HYUNDAI HEAVY INDUSTRIES CO.,LTD.	**HiBallast™ Ballast Water Management System**

Document 3-2. Land-based Test Report

APPLICATION/PROJECT	Alternate Management System (AMS)
APPROVAL AUTHORITY	USCG
DOCUMENT NO.	HiB-03200-AMS
APPLICANT	Hyundai Heavy Industries Co., Ltd.
ISSUING PARTY	Engine & Machinery Research Institute / R&D Division

Rev.	Date	Reason for Issue	Prepared	Checked	Approved
0	25 Sep., 2012	Draft	T. J. Rhee	Y. G. Kim	K. N. Chung
1	25 Oct., 2012	Final	S. H. Yoon	Y. G. Kim	K. N. Chung
2					
3					
4					

시험성적서
Certificate of Test

1. 신 청 자
Applicant

ㅇ **회사명** : Hyundai Heavy Industries Co., Ltd.
Name

ㅇ **주 소** : #1, Jeonha-Dong, Dong-Gu, Ulsan, Korea
Address

ㅇ **접수일자** : Dec. 02, 2009
Date of Receipt

2. 시험대상품
Equipment Under Test

ㅇ **시험품명** : Ballast Water Management System (full-scale)
Name of Product

ㅇ **모 델** : HiBallast™ 300 ㅇ **일련번호** : -
Model *Serial No.*

3. 성적서 용도 : Type Approval of the Land-based test by the Ministry of Land, Transport and Maritime Affair, Republic of Korea
Purpose of Test

4. 시험규격 : The Provisional Regulation of Type Approval of Ballast Water Management System by the Ministry of Land, Transport and Maritime Affairs (PR No. 2009-1210), Methods in accordance with the requirements of G8 (IMO Res. MEPC. 174(58))
Test Standards

5. 시험환경 : ㅇ **Temperature** : (20.0 ± 1.0) °C , ㅇ **Relative Humidity** : (40 ± 5) % R.H.
Environment

6. 시험기간 : Apr. 01, 2010 ~ Jul. 13, 2010
Test Period

7. 발행일자 : Nov. 30, 2010
Issued Date

8. 시험결과 : **PASS**
Test Result

본 시험성적서의 시험결과는 상기 신청인으로부터 제공된 시험품에만 적용되며, 본 연구원의 사전 서면승인 없이 성적서의 전부 또는 일부를 복사하여 사용할 수 없음.

The test results attached herewith contained apply only to the test sample(s) supplied by the named applicant, and this test report shall not be reproduced in full or in part without the prior written approval of the KOMERI.

* 시험성적서는 제 0906_KOMERI-10T646호의 대체문서 임.

* This document is substitute for certificate No. 0906_KOMERI-10T646.

Nov. 30, 2010

백 상희 강재욱

Prepared by Documentation Specialist
Name : Sang-Hee Baek

Approved by Quality Manager
Name : Jae-Uk Kang

KOMERI
한국조선기자재연구원
Korea Marine Equipment Research Institute

부산광역시 영도구 동삼동 1125-22 (우 606-806)
1125-22, Dongsam-Dong, Youngdo-Gu, Busan, 606-806, Korea
Tel:+82-51-400-5000 Fax:+82-51-400-5091
http://www.komeri.re.kr

TEST REPORT

1. APPLICANT INFORMATION

Company	:	Hyundai Heavy Industries Co., Ltd.
Address	:	#1, Jeonha-Dong, Dong-Gu, Ulsan, 682-792, Korea
Name of Client	:	Byeong-Uk Oh, Jae-Seong Lee
Telephone	:	+82-52-202-3229
Facsimile	:	+82-52-202-9588

2. MANUFACTURER INFORMATION

Company	:	Hyundai Heavy Industries Co., Ltd.
Address	:	#1, Jeonha-Dong, Dong-Gu, Ulsan, 682-792, Korea
Telephone	:	+82-52-202-3229
Facsimile	:	+82-52-202-9588

3. LABORATORY INFORMATION

Laboratory	:	Korea Marine Equipment Research Institute
Address	:	#1125-22, Dongsam-Dong, Youngdo-Gu, Busan, 606-806, Korea
Telephone	:	+82-51-400-5000
Facsimile	:	+82-51-400-5091

4. EQUIPMENT UNDER TEST (EUT) INFORMATION

EUT Name	:	Ballast Water Management System (full-scale)
Model	:	HiBallast™ 300
Serial No.	:	-
Power	:	-

5. TEST SUMMARY

Period	Cycle	Test duration (Ballasting to de-Ballasting)	Test Standard	Remarks
1 (> 32 PSU)	1	Apr. 01. 2010 - Apr. 06. 2010	- The Provisional Regulation of Type Approval of Ballast Water Management System by the Ministry of Land, Transport and Maritime Affairs (PR No. 2009-1210) - Methods in accordance with the requirements of G8 (IMO Res. MEPC. 174(58))	PASS
	2	Apr. 08. 2010 - Apr. 13. 2010		
	3	Apr. 15. 2010 - Apr. 20. 2010		
	4	Apr. 22. 2010 - Apr. 27. 2010		
	5	Apr. 29. 2010 - May. 04. 2010		
	6	Jul. 08. 2010 - Jul. 13. 2010		
2 (3-32 PSU)	1	May. 27. 2010 - Jun. 01. 2010		
	2	Jun. 03. 2010 - Jun. 08. 2010		
	3	Jun. 10. 2010 - Jun. 15. 2010		
	4	Jun. 17. 2010 - Jun. 22. 2010		
	5	Jun. 24. 2010 - Jun. 29. 2010		

TABLE OF CONTENTS

1. LAND-BASED TEST 5
1.1 TEST ENVIRONMENT 5
1.2 TEST STANDARD 5
1.3 TEST EQUIPMENT 6
1.4 TEST SET-UP 7
1.5 TEST PROCEDURE 7
1.6 TEST SCHEDULE 8
1.7 TEST RESULTS 8
1.8 CONCLUSION 14

APPENDIX Ⅰ. DRAWING 15
APPENDIX Ⅱ. PROCEDURE OF LAND-BASED TEST 16
APPENDIX Ⅲ. SPECIES COMPOSITION IN THE TEST WATER 17
APPENDIX Ⅳ. TEST RESULT DETAILS 28
APPENDIX Ⅴ. TEST PICTURES 39
APPENDIX Ⅵ. CHAIN OF CUSTODY RECORDS 160

1. LAND-BASED TEST

1.1 TEST ENVIRONMENT

· Ambient temperature	(20.0 ± 1.0) ℃	※15.0 ℃ to 35.0 ℃
· Relative Humidity	(40 ± 5) % R.H.	※25 % R.H. to 75 % R.H.

1.2 TEST STANDARD

· Test standard used in this test is adequate to the Provisional Regulation for Type Approval of Ballast Water Management System by the Ministry of Land, Transport and Maritime Affairs (PR No. 2009-1210), Methods in accordance with the requirements of G8 (IMO Res. MEPC. 174(58)) and details as below;

· pH : Standard Method 4500 H^+ B (APHA, 2005) - Measurement with Electrode multiprobe (Hydrolab, USA)
· Water temperature : Standard Method 2550 (APHA, 2005) - Measurement with Electrode multiprobe (Hydrolab, USA)
· DO : Standard Method 4500-O G (APHA, 2005) - Measurement with Electrode multiprobe (Hydrolab, USA)
· Turbidity : Standard Method 2130 B (APHA, 2005) - Measurement with Electrode multiprobe (Hydrolab, USA)
· Salinity : Standard Method 2520 B (APHA, 2005) - Measurement with Electrode multiprobe (Hydrolab, USA)
· DOC and POC : ISO 8245 (2004)
· TSS : Standard Method 2540 D (APHA, 2005)
· Viable organisms (≥ 10-50 μm) : Fluorescein dying with 5-CFDA AM (Anja et al., 2005), Standard Method 10200 C (APHA, 2005), Culture methods (Manual and Guide, UNESCO, 2005)
· Viable organisms (≥ 50 μm) : Staining method (Tang et al., 2006), Standard Method 10200 C (APHA, 2005)
· Heterotrophic bacteria : Standard Method 9215 (APHA, 2005)
· Total Coliform : Standard Method 9222 B (APHA, 2005)
· *Escherichia coli* : US EPA 1603 (2006)
· Intestinal *Enterococci* : US EPA 1600 (2006)
· Toxicogenic *Vibrio cholerae* : Standard Method 9260 H (APHA, 2005) and/or API 20E kit (BioMerieux, Inc.)

1.3 TEST EQUIPMENT

	Description	Manufacturer	Model Number	Calibration Due
◆	Multiprobe (Hydrolab)	Hach	DS-5	-
◆	Fluorescent microscope (Scale bar)	Olympus	CKX41	-
◆	Stereo-microscope	Olympus	SZ40	-
◆	Sedgewick-Rafter counting chamber	-	-	-
◆	Hemacytometer	-	-	-
◆	Bogorov counting chamber	-	-	-
◆	Incubator (bacterial)	DH Sci.	WIG-155	~ 2010. 12. 08
◆	Clean bench	SY Sci.	SH-150S	-
◆	Clean room	DS Techwin	10 000 class	-
◆	Dry oven	DH Sci.	WON-105	~ 2010. 12. 14
◆	Image analyzer	BAUMER	TDI DMC3	-
◆	Image analyzer	Dixi Optics	JUJAK 5.5	-
◆	Electronic Weighing	OHAUS	Pioneer™	~ 2010. 12. 14
◆	Autoclave	DH Sci.	WAC-60	~ 2010. 12. 08
◆	Standard sieve	-	50 μm	~ 2011. 08. 10
◆	Plankton net (10 μm, 50 μm)	Aqua Net (DK)	10 μm, 50 μm	-
◆	Auto pipette	Axygen	AX-10000	~ 2013. 02. 20
◆	Auto pipette	Axygen	AX-1000	~ 2013. 02. 20
◆	Colony counter	SUNTEX	570	-

1.4 TEST SET-UP

· A schematic diagram of the Land-based test is shown below. Water samples are collected from the sampling ports S1 to S4.

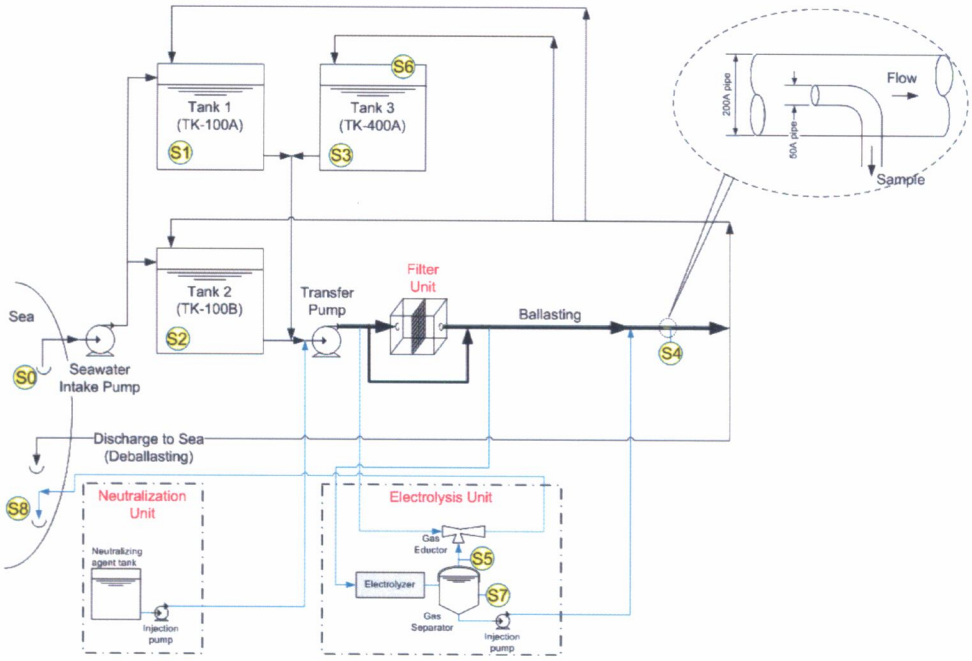


Figure 1. Schematic diagram of the land-based test facility of the "HiBallast™ 300" BWMS and sampling ports.

1.5 TEST PROCEDURE

· See Appendix Ⅱ. PROCEDURE OF LAND-BASED TEST.

1.6 TEST SCHEDULE

Period	Cycle	Test date		Salinity
		Ballasting	de-Ballasting	(PSU)
1 (> 32 PSU)	1	Apr. 01. 2010	Apr. 06. 2010	35.74
	2	Apr. 08. 2010	Apr. 13. 2010	35.61
	3	Apr. 15. 2010	Apr. 20. 2010	35.64
	4	Apr. 22. 2010	Apr. 27. 2010	35.15
	5	Apr. 29. 2010	May. 04. 2010	35.56
	6	Jul. 08. 2010	Jul. 13. 2010	34.25
2 (3-32 PSU)	1	May. 27. 2010	Jun. 01. 2010	20.39
	2	Jun. 03. 2010	Jun. 08. 2010	20.44
	3	Jun. 10. 2010	Jun. 15. 2010	20.69
	4	Jun. 17. 2010	Jun. 22. 2010	20.66
	5	Jun. 24. 2010	Jun. 29. 2010	20.48

1.7 TEST RESULTS

1.7.1 TEST WATER

1.7.1.1 Basic parameter of test water

Period	Cycle	DOC (mg/L)	POC (mg/L)	TSS (mg/L)	Remarks
1 (> 32 PSU)	1	2.36	1.87	30.80	PASS
	2	2.64	1.19	22.13	PASS
	3	2.44	1.83	28.13	PASS
	4	2.29	1.51	17.60	PASS
	5	2.27	1.83	22.13	PASS
	6	2.57	1.33	20.80	PASS
Requirement	-	**> 1**	**> 1**	**> 1**	-
2 (3-32 PSU)	1	8.94	17.40	89.47	PASS
	2	7.68	21.10	82.67	PASS
	3	6.72	19.40	78.93	PASS
	4	5.52	17.00	81.33	PASS
	5	7.26	17.40	71.73	PASS
Requirement	-	**> 5**	**> 5**	**> 50**	-

* Data indicates an arithmetic mean.

1.7.1.2 Viable organism density of test water

Period	Cycle	Viable organisms (≥ 50 μm, inds./m^3)	Viable organisms (≥ 10-50 μm, inds./mL)	Heterotrophic bacteria (cells/mL)	Remarks
1 (> 32 PSU)	1	521 000	1 722	77 091	PASS
	2	287 000	1 412	10 590	PASS
	3	569 000	1 419	9 591	PASS
	4	307 000	1 363	8 590	PASS
	5	399 000	2 340	14 090	PASS
	6	864 166	1 522	10 590	PASS
2 (3-32 PSU)	1	310 000	2 134	24 000	PASS
	2	163 000	1 374	22 864	PASS
	3	755 000	2 132	22 545	PASS
	4	415 000	2 099	44 909	PASS
	5	508 000	1 923	44 682	PASS
Requirement	-	**≥ 100 000**	**≥ 1 000**	**≥ 10 000**	-

* Data indicates an arithmetic mean.

1.7.1.3 Identifications of viable organism in test water

Period	Cycle	Viable organism classification	Species composition	Remarks	**Requirement (Standard condition)**
1 (> 32 PSU)	1	≥ 50 μm	4 phylum 8 species	PASS	≥ 50 μm : ≥ 3 Phyla/Division 5 species, ≥ 10-50 μm : ≥ 3 Phyla/Division 5 species
		≥ 10-50 μm	5 division 9 species		
	2	≥ 50 μm	4 phylum 10 species	PASS	
		≥ 10-50 μm	4 division 12 species		
	3	≥ 50 μm	4 phylum 11 species	PASS	
		≥ 10-50 μm	4 division 9 species		
	4	≥ 50 μm	4 phylum 11 species	PASS	
		≥ 10-50 μm	4 division 9 species		
	5	≥ 50 μm	3 phylum 10 species	PASS	
		≥ 10-50 μm	3 division 10 species		
	6	≥ 50 μm	5 phylum 8 species	PASS	
		≥ 10-50 μm	4 division 9 species		
2 (3-32 PSU)	1	≥ 50 μm	3 phylum 5 species	PASS	
		≥ 10-50 μm	3 division 6 species		
	2	≥ 50 μm	5 phylum 9 species	PASS	
		≥ 10-50 μm	3 division 9 species		
	3	≥ 50 μm	4 phylum 7 species	PASS	
		≥ 10-50 μm	5 division 8 species		
	4	≥ 50 μm	4 phylum 6 species	PASS	
		≥ 10-50 μm	5 division 5 species		
	5	≥ 50 μm	4 phylum 6 species	PASS	
		≥ 10-50 μm	4 division 6 species		

1.7.2 NUMBER OF VIABLE ORGANISMS

1.7.2.1 Viable organisms (≥ 50 μm, individuals/m^3)

Cycle	1 period (> 32 PSU)		2 period (3-32 PSU)		Remarks
	Untreated water	Treated water	Untreated water	Treated water	
1	2 433	6	3 833	0	PASS
2	1 700	0	4 150	0	
3	3 633	0	49 667	0	
4	2 217	0	2 750	0	
5	4 233	0	20 333	0	
6	2 861	0	-	-	
Requirement	**> 100**	**< 10**	**> 100**	**< 10**	-

* Data indicates an arithmetic mean.

1.7.2.2 Viable organisms (≥ 10-50 μm, individuals/mL)

Cycle	1 period (> 32 PSU)		2 period (3-32 PSU)		Remarks
	Untreated water	Treated water	Untreated water	Treated water	
1	280	0	718	0	PASS
2	266	0	290	1	
3	334	1	456	0	
4	325	1	519	0	
5	260	1	253	1	
6	248	0	-	-	
Requirement	**> 100**	**< 10**	**> 100**	**< 10**	-

* Data indicates an arithmetic mean.

1.7.2.3 Bacteria group

Cycle	Test item (cfu/100 mL)	1 period (> 32 PSU)			2 period (3-32 PSU)			Remarks
		Untreated water	Treated water	**Requirement**	Untreated water	Treated water	**Requirement**	
1	Toxic *Vibrio cholerae*	0	0	**< 1**	0	0	**< 1**	PASS
	Intestinal *Enterococci*	125	0	**< 100**	41	13	**< 100**	
	Escherichia coli	11	0	**< 250**	1	0	**< 250**	
2	Toxic *Vibrio cholerae*	0	0	**< 1**	0	0	**< 1**	
	Intestinal *Enterococci*	16	0	**< 100**	204	17	**< 100**	
	Escherichia coli	0	0	**< 250**	1	0	**< 250**	
3	Toxic *Vibrio cholerae*	0	0	**< 1**	0	0	**< 1**	
	Intestinal *Enterococci*	60	0	**< 100**	50	17	**< 100**	
	Escherichia coli	1	0	**< 250**	0	0	**< 250**	
4	Toxic *Vibrio cholerae*	0	0	**< 1**	0	0	**< 1**	
	Intestinal *Enterococci*	49	2	**< 100**	88	10	**< 100**	
	Escherichia coli	0	0	**< 250**	4	0	**< 250**	
5	Toxic *Vibrio cholerae*	0	0	**< 1**	0	0	**< 1**	
	Intestinal *Enterococci*	142	0	**< 100**	228	24	**< 100**	
	Escherichia coli	7	0	**< 250**	17	0	**< 250**	
6	Toxic *Vibrio cholerae*	0	0	**< 1**	-	-	**< 1**	
	Intestinal *Enterococci*	89	1	**< 100**	-	-	**< 100**	
	Escherichia coli	18	0	**< 250**	-	-	**< 250**	

* Data indicates an arithmetic mean.

1.7.3 NUMBER VIABLE ORGANISMS OF UNTREATED WATER

1.7.3.1 Viable Organisms (≥ 50 μm, individuals/m^3)

Cycle	1 period (> 32 PSU)	2 period (3-32 PSU)	Remarks
1	2 433	3 833	PASS
2	1 700	4 150	
3	3 633	49 667	
4	2 217	2 750	
5	4 233	20 333	
6	2 861	-	
Requirement	**> 100**	**> 100**	-

* Data indicates an arithmetic mean.

1.7.3.2 Viable Organisms (≥ 10-50 μm, individuals/mL)

Cycle	1 period (> 32 PSU)	2 period (3-32 PSU)	Remarks
1	280	718	PASS
2	266	290	
3	334	456	
4	325	519	
5	260	253	
6	248	-	
Requirement	**> 100**	**> 100**	-

* Data indicates an arithmetic mean.

1.8 CONCLUSION :

· Test was performed in accordance with the requirements of the *Guidelines for approval of ballast management system* (IMO Res. MEPC. 174(58), Annex 4) and the Regulation D-2 (BWM/CONF/36). Test results show that the Land-based test of Hyundai Heavy Industries Co., Ltd. (HiBallast™ 300) mets the ballast water performance standard Regulation D-2 of the IMO ballast water management convention.

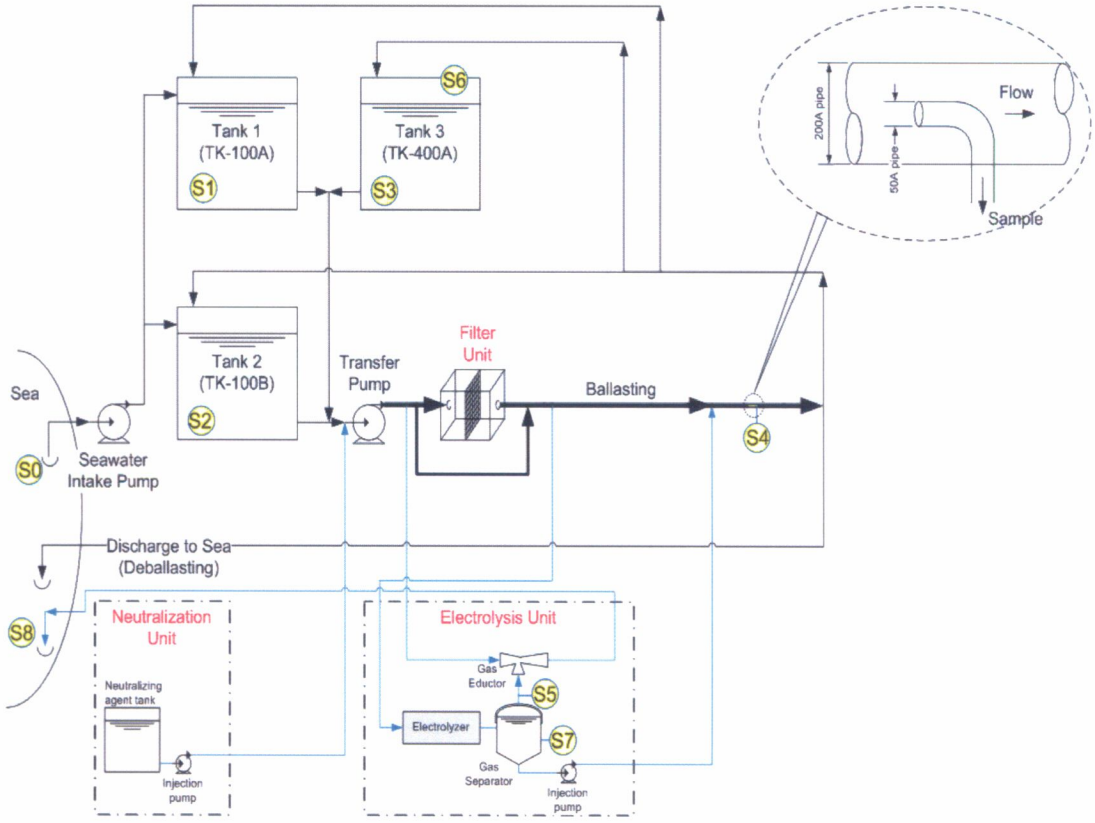
Period	Cycle	Test duration (Ballasting to de-Ballasting)	Results (Reg. D-2)	Valid condition (Reg. D-2.1) (IMO Res.MEPC. 174(58) ANNEX 4 Part 2-2.3.36)
1 (> 32 PSU)	1	Apr. 01. 2010 - Apr. 06. 2010	PASS	PASS
	2	Apr. 08. 2010 - Apr. 13. 2010	PASS	PASS
	3	Apr. 15. 2010 - Apr. 20. 2010	PASS	PASS
	4	Apr. 22. 2010 - Apr. 27. 2010	PASS	PASS
	5	Apr. 29. 2010 - May. 04. 2010	PASS	PASS
	6	Jul. 08. 2010 - Jul. 13. 2010	PASS	PASS
2 (3-32 PSU)	1	May. 27. 2010 - Jun. 01. 2010	PASS	PASS
	2	Jun. 03. 2010 - Jun. 08. 2010	PASS	PASS
	3	Jun. 10. 2010 - Jun. 15. 2010	PASS	PASS
	4	Jun. 17. 2010 - Jun. 22. 2010	PASS	PASS
	5	Jun. 24. 2010 - Jun. 29. 2010	PASS	PASS

Tested by : Jun-Hyuk Yang

Technical Manager : Young-Soo Kim

APPENDIX

Ⅰ. DRAWING



II. PROCEDURE OF LAND-BASED TEST

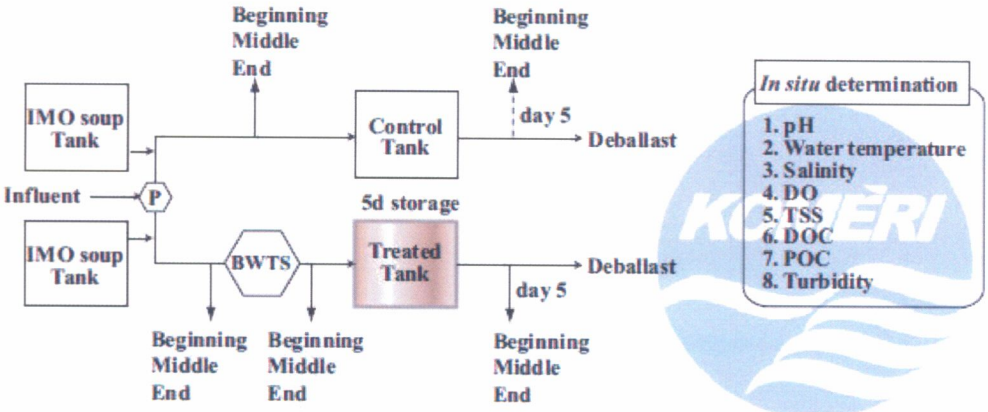
KOMERI SOP BWMS 01
Rev 1.0
Sep. 2008

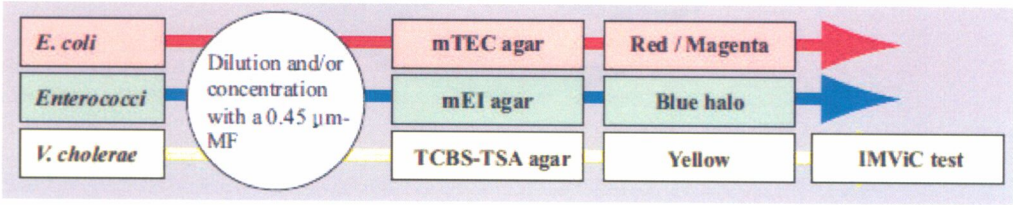
BWMS Test Procedure on Land-Based Test

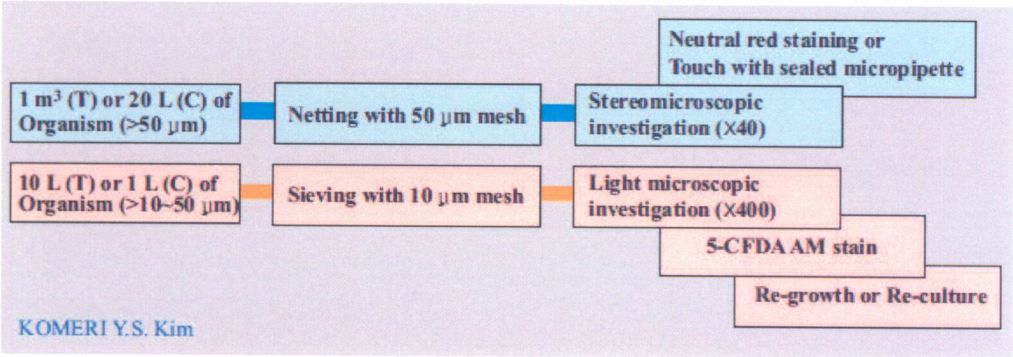
Standard for valid test (IMO soup)

Organism > 50 μm	3 div. 5 spp., > 10^3 ind./m^3
Organism 10 ~ 50 μm	3 phy. 5 spp., > 10^4 ind./mL
Heterotrophic bacteria	10^4 living cells/mL

	Salinity		
	> 32 PSU	3~32 PSU	< 3 PSU
DOC	> 1 mg/L	> 5 mg/L	> 5 mg/L
POC	> 1 mg/L	> 5 mg/L	> 5 mg/L
TSS	> 1 mg/L	> 50 mg/L	> 50 mg/L







III. SPECIES COMPOSITION IN THE TEST WATER

1 Period (> 32 PSU)

1 cycle	Phylum/Division	Order	Genus/Species
Viable organisms ≥ 10-50 μm	Chlorophyta	Chlorodendrales	*Tetraselmis suecica*
	Bacillariophyta	Thalassiosirales	*Thalassiosira* sp.
		Coscinodiscales	*Actinoptychus* sp.
	Dinophyta	Protocetrales	*Prorocentrum* sp.
		Gymnodiniales	*Amphidinium* sp.
		Peridiniales	*Scrippsiella* sp.
	Heterokontophyta	Dictyocales	*Dictyocha* sp.
	Protozoa		
	Unidentified diatom		
Viable organisms ≥ 50 μm	Rotifera	Ploimida	*Brachionus plicatilis*
	Arthropoda	Anostraca	*Artemia salina*
		Calanoida	*Paracalanus* sp.
			Acartia omorii
		Sessilia	*Balanus* larvae
		Copepod nauplius	-
	Annelida	Polychaeta nauplius	-
	Mollusca	Bivalve Larvae	-

III. TO BE CONTINUED

1 Period (> 32 PSU)

2 cycle	Phylum/Division	Order	Genus/Species
Viable organisms ≥ 10-50 μm	Chlorophyta	Chlorodendrales	*Tetraselmis suecica*
	Bacillariophyta	Thalassiosirales	*Thalassiosira* sp.
			Detonula sp.
		Coscinodiscales	*Coscinodiscus* sp.
			Actinoptychus sp.
		Chaetocerotales	*Chatoceros* spp. (4sp.)
	Dinophyta	Gymnodiniales	*Gyrodinium* sp.
	Protozoa		
	Unidentified diatom		
Viable organisms ≥ 50 μm	Rotifera	Ploimida	*Brachionus plicatilis*
	Arthropoda	Anostraca	*Artemia salina*
		Calanoida	*Paracalanus* sp.
		Harpacticoida	-
		Copepod nauplius	-
		Copepodite	-
		Amphipod larvae	-
	Annelida	Polychaeta nauplius	-
	Mollusca	Bivalve larvae	-
		Gastropod larvae	-

III. TO BE CONTINUED

1 Period (> 32 PSU)

3 cycle	Phylum/Division	Order	Genus/Species
Viable organisms ≥ 10-50 μm	Chlorophyta	Chlorodendrales	*Tetraselmis suecica*
	Bacillariophyta	Thalassiosirales	*Thalassiosira* sp.
			Detonula sp.
		Hemiaulales	*Eucampia* sp.
		Rhizosoleniales	*Guinardia* sp.
		Chaetocerotales	*Chatoceros* sp.
		Naviculaes	*Pleurosigma* sp.
	Dinophyta	Gymnodiniales	*Gyrodinium* sp.
	Protozoa		
Viable organisms ≥ 50 μm	Rotifera	Ploimida	*Brachionus plicatilis*
	Arthropoda	Anostraca	*Artemia salina*
		Calanoida	*Acartia omorii*
			Paracalanus sp.
		Cyclopoida	*Oithona* sp.
		Harpacticoida	-
		Sessilia	*Balanus* larvae
		Copepod nauplius	-
		Copepodite	-
	Annelida	Polychaeta nauplius	-
	Mollusca	Bivalve larvae	-

III. TO BE CONTINUED

1 Period (> 32 PSU)

4 cycle	Phylum/Division	Order	Genus/Species
Viable organisms ≥ 10-50 μm	Chlorophyta	Chlorodendrales	*Tetraselmis suecica*
	Bacillariophyta	Thalassiosirales	*Thalassiosira* sp.
		Coscinodiscales	*Coscinodiscus* sp.
		Hemiaulales	*Eucampia* sp.
		Lithodesmidales	*Ditylum* sp.
		Chaetocerotales	*Chatoceros* sp.
	Dinophyta	Gymnodiniales	*Gyrodinium* sp.
	Protozoa		
	Unidentified diatom		
Viable organisms ≥ 50 μm	Rotifera	Ploimida	*Brachionus plicatilis*
	Arthropoda	Anostraca	*Artemia salina*
		Calanoida	*Paracalanus* sp.
		Cyclopoida	*Oithona* sp.
		Harpacticoida	-
		Sessilia	*Balanus* larvae
		Copepod nauplius	-
		Copepodite	-
	Annelida	Polychaeta nauplius	-
	Mollusca	Bivalve larvae	-
		Gastropod larvae	-

III. TO BE CONTINUED

1 Period (> 32 PSU)

5 cycle	Phylum/Division	Order	Genus/Species
Viable organisms ≥ 10-50 μm	Chlorophyta	Chlorodendrales	*Tetraselmis suecica*
	Bacillariophyta	Thalassiosirales	*Thalassiosira* sp.
		Lithodesmidales	*Ditylum* sp.
		Coscinodiscales	*Coscinodiscus* sp.
			Actinoptychus sp.
		Naviculaes	*Pleurosigma* sp.
	Dinophyta	Dinophysiales	*Dinophysis* sp.
		Peridiniales	*Alexandrium* sp.
			Protoeperidinium sp.
	Unidentified diatom		
Viable organisms ≥ 50 μm	Rotifera	Ploimida	*Brachionus plicatilis*
	Arthropoda	Anostraca	*Artemia salina*
		Calanoida	*Acartia omorii*
			Paracalanus sp.
		Cyclopoida	*Oithona* sp.
			corycaeus affinis
		Harpacticoida	-
		Copepod nauplius	-
		Copepodite	-
	Annelida	Polychaeta nauplius	-

III. TO BE CONTINUED

1 Period (> 32 PSU)

6 cycle	Phylum/Division	Order	Genus/Species
Viable organisms ≥ 10-50 μm	Chlorophyta	Chlorodendrales	*Tetraselmis suecica*
	Bacillariophyta	Thalassiosirales	*Thalassiosira* sp.
		Chaetocerotales	*Chaetoceros* sp.
		Rhizosoleniales	*Guinardia* sp.
		Naviculaes	*Pleurosigma* sp.
	Dinophyta	Gymnodiniales	*Gyrodinium* sp.
		Peridiniales	*Protoeperidinium* sp.
	Ciliophora	Oligotrichida	*Tintinnopsis* sp.
	Unidentified diatom		
Viable organisms ≥ 50 μm	Rotifera	Ploimida	*Brachionus plicatilis*
	Protozoa	Tintinnida	*Tintinnopsis* sp.
	Arthropoda	Anostraca	*Artemia salina*
		Cladocera	*Podon* sp.
		Sessilia	*Balanus* larvae
		Copepodite	-
	Annelida	Polychaeta nauplius	-
	Platyhelminthes	Trurbellarian	Muller's larvae

III. TO BE CONTINUED

2 Period (3-32 PSU)

1 cycle	Phylum/Division	Order	Genus/Species
Viable organisms ≥ 10-50 μm	Chlorophyta	Chlorodendrales	*Tetraselmis suecica*
	Bacillariophyta	Thalassiosirales	*Thalassiosira* sp..
		Chaetocerotales	*Chaetoceros* sp.
		Leptocylindrales	*Leptocylindrus danicus*.
	Unidentified dinoflagellate		
	Unidentified diatom		
Viable organisms ≥ 50 μm	Rotifera	Ploimida	*Brachionus plicatilis*
	Arthropoda	Anostraca	*Artemia salina*
		Sessilia	*Balanus* larvae
		Copepod nauplius	-
	Chrysophyta	Coscinodiscales	*Coscinodiscus* sp.

III. TO BE CONTINUED

2 Period (3-32 PSU)

2 cycle	Phylum/Division	Order	Genus/Species
Viable organisms ≥ 10-50 μm	Chlorophyta	Chlorodendrales	*Tetraselmis suecica*
	Bacillariophyta	Thalassiosirales	*Thalassiosira* sp.
			Launderia sp.
		Melosirales	*Stephanopyxis* sp.
		Coscinodiscales	*Coscinodiscus* sp.
		Chaetocerotales	*Chatoceros* sp.
	Dinophyta	Dinophysiales	*Dinophysis* sp.
		Gymnodiniales	*Gyrodinium* sp.
		Peridiniales	*Scrippsiella* sp.
Viable organisms ≥ 50 μm	Rotifera	Ploimida	*Brachionus plicatilis*
	Protozoa	Tintinnida	*Tintinnopsis* sp.
	Arthropoda	Anostraca	*Artemia salina*
		Calanoida	*Paracalanus* sp.
		Sessilia	*Balanus* larvae
		Copepod nauplius	-
		Copepodite	-
	Annelida	Polychaeta nauplius	-
	Mollusca	Bivalve larvae	-

III. TO BE CONTINUED

2 Period (3-32 PSU)

3 cycle	Phylum/Division	Order	Genus/Species
Viable organisms ≥ 10-50 μm	Chlorophyta	Chlorodendrales	*Tetraselmis suecica*
	Bacillariophyta	Melosirales	*Stephanopyxis* sp.
		Chaetocerotales	*Chaetoceros* sp.
		Coscinodiscales	*Coscinodiscus* sp.
	Dinophyta	Gymnodiniales	*Gyrodinium* sp.
		Peridiniales	*Protoeperidinium* sp.
	Heterokontophyta	Chattonellaes	*Heterosigma* sp.
	Protozoa		
Viable organisms ≥ 50 μm	Rotifera	Ploimida	*Brachionus plicatilis*
	Protozoa	Tintinnida	*Tintinnopsis* sp.
	Arthropoda	Anostraca	*Artemia salina*
		Sessilia	*Balanus* larvae
		Copepod nauplius	-
	Annelida	Polychaeta nauplius	-
	Chrysophyta	Coscinodiscales	*Coscinodiscus* sp.

III. TO BE CONTINUED

2 Period (3-32 PSU)

4 cycle	Phylum/Division	Order	Genus/Species
Viable organisms ≥ 10-50 μm	Chlorophyta	Chlorodendrales	*Tetraselmis suecica*
	Bacillariophyta	Chaetocerotales	*Chaetoceros* sp.
	Dinophyta	Peridiniales	*Protoeperidinium* sp.
	Heterokontophyta	Chattonellaes	*Heterosigma* sp.
	Protozoa		
Viable organisms ≥ 50 μm	Rotifera	Ploimida	*Brachionus plicatilis*
	Arthropoda	Anostraca	*Artemia salina*
		Sessilia	*Balanus* larvae
		Copepod nauplius	-
	Annelida	Polychaeta nauplius	-
	Chrysophyta	Coscinodiscales	*Coscinodiscus* sp.

III. TO BE CONTINUED

2 Period (3-32 PSU)

5 cycle	Phylum/Division	Order	Genus/Species
Viable organisms ≥ 10-50 μm	Chlorophyta	Chlorodendrales	*Tetraselmis suecica*
	Bacillariophyta	Thalassiosirales	*Thalassiosira* sp..
		Chaetocerotales	*Chaetoceros* sp.
		Leptocylindrales	*Leptocylindrus danicus*.
	Dinophyta	Gymnodiniales	*Gyrodinium* sp.
	Protozoa		
Viable organisms ≥ 50 μm	Rotifera	Ploimida	*Brachionus plicatilis*
	Protozoa	Tintinnida	*Tintinnopsis* sp.
	Arthropoda	Anostraca	*Artemia salina*
		Sessilia	*Balanus* larvae
		Copepod nauplius	-
	Annelida	Polychaeta nauplius	-

IV. TEST RESULT DETAILS

> 32 PSU from 1 April to 6 April

1 period 1 cycle	Day 0 (Ballasting)						
	S1 (Test water)*	S2 (Untreated water)			S3 (Treated water)		
		B**	M	E	B	M	E
Water temperature (°C)	12.49	12.41	12.38	12.47	12.59	12.55	12.48
pH	7.75	7.76	7.77	7.76	7.77	7.82	7.81
ORP (mV)	441	926	903	836	937	938	943
Salinity (PSU)	35.74	35.71	35.77	35.52	35.75	35.79	35.71
Dissolved Oxygen (mg/L)	8.58	8.49	8.61	8.51	7.66	7.63	7.61
Turbidity (NTU)	13.00	11.90	15.70	15.20	14.50	13.30	12.70
Total Suspended Solid (mg/L)	30.80	35.07	37.20	33.33	30.00	29.60	30.13
Dissolve Organic Carbon (mg/L)	2.36	2.41	2.44	2.48	2.52	2.54	2.52
Particulate Organic Carbon (mg/L)	1.87	1.70	1.83	1.93	1.77	1.94	1.86
Organism (≥ 50 μm, inds./m^3)	521 000	378 000	416 000	340 000	1	0	0
Organism (≥ 10-50 μm, inds./mL)	1 722	2 034	1 719	1 866	0	0	0
Heterotrophic bacteria (cells/mL)	77 091	28 000	60 533	39 333	0	0	0
Total coliform (cfu/mL)	0	0	0	0	0	0	0
Escherichia coli (cfu/100 mL)	302	TNTC***	TNTC	508	0	0	0
Intestinal *Enterococci* (cfu/100 mL)	250	TNTC	TNTC	TNTC	0	0	0
Vibrio cholerae (cfu/100 mL)	0	0	0	0	0	0	0

* Test water represented to including viable organism and organic matter.

** B, beginning; M, middle; E, End.

*** Too numerous to count.

1 period 1 cycle	Day 5 (de-Ballasting)					
	S2 (Untreated water)			S4 (Treated water)		
	B*	M	E	B	M	E
Water temperature (°C)	12.58	12.60	12.71	13.58	13.60	13.54
pH	7.38	7.38	7.38	7.55	7.59	7.56
ORP (mV)	458	443	435	771	698	648
Salinity (PSU)	35.87	35.95	35.85	35.81	35.80	35.89
Dissolved Oxygen (mg/L)	7.45	7.68	7.80	7.83	7.84	7.81
Turbidity (NTU)	7.68	7.89	8.36	12.20	10.60	10.80
Total Suspended Solid (mg/L)	23.33	22.13	23.60	26.93	33.33	21.07
Dissolve Organic Carbon (mg/L)	1.46	1.37	1.40	2.82	2.82	2.78
Particulate Organic Carbon (mg/L)	0.17	0.59	0.49	1.65	1.63	1.54
Organism (≥ 50 μm, inds./m^3)	3 100	2 200	2 000	8	2	8
Organism (≥ 10-50 μm, inds./mL)	293	224	323	0	0	0
Heterotrophic bacteria (cells/mL)	14 267	600	1 967	17	3	60
Total coliform (cfu/mL)	0	0	0	0	0	0
Escherichia coli (cfu/100 mL)	10	14	10	0	0	0
Intestinal *Enterococci* (cfu/100 mL)	100	130	146	0	0	0
Vibrio cholerae (cfu/100 mL)	0	0	0	0	0	0

* B, beginning; M, middle; E, End.

IV. TO BE CONTINUED

> 32 PSU from 8 April to 13 April

1 period 2 cycle	Day 0 (Ballasting)						
	S1 (Test water)*	S2 (Untreated water)			S3 (Treated water)		
		B**	M	E	B	M	E
Water temperature (°C)	11.70	12.15	12.03	12.04	12.83	12.61	12.57
pH	7.90	7.98	7.95	8.00	7.75	7.92	7.93
ORP (mV)	578	820	799	781	910	934	948
Salinity (PSU)	35.61	35.53	35.53	35.57	35.47	35.46	35.50
Dissolved Oxygen (mg/L)	9.61	9.84	9.72	9.71	8.40	8.41	8.41
Turbidity (NTU)	6.48	7.37	6.49	6.77	6.44	6.22	7.35
Total Suspended Solid (mg/L)	22.13	17.60	18.13	22.40	20.40	21.33	21.47
Dissolve Organic Carbon (mg/L)	2.64	2.66	2.73	2.74	2.76	2.65	2.80
Particulate Organic Carbon (mg/L)	1.19	2.08	1.38	1.66	1.16	1.36	0.98
Organism (≥ 50 μm, inds./m^3)	287 000	295 000	303 000	282 000	0	1	0
Organism (≥ 10-50 μm, inds./mL)	1 412	1 198	1 315	1 187	0	0	0
Heterotrophic bacteria (cells/mL)	10 590	13 066	13 033	12 800	0	0	0
Total coliform (cfu/mL)	0	0	0	0	0	0	0
Escherichia coli (cfu/100 mL)	8	13	25	10	0	0	0
Intestinal *Enterococci* (cfu/100 mL)	165	28	57	288	0	0	0
Vibrio cholerae (cfu/100 mL)	0	0	0	0	0	0	0

* Test water represented to including viable organism and organic matter.

** B, beginning; M, middle; E, End.

1 period 2 cycle	Day 5 (de-Ballasting)					
	S2 (Untreated water)			S4 (Treated water)		
	B*	M	E	B	M	E
Water temperature (°C)	12.96	12.92	12.98	13.06	12.88	12.80
pH	7.71	7.66	7.71	7.32	7.75	7.80
ORP (mV)	533	530	525	765	727	702
Salinity (PSU)	35.55	35.42	35.24	35.29	35.46	35.52
Dissolved Oxygen (mg/L)	8.18	8.28	8.31	8.61	8.59	8.73
Turbidity (NTU)	2.83	2.08	2.39	6.19	6.29	6.50
Total Suspended Solid (mg/L)	12.27	12.53	12.53	19.20	18.67	19.33
Dissolve Organic Carbon (mg/L)	1.62	1.53	1.44	2.75	2.72	2.71
Particulate Organic Carbon (mg/L)	0.41	0.52	0.52	2.04	1.71	1.70
Organism (≥ 50 μm, inds./m^3)	1 800	1 300	2 000	0	0	0
Organism (≥ 10-50 μm, inds./mL)	178	384	235	0	0	1
Heterotrophic bacteria (cells/mL)	800	833	1 233	13	100	57
Total coliform (cfu/mL)	0	0	0	0	0	0
Escherichia coli (cfu/100 mL)	0	0	0	0	0	0
Intestinal *Enterococci* (cfu/100 mL)	9	24	16	0	0	0
Vibrio cholerae (cfu/100 mL)	0	0	0	0	0	0

* B, beginning; M, middle; E, End.

IV. TO BE CONTINUED

> 32 PSU from 15 April to 20 April

1 period 3 cycle	Day 0 (Ballasting)						
	S1 (Test water)*	S2 (Untreated water)			S3 (Treated water)		
		B**	M	E	B	M	E
Water temperature (°C)	11.44	11.29	11.36	11.44	11.31	11.31	11.34
pH	7.95	7.98	8.00	8.01	7.51	8.03	8.06
ORP (mV)	557	832	789	766	944	970	978
Salinity (PSU)	35.64	35.62	35.77	35.77	35.64	35.63	35.63
Dissolved Oxygen (mg/L)	8.87	9.49	9.43	9.29	8.60	8.58	8.59
Turbidity (NTU)	9.42	8.55	9.17	8.46	8.75	8.36	9.37
Total Suspended Solid (mg/L)	28.13	24.53	18.00	22.27	23.33	16.00	37.73
Dissolve Organic Carbon (mg/L)	2.44	2.32	2.27	2.22	2.48	2.42	2.59
Particulate Organic Carbon (mg/L)	1.83	1.66	2.09	2.07	1.77	1.86	1.85
Organism (≥ 50 μm, inds./m^3)	569 000	480 000	460 000	477 000	0	0	0
Organism (≥ 10-50 μm, inds./mL)	1 419	1 403	1 452	1 458	1	1	0
Heterotrophic bacteria (cells/mL)	9 591	8 833	12 633	11 867	3	0	0
Total coliform (cfu/mL)	0	37	10	0	0	0	0
Escherichia coli (cfu/100 mL)	130	137	162	125	0	0	0
Intestinal *Enterococci* (cfu/100 mL)	535	595	657	652	0	0	0
Vibrio cholerae (cfu/100 mL)	0	0	0	0	0	0	0

* Test water represented to including viable organism and organic matter.

** B, beginning; M, middle; E, End.

1 period 3 cycle	Day 5 (de-Ballasting)					
	S2 (Untreated water)			S4 (Treated water)		
	B*	M	E	B	M	E
Water temperature (°C)	13.02	13.04	13.03	13.72	13.63	13.61
pH	7.73	7.75	7.78	7.79	7.78	7.79
ORP (mV)	639	623	611	747	715	696
Salinity (PSU)	35.59	35.58	35.63	35.32	35.58	35.54
Dissolved Oxygen (mg/L)	8.16	8.27	8.39	8.50	8.55	8.41
Turbidity (NTU)	2.61	4.12	3.81	8.70	9.40	9.32
Total Suspended Solid (mg/L)	15.87	16.53	14.00	24.93	24.80	24.93
Dissolve Organic Carbon (mg/L)	1.46	1.28	1.30	2.71	2.62	2.64
Particulate Organic Carbon (mg/L)	0.14	0.31	0.20	1.76	1.88	1.73
Organism (≥ 50 μm, inds./m^3)	4 500	4 000	2 400	0	0	0
Organism (≥ 10-50 μm, inds./mL)	322	324	356	1	1	0
Heterotrophic bacteria (cells/mL)	1 633	2 266	1 900	10	7	3
Total coliform (cfu/mL)	4	5	89	0	0	0
Escherichia coli (cfu/100 mL)	0	4	0	0	0	0
Intestinal *Enterococci* (cfu/100 mL)	54	59	66	0	0	0
Vibrio cholerae (cfu/100 mL)	0	0	0	0	0	0

* B, beginning; M, middle; E, End.

IV. TO BE CONTINUED

> 32 PSU from 22 April to 27 April

1 period 4 cycle	Day 0 (Ballasting)						
	S1 (Test water)*	S2 (Untreated water)			S3 (Treated water)		
		B**	M	E	B	M	E
Water temperature (°C)	12.35	12.39	12.35	12.36	12.41	12.41	12.38
pH	7.90	7.94	8.01	8.00	7.91	7.98	8.01
ORP (mV)	557	649	628	604	934	963	973
Salinity (PSU)	35.15	35.38	35.29	35.43	35.32	35.34	35.28
Dissolved Oxygen (mg/L)	8.65	8.82	9.12	8.83	8.31	8.31	8.33
Turbidity (NTU)	4.95	4.08	4.85	4.58	4.25	4.12	3.65
Total Suspended Solid (mg/L)	17.60	20.13	17.60	20.27	18.53	21.20	19.20
Dissolve Organic Carbon (mg/L)	2.29	2.30	2.33	2.26	2.39	2.48	2.37
Particulate Organic Carbon (mg/L)	1.51	1.75	1.13	1.31	1.93	1.37	1.60
Organism (≥ 50 μm, inds./m^3)	307 000	237 000	253 000	218 000	0	0	0
Organism (≥ 10-50 μm, inds./mL)	1 363	1 439	1 502	1 504	0	0	1
Heterotrophic bacteria (cells/mL)	8 590	14 333	16 000	16 266	0	0	0
Total coliform (cfu/mL)	TNTC***	TNTC	7	TNTC	0	0	0
Escherichia coli (cfu/100 mL)	22	2	10	8	0	0	0
Intestinal *Enterococci* (cfu/100 mL)	577	437	398	390	0	0	0
Vibrio cholerae (cfu/100 mL)	0	0	0	0	0	0	0

* Test water represented to including viable organism and organic matter.

** B, beginning; M, middle; E, End.

*** Too numerous to count.

1 period 4 cycle	Day 5 (de-Ballasting)					
	S2 (Untreated water)			S4 (Treated water)		
	B*	M	E	B	M	E
Water temperature (°C)	14.17	14.10	13.97	14.50	14.61	14.50
pH	7.56	7.62	7.64	7.73	7.84	7.84
ORP (mV)	629	606	597	760	719	695
Salinity (PSU)	35.04	35.33	35.29	35.29	35.22	35.34
Dissolved Oxygen (mg/L)	7.77	7.92	8.00	8.21	8.23	8.25
Turbidity (NTU)	1.61	1.80	1.98	3.85	3.35	3.28
Total Suspended Solid (mg/L)	12.80	13.73	13.07	16.40	18.40	18.00
Dissolve Organic Carbon (mg/L)	1.40	1.35	1.33	2.59	2.64	2.63
Particulate Organic Carbon (mg/L)	0.18	0.32	0.34	1.52	1.34	1.22
Organism (≥ 50 μm, inds./m^3)	2 100	1 750	2 800	0	0	0
Organism (≥ 10-50 μm, inds./mL)	314	339	322	1	1	0
Heterotrophic bacteria (cells/mL)	2 667	2 567	1 433	77	50	80
Total coliform (cfu/mL)	330	422	40	0	0	0
Escherichia coli (cfu/100 mL)	0	0	0	0	0	0
Intestinal *Enterococci* (cfu/100 mL)	24	64	59	4	1	1
Vibrio cholerae (cfu/100 mL)	0	0	0	0	0	0

* B, beginning; M, middle; E, End.

IV. TO BE CONTINUED

> 32 PSU from 29 April to 4 May

1 period 5 cycle	Day 0 (Ballasting)						
	S1 (Test water)*	S2 (Untreated water)			S3 (Treated water)		
		B**	M	E	B	M	E
Water temperature (°C)	11.87	12.27	12.28	12.33	12.42	12.40	12.39
pH	7.83	7.91	7.94	7.69	7.34	7.89	7.87
ORP (mV)	558	772	741	722	946	980	981
Salinity (PSU)	35.56	35.60	35.59	35.53	35.47	35.48	35.51
Dissolved Oxygen (mg/L)	8.69	8.88	8.91	9.03	8.29	8.33	8.29
Turbidity (NTU)	8.34	9.32	9.32	9.01	8.78	7.81	8.70
Total Suspended Solid (mg/L)	22.13	22.80	24.67	24.27	23.47	22.27	22.00
Dissolve Organic Carbon (mg/L)	2.27	2.20	2.22	2.22	2.37	2.48	2.36
Particulate Organic Carbon (mg/L)	1.83	1.83	1.63	1.90	1.90	1.68	1.57
Organism (≥ 50 μm, inds./m^3)	399 000	217 000	194 000	174 000	0	0	0
Organism (≥ 10-50 μm, inds./mL)	2 340	1 681	1 643	1 796	0	0	1
Heterotrophic bacteria (cells/mL)	14 090	10 466	13 300	9 833	0	0	0
Total coliform (cfu/mL)	TNTC***	TNTC	TNTC	TNTC	0	0	0
Escherichia coli (cfu/100 mL)	TNTC	TNTC	TNTC	TNTC	0	0	0
Intestinal *Enterococci* (cfu/100 mL)	TNTC	TNTC	TNTC	TNTC	0	0	0
Vibrio cholerae (cfu/100 mL)	0	0	0	0	0	0	0

* Test water represented to including viable organism and organic matter.

** B, beginning; M, middle; E, End.

*** Too numerous to count.

1 period 5 cycle	Day 5 (de-Ballasting)					
	S2 (Untreated water)			S4 (Treated water)		
	B*	M	E	B	M	E
Water temperature (°C)	16.48	16.75	16.44	17.58	17.56	17.49
pH	7.59	7.63	7.64	7.73	7.75	7.76
ORP (mV)	610	597	592	647	623	616
Salinity (PSU)	35.55	35.32	35.52	35.47	35.48	35.57
Dissolved Oxygen (mg/L)	7.54	7.54	7.66	7.96	7.82	7.74
Turbidity (NTU)	2.54	2.80	2.66	7.26	6.95	7.25
Total Suspended Solid (mg/L)	21.33	20.27	20.27	12.80	13.60	13.47
Dissolve Organic Carbon (mg/L)	1.21	1.15	1.16	2.44	2.46	2.39
Particulate Organic Carbon (mg/L)	0.18	0.21	0.31	1.39	1.48	1.59
Organism (≥ 50 μm, inds./m^3)	3 800	4 600	4 300	0	0	0
Organism (≥ 10-50 μm, inds./mL)	276	242	263	1	1	0
Heterotrophic bacteria (cells/mL)	2 350	2 350	1 500	95	0	15
Total coliform (cfu/mL)	6	6	8	0	0	0
Escherichia coli (cfu/100 mL)	4	6	11	0	0	0
Intestinal *Enterococci* (cfu/100 mL)	134	136	155	0	0	0
Vibrio cholerae (cfu/100 mL)	0	0	0	0	0	0

* B, beginning; M, middle; E, End.

IV. TO BE CONTINUED

> 32 PSU from 8 July to 13 July

1 period 6 cycle	Day 0 (Ballasting)						
	S1 (Test water)*	S2 (Untreated water)			S3 (Treated water)		
		B**	M	E	B	M	E
Water temperature (°C)	20.07	20.89	20.89	20.60	20.70	20.59	20.80
pH	7.74	7.77	7.76	7.78	7.76	7.78	7.78
ORP (mV)	319	384	361	350	752	782	793
Salinity (PSU)	34.25	34.17	34.29	34.41	34.29	34.22	34.26
Dissolved Oxygen (mg/L)	7.53	8.29	8.22	8.08	7.36	7.38	7.34
Turbidity (NTU)	4.25	4.21	4.09	4.15	4.02	4.11	4.13
Total Suspended Solid (mg/L)	20.80	19.47	32.40	21.60	19.07	19.47	19.73
Dissolve Organic Carbon (mg/L)	2.57	2.37	2.41	2.32	3.28	3.18	3.26
Particulate Organic Carbon (mg/L)	1.33	1.45	1.44	1.83	1.90	2.39	2.06
Organism (≥ 50 μm, inds./m^3)	864 166	156 333	154 666	115 000	3	3	1
Organism (≥ 10-50 μm, inds./mL)	1 522	1 679	1 707	1 608	1	1	1
Heterotrophic bacteria (cells/mL)	10 590	15 133	15 133	15 800	0	2	0
Total coliform (cfu/mL)	TNTC***	TNTC	TNTC	TNTC	0	0	0
Escherichia coli (cfu/100 mL)	720	935	902	962	0	0	0
Intestinal *Enterococci* (cfu/100 mL)	427	380	365	365	0	0	0
Vibrio cholerae (cfu/100 mL)	0	0	0	0	0	0	0

* Test water represented to including viable organism and organic matter.

** B, beginning; M, middle; E, End.

*** Too numerous to count.

1 period 6 cycle	Day 5 (de-Ballasting)					
	S2 (Untreated water)			S4 (Treated water)		
	B*	M	E	B	M	E
Water temperature (°C)	22.08	22.13	22.12	22.33	22.36	22.33
pH	7.08	7.07	7.10	7.59	7.60	7.60
ORP (mV)	438	359	320	529	487	453
Salinity (PSU)	34.44	34.44	34.44	34.42	34.45	34.44
Dissolved Oxygen (mg/L)	6.44	7.08	6.23	7.49	7.47	7.46
Turbidity (NTU)	2.83	3.02	3.36	3.62	3.98	3.73
Total Suspended Solid (mg/L)	11.47	6.67	9.33	13.47	10.67	10.00
Dissolve Organic Carbon (mg/L)	1.79	1.95	1.72	3.65	3.65	3.67
Particulate Organic Carbon (mg/L)	0.38	0.27	0.44	1.73	1.82	1.67
Organism (≥ 50 μm, inds./m^3)	2 833	3 083	2 666	0	0	0
Organism (≥ 10-50 μm, inds./mL)	210	179	355	0	1	0
Heterotrophic bacteria (cells/mL)	3 633	10 033	4 267	853	720	0
Total coliform (cfu/mL)	TNTC**	TNTC	TNTC	TNTC	TNTC	TNTC
Escherichia coli (cfu/100 mL)	12	22	20	0	0	0
Intestinal *Enterococci* (cfu/100 mL)	125	72	70	1	1	1
Vibrio cholerae (cfu/100 mL)	0	0	0	0	0	0

* B, beginning; M, middle; E, End.

** Too numerous to count.

Ⅳ. TO BE CONTINUED

3-32 PSU from 27 May to 1 June

2 period 1 cycle	Day 0 (Ballasting)						
	S1 (Test water)*	S2 (Untreated water)			S3 (Treated water)		
		B**	M	E	B	M	E
Water temperature (°C)	14.02	14.28	14.28	14.26	14.40	14.34	14.35
pH	7.91	7.92	7.98	8.00	8.13	8.16	8.19
ORP (mV)	529	832	767	730	942	959	967
Salinity (PSU)	20.39	20.39	20.41	20.41	20.36	20.36	20.35
Dissolved Oxygen (mg/L)	9.03	9.82	9.84	9.78	8.80	8.77	8.74
Turbidity (NTU)	29.40	29.10	30.10	28.00	26.90	28.20	27.20
Total Suspended Solid (mg/L)	89.47	80.00	80.93	82.27	77.47	79.20	79.60
Dissolve Organic Carbon (mg/L)	8.94	9.61	9.66	9.49	10.10	10.20	10.20
Particulate Organic Carbon (mg/L)	17.40	18.30	20.70	19.00	20.50	22.20	18.80
Organism (≥ 50 μm, inds./m^3)	310 000	110 000	90 500	57 000	4	8	5
Organism (≥ 10-50 μm, inds./mL)	2 134	2 010	2 286	1 899	1	1	1
Heterotrophic bacteria (cells/mL)	24 000	27 233	23 033	23 633	0	0	0
Total coliform (cfu/mL)	TNTC***	TNTC	TNTC	TNTC	0	0	0
Escherichia coli (cfu/100 mL)	215	290	162	215	0	0	0
Intestinal *Enterococci* (cfu/100 mL)	308	438	257	322	0	0	0
Vibrio cholerae (cfu/100 mL)	0	0	0	0	0	0	0

* Test water represented to including viable organism and organic matter.

** B, beginning; M, middle; E, End.

*** Too numerous to count.

2 period 1 cycle	Day 5 (de-Ballasting)					
	S2 (Untreated water)			S4 (Treated water)		
	B*	M	E	B	M	E
Water temperature (°C)	15.90	15.92	15.92	16.37	16.32	16.38
pH	7.01	7.12	7.14	7.59	7.54	7.59
ORP (mV)	581	543	523	730	705	669
Salinity (PSU)	20.43	20.38	20.40	20.40	20.41	20.41
Dissolved Oxygen (mg/L)	7.82	7.97	8.19	8.74	8.71	8.69
Turbidity (NTU)	7.92	6.46	7.89	20.10	19.10	18.20
Total Suspended Solid (mg/L)	22.93	18.13	20.80	53.20	52.80	50.80
Dissolve Organic Carbon (mg/L)	7.79	7.60	7.69	10.10	9.98	10.00
Particulate Organic Carbon (mg/L)	3.83	3.41	3.43	14.40	13.80	12.80
Organism (≥ 50 μm, inds./m^3)	3 500	4 000	4 000	0	0	0
Organism (≥ 10-50 μm, inds./mL)	762	793	600	1	0	0
Heterotrophic bacteria (cells/mL)	23 833	22 167	21 433	2 097	1 883	1 440
Total coliform (cfu/mL)	TNTC**	TNTC	TNTC	0	0	0
Escherichia coli (cfu/100 mL)	1	1	1	0	0	0
Intestinal *Enterococci* (cfu/100 mL)	51	32	40	16	11	12
Vibrio cholerae (cfu/100 mL)	0	0	0	0	0	0

* B, beginning; M, middle; E, End.

** Too numerous to count.

IV. TO BE CONTINUED

3-32 PSU from 3 June to 8 June

2 period 2 cycle	Day 0 (Ballasting)						
	S1 (Test water)*	S2 (Untreated water)			S3 (Treated water)		
		B**	M	E	B	M	E
Water temperature (°C)	17.19	17.58	17.60	17.61	17.95	17.75	18.31
pH	8.13	8.10	8.16	8.15	8.23	8.26	8.24
ORP (mV)	527	723	682	652	941	950	956
Salinity (PSU)	20.44	20.48	20.51	20.48	20.42	20.42	20.41
Dissolved Oxygen (mg/L)	8.52	9.17	9.25	9.05	8.61	8.30	8.23
Turbidity (NTU)	23.80	26.00	26.00	24.00	24.70	23.70	23.10
Total Suspended Solid (mg/L)	82.67	74.53	74.67	74.93	78.80	73.87	73.73
Dissolve Organic Carbon (mg/L)	7.68	7.58	7.47	7.67	7.73	7.61	7.58
Particulate Organic Carbon (mg/L)	21.10	17.90	17.90	17.90	20.10	20.50	20.60
Organism (≥ 50 μm, inds./m^3)	163 000	14 500	9 083	7 300	6	4	7
Organism (≥ 10-50 μm, inds./mL)	1 374	1 878	1 927	1 877	1	0	1
Heterotrophic bacteria (cells/mL)	22 864	24 600	23 467	19 800	3	0	0
Total coliform (cfu/mL)	TNTC***	TNTC	TNTC	52	0	0	0
Escherichia coli (cfu/100 mL)	30	18	42	40	0	0	0
Intestinal *Enterococci* (cfu/100 mL)	495	523	532	535	0	0	0
Vibrio cholerae (cfu/100 mL)	0	0	0	0	0	0	0

* Test water represented to including viable organism and organic matter.

** B, beginning; M, middle; E, End.

*** Too numerous to count.

2 period 2 cycle	Day 5 (de-Ballasting)					
	S2 (Untreated water)			S4 (Treated water)		
	B*	M	E	B	M	E
Water temperature (°C)	20.48	20.60	20.61	21.00	20.96	21.01
pH	6.81	6.87	7.00	7.65	7.70	7.75
ORP (mV)	469	472	449	510	505	485
Salinity (PSU)	20.54	20.42	20.53	20.42	20.49	20.52
Dissolved Oxygen (mg/L)	6.87	7.42	7.68	7.87	8.02	8.03
Turbidity (NTU)	7.99	6.53	6.28	12.90	13.00	12.50
Total Suspended Solid (mg/L)	20.67	16.53	15.87	40.13	38.13	39.60
Dissolve Organic Carbon (mg/L)	5.89	5.73	5.71	7.92	7.86	7.84
Particulate Organic Carbon (mg/L)	4.39	2.81	3.03	9.57	10.00	11.10
Organism (≥ 50 μm, inds./m^3)	4 750	3 600	4 100	1	0	0
Organism (≥ 10-50 μm, inds./mL)	274	308	289	1	0	1
Heterotrophic bacteria (cells/mL)	10 266	8 933	9 600	2 253	1 967	1 363
Total coliform (cfu/mL)	TNTC**	TNTC	TNTC	67	69	36
Escherichia coli (cfu/100 mL)	1	1	1	0	0	0
Intestinal *Enterococci* (cfu/100 mL)	238	189	184	33	12	7
Vibrio cholerae (cfu/100 mL)	0	0	0	0	0	0

* B, beginning; M, middle; E, End.

** Too numerous to count.

IV. TO BE CONTINUED

3-32 PSU from 10 June to 15 June

2 period 3 cycle	Day 0 (Ballasting)						
	S1 (Test water)*	S2 (Untreated water)			S3 (Treated water)		
		B**	M	E	B	M	E
Water temperature (°C)	19.81	20.39	20.52	20.39	20.43	20.45	20.71
pH	8.08	8.18	8.20	8.22	7.24	8.26	8.26
ORP (mV)	505	742	673	626	940	951	962
Salinity (PSU)	20.69	20.66	20.64	20.71	20.63	20.62	20.64
Dissolved Oxygen (mg/L)	9.18	8.69	8.85	8.65	7.86	7.86	7.82
Turbidity (NTU)	23.50	25.60	26.50	26.60	21.30	22.60	21.90
Total Suspended Solid (mg/L)	78.93	81.87	82.00	82.27	76.00	77.73	75.60
Dissolve Organic Carbon (mg/L)	6.72	6.92	6.98	7.03	7.14	7.14	7.08
Particulate Organic Carbon (mg/L)	19.40	19.26	17.58	19.39	18.30	20.40	19.20
Organism (≥ 50 μm, inds./m^3)	755 000	204 000	111 000	49 000	16	17	15
Organism (≥ 10-50 μm, inds./mL)	2 132	1 896	2 096	2 089	0	0	0
Heterotrophic bacteria (cells/mL)	22 545	19 800	21 167	16 800	0	0	0
Total coliform (cfu/mL)	TNTC***	TNTC	TNTC	TNTC	0	0	0
Escherichia coli (cfu/100 mL)	10	3	13	18	0	0	0
Intestinal *Enterococci* (cfu/100 mL)	697	455	523	493	0	0	0
Vibrio cholerae (cfu/100 mL)	0	0	0	0	0	0	0

* Test water represented to including viable organism and organic matter.

** B, beginning; M, middle; E, End.

*** Too numerous to count.

2 period 3 cycle	Day 5 (de-Ballasting)					
	S2 (Untreated water)			S4 (Treated water)		
	B*	M	E	B	M	E
Water temperature (°C)	22.72	22.67	22.50	22.69	22.69	22.79
pH	6.88	6.92	6.95	7.59	7.60	7.61
ORP (mV)	447	422	418	599	562	537
Salinity (PSU)	20.75	20.70	20.75	20.82	20.79	20.80
Dissolved Oxygen (mg/L)	6.82	7.00	7.18	7.85	7.96	7.90
Turbidity (NTU)	8.91	10.10	10.40	10.20	12.30	9.58
Total Suspended Solid (mg/L)	20.27	22.67	26.40	39.07	40.40	39.87
Dissolve Organic Carbon (mg/L)	5.20	5.20	5.15	7.46	7.43	7.43
Particulate Organic Carbon (mg/L)	2.77	4.28	4.00	8.58	8.72	8.11
Organism (≥ 50 μm, inds./m^3)	39 000	51 000	59 000	0	0	0
Organism (≥ 10-50 μm, inds./mL)	445	497	427	0	0	0
Heterotrophic bacteria (cells/mL)	TNTC**	TNTC	TNTC	1 140	2 010	880
Total coliform (cfu/mL)	TNTC	TNTC	TNTC	106	94	81
Escherichia coli (cfu/100 mL)	1	0	0	0	0	0
Intestinal *Enterococci* (cfu/100 mL)	39	55	56	21	10	19
Vibrio cholerae (cfu/100 mL)	0	0	0	0	0	0

* B, beginning; M, middle; E, End.

** Too numerous to count.

Ⅳ. TO BE CONTINUED

3-32 PSU from 17 June to 22 June

2 period 4 cycle	Day 0 (Ballasting)						
	S1 (Test water)*	S2 (Untreated water)			S3 (Treated water)		
		B**	M	E	B	M	E
Water temperature (°C)	21.89	22.57	22.35	22.49	22.38	22.36	22.25
pH	8.15	8.13	8.18	8.20	8.29	8.32	8.33
ORP (mV)	392	626	563	537	915	935	943
Salinity (PSU)	20.66	20.47	20.48	20.48	20.56	20.56	20.61
Dissolved Oxygen (mg/L)	8.40	9.01	8.94	8.71	7.97	7.96	8.00
Turbidity (NTU)	21.60	23.00	22.70	22.90	20.90	21.10	19.80
Total Suspended Solid (mg/L)	81.33	83.20	80.93	82.00	76.13	70.53	72.93
Dissolve Organic Carbon (mg/L)	5.52	5.42	5.33	5.43	6.72	6.82	6.71
Particulate Organic Carbon (mg/L)	17.00	18.10	19.50	19.80	19.20	17.20	18.40
Organism (≥ 50 μm, inds./m^3)	415 000	186 000	191 000	195 000	19	21	28
Organism (≥ 10-50 μm, inds./mL)	2 099	1 590	1 848	1 909	1	1	0
Heterotrophic bacteria (cells/mL)	44 909	30 633	31 733	27 800	0	0	0
Total coliform (cfu/mL)	TNTC***	TNTC	TNTC	TNTC	0	0	0
Escherichia coli (cfu/100 mL)	277	243	293	208	0	0	0
Intestinal *Enterococci* (cfu/100 mL)	898	333	393	392	0	0	0
Vibrio cholerae (cfu/100 mL)	0	0	0	0	0	0	0

* Test water represented to including viable organism and organic matter.

** B, beginning; M, middle; E, End.

*** Too numerous to count.

2 period 4 cycle	Day 5 (de-Ballasting)					
	S2 (Untreated water)			S4 (Treated water)		
	B*	M	E	B	M	E
Water temperature (°C)	24.22	24.49	24.05	24.51	24.49	24.60
pH	7.35	7.36	7.45	8.17	8.23	8.22
ORP (mV)	241	199	190	454	433	402
Salinity (PSU)	20.52	20.42	20.59	20.71	20.73	20.64
Dissolved Oxygen (mg/L)	6.77	7.00	7.35	7.91	7.91	7.86
Turbidity (NTU)	6.90	7.45	7.84	9.66	9.57	9.02
Total Suspended Solid (mg/L)	16.80	19.20	20.67	32.67	31.60	32.27
Dissolve Organic Carbon (mg/L)	7.79	7.75	7.77	7.03	6.89	6.97
Particulate Organic Carbon (mg/L)	2.64	3.01	3.55	6.81	7.16	6.75
Organism (≥ 50 μm, inds./m^3)	3 250	2 750	2 250	0	0	0
Organism (≥ 10-50 μm, inds./mL)	536	555	466	0	0	0
Heterotrophic bacteria (cells/mL)	34 033	34 066	33 400	1 077	1 387	1 767
Total coliform (cfu/mL)	0	0	0	0	0	0
Escherichia coli (cfu/100 mL)	4	5	4	0	0	0
Intestinal *Enterococci* (cfu/100 mL)	88	76	99	14	8	7
Vibrio cholerae (cfu/100 mL)	0	0	0	0	0	0

* B, beginning; M, middle; E, End.

Ⅳ. TO BE CONTINUED

3-32 PSU from 24 June to 29 June

2 period 5 cycle	Day 0 (Ballasting)						
	S1 (Test water)*	S2 (Untreated water)			S3 (Treated water)		
		B**	M	E	B	M	E
Water temperature (°C)	20.21	20.89	20.91	21.03	20.86	21.35	21.06
pH	8.90	8.94	9.04	9.04	9.10	9.12	9.14
ORP (mV)	469	546	501	487	879	908	917
Salinity (PSU)	20.48	20.54	20.51	20.49	20.40	20.43	20.43
Dissolved Oxygen (mg/L)	8.87	9.28	9.23	9.11	8.21	8.19	8.22
Turbidity (NTU)	21.30	22.50	20.90	21.80	19.70	20.20	18.20
Total Suspended Solid (mg/L)	71.73	68.27	66.53	68.00	69.47	82.40	66.40
Dissolve Organic Carbon (mg/L)	7.26	7.29	7.46	7.62	7.77	7.87	7.83
Particulate Organic Carbon (mg/L)	17.4	16.70	14.80	16.80	17.80	19.30	16.80
Organism (≥ 50 μm, inds./m^3)	508 000	161 166	167 500	213 333	57	40	49
Organism (≥ 10-50 μm, inds./mL)	1 923	1 405	1 603	1 753	1	0	0
Heterotrophic bacteria (cells/mL)	44 682	21 667	21 233	18 167	0	0	0
Total coliform (cfu/mL)	TNTC***	TNTC	TNTC	TNTC	0	0	0
Escherichia coli (cfu/100 mL)	900	367	410	342	0	0	0
Intestinal *Enterococci* (cfu/100 mL)	898	1,083	1,158	1,133	0	0	0
Vibrio cholerae (cfu/100 mL)	0	0	0	0	0	0	0

* Test water represented to including viable organism and organic matter.

** B, beginning; M, middle; E, End.

*** Too numerous to count.

2 period 5 cycle	Day 5 (de-Ballasting)					
	S2 (Untreated water)			S4 (Treated water)		
	B*	M	E	B	M	E
Water temperature (°C)	22.35	22.33	22.26	22.70	22.61	22.56
pH	6.62	6.67	6.67	7.40	7.42	7.42
ORP (mV)	154	170	169	310	286	281
Salinity (PSU)	19.99	20.00	20.07	19.95	19.91	19.92
Dissolved Oxygen (mg/L)	8.24	8.13	8.21	8.41	8.25	8.19
Turbidity (NTU)	8.25	8.40	7.71	9.29	8.32	7.95
Total Suspended Solid (mg/L)	22.93	23.33	21.47	28.80	27.33	28.40
Dissolve Organic Carbon (mg/L)	7.22	7.16	7.14	7.77	7.87	7.90
Particulate Organic Carbon (mg/L)	3.90	3.73	3.65	7.29	5.97	6.16
Organism (≥ 50 μm, inds./m^3)	17 250	20 833	22 916	0	0	0
Organism (≥ 10-50 μm, inds./mL)	263	228	267	0	3	0
Heterotrophic bacteria (cells/mL)	TNTC**	TNTC	TNTC	1 923	1 757	3 633
Total coliform (cfu/mL)	52	50	15	96	109	12
Escherichia coli (cfu/100 mL)	20	19	13	0	0	0
Intestinal *Enterococci* (cfu/100 mL)	197	198	290	22	12	39
Vibrio cholerae (cfu/100 mL)	0	0	0	0	0	0

* B, beginning; M, middle; E, End.

** Too numerous to count.