



Certificate No:
TAP00002M8

TYPE APPROVAL DESIGN CERTIFICATE

This is to certify:

That the **Ballast Water Management System**

with type designation(s)
BSKY BWMS (BSKY300 - BSKY6000)

Issued to

Wuxi Brightsky Electronic Co., Ltd
Wuxi City, China

is found to comply with

DNV rules for classification – Ships Pt.6 Ch.7 Sec.1 Ballast water management – BWM
DNV class guideline DNV-CG-0339 – Environmental test specification for electrical, electronic and programmable equipment and systems

Application :

Product(s) approved by this certificate is/are accepted for installation on all vessels classed by DNV.

Compliance with the IMO D-2 performance standard is not covered by this certificate. Such compliance shall be confirmed by a separate type approval certificate issued by an Administration.

Alterations to the applicable rules may have impact on validity of this certificate and require re-assessment of the system design.

Issued at **Høvik** on **2022-11-15**

This Certificate is valid until **2027-11-14** .

DNV local unit: **Jiangyin NB & CMC**

for **DNV**

Approval Engineer: **Martin Olofsson**

Dag Sæle-Nilsen
Head of Section

This Certificate is subject to terms and conditions overleaf. Any significant change in design or construction may render this Certificate invalid. The validity date relates to the Type Approval Certificate and not to the approval of equipment/systems installed.

LEGAL DISCLAIMER: Unless otherwise stated in the applicable contract with the holder of this document, or following from mandatory law, the liability of DNV AS, its parent companies and their subsidiaries as well as their officers, directors and employees ("DNV") arising from or in connection with the services rendered for the purpose of the issuance of this document or reliance thereon, whether in contract or in tort (including negligence), shall be limited to direct losses and under any circumstance be limited to 300,000 USD.



Product description

The BSKY Ballast Water Management System (BWMS) applies physical hydrocyclone separation (CY) and subsequent ultrasonic treatment (US) and UV irradiation (UV) during ballast water uptake and a second treatment with US and UV during discharge. The BSKY BWMS includes 69 model sizes with a Treatment Rated Capacity (TRC) from 80 m³/h to 6000 m³/h.

The major components of the BSKY BWMS models, as well as the TRC and minimum flow rate of the designated BSKY BWMS models are specified in the table below. The TRC is determined by the treatment capacities of the US and UV units. The minimum flow rate (with low-low flow alarm) is linked to the treatment efficacy of CY. Further details on installation and operation of the BWMS are included in the Operation, Maintenance and Safety Manual (OMSM).

BWMS model	TRC [m ³ /h]	Min. flow rate [m ³ /h]	Hydrocyclone unit (CY)	US unit (US)	UV module (UV)
BSKY300 (081)	80	60	CY08×1	US25	UV408
BSKY300 (101)	130	98	CY10×1		
BSKY300 (082)	160	120	CY08×2		
BSKY300 (121)	200	150	CY12×1		
BSKY300 (083)	240	180	CY08×3		
BSKY300 (102)	260	195	CY10×2		
BSKY300 (084)	300	240	CY08×4		
BSKY300 (103)	300	293	CY10×3		
BSKY300 (122)	300	300	CY12×2		
BSKY600 (103)	390	293	CY10×3	US35	UV514
BSKY600 (085)	400	300	CY08×5		
BSKY600 (122)	400	300	CY12×2		
BSKY600 (086)	480	360	CY08×6		
BSKY600 (104)	520	390	CY10×4		
BSKY600 (087)	560	420	CY08×7		
BSKY600 (123)	600	450	CY12×3		
BSKY600 (105)	600	488	CY10×5		
BSKY900 (106)	780	585	CY10×6	US45	UV520
BSKY900 (124)	800	600	CY12×4		
BSKY900 (107)	900	683	CY10×7		
BSKY900 (125)	900	750	CY12×5		
BSKY1200 (125)	1000	750	CY12×5	US50	UV626
BSKY1200 (108)	1040	780	CY10×8		
BSKY1200 (109)	1170	878	CY10×9		
BSKY1200 (126)	1200	900	CY12×6		
BSKY1200 (1010)	1200	975	CY10×10		
BSKY1500 (1010)	1300	975	CY10×10	US55	UV632
BSKY1500 (127)	1400	1050	CY12×7		
BSKY1500 (1011)	1430	1073	CY10×11		
BSKY1500 (1012)	1500	1170	CY10×12		
BSKY1500 (128)	1500	1200	CY12×8		

Configurations of parallel installed BWMS

BWMS model	TRC [m ³ /h]	Min. flow rate [m ³ /h]	Model in parallel	Numbers in parallel
BSKY1800 (1012)	1560	1170	BSKY900 (106)	2
BSKY1800 (128)	1600	1200	BSKY900 (124)	2
BSKY1800 (1014)	1800	1365	BSKY900 (107)	2
BSKY1800 (1210)	1800	1500	BSKY900 (125)	2
BSKY2400 (1210)	2000	1500	BSKY1200 (125)	2
BSKY2400 (1016)	2080	1560	BSKY1200 (108)	2
BSKY2400 (1018)	2340	1755	BSKY1200 (109)	2
BSKY2400 (1212)	2400	1800	BSKY1200 (126)	2
BSKY2400 (1020)	2400	1950	BSKY1200 (1010)	2

BWMS model	TRC [m³/h]	Min. flow rate [m³/h]	Model in parallel	Numbers in parallel
BSKY2700 (1018)	2340	1755	BSKY900 (106)	3
BSKY2700 (1212)	2400	1800	BSKY900 (124)	3
BSKY2700 (1021)	2700	2048	BSKY900 (107)	3
BSKY2700 (1215)	2700	2250	BSKY900 (125)	3
BSKY3000 (1020)	2600	1950	BSKY1500 (1010)	2
BSKY3000 (1214)	2800	2100	BSKY1500 (127)	2
BSKY3000 (1022)	2860	2145	BSKY1500 (1011)	2
BSKY3000 (1024)	3000	2340	BSKY1500 (1012)	2
BSKY3000 (1216)	3000	2400	BSKY1500 (128)	2
BSKY3600 (1215)	3000	2250	BSKY1200 (125)	3
BSKY3600 (1024)	3120	2340	BSKY1200 (108)	3
BSKY3600 (1027)	3510	2633	BSKY1200 (109)	3
BSKY3600 (1218)	3600	2700	BSKY1200 (126)	3
BSKY3600 (1030)	3600	2925	BSKY1200 (1010)	3
BSKY4500 (1030)	3900	2925	BSKY1500 (1010)	3
BSKY4500 (1221)	4200	3150	BSKY1500 (127)	3
BSKY4500 (1033)	4290	3218	BSKY1500 (1011)	3
BSKY4500 (1036)	4500	3510	BSKY1500 (1012)	3
BSKY4500 (1224)	4500	3600	BSKY1500 (128)	3
BSKY4800 (1220)	4000	3000	BSKY1200 (125)	4
BSKY4800 (1032)	4160	3120	BSKY1200 (108)	4
BSKY4800 (1036)	4680	3510	BSKY1200 (109)	4
BSKY4800 (1224)	4800	3600	BSKY1200 (126)	4
BSKY4800 (1040)	4800	3900	BSKY1200 (1010)	4
BSKY6000 (1040)	5200	3900	BSKY1500 (1010)	4
BSKY6000 (1228)	5600	4200	BSKY1500 (127)	4
BSKY6000 (1044)	5720	4290	BSKY1500 (1011)	4
BSKY6000 (1048)	6000	4680	BSKY1500 (1012)	4
BSKY6000 (1232)	6000	4800	BSKY1500 (128)	4

Technical specifications

The main units of BSKY BWMS are specified in the table below.

Unit	Material	Model name	Manufacturer
Hydrocyclone unit (CY)	Duplex & SUS316L	CY08, CY10, CY12	Wuxi Brightsky Electronic Co., Ltd.
US unit (US)	Duplex & SUS316L	US25(Ex), US35(Ex), US45(Ex), US50(Ex), US55(Ex)	
UV module (UV)	SUS316L & SUS329J3L	UV408(Ex), UV514(Ex), UV520(Ex), UV626(Ex), UV632(Ex)	
Local control panel	SS400	BSKY_BWMS_CON	
Remote control panel (optional)	SS400	BSKY_BWMS_CON_R	
Auxiliary control panel (for parallel installations)	SS400	BSKY_BWMS_A	
US power supply	SS400	BSKY_BWMS_USPS	
UV power supply	SS400	BSUV	
Control rack	Epoxy coated steel (SS400)	BSKY_BWMS_CR106 /109/112/106F/109F/112F	
UVI sensor	SUS329J3L	UVC1000(Ex)	Pepperl & Fuchs AG
Purge control system		6500-01-EXT1-PNO-LNO	

Technical specification of the hydrocyclone unit

Model	Flow range ⁽¹⁾ [m³/h]	Range of working pressure [MPa]	Diameter [mm]	Size (L×W×H) [mm]
CY08	60 ~ 88	0.12 ~ 0.5	inlet/outlet/drain DN 100/80/50	355×472×1215
CY10	98 ~ 143	0.12 ~ 0.5	inlet/outlet/drain DN 125/125/65	447×585×1533
CY12	150 ~ 220	0.12 ~ 0.5	inlet/outlet/drain DN 150/150/80	483×653×1842

(1) The flow range of the hydrocyclone is calculated as 75 ~ 110% of TRC. It means the TRC of CY08 is 80 m³/h, CY10 is 130 m³/h and CY12 is 200 m³/h.

Technical specification of the US (ultrasonic) unit

Model ⁽¹⁾	TRC [m³/h]	Max. power [kW]	Number of generators	Protection degree
US25 (Ex)	300	8.4	1	IP55
US35 (Ex)	600	12.6	1	
US45 (Ex)	900	15.4	2	
US50 (Ex)	1200	18.2	2	
US55 (Ex)	1500	19.6	2	

(1) The US unit can be supplied as an Ex-proof unit, then the model's name ends with (Ex).

Technical specification of the UV (ultraviolet) module

Model ⁽¹⁾	TRC [m³/h]	Number of lamps	Max. power per lamp [kW]	Number of UV power supply	Protection degree
UV408 (Ex)	300	8	5.5	4	IP55
UV514 (Ex)	600	14	5.5	7	
UV520 (Ex)	900	20	5.5	10	
UV626 (Ex)	1200	26	5.5	13	
UV632 (Ex)	1500	32	5.5	16	

(1) The UV module can be supplied as an Ex-proof unit, then the model's name ends with (Ex).

Technical specification of the control and monitoring equipment

Model	Control location	Size [mm]	Power supply	Protection degree
BSKY_BWMS_CON	local control	800×300×1050	AC 220 V ±10%, single phase, 50/60 Hz ±5%	IP44
BSKY_BWMS_CON_R	remote control	500×200×450	DC 24 V	
BSKY_BWMS_A	local control (for parallel installations)	800×300×1050	AC 220 V ±10%, single phase, 50/60 Hz ±5%	

Technical specification of the control rack (including UV power supply and US generator)

Model	Size [mm]	Power supply	Protection degree
BSKY_BWMS_CR106	750×750×1330	AC 360-484 V 3-phase 50/60 Hz ±10% or AC 220 V ±10% single phase 50/60 Hz ±10%	IP44
BSKY_BWMS_CR109	750×750×1650		
BSKY_BWMS_CR112	750×750×1970		
BSKY_BWMS_CR106F	845×845×1410		
BSKY_BWMS_CR109F	845×845×1760		
BSKY_BWMS_CR112F	845×1049×1760		

Operating conditions

The operating conditions of BSKY BWMS are listed in the table below. The parameters have been used for reference when evaluating the technical design according to DNV Rules.
The conditions are copied from IMO document MEPC 76/INF.66, Information on the type approval of the BSKY Ballast Water Management System Submitted by China, dated 7 April 2021.

Condition	sort	Limitation
Minimum UVT of ballast water	UVT	≥60% UVT
Minimum UV dose	mJ/cm ²	UV408: ≥167.0 UV514: ≥147.2 UV520: ≥141.6 UV626: ≥136.6 UV632: ≥134.8
Minimum power of US unit	kW	US25: ≥5.04 US35: ≥7.56 US45: ≥9.24 US50: ≥10.09 US55: ≥11.76
Minimum holding time	hour	≥72 hours
Ballast water temperature	°C	No limitation
Salinity	PSU	No limitation
Minimum inlet pressure	MPa	≥0.1
Maximum working pressure	MPa	0.5
Environment temperature	°C	0~55

Installation of the BWMS

Installation of BSKY BWMS shall be according to the below listed equipment/assembly drawings.

Type of document	Title	Drawing No.	Rev. / Date
OMSM	OMSM of BSKY BWMS / INSTRUCTION	Chapters 1-6 (and 12 for Ex)	Rev.D 2022-10-28
General Arrangement drawings	1-General Arrangement Drawings	BSKY_BWMS_DWG001 R01	Rev.1.0.2 2020-04-19
P&ID	2-Piping & Instrumentation Diagram	BSKY_BWMS_DWG002 R01	Rev.1.0.2 2021-04-20
Electric drawings	Electric Wiring Diagram Drawings	BSKY_BWMS_DWG003 R01	Rev.D 2022-08
Bill of Materials	Bill of Materials & Certificates of Components	within OMSM, Chapter 6	Rev. 1.1.4 2022-10-28
	Bill of Materials & Certificates of Ex-proof Components	OMSM, Chapter 12 (if applicable)	Rev. 1.0.6 2022-08-19
Installation instruction	Installation and Maintenance Instruction Manual	Appendix 9	Rev G 2022-10-09

Hazardous area / Ex-proof

The BSKY BWMS has been evaluated for compliance with DNV Rules Pt.4 Ch.8 Sec.11 for hazardous area installations. The UV module, US unit, valves and flowmeters have Ex-certification and can be installed in hazardous area zone 1, gas group IIC and temperature class T4, but the electrical power supply and control systems are to be in a safe zone. Ex-certification is not covered by this certificate. Installation in a hazardous area is to be approved in each case according to the Rules and Ex-certification / Special Condition for Safe Use, listed in a valid Ex-certificate issued by a notified/recognized Certification Body.

Control and monitoring equipment

Software version

The BSKY BWMS is type approved with the system control software version

ARM: CON_V1.x; HMI: DIS_V1.x (where x shall be 0 or higher).

Any changes to the software are to be recorded as long as the BWMS is in use on board. The records of all changes are to be forwarded to DNV for evaluation. Major changes in the software, which can alter the performance of the system, require approval. Testing of the application functions of the revised software may be required.

Safety measures

The BSKY BWMS is type approved with the following instruments related to safety:

- Flow meter installed for each US+UV unit, providing low flow alarm/shutdown in case of low flow rate (minimum flow for each unit is to be <70% of TRC).
- Temperature sensor installed within each UV module, triggering independent high temperature alarm/shutdown when above 60°C.
- Pressure transmitters mounted at inlet of the CY unit and at outlet of the UV module, triggering BWMS shutdown at high pressure of >0.5 MPa.

Electrical and electronic components

The type approved BWMS shall include the following control and monitoring equipment (including the above listed instruments related to safety) indicated on the P&ID and specified on the component lists (chapter 6 or chapter 12 to the OMSM). Except for the components listed below, alternate models to the ones specified on the component lists may be used provided that information regarding the selected components is part of the documentation related to the specific installation, by providing either a reference to a valid type approval certificate or technical documentation demonstrating that the selected component was subject to environmental testing as per IACS UR E10. EMC in the range 2 GHz to 6 GHz according to DNV-CG-0339 (August 2021) shall be documented for installation on ships which are contracted for construction on or after 2022-01-01.

For the following electrical and electronic components, only the model specified in the component list shall be used:

Component	Model	Manufacturer
UVI sensor	UVC1000(Ex)	Wuxi Brightsky Electronic Co., Ltd.
Control unit	BSKY_BWMS_CR1##/ BSKY_BWMS_CON	
UV power supply	BSUV	
US power supply	BSKY_BWMS_USPS	
Control rack (Including UV power supply & US generator)	CR106, CR109, CR112, CR106F, CR109F, CR112F	
Remote control panel (optional)	BSKY_BWMS_CON_R	
Auxiliary control panel (for parallel installations)	BSKY_BWMS_A	

Documents approval for an installation

The following documentation is to be submitted for approval for each BWMS installation:

- Piping and Instrumentation Diagram (P&ID) of the ballast system including the treatment system installation
- Interface description towards ship's existing systems including alarms for failure
- Description confirming the arrangement of alarms for bypass of the BWMS system (as part of Ballast Water Management Plan)
- Power supply arrangement
- List of Ex equipment according to Pt.4 Ch.8 Sec.11 if the system is to be installed in hazardous area zone
- BWMS Commissioning procedure

Design type approval documentation

Test plans and reports

- Environmental test report No. S033A-2020, by Shanghai Marine Auxiliary Electromechanical Equipment Performance and Environmental Testing Center, 2022-10-29

System documents

- BSKY BWMS OMSM (Operation, Maintenance, Safety Manual) by BSKY, including Chapter 1 System Description (rev. 1.0.5), Chapter 2 The Introduction of Control and Monitoring System (rev. 1.0.8), Chapter 3 Maintenance Manual (rev. 1.0.8), Chapter 4 Operation Manual (rev. 1.1.2), Chapter 5, Safety Manual (rev. 1.0.2), Chapter 6 Bill of Materials & Certificates of Components (rev. 1.1.4), Chapter 12 Bill of Materials & Certificates of Ex-proof Components (rev. 1.0.6).
- Scaling Report of BSKY BWMS, Rev. 1.1.1, by Wuxi Brightsky Electronic Co., Ltd., 2020-09-22.
- Risk Assessment Report for BWMS, HAZID report - Brightsky Ballast Water Treatment System (generic design), Rev.1, by Lloyd's Register Classification Society (China) Co. Ltd. 2015-07-22.
- BSKY BWMS Factory Acceptance Test Procedure/Record by BSKY, Rev. B, dated 2022-05-16.
- BSKY BWMS Onboard Test Recording Procedure, Rev. D, dated 2022-09-01 (File No. QR-QP12-09).
- BSKY BWMS Control & Monitoring Program (BSKY_CON_E) Quality Assurance Plan, Rev. 1.1, dated 2017-01-23.
- BSKY BWMS Alarm list (Appendix 04), Rev. 1.0.2, dated 2022-05-07, by BSKY.
- IMO MEPC 76/INF.66, Information on the type approval of the BSKY Ballast Water Management System Submitted by China, dated 2021-04-07.

Tests carried out

Function tests of the control and automation system witnessed by DNV on 9 November 2022.

Marking of product

For traceability of this Type Approval for Design, each treatment system is to be marked with:

- Manufacturer's name or trademark
- Type designation
- Serial number

Periodical assessment

For retention of this Type Approval Design Certificate, DNV may perform periodical assessments to verify that the conditions of the TADC are not altered since the certificate was issued. The scope of periodical assessment includes:

- Review of the TA documentation and verification that the documentation is still used as basis for the production
- Review of possible changes in design, material and performance of the product
- Assessment of validity of the TADC in reference to the latest rules

Revision history

Revision	Date of issuance	Description
-	2022-11-15	First issuance. Complete review of technical documentation in relation to DNV Rules