Annex C
To: W8482-156642

TECHNICAL STATEMENT OF REQUIREMENT (TSOR)

FOR

HALIFAX CLASS OILY WATER SEPARATOR (OWS) SYSTEM

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APPENDICES

1. OBJECTIVE

1.1. This document outlines the technical requirements of the Department of National Defence (DND) for the supply of an Oily Water Separator (OWS) System, complete with an integrated Bilge Alarm and effluent control system, for operation on board Royal Canadian Navy (RCN) Halifax Class Frigates (HFX).

2. BACKGROUND

2.1. The Vessel Pollution and Dangerous Chemicals Regulations (SOR/2012-69) under the Canada Shipping Act 2001, which incorporates the Convention and Resolutions of the International Maritime Organization (IMO), requires ships to have the capability to process, monitor and control the discharge of shipboard generated bilge fluid. The permissible oil content of water being discharged at sea ranges from 15 ppm to no discharge in special areas such as the Canadian Arctic Ocean under the Arctic Waters Pollution Prevention Act.

2.2. HFX Class Vessels typically generate 1-3 m^3 of oily water per day with the majority of the liquid being water. Diesel Fuel/lubricating oil, oil emulsions and trace amounts of other liquid and solid contaminants make up the remainder of the volume. As such, oily water separation from bilge fluid is a technically challenging process. This results in the accumulation of large volumes of oily water and costly alongside discharge and disposal.

2.3. The RCN requires an efficient, reliable, compact system, with minimal user input, that can separate free and emulsified oil from bilge fluid providing an effluent discharge that meets or exceeds current national and international requirements.

3. APPLICABLE DOCUMENTS

3.1. In the event of conflict between the applicable documents referenced herein and the contents of the TSOR, the contents of the TSOR must apply. Documents referenced within are not applicable to this TSOR unless specifically stated in this TSOR.

3.2. Arctic Waters Pollution Prevention Act, 1985.

3.3. Canada Shipping Act 2001, Vessel Pollution and Dangerous Chemicals Regulations (SOR/2012-69).

3.4. Canadian Environmental Protection Act, 1999.

3.5. Canadian Forces Technical Order (CFTO) D-03-003-005/SF-000 General Electrical Specification for Canadian Forces Ships, 2012.

3.6. International Maritime Organization (IMO), MARPOL 73/78 Annex I, Chapter 2, Reg. 16.

3.7. International Maritime Organization (IMO), Resolution MEPC.107 (49), Revised Guidelines and Specifications for Pollution Prevention Equipment for Machinery Space Bilges of Ships, adopted 18 Jul 2003.

3.8. STANAG 1008, Edition 9: Characteristics of Shipboard Electrical Power Systems in Warships of the North Atlantic Treaty Navies, Aug 2004.

3.9. Transport Canada, Standard for 5 PPM Bilge Alarms for Canadian Inland Waters (TP 12301E), Apr 2008.

3.10. Workplace Hazardous Materials Information System (WHMIS) Regulation, 1988 and 2015.

3.11. Canadian Hazardous Products Act, 1985.

3.12. ASTM F 1166-07 Standard Practice for Human Engineering Design for Marine Systems, Equipment and Facilities.

3.13. Health Canada (2014). Guidelines for Canadian Drinking Water Quality—Summary Table. Water and Air Quality Bureau, Healthy Environments and Consumer Safety Branch, Health Canada, Ottawa, Ontario.

3.14. Mil-Std-3034A: Reliability Centered Maintenance (RCM) Process, April 2014.

3.15. Mil-Std-1798C. Mechanical Equipment and Subsystems Integrity Program, August 2013.

4. TERMINOLOGY

4.1. **Bilge Fluid**: is shipboard generated oily waste liquid from machinery space bilges. It is usually composed of two (2) distinct phases; a Free Oil phase and Bilge Water phase, and the ratio of either phase over the other may vary from virtually 0 to 100%. Contaminants may include diesel fuel, lubricating oil, hydraulic oil, additives, solvents, cleaners and various solid particles such as rust and carbon soot.

4.1.1. **Free Oil**: is the oil phase of the Bilge Fluid which has naturally separated to the surface.

4.1.2. **Bilge Water**: is the aqueous phase of the Bilge Fluid. It may contain the above-mentioned contaminants and be heavily emulsified by the effects of surfactants (e.g. detergents) and mechanical mixing (e.g. pumps). The water component usually comprises a combination of freshwater and seawater.

4.2. **Bilge Alarm**: means an Oil Content Meter (OCM) with associated OCM Alarm. It comprises the alarm arrangements specified in MARPOL 73/78 Annex I, Chapter 2, regulation 16(5) and outlined in Resolution MEPC 107(49). The Oil Content Meter (OCM) Alarm is the programmed set-point at which the integrated automatic effluent control system will stop effluent from overboard discharge when the OCM detects an oil concentration exceeding that of the programmed set-point.

4.3. **Consumable**: Material, fluids or chemicals consumed or expended during operation of a piece of equipment.

4.4. **Corrective maintenance**: A maintenance task performed to identify, isolate, and rectify a fault so that the failed equipment, component, subsystem, or system can be

restored to an operational condition within the tolerances or limits established for in-service operations. See Mil-Std-3034A.

4.5. **Effluent**:

4.5.1. **Effluent for Overboard Discharge**: Effluent that meets criteria for overboard discharge according to the OCM.

4.5.2. **Recirculated Effluent**: Effluent that does not meet criteria for overboard discharge according to the OCM and is recirculated for further processing.

4.6. **Fresh Water**: Water which meets the Health Canada standard for drinking as outlined in Health Canada (2014) Guidelines for Canadian Drinking Water Quality.

4.7. **Microplastics**: Plastic fragments or particles of 5mm or less in length.

4.8. **OWS**: Equipment to remove free and emulsified oil from bilge fluid with an integrated bilge alarm and effluent control system.

4.9. **Oil**: is defined as the total petroleum hydrocarbon content in a sample measured in accordance with an approved standard laboratory method.

4.10. **ppm of oil in water**: parts per million. The concentration of oil and other substances in water.

4.11. **Preventative Maintenance**: A structured program of planned tasks that achieve a desired level of equipment performance and availability at the most economic cost attainable. See Mil-Std-1798C.

4.12. **Recover**: Ability of an OWS to return to a steady state after an unexpected or controlled occurrence.

4.13. **Set-To-Work**: A systematic validation process after commissioning to confirm the OWS is correctly installed and operating according to OEM specifications.

4.14. **Steady State**: A state in which the OWS is capable of continuous, automatic and unattended operation after initial start-up.

4.15. **Special Tools**: tools provided for systems only available through the OEM. This definition also applies for special instruments, special external devices and special equipment for the proposed system.

5. SYSTEM DESIGN

5.1. OWS System General Requirements

5.1.1. The system must comprise an OWS that is certified in accordance with the International Maritime Organization (IMO), Resolution MEPC.107 (49), Revised Guidelines and Specifications for Pollution Prevention Equipment for Machinery Space Bilges of Ships, adopted 18 Jul 2003).

5.1.2. The Contractor should provide a feed pump.

5.1.2.1. If a feed pump is supplied, it should be installed in the same location as the existing pump, as outlined in Appendix B, Fig 1, Fig 2 and Table 1. Note that locations for a new feed pump include the batch tank location or existing feed pump location.

5.1.2.2. If a feed pump is supplied, it must be capable of pumping fluid 2 m vertically upward.

5.1.3. The existing gravity separation tank (the Batch Tank) will be removed by DND.

5.1.4. Incineration, evaporation and distillation must not be used as processing methods.

5.1.5. Gravity separation must not be the sole method used for the OWS system.

5.1.6. The Contractor’s OWS must be capable of continuous or cyclic operation for a minimum 8 hour period including an automatic self-cleaning process (if featured).

5.1.7. The Contractor’s OWS should be capable of continuous or cyclic operation for a period greater than 8 hours including an automatic self-cleaning process (if featured).

5.1.8. If the Contractor’s OWS experiences 100% oil during processing, the system should continue to process without operator intervention.

5.2. **OWS System Performance Requirements**

5.2.1. The Contractor's OWS must be capable of processing bilge fluid at or below 15 ppm at a minimum process flow rate of 0.375 m^3/h;

5.2.2. The Contractor's OWS should be capable of processing bilge fluid at or below 15 ppm with a process flow rate greater than 0.375 m^3/h.

5.2.3. The Contractor's OWS should not require any procedure to optimize the performance of the OWS oil/water separation process (i.e. tuning, calibration, adjusting, etc.) within any six month period.

5.2.4. The Contractor's OWS should be capable of remaining mechanically secure and be capable of continuous independent operation under the following environmental conditions:

Environmental Conditions	Max	Min
5.2.4.1. Machinery Space Temp (°C)	41	15
5.2.4.2. Machinery Space Relative Humidity (%)	100	0
5.2.4.3. Sea Temperature (°C)	32	-2.2
5.2.4.4. Bilge Fluid Temperature (°C)	35	-2

5.2.5. The time required for system start-up should not exceed 10 minutes from a normal shut-down state (not including calibration).

5.2.6. Any process or activity necessary to protect, recover or maintain OWS productivity must not consume more than 200 kg of fresh water within an 8 hour period.

5.2.7. Any process or activity necessary to protect, recover or maintain the Contractor's OWS productivity should not consume more than 75 kg of fresh water within an 8 hour period.

5.2.8. Any process or activity necessary to protect, recover or maintain the Contractor's OWS productivity should not return more than 150 kg of effluent to the Oily Water Collection Tank within an 8 hour period. See the current system diagram outlined in Appendix B, Figure 1.

5.2.9. Any discharge to the Recovered Oil Tank should contain a minimum quantity of water.

5.3. **Bilge Alarm General Requirements**

5.3.1. The Contractor's Bilge Alarm must have a "Certificate of Type Approval" in accordance with 3.7 (International Maritime Organization (IMO), Resolution MEPC.107 (49), Revised Guidelines and Specifications for Pollution Prevention Equipment for Machinery Space Bilges of Ships, adopted 18 Jul 2003.

5.3.2. The Contractor's Bilge Alarm should have a "Certificate of Type Approval" in accordance with Transport Canada, Standard for 5 PPM Bilge Alarms for Canadian Inland Waters (TP 12301E), Apr 2008.

5.3.3. The Contractor's Bilge Alarm during MEPC certification calibration tests as per the International Maritime Organization (IMO), Resolution MEPC.107 (49), Revised Guidelines and Specifications for Pollution Prevention Equipment for Machinery Space Bilges of Ships, adopted 18 Jul 2003 should not have:

5.3.3.1. Required re-calibration or re-zeroing;

5.3.3.2. Been damaged during the "shut off test";

5.3.3.3. Had a "calibration drift" or "zero drift" of more than 5 ppm, or

5.3.3.4. Been affected by changes to the water pressure or flow rate of the test mixture.

5.3.4. The Contractor's Bilge Alarm should have an annual Contractor authorized service calibration interval.

5.3.5. The Contractor's Bilge Alarm must not require calibration for 1300 hours of operation after an OEM certified calibration.

5.3.6. Verification of the Contractor's Bilge Alarm calibration should be accomplished by Ship Staff (SS) without using special instruments, tools or external devices.

5.3.7. The Contractor's Bilge Alarm should feature adjustable set-point limits of 5 ppm and 15 ppm that can be set by Ship Staff (SS) while onboard.

5.3.7.1. If adjustable set points are featured, the Contractor's Bilge Alarm set-points should be changeable within 1 hour.

5.3.7.2. When the Contractor's Bilge Alarm is set to 5 ppm, the OWS should process effluent at a minimum rate of 0.375 m^3/h.

5.3.8. If a Contractor's Bilge Alarm is permanently set at 5 ppm, the OWS must meet the minimum flow rate of 0.375 m^3/h.

5.4. **Physical Requirements**

5.4.1. As outlined in Appendix B, Fig 2, Fig. 3, Fig 4 and Fig 5, the overall external dimensions of the Contractor's OWS, including adequate space for repair and maintenance envelope, and shock mounting, must not exceed:

5.4.1.1. Height of 1500 mm (does not include 152 mm high tank plate);

5.4.1.2. Depth of 1210 mm; and

5.4.1.3. Length of 2150 mm.

5.4.2. The entire Contractor's OWS or each module, if a modular construction is used, must be capable of passing through a ship's soft patch opening measuring 1650 mm x 1300 mm.

5.4.3. The entire Contractor's OWS or each module, if a modular construction is used, should be capable of passing through a ship's hatch opening of 914 mm x 914 mm.

5.5. **Interface Requirements**

5.5.1. If ship services are required (power limits, water pressure and low-pressure air), the Contractor must adapt to the limits of the available ship services:

5.5.1.1. The Contractor may use the ship's available power: 440 VAC, 3 Phase, 60 HZ, maximum 50 Amps (see STANAG 1008, Edition 9, 24 August 2004: Characteristics of Shipboard Electrical Power Systems in Warships of the North Atlantic Treaty Navies;

5.5.1.2. The Contractor may use the hot (60^{o}C) and cold fresh water system pressure 206 – 483 kpa, and

5.5.1.3. The Contractor may use the low pressure air system: filtered compressed air at a working pressure of 840 kpa at 4.3 m^3/m, it has a minimum/maximum range of 550 – 1000 kpa.

5.5.2. The following equipment, piping and services for the installation of the system will be Government Supplied Material (GSM) and will not be required:

5.5.2.1. Oily water collection tank, 13.3 Tonnes;

5.5.2.2. Recovered oil tank, 9.5 Tonnes;

5.5.2.3. Piping and fittings to/from the oily water collection tank, recovered oil tank, and fresh water supply, and

5.5.2.4. Low pressure air piping to control valves.

5.5.3. The Contractor's OWS must have provision for remote indication of information, relating to the system operating parameters to ensure monitoring for safe and efficient operation of the OWS, by interfacing with IPMS (Integrated Platform

Management System) via a CAT 5 cable. The communication User Datagram Protocol (UDP) is preferred (Transmission Control Protocol/Internet Protocol [TCP/IP] acceptable) compliant with MODBUS 5 protocol. Further details of IPMS required for integration can be provided upon request.

5.5.4. The Contractor's OWS should have common signal grounding with the interfacing equipment as per CFTO D-03-003-005/SF-000 General Electrical Specification for Canadian Forces Ships, 2012.

5.5.5. Wireless components must not be included in the Contractor's OWS or associated equipment.

5.6. **Safety Requirements**

5.6.1. The Contractor's OWS operator control panel must comply with ASTM F 1166-07.

5.6.2. A functioning, physical Emergency Stop button complying with ASTM F 1166-07 must be featured as part of the Contractor's OWS:

5.6.2.1. The emergency stop button must power down the equipment in a fail-safe mode; and

5.6.2.2. The time required to bring the Contractor's OWS to a steady state after an Emergency Stop of a 24-hr duration should not exceed 10 minutes.

5.6.3. The Contractor's OWS operator controls and the emergency stop button can be relocated in order to meet the height requirements in ASTM F 1166-07. Dimensions are indicated in Appendix B, Figure 5. Heights for control location purposes are relative to the catwalk operating position as indicated in Appendix B, Figure 5.

5.6.4. The Contractor's OWS must incorporate safety interlocks, guards or guides which prevent damage to equipment and injury to personnel while the equipment is energized.

5.7. **Maintenance Requirements**

5.7.1. All the Contractor's OWS maintenance should be performed in-situ.

5.7.1.1. First and second level corrective and planned maintenance tasks having a periodicity of less than 30 days should be carried out without dismantling external electrical connections, fittings or piping interfaces. A definition of maintenance levels is provided in Appendix C.

5.7.1.2. The frequency of replacing or repairing components should be lower than one component per month (based on 8 hours of OWS operation per day for 30 days, or 240 hours of operation).

5.7.1.3. The frequency of replacing or replenishing process treatment consumables (e.g. filtration media, chemicals, etc.) should be lower than one component within an 8 hour period of bilge water processing.

5.7.1.4. Lubrication points should be located and serviced at the periphery of the equipment and accessible without dismantling in accordance with ASTM F 1166-07 Standard Practice for Human Engineering Design for Marine Systems, Equipment and Facilities.

5.7.1.5. The average monthly effort to complete all first and second level planned maintenance should not exceed 8 hours.

5.7.2. Any cleaning agents, fluids, chemicals or spares required for maintenance or OWS operation must be safe for storage onboard without restriction given the environmental conditions indicated in para 5.2.4;

5.7.3. The Contractor's OWS should be capable of being completely drained manually without the use of external equipment.

5.7.4. For sub-assemblies that require more than 8 hours to repair, special tools or equipment and specialized training outside the scope of expected Ship Staff (SS) duties, the maintenance policy should be "Repair by Replacement". A definition of maintenance levels is provided in Appendix C.

5.7.5. All spares should be capable of being installed with a minimum use of special tools (i.e. no more than two).

5.7.6. Any required special test equipment, jigs and alignment tools should allow rapid and accurate calibration (with less than 5% error), adjustment or checking of equipment.

5.7.7. Any required special tools or special equipment should require less than eight hours of training for proper use.

5.7.8. The total volume required for storage of the system's onboard consumables and spares during at-sea operations (up to a maximum of 6 months) should be as low as possible.

5.8. **Material Requirements**

5.8.1. Any of the Contractor's OWS components in contact with the deck or system fluids must be constructed of materials resistant to corrosive and erosive effects at temperatures and pressures encountered during normal operation of the system.

5.8.2. The following restrictions apply:

5.8.2.1. Asbestos in any form must not be used;

5.8.2.2. Cadmium must not be used;

5.8.2.3. Chlorosulphonated polyethylene (CSP, trade name "hypalon") and polyvinyl chloride (PVC) must not be used as insulators for electrical cables; and

5.8.2.4. Plastic must not be used as structural components.

5.8.3. Materials included in the Contractor's OWS design or used during operation, maintenance or repair of the OWS, must meet the legislation in the Canadian Hazardous Products Act (1985).

5.8.4. Material included in the Contractor's OWS design or used during operation, maintenance or repair of the system, must meet the legislation in the Canadian Environmental Protection Act.

5.8.5. Material included in the Contractor's OWS design or used during system operation should not contain or produce microplastics.

5.8.6. Workplace Hazardous Material Information System (WHMIS) material safety data sheets (MSDS), or the Globally Harmonized System of Classification and Labelling of Chemicals (GHS), must be provided for cleaning agents and any other components used for the proposed Contractor's OWS, see the Workplace Hazardous Materials Information System Regulation (1988 and 2015).

APPENDIX A

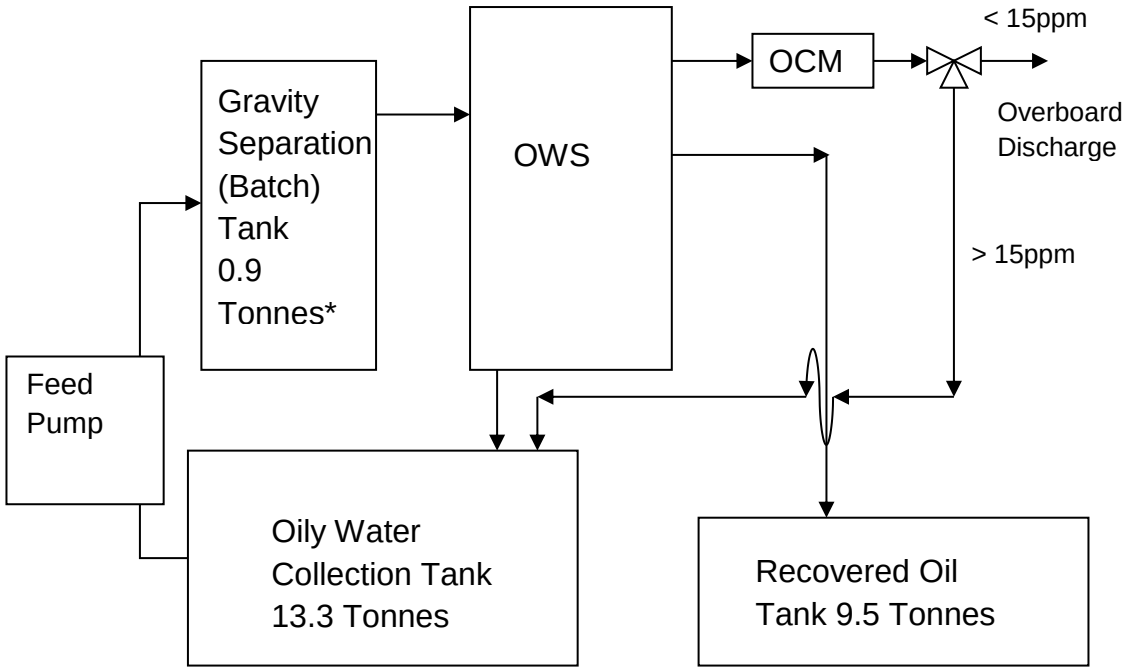
GLOSSARY OF TERMS

TERM	DEFINITION
MTBF	MEAN TIME BETWEEN FAILURE
PA	PROCUREMENT AUTHORITY
CFTO	CANADIAN FORCES TECHNICAL ORDER
DND	DEPARTMENT OF NATIONAL DEFENCE (CANADA)
FSR	FIELD SERVICE REPRESENTATIVE
HFX	HALIFAX CLASS SHIPS (CANADA)
IEEE	INSTITUTE OF ELECTRONIC AND ELECTRICAL ENGINEERS
IMO	INTERNATIONAL MARITIME ORGANISATION
MEPC	MARITIME ENVIRONMENTAL PROTECTION COMMITTEE
NEMA	NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION
NETE	NAVAL ENGINEERING TEST ESTABLISHMENT
OEM	ORIGINAL EQUIPMENT MANUFACTURER
OCM	OIL CONTENT METER
OWS	OILY WATER SEPARATOR
SS	SHIP STAFF
TA	TECHNICAL AUTHORITY
TDP	TECHNICAL DATA PACKAGE
TSOR	TECHNICAL STATEMENT OF REQUIREMENTS
WHMIS	WORKPLACE HAZARDOUS MATERIALS INFORMATION SYSTEM

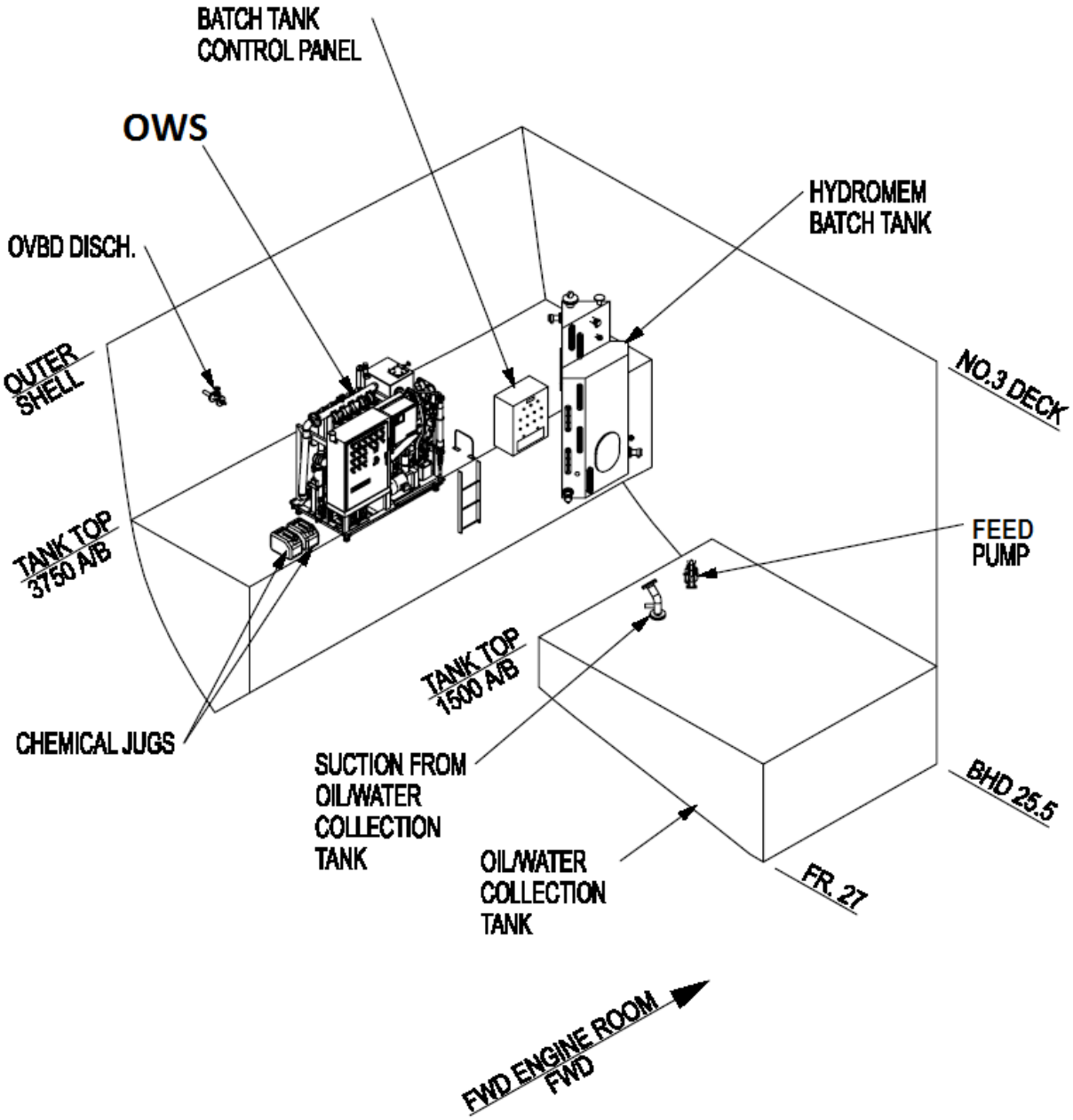
APPENDIX B

CURRENTLY INSTALLED OILY WATER SEPARATOR

Appendix B, Figure 1: Current System (General Representation)
* Gravity Separation (Batch) tank will be removed.



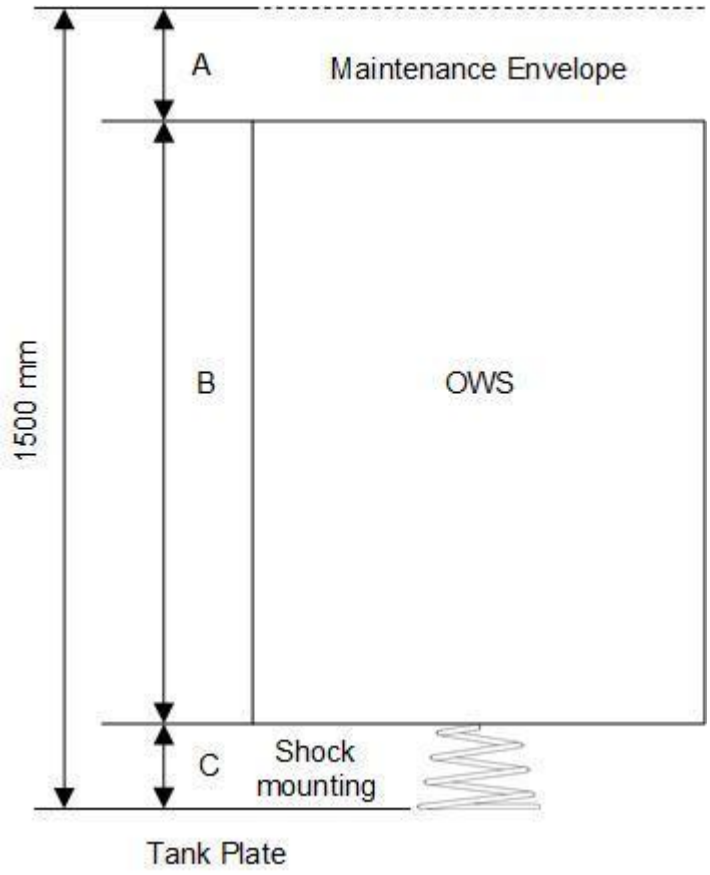
Appendix B, Figure 2: Current System location diagram (general representation).
Note that OWS Batch tank (Gravity Separation tank) will be removed.
The current feed pump may be removed if required. Suggested locations of a new feed pump include the batch tank location and existing feed pump location.



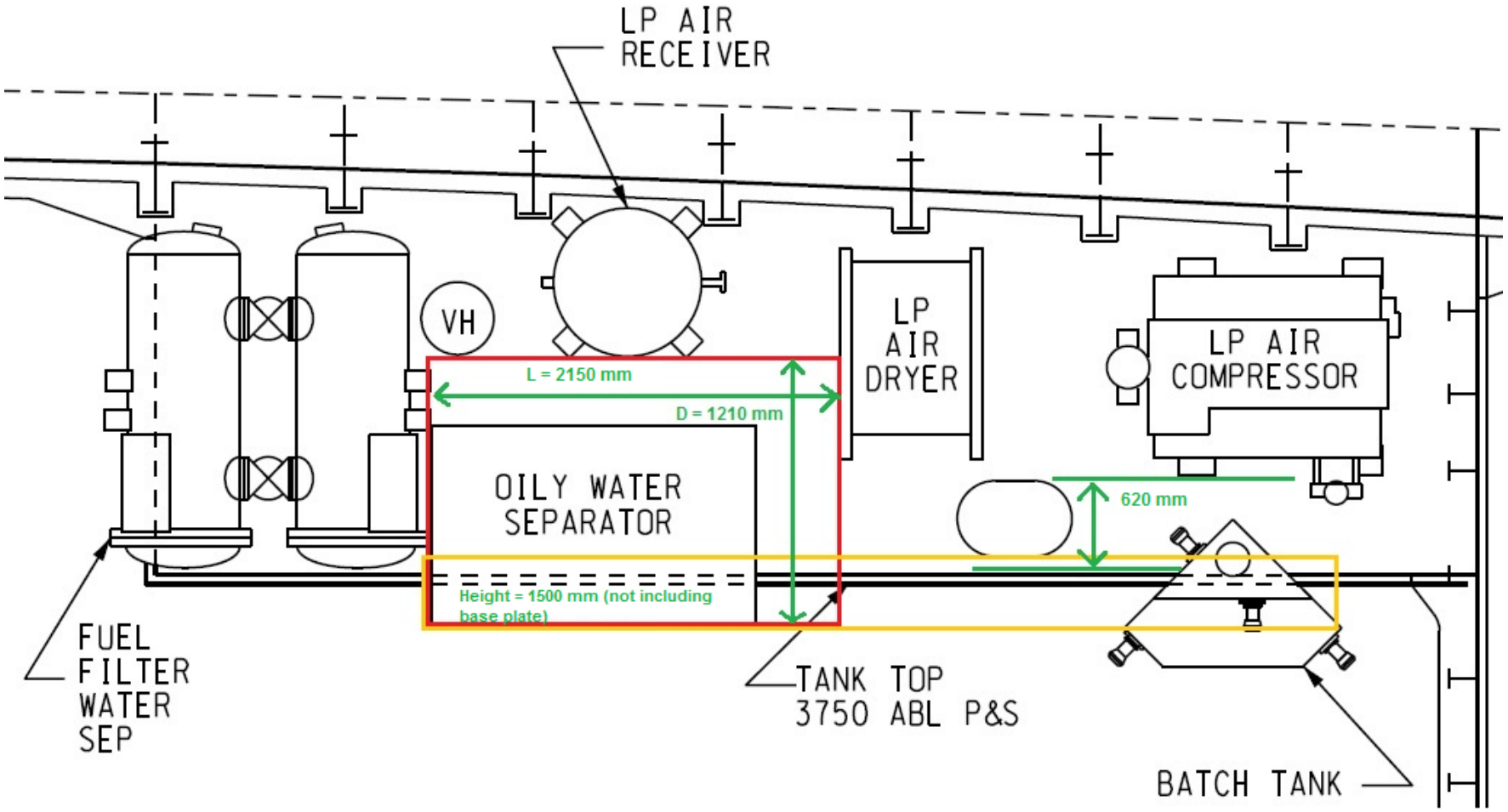
Appendix B, Table 1: Current System Dimensions and Weights. Note that the Oily Water Separator Batch Tank will be removed and the Oily Water Feed Pump may be removed if required.

Equipment	Dimensions, mm (LxWxH)	Weight, Kg
Oily Water Feed Pump	185x267x279	12
Oily Water Separator Batch Tank (will be removed)	1171x795x2500	544

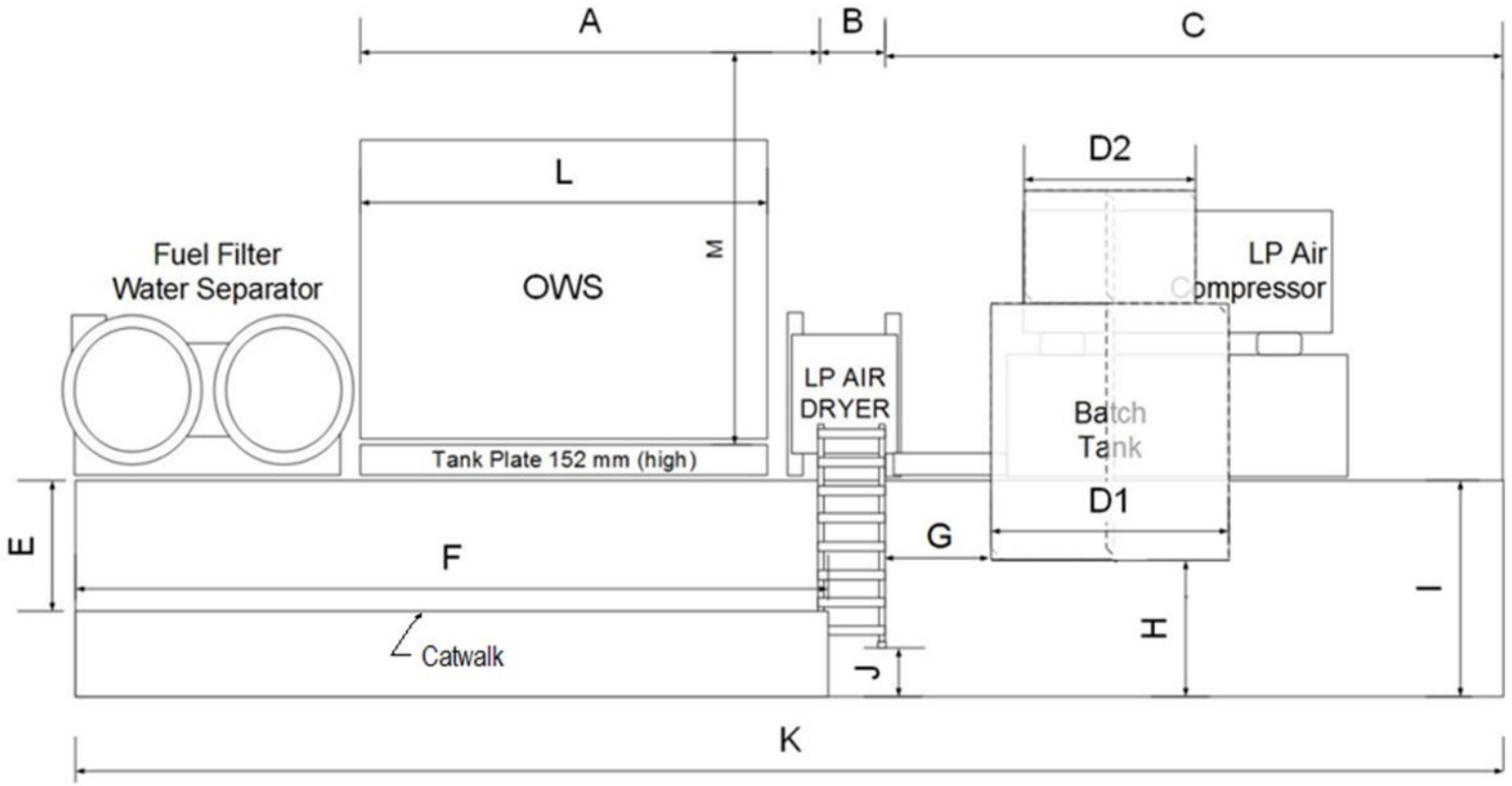
Appendix B, Figure 3: The system overall external dimensions. The diagram indicates space for the repair and maintenance envelope (A), the OWS (B) and shock mounting (C).



Appendix B, Figure 4: The OWS area (in Red), and suggested control position (orange). Note that the Batch Tank will be **removed**.



Appendix B, Figure 5: Side-view of OWS installation position



Legend:
A = 2260 mm; B = 330 mm; C = 3000 mm; D1 = 1160 mm at widest point (bottom section); D2 = 840 mm (top section); E = 640 mm; F = 3170 mm (including step); G = 1270 mm; H = 75 mm; I = 1060 mm; J = 210 mm; K = 7020 mm; L = 2150 mm; M = 1500 mm

APPENDIX C

MAINTENANCE LEVEL DEFINITIONS

Maintenance Level Definitions

1. DND utilizes a maintenance management system involving three levels of maintenance, i.e. 1st, 2nd and 3rd level maintenance activities as defined below.

2. 1st Level Maintenance – maintenance normally performed onboard ship by shipboard naval technicians required to ensure continued reliable operation, such as but not limited to: operating checks and trouble-shooting, membrane cartridge checks and change as well as preservation and cold weather protection (as required for shipping); repairing fluid leaks; checking and repairing valves and switches; repairing actuator assembly switch, changing o-rings, etc.

3. 2nd Level Maintenance – maintenance normally performed onboard ship by specialized shore-based support facilities which is more complex, time consuming and involves higher skill levels than 1st level maintenance activities, such as but not limited to: Bilge Alarm Calibration; Preventative Maintenance testing; removal and replacement of acoustic hardware (mounts, expansion joins, flexible hoses and connections); and

4. 3rd Level Maintenance – maintenance normally conducted in a specialized shore-based repair facility by highly skilled technicians, such as but not limited to: complete equipment overhauls; complete overhaul of major components removed during 2nd level activities and 3rd level equipment overhauls; modification, and testing and evaluation.