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Preliminary Review of Ballast Water Legal Framework and Processes in Nigeria

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Abstract: *Ballast water provides stability to ships. These ballast water harbours several invasive organisms which are usually abundant and have the potentials to displace indigenous species and cause deleterious effects on Port infrastructures and the environment. These invasive species are present in Ballast water, Sediment and biofilms of ships. Prior to the promulgation of the Nigerian Merchant Shipping (Ballast Water Management) Regulations, 2012, there were no Ballast water guidelines in Nigeria. Ships from various Ports of call discharge ballast water without any form of restrain from regulatory agencies. In order to improve Nigeria's commitment to Ballast water management, the Nigerian Merchant Shipping (Ballast Water Management) Regulations, 2012 needs to be strengthened. Key areas requiring some improvements is the Ballast water performance standard (D-2) i.e. Part III of the Merchant Shipping (Ballast Water Management) Regulations, 2012. The Ballast water performance standard (D-2) should include physicochemical parameters (pH, Temperature, Nutrients, Heavy metals, Organics and Radioactive substances); Biofilms (as part of the habitats of invasive species) and toxicity test organisms (spanning across various trophic levels).Relevant agencies in Nigeria saddled with the responsibility of regulating shipping operations (Nigerian Maritime Administration and Safety Agency, Nigerian Port Authority) and environmental management (Federal Ministry of Environment, Department of Petroleum Resources and National Environmental Standards and Regulations Enforcement Agency) can develop a Ballast Water Monitoring Programme, geared at providing compliance standards for ballast water discharges in Nigeria.*

Keywords: *Ballast water, International Maritime Organization, Invasive Alien Species*

I. Introduction

Shipping carries about 90% of the world's trade in volume and moves an estimated 3 to 5 billion tonnes of ballast water globally each year(IMO, 2014a).Ballast water is essential to control trim, list, draught, stability, or stresses of the ship. Nigeria has a rich history of port operations and development dating back to the middle of the 19th century (NPA, 2014). The volume of cargo throughput calling at various ports (Lagos Port Complex; Tin Can Island Port Complex, Rivers Port Complex, Delta Ports Complex, Onne Port Complex and Calabar Port) in Nigeria ranged from 65.7 million tonnes in 2009 to 85.0 million tonnes in 2014; with the Lagos Port complex recording the highest number (Table 1). There were no legislation to regulate this discharges until about 2012 when the Merchant Shipping (Ballast Water Management) Regulations, was enacted.

Ballast water contains varying species of living organisms which include planktons and microorganisms. The introduction of these species commonly referred to as Invasive Alien Species (IAS) to new environment via ship ballast water and other vector has been identified as one of the world's greatest threats to global biodiversity (Wilcov*et al* 1998).In a bid to safeguard global diversity in the world's aquatic ecosystem, the International Maritime Organization (IMO) promulgated the adoption of a universal legal guideline among member countries through the adoption of new ballast water convention in February 2004.The International Convention for the Control and Management of Ships Ballast Water and Sediments was adopted by consensus by member countries. The obligation sort by IMO to member countries was to prevent, minimize and ultimately eliminate the transfer of harmful aquatic organisms and pathogens through the control and management of ship's ballast water and sediments.

The Nigerian territorial waters have come under severe threats and the oceanic biodiversity are the worst hit. Shipsfrom different Ports of call convey alien invasive species (microorganisms and planktons) in ballast tanks, in addition to varying concentrations of heavy metals, nutrients and petroleum-related products which have the potential of causing deleterious effects on aquatic biodiversity. With concerted efforts by the IMO to provide technical assistance (article 13) to development countries through the GTF|UNDP|IMO Global Ballast Water Management Programme (Globallast) initiative, the Nigeria Maritime Administration and Safety Agency (NIMASA) in 2011, developed the economic assessment of ballast water management which metamorphosed into the promulgation of several legislation guiding ballast water management in Nigeria. This was doneinline with the international convention for the control and management of ships ballast water and sediments,2004.The studyfocuses on the Ballast Water and Sediment Management Section (Part III) of the

Merchant Shipping (Ballast Water Management) Regulations, 2012. This study is geared at reviewing key pollution indicators for Ballast water management inline with the Ballast water performance standard (D-2) of theBallast Water Convention, 2004.

Table 1:Volume of Cargo Throughput (Million Metric Tonnes) (2009 to 2014)

Port	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**
Lagos Port complex	21.6	21.2	22.8	20.0	20.3	20.6
Tin Can Island Port complex	13.5	14.5	16.2	15.2	16.1	17.5
Rivers Port	5.1	5.8	7.5	5.6	4.9	6.3
Onne Port Complex	17.2	23.8	26.5	27.6	24.8	28.0
Calabar Port	1.7	1.6	1.9	1.7	1.7	2.4
Delta Ports	6.6	9.8	8.5	7.0	10.4	10.2
Grand Total	**65.7**	**76.7**	**83.4**	**77.1**	**78.2**	**85.0**

Source: NPA, 2014b

International Maritime Organization (IMO) Resolutions for Ballast Water Management

The International Maritime Organization during the 28th session approved the resolution for the Ballast Water Management Convention. The Ballast Water Management Convention will see ships regardless of size, that are designed to carry dischargeable ballast water, install and implement a ballast water management system at the first renewal survey following entry into force (IMO, 2004). The IMO resolutions for Ballast Water Management are presented in Table 2.

Table 2:The IMO resolutions for Ballast Water Management

S/N	**Resolution Number**	**Title**	**Description**
1	Resolution MEPC.152(55)	Guidelines for Sediment Reception Facilities (G1)	The purpose of these guidelines is to provide guidance for the provision of facilities for the reception of sediments that are provided in accordance with Article 5 of the Convention. The guidance is also intended to encourage a worldwide uniform interface between such facilities and the ships without prescribing dedicated shoreside reception plants.
2	Resolution MEPC.173(58)	Guidelines For Ballast Water Sampling (G2)	The objectives of these Guidelines are to provide Parties, including port State control officers, with practical and technical guidance on ballast water sampling and analysis for the purpose of determining whether the ship is in compliance with the Ballast Water Management Convention (the Convention) according to article 9 "Inspection of Ships". These Guidelines only address general technical sampling procedures, and do not address legal requirements.
3	(Resolution MEPC.123 (53)	Guidelines for Ballast Water Management Equivalent Compliance (G3)	These Guidelines apply to pleasure craft used solely for recreation or competition or craft used primarily for search and rescue less than 50 metres in overall length and with a maximum ballast water capacity of eight cubic metres. Overall length means the length of the hull excluding bowsprits, booms, bumpkins, pulpits, etc.
4	Resolution MEPC.127(53)	Guidelines for Ballast Water Management and Development of Ballast Water Management Plans (G4)	The Guidelines apply to all ships and to Flag Administrations, port States, coastal States, ship owners, ship operators, ships' personnel involved in Ballast Water Management, ship designers, ship builders, classification societies as well as other interested parties. The objectives of these Guidelines are to assist Governments, appropriate authorities, ships masters, operators and owners, and port authorities, as well as other interested parties, in preventing, minimizing and ultimately eliminating the risk of introducing harmful aquatic organisms and pathogens from ships' ballast water and associated sediments while protecting ships' safety in applying the International Convention for the Control and Management of Ships' Ballast Water and Sediments
5	Resolution MEPC.153 (55)	Guidelines for Ballast Water Reception Facilities (G5)	The purpose of these guidelines is to provide guidance for the provision of facilities for the reception of ballast water as referred to in Regulation B-3.6 of the Convention. These guidelines are not intended to require that a Party shall provide such facilities. The guidance is also intended to encourage a worldwide uniform interface between such facilities and the ships without prescribing dedicated shoreside reception plants.

S/N	Resolution Number	Title	Description
6	Resolution MEPC.124(53)	Guidelines For Ballast Water Exchange (G6)	The purpose of these Guidelines is to provide ship owners and operators with general guidance on the development of ship specific procedures for conducting ballast water exchange. Whenever possible ship owner and operators should enlist the assistance of classification societies or qualified marine surveyors in tailoring ballast exchange practices for various conditions of weather, cargo and stability. The application of processes and procedures concerning ballast water management are at the core of the solution to prevent, minimize and ultimately eliminate the introduction of harmful aquatic organisms and pathogens. Ballast water exchange offers a means, when used in conjunction with good ballast water management practices, to assist in achieving this solution
7	Resolution MEPC.162(56)	Guidelines For Risk Assessment Under Regulation A-4 Of The BWM Convention (G7)	The purpose of these Guidelines is to assist Parties to ensure that provisions of regulation A-4 of the Convention are applied in a consistent manner, and based on scientifically robust risk assessment, which ensures that the general and specific obligations of a Party to the Convention are achieved. An additional purpose is to provide assurance to affected States that exemptions granted by a Party meet the regulation A-4.3 obligations. The Guidelines outline three risk assessment methods that will enable Parties to identify unacceptable high risk scenarios and acceptable low risk scenarios, and advise Parties on procedures for granting and withdrawing exemptions in accordance with regulation A-4.
8	Resolution MEPC.174(58)	Guidelines for Approval Of Ballast Water Management Systems (G8)	These Guidelines for approval of ballast water management systems are aimed primarily at Administrations, or their designated bodies, in order to assess whether ballast water management systems meet the standard as set out in regulation D-2 of the "International Convention for the Control and Management of Ships' Ballast Water and Sediments," hereafter referred to as the "Convention". In addition, this document can be used as guidance for manufacturers and ship owners on the evaluation procedure that equipment will undergo and the requirements placed on ballast water management systems. These Guidelines should be applied in an objective, consistent and transparent way and their application should be evaluated periodically by the Organization.
9	Resolution MEPC.169(57)	Procedure for Approval Of Ballast Water Management Systems That Make Use Of Active Substances (G9)	This procedure describes the approval and withdrawal of approval of ballast water management systems that make use of Active Substances to comply with the Convention and their manner of application as set out in regulation D-3 of the "International Convention for the Control and Management of Ships' Ballast Water and Sediments". The Convention requires that at withdrawal of approval, the use of the relevant Active Substance or Substances shall be prohibited within 1 year after the date of such withdrawal.
10	Resolution MEPC.140(54)	Guidelines For Approval And Oversight Of Prototype Ballast Water Treatment Technology Programmes (G10)	These Guidelines provide recommendations for Administrations on the approval and oversight of programmes for prototype ballast water treatment technologies in accordance with regulation D-4 of the "International Convention for the Control and Management of Ships' Ballast Water and Sediments, 2004" (the Convention). The intention of regulation D-4 is to provide opportunities to test and evaluate promising ballast water treatment technologies aboard ships with the potential to meet or exceed the performance standards in regulation D-2 of the Convention. The document may also assist manufacturers, ship owners and other stakeholders undertaking development activities in the area of ballast water treatment. The Guidelines also make recommendations on criteria for approval of such programmes. Recommendations outlined in these Guidelines should be applied in an objective, consistent and transparent way and their application should be evaluated periodically by the Organization.
11	Resolution MEPC.169(57)	Procedure for Approval Of Ballast Water Management Systems That Make Use Of Active Substances (G9)	This procedure describes the approval and withdrawal of approval of ballast water management systems that make use of Active Substances to comply with the Convention

S/N	Resolution Number	Title	Description
			and their manner of application as set out in regulation D-3 of the "International Convention for the Control and Management of Ships' Ballast Water and Sediments". The Convention requires that at withdrawal of approval, the use of the relevant Active Substance or Substances shall be prohibited within 1 year after the date of such withdrawal.
12	(Resolution MEPC.140(54)	Guidelines For Approval and Oversight Of Prototype Ballast Water Treatment Technology Programmes (G10)	These Guidelines provide recommendations for Administrations on the approval and oversight of programmes for prototype ballast water treatment technologies in accordance with regulation D-4 of the "International Convention for the Control and Management of Ships' Ballast Water and Sediments, 2004" (the Convention). The intention of regulation D-4 is to provide opportunities to test and evaluate promising ballast water treatment technologies aboard ships with the potential to meet or exceed the performance standards in regulation D-2 of the Convention. The document may also assist manufacturers, ship owners and other stakeholders undertaking development activities in the area of ballast water treatment. The Guidelines also make recommendations on criteria for approval of such programmes. Recommendations outlined in these Guidelines should be applied in an objective, consistent and transparent way and their application should be evaluated periodically by the Organization.
13	(Resolution MEPC.149(55)	Guidelines for Ballast Water Exchange Design And Construction Standards (G11)	These Guidelines outline recommendations for the design and construction of ships to assist compliance with Regulation D-1 (*Ballast Water Exchange Standard*) of the International Convention for the Control and Management of Ships' Ballast Water and Sediments (the Convention). These Guidelines have been developed to give guidance to shipbuilders, ship designers, owners and operators of ships in designing safe, environmentally acceptable, technically achievable, practicable, and cost effective ballast water exchange as required in Regulation D-1.

Nigerian Merchant Shipping (Ballast Water Management) Regulations, 2012

The Nigerian Merchant Shipping (Ballast Water Management) Regulations, 2012 is a good adaptation of the IMO International Convention for the Control and Management of Ship's Ballast Water and Sediments aimed at reducing the risk of spreading harmful aquatic organisms and pathogens released with ballast water.A summary of Part III of the Nigerian Merchant Shipping (Ballast Water Management) regulation is presented as follows:

Nigerian Merchant Shipping (Ballast Water Management) Regulations, 2012: Ballast Water Management (Part III)

1) A ship constructed before 2009 with a Ballast Water Capacity of between 1500 and 5000 cubic metres, inclusive, shall –

a) Until 2014, perform Ballast Water exchange with an efficiency of at least 95 percent volumetric exchange of Ballast Water, provided that for ships exchanging Ballast Water by the pumping – through method, pumping through three times the volume of each Ballast Water tank shall be considered to meet the standard described in this sub-regulation and pumping through less than three times the volume may be accepted where the ship can demonstrate that at least 95 percent volumetric exchange is met: and

b) After 2014 discharge less than 10 viable organisms per cubic meter greater than or equal to 50 micrometers in minimum dimension and less than 10 viable organisms per milliliter less than 50 micrometers in minimum dimension and greater than or equal to 10 micrometres in minimum dimension; and discharge of the indicator microbes shall not exceed the following specified concentrations –

Indicator microbes, as a human health standard, shall include:

i. Toxicogenic *Vibrio cholera* (O1 and O139) with less than 1 colony forming unit (cfu) per 100 milliliters or less than 1 cfu per 1 gram (wet weight) zooplankton samples;

ii. *Intestinal Enterococci* less than 100 cfu per 100 milliliters.

2) Sediment management for ships

1. Ships shall remove and dispose of sediments from spaces designated to carry Ballast Water in accordance with the provisions of the ship's Ballast Water Management plan;

2. Ships described in regulations 9 to 11 of these Regulations shall, without compromising safety or operational efficiency, be designed and constructed with a view to minimize the uptake and undesirable entrapment of sediments, facilitate removal of sediments. And provide safe access to allow for sediment removal and sampling, taking into account guidelines developed by the organization.

II. Discussion

There are some inherent pollution indicators and habitats for invasive species still exist and not captured in the Ballast Water performance standard (D-2) (Part III) section of the Nigerian Merchant Shipping (Ballast Water Management) Regulations, 2012. These pollution indicators are important to properly evaluate the potential risk of Ballast water to Port infrastructures and aquatic flora and fauna in the recipient environment. Key pollution indicators that can help evaluate these risks include: physicochemical parameters, Toxicity of Ballast water and Biofilms enumeration.

Physicochemical Parameters

In addition to the biological components (invasive species) in ballast water, great attention should also be placed on the physicochemical characteristics of the water. These parameters provide optimum condition for the survival of these organisms. Generally, lotic water bodies receive several substrates from its catchment area and can be influenced by pollutants from human sources(Cushing and Allan2001; Allan 1995). Ballast water from a destination port may contain significant high levels of contaminants especially within ports were there are no stringent environmental guidelines and implementation. These contaminants may cause deleterious effects on Port infrastructures at various Port of call e.g. facilitate biocorrosion of Quay,Wharf and Mooring dolphins. Some contaminants have the potential of bioaccumulatingin tissues of flora and fauna and increase environmental risk considerably.

In the light of the aforementioned, parameters such as pH, Temperature, Nutrient levels (nitrate, sulphate), Turbidity, Heavy metals, Organics (Polycyclic Aromatic Hydrocarbons, Total Petroleum Hydrocarbon) and Radioactive substances should be included in the D2 performance section to help evaluate the risk of pollution in surface water and sediment. These parameters are key indices used for various water evaluation criteria (EPA 2012).Appropriate compliance levels should also be included for these parameters. This can be achieved through a robust Ballast water quality monitoring program.

Toxicity Of Ballast Water

The toxicity of ballast water has been discussed elaborately in the IMO Guidelines for Ballast Water Exchange (G6) (Resolution MEPC.124(53) and covers acute toxicity, bioconcentration and biomagnification. Different organisms have various levels of tolerance to selected contaminants in ballast water, it will be worthwhile to includeuniform selected test organisms across the various trophic levels spanning from fresh water to marine environment ecosystems. This can also be adopted in the Ballast water and sediment management section of the Merchant Shipping (Ballast Water Management) Regulations, 2012.Furthermore, toxicity methodologies can also be included inline with OSPAR guidelines for Toxicity Testing 2005.

Biofilms Enumeration

Biofilms are structured community of microorganisms encapsulated within a self-developed polymeric matrix and adherent to a living or inert surface (Lear and Lewis (ed), 2012). Microorganisms in biofilms produce extracellular polymeric substances (EPS) that holdthe cell aggregates together and form the structural biofilm matrix scaffold (Stewart and Franklin, 2008; Flemming, 2007; Brandaet *al*, 2005). Organic matrices consistently form on the interior tank surfaces and harbor various physiological forms of organisms (Bacteria, fungi, viruses and microalgae).These habitats (biofilms) have the potential of serving as an ecological niche for invasive alien species. Depending on the composition of the biofilms, it can be resistant to various temperatures spanning several climatic regimes. As part of the habitats within ships, it will be worthwhile to include biofilms management in the Merchant Shipping (Ballast Water Management) Regulations as its importance in ecosystem dynamics cannot be overemphasized.

III. Conclusion

Ballast water in Nigeria is fast gaining attention due to the promulgation of the Merchant Shipping (Ballast Water Management) Regulations, 2012. With very high vessel traffic in Nigerian Ports, foreign-based vessels discharge several tonnes of ballast water annually. The IMO Ballast Water Convention have several resolutions on Ballast water management in which the Merchant Shipping (Ballast Water Management) Regulations, 2012 has clearly adopted. However in order to improve Nigeria's commitment on Ballast water management, the Merchant Shipping (Ballast Water Management) Regulations, 2012 needs to be strengthened. Key areas requiring some improvements is the Ballast water performance standard (D-2) i.e. Part III of the

Merchant Shipping (Ballast Water Management) Regulations, 2012. The Ballast water performance standard (D-2) should include physicochemical parameters (pH, Temperature, Nutrients, Heavy metals, Organics and Radioactive substances); Biofilms (as part of the habitats of invasive species) and toxicity test organisms (spanning across various trophic levels).

Relevant agencies in Nigeria saddled with the responsibility of regulating shipping activities (Nigerian Maritime Administration and Safety Agency, Nigerian Port Authority) and environmental management (Federal Ministry of Environment, Department of Petroleum Resources and National Environmental Standards and Regulations Enforcement Agency)can develop a Ballast water monitoring programme, geared at providing compliance standards for ballast water discharges.

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