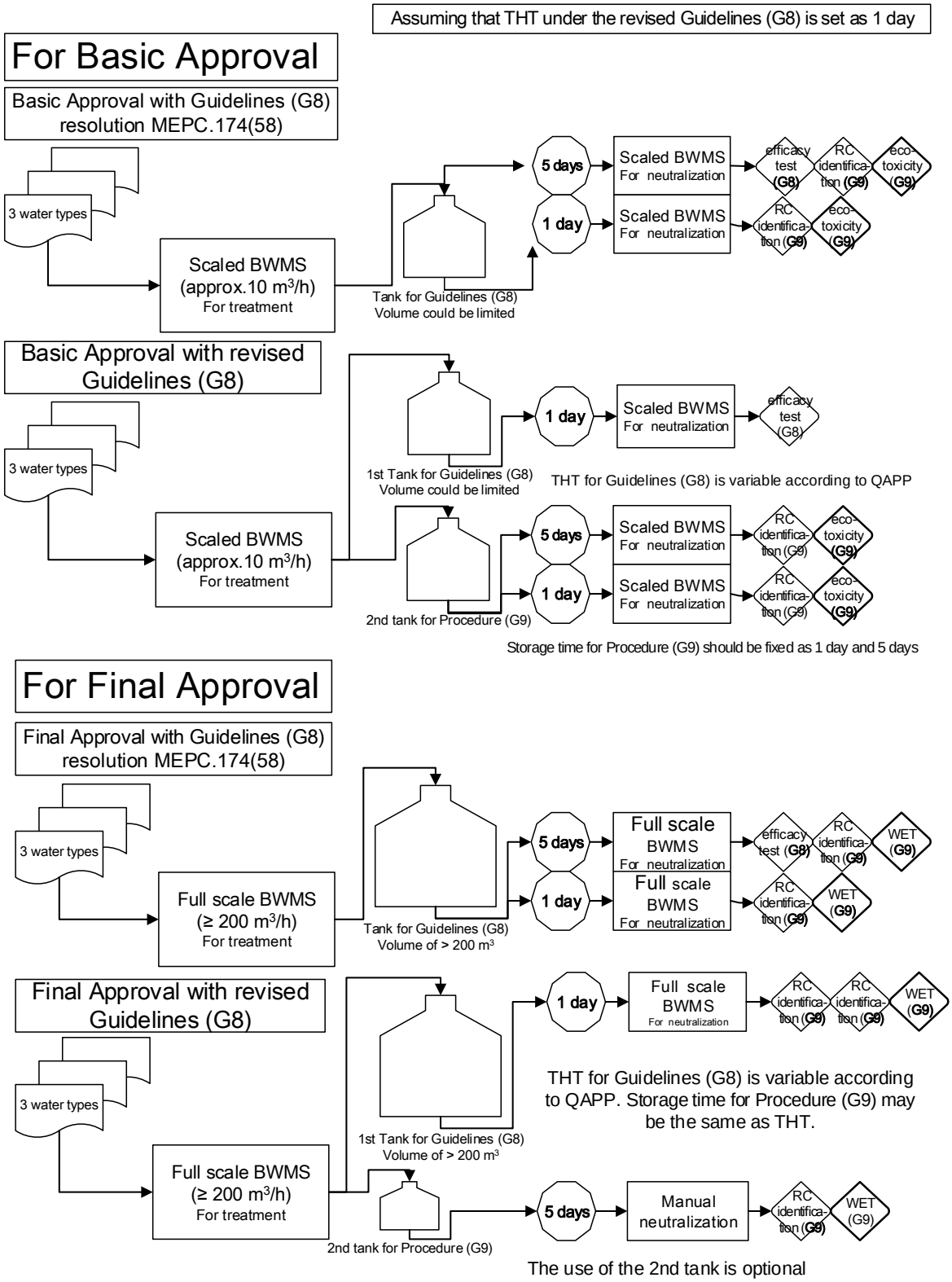
ANNEX 2

EXAMPLE SCHEMATIC DIAGRAM FOR TANK HOLDING TIMES UNDER GUIDELINES (G8) AND PROCEDURE (G9)



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ANNEX 3

DRAFT AMENDMENTS TO THE METHODOLOGY FOR INFORMATION GATHERING AND CONDUCT OF WORK OF THE GESAMP-BWWG (BWM.2/Circ.13/Rev.3)

Paragraphs 7.1.2 to 7.1.3 and 7.1.5 to 7.1.7 are replaced by the following:

"7.1.2 The BWMS that make use of an Active Substance (such as hypochlorite electrolysis, chlorine dioxide, sodium hypochlorite, peroxyacetic acid or ozone) may have a direct effect on organic material like epoxy tank coatings. Depending on the dose and degradation rate of Active Substance there could be an impact on the coating system. For a BWMS with a TRO dose ≥ 10 mg/L, expressed as Cl_2, the compatibility with coating systems is to be validated by the testing described in paragraph 7.1.3.

7.1.3 Testing should be conducted in accordance with the NACE TM0112-2012 Standard Test Method with two series of test panels and the coating shall be applied in accordance with table 1 of the *Performance standard for protective coatings for dedicated seawater ballast tanks in all types of ships and double-side skin spaces of bulk carriers* (PSPC) (resolution MSC.215(82)). One set of panels should be exposed to treated ballast water. Other test conditions are described in the table below:"

"7.1.5 After the exposure duration, several corrosion relevant measurements as listed in paragraph 7.1.7 should be scored against the PSPC criteria and reported.

Acceptance criteria

7.1.6 In order to determine whether the BWMS has influenced the coating's properties as evaluated according to ISO standards, the principles and acceptance criteria mentioned in paragraph 7.1.7 should be employed. Paint coatings evaluation should be made subject to treated ballast water. Paint coatings for BWMS compliance testing will already be required to have PSPC approval and this additional evaluation is to employ the NACE TM01122012 Standard Test Method to assess any potential detrimental effects on a coating system resulting from the use of a particular BWMS.

7.1.7 For the BWMS to be found suitable for Final Approval, it should not fail in any test evaluation of epoxy based coating systems as specified below:

.1 ISO 4624: Adhesion: "Fail" if the adhesive or cohesive values at the treated panel are below those required in the table in resolution MSC.215(82), annex 1, appendix 1, paragraph 3.1.

.2 ISO 4628-2: Blistering: "Fail" if any blistering occurs.

.3 ISO 4628-4: Cracking: "Fail" if any cracking occurs.

.4 ISO 4628-3: Rusting: "Fail" if any rusting occurs.

.5 ISO 4628-8: Delamination and corrosion around a scribe: "Fail" if the delamination at the treated panel is greater than that specified in the table in resolution MSC.215(82), annex 1, appendix 1, paragraph 3.1.

.6 ISO 15711: Cathodic protection – disbondment from artificial holiday (NACE TM0112-2012 Method B – Sacrificial Anode): "Fail" if the values at

the treated panel are greater than those required in the table in resolution MSC.215(82), annex 1, appendix 1, paragraph 3.1."

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ANNEX 4

NEW SUGGESTED DETECTION LIMITS AND RELATIVE SENSITIVITY (S_r) FOR RELEVANT CHEMICALS LISTED IN THE GESAMP-BWWG DATABASE

Chemical name	Suggested DL (mg/L)	S_r based on PEC/PNEC	S_r based on RCR
Aldehyde			
Acetaldehyde	1	82	$> 10^3$
Formaldehyde	1	112	$> 10^3$
Aldehyde hydrate			
Chloral hydrate	50	72	$> 10^3$
Haloacetic acid			
Bromochloroacetic acid	0.2	$> 10^3$	$> 10^3$
Dibromoacetic acid	0.2	$> 10^3$	202
Dibromochloroacetic acid	0.2	$> 10^3$	$> 10^3$
Dichloroacetic acid	0.2	$> 10^3$	$> 10^3$
Dichlorobromoacetic acid	0.2	$> 10^3$	$> 10^3$
Monobromoacetic acid	0.2	$> 10^3$	$> 10^3$
Monochloroacetic acid	0.2	108	$> 10^3$
Tribromoacetic acid	0.2	$> 10^3$	$> 10^3$
Trichloroacetic acid	0.2	$> 10^3$	$> 10^3$
Halopropionic acid			
Dalapon	5	82	$> 10^3$
Haloacetonitrile			
Bromochloroacetonitrile	0.02	$> 10^3$	$> 10^3$
Dibromoacetonitrile	0.02	103	$> 10^3$
Dichloroacetonitrile	0.02	$> 10^3$	$> 10^3$
Monobromoacetonitrile	0.02	$> 10^3$	$> 10^3$
Monochloroacetonitrile	0.02	346	$> 10^3$
Trichloroacetonitrile	0.02	$> 10^3$	178
Haloamine			
Monochloramine[a]	0.04	426	73
Halomethane			
Dibromochloromethane	0.02	$> 10^3$	$> 10^3$
Dibromomethane	0.02	$> 10^3$	$> 10^3$
Dichlorobromomethane	0.02	$> 10^3$	82
Dichloromethane	0.02	$> 10^3$	$> 10^3$
Tetrachloromethane	0.02	$> 10^3$	115
Tribromomethane	0.02	$> 10^3$	$> 10^3$
Trichloromethane	0.02	$> 10^3$	$> 10^3$

Haloethane			
1,1-Dibromoethane	0.1	> 10^3	> 10^3
1,1-Dichloroethane	0.1	> 10^3	> 10^3
1,2-Dichloroethane	0.03	> 10^3	33
1,1,1-Trichloroethane	0.1	> 10^3	> 10^3
1,1,2-Trichloroethane	0.1	> 10^3	> 10^3
Haloethene			
Trichloroethene[b]	0.001	> 10^3	32
Halopropane			
1,2-Dibromo-3-chloropropane	0.1	> 10^3	99
1,2-Dichloropropane	0.1	> 10^3	> 10^3
1,2,3-Trichloropropane[c]	0.00002	> 10^3	45
Halonitroalkane			
Chloropicrin	0.02	126	330
Halophenol			
2,4,6-Tribromophenol	0.5	150	> 10^3
Inorganic			
Bromate ion	0.2	> 10^3	167
Sodium hypochlorite[d,e]	0.2	43	NA
Sodium thiosulphate	100	299	> 10^3

[a] Analytical method 6c

[b] Current $DL_{analytical}$ is 0.005 mg/L, for which $\left(\frac{CV_{DNEL-DMEL}}{DL_{suggested}}\right)$ = 6.5

[c] Current $DL_{analytical}$ is 0.0004 mg/L, for which $\left(\frac{CV_{DNEL-DMEL}}{DL_{suggested}}\right)$ = 2.3

[d] Current $DL_{analytical}$ by colorimetry is 2 mg/L, for which $\left(\frac{CV_{PNEC}}{DL_{suggestedl}}\right)$ = 4.3

[e] Current $DL_{analytical}$ by amperometry is 1.2 mg/L, for which $\left(\frac{CV_{PNEC}}{DL_{suggestedl}}\right)$ = 7.1

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ANNEX 5

UPDATES TO THE GESAMP-BWWG DATABASE

Dibromoacetic acid

New data from Fisher et al. (2014).

- Two acute values and three chronic values for three different trophic levels.

PNEC general AF changed from 10,000 (Rule 1) to 10 (Rule 6).
PNEC general changed from 6.9E + 0 µg/L to 6.9E + 3 µg/L.

Dichloroacetic acid

New data from Fisher et al. (2014).

- One acute fish and one algae ecotoxicity value.

PNEC general AF changed from 10,000 (Rule 1) to 1,000 (Rule 2).
PNEC general changed from 2.3E + 0 to 2.3E + 1 µg/L.

Tribromoacetic acid

New data from Fisher et al. (2014):

- Three acute values and three chronic values for three different trophic levels.

PNEC general AF changed from 50 (rule 5) to 10 (rule 6).
New lowest ecotoxicity value of 138.2 mg/L (*D. magna* NOEC).
PNEC general changed from 6.0E + 1 µg/L to 1.4E + 4 µg/L.

Formaldehyde

New data from De Orte et al. (2013):

- Two acute algae values and one chronic value for algae.

New data from Carballeira et al. (2013):

- Two acute Echinoderm values and a chronic Echinoderm value.

PNEC general AF was not changed.
New lowest ecotoxicity value of 3.05 mg/L (acute algae EC_{50}).
PNEC changed from 5.8E + 0 µg/L to 3.0E + 0 µg/L.

Hypochlorite

New data from Carballeira et al. (2013):

- Two acute Echinoderm ecotoxicity values.

New data from De Orte et al. (2013):

- Two acute algae values and one chronic algae value.

PNEC general unchanged.
New data accepted as background data in the Database.

Trichloroacetic acid

New data from Fisher et al. (2014):

- One chronic crustacean ecotoxicity value.

PNEC general AF changed from 50 (rule 5) to 10 (rule 6).
PNEC general changed from 6.0E + 1 µg/L to 3.0E + 2 µg/L.

Mixed halogen trihaloacetic acids:
Dibromochloroacetic acid and Dichlorobromoacetic acid

There are no ecotoxicity values for the mixed halogen trihaloacetic acids. (The Database uses read across values from TCA to set the PNEC for these compounds.)

PNEC general changed from 6.0E+1 µg/L to 3.0E+2 µg/L.

References

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De Orte, M.R., Carballeira, C., Viana, I.G., Carballeira, A., 2013. Assessing the toxicity of chemical compounds associated with marine land-based fish farms: The use of mini-scale microalgal toxicity tests. Chemistry and Ecology Vol. 29, No. 6, 554-563.

Fisher, D., Yonkos, L., Ziegler, G., Friedel, E., Burton, D., 2014. Acute and chronic toxicity of selected disinfection by-products to *Daphnia magna*, *Cyprinodon variegatus*, and *Isochrysis galbana*. Water Research 55, 233-244.

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ANNEX 4

Position paper of GESAMP-BWWG on THT to Correspondence Group

1 INTRODUCTION

1.1 Establishing the worst case concentrations of Relevant Chemicals (RCs) in discharged ballast water is a fundamental process for the appropriate evaluation according to Procedure (G9). In general, the concentrations of RCs will increase during the voyage time, in which treated ballast water will be held in a ballast water tank (hereafter Tank Holding Time).

1.2 However, there are no quantitative requirements on the minimum tank holding time applied before chemical analysis of RCs either in Procedure (G9) or its Methodology. The Group has accepted five days' tank holding time, which is required in paragraph 2.3.2.2 of Guidelines (G8), since all applicants do measure the concentrations in the treated or discharged ballast water that has been prepared in accordance with the Guidelines (G8) both for Basic Approval (BA) and Final Approval (FA).

1.3 During the discussion on the review of Guidelines (G8), MEPC 69 and the Correspondence Group on the review of Guidelines (G8) (the CG) discussed whether the five days' tank holding time required in Guidelines (G8) could be variable. On the other hand, MEPC 69 also decided to recommend maintaining the five days' period for the purpose of Procedure (G9), even if five days' tank holding is shortened. To avoid confusion, in this document the term 'tank holding time' is referring to Guidelines (G8), whilst the term 'storage period' is referring to Procedure (G9).

1.4 As it is not practical to request applicants to prepare another set of test waters only for the purpose of testing in accordance with Procedure (G9), one part of the treated ballast water that has been prepared for the testing according to the revised Guidelines (G8) will have to be kept separately in a different tank. For reasons of consistency in relation to any future applications that will have to comply with the revised Guidelines (G8), the Group will have to provide new recommendations on how the applicant should implement the five days storage period.

1.5 The GESAMP-BWWG (the Group) submitted to MEPC 69 a shortened version of the STW 7 report, together with the future testing arrangement for Basic and Final Approval with five days' storage period, attached as Appendix 2 to this paper. MEPC 69 endorsed the recommendations by the Group regarding testing arrangements, in conjunction with the anticipated amendments to tank holding time requirements under Guidelines (G8), in general.

1.6 However, there were several concerns raised among the members, such as follows;

.1 Using five days' Storage Period would not lead to the worst case concentration of RCs, such that in some cases, more time will be needed to achieve to the worst case (maximum) concentrations,

.2 Moreover, other parameters will affect the production of RCs, particularly, the specifications of DOC will change the production rate of RCs, significantly,

.3 For Basic Approval, only one sample at day five may be sufficient for establishing the indicative worst case concentration of RCs, if the Group indicates unified additives for DOCs,

.4 An appropriate simulation model may be used instead of the actual monitoring, and

.5 Several requests to correct the schematic flow in the appendix 1.

1.7 Several of these points have been already discussed during STW 7, but were not reported back in the shortened version. Therefore, in this position paper, the Group would like to respond to the concerns raised, and to clarify the current position of the Group on 'THT' and 'storage period' from a technical viewpoint.

1.8 In addition, the Group would like to point out one missing link between the current draft of Guidelines (G8) and Procedure (G9). The issue being that one part of the treated ballast water during the 'Preliminary Test', as required in paragraph 3.1 of the Guidance (BWM.2/Circ.43), is being used also for tests for BA applications. However, this linkage is not included in any part of the current text of the Guidelines (G8) draft. In order to finalise the applicable conditions for the testing arrangements for the BA application, the Group would like to have a clarification with regards to the future linkage between testing arrangement for the BA application and the future 'Preliminary Test'.

1.9 Furthermore, the Group would like to stress, that when the GESAMP-BWWG recommends a minimum 'Storage Period' according to Procedure (G9), which is longer than the minimum THT required for Guidelines (G8) efficacy, the Group strongly recommends that the ballast water should not be discharged until the minimum 'Storage Period' under Procedure (G9) has passed. For example, some applicants try to accelerate the degradation rate of the Active Substance (AS) using enzymes. In such a case the Group may establish a minimum 'Storage Period' according to Procedure (G9), taking into account a safety margin under extreme lower temperatures. Consequently, it is quite probable that a longer 'Storage Period' according to Procedure (G9) will be required as compared to the THT required under Guidelines (G8). In this case, to ensure the environmental acceptability, longer 'Storage Period' should be shown on the top page of the Type Approval certificate, rather than the minimum THT identified during testing according to Guidelines (G8).

2 THE CURRENT MANNER OF ESTABLISHING THE WORST-CASE CONCENTRATION OF RELEVANT CHEMICALS

2.1 Requirements in Procedure (G9) and the Methodology of establishing the worst-case concentration of RCs.

2.1.1 Procedure (G9) does not state any required conditions on test water or tank holding conditions to establish the worst-case concentration of RCs. Procedure (G9) only requests to perform quantitative assessment both on 'Ship and personnel safety' in 6.3.3 and 'Environmental protection' in 6.4.2.

2.1.2 Revision 2 of the Methodology requests the performance of an RCR Assessment for Human Exposure and also requests the performance of a PEC/PNEC ratio assessment for environmental acceptability. Both assessments should be performed on all the Relevant Chemicals identified by the Group.

2.1.3 Particularly for the PEC of RCs, paragraph 6.3.1.1 states that 'Based on measured data of Relevant Chemicals, the worst-case concentration at discharge should be established'.

2.1.4 In accordance with these recommendations, almost all applicants have performed chemical analyses at multiple timings, including five days, together with Guidelines (G8) efficacy tests.

2.2 The Current sampling conditions and timings

2.2.1 To establish the worst–case concentration of RCs, almost all applicants perform sampling and chemical analysis under multiple timings and conditions as shown in table 2-1 below. Please note that in this table, the applicants made up all the treated water for BA together with the 'preliminary test' as required by 'Amendments to the Guidance for Administrations on the

type approval process for ballast water management systems in accordance with Guidelines (G8)' (BWM.2/Circ.43).

2.2.2 The purpose of the 'preliminary test' is to ensure that the BWMS is viable, will meet the D-2 standard, will work on board a ship and that the system has been determined not to pose any unacceptable risk to the environment. Therefore, all the source water is prepared in accordance with the requirements in Guidelines (G8), such as salinity, POC, DOC, TSS, and biological concentration for L-size and S-size category. Furthermore, a small scale BWMS (such as TRC > 10 m3/h) with all treatment components, monitoring, and control functions will be used.

2.2.3 In total 12 cases of chemical analyses are required. Some applicants have, however, omitted some test cases. In general, the Group has accepted such omissions without further comments.

Table 2-1: The test waters needed for RCs identification conjunction with current Guidelines (G8)

Parameter name	Requirements in G8 and G9's methodology
Test water type(3)	seawater, brackish and fresh water
Sample timing (2)	24 and/or 48 hours, 120 hours
Treatment (2)	prior and after neutralization process
Temperature (1)	Not specified

*1 The number in the brackets shows minimum cases for each parameter.
*2 The Group assumes that all the treated water for BA will be made up together with the 'preliminary test' required by BWM.2/Circ.43.

2.2.4 For the three water types among the test water types, not only salinity but also requirements on POC, DOC and TSS can be significantly different among the three water types. Therefore, the Group considered that it is necessary to perform the RCs identification on all three water types.

Table 2-2: Guidelines (G8) test water conditions for three water types

	Seawater	**Brackish water**	**Fresh water**
Salinity	>32 PSU	3-32 PSU	<3 PSU
Dissolved Organic Carbon (DOC)	>1 mg/L	>5 mg/L	>5 mg/L
Particulate Organic Carbon (POC)	>1 mg/L	>5 mg/L	>5 mg/L
Total Suspended Solids (TSS)	>1 mg/L	>50 mg/L	>50 mg/L

Guidelines (G8) require testing in two water types (more than 10 PSU apart). However, MEPC encourages to perform Guidelines (G8) testing in all three water types.

2.2.5 With respect to multiple sample timing, the Group considered that the total amount of RCs produced after sufficient Tank Holding Time (i.e. > 10 days under normal temperature) is not time duration dependent, but is mainly linked to the AS dose and specification of DOC. Therefore, if the Tank Holding Time is limited to five days, the RC concentration, which is not yet saturated, could be effected by temperature. However, no scientific background based on kinetics gives a clear answer with regards to quantitative analysis of non-saturated concentration of RCs has been provided in the past applications. In other words, the current manner of using five days is purely coming from the practicability of using the same time as for the tests performed for biological efficacy.

2.2.6 The last time point for the sampling after five days may refer to Guidelines (G8) requirements and the sampling timing at day 1 or day 2 may refer to the timing for acute eco-toxicity testing recommended in paragraph 6.2.3.2 of the Methodology.

2.2.7 After the discussion at STW 6, the Group concluded that the concentrations of most RCs are still increasing in treated ballast water after 5 days tank holding time (refer to GESAMP-BWWG STW 6/7/1). On the other hand, some chemicals such as bromate and bromochloroacetic acid, will reach the worst-case concentrations earlier than after 5 days. Therefore, the Group considered that multiple sampling timings, including 5 days, will be needed. A summary is shown in Table 2-3.

Table 2-3: Relative changes (%) in concentrations of main Relevant Chemicals in treated ballast waters with time. Mean values are obtained from 10 chemical data sets provided by applicants in non-confidential applications. The number of values is given by n (refer to GESAMP-BWWG STW 6/7/1).

Substance	Day 0 (%)	Day 1	N	Day 2	N	Day 5	N
Bromate ion	100%	254%	7	119%	4	131%	9
Bromoacetonitrile	100%	333%	4	114%	2	336%	6
Bromochloroacetic aicd	100%	349%	6	163%	5	180%	8
Bromochloroacetonitrile	100%	219%	3		0	148%	3
Bromodichloroacetic acid	100%	66%	1		0	11%	1
Bromodichloroacetonitrile	100%	283%	1		0	1%	1
Chlorate	100%	102%	3	98%	3	100%	3
Chlorodibromoacertic acid	100%	141%	1		0	148%	1
Dibromoacetic acid	100%	305%	7	291%	4	332%	9
Dibromoacetonitrile	100%	90%	5	124%	2	91%	7
Dibromochloroacetic acid	100%	156%	5	127%	4	108%	7
Dibromochloromethane	100%	197%	8	701%	5	408%	10
Dichloroacetic acid	100%	158%	3	180%	2	201%	4
Dichloroacetonitrile	100%	2%	2		0	2%	2
Dichlorobromoacetic acid	100%	93%	3	183%	4	258%	5
Dichlorobromomethane	100%	130%	6	1567%	4	470%	8
Tribromoacetic acid	100%	289%	6	285%	4	373%	8
Tribromoacetonitrile	100%	173%	2		0	269%	2
Tribromomethane (bromoform)	100%	268%	8	250%	5	388%	10
Trichloro(nitro)methane	100%		0	839%	1	462%	1
Trichloroacetic acid	100%	115%	5	166%	3	138%	7
Trichloromethane (chloroform)	100%	69%	3	827%	3	439%	4

Yellow colored column shows the maximum rate among 1, 2 and 5 days tank holding time.
Red colored substances are listed in the GESAMP BWWG Database of chemicals most commonly associated with treated ballast water.

2.2.8 With respect to the impact of the neutralization process, there are two reasons to recommend the analysis of the RC concentrations both prior to and after neutralization. Firstly it should be quantitatively verified whether each individual RC can be neutralized or not. It should be noted that the concentration of some evaporable RCs can decrease in the mixing process with air bubbles, even if the neutralizer hardly reacts with them. Additionally, the Group has already

observed that several RCs in the µg/l order may partially react with the neutralizer, provided that it had been over-dosed significantly against stoichiometric demands of AS in mg /L order. Secondly, the RC concentrations prior to and after the neutralization should be identified in ballast water tanks and in discharged water.

2.2.9 With respect to temperature, there are no requirements either in Guidelines (G8) or Procedure (G9). As the volume of the tank for Guidelines (G8) testing at FA should be more than 200 m3, the temperature control on test water at FA is impractical. Therefore, the Group has accepted the raw concentrations of RCs without any adjustment with regards to temperature, which can vary from 4-30°C. Several applicants have submitted data on the concentrations of RCs under varied conditions both concerning tank holding time and temperature. The data indicates that the variation of concentrations for RCs due to temperature is not clear.

2.3 The selection of worst-case concentration of RCs in ballast water tank and at discharge

2.3.1 Currently, the Group selects the highest concentration for each RC among all samples water.

3 CONCLUSIONS

Please note that in principle there is no different between the content in this position paper in comparison with the output in the shortened version of the report from STW 7 that was sent to MEPC. This position paper however, provides a detailed manner of the proposed test arrangements both for BA and FA.

4 RELEVANT ASPECTS

4.1 Definitions

4.1.1 These new terms should be defined in the Methodology:

.1 ‘Tank holding time,’ means the total time duration, in which treated Ballast Water will be held in a simulated ballast water tank, with a purpose to verify biological efficacy under Guidelines (G8).

.2 “Storage period’ means the total time duration, in which treated ballast water will be held in a simulated ballast water tank, with the purpose to identify the worst-case concentrations of RCs and ecotoxicity in treated and discharged ballast water.

4.1.2 To avoid any confusions, the terms are also defined in the revised Guidelines (G8).

4.2 Time duration for the period

4.2.1 The storage period should be 5 days, including the THT for Guidelines (G8).

4.2.2 For BA, the applicant should prepare additional treated ballast water in a second tank, together with ‘the preliminary test’ for Guidelines (G8). If the treatment process will be separately performed, then an identical test water and BWMS as ‘the preliminary test’ should be applied.

4.2.3 For FA, theoretically, the same concept of using two different tanks may be applied. However, as the volume of the tank for Procedure (G9) purpose should be smaller than that of the first tank for Guidelines (G8) purpose, it is difficult to perform the post treatment (i.e. neutralization process) using the full scale BWMS. The Group considers that a manual neutralization process may introduce a potential artefact on the concentrations of RCs and residual toxicity. In conclusion however, from a pragmatic viewpoint, the workshop could accept

a single sample timing, same as the THT for Guidelines (G8), if the CG and MEPC decided that the THT for Guidelines (G8) may be flexible.

4.2.4 However, as mentioned above, since the concept of the flexible THT for Guidelines (G8) still has some uncertain points to clarify, the Group may change the recommended frameworks for FA at a future stage.

4.2.5 In addition, the Workshop agreed to accept the use of the second tank to keep the treated ballast water with tank holding time of 5 days. In this case same as in the BA application, the treated water should be split to the tank for Guidelines (G8) efficacy test and the second tank to guarantee original treated water is also kept in the second tank. In other words, transferring from the main tank for THT to the second tank for the Procedure (G9) storage period is not recommended.

4.3 Tank construction for the period

4.3.1 The volume of the second ballast water tank should be > 5m3. Using an air tight and dark tank is recommended. The proposal for the criterion on Surface-area-to-volume ratio of the storage tank was not supported by the STW.

4.4 Multiple Sample timing during the total period

4.4.1 In addition to the sampling and analysis at day 5, the applicant should take another test water sample at different timings, such as 24 or 48 hours, to identify the worst case concentrations of RCs during the period. If the transfer timing is different from 24 and 48 hours, the sampling at the timing just prior to the transfer is recommended, which means totally three samples during the 5 days period. There is no need for any chemical analysis at 0 hours because there are less possibilities to indicate worst-case concentrations at 0 hours.

4.5 Temperature during the period to maintain

4.5.1 The Workshop shortly discussed whether the temperature during storage period can be controlled in the future. The Group noted that for BA, the applicant can raise the temperature during the total period since treated water has been prepared in the second tank from day 0 (refer to paragraph 4.2.2). For FA it is not practical to control the temperature in the first tank with a full volume of >200 m3 as required by Guidelines (G8). If the applicant raises the temperature only in the second tank, this may cause a temperature shock.

4.5.2 However, the Workshop concluded that it is premature to provide a unified recommendation on this aspect in the Methodology and agreed to continue the work on this aspect at a future STW. Therefore, the Group would like to ask CG or the intersessional meeting of RG to note the progress and provide the Group with clear instructions, if this is considered to be appropriate.

4.6 How the post-treatment should be applied?

4.6.1 If any post-treatment, such as neutralization, will be applied at discharge, then the sample and analysis should be performed both at prior to and after the treatment.

4.6.2 For BA, any post-treatment prior to discharge should be performed while using a small scale BWMS that has been used for the treatment.

4.6.3 For FA, as the workshop could accept a single sample timing, same as the THT for Guidelines (G8), (refer to paragraph 4.2.3), any post-treatment prior to discharge should be

performed while using the full scale BWMS that has been used for Guidelines (G8) biological efficacy test.

4.6.4 When using the second tank to conduct storage for 5 days, the Workshop identified the impracticability in applying the neutralization process while using full scale BWMS. In this case, the Workshop concluded to accept the RC identification on the sample water without neutralization, since almost none of the RCs will react with the neutralizer used in the BWMS, hence the concentrations in the non-neutralized water may be identified as representing the worst-case (refer to paragraph 2.2.7).

4.7 Total cases for RCs identification

4.7.1 The total cases of test water required for RCs identification during BA is shown I Table 4-1. There are no fundamental changes from the current situation as shown in Table 2-1. The only change required is for the applicant is to prepare the small volume of the second tank at BA. For BA, the Group considers that this new process will not be in conflict with the new procedure under the revised Guidelines (G8). It should be noted that in this table, the Group assumes that all the treated water for BA will be made up together with the 'preliminary test' required by 'Amendments to the Guidance for Administrations on the type approval process for ballast water management systems in accordance with Guidelines (G8)' (BWM.2/Circ.43).

Table 4-1: Test waters needed for RCs identification in conjunction with revised Guidelines (G8) (variable tank holding time) for BA

Parameter name	Requirement in Procedure (G9)'s methodology
Test water type(3)	seawater, brackish water and fresh water
Sample timing (2)	24 and/or 48 hours, 120 hours*1
Treatment (2)	prior and after neutralization process
Temperature (1)	Not specified

*1 The number in the brackets shows minimum cases for each parameter.
*2 The Group assume that all the treated water will be made up together with the 'preliminary test' required by BWM.2/Circ.43.
*3 Sample at 120 hours may be taken from the second tank.

4.7.2 The total cases of test water required for RCs identification during FA is shown in Table 4-2, the Workshop temporally concluded that the Workshop could accept a single sample timing, same as the THT for Guidelines (G8), if the CG and MEPC decided that the THT for Guidelines (G8) may be flexible and the minimum holding time is 24 hours. However, there are still uncertainties on the manner for flexible THT for Guidelines (G8), such as reproduction of test organisms during THT, the Group may change the drafting in the future conjunction with the finalized Guidelines (G8) text regarding this aspect.

Table 4-2: Test waters needed for RCs identification in conjunction with revised Guidelines (G8) (variable tank holding time) for FA

Parameter	Requirement in Procedure (G9)'s methodology
Test water type (3)	seawater, brackish water and fresh water
Sample timing (1)	[THT designated by the Administration]
Treatment (2)	before and after neutralization process
Temperature	No specific recommendation

The number in the brackets shows minimum sample situations for each parameter.

4.7.3 It should be noted that paragraph 6.3.1.2 in Procedure (G9) states that 'Environmental concentrations after discharge of treated ballast water under controlled conditions during development and type approval tests should be estimated and provided in the application dossier for Basic Approval.' This paragraph implies that there is no need for a full PEC/PNEC assessment at FA. Also it should be noted that in paragraph 8.2.1 in Procedure (G9) it is stated that the results should be conveyed to the Organization for confirmation that the residual toxicity of the discharge conforms to the evaluation undertaken for Basic Approval. Furthermore, the Group has already decided its hierarchy in which the results of WET should overrule the PEC/PNEC assessment at FA.

4.7.4 From the view points above, the Workshop discussed the potential omission of test cases at FA, such as:

.1 One of two 'sample timings' in the table can be omitted, in accordance with the results at BA;

.2 One of 'test water type' in the table can be omitted, in accordance with the results at BA;

.3 Target RCs could be limited only to the substances identified at BA; and

.4 All these omissions will not be applicable, if the Group find out any uncertainties at BA evaluation.

4.7.5 The Group identified possible omissions that might occur in the future, however, it is premature to establish quantitative extrapolations to assume the concentrations at FA from the BA results using a small scale BWMS. Therefore, the Workshop decided not to implement such omissions at this point in time.

4.7.6 Furthermore, in the future the Group may accept adjusted concentrations of RCs resulting only from a single sampling time together with the results from a simulation model (as mentioned in 1.6.5). During STW 6 results were presented and discussed from a research project carried out in the Swiss Institute of Aquatic Science and Technology, funded by Germany, which was initially aimed at the development of a model for the prediction of RC formation. (MEPC 68/2/8, paragraphs 19-21). Following discussion the Workshop however concluded at that time, that it was too early to start using this simulation model in the same way as MAMPEC is being used, and that more development would be needed to further develop the model.

4.7.7 However, the available time and financial resources were not sufficient to complete the research and generate enough data for model development. Substantial additional work, in particular with regard to the influence of organic matter (DOC), needs to be conducted, which would require additional funding in the order of about 100.000 USD.

4.8 The targeting substances list for RCs

4.8.1 At least, the substances listed in appendix 6 in the Methodology should be measured if the BWMS uses electrolysis, ozonation and/or sodium hypochlorite.

4.9 Screening and selection of the worst-case concentration of RCs

4.9.1 A screening process on the all data measured should be performed by the applicant, including assessment on the quality of control water. If the applicant finds any unpredicted results, then the total procedure, including preparation, should be repeated.

4.9.2 The applicant may propose two worst-case concentrations, one for human health assessment (in a ballast water tank) and the other for environmental risk assessment (in the

discharged ballast water), if the applicant can provide scientific background, in which their post treatment procedure, such as aeration, may affect the concentrations in the ballast water tanks.

4.10 The additives for DOC

4.10.1 As was reported in MEPC 69/4/3, although the Group identified the effects on the production of RCs by using different specifications of additives for DOC, the Workshop was not able to recommend a standardized DOC additive to be specified in the Methodology, as more research in this area was considered necessary. The Workshop also identified that further assessment will be needed with regard to establishing a suitable level at which to adjust DOC, in comparison with representative natural DOC. Therefore, it was decided to continue this task at a future Stocktaking Workshop in 2017 that will report back to MEPC 70 with a recommended additive for unified applications among TFs and/or target range of UV Absorbance at 254 nm.

5. FUTURE WORKS TO FINALISE THE TEST ARRANGEMENT BOTH FOR BA AND FA

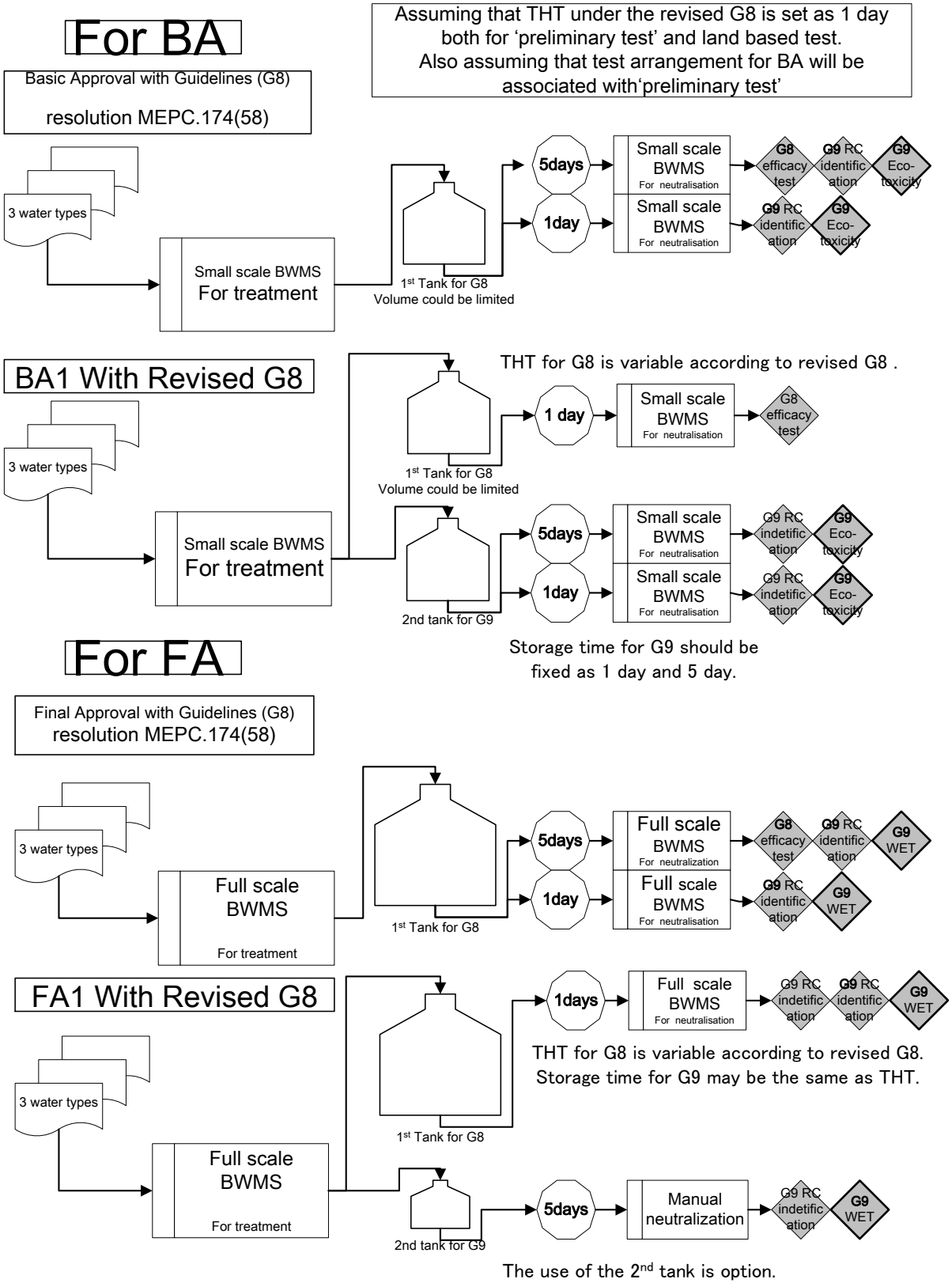
5.1 The Group will continue its work to finalise the testing arrangements for Basic and Final Approval in conjunction with the anticipated amendments to tank holding time requirements under Guidelines (G8), taking the concerns raised in paragraph 1.6 into consideration in its future work.

5.2 With respect to the test arrangement for BA application and scale of BWMS used for setup, the Group would like to have a clarification whether one part of the treated ballast water during the ‘Preliminary Test’, as required in paragraph 3.1 of the Guidance (BWM.2/Circ.43), would be used for tests for BA applications even in the future framework. Furthermore, the Group would like to have a clarification whether a revised THT and water criteria for land-based test will be applied for the ‘preliminary test’ as well. If this is not the case, the Group will prepare another arrangement plan in order to optimise the test arrangements solely for the purpose of compliance with Procedure (G9).

5.3 The Group considered it to be a possibility that MEPC would decide to revise this Guidance (BWM.2/Circ.43) sometime in the future, together with the conditions to be used while conducting a ‘preliminary test’ after the adoption of the revised Guidelines (G8). If this will be the case, the Group may keep the arrangement for BA until such time, and concentrate only on the arrangement for FA with a revised THT concept at this stage.

APPENDIX 1 to Annex 4

EXAMPLE SCHEMATIC DIAGRAM FOR TANK HOLDING TIMES UNDER GUIDELINES (G8) AND PROCEDURE (G9)



APPENDIX 2 to Annex 4

Five-day period for Relevant Chemicals determination under Procedure (G9)

1 The Workshop recalled that MEPC 68 had agreed that, for the purpose of Procedure (G9), a five-day storage period for the determination of Relevant Chemicals (RCs) in treated ballast water should be maintained, while the required tank holding time (THT) for the purpose of Guidelines (G8) should be made flexible and this would be further considered in the context of the review of the Guidelines (G8) (MEPC 68/21, paragraph 2.42, and MEPC 68/WP.8, paragraphs 10 and 17). To avoid confusion, in this document the term "tank holding time (THT)" refers to Guidelines (G8), whilst the term "storage period" refers to Procedure (G9). The Workshop considered the scientific background regarding the multiple sampling timings during the storage period, together with recommendations on how applicants could implement this in conjunction with the anticipated revised requirements in Guidelines (G8).

2 In order to establish worst–case concentrations of RCs, most applicants perform sampling and chemical analysis at multiple timings and conditions. In total 12 chemical analyses (combinations of timings and conditions) may be performed, including for example three salinities (seawater, brackish water, fresh water), two sample timings (e.g. 24 and/or 48 hours, 120 hours) and two treatment stages (prior to and after neutralization); the number may increase if more than one temperatures are applied, which is however not required.

3 With respect to multiple sample timings, the Group has concluded that the concentrations of most RCs are still increasing in treated ballast water even after a 5-day tank holding time or storage period, while some chemicals reach their worst-case concentrations earlier. Therefore, the Group is of the position that multiple sampling times, including five days, will be needed. As for neutralization, the Group has recommended to analyse the RC concentrations both prior to and after the neutralization process. Furthermore, it should be quantitatively verified whether each individual RC can be neutralized or not. Finally, the Group has accepted the raw concentrations of RCs without any adjustment with regard to temperature, which can vary significantly. Data from past applications indicate that the variation of concentrations for RCs in relation to temperature is not clear. For the selection of the worst-case concentrations of RCs, the current practice of the Group is to select the highest concentration for each RC amongst all water samples.

4 Following discussion, the Workshop agreed on the following points (see also the explanatory figure in annex 2), noting that new text, which will be developed following the finalization of the review of the Guidelines (G8), should be added to the Methodology for information gathering and conduct of work of the GESAMP-BWWG (hereafter the Methodology) to reflect these points:

.1 the total storage period should be five days, irrespective of any flexible tank holding times used for Guidelines (G8);

.2 for Basic Approval the applicant should prepare additional treated ballast water in a separate tank used for testing under Procedure (G9), together with tests for Guidelines (G8);

.3 for Final Approval the same concept may be applied. However, as the volume of the tank used for testing under Procedure (G9) should be smaller than that for Guidelines (G8) purposes, it may be difficult to perform the neutralization process using the full scale BWMS. From a pragmatic viewpoint, the Group could accept a single sample timing, which would then be the same as the THT under Guidelines (G8). However, since the details of flexible THT for Guidelines (G8) are still under discussion, the Group may reconsider this approach for Final Approval at a later stage; and

.4 for both Basic and Final Approval any post-treatment prior to discharge should be verified using the BWMS that is used for the biological efficacy tests under Guidelines (G8).

Five-day period for ecotoxicity and WET tests under Procedure (G9)

5 The ecotoxicity of the discharged ballast water is directly linked to the concentration of RCs in the water. Hence, the storage period for ecotoxicity and whole effluent toxicity (WET) tests is directly related to that required for the chemical analysis of the RCs (paragraphs 1 to 4 above) and some of the main relevant considerations and conclusions of the Workshop are similar and linked to those in paragraphs 3 and 4 above.

6 The Workshop recognized the complex nature of aquatic toxicity, which may be the result of any reaction between AS and various organic matter sources to result in any given RC, and recalled that at Final Approval the Group has been giving more weight to the results of WET tests than to the PEC/PNEC assessment, which is based only on the chemical analysis. The Workshop also recognized that, while it is generally expected that higher concentrations of RCs in the discharged water will lead to higher aquatic toxicity, the most adverse ecotoxicological effects may not only result from the highest concentrations but from a combination of different RCs. In comparison with the human risk assessment, where the concentration of RCs before neutralization will also be of interest, for the environmental risk assessment in total six chemical analyses (combinations of timings and conditions) may be performed, as there is no need to test the ballast water prior to neutralization.

7 Based on data from past applications, there is an observed trend of higher aquatic toxicity in discharged ballast water with a storage period of five days, compared for example to day 1 in the algal growth inhibition test. Therefore, the Workshop was of the position that multiple sampling timings, including five days, will also be needed in this context, as was the case with RC identification, see paragraph 3 above. Moreover, the observations on the effects of temperature in that paragraph are also applicable here.

8 After discussion, the Workshop agreed on the following points, noting that new text, which will be developed following the finalization of the review of the Guidelines (G8), should be added to the Methodology to reflect these points:

.1 the numbers and time of sampling for aquatic toxicity tests should be defined based on practicability and test results for the applications for Basic as well as Final Approval;

.2 for Basic Approval, consistent with RC identification, the test water should be sampled at least twice, at day 1 or 2 and at day 5. All the recommendations on sampling for the identification of RCs (paragraph 4) should also be applied to ecotoxicity and WET tests; and

.3 for Final Approval, similarly to RC identification, from a pragmatic point of view the Group may accept that the test water may be sampled only at the end of the THT applied for Guidelines (G8). However, due to potential changes in Guidelines (G8), the Group may revisit its position on this issue when the review of Guidelines (G8) is finalized.

Action requested of the Committee

9 The Committee is invited to note the outcome of the Seventh Stocktaking Workshop of the GESAMP-BWWG and in particular to:

.1 Endorse the Workshop's recommendations regarding testing arrangements for Basic and Final Approval in conjunction with the anticipated amendments to tank holding time requirements under Guidelines (G8) and note the Group's intention to prepare corresponding amendments to the Methodology (BWM.2/Circ.13/Rev.3) for its next revision, which will be carried out following the finalization of the revision of the Guidelines (G8) (paragraphs 4 and 8).

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ANNEX 5

Position paper of GESAMP-BWWG on risk based or hazard based approach to Correspondence Group

1 The Group noted the last draft of the Guidelines (G8) (reference: Guidelines G8 – proposed changes in track changes April 2016) (hereafter 'New G8') that were presented and discussed at MEPC 69 (and that were sent around to the members of the Correspondence Group (CG) on G8 on 1 May 2016 by the coordinator Ms. Leanne Page).

2 The Group also noted that the hazards mentioned in the current Guidelines (G8) (adopted by resolution MEPC.174(58)) (hereafter 'Current G8') are mainly related to electrical equipment (refer to paragraph 4.7 and 4.9 of 'Current G8'), and where the environment, ship and public health are concerned, reference is made to the evaluation of BWMS under Procedure (G9) (paragraph 1.6.4 in Annex part 1 of 'Current G8').

3 The Group also noted that MEPC has adopted the relevant guidance for 'hazard identification' as BWM.2/Circ.20 and BWM.2/Circ.43. Particularly, the latter Guidance requests the relevant Administration to verify a safety and hazard assessment, which will include at minimum any potential impact on the crew health and safety and references to the classification society safety and hazard rules and recommendation. The Group also noted that the classification society issued its rule and recommendation as UR M74.

4 The Group further noted that in 'New G8' some references are made to hazard analysis in relation to substances, e.g. 4.7 rev and Annex para 1.6.4bis. Here it is indicated that a hazard identification should be carried out to avoid dangerous situations. The Group also considered the section of the Correspondence Group report on the review of the Guidelines (G8) concerning the unresolved issue of hazard analysis and appropriate control measures.

5 For information, the Group currently addresses the potentially hazardous emissions of gases such as hydrogen under its Methodology and carries out detailed appraisals at both Basic and Final Approval stages. The Group examines the safety precautions submitted by the applicants in relation to potentially dangerous situations arising from the use of the ballast water treatment system, and will consider the proposed safety measures such as gas detection, and the provision of duplicated alarm mechanisms in the event of LEL's approaching set parameters. In addition to this, the Group can also estimate the production rates of such gasses.

6 The Group also has experience with the determination of the Total Residual Oxygen (TRO) concentration in relation to the detrimental corrosion of ship structures and fittings. As a result, the Group has designated a concentration of TRO < 10 mg/L as Cl2 to be the lower limit allowable before full corrosion analysis as per the Methodology is required. The IPPIC and NACE International are involved in corresponding with the Group and the setting of corrosion criteria.

7 The Group is also experienced in dealing with the production of chlorine (Cl2) gas, in many cases as the Active Substance, and how it is produced and transported in ballast tanks, where the substance as Cl2 or as hypochlorite does its disinfection work. In this case, disinfection by-products may be formed and considered as volatile. For all these chemicals, the Methodology of GESAMP-BWWS (Methodology for information gathering and conduct of work of the GESAMP-BWWG, BWM.2/Circ.13/Rev.3) describes in detail how the risk assessment is performed.

8 The Methodology of the GESAMP-BWWG represents a contemporary and detailed risk assessment for the Active Substances and by-products associated with Ballast Water Management Systems. This risk assessment applies to the hazardous properties of the chemicals generated by G9 systems and is based on a quantitative approach using established scientific criteria.

9 In conclusion, considering the role of the BWWG Group in the field of hazard and risk assessments, the Group would like to have a clarification from the CG on the proposed hazard based approach submitted under the revised Guidelines (G8) and its interrelations with the risk assessments carried out under Procedure (G9).The level of detail required under the proposed Guidelines (G8) amendments should be established so that areas of commonality in the present Procedure (G9) arrangements can be determined. The Group is of the opinion that all necessary care should be taken to avoid the establishment of inconsistent or even conflicting approaches with regard to safety of the ship, environment and public health under the revised Guideline (G8) and Procedure (G9), respectively.