B	01.10.2024	REVISED AS PER COMMENTS	MCM	TT	GC
A	25.09.2024	ISSUED FOR APPROVAL	MCM	TT	GC
REV.	DATE	DESCRIPTION	MOD.BY	CKD.BY	APP.BY

REVISIONS

Goltens
Singapore Pte Ltd.

SHIP

JP88 STORK

TITLE

BALLAST WATER MANAGEMENT PLAN

SCALE N.T.S.	DRAWN	MCM	DRAWING NUMBER GSPL-P1482-GE-0003	HULL NUMBER --	REV B
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SIZE: A4	VERIFIED	GC	DATE:-25.09.2024	SHEET:- 1	

BALLAST WATER MANAGEMENT PLAN

Vessel Name: JP88 STORK
IMO No: 9354947

REVISION HISTORY

Rev. No	Date	Reason for issue	Prepared by	Verified by	Approved By
A	25/09/2024	For Approval	VJ	TT	GC
B	01/10/2024	Revised as per comments	VJ	TT	GC
C	15/10/2024	For Approval	VJ	TT	GC

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1 INTRODUCTION

Ballast water is essential to control trim, list, draught, stability, or stresses of the vessel. However, ballast water may contain aquatic organisms or pathogens which, if introduced into the sea including estuaries, or into freshwater courses, may create hazards to the environment, human health, property, or resources, impair biological diversity or interfere with other legitimate uses of such areas.

This plan is written in accordance with the requirements of Regulation B-1 of the International Convention for the Control and Management of Vessels' Ballast Water and Sediments, 2004 (the Convention) and the associated Guidelines.

The purpose of the plan is to meet the requirements for the control and management of vessel’s ballast water and sediments in accordance with the Guidelines for Ballast Water Management and the Development of Ballast Water Management Plans (G4) resolution MEPC.127(53). It provides standard operational guidance for the planning and management of vessels' ballast water and sediments and describes safe procedures to be followed.

The selection of appropriate methods of Ballast Water Management should consider the need to ensure that Ballast Water Management practices used to comply with the Convention do not cause greater harm to the environment, human health, property or resources of any States and the safety of vessels, than they prevent.

This plan has been approved by the LR and no alteration or revision shall be made to any part of it without the prior approval of LR.

This plan may be inspected on request by an authorized authority. This plan should be kept available for inspection on request by a port state control officer or by a port state quarantine officer.

2 VESSEL PARTICULARS

VESSEL NAME	JP88 STORK
IMO NO	9354947
Vessel type	AHTS
Flag	Malaysia
Port of registry	Port Kelang
Owner	Bitara Prospek Sdn Bhd
International call sign	9WND2
Classification Society	LR
Dimensions	
Length O.A	70.70 m
Length B.P	63.00 m
Breadth (MLD)	16.00 m
Depth, Moulded	7.20 m
Gross Tonnage	2569 ton
Total ballast water capacity	362.70 m^3
Deepest Ballast Draught	4.525 m and 4.241 m
Designated ballast water management officer(rank of officer)	Chief officer
Main ballast water management method(s):	D-2: Ballast water treatment – Filtration & UV

3 PURPOSE

The ballast water management plan aims to assist governments, appropriate authorities, vessel's Masters, operators, owners, port authorities as well as other interested parties, in preventing, minimizing, and ultimately eliminating the risk of introducing harmful aquatic organisms and pathogens from vessels' ballast water and associated sediments while protecting vessel's safety. Good record keeping is critical to the success of a sound ballast water management program. The appointed ballast water management officer is responsible for ensuring the maintenance of appropriate records and that the ballast water management and treatment procedures are followed and recorded.
It is the owners/managers or master's responsibility to regularly review the plan and ensure that the information contained therein is accurate and updated.

RECORD OF CIRCULATION

This document is to be circulated to ships staff that will be responsible for Ballast Water Management. After reading, the Ballast Water Management Plan it is to be signed and returned to the Ballast Water Management Officer.

Name	Rank	Date Joined	Signature and date

MASTERS MONTHLY VERIFICATION OF LOG AND PROCEDURES

The Master shall verify the correct implementation of the procedures and the log records at monthly intervals in the table below.

Date	Masters Signature	Date	Masters Signature

RECORD OF AMENDMENTS

No	Date	Revised Part	Revision details/description	Signature

4 DESCRIPTION OF THE BALLAST SYSTEM

Ballast water is essential to control trim, list, draught, stability or stresses of the vessel. The following is a description the ballast system used onboard.

4.1 Overview of BWM Method applied

BW treatment is applicable for all ballast tanks.

4.2 Ballast Tanks

Tank Description	Frame pos.	Capacity(m^3)	Pumps Available
FPTDW&SWBTK.C	FR.98-F.E	207.10	Bilge/Ballast/Fire Pump & Bilge/G.S/Fire Pump
APTDW&SWBTK.P	FR.5-A.E	60.80	
APTDW&SWBTK.S	FR.5-A.E	60.80	
APTDW&SWBTK.C	FR.2-A.E	34.00	
TOTAL		362.70	

4.3 Pump Data

No	Pumps	Rated Capacity	Type	Location
1.	Bilge/Ballast/Fire Pump	60 m^3/h	Centrifugal Self-Priming	E/R Bottom Platform (Stbd)
2.	Bilge/G.S/Fire Pump	60 m^3/h	Centrifugal Self-Priming	E/R Bottom Platform (Stbd)
3.	Drill Water Pump	120 m^3/h	Centrifugal Self-Priming	E/R Bottom Platform (Stbd

5 BALLAST WATER MANAGEMENT OPERATION

5.1 General

Ballast Water Management System (BWMS) means any system which processes ballast water such that it meets or exceeds the ballast water performance standard in regulation D-2. The BWMS includes ballast water treatment equipment, all associated control equipment, monitoring equipment and sampling facilities.

BWMS means equipment which mechanically, physically, chemically, or biologically processes, either singularly or in combination, to remove, render harmless, or avoid the uptake or discharge of harmful aquatic organisms and pathogens within ballast water and sediments. Ballast water treatment equipment may operate at the uptake or discharge of ballast water, during the voyage, or at a combination of these events.

It must be ensured that the ballast water treatment system installed is approved in accordance with Regulation D-2 of the Convention. All systems (type) approved by (or on behalf of) the relevant administration and physically inspected by Class’s surveyor after installation on behalf of the administration should fulfil this requirement.

The system should only be operated in accordance with the system design criteria and manufacturer's operational and maintenance instructions. When the system encounters malfunctions or failure, these are to be recorded in the ballast water record book.

6 BALLAST WATER TREATMENT

6.1 Treatment system details

No	Parameter	Specification
1	Manufacturer	BIO-UV
2	Model Name	BIO-SEA L02-0060
3	Technology	Mechanical Filtration & Ultraviolet Radiation
4	Operation required	Ballasting & De-Ballasting
5	Max Flow Rate per UV Reactor in m3/h	• 30 m^3/hr (in IMO Mode) • 20 m^3/hr (in USCG Mode)
6	Installation location	E/R Bottom
7	USCG Type approval Certificate no.	162.060/9/4
8	Number of Ballast pumps to be used	One ballast pump

Ballast water treatment system's operation manual
The system should only be operated in accordance with the system design criteria and manufacturer's operational and maintenance instructions given in "OMSM (Operating, Maintenance & Safety Manual".

7 GENERAL DESCRIPTION OF BIO-SEA SYSTEM

7.1 Definition

Bio-Sea is a treatment system specifically designed for inactivation and elimination of organisms contained in ballast water, in order to comply with the IMO D-2 and USCG standards for discharge of such water by vessels during their operations

The system is composed of two treatment steps:

- Step 1 **: Mechanical Filtration**

It aims at reducing the amount of total suspended particles, organic or not, present in the sea water, through filtration with a 20 µm screen.

- Step 2 : **Ultraviolet Disinfection**

Without any addition of chemicals, nor creation of active substances, the UV-c light inactivates the microorganisms present in the water (bacteria, phytoplankton, zooplankton).
The entire operation of the Bio-Sea® system is automated (valves opening and closing, filter cleaning, UV intensity regulation, event recording, etc).
The use of the Bio-Sea® system should be integrated to the Ballast Water Management Plan of the ship.

7.2 Process Description

The Bio-Sea® treatment system should be operated at every ballasting and deballasting operations.

• During ballasting, both operations of filtration and UV disinfection are carried out: the objective is to restrain the load of suspended solids and living microorganisms in the ballast tanks. The filtrate is flushed out of the filter, thanks to automatic cleaning, and the filtered organisms are sent back to the local water.

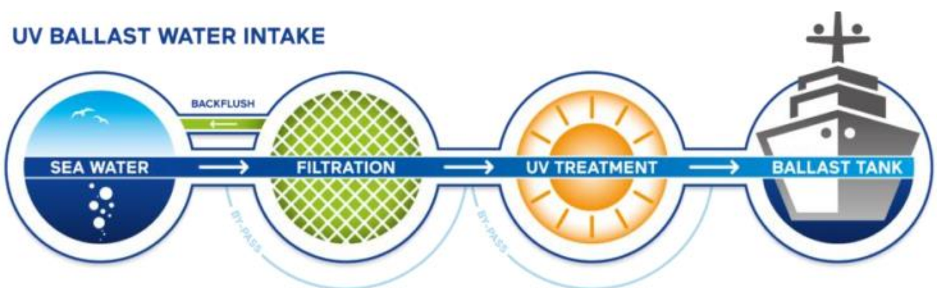


Figure 7-1 UV Ballast Water Intake.

• During deballasting, only UV disinfection is completed (the filter is by-passed).
This allows retreating the water, after retention and/or mix with other water volumes in the ship's ballast tanks during voyage, in order to eliminate any possible biological recontamination, and to ensure compliance with the IMO D-2 standard for discharge of ballast water.
At the end of each operation, a cleaning cycle is triggered in order to flush and refill the complete system with fresh water.

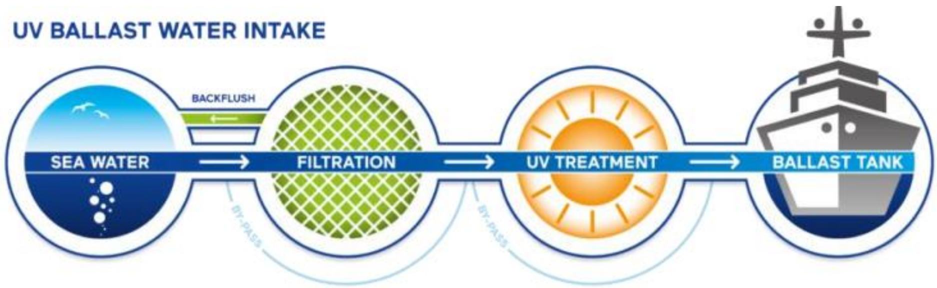


Figure 7-2 UV Ballast Water Discharge.

7.2.1 Treatment Process Description

7.2.1.1 Treatment During Ballasting

During ballasting, both operations of filtration and UV disinfection are carried out:

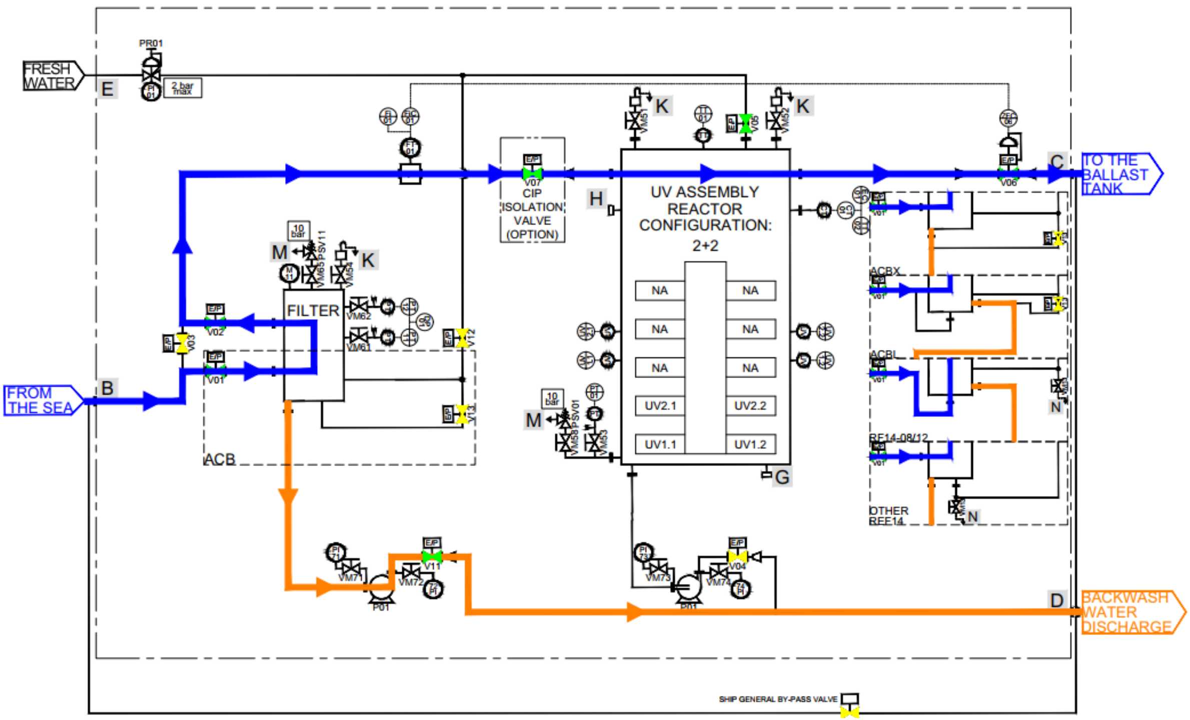


Figure 7-3 Ballasting Operation.

During the ballasting operation, the outlet control valve allows the flow through the system to be always below the maximum treatment rate of the system (TRC).
Backflush stream is only composed of local water and can be discharged to the sea at the uptake location.

7.2.1.2 Treatment During Deballasting

During deballasting, only UV disinfection is completed (the filter is by-passed).
This allows retreating the water, after retention and/or mixing with other managed water volumes in the ship's ballast tanks during voyage, in order to eliminate any possible biological recontamination, and to ensure compliance with the regulations for discharge of ballast water.

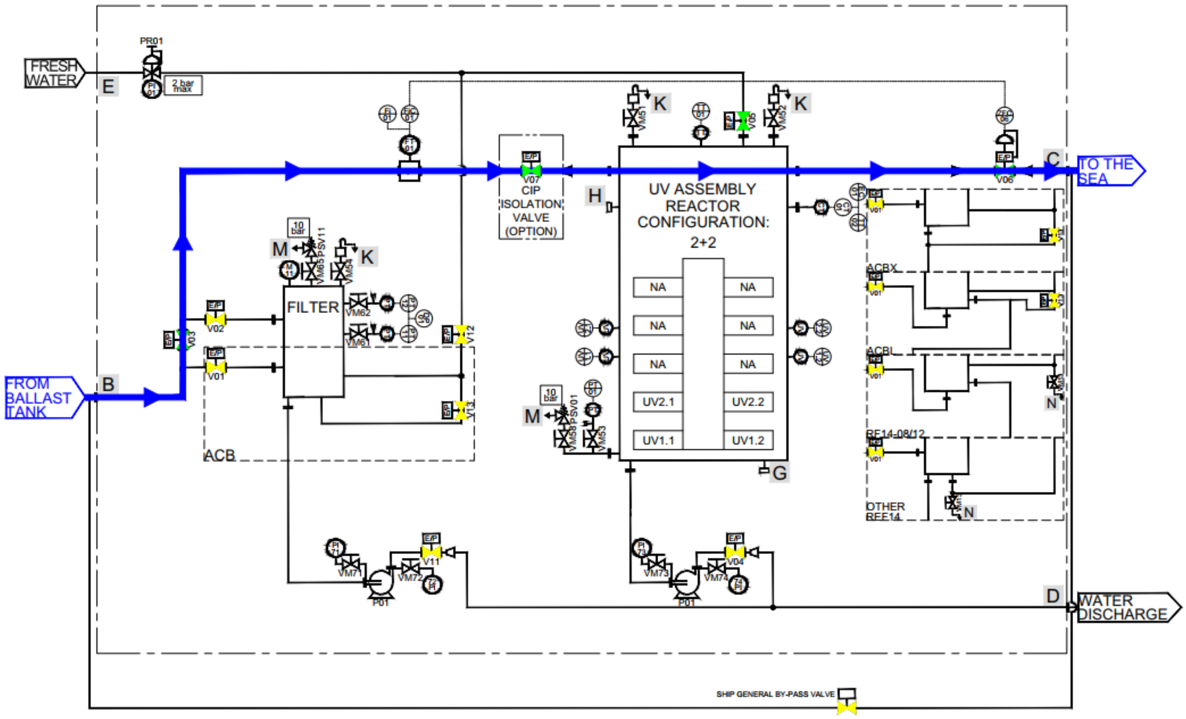


Figure 7-4 Deballasting Operation

During the deballasting operation, the outlet control valve allows the flow through the system to be always below the maximum treatment rate of the system (TRC).
When tanks are almost empty, deballasting is still possible with stripping. If backwash is used, water discharge should be rejected directly to the sea.

7.2.1.3 Cleaning

When operations are over, a cleaning cycle can be triggered in order to flush and refill the complete system with fresh water. This will avoid potential growth of marine organisms inside the filter, and salt/sediment deposits on quartz sleeves.
Deposits on quartz sleeves can also be cleaned punctually with a "cleaning-in-place" (CIP) option. This device can be automatic (BIOSEA Clean) or manual (BIOSEA M-Clean) and uses acid citric solution.
When a BIO-SEA® Clean device is used, UV assembly can be cleaned with sea water already contained in the BWTS in order to save fresh water. When launching the CIP cycle, it is possible to select if the assembly will be refilled with fresh water or not (ie, with sea water instead). However, unless the system will be used within a short time, it is better to refill with fresh water at the end of CIP Cleaning.

If no CIP option has been installed, the quartz sleeves can be cleaned manually by dismounting them and wiping them with white vinegar or acid solution.
To determine the required cleaning volume, it is important to take into account the piping connecting the UV assembly. In the picture below:

- The circuit in blue shows piping and components that will be filled with fresh water during the UV assembly standard cleaning or the CIP cleaning.
- The circuit in green shows the components that will be filled with fresh water during the filter cleaning.

As an option, reduce water consumption during cleaning, an isolation valve (V07) can been added before the UV assembly.

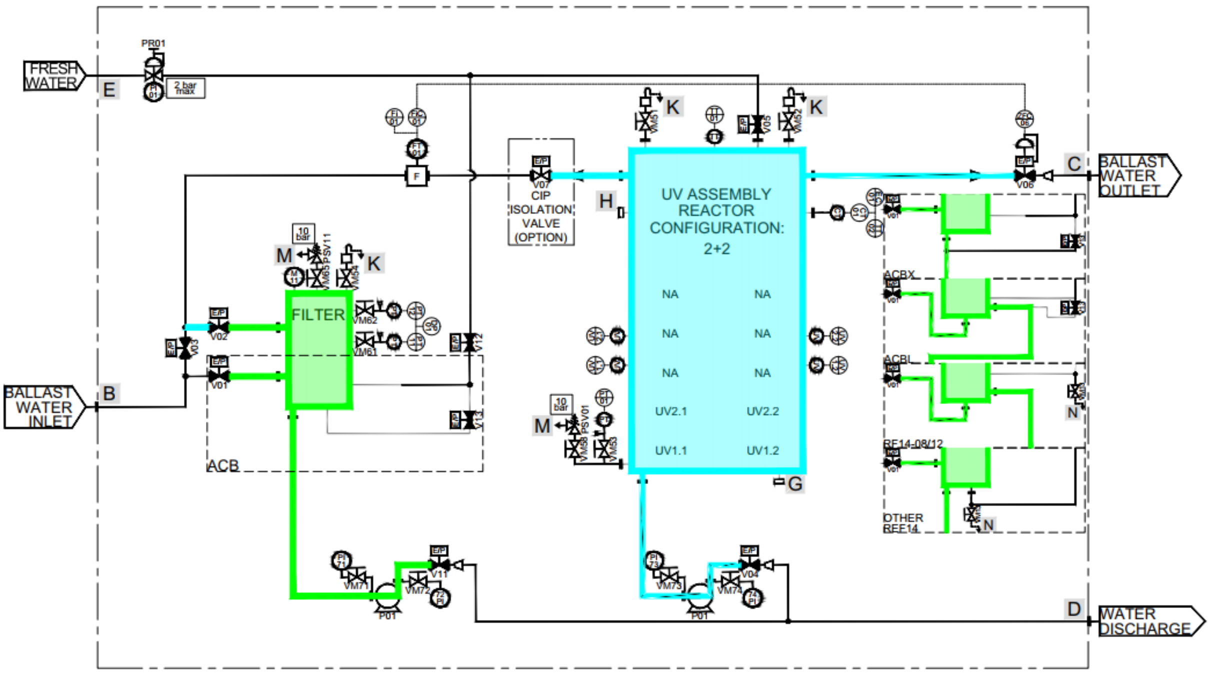


Figure 7-5 Cleaning Operation

8 PRECAUTIONARY PRACTICES

8.1 Minimizing uptake or transfer of harmful aquatic organisms, pathogens and sediments

Wherever possible, ballast water should be taken outside of port waters and as far from the coast as practicable. Consideration should also be given to the use of dockside water supplies (water not taken directly from the harbour, such as fresh water, potable water etc.). as source for ballast water.

When loading ballast water, every effort should be made to avoid the uptake of potentially harmful aquatic organisms, pathogens and sediments that may contain such organisms. The uptake of ballast water should be minimized or, where practicable, avoided in areas and situations such as:

1. Areas identified by the port state in connection with warnings provided by ports concerning ballast uptake and any other port contingency arrangements in the event of emergency situations.
2. In darkness when organisms may rise in the water column
3. In very shallow water
4. Where propellers may stir up sediment
5. Areas with current large phytoplankton blooms (algal blooms such as red tides)
6. Nearby sewage outfalls
7. where a tidal stream is known to be more turbid
8. Where tidal flushing is known to be poor
9. In areas close to aquaculture
10. Where dredging is or recently has been carried out.

If it is necessary to take on and discharge ballast water in the same location, care should be taken to avoid unnecessary discharge of ballast water that has been taken up in another location.

8.2 Non – release/minimal release of ballast water

The requirements to ballast water management differ from port state to port state. Some have no requirements; some require reporting of ballast water practice and record book, and others require ballast water exchange before arrival in their waters. In case ballast water exchange is requested by the port states, this will be applicable to ballast tanks planned to be discharged in their waters. For some loading conditions not, all tanks need to be discharged, hence these will not have to be exchanged prior to arrival.

8.3 Discharge to reception facilities

If reception facilities for ballast water and/or sediments are provided by a port state, they should, where appropriate, be utilized.

8.4 Procedure for safe tank entry

8.4.1 Confined space entry procedure

8.4.1.1 General

Societies should include in their procedures the requirements that Surveyors should refuse to enter a confined space (or should exit the space) if:

1. Safe entry procedures (such as entry permit, "safe for workers" certificate, "safe for hot work certificate, etc.) are not in place, have time expired or are not being followed.

2. The Responsible and Competent Persons are not identified.
3. The access and exit arrangements to and within the confined space are not considered safe (where available, multiple entry and exits ways should be opened).
4. Communications arrangements are not adequate.
5. The confined space is not adequately clean to allow safe working.
6. Lighting is not adequate for entry and exit and to allow safe working in the confined space.
7. The atmosphere has not been demonstrated as being safe (safe limits are atmospheric oxygen the range of 20.6% to 22% by volume, combustible gases less than 5% of lower explosive limit, toxics within acceptable limits).
8. Adequate ventilation arrangements are not in place or not functioning.
9. Isolation of the confined space, as applicable, from other tanks, cargo spaces, pipes, etc. .and of machinery in the space, is not confirmed.
10. They are required to wear breathing apparatus.
11. The surveyor may wear a respirator or other escape device if required by an Owner's policy but only if sufficiently trained in the use of such equipment. However, the space should be safe first.
12. Effective communication is adversely impacted by the surrounding noise.
13. Extreme temperature effects are not adequately considered.
14. Electrical equipment in the confined space is not suitable or not in acceptable condition.
15. 15 Toxic Product is contained in an adjacent space, until the followings are carried out:
    - A risk assessment is completed by the vessel's Management Company and the risk is mitigated.
    - All identified controls are confirmed in place prior to tank entry.
16. A dedicated Attendant is not provided by the vessel's management or the management of the facility where the surveyor's activities are carried out for the complete duration of the time spent working in the confined space and/or the Attendant does not have suitable means of initiating emergency response.
17. Adequate emergency response arrangements are not in place.
18. In any other situation where the surveyor has a valid concern over the safety of the confined space.

The points addressed above should be considered and reviewed as changes occur during any Confined Space Entry.
No surveyor should be the first to enter a confined space, and they should be always accompanied where the size of the space permits.
No surveyor should be part of a rescue team.
Surveyors should immediately leave a confined space, by the nearest safe exit, if any alarms sound, or any physical impairment or distress is experienced by the surveyor.
In addition to the above prior to entry into a confined space the following procedure should be adopted:

1. A Safety meeting should be held prior to the survey to discuss all aspects of safety measures.
2. Entry Permit should be obtained for the space to be entered.
3. Identify potentially unsafe conditions by reviewing the following information provided by the owner:
    - Latest content of the spaces to be surveyed.
    - Contents of adjacent spaces.
    - For Gas Carriers: a data sheet for the last cargo.
    - For Chemical Tankers: a data sheet for the previous three cargoes.
4. Evaluate ventilation of the space:
    - Check that the confined space or tank is empty, cleaned, and ventilated.
5. Evaluate need for isolation of the space.
6. Ensure that an Attendant is in place.
7. Ensure that a standby person and/or a rescue team is in place.

8. It is strongly recommended that Emergency Escape Breathing Devices (EEBD) are placed at the entry points of the space to be entered for use in emergency or recovery of a surveyor from the space.
9. Check and evaluate gas measurements taken by the Owner Representative. For testing limit values see item 4 below.
    - As a minimum, oxygen measurements should be carried out before entry into the enclosed space. The Surveyor may request to carry out measurements under his supervision, when deemed necessary.
    - A set of additional control measures should be evaluated depending on what type of confined space is to be surveyed. See Annex, Checklist for Entry into confined space. The surveyor should always use their personal gas measuring equipment during the survey, but this is not intended to substitute the measurements taken by the Owner or Owner Representative.
10. Evaluate need for precaution against extreme temperature. See Part two.
11. Evaluate the lighting arrangements. See Part two.
12. Evaluate if special clothing and/or equipment is required.

A checklist with the items above is recommended to be used for evaluation if the space is safe to enter.
If extensive work is to be carried out within a large space, such as a cargo tank, it is recommended that a full assessment of the tank atmosphere is undertaken after the initial tests have been satisfactorily carried out and recorded. The tank atmosphere should be checked frequently during this entry, with particular attention being placed on testing the work location(s) and places that are inaccessible for testing from the entry point.

8.4.1.2 Entering confined space adjacent to loaded tanks.

It is important to be aware that confined spaces may be, or have been, subject to leakage from the adjacent space. The risk is that such leakage often remains undetected because the space is not subject to regular gas measurements and ventilation.
Confined spaces adjacent to loaded tanks may be entered provided the procedure for entry as given in item 4 below is completed.
Spaces adjacent to cargo tanks, like cofferdams and double bottom tanks may contain accumulated residues from previous cargoes and information about these cargoes is needed to determine proper test methods for the atmosphere in the adjacent spaces.
If a tank is loaded with cargoes having a toxic product hazard identified, or with a toxic symbol in the Data Sheet, no survey should be carried out in a confined space adjacent to that tank. Be aware that toxicants produced by work (like coating, sandblasting and hydro blasting) in a confined space can enter and accumulate in the confined space.

8.4.1.3 Entering confined spaces adjacent to inert tanks

When other tanks in an inert condition are either adjacent or interconnected (e.g. pipeline) to the space to be entered, personnel should be alert to the possibility of inert gas leaking into that space through, for example, bulkhead fractures or defective valves. The risk of this occurring can be minimized by maintaining a small but positive pressure in the space to be entered relative to the inert gas pressure. At all times the procedures on the vessel are to be followed.

8.4.1.4 Permit-to-work and permit-to-enter

The ISM code requires the Company to establish safe practices in ship operation and a safe working environment. This is commonly provided for by a permit-to-work system that is drawn up to provide a formal written safety control system. Nonconventional vessels, new construction shipyards and repair facilities, etc. not covered by ISM code may have a similar permit-to-work system.

A permit-to-work should:

- set out the work to be done, the location and the precautions to be taken.
- Predetermine safe methods of work.
- Provide a clear record that all foreseeable risks have been considered.
- Define the precautions to be taken and their sequence.
- Provide written authority for the confined space to be entered and the work to start and
- the time when the work should cease.

Entry into a confined space should only be allowed after a separate permit-to-enter has been issued. This permit should only be issued after tests have taken place to ensure that the atmosphere is safe for entry.

Note: Use of non-explosion proof equipment like cameras, torches, chipping hammers, may be allowed provided that it is stated in the entry permit issued and the space is safe for hot work or safe for workers and LEL is measured to 0%.

8.4.1.5 Training

All surveyors who are expected to enter and work in confined spaces should be trained in Occupational Safety and Health requirements for such activities. This should include the following:

- Recognizing a confined space
- Role of the Competent Person, Responsible Person, Attendant and Marine Chemist
- How to recognize the hazards and manage the risks associated with Confined Space
- Entries
- PERMIT TO ENTER (PTW or PTE) systems/control procedures at the workplace.
- Requirements for atmosphere testing and the interpretation of their results
- Use of personal multi gas meter.
- Access, exit and safe working requirements.
- Emergency arrangements.

Competency in the areas covered by the training identified above should be periodically assessed and appropriate refresher training should be provided.

9 SEDIMENT MANAGEMENT

Water taken up as vessels' ballast can contain solid alluvial matter that, once the water is becalmed in a vessel's ballast tank, will settle out onto the bottom of the tank and other internal structures.

Aquatic organisms can also settle out of the ballast water and can continue to exist within the sediment. These organisms can survive for long periods after the water they were originally in has been discharged. They may thereby be transported from their natural habitat and discharged in another port or area where they may cause injury or damage to the environment, human health, property and resources.

9.1 General requirements

All practical steps should be taken during ballast uptake to avoid sediment accumulation, it is however recognized that sediment will be taken on board and settle on tank surfaces. The volume of the sediment should be monitored on a regular basis.

Sediment in ballast tanks should be removed in a timely basis and as found necessary. The frequency and timing of removal will depend on factors such as sediment build up, vessel's trading pattern, availability of reception facilities, workload of the vessel's personnel and safety considerations.

9.2 Disposal of sediments to shore

Removal of sediment from ballast tanks should preferably be undertaken under controlled conditions in port, at a repair facility or in dry dock. The removed sediment should preferably be disposed of in a sediment reception facility if available, reasonable and practicable.

One should be aware that sediments lying undisturbed for some time may give off toxic gases and appropriate measures must be taken to protect the crew carrying out the job.

9.3 Disposal of sediments at sea

When sediment is removed from the vessel's ballast tanks and is to be disposed of by that vessel at sea, such disposal should only take place in areas outside 200nm from land and in water depths of over 200m.

Part of the mud may be removed by water movement within a tank to bring sediments to suspension. In double bottom tanks this is achieved by filling clean water 0.5-1 meter sounding in mild weather conditions and keeping it for about 6 hours before pumping it out. In addition the Master may decide to store the sediments onboard the vessel when this will not hamper the security and operational maintenance of the vessel, her cargo and the crew. Special care is to be taken if ballast water has been carried in spaces designated for other purposes, such as fuel, oil, freshwater tanks etc. Disposal of the sediments then depends upon the final mixture, e.g. if ballast water is carried in the fuel tanks, more stringent requirements than described above are to be considered. When sediment is removed from the vessel's ballast tanks and is to be disposed of by that vessel at sea, such disposal should only take place in areas outside 200 nm from land and in water depths of over 200 m.

9.4 Details of the sediment management system on board

Manual cleaning of BW tanks at dry-docking.

10 BALLAST WATER SAMPLING

Sampling of ballast water is primarily a matter for the authorized inspection officers during port state control. For crew members there is unlikely any need to take samples except at the express request and under the supervision of authorized inspection officers.

10.1 General

The table below indicates sampling and access points in pipelines and tanks, to enable crew members to quickly assist the authorized officers of a party that have reasons to obtain samples.

No.	Sample Point	Position	Type
1	Discharge Line (stbd side)	FR53 – 241; CL -6176; TWEEN DECK – 31;	Sampling Facility
2	Discharge Line (stbd side)	FR50 + 290; CL -5966; TWEEN DECK – 1218;	Sampling Facility

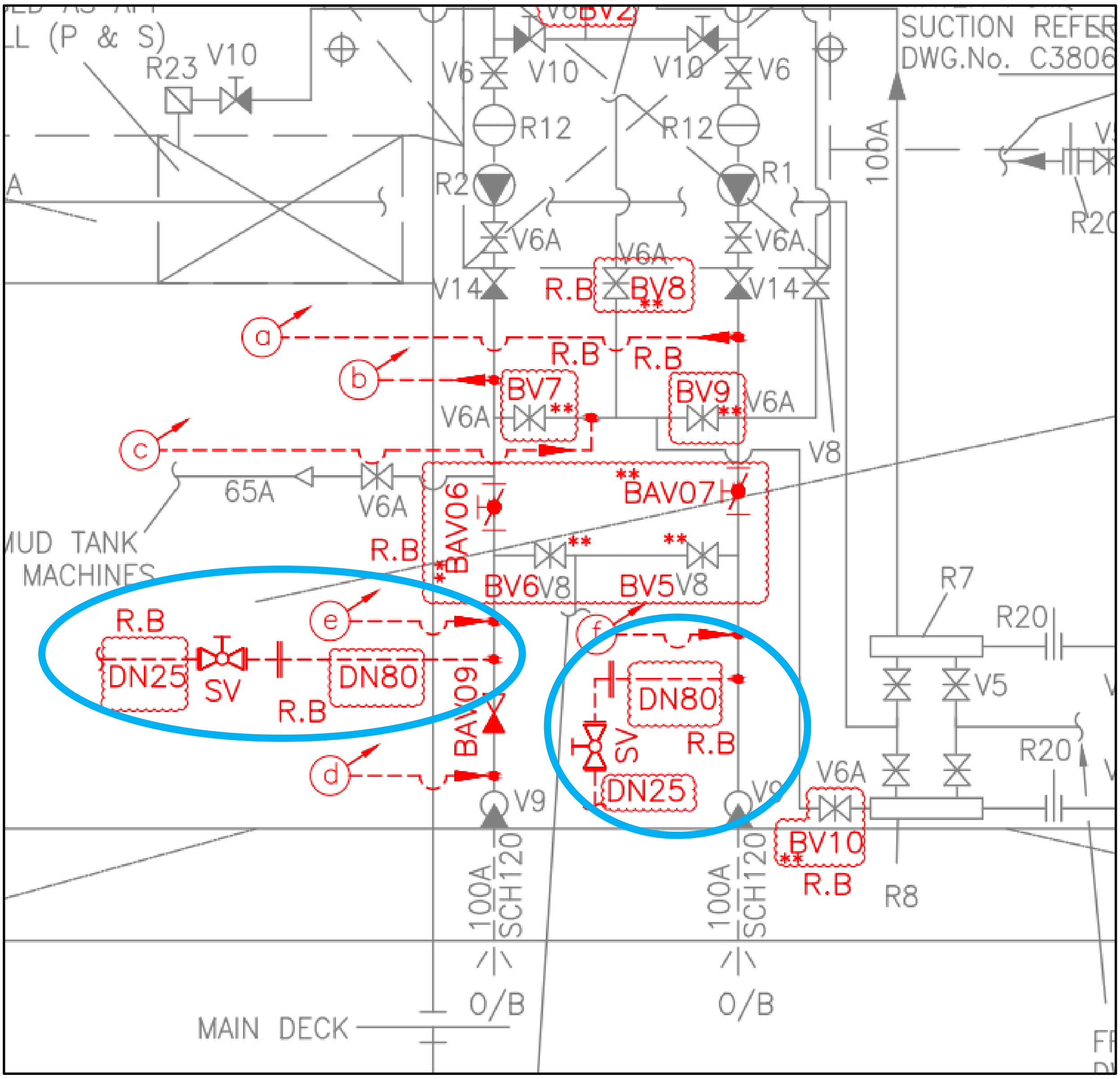
For practical recommendations regarding sampling techniques and procedures, refer to annex to MEPC.173 (58) – G2 Guidelines, addressing the following:

- Sampling from the ballast water discharge line
- Sampling and analysis protocols
- Sample data forms
- Health and safety aspects
- Recommendation for a port state control ballast water sampling kit
- Maintenance, storage, labeling and transportation
- Chain of custody record

10.2 Sampling for compliance with the performance standard (Regulation D-2)

Compliance with ballast water performance standard (D-2) should be assessed at ballast water discharge, as near to the point of discharge as practicable, during ballast water discharge whenever this is possible.
For this vessel, sampling for compliance with the ballast water discharge standard is provided through the following:
For provision of sampling of treated ballast water, sampling points are provided at main ballast discharge overboard .

- Sampling valves at BWTS After treatment (Stbd)



11 METHODS OF COMMUNICATION

This section contains procedures to assist the Master in coordinating the discharge of ballast in waters of a coastal state, local government, or other involved parties. The quick and effective communication between the vessel and coastal state or other involved party becomes vital in mitigating the effects of an unnecessary delay. The requirements and roles of the various national and local authorities involved vary widely between states and even from port to port. Approaches to the responsibility for ballast water exchange also vary. In the majority of coastal states, responsibility for compliance with port state requirements is placed on the vessel owner and the vessel. The port state authorities should be contacted for specific ballast water discharge requirements and reporting, prior to the vessel's arrival in port state's territorial waters. Therefore, the Master with the responsible officer should timely obtain all necessary information and prepare the vessel, accordingly, taking into consideration the safety and operational restrictions as described in this plan and relevant sections. Information on specific port state procedures can be obtained by consulting the company and local agent for latest information and requirements.

The Master is to contact the relevant parties such as coastal state, etc. to operate her ballast water in case of the emergency (fail of power, malfunction of BWTS, etc.).

11.1 Action to be taken by the vessel where coastal state has specific procedures for discharge of ballast water

1. Follow agreed reporting procedures.
2. Contact vessel's agent and/or company to ascertain latest information on ballast discharge.
3. Requirements in the water of respective state.
4. Ensure to timely plan for above actions and that safety and operational restrictions are met.
5. Keep proper records and have them readily available for possible inspection.

11.2 Action to be taken by the vessel where coastal state has no specific procedures for discharge of ballast water

1. Contact vessel's agent and/or company to obtain latest information on ballast discharge requirements in the water of respective state.
2. Carry out discharge of ballast water as per the ballast water management plan.
3. Take into consideration safety and operational procedures related to respective discharge.
4. Keep proper records and have them readily available for possible inspection.

12 DUTIES OF THE BALLAST WATER MANAGEMENT OFFICER

The ballast water management officer is responsible for implementing the procedures of the ballast water management plan.

Duties of the ballast water management officer:

- Ensure the safety of the vessel and crew.
- Ensure that ballast water management and/or treatment procedures are followed and recorded.
- Ensure adequate personnel and equipment is available for the execution of the planned ballast water management operations.
- Ensure all required ballast water management records are maintained and up to date, including the ballast water record book.
- Prepare the ballast water declaration form prior to arrival in port.
- Maintain the ballast water handling log.
- Where required, prepare the appropriate national or port ballast water declaration forms prior to arrival.
- Assist the port state control or quarantine officers for any sampling that may need to be taken.
- Undertake familiarization and training of crew in ballast water management requirements and applicable shipboard systems and procedures.
- Other duties, as specified by the company.

The Master must ensure that the ballast water management plan is clearly understood by the appointed officer and by any other vessel staff that may need to be involved. The ballast water management officer must keep the Master advised on the progress of the ballast water management operations and any envisaged deviations from the agreed plan. Should there be any doubt or if the management plan is not in line with the schedule, the Master shall be advised accordingly.

13 CREW TRAINING AND FAMILIARIZATION

It is essential that the Master, vessel's officer, and crew have an understanding of the need for ballast water management. If crew members understand the reasons for the treatment or exchange of ballast water and associated sediments, they are more likely to ensure that it is carried out effectively and efficiently. Owners, managers, operators and others involved in officer and crew training for ballast water management should consider the following:

- Training for vessels' Masters and crews as appropriate should include instructions on the requirements of the Convention, the ballast water and sediment management procedures and the ballast water record book, drawing particular attention to matters of vessel safety, maintenance of records and reporting requirements in accordance with the Convention.

Vessels' officers and ratings engaged in ballast water exchange at sea must be aware of what is expected of them and should be familiarized and trained in the following:

- Vessel’s pumping arrangements including ballast arrangements.
- Location of air and sounding pipes of all ballast tanks.
- Positions of all ballast tank suctions and pipelines.
- Overboard discharge arrangements and openings for release of water on deck.
- Inspection and maintenance for ensuring that sounding pipes are clear and that air pipes and non-return devices are in good order.
- Methods used for ballast water treatment at sea, the related safety precautions and associated hazards.
- Location and suitable access points for sampling purposes; and
- The method of on-board ballast water record keeping, reporting and recording of routine soundings.

The Master and ballast water management officer should ensure that the personnel assigned key responsibilities in any ballast water treatment procedures are suitable and well trained according to the above. Special attention should be given to the safety aspects related with the subject procedures. All records relating to training are maintained on board for 2 years to identify trainee. That is any document relating to the plan. Provisions for crew training and familiarization include the following:

1. General requirements for ballast water management.
2. Training and information on ballast water management practices.
3. Ballast water treatment systems installed on board.
4. General safety considerations.
5. The ballast water record book and maintenance of records.
6. The operation and maintenance of installed ballast water treatment systems.
7. Safety aspects associated with the systems and procedures used on board the vessel which affect the safety or human health of crew and passengers and/or the safety of the vessel.
8. Precautions for entering tanks for sediment removal.
9. Procedures for the safe handling and packaging of sediment; and 10 Storage of sediment.

Sample crew training record can be referred below.

Training Record for Ballast Water Management Manual

It is hereby confirmed that I/We have been informed by the Vessel's ECO on the IMO's Resolution A.868(20) Guidelines for the control and management of ship's ballast water to minimize the transfer of harmful aquatic organisms and pathogens, Furthermore I have been informed on the Company's "Ballast Water Management Manual" and relative procedures established on board.

Date	Name	Rank	Signature	Remarks	Verified By

Vessel shall prepare two copies of this record, one copy shall keep on board in training file and copy shall sent to Company every three months period .The training shall be carried out in the concept of Specific Familiarization (one week period after the embarkation of the vessel) in accordance with STCW95 Convention A-VI/14 .In addition to Familiarization trainings, Ballast Water Management Training shall carried out and reviewed for officers in three months period.

14 BALLAST WATER HANDLING RECORD BOOK -PARTS 1 & 2

PART 1

Record of ballast water management on board (to be maintained in separate logbook as well, as per flag requirement)

Ship .... Port of Registry .... IMO number ....

TANK LOCATION	DATE	INITIAL CONTENT (tonnes)	FINAL CONTENT (tonnes)	GEOGRAPHIC LOCATION OF SHIP (Port or Lat. & Long.)	PUMPS USED, or GRAVITATE	DURATION OF OPERATION	DENSITY	SIGNATURE OF OFFICER IN CHARGE	RANK

Ballast Water Management Officer ....

Page..........

PART 2

Narrative record of events related to ballast water management on board.

Ship .... Port of Registry .... IMO number ....

Record here events which are relevant to ballast management, and which will be of interest to quarantine officers, such as sediment removal during dry-dock, or tank flushing at sea. Each entry should be completed with the signature and rank of the officer making the entry.

Date	Activity	Comments	Signature/ Rank

Ballast Water Management Officer...

Page..........

15 CONTINGENCY MEASURES

Vessel Name: JP88 STORK
IMO Number: 9354947
BWMS Manufacturer: BIO-UV
BWMS Model: BIO-SEA L02-0060

PART 1: Reporting – In case of BWMS failure.

1. The responsible officer should report to the Company using the BWMS failure reporting form.
2. The company should report the BWMS failure to the Flag Administration, the BWMS manufacturer and, if the failure is significant, the Class Society.
3. Based on feedback from the Flag Administration and the BWMS manufacturer, the company should agree on a BWMS Repair Plan which would include all relevant supporting information, including historical failure and a schedule with a specific timeline for the repair to be completed (see Part 3 for guidance on the BWMS Repair Plan).
4. The company should submit a Ballast Water Contingency Measure Request Form to the Port State authority where the ballast water is intended to be discharged. The Ballast Water Contingency Measure Request Form should include a copy of the BWMS Failure Reporting Form, the BWMS Repair Plan and any other relevant documentation regarding the incident (see Annex I: Ballast Water Contingency Measure Request Form).
5. Based on the previous points, the company will confirm to the ship which Contingency Measure is to be undertaken and provide any additional guidance or instructions necessary to fulfil the requirements of the Port State authority, Flag Administration or Class Society, as necessary.

PART 2: Contingency Measures

In case of any failure of the installed treatment system sequential method shall be followed. Contingency measures are to be taken in the event a BWMS fails which is detailed in appendix E.

PART 3: BWMS Repair Plan

The BWMS Repair Plan should be prepared by the BWMS manufacturer in consultation with the company.

The BWMS Repair Plan should provide a schedule with a specific timeline from the BWMS manufacturer as to when the BWMS will be repaired. The schedule for repairs is important as it will allow the owner and the Port State to determine whether this is short term fix or a longer-term issue that may impact future port calls.

As a minimum, the BWMS Repair Plan should provide details of

- the BWMS, its repairs and all previous maintenance and failure history
- the length of time the system has been inoperable.
- the suspected cause of failure
- repairs that have already been completed
- details relating to the attempts to repair the BWMS
- the schedule for the proposed repair (corrective action)
- communications between the company and the manufacturer

- other relevant operational data.

ANNEX – I

Ballast Water Contingency Measure Request Form

1 COMPANY INFORMATION

1.1 Company name: ______________________________

1.2 Designated officer: ______________________________

1.3 Email: ____________________ 1.4 Tel. ______________________________

2 SHIP'S PARTICULARS

2.1 Name of ship: ______________________________

2.2 IMO Number: ______________________________

2.3 Master: ______________________________

3 BALLAST WATER MANAGEMENT SYSTEM

3.1 BWMS Manufacturer: ______________________________

3.2 BWMS Model: ______________________________

4 PORT/LOCATION OF BWMS FAILURE

4.1 Country: ______________________________

4.2 Name of port or area: ______________________________

4.3 Longitude/Latitude: ______________________________

4.4 Time and date of occurrence: ______hrs __/__/____ (dd/mm/yyyy)

5 INTENDED BALLAST WATER DISCHARGE

5.1 Country: ______________________________

5.2 Name of port or area: ______________________________

5.3 Quantity of ballast water to be discharged (m3): ______________________________

7 ADDITIONAL REMARKS AND INFORMATION

8 PROPOSED CONTINGENCY MEASURE

Insert description of the proposed contingency measure including all relevant details on how the measure will be conducted, as per the details provided in the ship's BWMP.

Insert additional details relating to the time and location the measure will be conducted, as per the Ballast Water Report Form.

9 ADDITIONAL INFORMATION

The following documents are appended to this Form:

1. A completed **Ballast Water Report Form** as per the recommended format provided in the 2017 Guidelines for Ballast Water Exchange (G6) – Resolution MEPC.288 (71)

   For the US, this should be in the format of the National Ballast Information Clearinghouse (NBIC) reporting form.

2. The **BWMS Failure Report** as submitted by the designated officer in charge on the vessel.

3. **BWMS Repair Plan** as developed by the BWMS manufacturer in consultation with the company.

4. **Certificate of Compliance** (IBWMC) with the IMO Ballast Water Management Convention

5. Copy of the **BWMS Type Approval Certificate**

6. Copies of the **Ballast Water Record Book** covering at least the previous three ballast water management operations.

7. *For the US, USCG approval letter for the system or a USCG Alternate Management System (AMS) letter issued to the vessel.*

8. *For the US, reference to the relevant crew training documentation as provided in the BWMP should also be included with a clear description of the training for both operation and maintenance of the BWMS.*

We invite you to review the information provided together with the proposed contingency measure and advise the undersigned as soon as possible of your consent to undertake the procedure described above.

In the event an alternative measure is proposed or more details are required, please contact the undersigned.

Company representative: ________________________ Date: __/__/____ (dd/mm/yyyy)

ANNEX – II

Ballast Water Management System (BWMS) Failure Reporting Form

1. SHIP'S PARTICULARS

1.1 Name of ship: ______________________________

1.2 IMO Number: ______________________________

1.3 Responsible officer: ______________________________

2. BALLAST WATER MANAGEMENT SYSTEM

2.1 BWMS Manufacturer: ______________________________

2.2 BWMS Model: ______________________________

3. PORT/LOCATION OF BWMS FAILURE

3.1 Country: ______________________________

3.2 Name of port or area: ______________________________

3.3 Longitude/Latitude: ______________________________

3.4 Time and date of occurrence: ______hrs __/__/____ (dd/mm/yyyy)

4 INFORMATION ON THE BWMS FAILURE

4.1 Description of failure (please include any details of the components that failed):

____

____

____

____

4.2 Details of actions taken to repair BWMS:

____

____

____

____

4.3 Total volume of ballast pumped prior to failure: ____________________

4.4 Hours BWMS in use prior to failure: ____________________

4.5 Tanks treated/partially treated/untreated (TT/PT/UT):

____

Tank*									
TT/PT/UT									

** Refer to vessel BWMP for ballast tank coding*

5 PROPOSED CONTINGENCY MEASURE(S)

Based on the Contingency Measures listed in the ships' BWMP, the following Contingency Measures are
proposed for this event:

Contingency Measures listed in the BWMP	Proposed Measure*
ECM.1 Repair BWMS at the ballast loading port	
ECM.2 Repair the BWMS en route	
ECM.3.1 Mid-ocean ballast water exchange (BWE) – without BWMS	
ECM.3.2 Mid-ocean ballast water exchange (BWE) – with BWMS	
ECM.4 Ballast water exchange in a designated ballast water exchange area	
ECM.5 Shore based mobile treatment systems at the ballast discharge port	
ECM.5.1 Ballast water treatment boat or barge	
ECM.5.2 Mobile treatment facility transported on a barge or truck	
ECM.5.3 Mobile ballast water treatment equipment	
ECM.6 Discharge to a port reception facility at the ballast discharge port	
ECM.7 Retain ballast water onboard	
ECM.8 Use water from a Public Water System	
ECM.9 Partial ballast water discharge at 12nm from nearest land (US only)	

** Tick as appropriate*

6 ADDITIONAL REMARKS AND INFORMATION

____

____

____

Master's signature ______________________ Date: __/__/____ (dd/mm/yyyy)

16 RECORDING REQUIREMENTS

The ballast water management officer is to ensure that the Ballast Water Record Book and any other necessary documentation and forms are kept up to date.

The Ballast Water Record Book may be an electronic record system or may be integrated into another record book or system.

The Ballast Water Record Book entries shall be maintained on board the vessel for a minimum period of two years after the last entry has been made. Thereafter, the record book should be maintained in the company's control for a minimum period of three years.

In the event of discharging of ballast water pursuant to regulations A-3, A-4 or B-3 or in the vent of the accidental or exceptional discharge of ballast water not otherwise exempted by the Convention, an entry shall be made in the Ballast Water Record Book describing the circumstances, and the reason for, the discharge.

Each operation concerning ballast water shall be fully recorded without delay in the Ballast Water Record Book.

In the event of discharging of ballast water pursuant to regulations A -3, A-4 or B-3 or in the event of the accidental or exceptional discharge of ballast water not otherwise exempted by the Convention, an entry shall be made in the Ballast Water Record Book describing the circumstances, and the reason for, the discharge.

Each operation concerning ballast water shall be fully recorded without delay in the Ballast Water Record Book.

When the systems encounter failure and/or malfunctions, these are to be also recorded in the Ballast Water Record Book.

The control equipment of the ballast water treatment system is able to store data for at least 24 months.

The requirements for type approval are that the control equipment should be able to display or print a record for official inspections as required.

In the event the control equipment is replaced, means should be provided to ensure the data recorded prior to replacement remains available on board for 24 months

APPENDIX

Appendix-A: General Arrangement

GENERAL ARRANGEMENT PLAN - JP88 STORK

PRINCIPAL PARTICULARS

LENGTH (O.A.)	:	70.70	m
LENGTH (B.P.)	:	63.00	m
BREADTH (MLD.)	:	16.00	m
DEPTH (MLD.)	:	7.20	m
DESIGN DRAFT	:	6.00	m
SCANTLING DRAFT	:	6.20	m
COMPLEMENT	:	40	MEN
CARGO DECK SPACE	:	500	m²
FUEL OIL	:	960	m³
POTABLE WATER	:	660	m³
DRIL WATER (INCLUDE C. LKR.)	:	650	m³
RECOVERED OIL	:	376	m³
DISPERSANT	:	12	m³
SEWAGE	:	15	m³
FOAM	:	11	m³
CHAIN LOCKER	:	220	m³
BULK CEMENT	:	10000	m³

NOTE:

01. THE DRAWING PREPARED FOR CONVERSION FROM MUD TANK TO RECOVERED OIL TANK
02. ADD NEW HATCH FOR RECOVERED OIL TANK

REFERENCE DWG.

01. GENERAL ARRANGEMENT_DWG. NO. C3806A/G-1

LEGEND

- : EXISTING
- : NEW MODIFICATION

JP88 STORK

UID	REV	DATE	DESCRIPTION	REVISED BY	APPROVED
133594	1	19.07.22	REMOVE NEW HATCH	AFA	DD
131700	0	13.07.22	ISSUED FOR APPROVAL	–	DD

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TITLE:

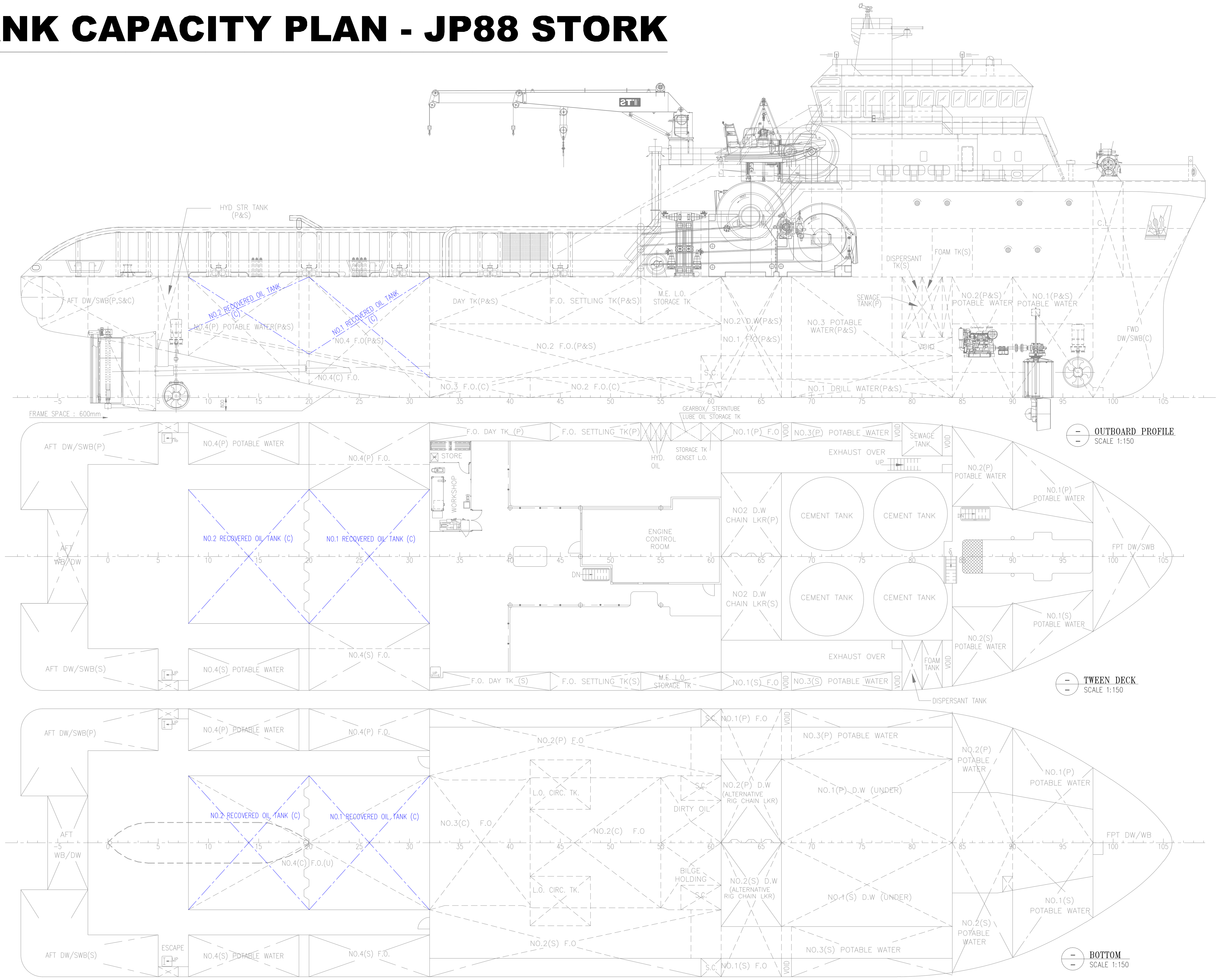
GENERAL ARRANGEMENT

VESSEL NAME: JP88 STORK	DATE : 19.07.22	DWG. No : DG2472/2001
DRAWN BY : DH	JOB No : DG2472	SHEET : 01 OF 01
CHECKED BY : W	SCALE : 1:150	REV : 1 SIZE A1

FILENAME: DG2472_2001_GENERAL ARRANGEMENT_REV-1.DWG

Appendix-B: Capacity Plan

TANK CAPACITY PLAN - JP88 STORK



TANK NO.	TANK TYPE	FRAME NO.	CAPACITY VOLUME (cu.m) 98%	CAPACITY VOLUME (cu.m) 100%	CAPACITY WEIGHT (mt) 98%	CAPACITY WEIGHT (mt) 100%	VCG (m) @ 100%	LCG (m) @ 100%	FSM (mt) @ 98%
1) SEA WATER (SG = 1.025)									
FPTDW&SWBTK.C	FORE PEAK D.W & S.W.B TANK	FR.98–F.E.	202.90	207.10	208.01	212.26	6.016	29.164f	331.80
APTDW&SWBTK.P	AFT PEAK D.W & S.W.B TANK	FR.5–A.E.	59.50	60.80	61.03	62.28	6.143	33.144a	59.19
APTDW&SWBTK.S	AFT PEAK D.W & S.W.B TANK	FR.5–A.E.	59.50	60.80	61.03	62.28	6.143	33.144a	59.19
APTDW&SWBTK.C	AFT PEAK D.W & S.W.B TANK	FR.–2–A.E.	33.30	34.00	34.17	34.87	5.421	33.659a	29.72
TOTAL			355.20	362.70	364.24	371.69			
2) DRILL WATER (SG = 1.000)									
NO1DWTK.P	NO.1 DRILL WATER TANK	FR.67–FR.84	47.30	48.20	47.28	48.25	0.519	13.797f	104.67
NO1DWTK.S	NO.1 DRILL WATER TANK	FR.67–FR.84	47.30	48.20	47.28	48.25	0.519	13.797f	104.67
NO2DWTK.P	NO.2 DRILL WATER TANK	FR.61–FR.67	107.90	110.10	107.87	110.07	4.096	6.898f	36.94
NO2DWTK.S	NO.2 DRILL WATER TANK	FR.61–FR.67	107.90	110.10	107.87	110.07	4.096	6.898f	36.94
TOTAL			310.40	316.60	310.30	316.64			
3) POTABLE WATER (SG = 1.000)									
NO1PWTK.P	NO.1 PORTABLE WATER TANK	FR.90–FR.98	90.10	91.90	90.10	91.94	3.791	24.566f	18.82
NO1PWTK.S	NO.1 PORTABLE WATER TANK	FR.90–FR.98	90.10	91.90	90.10	91.94	3.791	24.566f	18.82
NO2PWTK.P	NO.2 PORTABLE WATER TANK	FR.84–FR.90	105.20	107.30	105.19	107.34	3.499	20.625f	25.08
NO2PWTK.S	NO.2 PORTABLE WATER TANK	FR.84–FR.90	104.40	106.60	104.44	106.58	3.518	20.614f	25.08
NO3PWTK.P	NO.3 PORTABLE WATER TANK	FR.68–FR.84	84.00	85.70	84.00	85.71	2.618	13.174f	0.66
NO3PWTK.S	NO.3 PORTABLE WATER TANK	FR.68–FR.84	84.00	85.70	84.00	85.71	2.618	13.174f	0.66
NO4PWTK.P	NO.4 PORTABLE WATER TANK	FR.8–FR.19	48.80	49.80	48.81	49.80	5.614	23.142a	8.46
NO4PWTK.S	NO.4 PORTABLE WATER TANK	FR.8–FR.19	48.80	49.80	48.81	49.80	5.614	23.142a	8.46
TOTAL			655.40	668.70	655.45	668.82			
4) HYDRAULIC OIL (SG = 0.900)									
NO1HYDOILTK.P	NO.1 HYDRAULIC OIL TANK	FR.55–FR.56	1.80	1.80	1.61	1.64	5.800	1.800f	0.06
NO2HYDOILTK.P	NO.2 HYDRAULIC OIL TANK	FR.54–FR.55	1.80	1.80	1.61	1.64	5.800	1.200f	0.06
NO3HYDOILTK.P	NO.3 HYDRAULIC OIL TANK	FR.5–FR.7	1.70	1.70	1.51	1.54	6.233	27.895a	0.04
STRHYDOILTK.P	STR. HYDRAULIC OIL TANK	FR.53–FR.54	1.80	1.80	1.61	1.64	5.800	0.600f	0.06
TOWHYDOILTK.S	TOW. HYDRAULIC OIL TANK	FR.5–FR.7	1.70	1.70	1.51	1.54	6.233	27.895a	0.04
TOTAL			8.80	8.80	7.85	8.00			
5) RECOVERED OIL (SG = 0.980)									
NO1RECOVOILTK.C	NO.1 RECOVERED OIL TANK	FR.20–FR.32	289.40	295.30	283.61	289.40	4.581	15.735a	756.42
NO2RECOVOILTK.C	NO.2 RECOVERED OIL TANK	FR.8–FR.20	211.50	215.90	207.27	211.58	5.274	22.875a	756.42
TOTAL			500.90	511.20	490.88	500.98			

TANK NO.	TANK TYPE	FRAME NO.	CAPACITY VOLUME (cu.m) 98%	CAPACITY VOLUME (cu.m) 100%	CAPACITY WEIGHT (mt) 98%	CAPACITY WEIGHT (mt) 100%	VCG (m) @ 100%	LCG (m) @ 100%	FSM (mt) @ 98%
6) FUEL OIL (SG = 0.855)									
NO1FOTK.P	NO.1 FUEL OIL TANK	FR.61–FR.67	58.70	59.90	50.18	51.20	2.181	6.904f	0.34
NO1FOTK.S	NO.1 FUEL OIL TANK	FR.61–FR.67	58.70	59.90	50.18	51.20	2.181	6.904f	0.34
NO2FOTK.P	NO.2 FUEL OIL TANK	FR.32–FR.61	117.00	119.30	100.00	102.04	1.729	3.624a	1.63
NO2FOTK.S	NO.2 FUEL OIL TANK	FR.32–FR.61	117.00	119.30	100.00	102.04	1.729	3.624a	1.63
NO2FOTK.C	NO.2 FUEL OIL TANK	FR.42–FR.55	53.70	54.80	45.91	46.84	0.608	1.809a	154.44
NO3FOTK.C	NO.3 FUEL OIL TANK	FR.32–FR.42	51.40	52.50	43.97	44.87	0.611	9.308a	180.97
NO4FOTK.P	NO.4 FUEL OIL TANK	FR.20–FR.32	119.10	121.50	101.82	103.90	4.852	15.697a	32.34
NO4FOTK.S	NO.4 FUEL OIL TANK	FR.20–FR.32	119.10	121.50	101.82	103.90	4.852	15.697a	32.34
NO4FOTK.C	NO.4 FUEL OIL TANK	FR.8–FR.32	156.80	160.00	134.09	136.83	1.855	19.131a	72.59
FODAYTK.P	FUEL OIL FOR DAY TANK	FR.32–FR.42	21.40	21.80	18.30	18.68	5.800	8.700a	0.67
FODAYTK.S	FUEL OIL FOR DAY TANK	FR.32–FR.42	20.70	21.10	17.67	18.03	5.800	8.586a	0.64
FOSETTK.P	FUEL OIL FOR SETTING TANK	FR.42–FR.53	16.10	16.40	13.73	14.01	5.800	2.400a	0.50
FOSETTK.S	FUEL OIL FOR SETTING TANK	FR.42–FR.53	16.10	16.40	13.73	14.01	5.800	2.400a	0.50
TOTAL			925.80	944.40	791.56	807.46			
7) LUBRICATION OIL (SG = 0.900)									
GLOSTK.P	LUBRICATION OIL FOR GEAR BOX	FR.56–FR.59	3.60	3.60	3.21	3.28	5.800	4.500f	0.12
ALOSTK.P	LUBRICATION OIL FOR GENSET TANK	FR.59–FR.61	5.40	5.50	4.82	4.91	5.800	3.000f	0.18
MLOSTK.S	LUBE OIL STORAGE FOR MAIN ENGINE	FR.53–FR.61	14.30	14.60	12.84	13.11	5.800	2.700f	0.47
LOCTK.P	LUBRICATION OIL CIRCULATE TANK	FR.42–FR.48	12.30	12.50	11.06	11.29	0.632	4.500a	8.04
LOCTK.S	LUBRICATION OIL CIRCULATE TANK	FR.42–FR.48	12.30	12.50	11.06	11.29	0.632	4.500a	8.04
TOTAL			47.90	48.70	42.99	43.88			
8) MISC. (SG = 0.900 FOR DIRTY OIL, SG = 1.000 FOR BILGE & SEWAGE, SG = 1.145 FOR FOAM, SG = 1.163 FOR DISP.)									
DIRTYOIL.P	DIRTY OIL HOLDING TANK	FR.55–FR.61	9.30	9.50	8.34	8.51	0.457	3.119f	9.67
BILGE.S	BILGE HOLDING TANK	FR.55–FR.61	9.30	9.50	9.26	9.45	0.457	3.119f	10.74
SEWAGE.P	SEWAGE HOLDING TANK	FR.79–FR.83	14.30	14.50	14.26	14.55	5.451	17.068f	1.23
FOAM.S	FOAM TANK	FR.81–FR.83	11.40	11.70	13.09	13.35	5.438	17.694f	2.74
DISPERSANT.S	DISPERSANT TANK	FR.79–FR.81	12.00	12.20	13.96	14.24	5.425	16.496f	3.03

General Notes:

1. Reference Point is Midship at Fwd 300mm of Fr.52.
2. "a" is Aft of Midship, "f" is Fwd of Midship.

NOTE:

01. THE DRAWING PREPARED FOR CONVERSION FROM MUD TANK TO RECOVERED OIL TANK WITH REF. TO CLASS LR RULES
02. THE CHANGE IN SPECIFIC GRAVITY FROM MUD TANK (SG :2.5) TO RECOVERED OIL TANK (SG :0.98)

REFERENCE DWG.

01. TANK CAPACITY PLAN_DWG. NO. C3806A/C-14

LEGEND

: EXISTING
: NEW MODIFICATION

PRINCIPAL PARTICULARS

LENGTH (O.A.)	:	70.70	m
LENGTH (B.P.)	:	63.00	m
BREADTH (MLD.)	:	16.00	m
DEPTH (MLD.)	:	7.20	m
DESIGN DRAFT	:	6.00	m
SCANTLING DRAFT	:	6.20	m

JP88 STORK

UID	REV	DATE	DESCRIPTION	REVISED BY	APPROVED
131699	0	13.07.22	ISSUED FOR APPROVAL	–	DD

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TITLE:

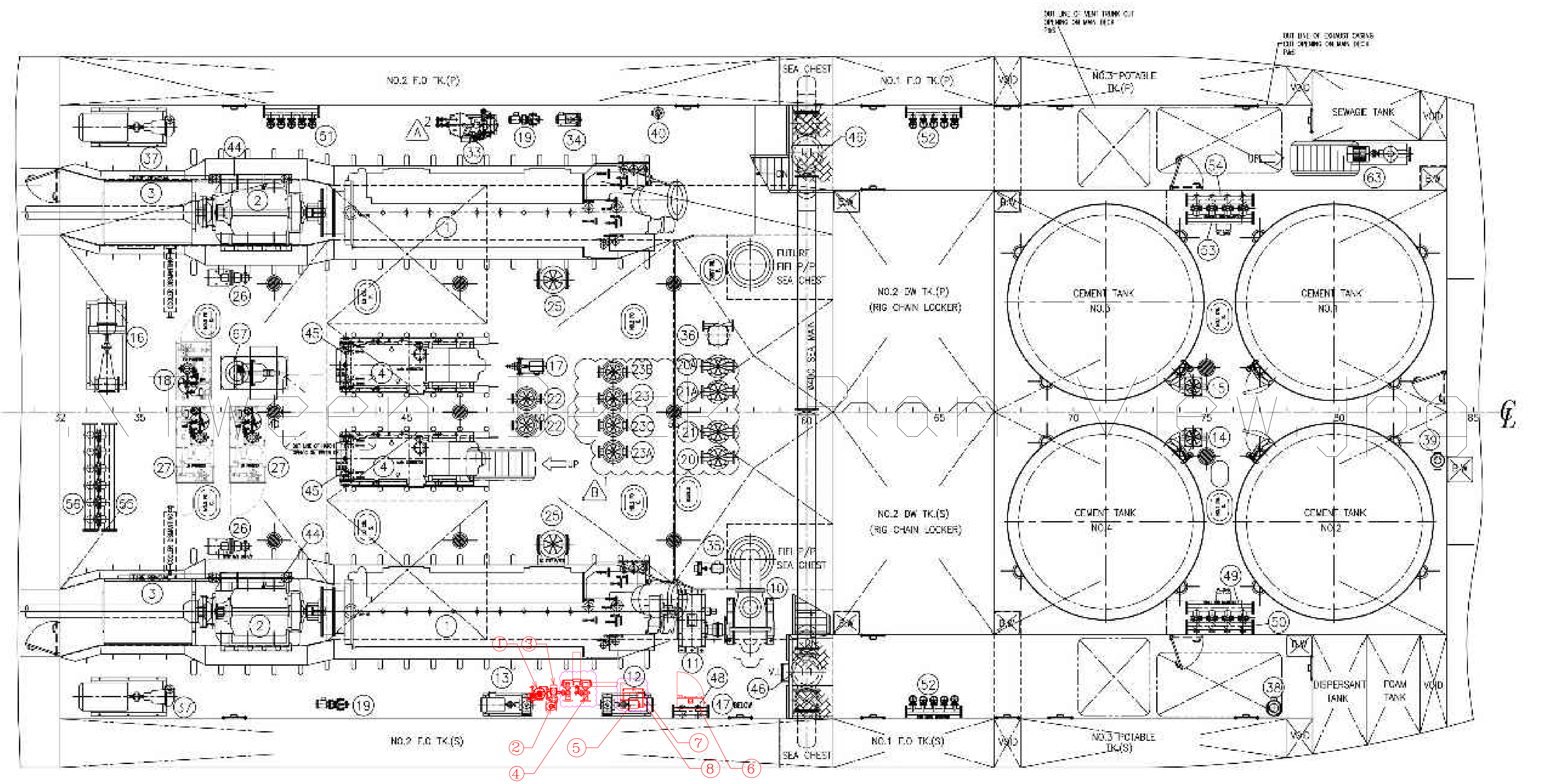
TANK CAPACITY PLAN

VESSEL NAME : JP88 STORK	DATE : 13.07.22	DWG. No : DG2472/2002
DRAWN BY : DH	JOB No : DG2472	SHEET : 01 OF 01
CHECKED BY : W	SCALE : 1:150	REV : 0 SIZE A1

FILENAME: DG2472_2002_TANK CAPACITY PLAN_REV.0.DWG

Appendix-C: Machinery Arrangement

LIST OF EQUIPMENTS	
SL.NO.	DESCRIPTION
1	FILTER
2	FLOW METER
3	BACKFLUSH PUMP
4	UV ASSEMBLY
5	SWITCH BOARD CABINET
6	CONTROL CABINET
7	ELECTRONIC BALLAST NO.1
8	ELECTRONIC BALLAST NO.2



ENGINE ROOM PLAN BELOW TWEEN DECK

EQUIPMENT/PUMP DETAILS			
ITEM	TYPE	CAPACITY	DIFF. HEAD (BAR)
BILGE/BALLAST/FIRE PUMP	CENTRIFUGAL PUMP	60m³/hr	6
BILGE/G.S/FIRE PUMP	CENTRIFUGAL PUMP	60m³/hr	6
BWTS SYSTEM	UV TREATMENT	60m³/hr	–

SH. SIZE	A3	DRAWING TITLE	DRAWING NO.	REV.	SH. NO.
SCALE	N.T.S	BWTS EQUIPMENT ARRANGEMENT DRAWING	GSPL-P1482-ME-0201	B	02

NOTICE : This drawing and the information it contains are property of Goltens Singapore Pte Ltd. and may not be reproduced or used in part or in whole for any purpose exept by written permission of this company.

Appendix-D: Type Approval Certificate

U. S. Department of Homeland Security

United States Coast Guard

Certificate of Approval

Coast Guard Approval Number: 162.060/9/4 Expires: 20 June 2028

BALLAST WATER MANAGEMENT SYSTEM
Filtration/Ultraviolet

BIO-UV Group
850 Avenue Louis Médard
Lunel, FRANCE

Name of BWMS: BIO-SEA

Capacities: BIO-SEA B: 55 - 1,400 m3/h
BIO-SEA L: 20 – 80 m3/h
BIO-SEA M: 150 – 1,400 m3/h

This is to certify that the above listed BWMS, with the listed treatment capacities, has been satisfactorily examined and tested by Independent Lab DNV in accordance with the requirements contained in 46 CFR 162.060. The system shall be installed and operated in accordance with the below listed Operation, Maintenance, and Safety Manual (OMSM) applicable to the particular model.

BIO-SEA B01-0055 to B14-2100 and BIO-SEA L01-0030 to L04-0120: OMSM, Ref. BS3-01 rev C00, dated February 2023
BIO-SEA M02-0150 to M14-2100: OMSM, Ref. BSM-01 rev A03, dated September 2022

Installation Limitations: See Appendix

Operational Limitations: See Appendix

The BWMS must be marked in accordance with 46 CFR 162.060-22. A copy of this Type Approval Certificate shall be carried on board a vessel fitted with the BWMS at all times.

Vessel owners/operators are expected to consult with the manufacturer to ensure the BWMS's operational limitations and treatment flow rates are acceptable for the waters frequented by their vessels.

This certificate supersedes Approval number 162.060/9/3 dated December 14, 2021; update includes approval for US flag installation for BIO-SEA M, B & L and renewal.

*** End ***

THIS IS TO CERTIFY THAT the above named manufacturer has submitted to the undersigned satisfactory evidence that the item specified herein complies with the applicable laws and regulations as outlined on the reverse side of this Certificate, and approval is hereby given. This approval shall be in effect until the expiration date hereon unless sooner canceled or suspended by proper authority.

GIVEN UNDER MY HAND THIS 20th DAY OF
JUNE 2023, AT WASHINGTON D.C.

S. M. PETERSON
Chief, Engineering Division
BY DIRECTION OF THE COMMANDANT

TERMS: The approval of the item described on the face of the Certificate has been based upon the submittal of satisfactory evidence that the item complies with the applicable provisions of the navigation and shipping laws and the applicable regulations in Title 33 and/or Title 46 of the Code of Federal Regulations. The approval is subject to any conditions noted on this Certificate and in the applicable laws and regulations governing the use of the item on vessels subject to Coast Guard inspection or on other vessels and boats.

Consideration will be given to an extension of this approval provided application is made 3 months prior to the expiration date of this Certificate.

The approval holder is responsible for making sure that the required inspections or tests of materials or devices covered by this approval are carried out during production as prescribed in the applicable regulations.

The approval of the item covered by this certificate is valid only so long as the item is manufactured in conformance with the details of the approved drawings, specifications, or other data referred to. No modification in the approved design, construction, or materials is to be adopted until the modification has been presented for consideration by the Commandant and confirmation received that the proposed alteration is acceptable.

NOTICE: Where a manufacturer of safety-at-sea equipment is offering for sale to the maritime industry, directly or indirectly, equipment represented to be approved, which fails to conform with either the design details or material specifications, or both, as approved by the Coast Guard, immediate action may be taken to invoke the various penalties and sanctions provided by law including prosecution under 46 U.S.C. 3318, which provides:

"A person that knowingly manufactures, sells, offers for sale, or possesses with intent to sell, any equipment subject to this part *(Part B. of Subtitle II of Title 46 U.S.C.).* and the equipment is so defective as to be insufficient to accomplish the purpose for which it is intended, shall be fined not more than $10,000, imprisoned for not more than 5 years or both."

APPENDIX
U. S. Coast Guard Approval Number: 162.060/9/4
Expires: 20 June 2028

INSTALLATION LIMITATIONS

In addition to meeting 46 CFR 162.060, which approves the operation of this BWMS in U.S. waters, this type approval certificate also allows for the installation and operation of this BWMS on the following vessels and/or shipboard locations:

BWMS Model	U.S. Flag Installation	Hazardous Location Installation (U.S. Flag)[1]	Hazardous Location Installation (Foreign Flag)[2]
Bio-Sea B	X		
Bio-Sea L	X		
Bio-Sea M	X		

1) Models have been verified to meet the requirements of 46 CFR 111.105
2) Subject to approval of the foreign administration

Note: "X" indicates approval for installation.

OPERATIONAL LIMITATIONS

Salinity: Not Applicable
Water Temperature: -2-40ºC
Hold Time with FILTREX filter:
- >24 Hours in Marine Water (>28 PSU)
- >19 Hours in Brackish Water (<28 PSU)
- Not Applicable in Fresh Water (<1 PSU)

Hold Time with HYDAC filter: Not Applicable
UV-Intensity at full flow:
- BIO-SEA B: >725 W/m2
- BIO-SEA L: >1,700 W/m2
- BIO-SEA M02: >630 W/m2
- BIO-SEA M04: >500 W/m2
- BIO-SEA M05: >450 W/m2
- BIO-SEA M07: >500 W/m2

*** END ***

Appendix-E: Existing BWMP

Ballast Water Management Plan

Lewek Stork (IMO 9354947)

Name of Company: EMAS MARINE

EXAMINED

Lloyd's Register

This plan has been examined and given the status as shown in the Design Appraisal Document (DAD) number below:

SATS/ENV/0017387

Date: **August-30, 2017** Initials: **ML**

Marine
South Asia Technical Support Office
Lloyd's Register Asia

LR001.1.2016.06

Reference:
EOL-BWMP-LSK-0

Plan date:
30 May 2017

Plan by:
Emas Offshore Services Technical Dept

BWMP Version 0: January 2014

Lloyd's Register

IMO No. 9354947

BALLAST WATER MANAGEMENT PLAN

This ballast water management plan has been appraised for compliance with Regulation B-1 of the International Convention for the Control and Management of Ship's Ballast Water and Sediments, 2004, and IMO Resolution MEPC.127(53).

Date: 30 August 2017

Signed:

Malcolm Lim
August-30, 2017
Marine
South Asia Technical Support Office
Lloyd's Register Asia

Surveyor to Lloyd's Register Asia

A member of the Lloyd's Register Group

A

Approval is subject to verification that the arrangements onboard are identical to those described in this manual.

I hereby certify that the above condition has been complied with:-

Signature ________________________ Date:

Surveyor to Lloyd's Register

"Lloyd's Register, 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 Group'. The Lloyd's Register Group 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 Group 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."

IMO No. 9354947

APPRAISAL HISTORY			
Original appraisal			
'LEWEK STORK'	LABUAN MALAYSIA	9WND2	Malcolm Lim August-30, 2017 Marine South Asia Technical Support Office Lloyd's Register Asia Lloyd's Register
NAME	PORT OF REGISTRY AND FLAG	OFFICIAL NO. OR CALL SIGN	SURVEYOR/DATE
Changes:			

"Lloyd's Register, 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 Group'. The Lloyd's Register Group 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 Group 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."

Contents

Ballast Water Management Plan

For compliance with Regulation B-1 of the International Convention for the Control and Management of Ships' Ballast Water and Sediments 2004 and the IMO 'Guidelines for Ballast Water Management and Development of Ballast Water Management Plans' Resolution MEPC 127 (53).

Note: This plan is to be written in the working language of the crew; if the text is not in English, French or Spanish the plan is to include a translation into one of these languages.

1. Ship particulars

Ship's name	Lewek Stork
Ship type	AHTS
Flag	Malaysia
Port of registry	Labuan
Gross tonnage	2569 T
IMO number	9354947
Keel laying date	12th April 2005
Delivery date	29th December 2005
Length (between perpendiculars)	63.0 m
Breadth (moulded)	16.0 m
International call sign	9WND2
Deepest ballast drafts	5.712 m
Total ballast capacity[1]	362.7 m^3
Ballast water management method(s) used	Sequential
Identification (rank) of Ballast Water Management Officer	Chief Officer

[1] In m3 or other units if applicable to the ship

2. Introduction

This Plan is written in accordance with the requirements of regulation B-1 of the International Convention for the Control and Management of Ships' Ballast Water and Sediments, 2004 (the BWM Convention) and the associated guidelines.

The purpose of the Plan is to meet the requirements for the control and management of ship's ballast water and sediments in accordance with IMO Resolution MEPC 127(53) – Guidelines for Ballast Water Management and the Development of Ballast Water Management Plans. It provides standard operational guidance for the planning and management of ships' ballast water and sediments.

This Plan has been examined by Lloyd's Register EMEA and no alteration or revision shall be made to any part of it without the prior approval of the Lloyd's Register Group.

This Plan may be inspected on request by an authorised authority.

Changes to non-mandatory information in Appendices will not be required to be approved.

It is the owner/operator's or Master's responsibility to regularly review the Plan and ensure that the information it contains is accurate and up-to-date.

3. Record of circulation

This document is to be circulated to the ship's staff that will be responsible for ballast water management. After reading, it is to be signed and returned to the Ballast Water Management Officer.

Name	Rank	Date joined	Signature and date

4. Record of Amendments

No.	Date	Revised part	Details/description of revision	Signature

5. Purpose of the Plan

Ballast water is essential to control the trim, list, draught, stability, or stresses of the ship. However, ballast water may contain aquatic organisms or pathogens which, if introduced into the sea (including estuaries) or into fresh water courses, may create hazards to the environment, human health, property or resources, impair biological diversity or interfere with other legitimate uses of such areas.

The selected methods of ballast water management take into account the need to ensure that the ballast water management practices used to comply with the BWM Convention do not cause greater harm than they present to the environment, human health, property or resources of any states and the safety of the ship.

It is estimated that at least 7,000 different species are being carried in ships' ballast tanks around the world. Studies carried out in several countries indicated that many species of bacteria, plants, and animals can survive in a viable form in the ballast water and sediment carried in ships, even after journeys of several months' duration.

Subsequent discharge of ballast water or sediment into the waters of port states may result in the establishment of harmful aquatic organisms and pathogens which may pose threats to indigenous human, animal and plant life, and the marine environment. When all factors are favourable, an introduced species may survive to establish a reproductive population in the host environment; it may even become invasive, out-competing native species and multiplying to pest proportions. Although other media have been identified as being responsible for transferring organisms between geographically separated water bodies, ballast water discharge from ships appears to have been among the most prominent.

As a result, the IMO has developed guidelines for the development and implementation of ballast water management plans on board ships (IMO Resolution MEPC 127(53)) aiming to assist governments, appropriate authorities, ships' Masters, operators, owners and port authorities, as well as other interested parties, in preventing, minimising and ultimately eliminating the risk of introducing harmful aquatic organisms and pathogens from ships' ballast water and associated sediments, while protecting ships' safety.

Good record keeping is critical to the success of a sound ballast water management program. The appointed ballast water management officer is responsible for ensuring the maintenance of appropriate records and that ballast water management and/or treatment procedures are followed and recorded.

The function of the Ballast Water Management Plan is to assist in complying with the BWM Convention guidelines and associated national and local measures intended to minimise the risk of transplanting harmful aquatic organisms and pathogens from ships' ballast water and associated sediments, while maintaining ship safety.

As part of this function the plan provides information to port state control and other authorised officers about a ship's ballast handling system, sampling points and ballast water management system.

6. Plans and drawings of the ballast system

The following plans and information are located in Appendix 1:

1. Ballast tank arrangement
2. Ballast capacity plan
3. Ballast water piping and pumping arrangement, including air pipes and sounding arrangements
4. Ballast water pump capacities
5. Ballast water management system used on board with references to detailed operational and maintenance manuals held on board
6. Plan and profile drawing of the ship, or a schematic drawing of the ballast arrangement
7. List and/or diagrams indicating the location of sampling and access points in pipelines and ballast water tanks

7. Description of the ballast system

The following is a description of the ballast system used on board. Reference plans can be found in Appendix 1.

7.1 Ballast tank data

Tank(s)	Location (frame nos.)	Capacity (m^3)	Pump(s) available
FPTDW&SWBTK.C	FR.98 – F.E.	207.10	BALLAST PMP, GS/Fire PMP
APTDW&SWBTK.P	FR.5 – A.E.	60.80	BALLAST PMP, GS/Fire PMP
APTDW&SWBTK.S	FR.5 – A.E.	60.80	BALLAST PMP, GS/Fire PMP
APTDW&SWBTK.C	FR.2 – A.E.	34.00	BALLAST PMP, GS/Fire PMP

7.2 Pump(s) data

Pump(s)	Rated capacity (m^3/hr)	Type	Location
Bilge/Ballast/Fire Pump	60 m^3/ hr	Centrifugal Self-Priming	E/RM Bottom Platform (Stbd)
Bilge/G.S./Fire Pump	60 m^3 / hr	Centrifugal Self-Priming	E/RM Bottom Platform (Stbd)
Drill Water Pump	120m^3 / hr	Centrifugal Self-Priming	E/RM Bottom Platform (Stbd)

7.3 Overflow and filling line data (for flow through and dilution method)

Tank	No. of overflow lines per tank (air vents or overflow lines per tank)	Overflow line nominal diameter (mm)	Overflow lines total cross sectional area (mm^2)	Filling line nominal diameter (mm)	Filling line total cross sectional area (mm^2)	Ratio of overflow/filling line total cross sectional area
FPTDW&SWBTK.C	1	150	17671.46	125	12271.85	0.694
APTDW&SWBTK.P	1	150	17671.46	125	12271.85	0.694
APTDW&SWBTK.S	1	150	17671.46	125	12271.85	0.694
APTDW&SWBTK.C	1	150	17671.46	125	12271.85	0.694

Note: Flow through method should not be performed in tanks which have not been designed to a head up to the top of overflow, due to the risk of over pressurisation.

Note: In case that flow through method is being used, it is necessary prior to this operation to ensure that the overflow arrangements are open. On completion of each tank's ballast exchange the overflow arrangements must be re-secured.

Note: For safety reasons it is strongly recommended that access openings/manhole covers on upper deck should not be used as overflow discharge, unless a blank flange with a seat is fitted to the access cover so that a portable overflow pipe with 90° elbow can be connected during the flow through operation.

8. Ballast water sampling points

Information regarding the location of the ballast water sampling points is contained in Appendix 1.

Compliance monitoring may be undertaken by authorised officers (e.g. port state control), by taking and analysing ballast water and sediment samples from ships.

There is unlikely to be any need for crew members to take samples except at the express request, and under the supervision, of an authorised officer.

Authorised officers must be advised of all safety procedures to be observed when entering enclosed spaces.

Where ballast water or sediment sampling for compliance or effectiveness monitoring is being undertaken, the time required to analyse the samples shall not be used as a basis for unduly delaying the operation, movement or departure of the ship.

When sampling for research or compliance monitoring, authorised officers (e.g. port state control) should give as much notice to the Master as possible that sampling will occur, to assist the Master in planning staffing and operational resources to assist.

The Master has a general obligation to provide reasonable assistance for the above monitoring and information pertaining to ballast arrangements and sampling points.

Port state authorities should indicate to the Master or responsible officer the purpose for which the sample is taken (i.e. monitoring, research or enforcement).

Port state authorities may sample or require samples to analyse ballast water and sediment, before permitting a ship to discharge its ballast water.

Additional guidance regarding sampling procedures may be found in the Annex to MEPC.173(58) – Guidelines for Ballast Water Sampling (G2).

9. Operation of the ballast water management system

Forward planning is essential to ensure that all safety considerations, as addressed in sections 10 and 11, are in compliance with ballast exchange, ballast water treatment or other control options.

9.1 Ballast water exchange

Ballast water exchange in open water and the need to exchange should be carefully examined and prepared in advance, in a similar manner to the preparation of a cargo plan for a loaded voyage, and with the same degree of thoroughness.

The BWM Convention requires that vessels should conduct ballast water exchange:

– at least 200 nautical miles from the nearest land and in water at least 200 metres deep; if this is not possible

– as far from the nearest land as possible, and in all cases at least 50 nautical miles from the nearest land and in water at least 200 metres deep; or

– in sea areas designated by the port state.

All local and/or national regulations should be taken into consideration as they may specify other depths and distances from land.

A ship will not be required to deviate from its intended voyage or delay the voyage in order to comply with any particular requirement as stated above. In addition, if the Master decides reasonably that an exchange would threaten the safety or stability of the ship, its crew or its passengers because of adverse weather, ship design or stress, equipment failure, or any other extraordinary condition he is not required to comply with the above paragraphs.

There are three methods of ballast water exchange which have been evaluated and accepted by the IMO. These are the sequential method, the flow through method and the dilution method. The flow through method and the dilution method are considered ‘pump through’ methods.

9.1.1 Sequential method

The Sequential method is the chosen method for Lewek Stork and is a process by which a ballast tank intended for the carriage of ballast water is first emptied and then refilled with replacement ballast water to achieve at least a 95 per cent volumetric exchange.

In each tank, all of the ballast water should be discharged until suction of the pumps is lost, and stripping pumps or eductors should be used if possible. This is to avoid a possible situation where organisms are left in the bottom part of the tank and the tank is refilled with new water which may allow re-emergence of organisms.

The sequential method requires careful planning and monitoring by the ship’s staff to mitigate risks to the ship in respect of:

– longitudinal strength

– dynamic loads

– excessive trim

– bottom forward slamming

– propeller emergence

– intact stability; and

– bridge visibility.

A detailed step-by-step operational description of the ballast exchange sequence should be prepared and should be consulted before, during and after the exchange, in addition to the safety considerations in sections 10 and 11. At the same time, the ship's staff should be taking account of the ship's position in relation to the land, navigational hazards, shipping density, current and forecast weather, machinery performance and degree of crew fatigue, before proceeding to the next pair of steps. If any factors are considered unfavourable the ballast exchange should be suspended or halted.

9.1.2 Flow through method

The flow through method is a process by which replacement ballast water is pumped into a ballast tank intended for the carriage of ballast water, allowing water to flow through overflow or other arrangements to achieve at least 95 per cent volumetric exchange of ballast water. Pumping through three times the volume of each ballast water tank shall usually be considered to meet the volumetric exchange standard described above. Pumping through less than three times the volume may be accepted, provided the ship can demonstrate that at least 95 per cent volumetric exchange is met.

The flow through method has the advantage that it can be used in weather conditions which would be marginal for use of the sequential method, since there is little change to the condition of the ship and it is relatively easy to follow for the ship's staff. However, the flow through method introduces certain other risks and problems which must be considered before using this procedure. Refer also to section 6 – "Safety procedures for the ship and the crew".

The disadvantages are that not all tanks are designed with a head to the top of the overflow. Moreover, some tank configurations can be difficult to flush through effectively, in particular cellular double bottom spaces and peak tanks. There is a danger of over pressurisation of tanks and there can be an accumulation of water on deck, which in sub-zero temperature conditions makes the method impractical and dangerous for crew. In addition, pumps and piping will experience an increase in workload.

The above, in addition to the safety aspects addressed in Sections 10 and 11, should be carefully consulted and followed where applicable.

Where peak tanks are partially filled, the flow through method should be avoided to prevent inadvertently exceeding permissible hull girder bending moments and shear forces.

9.1.3 Dilution method

The dilution method is a process by which replacement ballast water is filled through the top of the ballast tank intended for the carriage of ballast water with simultaneous discharge from the bottom, at the same flow rate and maintaining a constant level in the tank throughout the ballast exchange operation to achieve at least 95 per cent volumetric exchange of ballast water.

Pumping through three times the volume of each ballast water tank shall usually be considered to meet the volumetric exchange standard described above. Pumping through less than three times the volume may be accepted, provided the ship can demonstrate that at least 95 per cent volumetric exchange is met.

Safety considerations addressed in Sections 10 and 11 should be carefully consulted and followed as applicable.

9.2 Precautionary practices

9.2.1 Minimising uptake of harmful aquatic organisms, pathogens and sediments

When loading ballast, every effort should be made to avoid the uptake of potentially harmful aquatic organisms, pathogens and sediment that may contain such organisms. The uptake of ballast water should be minimised or, where practicable, avoided in the following areas and situations:

- areas identified by the port state, including:
  - areas with outbreaks, infestations or known populations of harmful organisms and pathogens
  - areas with current phytoplankton blooms (algal blooms, such as red tides)
  - nearby sewage outfalls
  - nearby dredging operations
  - when a tidal stream is known to be turbid
  - areas where tidal flushing is known to be poor, and
- in darkness when bottom-dwelling organisms may rise up in the water column
- in very shallow water
- where propellers may stir up sediment.

If it is necessary to take on and discharge ballast water in the same port to facilitate safe cargo operations, care should be taken to avoid unnecessary discharge of ballast water that has been taken up in another port.

Managed ballast water which is mixed with unmanaged ballast water is no longer in compliance with Regulations D-1 and D-2 of the Annex to the BWM Convention.

Every effort should be made to minimise departure and arrival ballast quantities, but always within the constraints of safe navigation.

9.2.2 Non-release or minimal release of ballast water

In cases where ballast exchange or other treatment options are not possible, ballast water may be retained in tanks or holds. Should this not be possible, the ship should only discharge the minimum essential amount of ballast water in accordance with port states' contingency strategies.

9.2.3 Discharge to reception facilities

If reception facilities for ballast water and/or sediments are provided by a port state, they should be used where appropriate.

10. Safety procedures for the ship and the crew

Forward planning is essential to ensure that all safety considerations, as addressed in sections 10 and 11, are in compliance with ballast exchange, ballast water treatment or other control options.

10.1 Exchange at sea

The exchange of ballast water in open sea has to be distinguished from ballast operations carried out in ports or in sheltered waters.

Ballast water operation at sea has the potential to be more hazardous than ballast water operations carried out in port.

It is the Master's responsibility to plan and conduct a detailed procedure for ballast water exchange using and taking into account the provisions of section 12.

A decision should be made at the completion of each sequence, taking into account factors such as the ship's position, weather forecast, machinery performance, stability, strength, and the degree of crew fatigue, before proceeding to the next sequence. If any factors are considered unfavourable to the ballast exchange, a decision should be made to either suspend exchange operations until conditions become more favourable or halt exchange operations.

Contingency procedures should be considered for situations which may affect ballast water exchange at sea, including deteriorating weather conditions, pump failure and loss of power, time to complete the ballast water exchange for each tank or an inappropriate sequence thereof, and continual monitoring of the ballast water operation. Monitoring should include pumps, levels in tanks, line and pump pressures, stability and stresses.

10.2 Safety considerations

Ballast water exchange has a number of safety considerations. These include:

- avoiding over and under-pressurisation of ballast tanks
- avoiding sloshing loads in tanks
- maintaining adequate intact stability in accordance with an approved trim and stability booklet, taking into account the free surface effects
- keeping hull girder shear forces and bending moments within permissible seagoing strength limits as shown in the approved loading manual
- minimising torsional forces
- managing draughts and trim to ensure adequate:
  - bridge visibility
  - propeller immersion to prevent temporary loss of manoeuvrability and/or ability to make headway
  - draft forward to prevent slamming damage to ship bottom forward
- re-securing watertight closures (e.g., manholes) which may have been opened during ballast exchange; crew safety is paramount during this operation
- controlling maximum pumping/flow rates to ensure the tank is not subjected to a pressure greater than that for which it has been designed

- ensuring weather conditions are suitable and implementing weather routing in areas seasonably affected by cyclones, typhoons, hurricanes, or heavy icing conditions.

10.2.1 Sequential method

- keeping hull girder shear forces and bending moments within permissible seagoing strength limits as shown in the approved loading manual
- maintaining adequate intact stability in accordance with an approved trim and stability booklet, taking into account the free surface effects
- managing draughts and trim to ensure adequate:
  - bridge visibility
  - propeller immersion to prevent temporary loss of manoeuvrability and/or ability to make headway
  - draft forward to prevent slamming damage to ship bottom forward
- preventing structural damage to topside and hopper side tanks caused by inertia loading, as a result of a full ballast hold with empty adjacent wing tanks
- preventing structural damage to partially filled ballast water tanks or holds caused by sloshing as a result of resonance with ship motion.

10.2.2 Flow through method

- avoiding accumulation of water on decks which can cause a safety hazard to crew working on deck; effects on the stability may be negligible.

10.2.3 Dilution method

- avoiding under-pressurisation or over-pressurisation damage of ballast water tanks caused by blockages in air pipes or using excessive pumping rates relative to the design of the ballast system.

10.3 Conditions under which ballast water exchange at sea should not be undertaken

These circumstances may result from critical situations of an exceptional nature or force majeure due to stress of weather, known equipment failures or defects, or any other circumstances in which human life or safety of the ship is threatened.

Ballast water exchange at sea should be avoided in freezing weather conditions. However, if it is necessary, particular attention should be paid to the hazards associated with the freezing of overboard discharge arrangements, air pipes, ballast system valves together with their means of control, and the build up of ice on deck.

Consideration must always be given to personnel safety, including precautions which may be required when personnel are required to work on deck at night, in heavy weather, when ballast water overflows the deck, and in freezing conditions. These concerns may be related to the risks to personnel of falling and injury, due to the slippery wet surface of the deck plate, when water is overflowing on deck, and to direct contact with the ballast water, in terms of occupational health and safety.

10.4 Precautionary advice to Masters when undertaking ballast water exchange operations

Masters should take all necessary precautions when undertaking ballast water exchange sequences that involve periods when the criteria for propeller immersion, minimum forward draft and bridge visibility cannot be met.

During ballast water exchange sequences there may be times when, for a transitory period, one or more of the following criteria cannot be fully met or are found to be difficult to maintain:

- bridge visibility standards (SOLAS V/22)
- propeller immersion
- minimum draft forward
- emergency fire pump suction.

In planning a ballast water exchange operation that includes sequences which involve periods when the criteria for propeller immersion, minimum draft and/or trim are not met, the following should be taken into consideration:

- the duration(s) and time(s) during the operation that any of the criteria will not be met
- the effect(s) on the navigational and manoeuvring capabilities of the ship; and
- the time to complete the operation.

A decision to proceed with the operation should only be taken when it is anticipated that:

- the ship will be in open water
- the traffic density will be low
- an enhanced navigational watch will be maintained including, if necessary, an additional look out forward with adequate communications with the navigation bridge
- the manoeuvrability of the vessel will not be unduly impaired by the draft and trim and/or propeller immersion during the transitory period; and
- the general weather and sea state conditions will be suitable and unlikely to deteriorate.

11. Operational or safety restrictions

11.1 Ballast water exchange

A ballast plan for a ballast voyage should be prepared in advance, in a similar manner to the preparation of a cargo plan for a loaded voyage, and with the same degree of thoroughness. This pre-planning is necessary in order to maintain safety and in case compliance with ballast exchange or other ballast water treatment or control options is required.

The safety information in Section 10 should be taken into account when preparing the voyage plan.

This section gives guidance on additional operational and safety ballast handling procedures to be followed at sea.

Additionally, operational limits defined for specific ballast exchange conditions must be adhered to during operation. Therefore, it is considered imperative to plan for and find the appropriate weather window to conduct safe sequential ballast exchange operations.

Ballast exchange operations are complex procedures and may last from several hours to days. All personnel engaged in ballast exchange should be trained to respond to routine and emergency procedures.

It should always be considered that while performing a ballast exchange at sea, failure of the power system or any part of the ballast pumping and piping system can occur. Such incidents should be brought immediately to the attention of the company's safety officer and emergency procedures should be activated to bring the ship back to her ballast seagoing condition as soon as possible. Such emergency procedures could be ballasting by gravity and even utilisation of the general service pump. Ships enrolled with the LR Ship Emergency Response Service (SERS) could, if necessary, activate the service.

11.2 Procedures for safe tank entry

Extract from SEMM Section 7.3.2 Enclosed Space Entry

"Enclosed space" means a space that has limited openings for entry and exit, unfavourable natural ventilation and that is not designed for continuous worker occupancy.

The enclosed spaced are which have any of the following characteristics:

a. Limited openings for entry and exit;
b. unfavourable natural ventilation; and
c. is not designed for continuous worker occupancy, and includes, but is not limited to, cargo holds, cargo tanks, double bottoms, fuel tanks, ballast tanks, pump rooms, compressor rooms, cofferdams, void spaces, duct keels, inter-barrier spaces and sewage tanks, in which the atmosphere may be hazardous due to the presence of hydrocarbon, toxic gases, inert gas or oxygen deficient.
d. Enclosed spaced also includes any item of machinery or equipment that is not routinely ventilated and entered, such as boilers and main engine crankcase.

Responsible Person for any enclosed space entry operations will be Chief Officer or Chief Engineer. In the event if Chief Officer will be the Team Leader, then the Chief Engineer shall be the Responsible Person and vice versa.

No more than one Senior Officer from each department shall enter an enclosed space at the same time.

Gas measuring instruments should be tested in accordance with the manufacturer's instructions before the commencement of operations requiring their use. Such tests are designed only to ensure that the instrument is working properly. They should not be confused with calibration. Instruments should only be used if the tests indicate that the instrument is giving accurate readings and that alarms, if fitted, are operating at the predetermined set" points.

Physical checks should include:

e. Hand pump.
f. Extension tubes.
g. Tightness of connections.
h. Batteries.
i. Housing and case.

Instruments not passing these operational tests should be re-calibrated before they are returned to operational use. If this is not possible, they should be removed from service and clearly labelled to denote that they are not to be used.

Hazards Appreciation for Enclosed Space Entry
The “Responsible Authority” shall determine that it is safe to enter an enclosed space by ensuring;

j. Potential hazards have been identified in the assessment and as far as possible isolated or made safe;
k. The space has been thoroughly ventilated by natural or mechanical means to remove any toxic or flammable gases and to ensure an adequate level of oxygen throughout the space (by continuous ventilation);
l. The atmosphere in any enclosed space may be deficient in oxygen and/or contain flammable and/or toxic gases or vapours. Such an unsafe atmosphere could also subsequently occur in a space previously found to be safe. Unsafe atmosphere may also be present in spaces adjacent to those spaces where a hazard is known to be present. The atmosphere of the space has been tested as appropriate with recently calibrated instruments to ascertain acceptable levels of oxygen and acceptable levels of flammable or toxic vapours;
m. Reference to relevant MSDS document shall be made to determine the possible gases present and their TLV
n. The space has been secured for entry and properly illuminated;
o. A suitable system of communication between all parties for use during entry has been agreed and tested;
p. An attendant has been instructed to remain at the entrance to the space whilst it is occupied;
q. Rescue equipment such as lifelines, harnesses, approved positive pressure breathing apparatus & spare bottles and resuscitation equipment has been positioned ready for use at the entrance to the space, and that rescue arrangements have been agreed; and
r. Personnel are properly clothed and equipped, including personal gas detector meters for the entry and subsequent tasks;

Only trained personnel should be assigned duties of entering or functioning as attendants or as members of rescue teams. Ship' crews should be drilled periodically in rescue and first aid.
Appropriate testing of the atmosphere of a space should be carried out with recently calibrated equipment by persons trained in the use of the equipment and competent to interpret the results correctly. The manufacturers' instructions should be strictly followed.

Testing should be carried out before any person enters the space and at regular intervals thereafter until all work is completed. Where appropriate, the testing of the space should be carried out at as many different levels as is necessary to obtain a representative sample of the atmosphere in the space.

For entry purpose, steady readings of the following should be obtained:

(i) 20.8% oxygen by volume by oxygen content meter, and

(ii) Not more than 1% of lower flammable limit (LFL) on a suitably sensitive combustible gas indicator, where the preliminary assessment has determined that there is potential for flammable gases or vapours.

(iii) No toxic or other contaminants are present

When a Combustible Gas Detector is used in a rich hydrocarbon atmosphere, the readings on the gas meter would swing to max 100% LEL and return to 0% LEL immediately. Which is dangerous if not closely monitored as the person might have a false sense of security of the reading to be 0% LEL.

If above mentioned conditions for tank atmosphere cannot be met, additional ventilation should be applied to the space and re-testing should be conducted after a suitable interval.

Any gas testing should be carried out with ventilation to the enclosed space stopped, in order to obtain accurate readings.

Where the preliminary, assessment has determined that there is potential for the presence of toxic gases and vapours, appropriate testing should be carried out using fixed or portable gas or vapour detection equipment. The readings obtained by this equipment should be below the occupational exposure limits for the toxic gases or vapours given in accepted national or international standards. It should be noted that testing for flammability does not provide a suitable means of measuring of toxicity, nor vice versa.

It should be emphasised that pockets of gas or oxygen-deficient areas can exist and should always be suspected even when an enclosed space has been satisfactorily tested as being suitable for entry.

In the event that gas analysing equipment is not operational and a spare is not available onboard prior to enclosed space entry or arrival port, a risk assessment shall be carried out and vessel superintendent informed. Superintendent shall try to arrange repairs of the non-operational gas analysing equipment in the next convenient port of call. Enclosed space entry shall be deferred till the instrument has been repaired. In case cargo tank or adjacent space atmosphere sampling is required as per terminal or other requirements, Master shall liaise with vessel superintendent and local agent to arrange a spare gas analysing instrument prior arrival port.

Toxic Atmospheric Conditions in Enclosed Space

(i) Toxic atmospheric conditions may exist if:
   (a) The enclosed space holds or tanks which has held cargo, which has toxic properties.
   (b) Adjacent compartments or hold have held cargo or materials which have/had toxic properties.
   (c) The enclosed space has recently been painted; float coated or has been subject to repairs of conversion.
   (d) Welding, burning or cutting has been carried out in the enclosed space.

(ii) Cargoes or material which produces or are suspect of producing toxic vapours must be loaded, stowed, handled, transferred or discharged with special care and due caution must be exercised to prevent exposure to, contact with or inhalations of vapour or liquid. Cargo data sheets must be obtained prior loading of the particular cargo

(iii) Hazard notifications should be posted in appropriate places and the Chief Officer should be well versed with the cargo's physical nature and chemical properties, flash point, threshold limit value and Reid vapour pressure etc. As all petroleum products and most chemical products are hazardous and physical contact with them is detrimental to health, all personnel must be fully instructed regarding safety precautions prior to, during and after the carriage of such cargoes.

Ventilating Enclosed Spaces

(i) All enclosed spaces, which require entry by personnel, must be adequately ventilated for a prolonged period, and the ventilation must be maintained during the total occupancy of the space. Permission for entry must be obtained from the Master or Chief Officer.

(ii) Natural ventilation (opening hatch covers or manholes) must be maintained for at least 24 consecutive hours, and the space must be tested for oxygen, toxicity and/or combustibility contents prior to entry by personnel.

(iii) Forced ventilation (wind sail or mechanical) must be maintained until the atmosphere in the space has been changed twice. Mechanical ventilation, when utilised, should be able to provide at least 10 air changes/hour or more. The space must be tested for oxygen, toxicity and/or combustibility contents, and prior to entry by personnel.

(iv) The space to be entered should, if not utilised for cargo, be clean and void of petroleum products, petrochemical products, edible oils, fats or gases (LPG or LNG). Small puddles on the tank top or in the bilges may cause gas concentrations equal to concentrations in a fully loaded tank. Cargo lines, dresser couplings, valves and strainers may release small quantities of product which form puddles and in order to prevent locally unsafe atmospheric conditions in an enclosed space, the ventilation should be directed over those areas where personnel are engaged and work is in progress. During the occupancy of the enclosed space, tests for oxygen, toxicity and/or combustibility contents must be continuously monitored and at various levels. This should be considered routine procedures during work-periods in any enclosed space.

Precautions during Enclosed Space Entry

(i) The atmosphere should be tested frequently whilst the enclosed space is occupied and person should be instructed to leave the space should there be deterioration in the conditions.

(ii) Ventilation should continue during the period that the space is occupied and during temporary breaks. Before re-entry after a break, the atmosphere should be retested.

(iii) In the event of failure of the ventilation system, any persons in the space should leave immediately.

(iv) All entrances to the cargo and ballast pump rooms, nitrogen gas storage rooms, battery room and other similar spaces to be conspicuously marked outside the entranced door:

"WARNING! DANGER! DO NOT ENTER WITHOUT PERMISSION OF MASTER OR CHIEF OFFICER. VENTILATE AT LEAST FOR 30 MINS PRIOR ENTRY".

Enclosed Space Entry Tags:

(i) As soon as the access point to an enclosed space has been opened, a red plastic tag is to be placed at the access. This red tag will advise that entry is prohibited. When entry to the space is permitted the Permit number, Name of designated space and validity of permit is to be written on the green Entry Tag. This green tag shall only be displayed once all entry precautions have been met.

Entry into a Space Where the Atmosphere is Known or Suspected to be Unsafe

(i) For enclosed spaces where atmosphere is known or suspected to be unsafe Head office authorisation shall be required prior enclosed space entry.

(ii) The space shall only be entered if no other practical alternative is possible. Entry shall only be made for essential operation, as for the safety of life or safety of a ship. The number of persons entering the space should be minimum compatible with the work to be performed.

(iii) Suitable breathing apparatus, e.g., of the air-line or self-contained type shall always be donned, and only personnel trained in its use should be allowed to enter the space. Air-purifying respirators should not be used as they do not provide a supply of clean air from a source independent of the atmosphere within the space.

(iv) Rescue harnesses should be worn and unless impractical, lifelines should be used.

(v) Appropriate protective clothing should be worn particularly where there is any risk of toxic substances or chemicals coming into contact with the skin or eyes of those entering the space.

(vi) In an emergency Rescue and Resuscitation procedures from Enclosed Space shall be complied.

Authorization of Entry

(i) No person should open or enter an enclosed space unless authorised by the Master and the appropriate procedures laid down for the particular ship have been followed.

(ii) Entry into enclosed space(s) should be planned and the use of entry Permit to Work Certificate and enclosed Space entry checklist has been duly completed and all control measures are in place.

(iii) Times of entry and exit of personnel shall be recorded and duration of entry shall be closely monitored.

(iv) If entry is to be made in a group of enclosed spaces, separate permit for each enclosed space to be issued.

Assessment of Risk for Enclosed Space Entry

In order to ensure safety, the safety officer shall always make a preliminary assessment of any potential hazards in the space to be entered taking into account the previous cargo carried, ventilation of the space, coating of the space and other relevant factors. The Chief Officer's preliminary assessment should determine the potential for the presence of an oxygen-deficient, flammable or toxic atmosphere.

The procedures to be followed for testing the atmosphere in the space and for entry should be decided on the basis of the preliminary assessment. These will depend on whether the preliminary assessment shows that:

(i) there is minimal risk to the health or life of personnel entering the space

(ii) there is no immediate risk to health or life but a risk could arise during the course of work in the space

(iii) A risk to health or life is identified.

Where the preliminary assessment indicates that there is minimal risk to health or life and that the conditions in the space will not change, entry may be permitted without restriction.

Where the preliminary assessment indicates no immediate risk to health or life but potential for a risk to arise during the course of work in the space, the entry shall be treated as an enclose space entry and treated as such.

Where the preliminary assessment identifies risk to life or health, if entry is to be made, additional precautions outlined in this section for entry into spaces where the atmosphere is known or suspected to be unsafe is particularly relevant in this context.

The list of ship specific enclosed spaces shall be prepared and maintained on board each vessel. This list should be produced after conducting a risk assessment to identify all enclosed spaces on board the ship and the risk assessment shall be periodically revisited to ensure its continued validity.

Cargo/Oil/Bunker/Ballast Tank entry procedures

Cargo/Oil/Bunker tanks, even though is empty and has been properly washed, mucked and gas freed, atmospheric conditions in the space may be detrimental to health. Petroleum, vegetable oil or chemical cargo residues may have remained on the tank's sides, underneath scale and in cargo lines and valves may give off harmful gases rendering the space oxygen depleted, combustible, toxic or explosive.

Cargo tanks, when inerted, are oxygen depleted as oxygen contents will be 8% or less and atmospheric conditions will not support life.

Entry into Cargo/Oil/Ballast Tanks

(i) In view of the serious consequences, the entry into cargo tanks should be strictly prohibited for non-operational personnel during cargo loading, discharge or transfer, ballast or tank cleaning operations and during normal operational overhaul, maintenance or during gas freeing, repairs or conversion.

(ii) Operational personnel

(iii) Entry procedures shall include enclosed space entry procedures and: require the Master's authorisation before entering cargo tanks.

(a) Starting ventilation of tank using portable. Ventilators or dehumidifier fan, preferably 12 hours to entry.
(b) Where portable ventilators are of the reversible type, allow air extraction for 6 hours and air supply for 6 hours.
(c) Maintain ventilation throughout the total occupancy.
(d) Never enter a cargo tank, unless a responsible person remains on stand-by the tank's hatch keeping a vigilant watch on the activities inside the tank.
(e) Wearing a safety harness and lifeline when entry is made via a tank ladder
(f) Having a BA set ready at hand, fitted with full charged cylinder(s).
(g) Notifying the Duty Officer of your intention and ensuring that the entry may be safely undertaken after confirmation by the Ship's Safety Officer.
(h) Obtain readings of oxygen, toxicity and combustibility contents.
(i) Wearing protective clothing and using intrinsically safe lighting and tools.
(j) Providing a communication system with the "stand-by" at tank hatch.
(k) Reporting your completed mission to the Duty Officer.

Rescue and Resuscitation procedures from Enclosed Space

Many lives have been lost during attempts to rescue people from enclosed spaces without the use of proper equipment. In a number of cases both the casualties and the rescuer have perished.

In the event of an emergency, under no circumstances should the attending crew member enter the space before help has arrived and the situation has been evaluated to ensure the safety of those entering the space to undertake rescue operations.

Depending on the circumstances and available space, decision to be taken to use either stretcher or Safety Harness to evacuate casualty. Preferable stretcher to be used.

An attempted rescue from the any enclosed space should never be made unless compressed air breathing apparatus is utilized. The victim in the space may be affected by lack of oxygen or toxic vapor and the rescue should be planned accordingly.

A team of at least three well trained people will be required to rescue the victim from an enclosed space. More may be necessary to rescue a victim form a large compartment.

The rescue operation will depend upon the circumstances and can be divided into two basic situations:

(i) Where the victim's still breathing when the rescue team arrives, he may be conscious or even unconscious.

(ii) Where the victim is not breathing when the rescue team arrives, in this case, the victim is most likely to be unconscious.

(iii) In either situation, the rescuers must try to resuscitate the victim in the shortest possible time.

The length of time before brain damage occurs depends on the concentrations of gas, the amount of oxygen present and the condition of the victim. In most situations the first objective of the rescue team is to get to the victim fast and commence administering resuscitation of the victim within 4 minutes of the casualty losing consciousness.

12. Description of the methods used on board for ballast water management and sediment control

12.1 Procedures for ballast water exchange (if applicable)

When exchanging ballast at sea, safety and operational information and restrictions must be taken into account at all times.

For ship-specific Ballast Exchange Plan(s) see Appendix 3.

BEP no.	Description of conditions	Condition Number from Approved Manual, which the BEP is based on	Methods of Ballast exchange examined

12.2 Procedures for ballast water treatment (if applicable) – NA

See Appendix 4 for a description of the ballast water treatment system installed on board.

Vessel is not equipped with a Ballast Water Treatment Plant.

13. Procedures for the disposal of sediments

Where practicable, routine cleaning of the ballast tank to remove sediments should be carried out in mid-ocean, under controlled arrangements in port, or in dry dock.

When sediment has accumulated, consideration should be given to flushing tank bottoms and other surfaces when in suitable areas, i.e., outside 200 nautical miles from land and in water depths of over 200 metres.

The volume of sediment in a ballast tank should be monitored on a regular basis.

Sediment in ballast tanks should be removed in a timely manner and as necessary, always taking into account the safety and operational considerations addressed in this Plan. The frequency and timing of removal will also depend on factors such as sediment build up, the ship's trading pattern, availability of reception facilities, workload of the ship's personnel and safety considerations.

Removal of sediment from the ballast tank should preferably be undertaken under controlled conditions in port, at a repair facility, or in dry dock. The removed sediment should preferably be disposed of in a sediment reception facility if available, reasonable and practicable.

Flushing by using water movement within a tank to bring sediment into suspension will only remove a part of the mud, depending on the configuration of an individual tank and its piping arrangement. Removal may be more appropriate on a routine basis during scheduled dry dockings. This is often needed for other reasons anyway.

However, flushing at sea may be a useful tool on some occasions such as when a ship changes its trading area.

When sediment is removed from the ship's ballast tanks and is to be disposed of by that ship at sea, disposal should only take place in areas outside 200 nautical miles from land and in water over 200 metres deep.

14. Methods of communication

This section contains information to assist the Master in the procedures for co-ordinating the discharge of ballast water of a coastal state, local government or other involved parties. The quick and effective communication between the ship and coastal state or other involved parties becomes vital in mitigating the effects of an unnecessary delay for ships seeking entry to port states.

The requirements and roles of the various national and local authorities involved vary widely between states and even from port to port. Approaches to the responsibility for ballast water exchange also vary. In the majority of coastal states, responsibility for compliance with port state requirements is placed on the shipowner and the ship.

Generic reports and information can be found in Appendix 5 to assist the Master when communicating a ballast water exchange and treatment plan to a port state which has not issued any specific requirements.

The coastal state should be contacted for specific ballast water discharge requirements and reporting before the vessel's arrival in port states' territorial waters.

Therefore, the Master with the responsible officer should obtain all necessary information and prepare the vessel accordingly, taking into consideration the safety and operational restrictions as described in this Plan and relevant sections. Information on specific port state procedures can be obtained by referring to the appendices of this Plan, or consulting the company and/or local agent for latest information/requirements.

14.1 Action to be taken by the vessel when the coastal state has specific procedures for discharge of ballast water

- Follow agreed reporting procedures.
- Contact the ship's agent to ascertain the latest information/requirements on ballast discharge in the waters of the respective states
- Advise/communicate with the company and request any other information they might hold on ballast water discharge.
- Ensure that you plan for all above actions and that safety and operational restrictions are consulted.

14.2 Action to be taken by the vessel when the coastal state has no specific procedures for discharge of ballast water

- Contact the ship's agent and/or company to obtain latest information on the discharge requirements at the port state territory.
- Carry out discharge of ballast water as per the ballast exchange sequence or ballast water treatment system as applicable.
- Take into consideration safety and operational procedures related to respective discharge.
- Keep proper records and have them readily available for possible inspection.

15. Duties of the Ballast Water Management Officer

The Ballast Water Management Officer is responsible for implementing the procedures of the Ballast Water Management Plan. Their role is to:

- ensure the safety of the ship and crew
- ensure that ballast water management and/or treatment procedures are followed and recorded
- where ballast exchange is required, ensure that the steps/sequences of the ballast exchange sequence are followed in the prepared order
- where ballast water treatment is required, ensure that all safety precautions and considerations, as detailed in the manufacturer's manuals, are taken into account by the personnel involved
- when applicable, ensure that the treatment system is operated within the design parameters in accordance with the manufacturer's instructions
- ensure adequate personnel and equipment are available for the execution of the planned ballast water management operations
- ensure all required ballast water management records are maintained and up-to-date, including the Ballast Water Record Book
- where required, prepare the appropriate national or port ballast water declaration form before arrival
- assist the port state control or quarantine officers with any sampling that may need to be undertaken
- undertake familiarisation and training of crew in ballast water management requirements and applicable shipboard systems and procedures
- perform other duties, as specified by the company.

The Master must ensure that the Ballast Water Management Plan is clearly understood by the appointed officer and by any other ship's staff that may be involved.

The Ballast Water Management Officer must keep the Master advised on the progress of the ballast water management operations and any envisaged deviations from the agreed plan. Should there be any doubt, or if the Management Plan is not in line with the schedule, the Master shall be advised accordingly.

16. Recording requirements

The Ballast Water Management Officer is to ensure that the Ballast Water Record Book and any other necessary documentation/forms are completed and kept up-to-date.

16.1 Ballast Water Record Book

The Ballast Water Record Book may be an electronic record system or it may be integrated into another record book or system and shall at least contain the information as specified in Appendix II of the BWM Convention.

The Ballast Water Record Book is to be maintained on board for a minimum of two years in order to provide port state control or other authorised officers with information they may require concerning the ballast water on board the ship. Thereafter, the manual should be maintained in the company's control for a minimum period of three years.

As and when the Ballast Water Exchange is carried out on board the vessel, a record shall be inserted in the Deck Log Book.

17. Crew training and familiarisation

It is essential that the Master, ship's officer and crew have an understanding of the need for ballast water management.

If crew members understand the reasons for the exchange or treatment of ballast water and associated sediments, they are more likely to ensure that it is carried out effectively and efficiently.

Owners, managers, operators and others involved in officer and crew training for ballast water management should consider the following:

Training for ships' Masters and crews as appropriate should include instructions on the requirements of the BWM Convention, the ballast water and sediment management procedures, and the Ballast Water Record Book, particularly having regard to matters of ship safety, maintenance of records and reporting requirements in accordance with the information contained in the Convention.

Ships' officers and ratings engaged in ballast water exchange at sea must be aware of what is expected of them and should be trained in and familiarised with the following:

- ship's pumping arrangements including ballast arrangements
- locations of air and sounding pipes of all ballast tanks
- positions of all ballast tank suctions and pipelines
- overboard discharge arrangements and openings for release of water on deck
- inspection and maintenance for ensuring that sounding pipes are clear and non-return devices and air pipes are in good order
- times and circumstances required to undertake the various ballast water exchange operations
- methods used for ballast water exchange at sea, the related safety precautions and associated hazards
- methods of on board ballast water record keeping, reporting and recording of routine soundings
- locations and suitable access points for sampling purposes.

The Master and Ballast Water Management Officer should ensure that the personnel assigned key responsibilities in any ballast exchange procedures are suitable and well trained according to the above. Special attention should be given to the safety aspects related to the subject procedures.

Provisions for crew training and familiarisation include the following:

- requirements of a general nature regarding ballast water management
- training and information on ballast water management practices
- ballast water exchange
- ballast water treatment systems
- general safety considerations
- the Ballast Water Record Book and maintenance of records
- the operation and maintenance of installed ballast water treatment systems (when a treatment system is required to be installed under Regulation B-3 of the BWM Convention)

- limitations and operational restrictions of the installed ballast water treatment systems (when a treatment system is required to be installed under Regulation B-3 of the BWM Convention)
- training and information on handling and storage of any active substances used in the installed ballast water treatment system (when a treatment system is required to be installed under Regulation B-3 of the BWM Convention)
- training and information on emergency procedures and bypass arrangements of the installed ballast water treatment system (when a treatment system is required to be installed under Regulation B-3 of the BWM Convention)
- safety aspects associated with the particular systems and procedures used on board the ship which affect the safety or human health of crew and passengers and/or the safety of the ship
- precautions for entering tanks for sediment removal
- procedures for the safe handling and packaging of sediment
- storage of sediment.

Chief Officer shall carry out BWM training on board every quarterly. Record of the training shall be reflected on the Training Record Form as in Section 17.1, Drill Report Form and the Deck Log Book.

17.1 Training record for ballast water management manual

Date	Name	Rank	Signature	Remarks	Verified by

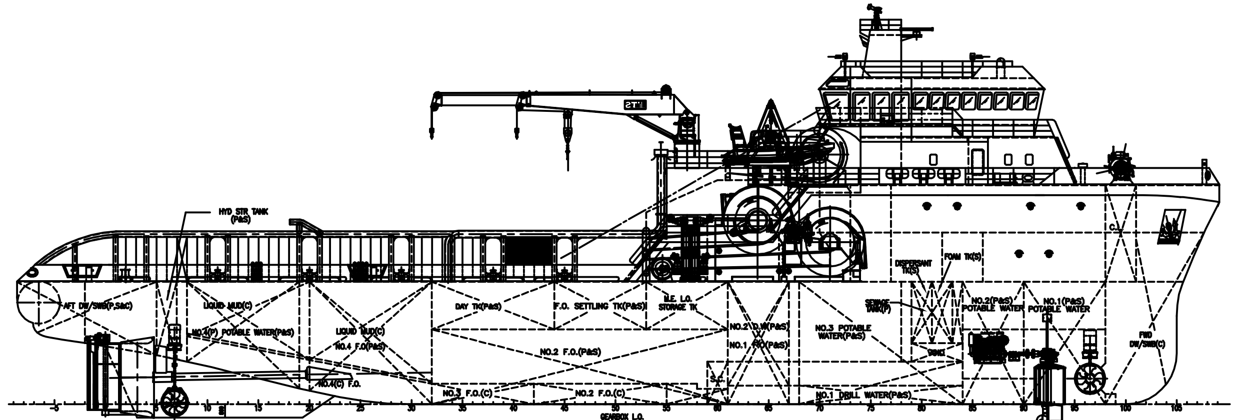
18. Exemptions

[Insert details of any exemptions granted to the ship under regulation A-4 of the BWM Convention.]

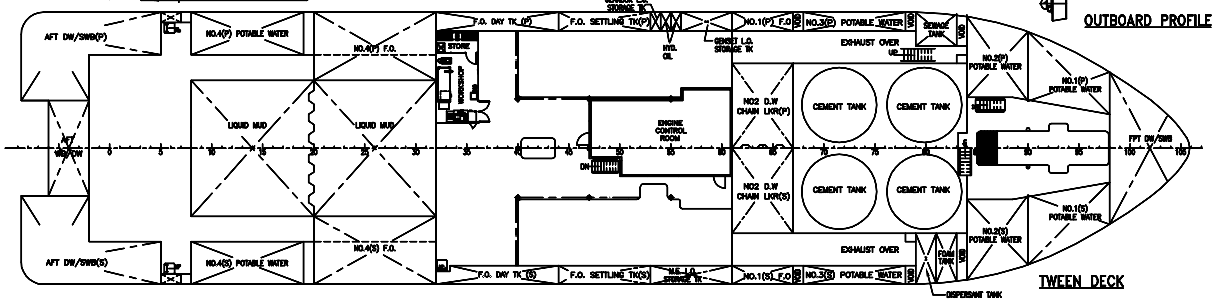
[Exemptions granted under regulation A-4 are also to be recorded in the Ballast Water Record Book.]

Appendix 1 – Plans

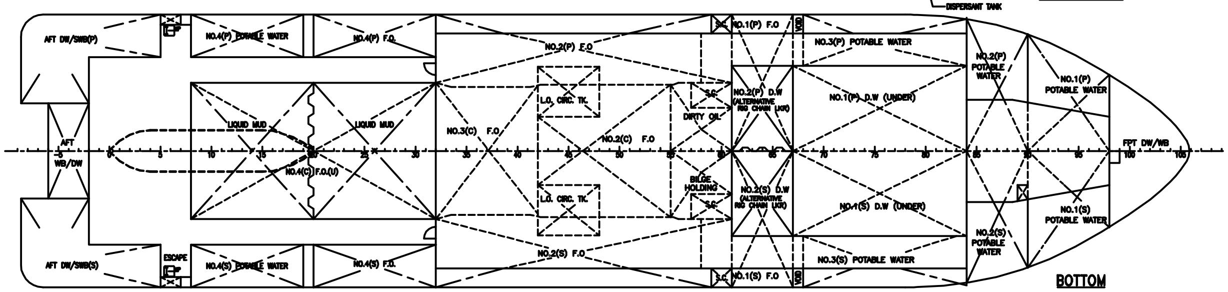
- 3806A P-11 Position of Tank Air Vents, Sounding & Filling Pipes
  - A list and/or diagrams indicating the location of sampling and access points in pipelines and ballast water tanks
  - Ballast water piping and pumping arrangement, including air pipes and sounding arrangements
- 3806A P-01 Bilge, Ballast & D.W. System
  - A plan and profile of the ship, or a schematic drawing of the ballast arrangement
  - Ballast tank arrangement
  - Ballast water pump capacities
- C3806A C-14 Tank Capacity Plan (Final)
  - Ballast capacity plan
- Ballast Pump Manuals



OUTBOARD PROFILE



TWEEN DECK



BOTTOM

TANK NO.	TANK TYPE	FRAME NO.	CAPACITY VOLUME (cu.m) 98%	CAPACITY VOLUME (cu.m) 100%	CAPACITY WEIGHT (mt) 98%	CAPACITY WEIGHT (mt) 100%	VCG (m) @ 100%	LCG (m) @ 100%	FSM (mt) @ 98%
1) SEA WATER (SG = 1.025)									
FPTDW&SWBTK.C	FORE PEAK D.W & S.W.B TANK	FR.98–F.E.	202.90	207.10	208.01	212.26	6.016	29.164f	331.80
APTDW&SWBTK.P	AFT PEAK D.W & S.W.B TANK	FR.5–A.E.	59.50	60.80	61.03	62.28	6.143	33.144a	59.19
APTDW&SWBTK.S	AFT PEAK D.W & S.W.B TANK	FR.5–A.E.	59.50	60.80	61.03	62.28	6.143	33.144a	59.19
APTDW&SWBTK.C	AFT PEAK D.W & S.W.B TANK	FR.–2–A.E.	33.30	34.00	34.17	34.87	5.421	33.659a	29.72
TOTAL			355.20	362.70	364.24	371.69			
2) DRILL WATER (SG = 1.000)									
NO1DWTK.P	NO.1 DRILL WATER TANK	FR.67–FR.84	47.30	48.20	47.28	48.25	0.519	13.797f	104.67
NO1DWTK.S	NO.1 DRILL WATER TANK	FR.67–FR.84	47.30	48.20	47.28	48.25	0.519	13.797f	104.67
NO2DWTK.P	NO.2 DRILL WATER TANK	FR.61–FR.67	107.90	110.10	107.87	110.07	4.096	6.898f	36.94
NO2DWTK.S	NO.2 DRILL WATER TANK	FR.61–FR.67	107.90	110.10	107.87	110.07	4.096	6.898f	36.94
TOTAL			310.40	316.60	310.30	316.64			
3) POTABLE WATER (SG = 1.000)									
NO1PWTK.P	NO.1 PORTABLE WATER TANK	FR.90–FR.98	90.10	91.90	90.10	91.94	3.791	24.578f	18.82
NO1PWTK.S	NO.1 PORTABLE WATER TANK	FR.90–FR.98	90.10	91.90	90.10	91.94	3.791	24.578f	18.82
NO2PWTK.P	NO.2 PORTABLE WATER TANK	FR.84–FR.90	105.20	107.30	105.19	107.34	3.499	20.625f	25.08
NO2PWTK.S	NO.2 PORTABLE WATER TANK	FR.84–FR.90	104.40	106.60	104.44	106.58	3.518	20.614f	25.08
NO3PWTK.P	NO.3 PORTABLE WATER TANK	FR.68–FR.84	84.00	85.70	84.00	85.71	2.618	13.174f	0.68
NO3PWTK.S	NO.3 PORTABLE WATER TANK	FR.68–FR.84	84.00	85.70	84.00	85.71	2.618	13.174f	0.68
NO4PWTK.P	NO.4 PORTABLE WATER TANK	FR.8–FR.19	48.80	49.80	48.81	49.80	5.614	23.142a	8.46
NO4PWTK.S	NO.4 PORTABLE WATER TANK	FR.8–FR.19	48.80	49.80	48.81	49.80	5.614	23.142a	8.46
TOTAL			655.40	668.70	655.45	668.82			
4) HYDRAULIC OIL (SG = 0.900)									
NO1HYDOILTK.P	NO.1 HYDRAULIC OIL TANK	FR.55–FR.56	1.80	1.80	1.61	1.64	5.800	1.800f	0.06
NO2HYDOILTK.P	NO.2 HYDRAULIC OIL TANK	FR.54–FR.55	1.80	1.80	1.61	1.64	5.800	1.200f	0.06
TOWHYDOILTK.S	TOW. HYDRAULIC OIL TANK	FR.5–FR.7	1.70	1.70	1.51	1.54	6.233	27.895a	0.04
TOTAL			5.30	5.30	4.73	4.82			
5) LIQUID MUD (SG = 2.500)									
NO1MUDTK.C	NO.1 LIQUID MUD TANK	FR.20–FR.32	289.40	295.30	723.45	738.21	4.581	15.735a	756.42
NO2MUDTK.C	NO.2 LIQUID MUD TANK	FR.8–FR.20	211.50	215.90	528.86	539.65	5.274	22.875a	756.42
TOTAL			500.90	511.20	1252.31	1277.86			

TANK NO.	TANK TYPE	FRAME NO.	CAPACITY VOLUME (cu.m) 98%	CAPACITY VOLUME (cu.m) 100%	CAPACITY WEIGHT (mt) 98%	CAPACITY WEIGHT (mt) 100%	VCG (m) @ 100%	LCG (m) @ 100%	FSM (mt) @ 98%
6) FUEL OIL (SG = 0.855)									
NO1FOTK.P	NO.1 FUEL OIL TANK	FR.61–FR.67	58.70	59.90	50.18	51.20	2.181	6.904f	0.34
NO1FOTK.S	NO.1 FUEL OIL TANK	FR.61–FR.67	58.70	59.90	50.18	51.20	2.181	6.904f	0.34
NO2FOTK.P	NO.2 FUEL OIL TANK	FR.32–FR.61	117.00	119.30	100.00	102.04	1.729	3.624a	1.63
NO2FOTK.S	NO.2 FUEL OIL TANK	FR.32–FR.61	117.00	119.30	100.00	102.04	1.729	3.624a	1.63
NO2FOTK.C	NO.2 FUEL OIL TANK	FR.42–FR.55	53.70	54.80	45.91	46.84	0.608	1.809a	154.44
NO3FOTK.C	NO.3 FUEL OIL TANK	FR.32–FR.42	51.40	52.50	43.97	44.87	0.611	9.308a	180.97
NO4FOTK.P	NO.4 FUEL OIL TANK	FR.20–FR.32	119.10	121.50	101.82	103.90	4.852	15.697a	32.34
NO4FOTK.S	NO.4 FUEL OIL TANK	FR.20–FR.32	119.10	121.50	101.82	103.90	4.852	15.697a	32.34
NO4FOTK.C	NO.4 FUEL OIL TANK	FR.8–FR.32	156.80	160.00	134.09	136.83	1.855	19.131a	72.59
FODAYTK.P	FUEL OIL FOR DAY TANK	FR.32–FR.44	21.40	21.80	18.30	18.68	5.800	8.700a	0.67
FODAYTK.S	FUEL OIL FOR DAY TANK	FR.32–FR.44	20.70	21.10	17.67	18.03	5.800	8.586a	0.64
FOSETTK.P	FUEL OIL FOR SETTING TANK	FR.44–FR.53	16.10	16.40	13.73	14.01	5.800	2.400a	0.50
FOSETTK.S	FUEL OIL FOR SETTING TANK	FR.44–FR.53	16.10	16.40	13.73	14.01	5.800	2.400a	0.50
TOTAL			925.80	944.40	791.56	807.46			
7) LUBRICATION OIL (SG = 0.900)									
GLOSTK.P	LUBRICATION OIL FOR GENSET TANK	FR.56–FR.61	8.90	9.10	8.03	8.19	5.800	3.600f	0.29
MLOSTK.S	LUBE OIL STORAGE FOR MAIN ENGINE	FR.53–FR.61	14.30	14.60	12.84	13.11	5.800	2.700f	0.47
LOCTK.P	LUBRICATION OIL CIRCULATE TANK	FR.42–FR.48	12.30	12.50	11.06	11.29	0.632	4.500a	8.04
LOCTK.S	LUBRICATION OIL CIRCULATE TANK	FR.42–FR.48	12.30	12.50	11.06	11.29	0.632	4.500a	8.04
AFTLOSTK.P	LUBRICATION OIL STORAGE TANK	FR.5–FR.7	1.70	1.70	1.51	1.54	6.233	27.895a	0.04
FWDLOSTK.P	LUBRICATION OIL STORAGE TANK	FR.53–FR.54	1.80	1.80	1.61	1.64	5.800	0.600f	0.06
TOTAL			51.30	52.20	46.11	47.06			
8) MISC. (SG = 0.900 FOR DIRTY OIL, SG = 1.000 FOR BILGE & SEWAGE, SG = 1.145 FOR FOAM, SG = 1.163 FOR DISP.)									
DIRTYOIL.P	DIRTY OIL HOLDING TANK	FR.55–FR.61	9.30	9.50	8.34	8.51	0.457	3.119f	9.67
BILGE.S	BILGE HOLDING TANK	FR.55–FR.61	9.30	9.50	9.26	9.45	0.457	3.119f	10.74
SEWAGE.P	SEWAGE HOLDING TANK	FR.79–FR.83	14.30	14.50	14.26	14.55	5.451	17.068f	1.23
FOAM.S	FOAM TANK	FR.81–FR.83	11.40	11.70	13.09	13.35	5.438	17.694f	2.74
DISPERSANT.S	DISPERSANT TANK	FR.79–FR.81	12.00	12.20	13.96	14.24	5.425	16.496f	3.03

General Notes:

1. Reference Point is Midship at Fwd 300mm of Fr.52.
2. "a" is Aft of Midship, "f" is Fwd of Midship.

PRINCIPAL PARTICULARS

LENGTH OA ---------- 70.70m
LENGTH BP ---------- 63.00m
BEAM MLD. ---------- 16.00m
DEPTH MLD ---------- 7.20m
DESIGN DRAFT --------- 6.00m
SCANTLING DRAFT ------ 6.20m

DATE	MODIFICATION	REV	BY

SHIP: 12000HP A.H./SUPPLY VESSEL

TITLE: TANK CAPACITY PLAN (FINAL)

OWNER	LEWEK SHIPPING PTE LTD		
BUILDER	PAN UNITED MARINE LIMITED	YARD NO.	165
CLASS	LLOYDS		

CONAN WU & ASSOCIATES
NAVAL ARCHITECTS
INFORMATICS BLDG., 5 INTERNATIONAL BUSINESS PARK, JURONG EAST, SINGAPORE 609914
TEL: (65) 6562-1138 FAX: (65) 6562-1238, (65) 6562-0123 E-MAIL: mail@cwa.com.sg

DRAWN	CHECKED	APPROVED	SCALE	DRAWING NO.	REV
gh Zhang			NIL	C3806A/C-14	4

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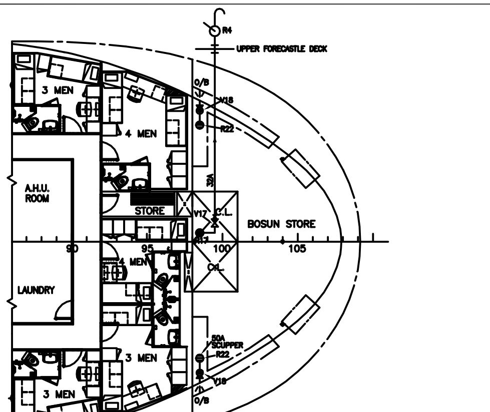
NOTES:

1. ALL BILGE, BALLAST & DRILL WATER PIPES TO BE HOT-DIPPED M.S. GALVD. SCH.40 (STPG 38E OR EQUIVALENT) & WHERE PIPES PASSING THROUGH F.O. TANKS TO BE SEAMLESS BLACK M.S. SCH.80.
2. WHERE PIPING PENETRATES A W.T. BHD, A DECK OR TANK TOP, AN ADEQUATE PENETRATION FITTING IS TO BE PROVIDED TO ENSURE THE WATERTIGHTNESS OF THE STRUCTURE.
3. VALVE MARKED ✓✗ TO HAVE SHUT DOWN DEVICE TO FREEBOARD DECK C/W OPEN/SHUT INDICATOR AND TO BE ADEQUATELY PROTECTED FROM MECHANICAL DAMAGE.
4. ALL VALVES ARE TO BE EITHER OF THE RISING STEM TYPE OR FITTED WITH AN INDICATOR TO SHOW WHETHER THE VALVE IS OPEN OR CLOSED.
5. ALL VALVES TO BE FITTED WITH BRASS LABEL PLATES.
6. OILY BILGE SYSTEM WILL BE SHOWN IN A SEPARATE DRAWING.
7. PRESSURE GAUGES SHALL BE FITTED ON THE SUCTION & DISCHARGE SIDES OF PUMPS.
8. EXPANSION ELBOW OR BENDS ARE TO BE FITTED WHERE NECESSARY TO AVOID DAMAGE DUE TO EXPANSION OR MOVEMENT OF STRUCTURE.
9. EMERGENCY BILGE SUCTION TO BE CONNECTED TO THE MAIN ENGINE STANDBY S.W. PUMP. REFER DWG. No. C3806A/P-3 ENGINES COOLING SYSTEM.
10. FOR FIRE FIGHTING & DECK WASH SYSTEM, PLEASE REFER TO DWG. No. C3806A/P-2.
11. NODULAR CAST IRON VALVES V1 & V2 ARE TO BE MANUFACTURED AND TESTED IN ACCORDANCE WITH THE REQ'TS OF CHAPTER 7 OF THE RULES FOR MATERIALS(PART 2).

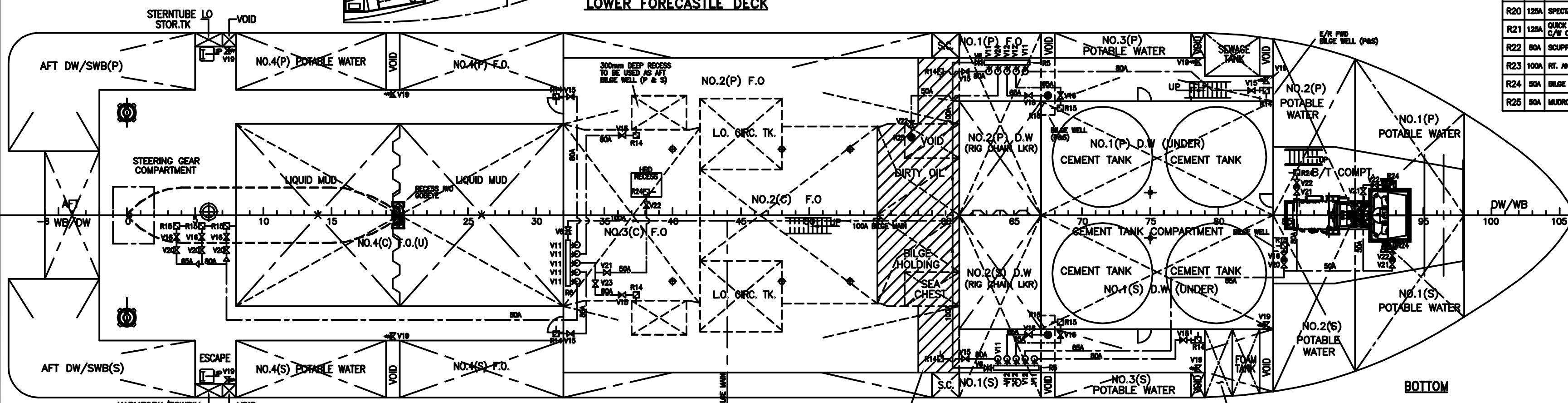


LOWER FORECASTLE DECK

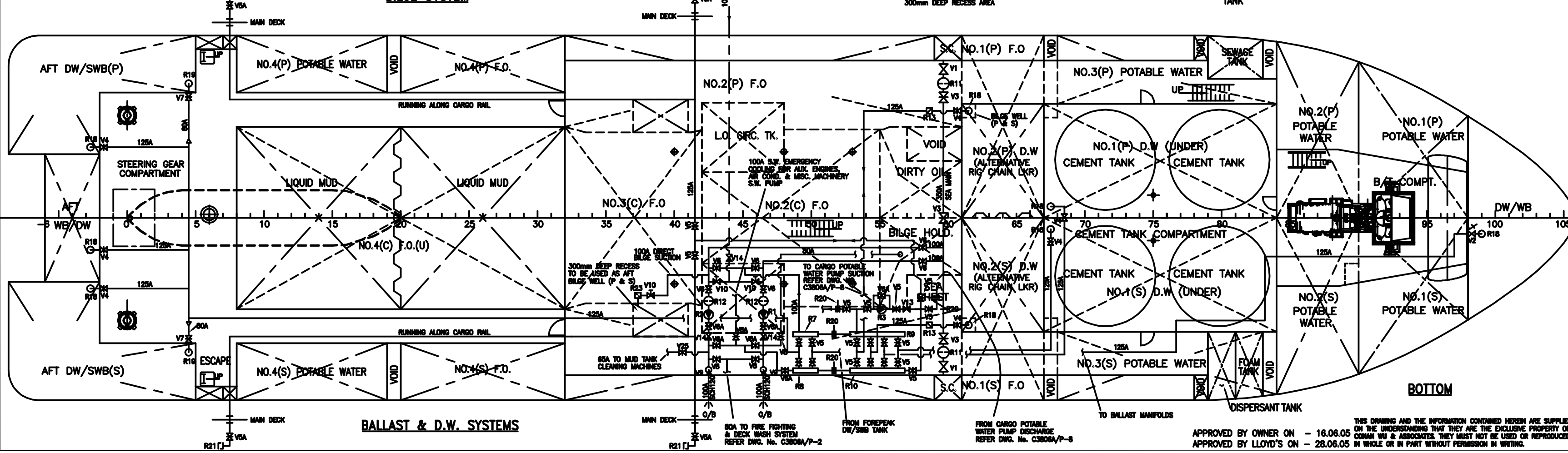
No.	Size	Description	Qty.	Material	Remarks
V1	400A	GATE VALVE	2	NODULAR CAST IRON	JIS 10K
V2	125A	GATE VALVE	1	NODULAR CAST IRON	JIS 10K, FITTED WITH EXTENDED SPINDLE TO UPPER FORECASTLE DECK
V3	400A	BUTTERFLY VALVE	3	CAST IRON	JIS 5K, WAFER TYPE
V4	125A	BUTTERFLY VALVE	7	CAST IRON	JIS 10K, LUG TYPE
V5	125A	BUTTERFLY VALVE	20	CAST IRON	JIS 10K, WAFER TYPE
V5A	125A	BUTTERFLY VALVE	4	NODULAR CAST IRON	JIS 10K, LUG TYPE
V6	100A	BUTTERFLY VALVE	9	CAST IRON	JIS 5K, WAFER TYPE
V6A	100A	BUTTERFLY VALVE	7	CAST IRON	JIS 10K, WAFER TYPE
V7	80A	BUTTERFLY VALVE	2	CAST IRON	JIS 10K, LUG TYPE
V8	80A	BUTTERFLY VALVE	3	CAST IRON	JIS 10K, WAFER TYPE
V9	100A	ANGLE S.D.N.R. VALVE	2	NODULAR CAST IRON	JIS 10K
V10	100A	S.D.N.R. VALVE	3	CAST IRON	JIS 5K

No.	Size	Description	Qty.	Material	Remarks
V11	80A	ANGLE S.D.N.R. VALVE	9	CAST IRON	JIS 5K
V12	65A	ANGLE S.D.N.R. VALVE	5	CAST IRON	JIS 5K
V13	125A	CHECK VALVE	1	CAST IRON	JIS 10K
V14	100A	CHECK VALVE	3	CAST IRON	JIS 10K
V15	80A	CHECK VALVE	8	CAST IRON	JIS 5K
V16	65A	CHECK VALVE	8	CAST IRON	JIS 5K
V17	32A	CHECK VALVE	1	BRONZE	JIS 5K
V18	50A	STORM VALVE	2	NODULAR CAST IRON	JIS 5K
V19	50A	GLOBE VALVE	8	NODULAR CAST IRON	SPRING LOADED TYPE
V20	65A	GATE VALVE	4	CAST IRON	JIS 5K
V21	50A	GATE VALVE	4	CAST IRON	JIS 5K
V22	50A	CHECK VALVE	5	CAST IRON	JIS 5K
V23	80A	GATE VALVE	1	CAST IRON	JIS 5K
V24	50A	ANGLE S.D.N.R. VALVE	1	CAST IRON	JIS 5K
V25	65A	BUTTERFLY VALVE	1	CAST IRON	JIS 10K, WAFER TYPE

No.	Size	Description	Qty.	Material	Remark
R1		BILGE/BALLAST/FIRE PUMP	1	MAKER'S STANDARD	DESMI S80-70-220/D-2, HORIZONTAL CENTRIFUGAL SELF-PRIMING, DIRECT COUPLED TO A 22KW x 3500rpm, 440/3/60 MOTOR. CAP. 60m³/hr x 60m
R2		BILGE/G.S./FIRE PUMP	1	MAKER'S STANDARD	
R3		DRILL WATER PUMP	1	MAKER'S STANDARD	DESMI S100-80-275N/A-2, HORIZONTAL CENTRIFUGAL, DIRECT COUPLED TO A 76KW x 3500rpm, 440/3/60 MOTOR. CAP. 120m³/hr x 80m
R4	32A	SEMI-ROTARY HAND PUMP	1	CAST IRON	
R5	125A	FWD. BILGE MANIFOLD	2	M.S. GALVD.	SCH. 80 PIPE
R6	125A	AFT. BILGE MANIFOLD	1	M.S. GALVD.	SCH. 80 PIPE
R7	150A	BALLAST/D.W. SUCTION MANIFOLD	1	M.S. GALVD.	SCH. 80 PIPE
R8	150A	BALLAST/D.W. DELIVERY MANIFOLD	1	M.S. GALVD.	SCH. 80 PIPE
R9	150A	D.W. SUCTION MANIFOLD	1	M.S. GALVD.	SCH. 80 PIPE
R10	150A	D.W. DELIVERY MANIFOLD	1	M.S. GALVD.	SCH. 80 PIPE
R11	400A	S.W. STRAINER	2	M.S. GALVD. S.S. SCREEN	
R12	100A	S.W. STRAINER	2	M.S. GALVD. S.S. SCREEN	
R13	125A	S.W. STRAINER	2	M.S. GALVD. S.S. SCREEN	OPEN AREA OF NOT LESS THAN TWICE TIMES OF SUCTION PIPE
R14	80A	BILGE STRAINER	8	M.S. GALVD. S.S. SCREEN	OPEN AREA OF NOT LESS THAN TWICE TIMES OF SUCTION PIPE
R15	65A	BILGE STRAINER	6	M.S. GALVD. S.S. SCREEN	OPEN AREA OF NOT LESS THAN TWICE TIMES OF SUCTION PIPE
R16	65A	MUDROSE BOX	2	M.S. GALVD.	OPEN AREA OF NOT LESS THAN TWICE TIMES OF SUCTION PIPE
R17	32A	MUDROSE BOX	1	M.S. GALVD.	OPEN AREA OF NOT LESS THAN TWICE TIMES OF SUCTION PIPE
R18	125A	BELLMOUTH	8	M.S. GALVD.	
R19	80A	BELLMOUTH	2	M.S. GALVD.	
R20	125A	SPECTACLE FLANGE	4	M.S. GALVD.	KAMLOCK
R21	125A	QUICK CONNECTION COUPLING C/W CAPS.	4	BRONZE	KAMLOCK OR EQUAL.
R22	50A	SCUPPER	2	M.S. GALVD.	
R23	100A	RT. ANGLE STRAINER	1	M.S. GALVD.	
R24	50A	BILGE STRAINER	4	M.S. GALVD. S.S. SCREEN	OPEN AREA OF NOT LESS THAN TWICE TIMES OF SUCTION PIPE
R25	50A	MUDROSE BOX	1	M.S. GALVD.	OPEN AREA OF NOT LESS THAN TWICE TIMES OF SUCTION PIPE



BILGE SYSTEM



BALLAST & D.W. SYSTEMS

APPROVED BY OWNER ON – 16.06.05
APPROVED BY LLOYD'S ON – 28.06.05

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DATE	MODIFICATION	REV	BY
11.02.06	AMENDED AS PER AS-BUILT	B	PUM
05.07.05	1. ADDED LLOYD'S COMMENTS & APPROVAL DATE FOR REV. 0	A	WONG
03.07.05	1. ADDED OWNER'S APPROVAL DATE & COMMENTS FOR REV.0	A	ALEX

SHIP:

12000HP A.H./SUPPLY VESSEL

TITLE:

BILGE, BALLAST & D.W. SYSTEMS

OWNER	LEWEK SHIPPING PTE LTD		
BUILDER	PAN UNITED MARINE LIMITED	YARD NO.	165
CLASS	LLOYDS		

CONAN WU & ASSOCIATES
NAVAL ARCHITECTS
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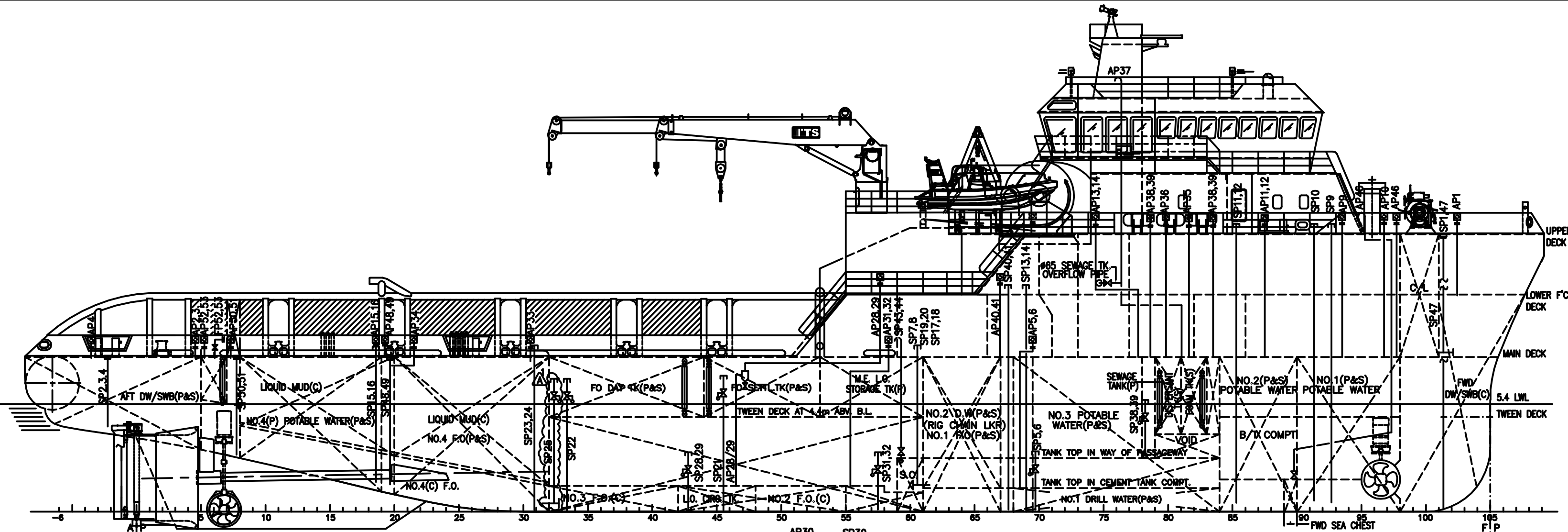
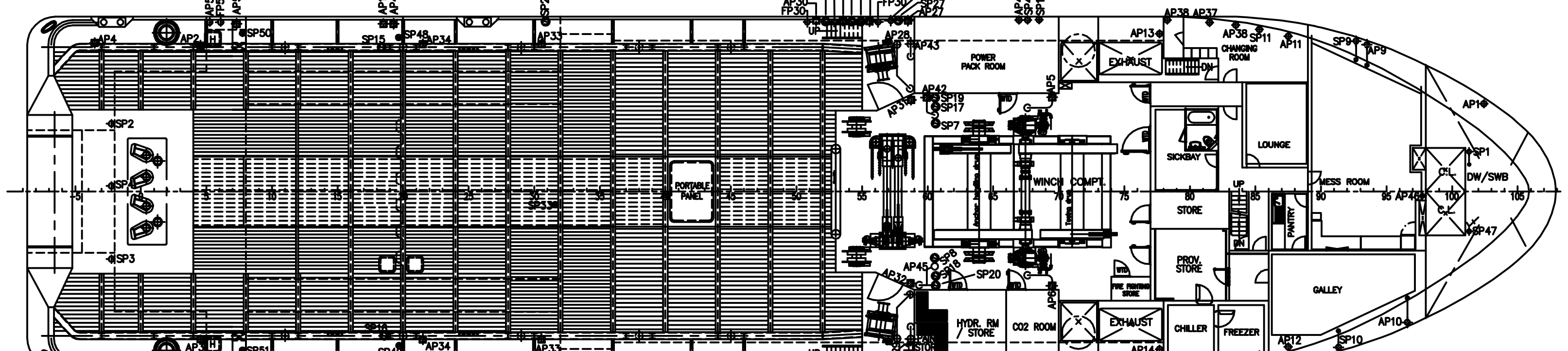
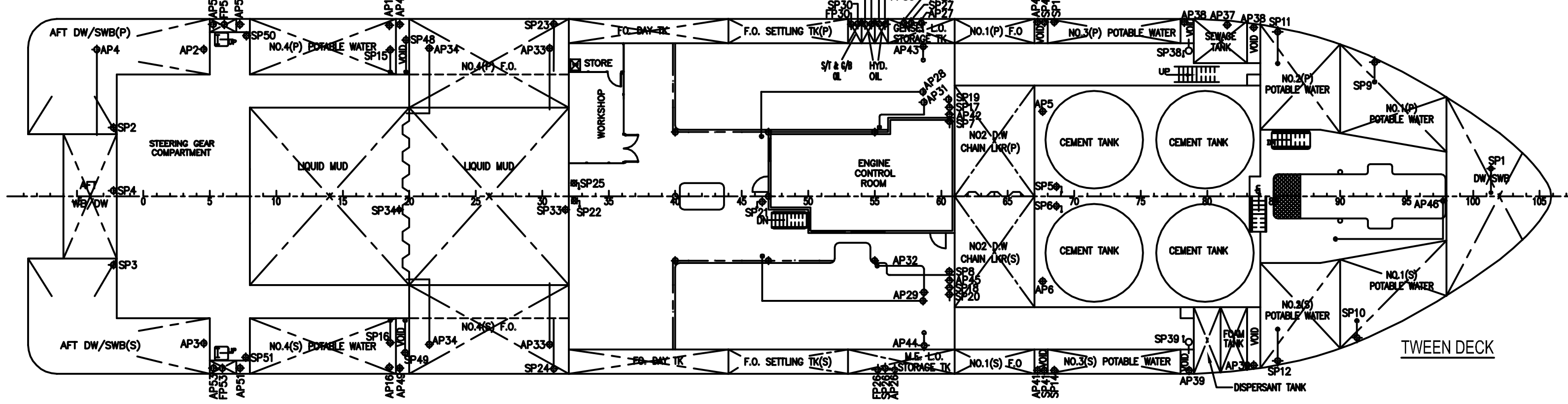
DRAWN	CHECKED	APPROVED	SCALE	DRAWING NO.	REV
WUN/LUA	WUN		100	C3806A/P-1	B
18.04.05	21.04.05				



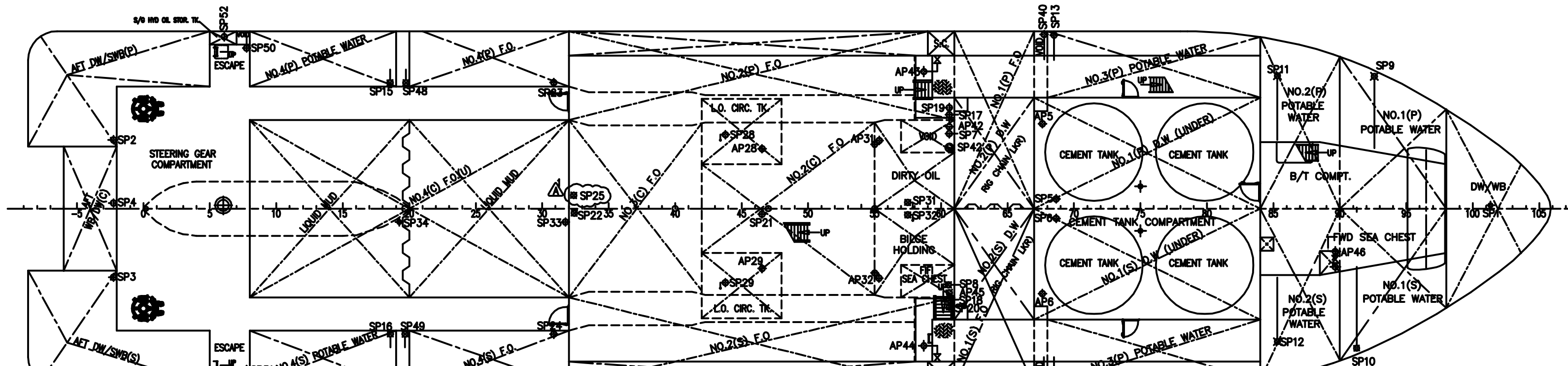
OUTBOARD PROFILE



MAIN DECK

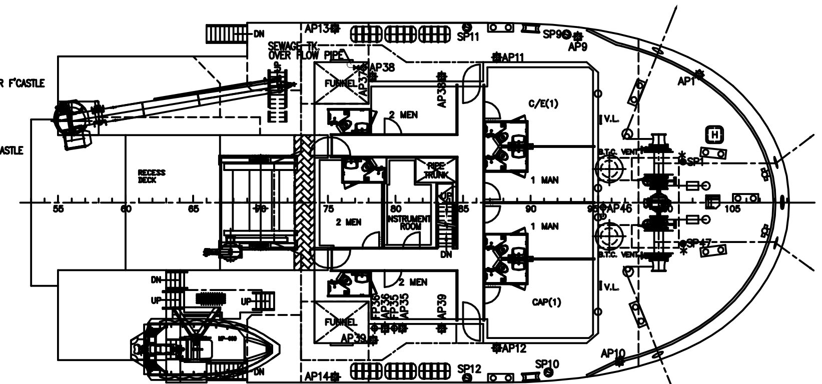


TWEEN DECK

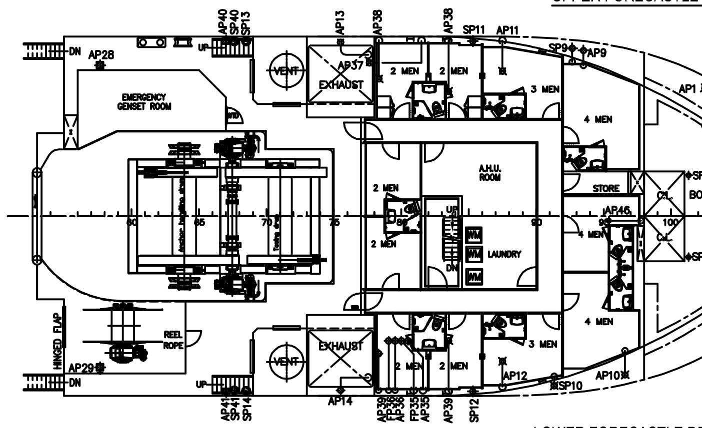


TANK TOP

DESCRIPTION	AIR VENT			SOUNDING			FILLING			REMARK
	ITEM	SIZE	QTY.	ITEM	SIZE	QTY.	ITEM	SIZE	QTY.	
F.O. DAY TK. (P)	–	–	–	LEVEL GAUGE		1	–	–	–	COMMON VENT REFER DWG. NO. C3806A/P-6 FITTED WITH FLAT TYPE LEVEL GAUGE c/w SELF-CLOSING VALVE @ TOP & BTM.
F.O. DAY TK. (S)	–	–	–			1	–	–	–	
F.O. SETTLING TK. (P)	–	–	–			1	–	–	–	
F.O. SETTLING TK. (S)	–	–	–			1	–	–	–	



UPPER FORECASTLE DECK



LOWER FORECASTLE DECK

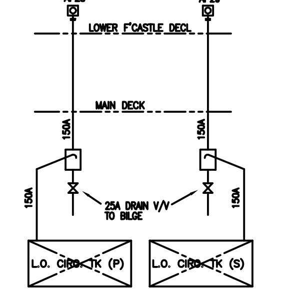
DESCRIPTION	AIR VENT			SOUNDING			FILLING			REMARK
	ITEM	SIZE	QTY.	ITEM	SIZE	QTY.	ITEM	SIZE	QTY.	
FORE PEAK D.W./S.W.B.	AP1	150A	1	SP1	40A	1	–	–	–	SP1 – FLUSH DECK FITTING
AFT PEAK D.W./S.W.B.(P)	AP2	150A	1	SP2	40A	1	–	–	–	SP2 – FLUSH DECK FITTING
AFT PEAK D.W./S.W.B. (S)	AP3	150A	1	SP3	40A	1	–	–	–	SP3 – FLUSH DECK FITTING
AFT PEAK D.W./S.W.B. (C)	AP4	150A	1	SP4	40A	1	–	–	–	SP4 – FLUSH DECK FITTING
NO.1 D.W. (P)	AP5	150A	1	SP5	40A	1	–	–	–	SP5 – C/W SELF-CLOSING VALVE
NO.1 D.W. (S)	AP6	150A	1	SP6	40A	1	–	–	–	SP6 – C/W SELF CLOSING VALVE
NO.2 D.W./RIG CHAIN LKR. (P)	AP7	150A	1	SP7	40A	1	–	–	–	
NO.2 D.W./RIG CHAIN LKR. (S)	AP8	150A	1	SP8	40A	1	–	–	–	
NO.1 POTABLE WATER (P)	AP9	150A	1	SP9	40A	1	–	–	–	
NO.1 POTABLE WATER (S)	AP10	150A	1	SP10	40A	1	–	–	–	
NO.2 POTABLE WATER (P)	AP11	150A	1	SP11	40A	1	–	–	–	
NO.2 POTABLE WATER (S)	AP12	150A	1	SP12	40A	1	–	–	–	
NO.3 POTABLE WATER (P)	AP13	150A	1	SP13	40A	1	–	–	–	
NO.3 POTABLE WATER (S)	AP14	150A	1	SP14	40A	1	–	–	–	
NO.4 POTABLE WATER (P)	AP15	150A	1	SP15	40A	1	–	–	–	
NO.4 POTABLE WATER (S)	AP16	150A	1	SP16	40A	1	–	–	–	
NO.1 F.O.T. (P)	–	–	–	SP17	40A	1	–	–	–	SP17, SP18 – REFER TYPICAL SOUNDING PIPE.
NO.1 F.O.T. (S)	–	–	–	SP18	40A	1	–	–	–	
NO.2 F.O.T. (P)	–	–	–	SP19	40A	1	–	–	–	
NO.2 F.O.T. (S)	–	–	–	SP20	40A	1	–	–	–	
NO.2 F.O.T. (C)	–	–	–	SP21	40A	1	–	–	–	REFER DWG. NO. C3806A/P-6 F.O. COMMON AIR VENT & OVERFLOW SYSTEM
NO.3 F.O.T. (C)	–	–	–	SP22	40A	1	–	–	–	
NO.4 F.O.T. (P)	–	–	–	SP23	40A	1	–	–	–	
NO.4 F.O.T. (S)	–	–	–	SP24	40A	1	–	–	–	
NO.4 F.O.T. (C)	–	–	–	SP25	40A	1	–	–	–	SP25 – REFER TYPICAL SOUNDING PIPE
M/E L.O. STORAGE TK. (S)	AP26	65A	1	SP26	40A	1	FP26	50A	1	
GENSET L.O. STORAGE TK. (P)	AP27	65A	1	SP27	40A	1	FP27	50A	1	
L.O. CIRC. TK. (P)	AP28	150A	1	SP28	40A	1	–	–	–	SP28 – C/W SELF CLOSING VALVE
L.O. CIRC. TK. (S)	AP29	150A	1	SP29	40A	1	–	–	–	SP29 – C/W SELF CLOSING VALVE AP29 – BHD FITTED TYPE AIR VENT HEAD
HYD. OIL TK. (P)	AP30	65A	3	SP30	40A	3	FP30	50A	3	
DIRTY OIL TK. (P)	AP31	65A	1	SP31	40A	1	–	–	–	SP31 – C/W SELF CLOSING VALVE
BILGE HOLDING TK. (S)	AP32	100A	1	SP32	40A	1	–	–	–	SP32 – C/W SELF CLOSING VALVE
LIQUID MUD TK. (C) FR.20-FR.32	AP33	150A	2	SP33	50A	1	–	–	–	MUD TANKS FITTED WITH HIGH & LOW LEVEL ALARMS. SP33, SP34 – FLUSH DECK FITTING
LIQUID MUD TK. (C) FR.8-FR.20	AP34	150A	2	SP34	50A	1	–	–	–	
FOAM TANK (S)	AP35	65A	1	LEVEL GAUGE		1	FP35	50	1	
DISPERSANT TANK (S)	AP36	65A	1	LEVEL GAUGE		1	FP36	50	1	
SEWAGE TANK (P)	AP37	65A	1	LEVEL GAUGE		1	–	–	–	
VOID FR.78-FR.84 (P)	AP38	65A	2	SP38	40A	1	–	–	–	SP38 – C/W SELF CLOSING VALVE
VOID FR.78-FR.84 (S)	AP39	65A	2	SP39	40A	1	–	–	–	SP39 – C/W SELF CLOSING VALVE
VOID FR.67-FR.68 (P)	AP40	65A	1	SP40	40A	1	–	–	–	
VOID FR.67-FR.68 (S)	AP41	65A	1	SP41	40A	1	–	–	–	
VOID FR.57-FR.61 BTM. (P)	AP42	65A	1	SP42	40A	1	–	–	–	
MAIN SEA CHEST (P)	AP43	65A	1	–	–	–	–	–	–	
MAIN SEA CHEST (S)	AP44	65A	1	–	–	–	–	–	–	
FIFI SEA CHEST (S)	AP45	65A	1	–	–	–	–	–	–	
FWD. SEA CHEST	AP46	65A	1	–	–	–	–	–	–	
CHAIN LOCKER	–	–	–	SP47	40A	1	–	–	–	SP47 – FLUSH DECK FITTING
VOID FR.19-FR.20 (P)	AP48	65A	1	SP48	40A	1	–	–	–	SP48 – FLUSH DECK FITTING
VOID FR.19-FR.20 (S)	AP49	65A	1	SP49	40A	1	–	–	–	SP49 – FLUSH DECK FITTING
VOID FR.7-FR.8 (P)	AP50	65A	1	SP50	40A	1	–	–	–	SP50 – FLUSH DECK FITTING
VOID FR.7-FR.8 (S)	AP51	65A	1	SP51	40A	1	–	–	–	SP51 – FLUSH DECK FITTING
KARM FORK/TOWPIN HYD. OIL TK. (P)	AP52	65A	1	LEVEL GAUGE		1	FP52	50A	1	
KARM FORK/TOWPIN HYD. OIL TK. (S)	AP53	65A	1	LEVEL GAUGE		1	FP53	50A	1	

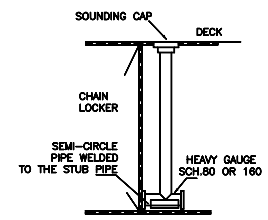
NOTES:

1. SOUNDING MARKED (✱) TO BE FLUSHED TYPE.
2. SOUNDING MARKED (✓) TO BE TYPICAL SOUNDING PIPE.
3. ALL AIR PIPES ON EXPOSED FREEBOARD DECK TO BE SCH.80 (SCH.40 TO BE USED BELOW DECK).
4. a) M.S. BLACK PIPE FOR F.O., L.O., HYDRAULIC OIL & SLUDGE TANK.
   b) M.S. GALVANISED PIPE FOR OTHER TANKS & COMPARTMENT.
5. FLAT GLASS TYPE SIGHT-GLASS (CLASS APPROVED) WILL BE PROVIDED FOR F.O. DAY TANKS & HYDRAULIC OIL TANKS.
6. ALL SOUNDING, FILLING & VENT PIPES TO BE LABELLED WITH NAME PLATES OF BRASS ENGRAVED WITH TANK NUMBER & PURPOSE.
7. ADDITIONAL APPROVED TYPE LEVEL GAUGE IS TO BE PROVIDED FOR DOUBLE-BOTTOM NO.2C TANK.
8. FOR FINAL LOCATION OF SOUNDING PIPES INSIDE MACHINERY SPACE, IT MUST BE CHECKED & CONFIRMED AT SITE WITH REFERENCE TO THE ENGINE ROOM LAYOUT DRAWING.
9. THE AUTOMATIC CLOSING APPLIANCES ARE TO BE OF A TYPE APPROVED BY ABS.
10. THE HEIGHT OF AIR VENTS FROM EXPOSED MAIN DECK TO THE POINT WHERE WATER MAY HAVE ACCESS BELOW ARE TO BE AT LEAST 760mm (POS.1) & 450mm ON THE SUPER STRUCTURE DECK(POS.2).
12. MUD TANKS SHALL BE INSTALLED WITH HIGH & LOW LEVEL ALARMS.
13. FOR DETAILS OF TANK VENTS, SOUNDING & FILLING PIPES, PLEASE REFER TO SHIPYARD'S PIPING STANDARD.

LEGEND

DECK / BTM OF TK.	SOUNDING CAP (FLUSH TYPE)
WATER ENTRY / 760 / DECK	VENT HEAD C/W FLOAT BALL FLAME ARRESTOR FOR OIL TANK MOSQUITO SCREEN FOR F.W. TANK
	SOUNDING CAP C/W KEEP CHAIN
	FILLER CAP C/W KEEP CHAIN
	SOUNDING CAP C/W SELF-CLOSING COCK ADDITIONAL TEST COCK FOR F.O.T. ONLY





TYPICAL SOUNDING PIPE

APPROVED BY OWNER ON – 11.05.05

PRINT RECORD									
Appr/Constr/Ref/Fly.	A	C							
NO. OF PRINT	4	12							
DATE	25/04	06/06							
REVISION	0	A							
OWNER	2	1							
CLASS	–	–							
PJS	1	1							
COM (SB)	–	1							
QC	–	1							
PRODUCTION	1	8							

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DATE	REV	MODIFICATION	BY
27.02.06	B	AMENDED AS PER AS-BUILT	PUM
02.07.05	A	1. ADDED LLOYD'S COMMENTS & APPROVAL DATE FOR REV.0	WONG
20.05.05	A	1. ADDED OWNER COMMENTS & APPROVAL DATE	KUMAR

SHIP:

12000HP A.H./SUPPLY VESSEL

TITLE:

POSITION OF TANK AIR VENTS, SOUNDING & FILLING PIPES

OWNER	LEWEK SHIPPING PTE. LTD.	
BUILDER	PAN UNITED MARINE LTD.	YARD NO. 165
CLASS	LLOYDS	

CONAN WU & ASSOCIATES
NAVAL ARCHITECTS
INFORMATICS BLDG., LEVEL 3, 5 INTERNATIONAL BUSINESS PARK, JURONG EAST, S'PORE 609914.
TEL.: (65) 562-1138, FAX.: (65) 562-1238, (65) 562-0123, E-MAIL : mail@cwa.com.sg

DRAWN	CHECKED	APPROVED	SCALE	DRAWING NO.	REV
WUN/LUA	W.S. Wun		1:150	C3806A/P-11	B
19-04-05	21-04-05				

Appendix 2 – Assessment criteria for the sequential method

[For compliance with Lloyd's Register ShipRight procedure – assessment of Ballast Water Management Plans)

[Applicable until a treatment system is required to be installed under Regulation B-3 of the BWM Convention]

Stability

The following pages have been extracted from the ship's approved LSK - Inclining Experiment & Intact Stability Report (Final).

The Master and appointed Officer shall ensure that the effects of combined free surface moments are always taken into account during ballast water exchange operations. Reference shall be made to the vessel's approved Trim and Stability Booklet.

BIBLIOGRAPHY

SHIP NO.	: 165
SHIPBUILDER	: PAN UNITED MARINE LIMITED
SHIP'S NAME	: "LEWEK STORK"
SHIP OWNER	: LEWEK SHIPPING PTE LTD
SHIP :	12000HP A.H. / SUPPLY VESSEL

INCLINING EXPERIMENT AND INTACT STABILITY REPORT (FINAL)

SCALE :

CWA

CONAN WU & ASSOCIATES

NAVAL ARCHITECTS

SINGAPORE

verified by

Lloyd's Register Asia
Singapore Office
Lloyd's Register

ARIE PRABOWO
26/04/06

PREPARED BY :	gh Zhang 30/04/05
CHECKED BY :	
APPROVED BY :	
DRAWING NO. : C3806/C-4	REV. 0

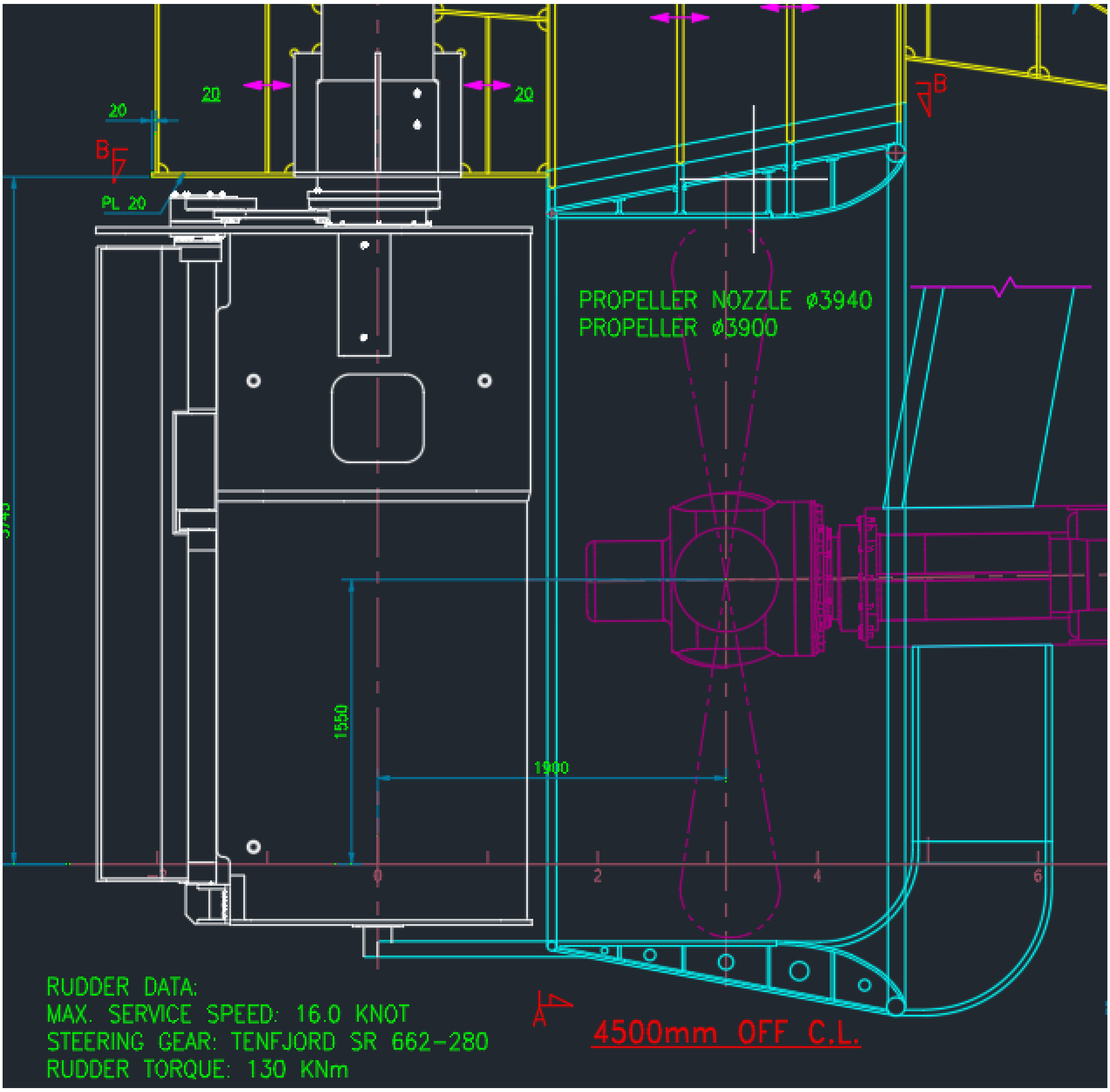
Minimum draught forward

Min draught forward Tfb : 3.12 [m]

```
04-05-11 16:03:37        Conan Wu & Associates Pte Ltd                Page 13
GHS 8.50                 12000HP A.H. / SUPPLY VESSEL

                     CONDITION NO. 0 : LIGHTSHIP CONDITION
                     -------------------------------------

                        WEIGHT and DISPLACEMENT STATUS
                        Baseline draft: 3.642 @ Origin
                      Trim: Aft 1.039/63.000,  Heel: zero
Part-----------------------------Weight(MT)----LCG-----TCG-----VCG-------FSM
WEIGHT                             2,620.00  0.500f  0.000   6.700
                Load-----SpGr-----Weight(MT)----LCG-----TCG-----VCG
  Total Tanks--------->                 0.00                                0.00
                                   Displ(MT)----LCB-----TCB-----VCB
HULL                      1.025    2,619.99  0.424f  0.000   1.976
----------------------------------------------------------------------------
               Righting Arms:                0.002f  0.000
Distances in METERS.---------------------------------------Moments in M.-MT.


                              SUMMARY OF LOADING
        0.0 Cu.M. (0  %) SALT WATER          0.0 Cu.M. (0  %) DRILL WATER
        0.0 Cu.M. (0  %) FRESH WATER         0.0 Cu.M. (0  %) FUEL OIL
        0.0 Cu.M. (0  %) HYDRO OIL           0.0 Cu.M. (0  %) LUBE OIL
        0.0 Cu.M. (0  %) DIRTY OIL           0.0 Cu.M. (0  %) BILGE
        0.0 Cu.M. (0  %) SEWAGE              0.0 Cu.M. (0  %) FOAM
        0.0 Cu.M. (0  %) DISPERSANT          0.0 Cu.M. (0  %) MUD


                           HYDROSTATIC PROPERTIES
                 Trim: Aft 1.039/63.000, No Heel, VCG = 6.700

   LCF   Displacement   Buoyancy-Ctr.  Weight/          Moment/
 Draft----Weight(MT)----LCB-----VCB-------CM-----LCF---CM trim----GML-----GMT
 3.667     2,619.99   0.424f  1.976     8.96   1.514a   36.59   87.97   1.464
Distances in METERS.-----Specific Gravity = 1.025.-----------Moment in M.-MT.
                             Trim is per 63.00M.
Draft is from Baseline.


                                DRAFT STATUS

                              Draft @ FP  &  AP
                  Baseline draft: 3.123 @ 31.50f, 4.162 @ 31.50a

                              Draft @ Midship
                        Baseline draft: 3.642 @ Origin


           Note : Reference point is at Midship (@ 300mm fwd of FR.52)
                        31.50f = FP,    31.50a = AP
```

Propeller immersion

		1.55		
Propeller shaft above baseline	H	: ~~2.325~~	[m]	~~(Inclusive of the Skeg, 0.825m)~~
Propeller diameter	Dp	: 3.90	[m]	



Propeller immersion is defined as the distance between propeller tip and waterline.

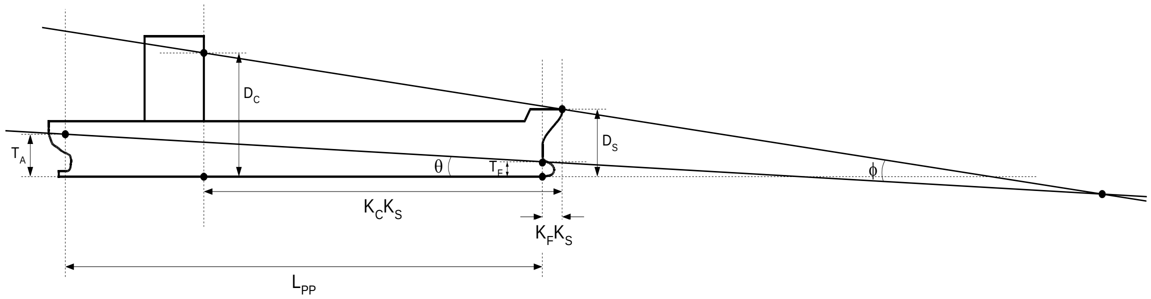
Propeller is 100% immersed at 3.59m Draft.

The following information has been extracted from the ship's approved Rolls Royce CPP Manual 94 P1/4 T and GA Plan C3806A / G1.

Bridge visibility forward

When bridge visibility requirements of SOLAS, Chapter V Safety of Navigation, Regulation 22 Navigation bridge visibility cannot be maintained for transition periods during sequential ballast exchange operations ships in service are expected to take into account the precautions and guidance in Section 6.

[The bridge visibility forward will be checked by Lloyd's Register on the basis of the following data]



Length overall	Loa	70.70	[m]
Length between perpendiculars	Lpp:	63.00	[m]
Height of conning position	Dc:	18.17	[m]
Height of position 'S'	Ds:	13.92	[m]
Horizontal distance from conning position to position 'S'	KcKs:	10.51	[m]
Horizontal distance from FP to position 'S'	KfKs:	1.83	[m]

Note: Where there are containers or other cargo on deck, the position 'S' should be considered in respect of worst visibility. If the position 'S' is aft of the fore perpendicular, then KfKs is to be taken as a negative value.

Maximum allowable bridge invisible length forward : 26.71 [m]

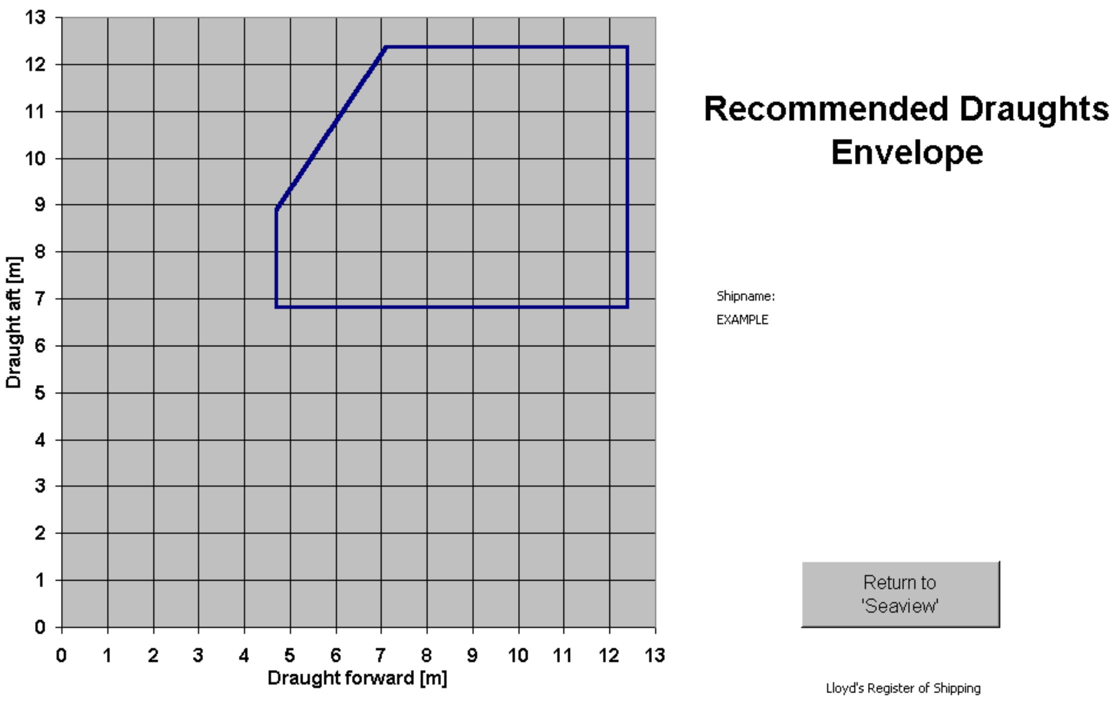
For sequences where bridge visibility forward is affected the master should take into account the guidance in Section 10.

Envelope of recommended draughts

The envelope of recommended draughts is based on the required view of the sea surface forward from the conning position, minimum draught forward, summer draught and propeller immersion, and is provided for reference.

[The envelope of recommended draughts covering the required view of the sea surface forward from the conning position, minimum draught forward, summer draught and propeller immersion will be advised by Lloyd's Register]

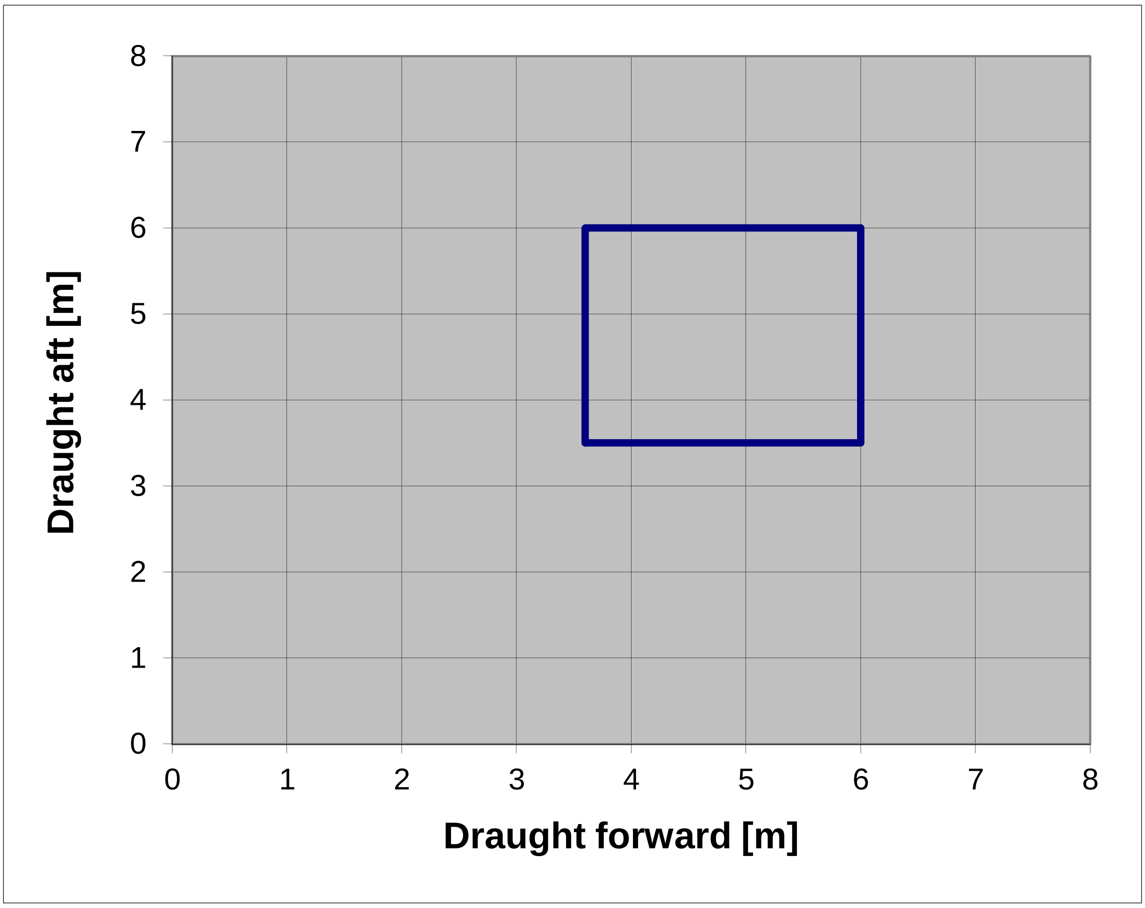
[A typical example is shown below]



Recommended Draughts Envelope

Shipname: **LEWEK STORK**

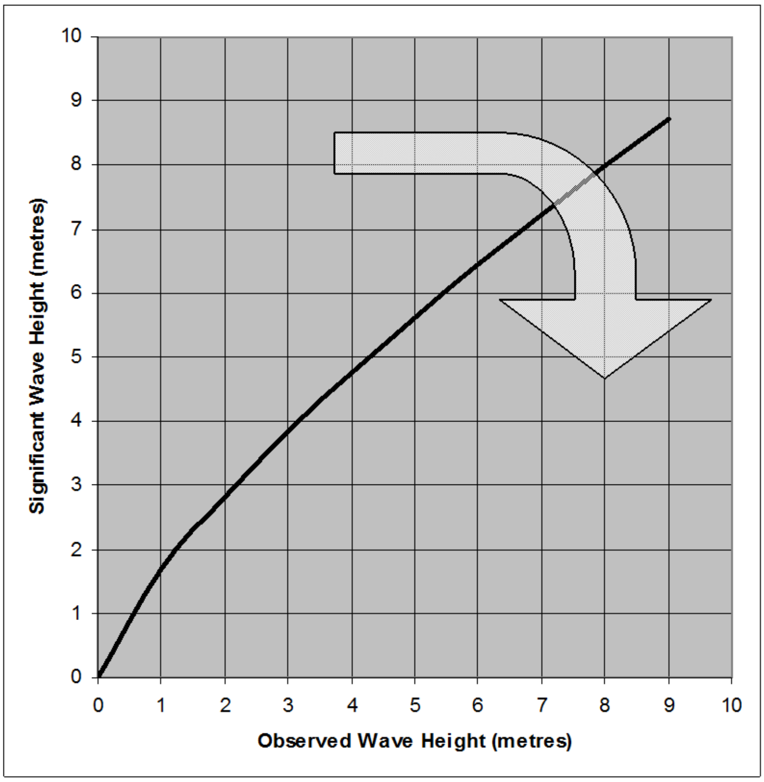
IMO No: **9354947**



Definition of sea state according to WMO

Sea state code	Description	Range of significant wave height (metres)
0	Calm (glassy)	0
1	Calm (rippled)	0 – 0,1
2	Smooth (wavelets)	0,1 – 0,5
3	Slight	0,5 – 1,25
4	Moderate	1,25 – 2,5
5	Rough	2,5 – 4,0
6	Very Rough	4,0 – 6,0
7	High	6,0 – 9,0
8	Very High	9,0 – 14,0
9	Phenomenal	> 14,0

The significant wave height can be transformed into an observed wave height using the figure below:



Appendix 3 – Ballast exchange sequences

1. Condition 6 - Arrival of Condition No.5 with 10% Consumables

Example format of exchange sequences:

W.B.T	W.B.T	W.B.T	W.B.T	W.B.T	W.B.T	W.B.T	W.B.T	W.B.T	FO/DO/ LO/FW	Draft Aft	Trim	Draft Fwd	Stability Criteria	S.W. B.M.	S.W. S.F.	Prop. Imm.	Invisible Length	Estimated Time	Remarks
A.P.T.	Tank ID	Tank ID	Tank ID	Tank ID	Tank ID	Tank ID	Tank ID	F.P.T.											
	P / S	P / S	C	P / S	C	P / S	P / S		MT	m	m	>x.xx		%	%	>xx	<xxx m	hours	
Initial Condition:																			
STEP 1: Pump out ...Tank(s) ID ... - Ballast Pump No ... used																			
STEP 2: Pump out ... Tank(s) ID ...OR Refill ...Tank(s) ID ... - Ballast Pump No ... used																			
																			See Note(s)...
STEP 3:																			
																			See Note(s)...
STEP 4:																			
STEP XX:																			
STEP XXX:																			
																		Total Time(h)	
PRESENTAGE OF TANK LEVEL OR SYMBOLS SUCH AS THOSE									**Min Values**										
PRESENTED BELOW COULD BE USED AS NECESSARY.									**Max Values**										

e	Empty at start	f	Full at start	WHERE GREATER DETAIL IS REQUIRED, ADDITIONAL SYMBOLS CAN BE DEFINED
f	Filling	E	Discharging	
F	Full at end	E	Empty at end	THE COLOURING OF THE CELLS WHERE THE CRITERIA ARE NOT SATISFIED CAN ENHANCE THE UNDERSTANDING OF THE BEP

Note 1: The Master is advised that the propeller will not be fully immersed during this step/sequence.

Note 2: The Master is advised that bridge visibility forward will be reduced during this step/sequence.

Note 3: This step/sequence is to be carried out in calm seas, i.e. zero sea state.

Note 4: This step/sequence is to be carried out up to moderate sea.

Note 5: This step/sequence is to be carried out up to rough sea.

	Pump No ...		Pump No ...	
	...... m^3/hr		...... m^3/hr	
Tank ID	3 x Vol.	4 x Vol.	3 x Vol.	4 x Vol.
...	...	...	...	...
...	...	...	...	...
...	...	...	...	...
...	...	...	...	...

Note 6: In the critical fill range 70%-95% this step/sequence is to be carried out up to moderate sea.

Note 7: The Master is advised to verify that tanks shown as "e" or "E" are totally empty and tanks shown as "f" or "F" are totally full, at the start and end of the step/sequence.

Note 8: Where two ballast pumps are used for filling purposes, when the fill level reaches 80% - 90%, then one of the pumps is to be deployed.

Note 9: The indicative times for ballast exchange by flow-through method of … Tank(s) ID … are provided separately.

PLEASE RETAIN OR DELETE OR AMEND THE NOTES AS APPROPRIATE

FOR CONSERVATIVE REASONS, WHERE AT THE END OF A STEP / SEQUENCE A TANK REMAINS PARTIALLY FILLED, ADDITIONAL CONDITIONS AT ± 10 % OF THE PARTIAL FILL LEVEL SHOULD ALSO BE ASSESSED, SINCE IT IS PRACTICALLY DIFFICULT TO MATCH THE SPECIFIED PARTIAL FILL LEVEL WHILST SHIP MOTIONS ARE EXPERIENCED

AIM TO DEVELOP SEQUENCES WHERE THE STILL WATER BENDING MOMENTS AND SHEAR FORCES DO NOT EXCEED 85% OF THE PERMISSIBLE VALUES, IN ORDER TO ACCOUNT FOR SMALL DEVIATIONS IN SERVICE, SO THAT THE MASTER AND THE APPOINTED BALLAST WATER MANAGEMENT OFFICER CAN HAVE CONFIDENCE IN FOLLOWING THE PROPOSED SEQUENCES

EMAS Marine

Appendix 3 - Ballast Exchange Sequences (Sequential Method)

Condition No.6 - Arrival of Condition No.5 with 10% Consumables

SWBT FPTDW&SWBTK	SWBT APTDW&SWBTK	SWBT APTDW&SWBTK	SWBT APTDW&SWBTK	FO/DO/LO/FW	Draft Aft	Trim (-) Fwd / (+) Aft	Draft Fwd	Stability Criteria	S.W.B.M.	S.W.S.F	Propeller Immersion	Invisbile Length (Bridge	Estimated Time	Remarks
C	P	S	C	MT	m	m	m		%	%	%	m	Hours	
Initial Condition:														
E	F	F	F	228.77	4.525	+0.285	4.241	OK	NA	NA	126	23.94		Propeller Immersion = 3.59m
Step 1: Pump out APTDW&SWBTK.P Ballast / ~~GS~~ Pump used.														
E	E	F	F	228.77	4.284	-0.174	4.422	OK	NA	NA	119	23.49	1.1	
Step 2: Refill APTDW&SWBTK.P Ballast / ~~GS~~ Pump used.														
E	F	F	F	228.77	4.525	+0.285	4.241	OK	NA	NA	126	23.94	1.1	
Step 3: Pump out APTDW&SWBTK.S Ballast / ~~GS~~ Pump used.														
E	F	E	F	228.77	4.306	-0.076	4.381	OK	NA	NA	120	23.59	0.5	
Step 4: Refill APTDW&SWBTK.S Ballast / ~~GS~~ Pump used.														
E	F	F	F	228.77	4.525	+0.285	4.241	OK	NA	NA	126	23.94	0.5	
Step 5: Pump out APTDW&SWBTK.C Ballast / ~~GS~~ Pump used.														
E	F	F	E	228.77	4.371	+0.033	4.338	OK	NA	NA	122	23.70	0.6	
Step 6: Refill APTDW&SWBTK.C Ballast / ~~GS~~ Pump used.														
E	F	F	F	228.77	4.525	+0.285	4.241	OK	NA	NA	126	23.94	0.6	
													Total Time (h)	
				Min Values	4.284	+0.033	4.241		NA	NA	119	23.49	4.4	
				Max Values	4.525	+0.285	4.422				126	23.94		

Percentage of Tank Level or Symbols such as those presented below could be used as necessary.

E	Empty
F	Full

	Ballast Pump	GS/Fire Pump
	m3/hr	m3/hr
Step 1	60	
Step 2	60	
Step 3	60	
Step 4	60	
Step 5	60	
Step 6	60	
Time Taken	4.4	

Note 1: The Master is advised that the propeller will be fully immersed during all steps.

Note 2: The Master is advised that bridge visibility forward will be reduced during initial step,Steps 2, 4 and 6.

Note 3: All steps may be carried out in calm seas, i.e. zero sea state.

Note 4: All steps may be carried out in moderate sea.

Note 5: No steps are to be carried out in rough sea.

Note 6: The Master is advised to verify that tanks shown as "e" or "E" are totally empty and tanks showing as "f" or "F" are totally full, at the start and end of all steps.

Note 7: Where two ballast pumps are used for filling purposes, when the fill level reaches 80% - 90%, then one of the pumps is to be deployed.

FPT WB (C)	APT WB (P)	APT WB (S)	APT WB (C)	FO/DO/FW & Others Constant (tonnes)	Draft Aft (m)	Mean Draught (m)	Draft Forward (m)	Trim by Stern (- by Bow)	Stability Criteria	Propeller Immersion (%) > 100%	Invisible length (m) < 141.4m	Remarks, See Notes:
Initial Condition												
E	F0	80%	F0	562.41	4.53	4.38	4.24	0.28	OK	126.28	24.24	1,2,3
Step No.1 : Empty APT WB (P)												
E	E	80%	F0	562.41	4.25	4.34	4.42	-0.17	OK	119.18	23.33	1,2,3
Step No.2 : Fill up APT WB (P)												
E	F1	80%	F0	562.41	4.53	4.38	4.24	0.28	OK	126.28	24.24	1,2,3
Step No.3 : Empty APT WB (S)												
E	F1	E	F0	562.41	4.31	4.34	4.38	-0.08	OK	120.67	23.52	1,2,3
Step No.4 : Fill up APT WB (S)												
E	F1	80%	F0	562.41	4.53	4.38	4.24	0.28	OK	126.28	24.24	1,2,3
Step No.5 : Empty APT WB (C)												
E	F1	80%	E	562.41	4.37	4.35	4.34	0.03	OK	122.33	23.72	1,2,3
Step No.6 : Fill up APT WB (C)												
E	F1	80%	F1	562.41	4.53	4.38	4.24	0.28	OK	126.28	24.24	1,2,3

F0	Full at Start
xx%	Slack at Start
E	Empty
xx%	Slack after Changed
F1	Changed Full

Malcolm Lim
August-30, 2017

Marine
South Asia Technical Support Office
Lloyd's Register Asia

Lloyd's Register

LR032.2016.09

Notes:

(1) Master is advised to verify that the tanks that are shown as 'FULL' are completely full and those that are shown as 'EMPTY' are completely empty at the beginning and end of each sequence.

(2) In the Diagonal Sequential Exchange the ship's heading should be as close as practicable to head seas.

(3) Where two Ballast pumps are used for filling purposes, when the fill level reaches 80% then one of the pumps is to be deployed.

Condition: LC 6 ARRIVAL OF COND 5

Description: Initial Condition

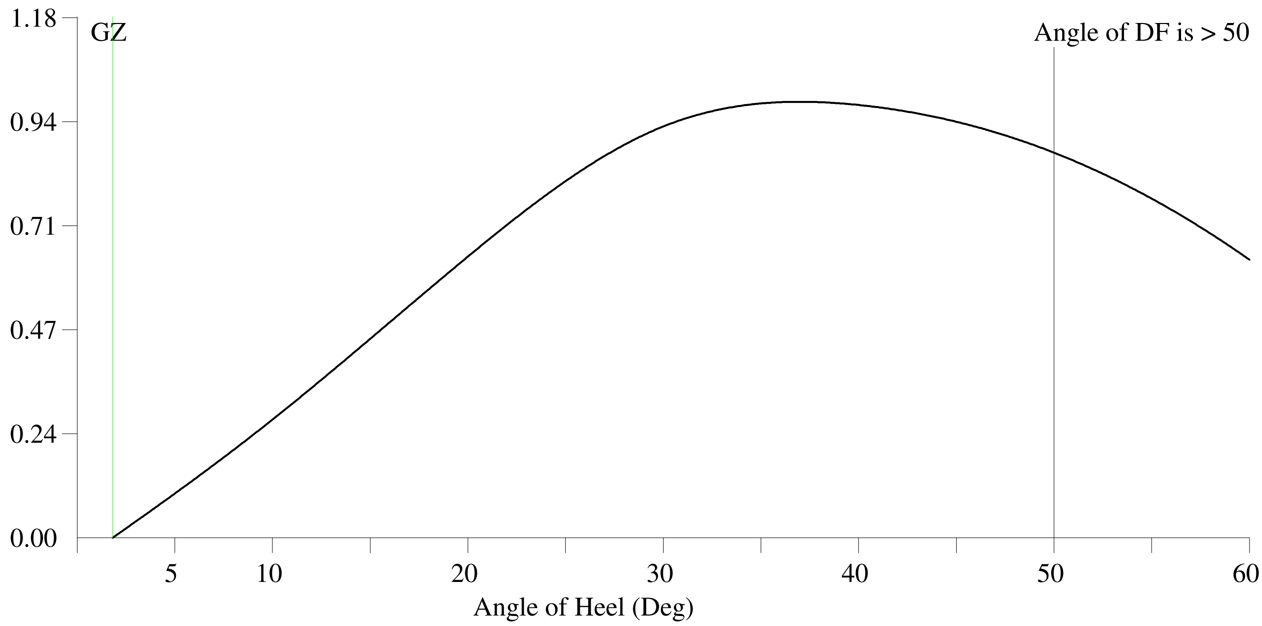
Date: 30-12-2011

DRAFTS,TRIMS & INTACT STABILITY SHEET

Sea Water Density	=	1.0250	(t/cu. m.)	LoadLine	=	6.032 m (Summer Load Line)	
Displacement	=	3261.67	T	Propeller Immersion Draft	=	3.59	m
DRAFTS & TRIM				**DRAFTS AT MARKS**			
Draft AP(USK)	=	4.525	m	Draft AFT Marks	=	4.517	m
Draft FP(USK)	=	4.241	m	Draft FWD Marks	=	4.241	m
Draft (Mean)	=	4.383	m	Trim	=	0.285	m
TCG	=	-0.056	m	List Angle	=	1.831	Deg. Port
INTACT STABILITY							
LCB	=	32.394	m	MCT	=	43.400	T-M/cm
KG	=	5.732	m	GoMt	=	1.695	m
GGo	=	0.233	m	KMT	=	7.659	m
KGo	=	5.964	m	Permissible KG	=	7.296	m

RIGHTING ARM CURVE

Angle (Deg.)	5	10	20	30	40	50	60
KN (m)	0.676	1.358	2.729	3.961	4.856	5.476	5.823
GZ (m)	0.099	0.267	0.636	0.930	0.979	0.871	0.629



COMPLIANCE WITH IMO CRITERIA

		Computed values		Minimum Required	
Maximum GZ Occurs at	=	36.99	Deg	15.00	Deg
Area Upto 30.00 deg	=	0.236	m-rad	0.055	m-rad
Area 30 deg - 40 deg/Angle DF	=	0.171	m-rad	0.030	m-rad
Maximum GZ or GZ @ 30 Deg	=	0.99	m	0.20	m
GoMt	=	1.69	m	0.15	m

JUDGEMENT :

Loadline Draft : OK

IMO Stability Criteria : OK

Condition: LC 6 ARRIVAL OF COND 5

Description: Initial Condition

Date: 30-12-2011

FOLLOWING IS IMMERSION STATUS

SR. No.	Item Name	Fr. No.	Ht.From BL	Dist.From CL	Dist. WaterLine	Immersed	Opening Type
1	E/R VENT (P)	69.00	11.97	-6.85	7.42	No	2
2	E/R VENT (S)	69.00	11.97	6.85	7.86	No	2
3	E/R VENT (P)	69.00	11.30	-6.00	6.78	No	2
4	E/R VENT (S)	69.00	11.30	6.00	7.16	No	2
5	Deck Edge Aft (P)	-8.00	7.20	-8.00	2.41	No	0
6	Deck Edge Aft (S)	-8.00	7.20	8.00	2.92	No	0
7	Deck Edge Mid (P)	52.00	7.20	-8.00	2.57	No	0
8	Deck Edge Mid (S)	52.00	7.20	8.00	3.08	No	0
9	Deck Edge Fwd (P)	105.00	12.95	-8.00	8.46	No	0
10	Deck Edge Fwd (S)	105.00	12.95	8.00	8.97	No	0
11	Check point (0.76m above deck edge)	-8.00	7.96	-8.00	3.17	No	1
12	Check point (0.76m above deck edge)	-8.00	7.96	8.00	3.68	No	1
13	Check point (0.76m above deck edge)	0.00	7.96	-8.00	3.19	No	1
14	Check point (0.76m above deck edge)	0.00	7.96	8.00	3.70	No	1
15	Check point (0.76m above deck edge)	8.00	7.96	-8.00	3.21	No	1
16	Check point (0.76m above deck edge)	8.00	7.96	8.00	3.72	No	1
17	Check point (0.76m above deck edge)	16.00	7.96	-8.00	3.23	No	1
18	Check point (0.76m above deck edge)	16.00	7.96	8.00	3.75	No	1
19	Check point (0.76m above deck edge)	24.00	7.96	-8.00	3.26	No	1
20	Check point (0.76m above deck edge)	24.00	7.96	8.00	3.77	No	1
21	Check point (0.76m above deck edge)	32.00	7.96	-8.00	3.28	No	1
22	Check point (0.76m above deck edge)	32.00	7.96	8.00	3.79	No	1
23	Check point (0.76m above deck edge)	40.00	7.96	-8.00	3.30	No	1
24	Check point (0.76m above deck edge)	40.00	7.96	8.00	3.81	No	1
25	Check point (0.76m above deck edge)	48.00	7.96	-8.00	3.32	No	1
26	Check point (0.76m above deck edge)	48.00	7.96	8.00	3.83	No	1
27	Check point (0.76m above deck edge)	56.00	13.71	-8.00	9.09	No	1
28	Check point (0.76m above deck edge)	56.00	13.71	8.00	9.60	No	1
29	Check point (0.76m above deck edge)	64.00	13.71	-8.00	9.11	No	1
30	Check point (0.76m above deck edge)	64.00	13.71	8.00	9.62	No	1
31	Check point (0.76m above deck edge)	72.00	13.71	-8.00	9.13	No	1
32	Check point (0.76m above deck edge)	72.00	13.71	8.00	9.64	No	1
33	Check point (0.76m above deck edge)	80.00	13.71	-8.00	9.15	No	1
34	Check point (0.76m above deck edge)	80.00	13.71	8.00	9.67	No	1
35	Check point (0.76m above deck edge)	88.00	13.71	-7.50	9.19	No	1
36	Check point (0.76m above deck edge)	88.00	13.71	7.50	9.67	No	1
37	Check point (0.76m above deck edge)	96.00	13.71	-4.00	9.33	No	1
38	Check point (0.76m above deck edge)	96.00	13.71	4.00	9.58	No	1
39	Check point (0.76m above deck edge)	104.00	13.71	-1.50	9.43	No	1
40	Check point (0.76m above deck edge)	104.00	13.71	1.50	9.52	No	1

0 - Deck edge, 1 - Progressive DownFlooding Point, 2 - Unprotected Opening

Condition: LC 6 ARRIVAL OF COND 5

Description: Initial Condition

Date: 30-12-2011

Sr. No	Item	Density/ Stowage Factor	%	Weight (T)	VCG (m)	LCG (m)	TCG (m)	FSM (T-M)
	Water Ballast	**(t/cu. m.)**						
1	F P S W B TK - C	1.025	0.0	0.000	6.016	59.541	0.000	0.0
2	A P S W B TK - P	1.025	100.0	62.320	6.143	-1.644	-5.703	0.0
3	A P S W B TK - S	1.025	79.9	49.820	6.143	-1.635	5.659	60.7
4	A P S W B TK - C	1.025	100.0	34.850	5.421	-2.159	0.000	0.0
	Sub Total			**146.990**	**5.972**	**-1.763**	**-0.500**	**60.7**
	Consumables	**(t/cu. m.)**						
	Fuel Oil							
5	NO.1 F O TK - P	0.855	67.8	34.710	0.970	38.406	-4.798	129.3
6	NO.1 F O TK - S	0.855	65.8	33.690	0.927	38.406	4.746	129.3
7	NO.2 F O TK - P	0.855	0.0	0.000	0.110	28.385	-4.437	0.0
8	NO.2 F O TK - S	0.855	0.0	0.000	0.110	28.385	4.437	0.0
9	NO.2 F O TK - C	0.855	0.0	0.000	0.022	29.200	0.000	0.0
10	NO.3 F O TK - C	0.855	9.8	4.400	0.078	22.210	0.000	180.1
11	NO.4 F O TK - P	0.855	0.0	0.000	0.538	18.934	-5.695	0.0
12	NO.4 F O TK - S	0.855	0.0	0.000	0.538	18.934	5.695	0.0
13	NO.4 F O TK - C	0.855	0.0	0.000	0.011	18.321	0.000	0.0
14	F O DAY TK - P	0.855	9.8	1.830	4.537	22.800	-7.450	0.6
15	F O DAY TK - S	0.855	9.8	1.830	4.537	22.800	7.450	0.6
16	F O SETT. TK - P	0.855	9.8	1.370	4.537	29.100	-7.450	0.5
17	F O SETT. TK - S	0.855	9.8	1.370	4.537	29.100	7.450	0.5
	Sub Total			**79.200**	**1.190**	**36.463**	**-0.084**	**440.8**
	Lube Oil							
18	A L O ST TK - P	0.900	98.0	8.030	5.773	35.100	-7.450	0.3
19	M L O ST TK - S	0.900	97.7	12.840	5.772	34.200	7.450	0.5
20	L O CIR. TK - P	0.900	98.3	11.060	0.621	27.000	-3.536	6.3
21	L O CIR. TK - S	0.900	98.3	11.060	0.621	27.000	3.536	6.3
	Sub Total			**42.990**	**3.121**	**30.663**	**0.834**	**13.4**
	Hyd Oil							
22	NO.1 HYD.OIL TK - P	0.900	99.4	1.610	5.775	33.300	-7.450	0.6
23	NO.2 HYD.OIL TK - P	0.900	99.4	1.610	5.789	32.700	-7.450	0.6
24	NO.3 HYD.OIL TK - P	0.900	99.4	1.610	5.775	32.100	-7.450	0.6
25	STR HYD OIL TK - P	0.900	98.7	1.510	6.213	3.605	-7.594	0.0
26	TOW HYD.OIL TK - S	0.900	98.7	1.510	6.213	3.605	7.594	0.0
	Sub Total			**7.850**	**5.947**	**21.507**	**-4.584**	**1.8**
	Fresh Water							
27	NO.1 PORTABLE W TK - P	1.000	10.0	9.200	0.406	56.175	-1.853	20.6
28	NO.1 PORTABLE W TK - S	1.000	10.0	9.200	0.405	56.175	1.853	20.6

Condition: LC 6 ARRIVAL OF COND 5

Description: Initial Condition

Date: 30-12-2011

Sr. No	Item	Density/ Stowage Factor	%	Weight (T)	VCG (m)	LCG (m)	TCG (m)	FSM (T-M)
	Consumables	**(t/cu. m.)**						
29	NO.2 PORTABLE W TK - P	1.000	10.0	10.710	0.363	52.118	-2.452	71.6
30	NO.2 PORTABLE W TK - S	1.000	10.0	10.640	0.373	52.072	2.465	71.5
31	NO.3 PORTABLE W TK - P	1.000	10.0	8.570	0.383	44.829	-6.069	11.8
32	NO.3 PORTABLE W TK - S	1.000	10.0	8.570	0.383	44.829	6.069	11.8
33	NO.4 PORTABLE W TK - P	1.000	10.0	4.990	3.884	9.839	-6.293	3.4
34	NO.4 PORTABLE W TK - S	1.000	10.0	4.990	3.884	9.839	6.293	3.4
	Sub Total			**66.870**	**0.907**	**45.049**	**-0.000**	**214.7**
	Miscellaneous							
35	DIRTY OIL TK - P	1.000	87.8	8.340	0.405	34.620	-1.558	9.7
36	BILGE HOLDING TK - S	1.000	97.5	9.260	0.448	34.620	1.561	10.7
37	SEWAGE HOLDING TK - P	1.000	98.3	14.260	5.451	48.568	-6.958	1.2
	Sub Total			**31.860**	**2.676**	**40.863**	**-3.068**	**21.6**
	Drill Water							
38	F P D W TK - C	1.000	0.0	0.000	0.031	59.541	0.000	0.0
39	A P D W TK - P	1.000	0.0	0.000	4.383	-1.590	-2.954	0.0
40	A P D W TK - S	1.000	0.0	0.000	4.383	-1.590	2.954	0.0
41	A P D W TK - C	1.000	0.0	0.000	3.643	-1.312	0.000	0.0
42	NO.1 D W TK - P	1.000	100.0	48.200	0.519	45.297	-2.446	0.0
43	NO.1 D W TK - S	1.000	100.0	48.200	0.519	45.297	2.446	0.0
44	NO.2 D W TK - P	1.000	100.0	110.100	4.096	38.398	-2.500	0.0
45	NO.2 D W TK - S	1.000	100.0	110.100	4.096	38.398	2.500	0.0
	Sub Total			**316.600**	**3.007**	**40.499**	**-0.000**	**0.0**
	Mud							
46	NO.1 MUD TK - C	2.500	0.0	0.000	1.156	18.919	0.000	0.0
47	NO.2 MUD TK - C	2.500	0.0	0.000	2.478	11.712	0.000	0.0
	Sub Total			**0.000**	**0.000**	**0.000**	**0.000**	**0.0**
	Foam							
48	FOAM TANK - S	1.145	9.8	1.310	5.438	49.194	6.372	2.7
	Sub Total			**1.310**	**5.438**	**49.194**	**6.372**	**2.7**
	Dispersant							
49	DISPERSANT TANK - S	1.163	9.9	1.400	5.425	47.996	6.440	3.0
	Sub Total			**1.400**	**5.425**	**47.996**	**6.440**	**3.0**
	Deadweight Constants							
50	CREW EFFECT			4.300	10.100	52.800	0.000	0.0
51	PROVISION STORE			0.040	8.500	48.600	3.500	0.0

Condition: LC 6 ARRIVAL OF COND 5

Description: Initial Condition

Date: 30-12-2011

Sr. No	Item	Density/ Stowage Factor	%	Weight (T)	VCG (m)	LCG (m)	TCG (m)	FSM (T-M)
	Deadweight Constants							
52	SHIP STORE			10.000	9.000	50.400	3.000	0.0
53	DRY BULK			0.000	4.150	45.300	0.000	0.0
	Sub Total			**14.340**	**9.328**	**51.115**	**2.102**	**0.0**
	Main Deck							
54	Main Deck			0.000	8.200	15.000	0.000	---
	Sub Total			**0.000**	**0.000**	**0.000**	**0.000**	**---**
	Mezzanine Deck							
55	Mezzanine Deck			0.000	12.200	36.600	0.000	---
	Sub Total			**0.000**	**0.000**	**0.000**	**0.000**	**---**
	DeckHouse Deck							
56	Deckhouse Deck			0.000	15.200	44.700	0.000	---
	Sub Total			**0.000**	**0.000**	**0.000**	**0.000**	**---**

	Weight	VCG	LCG	TCG	FSM
LIGHTSHIP	2552.3	6.385	32.732	-0.021	0.0
DISPLACEMENT	**3261.67**	**5.732**	**32.394**	**-0.056**	**758.7**

Condition: LC 6 ARRIVAL OF COND 5

Description: Step 1

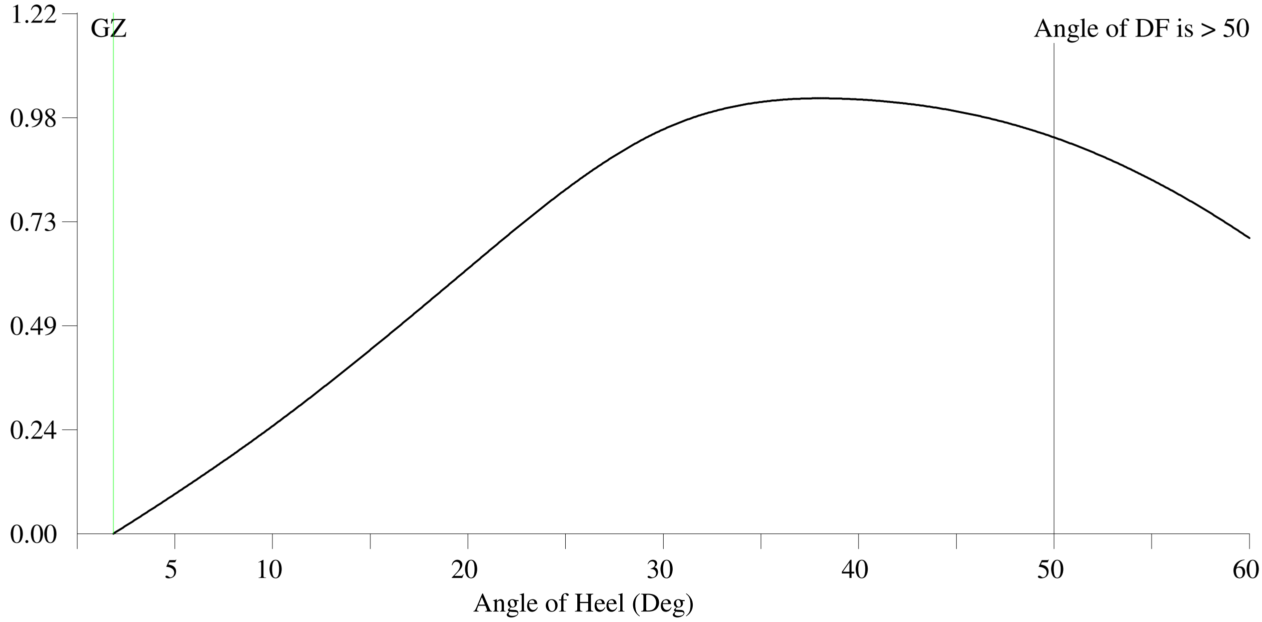
Date: 30-12-2011

DRAFTS,TRIMS & INTACT STABILITY SHEET

Sea Water Density	=	1.0250	(t/cu. m.)	LoadLine	=	6.032 m (Summer Load Line)	
Displacement	=	3199.35	T	Propeller Immersion Draft	=	3.59	m
DRAFTS & TRIM				**DRAFTS AT MARKS**			
Draft AP(USK)	=	4.248	m	Draft AFT Marks	=	4.253	m
Draft FP(USK)	=	4.422	m	Draft FWD Marks	=	4.421	m
Draft (Mean)	=	4.335	m	Trim	=	-0.174	m
TCG	=	0.054	m	List Angle	=	1.856	Deg. Stbd
INTACT STABILITY							
LCB	=	33.057	m	MCT	=	41.006	T-M/cm
KG	=	5.724	m	GoMt	=	1.606	m
GGo	=	0.237	m	KMT	=	7.567	m
KGo	=	5.961	m	Permissible KG	=	7.327	m

RIGHTING ARM CURVE

Angle (Deg.)	5	10	20	30	40	50	60
KN (m)	0.665	1.340	2.710	3.974	4.890	5.529	5.882
GZ (m)	0.093	0.252	0.621	0.948	1.018	0.929	0.693



COMPLIANCE WITH IMO CRITERIA

		Computed values		Minimum Required	
Maximum GZ Occurs at	=	38.06	Deg	15.00	Deg
Area Upto 30.00 deg	=	0.232	m-rad	0.055	m-rad
Area 30 deg - 40 deg/Angle DF	=	0.176	m-rad	0.030	m-rad
Maximum GZ or GZ @ 30 Deg	=	1.02	m	0.20	m
GoMt	=	1.61	m	0.15	m

JUDGEMENT :

Loadline Draft : OK

IMO Stability Criteria : OK

Condition: LC 6 ARRIVAL OF COND 5

Description: Step 1

Date: 30-12-2011

FOLLOWING IS IMMERSION STATUS

SR. No.	Item Name	Fr. No.	Ht.From BL	Dist.From CL	Dist. WaterLine	Immersed	Opening Type
1	E/R VENT (P)	69.00	11.97	-6.85	7.83	No	2
2	E/R VENT (S)	69.00	11.97	6.85	7.39	No	2
3	E/R VENT (P)	69.00	11.30	-6.00	7.14	No	2
4	E/R VENT (S)	69.00	11.30	6.00	6.75	No	2
5	Deck Edge Aft (P)	-8.00	7.20	-8.00	3.24	No	0
6	Deck Edge Aft (S)	-8.00	7.20	8.00	2.72	No	0
7	Deck Edge Mid (P)	52.00	7.20	-8.00	3.14	No	0
8	Deck Edge Mid (S)	52.00	7.20	8.00	2.62	No	0
9	Deck Edge Fwd (P)	105.00	12.95	-8.00	8.80	No	0
10	Deck Edge Fwd (S)	105.00	12.95	8.00	8.28	No	0
11	Check point (0.76m above deck edge)	-8.00	7.96	-8.00	4.00	No	1
12	Check point (0.76m above deck edge)	-8.00	7.96	8.00	3.48	No	1
13	Check point (0.76m above deck edge)	0.00	7.96	-8.00	3.98	No	1
14	Check point (0.76m above deck edge)	0.00	7.96	8.00	3.46	No	1
15	Check point (0.76m above deck edge)	8.00	7.96	-8.00	3.97	No	1
16	Check point (0.76m above deck edge)	8.00	7.96	8.00	3.45	No	1
17	Check point (0.76m above deck edge)	16.00	7.96	-8.00	3.96	No	1
18	Check point (0.76m above deck edge)	16.00	7.96	8.00	3.44	No	1
19	Check point (0.76m above deck edge)	24.00	7.96	-8.00	3.94	No	1
20	Check point (0.76m above deck edge)	24.00	7.96	8.00	3.42	No	1
21	Check point (0.76m above deck edge)	32.00	7.96	-8.00	3.93	No	1
22	Check point (0.76m above deck edge)	32.00	7.96	8.00	3.41	No	1
23	Check point (0.76m above deck edge)	40.00	7.96	-8.00	3.92	No	1
24	Check point (0.76m above deck edge)	40.00	7.96	8.00	3.40	No	1
25	Check point (0.76m above deck edge)	48.00	7.96	-8.00	3.90	No	1
26	Check point (0.76m above deck edge)	48.00	7.96	8.00	3.39	No	1
27	Check point (0.76m above deck edge)	56.00	13.71	-8.00	9.64	No	1
28	Check point (0.76m above deck edge)	56.00	13.71	8.00	9.12	No	1
29	Check point (0.76m above deck edge)	64.00	13.71	-8.00	9.62	No	1
30	Check point (0.76m above deck edge)	64.00	13.71	8.00	9.11	No	1
31	Check point (0.76m above deck edge)	72.00	13.71	-8.00	9.61	No	1
32	Check point (0.76m above deck edge)	72.00	13.71	8.00	9.09	No	1
33	Check point (0.76m above deck edge)	80.00	13.71	-8.00	9.60	No	1
34	Check point (0.76m above deck edge)	80.00	13.71	8.00	9.08	No	1
35	Check point (0.76m above deck edge)	88.00	13.71	-7.50	9.57	No	1
36	Check point (0.76m above deck edge)	88.00	13.71	7.50	9.08	No	1
37	Check point (0.76m above deck edge)	96.00	13.71	-4.00	9.44	No	1
38	Check point (0.76m above deck edge)	96.00	13.71	4.00	9.18	No	1
39	Check point (0.76m above deck edge)	104.00	13.71	-1.50	9.35	No	1
40	Check point (0.76m above deck edge)	104.00	13.71	1.50	9.25	No	1

0 - Deck edge, 1 - Progressive DownFlooding Point, 2 - Unprotected Opening

Condition: LC 6 ARRIVAL OF COND 5

Description: Step 1

Date: 30-12-2011

Sr. No	Item	Density/ Stowage Factor	%	Weight (T)	VCG (m)	LCG (m)	TCG (m)	FSM (T-M)
	Water Ballast	**(t/cu. m.)**						
1	F P S W B TK - C	1.025	0.0	0.000	6.016	59.541	0.000	0.0
2	A P S W B TK - P	1.025	0.0	0.000	6.143	-1.590	-2.954	0.0
3	A P S W B TK - S	1.025	79.9	49.820	6.143	-1.635	5.659	60.7
4	A P S W B TK - C	1.025	100.0	34.850	5.421	-2.159	0.000	0.0
	Sub Total			**84.670**	**5.846**	**-1.851**	**3.330**	**60.7**
	Consumables	**(t/cu. m.)**						
	Fuel Oil							
5	NO.1 F O TK - P	0.855	67.8	34.710	0.970	38.406	-4.798	129.3
6	NO.1 F O TK - S	0.855	65.8	33.690	0.927	38.406	4.746	129.3
7	NO.2 F O TK - P	0.855	0.0	0.000	0.110	28.385	-4.437	0.0
8	NO.2 F O TK - S	0.855	0.0	0.000	0.110	28.385	4.437	0.0
9	NO.2 F O TK - C	0.855	0.0	0.000	0.022	29.200	0.000	0.0
10	NO.3 F O TK - C	0.855	9.8	4.400	0.078	22.210	0.000	180.1
11	NO.4 F O TK - P	0.855	0.0	0.000	0.538	18.934	-5.695	0.0
12	NO.4 F O TK - S	0.855	0.0	0.000	0.538	18.934	5.695	0.0
13	NO.4 F O TK - C	0.855	0.0	0.000	0.011	18.321	0.000	0.0
14	F O DAY TK - P	0.855	9.8	1.830	4.537	22.800	-7.450	0.6
15	F O DAY TK - S	0.855	9.8	1.830	4.537	22.800	7.450	0.6
16	F O SETT. TK - P	0.855	9.8	1.370	4.537	29.100	-7.450	0.5
17	F O SETT. TK - S	0.855	9.8	1.370	4.537	29.100	7.450	0.5
	Sub Total			**79.200**	**1.190**	**36.463**	**-0.084**	**440.8**
	Lube Oil							
18	A L O ST TK - P	0.900	98.0	8.030	5.773	35.100	-7.450	0.3
19	M L O ST TK - S	0.900	97.7	12.840	5.772	34.200	7.450	0.5
20	L O CIR. TK - P	0.900	98.3	11.060	0.621	27.000	-3.536	6.3
21	L O CIR. TK - S	0.900	98.3	11.060	0.621	27.000	3.536	6.3
	Sub Total			**42.990**	**3.121**	**30.663**	**0.834**	**13.4**
	Hyd Oil							
22	NO.1 HYD.OIL TK - P	0.900	99.4	1.610	5.775	33.300	-7.450	0.6
23	NO.2 HYD.OIL TK - P	0.900	99.4	1.610	5.789	32.700	-7.450	0.6
24	NO.3 HYD.OIL TK - P	0.900	99.4	1.610	5.775	32.100	-7.450	0.6
25	STR HYD OIL TK - P	0.900	98.7	1.510	6.213	3.605	-7.594	0.0
26	TOW HYD.OIL TK - S	0.900	98.7	1.510	6.213	3.605	7.594	0.0
	Sub Total			**7.850**	**5.947**	**21.507**	**-4.584**	**1.8**
	Fresh Water							
27	NO.1 PORTABLE W TK - P	1.000	10.0	9.200	0.406	56.175	-1.853	20.6
28	NO.1 PORTABLE W TK - S	1.000	10.0	9.200	0.405	56.175	1.853	20.6

Condition: LC 6 ARRIVAL OF COND 5

Description: Step 1

Date: 30-12-2011

Sr. No	Item	Density/ Stowage Factor	%	Weight (T)	VCG (m)	LCG (m)	TCG (m)	FSM (T-M)
	Consumables	**(t/cu. m.)**						
29	NO.2 PORTABLE W TK - P	1.000	10.0	10.710	0.363	52.118	-2.452	71.6
30	NO.2 PORTABLE W TK - S	1.000	10.0	10.640	0.373	52.072	2.465	71.5
31	NO.3 PORTABLE W TK - P	1.000	10.0	8.570	0.383	44.829	-6.069	11.8
32	NO.3 PORTABLE W TK - S	1.000	10.0	8.570	0.383	44.829	6.069	11.8
33	NO.4 PORTABLE W TK - P	1.000	10.0	4.990	3.884	9.839	-6.293	3.4
34	NO.4 PORTABLE W TK - S	1.000	10.0	4.990	3.884	9.839	6.293	3.4
	Sub Total			**66.870**	**0.907**	**45.049**	**-0.000**	**214.7**
	Miscellaneous							
35	DIRTY OIL TK - P	1.000	87.8	8.340	0.405	34.620	-1.558	9.7
36	BILGE HOLDING TK - S	1.000	97.5	9.260	0.448	34.620	1.561	10.7
37	SEWAGE HOLDING TK - P	1.000	98.3	14.260	5.451	48.568	-6.958	1.2
	Sub Total			**31.860**	**2.676**	**40.863**	**-3.068**	**21.6**
	Drill Water							
38	F P D W TK - C	1.000	0.0	0.000	0.031	59.541	0.000	0.0
39	A P D W TK - P	1.000	0.0	0.000	4.383	-1.590	-2.954	0.0
40	A P D W TK - S	1.000	0.0	0.000	4.383	-1.590	2.954	0.0
41	A P D W TK - C	1.000	0.0	0.000	3.643	-1.312	0.000	0.0
42	NO.1 D W TK - P	1.000	100.0	48.200	0.519	45.297	-2.446	0.0
43	NO.1 D W TK - S	1.000	100.0	48.200	0.519	45.297	2.446	0.0
44	NO.2 D W TK - P	1.000	100.0	110.100	4.096	38.398	-2.500	0.0
45	NO.2 D W TK - S	1.000	100.0	110.100	4.096	38.398	2.500	0.0
	Sub Total			**316.600**	**3.007**	**40.499**	**-0.000**	**0.0**
	Mud							
46	NO.1 MUD TK - C	2.500	0.0	0.000	1.156	18.919	0.000	0.0
47	NO.2 MUD TK - C	2.500	0.0	0.000	2.478	11.712	0.000	0.0
	Sub Total			**0.000**	**0.000**	**0.000**	**0.000**	**0.0**
	Foam							
48	FOAM TANK - S	1.145	9.8	1.310	5.438	49.194	6.372	2.7
	Sub Total			**1.310**	**5.438**	**49.194**	**6.372**	**2.7**
	Dispersant							
49	DISPERSANT TANK - S	1.163	9.9	1.400	5.425	47.996	6.440	3.0
	Sub Total			**1.400**	**5.425**	**47.996**	**6.440**	**3.0**
	Deadweight Constants							
50	CREW EFFECT			4.300	10.100	52.800	0.000	0.0
51	PROVISION STORE			0.040	8.500	48.600	3.500	0.0

Condition: LC 6 ARRIVAL OF COND 5

Description: Step 1

Date: 30-12-2011

Sr. No	Item	Density/ Stowage Factor	%	Weight (T)	VCG (m)	LCG (m)	TCG (m)	FSM (T-M)
	Deadweight Constants							
52	SHIP STORE			10.000	9.000	50.400	3.000	0.0
53	DRY BULK			0.000	4.150	45.300	0.000	0.0
	Sub Total			**14.340**	**9.328**	**51.115**	**2.102**	**0.0**
	Main Deck							
54	Main Deck			0.000	8.200	15.000	0.000	---
	Sub Total			**0.000**	**0.000**	**0.000**	**0.000**	**---**
	Mezzanine Deck							
55	Mezzanine Deck			0.000	12.200	36.600	0.000	---
	Sub Total			**0.000**	**0.000**	**0.000**	**0.000**	**---**
	DeckHouse Deck							
56	Deckhouse Deck			0.000	15.200	44.700	0.000	---
	Sub Total			**0.000**	**0.000**	**0.000**	**0.000**	**---**

	Weight (T)	VCG (m)	LCG (m)	TCG (m)	FSM (T-M)
LIGHTSHIP	2552.3	6.385	32.732	-0.021	0.0
DISPLACEMENT	**3199.35**	**5.724**	**33.057**	**0.054**	**758.7**

Condition: LC 6 ARRIVAL OF COND 5

Description: Step 2

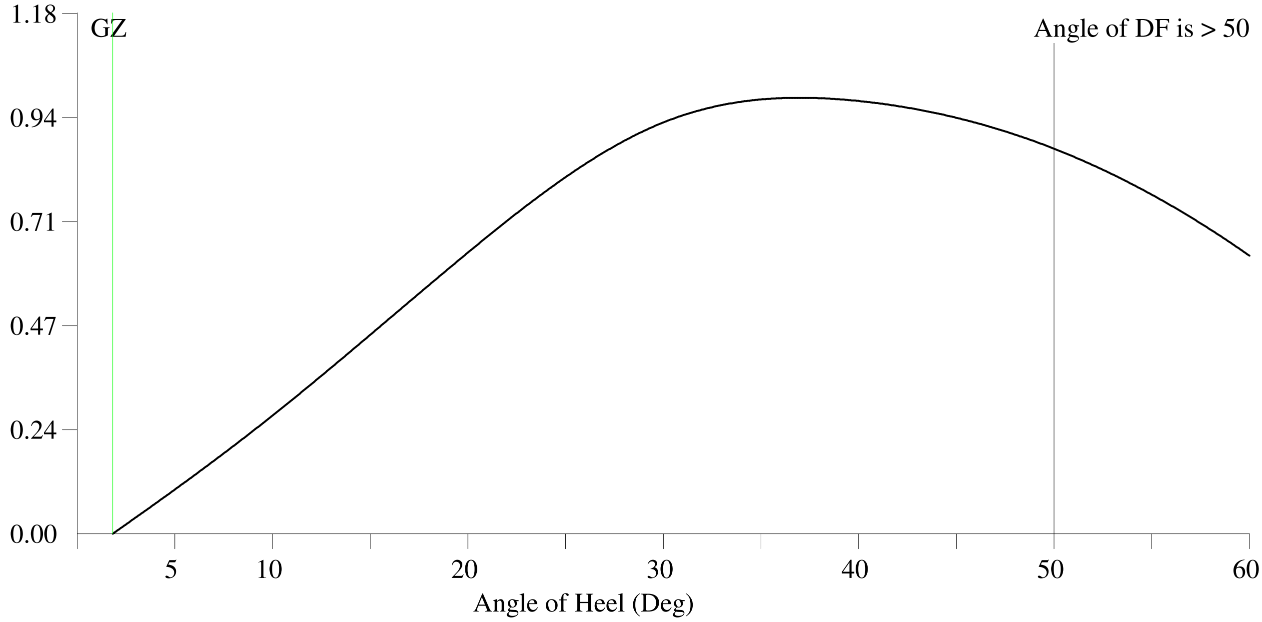
Date: 30-12-2011

DRAFTS,TRIMS & INTACT STABILITY SHEET

Sea Water Density	=	1.0250	(t/cu. m.)	LoadLine	=	6.032 m (Summer Load Line)	
Displacement	=	3261.67	T	Propeller Immersion Draft	=	3.59	m
DRAFTS & TRIM				**DRAFTS AT MARKS**			
Draft AP(USK)	=	4.525	m	Draft AFT Marks	=	4.517	m
Draft FP(USK)	=	4.241	m	Draft FWD Marks	=	4.241	m
Draft (Mean)	=	4.383	m	Trim	=	0.285	m
TCG	=	-0.056	m	List Angle	=	1.831	Deg. Port
INTACT STABILITY							
LCB	=	32.394	m	MCT	=	43.400	T-M/cm
KG	=	5.732	m	GoMt	=	1.695	m
GGo	=	0.233	m	KMT	=	7.659	m
KGo	=	5.964	m	Permissible KG	=	7.296	m

RIGHTING ARM CURVE

Angle (Deg.)	5	10	20	30	40	50	60
KN (m)	0.676	1.358	2.729	3.961	4.856	5.476	5.823
GZ (m)	0.099	0.267	0.636	0.930	0.979	0.871	0.629



COMPLIANCE WITH IMO CRITERIA

		Computed values		Minimum Required	
Maximum GZ Occurs at	=	36.99	Deg	15.00	Deg
Area Upto 30.00 deg	=	0.236	m-rad	0.055	m-rad
Area 30 deg - 40 deg/Angle DF	=	0.171	m-rad	0.030	m-rad
Maximum GZ or GZ @ 30 Deg	=	0.99	m	0.20	m
GoMt	=	1.69	m	0.15	m

JUDGEMENT :

Loadline Draft : OK

IMO Stability Criteria : OK

Condition: LC 6 ARRIVAL OF COND 5

Description: Step 2

Date: 30-12-2011

FOLLOWING IS IMMERSION STATUS

SR. No.	Item Name	Fr. No.	Ht.From BL	Dist.From CL	Dist. WaterLine	Immersed	Opening Type
1	E/R VENT (P)	69.00	11.97	-6.85	7.42	No	2
2	E/R VENT (S)	69.00	11.97	6.85	7.86	No	2
3	E/R VENT (P)	69.00	11.30	-6.00	6.78	No	2
4	E/R VENT (S)	69.00	11.30	6.00	7.16	No	2
5	Deck Edge Aft (P)	-8.00	7.20	-8.00	2.41	No	0
6	Deck Edge Aft (S)	-8.00	7.20	8.00	2.92	No	0
7	Deck Edge Mid (P)	52.00	7.20	-8.00	2.57	No	0
8	Deck Edge Mid (S)	52.00	7.20	8.00	3.08	No	0
9	Deck Edge Fwd (P)	105.00	12.95	-8.00	8.46	No	0
10	Deck Edge Fwd (S)	105.00	12.95	8.00	8.97	No	0
11	Check point (0.76m above deck edge)	-8.00	7.96	-8.00	3.17	No	1
12	Check point (0.76m above deck edge)	-8.00	7.96	8.00	3.68	No	1
13	Check point (0.76m above deck edge)	0.00	7.96	-8.00	3.19	No	1
14	Check point (0.76m above deck edge)	0.00	7.96	8.00	3.70	No	1
15	Check point (0.76m above deck edge)	8.00	7.96	-8.00	3.21	No	1
16	Check point (0.76m above deck edge)	8.00	7.96	8.00	3.72	No	1
17	Check point (0.76m above deck edge)	16.00	7.96	-8.00	3.23	No	1
18	Check point (0.76m above deck edge)	16.00	7.96	8.00	3.75	No	1
19	Check point (0.76m above deck edge)	24.00	7.96	-8.00	3.26	No	1
20	Check point (0.76m above deck edge)	24.00	7.96	8.00	3.77	No	1
21	Check point (0.76m above deck edge)	32.00	7.96	-8.00	3.28	No	1
22	Check point (0.76m above deck edge)	32.00	7.96	8.00	3.79	No	1
23	Check point (0.76m above deck edge)	40.00	7.96	-8.00	3.30	No	1
24	Check point (0.76m above deck edge)	40.00	7.96	8.00	3.81	No	1
25	Check point (0.76m above deck edge)	48.00	7.96	-8.00	3.32	No	1
26	Check point (0.76m above deck edge)	48.00	7.96	8.00	3.83	No	1
27	Check point (0.76m above deck edge)	56.00	13.71	-8.00	9.09	No	1
28	Check point (0.76m above deck edge)	56.00	13.71	8.00	9.60	No	1
29	Check point (0.76m above deck edge)	64.00	13.71	-8.00	9.11	No	1
30	Check point (0.76m above deck edge)	64.00	13.71	8.00	9.62	No	1
31	Check point (0.76m above deck edge)	72.00	13.71	-8.00	9.13	No	1
32	Check point (0.76m above deck edge)	72.00	13.71	8.00	9.64	No	1
33	Check point (0.76m above deck edge)	80.00	13.71	-8.00	9.15	No	1
34	Check point (0.76m above deck edge)	80.00	13.71	8.00	9.67	No	1
35	Check point (0.76m above deck edge)	88.00	13.71	-7.50	9.19	No	1
36	Check point (0.76m above deck edge)	88.00	13.71	7.50	9.67	No	1
37	Check point (0.76m above deck edge)	96.00	13.71	-4.00	9.33	No	1
38	Check point (0.76m above deck edge)	96.00	13.71	4.00	9.58	No	1
39	Check point (0.76m above deck edge)	104.00	13.71	-1.50	9.43	No	1
40	Check point (0.76m above deck edge)	104.00	13.71	1.50	9.52	No	1

0 - Deck edge, 1 - Progressive DownFlooding Point, 2 - Unprotected Opening

Condition: LC 6 ARRIVAL OF COND 5

Description: Step 2

Date: 30-12-2011

Sr. No	Item	Density/ Stowage Factor	%	Weight (T)	VCG (m)	LCG (m)	TCG (m)	FSM (T-M)
	Water Ballast	**(t/cu. m.)**						
1	F P S W B TK - C	1.025	0.0	0.000	6.016	59.541	0.000	0.0
2	A P S W B TK - P	1.025	100.0	62.320	6.143	-1.644	-5.703	0.0
3	A P S W B TK - S	1.025	79.9	49.820	6.143	-1.635	5.659	60.7
4	A P S W B TK - C	1.025	100.0	34.850	5.421	-2.159	0.000	0.0
	Sub Total			**146.990**	**5.972**	**-1.763**	**-0.500**	**60.7**
	Consumables	**(t/cu. m.)**						
	Fuel Oil							
5	NO.1 F O TK - P	0.855	67.8	34.710	0.970	38.406	-4.798	129.3
6	NO.1 F O TK - S	0.855	65.8	33.690	0.927	38.406	4.746	129.3
7	NO.2 F O TK - P	0.855	0.0	0.000	0.110	28.385	-4.437	0.0
8	NO.2 F O TK - S	0.855	0.0	0.000	0.110	28.385	4.437	0.0
9	NO.2 F O TK - C	0.855	0.0	0.000	0.022	29.200	0.000	0.0
10	NO.3 F O TK - C	0.855	9.8	4.400	0.078	22.210	0.000	180.1
11	NO.4 F O TK - P	0.855	0.0	0.000	0.538	18.934	-5.695	0.0
12	NO.4 F O TK - S	0.855	0.0	0.000	0.538	18.934	5.695	0.0
13	NO.4 F O TK - C	0.855	0.0	0.000	0.011	18.321	0.000	0.0
14	F O DAY TK - P	0.855	9.8	1.830	4.537	22.800	-7.450	0.6
15	F O DAY TK - S	0.855	9.8	1.830	4.537	22.800	7.450	0.6
16	F O SETT. TK - P	0.855	9.8	1.370	4.537	29.100	-7.450	0.5
17	F O SETT. TK - S	0.855	9.8	1.370	4.537	29.100	7.450	0.5
	Sub Total			**79.200**	**1.190**	**36.463**	**-0.084**	**440.8**
	Lube Oil							
18	A L O ST TK - P	0.900	98.0	8.030	5.773	35.100	-7.450	0.3
19	M L O ST TK - S	0.900	97.7	12.840	5.772	34.200	7.450	0.5
20	L O CIR. TK - P	0.900	98.3	11.060	0.621	27.000	-3.536	6.3
21	L O CIR. TK - S	0.900	98.3	11.060	0.621	27.000	3.536	6.3
	Sub Total			**42.990**	**3.121**	**30.663**	**0.834**	**13.4**
	Hyd Oil							
22	NO.1 HYD.OIL TK - P	0.900	99.4	1.610	5.775	33.300	-7.450	0.6
23	NO.2 HYD.OIL TK - P	0.900	99.4	1.610	5.789	32.700	-7.450	0.6
24	NO.3 HYD.OIL TK - P	0.900	99.4	1.610	5.775	32.100	-7.450	0.6
25	STR HYD OIL TK - P	0.900	98.7	1.510	6.213	3.605	-7.594	0.0
26	TOW HYD.OIL TK - S	0.900	98.7	1.510	6.213	3.605	7.594	0.0
	Sub Total			**7.850**	**5.947**	**21.507**	**-4.584**	**1.8**
	Fresh Water							
27	NO.1 PORTABLE W TK - P	1.000	10.0	9.200	0.406	56.175	-1.853	20.6
28	NO.1 PORTABLE W TK - S	1.000	10.0	9.200	0.405	56.175	1.853	20.6

Condition: LC 6 ARRIVAL OF COND 5

Description: Step 2

Date: 30-12-2011

Sr. No	Item	Density/ Stowage Factor	%	Weight (T)	VCG (m)	LCG (m)	TCG (m)	FSM (T-M)
	Consumables	**(t/cu. m.)**						
29	NO.2 PORTABLE W TK - P	1.000	10.0	10.710	0.363	52.118	-2.452	71.6
30	NO.2 PORTABLE W TK - S	1.000	10.0	10.640	0.373	52.072	2.465	71.5
31	NO.3 PORTABLE W TK - P	1.000	10.0	8.570	0.383	44.829	-6.069	11.8
32	NO.3 PORTABLE W TK - S	1.000	10.0	8.570	0.383	44.829	6.069	11.8
33	NO.4 PORTABLE W TK - P	1.000	10.0	4.990	3.884	9.839	-6.293	3.4
34	NO.4 PORTABLE W TK - S	1.000	10.0	4.990	3.884	9.839	6.293	3.4
	Sub Total			**66.870**	**0.907**	**45.049**	**-0.000**	**214.7**
	Miscellaneous							
35	DIRTY OIL TK - P	1.000	87.8	8.340	0.405	34.620	-1.558	9.7
36	BILGE HOLDING TK - S	1.000	97.5	9.260	0.448	34.620	1.561	10.7
37	SEWAGE HOLDING TK - P	1.000	98.3	14.260	5.451	48.568	-6.958	1.2
	Sub Total			**31.860**	**2.676**	**40.863**	**-3.068**	**21.6**
	Drill Water							
38	F P D W TK - C	1.000	0.0	0.000	0.031	59.541	0.000	0.0
39	A P D W TK - P	1.000	0.0	0.000	4.383	-1.590	-2.954	0.0
40	A P D W TK - S	1.000	0.0	0.000	4.383	-1.590	2.954	0.0
41	A P D W TK - C	1.000	0.0	0.000	3.643	-1.312	0.000	0.0
42	NO.1 D W TK - P	1.000	100.0	48.200	0.519	45.297	-2.446	0.0
43	NO.1 D W TK - S	1.000	100.0	48.200	0.519	45.297	2.446	0.0
44	NO.2 D W TK - P	1.000	100.0	110.100	4.096	38.398	-2.500	0.0
45	NO.2 D W TK - S	1.000	100.0	110.100	4.096	38.398	2.500	0.0
	Sub Total			**316.600**	**3.007**	**40.499**	**-0.000**	**0.0**
	Mud							
46	NO.1 MUD TK - C	2.500	0.0	0.000	1.156	18.919	0.000	0.0
47	NO.2 MUD TK - C	2.500	0.0	0.000	2.478	11.712	0.000	0.0
	Sub Total			**0.000**	**0.000**	**0.000**	**0.000**	**0.0**
	Foam							
48	FOAM TANK - S	1.145	9.8	1.310	5.438	49.194	6.372	2.7
	Sub Total			**1.310**	**5.438**	**49.194**	**6.372**	**2.7**
	Dispersant							
49	DISPERSANT TANK - S	1.163	9.9	1.400	5.425	47.996	6.440	3.0
	Sub Total			**1.400**	**5.425**	**47.996**	**6.440**	**3.0**
	Deadweight Constants							
50	CREW EFFECT			4.300	10.100	52.800	0.000	0.0
51	PROVISION STORE			0.040	8.500	48.600	3.500	0.0

Condition: LC 6 ARRIVAL OF COND 5

Description: Step 2

Date: 30-12-2011

Sr. No	Item	Density/ Stowage Factor	%	Weight (T)	VCG (m)	LCG (m)	TCG (m)	FSM (T-M)
	Deadweight Constants							
52	SHIP STORE			10.000	9.000	50.400	3.000	0.0
53	DRY BULK			0.000	4.150	45.300	0.000	0.0
	Sub Total			**14.340**	**9.328**	**51.115**	**2.102**	**0.0**
	Main Deck							
54	Main Deck			0.000	8.200	15.000	0.000	---
	Sub Total			**0.000**	**0.000**	**0.000**	**0.000**	**---**
	Mezzanine Deck							
55	Mezzanine Deck			0.000	12.200	36.600	0.000	---
	Sub Total			**0.000**	**0.000**	**0.000**	**0.000**	**---**
	DeckHouse Deck							
56	Deckhouse Deck			0.000	15.200	44.700	0.000	---
	Sub Total			**0.000**	**0.000**	**0.000**	**0.000**	**---**

LIGHTSHIP	2552.3	6.385	32.732	-0.021	0.0
DISPLACEMENT	**3261.67**	**5.732**	**32.394**	**-0.056**	**758.7**

Condition: LC 6 ARRIVAL OF COND 5

Description: Step 3

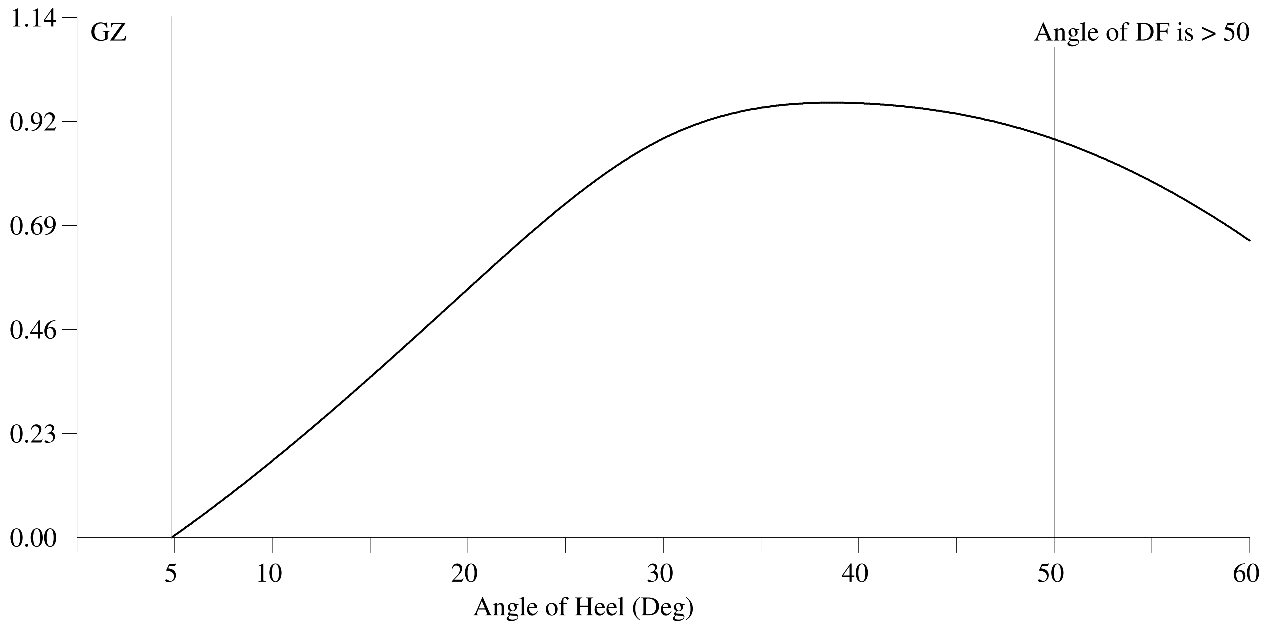
Date: 30-12-2011

DRAFTS,TRIMS & INTACT STABILITY SHEET

Sea Water Density	=	1.0250	(t/cu. m.)	LoadLine	=	6.032 m (Summer Load Line)	
Displacement	=	3211.85	T	Propeller Immersion Draft	=	3.59	m
DRAFTS & TRIM				**DRAFTS AT MARKS**			
Draft AP(USK)	=	4.306	m	Draft AFT Marks	=	4.308	m
Draft FP(USK)	=	4.381	m	Draft FWD Marks	=	4.381	m
Draft (Mean)	=	4.343	m	Trim	=	-0.076	m
TCG	=	-0.145	m	List Angle	=	4.857	Deg. Port
INTACT STABILITY							
LCB	=	32.921	m	MCT	=	41.654	T-M/cm
KG	=	5.725	m	GoMt	=	1.635	m
GGo	=	0.217	m	KMT	=	7.578	m
KGo	=	5.943	m	Permissible KG	=	7.320	m

RIGHTING ARM CURVE

Angle (Deg.)	5	10	20	30	40	50	60
KN (m)	0.667	1.343	2.714	3.973	4.884	5.520	5.871
GZ (m)	0.004	0.168	0.545	0.876	0.953	0.874	0.652



COMPLIANCE WITH IMO CRITERIA

		Computed values		Minimum Required	
Maximum GZ Occurs at	=	38.63	Deg	15.00	Deg
Area Upto 30.00 deg	=	0.195	m-rad	0.055	m-rad
Area 30 deg - 40 deg/Angle DF	=	0.163	m-rad	0.030	m-rad
Maximum GZ or GZ @ 30 Deg	=	0.95	m	0.20	m
GoMt	=	1.64	m	0.15	m

JUDGEMENT :

Loadline Draft : OK

IMO Stability Criteria : OK

Condition: LC 6 ARRIVAL OF COND 5

Description: Step 3

Date: 30-12-2011

FOLLOWING IS IMMERSION STATUS

SR. No.	Item Name	Fr. No.	Ht.From BL	Dist.From CL	Dist. WaterLine	Immersed	Opening Type
1	E/R VENT (P)	69.00	11.97	-6.85	7.00	No	2
2	E/R VENT (S)	69.00	11.97	6.85	8.16	No	2
3	E/R VENT (P)	69.00	11.30	-6.00	6.41	No	2
4	E/R VENT (S)	69.00	11.30	6.00	7.43	No	2
5	Deck Edge Aft (P)	-8.00	7.20	-8.00	2.21	No	0
6	Deck Edge Aft (S)	-8.00	7.20	8.00	3.57	No	0
7	Deck Edge Mid (P)	52.00	7.20	-8.00	2.17	No	0
8	Deck Edge Mid (S)	52.00	7.20	8.00	3.52	No	0
9	Deck Edge Fwd (P)	105.00	12.95	-8.00	7.86	No	0
10	Deck Edge Fwd (S)	105.00	12.95	8.00	9.22	No	0
11	Check point (0.76m above deck edge)	-8.00	7.96	-8.00	2.97	No	1
12	Check point (0.76m above deck edge)	-8.00	7.96	8.00	4.33	No	1
13	Check point (0.76m above deck edge)	0.00	7.96	-8.00	2.96	No	1
14	Check point (0.76m above deck edge)	0.00	7.96	8.00	4.32	No	1
15	Check point (0.76m above deck edge)	8.00	7.96	-8.00	2.96	No	1
16	Check point (0.76m above deck edge)	8.00	7.96	8.00	4.31	No	1
17	Check point (0.76m above deck edge)	16.00	7.96	-8.00	2.95	No	1
18	Check point (0.76m above deck edge)	16.00	7.96	8.00	4.31	No	1
19	Check point (0.76m above deck edge)	24.00	7.96	-8.00	2.95	No	1
20	Check point (0.76m above deck edge)	24.00	7.96	8.00	4.30	No	1
21	Check point (0.76m above deck edge)	32.00	7.96	-8.00	2.94	No	1
22	Check point (0.76m above deck edge)	32.00	7.96	8.00	4.30	No	1
23	Check point (0.76m above deck edge)	40.00	7.96	-8.00	2.94	No	1
24	Check point (0.76m above deck edge)	40.00	7.96	8.00	4.29	No	1
25	Check point (0.76m above deck edge)	48.00	7.96	-8.00	2.93	No	1
26	Check point (0.76m above deck edge)	48.00	7.96	8.00	4.28	No	1
27	Check point (0.76m above deck edge)	56.00	13.71	-8.00	8.65	No	1
28	Check point (0.76m above deck edge)	56.00	13.71	8.00	10.01	No	1
29	Check point (0.76m above deck edge)	64.00	13.71	-8.00	8.65	No	1
30	Check point (0.76m above deck edge)	64.00	13.71	8.00	10.00	No	1
31	Check point (0.76m above deck edge)	72.00	13.71	-8.00	8.64	No	1
32	Check point (0.76m above deck edge)	72.00	13.71	8.00	10.00	No	1
33	Check point (0.76m above deck edge)	80.00	13.71	-8.00	8.64	No	1
34	Check point (0.76m above deck edge)	80.00	13.71	8.00	9.99	No	1
35	Check point (0.76m above deck edge)	88.00	13.71	-7.50	8.67	No	1
36	Check point (0.76m above deck edge)	88.00	13.71	7.50	9.94	No	1
37	Check point (0.76m above deck edge)	96.00	13.71	-4.00	8.96	No	1
38	Check point (0.76m above deck edge)	96.00	13.71	4.00	9.64	No	1
39	Check point (0.76m above deck edge)	104.00	13.71	-1.50	9.17	No	1
40	Check point (0.76m above deck edge)	104.00	13.71	1.50	9.42	No	1

0 - Deck edge, 1 - Progressive DownFlooding Point, 2 - Unprotected Opening

Condition: LC 6 ARRIVAL OF COND 5

Description: Step 3

Date: 30-12-2011

Sr. No	Item	Density/ Stowage Factor	%	Weight (T)	VCG (m)	LCG (m)	TCG (m)	FSM (T-M)
	Water Ballast	**(t/cu. m.)**						
1	F P S W B TK - C	1.025	0.0	0.000	6.016	59.541	0.000	0.0
2	A P S W B TK - P	1.025	100.0	62.320	6.143	-1.644	-5.703	0.0
3	A P S W B TK - S	1.025	0.0	0.000	6.143	-1.590	2.954	0.0
4	A P S W B TK - C	1.025	100.0	34.850	5.421	-2.159	0.000	0.0
	Sub Total			**97.170**	**5.884**	**-1.829**	**-3.658**	**0.0**
	Consumables	**(t/cu. m.)**						
	Fuel Oil							
5	NO.1 F O TK - P	0.855	67.8	34.710	0.970	38.406	-4.798	129.3
6	NO.1 F O TK - S	0.855	65.8	33.690	0.927	38.406	4.746	129.3
7	NO.2 F O TK - P	0.855	0.0	0.000	0.110	28.385	-4.437	0.0
8	NO.2 F O TK - S	0.855	0.0	0.000	0.110	28.385	4.437	0.0
9	NO.2 F O TK - C	0.855	0.0	0.000	0.022	29.200	0.000	0.0
10	NO.3 F O TK - C	0.855	9.8	4.400	0.078	22.210	0.000	180.1
11	NO.4 F O TK - P	0.855	0.0	0.000	0.538	18.934	-5.695	0.0
12	NO.4 F O TK - S	0.855	0.0	0.000	0.538	18.934	5.695	0.0
13	NO.4 F O TK - C	0.855	0.0	0.000	0.011	18.321	0.000	0.0
14	F O DAY TK - P	0.855	9.8	1.830	4.537	22.800	-7.450	0.6
15	F O DAY TK - S	0.855	9.8	1.830	4.537	22.800	7.450	0.6
16	F O SETT. TK - P	0.855	9.8	1.370	4.537	29.100	-7.450	0.5
17	F O SETT. TK - S	0.855	9.8	1.370	4.537	29.100	7.450	0.5
	Sub Total			**79.200**	**1.190**	**36.463**	**-0.084**	**440.8**
	Lube Oil							
18	A L O ST TK - P	0.900	98.0	8.030	5.773	35.100	-7.450	0.3
19	M L O ST TK - S	0.900	97.7	12.840	5.772	34.200	7.450	0.5
20	L O CIR. TK - P	0.900	98.3	11.060	0.621	27.000	-3.536	6.3
21	L O CIR. TK - S	0.900	98.3	11.060	0.621	27.000	3.536	6.3
	Sub Total			**42.990**	**3.121**	**30.663**	**0.834**	**13.4**
	Hyd Oil							
22	NO.1 HYD.OIL TK - P	0.900	99.4	1.610	5.775	33.300	-7.450	0.6
23	NO.2 HYD.OIL TK - P	0.900	99.4	1.610	5.789	32.700	-7.450	0.6
24	NO.3 HYD.OIL TK - P	0.900	99.4	1.610	5.775	32.100	-7.450	0.6
25	STR HYD OIL TK - P	0.900	98.7	1.510	6.213	3.605	-7.594	0.0
26	TOW HYD.OIL TK - S	0.900	98.7	1.510	6.213	3.605	7.594	0.0
	Sub Total			**7.850**	**5.947**	**21.507**	**-4.584**	**1.8**
	Fresh Water							
27	NO.1 PORTABLE W TK - P	1.000	10.0	9.200	0.406	56.175	-1.853	20.6
28	NO.1 PORTABLE W TK - S	1.000	10.0	9.200	0.405	56.175	1.853	20.6

Condition: LC 6 ARRIVAL OF COND 5

Description: Step 3

Date: 30-12-2011

Sr. No	Item	Density/ Stowage Factor	%	Weight (T)	VCG (m)	LCG (m)	TCG (m)	FSM (T-M)
	Consumables	**(t/cu. m.)**						
29	NO.2 PORTABLE W TK - P	1.000	10.0	10.710	0.363	52.118	-2.452	71.6
30	NO.2 PORTABLE W TK - S	1.000	10.0	10.640	0.373	52.072	2.465	71.5
31	NO.3 PORTABLE W TK - P	1.000	10.0	8.570	0.383	44.829	-6.069	11.8
32	NO.3 PORTABLE W TK - S	1.000	10.0	8.570	0.383	44.829	6.069	11.8
33	NO.4 PORTABLE W TK - P	1.000	10.0	4.990	3.884	9.839	-6.293	3.4
34	NO.4 PORTABLE W TK - S	1.000	10.0	4.990	3.884	9.839	6.293	3.4
	Sub Total			**66.870**	**0.907**	**45.049**	**-0.000**	**214.7**
	Miscellaneous							
35	DIRTY OIL TK - P	1.000	87.8	8.340	0.405	34.620	-1.558	9.7
36	BILGE HOLDING TK - S	1.000	97.5	9.260	0.448	34.620	1.561	10.7
37	SEWAGE HOLDING TK - P	1.000	98.3	14.260	5.451	48.568	-6.958	1.2
	Sub Total			**31.860**	**2.676**	**40.863**	**-3.068**	**21.6**
	Drill Water							
38	F P D W TK - C	1.000	0.0	0.000	0.031	59.541	0.000	0.0
39	A P D W TK - P	1.000	0.0	0.000	4.383	-1.590	-2.954	0.0
40	A P D W TK - S	1.000	0.0	0.000	4.383	-1.590	2.954	0.0
41	A P D W TK - C	1.000	0.0	0.000	3.643	-1.312	0.000	0.0
42	NO.1 D W TK - P	1.000	100.0	48.200	0.519	45.297	-2.446	0.0
43	NO.1 D W TK - S	1.000	100.0	48.200	0.519	45.297	2.446	0.0
44	NO.2 D W TK - P	1.000	100.0	110.100	4.096	38.398	-2.500	0.0
45	NO.2 D W TK - S	1.000	100.0	110.100	4.096	38.398	2.500	0.0
	Sub Total			**316.600**	**3.007**	**40.499**	**-0.000**	**0.0**
	Mud							
46	NO.1 MUD TK - C	2.500	0.0	0.000	1.156	18.919	0.000	0.0
47	NO.2 MUD TK - C	2.500	0.0	0.000	2.478	11.712	0.000	0.0
	Sub Total			**0.000**	**0.000**	**0.000**	**0.000**	**0.0**
	Foam							
48	FOAM TANK - S	1.145	9.8	1.310	5.438	49.194	6.372	2.7
	Sub Total			**1.310**	**5.438**	**49.194**	**6.372**	**2.7**
	Dispersant							
49	DISPERSANT TANK - S	1.163	9.9	1.400	5.425	47.996	6.440	3.0
	Sub Total			**1.400**	**5.425**	**47.996**	**6.440**	**3.0**
	Deadweight Constants							
50	CREW EFFECT			4.300	10.100	52.800	0.000	0.0
51	PROVISION STORE			0.040	8.500	48.600	3.500	0.0

Condition: LC 6 ARRIVAL OF COND 5

Description: Step 3

Date: 30-12-2011

Sr. No	Item	Density/ Stowage Factor	%	Weight (T)	VCG (m)	LCG (m)	TCG (m)	FSM (T-M)
	Deadweight Constants							
52	SHIP STORE			10.000	9.000	50.400	3.000	0.0
53	DRY BULK			0.000	4.150	45.300	0.000	0.0
	Sub Total			**14.340**	**9.328**	**51.115**	**2.102**	**0.0**
	Main Deck							
54	Main Deck			0.000	8.200	15.000	0.000	---
	Sub Total			**0.000**	**0.000**	**0.000**	**0.000**	**---**
	Mezzanine Deck							
55	Mezzanine Deck			0.000	12.200	36.600	0.000	---
	Sub Total			**0.000**	**0.000**	**0.000**	**0.000**	**---**
	DeckHouse Deck							
56	Deckhouse Deck			0.000	15.200	44.700	0.000	---
	Sub Total			**0.000**	**0.000**	**0.000**	**0.000**	**---**

LIGHTSHIP	2552.3	6.385	32.732	-0.021	0.0
DISPLACEMENT	**3211.85**	**5.725**	**32.921**	**-0.145**	**698.0**

Condition: LC 6 ARRIVAL OF COND 5

Description: Step 4

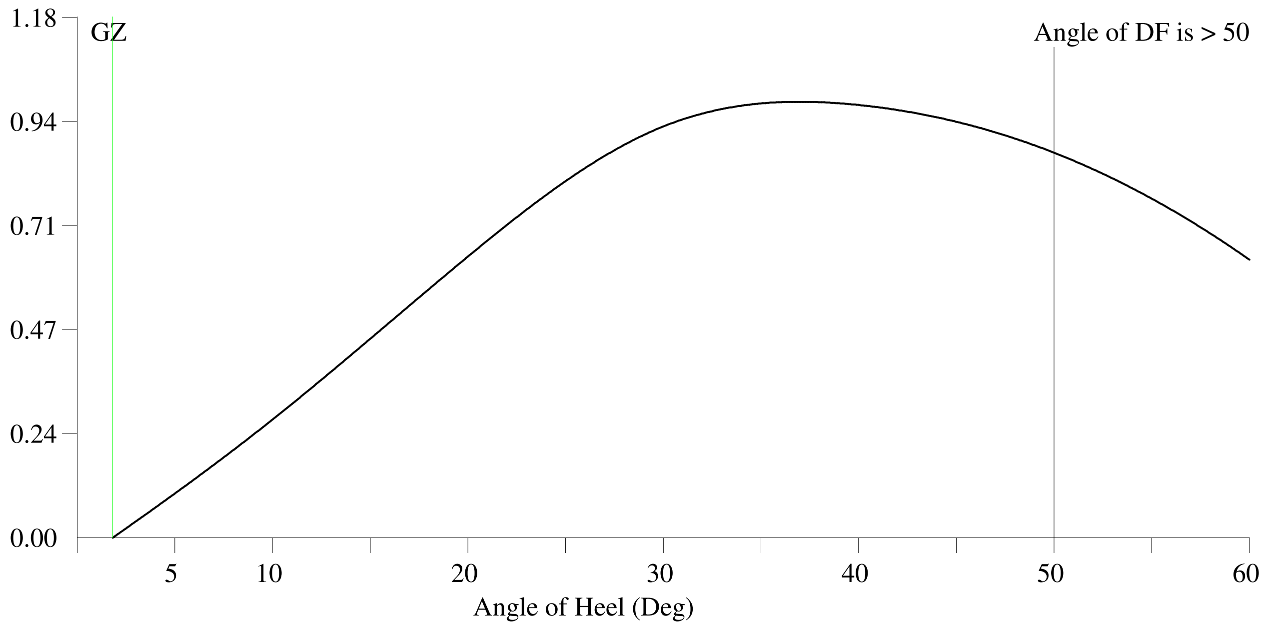
Date: 30-12-2011

DRAFTS,TRIMS & INTACT STABILITY SHEET

Sea Water Density	=	1.0250	(t/cu. m.)	LoadLine	=	6.032 m (Summer Load Line)	
Displacement	=	3261.64	T	Propeller Immersion Draft	=	3.59	m
DRAFTS & TRIM				**DRAFTS AT MARKS**			
Draft AP(USK)	=	4.525	m	Draft AFT Marks	=	4.517	m
Draft FP(USK)	=	4.241	m	Draft FWD Marks	=	4.242	m
Draft (Mean)	=	4.383	m	Trim	=	0.285	m
TCG	=	-0.057	m	List Angle	=	1.833	Deg. Port
INTACT STABILITY							
LCB	=	32.394	m	MCT	=	43.399	T-M/cm
KG	=	5.732	m	GoMt	=	1.695	m
GGo	=	0.233	m	KMT	=	7.659	m
KGo	=	5.964	m	Permissible KG	=	7.296	m

RIGHTING ARM CURVE

Angle (Deg.)	5	10	20	30	40	50	60
KN (m)	0.676	1.358	2.728	3.961	4.856	5.476	5.823
GZ (m)	0.099	0.267	0.636	0.930	0.979	0.871	0.629



COMPLIANCE WITH IMO CRITERIA

		Computed values		Minimum Required	
Maximum GZ Occurs at	=	36.99	Deg	15.00	Deg
Area Upto 30.00 deg	=	0.236	m-rad	0.055	m-rad
Area 30 deg - 40 deg/Angle DF	=	0.171	m-rad	0.030	m-rad
Maximum GZ or GZ @ 30 Deg	=	0.99	m	0.20	m
GoMt	=	1.69	m	0.15	m

JUDGEMENT :

Loadline Draft : OK

IMO Stability Criteria : OK

Condition: LC 6 ARRIVAL OF COND 5

Description: Step 4

Date: 30-12-2011

FOLLOWING IS IMMERSION STATUS

SR. No.	Item Name	Fr. No.	Ht.From BL	Dist.From CL	Dist. WaterLine	Immersed	Opening Type
1	E/R VENT (P)	69.00	11.97	-6.85	7.42	No	2
2	E/R VENT (S)	69.00	11.97	6.85	7.86	No	2
3	E/R VENT (P)	69.00	11.30	-6.00	6.78	No	2
4	E/R VENT (S)	69.00	11.30	6.00	7.16	No	2
5	Deck Edge Aft (P)	-8.00	7.20	-8.00	2.41	No	0
6	Deck Edge Aft (S)	-8.00	7.20	8.00	2.92	No	0
7	Deck Edge Mid (P)	52.00	7.20	-8.00	2.57	No	0
8	Deck Edge Mid (S)	52.00	7.20	8.00	3.08	No	0
9	Deck Edge Fwd (P)	105.00	12.95	-8.00	8.46	No	0
10	Deck Edge Fwd (S)	105.00	12.95	8.00	8.97	No	0
11	Check point (0.76m above deck edge)	-8.00	7.96	-8.00	3.17	No	1
12	Check point (0.76m above deck edge)	-8.00	7.96	8.00	3.68	No	1
13	Check point (0.76m above deck edge)	0.00	7.96	-8.00	3.19	No	1
14	Check point (0.76m above deck edge)	0.00	7.96	8.00	3.70	No	1
15	Check point (0.76m above deck edge)	8.00	7.96	-8.00	3.21	No	1
16	Check point (0.76m above deck edge)	8.00	7.96	8.00	3.72	No	1
17	Check point (0.76m above deck edge)	16.00	7.96	-8.00	3.23	No	1
18	Check point (0.76m above deck edge)	16.00	7.96	8.00	3.75	No	1
19	Check point (0.76m above deck edge)	24.00	7.96	-8.00	3.26	No	1
20	Check point (0.76m above deck edge)	24.00	7.96	8.00	3.77	No	1
21	Check point (0.76m above deck edge)	32.00	7.96	-8.00	3.28	No	1
22	Check point (0.76m above deck edge)	32.00	7.96	8.00	3.79	No	1
23	Check point (0.76m above deck edge)	40.00	7.96	-8.00	3.30	No	1
24	Check point (0.76m above deck edge)	40.00	7.96	8.00	3.81	No	1
25	Check point (0.76m above deck edge)	48.00	7.96	-8.00	3.32	No	1
26	Check point (0.76m above deck edge)	48.00	7.96	8.00	3.83	No	1
27	Check point (0.76m above deck edge)	56.00	13.71	-8.00	9.09	No	1
28	Check point (0.76m above deck edge)	56.00	13.71	8.00	9.60	No	1
29	Check point (0.76m above deck edge)	64.00	13.71	-8.00	9.11	No	1
30	Check point (0.76m above deck edge)	64.00	13.71	8.00	9.62	No	1
31	Check point (0.76m above deck edge)	72.00	13.71	-8.00	9.13	No	1
32	Check point (0.76m above deck edge)	72.00	13.71	8.00	9.64	No	1
33	Check point (0.76m above deck edge)	80.00	13.71	-8.00	9.15	No	1
34	Check point (0.76m above deck edge)	80.00	13.71	8.00	9.67	No	1
35	Check point (0.76m above deck edge)	88.00	13.71	-7.50	9.19	No	1
36	Check point (0.76m above deck edge)	88.00	13.71	7.50	9.67	No	1
37	Check point (0.76m above deck edge)	96.00	13.71	-4.00	9.33	No	1
38	Check point (0.76m above deck edge)	96.00	13.71	4.00	9.58	No	1
39	Check point (0.76m above deck edge)	104.00	13.71	-1.50	9.43	No	1
40	Check point (0.76m above deck edge)	104.00	13.71	1.50	9.52	No	1

0 - Deck edge, 1 - Progressive DownFlooding Point, 2 - Unprotected Opening

Condition: LC 6 ARRIVAL OF COND 5

Description: Step 4

Date: 30-12-2011

Sr. No	Item	Density/ Stowage Factor	%	Weight (T)	VCG (m)	LCG (m)	TCG (m)	FSM (T-M)
	Water Ballast	**(t/cu. m.)**						
1	F P S W B TK - C	1.025	0.0	0.000	6.016	59.541	0.000	0.0
2	A P S W B TK - P	1.025	100.0	62.320	6.143	-1.644	-5.703	0.0
3	A P S W B TK - S	1.025	79.9	49.794	6.143	-1.635	5.659	60.7
4	A P S W B TK - C	1.025	100.0	34.850	5.421	-2.159	0.000	0.0
	Sub Total			**146.964**	**5.972**	**-1.763**	**-0.501**	**60.7**
	Consumables	**(t/cu. m.)**						
	Fuel Oil							
5	NO.1 F O TK - P	0.855	67.8	34.710	0.970	38.406	-4.798	129.3
6	NO.1 F O TK - S	0.855	65.8	33.690	0.927	38.406	4.746	129.3
7	NO.2 F O TK - P	0.855	0.0	0.000	0.110	28.385	-4.437	0.0
8	NO.2 F O TK - S	0.855	0.0	0.000	0.110	28.385	4.437	0.0
9	NO.2 F O TK - C	0.855	0.0	0.000	0.022	29.200	0.000	0.0
10	NO.3 F O TK - C	0.855	9.8	4.400	0.078	22.210	0.000	180.1
11	NO.4 F O TK - P	0.855	0.0	0.000	0.538	18.934	-5.695	0.0
12	NO.4 F O TK - S	0.855	0.0	0.000	0.538	18.934	5.695	0.0
13	NO.4 F O TK - C	0.855	0.0	0.000	0.011	18.321	0.000	0.0
14	F O DAY TK - P	0.855	9.8	1.830	4.537	22.800	-7.450	0.6
15	F O DAY TK - S	0.855	9.8	1.830	4.537	22.800	7.450	0.6
16	F O SETT. TK - P	0.855	9.8	1.370	4.537	29.100	-7.450	0.5
17	F O SETT. TK - S	0.855	9.8	1.370	4.537	29.100	7.450	0.5
	Sub Total			**79.200**	**1.190**	**36.463**	**-0.084**	**440.8**
	Lube Oil							
18	A L O ST TK - P	0.900	98.0	8.030	5.773	35.100	-7.450	0.3
19	M L O ST TK - S	0.900	97.7	12.840	5.772	34.200	7.450	0.5
20	L O CIR. TK - P	0.900	98.3	11.060	0.621	27.000	-3.536	6.3
21	L O CIR. TK - S	0.900	98.3	11.060	0.621	27.000	3.536	6.3
	Sub Total			**42.990**	**3.121**	**30.663**	**0.834**	**13.4**
	Hyd Oil							
22	NO.1 HYD.OIL TK - P	0.900	99.4	1.610	5.775	33.300	-7.450	0.6
23	NO.2 HYD.OIL TK - P	0.900	99.4	1.610	5.789	32.700	-7.450	0.6
24	NO.3 HYD.OIL TK - P	0.900	99.4	1.610	5.775	32.100	-7.450	0.6
25	STR HYD OIL TK - P	0.900	98.7	1.510	6.213	3.605	-7.594	0.0
26	TOW HYD.OIL TK - S	0.900	98.7	1.510	6.213	3.605	7.594	0.0
	Sub Total			**7.850**	**5.947**	**21.507**	**-4.584**	**1.8**
	Fresh Water							
27	NO.1 PORTABLE W TK - P	1.000	10.0	9.200	0.406	56.175	-1.853	20.6
28	NO.1 PORTABLE W TK - S	1.000	10.0	9.200	0.405	56.175	1.853	20.6

Sr. No	Item	Density/ Stowage Factor	%	Weight (T)	VCG (m)	LCG (m)	TCG (m)	FSM (T-M)
	Consumables	**(t/cu. m.)**						
29	NO.2 PORTABLE W TK - P	1.000	10.0	10.710	0.363	52.118	-2.452	71.6
30	NO.2 PORTABLE W TK - S	1.000	10.0	10.640	0.373	52.072	2.465	71.5
31	NO.3 PORTABLE W TK - P	1.000	10.0	8.570	0.383	44.829	-6.069	11.8
32	NO.3 PORTABLE W TK - S	1.000	10.0	8.570	0.383	44.829	6.069	11.8
33	NO.4 PORTABLE W TK - P	1.000	10.0	4.990	3.884	9.839	-6.293	3.4
34	NO.4 PORTABLE W TK - S	1.000	10.0	4.990	3.884	9.839	6.293	3.4
	Sub Total			**66.870**	**0.907**	**45.049**	**-0.000**	**214.7**
	Miscellaneous							
35	DIRTY OIL TK - P	1.000	87.8	8.340	0.405	34.620	-1.558	9.7
36	BILGE HOLDING TK - S	1.000	97.5	9.260	0.448	34.620	1.561	10.7
37	SEWAGE HOLDING TK - P	1.000	98.3	14.260	5.451	48.568	-6.958	1.2
	Sub Total			**31.860**	**2.676**	**40.863**	**-3.068**	**21.6**
	Drill Water							
38	F P D W TK - C	1.000	0.0	0.000	0.031	59.541	0.000	0.0
39	A P D W TK - P	1.000	0.0	0.000	4.383	-1.590	-2.954	0.0
40	A P D W TK - S	1.000	0.0	0.000	4.383	-1.590	2.954	0.0
41	A P D W TK - C	1.000	0.0	0.000	3.643	-1.312	0.000	0.0
42	NO.1 D W TK - P	1.000	100.0	48.200	0.519	45.297	-2.446	0.0
43	NO.1 D W TK - S	1.000	100.0	48.200	0.519	45.297	2.446	0.0
44	NO.2 D W TK - P	1.000	100.0	110.100	4.096	38.398	-2.500	0.0
45	NO.2 D W TK - S	1.000	100.0	110.100	4.096	38.398	2.500	0.0
	Sub Total			**316.600**	**3.007**	**40.499**	**-0.000**	**0.0**
	Mud							
46	NO.1 MUD TK - C	2.500	0.0	0.000	1.156	18.919	0.000	0.0
47	NO.2 MUD TK - C	2.500	0.0	0.000	2.478	11.712	0.000	0.0
	Sub Total			**0.000**	**0.000**	**0.000**	**0.000**	**0.0**
	Foam							
48	FOAM TANK - S	1.145	9.8	1.310	5.438	49.194	6.372	2.7
	Sub Total			**1.310**	**5.438**	**49.194**	**6.372**	**2.7**
	Dispersant							
49	DISPERSANT TANK - S	1.163	9.9	1.400	5.425	47.996	6.440	3.0
	Sub Total			**1.400**	**5.425**	**47.996**	**6.440**	**3.0**
	Deadweight Constants							
50	CREW EFFECT			4.300	10.100	52.800	0.000	0.0
51	PROVISION STORE			0.040	8.500	48.600	3.500	0.0

Condition: LC 6 ARRIVAL OF COND 5

Description: Step 4

Date: 30-12-2011

Sr. No	Item	Density/ Stowage Factor	%	Weight (T)	VCG (m)	LCG (m)	TCG (m)	FSM (T-M)
	Deadweight Constants							
52	SHIP STORE			10.000	9.000	50.400	3.000	0.0
53	DRY BULK			0.000	4.150	45.300	0.000	0.0
	Sub Total			**14.340**	**9.328**	**51.115**	**2.102**	**0.0**
	Main Deck							
54	Main Deck			0.000	8.200	15.000	0.000	---
	Sub Total			**0.000**	**0.000**	**0.000**	**0.000**	**---**
	Mezzanine Deck							
55	Mezzanine Deck			0.000	12.200	36.600	0.000	---
	Sub Total			**0.000**	**0.000**	**0.000**	**0.000**	**---**
	DeckHouse Deck							
56	Deckhouse Deck			0.000	15.200	44.700	0.000	---
	Sub Total			**0.000**	**0.000**	**0.000**	**0.000**	**---**

LIGHTSHIP	2552.3	6.385	32.732	-0.021	0.0
DISPLACEMENT	**3261.64**	**5.732**	**32.394**	**-0.057**	**758.7**

Condition: LC 6 ARRIVAL OF COND 5

Description: Step 5

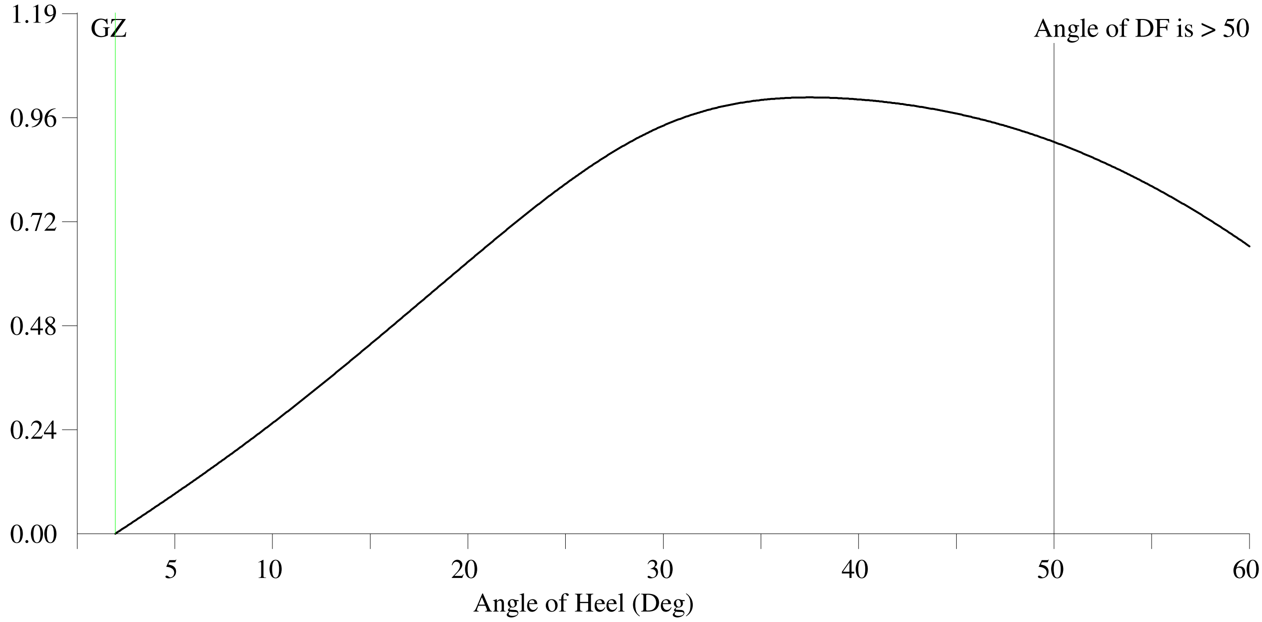
Date: 30-12-2011

DRAFTS,TRIMS & INTACT STABILITY SHEET

Sea Water Density	=	1.0250	(t/cu. m.)	LoadLine	=	6.032 m (Summer Load Line)	
Displacement	=	3226.79	T	Propeller Immersion Draft	=	3.59	m
DRAFTS & TRIM				**DRAFTS AT MARKS**			
Draft AP(USK)	=	4.371	m	Draft AFT Marks	=	4.370	m
Draft FP(USK)	=	4.338	m	Draft FWD Marks	=	4.338	m
Draft (Mean)	=	4.355	m	Trim	=	0.033	m
TCG	=	-0.057	m	List Angle	=	1.949	Deg. Port
INTACT STABILITY							
LCB	=	32.767	m	MCT	=	42.316	T-M/cm
KG	=	5.735	m	GoMt	=	1.624	m
GGo	=	0.235	m	KMT	=	7.594	m
KGo	=	5.970	m	Permissible KG	=	7.313	m

RIGHTING ARM CURVE

Angle (Deg.)	5	10	20	30	40	50	60
KN (m)	0.669	1.346	2.718	3.970	4.877	5.508	5.858
GZ (m)	0.092	0.254	0.623	0.936	0.995	0.898	0.659



COMPLIANCE WITH IMO CRITERIA

		Computed values		Minimum Required	
Maximum GZ Occurs at	=	37.51	Deg	15.00	Deg
Area Upto 30.00 deg	=	0.232	m-rad	0.055	m-rad
Area 30 deg - 40 deg/Angle DF	=	0.173	m-rad	0.030	m-rad
Maximum GZ or GZ @ 30 Deg	=	1.00	m	0.20	m
GoMt	=	1.62	m	0.15	m

JUDGEMENT :

Loadline Draft : OK

IMO Stability Criteria : OK

Condition: LC 6 ARRIVAL OF COND 5

Description: Step 5

Date: 30-12-2011

FOLLOWING IS IMMERSION STATUS

SR. No.	Item Name	Fr. No.	Ht.From BL	Dist.From CL	Dist. WaterLine	Immersed	Opening Type
1	E/R VENT (P)	69.00	11.97	-6.85	7.39	No	2
2	E/R VENT (S)	69.00	11.97	6.85	7.86	No	2
3	E/R VENT (P)	69.00	11.30	-6.00	6.76	No	2
4	E/R VENT (S)	69.00	11.30	6.00	7.16	No	2
5	Deck Edge Aft (P)	-8.00	7.20	-8.00	2.57	No	0
6	Deck Edge Aft (S)	-8.00	7.20	8.00	3.11	No	0
7	Deck Edge Mid (P)	52.00	7.20	-8.00	2.59	No	0
8	Deck Edge Mid (S)	52.00	7.20	8.00	3.13	No	0
9	Deck Edge Fwd (P)	105.00	12.95	-8.00	8.35	No	0
10	Deck Edge Fwd (S)	105.00	12.95	8.00	8.89	No	0
11	Check point (0.76m above deck edge)	-8.00	7.96	-8.00	3.33	No	1
12	Check point (0.76m above deck edge)	-8.00	7.96	8.00	3.87	No	1
13	Check point (0.76m above deck edge)	0.00	7.96	-8.00	3.33	No	1
14	Check point (0.76m above deck edge)	0.00	7.96	8.00	3.87	No	1
15	Check point (0.76m above deck edge)	8.00	7.96	-8.00	3.33	No	1
16	Check point (0.76m above deck edge)	8.00	7.96	8.00	3.87	No	1
17	Check point (0.76m above deck edge)	16.00	7.96	-8.00	3.33	No	1
18	Check point (0.76m above deck edge)	16.00	7.96	8.00	3.88	No	1
19	Check point (0.76m above deck edge)	24.00	7.96	-8.00	3.34	No	1
20	Check point (0.76m above deck edge)	24.00	7.96	8.00	3.88	No	1
21	Check point (0.76m above deck edge)	32.00	7.96	-8.00	3.34	No	1
22	Check point (0.76m above deck edge)	32.00	7.96	8.00	3.88	No	1
23	Check point (0.76m above deck edge)	40.00	7.96	-8.00	3.34	No	1
24	Check point (0.76m above deck edge)	40.00	7.96	8.00	3.88	No	1
25	Check point (0.76m above deck edge)	48.00	7.96	-8.00	3.34	No	1
26	Check point (0.76m above deck edge)	48.00	7.96	8.00	3.89	No	1
27	Check point (0.76m above deck edge)	56.00	13.71	-8.00	9.09	No	1
28	Check point (0.76m above deck edge)	56.00	13.71	8.00	9.64	No	1
29	Check point (0.76m above deck edge)	64.00	13.71	-8.00	9.10	No	1
30	Check point (0.76m above deck edge)	64.00	13.71	8.00	9.64	No	1
31	Check point (0.76m above deck edge)	72.00	13.71	-8.00	9.10	No	1
32	Check point (0.76m above deck edge)	72.00	13.71	8.00	9.64	No	1
33	Check point (0.76m above deck edge)	80.00	13.71	-8.00	9.10	No	1
34	Check point (0.76m above deck edge)	80.00	13.71	8.00	9.64	No	1
35	Check point (0.76m above deck edge)	88.00	13.71	-7.50	9.12	No	1
36	Check point (0.76m above deck edge)	88.00	13.71	7.50	9.63	No	1
37	Check point (0.76m above deck edge)	96.00	13.71	-4.00	9.24	No	1
38	Check point (0.76m above deck edge)	96.00	13.71	4.00	9.51	No	1
39	Check point (0.76m above deck edge)	104.00	13.71	-1.50	9.33	No	1
40	Check point (0.76m above deck edge)	104.00	13.71	1.50	9.43	No	1

0 - Deck edge, 1 - Progressive DownFlooding Point, 2 - Unprotected Opening

Condition: LC 6 ARRIVAL OF COND 5

Description: Step 5

Date: 30-12-2011

Sr. No	Item	Density/ Stowage Factor	%	Weight (T)	VCG (m)	LCG (m)	TCG (m)	FSM (T-M)
	Water Ballast	**(t/cu. m.)**						
1	F P S W B TK - C	1.025	0.0	0.000	6.016	59.541	0.000	0.0
2	A P S W B TK - P	1.025	100.0	62.320	6.143	-1.644	-5.703	0.0
3	A P S W B TK - S	1.025	79.9	49.794	6.143	-1.635	5.659	60.7
4	A P S W B TK - C	1.025	0.0	0.000	5.421	-1.312	0.000	0.0
	Sub Total			**112.114**	**6.143**	**-1.640**	**-0.657**	**60.7**
	Consumables	**(t/cu. m.)**						
	Fuel Oil							
5	NO.1 F O TK - P	0.855	67.8	34.710	0.970	38.406	-4.798	129.3
6	NO.1 F O TK - S	0.855	65.8	33.690	0.927	38.406	4.746	129.3
7	NO.2 F O TK - P	0.855	0.0	0.000	0.110	28.385	-4.437	0.0
8	NO.2 F O TK - S	0.855	0.0	0.000	0.110	28.385	4.437	0.0
9	NO.2 F O TK - C	0.855	0.0	0.000	0.022	29.200	0.000	0.0
10	NO.3 F O TK - C	0.855	9.8	4.400	0.078	22.210	0.000	180.1
11	NO.4 F O TK - P	0.855	0.0	0.000	0.538	18.934	-5.695	0.0
12	NO.4 F O TK - S	0.855	0.0	0.000	0.538	18.934	5.695	0.0
13	NO.4 F O TK - C	0.855	0.0	0.000	0.011	18.321	0.000	0.0
14	F O DAY TK - P	0.855	9.8	1.830	4.537	22.800	-7.450	0.6
15	F O DAY TK - S	0.855	9.8	1.830	4.537	22.800	7.450	0.6
16	F O SETT. TK - P	0.855	9.8	1.370	4.537	29.100	-7.450	0.5
17	F O SETT. TK - S	0.855	9.8	1.370	4.537	29.100	7.450	0.5
	Sub Total			**79.200**	**1.190**	**36.463**	**-0.084**	**440.8**
	Lube Oil							
18	A L O ST TK - P	0.900	98.0	8.030	5.773	35.100	-7.450	0.3
19	M L O ST TK - S	0.900	97.7	12.840	5.772	34.200	7.450	0.5
20	L O CIR. TK - P	0.900	98.3	11.060	0.621	27.000	-3.536	6.3
21	L O CIR. TK - S	0.900	98.3	11.060	0.621	27.000	3.536	6.3
	Sub Total			**42.990**	**3.121**	**30.663**	**0.834**	**13.4**
	Hyd Oil							
22	NO.1 HYD.OIL TK - P	0.900	99.4	1.610	5.775	33.300	-7.450	0.6
23	NO.2 HYD.OIL TK - P	0.900	99.4	1.610	5.789	32.700	-7.450	0.6
24	NO.3 HYD.OIL TK - P	0.900	99.4	1.610	5.775	32.100	-7.450	0.6
25	STR HYD OIL TK - P	0.900	98.7	1.510	6.213	3.605	-7.594	0.0
26	TOW HYD.OIL TK - S	0.900	98.7	1.510	6.213	3.605	7.594	0.0
	Sub Total			**7.850**	**5.947**	**21.507**	**-4.584**	**1.8**
	Fresh Water							
27	NO.1 PORTABLE W TK - P	1.000	10.0	9.200	0.406	56.175	-1.853	20.6
28	NO.1 PORTABLE W TK - S	1.000	10.0	9.200	0.405	56.175	1.853	20.6

Condition: LC 6 ARRIVAL OF COND 5

Description: Step 5

Date: 30-12-2011

Sr. No	Item	Density/ Stowage Factor	%	Weight (T)	VCG (m)	LCG (m)	TCG (m)	FSM (T-M)
	Consumables	**(t/cu. m.)**						
29	NO.2 PORTABLE W TK - P	1.000	10.0	10.710	0.363	52.118	-2.452	71.6
30	NO.2 PORTABLE W TK - S	1.000	10.0	10.640	0.373	52.072	2.465	71.5
31	NO.3 PORTABLE W TK - P	1.000	10.0	8.570	0.383	44.829	-6.069	11.8
32	NO.3 PORTABLE W TK - S	1.000	10.0	8.570	0.383	44.829	6.069	11.8
33	NO.4 PORTABLE W TK - P	1.000	10.0	4.990	3.884	9.839	-6.293	3.4
34	NO.4 PORTABLE W TK - S	1.000	10.0	4.990	3.884	9.839	6.293	3.4
	Sub Total			**66.870**	**0.907**	**45.049**	**-0.000**	**214.7**
	Miscellaneous							
35	DIRTY OIL TK - P	1.000	87.8	8.340	0.405	34.620	-1.558	9.7
36	BILGE HOLDING TK - S	1.000	97.5	9.260	0.448	34.620	1.561	10.7
37	SEWAGE HOLDING TK - P	1.000	98.3	14.260	5.451	48.568	-6.958	1.2
	Sub Total			**31.860**	**2.676**	**40.863**	**-3.068**	**21.6**
	Drill Water							
38	F P D W TK - C	1.000	0.0	0.000	0.031	59.541	0.000	0.0
39	A P D W TK - P	1.000	0.0	0.000	4.383	-1.590	-2.954	0.0
40	A P D W TK - S	1.000	0.0	0.000	4.383	-1.590	2.954	0.0
41	A P D W TK - C	1.000	0.0	0.000	3.643	-1.312	0.000	0.0
42	NO.1 D W TK - P	1.000	100.0	48.200	0.519	45.297	-2.446	0.0
43	NO.1 D W TK - S	1.000	100.0	48.200	0.519	45.297	2.446	0.0
44	NO.2 D W TK - P	1.000	100.0	110.100	4.096	38.398	-2.500	0.0
45	NO.2 D W TK - S	1.000	100.0	110.100	4.096	38.398	2.500	0.0
	Sub Total			**316.600**	**3.007**	**40.499**	**-0.000**	**0.0**
	Mud							
46	NO.1 MUD TK - C	2.500	0.0	0.000	1.156	18.919	0.000	0.0
47	NO.2 MUD TK - C	2.500	0.0	0.000	2.478	11.712	0.000	0.0
	Sub Total			**0.000**	**0.000**	**0.000**	**0.000**	**0.0**
	Foam							
48	FOAM TANK - S	1.145	9.8	1.310	5.438	49.194	6.372	2.7
	Sub Total			**1.310**	**5.438**	**49.194**	**6.372**	**2.7**
	Dispersant							
49	DISPERSANT TANK - S	1.163	9.9	1.400	5.425	47.996	6.440	3.0
	Sub Total			**1.400**	**5.425**	**47.996**	**6.440**	**3.0**
	Deadweight Constants							
50	CREW EFFECT			4.300	10.100	52.800	0.000	0.0
51	PROVISION STORE			0.040	8.500	48.600	3.500	0.0

Condition: LC 6 ARRIVAL OF COND 5

Description: Step 5

Date: 30-12-2011

Sr. No	Item	Density/ Stowage Factor	%	Weight (T)	VCG (m)	LCG (m)	TCG (m)	FSM (T-M)
	Deadweight Constants							
52	SHIP STORE			10.000	9.000	50.400	3.000	0.0
53	DRY BULK			0.000	4.150	45.300	0.000	0.0
	Sub Total			**14.340**	**9.328**	**51.115**	**2.102**	**0.0**
	Main Deck							
54	Main Deck			0.000	8.200	15.000	0.000	---
	Sub Total			**0.000**	**0.000**	**0.000**	**0.000**	**---**
	Mezzanine Deck							
55	Mezzanine Deck			0.000	12.200	36.600	0.000	---
	Sub Total			**0.000**	**0.000**	**0.000**	**0.000**	**---**
	DeckHouse Deck							
56	Deckhouse Deck			0.000	15.200	44.700	0.000	---
	Sub Total			**0.000**	**0.000**	**0.000**	**0.000**	**---**

LIGHTSHIP	2552.3	6.385	32.732	-0.021	0.0
DISPLACEMENT	**3226.79**	**5.735**	**32.767**	**-0.057**	**758.7**

Condition: LC 6 ARRIVAL OF COND 5

Description: Step 6

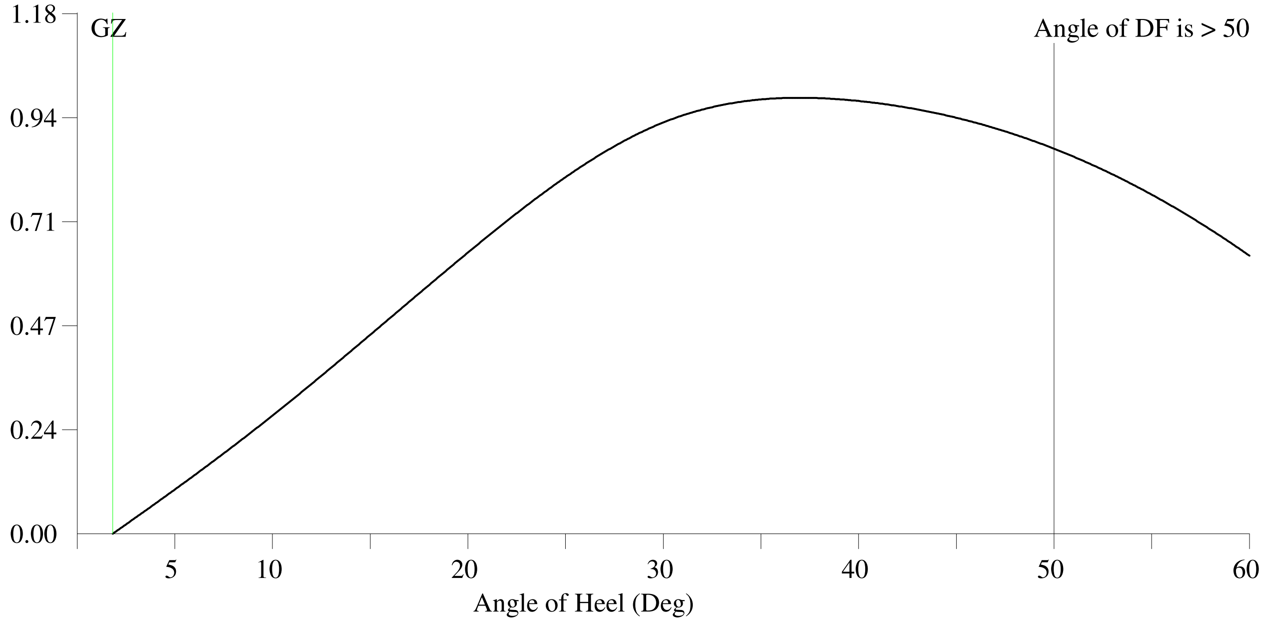
Date: 30-12-2011

DRAFTS,TRIMS & INTACT STABILITY SHEET

Sea Water Density	=	1.0250	(t/cu. m.)	LoadLine	=	6.032 m (Summer Load Line)	
Displacement	=	3261.64	T	Propeller Immersion Draft	=	3.59	m
DRAFTS & TRIM				**DRAFTS AT MARKS**			
Draft AP(USK)	=	4.525	m	Draft AFT Marks	=	4.517	m
Draft FP(USK)	=	4.241	m	Draft FWD Marks	=	4.242	m
Draft (Mean)	=	4.383	m	Trim	=	0.285	m
TCG	=	-0.057	m	List Angle	=	1.833	Deg. Port
INTACT STABILITY							
LCB	=	32.394	m	MCT	=	43.399	T-M/cm
KG	=	5.732	m	GoMt	=	1.695	m
GGo	=	0.233	m	KMT	=	7.659	m
KGo	=	5.964	m	Permissible KG	=	7.296	m

RIGHTING ARM CURVE

Angle (Deg.)	5	10	20	30	40	50	60
KN (m)	0.676	1.358	2.728	3.961	4.856	5.476	5.823
GZ (m)	0.099	0.267	0.636	0.930	0.979	0.871	0.629



COMPLIANCE WITH IMO CRITERIA

		Computed values		Minimum Required	
Maximum GZ Occurs at	=	36.99	Deg	15.00	Deg
Area Upto 30.00 deg	=	0.236	m-rad	0.055	m-rad
Area 30 deg - 40 deg/Angle DF	=	0.171	m-rad	0.030	m-rad
Maximum GZ or GZ @ 30 Deg	=	0.99	m	0.20	m
GoMt	=	1.69	m	0.15	m

JUDGEMENT :

Loadline Draft : OK

IMO Stability Criteria : OK

Condition: LC 6 ARRIVAL OF COND 5

Description: Step 6

Date: 30-12-2011

FOLLOWING IS IMMERSION STATUS

SR. No.	Item Name	Fr. No.	Ht.From BL	Dist.From CL	Dist. WaterLine	Immersed	Opening Type
1	E/R VENT (P)	69.00	11.97	-6.85	7.42	No	2
2	E/R VENT (S)	69.00	11.97	6.85	7.86	No	2
3	E/R VENT (P)	69.00	11.30	-6.00	6.78	No	2
4	E/R VENT (S)	69.00	11.30	6.00	7.16	No	2
5	Deck Edge Aft (P)	-8.00	7.20	-8.00	2.41	No	0
6	Deck Edge Aft (S)	-8.00	7.20	8.00	2.92	No	0
7	Deck Edge Mid (P)	52.00	7.20	-8.00	2.57	No	0
8	Deck Edge Mid (S)	52.00	7.20	8.00	3.08	No	0
9	Deck Edge Fwd (P)	105.00	12.95	-8.00	8.46	No	0
10	Deck Edge Fwd (S)	105.00	12.95	8.00	8.97	No	0
11	Check point (0.76m above deck edge)	-8.00	7.96	-8.00	3.17	No	1
12	Check point (0.76m above deck edge)	-8.00	7.96	8.00	3.68	No	1
13	Check point (0.76m above deck edge)	0.00	7.96	-8.00	3.19	No	1
14	Check point (0.76m above deck edge)	0.00	7.96	8.00	3.70	No	1
15	Check point (0.76m above deck edge)	8.00	7.96	-8.00	3.21	No	1
16	Check point (0.76m above deck edge)	8.00	7.96	8.00	3.72	No	1
17	Check point (0.76m above deck edge)	16.00	7.96	-8.00	3.23	No	1
18	Check point (0.76m above deck edge)	16.00	7.96	8.00	3.75	No	1
19	Check point (0.76m above deck edge)	24.00	7.96	-8.00	3.26	No	1
20	Check point (0.76m above deck edge)	24.00	7.96	8.00	3.77	No	1
21	Check point (0.76m above deck edge)	32.00	7.96	-8.00	3.28	No	1
22	Check point (0.76m above deck edge)	32.00	7.96	8.00	3.79	No	1
23	Check point (0.76m above deck edge)	40.00	7.96	-8.00	3.30	No	1
24	Check point (0.76m above deck edge)	40.00	7.96	8.00	3.81	No	1
25	Check point (0.76m above deck edge)	48.00	7.96	-8.00	3.32	No	1
26	Check point (0.76m above deck edge)	48.00	7.96	8.00	3.83	No	1
27	Check point (0.76m above deck edge)	56.00	13.71	-8.00	9.09	No	1
28	Check point (0.76m above deck edge)	56.00	13.71	8.00	9.60	No	1
29	Check point (0.76m above deck edge)	64.00	13.71	-8.00	9.11	No	1
30	Check point (0.76m above deck edge)	64.00	13.71	8.00	9.62	No	1
31	Check point (0.76m above deck edge)	72.00	13.71	-8.00	9.13	No	1
32	Check point (0.76m above deck edge)	72.00	13.71	8.00	9.64	No	1
33	Check point (0.76m above deck edge)	80.00	13.71	-8.00	9.15	No	1
34	Check point (0.76m above deck edge)	80.00	13.71	8.00	9.67	No	1
35	Check point (0.76m above deck edge)	88.00	13.71	-7.50	9.19	No	1
36	Check point (0.76m above deck edge)	88.00	13.71	7.50	9.67	No	1
37	Check point (0.76m above deck edge)	96.00	13.71	-4.00	9.33	No	1
38	Check point (0.76m above deck edge)	96.00	13.71	4.00	9.58	No	1
39	Check point (0.76m above deck edge)	104.00	13.71	-1.50	9.43	No	1
40	Check point (0.76m above deck edge)	104.00	13.71	1.50	9.52	No	1

0 - Deck edge, 1 - Progressive DownFlooding Point, 2 - Unprotected Opening

Condition: LC 6 ARRIVAL OF COND 5

Description: Step 6

Date: 30-12-2011

Sr. No	Item	Density/ Stowage Factor	%	Weight (T)	VCG (m)	LCG (m)	TCG (m)	FSM (T-M)
	Water Ballast	**(t/cu. m.)**						
1	F P S W B TK - C	1.025	0.0	0.000	6.016	59.541	0.000	0.0
2	A P S W B TK - P	1.025	100.0	62.320	6.143	-1.644	-5.703	0.0
3	A P S W B TK - S	1.025	79.9	49.794	6.143	-1.635	5.659	60.7
4	A P S W B TK - C	1.025	100.0	34.850	5.421	-2.159	0.000	0.0
	Sub Total			**146.964**	**5.972**	**-1.763**	**-0.501**	**60.7**
	Consumables	**(t/cu. m.)**						
	Fuel Oil							
5	NO.1 F O TK - P	0.855	67.8	34.710	0.970	38.406	-4.798	129.3
6	NO.1 F O TK - S	0.855	65.8	33.690	0.927	38.406	4.746	129.3
7	NO.2 F O TK - P	0.855	0.0	0.000	0.110	28.385	-4.437	0.0
8	NO.2 F O TK - S	0.855	0.0	0.000	0.110	28.385	4.437	0.0
9	NO.2 F O TK - C	0.855	0.0	0.000	0.022	29.200	0.000	0.0
10	NO.3 F O TK - C	0.855	9.8	4.400	0.078	22.210	0.000	180.1
11	NO.4 F O TK - P	0.855	0.0	0.000	0.538	18.934	-5.695	0.0
12	NO.4 F O TK - S	0.855	0.0	0.000	0.538	18.934	5.695	0.0
13	NO.4 F O TK - C	0.855	0.0	0.000	0.011	18.321	0.000	0.0
14	F O DAY TK - P	0.855	9.8	1.830	4.537	22.800	-7.450	0.6
15	F O DAY TK - S	0.855	9.8	1.830	4.537	22.800	7.450	0.6
16	F O SETT. TK - P	0.855	9.8	1.370	4.537	29.100	-7.450	0.5
17	F O SETT. TK - S	0.855	9.8	1.370	4.537	29.100	7.450	0.5
	Sub Total			**79.200**	**1.190**	**36.463**	**-0.084**	**440.8**
	Lube Oil							
18	A L O ST TK - P	0.900	98.0	8.030	5.773	35.100	-7.450	0.3
19	M L O ST TK - S	0.900	97.7	12.840	5.772	34.200	7.450	0.5
20	L O CIR. TK - P	0.900	98.3	11.060	0.621	27.000	-3.536	6.3
21	L O CIR. TK - S	0.900	98.3	11.060	0.621	27.000	3.536	6.3
	Sub Total			**42.990**	**3.121**	**30.663**	**0.834**	**13.4**
	Hyd Oil							
22	NO.1 HYD.OIL TK - P	0.900	99.4	1.610	5.775	33.300	-7.450	0.6
23	NO.2 HYD.OIL TK - P	0.900	99.4	1.610	5.789	32.700	-7.450	0.6
24	NO.3 HYD.OIL TK - P	0.900	99.4	1.610	5.775	32.100	-7.450	0.6
25	STR HYD OIL TK - P	0.900	98.7	1.510	6.213	3.605	-7.594	0.0
26	TOW HYD.OIL TK - S	0.900	98.7	1.510	6.213	3.605	7.594	0.0
	Sub Total			**7.850**	**5.947**	**21.507**	**-4.584**	**1.8**
	Fresh Water							
27	NO.1 PORTABLE W TK - P	1.000	10.0	9.200	0.406	56.175	-1.853	20.6
28	NO.1 PORTABLE W TK - S	1.000	10.0	9.200	0.405	56.175	1.853	20.6

Condition: LC 6 ARRIVAL OF COND 5

Description: Step 6

Date: 30-12-2011

Sr. No	Item	Density/ Stowage Factor	%	Weight (T)	VCG (m)	LCG (m)	TCG (m)	FSM (T-M)
	Consumables	**(t/cu. m.)**						
29	NO.2 PORTABLE W TK - P	1.000	10.0	10.710	0.363	52.118	-2.452	71.6
30	NO.2 PORTABLE W TK - S	1.000	10.0	10.640	0.373	52.072	2.465	71.5
31	NO.3 PORTABLE W TK - P	1.000	10.0	8.570	0.383	44.829	-6.069	11.8
32	NO.3 PORTABLE W TK - S	1.000	10.0	8.570	0.383	44.829	6.069	11.8
33	NO.4 PORTABLE W TK - P	1.000	10.0	4.990	3.884	9.839	-6.293	3.4
34	NO.4 PORTABLE W TK - S	1.000	10.0	4.990	3.884	9.839	6.293	3.4
	Sub Total			**66.870**	**0.907**	**45.049**	**-0.000**	**214.7**
	Miscellaneous							
35	DIRTY OIL TK - P	1.000	87.8	8.340	0.405	34.620	-1.558	9.7
36	BILGE HOLDING TK - S	1.000	97.5	9.260	0.448	34.620	1.561	10.7
37	SEWAGE HOLDING TK - P	1.000	98.3	14.260	5.451	48.568	-6.958	1.2
	Sub Total			**31.860**	**2.676**	**40.863**	**-3.068**	**21.6**
	Drill Water							
38	F P D W TK - C	1.000	0.0	0.000	0.031	59.541	0.000	0.0
39	A P D W TK - P	1.000	0.0	0.000	4.383	-1.590	-2.954	0.0
40	A P D W TK - S	1.000	0.0	0.000	4.383	-1.590	2.954	0.0
41	A P D W TK - C	1.000	0.0	0.000	3.643	-1.312	0.000	0.0
42	NO.1 D W TK - P	1.000	100.0	48.200	0.519	45.297	-2.446	0.0
43	NO.1 D W TK - S	1.000	100.0	48.200	0.519	45.297	2.446	0.0
44	NO.2 D W TK - P	1.000	100.0	110.100	4.096	38.398	-2.500	0.0
45	NO.2 D W TK - S	1.000	100.0	110.100	4.096	38.398	2.500	0.0
	Sub Total			**316.600**	**3.007**	**40.499**	**-0.000**	**0.0**
	Mud							
46	NO.1 MUD TK - C	2.500	0.0	0.000	1.156	18.919	0.000	0.0
47	NO.2 MUD TK - C	2.500	0.0	0.000	2.478	11.712	0.000	0.0
	Sub Total			**0.000**	**0.000**	**0.000**	**0.000**	**0.0**
	Foam							
48	FOAM TANK - S	1.145	9.8	1.310	5.438	49.194	6.372	2.7
	Sub Total			**1.310**	**5.438**	**49.194**	**6.372**	**2.7**
	Dispersant							
49	DISPERSANT TANK - S	1.163	9.9	1.400	5.425	47.996	6.440	3.0
	Sub Total			**1.400**	**5.425**	**47.996**	**6.440**	**3.0**
	Deadweight Constants							
50	CREW EFFECT			4.300	10.100	52.800	0.000	0.0
51	PROVISION STORE			0.040	8.500	48.600	3.500	0.0

Condition: LC 6 ARRIVAL OF COND 5

Description: Step 6

Date: 30-12-2011

Sr. No	Item	Density/ Stowage Factor	%	Weight (T)	VCG (m)	LCG (m)	TCG (m)	FSM (T-M)
	Deadweight Constants							
52	SHIP STORE			10.000	9.000	50.400	3.000	0.0
53	DRY BULK			0.000	4.150	45.300	0.000	0.0
	Sub Total			**14.340**	**9.328**	**51.115**	**2.102**	**0.0**
	Main Deck							
54	Main Deck			0.000	8.200	15.000	0.000	---
	Sub Total			**0.000**	**0.000**	**0.000**	**0.000**	**---**
	Mezzanine Deck							
55	Mezzanine Deck			0.000	12.200	36.600	0.000	---
	Sub Total			**0.000**	**0.000**	**0.000**	**0.000**	**---**
	DeckHouse Deck							
56	Deckhouse Deck			0.000	15.200	44.700	0.000	---
	Sub Total			**0.000**	**0.000**	**0.000**	**0.000**	**---**

LIGHTSHIP	2552.3	6.385	32.732	-0.021	0.0
DISPLACEMENT	**3261.64**	**5.732**	**32.394**	**-0.057**	**758.7**

Appendix 4 – National or local requirements

National or local requirements for the control and management of ship's ballast water and sediments, including report forms (where applicable).

This section should be maintained up-to-date by the Ballast Water Management Officer.

- MALAYSIA SHIPPING NOTICE, JABATAN LAUT MALAYSIA, MSN 28/2011

  IMPLEMENTATION OF INTERNATIONAL CONVENTION FOR THE CONTROL AND MANAGEMENT OF SHIPS' BALLAST WATER AND SEDIMENTS, 2004 (BMW 2004)

Example ballast water reporting form

(To be provided to the port state authority on request)

Ballast Water Reporting Form (based on MEPC 52/2, ANNEX 2)

1. VESSEL INFORMATION **2. BALLAST WATER**

Vessel Name:	Type:	IMO Number:	Specify Units: m^3, MT, LT, ST
Owner:	GT:	Call Sign:	Total Ballast Water Onboard:
Flag:	Arrival Date:	Agent:	
Last Port and Country:		Arrival Port:	Total Ballast Water Capacity:
Next Port and Country:			

3. BALLAST WATER TANKS

BALLAST WATER MANAGEMENT PLAN ONBOARD? YES_____NO______ HAS THIS BEEN IMPLEMENTED? YES_____NO______

TOTAL NO. OF TANKS ONBOARD______ NO. OF TANKS IN BALLAST_____IF NONE IN BALLAST GO TO NO. 5

NO. OF TANKS EXCHANGED_____ NO. OF TANKS NOT EXCHANGED_______

4. BALLAST WATER HISTORY:

RECORD ALL TANKS THAT WILL BE DEBALLASTED IN PORT STATE OF ARRIVAL; IF NONE GO TO NO. 5.

Tanks/Holds (list multiple sources/tanks separately)	Ballast Water Source				BW EXCHANGE: circle one: Empty/Refill or Flow Through					Ballast Water Discharge			
	DATE/ TIME ddmmyy/ hhmmss	PORT or LAT./ LONG.	VOL. (units)	TEMP (units)	DATE/ TIME ddmmyy/ hhmmss	ENDPOINT LAT./ LONG.	VOL. (units)	% Exch.	SEA HGT. (m)	DATE/ TIME ddmmyy/ hhmmss	PORT or LAT./ LONG.	VOLUME (units)	SALINITY (units)
Ballast Water Tank Codes: Forepeak = FP, Aft Peak = AP, Double Bottom = DB, Wing Tank = WT, Center Tank = CT, Topside Tank = TS, Cargo Hold = CH, O = Other													

Ballast Water Reporting Form (continued)

IF EXCHANGES WERE NOT CONDUCTED, STATE OTHER CONTROL ACTION(S) TAKEN:

IF NONE, STATE REASON WHY NOT:

5. IMO BALLAST WATER GUIDELINES AND THE INTERNATIONAL CONVENTION) ONBOARD? **YES**___ **NO**___

RESPONSIBLE OFFICER:

NAME________________________(PRINTED)

TITLE________________________(PRINTED)

SIGNATURE__________________________DATE __________________

Guidelines for completing the ballast water reporting form

Section 1: ship information

Ship's name: Print the name of the ship.

Owner: The registered owners or operators of the ship.

Flag: Country or port of registry.

Last port and country: Last port and country at which the ship called before arrival in the current port – no abbreviations please.

Next port and country: Next port and country at which the ship will call, upon departure from the current port – no abbreviations please.

Type: List specific ship type – write out or use the following abbreviations: bulk(bc); ro-ro(rr); container(cs); tanker(tk); passenger(pa); oil/bulk ore(ob); general cargo(gc). Write out any additional ship types.

GT: Gross tonnage.

Arrival date: Arrival date at current port. Please use the European date format (DDMMYY).

IMO Number: identification number of the ship used by the International Maritime Organization.

Call Sign: Official call sign.

Agent: Agent used for this voyage.

Arrival port: This is the current port – no abbreviations please.

Section 2: ballast water

(Note: segregated ballast water = clean, non-oily ballast)

Total ballast water on board: Total segregated ballast water upon arrival at current port – with units.

Total ballast water capacity: Total volume of all ballastable tanks or holds – with units.

Section 3: ballast water tanks

(Note: count all tanks and holds separately e.g., port and starboard tanks should be counted separately)

Total number of tanks on board: Count all tanks and holds that can carry segregated ballast water.

Ballast Water Management Plan on board? Do you have a Ballast Water Management Plan specific to your ship on board? Circle Yes or No.

Management Plan implemented? Do you follow the above Plan? Circle Yes or No.

Number of tanks in ballast: Number of segregated ballast water tanks and holds with ballast at the start of the voyage to the current port. If you have no ballast water on board go to Section 5.

Number of tanks exchanged: This refers only to tanks and holds with ballast at the start of the voyage to the current port.

Number of tanks not exchanged: This refers only to tanks and holds with ballast at the start of the voyage to the current port.

Section 4: ballast water history

Ballast water history: Please list all tanks and holds that you have discharged or plan to discharge in this port. Carefully write out, or use the codes listed below the table. Follow each tank across the page, listing all source(s), exchange events, and/or discharge events separately. If the ballast water history is identical (i.e., the same source, exchange and discharge dates and locations) sets of tanks can be combined (e.g., wing tank1 with wing tank 2, both water from Belgium, exchanged 02.11.07, mid ocean). Please use an additional page if you need to, being careful to include the arrival date, ship's name and IMO number at the top.

Ballast water source:

Date: Date of ballast water uptake. Please use the European date format (DDMMYY).

Port or latitude/longitude: Location of ballast water uptake.

Volume: Volume of ballast water uptake – with units.

Temperature: Water temperature at the time of ballast water uptake, in degrees centigrade (Celsius).

Ballast water exchange: Indicate exchange method. Circle either Empty/Refill or Flow Through.

Date: Date of ballast water exchange. Please use the European date format (DDMMYY).

Endpoint or latitude/longitude: Location of ballast water exchange. If it occurred over an extended distance, list the end point latitude or longitude.

Volume: Volume of ballast water exchanged – with units.

Percent exchanged: Percentage of ballast water exchanged. Calculate this by dividing the number of units of water exchanged by the original volume of ballast water in the tank. If necessary, estimate this based on pump rate. (Note: for effective flow through exchange this value should be at least 300%).

Sea Height (m): Record the sea height in metres at the time of the ballast exchange. (Note: this is the combined height of the wind seas and swell, measured from crest to trough. It does not refer to the depth).

Ballast water discharge:

Date: Date of ballast water discharge. Please use the European date format (DDMMYY).

Port or latitude/longitude: Location of ballast water discharge – no abbreviations for ports please.

Volume: Volume of ballast water discharged – with units.

Salinity: Record salinity of ballast water at the time of discharge – with units (i.e. specific gravity (sg) or parts per thousand (ppt)).

If exchanges were not conducted, state other control action(s) taken: If exchanges were not made on all tanks and holds to be discharged, what other actions were taken (e.g. transfer of water to a land-based holding facility, or other approved treatment)?

If none, state reasons why not: List specific reasons why ballast exchange was not done. This applies to all tanks and holds being discharged.

Section 5: Misc

IMO Ballast Water Convention and IMO Guidelines on board? Do you have a copy of the Convention and Guidelines on board? Circle Yes or No.

Responsible Officer's name, title and signature: The Responsible Officer (e.g. the First Mate, Captain or Chief Engineer) must PRINT their name and title and sign the form.

Appendix 5 – Reference documents

[Insert a list of reference documents, for example:

- The International Convention for the Control and Management of Ships' Ballast Water and Sediments 2004
- Resolution MEPC.127(53) – Guidelines for Ballast Water Management and Development of Ballast Water Management Plans
- Resolution MEPC.124(53) – Guidelines for Ballast Water Exchange
- Resolution MEPC.173(58) – Guidelines for Ballast Water Sampling
- other documents.]

Appendix 6 – Ballast Water Record Book

International Convention for the Control and Management of Ships' Ballast Water and Sediments

Period From: .... To: ....

Name of ship: ....

Registration number[2]: ....

Gross tonnage: ....

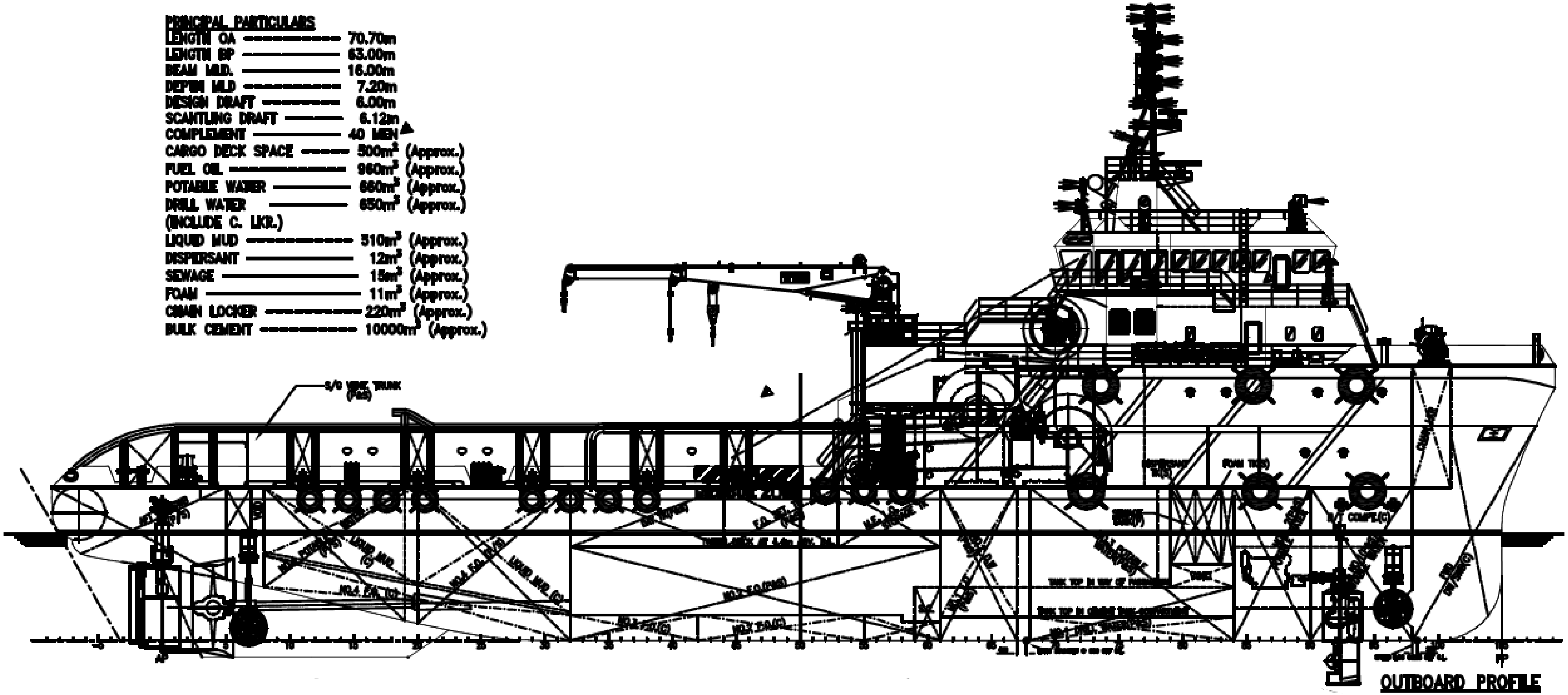
Flag: ....

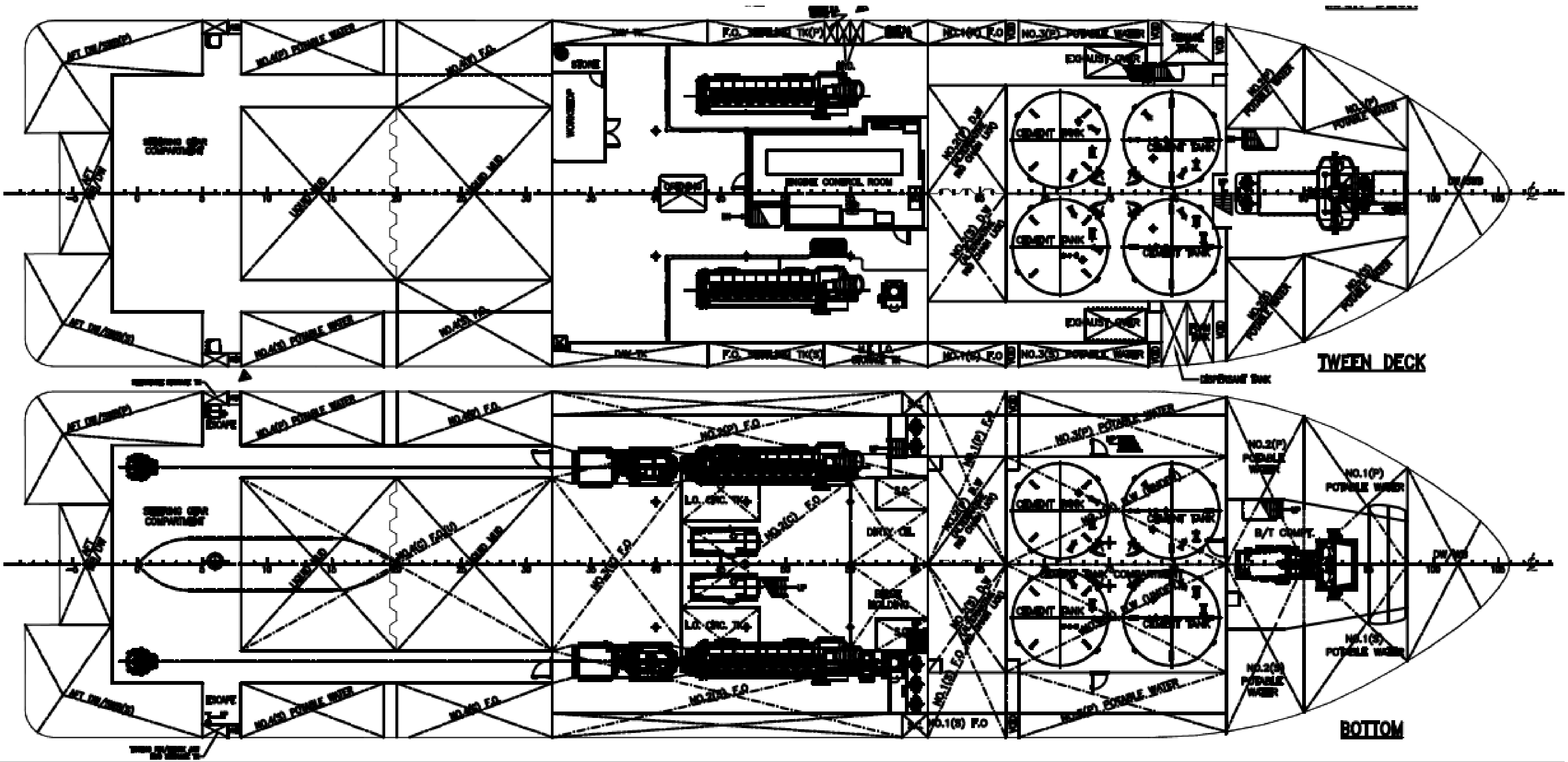
Total ballast water capacity (in cubic metres): ....

The ship is provided with a Ballast Water Management Plan: (Y/N)

[2] Registration number = IMO number and/or other registration numbers.

Diagram of ship indicating ballast tanks:




ENGINE CONTROL ROOM
TWEEN DECK
BOTTOM

1. Introduction

In accordance with regulation B-2 of the Annex to the International Convention for the Control and Management of Ships' Ballast Water and Sediments, a record is to be kept of each ballast water operation. This includes discharges at sea and to reception facilities.

2. Ballast water and ballast water management

"Ballast water" means water with its suspended matter taken on board a ship to control trim, list, draught, stability, or stresses of a ship. Management of ballast water shall be in accordance with an approved Ballast Water Management Plan and take into account Guidelines developed by the IMO.

3. Entries in the Ballast Water Record Book

Entries in the Ballast Water Record Book shall be made on each of the following occasions:

3.1 When Ballast Water is taken on board:

1. date, time and location port or facility of uptake (port or lat/long), depth if outside port
2. estimated volume of uptake in cubic metres
3. signature of the officer in charge of the operation.

3.2 Whenever Ballast Water is circulated or treated for Ballast Water Management purposes:

1. date and time of operation
2. estimated volume circulated or treated (in cubic metres)
3. WI-tether conducted in accordance with the Ballast Water Management plan
4. signature of the officer in charge of the operation.

3.3 When ballast water is discharged into the sea:

1. date, time and location port or facility of discharge (port or lat/long)
2. estimated volume discharged in cubic metres plus remaining volume in cubic metres
3. whether approved Ballast Water Management plan had been implemented prior to discharge.
4. signature of the officer in charge of the operation.

3.4 When ballast water is discharged to a reception facility:

1. date, time, and location of uptake
2. date, time, and location of discharge
3. port or facility
4. estimated volume discharged or taken up, in cubic metres
5. whether approved Ballast Water Management plan had been implemented prior to discharge
6. signature of officer in charge of the operation

3.5 Accidental or other exceptional uptake or discharges of Ballast Water:

1. date and time of occurrence
2. port or position of the ship at time of occurrence
3. estimated volume of Ballast Water discharged
4. circumstances of uptake, discharge, escape or loss, the reason therefore and general remarks.

5. whether approved Ballast Water Management Plan had been implemented prior to discharge
6. signature of officer in charge of the operation

3.6 Additional operational procedure and general remarks:

4. Volume of ballast water

The volume of ballast water on board should be estimated in cubic metres. The Ballast Water Record Book contains many references to estimated volume of ballast water. It is recognized that the accuracy of estimating volumes of ballast is left to interpretation.

Record of ballast water management actions

Sample Ballast Water Record Book page

Name of ship: ....

Registration number: ....

Date	Item (number)	Record of management actions	Signature of officer in charge

Signature of Master: ....

For further information about this template, please contact:
marine-environment@lr.org

For more information about ballast water management please visit:
www.lr.org/bwm
www.lr.org/environment

For more information about the contents of this plan, please contact the plan author.

Appendix-F: BWTS Piping Schematic

Symbol	Name
	BWTS Line
	BWTS Control & Auxiliary Air Line
	Pressure reducing valve
E/P	Electropneumatic ball valve
E/P	Electropneumatic butterfly valve
	Manual valve
E/P	Electropneumatic control valve
	Pressure safety valve
	Vent
	Sensor
FT F	Flowmeter
	Centrifugal pump
	Flexible sleeve
	Ejector or eductor
	Butterfly valve
	Check Valve
	Air Filter

NOTES

1	VALVE ACTUATION MEANS IS PROVIDED VIA INSTRUMENT AIR
2	QUALITY AND PRESSURE OF COMPRESSED AIR SHALL MEET BWTS MAKER STANDARDS
3	VALVES MARKED WITH ** SYMBOL TO BE MONITORED DURING BWTS OPERATION.
4	VALVE BAV08 ACT AS BYPASS VALVE FOR THE BWTS.
5	THE SPILLAGE LINE SUITABLY ROUTED TO NEAR BILGE WELL/SCUPPER
6	REFER BIOSEA BWTS (OMSM)

EQUIPMENT/PUMP DETAILS

ITEM	TYPE	CAPACITY	DIFF. HEAD (BAR)	LOCATION
BILGE/BALLAST /FIRE PUMP	CENTRIFUGAL PUMP	$60m^3/hr$	6	ENGINE ROOM
BILGE/G.S/FIRE PUMP	CENTRIFUGAL PUMP	$60m^3/hr$	6	ENGINE ROOM
BWTS SYSTEM	UV TREATMENT	$60m^3/hr$	–	ENGINE ROOM

REFERENCE DRAWING/DOCUMENT

DRAWING No.	Rev.	DRAWING TITLE
GSPL–P1482–PI–0004	B	SANITARY & F.W SERVICE SYSTEM PIPING SCHEMATIC
GSPL–P1482–PI–0003	B	COMPRESSED AIR SYSTEM (CONTROL AIR) PIPING SCHEMATIC

R.D

SYSTEM	DESIGN CONDITION		CLASS	TESTING		NOM. DIA.	PIPE	FITTINGS/FLANGE			GASKET	COATING	VALVE		REMARKS
	PRESSURE (bar)	TEMP. (°C)		MEDIUM	PRESSURE (bar)		MATERIAL & SCHEDULE	MATERIAL (FITTINGS)	MATERIAL (FLANGES)	FLANGE RATING			MATERIAL BODY	MATERIAL TRIM	
BWTS	6	AMB	III	WATER	9	300A TO 600A	JIS G3454 STPG370,Sch40	JIS B2312 PG370	JIS B2220 SF440	JIS 10K /PN10	NON ASBESTOS	HOT–DIP GALVANIZED	CAST IRON	AL. BRONZE	
						200A TO 250A	JIS G3454 STPG370,Sch40	JIS B2312 PG370	JIS B2220 SF440	JIS 10K/ PN10					
						50A TO 150A	JIS G3454 STPG370,Sch40	JIS B2312 PG370	JIS B2220 SF440	JIS 10K/ PN10	NON ASBESTOS	HOT–DIP GALVANIZED		BRONZE	
						15A TO 40A							BRONZE		

R.D

ITEM LIST

No.	ITEM	ITEM NO.	REMARKS
1	PIPE	BA01–BA06	
2	VALVE	BAV01–BAV11 CAV01–CAV11 R.D	
3	SAMPLING DEVICE	SV	
4	FLOW METER	FT	

REV	REMARKS	DWN	DATE
D	COMP.AIR MANIFOLD UPDATED	NS	13/10/2024
C	BYPASS VALVE CONFIG. UPDATED	NS	23/09/2024
B	BYPASS VALVE CONFIG. UPDATED	NS	10/09/2024
A	ISSUED FOR APPROVAL	NS	28/08/2024

Goltens
Singapore Pte Ltd.

BWTS PIPING SCHEMATIC

SCALE	NTS	OWNER	EMAS OFFSHORE LIMITED		
DRAWN	NS	YARD			
DATE	13/10/2024	CLASS	LR	PROJECT NO.	P1482
CHCKD.	TT	PROJECT NAME	JP 88 STORK	DRAWING NO.	GSPL–P1482–PI–0001
APPRD.	GC			REV.	D

SH. SZ. A3
NO. OF SHEETS 04
SH. NO. 01

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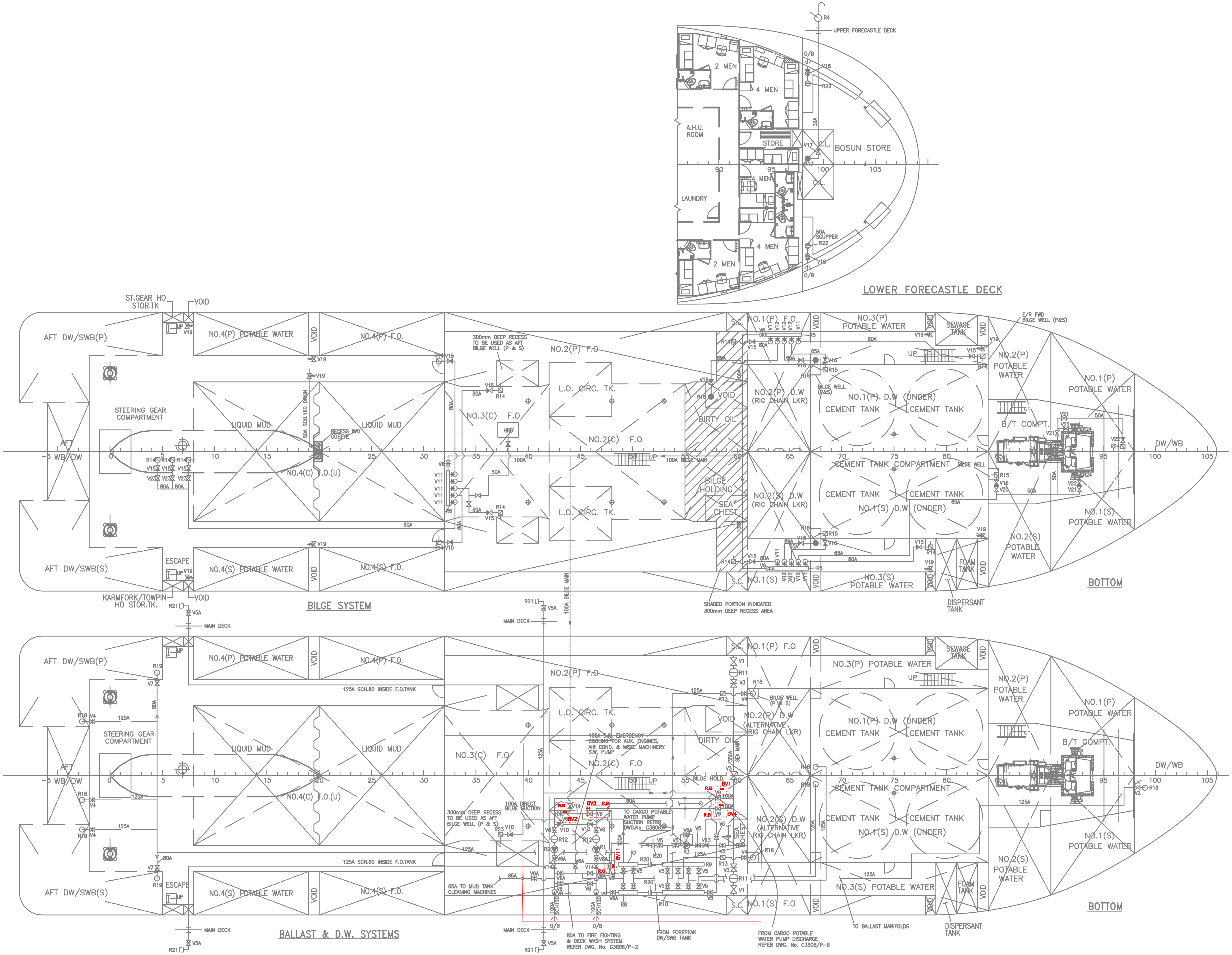
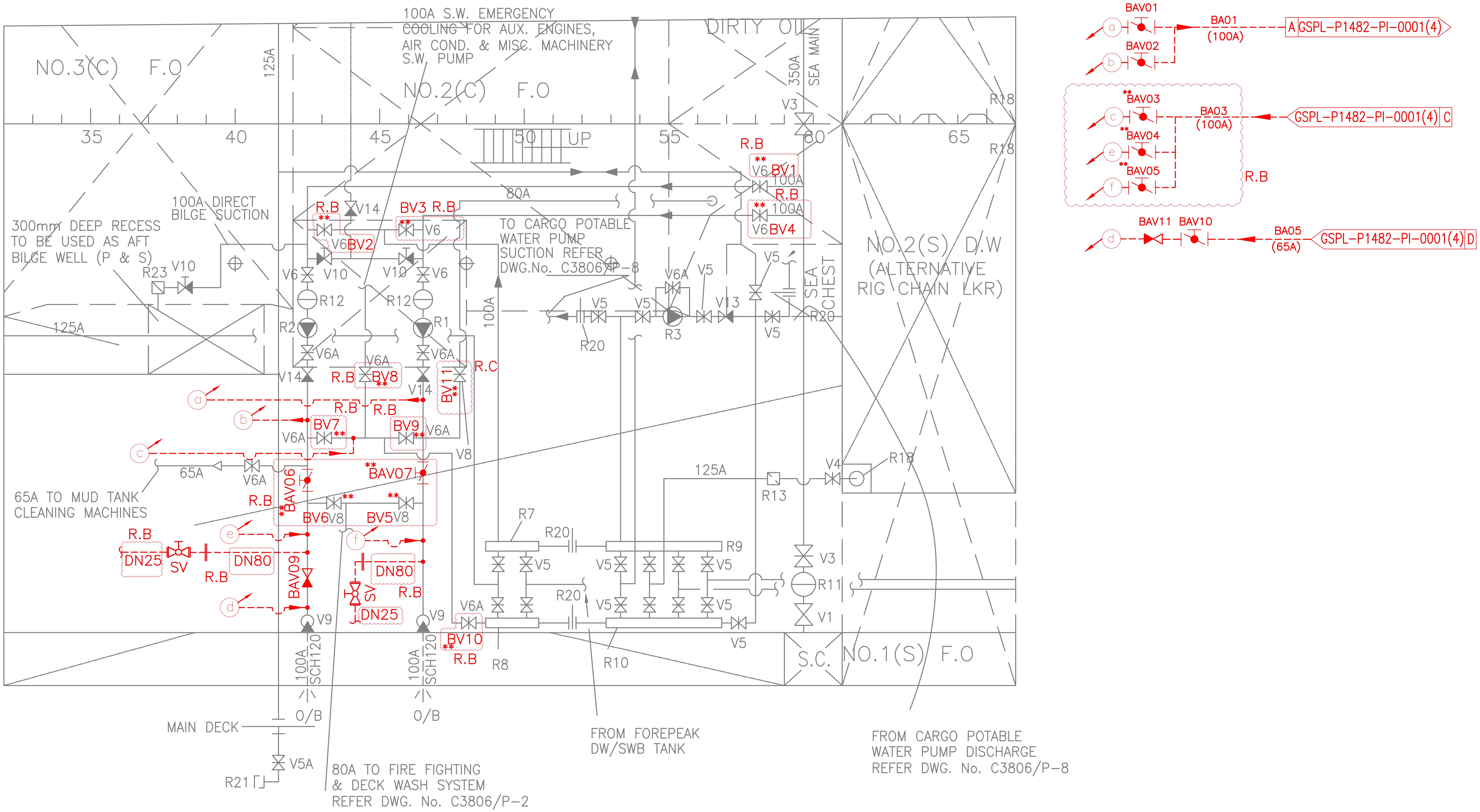
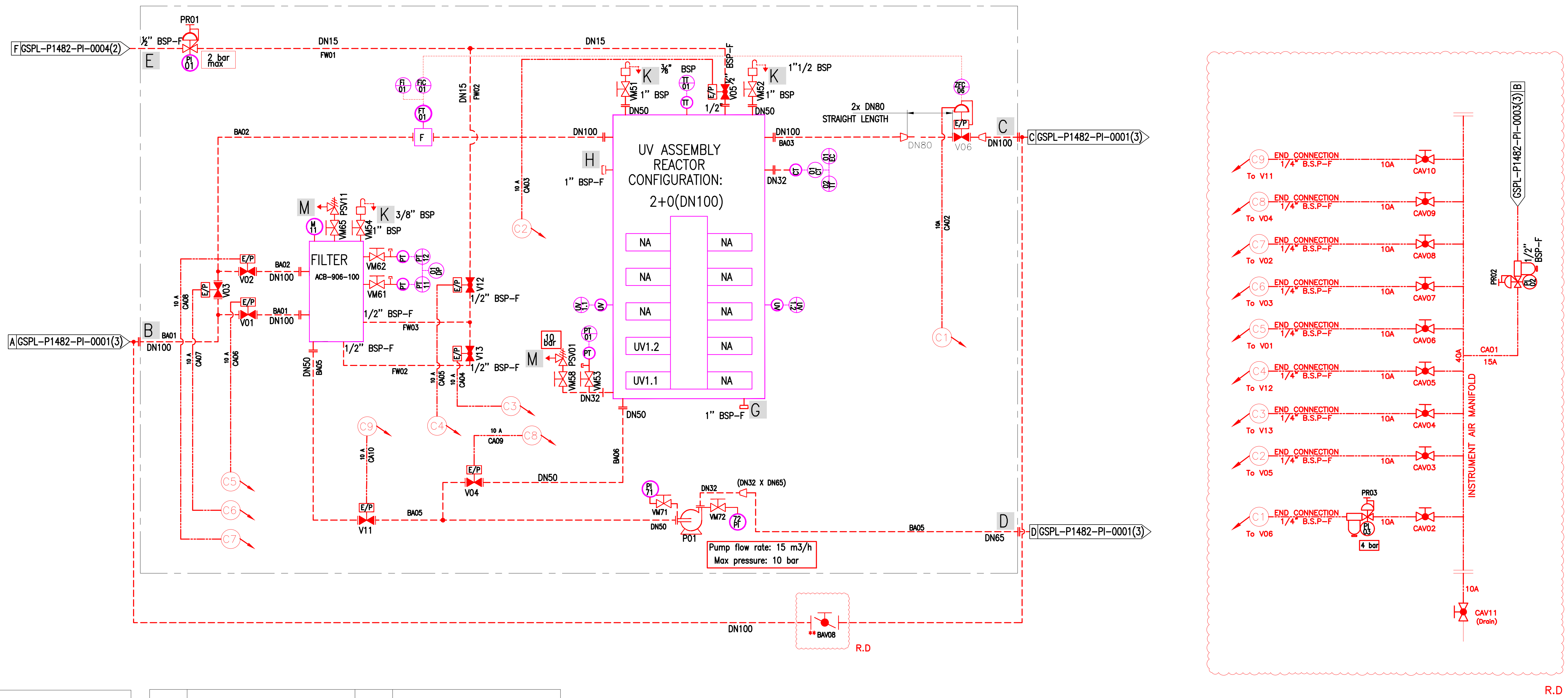


LOWER FORECASTLE DECK
UPPER FORECASTLE DECK
2 MEN
4 MEN
A.H.U. ROOM
STORE
BOSUN STORE
LAUNDRY
50A SCUPPER
BILGE SYSTEM
ST.GEAR HO STOR.TK
VOID
AFT DW/SWB(P)
AFT DW/SWB(S)
NO.4(P) POTABLE WATER
NO.4(S) POTABLE WATER
NO.4(P) F.O.
NO.4(S) F.O.
STEERING GEAR COMPARTMENT
LIQUID MUD
NO.4(C) F.O.(U)
300mm DEEP RECESS TO BE USED AS AFT BILGE WELL (P & S)
NO.2(P) F.O
NO.3(C) F.O
NO.2(C) F.O
L.O. CIRC. TK.
DIRTY OIL
SEA CHEST
S.C.
NO.1(P) F.O
NO.1(S) F.O
NO.3(P) POTABLE WATER
NO.3(S) POTABLE WATER
SEWAGE TANK
NO.2(P) D.W (RIG CHAIN LKR)
NO.2(S) D.W (RIG CHAIN LKR)
NO.1(P) D.W (UNDER)
NO.1(S) D.W (UNDER)
CEMENT TANK
CEMENT TANK COMPARTMENT
BILGE WELL
NO.2(P) POTABLE WATER
NO.2(S) POTABLE WATER
NO.1(P) POTABLE WATER
NO.1(S) POTABLE WATER
B/T COMPT.
DW/WB
FOAM TANK
DISPERSANT TANK
BOTTOM
ESCAPE
KARMFORK/TOWPIN HO STOR.TK.
100A BILGE MAIN
SHADED PORTION INDICATED 300mm DEEP RECESS AREA
E/R FWD BILGE WELL (P&S)
MAIN DECK
BALLAST & D.W. SYSTEMS
125A SCH.80 INSIDE F.O.TANK
NO.2(P) D.W (ALTERNATIVE RIG CHAIN LKR)
NO.2(S) D.W (ALTERNATIVE RIG CHAIN LKR)
100A S.W. EMERGENCY COOLING FOR AUX. ENGINES, AIR COND. & MISC. MACHINERY S.W. PUMP
100A DIRECT BILGE SUCTION
TO CARGO POTABLE WATER PUMP SUCTION REFER DWG.No. C3806/P-8
65A TO MUD TANK CLEANING MACHINES
80A TO FIRE FIGHTING & DECK WASH SYSTEM REFER DWG. No. C3806/P-2
FROM FOREPEAK DW/SWB TANK
FROM CARGO POTABLE WATER PUMP DISCHARGE REFER DWG. No. C3806/P-8
TO BALLAST MANIFOLDS

SHEET: 2/4


100A S.W. EMERGENCY COOLING FOR AUX. ENGINES, AIR COND. & MISC. MACHINERY S.W. PUMP
NO.3(C) F.O
NO.2(C) F.O
DIRTY OIL
350A SEA MAIN
NO.2(S) D.W (ALTERNATIVE RIG CHAIN LKR)
300mm DEEP RECESS TO BE USED AS AFT BILGE WELL (P & S)
100A DIRECT BILGE SUCTION
TO CARGO POTABLE WATER PUMP SUCTION REFER DWG.No. C3806/P-8
SEA CHEST
65A TO MUD TANK CLEANING MACHINES
S.C.
NO.1(S) F.O
MAIN DECK
80A TO FIRE FIGHTING & DECK WASH SYSTEM REFER DWG. No. C3806/P-2
FROM FOREPEAK DW/SWB TANK
FROM CARGO POTABLE WATER PUMP DISCHARGE REFER DWG. No. C3806/P-8
BAV01
BAV02
BA01 (100A)
A GSPL-P1482-PI-0001(4)
**BAV03
**BAV04
**BAV05
BA03 (100A)
GSPL-P1482-PI-0001(4) C
R.B
BAV11 BAV10
BA05 (65A)
GSPL-P1482-PI-0001(4) D
BV1
BV2
BV3
BV4
BV5
BV6
BV7
BV8
BV9
BV10
BV11
BAV06
BAV07
BAV09
DN25
DN80
SV
R.B
R.C



B	Main water inlet
C	Main water outlet
D	Water discharge (backwash & draining)
E	Fresh water inlet
F	Air inlet
G	"To CIP inlet" connection
H	"From CIP outlet" connection
I	"To Stripping ejector" connection
J	"From Stripping ejector" conection
K	Vent outlet to gutter or bilge water
M	Saferty valve outlet to gutter or bilge water

CT	Conductivity transmitter
DP	Differential pressure
EC	Electrical conductivity
F	Flow sensor
Fi	Flow information
FiC	Flow control
FT	Flow transmitter
HA	Visual and audible alarm
P	Pump
PI	Pressure indicator (indicative values, for information only)

PR	Pressure reducing valve
PSV	Pressure safety valve
PT	Pressure transmitter
TT	Temperature transmitter
UV	UV irradiance
V	Valve
VM	Manual valve
ZEC	Control valve opening

Appendix-G: BWMS Operation Maintenance and Safety Manual

BALLAST WATER TREATMENT SYSTEM

B01-0055 to B14-2100
& L01-0030 to L04-0120

OMSM (Operating, Maintenance & Safety Manual)

Ref: BS3-01 rev D01

Release date : July 2024

BIO-UV Group
Email: servicebiosea@bio-uv.com
Phone: +33(0)499.133.911

Revision history

Revision nr	Date	Description of main changes
A00	May 2021	• First release based on manual BSB-01 rev A01 • New PLC model • Software version 3.00 • Update of BIO-SEA models names
B00	June 2021	• Software version 3.01 • Addition of Hydac filter • Replacement of Standard parameters tables by a reference to the parameters list FIC-BET-29 in commissioning book BS3-03
B01	August 2021	• Software version 3.02 (pop up for validation of system settings) • Information about delays for triggering the downgraded mode • Addition of daily checking on VM13 valve and correction of Hydac filter spare parts references
B02	November 2021	• Chapter 6.6.3 : Limitation of 2h retention time removed for BW and FW in USCG mode
B03	December 2021	• Update of chapter 5.2.3: End of Life - System utilization and disposal
B04	March 2022	• Software version 3.03 : update of user access and management (chapter 8.4) • Updated the following Chapters : 1.3, 2.5, 8.3, 11, 12.3 • Suppression of Datamanager paragraph (chapter 11.3.2)

C00	February 2023	• Addition of recommendation for piping material between CIP and BWTS on US flag ships (chapter 6.7.10)
		• Addition of models of BWTS with new Hydac filter models (chapter 6.5), update of filters specifications (chapter 6.7.1)
		• Addition of reactor disabling procedure (chapter 25.5)
		• Clarification of CIP recommendations (chapter 17.3)
		• Software version 3.04:
		    · Modification of user access management (chapter 11)
		    · Pump information recording (chapter 10.3.3)
		    · Update of downgraded mode (reactor deactivation) (chapter 19.2)
		• Update of spare parts catalog:
		    · Addition of reference of 20m UV sensor cable (chapter 37)
		    · Correction of CPU code on spare parts catalog (chapter 45)
		    · New Hydac spare parts (chapter 48.1)

C01	June 2023	• Upgrade of lamp holder (Chapter 24 & 39) • Restoration of Datamanager paragraph (chapter 12.3.2) • Addition of material information for compliance with USCG subchapter F • Update of maintenance times based on experience (Chapter 22.7)

D00	May 2024	• Addition of ACBX filter range in chap 6.5
		• All PID in the manual are updated to show v07 valve
		• Valve information in chap 6.7.8, 9.2 and 21.3
		• Operation sequences updated with V07 status in chap.16 and 17
		• Software 3.05 including changes for V07:
		    · Process and CIP process screens
		    · Butterfly valves parameters
		    · CIP auto options
		• Spares for Filtrex filter (chapter 48) and for butterfly valve (chapter 42.5)

Revision nr	Date	Description of main changes
D01	July 2024	• Correcting erroneous min flow values for stripping in para 6.5.2 and 18 • Adding reference to IACS UR M74 for electrical installation of BWMS in chapter 4.1 and 7.5.1 • Referring to Resolution MEPC.387(81) to provide guidance for operating in challenging water quality conditions in chapter 19

Introduction

Safety, health and environment

Specifications

Control and monitoring

BWTS Operation

Maintenance

Troubleshooting

Survey

Spare parts catalog

Safety Data Sheet

Maintenance and survey checklists

Appendix to the OMSM

1. Foreword

1.1. Scope of the manual

The **BIO-SEA**® manual contains instructions and information about **BIO-SEA**® systems based on the specifications delivered by **BIO-UV Group** company for the proper intended uses. The complete manual is composed of the following parts:

- this Operation, Maintenance and Safety Manual (BS3-01) applying to **BIO-SEA**® B & L models, for the use of the ship crew or service engineers
- the specific technical binder relative to the purchased **BIO-SEA**® system, including system characteristic (power, weight, dimensions...) applicable drawings, datasheets and component manuals
- the Installation Manual (BS3-02), for the use of installers and shipyards
- the Commissioning Manual (BS3-03), for the commissioning with the **BIO-UV Group** engineer or its representative

BIO-UV Group recommends carefully reading this manual before attempting to operate or to perform maintenance on **BIO-SEA**® system.

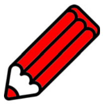
Non compliance with the information contained in this manual compromises the safety features and correct functioning of your **BIO-SEA**® system.

General characteristics are guaranteed by **BIO-UV Group** under the following conditions:

- Read carefully the operating instructions before attempting to operate the system.
- Always operate with full knowledge and appreciation of **BIO-SEA**® BWTS warnings and alarms.
- Always refer to labeling and instructions in order to avoid compromising BWTS integrity.

1.2. Document symbols

To alert the operator of potentially hazardous conditions, symbols described in this chapter are provided wherever necessary throughout the notice.

	Emphasizes information that can be helpful to the operator before, during or after a specific operational function.
	Emphasizes information that must be followed to avoid possible damage to the system.
	Emphasizes information that must be followed to avoid hazard to either the operator or the environment, or both.
	Emphasizes important information that must be followed to avoid environmental impact or exposure to potentially infectious material.

1.3. Abbreviations

Table 1: Abbreviations

	Definition.		Definition
BWM	Ballast Water Management	IMO	International Maritime Organization
BWMP	Ballast Water Management Plan	MEPC	Marine Environment Protection Committee
BWMS	Ballast Water Management System	MMC	Multimedia Card
BWTS	Ballast Water Treatment System	MPN	Most Probable Number Method
CFR	Code of Federal Regulation	NC	Normally Closed (for valves)
CIP	Cleaning In Place (Option)	NO	Normally Open (for valves)
CMFDA	5-chloromethylfluorescein diacetate staining protocol	PID	Piping and Instrumentation Diagram
D-2	IMO Discharge Standard for Ballast Water	PLC	Programmable Logic Controller
EMC	Electromagnetic Compatibility	TRC	Treatment Rate Capacity
ETV Protocol	Environmental technology verification protocol; protocol for the verification of ballast water treatment technologies v5.1 09/2010	USCG	United States Coast Guard
G2	Guidelines for Ballast Water Sampling; IMO resolution MEPC.173(58)	UVI	UV intensity
HMI	Human Machine Interface	UVT	UV transmittance

1.4. Standard measuring units

Table 2: Measuring unit list

Measuring type	Name	Abbreviation
Conductivity	milliSiemens per centimeter	mS/cm
Dimension	Millimeter	mm
	Inch	"
Volume	Liter	L
Flow rate	Cubic meter per hour	m^3/h
Pressure	Bar	bar
Weight	Kilogram	kg
Temperature	Celsius degree	°C
Electric voltage	Volt	V
	Volt Direct Current	VDC
Electric intensity	Ampere	A
Electric power	Kilowatt	kW
	Watt	W
Electric frequency	Hertz	Hz
Salinity	Practical Salinity Unit	PSU
UV intensity	Watt per square meter	W/m^2

2. Legal Information

2.1. Notice of liability and warranty

The information in this manual is distributed on an "As Is" basis, without warranty.

While every precaution has been taken in the preparation of this manual, **BIO-UV Group** will not assume any liability to any persons or entities with respect to loss or damage, caused or alleged to be caused directly or indirectly by not following the instructions contained in this document, or by using the **BIO-SEA**® system described herein in a manner inconsistent with our product labeling.

BIO-UV Group reserves the right to modify the technical data enclosed without prior notice.

The duration of warranty is stipulated in the Sales and Service Conditions associated with the purchase of the **BIO-SEA**® BWTS. To validate the warranty, ensure the following is fulfilled:

- The BWTS has been installed and commissioned as instructed in the **BIO-SEA**® manual (see Installation book BS3-02 and Commissioning book BS3-03).
- The BWTS is operated as instructed in this **BIO-SEA**® manual (see BWTS Operation section in OMSM BS3-01).
- Service is done according to **BIO-UV Group** recommendations and proper tools are used when maintenance or troubleshooting operations are performed.
- Only spare parts supplied by **BIO-UV Group** or a local representative can be used, unless they have been expressly specified in the **BIO-SEA**® manual.
- No changes or modifications to the equipment are permitted without express authorization from the manufacturer or his representative.
- The electrical installation must adhere to national or international regulations.

You should always note and communicate the part numbers of your unit (BSEAXXXXXX) when requesting service assistance or ordering spare parts.

2.2. Registered trademarks

BIO-SEA® is registered trademark of **BIO-UV Group**.

Other product names mentioned within this publication may be trademarks or registered trademarks of their respective owners.

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Email: marketing@bio-uv.com

2.5. Software version

The screens and the software version in this documentation can be different from your system without affecting the operating principle.

The information included in this manual are compatible for systems using software version V3.05 or later.

3. Contacts and Technical Service

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FRANCE
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Fax: +33(0) 499 133 919

Email: servicebiosea@bio-uv.com or bio-sea@bio-uv.com

If you have any doubt or if you need any further technical information, please contact your local **BIO-UV Group** representative.

4. Risk analysis and general safety precautions

4.1. General

BIO-SEA® system design and construction comply with latest industrial best practices and general requirements for water treatment technology and with the general safety requirements, in accordance with Rules for Classification of Steel Ships and offshore units.

The design of the **BIO-SEA**® BWTS is intended for treatment of ballast water only.

An improper use may cause operator injuries or severe damages to the BWTS equipment.

Failure to comply with the conditions of use described in the present notice will be considered as improper use. In this case **BIO-UV Group** can not guarantee this product in terms of security and performance.

BIO-UV Group has conducted HAZOP and HAZID/FMECA analysis for all components and operations of the **BIO-SEA**® **BWTS**.

Results of the analysis have been used for establishing safety warnings on the software and in this manual.

The **BIO-SEA**® BWTS should not be installed in hazardous area.

Shipyard/installer should follow the recommendations of IACS UR M74 for installation of BWMS.

4.2. Identified risks for Filter

4.2.1. Heavy weight

Use protective gloves for handling and maintenance of the filter.
During installation and maintenance, while using lifting equipment:
- Make sure that the filter or the lifted part is chained securely and in a safe manner.
- Avoid working below lifted equipment.
- Wear a safety helmet while working around lifted equipment.

4.2.2. Pressure equipment

Filters are pressure vessels. They are equipped with pressure gauge and automatic air release.

- Do not open or tighten filter covers during operation or under pressure.
- Do not expose the equipment to working pressure & temperature over the Design Pressure & Temperature.

4.3. Identified risks for UV Reactors

4.3.1. UV light exposure

The operator must always follow the operating and maintenance instructions described in the manual to prevent from any risks of exposure of UV light.
- UV Lamps protection covers must never be handled nor opened when the BWTS is operating.
- Standard eye protection should be worn to avoid direct exposure to UV light during maintenance procedures.

4.3.2. Hot surfaces

About 5 minutes after the lamp start-up, the lamp wire sheath (metallic tube between the connecting box and the reactor end) becomes very hot.

Take care not to touch it when the lamp is functioning as there is a burning risk.

Insufficient flow in the UV reactor can cause heating of the reactor.

An automatic shutdown of the system is triggered when flow is lower or equal to $4m^3/h$ per reactor during 10s (first safety of double layer safety) or when TT01/TT02 temperature reaches 70°C (second safety of double layer safety).

Always switch off the lamp and wear protective gloves when handling the reactor.

4.3.3. Pressure equipment

UV assemblies are pressure vessels. They are equipped with pressure gauge and automatic air release.

- Do not open or tighten assembly flanges or connections during operation or under pressure.
- Do not expose the equipment to working pressure & temperature over the Design Pressure & Temperature.

4.3.4. Possible release of mercury

Mercury (CAS nr: 7439-97-6, see MSDS in Appendix chapter of the OMSM BS3-01) is present in small amount in the UV lamps. Hypothetically, breakage of a UV lamp within the system could release the small amount (<1190 mg for **BIO-SEA® B** lamps or <343mg for **BIO-SEA® L** lamps) of mercury into the system although this would be rapidly diluted to <0.1 µg/L in a ballast tank and to much lower concentrations on deballasting. Inert gases are not chemically active and would not pose any toxic threat.

In normal operational conditions, release of mercury would not be possible as the UV lamps are encased quartz sleeves that are further protected by a titanium chamber. A breach of this chamber is extremely unlikely.

If a lamp is broken during maintenance operations, avoid all contact with skin and eyes. Do not inhale vapors.
Mercury can be rendered harmless by binding it with sulphur powder. A Mercury recovery kit can be ordered with the code OUT014179.

4.3.5. Quartz breakage

Always wear protective gloves when handling the quartz sleeves or the UV lamps.

Quartz sleeves protecting UV lamps can break inside the reactor or during handling for maintenance.
Specific procedures and appropriate warnings for packaging, handling and disposal of glass components have been established and must always be referred by the user.

4.4. Identified risks for electrical components

All **BIO-SEA®** components used are approved and tested for used in engine room environment. However, operator injury may occur from an electric shock.

- Only electrical skilled personnel should operate on the supply cabinets.
- Always switch off general power circuit before any intervention on one of the cabinets or on connection boxes of the lamps on the reactors.
- The operation area must be secured before intervention.

4.5. Operational risks

In order to ensure the correct handling of the **BIO-SEA®** BWTS during installation, commissioning, operation and maintenance, the following information should be supplied to the crew member in charge:

- all the instructions for installing and operating the BWTS.
- the information related to safety and prevention of accidents.
- the list of equipments and specific tools needed for operations.
- the defined responsibilities for each activity (installation, maintenance and servicing).

Easy access for safe maintenance operations of all the components of the system must be respected.

Exposure to noise and vibrations is detailed in document FIC-BET-13.

Operator should wear hear protection equipment when working close to the system.

4.6. Identified risks for CIP system

The CIP system uses citric acid (CAS 5949-29-1) powder diluted in fresh water. The solution, at the time of discharge (in a ballast or to the sea), is mixed with seawater volume associated with the operation. In general, this volume generates a dilution of 100 to 1000 times (or more) and, consequently, the concentration drops below a level lower than 100mg/l which is the aquatic toxicity threshold (see MSDS in chapter Safety Data Sheet section in OMSM BS3-01).

4.6.1. Storage of powder

This product must be stored in fresh and dry place such as vessel storeroom for chemical products (Storage class 11) at a temperature of 15 to 25°C.

A release of citric acid would occur in case of improper storage of bags. It is recommended to place it in closed metallic container.

4.6.2. Handling

- Citric acid powder can cause serious eye irritation and slight skin irritation.
- It is strongly recommended to avoid contact during handling.
- When handling the cleaning solution, protection equipment must be worn such as gloves, safety goggles and protective clothes to protect the skin from irritation.

CIP and BWTS components have been chosen to be resistant to diluted citric acid used for cleaning.

See also 5.3.2. Citric acid (CIP), page 26, for environmental acceptability.

5. Environmental impact

5.1. No generation of By-products

The **BIO-SEA® BWTS** only uses mechanical filtration and Medium Pressure (MP) UV light for disinfection; it does not use any chemical additives, catalysis or any procedure resulting in the formation of active substances, by-products or relevant chemicals.

Consequently **BIO-SEA®** Treatment has no impact on the vessel's ballast water (no variation of the corrosivity) and no adverse effect on ballast water tanks, ballast water piping and/or pumping systems.

BIO-SEA® BWTS BWTS does not use chemicals nor generate by-products. It has no impact on the vessel's ballast water, ballast water tanks, ballast water piping and pumping systems.

5.2. BIO-SEA® BWTS waste

5.2.1. Side streams

Three sides streams are identified:

- The filtration concentrate is composed of local water and retained organisms. It can be discharged at the uptake location (ballasting process) without further management.
- The fresh water issued from cleaning sequences, is to be drained automatically or manually. It can be released without further management.
- The cleaning solution for CIP device:
    - In CIP tank, concentration is 400g/l. A drip tray is provided below the parts where concentrated acid is circulating. Otherwise, spill may be carefully neutralized with lime (calcium oxide, CaO).
    - After injection in the BWTS, concentration is 5g/l (CIP cleaning cycle).To dilute this amount at discharge below the aquatic toxicity threshold, this water stream should be discharged in the ballast water line (at ballasting/deballasting). The ship is responsible for directing the discharge to the appropriate destination, as required (i.e. overboard discharge, holding tank, or other destination).

5.2.2. Wastes

Disposable used accessories and consumables must be collected by specialized structures for elimination and recycling of this kind of material according to the local legislation.

In particular, worn UV lamps should be placed in specific container for UV lamp disposal in order to be collected by approved agency or sent directly to **BIO-UV Group** which is a licensed collector organization.

5.2.3. End of Life - System utilization and disposal

At the end of **BIO-SEA**® system lifetime, the equipment should be dismantled, and its components should be separated according to their nature (electrical, hazardous, metallic…). Disposal of these different elements should be managed according to regulations in force.

In accordance with the requirements of the IMO Hong Kong Convention for the Safe and Environmentally Sound Recycling of Ships and the EU Ship Recycling Regulation No 1257/2013, **BIO-UV Group** has identified hazardous material in the **BIO-SEA® BWTS** and verified information from its suppliers for recycling purpose, and provides required records and documentation for Inventory of Hazardous Materials (IHM).

5.3. Risks to the Aquatic environment

5.3.1. UV treatment

Whole Effluent Toxicity (WET) tests have been conducted as part of a series of land-based trials of a BIO SEA® BWTS, at the DHI test site in Hundested - Denmark, and also at the Maritime Environmental Resources Center (MERC), in Maryland - USA.

It was concluded that no toxicity was associated with UV treated water.

5.3.2. Citric acid (CIP)

Due to its physico-chemical characteristics, citric acid is highly mobile in the environment and will partition to the aquatic compartment. Citric acid is "generally recognized as safe," or GRAS (see 21 CFR 182.1033). Consequently, this product cannot be considered as a hazardous material and no alarm for unintentional release is needed (as required by CFR 160.060-20 (C)(7)).

Information about elimination (persistence and degradability):

- Easily biodegradable.
- Degradability > 98% (mod. Zalm - Wellens Test (OE CD 302 B)).

Aquatic toxicity threshold:

- LC 50 / 24h 1535 mg/l (Daphnia magna).

LC 50 / 48 h 440 mg/l (Fish).

6. General Description of BIO-SEA® System

For exact dimensions and weight of system skid and/or Components, please refer to technical binder.

6.1. Scope of the system

BIO-SEA® is a treatment system specifically designed for inactivation and elimination of organisms contained in ballast water, in order to comply with the IMO D-2 standard and USCG regulations for discharge of such water by vessels during their operations.

Table 3: IMO D-2 Standard for discharge of ballast water

Microorganism category	Regulation
Plankton, size > 50 µm	< 10 viable cells / m3
Plankton, size 10-50 µm	< 10 viable cells / mL
Toxicogenic Vibrio Cholerae	< 10 Colony Forming Unit / 100 mL
Escherichia Coli	< 250 Colony Forming Unit / 100 mL
Intestinal Enterococci	< 100 Colony Forming Unit / 100 mL

IMO and USCG have two separated approval processes with different analysis methods:

- IMO uses BWMS code (IMO Resolution MEPC.300(72)), accepting the MPN method for the analysis of the 10-50µm organisms category.
- USCG follows ETV protocol, only accepting CMFDA/FDA method for analysis of the 10-50µm organisms category.

For compliance with the D-2 standard, **BIO-SEA® BWTS** applies different treatment levels according to the analysis method used. **BIO-SEA®**Software allows selecting:

- MPN/IMO settings only.
- CMFDA/USCG settings only.
- MPN/IMO or CMFDA/USCG settings (selected before each operation through a pop-up window).

The system combines two technologies:

- Mechanical Filtration.

The objective of the filtration is to retain the suspended particles, organic or not, present in the sea water at uptake, with a 20µm screen. The filtrate is flushed out of the filter, thanks to automatic cleaning, and the filtered organisms are sent back to the local water.

- Ultraviolet Disinfection.

Without any addition of active substances, nor creation of by-products, the UV-C light inactivates the microorganisms present in the water (bacteria, phytoplankton, zooplankton).

The **BIO-SEA®** treatment system is intended to be operated at every ballasting and deballasting operation, according to the ballast water management plan of the vessel. Treatment has to be applied also during stripping operation, using the ejector / fire line.

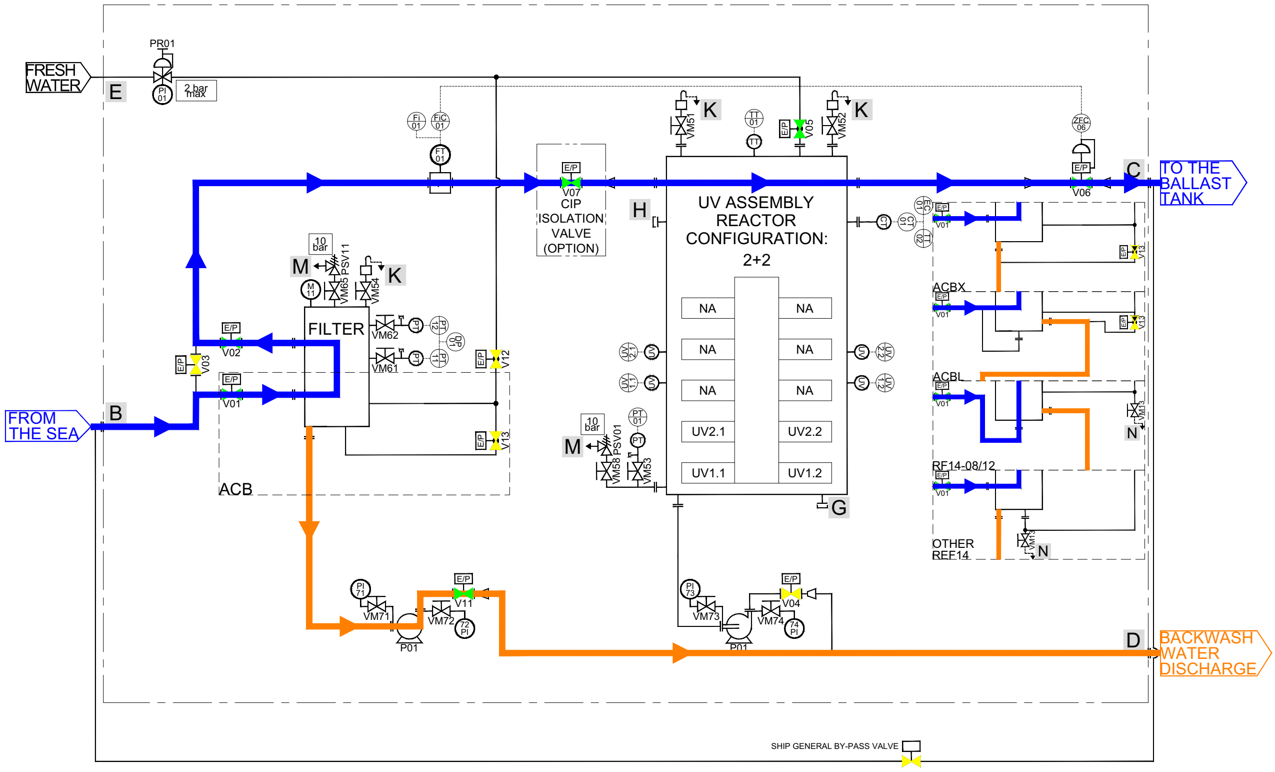
In order to ensure the vessel compliance with the IMO D-2 discharge standard, the following points should be observed:

- The **BIO-SEA®** treatment system should be operated at every ballasting and deballasting operations, according to the ballast water management plan of the vessel.
- An adequate flushing procedure should be determined and included in the ballast water management plan in order to prevent any mixing or discharge of unmanaged water (that could remain in the pipes or sea chest).

6.2. Treatment process description

6.2.1. Treatment during ballasting

During ballasting, both operations of filtration and UV disinfection are carried out:



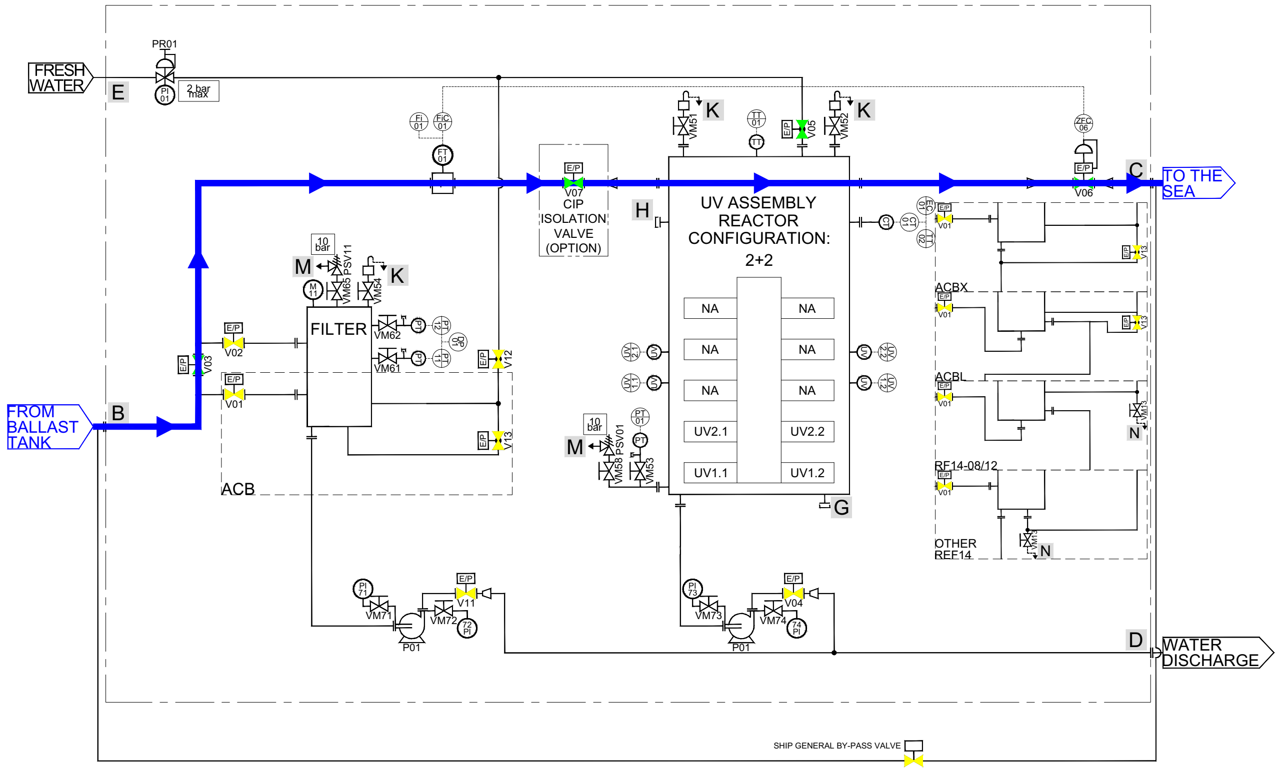
During the ballasting operation, the outlet control valve allows the flow through the system to be always below the maximum treatment rate of the system (TRC).

Backflush stream is only composed of local water and can be discharged to the sea at the uptake location.

6.2.2. Treatment during deballasting

During deballasting, only UV disinfection is completed (the filter is by-passed).

This allows retreating the water, after retention and/or mixing with other managed water volumes in the ship's ballast tanks during voyage, in order to eliminate any possible biological recontamination, and to ensure compliance with the regulations for discharge of ballast water.



During the deballasting operation, the outlet control valve allows the flow through the system to be always below the maximum treatment rate of the system (TRC).

When tanks are almost empty, deballasting is still possible with stripping. This operation with special conditions can be performed in several ways that are described in 16.3. Stripping, page 114. If backwash is used, water discharge should be rejected directly to the sea.

6.2.3. Cleaning

When operations are over, a cleaning cycle can be triggered in order to flush and refill the complete system with fresh water. This will avoid potential growth of marine organisms inside the filter, and salt/sediment deposits on quartz sleeves.

Deposits on quartz sleeves can also be cleaned punctually with a "cleaning-in-place" (CIP) option. This device can be automatic (BIOSEA Clean) or manual (BIOSEA M-Clean) and uses acid citric solution.

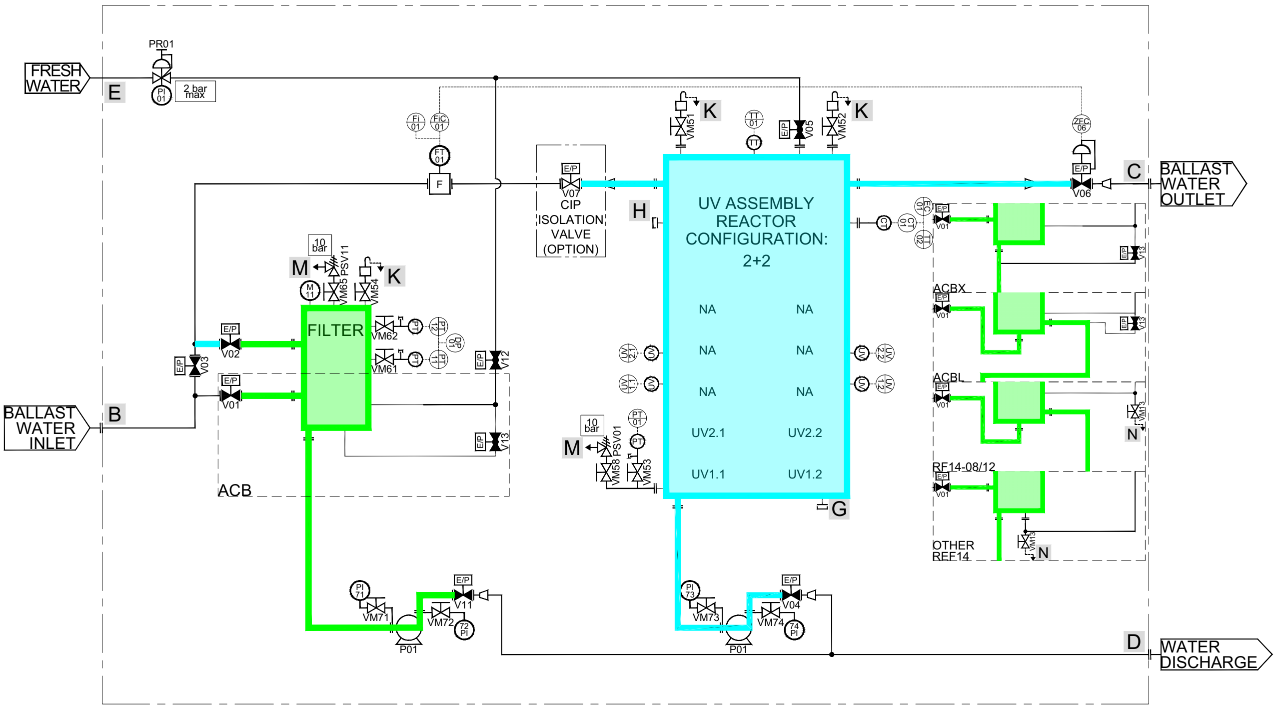
When a **BIO-SEA®** Clean device is used, UV assembly can be cleaned with sea water already contained in the BWTS in order to save fresh water. When launching the CIP cycle, it is possible to select if the assembly will be refilled with fresh water or not (ie, with sea water instead). However, unless the system will be used within a short time, it is better to refill with fresh water at the end of CIP Cleaning.

If no CIP option has been installed, the quartz sleeves can be cleaned manually by dismounting them and wiping them with white vinegar or acid solution.

To determine the required cleaning volume, it is important to take into account the piping connecting the UV assembly. In the picture below:

- The circuit in blue shows piping and components that will be filled with fresh water during the UV assembly standard cleaning or the CIP cleaning.
- The circuit in green shows the components that will be filled with fresh water during the filter cleaning.

As an option, o reduce water consumption during cleaning, an isolation valve (V07) can been added before the UV assembly.



6.2.4. Mitigation of contamination risk

A few cubic meters of unmanaged water can contaminate a whole discharge.

It is important that procedures are followed to avoid transporting untreated water in the vessel at any time:

- pipe flushing procedures should be performed each time untreated water is circulated.
- untreated water trapped between seachest and BWTS, or in pipe dead ends, should be evacuated at the end of each port operation.
- tank cleaning procedures should be defined in case unmanaged water is loaded in ballast tanks.

6.3. Flow and power regulation

Regulation of UV power and seawater flow are part of the BWTS approval to ensure performance according to the standards. To get a good treatment of the ballast water, this function manages the interaction between:

- the UVI (ensuring treatment performance).
- the flow rate (regulated by the outlet control valve (V06)).
- the treatment method: MPN/IMO or CMFDA/USCG.

During ballasting, deballasting or stripping operations, BWTS can have several behaviors:

- When water has good quality (high UVT), UV dimming (UVI threshold for power regulation) is used in order to reduce power consumption.
- When water has bad quality (low UVT), the system can maintain full power until UVI threshold; after that, flow rate is reduce to maintain required UV dose.

The user has no need to adjust set-points because **BIO-SEA®** BWTS operates automatically according to water conductivity, UV irradiance (or UV intensity, UVI) and flow rate.

UV setpoints and conductivity thresholds are set directly in the software and cannot be changed on the screen.

When the system has more than 1 reactor, the lowest value of UV sensor is taken to determine if flow regulation is necessary.

Operation, warning and alarms setpoints can be modified only with specific access rights, but generally should not be modified as it has already been set during the commissioning.

All the parameters for operation, warning and alarms are summarized in the commissioning book.

6.4. System interfaces

On the Piping and Instrumentation Diagram (PID), all connections of the BWTS can be located. In particular, external connections are tagged with a letter.

*Figure 1: PID for a **BIO-SEA® BWTS** model B04-0515 with manifold configuration 2+2*

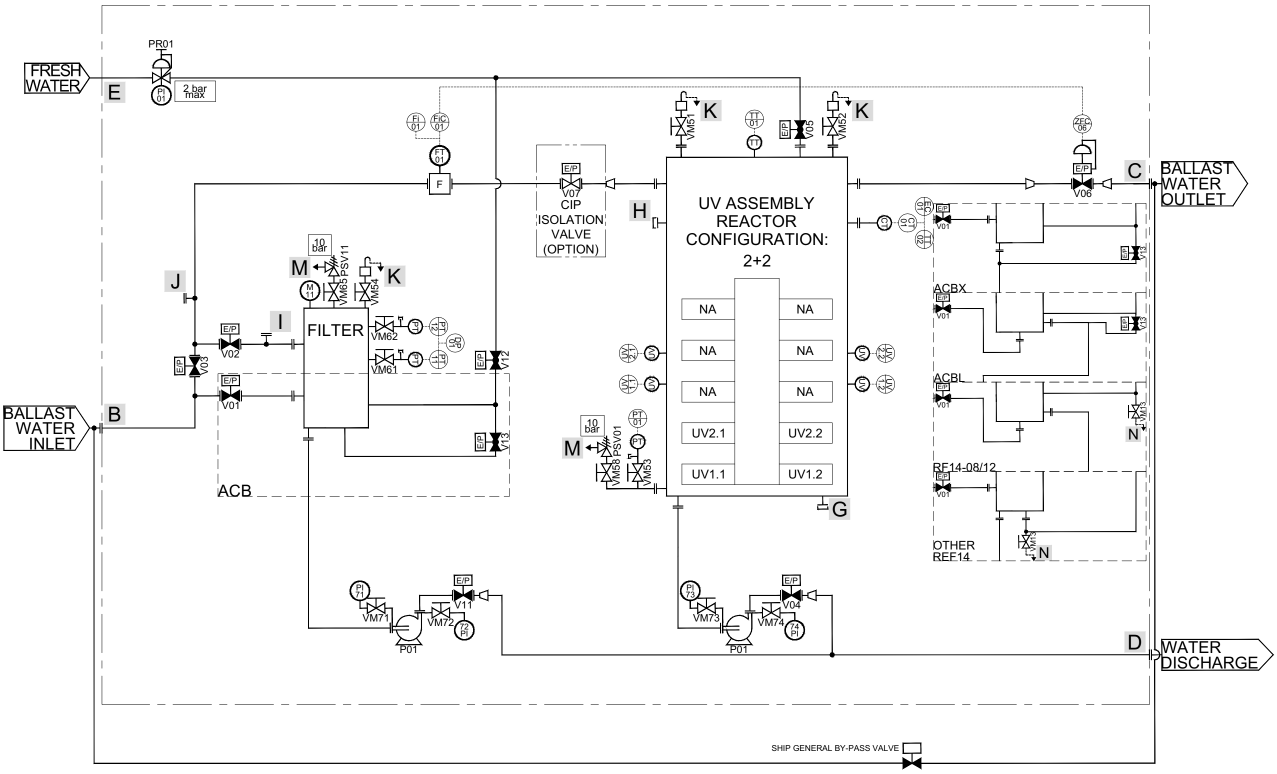


Table 4: Legend of connections tagged with a letter

Letter	Corresponding connection
B	Main water inlet
C	Main water outlet
D	Water discharge (backwash & draining)
E	Fresh water inlet
G	CIP solution outlet (connection to CIP inlet)
H	CIP solution inlet (connection to CIP outlet)
I	Filtered driving water outlet (to stripping ejector line)
J	Stripping water inlet (from stripping ejector line)
K	Vent outlet to drip tray or bilge water
M	Safety valve outlet to drip tray or bilge water

6.5. Main configurations and capacities

6.5.1. Configurations

*Table 5: Main components of **BIO-SEA**® models*

BIO-SEA® model	Manifold configuration	Filter (Standard) ACB	Filter (Standard) ACB X/L	Filter (Standard) RF14	UV Reactor	Power Cabinet Standard version	Power Cabinet Compact version	Electronic ballast (ELC)	Control Command Cabinet	Pump[1]
		Ref	Ref	Ref	Qty	Qty	Qty	Qty	Qty	Qty
L01-0030[2]	1+0 or without manifold	903-065	NA	08c	1	NA	NA	1	1	1
L01-0055	1+0	904-080	NA	NA	1	NA	NA	1	1	1
L02-0035	2+0	903-065	NA	NA	2	NA	NA	2	1	1
L02-0055	2+0	904-080	NA	NA	2	NA	NA	2	1	1
L02-0060	2+0	906-100	906-100X	08	2	NA	NA	2	1	1
L03-0055	3+0	904-080	NA	NA	3	NA	NA	3	1	1
L03-0087	3+0	906-100	906-100X	NA	3	NA	NA	3	1	1
L03-0090	3+0	NA	NA	10	3	NA	NA	3	1	1
L04-0087	4+0 or 2+2	906-100	906-100X	NA	4	NA	NA	4	1	1
L04-0120	4+0 or 2+2	910-150	910-150X	NA	4	NA	NA	4	1	1
B01-0055	1+0	904-080	NA	NA	1	1	1	NA	1	1 or 2
B01-0087	1+0	906-100	906-100X	NA	1	1	1	NA	1	1 or 2
B01-0110	1+0	NA	NA	12c	1	1	1	NA	1	1 or 2
B01-0135	1+0	910-150	910-150X	NA	1	1	1	NA	1	1 or 2
B01-0150	1+0	915-150	915-150X	10	1	1	1	NA	1	1 or 2
B02-0150	2+0 or 1+1	NA	NA	10	2	1	1	NA	1	1 or 2
B02-0190	2+0 or 1+1	915-150	915-150X	NA	2	1	1	NA	1	1 or 2
B02-0255	2+0 or 1+1	935-200	935-200X	NA	2	1	1	NA	1	1 or 2
B02-0300	2+0 or 1+1	945-200	940-200X	15	2	1	1	NA	1	1 or 2
B03-0300	3+0 or 2+1	NA	940-200X	15	3	NA	1	NA	1	1 or 2
B03-0340	3+0 or 2+1	945-200	945-200X	NA	3	NA	1	NA	1	1 or 2
B03-0450	3+0 or 2+1	955-250	955-250X	20	3	NA	1	NA	1	1 or 2
B04-0515	4+0 or 2+2	955-250	955-250X	NA	4	NA	1	NA	1	1 or 2
B04-0530	4+0 or 2+2	NA	NA	20	4	NA	1	NA	1	1 or 2
B04-0600	4+0 or 2+2	985-300	960-250X	25	4	NA	1	NA	1	1 or 2
B05-0515	5+0 or 3+2	955-250	955-250X	NA	5	NA	1	NA	1	1 or 2
B05-0530	5+0 or 3+2	NA	NA	20	5	NA	1	NA	1	1 or 2
B05-0750	5+0 or 3+2	985-300	985-300X	25	5	NA	1	NA	1	1 or 2
B06-0600	3+3 or 2x(2+1	NA	960-250X	NA	6	NA	1	NA	1	1 or 2
B06-0750	3+3 or 2x(2+1)	NA	NA	25	6	NA	1	NA	1	1 or 2
B06-0770	3+3 or 2x(2+1)	985-300	985-300X	NA	6	NA	1	NA	1	1 or 2
B06-0900	3+3 or 2x(2+1)	999-350	999-350X	30	6	NA	1	NA	1	1 or 2
B07-0750	4+3	NA	NA	25	7	NA	2	NA	1	1 or 2
B07-0770	4+3	985-300	985-300X	NA	7	NA	2	NA	1	1 or 2
B07-1040	4+3	999-350	999-350X	NA	7	NA	2	NA	1	1 or 2
B07-1050	4+3	NA	NA	30	7	NA	2	NA	1	1 or 2
B08-1040	4+4 or 2x(2+2)	999-350	999-350X	NA	8	NA	2	NA	1	1 or 2
B08-1050	4+4 or 2x(2+2)	NA	NA	30	8	NA	2	NA	1	1 or 2
B08-1200	4+4 or 2x(2+2)	9100-400	9100-400L	35	8	NA	2	NA	1	2
B09-1350	5+4	9100-400	9100-400L	40	9	NA	2	NA	1	2
B10-1040	5+5 or 2x(2+3)	999-350	999-350X	NA	10	NA	2	NA	1	2
B10-1050	5+5 or 2x(2+3)	NA	NA	30	10	NA	2	NA	1	2
B10-1500	5+5 or 2x2+3)	9100-400	9100-400L	40	10	NA	2	NA	1	2
B12-1210	2x(3+3)	NA	NA	35	12	NA	2	NA	1	2
B12-1500	2x(3+3)	9100-400	9100-400L	NA	12	NA	2	NA	1	2
B12-1725	2x(3+3)	NA	NA	40	12	NA	2	NA	1	2
B12-1800	2x(3+3)	9120-500	9120-500L	NA	12	NA	2	NA	1	2
B14-1500	2x(4+3)	9100-400	9100-400L	NA	14	NA	3	NA	1	2
B14-1725	2x(4+3)	NA	NA	40	14	NA	3	NA.	1	2
B14-2070	2x(4+3)	NA	NA	45	14	NA	3	NA	1	2
B14-2100	2x(4+3)	9120-500	9120-500L	NA	14	NA	3	NA	1	2

1. Pump quantity depends on skid configuration or modular installation. Usually, skid configuration uses only one pump and modular installation uses two pumps.
2. When the suffix "Mini" is added to this model name, it means there is no manifold. The system arrangement differs from the other models but performances and parameters are the same.

6.5.2. Rated capacities

Table 6: Flows of ***BIO-SEA***® *models*

BIO-SEA® model	Filter range	Max Flow Rate		Min Operational Flow Rate[1]		Min Allowable Flow Rate[2]		Min flow for operation start	
		USCG/ CMFDA method	IMO/MPN method	during ballasting	during deballasting	during ballasting	during deballasting	during ballasting	during deballasting
		m³/h	m³/h	m³/h	m³/h	m³/h	m³/h	m³/h	m³/h
L01-0030	ACB RF14	20	30	18 13	10	13	5	13	7
L01-0055	ACB	20	30	20	10	15	5	15	7
L02-0035	ACB	35	35	28	20	18	10	18	14
L02-0055	ACB	40	55	30	20	20	10	20	14
L02-0060	ACB ACBX/L RF14	40	60	35 25	20	25	10	25	14
L03-0055	ACB	55	55	40	30	25	15	25	21
L03-0087	ACB ACBX/L	60	87	45	30	30	15	30	21
L03-0090	RF14	60	90	30		30	15	30	21
L04-0087	ACB ACBX/L	80	87	55	40	35	20	35	28
L04-0120	ACB ACBX/L	80	120	65	40	45	20	45	28
B01-0055	ACB	55	55	50		15	5	30	20
B01-0087	ACB ACBX/L	87	87	50		20	5	35	20
B01-0110	RF14	110	110	50		30	5	45	20
B01-0135	ACB ACBX/L	100	135	50		30	5	45	20
B01-0150	ACB ACBX/L RF14	100	150	50		40 45	5	55 50	20
B02-0150	RF14	150	150	100		50	10	80	40
B02-0190	ACB ACBX/L	190	190	100		45	10	75	40
B02-0255	ACB ACBX/L	200	255	100		45	10	75	40
B02-0300	ACB ACBX/L RF14	200	300	100		57 52 75	10	87 82 100	40
B03-0300	ACBX/L RF14	300	300	150		57 80	15	102 125	60
B03-0340	ACB ACBX/L	300	340	150		62	15	107	60
B03-0450	ACB ACBX/L RF14	300	450	150		62 100	15	107 145	60
B04-0515	ACB ACBX/L	400	515	200		67	20	127	80
B04-0530	RF14	400	530	200		105	20	165	80
B04-0600	ACB ACBX/L RF14	400	600	200		90 74 125	20	150 134 185	80
B05-0515	ACB ACBX/L	500	515	250		72	25	147	100
B05-0530	RF14	500	530	250		110	25	185	100
B05-0750	ACB ACBX/L RF14	500	750	250		95 130	25	170 205	100
B06-0600	ACBX/L	600	600	300		84	30	174	120
B06-0750	RF14	600	750	300		135	30	225	120
B06-0770	ACB ACBX/L	600	770	300		100	30	190	120
B06-0900	ACB ACBX/L RF14	600	900	300		124 155	30	214 245	120
B07-0750	RF14	700	750	350		140	35	245	140
B07-0770	ACB ACBX/L	700	770	350		105	35	210	140
B07-1040	ACB ACBX/L	700	1040	350		129	35	234	140

*Table 6: Flows of **BIO-SEA**® models*

BIO-SEA® model	Filter range	Max Flow Rate		Min Operational Flow Rate[1]		Min Allowable Flow Rate[2]		Min flow for operation start	
		USCG/ CMFDA method	IMO/MPN method	during ballasting	during deballasting	during ballasting	during deballasting	during ballasting	during deballasting
		m^3/h	m^3/h	m^3/h	m^3/h	m^3/h	m^3/h	m^3/h	m^3/h
B07-1050	RF14	700	1050	350		160	35	265	140
B08-1040	ACB ACBX/L	800	1040	400		134	40	254	160
B08-1050	RF14	800	1050	400		165	40	285	160
B08-1200	ACB ACBX/L RF14	800	1200	400		166 165	40	286 285	160
B09-1350	ACB ACBX/L RF14	900	1350	450		171 195	45	306 330	180
B10-1040	ACB ACBX/L	1000	1040	500		144	50	294	200
B10-1050	RF14	1000	1050	500		175	50	325	200
B10-1500	ACB ACBX/L RF14	1000	1500	500		176 200	50	326 350	200
B12-1210	RF14	1200	1210	600		185	60	365	240
B12-1500	ACB ACBX/L	1200	1500	600		186	60	366	240
B12-1725	RF14	1200	1725	600		210	60	390	240
B12-1800	ACB ACBX/L	1200	1800	600		186	60	366	240
B14-1500	ACB ACBX/L	1400	1500	700		196	70	406	280
B14-1725	RF14	1400	1725	700		220	70	430	280
B14-2070	RF14	1400	2070	700		220	70	430	280
B14-2100	ACB ACBX/L	1400	2100	700		196	70	406	280

1. Above this flow rate, the system operates in optimal conditions. Below this approved limit for performance, a Warning is triggered.
2. The system could not operate correctly below this flow rate: a Defect is triggered and the system stops.

When the system has more than 1 reactor, the lowest value of UV sensor is taken to determine if flow regulation is necessary.

6.6. Operating conditions and performance limits

6.6.1. Water quality and ship environment

The **BIO-SEA**® system has been developed and tested according to requirements of the BWMS code (IMO Resolution MEPC.300(72)), USCG regulations (46CFR 162.060-30), and Rules for Classification of Steel Ships and Offshore Units (IACS unified standards E10) to ensure adequate functioning in ship-board environment (temperature and humidity, vibration, pitch and roll, power supply variation, EMC).

The **BIO-SEA**® system must be operated in accordance with the Operating Environment specifications in order to validate the warranty of the system.

The system is not approved for installation in hazardous areas.

For ACBX/L filters, as well as RF14-08/12 filters, it is recommended to pre-filter ballast water upstream the BWTS to 4-6mm.

The **BIO-SEA**® system can be used in the common water condition encountered around the globe. Tests and field experience allow **BIO-UV Group** to claim no limitation linked to water salinity and temperature. Ambient parameters which can have a limiting effect on the system are:

- water transmittance (UVT) linked to UVI reading.
- suspended solids (TSS), linked to filter backwash frequency.

Table 7: Environmental factors

Parameters	Unit	Expected range when operating in worldwide waters	**BIO-SEA**® Claims
Salinity	PSU	0-39	No impact on performance of the system. Operation can be affected in USCG mode due to holding time which differs according to water type (sea, brackish or fresh). **BIO-SEA**® system has been tested in the 3 salinity ranges (0 to 42 PSU).
Water temperature	°C	-2 to +40	No impact of temperature on the operation or performance of the system. **BIO-SEA**® system has been tested in water temperatures from 2.6 °C to 29 °C

Table 7: Environmental factors

Parameters	Unit	Expected range when operating in worldwide waters	**BIO-SEA**® Claims
Ambient temperature	°C	0 to +55	**BIO-SEA**® system has been tested according to requirements of the BWMS code (IMO Resolution MEPC.300(72)), USCG regulations (46CFR 162.060-30), and Rules for Classification of Steel Ships and Offshore Units (IACS unified standards E10).
Ambient humidity	%	Up to 95	
TSS	mg/l	0 - 300 and more	TSS is highly variable (size, number, nature of particles) and no fixed value can be given as an operational limit. During shipboard testing, ballasting operations have been successfully performed above 450 mg/L. See section on operational parameters (dP).
UV transmittance	%	10 to 98 Average: 60-80	**BIO-SEA**® system is designed to operate in waters with UVT > 60%, and has been tested successfully down to 42% in IMO/MPN mode. See section on operational parameters (UVI).

6.6.2. Operational Parameters and Performance Control

Main parameters controlling operation of **BIO-SEA® BWTS** are listed in Table 8 & Table 9 below, with high/ low values (used for warning and alarms).

Table 8: Operational Parameters for filtration step

Parameter	Unit	Range for **BIO-SEA® B/L** models	Method for control and monitoring
Flow rate	m3/h	Flow < 105% Max TRC of the filter	Flowmeter installed after filter. Warning and Alarm for overflow and low flow.
Differential pressure	bar	When using Filtrex filter: • 0,3 for triggering backflush • Max dP (alarm) = 0,5 • Clean dP < 0,1	Pressure sensors (dP) Backwash frequency
		When using Hydac filter: • 0,5 for triggering backflush • Max dP (alarm) = 1 • Clean dP < 0,1	
Service pressure	bar	• Min : 2 • Max: 10	Pressure sensors (Warning = 4,5/8 bar, Alarm = 6/10 bar) and safety valves
Backwash pressure	bar	• Min: 0,5 during filtration • Min: 1,5 during cleaning	Pressure sensors

Table 9: Operational Parameters for UV treatment

Parameter	Treatment mode	Unit	**BIO-SEA® B** models	**BIO-SEA® L** models	Method for control and monitoring
Min. Flow rate per reactor	All modes	m3/h	50	10	Control valve Warning and alarm Downgraded mode
Min UVI at reduced flow of the BWTS	IMO mode	W/m^2	150	900	UVI sensor
	USCG mode	W/m^2	725	1700	
Max TRC per reactor	IMO mode	m^3/h	150	30	Control valve Warning and alarm Downgraded mode
	USCG mode	m^3/h	100	20	
Min UVI at full flow	IMO mode	W/m^2	750	2100	UVI sensor
	USCG mode	W/m^2	1440	2900	
Power per lamp	Min	W	4400	1600	Value displayed on HMI screen
	Max	W	22000	6000	
Flow for safety	All modes	m^3/h	>5	>5	Warning and alarm
Service pressure	Min	bar	2	2	Pressure sensors (Warning = 4,5/8 bar, Alarm = 6/10 bar) and safety valves
	Max	bar	10	10	
Temperature for safety	Warning	°C	55	55	Temperature sensor (TT01) and conductivity sensor (TT02)
	alarm	°C	70	70	

When BIO-SEA BWTS is operated outside its performance parameters, or is malfunctioning or inoperating, contingency measures should be adopted to avoid unacceptable risks to the environment. For more details, see paragraph 19.3. Management of untreated water, page 134.

Specifications

6.6.3. Minimum holding time (USCG approval)

IMO type approval shows no restriction on holding time. System performance was tested with holding time from 24h to 120h during type approval.

For USCG approval, retention time to apply reflects strictly the tested duration during land-based testing, which implies differences between salinities and filter brands, due to agreed test plans in different testing periods. This is actually not a real technical limitation, but **BIO-UV Group** has implemented pop-up to inform the end-used of the retention approved in USCG certificate.

If a change in water quality is detected during ballasting operation, this will be logged in the system as an event, and the more restrictive holding time should be applied.

The Table 10 explains the time the ballasted water has to be kept (0, 19 or 24 hours), to comply with the USCG regulations.

Table 10: Holding time regarding tank water quality for deballasting operation

Water quality (conductivity)	min. holding time	
	Filtrex	Hydac
Marine (> 43,5 mS/cm)	24 hours	0 hour
Brackish (1,9-43,5 mS/cm)	19 hours	0 hour
Fresh (< 1,9 mS/cm)	0 hour	0 hour

In case of mixed waters, apply the highest holding time.

6.6.4. Certificates

The **BIO-SEA**® Ballast Water Treatment System is Type Approved according to:

- IMO Resolution MEPC.300(72) Code for approval of Ballast Water Management Systems (BWMS code), contained in the International Convention for the Control and Management of Ships' Ballast Water and Sediments (2004).
- USCG regulations 46CFR 162.060 "Ballast Water Management Systems".

The Type Approval Certificates are delivered as part of the system documentation.

Operating and performance limits of the **BIO-SEA**® system are described in the statutory Type Approval certificates. Detailed setpoints are described in the Commissioning book BS3-03.

If specific approvals or certificates are required linked to class regulations, they will be delivered as part of the technical documentation.

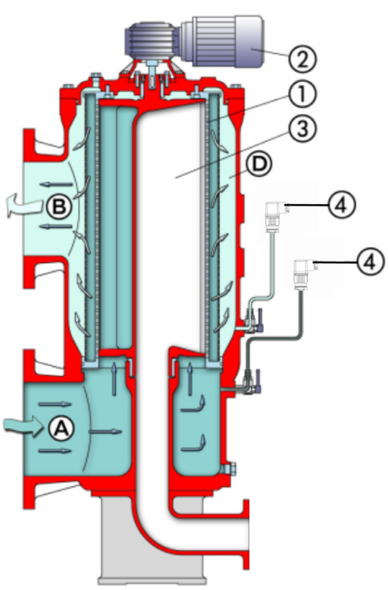
6.7. Description of the Sub-assemblies

For exact dimensions and weight of system skid and/or Components, please refer to technical binder.

6.7.1. Filter assembly

The filter presents a cylindrical housing with a filtration screen (mesh) of 20µm. An extended filtering surface allows a good retention rate. The needed surface is dimensioned depending on the flow rate to treat. Filtration is carried out from inside (entry of dirty water) to outside (filtered water).

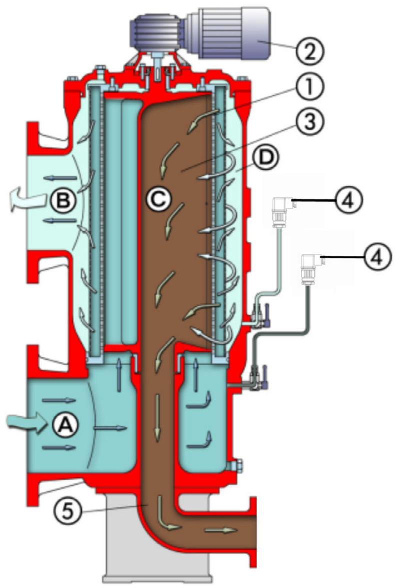
Figure 2: Filter principle



PHASE 1 : FILTRATION PHASE

LEGEND

A	Inlet Flange
B	Outlet Flange
C	Backwash Chamber
D	Filter Chamber
1	Filter Basket Element Sectors
2	Electric Motor & Gear
3	Nozzle
4	Pressure transmitter
5	Outlet Backwash Duct



PHASE 2 : FILTRATION AND CLEANING PHASE

When the difference of pressure measured by the pressure transmitters between filter inlet and outlet reaches the defined threshold value, indicating filter clogging, a suction device is automatically started to clean the screen.

A specific pump boosts the suction process to unstick the clogged solids, and drive them back to the original seawater (harbor) through the discharge pipe, so that the suspended solids and biggest organisms are pumped back into the medium from which they came. The cleaning cycle of the filter screen does not disrupt the filtration process, allowing no significant variation of the treated flow rate.

At the end of the ballasting operation, the filter must be drained and refilled with fresh water.

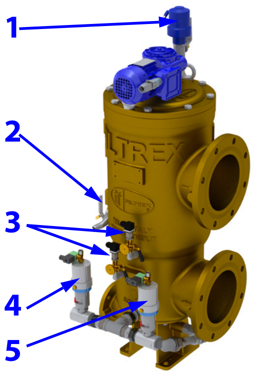
Two types of filter can be installed: Filtrex or Hydac, they both present the same operational principle (see next page for filter models overview).

For ACBX/L filters, as well as RF14-08/12 filters, it is recommended to pre-filter ballast water upstream the BWTS to 4-6mm.

Figure 3: View of available filter models

Filtrex filter

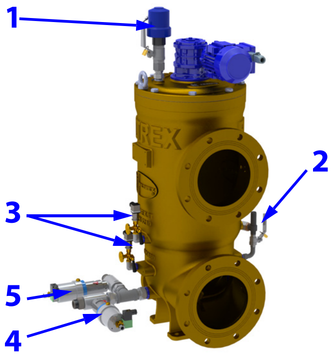
ACB



<u>Inlet/outlet position:</u> on the side

<u>Material:</u> Bronze-aluminum alloy (UNS C95800)
<u>Production type:</u> Casted

ACBX



<u>Inlet/outlet position:</u> on the side

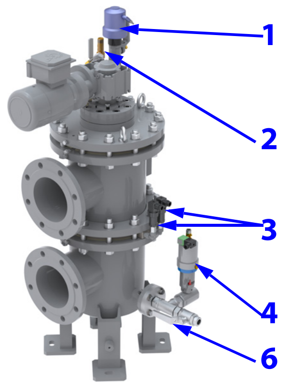
<u>Material:</u> Bronze-aluminum alloy (UNS C95800)
<u>Production type:</u> Casted

ACBL

<u>Inlet/outlet position:</u> inlet on the bottom and outlet on the side
<u>Material:</u> Bronze-aluminum alloy (UNS C95800)
<u>Production type:</u> Casted

Hydac filters

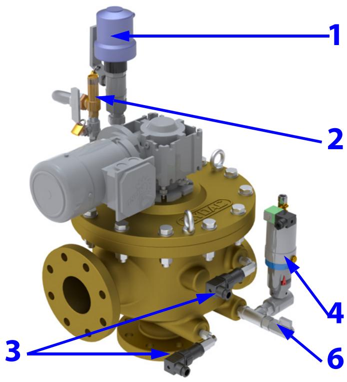
RF14-10 to RF14-45



<u>Inlet/outlet position:</u> on the side

<u>Material:</u> Carbon steel (P265GH), painted outside, coated with polyurethane inside.
<u>Production type:</u> Welded

RF14-08/12



<u>Inlet/outlet position:</u> inlet on the bottom and outlet on the side
<u>Material:</u> Aluminium Bronze (UNS C95800)

<u>Production type:</u> Casted

<u>Accessories:</u>
1- Automatic vent valve (with manual valve VM54)
2- Safety valve (PSV11)
3- Pressure sensors (PT11 & PT12)
4- Fresh water valve (automatic pneumatic valve V12)
5- Draining valve (automatic pneumatic valve V13)
6- Draining valve (manual valve VM13)

6.7.2. UV assembly

- **UV Reactor**

Designed by CFD (Computational Fluid Dynamic), the UV reactor used in the **BIO-SEA**® system is a tubular-type reactor equipped with a single medium pressure UV lamp placed in a central position. This design has been optimized considering the quality of seawater to be treated, especially its UV transmittance.

In standard version, UV reactors are installed on the manifolds with DIN flanges but, as an option, this connection can be done with Victaulic coupling.

The characteristics of the **BIO-SEA**® UV reactors are:

- Reactor equipped with a single medium pressure UV lamp, polychromatic, high intensity.
- Protection of the UV lamp in a quartz sleeve of high purity.
- Lamp driven by electronic ballast, allowing precise management of the UV lamp in order to optimize its dimming, reduce the power consumption and prolong its life.
- Monitoring through UV sensor (intensity).
- Modular design that facilitates the installation of UV reactors in parallel, and a better adjustment to the flow that has to be treated.

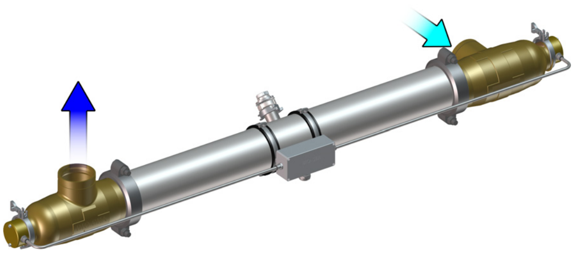
Two sizes of UV reactor have been approved: B reactor (based unit) and L reactor (downscaled unit).

They can be installed in parallel to treat higher flow rates but B and L reactors cannot be mixed in one system.

UV reactors are identified as Rx.y and UV sensor as UVx.y; refer to PID for the numbering on your system.

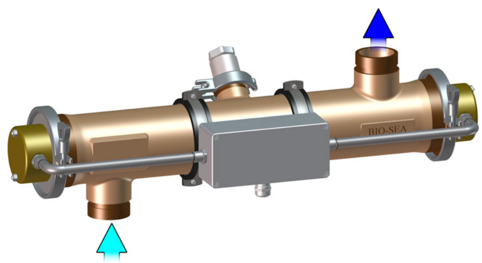
*Figure 4: UV reactor for **BIO-SEA**® **B** and for **BIO-SEA**® **L***

B reactor



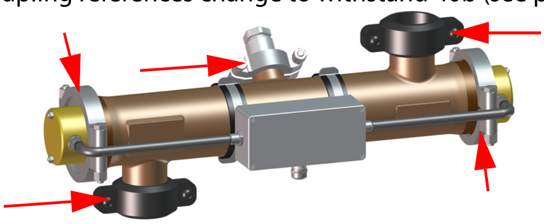
Min flow rate: 5m3/h
Max flow rate: 150 m^3/h if IMO/MPN method is selected or 100 m^3/h if USCG/CMFDA method is selected
Volume: 30L
Material: Seat in copper-aluminum alloy (CC333G / UNS C95500) and body in titanium (T40 Gr2 / UNS R50400)

L reactor



Min flow rate: 5m3/h
Max flow rate: 30 m^3/h if IMO/MPN method is selected or 20 m^3/h if USCG/CMFDA method is selected
Volume: 3,5L
Material: Covers in copper-aluminum alloy (CC333G / UNS C95500) and body in bronze (CuSn7 / UNS C93200)

For ship under US flag, drawing of **BIO-SEA**® **L** reactor should be A0468-01. This implies that clamps and coupling references change to withstand 40b (see picture below).



- **Manifolds**

The manifolds allow supporting of UV reactors in different configurations and ensure that flow rates are balanced in all UV reactors.Standard manifolds are designed for vertical installation and are made of hot dipped galvanized steel.

Depending on the number of reactors to install, the reactors connections on the manifold can be:

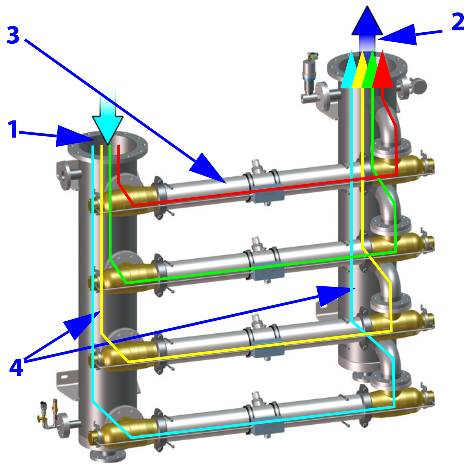
- on only one side (maximum 5 reactors per manifold in standard configuration)
- on both sides and pair (4, 6, 8 or 10 reactors per manifold in standard configuration)
- on both side and odd (3,5,7 or 9 reactors per manifold in standard configuration)

For the same configuration of manifold, it is possible to have only one pair of manifold or two pairs of manifold. For example, a system with 8 reactors can have:

- one pair of manifold with 4 reactors on both sides (4+4)
- two pairs of manifold with 2 reactors on both sides (2x(2+2))

Two pairs of manifolds are only possible if both pairs of manifolds are exactly identical.

Figure 5: Example of UV assembly with manifolds configuration 4+0



1- Inlet
2- Outlet
3- UV reactor
4- Manifolds

According to the manifolds configuration, water flow can come from the top or the bottom to ensure good flow balance in the UV assembly

6.7.3. Power Cabinet and independent electronic ballasts

For **BIO-SEA® B** models, power cabinets are provided to supply electrical power to the UV lamps with electronic ballasts. Two configurations are possible: standard power cabinet or compact power cabinet.

Figure 6: Standard power Cabinets

Standard power cabinet with 1 ballast

Standard power cabinet with 2 ballasts

Figure 7: Compact power Cabinets

Compact Power cabinet with 1, 2 or 3 pairs of ballasts

Compact Power cabinet with 4 pairs of ballasts

Compact Power cabinet with 5 or 6 pairs of ballasts

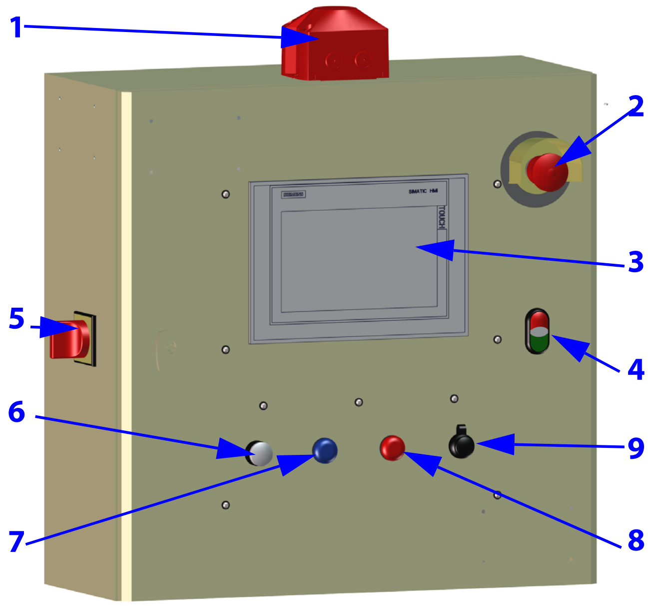
For **BIO-SEA® L** models, independent electronic ballasts are provided to supply electrical power to the UV lamps.

Figure 8: Independent electronic ballasts (ELC)

6.7.4. Control Cabinet

Local operation and monitoring of **BIO-SEA**® system are achieved through touch screen on control cabinet

Figure 9: Control Cabinet



1- Flashing alarm
2- Emergency stop
3- Touchscreen 9" with Data log memory card
4- ON/OFF buttons
5- Main power switch
6- Main power 400-440V indicator (white)
7- 24Vdc indicator (blue)
8- Audible alarm (red)
9- USB plug

Other specifications:

- PLC: Siemens ET200SP
- Cabinet is IP55 class.
- Material: Painted steel (RAL7035)

- Audio and visual alarm signals are required in all stations from where operation can be controlled.
- The visual and audible signals are enabled when an alarm is present on the system until it has been acknowledged or the "MUTE" button has been pressed on the Alarm screen. This visual alarm is activated as well when service or maintenance mode is enabled.

The control cabinet allows connecting several options:

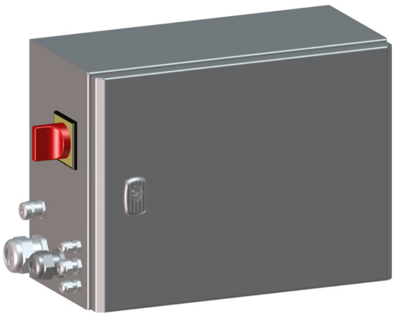
- Wired remote control
- 4-20mA flow information
- RS485 communication
- GPS Signal
- Remote control screen and/or Remote access
- CIP equipment

For cybersecurity reasons, vacant ports have been disabled either by physical seal or re-assignation. For this purpose, a kit (ref SET017386) can be ordered to lock the door and the USB port.

6.7.5. Switchboard cabinet (only for BIO-SEA® L models)

This cabinet supplies power to control cabinet and electronic ballasts. It regroups breakers and terminals to protect and connect main power supply. and dispatch it to control cabinet and electronic ballasts. In addition to these components, a 24V power supply provides 24VDC supply to electronic ballasts.

Figure 10: Switchboard cabinet



- Same cabinet is used for all **BIO-SEA**® models
- Material: Painted steel (RAL7035)
- Main power switch

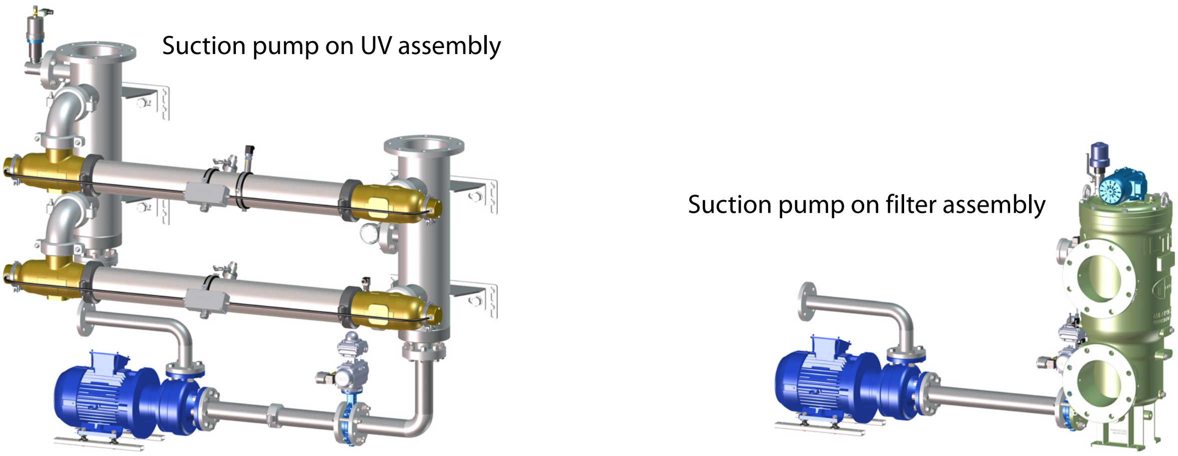
6.7.6. Suction pump

In skid configuration, only one pump is used for filter and UV assembly. It will be used for

- filter backwash (cleaning)
- filter draining
- UV draining

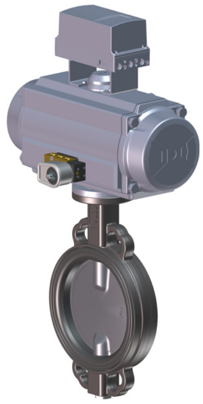
In modular configuration, it is possible to install two pumps, one for the UV assembly and another for the filter assembly, as shown on the pictures below. The pump size is adapted according to the filter type and model.

Figure 11: View of a suction pump



6.7.7. Control valve

Figure 12: Electro-Pneumatic valve for operation



The UV outlet control valve (V06) is equipped with an electro-pneumatic positioner that controls the opening of the valve. It is used for:

- limiting the flow in case of overflow (flow higher than the maximum TRC (Treatment Rate Capacity)
- reducing the flow automatically in the event of a low UVI reading

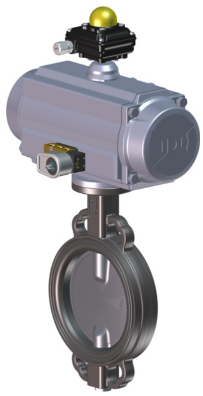
Material:

- Body: Ductile iron, coated with polyurethane
- Shaft: SS 1.4028
- Disc: Aluminum bronze
- Liner: EPDM
- Actuator: Aluminium
- Posiitoner: Glass-fiber reinforced polycarbonate (PC)

6.7.8. Other valves

- **Valves for operations**

Figure 13: Electro-Pneumatic valve for operation



These valves are pneumatic butterfly valves. They allow for the automatically managing of water displacements in the BWTS.
They are automatically operated to manage water flows in the BWTS (e.g. ballasting, deballasting, stop...).
Material:

- Body: Ductile iron, coated with polyurethane
- Shaft: SS 1.4028
- Disc: Aluminum bronze
- Liner: EPDM
- Actuator: Aluminium
- Limit switch box: ABS

The CIP isolation valve V07 is normally opended while the other valves are normally opened. Their components are identical, only the mounting differs

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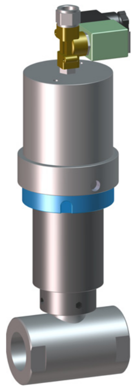
- **Valves for fresh water filling and filter/UV assembly draining**

Figure 14: Ball valve for fresh water and filter cleaning



These valves are pneumatic ball valves used for fresh water filling and draining in the UV assembly and the filter.
Material:

- Body: Stainless steel AISI 316
- Ball gasket: virgin PTFE

6.7.9. Sensors

- **UV sensor (UVx.y)**

Figure 15: UV sensor

- The UV sensor measures UV Intensity.
- It allows to adjust automatically lamp power by comparing UV Intensity in real time and UV Intensity threshold defines to guarantee efficiency.
- Voltage: 24Vdc.
- Modbus communication for UV Intensity monitoring and data recording.
- UV Intensity is displayed on the touchscreen in W/m^2.
- Measuring range: 100 to 6000 W/m^2 with 20% accuracy. (Önorm certification).

- **Temperature sensor (TT01)**

Figure 16: Temperature sensor

- Temperature sensor measures temperature (TT01) of the reactor, it allows stopping the system if the temperature exceeds the threshold.
- Temperature threshold alarm is set at 70°C.
- PT100 sensor with 4-20mA signal.
- Temperature is displayed on the touchscreen in °C.
- Measuring range: 0 to +100 °C with +/-10% accuracy.
- Sensor material: Stainless steel 316L.

- **Conductivity sensor (CT01:EC01/TT02)**

Figure 17: Conductivity sensor

- Conductivity sensor measures the conductivity (EC01) and the temperature (TT02) of the water to indicate the type of water present inside the manifold: brackish water, marine water or fresh water. This information will determine the retention type according to the water quality.
- Measure is displayed on the touchscreen in mS/cm.
- Measuring range: 0-200ms/cm with accuracy lower than 1% at 25°C.
- Process temperature range: -20 to +150°C with accuracy lower than 0,4%.
- Ambient temperature range: -30 to +80°C.
- Output signal : 4-20mA.
- Sensor material: PEEK and AISI 316L.

- **Pressure transmitter**

Figure 18: Pressure transmitter

JUMO model

HYDAC model

- These sensors are used to measure:
  - the pressure of the filter inlet.
  - the pressure of the filter outlet.
  - the pressure of the UV assembly manifold.
- Measure is displayed on the touchscreen in bar.
- Measuring range: -1-15 bars with 0,5% accuracy at 20°C.
- Output signal: 4-20mA.
- Sensor material: Stainless steel (JUMO) / Stainless steel & Ceramic (HYDAC).

- **Flowmeter**

Figure 19: Flow meter view

Compact version

Separate version

- Electromagnetic flow meter.
- Dimensions depending on the piping size.
- Transmitter, in painted steel, directly fixed on the flow meter in compact version or remote transmitter for separate version.
- Supply voltage: 24VDC.
- IP 54.
- Measuring accuracy: 0,3% of measured value + 1mm/s.
- Max. 10m cable length between flow sensor and flow transmitter.

6.7.10. CIP system

Cleaning-in-Place (CIP) allows to reduce UV reactors maintenance by performing cleaning cycles of quartz sleeves without disassembling the reactor. It is used at the end of the **BIO-SEA® BWTS** operations when all UV reactors were emptied, flushed and filled with fresh water or kept filled with sea water if "CIP salt water" is selected.

Two versions of CIP are available: **BIO-SEA® Clean** (automatic) and **BIO-SEA® M-Clean** (manual). Both allow "Ready to connect" installation.

Please refer to technical binder to know applicable specifications corresponding to the CIP installed with your BWTS.

The **BIO-SEA®** uses a cleaning solution composed of citric acid (see paragraph "Cleaning product: Citric acid powder", page 53) stored in the CIP tank. This can be mixed with seawater or fresh water for circulation of diluted solution into the system.

CIP and BWTS components have been chosen to be resistant to the diluted citric acid used for cleaning.

- For compliance with USCG approval of **BIO-SEA® BWTS**, CIP device must be connected.
- The system is not approved for installation in hazardous areas. It is recommended to install it inside the machinery space (engine or ballast pump room). For other locations, please contact **BIO-UV Group** representative.

- **BIO-SEA® M-Clean (not recommended when V07 valve is installed)**

BIO-SEA® M-Clean performs manual cleaning cycles.

The CIP cycle is launched manually when end of cycle cleaning is over.

Three models of manual cleaning system exists with different capacities: **BIO-SEA® M-Clean** 11L, **BIO-SEA® M-Clean** 30L or **BIO-SEA® M-Clean** 60L.

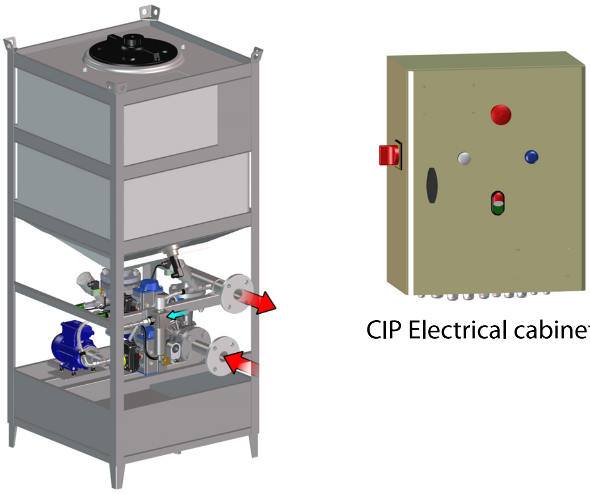
*Figure 20: Overview of a **BIO-SEA®** M-Clean 11L (on the left) and 30L (on the right)*

- **BIO-SEA® Clean**

Three models of automatic cleaning system exists with different capacities: **BIO-SEA® Clean** 250, **BIO-SEA® Clean** 500 or **BIO-SEA® Clean** 1000.

The CIP system is permanently connected to the **BIO-SEA® BWTS** manifolds but isolated by manual valves not provided with the system.

Figure 21: Overview of a **BIO-SEA® Clean** *500*



The piping between the **BIO-SEA® Clean** and the **BIO-SEA® BWTS** is not provided. As **BIO-SEA® Clean** uses corrosive fluids, the piping should be protected against corrosion inside and outside, like hot-dip galvanizing treatment for example. For US flag ships, the pipes must comply with materials US requirements of 46 CFR 56.60.

- **Cleaning product: Citric acid powder**

The cleaning solution is obtained by mixing citric acid powder with water in order to get a concentration of:

- 400g/l for the **BIO-SEA® Clean**
- 5g/l for the **BIO-SEA® M-Clean** (refer to **BIO-SEA® M-Clean** manual BS_M-CIP for dilution)

This mixing step is done manually by pouring bags of citric acid powder (ref: PRO009065) and adding clean fresh water into the tank.

According to the CIP model and volume of the **BIO-SEA® BWTS** UV assembly, the CIP automatically injects the suitable quantity to clean the quartz sleeves of the UV reactors at a concentration of 5g/l.

Table 11: Specifications of the provided product

Reference	Name	CAS Nr	EC Nr	Packing
PRO009065	Citric acid monohydrate (powder)	5949-29-1	201-069-1	Bags of 25kg
	or			
	Citric acid anhydrous (powder)	77-92-9		

- For further details, refer to the MSDS (CAS 5949-29-1) in chapter 51.1. Monohydrate citric acid, page 307.
- Anhydrous citric acid can also be used (CAS Nr: 77-92-9) but has a lower solubility in water, see MSDS in chapter 51.2. Anhydrous citric acid, page 315.

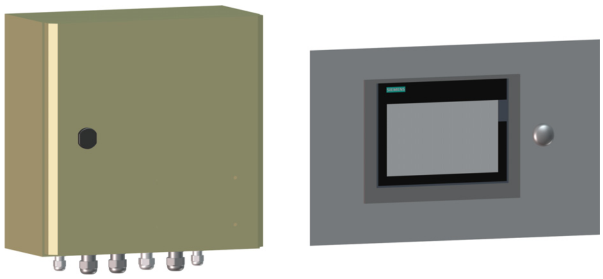
6.7.11. Remote control screen

One or two additional touch screens can be ordered and installed on board to provide remote control on the **BIO-SEA**® BWTS. This screen can be provided in 9'' or 15'' and is always installed with an audible alarm (buzzer) to warn operator when control has been lost.

For easiness of installation, the remote station can be provided:

- With all components (screen, buzzer, cables..) integrated in a specific box (complete remote control box)
- As separate components: screen and buzzer to be installed on the ship, with a separate remote control box

Figure 22: Separate Remote control box



- Material: Painted steel (RAL7035)
- Screen size: 9" or 15"
- Sound level of the buzzer: 60dB at 1m, 83dB at 10cm
- The screen with buzzer can have a maximum distance of 20m from the box

Figure 23: Complete Remote control box

- Material: Painted steel (RAL7035)
- Screen size: 9" or 15"
- Sound level of the buzzer: 60dB (at 1m)

7. General arrangement

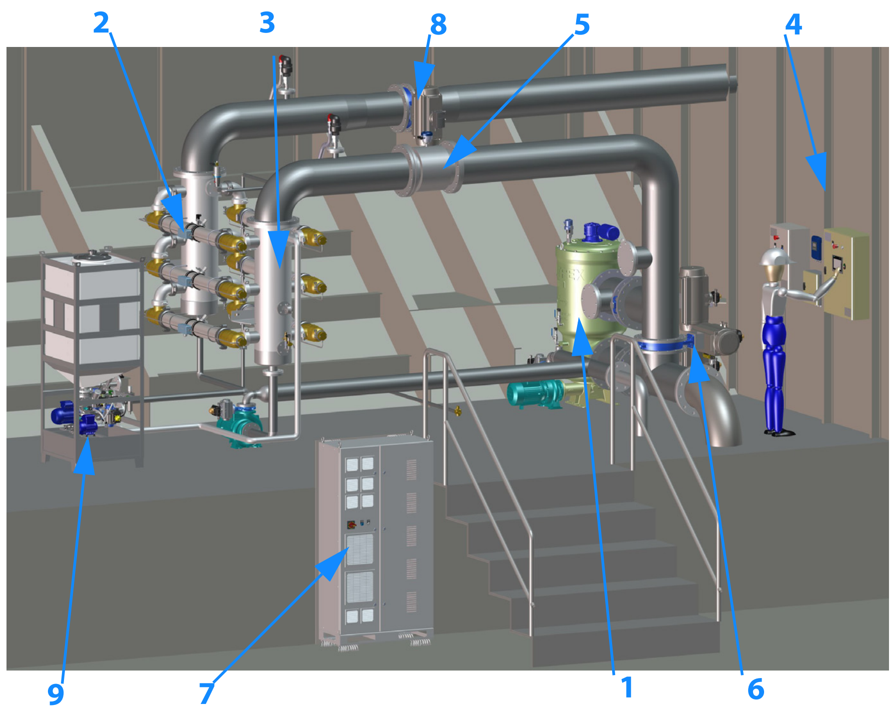
For a given system, all the technical specifications, drawings and/or data sheets (for each sub-assembly), are given in the technical binder.

7.1. Configuration

7.1.1. Modular configuration

Each subcomponent can be located separately, allowing flexibility where space is scarce.

Figure 24: Example of B06-0750 Modular Installation



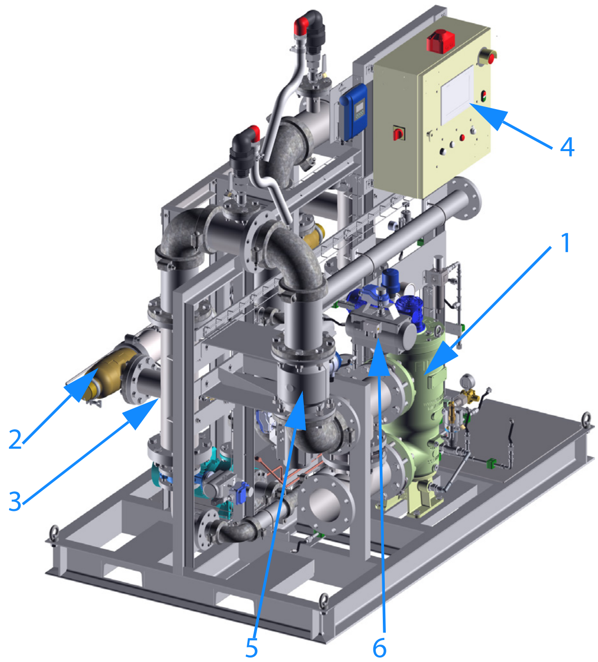
1- Self-cleaning Filter with 20µm screen
2- UV Reactors
3- Manifold
4- Control Cabinet with touch screen
5- Flow Meter
6- Automatic Valves
7- Compact power Cabinet
8- Control valve
9- Automatic cleaning system BIOSEA Clean (Optional CIP)

Sampling port is installed apart of the system and located on the discharge line, as near to the point of discharge as practicable.

7.1.2. Skid configuration

Skid mounting allows installing the system as "Plug and Play"

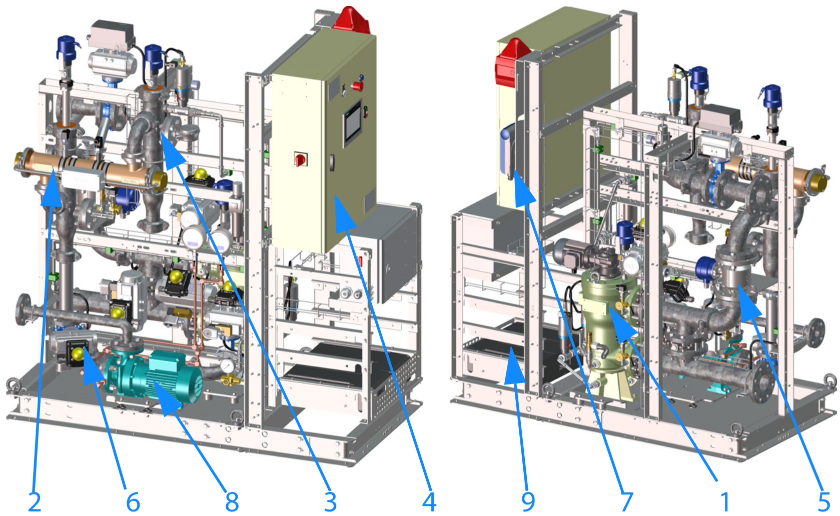
*Figure 25: Example of **BIO-SEA**® B01-0150 Skid*



1- Self-cleaning Filter with 20µm screen
2- UV Reactors
3- Manifold
4- Control Cabinet with touch screen
5- Flow Meter
6- Automatic Valves

Power Cabinets aren't present on this illustration. They are placed outside of the skid (location should be defined before installation)

*Figure 26: Example of **BIO-SEA**® L01-0055 Skid*



1- Self-cleaning Filter with 20µm screen
2- UV Reactors
3- Manifold
4- Control Cabinet with touch screen
5- Flow Meter
6- Automatic Valves
7- Flowmeter transmitter
8- Suction pump
9- Electronic ballast

In this configuration, frame and cabinets are painted RAL7035 and the whole piping is hot-dip galvanized for protection against corrosion. Sampling port is installed apart of the system and located on the discharge line, as near to the point of discharge as practicable. The sampling point is usually tagged with SP01 (SP02, SP03... if several sampling points exist).

7.2. Identification of the system

7.2.1. System identification plate

In accordance with **BIO-SEA**® Type Approval certificate, each Ballast Water Treatment System is marked with a engraved plate located on the control cabinet.

Figure 27: System identification plate

Manufacturer	BIO-UV Group
Designation	BALLAST WATER MANAGEMENT SYSTEM
Model	BIO-SEA Bxx-xxxx or Lxx-xxxx
Maximum TRC (IMO)	xxxxx m3/h
Mark of Conformity	XXXXXX[1]
Maximum TRC (USCG)	xxxxx m3/h
USCG Approval number	xxxxxxxxxxxx
Part Number	BSEAxxxxxxxx
Serial Number	xxxxxxxxxxxx
Month / Year of manufacture	MM / YYYY
Maximum allowable working pressure	xx bar
Class Marking (if applicable)	

Fixed on the control cabinet

1. marking according to requirements of the applicable IMO type approval certificate

7.2.2. Identification of sub-assemblies

Each sub-assembly is marked with the manufacturer plate

- Cabinets (& ELC if applicable)
- Reactors
- Filter
- Flowmeter
- Pumps
- Valves

7.2.3. Symbols

The following symbols can be found on the components of the **BIO-SEA**® System.

O	Switch off position	I	Switch on position
~	Alternating current		Packaging recycling mark
	Caution, heat source		Caution, moving mechanism
	Caution, risk of electric shock		Warning, Caution Never watching when light ON U.V. rays dangerous for eyes

Standard symbols for P&ID

	Manual ball valve		Manual butterfly valve
	Ball valve (normally closed)		Butterfly valve (normally closed)
	Ball valve (normally open)		Butterfly valve (normally open)
E/P	Electropneumatic actuator		Closed flanged connection
E/H	Electroydraulic actuator		Double effect vent
	Filter		Pressure reducing valve
	Actuator for regulating valve		

7.3. Delivery specifications

The **BIO-SEA**® BWTS must be transported in a safe and stable manner, in accordance with best practices and regulations.

- The boxes of power cabinets should always be handled vertically.
- Labels are placed on boxes that should not be stacked up.

The delivery will include the following elements:

- The system itself: On a frame for Skid configuration or in separated elements for modular configuration. This is summarized by the Bill of Material (BOM) specific to the system and placed in the technical documentations.
- Tools kit.
- Spare parts (if ordered).
- User manuals.
- Technical files specific to the system (Technical Documentation).

Most of the time, **BIO-SEA**® systems are shipped in 20" or 40" containers.

All parts are packed in wood cases that meet international standards for phytosanitary measures 15 NIMP15 (IPPC).

Identification labels are located on each box and/or pallet, according to the shipping list.

Protections are provided for safe storage of the system during the installation phase at yard.

For skid configuration in closed containers, the system can be filmed except the power cabinets that will always be in wood boxes.

Protection equipment and good cleanliness of the BWTS should be kept during all the ship construction, especially against splashes of painting, welding, grinding...

For handling of BWTS skid, two means are possible:

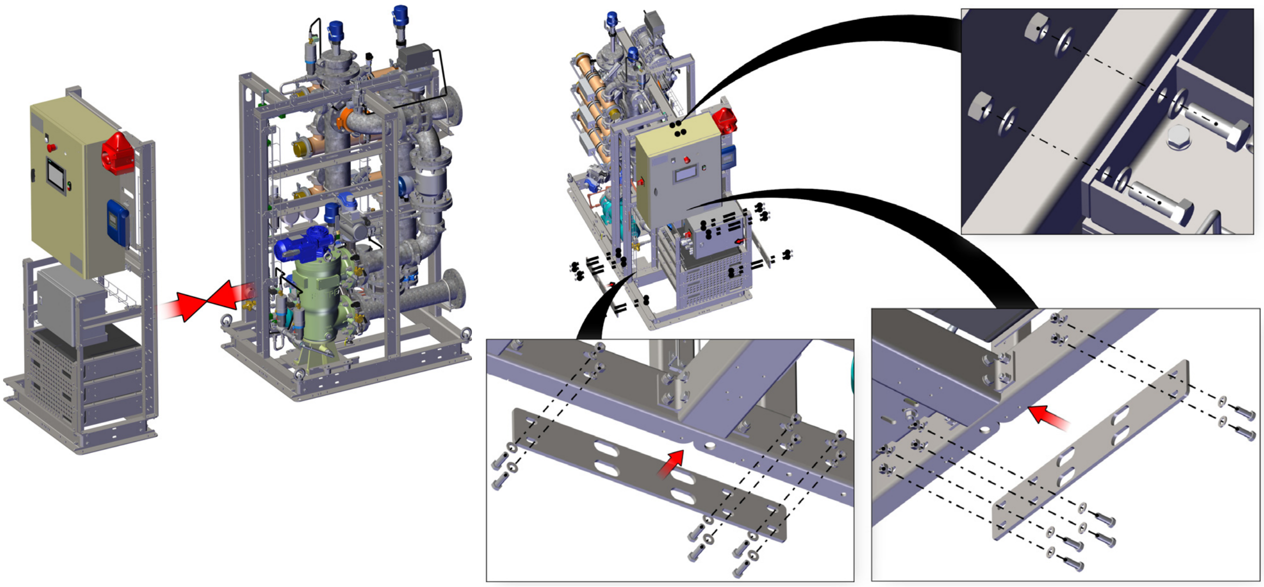
- Using a lifting truck or a pallet truck. Specific holes are provided on the skid frame for this use.
- Using handling points. In this case, slings with suitable dimensions have to be used, in order not to damage the system piping.

During lifting, use protective equipment like safety helmet and do not work below the lifted system.

In the case of Split skid configuration, the BWTS must be lifted only when both skids (Electric skid and Mechanical skid) are assembled together by mean of the set of parts delivered for this usage.

The set includes 2 plates and bolts and they should be mounted as shown on the drawing below.

Figure 28: Split skid assembly for handling



7.4. System location on board

The system location should be chosen to comply with and ambient/environmental conditions tested for **BIO-SEA®** system:

- Temperature range: 0°C to +55°C
- Maximal Humidity: 95%
- IP54

It is therefore recommended to install the system inside the machinery space (engine or ballast pump room).

- Max generated Head Loss: 0,55 bar
  - Pressure loss in the filter: 0 bar (clean) to 0,3 bar (when starting backwash)
  - Pressure loss in UV assembly: 0,25 bar

- UV reactors in parallel do not increase pressure loss in the installation.
- The installation of the filter and the **BIO-SEA®** reactors must be designed to minimize pressure loss on the ballast circuit.

This version of **BIO-SEA®** system is not suitable for installation in hazardous areas. It is recommended to install it inside the machinery space (engine or the ballast pump room). For other locations, please observe applicable Rules of the vessel classification society. In case of doubt, contact **BIO-UV Group** representative.

- Cabinets location must be chosen according to:
  - System configuration
  - Maximum cable lengths
  - Available service space (door opening)
- System fixation on the hull is under the responsibility of the installer, taking into account weights and space requirements for the sub-assemblies
- The installer must ensure sufficient service space (reactors, filters, valves...) and lifting points for system maintenance, including adequate distances and/or structures for safe circulation and easy access.
- The sampling point is to be installed as indicated in BS3-02, chapter 6.5. Alternatively, installer can design the appropriate sample port by following ISO 11711-1:2019 Ships and marine technology - Aquatic nuisance species Part 1: Ballast water discharge sample port.

The **BIO-SEA®** system MUST be placed downstream of the ballast pumps.

7.5. Required supplies

7.5.1. Power

- Voltage: 400V or 440V on 3 phases. For other voltages, a transformer has to be used.
- Frequency: 50 (for 400V) or 60 Hz (for 440V).
- Current: Alternative Current (AC). For the total amperage of the system, refer to the technical agreement of your system.
- **BIO-SEA**® system has been tested according to the Rules for Classification of Steel Ships (Unified Requirements, U10)for power supply variation or power supply failure.
- Shipyard or shipowner has responsibility to provide and wire main power supply according to recommendations.
- Distribution cabinet can be installed under shipyard or shipowner decision for main electric supply of the system (not provided by **BIO-UV Group**).
- When it is required to have an automatic shutdown of the BWMS for safety reasons, this must be initiated by a safety system independent of the BWM control system (IACS UR M74).
- Overcurrent or overvoltage protection is to be installed to protect UV type BWMS (IACS UR F45).

7.5.2. Freshwater Supply

- Fresh water is used in the **BIO-SEA**® system for several different functions, e.g. to flush the filter, reactor(s), piping and to preserve the filter and reactor(s).
- Poor quality of the fresh water may with time cause scaling and/or corrosion. Therefore, Quality specification for fresh water should be:
  - Max. particles size = 50 µm.
    Preliminary filtration is recommended to eliminate any particles present in the water circuit (particularly iron particles). Filtration should block particles bigger than 50µm.
  - Total Hardness = 0-20° dH.
    Hard water may with time cause scaling in the reactor(s) and on quartz sleeve(s). The precipitation rate is accelerated with increased temperature. These effects become more severe the harder the water is.
  - Chloride content max = 170 ppm NaCl (equivalent 100 mg Cl / l).
    Chloride ions contribute to corrosion. The chloride content and pH requirements are set to keep the system below the threshold for corrosion at all machine room temperatures.
  - pH > 6.
  - Operating temperature = 5-60°C.
- The recommended pressure for fresh water supply is 2 bars. A pressure relief valve (PR01) is installed in the event where the pressure of fresh water line on the vessel exceeds 2 bars.
- Water consumption can be evaluated through by the total volume of the system including piping between elements. It can be monitored by installing a water counter. (not provided).

It is recommended to install a check valve upstream the pressure relief valve PR01, on vessel side, to prevent any contamination of the vessel water.

7.5.3. Air supply for valve actuators

Minimum and operating air pressure: 6 bar (a variation of 0 to +10% is acceptable).

Maximum air pressure:. .... 7bar.

The supply main circuit should be made from rigid copper or stainless steel pipe (size 1/4"-DN10 for valves lower than DN350, size 1/2''-DN15 for main pipe and for valves higher than or equal to DN350) and from flexible aluminium coated pipes for piping between main circuit and valves.

Air supply should be filtrated according to ISO 8573-1 Class 5:

- particles < 25µm.
  A pressure reducing valve (PR02) is installed with a 25µm filter at air supply inlet. It should be adjusted to 6 bars. Another pressure reducing valve (PR03) is mounted on the outlet control valve (V06) with a 5µm filter. It should be adjusted to 4 bars. Both pressure reducing valves are safety measures to protect the valves.

- Refer to technical binder for data sheets of the pressure reducing valve.
- PR03 reducing valve has 1/2" BSP inlet, which corresponds to main air supply inlet.
- PR03 must be installed as close as possible from V06.

- water concentration < 7,8g/m3 at 7°C.
  In the compressed air system a condensation takes place at various rates, depending of the moisture content at the air inlet, the temperature before and after the compressor, partially lower in any cold zone passed by the pipe (outdoor, cellar, etc) and the like.

The air must thus be dried with regards to the lowest temperature existing after the drying device, so that condensate in the instruments is avoided. Note that the air will also be cooled through expansion after passing constrictions and nozzles in the instruments, with condensation as a result. In view of the above, the following must be observed.

At the inlet to an instrument, the dew point of the compressed air should lie at least 10°C below the lowest air temperature. This is usually obtained by using an absorption drier of suitable capacity. If the air contains much water, provide a primary separator before the filter.

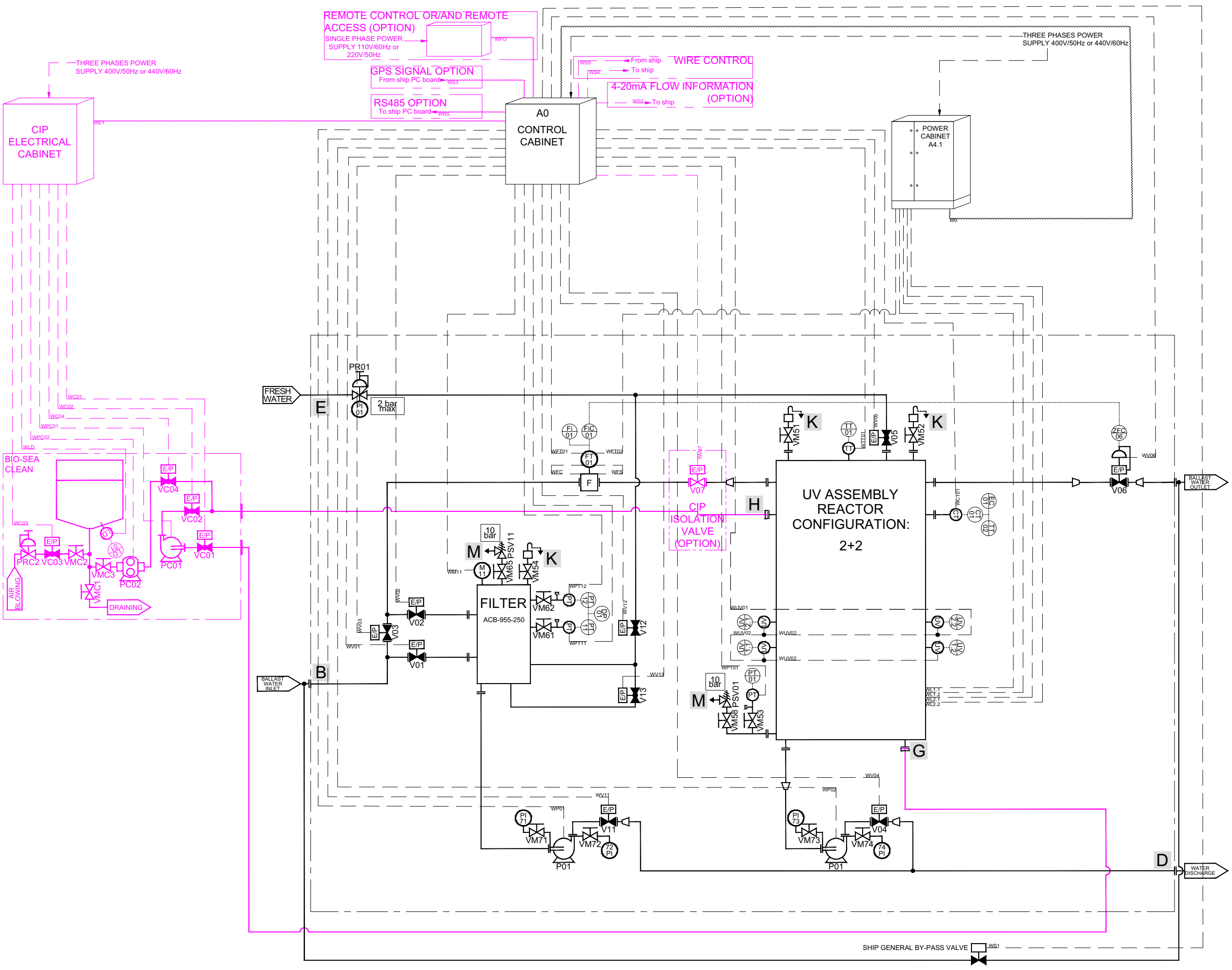
- oil concentration < 25mg/m3.
  It constitutes a serious contamination, which is difficult to remove from the instruments. Special filters or oil separators must, therefore, be provided before the instruments. In small plants, oil free compressor can be provided as an alternative.

8. PLC general description

8.1. Control and monitoring architecture

The detailed synoptic given with the P&ID in the Technical Binder shows the instrumentation and control architecture for a given system. In the example below, colored parts are optional.

Figure 29: Exemple of detailed synoptic diagram for ***BIO-SEA***® *B04-0500*



8.2. PLC Main functions

The entire operation of the **BIO-SEA**® system is automated (opening and closing of valves, filter cleaning, UV intensity regulation, event recording, etc).

The use of the **BIO-SEA**® system must be integrated to the Ballast Water Management Plan of the ship.

Through the touchscreen, **BIO-SEA**® PLC allows to:

- start and shut off the system (see 9.1. Home screen, page 69).
- operate the system for treating ballast water during intake and discharge, including cleaning cycles (see 16. Treatment, page 110, 16.2. Deballasting, page 113,16.3. Stripping, page 114 and 17.3. Cleaning cycles for BWTS, page 118).
- select the operating mode: automatic / maintenance / service / stop (see 8.4. Management modes, page 68).
- define different user levels with different rights through logins and passwords.
- monitor operation through displays of screens, alarms and events (see 9.2. Process screen, page 71, 10. Defaults and Alarms, page 75 and Figure 40: Alarms History screen, page 81).
- record operations and alarms, to cover a history of 24 months as required by 46 CFR 162.060-20 (b) and BWMS code.

- In the event that the control and monitoring equipment is replaced, actions must be taken to ensure the data recorded prior to replacement remain available on board for a minimum of 24 months.
- A security seal is placed on the PLC SD card slot, to prevent any manipulation of the SD card.

- record and visualize operational data measured with sensors:
  - Inlet filter pressure (bars): PT11
  - Outlet filter pressure (bars) PT12
  - Pressure variation between PT11 and PT12 (bars): DP01
  - Manifold pressure (bars)..PT01
  - Water conductivity (mS/cm):...EC01 from conductivity sensor CT01
  - UV Intensity (W/m^2):...UVx.y (refer to PID for the numbering on your system)
  - Flow rate (m^3/h): FT01
  - Temperature (°C):...TT01 on the reactor and TT02 from conductivity sensor CT01
- regulate flow to prevent overflow through the system, and to allow treatment at lower water transmittances (by maintaining the proper UV dose for treatment taking into account the UV irradiance reading).
- regulate lamp power (UV dimming) to reduce the power consumption in high transmittance waters, maintaining UVI at the defined threshold.
- manage user accounts when high security level (Cybersecurity) is applied.

- This continuous self-monitoring allows to automatically trigger needed backwash cycles, and adjust automatically UV intensity and flow rate for proper treatment according to water quality.
- Each UV sensor controls the power dimming of its corresponding lamp but the value used for the flow regulation comes from the UV sensor that gives the lowest value.

Audio and visual alarm signals are required in all stations from where operation can be controlled. The visual and audible signals (105dB max) are enabled when an alarm is present on the system until it has been acknowledged or the "MUTE" button has been pressed on the Alarm screen. This visual alarm is activated as well when service or maintenance mode is enabled.

The audible and visual alarm is disabled in case of power failure or emergency stop. BWTS Default contact (dry contact from WS1) should be wired in positive safety to ship monitoring system.

8.3. Overview of menus

Touch buttons are available within the HMI screens for navigation and selection of command.

All the available menus are presented in Figure 30: Tree view of the screens with access levels, page 67.

3 levels of access are defined to operate the system:

(1) Operator level: for basic operation and monitoring of the system, without access control. Automatic ballasting, deballasting, stripping and cleaning cycles. Visualization of process, events, curves, alarms.

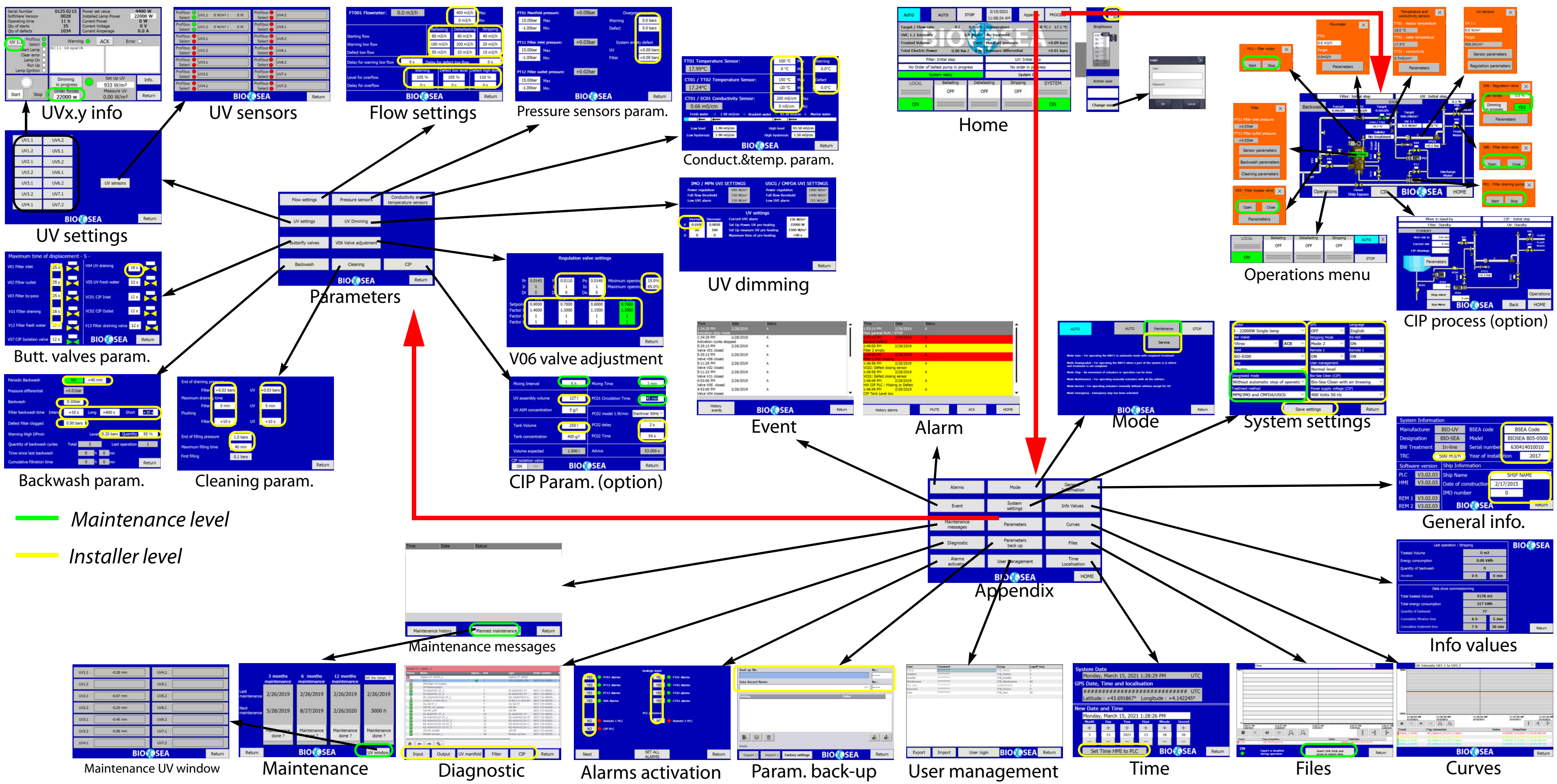
(2) Maintenance level: this requires a login and password. In addition to functions available in Operator level, Maintenance and service mode are available as well as operation of all mechanical parts. This level should be used for maintenance operations and troubleshooting activities.

(3) **Installer level**: this requires a login and password. In addition to functions available in Maintenance level, Process and system parameters can be modified. This level is usually used for commissioning and specific maintenance by **BIO-UV Group** technician or its representative.

The ship-owner or captain would determine which crew member should have access to maintenance levels.

Service technicians from **BIO-UV Group** and its representatives have access to the Installer level.

Figure 30: Tree view of the screens with access levels



8.4. Management modes

There are 5 modes for system operation:

- **Automatic Mode:** automatic operation of the **BIO-SEA**® BWTS.
- **Maintenance Mode:** for basic operations when automatic mode is not available, or for unusual operations. In this mode, the safety is ON, this mode can be also used for troubleshooting for the crew. It is not possible to modified any settings.
- **Service Mode:** to be used during troubleshooting phase and maintenance activities. Safety systems are not available in this mode. This mode is used during the commissioning to set up the system. The access is given to advanced operators to do some major modifications.

Any modification of the system must be previously discussed with **BIO-SEA**® service.

- **Stop Mode**: software emergency stop; shutdown of the operation, only monitoring is maintained. During the starting phases of the PLC, system is into stop mode. An EMERGENCY SHUTDOWN is also available, when the emergency button is pushed on the control cabinet.
- **Downgraded Mode**: automatic operation of the **BIO-SEA**® BWTS with presence of default that can impact System performances. This is not a normal running mode, so it shouldn't be used for long time. The default has to be solved to return in Automatic mode.

The table below shows the possible MODE changes.

Table 12: Authorized changes of MODES

To / From	STOP	SERVICE	MAINTENANCE	AUTO	AUTO DOWN-GRADED
STOP	-	YES	YES	YES	NO
SERVICE	YES	-	YES	NO	NO
MAINTENANCE	YES	YES	-	NO	NO
AUTO	YES	NO	NO	-	NO
AUTO DOWN-GRADED	YES	NO	NO	NO	-

During a mode change, the movements of all mechanisms are interrupted.

9. Main screens

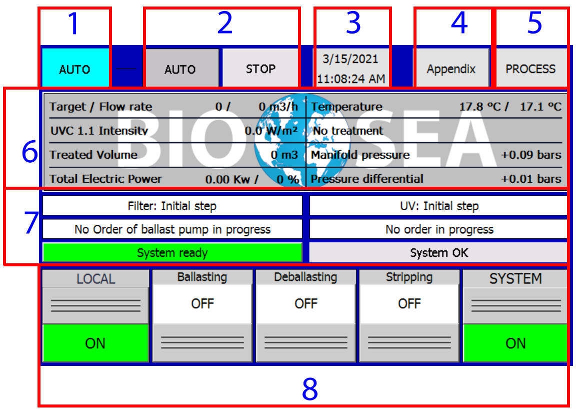
The screens described in this manual can change according to:

- the type of filter: Filtrex or Hydac
- the number of pumps: 1 or 2
- the presence of a CIP system on the **BIO-SEA**® BWTS
- the UV reactor type: B or L

9.1. Home screen

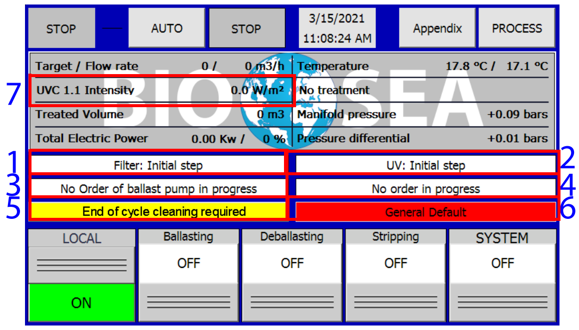
The figure below shows the starting screen of the application. This screen is visible when the system is energized.

Figure 31: Home screen



1	Selected mode	5	to **Process** view
2	Mode selection AUTO / STOP	6	Sensors measurements
3	Current date and time	7	Details of system status
4	to **Appendix** view	8	Buttons for operation control

Figure 32: Détails of Home screen status and measurement



1 Status of filtration

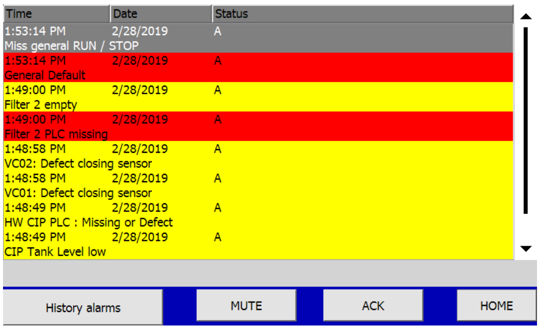
2 Status of UV disinfection

3 Information coming from the main Control board (pump start order / defaults)

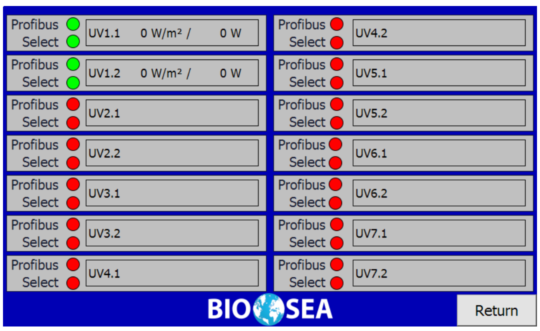
4 Information of operation order (ballasting / deballasting/stripping). Active operations appear in yellow. The treatment method (IMO/MPN or USCG/CMFDA) will also appear on the status

5 General state of the system

6 Alarm information. This button allows access to Alarms view when a default is present



7 The UV displayed is the one which gives the lowest value.
It is possible to visualize UV measures by pressing on the UVC intensity line.

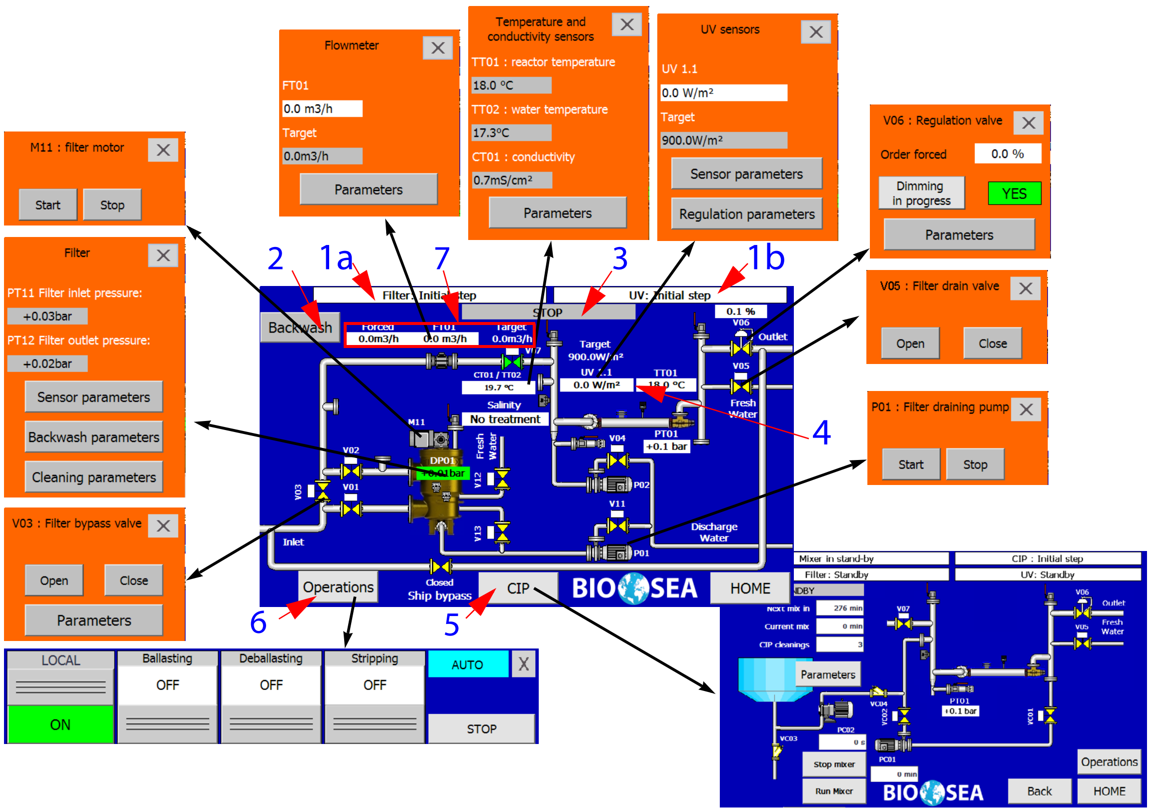


9.2. Process screen

This synoptic view of the installation allows:

- visualizing the status of the treatment cycles (filtration, UV, cleaning phases).
- visualizing subcomponents, with colors indicating their status (closed / open, ON / OFF, etc).
- monitoring values for operational parameters (sensors TT01, UV1.1, FT01).
- accessing to pop-up windows for main components.

Figure 33: View of Process screen



1	Status of the treatment cycles: filter (1a) and UV assembly (1b).	5	Access to CIP process screen (if CIP option is selected)
2	Button to launch a backwash cycle on the filter	6	Access to Operation quick menu
3	Operation order.	7	Flow measurement and targets. Forced flow setpoint can be used to override flow target (inactive when set to 0)
4	UV Sensor Value. The displayed measurement is for the UV which gives the lowest value.		

Generally, the access to Parameters Buttons in the pop-up windows requires an Installer Level password.

Figure 34: Legend of symbols on the screen

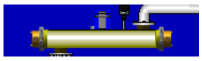
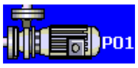
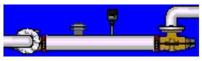
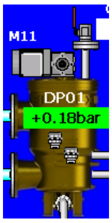
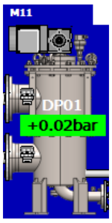
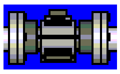
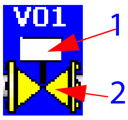
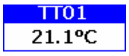
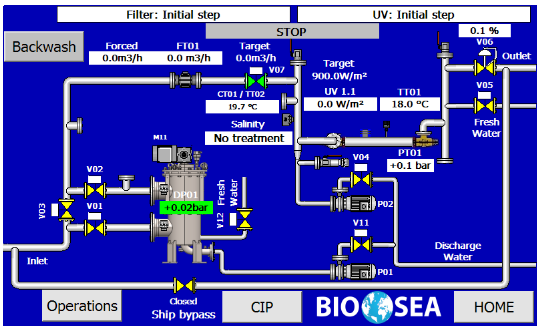
Files	Button grey = inactive ; white = active		6kW **(BIO-SEA® L)** UV reactor (UVx.y)
	Pump (Pxx)		22kW **(BIO-SEA® B)**
 Filtrex filter  HYDAC filter	Filter with dp indicator (green / red) and motor (Mxx)		Flowmeter
	1- Valve actuator Green= active; White= inactive 2- Automatic valve (Vxx) Green= opened; Yellow= closed; White= undetermined; Red = default		Value of control parameter (TT, UV, FT,PT, DP,EC) Background color changes if a defect occurs: • orange for sensor or cable break • yellow for warning • red for alarm

Table 13: Identification of Valves and Pumps

Valve number	Description	Pump or motor nr	Description
V01	Filter inlet valve	P01	Suction pump
V02	Filter outlet valve	P02[1]	Suction pump (optional)
V03	Filter by-pass valve	M11	Filter backwash motor
V04	UV Draining valve		
V05	UV Fresh water valve		
V06	UV outlet control valve		
V07	CIP isolation valve		
V11	Filter backwash outlet valve		
V12	Filter Fresh water valve		
V13	Filter draining valve (only for FILTREX filter)[2]		

1. As an option, for the UV assembly. Usually installed for modular configurations.
2. For HYDAC filter, this valve is replaced by a manual valve VM13 to discharge remaining water into the chest.

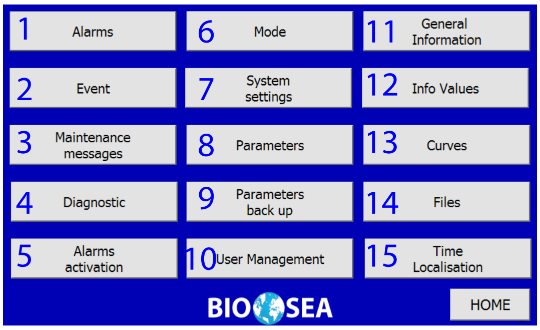
Figure 35: View of Process screen with a Hydac filter



9.3. Appendix screen

The Appendix screen displays buttons that gives access to variety of use and information about the system operation:

Figure 36: Appendix Screen



- Troubleshooting and Maintenance

1- Alarms: displays the active alarms of the system with a description (see Figure 39: page 81).

2- Event: displays events in progress and recorded events (see Figure 46: page 87).

3- Maintenance messages: displays counters for preventive maintenance (see Figure 78: page 143).

4- Diagnostic: allows accessing to specific details of PLC components and their internal events (see paragraph 35. page 217).

5- Alarms activation: allows enabling/disabling various alarms to perform tests (see paragraph 35. page 217).

6- Mode: allows selecting running mode (Stop, Auto, Maintenance or Service) (see Figure 76: page 137).

- System settings and configuration:

7- System settings: displays the basic configuration of the BWTS (model, TRC, filter, etc...)(see screens tree view on Figure 30: page 67).

8- Parameters: displays a screen with buttons to access components parameters. (see screens tree view on Figure 30: page 67).

9- Parameters back-up: allows saving/restoring parameters of the BWTS (see Figure 112: page 193).

10- User management: displays the existing user accounts (see Figure 43: User management screen, page 84). If High level of cybersecurity is enabled, these accounts could be administrated by the vessel.

- Information

11- General information: gives information about the system specification, ship information and software version (see screens tree view on Figure 30: page 67).

12- Info values: displays treated volume and energy consumption for the last operation or since commissioning (see Figure 45: page 87).

13- Curves: shows instantaneous data for each parameter: UV intensity for each reactor, temperature, conductivity, treated volume and flow rate (see Figure 44: page 86).

14- Files: displays curves and Files archiving functions (see Figure 48: page 88).

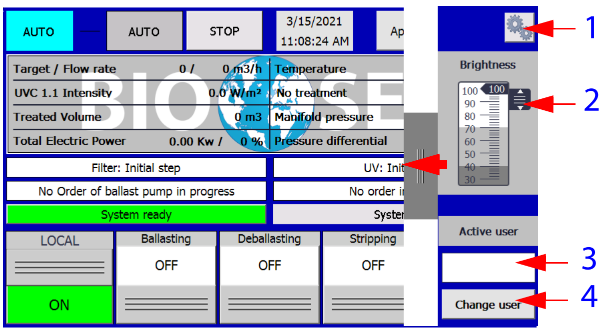
15- Time/Localization: displays the current date and time set on the PLC and the GPS information if wired (see screens tree view on Figure 30: page 67).

9.4. Vertical sliding menu

This menu allows logging in/out and adjusting the screen brightness.

This menu can be displayed from any screen by tapping twice the right side of the screen. It disappears after few seconds of inaction.

Figure 37: Vertical sliding menu

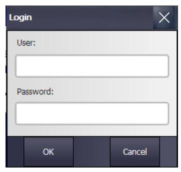


1- Access to Touch screen settings (Installer level required).

2- Cursor to make the touch screen brighter or darker.

3- Displays the user currently logged on.

4- Allows to display the login menu to changer the user.



- Bright and Dark parameters are set in the System settings screen.
- It is possible to log a user out by emptying the field on the login screen and press OK.

10. Defaults and Alarms

10.1. Definitions

A default is the result of an event that might jeopardize:

- the safety of the vessel.
- the safety of the crew or the environment.
- the integrity or the availability of all or part of the installation.
- the quality or safety of the BWTS system.

The detection of a default can be done through:

- State of a sensor.
- Information discordance.
- Control defined on the PLC program.

10.2. Hierarchy and Classification

Defaults are subjected to hierarchization (warning / default) and classification (by family) in order to guide the response of the operator when an event occurs.

- The hierarchy allows to inform the operator about the level of severity of the default.
- The classification by family allows the treatment of defaults at PLC level, according to their impact on the process and mechanisms.

10.2.1. Hierarchy

- **Warning (yellow)**

- Definition: A warning represents an event that informs a deviation of the normal operation and, consequently, that the system will run with a default or a general default if the deviation is not managed.
- Impact on automation: None.
- Visual and audible alarm: lights ON.

- **Non compliant fault (orange)**

- Definition: A **non compliant fault** represents an event involving consequences on the running or the performances of the system. This event can tolerate a delayed action.

  A pop-upwindow appears on the screen: select "Stop" to stop the cycle and the mechanisms (STOP mode) or "Continue" to carry on the cycle in AUTO DOWNGRADED MODE (in non compliant conditions).

- Impact on automation: AUTO DOWNGRADED mode is activated.
- Visual and audible alarm: lights ON and alarm rings.

- When a non compliant fault occurs the system switches automatically in Auto downgraded mode. However, this defect is a "Biosea_fault" sent to the vessel. An audible and visible alarm is also activated until a choice has been done on the screen or the defect has been acknowledged. Any action or no action is recorded in the datalog.
- According to the fault, a delay is applied before the downgraded mode is triggered (0s for by-pass fault, 60s or 600s for overflow defect, 30s for low UVI fault).

- **General default (red)**

- Definition: A general default represents an event that has an immediate impact on the installation (vessel), the environment, the crew / or the system. The system cannot be restarted without solving the general default.
- Impact on automation: Stop of the cycle / Stop of the mechanisms and return in their initial state. (STOP mode).
- Visual and audible alarm: lights ON and alarm rings.

10.2.2. Classification of defaults

Defaults are classified according to three (3) families of elementary defaults:

- **Default on Devices**

- Peripheral PLC: digital and / or analog cards.
- Communication error with specific cards: Profibus DP cards.

- **Default on Equipments**

This family covers all defects related to sensors and mechanisms.

- Default of consistency: contradiction between information received from two sensors.
- Discordance: mismatch between control and control copy.
- Movement default: movement not made or failure of limit switch.
- Lack of safety: failure of the safety requirements for protection of the operator and/or the system.
- Internal defect on ELC / UV lamp.

- **Default on Process**

This family covers all defects not related to a mechanism.

- Default linked to a measurement threshold (example: UV intensity, pressure, temperature , flow rate...).
- Default linked to the system operation (automatic sequence).

10.2.3. List of defaults for BIO-SEA® BWTS

There are three main categories or sources of default that are displayed on the Home screen: Warning, General default and Non compliant fault (Downgraded mode). The identification of each specific default is shown in the Alarm screen (see Figure 39: Alarms screen, page 81).

Table 14: List of Defaults

Defaults message	Hierarchy	Classification	Auto acquit
High load - continuous backwash	Warning	Process	No
Filter clogged	General default	Process	No
High DP min	Warning	Process	No
Warning low Flow	Warning	Process	No
Defect low Flow	General default	Process	No
Warning overflow	Warning	Process	No
Overflow	Non compliant fault	Process	No
M11: Defect circuit breaker absence	General default	Equipment	No
M11: Order failure defect	General default	Equipment	Yes
Miss general RUN / STOP	General default	Process	No
Pxx[1]: Defect circuit breaker absence	General default	Equipment	No
Pxx[1]: Defect of lack of safety	General default	Equipment	No
Pxx[1]: Order failure defect	General default	Equipment	Yes
PB emergency stop	General default	Process	No
Defect dual order	General default	Process	No
ELCx.y[2]: Defect slave missing on Profibus	General default	Equipment	No
ELCx.y[2] Order failure defect	General default	Process	No
ELCx.y[2] Internal defect ELC	General default	Device	No
ELCx.y[2] Defect low flow cut off	General default	Process	No
ELCx.y[2] Defect of lack of safety	General default	Process	No
UVx.y[2]: Alarm UV irradiance too low	Non compliant fault	Process	No
UVx.y[2]: Defect sensor or cable break	General default	Equipment	No
Vxx[3]: Defect closing sensor	General default	Equipment	No
Vxx[3]: Defect opening sensor	General default	Equipment	No
Y Ship_bypass: Ship bypass open	Non compliant fault	Process	No
Y Ship_bypass: Defect stripping valve open	General default	Process	No
Y Ship_bypass: Warning stripping valve open	Warning	Process	Yes
YYxx[4]: Defect sensor or cable break	General default	Equipment	No
PTxx[5]: High pressure	Warning	Process	Yes
PTxx[5]: Overpressure	General default	Process	No
TTxx[6]: Warning temperature	Warning	Process	Yes
TTxx[6]: Defect temperature maxi	General default	Process	No
CT01: Conductivity control failure	Warning	Equipment	No
No reactor selected	General default	Process	Yes
Maintenance required	Warning	Process	Yes
HMI loss of connection	General default	Device	No
RS485 loss of connection	General default	Device	No
RS485 loss of connection	Warning	Device	No

Table 14: List of Defaults

Defaults message	Hierarchy	Classification	Auto acquit
Remote control defect	General default	Device	No
Remote Screen 1 loss of connection	General default	Device	No
Remote Screen 2 loss of connection	General default	Device	No
HW remote 1 PLC : Missing or defect	General default /Warning[7]	Equipment	Yes
HW remote 1PLC : Card failure	General default /Warning[7]	Equipment	Yes
HW remote 2 PLC : Missing or defect	General default /Warning[7]	Equipment	Yes
HW remote 2 PLC : Card failure	General default /Warning[7]	Equipment	Yes
HW Main PLC: Card An[8] missing	General default	Equipment	Yes
HW Main PLC: Card An[8] failure	General default	Equipment	Yes
Manifold empty	Warning	Device	Yes
UV manifold draining too long	General default	Process	No
Filter1 empty	Warning	Device	Yes
Filter draining too long	General default	Device	No
Fresh water filling incomplete	Warning	Process	No
Downgraded mode accepted	Non compliant fault	Process	Yes
Downgraded mode not validated	Non compliant fault	Process	Yes
CIP option			
Miss CIP RUN / STOP	Warning	Process	No
HW CIP PLC: Card failure	Warning	Equipment	Yes
HW CIP PLC: Missing or Defect	Warning	Equipment	Yes
PCxx[9]: Defect circuit breaker absence	Warning	Equipment	No
PCxx[9]: Defect of lack of safety	Warning	Equipment	No
PCxx[9]: Order failure defect	Warning	Equipment	Yes
PB CIP Emergency stop (or RUN/STOP)	Warning	Process	No
VCxx[10]: Defect closing sensor	Warning	Equipment	No
VCxx[10]: Defect opening sensor	Warning	Equipment	No
CIP tank level low	Warning	Process	No
CIP filling in progress	Warning	Process	No

1. Pxx refers to a pump's number.
2. x.y refers to a reactor's number (x is the number of the corresponding cabinet Ax and y is the number of the corresponding ELC).
3. Vxx refers to a valve's number.
4. YYxx refers to the name of the sensor: PT01, PT11, PT12, TT01, TT02, EC01, UVx.y, FT01, V06.
5. PTxx refers to a pressure transmitter's number.
6. TTxx refers to a temperature transmitter number.
7. This defect is a Warning if the corresponding remote is not currently in use or a General default if the corresponding remote is currently in use.
8. An refers to the electronic card number on the PLC.
9. PCxx refers to a pump number on the CIP system.
10. VCxx refers to a valve number on the CIP system.

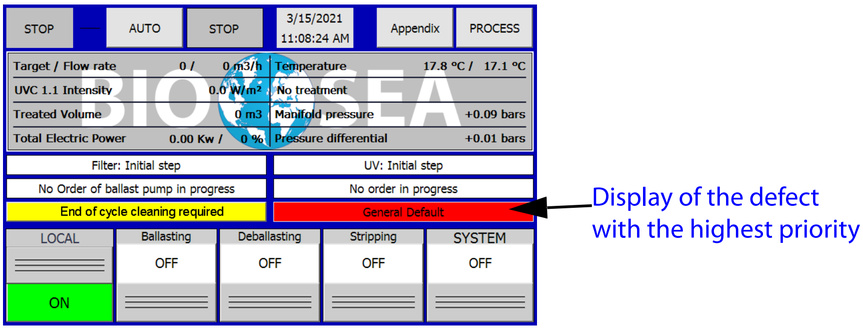
For further identification of the elements, refer to PID or general wiring diagram of the system.

10.3. Treatment of defaults

The presence of a warning or a default is signaled by :

- An audible and visible alarm. The audible alarm can be stopped by pressing "MUTE" on the Alarm screen: a "Q" is added on the defect status in Alarm screen but it doesn't disappear. However, even if the audible alarm is off, the visual alarm remains active if a defect is still active.
- A blinking field on Home screen. This field doesn't blink anymore as long as "MUTE" or "ACK" button has been pressed on the Alarm screen. Following the hierarchy of the default, it will get a different color:
  - Yellow for a warning.
  - Orange for a non compliant fault.
  - Red for a general default.

Figure 38: Example of home screen with a default (here a general default)



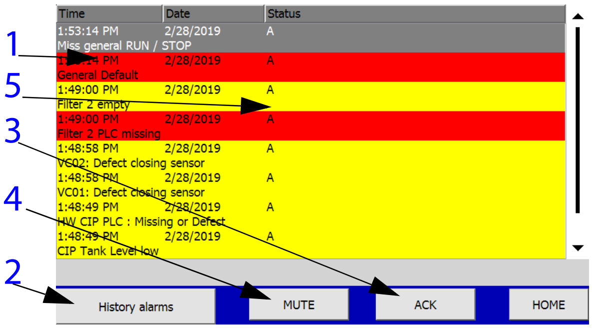
- A description of the default can be found in the Alarm screen.

Table 15: Alarm status on the Alarm screen

Alarm status	Meaning	Background color	Audible and visible alarm
A	Defect or warning active	Red blinking for defect or yellow blinking for warning (grey when selected)	Sound and light are ON for a defect Only light is ON for a warning
AQ	Defect acknowledged but still active	Red for defect or yellow for warning (grey when selected)	Only light is ON
AQD / ADQ / AD	Defect or warning inactive	White (blue when selected)	No light, no sound

Defaults are acknowledged in a single time by the operator on the Alarms Screen.

Figure 39: Alarms screen



1- List of alarms in progress.
2- To open the Alarms history (see below).
3- Acknowledgment button.
4- Acknowledgment of audible alarm. Pressing this button adds a "Q" on all alarm status.
5- Alarm status:

A = Appearing / Active, text blinking red.
AQ, = Acknowledged but still active, text red
Fields appearing in yellow are warnings.

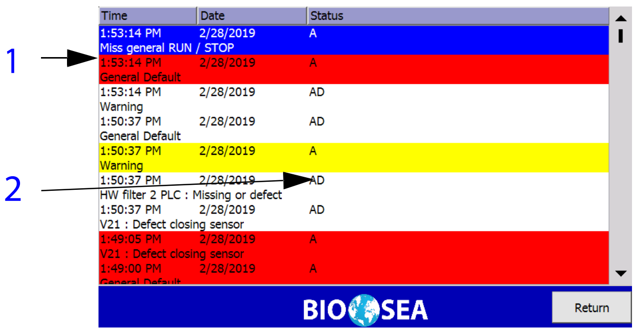
Defaults could not disappear only by acknowledging them, so refer to the Troubleshooting section in the "Operation and Maintenance" book (BSB2_FX_03) to solve them.

The occurrence of a default does not prevent from activating the Maintenance Mode in order to use the mechanisms that are not affected by the default.

Actions to undertake when an alarm occurs are described in the "Troubleshooting" section of this Manual. See Troubleshooting, page 202.

All displayed defaults are recorded and visible in the Alarm history.

Figure 40: Alarms History screen



1- History of alarms: hour, date, description, status.
2- Status of alarms:

A = Appearing / Active.
AD = Disappearing / Deactivated.
AQ, ADQ or AQD = Acknowledged .

11. User management

11.1. User management levels

2 types of user management are available:

- Normal: basic users (operator level) doesn't require any identification. Authentication is required to access functionalities and parameters (maintenance or installer level). Passwords should have at least 8 characters and are not subject to aging. There is no administrator.
- High: this is intended for higher cybersecurity. All actions are subject to authentication. Passwords should have at least 8 characters and are subject to periodic change (90 days aging with 5 successive different passwords). Vessel can administrate accounts.

In any case, there is no need to log on to be able to navigate through the screens.

When High level is selected and validated, it is definitively locked.

DNV Rules do not allow to have a password for starting the BWT system, therefore high level of access management should not be chosen for vessels classed by DNV society.

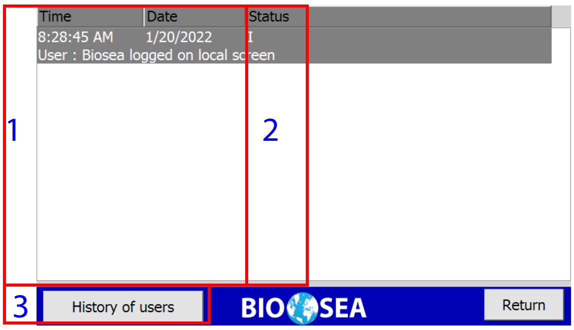
User accounts can be imported or exported from any screen of the system to another screen.

User's connection are data logged for every screen.

11.2. User datalog

Log in and log out data of all accounts with authentication can be retrieved through the Users history screen that covers about 130000 log in/out entries.

Figure 41: User datalog screen

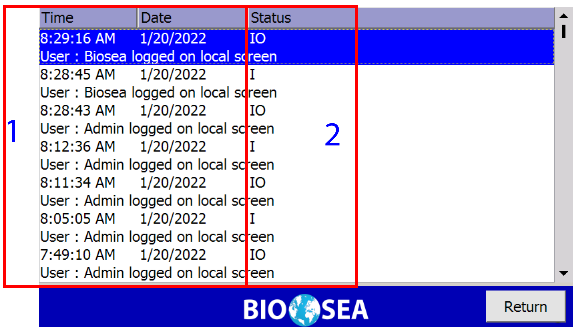


1 List of the user currently logged on

2 Status of the user: I= log in, IO= log out

3 To access history of the users

Figure 42: Users history screen



1 History of users log in/out: hour, date, name

2 Status of the user event: I= log in, IO= log out

11.3. Account management (High level only)

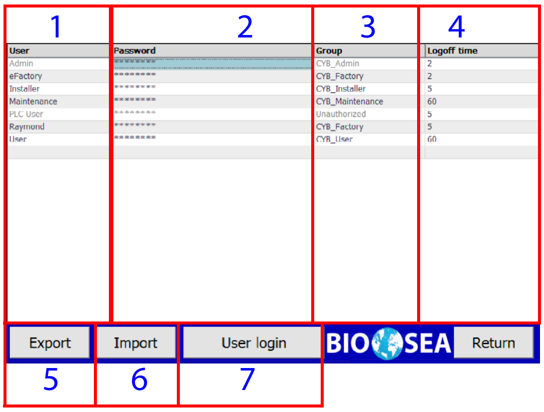
11.3.1. Definition of access groups

This list is given with a hierarchic order, from the lowest rights to the highest rights.

- Cyb_User: This group allows to use the system with basic user rights.
- Unauthorized: This group allows to deactivate an account.
- Cyb Maintenance: This group allows to use the system with Maintenance rights.
- Cyb_Admin: This group allows to manage accounts for User, Unauthorized and Maintenance groups: modification of name and password, modification of logoff time, set-up or deletion of an account.

Other groups exist and are visible at the Administrator level. However they should be used only by **BIO-UV Group** technicians or representative.

Figure 43: User management screen



1	Account name		5	Button to export existing accounts on a USB stick.
2	Account password		6	Button to import accounts from a USB stick.
3	Access group		7	Access to User datalog screen (see 11.2. User datalog, page 83)
4	Log off time in minute (5 minutes by default)			

- Each account can see the accounts of their own group or from the groups with lower rights.
- Each account can modify its own name, password or log off time. For that, touch the corresponding field and enter the new value/text.

Cyb_administration rights give access to account definition. Warranty is waived if Administrator creates Installer or Factory accounts, or modifies the characteristics of user and groups beyond what is authorized and explained in this Manual and during training.

11.3.2. Password renewal (High Level)

When High level of account management is active, passwords expire after 90 days and must be changed. The user will be warned 7 days before expiration.

1- Log on with user's Cyb_ account: after entering account name and the current password, a window will appear to enter new password.

2- Enter the new password twice then validate. The new password must be different from the 5 previous passwords.

If any issues arise when renewing password, contact your Administrator.

11.3.3. Account management (Cyb_admin only)

- **To create an account**

1- Log on with a Cyb_Admin account.

2- Touch a blank field on the account name column (named "User").

3- Capture the name of the new account, the password, the suitable group and the log off time.

Password Characteristics are the same for all secured accounts:
- it must consist of 8 digits minimum. However, according to cybersecurity best practice, passwords should contain letters, numbers and special characters.
- it cannot be the same as the previous 5 passwords.

- **To suppress an account**

1- Log on with a Cyb_Admin account.

2- Touch the name of the account to suppress.

3- Delete the name by using the virtual keyboard and validate.

- **To deactivate/reactivate an account**

1- Log on with a Cyb_Admin account.

2- Touch the name of the account to suppress.

3- Select the suitable group for inactivating (Unauthorized) or reactivating the account (Cyb_User / Cyb_Maintenance).

- **To save or restore an account (useful to transfer accounts from one screen to another)**

1- Log on with a Cyb_Admin account.

2- Insert a USB stick.

3- Press Export (5) to save all accounts on the USB stick or Import (6) to restore all accounts from the USB stick.

The Import or Export functions should be used carefully: every accounts with the same name will be overwritten on the destination media (USB or screen).

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12. Data management

The **BIO-SEA**® PLC continuously monitors and records the functioning and failure of the system.

Data are archived on a SD card, that provides enough space for a 24/24 recording during 24 months as required by 46 CFR 162.060-20 (b) and IMO BWMS code.

A security seal is placed behind the screen, on the SD card slot, to prevent any manipulation of the SD card.

Data on the SD card are recorded in CSV (ASCII) format, compatible with EXCEL for archive retrieval. 1 file contains 10 000 data.

Archiving on the SD card is first launched during commissioning of the BWTS.

Archive retrieval on USB stick can only be done from the main screen on the control cabinet, not from a remote control screen.

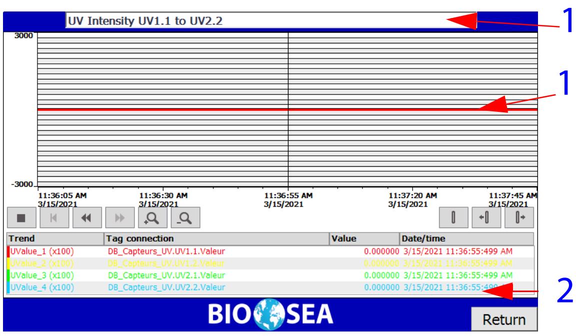
12.1. Data display

From the Appendix Menu (see Figure 36: Appendix Screen, page 73), data of current or passed operations can be checked.

12.1.1. Curves from sensors

Go to "Curves" screen (Curves on Figure 36: Appendix Screen, page 73): curves screen shows instantaneous data for each parameter: UV intensity for each reactor, temperature, conductivity, treated volume and flow rate.

Figure 44: Curves Screen



1- Selection of the curves to display.

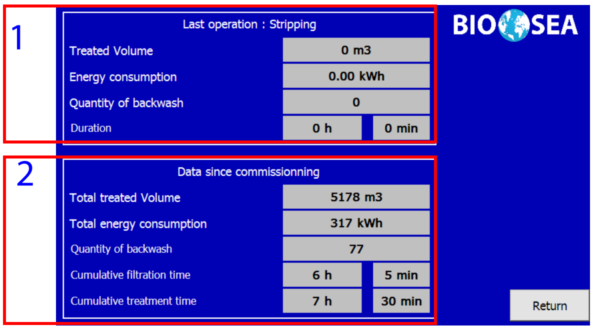
2- Curve of one of the parameters (last 15min of operation are displayed).

3- List of data (with instantaneous value) and cursor.

12.1.2. Data of the last operation

Go to "Info Values" screen.

Figure 45: Info Values screen



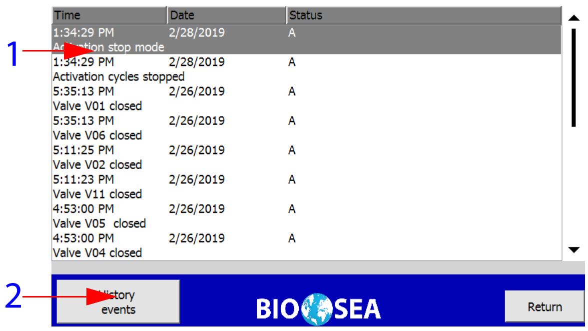
1- Treated Volume and energy consumption since the beginning of last operation ((automatically reseted at each operation start)).

2- Treated Volume and energy consumption since commissioning (cannot be reset).

12.1.3. Recorded Events and Alarms

Go to "Events" screen (accessible with the «Events» button on the Appendix screen) to see the operations/events in progress and History of events.

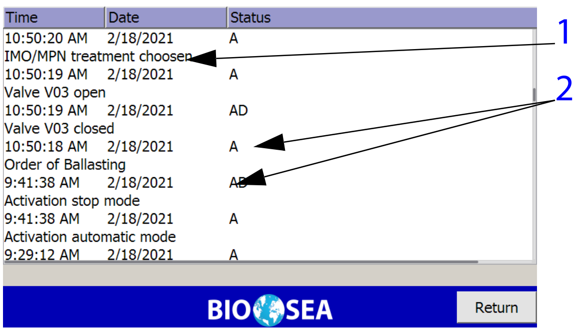
Figure 46: Events Screen



1- List of Events in progress.

2- To open Events history.

Figure 47: Events History screen



1- History of events: hour, date, description, status.

2- Status of the events:

A = Appearing.
AD = Disappearing.

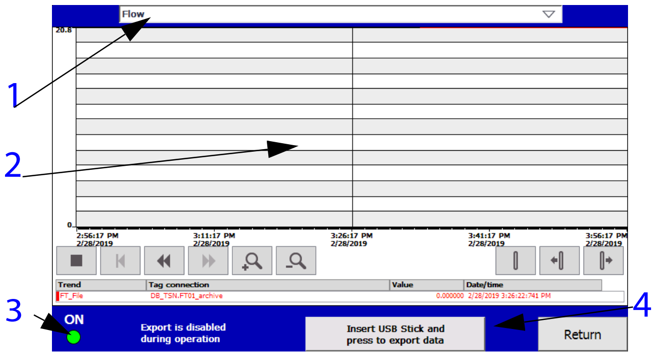
Even if it doesn't appear on the event list, any modification of values or parameters on the screen is recorded on the datalog SD card.

Go to "Alarms" screen to see the operations/events in progress and History of alarms (see Figure 40: Alarms History screen, page 81).

12.2. Datalog

- Press the «Files» button on the Appendix screen. It displays Files archiving functions on the lower part of the screen (the curves are the same than in the «Curve» screens).

Figure 48: Example of archiving screen



1- Selection of the parameter to be displayed on the screen.

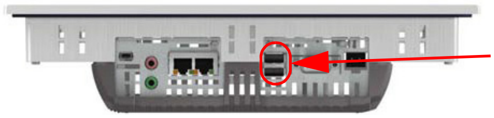
2- Display of measured parameters (curves).

3- Archiving function:
  - Green= Archiving in progress.
  - Yellow= No archiving.

4- To export available archives on a USB stick (Maintenance level is required).

- Insert a USB stick behind the screen. This stick should not contain **BIO-SEA**® archives or they will be overwritten by the new files.

Figure 49: Location of the USB port, at the bottom of Touch screen

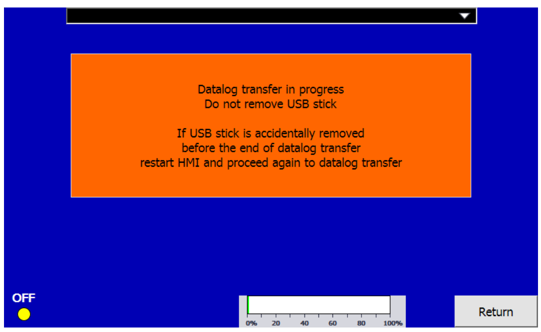


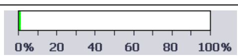
USB ports

- Exporting the data is possible only if no operation is in progress (ballasting, deballasting or stripping) and maintenance or service mode is disabled. The archiving indicator (3) is always green except during export data where it becomes yellow.
- Press the button (4) [Insert USB Stick and press to export data] (There is no need to stop archiving while exporting data)
- Wait until the transfer is over.

During the data transfer, the USB stick must not be removed. In the event of USB stick removing:

- The Export data button changes [USB stick missing Acquit and restart transfer].
- The event is recorded in the datalog
- The HMI must be entirely restarted and transfer must be performed again.



- When done, the button  should change into [Remove USB Stick then press the button]. As indicated, remove the USB stick, then press the button.
- Files are in CSV (ASCII) format, compatible with Excel format (MS office software). They are located into folders (curves, events, alarms, power) that are saved at USB stick root.

12.3. Datalog files analysis

BIO-UV Group cannot ensure that data is not modified in csv files once exported to a computer: these files are not tamper proof. In case of doubt, extraction of data should be carried out again.

12.3.1. Structure of the files

Datalog files are readable with Excel, and the following paragraphs show an example of how to navigate through them.

When extracted, the datalog is composed of 6 folders:

- Alarms contains all the alarms and warning.
- Curve contains all the value measured by the sensors.
- Event contains all the event logs.
- Logs contains all events related to the log (errors, stop etc… of recording).
- Maintenance contains all the maintenance operation events.
- Power contains the data of the electrical consumption of the system.

12.3.2. Datamanager

- **Periodic report for BWTS operations**

BIO-UV Group has developed a software called "Datamanager" to manage datalog files recorded by the BWTS. This software allows:

- Visualizing values for each sensor.
- Looking for events or alarms.
- Generating preset/standard reports for BWTS operation.

Periodic report is generated in pdf format from the data uploaded in the software. Period can be selected from days to 1 month.

The report contains:

- Data from system (model and TRC) and vessel (IMO nr).
- Chosen period.
- Curve for UVI of each reactor.
- Curve for power of each reactor.
- Curve for flow rate.

- Ballasting/deballasting events with
  - Start/Stop date and time.
  - Treatment applied (IMO/USCG).
  - Total duration and volume treated.
  - Average flow of operation.
  - Alarm occurred (general).
- Cleaning events.
- Other important event when no operation is active: ship bypass, setting changes, mode changes, datalog transfers and alarms.

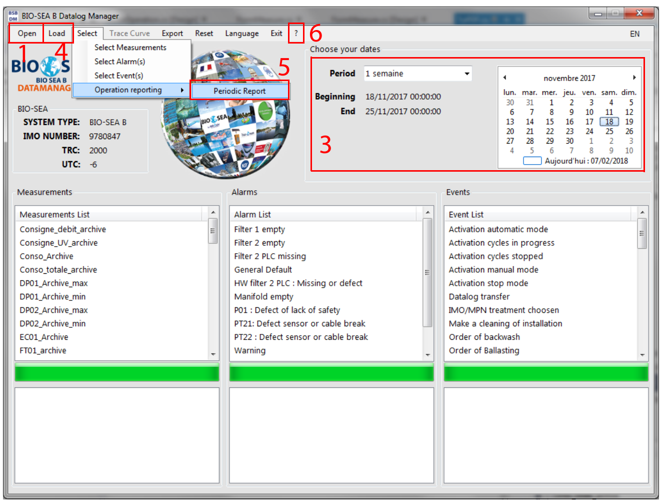
Periodic report meets ETV requirements included in " Protocol for the Verification of Ballast Water Treatment Technologies " chapter 3.5. Datamanager is able to print or stored electronically reports and logged data upon the following events:

- the BWTS is started.
- the BWTS is stopped.
- an alarm condition develops.
- normal conditions are restored.
- manual override is engaged.

Datamanager use

First copy the file on the computer then launch the software.

When this window appears, press User access to open Workspace window.



Steps to follow to read datalog files with Datamanager software:

1- Click "Open" in the menu bar.

2- Select the folder where datalog files can be found.

3- Select the beginning and the duration of the period to display.

4- Click "Load" in the menu bar.

5- Go to "Select" > "Operation reporting" > "Periodic report": the generated report is displayed. Press "Edit pdf" to generate a pdf file.

6- Click "?" to get more help on software use.

To get this software, please contact **BIO-UV Group** staff.

12.3.3. Using .CSV files

- **Retrieving the beginning and the end of an operation (Event folder)**

Go into the Event folder and open the last CSV file. If there are different files, choose the one with the highest index to retrieve the most recent information.

Nom	Modifié le	Type	Taille
Archive_evenements0.csv	05/06/2015 10:10	Microsoft Excel C...	932 Ko
Archive_evenements1.csv	05/06/2015 10:24	Microsoft Excel C...	394 Ko

In the log file, the three important columns are "TimeString" (Column N), "MsgText" (Column O) and "StateAfter" (Column C).

- The column "MsgText" indicates the name of the event.
- The column "StateAfter" indicates the state of an event, 1 is for the appearing and 0 for the disappearing.
- The column "TimeString" indicates the time of the event change. Date format is DD.MM.YYYY where DD indicates day, MM indicates month, and YYYY indicates year.

For example, in order to retrieve all information about the last ballasting operation it is necessary to search the “Order of ballasting” change:

- Sort the document by MsgText (column O).
- Go the last “Order of ballasting” event.
- Check start (1 in column "StateAfter") and end (0 in column "StateAfter") of the event.

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
1	Time_ms	MsgProc	StateAfter	MsgClass	MsgNumber	Var1	Var2	Var3	Var4	Var5	Var6	Var7	Var8	TimeString	MsgText
1164	42151449011	2	1	2	191									27.05.2015 10:46:35	Order of Ballasting
1165	42151453835	2	0	2	191									27.05.2015 10:53:31	Order of Ballasting
1166	42151548191	2	1	2	191									27.05.2015 13:09:24	Order of Ballasting
1167	42151551013	2	0	2	191									27.05.2015 13:13:28	Order of Ballasting
1168	42151551752	2	1	2	191									27.05.2015 13:14:31	Order of Ballasting
1169	42151551913	2	0	2	191									27.05.2015 13:14:45	Order of Ballasting
1170	42151553717	2	1	2	191									27.05.2015 13:17:21	Order of Ballasting
1171	42151553752	2	0	2	191									27.05.2015 13:17:24	Order of Ballasting
1172	42153498611	2	1	2	191									29.05.2015 11:58:00	Order of Ballasting
1173	42153498715	2	0	2	191									29.05.2015 11:58:09	Order of Ballasting
1174	42153565003	2	1	2	191									29.05.2015 13:33:36	Order of Ballasting
1175	42153570902	2	1	2	191									29.05.2015 13:42:06	Order of Ballasting
1176	42153575893	2	0	2	191									29.05.2015 13:49:17	Order of Ballasting
1177	42156468788	2	1	2	191									01.06.2015 11:15:03	Order of Ballasting
1178	42156481771	2	1	2	191									01.06.2015 11:33:45	Order of Ballasting
1179	42157396874	2	1	2	191									02.06.2015 09:31:30	Order of Ballasting
1180	42157396897	2	0	2	191									02.06.2015 09:31:32	Order of Ballasting
1181	42157400426	2	1	2	191									02.06.2015 09:36:37	Order of Ballasting
1182	42157400438	2	0	2	191									02.06.2015 09:36:38	Order of Ballasting
1183	42157483278	2	1	2	191									02.06.2015 11:35:55	Order of Ballasting
1184	42157501386	2	0	2	191									02.06.2015 12:02:00	Order of Ballasting
1185	42157591081	2	1	2	191									02.06.2015 14:11:09	Order of Ballasting
1186	42157591370	2	0	2	191									02.06.2015 14:11:34	Order of Ballasting
1187	42158600029	2	1	2	191									03.06.2015 14:24:03	Order of Ballasting
1188	42158603014	2	0	2	191									03.06.2015 14:28:20	Order of Ballasting
1189	42159467986	2	1	2	191									04.06.2015 11:13:54	Order of Ballasting
1190	42159468009	2	0	2	191									04.06.2015 11:13:56	Order of Ballasting
1191	42160386740	2	1	2	191									05.06.2015 09:16:54	Order of Ballasting
1192	42160386845	2	0	2	191									05.06.2015 09:17:03	Order of Ballasting
1193	42160390619	2	1	2	191									05.06.2015 09:22:29	Order of Ballasting
1194	42160433730	2	0	2	191									05.06.2015 10:24:34	Order of Ballasting
1195	42159464524	2	1	2	105									04.06.2015 11:08:55	Order of CIP Cleaning
1196	42159467790	2	0	2	105									04.06.2015 11:13:37	Order of CIP Cleaning
1197	42146759466	2	1	2	105									22.05.2015 18:13:38	Order of CIP Wwashing
1198	42146767463	2	0	2	105									22.05.2015 18:25:09	Order of CIP Wwashing
1199	42146797678	2	1	2	105									22.05.2015 19:08:39	Order of CIP Wwashing
1200	42146799397	2	0	2	105									22.05.2015 19:11:08	Order of CIP Wwashing
1201	42146809063	2	1	2	105									22.05.2015 19:25:03	Order of CIP Wwashing

In this example, the last ballasting operation was done on the 5th of June between 9:22 and 10:24.

- **Log of events (Event folder)**

In the example below, lines are sorted by "TimeString" (column N).

All the entries before and after the date of the searched operation (05/06/2015) have been hidden.

We can see all the sequence of events during the last ballasting (ie, between 9:22 and 10:24).

For an example at 9:44:52 an order of backwash has been set and reset at 9:45:02, the draining valve V11 has moved as required.

1	Time_ms	MsgProc	StateAfte	MsgClass	MsgNum	Var1	Var2	Var3	Var4	Var5	Var6	Var7	Var8	TimeString	MsgText	PLC
4162	42160390609	2	0	2	203									05.06.2015 09:22:29	Stop ballasting	<internal>
4163	42160390619	2	1	2	191									05.06.2015 09:22:29	Order of Ballasting	Liaison_IHM_1
4164	42160390641	2	0	2	218									05.06.2015 09:22:31	Valve V06 closed	Liaison_IHM_1
4165	42160390665	2	0	2	228									05.06.2015 09:22:33	Valve V02 closed	Liaison_IHM_1
4166	42160390665	2	1	2	227									05.06.2015 09:22:33	Valve V02 open	Liaison_IHM_1
4167	42160390687	2	0	2	226									05.06.2015 09:22:35	Valve V01 closed	Liaison_IHM_1
4168	42160390699	2	1	2	225									05.06.2015 09:22:36	Valve V01 open	Liaison_IHM_1
4169	42160390710	2	1	2	217									05.06.2015 09:22:37	Valve V06 open	Liaison_IHM_1
4170	42160390867	2	1	2	203									05.06.2015 09:22:51	Stop ballasting	<internal>
4171	42160394389	2	1	2	202									05.06.2015 09:27:55	Alarm	Liaison_IHM_1
4172	42160394529	2	0	2	202									05.06.2015 09:28:07	Alarm	Liaison_IHM_1
4173	42160397079	2	1	2	202									05.06.2015 09:31:48	Alarm	Liaison_IHM_1
4174	42160397231	2	0	2	202									05.06.2015 09:32:01	Alarm	Liaison_IHM_1
4175	42160406162	2	1	2	137									05.06.2015 09:44:52	Order of backwash	Liaison_IHM_1
4176	42160406163	2	0	2	232									05.06.2015 09:44:53	Valve V11 closed	Liaison_IHM_1
4177	42160406163	2	1	2	231									05.06.2015 09:44:53	Valve V11 open	Liaison_IHM_1
4178	42160406279	2	0	2	137									05.06.2015 09:45:02	Order of backwash	Liaison_IHM_1
4179	42160406279	2	1	2	232									05.06.2015 09:45:03	Valve V11 closed	Liaison_IHM_1
4180	42160406279	2	0	2	231									05.06.2015 09:45:03	Valve V11 open	Liaison_IHM_1
4181	42160407419	2	1	2	202									05.06.2015 09:46:41	Alarm	Liaison_IHM_1
4182	42160407501	2	0	2	202									05.06.2015 09:46:48	Alarm	Liaison_IHM_1
4183	42160411001	2	1	2	202									05.06.2015 09:51:51	Alarm	Liaison_IHM_1
4184	42160411176	2	0	2	202									05.06.2015 09:52:06	Alarm	Liaison_IHM_1
4185	42160412859	2	1	2	202									05.06.2015 09:54:31	Alarm	Liaison_IHM_1
4186	42160413058	2	0	2	202									05.06.2015 09:54:48	Alarm	Liaison_IHM_1
4187	42160417304	2	1	2	202									05.06.2015 10:00:55	Alarm	Liaison_IHM_1
4188	42160417419	2	0	2	202									05.06.2015 10:01:05	Alarm	Liaison_IHM_1
4189	42160425924	2	1	2	202									05.06.2015 10:13:20	Alarm	Liaison_IHM_1
4190	42160426274	2	0	2	7									05.06.2015 10:13:50	Activation automatic mode	Liaison_IHM_1
4191	42160426274	2	1	2	201									05.06.2015 10:13:50	Activation Auto degraded mode	Liaison_IHM_1
4192	42160426274	2	0	2	202									05.06.2015 10:13:50	Alarm	Liaison_IHM_1
4193	42160426356	2	1	2	112									05.06.2015 10:13:57	Downgraded mode accepted	Liaison_IHM_1
4194	42160432202	2	0	2	425									05.06.2015 10:22:22	Water change : Low conductivity	Liaison_IHM_1
4195	42160432202	2	1	2	427									05.06.2015 10:22:22	Water change : High conductivity	Liaison_IHM_1
4196	42160432983	2	1	2	425									05.06.2015 10:23:30	Water change : Low conductivity	Liaison_IHM_1
4197	42160432983	2	0	2	427									05.06.2015 10:23:30	Water change : High conductivity	Liaison_IHM_1
4198	42160432994	2	0	2	425									05.06.2015 10:23:31	Water change : Low conductivity	Liaison_IHM_1
4199	42160432994	2	1	2	427									05.06.2015 10:23:31	Water change : High conductivity	Liaison_IHM_1
4200	42160433252	2	1	2	426									05.06.2015 10:23:53	Water change : Medium conductivity	Liaison_IHM_1
4201	42160433252	2	0	2	427									05.06.2015 10:23:53	Water change : High conductivity	Liaison_IHM_1
4202	42160433521	2	1	2	425									05.06.2015 10:24:16	Water change : Low conductivity	Liaison_IHM_1
4203	42160433521	2	0	2	426									05.06.2015 10:24:16	Water change : Medium conductivity	Liaison_IHM_1
4204	42160433528	2	0	2	217									05.06.2015 10:24:17	Valve V06 open	Liaison_IHM_1
4205	42160433552	2	1	2	217									05.06.2015 10:24:19	Valve V06 open	Liaison_IHM_1
4206	42160433715	2	0	2	203									05.06.2015 10:24:33	Stop ballasting	<internal>
4207	42160433730	2	0	2	191									05.06.2015 10:24:34	Order of Ballasting	Liaison_IHM_1
4208	42160433737	2	0	2	217									05.06.2015 10:24:35	Valve V06 open	Liaison_IHM_1
4209	42160433737	2	1	2	226									05.06.2015 10:24:35	Valve V01 closed	Liaison_IHM_1
4210	42160433737	2	0	2	225									05.06.2015 10:24:35	Valve V01 open	Liaison_IHM_1
4211	42160433742	2	1	2	228									05.06.2015 10:24:35	Valve V02 closed	Liaison_IHM_1
4212	42160433742	2	0	2	227									05.06.2015 10:24:35	Valve V02 open	Liaison_IHM_1
4213	42160433760	2	1	2	218									05.06.2015 10:24:37	Valve V06 closed	Liaison_IHM_1

Archive_evenements1

We will use this example later, in the Curve folder, to retrieve values of parameters (DP entries for example).

- **Alarms folder**

In the spreadsheet the three important columns are "TimeString" (Column N), "MsgText" (Column O) and "StateAfter" (Column C).

- The column "MsgText" indicates the name of the alarm/warning.
- The column "TimeString" the time of the change of status.
- The column "StateAfter" indicates the status of the alarm.
  - 0 = Appearing/Disappearing (AD).
  - 1 = Appearing (A).
  - 2 = Appearing/Acquit/Disappearing (AQD).
  - 3 = Appearing/Acquit (AQ).

1	Time_ms	MsgProc	StateAfter	MsgClass	MsgNumber	Var1	Var2	Var3	Var4	Var5	Var6	Var7	Var8	TimeString	MsgText
3509	4,216E+10	2	2	1	199									05.06.2015 09:32:01	Warning
3510	4,216E+10	2	1	1	199									05.06.2015 09:46:41	Warning
3511	4,216E+10	2	1	1	216									05.06.2015 09:46:41	Warning overflow
3512	4,216E+10	2	3	1	199									05.06.2015 09:46:46	Warning
3513	4,216E+10	2	3	1	216									05.06.2015 09:46:46	Warning overflow
3514	4,216E+10	2	2	1	199									05.06.2015 09:46:48	Warning
3515	4,216E+10	2	2	1	216									05.06.2015 09:46:48	Warning overflow
3516	4,216E+10	2	1	1	199									05.06.2015 09:51:51	Warning
3517	4,216E+10	2	1	1	216									05.06.2015 09:51:51	Warning overflow
3518	4,216E+10	2	3	1	199									05.06.2015 09:51:56	Warning
3519	4,216E+10	2	3	1	216									05.06.2015 09:51:56	Warning overflow
3520	4,216E+10	2	2	1	216									05.06.2015 09:52:06	Warning overflow
3521	4,216E+10	2	2	1	199									05.06.2015 09:52:06	Warning
3522	4,216E+10	2	1	1	199									05.06.2015 09:54:31	Warning
3523	4,216E+10	2	1	1	216									05.06.2015 09:54:31	Warning overflow
3524	4,216E+10	2	3	1	199									05.06.2015 09:54:44	Warning
3525	4,216E+10	2	3	1	216									05.06.2015 09:54:44	Warning overflow
3526	4,216E+10	2	2	1	199									05.06.2015 09:54:48	Warning
3527	4,216E+10	2	2	1	216									05.06.2015 09:54:49	Warning overflow
3528	4,216E+10	2	1	1	216									05.06.2015 10:00:55	Warning overflow
3529	4,216E+10	2	1	1	199									05.06.2015 10:00:55	Warning
3530	4,216E+10	2	3	1	216									05.06.2015 10:01:01	Warning overflow

For example : on event log we can see a warning at 9:46:41, in the alarm log we retrieve this alarm by timestring column (N) and looking at the StateAfter column (C), we can see the status = 1 (it was an overflow), at 9:46:46 it has been acquit (status = 3) and it disappeared at 9:46:48 (Status = 2).

▪ Curve Folder

There are 3 columns to read in curve files:

- VarName (Column A), it is the name of the data.
- TimeString (Column B), it is the hour of the entry.
- Value (Column C), it is the effective value of the data.

All variable names are described in Table 16: Recorded Parameters, page 95.

In our example, in Event log, we had an order of backwash disappearing at 9:45:02, the min and max DP during a backwash are logged so we can retrieve the log in the DP file.

We can see 4 entries at 9:45:02 :

- DB_TSN.DP01_Archive_min (minimum value during the backwash).
- DB_TSN.DP01_Archive_max (maximum value during the backwash).
- DB_TSN.Quantité_backwah_cycle (Quantity of backwash during the operation).
- DB_TSN.Quantité_backwash_total (Total quantity of backwash of the system).

The RT_OFF entry means that HMI was off.

98	RT_OFF	01.06.2015 15:56:16	0	2	4,2157E+10
99	RT_OFF	01.06.2015 17:48:46	0	2	4,2157E+10
00	RT_OFF	01.06.2015 17:53:32	0	2	4,2157E+10
01	RT_OFF	02.06.2015 08:54:55	0	2	4,2157E+10
02	RT_OFF	02.06.2015 09:58:49	0	2	4,2157E+10
03	RT_OFF	02.06.2015 11:25:28	0	2	4,2157E+10
04	DB_TSN.DP01_Archive_min	02.06.2015 11:51:05	2,78E-02	1	4,2157E+10
05	DB_TSN.DP01_Archive_max	02.06.2015 11:51:05	7,64E-02	1	4,2157E+10
06	DB_TSN.Quantité_backwah_cycle	02.06.2015 11:51:05	1	1	4,2157E+10
07	DB_TSN.Quantité_backwash_total	02.06.2015 11:51:05	15	1	4,2157E+10
08	DB_TSN.DP01_Archive_min	02.06.2015 11:53:17	-1,85E-02	1	4,2157E+10
09	DB_TSN.DP01_Archive_max	02.06.2015 11:53:17	7,18E-02	1	4,2157E+10
10	DB_TSN.Quantité_backwah_cycle	02.06.2015 11:53:17	2	1	4,2157E+10
11	DB_TSN.Quantité_backwash_total	02.06.2015 11:53:17	16	1	4,2157E+10
12	DB_TSN.Quantité_backwah_cycle	02.06.2015 13:53:45	0	1	4,2158E+10
13	RT_OFF	03.06.2015 08:26:55	0	2	4,2158E+10
14	RT_OFF	03.06.2015 14:22:52	0	2	4,2159E+10
15	RT_OFF	04.06.2015 10:54:53	0	2	4,2159E+10
16	RT_OFF	04.06.2015 15:25:16	0	2	4,216E+10
7	DB_TSN.DP01_Archive_min	05.06.2015 09:45:02	2,78E-02	1	4,216E+10
8	DB_TSN.DP01_Archive_max	05.06.2015 09:45:02	6,48E-02	1	4,216E+10
9	DB_TSN.Quantité_backwah_cycle	05.06.2015 09:45:02	1	1	4,216E+10
0	DB_TSN.Quantité_backwash_total	05.06.2015 09:45:02	17	1	4,216E+10
21					

12.3.4. List of recorded parameters

Table 16: Recorded Parameters

Parameter	Frequency of record	Folder / File Name	Variable of archive	Max nr of files
Alarms (warning and defaults)[1]	At each detection	Alarms /Archive_alarmesn[5]	NA	106
Events[1]	At each detection	Event / Archive_evenementsn[5]	NA	106
Maintenance[1]	At each detection	Curve/ Archive_Maintenancen[5]	NA	106
Energy Consumption[2]	Every 10 minutes + at each operation start/stop	Power / Archive_Conson[5]	DB_TSN.Conso_Archive	11
Energy Consumption since installation[2]	Every 10 minutes + at each operation start/stop	Power / Archive_Conson[5]	DB_TSN.Conso_totale_archive	11
Instantaneous ballast power[2]	Every 10 minutes + at each operation start/stop	Power / Archive_Puissancen[5]	DB_TSN.Puissance_ballast_x.y_Archive	106
Instantaneous total power[2]	Every 10 minutes + at each operation start/stop	Power / Archive_Puissancen[5]	DB_TSN.Puissance_Archive	106
Differential pressure max (DP)[3]	At each backwash + at each detection value higher than "Filter clogged" alarm	Curve/ Archive_DPn[5]	DB_TSN.DP0x_Archive_max	106
Differential pressure min (DP)	At each backwash	Curve/ Archive_DPn[5]	DB_TSN.DP0x_Archive_min	106
Quantity of backwashes during ongoing operation	At each detection	Curve / Archive_DPn[8]	DB_TSN.Quantité_backwah_cycle	106
Quantity of backwashes since installation	At each detection	Curve / Archive_DPn[5]	DB_TSN.Quantité_backwash_total	106
Cumulative filtration time (hours)	At each detection	Curve / Archive_DPn[5]	DB_TSN.temps_tot_prod_h_f1	106
Cumulative filtration time (minutes)	At each detection	Curve / Archive_DPn[5]	DB_TSN.temps_tot_prod_mn_f1	106
Cumulative treatment time (hours)	At each detection	Curve / Archive_DPn[5]	DB_TSN.temps_tot_prod_h_UV	106
Cumulative treatment time (minutes)	At each detection	Curve / Archive_DPn[5]	DB_TSN.temps_tot_prod_mn_UV	106
Conductivity (EC)[2]	Every minutes + at each operation start/stop	Curve/ Archive_ECn[5]	DB_TSN.EC01_Archive	106
Order of flow rate[2]	Every 30s + at each backwash + at each operation start/stop	Curve / Archive_FTn[5]	DB_TSN.Consigne_debit_archive	106
Flow rate through the system (FT)[2]	Every 30s + at each backwash + at each operation start/stop	Curve / Archive_FTn[5]	DB_TSN.FT01_archive	106
Pressure (PT)[4]	Every 10s + at each backwash + at each operation start/stop	Curve/ Archive_PTn[5]	DB_TSN.PTxy_Archive	106
Control valve (V06)[2]	Every 10s + at each backwash + at each operation start/stop	Curve/ Archive_V06_n[5]	DB_TSN.V06_eana	106
Temperatures (TT01/ TT02)[4]	Every 10 min + at each operation start/stop	Curve / Archive_TTn[5]	DB_TSN.TT0x_Archive	106
UV intensity setpoint[2]	Every 1 min + at each operation start/stop	Curve / Archive_UVn[5]	DB_TSN.Consigne_UV_Archive	106
UV intensity on reactor UVx.y[2]	Every 1 min + at each operation start/stop	Curve / Archive_UVn[5]	DB_TSN.UVx.y_archive	106

Table 16: Recorded Parameters

Parameter	Frequency of record	Folder / File Name	Variable of archive	Max nr of files
Volume treated by the system during ongoing operation (Vol)[2]	Every 2 minutes + at each operation start/stop	Curve / Archive_Voln[5]	DB_TSN.Volume_archive	106
Volume treated by the system since installation[2]	Every 10 minutes + at each operation start/stop	Curve / Archive_Voln[5]	DB_TSN.Volume_total_archiv e	106
Name of the ship	At each return from general information screen	Logs / Archive_Datan[5]	Ship_name	10
IMO number of the ship	At each return from general information screen	Logs / Archive_Datan[5]	IMO_number	10
Date of construction of the ship	At each return from general information screen	Logs / Archive_Datan[5]	Date_Construction_Ship	10
Model of the system	At each return from general information screen	Logs / Archive_Datan[5]	Model	10
TRC max of the system	At each return from general information screen	Logs / Archive_Datan[5]	TRC	10
BSEA Code of the system	At each return from general information screen	Logs / Archive_Datan[5]	Code_BSEA	10
Serial Number of the system	At each return from general information screen	Logs / Archive_Datan[5]	Serial_Number	10
Date of installation of the system	At each return from general information screen	Logs / Archive_Datan[5]	Install_Year	10
PLC software revision	At each return from general information screen	Logs / Archive_Datan[5]	PLC_software_rev	10
HMI software revision	At each return from general information screen	Logs / Archive_Datan[5]	HMI_software_rev	10
Remote 1 software revision	At each return from general information screen	Logs / Archive_Datan[5]	Remote_1_Software_rev	10
Remote 2 software revision	At each return from general information screen	Logs / Archive_Datan[5]	Remote_2_Software_rev	10
GPS longitude	At every operation and system by-pass	Logs / Archive_Datan[5]	GPS_Longitude	10
GPS latitude	At every operation and system by-pass	Logs / Archive_Datan[5]	GPS_Latitude	10

1. Record in Auto/Service/Maintenance/Stop modes
2. Record in Auto/Downgraded/Service/Maintenance modes
3. Record during backwash and if High DP alarm (DP01>0,3 bars for Filtrex filters or DP>0,5bars for Hydac filters)
4. Record in Service/Maintenance + during operation + warning detection
5. where n is the number of the file (starting from 0)

13. Remote control (option)

13.1. General features

In addition to the local touch screen on the control cabinet, it is possible to take control of the system by three different equipments:

- Dry contacts with switches and lights (Remote SW).
- RS485 communication (Remote RS).
- Remote control screen (Remote SCR1/SCR2).

The remote control has been programmed to respect the following rules:

- The main screen (on the control cabinet) can override any other remote control without stopping the operation in progress.
- Only the main screen can be used to modify the system settings and use MAINTENANCE/SERVICE modes.
- Remote authorization on another station can only be done when button "SYSTEM" is OFF (no operation in progress).
- Switching LOCAL button to OFF will automatically switch SYSTEM button to OFF and stop operation in progress.
- If the remote control loses the connection the control cabinet will get back the commands and the operation in progress will stop.
- Audible and visual alarm is activated when control is switched from main screen to remote control screen.

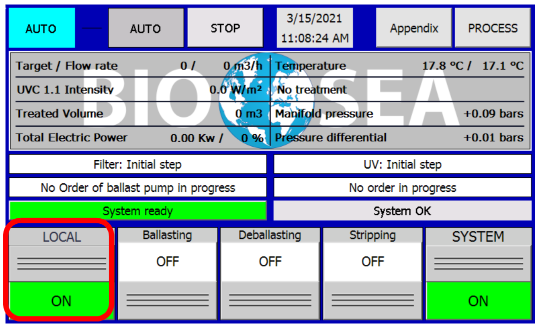
The table below shows the colour of the "Local" button on various screen according to the active control.

Display	Active control					
	No control	Local control	Remote screen 1	Remote screen 2	Dry contacts	RS485
Local control	White	Green	Orange	Orange	Orange	Orange
Remote screen 1	White	Orange	Green	Orange	Orange	Orange
Remote screen 2	White	Orange	Orange	Green	Orange	Orange

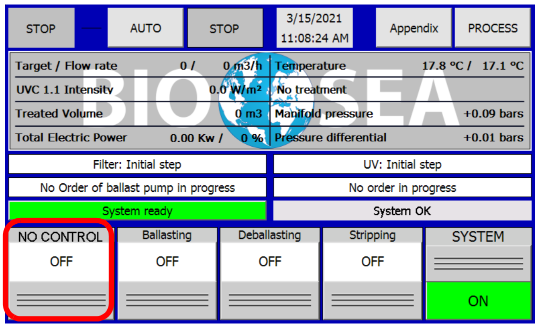
13.2. Switching control

13.2.1. Giving control from local screen to remote control

On the main local screen, the button "LOCAL/REMOTE" allows giving the control rights.



LOCAL ON (green): the control rights remains on the main screen (on the control cabinet). Any remote control cannot get control of the BWTS.

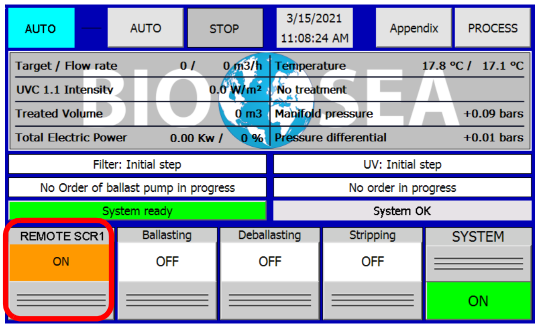


NO CONTROL (white): the control rights remains on the main screen (on the control cabinet) Remote controls are able to get control of the BWTS.

At any time, the main screen can take back command by switching up the button "LOCAL/REMOTE" (Remote OFF/Local ON). This action doesn't stop the operation in progress.

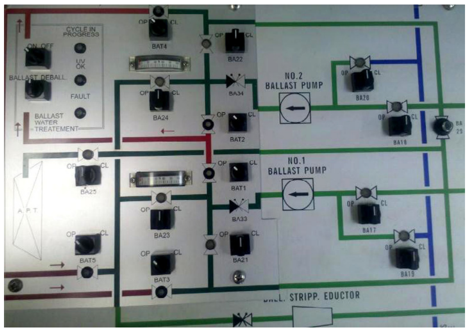
13.2.2. Taking control from Remote SW (dry contact)

On main screen (control cabinet)



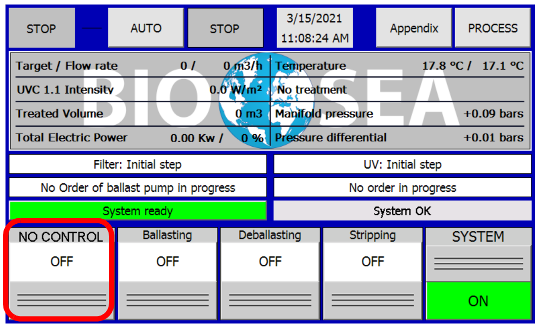
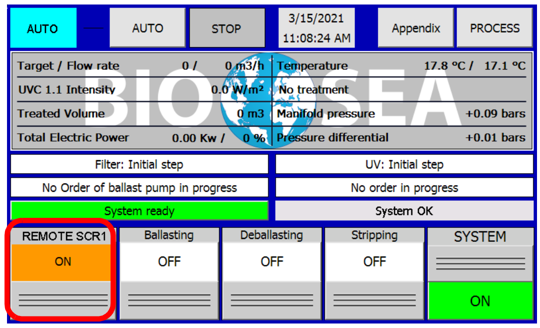
REMOTE SW ON (orange): the BWTS is under control of wired dry contacts with switches and lights.

On remote wired control



- Dry contacts (Remote SW) can only be activated if AUTO or DOWNGRADED mode is active.
- If dry contact is active and the system is switched to STOP mode, the system will switch to LOCAL mode.

13.2.3. Taking control from remote RS and SCR

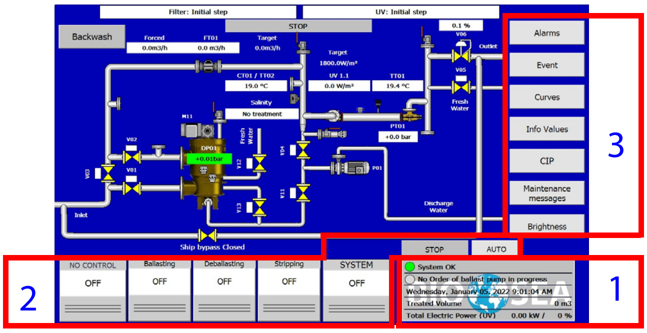
On remote control screen/RS485, switch ON LOCAL button.	LOCAL button becomes REMOTE RS/REMOTE SCR ON (orange): the BWTS is under control of the RS485 communication box (Remote RS) or the remote control screen 1 or 2 (Remote SCR1/SCR2).
	

At each remote control station, an audible and visual alarm is installed with the screen. The audible signal buzzes in case the control is lost from the remote control.

13.3. Remote control screen

1 or 2 optional remote screen(s) (typically for Ship office and bridge) can be connected to the system by Ethernet connection with two different sizes available (9 inches or 15 inches). Only 1 remote screen can control the system and launch operation.

Figure 50: View of Process screen on remote control screen (15 inches screen)



1- View of system status similar to local home screen.

2- Button to launch operations.

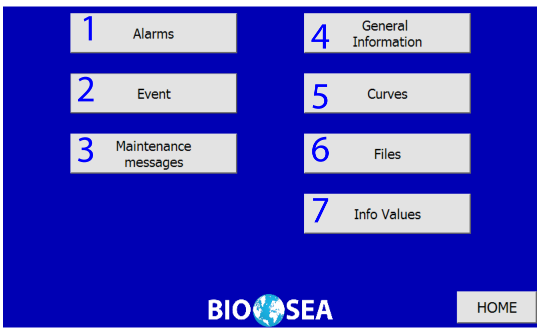
3- Only for the 15 inches screen, buttons similar to the appendix screen.

Operator can launch automatic operations (ballasting, deballasting, stripping, cleaning), set the system in AUTO or STOP mode, but cannot change settings or access MAINTENANCE/SERVICE mode.

Those screens display all sensors values and curves, actuators positions, operation informations, alarms and events. Datalog can not be stored on those screens.

All screens are similar to the main local screen except the Appendix menu which contains less buttons because there are less functions accessible than from the main local screen. For 15 inches screen, Appendix screen doesn't exist as the buttons are directly on the process screen.

Figure 51: Remote Appendix screen ((9 inches screen)



1	Button to access "Alarm" screen
2	Button to access "Event" screen
3	Button to access "Maintenance messages" screen
4	Button to access "General information" screen
5	Button to access "Curves" screen
6	Button to access archiving screen (no USB export possible)
7	Button to access "Info Values" screen

An alarm is generated when a remote screen is active and the connection is lost. The current operation is immediately stopped.

The ballasting, deballasting or stripping operations don't require any specific skill. However, for a safe and optimal use of the system, any user has to be trained by a **BIO-UV Group** technician or its approved representative. One person is enough to operate the system.

In order to ensure the vessel compliance with the IMO D-2 discharge standard, the following points should be observed:

- The **BIO-SEA**® treatment system should be operated at every ballasting and deballasting operation, according to the ballast water management plan of the vessel.
- An adequate flushing procedure should be determined and included in the ballast water management plan in order to prevent any mixing or discharge of unmanaged water (that could remain in the pipes or sea chest).

14. Power sequences

- Power sequences have to be carried out for start up (at commissioning), after a scheduled power off or a blackout. When the BWTS is temporarily not in use, it remains powered and ON (STOP mode)
- On power up after loss of power, system powers up automatically if main breaker of control cabinet hasn't been switched off. After system restart, the system is in "STOP" mode and can return to "AUTO" mode if all defects have been solved and acknowledged.
- Start-up and restarts operations don't require any specialized knowledge of the system.
- Air supply and Fresh water valves have to be open for start-up

14.1. General power supply

- Check power supply is suitable to the BWTS specifications (see ID plate on the control cabinet).
- Check the vessel's breaker is ON.
- Check all breakers are ON inside the switchboard cabinet (if installed) then switch on the main breaker.

14.2. Power cabinets (only for BIO-SEA® B models)

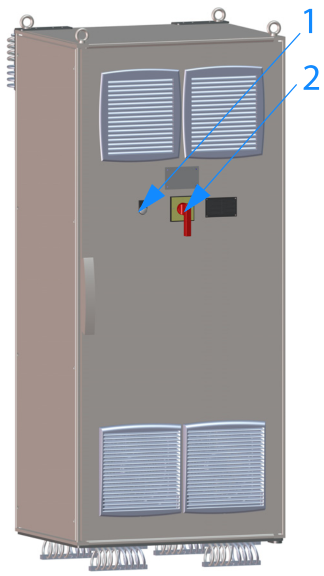
For **BIO-SEA® L** models, there is only need to switch on the main breaker of the switchboard cabinet to power on the electronic ballasts.

14.2.1. Standard power cabinets

Proceed as follows for all power cabinets

- Check there are no breakers off inside the cabinet.
- Check voltage with a multimeter between phase and main supply.
- Check the phases are in good order according to the electrical diagram.
- Check the white indicator 400-440v (1) is ON.

Figure 52: Standard power cabinet

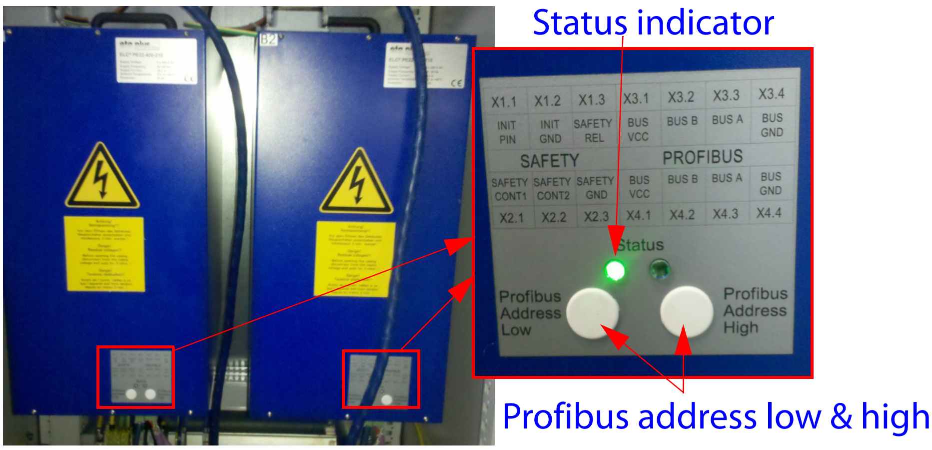


1- White indicat.or for 400-440Vac

2- Main power switch

- Switch on the main power switch (2) on power cabinets.
- Check the green status indicator on each ELC is ON.

Figure 53: Indicators on the ballasts



If the light is red, proceed as following:

- Switch off the breaker of the corresponding ELC (Q4 or Q5), and check the Profibus connection and the power ballasts address (see ballasts adresses on Table 17 "Electronic Ballasts Address", page 103).
- Switch on the breaker again.

Table 17: Electronic Ballasts Address

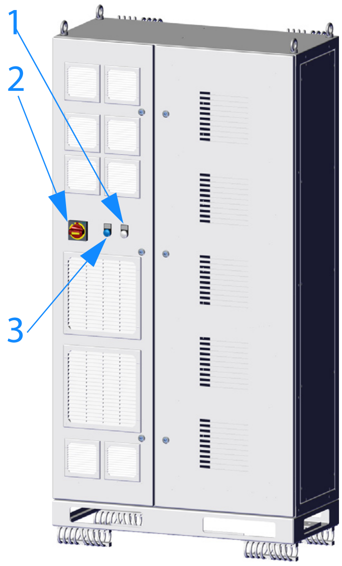
Ballast Address	Low	High	Ballast Address	Low	High
Ballast 1.1	5	0	Ballast 4.2	C	0
Ballast 1.2	6	0	Ballast 5.1	D	0
Ballast 2.1	7	0	Ballast 5.1	E	0
Ballast 2.2	8	0	Ballast 6.1	F	0
Ballast 3.1	9	0	Ballast 6.2	0	1
Ballast 3.2	A	0	Ballast 7.1	1	1
Ballast 4.1	B	0	Ballast 7.2	2	1

14.2.2. Compact power cabinets

Proceed as follows for all power cabinets:

- Check there are no breakers off inside the cabinet.
- Check voltage with a multimeter between phase and main supply.
- Check the phases are in good order according to the electrical diagram.
- Check the white indicator 400-440v (1) is ON.
- Check heater light (3) is ON.

Figure 54: Compact power cabinet



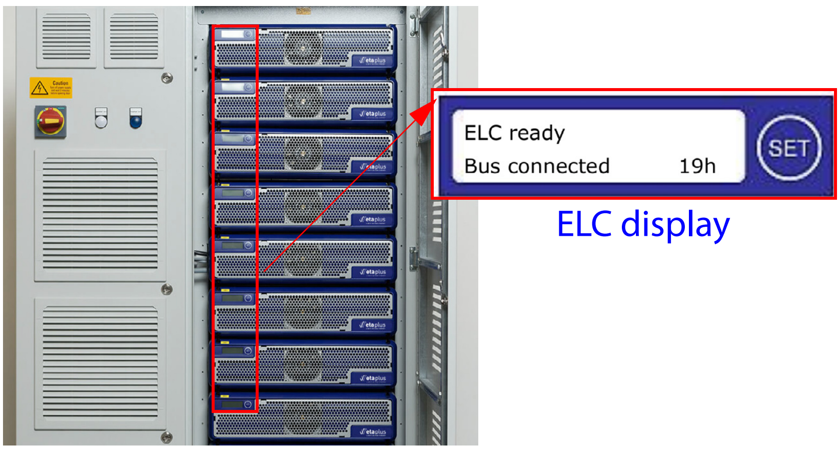
1- White indicator for 400-440Vac

2- Main power switch

3- Heater ON light

- Switch on the main power switch (2) on power cabinets. It could be necessary to reset the switch. For that, turn a little the switch clockwise the counterclockwise to the stop, after the OFF position. After this operation, it is possible to restart the cabinet by turning the main switch clockwise to the stop.
- Check each ELC displays "ELC ready" and "BUS connected".

Figure 55: Indicators on the ballasts



If the electronic ballast displays a message different than "ELC ready" and "Bus connected":

- check the Profibus connection and the power ballasts address (see ballasts adresses on Table 18 "Electronic Ballasts Address", page 104).

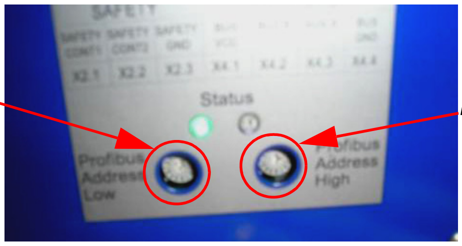
Table 18: Electronic Ballasts Address

Ballast Address	Low	High	Ballast Address	Low	High
Ballast 1.1	5	0	Ballast 4.2	C	0
Ballast 1.2	6	0	Ballast 5.1	D	0
Ballast 2.1	7	0	Ballast 5.1	E	0
Ballast 2.2	8	0	Ballast 6.1	F	0

Table 18: Electronic Ballasts Address

Ballast Address	Low	High	Ballast Address	Low	High
Ballast 3.1	9	0	Ballast 6.2	0	1
Ballast 3.2	A	0	Ballast 7.1	1	1
Ballast 4.1	B	0	Ballast 7.2	2	1

Figure 56: Profibus address low and high



On ballasts of standard power cabinets

On ballasts of compact power cabinets or on independent electronic ballasts (**BIO-SEA® L**)

On ballasts of compact power cabinets or on independent electronic ballasts, follow this procedure to set the ballast address:

1- Display the ballast address screen by pressing "SET" button during 5 seconds.

2- Adjust the "high" address by pressing briefly on "SET" button until getting the correct setting.

3- Press "SET" button during 2 seconds to access "low" address adjustment.

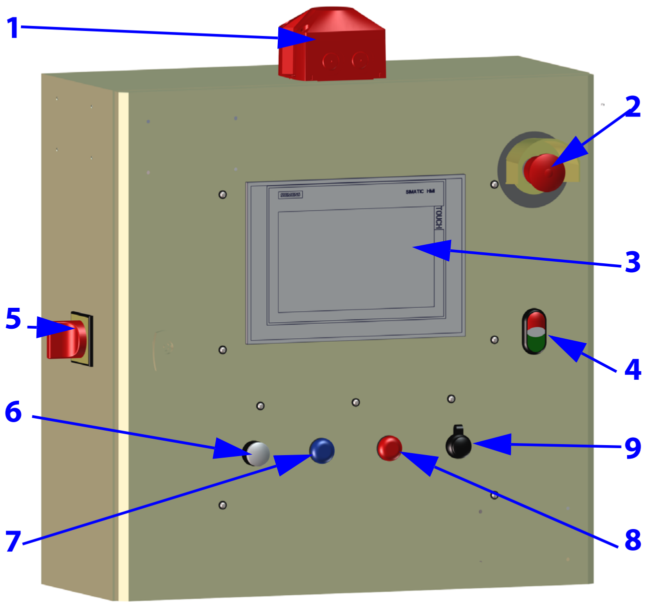
4- Adjust the "low" address by pressing briefly on "SET" button until getting the correct setting.

5- Press "SET" button during 2 seconds to save the address.

- please refer to the troubleshooting part of the ballast user manual.

14.3. Control cabinet

Figure 57: Control Cabinet



1- Flashing alarm
2- Emergency stop
3- Touchscreen 9"
4- ON/OFF button
5- Main power switch of the control cabinet
6- White indicator for 400-440Vac
7- Blue indicator for 24Vdc
8- Audible alarm (red)
9- USB plug

- Check there are no breakers off inside the cabinet.
- Check Emergency stop (2)is disabled.
- Check the white indicator 400-440v (6) is ON.
- Switch on the main breaker (5)on control cabinet.
- Check the blue indicator 24V (7) is ON. The touch screen(3) should be ON (Home Screen) but not active.
- Press on green button ON (4)(software switch). The white led indicator between the green button (ON) and the red button (OFF) is on.
- The Touch screen is now activated.

- The system keeps its previous settings before power OFF. So, in case of power failure, there is no need to configure again the PLC.
- When the system is electrically powered on, a delay is necessary to get the system ready. So, default messages (General default, Miss general Run/Stop) appear. At this moment, this message is normal and can be acknowledged after a short time, when the communication is effective.

- Switch on AUTO mode to be able to begin operations.

When a UV lamp has turned off, it is necessary to wait about 5 minutes before starting it again. This is a safety measure in order to not damage the lamp.

This delay appears also on the screen and UV lamps can not be turned on.

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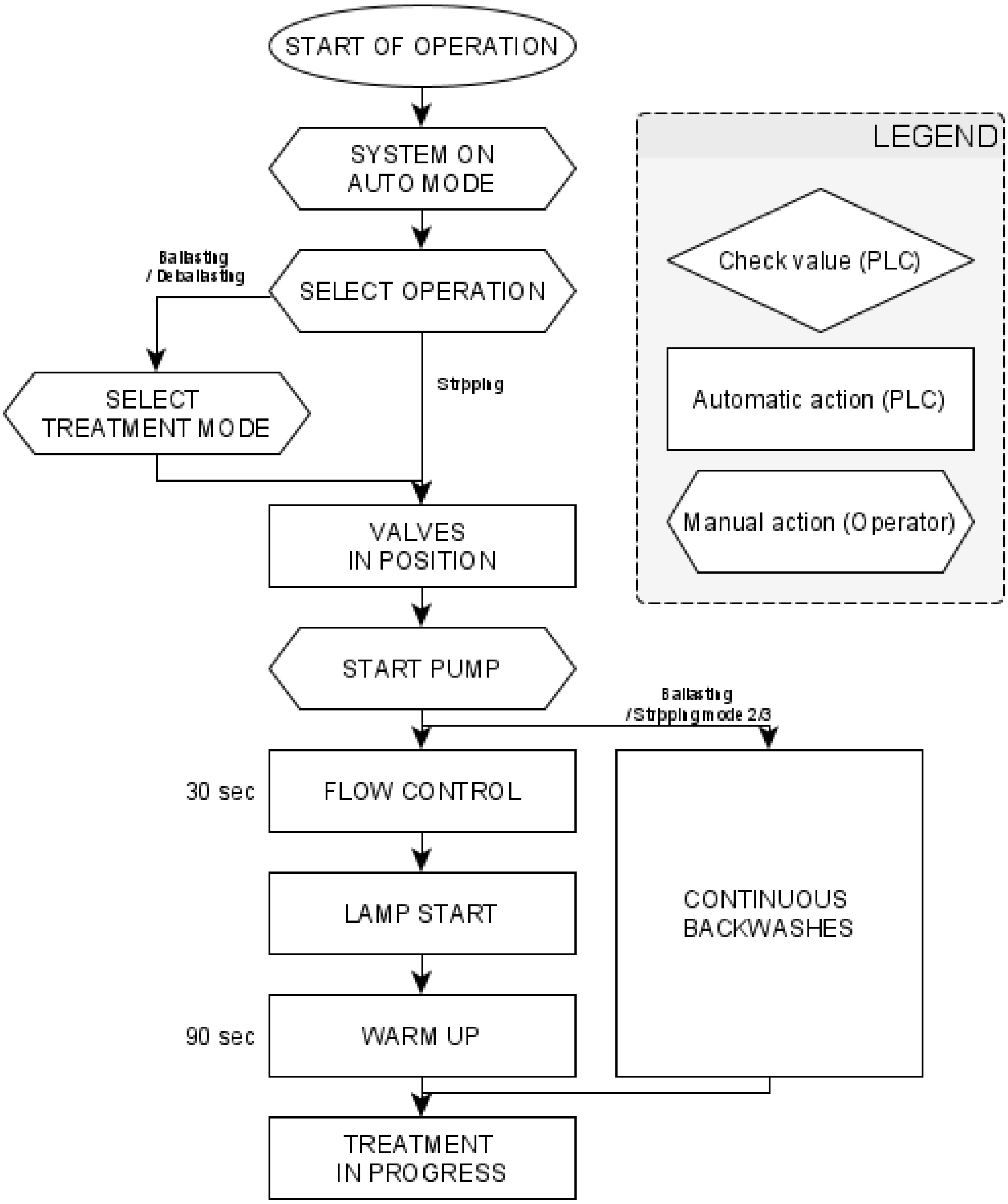
15. Start and Warm Up

Figure 58: Principle diagram of operation start and warm up



UV technology used in the BWTS requires a short warm-up time (2 minutes) during which:

- Flow must circulate in the UV reactors (lamp cooling).
- Water is not treated at the approved level (lamp not at 100% while warming up).

Water used for warm up is thus considered as unmanaged water; a proper circulation should be established to avoid uptake or discharge of untreated water which would create a contamination:

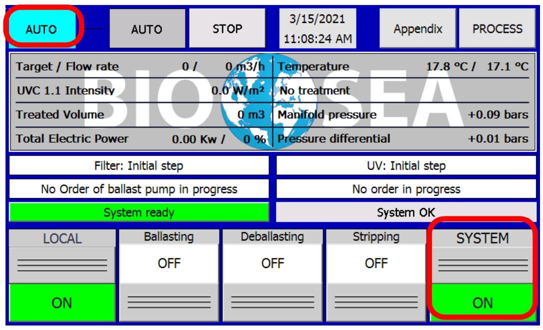
- At ballasting, sea to sea circulation.
- At deballasting, tank to tank circulation.

If a general by-pass is present on the ship, it must be closed before launching an operation.

When a UV lamp has turned off after warm-up, it is necessary to wait about 5 minutes before starting it again or launching a new operation. This is a safety in order to not damage the lamp.

1- The system must already be in AUTO mode before switching ON System.

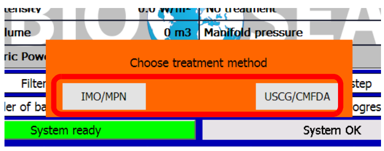
Figure 59: Home screen with SYSTEM ON



2- On Home screen, check "System" button is ON.

3- Switch ON the chosen operation mode by using the Ballasting/Deballasting/Stripping button: automatically, filter and UV valves open as needed. In the same time, the information "Pump start order" (dry relay contact) is sent to the vessel switchboard.

4- If the system has been configured for possible treatment with both methods (MPN/IMO and CMFDA/USCG method), a pop-up window will appear after using the ballasting/deballasting button. Operator will have to select the treatment method.



Depending on the selected treatment method (MPN/IMO or CMFDA/USCG method), ballasting/deballasting operation will be carried out at different regulation level (UV power or flow rate).

5- Start the Ballast/Bilge pump.

6- After 30 seconds, when the flow is higher than the parameter for "Starting flow", UV lamps warm up

7- When the UV lamps reach the intensity setpoint, the information "Treatment in progress" (dry relay contact) is displayed. **BIO-SEA®** system is ready for treatment.

8- According to the selected treatment method, the systems status changes: "Order of (de)ballasting IMO/MPN in progress" or "Order of (de)ballasting USCG/CMFDA in progress".

9- If the UV low intensity threshold is not attained after the time limit, then the system switches automatically in Auto Downgraded mode.

At the beginning of each ballasting, during warm up, backwash cycle are triggered continuously until the end of the warm up (UV lamp ready) in order to maintain the filter clean.

UV status displayed on the touchscreen:

- UV: Initial step
- UV: Stand-by
- UV: Pre-heating UV

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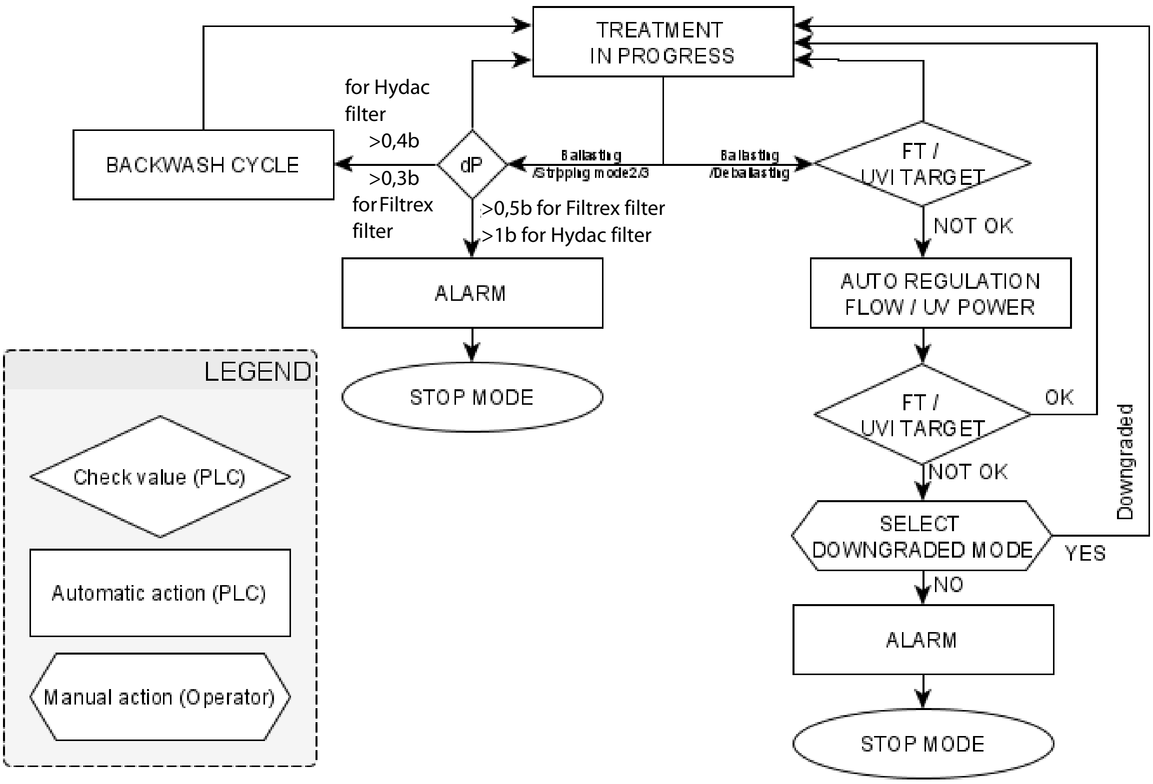
16. Treatment

Figure 60: Principle diagram of treatment cycle

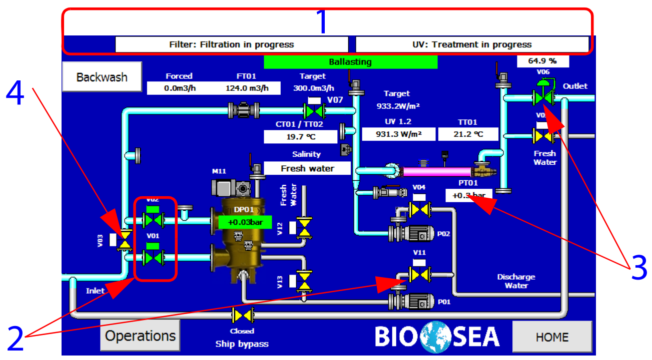


16.1. Ballasting

Water flows through filter and UV reactors. Treatment cycle operates automatically according to measured conductivity and UV intensity, regulating UV power and/or flow rate in the system in order to maintain required performances.

For filter smooth operation, it is not recommended to start a ballasting at full flow, but rather by increasing the flow gradually.

Figure 61: Process screen during Ballasting operation



1- Status of the Filter and UV cycles = IMO/MPN or USCG/CMFDA treatment in progress.

2- FILTER: valves V01 and V02 are open, backwash valve V11 is closed.

3- UV system: valve V06 is, open. UV lamp ON (reactor is pink).

4- By pass valves is closed (V03).

- Fresh water inlet (V12 and V05) and overboard discharge (V11 and V04) are closed.
- For backwash cycles, backwash valve V11 opens and Filter backwash pump is ON.
- CIP isolation valve V07 remains open.

Filter status displayed on the touchscreen:

- Filter: Initial step
- Filter: Stand by
- Filter: Opening exit valve
- Filter: Opening entry valve
- Filter: Closing valve by-pass
- Filter: Filtration in progress

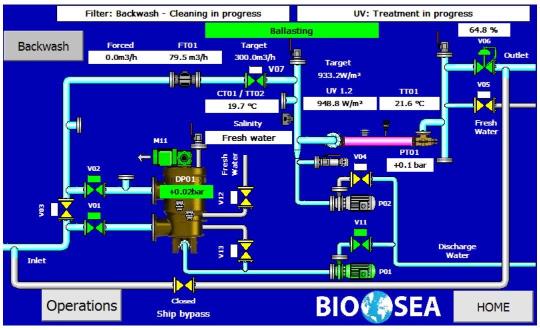
UV status displayed on the touchscreen:

- UV: Opening exit valve
- UV: Treatment in progress

When the pressure difference measured between inlet and outlet (DP01) reaches the pressure threshold set for the filter (DP01 = 0,3 bars for Filtrex filters or DP=0,5bars for Hydac filters), the pressure switch symbol becomes red and the automatic cleaning is triggered.

Even if differential pressure threshold is not reached, an automatic Backwash is triggered after a time defined during commissioning (by default: 40minutes) in order to ensure that filter does not remain accumulating particles during too long ("Periodic Backwash" should be set to YES).

Figure 62: Process view: starting backwash cycle



During backwash cycle, valves V01, V02 and V11 are open, allowing simultaneously the cleaning of the filtration screen and the filtration process.The valves V03, V04, V12 and V13/VM13, are closed but CIP isolation valve V07 remains open.

The suction pump (P01) is ON.

Filter status displayed on the touchscreen:

- Filter: Backwash - Closing partial of the exit valve
- Filter: Cleaning - Opening drain valve
- Filter: Cleaning - Starting suction pump
- Filter: Backwash - Cleaning in progress
- Filter: Cleaning - Draining after cleaning
- Filter: Cleaning - Stop suction pump
- Filter: Cleaning - Closing drain valve
- Filter: Backwash - Control DP

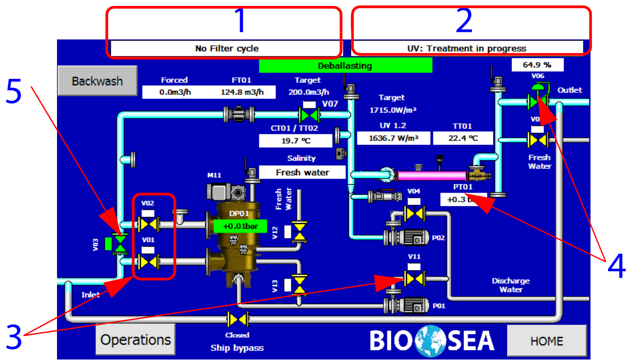
When ballast pump is not able to provide sufficient flow, it is possible to increase pressure in the pipes by reducing flow target and then by set a value for a forced flow target in the process screen (see18.1.3. Manual forcing of flow target, page 130).

16.2. Deballasting

Treatment cycle operates automatically according to measured conductivity and UV intensity, regulating UV power and/or flow rate in the system in order to maintain required performances.

- Filter is by-passed.
- Only disinfection is in progress.
- Suction pumps are OFF.

Figure 63: Process screen during Deballasting operation



1- Status of the Filter= Standby.

2- Status of UV cycles = USCG/CMFDA or IMO/MPN treatment in progress.

3- FILTER: valves V01 and V02 are closed, backwash valve V11 is closed.

4- UV system: valves V06 is open. UV lamp ON (reactor is pink).

5- Filter By pass valve V03 is open

- Fresh water inlet (V12 and V05) and overboard discharge (V11 and V04) are closed.
- CIP isolation valve V07 remains open.

When ballast pump is not able to provide sufficient flow, it is possible to increase pressure in the pipes by reducing flow target and then by set a value for a forced flow target in the process screen (see18.1.3. Manual forcing of flow target, page 130).

Filter status displayed on the touchscreen:

- Filter: Opening by-pass valve

UV status displayed on the touchscreen:

- UV: Opening exit valve
- UV: Treatment in progress

16.3. Stripping

The type of stripping operation is set in the Configuration screen. The mode selection is made during the commissioning by the installer (identification with password is required). If this mode is set to OFF, then the stripping option is disabled.

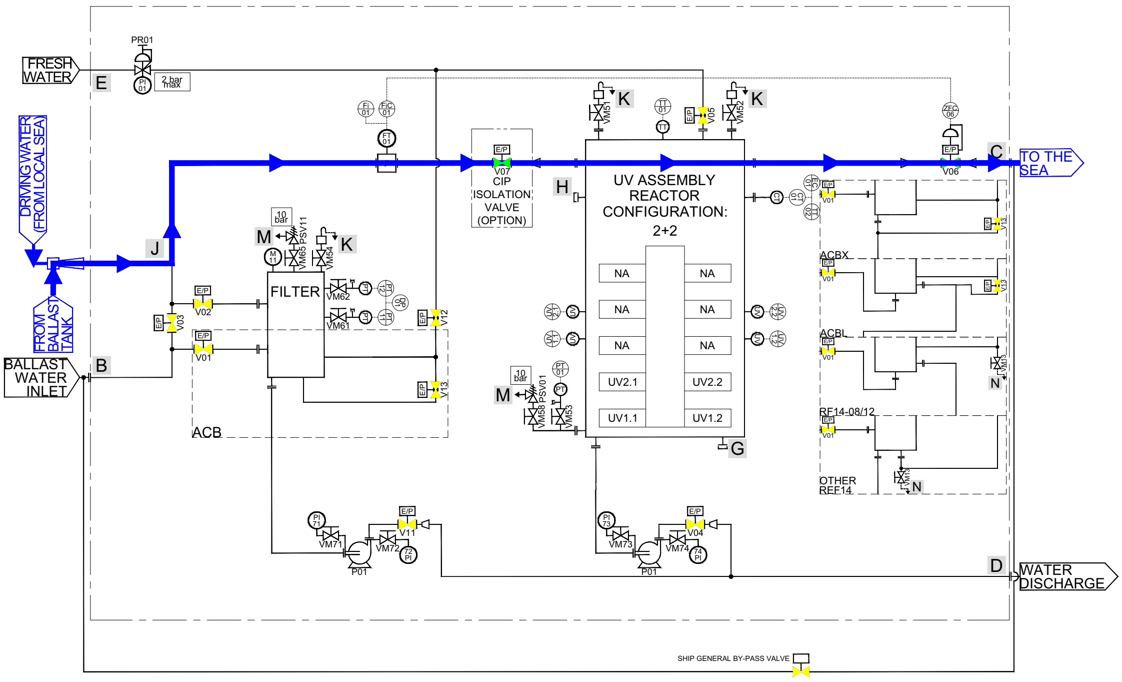
The minimum acceptable flow rate in each reactor is 5 m3/h in order to maintain UV lamps cooling during the stripping operation. Therefore, when choosing the stripping solution, ensure that the driving water flow rate through the eductor is at least equal to 5 times the number of reactors.

During stripping operation:

- the settings for "Warning low flow stripping" and "Defect low flow stripping" will override the "Warning low flow" and "Defect low flow" setpoints used for ballasting or deballasting operations.
- Regulations are disabled:
  - Control valve V06 remains fully open.
  - UV lamp power is set at maximum.
- "Low UVI" defect threshold is disabled (presence of air inside the reactor could cause bad readings).

16.3.1. Recommended stripping: no treatment of driving water (mode 1)

The driving water is local water (which doesn't require treatment) or treated water coming from another ballast tank, and the mixture is discharged through normal deballasting procedure.



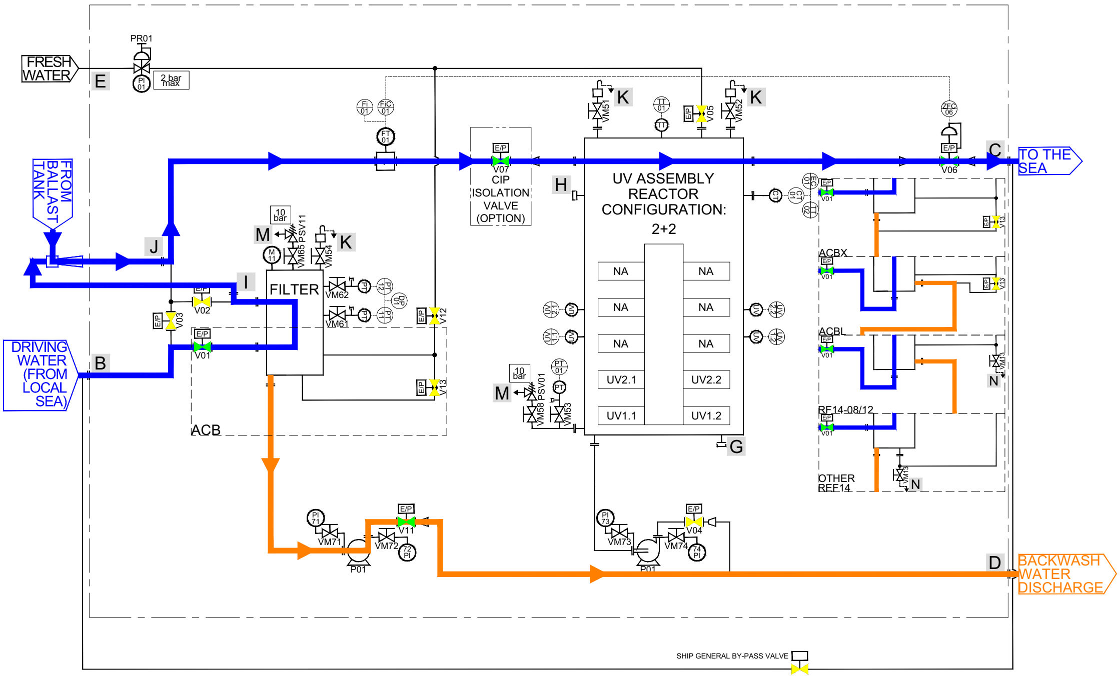
After the stripping cycle mode1, a ballasting cycle from sea to sea should be performed to clean remaining organisms present in the BWTS.

16.3.2. Filtrating of driving water (modes 2 & 3)

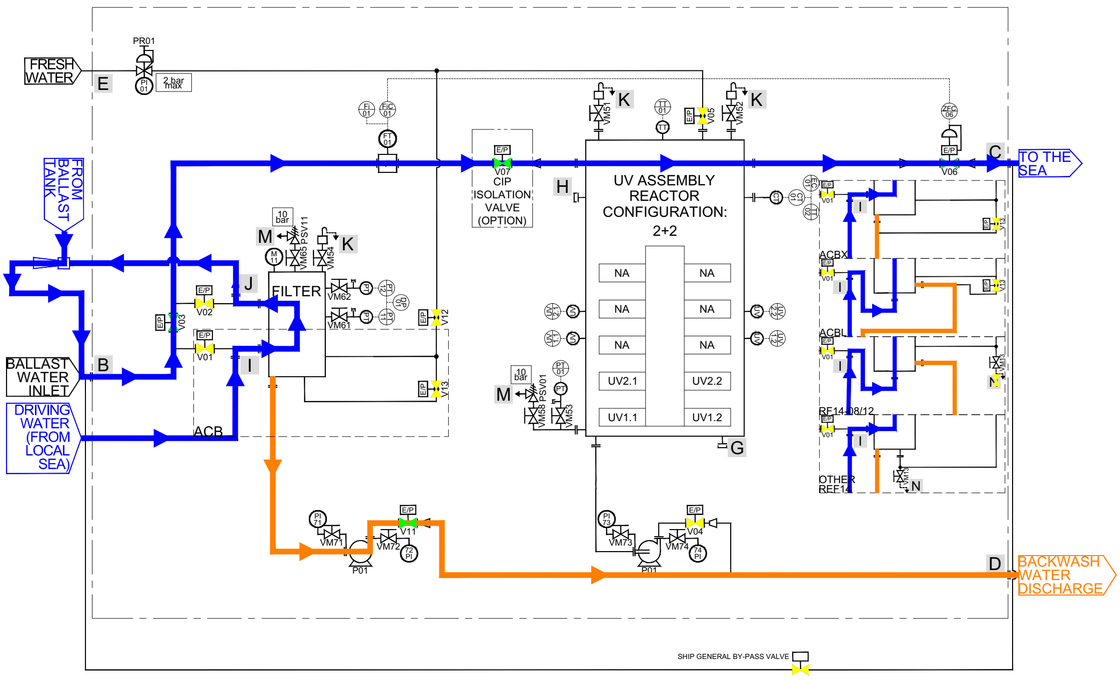
As another stripping procedure, **BIO-SEA**® allows to filtrate at uptake before mixing it with treated ballast water, and the mixture is discharged through normal deballasting procedure. During filtration, Backwash cycles can also be performed.

For this type of treatment, two configurations are possible:

- **Mode 2: Driving water is injected before Filter in let valve**

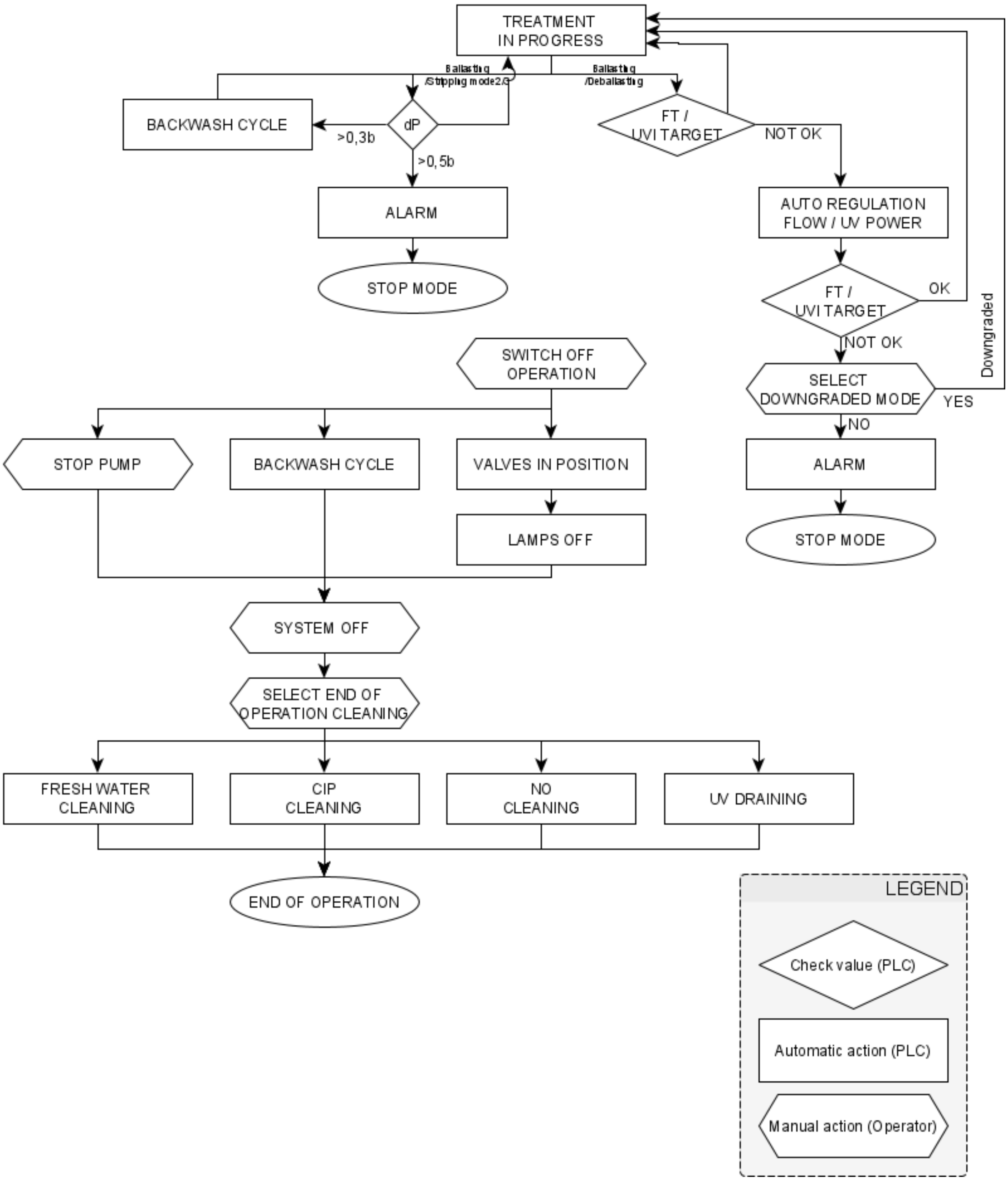


- **Mode 3: Driving water is injected after Filter in let valve**



17. End of operation

Figure 64: Principle diagram of operation stop



17.1. Stop operation

1- Switch OFF the (de)ballasting mode on the **BIO-SEA®** system.

- The (de)ballasting button has to be switched off in a short time: If the flow isn't enough after few seconds, a warning, then an alarm "Low flow", will occur and put the **BIO-SEA®** system in STOP mode.
- Stopping the pump after operation stop has to be done quickly time in order to prevent pressure grow up through the system or the piping.

When the ballasting mode is switched OFF, a backwash cycle is triggered. Consequently, the BWTS stops about 30 seconds after the button is switched OFF or if flow goes down to "Low flow" warning level.

2- The system stops but remains in AUTO mode and valves are put back to their initial state:

- Filter: Closing inlet and outlet valves or bypass valve.
- UV: Closing outlet control valve, CIP isolation valve V07 remains open.

UV reactors should always stay filled with water when not in operation (system in stand-by).

17.2. Flushing unmanaged water

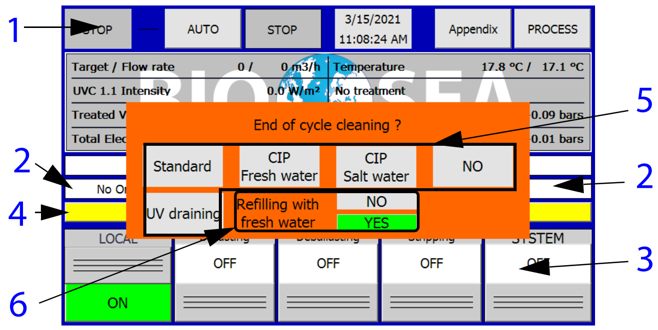
When operations are finalized in a given harbor, untreated water could be present in pipes between sea chest and BWTS. Therefore a flushing of lines should be done with treated water (deballasting) in order to avoid contamination at a later stage.

17.3. Cleaning cycles for BWTS

When the ongoing operations (ballasting, deballasting and/or stripping sequences) are over and the BWTS is still in AUTO mode, the system (local or remote) command can be switched to OFF to be able to launch a cleaning cycle. The status field blinks yellow/black and displays "End of cycle cleaning required". At this moment, a new window appears to select the action to carry out:

- **Standard**: start automatic cleaning cycle for the UV assembly, then for the filter.
- **CIP** (if option exists): start the CIP cleaning cycle for the UV assembly, then the standard cleaning cycle for the filter. If, at the end of the operation, UV irradiance have decrease from about 25% since the beginning, this cleaning will strongly be recommended.Refer to the BIOSEA Clean manual for further informations. If "CIP fresh water" is selected, fresh water will be used for CIP cleaning cycle. If "CIP Salt water" is selected, UV assembly won't be drained and sea water contained in the UV assembly will be used for CIP cleaning cycle.
- **NO**: the cleaning cycle does not start and the window closes to return to the previous state.
- **UV draining**: only the UV assembly is drained and no cleaning cycle is triggered. UV assembly remains full of air.

Figure 65: Home screen before Cleaning cycle



1- AUTO mode is activated.

2- Treatment Operations are OFF.

3- Put the system on OFF.

4- System status: here "End of cycle cleaning required".

5- Select the action to trigger:

- "Standard": standard cleaning cycle.
- "CIP"(optional): CIP cleaning cycle.
- "NO": no cleaning.
- "UV draining": no cleaning but UV assembly draining.

6- Select if UV assembly should be refilled with fresh water at the end of a CIP cycle.

If "SYSTEM" is switched OFF using wired control, standard cleaning cycle will automatically be triggered.

When STANDARD or CIP is selected, the message "Cleaning in progress" displays until the end of the cycle. In any case, filter cleaning remains standard and CIP has no impact on filter cleaning cycle.

Before launching a CIP Cleaning cycle, do not forget to indicate with YES/NO buttons if the UV assembly should be drained and refilled with fresh water at the end of the CIP cleaning. This parameter is only used if a CIP cleaning cycle is selected.

- It is set by default to YES in order to protect the system against corrosive effects during stand-by.
- NO can be used when successive CIP cycles need to be performed, in order to avoid wasting fresh water after each cycle.

When a CIP isolation valve is installed (V07), the CIP isolation valve closes as soon as a cleaning is launched (standard or CIP),

It opens again when UV cleaning is over or at the end of CIP cycle if CIP mode has been selected.

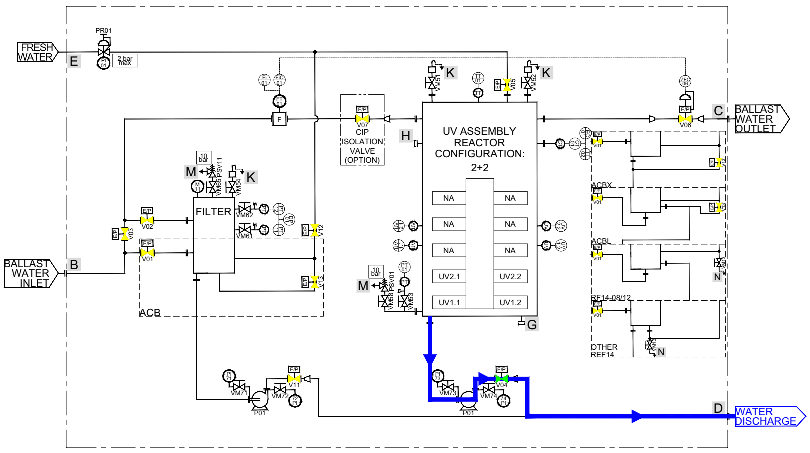
After a CIP Cycle, if no improvement is obtained on UVI reading, before launching other successive CIP cycles, it is recommended to check cleanliness of UV window and %UVT of uptake water, as the reason may not be a quartz fooling.

Too many successive CIP cycles, and/or system stand-by in cleaning solution for several days may affect lifespan of the UV assembly components.

17.3.1. UV Cleaning sequence

- **UV Draining**

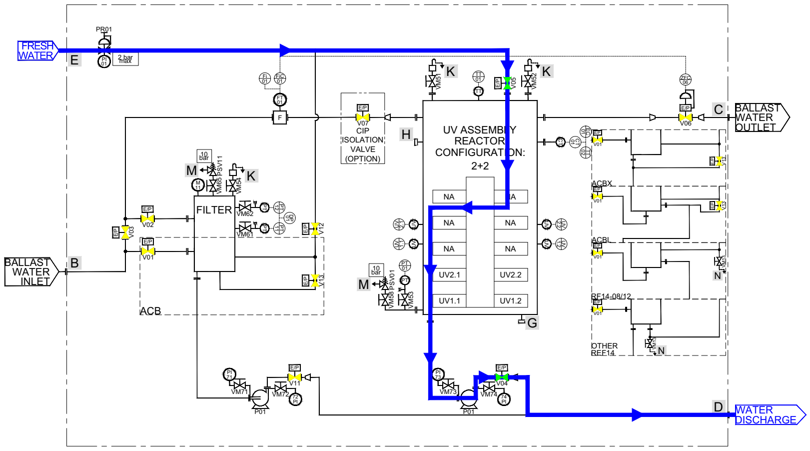
Figure 66: Process during UV Draining



- CIP isolation valve V07 closes.
- During UV draining, valve V04 is open to allow emptying of each UV reactor. The other automatic valves are closed.
- Automatic vent allows air entrance to avoid creating vacuum.
- The suction pump P01 is ON.
- The UV draining stops when the pressure inside the manifold is lower than the parameter "End of draining pressure" for UV, then the UV flushing begins. If the draining is too long (time defined during commissioning), an alarm "UV manifold draining too long" is displayed on the screen.

Flushing UV

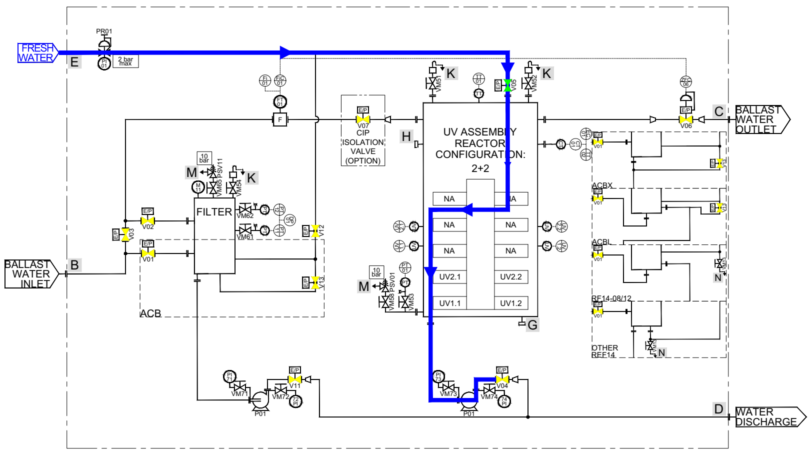
Figure 67: Process during UV flushing



- During flushing operation, valves V05 and V04 are opened to allow fresh water entry in order to flush the UV reactors. The other automatic valves are closed.
- Automatic vent allows air entrance to avoid creating vacuum.
- The suction pump P01 is ON.
- The UV flushing stops when Flushing time for the UV is elapsed, then the UV filling begins.

UV Filling with fresh water

Figure 68: Process during UV filling



- During filling process, valve V05 is open to allow fresh water inlet. The other automatic valves are closed.
- Automatic vent allows air exhaust to avoid air pocket inside the assembly.
- The suction pump P01 is OFF.
- UV filling stops when the pressure inside the manifold reaches the parameter "End of filling pressure", then the filter cleaning cycle begins.
- If CIP mode has been selected, the CIP cycle begins too and CIP isolation valve V07 remains closed.
- If CIP has not been selected, CIP isolation valve V07 opens.

17.3.2. UV cleaning with CIP system

Cleaning-in-Place (CIP) is used at the end of the **BIO-SEA® BWTS** operations when all UV reactors were emptied, flushed and, if applicable, filled with fresh water or directly after the end of the operations if "CIP Salt water" is selected.

The principle is the circulation of an acid solution in the UV assembly:

- Either automatically, with the **BIO-SEA® Clean** system
- Or manually, thanks to a portable device **BIO-SEA® M-Clean**

For further information about your CIP system, refer to the user manual corresponding to the **BIO-SEA® Clean** or the **BIO-SEA® M-Clean.**

- **BIO-SEA® Clean**

The CIP cleaning is strongly recommended when UV irradiance has decrease from about 25% since the beginning of the operation.

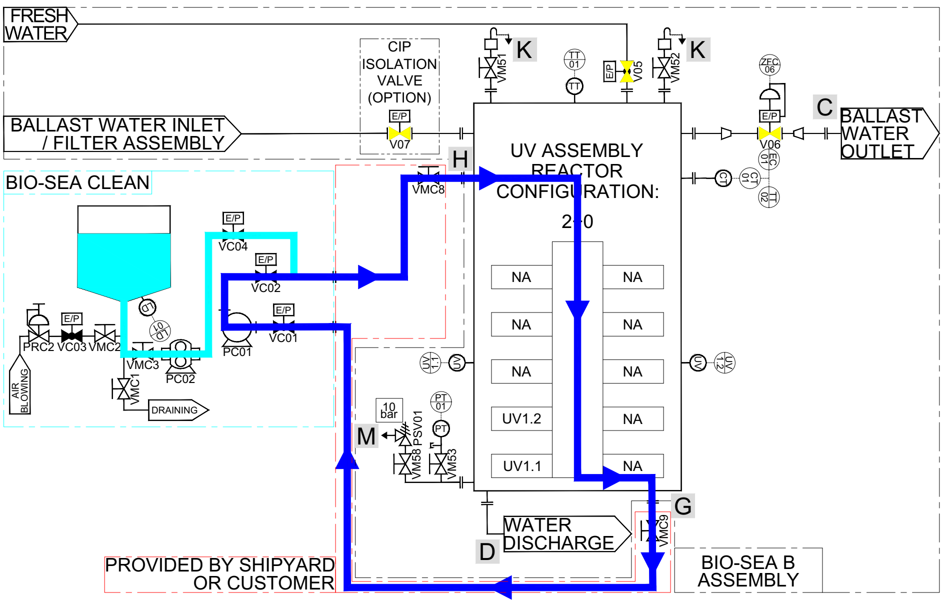
BIO-SEA® Clean equipment performs automatic cleaning cycles. The **BIO-SEA® Clean** cycle is integrated to the automatic cleaning cycle of the **BIO-SEA® BWTS**. The visualization of the **BIO-SEA® Clean** cycle is displayed on the **BIO-SEA® BWTS** screen.

The **BIO-SEA® Clean** is permanently connected to the manifolds but isolated by manual valves not provided with the system (see Figure 69: BIO-SEA® Clean example when integrated on a BIO-SEA® BWTS UV assembly, page 121).

The **BIO-SEA® Clean** uses a cleaning solution composed of citric acid (see paragraph "Cleaning product: Citric acid powder", page 51) stored in the CIP tank. This can be mixed with seawater or fresh water for circulation of diluted solution into the system.

The CIP cycle starts automatically as soon as the water filling of reactors begins or directly after the end of the operations if "CIP Salt water" is selected.

Figure 69: **BIO-SEA® Clean** *example when integrated on a* ***BIO-SEA® BWTS*** *UV assembly*



When CIP isolation valve is installed, it remains closed during the automatic CIP cycle.
It opens again when CIP cycle is over.

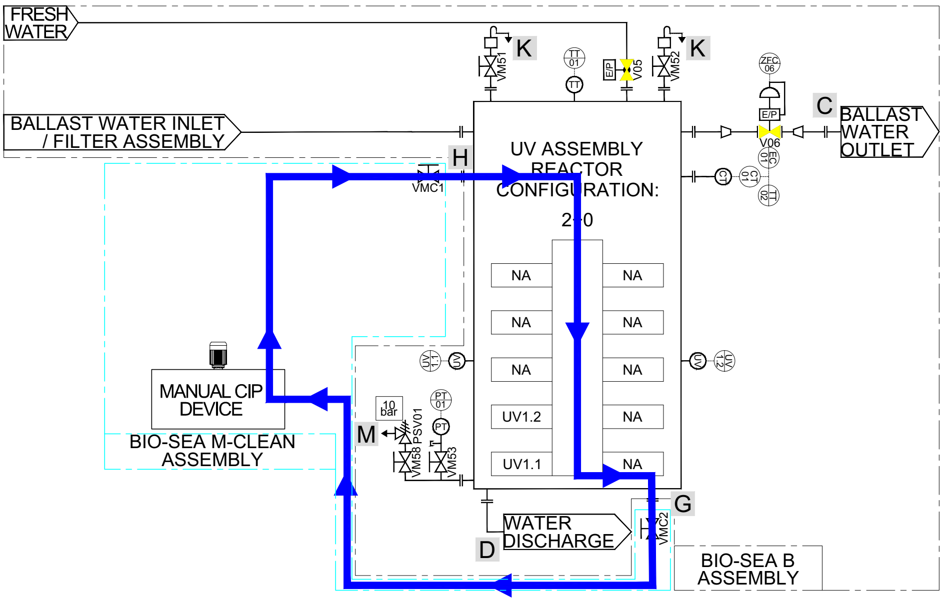
- **BIO-SEA® M-Clean (not recommended when V07 valve is installed)**

The CIP device is isolated from the **BIO-SEA® BWTS** by manual valves VMC1 and VMC 2 (see Figure 70: BIO-SEA® M-Clean example when integrated on a BIO-SEA® BWTS UV assembly, page 122).

The **BIO-SEA®** M-Clean uses a cleaning solution composed of citric acid (see paragraph "Cleaning product: Citric acid powder", page 51).

The CIP cycle is launched manually when end of cycle cleaning is over.

*Figure 70: **BIO-SEA® M-Clean** example when integrated on a **BIO-SEA® BWTS** UV assembly*

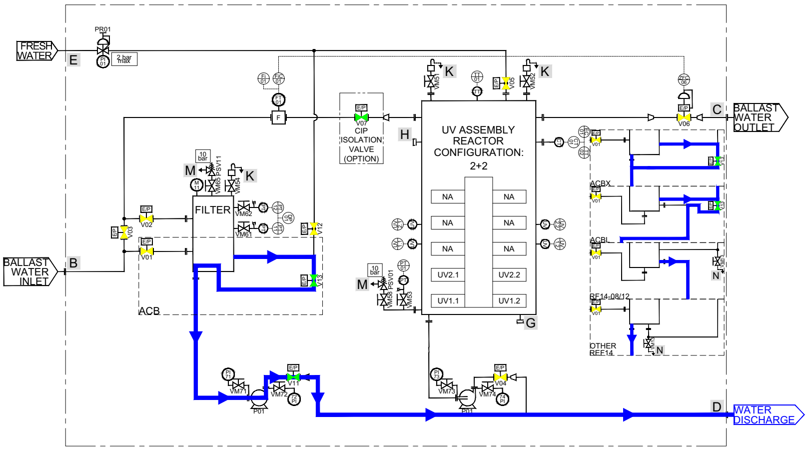


When CIP isolation valve is installed, it remains opened as it is a normally open valve and no automatic valve is actuated during manual CIP cycle.

17.3.3. Filter Cleaning sequence

- **Filter draining**

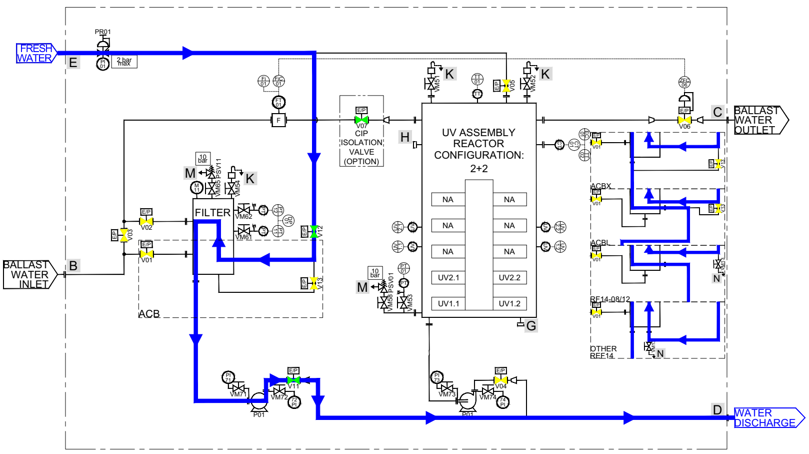
Figure 71: Process during Filter Drain



- During filter draining, valves V11 (and V13 for Filtrex filter) are open to achieve a complete emptying of the filter. The other automatic valves are closed.
- Automatic vent allows air entrance to avoid creating vacuum.
- The suction pump P01 is ON.
- The filter draining stops when the pressure inside the filter is lower than the parameter "End of draining pressure" for filter, then the filter flushing begins. If the draining is too long (time defined during commissioning), an alarm "Filter draining too long" is displayed on the screen.

- **Filter flushing**

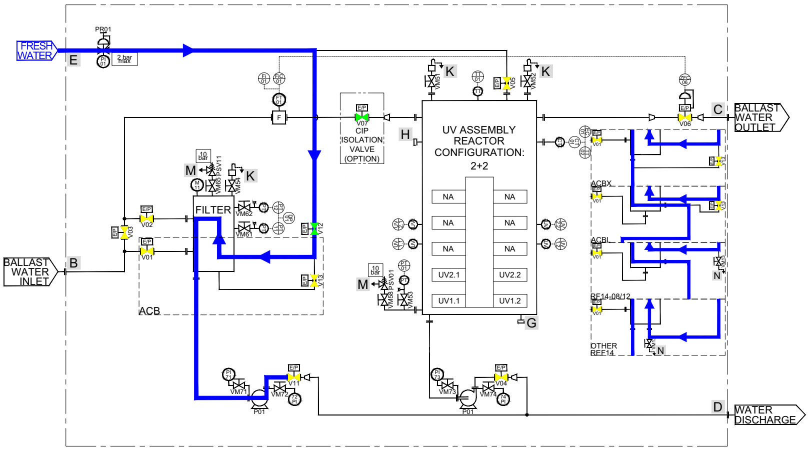
Figure 72: Process during Flushing



- During flushing process, valves V12 and V11 are open to allow fresh water circulation. The other automatic valves are closed.
- Automatic vent allows air entrance to avoid creating vacuum.
- The suction pump P01 is ON.
- The filter flushing stops when Flushing time for the filter is elapsed, then the filter filling begins

- **Filter filling with fresh water**

Figure 73: Process during Filter filling



- During filling in progress, valve V12 is open to allow fresh water inlet. The other automatic valves are closed.
- Automatic vent allows air exhaust to avoid air pocket inside the assembly.
- The suction pump P01 is OFF.
- Filter filling stops when the pressure inside the filter reaches the parameter "End of filling pressure"
- The cleaning cycle is over: System status displays "Cleaning is OK".

18. Flow management

Operation of **BIO-SEA® BWTS** is defined by the ability to treat water in different conditions, to ensure compliance with IMO and USCG discharge standards.

It is important to understand how operational flow rate is driven by environmental and ship conditions. Table 19 below displays the different operational flows for the BWTS range and details are provided in sub-paragraphs.

*Table 19: Operational flows of **BIO-SEA®** models*

BIO-SEA® model	Filter range	Max Flow Rate		Min Operational Flow Rate[1]		Min Allowable Flow Rate[2]		Min flow for operation start	
		USCG/ CMFDA method	IMO/MPN method	during ballasting	during deballasting	during ballasting	during deballasting	during ballasting	during deballasting
		m^3/h	m^3/h	m^3/h	m^3/h	m^3/h	m^3/h	m^3/h	m^3/h
L01-0030	ACB RF14	20	30	18 13	10	13	5	13	7
L01-0055	ACB	20	30	20	10	15	5	15	7
L02-0035	ACB	35	35	28	20	18	10	18	14
L02-0055	ACB	40	55	30	20	20	10	20	14
L02-0060	ACB ACBX/L RF14	40	60	35 25	20	25	10	25	14
L03-0055	ACB	55	55	40	30	25	15	25	21
L03-0087	ACB ACBX/L	60	87	45	30	30	15	30	21
L03-0090	RF14	60	90	30		30	15	30	21
L04-0087	ACB ACBX/L	80	87	55	40	35	20	35	28
L04-0120	ACB ACBX/L	80	120	65	40	45	20	45	28
B01-0055	ACB	55	55	50		15	5	30	20
B01-0087	ACB ACBX/L	87	87	50		20	5	35	20
B01-0110	RF14	110	110	50		30	5	45	20
B01-0135	ACB ACBX/L	100	135	50		30	5	45	20
B01-0150	ACB ACBX/L RF14	100	150	50		40 45	5	55 50	20
B02-0150	RF14	150	150	100		50	10	80	40
B02-0190	ACB ACBX/L	190	190	100		45	10	75	40
B02-0255	ACB ACBX/L	200	255	100		45	10	75	40
B02-0300	ACB ACBX/L RF14	200	300	100		57 52 75	10	87 82 100	40
B03-0300	ACBX/L RF14	300	300	150		57 80	15	102 125	60
B03-0340	ACB ACBX/L	300	340	150		62	15	107	60
B03-0450	ACB ACBX/L RF14	300	450	150		62 100	15	107 145	60
B04-0515	ACB ACBX/L	400	515	200		67	20	127	80

*Table 19: Operational flows of **BIO-SEA**® models*

BIO-SEA® model	Filter range	Max Flow Rate: USCG/ CMFDA method	Max Flow Rate: IMO/MPN method	Min Operational Flow Rate[1]: during ballasting	Min Operational Flow Rate[1]: during deballasting	Min Allowable Flow Rate[2]: during ballasting	Min Allowable Flow Rate[2]: during deballasting	Min flow for operation start: during ballasting	Min flow for operation start: during deballasting
		m³/h	m³/h	m³/h	m³/h	m³/h	m³/h	m³/h	m³/h
B04-0530	RF14	400	530	200		105	20	165	80
B04-0600	ACB	400	600	200		90	20	150	80
	ACBX/L					74		134	
	RF14					125		185	
B05-0515	ACB ACBX/L	500	515	250		72	25	147	100
B05-0530	RF14	500	530	250		110	25	185	100
B05-0750	ACB ACBX/L	500	750	250		95	25	170	100
	RF14					130		205	
B06-0600	ACBX/L	600	600	300		84	30	174	120
B06-0750	RF14	600	750	300		135	30	225	120
B06-0770	ACB ACBX/L	600	770	300		100	30	190	120
B06-0900	ACB ACBX/L	600	900	300		124	30	214	120
	RF14					155		245	
B07-0750	RF14	700	750	350		140	35	245	140
B07-0770	ACB ACBX/L	700	770	350		105	35	210	140
B07-1040	ACB ACBX/L	700	1040	350		129	35	234	140
B07-1050	RF14	700	1050	350		160	35	265	140
B08-1040	ACB ACBX/L	800	1040	400		134	40	254	160
B08-1050	RF14	800	1050	400		165	40	285	160
B08-1200	ACB ACBX/L	800	1200	400		166	40	286	160
	RF14					165		285	
B09-1350	ACB ACBX/L	900	1350	450		171	45	306	180
	RF14					195		330	
B10-1040	ACB ACBX/L	1000	1040	500		144	50	294	200
B10-1050	RF14	1000	1050	500		175	50	325	200
B10-1500	ACB ACBX/L	1000	1500	500		176	50	326	200
	RF14					200		350	
B12-1210	RF14	1200	1210	600		185	60	365	240
B12-1500	ACB ACBX/L	1200	1500	600		186	60	366	240
B12-1725	RF14	1200	1725	600		210	60	390	240
B12-1800	ACB ACBX/L	1200	1800	600		186	60	366	240
B14-1500	ACB ACBX/L	1400	1500	700		196	70	406	280
B14-1725	RF14	1400	1725	700		220	70	430	280
B14-2070	RF14	1400	2070	700		220	70	430	280
B14-2100	ACB ACBX/L	1400	2100	700		196	70	406	280

1. Above this flow rate, the system operates in optimal conditions. Below this limit, a Warning is triggered.
2. The system could not operate correctly below this flow rate: a Defect is triggered and the system stops

*Table 20: Operational flows of **BIO-SEA**® models for stripping option*

BIO-SEA® model	Filter range	Min Operational Flow Rate[1] during stripping mode 1 (m³/h)	Min Operational Flow Rate[1] during stripping mode 2 or 3 (m³/h)	Min Allowable Flow Rate[2] during stripping mode 1 (m³/h)	Min Allowable Flow Rate[2] during stripping mode 2 or 3 (m³/h)	Min flow for operation start during stripping mode 1 (m³/h)	Min flow for operation start during stripping mode 2 or 3 (m³/h)
L01-0030	ACB RF14	10	13	5	13	7	13
L01-0055	ACB	10	15	5	15	7	15
L02-0035	ACB	20	18	10	18	14	18
L02-0055	ACB	20	20	10	20	14	20
L02-0060	ACB ACBX/L RF14	20	25	10	25	14	25
L03-0055	ACB	30	25	15	25	21	25
L03-0087	ACB ACBX/L	30	30	15	30	21	30
L03-0090	RF14	30	30	15	30	21	30
L04-0087	ACB ACBX/L	40	35	20	35	28	35
L04-0120	ACB ACBX/L	40	45	20	45	28	45
B01-0055	ACB	10	15	5	15	20	15
B01-0087	ACB ACBX/L	10	20	5	20	20	20
B01-0110	RF14	10	30	5	30	20	30
B01-0135	ACB ACBX/L	10	30	5	30	20	30
B01-0150	ACB ACBX/L	10	40	5	40	20	40
	RF14		45		45		45
B02-0150	RF14	20	50	10	50	40	50
B02-0190	ACB ACBX/L	20	45	10	45	40	45
B02-0255	ACB ACBX/L	20	45	10	45	40	45
B02-0300	ACB	20	57	10	57	40	57
	ACBX/L		52		52		52
	RF14		75		75		75
B03-0300	ACBX/L	30	57	15	57	60	57
	RF14		80		80		80
B03-0340	ACB ACBX/L	30	62	15	62	60	62
B03-0450	ACB ACBX/L	30	62	15	62	60	62
	RF14		100		100		100
B04-0515	ACB ACBX/L	40	67	20	67	80	67
B04-0530	RF14	40	105	20	105	80	105
B04-0600	ACB	40	90	20	90	80	90
	ACBX/L		74		74		74
	RF14		125		125		125
B05-0515	ACB ACBX/L	50	72	25	72	100	72
B05-0530	RF14	50	110	25	110	100	110
B05-0750	ACB ACBX/L	50	95	25	95	100	95
	RF14		130		130		130
B06-0600	ACBX/L	60	84	30	84	120	84

*Table 20: Operational flows of **BIO-SEA**® models for stripping option*

BIO-SEA® model	Filter range	Min Operational Flow Rate[1]		Min Allowable Flow Rate[2]		Min flow for operation start	
		during stripping mode 1	during stripping mode 2 or 3	during stripping mode 1	during stripping mode 2 or 3	during stripping mode 1	during stripping mode 2 or 3
		m^3/h	m^3/h	m^3/h	m^3/h	m^3/h	m^3/h
B06-0750	RF14	60	135	30	135	120	135
B06-0770	ACB ACBX/L	60	100	30	100	120	100
B06-0900	ACB ACBX/L	60	124	30	124	120	124
	RF14		155		155		155
B07-0750	RF14	70	140	35	140	140	140
B07-0770	ACB ACBX/L	70	105	35	105	140	105
B07-1040	ACB ACBX/L	70	129	35	129	140	129
B07-1050	RF14	70	160	35	160	140	160
B08-1040	ACB ACBX/L	80	134	40	134	160	134
B08-1050	RF14	80	165	40	165	160	165
B08-1200	ACB ACBX/L	80	166	40	166	160	166
	RF14		165		165		165
B09-1350	ACB ACBX/L	90	171	45	171	180	171
	RF14		195		195		195
B10-1040	ACB ACBX/L	100	144	50	144	200	144
B10-1050	RF14	100	175	50	175	200	175
B10-1500	ACB ACBX/L	100	176	50	176	200	176
	RF14		200		200		200
B12-1210	RF14	120	185	60	185	240	185
B12-1500	ACB ACBX/L	120	186	60	186	240	186
B12-1725	RF14	120	210	60	210	240	210
B12-1800	ACB ACBX/L	120	186	60	186	240	186
B14-1500	ACB ACBX/L	140	196	70	196	280	196
B14-1725	RF14	140	220	70	220	280	220
B14-2070	RF14	140	220	70	220	280	220
B14-2100	ACB ACBX/L	140	196	70	196	280	196

1. Above this flow rate, the system operates in optimal conditions. Below this limit, a Warning is triggered.
2. The system could not operate correctly below this flow rate: a Defect is triggered and the system stops

18.1. Operational flow regulated by the BWTS

According to water quality and/or system state (cleanliness of quartz sleeve, UV sensor deviation, lamp life...), the operational flow is automatically managed by the BWTS PLC (depending on the lower UVi reading), with a flow target between max TRC and minimum operating flow rate.

Below this flow rate, the system triggers the Downgraded mode as requested by type approval conditions. According to the system setting chosen during commissioning, the BWTS stops or simply displays a message to stop or resume the current operation.

18.1.1. Maximum treatment rate capacity (max TRC)

This parameter is the maximum flow at which the BWTS is able to apply the approved treatment in optimum conditions. This flow changes according to the treatment mode and **BIO-SEA®** type:

- For **BIO-SEA® B** models:
    - with USCG/CMFDA mode: the lowest between 100m3/h x the number of reactors or the filter maximum flow rate.
    - with IMO/MPN mode: the lowest between 150m3/h x the number of reactors or the filter maximum flow rate.
- For **BIO-SEA® L** models:
    - with USCG/CMFDA mode: the lowest between 20m3/h x the number of reactors or the filter maximum flow rate.
    - with IMO/MPN mode: the lowest between 30m3/h x the number of reactors or the filter maximum flow rate.

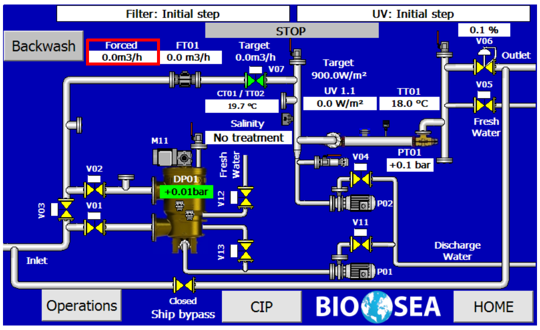
18.1.2. Minimum operational flow rate (min TRC)

This parameter is the minimum flow at which approved UV treatment can be applied. In order to maintain hydraulic balance between reactors, this parameter cannot be set below 10m3/h per reactor for **BIO-SEA® L** models or 50m3/h per reactor for **BIO-SEA® B** models. Consequently, flow is automatically adjusted by the regulation valve (according to UV measurement) between minimum operational flow rate and maximum TRC.

18.1.3. Manual forcing of flow target

When ballast pump is not able to provide sufficient flow, it is possible to increase pressure in the pipes by using the regulation valve, changing flow target by a forced flow target. For that, there is only need to modify forced value in Process screen by a value chosen between Max TRC for the treatment method and Min TRC (see Figure 74: View of forced flow on Process screen, page 130).

Figure 74: View of forced flow on Process screen



To disable forced value during operation, operator should enter 0 for forced value. At the end of operation, forced value will automatically reset to 0.

18.2. Minimum allowable flows

18.2.1. Minimum flow for operation start

This parameter is the minimum required flow above which the BWTS can allow starting the UV lamps when launching a treatment operation.

By default, this parameter is set at

- for **BIO-SEA® B** models,
  - 20m3/h per reactor + filter minimum flow rate for ballasting operations.
  - 20m3/h per reactor for deballasting operations.
  - 20m3/h per reactor for stripping operations in mode 1.
  - 5m3/h per reactor + filter minimum flow rate for stripping operations in mode 2 or 3.
- for **BIO-SEA® L** models,
  - 7m3/h per reactor + filter minimum flow rate for ballasting operations.
  - 7m3/h per reactor for deballasting operations.
  - 7m3/h per reactor for stripping operations in mode 1.
  - 5m3/h per reactor + filter minimum flow rate for stripping operations in mode 2 or 3.

Below this flow rate, the system cannot start operations.

18.2.2. Minimum allowable flow for operations

This parameter is the minimum flow where the BWTS can perform operations without a critical defect. This min flow prevents reactor overheating when no sufficient flow is provided by the ship ballast system.

By default, this parameter is set at

- 5m3/h per reactor + filter minimum flow rate for ballasting operations.
- 5m3/h per reactor for deballasting operations.
- 5m3/h per reactor for stripping operations in mode 1.
- 5m3/h per reactor + filter minimum flow rate for stripping operations in mode 2 or 3.

When flow rate is between minimum operational flow rate and minimum allowable flow rate, the BWTS is in downgraded mode. According to the system setting chosen during commissioning, the BWTS stops or simply displays a message to stop or resume the current operation.

Below this flow rate, the system could not operate correctly: a Defect "low Flow" is triggered and the system stops.

18.3. Operation by gravity

Water treatment is possible when using gravity to fill or empty ballast tanks, as long as the parameters remain within the limits of system specification:

- Min/max flow rates (controlled or monitored by the BWTS).
- Pressure between 1,5 and 6/10 bars.

Before the **BIO-SEA**® system begins UV treatment, it will be necessary to start the pump at least during the UV lamp warm-up, in order to initiate the system. After treatment has started (system ready), the pump can be stopped for use of gravitational ballasting/deballasting.

If control integration has been done in order to enslave **BIO-SEA**® BWTS to ballast water pump, then the BWTS must be manually started and/or stopped when operating by gravity.

It is generally observed that water movements made by gravity provide greater flow rate than the ballast water pump TRC.

However, if the flow rate of the ballast water is higher than the maximum flow rate of the system, the control valve placed after the UV assembly allows reducing the flow rate and so treating the water in good conditions.

19. Abnormal operations

The **BIO-SEA**® self-monitoring system provides indications to the crew of the challenges experienced by the BWMS during operation.

Warnings such as frequent backwashes, reduced flow or low UVI should be taken into account by operators in order to take pre-emptive or corrective actions and avoid by-passing the system.

When abnormal operations lead to triggering the by-pass of the BMWS, return to compliance for the next discharge should be ensured.

IMO has developed guidance for planning, mitigation, recovery, record-keeping and communication in such situations:

- Circular BWM.2/Circ.62 "Guidance on contingency measures under the BWM Convention" (as may be revised)
- Resolution MEPC.387(81) "Interim guidance on the application of the BWM Convention to ships operating in challenging water quality conditions"

These should be consulted in advance for incorporating in the BWMP :

- A list of critical alarms identifying operational issues that could compromise the treatment process
- Mitigation instructions for coping with these different situations
- Recovery actions that can be taken to reduce risk to the environment and resources

Consult your **BIO-SEA**® team for support on technical information and/or possible actions to be included in a ship-specific BWMP.

19.1. Warnings, Alarms and Troubleshooting

During operation, monitoring through sensors can trigger warnings, in particular due to water conditions outside of the operational or performance limit of the system.

For example:

- water with high sediment load: the filter will start backwashing continuously and if this is not sufficient to clean the filter basket completely, this can lead to clogging after a certain time of operation.
- water with low transmittance: the UVI sensor will trigger flow regulation until the lowest operational limit, below which the water is not treated sufficiently.

To cope with these situations and other warnings (pressure, temperature, flow…), crew should be familiarized with the Warning and Default messages in this Manual (see Troubleshooting section).

Setpoints for warnings and alarms are detailed in Commissioning book BS3-03, and visible in "Parameters alarms" screen.

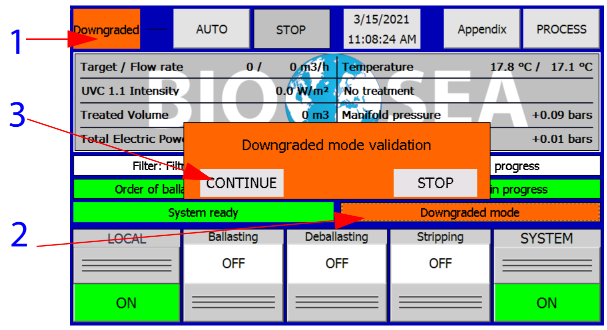
19.2. AUTO downgraded mode

In Auto degraded mode
- Slavery and safety functions are available.
- Stop or shut down are triggered by alarms on system defaults.

19.2.1. Downgraded mode due to improper operational conditions

During commissioning, it is chosen if the system will automatically stop when operating conditions are out of the expected range for the system, or if it will continue operating in downgraded mode, as an abnormal mode of operation.

Figure 75: Main screen during auto downgraded mode



1- Auto Downgraded mode is activated.
2- Button to access the Alarm screen. It also indicates the Default category.
3- Button to activate the Auto downgraded mode.

At the appearance of one of the triggering defects (low UVI, overflow, by-pass) a dialog window appears.
- If STOP is selected: the system switches to STOP mode.
- if CONTINUE is selected: the system switches to Downgraded mode.

At the end of the operation, the system will remain in downgraded mode. To be able to launch another operation, it is necessary to
- switch to STOP mode before enabling AUTO mode.
- solve the defects that are still present, otherwise the downgraded mode will be activated again.

The defects hereafter can lead to the auto downgraded mode:
- UV irradiance too low: this default can be caused by poor water quality, a dirty quartz sleeve, a damaged UV sensor or a UV lamp in end of life. The downgraded mode is triggered when this alarm is detected during 30 seconds.
- Overflow: this default can be caused by a malfunction of the outlet control valve and the flow rate exceeds the maximum limit of the system. The downgraded mode is triggered if 5-10% overflow is detected during 600 seconds, or if >10% overflow is detected during 60 seconds.
- Y Ship_bypass: Ship bypass open: this default occurs when the combination of ship valves positions indicates that ballast water is not passing through the system. The downgraded mode is triggered as soon as this alarm is detected.

19.2.2. Downgraded mode after reactor disabling

When **BIO-SEA**® BWTS is used in auto downgraded mode, the treatment effectiveness is not guaranteed. The use of this mode is under the responsibility of the crew as water treatment could not be correct.

The ballast water must be managed as mixed water or untreated water, according to ballast water management procedures.

When a reactor is malfunctioning and cannot be serviced before long, it is possible to use the redundancy of the UV assembly in order to partially treat water, rather than by-passing the system and contaminating the vessel and/or the environment with invasive species.

In this case, the faulty reactor must be dismounted and the corresponding ballast must be disabled. On the next automatic operation, the system will automatically adjust the flow rate to the remaining number of reactors, but will also switch to downgraded mode because water balance through the manifolds is not in accordance with the approved hydraulics anymore.

19.3. Management of untreated water

It is expected that in some occasions the BWTS will not be able to treat water to the D-2 standard.

This can be caused by:

- system being not operated correctly, or being by-passed.
- system being outside of its performance limits.
- system being inoperable, damaged or malfunctioning.
- water contamination occurring outside of the treatment loop.

In such cases, an alarm will indicate the situation to the crew and mitigation measures should be taken to avoid unacceptable risk to the environment, such as:

- retaining ballast on board until BWTS is repaired.
- discharging untreated water to a reception facility or treatment barge.
- applying an emergency treatment accepted by the port state.
- exchanging unmanaged water in high sea upon agreement with port state.

In order to help shipowners, operators and ports in adopting appropriate measures, the IMO Marine Environment Protection Committee (MEPC) approved:

- Circular BWM.2/Circ.62 "Guidance on contingency measures under the BWM Convention" (as may be revised).
- Resolution MEPC.387(81) “Interim guidance on the application of the BWM Convention to ships operating in challenging water quality conditions”

These documents should be consulted in advance for integrating the best specific approaches to the BWMP of the vessel, depending on the BWMS particulars and the vessel operational profile.

Your **BIO-SEA**® team can support you with technical information and/or possible actions to be considered.

20. STOP Mode / EMERGENCY STOP

- This mode allows to stop the operation of the **BIO-SEA**® BWTS and put all mechanisms in a safe status (initial position/state).
- When this mode is activated, the dry contact "Pump start order" opens to inform the crew that the ballast pump must be stopped.
- Only the monitoring function is maintained. No datalog is done, except for alarms, warnings and events.
- During the starting phase of the PLC, system is in STOP mode.

In case of freezing risk, it is recommended to completely drain the system. A cleaning of the system is also recommended before restarting the system.

- An EMERGENCY SHUTDOWN mode is also available, when the emergency button is pushed on the control cabinet (see Figure 57: Control Cabinet, page 106).
- In the event where the touchscreen is broken or out of order, the BWTS must be stop by using the Emergency stop button on the control cabinet.

20.1. STOP button

To enter this mode, press "STOP button" on the HOME screen or remote control board.

Activating this mode has the effect of:

- stopping of the ongoing cycle.
- making a software emergency stop.
- setting PLC outputs to the zero state.
- securing the mechanisms.

The operations of ballasting, deballasting or stripping should not be stopped by using the STOP button but rather by switching their corresponding button to OFF on the screen.

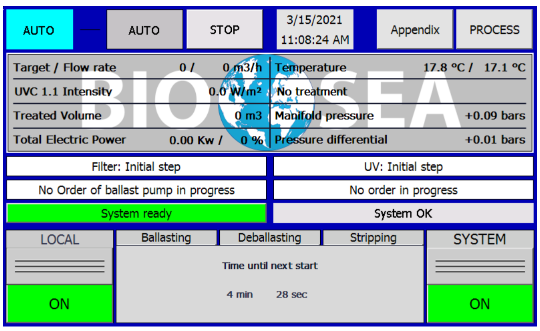
20.2. EMERGENCY SHUTDOWN MODE

- The emergency stop is activated, when the red push button is pressed on the control cabinet. It has the effect of putting all the mechanisms in a safety condition.
- At PLC level, the processes associated with the emergency stop are identical to those made in stop mode. Additionally, the emergency stop causes the deactivation of the remote control mechanisms.
- The inputs Management (AON, analog) remain intact.
- The BWTS can then be by-passed through the vessel control system.

20.3. Restart

- Stopping the system could give a default or a general default. So before restarting the system, it is necessary to solve the default and acknowledge it.
- In the case of an emergency stop, first disable the red punch button to bring back power and press the green button.
- On power up after loss of power, system power up automatically if main breaker of control cabinet hasn't been switch off.
- Start-up and restarts operations don't require any specialized knowledge of the system.

When a UV lamp has turned off, it is necessary to wait about 5 minutes before starting it again or launching a ballasting, deballasting or stripping operation. This is a safety not to damage the lamp.



21. MAINTENANCE Mode

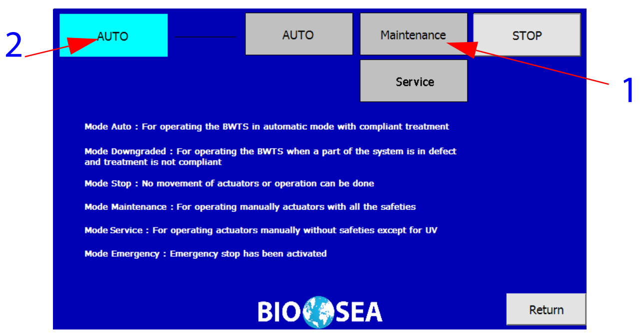
- MAINTENANCE Mode is used for maintenance activities.
- This mode requires an identification with a maintenance level.
- This Mode can be selected through MODE screen (accessible since Appendix screen).
- Change to MAINTENANCE Mode is data logged to ensure traceability.

21.1. Access to Maintenance mode

- To access MAINTENANCE mode, LOCAL control must be first switched on. Do not forget, when finishing Maintenance operation, to switch back to either STOP or AUTO mode, and switch off LOCAL control.
- This mode is logged out after 60 minutes of inactivity on the screen.

- Before changing Mode, check that all mechanisms are stopped to avoid any damage of/by moving parts.

Figure 76: Mode screen



1- Press MAINTENANCE to select. An identification with the maintenance level is required.

2- The selected mode is shown on the left of the screen.

21.2. Features in Maintenance mode

- All the safety features are provided in the MAINTENANCE mode.
- Sensor values, alarms and events are data logged to ensure traceability.
- When Maintenance mode is enabled, visual alarm is activated.

- Only basic operations are available, in order to temporarily manage the operation of the system manually:
  - Lamps can be switched ON and OFF (ex: to check lamp functioning after a lamp replacement) only if there is enough flow in the pipes to prevent damage to the system.
  - Dimming can be enable/disable (ex: to check if lamp power is correctly adjusted).
  - Valves can be opened and closed (ex: to change their status, or to check if they operate correctly).
  - Pumps and motors can be started and stopped (ex: to check their functioning).

21.3. Use of the Maintenance mode

Take care when you activate valve(s), motor(s) or pump(s).

Incorrect use of equipments can injure operators or damage BWTS components.

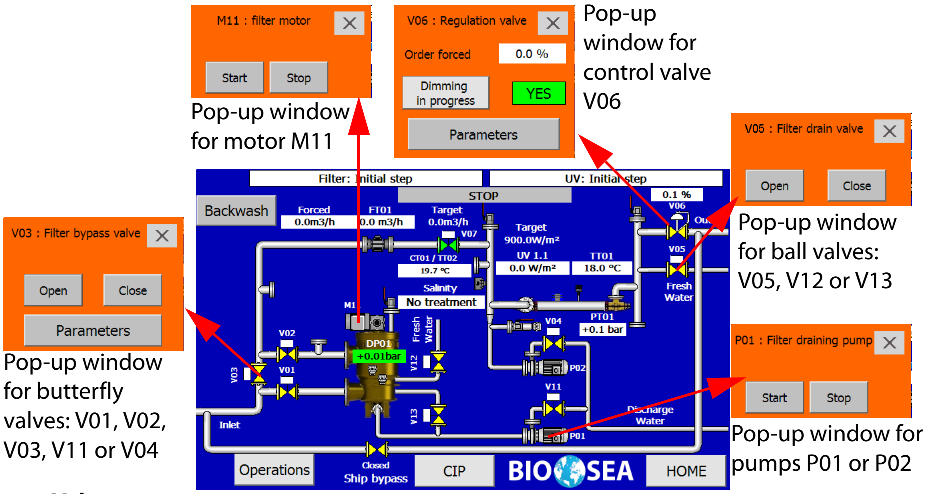
When valves, motors or pumps symbols become RED, it means they are in DEFAULT.

In case of default an audible and visible alarm is activated.

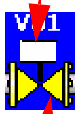
- If only one pump is installed, V04 or V11 must be OPENED before operating the P01 pump. However, draining of UV assembly and filter should be made separately to avoid alarm (both valves should not be opened in the same time).
- If two pumps are installed with only one filter, V04 must be OPENED before operating P01 pump and V11 must be OPENED before operating P02 pump.

- Even if recording of Maintenance Schedule on the datalog exists on the screen, all maintenance operations should be manually recorded by the operator. Sensor values, alarm and events are datalogged in MAINTENANCE mode to ensure traceability. Maintenance checklists (for 3, 6 and 12 months maintenance) are provided at the end of this book.
- When Maintenance mode is enabled, visual alarm is activated.

Figure 77: Manual use of the components in Maintenance mode on Process screen



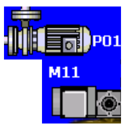
Actuator



Valve body

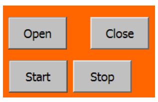
Valves status

- Actuator
  - White actuator = not activated (valve in its normal position, eg. V01 is Normally Closed)
  - Green actuator = activated (valve V11 is NC, and has been opened)
  - Red = Defect component
- Valve body
  - Green valve = valve open
  - Yellow valve = valve closed
  - Red = Error or wrong position



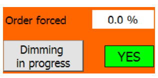
Motor or pump status:

- Grey = rest position
- Green (flashing) = running
- Red = Defect components



Buttons OPEN / CLOSE or START/STOP

- White button = Action authorized (eg. press button to open valve V11)
- Grey button = No permission to change the status



V06 pop-up window

- "Dimming in progress" button: to launch automatic dimming for V06 valve opening. An Indicator on the left shows dimming status: YES = active, NO = inactive
- "Order forced": V06 opening order when automatic dimming is inactive

Table 21: Identification of Valves and Pumps

Valve nr	Rest pos.	Description	Valve nr	Rest pos.	Description
V01	NC	Filter inlet valve	V04	NC	UV Draining valve
V02	NC	Filter outlet valve	V05	NC	UV Fresh water valve
V03	NC	Filter by-pass valve	V06	NC	UV outlet control valve
V11	NC	Filter backwash outlet valve	V07	NO	CIP isolation valve
V12	NC	Filter Fresh water valve	M11	-	Filter backwash motor
V13	NC	Filter draining valve (only for FILTREX filter)[1]	P01	-	Suction pump
			P02[2]	-	Suction pump
NC = Normally closed valve / - = Not applicable (e.g. Motors)					

1. For HYDAC filter, this valve is replaces by a manual valve VM13 to discharge remaining water into the chest.
2. It is used in option for UV assembly draining, usually in modular configuration.

22. Maintenance Schedule

- The **BIO-SEA**® BWTS Maintenance has to be carried out according to the recommended frequencies.
- The system warranty may be affected if damage occurs when the system maintenance is not carried out as described in the present document or if replaced spare parts and consumables do not come from a **BIO-UV Group** approved origin.
- MAINTENANCE mode must be active for each maintenance operation.
- Annual sensor checks should be carried out by a **BIO-UV Group** technician or its representative.

The Maintenance schedule of the **BIO-SEA**® BWTS should be included into the maintenance plan of the vessel.

22.1. Required Tools and Products

Protective gloves and eye protection must be worn by the operator for the maintenance operations of the reactors.

Local or national regulations must be applied in all the operations.

*Table 22: Standard tool kit (OUT015810) supplied with the **BIO-SEA**® **L** models*

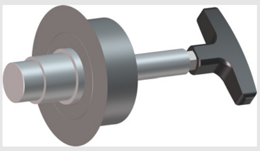
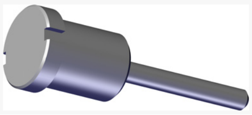
Designation		Quantity	Use for **BIO-SEA**® BWTS Installation	Reference
Quartz sleeve dismounting tool		1	Specific tools for quartz operations	OUT014366
Victaulic plug 1”		2	To block pipes when a reactor is removed	ACC015577

*Table 23: Standard tool kit (OUT015811) supplied with the **BIO-SEA® B** models*

Designation		Quantity	Use for **BIO-SEA®** BWTS Installation	Reference
Quartz sleeve pusher		1	Specific tools for quartz operations	OUT009228
Quartz sleeve guiding tool		1		OUT009227
Victaulic plug DN100		2	To block pipes when a reactor is removed	RAC009839
Measuring window gauge		1	For adjustment of UV window position	USI600806
Pin key D40		1		PIEA600559
Pin key D58		1		PIEA600558

To be able to carry out the maintenance correctly, please read the manuals for all main sub-components provided in the technical binder. Spare parts can be required for replacement. References of spare parts can be found i n chapter Spare parts catalog, page 226.

Table 24: Required measuring devices (not provided with the system)

Designation	Part number or reference
Digital UV Meter	OUT011882
Calibrated UV sensor (digital)	ELE008712
Water Analysis Calibration Solution 12880µS/cm	PDP014387
Water Analysis Calibration Solution1413µS/cm	PDP014388
Caliper with depth gauge	-

Table 25: Required tools and products (not provided with the system)

Designation	Part number or reference
Standard tools	
Screw driver for electrical terminals connections	Flat (thin) and Pozidrive
Screw drivers for WAGO terminal	OUT009229
Torx Wrench	Sizes vary following the type of equipment
Allen Wrench	Sizes vary following the type of equipment

Table 25: Required tools and products (not provided with the system)

Designation	Part number or reference
Spanner	Sizes vary following the type of equipment
High pressure cleaner	-
Specific tool for filter operation (only for information)	
Lifting ring	-
Circlip plier	-
Hub remover	-
Key extension tool (for big size Filtrex filters)	
Products	
Acid solution	White vinegar or acid product
Marine grease for all uses	BARDAHL (Cap Horn type)
Mercury recovery kit	OUT014179

Always use gloves or a clean cloth when handling the lamp, the quartz or the UV sensor.

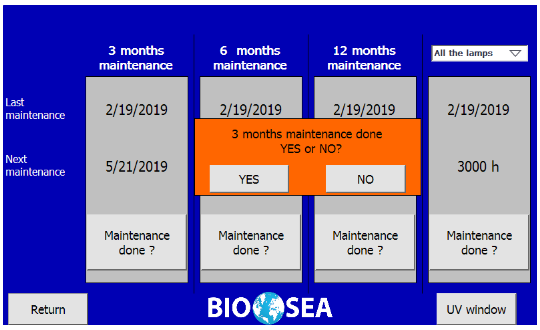
Disposable used accessories and consumables must be collected by specialized structures for elimination and recycling of this kind of material according to the local legislation.

22.2. Maintenance recording

22.2.1. Maintenance screen

This screen can be reached by following the path:
"Home" screen > "Appendix" > "Maintenance messages" > Planned Maintenance.

Figure 78: Maintenance screen



According to the maintenance schedule, a warning will appear for 3-month maintenance, 6-month maintenance, 12-month maintenance or for lamp replacement. This warning does not prevent from operating the system.

The preventive maintenance should be done when the maintenance warning appears. However, it is possible to proceed to maintenance earlier by pressing on "Maintenance done?" button. In this case, Next maintenance date will be set at 3, 6 or 12 months from the maintenance date.

If you choose to proceed to maintenance, select "Yes" to warning message or "No" if you want to do it later.

Preventive maintenance cannot be done if AUTO mode or AUTO DOWNGRADED mode is active.

- Each action on this screen for preventive maintenance or lamp replacement is recorded on the SD card for data log.
- In case of program update, all the maintenance dates are reseted.

22.2.2. Templates tables

Details on calibration, preventive or corrective maintenance should be recorded manually when performed.

You can find templates at the end of this book, or use the vessel record book as long as it has the same content: Date, Operation performed, Status of Control/Repair (Ok/not OK), Person in charge (Signature), Final status, New serial number (if applicable).

Each record should match with the maintenance events in the datalog. These records could be checked by the service engineer during the various checking in order to ensure the maintenance and servicing have been well performed.

22.3. Spare parts

Spare parts are summarized in the chapter Spare parts catalog, page 226, with their references according to the model. They are separated in 3 levels:

- L1: these parts are strongly recommended to keep in stock on board. They are required to keep the system functional in case of breakage or wear.
- L2: these parts are recommended to perform a maintenance according to the schedule. They only concern the UV reactor:
    - Clamp and Victaulic couplings
    - UV window nut
    - Lamp attachment system
    - Ceramic terminal
    - Sealing rings
    - Round pipe holder with rubber protection
    - Protection tube for lamp cable
- L3: these parts are given for information. They are not considered as essential or not supposed to break.

Disposable used accessories and consumables must be collected by specialized structures for elimination and recycling of this kind of material according to the local legislation.

In particular, worn UV lamps should be placed in specific container for UV lamp disposal in order to be collected by approved agency or sent directly to **BIO-UV Group**.

22.4. Maintenance level

According to industrial standards, the maintenance operations have been classified into 5 levels:

- **Level 1**: Simple adjustments, checks, replacements of consumable parts or cleaning operations that can be carried out by the user without tool nor equipment dismounting.
- **Level 2**: Standard replacements or minor preventive maintenance carried out by a skilled technician with standard tools defined in the manual.
- **Level 3**: Identification, diagnostic of failure, replacement of complex elements, minor mechanical reparations or preventive maintenance carried out by a skilled technician with specific and/or standard tools.
- **Level 4**: Every important work of corrective or preventive maintenance, except reconditioning or rebuilding, carried out by a team with a specialized technical management with specialized tools and a complete documentation. This level also includes adjustment of measuring devices used for maintenance and, eventually, the verification of standard measuring tools by specialized organisms.
- **Level 5**: Rebuilding or reconditioning carried out by the manufacturer with means defined by the manufacturer. This level is not present in this manual.

22.5. Daily Checks

During normal operation of the **BIO-SEA**® system, a daily check of the installation is recommended, in order to verify:

- there is no leakage from piping, connections and mechanical assemblies (drive screw, drive shaft).
- pressure and good state of the air supply line and drain air filter if necessary.
- that the system is full of (fresh) water when not in operation.
- the pressure sensors show normal values.
- fans of each power cabinet or independent electronic ballasts are functioning.
- manual valves of pressure transmitters, pressure safety valves on manifold and filter and automatic vents on manifolds and filter are open.
- for Hydac filters, manual valve VM13 for filter manual draining is closed.
- there is no unexpected noises on the gearbox of the filter during functioning.

Pay specific attention to manual valves of pressure safety valves that must always remain opened except in case of replacement.

These operations are maintenance **level 1**.

22.6. Monthly checks

- If the system has not been used during 1 month, at least one ballasting and one deballasting operations should be carried out to check BWTS correct operation, see 16. Treatment, page 110 and 16.2. Deballasting, page 113.

It is important to keep using the BWTS at least once a month to maintain warranty conditions.

- Drain the condensation of the air filter reducing valves.

These operations are maintenance **level 1**.

22.7. Maintenance Frequency Chart

22.7.1. 3 months maintenance

Table 26: 3 months operations

Operations	Maint. Level	Instructions	Required Tools or Products	Skill and personal requirement	Required Time
For **BIO-SEA® B** models, cleaning of the fans filter on each power cabinet	1	See 27.2.1., page 185	Screw driver, Air blower	User or electrician	3 min / cabinet
For skid configuration, checking of the screws and bolts tightening on the skid frame and the piping	1	None	None	User	1 min
Check safety valves outlets are clean	1	None	None	User	1 min

22.7.2. 6 months maintenance

Table 27: UV reactors Maintenance, 6 months operations

Operations	Maint. Level	Instructions	Required Tools or Products	Skill and personal requirement	Required Time
Drain the UV assembly	1	See 24.1.1., page 157	None	User	5 min
Visual checking of the UV sensor (general state)	1	See 25.1., page 174	None	User or electrician	10 min/ reactor
UV sensor window cleaning	1	See 25.2., page 175	Air blower	User or electrician	10 min/ reactor
Visual checking of the Temperature sensor (general state)	1	See 23.2.1., page 152	Screw driver, wrench	User or electrician	10 min
Tightening verification of clamps on side, UV window clamps, UV reactors clamps	1	None	None	User or electrician	1 min/ reactor
Leaking test of the quartz (looking inside the reactor)	1	See 24.3.4., page 171	None	User or electrician	10 min/ reactor
Carry out a careful visual check of the automatic air release on the manifold	1	None	None	User or electrician	10 min

Table 27: UV reactors Maintenance, 6 months operations

Operations	Maint. Level	Instructions	Required Tools or Products	Skill and personal requirement	Required Time
Tightening control of electrical terminals:					
• In the Boxes of connections on UV lamp reactors,	2	None	Screw driver	1 electrician	5 min/ reactor
• Actuators of valves,	2				5 min/ actuator
• Flow meter,	2				10 min
• Electrical pumps motors,	2				5 min

Table 28: Power cabinet or independent electronic ballast and control cabinet Maintenance, 6 months operations

Operations	Maint. Level	Instructions	Required Tools or Products	Skill and personal requirement	Required Time
Visual checking of the status of the fans	1	None	None	1 electrician	10 seconds
Tightening control of electrical terminals:					
• Inside power cabinets or on independent electronic ballasts	2	None	Screw driver	1 electrician	20 min/ cabinet or 5 min/ ballast
• Inside control cabinet	2		Standard Screw driver and Screw drivers for WAGO terminal	1 electrician	30 min

Table 29: : Filter Maintenance, 6 months operations

Operations	Maint. Level	Instructions	Required Tools or Products	Skill and personal requirement	Required Time
Visual checking of the filter and filtering elements status	2	See filter manual	Keys, screw drivers, lifting device and filter manual	2 officers or engineers	30-60 min
Cleaning of the prefilter and the filtering element	2		Fresh water	1 engineer	30 min
Checking the rotation of the backwash shaft	1	See 28.3.2., page 189	None	1 user	5 min
For Hydac filter, check filter internal coating.	1	Visual checking, Repair if possible or contact your **BIO-SEA**® representative	None	User	5mn
Tightening control of electrical terminals:					

Table 29: : Filter Maintenance, 6 months operations

Operations	Maint. Level	Instructions	Required Tools or Products	Skill and personal requirement	Required Time
• Electrical pumps motors,	2	None	Screw driver	1 electrician	5 min
• Electrical motors of the filter back wash shaft	2				5 min
Carry out a careful visual check of the automatic air release	1	None	None	User or electrician	5 min

22.7.3. 12 months maintenance

The yearly maintenance operations below must be done in addition to the biannual maintenance operations described in 22.7.2. 6 months maintenance, page 146

Table 30: Air filter Maintenance, 12 months operations

Operations	Maint. Level	Instructions	Required Tools or Products	Skill and personal requirement	Required Time
Replace main air filter cartridge	1	Rotate the filter bowl a quarter clockwise to disassemble it and replace the filter cartridge. Reassemble the bowl by rotating it a quarter turn counterclockwise	25µm cartridge	User	2 min

Table 31: UV maintenance, 12 months operations

Operations	Maint. Level	Instructions	Required Tools and Products	Skill and personal requirement	Required Time
Preventively, change the UV lamp when the hour counter > 3000h.	2	See 24.1., page 157, 24.4., page 172 and 24.5., page 173	Screw driver, spanner	Officer or engineer	1-15 min
If the lamp has been changed by a new one, change the quartz sleeve too. If not, clean or change, if needed, the Quartz sleeve. In any case, change the Gaskets on the reactors.	2	See 24.2., page 160 and 24.3., page 165	Clean cloth, silicon grease	Officer or engineer	25 min
Replacing the gasket of the UV sensor window	2	See 25.2., page 175	Screw driver	Officer or engineer	5 min

Table 31: UV maintenance, 12 months operations

Operations	Maint. Level	Instructions	Required Tools and Products	Skill and personal requirement	Required Time
Checking the tightness on the quartz by removing cap on the side of the reactor (system full of water)	2	See 24.3.4., page 171	Screw driver, Spanner	Officer or engineer	10 min
Checking that clamps are tightened (side clamps , UV window clamps, UV reactors clamps)	2	None	Spanner	Officer or engineer	1 min
Visual check of the automatic air release on the manifold	1	Automatic air release should not leak when manual valve is open. Otherwise, it should be replaced	None	User	5 min
Checking test of the manifold safety manual valves (opening and closing)	1	Open and close valves (must remain open after the test)	None	User	5 min
Verification of the UV sensor or UV sensor replacement	4	See 23.1., page 152	UV meter / Calibrated UV sensor	BIO-UV technician or its representative	30 min/ reactor
Verification of the temperature sensor	3 or 4[1]	See 23.2., page 152	Screw driver, Calibration oven	BIO-UV technician or its representative	30 min
Verification of the pressure sensor	3 or 4[1.]	See 23.4., page 155	Reference manometer and hand pump	BIO-UV technician or its representative	10 min
Verification of the conductivity sensor	3 or 4[1.]	See 23.5., page 155	Spanner Control solution	BIO-UV technician or its representative	30 min
Verification of pump flow rate of UV draining pump (if two pumps are installed)	1	See 28.4., page 190	None	User	10 min
Test safety valves	1	Use the test knob on the safety valve at 80% of the BWTS max pressure	None	User	1 min

1. If no standard measuring tool on board

Table 32: Filter Maintenance, 12 months operations

Operations	Maint. Level	Instructions	Required Tools and Products	Skill and personal requirement	Required Time
Cleaning the pre-filter (if installed), the filtering elements. Replacing the gaskets.	2	See Filter manual	Key extension tool, Circlip plier, Spanner, Allen key, Lifiting device, Filter manual	1 officer + 1 engineer	30-60 min
For Filtrex filter, Check gap between upper/bottom bushing and filter shaft	2	See 28.1., page 186	Caliper	1 officer + 1 engineer	15mn
For Filtrex filter, Grease thrust bearing (6)	1	None	Greasing pump	1 engineer	1min
Test of Backwash	1	See 28.3., page 188	None	User	10 min
Verification of pump flow rate of backwash pump	1	See 28.4., page 190	None	User	10 min
Visual check of the automatic air release	1	Automatic air release should not leak when manual valve is open. Otherwise, it should be replaced	None	User	5 min
Test safety valves	1	Use the test knob on the safety valve at 80% of the BWTS max pressure	None	User	1 min
V03 leak check	1	See 28.5., page 192	None	User	45min

Table 33: Pump Maintenance, 12 months operations

Operations	Maint. Level	Instructions	Required Tools and Products	Skill and personal requirement	Required Time
Checking state of bearings, impeller and gaskets of the pumps. In case of leak or bad state of parts, replace the pump	3	See pump manual	.Pump manual	1 officer + 1 technician	60 min

Table 34: Flowmeter Maintenance, annual operations

Operations	Maint. Level	Instructions	Required Tools and Products	Skill and personal requirement	Required Time
Verification of the flow meter • Checking the electronic connections • Checking 5% tolerance of the measured values	4	See Flow meter Manual and 23.3., page 154	Opticheck Console, Flow meter manual	BIO-UV technician or its representative	30 min

Table 35: Maintenance of the power cabinets fans, annual operations

Operations	Maint. Level	Instructions	Required Tools and Products	Skill and personal requirement	Required Time
Replacement of the fans filter on each power cabinet	2	See 27.2.1., page 185	Screw driver	Officer or engineer	3 min / cabinet

22.8. Annual Check attendance by BIO-UV Group

Annual attendance by **BIO-UV Group** Certified Service Engineer is to be performed in order to ensure that the system maintain good operational conditions and remain in conformity with the applicable regulations.

The Annual Attendance also allows the annual renewal of sensor certificate required by USCG regulation.

The attendance include the following scope:

- General inspection of the system
- Log extraction
- Software updates (if applicable)
- System start-off, basic operational tests and UV lamp(s) condition assessment (if circumstances allow)
- Sensors calibration verification:
    - Pressure Sensor Checking
    - UV Sensor Checking or exchange
    - Temperature Sensor Checking
    - Flowmeter Checking

For details about sensor checking refer to 23. Sensors checking, page 152

Attendance will result in the following deliverables:

- Report on system condition
- **BIO-UV Group** recommendation for operation improvement (crew training, spare parts)
- Official sensor certificate (or recommendation of replacement)
- Edition of one-year certificates

23. Sensors checking

For further information about the sensors verification procedures, please contact **BIO-UV Group** staff.

- This paragraph provides simple means available aboard the vessel to identify drift and repeatability fluctuation and re-zero measuring devices that are parts of the control and monitoring equipment according to 46 CFR 162.060-20 (e) (3).
- Procedures for yearly checking of the sensors has to be done by **BIO-UV Group** representative.

23.1. Checking UV Sensor

Refer to 25.3. Checking UV sensor, page 176.

23.2. Checking temperature sensor

23.2.1. Visual checking

- Dismount the connector: remove the screw then pull the connector.
- Unscrew the temperature sensor with hand.
- Check visual aspect of the temperature sensor and inside its support.
- Clean it if needed and remove particles or deposits that could avoid good contact between the sensor and its support.
- Screw back the sensor with hand.
- Plug the connector and tight the screw.

23.2.2. Measurement checking

For reliable checking, the thermometer should be calibrated and have a valid certificate.

Compare the Temperature value measured with the temperature sensor and a thermometer. For that:

- Prepare a container with water at ambient temperature, another with hot water and another with cold water.
- Remove the temperature sensor from the reactor but still electrically connected.
- Plunge thermometer and the temperature sensor in one of the container and write temperatures when stabilized (value of temperature sensor can be read on the screen). Then, do the same for each container.
- Do the previous operations a second time.
- Records results in the sensors verification template.
- Compare the read value for both instruments. If the temperature differs for more than +/-5%, then replace the temperature sensor by a new one kept in stock on the ship.

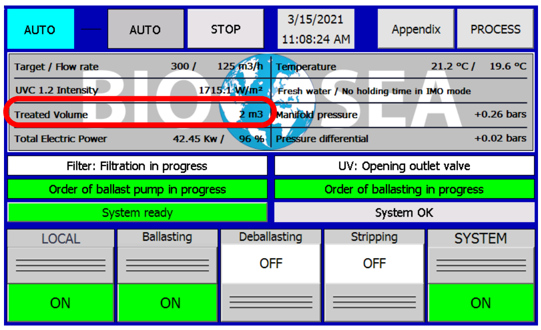
23.3. Checking Flow meter

- As flow rate cannot be directly measured by another device, crew operator can compare treated volume recorded by the BWTS (displayed on the screen) with difference of volume in tank (as observed on the vessel) before and after a deballasting operation.

- To avoid possible error because of a defective level probe, it is recommended to perform tank level measure with "manual sounding".
- Deballasting operation should be used preferably to avoid additional rinsing procedure at the end of the operation.

- Proceed as follow:
  - Measure tank level.
  - Perform a sea to sea circulation and launch a deballasting operation.
  - After 20 minutes of deballasting, stop the operation and read the treated volume on Home screen (see here below).

Figure 79: Home screen



  - Measure tank level when the operation is over.
  - Calculate discharged volume.
  - Compare the calculated volume obtained with the measured levels with the "Treated volume" value read on the screen for the last operation.
  - The Results should be recorded in the sensors verification templates.
  - If the flow differs more than +/-5%, repeat the test 2 more times to check if the deviation is consistent.
  - If the 3 measures differ more than +/-5% from flowmeter reading, contact your **BIO-UV Group** representative in order to organize a full check of flowmeter.

These tests can be adapted according to ship conditions and to what is possible on board: ballasting instead deballasting, more or less 20 minutes, etc...

When flowmeter is not measuring accurately the flow passing in the BWTS, water may not be treated in accordance with the Type Approval Certificate.

- If flowmeter reads 5% more flowrate than real value, there is no impact on the treatment as regulation will actually give more than needed UV dose. Consequently, crew can use the BWTS while waiting for **BIO-UV Group** technician.
- If flowmeter is reading 5% less flowrate than real value, there is an impact on the treatment and we cannot warranty that regulation will give the correct UV dose from TAC. Consequently, crew can use the BWTS but should consider further management of the water (as for downgraded mode) while waiting for **BIO-UV Group** technician. In this case, the ballast water management plan of the ship should help to manage the possible non-compliant ballast water.

- The replacement of the flowmeter depends on the diagnostic performed by **BIO-UV Group** technician (transmitter defect, flow sensor defect).

23.4. Checking pressure sensors

The checking should be performed with the reference manometer (calibrated with a valid certificate).

The pressure should not differ for more than +/-0,08 bar (on rising or lowering). Otherwise, the pressure sensor has to be replaced by a new one kept in stock on the ship.

The Results should be recorded in the sensors verification templates.

23.5. Checking conductivity sensor

Temperature TT02 coming from the conductivity sensor must be checked too, see23.2. Checking temperature sensor, page 152.

The checking should be performed with control solutions at different conductivity levels. As indicated on Table 24:, page 141, two different calibration solutions can be ordered: a high salinity solution (ref: PDP014387) and a brackish solution (ref: PDP014388). An additional check can be done with fresh water which should return about 0 µS/cm. For each liquid:

- For each liquid plunge the head of the conductivity sensor into the liquid in to have the hole under the surface.
- Once measure on the screen is stabilized, note the conductivity and temperature measures.

Remove the conductivity sensor from the liquid, then clean and dry the head of the conductivity sensor.

The measurement should not differ for more than +/-10% from the conductivity indicated in the table on the solution bag according to the solution temperature. Otherwise, the conductivity sensor has to be replaced by a new one kept in stock on the ship.

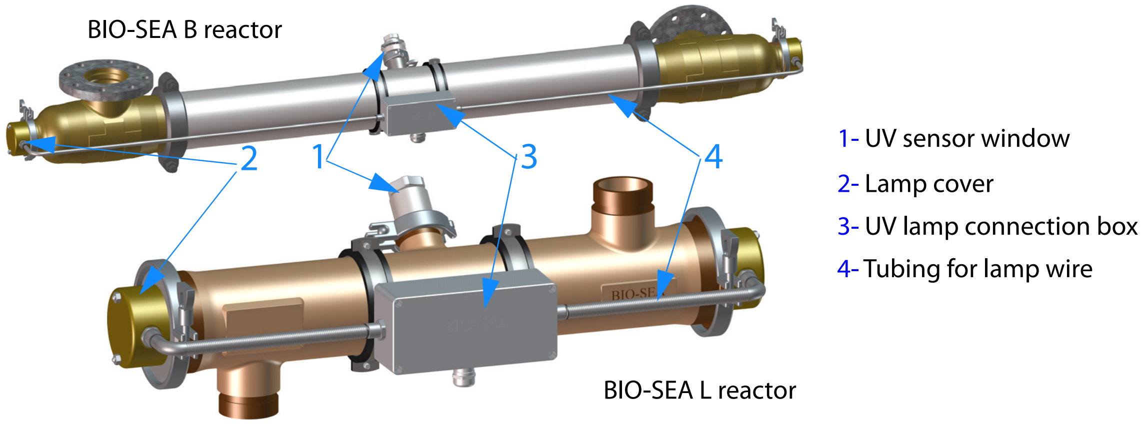
The Results should be recorded in the sensors verification templates.

24. UV lamp & quartz

Disposable used accessories and consumables must be collected by specialized structures for elimination and recycling of this kind of material according to the local legislation.

In particular, worn UV lamps should be placed in specific container for UV lamp disposal in order to be collected by approved agency or sent directly to **BIO-UV Group**.

*Figure 80: Complete view of **BIO-SEA**® UV reactor*



For quartz dismounting, it is recommended to have two people available, wearing gloves.

Specific tools are needed for quartz dismounting (for **BIO-SEA**® **B** models: OUT009228 and OUT009227, for **BIO-SEA**® **L** models: OUT014366).

See Table 22: Standard tool kit (OUT015810) supplied with the BIO-SEA® L models, page 140 or Table 22: Standard tool kit (OUT015810) supplied with the BIO-SEA® L models, page 140.

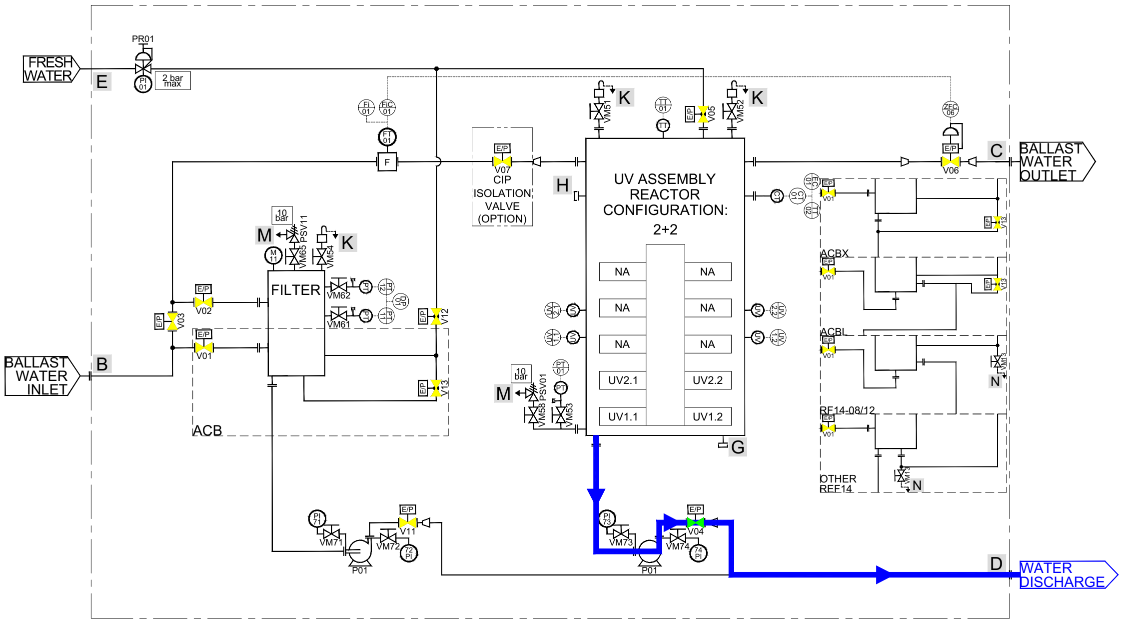
Lamp replacement warning appears when lamp has reached 3000 operating hours. Answer "Yes" to the warning message and replace the lamp. When replacement is done, select the corresponding lamp, press "Maintenance done?" button and confirm with yes.

24.1. Dismounting the UV lamp

24.1.1. Before dismounting

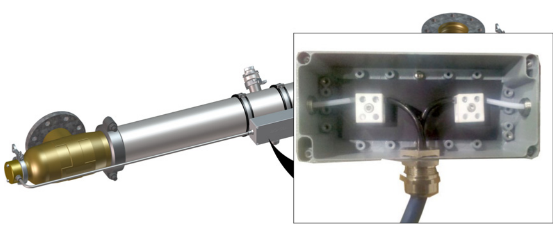
- Drain the UV system in MAINTENANCE mode. For that:
  - Select MAINTENANCE mode.
  - To access MAINTENANCE mode, LOCAL control must be first switched on. Do not forget, when finishing Manual operation to switch back to either STOP or AUTO mode, and switch off LOCAL control.
  - Open valve V04 to empty the UV reactors. Automatic inlet air valve allows air entrance to avoid vacuum.
  - Launch the suction pump P01 or P02 if a second pump is installed.
  - When the UV assembly is empty, stop the pump and close the valve V04.

Figure 81: Uv assembly draining

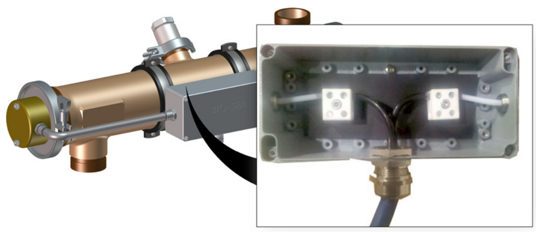


- De-energized the corresponding cabinet by switching off its general breaker.
- Disconnect the wires of the UV lamp inside the connection box.

Figure 82: Lamp Connection box



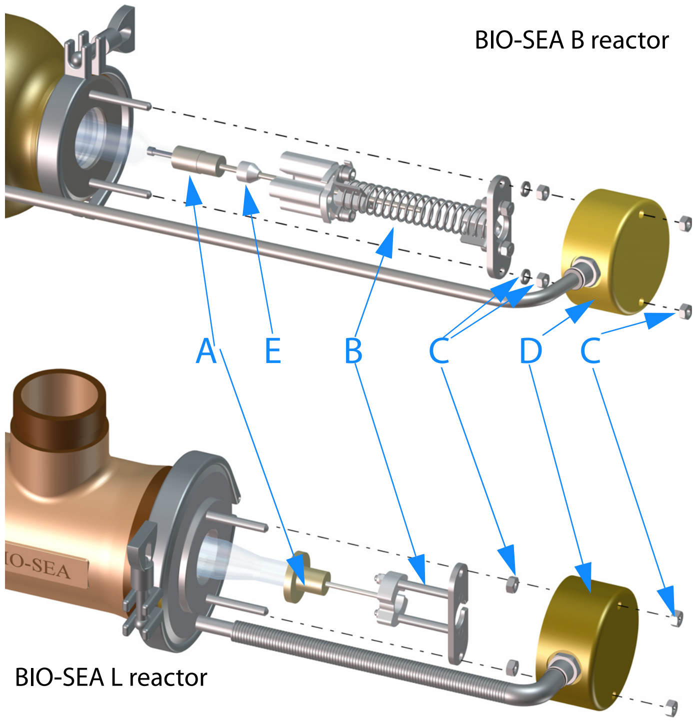
BIO-SEA® B reactor



BIO-SEA® L reactor

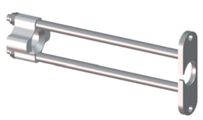
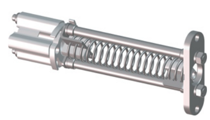
24.1.2. Dismounting procedure

Figure 83: Overview of the lamp assembly



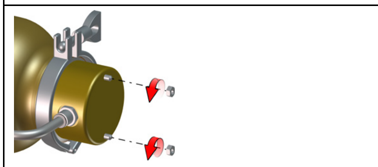
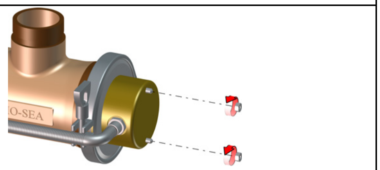
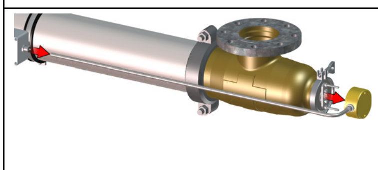
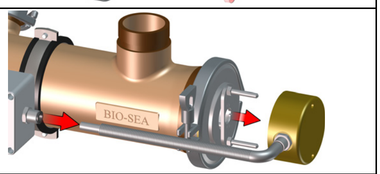
A- UV Lamp
B- Lamp Holder
C- M6 Nuts (with washers for BIO-SEA B reactors)
D- Lamp cover
E- Lamp guide

For **BIO-SEA® B** reactors, the lamp holder (B) can differ according the date of manufacturing. Both versions are approved to be mounted at the same place, however the same version must be present on both sides of each lamp of the reactor.

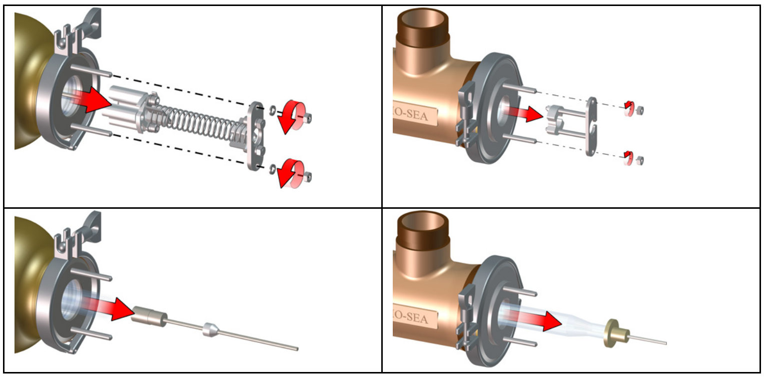
Version 1 (ASM007186) until 2023	Version 2 (ASM605225) from 2023
	

This procedure can be done symmetrically by beginning by the other side of the reactor.

Figure 84: Removing Lamp

BIO-SEA® B reactor	**BIO-SEA®** L reactor
	
	

- Remove the two M6 nuts on each side of the reactor.
- On each side of the reactor, remove the covers with the tubing for lamp wire.



- Remove the two nuts, as well as the washers for the BIO-SEA B reactors, from the lamp holder on each side.
- Remove the lamp holders on each side.

- Remove the lamp.

Always use gloves or a clean cloth when handling the lamp, in order to avoid fingerprints.

- Check the lamp and wipe it with a clean cloth and acid solution or white vinegar or replace if the lifetime is over.

If lamp is changed, the corresponding lamp counter should be reset (in Appendix Menu > Parameters > UV settings > UVx.y). See Figure 99: UVx.y screen, page 173.

In case of breakage of a UV lamp during maintenance operations, avoid all contacts with skin and eyes. Do not inhale vapors.

Mercury can be rendered harmless by binding it with sulphur powder.

Mercury CAS number is 7439-97-6 (see MSDS in 4.3. Identified risks for UV Reactors, page 21).

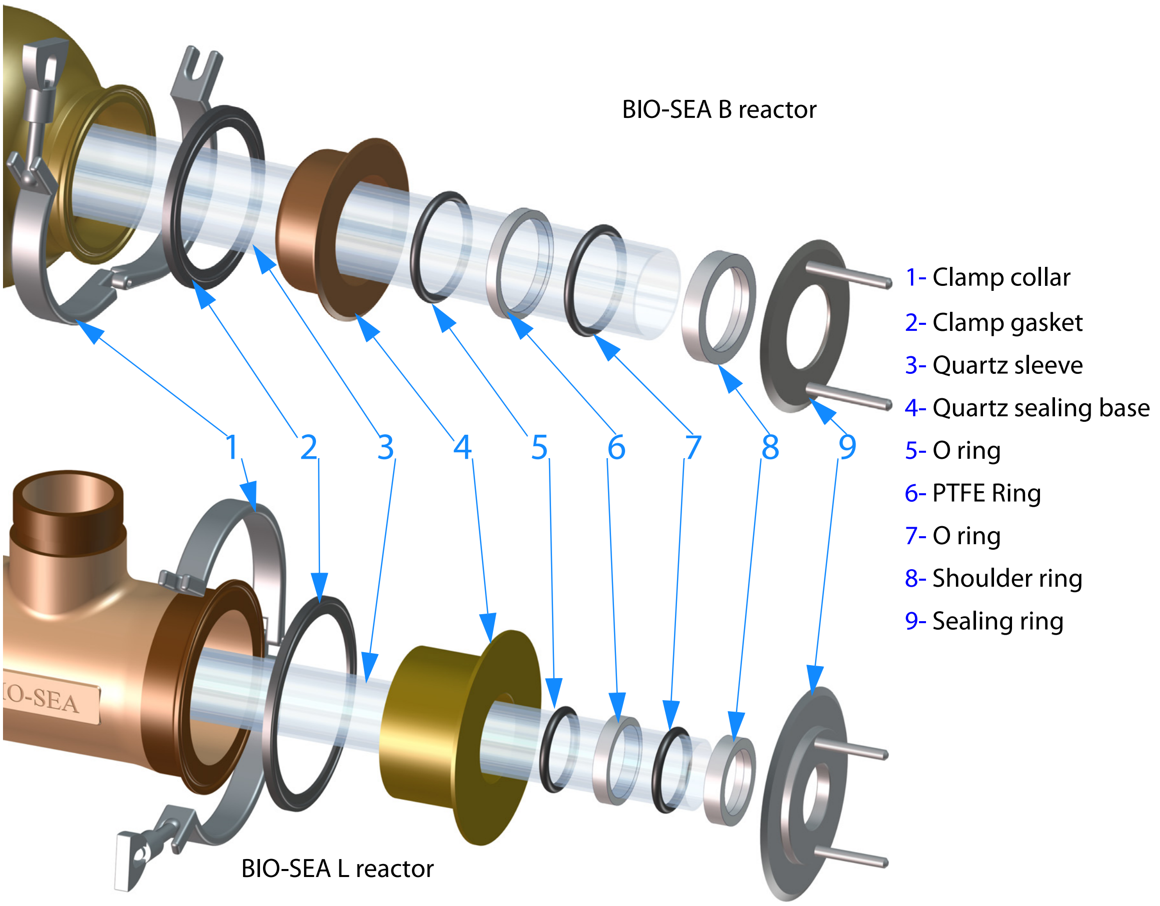
- If the quartz doesn't need to be checked, reassemble the lamp protection and connections: see 24.4. UV Lamp Mounting, page 172.

- If quartz sleeve need to be checked, cleaned or changed, see below: 24.2. Dismounting the Quartz Sleeve, page 160.

24.2. Dismounting the Quartz Sleeve

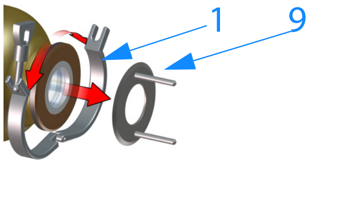
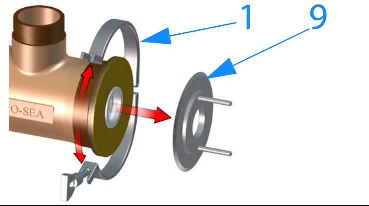
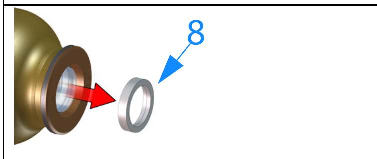
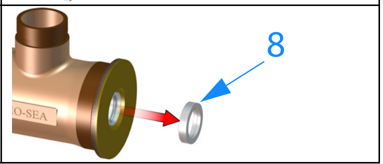
Before starting the dismounting procedure, it is strongly recommended to have another quartz sleeve for spare in the event of a breakage.

Figure 85: Quartz sleeve assembly overview



This procedure can be done symmetrically by beginning by the other side of the reactor.

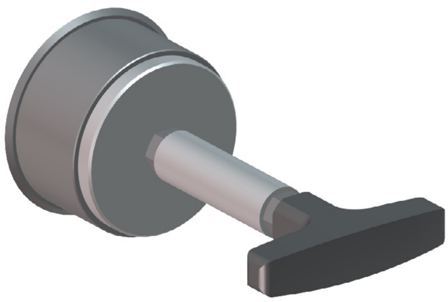
Figure 86: Removing clamp collar and shoulder rings on each side of the reactor

BIO-SEA® B reactor	**BIO-SEA**® L reactor
	
	

- Remove the clamp collar (1) and the sealing ring (9).
- Remove the shoulder ring (8).

Figure 87: Specific tools for quartz sleeve removal

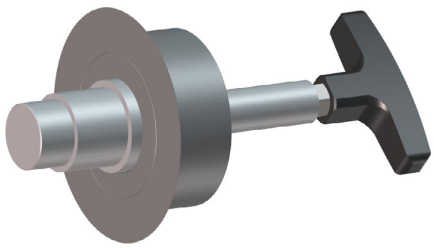
Specific tools for **BIO-SEA**® B reactor



Quartz sleeve pusher (OUT009228)

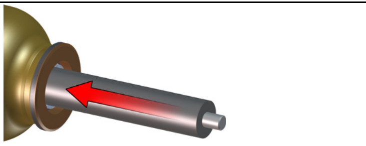
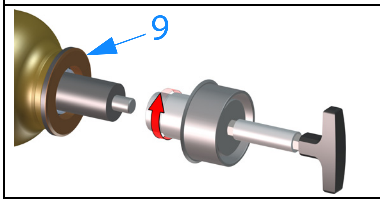
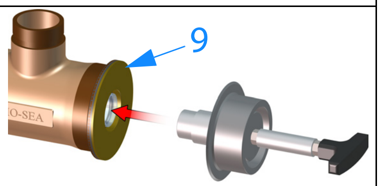
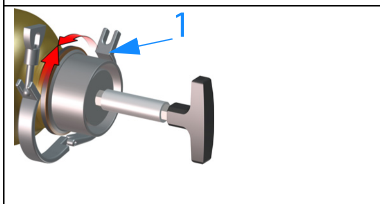
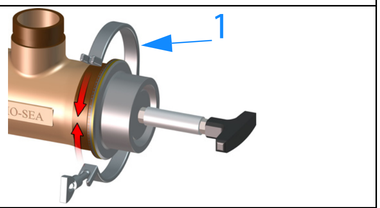
Quartz sleeve guiding tool (OUT009227)

Specific tool for **BIO-SEA**® L reactor

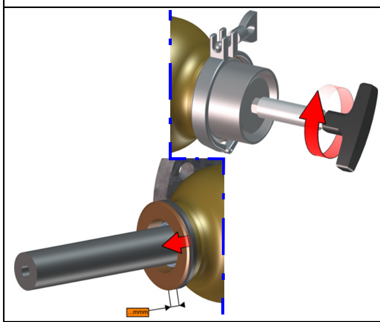
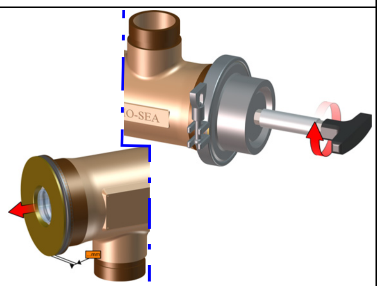


Quartz dismounting tool (OUT014366)

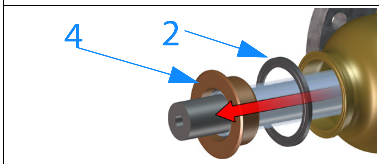
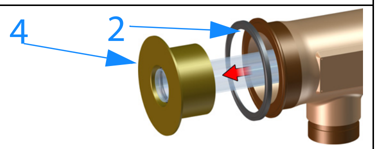
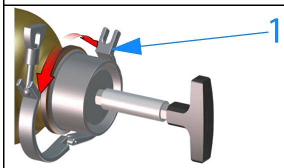
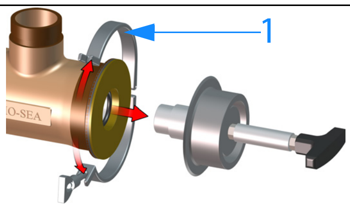
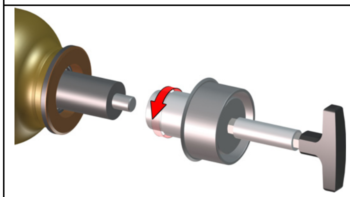
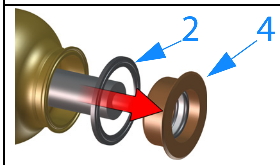
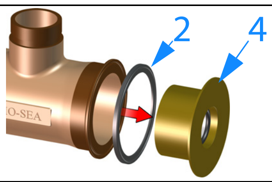
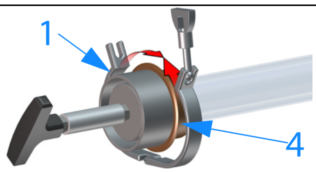
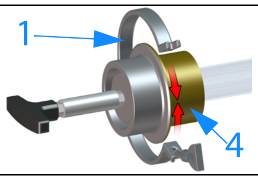
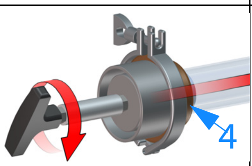
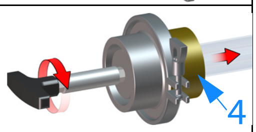
Figure 88: Using the quartz dismounting tools

BIO-SEA® B reactor	**BIO-SEA®** L reactor	
	N/A	• Insert the guiding tool inside the quartz sleeve.
	N/A	• Screw the pusher on the guiding tool. • Place the quartz sleeve pusher on the quartz sealing base (9).
N/A		• Introduce the quartz dismounting tool into the reactor quartz sleeve until the tool is in contact with the quartz sealing base (9).
		• Place the clamp collar (1) to lock the tool.

Be careful not to push the quartz housing base further, because it may drop the quartz extremity into the reactor, and break it.

BIO-SEA® B reactor	**BIO-SEA®** L reactor	
		• Gently turn clockwise the tool handle to push the quartz further in the housing, in order to unstick it from its sealing base (4) on the other side of the reactor from few millimeters.

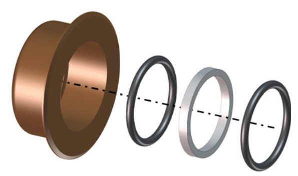
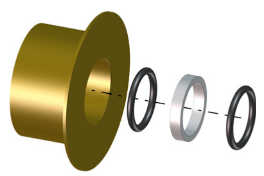
Always use clean gloves or a clean cloth when handling the quartz sleeve, in order to avoid fingerprints.

<table>
<tr><th>BIO-SEA® B reactor</th><th>BIO-SEA® L reactor</th><th></th></tr>
<tr><td>
</td><td>
</td><td>• Carefully pull with hands the quartz sealing base (4) on the other side in order to get the quartz out of the reactor (for BIO-SEA® B reactor, the guiding tool stays inside the reactor).This operation should be done very gently and carefully not to break the quartz against the reactor wall.
• Remove the clamp seal (2).</td></tr>
<tr><td>
</td><td>
</td><td>• Remove the tool and the clamp collar (1).</td></tr>
<tr><td></td><td>N/A</td><td>• Unscrew the dismounting tool from the guiding rod.</td></tr>
<tr><td>
</td><td>
</td><td>• Remove the quartz sealing base (4) and the clamp seal (2).</td></tr>
<tr><td colspan="3">• If the quartz sleeve remains stick on the quartz sealing base, use the dismounting tool to push the quartz out of the sealing base.</td></tr>
<tr><td>
</td><td>
</td><td>• Mount the clamp collar (1) on the quartz sealing base.</td></tr>
<tr><td>
</td><td>
</td><td>• Turn clockwise the tool handle in order to unstick the quartz from the sealing base (4).
• Once the quartz is removed, dismount the tool and the clamp collar.</td></tr>
</table>

- When the quartz sleeve is removed, check its general aspect (deposits, fouling).

- Clean the quartz sleeve with white vinegar or an acid solution to eliminate deposit which could affect UV transmittance.
- If cleaning is not possible, replace the quartz with a new one.
- Check the general aspect inside the reactor (deposits, fouling).

Figure 89: Dismounting o-rings and PTFE rings from the quartz sealing bases

BIO-SEA® B reactor	**BIO-SEA**® L reactor
	

- On each sealing base, remove O'rings and PTFE ring.
- Check the state of quartz rings on both sides (sealing bases, O-rings, clamp sealings, and PTFE rings). If they are damaged, change them.

- Check the lamp holders and their screwing.

24.3. Reassembling the quartz sleeve and seals

The quartz sleeve and the lamp have been checked and cleaned, or replaced if needed..

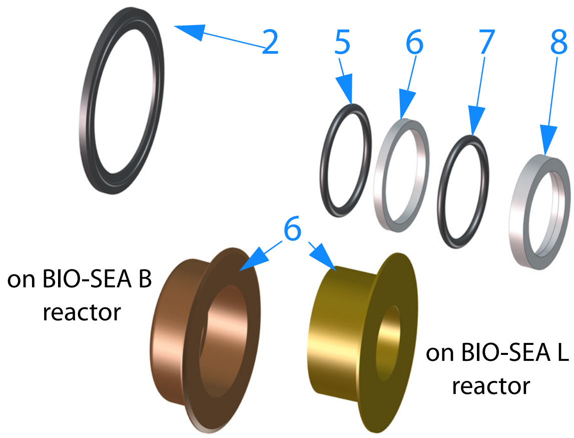
The O-rings and the clamp gasket must be replaced each time the quartz sleeve maintenance is performed. The sealing pack (SET008688 for **BIO-SEA**® B or SET001163 for **BIO-SEA**® L) has to be used.

Do not forget to apply suitable grease on seals before mounting.

24.3.1. Quartz Sleeve Sealing Pack

It is useful to prepare the quartz sealing base with seals and rings (without the shoulder ring) as it would be ready to be mounted.

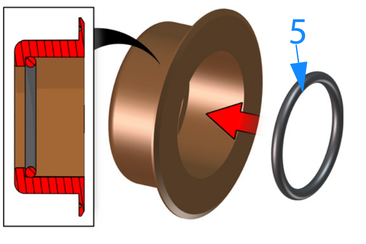
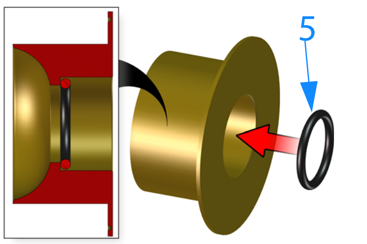
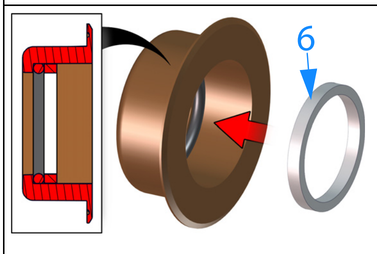
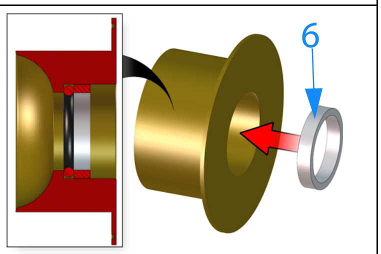
Figure 90: Sealing pack detail with quartz sealing base



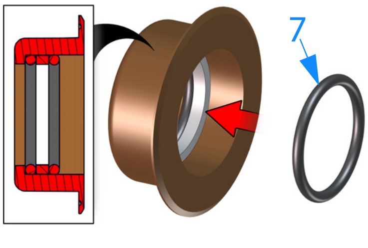
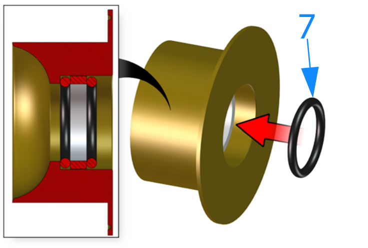
Sealing Pack:
- 2: Clamp sealing ring
- 5: O ring
- 6: PTFE Ring
- 7: O ring
- 8: Shoulder ring

4: Quartz sealing base (not included in the sealing pack)

Figure 91: Placing the sealing rings

BIO-SEA® B reactor	**BIO-SEA**® L reactor
	
	

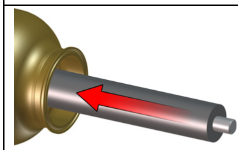
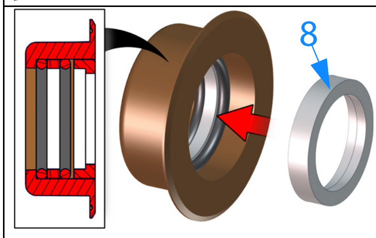
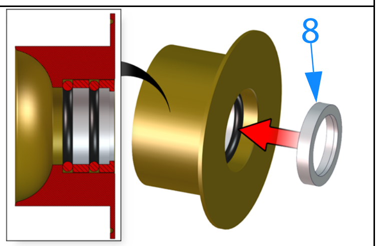
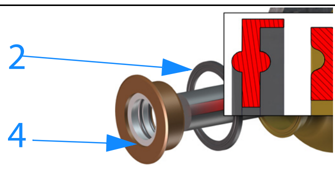
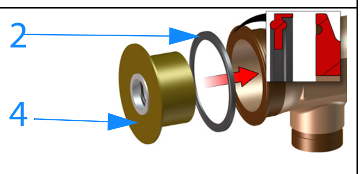
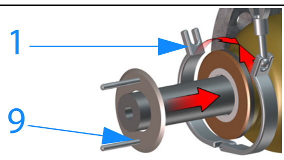
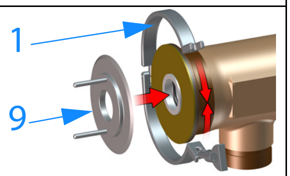
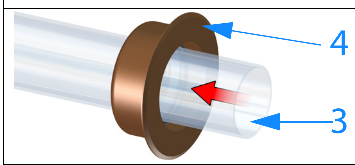
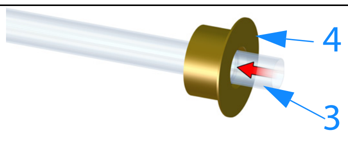
- Place the O-ring (5) inside the quartz sealing base.
- Then Place the PTFE ring (6).

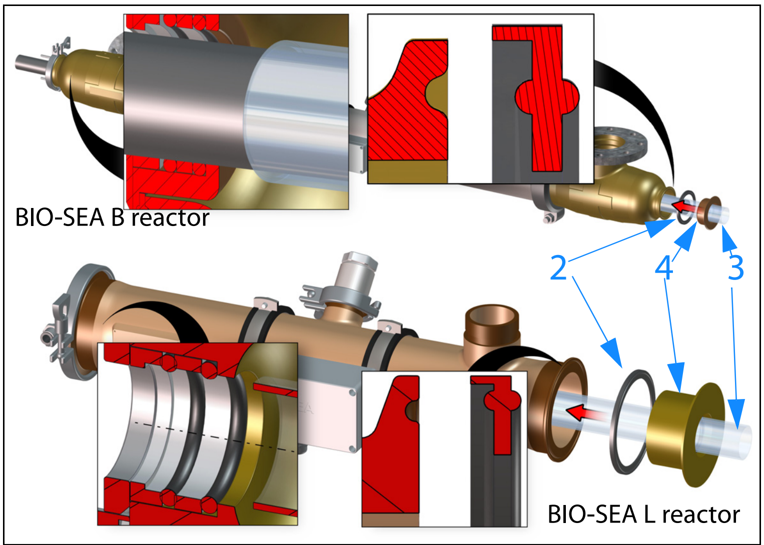
- Place the other O-ring (7) inside the quartz sealing base.
- Do not place the shoulder ring yet, the quartz sleeve must be placed before (see 24.3.2. Quartz Sleeve Mounting, page 166).

24.3.2. Quartz Sleeve Mounting

Figure 92: Inserting quartz guide and quartz sleeve

BIO-SEA® B reactor	**BIO-SEA®** L reactor
	N/A
	
	
	
	

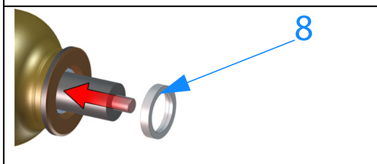
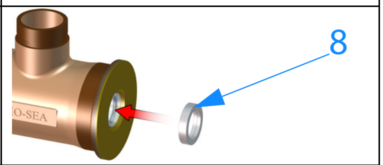
- Insert the guiding tool into the reactor in order to have each end of the tool out of the reactor.
- Insert the shoulder ring (8) into the quartz sealing base with shoulder on outer side.
- Place the clamp gaskets (2), paying attention to the good position of the shape.
- Insert the quartz sealing base (4) into the reactor.
- Screw the pusher on the guiding tool.
- Place the quartz sleeve pusher on the quartz sealing base.
- Place the clamp collar and screw it moderately in order to hold the end of the quartz sleeve and prevent it from falling into the reactor.
- Insert the quartz sleeve (3) into the quartz sealing base (4) equipped with o-rings and PTFE ring but without shoulder ring (8).



- On the other side of the reactor, place the clamp gaskets (2), taking care to position the seal correctly as shown in the image to the left.
- Insert the quartz sleeve (3) into the reactor with the quartz sealing base (4). The quartz sleeve should remain well aligned with the reactor.For the **BIO-SEA® B** reactor, the guiding rod will help to that.
- Push the quartz sleeve until it stops against the shoulder ring of the opposite side.

When placing the quartz sleeve in the housing, pay attention to the overhang in the reactor.

Figure 93: Mounting the clamp gasket

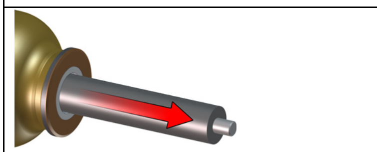
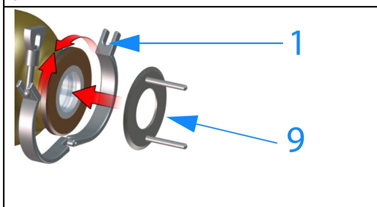
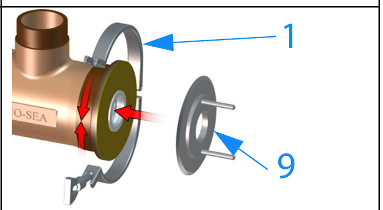
BIO-SEA® B reactor	**BIO-SEA®** L reactor
	

- Insert the shoulder ring (8) into the quartz sealing base with shoulder on outer side.

Fro **BIO-SEA®** B reactor, keep the guiding tool in the quartz during handling to avoid quartz sleeve falling and breaking during this operation.

Proceed with care as quartz is very fragile.

Figure 94: Finalizing quartz mounting

BIO-SEA® B reactor	**BIO-SEA®** L reactor
	N/A
	

- Remove the guiding tool maintening the shoulder ring in place.
- Place the sealing ring (9).
- Screw the clamp collar (1) to be watertight.

- If it has been dismounted, mount the reactor on the manifold.

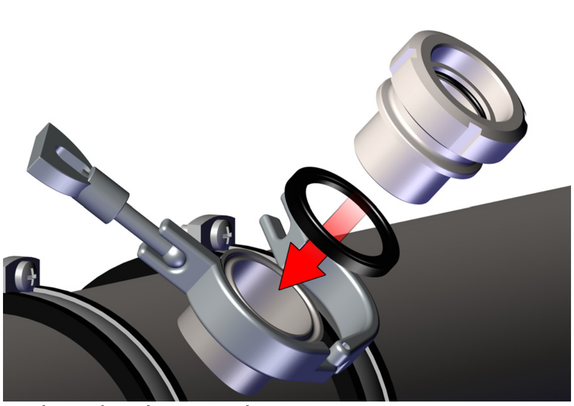
24.3.3. Adjustment of UV windows position (only for BIO-SEA® B models)

After dismounting the quartz sleeve or replacing the UV window, the measuring window position should be readjusted. For that, additional parts will be required:

- Measuring window gauge: ref USI600806
- Pin key D40: ref PIEA600559
- Pin key D58: ref PIEA600558
- Caliper with depth gauge

In addition to these parts, we recommend to use cleaning wipes DIV002791 to clean the lens.

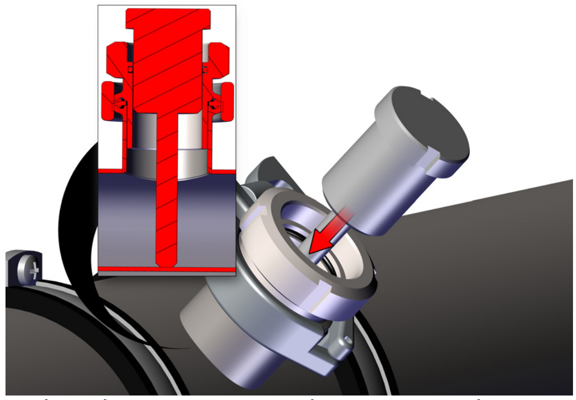
If only UV window has been dismounted for cleaning or lens checking, it is enough to follow step 7 to 14. Before carrying this procedure, the UV window must have been dismounted first. For that, follow the procedure to the reverse from the end to the beginning without the measuring tool and gauge.



1- Place the clamp seal.

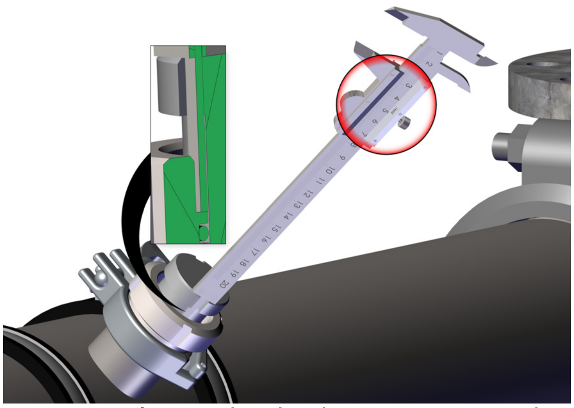
2- Install the measuring window.

3- Place the clamp and tighten it.

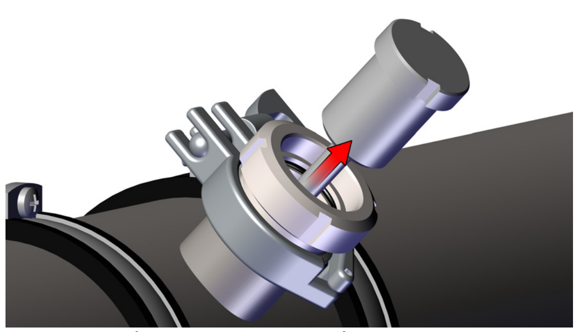


4- Place the measuring window gauge until its extremity is in contact with the quartz sleeve

Take care to insert carefully the gauge in order touch gently the quartz surface as the quartz sleeve is fragile and could be broken.

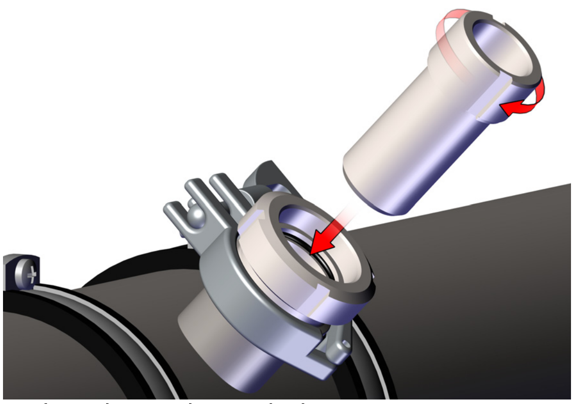


5- Using a caliper with a depth gauge, measure the position of the measuring window gauge through one of its groove.
NB: this measure must be wrote down to be saved in the touch screen later.

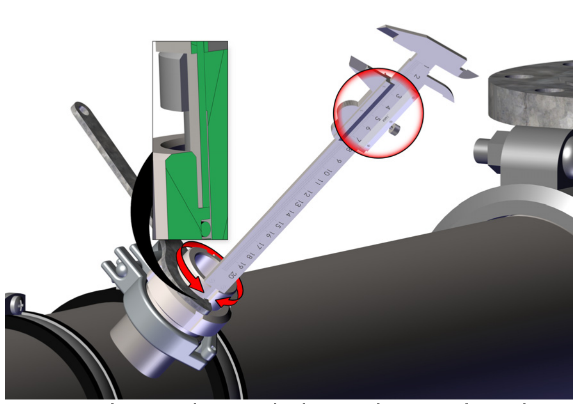


6- Remove the measuring window gauge.

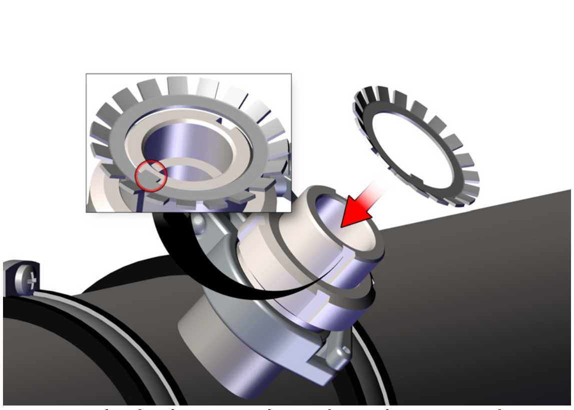
Before inserting the window, it is recommended to grease the seal and check its position in order to facilitate the introduction of the window.



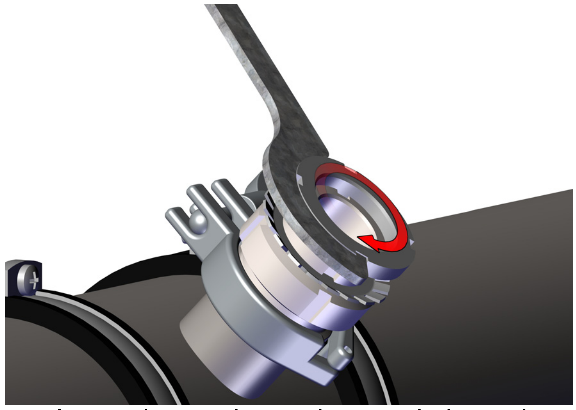
7- Clean the window with cleaning wipe DIV002791 or clean lint-free cloth with alcohol or a slightly acid solution then install the adjustable measuring window.



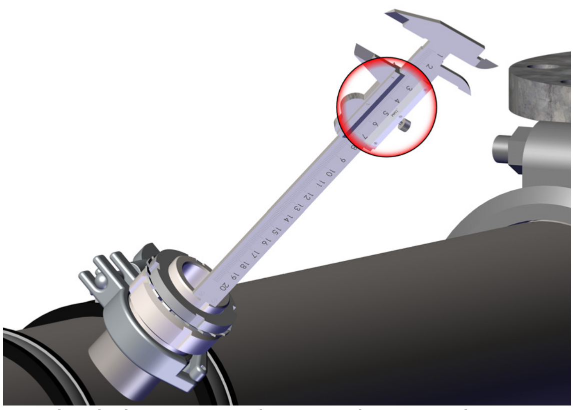
8- Screw the window with the pin key until reaching the same measure as step 5.



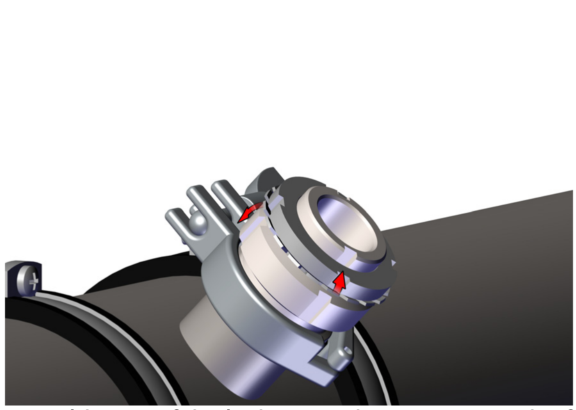
9- Insert the locking washer. Place the internal pin in one of the groove of the measuring window, then fold a pin of the locking washer down to a notch of the measuring window.



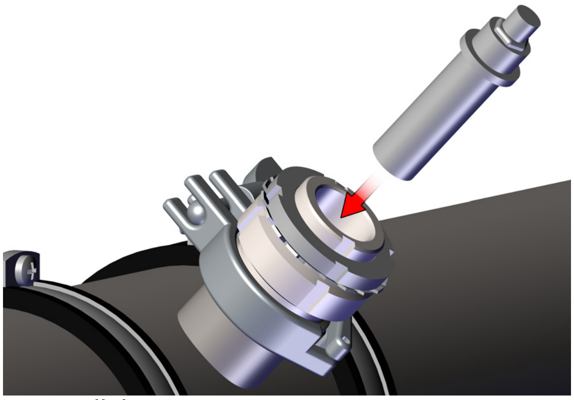
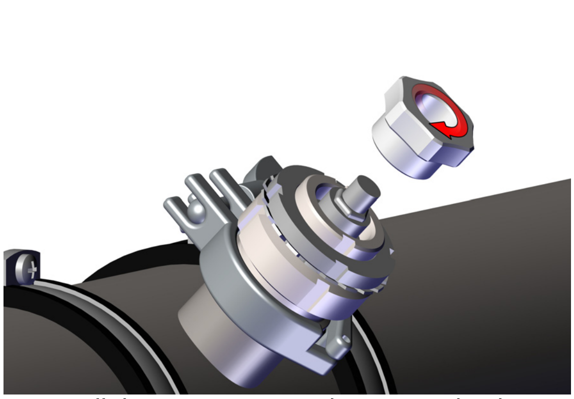
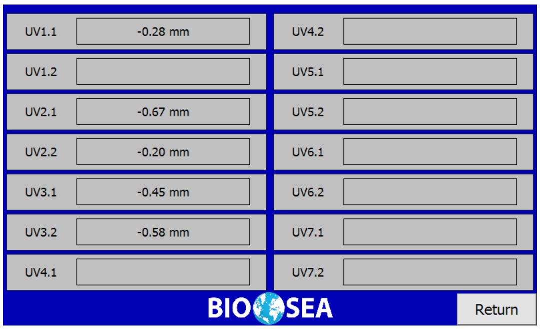
10- Place and screw the notch nut with the pin key D40 to the stop. If need, use pin key D40 to keep in place the window to maintain window adjustment: the distance between the window and the quartz must not change.



11- Check the measure has not change. Take care to use the groove free from the internal pin of the locking washer.



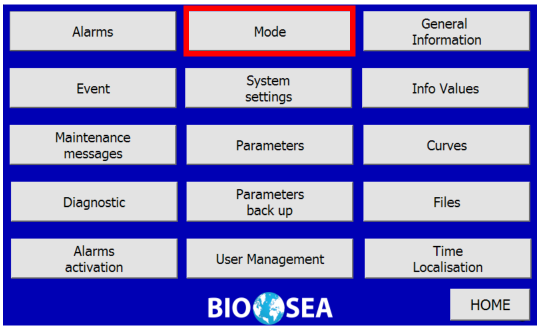
12- Fold a pin of the locking washer up to a notch of the notch nut.

 13- Install the UV sensor.	 14- Install the measuring window nut and tight it with hand.
 15- For each reactor record the new measured value obtained in step 5 in "UV window screen. This screen can be reached by following the path: Home screen > Appendix > Maintenance messages > Planned maintenance > UV window.	

24.3.4. Checking watertightness

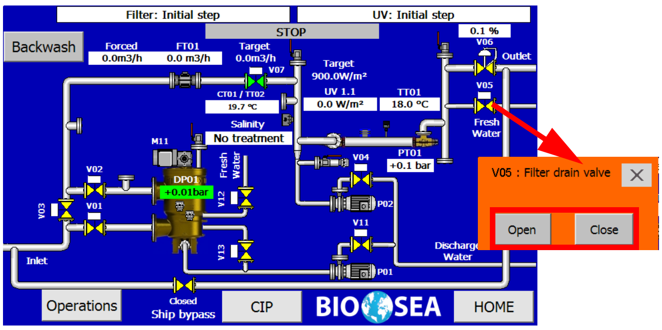
- Power on the system.
- To access MAINTENANCE mode, LOCAL control must be first switched on. Do not forget, when finishing Manual operation to switch back to either STOP or AUTO mode, and switch off LOCAL control.

Figure 95: Appendix menu



- On **Appendix**, press on **Mode**, then press **MAINTENANCE** (Maintenance level is required).

Figure 96: Process screen



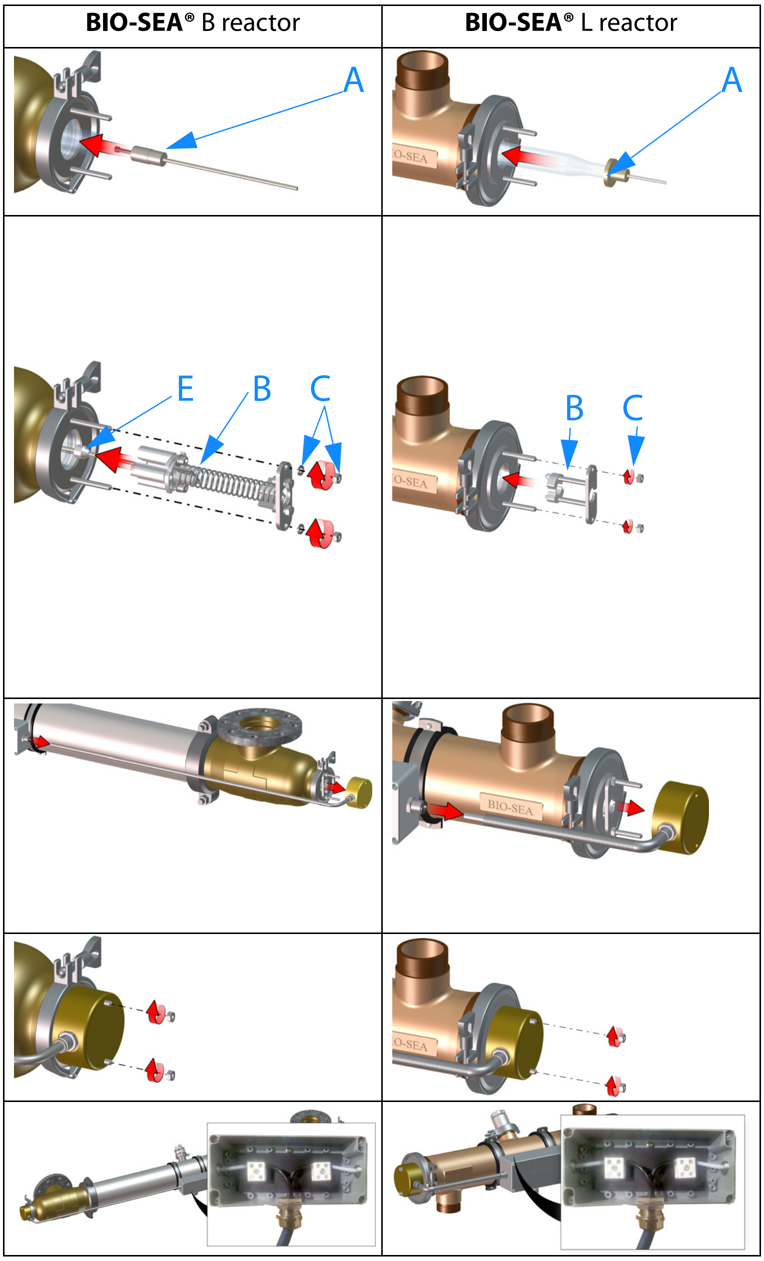
- Back in **Process** screen.
- Press on V05 and open the valve (fresh water) to fill the reactor.
- Close V05 valve when the system is completely filled, air totally drained.

- Check there is no leak on the reactor.

24.4. UV Lamp Mounting

Always use clean gloves or a clean cloth when handling the lamp.
Proceed with care as the lamp is very fragile.

Figure 97: Mounting the lamp holder and the protection



- Slip the new or clean lamp (A) inside the quartz sleeve.

- For each side of the reactor:

1- Insert the lamp wire into the PTFE housing of the lamp holder (B). For the **BIO-SEA**® B reactor, **do not forget to insert the lamp guide (E) on the lamp wire**.

2- Insert the lamp holder (B) into the reactor in order to get the lamp guide (E) and the lamp end (A) in the lamp holder (B).

3- Screw the M6 nuts (C), with their washers for the BIO-SEA B reactors, according to the lamp length.

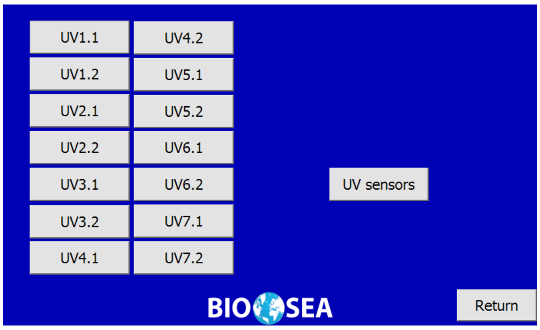
- On each side of the reactor, insert the lamp wire through the fitting of the covers and the protection tube. In the same time, place the protective covers and connect the protection tube on the connection box.

- On each side of the reactor, fix the protective cover by screwing the two M6 nuts.

- Connect the UV lamp wires inside the connection box and close it.

24.5. Checking UV lamps

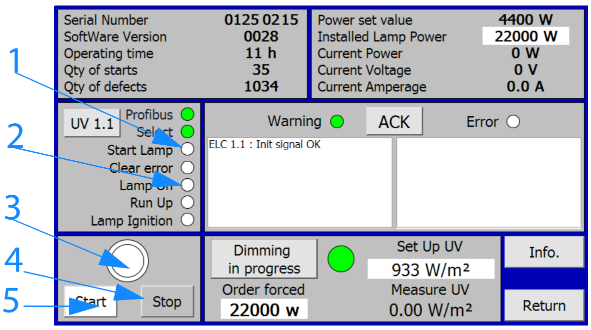
Figure 98: UV menu



- Access this screen by following the path: Home screen > Appendix > Parameters > UV settings
- UV menu is displayed.
- Select the UV reactor you would like to test.

- In the menu of Figure 99: UVx.y screen, page 173, press Start button (5) to start the lamp. When you see that the lamp works (2 and 3), turn it off (4) to prevent heat damage.

Figure 99: UVx.y screen



1- Start lamp indicator.

2- "Lamp on" indicator.

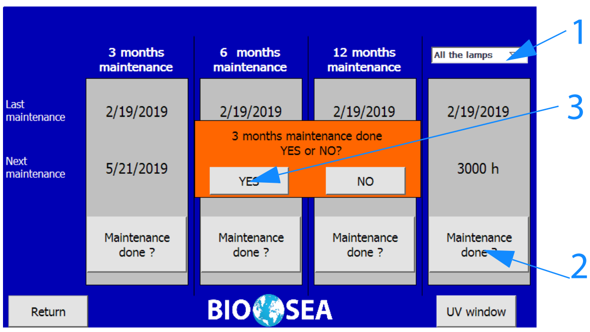
3- Lamp indicator: Green when running, red when in fault.

4- Stop button for manual and maintenance use.

5- Start button for manual and maintenance use.

- When a new lamp is installed, its counter has to be reseted. On the Maintenance screen (Accessible through the path Appendix screen > Maintenance Messages > Planned maintenance):
  - Select the replaced lamp (1).
  - Press on "Proceed to maintenance?" (2) (or "Maintenance done?").
  - Press "Yes" (3).

Figure 100: Maintenance screen



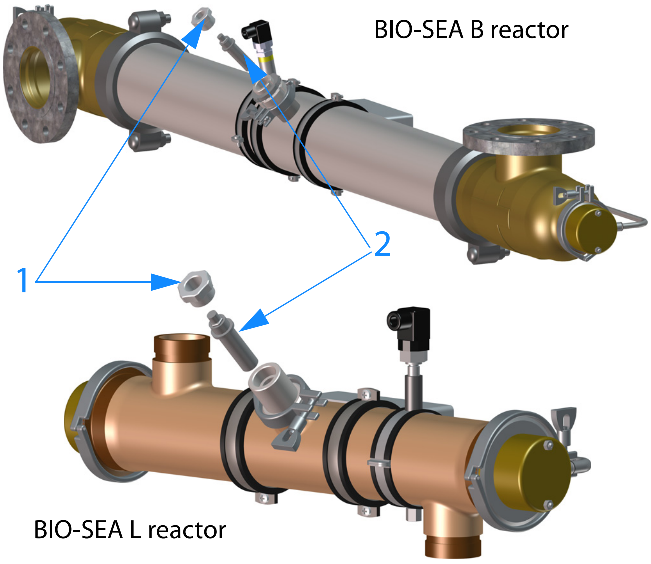
- Record in the maintenance log the operations that have been performed.

25. UV Sensor and Window

25.1. Checking cleanliness of UV sensor

- Check that the system is OFF.

Figure 101: UV sensor checking



- Unscrew the locking nut (1) and pull the UV sensor (2) from its window.

- Unplug the UV sensor by unscrewing the connector.

- Check general aspect of the UV sensor and its cleanliness. The end of the sensor and the inner window must be very clean to avoid a poor reading of the UV intensity.
- Clean the UV sensor lens and inner side of the window lens with clean lint-free cloth and alcohol or a slightly acid solution.

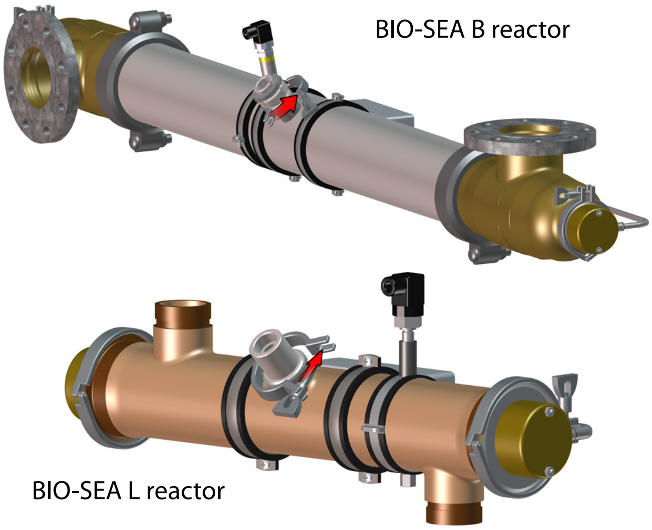
- When putting the UV sensor back in its window, it is very important to ensure that the UV sensor is at the bottom of the window and that there is no air remaining between the bottom of the window and the extremity of the UV sensor.
- Before mounting the UV sensor, it is also strongly recommended to check the o-ring of the sensor is still in place on the sensor.

- Then plug the connector to the sensor.

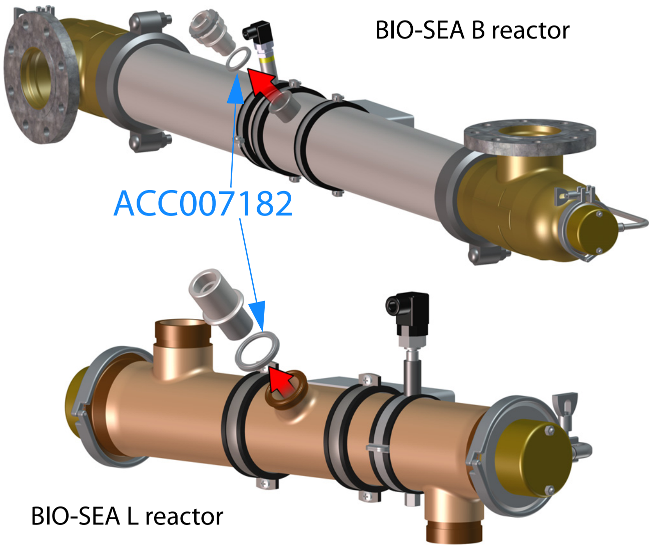
25.2. Checking cleanliness of UV window

- Drain the UV assembly by following the procedure in the paragraph 24.1. Dismounting the UV lamp, page 157.
- Check that the system is off.

Figure 102: Removing the sensor window



- Unscrew the clamp collar.



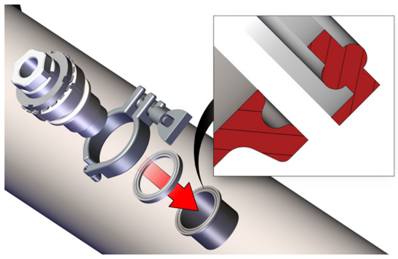
- Remove the window with its gasket.

- Check the window and its cleanliness.
- Clean the outer side of the window lens with clean cloth and alcohol.
- Check the state of the gasket (ACC007182), and change it if needed.

If the window cannot be totally cleaned, replace it to avoid poor UV reading.

- Put back the window, with the gasket in its housing.

Be careful to install the gasket in the proper position as shown on the picture on the right.



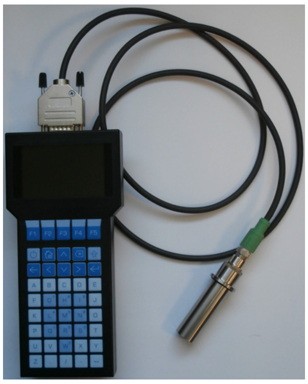
- Install the clamp collar.
- Screw the clamp collar to be watertight.
- Check the assembly as described in "Checking UV lamps", chapter Specifications, page 173.

25.3. Checking UV sensor

- It is recommended to use a referenced UV meter yearly to check the reading of the UV sensor.

- This device will be brought by the **BIO-UV Group** technician or its representative.
- Sensor verification has to be done by a **BIO-SEA**® representative.

Figure 103: UV Meter



- The UV sensor and UV meter values should be compared with the same environment and water.
- Results of measured values are to be recorded in the Sensors record table (see 52. Maintenance Records and checklists templates, page 327).
- Before reading UV value with the UV meter:
  - Check UV meter is well connected to the calibrated UV sensor.
  - Check UV meter is On. If not, use button .
  - Check the UV meter has enough battery. If not, it is possible to plug it on a 100-240V socket.
  - Check UV meter is in "Radiometer" mode.

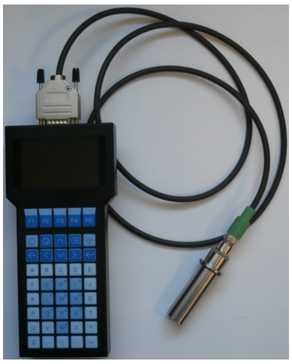
- UV measurement should be done at several lamp power on each UV sensor (Rising and Lowering).
- The maximal admissible difference between the values measured by the referenced sensor and the plant sensor is 20%. Otherwise, the UV sensor should be replaced.
- The Results should be recorded in the sensors verification templates.

The Addressing procedure must be done at each UV sensor replacement, see 25.4. Addressing a UV sensor, page 177. If not, the new UV sensor may not work.

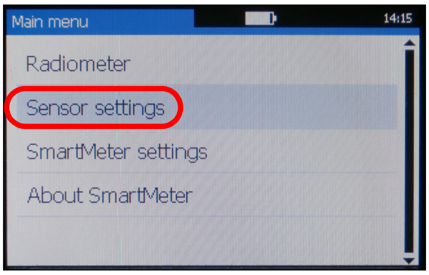
25.4. Addressing a UV sensor

- The Addressing procedure must be done at each UV sensor replacement with the digital UV meter (OUT011882). If not, the new UV sensor may not work.
- The Reference UV sensor (ELE008712) on the UV meter should be checked at least once a year.

Figure 104: Addressing procedure

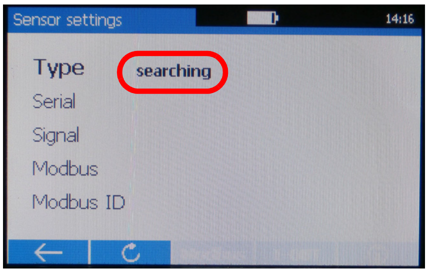


- Before addressing the UV sensor with the UV meter:
  - Check UV meter is well connected to the calibrated UV sensor.
  - Check UV meter is On. If not, use button .
  - Check the UV meter has enough battery. If not, it is possible to plug it on a 100-240V socket.
  - Check UV meter is in "Radiometer" mode.

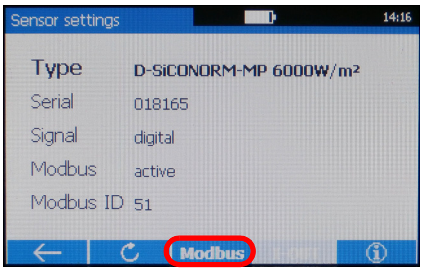


1- When the home screen is displayed, select "Sensor settings" with the key or then validate with key .

- Note: It is possible to return to this screen at any time by pressing on key .

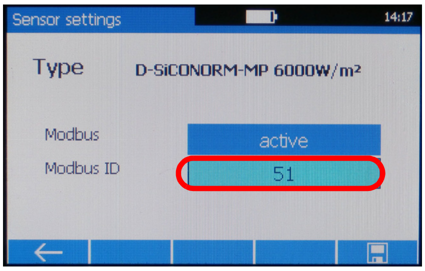


2- When accessing the Sensor settings screen, the Smart meter begins searching for a sensor.



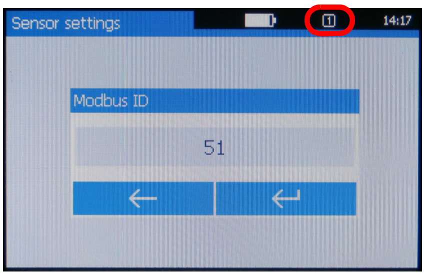
3- When UV sensor has been found, information about the sensor appears: Serial number, Signal type, Modbus activation and Modbus ID.

4- Press key to access Modbus configuration.



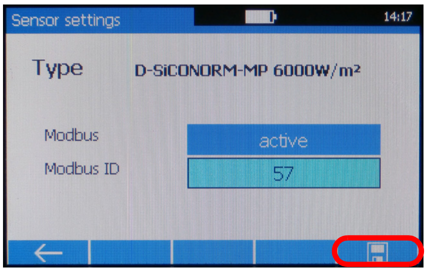
5- Select Modbus ID with the key or then validate with key .

- Note : Do not change the Modbus active to inactive. Modbus must always be set to active.

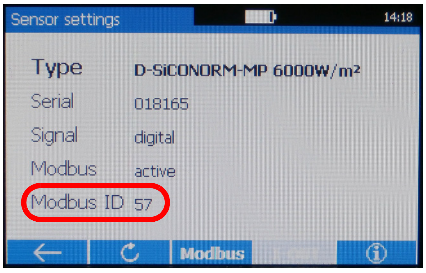


6- Check numeric pad is activated: symbol should be displayed on the top right of the screen. If not, press on key .

7- Enter the new address (for example 57) with numeric pad validate with key . If need use key to suppress a value or key to cancel.



8- The Modbus ID should now display "57". Validate the setting by pressing key .



9- The screen returns the Sensor settings screen, the Smart meter begins searching for sensor information update: Modbus "Active" and Modbus ID "57".

10- Press or to return to the home screen.

Reactor name	Modbus ID	Reactor name	Modbus ID
Reactor 1.1	51	Reactor 5.1	59
Reactor 1.2	52	Reactor 5.2	60
Reactor 2.1	53	Reactor 6.1	61
Reactor 2.2	54	Reactor 6.2	62
Reactor 3.1	55	Reactor 7.1	63
Reactor 3.2	56	Reactor 7.2	64
Reactor 4.1	57		
Reactor 4.2	58		

11- The sensor can now be disconnected and is ready to be used.

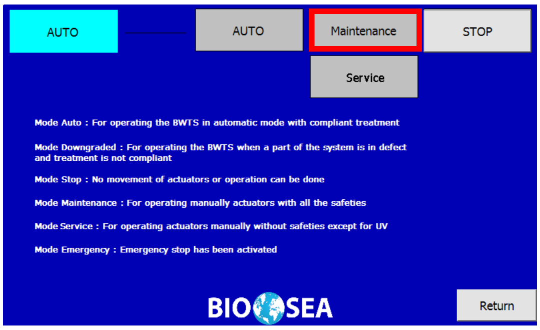
- Note : The UV sensor can only be placed on the reactor corresponding to its address.

26. UV reactor removal

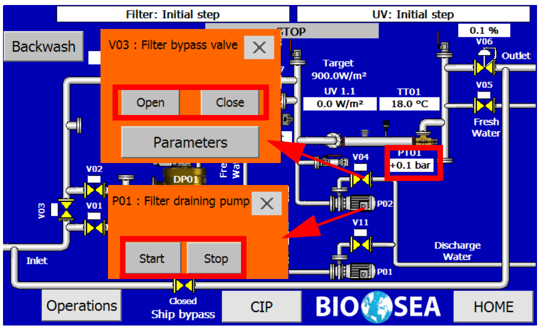
In case of malfunction, a UV reactor can be removed from the UV assembly and replaced by plugs in order to be able to perform automatic operations in downgraded mode.

Before starting the operation, make sure the power cabinet is powered off and secured.

26.1. Draining the UV reactor



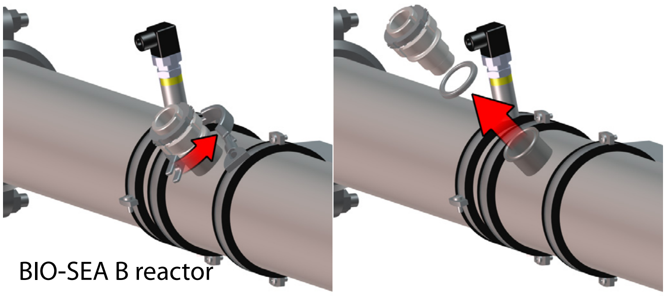
1- Check Maintenance mode is enabled.



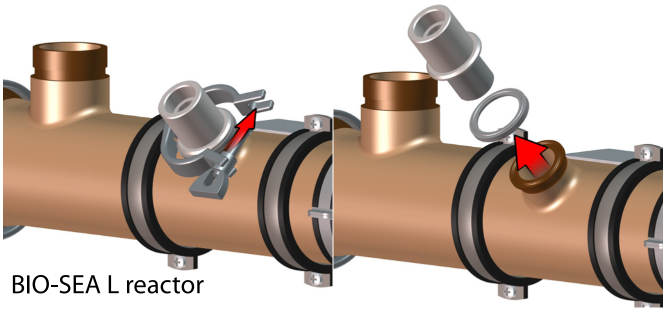
2- Open valve V04 then start pump P01 (or P02 if 2 pumps are installed) to drain the UV assembly.

3- Watch the PT01 pressure and stop the pump as soon as the value is below 0,03bar as the UV assembly will be almost empty, then close the valve V04.

4- Disconnect the UV sensor cable and connect it to the Y adapter of the next reactor. If the dismounted reactor is the last, do not disconnect the UV sensor of the reactor but remove the Y adapter of the previous reactor and directly connect the UV sensor cable of the previous reactor directly on the UV sensor.



BIO-SEA B reactor



BIO-SEA L reactor

5- Check the reactor is well drained by untightening the UV window clamp collar: proceed carefully as water may leak from the hole. In this case, tight the collar again and drain again the UV assembly.

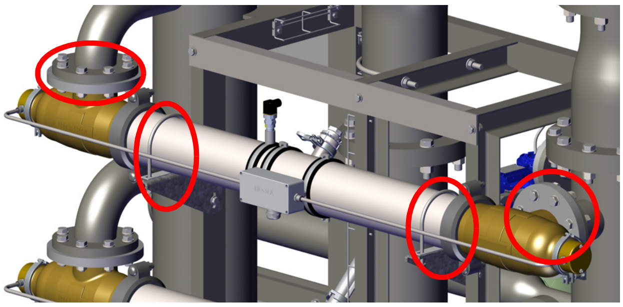
6- When there is no leak, remove the clamp collar and slide out the UV window taking care of the clamp seal.

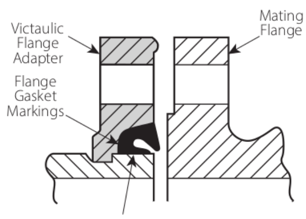
7- Check inside the reactor there is no water left, then reassemble the UV window at its place and tight the clamp collar.

26.2. Removing a UV reactor

Compact power cabinet

Standard power cabinet





Proper Flange Gasket Positioning

1- If **BIO-SEA**® B reactor is installed

a- Check the power cabinet is powered off and secured.

b- Switch off the breaker of the electronic ballast corresponding to the defective reactor (refer to the power cabinet electrical drawing).

c- Unwire the lamp cable WMLx.y corresponding to the defective reactor and remove it from the power cabinet. Roll up the cable and place it on the reactor.

d- Untight and remove the U bolts of the reactor.

e- Untight the inlet and outlet reactor flanges, then remove the Victaulic flange adapters.

f- Remove the UV reactor from the UV assembly.

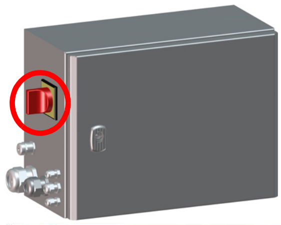
As the reactor weighs about 45 kg, two people are recommended to move the reactor.

---

g- Take the two Victaulic flange adapters with their gasket and the Victaulic plugs (ref: RAC009839) provided with the system tool kit (seeTable 23:, page 141). Place the plugs on the flange adapter: the plug side marked "side in" should face inside the UV assembly.

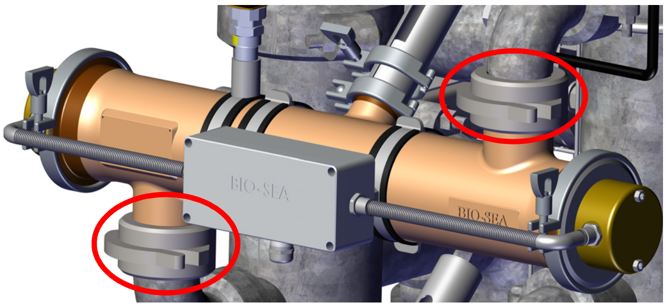
h- Put grease (marine grease or vaseline) on the Victaulic gasket and install it according to the drawing.

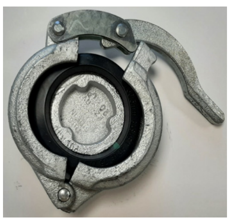
i- Install the Victaulic adapter flange assembly against the UV manifold flange and tight it.



Distribution cabinet

Electronic ballast





2- If **BIO-SEA**® L reactor is installed

a- Check the distribution cabinet is powered off and secured

b- Inside the distribution cabinet, switch off the breaker of the electronic ballast corresponding to the defective reactor (refer to the distribution cabinet electrical drawing).

c- Remove the cover of the Electronic ballast corresponding to the defective reactor, unwire the lamp cable WMLx.y and remove it from the ballast. Roll up the cable and place it on the reactor.

d- Untight Snap joint coupling on the reactor inlet and outlet by levering with a screwdriver for example and remove the coupling.

e- Remove the UV reactor from the UV assembly.

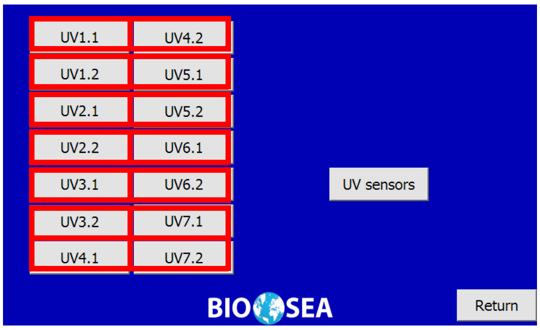
f- Take the two Victaulic snap joints with their gasket and the Victaulic plugs (ref: ACC015577) provided with the system tool kit (seeTable 22:, page 140).

g- Put grease (marine grease or vaseline) on the Victaulic gasket and install it on the plug.

h- Insert the plugs with the gasket on manifold pipes: the plug side marked "side in" should face inside.

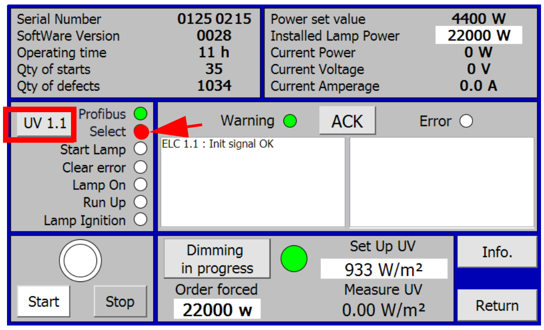
i- Mount the Victaulic snap joint on the gasket and tight. Check the snap joint engages the groove of the manifold pipe.

26.3. Disabling reactor on HMI

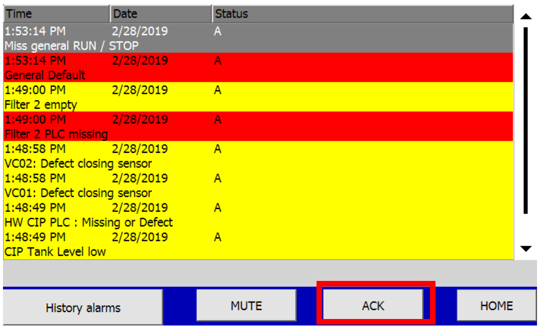


1- On the touch screen, go to UV parameters screen: Home> Appendix > Parameters > UV settings.

2- Press teh Ux.y button corresponding to the defective reactor to open the "UVx.y info" screen.



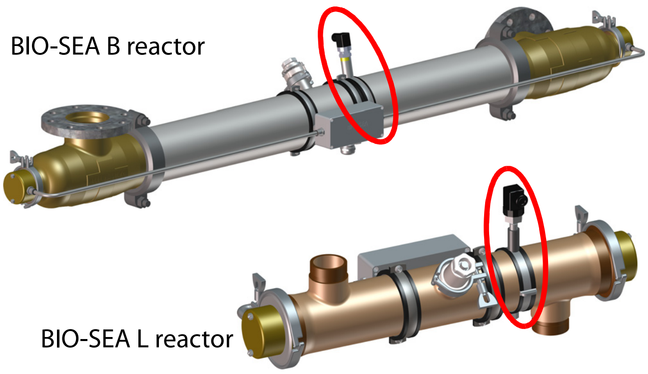
3- Press the button UVx.y in order to unselect it: the "Select" light will turn from green to red.



4- A tag will be made on the datalog to record the UVx.y deactivation (Parameter change: UVx.y selection). The system will automatically recalculate the flow target with the new system capacity.

5- Acknowledge the alarms present in the alarm screen.

BIO-SEA B reactor



BIO-SEA L reactor

6- Make sure the temperature sensor is located on the highest « active » reactor. If not, dismount the temperature sensor collar and mount it on the highest reactor.

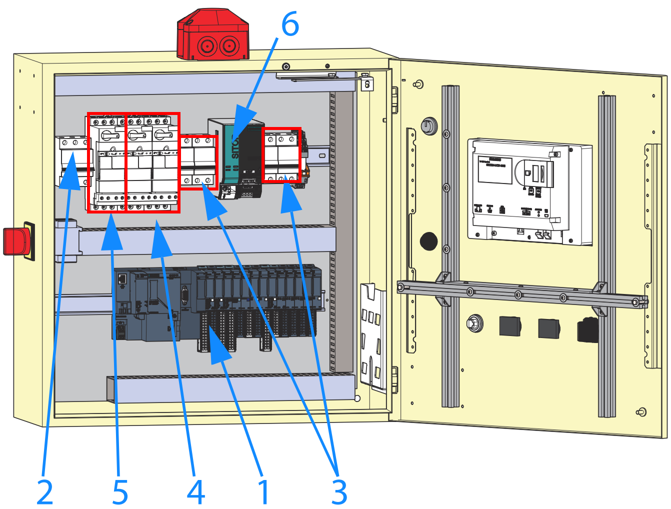
27. Control and Power Cabinets maintenance

27.1. Control Cabinet

Power off cabinet with the main switch on control cabinet before proceeding.

- Check the breakers.

Figure 105: Control cabinet main breakers



1- PLC assembly

2- Main breaker Q1

3- Breakers:

- QI0: White Led 400/440V
- Q2: 24V
- Q3: Motors order and door components supply
- Q4: PLC rack

4- QP01 (and QP02 if 2 pumps are installed): Back wash pump control unit

5- QM11: Engine cleaning control unit

6- 24V supply

- Check if breakers' and terminals' screws are tightened.
- To clean the touch screen use a clean and soft cloth, with no chemical product.

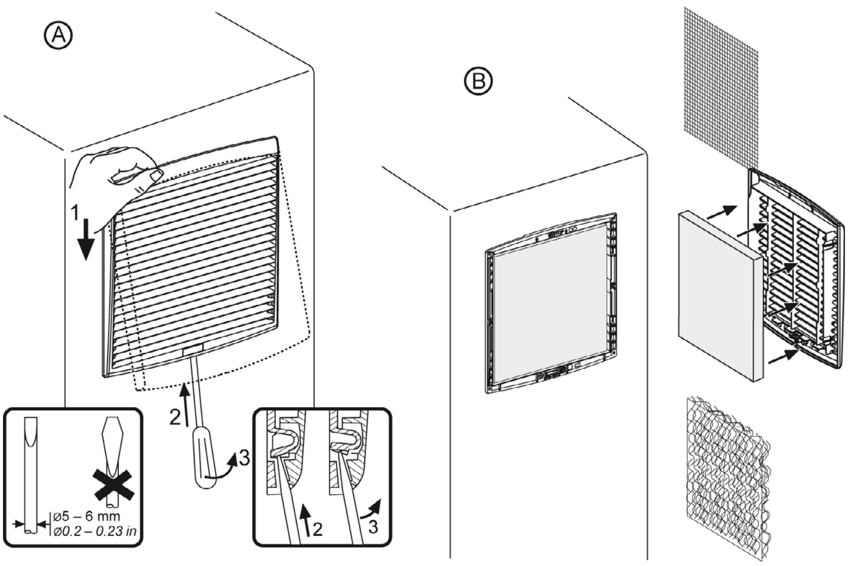
27.2. Power cabinet (only for BIO-SEA® B models)

Power off cabinet with the main switch on power cabinet before proceeding.

27.2.1. Filters cleaning

- Use a screw driver to open the Fan grid and remove the filter to clean it or replace it
- Put back the filter and the grid by clipping it

Figure 106: Fan filter dismounting



27.2.2. Breakers checking

- Check if breakers and terminals screws are tightened.

28. Filter

28.1. Checking of upper and bottom bushing (for Filtrex filter)

When filter screen has been dismounted, check gap between upper (11) / bottom (18) bushing and filter shaft. For that, measure bushing inner diameter and shaft outer diameter. Compare both measures: if difference is higher than 300 to 400µm, the bushing must be replaced.

28.2. Filter cleaning

28.2.1. Cleaning without filter dismounting

Filter cleaning can be done without dismounting by performing a ballasting operation in sea to sea at minimum flow rate (50m3/h per reactor). This should be done in sea where water has a good quality to avoid clogging the filter and reduce impurities amount in the filter.

This cleaning is recommended when warning "High dP min" appears at the end of a ballasting operation, or when filter has clogged.

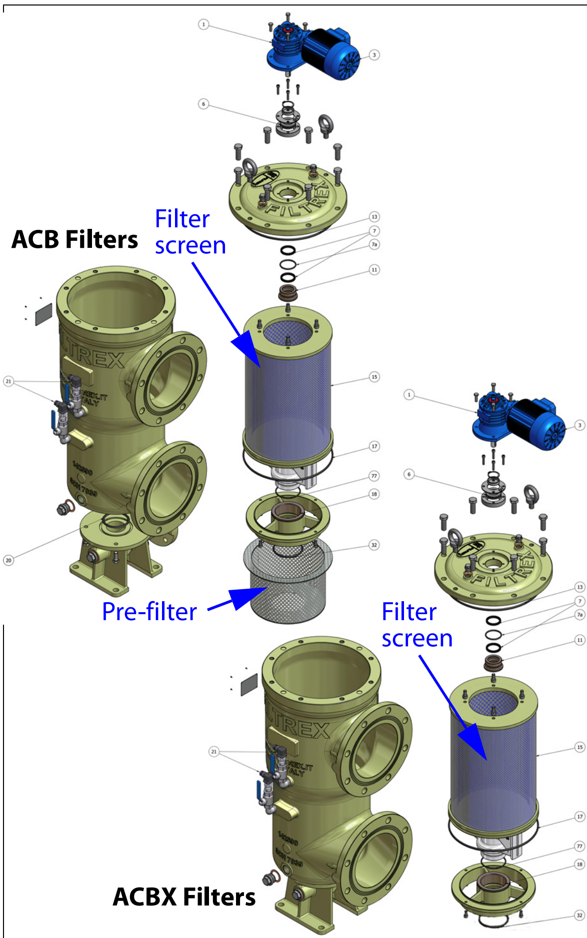
For HYDAC filter, this is referred in their manual as powerwash.

28.2.2. Cleaning with filter dismounting

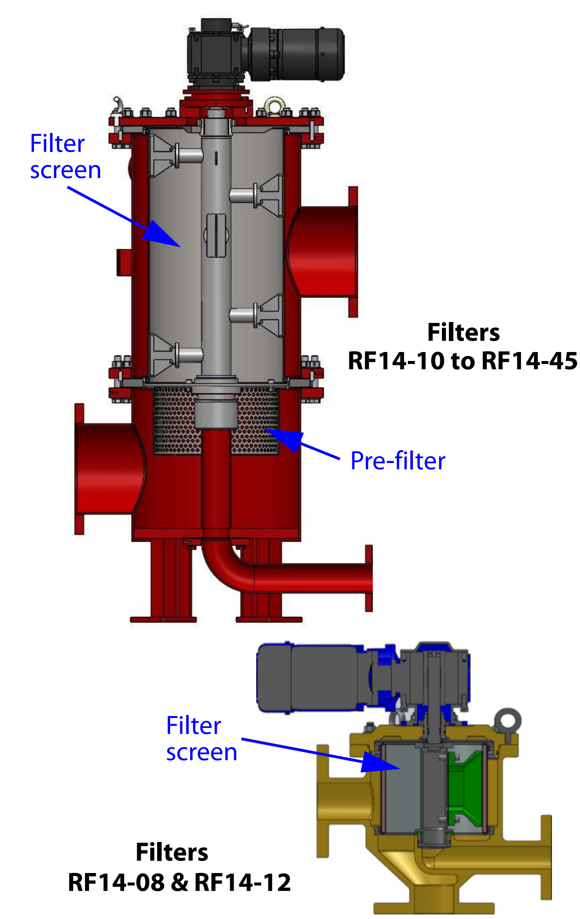
Principal maintenance operations for the filter are:

- Filter dismounting according to operations described in the filter manual included the technical documentation.
- Cleaning of pre-filter with high pressure cleaner (from outside to inside) (This operation is useless for filters RF14-08 and RF14-12 as they are not equipped with pre-filter)
- Cleaning of filter screen with high pressure cleaner
- Visual checking of the filter and filtering elements status

For Filtrex filter cleaning a descaling product suitable for bronze aluminum is advised.



Filtrex filter



Hydac filter

- For detailed description of operations, please refer to the filter manual in the technical documentation.
- When dismounting filter, take care not to scratch gaskets and before replacing the gaskets ensure gasket seat is clean.

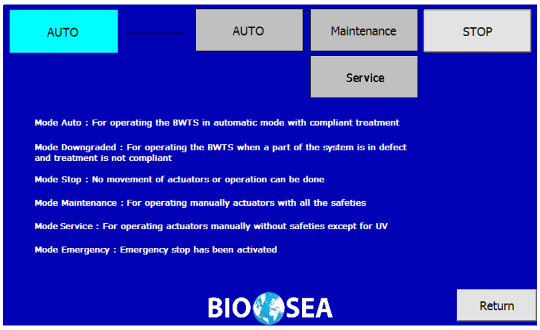
28.3. Backwash test

This test can be required for preventive or curative maintenance operations.

The number of backwash performed on the system since the first installation of the BWTS or since the last cycle is available in the Backwash parameter screen (access path Appendix> Parameters > Backwash).

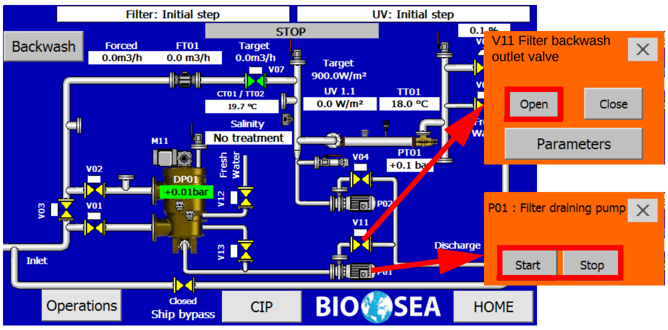
28.3.1. In maintenance mode

Figure 107: Mode



- To access **MAINTENANCE mode**, **LOCAL control** must be first switched on. Do not forget, when finishing Manual operation to switch back to either STOP or AUTO mode, and switch off LOCAL control.
- Select **Maintenance Mode** (Maintenance level is required).
- Press **Return** to **Appendix.**

Figure 108: Process screen



- Press on Valve V11 then open the valve (suction valve of the suction pump P01).
- Press on Pump P01 then make a quick «ON / OFF» to check the rotating direction of the pump rotor.

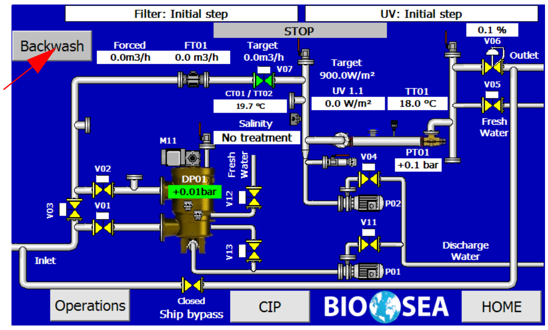
28.3.2. In automatic mode

- **Force Backwash**

Press the "Backwash" button (1) to verify that it triggers immediately a backwash cycle (to perform 3 times).

Figure 109: Process view

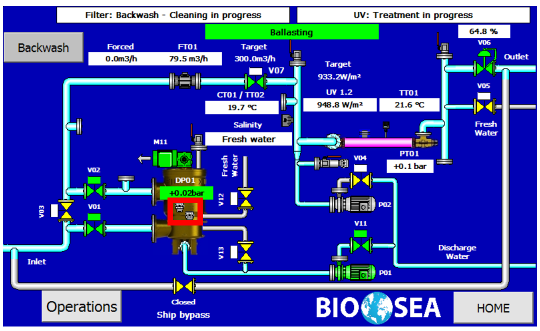
1



- **Isolating one pressure sensor**

The test of back wash can be simulated under fresh water if you cannot use the ballast pump of the ship.

Figure 110: Process menu



Backwash process (to perform 3 times):

- During a ballasting operation, close manual valve of the pressure sensor for the inlet or the outlet of the filter.
- Open the valve of the pressure sensor as soon as backwash cycle is on.
- When the backwash test is over, stop the ballasting operation.

28.4. Backwash pump performance test :

This test is performed to ensure the backwash pump works on its range.

1- Check the backwash flow rate specification corresponding to your filter (see tables below).

Table 36: Pump flow rate regarding models of Filtrex filters

	Unit	ACB-903-065	ACB-904-080	ACB(X)-906-100	ACB(X)-910-150	ACB(X)-915-150	ACB(X)-935-200	ACBX -940-200
Nominal flow rate	m3/h	8	10	15	25	35	35	42
Min Backwash flow rate required	m3/h	8	10	15	25	35	35	42
Max Backwash flow rate allowed	m3/h	11	15	18	32	43	43	50
	Unit	ACB(X)-945-200	ACB(X)-955-250	ACBX-960-250	ACB(X)-985-300	ACB(X)-999-350	ACB(L)-9100-400	ACB(L)-9120-500
Nominal flow rate	m3/h	46	50	54	69	95	126	126
Min Backwash flow rate required	m3/h	46	46	54	69	94	126	126
Max Backwash flow rate allowed	m3/h	54	54	65	89	112	144	144

Table 37: Pump flow rate regarding models of Hydac filters

	Unit	RF14-08c	RF14-08	RF14-12c	RF14-12	RF14-10	RF14-15	RF14-20	RF14-25	RF14-30	RF14-35	RF14-40	RF14-45
Nominal flow rate	m3/h	20	25	30	50	40	65	85	105	125	125	150	150

2- Calculate the head (H) of the pump by reading the inlet and outlet pressure of the backwash pump in operation.

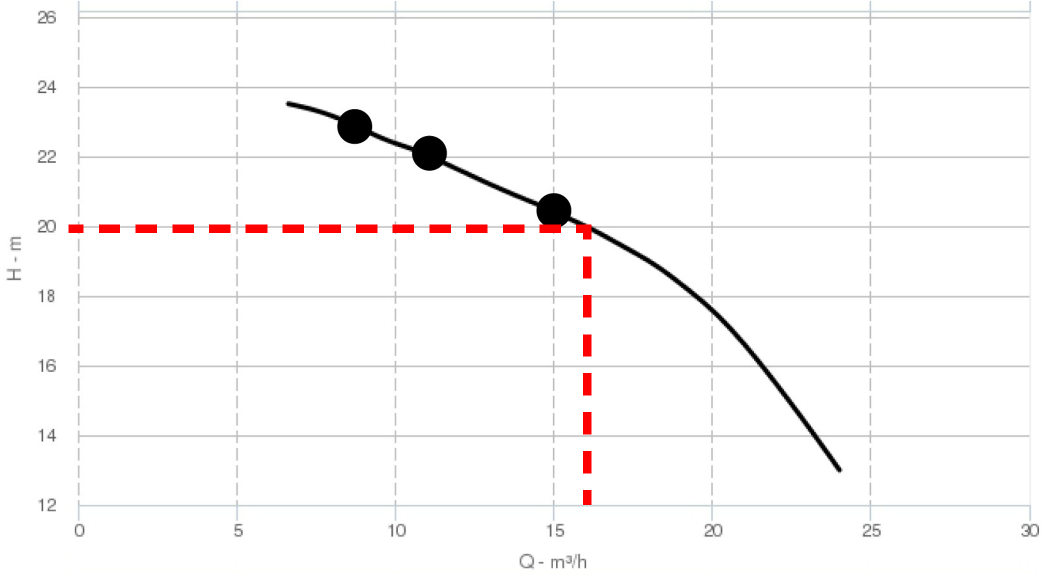
Example:

- Manometer on pump discharge = 3.5 bar.
- Manometer on pump suction = 1.5 bar.
- Pressure increase in the pump is 3.5-1.5 = 2 bar.
- 0.1 bar = 1 m so the total head (H) of the pump would be 2/0.1 = 20 m.

3- Check the corresponding flow rate by using the pump diagram on the pump datasheet:

Example: for 20m head the pump rate is about 16m3/h (see See Figure 111:, page 191).

Figure 111: Performance diagram of a suction pump BNM 32/12S 230/400/50 HZ for filter ACB906-100



4- Compare the value found on the diagram with the backwash flow rate specification:

- if the value of the diagram is between the minimum and maximum backwash flow rate, the pump operates correctly.
- if the value of the diagram is lower than the minimum backwash flow rate or higher than the maximum backwash flow rate, the pump is defective pump and it should be replaced or undergo maintenance operations.

In the example here above, the value of the diagram (16m3/h) is higher than backwash nominal flow rate (15m3/h) and lower than the maximum backwash flow rate (18m3/h), then the pump operates correctly.

28.5. V03 leak check

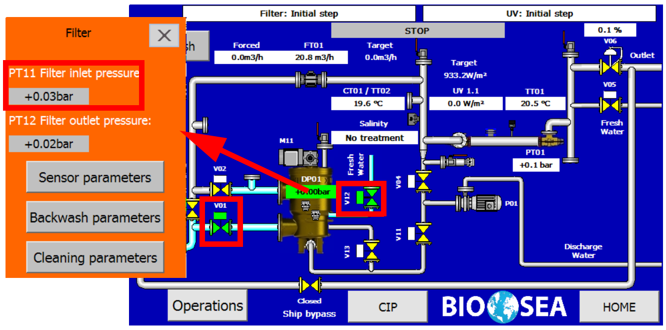
This test is performed to ensure there is no leak on V03 and thus no contamination during treatment

1- Close all valves of the BWTS.

2- Press on V01 then open the valve.

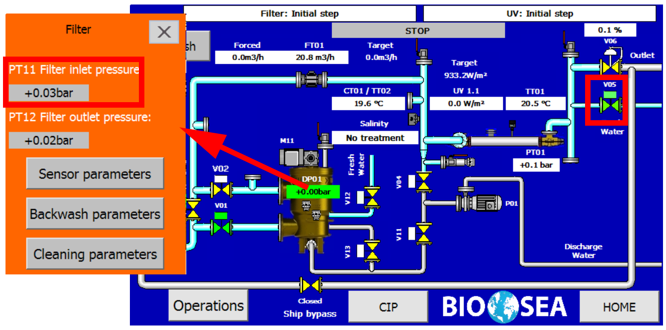
3- Press on V12 then open the valve to fill the filter and the piping upward the BWTS.

4- Wait until PT11 displays a pressure between 1bar and 1.5 bar then close V12.



5- Press on V05 then open V05 to build up in pressure.

6- Wait about 30minutes watching pressure on PT11: pressure should not change:



- If pressure on PT11 remains the same, there is no leak.
- If pressure on PT11 changes, it means there is a leak and a maintenance on this must be performed (valve check, seal replacement...). In this case, it is necessary to determine which valve is leaking: V02 or V03. For that, close valve V01 and wait about 15 minutes:
  - If pressure continues to increase, V02 is leaking
  - If pressure remains the same, open V01: if pressure increase, it means there is a leak on V03

7- Close all valves on the BWTS.

8- If need it, Proceed to maintenance of the leaking valve (valve check, seal replacement...).

29. Programs update

A new version of **BIO-SEA**® program requires to update the automation program inside the PLC and the screen program inside the HMI.

This can only be carried out by authorized personal.

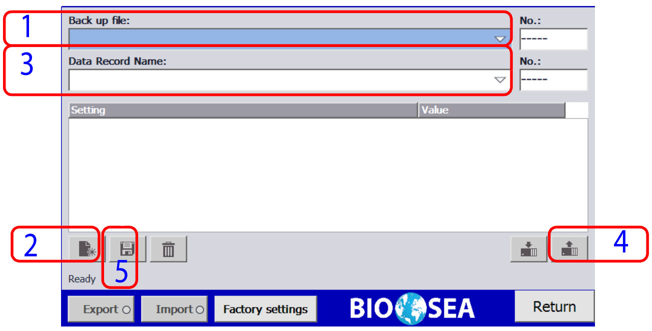
29.1. Saving recorded data

As required by 46 CFR 162.060-20 (b), before proceeding to program update, all recorded data have to be saved and stored. These data should remain available on board for a minimum of 24 months.

29.2. Saving settings and values

To reach this screen follow the path HOME > Appendix > Parameters back-up. An identification with an installer level will be necessary.

Figure 112: Parameters back-up screen



1- Select the type of back-up file type (only backup is selectable).

2- Create a file by pressing the button[1].

3- Write the name of the new file.

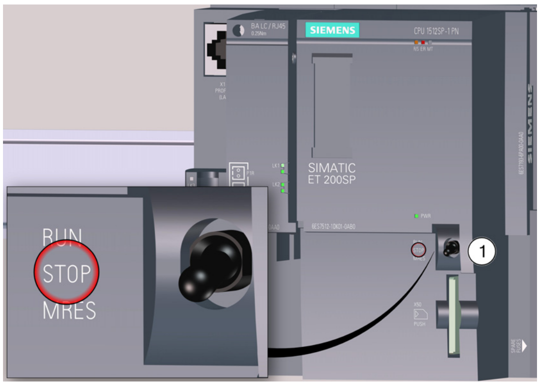
4- Load the values/settings currently loaded in the PLC memory.

5- Save the values/settings currently loaded in the PLC memory.

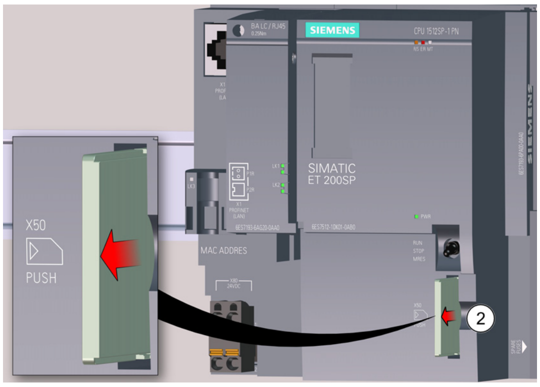
1. It is also possible to overwrite a file by only selecting a file on the drop-down menu but this is not recommended. In this event, a message box will appear to confirm the file overwriting.

29.3. PLC program replacement

This procedure is used to change the program inside the PLC using a MMC memory card.



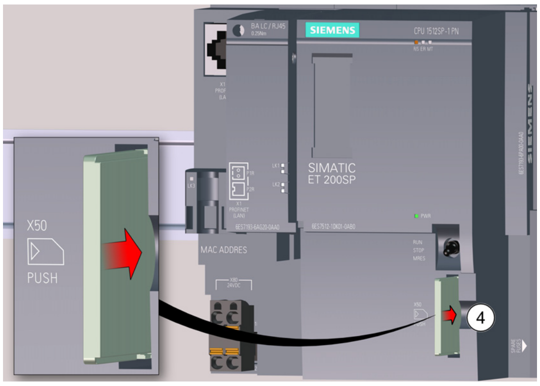
6- Switch the PLC to the STOP position, the light on the PLC RAK does not suppose to change.



7- Remove the MMC card:after a few seconds: all the diag light of the cards supposed to flash at the same time except for the first card A2, the R/S LED is supposed to be orange, the ER LED is supposed to flash red, the PWR LED must be green, if you have some cable connected, you should have the LK1 and LK2 green LED.

8- Copy the new PLC software on the MMC card:

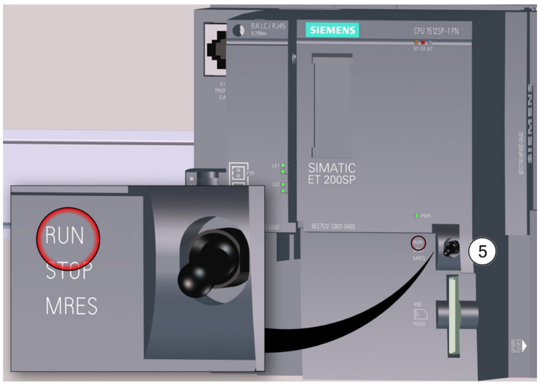
- Insert the SD card to your computer make sure that the Lock button is on the top position of the card.
- DO NOT FORMAT THE CARD.
- Back up the files already present on the card: cut all the documents on the card, then create a new folder on your computer to paste all the documents which was on the card.
- Copy all the three documents of the new software version: you are supposed to have three documents named s7p.web.apps; SIMATIC.S7S; S7_JOB.S7S.
- Remove the MMC card from your computer



9- Insert the new programmed MMC card: all LED will stop except the R/S LED.

10- After about 60 seconds in STOP position, all LED will return to normal conditions:

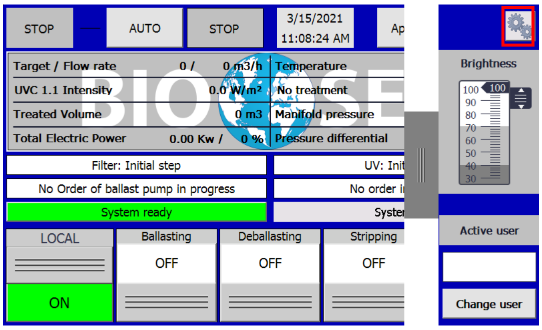
- all the diag lights of the cards are supposed to be green fixed except for the first card which is supposed to flash red.
- the R/S LED is supposed to be orange.
- the ER LED is supposed to flash red.
- the PWR LED must be green.
- if you have some cable connected, you should have the LK1 and LK2 LED in green.



11- Switch the PLC to the RUN position.

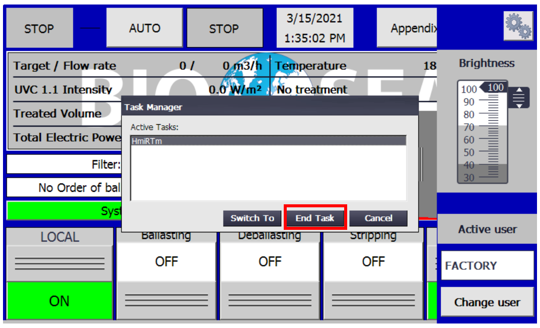
29.4. HMI program replacement

This procedure is used to change the program inside the HMI using a USB stick.

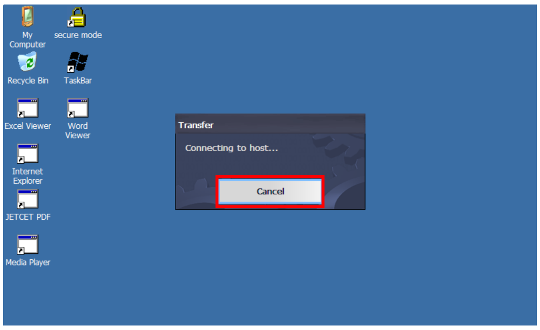


1- Press the right side of the screen and slide to the left to display the vertical menu.

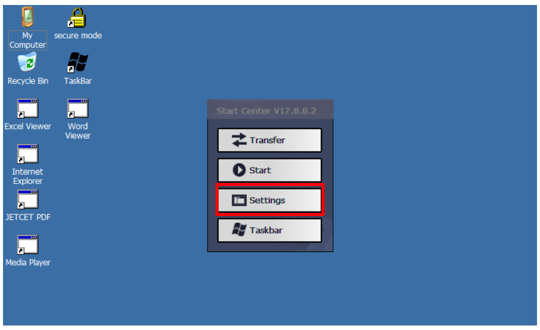
2- Press the "Gear" button.



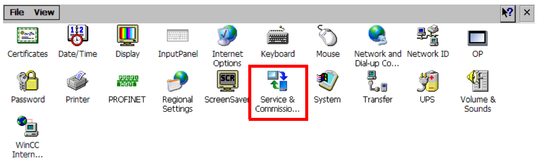
3- A window appears: click on "End Task".



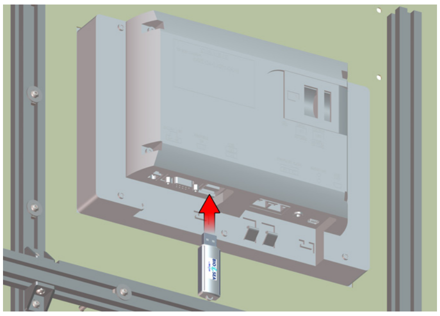
4- The **BIO-SEA**® program will close and a "transfer" pop-up will appear: click on cancel.



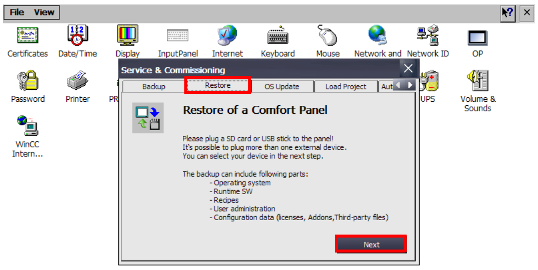
Once this screen appears, press on one of the button of the window and enter the Admin password, then press "Settings" button.



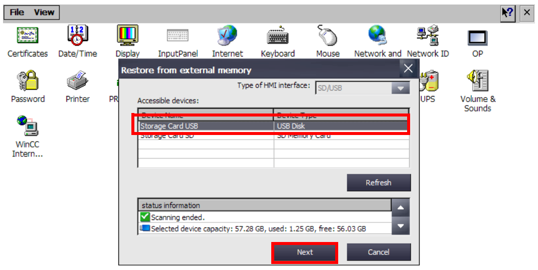
5- Press the "Service & Commissioning" icon.



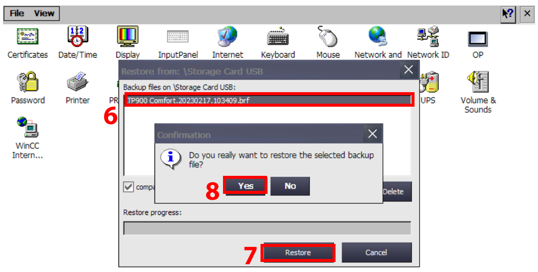
6- Insert the USB stick containing the HMI program update.



7- Go to the "Restore" tab and press "Next".



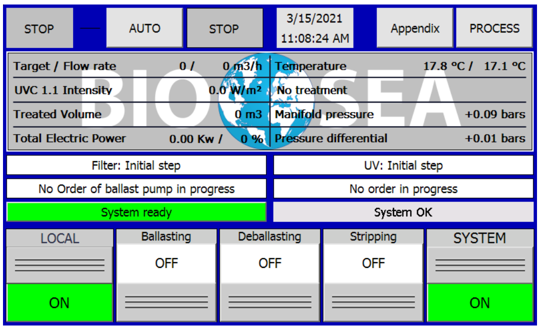
8- Select the line "Storage Card USB" and press "Next".



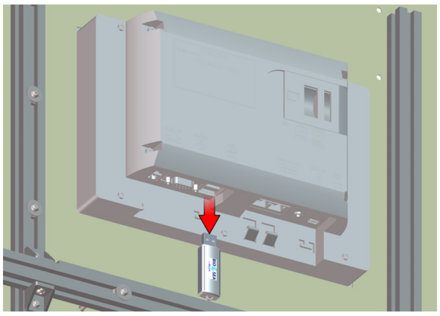
9- Select the file on the USB stick.

10- Press "Restore"

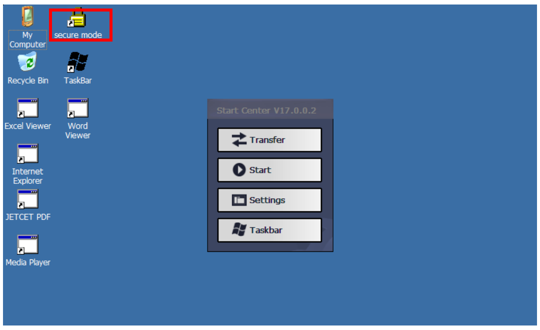
11- Press "Yes".



12- Once the restoration is over, the program launches itself.

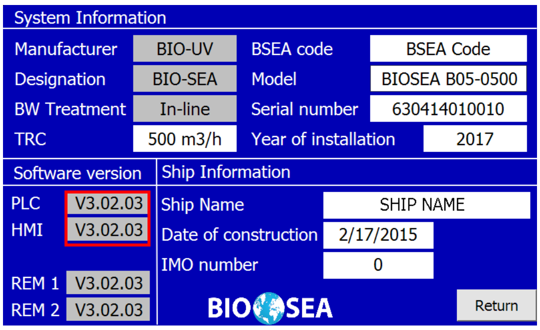


13- Remove the USB stick.



14- Restore the secure mode:

- Stop the program as indicated on steps 1 to 4.
- Double click on "secure mode": "secure mode" is ON.
- Power OFF then ON the control cabinet: the software will restart itself.



15- Check the software version of the PLC and the HMI are consistent.

16- The default program loaded on the screen is the standard **BIO-SEA**® program. Parameters should be restored again, see paragraph hereafter.

29.5. Restoring settings and values

To reach this screen follow the path HOME > Appendix > Parameters back-up. An identification with an installer level will be necessary.

Figure 113: Parameters back-up screen

1- Select the type of back-up file type (only backup is selectable).

2- Select a file name in the drop-down menu.

3- Send the values/settings of the selected file to the PLC memory.

30. Winterizing procedure

30.1. Preparing the system for winterization

1- After last operation, drain entirely the system.

2- De-energize the system.

3- Make sure there is no water remaining inside piping, and inside key components such as flowmeter, filter, reactors, manifolds and pumps.

- Open piping on lower part of dead ends.
- For the Flowmeter, untight one of the flange.
- For the filter, drain and dry it as much as possible.
- For the reactor, dismount lamp and quartz sleeves. Make sure they are stored dry then drain and dry the reactor.
- For the manifold, dismount the bottom flange.
- For the pumps, there is a plug on the lower part which makes draining easier.

4- Ensure the system is dry.

Make sure the system won't be exposed to thermal shock, not exceeding 20°C/h, as equipments are sensitive to temperature variation.

30.2. Storage during winterization

1- Dismounted equipments should be properly stored.

2- System should be protected from direct exposure to extreme weather condition and dust, being stored inside container or equivalent. If it cannot be moved, use suitable means to protect the system.

3- Some of the electronic equipment (automation, sensors) are sensitive to low temperature, make sure a minimum of -20°C is not exceeded. If not, parts could have to be replaced prior restarting the system. These parts cannot be covered by warranty.

30.3. Preparing the system for operation after winterization

Make sure the system won't be exposed to thermal shock, not exceeding 20°C/h, as equipments are sensitive to temperature variation.

1- Check if there is any crack on dismounted parts (lamps, quartz...).

2- Fit back all elements which had to be dismounted (reactors, filter, pump, manifolds) then check tightening of flanges and connections.

3- Check ELC are in good condition (no condensation nor corrosion).

4- Re-energize the system. If the de-energizing has lasted over 6 weeks, check and set the time if necessary.

5- Check if there is any crack on piping and external part of each component.

6- Make sure the system is in its correct thermal condition before filling in it (all flanges properly tightened).

7- Proceed to installation and commissioning checks, to make sure all is working properly (specially leak and functional tests). The commissioning should be performed by **BIO-SEA**® representative: please contact servicebiosea@bio-uv.com.

8- If a CIP system is installed, proceed to a CIP cleaning cycle.

31. Possible warnings during operation

- Warnings are pre-conditions for alarm and an action is required to mitigate the situation before a default appears that could cause a STOP or a DOWNGRADED mode.
- Setpoints for warnings and alarms are in "Parameters alarms" screen.

Table 38: Troubleshooting for warnings

Warning message	Possible causes	Remedies
High load continuous backwash	There are too much suspended solids in sea water. The filter is getting dirty.	Reduce the inlet flow by using ballast pump or a valve on the ballast water circuit.
		If warning is still present, wait the end of the operation to clean the filter (see 28.2. Filter cleaning, page 186).
High DP min.	The cleaning capacity of the filter is not allowing to retrieve a differential pressure sufficiently low.	Check "DP min" curve in File screen: If curve is constant, filter should clean itself during the next operation with a better water quality. If curve is increasing, the filter is getting dirty and it should be cleaned (see 28.2. Filter cleaning, page 186).
	A deballasting operation is launched whereas the BWTS is configured for stripping operation.	Stop the operation. Launch the suitable operation or properly configure the BWTS.
Warning low Flow	Water flow is too low.	Check control valve is sufficiently opened. If not, check air pressure on reducing valve PR03 is correct and check dimming of the control valve is YES on V06 pop-up window (touch the valve symbol in the process screen to open it).
		Check ballast pump supplies a sufficient water flow rate.
		Check if a ship valve prevent the system to get a sufficient flow rate.
	Flow meter and PLC displays don't match. Flow displayed doesn't match with real flow.	Check parameters for transmitter 4-20mA output and 4-20mA input of the PLC are the same. Check Max value is about max TRC + 30%.
	Flow sensor could have a deviation.	Refer to 23.3. Checking Flow meter, page 154, then contact your **BIO-UV Group** representative.

Table 38: Troubleshooting for warnings

Warning message	Possible causes	Remedies
Warning overflow	Control valve does not close enough.	Check air pressure on control valve actuator.(PR03).
	Flow meter and PLC displays don't match. Flow displayed doesn't match with real flow.	Check parameters for transmitter 4-20mA output and 4-20mA input of the PLC are the same. Check Max value is about max TRC + 30%.
	Flow sensor could have a deviation.	Refer to 23.3. Checking Flow meter, page 154, then contact a **BIO-UV Group** technician or its representative or contact your **BIO-UV Group** representative.
PTxx[1]: High pressure	Pressure inside the system is increasing.	During stripping, open a ship valve on the fire line to release pressure caused by the fire pump. During other operations, check valves position on the BWTS.
	Pressure transmitter out of order.	Refer to 23.4. Checking pressure sensors, page 155, then, if needed, contact a **BIO-UV Group** technician or its representative or change the pressure transmitter.
TTxx[2]:Warning temperature	Air inside reactor.	Check that automatic vent valve is functioning and change it if it is out of order.
	An external heat source influences the sensor.	Reduce or eliminate the external heat source.
	Temperature sensor badly positioned.	Check the sensor is well inserted into its seat and touches the bottom of hole.
	Temperature sensor out of order.	Refer to 23.2. Checking temperature sensor, page 152, then, if needed, contact a **BIO-UV Group** technician or its representative or change the temperature sensor.
Maintenance required	A preventive maintenance needs to be done on the BWTS according to maintenance schedule (see 22.7. Maintenance Frequency Chart, page 146).	Go to Maintenance screen to proceed to maintenance. (see 22.2.1. Maintenance screen, page 143). When maintenance is complete, return to Maintenance screen and press "Maintenance done" to acquit off the Warning.
Fresh water filling incomplete	There is a leak on the UV or the filter assemblies.	Check for leaks and fix it. When done, launch a new cleaning cycle.
	Fresh water pressure is too low.	Refer to the chief engineer to increase water pressure to a value higher than the filling pressure threshold.
	Ship water supply valve is not open.	Refer to chief engineer to open fresh water supply valve.
	Adjustment of Water pressure reducer (PR01) has been changed.	Adjust water pressure reducer checking fresh water pressure to get 2 bars in outlet.
	One of the fresh water filling valves (V05, V12 or V22) remains closed.	Check pneumatic supply of these valves.
		Valves is jammed: dismount it to release it.

Table 38: Troubleshooting for warnings

Warning message	Possible causes	Remedies
RS485 Loss of connection (Warning)	Local mode is active and communication between RS485 communication box and control cabinet is lost.	Check state and connection of the Ethernet cable between PLC of the RS485 communication box and PLC of the control cabinet.
CT01: Conductivity control failure	Cable not connected, not wired or not plugged correctly.	Check cables and wiring.
	Conductivity sensor out of order.	Refer to 23.5. Checking conductivity sensor, page 155, then, if needed, contact a **BIO-UV Group** technician or its representative or change the Conductivity sensor.
Ballasting of brackish water	Brackish water is being ballasted in USCG mode.	Validate pop-up screen and choose to continue or stop the operation. To comply with USCG approval, brackish water uptaken in USCG mode should be kept 19 hours before deballasting.
Deballasting of brackish water	Brackish water is being deballasted in USCG mode.	Validate pop-up screen and choose to continue or stop the operation. To comply with USCG approval, brackish water uptaken in USCG mode should be kept 19 hours before deballasting.
Y Ship_bypass: Warning stripping valve open	One or several specific valves for stripping process are open and no operation of stripping is active.	Close the valve(s) except if an stripping operation is about to be started.

1. PTxx refers to a pressure transmitter's number.
2. TTxx refers to temperature transmitter number.

Table 39: Troubleshooting for warnings concerning the CIP option

Warning message	Possible causes	Remedies
Miss CIP RUN / STOP	Button "I" on the control cabinet is released.	Push "I" button on the CIP cabinet If default is still present, check wiring (See wiring diagram in the technical documentation).
PCxx[1]: Defect circuit breaker absence	Pump circuit breaker is off.	Switch on the pump circuit breaker.
PCxx[1] Defect of lack of safety	PLC detects pump valve is closed.	Check pressure is sufficient for valve opening. Check time parameter for valve opening on the screen is sufficient to let the valve the time to be open Adjust valve operating speed by adjusting the screws in the mufflers.
		Operate again the valve in correct position If sensor doesn't change its state, replace electronic card of the actuator.

Table 39: Troubleshooting for warnings concerning the CIP option

Warning message	Possible causes	Remedies
PB CIP emergency stop	Emergency button is activated.	After checking why button has been pushed, release emergency button on control cabinet. If after releasing the emergency button the default is still present, check wiring. (See wiring diagram in the technical documentation.).
	Push button out of order.	Change the push button.
VCxx[2]: Defect closing sensor VCxx[2]: Defect opening sensor	Valve is not supplied with air.	Check opening of ship's valve for air supply.-
		Check the pipes and connections.
	Valve is not supplied with electricity.	Check cable and electric connections.
		Check that cable is electrically supplied.
	Valve body is blocked.	Move the valve manually to check if it can fully open and close. If not, change the valve.
	Limit switch is blocked.	Position again the valve in correct position. If sensor doesn't change its state, replace electronic card of the actuator.
LD01: CIP tank level low	The level of cleaning solution is under the minimum limit.	Make a new preparation of cleaning solution.
	Level transmitter out of order.	Change the transmitter.
CIP PLC missing	Data between PLCs are not reached.	Check data cable.
		Check that connectors DP switches on each PLC are in ON position.
		Check if Profibus address is set to 3.
		If the default is still present, replace the Profibus coupler module on the PLC.
HW CIP PLC: Missing or defect	Hardware CIP PLC, Card removed or card defect on CIP PLC.	Check if all cards are plugged or card defect.
HW CIP PLC: Card failure	Card out of order.	Replace the card.

1. PCxx refers to a pump number on the CIP system.
2. VCxx refers to a valve number on the CIP system.

32. Defaults with screen messages

When a spare parts replacement is required, refer to the spare parts catalog to know the reference of the spare part.

Defects can impact the treatment performances. They're marked with "*" in the tables hereafter. When they happen, the ballast water must be managed as mixed water or untreated water, according to ballast water management procedures.

Table 40: Troubleshooting for defaults with screen messages on the BWTS

Default message	Possible causes	Remedies
Filter clogged	Backwash valve doesn't operate correctly.	Check air supply connections as well as electric wiring of the valve controller.
		Change the valve.
	Suction pump is blocked.	Fix the pump or replace it.
	Pressure transmitters doesn't operate at the correct pressure.	The pressure transmitters need to be calibrated again or to be changed.
	Filter is clogged.	If all the possible causes here above have been solved, clean filter (see 28.2. Filter cleaning, page 186). It is recommended increase flow rate very slowly at the next operation.
	High DP.	Check "DP max" curve in File screen: If curve is constant, filter should clean itself during the next operation with a better water quality. If curve is increasing, the filter is getting dirty and it should be cleaned (see 28.2. Filter cleaning, page 186).
Defect low Flow	Flow not present, Water is not sent in the line.	Open the ballast pump valve to allow water flowing through the system.
	Flowmeter default.	See Flow meter manual.
	Flow meter and PLC displays don't match. Flow displayed doesn't match with real flow.	Check parameters for transmitter 4-20mA output in order to have 20mA output for the maximum TRC of your system.
		Check if flow meter is installed correctly (See Flow meter manual).
		Check if parameters of the sensor match with its data plate.

Table 40: Troubleshooting for defaults with screen messages on the BWTS

Default message	Possible causes	Remedies
Overflow*	Gravitational effect during ballasting or deballasting, so Flow on the transmitter is higher than the system TRC.	Reduce the flow by partially closing the ballast pump valve on the line.
Mxx[1]: Defect circuit breaker absence	Motor circuit breaker is off.	Switch on the motor circuit breaker.
	Motor circuit breaker doesn't stay on.	Check if the rating of the motor circuit breaker is set correctly.
	Motor circuit breaker is damaged.	Replace the circuit breaker.
	Motor is damaged.	Change the motor.
	Obstruction between filtering element and back wash shaft.	Remove obstruction.
	Misalignment of the backwash arm.	Check back wash arm alignment.
	Misalignment between filter connections (INLET, OUTLET, BACKWASH) and pipings.	Lose the bolts and try again to rotate the back wash shaft.
Miss general RUN / STOP	Button "I" on the control cabinet is released.	Push "I" button on the control cabinet. If default is still present, check wiring (See wiring diagram in the technical documentation).
Pxx[2]: Defect circuit breaker absence	Pump circuit breaker is off.	Switch on the pump circuit breaker.
	Pump circuit breaker doesn't stay on.	Check if the rating of the pump circuit breaker is set correctly.
	Pump circuit breaker is damaged	Replace the circuit breaker.
	Pump is damaged.	Change the pump.
Pxx[2]: Defect of lack of safety	PLC detects pump valve is closed.	Operate again the valve in correct position. If sensor doesn't change its state, replace electronic card of the actuator.
PB emergency stop	Emergency button is activated.	After checking why button has been pushed, release emergency button on control cabinet. If after releasing the emergency button the default is still present, check wiring. (See wiring diagram in the technical documentation).
Defect dual order	Two orders of operation are sent at the same time.	Disable the operation orders and start again the required operation once
ELCx.y[3] : Defect slave missing on Profibus	Lamp is off.	See default "Lamp off" in 33. Defaults without screen messages, page 212.
	Profibus communication lost.	Check Profibus cable and wiring of the connector X4 (See wiring diagram in the technical documentation).

Table 40: Troubleshooting for defaults with screen messages on the BWTS

Default message	Possible causes	Remedies
ELCx.y[3] : Order failure defect	Lamp is off.	See default "Lamp off" in 33. Defaults without screen messages, page 212.
	Connectors X3 on the electronic ballast.	Check wiring of the connectors X3 (See wiring diagram in the technical documentation).
ELCx.y[3] : Internal defect ELC	Lamp is off.	See default "Lamp off" in 33. Defaults without screen messages, page 212.
	The electronic ballast has an Internal defect.	Check default on UVx.y menu, see 34. ELC specific warnings and errors, page 214. Restart it by using its circuit breaker.
ELCx.y[3] : Defect low flow cut off	Cable FT01 between the flowmeter and cabinet A1 is defective.	Check cable state.
		Check cable connections.
	Profibus cables between power cabinets is defective.	Check cables state.
		Check cable connections.
	Flow rate is lower than 4m3/h per reactor.	Check ballast pump flow rate.
	Flowmeter is defective.	Check flowmeter power supply and parameters.
ELCx.y[3] : Defect of lack of safety	One of the safety conditions to start UV lamp is not OK.	Check pressure settings and measurements.
		Check temperature settings and measurements.

Table 40: Troubleshooting for defaults with screen messages on the BWTS

Default message	Possible causes	Remedies
UVx.y³: Alarm UV irradiance too low	Quartz sleeve and/or UV sensor window is dirty *.	Clean quartz sleeve and/or sensor window manually, see 24.2. Dismounting the Quartz Sleeve, page 160 and 25. UV Sensor and Window, page 174. If a CIP option is installed, it is possible to clean them without any dismounting: automatically with a BIOSEA Clean device or manually with **BIO-SEA**® M-Clean.
		If CIP cycle has already been launched, check the CIP cycle has been properly performed (manual valves opened, acid solution flows through the BWTS, sufficient air pressure...).
		If CIP has not been efficient enough, the quartz sleeve should be dismounted to be clean with hands.
	Water transmittance is too low *.	System is out of range / possibility to activate downgraded mode in non-compliant conditions.
	UV sensor is malfunctioning or needs to be calibrated again.	Check the sensor with a calibrated UV sensor or a UV meter, see 23.1. Checking UV Sensor, page 152. Replace the UV sensor.
	Air inside reactor.	Check automatic vent valve functioning and change it if out of order.
	Lamp's UV output is low: end of lamp life, or lamp out of order.	Check the lamp's operating time. Replace the lamp and reset the counter.
	UV window is not properly positioned (Only for **BIO-SEA**® B models).	Check UV window position using procedure in paragraph 24.3.3. Adjustment of UV windows position (only for BIO-SEA® B models), page 168.
UVx.y³: Defect sensor or cable break	Cable not connected, not wired or not plugged correctly	Check sensors' cables and wiring.
		Check Modbus communication is active.
		Check UV sensor address suitable.
	Sensor out of order.	Change the sensor.
Vxx⁴: Defect closing sensor Vxx⁴: Defect opening sensor	Valve is not supplied with air	- Check opening of ship's valve for air supply. - Check the pipes and connections.
	Valve is not supplied with electricity.	- Check cable and electric connections. - Check that cable is electrically supplied.
	Valve body is blocked.	Move the valve manually to check if it can fully open and close. If not, change the valve.
	Limit switch is blocked.	Position again the valve in correct position. If sensor doesn't change its state, replace electronic card of the actuator.
YYxx⁵: Defect sensor or cable break	Cable not connected, not wired or not plugged correctly.	Check sensors cables and wiring.
	Sensor out of order.	Change the sensor.

Table 40: Troubleshooting for defaults with screen messages on the BWTS

Default message	Possible causes	Remedies
PTxx[6]: Overpressure	Pressure exceeds maximum pressure of the system.	Take care of not exceeding maximum pressure, risk of equipment and personal damages.
	Pressure transmitter out or order.	Change the pressure transmitter.
Defect temperature high	Air inside reactor.	Check that automatic vent valve is functioning and change it if it is out of order.
	Temperature sensor default.	The temperature sensor needs to be checked see 23.2. Checking temperature sensor, page 152 then contact a **BIO-UV Group** technician or its representative or replace the sensor by a new one with up to date calibration certificate.
	Temperature alarm threshold.	Check that the threshold in the Alarms parameters menu is 70°C. If not, an Installer access is required to change the value. Please contact your after sale representative.
No reactor selected	No reactor selected.	Need at least one reactor selected, normally all reactors present in the system have to be selected. Contact a **BIO-UV Group** technician or its representative.
HMI Loss of connection	Communication between HMI and PLC is lost.	Check Ethernet cable between HMI and PLC.
RS485 Loss of connection (Defect)	RS485 mode is active and communication between RS485 communication box and control cabinet is lost (BWTS has returned in local mode and stop mode).	Check state and connection of the Ethernet cable between PLC of the RS485 communication box and PLC of the control cabinet.
Remote control defect	Control cable (WSHIP) between control cabinet and vessel's wired control is damaged or disconnected.	Check if the control cable is wired correctly and is not cut. (See wiring diagram in the technical documentation) Rewire it or change it depending on your observation.
HW Main PLC: Card An[7] missing	Hardware main PLC, Card has been removed.	Plug the card.
HW Main PLC: Card An[7] failure	Wiring issue from analog sensors, on analog card only.	Check the wiring of the sensor.
	Analog sensors out of order, on analog card only.	Replace the sensor.
	Card out of order	Replace the card
Temperature not displayed: ******* is displayed	No data are sent to PLC by the temperature sensor.	Check temperature sensor's cable, connector and wiring. See wiring diagram in the technical documentation.
	Temperature sensor is damaged.	Replace the temperature sensor.
Wire HMI PLC Defect	Control cable between control cabinet and the tactile screen.	Check if the control cable is wired correctly and is not cut. (See wiring diagram in the technical documentation). Rewire it or change it depending on your observation.

Table 40: Troubleshooting for defaults with screen messages on the BWTS

Default message	Possible causes	Remedies
Manifold empty	A leak is present on the manifold when no operation is in progress.	Check for leaks and fix it. When done, fill again the manifold with fresh water.
Filter 1 empty	A leak is present on the filter, when no operation is in progress.	Check for leaks and fix it. When done, fill again the filter with fresh water.
Y Ship_bypass: Ship bypass open (Alarm)	General ship by-pass for the BWTS is open.	Close the by-pass valve to be compliant with the IMO D-2 standard and USCG regulations for ballast water discharge.
	The cable is broken or disconnected.	Check the cable state. Check cable is correctly connected the terminals inside the control cabinet and on the ship terminals.
Y Ship_bypass: Defect stripping valve open (Alarm)	One or several specific valves for stripping process by-passing the system are open.	Close the by-pass valve(s) to be compliant with the IMO D-2 standard and USCG regulations for ballast water discharge.
	The cable is broken or disconnected.	Check the cable state. Check cable is correctly connected the terminals inside the control cabinet and on the ship terminals.
	Another operation than Stripping has been launched.	Acquit defect and launch the stripping operation instead of ballasting or deballasting operation.

1. Mxx refers to the number of a filter's motor.
2. Pxx refers to a pump's number.
3. x.y refers to a reactor's number (x is the number of the corresponding cabinet Ax and y is the number of the corresponding ELC).
4. Vxx refers to a valve number.
5. YYxx refers to the name of the sensor: PT01, PT11, PT12, TT01, TT02, EC01, UVx.y, FT01.
6. PTxx refers to a pressure transmitter's number.
7. An refers to the electronic card number on the PLC.

33. Defaults without screen messages

These defects are detected without PLC message.

Defects can impact the treatment performances. They're marked with "*" in the tables hereafter. When they happen, the ballast water must be managed as mixed water or untreated water, according to ballast water management procedures.

Table 41: UV Reactor Troubleshooting

Defaults	Possible causes	Remedies
Lamp OFF on reactor UVx.y	ELC (Electronic ballast) corresponding to the UVx.y is off.	Check if the circuit breaker is ON and power supply comes on the electronic ballast. If circuit breaker trips then change it. If electronic ballast is OFF even if circuit breaker is ON then change the electronic ballast.
	On the ELC (Electronic ballast) corresponding to the UVx.y, red and Green LED are blinking. (ELC data malfunction: ELC not ready for operation, no PROFIBUS connection).	Restart it by switching OFF/ON the circuit breaker.
	On ELC (Electronic ballast) corresponding to the UVx.y, red LED is blinking and Green LED is OFF. (ELC internal error.)	Restart it by switching OFF/ON the circuit breaker. If the electronic ballast is still OFF after restarted then change the electronic ballast (Do not forget to set the address, see paragraph "Electrical checking" in the "installation & Commissioning" book.
	Lamp unplugged or poor connection.	Check lamp connector on the electronic ballast located in the power cabinet and check terminals in the connection box located on the reactor. - If the lamp is still off then check lamp cable by connecting it on another lamp. - If the other lamp is ON, it means the first lamp is out of order. Replace it and reset its counter. - If the other lamp is still off then change the lamp cable.
	Lamp out of order.	Replace the lamp, see 24.1. Dismounting the UV lamp, page 157, and reset lamp counter.

Table 42: Troubleshooting for Flowmeter

Defaults	Possible causes	Remedies
Flow meter without reading	Flowmeter is not electrically supplied.	Check voltage supply and wiring.
	A component of the flowmeter has a default.	See Flow meter manual.
Fault message on the transmitter	There is an Internal default on the transmitter.	See BIO-SEA parameters and Flow meter manual for assistance.

Table 43: Lack of Fresh Water in the System

Defaults	Possible causes	Remedies
Pressure transmitter reading low or no pressure (Lack of Fresh Water in the System)	Fresh water not supplied.	Open water supply.
	Fresh water valve is blocked.	Unblock the valve and operate it correctly.
	Fresh water valve is not supplied with air or electricity.	Check the cables, pipes and connections. Check air and/or electricity supply, then open them.
	Manual valves on manifolds are closed.	Open manual valves on manifold.
	Automatic vent valves are malfunctioning.	Check functioning of Automatic vent valves and change them if needed.
	There is a leak on the system.	Repair the leak(s).

34. ELC specific warnings and errors

These warnings and defaults are visible on the UVx.y info screen and are linked to a malfunction of the ELC, the lamp or the communication between them.

- **Warnings**

They can be divided in 2 groups

- Group 1 indicates critical operating conditions of the lamp. No shut down of the lamp occurs.
- Group 2 indicates that lamp operation is not possible (the lamps cannot be started or will be shut down during operation).

Table 44: UV specific Warnings

<table>
<tr><th>Group</th><th>Warning</th><th>Description</th><th>Action</th></tr>
<tr><td>1</td><td>Run Up Long</td><td>Warm up of the lamp takes longer than expected.</td><td rowspan="4">When one of this message appears, the ELC should be stopped. So, the defect has to be acknowledged and the current operation (ballasting or deballasting) has to be restarted.</td></tr>
<tr><td>1</td><td>Lamp Voltage Low</td><td>Burning voltage of the lamp falls below its minimum.</td></tr>
<tr><td>2</td><td>Lamp Ignition Failed</td><td>The ELC cannot ignite the lamp.</td></tr>
<tr><td>2</td><td>low flow cut off</td><td>Safety relay is not closed.</td></tr>
</table>

- Errors

In case of an error, the ELC will not try to ignite the lamp, or will shut it down automatically. After eliminating the error, the error register has to be cleared («clear error» signal) by pressing the ACK button.

An error on the ELC / UV lamp will be reported on the Touch Screen as a general alarm "UVx.y internal defect ELC" (see 32. Defaults with screen messages, page 206).

Table 45: UV specific Errors

Errors	Description	Possible Cause	Corrective action
Lamp Power Low	The lamp extinguishes on its own during lamp operation.	Lamp defect.	Replace the lamp.
Earth Leakage Fault (Lamp side)	A leakage current to ground is detected.	Bad wiring on the lamp, high air humidity, polluted cables or connections.	Check lamp wiring If cable and wiring is ok, change the ballast.
		ELC firmware is not up to date.	Contact **BIO-SEA**® representative to perform firmware update.
Lamp Voltage High	Burning voltage of the lamp is too high.	Lamp type not correct.	Check lamp type and switch lamp.
Bus Connection Error	PROFIBUS connection is interrupted during lamp operation.	Bus termination faulty, loosen connector.	Check termination and connector.
	PROFIBUS connection cannot be achieved before lamp operation.	ELC address is not correctly set.	Check ELC address and reset it.
ELC Temperature High	Acceptable temperature is exceeded (55°C).	Ambient temperature too high.	Check ballast fans and power cabinet fans. Clean fans and filter.
Main Voltage Low	Main voltage falls below the allowed minimum during lamp operation.	Main voltage drop or fluctuations.	Check connections and mains voltage (if possible).
DC Link Undervoltage	Internal DC link is too low.	Ballast main voltage is too low.	Check fuses. Check mains voltage. Consider charge time.

Table 45: UV specific Errors

Errors	Description	Possible Cause	Corrective action
Fan error	Malfunction of one or more of the three ELC-fans (one main fan, two internal).	Fan needs maintenance or connectors are bad connected or defective.	Check for • ball bearing defect. • connector between front hood and main board). • corroded connection. • blocked rotors. • squeezed cables. Change fan or remove cause.
Slave defect	Error detected in slave module.	Faulty connection between master and slave.	Check internal wiring. If cable and wiring is ok, change the ballast.
For other messages, please contact your **BIO-UV Group** representative.			

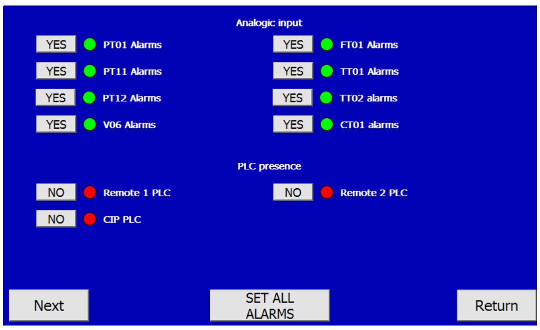
35. Help for troubleshooting

The use of these screens requires advanced knowledge of the system. It is recommended to ask for help to BIO-SEA support or its representative.

35.1. Alarms deactivation

This screen allows enabling/disabling various alarms individually to perform tests for Service and Factory purposes. For an easier use, a button allows activating all alarms in once time. These functions are only available when an Installer identification is logged in. As soon as the installer identification is logged out or the AUTO mode is selected, all alarms are set again to ON.

Figure 114: Alarms activation screen



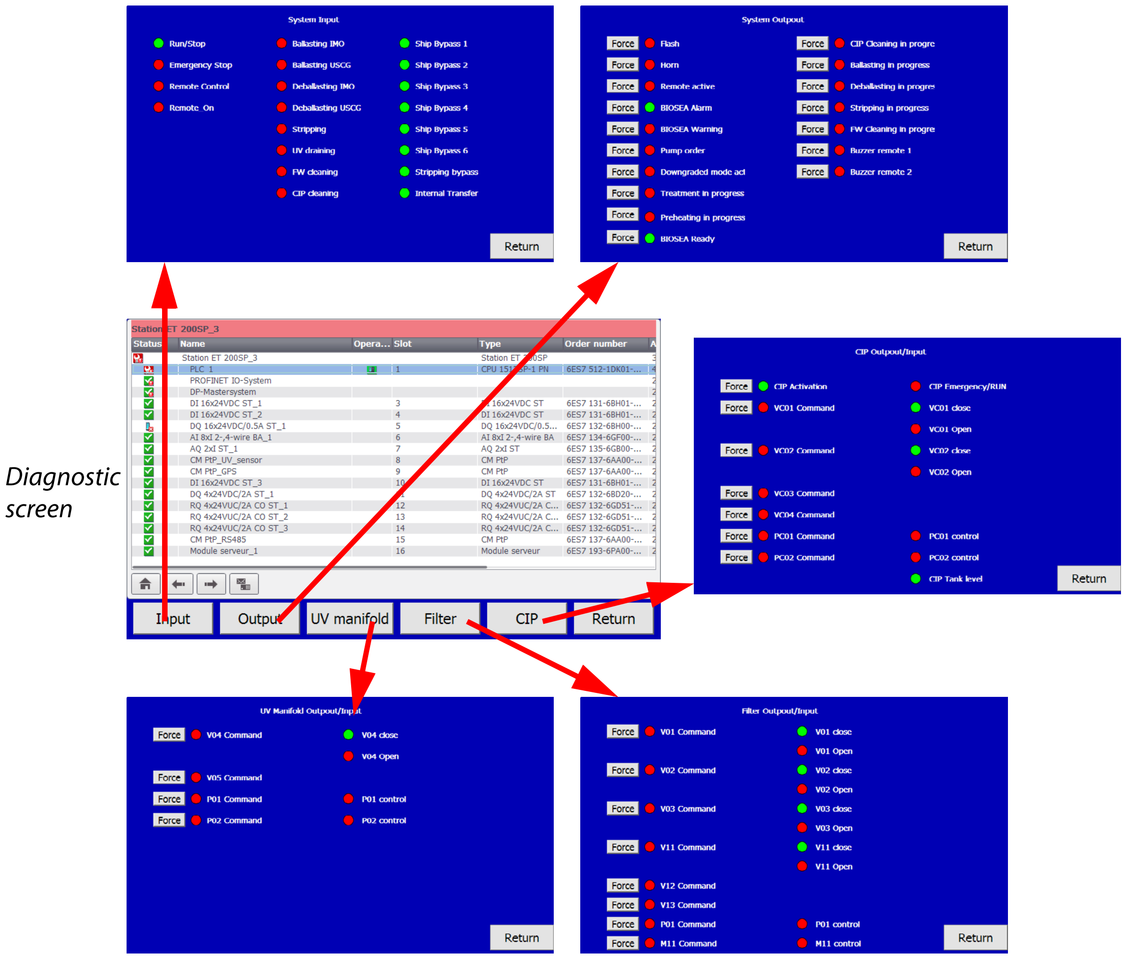
35.2. Diagnostic screen

This screen allows accessing to specific details of PLC components and their internal events.

It also allows accessing other screen to show outputs states or to force various outputs as shown on the pictures below. Forcing these outputs requires to log in with a Installer identification.

The forcing buttons are active only when presses. It is inactivated as soon as it is released. Indicators for display the state of the inputs or the outputs: green = active, red = inactive.

Figure 115: Diagnostic screen



36. Survey

The information contained on this section is for general information purposes only.

Whilst **BIO-UV Group** endeavors to keep the information up to date, **BIO-UV Group** makes no representations or warranties of any kind, express or implied about the completeness, accuracy, reliability, suitability or availability with respect to the below information, and cannot be held liable for any false, inaccurate, inappropriate or incomplete information presented here.

It is expected that Administrations will take into account the "Survey Guidelines for the purpose of the International Convention for the Control and Management of Ships' Ballast Water and Sediments under the Harmonized System of Survey and Certification", developed by the IMO, to undertake the various surveys required under regulation E-1 of the BWM Convention.

In addition, IMO has adopted "Guidelines for Ports State Control under the BWM Convention" (Res.MEPC.252(67)), which provide basic guidance for the conduct of a port State control (PSC) inspection to verify compliance with the requirements of the BWM Convention.

This section intends to give some guidance on which information the ship-owner or surveyor could use for answering these survey requirements.

36.1. Installation Survey / Initial surveys

When a Type Approved ballast water management system is installed on board, an installation survey should be carried out by the Administration to verify that:

- The installed BWTS is in conformity with the Type Approval Certificate for **BIO-SEA**® BWTS.
- the installation has been carried out in accordance with our specifications, and the workmanship of the installation is satisfactory.
- any operational inlets and outlets are located in the positions indicated on the drawings of the pumping and piping arrangements (P&ID).
- sampling facilities are provided and arranged (according to IMO G2 guidelines) in order to collect representative samples of the ships ballast water at discharge.
- the BWTS and its Control and Monitoring Equipment operate correctly, including any audible or visual alarms.
- the BWTS recording device is operable and data are retrievable on USB stick (see 12.2. Datalog, page 88).
- the whole ballast water system allows to meet the D-2 discharge standard.

36.1.1. Functional tests and checks

It is required that the manufacturer provides a "recommended test and checkout procedure specific to the BWMS": these are the installation and commissioning procedures contained in BS3-02, BS3-03 and the corresponding checklists (ENR-BSE-20 and ENR-BSE-22), usually filled and signed for the specific installation.

36.1.2. Documentation

Specific documentation on the BWMS should be available on board in a suitable format.

For this, **BIO-UV Group** provides in its technical binder:

- a copy of the Type Approval Certificate of BWMS, which include the confirmation that the electrical and electronic components of the BWMS have been type-tested (environmental testing).
- equipment manuals for major components of the **BIO-SEA**® BWTS.
- the complete Manual for the BWMS (approved by the Administration issuing the Type Approval certificate for **BIO-SEA**®BWTS), which contains:
    - a technical description of the **BIO-SEA**® BWTS.
    - its operational procedures, as well as troubleshooting and maintenance procedures in case of equipment malfunction.
    - installation specifications, as well as installation and commissioning procedures (BS3-02).
    - verification procedures for sensors.
    - when a CIP is installed, dosage instruction for cleaning solution are available in **BIO-SEA®Clean** operating manual.
- the checklists for installation and commissioning, filled and signed by the subcontractor, the customer, **BIO-UV Group** representative and the class surveyor (when applicable), for **BIO-SEA**® BWTS installation and commissioning.

In addition, the vessel should come with a Ballast Water Management Plan and a Ballast Water Record Book.

The BWTS instructions should be integrated in the crew instructions regarding Ballast Water Management and Equipment servicing, including monitoring and reporting obligations.

36.1.3. Ballast Water Management Plan

Depending on the selected **BIO-SEA**® model and integration choices, the Ballast Water Management Plan should be reviewed and modified in order to include:

1- BWTS description.

2- Use of Exchange and/or Treatment processes during ship's operation, in order to be in compliance with IMO D-1 and D-2 rules and USCG regulations.

3- Emergency procedures in case of system failure.

4- Reporting procedures for Port State Control (BWTS datalog). This may also include national or regional ballast water regulations (for ex: specific reports).

36.1.4. Commissioning test

Flags may require the newly installed BWMS to undergo a Commissioning Test, taking into account the IMO circular BWM.2/Circ.70 (as may be amended) on "Guidance for the commissioning testing of ballast water management systems".

The purpose of this Commissioning test is to verify that the mechanical, physical, chemical and biological processes of the installed BWMS are working properly, including the whole ballast water circuit (tanks, piping, pumps), allowing the vessel to comply with the D-2 standard at discharge.

The commissioning test is not intended to re-validate the type approval of the BWMS.

The arrangement for conducting the test and any commercial dealings pertaining to the commissioning test should be between the shipowners/manager/shipyard and the contractor laboratory, and be independent of the BWTS manufacturer.

The discharge ballast water sample collected for the commissioning test should be a representative sample, analyzed using at least an appropriate indicative method, as listed in BWM.2/Circ.42/Rev.1, "Guidance on ballast water sampling and analysis" (as may be amended). The use of a test kit by the vessel's crew or the manufacturer of the treatment system is not an acceptable alternative to biological efficacy testing performed by an independent test facility.

For **BIO-SEA**® BWTS, due to the 2 different treatment modes available, **BIO-UV Group** recommends the following methods for counting of the 10-50µm fraction:

- MPN (detailed) or ATP (indicative methods) if using the IMO/MPN mode,
- CMFDA/FDA (detailed) or fluorescence methods (indicative) if using the USCG/CMFDA mode,

in order to apply the same level of stringency for this test than during Type Approval process.

The commissioning test is considered to be successful if

- the analysis indicates that the sample does not exceed the D-2 standard and,
- the self-monitoring equipment of the BWMS indicates correct operation of all sensors and related equipment.

For **BIO-SEA**® BWTS, this means that:

- UVI reading should be above the limit threshold (no low UVI alarm, no degraded mode).
- Filter can operate (normal backwash, no clogging risk).

In case the commissioning test could not be successfully carried out due to the equipment's system design limitation (eg: too much TSS for the filter, or too low UVT for the UV reactors), Flag Administration will indicate the time frame in which a new test can be conducted for issuance of a final International Ballast Water Management Certificate (IBWMC).

A written report including methods and detailed results of the commissioning testing should be provided by the laboratory.

If discharge results of the commissioning test are not compliant with D-2 standard, an analysis of the possible causes should be led by the vessel owner/manager.

Based on the experience of shipboard testing and previous installations, BIO-UV can help the shipowner to identify possible causes, such as:

- Contamination from untreated water (leakage of by-pass valve, dead-ends…).
- Contamination from tanks (not cleaned).
- Improper use of the BWTS.
- Etc…

After completion of a satisfactory initial survey, the International Ballast Water Management Certificate should be issued.

36.2. Other Surveys

Intermediate, annual and renewal surveys should allow to verify the proper use and functioning of the BWTS, and confirm or renew the validity of the International Oil Pollution Prevention Certificate.

A survey checklist (ENR-BSE-23) is provided by **BIO-UV Group** in the template section of this manual for reference, in order to address specific checks for **BIO-SEA**® BWTS.

The surveyor would check:

- whether any new equipment has been fitted on the BWTS and, if so, confirm that it has been approved before installation and that any changes are reflected in the applicable documentation.
- that the Ballast Water Management Plan is on board.
- whether the appropriate entries have been made in the Ballast Record Book.
- that the Type Approval Certificate of installed BWMS is available on board.

The surveyor would also check the installed BWTS externally and confirm, as far as practicable, its satisfactory state and operation, including (as applicable):

- obvious defects, deterioration, damage, wear or corrosion on the BWTS.
- the satisfactory operation of the BWTS by simulated test or equivalent.
- that the performance of the BWMS components that take measurements is maintained through calibration and/or verification, according to the **BIO-UV Group** instructions in the OMSM.
- that the control and monitoring equipment, including the recording device, is functioning properly.
- the proper maintenance of the BWTS according to **BIO-UV Group** instructions in the OMSM, including the sufficient provision of consumables or substances on board.

- After completion of satisfactory survey, the International Ballast Water Management Certificate should be endorsed or renewed.
- If a survey shows that the condition of a ship or its equipment is unsatisfactory, the relevant certificate (IOPP) could be withdrawn and the Administration notified immediately. If the ship is in the port of another Party, the appropriate authorities of the port State should also be notified immediately.

36.3. Port State Inspections

This PSC procedure can be described as a four-stage inspection:

1- "initial inspection": it should focus on documentation and ensuring that an officer has been designated to be responsible for the BWMP, and that designated officers and crew are familiar with essential BWM procedures, including the operation of the BWMS.
If clear grounds are found in stage 1, the PSC officer will conduct stage 2.

2- "more detailed inspection": is where the operation of the BWMS is checked and the PSC officer clarifies whether the BWMS has been operated adequately according to the BWMP and the self-monitored operational indicators (as verified during type approval procedures). See 36.3.1. Documentation, page 223
Outcomes of stage 2 may result in sampling (stage 3).

3- "indicative analysis": sampling is envisaged to identify whether the ship is meeting the ballast water management performance standard described in regulation D-2 through indicative methods, or whether detailed analysis (stage 4) is necessary.

4- "detailed analysis": sampling incorporates detailed analysis to ascertain compliance with the D-2 standard.

For means of adequate sampling, see 36.3.2. Sampling, page 224.

36.3.1. Documentation

During initial inspection, the PSC officer should perform verification of required documentation: a valid International Ballast Water Management Certificate (IBWMC), an approved Ballast Water Management Plan (BWMP), the Ballast Water Record Book (BWRB).

BIO-UV Group does not bear any responsibility on these documents which are property of the vessel owner or operator.

The PSC Officer should also do a visual check of the BWT equipment and arrangements. He may consult the BWMP to obtain ship-specific information on the BWMS and its use, or ask to check the Type Approval Certificate (TAC) of the BWMS, in order to determine whether it has been used in accordance with any limiting conditions mentioned on the TAC.

In the more detailed inspection, PSC officer can check more precisely how BWMS is used (safety procedures, good working order, operational limitations, self-monitoring) to meet the arrangement described in the BWMP.

Datalog of **BIO-SEA®** BWTS allows retrieving this type of information (values of monitored parameters, events and alarms, by-passes…). For further information about retrieving datalog and data analysis refer to 12.3. Datalog files analysis, page 89.

36.3.2. Sampling

Voluntary or mandatory sampling of ballast water can be performed by surveyors at discharge, for compliance check (Resolution MEPC.252(67): Guidelines for Port State Control under the BWM convention) or for data gathering (Resolution MEPC.291(71): the Experience building phase associated with the BWM convention).

BIO-UV Group can provide isokinetic sampling points designed according to IMO Guidelines for Ballast Water Sampling (G2) (resolution MEPC.173(58)).

The table below gives the adequate sampling flow to use in order to guarantee isokinetic conditions and optimum sample representativity.

Table 46: Recommended sampling flow

BIO-SEA® model	DN of ballast piping (at outlet)	DN of sampling port	Internal diameter of sampling port	External diameter of sampling pipe	Recommended flow for sampling	
					at system min. flow rate	at system max. flow rate
			mm	mm	m^3/h	m^3/h
L01-0030	80	100	105	34	0,3	0,5
L01-0055	80	100	105	34	0,3	0,6
L02-0035	80	100	105	34	0,5	1
L02-0055	80	100	105	34	0,5	1,1
L02-0060	100	100	105	34	0,5	1,1
L03-0055	100	100	105	34	0,8	1,6
L03-0087	100	100	105	34	0,8	1,6
L03-0090	100	100	105	34	0,8	1,6
L04-0087	150	150	159	34	1,1	2,2
L04-0120	150	150	159	34	1,1	2,2
B01-0055	80	100	105	34	1,4	1,4
B01-0087	100	100	105	34	1,4	2,2
B01-0110	150	150	159	34	0,6	1,1
B01-0135	150	150	159	34	0,6	1,1
B01-0150	150	150	159	34	0,6	1,1
B02-0150	150	150	159	34	0,6	1,1
B02-0190	150	150	159	34	1,3	2,2
B02-0255	200	200	207	42	1,2	2,3
B02-0300	200	200	207	42	1,2	2,3
B03-0300	200	200	207	42	1,2	2,3
B03-0340	200	200	207	42	1,9	3
B03-0450	250	250	260	42	1,2	2,1
B04-0515	250	250	260	42	1,6	2,9
B04-0530	250	250	260	42	1,6	2,9
B04-0600	300	300	311	42	1,1	2
B05-0515	250	250	260	42	2	3
B05-0530	250	250	260	42	2	3

Table 46: Recommended sampling flow

BIO-SEA® model	DN of ballast piping (at outlet)	DN of sampling port	Internal diameter of sampling port	External diameter of sampling pipe	Recommended flow for sampling	
					at system min. flow rate	at system max. flow rate
			mm	mm	m^3/h	m^3/h
B05-0750	300	300	311	42	1,4	2,5
B06-0600	250	250	260	42	1,6	2,9
B06-0750	300	300	311	42	1,4	2,5
B06-0770	300	300	311	42	1,7	3
B06-0900	350	350	343	42	1,4	2,5
B07-0750	300	300	311	42	1,4	2,5
B07-0770	300	300	311	42	1,9	3
B07-1040	350	350	343	42	1,6	2,9
B07-1050	350	350	343	42	1,6	2,9
B08-1040	350	350	340	42	1,8	2,9
B08-1050	350	350	343	42	1,6	2,9
B08-1200	400	400	393	42	1,4	2,5
B09-1350	400 (Filtrex) 450 (Hydac)	400 (Filtrex) 450 (Hydac)	393 (Filtrex) 444 (Hydac)	42 (Filtrex) 42 (Hydac)	1,5 (Filtrex) 2,1 (Hydac)	2,8 (Filtrex) 2,5 (Hydac)
B10-1040	350	350	343	42	2,3	3
B10-1050	350	350	343	42	2,3	3
B10-1500	400 (Filtrex) 450 (Hydac)	400 (Filtrex) 450 (Hydac)	390 (Filtrex) 444 (Hydac)	42 (Filtrex) 42 (Hydac)	1,7 (Filtrex) 2,3 (Hydac)	3,1 (Filtrex) 2,7 (Hydac)
B12-1210	400	400	393	42	1,4	2,5
B12-1500	500	500	495	42	2,1	3
B12-1725	450	450	444	42	2,7	3
B12-1800	500	500	495	42	1,3	2,4
B14-1500	400	400	393	42	2,4	4
B14-1725	450	450	444	42	2,7	3
B14-2070	500	500	495	42	2,5	2,8
B14-2100	500	500	495	42	1,5	2,8

Any corrosion or fouling of the sampling system may affect sample flow rates and sample representativeness.

It is then recommended to clean the sampling pipe before use.

As flow control is required for sampling outlet, a diaphragm valve or similar valve type should be used in order to minimize sharp velocity transitions. This regulating valve is not provided by **BIO-UV Group**.

Ball, gate and butterfly valve types should be avoided as they may cause significant shear forces which may result in organism mortality inside sampled water. A manual ball valve is provided with the sampling pipe for safety closing, and not for regulation of sampling outlet.

37. Contacts and Technical Service

850 Avenue Louis Médard

34400 Lunel Cedex

FRANCE

Tel: +33(0) 499 133 911

Fax: +33(0) 499 133 919

Email: servicebiosea@bio-uv.com or bio-sea@bio-uv.com

If you have any doubt or if you need any further technical information, please contact your local **BIO-UV Group** representative. Don't hesitate to contact us to get the list of the closest **BIO-SEA®** partners for your region.

It is **essential** to provide the **BIO-SEA® model and the ID number** before any request concerning spare parts. You can get them on the System Identification plate fixed on the control cabinet.

When replacing a components marked with a label (like P01 on a pump), it is necessary to make sure the new component is marked as well

38. Spare parts list for installation

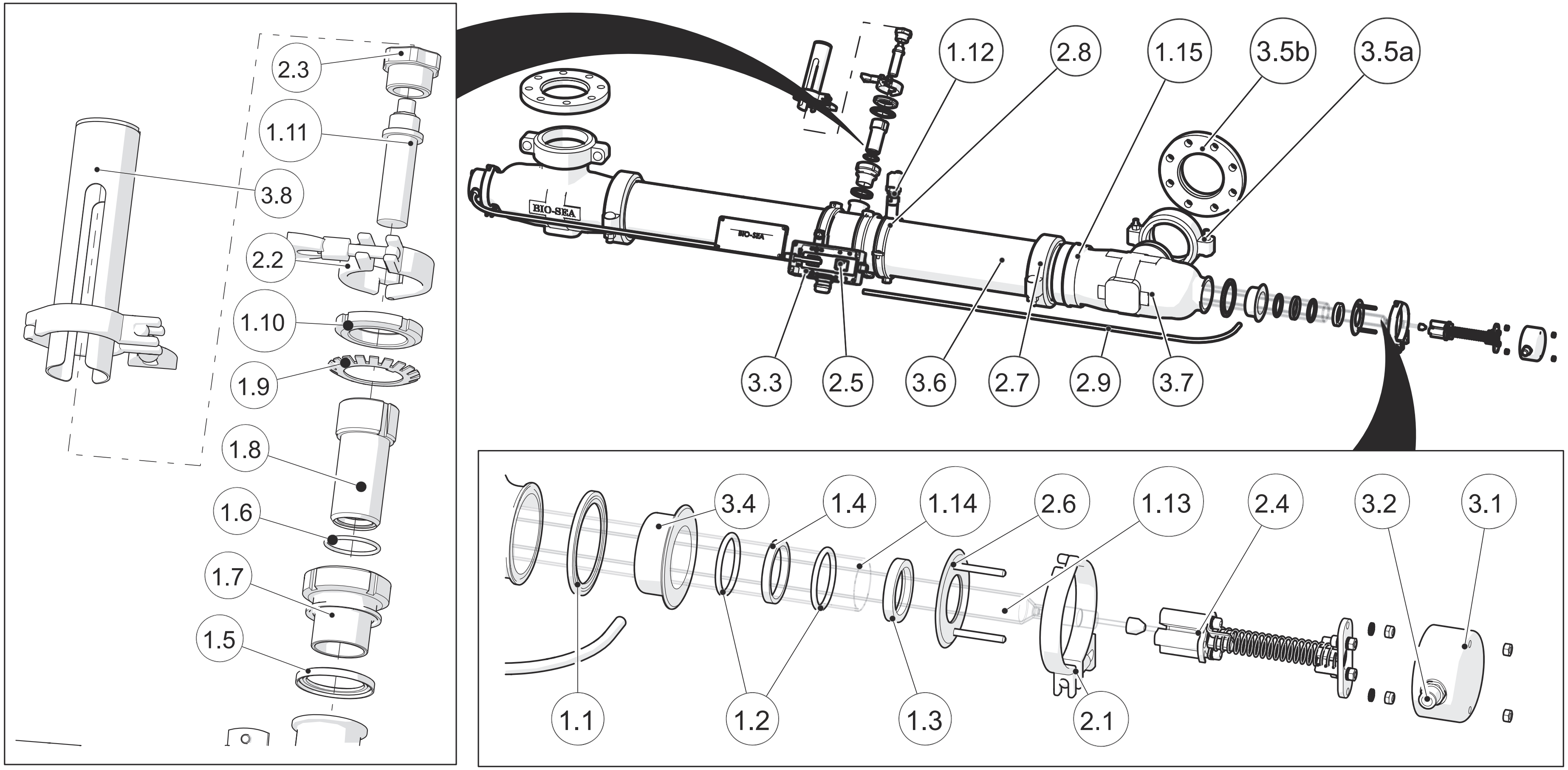
38.1. for BIO-SEA® B models

Ref PMI	Description	Qty
LPE006881	Lamp	1
QUA006882	Quartz	1
SET008688	Sealing Set Quartz	1
ELE008886	Distribution block Y	1
ELE008887	UV sensor cable (between sensors,5m)	1
ELE009472	UV sensor cable (from control cabinet to UV sensor, 10m)	1
ELE016803	UV sensor cable (from control cabinet to UV sensor, 20m)	
ELE006815	Lamp cable connector for 22kW ballast	1

38.2. for BIO-SEA® L models

Ref PMI	Description	Qty
LPE008659	Lamp	1
QUA008675	Quartz	1
SET001163	Sealing Set Quartz	1
ELE008886	Distribution block Y	1
ELE008887	UV sensor cable (between sensors,5m)	1
ELE009472	UV sensor cable (from control cabinet to UV sensor, 10m)	1
ELE016803	UV sensor cable (from control cabinet to UV sensor, 20m)	

39. BIO-SEA® B Reactors

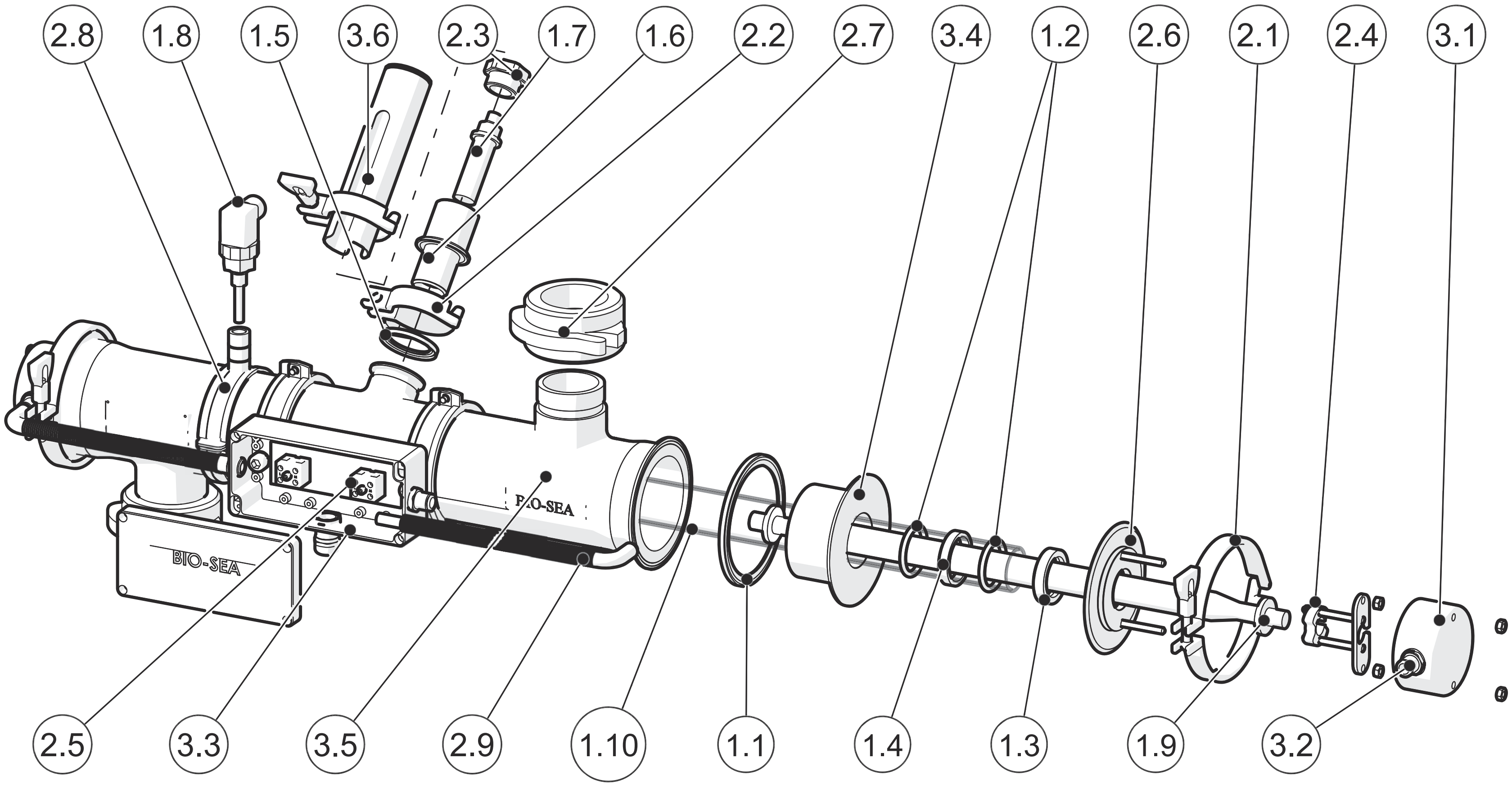


ID	Ref PMI	Description	Qty	Kit ref	Qty/kit
Level 1: Spare parts recommended to always keep on board					
--	-	Silicon grease	-	SET008688	1
1.1	ACC005823	Clamp gasket ISO DN65	2		2
1.2	JTS009103	Oring Ø46.99x5.33 FKM 80SH	4		4
1.3	USI007190	Shouldered ring for BIOE-SEA sealing	2		2
1.4	USI007189	PTFE ring Bio-Sea	2		2
1.5	ACC007182	Clamp gasket ISO DN32	1		1
1.6	JTS015282	Oring Ø32x3	1		1
1.7	USI600338	Measuring window	1	ASM600826[i]	x
1.8	ASM603963	Adjustable window base	1		x
1.9	VIS014897	Locking washer M40	1		x
1.10	VIS014899	Notch nut M40x1.5	1	x	x
1.11	ELE008712	UV sensor ONORM digital (6000 W-m^2)	1	x	x
1.12	ELE010823	Temperature probe 4-20mA	1	x	x
1.13	LPE006881	Lamp MP 22Kw	1	x	x
1.14	QUA006882	Quartz D47	1	x	x
1.15	JTS008690	Seal_coupling Ø139.7 ZEROFLEX	2	SET008689	2
--	-	Silicon grease	-		-
Level 2: Recommended spare parts for maintenance					
2.1	ACC005829	Clamp coupling DN65-76	2	x	x
2.2	ACC005828	Clamp coupling DN20-25-32-38	1	x	x
2.3	USI007183	Nut for UV sensor housing Bio-Sea	1	x	x
2.4	ASM605225[ii]	Lamp holder Bio-Sea	2	x	x
2.5	ELE000068	Ceramic terminal	2	x	x
2.6	ASM008059	Sealing ring Bio-Sea	2	x	x
2.7	RAC008061	VIC COUPLING STYLE 07 RIGID Ø139.7 Galvanized	2	x	x
2.8	ASM601738	Support collar for temperature sensor	1	x	x
2.9	PIE012102	Protection tube for lamp cable Bio-Sea	2	x	x
Level 3: For information					
3.1	USI007195	Protection cover for reactor end Bio-Sea	2	x	x
3.2	RAC008069	Connection Ø10-3-8P	2	x	x
3.3	ELE007242	Box 81x177x57 Bio-Sea (al 081806)	1	x	x
3.4	USI007180	Quartz sealing base Bio-Sea	2	x	x
3.5a	RAC008061[iii]	VIC COUPLING STYLE 07 RIGID Ø139.7 Galvanized	2	x	x
3.5b	RAC008070[iii]	Adapter Flange DN100-4"	2	x	x
3.6	PIE008056	Body D139.7	1	x	x
3.7	PIE008060	Subbase Bio-Sea	2	x	x

ID	Ref PMI	Description	Qty	Kit ref	Qty/kit
3.8	ASM014483 iv	UV sensor shield kit	1	x	x

i. To order the complete adjustable measuring window ASM600826, it is recommended to order the kit SET015844 instead which also include clamp seal ACC007182 (id:1.5)
ii. This code is for the version 2 applicable starting from 2023. To order the version 1 applicable until 2023, use code ASM007186. Both versions are approved to be mounted at the same place, however the same version must be present on both sides of each lamp of the reactor.
iii. According to BWTS configuration: with victaulic coupling or DIN flange
iv. Optional accessory

40. BIO-SEA® L Reactors

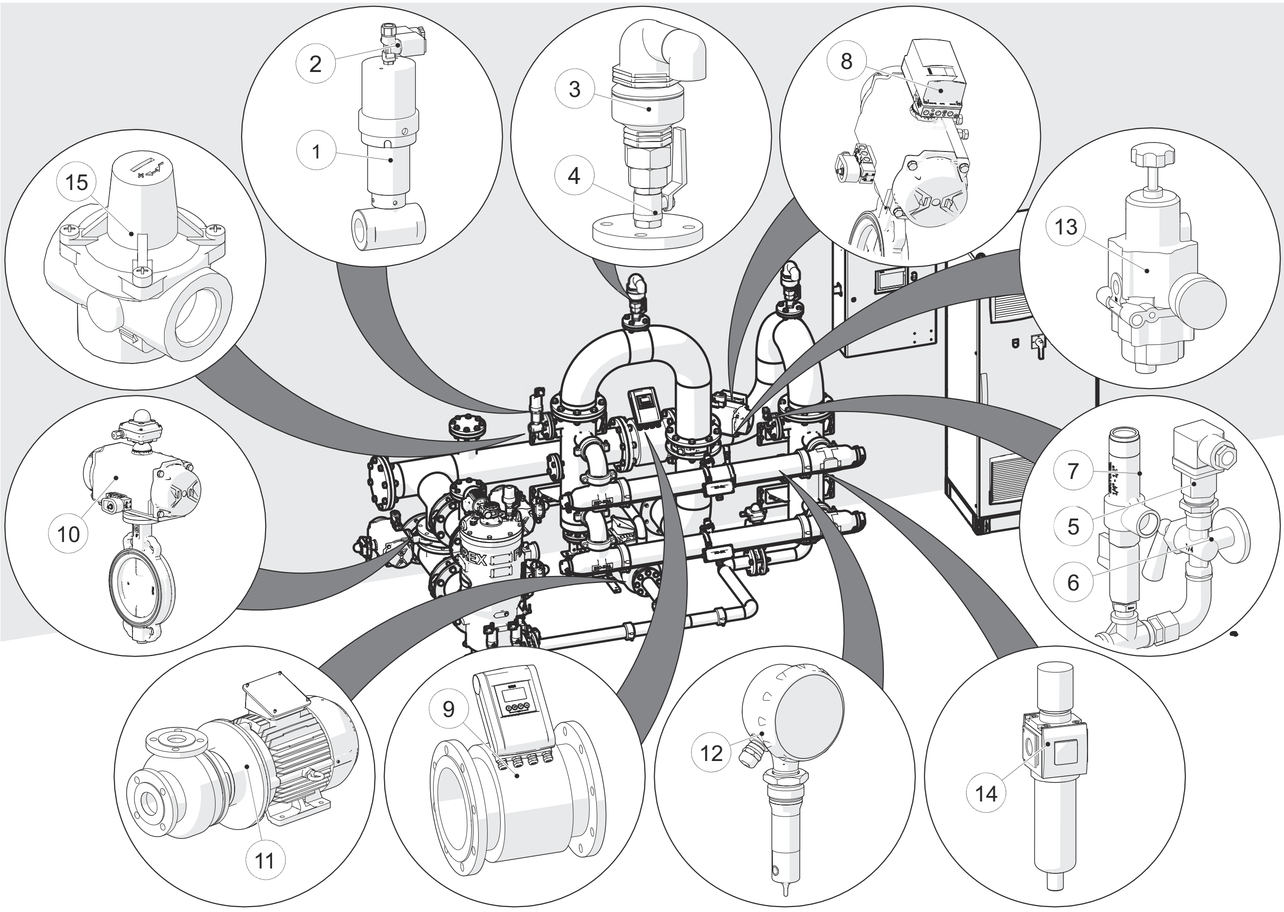


ID	Ref PMI	Description	Qty	Kit ref	Qty/kit
Level 1: Spare parts recommended to always keep on board					
--	-	Silicon grease	-	SET001163	1
1.1	ACC008833	Clamp gasket DIN DN100	2		2
1.2	JTS009450	Oring Ø40x5	4		4
1.3	USI014482	Shouldered ring for BIOE-SEA sealing	2		2
1.4	USI008826	PTFE ring Bio-Sea	2		2
1.5	ACC007182	Clamp gasket ISO DN32	1		1
1.6	ASM603985	Measuring window	1	x	1
1.7	ELE008712	UV sensor ONORM digital (6000 W-m^2)	1	x	x
1.8	ELE010823	Temperature probe 4-20mA	1	x	x
1.9	LPE008659	Lamp MP 6Kw	1	x	x
1.10	QUA008675	Quartz D40x2	1	x	x
Level 2: Recommended spare parts for maintenance					
2.1	ACC008829	Clamp coupling DN104 (standard design)	2	x	x
	ACC018464	HP clamp DN119 (only for ship under US flag)	2	x	x
2.2	ACC005828	Clamp coupling DN20-25-32-38 (standard design)	1	x	x
	ACC018463	HP clamp DN50 (only for ship under US flag)	1	x	x
2.3	USI007183	Nut for UV sensor housing Bio-Sea	1	x	x
2.4	ASM009453	Lamp attachment system Bio-Sea	2	x	x
2.5	ELE000068	Ceramic terminal	2	x	x
2.6	ASM012261	Sealing ring assembly	2	x	x
2.7	RAC008832	Coupling Snap joint DN50 (standard design)	2	x	x
	RAC009923	Victaulic coupling 2" (only for ship under US flag)	2	x	x
2.8	ASM601494	Support collar for temperature sensor	1	x	x
2.9	ELE010415	Conduit protection 10x3	0,6m	x	x
	PIE012329	Stainless steel pipe for lamp cable	2	x	x
Level 3: For information					
3.1	USI007195	Protection cover for reactor end Bio-Sea	2	x	x
3.2	RAC008069	Connection Ø10-3-8P	2	x	x
3.3	PIE011554	Box 81x177x57 Bio-Sea (al 081806)	1	x	x
3.4	USI008831	Quartz sealing base Bio-Sea	2	x	x
3.5	PIE014471	Reactor Body 30m3/h	1	x	x
3.6	ASM014483[i]	UV sensor shield kit	1	x	x

i. Optional accessory

41. System components

41.1. for BIO-SEA® B models

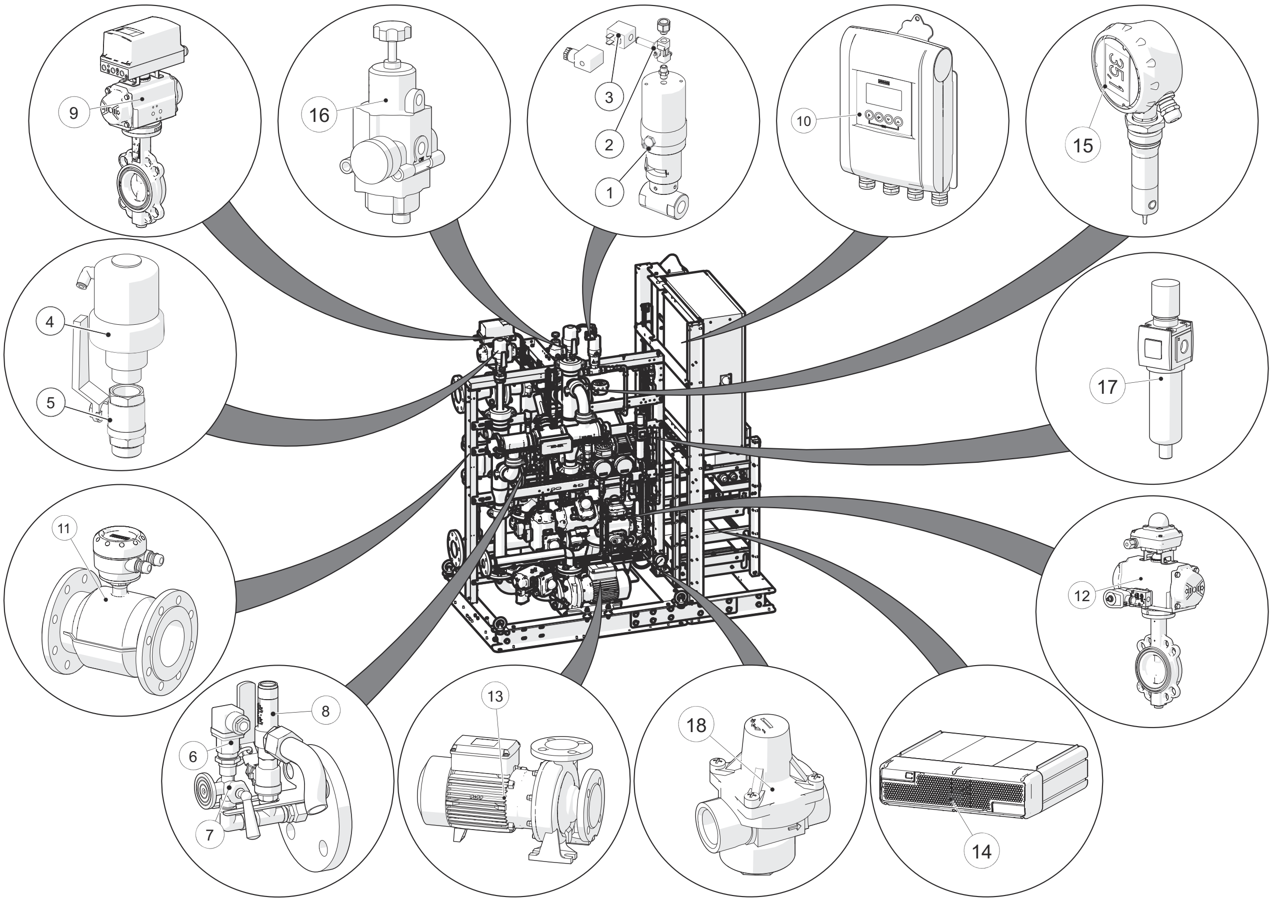


ID	Description	Ref PMI	Manufacturer
Level 1: Spare parts recommended to always keep on board			
2	Elcetrovalve3/2 NC 1/8" D1.2 AC/DC	RAC010405	-
3	Automatic vent valve 2”	PNEU009930	AVK
5	Pressure sensor -1...15 bar, connection G1/4”	ELE010927	JUMO
		HYSP1370060	HYDAC
12	Conductivity sensor	ELE010828	BAUMER
13	Filtering element 5µm	PNEU013484	-
14	Filtering element 25µm	PNEU013468	-

ID	Description	Ref PMI	Manufacturer
	Level 3: For information		
1	Automatic ball valve DN15 / 1/2"	VALV009238	VALVAUT
	Automatic ball valve DN25 / 1"	VALV008961	VALVAUT
	Automatic ball valve DN50 / 2"	VALV010394	VALVAUT
4	Manual valve 1"	ACC007465	-
6	Manual valve with test plug 1/4" brass	PNEU012072	-
7	Safety valve 1/4"	VALV014437	-
8	Electro-pneumatic positioner box for control valve	VALVSP00003 (and See 43. Electro-pneumatic control valve, page 265)	SIEMENS
9[i]	Flow transmitter	FLOW009932	KRHONE
	Flow sensor DN80	FSENSOR080	
	Flow sensor DN100	FSENSOR100	
	Flow sensor DN150	FSENSOR150	
	Flow sensor DN200	FSENSOR200	
	Flow sensor DN250	FSENSOR250	
	Flow sensor DN300	FSENSOR300	
	Flow sensor DN350	FSENSOR350	
	Flow sensor DN400	FSENSOR400	
	Flow sensor DN450	FSENSOR450	
	Flow sensor DN500	FSENSOR500	
10	Electro-pneumatic butterfly valve	See 42. Electro-pneumatic butterfly valve, page 237	GHIBSON (by PICON)
11	Suction pump	See 44. Suction pump details, page 276	CALPEDA
13	Air pressure reducing valve for control valve (5µm)	PNEU011556	-
14	Main air pressure reducing valve with filter (25µm)	PNEU012383	-
15	Water pressure limiter DN25	RAC011102	-
	Water pressure limiter DN50	RAC011103	-

i. These references refer to flowmeters in separate configuration. For spare parts of flowmeters in compact version, please contact **BIO-UV Group** or its representative.

41.2. for BIO-SEA® L models



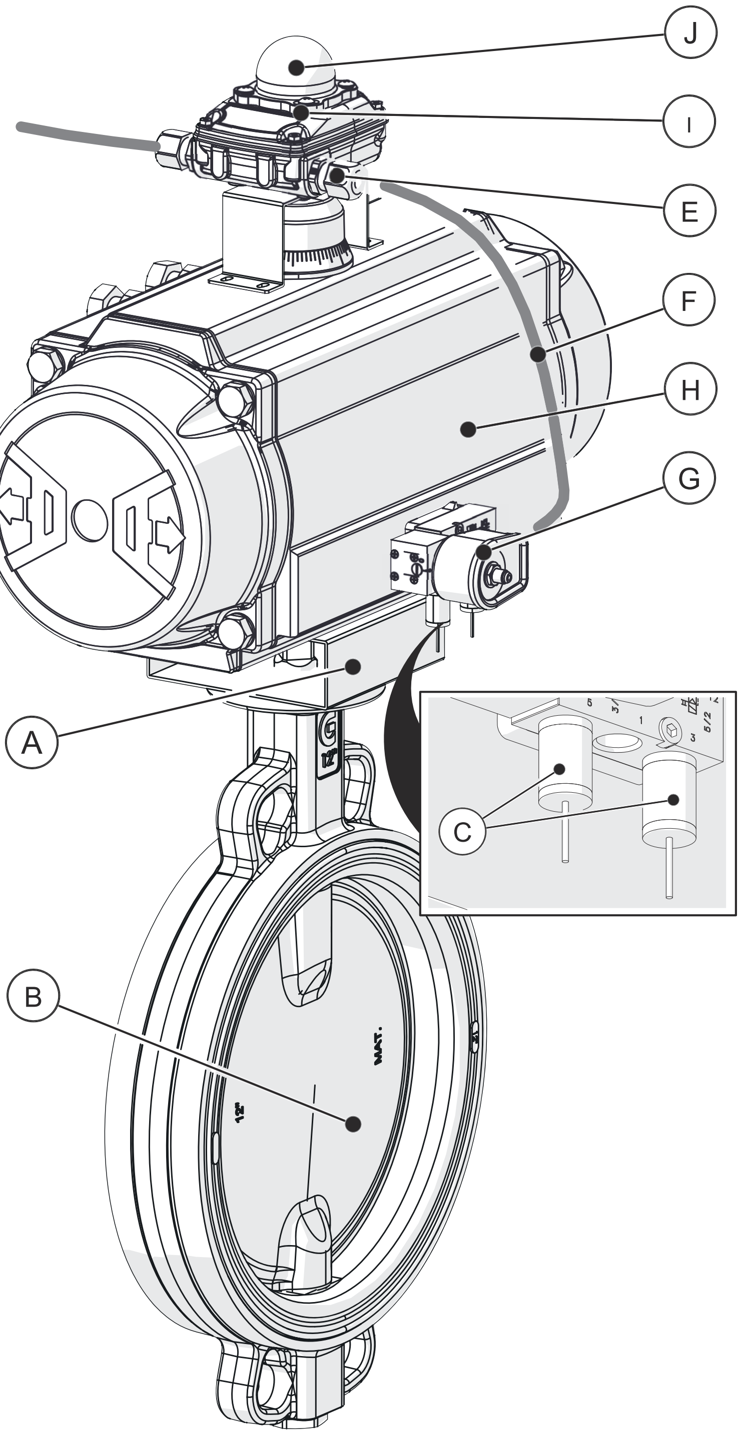
ID	Description	Ref PMI	Manufacturer
Level 1: Spare parts recommended to always keep on board			
2	Actuator 3/2 NC 1/8"	RAC010405	-
3	Green Coil 24Vdc	RAC010404	ASCO
4	Automatic vent valve 1”	PNEU006807	AVK
6	Pressure sensor -1...15 bar, connection G1/4”	ELE010927	JUMO
15	Conductivity sensor	ELE010828	BAUMER
16	Filtering element 5µm	PNEU013484	-
17	Filtering element 25µm	PNEU013468	-
Level 3: For information			
1	Automatic ball valve DN15 / 1/2”	VALV009238	VALVAUT
5	Manual valve 1”	ACC007465	-

Spare parts

ID	Description	Ref PMI	Manufacturer
7	Manual valve with test plug 1/4" brass	PNEU012072	-
8	Safety valve 1/4"	VALV014437	-
9	Electro-pneumatic positioner box for control valve	VALVSP00003 (and See 43. Electro-pneumatic control valve, page 265)	SIEMENS
10[i]	Flow transmitter	FLOW009932	KRHONE
11	Flow sensor DN80	FSENSOR080	
	Flow sensor DN100	FSENSOR100	
	Flow sensor DN150	FSENSOR150	
12	Electro-pneumatic butterfly valve	See 42. Electro-pneumatic butterfly valve, page 237	GHIBSON (by PICON)
13	Suction pump	See 44. Suction pump details, page 276	CALPEDA
14	Ballast 8kW	BAL008672	ETA Plus
16	Air pressure reducing valve for control valve (5µm)	PNEU011556	-
17	Main air pressure reducing valve with filter (25µm)	PNEU012383	-
18	Water pressure limiter DN15	RAC011101	-

i. These references refer to flowmeters in separate configuration. For spare parts of flowmeters in compact version, please contact **BIO-UV Group** or its representative.

42. Electro-pneumatic butterfly valve



42.1. What is the type of your valve?

To check the type of your valve, look at the name plate of the valve body and ID on the actuator (see picture below)

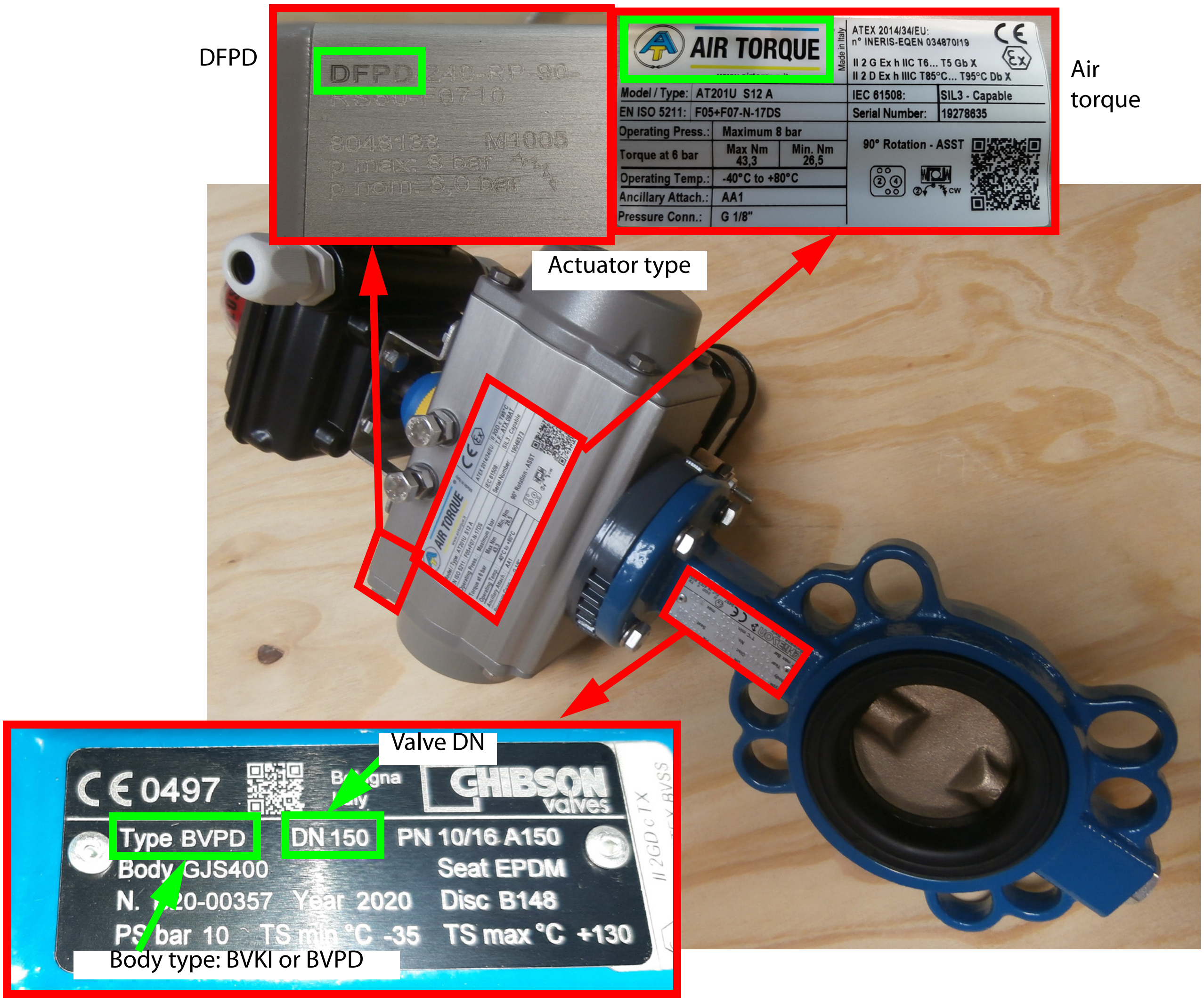


Table 47: Identification of the valve type with the valve body type and the actuator type

Valve type	Valve body type	Actuator type
GHIA	BVKI	AIR TORQUE
GHIB	BVPD	AIR TORQUE
GHIC	BVPD	DFPD

42.2. GHIA type valves

Complete butterfly valve with actuator		Spare parts					Mounted actuator reference
Reference	Designation	ID	Reference	Designation	Level[i]	Qty	
VALV040EPSE-GHIA	Butterfly valve auto EP SE DN40	B	VALVSP00014	Butterfly valve body PN16 DN40	3	1	-
		C	PNEU011472	Adjustable muffler 1/4 BSP	1	2	ACTSP0000001
		E	VALVSP00001	Gland cable for limit switch	3	2	
		F	VALVSP00002	Cable SABIX BL438CFRNC	3	1	
		G	VALVSP00007	Solenoid valve m-stable 3/2-5/2 1/4 BSP 24VCC	1	1	
		I	VALVSP00013	Limit switch box IP67	1	1	
		H	VALVSP00027	Actuator s.effect AT201S10A	1	1	
VALV050EPSE-GHIA	Butterfly valve auto EP SE DN50	B	VALVSP00015	Butterfly valve body PN16 DN50	3	1	-
		C	PNEU011472	Adjustable muffler 1/4 BSP	1	2	ACTSP0000001
		E	VALVSP00001	Gland cable for limit switch	3	2	
		F	VALVSP00002	Cable SABIX BL438CFRNC	3	1	
		G	VALVSP00007	Solenoid valve m-stable 3/2-5/2 1/4 BSP 24VCC	1	1	
		I	VALVSP00013	Limit switch box IP67	1	1	
		H	VALVSP00027	Actuator s.effect AT201S10A	1	1	

Complete butterfly valve with actuator		Spare parts					Mounted actuator reference
Reference	Designation	ID	Reference	Designation	Level[i]	Qty	
VALV065EPSE-GHIA	Butterfly valve auto EP SE DN65	B	VALVSP00016	Butterfly valve body PN16 DN65	3	1	-
		C	PNEU011472	Adjustable muffler 1/4 BSP	1	2	ACTSP0000001
		E	VALVSP00001	Gland cable for limit switch	3	2	
		F	VALVSP00002	Cable SABIX BL438CFRNC	3	1	
		G	VALVSP00007	Solenoid valve m-stable 3/2-5/2 1/4 BSP 24VCC	1	1	
		I	VALVSP00013	Limit switch box IP67	1	1	
		H	VALVSP00027	Actuator s.effect AT201S10A	1	1	
VALV080EPSE-GHIA	Butterfly valve auto EP SE DN80	B	VALVSP00017	Butterfly valve body PN16 DN80	3	1	-
		C	PNEU011472	Adjustable muffler 1/4 BSP	1	2	ACTSP0000002
		E	VALVSP00001	Gland cable for limit switch	3	2	
		F	VALVSP00002	Cable SABIX BL438CFRNC	3	1	
		G	VALVSP00007	Solenoid valve m-stable 3/2-5/2 1/4 BSP 24VCC	1	1	
		I	VALVSP00013	Limit switch box IP67	1	1	
		H	VALVSP00028	Actuator s.effect AT301S10A	1	1	
VALV100EPSE-GHIA	Butterfly valve auto EP SE DN100	B	VALVSP00018	Butterfly valve body PN16 DN100	3	1	-
		C	PNEU011472	Adjustable muffler 1/4 BSP	1	2	ACTSP0000003
		E	VALVSP00001	Gland cable for limit switch	3	2	
		F	VALVSP00002	Cable SABIX BL438CFRNC	3	1	
		G	VALVSP00007	Solenoid valve m-stable 3/2-5/2 1/4 BSP 24VCC	1	1	
		I	VALVSP00013	Limit switch box IP67	1	1	
		H	VALVSP00029	Actuator s.effect AT301S12A	1	1	

Complete butterfly valve with actuator		Spare parts					Mounted actuator reference
Reference	Designation	ID	Reference	Designation	Level[i]	Qty	
VALV125EPSE-GHIA	Butterfly valve auto EP SE DN125	B	VALVSP00019	Butterfly valve body PN16 DN125	3	1	-
		C	PNEU011472	Adjustable muffler 1/4 BSP	1	2	ACTSP0000004
		E	VALVSP00001	Gland cable for limit switch	3	2	
		F	VALVSP00002	Cable SABIX BL438CFRNC	3	1	
		G	VALVSP00007	Solenoid valve m-stable 3/2-5/2 1/4 BSP 24VCC	1	1	
		H	VALVSP00030	Actuator s.effect AT351S10A	1	1	
		I	VALVSP00046	Limit switch box IP67 ST2	1	1	
VALV150EPSE-GHIA	Butterfly valve auto EP SE DN150	B	VALVSP00020	Butterfly valve body PN16 DN150	3	1	-
		C	PNEU011472	Adjustable muffler 1/4 BSP	1	2	ACTSP0000005
		E	VALVSP00001	Gland cable for limit switch	3	2	
		F	VALVSP00002	Cable SABIX BL438CFRNC	3	1	
		G	VALVSP00007	Solenoid valve m-stable 3/2-5/2 1/4 BSP 24VCC	1	1	
		H	VALVSP00031	Actuator s.effect AT401S10A	1	1	
		I	VALVSP00046	Limit switch box IP67 ST2	1	1	
VALV200EPSE-GHIA	Butterfly valve auto EP SE DN200	B	VALVSP00021	Butterfly valve body PN10 DN200	3	1	-
		C	PNEU011472	Adjustable muffler 1/4 BSP	1	2	ACTSP0000006
		E	VALVSP00001	Gland cable for limit switch	3	2	
		F	VALVSP00002	Cable SABIX BL438CFRNC	3	1	
		G	VALVSP00007	Solenoid valve m-stable 3/2-5/2 1/4 BSP 24VCC	1	1	
		H	VALVSP00032	Actuator s.effect AT501S10A	1	1	
		I	VALVSP00046	Limit switch box IP67 ST2	1	1	

Complete butterfly valve with actuator		Spare parts					Mounted actuator reference
Reference	Designation	ID	Reference	Designation	Level[i]	Qty	
VALV250EPSE-GHIA	Butterfly valve auto EP SE DN250	B	VALVSP00022	Butterfly valve body PN10 DN250	3	1	-
		C	PNEU011472	Adjustable muffler 1/4 BSP	1	2	ACTSP0000007
		E	VALVSP00001	Gland cable for limit switch	3	2	
		F	VALVSP00002	Cable SABIX BL438CFRNC	3	1	
		G	VALVSP00007	Solenoid valve m-stable 3/2-5/2 1/4 BSP 24VCC	1	1	
		H	VALVSP00033	Actuator s.effect AT551S10A	1	1	
		I	VALVSP00047	Limit switch box IP67 ST4	1	1	
VALV300EPSE-GHIA	Butterfly valve auto EP SE DN300	A	VALVSP00009	Adapt F10/F14F16 VALVE DN300 C	3	1	-
		B	VALVSP00023	Butterfly valve body PN10 DN300	3	1	-
		C	PNEU011472	Adjustable muffler 1/4 BSP	1	2	ACTSP0000008
		D	PNEU011560	Brass reducer M/F 15X08	3	1	
		E	VALVSP00001	Gland cable for limit switch	3	2	
		F	VALVSP00002	Cable SABIX BL438CFRNC	3	1	
		G	VALVSP00007	Solenoid valve m-stable 3/2-5/2 1/4 BSP 24VCC	1	1	
		H	VALVSP00034	Actuator s.effect AT601S10A	1	1	
		I	VALVSP00047	Limit switch box IP67 ST4	1	1	

Complete butterfly valve with actuator		Spare parts					Mounted actuator reference
Reference	Designation	ID	Reference	Designation	Level[i]	Qty	
VALV350EPSE-GHIA	Butterfly valve auto EP SE DN350	A	VALVSP00010	Adapt F12/F12F14 VALVE DN350 Ø	3	1	-
		B	VALVSP00024	Butterfly valve body PN10 DN350	3	1	-
		C	PNEU011472	Adjustable muffler 1/4 BSP	1	2	ACTSP0000009
		D	PNEU011560	Brass reducer M/F 15X08	3	1	
		E	VALVSP00001	Gland cable for limit switch	3	2	
		F	VALVSP00002	Cable SABIX BL438CFRNC	3	1	
		G	VALVSP00008	Solenoid valve m-stable 3/2 1/2 BSP 24VCC	1	1	
		H	VALVSP00035	Actuator s.effect AT651S10A	1	1	
		I	VALVSP00047	Limit switch box IP67 ST4	1	1	
VALV400EPSE-GHIA	Butterfly valve auto EP SE DN400	A	VALVSP00011	Adapt F12/F14F16 VALVE DN400 Ø	3	1	-
		B	VALVSP00025	Butterfly valve body PN10 DN400	3	1	-
		C	PNEU011472	Adjustable muffler 1/4 BSP	1	2	ACTSP0000010
		D	PNEU011560	Brass reducer M/F 15X08	3	1	
		E	VALVSP00001	Gland cable for limit switch	3	2	
		F	VALVSP00002	Cable SABIX BL438CFRNC	3	1	
		G	VALVSP00008	Solenoid valve m-stable 3/2 1/2 BSP 24VCC	1	1	
		H	VALVSP00036	Actuator s.effect AT651S12A	1	1	
		I	VALVSP00047	Limit switch box IP67 ST4	1	1	

Complete butterfly valve with actuator		Spare parts					Mounted actuator reference
Reference	Designation	ID	Reference	Designation	Level[i]	Qty	
VALV450EPSE-GHIA	Butterfly valve auto EP SE DN450	A	VALVSP00012	Adapt F16/F14F16 VALVE DN450 Ø	3	1	-
		B	VALVSP00038	Butterfly valve body PN10 DN450	3	1	-
		C	PNEU011472	Adjustable muffler 1/4 BSP	1	2	ACTSP0000011
		D	PNEU011560	Brass reducer M/F 15X08	3	1	
		E	VALVSP00001	Gland cable for limit switch	3	2	
		F	VALVSP00002	Cable SABIX BL438CFRNC	3	1	
		G	VALVSP00008	Solenoid valve m-stable 3/2 1/2 BSP 24VCC	1	1	
		H	VALVSP00037	Actuator s.effect AT701S10A	1	1	
		I	VALVSP00047	Limit switch box IP67 ST4	1	1	
VALV500EPSE-GHIA	Butterfly valve auto EP SE DN500	A	VALVSP00012	Adapt F16/F14F16 VALVE DN500 Ø	3	1	-
		B	VALVSP00026	Butterfly valve body PN10 DN500	3	1	-
		C	PNEU011472	Adjustable muffler 1/4 BSP	1	2	ACTSP0000011
		D	PNEU011560	Brass reducer M/F 15X08	3	1	
		E	VALVSP00001	Gland cable for limit switch	3	2	
		F	VALVSP00002	Cable SABIX BL438CFRNC	3	1	
		G	VALVSP00008	Solenoid valve m-stable 3/2 1/2 BSP 24VCC	1	1	
		H	VALVSP00037	Actuator s.effect AT701S10A	1	1	
		I	VALVSP00047	Limit switch box IP67 ST4	1	1	

i. Level 1: Spare parts recommended to always keep on board
Level 2: Recommended spare parts for maintenance
Level 3: For information

Spare parts

42.3. GHIB type valves

Complete butterfly valve with actuator		Spare parts					Mounted actuator reference
Reference	Designation	ID	Reference	Designation	Level[i]	Qty	
VALV080EPSE-GHIB	Butterfly valve auto EP SE DN80 BVPD	B	VALVSP00073	Butterfly valve body PN10 DN80 BVPD	3	1	-
		C	PNEU011472	Adjustable muffler 1/4 BSP	1	2	ACTSP0000001
		E	VALVSP00001	Gland cable for limit switch	3	2	
		F	VALVSP00002	Cable SABIX BL438CFRNC	3	1	
		G	VALVSP00007	Solenoid valve m-stable 3/2-5/2 1/4 BSP 24VCC	1	1	
		I	VALVSP00013	Limit switch box IP67	1	1	
		H	VALVSP00027	Actuator s.effect AT201S10A	1	1	
VALV100EPSE-GHIB	Butterfly valve auto EP SE DN100 BVPD	B	VALVSP00074	Butterfly valve body PN10 DN100 BVPD	3	1	-
		C	PNEU011472	Adjustable muffler 1/4 BSP	1	2	ACTSP0000022
		E	VALVSP00001	Gland cable for limit switch	3	2	
		F	VALVSP00002	Cable SABIX BL438CFRNC	3	1	
		G	VALVSP00007	Solenoid valve m-stable 3/2-5/2 1/4 BSP 24VCC	1	1	
		I	VALVSP00013	Limit switch box IP67	1	1	
		H	VALVSP00084	Actuator s.effect AT251US12A	1	1	

Complete butterfly valve with actuator		Spare parts					Mounted actuator reference
Reference	Designation	ID	Reference	Designation	Level[i]	Qty	
VALV150EPSE-GHIB	Butterfly valve auto EP SE DN150 BVPD	B	VALVSP00076	Butterfly valve body PN10 DN150 BVPD	3	1	-
		C	PNEU011472	Adjustable muffler 1/4 BSP	1	2	ACTSP0000004
		E	VALVSP00001	Gland cable for limit switch	3	2	
		F	VALVSP00002	Cable SABIX BL438CFRNC	3	1	
		G	VALVSP00007	Solenoid valve m-stable 3/2-5/2 1/4 BSP 24VCC	1	1	
		H	VALVSP00030	Actuator s.effect AT351S10A	1	1	
		I	VALVSP00013	Limit switch box IP67	1	1	
VALV200EPSE-GHIB	Butterfly valve auto EP SE DN200 BVPD	B	VALVSP00077	Butterfly valve body PN10 DN200 BVPD	3	1	-
		C	PNEU011472	Adjustable muffler 1/4 BSP	1	2	ACTSP0000005
		E	VALVSP00001	Gland cable for limit switch	3	2	
		F	VALVSP00002	Cable SABIX BL438CFRNC	3	1	
		G	VALVSP00007	Solenoid valve m-stable 3/2-5/2 1/4 BSP 24VCC	1	1	
		H	VALVSP00031	Actuator s.effect AT401S10A	1	1	
		I	VALVSP00013	Limit switch box IP67	1	1	
VALV250EPSE-GHIB	Butterfly valve auto EP SE DN250 BVPD	B	VALVSP00078	Butterfly valve body PN10 DN250 BVPD	3	1	-
		C	PNEU011472	Adjustable muffler 1/4 BSP	1	2	ACTSP0000023
		E	VALVSP00001	Gland cable for limit switch	3	2	
		F	VALVSP00002	Cable SABIX BL438CFRNC	3	1	
		G	VALVSP00007	Solenoid valve m-stable 3/2-5/2 1/4 BSP 24VCC	1	1	
		H	VALVSP00086	Actuator s.effect AT451US12A	1	1	
		I	VALVSP00046	Limit switch box IP67 ST2	1	1	

Complete butterfly valve with actuator		Spare parts					Mounted actuator reference
Reference	Designation	ID	Reference	Designation	Level[i]	Qty	
VALV300EPSE-GHIB	Butterfly valve auto EP SE DN300 BVPD	A	VALVSP00009	Adapt F10/F14F16 VALVE DN300 C	3	1	-
		B	VALVSP00079	Butterfly valve body PN10 DN300 BVPD	3	1	-
		C	PNEU011472	Adjustable muffler 1/4 BSP	1	2	ACTSP0000007
		E	VALVSP00001	Gland cable for limit switch	3	2	
		F	VALVSP00002	Cable SABIX BL438CFRNC	3	1	
		G	VALVSP00007	Solenoid valve m-stable 3/2-5/2 1/4 BSP 24VCC	1	1	
		H	VALVSP00033	Actuator s.effect AT551S10A	1	1	
		I	VALVSP00047	Limit switch box IP67 ST4	1	1	
VALV350EPSE-GHIB	Butterfly valve auto EP SE DN350 BVPD	A	VALVSP00010	Adapt F12/F12F14 VALVE DN350 Ø	3	1	-
		B	VALVSP00080	Butterfly valve body PN10 DN350 BVPD	3	1	-
		C	PNEU011472	Adjustable muffler 1/4 BSP	1	2	ACTSP0000008
		D	PNEU011560	Brass reducer M/F 15X08	3	1	
		E	VALVSP00001	Gland cable for limit switch	3	2	
		F	VALVSP00002	Cable SABIX BL438CFRNC	3	1	
		G	VALVSP00007	Solenoid valve m-stable 3/2-5/2 1/4 BSP 24VCC	1	1	
		H	VALVSP00034	Actuator s.effect AT601S10A	1	1	
		I	VALVSP00047	Limit switch box IP67 ST4	1	1	

Complete butterfly valve with actuator		Spare parts					Mounted actuator reference
Reference	Designation	ID	Reference	Designation	Level[i]	Qty	
VALV400EPSE-GHIB	Butterfly valve auto EP SE DN400 BVPD	A	VALVSP00011	Adapt F12/F14F16 VALVE DN400 Ø	3	1	-
		B	VALVSP00081	Butterfly valve body PN10 DN400 BVPD	3	1	-
		C	PNEU011472	Adjustable muffler 1/4 BSP	1	2	ACTSP0000009
		D	PNEU011560	Brass reducer M/F 15X08	3	1	
		E	VALVSP00001	Gland cable for limit switch	3	2	
		F	VALVSP00002	Cable SABIX BL438CFRNC	3	1	
		G	VALVSP00008	Solenoid valve m-stable 3/2 1/2 BSP 24VCC	1	1	
		H	VALVSP00035	Actuator s.effect AT651S10A	1	1	
		I	VALVSP00047	Limit switch box IP67 ST4	1	1	
VALV450EPSE-GHIB	Butterfly valve auto EP SE DN450 BVPD	A	VALVSP00012	Adapt F16/F14F16 VALVE DN450 Ø	3	1	-
		B	VALVSP00082	Butterfly valve body PN10 DN450 BVPD	3	1	-
		C	PNEU011472	Adjustable muffler 1/4 BSP	1	2	ACTSP0000009
		D	PNEU011560	Brass reducer M/F 15X08	3	1	
		E	VALVSP00001	Gland cable for limit switch	3	2	
		F	VALVSP00002	Cable SABIX BL438CFRNC	3	1	
		G	VALVSP00008	Solenoid valve m-stable 3/2 1/2 BSP 24VCC	1	1	
		H	VALVSP00035	Actuator s.effect AT651S10A	1	1	
		I	VALVSP00047	Limit switch box IP67 ST4	1	1	

Complete butterfly valve with actuator		Spare parts					Mounted actuator reference
Reference	Designation	ID	Reference	Designation	Level[i]	Qty	
VALV500EPSE-GHIB	Butterfly valve auto EP SE DN500 BVPD	A	VALVSP00012	Adapt F16/F14F16 VALVE DN500 Ø	3	1	-
		B	VALVSP00083	Butterfly valve body PN10 DN500 BVPD	3	1	-
		C	PNEU011472	Adjustable muffler 1/4 BSP	1	2	ACTSP0000009
		D	PNEU011560	Brass reducer M/F 15X08	3	1	
		E	VALVSP00001	Gland cable for limit switch	3	2	
		F	VALVSP00002	Cable SABIX BL438CFRNC	3	1	
		G	VALVSP00008	Solenoid valve m-stable 3/2 1/2 BSP 24VCC	1	1	
		H	VALVSP00035	Actuator s.effect AT651S10A	1	1	
		I	VALVSP00047	Limit switch box IP67 ST4	1	1	

i. Level 1: Spare parts recommended to always keep on board
Level 2: Recommended spare parts for maintenance
Level 3: For information

42.4. GHIC type valves

Complete butterfly valve with actuator		Spare parts					Mounted actuator reference
Reference	Designation	ID	Reference	Designation	Level[i]	Qty	
VALV040EPSE-GHIC	Butterfly valve auto EP SE DN40 BVKI	A	VALVSP00093	Adapter F05 F07 P DA SR	3	1	-
		B	VALVSP00014	Butterfly valve body PN16 DN40 BVKI	3	1	-
		C	VALVSP00105	Air exhaust flow control 1/4i BSP with adjustable silencer	1	2	ACTSP0000026
		E	VALVSP00108	Cable gland ISO20 Eurocap	3	1	
			VALVSP00109	Cable gland ISO16 Eurocap	3	1	
		F	VALVSP00002	Cable SABIX BL438CFRNC	3	1	
		G	VALVSP00104	Solenoid valve m-stable 5/2 1/4i BSP 24VCC	1	1	
		I	VALVSP00106	Limit switch box BFC IP66	1	1	
		H	VALVSP00096	Actuator single acting DFPD-0040	1	1	

Complete butterfly valve with actuator		Spare parts					Mounted actuator reference
Reference	Designation	ID	Reference	Designation	Level[i]	Qty	
VALV050EPSE-GHIC	Butterfly valve auto EP SE DN50 BVKI	A	VALVSP00093	Adapter F05 F07 P DA SR	3	1	-
		B	VALVSP00015	Butterfly valve body PN16 DN50 BVKI	3	1	-
		C	VALVSP00105	Air exhaust flow control 1/4i BSP with adjustable silencer	1	2	ACTSP0000026
		E	VALVSP00108	Cable gland ISO20 Eurocap	3	1	
			VALVSP00109	Cable gland ISO16 Eurocap	3	1	
		F	VALVSP00002	Cable SABIX BL438CFRNC	3	1	
		G	VALVSP00104	Solenoid valve m-stable 5/2 1/4i BSP 24VCC	1	1	
		I	VALVSP00106	Limit switch box BFC IP66	1	1	
		H	VALVSP00096	Actuator single acting DFPD-0040	1	1	
VALV065EPSE-GHIC	Butterfly valve auto EP SE DN65 BVKI	A	VALVSP00093	Adapter F05 F07 P DA SR	3	1	-
		B	VALVSP00016	Butterfly valve body PN16 DN65 BVKI	3	1	-
		C	VALVSP00105	Air exhaust flow control 1/4i BSP with adjustable silencer	1	2	ACTSP0000026
		E	VALVSP00108	Cable gland ISO20 Eurocap	3	1	
			VALVSP00109	Cable gland ISO16 Eurocap	3	1	
		F	VALVSP00002	Cable SABIX BL438CFRNC	3	1	
		G	VALVSP00104	Solenoid valve m-stable 5/2 1/4i BSP 24VCC	1	1	
		I	VALVSP00106	Limit switch box BFC IP66	1	1	
		H	VALVSP00096	Actuator single acting DFPD-0040	1	1	

Complete butterfly valve with actuator		Spare parts					Mounted actuator reference
Reference	Designation	ID	Reference	Designation	Level[i]	Qty	
VALV080EPSE-GHIC	Butterfly valve auto EP SE DN80 BVPD	A	VALVSP00093	Adapter F05 F07 P DA SR	3	1	-
		B	VALVSP00073	Butterfly valve body PN10 DN80 BVPD	3	1	-
		C	VALVSP00105	Air exhaust flow control 1/4i BSP with adjustable silencer	1	2	ACTSP0000026
		E	VALVSP00108	Cable gland ISO20 Eurocap	3	1	
			VALVSP00109	Cable gland ISO16 Eurocap	3	1	
		F	VALVSP00002	Cable SABIX BL438CFRNC	3	1	
		G	VALVSP00104	Solenoid valve m-stable 5/2 1/4i BSP 24VCC	1	1	
		I	VALVSP00106	Limit switch box BFC IP66	1	1	
		H	VALVSP00096	Actuator single acting DFPD-0040	1	1	
VALV100EPSE-GHIC	Butterfly valve auto EP SE DN100 BVPD	A	VALVSP00093	Adapter F05 F07 P DA SR	3	1	-
		B	VALVSP00074	Butterfly valve body PN10 DN100 BVPD	3	1	-
		C	VALVSP00105	Air exhaust flow control 1/4i BSP with adjustable silencer	1	2	ACTSP0000027
		E	VALVSP00108	Cable gland ISO20 Eurocap	3	1	
			VALVSP00109	Cable gland ISO16 Eurocap	3	1	
		F	VALVSP00002	Cable SABIX BL438CFRNC	3	1	
		G	VALVSP00104	Solenoid valve m-stable 5/2 1/4i BSP 24VCC	1	1	
		I	VALVSP00106	Limit switch box BFC IP66	1	1	
		H	VALVSP00097	Actuator single acting DFPD-0080	1	1	

Complete butterfly valve with actuator		Spare parts					Mounted actuator reference
Reference	Designation	ID	Reference	Designation	Level[i]	Qty	
VALV125EPSE-GHIC	Butterfly valve auto EP SE DN125 BVPD	A	VALVSP00093	Adapter F05 F07 P DA SR	3	1	-
		B	VALVSP00075	Butterfly valve body PN10 DN125 BVPD	3	1	-
		C	VALVSP00105	Air exhaust flow control 1/4i BSP with adjustable silencer	1	2	ACTSP0000028
		E	VALVSP00108	Cable gland ISO20 Eurocap	3	1	
			VALVSP00109	Cable gland ISO16 Eurocap	3	1	
		F	VALVSP00002	Cable SABIX BL438CFRNC	3	1	
		G	VALVSP00104	Solenoid valve m-stable 5/2 1/4i BSP 24VCC	1	1	
		I	VALVSP00106	Limit switch box BFC IP66	1	1	
		H	VALVSP00098	Actuator single acting DFPD-0160	1	1	
VALV150EPSE-GHIC	Butterfly valve auto EP SE DN150 BVPD	A	VALVSP00093	Adapter F05 F07 P DA SR	3	1	-
		B	VALVSP00076	Butterfly valve body PN10 DN150 BVPD	3	1	-
		C	VALVSP00105	Air exhaust flow control 1/4i BSP with adjustable silencer	1	2	ACTSP0000029
		E	VALVSP00108	Cable gland ISO20 Eurocap	3	1	
			VALVSP00109	Cable gland ISO16 Eurocap	3	1	
		F	VALVSP00002	Cable SABIX BL438CFRNC	3	1	
		G	VALVSP00104	Solenoid valve m-stable 5/2 1/4i BSP 24VCC	1	1	
		I	VALVSP00107	Limit switch box BFC IP66	1	1	
		H	VALVSP00099	Actuator single acting DFPD-0240	1	1	

<table>
<tr><th colspan="2">Complete butterfly valve with actuator</th><th colspan="5">Spare parts</th><th rowspan="2">Mounted actuator reference</th></tr>
<tr><th>Reference</th><th>Designation</th><th>ID</th><th>Reference</th><th>Designation</th><th>Level[i]</th><th>Qty</th></tr>
<tr><td rowspan="10">VALV200EPSE-GHIC</td><td rowspan="10">Butterfly valve auto EP SE DN200 BVPD</td><td>A</td><td>VALVSP00094</td><td>Adapter F10 F10 P DA SR</td><td>3</td><td>1</td><td>-</td></tr>
<tr><td>B</td><td>VALVSP00077</td><td>Butterfly valve body PN10 DN200 BVPD</td><td>3</td><td>1</td><td>-</td></tr>
<tr><td>C</td><td>VALVSP00105</td><td>Air exhaust flow control 1/4i BSP with adjustable silencer</td><td>1</td><td>2</td><td rowspan="8">ACTSP0000030</td></tr>
<tr><td rowspan="2">E</td><td>VALVSP00108</td><td>Cable gland ISO20 Eurocap</td><td>3</td><td>1</td></tr>
<tr><td>VALVSP00109</td><td>Cable gland ISO16 Eurocap</td><td>3</td><td>1</td></tr>
<tr><td>F</td><td>VALVSP00002</td><td>Cable SABIX BL438CFRNC</td><td>3</td><td>1</td></tr>
<tr><td>G</td><td>VALVSP00104</td><td>Solenoid valve m-stable 5/2 1/4i BSP 24VCC</td><td>1</td><td>1</td></tr>
<tr><td>I</td><td>VALVSP00107</td><td>Limit switch box BFC IP66</td><td>1</td><td>1</td></tr>
<tr><td>H</td><td>VALVSP00100</td><td>Actuator single acting DFPD-0300</td><td>1</td><td>1</td></tr>
<tr><td colspan="5"></td></tr>
<tr><td rowspan="9">VALV250EPSE-GHIC</td><td rowspan="9">Butterfly valve auto EP SE DN250 BVPD</td><td>A</td><td>VALVSP00094</td><td>Adapter F10 F10 P DA SR</td><td>3</td><td>1</td><td>-</td></tr>
<tr><td>B</td><td>VALVSP00078</td><td>Butterfly valve body PN10 DN250 BVPD</td><td>3</td><td>1</td><td>-</td></tr>
<tr><td>C</td><td>VALVSP00105</td><td>Air exhaust flow control 1/4i BSP with adjustable silencer</td><td>1</td><td>2</td><td rowspan="7">ACTSP0000031</td></tr>
<tr><td rowspan="2">E</td><td>VALVSP00108</td><td>Cable gland ISO20 Eurocap</td><td>3</td><td>1</td></tr>
<tr><td>VALVSP00109</td><td>Cable gland ISO16 Eurocap</td><td>3</td><td>1</td></tr>
<tr><td>F</td><td>VALVSP00002</td><td>Cable SABIX BL438CFRNC</td><td>3</td><td>1</td></tr>
<tr><td>G</td><td>VALVSP00104</td><td>Solenoid valve m-stable 5/2 1/4i BSP 24VCC</td><td>1</td><td>1</td></tr>
<tr><td>I</td><td>VALVSP00107</td><td>Limit switch box BFC IP66</td><td>1</td><td>1</td></tr>
<tr><td>H</td><td>VALVSP00101</td><td>Actuator single acting DFPD-0480</td><td>1</td><td>1</td></tr>
</table>

Complete butterfly valve with actuator		Spare parts					Mounted actuator reference
Reference	Designation	ID	Reference	Designation	Level[i]	Qty	
VALV300EPSE-GHIC	Butterfly valve auto EP SE DN300 BVPD	A	VALVSP00095	Adapter F12 F12F14 P	3	1	-
		B	VALVSP00079	Butterfly valve body PN10 DN300 BVPD	3	1	-
		C	VALVSP00105	Air exhaust flow control 1/4i BSP with adjustable silencer	1	2	ACTSP0000032
		E	VALVSP00108	Cable gland ISO20 Eurocap	3	1	
			VALVSP00109	Cable gland ISO16 Eurocap	3	1	
		F	VALVSP00002	Cable SABIX BL438CFRNC	3	1	
		G	VALVSP00104	Solenoid valve m-stable 5/2 1/4i BSP 24VCC	1	1	
		I	VALVSP00107	Limit switch box BFC IP66	1	1	
		H	VALVSP00102	Actuator single acting DFPD-1200	1	1	
VALV350EPSE-GHIC	Butterfly valve auto EP SE DN350 BVPD	A	VALVSP00095	Adapter F12 F12F14 P	3	1	-
		B	VALVSP00080	Butterfly valve body PN10 DN350 BVPD	3	1	-
		C	VALVSP00105	Air exhaust flow control 1/4i BSP with adjustable silencer	1	2	ACTSP0000032
		E	VALVSP00108	Cable gland ISO20 Eurocap	3	1	
			VALVSP00109	Cable gland ISO16 Eurocap	3	1	
		F	VALVSP00002	Cable SABIX BL438CFRNC	3	1	
		G	VALVSP00104	Solenoid valve m-stable 5/2 1/4i BSP 24VCC	1	1	
		I	VALVSP00107	Limit switch box BFC IP66	1	1	
		H	VALVSP00102	Actuator single acting DFPD-1200	1	1	

Complete butterfly valve with actuator		Spare parts						Mounted actuator reference
Reference	Designation	ID	Reference	Designation	Level[i]	Qty		
VALV400EPSE-GHIC	Butterfly valve auto EP SE DN400 BVPD	A	VALVSP00011	Adapter F12 F14F16 P	3	1	-
		B	VALVSP00081	Butterfly valve body PN10 DN400 BVPD	3	1	-
		C	VALVSP00105	Air exhaust flow control 1/4i BSP with adjustable silencer	1	2	ACTSP0000033
		E	VALVSP00108	Cable gland ISO20 Eurocap	3	1	
			VALVSP00109	Cable gland ISO16 Eurocap	3	1	
		F	VALVSP00002	Cable SABIX BL438CFRNC	3	1	
		G	VALVSP00104	Solenoid valve m-stable 5/2 1/4i BSP 24VCC	1	1	
		I	VALVSP00107	Limit switch box BFC IP66	1	1	
		H	VALVSP00103	Actuator single acting DFPD-2300	1	1	
VALV450EPSE-GHIC	Butterfly valve auto EP SE DN450 BVPD	A	VALVSP00012	Adapter F16 F14F16 P	3	1	-
		B	VALVSP00082	Butterfly valve body PN10 DN450 BVPD	3	1	-
		C	VALVSP00105	Air exhaust flow control 1/4i BSP with adjustable silencer	1	2	ACTSP0000033
		E	VALVSP00108	Cable gland ISO20 Eurocap	3	1	
			VALVSP00109	Cable gland ISO16 Eurocap	3	1	
		F	VALVSP00002	Cable SABIX BL438CFRNC	3	1	
		G	VALVSP00104	Solenoid valve m-stable 5/2 1/4i BSP 24VCC	1	1	
		I	VALVSP00107	Limit switch box BFC IP66	1	1	
		H	VALVSP00103	Actuator single acting DFPD-2300	1	1	

Complete butterfly valve with actuator		Spare parts					Mounted actuator reference
Reference	Designation	ID	Reference	Designation	Level[i]	Qty	
VALV500EPSE-GHIC	Butterfly valve auto EP SE DN500 BVPD	A	VALVSP00012	Adapter F16 F14F16 P	3	1	-
		B	VALVSP00083	Butterfly valve body PN10 DN500 BVPD	3	1	-
		C	VALVSP00105	Air exhaust flow control 1/4i BSP with adjustable silencer	1	2	ACTSP0000033
		E	VALVSP00108	Cable gland ISO20 Eurocap	3	1	
			VALVSP00109	Cable gland ISO16 Eurocap	3	1	
		F	VALVSP00002	Cable SABIX BL438CFRNC	3	1	
		G	VALVSP00104	Solenoid valve m-stable 5/2 1/4i BSP 24VCC	1	1	
		I	VALVSP00107	Limit switch box BFC IP66	1	1	
		H	VALVSP00103	Actuator single acting DFPD-2300	1	1	

i. Level 1: Spare parts recommended to always keep on board
Level 2: Recommended spare parts for maintenance
Level 3: For information

42.5. CIP isolation valve (V07)

Complete butterfly valve with actuator		Spare parts					Mounted actuator reference
Reference	Designation	ID	Reference	Designation	Level[i]	Qty	
VALV065EPSENO-GHIC	Butterfly valve auto EP SE DN65 BVKI Normally Open	A	VALVSP00093	Adapter F05 F07 P DA SR	3	1	-
		B	VALVSP00016	Butterfly valve body PN16 DN65 BVKI	3	1	-
		C	VALVSP00105	Air exhaust flow control 1/4i BSP with adjustable silencer	1	2	Contact **BIO-UV Group**
		E	VALVSP00108	Cable gland ISO20 Eurocap	3	1	
			VALVSP00109	Cable gland ISO16 Eurocap	3	1	
		F	VALVSP00002	Cable SABIX BL438CFRNC	3	1	
		G	VALVSP00104	Solenoid valve m-stable 5/2 1/4i BSP 24VCC	1	1	
		I	VALVSP00106	Limit switch box BFC IP66	1	1	
		J	VALV018522	Reversed index green/red	3	1	
		H	VALVSP00096	Actuator single acting DFPD-0040	1	1	

Complete butterfly valve with actuator		Spare parts					Mounted actuator reference
Reference	Designation	ID	Reference	Designation	Level[i]	Qty	
VALV080EPSENO-GHIC	Butterfly valve auto EP SE DN80 BVPD Normally Open	A	VALVSP00093	Adapter F05 F07 P DA SR	3	1	-
		B	VALVSP00073	Butterfly valve body PN10 DN80 BVPD	3	1	-
		C	VALVSP00105	Air exhaust flow control 1/4i BSP with adjustable silencer	1	2	Contact **BIO-UV Group**
		E	VALVSP00108	Cable gland ISO20 Eurocap	3	1	
			VALVSP00109	Cable gland ISO16 Eurocap	3	1	
		F	VALVSP00002	Cable SABIX BL438CFRNC	3	1	
		G	VALVSP00104	Solenoid valve m-stable 5/2 1/4i BSP 24VCC	1	1	
		I	VALVSP00106	Limit switch box BFC IP66	1	1	
		J	VALV018522	Reversed index green/red	3	1	
		H	VALVSP00096	Actuator single acting DFPD-0040	1	1	
VALV100EPSENO-GHIC	Butterfly valve auto EP SE DN100 BVPD Normally Open	A	VALVSP00093	Adapter F05 F07 P DA SR	3	1	-
		B	VALVSP00074	Butterfly valve body PN10 DN100 BVPD	3	1	-
		C	VALVSP00105	Air exhaust flow control 1/4i BSP with adjustable silencer	1	2	Contact **BIO-UV Group**
		E	VALVSP00108	Cable gland ISO20 Eurocap	3	1	
			VALVSP00109	Cable gland ISO16 Eurocap	3	1	
		F	VALVSP00002	Cable SABIX BL438CFRNC	3	1	
		G	VALVSP00104	Solenoid valve m-stable 5/2 1/4i BSP 24VCC	1	1	
		I	VALVSP00106	Limit switch box BFC IP66	1	1	
		J	VALV018522	Reversed index green/red	3	1	
		H	VALVSP00097	Actuator single acting DFPD-0080	1	1	

Spare parts

BIO-SEA® L Reactors

Complete butterfly valve with actuator		Spare parts					Mounted actuator reference
Reference	Designation	ID	Reference	Designation	Level[i]	Qty	
VALV125EPSENO-GHIC	Butterfly valve auto EP SE DN125 BVPD Normally Open	A	VALVSP00093	Adapter F05 F07 P DA SR	3	1	-
		B	VALVSP00075	Butterfly valve body PN10 DN125 BVPD	3	1	-
		C	VALVSP00105	Air exhaust flow control 1/4i BSP with adjustable silencer	1	2	Contact **BIO-UV Group**
		E	VALVSP00108	Cable gland ISO20 Eurocap	3	1	
			VALVSP00109	Cable gland ISO16 Eurocap	3	1	
		F	VALVSP00002	Cable SABIX BL438CFRNC	3	1	
		G	VALVSP00104	Solenoid valve m-stable 5/2 1/4i BSP 24VCC	1	1	
		I	VALVSP00106	Limit switch box BFC IP66	1	1	
		J	VALV018522	Reversed index green/red	3	1	
		H	VALVSP00098	Actuator single acting DFPD-0160	1	1	
VALV150EPSENO-GHIC	Butterfly valve auto EP SE DN150 BVPD Normally Open	A	VALVSP00093	Adapter F05 F07 P DA SR	3	1	-
		B	VALVSP00076	Butterfly valve body PN10 DN150 BVPD	3	1	-
		C	VALVSP00105	Air exhaust flow control 1/4i BSP with adjustable silencer	1	2	Contact **BIO-UV Group**
		E	VALVSP00108	Cable gland ISO20 Eurocap	3	1	
			VALVSP00109	Cable gland ISO16 Eurocap	3	1	
		F	VALVSP00002	Cable SABIX BL438CFRNC	3	1	
		G	VALVSP00104	Solenoid valve m-stable 5/2 1/4i BSP 24VCC	1	1	
		I	VALVSP00107	Limit switch box BFC IP66	1	1	
		J	VALV018522	Reversed index green/red	3	1	
		H	VALVSP00099	Actuator single acting DFPD-0240	1	1	

Complete butterfly valve with actuator		Spare parts					Mounted actuator reference
Reference	Designation	ID	Reference	Designation	Level[i]	Qty	
VALV200EPSENO-GHIC	Butterfly valve auto EP SE DN200 BVPD Normally Open	A	VALVSP00094	Adapter F10 F10 P DA SR	3	1	-
		B	VALVSP00077	Butterfly valve body PN10 DN200 BVPD	3	1	-
		C	VALVSP00105	Air exhaust flow control 1/4i BSP with adjustable silencer	1	2	Contact **BIO-UV Group**
		E	VALVSP00108	Cable gland ISO20 Eurocap	3	1	
			VALVSP00109	Cable gland ISO16 Eurocap	3	1	
		F	VALVSP00002	Cable SABIX BL438CFRNC	3	1	
		G	VALVSP00104	Solenoid valve m-stable 5/2 1/4i BSP 24VCC	1	1	
		I	VALVSP00107	Limit switch box BFC IP66	1	1	
		J	VALV018522	Reversed index green/red	3	1	
		H	VALVSP00100	Actuator single acting DFPD-0300	1	1	
VALV250EPSENO-GHIC	Butterfly valve auto EP SE DN250 BVPD Normally Open	A	VALVSP00094	Adapter F10 F10 P DA SR	3	1	-
		B	VALVSP00078	Butterfly valve body PN10 DN250 BVPD	3	1	-
		C	VALVSP00105	Air exhaust flow control 1/4i BSP with adjustable silencer	1	2	Contact **BIO-UV Group**
		E	VALVSP00108	Cable gland ISO20 Eurocap	3	1	
			VALVSP00109	Cable gland ISO16 Eurocap	3	1	
		F	VALVSP00002	Cable SABIX BL438CFRNC	3	1	
		G	VALVSP00104	Solenoid valve m-stable 5/2 1/4i BSP 24VCC	1	1	
		I	VALVSP00107	Limit switch box BFC IP66	1	1	
		J	VALV018522	Reversed index green/red	3	1	
		H	VALVSP00101	Actuator single acting DFPD-0480	1	1	

Spare parts
BIO-SEA® L Reactors

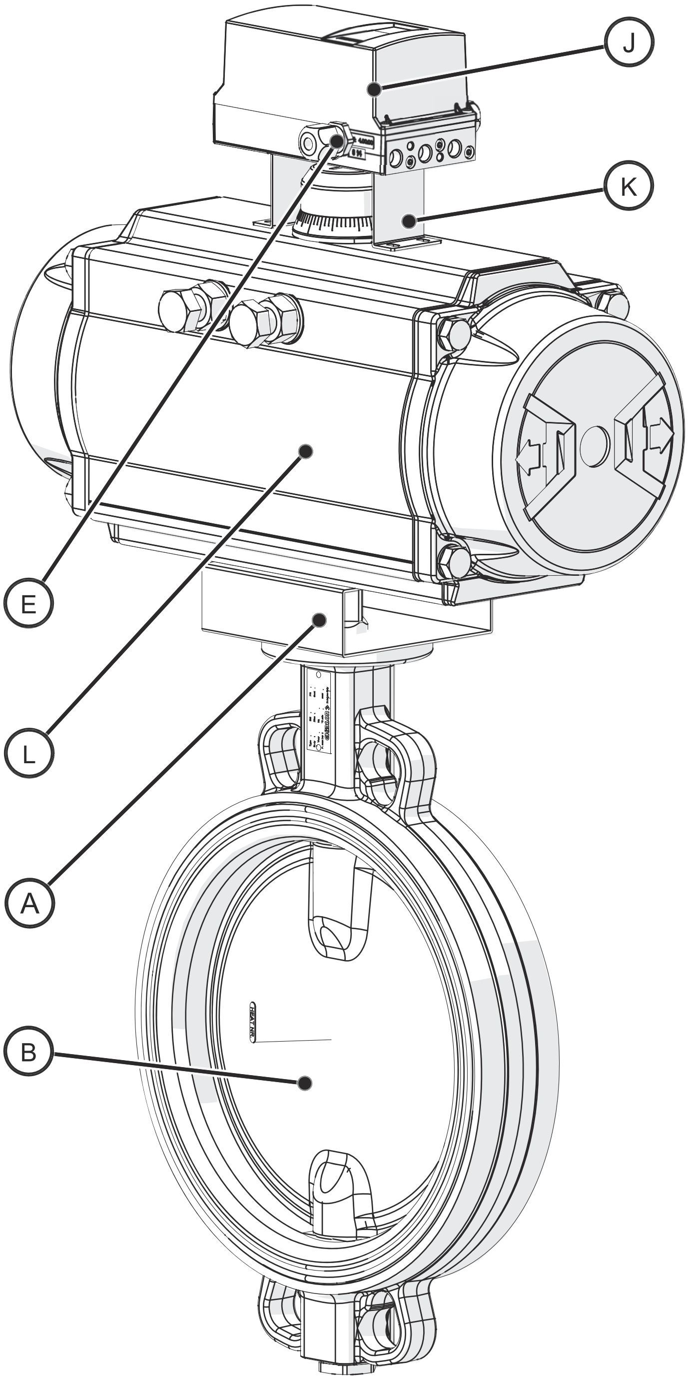
Complete butterfly valve with actuator		Spare parts					Mounted actuator reference
Reference	Designation	ID	Reference	Designation	Level[i]	Qty	
VALV300EPSENO-GHIC	Butterfly valve auto EP SE DN300 BVPD Normally Open	A	VALVSP00095	Adapter F12 F12F14 P	3	1	-
		B	VALVSP00079	Butterfly valve body PN10 DN300 BVPD	3	1	-
		C	VALVSP00105	Air exhaust flow control 1/4i BSP with adjustable silencer	1	2	Contact **BIO-UV Group**
		E	VALVSP00108	Cable gland ISO20 Eurocap	3	1	
			VALVSP00109	Cable gland ISO16 Eurocap	3	1	
		F	VALVSP00002	Cable SABIX BL438CFRNC	3	1	
		G	VALVSP00104	Solenoid valve m-stable 5/2 1/4i BSP 24VCC	1	1	
		I	VALVSP00107	Limit switch box BFC IP66	1	1	
		J	VALV018522	Reversed index green/red	3	1	
		H	VALVSP00102	Actuator single acting DFPD-1200	1	1	
VALV350EPSENO-GHIC	Butterfly valve auto EP SE DN350 BVPD Normally Open	A	VALVSP00095	Adapter F12 F12F14 P	3	1	-
		B	VALVSP00080	Butterfly valve body PN10 DN350 BVPD	3	1	-
		C	VALVSP00105	Air exhaust flow control 1/4i BSP with adjustable silencer	1	2	Contact **BIO-UV Group**
		E	VALVSP00108	Cable gland ISO20 Eurocap	3	1	
			VALVSP00109	Cable gland ISO16 Eurocap	3	1	
		F	VALVSP00002	Cable SABIX BL438CFRNC	3	1	
		G	VALVSP00104	Solenoid valve m-stable 5/2 1/4i BSP 24VCC	1	1	
		I	VALVSP00107	Limit switch box BFC IP66	1	1	
		J	VALV018522	Reversed index green/red	3	1	
		H	VALVSP00102	Actuator single acting DFPD-1200	1	1	

Complete butterfly valve with actuator		Spare parts					Mounted actuator reference
Reference	Designation	ID	Reference	Designation	Level[i]	Qty	
VALV400EPSENO-GHIC	Butterfly valve auto EP SE DN400 BVPD Normally Open	A	VALVSP00011	Adapter F12 F14F16 P	3	1	-
		B	VALVSP00081	Butterfly valve body PN10 DN400 BVPD	3	1	-
		C	VALVSP00105	Air exhaust flow control 1/4i BSP with adjustable silencer	1	2	Contact **BIO-UV Group**
		E	VALVSP00108	Cable gland ISO20 Eurocap	3	1	
			VALVSP00109	Cable gland ISO16 Eurocap	3	1	
		F	VALVSP00002	Cable SABIX BL438CFRNC	3	1	
		G	VALVSP00104	Solenoid valve m-stable 5/2 1/4i BSP 24VCC	1	1	
		I	VALVSP00107	Limit switch box BFC IP66	1	1	
		J	VALV018522	Reversed index green/red	3	1	
		H	VALVSP00103	Actuator single acting DFPD-2300	1	1	
VALV450EPSENO-GHIC	Butterfly valve auto EP SE DN450 BVPD Normally Open	A	VALVSP00012	Adapter F16 F14F16 P	3	1	-
		B	VALVSP00082	Butterfly valve body PN10 DN450 BVPD	3	1	-
		C	VALVSP00105	Air exhaust flow control 1/4i BSP with adjustable silencer	1	2	Contact **BIO-UV Group**
		E	VALVSP00108	Cable gland ISO20 Eurocap	3	1	
			VALVSP00109	Cable gland ISO16 Eurocap	3	1	
		F	VALVSP00002	Cable SABIX BL438CFRNC	3	1	
		G	VALVSP00104	Solenoid valve m-stable 5/2 1/4i BSP 24VCC	1	1	
		I	VALVSP00107	Limit switch box BFC IP66	1	1	
		J	VALV018522	Reversed index green/red	3	1	
		H	VALVSP00103	Actuator single acting DFPD-2300	1	1	

Complete butterfly valve with actuator		Spare parts					Mounted actuator reference
Reference	Designation	ID	Reference	Designation	Level[i]	Qty	
VALV500EPSENO-GHIC	Butterfly valve auto EP SE DN500 BVPD Normally Open	A	VALVSP00012	Adapter F16 F14F16 P	3	1	-
		B	VALVSP00083	Butterfly valve body PN10 DN500 BVPD	3	1	-
		C	VALVSP00105	Air exhaust flow control 1/4i BSP with adjustable silencer	1	2	ACTSP0000033
		E	VALVSP00108	Cable gland ISO20 Eurocap	3	1	
			VALVSP00109	Cable gland ISO16 Eurocap	3	1	
		F	VALVSP00002	Cable SABIX BL438CFRNC	3	1	
		G	VALVSP00104	Solenoid valve m-stable 5/2 1/4i BSP 24VCC	1	1	
		I	VALVSP00107	Limit switch box BFC IP66	1	1	
		J	VALV018522	Reversed index green/red	3	1	
		H	VALVSP00103	Actuator single acting DFPD-2300	1	1	

i. Level 1: Spare parts recommended to always keep on board
Level 2: Recommended spare parts for maintenance
Level 3: For information

43. Electro-pneumatic control valve



43.1. What is the type of your valve?

To check the type of your valve, look at the name plate of the valve body and ID on the actuator (see picture below)

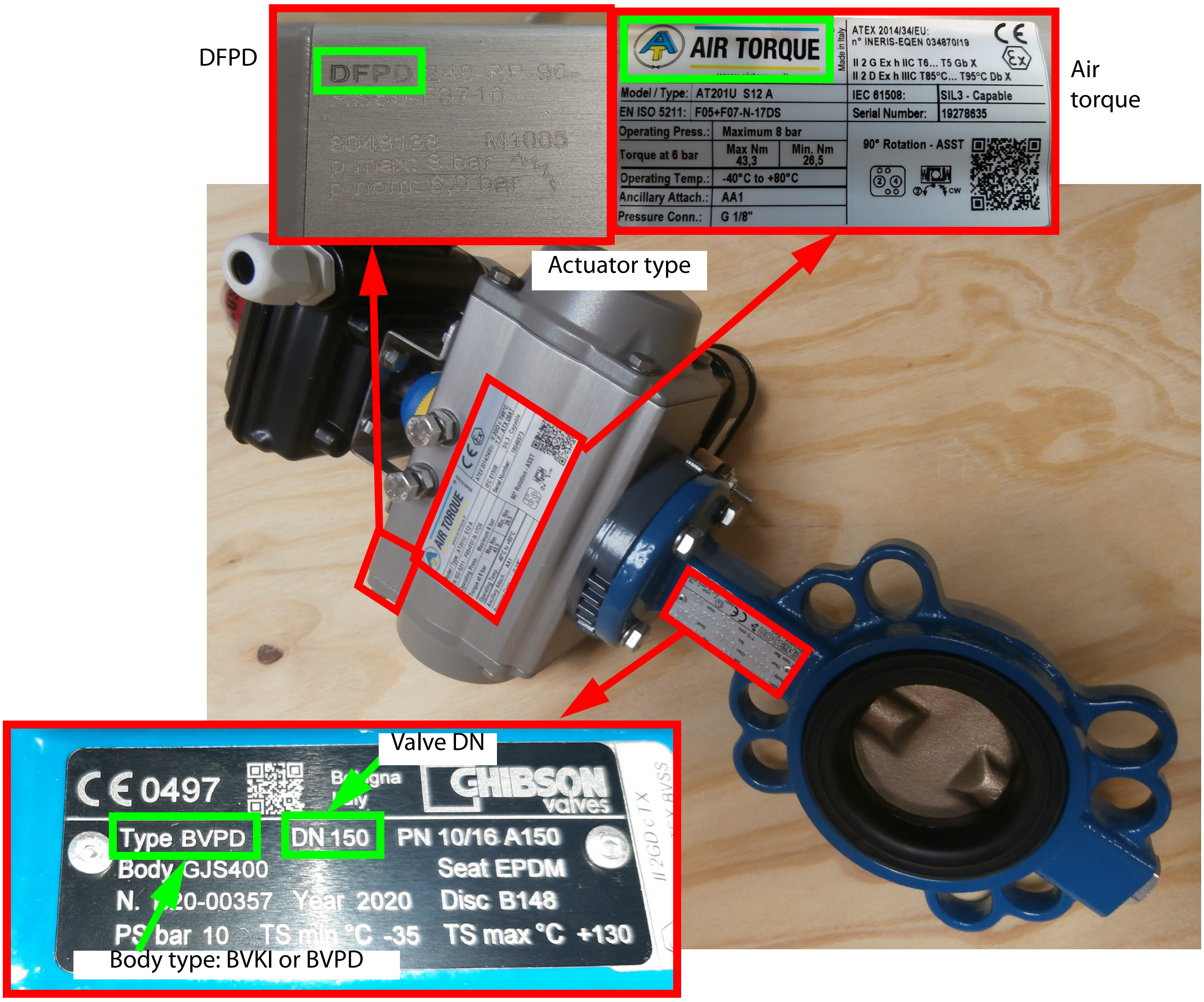


Table 48: Identification of the valve type with the valve body type and the actuator type

Valve type	Valve body type	Actuator type
GHIA	BVKI	AIR TORQUE
GHIC	BVPD	DFPD

43.2. GHIA type control valves

Complete butterfly valve with actuator		Spare parts					Mounted actuator reference
Reference	Designation	ID	Reference	Designation	Level[i]	Qty	
VALV065EPSER-GHIA	Butterfly control valve EP DN65	B	VALVSP00016	Butterfly valve body PN16 DN65	3	1	-
		E	VALVSP00001	Gland cable for limit switch	3	1	ACTSP0000001
		J	VALVSP00003	Positioner PS2 S.effect 4-20m	1	1	
		K	VALVSP00006	Mounting bracket NAMUR	3	1	
		H	VALVSP00027	Actuator S.effect AT201S10A	1	1	
VALV080EPSER-GHIA	Butterfly control valve EP DN80	B	VALVSP00017	Butterfly valve body PN16 DN80	3	1	-
		E	VALVSP00001	Gland cable for limit switch	3	1	ACTSP0000012
		J	VALVSP00003	Positioner PS2 S.effect 4-20m	1	1	
		K	VALVSP00006	Mounting bracket NAMUR	3	1	
		H	VALVSP00029	Actuator S.effect AT301S12A	1	1	
VALV100EPSER-GHIA	Butterfly control valve EP DN100	B	VALVSP00018	Butterfly valve body PN16DN100	3	1	-
		E	VALVSP00001	Gland cable for limit switch	3	1	ACTSP0000013
		J	VALVSP00003	Positioner PS2 S.effect 4-20m	1	1	
		K	VALVSP00005	Mounting bracket NAMUR	3	1	
		H	VALVSP00030	Actuator S.effect AT351S10A	1	1	

Complete butterfly valve with actuator		Spare parts					Mounted actuator reference
Reference	Designation	ID	Reference	Designation	Level[i]	Qty	
VALV125EPSER-GHIA	Butterfly control valve EP DN125	B	VALVSP00019	Butterfly valve body PN16D125	3	1	-
		E	VALVSP00001	Gland cable for limit switch	3	1	ACTSP0000014
		J	VALVSP00003	Positioner PS2 S.effect 4-20m	1	1	
		K	VALVSP00005	Mounting bracket NAMUR	3	1	
		H	VALVSP00031	Actuator S.effect AT401S10A	1	1	
VALV150EPSER-GHIA	Butterfly control valve EP DN150	B	VALVSP00020	Butterfly valve body PN16DN150	3	1	-
		E	VALVSP00001	Gland cable for limit switch	3	1	ACTSP0000015
		J	VALVSP00003	Positioner PS2 S.effect 4-20m	1	1	
		K	VALVSP00005	Mounting bracket NAMUR	3	1	
		H	VALVSP00032	Actuator S.effect AT501S10A	1	1	
VALV200EPSER-GHIA	Butterfly control valve EP DN200	B	VALVSP00021	Butterfly valve body PN10DN200	3	1	-
		E	VALVSP00001	Gland cable for limit switch	3	1	ACTSP0000016
		J	VALVSP00003	Positioner PS2 S.effect 4-20m	1	1	
		K	VALVSP00004	Mounting bracket NAMUR	3	1	
		H	VALVSP00033	Actuator S.effect AT551S10A	1	1	
VALV250EPSER-GHIA	Butterfly control valve EP DN250	B	VALVSP00022	Butterfly valve body PN10DN250	3	1	-
		E	VALVSP00001	Gland cable for limit switch	3	1	ACTSP0000017
		J	VALVSP00003	Positioner PS2 S.effect 4-20m	1	1	
		K	VALVSP00004	Mounting bracket NAMUR	3	1	
		H	VALVSP00034	Actuator S.effect AT601S10A	1	1	

Complete butterfly valve with actuator		Spare parts					Mounted actuator reference
Reference	Designation	ID	Reference	Designation	Level[i]	Qty	
VALV300EPSER-GHIA	Butterfly control valve EP DN300	A	VALVSP00009	Adapt F10/F14F16 VALVE DN300 C	3	1	-
		B	VALVSP00023	Butterfly valve body PN10DN300	3	1	-
		E	VALVSP00001	Gland cable for limit switch	3	1	ACTSP0000018
		J	VALVSP00003	Positioner PS2 S.effect 4-20m	1	1	
		K	VALVSP00004	Mounting bracket NAMUR	3	1	
		H	VALVSP00035	Actuator S.effect AT651S10A	1	1	
VALV350EPSER-GHIA	Butterfly control valve EP DN350	A	VALVSP00010	Adapt F12/F12F14 VALVE DN350 Ø	3	1	-
		B	VALVSP00024	Butterfly valve body PN10DN350	3	1	-
		E	VALVSP00001	Gland cable for limit switch	3	1	ACTSP0000019
		J	VALVSP00003	Positioner PS2 S.effect 4-20m	1	1	
		K	VALVSP00004	Mounting bracket NAMUR	3	1	
		H	VALVSP00036	Actuator S.effect AT651S12A	1	1	
VALV400EPSER-GHIA	Butterfly control valve EP DN400	A	VALVSP00011	Adapt F12/F14F16 VALVE DN400 Ø	3	1	-
		B	VALVSP00025	Butterfly valve body PN10DN400	3	1	-
		E	VALVSP00001	Gland cable for limit switch	3	1	ACTSP0000020
		J	VALVSP00003	Positioner PS2 S.effect 4-20m	1	1	
		K	VALVSP00004	Mounting bracket NAMUR	3	1	
		H	VALVSP00036	Actuator S.effect AT651S12A	1	1	

Complete butterfly valve with actuator		Spare parts					Mounted actuator reference
Reference	Designation	ID	Reference	Designation	Level[i]	Qty	
VALV450EPSER-GHIA	Butterfly control valve EP DN450	A	VALVSP00012	Adapt F16/F14F16 VALVE DN450 Ø	3	1	-
		B	VALVSP00048	Butterfly valve body PN10DN450	3	1	-
		E	VALVSP00001	Gland cable for limit switch	3	1	ACTSP0000021
		J	VALVSP00003	Positioner PS2 S.effect 4-20m	1	1	
		K	VALVSP00004	Mounting bracket NAMUR	3	1	
		H	VALVSP00037	Actuator S.effect AT701S10A	1	1	
VALV500EPSER-GHIA	Butterfly control valve EP DN500	A	VALVSP00012	Adapt F16/F14F16 VALVE DN500 Ø	3	1	-
		B	VALVSP00026	Butterfly valve body PN10DN500	3	1	-
		E	VALVSP00001	Gland cable for limit switch	3	1	ACTSP0000021
		J	VALVSP00003	Positioner PS2 S.effect 4-20m	1	1	
		K	VALVSP00004	Mounting bracket NAMUR	3	1	
		H	VALVSP00037	Actuator S.effect AT701S10A	1	1	

i. Level 1: Spare parts recommended to always keep on board
Level 2: Recommended spare parts for maintenance
Level 3: For information

43.3. GHIC type control valves

Complete butterfly valve with actuator		Spare parts					Mounted actuator reference
Reference	Designation	ID	Reference	Designation	Level[i]	Qty	
VALV065EPSER-GHIC	Butterfly control valve EP DN65	A	VALVSP00093	Adapter F05 F07 P DA SR	3	1	-
		B	VALVSP00016	Butterfly valve body PN16 DN65	3	1	-
		E	VALVSP00001	Gland cable for limit switch	3	1	ACTSP0000034
		J	VALVSP00003	Positioner PS2 S.effect 4-20m	1	1	
		K	VALVSP00110	VDI-VDE support SS 80x30xH20	3	1	
		H	VALVSP00096	Actuator Single acting DFPD-0040	1	1	
VALV080EPSER-GHIC	Butterfly control valve EP DN80	A	VALVSP00093	Adapter F05 F07 P DA SR	3	1	-
		B	VALVSP00073	Butterfly valve body PN10 DN80 BVPD	3	1	-
		E	VALVSP00001	Gland cable for limit switch	3	1	ACTSP0000034
		J	VALVSP00003	Positioner PS2 S.effect 4-20m	1	1	
		K	VALVSP00110	VDI-VDE support SS 80x30xH20	3	1	
		H	VALVSP00096	Actuator Single acting DFPD-0040	1	1	

Complete butterfly valve with actuator		Spare parts					Mounted actuator reference
Reference	Designation	ID	Reference	Designation	Level[i]	Qty	
VALV100EPSER-GHIC	Butterfly control valve EP DN100	A	VALVSP00093	Adapter F05 F07 P DA SR	3	1	-
		B	VALVSP00074	Butterfly valve body PN10 DN100 BVPD	3	1	-
		E	VALVSP00001	Gland cable for limit switch	3	1	ACTSP0000035
		J	VALVSP00003	Positioner PS2 S.effect 4-20m	1	1	
		K	VALVSP00110	VDI-VDE support SS 80x30xH20	3	1	
		H	VALVSP00097	Actuator Single acting DFPD-0080	1	1	
VALV125EPSER-GHIC	Butterfly control valve EP DN125	A	VALVSP00093	Adapter F05 F07 P DA SR	3	1	-
		B	VALVSP00075	Butterfly valve body PN10 DN125 BVPD	3	1	-
		E	VALVSP00001	Gland cable for limit switch	3	1	ACTSP0000036
		J	VALVSP00003	Positioner PS2 S.effect 4-20m	1	1	
		K	VALVSP00110	VDI-VDE support SS 80x30xH20	3	1	
		H	VALVSP00098	Actuator Single acting DFPD-0160	1	1	
VALV150EPSER-GHIC	Butterfly control valve EP DN150	A	VALVSP00093	Adapter F05 F07 P DA SR	3	1	-
		B	VALVSP00076	Butterfly valve body PN10 DN150 BVPD	3	1	-
		E	VALVSP00001	Gland cable for limit switch	3	1	ACTSP0000037
		J	VALVSP00003	Positioner PS2 S.effect 4-20m	1	1	
		K	VALVSP00111	VDI-VDE support SS 80+130x30xH30	3	1	
		H	VALVSP00099	Actuator Single acting DFPD-0240	1	1	

Complete butterfly valve with actuator		Spare parts					Mounted actuator reference
Reference	Designation	ID	Reference	Designation	Level[i]	Qty	
VALV200EPSER-GHIC	Butterfly control valve EP DN200	A	VALVSP00094	Adapter F10 F10 P DA SR	3	1	-
		B	VALVSP00077	Butterfly valve body PN10 DN200 BVPD	3	1	-
		E	VALVSP00001	Gland cable for limit switch	3	1	ACTSP0000038
		J	VALVSP00003	Positioner PS2 S.effect 4-20m	1	1	
		K	VALVSP00111	VDI-VDE support SS 80+130x30xH30	3	1	
		H	VALVSP00100	Actuator Single acting DFPD-0300	1	1	
VALV250EPSER-GHIC	Butterfly control valve EP DN250	A	VALVSP00094	Adapter F10 F10 P DA SR	3	1	-
		B	VALVSP00078	Butterfly valve body PN10 DN250 BVPD	3	1	-
		E	VALVSP00001	Gland cable for limit switch	3	1	ACTSP0000039
		J	VALVSP00003	Positioner PS2 S.effect 4-20m	1	1	
		K	VALVSP00111	VDI-VDE support SS 80+130x30xH30	3	1	
		H	VALVSP00101	Actuator Single acting DFPD-0480	1	1	
VALV300EPSER-GHIC	Butterfly control valve EP DN300	A	VALVSP00094	Adapter F10 F10 P DA SR	3	1	-
		B	VALVSP00079	Butterfly valve body PN10 DN300 BVPD	3	1	-
		E	VALVSP00001	Gland cable for limit switch	3	1	ACTSP0000040
		J	VALVSP00003	Positioner PS2 S.effect 4-20m	1	1	
		K	VALVSP00111	VDI-VDE support SS 80+130x30xH30	3	1	
		H	VALVSP00102	Actuator Single acting DFPD-1200	1	1	

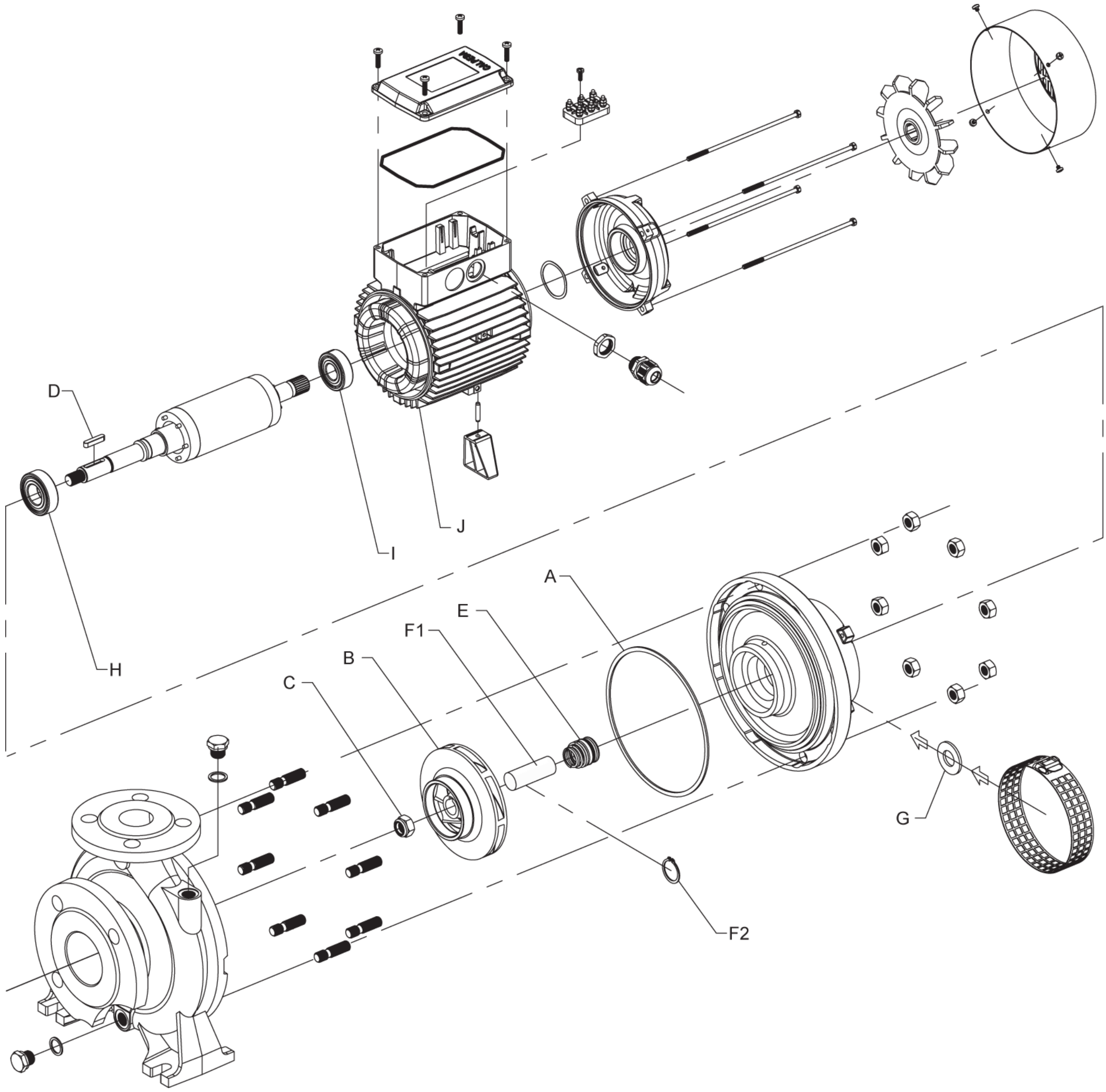
Complete butterfly valve with actuator		Spare parts					Mounted actuator reference
Reference	Designation	ID	Reference	Designation	Level[i]	Qty	
VALV350EPSER-GHIC	Butterfly control valve EP DN350	A	VALVSP00095	Adapter F12 F12F14 P	3	1	-
		B	VALVSP00080	Butterfly valve body PN10 DN350 BVPD	3	1	-
		E	VALVSP00001	Gland cable for limit switch	3	1	ACTSP0000040
		J	VALVSP00003	Positioner PS2 S.effect 4-20m	1	1	
		K	VALVSP00111	VDI-VDE support SS 80+130x30xH30	3	1	
		H	VALVSP00102	Actuator Single acting DFPD-1200	1	1	
VALV400EPSER-GHIC	Butterfly control valve EP DN400	A	VALVSP00011	Adapter F12 F14F16 P	3	1	-
		B	VALVSP00081	Butterfly valve body PN10 DN400 BVPD	3	1	-
		E	VALVSP00001	Gland cable for limit switch	3	1	ACTSP0000041
		J	VALVSP00003	Positioner PS2 S.effect 4-20m	1	1	
		K	VALVSP00111	VDI-VDE support SS 80+130x30xH30	3	1	
		H	VALVSP00103	Actuator Single acting DFPD-2300	1	1	
VALV450EPSER-GHIC	Butterfly control valve EP DN450	A	VALVSP00012	Adapter F16 F14F16 P	3	1	-
		B	VALVSP00082	Butterfly valve body PN10 DN450 BVPD	3	1	-
		E	VALVSP00001	Gland cable for limit switch	3	1	ACTSP0000041
		J	VALVSP00003	Positioner PS2 S.effect 4-20m	1	1	
		K	VALVSP00111	VDI-VDE support SS 80+130x30xH30	3	1	
		H	VALVSP00103	Actuator Single acting DFPD-2300	1	1	

Complete butterfly valve with actuator		Spare parts					Mounted actuator reference
Reference	Designation	ID	Reference	Designation	Level[i]	Qty	
VALV500EPSER-GHIC	Butterfly control valve EP DN500	A	VALVSP00012	Adapter F16 F14F16 P	3	1	-
		B	VALVSP00083	Butterfly valve body PN10 DN500 BVPD	3	1	-
		E	VALVSP00001	Gland cable for limit switch	3	1	ACTSP0000041
		J	VALVSP00003	Positioner PS2 S.effect 4-20m	1	1	
		K	VALVSP00111	VDI-VDE support SS 80+130x30xH30	3	1	
		H	VALVSP00103	Actuator Single acting DFPD-2300	1	1	

i. Level 1: Spare parts recommended to always keep on board
   Level 2: Recommended spare parts for maintenance
   Level 3: For information

44. Suction pump details

44.1. Pumps with power rate lower or equal to 2,2kW



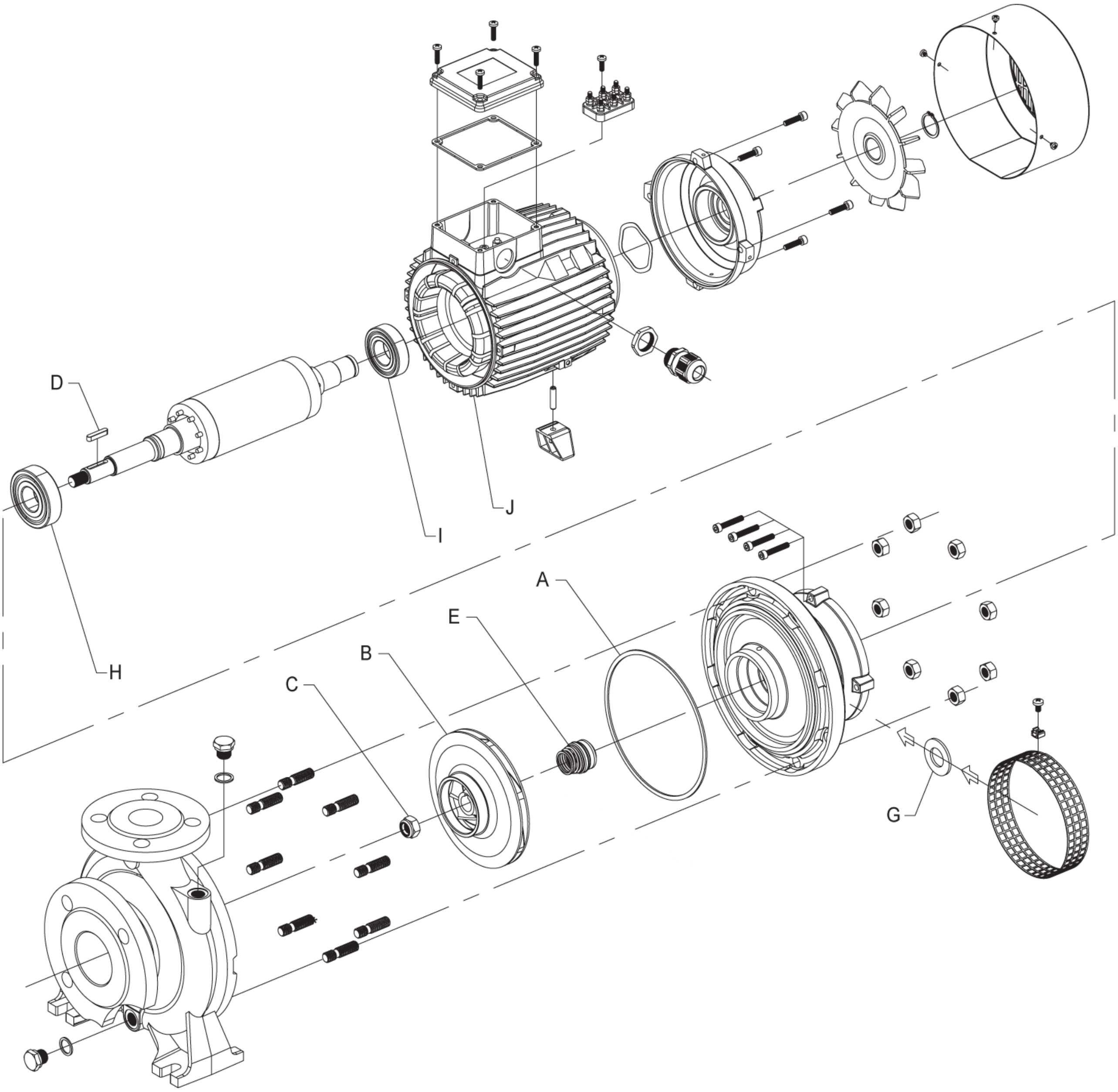
ID	Pumps in 400V 50HZ			Pumps in 440V 60HZ			Corresponding filter
	Ref PMI	Description	QTY	Ref PMI	Description	QTY	
PUMP	CP2032125015050-CAL	Pump 32 125 1.5Kw 400V 50Hz IE2 EN733 15m3/h 2Bars	-	CP2032125015060-CAL	Pump 32 125 1.5Kw 440V 60Hz IE2 EN733 15m3/h 2Bars	-	ACB 903-065 ACB 904-080 ACB(X) 906-100 RF14-08c RF14-08
Level 1: Spare parts recommended to always keep in stock							
A	PUMPSP000001	Body pump gasket 134X142X2	1	PUMPSP000001	Body pump gasket 134X142X2	1	
E	PUMPSP000005	Mechanical seal D18 R3-X6H62V6	1	PUMPSP000005	Mechanical seal D18 R3-X6H62V6	1	
Level 3: For information							
B	PUMPSP000002	Turbine N-NM 32/125A	1	PUMPSP000002	Turbine N-NM 32/125A	1	
C	PUMPSP000003	Nut M10X1 H=5,5MM UNI5589 AISI 316	2	PUMPSP000003	Nut M10X1 H=5,5MM UNI5589 AISI 316	2	
D	PUMPSP000004	Wedge A5X5X20 UNI 6604 AISI 316	1	PUMPSP000004	Wedge A5X5X20 UNI 6604 AISI 316	1	
F1	PUMPSP000006	Spacer frame 17X22X8 316 466539 AISI 316	1	PUMPSP000006	Spacer frame 17X22X8 316 466539 AISI 316	1	
G	PUMPSP000007	Deflector 17,7X33X3	1	PUMPSP000007	Deflector 17,7X33X3	1	
H	PUMPSP000008	Ball bearing6205 C3 2RS	1	PUMPSP000008	Ball bearing6205 C3 2RS	1	
I	PUMPSP000009	Ball bearing6204 C3 2RS	1	PUMPSP000009	Ball bearing6204 C3 2RS	1	
J	PUMPSP000031	Motor B-NM 32/12S 3x400V-IP55-50HZ	1	PUMPSP000043	Motor B-NM 32/12SE-60 3x440V-IP55-60HZ	1	

Spare parts

BIO-SEA® L Reactors

ID	Pumps in 400V 50HZ			Pumps in 440V 60HZ			Corresponding filter
	Ref PMI	Description	QTY	Ref PMI	Description	QTY	
PUMP	CP2040125022050-CAL	Pump 40 125 2.2Kw 400V 50Hz IE2 EN733 35m3/h 2Bars	-	CP2040125022060-CAL	Pump 40 125 2.2Kw 440V 60Hz IE2 EN733 35m3/h 2Bars	-	ACB(X) 910-150 RF14-12c
Level 1: Spare parts recommended to always keep in stock							
A	PUMPSP000001	Body pump gasket 134X142X2	1	PUMPSP000001	Body pump gasket 134X142X2	1	
E	PUMPSP000013	Mechanical seal D20 R3-X6H62V6	1	PUMPSP000013	Mechanical seal D20 R3-X6H62V6	1	
Level 3: For information							
B	PUMPSP000010	Turbine 40/125A D134	1	PUMPSP000010	Turbine 40/125A D134	1	
C	PUMPSP000011	Nut M14X1,5 H=8MM UNI5589 AISI 316	2	PUMPSP000011	Nut M14X1,5 H=8MM UNI5589 AISI 316	2	
D	PUMPSP000012	Wedge A6X6X30 UNI 6604 AISI 316	1	PUMPSP000012	Wedge A6X6X30 UNI 6604 AISI 316	1	
F2	PUMPSP000014	Circlips D19 INOX	1	PUMPSP000014	Circlips D19 INOX	1	
G	PUMPSP000015	Deflector 19,7X40X3	1	PUMPSP000015	Deflector 19,7X40X3	1	
H	PUMPSP000008	Ball bearing6205 C3 2RS	1	PUMPSP000008	Ball bearing6205 C3 2RS	1	
I	PUMPSP000009	Ball bearing6204 C3 2RS	1	PUMPSP000009	Ball bearing6204 C3 2RS	1	
J	PUMPSP000032	Motor B-NM 40/12A/A 3x400V-IP55-50HZ	1	PUMPSP000044	Motor B-NM 40/12A-60/B 3x440V-IP55-60HZ	1	

44.2. Pumps with power rate higher than 2,2kW



ID	PUMPS IN 400V 50HZ			PUMPS IN 440V 60HZ			Corresponding filter
	Ref PMI	Description	QTY	Ref PMI	Description	QTY	
PUMP	CP2040160030050-CAL	Pump 40 160 3Kw 400V 50Hz IE2 EN733 35m3/h 2Bars	-	CP2040160030060-CAL	Pump 40 160 3Kw 440V 60Hz IE2 EN733 35m3/h 2Bars	-	ACB(X) 915-150 ACB(X) 935-200
Level 1: Spare parts recommended to always keep in stock							
A	PUMPSP000016	Body pump gasket 174X184X2,5	1	PUMPSP000016	Body pump gasket 174X184X2,5	1	
E	PUMPSP000019	Mechanical seal D24 R3-X6H62V6	1	PUMPSP000019	Mechanical seal D24 R3-X6H62V6	1	
Level 3: For information							
B	PUMPSP000056	Turbine BNM 40/160B D151	1	PUMPSP000056	Turbine BNM 40/160B D151	1	
C	PUMPSP000057	Nut M14X1.5 H=8MM UNI5589 AISI 316	2	PUMPSP000057	Nut M14X1.5 H=8MM UNI5589 AISI 316	2	
D	PUMPSP000012	Wedge A6X6X30 UNI 6604 AISI 316	1	PUMPSP000012	Wedge A6X6X30 UNI 6604 AISI 316	1	
G	PUMPSP000055	Deflector 23.7X45X3	1	PUMPSP000055	Deflector 23.7X45X3	1	
H	PUMPSP000020	Ball bearing6306 C3 2RS	1	PUMPSP000020	Ball bearing6306 C3 2RS	1	
I	PUMPSP000021	Ball bearing6206 C3 2RS	1	PUMPSP000021	Ball bearing6206 C3 2RS	1	
J	PUMPSP000033	Motor B-NM 40/16B/A 3x400V-IP55-50HZ	1	PUMPSP000045	Motor B-NM 40/16B-60/B 3x440V-IP55-60HZ	1	

ID	PUMPS IN 400V 50HZ			PUMPS IN 440V 60HZ			Corresponding filter
	Ref PMI	Description	QTY	Ref PMI	Description	QTY	
PUMP	CP2050125040050-CAL	Pump 50 125 4Kw 400V 50Hz IE2 EN733 50m3/h 2Bars	-	CP2050125040060-CAL	Pump 50 125 4Kw 440V 60Hz IE2 EN733 50m3/h 2Bars	-	ACBX 940-200 ACB(X) 945-200 ACB(X) 955-250 ACBX 960-250 RF14-10 RF14-12 RF14-15
Level 1: Spare parts recommended to always keep in stock							
A	PUMPSP000016	Body pump gasket 174X184X2,5	1	PUMPSP000016	Body pump gasket 174X184X2,5	1	
E	PUMPSP000019	Mechanical seal D24 R3-X6H62V6	1	PUMPSP000019	Mechanical seal D24 R3-X6H62V6	1	
Level 3: For information							
B	PUMPSP000017	Turbine BNM 50/125A D146	1	PUMPSP000017	Turbine BNM 50/125A D146	1	
C	PUMPSP000018	Nut M14X1,5 H=8MM UNI5589 AISI 316	2	PUMPSP000018	Nut M14X1,5 H=8MM UNI5589 AISI 316	2	
D	PUMPSP000012	Wedge A6X6X30 UNI 6604 AISI 316	1	PUMPSP000012	Wedge A6X6X30 UNI 6604 AISI 316	1	
G	PUMPSP000055	Deflector 23.7X45X3	1	PUMPSP000055	Deflector 23.7X45X3	1	
H	PUMPSP000020	Ball bearing 6306 C3 2RS	1	PUMPSP000020	Ball bearing6306 C3 2RS	1	
I	PUMPSP000021	Ball bearing6206 C3 2RS	1	PUMPSP000021	Ball bearing6206 C3 2RS	1	
J	PUMPSP000034	Motor B-NM 50/12A/A 3x400V-IP55-50HZ	1	PUMPSP000046	Motor B-NM 50/12A-60/A 3x440V-IP55-60HZ	1	

Spare parts
BIO-SEA® L Reactors

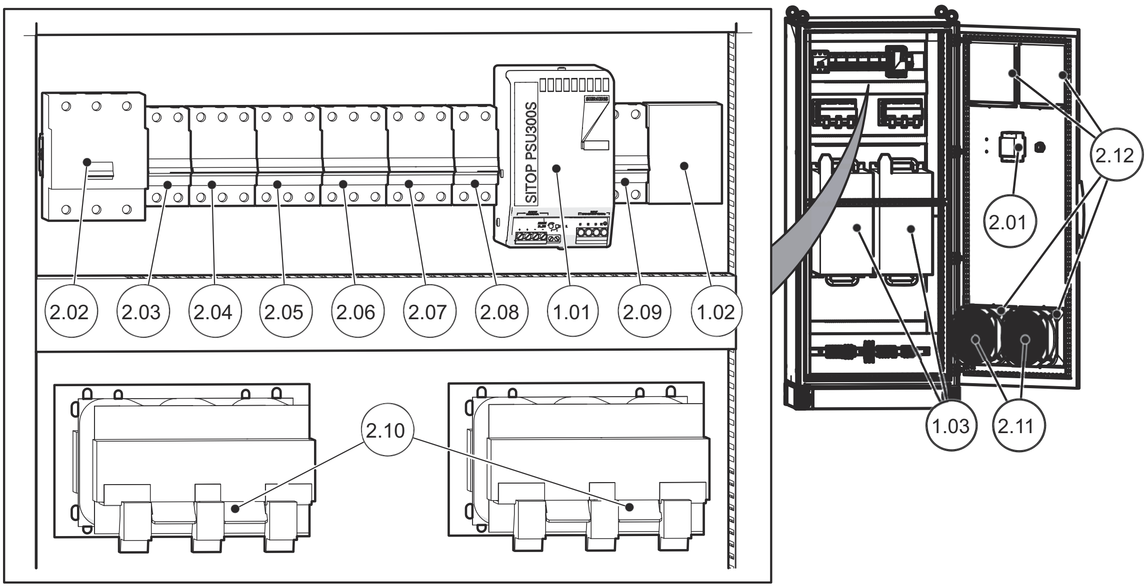
ID	PUMPS IN 400V 50HZ			PUMPS IN 440V 60HZ			Corresponding filter
	Ref PMI	Description	QTY	Ref PMI	Description	QTY	
PUMP	CP2065125055050-CAL	Pump 65 125 5.5Kw 400V 50Hz IE2 EN733 65m3/h 2Bars	-	CP2065125055060-CAL	Pump 65 125 5.5Kw 440V 60Hz IE2 EN733 65m3/h 2Bars	-	ACB(X) 985-300
Level 1: Spare parts recommended to always keep in stock							
A	PUMPSP000016	Body pump gasket 174X184X2,5	1	PUMPSP000016	Body pump gasket 174X184X2,5	1	
E	PUMPSP000025	Mechanical seal D32 R3-X6X62V6	1	PUMPSP000025	Mechanical seal D32 R3-X6X62V6	1	
Level 3: For information							
B	PUMPSP000022	Turbine BNM 65/125A D.146,5	1	PUMPSP000022	Turbine BNM 65/125A D.146,5	1	
C	PUMPSP000023	Nut M18X1.5 H=9MM UNI5589 AISI 316	2	PUMPSP000023	Nut M18X1.5 H=9MM UNI5589 AISI 316	2	
D	PUMPSP000024	Wedge A8X7X35 UNI 6604 AISI 316	1	PUMPSP000024	Wedge A8X7X35 UNI 6604 AISI 316	1	
G	PUMPSP000026	Deflector 31,7X55X3	1	PUMPSP000026	Deflector 31,7X55X3	1	
H	PUMPSP000027	Ball bearing6308 C3 2RS	1	PUMPSP000027	Ball bearing6308 C3 2RS	1	
I	PUMPSP000028	Ball bearing6207 C3 2RS	1	PUMPSP000028	Ball bearing6207 C3 2RS	1	
J	PUMPSP000036	Motor B-NM 65/125A/B 3x400V-IP55-50HZ	1	PUMPSP000048	Motor B-NM 65/125A-60/A 3x440V-IP55-60HZ	1	

ID	PUMPS IN 400V 50HZ			PUMPS IN 440V 60HZ			Corresponding filter
	Ref PMI	Description	QTY	Ref PMI	Description	QTY	
PUMP	CP2065125075050-CAL	Pump 65 125 7.5Kw 400V 50Hz IE2 EN733 95m3/h 2Bars	-	CP2065125075060-CAL	Pump 65 125 7.5Kw 440V 60Hz IE2 EN733 95m3/h 2Bars	-	ACB(X) 999-350 RF14-20 RF14-25
Level 1: Spare parts recommended to always keep in stock							
A	PUMPSP000016	Body pump gasket 174X184X2,5	1	PUMPSP000016	Body pump gasket 174X184X2,5	1	
E	PUMPSP000025	Mechanical seal D32 R3-X6X62V6	1	PUMPSP000025	Mechanical seal D32 R3-X6X62V6	1	
Level 3: For information							
B	PUMPSP000029	Turbine BNM 65/125C D138	1	PUMPSP000029	Turbine BNM 65/125C D138	1	
C	PUMPSP000030	Nut M18X1.5 H=9MM UNI5589 AISI 316	2	PUMPSP000030	Nut M18X1.5 H=9MM UNI5589 AISI 316	2	
D	PUMPSP000024	Wedge A8X7X35 UNI 6604 AISI 316	1	PUMPSP000024	Wedge A8X7X35 UNI 6604 AISI 316	1	
G	PUMPSP000026	Deflector 31,7X55X3	1	PUMPSP000026	Deflector 31,7X55X3	1	
H	PUMPSP000027	Ball bearing6308 C3 2RS	1	PUMPSP000027	Ball bearing6308 C3 2RS	1	
I	PUMPSP000028	Ball bearing6207 C3 2RS	1	PUMPSP000028	Ball bearing6207 C3 2RS	1	
J	PUMPSP000035	Motor B-NM 65/125C/B 3x400V-IP55-50HZ	1	PUMPSP000047	Motor B-NM 65/125C-60/A 3x440V-IP55-60HZ	1	

ID	PUMPS IN 400V 50HZ			PUMPS IN 440V 60HZ			Corresponding filter
	Ref PMI	Description	QTY	Ref PMI	Description	QTY	
PUMP	CP2080160920050-CAL	Pump 80 160 9.5Kw 400V 50Hz IE2 EN733 126m3/h 2Bars	-	CP2080160920060-CAL	Pump 80 160 9.5Kw 440V 60Hz IE2 EN733 126m3/h 2Bars	-	ACB(L) 9100-400 ACB(L) 9120-500 RF14-30 RF14-35 RF14-40 RF14-45
Level 1: Spare parts recommended to always keep in stock							
A	PUMPSP013706	Body pump gasket 189X199X2,5	1	PUMPSP013706	Body pump gasket 189X199X2,5	1	
E	PUMPSP000025	Mechanical seal D32 R3-X6X62V6	1	PUMPSP000025	Mechanical seal D32 R3-X6X62V6	1	
Level 3: For information							
B	PUMPSP013708	Turbine BNM 80/160E	1	PUMPSP013708	Turbine BNM 80/160E	1	
C	PUMPSP000023	Nut M18X1.5 H=9MM UNI5589 AISI 316	2	PUMPSP000023	Nut M18X1.5 H=9MM UNI5589 AISI 316	2	
D	PUMPSP000024	Wedge A8X7X35 UNI 6604 AISI 316	1	PUMPSP000024	Wedge A8X7X35 UNI 6604 AISI 316	1	
G	PUMPSP000026	Deflector 31,7X55X3	1	PUMPSP000026	Deflector 31,7X55X3	1	
H	PUMPSP000027	Ball bearing6308 C3 2RS	1	PUMPSP000027	Ball bearing6308 C3 2RS	1	
I	PUMPSP000028	Ball bearing6207 C3 2RS	1	PUMPSP000028	Ball bearing6207 C3 2RS	1	
J	PUMPSP013750	Motor B-NM 80/160D/C 3x400V-IP55-50HZ	1	PUMPSP013751	Motor B-NM 80/160D/C 3x440V-IP55-60HZ	1	

45. Power cabinet (only for BIO-SEA® B models)

45.1. Standard power cabinet



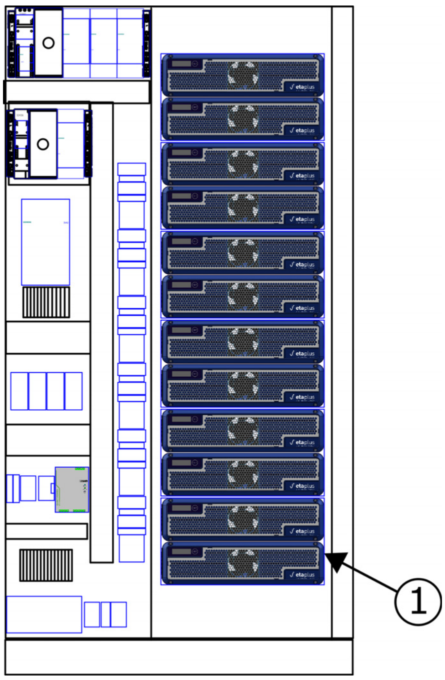
ID	Ref PMI	Description	Mark on electrical diagram
Level 1: Spare parts recommended to always keep on board			
1.01	ELE007142	Power supply MONO 120-500V 24V 5A (Only for cabinet A1)	U1
1.02	ELE010422	Terminator RS485 (Only for cabinet A1)	XBUS
1.03	BAL010815	Electronic ballast ELC 22kW	B1-B2
Level 3: For information			
2.01	ELE006854	Disconnecting switch 175A	Q1
2.02	ELE006828	Circuit Breaker NG125 3P 100A C	Q2
2.03	ELE002334	Circuit breaker 2P 6A curve C	Q3
2.04	ELE006827	Circuit breaker 3P 50A curve C	Q4
2.05	ELE006827	Circuit breaker 3P 50A curve C	Q5
2.06	ELE006830	Circuit Breaker 3P 10 C	Q6
2.07	ELE006830	Circuit Breaker 3P 10 C	Q7

Spare parts

ID	Ref PMI	Description	Mark on electrical diagram
2.08	ELE002207	Circuit Breaker 2P 6A D (UL standard) (Only for cabinet A1)	Q8
2.09	ELE002207	Circuit Breaker 2P 6A D (UL standard) (Only for cabinet A1)	Q9
2.10[i]	ELE006818	Inductor TRI 40A-0.73mH - HORIZONTAL MOUNTING	L1-L2
	ELE012522	~ Line Choke 440V 36A 0.9mH - VERTICAL MOUNTING	
2.11	ELE010802	Fan 850m3/h 400-440V	M1-M2
2.12	ELE011125	Fan filter	-

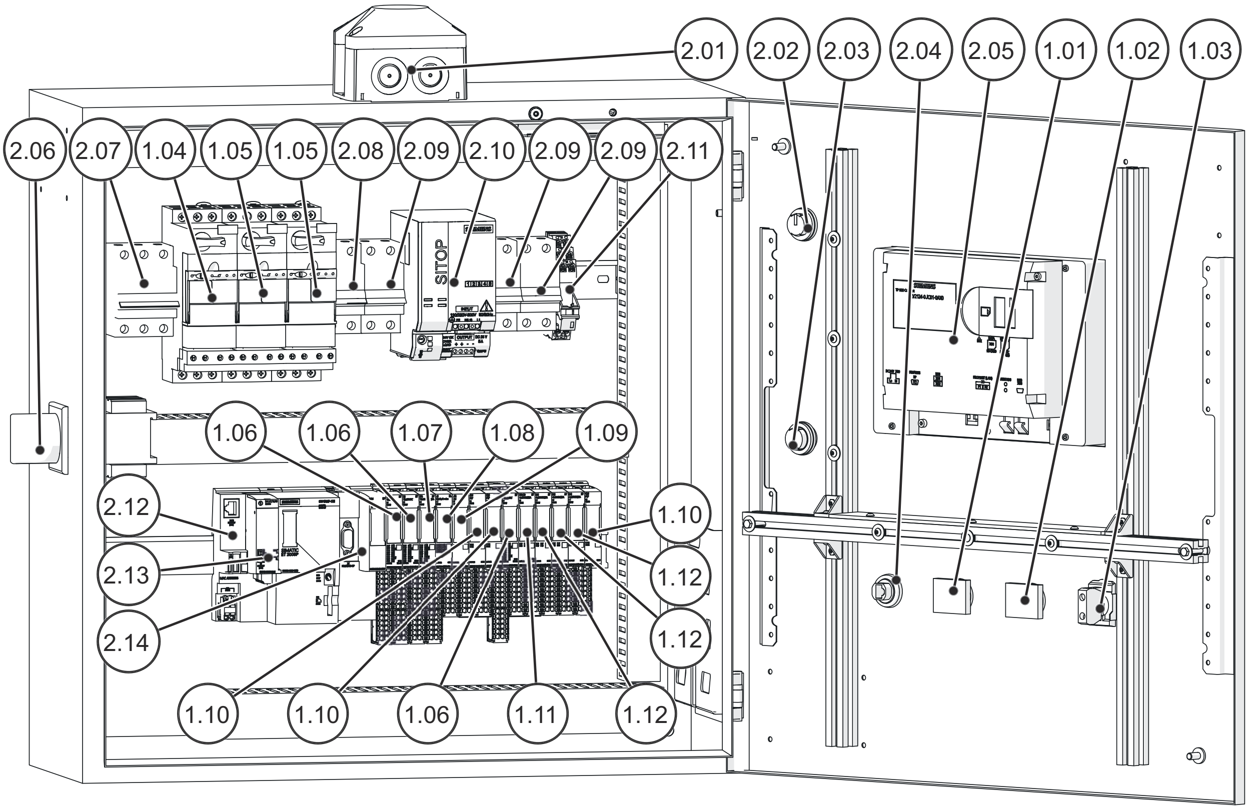
i. Check mounting (Horizontal or vertical) before ordering this spare

45.2. Compact power cabinet



ID	Ref PMI	Description	Mark on electrical diagram
		Level 1: Spare parts recommended to always keep on board	
1	BAL015385	Electronic ballast ELC 2x12kW	1TA1-6TA1
-	ELE016889	Fan filtering element 283x283x12 mm	-
-	ELE016890	Fan filtering element 118x118x12 mm	-

46. Control cabinet



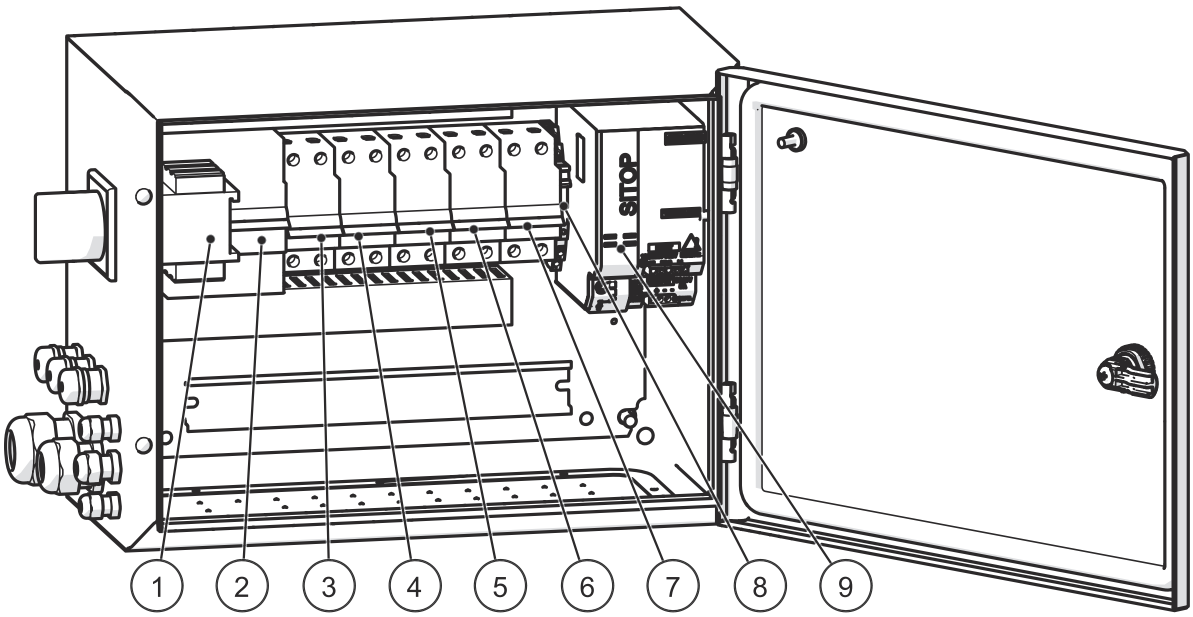
*This figure is for information as control cabinet can change according to **BIO-SEA**® model and filter's model.*

ID	Ref PMI	Description	
Level 1: Spare parts recommended to always keep on board			
1.01	ELE015723	Luminous red buzzer	HA01-2
1.02	ELE006353	Blue LED	H2
1.03	ELE011352	White indicator	H1
1.04	ELE015813	Power base for backwash motor M11	QM11
	ELE015816	Standard control unit for backwash motor M11	
1.05	Refer to the electrical diagram of the control cabinet	Power base for the pump P01 or P02	QP01, QP02[i]
		Standard control unit for the pump P01or P02	
1.06	ELE015725	Module 16I DI 24Vdc	A3, A4, A10
1.07	ELE015726	Module 16O DO 24Vdc 0.5A	A5

ID	Ref PMI	Description	
1.08	ELE015718	Module 8I Analog 4-20mA	A6
1.09	ELE015719	Module 2O Analog 4-20mA	A7
1.10	ELE015724	Module CM PtP RS422-RS485-RS23	A8, A9, A15
1.11	ELE015727	Module 4O DO 24Vdc 2A	A11
1.12	ELE015730	Module 4O relay 24Vdc	A12, A13, A14
Level 3: For information			
2.01	ELE015731	Flashing beacon (Red)	HA01-1
2.02	ELE007533	Emergency stop	S1
2.03	ELE007534	Double pushing buttons (green/red)	S2
2.04	ELE015752	USB socket	X2
2.05	ELE015916	Touch screen (IHM TP900 COMFORT)	I1
2.06	ELE000117	Section switch 25A	Q0
2.07	ELE001647	Circuit breaker 3P 25A CURVE C	Q1
2.08	ELE001445	Circuit Breaker 2P 2A C60N Curve C	QI0
2.09	ELE002334	Circuit Breaker 2P 6A C60N Curve C	Q2, Q3, Q4
2.10	ELE007142	Power supply SITOP MONO 120-500V 24V 5A 120W	U1
2.11	ELE015159	25Vdc relay 2 inverters	KA1
2.12	ELE0015717	CPU 1512SP-1 PN	A1
2.13	ELE016714	Bus adapter	
2.14	ELE015720	Master interface module with profibus	A2

i. Only for configuration with two pumps

47. Switchboard cabinet (only for BIO-SEA® L models)



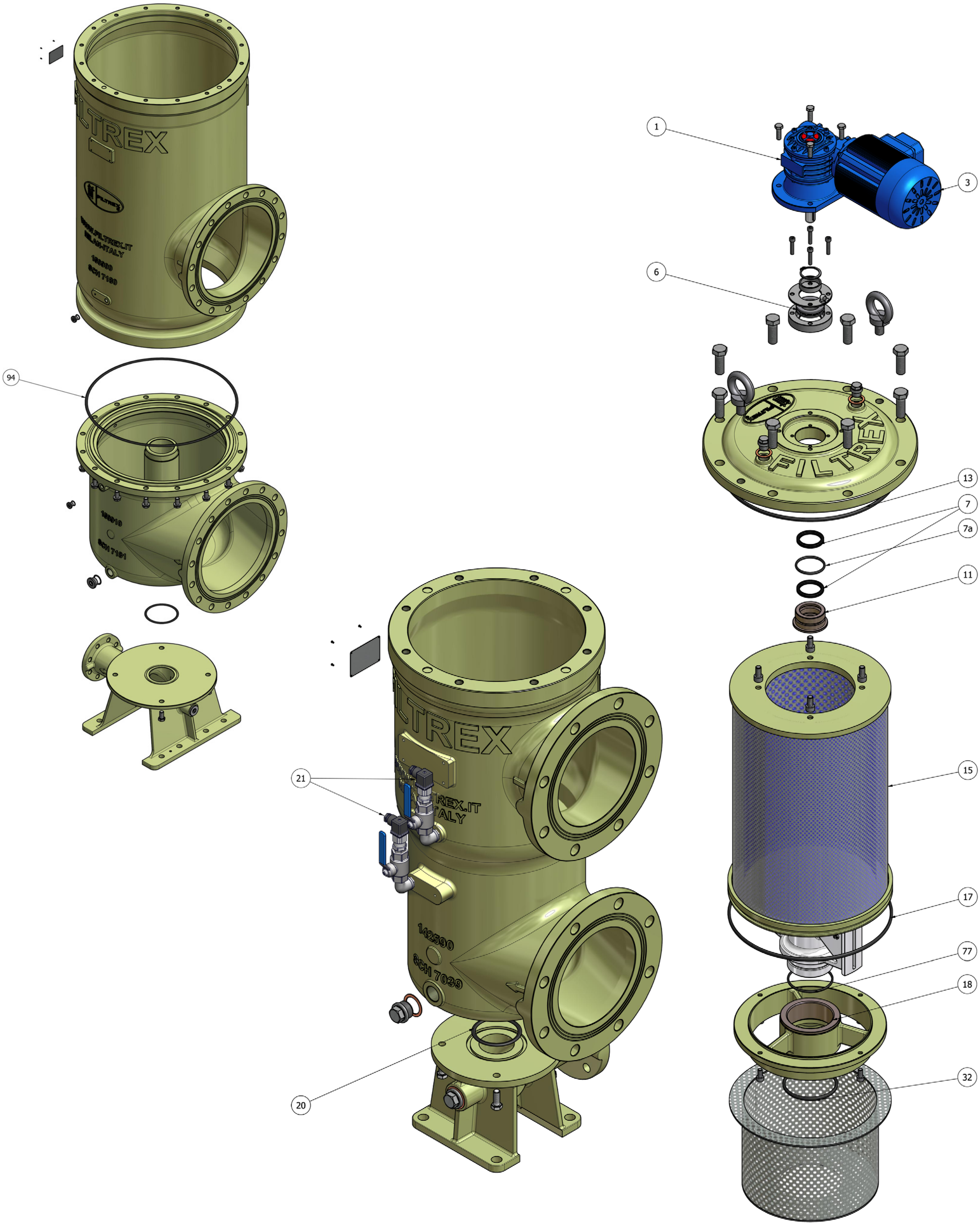
*This figure is for information as switchboard cabinet and can change according to **BIO-SEA**® model.*

ID	Ref PMI	Description	BIO-SEA® models			
			L01-xxxx	L02-xxxx	L03-xxxx	L04-xxxx
Level 1: Spare parts recommended to always keep on board						
8	ELE013510	24DC relay 1NO	KA1	KA1	KA1	KA1
9	ELE007142	Power supply SITOP MONO 120-500V 24V 5A 120W	U1	U1	U1	U1
Level 3: For information						
1	ELE000117	Section switch 25A	Q0	x	x	x
	ELE000112	Section switch 40A	x	Q0	Q0	x
	ELE000140	Section switch 63A	x	x	x	Q0
2	ELE001647	Circuit Breaker C60N Tri 25A Curve C	Q1	x	x	x
	ELE008888	Circuit Breaker C60N Tri 40A Curve C	x	Q1	Q1	x
	ELE013645	Circuit Breaker C60N Tri 63A Curve C	x	x	x	Q1
3	ELE000747	Circuit Breaker C60N Bi 25A Curve C	Q2	Q2	Q2	Q2
4	ELE000747	Circuit Breaker C60N Bi 25A Curve C	x	Q3	Q3	Q3
5	ELE000747	Circuit Breaker C60N Bi 25A Curve C	x	x	Q4	Q4

Spare parts
Switchboard cabinet (only for BIO-SEA® L models)

ID	Ref PMI	Description	BIO-SEA® models			
			L01-xxxx	L02-xxxx	L03-xxxx	L04-xxxx
6	ELE000747	Circuit Breaker C60N Bi 25A Curve C	x	x	x	Q5
7	ELE002334	Circuit Breaker C60N Bi 6A Curve C	Q3	Q4	Q5	Q6

48. Filtrex filter



<table>
<tr><th rowspan="2">ID</th><th rowspan="2">Description</th><th colspan="7">Ref</th></tr>
<tr><th>Filter model: ACB-903-065</th><th>Filter model: ACB-904-080</th><th>Filter model: ACB(X)-906-100</th><th>Filter model: ACB(X)-910-150</th><th>Filter model: ACB(X)-915-150</th><th>Filter model: ACB(X)-935-200</th><th>Filter model: ACBX-940-200</th></tr>
<tr><td colspan="9">Level 1: Spare parts recommended to always keep in stock</td></tr>
<tr><td>7</td><td>Backwash nozzle gasket</td><td rowspan="6">FX015761</td><td rowspan="6">FX011853</td><td rowspan="6">FX010291</td><td rowspan="6">FX011035</td><td rowspan="7">FX011038</td><td rowspan="7">FX011039</td><td rowspan="7">FX011039</td></tr>
<tr><td>7a</td><td>Backwash shaft bushing gasket</td></tr>
<tr><td>13</td><td>Self-cleaning filter cover gasket</td></tr>
<tr><td>17</td><td>Self-cleaning filtering element gasket</td></tr>
<tr><td>20</td><td>Backwash line gasket[i]</td></tr>
<tr><td>77</td><td>Backwash nozzle gasket</td></tr>
<tr><td>32</td><td>Backwash nozzle support gasket</td><td>N/A</td><td>N/A</td><td>N/A</td><td>N/A</td></tr>
<tr><td>21</td><td>Pressure sensor -1...15 bar, connection G1/4”</td><td>ELE010927</td><td>ELE010927</td><td>ELE010927</td><td>ELE010927</td><td>ELE010927</td><td>ELE010927</td><td>ELE010927</td></tr>
<tr><td colspan="9">Level 3: For information</td></tr>
<tr><td>1</td><td>Gear reducer</td><td>FXSP000001</td><td>FXSP000001</td><td>FXSP000001</td><td>FXSP000001</td><td>FXSP000001</td><td>FX011128</td><td>FX011128</td></tr>
<tr><td>3</td><td>Electric motor</td><td>FXSP000005</td><td>FXSP000005</td><td>FXSP000005</td><td>FXSP000005</td><td>FXSP000005</td><td>FX011130</td><td>FX011130</td></tr>
<tr><td>6</td><td>Thrust bearing</td><td>FXSP000050</td><td>FXSP000050</td><td>FXSP000009</td><td>FXSP000010</td><td>FXSP000011</td><td>FXSP000012</td><td>FXSP000012</td></tr>
<tr><td>11</td><td>Backwash shaft bushing</td><td>FXSP000051</td><td>FXSP000051</td><td>FXSP000017</td><td>FXSP000018</td><td>FXSP000019</td><td>FXSP000020</td><td>FXSP000020</td></tr>
<tr><td>15</td><td>Self-cleaning filtering element (20µm)</td><td>FXSP000074</td><td>FXSP000052</td><td>FXSP000033</td><td>FXSP000034</td><td>FXSP000035</td><td>FXSP000036</td><td>FXSP019597</td></tr>
<tr><td>18</td><td>Backwash shaft bushing</td><td>FXSP000075</td><td>FXSP000053</td><td>FXSP000041</td><td>FXSP000042</td><td>FXSP000043</td><td>FXSP000044</td><td>FXSP000044</td></tr>
</table>

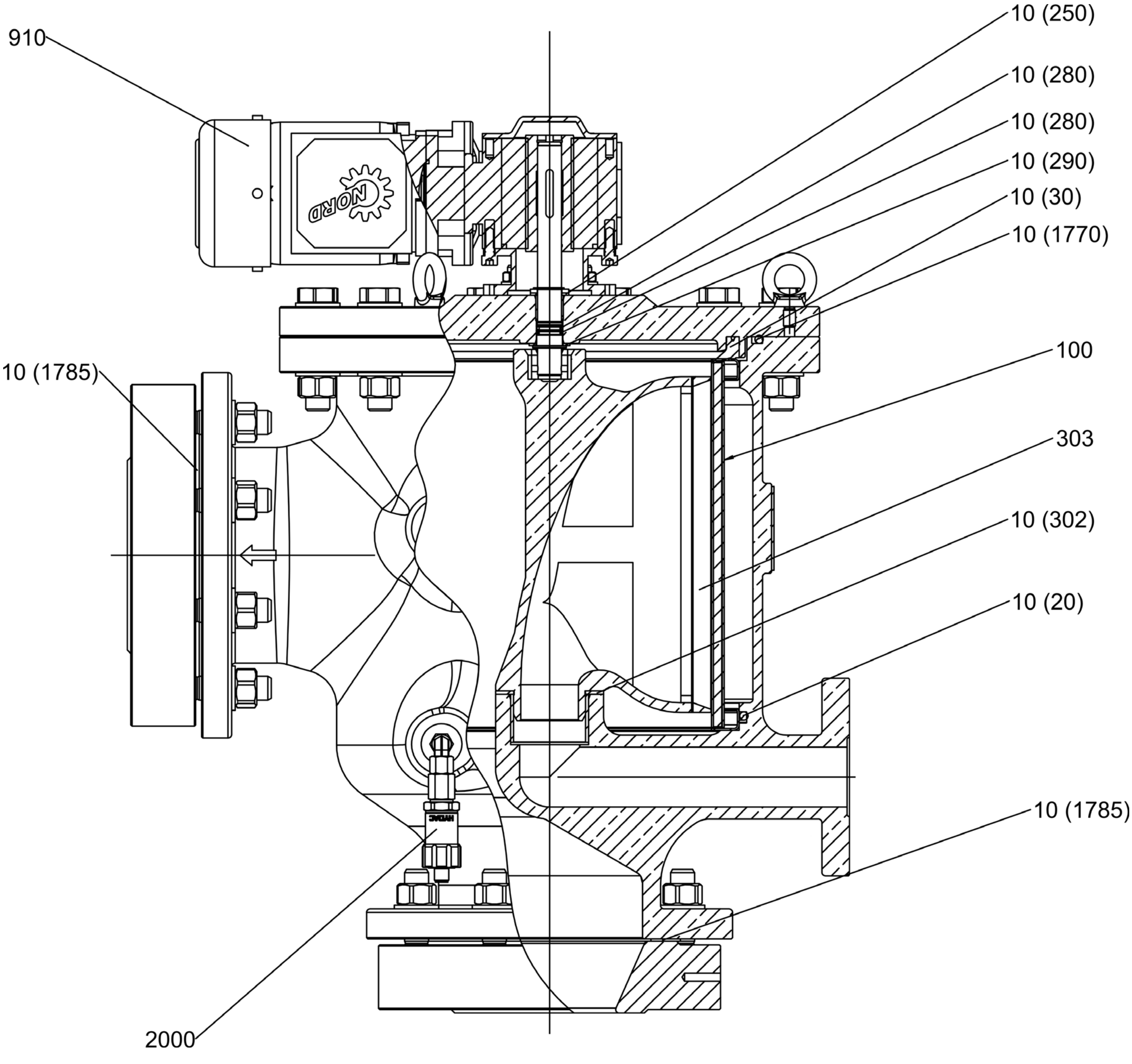
i. Not applicable to ACBX/L filters

<table>
<tr><th rowspan="2">ID</th><th rowspan="2">Description</th><th colspan="7">Ref</th></tr>
<tr><th>Filter model: ACB(X)-945-200</th><th>Filter model: ACB(X)-955-250</th><th>Filter model: ACBX-960-250</th><th>Filter model: ACB(X)-985-300</th><th>Filter model: ACB(X)-999-350</th><th>Filter model: ACB(L)-9100-400</th><th>Filter model: ACB(L)-9120-500</th></tr>
<tr><td colspan="9">Level 1: Spare parts recommended to always keep in stock</td></tr>
<tr><td>7</td><td>Backwash nozzle gasket</td><td rowspan="7">FX011040</td><td rowspan="7">FX011041</td><td rowspan="7">FX011041</td><td rowspan="7">FX011042</td><td rowspan="7">FX011043</td><td rowspan="8">FXSP000064</td><td rowspan="8">FXSP000065</td></tr>
<tr><td>7a</td><td>Backwash shaft bushing gasket</td></tr>
<tr><td>13</td><td>Self-cleaning filter cover gasket</td></tr>
<tr><td>17</td><td>Self-cleaning filtering element gasket</td></tr>
<tr><td>20</td><td>Backwash line gasket[i]</td></tr>
<tr><td>77</td><td>Backwash nozzle gasket</td></tr>
<tr><td>32</td><td>Backwash nozzle support gasket</td></tr>
<tr><td>94</td><td>Intermediate body flange gasket[i]</td><td>N/A</td><td>N/A</td><td>N/A</td><td>N/A</td><td>N/A</td></tr>
<tr><td>21</td><td>Pressure sensor -1…15 bar, connection G1/4”</td><td>ELE010927</td><td>ELE010927</td><td>ELE010927</td><td>ELE010927</td><td>ELE010927</td><td>ELE010927</td><td>ELE010927</td></tr>
<tr><td colspan="9">Level 3: For information</td></tr>
<tr><td>1</td><td>Gear reducer</td><td>FX011128</td><td>FXSP000003</td><td>FXSP000003</td><td>FX011129</td><td>FX011129</td><td>FXSP000054</td><td>FXSP000055</td></tr>
<tr><td>3</td><td>Electric motor</td><td>FX011130</td><td>FXSP000007</td><td>FXSP000007</td><td>FX011131</td><td>FX011131</td><td>FX011131</td><td>FXSP000056</td></tr>
<tr><td>6</td><td>Thrust bearing</td><td>FXSP000013</td><td>FXSP000014</td><td>FXSP000014</td><td>FXSP000015</td><td>FXSP000016</td><td>FXSP000057</td><td>FXSP000057</td></tr>
<tr><td>11</td><td>Backwash shaft bushing</td><td>FXSP000021</td><td>FXSP000022</td><td>FXSP000022</td><td>FXSP000023</td><td>FXSP000024</td><td>FXSP000058</td><td>FXSP000059</td></tr>
<tr><td>15</td><td>Self-cleaning filtering element (20µm)</td><td>FXSP000037</td><td>FXSP000038</td><td>FXSP019598</td><td>FXSP000039</td><td>FXSP000040</td><td>FXSP000060</td><td>FXSP000061</td></tr>
<tr><td>18</td><td>Backwash shaft bushing</td><td>FXSP000045</td><td>FXSP000046</td><td>FXSP000046</td><td>FXSP000047</td><td>FXSP000048</td><td>FXSP000062</td><td>FXSP000063</td></tr>
</table>

i. Not applicable to ACBX/L filters

49. Hydac filter

49.1. Filters RF14-08/08c and RF14-12/12c



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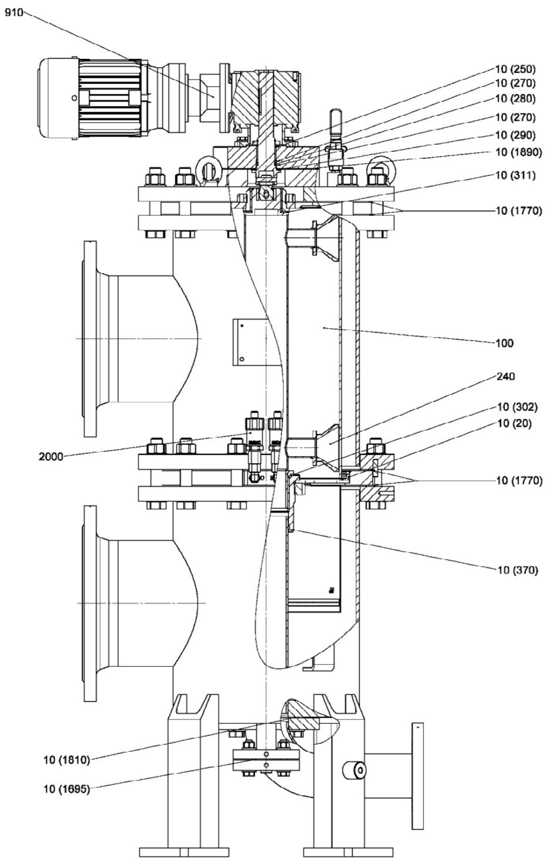
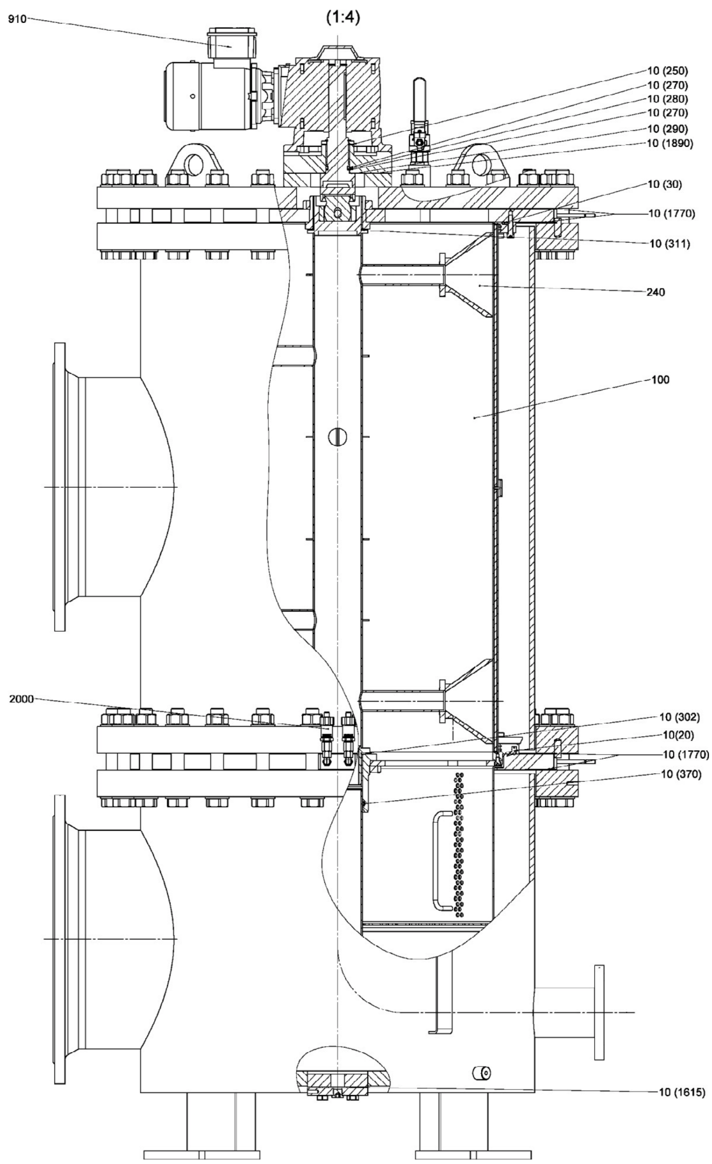
<tr><th rowspan="2">ID</th><th rowspan="2" colspan="2">Description</th><th colspan="4">Filter model:</th></tr>
<tr><th>RF14-08c</th><th>RF14-08</th><th>RF14-12c</th><th>RF14-12</th></tr>
<tr><td colspan="7">Level 1: Spare parts recommended to always keep in stock</td></tr>
<tr><td>10</td><td colspan="2">Sealing set</td><td>HYSP1369632</td><td>HYSP1369633</td><td>HYSP1369634</td><td>HYSP1369635</td></tr>
<tr><td rowspan="2">2000</td><td rowspan="2">Pressure transmitter</td><td>JUMO</td><td>ELE010927</td><td>ELE010927</td><td>ELE010927</td><td>ELE010927</td></tr>
<tr><td>HYDAC</td><td>HYSP1370060</td><td>HYSP1370060</td><td>HYSP1370060</td><td>HYSP1370060</td></tr>
<tr><td colspan="7">Level 3: For information</td></tr>
<tr><td>100</td><td colspan="2">Filter Basket</td><td>HYSP1370131</td><td>HYSP1370131</td><td>HYSP1370132</td><td>HYSP1370132</td></tr>
<tr><td>303</td><td colspan="2">Backflush strip</td><td>HYSP4645673
(x1)</td><td>HYSP4645672
(x1)</td><td>HYSP4646211
(x1)</td><td>HYSP4646210
(x1)</td></tr>
<tr><td>910</td><td colspan="2">Gearmotor</td><td>HYSP6287917</td><td>HYSP6287917</td><td>HYSP6287917</td><td>HYSP6287917</td></tr>
<tr><td>-</td><td colspan="2">Vent</td><td>PNEU006807</td><td>PNEU006807</td><td>PNEU006807</td><td>PNEU006807</td></tr>
</table>

49.2. Filters RF14-10 to RF14-45





ID	Description		Filter model:			
			RF14-10	RF14-15	RF14-20	RF14-25
Level 1: Spare parts recommended to always keep in stock						
10	Sealing set		HYSP1370012	HYSP1370013	HYSP1370014	HYSP1370015
2000	Pressure transmitter	JUMO	ELE010927	ELE010927	ELE010927	ELE010927
		HYDAC	HYSP1370060	HYSP1370060	HYSP1370060	HYSP1370060
Level 3: For information						
100	Filter Basket		HYSP1366996	HYSP1366997	HYSP1366998	HYSP1366999
240	Backflush strip		HYSP4440160 (4x)	HYSP4569120 (3x)	HYSP4412158 (6x)	HYSP4425299 (6x)
910	Gearmotor		HYSP6278099	HYSP6278099	HYSP6278100	HYSP6278098
-	Vent 1”		PNEU006807	PNEU006807	PNEU006807	PNEU006807

ID	Description		Filter model:			
			RF14-30	RF14-35	RF14-40	RF14-45
Level 1: Spare parts recommended to always keep in stock						
10	Sealing set		HYSP1370016	HYSP1370017	HYSP1370018	HYSP1370019
2000	Pressure transmitter	JUMO	ELE010927	ELE010927	ELE010927	ELE010927
		HYDAC	HYSP1370060	HYSP1370060	HYSP1370060	HYSP1370060
Level 3: For information						
100	Filter Basket		HYSP1370000	HYSP1370001	HYSP1370002	HYSP1370003
240	Backflush strip		HYSP4494179 (6x)	HYSP4414201 (6x)	HYSP4415712 (6x)	HYSP4452989 (6x)
910	Gearmotor		HYSP6278097	HYSP6278097	HYSP6278097	HYSP6250449
-	Vent		PNEU006807	PNEU006807	PNEU006807	PNEU006807

50. Mercury safety datasheet

Safety data sheet
according to 1907/2006/EC, Article 31

Printing date 14.01.2015 Version number 16 Revision: 14.01.2015

* **SECTION 1: Identification of the substance/mixture and of the company/undertaking**

· **1.1 Product identifier**
· **Trade name:** mercury
· **Article number:** 2564-01
· **CAS Number:**
7439-97-6
· **EC number:**
231-106-7
· **Index number:**
080-001-00-0
· **1.2 Relevant identified uses of the substance or mixture and uses advised against**
No further relevant information available.
· **Application of the substance / the mixture** : For Laboratory, Research or Manufacturing use.

· **1.3 Details of the supplier of the safety data sheet**
· **Manufacturer/Supplier:**
Avantor Performance Materials B.V. Tel:(+31) (0)570 - 687500
P.O.Box 1 Fax:(+31) (0)570 - 687574
7400 AA Deventer E-mail : jtbaker.nl@avantormaterials.com
The Netherlands
· **Informing department:**
E-mail : pawel.skiba@avantormaterials.com
Avantor Performance Materials Sales Office Tel.: +31(0) 570 687500
· **1.4 Emergency telephone number:**
Environment Health & Safety department
during normal opening times (8 am till 5.30 pm) tel: (+31)(0) 570 687500

* **SECTION 2: Hazards identification**

· **2.1 Classification of the substance or mixture**
· **Classification according to Regulation (EC) No 1272/2008**

Acute Tox. 2	H330	Fatal if inhaled.
Repr. 1B	H360D	May damage the unborn child.
STOT RE 1	H372	Causes damage to organs through prolonged or repeated exposure.
Aquatic Acute 1	H400	Very toxic to aquatic life.
Aquatic Chronic 1	H410	Very toxic to aquatic life with long lasting effects.

· **Classification according to Directive 67/548/EEC or Directive 1999/45/EC**
T+; Very toxic
R26: Very toxic by inhalation.

T; Toxic
Repr. Cat. 2
R61-48/23: May cause harm to the unborn child. Toxic: danger of serious damage to health by prolonged exposure through inhalation.

N; Dangerous for the environment
R50/53: Very toxic to aquatic organisms, may cause long-term adverse effects in the aquatic environment.
· **Information concerning particular hazards for human and environment:** void

· **2.2 Label elements**
· **Labelling according to Regulation (EC) No 1272/2008**
The substance is classified and labelled according to the CLP regulation.

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Safety Data Sheet

Safety data sheet
according to 1907/2006/EC, Article 31

Printing date 14.01.2015 *Version number 16* *Revision: 14.01.2015*

Trade name: mercury

(Contd. of page 1)

· ***Hazard pictograms***

GHS06 GHS08 GHS09

· ***Signal word*** *Danger*
· ***Hazard statements***
H330 Fatal if inhaled.
H360D May damage the unborn child.
H372 Causes damage to organs through prolonged or repeated exposure.
H410 Very toxic to aquatic life with long lasting effects.
· ***Precautionary statements***
P260 Do not breathe dust/fume/gas/mist/vapours/spray.
P284 Wear respiratory protection.
P281 Use personal protective equipment as required.
P310 Immediately call a POISON CENTER/doctor.
P304+P340 IF INHALED: Remove victim to fresh air and keep at rest in a position comfortable for breathing.
P405 Store locked up.
· ***2.3 Other hazards***
· ***Results of PBT and vPvB assessment***
· ***PBT:*** *Not applicable.*
· ***vPvB:*** *Not applicable.*

SECTION 3: Composition/information on ingredients

· ***3.1 Chemical characterisation: Substances***
· ***CAS No. Designation:***
7439-97-6 mercury
· ***Identification number(s):***
· ***EC number:*** *231-106-7*
· ***Index number:*** *080-001-00-0*

*
SECTION 4: First aid measures

· ***4.1 Description of first aid measures***
· ***General information***
Instantly remove any clothing soiled by the product.
Remove breathing apparatus only after soiled clothing has been completely removed.
In case of irregular breathing or respiratory arrest provide artificial respiration.
· ***After inhalation***
Supply fresh air or oxygen; call for doctor.
In case of unconsciousness bring patient into stable side position for transport.
· ***After skin contact*** *Instantly wash with water and soap and rinse thoroughly.*
· ***After eye contact*** *Rinse opened eye for several minutes under running water. Then consult doctor.*
· ***After swallowing***
Rinse out mouth and then drink plenty of water.
Induce vomiting and call for medical help.
· ***4.2 Most important symptoms and effects, both acute and delayed*** *No further relevant information available.*
· ***4.3 Indication of any immediate medical attention and special treatment needed***
No further relevant information available.

GB

(Contd. on page 3)

(Contd. of page 2)

*
SECTION 5: Firefighting measures

· **5.1 Extinguishing media**
· **Suitable extinguishing agents**
CO2, extinguishing powder or water jet. Fight larger fires with water jet or alcohol-resistant foam.
· **For safety reasons unsuitable extinguishing agents** Water with a full water jet.
· **5.2 Special hazards arising from the substance or mixture** No further relevant information available.
· **5.3 Advice for firefighters**
· **Protective equipment:**
Wear self-contained breathing apparatus.
Put on breathing apparatus.

*
SECTION 6: Accidental release measures

· **6.1 Personal precautions, protective equipment and emergency procedures** Not required.
· **6.2 Environmental precautions:**
Inform respective authorities in case product reaches water or sewage system.
· **6.3 Methods and material for containment and cleaning up:**
Absorb with liquid-binding material (sand, diatomite, acid binders, universal binders, sawdust).
Dispose of contaminated material as waste according to item 13.
Ensure adequate ventilation.
· **6.4 Reference to other sections**
See Section 7 for information on safe handling
See Section 8 for information on personal protection equipment.
See Section 13 for information on disposal.

*
SECTION 7: Handling and storage

· **7.1 Precautions for safe handling**
Ensure good ventilation/exhaustion at the workplace.
Open and handle container with care.
· **Information about protection against explosions and fires:** Keep breathing equipment ready.

· **7.2 Conditions for safe storage, including any incompatibilities**
· **Storage**
· **Requirements to be met by storerooms and containers:** No special requirements.
· **Information about storage in one common storage facility:** Not required.
· **Further information about storage conditions:**
+ 15 °C - +25 °C
Keep container tightly sealed.
· **7.3 Specific end use(s)** No further relevant information available.

*
SECTION 8: Exposure controls/personal protection

· **8.1 Control parameters**
· **Components with critical values that require monitoring at the workplace:**

· **Ingredients with biological limit values:**	
7439-97-6 mercury	
BMGV	20 µmol/mol creatinine Medium: urine Sampling time: random Parameter: mercury

· **Additional information:** The lists that were valid during the compilation were used as basis.

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GB

Safety Data Sheet

Safety data sheet
according to 1907/2006/EC, Article 31

Printing date 14.01.2015 Version number 16 Revision: 14.01.2015

Trade name: mercury

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· **8.2 Exposure controls**
· **Personal protective equipment**
· **General protective and hygienic measures**
Keep away from foodstuffs, beverages and food.
Instantly remove any soiled and impregnated garments.
Wash hands during breaks and at the end of the work.
Store protective clothing separately.
· **Breathing equipment:**
In case of brief exposure or low pollution use breathing filter apparatus. In case of intensive or longer exposure use breathing apparatus that is independent of circulating air.
· **Protection of hands:**
The glove material has to be impermeable and resistant to the product/ the substance/ the preparation.
Due to missing tests no recommendation to the glove material can be given for the product/ the preparation/ the chemical mixture.
Selection of the glove material on consideration of the penetration times, rates of diffusion and the degradation
· **Material of gloves**
Nitrile rubber, NBR
The selection of the suitable gloves does not only depend on the material, but also on further marks of quality and varies from manufacturer to manufacturer.
· **Penetration time of glove material**
The exact break trough time has to be found out by the manufacturer of the protective gloves and has to be observed.
· **Eye protection:** Safety glasses recommended during refilling.
· **Body protection:** Protective work clothing.

*

SECTION 9: Physical and chemical properties

· **9.1 Information on basic physical and chemical properties**	
· **General Information**	
· **Appearance:**	
Form:	Fluid
Colour:	Silver-coloured
· **Smell:**	Odourless
· **Odour threshold:**	Not determined.
· **pH-value:**	Not determined.
· **Change in condition**	
Melting point/Melting range:	-38.86 °C
Boiling point/Boiling range:	356.73 °C
· **Flash point:**	Not applicable
· **Inflammability (solid, gaseous)**	Not applicable.
· **Ignition temperature:**	
Decomposition temperature:	Not determined.
· **Self-inflammability:**	Not determined.
· **Danger of explosion:**	Product is not explosive.
· **Critical values for explosion:**	
Lower:	Not determined.
Upper:	Not determined.
· **Steam pressure at 20 °C:**	0.00163 hPa
· **Density at 20 °C**	13.54 g/cm³
· **Relative density**	Not determined.
· **Vapour density**	Not determined.
· **Evaporation rate**	Not determined.

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GB

Safety data sheet
according to 1907/2006/EC, Article 31

Printing date 14.01.2015 | Version number 16 | Revision: 14.01.2015

Trade name: mercury

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· **Solubility in / Miscibility with**
  Water: not or partly miscible
· **Partition coefficient (n-octanol/water):** 4.5 log POW

· **Viscosity:**
  dynamic: Not determined.
  kinematic: Not determined.
· **9.2 Other information** No further relevant information available.

*
SECTION 10: Stability and reactivity

· **10.1 Reactivity**
· **10.2 Chemical stability**
· **Thermal decomposition / conditions to be avoided:** Heat,boiling temperatures.
· **10.3 Possibility of hazardous reactions** No dangerous reactions known
· **10.4 Conditions to avoid** No further relevant information available.
· **10.5 Incompatible materials:** No further relevant information available.
· **10.6 Hazardous decomposition products:** Poisonous gases/vapours

*
SECTION 11: Toxicological information

· **11.1 Information on toxicological effects**
· **Acute toxicity:**
· **Primary irritant effect:**
· **on the skin:** redness
· **on the eye:** redness
· **Sensitisation:** No sensitizing effect known.
· **CMR effects (carcinogenity, mutagenicity and toxicity for reproduction)**
Repr. 1B

*
SECTION 12: Ecological information

· **12.1 Toxicity**

· **Aquatic toxicity:**

EC50/48h	0.0052 mg/l (daphnia magna)
LC50/96h	0.35 mg/l (Ictalurus punctatus)

· **12.2 Persistence and degradability** No further relevant information available.
· **12.3 Bioaccumulative potential** No further relevant information available.
· **12.4 Mobility in soil** No further relevant information available.
· **Ecotoxical effects:**
· **Remark:** Very toxic for fish
· **Additional ecological information:**
· **General notes:**
Water danger class (D) 3 (Assessment by list): extremely hazardous for water.
Do not allow product to reach ground water, water bodies or sewage system, even in small quantities.
Danger to drinking water if even extremely small quantities leak into soil.
Also poisonous for fish and plankton in water bodies.
Very toxic for aquatic organisms
· **12.5 Results of PBT and vPvB assessment**
· **PBT:** Not applicable.
· **vPvB:** Not applicable.

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GB

Safety Data Sheet

Safety data sheet
according to 1907/2006/EC, Article 31

Trade name: mercury

(Contd. of page 5)

· **12.6 Other adverse effects** No further relevant information available.

SECTION 13: Disposal considerations

· **13.1 Waste treatment methods**
· **Recommendation**
Must not be disposed of together with household garbage. Do not allow product to reach sewage system.

· **Uncleaned packagings:**
· **Recommendation:** Disposal must be made according to official regulations.

*

SECTION 14: Transport information

· **14.1 UN-Number**
· **ADR, IMDG, IATA** UN2809

· **14.2 UN proper shipping name**
· **ADR** 2809 MERCURY
· **IMDG, IATA** MERCURY

· **14.3 Transport hazard class(es)**

· **ADR**

· **Class** 8 (CT1) Corrosive substances.
· **Label** 8+6.1

· **IMDG, IATA**

· **Class** 8 Corrosive substances.
· **Label** 8+6.1

· **14.4 Packing group**
· **ADR, IMDG, IATA** III

· **14.5 Environmental hazards:** Environmentally hazardous substance, liquid
· **Marine pollutant:** No

· **14.6 Special precautions for user** Warning: Corrosive substances.
· **Kemler Number:** 80
· **EMS Number:** F-A,S-B
· **Segregation groups** Heavy metals and their salts (including their organometallic compounds), mercury and mercury compounds

· **14.7 Transport in bulk according to Annex II of MARPOL73/78 and the IBC Code** Not applicable.

· **Transport/Additional information:**

· **ADR**
· **Limited quantities (LQ)** 5 kg

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· ***Excepted quantities (EQ)***	*Code: E0* *Not permitted as Excepted Quantity*
· ***Transport category***	*3*
· ***Tunnel restriction code***	*E*
· ***IMDG***	
· ***Limited quantities (LQ)***	*5 kg*
· ***Excepted quantities (EQ)***	*Code: E0* *Not permitted as Excepted Quantity*
· ***UN "Model Regulation":***	*UN2809, MERCURY, 8 (6.1), III*

*
SECTION 15: Regulatory information

· ***15.1 Safety, health and environmental regulations/legislation specific for the substance or mixture***
· ***Labelling according to Regulation (EC) No 1272/2008***
The substance is classified and labelled according to the CLP regulation.
· ***Hazard pictograms***

GHS06 GHS08 GHS09

· ***Signal word*** *Danger*
· ***Hazard statements***
H330 Fatal if inhaled.
H360D May damage the unborn child.
H372 Causes damage to organs through prolonged or repeated exposure.
H410 Very toxic to aquatic life with long lasting effects.
· ***Precautionary statements***
P260 Do not breathe dust/fume/gas/mist/vapours/spray.
P284 Wear respiratory protection.
P281 Use personal protective equipment as required.
P310 Immediately call a POISON CENTER/doctor.
P304+P340 IF INHALED: Remove victim to fresh air and keep at rest in a position comfortable for breathing.
P405 Store locked up.
· ***15.2 Chemical safety assessment:*** *A Chemical Safety Assessment has not been carried out.*

SECTION 16: Other information

These data are based on our present knowledge. However, they shall not constitute a guarantee for any specific product features and shall not establish a legally valid contractual relationship.

· ***Department issuing data specification sheet:*** *EHS*
· ***Contact:*** *Paweł Skiba*
· ***Abbreviations and acronyms:***
RID: Règlement international concernant le transport des marchandises dangereuses par chemin de fer (Regulations Concerning the International Transport of Dangerous Goods by Rail)
IATA-DGR: Dangerous Goods Regulations by the "International Air Transport Association" (IATA)
ICAO: International Civil Aviation Organisation
ICAO-TI: Technical Instructions by the "International Civil Aviation Organisation" (ICAO)
ADR: Accord européen sur le transport des marchandises dangereuses par Route (European Agreement concerning the International Carriage of Dangerous Goods by Road)
IMDG: International Maritime Code for Dangerous Goods
IATA: International Air Transport Association
GHS: Globally Harmonised System of Classification and Labelling of Chemicals
EINECS: European Inventory of Existing Commercial Chemical Substances

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Trade name: mercury

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CAS: Chemical Abstracts Service (division of the American Chemical Society)
Acute Tox. 2: Acute toxicity, Hazard Category 2
Repr. 1B: Reproductive toxicity, Hazard Category 1B
STOT RE 1: Specific target organ toxicity - Repeated exposure, Hazard Category 1
Aquatic Acute 1: Hazardous to the aquatic environment - AcuteHazard, Category 1
Aquatic Chronic 1: Hazardous to the aquatic environment - Chronic Hazard, Category 1

· **** Data compared to the previous version altered.***

GB

51. Citric acid safety data sheet (monohydrate and anhydrous)

51.1. Monohydrate citric acid

PanReac AppliChem
ITW Reagents

Safety Data Sheet
acc. to OSHA HCS

Printing date 06/03/2017
Reviewed on 06/03/2017
Version number: 4

*

1 Identification

· **Product identifier**

· **Trade name: Citric acid monohydrate**

· **Article number:** A4212
· **CAS Number:**
5949-29-1
· **EC number:**
201-069-1
· **Application of the substance / the mixture** Laboratory chemical

· **Details of the supplier of the safety data sheet**
· **Manufacturer/Supplier:**

AppliChem GmbH
Ottoweg 4
D-64291 Darmstadt
Tel.: +49 (0)6151 93570
Fax.: +49 (0)6151 935711
msds@applichem.com

· **Information department:** Dept. Compliance
· **Emergency telephone number:** +49(0)6151 93570 (Inside normal buisness hours)

*

2 Hazard(s) identification

· **Classification of the substance or mixture**
Eye Irritation - Category 2A H319 Causes serious eye irritation.

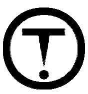
· **Label elements**
· **GHS label elements**
The substance is classified and labeled according to the Globally Harmonized System (GHS).
· **Hazard pictograms**

GHS07

· **Signal word** Warning
· **Hazard statements**
H319 Causes serious eye irritation.
· **Precautionary statements**

P264	Wash thoroughly after handling.
P280	Wear protective gloves/protective clothing/eye protection/face protection.
P305+P351+P338	IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing.
P337+P313	If eye irritation persists: Get medical advice/attention.

· **Hazard description:**
· **WHMIS-symbols:**
D2B - Toxic material causing other toxic effects



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CA

Safety Data Sheet
acc. to OSHA HCS

Printing date 06/03/2017
Reviewed on 06/03/2017
Version number: 4

Trade name: Citric acid monohydrate

(Contd. of page 1)

· **Classification system:**
· **NFPA ratings (scale 0 - 4)**

Health = 1
Fire = 0
Reactivity = 0

· **HMIS-ratings (scale 0 - 4)**

HEALTH	1
FIRE	0
REACTIVITY	0

Health = 1
Fire = 0
Reactivity = 0

*
3 Composition/information on ingredients

· **Chemical characterization: Substances**
· **CAS No. Description**
5949-29-1 Citric acid monohydrate
· **Identification number(s)**
· **EC number:** 201-069-1

*
4 First-aid measures

· **Description of first aid measures**
· **General information:**
Immediately remove any clothing soiled by the product.
Personal protection for the First Aider.
Take affected persons out into the fresh air.
· **After inhalation:** Supply fresh air; consult doctor in case of complaints.
· **After skin contact:**
Wash off with plenty of water.
Immediately wash with water and soap and rinse thoroughly.
Immediately remove any clothing soiled by the product.
If skin irritation continues, consult a doctor.
· **After eye contact:**
Rinse opened eye for several minutes under running water.
Call a doctor immediately.
· **After swallowing:**
make victim drink water (maximum of 2 drinking glasses)
If symptoms persist consult doctor.
· **Information for doctor:**
· **Most important symptoms and effects, both acute and delayed**
No further relevant information available.
· **Indication of any immediate medical attention and special treatment needed**
No further relevant information available.

*
5 Fire-fighting measures

· **Extinguishing media**
· **Suitable extinguishing agents:**
CO2, extinguishing powder or water spray. Fight larger fires with water spray or alcohol resistant foam.
· **For safety reasons unsuitable extinguishing agents:** Water with full jet
· **Special hazards arising from the substance or mixture**
Combustible.
Formation of toxic gases is possible during heating or in case of fire.
In case of fire, the following can be released:
CO, CO2

(Contd. on page 3)

CA

Safety Data Sheet

Trade name: Citric acid monohydrate

(Contd. of page 2)

· **Advice for firefighters**
· **Protective equipment:** Wear self-contained respiratory protective device.
· **Additional information**
Dispose of fire debris and contaminated fire fighting water in accordance with official regulations.

6 Accidental release measures

· **Personal precautions, protective equipment and emergency procedures**
Avoid formation of dust.
Do not inhale dust.
Avoid substance contact.
Ensure adequate ventilation
· **Environmental precautions:** Do not allow to enter sewers/ surface or ground water.
· **Methods and material for containment and cleaning up:**
Pick up mechanically.
Avoid generation of dusts.
Clean up affected area.
· **Reference to other sections**
See Section 7 for information on safe handling.
See Section 8 for information on personal protection equipment.
See Section 13 for disposal information.

*
7 Handling and storage

· **Handling:**
· **Precautions for safe handling**
Any deposit of dust which cannot be avoided must be regularly removed.
Keep receptacles tightly sealed.
· **Information about protection against explosions and fires:** No special measures required.

· **Conditions for safe storage, including any incompatibilities**
· **Storage:**
· **Requirements to be met by storerooms and receptacles:** Provide acid-resistant floor.
· **Information about storage in one common storage facility:** Not required.
· **Further information about storage conditions:**
Keep receptacle tightly sealed.
Open receptacle only under localized extractor facilities.
· **Recommended storage temperature:** +15 - +25 °C
· **Storage class:** 11
· **Specific end use(s)** No further relevant information available.

*
8 Exposure controls/personal protection

· **Additional information about design of technical systems:** No further data; see item 7.

· **Control parameters**
· **Components with limit values that require monitoring at the workplace:** Not required.
· **Additional information:** The lists that were valid during the creation were used as basis.

· **Exposure controls**
· **Personal protective equipment:**
· **General protective and hygienic measures:**
Keep away from foodstuffs, beverages and feed.
Immediately remove all soiled and contaminated clothing.
Wash hands before breaks and at the end of work.
Avoid contact with the eyes.
Avoid contact with the eyes and skin.
· **Breathing equipment:** Filter P2

(Contd. on page 4)

Trade name: Citric acid monohydrate

(Contd. of page 3)

· **Protection of hands:**
The glove material has to be impermeable and resistant to the product/ the substance/ the preparation.
Selection of the glove material on consideration of the penetration times, rates of diffusion and the degradation
· **Material of gloves**
The selection of the suitable gloves does not only depend on the material, but also on further marks of quality and varies from manufacturer to manufacturer.
· **Penetration time of glove material**
The exact break through time has to be found out by the manufacturer of the protective gloves and has to be observed.
· **For the permanent contact gloves made of the following materials are suitable:**
Nitrile rubber, NBR
Recommended thickness of the material: ≥ 0.11 mm
Value for the permeation: Level ≥ 480 min
· **Eye protection:**

Tightly sealed goggles

· **Body protection:**
Protective clothing should be selected specifically for the working place, depending on concentration and quantity of the hazourdous substances handled.

9 Physical and chemical properties

· **Information on basic physical and chemical properties**	
· **General Information**	
· **Appearance:**	
Form:	Solid
Color:	White
· **Odor:**	Odorless
· **Odor threshold:**	Not determined.
· **pH-value:**	1.8
· **Change in condition**	
Melting point/Melting range:	135-152 °C
Boiling point/Boiling range:	Undetermined.
· **Flash point:**	Not applicable.
· **Flammability (solid, gaseous):**	Product is not flammable.
· **Ignition temperature:**	
Decomposition temperature:	Not determined.
· **Auto igniting:**	Not determined.
· **Danger of explosion:**	Product does not present an explosion hazard.
· **Explosion limits:**	
Lower:	Not determined.
Upper:	Not determined.
· **Vapor pressure:**	Not applicable.
· **Density at 20 °C:**	1.54 g/cm³
· **Relative density**	Not determined.
· **Vapor density**	Not applicable.
· **Evaporation rate**	Not applicable.

(Contd. on page 5)
CA

Safety Data Sheet
acc. to OSHA HCS

Trade name: Citric acid monohydrate

(Contd. of page 4)

· **Solubility in / Miscibility with**
Water at 20 °C: 676 g/l
· **Partition coefficient (n-octanol/water):** Not determined.
· **Viscosity:**
Dynamic: Not applicable.
Kinematic: Not applicable.
· **Other information** No further relevant information available.

*
10 Stability and reactivity

· **Reactivity** No dangerous reactions known.
· **Chemical stability**
· **Thermal decomposition / conditions to be avoided:** Strong heating
· **Possibility of hazardous reactions**
Exothermic reactions with:
oxidizing agent
reducing agents
metals
Bases
· **Conditions to avoid** Thermal decomposition: >170 °C
· **Incompatible materials:**
oxidizing agent
Bases
reducing agents
· **Hazardous decomposition products:** In the event of fire: See chapter 5
· **Additional information:** releases water of crystallization when heated.

*
11 Toxicological information

· **Information on toxicological effects**
· **Acute toxicity:**
· **LD/LC50 values that are relevant for classification:**
Quantitative data on the toxicological effect of this product are not available.

· Components	Type	Value	Species
Oral	LD50	5400 mg/kg (mouse)	
Dermal	LD50	>2000 mg/kg (rat)	

· **Primary irritant effect:**
· **on the eye:** Irritating effect.
· **Additional toxicological information:**

· **Carcinogenic categories**
· **IARC (International Agency for Research on Cancer)** Substance is not listed.
· **NTP (National Toxicology Program)** Substance is not listed.

*
12 Ecological information

· **Toxicity**
· **Aquatic toxicity:** No further relevant information available.

· Type of test	Effective concentration	Method	Assessment
LC50/24 h	1535 mg/l (daphnia magna)		
LC50/48 h	440 mg/l (fish)		

· **Persistence and degradability** The product is easily biodegradable.

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CA

Safety Data Sheet
acc. to OSHA HCS

Printing date 06/03/2017
Reviewed on 06/03/2017
Version number: 4

Trade name: Citric acid monohydrate

(Contd. of page 5)

· **Behavior in environmental systems:**
· **Bioaccumulative potential** No further relevant information available.
· **Mobility in soil** No further relevant information available.
· **Additional ecological information:**
· **General notes:**
Rinse off of bigger amounts into drains or the aquatic environment may lead to decreased pH-values. A low pH-value harms aquatic organisms. In the dilution of the use-level the pH-value is considerably increased, so that after the use of the product the aqueous waste, emptied into drains, is only low water-dangerous.
Water hazard class 1 (Self-assessment): slightly hazardous for water
Do not allow to enter waters, waste water, or soil.
· **Results of PBT and vPvB assessment**
· **PBT:** Not applicable.
· **vPvB:** Not applicable.
· **Other adverse effects** No further relevant information available.

13 Disposal considerations

· **Waste treatment methods**
· **Recommendation:**
Chemicals must be disposed of in compliance with the respective national regulations.
Must not be disposed of together with household garbage. Do not allow product to reach sewage system.

· **Uncleaned packagings:**
· **Recommendation:**
Disposal must be made according to official regulations.
Packagings that cannot be cleansed are to be disposed of in the same manner as the product.
· **Recommended cleansing agent:** Water, if necessary with cleansing agents.

14 Transport information

· **UN-Number** · **DOT, TDG, ADN, IMDG, IATA**	Void
· **UN proper shipping name** · **DOT, TDG, ADN, IMDG, IATA**	Void
· **Transport hazard class(es)** · **DOT, TDG, ADN, IMDG, IATA** · **Class**	Void
· **Packing group** · **DOT, TDG, IMDG, IATA**	Void
· **Environmental hazards:**	Not applicable.
· **Special precautions for user**	Not applicable.
· **Transport in bulk according to Annex II of MARPOL73/78 and the IBC Code**	Not applicable.
· **Transport/Additional information:**	Not dangerous according to the above specifications.
· **UN "Model Regulation":**	Void

CA

(Contd. on page 7)

Trade name: Citric acid monohydrate

(Contd. of page 6)

*
15 Regulatory information

· **Safety, health and environmental regulations/legislation specific for the substance or mixture**
· **Sara**
· **Section 355 (extremely hazardous substances):** Substance is not listed.
· **Section 313 (Specific toxic chemical listings):** Substance is not listed.
· **TSCA (Toxic Substances Control Act):** Substance is not listed.
· **Canadian substance listings:**
· **Canadian Domestic Substances List (DSL)** Substance is listed.
· **Canadian Ingredient Disclosure list (limit 0.1%)** Substance is not listed.
· **Canadian Ingredient Disclosure list (limit 1%)** Substance is not listed.
· **GHS label elements**
The substance is classified and labeled according to the Globally Harmonized System (GHS).
· **Hazard pictograms**

GHS07

· **Signal word** Warning
· **Hazard statements**
H319 Causes serious eye irritation.
· **Precautionary statements**

P264	Wash thoroughly after handling.
P280	Wear protective gloves/protective clothing/eye protection/face protection.
P305+P351+P338	IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing.
P337+P313	If eye irritation persists: Get medical advice/attention.

· **Chemical safety assessment:** A Chemical Safety Assessment has been carried out.

16 Other information

This information is based on our present knowledge. However, this shall not constitute a guarantee for any specific product features and shall not establish a legally valid contractual relationship.

· **Department issuing SDS:** Dept. Compliance
· **Contact:** Mr. Th. Stöckle
· **Date of preparation / last revision** 06/03/2017 / 3
· **Abbreviations and acronyms:**
IMDG: International Maritime Code for Dangerous Goods
DOT: US Department of Transportation
IATA: International Air Transport Association
EINECS: European Inventory of Existing Commercial Chemical Substances
CAS: Chemical Abstracts Service (division of the American Chemical Society)
NFPA: National Fire Protection Association (USA)
HMIS: Hazardous Materials Identification System (USA)
WHMIS: Workplace Hazardous Materials Information System (Canada)
LC50: Lethal concentration, 50 percent
LD50: Lethal dose, 50 percent
PBT: Persistent, Bioaccumulative and Toxic
vPvB: very Persistent and very Bioaccumulative
· *** Data compared to the previous version altered.**

CA

51.2. Anhydrous citric acid

Safety data sheet
according to 1907/2006/EC, Article 31

Printing date 20.02.2020
Revision: 20.02.2020
Version number 9

* **SECTION 1: Identification of the substance/mixture and of the company/undertaking**

· **1.1 Product identifier**

· **Trade name: Citronensäure**

· **Article number:** 1808
· **CAS Number:**
77-92-9
· **EC number:**
201-069-1
· **Registration number** 01-2119457026-42-XXXX
· **1.2 Relevant identified uses of the substance or mixture and uses advised against**
· **Sector of Use**
SU1 Agriculture, forestry, fishery
SU2a Mining, (without offshore industries)
SU2b Offshore industries
SU3 Industrial uses: Uses of substances as such or in preparations at industrial sites
SU5 Manufacture of textiles, leather, fur
SU6b Manufacture of pulp, paper and paper products
SU8 Manufacture of bulk, large scale chemicals (including petroleum products)
SU9 Manufacture of fine chemicals
SU10 Formulation [mixing] of preparations and/or re-packaging (excluding alloys)
SU11 Manufacture of rubber products
SU12 Manufacture of plastics products, including compounding and conversion
SU13 Manufacture of other non-metallic mineral products, e.g. plasters, cement
SU14 Manufacture of basic metals, including alloys
SU15 Manufacture of fabricated metal products, except machinery and equipment
SU16 Manufacture of computer, electronic and optical products, electrical equipment
SU17 General manufacturing, e.g. machinery, equipment, vehicles, other transport equipment
SU18 Manufacture of furniture
SU19 Building and construction work
SU20 Health services
· **Product category**
PC1 Adhesives, sealants
PC2 Adsorbents
PC3 Air care products
PC4 Anti-Freeze and de-icing products
PC7 Base metals and alloys
PC8 Biocidal products
PC9a Coatings and paints, thinners, paint removers
PC9b Fillers, putties, plasters, modelling clay
PC9c Finger paints
PC12 Fertilisers
PC14 Metal surface treatment products
PC16 Heat transfer fluids
PC17 Hydraulic fluids
PC18 Ink and toners
PC19 Intermediate
PC20 Processing aids such as pH-regulators, flocculants, precipitants, neutralization agents
PC21 Laboratory chemicals
PC23 Leather treatment products
PC25 Metal working fluids
PC26 Paper and board treatment products
PC28 Perfumes, fragrances

(Contd. on page 2)

Trade name: Citronensäure

(Contd. of page 1)

PC30 Photo-chemicals
PC31 Polishes and wax blends
PC32 Polymer preparations and compounds
PC34 Textile dyes, and impregnating products
PC35 Washing and cleaning products (including solvent based products)
PC36 Water softeners
PC37 Water treatment chemicals
PC39 Cosmetics, personal care products
PC40 Extraction agents

· **Process category**

PROC1 Chemical production or refinery in closed process without likelihood of exposure or processes with equivalent containment conditions.
PROC2 Chemical production or refinery in closed continuous process with occasional controlled exposure or processes with equivalent containment conditions
PROC3 Manufacture or formulation in the chemical industry in closed batch processes with occasional controlled exposure or processes with equivalent containment condition
PROC4 Chemical production where opportunity for exposure arises
PROC5 Mixing or blending in batch processes
PROC7 Industrial spraying
PROC8a Transfer of substance or mixture (charging and discharging) at non-dedicated facilities
PROC8b Transfer of substance or mixture (charging and discharging) at dedicated facilities
PROC9 Transfer of substance or mixture into small containers (dedicated filling line, including weighing)
PROC10 Roller application or brushing
PROC11 Non industrial spraying
PROC13 Treatment of articles by dipping and pouring
PROC14 Tabletting, compression, extrusion, pelletisation, granulation
PROC15 Use as laboratory reagent
PROC17 Lubrication at high energy conditions in metal working operations
PROC18 General greasing /lubrication at high kinetic energy conditions
PROC19 Manual activities involving hand contact
PROC20 Use of functional fluids in small devices
PROC21 Low energy manipulation and handling of substances bound in/on materials or articles
PROC22 Manufacturing and processing of minerals and/or metals at substantially elevated temperature
PROC23 Open processing and transfer operations at substantially elevated temperature
PROC24 High (mechanical) energy work-up of substances bound in /on materials and/or articles

· **Environmental release category**

ERC1 Manufacture of the substance
ERC2 Formulation into mixture
ERC3 Formulation into solid matrix
ERC4 Use of non-reactive processing aid at industrial site (no inclusion into or onto article)
ERC5 Use at industrial site leading to inclusion into/onto article
ERC6a Use of intermediate
ERC6b Use of reactive processing aid at industrial site (no inclusion into or onto article)
ERC7 Use of functional fluid at industrial site
ERC8a Widespread use of non-reactive processing aid (no inclusion into or onto article, indoor)
ERC8b Widespread use of reactive processing aid (no inclusion into or onto article, indoor)
ERC8c Widespread use leading to inclusion into/onto article (indoor)
ERC8d Widespread use of non-reactive processing aid (no inclusion into or onto article, outdoor)
ERC8f Widespread use leading to inclusion into/onto article (outdoor)
ERC9a Widespread use of functional fluid (indoor)
ERC9b Widespread use of functional fluid (outdoor)
ERC10a Widespread use of articles with low release (outdoor)
ERC10b Widespread use of articles with high or intended release (outdoor)
ERC11a Widespread use of articles with low release (indoor)
ERC11b Widespread use of articles with high or intended release (indoor)
ERC12a Processing of articles at industrial sites with low release

· **Article category**

AC4 Stone, plaster, cement, glass and ceramic articles

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(Contd. of page 2)

AC5 Fabrics, textiles and apparel
AC6 Leather articles
AC8 Paper articles
AC11 Wood articles
AC35 Scented paper articles

· **Application of the substance / the mixture**
Chemical analytics
Molecular biology
Pharmaceutical analysis
Laboratory chemical

· **1.3 Details of the supplier of the safety data sheet**
· **Manufacturer/Supplier:**
PANREAC QUIMICA S.L.U.
C/Garraf 2
Polígono Pla de la Bruguera
E-08211 Castellar del Vallès (Barcelona)
Tel. (+34) 937 489 400
Fax. (+34) 937 489 401
e-mail: product.safety@panreac.com

· **Further information obtainable from:** email: product.safety@panreac.com
· **1.4 Emergency telephone number:**
Single telephone number for emergency calls: 112 (EU)
Tel.: (+34) 937 489 499

SECTION 2: Hazards identification

· **2.1 Classification of the substance or mixture**
· **Classification according to Regulation (EC) No 1272/2008**
Eye Irrit. 2 H319 Causes serious eye irritation.

· **2.2 Label elements**
· **Labelling according to Regulation (EC) No 1272/2008**
The substance is classified and labelled according to the CLP regulation.
· **Hazard pictograms**

GHS07

· **Signal word** Warning
· **Hazard statements**
H319 Causes serious eye irritation.
· **Precautionary statements**

P264	Wash thoroughly after handling.
P280	Wear eye protection / face protection.
P305+P351+P338	IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing.
P337+P313	If eye irritation persists: Get medical advice/attention.

· **2.3 Other hazards**
· **Results of PBT and vPvB assessment**
· **PBT:** Not applicable.
· **vPvB:** Not applicable.

SECTION 3: Composition/information on ingredients

· **3.1 Chemical characterisation: Substances**
· **CAS No. Description**
77-92-9 Citronensäure

(Contd. on page 4)
EU

Trade name: Citronensäure

(Contd. of page 3)

· **Identification number(s)**
· **EC number:** 201-069-1

SECTION 4: First aid measures

· **4.1 Description of first aid measures**
· **General information:** Involve doctor immediately.
· **After inhalation:** Supply fresh air; consult doctor in case of complaints.
· **After skin contact:**
Immediately rinse with water.
Immediately remove any clothing soiled by the product.
If skin irritation continues, consult a doctor.
· **After eye contact:** Rinse opened eye for several minutes under running water. Then consult a doctor.
· **After swallowing:**
Rinse out mouth.
make victim drink water (maximum of 2 drinking glasses)
Do not induce vomiting; call for medical help immediately.
If symptoms persist consult doctor.
· **4.2 Most important symptoms and effects, both acute and delayed**
No further relevant information available.
· **4.3 Indication of any immediate medical attention and special treatment needed**
No further relevant information available.

SECTION 5: Firefighting measures

· **5.1 Extinguishing media**
· **Suitable extinguishing agents:**
CO2, powder or water spray. Fight larger fires with water spray or alcohol resistant foam.
· **5.2 Special hazards arising from the substance or mixture**
In case of fire, the following can be released:
Carbon monoxide and carbon dioxide
· **5.3 Advice for firefighters**
· **Protective equipment:** Wear self-contained respiratory protective device.
· **Additional information**
Dispose of fire debris and contaminated fire fighting water in accordance with official regulations.

SECTION 6: Accidental release measures

· **6.1 Personal precautions, protective equipment and emergency procedures**
Avoid formation of dust.
Use respiratory protective device against the effects of fumes/dust/aerosol.
Avoid substance contact.
Ensure adequate ventilation
· **6.2 Environmental precautions:** Do not allow to enter sewers/ surface or ground water.
· **6.3 Methods and material for containment and cleaning up:**
Pick up mechanically.
Avoid formation of dust.
Clean up affected area.
· **6.4 Reference to other sections**
See Section 7 for information on safe handling.
See Section 8 for information on personal protection equipment.
See Section 13 for disposal information.

SECTION 7: Handling and storage

· **7.1 Precautions for safe handling** Any unavoidable deposit of dust must be regularly removed.

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· **Information about fire - and explosion protection:** No special measures required.

· **7.2 Conditions for safe storage, including any incompatibilities**
· **Storage:**
· **Requirements to be met by storerooms and receptacles:** Provide acid-resistant floor.
· **Information about storage in one common storage facility:** Store away from oxidising agents.
· **Further information about storage conditions:**
Keep container tightly sealed.
Open receptacle only under localised extractor facilities.
· **Recommended storage temperature:** Room Temperature
· **Storage class:** 11
· **7.3 Specific end use(s)** No further relevant information available.

SECTION 8: Exposure controls/personal protection

· **Additional information about design of technical facilities:** No further data; see item 7.

· **8.1 Control parameters**
· **Ingredients with limit values that require monitoring at the workplace:** Not required.

· **PNECs**	
Aquatic compartment - freshwater	0.44 mg/L
Aquatic compartment - marine water	0.044 mg/L
Aquatic compartment - sediment in freshwater	3.46 mg/kg
Aquatic compartment - sediment in marine water	34.6 mg/kg
Terrestrial compartment - soil	33.1 mg/kg
Sewage treatment plant	>1,000 mg/L

· **Additional information:** The lists valid during the making were used as basis.

· **8.2 Exposure controls**
· **Personal protective equipment:**
· **General protective and hygienic measures:**
Keep away from foodstuffs, beverages and feed.
Immediately remove all soiled and contaminated clothing
Wash hands before breaks and at the end of work.
Avoid contact with the eyes and skin.
· **Respiratory protection:**
Required when dusts are generated.
Filter P2
· **Protection of hands:**
The glove material has to be impermeable and resistant to the product/ the substance/ the preparation.
Selection of the glove material on consideration of the penetration times, rates of diffusion and the degradation
· **Material of gloves**
The selection of the suitable gloves does not only depend on the material, but also on further marks of quality and varies from manufacturer to manufacturer.
· **Penetration time of glove material**
The exact break through time has to be found out by the manufacturer of the protective gloves and has to be observed.
· **For the permanent contact gloves made of the following materials are suitable:**
Nitrile rubber, NBR
Recommended thickness of the material: ≥ 0.11 mm
Value for the permeation: Level ≥ 480 min
· **As protection from splashes gloves made of the following materials are suitable:**
Nitrile rubber, NBR
Recommended thickness of the material: ≥ 0.11 mm
Value for the permeation: Level ≥ 480 min

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Trade name: Citronensäure

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· **Eye protection:**

Tightly sealed goggles

· **Body protection:**
Protective clothing should be selected specifically for the working place, depending on concentration and quantity of the hazourdous substances handled.

SECTION 9: Physical and chemical properties

· **9.1 Information on basic physical and chemical properties**	
· **General Information**	
· **Appearance:**	
Form:	Solid
Colour:	White
· **Odour:**	Odourless
· **Odour threshold:**	Not determined.
· **pH-value:**	1.7
· **Change in condition**	
Melting point/freezing point:	153 °C
Initial boiling point and boiling range:	>175 °C
· **Flash point:**	>93 °C
· **Flammability (solid, gas):**	Product is not flammable.
· **Ignition temperature:**	540 °C
· **Decomposition temperature:**	>175 °C
· **Auto-ignition temperature:**	Not determined.
· **Explosive properties:**	Product does not present an explosion hazard.
· **Explosion limits:**	
Lower:	Not determined.
Upper:	Not determined.
· **Vapour pressure at 20 °C:**	<0.00133322 hPa
· **Density at 20 °C:**	1.665 g/cm³
· **Bulk density:**	560 kg/m³
· **Relative density**	Not determined.
· **Vapour density**	Not applicable.
· **Evaporation rate**	Not applicable.
· **Solubility in / Miscibility with**	
water at 20 °C:	1330 g/l
· **Partition coefficient: n-octanol/water:**	-1.72011
· **Viscosity:**	
Dynamic:	Not applicable.
Kinematic:	Not applicable.
· **9.2 Other information**	No further relevant information available.

SECTION 10: Stability and reactivity

· **10.1 Reactivity** No further relevant information available.

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EU

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· **10.2 Chemical stability**
· **Thermal decomposition / conditions to be avoided:** Heating.
· **10.3 Possibility of hazardous reactions** No dangerous reactions known.
· **10.4 Conditions to avoid** No further relevant information available.
· **10.5 Incompatible materials:**
oxidizing agent
reducing agents
alkali compounds
· **10.6 Hazardous decomposition products:** In the event of fire: See chapter 5

SECTION 11: Toxicological information

· **11.1 Information on toxicological effects**
· **Acute toxicity** Based on available data, the classification criteria are not met.
· **LD/LC50 values relevant for classification:**
Quantitative data on the toxicological effect of this product are not available.

· Components	Type	Value	Species
Oral	LD50	5,400 mg/kg (mouse)	
		3,000 mg/kg (rat)	
Dermal	LD50	2,700 mg/kg (mouse)	
		5,500 mg/kg (rat)	

· **Primary irritant effect:**
· **Skin corrosion/irritation** Based on available data, the classification criteria are not met.
· **Serious eye damage/irritation**
Causes serious eye irritation.
· **After inhalation:**
Irritation symptoms in the respiratory tract.
coughing
· **Respiratory or skin sensitisation** Based on available data, the classification criteria are not met.

· Subacute to chronic toxicity:		
Oral	NOAEL	1,200 mg/kg (rat)

· **CMR effects (carcinogenity, mutagenicity and toxicity for reproduction)**
· **Germ cell mutagenicity** Based on available data, the classification criteria are not met.
· **Carcinogenicity** Based on available data, the classification criteria are not met.
· **Reproductive toxicity** Based on available data, the classification criteria are not met.
· **STOT-single exposure** Based on available data, the classification criteria are not met.
· **STOT-repeated exposure** Based on available data, the classification criteria are not met.
· **Aspiration hazard** Based on available data, the classification criteria are not met.

SECTION 12: Ecological information

· **12.1 Toxicity**
· **Aquatic toxicity:** No further relevant information available.

· Type of test	Effective concentration	Method	Assessment
EC50/72 h	120 mg/l (daphnia magna)		
LC50/24 h	1,535 mg/l (daphnia magna)		
LC50/96 h	440-760 mg/l (fish)		

· **12.2 Persistence and degradability** No further relevant information available.
· **12.3 Bioaccumulative potential** -1.72 log Pow
· **12.4 Mobility in soil** No further relevant information available.
· **Additional ecological information:**
· **General notes:**
Rinse off of bigger amounts into drains or the aquatic environment may lead to decreased pH-values. A low pH-value harms aquatic organisms. In the dilution of the use-level the pH-value is considerably increased, so that after the use of the product the aqueous waste, emptied into drains, is only low

(Contd. on page 8)

(Contd. of page 7)

water-dangerous.
Water hazard class 1 (German Regulation) (Assessment by list): slightly hazardous for water
Do not allow product to reach ground water, water course or sewage system.

- **12.5 Results of PBT and vPvB assessment**
- **PBT:** Not applicable.
- **vPvB:** Not applicable.
- **12.6 Other adverse effects** No further relevant information available.

SECTION 13: Disposal considerations

- **13.1 Waste treatment methods**
- **Recommendation**

Chemicals must be disposed of in compliance with the respective national regulations.
Must not be disposed together with household garbage. Do not allow product to reach sewage system.

- **Uncleaned packaging:**
- **Recommendation:**

Disposal must be made according to official regulations.
Packagings that may not be cleansed are to be disposed of in the same manner as the product.

SECTION 14: Transport information

14.1 UN-Number **ADR, ADN, IMDG, IATA**	Void
14.2 UN proper shipping name **ADR, ADN, IMDG, IATA**	Void
14.3 Transport hazard class(es) **ADR, ADN, IMDG, IATA** **Class**	Void
14.4 Packing group **ADR, IMDG, IATA**	Void
14.5 Environmental hazards:	Not applicable.
14.6 Special precautions for user	Not applicable.
14.7 Transport in bulk according to Annex II of Marpol and the IBC Code	Not applicable.
Transport/Additional information:	Not dangerous according to the above specifications.
UN "Model Regulation":	Void

SECTION 15: Regulatory information

- **15.1 Safety, health and environmental regulations/legislation specific for the substance or mixture**
- **Directive 2012/18/EU**
- **Named dangerous substances - ANNEX I** Substance is not listed.
- **15.2 Chemical safety assessment:** A Chemical Safety Assessment has been carried out.

EU

(Contd. on page 9)

(Contd. of page 8)

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SECTION 16: Other information

This information is based on our present knowledge. However, this shall not constitute a guarantee for any specific product features and shall not establish a legally valid contractual relationship.

· **Abbreviations and acronyms:**
RID: Règlement international concernant le transport des marchandises dangereuses par chemin de fer (Regulations Concerning the International Transport of Dangerous Goods by Rail)
ADR: Accord européen sur le transport des marchandises dangereuses par Route (European Agreement concerning the International Carriage of Dangerous Goods by Road)
IMDG: International Maritime Code for Dangerous Goods
IATA: International Air Transport Association
GHS: Globally Harmonised System of Classification and Labelling of Chemicals
EINECS: European Inventory of Existing Commercial Chemical Substances
CAS: Chemical Abstracts Service (division of the American Chemical Society)
PNEC: Predicted No-Effect Concentration (REACH)
LC50: Lethal concentration, 50 percent
LD50: Lethal dose, 50 percent
PBT: Persistent, Bioaccumulative and Toxic
vPvB: very Persistent and very Bioaccumulative
Eye Irrit. 2: Serious eye damage/eye irritation – Category 2

· *** Data compared to the previous version altered.**

Annex: Exposure scenario

· **Short title of the exposure scenario** Formulation and packing/repacking of substances and mixtures

· **Sector of Use**
SU3 Industrial uses: Uses of substances as such or in preparations at industrial sites
SU10 Formulation [mixing] of preparations and/or re-packaging (excluding alloys)
SU1 Agriculture, forestry, fishery
SU2a Mining, (without offshore industries)
SU2b Offshore industries
SU5 Manufacture of textiles, leather, fur
SU6b Manufacture of pulp, paper and paper products
SU8 Manufacture of bulk, large scale chemicals (including petroleum products)
SU9 Manufacture of fine chemicals
SU11 Manufacture of rubber products

· **Product category**
PC1 Adhesives, sealants
PC2 Adsorbents
PC3 Air care products
PC4 Anti-Freeze and de-icing products
PC7 Base metals and alloys
PC8 Biocidal products
PC9a Coatings and paints, thinners, paint removers
PC9b Fillers, putties, plasters, modelling clay
PC9c Finger paints
PC12 Fertilisers
PC14 Metal surface treatment products
PC16 Heat transfer fluids
PC17 Hydraulic fluids
PC18 Ink and toners
PC19 Intermediate
PC20 Processing aids such as pH-regulators, flocculants, precipitants, neutralization agents
PC21 Laboratory chemicals
PC23 Leather treatment products
PC25 Metal working fluids
PC26 Paper and board treatment products
PC28 Perfumes, fragrances
PC30 Photo-chemicals
PC31 Polishes and wax blends
PC32 Polymer preparations and compounds
PC34 Textile dyes, and impregnating products
PC35 Washing and cleaning products (including solvent based products)

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PC36 Water softeners
PC37 Water treatment chemicals
PC39 Cosmetics, personal care products
PC40 Extraction agents

· **Process category**
PROC1 Chemical production or refinery in closed process without likelihood of exposure or processes with equivalent containment conditions.
PROC2 Chemical production or refinery in closed continuous process with occasional controlled exposure or processes with equivalent containment conditions
PROC3 Manufacture or formulation in the chemical industry in closed batch processes with occasional controlled exposure or processes with equivalent containment condition
PROC4 Chemical production where opportunity for exposure arises
PROC5 Mixing or blending in batch processes
PROC7 Industrial spraying
PROC8a Transfer of substance or mixture (charging and discharging) at non-dedicated facilities
PROC8b Transfer of substance or mixture (charging and discharging) at dedicated facilities
PROC9 Transfer of substance or mixture into small containers (dedicated filling line, including weighing)
PROC10 Roller application or brushing
PROC11 Non industrial spraying
PROC13 Treatment of articles by dipping and pouring
PROC14 Tabletting, compression, extrusion, pelletisation, granulation
PROC15 Use as laboratory reagent
PROC17 Lubrication at high energy conditions in metal working operations
PROC18 General greasing /lubrication at high kinetic energy conditions
PROC19 Manual activities involving hand contact
PROC20 Use of functional fluids in small devices
PROC21 Low energy manipulation and handling of substances bound in/on materials or articles
PROC22 Manufacturing and processing of minerals and/or metals at substantially elevated temperature
PROC23 Open processing and transfer operations at substantially elevated temperature
PROC24 High (mechanical) energy work-up of substances bound in /on materials and/or articles

· **Article category**
AC4 Stone, plaster, cement, glass and ceramic articles
AC5 Fabrics, textiles and apparel
AC6 Leather articles
AC8 Paper articles
AC11 Wood articles
AC35 Scented paper articles

· **Environmental release category**
ERC1 Manufacture of the substance
ERC2 Formulation into mixture
ERC3 Formulation into solid matrix
ERC4 Use of non-reactive processing aid at industrial site (no inclusion into or onto article)
ERC5 Use at industrial site leading to inclusion into/onto article
ERC6a Use of intermediate
ERC6b Use of reactive processing aid at industrial site (no inclusion into or onto article)
ERC7 Use of functional fluid at industrial site
ERC8a Widespread use of non-reactive processing aid (no inclusion into or onto article, indoor)
ERC8b Widespread use of reactive processing aid (no inclusion into or onto article, indoor)
ERC8c Widespread use leading to inclusion into/onto article (indoor)
ERC8d Widespread use of non-reactive processing aid (no inclusion into or onto article, outdoor)
ERC8f Widespread use leading to inclusion into/onto article (outdoor)
ERC9a Widespread use of functional fluid (indoor)
ERC9b Widespread use of functional fluid (outdoor)
ERC10a Widespread use of articles with low release (outdoor)
ERC10b Widespread use of articles with high or intended release (outdoor)
ERC11a Widespread use of articles with low release (indoor)
ERC11b Widespread use of articles with high or intended release (indoor)
ERC12a Processing of articles at industrial sites with low release

(Contd. on page 11)

EU

Safety Data Sheet

Safety data sheet
according to 1907/2006/EC, Article 31

Printing date 20.02.2020
Revision: 20.02.2020
Version number 9

Trade name: Citronensäure

(Contd. of page 10)

· **Description of the activities / processes covered in the Exposure Scenario**
See section 1 of the annex to the Safety Data Sheet.
· **Conditions of use**
· **Duration and frequency** 5 workdays/week.
· **Physical parameters**
· **Physical state** Solid
· **Concentration of the substance in the mixture** Raw material.
· **Used amount per time or activity** <10 tons per day
· **Other operational conditions**
· **Other operational conditions affecting environmental exposure** No special measures required.
· **Other operational conditions affecting worker exposure**
Avoid contact with eyes.
Indoor application.
Outdoor application.
· **Other operational conditions affecting consumer exposure** No special measures required.
· **Other operational conditions affecting consumer exposure during the use of the product**
Not applicable.
· **Risk management measures**
· **Worker protection**
· **Organisational protective measures** No special measures required.
· **Technical protective measures**
Ensure that suitable extractors are available on processing machines
· **Personal protective measures**
Do not inhale dust / smoke / mist.
Avoid contact with the eyes.
Tightly sealed goggles
· **Measures for consumer protection** Ensure adequate labelling.
· **Environmental protection measures**
· **Water** No special measures required.
· **Disposal measures** Ensure that waste is collected and contained.
· **Disposal procedures**
Must not be disposed together with household garbage. Do not allow product to reach sewage system.
· **Waste type** Partially emptied and uncleaned packaging
· **Exposure estimation**
· **Worker (dermal)** The calculated value is smaller than the DNEL.
· **Worker (inhalation)** The calculated value is smaller than the DNEL.
· **Consumer** Not relevant for this Exposure Scenario.
· **Guidance for downstream users** No further relevant information available.

EU

52. Maintenance Records and checklists templates

This chapter gives templates as examples. Three kinds of templates can be used:

- Maintenance checklists:

They allow following the maintenance regarding the maintenance schedule. With the help of "Operation and Maintenance book", each step of the maintenance operations can be checked as done. Three different checklists are available

  - Quarterly maintenance checklist
  - Biannual maintenance checklist
  - Annual maintenance checklist

- Sensors and instrumentation records:

Devices or components of the BWMS that take operational measurements must be checked for drift, repeatability and accuracy, at minimum with a yearly frequency. This document allow following correct functioning of each sensor and instrumentation during the system lifetime.

- Survey checklist

This document should be used for official inspections (e.g.: port state control or class society representative).

Equipment Model:	Serial number:	Hull or Yard nr:
....	....	....

3 MONTHS MAINTENANCE CHECKLIST

☐ Retrofit : Vessel name:.. IMO nr:..	☐ New construction: Shipyard name:..
Location : ☐ dry dock / ☐ dock side / ☐ on voyage	Country:..
Classification Society:	Company in charge of commissioning: ....

- Tick YES if the item described is correctly done.
- Tick NO if the item described is incorrectly done and describe in Comments column the solution to turn it OK.
- Tick NO if the item described is not applicable to this proper case and write "not applicable" in the Comments column.

For further information about the maintenance procedures, please read the "Operation and maintenance" book

Item	Operation	Done		Comments
		Yes	No	
1	**Cleaning of fanfilters on each power cabinet**			
1.1	Cabinet A1			
1.2	Cabinet A2			
1.3	Cabinet A3			

Templates

3 months maintenance checklist

Equipment Model:	Serial number:	Hull or Yard nr:
....	....	....

Item	Operation	Done		Comments
		Yes	No	
1.4	Cabinet A4			
1.5	Cabinet A5			
1.6	Cabinet A6			
1.7	Cabinet A7			

OPERATION INFORMATION	
Date: ..../........./.........	Sign when all applicable items are done
Comments	
Person in charge of the maintenance (name)	Signature ....

Equipment Model:	Serial number:	Hull or Yard nr:
....	....	....

6 MONTHS MAINTENANCE CHECKLIST

☐ Retrofit : Vessel name: .... IMO nr:	☐ New construction: Shipyard name: ....
Location : ☐ dry dock / ☐ dock side / ☐ on voyage	Country: ....
Classification Society:	Company in charge of commissioning: ....

- Tick YES if the item described is correctly done.
- Tick NO if the item described is incorrectly done and describe in Comments column the solution to turn it OK.
- Tick NO if the item described is not applicable to this proper case and write "not applicable" in the Comments column.

For further information about the maintenance procedures, please read the "Operator and maintenance" book

Templates
6 months maintenance checklist

Equipment Model:	Serial number:	Hull or Yard nr:
....	....	....

A. CLEANING OF FANS FILTERS ON EACH POWER CABINET

Item	Operation	Done		Comments
		Yes	No	
1	Cabinet A1			
2	Cabinet A2			
3	Cabinet A3			
4	Cabinet A4			
5	Cabinet A5			
6	Cabinet A6			
7	Cabinet A7			

Equipment Model:	Serial number:	Hull or Yard nr:
....	....	....

B. UV REACTORS MAINTENANCE

Item	Operation	Done		Comments
		Yes	No	
1	Visual checking of the UV sensors (general state)			
2	Visual checking of the UV sensor windows (general state)			
3	UV sensor windows cleaning			
4	Visual checking of the Temperature sensor (general state)			
5	Tightening verification of clamps on side, UV window clamps, UV reactors clamps			
6	Leaking test of the quartz (side of the reactor)			
7	Carry out a careful visual check of the automatic air release on the manifold			
8	Tightening control of electrical terminals: in the Boxes of connections on UV lamp reactors,			

Equipment Model:	Serial number:	Hull or Yard nr:
....	....	....

C. POWER CABINET AND CONTROL CABINET MAINTENANCE

Item	Operation	Done		Comments
		Yes	No	
1	Tightening control of electrical terminals: inside cabinets			
2	Visual checking of the status of the fans			

D. FILTER MAINTENANCE

Item	Operation	Done		Comments
		Yes	No	
1	Visual checking of the filter and filtering elements status			
2	Cleaning of the prefilter			
3	Checking the rotation of the backwash shaft			
4	Tightening control of electrical terminals of electrical motors of the filter back wash shaft			

Equipment Model:	Serial number:	Hull or Yard nr:
....	....	....

E. OTHER EQUIPMENT MAINTENANCE

Item	Operation	Done		Comments
		Yes	No	
1	Tightening control of electrical terminals:			
	1.2 Actuators of valves			
	1.3 Flow meter			
	1.4 Electrical pumps motors			

OPERATION INFORMATION	
Date: ………/………/………	Sign when all applicable items are done
Comments	
Person in charge of the maintenance (name)	Signature ....

Templates

6 months maintenance checklist

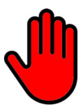
Equipment Model:	Serial number:	Hull or Yard nr:
....	....	....

Equipment Model:	Serial number:	Hull or Yard nr:
....	....	....

12 MONTHS MAINTENANCE CHECKLIST

☐ Retrofit : Vessel name: .... IMO nr:	☐ New construction: Shipyard name: ....
Location : ☐ dry dock / ☐ dock side / ☐ on voyage	Country: ....
Classification Society:	Company in charge of commissioning: ....

- Tick YES if the item described is correctly done.
- Tick NO if the item described is incorrectly done and describe in Comments column the solution to turn it OK.
- Tick NO if the item described is not applicable to this proper case and write "not applicable" in the Comments column.



For further information about the maintenance procedures, please read the "Operator and maintenance" book

Equipment Model:	Serial number:	Hull or Yard nr:
....	....	....

F. REPLACEMENT OF FANS FILTERS ON EACH POWER CABINET

Item	Operation	Done		Comments
		Yes	No	
1	Cabinet A1			
2	Cabinet A2			
3	Cabinet A3			
4	Cabinet A4			
5	Cabinet A5			
6	Cabinet A6			
7	Cabinet A7			

Equipment Model:	Serial number:	Hull or Yard nr:
…………………………………………	…………………………………………	…………………………………………

G. UV REACTORS MAINTENANCE

Item	Operation	Done		Comments
		Yes	No	
1	Visual checking of the UV sensors (general state)			
2	Visual checking of the UV sensor windows (general state)			
3	UV sensor windows cleaning			
4	Visual checking of the Temperature sensor (general state)			
5	Tightening verification of clamps on side, UV window clamps, UV reactors clamps			
6	Leaking test of the quartz (side of the reactor)			
7	Carry out a careful visual check of the automatic air release on the manifold			
8	Tightening control of electrical terminals in the Boxes of connections on UV lamp reactors,	-	-	
9	Replacing the UV Lamp (3000)			
10	Replacing the Quartz and the Gaskets on the reactors.			
11	Replacing the gasket of the UV sensor windows			
12	Checking the tightness on the quartz removing cap on the side of the reactor (system full of water)			

Equipment Model:	Serial number:	Hull or Yard nr:
....	....	....

Item	Operation	Done		Comments
		Yes	No	
13	Checking that clamps are tightened (side clamps , UV window clamps, UV reactors clamps)			
14	Visual check of the automatic air release on the manifold			
15	Checking test of the manifold safety manual valves (opening and closing)			
16	Verification of the UV sensors or UV sensors replacement			

H. POWER CABINET AND CONTROL CABINET MAINTENANCE

Item	Operation	Done		Comments
		Yes	No	
1	Tightening control of electrical terminals: inside cabinets			
2	Replacement of the fans filter on each power cabinet			

Equipment Model:	Serial number:	Hull or Yard nr:
....	....	....

I. FILTER MAINTENANCE

Item	Operation	Done		Comments
		Yes	No	
1	Visual checking of the filter and filtering elements status			
2	Cleaning of the prefilter			
3	Checking the rotation of the backwash shaft			
4	Repairing damage to the coating			
5	Tightening control of electrical terminals of Electrical motors of the filter back wash shaft			
6	Cleaning the pre-filter, the filtering elements. Replacing the gaskets.			
7	Test of Backwash			

Templates
12 months maintenance checklist

Equipment Model:	Serial number:	Hull or Yard nr:
....	....	....

J. OTHER EQUIPMENT MAINTENANCE

Item	Operation	Done		Comments
		Yes	No	
1	Tightening control of electrical terminals:			
	1.2 Actuators of valves,			
	1.2 Flow meter,			
	1.3 Electrical pumps motors,			
2	Verification of the Pressure sensors			
3	Verification of the conductivity sensor			
4	Verification of the temperature sensor			
5	Checking state of bearings, impeller and gaskets of the pumps			

BIO SEA by BIO UV Group

Equipment Model:	Serial number:	Hull or Yard nr:
....	....	....

OPERATION INFORMATION	
Date: ..../........./.........	Sign when all applicable items are done
Comments	
Person in charge of the maintenance (name)	Signature ....

Templates

12 months maintenance checklist

Equipment Model:	Serial number:	Hull or Yard nr:
....	....	....

BWTS Model:	BWTS Serial number:	Vessel name:	IMO nr:
....	....	....	....

SENSORS AND INSTRUMENTATION RECORDS

Date	Designation	P&ID tag	Serial Nr	PLC value	Measured value	Deviation (%)[1]	Replacement (Y/N)	Date of replacement	New Serial Nr	Controller name + Signature

1. The deviation can be found with the formula $\frac{\text{PLC value - Measured value}}{\text{Measured value}} \times 100$

Templates

Sensors and instrumentation records

BWTS Model:	BWTS Serial number:	Vessel name:	IMO nr:
....	....	....	....

Date	Designation	P&ID tag	Serial Nr	PLC value	Measured value	Deviation (%)[1]	Replace-ment (Y/N)	Date of re-placement	New Serial Nr	Controller name + Signature

1. The deviation can be found with the formula $\frac{\text{PLC value - Measured value}}{\text{Measured value}} \times 100$

Survey checklist
Modular & skid configuration

Equipment model	Serial number :
…………………………………………………………………………	…………………………………………………………………………

BWTS SURVEY CHECKLIST

This checklist is to be used as guidance by surveyors for survey of the BIO-SEA BWTS

TO RETURN COMPLETED TO BIO-UV OR ITS LOCAL REPRESENTATIVE FOR WARRANTY VALIDATION	
Vessel name:……………………………………………………	Classification Society:………………………………………
IMO nr:……………………………………………………………	Flag:……………………………………………………………
Shipyard name: ………………………………………………… (if applicable)	Date:…………………………………………………………… Surveyor:……………………………………………………

- System description and detailed information can be found in the BIO-SEA BWTS Manuals
- Maintenance records should be available

A. DOCUMENTATION CHECKING

Item	Designation	Comments
1	Check that BIO-SEA BWTS Approval Certificate is available on board	
2	The installed BWTS is in conformity with the Type Approval Certificate issued by the Administration or its representative (model, components)	
3	Plans of the installation of ballast water management systems are available (drawings and PID)	

Equipment model	Serial number :
....	....

Item	Designation	Comments
4	Check that configuration of BWTS (filter, CIP, RS485, option) in configuration screen are in accordance with the installed system	
5	Check that BWTS manuals are available	
	Specifications and integration guidelines	
	Installation and commissioning	
	Operations and maintenance	
	PLC manual	
	Spare parts catalog	
	CIP manual (if installed)	
	Manuals of required components: filter, flowmeter…	

Equipment model	Serial number :
....	....

Item	Designation	Comments
6	Check Maintenance record to verify that all planned maintenance have been performed	
7	Check corrective maintenance and verify if changes have been made to the initial installation	
8	The Ballast Water Management Plan includes the BWMS and its use	
9	The Ballast Water Record Book is available and record the use of the BWTS in accordance with the Ballast Water Management Plan	

Equipment model	Serial number :
....	....

B. INSTALLATION CHECKING

Item	Designation	Comments
10	Check the workmanship and the state of the installation is satisfactory (no wear, damage, corrosion…)	
11	Check presence and correct location of all components according to PID, in particular the correct location of operational inlets and outlets	
12	Check that at least one sampling point is installed on the discharge line	
13	Check the sampling valve is in place, cleaned and opening/closing properly	
14	Check that, if a CIP is used, sufficient citric acid is provided on board and that CIP manual is available on board	
15	Check electrical connections and cables are in proper state	
16	Check the air supply connection on the valves is in good state	
17	Check that the regulator and dehumidifier of air supply are installed before the BWTS circuit and in good state	

Equipment model	Serial number :
....	....

Item	Designation	Comments
18	Check the automatic air release valve is working on the manifolds.	
19	Check that the fresh water supply is correctly connected, on the filter and on the manifolds of the reactors.	
20	Check that the fresh water regulator, filter and counter are in good state (if installed)	
21	Check that temperature sensor is on the highest reactor, and in good state	
	Check Maintenance records to verify the last verification date and results of the temperature sensor	
22	Check conductivity sensor is properly installed and in good state	
	Check Maintenance records to verify the last verification date and results of the conductivity sensor	
23	Check UV sensors are present and clean on their corresponding reactor	
	Check Maintenance records to verify the last verification date and results of the UV sensors	

Equipment model …………………………………………………………	Serial number : …………………………………………………………

Item	Designation	Comments
24	Check flowmeter is properly installed and in good state	
	Check Maintenance records to verify the last verification date and results of the flowmeter	
25	Check pressure sensors are properly installed and in good state with manual valve open	
	Check Maintenance records to verify the last verification date and results of pressure sensors	

Equipment model	Serial number :
....	....

C. FUNCTIONAL CHECKING

Item	Designation	Comments
26	Check HMI screen is operating and readable	
27	Check the satisfactory operation of the ballast water management system, including any audible or visual alarms. If necessary, refer to the commissioning checklist (ENR-BSE-25) and perform the tests in automatic mode	
28	Check alarms are enabled when the machine fails by causing the following default	
	Disconnect a sensor: general alarm is triggered and audible and visual alarm rings and flashes	
	Disconnect the 24V screen supply: general alarm is triggered and audible and visual alarm rings and flashes	
29	If a remote control is installed, check orders and/or alarms are functioning	
30	Do an extract of date on a USB stick (refer to Operation and maintenance manual BSB_FX_03) to confirm that the recording device is operable and that there is a sufficient history of records	

BIO SEA

by BIO UV Group

BALLAST WATER TREATMENT SYSTEM

B01-0055 to B14-2100 & L01-0030 to L04-0120

Appendix to the OMSM

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Pages intentionally left blank

A. FIC-BET-27: list of all documentations and drawings (rev H)

B. Technical binder

00-General information (Technical agreement)
01-General arrangement
02-Filter
03-UV assembly
04-Power cabinet
05-Control cabinet
06-Cables
07-Sensors
08-Valves
09-Pump
10-Sampling point
11-BIO-SEA Manuals
12-Certificates
13-System settings (FIC-BET-29)
14-CIP
15-Remote control box
16-Installation checklist

C. Installation manual

D. Commissioning manual