

型式指定書
TYPE APPROVAL CERTIFICATE OF BALLAST WATER
MANAGEMENT SYSTEM



日本国
JAPAN

ここにバラスト水管理システムの承認に関するコード (決議 MEPC.300(72)) に含まれる性能要件に従い、以下のバラスト水管理システムが調査及び試験されたことを証明する。この証明書は、以下に示されるバラスト水管理システムについてのみ有効である。

This is certify that the Ballast Water Management Systems 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 the ballast water management system referred to below.

バラスト水管理システムの名称

Name of ballast water management system : Optimarin Ballast System

バラスト水管理システムの製造者

Ballast water management system manufactured by Optimarin AS

型式名

Under type and model designation(s) and incorporating: OBS

完成図書番号及び日付

To equipment/assembly drawing No. See APPENDIX

その他装置の製造者、完成図書番号及び日付

Other equipment manufactured by See APPENDIX

to equipment/assembly drawing No. See APPENDIX

定格処理能力

Treatment Rated Capacity 72 - 3,000 m³/h

検査の際に利用できるよう、この証明書の写しを、バラスト水管理システムとともに船上に備え置くこと。この証明書を他の主管庁の認証に基づき発行した場合は、当該認証につき明記する。

A copy of this Type Approval Certificate shall be carried on board a ship fitted with this ballast water management system, for inspection on board the ship. If the Type Approval Certificate is issued based on approval by another Administration, reference to that Type Approval Certificate shall be made.

*2020年10月23日付証明書番号 TAP0000271 ノルウェー主管庁を代行し DNV-GL が発行。

*Certificate No: TAP0000271 issued by DNV-GL, on behalf of the Norwegian Maritime Directorate on 23 October 2020

課された制限操作条件は、この証明書に記す。

Limiting Operation Conditions imposed are described in this document.

水温

• Water Temperature ; No limitation

塩分濃度

• Salinity ; No limitation

タンク保持時間

• Holding Time ; No limitation

他の制限事項は以下を含む

Other restrictions imposed include the following:

この装置は、以下の条件で操作するよう設計されている。

This equipment has been designed for operation in the following conditions (System Design Limitations.):

定格処理流量

- Treatment Rated Capacity ; 40 m³/h ~167 m³/h (per one UV chamber)

定格処理流量におけるUVI

- UVI lower limit at full flow ; 400 [W/m²]

定格処理流量の24%におけるUVI

- UVI lower limit at 24% of full flow ; 150 [W/m²]

フィルタ圧力

- Pressure of Filter ; See APPENDIX

(印 章)
(official stamp)



Signed

小磯 康

(Koiso Ko)

Director, Inspection and Measurement Division, Maritime Bureau
Ministry of Land, Infrastructure, Transport and Tourism,
Government of Japan

2021年10月26日発給した。

Issued this 26 day of October, 2021.

2026年10月25日まで有効である。

Valid until this 25 day of October, 2026.

APPENDIX

1. TECHNICAL DESCRIPTION OF MAJOR COMPONENTS

| UV chamber | |
|---------------|---|
| Manufacturer | Manifold & UV chamber: Design of Optimarin AS produced by CIG Piping Technology UV sensor: IL Metronic Sensortechnik GmbH UV lamp: Ultralight AG, Eta plus electronic GmbH, UV-Technik Speziallampen GmbH |
| Specification | Power of UV lamp: 35 kW |

| Filter | | |
|--------------------------------|--|--|
| Manufacturer | Boll & Kirch | Filtrex |
| Type | aquaBoll 6.18.3, BK3 | ACB, FX2 |
| Flow Range (m ³ /h) | aquaBoll 273: 19 - 72 aquaBoll 324: 19 - 94 aquaBoll 356: 24 - 204 aquaBoll 419: 33 - 378 aquaBoll 521: 33 - 518 aquaBoll 600: 34 - 614 aquaBoll 750: 50 - 1274 aquaBoll 900: 47 - 1384 aquaBoll 1000: 47 - 2040 aquaBoll 1100: 69 - 3100 | 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 |
| Filter element | 25 µm | 20 µm |
| Design pressure | 10 bar | 10 bar |

| Control Panel (CP) | |
|--------------------|-------------------|
| Manufacturer | Optimarin AS |
| Model | Control Panel MK3 |
| Specification | Enclosure: IP 65 |

| UV Power cabinet (UVP) | | | |
|------------------------|---|---|---|
| Manufacturer | Nedap N.V. | Eta plus electronic GmbH | Uvantech AS |
| Model | NED MK3 | ETA | UVA |
| Specification | Enclosure: IP 44 Operation Voltage: AC 1260V | Enclosure: IP 54 Operation Voltage: AC 2150V | Enclosure: IP 54 Operation Voltage: AC 2150V |

2. APPROVED RATINGS

| SYSTEM MODEL | TRC (ballasting / deballasting) [m ³ /h] | FILTER UNIT | UV UNIT |
|---------------------------------------|--|-------------------|-----------------|
| With filter type aquaBoll 6.18.3, BK3 | | | |
| OBS 167/72BK3 (EX) | 72 / 167 | aquaBoll 273 x 1 | UV chamber x 1 |
| OBS 167/94BK3 (EX) | 94 / 167 | aquaBoll 324 x 1 | UV chamber x 1 |
| OBS 167/204BK3 (EX) | 167 / 167 | aquaBoll 356 x 1 | UV chamber x 1 |
| OBS 334/204BK3 (EX) | 204 / 334 | aquaBoll 356 x 1 | UV chamber x 2 |
| OBS 334/378BK3 (EX) | 334 / 334 | aquaBoll 419 x 1 | UV chamber x 2 |
| OBS 500/378BK3 (EX) | 378 / 500 | aquaBoll 419 x 1 | UV chamber x 3 |
| OBS 500/518BK3 (EX) | 500 / 500 | aquaBoll 521 x 1 | UV chamber x 3 |
| OBS 667/518BK3 (EX) | 518 / 667 | aquaBoll 521 x 1 | UV chamber x 4 |
| OBS 667/614BK3 (EX) | 614 / 667 | aquaBoll 600 x 1 | UV chamber x 4 |
| OBS 667/1274BK3 (EX) | 667 / 667 | aquaBoll 750 x 1 | UV chamber x 4 |
| OBS 834/1274BK3 (EX) | 834 / 834 | aquaBoll 750 x 1 | UV chamber x 5 |
| OBS 1000/1274BK3 (EX) | 1000 / 1000 | aquaBoll 750 x 1 | UV chamber x 6 |
| OBS 1167/1274BK3 (EX) | 1167 / 1167 | aquaBoll 750 x 1 | UV chamber x 7 |
| OBS 1334/1274BK3 (EX) | 1274 / 1334 | aquaBoll 750 x 1 | UV chamber x 8 |
| OBS 1334/1384BK3 (EX) | 1334 / 1334 | aquaBoll 900 x 1 | UV chamber x 8 |
| OBS 1500/1384BK3 (EX) | 1384 / 1500 | aquaBoll 900 x 1 | UV chamber x 9 |
| OBS 1500/2040BK3 (EX) | 1500 / 1500 | aquaBoll 1000 x 1 | UV chamber x 9 |
| OBS 1667/2040BK3 (EX) | 1667 / 1667 | aquaBoll 1000 x 1 | UV chamber x 10 |
| OBS 1834/2040BK3 (EX) | 1834 / 1834 | aquaBoll 1000 x 1 | UV chamber x 11 |
| OBS 2000/2040BK3 (EX) | 2000 / 2000 | aquaBoll 1000 x 1 | UV chamber x 12 |
| OBS 2167/2040BK3 (EX) | 2040 / 2167 | aquaBoll 1000 x 1 | UV chamber x 13 |
| OBS 2167/3100BK3 (EX) | 2167 / 2167 | aquaBoll 1100 x 1 | UV chamber x 13 |
| OBS 2334/3100BK3 (EX) | 2334 / 2334 | aquaBoll 1100 x 1 | UV chamber x 14 |
| OBS 2500/3100BK3 (EX) | 2500 / 2500 | aquaBoll 1100 x 1 | UV chamber x 15 |
| OBS 2667/3100BK3 (EX) | 2667 / 2667 | aquaBoll 1100 x 1 | UV chamber x 16 |
| OBS 2834/3100BK3 (EX) | 2834 / 2834 | aquaBoll 1100 x 1 | UV chamber x 17 |
| OBS 3000/3100BK3 (EX) | 3000 / 3000 | aquaBoll 1100 x 1 | UV chamber x 18 |
| With filter type ACB, FX2 | | | |
| OBS 167/87FX2 | 87 / 167 | ACB-906-100 x 1 | UV chamber x 1 |
| OBS 167/135FX2 | 135 / 167 | ACB-910-150 x 1 | UV chamber x 1 |
| OBS 167/190FX2 | 167 / 167 | ACB-915-150 x 1 | UV chamber x 1 |
| OBS 334/190FX2 | 190 / 334 | ACB-915-150 x 1 | UV chamber x 2 |
| OBS 334/255FX2 | 255 / 334 | ACB-935-200 x 1 | UV chamber x 2 |
| OBS 334/340FX2 | 334 / 334 | ACB-945-200 x 1 | UV chamber x 2 |
| OBS 500/340FX2 | 340 / 500 | ACB-945-200 x 1 | UV chamber x 3 |
| OBS 500/515FX2 | 500 / 500 | ACB-955-250 x 1 | UV chamber x 3 |
| OBS 667/515FX2 | 515 / 667 | ACB-955-250 x 1 | UV chamber x 4 |
| OBS 667/770FX2 | 667 / 667 | ACB-985-300 x 1 | UV chamber x 4 |
| OBS 834/770FX2 | 770 / 834 | ACB-985-300 x 1 | UV chamber x 5 |
| OBS 834/1040FX2 | 834 / 834 | ACB-999-350 x 1 | UV chamber x 5 |
| OBS 1000/1040FX2 | 1000 / 1000 | ACB-999-350 x 1 | UV chamber x 6 |
| OBS 1167/1040FX2 | 1040 / 1167 | ACB-999-350 x 1 | UV chamber x 7 |
| OBS 1167/1500FX2 | 1167 / 1167 | ACB-9100-400 x 1 | UV chamber x 7 |

| | | | |
|------------------|-------------|------------------|-----------------|
| OBS 1334/1500FX2 | 1334 / 1334 | ACB-9100-400 x 1 | UV chamber x 8 |
| OBS 1500/1500FX2 | 1500 / 1500 | ACB-9100-400 x 1 | UV chamber x 9 |
| OBS 1667/2100FX2 | 1667 / 1667 | ACB-9120-500 x 1 | UV chamber x 10 |
| OBS 1834/2100FX2 | 1834 / 1834 | ACB-9120-500 x 1 | UV chamber x 11 |
| OBS 2000/2100FX2 | 2000 / 2000 | ACB-9120-500 x 1 | UV chamber x 12 |
| OBS 2167/2100FX2 | 2100 / 2167 | ACB-9120-500 x 1 | UV chamber x 13 |
| OBS 2167/3000FX2 | 2167 / 2167 | ACB-9200-600 x 1 | UV chamber x 13 |
| OBS 2334/3000FX2 | 2334 / 2334 | ACB-9200-600 x 1 | UV chamber x 14 |
| OBS 2500/3000FX2 | 2500 / 2500 | ACB-9200-600 x 1 | UV chamber x 15 |
| OBS 2667/3000FX2 | 2667 / 2667 | ACB-9200-600 x 1 | UV chamber x 16 |
| OBS 2834/3000FX2 | 2834 / 2834 | ACB-9200-600 x 1 | UV chamber x 17 |
| OBS 3000/3000FX2 | 3000 / 3000 | ACB-9200-600 x 1 | UV chamber x 18 |

3. LAND BASED TEST SUMMARY

| Marine water test cycles (28-36 PSU) BK1 FILTER with 40 µm screen | | | | | | |
|---|----------|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|
| Size category & Water parameter | Sample | Test cycle 1 | Test cycle 2 | Test cycle 3 | Test cycle 4 | Test cycle 5 |
| Organisms ≥ 50µm(inds/m ³) | Influent | 161,917 | 115,308 | 232,633 | 145,239 | 138,740 |
| | Control | 61,846 | 74,619 | 111,792 | 162,222 | 57,707 |
| | Treated | 1.2 | 1.7 | 1.4 | <0.3 | <0.3 |
| Organisms ≥ 10 and < 50µm (inds/mL) | Influent | 1,946 | 3,429 | 2,146 | 3,413 | 2,104 |
| | Control | 430 | 230 | >230 | 330 | 290 |
| | Treated | <0.06 | <0.06 | 0.06 | <0.06 | <0.06 |
| Vibrio cholerae (cfu/100mL) | Influent | - | - | - | - | - |
| | Control | - | - | - | - | - |
| | Treated | <1 | <1 | <1 | <1 | <1 |
| Toxicogenic Vibrio cholerae (cfu/100mL) | Influent | - | - | - | - | - |
| | Control | - | - | - | - | - |
| | Treated | <1 | <1 | <1 | <1 | <1 |
| Coliform (cfu/100mL) | Influent | 86* | 228 | 94 | 1,797 | 41 |
| | Control | 263* | 205 | 105 | 1,830 | 66 |
| | Treated | <10 | <10 | <10 | <10 | <10 |
| Escherichia coli (cfu/100mL) | Influent | - | - | - | - | - |
| | Control | - | - | - | - | - |
| | Treated | <10 | <10 | <10 | <10 | <10 |
| Enterococcus group (cfu/100mL) | Influent | <10 | <10 | <10 | <10 | <10 |
| | Control | <10 | <10 | <10 | <10 | <10 |
| | Treated | <10 | <10 | <10 | <10 | <10 |
| Intestinal Enterococci (cfu/100mL) | Influent | - | - | - | - | - |
| | Control | - | - | - | - | - |
| | Treated | <10 | <10 | <10 | <10 | <10 |
| Heterotrophic bacteria (cfu/mL) | Influent | 8.8 x 10 ⁴ | 6.4 x 10 ⁴ | 3.2 x 10 ⁵ | 3.0 x 10 ⁴ | 2.7 x 10 ⁵ |
| | Control | 2.1 x 10 ² | 4.9 x 10 ⁵ | 4.8 x 10 ⁴ | 3.4 x 10 ⁵ | 2.6 x 10 ⁵ |
| | Treated | 1.1 x 10 ³ | 2.4 x 10 | 7.7 x 10 | 9.0 x 10 ² | 1.1 x 10 ³ |
| DOC(mg/L) | Influent | 6.3 | 6.7 | 5.2 | 6.0 | 5.9 |
| | Control | 6.8 | 5.4 | 5.7 | 5.4 | 5.4 |
| | Treated | 6.8 | 5.5 | 5.1 | 4.9 | 5.6 |
| POC(mg/L) | Influent | 5.7 | 5.6 | 5.3 | 4.9 | 4.9 |
| | Control | 3.4 | 1.6 | 0.8 | 0.9 | 0.8 |
| | Treated | 3.0 | 1.3 | 0.7 | 0.8 | 0.7 |
| TSS(mg/L) | Influent | 29.5 | 31.3 | 27.3 | 26.0 | 27.0 |
| | Control | 17.7 | 8.5 | 2.4 | 6.4 | 4.1 |
| | Treated | 19.2 | 10.7 | 8.1 | 8.3 | 9.0 |
| Temperature (°C) | Influent | 14.53 | 10.73 | 10.2 | 10.0 | 12.3 |
| | Control | 15.0 | 11.0 | 10.1 | 9.6 | 11.6 |
| | Treated | 15.1 | 11.3 | 9.8 | 9.7 | 11.9 |
| Salinity (PSU) | Influent | 32.4 | 30.2 | 29.9 | 28.9 | 28.4 |
| | Control | 32.4 | 30.1 | 29.6 | 28.8 | 28.4 |
| | Treated | 32.5 | 30.2 | 29.6 | 28.9 | 28.4 |
| pH | Influent | 8.4 | 8.0 | 8.0 | 8.2 | 8.1 |
| | Control | 8.3 | 7.9 | 8.0 | 7.9 | 8.0 |
| | Treated | 8.1 | 8.1 | 8.0 | 7.9 | 8.0 |

| | | | | | | |
|--|--------------|------------------------------|-----------------------|------------------------------|-----------------------|-------|
| Dissolved oxygen (mg/L) | Influent | 12.30 | 9.75 | 10.24 | 10.06 | 10.87 |
| | Control | 11.97 | - | 8.77 | - | 8.47 |
| | Treated | 12.00 | 7.99 | 8.20 | 7.88 | 9.08 |
| Turbidity(NTU) | Influent | 11.8 | 14.9 | 11.1 | 10.1 | 11.2 |
| | Control | - | - | - | - | - |
| | Treated | - | - | - | - | - |
| Flow rate(m ³ /h) | Ballasting | 334 | 335 | 333 | 333 | 333 |
| | Deballasting | 333 | 334 | 334 | 333 | 333 |
| UVdose (W/m ²) | Ballasting | 728 | 388.5 | 471 | 624 | 440 |
| | Deballasting | 702 | 413.5 | 523 | 656 | 459.5 |
| Holding Time (Days) | - | 3 | 5 | 5 | 5 | 5 |
| Marine water test cycles (28-36 PSU) | | | | | | |
| Filter Type | | BK3 FILTER with 25 µm screen | | FX2 FILTER with 20 µm screen | | |
| Size category & Water parameter | Sample | Test cycle 6 | Test cycle 7 | Test cycle 8 | Test cycle 9 | |
| Organisms ≥ 50µm(inds/m ³) | Influent | 140,388 | 276,000 | 152,713 | 230,646 | |
| | Control | 192,250 | 276,621 | 192,250 | 276,621 | |
| | Treated | 0.7 | 1.3 | <1 | <1 | |
| Organisms ≥ 10 and < 50µm (inds/mL) | Influent | 1,800 | 1,367 | 1,867 | 1,413 | |
| | Control | 2,000 | >2,700 | 2,000 | >2,700 | |
| | Treated | <0.07 | 0.14 | <0.07 | <0.07 | |
| Vibrio cholerae (cfu/100mL) | Influent | - | - | - | - | |
| | Control | - | - | - | - | |
| | Treated | <1 | <1 | <1 | <1 | |
| Toxicogenic Vibrio cholerae (cfu/100mL) | Influent | - | - | - | - | |
| | Control | - | - | - | - | |
| | Treated | <1 | <1 | <1 | <1 | |
| Coliform (cfu/100mL) | Influent | - | - | - | - | |
| | Control | - | - | - | - | |
| | Treated | - | - | - | - | |
| Escherichia coli (cfu/100mL) | Influent | <10 | <10 | 13 | <10 | |
| | Control | <10 | <10 | <10 | <10 | |
| | Treated | <10 | <10 | <10 | <10 | |
| Enterococcus group (cfu/100mL) | Influent | - | - | - | - | |
| | Control | - | - | - | - | |
| | Treated | - | - | - | - | |
| Intestinal Enterococci (cfu/100mL) | Influent | <10 | <10 | <10 | <10 | |
| | Control | <10 | <10 | <10 | <10 | |
| | Treated | <10 | <10 | <10 | <10 | |
| Heterotrophic bacteria (cfu/mL) | Influent | 1.6 x 10 ⁵ | 3.7 x 10 ⁵ | 1.5 x 10 ⁵ | 3.6 x 10 ⁵ | |
| | Control | 1.6 x 10 ⁵ | 2.1 x 10 ⁵ | 1.6 x 10 ⁵ | 2.1 x 10 ⁵ | |
| | Treated | 4.3 x 10 | 1.7 x 10 ³ | 1.7 x 10 | 1.2 x 10 ³ | |
| DOC(mg/L) | Influent | 8 | 8 | 8 | 8 | |
| | Control | 6 | 7 | 6 | 7 | |
| | Treated | 7 | 8 | 7 | 7 | |
| POC(mg/L) | Influent | 6 | 7 | 6 | 7 | |
| | Control | 4 | 3 | 4 | 3 | |
| | Treated | 3 | 2 | 3 | 2 | |

| | | | | | | |
|--|--------------|--------------|--------------|--------------|--------------|--------------|
| TSS(mg/L) | Influent | 65 | 66 | 66 | 64 | |
| | Control | 41 | 45 | 63 | 62 | |
| | Treated | 43 | 49 | | | |
| Temperature (°C) | Influent | 7 | 7 | 6 | 7 | |
| | Control | - | - | - | - | |
| | Treated | 6 | 7 | 7 | 7 | |
| Salinity (PSU) | Influent | 31.0 | 30.0 | 31.0 | 30.0 | |
| | Control | 31.0 | 30.0 | 31.0 | 30.0 | |
| | Treated | 31.0 | 29.0 | 31.0 | 30.0 | |
| pH | Influent | 8.0 | 7.9 | 8.0 | 7.9 | |
| | Control | 8.0 | 7.8 | 8.0 | 7.8 | |
| | Treated | 8.0 | 7.9 | 8.0 | 7.9 | |
| Dissolved oxygen(mg/L) | Influent | 10.84 | 10.12 | 10.13 | 10.04 | |
| | Control | 10.26 | 9.99 | 10.26 | 9.99 | |
| | Treated | 10.04 | 9.81 | 10.18 | 9.99 | |
| Turbidity(NTU) | Influent | 32.8 | 32.9 | 32.8 | 32.4 | |
| | Control | - | - | - | - | |
| | Treated | - | - | - | - | |
| Flow rate(m ³ /h) | Ballasting | 332 | 327 | 331 | 330 | |
| | Deballasting | 332 | 333 | 333 | 333 | |
| UV dose (W/m ²) | Ballasting | 472 | 454 | 479.5 | 464.5 | |
| | Deballasting | 493.5 | 491 | 501 | 495.5 | |
| Holding Time (Days) | | 1 | 1 | 1 | 1 | |
| Brackish water test cycles (10-20 PSU) BK3 FILTER with 25 µm screen | | | | | | |
| Size category & Water parameter | Sample | Test cycle 1 | Test cycle 2 | Test cycle 3 | Test cycle 4 | Test cycle 5 |
| Organisms ≥ 50µm(inds/m ³) | Influent | 184,954 | 129,063 | 130,363 | 251,646 | 1,107,967 |
| | Control | 222,117 | 96,654 | 96,654 | 247,533 | 499,033 |
| | Treated | 3 | <1 | <1 | 4 | <1 |
| Organisms ≥ 10 and < 50µm (inds/mL) | Influent | 7,300 | 3,875 | 4,158 | 5,133 | 1,050 |
| | Control | 7,233 | 4,100 | 4,100 | 5,900 | 1,050 |
| | Treated | <0.07 | <0.07 | <0.07 | 0.72 | <0.07 |
| Vibrio cholerae (cfu/100mL) | Influent | - | - | - | - | - |
| | Control | - | - | - | - | - |
| | Treated | <1 | <1 | <1 | <1 | <1 |
| Toxicogenic Vibrio cholerae (cfu/100mL) | Influent | - | - | - | - | - |
| | Control | - | - | - | - | - |
| | Treated | <1 | <1 | <1 | <1 | <1 |
| Coliform (cfu/100mL) | Influent | - | - | - | - | - |
| | Control | - | - | - | - | - |
| | Treated | - | - | - | - | - |
| Escherichia coli (cfu/100mL) | Influent | <10 | <10 | <10 | <10 | <10 |
| | Control | <10 | <10 | <10 | <10 | <10 |
| | Treated | <10 | <10 | <10 | <10 | <10 |
| Enterococcus group (cfu/100mL) | Influent | - | - | - | - | - |
| | Control | - | - | - | - | - |
| | Treated | - | - | - | - | - |

| | | | | | | |
|--|--------------|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|
| Intestinal Enterococci (cfu/100mL) | Influent | <10 | <10 | <10 | <10 | <10 |
| | Control | <10 | <10 | <10 | <10 | <10 |
| | Treated | <10 | <10 | <10 | <10 | <10 |
| Heterotrophic bacteria (cfu/mL) | Influent | 4.3 x 10 ⁴ | 9.5 x 10 ⁴ | 8.7 x 10 ⁴ | 7.7 x 10 ⁴ | 1.9 x 10 ⁴ |
| | Control | 1.9x 10 ⁴ | 6.8 x 10 ⁵ | 6.8x 10 ⁵ | 1.6 x 10 ⁵ | 1.7 x 10 ⁵ |
| | Treated | 5.6 x 10 ² | 1.5 x 10 ² | 2.5 x 10 ⁴ | 4.2 x 10 ⁴ | 1.0 x 10 ² |
| DOC(mg/L) | Influent | 8 | 8 | 8 | 11 | 8 |
| | Control | 8 | 8 | 8 | 11 | 9 |
| | Treated | 8 | 7 | 7 | 11 | 8 |
| POC(mg/L) | Influent | 7 | 6 | 5 | 6 | 5 |
| | Control | 4 | 1 | 1 | 3 | 2 |
| | Treated | 2 | 1 | 1 | 2 | 2 |
| TSS(mg/L) | Influent | 66 | 62 | 66 | 61 | 57 |
| | Control | 46 | 8 | 8 | 39 | 28 |
| | Treated | 38 | 20 | 21 | 36 | 35 |
| Temperature (°C) | Influent | 8.99 | 9.80 | 9.95 | 10.01 | 8.90 |
| | Control | 8.76 | 9.57 | 9.57 | 10.01 | 8.14 |
| | Treated | 10.0 | 9.91 | 10.02 | 10.66 | 10.13 |
| Salinity (PSU) | Influent | 18.70 | 19.01 | 18.90 | 18.65 | 19.00 |
| | Control | 18.67 | 18.97 | 18.97 | 18.54 | 18.84 |
| | Treated | 18.79 | 18.96 | 18.91 | 18.43 | 18.65 |
| pH | Influent | 7.89 | 7.90 | 7.91 | 8.09 | 8.06 |
| | Control | 7.90 | 7.94 | 8.94 | 8.15 | 8.10 |
| | Treated | 7.83 | 7.54 | 7.50 | 8.09 | 7.96 |
| Dissolved oxygen(mg/L) | Influent | 10.58 | 9.52 | 9.53 | 9.88 | 10.03 |
| | Control | 10.43 | 9.61 | 9.61 | 10.27 | 10.03 |
| | Treated | 10.00 | 8.04 | 7.66 | 10.28 | 9.71 |
| Turbidity(NTU) | Influent | 33.1 | 32.6 | 30.9 | 32.1 | 31.8 |
| | Control | - | - | - | - | - |
| | Treated | - | - | - | - | - |
| Flow rate(m ³ /h) | Ballasting | 163 | 178 | 176 | 337 | 90 |
| | Deballasting | 149 | 209 | 200 | 333 | 83 |
| UV dose(W/m ²) | Ballasting | 241 | 258 | 253.5 | 417.5 | 167 |
| | Deballasting | 229 | 291.5 | 282 | 436 | 163.5 |
| Holding Time (Days) | - | 1 | 5 | 5 | 1 | 1 |
| Brackish water test cycles (10-20 PSU) FX2 FILTER with 20 µm screen | | | | | | |
| Size category & Water parameter | Sample | Test cycle 6 | | | Test cycle 7 | |
| Organisms ≥ 50µm(inds/m ³) | Influent | 221,525 | | | 1,437,675 | |
| | Control | 247,533 | | | 499,033 | |
| | Treated | 0.7 | | | 0.3 | |
| Organisms ≥ 10 and < 50µm (inds/mL) | Influent | 5,367 | | | 1,042 | |
| | Control | 5,900 | | | 1,050 | |
| | Treated | 0.39 | | | 0.39 | |
| Vibrio cholerae (cfu/100mL) | Influent | - | | | - | |
| | Control | - | | | - | |
| | Treated | <1 | | | <1 | |

| | | | |
|---|--------------|-------------------|-------------------|
| Toxicogenic Vibrio cholerae (cfu/100mL) | Influent | - | - |
| | Control | - | - |
| | Treated | <1 | <1 |
| Coliform (cfu/100mL) | Influent | - | - |
| | Control | - | - |
| | Treated | - | - |
| Escherichia coli (cfu/100mL) | Influent | <10 | <10 |
| | Control | <10 | <10 |
| | Treated | <10 | <10 |
| Enterococcus group (cfu/100mL) | Influent | - | - |
| | Control | - | - |
| | Treated | - | - |
| Intestinal Enterococci (cfu/100mL) | Influent | <10 | <10 |
| | Control | <10 | <10 |
| | Treated | <10 | <10 |
| Heterotrophic bacteria (cfu/mL) | Influent | 4.6×10^4 | 2.1×10^4 |
| | Control | 1.6×10^5 | 1.7×10^5 |
| | Treated | 1.4×10^2 | 8.8×10^2 |
| DOC(mg/L) | Influent | 10 | 9 |
| | Control | 10 | 9 |
| | Treated | 10 | 8 |
| POC(mg/L) | Influent | 6 | 5 |
| | Control | 3 | 2 |
| | Treated | 2 | 2 |
| TSS(mg/L) | Influent | 62 | 55 |
| | Control | 39 | 28 |
| | Treated | 35 | 36 |
| Temperature (°C) | Influent | 10.02 | 8.90 |
| | Control | 10.05 | 9.01 |
| | Treated | 10.40 | 10.16 |
| Salinity (PSU) | Influent | 18.60 | 19.00 |
| | Control | 18.84 | 18.84 |
| | Treated | 18.37 | 19.01 |
| pH | Influent | 8.11 | 8.06 |
| | Control | 8.11 | 8.09 |
| | Treated | 8.08 | 7.97 |
| Dissolved oxygen(mg/L) | Influent | 10.19 | 10.00 |
| | Control | 10.27 | 10.03 |
| | Treated | 10.46 | 9.71 |
| Turbidity(NTU) | Influent | 32.9 | 31.0 |
| | Control | - | - |
| | Treated | - | - |
| Flow rate(m ³ /h) | Ballasting | 332 | 89 |
| | Deballasting | 332 | 79 |
| UV dose(W/m ²) | Ballasting | 415 | 165.5 |
| | Deballasting | 443 | 157.5 |
| Holding Time (Days) | - | 1 | 1 |

| Fresh water test cycles (<1 PSU) BK3 FILTER with 25 µm screen | | | | | | |
|---|----------|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|
| Size category & Water parameter | Sample | Test cycle 1 | Test cycle 2 | Test cycle 3 | Test cycle 4 | Test cycle 5 |
| Organisms ≥50µm(inds/m ³) | Influent | 156,513 | 149,895 | 671,824 | 1,392,036 | 1,298,360 |
| | Control | 144,279 | 134,937 | 415,497 | 1,065,633 | 1,065,633 |
| | Treated | <1 | 3.2 | <1 | <1 | 0.3 |
| Organisms ≥10 and <50µm (inds/mL) | Influent | 2,139 | 2,506 | 3,959 | 1,204 | 1,100 |
| | Control | 2,172 | 2,728 | 5,133 | 1,392 | 1,392 |
| | Treated | 0.12 | <0.07 | <0.07 | <0.07 | <0.07 |
| Vibrio cholerae (cfu/100mL) | Influent | - | - | - | - | - |
| | Control | - | - | - | - | - |
| | Treated | <1 | <1 | <1 | <1 | <1 |
| Toxicogenic Vibrio cholerae (cfu/100mL) | Influent | - | - | - | - | - |
| | Control | - | - | - | - | - |
| | Treated | <1 | <1 | <1 | <1 | <1 |
| Coliform (cfu/100mL) | Influent | - | - | - | - | - |
| | Control | - | - | - | - | - |
| | Treated | - | - | - | - | - |
| Escherichia coli (cfu/100mL) | Influent | <1 | <1 | <1 | <1 | <1 |
| | Control | <1 | <1 | <1 | <1 | <1 |
| | Treated | <1 | <1 | <1 | <1 | <1 |
| Enterococcus group (cfu/100mL) | Influent | - | - | - | - | - |
| | Control | - | - | - | - | - |
| | Treated | - | - | - | - | - |
| Intestinal Enterococci (cfu/100mL) | Influent | <1 | <1 | 1 | 3 | 3 |
| | Control | <1 | <1 | 2 | <1 | <1 |
| | Treated | <1 | <1 | <1 | <1 | <1 |
| Heterotrophic bacteria (cfu/mL) | Influent | 9.9 x 10 ³ | 2.1 x 10 ⁵ | 1.3 x 10 ⁵ | 3.1 x 10 ⁵ | 3.3 x 10 ⁵ |
| | Control | 9.8 x 10 ³ | 2.1 x 10 ⁵ | 1.0 x 10 ⁵ | 2.8 x 10 ⁵ | 2.8 x 10 ⁵ |
| | Treated | 5.0 x 10 ² | 2.9 x 10 ² | ≤ 9.0 x 10 * | 4.5 x 10 ² | 1.1 x 10 ³ |
| DOC(mg/L) | Influent | 8 | 10 | 8 | 8 | 8 |
| | Control | 9 | 10 | 8 | 7 | 7 |
| | Treated | 9 | 10 | 8 | 8 | 8 |
| POC(mg/L) | Influent | 8 | 6 | 7 | 6 | 7 |
| | Control | 2 | 2 | 2 | 1 | 1 |
| | Treated | 3 | 2 | 2 | 1 | 1 |
| TSS(mg/L) | Influent | 63 | 64 | 63 | 62 | 62 |
| | Control | 31 | 37 | 37 | 11 | 11 |
| | Treated | 39 | 43 | 42 | 26 | 28 |
| Temperature (°C) | Influent | 10.29 | 13.45 | 16.65 | 14.59 | 14.74 |
| | Control | 10.75 | 13.19 | 16.64 | 15.29 | 15.29 |
| | Treated | 11.45 | 13.57 | 17.24 | 15.76 | 15.86 |
| Salinity (PSU) | Influent | 0.26 | 0.17 | 0.17 | 0.20 | 0.20 |
| | Control | 0.24 | 0.17 | 0.18 | 0.18 | 0.18 |
| | Treated | 0.10 | 0.09 | 0.09 | 0.10 | 0.11 |

| | | | | | | |
|------------------------------|--------------|-------|-------|-------|-------|-------|
| pH | Influent | 8.56 | 8.23 | 8.07 | 7.97 | 7.97 |
| | Control | 8.53 | 8.25 | 8.10 | 7.98 | 7.98 |
| | Treated | 8.49 | 8.07 | 7.98 | 7.67 | 7.60 |
| Dissolved oxygen(mg/L) | Influent | 11.47 | 11.24 | 10.43 | 10.69 | 10.49 |
| | Control | 11.86 | 11.25 | 10.37 | 10.49 | 10.49 |
| | Treated | 11.29 | 11.22 | 9.86 | 8.61 | 8.93 |
| Turbidity(NTU) | Influent | 32.8 | 36.6 | 37.6 | 36.4 | 36.4 |
| | Control | - | - | - | - | - |
| | Treated | - | - | - | - | - |
| Flow rate(m ³ /h) | Ballasting | 119 | 331 | 172 | 203 | 210 |
| | Deballasting | 111 | 331 | 160 | 263 | 260 |
| UV dose(W/m ²) | Ballasting | 209.5 | 443 | 249 | 277 | 269 |
| | Deballasting | 203.5 | 442 | 240 | 240 | 338 |
| Holding Time (Days) | - | 1 | 1 | 1 | 5 | 5 |

*contamination of the sterility control plates, see Chapter 7.3. NIVA, Land-based testing, Final Report, Report SNO 7523-2020, Final report,

| Fresh water test cycles (< 1 PSU) FX2 FILTER with 20 µm screen | | | |
|--|----------|-----------------------|-----------------------|
| Size category & Water parameter | Sample | Test cycle 6 | Test cycle 7 |
| Organisms ≥ 50µm(inds/m ³) | Influent | 650,300 | 262,292 |
| | Control | 415,497 | 439,850 |
| | Treated | <1 | 1.3 |
| Organisms ≥ 10 and < 50µm (inds/mL) | Influent | 5,283 | 1,413 |
| | Control | 5,133 | 1,496 |
| | Treated | <0.07 | <0.07 |
| Vibrio cholerae (cfu/100mL) | Influent | - | - |
| | Control | - | - |
| | Treated | <1 | <1 |
| Toxicogenic Vibrio cholerae (cfu/100mL) | Influent | - | - |
| | Control | - | - |
| | Treated | <1 | <1 |
| Coliform (cfu/100mL) | Influent | - | - |
| | Control | - | - |
| | Treated | - | - |
| Escherichia coli (cfu/100mL) | Influent | <1 | <1 |
| | Control | <1 | <1 |
| | Treated | <1 | <1 |
| Enterococcus group (cfu/100mL) | Influent | - | - |
| | Control | - | - |
| | Treated | - | - |
| Intestinal Enterococci (cfu/100mL) | Influent | <1 | 5 |
| | Control | 2 | <1 |
| | Treated | <1 | <1 |
| Heterotrophic bacteria (cfu/mL) | Influent | 1.3 x 10 ⁵ | 2.0 x 10 ⁵ |
| | Control | 1.0 x 10 ⁵ | 2.9 x 10 ⁵ |
| | Treated | 1.4 x 10 ⁴ | 6.0 x 10 ² |

| | | | |
|------------------------------|--------------|-------|-------|
| DOC(mg/L) | Influent | 8 | 7 |
| | Control | 8 | 7 |
| | Treated | 8 | 7 |
| POC(mg/L) | Influent | 6 | 8 |
| | Control | 2 | 2 |
| | Treated | 3 | 2 |
| TSS(mg/L) | Influent | 62 | 58 |
| | Control | 37 | 29 |
| | Treated | 47 | 37 |
| Temperature (°C) | Influent | 16.34 | 19.84 |
| | Control | 16.99 | 20.10 |
| | Treated | 16.63 | 20.17 |
| Salinity (PSU) | Influent | 0.17 | 0.22 |
| | Control | 0.18 | 0.21 |
| | Treated | 0.18 | 0.22 |
| pH | Influent | 8.02 | 8.65 |
| | Control | 8.10 | 8.62 |
| | Treated | 7.94 | 8.63 |
| Dissolved oxygen(mg/L) | Influent | 10.51 | 10.79 |
| | Control | 10.37 | 10.64 |
| | Treated | 10.04 | 10.23 |
| Turbidity(NTU) | Influent | 37.6 | 31.2 |
| | Control | - | - |
| | Treated | - | - |
| Flow rate(m ³ /h) | Ballasting | 165 | 340 |
| | Deballasting | 158 | 330 |
| UV dose(W/m ²) | Ballasting | 243 | 487 |
| | Deballasting | 237 | 493 |
| Holding Time (Days) | - | 1 | 1 |

4. SHIPBOARD TEST SUMMARY

| Size category & Water parameter | Sample | Test cycle 1 | Test cycle2 | Test cycle 3 |
|---|--------------|--------------|-------------|--------------|
| Organisms $\geq 50\mu\text{m}$ (inds/m ³) | Influent | 57,250 | 23,239 | 20,498 |
| | Treated | 7.2 | <1 | 0.17 |
| Organisms ≥ 10 and $< 50\mu\text{m}$ (inds/mL) | Influent | 138 | 121 | 120 |
| | Treated | 0.2 | 5.7 | <0.2 |
| Vibrio cholerae (cfu/100mL) | Influent | - | - | - |
| | Treated | <1 | <1 | <1 |
| Toxicogenic Vibrio cholerae (cfu/100mL) | Influent | - | - | - |
| | Treated | <1 | <1 | <1 |
| Coliform (cfu/100mL) | Influent | - | - | - |
| | Treated | - | - | - |
| Escherichia coli (cfu/100mL) | Influent | - | - | - |
| | Treated | <10 | <10 | <10 |
| Enterococcus group (cfu/100mL) | Influent | - | - | - |
| | Treated | - | - | - |
| Intestinal Enterococci (cfu/100mL) | Influent | - | - | - |
| | Treated | <10 | <10 | <10 |
| Heterotrophic bacteria(cfu/mL) | Influent | - | - | - |
| | Treated | - | - | - |
| Temperature (°C) | Influent | 11.1 | 27.2 | 29.7 |
| | Treated | 12 | 28.2 | 29.8 |
| Salinity (PSU) | Influent | 30.3 | 18.1 | 33.1 |
| | Treated | 30.5 | 18.8 | 33.0 |
| pH | Influent | 7.91 | NA | NA |
| | Treated | 7.78 | NA | NA |
| Turbidity (UVT) (%) | Influent | 67 | 91 | 95 |
| | Treated | 78 | 93 | 96 |
| TSS(mg/L) | Influent | 41.93 | 6.27 | 5.87 |
| | Treated | 15.87 | 4.40 | 4.47 |
| DOC(mg/L) | Influent | 1.43 | 1.73 | 1.50 |
| | Treated | 1.77 | 1.47 | 1.43 |
| POC(mg/L) | Influent | 0.81 | <0.1 | <0.1 |
| | Treated | 0.36 | <0.1 | <0.1 |
| Flow rate(m ³ /h) | Ballasting | 995 | 997 | 997 |
| | Deballasting | 995 | 995 | 993 |
| UV dose(W/m ²) | Ballasting | 473 | 801 | 1,882 |
| | Deballasting | 1,224 | 750 | 1,868 |

5. APPROVAL DOCUMENTATION

| LIST NO. | DOCUMENTS | DATE |
|----------|--|------|
| 1 | NIVA, Land-based testing, Final Report, Report SNO 6921-2015, Final report v2.1 | |
| 2 | NIVA, Shipboard testing, Report SNO 7063-2016, Final report v2.0, | |
| 3 | NIVA, Land-based testing, Final Report, Report SNO 7523-2020, Final report, | |
| 4 | Applica Technical Report, Environmental testing of Temperatures Switches, Report No. 21250 Rev 1 | |
| 5 | Applica Technical Report, Environmental testing of Sensor Box +EXSB01 and temperature transmitter TR-34, Report No. 21356 Rev 0 | |
| 6 | Applica Technical Report, Environmental testing, Report No.20597 Rev 0 | |
| 7 | Applica Technical Report, Environmental testing of Environmental testing of TB (Terminal Boxes) Report No. 20984 Rev 0 | |
| 8 | Applica Technical Report, EMC and Environmental testing of new components to Optimarin BWMS, Report No. 30486 Rev 0 | |
| 9 | DNV GL Type Approval Certificate TAE000037U issued to UVANTECHAS for UV Power Cabinet Type UVA. | |
| 10 | Installation Manual for Optimarin Ballast System, Rev 6, Template dated 14/10/2020. This manual is specific to BK3 or FX2 or BK3EX filters | |
| 11 | Operation, Maintenance and Safety Manual Rev. 6 14/10/2020, This manual is specific to BK3 or FX2 or BK3EX filters | |
| 12 | OM-C-59 Software maintenance and development checklist, Rev 3 | |
| 13 | UV chamber with instrumentation, Illustration for DNVGL dual safety layer requirement, Drawing No. 100000 | |
| 14 | DNV GL report: flow balance calculation, Flow Distribution in Parallell UV chambers, 2015-0885, Rev. 1, 25.09.2015 | |
| 15 | DNV GL, Filter comparison of Boll & Kirch filter model 6.18.2 and 6.18.3, 385FIST130315-2 | |
| 16 | Filter Comparison Data TYPE BK, 2020 | |
| 17 | Filter Comparison Data TYPE FX, 2020 | |
| 18 | Flow pressure valve replacement report, Rev1 | |
| 19 | Class survey checklist for Optimarin Ballast System, Rev. 2 Template dated 2.20.2018 | |

6. CONDITION OF CERTIFICATION

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

| Filter Type | Minimum inlet pressure (back-pressure) | Differential pressure triggering backflushing | Maximum operating pressure |
|-----------------------|--|---|----------------------------|
| Filtrex Type ACB, FX2 | 1.5bar | $\geq 0.3\text{bar}$ | 10bar |
| aquaBoll 6.18.3, BK3 | 1.5bar | $\geq 0.38\text{bar}$ | 10bar |