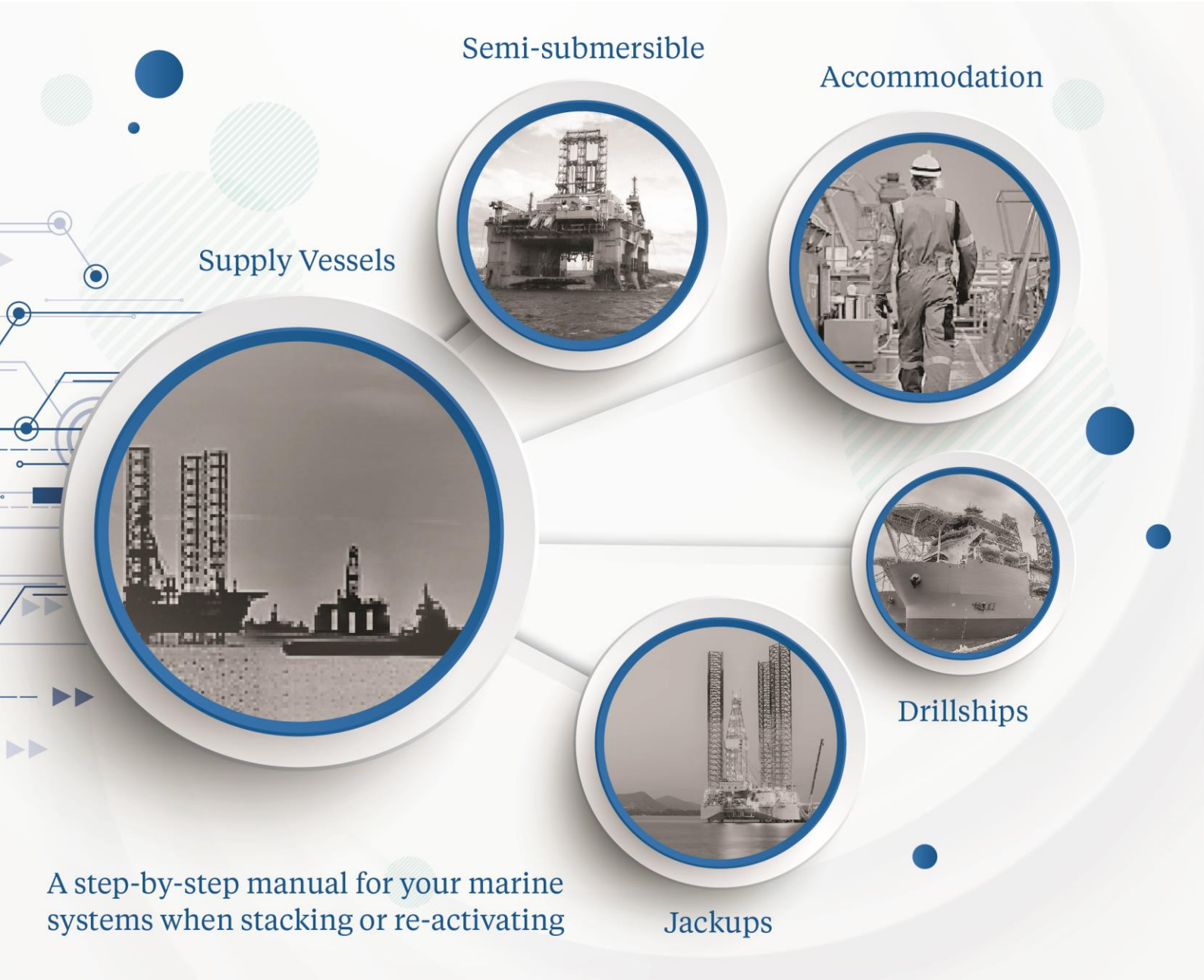
Wilhelmsen Ships Service

Offshore Preservation & Re-activation Manual



A step-by-step manual for your marine systems when stacking or re-activating

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1. Introduction

In challenging market conditions, many contractors choose to temporarily stack/lay-up assets. Wilhelmsen assist offshore contractors in this process by planning, cleaning and preserving technical equipment and superstructure. Our solution offers systematic and ISO/DNVGL compliant procedures to stacking and preserving MODUs (Mobile Offshore Drilling Units), OSV (Offshore Support Vessels) and other offshore vessels. Partnering with Wilhelmsen for your stacking and preservation projects translates to cost effective, standardised, compliant and quality solutions for your requirements

As the largest global marine chemicals supplier, Wilhelmsen Ships Service provides a range of quality cleaning chemicals/equipment, water treatment chemicals, fuel oil treatments and preservation/maintenance products. Our Unitor™ and Nalfleet™ chemicals are formulated to meet the latest requirements, compliant with IMO (MARPOL 73/78) under OSPARCOM regulations and with many HOCNF and CEFAS certifications. As a customer, one also have the option of partnering with our sister company, Wilhelmsen Ship Management, to provide an end-to-end solution - including pre-planning services, stacking location, de-activation, maintenance assistance, documentation and re-activation services/manning in selected locations.

The *Offshore Preservation & Re-Activation Manual* has been created to provide a quick reference guide to preservation and re-activation challenges. As the need for pre-planning, stacking location, documentation etc. varies greatly, this document will focus more on practical challenges concerning cleaning and asset preservation by chemical treatments - which by nature is more generic and system driven.

The manual's structure is split in three. We commence by highlighting the importance of pre-stacking cleaning - which can be handled by existing crew, before the unit is de-activated. Proper pre-stacking cleaning can reduce costs considerably and will prepare the unit for preservation. Specific operational cleaning task are described, combined with technical guidance and product application suggestion. The following section, starts with briefly describing our sister company's (Wilhelmsen Ship Management) stacking services. (Section 3.1-3.2) Continuing, we focus on Wilhelmsen Ships Service core capabilities; to provide guidance on how to preserve specific systems or equipment on-board the rig or offshore vessel. This is predominantly based on chemical preservation treatments. Finally we conclude with support and guidance on the re-activation phase and how our solutions can support a cost effective start-up of the unit.

If you need further information regarding our services and products, please contact your WSS representative for assistance.

2. Pre-Stacking Cleaning

2.1 Cleaning Equipment for General Cleaning

It is important to remove the salt layer on deck and superstructure to maintain the paint coating in good condition and to reduce corrosion. For safety reasons one should also clean off any contamination such oil, grease and dirt in order to avoid slippery surfaces that can cause accidents and hazards.

To achieve fast and efficient cleaning, the correct high pressure cleaning equipment should be used. These are effective for cleaning and also for surface preparation when used in conjunction with the right accessories. There are two main types of high pressure machines: electrical or air driven. The air driven units are ideal for 'Ex' areas. For application of chemicals on large areas we recommend the use of the 'Hydra' clean or 'Handymax' kit, for smaller areas we recommend to use the Jet spray. Efficient and correct dilution of the chemicals can be achieved with the Unitor Mixing Stations.

Always remember to flush high pressure cleaners and application equipment thoroughly with fresh water after use and before storage.

Recommended products:		Application:
721520	HPCE 520 INOX, 3 x 440V/60HZ	N/A
721209	POWERSPEED ROTARY NZZL EXTREME 520	N/A
721175	SANDBLASTING EXTREME PACK 520	N/A
734095	HPC AIRCLEAN 32	N/A
625293	PRESIDENT 10:1, HYDRA CLEAN.	N/A
778866	HANDYMAX CARGO HOLD CLEANING KIT	N/A
572123	JET SPRAY UNIT 10 LTR ST.ST	N/A
778822	UNITOR CLEANING STATION 2	N/A
778833	UNITOR MIXING STATION 4 – 14	N/A

2.2 Deck & Superstructure Cleaning

Cleaning of deck and superstructure will ease the preservation work to be executed on the unit in question. This can be done by onboard crew and reduce the use of costly third party support for a simple operational task. Depending on the contaminants on the surface to be cleaned, the correct type of cleaning chemical is essential.

2.2.1 General purpose cleaning

For cleaning of grease, dirt and soot on deck we recommend to dilute Cleanrig CHP or Multi Clean to a 5-10% solution. Apply this solution to the area to be cleaned. Use suitable application equipment

and let it soak on the surface for 10-30min. During this time the cleaning solution should not be allowed to dry on the surface to be cleaned. Wash down with water hose preferably with hot fresh water or by use of high pressure cleaning equipment.

Note also that this product, Cleanrig CHP, is CEFAS and HOCNF approved, while Multiclean does not carry such approvals.

Recommended products:		Application
726040	UNITOR CLEANRIG CHP 200 LTR	General Purpose Cleaner
777708	MULTICLEAN 25 LTR	General Purpose Cleaner

2.2.2 Heavy duty de-greasing

For cleaning of grease, condensed oil and lube oil on the deck, we recommend to use Cleanphase CB at full strength or diluted 50% in fresh water. Apply to the soiled surface by chemical sprayer, mixing station, immersion or brushing and let is soak for 30 to 60 minutes and rinse, preferably with hot fresh water, or by use of high pressure cleaning equipment. The emulsion formed will break after cleaning operation, reducing the load on oily water separator.

Note also that this product, Cleanphase CB, is CEFAS and HOCNF approved.

Recommended products:		Application
726050	Cleanphase CB 25 LTR	Heavy Duty Degreasing

2.2.3 Rust removal, pre-painting treatment and aluminium brightening

Metal Brite HD is recommended for the removal of rust and hardness /salt stains from all the surfaces. If present, firstly physically remove dirt, rust flakes oil and grease prior to using Metal Brite HD. Metal Brite HD should be used neat on heavy stains and diluted 10-30% for lighter stains. When mixing or diluting, always add Metal Brite HD to the water, not vice versa. Allow it to soak for about 20 minutes and rinse of surface with water. Do not let Metal Brite HD dry on surface.

Note also that this product, Metal Brite HD, is CEFAS and HOCNF approved.

Recommended products:		Application
571679	Metal Brite HD 25 LTR	Rust Removal, Pre-painting and Aluminium brightening

2.3 Engine and Engine Room Cleaning

When cleaning engine room machinery, the most effective product to use will depend on the type and amount of soiling. The cleaning operation can also be conducted on external sufaces as well and internal equipment parts.

2.3.1 Heavy duty degreasing

Both Seaclan Plus and Unitor Cleanphase CB are excellent degreasers used to remove oil, wax, and sludge from engine room machinery, floors, tanks, bilges, heat exchangers, etc. The product can be sprayed neat onto the surface to be cleaned and contact time should be about 30 minutes. Wash down by using high pressure cleaning machines. The best result is achieved when using hot water at 50°C.

Note, Unitor Cleanphase CB is HOCNF & CEFAS approved, while Seaclan Plus does not carry such approval.

Recommended products:		Application:
654715	Seaclean Plus 25 LTR	Heavy Duty Degreasing
726050	Unitor Cleanphase CB 25 LTR	Heavy Duty Degreasing

2.3.2 Degreasing boiler and engine cooling systems

Before preserving the boiler or cooling water systems, an inspection must be performed. This is to identify the presence of hydrocarbons or dirt. If such substances are present, cleaning is required. A solution strength 1 to 6% of Seaclean Pluss or Unitor Cleanphase should be circulated between 5 to 24 hours at temperature between 50 to 60°C. Complete the process by draining and flushing system.

For a detailed procedure on the above, please see the Offshore Cleaning & Chemicals Manual, section 9.3.1. See also section 3.3.1 and section 3.3.2 in this document for how to move from the cleaning to a preservation process of the same system.

Note, Unitor Cleanphase CB is HOCNF & CEFAS approved, while Seaclan Plus does not carry such approvals.

Recommended products:		Application:
654715	Seaclean Plus 25 LTR	Heavy Duty Degreasing
726050	Unitor Cleanphase CB 25 LTR	Heavy Duty Degreasing

2.3.3 Electrical components and motor cleaning

Apply Electrosol Plus neat by brushing or engine component immersion. If a spray gun is used, it must be fitted with a jet nozzle. An atomising spray should not be used. Flush deposits of dirt and grease away with Electrosol PLUS. After cleaning, evaporate remaining solvent by using low pressure and high volume compressed air, or let it dry in a warm place.

Note also that this product, Unitor Electrosol Plus, is CEFAS and HOCNF approved.

Recommended products:	Application
726065 UNITOR ELECTROSOL PLUS 25 LTR	Electric components Cleaning

2.3.4 Carbon deposits removal

To remove carbonaceous deposits from engines parts, such as pistons rings, valves and valve cages, fuel and lube oil filters, we recommend using Carbonclean LT. The items to be cleaned should be dipped into the cleaning solution. For light carbon deposits or oil, a dilution of up to 1:2 in fresh water can be used. Lights deposits will be removed after 1 hour. After components have been removed from soaking, flush with water.

Recommended product:	Application:
575696 Carbonclean LT 25 L	Carbon deposits removal

2.3.5 Air cooler cleaning

Conventional cleaning methods to clean turbocharger air coolers and scavenge trunking, involve engine shut down. Using ACC Plus, a microemulsion type cleaner, the cleaning takes place while the engine is in service. Apply a mixture of 3L of water to 1L of ACC Plus in the dosing pot. Inject the mixture over a period of 10 minutes. Wait 10 minutes, then inject 3L of fresh water to rinse off the emulsified deposits.

Recommended product:	Application:
698704 ACC Plus 25 LTR	Air Coolers Cleaning

2.3.6 Acid descaling of evaporators and sea water cooling systems

Removal of fresh water or seawater hardness deposits can be economically achieved by using a safe-to-handle dry acid that includes an inhibitor to minimize base metal attack. Dissolve Scaleclean EX or Descalex in warm water at concentration between 10% to 30%, raise temperature to 60°C and circulate for 4 to 12 hours. Drain system and flush with fresh water for 2 hours minimum to raise pH.

Note: Scaleclean EX is HOCNF & CEFAS approved, while Descalex does not carry such approvals.

Recommended products:		Application:
571646	Descalex 25 KG	Inorganic deposit/scale removal
719070	Scaleclean EX 25 KG	Inorganic deposit/scale removal

2.4 Tank Cleaning

Tank cleaning is a challenge which needs to be adressed when stacking. The optimal cleaning solution varies though depending on the function of the tank in question. Note also that tank cleaning is often used as a preservation method for dry storing the tank after cleaning. Due to this, we will only touch on the most common tank cleaning procedures in this section while return to the subject matter in section 3.3 and 3.4. In the referenced section we will state the tank cleaning procedures as an integrated part of dry or wet tank preservation.

2.4.1 Sewage tanks

Sewage tanks, grey and black water tanks and the sewage treatment plant requires cleaning. The need is often urgent, as foul smellsl can develop rapidly during or after stacking. These tanks and systems are recommended to be cleaned and dry-stored for preservation. We will thus return to the cleaning and preservation approach of these tanks/systems in section 3.3.7. For quick referance, we recommend Gamazyme 700FN for sewage tanks, black and grey water tanks and sewage treatment plant cleaning.

Reccomended Product		Application
571711	GAMAZYME 700FN	Organic matter degradation

2.4.2 Fuel tank cleaning

For fuel tank cleaning the recommended approach is described below. Note however that if one seeks not to clean the tank but to preserve and potentially burn fuel during stacking, that this approach is detailed in section 3.4.

For badly contaminated or empty fuel tanks, a thorough cleaning is recommended to avoid formation of sludge and deposits that will adhere to tank surfaces. Note, that the described tank cleaning can be done at re-activation point as well, but can prove challenging, dependent on how long the unit has been out of operation.

Before entering the fuel tank to clean, always ensure to follow safe working practice for enetering Confined Spaces. When inside, apply Aquatuff at concentration 10% to 20% to all surfaces of the tank and let the chemical work for approximately 30 minutes, but wash off before it dries. Flush with fresh water and repeat if necessary. Flush out the tank and pipes, then allow to dry.

Recommended products:		Application:
625293	10:1 Hydra Clean Chemical Applicator	N/A

607826	Aquatuff 25 LTR	Water based, alkaline cleaner
721520	HPCE 520 INOX, 3 x 440V/60HZ	N/A

2.4.3 Bilge cleaning

Pump the bilge dry as much as practicable. Then spray 10% dispersion of Cleanphase CB or Seaclean Plus in water on all contaminated surfaces. Allow 30-60 minutes for the cleaner to penetrate the deposits. Mechanical actions like brushing will help decreasing the required residence time. Agitate and wash down with a high-pressure jet preferably using hot fresh water.

If there are heavily contaminated surfaces that have difficult to remove deposits, spray Cleanphase CB or Seaclean Plus neat on these surfaces and allow to soak for 30-60 minutes before washing down with hot water using a high-pressure jet.

Note, Unitor Cleanphase CB is HOCNF & CEFAS approved, while Seaclan Plus does not carry such approvals.

Recommended products:		Application:
654715	SEACLEAN PLUS 25 LTR	Heavy Duty Degreaser
726050	UNITOR CLEANPHASE CB 25 LTR	Heavy Duty Degreaser

2.4.4 Oily-water separator

Internal surfaces where water scale, oil deposits, etc. are present, should be cleaned using Disclean. Prepare a 50% solution of Disclean, then soak the parts in the solution or circulate through for best effect. The ideal temperature for the solution would be 40 to 50°C. If the parts a soaked in the solution, leave the parts to soak for 8 hours. At last, rinse with fresh water.

Recommended products:		Application:
571687	Disclean 25 LTR	Oily & Inorganic Deposits

2.5 Accommodation Cleaning

With living and working areas in close proximity, it is important to clean the accommodation areas before stacking. In order to maintain a healthy environment free from dangerous bacteria, viruses, moulds and bugs, we recommend full clean down procedures are carried out in the accommodation areas.

2.5.1 Living quarters

To clean and deodorize soft surfaces like carpets and furniture, spray with Easyclean Soft Surface & Spot and brush. Humidify the area and leave it overnight. Vacuum up the residue when the treated area is dry.

For floor and hard surfaces, use a 0,5% solution of Easyclean Floor & Hard Surface. Wipe over the surface, remove excess water and leave it to air-dry.

The build up of deposits in Grease traps can create a nasty odour if left untreated. To avoid this, dilute 200g of Gamazyme 700 FN in 10 L of water (25°C). Leave the solution for 15 minutes (stirring periodically), and dose all grease traps.

Recommended products:		Application:
778849	Easyclean Soft Surface & Spot	Soft surf. & furniture cleaning
778843	Easyclean Floor & Hard Surface	Hard Surface cleaning
571711	Gamazyme 700 FN	Organic matter degradation
778844	Unitor Mixing Station 4 – 4	N/A

2.5.2 Galley

Clean heavy soiled areas with Easyclean Floor & Hard Surface prior to disinfection. Disinfect the galley, kitchen, pantry and provision areas with Easyclean Cleaning & Disinfection as a 1% solution. Clean the oven and grill with Easyclean Oven & Grill.

It is important to clean and degrease the kitchen exhaust ventilator to avoid ‘fat traps’, fire hazards and to remove microbal contamination. The Easyclean Oven & Grill should be applied. Let the treatment soak well into the exhaust ventilator surface before rinsing it off.

Recommended products:		Application:
778843	Easyclean Floor & Hard Surface	Hard surface cleaning
778860	Easyclean Oven & Grill	Kitchen exhaust degreasing
778844	Unitor Mixing Station 4 – 4	N/A

2.5.3 Bathrooms

Toilets, shower areas, lockers and changing rooms must be kept particularly clean and odour free to maintain a safe working and living environment. Dilute the Easyclean Basin & Toilet Bowl chemical to a 1% cleaning solution. Spray the solution on the surfaces and clean.

Odours come up through the sinks and drains from the organic soil lying in the sanitary pipe work. Surfaces in bathrooms become contaminated by body fats and soap residues and require thorough cleaning. A liquid solution should be prepared by mixing of 0.5 kg of Gamazyme 700FN in 15 litres (35°C) of fresh water. Stir and if possible, leave for 15 minutes to reactivate the bacteria. Whilst constantly agitating the solution, 1 litre should be dosed into sinks, scuppers, showers, drains, waste disposal units. Harsh toxic cleaners (acids, caustics, disinfectants) should not be used as these will kill off the bacterial action in the pipes.

Recommended products:		Application:
778851	EASYCLEAN BASIN & TOILET BOWL	Toilets, shower areas, etc clean.
571711	Gamazyme 700 FN	Organic matter degradation
778844	Unitor Mixing Station 4 – 4	N/A

3. Preservation

3.1 Hull & Anchor Chain Solution for Preservation

Corrosion to hull and pontoons during stacking is a common challenge, especially when cold stacking. Another common issue is anchor kinking if the unit does not have multiple anchor points. The latter occurs due to wind and water currents causing the structure to rotate, thereby twisting the anchor chains. Note, the services as presented in section 3.1 is provided by our sister company, Wilhelmsen Ship Management.

3.1.1 Hull preservation

To protect the hull/pontoons against corrosion, galvanic anodes are installed with a wire network around the structure. The galvanic anodes are made from a metal alloy with a more "active" voltage (more negative reduction potential / more positive electrochemical potential) than the metal of the structure. The difference in potential between the two metals means that the galvanic anode corrodes, so that the anode material is consumed in preference to the metal of the structure itself. Hence, natural oxidation reactions on the hull/pontoons is prevented by transferring them to the galvanic anode, which will be sacrificed in favour of the structure under protection.

The method as described above is widely used in shipyards for new-builds as well as larger upgrade projects. The method is also recommended during stacking and especially for ‘cold stacking’. Taking a proactive approach to the challenges of hull and pontoon corrosion will support a hassle free, timely and cost effective re-activation.

3.1.2 Anchor chain preservation

With respect to the kinking issue, WSS can offer a swivel for the anchor chain. Installing the swivel is easy and hassle-free. It protects the anchor chain from twisting from the effects of wind and water current changes. Note though that a multi point anchoring (mooring) system will prevent kinking without the need for installing swivels.

3.2 Sealing & Dehumidification/Heaters for Preservation

Humidity is a risk for stacked units. Corrosion and moisture damage can be costly and cause serious delays when the time comes to re-activate. The same is the case when stacking the unit in adverse temperature conditions. Note, the services as presented in section 3.2 is provided by our sister company, Wilhelmsen Ship Management.

3.2.1 Sealing and de-humidification

From past experience, we know that stacking with proper de-humidification equipment and seals helps to preserve the asstes' integrity. Effective sealing of areas such as living quarters, below deck machinery spaces, compressor rooms etc. should be initiated at the earliest opportunity. Following this, de-humidifiers should be installed to reduced corrosion and protect machinery and electrical equipment.

Humidity poses a severe risk for stacked offshore units. Iron begins to significantly corrode at 60% relative humidity (RH) and above. The best results in preserving below deck equipment and machinery spaces are achieved at 35% to 45% RH. This prevents sweating/humidity corrosion damage. Holding a relative humidity of 40% to 75% will preserve the integrity of seals and gaskets. Based on the above, a relative humidity around 45% is typically the recommended limit.

De-humidifying machinery areas below deck is an obvious necessary task. However, it is also recommended to de-humidify living quarters if the unit will remain uninhabited during stacking. De-humidifying the living quarters prevents moulds and mildew from growing in the closed quarters, the bedding stays nice and dry and the overhead ducting and structure does not rust

3.2.2 Heaters

Cool climates and temperature fluctuations will also affect the asset's integrity adversely. Temperature control of vital machinery, process and utility rooms is vital as fluctuations and especially sub-zero temperatures can compromise the integrity of machinery and electrical equipment.

In line with DNV-GL guidelines, the temperature in engine and boiler rooms should be maintained about 3°C above the outside temperature and never below 0°C. Electrical equipment should also be maintained with a temperature a few degrees above surrounding atmosphere or in a dehumidified atmosphere (RH < 50%). Installing heaters will help protect the asset and sensitive equipment in line with the referenced and O.E.M. guidelines.

If no heaters are installed, it is advised that built-in heating elements in generators, motors etc. is maintained operational. Equipment not initially fitted with heaters should also be periodically put into service, so that it is heated sufficiently until any moisture is removed.

3.3 Water Treatment for System Preservation

All water-filled systems, whether this is with sea or fresh water will be subject to various risks of deterioration during an installation's dormant storage period and this should be taken as a high priority when stacking or laying-up.

The issues faced will typically be the 'normal' operational condition issues or more particularly related to long-term inactivity. Common challenges to be avare of concerning the different water filled systems are;

- Seawater : fouling (marine life), scale deposition, corrosion
- Fresh water : scale deposition, corrosion, bacterial contamination
- Potable water : scale deposition, corrosion, bacterial contamination

It should be clearly pointed out that if any system is to be considered to be 'in use' or 'in service' i.e. filled, on-line and used in the 'normal' mode of operation, even for reduced operations e.g. domestic water systems are to remain in use for 'skeleton' crew to use, these should necessarily be considered, for operational purposes, to be treated as being run in their full service mode. This may also include, for example, engine cooling jackets which will be serving standby generators that will be called to service, even if only periodically.

The following sections provides a short summary of affected equipment, the pertinent issues and recommendations for protection. It is also critical to highlight that O.E.M. recommendations should ALWAYS be consulted prior to implementation of any lay-procedures. Hence, all recommendations made in this document should always be read in conjunction with O.E.M.'s guidelines, which should always be strictly adhered to.

3.3.1 Boiler water treatment

Before preserving the boiler, an inspection must be performed. This to identify the presence of hydrocarbons, sludge/dirt or sevre corrosion or mineral scale deposition. If such substances are present, cleaning is required before proceeding with the preservation. Please see section 2.3.2 where this process and applicable chemicals are recommended.

It is important to take extra measures to protect boilers from corrosion when they are taken offline for short or long-term periods. When a boiler is off-line, rapid corrosion attack will occur when air (OXYGEN) comes into contact with moist metal surfaces. There are two general approaches to prevent corrosion during periods of shutdown;

1. Drain the boiler down and keep all surfaces dry
2. "Water Wedge" the boiler to exclude all air and apply treatments to inhibit corrosion.

Whether to opt for method one (drain down and dry storage) or method two (water wedge and wet storage) depends on the expected duration of innactivity. Wet preservation is recommended for warm lay-up/stacking, while dry preservation is recommended for cold lay-up/stacking. Please see below for the three recommended approaches

A) For short-term lay-up/warm stacking (< 1-2 months), the recommended practice is to fill up the boiler with an excess level of Oxygen Scavenger Plus and adjust the pH to alkaline conditions. The procedure cannot be used if exposed to temperatures below the freezing point. Control weekly DEHA Residuals: 100 – 200 ppm and pH: 9,5 – 10,5.

B) For long-term lay-up/cold stacking (> 1-2 months), the recommended pratice is as follows; 30 minutes before the boiler is to come off-line, dose addition of a nitrite based corrosion inhibitor, such as the Engine Water Treatment 9-108. If the system is likely to be exposed to freezing conditions, sufficient quantities of glycol must be added according to ambient conditions. Control Monthly Nitrite Residuals: 2000 – 3000 ppm and pH: 9,5 – 10,5.

C) For cold stacking the following dry preservation approach is recommended; after the boiler has cooled it should be drained completely, ensuring water is removed from all low spots.The internal surfaces of the boiler should be thoroughly dried using warm air circulation. Trays of silica gel (or 'quick lime') should be placed in the boiler drum and headers to 'mop-up' any moisture. As a rule of thumb, allow 5 kg silica gel per tonne/hr steaming capacity. Alternatively, a vapour phase inhibitor (neutralising amines) may be used. Seal the boiler carefully, blanking off all openings through which air or steam might enter. Inspect the moisture absorbent every 8 weeks and replace as required.

Recommended products:		Application:
698712	Oxygen Scavenger Plus 25 LTR	Corrosion Inhibitor (DEHA based)
698720	Autotreat - 25 LTR	Multifunctional Treatment
777703	Engine Water Treatment 9-108 25 LTR	Corrosion Inhibitor (Nitrite based)
739482	Spectrapak 315	pH, P-Alk and Chloride test kit
698746	Spectrapak 313	DEHA test kit
739466	Spectrapak 309	Nitrite, pH and Chloride test kit

3.3.2 Engine cooling water treatment

The principal risk for cooling jackets treated with fresh water is corrosion. Whatever standard corrosion inhibition treatment programme, it is advisable to 'overdose' and run at a higher inhibitor reserve when stacked. Typical 'best practice' suggests that high dosage (i.e. 25 – 100% over 'normal' operational dosage rates) may be more effective in reducing corrosion rates and reduce frequency of monitoring by manual test when the engine is not running. Note however that O.E.M.'s guidelines should always be strictly adhered to.

Nalfleet 2000 and Engine Water Treatment 9-108 represent our reccomended treatments. Both chemicals are nitrite based with corrosion inhibitors. Engine Water Treatment 9-108 is mainly used in larger systems with no aluminium components, while Nalfleet 2000 has silicate added – making it the preferred choice for systems containing aluminium. Within the offshore industry, Nalfleet 2000 is the most frequently used treatment. This treatment combines film- forming multi-metal corrosion inhibitors with a scale suppressant in liquid form. It protects all common metals in cooling systems from

corrosive attack and cavitation erosion. At the same time it is compatible with anti-freeze solutions and minimizes sludge and scale deposits.

If an all-organic based and biodegradeable inhibitor is required, we recommend Cooltreat AL. This chemical is an organic liquid corrosion inhibitor with extended life for use in closed cooling water systems. The product offers protection for all commonly used materials in engine cooling water systems, including and especially aluminium. Unlike other coolants, Cooltreat AL does not contain components subject to rapid depletion i.e. Nitrite and Silicate. Based on aliphatic acid technology Cooltreat AL is stable and hence the test frequency can be reduced.

Note also that if the egine cooling water systems has been topped-up with shore water, while nitrite-based corrosion inhibitors are in use, a suitable biocide such as MAR71 is recommended to be dosed for preventing growth of nitrite-metabolising bacterial species. These bacteria use the inhibitor as a nutrient and will render the system unprotected. One thus risks a severe corrosive attack if this is not treated.

Recommendeded products:		Application:
777703	Engine Water Treatment 9-108 25 LTR	Corrosion Inhibitor (Nitrite based)
777710	Nalfleet 2000 25 LTR	Corrosion Inhibitor (Nitrite based)
680843	CooltreatT AL 25 LTR	Corrosion Inhibitor (Organic)
735977	MAR-71 Biocide 3X5L (NOT IN USA&CAN)	Biocide
661991	Spectrus NX 1100 25 LTR (only for USA and Canada)	Biocide
568568	Bacteria Count Test (10 PCS)	Bacteria Test Kit
739466	Spectrapak 309	Nitrite, pH and Chloride test kit

3.3.3 Ballast water treatment

If systems are to remain filled with ballast throughout the storage period, risk of corrosion is the principal issue. For this we recommend Ballast Tank inhibitor 9-933. This chemical is a liquid film-forming corrosion inhibitor for use in ballast tanks, bilges and voids where the system is filled with sea-water. Ballast Tank inhibitor 9-933 is a blend of organic and inorganic inhibitors and contains no chromates making it completely soluble in seawater. The product come highly recommended for ballast and other tank protection during lay-up/stacking.

If the ballast water is severely contaminated, causing sediments of mud and silt to form in pipelines and tanks, it is recommended to remove these deposits before applying Ballast Tank inhibitor 9-933. Regardless of application point, the Ballast Tank inhibitor 9-933 represents a a strong corrosion inhibitor, but will not protect against buildup of sediments which can cause a breeding ground for micro and macro organisms. To tackle this challenge it is recommended to apply WSS Mud & Silt Remover. This chemical is a liquid organic polyelectrolyte that is formulated to keep mud and silt in suspension and help clean fouled systems. It removes silt and mud from ballast tanks by attracting particles together and making them more fluid in suspension thus preventing build-up of hard packed layers in tanks. Note that Ballast Tank Inhibitor cannot protect metal surfaces which are covered in silt or mud.

The recommended approach is thus to apply the Mud & Silt Remover, discharge the ballast and refill the system with clean water. Nalfleet Ballast Tank inhibitor 9-933 is then applied, and in some cases, a biocide may be required to prevent bacteriological proliferation. The latter will depend on whether sea water or fresh water is used and whether the water ultimately will be discharged to sea. Our recommended biocide is MAR-71. If discharge will be to the sea then Antifoulant Biocide such as Bioguard Plus should be used instead.

MAR-71 combat microbiological growth in ballast water and closed cooliong water systems. Bacteria are the cause of many corrosion problems, as while they grow, they produce a variety of acids and in some cases slimy layers on metal surfaces. Adding MAR-71 to the new ballast water in conjuction with the Nalfleet Ballast Tank inhibitor 9-933 could thus be an advantage for maximum protection.

Recommended products:		Application:
777013	Ballast Tank inhibitor 9-933	Corrosion Inhibitor
635326	Mud & Silt Remover	Mud and solids removal
735977	MAR-71	Biocide
661991	Spectrus NX 1100 25 LTR (for USA and Canada only)	Biocide
778918	Bioguard Plus	Antifoulant (as biocide)
Nalco 73551 (for USA and Canada only)		Antifoulant (as biocide)

3.3.4 Water production systems

For water destilliation systems such as “Reverse Osmosis” and “Evaporators” the approach to preservation is slightly different. While it for “Reverse Osmosis” systems and especially the membranes is recommended to do a “wet” preservation, the Eavporators can be drained and preserved “dry”.

3.3.4.1 Reverse osmosis

The most common challenge with R.O. systems and membranes are scaling and iron fouling due to salts in the feedwater. Scaling and iron fouling reduce system performance and leads to premature membrane replacement. To fight these challenges, our Ro Scale Control will protect the membrane while the Ro Bisulphite works as a de-chlorinating agent. The Ro Alkaline Cleaner and Ro Mild Acid Cleaner will both function as membrane cleaners.

When shutting down R.O. systems, it is recommended to preserve the membranes when the unit is out of production for more than 24 hours. Hence, a “wet” membrane preservation is recommended in accordance with O.E.M. gudelines. Failure to preserve membranes may result in the development of biofilm on the membrane surface. Below the most cirtical steps in preserving the membranes during shurt down is highlighted. Note, that we are here referring to methods applicabale for preserving R.O. and Nano-Filtration membranes and systems. (Polyamide, TFC, CPA membranes). For Cellulose Acetate and Polysulphone Ultrafiltration Membranes, please contact you WSS representative.

3.3.4.1.1 Pre R.O. shutdown - cleaning

Prior to shutdown, R.O. membranes need to be cleaned. The system MUST be reversed flushed with R.O. permeate before a potential cleaning solution and then preservation solutions is applied. In addition to the flushing, it is recommended that the system is run with our R.O .Alkaline Cleaner and R.O. Mild Acid Cleaner.

Our R.O. Alkaline Cleaner is a membrane cleaner developed to break down & remove biofilm, colloidal & organic material and support the cleaning of acid in soluble sulfates of calcium, barium and strontium as well as calcium fluoride. The R.O. Mild Acid Cleaner is a membrane cleaner specifically designed to remove iron fouling. It also is effective against light calcium carbonate scaling.

Recommend products:		Application:
777718	R.O. Alkaline Cleaner	Organic deposits cleaning
777715	R.O. Mild Acid Cleaner	Inorganic deposits cleaning

3.3.4.1.2 R.O. preservation – pH

For preservation we recommend to fill the entire system with a solution of 2.5 % R.O. Bisulphite for de-chlorination. When the element housings are filled with the above solution, close the appropriate valves to prevent air from entering into the system. It is recommended to measure the pH regularly. A fresh solution is needed when the pH < 3. A fresh solution is also needed when the liquid becomes turbid or changes colour. Regular inspections (weekly) are recommended.

Note, it has to be verified that the plastic materials (including pressure vessels) used in the membrane plant are resistant to sodium bisulphite. Otherwise cracks might occur in the plastic materials.

Recommend products:		Application:
777852	RO Bisulphite	Membrane preservation
778420	Checkit Comparator	Free Chlorine and pH analysis (kit)
778457	Checkit Test Cell	Free Chlorine and pH analysis (kit)
778422	Chekit pH Disc (6.5 to 8.4)	pH analysis (kit)
777936	Phenol Red Tablets (pH)	pH analysis (reagent)

3.3.4.1.3 RO preservation – pH and freeze protection

If freeze protection is required for long term shutdown of R.O. elements, a solution of 20% glycol and 2.5 % R,O, Bisulphite is recommended.

Recommend products:	Application:

909018	Monoethylene Glycol Regual Antifreeze	Freezing protection
777852	R.O. Bisulphite	Membrane preservation

3.3.4.2 Water destillation - evaporators

It is reccomended to drain down and dry store the evaporator. The heating and water supply should also be be cut off. Note, allways follow OEM procedures for shut down.

3.3.5 Potable water treatment

If the potable water tanks/systems will be out of service for extended periods, it is recommended to drain the system and dry store/preserve. Wet system “preservation” is not recommended if the system is not in use.

Conversly, if the system is required to be in service at any time, however occasionally, while the unit is out of operation, the potable water tanks/systems must be maintained to the relevant hygiene standards as if the installation is working under nomal operations. Due to the public health considerations, it is nessesary to adhere to local, regional and company-specific guidelines for potable water systems.

3.3.5.1 Potable Water Treatment

If the system is required to be operational while the unit is stacked, the main issues are bacteria, scale, corrosion and pH. WSS Sodium Hypochlorite is dosed to control and eliminate bacterial growth. This chemical holds approvals such as NSF, UK DWI and US EPA. In addition, polyphosphate can be added for scale and corrosion control in the system. More specifically, WSS Nalfleet Potable Water Stabiliser Liquid should be applied. Finally we recommend Hydrochloric Acid 33-35 % as a PH Increaser to regulate pH levels.

Recommended products:		Application
909001	Sodium Hypochlorite	Free Chlorine residuals (Liquid)
766402	Calcium Hypochlorite	Free Chlorine Residuals (Tablets)
777714	Potable Water Stabiliser	Corrosion Inhibitor

773408	Hydrochloric Acid 33-35 %	pH control (reduction)
766537	PH Increaser	pH control (increasing)
778420	Checkit Comparator (1 unit)	Free Chlorine and pH analysis (kit)
778457	Checkit Test Cell (2 units)	Free Chlorine and pH analysis (kit)
778421	Checkit Free Chlorine Disc (1 unit)	Free Chlorine analysis (kit)
777934	Chlorine DPD No. 1 Tablets (Free)	Free Chlorine analysis (reagent)
778422	Chekit pH Disc	pH analysis (kit)
777936	Phenol Red Tablets	pH analysis (reagent)

3.3.6 Seawater cooling systems

There are two options for storing this type of system, either, wet or dry. For wet preservation one can opt for two approches, fresh water preservation and sea water preservation. In the subsequent sections we will address these options:

- Fresh water preservation (wet preservation)
- Sea water preservation (wet preservation)
- Dry preservation

For wet preservation the systems are isolated, sea water drained and then flushed and filled with fresh water that is treated with an inhibitor. Engine Water Treatment 9-108 will give protection to all the metals found in the system, i.e. steel, copper, brass, solder. This nitrite based inhibitor will protect the sea water cooling system during stacking, and works well when fresh water is utilised for storage. Note, when recommissioning, flush the system with sea water before re-starting the system.

For sea water preservation, challanges releated to fouling need to be addressed. The two main problematic organisms are Mussels (Mytilus Edulis) and Barnacles (Balanus Balanoides). These organisms can be deterred using an Antifoulant such as Bioguard Plus. For corrosion protection, both Bioguard Plus can be reccomended. For both options, the sea chests should be blanked off, with the addition of Bioguard Plus to prevent marine growth fouling. Dose rate is 1 litre of Bioguard Plus per 10 tons of water prior to ballasting, followed by a monthly dose of 2 litres per 100 tons.

For dry preservation, the systems are blanked off and the system drained and dried. The only part that remains wet is the condenser which again should be treated with a suitable corrosion inhibitor.

Recommended products:		Application:
777703	Engine Water Treatment 9-108 25 LTR	Corrosion Inhibitor (Nitrite based)
778918	Bioguard Plus 25 LTR	Seawater dispersant

L83351.11U	Nalco 73551 (19 LTR) (US and Canada only)	Seawater dispersant
739466	Spectrapak 309	Nitrite, pH and Chloride test kit

3.3.7 Sewage systems and holding tanks

Liquids and solids in black & grey water systems should be removed from pipes, vacuum generators, holding tanks etc. prior to stacking. If not treated, these liquids and solids will harden and generate a potential problem when the system is put back to operation. Liquids in grey/black water systems may generate hydrogen-sulphide when oxygen is not present. Failure to clean and dry store/preserve these systems will thus reduce the long term operational efficiency of the equipment/system and pose a health and safety risk.

Note also that tank cleaning in general is handled in section 2.4. In this section, the focus here will be more specifically on sewage systems, tanks and the preservation phase, not the cleaning process.

3.3.7.1 Cleaning and preserving sewage (black water) pipework

Preserving black water pipes is best done by acid cleaning. This will dissolve water scale, uric stone/scale, rust etc. from the sewage pipes. The recommended chemical to apply is Metal Brite HD. Complete the treatment with a thorough cleaning with fresh water and 0.5% Alkalinity Control to remove traces of acids.

An alternative method to clean and preserve the pipes is to apply a high dosage of Gamazyme TDS, one sachet per toilet per day, in the two lasts months the unit is operative. This however requires more long term planning.

Recommended products:		Application
743146	Gamazyme TDS 5 KG Blue Sachet W/ Mint	Scale Removal
571679	Metal Brite HD 25 LTR	Scale Removal (Heavy duty)
571307	Alkalinity Control 25 LTR	pH Neutralization

3.3.7.2 Cleaning and preserving (grey water) pipework

Preserving grey water pipes (grey water, pulpers, drains from galley etc) is best done by using Gamazyme DPC, isolating the pipes and filling them with 1 solupac diluted in 10 L of hand hot water. Maintain solution inside pipes for 48 hours before draining. The treatment will leave the pipes clean and prevent bacteria gowth, foul smell and solidification of fat/oils and food waste.

In cases where extreme deposition has occurred it may be necessary to use Metabrite HD

571679	Metal Brite HD 25 LTR	Scale Removal (Heavy duty)

Recommended products:		Application
587055	Gamazyme DPC 4.0 KG	Drains and pipes cleaning

3.3.7.3 Holding tanks

Grey and black water holding tanks, sewage tanks, and the sewage treatment plant should be flooded and pumped empty to clear excess soil/sludge before cleaning. The tank should then be filled to 75% capacity with fresh or sea water. Mix approximately 0.5 kg of Gamazyme 700FN in 5 to 10 litres of fresh hand hot (35°C) water. Leave the mixture to stand for 10-15 minutes before dosing it into the tank. Dosing can be either direct in the tank or via the nearest toilet. The tank should then be filled up maximum level and left for at least 48 hours or more.

Note, holding tanks must be fitted with an air manifold connected to a low pressure air line of sufficient volume to gently turn the mass of water within the tank. In sewage treatment tanks the normal air supply will suffice.A continuous supply of air will increase the effect of the chemical treatment by creating an ideal environment for waste degradation.

The above treatment leaves the holding tanks clean and ready for dry preservation.

Recommended products:		Application:
571711	Gamazyme 700 FN 12 KG	Organic matter degradation

3.4 Fuel Oil System Preservation

Lighter fuels, like diesel oil, can easily be contaminated by microorganisms that lead to sludge formation,blockage, corrosion and filtering problems. The microorganisms also produce waste material that is corrosive to tank surfaces and fuel lines. Water is also a contaminant that can be found in heavy fuels and it is especially serious if the contaminating water is salt water, as this will lead to corrosion of tanks and fuel lines.

3.4.1 Microbiological activity in fuel tanks

Microorganisms can live and multiply in diesel fuels at the water/fuel interface. Just 0.01% of water is sufficient for microbial growth. The consequences of microbial growth are sludge formation and corrosion as a result of acidic by-products from the microorganisms. Dosing 800 mL / tonne of MDO/MGO with Unitor DieselPower MAR 71 will be sufficient to decontaminate fuels that are already contaminated. In order to avoid microbial growth in storage tanks, DieselPower MAR 71 should also be dosed as a preventative measure during stacking/lay-up (200 mL / Ton of MDO/MGO.

Recommended products:		Application:
571257	DieselPower MAR 71	Diesel Oil Biocide
661991	Spectrus NX 1100 (For US & Canada only)	Diesel Oil Biocide

764493	Unitor Bacteria Single	Bacteria Test Kit

3.4.2 Storage problems and sludge formation in fuel tanks

Most distillate fuels leave the refinery with a 6 month life before deterioration sets in Long term storage of distillate fuel and water content could cause problems with emulsions, sedimentation and oxidation. Oxidation of fuel can start a gum formation, aging reactions tend to cause sedimentation and colour change can happen through deterioration via UV light, air or temperature effects. WSS recommend to dose 35 mL /tonne of MDO/MGO of DieselPower Enhancer in order to avoid distillate fuel degradation.

Recommend products:		Application:
778785	DieselPower Enhancer	Diesel Oil Stabiliser

3.4.3 Storage in cold weather and paraffin crystallization

Considering lay-up areas with temperatures lower than -9°C, paraffin crystallization (waxing), forming deposits inside tanks will be an issue. To prevent this WSS recommend to dose 1 L / Ton of MDO/MGO of Unitor DieselPower CFPP.

Recommend products:		Application:
778405	DieselPower CFPP	Cold weather protection

3.5 Refrigeration & AC System Preservation

When a refrigeration system is to be switched off for longer periods, the recommended step by step process for lay-up is described below. The only equipment needed to perform the operation is the Refrigerant Recovery Package F/220v. See below for the shut down procedure;

Note however that the below is just a general description and that one should allways contact the manufacturer to verify the procedure or obtain the manufacturer's procedure.

1. Close the outlet valve (liquid refrigerant valve) at the bottom of the condenser. Run the system until all the refrigerant has been trapped in the condenser (the compressor will stop automatically on LP switch). Then close the compressor outlet valve.

2. Switch off the main power line to the system, and switch off / disconnect the oil heater in the crankcase (if present).

3. Close the valves for the cooling water in / out of the condenser. The condenser should be full of water to avoid corrosion during stand-still period.

Purging of piping: Purge with Nitrogen N-5030

Purge (and blanket) piping with Nitrogen

While the above described the shut down of the system, the following procedure is advised to be followied during start up.

1. Switch on the oil heater in the crank case 1 day prior to start up to ensure proper oil temperature.

2. Open water valves for the condenser in / out

3. Upon start-up the compressor will be empty of gas due to dry shaft seal. Open the discharge valve on the compressor. Open the liquid line valve for 5 seconds and close it again, start the compressor, and the oil will lubricate the shaft seal and make it leak tight in 10 – 30 seconds.

4. Open the liquid line valve fully and let the system run in normal automatic operation.

N.B. Failure to close the mentioned valves will allow for the complete refrigerant charge to escape during the lay-up period (after the shaft seal has dried out) This is damaging to the environment and costly of course and should be avoided at all costs. However a new complete charge can be ordered from WSS should this occur.

4. Re-Activation

4.1 Pre-Operation Cleaning

After a deactivation period, if the unit is in location or has been stacked in a marine environment salt layering and corrosion on deck, superstructure and elsewhere is inevitable. A pre-painting cleaning and surface preparation treatment preceeded by a general cleaning must be executed to remove salt residues, corrosion and potentail oil and grease present due to equipment maintenance/commissioning. For the required cleaning equipment needed for this work, please see section 2.1. For the recommended cleaning products, please see section 4.1.1 and 4.1.2 below.

4.1.1 General purpose cleaning

Before any kind of pre-painting surface treatment is done, salt layers must be removed to ensure an optimal result. Please see section 2.2.3 for reference on how to procedurally execute this work and the recommended products.

4.1.2 Rust removal, pre painting treatment and aluminium brightning

Please see section 2.2.3 for reference on how to procedurally execute this work and the recommended products.

4.1.3 Engine room cleaning

When cleaning engine room machinery, the most effective product to use will depend on the type and amount of soiling. The cleaning operation can also be conducted on external surfaces as well as internal equipment parts. For the recommended cleaning products, please see section 4.1.3.1 to 4.1.3.5 below.

4.1.3.1 Heavy duty degreasing

Please see section 2.3.1 for reference on how to procedurally execute this work and the recommended products.

4.1.3.2 Electrical components and motor cleaning

Please see section 2.3.3 for reference on how to procedurally execute this work and the recommended products.

4.1.3.3 Carbon deposits removal

Please see section 2.3.4 for reference on how to procedurally execute this work and the recommended products.

4.1.3.4 Air cooler cleaning

Please see section 2.3.5 for reference on how to procedurally execute this work and the recommended products.

4.1.3.5 Acid descaling of evaporators and sea water cooling systems

Please see section 2.3.6 for reference on how to procedurally execute this work and the recommended products.

4.2 Pre-Operation Testing & Initial Water Treatment

Before re-activating the vessel or rig, it is vital to carry out the necessary testing, initial water treatment and commissioning to make the unit ready for operation.

4.2.1 Boiler water treatment

4.2.1.1 Low and medium pressure boilers

As an initial treatment to remove scale, rust, oil and grease from low and medium pressure boilers, our Commissioning Cleaner should be circulated through the system at 5-10% concentration, for 5 to 8 hours at minimum of 60°C. Drain and flush system with fresh water until the effluent is clear. Then, re-inspect and start operational boiler water treatment in accordance with recommendations below.

Following commissioning and inspection, water treatment must be applied. It is recommended to fill the equipment up to operational level and add the initial dosage of Autotreat and Oxygen Scavenger Plus. A daily analytical routine must be followed. For more details, please refer to Offshore Cleaning & Chemicals Manual, section 9.5.

Test Kits to Boiler Analytical Routines: Spectrapak 315 and Spectrapak 313.

Recommended products:		Application:
624932	Commissioning Cleaner 25 LTR	Boiler pre-treatment
698720	Autotreat 25 LTR	Multifunctional treatment
698712	Oxygen Scavenger Plus 25 LTR	Oxygen scavenger (DEHA based)
698746	Spectrapak 313	DEHA Test Kit
739490	Spectrapak 315	pH, p-Alk and Chloride test kit

4.2.1.2 High pressure boilers

For all High Pressure systems, please contact product specialist for assistance.

4.2.2 Engine cooling water treatment

As an initial treatment to remove scale, rust, oil and grease from the engine cooling water system, WSS Commissioning Cleaner should be circulated through the system at 5-10% concentation, for 5 to 8 hours at a minimum 60°C ideally. Drain and flush system with fresh water until the effluent is clear. Then, re-inspect and start operational cooling water treatment in accordance with recommendations below following addition of an initial dose of the correct corrosion inhibitor.

Following commissioning and inspection an analysis of Cooling Water Treatment Control Parameters, observing the appearance of the sample and checking for bacterial contamination (using Bacteria Count Test) should be execute. In case of confirmation of bacterial contamination, systems should be treated using Mar-71 Biocide or Spectrus NX 1100.. According to results, a supplementary dosage of corrosion inhibitor may be applicable (Nalfleet 2000 or Engine Water Treatment 9-108). For reference and more information on this procedure, please see the Offshore Cleaning & Chemicals Manual, section 10.2.

Recommended products:		Application
624932	Commissioning Cleaner 25 LTR	Cooling System pre-treatment
777710	Nalfleet 2000 25 LTR	Corrosion Inhibitor (Nitrite based)
777703	Engine Water Treatment 9-108 25 LTR	Corrosion Inhibitor (Nitrite based)
680843	Cooltreat AL	Corrosion Inhibitor (all organic)
735977	Mar-71 Biocide 3X5L Not in USA& Can	Biocide
661991	Spectrus NX 1100 25 LTR *(for USA and Canada only)*	Biocide
739466	Spectrapak 309	Nitrite, pH and Chloride test kit
568568	Bacteria Count Test (10 PCS)	Bacteria test kit

4.2.3 Ballast water treatment

After a period of preservation whilst in warm of cold stack,it is recommended to inspect ballast tanks in order to check the integrity of coating and sludge formation inside tanks. If sludge is identified, please refer to section 3.3.3 for Mud & Silt Remover and Nalfleet Balast Tank Inhibitor 9-333 aplications.

Recommended products:		Application
777013	Ballast Tank inhibitor 9-933	Corrision Inhibitor
635326	Mud & Silt Remover	Mud and solids removal

4.2.4 Water production system

4.2.4.1 Reverse osmosis

When returning the system to operational mode, flush it at low pressure for at least 90 minutes prior to returning the membrane system to service. This is to remove any fluid that has permeated the membrane during the preservation process. When reverse osmosis system is operational, the anti-scale dosage (RO Scale Control) must always be correctly dosed through the chemical metering dosing pump.

Recommended products:		Application:
777716	RO Scale Control 25 LTR	Anti-scale treatment

4.2.4.2 Water distillation - evaporators

Before returning to operation, inspection of the evaporator plates or tubes is required to identify potential corrosion (flash rust). If present, please go to section 2.3.5 for the applicable procedure for clean up. As soon as the equipment is in operation, Vaptreat must be applied to the system, through flowmeter or dosing pump.

Recommended products:		Application:
571364	Vaptreat 25 LTR	Anti-scale treatment

4.2.5 Potable water

Before the potable water tanks are returned to normal operation, an inspection must be carried out to identify presence of sludge, corrosion products or cracks in the coating. After inspection and/or applicable maintenance, proceed with cleaning and disinfection of tank. See below for procedures.

Top up the tank and isolate the system, storage tank and all outlets. Add chlorinating agents until the measurement level of free chlorine in the tank is > 50 ppm. Leave the solution to work for 2 hours. Drain down through all outlets and flush with fresh water until free chlorine is < 1 ppm in the tank and outlets. Maintain routine monitoring programme.

Recommended products		Application
909001	Sodium Hypochlorite	Free Chlorine residuals (Liquid)
766402	Calcium Hypochlorite	Free Chlorine Residuals (Tablets)
777714	Potable Water Stabiliser	Corrosion Inhibitor
773408	Hydrochloric Acid 33-35 %	pH control (reduction)
766537	PH Increaser	pH control (increasing)
778419	Potable Water Test Kit	Bacteria Analysis
778420	Checkit Comparator (1 unit)	Free Chlorine and pH analysis (kit)
778457	Checkit Test Cell (2 units)	Free Chlorine and pH analysis (kit)
778421	Checkit Free Chlorine Disc (1 unit)	Free Chlorine analysis (kit)
777934	Chlorine DPD No. 1 Tablets (Free)	Free Chlorine analysis (reagent)

778422	Chekit pH Disc	pH analysis (reagent)
777936	Phenol Red Tablets	pH analysis (reagent)

4.2.6 Seawater cooling system

For dry preservation, remove the blankets from system and initiate water circulation. For wet preservation, drain preservation solution and initiate water circulation. In both cases initiate antifoulant dosages with Bioguard Plus or Nalco 73551, if chemical dosing is used.

Recommended products:		Application:
778918	Bioguard Plus 25 LTR	Seawater dispersant
L83351.11U	Nalco 73551 (19 LTR) *US and Canada only*	Seawater dispersant

4.2.7 Sewage systems and holding tanks

To re-activate the plant, 1 kg Gamazyme 700 FN should be mixed with 10 – 15 L of hand hot (35°C) fresh water. Stir the solution periodically for 10-15 minutes to stimulate bacteria activation, before dosing into the tank daily until system is operating efficiently. Then, change to a weekly maintenance dosage: 0,1 kg diluted in warm water.

Recommended products:		Application:
571711	Gamazyme 700 FN	Organic matter degradation

4.3 Pre-Operation Testing & Initial Fuel Oil Treatment

Before reactivating the vessel or rig, it is vital to carry out the necessary testing, initial fuel oil treatment and commissioning to make the unit ready for operation. The most common issues for distillate fuels post stacking are covered below, for reference about dosage, please refer section 3.4.

4.3.1 Distillate fuel oil testing and treatment

There are two main problems that can happen with distillate fuels, water and oxygen. When a distillate fuel is stored the main risk is that oxygen reacts with components of the fuel. Over time, this will change the color of the fuel but also create insoluble and non-combustible material. The color change is an indication that the fuel is changing and deteriorating. In this situation, the insolubles are the result of the degradation. Insolubles are small particles that will cause deposits as well as gum and wax formation. There is no easy way to test for this issue unless a sample is sent to a lab for oxidation stability testing. However, if the fuel is suspected to be unstable further deterioration can be hindered if the correct product is added. WSS Unitor DieselPower Enhancer contains antioxidants that will stop any further deterioration. However, if the fuel is determined to be in such poor condition that it is unuseable, it should be disposed of to a suitable reception facility, tanks cleaned and then refilled with fresh fuel before using in any engines on board.

The presence of water is also an issue when storing distillate fuels. If water is found (and there will almost certainly be some present – especially if the unit has been laid-up in a warm and humid location) it is very important to drain off all the water - including the hazy layer between the water and the clean fuel. It is in the hazy layer the microbes like to live and feed. Hence, during stacking or pre-operation it is very important to drain the water from the fuel tanks. In addition, the water content should be tested using the Unitor Water in Oil test kit to determine the level of contamination. To chemically support the removal of water, WSS Unitor FuelPower Demulsifier should also be added for treatment.

The most common problem with storing distillate fuel is microbiological contamination. Prior to operation of any machinery using stored fuel it is important to test for presence of microbes, even if a biocide has been used during stacking. If microbes are found, WSS Unitor DieselPower MAR 71 should be added to remove the microbes. The dosage should be adjusted according to the test results, but one should be aware that 'shock' dosing is commonly required if the fuel has been left untreated for an extended period. If the contamination is substantial, it may be necessary to remove and disinfect the fuel and the entire fuel system. Clearly this, takes time and adds significant costs including environmentally correct disposal. in the worst case, the fuel might be beyond treatment. The above is why it is recommended to test the fuel regularly during storage to be able to indetify microbial contaminations early and incresase treatment as necessary.

To test for microbes use the Unitor Bacteria Test Kit which indentifies diesel bug SPECIFIC contamination in 10-15 minutes. Sending a sample to a lab will take at least 48 hours - time which many might not be available in a hectic re-activation phase. With the Unitor Bacteria Test Kit one can test onboard with no extra equipment. This test is widely used in the aviation industry and is approved by IATA for testing Jet A1 AVTUR for commercial aviation. This test is far superior to generic dipslides for testing for 'diesel bug' and has the benefit of giving a very rapid result.

Recommended products:		Application:
773155	Unitor EasyShip Water in Oil test kit	Water in Oil analysis
778791	FuelPower Demulsifier	Improve water removal
777190	DieselPower Enhancer	Diesel Oil preservation
764493	Unitor Bacteria Test Kit	Bacteria test kit
571257	DieselPower MAR 71	Diesel Oil biocide

4.4 Pre-Operation Testing & Refrigeration/AC System Activation

The shut down procedure described in section 3.5 should be referred to in relation to re-start and the following procedure is advised during start up.

1. Switch on the oil heater in the crank case 1 day prior to start up to ensure proper oil temperature.

2. Open water valves for the condenser in / out

3. Upon start-up the compressor will be empty of gas due to dry shaft seal. Open the discharge valve on the compressor. Open the liquid line valve for 5 seconds and close it again, start the compressor, and the oil will lubricate the shaft seal and make it leak-tight in 10 – 30 seconds.

4. Open the liquid line valve fully and let the system run in normal automatic operation.

N.B. Failure to close the aforementioned valves will allow for the complete refrigerant charge to escape during the stand-still period (after the shaft seal has dried out).

This is damaging to the environment and costly of course and should be avoided at all costs. However a new complete charge can be ordered from WSS should this occur.

4.5 Pre-Operation Maintenance, Modifications & Hot Work

WSS offer a wide range of general maintenance and workshop tools, surface preperation tools,welding equipment and gases. See below for more details on the various products that will assist yourcrews during the reactivation process.

4.5.1 Workshop and surface preparation tools

At reactivation, various maintenance work is required for the vessel or rig to return to safe and compliant class standard. Be it for a workshop related task, mechanical maintenance or surface peparation operation – WSS can support you. Our range includes everything from electric and battery tools used in the workshop to hydraulic equipment, grinders, wrenches and hammers for superstructure maintenance and surface prepaeration. See below for selected product recommendations.

Recommended products:		Application:
779025	Battery Drill 10.8V	N/A
614005	Drill Set, HSS	N/A
722199	Impact Wrench IW PRO 1	N/A
762676	Low Vib. Pistol Needle Scaler	N/A
TBD	ATEX Certified Needle Scaler	N/A
728766	Needle 3mm x 180mm	N/A
762677	Chisel Tipped Needle 3mm x 180mm	N/A
756901	Angle Grinder	N/A
633515	Cutting Discs 100X2.5X16	N/A

4.5.2 Welding equipment and consumables

During reactivation, unexpected surface and structural repairs are often required. For this a high quality range of portable welding machines and electrodes developed specifically for the offshore marine environment is available from WSS. For offshore rigs and platforms, characterized by large tubular T-K-Y and complex node connections, we support with selected products, such as Portable Welding Machine UWI-150 TP and electrodes GPO-302 N, GPR-300H, LH 314, etc.

If hot operations are not possible/desirable, we can also offer a Polymer Kit. This repair kit is useful for sealing leaks in areas where welding or hotwork is not allowed or for emergency repairs requiring rapid response.

Recommended products:		Application:
150150	UWI-150TP	Portable welding machine
699165	GPO-302N 2.5 mm Mild Steel	Unalloyed steel general welding
699173	GPO-302N 3.2 mm Mild Steel	Unalloyed steel general welding
699249	GPR-300H 4 mm Mild Steel	Unalloyed steel large welds
699264	LH 314N 2.5 mm	Unalloyed & low alloyed steel
699272	LH 314N 3.2 mm	Unalloyed & low alloyed steel
699512	NIFE 3.2 mm Cast iron	Cast Iron welds
699405	18/8-213 2.5 mm Stainless Steel	SS AISI 304/316L welds
659300	Cold Repair System Kit-A	Emergency repair
TBD	Welding Electrode with high Tensile/Yield Strength	
TBD	Welding Electrode with high Tensile/Yield Strength	

4.5.3 Gas and cylinder transportation racks

WSS deliver a full range of compressed industrial gases, DNV 2.7-1 certified transportation racks for offshore lifting operations, supporting welding equipment and other accessories suitable for the offshore environment. A small selection of recommended products applicable for the re-activation phase is listed below and full a catalgoue is available on request.

Recommended products:		Application
772202	Cylinder Transport Rack Offshore DNV Approved	N/A
905026	Acetylene A-40 Filling	AC/OX weld ops.
905034	Oxygen A-40 Filling	AC/OX weld ops.
905174	Argon 50 ltr	Welding ops.
905695	CO” C-27	Welding ops.
905208	Nitrogen (99.9% purity)	Blanketing/Purging/Calibration
905618	Helium	Leakage Testing
620138	Hydrogen Sulphide/N2 25 Ppm (S 58)	Span Gas /Calibration
619965	Minimix 2.5% Methane-Air	Span Gas/Calibration
588996	Propane	Span Gas/Calibration
176024	Standard Acessories kit for Acetylene and Oxygen Cyl.	N/A
500000	UCT-500 Master Kit	N/A
778145	Cylinder Trolley A-40/O-40	Cylinder Transport

5. Appendices

5.1 TABLE OF PRODUCTS

Area	Application	Product	EDP	HOCNF Approved	CFAS Approved	Manual page
PRE-STACKING CLEANING						
Deck & Superstructure	General Purpose Cleaning	UNITOR CLEANRIG CHP 200 LTR	726040	✓	✓	#6
		MULTI CLEAN 25 LTR	777708			
	Heavy Duty Degreaser	UNITOR CLEANPHASE CB 25 LTR	726050	✓	✓	
	Rust removal, prepainting and aluminium brightining	METAL BRITE HD 25 LTR	571679	✓		
Engine Room Cleaning	Heavy Duty Degreaser and Boiler or Engine Degreasing	COLDWASH HD	571430			#7
		SEACLEAN PLUS 25 LTR	654715			
		UNICLEAN	726060	✓	✓	
		UNITOR CLEANPHASE CB 25 LTR	726050	✓	✓	
	Electrical components and motor cleaning	UNITOR ELECTROSOL PLUS 25 LTR	726065	✓	✓	#8
	Carbon deposits removal	CARBONCLEAN LT 25 LTR	575696			
	Air Cooler Cleaning	ACC PLUS 25 LTR	698704			
	Acid descaling of evaporators and sea water cooling systems	DESCALEX 25 KG	571646			
		SCALECLEAN DL	719088	✓	✓	
		SCALECLEAN EX 25 KG	719070	✓	✓	
Tank Cleaning	Sewage Tank	GAMAZYME 700 FN	571711			#9
	Fuel Tank Cleaning	AQUATUFF 25 LTR	607826			
	Bilge Cleaning	CLEANBREAK 25 LTR	571497			#10
		UNITOR CLEANPHASE CB 25 LTR	726050	✓	✓	

	Oily water separator	DISCLEAN 25 LTR	571687			
Accomodation Cleaning	Soft surfaces and furniture cleaning	EASYCLEAN SOFT SURFACE & SPOT	778849			#11
	Hard Surfaces cleaning	EASYCLEAN FLOOR & HARD SURFACE	778843			
	Grease trap cleaning	GAMAZYME 700 FN 12 KG	571711			
Galley	Heavy soiled areas cleaning	EASYCLEAN FLOOR & HARD SURFACE	778843			
	Degrease kitchen exhaust	EASYCLEAN OVEN & GRILL	778860			
Bathroom	Toilets, shower areas, locker and change room cleaning	EASYCLEAN BASIN & TOILET BOWL	778851			#12
	Sinks and drains cleaning	GAMAZYME 700 FN 12 KG	571711			
PRESERVATION						
Engine Room	Boiler Preservation	OXYGEN SCAVENGER PLUS 25 LTR	698712	✓		#14
		AUTOTREAT 25 LTR	698720			
		ENGINE WATER TREATMENT 9-108 25 LTR	777703	✓	✓	
	Engines Preservation	NALFLEET 2000 25 LTR	777710	✓	✓	#15
		COOLTREAT AL 25 LTR	680843			
		ENGINE WATER TREATMENT 9-108 25 LTR	777703	✓	✓	
		MAR-71 BIOCIDE 3X5L NOT IN USA&CAN	735977	✓	✓	
		SPECTRUS NX 1100 25 LTR (for USA and Canada only)	661991			
	Ballast water treatment	BALLAST TANK INHIBITOR 9-333 25 LTR	777013			#16
		MUD & SILT REMOVER 25 LTR	635326			
		MAR-71 BIOCIDE 3X5L NOT IN USA&CAN	735977	✓	✓	

		SPECTRUS NX 1100 25 LTR (for USA and Canada only)	661991			
		BIOGUARD PLUS 25 LTR	778918	✓	✓	
		NALCO 73551 (19 LTRS) US and Canada only	L83351.1 U			
	Reverse Osmosis Cleaning	RO ALKALINE CLEANER 25 LTR	777718			#18
		RO MILD ACID CLEANER 24 LTR	777715			
	Reverse Osmosis Preservation	RO BISULPHITE 25 LTR	777852			
		MONOETHYLENE GLYCOL ANTIFREEZE	909018			
	Evaporators	-	-			#19
	Potable Water Tanks	SODIUM HYPOCHLORITE POTABLE GRADE	909001			
		CALCIUM HYPOCHLORITE	766402			
		POTABLE WATER STABILIZER	777714			
		HYDROCHLORIC ACID 33-25%	773408			
		PH INCREASER	766537			
	Seawater Cooling System Preservation	ENGINE WATER TREATMENT 9-108 25 LTR	777703	✓	✓	#20
		BIOGUARD PLUS 25 LTR	778918	✓	✓	
		NALCO 73551 (19 LTRS) US and Canada only	L83351.1 U			
	Cleaning and Preserving black water pipes	GAMAZYME TDS 5 KG BLUE SACHET W/MINT	743146			
		METAL BRITE HD 25 LTR	571679	✓		
		ALKALINITY CONTROL 25 LTR	571307	✓		
	Cleaning and preserving grey water pipes	GAMAZYME DPC 4.0 KG	587055			#21
	Holding Tanks Cleaning and Preservation	GAMAZYME 700 FN 12 KG	571711			

Fuel Oil System	Microbiological Activity in fuel tanks	DIESELPOWER MAR 71 25 LTR	57125			#22
		SPECTRUS NX 1100 25 LTR (for USA and Canada only)	661991			
	Storage problems and sludge formation in fuel tanks	DIESELPOWER ENHANCER 25 LTR	778785			#23
	Storage in cold weathers	DIESELPOWER CFPP	778405			
Refrigeration and AC	System Preservation	-	-			
RE-ACTIVATION						
Deck & Superstructure	General Purpose Cleaning	UNITOR CLEANRIG CHP 200 LTR	726040	✓	✓	#24
		MULTI CLEAN 25 LTR	777708			
	Rust removal, prepainting and aluminium brightining	METAL BRITE HD 25 LTR	571679	✓		
Engine Room	Heavy duty degreasing	COLDWASH HD 25 LTR	571430			#25
		UNICLEAN	726060	✓	✓	
		UNITOR CLEANPHASE CB 25 LTR	726050	✓	✓	
	Electrical components and motor cleaning	UNITOR ELECTROSOL PLUS 25 LTR	726065	✓	✓	
	Carbon deposits removal	CARBONCLEAN LT 25 LTR	575696			
	Air Cooler Cleaning	ACC PLUS 25 LTR	698704			
	Acid descaling of evaporators and sea water cooling systems	DESCALEX 25 KG	571646			
		SCALECLEAN DL 25 LTR	719088	✓	✓	
		SCALECLEAN EX 25 KG	719070	✓	✓	
Initial Treatment & Testing	Cleaning & commissioning	COMMISSIONING CLEANER 25 LTR	624932			#26
	Boiler Water Treatment	AUTOTREAT 25 LTR	698720			
		OXYGEN SCAVENGER PLUS 25 LTR	698712	✓		
	High Pressure Boilers	-	-			

	Engine Cooling Water Treatment	NALFLEET 2000 25 LTR	777710	✓	✓	
		ENGINE WATER TREATMENT 9-108 25 LTR	777703	✓	✓	
		COOLTREAT AL 25 LTR	680843			
		MAR-71 BIOCIDE 3X5L NOT IN USA&CAN	735977	✓	✓	
		SPECTRUS NX 1100 25 LTR (for USA and Canada only)	661991			
Ballast Tank	Ballast water treatment	BALLAST TANK INHIBITOR 9-333 25 LTR	777013			#27
		MUD & SILT REMOVER 25 LTR	635326			
Water Production Systems	Reverse Osmosis	RO SCALE CONTROL 25 LTR	777716	✓		
	Evaporators	VAPTREAT 25 LTR	571364	✓		#28
Potable Water System	Potable Water Tanks Cleaning & Disinfection	SODIUM HYPOCHLORITE POTABLE GRADE	909001			
		CALCIUM HYPOCHLORITE	766402			
		POTABLE WATER STABILIZER	777714			
		HYDROCHLORIC ACID 33-25%	773408			
		PH INCREASER	766537			
Sewater Cooling System	Seawater Cooling System Treatment	BIOGUARD PLUS 25 LTR	778918	✓	✓	#29
		NALCO 73551 (19 LTRS) US and Canada only	L83351.1 U			
Sewage System & Holding Tank	Sewage Tank Treatment	GAMAZYME 700 FN 12 KG	571711			
Fuel Oil System	Distillate Fuel Treatment	FUELPOWER DEMULSIFIER 25 LTR	778791			
		DIESELPOWER ENHANCER 25 LTR	777190			
		DIESELPOWER MAR 71 25 LTR	571257			

Refrigeration and AC	System Re-Activation	-	-			#30
Maintenance, modifications and hot work	Workshop and surface preparations tools	BATTERY DRILL 10.8 V	779025			#31
		DRILL SET, HSS	614005			
		IMPACT WRENCH IW PRO 1	722199			
		LOW VIB. PISTOL NEEDLE SCALER	762676			
		NEEDLE 3MM X 180MM	728766			
		CHISEL TIPPED NEEDLE 3MM X 180MM	762677			
		ANGLE GRINDER	756901			
		CUTTING DISCS 100X2.5X16	633515			#32
	Welding equipment and consumables	UWI-150 TP	150150			
		GPO-302N 2.5MM MILD STEEL	699165			
		GPO-302N 3.2MM MILD STEEL	699173			
		GPR-300H 4MM MILD STEEL	699249			
		LH 314N 2.5MM	699264			
		LH 314N 3.2MM	699272			
		NIFE 3.2MM CAST IRON	699512			
		18/8-213 2.5MM STAINLESS STEEL	699405			
		COLD REPAIR SYSTEM KIT-A	659300			
		WELDING ELECTRODE WITH HIGH TENSILE/YIELD STRENGTH	TBD			
		WELDING ELECTRODE WITH HIGH TENSILE/YIELD STRENGTH	TBD			
	Gases and Cylinder Transportation Racks	CYLINDER TRANSPORT RACK OFFSHORE DNV APPROVED	772202			#33
		ACETYLENE A-40 FILLING	905026			

		OXYGEN A-40 FILLING	905034			
		ARGON 50 LTR	905174			
		CO” C-27	905695			
		NITROGEN (99.9% PURITY)	905208			
		HELIUM	905618			
		HYDROGEN SULPHIDE/N2 25 PPM (S 58)	620138			
		MINIMIX 2.5% METHANE-AIR	619965			
		PROPANE	588996			
		STANDARD ACESSORIES KIT FOR ACETYLENE AND OXYGEN CYLINDERS	176024			
		UCT-500 MASTER KIT	500000			
		CYLINDER TROLLEY A-40/O-40	778145			

5.2 TABLE OF TEST KITS

Area	Application	Product	EDP	Manual page
PRESERVATION				
Engine Room	Boiler Short Term Preservation - pH and P-Alkalinity Analysis	SPECTRAPAK 315	739482	#14
	Boiler Short Term Preservation - Boiler DEHA Residuals (Oxygen Scavenger)	SPECTRAPAK 313	698746	
	Boiler Long Term Preservation - Nitrite and pH analysis	SPECTRAPAK 309	739466	
	Engines Water Bacteria Test	BACTERIA COUNT TEST (10 PCS)	568568	#15
	Nitrite Residuals and pH Analysis	SPECTRAPAK 309	739466	
	Cooltreat AL Concentration and pH Analysis	TEST KIT FOR COOLTREAT AL	758904	
	Reverse Osmosis Preservation Solution pH Analysis	CHECKIT COMPARATOR	778420	#18
		CHECKIT TEST CELL	778457	
		CHECKIT PH DISC (6.5 TO 8.4)	778422	
		PHENOL RED TABLETS (PH)	777936	

	Potable Water Tanks pH and Chlorine Residuals	CHECKIT COMPARATOR	778420	#19
		CHECKIT TEST CELL	778457	
		CHECKIT FREE CHLORINE DISC (0 TO 4 ppm)	778421	
		CHLORINE DPD No. 1 TABLETS (FREE)	777934	
		CHECKIT PH DISC (6.5 TO 8.4)	778422	
		PHENOL RED TABLETS (PH)	777936	
	Seawater Cooling System Preservation - using EWT 9-108 (Nitrite and pH analysis)	SPECTRAPAK 309	739466	#20
Fuel Oil System	Microbiological Activity in fuel tanks	UNITOR BACTERIA SINGLE TEST KIT	764493	#22
RE-ACTIVATION				
Boiler Water Tretment	pH, P-Alkalinity and Chlorides Analysis	SPECTRAPAK 315	739490	#26
	Deha Residuals (Oxygen Scavenger) Analysis	SPECTRAPAK 313	698746	
Engine Cooling Water Treatment	NItrite Residuals, pH and Chloride Analysis	SPECTRAPAK 309	769466	
	Engine Water Bacteria Test	BACTERIA COUNT TEST (10 PCS)	568568	

Potable Water System	Potable Water Tanks Cleaning & Disinfection	CHECKIT COMPARATOR	778420	#28
		CHECKIT TEST CELL	778457	
		CHECKIT FREE CHLORINE DISC (0 TO 4 ppm)	778421	
		CHLORINE DPD No. 1 TABLETS (FREE)	777934	
		CHECKIT PH DISC (6.5 TO 8.4)	778422	
		PHENOL RED TABLETS (PH)	777936	
Lube & Fuel Oil System	Water in Oil Analsys	UNITOR EASYSHIP WATER IN OIL TEST KIT	773155	#29
	Microbiological Activity in fuel tanks	UNITOR BACTERIA SINGLE TEST KIT	764493	
	Water, viscosity, TBN, insolubles	UNITOR EASYSHIP COMBINED OIL TEST KIT	773154	
	Mettalic iron wear	UNITOR FERROUS WEAR METER TEST KIT	735754	