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**INTERNATIONAL CONVENTION FOR THE CONTROL AND MANAGEMENT
OF SHIPS' BALLAST WATER AND SEDIMENTS, 2004**

Engineering Questionnaire on Ballast Water Management Systems

1 The Sub-Committee on Bulk Liquids and Gases, at its thirteenth session (2 to 6 March, 2009), noted the information provided in document BLG 13/INF.5 (Brazil) regarding an engineering questionnaire on the ballast water management systems.

2 Recognizing that the questionnaire, contained in the annex of document BLG 13/INF.5, might assist interested parties in the evaluation and comparison of different ballast water management systems, BLG 13 agreed that it would be beneficial to prepare a technical circular containing the engineering questionnaire for the information of the interested parties and their future reference.

3 The Marine Environment Protection Committee, at its fifty-ninth session (13 to 17 July 2009), endorsed the view of BLG Sub-Committee and approved the dissemination of the above-mentioned questionnaire through this circular.

4 Member Governments are invited to bring this circular to the attention of all parties concerned.

ANNEX

ENGINEERING QUESTIONNAIRE ON BALLAST WATER MANAGEMENT SYSTEMS

The purpose of this Engineering Questionnaire on ballast water management systems is to provide a source of reference to be used by interested parties in order to: select and acquire these systems; develop technical specifications for the purchase and installation of a ballast water management system on board a vessel; design the installation of the ballast water management system for a ship or a group of ships; enable the comparison among different alternatives of ballast water treatment technologies and/or ballast water management systems (applying the same conceptual basis for such purpose); and obtain assistance on other related technical matters.

It is intended to assist ballast water management system manufacturers, vendors or suppliers, and ship designers, shipping companies, shipowners, shipbuilders, ship operators, classification societies, Administrations, etc., to better deal with such tasks, improving and speeding up communication between clients and vendors or manufacturers, which is vital to the required technical consultation and negotiation process. Vendors and manufacturers may opt for the confidentiality of some information collected or provided through the questionnaire (by means of setting confidentiality terms and conditions for the interested parties).

Comments: The questionnaire is not intended to be answered by manufacturers and forwarded to IMO for appraisal. Consequently, it does not require the establishment of a large database to be collated by the Organization, containing all the answers to the questionnaire. The purpose of this questionnaire is merely to provide a source of reference to potential buyers, serving as a technical guide only, so as to enable the required consultation, evaluation and comparison between different alternatives of ballast water treatment technologies.

Part 1 Technical form highlighting the basic characteristics and main data about the ballast water management system

The purpose of this form is to present the main characteristics of the ballast water management system to enable a clear and prompt understanding of its more relevant information. Thus, consideration of the group of questions set bellow will be facilitated, containing more technical details, when addressing engineering tasks.

The following data should be provided by the ballast water management system manufacturer, vendor or supplier:

- 1.1 System: official, commercial and other name;
- 1.2 Manufacturer and supplier: Name(s), full address(es), including electronics;
- 1.3 Ballast water management system description: main components, materials, technologies, treatment processes, functioning ways and basic diagram;
- 1.4 Flow-rate capacities that can be supplied in m^3/h ; normal and maximum flow rate of the system under consideration to be installed on board a particular ship;
- 1.5 Footprint needed for each flow-rate in m^2 , including the footprint required for the particular ship under consideration on board which the installation is intended; system and components weight.

1.6 As regards water treatment, provide the following information on how the system operates:

1.6.1 online during ballasting;

1.6.2 online during deballasting;

1.6.3 both the conditions above;

1.6.4 during voyage, either re-circulating the water or not (give details);

1.6.5 directly in the ballast tanks;

1.6.6 other (explain).

1.7 Regarding the ballast water treatment principle:

1.8 Does the system use an Active Substance(s)?

1.8.1 If so: What are such Active Substances? Are they generated on board ship or supplied to the ship?

1.8.2 If the system does not use an Active Substance(s) but produces/generates such substances, provide details about this process, pertinent safety precautions and recommendations, as well as technical reference about IMO document(s) on system approval, where more details can be obtained.

1.8.3 If the system does not use or produce an Active Substance(s), please provide details on the following:

1.8.4 Does it modify the composition of the treated ballast water?

1.9 Does it require storage and handling of chemical products on board for ballast water treatment purposes?

Note: The above information is related to the concern about potential impact on the environment (deballasting site).

1.10 Regarding the possible assembling arrangements for the system on board ship:

1.10.1 Should the system be placed in a concentrated and unique area? Or

1.10.2 Does it allow for the installation of its modules in different locations, optimizing the existing ship's free spaces? Or

1.10.3 Both assembly arrangements are possible.

1.11 Is the system adequate to be installed in dangerous zones or spaces in tankers (such as pump room and/or main deck)?

1.12 Regarding the process required to obtain the type approval certification for the ballast water management system, provide the following information, dates and reference details related to:

1.12.1 The ballast water management system Basic Approval by IMO/MEPC, informing the GESAMP-BWWG meeting when the system, after the evaluation of its active(s) substance(s), was recommended for this approval, the identification numbers of the related IMO/MEPC report that granted this approval and of the non-confidential IMO document submitted to the MEPC, as well as other available pertinent technical references.

1.12.2 The ballast water management system Final Approval by IMO/MEPC, informing the GESAMP-BWWG meeting when the system, after the evaluation of its active(s) substance(s), was recommended for this approval, the identification numbers of the related IMO/MEPC report that granted this approval and of the non-confidential IMO document submitted to the MEPC, as well as other available pertinent technical references.

Note: It is recommended to also include information that corroborates that all the GESAMP-BWWG and MEPC recommendations were properly attended.

1.12.3 The Type Approval Certification by the Administration, informing the Administration and recognized organization/classification society involved and/or responsible for the approval process, providing copy of the granted Type Approval Certificate.

1.12.4 Specify the last versions of Guidelines (G8) and Procedure (G9) applied in the system approval.

1.12.5 Indicate where the land-based tests required by Guidelines (G8) were carried out (place and name of the responsible institution or laboratory).

1.12.6 Indicate the name, type and deadweight of the ship (or ships) where the shipboard tests required by Guidelines (G8) were carried out.

1.13 On what types of ship this ballast water management system can be used? On what types of vessel, and under what conditions, has the system been tested on board?

1.14 What is the deadweight tonnage and ballast capacity that the system can be applied to? (Specify the minimum and maximum values.)

1.15 Provide a reference list about the ships, shipowners, ship operators and shipyards that have already acquired the ballast water management system (confidential treatment is suggested between the parties in negotiation for this kind of information).

1.16 What kind of information is available, i.e. video, technical leaflet or catalogue, computer presentation (with animation) or other source, such as the manufacturer website, to better describe how the ballast water management system, its equipment, and components operates to treat ballast water? Can this material be provided for the interested clients? (Provide comments and details.)

Part 2 Practicability and compatibility with the ship's design, operation and existing systems, as well as other technical details

- 2.1 What are the performance parameters of the system? (Essential to its control.)
- 2.2 Does the system allow for controlling the performance of the treated water as regards the D-2 Standard during the treatment process? If so, describe it.
- 2.3 How long does it take to treat a given volume of ballast water? At what temperatures?
- 2.4 Are post-treatment residence times required before discharge, and if so, what are the required times?
- 2.5 Does the system require complete re-circulation of the ballast water? If complete re-circulation is needed, how many re-circulations are required to meet the requirements of regulation D-2 of the BWM Convention?
- 2.6 Is the system automated? Completely or partially? (Make comments, providing technical details on the automation level and scope and on the system's controls.)
- 2.7 In case yes, how to control? (Algae and/or organisms detector or monitor, corresponding recorder, etc.)
- 2.8 Would this control system be reliable, accurate and sufficiently capable of dispensing with the collection of ballast water samples to check compliance with the D-2 requirements in the laboratory? (With the understanding and acknowledgement of such capacity by port State control inspectors, and with a pertinent certification for this purpose.)
- 2.9 Is the control system also suitable for adjusting the treatment process (such as, for instance, to intensify or reduce the electric current supply to an electrolytic cell used to generate the Active Substance and/or to dose the Active Substance or chemical injection for water treatment)? (In case yes, please provide details.)
- 2.10 In the case of a ballast water management system that requires the Active Substance to be supplied to the ship, is there a dosing pump for the injection of such substance? Is the control of such injection by the dosing pump automatic?
- 2.11 Is the system supplied with devices that facilitate collecting more representative samples of ballast water (in compliance with the Guidelines (G2))? In case yes, provide details.
- 2.12 When the system needs to receive the Active Substance or chemical, indicate the tank capacity required for that (in cubic metres), show the product supply arrangements to the ship and to the system, as well as other related details.
- 2.13 Provide information about the worldwide net of suppliers capable to provide the required Active Substances used by this ballast water management system to the ship. Inform the main ports where this supply can be effectively and promptly done.
- 2.14 Which were the results of the system's environmental tests required by the Guidelines (G8)? Summarize them.

- 2.15 How the shipboard tests required by Guidelines (G8) were performed? Inform the trip conditions, mentioning the ship's route, the ocean areas and latitudes involved, as well as the season and the total period of time for performing these tests. Inform also on which type of ship the shipboard tests were performed and how many trips were made for this purpose.
- 2.16 Inform if there were some failures during the system's environmental, land-based (these performed at a land-based testing facility) and shipboard tests, which implied on certain modifications and corrections of the ballast water management system under development, and which were the adjustments done to solve them and to obtain the type approval certification for the system.
- 2.17 What is the additional workload on board introduced by the ballast water management system and the staffing requirements for the system?
- 2.18 What is the highest sea state in the Beaufort scale in which the system can still operate?
- 2.19 Does the ballast water management system's operation affect the corrosion rate and the wastage of tanks, pipelines or any other equipment of the ship's ballast system associated with it?
- 2.20 Can the system be affected by incrustation that could lead to a drop in pressure and/or to a reduction in the flow rate? If so, indicate the percentages.
- 2.21 Is the system applicable to existing ships?
- 2.22 What are the installation requirements for the system? What are the system's requirements for deck space, weather-tight space or machinery room space?
- 2.22.1 Can the system only be installed during a dry-docking period?
- 2.22.2 Can the system be installed and evaluated while the vessel is alongside the pier, in service or removed from service?
- 2.23 What are the maintenance requirements for the system?
- 2.23.1 Can the system only be maintained during a dry-docking period?
- 2.23.2 Can the system be maintained available dockside?
- 2.23.3 Is specialist maintenance expertise required and is this available worldwide?
- 2.24 Are the ship's other functions and systems independent from the ballast water management system's operation?
- 2.25 Could the system be integrated into the other ship systems?
- 2.26 What are the calibration requirements of the system?
- 2.27 What are the results of the following system's environmental tests and evaluations?
- 2.27.1 exposure to various environmental extreme conditions including heat, cold, humidity, vibration, more critical conditions of ship's list and trim, and power fluctuations?

2.27.2 reliability and durability?

2.28 What is the expected life of the system?

2.29 Regarding land-based and full-scale shipboard tests, describe the experiments, equipment, and system configurations which were used, as well as provide a list of technical documents to be consulted to get additional information on these issues.

2.30 Has the system been assessed, by a competent Authority and/or by a recognized organization, as suitable for onboard application?

2.30.1 for new ships?

2.30.2 for existing ships?

2.30.3 In affirmative case, list all installation approvals that have been granted with the correspondent granting authority (or recognized organization)? (This question is a complement to the question of Part 1 related to “ballast water management system list of reference”).

2.31 Are there any individual system requirements, which affect the existing layout of the ship, like watertight envelope, generator capacity, etc.?

2.32 What are the requirements for on board storage of component spares and consumables?

2.33 What are the consistency results of multiple manufactured units of a system?

2.34 What type of supply shall the system need for its functioning on board – such as: electric energy (voltage; frequency; expected power required); compressed air (defining the pressure and flow rate); fresh and/or salt water (respective pressures and flow rates), etc?

2.35 Can the system be considered or categorized as an alternative ballast water management system in accordance with the provisions and purposes of the regulation B-3.7 of the BWM Convention? If so, provide further comments and considerations about this issue.

2.36 Can the system be installed on ships with special arrangements of ballast system, such as: bulk carriers with various overboard discharge points for deballasting; and tankers with one submerged pump inside each ballast tank (ships which do not have pump room too)? If so, indicate how and provide details of these special arrangements for installation of the ballast water management system.

Part 3 Safety

3.1 Do the system and its treatment processes present any risks to the health or safety of the crew, in particular to those responsible for operating the system, or even to the passengers, or risks to ship’s safety? If so, describe the risks involved and specify the risk level as either: High; Medium, Low; Negligible; No Risk.

3.2 Are there, for instance, high voltage components, processes involving high heat, cryogenic processes, use of radiation or lasers, chemical reactions whose constituents or by-products present any risks, or high pressure liquids or gases? If so, what safety provisions are incorporated into the design and operating procedures for the system?

3.3 Does the system involve the use of Active Substances or components with special storage or handling needs? If so, how have these needs been addressed, in the system's operation and maintenance manuals? Furthermore, provide information on the applicable care to be followed and pertinent precautions to be taken into consideration.

3.4 Has a complete risk assessment, related to the installation of the ballast water management system in the intended ship, such as a HAZOP review, been conducted, by a specialized and competent organization? In affirmative case, what were the major safety findings?

3.5 Are there components with dissimilar metals exposed to saltwater? If so, what safeguards have been incorporated to protect the ship's structures, pipelines, equipment, valves and accessories against corrosion and excessive wastage? How have these needs been addressed, by the system and in the operation and maintenance manuals?

3.6 If the system operates during ballast operations, including uptake, discharge or transfer, are there adequate safety interlocks and failsafe measures to ensure vessel stability and structure is not compromised?

3.7 In the event of a vessel casualty does the system pose any additional risks?

3.7.1 Are there additional risks in the event of flooding?

3.7.2 Does vessel power loss present any additional risks?

Part 4 Biological efficacy, including pathogens

4.1 Present the findings of the system's biological efficacy tests, related to its approval process to type approval certification and compliance with D-2 standard.

4.2 Beyond D-2 requirements, when additional data are available, provide also the following useful information (considering possible additional/unilateral measures to be met).

4.2.1 System capability for the removal, elimination or inactivation of aquatic organisms for the various taxonomic groups, phytoplankton and zooplankton, beyond standard contained in regulation D-2.1, and for pathogens, beyond standard contained in regulation D-2.2 of BWM Convention.

4.2.2 Does the system eliminate:

4.2.2.1 Cysts? If so, describe and quantify.

4.2.2.2 All species or life stages which may present hazard to the aquatic environment? (A uniform way of presenting this information needs to be established.)

4.3 In case ballast water management is carried out during ballasting:

4.3.1 Could there be a re-growth of the organisms already treated during ballasting within the ballast tanks during the ship's subsequent voyage or time?

4.3.2 If so, what could be the estimated progression of the re-growth after 1, 2, 3, 4, 5 and 6 weeks after treatment? What is the recommended solution to ensure the performance standard of the ballast water at deballasting, as required by regulation D-2?

4.4 Can the system's efficacy be compromised if there is an increase in the ballast water's turbidity? If so, please describe the decrease in system's efficacy and performance.

4.5 Inform the percentage of the reduction in sediments that the system allows.

4.6 Concerning the concentration of solids in suspension in ballast water, what were the worst environmental conditions under which the ballast water management system was tested for approval?

4.7 What type(s) of adjustment(s) shall be required to the ballast water management system when it has to operate in environmental conditions more severe than those it was tested for approval? All the steps of these procedures need to be clearly specified.

Part 5 Cost-benefits, economic aspects and efficiency

5.1 What is the system's Capex (capital expenditure; in US\$)? This answer is to be related to one or more specific flow rates (in m³/h) that the system can contemplate.

5.2 Regarding the composition of Capex, what is the known or estimated cost of the system purchase and installation for vessels at the time of construction, and for the retrofitting of an existing vessel?

5.3 What is the system's Opex (operating expenditure; in US\$/1000 m³)? This answer is to be related to the cost of the system to treat a volume unit of ballast water.

5.4 In case of ballast water management system to be installed on board a ship in dangerous areas, such as the pump room and the main deck of oil carriers, there will be an additional cost in relation to the informed Capex? Provide further comments and details about this, inclusive if the ballast water management system, or part of its modulus and components, will have to be adapted and certified for this purpose as explosion proof or intrinsically safe system / equipment. Furthermore, indicate if such adaptation can take some time and what time is estimated for this entire process to be duly carried out and successfully concluded.

5.5 What is the increase of fuel or oil consumption that is introduced by the use of this system on board? (According to ship's type and ballast capacity.)

5.6 What are the known or estimated maintenance costs on an annual basis?

5.7 What are the estimated costs of component spares and consumables on an annual basis?

5.8 What are the known or estimated disposal costs of any wastes, residuals, components or replacement parts?

5.9 When the treatment is done during ballasting, can all ballast water be treated to meet D-2 standard during the ship ballasting without delaying the ballasting operations? If delays to the ballasting operations are caused, indicate the time percentage or the additional hours needed to complete the ballasting operation.

5.10 What are the ship staffing requirements for system operation?

5.11 Could the system be considered efficient in energetic terms?

5.11.1 Which is its efficiency in terms of energy (expressed as units of energy required for treating each cubic metre of ballast water)?

5.11.1.1 Should the energetic efficiency be expressed as a function of the amount of energy required to treat a determined volume of water, or as a function of the power required to treat a determined flow rate of ballast?

5.11.1.2 Another conceptual way to express this energetic efficiency would be in terms of a percentage related to the energy supplied to the system and the energy effectively used in the treatment process.

5.11.1.3 An equipment certification like that used for refrigerators and a few other domestic appliances, in relation to greater or lower energy consumption, could also be considered.

5.11.1.4 Another current concern is to minimize the emission of pollutants, GHG and, mainly, CO₂, to the atmosphere. Present comments and technical details on the system about this.

5.11.2 It is suggested that the supplier of the ballast water management system gives due technical consideration to these above aspects and provides the best information about these issues.

Note: Lloyd's Register Guide on Ballast Water Treatment Technologies uses power in kW/1000 m³ of treated BW.

5.12 When the ballast system is operating at a flow rate lower than its rated capacity (for instance, using only one of two ballast pumps for deballasting), does the ballast water management system allow for adjustments for operating under these conditions in order to be more economic and efficient from the energy standpoint?

5.13 Can the ballast water management system be considered as a process that uses a more advanced, cleaner and environmentally sound technology? (It can be effective, but, also, it can be effective and efficient.)

Part 6 Environmental acceptability and possible impacts of the system's by-products on the environment, crew, passengers and general public health, and resources

- 6.1 Does the system generate by-products that can have an adverse impact:
- 6.1.1 on the environment?
 - 6.1.2 on human health: (a) ship's crew? (b) ship's passengers? (c) general public health in the areas where the ship operates?
 - 6.1.3 on resources: (a) natural resources? (b) industrial resources? (c) other?
- 6.2 Does the system require any conditioning/neutralization of treated ballast water, prior to discharge it into the environment? If so, include details.
- 6.3 What are the characteristics of any additional air emissions, which result from the use of the treatment system?
- 6.4 Are there waste streams such as the residue of any filtering process or centrifugal concentrate? If so, inform:
- 6.4.1 What are the characteristics of the waste streams?
 - 6.4.2 Are they suitable for discharge or must they be disposed of on shore?
 - 6.4.3 What is the planned disposition of the waste streams?
 - 6.4.4 When BW treatment is done during ship's ballasting, can waste streams be promptly and simultaneously discharged at the ship's ballasting site/port with the ballast water treatment?
 - 6.4.5 When it is adequate to be discharged at sea, how quickly do the waste streams dissipate after discharge; and at what waste flow rate, sea state, marine current speed, tide regime, the discharge dissipation was tested/verified?
- 6.5 What are the system's possible impacts to the environmental, public health and resources, related to?
- 6.5.1 the interaction of the components and processes of its treatment with the environment, as a function of its ordinary use?
 - 6.5.2 an eventual system failure?
 - 6.5.3 its components or processes which, if damaged/affected due to an eventual vessel casualty, could cause problems and losses?
- 6.6 Does the use of the treatment system result in the discharge of ballast water at other than ambient temperature? If so, provide details.

6.7 Does the system have components or processes which use or produce Active Substances, produce residuals or by-products which present problems in handling, storage or disposal? If so, provide details. What system's components, such as batteries or lead-containing fixtures, cause special disposal concerns?

6.8 The total time required for ballast water management on board should be recorded according to the following table:

**Information and monitoring of the time and re-circulation required
for ballast water management**

Ballast water treatment time	Total time required to treat BW (in hours)	Normal time for (in hours)		Additional time required for the BW treatment (in hours)	
During ballasting		Ship's unloading		Interference beyond the ship discharge normal time	
On voyage		Ship's ballast voyage		Interference beyond the ballast voyage normal time	
During deballasting		Ship's loading		Interference beyond the ship loading time	
Number of times required to re-circulate the BW on board for treatment				Correspondent time for applying the total BW re-circulation	
