



Type Approval Certificate of Ballast Water Management System

This is to certify that the Ballast Water Management System listed below has been examined and tested in accordance with the requirements of the specifications contained in the **Code for Approval of Ballast Water Management Systems (resolution MEPC.300(72))**. This certificate is valid only for Ballast Water Management system referred to below on behalf of the Danish Environmental Protection Agency and Danish Maritime Authority, dated 21 September 2018.

This certificate is issued to

Producer **DESMI OCEAN GUARD A/S**

Address

**Lufthavnsvej 12
DK-9400 Nørresundby
Denmark**

Ballast Water Management System supplied:

DESMI OCEAN GUARD - CompactClean

Under type and model designation and incorporating:

**CompactClean 35 ; CompactClean 55 ; CompactClean 85 ;
CompactClean 135 ; CompactClean 190 ; CompactClean 250 ; CompactClean 340 ;
CompactClean 500 ; CompactClean 750 ; CompactClean 1000 ; CompactClean 1500 ;
CompactClean 2000 ; CompactClean 2500 and CompactClean 3000
Models intended for installation in Hazardous Areas are to be marked with an
EX suffix**

Ballast Water Management System manufactured by:

DESMI OCEAN GUARD A/S

To equipment/assembly drawing No:

470250 - P&ID Piping and Instrumentation diagram
CompactCleanTM BWMS 35-1500 m3/h
470251 - P&ID Piping and Instrumentation diagram
CompactCleanTM BWMS 2000-3000 m3/h

Date: 21 September 2018

Date: 21 September 2018

Other equipment manufactured by:

Item
Automatic Self-Cleaning Backwashing Filter

Maker
Filtrex

To equipment/assembly drawing No:

158837 – ACB OMM.73

Date: 03 July 2017

Treatment Rated Capacity:

35 to 3000

m³/h

A copy of this Type Approval Certificate should be carried on board a vessel fitted with this Ballast Water Management System at all times. A reference to the test protocol and a copy of the test results should be available for inspection on board the vessel. If the Type Approval Certificate is issued based on approval by another Administration, reference to that Type Approval Certificate shall be made.

Limiting Operating Conditions imposed as described in the Design Appraisal Document forms part of this certificate

This certificate remains valid up to the expiry dated unless cancelled or revoked, or until such date where it is superseded by the requirements of the Marine Equipment Directive whichever is the earlier, provided the conditions in the attached schedule are complied with and the equipment remains satisfactory in service.

Date of issue **16 May 2019**

Expiry date **15 May 2024**

Certificate No. **19/00006**

Signed

Sheet No **1 of 13**

Name

Søren Skive
Senior Specialist to Lloyd's Register EMEA
a subsidiary of the Lloyd's Register Group

Note:

This certificate is not valid for equipment, the design or manufacture of which has been varied or modified from the specimen tested. The manufacturer should notify the nominated body named on this certificate of any modification or changes to the equipment in order to obtain a valid Certificate.

This certificate is issued under the authority 'order on management of ballast water and sediments from ships ballast water tanks and order on survey and certification of ships using ballast water and on ballast water management plans and ballast records'.

Lloyd's Register Group Limited, its affiliates and subsidiaries and their respective officers, employees or agents are, individually and collectively, referred to in this clause as the 'Lloyd's Register'. Lloyd's Register assumes no responsibility and shall not be liable to any person for any loss, damage or expense caused by reliance on the information or advice in this document or howsoever provided, unless that person has signed a contract with the relevant Lloyd's Register entity for the provision of this information or advice and in that case any responsibility or liability is exclusively on the terms and conditions set out in that contract.



Lloyd's
Register

Lloyd's Register EMEA

**MARINE TECHNOLOGY & ENGINEERING
SERVICES**

*Lloyd's Register Global Technology Centre, Southampton Boldrewood
Innovation Campus, Burgess Road, Southampton, SO16 7QF*

Telephone 0330 4140 345

Email tass@lr.org

Page 2 of 13
Document number 19/00006
Issue number 0

DESIGN APPRAISAL DOCUMENT

Date 16 May 2019	Quote this reference on all future communications T/I119772/1700108/SSX
---------------------	--

ATTACHMENT TO CERTIFICATE OF TYPE APPROVAL No. 19/00006

The undernoted models, identification and documents have been appraised for compliance with the relevant International Conventions for the Type Approval of Ballast Water Management Systems.

This Design Appraisal Document forms part of the Certificate that is issued under the authority given in the Bekendtgørelse om håndtering af ballastvand og sedimenter fra skibes ballastvandtanke and Bekendtgørelse om syn og certificering af skibe, der anvender ballastvand, og om ballastvandplaner og -journaler.

MODEL AND TYPE DESIGNATION

**CompactClean
CompactClean EX**

Equipment Assembly Drawings

Type	Title	Dwg. No.	Rev.	System Type designation
Piping and Instrumentation Diagram	P&ID Piping and Instrumentation diagram CompactClean™ BWMS 35-1500 m3/h	470250	J	CompactClean
	- IECEX - ATEX	470261	B	CompactClean EX
Piping and Instrumentation Diagram	P&ID Piping and Instrumentation diagram CompactClean™ BWMS 2000-3000 m3/h	470251	B	CompactClean
	- IECEX - ATEX	470262	A	CompactClean EX

PRODUCT DESCRIPTION

Treatment sequence:

Ballast Water Uptake: Mechanical Filtration followed by Ultra Violet -C Radiation
Ballast Water Discharge: Ultra Violet -C Radiation

CompactClean is approved with:

13 Filter sizes: Filtrex ACB Automatic Filter with Woven mesh, single basket, mesh size 20 µm
6 UV-Reactor sizes: DESMI UV-Unit, 135, 340, 500, 750, 1000, 1500 m3/h
Clean-in-place (CIP): A manually operated and integrated CIP function
Ex Classification: IECEX EX II 2G Ex IIB T4 Gb



Lloyd's Register

Lloyd's Register EMEA

MARINE TECHNOLOGY & ENGINEERING SERVICES

Lloyd's Register Global Technology Centre, Southampton Boldrewood Innovation Campus, Burgess Road, Southampton, SO16 7QF

Telephone 0330 4140 345

Email tass@lr.org

Page 3 of 13
Document number 19/00006
Issue number 0

DESIGN APPRAISAL DOCUMENT

Date 16 May 2019	Quote this reference on all future communications T/I119772/1700108/SSX
---------------------	--

SYSTEM DESIGN LIMITATIONS

This equipment has been designed for operation in the following conditions:

UV Intensity

UV-reactor size (m ³ /h)	UV intensity lower Limit in All Salinities (W/m ²) ^{1,2}	UV minimum intensity @ full flow in All Salinities (W/m ²) ^{1,2}
135	227	880
340	227	880
500	227	880
750	227	880
1000	227	880
1500	227	880

- 1) UV intensity below lower limit, corresponding to an UV transmission of approx. 42% and approx 20% of the TRC for a given model, implies that the ballast water is not treated in accordance with this certificate
- 2) Set in respect of max flow of given UV-Reactor size

The BWMS includes UV-lamp power and flow optimization controls.

Flowrate is reduced below a corresponding UV-I value of 880 W/m² @ full flow;

Power is reduced above a corresponding UV-I value of 1000 W/m² (approx 66% UV-T), and gradually reduced, as a function of UV transmission increase.

Minimum required dose has been verified during Landbased testing and by supporting Scaling Report and Documentation details, as reviewed and approved by Lloyd's Register.

Temperature and Salinity

The CompactClean BWMS have been found to hold no limitation, as successfully tested during landbased and shipboard testing.

Holding Time

The CompactClean BWMS have passed minimum 2 test pr salinity with a hold time of 24 hours.

In addition of supporting 'Hold Time Limitation of CompactClean BWMS' report, DESMI Ocean Guard, dated 29 August 2018 (confidential), the CompactClean BWMS have been considered to hold no limitation, in respect of Part 2, 2.13 requirements of the Code, as accepted by DEPA/DMA.



Lloyd's
Register

Lloyd's Register EMEA

**MARINE TECHNOLOGY & ENGINEERING
SERVICES**

Lloyd's Register Global Technology Centre, Southampton Boldrewood
Innovation Campus, Burgess Road, Southampton, SO16 7QF

Telephone 0330 4140 345

Email tass@lr.org

Page 4 of 13
Document number 19/00006
Issue number 0

DESIGN APPRAISAL DOCUMENT

Date 16 May 2019	Quote this reference on all future communications T/I119772/1700108/SSX
---------------------	--

Treatment Rated Capacities /TRC

BWMS Model	TRC ¹⁾ Flow Rate (Discharge) ²⁾⁴⁾ (m ³ /h)	Primary Treatment		Secondary Treatment	
		Filter		UV Reactor	
		Filtrex	Unit No(s)	DESMI Ocean Guard	Unit No(s)
CC-35	8 - 35 (5 - 135)	ACB-903-65	1	UV-UNIT 135	1
CC-55	10 - 55 (5 - 135)	ACB-904-80	1	UV-UNIT 135	1
CC-87	15 - 87 (5 - 135)	ACB-906-100	1	UV-UNIT 135	1
CC-135	25 - 135 (5 - 135)	ACB-910-150	1	UV-UNIT 135	1
CC-190	35 - 190 (9 - 340)	ACB-915-150	1	UV-UNIT 340	1
CC-255	35 - 255 (9 - 340)	ACB-935-200	1	UV-UNIT 340	1
CC-340	45 - 340 (9 - 340)	ACB-945-200	1	UV-UNIT 340	1
CC-500	50 - 500 (13 - 500)	ACB-955-250	1	UV-UNIT 500	1
CC-750	65 - 750 (19 - 750)	ACB-985-300	1	UV-UNIT 750	1
CC-1000	95 - 1000 (26 - 1000)	ACB-999-350	1	UV-UNIT 1000	1
CC-1500	126 - 1500 (38 - 1500)	ACB-9100-400	1	UV-UNIT 1500	1
CC-2000	126 - 2000 (52 - 2000)	ACB-9120-500	1	UV-UNIT 1000	2 ³⁾
CC-2500	126 - 2500 (64 - 2500)	ACB-9200-600	1	UV-UNIT 1000	1
				UV-UNIT 1500	1
CC-3000	126 - 3000 (76 - 3000)	ACB-9200-600	1	UV-UNIT 1500	2 ³⁾

- 1) TRC is the max Inlet flow to the BWMS, a flow exceeding the given value implies that the ballast water is not treated in accordance with this certificate.
- 2) Value in brackets are given if flow rate limits differ between Ballast Water Intake and Ballast Water Discharge, as defined by either Filter and/or UV-unit flow capacities.
- 3) UV Units are to be mounted in parallel.
- 4) The flowrate limitations for Ballast Water Stripping operation corresponds to the flowrate limitations for Ballast Water Discharge.



Lloyd's Register

Lloyd's Register EMEA

MARINE TECHNOLOGY & ENGINEERING SERVICES

Lloyd's Register Global Technology Centre, Southampton Boldrewood Innovation Campus, Burgess Road, Southampton, SO16 7QF

Telephone 0330 4140 345

Email tass@lr.org

Page 5 of 13
Document number 19/00006
Issue number 0

DESIGN APPRAISAL DOCUMENT

Date 16 May 2019	Quote this reference on all future communications T/I119772/1700108/SSX
---------------------	--

OPERATIONAL SPECIFICATIONS AND IDENTIFICATION OF THE APPROVED COMPONENTS

Main Unit(s) Description(s)

Name Drawing Legend (Document)	Maker / Model / Type			Flow Rate (m3/h)	Design Limit (pressure / bar)
FILTER -W1-H1-HQ1	Filtrex	Filter screen Mesh size	dP for backflush		
	ACB-903-65	20 µm	0,5 - 0,3 bar	8 - 35	10
	ACB-904-80			10 - 55	
	ACB-906-100			15 - 87	
	ACB-910-150			25 - 135	
	ACB-915-150			35 - 190	
	ACB-935-200			35 - 255	
	ACB-945-200			45 - 340	
	ACB-955-250			50 - 515	
	ACB-985-300			65 - 770	
	ACB-999-350			95 - 1040	
	ACB-9100-400			126 - 1500	
	ACB-9120-500			126 - 2100	
ACB-9200-600	126 - 3000				
UV-UNIT -W1-V1-VP1	DESMI OCEAN GUARD				10
	CC-135			5 - 135	
	CC-340			9 - 340	
	CC-500			13 - 500	
	CC-750			19 - 750	
	CC-1000			26 - 1000	
	CC-1500			38 - 1500	
	DESMI OCEAN GUARD			Item no	Versions (BWMS Model)
CIP TANK -W5-CM1	-			142023	CC 35 - CC 3000



Lloyd's
Register

Lloyd's Register EMEA

**MARINE TECHNOLOGY & ENGINEERING
SERVICES**

*Lloyd's Register Global Technology Centre, Southampton Boldrewood
Innovation Campus, Burgess Road, Southampton, SO16 7QF*

Telephone 0330 4140 345

Email tass@lr.org

Page 6 of 13
Document number 19/00006
Issue number 0

DESIGN APPRAISAL DOCUMENT

Date 16 May 2019	Quote this reference on all future communications T/I119772/1700108/SSX
---------------------	--

Monitoring and Installation

The type approved system must be installed with a UV-sensor (W1-V1-BR1), temperature sensor (W1-V1-BT1), pressure sensors (W1-H1-BP1 and 2), flow meter(s) (W1-BF1 (CC35 - CC1500) or W3-BF1 + W9-BF1 + W10-BF1 (CC2000 - CC3000) and flow control valve(s) (W1-RM2/MA2 (CC35 - CC1500) or W1-RM2/MA2 + W9-RM1/MA1 + W10-RM1/MA1 (CC2000 - CC3000)) according to the P&IDs.

Following switches and/or sensor points are arranged with an independent shutdown functionality:

W1-H1-BP1 - 'High pressure BWMS Inlet' ; W1-V1-BT1 - Fault High temperature UV unit - BWMS' ; W1-BF1 (CC35 - CC1500) or W9-BF1 + W10-BF1 (CC2000 - CC3000) - 'Low flow UV unit - BWMS' ; W1-V1-BR1 - 'UV Transmitter fault UV unit - BWMS' ; W1-BL1 - 'Water level low UV Unit - BWMS'.

Information regarding the selected components shall be part of the documentation related to the specific installation, either by a reference to valid type approval certificate or technical documentation.

Control Equipment / Sensors / Software

Name Drawing Legend (Doc. ref.)	Maker / Model / Type	Item no	Versions (UV Unit)
	DESMI OCEAN GUARD		
MAIN PANEL -UC01	Main Panel	441400	CC 340
		441401	CC 500
		441402	CC 750
		441403	CC 1000
		441404	CC 1500
UV LAMP -W1-V1-EA1>EAXX	UV Lamp Desmi 4kW Synthetic Quartz	721667	CC 135
	UV Lamp Desmi 6kW Synthetic Quartz	721666	CC 340
			CC 500
			CC 750
			CC 1000
UV SENSOR -W1-V1-BR1	UV Sensor - DVGW-Type SUV 20.2 A2 Y2 C	720872	CC 135
	DVGW-Type SUV 20.2 A2 Y2 C Ex Ia IIC T6 Ga	721773	- CC 1500
	DESMI OCEAN GUARD	Item no	Versions (BWMS Model)
EXTERNAL CONTROL BOX - UC03	External Control Box External Control Box IEX	441510	CC 35 - CC 3000
		441712	
	DESMI OCEAN GUARD	SW Vers no	
(AQA 001009)	PLC Software	V0.52	



Lloyd's
Register

Lloyd's Register EMEA

**MARINE TECHNOLOGY & ENGINEERING
SERVICES**

*Lloyd's Register Global Technology Centre, Southampton Boldrewood
Innovation Campus, Burgess Road, Southampton, SO16 7QF*

Telephone 0330 4140 345

Email tass@lr.org

Page 7 of 13
Document number 19/00006
Issue number 0

DESIGN APPRAISAL DOCUMENT

Date 16 May 2019	Quote this reference on all future communications T/I119772/1700108/SSX
---------------------	--

Explosion proof version CompactClean BWMS EX

The CompactClean BWMS EX, with the exception of the Main Panel and the Frequency Converter, is suitable for use in hazardous area Zone 1, as defined in IEC 60079-10-1: Explosive atmospheres – Part 10-1: Classification of areas – Explosive gas atmospheres.

The system is built up by components, individually certified, suitable for the use in the classified zone.

Ex-certification is not covered by this certificate. Installation in hazardous area are to be approved in each case according to the Rules and Ex-Certification/ Special Condition for Safe Use listed in valid Ex-certificate issued by a notified/recognized Certification Body.

The Ex certified components are listed in the manufacturers document 161576 and 162300.

BIOLOGICAL TEST REPORTS

Document No.	Rev.	Title	Date
11821290	-	Biological efficacy performance evaluation of CompactClean Ballast Water Management System in landbased test Test Plan	12 September 2017
11821290	-	Amendment No. 1	15 January 2018
11821290	Final	Biological efficacy performance evaluation of CompactClean Ballast Water Management System in landbased test Lloyd's Register EMEA Land-based test report	21 September 2018
11821290	-	Biological efficacy performance evaluation of CompactClean Ballast Water Management System in shipboard test Test Plan	03 November 2017
11821290	Final	Biological efficacy performance evaluation of CompactClean Ballast Water Management System in shipboard test Lloyd's Register EMEA Shipboard test report	21 September 2018

ENVIRONMENTAL TEST REPORTS

Document No.	Rev.	Title	Date
117-36341-1	-	Marine type testing of DESMI CompactClean BWMS TEST REPORT	20 August 2018



Lloyd's
Register

Lloyd's Register EMEA

**MARINE TECHNOLOGY & ENGINEERING
SERVICES**

*Lloyd's Register Global Technology Centre, Southampton Boldrewood
Innovation Campus, Burgess Road, Southampton, SO16 7QF*

Telephone 0330 4140 345

Email tass@lr.org

Page 8 of 13
Document number 19/00006
Issue number 0

DESIGN APPRAISAL DOCUMENT

Date 16 May 2019	Quote this reference on all future communications T/I119772/1700108/SSX
---------------------	--

SYSTEM SUPPORTING REPORTS

Document No.	Rev.	Title	Date
1702-0040	2	UV Compact Clean - Scaling methodology evaluation Technical Investigation Department Lloyd's Register EMEA	02 June 2018
-	4	Shipboard Performance Report of DESMI Ocean Guard Ballast Water Management System onboard PROVIDANA	30 August 2018

SYSTEM DESCRIPTIVE DOCUMENTATION

Document No.	Rev.	Title	Date
161335	C.23	Operation Maintenance and Safety Manual	20 September 2018

Document Lists:

HTO/ETS 39022-19	0	"Design Appraisal Document - ETS - Ballast Water Treatment System IMO (G8) Type Approval DESMI CompactClean - DESMI Ocean Guard A/S"	03 May 2019
HPC1762078/37383- 18/JW/	0	Memorandum - ENS - IMO G8 type approval for DESMI CompactClean BWTS	21 September 2018

Ex Certificate Lists:

161576	27	Component Overview CC190-1500 IEX	-
162300	16	Component Overview CC2000-3000 IEX	-

PLACE OF PRODUCTION

DESMI, Aalborg-Nørresundby, Denmark
DESMI, Chesapeake, United States of America
DESMI, Suzhou, China
Phone: +45 9632 8199
www.desmioceanguard.com



Lloyd's
Register

Lloyd's Register EMEA

**MARINE TECHNOLOGY & ENGINEERING
SERVICES**

*Lloyd's Register Global Technology Centre, Southampton Boldrewood
Innovation Campus, Burgess Road, Southampton, SO16 7QF*

Telephone 0330 4140 345

Email tass@lr.org

Page 9 of 13
Document number 19/00006
Issue number 0

DESIGN APPRAISAL DOCUMENT

Date 16 May 2019	Quote this reference on all future communications T/I119772/1700108/SSX
---------------------	--

CONDITIONS OF CERTIFICATION

- 1 It is to be noted that during operation only the CompactClean BWMS-IEx model versions have been approved to operate in hazardous areas as defined in IEC 60079-10-1.
- 2 The alarm in all control stations of ballast water operation including the navigation bridge need to be verified at installation commissioning of the ballast water management system.
- 3 The licensee must report immediately all events to the Danish Maritime Authority (DMA) leading to harm either to human health or the environment as a result of the operation of the ballast water management system.
- 4 Any indications that the ballast water management system is not performing to the standards of the ballast water convention must be reported to the DMA including any deficiencies identified by port State control.
- 5 All accidents (e.g., accidental exposure to Mercury) in connection with the ballast water management system must be reported immediately to the DMA.
- 6 Significant changes in the construction of the ballast water management system must be reported to both the DMA and the recognised organisation that issued the type approval certificate on behalf of the DMA; if they potentially affect the efficiency of the system, they must be approved by the DMA.
- 7 The licensee must take reasonable measures to ensure that the operator of the system is familiar with the operation of the system and is capable of operating and maintaining the system in accordance with the operating manual.
- 8 If the licensee does not comply with these additional provisions, the type approval may be revoked by the DMA.



LR031.1.2016.06

Søren Skive
Senior Specialist
Copenhagen Technical Support Office
Lloyd's Register EMEA
T: +45 39 48 42 55
E: soeren.skive@lr.org



Lloyd's
Register

Lloyd's Register EMEA

**MARINE TECHNOLOGY & ENGINEERING
SERVICES**

*Lloyd's Register Global Technology Centre, Southampton Boldrewood
Innovation Campus, Burgess Road, Southampton, SO16 7QF*

Telephone 0330 4140 345

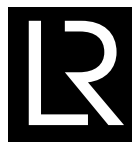
Email tass@lr.org

Page 10 of 13
Document number 19/00006
Issue number 0

DESIGN APPRAISAL DOCUMENT

Date 16 May 2019	Quote this reference on all future communications T/I119772/1700108/SSX
---------------------	--

APPENDIX 1 - SUMMARY OF TESTING



Lloyd's Register

Lloyd's Register EMEA

MARINE TECHNOLOGY & ENGINEERING SERVICES

Lloyd's Register Global Technology Centre, Southampton Boldrewood Innovation Campus, Burgess Road, Southampton, SO16 7QF

Telephone 0330 4140 345

Email tass@lr.org

Page 11 of 13
Document number 19/00006
Issue number 0

DESIGN APPRAISAL DOCUMENT

Date 16 May 2019	Quote this reference on all future communications T/I119772/1700108/SSX
---------------------	--

Summary of Land-based testing for DESMI Ocean Guard, CompactClean 340, using Filtrex ACB-945-200 with 20 µm mesh screen and DESMI UV-unit CC-340 with a rated max flow 340 m³/h.

Table 1 Inlet Test water conditions in Fresh, Brackish and Marine water Test Cycles

Test Cycle	TSS	POC (mg/L)	DOC (mg/L)	Temp. (°C)	Salinity (PSU)	UV-T (%)	UV-I (W/m²) ¹⁾	Flow Rate Inlet (m³/h) ²⁾	Flow Rate Treated (m³/h) ³⁾	Holding Time (days)	Power Consumption (kWh/100 m³) ⁴⁾
F-3	59	5.4	6.7	13	0.37	54	541-570	193	169	5	31
F-4	59	5.4	6.7	13	0.37	54	539-559	192	171	5	31
F-5	59	6.2	11	8.9	0.36	47	311-326	99	89	1	59
F-6	59	6.2	11	9	0.36	47	310-322	98	91	1	57
F-7	51	5.9	11	6.9	0.36	45	269-285	82	76	5	68
B-1	60	9.4	18	15	18	42	227-251	104	92	1	57
B-2	58	7.2	13	12	19	56	489-501	174	164	5	32
B-3	58	7.2	13	12	19	56	491-503	174	166	5	31
B-4	54	7.1	7.6	4.9	19	65	839-899	330	299	1	18
B-5	54	7.1	7.6	5	19	65	769-937	328	306	1	18
M-1	61	6.4	7.3	6.3	29	68	825-986	332	296	1	19
M-2	61	6.4	7.3	6.3	29	68	829-995	332	301	1	18
M-3	81	10	7.6	1.2	28	62	835-943	329	296	5	19
M-4	81	10	7.6	1.3	28	62	789-938	329	295	5	19
M-5	58	8	7	2.5	28	71	970-1,094	332	305	6	18

Requirements

Fresh water and Brackish Water	>50	>5	>5	-	<1 / 10-20	-	-	-	-	-	-
Marine Water	>1	>1	>1	-	28-36	-	-	-	-	-	-

Notes

- 1) UV-I measured at stable operating conditions (minimum and maximum)
- 2) Average flowrate measured before filtration and considered as TRC verification data
- 3) Average flow rate measured after filtration as inlet to the UV-unit and considered as SDL Performance Curve verification
- 4) Power consumption measured during Ballast



Lloyd's Register

Lloyd's Register EMEA

MARINE TECHNOLOGY & ENGINEERING SERVICES

Lloyd's Register Global Technology Centre, Southampton Boldrewood Innovation Campus, Burgess Road, Southampton, SO16 7QF

Telephone 0330 4140 345

Email tass@lr.org

Page 12 of 13
Document number 19/00006
Issue number 0

DESIGN APPRAISAL DOCUMENT

Date 16 May 2019	Quote this reference on all future communications T/I119772/1700108/SSX
---------------------	--

Table 2 Average numbers (three replicates) of live organisms in Inlet, Treated and Control discharge waters. Live organisms ≥ 10 and $< 50 \mu\text{m}$ were quantified by microscopy counting after staining with CMFDA/FDA. All counts of pathogenic bacteria (*E. coli*, enterococci and *Vibrio cholerae*) in the test cycles were below the ballast water discharge standard.

Test Cycle	Organisms $\geq 50 \mu\text{m}$ (Org/m ³)	Organisms $\geq 10 \mu\text{m}$ and $< 50 \mu\text{m}$ (Org/m ³)	Organisms $\geq 50 \mu\text{m}$ (Org/m ³)		Organisms $\geq 10 \mu\text{m}$ and $\leq 50 \mu\text{m}$ (Org/m ³)	
			Discharge		Discharge	
Sample	Inlet to BWMS	Inlet to BWMS	Treated	Control	Treated	Control
			Microscopy		CMFDA/FDA Microscopy	
F-3	502,350	1,108	0.00	258,169	0.83	1,159
F-4	523,742	1,179	0.00	258,169	1.30	1,159
F-5	468,556	3,456	4.60	208,074	7.00	2,014
F-6	311,073	3,091	0.57	208,074	8.00	2,014
F-7	346,614	2,936	0.00	177,753	5.00	1,850
B-1	244,114	1,373	1.00	96,060	9.30	890
B-2	188,653	1,097	0.00	62,781	3.50	1,941
B-3	232,694	1,183	0.33	62,781	4.80	1,941
B-4	251,153	1,424	0.00	50,519	6.50	790
B-5	191,233	1,073	0.00	50,519	5.00	790
M-1	174,522	2,100	4.00	60,671	6.00	1,466
M-2	158,542	1,807	0.00	60,671	4.70	1,466
M-3	229,531	6,839	0.00	135,936	0.17	771
M-4	221,678	7,750	0.00	135,936	0.83	771
M-5	286,653	3,976	0.00	69,507	0.00	741



Lloyd's Register

Lloyd's Register EMEA

MARINE TECHNOLOGY & ENGINEERING SERVICES

Lloyd's Register Global Technology Centre, Southampton Boldrewood Innovation Campus, Burgess Road, Southampton, SO16 7QF

Telephone 0330 4140 345

Email tass@lr.org

Page 13 of 13
Document number 19/00006
Issue number 0

DESIGN APPRAISAL DOCUMENT

Date 16 May 2019	Quote this reference on all future communications T/I119772/1700108/SSX
---------------------	--

Summary of Shipboard testing for DESMI Ocean Guard, CompactClean 1000, using Filtrex ACB-999-350 with 20 µm mesh screen and DESMI UV-unit CC-1000 with a rated max flow 1040 m³/h.

Table 3 Flow Rate, UV-T, UV-I and Average numbers (three replicates) of live organisms in Inlet and Treated discharge waters.
Live organisms ≥10 and <50 µm were quantified by microscopy counting after staining with CMFDA/FDA. All counts of pathogenic bacteria (E. coli, enterococci and Vibrio cholerae) in the test cycles were below the ballast water discharge standard.

Test Cycle	Average flow rate during Ballast operation (m3/h)	Temp. (°C)	Salinity (PSU)	UV-T (%)	UV-I (average) (W/m²)	Organisms ≥ 50 µm (Org/m³)		Organisms ≥ 10 µm and ≤ 50 µm (Org/m³)		Holding Time (days:hours)
						Inlet	Discharge	Inlet	Discharge	
						Microscopy		CMFDA/FDA Microscopy		
SB-1	993	11	7.9	93	1,062	15,395	1.3	114	0.17	0:23
SB-2	983	16	28	93	1,027	10,911	1.1	153	0.33	5:22
SB-3	986	15	28	91	1,061	12,749	2.4	106	0.17	5:11
SB-4	836	24	37	95	702	32,677	1.2	109	0.17	2:19
SB-5	991	23	37	86	840	29,207	5.0	106	0.17	1:21
Requirements										
	Upper Range of TRC	-	-	-	-	≥ 100	-	≥ 100	-	-