

TYPE APPROVAL CERTIFICATE

This is to certify:

That the **Ballast Water Management System**

with type designation(s)
LanghBW300, LanghBW600

Issued to

Langh Tech Oy Ab
Pikis, Finland

is found to comply with

IMO Resolution MEPC.300(72) - Code for Approval of Ballast Water Management Systems (BWMS Code)
DNV rules for classification – Ships Pt.6 Ch.7 Sec.1 Ballast water management – BWM
DNV class programme DNV-CP-0209 – Type approval – Ballast water management systems
DNV class guideline DNV-CG-0339 – Environmental test specification for electrical, electronic and programmable equipment and systems

Application :

This is to certify that the **Ballast Water Management System** listed above has been examined and tested in accordance with the requirements of the specifications contained in the **BWMS Code (MEPC.300(72))** and **DNV rules** stated above. This certificate is valid only for the **Ballast Water Management System** referred to above.

System Design Limitations / Limiting Operating Conditions imposed are described in this certificate.

For the compliance with the BWMS Code, the certificate is issued on behalf of the **Finnish Transport and Communications Agency (Traficom)**.

Product(s) approved by this certificate is/are accepted for installation on all vessels classed by DNV, unless otherwise instructed by relevant **Maritime Administrations**.

Issued at **Høvik** on **2022-05-12**

This Certificate is valid until **2027-05-11**.

DNV local station: **Finland CMC**

for **DNV**

Approval Engineer: **Michael Lehmann**

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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.



Name of ballast water management system (BWMS)

LanghBW BWMS

Ballast water management system manufactured by

Langh Tech Oy Ab

Place of production

Langh Tech Oy Ab, Alaskartano, 21500 Pikis, Finland

Type and model designations

LanghBW300 and LanghBW600

Equipment / Assembly drawings

The LanghBW BWMS shall be installed in accordance with the documents listed below.

Type	Title		Drawing no. ⁽¹⁾	Revision	
Operation, maintenance and safety manual (OMSM)	LanghBW300 Ballast Water Management System Operation, Maintenance and Safety Manual (OMSM)		5000.2000.10	A	
	LanghBW600 Ballast Water Management System Operation, Maintenance and Safety Manual (OMSM)		5000.2000.11	A	
Piping and instrumentation diagram (P&ID)	LT BWMS P&ID	LanghBW300	5000.1700.20	A	
		LanghBW600	5000.1700.30	A	
Bill of materials (BoM)	LT BWMS Equipment List	LanghBW300	5000.1700.20	A	
		LanghBW600	5000.1700.30	A	
Electrical wiring diagram	Cabling diagram		LanghBW300	5000.900.101	-
			LanghBW600	5000.900.111	-
	Circuit diagram	Control cabinet	LanghBW300	5000.900.102	-
			LanghBW600	5000.900.112	-
		Remote I/O cabinet	LanghBW300	5000.900.103	-
			LanghBW600	5000.900.113	-
		UV-lamp power cabinet	LanghBW300	5000.900.104	-
			LanghBW600	5000.900.114 (UVP1) 5000.900.116 (UVP2)	-
		Reactor unit	LanghBW300	5000.900.105	-
			LanghBW600	5000.900.115 (RU1) 5000.900.117 (RU2)	-
Manifold drawings for parallel installation of multiple UV reactors	LanghBW600 Approved manifolds	Manifold arrangement 1	000.5000.31	A	
		Manifold arrangement 2	000.5000.32	A	
		Manifold arrangement 3	000.5000.33	A	

(1) The documentation provided for a specific installation will have a case specific drawing number with 5001, 5002, 5003, etc. (consecutive numbering) instead of 5000.

Other equipment manufactured by

The LanghBW BWMS applies filters of the RF14 series manufactured by HYDAC Process Technology GmbH with a filtration degree of 20 µm (Δ-Mesh filter element).

Treatment Rated Capacity

300 - 600 m³/h

Product description

Treatment sequence:

- Ballast water uptake: Filtration followed by UV treatment
- Ballast water discharge: UV treatment

The LanghBW BWMS may apply filtration and UV treatment at uptake only with no UV treatment at discharge when treating ballast water with a salinity of at least 28 PSU. This one way treatment option requires that the system is equipped with a salinity sensor and that the salinity of ballasted water is recorded for each ballast water uptake operation. Ballast water that is treated only at intake must be ballasted to a tank that either is emptied to an extent that no ballast water of salinity below 28 PSU is present or that contains treated ballast water of at least 28 PSU.

System design limitations / Water quality parameters

Temperature & salinity

Temperature and salinity of the ballast water are not limiting conditions for the LanghBW BWMS.

The option to apply UV treatment during ballast water uptake only (one way treatment option) is limited to taking up ballast water with a salinity of at least 28 PSU.

System design limitations / Operational parameters

Holding time

The LanghBW BWMS has demonstrated performance to the discharge standard with a minimum holding time between uptake and discharge of 24 hours in land-based testing in each of the three salinity ranges. UV treatment is instant and does not require any hold time in a ballast tank to render organisms inviable. Therefore, holding time is not found to be a limiting condition for the BWMS.

UV dose

The LanghBW BWMS evaluates the water quality through measurements of UV intensity (UVI). At high UVT levels, the BWMS reduces the power to the UV lamps to maintain the minimum UVI limit for operating at TRC. At low UVT levels, the BWMS automatically adjusts the flow rate by use of a flow control valve installed after the UV reactor with the target flow being a function of the measured UVI. The UVI activating flow reduction, the minimum flow rate and the minimum UVI limit at the minimum flow rate are listed below.

Model	UVI activating automatic flow reduction	UVI limit at minimum flow rate
LanghBW300	600 W/m ² at 300 m ³ /h	225 W/m ² at 100 m ³ /h
LanghBW600	600 W/m ² at 600 m ³ /h	225 W/m ² at 200 m ³ /h

Land-based tests confirmed treatment in compliance with the discharge standard at a UVT down to 46%.

Treatment Rated Capacity

The maximum flow rates of the UV reactor unit models and the HYDAC RF14 filter models applied by the LanghBW BWMS are listed below. For ballast water uptake operations, the Treatment Rated Capacity (TRC) of a specific LanghBW BWMS model is limited by the maximum flow rate of either the selected UV reactor unit or filter model, whichever is lower. For ballast water discharge operations, the TRC is limited by the maximum flow rate of the selected UV reactor unit.

The BWMS automatically controls the flow rate with a flow control valve targeting TRC or flow rate corresponding to the measured UVI when treating ballast water with lower UVT levels.

UV reactor unit	Number of UV reactors	Maximum flow rate [m ³ /h]
LanghBW300	1	300
LanghBW600	2	600

Filter model	Maximum flow rate [m ³ /h]
RF14-15	300
RF14-20	520
RF14-25	800

Pressure

The minimum and maximum system operating pressure and the differential pressure triggering backflushing are listed below.

Minimum operating pressure (minimum filter inlet pressure)	Maximum operating pressure (maximum reactor unit pressure)	Differential pressure triggering backflushing
2.0 bar	3.5 bar	0.5 bar

A booster pump (optional) may be installed if the capacity or pressure head of the exiting ballast water pumps are found insufficient. A backflush pump (optional) may be installed to improve filter backflushing.

Control and monitoring equipment

Software version

The LanghBW BWMS is type approved with the system control software version V1.X.Y.C5000.A. "V1" represents the major release number of the software. A major release of the software will be any change to the control and operating philosophy of the system. The "X" represents the minor release version of the software and indicates any functional extensions of the software. The "Y" represents the patch level which is changed in case of bug fixes to the software. The "C5000" represents the project specific software version, and each project will have a specific case number (consecutive numbering C5001, C5002, C5003, etc.). The "A" represents the revision of the project specific software version.

Any changes to the software are to be recorded as long as the system is in use on board. Records of any major software changes or any changes to the hardware are to be forwarded to DNV for evaluation. Major software changes include any change to the control and operating philosophy of the BWMS, which can alter the performance of the system. Testing of the application functions of the revised software may be required.

Safety measures

The LanghBW BWMS is type approved with the following instruments for monitoring the safe operation of the BWMS and for activating, as necessary, an automatic shutdown of the BWMS:

- Pressure transducers FU1PT01 and FU1PT02 before and after the filter;
- UV reactor temperature transmitter RUXTT01 installed on each reactor;
- UV reactor temperature switch RUXTS01 installed on each reactor (each arranged with safety function independent of BWMS control).

Electrical and electronic components

The LanghBW BWMS is type approved with the electrical and electronic components indicated on the P&ID and specified on the BoM.

Except for the components listed below, alternate components to the ones specified on the BoM 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 (rev. 7 or as amended).

EMC in the range 2 GHz to 6 GHz according to DNVGL-CG-0339 (December 2019) has not been documented for the pressure transmitters DMK 457 by BD Sensors and IS-3 by WIKA IS-3, the temperature transmitter TR10-B by WIKA and the salinity transmitter SL8040 by Daniamant Electronics. EMC up to 6 GHz must additionally be documented for these components for installation on ships contracted for construction on or after 2022-01-01.

For the following electrical and electronic components only the models specified in the BoM shall be used:

Tag No.	Component name	Manufacturer	Model(s)
CC1	Control cabinet	Langh Tech / Gistele	As per circuit diagram 5000.900.102 (LanghBW300) or 5000.900.112 (LanghBW600)
	Central processing unit (CPU) (part of control cabinet)	Siemens	SIMATIC CPU 1510SP-1 PN
	HMI panel (part of control cabinet)	Siemens	SIMATIC MTP1000
-	Remote control HMI panel	Siemens	SIMATIC MTP1000
UVPX	UV power cabinet	Langh Tech / Gistele	As per circuit diagram 5000.900.104 (LanghBW300) or 5000.900.114 (UVP1) and 5000.900.116 (UVP2) (LanghBW600)
-	Medium pressure UV lamps	USHIO	UVE 063101 6 kW
RUXRT01	UVI sensor	uv technik	SUV 20.2

Hazardous area / Ex-proof

The LanghBW BMWS is not intended to be installed in hazardous area.

Documents approval

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;
- Commissioning procedure;
- Interface description towards ship's existing systems including alarms for failure.

Type approval documentation

Test plan and reports:

- NIVA: Test/Quality Assurance Plan (TQAP) for full scale land-based testing of the Ballast Water Management System of Langh Tech (Journal no: 0122/21), Rev. 2.0 dated 18 May 2021
- NIVA: Test/Quality Assurance Plan (TQAP) for shipboard testing of Ballast Water Management System of Langh Tech (Journal No. 0239/21), Version No. 2.1 dated 14 July 2021
- NIVA: Full scale land-based testing of the Ballast Water Management System of Langh Tech (NIVA report no. 7655-2021), Final version dated 16 December 2021
- NIVA: Shipboard testing of the Ballast Water Management System of Langh Tech Oy Ab (NIVA report no. 7727-2022), Final version dated 11 March 2022
- Applica Test & Certification: Test plan for Langh Tech Oy Ab - ENV and EMC testing of components of new ballast water management system BWMS, Rev. A dated 15 October 2021

- Applica Test & Certification: Technical report - EMC and Environmental testing of Langh Tech Ballast Water Management System (Report no. 30817), Rev. 1 dated 5 April 2022
- Langh Tech Oy Ab: LanghBW RU pressure test, Rev. A dated 17 March 2022

System documentation:

- Langh Tech Oy Ab: LanghBW300 Ballast Water Management System Operation, Maintenance and Safety Manual (OMSM), Rev. A
- Langh Tech Oy Ab: LanghBW600 Ballast Water Management System Operation, Maintenance and Safety Manual (OMSM), Rev. A
- Langh Tech Oy Ab: Automation Functional Description, Rev. A
- Langh Tech Oy Ab: Function test plan LanghBW300, Rev. A
- Langh Tech Oy Ab: Function test plan LanghBW600, Rev. A
- Langh Tech Oy Ab: LanghBW300 Commissioning procedure, Rev. A
- Langh Tech Oy Ab: LanghBW600 Commissioning procedure, Rev. A
- Langh Tech Oy Ab: LanghBW600 – Manifold study M3 - CFD Analysis Report, Rev. B
- Langh Tech Oy Ab: BWMS control system software quality plan, Rev. B

Tests carried out

- Land-based testing with LanghBW300 BWMS with one UV reactor and a HYDAC RF14-15 filter
- Shipboard testing with LanghBW600 BWMS with two UV reactors in parallel and a HYDAC RF14-20 filter
- Function tests of the control and monitoring system and pressure test witnessed by DNV
- Environmental testing in accordance with DNV class guidelines for Environmental test specification for electrical, electronic and programmable equipment and systems (DNV-CG-0339, Edition August 2021) and IACS UR E10 (rev. 8)

Marking of product

For traceability of this type approval, each treatment system is to be marked with:

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

Periodical assessment

For retention of the Type Approval, DNV Surveyor shall perform periodical assessments to verify that the conditions of the TA 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.
- Verification of the company's production and quality systems ensuring continued consistent production of the type approved products to the required quality.
- Verification that the product marking for identification and traceability to the TA Certificate is not altered



Job Id: 262.1-035135-1
Certificate No: TAP00002GN

Copy of type approval certificate

A copy of this type approval certificate should always be carried on board a vessel fitted with this ballast water management system. An annex containing the summary reports of the test results of land-based and shipboard tests should be available for inspection on board the vessel.

Revision history of this certificate

Revision No.	Date of Issuance	Description
-	2022-05-13	Initial certificate

Annex A: Summary of testing

Land-based testing

Table 1 Test water conditions and operational parameters in land-based testing with the LanghBW300 BWMS with one UV reactor and a HYDAC RF14-15 filter at NIVA's test facility at Solbergstrand, Drøbak, Norway, during the period from 19 May to 27 July 2021.

Test cycle	Water temperature [°C]	Salinity [PSU]	UVT [%]	DOC [mg/L]	POC [mg/L]	TSS [mg/L]	Holding time [hours]	Average UVI at uptake ⁽¹⁾ [W/m ²]	Average flow rate at uptake (after filtration) [m ³ /h]
<i>Marine water</i>									
1	13	30	66	8.3	6.2	64	23	600	297
2	12	31	61	9.8	7.0	68	119	602	231
3	12	31	60	10.1	6.6	71	119	601	223
4	15	30	72	9.3	7.2	42	24	602	297
5	15	30	73	9.3	7.5	42	24	602	295
<i>Brackish water</i>									
6	18	18	53	12.2	6.1	57	25	361	179
7	16	18	47	12.5	6.8	66	23	273	133
8	17	18	46	13.1	7.1	65	23	271	133
9	17	18	57	9.7	6.4	57	119	370	185
10	18	18	56	9.6	7.0	58	119	365	185
<i>Fresh water</i>									
11	16	0	54	13.9	5.5	56	23	226	102
12	16	0	54	14.1	5.6	56	23	229	104
13	20	0	67	9.6	7.7	57	119	406	199
14	21	0	66	9.7	7.0	58	120	403	203
15	20	0	59	13.1	7.6	69	22	229	105

(1) Stated values are the average of the UVI displayed on the HMI and periodically recorded by NIVA.

Table 2 Average numbers of live organisms in influent water, treated discharge water and control water in land-based testing with the LanhBW300 BWMS. Live organisms ≥ 10 and < 50 μm were quantified by microscopy counting after staining with FDA/CMFDA. Concentrations of the indicator microbes *Escherichia coli*, Enterococci and *Vibrio cholerae* in treated discharge water were below the D-2 standard in all test cycles.

Test cycle	Organisms ≥50 μm [organisms/m³]				Organisms ≥10-<50 μm [organisms/mL]			
	Influent water	Treated discharged water (UV treatment during uptake only)	Treated discharged water (UV treatment during uptake and discharge)	Control water	Influent water	Treated discharged water (UV treatment during uptake only)	Treated discharged water (UV treatment during uptake and discharge)	Control water
Marine water								
1	353 563	0.3	<0.3 ⁽¹⁾	167 617	1 542	4.8	0.5	447
2	137 438	<0.3 ⁽¹⁾	<0.3 ⁽¹⁾	82 817 ⁽²⁾	5 317	2.0	<0.2 ⁽¹⁾	275 ⁽²⁾
3	147 883	<0.3 ⁽¹⁾	<0.3 ⁽¹⁾		5 767	8.3	<0.2 ⁽¹⁾	
4	1 006 863	<0.3 ⁽¹⁾	<0.3 ⁽¹⁾	627 928 ⁽²⁾	9 167	5.5	0.5	2 627 ⁽²⁾
5	787 983	<0.3 ⁽¹⁾	<0.3 ⁽¹⁾		9 150	4.8	0.7	
Brackish water								
6	872 779	<0.3 ⁽¹⁾	<0.3 ⁽¹⁾	971 642	3 392	8.0	0.3	1 417
7	1 238 492	0.3	1.7	144 288 ⁽²⁾	6 642	7.3	0.2	4 467 ⁽²⁾
8	1 066 471	0.3	1.0		6 967	7.3	0.2	
9	993 904	<0.3 ⁽¹⁾	<0.3 ⁽¹⁾	208 250 ⁽²⁾	7 467	26.5	<0.2 ⁽¹⁾	620 ⁽²⁾
10	1 149 850	0.3	0.3		7 700	15.3	0.3	
Fresh water								
11	352 935	30	0.7	160 147 ⁽²⁾	3 158	4.2	0.3	3 317 ⁽²⁾
12	455 404	37	0.7		3 475	5.8	<0.2 ⁽¹⁾	
13	347 129	ND	<0.3 ⁽¹⁾	356 317 ⁽²⁾	7 600	ND	<0.2 ⁽¹⁾	3 525 ⁽²⁾
14	417 475	ND	<0.3 ⁽¹⁾		8 467	ND	<0.2 ⁽¹⁾	
15	423 817	ND	<0.3 ⁽¹⁾	335 467	7 933	ND	0.3	7 533

(1) No viable organisms detected. Detection limit is reported.

(2) Two test cycles were performed on the same day using the same control water tank.

ND Not determined. Additional samples prior to the 2nd UV treatment were only taken during the first two test cycles in fresh water. When these test cycles showed non-compliance for organisms in the size class ≥ 50 μm , taking additional samples was discontinued.

Shipboard testing

Table 3 Test water conditions and operational parameters in shipboard testing with the LanghBW600 BWMS with two UV reactors in parallel and a HYDAC RF14-20 filter on board the container ship LINDA (IMO No. 9354325) during the period of 10 July 2021 to 1 February 2022.

Test cycle	Water temperature [°C]	Salinity [PSU]	UVT [%]	DOC [mg/L]	POC [mg/L]	TSS [mg/L]	Holding time [h]	Average UVI at uptake ⁽²⁾ [W/m ²]	Average flow rate at uptake ⁽¹⁾ (before filtration) [m ³ /h]
1	13	26	91	2.1	0.4	1.5	22	530 / 530	494
4	18	13	86	4.2	0.4	1.6	24	532 / 529	514
5	16	7	83	4.6	0.4	1.3	24	472 / 457	455
6	17	12	87	3.8	0.3	1.4	28	530 / 528	513
7	15	7	84	4.2	0.3	1.3	28	530 / 529	507
8	8	34	92	1.3	0.4	9.0	31	528 / 529	509

(1) The ballast water pumps on board the selected test vessel delivered a maximum flow rate of approximately 530 m³/h. Therefore, the TRC of the LanghBW600 BWMS used for SB testing was adjusted from 600 m³/h to 530 m³/h by adjusting the flow control curve and the UVI setpoint for activating automatic flow reduction from 600 W/m² to 530 W/m².

(2) Stated values are the average of the UVI displayed on the HMI and periodically recorded by NIVA for each of the two UV reactors. For determining the appropriate flow rate, the LanghBW BWMS considers the lowest UVI if several UV reactors are installed in parallel.

Table 4 Average numbers of live organisms in influent water and treated discharge water in shipboard testing with the LanghBW600 BWMS. Live organisms ≥10 and <50 µm were quantified by microscopy counting after staining with FDA/CMFDA. Concentrations of the indicator microbes *Escherichia coli*, Enterococci and *Vibrio cholerae* in treated discharge water were below the D-2 standard in all test cycles.

Test cycle	Influent water	Organisms ≥50 µm [organisms/m ³]		Influent water	Organisms ≥10-<50 µm [organisms/mL]	
		Treated discharged water (UV treatment during uptake only)	Treated discharged water (UV treatment during uptake and discharge)		Treated discharged water (UV treatment during uptake only)	Treated discharged water (UV treatment during uptake and discharge)
1	125 147	2.3	<0.3 ⁽¹⁾	124	2.7	0.3
4	15 113	4.2	1.8	113	1.8	0.2
5	7 205	4.4	1.3	105	3.0	0.3
6	250 985	1.4	0.2	314	2.0	0.5
7	36 610	<0.3 ⁽¹⁾	0.2	132	3.3	0.2
8	413	0.6	0.5	6	<0.2 ⁽¹⁾	<0.2 ⁽¹⁾

(1) No viable organisms detected. Detection limit is reported.