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ENVIRONMENTALLY SOUND AND SAFE REMOVAL OF HARMFUL ANTI-FOULING SYSTEMS AND OF CLEANING OF SHIPS' HULLS

SAFEMED Project Task 3.8 O

FINAL REPORT

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by

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GLOSSARY

AFS	Anti-Fouling Systems
Fresh water	Water with a salinity of less than 0.5 gram/litre
Groundwater	Sub-Soil water; water table at some depth under the soil surface
IMO	International Maritime Organization
MCPAs	Marine and Coastal Protected Areas
Marine Water	Water bodies with a salinity of more than 0.5 gram/litre; (subdivision: fully marine (salinity>3 g/l); brackish (salinity between 0.5 and 3 g/l)
	OT Organotins, class of highly toxic substances that contains the TBT, the predominantly used compound in AFS. OTs are no longer allowed to be present on ships under the AFS Convention (2001) and the EC Regulation on the prohibition of organotin compounds on ships (2003) as of 01 January 2008
Protective gear	Clothing and equipment that protects personnel from damage/injury. Includes: - Safety Helmets (BS EN 397:1995) - Safety Footwear (BS EN ISO 20345:2004 or 20347:2004) - Safety glasses (BS EN 166:2002) - Protective clothing (EU Directive on Personal Protective Clothing (PPE) 89/886/EC)
PSC	Port State Control
Salinity	Salt content
Surface water	Water bodies that are open to the atmosphere (applies to fresh water)
TBT	Tributyltin, the active compound of AFS
TSS	Total suspended solids; the amount of solid particles that are not deposited in the sediment
Treated water	Water that has been treated to remove AFS particles and AFS waste resulting from operation at the facility. Waste water is treated by employing the property to adhere to suspended particles by allowing the suspended solids to deposit with a resulting total suspended solids (TSS) content of not more than 100 mg/litre. When the treated water will be discharged in a sensitive (sea) area, such as a MCPA, the water may be further treated by filtering over a sand-bed filter to a TSS content of not more than 50 mg/litre.

1. INTRODUCTION

While the international mandatory process to ban Harmful Anti-Fouling Systems is exceeding the dates set by the IMO Anti-Fouling Systems Convention, awaiting world-wide implementation by the Entry into Force of the AFS Convention, certain regions have decided to adhere to the dates set in the AFS Convention. The European Union will have prohibited all use, presence or application of harmful anti-fouling systems on ships that use organotins (OT) from 1 January 2008. Following the EU decision, it is important to prevent transfer of the problems associated with the use of organotins to non EU countries. Ship yard maintenance and repair activities comprise a major route to organotin contamination of the marine environment. AFS removal at ship repair and maintenance facilities is been done on a slipway, a floor or in a dry dock.

Procedures for removal, handling, reception, transport, treatment and destruction or disposal of anti-fouling from ships can support prevention of such risk. Anti-fouling paint removal from ships in docks, on slipways, in ports or in other circumstances, can, when not well controlled, be a major contributor to the presence of tributyltin (TBT), the organotin that was predominantly used from the early 1970s in most anti-fouling systems.

2. HARMFUL ANTI-FOULING SYSTEMS, TRIBUTYLTIN (TBT) - HARMFUL EFFECTS.

Since the early 1970s the predominantly used anti-fouling systems were paints based on Tributyltin (TBT) as active ingredient. The paint was first used as a free-association paint with an uncontrolled leaching out rate of TBT. Later on TBT was applied in a self-polishing formulation, allowing for a controlled leaching rate of TBT into the environment. The self-polishing properties made TBT-based paints a reliable anti-fouling system, although the system needed additional booster biocides and copper as a hydrolysing agent to sustain the self-polishing properties. The paint worked well, although not all fouling was barred and ships that had a TBT-based paint for some years, needed cleaning of the hull, well before the end of the docking interval. The system was used throughout for sea-going ships, both on larger commercial ship and on small vessels and yachts. The paint was not cheap, and may have been less applied in poorer areas.

In the early 1980s oyster production dropped in the Bay of Arcachon (France, a yachting and shellfish aquaculture estuary), while the shells showed serious malformations. TBT from yachting proved to be at cause, to which France followed suit by banning the use of TBT-based anti-fouling systems for ships not larger than 25 meters (Alzieu et al., 1989).

Soon after, in the UK, TBT was found to cause sexual alterations in intertidal female snails (the gastropod species *Nucella lapillus*), resulting in decline of populations to the extent that they became locally extinct. The female snails developed male sexual parts (a phenomenon called ‘imposex’), eventually got their oviduct blocked, resulting in abortion of the eggs and death of the females. A clear dose-effect relationship with TBT exposure was shown for both the frequency and the severity of imposex as well as for the population decline. (Bryan et al., 1986, 1987; Gibs & Bryan, 1986; Gibbs et al., 1988, 1990). The UK responded to the findings by a ban of similar content as the French one; the US and the European Community followed suit and in 1990 the IMO adopted a recommendation to the same effect (Resolution MEPC 46(30)). It was assumed that by banning TBT from small vessels, the problem would be solved as the TBT concentrations of TBT brought by merchant shipping into the seas offshore were expected to be too low to cause harm. How wrong these expectations would later prove to be. Several other intertidal snail species proved to suffer imposex and related effects from exposure to TBT (Oehlmann et al, 1993).

Imposex proved to be just one of the sex-related effects of TBT; in female snails exposed to TBT testosterone levels (the male sexual hormone) increased significantly. A dose-effect relationship was proven between the levels of testosterone and TBT exposure time and

concentration (Spooner et al., 1991). These effects may be commonly occurring throughout the animal kingdom, although the initial findings of such effects have as yet to be further studied (Heidrich et al., 1999; Whalen et al., 1999**)**.

Apart from such endocrine effects, TBT causes many other effects on a neurology and immune system level and affects skin and other tissues. In the mid-1990s concerns about handling TBT lead German dockyard personnel to make a strong statement.

Tributyltin is a complex contaminant, which explains its highly toxic behaviour, resulting in serious effects, such as imposex and population decline at concentrations as low as 1 nanogramme per litre. As early as 1988 TBT was recognised as the most toxic compound ever entering the aquatic environment (Ward, 1988).

By its properties, TBT has a strong tendency to adhere to particles, both to suspended solids and to organism tissue, where it easily penetrates through the membranes to act toxic inside the organism. Allowing suspended solids, which are contaminated with TBT from TBT-contaminated waters, to deposit helps to catch the compound, although it will not remove all TBT from the fluid.

TBT is slow to degrade, in particular when deposited in the sediment and at lower temperatures; in sediments that are partly anoxic (which most underwater sediment beds of finer grain structure are), TBT can remain unaltered for decades (CEFAS, 2004). All surface sea water has a low-level background value of TBT contamination, that could only have entered the environment from shipping and related activities, such as disposal of contaminated harbour dredge spoil in open waters or in the sea. TBT has been found to occur in many different species of animals and plants throughout the world seas and has even been found in liver and tissue of sperm whales, a cetacean species that exclusively lives and feeds in the deep ocean (Ariese et al., 1998). Illegal use of OT continued, even in countries that had implemented Resolution MEPC 46(30) (Kettle, 2000). In shallow waters TBT can also volatilise into the air (Amoureaux et al., 2000) and has been found to precipitate with rain (Ariese et al. 1998).

While research and policy concentrated on the impact of TBT used by coastal small shipping on intertidal snails (ten Hallers-Tjabbes and Boon, 1995), research in the offshore North Sea showed that imposex was present in the sub-tidal gastropod snail, the whelk, *Buccinum undatum* L.. The incidence of imposex coincided significantly with the number of ships passing within 15 NM of the research locations. Moreover, research from the early 1970s (when TBT-based anti-fouling had only just become available on the shipping market) showed that female *B. undatum* then had no imposex at similar locations as sampled in 1991 and 1992 (ten Hallers-Tjabbes et al., 1994).

These findings, together with evidence that TBT was present in the vicinity of shipping routes, with increased concentrations in densely shipped areas led the North Sea countries to ask IMO to further regulate TBT. (Copenhagen Statement of Conclusions, 1993; Esbjerg Declaration, 1995). *B. undatum* had also seriously declined between around 1970 and the early 1990s in shipping areas and had disappeared completely in several densely shipped coastal areas. TBT was found to be partly at cause for decline, increased fisheries might have contributed as well to a general pattern of affecting the whelk populations (ten Hallers-Tjabbes et al., 1996). A clear and well-documented dose-effect relationship has been found between TBT exposure and development of masculinisation of juvenile female whelks (until four years of age), to an extent where all individuals where morphologically male and sexual tissue showed masculinised development (Mensink et al., 1996; 2002). At the turn of the century imposex incidence and levels of TBT and metabolites had continued to remain high in European shipping areas (IMO, 2001b; ten Hallers-Tjabbes et al., 2003a; Gomez Ariza et al., 2006). Due to the European (EU) implemented Directive (1989) to ban organotins from ships not larger than 25 meters, intertidal snails along the Portuguese coast had partly recovered from imposex between 1995 and 2000 **(**Santos et al, 2002).

In 1994 IMO responded to the North Sea countries by stating that the present regulations to restrict TBT were sufficient. In 1995 and 1996 research in South-East Asian waters showed that more than 20 offshore snail species suffered from high levels of imposex in the vicinity of shipping routes, while in areas with none or very little shipping imposex was absent or very low (Swennen et al., 1996, 1997). The findings were submitted as a document to MEPC 38 (IMO, 1998). Together with a second request from the North Sea countries, the mounting evidence that TBT was causing serious harm to the environment and to food resources, formed a lever for a decision to further regulate TBT by MEPC. In 1998 MEPC decided to develop a mandatory instrument (IMO, 1998), which resulted in the adoption of the Anti-Fouling Convention (IMO, October 2001a). The cooperation between science and policy in the process of developing policies for harmful AFS was further explored in an EU context (ten Hallers-Tjabbes et al., 2003b).

Health risks of AFS and associated waste

Compounds and wastes that are an environmental risk are also a risk for human health.
This holds in particular for organotin-based AFS (Snoeij et al., 1987; Fent 1996).
Skin contact with such systems or their waste bears a health risk as does inhaling AFS dust particles. Waste water and contaminated sediment also pose a health risk. Seafood has been found to accumulate organotins (Belfroid et al., 2000)

3. INTERNATIONAL LEGAL FRAMEWORK

3.1 International Framework: IMO Anti-Fouling Systems Convention

Following the findings of adverse impact of TBT from small ships in coastal areas the harmful environmental effects of organotin compounds were recognized by IMO in 1989. In 1990 IMO's Marine Environment Protection Committee (MEPC) adopted a resolution which recommended that Governments adopt measures to eliminate the use of anti-fouling paint containing TBT on non-aluminium hulled vessels of less than 25 metres in length and eliminate the use of anti-fouling paints with a leaching rate of more than four micrograms of TBT per day. Merchant shipping in offshore waters was not considered to be a risk of TBT contamination as the levels of TBT were assumed to be too low to cause harm.

First indications that TBT could cause impact in offshore seas, as communicated by the North Sea Countries, were not considered to need a change of policy (IMO, 1994).
Mounting evidence that TBT on merchant shipping was also an important contributor of TBT contamination in offshore seas, to the detriment of marine organisms and food resources, not only in Northern waters but also in South-East Asian seas led the IMO to reconsider its present anti-fouling policy and to decide that further regulation would be necessary (IMO, 1996).

In 1998 it had become clear that a mandatory instrument was needed to prevent further harm from organotins in anti-fouling systems. (IMO, 1998a).

In November 1999, IMO adopted an Assembly resolution that called on the MEPC to develop an instrument, legally binding throughout the world, to address the harmful effects of anti-fouling systems used on ships. The resolution called for a global prohibition on the application of organotin compounds which act as biocides in anti-fouling systems on ships by 1 January 2003, and a complete prohibition by 1 January 2008.

Consequently the IMO adopted the International Convention on the Control of Harmful Anti-Fouling Systems on Ships, 2001 (IMO, 2001a).

3.1.1 AFS Convention

The Anti-Fouling Systems Convention (AFS) has the objective to reduce or eliminate adverse effects on the marine environment and human health caused by anti-fouling systems and will prohibit the use of harmful organotins in anti-fouling paints used on ships and will establish a mechanism to prevent the potential future use of other harmful substances in anti-fouling systems.

Brief description
The Convention applies to all commercial ships (Article 3) and prohibits the application and consequently the use of organotins, the harmful anti-fouling system as identified in the Convention Annex I (Controls on anti-fouling systems) (Article 4).

Annex I states on organotin (OT) compounds which act as biocides in anti-fouling systems:

1. Ships shall no longer apply or re-apply such compounds - as of 1 January 2003;
2. (1) Ships shall no longer bear such compounds - as of 1 January 2008;
2. (2) Ships shall bear a coating that bars such compounds to leach from the underlying non-compliant anti-fouling systems - as of 1 January 2008.

The AFS Convention states that waste materials resulting from application or removal of an anti-fouling system controlled in Annex I should be collected, handled, treated and disposed of in a safe and environmentally sound manner to protect human health and the environment (Article 5).

The Convention provides for regulating survey and certification (Article 10), Inspection of ships (Article 11), Communication and exchange of information (article 9).
Entry into Force conditions (Article 18) are at present not yet met.

Entry into force: The convention will enter into force 12 months after 25 States representing 25% of the world's merchant shipping tonnage have ratified it.

As of 31 July 2007, the Convention was ratified by 24 Contracting States, comprising 16.63% of the world tonnage.

Provisions of the AFS Convention
Under the terms of the AFS Convention, Parties to the Convention are required to prohibit and/or restrict the use of harmful anti-fouling systems on ships flying their flag, as well as ships not entitled to fly their flag but which operate under their authority and all ships that enter a port, shipyard or offshore terminal of a Party.

- Ships of 400 gross tonnage and above engaged in international voyages will be required to undergo an initial survey before the ship is put into service or before the International Anti-fouling System Certificate is issued for the first time; and a survey when the anti-fouling systems are changed or replaced.

- Ships of 24 metres or more in length but less than 400 gross tonnage engaged in international voyages will have to carry a Declaration on Anti-fouling Systems signed by the owner or authorized agent. The Declaration should be accompanied by appropriate documentation such as a paint receipt or contractor invoice.

Anti-fouling systems to be prohibited or controlled are listed in Annex 1, which will be updated as and when necessary. Annex I states that as of 1 January 2003, all ships shall not apply or re-apply organotins compounds which act as biocides in anti-fouling systems. Given that this date has already passed, IMO has been urging States to ratify the convention as soon as possible in order to achieve entry into force conditions. In

November 2001, the IMO Assembly adopted Resolution A.928(22) *Resolution on early and effective application of the international convention on the control of harmful anti-fouling systems on ships.* If the Convention has not entered into force on 1 January 2003, then the effect of the 1 January 2003 date is suspended until the entry into force date. Before the entry into force of the convention, port States cannot apply any requirements of the convention to foreign ships calling into their ports. Flag States may apply the requirements of the convention to their national fleet, but they may not expect the International Certificates to be recognized as effective until the date of entry into force.

By 1 January 2008 (effective date), ships either:

(a) shall not bear such compounds on their hulls or external parts or surfaces; or

(b) shall bear a coating that forms a barrier to such compounds leaching from the underlying non-compliant anti-fouling systems.

This applies to all that have been constructed prior to 1 January 2003 and that have not been in dry-dock on or after 1 January 2003. The Convention includes a clause to entitle a ship to compensation if it is unduly detained or delayed while undergoing inspection for possible violations of the Convention (Art.12). The Convention provides for the establishment of a technical group with relevant expertise, to review proposals for other substances used in anti-fouling systems to be prohibited or restricted. Article 6 sets out how to evaluate an anti-fouling system.

3.1.2 Four Resolutions adopted at the International AFS Conference

Resolution 1 Early and Effective Application of the Convention – invites Member States of the Organization to do their utmost to prepare for implementing the Convention and urges the relevant industries to refrain from marketing, sale and application of the AFS controlled by the Convention.

Resolution 2 Future work of the Organization pertaining to the Convention – invites IMO to develop guidelines for brief sampling of anti-fouling systems, for inspection of ships; and for surveys of ships. The guidelines should ensure global and uniform application of the articles of the Convention which require sampling, inspection and surveys.

Resolution 3 Approval and Test Methodologies for Anti-Fouling Systems on Ships - invites States to approve, register or license anti-fouling systems applied in their territories. It also urges States to continue the work, in appropriate international forums, for the harmonisation of test methods and performance standards for anti-fouling systems containing biocides.

Resolution 4 Promotion of Technical Co-operation – requests IMO Member States, in co-operation with IMO, other interested States, competent international or regional organizations and industry programmes, to promote and provide directly, or through IMO, support to States in particular developing States that request technical assistance for:

(a) the assessment of the implications of ratifying, accepting, approving, or acceding to and complying with the Convention;

(b) the development of national legislation to give effect to the Convention; and

(c) the introduction of other measures, including the training of personnel, for the effective implementation and enforcement of the Convention.

and requests Member States, to promote co-operation for scientific and technical research on the effects of anti-fouling systems and effects monitoring.

3.1.3 Three guidelines for uniform interpretation of the AFS Convention according to Resolution 2 to the AFS Convention have since been adopted:

- Guidelines for survey and certification of anti-fouling systems on ships - adopted by resolution MEPC.102(48) (IMO, 2002);
- Guidelines for brief sampling of anti-fouling systems on ships - adopted by resolution MEPC.104(49) (IMO, 2003a); and
- Guidelines for inspection of anti-fouling systems on ships - adopted by resolution MEPC.105(49) (IMO, 2003b).

- Guidelines for the Survey and Certification of anti-fouling systems on ships refer to the issuance of an International Anti-Fouling Certificate after initial survey of a ship (3.1). Whenever an anti-fouling system is changed or replaced a survey should be carried out (3.3). Repairs affecting 25 % or more of the anti-fouling system are considered as a change or replacement. Requests for survey require documentation on the anti-fouling system used, including the active ingredient. Survey should certify that the anti-fouling system present is consistent with the AFS certificate. The same holds for a sealer coat, if that has been applied.

- Guidelines for Brief Sampling of anti-fouling systems on ships refer to sampling to support the effectiveness of survey and inspection and to verify compliance with the provisions of the Convention.

- Guidelines for Inspection of anti-fouling systems on ships refer to Port State control inspections of anti-fouling systems on ships. Ships flying the flag of a party to the Convention are obliged to carry an international certificate or declaration on anti-fouling systems (IAFS) for inspection. If a ship belongs to a non-party PSC inspection should look for other documentation about the anti-fouling system on the ship. If the IAFS certificate is not properly completed, inspection should seek further information on the anti-fouling system, including re-application, removal and related circumstances.

3.2 International Conventions:

3.2.1 Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal

The Basel Convention is the most comprehensive global environmental agreement on hazardous and other wastes. It has over 160 Parties and aims to protect human health and the environment against the adverse effects resulting from the generation, management, transboundary movements and disposal of hazardous and other wastes. It came into force in 1992. The Convention has two pillars; it regulates the transboundary movements of hazardous and other wastes and it obliges its Parties to ensure that such wastes are managed and disposed of in an environmentally sound manner (ESM).

Parties are expected to minimise the quantities that are moved across borders, to treat and dispose of wastes as close as possible to their place of generation and to prevent or minimise the generation of wastes at source. Strong controls have to be applied from the generation of a hazardous waste to its storage, transport, treatment, reuse, recycling, recovery and final disposal. The Convention covers toxic, poisonous, explosive, corrosive, flammable, ecotoxic and infectious wastes. The Basel Convention is part of the United Nations Environment Programme (UNEP) and entered into force: 5 May 1992 (UNEP, 1992). UNEP published a concise guide to the Convention (UNEP, 2002).

3.2.2 London Convention 1972

Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter 1972 and 1996 Protocol Thereto (London Convention, 1972)
The “London Convention”, one of the first global conventions to protect the marine environment from human activities, in force since 1975, aims to promote the effective control of all sources of marine pollution and to prevent pollution of the sea by dumping of wastes and other matter.

In 1996, the "London Protocol" was agreed to further modernize the Convention and, eventually, replace it. Under the Protocol all dumping is prohibited, except for possibly acceptable wastes on the so-called "reverse list". The Protocol entered in to force on 24 March 2006 and is much more restrictive. The Protocol, intended to replace the 1972 Convention represents a major change on regulating the use of the sea as a depository for waste materials. The precautionary approach is introduced (in Article 3), requiring that appropriate preventative measures are taken when there is reason to believe that wastes or other matter introduced into the marine environment are likely to cause harm even when there is no conclusive evidence to prove a causal relation between inputs and their effects. The article also states that the polluter should, in principle, bear the cost of pollution, while Contracting Parties should ensure that the Protocol prevents that pollution is transferred from one part of the environment to another.

The 1972 Convention permits dumping to be carried out under specific conditions. The severity of these conditions varies according to the danger to the environment presented by the materials themselves and there is a "black list" containing materials which may not be dumped at all. The 1996 Protocol, in Article 4 states that Contracting Parties shall prohibit the dumping of any wastes or other matter with the exception of those listed in Annex 1:

1. Dredged material
2. Sewage sludge
3. Fish waste, or material resulting from industrial fish processing operations
4. Vessels and platforms or other man-made structures at sea
5. Inert, inorganic geological material
6. Organic material of natural origin
7. Bulky items primarily comprising iron, steel, concrete and similar not harmful materials for which the concern is physical impact and limited to those circumstances, where such wastes are generated at locations, such as small islands with isolated communities, having no practicable access to disposal options other than dumping. The only exceptions to this reverse list and permits dumping to be carried out in cases of force majeure caused by stress of weather, or in any case which constitutes a danger to human life or a real threat to vessels. (Art. 8). Incineration of wastes at sea that was permitted under the 1972 Convention, to be prohibited under amendments adopted in 1993, is specifically prohibited by the 1996 Protocol (Art. 5). The protocol does not allow Contracting Parties not to export wastes or other matter to other countries for dumping or incineration at sea (Art. 6)

The Protocol recognizes the importance of implementation. Article 11 details compliance procedures to assess and promote compliance, no later than two years after the entry into force of the Protocol. A key provision is the so-called transitional period (Article 26) which allows new Contracting Parties to phase in compliance with the convention over a period of five years, supported by extended technical assistance provisions.

3.3 Regional Conventions

3.3.1 Barcelona Convention

The Barcelona Convention on Pollution of the Mediterranean recognises organotins as a priority harmful substance. The AFS Convention is mentioned as one of the 'Safety and Prevention of Marine Pollution Conventions' that all Parties to the Barcelona Convention should sign up to. AFS is also mentioned in Resolution 1 of the Final Act of the Conference of Plenipotentiaries on the Protocol Concerning Cooperation in Preventing Pollution from Ships and, in cases of Emergency, Combating Pollution of the Mediterranean Sea, the AFS Convention). No specific 'strategy' has been developed as yet.

3.3.2. Convention for the Protection of the Marine Environment of the North- East Atlantic (OSPAR, 1992)

PARCOM, the predecessor of OSPAR, recognised the risk of organotins contamination through docking activities early on and had recommended measures to reduce organotins compounds reaching the aquatic environment through docking activities (PARCOM, 1988). The measures included technologies and procedures to reduce the amounts of organotins reaching the aquatic environment through docking activities such as grit-blasting, to stimulate the implementation of the technologies and procedures and to report back to the Paris Commission. In 2000 OSPAR identified ship building and repair activities as a major route of organotin contamination of the marine environment and proposed measures and activities to reduce aquatic OT contamination from both point sources (such as a specific ship yard) and diffuse sources (such as contaminated streams) (OSPAR, 2000). Organotins are identified as chemicals for priority action (OSPAR, 2003)

3.3.3 Aarhus Convention: Convention on access to information, public participation in decision making and access to justice in environmental matters

The Aarhus Convention (adopted June 1998) defines the access to information to the public and seeks to strengthen the role of the public and environmental organisations in protecting and improving the environment for the benefit of future generations.

The Convention aims to allow greater public access to environmental information held by public authorities, to increase transparency and accountability of government and to provide an opportunity to express opinions and concerns on environmental matters and to ensure that decision makers take due account of these. The Convention also aims to provide public access to review procedures when their rights to information and participation have been breached, environmental law has more generally been violated.

The access to information includes matters such as granting local residents a say in new schemes or in the location of waste treatment facilities or disposal sites. Members of the public, who know the state of their environment and are aware of cover up attempts by polluters, are better protected when voicing concerns.

The Convention has been signed by over 40 European countries, including all 15 EU Member States and the European Community. The Convention entered into force on 30 October 2001 [1].

[1] http://www.unece.org/env/pp/welcome.html

Almaty decision by the Parties to the Aarhus Convention

The Parties to the Aarhus Convention at their second meeting (Almaty, 25 May 2005), adopted a decision on how Parties should apply the principles of the Aarhus Convention in other international environment-related forums. The guidelines are expected to lead to greater transparency and accountability in a wide range of international bodies and processes dealing with environmental issues in which the Parties to the Convention have a strong influence. The Meeting further established a task force to enter into consultations regarding the guidelines with relevant international forums.

3.4 Regional Policy Frameworks:

European Union

The European Union has issued Regulation (EC) no 782/2003 (14 July 2003) on the prohibition of organotin compounds on ships, a mandatory regulation in line with the terms as set in the AFS Convention (European Union, 2003). The regulation demands to cease application of TBT on ships as of 1 January 2003 and prohibition of ships to use TBT as of 1 January 2008 (except in those cases where TBT is securely sealed off under a seal coat). The regulation holds for ships sailing an EU country flag or fall under the authority of a Member State as well as for other ships entering EU ports or offshore terminals (Art. 3) and prohibits such ships to either not bear organotin compounds which act as biocides in anti-fouling systems on their hulls or bear a coating that forms a barrier to such compounds leaching from the underlying non-compliant anti-fouling system (Art. 5.2). A provision is made for appropriate measures to inspect and control compliance with the regulation if the AFS Convention has not entered into force by 1 January 2007 (Art.6.3; Art. 7). Annex I specifies AFS survey and certification requirements for ships flying a Member State flag, in accordance with the AFS Convention; Annex II specifies AFS certificate and record forms; Annex III specifies the AFS declaration for ships >= 24 meters, but less than 400 GT. The Regulations calls on Member States for early ratification of the AFS Convention and to remove any obstacles to that end.

Where the AFS Convention in a resolution asked parties not to market organotins, the EC prohibits the use and marketing of organotin-based AFS for all ships (Community Directive 2002/62/EC). In a wider EU context, the European Water Framework Directive recognises organotins as priority hazardous substances.

4. CONSEQUENCES FOR SHIP YARD PRACTICE IN SHIP HULL MAINTENANCE AND REPAIR AND DEVELOPMENT OF PROCEDURES FOR SAFE REMOVAL OF WASTE FROM CLEANING AND REPAIRING SHIP'S HULLS

4.1 Introduction

The ultimate purpose of the Procedures for safe removal of AFS and resulting wastes is to prevent waste from anti-fouling paints to enter the environment by any route (by means of water, soil, air or fire) and prevent humans from exposure, coming into contact with or inhale such waste directly as well as from having to operate at a facility which, environment and waters are contaminated by long-standing exposure to such waste. Apart from adhering to Procedures the practice at the yard or other facility is a major tool to work in an environmentally sound manner. Good housekeeping can reduce emissions and human health risks considerably.

In developing the procedures both the benefit to the environment and the specific conditions of ship maintenance and repair practice need to be considered to find a feasible balance between the ideal protection situation and what is actually achievable.

A consistent AFS pollution prevention regime/strategy where all input to the environment and contamination of humans is prevented, should meet at least the following requirements. Hull cleaning and removal of anti-fouling systems should be done on land, on a fluid-impermeable floor that is permanent, or, if that is not possible, temporarily installed. A water catchment and collection system should be present as well as a solid waste collection system. Other essential elements are the presence of waste water processing facilities, a waste collection infrastructure, of specialised waste processing facilities and adequate waste transport equipment.

The different practices for removing AFS or cleaning of ships' hulls generate specific categories of AFS waste. For cleaning of ships' hulls the waste consists of contaminated fouling organisms and adhering paint flakes, which can be collected and contained when hulls are cleaned on land. It is impossible to collect and contain such wastes when hulls are cleaned in the water. Scraping off of AFS generates dry waste that can be collected and contained, unless it rains when contaminated water is generated, which can be collected and contained.

Grit blasting to remove AFS generates specific wastes. Dry grit blasting generates dry waste, both solid and air borne, of the latter air dispersal and inhalation can be prevented. If it rains dry grit blasting results in wet waste, as does wet grit blasting. Wet waste can be collected and contained.

The AFS Convention, Article 5, says:
Waste materials resulting from application or removal of an Annex I Anti-Fouling System should be *collected, handled, treated and disposed of* in a *safe and environmentally sound manner.*

Management of waste streams resulting from the removal of AFS from ships, with a focus on TBT, was discussed in the framework of the London Convention, with reference to different techniques used (LC/SG 30/8, 2007).
The procedures are intended for Port and Coastal States to *prevent* AFS contamination from cleaning of ships' hulls and removal of AFS from ships.

The prevention targets of the procedures are human health, the environment, natural resources, including marine and fresh water food resources.

- Preventing contamination of humans aims to prevent the AFS and AFS waste to come into contact with the skin and with inhalation of those involved in ship maintenance and repair and to contamination of food resources

- Preventing contamination of the environment holds for wet and dry environments, and for associated environment and consequential effects
  - A wet environment consists of marine waters, surface (fresh) waters or ground water
  - A dry environment consists of soil, exposed surfaces and aerial dispersal.

- Associated and consequential effects refer to indirect contamination from a contaminated environment, such as uptake or ingestion in marine food resources and consequential passing on through the food chain and from secondary leaching from sediments

The prevention of AFS contamination should be implemented on all levels of the *AFS Removal Chain:*

- Safe removal of AFS paint
- Safe waste collection
- Safe waste handling
- Waste treatment
- Safe waste disposal

The Procedures refer to two major practices in ship maintenance and repair work, to the further consequences for managing waste resulting from the activities and to the general provisions that a ship repair and maintenance facility should meet.

The introduction to the procedures briefly describe how AFS contamination is generated by cleaning of ships' hulls and removal of anti-fouling systems

Hull Cleaning consists of brushing off of fouling organisms, wiping off slimy (algal) films and removal of corrosion

AFS Removal consists of scraping off of old paint layers or grit blasting, either dry, wet or high pressure blasting.

The environmentally sound maintenance and repair of ships' hulls below is composed of a description of the practice (in normal script) and of the general provisions that are implemented in the Procedures (*in italics*)

To meet the different conditions of operation four procedures were developed
Procedure 1: Fully equipped facility
Procedure 2: Incompletely equipped facility
Procedure 3: Improvised facility
Procedure 4: Shore/beach location

The procedures are structured according to:

1. Practice
A. Operation at the facility
1.1 *Facility Practice*

B. Organisation of the facility
1.2 *Facility equipment*
1.3 *Facility structure*
1.4 *Waste collection and handling at the facility*.

2. Hull cleaning
2.1 In-water hull cleaning – an environmental and health risk
2.2 Hull cleaning on land

3. Removal of anti-fouling systems
3.1 Preparatory assessment for removal of AFS
3.2 Preparatory action for removal of AFS
3.3 Safe operation and waste collection

4. *The anti-fouling removal waste chain*
    - 4.1 AFS removal waste collection
    - 4.2 AFS removal waste water collection
    - 4.3 AFS removal waste water and water-treatment waste handling
    - 4.4 AFS removal waste handling and treatment
    - 4.5 Grit-blasting waste handling
    - 4.6 Grit-blasting waste treatment

5. Ship recycling and AFS removal – a special case

4.2 Order of elements covered in the procedures

For both cleaning of Ship's hulls and removal of anti-fouling systems the consequent practice as to generated waste and preventing contamination of the environment and humans should be implemented on all levels of the AFS Removal Chain, which consists of:

- Safe removal of AFS paint and safe hull cleaning
- Safe waste collection
- Safe waste handling
- Waste treatment
- Safe waste disposal

4.3 Essential preventive measures – summary

Prevention Targets are human health, the environment and natural resources; the latter include marine and fresh water food resources

Before Starting the work one should assess the AFS to be removed and whether AFS has been applied at all. The initial environmental conditions of the facility should be assessed so as to know if the soil is contaminated or not, if the water is contaminated or not and whether similar facilities are present in the vicinity

Prevention of AFS Contamination – General Principles
Have a sound set of Procedures for Waste Management that should cover *each step* in the *AFS Removal Chain.* Have clear responsibilities and instruct all personnel involved and develop a waste prevention discipline that includes ***Maintaining Good House Keeping***

Prevention of AFS Contamination - the Practice
Personnel should wear protective clothing, keep different wastes separate and contain them and have separate marked containers for each type of waste, while full containers are removed and replaced by empty ones. The work should start at a clean facility. When operating one should prevent contaminated dust to disperse into the air and prevent contaminated fluids to leak through the work floor. Operate with a collection system for wet waste and waste water and contain wet waste and waste water. The facilities should be cleaned immediately after completion of the work and the waste should be collected and contained.

Waste water treatment based on specific properties of OT-based AFS
Organotin based AFS (TBT) adsorbs strongly to sediment particles, the organic matrix and biota, all particles that eventually sink in quiet waters. Once integrated in sediments organotins can last for decades. This adsorption property of OT-based AFS waste can be used to clean AFS waste water to a relatively safe level, without needing to use complicated treatment structures or processes. When AFS waste water is left standing in a tailored container, the sediment will settle, together with the organic matrix and biotic

particles, after which the supernatant water can be separated from the sediment and be discharged or be further treated when additional environmental requirements are present.

The discharge water from the deposition tank is safe to discharge when the level of suspended particles is below 100 mg/litre. This method to treat waste water from ship maintenance and repair facilities has been developed as a tailor-made approach for such facilities that would both fulfil the environmental requirements for discharge water and the requirements for adequate operation at the facility. The prototype strategy for environmental performance of ship building and repair facilities of which this specific water treatment is part, originally developed by the Netherlands water authorities in cooperation with the ship building industry, now stands an example for an overall EU environmental strategy for the ship building and repair industry (De Vries, B, VNSI) (Annex 4). The strategy to develop and implement better environmental performance for ship building and repair facilities exists of a set of measures that all result in improving environmental performance and has gradually been implemented from 1985 onwards. The strategy has been developed on the base of a Dutch government report (CUWVO, 1991). The strategy has as yet resulted in a 90% reduction in emissions; at the target year of implementing the strategy (2010) emissions will be reduced by 95% (De Vries, B, 1996/2005) (Annex 5).

Essential preventive measures in the chain of safe AFS removal to treatment or disposal

- *Before starting to operate a ship repair and maintenance facility the facility should ascertain the initial quality of the water and the soil at the facility*
- *Before starting the work the facility should ascertain the type of AFS that is to be removed.*
- *Always prevent waste from removal of anti-fouling or cleaning of ships' hulls to enter the surface water or the soil underneath the removal/cleaning facility and prevent workers to run a health risk. Collect waste and waste water from removal of antifouling or cleaning of ships' hulls in separate containers that are protected from the environment. Waste from such operation should be kept separate from other types of waste and should be collected and transported in containers that are protected from the environment. Any waste resulting from removal of anti-fouling or cleaning of ships' hulls should be brought to a waste processing facility that is able to process the waste by specific treatment so as to render it harmless.*
- *The waste water should be collected in a container to let the suspended solids (to which the AFS adheres) deposit. When the floating particles have sufficiently deposited the supernatant water should have a total suspended solids (TSS) content of less than 100 mg/litre. The water can then be discharged, subject to a permit.*
- *For rendering the resulting waste water suitable for discharge into highly sensitive areas, such as Marine and coastal protected areas (MCPA) the supernatant water should then be filtered over a filter bed that is protected from the environment, to further purify the water (<50 mg/litre of total suspended solids (TSS). The quality of the filtered water should regularly be monitored. The filter should regularly be cleaned by a specialised cleaning facility.*
- *The waste should be processed in a waste processing facility that adheres to a processing method that is adequate for the specific type of waste resulting from removal of anti-fouling or cleaning of ships' hulls. The waste should preferably be rendered harmless by specific processing, such as incineration in a high-temperature thermal destruction facility for highly toxic wastes that does not release exhaust gasfluids or solid waste from the incineration process into the environment. If deposition of the waste is the only option, then it should be done in a deposit licensed for such wastes and protected from the environment.*

- *Waste Treatment to Environmentally Harmless Material Should always be the first option. Even Safe Waste Deposit has many Disadvantages. It takes up space at the cost of other spatial use and is vulnerable to damage, The waste remains harmful, while aging enhances the chances of contact of the waste with the environment, with groundwater or surface waters and poses a risk of health hazards.*

The explanatory notes and procedure basis are drafted to be of a generic nature so as to be relevant for facilities of different character and level of organisation and operation.
In the Annexes 1-3 to the report the procedures have been developed into specific procedures tailored to a specific type of facility or mode of operation.

OVERVIEW OF THE DIFFERENT TYPES OF WASTE GENERATED DURING HULL CLEANING AND AFS REMOVAL AND CONSEQUENTIAL ACTIONS

Contained contaminated water:

- Water used during hull cleaning and AFS removal
- Rain water that fell during the work on the contaminated work floor
  - To be collected and contained
  - To be further processed
    - By specialised treatment to allow the AFS-loaded sediment to settle
    - And separate the settled sediment from the treated water
    - The settled sediment has to be treated or safely deposited

Waste water treatment chain:

- Let suspended particles deposit
  - In high-sensitivity areas filter the overlying water until clean
    - Meeting a discharge standard
- Further process the contaminated sediment
- Treatment or safe deposit

Contained contaminated solids:

- Water filter
- Used blasting grit
  - To be further processed
    - by specialised treatment facility
    - or, if treatment is not possible, to be deposited in a safe deposit

Contaminated materials used during the work:

- Contaminated clothing
- Contaminated tools, rags, brushes
  - Per type to be collected in separate containers
    - To be cleaned or further processed
- Solvents and other fluids
  - To be collected in separate containers
    - Further processing by specialised treatment facility

A Specialised Facility for AFS Waste Treatment should be fit for:

- **Safe treatment**
  - Cleaning, purifying and rendering the material harmless **<u>or</u>** if that is totally impossible
- **Safe deposit** at a specialised facility,
  - Protected from the environment and capped

Waste Treatment to Environmentally Harmless Material
Should always be the first option
Even safe Waste Deposit has many *Disadvantages:*

- Takes up space at the cost of other spatial use
- Is vulnerable to damage
- The waste remains harmful
- Aging enhances
  - The chances of contact of waste with
    - environment
    - groundwater
  - The risk of health hazards

Collect and contain all contaminated materials used or generated during the work

5. QUESTIONNAIRE

A questionnaire intended to inventory facility and legal aspects of anti-fouling management has been circulated amongst the participating countries. (Annex 3)
Below the response by the five respondents are summarised to give an impression of the situation, although this cannot be generalised due to the low rate of response.

10.1 Summarised response to questionnaire (5 respondents)

A. Facilities

1. a	Facilities present:	3
2.a	Type of facility	
	Ship-building & repair yard	3
	Dockyard	3
	Ship repair yard	2
	Ship building yard	1
	Part of a merchant shipping port	2
	Part of a Marina	1
	Navy Yard	4
	Other	1
2.b	Location of facility	
	In/at a harbour	5
	Town	1
	Industrial area	1
2.c	Length of ships handled	
	> 20 m	5
	5-20 m	1
2.d	Amount of ships	
	0-10/Yr	2
	10-50/Yr	1
	>50/Yr	2
2.e	Frequency	
	0-10/Yr	2
	10-100/Yr	2
	No accurate record	1

B. Legal

3. a	Status of AFS policy	
	Considered for development	5
	* Instructions to remove AFS waste	1
3.b	Present material	
	Guidelines	2
	Information documents	2
3.c	Timing AFS policy development	
	Within 6 months	1
	Within a year	2
	More than a year	1

4.a	Maritime industry informed on AFS legislation	
	Yes	4
	No	1
4.b	Regulations issued and application	
	National Application	1
	International application	1
	No regulations issued	1
4.c	Support for new AFS removal regulations	
	Yes	5

C. Anti-fouling paint wastes

5.	Use of TBT in country	Yes	No
	Provided information on AFS + risks	1	4
	TBT-based AFS used at present	2	3
	Non TBT-based AFS used at present	1	3
	Reports on environmental impact	1	4
	Reports on health effects		5
	Economics of shipping affected	2	2
	By phasing out TBT		

D. Support and Assistance (TCA)

6.	Indicate what would be helpful	
	Specific regulations	2
	Information	1
	More information on alternatives	1
	Increase the culture awareness among the maritime industry	1
	- Issuing laws and specific guidelines	1
	- Provide technical support in the following:	1
	- Training	
	- Assessment and equipment	

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Anti-fouling and Waste Regulations

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Regulation (EC) No 782/2003 of the European Parliament and of the Council of 14 April 2003 on the prohibition of organotin compounds on ships

Council Directive 91/689/EEC of 12 December 1991 on hazardous waste

EU Waste Legislation Links

Consolidated EU waste legislation that can be downloaded from the European Union CELEX site, but please note that this is not complete.

Specific links to individual pieces of EU waste management legislation, divided into five main sub-categories:

A. Framework European Union legislation on waste
B. European Union legislation on waste management operations
C. European Union legislation on specific waste streams
D. Reporting and questionnaire legislation
E. Useful links to other in/directly related legislation

A Summary of EU Waste Legislation is available here.

WASTE MANAGEMENT**,** GENERAL FRAMEWORK

- Framework Directive on waste disposal
- Strategy on the prevention and recycling of waste
- Implementation of legislation on waste - 1998-2000
- Integrated pollution prevention and control: IPPC Directive
- Waste management statistics
- Competitiveness of the recycling industries
- The landfill of waste
- Waste incineration
- Supervision and control of transfrontier shipments of waste

HAZARDOUS WASTE

- Controlled management of hazardous waste
- Basel Convention on the control of transboundary movements of hazardous waste

Useful links to other in/directly related EU legislation

1. Council Directive 80/68/EEC of 17 December 1979 on the protection of groundwater against pollution caused by certain dangerous substances
2. Council Directive 96/61/EC concerning integrated pollution prevention and control

Personnel Safety Regulations

Council Directive 89/655/EEC of 30 November 1989 concerning the minimum safety and health requirements for the use of work equipment by workers at work (second individual Directive within the meaning of Article 16 (1) of Directive 89/391/EEC)

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Procedure 1.

SAFE PROCEDURES FOR HULL CLEANING AND THE FULL ANTI-FOULING SYSTEMS REMOVAL CHAIN AT A FULLY EQUIPPED FACILITY

- **Before starting to operate a ship repair and maintenance facility the quality of the water and the soil at the facility should initially be ascertained.**
- **Before starting the work the facility should always ascertain the presence of safe waste treatment facilities and safe waste deposits that are protected from the environment.**
- **Before starting the work the facility should always fully inform itself on the existing infrastructure for the safe transport of AFS waste to treatment and deposit facilities, as well as the infrastructure for AFS waste treatment and safe deposition of AFS waste.**
- **Before starting the work the facility should always ascertain the type of AFS that is to be removed.**

1. The Facility

A. Operation at the facility

Whatever the type of a facility, a clear framework for safe operation and a recognised responsibility are paramount in support of sound environmental and safety practice at the facility. The management is responsible for establishing and communicating a clear code of practice for safe operation as to environment and health at the facility. The management should commit a member of the personnel to be responsible for surveying the implementation of the code of practice. All personnel should be fully informed about the code of practice and about the responsibilities at the facility as to the implementation of the code of practice and should adhere to the code.

Skin contact with anti-fouling systems or their waste bears a health risk as does inhaling AFS dust particles that are dispersed into the air. Apart from safe environmental operation, health hazards have to be prevented by wearing protective clothing, gloves, water-impermeable boots, and a breathing mask that prevents inhaling of AFS particles. Waste water and contaminated sediment should also be prevented from coming into contact with human skin (Wear working boots and gloves that are water-impermeable).
Whatever the level of protective structure and strategy at the facility, good house keeping, including cleaning prior to and immediately after the work has finished, can prevent waste to spread into the environment beyond the facility itself and can protect personnel at the facility to run health risks. Good house keeping, together with working only when the weather is dry at those facilities that have an incomplete waste water catchment and containment system, helps to prevent waste to spread into the water or in the soil.

1.1 Facility Practice

1.1.1 Facility code of practice for safe operation

1.1.1.1 Cleaning of ship's hulls and removal of anti-fouling paints should be done at specialised facilities that have a package of specialised measures, a code of practice, a dock-floor discipline or a similar framework for preventing contamination of the environment, as well as preventing the practice and its waste to affect the personnel's health.

1.1.1.2 The management should be responsible for the safe and environmentally clean operation and should inform all personnel involved of the used framework for sound and safe operation at the facility.

1.1.1.3 On the work floor one person should be made responsible for regular inspection of the facility, for checking the facility when an operation has finished and for overlooking the AFS removal chain.

1.1.1.4 All personnel should be familiar with the code of practice and the responsibilities for its implementation.

1.1.1.5 Personnel should be familiar with the character of the material they are working with and with associated risks and safe handling instructions for use of the material.

1.1.1.6 The relevant authorities should be informed on the used framework for sound operation at the facility and of the responsibilities as well as of problems with the implementation of the framework and the character of the problems, including possible proposed cures.

1.1.1.7 The work at the facility should be subject to a permit or similar legal authorisation for:
- Environmentally sound operation (yard practice)
- Clean water discharge permit
- Safe and healthy working conditions

1.1.2 Personnel practice

1.1.2.1 Personnel at the facility should adhere to the code of practice and to the good house keeping rules.

1.1.2.2 Personnel at the facility should wear certified protective gear to prevent coming into contact with the waste produced during operation or with any abrasive fluids or other materials used in the operation.

1.1.2.3 Personnel should thoroughly clean their hands and face before consuming food or drinks.

1.1.2.4 Personnel should clean hands and face immediately after the operation has finished

1.1.2..5 Personnel should not smoke during the work.

1.1.3 Emergency handling

1.1.3.1 In case of an emergency, when the code of practice cannot be implemented, the responsible person at the facility should be informed at the earliest opportunity.

1.1.3.2 In case of an emergency, when the code of practice could not be followed, the relevant authority should be notified on:
- the date of the event
- the character of the event
- if waste water had to be discharged:
- where the waste water has been discharged,
- an estimate of the amount of discharged waste water and the expected contaminants' load.
- what mitigation measures were taken
- which future additional preventive measures are envisaged

B. Organisation of the Facility

The types of facilities for ship maintenance and repair that are present are manifold and run from specified ship repair and docking yards at contained locations to just a location on a shore. It is clear that a contained space with tailored facilities, such as dry docks, floating docks and well-protected slipways, can develop a more refined system for preventing contamination of the environment and protection of its personnel than can facilities that are less well equipped. Dry docks are structured to allow for containment of waste, which can be cleaned before water is allowed into the dry dock. Floating docks need special provisions to contain waste and waste water within the dock space. Such provision can be a tightly fitting fluid-impermeable vertical barrier at each access end of the floating dock that prevents water to leak through and fine-mesh netting to contain grit-blasting material, waste and dust within the workspace.

Slipways and other work floors need to have a fluid-impermeable floor to prevent contaminated water to leak into the soil underneath. To contain and collect the waste water generated during the work and rain water that has become contaminated by AFS waste a slipway should have a system to catch the waste water and leads it to a provision to contain the waste water. However, wherever a ship's hull is cleaned or has its paint removed, a practice to prevent or reduce contamination of the environment and health risks of its personnel, should always be developed and be commonly known to all involved in the work at the facility. When a facility has not yet a fluid-impermeable floor; such floor should be established at the earliest possible opportunity.

A facility that has been operating without a fluid-impermeable floor with water catchment and containers to keep the waste water separate from the environment, is likely to have the soil underneath and around the facility contaminated by previous operation until depths that can vary between 10 - 50 centimetres of depth, depending on the soil character, the length of the period of contaminant input and the total amount of water (operation water and rain water). To prevent further spreading of the contamination, such soil needs to be cleaned or removed and treated, or if that proves not possible to be deposited on land at a specialised, licensed safe deposit, prior to making the facility environmentally sound and safe. Further contamination of the soil can be prevented by a temporary fluid-impermeable floor cover pending installation of a permanent fluid-impermeable floor with a water catchment and containment system.

Underwater sediment contaminated with AFS should be dredged and either treated or be stored on land at a specialised, licensed safe deposit. Such contaminated sediments should not be dumped in an aquatic environment, neither in fresh water, nor in the sea. If a permanent fluid-impermeable floor is not possible, a temporary provision can be installed to contain the waste and protect it from the underlying soil as well as to collect and contain the waste water.

Slipways with a fluid-impermeable floor that are periodically immersed in water can become undermined. In that case a non-impermeable floor is a better solution. However the risk of contaminating the soil underneath as well as the immersion water should be recognised and the soil and the adjacent water should be regularly monitored.

1.2 Facility Equipment

1.2.1 Facility design

1.2.1.1 The facility should have a good access and evacuation route

1.2.1.2 The facility should have a fluid-impermeable floor with a water catchment and containment system.

1.2.1.3 When a fluid-impermeable floor is present the work should start at a clean floor and the floor should be thoroughly cleaned after completion of the work.

1.2.1.4 The fluid-impermeable floor should have a system for catching and containing all waste water from the AFS removal or hull cleaning process, including rain water that falls in the period from the start of the work until the facility is thoroughly cleaned after completion of the work.

1.2.1.5 When a fluid-impermeable floor is not present a temporary fluid-impermeable protection floor should be installed. The temporary floor should be capable of containing the water in such manner that the waste water can be contained and collected for treatment. The temporary floor should be thoroughly cleaned after completion of the work

1.2.2 Environmental and safety provisions

1.2.2.1 Before the work starts, waste containers for different types of wastes and which are clearly marked, should be placed at the work floor.

1.2.2.2 Certified protective gear to be used by personnel during the work should include:
* Gloves and boots;
* Face mask to prevent inhaling waste and paint particles
* Safety glasses
* Protective suit
* Safety helmet

1.3 Facility Structures
Slipway, Floating and Dry Dock and Work Floor Handling

A slipway, dry or floating dock floor or other work floor where an AFS removal or hull cleaning operation has taken place contains a mixture of different types of waste, contaminated mud resulting from the hull cleaning, mechanical removal or grit blasting activities, used blasting grit, remains from welding work, used polishing cloth etc.

1.3.1 Floating Dock

1.3.1.1 A floating dock should have a provision at the open ends to contain waste water and waste inside the dock space and prevent water to leak into the environment. The provision for containing waste and waste water should be well fitting and fluid-impermeable. If grit-blasting is used, at least, the open ends should be closed by fine-mesh netting so as to contain blasting material within the dock space.

1.3.1.2 A floating dock, after the work has finished and before flooding, should remain closed at all sides to contain any waste water produced during the process of cleaning the ship's hulls and until all waste and all waste water has been removed and the floor and walls have been thoroughly cleaned.

1.3.2 Dry Dock

1.3.2.1 A dry dock should operate with fully closed gates, to prevent surrounding water to leak into the dock space, to prevent water inside the dock to leak into the surface waters and to prevent blasting waste and grit to spread into the environment.

1.3.2.2 After completion of the work in a dry dock, the dock gates should remain closed until all waste and waste water has been removed and the floor and walls have been thoroughly cleaned.

1.3.2.3 Prior to opening the dock gates, the responsible person at the facility should inspect the dock floor and walls and notify the relevant authorities of the intent to flooding the dock.

1.3.3 Slipway

1.3.3.1 A slipway should have a fluid-impermeable floor.

1.3.3.2 If the facility is operating a slipway, the slipway should have installed in the fluid-impermeable floor a catchment system for waste water resulting from the operation at the slipway and for rain water that has been falling during operation or when the slipway floor has not yet been thoroughly cleaned. The water-catchment system can consist of a gutter running underneath the floor and leading the water to a waste water container that is protected from the environment and closed on top, so no other material or water can enter the container.

1.3.3.3 When a fluid-impermeable floor is not present, a temporary fluid-impermeable protection floor should be installed. The temporary floor should be capable of containing the water in such manner that the waste water can be collected and contained for treatment. The temporary floor should be thoroughly cleaned after completion of the work.

1.4 Waste collection and handling at the facility

Preparation for the further AFS Removal Chain.

Different types of waste that are present or generated at the facility include remains of paint or surfactant fluids, used oil, chemicals, used and empty paint and solvent cans and materials used during the work, such as cleaning rags and brushes and other cleaning tools. The waste consists of solid wastes and waste water, which both should be collected and contained within the work space during and at the end of the work. Discharge of waste water and dumping of waste into the environment must be prevented at all times. As hull cleaning and AFS removal are done in the immediate vicinity of coastal or inland waters, waste from a facility, if not properly contained, is likely to enter the water, where it can spread unlimitedly and becomes itself a source of contamination of the sediments and natural and food resources in the water.

Surface and ground water are both human resources, for drinking, food and recreational use. It is paramount to protect both water and soil from becoming polluted to the detriment of the environment and of human health.

Organotin based AFS (TBT) adsorb strongly to sediment particles, the organic matrix and biota, all particles that eventually sink in quiet waters. Once integrated in sediments organotins can last for decades. This adsorption property of OT-based AFS waste can be used to clean AFS waste water to a relatively safe level, without needing to use complicated treatment structures or processes. When AFS waste water is left standing in a tailored container, the sediment will settle, together with the organic matrix and biotic particles, after which the supernatant water can be separated from the sediment and be discharged or be further treated when additional environmental requirements are present. The discharge water from the deposition tank is safe to discharge when the level of suspended particles is below 100 mg/litre. This method to treat waste water from ship maintenance and repair facilities has been developed as a tailor-made approach for such facilities that would both fulfil the environmental requirements for discharge water and the requirements for adequate operation at the facility. The prototype strategy for environmental performance of ship building and repair facilities of which this specific water treatment is part, originally developed by the Netherlands water authorities in cooperation with the ship building industry, now stands an example for an overall EU environmental strategy for the ship building and repair industry (De Vries, VNSI). The strategy to develop and implement better environmental performance for ship building and repair facilities exists of a set of measures that all result in improving environmental performance and has gradually been implemented from 1985 onwards. The strategy has been developed on the base of a Dutch government report (CUWVO, 1991). The strategy has as yet resulted in a 90% reduction in emissions; at the target year of implementing the strategy (2010) emissions will be reduced by 95% (De Vries, 1996/2005).

Waste handling and treatment upon and after removal from the facility.

AFS waste that is removed for treatment should be transported in a safe manner to a licensed facility for treatment. Depending on the waste material and the level of contamination treatment should be:

- Recycling (such as grit, sand-bed filters)
- Separating the material from its waste to render the cleaned material suitable for re-use
- Destruction / Rendering harmless of the waste.
- AFS waste can only be rendered harmless by controlled thermal destruction, in a specialised waste destruction facility (such as a rotary killn), at ultra-high temperatures with exhaust catchment and cleaning provisions.
- If all options for further treatment are impossible or not accessible then the waste should be deposited in a licensed facility that is protected from the environment and capped and cannot leak water or other fluids into the environment. The facility is subject to a permit.
- The options available for waste treatment depend on the available infrastructure.

Waste Treatment to Environmentally Harmless Material Should always be the first option. Even Safe Waste Deposit has many Disadvantages. It takes up space at the cost of other spatial use and is vulnerable to damage, The waste remains harmful, while aging enhances the chances of contact of the waste with the environment, with groundwater or surface waters and poses a risk of health hazards.

1.4.1 General rules for waste collection

1.4.1.1 Have a responsible person at the facility for waste and waste water management.

1.4.1.2 Personnel at the facility should adhere to the code of practice and the good house keeping rules. If in case of an emergency, the code of practice cannot be implemented, the responsible person at the facility should be informed at the earliest opportunity.

1.4.1.3 Different types of waste, generated during different activities should be kept separate in containers that are only intended for that specific type of waste. The containers should be clearly marked and should be available at the location where the work that generates the specific waste is taking place.

1.4.1.4 All generated waste should immediately be placed in the adequate container. When a container is full, it should be removed and immediately replaced by a clean one.

1.4.1.5 One person at the facility should be responsible for handling and temporary storage of waste at the facility; all Personnel at the facility should be familiar with the waste handling code of practice at the facility.

1.4.2 General rules for waste handling

1.4.2.1 After completion of the work, the waste containers should be removed for waste treatment at a specialised facility

1.4.2.2 Waste stored in specific containers should be collected by a specialised operator and upon collection the storage containers should be immediately replaced by empty ones.

1.4.2.3 Waste may temporarily be stored at the facility, pending final removal. Register/record temporarily stored waste and (waste) water.

1.4.2.4 Transport separate wastes in separate containers that are protected from the environment.

1.4.2.5 Bring waste to a licensed facility to process, treat and/or recycle the waste.

1.4.2.6 If treatment is not possible the waste may be deposited at a specialised safe deposit that is protected from the environment and capped. Such disposal of waste should be subject to a permit for safe disposal of the specific waste. The disposal facility should be recognised by the authorities.

1.4.2.7 After completion of the work, the remaining waste should never be removed by washing with water or by brushing it into the environment.

1.4.2.8 Waste collected during or after completion of the work should never be buried, incinerated or permanently stored at the facility or in the environment.

1.4.2.9 Waste collected during or after the completion of the work should never be disposed of outside the facility at a non-recognised disposal facility and without a permit for safe disposal.

1.4.2.10 Waste collected during or after completion of the work may, pending safe removal, be temporarily stored at the facility in a container that is protected from the environment and closed by a well-fitting lid. The container should be clearly marked with the type of waste, the amount of waste and the date of storage. No unauthorised personnel should be allowed to put waste into the containers. The relevant authorities should be notified of the temporary storage.

1.4.2.11 Record the amount of discharged water and the date and location of discharge.

1.4.2.12 Keep wastes separate and protected from the environment.

1.4.2.13 A ship repair and maintenance facility should have a transport system for used water and rain water that can come in contact with waste from its activities

1.4.3 Safe waste water collection

1.4.3.1 Waste water should be collected in a container that is protected from the environment and is closed by a lid. In the container only waste water resulting from the removal of AFS should be collected.

1.4.3.2 Waste water collected in a separate container should be subject to a deposition system to remove the contaminated waste that adheres to the sediment to render the water sufficiently free of harmful AFS to be suitable for discharge into surface waters. No untreated waste water should be allowed to be discharged into surface waters or ground water.

1.4.3.3 Waste water in the container should be left standing to allow suspended particles, to which AFS adheres, to settle.

1.4.4 Requirements for discharge water

1.4.4.1 The suspended particle load of discharged water should be less than (100 mg/litre) as a safety level for water that is feasible for discharge into surface waters.

1.4.4.2 The pH of discharged water should be within limits (pH between 6.5 and 9 as advisory range).

1.4.4.3 The amount of water to be discharged and the intended date of discharge should be reported to the relevant authorities

1.4.4.4 Report spills and accidents that contaminate surface waters and/or the soil.

1.4.5 Handling of the waste water system

1.4.5.1 The waste water system operated at the facility is for the sole use of waste water generated by the facility's activities and it should only be accessible for personnel of the facility.

1.4.5.2 Non-facility persons or instances should not be allowed to use the facility waste water system.

1.4.5.3 If the soil at the facility is contaminated by AFS waste water it should be removed and sent for treatment after approval by the relevant authorities.

1.4.6 Handling of waste water

1.4.6.1 The settled contaminated suspended particles in the deposit tank should be separated from the supernatant water.

1.4.6.2 The contaminated sediment from the deposition container should be removed and transported to a licensed facility for treatment or safe disposal.

1.4.6.3 If the facility is located in a special sensitive environment, such as a MPCA, the waste water should be further treated by filtering through a sand-bed filter to a lower TSS content (<50 mg/l) that itself should regularly be replaced by a clean one.

1.4.6.4 The contaminated sand-bed filter should be removed and be transported to a specialised facility for treatment, cleaning or recycling of sand- bed filters

1.4.6.5 The treated effluent water should meet the effluent standard and should be regularly monitored and be accessible for inspection by the responsible authority/administration. The amount of water to discharge and the intended date of discharge should be reported to the relevant authorities.

1.4.6.6 Discharge treated water into a sewer system with adequate sewer treatment if possible and subject to a permit from the relevant authority.

1.4.7 Emergency waste water handling

1.4.7.1 In case of emergency, when waste water has been discharged, the responsible authority should be notified that the procedure could not be followed where waste water has been discharged, and, if possible an estimate of the amount of discharged waste water and the expected contaminants present.. The authorities should also be notified of the mitigation measures undertaken by the facility and possible future additional preventive measures.

1.4.8 Handling of specific wastes

1.4.8.1 If contaminated blasting grit can be cleaned for re-use, then it should not be deposited.

1.4.9 Waste handling in a dock

1.4.9.1 Dry dock: all waste and waste water should be removed and contained and the walls and the floor should be thoroughly cleaned before the dock may be flooded and the gates opened.

1.4.9.2 Floating dock: the floor should be thoroughly cleaned and the waste water contained, before flooding the dock.

1.4.10 Preparatory action for the AFS waste chain

1.4.10.1 Contaminated water and rainwater that has been in contact with waste should be kept separate from surface waters; never allow discharge of contaminated water into surface waters.

1.4.10.2 A best further treatment option for AFS waste should be sought. The ranking of best preferential options is
1st Re-used after cleaning, the remaining waste to be treated
2nd Recycling
3rd Rendered harmless by specific and tailored treatment
4th Deposited at a licensed facility that is protected from the environment and capped

1.4.10.3 A facility should acquire a permit from the relevant authority for temporary storage and containment of waste and waste water and materials used, such as cleaning tools.

2. Hull Cleaning

Introduction and preventive regime
Hull Cleaning is done by brushing off fouling organisms, wiping off slimy (algal) films and removing corrosion.
Hulls cleaning practice is at present done:

- on land, where wastes can be contained
- in the water, where containing wastes is ***impossible***

The most commonly used organotin-based anti-fouling paints are highly toxic and can accumulate throughout the food chain and in human food resources. AFS waste should not enter the environment, neither in the water nor on land. Hull-fouling organisms are likely to have taken up an appreciable amount of active substances and biocides from the AFS used on the hull; they will therefore pose an ecotoxicological effect as well as a potential alien invader risk. Such organisms may settle in the adjacent, contaminated environment and grow in an environment that is contaminated by AFS waste, and may be ingested by human food resources or later on, when grown, be recognised themselves as food resources; a food resource that may have considerable amounts of the hormone disruptor tributyltin (TBT) and its metabolites.

(i) Waste from cleaning of ship's hulls should be contained and removed for treatment or safe disposal.

(ii) Collecting human food from areas where ships' hulls are cleaned under water should be prevented.

(iii) Collecting human food from areas where waste from ships' hull cleaning or AFS removal has been discharged into the environment should be prevented.

2.1 In-Water Hull Cleaning – an Environmental and Health Risk

In-water hull cleaning when in water releases anti-fouling particles and fouling organisms, which are contaminated by AFS and can bring AFS in the food chain and into human food resources.

The practice of in-water hull cleaning
Ship's hulls are regularly cleaned to remove fouling organisms from the hull (so as to maintain proper sailing quality).
When the underwater part of ship's hulls needs to be cleaned from fouling organisms or corroded parts, in the past the choice was often made to do that

when the ship is still in the water. The cleaning is done by brushing, or brushing/scrubbing systems, operated by (scuba) divers or, when small ships, also by personnel standing in the water. This practice, although convenient on economic and time-management grounds, brings about considerable risks for both the environment and human health. The waste from under-water cleaning of ship's hulls consists of paint flakes and particles, combined with fouling organisms. The major risk is posed by AFS particles that are released into the water, causing environmental impacts and a health risk for those who operate such under-water cleaning. An associated risk is the release into the water of fouling organisms that may have come from other seas transported on the ships' hull, enhancing the risk of alien invasions. Alien invasive species can affect local marine ecosystems and marine food resources and can bring about outbreaks of diseases.

AFS waste or organisms contaminated by AFS resulting from in-water hull cleaning cannot be contained

Long-standing experience with methods to clean ship's hulls under water has shown that when in the water it is not feasible to clean ship's hulls in such way that the resulting waste can be totally lifted out of the water so as to be completely separate from the surface waters. Although the practice has been sought in the past, this option should be phased out at the earliest opportunity. The waste of hull-cleaning activities underwater will always run the risk of bringing resulting waste into the environment, not only flakes and particles of anti-fouling paints, also the fouling organisms will be released, which can result in introduction and establishment of alien invasive organisms, which is also to the detriment of the natural aquatic ecosystem and natural resources. Extensive experiments have shown that when a ship remains in the water none of the applied methods have the capacity to catch the waste such that it is totally separated from the surrounding waters. Waste particles will always leak through protective devices, such as nets, curtains etc.

If an AFS paint is very hard, soft brushing when just an initial soft (slimy) layer has been formed might prevent AFS waste to enter the environment.

Such practice, although it minimised the risk of bringing AFS contamination into the water, still will release fouling organisms, thus enhancing the risk of alien invasions and harmful algal blooms.

2.1.1 When in-water cleaning of a ship's hull is carried out, the waste should in its entirety be brought to the surface, where it can be collected and contained

2.1.2 When operating under water for the purpose of cleaning a ship's hull, certified protective gloves should be worn and clothing that prevents skin contact with AFS and AFS waste removed from the hull.

2.1.3 When it is urgently needed to clean a ship that cannot be taken out of the water, this should only be done by a soft brush and at an early stage of fouling, when there is only a thin slimy algal layer, that can adequately be removed by soft brushing.

2.1.4 When organisms are stuck to the ship's hull, which removal runs the risk of damaging the AFS paint/system and releasing AFS particles, the ship should be taken out of the water to clean the hull.

2.1.5 Ship's hulls should always be cleaned on land; the practice of in-water cleaning of ship's hulls should be phased out at the earliest opportunity.

2.2 Hull Cleaning on Land

The practice of Hull cleaning on land

On land it is possible and feasible to collect and contain waste generated by hull cleaning.
On land ship's hulls are cleaned by high pressure water washing and/or brushing. This activity results in a waste consisting of paint flakes, rust particles and fouling organisms. As this activity is wet, the waste will mix with the water used and needs to be contained to prevent the wastewater entering the surface waters and to penetrate in the underlying and surrounding soil and underwater sediments. When operating a high-pressure wash in rain, the rainwater will become contaminated by the generated waste as well.

2.2.1 To prevent the contaminated hull-cleaning waste water to enter surface waters, cleaning of ship's hulls by high-pressure washing should be done on a fluid-impermeable floor, with a system to collect the waste water and to contain rainwater that has been in touch with the waste.

2.2.2 When a fluid-impermeable floor is present the work should start with a clean floor and the floor should be thoroughly cleaned after completion of the work.

2.2.3 When a fluid-impermeable floor is not present a temporary fluid-impermeable protection floor should be installed. The temporary floor should be capable of containing the waste and waste water in such manner that the waste water can be collected and left for treatment. The temporary floor should be thoroughly cleaned after completion of the work.

2.2.4 After operation the facility should be immediately cleaned after completion of the work.

2.3 Hull-Cleaning Waste Collection

2.3.1 Solid waste of material used during hull cleaning should be collected in a container that is protected from the environment.

2.3.2 The contaminated water from hull cleaning should be collected in a container that is protected from the environment and is separate from waste water resulting from other activities at the facility.

2.4 Hull-Cleaning Waste Handling

2.4.1 The suspended solids in the contained waste water should be allowed to settle to catch most of the AFS, which is adsorbed to the suspended particles.

2.4.2 When the suspended solids have settled, discharge of the supernatant waste water (TSS < 100 mg/l) should be subject to a permit.

2.4.3 When the suspended solids have settled the supernatant water should preferably be discharged through a general water treatment system, a sewage system or a similar facility that further processes waste water. If that is not possible the waste water may be discharged into surface waters, subject to a permit.

2.4.4 When the suspended solids have settled, and further treatment is sought due to specific sensitivity of the ecosystem of the waters in the surrounding area, the water can be further purified by filtering over a sand-bed or comparable cleaning filter until the effluent water meets the standard for discharge (not more than 50 mg/ litre of suspended solids).

2.4.5 The filter should be regularly checked for excess contamination and be cleaned on a regular basis by a licensed facility.

2.4.6 When the filter is too contaminated to be cleaned it should be transferred to a treatment facility (recycling or destruction), or if that is not possible be deposited at a licensed facility that is protected from the environment.

2.4.7 The sediment from the deposition tank should be transferred to a licensed facility for cleaning for re-use, for recycling or for further treatment.

2.4.8 If treatment or cleaning/recycling is not possible, the sediment should be deposited in a specialised licensed deposit facility that is protected from the environment and capped.

2.4.9 When the facility has previously been operating without a fluid-impermeable floor, the contaminated soil underneath the slipway or floor should be cleaned/ removed prior to installing a fluid-impermeable floor with a water catchment provision

3. Removal of Anti-Fouling Systems

AFS Removal from Ship's hulls can be done by mechanical removal, scraping off of old paint layers and by grit blasting. Grit blasting can be dry blasting, wet blasting or high-pressure blasting. Grit blasting roughens the surface so that loose AFS paint and corrosion or other particles can be easily removed completely and new paint will better adhere to the surface. Grit blasting, where grit is blasted with force to the hull surface, is likely to spread the blasting material to considerable distance and should therefore only be done at a space that has walls or other protective structures at all sides to contain the material within the work space. This means that grit blasting should only be done in either an enclosed hall or room, in a dry dock with the doors closed or in a floating dock that has fine-mesh netting at the open sides.

After 1 January 2008 the non-compliant organotin-based anti-fouling systems might have been sealed off by an impermeable sealer coat that fully prevents the non-compliant AFS to leach into the environment or into the compliant AFS layer on the hull.

3.1 Preparatory Assessment for Removal of AFS

3.1.1 Grit blasting, the most common practice for AFS removal, should only be done in a space that is protected by a fluid-impermeable floor and has walls or other structures at all sides to contain the blasting material within the work space and protected from the environment.

3.1.2 Prior to starting the operation to remove the old AFS layer, the facility should ascertain the type of AFS on the hull, when it was applied and who was the producer of the AFS; the AFS certificate should be checked and, if there is no such information or the certificate is incomplete, the facility should ascertain the type of AFS by other means and notify the relevant authority.

3.1.3 When a sealer coat is used to prevent the non-compliant AFS underneath from leaching out; the seal coat should be checked for being capable of remaining intact when grit-blasted.

3.1.4 Prior to removing the old AFS layer, the facility should ascertain the type of sealer coat on the hull, when it was applied and who was the producer of the sealer coat; the AFS certificate should be checked and, if there is no such information or the certificate is incomplete, the facility should ascertain the type of sealer coat by other means and notify the relevant authority.

3.2 Preparatory Action for Removal of AFS by Grit Blasting

3.2.1 Prior to grit-blasting the dock floor where the operation takes place should be thoroughly cleaned and unnecessary tools should be removed. Structures such as anchors should be positioned such that a minimum of their surface is exposed to contaminated blasting material.

3.2.2 Prior to removal of AFS without blasting, by mechanical scraping off, the dock floor, slipway or other floor where the operation takes place should be thoroughly cleaned and unnecessary tools should be removed. Structures such as anchors should be positioned such that a minimum of their surface is exposed to contaminated blasting material.

3.2.3 Personnel involved in grit-blasting should wear certified protective gear to prevent coming into contact with the waste produced during operation or with any abrasive fluids or other materials used in the operation. Protective gear should include:
* Fluid-impermeable gloves and boots;
* Face mask to prevent inhaling grit dust or paint particles
* Safety glasses
* Protective suit; that should prevent water from leaking through the clothing
* Safety Hat

3.2.4 Waste containers for different types of wastes that are protected from the environment and which are clearly marked, should be placed at the work floor.

3.2.5 Personnel should clean hands and face immediately after the operation has finished.

3.2.6 For dry grit blasting, provisions should be taken to prevent dust to disperse into the air.

3.2.7 High pressure washing, if needed in conjunction with grit basting, should be done after wet blasting and prior to dry blasting.

3.3 Safe operation and waste collection of AFS Removal by Grit Blasting

Grit blasting will always bring about waste that lands on the work floor, the slipway or the dock floor, often together with other waste particles generated in the operation. When using dry blasting, waste particles and paint dust can become spread into the environment by air, apart from falling on the floor. Air-borne particles from dry blasting can be contained, either by working in a cabin with a filter system for cleaning the exhaust air, by fine-mesh netting around the facility or by having a water screen that catches the air-borne particles and allows them to settle on the work floor. In the latter case the resulting wet waste should be treated

as waste water from wet blasting. When it is windy, dry grit blasting in the open air should not be done.

Grit blasting should always be done at a facility with a fluid-impermeable floor and a system to catch and remove waste water. When it rains during dry grit blasting, the waste will become mixed with the rain water; the resulting wet waste should be treated as waste water from wet blasting. Dry grit blasting, which is the most common practice, generates AFS waste in the form of dust. Such dust needs to be contained so as not to be dispersed into the air around the facility, while personnel should be well protected from inhaling the dust or coming into skin contact with the dust particles.

3.3.1 Dry grit blasting in a dock that is open to the air above should only be done in calm weather conditions.

3.3.2 A maximum allowable wind speed for dry blasting should be set; the maximum allowable wind speed might relate to wind direction.

3.3.3 The personnel should wear protective clothing and gear during the work.

3.3.4 Waste on the floor should immediately be cleaned after the operation has ended; this is a rule of practice that should be included in the rules for good housekeeping.

3.3.5 All waste should be collected in separate containers for specific waste types.

3.3.6 The waste water from grit-blasting should always be contained for treatment.

3.3.7 The contaminated grit should be collected and removed immediately after the operation has finished.

3.3.8 Rain water that runs off from the blasting facility should be collected and treated when work is carried out and also when rain falls on a floor that is not thoroughly cleaned, although no work is being carried out.

4 The Anti-Fouling Removal Waste Chain

Safe grit-blasting Waste Handling

Dry and wet grit-blasting results in contaminated grit mixed with other wastes that result from the operation. Contaminated grit may be re-used after sieving off the broken grit particles, recycled or cleaned. If the yard has a facility to clean used grit such that no waste or contamination can be released into the environment it may do so. If not, the contaminated grit and the sieving waste should be removed and be transferred to a facility licensed to clean blasting grit. Wet grit blasting results in waste water that needs to be always contained whether it has been raining or not.

Safe grit-blasting Waste Treatment

Grit blasting is being done by specific grit of a specific size. The grit consists of an organic material with a very low amount of organic material, which makes contaminated grit unsuitable for thermal destruction; although it might be fit for thermal cleaning. The type of grit material varies; materials used are steel blasting grit, copper cinder, corundum, aluminium, glass beads and other materials. Grit grains can break when hitting a ship's hull at high speed during the blasting process. The resulting grit, mixed with broken grit (grit dust), can be sieved to maintain the intact particles, which can be reused until it has become too contaminated to be fit for re-use. Blasting grit offered for recycling by a licensed facility can be recycled by a cyclone or by a centrifuge.

4.1 AFS Removal Waste Collection

4.1.1 Different types of waste, generated during different activities should be kept separate in containers only intended for that specific type of waste.

4.1.2 After completion of the work the waste containers should be removed for further waste treatment at a specialised facility.

4.1.3 If treatment is not possible the waste may be deposited at a specialised safe deposit that is protected from the environment and capped. Such disposal of waste should be subject to a permit for safe disposal of the specific waste. The disposal facility should be recognised by the authorities.

4.1.4 After terminating the work, the remaining waste should never be removed by washing with water or by brushing it into the environment.

4.1.5 Waste collected during or after the completion of the work should never be buried, incinerated or permanently stored at the facility or in the environment.

4.1.6 Waste collected during or after the completion of the work should never be disposed of outside the facility at a non-recognised disposal facility and without a permit for safe disposal.

4.1.7 Waste collected during or after the completion of the work should never be incinerated outside the facility at a non-recognised thermal destruction facility for highly toxic waste (such as AFS waste containing organotins) and without a permit for safe disposal.

4.1.8 Waste collected during or after completion of the work may, pending safe removal, be temporarily stored at the facility in a container that is protected from the environment and closed by a well-fitting lid. The container should be clearly marked with the type of waste, the amount of waste and the date of storage. No unauthorised personnel should be allowed to put waste into the containers. The relevant authorities should be notified of the temporary storage.

4.2 AFS Removal Waste Water Collection

4.2.1 Waste water should be collected in a container that is protected from the environment and is closed by a lid. In the container only waste water resulting from the removal of AFS should be collected.

4.2.2 The waste water in the container should be left standing to allow suspended particles, to which AFS adheres, to settle.

4.3 AFS Removal Waste Water and Water-Treatment Waste Handling

4.3.1 The waste water collected in a separate container should be subject to a system to remove the contaminated waste and render the water cleaned so as to meet a TSS content of <100 mg/l. No untreated waste water should be allowed to be discharged into surface waters or ground water.

4.3.2 The thus cleaned water could best be discharged through an adequate sewer system, if such system is present. A permit for such discharge from the relevant authorities should be sought.

4.3.3 The settled contaminated suspended particles in the deposit tank should be separated from the supernatant water.

4.3.4 The contaminated sediment from the container should be removed and transported to a licensed facility for treatment or safe disposal.

4.3.5 If discharge of the waste water into surface waters of a special protected area with a sensitive ecosystem is sought, the waste water should be further treated by filtering through a sand-bed filter that itself should regularly be replaced by a clean one.

4.3.6 The contaminated sand-bed filter should be removed and be transported to a specialised facility for treatment, cleaning or recycling of sand- bed filters.

4.3.7 The treated effluent water should have a lower TSS content (<50 mg/l) and should be regularly monitored and be accessible for inspection by the responsible authority/administration.

4.4 AFS Removal Waste handling and treatment upon and after removal from the facility

If contaminated grit cannot be treated it may be deposited in a specific deposit facility that meets the standards for adequate prevention of contact of the deposited matter with the environment. Such facilities should have a specific permit.
Waste treatment to environmentally harmless material should always be the first option. Even safe waste deposit has many disadvantages; it takes up space at the cost of other spatial use and is vulnerable to damage, the waste remains harmful, while aging enhances the chances of contact of the waste with the environment, with groundwater or surface waters and poses a risk of health hazards.

4.4.1 Waste that is removed from the facility should be transported to specialised facility for treatment**.**

4.4.2 The removed waste should be stored in separate containers that are clearly marked of its content, the amount and when it is stored for removal.

4.4.3 The relevant authority should be notified of the type, the amount, and the date of transport of the waste as well as the carrier and to which facility for further treatment the waste will be transported.

4.4.4 Whenever it is possible to treat the waste that option should be pursued. Deposition of waste should only be allowed if no feasible treatment option could be identified.

4.5 Grit-Blasting Waste Handling

4.5.1 Waste water from wet grit blasting should be caught, removed and contained.

4.5.2 The blasting grit that remains on the floor of the facility should be collected and removed for re-use, recycling, treatment (cleaning) or safe deposit.

4.5.3 The contaminated grit should be cleaned at a specific facility with expertise in cleaning of blasting grit.

4.6 Grit-Blasting Waste Treatment

4.6.1 Contaminated grit should be treated for re-use or recycling and should be analysed for being suitable for:
- sieving for re-use
- thermal cleaning
- disposal of the separated grit dust at a licensed facility that is protected from the environment
- disposal of the contaminated grit that is unfit for re-use or recycling at a licensed facility that is protected from the environment

4.6.2 Used grit and sieved off grit dust are contaminated and should be either thermally cleaned to render it harmless, or deposited in a specific licensed facility that is protected from the environment.

4.6.3 Cleaned and contaminated blasting grit should always be kept separate from each other.

4.6.4 Contaminated grit that cannot be treated/cleaned may be deposited in a specific licensed deposit facility that is protected from the surrounding environment.

5. Ship Recycling and AFS Removal – a Special Case

Ships that will be recycled will need a special approach, as, even when organotin-based AFS will no longer be present, underneath the sealer coat the non-compliant AFS may still be present. At present only organotin is identified as harmful anti-fouling in Annex I to the AFS Convention. In the future other AFS systems may be included in Annex I and then should be either totally removed or be treated by a sealer coat to protect the non-compliant AFS from leaching out to other compartments than between the sealer coat and the hull material of the ship, as well as protect it from leaching into the newly applied compliant AFS layer.

At present no best practice for the rendering harmless of non-compliant (organotin-based) AFS has been evolved. Organotins can probably only be adequately destructed by high-temperature incineration in a specialised facility with an adequate exhaust system to catch all toxic by and end products of the incineration. Volatilisation of organotins into the atmosphere from organotin waste left exposed to the air should be prevented.
One option is to break the sealer coat down by adequate techniques and remove the AFS from the hull by similar techniques as presently used for removal of AFS and with a similar environmental practice for catching and containing waste and waste water in specific containers and for the full AFS removal chain. At present organotins are nowhere recognised as substances that receive a specific prescription for destruction. The expectation is that, once organotin is banned from use on ships, this will be regulated by a ban on marketing the substance, so organotin-based AFS will not be available any more. Such practice will do for the normal ship maintenance and repair activities, provided the sealer coat is capable of totally blocking the non-compliant AFS to come into contact with the environment or the overlying compliant AFS layer. The practice will, however, not solve the problem of the potentially continuing presence of organotin underneath sealer coats that will be met when recycling ships.

The option to leave the AFS plus sealer coat on the iron parts to be reprocessed and allow the OT-based AFS to be incinerated in the smelter used for treating the iron for re-use is environmentally not acceptable. Although the high temperatures of iron casting would be sufficient to destroy the chemical bonds of organotins, the smelter process does not meet the required properties for safe thermal destruction of organotins. The exhaust and other waste from a smelter process will still contain highly toxic reaction products such as dioxins.

Both the rest waste and the exhaust products should need specific purification that is capable of catching noxious exhaust gasses and separate noxious substances that result from organotin incineration to remove them from the environment. Such specific provisions in an iron smelter or other facility for melting the bare hull material might mean substantial adaptations to the smelter itself and its waste handling system, with accompanying increased costs.

5.1 When preparing for ship recycling notify the relevant authorities that non-compliant AFS has been or might be encountered underneath a sealer coat.

5.2 Prior to the recycling operation, the facility should ascertain the type of sealer coat on the hull, when it was applied and who was the producer of the sealer coat; the AFS certificate should be checked and, if there is no such information or the certificate is incomplete, the facility should ascertain the type of sealer coat by other means and notify the relevant authority.

5.3 When preparing for ship recycling ascertain what options for treatment of organotin-based AFS waste are available or have been developed and adopted at that point in time.

5.4 If an adequate option for removal, handling and treatment of OT-based AFS waste is available, such treatment should be followed.

5.5 If an adequate option for removal, handling and treatment of OT-based AFS waste is not yet available, the waste should be temporarily deposited in a specialised deposit facility that is protected from the environment and capped. The temporary deposit should be subject to a permit.

5.6 If the sealer coat cannot be treated in conjunction with the treatment of the OT-based AFS, an adequate treatment option for the specific sealer coat should be identified. The sealer coat should then be treated according to the specific treatment available.

Procedure 2.

SAFE PROCEDURES FOR HULL CLEANING AND THE FULL ANTI-FOULING SYSTEMS REMOVAL CHAIN AT AN INCOMPLETELY EQUIPPED FACILITY

Not Fully Equipped Facility, Facility with only a slipway or comparable work floor For Cleaning of Ships' Hulls and Removal of Anti-Fouling Systems

- **Before starting to operate a ship repair and maintenance facility the quality of the water and the soil at the facility should initially be ascertained.**
- **Before starting the work the facility should always ascertain the presence of safe waste treatment facilities and safe waste deposits that are protected from the environment.**
- **Before starting the work the facility should always fully inform itself on the existing infrastructure for the safe transport of AFS waste to treatment and deposit facilities, as well as the infrastructure for AFS waste treatment and safe deposition of AFS waste.**
- **Before starting the work the facility should always ascertain the type of AFS that is to be removed.**

1. The Facility

A. Operation at the facility

Whatever the type of a facility, a clear framework for safe operation and a recognised responsibility are paramount in support of sound environmental and safety practice at the facility. The management is responsible for establishing and communicating a clear code of practice for safe operation as to environment and health at the facility. The management should commit a member of the personnel to be responsible for surveying the implementation of the code of practice. All personnel should be fully informed about the code of practice and about the responsibilities at the facility as to the implementation of the code of practice and should adhere to the code.

Skin contact with anti-fouling systems or their waste bears a health risk as does inhaling AFS dust particles that are dispersed into the air. Apart from safe environmental operation, health hazards have to be prevented by wearing protective clothing, gloves, water-impermeable boots, and a breathing mask that prevents inhaling of AFS particles. Waste water and contaminated sediment should also be prevented from coming into contact with human skin (Wear working boots and gloves that are water-impermeable).
Whatever the level of protective structure and strategy at the facility, good house keeping, including cleaning prior to and immediately after the work has finished, can prevent waste to spread into the environment beyond the facility itself and can protect personnel at the facility to run health risks. Good house keeping, together with working only when the weather is dry at those facilities that have an incomplete waste water catchment and containment system, helps to prevent waste to spread into the water or in the soil.

1.1 Facility Practice

1.1.1 Facility code of practice for safe operation

1.1.1.1 Cleaning of ship's hulls and removal of anti-fouling paints should be done at specialised facilities that have a package of specialised measures, a code of practice, a slipway discipline or a similar framework for preventing contamination of the environment, as well as preventing the practice and its waste to affect the personnel's health.

1.1.1.2 The management should be responsible for the safe and environmentally clean operation and should inform all personnel involved of the used framework for sound and safe operation at the facility.

1.1.1.3 On the work floor one person should be made responsible for regular inspection of the facility, for checking the facility when an operation has finished and for overlooking the AFS removal chain.

1.1.1.4 All personnel should be familiar with the code of practice and the responsibilities for its implementation.

1.1.1.5 Personnel should be familiar with the character of the material they are working with and with associated risks and safe handling instructions for use of the material.

1.1.1.6 The relevant authorities should be informed on the used framework for sound operation at the facility and of the responsibilities as well as of problems with the implementation of the framework and the character of the problems, including possible proposed cures.

1.1.1.7 The work at the facility should be subject to a permit or similar legal authorisation for:
- Environmentally sound operation (yard practice)
- Clean water discharge permit
- Safe and healthy working conditions

1.1.2 Personnel practice

1.1.2.1 Personnel at the facility should adhere to the code of practice and to the good house keeping rules.

1.1.2.2 Personnel at the facility should wear certified protective gear to prevent coming into contact with the waste produced during operation or with any abrasive fluids or other materials used in the operation.

1.1.2.3 Personnel should thoroughly clean their hands and face before consuming food or drinks.

1.1.2.4 Personnel should clean hands and face immediately after the operation has finished.

1.1.2.5 Personnel should not smoke during the work.

1.1.3 Emergency handling

1.1.3.1 In case of an emergency, when the code of practice cannot be implemented, the responsible person at the facility should be informed at the earliest opportunity.

1.1.3.2 In case of an emergency, when the code of practice could not be followed, the relevant authority should be notified on:

- the date of the event
- the character of the event
- if waste water had to be discharged:
- where the waste water has been discharged,
- an estimate of the amount of discharged waste water and the expected contaminants' load.
- what mitigation measures were taken
- which future additional preventive measures are envisaged

1.1.4 Facility limitations and consequence

1.1.4.1 Specific AFS removal techniques, such as grit blasting, require an enclosed dock space or easy and ready access to a specialised grit-blasting room, where the ship can safely grit-blasted.

1.1.4.2 A facility that has only a slipway and no dry or floating docks should not perform grit-blasting AFS cleaning.

B. Organisation of the Facility

The types of facilities for ship maintenance and repair that are present are manifold and run from specified ship repair and docking yards at contained locations to just a location on a shore. It is clear that a contained space with tailored facilities, such as dry docks, floating docks and well-protected slipways, can develop a more refined system for preventing contamination of the environment and protection of its Personnel than can facilities that are less well equipped. Dry docks are structured to allow for containment of waste, which can be cleaned before water is allowed into the dry dock. Floating docks need special provisions to contain waste and waste water within the dock space. Such provision can be a tightly fitting fluid-impermeable vertical barrier at each access end of the floating dock that prevents water to leak through and fine-mesh netting to contain grit-blasting material, waste and dust within the workspace.

Slipways and other work floors need to have a fluid-impermeable floor to prevent contaminated water to leak into the soil underneath. To contain and collect the waste water generated during the work and rain water that has become contaminated by AFS waste a slipway should have a system to catch the waste water and leads it to a provision to contain the waste water. However, wherever a ship's hull is cleaned or has its paint removed, a practice to prevent or reduce contamination of the environment and health risks of its personnel, should always be developed and be commonly known to all involved in the work at the facility. When a facility has not yet a fluid-impermeable floor; such floor should be established at the earliest possible opportunity.

A facility that has been operating without a fluid-impermeable floor with water catchment and containers to keep the waste water separate from the environment, is likely to have the soil underneath and around the facility contaminated by previous operation until depths that can

vary between 10 - 50 centimetres of depth, depending on the soil character, the length of the period of contaminant input and the total amount of water (operation water and rain water).

To prevent further spreading of the contamination, such soil needs to be cleaned or removed and treated, or if that proves not possible to be deposited on land at a specialised, licensed safe deposit, prior to making the facility environmentally sound and safe. Further contamination of the soil can be prevented by a temporary fluid-impermeable floor cover pending installation of a permanent fluid-impermeable floor with a water catchment and containment system.
Underwater sediment contaminated with AFS should be dredged and either treated or be stored on land at a specialised, licensed safe deposit. Such contaminated sediments should not be dumped in an aquatic environment, neither in fresh water, nor in the sea. If a permanent fluid-impermeable floor is not possible, a temporary provision can be installed to contain the waste and protect it from the underlying soil as well as to collect and contain the waste water.

Slipways with a fluid-impermeable floor hat are periodically immersed in water can become undermined. In that case a non-impermeable floor is a better solution. However the risk of contaminating the soil underneath as well as the immersion water should be recognised and the soil and the adjacent water should be regularly monitoring.

1.2 Facility Equipment

1.2.1 Facility design

1.2.1.1 The facility should have a good access and evacuation route.

1.2.1.2 The facility should have a fluid-impermeable floor with a water catchment and containment system.

1.2.1.3 When a fluid-impermeable floor is present the work should start at a clean floor and the floor should be thoroughly cleaned after completion of the work.

1.2.1.4 The fluid-impermeable floor should have a system for catching and containing all waste water from the AFS removal or hull cleaning process, including rain water that falls in the period from the start of the work until the facility is thoroughly cleaned after completion of the work.

1.2.1.5 When a fluid-impermeable floor is not present a temporary fluid-impermeable protection floor should be installed. The temporary floor should be capable of containing the water in such manner that the waste water can be contained and collected for treatment. The temporary floor should be thoroughly cleaned after completion of the work

1.2.2 Environmental and safety provisions

1.2.2.1 Before the work starts, waste containers for different types of wastes and which are clearly marked, should be placed at the work floor.

1.2.2.2 Certified protective gear to be used by personnel during the work should include:

* Gloves and boots;
* Face mask to prevent inhaling waste and paint particles
* Safety glasses
* Protective suit
* Safety helmet

1.3 Facility Structures

Slipway and Work Floor Handling
A slipway or other work floor where an AFS removal or hull cleaning operation has taken place contains a mixture of different types of waste, contaminated mud resulting from the hull cleaning, mechanical removal activities, remains from welding work, used polishing cloth etc.

1.3.1 Slipway

1.3.1.1 A **slipway** should have a fluid-impermeable floor.

1.3.1.2 If the facility is operating on a **slipway**, the slipway should have installed in the fluid-impermeable floor a catchment system for waste water resulting from the operation at the slipway and for rain water that has been falling during operation or when the slipway floor has not yet been thoroughly cleaned. The water-catchment system can consist of a gutter running underneath the floor and leading the water to a waste water container that is protected from the environment and closed on top, so no other material or water can enter the container.

1.3.1.3 When a fluid-impermeable floor is not present, a temporary fluid-impermeable protection floor should be installed. The temporary floor should be capable of containing the water in such manner that the waste water can be collected and contained for treatment. The temporary floor should be thoroughly cleaned after completion of the work

1.4 Waste collection and handling at the facility

Preparation for the further AFS Removal Chain.
Different types of waste that are present or generated at the facility include remains of paint or surfactant fluids, used oil, chemicals, used and empty paint and solvent cans and materials used during the work, such as cleaning rags and brushes and other cleaning tools. The waste consists of solid wastes and waste water, which both should be collected and contained within the work space during and at the end of the work. Discharge of waste water and dumping of waste into the environment must be prevented at all times. As hull cleaning and AFS removal are done in the immediate vicinity of coastal or inland waters, waste from a facility, if not properly contained, is likely to enter the water, where it can spread unlimitedly and becomes itself a source of contamination of the sediments and natural and food resources in the water.

Surface and ground water are both human resources, for drinking, food and recreational use. It is paramount to protect both water and soil from becoming polluted to the detriment of the environment and of human health.

Organotin-based AFS (TBT) adsorb strongly to sediment particles, the organic matrix and biota, all particles that eventually sink in quiet waters. Once integrated in sediments organotins can last for decades. This adsorption property of OT-based AFS waste can be used to clean AFS waste water to a relatively safe level, without needing to use complicated treatment structures or processes. When AFS waste water is left standing in a tailored container, the sediment will settle, together with the organic matrix and biotic particles, after which the supernatant water can be separated from the sediment and be discharged or be further treated when additional environmental requirements are present.

The discharge water from the deposition tank is safe to discharge when the level of suspended particles is below 100 mg/litre. This method to treat waste water from ship maintenance and repair facilities has been developed as a tailor-made approach for such facilities that would both fulfil the environmental requirements for discharge water and the requirements for adequate operation at the facility. The prototype strategy for environmental performance of ship building and repair facilities of which this specific water treatment is part, originally developed by the Netherlands water authorities in cooperation with the ship building industry, now stands an example for an overall EU environmental strategy for the ship building and repair industry (De Vries, VNSI). The strategy to develop and implement better environmental performance for ship building and repair facilities exists of a set of measures that all result in improving environmental performance and has gradually been implemented from 1985 onwards. The strategy has been developed on the base of a Dutch government report (CUWVO, 1991). The strategy has as yet resulted in a 90% reduction in emissions; at the target year of implementing the strategy (2010) emissions will be reduced by 95% (De Vries, 1996/2005).

Waste handling and treatment upon and after removal from the facility.
AFS waste that is removed for treatment should be transported in a safe manner to a licensed facility for treatment. Depending on the waste material and the level of contamination treatment should be:

- Recycling (such as grit, sand-bed filters)
- Separating the material from its waste to render the cleaned material suitable for re-use
- Destruction / Rendering harmless of the waste.
- AFS waste can only be rendered harmless by controlled thermal destruction, in a specialised waste destruction facility (such as a rotary killn), at ultra-high temperatures with exhaust catchment and cleaning provisions.
- If all options for further treatment are impossible or not accessible then the waste should be deposited in a licensed facility that is protected from the environment and capped and cannot leak water or other fluids into the environment. The facility is subject to a permit.
- The options available for waste treatment depend on the available infrastructure.

Waste Treatment to Environmentally Harmless Material should always be the first option. Even Safe Waste Deposit has many disadvantages. It takes up space at the cost of other spatial use and is vulnerable to damage, the waste remains harmful, while aging enhances the chances of contact of the waste with the environment, with groundwater or surface waters and poses a risk of health hazards.

1.4.1 General rules for waste collection

1.4.1.1 Have a responsible person at the facility for waste and waste water management.

1.4.1.2 Personnel at the facility should adhere to the code of practice and the good house keeping rules. If in case of an emergency, the code of practice cannot be implemented, the responsible person at the facility should be informed at the earliest opportunity.

1.4.1.3 Different types of waste, generated during different activities should be kept separate in containers that are only intended for that specific type of waste. The containers should be clearly marked and should be available at the location where the work that generates the specific waste is taking place.

1.4.1.4 All generated waste should immediately be placed in the adequate container. When a container is full, it should be removed and immediately replaced by a clean one.

1.4.1.5 One person at the facility should be responsible for handling and temporary storage of waste at the facility; all personnel at the facility should be familiar with the waste handling code of practice at the facility.

1.4.2 General rules for waste handling

1.4.2.1 After completion of the work, the waste containers should be removed for waste treatment at a specialised facility

1.4.2.2 Waste stored in specific containers should be collected by a specialised operator and upon collection the storage containers should be immediately replaced by empty ones.

1.4.2.3 Waste may temporarily be stored at the facility, pending final removal. Register/record temporarily stored waste and (waste) water.

1.4.2.4 Transport separate wastes in separate containers that are protected from the environment.

1.4.2.5 Bring waste to a licensed facility to process, treat and/or recycle the waste.

1.4.2.6 If treatment is not possible the waste may be deposited at a specialised safe deposit that is protected from the environment and capped. Such disposal of waste should be subject to a permit for safe disposal of the specific waste. The disposal facility should be recognised by the authorities.

1.4.2.7 After completion of the work, the remaining waste should never be removed by washing with water or by brushing it into the environment.

1.4.2.8 Waste collected during or after completion of the work should never be buried, incinerated or permanently stored at the facility or in the environment.

1.4.2.9 Waste collected during or after completion of the work should never be disposed of outside the facility at a non-recognised disposal facility and without a permit for safe disposal.

1.4.2.10 Waste collected during or after completion of the work may, pending safe removal, be temporarily stored at the facility in a container that is protected from the environment and closed by a well-fitting lid. The container should be clearly marked with the type of waste, the amount of waste and the date of storage. No unauthorised personnel should be allowed to put waste into the containers. The relevant authorities should be notified of the temporary storage.

1.4.2.11 Record the amount of discharged water and the date and location of discharge.

1.4.2.12 Keep wastes separate and protected from the environment.

1.4.2.13 A ship repair and maintenance facility should have a transport system for used water and rain water that can come in contact with waste from its activities.

1.4.3. Safe waste water collection

1.4.3.1 Waste water should be collected in a container that is protected from the environment and is closed by a lid. In the container only waste water resulting from the removal of AFS should be collected.

1.4.3.2 Waste water collected in a separate container should be subject to a deposition system to remove the contaminated waste that adheres to the sediment to render the water sufficiently free of harmful AFS to be suitable for discharge into surface waters. No untreated waste water should be allowed to be discharged into surface waters or ground water.

1.4.3.3 Waste water in the container should be left standing to allow suspended particles, to which AFS adheres, to settle.

1.4.4 Requirements for discharge water

1.4.4.1 The suspended particle load of discharged water should be less than (100 mg/litre) as a safety level for water that is feasible for discharge into surface waters.

1.4.4.2 The pH of discharged water should be within limits (pH between 6.5 and 9 as advisory range).

1.4.4.3 The amount of water to be discharged and the intended date of discharge should be reported to the relevant authorities

1.4.4.4 Report spills and accidents that contaminate surface waters and/or the soil.

1.4.5 Handling of the waste water system

1.4.5.1 The waste water system operated at the facility is for sole use for waste water generated by the facility's activities only; it should only be accessible for personnel of the facility.

1.4.5.2 Non-yard persons or instances should not be allowed to use the yard waste water system.

1.4.5.3 If yard soil is contaminated by AFS waste water it should be removed and sent for treatment after approval by the relevant authorities.

1.4.6 Handling of waste water

1.4.6.1 The settled contaminated suspended particle sin the deposit tank should be separated from the supernatant water.

1.4.6.2 The contaminated sediment from the deposition container should be removed and transported to a licensed facility for treatment or safe disposal.

1.4.6.3 If the facility is located in a special sensitive environment, such as a MPCA, the waste water should be further treated by filtering through a sand-bed filter to a lower TSS content (<50 mg/l) that itself should regularly be replaced by a clean one.

1.4.6.4 The contaminated sand-bed filter should be removed and be transported to a specialised facility for treatment, cleaning or recycling of sand- bed filters.

1.4.6.5 The treated effluent water should meet the effluent standard and should be regularly monitored and be accessible for inspection by the responsible authority/administration. The amount of water to discharge and the intended date of discharge should be reported to the relevant authorities.

1.4.6.6 Discharge treated water on a sewer system with adequate sewer treatment if possible and subject to a permit from the relevant authority.

1.4.7 Emergency waste water handling

1.4.7.1 In case of emergency, *when waste water has been discharged*, the responsible authority should be notified that the procedure could not be followed, where waste water has been discharged, and, if possible an estimate of the amount of discharged waste water and the expected contaminants present. The authorities should also be notified of the mitigation measures undertaken by the facility and possible future additional preventive measures.

1.4.8 Preparatory action for the AFS waste chain

1.4.8.1 Contaminated water and rainwater that has been in contact with waste should be kept separate from surface waters; never allow discharge of contaminated water into surface waters.

1.4.8.2 A best further treatment option for AFS waste should be sought. The ranking of best preferential options is:
1st Re-used after cleaning, the remaining waste to be treated
2nd Recycling
3rd Rendered harmless by specific and tailored treatment
4th Deposited at a licensed facility that is protected from the environment and capped

1.4.8.3 A facility should acquire a permit from the relevant authority for temporary storage and containment of waste and waste water and materials used, such as cleaning tools.

2. Hull Cleaning

Introduction and preventive regime

Hull Cleaning is done by brushing off fouling organisms, wiping off slimy (algal) films and removing corrosion.

Hulls cleaning practice is at present done:

- on land, where wastes can be contained
- in the water, where containing wastes is ***impossible***

The most commonly used organotin-based anti-fouling paints are highly toxic and can accumulate throughout the food chain and in human food resources. AFS waste should not enter the environment, neither in the water nor on land. Hull-fouling organisms are likely to have taken up an appreciable amount of active substances and biocides from the AFS used on the hull; they will therefore pose an ecotoxicological effect as well as a potential alien invader risk. Such organisms may settle in the adjacent, contaminated environment and grow in an environment that is contaminated by AFS waste, and may be ingested by human

food resources or later on, when grown, be recognised themselves as food resources; a food resource that may have considerable amounts of the hormone disruptor tributyltin (TBT) and its metabolites.

(i) Waste from cleaning of ship's hulls should be contained and removed for treatment or safe disposal.

(ii) Collecting human food from areas where ships' hulls are cleaned under water should be prevented.

(iii) Collecting human food from areas where waste from ships' hull cleaning or AFS removal has been discharged into the environment should be prevented.

2.1 In-Water Hull Cleaning – an Environmental and Health Risk

In-water hull cleaning when in water releases anti-fouling particles and fouling organisms, which are contaminated by AFS and can bring AFS in the food chain and into human food resources.

The practice of in-water hull cleaning
Ship's hulls are regularly cleaned to remove fouling organisms from the hull (so as to maintain proper sailing quality).
When the underwater part of ship's hulls needs to be cleaned from fouling organisms or corroded parts, in the past the choice was often made to do that when the ship is still in the water. The cleaning is done by brushing, or brushing/scrubbing systems, operated by (scuba) divers or, when small ships, also by personnel standing in the water. This practice, although convenient on economic and time-management grounds, brings about considerable risks for both the environment and human health. The waste from under-water cleaning of ship's hulls consists of paint flakes and particles, combined with fouling organisms. The major risk is posed by AFS particles that are released into the water, causing environmental impacts and a health risk for those who operate such under-water cleaning. An associated risk is the release into the water of fouling organisms that may have come from other seas transported on the ships' hull, enhancing the risk of alien invasions. Alien invasive species can affect local marine ecosystems and marine food resources and can bring about outbreaks of diseases.

AFS waste or organisms contaminated by AFS resulting from in-water hull cleaning cannot be contained
Long-standing experience with methods to clean ship's hulls under water has shown that when in the water it is not feasible to clean ship's hulls in such way that the resulting waste can be totally lifted out of the water so as to be completely separate from the surface waters. Although the practice has been sought in the past, this option should be phased out at the earliest opportunity. The waste of hull-cleaning activities underwater will always run the risk of bringing resulting waste into the environment, not only flakes and particles of anti-fouling paints, also the fouling organisms will be released, which can result in introduction and establishment of alien invasive organisms, which is also to the detriment of the natural aquatic ecosystem and natural resources. Extensive experiments have shown that when a ship remains in the water none of the applied methods have the capacity to catch the waste such that it is totally separated from the surrounding waters. Waste particles will always leak through protective devices, such as nets, curtains etc.

If an AFS paint is very hard, soft brushing when just an initial soft (slimy) layer has been formed might prevent AFS waste to enter the environment

Such practice, although it minimised the risk of bringing AFS contamination into the water, still will release fouling organisms, thus enhancing the risk of alien invasions and harmful algal blooms.

2.1.1 When in-water cleaning of a ship's hull is carried out, the waste should in its entirety be brought to the surface, where it can be collected and contained

2.1.2 When operating under water for the purpose of cleaning a ship's hull, certified protective gloves should be worn and clothing that prevents skin contact with AFS and AFS waste removed from the hull.

2.1.3 When it is urgently needed to clean a ship that cannot be taken out of the water, this should only been done by a soft brush and at an early stage of fouling, when there is only a thin slimy algal layer, that can adequately be removed by soft brushing.

2.1.4 When organisms are stuck to the ship's hull, which removal runs the risk of damaging the AFS paint/system and releasing AFS particles, the ship should be taken out of the water to clean the hull.

2.1.5 Ship's hulls should always be cleaned on land; the practice of in-water cleaning of ship's hulls should be phased out at the earliest opportunity.

2.2 Hull Cleaning on Land

The practice of Hull cleaning on land

On land it is possible and feasible to collect and contain waste generated by hull cleaning. On land ship's hulls are cleaned by high pressure water washing and/or brushing. This activity results in a waste consisting of paint flakes, rust particles and fouling organisms. As this activity is wet, the waste will mix with the water used and needs to be contained to prevent the wastewater entering the surface waters and to penetrate in the underlying and surrounding soil and underwater sediments. When operating a high-pressure wash in rain, the rainwater will become contaminated by the generated waste as well.

2.2.1 To prevent the contaminated hull-cleaning waste water to enter surface waters, cleaning of ship's hulls by high-pressure washing should be done on a fluid-impermeable floor, with a system to collect the waste water and to contain rainwater that has been in touch with the waste.

2.2.2 When a fluid-impermeable floor is present the work should start with a clean floor and the floor should be thoroughly cleaned after completion of the work.

2.2.3 When a fluid-impermeable floor is not present a temporary fluid-impermeable protection floor should be installed. The temporary floor should be capable of containing the waste and waste water in such manner that the waste water can be collected and left for treatment. The temporary floor should be thoroughly cleaned after completion of the work.

2.2.4 After operation the facility should be immediately cleaned after completion of he work.

2.3 Hull-Cleaning Waste Collection

2.3.1 Solid waste of material used during hull cleaning should be collected in a container that is protected from the environment.

2.3.2 The contaminated water from hull cleaning should be collected in a container that is protected from the environment and is separate from waste water resulting from other activities at the facility.

2.4 Hull-Cleaning Waste Handling

2.4.1 The suspended solids in the contained waste water should be allowed to settle to catch most of the AFS, which is adsorbed to the suspended particles.

2.4.2 When the suspended solids have settled, discharge of the supernatant waste water (TSS < 100 mg/l)should be subject to a permit.

2.4.3 When the suspended solids have settled the supernatant water should preferably be discharged through a general water treatment system, a sewage system or a similar facility that further processes waste water. If that is not possible the waste water may be discharged into surface waters, subject to a permit.

2.4.4 When the suspended solids have settled, and further treatment is sought due to specific sensitivity of the ecosystem of the waters in the surrounding area, the water can be further purified by filtering over a sand-bed or comparable cleaning filter until the effluent water meets the standard for discharge (not more than 50 mg/ litre of suspended solids).

2.4.5 The filter should be regularly checked for excess contamination and be cleaned on a regular basis by a licensed facility.

2.4.6 When the filter is too contaminated to be cleaned it should be transferred to a treatment facility (recycling or destruction), or if that is not possible be deposited at a licensed facility that is protected form the environment.

2.4.7 The sediment from the deposition tank should be transferred to a licensed facility for cleaning for re-use, for recycling or for further treatment.

2.4.8 If treatment or cleaning/recycling is not possible, the sediment should be deposited in a specialised licensed deposit facility that is protected from the environment and capped.

2.4.9 When the facility has previously been operating without a fluid-impermeable floor, the contaminated soil underneath the slipway or floor should be cleaned/ removed prior to installing a fluid-impermeable floor with water a catchment provision

3. Removal of Anti-Fouling Systems

AFS Removal from Ship's hulls can be done by mechanical removal, scraping off of old paint layers and by grit blasting. Grit blasting can be dry blasting, wet blasting or high-pressure blasting. Grit blasting roughens the surface so loose AFS paint and corrosion or other particles can be easily removed completely and new paint will better adhere to the surface.

Grit blasting, where grit is blasted with force to the hull surface, is likely to spread the blasting material to considerable distance and should therefore only been done at a space that has walls or other protective structures at all sides to contain the material within the work space. This means that grit blasting should only been done in either an enclosed hall or room, in a dry dock with the doors closed or in a floating dock that has fine-mesh netting at the open sides.

After 1 January 2008 the non-compliant organotin-based anti-fouling systems might have been sealed off by an impermeable sealer coat that fully prevents the non-compliant AFS to leach into the environment or into the compliant AFS layer on the hull.

3.1 Preparatory Assessment for Removal of AFS

3.1.1 AFS should only been removed by mechanical means such as scraping off

3.1.2 AFS should only be removed in a space that is protected by a fluid-impermeable floor with a water catchment and containment system.

3.1.3 Prior to starting the operation to remove the old AFS layer, the facility should ascertain the type of AFS on the hull, when it was applied and who was the producer of the AFS; the AFS certificate should be checked and, if there is no such information or the certificate is incomplete, the facility should ascertain the type of AFS by other means and notify the relevant authority.

3.1.4 When a sealer coat is used to prevent the non-compliant AFS underneath from leaching out; the seal coat should be checked for being capable of remaining intact when grit-blasted.

3.1.5 Prior to removing the old AFS layer, the facility should ascertain the type of sealer coat on the hull, when it was applied and who was the producer of the sealer coat; the AFS certificate should be checked and, if there is no such information or the certificate is incomplete, the facility should ascertain the type of sealer coat by other means and notify the relevant authority.

3.1.6 Grit blasting should never been done at a facility that has only a slipway or comparable work floor.

3.2 Preparatory Action for Removal of AFS

3.2.1 Prior to AFS removal the floor where the operation will take place should be thoroughly cleaned and unnecessary tools should be removed. Structures such as anchors should be positioned such that a minimum of their surface is exposed to contaminated material.

3.2.2 Personnel involved in AFS removal should wear certified protective gear to prevent coming into contact with the waste produced during operation or with any abrasive fluids or other materials used in the operation. Protective gear should include:

* Fluid-impermeable gloves and boots;
* Face mask to prevent inhaling dust or paint particles
* Safety glasses
* Protective suit; that should prevent water from leaking through the clothing
* Safety Hat

3.2.3 Waste containers for different types of wastes that are protected from the environment and which are clearly marked, should be placed at the work floor.

3.2.4 Personnel should clean hands and face immediately after the operation has finished.

3.2.5 High pressure washing, if needed, should be done prior to AFS removal.

Safe Removal of AFS by Mechanical Means, such as Scraping, and AFS Waste Collection

Mechanical AFS removal will always bring about waste that lands on the work floor, the slipway or the dock floor, often together with other waste particles generated in the operation. When scraping, paint dust may become dispersed by air, apart from particles falling on the floor. Air-borne particles can be prevented by not working in windy conditions and can be contained by fine-mesh netting around the facility or by having a water screen that catches the air-borne particles and allows them to settle on the work floor. In the latter case the resulting wet waste should be treated as waste water from wet blasting. Personnel should be well protected from inhaling the dust or coming into skin contact with the dust particles.

Mechanical AFS removal should always been done at a facility with a fluid-impermeable floor and a system to catch and remove waste water. When it rains at dry mechanical removal, the waste will become mixed with the rain water; the resulting wet waste should be treated as waste water from AFS removal.

3.3.1 Personnel should wear protective clothing and gear during the work.

3.3.2 Waste that is left on the floor should immediately be cleaned after the operation has ended; this is a rule of practice that should be included in the rules for good housekeeping.

3.3.3 All waste should be collected in separate containers for specific waste types.

3.3.4 The waste water from AFS removal should always be contained for treatment.

3.3.5 The contaminated AFS waste should be collected and removed immediately after the operation has finished.

3.3.6 Rain water run off from the facility should be collected and treated when work is carried out and also when rain falls on a floor that is not thoroughly cleaned, although no work is being carried out.

4 The Anti-Fouling Removal Waste Chain

AFS waste is highly toxic material, which should neither enter the environment nor come into contact with humans. A preventive approach is crucial in all steps from AFS waste collection to final rendering harmless or safe deposit. Waste Treatment to Environmentally Harmless Material should always be sought. Any waste deposit, no matter how safe, entails long-lasting risks of environmental and human health hazards.

4.1 AFS Removal Waste Collection

4.1.1 Different types of waste, generated during different activities should be kept in the separate in containers only intended for that specific type of waste.

4.1.2 After completion of the work the waste containers should be removed for further waste treatment at a specialised facility.

4.1.3 If treatment is not possible the waste may be deposited at a specialised safe deposit that is protected from the environment and capped. Such disposal of waste should be subject to a permit for safe disposal of the specific waste. The disposal facility should be recognised by the authorities.

4.1.4 After completion of the work, the remaining waste should never be removed by washing with water or by brushing it into the environment.

4.1.5 Waste collected during or after the completion of the work should never be buried, incinerated or permanently stored at the facility or in the environment.

4.1.6 Waste collected during or after the completion of the work should never be disposed of outside the facility at a non-recognised disposal facility and without a permit for safe disposal.

4.1.7 Waste collected during or after the completion of the work should never be incinerated outside the facility at a non-recognised thermal destruction facility for highly toxic waste (such as AFS waste containing organotins) and without a permit for safe disposal.

4.1.8 Waste collected during or after completion of the work may, pending safe removal, be temporarily stored at the facility in a container that is protected from the environment and closed by a well-fitting lid. The container should be clearly marked with the type of waste, the amount of waste and the date of storage. No unauthorised personnel should be allowed to put waste into the containers. The relevant authorities should be notified of the temporary storage.

4.2 AFS Removal Waste Water Collection

4.2.1 Waste water should be collected in a container that is protected from the environment and is closed by a lid. In the container only waste water resulting from the removal of AFS should be collected.

4.2.2 The waste water in the container should be left standing to allow suspended particles, to which AFS adheres, to settle.

4.3 AFS Removal Waste Water and Water-Treatment Waste Handling

4.3.1 The waste water collected in a separate container should be subject to a system to remove the contaminated waste and render the water cleaned so as to meet a TSS content of <100 mg/l. No untreated waste water should be allowed to be discharged into surface waters or ground water.

4.3.2 The thus cleaned water could best be discharged through an adequate sewer system, if such system is present. A permit for such discharge from the relevant authorities should be sought.

4.3.3 The settled contaminated suspended particles in the deposit tank should be separated from the supernatant water.

4.3.4 The contaminated sediment from the container should be removed and transported to a licensed facility for treatment or safe disposal.

4.3.5 If discharge of the waste water into surface waters of a special protected area with a sensitive ecosystem is sought, the waste water should be further treated by filtering through a sand-bed filter that itself should regularly be replaced by a clean one.

4.3.6 The contaminated sand-bed filter should be removed and be transported to a specialised facility for treatment, cleaning or recycling of sand- bed filters.

4.3.7 The treated effluent water should have a lower TSS content (<50 mg/l) and should be regularly monitored and be accessible for inspection by the responsible authority / administration.

4.4 AFS Removal Waste handling and treatment upon and after removal from the facility

If contaminated AFS waste cannot be treated it may be deposited in a specific deposit facility that meets the standards for adequate prevention of contact of the deposited matter with the environment. Such facilities should have a specific permit.

Waste treatment to environmentally harmless material should always be the first option. Even safe waste deposit has many disadvantages; it takes up space at the cost of other spatial use and is vulnerable to damage, the waste remains harmful, while aging enhances the chances of contact of the waste with the environment, with groundwater or surface waters and poses a risk of health hazards.

4.4.1 Waste that is removed from the facility should be transported to specialised facility for treatment.

4.4.2 The removed waste should be stored in separate containers that are clearly marked of its content, the amount and when it is stored for removal.

4.4.3 The relevant authority should be notified of the type, the amount, and the date of transport of the waste as well as the carrier and to which facility for further treatment the waste will be transported.

4.4.4 Whenever it is possible to treat the waste that option should be pursued. Deposition of waste should only be allowed if no feasible treatment option could be identified.

4.5 AFS Removal Waste Handling

4.5.1 Waste water from mechanical AFS removal should be caught, removed and contained.

4.5.2 The AFS waste that remains on the floor of the facility should be collected and removed for re-use, recycling or treatment (cleaning).

4.5.3 AFS removal waste should be removed to a specialised facility for treatment.

4.5.4 AFS removal waste that cannot be treated/cleaned may be deposited in a specific licensed deposit facility that is protected from the surrounding environment.

5. Ship Recycling and AFS Removal – a Special Case

Ships that will be recycled will need a special approach, as, even when organotin-based AFS will no longer be present, underneath the sealer coat the non-compliant AFS may still be present. At present only organotin is identified as harmful anti-fouling in Annex I to the AFS Convention. In the future other AFS systems may be included in Annex I and then should be either totally removed or be treated by a sealer coat to protect the non-compliant AFS from leaching out to other compartments than between the sealer coat and the hull material of the ship, as well as protect it from leaching into the newly applied compliant AFS layer.
At present no best practice for the rendering harmless of non-compliant (organotin-based) AFS has been evolved. Organotins can probably only be adequately destructed by high-temperature incineration in a specialised facility with an adequate exhaust system to catch all toxic by and end products of the incineration. Volatilisation of organotins into the atmosphere from organotin waste left exposed to the air should be prevented.

One option is to break the sealer coat down by adequate techniques and remove the AFS from the hull by similar techniques as presently used for removal of AFS and with a similar environmental practice for catching and containing waste and waste water in specific containers and for the full AFS removal chain. At present organotins are nowhere recognised as substances that receive a specific prescription for destruction. The expectation is that, once organotin is banned from use on ships, this will be regulated by a ban on marketing the substance, so organotin-based AFS will not be available any more. Such practice will do for the normal ship maintenance and repair activities, provided the sealer coat is capable of totally blocking the non-compliant AFS to come into contact with the environment or the overlying compliant AFS layer. The practice will, however, not solve the problem of the potentially continuing presence of organotin underneath sealer coats that will be met when recycling ships.

The option to leave the AFS plus sealer coat on the iron parts to be reprocessed and allow the OT-based AFS to be incinerated in the smelter used for treating the iron for re-use is environmentally not acceptable. Although the high temperatures of iron casting would be sufficient to destroy the chemical bonds of organotins, the smelter process does not meet the required properties for safe thermal destruction of organotins. The exhaust and other waste from a smelter process will still contain highly toxic reaction products such as dioxins. Both the rest waste and the exhaust products should need specific purification that is capable of catching noxious exhaust gasses and separate noxious substances that result from organotin incineration to remove them from the environment. Such specific provisions

in an iron smelter or other facility for melting the bare hull material might mean substantial adaptations to the smelter itself and its waste handling system, with accompanying increased costs.

5.1 When preparing for ship recycling notify the relevant authorities that non-compliant AFS has been or might be encountered underneath a sealer coat.

5.2 Prior to the recycling operation, the facility should ascertain the type of sealer coat on the hull, when it was applied and who was the producer of the sealer coat; the AFS certificate should be checked and, if there is no such information or the certificate is incomplete, the facility should ascertain the type of sealer coat by other means and notify the relevant authority.

5.3 When preparing for ship recycling ascertain what options for treatment of organotin-based AFS waste are available or have been developed and adopted at that point in time.

5.4 If an adequate option for removal, handling and treatment of OT-based AFS waste is available, such treatment should be followed.

5.5 If an adequate option for removal, handling and treatment of OT-based AFS waste is not yet available, the waste should be temporarily deposited in a specialised deposit facility that is protected from the environment and capped. The temporary deposit should be subject to a permit.

5.6 If the sealer coat cannot be treated in conjunction with the treatment of the OT-based AFS, an adequate treatment option for the specific sealer coat should be identified. The sealer coat should then be treated according to the specific treatment available.

Procedure 3.

SAFE PROCEDURES FOR HULL CLEANING AND THE FULL ANTI-FOULING SYSTEMS REMOVAL CHAIN AT AN IMPROVISED FACILITY

Not Fully Equipped temporarily established Facility, at a location not-specifically designed for ship maintenance and repair work,
for
Cleaning of Ships' Hulls and Removal of Anti-Fouling Systems

- **Before starting to operate a ship repair and maintenance facility the quality of the water and the soil at the facility should initially be ascertained.**
- **Before starting the work the facility should always ascertain the presence of safe waste treatment facilities and safe waste deposits that are protected from the environment.**
- **Before starting the work the facility should always fully inform itself on the existing infrastructure for the safe transport of AFS waste to treatment and deposit facilities, as well as the infrastructure for AFS waste treatment and safe deposition of AFS waste.**
- **Before starting the work the facility should always ascertain the type of AFS that is to be removed.**

1. The Facility

A. Operation at the facility

Whatever the type of a facility, a clear framework for safe operation and a recognised responsibility are paramount in support of sound environmental and safety practice at the facility. The management is responsible for establishing and communicating a clear code of practice for safe operation as to environment and health at the facility. The management should commit a member of the personnel to be responsible for surveying the implementation of the code of practice. All personnel should be fully informed about the code of practice and about the responsibilities at the facility as to the implementation of the code of practice and should adhere to the code.

Skin contact with anti-fouling systems or their waste bears a health risk as does inhaling AFS dust particles that are dispersed into the air. Apart from safe environmental operation, health hazards have to be prevented by wearing protective clothing, gloves, water-impermeable boots, and a breathing mask that prevents inhaling of AFS particles. Waste water and contaminated sediment should also be prevented from coming into contact with human skin (Wear working boots and gloves that are water-impermeable).
Whatever the level of protective structure and strategy at the facility, good house keeping, including cleaning prior to and immediately after the work has finished, can prevent waste to spread into the environment beyond the facility itself and can protect personnel at the facility to run health risks. Good house keeping, together with working only when the weather is dry at those facilities that have an incomplete waste water catchment and containment system, helps to prevent waste to spread into the water or in the soil.

1.1 Facility Practice

1.1.1 Facility code of practice for safe operation

1.1.1.1 Cleaning of ship's hulls and removal of anti-fouling paints should be done at specialised facilities that have a package of specialised measures, a code of practice, a work-floor discipline or a similar framework for preventing contamination of the environment, as well as preventing the practice and its waste to affect the personnel's health.

1.1.1.2 The management should be responsible for the safe and environmentally clean operation and should inform all personnel involved of the used framework for sound and safe operation at the facility.

1.1.1.3 On the work floor one person should be made responsible for regular inspection of the facility, for checking the facility when an operation has finished and for overlooking the AFS removal chain.

1.1.1.4 All personnel should be familiar with the code of practice and the responsibilities for its implementation.

1.1.1.5 Personnel should be familiar with the character of the material they are working with and with associated risks and safe handling instructions for use of the material.

1.1.1.6 The relevant authorities should be informed on the used framework for sound operation at the facility and of the responsibilities as well as of problems with the implementation of the framework and the character of the problems, including possible proposed cures.

1.1.1.7 The work at the facility should be subject to a permit or similar legal authorisation for:
- Environmentally sound operation (yard practice)
- Clean water discharge permit
- Safe and healthy working conditions

1.1.2 Personnel practice

1.1.2.1 Personnel at the facility should adhere to the code of practice and to the good house keeping rules.

1.1.2.2 Personnel at the facility should wear certified protective gear to prevent coming into contact with the waste produced during operation or with any abrasive fluids or other materials used in the operation.

1.1.2.3 Personnel should thoroughly clean their hands and face before consuming food or drinks.

1.1.2.4 Personnel should clean hands and face immediately after the operation has finished

1.1.2.5 Personnel should not smoke during the work.

1.1.3 Emergency handling

1.1.3.1 In case of an emergency, when the code of practice cannot be implemented, the responsible person at the facility should be informed at the earliest opportunity.

1.1.3.2 In case of an emergency, when the code of practice could not be followed, the relevant authority should be notified on:

- the date of the event
- the character of the event
- if waste water had to be discharged:
- where the waste water has been discharged,
- an estimate of the amount of discharged waste water and the expected contaminants' load.
- what mitigation measures were taken
- which future additional preventive measures are envisaged

1.1.4 Facility limitations and consequence

1.1.4.1 Specific AFS removal techniques, such as grit blasting, require an enclosed dock space or easy and ready access to a specialised grit-blasting room, where the ship can safely grit-blasted.

1.1.4.2 A facility that has been established at a not specifically-designed ship maintenance and repair location should never perform grit-blasting AFS cleaning.

B. Organisation of the Facility

The types of facilities for ship maintenance and repair that are present are manifold and run from specified ship repair and docking yards at contained locations to just a location on a shore. It is clear that a contained space with tailored facilities, such as dry docks, floating docks and well-protected slipways, can develop a more refined system for preventing contamination of the environment and protection of its personnel than can facilities that are less well equipped. Dry docks are structured to allow for containment of waste, which can be cleaned before water is allowed into the dry dock. Floating docks need special provisions to contain waste and waste water within the dock space. Such provision can be a tightly fitting fluid-impermeable vertical barrier at each access end of the floating dock that prevents water to leak through and fine-mesh netting to contain grit-blasting material, waste and dust within the workspace.

Slipways and other work floors need to have a fluid-impermeable floor to prevent contaminated water to leak into the soil underneath. To contain and collect the waste water generated during the work and rain water that has become contaminated by AFS waste a slipway should have a system to catch the waste water and leads it to a provision to contain the waste water. However, wherever a ship's hull is cleaned or has its paint removed, a practice to prevent or reduce contamination of the environment and health risks of its Personnel, should always be developed and be commonly known to all involved in the work at the facility. When a facility has not yet a fluid-impermeable floor; such floor should be established at the earliest possible opportunity.

A facility that has been operating without a fluid-impermeable floor with water catchment and containers to keep the waste water separate from the environment, is likely to have the soil underneath and around the facility contaminated by previous operation until depths that can vary between 10 - 50 centimetres of depth, depending on the soil character, the length of the

period of contaminant input and the total amount of water (operation water and rain water). To prevent further spreading of the contamination, such soil needs to be cleaned or removed and treated, or if that proves not possible to be deposited on land at a specialised, licensed safe deposit, prior to making the facility environmentally sound and safe. Further contamination of the soil can be prevented by a temporary fluid-impermeable floor cover pending installation of a permanent fluid-impermeable floor with a water catchment and containment system.

Underwater sediment contaminated with AFS should be dredged and either treated or be stored on land at a specialised, licensed safe deposit. Such contaminated sediments should not be dumped in an aquatic environment, neither in fresh water, nor in the sea. If a permanent fluid-impermeable floor is not possible, a temporary provision can be installed to contain the waste and protect it from the underlying soil as well as to collect and contain the waste water.
Slipways with a fluid-impermeable floor hat are periodically immersed in water can become undermined. In that case a non-impermeable floor is a better solution. However the risk of contaminating the soil underneath as well as the immersion water should be recognised and the soil and the adjacent water should be regularly monitoring.

1.2 Facility Equipment

1.2.1 Facility design

1.2.1.1 The facility should have a good access and evacuation route.

1.2.1.2 The facility should have a fluid-impermeable floor with a water catchment and containment system.

1.2.1.3 When a fluid-impermeable floor is present the work should start at a clean floor and the floor should be thoroughly cleaned after completion of the work.

1.2.1.4 The fluid-impermeable floor should have a system for catching and containing all waste water from the AFS removal or hull cleaning process, including rain water that falls in the period from the start of the work until the facility is thoroughly cleaned after completion of the work.

1.2.1.5 When a fluid-impermeable floor is not present a temporary fluid-impermeable protection floor should be installed. The temporary floor should be capable of containing the water in such manner that the waste water can be contained and collected for treatment. The temporary floor should be thoroughly cleaned after completion of the work

1.2.2 Environmental and safety provisions

1.2.2.1 Before the work starts, waste containers for different types of wastes and which are clearly marked, should be placed at the work floor.

1.2.2.2 Certified protective gear to be used by personnel during the work should include:
* Gloves and boots;
* Face mask to prevent inhaling waste and paint particles
* Safety glasses
* Protective suit
* Safety helmet

1.3 Facility Structures

Work Floor Handling
A work floor where an AFS removal or hull cleaning operation has taken place contains a mixture of different types of waste, contaminated mud resulting from the hull cleaning, mechanical removal activities, remains from welding work, used polishing cloth etc.

1.3.1 Work floor

1.3.1.1 A **work floor** should always have a fluid-impermeable floor.

1.3.1.2 When a fluid-impermeable floor is not present, a temporary fluid-impermeable protection floor should be installed. The temporary floor should be capable of containing the water in such manner that the waste water can be collected and contained for treatment. The water-catchment system can consist of a gutter in the floor leading the water to a waste water container that is lower than the work floor. The waste water container should be protected from the environment and closed on top, so no other material or water can enter the container.

1.3.1.3 The temporary floor should be thoroughly cleaned after completion of the work.

1.4 Waste collection and handling at the facility

Preparation for the further AFS Removal Chain.
Different types of waste that are present or generated at the facility include remains of paint or surfactant fluids, used oil, chemicals, used and empty paint and solvent cans and materials used during the work, such as cleaning rags and brushes and other cleaning tools. The waste consists of solid wastes and waste water, which both should be collected and contained within the work space during and at the end of the work. Discharge of waste water and dumping of waste into the environment must be prevented at all times. As hull cleaning and AFS removal are done in the immediate vicinity of coastal or inland waters, waste from a facility, if not properly contained, is likely to enter the water, where it can spread unlimitedly and becomes itself a source of contamination of the sediments and natural and food resources in the water.

Surface and ground water are both human resources, for drinking, food and recreational use. It is paramount to protect both water and soil from becoming polluted to the detriment of the environment and of human health.

Organotin based AFS (TBT) adsorb strongly to sediment particles, the organic matrix and biota, all particles that eventually sink in quiet waters. Once integrated in sediments organotins can last for decades. This adsorption property of OT-based AFS waste can be used to clean AFS waste water to a relatively safe level, without needing to use complicated treatment structures or processes. When AFS waste water is left standing in a tailored container, the sediment will settle, together with the organic matrix and biotic particles, after which the supernatant water can be separated from the sediment and be discharged or be further treated when additional environmental requirements are present. The discharge water from the deposition tank is safe to discharge when the level of suspended particles is below 100 mg/litre. This method to treat waste water from ship maintenance and repair facilities has been developed as a tailor-made approach for such facilities that would both fulfil the environmental requirements for discharge water and the requirements for adequate operation at the facility. The prototype strategy for environmental performance of ship building and repair facilities of which this specific water treatment is part, originally

developed by the Netherlands water authorities in cooperation with the ship building industry, now stands an example for an overall EU environmental strategy for the ship building and repair industry (De Vries, VNSI). The strategy to develop and implement better environmental performance for ship building and repair facilities exists of a set of measures that all result in improving environmental performance and has gradually been implemented from 1985 onwards. The strategy has been developed on the base of a Dutch government report (CUWVO, 1991). The strategy has as yet resulted in a 90% reduction in emissions; at the target year of implementing the strategy (2010) emissions will be reduced by 95% (De Vries, 1996/2005).

Waste handling and treatment upon and after removal from the facility.
AFS waste that is removed for treatment should be transported in a safe manner to a licensed facility for treatment. Depending on the waste material and the level of contamination treatment should be:

- Recycling (such as grit, sand-bed filters)
- Separating the material from its waste to render the cleaned material suitable for re-use
- Destruction / Rendering harmless of the waste.
- AFS waste can only be rendered harmless by controlled thermal destruction, in a specialised waste destruction facility (such as a rotary kiln), at ultra-high temperatures with exhaust catchment and cleaning provisions.
- If all options for further treatment are impossible or not accessible then the waste should be deposited in a licensed facility that is protected from the environment and capped and cannot leak water or other fluids into the environment. The facility is subject to a permit.
- The options available for waste treatment depend on the available infrastructure.

Waste Treatment to Environmentally Harmless Material should always be the first option. Even Safe Waste Deposit has many disadvantages. It takes up space at the cost of other spatial use and is vulnerable to damage, the waste remains harmful, while aging enhances the chances of contact of the waste with the environment, with groundwater or surface waters and poses a risk of health hazards.

1.4.1 General rules for waste collection

1.4.1.1 Have a responsible person at the facility for waste and waste water management.

1.4.1.2 Personnel at the facility should adhere to the code of practice and the good house keeping rules. If in case of an emergency, the code of practice cannot be implemented, the responsible person at the facility should be informed at the earliest opportunity.

1.4.1.3 Different types of waste, generated during different activities should be kept separate in containers that are only intended for that specific type of waste. The containers should be clearly marked and should be available at the location where the work that generates the specific waste is taking place.

1.4.1.4 All generated waste should immediately be placed in the adequate container. When a container is full, it should be removed and immediately replaced by a clean one.

1.4.1.5 One person at the facility should be responsible for handling and temporary storage of waste at the facility; all Personnel at the facility should be familiar with the waste handling code of practice at the facility.

1.4.2 General rules for waste handling

1.4.2.1 After completion of the work, the waste containers should be removed for waste treatment at a specialised facility.

1.4.2.2 Waste stored in specific containers should be collected by a specialised operator and upon collection the storage containers should be immediately replaced by empty ones.

1.4.2.3 Waste may temporarily be stored at the facility, pending final removal. Register/record temporarily stored waste and (waste) water.

1.4.2.4 Transport separate wastes in separate containers that are protected from the environment.

1.4.2.5 Bring waste to a licensed facility to process, treat and/or recycle the waste.

1.4.2.6 If treatment is not possible the waste may be deposited at a specialised safe deposit that is protected from the environment and capped. Such disposal of waste should be subject to a permit for safe disposal of the specific waste. The disposal facility should be recognised by the authorities.

1.4.2.7 After completion of the work, the remaining waste should never be removed by washing with water or by brushing it into the environment.

1.4.2.8 Waste collected during or after completion of the work should never be buried, incinerated or permanently stored at the facility or in the environment.

1.4.2.9 Waste collected during or after completion of the work should never be disposed of outside the facility at a non-recognised disposal facility and without a permit for safe disposal.

1.4.2.10 Waste collected during or after completion of the work may, pending safe removal, be temporarily stored at the facility in a container that is protected from the environment and closed by a well-fitting lid. The container should be clearly marked with the type of waste, the amount of waste and the date of storage. No unauthorised personnel should be allowed to put waste into the containers. The relevant authorities should be notified of the temporary storage.

1.4.2.11 Record the amount of discharged water and the date and location of discharge.

1.4.2.12 Keep wastes separate and protected from the environment.

1.4.2.13 A ship repair and maintenance facility should have a transport system for used water and rain water that can come in contact with waste from its activities.

1.4.3 Safe waste water collection

1.4.3.1 Waste water should be collected in a container that is protected from the environment and is closed by a lid. In the container only waste water resulting from the removal of AFS should be collected.

1.4.3.2 Waste water collected in a separate container should be subject to a deposition system to remove the contaminated waste that adheres to the sediment to render the water sufficiently free of harmful AFS to be suitable for discharge into surface waters. No untreated waste water should be allowed to be discharged into surface waters or ground water.

1.4.3.3 Waste water in the container should be left standing to allow suspended particles, to which AFS adheres, to settle.

1.4.4 Requirements for discharge water

1.4.4.1 The suspended particle load of discharged water should be less than (100 mg/litre) as a safety level for water that is feasible for discharge into surface waters.

1.4.4.2 The pH of discharged water should be within limits (pH between 6.5 and 9 as advisory range).

1.4.4.3 The amount of water to be discharged and the intended date of discharge should be reported to the relevant authorities

1.4.4.4 Report spills and accidents that contaminate surface waters and/or the soil.

1.4.5 Handling of the waste water system

1.4.5.1 The waste water system operated at the facility is for sole use for waste water generated by the facility's activities only; it should only be accessible for personnel of the facility.

1.4.5.2 Non-yard persons or instances should not be allowed to use the yard waste water system.

1.4.5.3 If yard soil is contaminated by AFS waste water it should be removed and sent for treatment after approval by the relevant authorities.

1.4.6 Handling of waste water

1.4.6.1 The settled contaminated suspended particles in the deposit tank should be separated from the supernatant water.

1.4.6.2 The contaminated sediment from the deposition container should be removed and transported to a licensed facility for treatment or safe disposal.

1.4.6.3 If the facility is located in a special sensitive environment, such as a MPCA, the waste water should be further treated by filtering through a sand-bed filter to a lower TSS content (<50 mg/l) that itself should regularly be replaced by a clean one.

1.4.6.4 The contaminated sand-bed filter should be removed and be transported to a specialised facility for treatment, cleaning or recycling of sand- bed filters.

1.4.6.5 The treated effluent water should meet the effluent standard and should be regularly monitored and be accessible for inspection by the responsible authority/administration. The amount of water to discharge and the intended date of discharge should be reported to the relevant authorities.

1.4.6.6 Discharge treated water on a sewer system with adequate sewer treatment if possible and subject to a permit from the relevant authority.

1.4.7 Emergency waste water handling

1.4.7.1 In case of emergency, *when waste water has been discharged*, the responsible authority should be notified that the procedure could not be followed, where waste water has been discharged, and, if possible an estimate of the amount of discharged waste water and the expected contaminants present. The authorities should also be notified of the mitigation measures undertaken by the facility and possible future additional preventive measures.

1.4.8 Preparatory action for the AFS waste chain

1.4.8.1 Contaminated water and rainwater that has been in contact with waste should be kept separate from surface waters; never allow discharge of contaminated water into surface waters.

1.4.8.2 A best further treatment option for AFS waste should be sought. The ranking of best preferential options is
1st Re-used after cleaning, the remaining waste to be treated
2nd Recycling
3rd Rendered harmless by specific and tailored treatment
4th Deposited at a licensed facility that is protected from the environment and capped

1.4.8.3 A facility should acquire a permit from the relevant authority for temporary storage and containment of waste and waste water and materials used, such as cleaning tools.

2. Hull Cleaning

Introduction and preventive regime

Hull Cleaning is done by brushing off fouling organisms, wiping off slimy (algal) films and removing corrosion.

Hulls cleaning practice is at present done:

- on land, where wastes can be contained
- in the water, where containing wastes is ***impossible***

The most commonly used organotin-based anti-fouling paints are highly toxic and can accumulate throughout the food chain and in human food resources. AFS waste should not enter the environment, neither in the water nor on land. Hull-fouling organisms are likely to have taken up an appreciable amount of active substances and biocides from the AFS used on the hull; they will therefore pose an ecotoxicological effect as well as a potential alien invader risk. Such organisms may settle in the adjacent, contaminated environment and grow in an environment that is contaminated by AFS waste, and may be ingested by human

food resources or later on, when grown, be recognised themselves as food resources; a food resource that may have considerable amounts of the hormone disruptor tributyltin (TBT) and its metabolites.

(i) Waste from cleaning of ship's hulls should be contained and removed for treatment or safe disposal.

(ii) Collecting human food from areas where ships' hulls are cleaned under water should be prevented.

(iii) Collecting human food from areas where waste from ships' hull cleaning or AFS removal has been discharged into the environment should be prevented.

2.1 In-Water Hull Cleaning – an Environmental and Health Risk

In-water hull cleaning when in water releases anti-fouling particles and fouling organisms, which are contaminated by AFS and can bring AFS in the food chain and into human food resources.

The practice of in-water hull cleaning
Ship's hulls are regularly cleaned to remove fouling organisms from the hull (so as to maintain proper sailing quality).

When the underwater part of ship's hulls needs to be cleaned from fouling organisms or corroded parts, in the past the choice was often made to do that when the ship is still in the water. The cleaning is done by brushing, or brushing/scrubbing systems, operated by (scuba) divers or, when small ships, also by personnel standing in the water. This practice, although convenient on economic and time-management grounds, brings about considerable risks for both the environment and human health. The waste from under-water cleaning of ship's hulls consists of paint flakes and particles, combined with fouling organisms. The major risk is posed by AFS particles that are released into the water, causing environmental impacts and a health risk for those who operate such under-water cleaning. An associated risk is the release into the water of fouling organisms that may have come from other seas transported on the ships' hull, enhancing the risk of alien invasions. Alien invasive species can affect local marine ecosystems and marine food resources and can bring about outbreaks of diseases.

AFS waste or organisms contaminated by AFS resulting from in-water hull cleaning cannot be contained
Long-standing experience with methods to clean ship's hulls under water has shown that when in the water it is not feasible to clean ship's hulls in such way that the resulting waste can be totally lifted out of the water so as to be completely separate from the surface waters. Although the practice has been sought in the past, this option should be phased out at the earliest opportunity. The waste of hull-cleaning activities underwater will always run the risk of bringing resulting waste into the environment, not only flakes and particles of anti-fouling paints, also the fouling organisms will be released, which can result in introduction and establishment of alien invasive organisms, which is also to the detriment of the natural aquatic ecosystem and natural resources. Extensive experiments have shown that when a ship remains in the water none of the applied methods have the capacity to catch the waste such that it is totally separated from the surrounding waters. Waste particles will always leak through protective devices, such as nets, curtains etc.
If an AFS paint is very hard, soft brushing when just an initial soft (slimy) layer has been formed might prevent AFS waste to enter the environment
Such practice, although it minimised the risk of bringing AFS contamination into the water, still will release fouling organisms, thus enhancing the risk of alien invasions and harmful algal blooms.

2.1.1 When in-water cleaning of a ship's hull is carried out, the waste should in its entirety be brought to the surface, where it can be collected and contained

2.1.2 When operating under water for the purpose of cleaning a ship's hull, certified protective gloves should be worn and clothing that prevents skin contact with AFS and AFS waste removed from the hull.

2.1.3 When it is urgently needed to clean a ship that cannot be taken out of the water, this should only been done by a soft brush and at an early stage of fouling, when there is only a thin slimy algal layer, that can adequately be removed by soft brushing.

2.1.4 When organisms are stuck to the ship's hull, which removal runs the risk of damaging the AFS paint/system and releasing AFS particles, the ship should be taken out of the water to clean the hull.

2.1.5 Ship's hulls should always be cleaned on land; the practice of in-water cleaning of ship's hulls should be phased out at the earliest opportunity.

2.2 Hull Cleaning on Land

The practice of Hull cleaning on land

On land it is possible and feasible to collect and contain waste generated by hull cleaning.
On land Ship's hulls are cleaned by high pressure water washing and/or brushing. This activity results in a waste consisting of paint flakes, rust particles and fouling organisms. As this activity is wet, the waste will mix with the water used and needs to be contained to prevent the wastewater entering the surface waters and to penetrate in the underlying and surrounding soil and underwater sediments. When operating a high-pressure wash in rain, the rainwater will become contaminated by the generated waste as well.

2.2.1 To prevent the contaminated hull-cleaning waste water to enter surface waters, cleaning of ship's hulls by high-pressure washing should be done on a fluid-impermeable floor, with a system to collect the waste water and to contain rainwater that has been in touch with the waste.

2.2.2 When a fluid-impermeable floor is present the work should start with a clean floor and the floor should be thoroughly cleaned after completion of the work.

2.2.3 When a fluid-impermeable floor is not present a temporary fluid-impermeable protection floor should be installed. The temporary floor should be capable of containing the waste and waste water in such manner that the waste water can be collected and left for treatment. The temporary floor should be thoroughly cleaned after completion of the work.

2.2.4 After operation the facility should be immediately cleaned after completion of the work.

2.3 Hull-Cleaning Waste Collection

2.3.1 Solid waste of material used during hull cleaning should be collected in a container that is protected from the environment.

2.3.2 The contaminated water from hull cleaning should be collected in a container that is protected from the environment and is separate from waste water resulting from other activities at the facility.

2.4 Hull-Cleaning Waste Handling

2.4.1 The suspended solids in the contained waste water should be allowed to settle to catch most of the AFS, which is adsorbed to the suspended particles.

2.4.2 When the suspended solids have settled, discharge of the supernatant waste water (TSS < 100 mg/l) should be subject to a permit.

2.4.3 When the suspended solids have settled the supernatant water should preferably be discharged through a general water treatment system, a sewage system or a similar facility that further processes waste water. If that is not possible the waste water may be discharged into surface waters, subject to a permit.

2.4.4 When the suspended solids have settled, and further treatment is sought due to specific sensitivity of the ecosystem of the waters in the surrounding area, the water can be further purified by filtering over a sand-bed or comparable cleaning filter until the effluent water meets the standard for discharge (not more than 50 mg/ litre of suspended solids).

2.4.5 The filter should be regularly checked for excess contamination and be cleaned on a regular basis by a licensed facility.

2.4.6 When the filter is too contaminated to be cleaned it should be transferred to a treatment facility (recycling or destruction), or if that is not possible be deposited at a licensed facility that is protected form the environment.

2.4.7 The sediment from the deposition tank should be transferred to a licensed facility for cleaning for re-use, for recycling or for further treatment.

2.4.8 If treatment or cleaning/recycling is not possible, the sediment should be deposited in a specialised licensed deposit facility that is protected from the environment and capped.

2.4.9 When the facility has previously been operating without a fluid-impermeable floor, the contaminated soil underneath the floor should be cleaned/ removed prior to installing a fluid-impermeable floor with water a catchment provision

3. Removal of Anti-Fouling Systems

AFS Removal from ship's hulls can be done by mechanical removal, scraping off of old paint layers and by grit blasting. Grit blasting can be dry blasting, wet blasting or high-pressure blasting. Grit blasting roughens the surface so that loose AFS paint and corrosion or other particles can be easily removed completely and new paint will better adhere to the surface. Grit blasting, where grit is blasted with force to the hull surface, is likely to spread the blasting material to considerable distance and should therefore only been done at a space that has walls or other protective structures at all sides to contain the material within the work space. This means that grit blasting should only been done in either an enclosed hall or room, in a dry dock with the doors closed or in a floating dock that has fine-mesh netting at the open sides.

After 1 January 2008 the non-compliant organotin-based anti-fouling systems might have been sealed off by an impermeable sealer coat that fully prevents the non-compliant AFS to leach into the environment or into the compliant AFS layer on the hull.

3.1 Preparatory Assessment for Removal of AFS

3.1.1 AFS should only been removed by mechanical means such as scraping off.

3.1.2 AFS should only be removed in a space that is protected by a fluid-impermeable floor with a water catchment and containment system.

3.1.3 Prior to starting the operation to remove the old AFS layer, the facility should ascertain the type of AFS on the hull, when it was applied and who was the producer of the AFS; the AFS certificate should be checked and, if there is no such information or the certificate is incomplete, the facility should ascertain the type of AFS by other means and notify the relevant authority.

3.1.4 When a sealer coat is used to prevent the non-compliant AFS underneath from leaching out; the seal coat should be checked for being capable of remaining intact when grit-blasted.

3.1.5 Prior to removing the old AFS layer, the facility should ascertain the type of sealer coat on the hull, when it was applied and who was the producer of the sealer coat; the AFS certificate should be checked and, if there is no such information or the certificate is incomplete, the facility should ascertain the type of sealer coat by other means and notify the relevant authority.

3.1.6 Grit blasting should never been done at a facility that has only a work floor.

3.2 Preparatory Action for Removal of AFS

3.2.1 Prior to AFS removal the floor where the operation will take place should be thoroughly cleaned and unnecessary tools should be removed. Structures such as anchors should be positioned such that a minimum of their surface is exposed to contaminated material.

3.2.3 Personnel involved in AFS removal should wear certified protective gear to prevent coming into contact with the waste produced during operation or with any abrasive fluids or other materials used in the operation. Protective gear should include:

* Fluid-impermeable gloves and boots;
* Face mask to prevent inhaling dust or paint particles
* Safety glasses
* Protective suit; that should prevent water from leaking through the clothing
* Safety Hat

3.2.4 Waste containers for different types of wastes that are protected from the environment and which are clearly marked, should be placed at the work floor.

3.2.5 Personnel should clean hands and face immediately after the operation has finished.

3.2.6 High pressure washing, if needed, should be done prior to AFS removal.

3.3 Safe Removal of AFS by Mechanical Means, such as Scraping, and AFS Waste Collection

Mechanical AFS removal will always bring about waste that lands on the work floor, the slipway or the dock floor, often together with other waste particles generated in the operation. When scraping, paint dust may become dispersed by air, apart from particles falling on the floor. Air-borne particles can be prevented by not working in windy conditions and can be contained by fine-mesh netting around the facility or by having a water screen that catches the air-borne particles and allows them to settle on the work floor. In the latter case the resulting wet waste should be treated as waste water from wet blasting. Personnel should be well protected from inhaling the dust or coming into skin contact with the dust particles.

Mechanical AFS removal should always been done at a facility with a fluid-impermeable floor and a system to catch and remove waste water. When it rains at dry mechanical removal, the waste will become mixed with the rain water; the resulting wet waste should be treated as waste water from AFS removal.

3.3.1 Personnel should wear protective clothing and gear during the work

3.3.2 Waste that is left on the floor should immediately be cleaned after the operation has ended; this is a rule of practice that should be included in the rules for good housekeeping.

3.3.3 All waste should be collected in separate containers for specific waste types

3.3.4 The waste water from AFS removal should always be contained for treatment

3.3.5 The contaminated AFS waste should be collected and removed immediately after the operation has finished.

3.3.6 Rain water run off from the facility should be collected and treated when work is carried out and also when rain falls on a floor that is not thoroughly cleaned, although no work is being carried out.

4 The Anti-Fouling Removal Waste Chain

AFS waste is highly toxic material, which should neither enter the environment nor come into contact with humans. A preventive approach is crucial in all steps from AFS waste collection to final rendering harmless or safe deposit. Waste Treatment to Environmentally Harmless Material should always be sought. Any waste deposit, no matter how safe, entails long-lasting risks of environmental and human health hazards.

4.1 AFS Removal Waste Collection

4.1.1 Different types of waste, generated during different activities should be kept in the separate in containers only intended for that specific type of waste.

4.1.2 After completion of the work the waste containers should be removed for further waste treatment at a specialised facility.

4.1.3 If treatment is not possible the waste may be deposited at a specialised safe deposit that is protected from the environment and capped. Such disposal of waste should be subject to a permit for safe disposal of the specific waste. The disposal facility should be recognised by the authorities.

4.1.4 After completion of the work, the remaining waste should never be removed by washing with water or by brushing it into the environment.

4.1.5 Waste collected during or after the completion of the work should never be buried, incinerated or permanently stored at the facility or in the environment.

4.1.6 Waste collected during or after the completion of the work should never be disposed of outside the facility at a non-recognised disposal facility and without a permit for safe disposal.

4.1.7 Waste collected during or after the completion of the work should never be incinerated outside the facility at a non-recognised thermal destruction facility for highly toxic waste (such as AFS waste containing organotins) and without a permit for safe disposal.

4.1.8 Waste collected during or after completion of the work may, pending safe removal, be temporarily stored at the facility in a container that is protected from the environment and closed by a well-fitting lid. The container should be clearly marked with the type of waste, the amount of waste and the date of storage. No unauthorised personnel should be allowed to put waste into the containers. The relevant authorities should be notified of the temporary storage.

4.2 AFS Removal Waste Water Collection

4.2.1 Waste water should be collected in a container that is protected from the environment and is closed by a lid. In the container only waste water resulting from the removal of AFS should be collected.

4.2.2 The waste water in the container should be left standing to allow suspended particles, to which AFS adheres, to settle.

4.3 AFS Removal Waste Water and Water-Treatment Waste Handling

4.3.1 The waste water collected in a separate container should be subject to a system to remove the contaminated waste and render the water cleaned so as to meet a TSS content of <100 mg/l. No untreated waste water should be allowed to be discharged into surface waters or ground water.

4.3.2 The thus cleaned water could best be discharged through an adequate sewer system, if such system is present. A permit for such discharge from the relevant authorities should be sought.

4.3.3 The settled contaminated suspended particles in the deposit tank should be separated from the supernatant water.

4.3.4 The contaminated sediment from the container should be removed and transported to a licensed facility for treatment or safe disposal.

4.3.5 If discharge of the waste water into surface waters of a special protected area with a sensitive ecosystem is sought, the waste water should be further treated by filtering through a sand-bed filter that itself should regularly be replaced by a clean one.

4.3.6 The contaminated sand-bed filter should be removed and be transported to a specialised facility for treatment, cleaning or recycling of sand- bed filters

4.3.7 The treated effluent water should have a lower TSS content (<50 mg/l) and should be regularly monitored and be accessible for inspection by the responsible authority/administration.

4.4 AFS Removal Waste handling and treatment upon and after removal from the facility

If contaminated AFS waste cannot be treated it may be deposited in a specific deposit facility that meets the standards for adequate prevention of contact of the deposited matter with the environment. Such facilities should have a specific permit. Waste treatment to environmentally harmless material should always be the first option.

Even safe waste deposit has many disadvantages; it takes up space at the cost of other spatial use and is vulnerable to damage, the waste remains harmful, while aging enhances the chances of contact of the waste with the environment, with groundwater or surface waters and poses a risk of health hazards.

4.4.1 Waste that is removed from the facility should be transported to specialised facility for treatment.

4.4.2 The removed waste should be stored in separate containers that are clearly marked of its content, the amount and when it is stored for removal.

4.4.3 The relevant authority should be notified of the type, the amount, and the date of transport of the waste as well as the carrier and to which facility for further treatment the waste will be transported.

4.4.4 Whenever it is possible to treat the waste that option should be pursued. Deposition of waste should only be allowed if no feasible treatment option could be identified.

4.5 Safe AFS Removal Waste Handling

4.5.1 Waste water from mechanical AFS removal should be caught, removed and contained.

4.5.2 The AFS waste that remains on the floor of the facility should be collected and removed for re-use, recycling or treatment (cleaning).

4.5.3 AFS removal waste should be removed to a specialised facility for treatment

4.5.4 AFS removal waste that cannot be treated/cleaned may be deposited in a specific licensed deposit facility that is protected from the surrounding environment.

5. Ship Recycling and AFS Removal – a Special Case

Ships that will be recycled will need a special approach, as, even when organotin-based AFS will no longer be present, underneath the sealer coat the non-compliant AFS may still be present. At present only organotin is identified as harmful anti-fouling in Annex I to the AFS Convention. In the future other AFS systems may be included in Annex I and then should be either totally removed or be treated by a sealer coat to protect the non-compliant AFS from leaching out to other compartments than between the sealer coat and the hull material of the ship, as well as protect it from leaching into the newly applied compliant AFS layer.

At present no best practice for the rendering harmless of non-compliant (organotin-based) AFS has been evolved. Organotins can probably only be adequately destructed by high-temperature incineration in a specialised facility with an adequate exhaust system to catch all toxic by and end products of the incineration. Volatilisation of organotins into the atmosphere from organotin waste left exposed to the air should be prevented.
One option is to break the sealer coat down by adequate techniques and remove the AFS from the hull by similar techniques as presently used for removal of AFS and with a similar environmental practice for catching and containing waste and waste water in specific containers and for the full AFS removal chain. At present organotins are nowhere recognised as substances that receive a specific prescription for destruction. The expectation is that, once organotin is banned from use on ships, this will be regulated by a ban on marketing the substance, so organotin-based AFS will not be available any more. Such practice will do for the normal ship maintenance and repair activities, provided the sealer coat is capable of totally blocking the non-compliant AFS to come into contact with the environment or the overlying compliant AFS layer. The practice will, however, not solve the problem of the potentially continuing presence of organotin underneath sealer coats that will be met when recycling ships.

The option to leave the AFS plus sealer coat on the iron parts to be reprocessed and allow the OT-based AFS to be incinerated in the smelter used for treating the iron for re-use is environmentally not acceptable. Although the high temperatures of iron casting would be sufficient to destroy the chemical bonds of organotins, the smelter process does not meet the required properties for safe thermal destruction of organotins. The exhaust and other waste from a smelter process will still contain highly toxic reaction products such as dioxins. Both the rest waste and the exhaust products should need specific purification that is capable of catching noxious exhaust gasses and separate noxious substances that result from organotin incineration to remove them from the environment. Such specific provisions in an iron smelter or other facility for melting the bare hull material might mean substantial adaptations to the smelter itself and its waste handling system, with accompanying increased costs.

5.1 When preparing for ship recycling notify the relevant authorities that non-compliant AFS has been or might be encountered underneath a sealer coat.

5.2 Prior to the recycling operation, the facility should ascertain the type of sealer coat on the hull, when it was applied and who was the producer of the sealer coat; the AFS certificate should be checked and, if there is no such information or the certificate is incomplete, the facility should ascertain the type of sealer coat by other means and notify the relevant authority.

5.3 When preparing for ship recycling ascertain what options for treatment of organotin-based AFS waste are available or have been developed and adopted at that point in time.

5.4 If an adequate option for removal, handling and treatment of OT-based AFS waste is available, such treatment should be followed.

5.5 If an adequate option for removal, handling and treatment of OT-based AFS waste is not yet available, the waste should be temporarily deposited in a specialised deposit facility that is protected from the environment and capped. The temporary deposit should be subject to a permit.

5.6 If the sealer coat cannot be treated in conjunction with the treatment of the OT-based AFS, an adequate treatment option for the specific sealer coat should be identified. The sealer coat should then be treated according to the specific treatment available.

Procedure 4.

SAFE PROCEDURES FOR HULL CLEANING AND THE FULL ANTI-FOULING SYSTEMS REMOVAL CHAIN AT A BEACH

No facility, at a location at a beach, not-specifically designed for ship maintenance and repair work, for Cleaning of Ships' Hulls and Removal of Anti-Fouling Systems

- **Before starting to operate ship repair and maintenance, the quality of the water and the soil at work place should initially be ascertained.**
- **Before starting the work the presence of safe waste treatment facilities and safe waste deposits that are protected from the environment should always be ascertained.**
- **Before starting the work the responsible operator should always fully inform itself on the existing infrastructure for the safe transport of AFS waste to treatment and deposit facilities, as well as the infrastructure for AFS waste treatment and safe deposition of AFS waste.**
- **Before starting the work the responsible operator should always ascertain the type of AFS that is to be removed.**

Definitions: Operator Person doing hull-cleaning/AFS-removal at the ship. If more people are involved in the work; one should be responsible for overlooking the work. Work floor specially prepared location at the beach[2] where the work will take place.

Introduction

The work is performed directly in the environment and in an area that is likely to be multi-functional for other human activities (fishing, clam-digging, recreation and maybe aquaculture) and where other people are present in the area. This situation requires special care for the well-being of others in the area as well as being aware of the limitations of what can be done in a safe and environmentally sound manner. A floor cover on the work floor to catch and contain all generated waste and any tools used must be installed. Catching and containing waste water will be very difficult in those circumstances if not impossible, hence only dry hull cleaning and AFS removal should be done and the work should only be done in dry weather and when no rain is expected. The risk of spreading AFS dust or particles into the air and into the environment should be kept at a minimum by only using techniques that are done by hand. Solvents or other chemicals should not be used at all.

1. The Facility

A. Operation at the facility

When operating at a beach, a clear understanding of safe operation is crucial, while a recognised responsibility is as important in support of sound environmental and safety practice at such sites that are open to access and not clearly protected from the environment or from other people. The operator is responsible for establishing and maintaining a clear code of practice for safe operation as to environment and health and for surveying the implementation of the code of practice. other operator(s) who join the work should be fully informed about the code of practice, its implementation and the need for adhering to the code.

[2] For special preparation see procedure below

Skin contact with anti-fouling systems or their waste bears a health risk as does inhaling AFS dust particles that are dispersed into the air. Apart from safe environmental operation, health hazards have to be prevented by wearing protective clothing, gloves, water-impermeable boots, and a breathing mask that prevents inhaling of AFS particles. Waste water and contaminated sediment should also be prevented from coming into contact with human skin (Wear working boots and gloves that are water-impermeable).

Whatever the level of protective structure and strategy, good house keeping, including cleaning prior to and immediately after the work has finished, can prevent waste to spread into the environment beyond the work place itself and can protect operator(s) to run health risks. Good house keeping, together with working only when the weather is dry when in this situation where it is unlikely to have a complete waste water catchment and containment system, helps to prevent waste to spread into the water or in the soil.

1.1 Work Place Practice

1.1.1 Code of practice for safe operation

1.1.1.1 Cleaning of ship's hulls and removal of anti-fouling paints should be done on the base of a package of specialised measures, a code of practice and a work-floor discipline for preventing contamination of the environment and natural resources, as well as preventing the practice and its waste to affect the health of the operator(s) and of other people present in the area.

1.1.1.2 The operator(s) should be responsible for the safe and environmentally clean operation and should inform any one else involved in the work of the used framework for sound and safe operation.

1.1.1.3 On the work floor the operator should be responsible for regular inspection of the work place, for checking when the work is completed and for overlooking the AFS removal chain.

1.1.1.4 All operator(s) should be familiar with the code of practice and the responsibilities for its implementation.

1.1.1.5 Operator(s) should be familiar with the character of the material they are working with and with associated risks and safe handling instructions for use of the material.

1.1.1.6 The relevant authorities should be informed on the used framework for sound operation and of problems with implementing the framework and of possible proposed cures.

1.1.1.7 The work at the beach work place should be subject to a permit or similar legal authorisation for:

- Environmentally sound operation (work place practice)
- Safe and healthy working conditions
- If water has been used or when it rained during the work and before cleaning up, a clean water discharge permit

1.1.2 Personnel practice

1.1.2.1 The operator(s) should adhere to the code of practice and maintain good house keeping

1.1.2.2 The operator(s) should wear certified protective gear to prevent coming into contact with the waste produced during operation or with any abrasive materials used.

1.1.2.3 The operator(s) should thoroughly clean hands and face before consuming food or drinks.

1.1.2.4 The operator(s) should clean hands and face immediately after the work is completed.

1.1.2.5 The operator(s) should not smoke during the work.

1.1.2.6 The operator should maintain a safe distance of the work place to others present in the area.

1.1.2.7 The operator should inform any one else present at the beach within a distance of 10 metres of the operation at hand and potential risks.

1.1.3 Emergency handling

1.1.3.1 In case of an emergency the responsible operator should stop the work immediately and prevent waste to spread into the environment.

1.1.3.2 In case of an emergency the relevant authority should be notified on:
- the date of the event
- the character of the event
- if waste or waste water had spread into the environment:
- where that happened,
- an estimate of the amount waste and waste water and the expected contaminants' load.
- what mitigation measures were taken
- which future additional preventive measures are envisaged

1.1.4 Work place limitations and consequence

1.1.4.1 Specific AFS removal techniques, such as grit blasting should never be done on a beach; they require an enclosed dock space or a specialised grit-blasting room, where the ship can safely be grit-blasted.

1.1.4.2 A work place that has been established at a beach location should only use dry hull-cleaning and AFS-removal techniques and only work in dry weather conditions, unless it is possible to install a safe and reliable water catchment and containment system. Even then, high-pressure washing should never be done because of the risk of contaminating the wider environment with waste water.

1.1.4.3 A work place at a beach should only use techniques that can be done by hand, with a minimum risk of spreading AFS dust or particles in the air and the environment.

1.1.4.4 A workplace at a beach should always install a clean floor cover that is able to catch and contain all generated waste and any tools used during the operation.

B. Organisation of the Work Place

The work place on a beach differs crucially from other types of work places for ship maintenance and repair that run from specified ship repair and docking yards, permanent slip ways and improvised slipways at contained locations. It is clear that a contained space with tailored facilities, such as dry docks, floating docks and well-protected slipways, can develop a more refined system for preventing contamination of the environment and protection of its personnel than can be developed at a beach.

Dry docks are structured to allow for containment of waste, which can be cleaned before water is allowed into the dry dock. Floating docks need special provisions to contain waste and waste water within the dock space. Such provision can be a tightly fitting fluid-impermeable vertical barrier at each access end of the floating dock that prevents water to leak through and fine-mesh netting to contain grit-blasting material, waste and dust within the workspace. Slipways and other work floors need to have a fluid-impermeable floor to contain and collect waste water generated during the work and rain water contaminated by AFS waste to prevent contaminated water to leak into the soil underneath.

Wherever a ship's hull is cleaned or has its AFS removed, a practice to prevent or reduce contamination of the environment and health risks of its operator(s), should always be developed and be commonly known to all involved in the work. When only a waste catchment and containment floor can be installed, but no fluid-impermeable floor with waste water catchment and containment system, no wet work should be done.

When work is performed at a beach location that has been used before for hull cleaning and AFS removal without a temporary protective waste containment floor, the soil underneath and around the work place is likely to be contaminated by previous operation until depths that can vary between 10 - 50 centimetres of soil depth, depending on the soil character, the length of the period of contaminant input and the total amount of water (operation water and rain water). To prevent further spreading of the contamination, such soil needs to be cleaned, removed and treated, or deposited on land at a specialised, licensed safe deposit, Further contamination of the soil can be prevented by carrying out dry work only and only in dry weather on a floor cover for catchment and containment of all waste, which floor cover is installed prior to the work and that will be cleaned and removed after completion of the work. Earlier AFS removal in the water is likely to have resulted in contamination of the underwater sediment. Contaminated sediment can only be removed by dredging, after which the dredged material should be sent for treatment or deposit on land at a specialised, licensed deposit. Such contaminated sediments should never be dumped in an aquatic environment, neither in fresh water, nor in the sea.

1.2 Equipment

1.2.1 Work place design

1.2.1.1 The work place should have a good access and evacuation route

1.2.1.2 The work place should have at minimum a temporary floor cover to catch and contain all waste generated during the work including any tools used, that can be thoroughly cleaned and removed from the beach after the work. Installing a temporary fluid-impermeable floor cover with a water catchment and

containment system will be hardly possible, which limits the work to dry activities only and only working in dry weather.

1.2.1.3 The work should start at a clean work floor and the floor should be thoroughly cleaned after completion of the work.

1.2.1.4 If it is possible to install a fluid-impermeable floor cover, this should be connected to a system for catching and containing all waste water from the AFS removal or hull cleaning process, including rain falling during the work and before cleaning after completion of the work.

1.2.1.5 The temporary work floor should be thoroughly cleaned after completion of the work and be removed from the beach location. Any tools used should be removed as well.

1.2.1.6 After completion of the work the work place should be checked for left tools and waste, which all should be removed.

1.2.2 Environmental and safety provisions

1.2.2.1 Before the work starts, waste containers for different types of wastes and which are clearly marked, should be placed at the work floor.

1.2.2.2 Certified protective gear to be used by operator(s) during the work should include:
* Gloves and boots;
* Face mask to prevent inhaling waste and paint particles
* Safety glasses
* Protective suit
* Safety helmet

1.3 Facility Structures - Work Floor Handling

A work floor where an AFS removal or hull cleaning operation has taken place contains a mixture of different types of waste, contaminated mud resulting from the hull cleaning, mechanical removal activities, remains from welding work, used polishing cloth etc.

1.3.1 Work floor

1.3.1.1 A work floor should have a temporary floor cover to contain all waste generated during the work. When rain is expected during the work or when wet work cannot be avoided a work floor should also have a fluid-impermeable floor cover that can hold the waste water.

1.3.1.2 In case it is possible to install a temporary fluid-impermeable protection floor with water catchment and containment system, the waste water container should be lower than the work floor. The waste water container should be kept closed at all times.

1.3.1.3 The temporary floor cover should be thoroughly cleaned after completion of the work and before removal of the cover.

1.4 Waste collection and handling at the work place

Preparation for the further AFS Removal Chain.
Different types of waste that are present or generated at the work place can include materials used during the work, such as cleaning rags and brushes and other cleaning tools; it may also contain remains of abrasive materials used and empty cans. The wastes should be collected and contained within the work space during and at the end of the work. Dumping of waste (and discharge of waste water) into the environment must be prevented at all times. Hull cleaning and AFS removal on a beach generate waste that, if not properly contained, is likely to end up in water, where it can spread unlimitedly and becomes itself a source of contamination for the sediments and natural food resources. Waste from the work place can also pose a hazard for others present or working at the beach, to the detriment of the environment and of human health. Surface and ground water are both human resources, for drinking, food and recreational use. It is paramount to protect both water and soil from becoming polluted.

Organotin based AFS (TBT) adsorb strongly to sediment particles, the organic matrix and biota, all particles that eventually sink in quiet waters. Once integrated in sediments organotins can last for decades. This adsorption property of OT-based AFS waste can be used to clean AFS waste water to a relatively safe level, without needing to use complicated treatment structures or processes. When AFS waste water is left standing in a tailored container, the sediment will settle, together with the organic matrix and biotic particles, after which the supernatant water can be separated from the sediment and be discharged or be further treated. The discharge water from the deposition tank is safe to discharge when the level of suspended particles is below 100 mg/litre. This method to treat waste water from ship maintenance and repair facilities has been developed as a tailor-made approach for such facilities that would both fulfil the environmental requirements for discharge water and the requirements for adequate operation at the facility. The prototype strategy for environmental performance of ship building and repair work places of which this specific water treatment is part, originally developed by the Netherlands water authorities in cooperation with the ship building industry, now stands an example for an overall EU environmental strategy for the ship building and repair industry (De Vries, VNSI). The strategy to develop and implement better environmental performance for ship building and repair facilities exists of a set of measures that all result in improving environmental performance and has gradually been implemented from 1985 onwards. The strategy has been developed on the base of a Dutch government report (CUWVO, 1991). The strategy has as yet resulted in a 90% reduction in emissions; at the target year of implementing the strategy (2010) emissions will be reduced by 95% (De Vries, 1996/2005).

Waste handling and treatment upon and after removal from the facility.

AFS waste that is removed for treatment should be transported in a safe manner to a licensed facility for treatment. Depending on the waste material and the level of contamination treatment should be:

- Recycling (such as contaminated tools) to render cleaned material suitable for re-use Destruction / Rendering harmless of the waste.
- AFS waste can only be rendered harmless by controlled thermal destruction, in a specialised waste destruction facility (such as a rotary killn), at ultra-high temperatures with exhaust catchment and cleaning provisions.
- If all options for further treatment are impossible or not accessible, the waste should be deposited in a licensed facility that is protected from the environment and capped and cannot leak fluids into the environment. The facility is subject to a permit.
- The options available for waste treatment depend on the available infrastructure.

Waste Treatment to Environmentally Harmless Material should always be the first option. Even Safe Waste Deposit has many Disadvantages. It takes up space at the cost of other spatial use and is vulnerable to damage, the waste remains harmful, while aging enhances the chances of contact of the waste with the environment, with groundwater or surface waters and poses a risk of health hazards.

1.4.1 General rules for waste collection

1.4.1.1 Have a responsible operator at the work place for waste and waste water management.

1.4.1.2 The operator(s) at the facility should adhere to the code of practice and maintain good house keeping. If in case of an emergency, the code of practice cannot be implemented, the responsible operator should be informed immediately.

1.4.1.3 Different types of waste, generated during different activities should be kept separate in containers that are only intended for that specific type of waste. he containers should be clearly marked and should be present at the work place.

1.4.1.4 All generated waste should immediately be placed in the adequate container. When a container is full, it should be removed and immediately replaced by a clean one.

1.4.1.5 The operator is responsible for handling and temporary storage of waste; all others involved in the work should be familiar with the waste handling code of practice.

1.4.1.6 No unauthorised persons should be allowed to put waste into the containers.

1.4.2 General rules for waste handling

1.4.2.1 Record the amount of waste.

1.4.2.2 Keep wastes separate and protected from the environment

1.4.2.3 After completion of the work, the waste containers should be removed for waste treatment at a specialised facility.

1.4.2.4 Waste stored in specific containers should be collected by a specialised operator and upon collection the storage containers should be immediately replaced by empty ones.

1.4.2.5 Waste may temporarily be stored, pending final removal; the storage should be registered.

1.4.2.6 Transport separate wastes in separate containers, protected from the environment.

1.4.2.7 Bring waste to a licensed facility to process, treat and/or recycle the waste.

1.4.2.8 If treatment is not possible the waste may be deposited at a specialised safe deposit that is protected from the environment and capped. Such disposal of waste should be subject to a permit for safe disposal. The disposal facility should be recognised by the authorities.

1.4.2.9 After completion of the work, the remaining waste should never be removed by washing with water or by brushing it into the environment.

1.4.2.10 Waste collected during or after the completion of the work should never be buried, incinerated or permanently stored at the work place or in the environment.

1.4.2.11 Waste collected during or after the completion of the work should never be disposed of outside the work place at a non-recognised disposal facility and without a permit for safe disposal.

1.4.3. Safe waste water collection

1.4.3.1 Report spills and accidents that contaminate surface waters and/or the soil.

1.4.3.2 If generating waste water could not be avoided during the work, this should be collected in a container that is protected from the environment and is closed by a lid. In the container only waste water resulting from the removal of AFS should be collected.

1.4.3.3 A waste water system at the work place is for sole use for waste water generated by the AFS-removal activities at the work place and should only be accessible for the operator(s).

1.4.3.4 Waste water collected in a separate container should be subject to a deposition system to remove the contaminated waste that adheres to the sediment and to render the water sufficiently free of harmful AFS to be suitable for discharge into surface waters. No untreated waste water should be allowed to be discharged into surface waters or ground water.

1.4.3.5 Waste water in the container should be left standing to allow suspended particles, to which AFS adheres, to settle.

1.4.3.6 The suspended particle load of discharged water should be less than (100 mg/litre) as a safety level for water that is feasible for discharge into surface waters.

1.4.3.7 The settled contaminated suspended particles in the deposit tank should be separated from the supernatant water.

1.4.3.8 The contaminated sediment from the deposition container should be removed and transported to a licensed facility for treatment or safe disposal.

1.4.3.9 The treated effluent water should meet the effluent standard and should be regularly monitored and be accessible for inspection by the responsible authority. The amount of water to discharge and the intended date of discharge should be reported to the relevant authorities.

1.4.3.10 Contaminated water and rainwater that has been in contact with waste and has not been treated should be kept contained; never allow discharge of contaminated water into surface waters.

1.4.4 Emergency waste water handling

1.4.4.1 In case of emergency, when waste water has been discharged, the responsible authority should be notified and be informed where waste water has been discharged, if possible an estimate of the amount of discharged waste water and what will be done in the future to prevent such emergency discharges.

1.4.5 Preparatory action for the AFS waste chain

1.4.5.1 A best further treatment option for AFS waste should be sought. The ranking of best preferential options is
1st Re-used after cleaning, the remaining waste to be treated
2nd Recycling
3rd Rendered harmless by specific and tailored treatment
4th Deposited at a licensed facility, protected from the environment and capped

1.4.5.2 The operator should acquire a permit from the relevant authority for temporary storage and containment of waste and materials used, such as cleaning tools,.

2. Hull Cleaning

Introduction and preventive regime
Hull Cleaning is done by brushing off fouling organisms, wiping off slimy (algal) films and removing corrosion.

Hulls cleaning practice is at present done:

- on land, where wastes can be contained
- in the water, where containing wastes is ***impossible***

The most commonly used organotin-based anti-fouling paints are highly toxic and can accumulate throughout the food chain and in human food resources. AFS waste should not enter the environment, neither in the water nor on land. Hull-fouling organisms are likely to have taken up an appreciable amount of active substances and biocides from the AFS used on the hull; they will therefore pose an ecotoxicological effect as well as a potential alien invader risk. Such organisms may settle in the adjacent, contaminated environment and grow in an environment that is contaminated by AFS waste, and may be ingested by human food resources or later on, when grown, be recognised themselves as food resources; a food resource that may have considerable amounts of the hormone disruptor tributyltin (TBT) and its metabolites.

(i) At a beach location never clean a ship's hull in the water as waste from cleaning of ship's hulls cannot be contained and removed for treatment or safe disposal.

(ii) Collecting human food from areas where ships' hulls are cleaned under water should be prevented.

(iii) Collecting human food from areas where waste from ships' hull cleaning or AFS removal has been discharged into the environment should be prevented.

2.1 In-Water Hull Cleaning – an Environmental and Health Risk

In-water hull cleaning releases anti-fouling particles and fouling organisms, which are contaminated by AFS and can bring AFS in the food chain and into human food resources.

The practice of in-water hull cleaning: Ship's hulls are regularly cleaned to remove fouling organisms from the hull (so as to maintain proper sailing quality).

When the underwater part of ship's hulls needs to be cleaned from fouling organisms or corroded parts, in the past the choice was often made to do that when the ship was still in the water. The cleaning was done by brushing, or brushing/scrubbing systems, operated by (scuba) divers or, when small ships, also by operator(s) standing in the water. This practice, although convenient on economic and time-management grounds, brings about considerable risks for both the environment and human health. The waste from in-water cleaning of ship's hulls consists of paint flakes and particles, combined with fouling organisms. The major risk is posed by AFS particles that are released into the water, causing environmental impacts and a health risk for those who operate such under-water cleaning. An associated risk is the release into the water of fouling organisms that may have come from other seas transported on the ships' hull, enhancing the risk of alien invasions. Alien invasive species can affect local marine ecosystems and marine food resources and can bring about outbreaks of diseases.

AFS waste or organisms contaminated by AFS resulting from in-water hull cleaning cannot be contained.
Long-standing experience with methods to clean ship's hulls under water has shown that when in the water it is not feasible to clean ship's hulls in such way that the resulting waste can be totally lifted out of the water so as to be completely separate from the surface waters. Although the practice has been sought in the past, this option should be phased out at the earliest opportunity. The waste of hull-cleaning activities underwater will always run the risk of bringing resulting waste into the environment, not only flakes and particles of anti-fouling paints, also the fouling organisms will be released. Apart from the risk of introduction and establishment of alien invasive organisms, such organisms are likely to be heavily contaminated by AFS, to the detriment of the aquatic ecosystem and of natural resources. Extensive experiments have shown that when a ship remains in the water none of the applied methods have the capacity to catch the waste such that it is totally separated from the surrounding waters. Waste particles will always leak through protective devices, such as nets.

If an AFS paint is very hard, soft brushing when just an initial soft (slimy) layer has been formed might prevent AFS waste to enter the environment
Such practice, although it minimises the risk of AFS contamination, still will release fouling organisms, thus enhancing the risk of alien invasions and harmful algal blooms.

2.1.1 Ship's hulls should always be cleaned on land; the practice of in-water cleaning of ship's hulls should be phased out at the earliest opportunity.

2.1.2 When it is urgently needed to perform minor cleaning on a ship that cannot be taken out of the water, this should only been done by a soft brush and at an early stage of fouling, when there is only a thin slimy algal layer, that can adequately be removed by soft brushing.

2.1.3 When operating under water for the purpose of cleaning a ship's hull, certified protective gloves should be worn and clothing that prevents skin contact with AFS and AFS waste removed from the hull.

2.1.4 When organisms are stuck to the ship's hull, which' removal runs the risk of damaging the AFS paint/system and releasing AFS particles, the ship should always be taken out of the water to clean the hull.

2.2 Hull Cleaning on Land

The practice of Hull cleaning on land

On land it is possible and feasible to collect and contain waste generated by hull cleaning. Hull cleaning results in a waste consisting of paint flakes, rust particles and fouling organisms. When it rains during the work, the waste will mix with water which needs to be contained to prevent the waste water from entering the surface waters and penetrating in the soil and in underwater sediments. On a beach hull cleaning should only be done by dry brushing; high pressure washing will contaminate the environment to the detriment of the environment, human health and marine food resources.

2.2.1 To prevent any contaminated hull-cleaning waste to enter surface waters, cleaning of ship's hulls should be done on a dry location with a floor cover to catch and contain the waste and tools that have been in contact with the waste.

2.2.2 A temporary work floor that is protected from the environment should be installed and be capable of containing the waste so the waste can be collected and removed.

2.2.3 The work should start with a clean floor and the temporary floor should be thoroughly cleaned after completion of the work and be removed from the beach location.

2.2.4 After completion of the work, the work place should be thoroughly checked for any tools left and for accidentally spilled waste into the beach environment.

2.2.5 Any material, tools or waste resulting from the hull cleaning outside the work floor area should be immediately removed upon completion of the work.

2.3 Hull-Cleaning Waste Collection

2.3.1 Solid waste of material used during hull cleaning should be collected in a container that is protected from the environment.

2.3.2 In case the generating of wet waste could not be avoided when the hull was cleaned at the beach, the contaminated water from hull cleaning should be collected in a container.

2.4 Hull-Cleaning Waste Handling

2.4.1 The collected waste should be removed from the beach work place and transported in a safe and environmentally sound manner to a licensed waste treatment or deposit facility.

2.4.2 The relevant authorities should be informed about the amount and type of waste that has been generated and its further processing.

2.4.3 In case the generating of wet waste could not be avoided, the contained waste water, the suspended solids in the contained waste water should be allowed to settle to catch most of the AFS, which is adsorbed to the suspended particles.

2.4.4 When the suspended solids have settled, the supernatant water (TSS < 100 mg/l) should preferably be discharged through a general water treatment system, a sewage system or a similar facility that further processes waste water. If that is not possible the waste water may be discharged into surface waters, subject to a permit.

2.4.5 The sediment from the deposition tank should be transferred to a licensed facility for cleaning for re-use, for recycling or for further treatment.

2.4.6 If treatment or cleaning/recycling is not possible, the sediment should be deposited in a specialised licensed deposit facility that is protected from the environment and capped.

3. Removal of Anti-Fouling Systems

AFS Removal from ship's hulls at a beach should only be done by mechanical removal, scraping off of old paint layers, but never by grit blasting; the latter should only be done in an enclosed hall or room, a dry dock with the doors closed or in a enclosed floating dock.
After 01 January 2008 the non-compliant organotin-based anti-fouling systems might have been sealed off by an impermeable sealer coat that fully prevents the non-compliant AFS to leach into the environment or into the compliant AFS layer on the hull.

3.1 Preparatory Assessment for Removal of AFS

3.1.1 At a beach work place AFS should only be removed by dry techniques and only when the weather is dry and is expected to remain dry.

3.1.2 AFS should only be removed by mechanical means such as scraping off

3.1.3 AFS should only be removed when the floor is covered by a waste containment floor.

3.1.4 Prior to starting the operation to remove the old AFS layer, the operator should ascertain the type of AFS on the hull, when it was applied and who produced the AFS; the AFS certificate should be checked and, if there is no such information or the certificate is incomplete, the operator should ascertain the type of AFS by other means and notify the relevant authority.

3.1.5 When a sealer coat is used to prevent the non-compliant AFS underneath from leaching out; the sealer coat should be checked for being capable of remaining intact when AFS is removed.

3.1.6 Prior to removing the old AFS layer, the operator should ascertain the type of sealer coat on the hull, when it was applied and who produced the sealer coat; the AFS certificate should be checked and, if there is no such information or the certificate is incomplete, the operator should ascertain the type of sealer coat by other means and notify the relevant authority.

3.1.7 Grit blasting should never be done at a work place at a beach.

3.2 Preparatory Action for Removal of AFS

3.2.1 Prior to AFS removal the floor where the operation will take place should be thoroughly cleaned and unnecessary tools should be removed. Structures such as anchors should be positioned such that a minimum of their surface is exposed to contamination.

3.2.2 Operator(s) involved in AFS removal should wear certified protective gear to prevent coming into contact with the waste produced during operation or with any abrasive fluids or other materials used in the operation. Protective gear should include:
* Fluid-impermeable gloves and boots;
* Face mask to prevent inhaling dust or paint particles
* Safety glasses
* Protective suit; that should prevent water from leaking through the clothing
* Safety Hat

3.2.3 Waste containers for different types of wastes that are protected from the environment and which are clearly marked, should be placed at the work floor.

3.2.4 Operator(s) should clean hands and face immediately after the work is completed.

3.3 Safe Removal of AFS by Mechanical Means, such as Scraping, and AFS Waste Collection

Mechanical AFS removal will always bring about waste that lands on the work floor, often together with other waste particles generated in the operation. When scraping, paint dust may become dispersed by air, apart from particles falling on the floor. Air-borne particles can be prevented by not working in windy conditions and can be contained by fine-mesh netting around the work place. Operator(s) should be well protected from inhaling the dust or coming into skin contact with dust particles.

Mechanical AFS removal should always be done at a work place with a waste containment floor cover. If contact of the AFS waste with water could not be avoided, the work place should also have a system to catch and contain waste water. When it rains during dry mechanical removal, the waste will become mixed with the rain water; the resulting wet waste should be treated as waste water from wet AFS removal.

3.3.1 Operator(s) should wear protective clothing and gear during the work

3.3.2 Waste that is left on the floor should immediately be cleaned after the work is completed; this rule of practice should be included in the good housekeeping.

3.3.3 All waste should be collected in separate containers for specific waste types

3.3.4 Waste from AFS removal should always be contained for treatment and be collected and removed immediately after the operation has finished.

3.3.5 When rain falls on a floor that is not thoroughly cleaned, although no work is being carried out, rain water run off from the work floor should be collected and treated.

4 The Anti-Fouling Removal Waste Chain

AFS waste is highly toxic material, which should neither enter the environment nor come into contact with humans. A preventive approach is crucial in all steps from AFS waste collection to final rendering harmless or safe deposit. Waste Treatment to Environmentally Harmless Material should always be sought. Any waste deposit, no matter how safe, entails long-lasting risks of environmental and human health hazards.

4.1 AFS Removal Waste Collection

4.1.1 Different types of waste, generated during different activities should be kept in separate containers intended only for that specific type of waste.

4.1.2 After completion of the work the waste containers should be removed for further waste treatment at a specialised facility.

4.1.3 When treatment is not possible the waste may be deposited at a specialised safe deposit that is protected from the environment and capped. Such disposal of waste should be subject to a permit. The disposal facility should be recognised by the authorities.

4.1.4 After completion of the work, the remaining waste should never be removed by washing with water or by brushing it into the environment.

4.1.5 Waste collected during or after the completion of the work should never be buried, incinerated or permanently stored at the facility or in the environment.

4.1.6 Waste collected during or after the completion of the work should never be disposed of outside the work place at a non-recognised disposal facility and without a permit for safe disposal.

4.1.7 Waste collected during or after the completion of the work should never be incinerated outside the work place at a non-recognised incinerator.

4.1.8 Waste collected during or after completion of the work may, pending safe removal, be temporarily stored at the work place in a tightly-closed container. The container should be clearly marked with the type of waste, the amount of waste and the date of storage. No unauthorised persons should be allowed to put waste into the containers. The relevant authorities should be notified of the temporary storage.

4.2 AFS Removal Waste Water Collection

4.2.1 Waste water should be collected in a container that is protected from the environment and is closed by a lid. In the container only waste water resulting from the removal of AFS should be collected.

4.2.2 The waste water in the container should be left standing to allow suspended particles, to which AFS adheres, to settle.

4.3 AFS Removal Waste Water and Water-Treatment Waste Handling

4.3.1 The waste water collected in a separate container should be subject to a system to remove the contaminated waste and render the water cleaned so as to meet a TSS content of <100 mg/l. No untreated waste water should be allowed to be discharged into surface waters or ground water. The settled contaminated suspended particles in the deposit tank should be separated from the supernatant water.

4.3.2 The thus cleaned water could best be discharged through an adequate sewer system and be subject to a permit.

4.3.3 The contaminated sediment from the container should be removed and transported to a licensed facility for treatment or safe disposal.

4.4 AFS Removal Waste handling and treatment upon and after removal from the facility

If contaminated AFS waste cannot be treated it may be deposited in a specific deposit facility that meets the standards for adequate prevention of contact of the deposited matter with the environment. Such facilities should have a specific permit.

Waste treatment to environmentally harmless material should always be the first option. Even safe waste deposit has many disadvantages; it takes up space at the cost of other spatial use and is vulnerable to damage, the waste remains harmful, while aging enhances the chances of contact of the waste with the environment, with groundwater or surface waters and poses a risk of health hazards.

4.4.1 Waste that is removed from the work place should be transported to specialised facility for treatment**.**

4.4.2 The removed waste should be stored in separate containers that are clearly marked of its content, the amount and when it is stored for removal.

4.4.3 The relevant authority should be notified of the type, the amount, and the date of transport of the waste as well as the carrier and to which facility for further treatment the waste will be transported.

4.4.4 Whenever it is possible to treat the waste that option should be pursued. Deposition of waste should only be allowed if no feasible treatment option could be identified.

4.5 Safe AFS Removal Waste Handling

4.5.1 Waste water from mechanical AFS removal should be caught, removed and contained.

4.5.2 The AFS waste that remains on the floor of the work place should be collected and removed for re-use, recycling or treatment (cleaning).

4.5.3 AFS removal waste should be removed to a specialised facility for treatment

4.5.4 AFS removal waste that cannot be treated/cleaned may be deposited in a specific licensed deposit facility that is protected from the surrounding environment.

5. Boat Recycling and AFS Removal – a Special Case

Boats that will be recycled will need a special approach, as, even when organotin-based AFS will no longer be present, underneath the sealer coat the non-compliant AFS may still be present. At present only organotin is identified as harmful anti-fouling in Annex I to the AFS Convention. In the future other AFS systems may be included in Annex I and then should be either totally removed or be treated by a sealer coat to protect the non-compliant AFS from leaching out to other compartments than between the sealer coat and the hull material of the ship, as well as protect it from leaching into the newly applied compliant AFS layer.
At present no best practice for the rendering harmless of non-compliant (organotin-based) AFS has been evolved. Organotins can probably only be adequately destructed by high-temperature incineration in a specialised facility with an adequate exhaust system to catch all toxic by and end products of the incineration. Volatilisation of organotins into the atmosphere from organotin waste left exposed to the air should be prevented.

One option is to break the sealer coat down by adequate techniques and remove the AFS from the hull by similar techniques as presently used for removal of AFS and with a similar environmental practice for catching and containing waste and waste water in specific containers and for the full AFS removal chain. At present organotins are nowhere recognised as substances that receive a specific prescription for destruction. The expectation is that, once organotin is banned from use on ships, this will be regulated by a ban on marketing the substance, so organotin-based AFS will not be available any more. Such practice will do for the normal ship maintenance and repair activities, provided the sealer coat is capable of totally blocking the non-compliant AFS to come into contact with the environment or the overlying compliant AFS layer. The practice will, however, not solve the problem of the potentially continuing presence of organotin underneath sealer coats that will be met when recycling ships.

The option to leave the AFS plus sealer coat on the hull parts to be reprocessed and allow the OT-based AFS to be incinerated in the smelter used for treating the iron for re-use is environmentally not acceptable. Although the high temperatures of iron casting would be sufficient to destroy the chemical bonds of organotins, the smelter process does not meet the required properties for safe thermal destruction of organotins. The exhaust and other waste from a smelter process will still contain highly toxic reaction products such as dioxins. Both the rest waste and the exhaust products should need specific purification that is capable of catching noxious exhaust gasses and separate noxious substances that result from organotin incineration to remove them from the environment. Such specific provisions in an iron smelter or other facility for melting the bare hull material might mean substantial adaptations to the smelter itself and its waste handling system, with accompanying increased costs.

5.1 When preparing for boat recycling notify the relevant authorities that non-compliant AFS has been or might be encountered underneath a sealer coat.

5.2 Prior to the recycling operation, the operator should ascertain the type of sealer coat on the hull, when it was applied and who was the producer of the sealer coat; the AFS certificate should be checked and, if there is no such information or the certificate is incomplete, the facility should ascertain the type of sealer coat by other means and notify the relevant authority.

5.3 When preparing for boat recycling ascertain what options for treatment of organotin-based AFS waste are available or have been developed and adopted at that point in time.

5.4 If an adequate option for removal, handling and treatment of OT-based ASF waste is available, such treatment should be followed.

5.5 If an adequate option for removal, handling and treatment of OT-based ASF waste is not yet available, the waste should be temporarily deposited in a specialised deposit facility that is protected from the environment and capped. The temporary deposit should be subject to a permit.

5.6 If the sealer coat cannot be treated in conjunction with the treatment of the OT-based AFS, an adequate treatment option for the specific sealer coat should be identified. The sealer coat should then be treated according to the specific treatment available.