New York State Department of Environmental Conservation
Division of Water
Bureau of Water Permits, 4th Floor
625 Broadway, Albany, NY 12233-3505
Phone: (518) 402-8111 • **Fax:** (518) 402-9029
Website: www.dec.ny.gov

Alexander B. Grannis
Commissioner

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US EPA Science Advisory Board
Ecological Processes and Effects Committee
Augmented for Ballast Water
1200 Pennsylvania Avenue, N.W.
Washington, D.C. 20460

Ballast Water Treatment Technology: Verification Issues

Dear Ms. Vu and Committee Members:

Thank you for the opportunity to address the Ecological Processes and Effects Committee Augmented for Ballast Water. As the Committee members begin to formulate preliminary advice to EPA pertaining to ballast water treatment technology, we encourage each member to carefully distinguish the differences between available testing protocols and the use of such, versus the efficacy of individual treatment systems as determined by independent testing facilities. While in the ideal world one would develop acceptable protocols for each of the proposed ballast water discharge standards (i.e. IMO, 100x IMO, 1000x IMO) the actual performance of systems is not dependent on such. As explained in more detail below, we believe that tests conducted using the widely available IMO testing protocols will allow testing facilities to determine the efficacy of treatment systems to at least an order of magnitude greater than the IMO D-2 discharge standard and multiple tests evaluating at least 30 m^3 of water cumulatively can be used to determine, with statistical rigor, if systems exceed the 100x IMO discharge standard.

Existing land-based facilities have been designed to test the ability of BWTS to achieve the IMO D-2 discharge standard following the guidelines of the IMO G8 and G9 documents. While it is generally recognized that use of larger sample volumes and additional replicate trials make it possible for facilities to test systems to more stringent standards, such as Condition 2 (100x IMO) of the NYS Certification to the EPA VGP, these approaches are still being studied. We see the development of such protocols as a logical extension of the formal testing protocols presently available to verify system performance to the IMO D-2 standard. Some test facility managers have claimed that testing to a more stringent discharge standard by sampling and analyzing larger volumes of water may be confounded by testing errors, i.e. representativeness will decline as time to conduct the biological analyses increases. This concern merits consideration but should not be viewed as an automatic barrier that halts all further discussion. The relevant discussion may need to consider, for example, whether the time to conduct biological analyses would necessarily increase when testing larger volumes, given the tendency for organism concentrations to be lower in samples that meet a more stringent standard.

A recent publication *Density Matters: Review of Approaches to Setting Organism-Based Ballast Water Discharge Standards* provides a good basis on which to develop more formal protocols for verifying to the 100x IMO and/ or 1000x IMO discharge standards, requiring smaller test volumes than previously deemed necessary. Of particular interest is chapter 10 *Statistical Considerations in Estimating the Concentrations of Organisms in Ballast Water Discharge* which states that "The probability of detecting an exceedance depends on: 1) the volume of ballast that is sampled; 2) the stringency of the discharge standard; and 3) the magnitude of the exceedance." and "When the true concentration of organisms is 0.1 m^{-3} [100x IMO] approximately 30 $m^3$of ballast water must be sampled." Figure 11B on page 81 provides a graphic in which the white regions of the plot indicate a >95% probability of detecting the exceedance.

It is important to note, that the values presented in the above referenced document are probably optimistic due to the fact that the calculations assume that organisms are randomly distributed. Most organisms, though, demonstrate at least some aggregation and for aggregated populations larger volumes must be sampled to obtain good estimates of concentrations. While aggregation is a particular form of non-uniform distribution of organisms, we note that concerns about non-uniform distribution are already partially addressed by existing procedures that are intended to ensure representativeness. Various testing protocols can and usually are utilized to ensure that test samples are representative of the total ballast discharge volume. If testing facilities follow the IMO G8 guidelines, this is accomplished by collecting three replicate samples of discharge treated water collected at each of three times during the period of discharge.

At least one technology developer, Ecochlor, appears to have met the minimum volume requirement suggested for determining if discharge from a treatment system exceeds the 100x IMO discharge standard. This was accomplished by batching individual 3 m^3 test runs (#7-16) conducted by NIOZ utilizing 5 mg/L active substance (vs. 4 mg/L for earlier tests) until a volume of 30 m^3 was reached. NIOZ staff detected 2 organisms >50 um in the 30 m^3 test samples, thus demonstrating compliance with the 100x IMO discharge standard for organisms >50um with about 58% confidence. Additional ship-board testing completed this past summer brought the total test volume to 39 m^3, with the number of organisms detected >50 um remaining at 2 resulting in an increased confidence level of approximately 75%. If this particular ballast water treatment system continues to operate with similar performance, additional testing will likely only increase statistical confidence levels. Two additional technology developers, Quindao Headway Tech and Techcross, may be able to demonstrate similar treatment performance.

Therefore, we conclude that ballast water treatment technology with the potential to comply with the more stringent ballast water discharge/ performance standards set by New York and Wisconsin (100x IMO) has been developed, has demonstrated reasonably high statistical confidence, and is commercially available. We encourage the Committee to carefully consider the information and concepts presented above, and to review the relevant land based and ship-board testing data for the three ballast water treatment systems noted.

We also take this opportunity to forward to you the latest listing of ballast water management systems that make use of Active Substances which received Basic and Final Approval from IMO and Type Approval Certification by their Administration. As noted by California State Lands

Commission staff in the report, *2010 Assessment of the Efficacy, Availability and Environmental Impacts of Ballast Water Treatment Systems for Use in California Waters*, at least eight of these treatment systems have demonstrated the potential to comply with the Commission's performance standards. Three of the eight systems show the potential to meet California's performance standards under more rigorous evaluation criteria. Given the extensive number of systems identified, we are confident that the number of systems capable of meeting more stringent discharge standards, such as 100x IMO or 1000x IMO, will increase in the very near future.

We thank you for the opportunity to present the aforementioned information to the Committee and look forward to hearing the remaining discussions of the various members and interested parties.

Sincerely,

Koon S. Tang, P.E.
Acting Director
Bureau of Water Permits

Table (1) – List of ballast water management systems that make use of Active Substances which received Basic Approval from IMO*

	Name of the system and proposing country	Name of manufacturer	Date of Basic Approval
1	SEDNA® Ballast Water Management System (Using Peraclean® Ocean), Germany	Degussa Gmbh, Germany	24 March 2006
2	Electro-Clean (electrolytic disinfection) system (subsequently changed to Electro-Cleen™), the Republic of Korea	Techcross Ltd. and Korea Ocean Research and Development Institute (KORDI)	24 March 2006
3	Special Pipe Ballast Water Management System (combined with Ozone treatment), Japan	Japan Association of Marine Safety (JAMS)	13 October 2006
4	EctoSys™ electrochemical System, Sweden	Permascand AB, Sweden, subsequently acquired by RWO GmbH, Germany	13 October 2006
5	PureBallast System, Sweden	Alfa Laval/ Wallenius Water AB	13 July 2007
6	NK Ballast Water Treatment System, the Republic of Korea (subsequently changed to NK-O3 BlueBallast System (Ozone))	NK Company Ltd., the Republic of Korea	13 July 2007
7	Hitachi Ballast Water Purification System (ClearBallast), Japan	Hitachi, Ltd. /Hitachi Plant technologies, Ltd.	4 April 2008
8	Resource Ballast Technologies System, South Africa	Resource Ballast Technologies (Pty) Ltd.	4 April 2008
9	GloEn-PatrolTM Ballast Water Management System, the Republic of Korea	Panasia Co., Ltd.	4 April 2008
10	OceanSaver® Ballast Water Management System (OS BWMS), Norway	MetaFil AS	4 April 2008
11	TG Ballastcleaner and TG Environmentalguard System (subsequently changed to JFE Ballast Water Management System), Japan	The Toagosei Group (TG Corporation, Toagosei Co. Ltd. and Tsurumi Soda Co. Ltd.)	10 October 2008
12	Greenship Sedinox Ballast Water Management System, the Netherlands	Greenship Ltd	10 October 2008
13	Ecochlor® Ballast Water Treatment System, Germany	Ecochlor, INC, Acton, the United States	10 October 2008

Table 1 (continue)

	Name of the system and proposing country	Name of manufacturer	Date of Basic Approval
14	Blue Ocean Shield Ballast Water Management System, China	China Ocean Shipping (Group) Company (COSCO)	17 July 2009
15	Hyundai Heavy Industries Co., Ltd. (HHI) Ballast Water Management System (EcoBallast), the Republic of Korea	Hyundai Heavy Industries Co., Ltd. the Republic of Korea	17 July 2009
16	AquaTriComb™ Ballast Water Treatment System, Germany	Aquaworx ATC GmbH	17 July 2009
17	SiCURETM Ballast Water Management System, Germany	Siemens Water Technologies	26 March 2010
18	Sunrui Ballast Water Management System (subsequently changed to BalClor Ballast Water Management System), China	Qingdao Sunrui Corrosion and Fouling Control Company	26 March 2010
19	DESMI Ocean Guard Ballast Water Management System, Denmark	DESMI Ocean Guard A/S	26 March 2010
20	Blue Ocean Guardian (BOG) Ballast Water Management System, (subsequently changed to "ARA Ballast" Ballast Water Management System), the Republic of Korea	21st Century Shipbuilding Co., Ltd.	26 March 2010
21	Hyundai Heavy Industries Co., Ltd. (HHI) Ballast Water Management System (HiBallast), the Republic of Korea	Hyundai Heavy Industries Co., Ltd. the Republic of Korea	26 March 2010
22	Kwang San Co., Ltd. (KS) Ballast Water Management System "En-Ballast", the Republic of Korea	Kwang San Co., Ltd.	26 March 2010
23	OceanGuard™ Ballast Water Management System, Norway	Qingdao Headway Technology Co., Ltd.	26 March 2010
24	Severn Trent DeNora BalPure® Ballast Water Management System, Germany	Severn Trent De Nora (STDN), LLC	26 March 2010
25	Techwin Eco Co., Ltd. (TWECO) Ballast Water Management System (Purimar), the Republic of Korea	Techwin Eco Co., Ltd.	1 October 2010
26	AquaStar Ballast Water Management System, the Republic of Korea	AQUA Eng. Co., Ltd.	1 October 2010
27	Kuraray Ballast Water Management System, Japan	Kuraray Co., Ltd.	1 October 2010

* More comprehensive information regarding these systems is available in document BWM.2/Circ.30.

Table (2) – List of ballast water management systems that make use of Active Substances which received Final Approval from IMO*

	Name of the system and proposing country	Name of manufacturer	Date of Final Approval
1	PureBallast System, Norway	Alfa Laval / Wallenius Water AB	13 July 2007
2	SEDNA® Ballast Water Management System (Using Peraclean® Ocean), Germany	Degussa Gmbh, Germany	4 April 2008
3	Electro-Cleen™ System, the Republic of Korea	Techcross Ltd. and Korea Ocean Research and Development Institute (KORDI)	10 October 2008
4	OceanSaver® Ballast Water Management System (OS BWMS), Norway	MetaFil AS	10 October 2008
5	Ballast Water Management System (CleanBallast), Germany	RWO GmbH Marine Water Technology, Germany	17 July 2009
6	NK-O3 BlueBallast System (Ozone), the Republic of Korea	NK Company Ltd., the Republic of Korea	17 July 2009
7	Hitachi Ballast Water Purification System (ClearBallast), Japan	Hitachi, Ltd. /Hitachi Plant technologies, Ltd.	17 July 2009
8	Greenship Sedinox Ballast Water Management System, the Netherlands	Greenship Ltd	17 July 2009
9	GloEn-Patrol™ Ballast Water Management System, the Republic of Korea	Panasia Co., Ltd.	26 March 2010
10	Resource Ballast Technologies System, South Africa	Resource Ballast Technologies (Pty) Ltd.	26 March 2010
11	JFE Ballast Water Management System, Japan	JFE Engineering Corporation	26 March 2010
12	Hyundai Heavy Industries Co., Ltd. (HHI) Ballast Water Management System (EcoBallast), the Republic of Korea	Hyundai Heavy Industries Co., Ltd. the Republic of Korea	26 March 2010
13	Special Pipe Hybrid Ballast Water Management System combined with Ozone treatment version (SP-Hybrid BWMS Ozone version), Japan	Mitsui Engineering & Shipbuilding Co., Ltd.	1 October 2010
14	"ARA Ballast" Ballast Water Management System, the Republic of Korea	21st Century Shipbuilding Co., Ltd.	1 October 2010
15	BalClor Ballast Water Management System, China	Qingdao Sunrui Corrosion and Fouling Control Company	1 October 2010
16	OceanGuard™ Ballast Water Management System, Norway	Qingdao Headway Technology Co., Ltd.	1 October 2010
17	Ecochlor® Ballast Water Management System, Germany	Ecochlor, INC, Acton, the United States	1 October 2010
18	Severn Trent De Nora BalPure® Ballast Water Management System, Germany	Severn Trent De Nora (STDN), LLC	1 October 2010

More comprehensive information regarding these systems is available in document BWM.2/Circ.30.

Table (3) – List of ballast water management systems which received Type Approval Certification by their respective Administrations (resolution MEPC 175 (58))*

	Approval Date	Name of the Administration	Name of the ballast water management system	Copy of Type Approval Certificate	Active Substance employed	MEPC report granting Final Approval
1	June 2008	Det Norske Veritas, as delegated by the Norwegian Administration	PureBallast System	provided	Yes, please refer to MEPC 56/2/2, annex 5	MEPC 56/23, paragraph 2.8
2	10 June 2008	Federal Maritime and Hydrographic Agency, Germany	SEDNA® Ballast Water Management System (Using Peraclean® Ocean)	Provided	Yes, please refer to MEPC 57/2/10, annex 7	MEPC 57/21, paragraph 2.16
3	31 December 2008	Ministry of Land, Transport and Maritime Affairs, the Republic of Korea	Electro-Cleen™ System	Provided	Yes, please refer to MEPC 58/2/7, annex 7	MEPC 58/23, paragraph 2.8
4	17 April 2009	Det Norske Veritas, as delegated by the Norwegian Administration	OceanSaver® Ballast Water Management System (OS BWMS)	Provided	Yes, please refer to MEPC 58/2/8, annex 4	MEPC 58/23, paragraph 2.10
5	24 November 2009	Ministry of Land, Transport and Maritime Affairs, the Republic of Korea	NK-O3 BlueBallast System (Ozone)	Provided	Yes, please refer to MEPC 59/2/16, annex 6	MEPC 59/24, paragraph 2.8.
6	4 December 2009	Ministry of Land, Transport and Maritime Affairs, the Republic of Korea	GloEn-Patrol™ Ballast Water Management System	Provided	Yes, please refer to MEPC 60/2/11, annex 4	MEPC 60/22, paragraph 2.7
7	5 March 2010	Ministry of Land, Infrastructure, Transport and Tourism of Japan	Hitachi Ballast Water Management System (ClearBallast)	Provided	Yes, please refer to MEPC 59/2/19, annex 4	MEPC 59/24, paragraph 2.8

Table 3 (continue)

	Approval Date	Name of the Administration	Name of the ballast water management system	Copy of Type Approval Certificate	Active Substance employed	MEPC report granting Final Approval
8	2 September 2008 19 January 2010	Office of the Maritime Administration, Marshall Islands Merchant Shipping Directorate of Malta	NEI Treatment System VOS-2500-101	Provided	No Active Substances used according to the communication received from the Administration of Marshall Islands	Not applicable
9	29 April 2009	Lloyd's Register, as delegated by the Administration of the United Kingdom	Hyde GUARDIAN™ ballast water management system	Provided	No Active Substances used according to the communication received from the Administration of United Kingdom (please refer to MEPC 59/INF.20)	Not applicable
10	12 November 2009	Det Norske Veritas, as delegated by the Norwegian Administration	OptiMarin Ballast System (OBS)	Provided	No Active Substances used according to the communication received from the Administration of Norway (please refer to MEPC 61/INF.4)	Not applicable

* This list was compiled based on the information provided by the respective Administrations.

Note: lists above updated in October 2010.