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ANTI-FOULING AND IN-WATER CLEANING GUIDELINES

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Anti-fouling and in-water cleaning guidelines

Introduction

The growth and accumulation of aquatic organisms (biofouling) on vessels and other movable submerged structures affects their performance and can lead to the spread of invasive aquatic species. Anti-fouling coatings are commonly used to protect submerged surfaces and prevent biofouling accumulation. Application, maintenance and removal of anti-fouling coatings on vessels and movable structures in maintenance facilities or in-water can result in contamination of the aquatic environment. Accidental release of biofouling organisms during cleaning operations can facilitate the spread of invasive aquatic species threatening human health, the aquatic environment, and social, cultural and economic values.

Purpose and principles

These guidelines provide guidance on best-practice approaches for the application, maintenance, removal and disposal of anti-fouling coatings and the management of biofouling and invasive aquatic species on vessels and movable structures in Australia and New Zealand. These guidelines are also intended to assist authorities to decide on the appropriateness of in-water cleaning operations in general and on a case-by-case basis. In achieving this purpose, it is the aim of the guidelines to minimise contamination and biosecurity risks associated with shore-based and in-water maintenance of vessels and movable structures.

These guidelines are based upon the following principles:

- The risks posed by biofouling management measures should be balanced with the risks of failing to manage biofouling.
- There is an operational need to manage biofouling on vessels and movable structures.
- It is preferable to minimise the accumulation of biofouling on vessels and movable structures.
- It is preferable for biofouling to be removed in the location where it was acquired before departing or moving to a new location.
- Release of potentially toxic chemicals and invasive aquatic species into the environment should be minimised.
- Where operationally and economically practicable, vessels and movable structures should be removed from the water for cleaning and maintenance, in preference to in-water operations.

Scope

These guidelines apply to all vessels and other movable structures in aquatic (marine, estuarine and freshwater) environments, regardless of whether they are coated in an anti-fouling coating. These guidelines should be used by resource managers, owners and operators of vessels and movable structures, operators and customers of maintenance facilities and contractors providing vessel maintenance services.

These guidelines replace the *ANZECC Code of practice for anti-fouling and in-water hull cleaning and maintenance* (1997).

The practices described in these guidelines have been aligned with international conventions intended to protect the aquatic environment from invasive aquatic species and contaminants from shipping. These include:

- the *International convention on the control of harmful anti-fouling systems on ships*
- the *1996 protocol to the Convention on the prevention of marine pollution by dumping of wastes and other matter, 1972*
- the *2011 Guidelines for the control and management of ships' biofouling to minimize the transfer of invasive aquatic species*.

These guidelines are consistent with both countries' developing national biofouling management approaches.

Occupational health and safety should always be a principal concern in vessel maintenance. These guidelines do not specify detailed occupational health and safety requirements. Such information can be found on relevant government websites as linked in the section on Application of the Guidelines.

Structure of these guidelines

These guidelines are divided into two main parts:

- **Part 1:** Best practice guidance for the application, maintenance, removal and disposal of anti-fouling coatings at shore-based maintenance facilities to minimise environmental risk.
- **Part 2:** Best practice guidance for in-water cleaning and maintenance of vessels and movable structures to minimise environmental risk.

Relevant supporting information is provided in:

- **Appendix 1:** A decision support tool to determine the appropriateness of in-water cleaning in specific circumstances.
- **Appendix 2:** Information on the types of anti-fouling coating commercially available and the means by which they prevent biofouling growth.
- **Appendix 3:** Information on currently available in-water cleaning techniques.
- **Appendix 4:** A template for a Biofouling Management Plan and a Biofouling Record Book developed by the International Maritime Organization.
- **Appendix 5:** Information on how to identify different biofouling types on vessels and movable structures.

Definitions

For the purposes of these guidelines the following definitions apply.

Adequate documentation	Records of the recent history of anti-fouling installation and hull maintenance undertaken on a vessel or movable structure.
Anti-fouling coating	A coating applied to submerged surfaces to prevent or reduce accumulation of biofouling. Common types of anti-fouling coating are described in Appendix 2.
Anti-fouling coating system	The combination of all component coatings, surface treatments (including primer, sealer, binder, anti-corrosive and anti-fouling coatings) or other surface treatments, used on a ship to control or prevent attachment of unwanted aquatic organisms.
AFS Convention, 2001	International Convention on Control of Harmful Anti-Fouling Systems on Ships, 2001.
AFS Certificate	An International Anti-Fouling System Certificate that vessels greater than 400 gross tonnes and registered to a Flag State that is a Party to the <i>International convention on the control of harmful anti-fouling systems on ships</i> are required to carry. This certificate indicates that the vessel's anti-fouling system complies with the convention.
Australian or New Zealand waters	Internal waters, the Territorial Sea and the Exclusive Economic Zone (EEZ) of Australia or New Zealand.
Biocide	A chemical substance incorporated into anti-fouling coatings to prevent settlement or survival of aquatic organisms.
Biofouling	Accumulation of aquatic organisms (micro-organisms, plants and animals) on surfaces and structures immersed in or exposed to the aquatic environment.
Biofouling type	The level and composition of biofouling that accumulates on submerged surfaces over time. These guidelines distinguish between two types of biofouling (see Appendix 5).
Biogeography	The association of species or species assemblages with location. The combination of physical features, such as rocky reefs, and constraints on species dispersal can generate assemblages that can be identified as characteristic of a specific location.
Biosecurity	The exclusion, eradication or effective management of pests and diseases that threaten the economy, environment, human health, social and cultural values.
Biosecurity risk	The potential harm to the economy, environment, human health and social and cultural values posed by pests and diseases entering, emerging, establishing or spreading in Australia and/or New Zealand.
Contaminant	Any undesirable substance occurring in the environment as a result of human activities, even without adverse effects being observed.
Contamination	The presence of a contaminant in the environment, or the process whereby a contaminant is introduced into the environment.
Controlled waste	Material or liquid waste that is regulated because of its toxicity or imminent hazardous nature.
Declaration on Anti-fouling System	The declaration required to be carried by vessels of less than 400 gross tonnes but greater than 24 metres, and registered to a Flag State that is Party to the <i>International convention on the control of harmful anti-fouling systems on ships</i> . This declaration ensures their anti-fouling coating system complies with the convention.
Exclusive Economic Zone	Those waters beyond the limits of the Territorial Sea out to 200 nautical miles.
Emergency situation	An event, actual or imminent, which endangers or threatens to endanger life, property or the environment and which requires a significant coordinated response.
In-water cleaning	The physical removal of biofouling and/or anti-fouling coating surface deposits from submerged surfaces. For the purposes of these guidelines, 'in-water' refers to the parts of a vessel or movable structure that are either below the load line or normally submerged and/or are coated in anti-fouling coating.

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Local water quality standards	The concentrations or discharge of contaminants (such as those arising from hull maintenance operations) regarded as acceptable by the relevant authority.
Maintenance facility	Any location or facility where on-shore maintenance of vessels or other movable structures is carried out. This includes maintenance, removal and application of anti-fouling coatings and removal of biofouling organisms.
Marine Growth Prevention System (MGPS)	An anti-fouling system used to prevent biofouling accumulation in internal seawater systems and sea chests; can include use of anodes, injection systems and electrolysis.
Movable structure	A structure or installation deployed in aquatic environments that can be moved between locations. Movable structures include (but are not limited to) oil and other exploration rigs, floating dry-docks, pontoons, aquaculture installations, navigational structures. The cleaning and movement of aquaculture stock falls outside the scope of these guidelines and should be covered in industry codes of practice or similar documents.
Niche areas	Areas on a vessel or movable structure more susceptible to biofouling accumulation due to different hydrodynamic forces, susceptibility to anti-fouling coating wear or damage or absence of anti-fouling coatings. They include, but are not limited to, waterline, sea chests, bow thrusters, propeller shafts, inlet gratings, jack-up legs, moon pools, bollards, braces and dry-docking support strips.
Planned in-service period	The intended interval (decided at the time of anti-fouling coating application) until the next scheduled application of anti-fouling coating on a vessel or movable structure
Relevant authority	The authority responsible for managing the environmental effects of activities. Refer to section on Application of these Guidelines for further information.
Service life	The period of time an anti-fouling coating system is expected to protect a treated surface from biofouling and/or corrosion if the coatings are applied in accordance with the manufacturer's specifications.
Statement of compliance	A document (and associated evidence) issued by a classification society to vessels greater than 400 gross tonnes that are registered in Flag States not Party to the <i>International convention on the control of harmful anti-fouling systems on ships</i> .
Vessel	Any craft that operates in an aquatic environment be it to transport people or commodities, to carry out maintenance or provide a platform for other activities (such as recreational, fishing, cruise, merchant, exploration, research or naval vessels and barges and other vessel types).

Part 1: Shore-based application, maintenance, removal and disposal of anti-fouling coatings

A. Anti-fouling coating types

A wide range of anti-fouling coatings are available for owners and operators of vessels and movable structures. For simplicity, these guidelines group anti-fouling coatings into two main categories, based on whether they rely on release of biocidal (toxic) compounds to prevent biofouling (see Appendix 2).

- **Biocidal coatings** release chemicals such as copper compounds that aim to prevent settlement or survival of aquatic organisms.
- **Biocide-free coatings** do not depend on chemicals or pesticides for their anti-fouling properties, instead relying on their physical nature.

Both biocidal and biocide-free anti-fouling coatings may contain harmful substances that pose a contamination risk if released into the environment.

All biocidal anti-fouling coatings must be registered and permitted for use as an 'anti-foulant' by the Australian Pesticides and Veterinary Medicines Authority in Australia or the Environmental Protection Authority in New Zealand before they can be applied in that country. Sale and application of unregistered biocidal coatings is prohibited in Australia and New Zealand, as is the addition of any biocidal additive to an anti-fouling coating.

The sale and application of anti-fouling coatings containing tributyltin are prohibited in Australia and New Zealand. However, Australian and New Zealand maintenance facilities may still carry out maintenance on vessels and movable structures that have tributyltin-based anti-fouling coatings beneath barrier coats and compliant anti-fouling coatings, provided the facilities are able to contain waste produced during maintenance and minimise release of contaminants.

Material Safety Data Sheets and relevant product descriptions should be consulted for advice and information on correct storage, handling and emergency treatment procedures for all anti-fouling coatings and chemicals.

Application, maintenance, removal and disposal of anti-fouling coatings should only be carried out at maintenance facilities that have adopted measures to ensure all biofouling, coatings and other physical contaminants removed from vessels and structures are retained and treated in a manner that is compliant with relevant local regulations. It is the responsibility of the person carrying out the maintenance to check all necessary approvals are in place and that they are familiar with all conditions specified in such approvals.

B. Choosing the correct anti-fouling coating

Different anti-fouling coatings are designed and developed with different uses in mind. It is essential, therefore, that the person buying and/or applying a coating obtains appropriate technical advice, generally from the coating manufacturer or supplier, before choosing an anti-fouling coating. Application of an inappropriate anti-fouling coating may result in increased and unnecessary accumulation of biofouling, increased loadings of biocide in the environment, or a requirement for more frequent maintenance.

The following factors should be considered when choosing an anti-fouling coating system:

- The activity profile of the vessel or movable structure—different anti-fouling coatings are designed to optimise anti-fouling performance for specific speeds, aquatic environments or levels of activity.
- Planned in-service periods before coating system renewal—different coating types and film thicknesses have different service lives that must be matched with planned maintenance and reapplication.
- Design and construction of the vessel or movable structure—the coating must be compatible with construction materials and use of specific coatings in niche or high and low water flow areas should be considered.
- Any legal requirements for the sale and use of anti-fouling coatings.

Planned in-service period

The anti-fouling coating manufacturer and/or commercial applicator should be consulted when choosing an anti-fouling coating to ensure it is capable of meeting or exceeding the planned in-service period. Anti-fouling coatings that are older than the planned in-service period may not provide adequate protection from biofouling.

For commercial vessels and structures, the type and thickness of anti-fouling coatings (in particular for self-polishing systems) are generally determined by the planned in-service period and operational profile. The planned in-service period is determined by logistic and economic factors, and should be recorded in the vessel's Biofouling Management Plan.

For recreational vessels, the maintenance schedule is not usually determined by operational forecasts and logistical constraints, and anti-fouling coatings are chosen according to other factors. Based on recommended service lives of currently available anti-fouling coatings, the following in-service periods are recommended: 12 months for biocidal anti-fouling coatings and 24 months for biocide-free coatings.

Record-keeping

Records should be kept of anti-fouling coatings chosen and applied.

For **commercial vessels and structures**, the preferred form of documentation of anti-fouling coating type and age is:

- a biofouling record book and/or biofouling management plan (see Appendix 4), or
- an anti-fouling system certificate or declaration on anti-fouling system, or
- original receipts or invoices stating the coating type and the volume purchased; vessel name and date of application, where the former documents are not held.

For **recreational vessels**, the preferred form of documentation is:

- a biofouling record book and/or biofouling management plan (see Appendix 4), or
- original receipts or invoices stating the coating type and the volume purchased, vessel name (if possible) and date of application, where the former document(s) are not held.

C. Requirements for shore-based maintenance facilities

Operators of shore-based maintenance facilities should:

- be familiar with best-practice recommendations set out in these guidelines for application, maintenance and removal of anti-fouling coatings and ensure that all customers are similarly informed.
- adopt measures to ensure biofouling waste, coating waste and other contaminants arising during maintenance activities are captured and retained in a manner that minimises their release into the terrestrial and aquatic environment.

Shore-based maintenance facilities should have:

- Clearly designated areas where maintenance activities producing debris are isolated from the environment. Facilities that enable customers to undertake maintenance on their own vessel or movable structure (that is, non-professional maintenance) should ensure sufficient information on how to prevent any discharges is provided.
- Clear operational rules that facility operators should ensure are followed, by supervising non-professional maintenance activities, as appropriate.

Coating and biofouling waste should be disposed of as controlled waste and the method of disposal should comply with relevant local regulations.

D. Application of anti-fouling coatings

General guidance

The manner in which an anti-fouling coating is applied influences its performance. Reduced performance will result in a need for more frequent maintenance. To achieve optimum performance, the following is strongly recommended:

- Technical advice regarding the correct surface preparation, application and curing time required for maximum performance of the anti-fouling coating should be sought from the manufacturer prior to applying the coating. All elements vary according to the type and brand of coating used and will affect performance.
- All anodes, sensitive fittings and sensors should be removed or heavily taped before application to avoid physical damage.
- Any primers and/or anti-corrosive coatings used must be compatible with the type of anti-fouling coating and appropriately applied to ensure optimal coating adhesion and distribution. Specialist or manufacturer's advice should be sought before new anti-fouling coating is applied over existing anti-fouling coating to ensure the coatings are compatible or that appropriate barrier coatings are used.
- It is important that the manufacturer's recommended coating film thickness be achieved to help ensure that the coating provides the expected service life.
- The manufacturer's recommended method of application must be followed to achieve optimal results. Use of non-approved techniques will compromise the anti-fouling and corrosion protection, and the service life of the coating system. Spray application of anti-fouling coatings achieves the best coating adhesion, surface consistency and smoothness. Where spray application is not possible, practical specialist advice should be sought about other application methods.
- Hull locations prone to high water flow and wear (e.g. exposed edges around bilge keels, intake grates and weld joints) should be coated with suitably durable anti-fouling coatings to the specified coating thickness. Housings, recesses and retractable fittings such as stabilizers, thruster bodies and guards should all be coated with a suitable anti-fouling coating.
- The position of docking blocks, slings, and other structures used to support vessels or movable structures during out of water maintenance should, where possible, be varied each time new coatings are applied. This ensures that areas under the docking blocks are coated with anti-fouling, at least at alternate dockings.

Specific guidance for professionals

- A work area should be used that is designed to minimise discharge of any contaminant into the environment, whether through run-off or aerosol distribution. This should include full bunding and screening of the work area, where appropriate.
- To prevent aerosols from drifting into neighbouring environments, all work should take place in an area that is protected from windy conditions.
- Clean, appropriate, efficient and well-maintained spray equipment must be used for application to ensure optimal coating thickness and distribution.
- Dedicated spray equipment must be used for silicone-based coatings to prevent silicone cross-contamination.
- All application equipment and containers should be cleaned immediately after use and left-over coatings disposed of in a manner that minimises contamination of the environment and follows local regulations for disposal of controlled waste.
- The relevant occupational health and safety requirements should be adhered to at all times.

Specific guidance for non-professionals

- Wherever possible, anti-fouling coatings should be applied by experienced professionals. However, non-professional application of anti-fouling coatings is common for small vessels, such as recreational yachts and launches or small fishing vessels. Non-professionals should follow manufacturer's recommendations when determining how they intend to apply the anti-fouling coating. The anti-fouling coating industry emphasises that spray application is the preferred method and will achieve the best coating performance. However, spray equipment should only be operated by professionals, or under the supervision of professionals, to ensure optimal application. Spray equipment should never be used outside of screening or other containment to prevent spray drift and contamination of nearby environments and structures.
- Anti-fouling coatings should be mixed (if necessary) in designated areas that are sealed, banded and well ventilated. Preparation and mixing of anti-fouling coatings must never be carried out in intertidal areas.
- Spills should be cleaned up using absorbent material and any residues should be allowed to dry rather than being washed into the wastewater collection system or aquatic environment.

- Any excess coating, empty coating and thinner containers and other material contaminated with primer, anti-corrosive or anti-fouling coatings should be disposed of as controlled waste. Empty coating and thinner containers should be allowed to air dry in a well-ventilated area prior to this. Coatings should not be allowed to enter water drains, gutters, sewers or the aquatic environment.
- Contaminants should be captured out of run-off water using permeable tarpaulins, screens or filter cloths.
- The area around maintenance areas should be swept or vacuumed frequently to minimise distribution of debris by wind.
- Contaminants such as coatings, pesticides, thinners, oils, detergents, paint strippers, etc. should be stored in accordance with Material Safety Data Sheets and in a manner that complies with any relevant local regulations.
- Relevant information on handling of, or exposure to coatings, thinners and other materials used during the application process should be obtained from the product label, the manufacturers' websites (such as Material Safety Data Sheets) or the retailer, and adhered to at all times.
- The recommended drying time of the primer and anti-fouling coatings must be observed to achieve optimal adhesion and coating performance. Premature over-coating or submersion will compromise coating adhesion and/or anti-fouling and anti-corrosion performance.

E. Maintenance and removal of anti-fouling coatings

Maintenance by professionals

Various methods are available for removal and maintenance of anti-fouling coatings. Each requires consideration of different factors. In all cases, disposal of removed material should follow the recommendations set out in Section F of these guidelines.

Hydroblasting (also known as hydrojetting, water jetting and water blasting) uses water propelled at high or ultrahigh pressure onto a surface to clean surfaces and remove old coatings. Abrasives are not used. Factors to consider:

- Spray drift created during hydroblasting contains anti-fouling residues. The dispersal of spray drift beyond the working area should be minimised by the use of screening and by avoiding spraying during windy conditions.
- Anti-fouling coatings are toxic and hazardous both to people and the environment. The work area where cleaning is carried out should be isolated and people engaged in the blasting should be completely protected from contact with all wastewater and spray drift.

Abrasive blasting (also known as grit blasting) uses air pressure, water pressure or centrifugal force to propel an abrasive material onto a surface to remove contamination, rust and old paint, and to create surface profile. Common abrasive materials used include sand, steel shot, steel grit, iron grit, copper slag, garnet and aluminium oxide. Dry abrasive blasting uses compressed air to propel the abrasive material. Wet abrasive blasting (slurry blasting) uses a slurry of water and abrasive material (rather than dry abrasive alone) to suppress dust generation. Vacuum blasting has vacuum technology added to dry abrasive blasting to capture used abrasive material and cleaning debris. Factors to consider:

- All anodes, sensitive fittings and sensors should be removed or heavily taped before blasting to avoid physical damage.
- Vacuum blasting is recommended over all other abrasive blasting methods.
- Wet abrasive blasting is preferred over dry blasting, as it creates less toxic dust.
- In the absence of vacuum blasting equipment, abrasive blasting operations should be conducted using one of the following options
 - an abrasive blasting chamber vented to the atmosphere via an effective dust collector or fabric filter, or
 - Ensure that the screening material for outdoor/open-air blasting is tear-resistant, UV-resistant, fire retardant and of suitable material and construction (preferably fully enclosed) to minimise escape of fine dust.
- Dry abrasive blasting should only be carried out in enclosed areas. Water or a proprietary suppressant agent should be used to minimise dust emissions from the work area.

Spot repair or maintenance

If coating removal or maintenance is carried out using small power tools or manual methods, the recommendations for non-professionals (below) should be followed.

Maintenance by non-professionals

These guidelines recognise that maintenance tools available to non-professionals may be different to those available to professionals. Therefore, some additional advice is provided here for non-professionals. In all cases, disposal of removed material should follow the recommendations set out in section F. In addition:

- Wherever feasible, mechanical or manual buffing and scraping should be used as they create debris that are more easily collected particularly when using wet techniques that further reduce the potential for aerial distribution.
- Pressure water blasting and abrasive grit blasting should only be conducted if appropriate screening and containment is available.
- All waste and debris should be collected using tarpaulins or drop-sheets and by avoiding work during windy conditions.
- Removal of coatings by wet sanding or scraping is preferred to chemical paint stripping as it creates less toxic waste material. The use of a heat gun can make coating removal easier on some surfaces. If chemical paint strippers must be used, consider soy-based or water-based products that are less hazardous. In all cases it is recommended that manufacturer's instructions are sought to determine the safest and most appropriate method for removing coatings.

F. Disposal of residues and wastes

To manage biosecurity and contaminant risks associated with shore-based maintenance activities, the following recommendations should be adhered to:

- Any removed material or liquid should not be allowed to enter any body of water or stormwater; and should not come into contact with any land that is below the high-water mark of any tidal body of water.
- All residues, solid coatings, liquid or any other form of waste, including removed biological material and used product containers should be collected and stored for disposal in line with the requirements of the relevant authority.
- Anti-fouling coatings should not be incinerated as this may generate toxic fumes, smoke and gases.

G. Emergency response

It is recommended that all maintenance facilities have an Emergency Response Plan, whether required by regulation or not. This plan should cover responses to spills of coatings and other hazardous substances, release of organisms, and other incidents with potential contamination and/or occupational health and safety risks. If such an emergency occurs, the relevant authority should be notified.

Any coating spillages should be assumed to contain hazardous substances and be disposed of as controlled waste and in accordance with the requirements of the relevant authority.

Spill clean-up equipment, such as absorbent materials, non-toxic dispersants, and booms (physical barriers for containing liquids) should be available for facility users and maintained in good condition. The relevant authority should be contacted for further information on decontamination procedures.

Part 2: In-water cleaning and maintenance

In-water cleaning can manage biofouling to optimise the performance of vessels and other movable structures and to minimise biosecurity risks. However, in-water cleaning can physically damage some anti-fouling coatings, shorten coating service life and release a pulse of biocide into the environment. In-water cleaning can also facilitate release of invasive aquatic pests into the surrounding environment. In-water cleaning should therefore only be undertaken when removal of biofouling does not harm the coating and presents an acceptable biosecurity or contaminant risk.

Although these guidelines recommend the use of in-water cleaning in some circumstances, vessels and movable structures should be removed from the water for cleaning and maintenance in preference to in-water operations, where this is operationally and economically practicable.

In-water cleaning should not be considered a replacement for coating maintenance and renewal at shore-based maintenance facilities.

Part 2 of these guidelines is divided into two sections:

- Section A: Information on the factors that determine the environmental risk of in-water cleaning.
- Section B: Specific guidance on situations where in-water cleaning may be acceptable and any conditions that may apply.

A. Determinants of contamination and biosecurity risk of in-water cleaning

The recommendations about in-water cleaning in these guidelines are made on the basis of the associated contamination and biosecurity risks. Several factors determine these risks and are described below.

Anti-fouling coating type

These guidelines distinguish between anti-fouling coatings that contain toxic biocides and those that do not (see Appendix 2). All types of anti-fouling coating pose a contamination risk during in-water cleaning. This risk is attributed on the basis of the toxicity and/or longevity of many approved biocides and other compounds found in coatings, including those that are biocide-free.

Not all anti-fouling coatings are suitable for in-water cleaning. For some coatings, specific methods need to be used to prevent damage to the coating and its future performance. Information on the suitability of an anti-fouling coating for in-water cleaning and the appropriate cleaning methods should be obtained from the coating manufacturer or retailer at the time of purchase. Cleaning technologies are outlined in Appendix 3.

Record-keeping

Documentation of coating type, date of application, and the planned in-service period of a vessel or movable structure should be kept on record as the relevant authority may need it when considering requests for in-water cleaning. If this information is not available the relevant authority may not be able to grant permission for in-water cleaning.

Examples of suitable systems for keeping and maintaining information on coatings and hull maintenance are the Biofouling Management Plan and the Biofouling Record Book recommended in the *Guidelines for the control and management of ships' biofouling to minimize the transfer of invasive aquatic species*. Templates for these documents are in Appendix 4.

Alternatively, the type and age of anti-fouling coatings can be provided using the documents required to demonstrate compliance with the *International convention on control of harmful anti-fouling systems on ships*; or other relevant documents, such as receipts or invoices that state the anti-fouling coating type and application date.

Biofouling origin

The geographic origin of biofouling organisms on a vessel or movable structure contributes to its biosecurity risk. If all biofouling was acquired in the same location where in-water cleaning is intended, cleaning may not pose a biosecurity risk as all biofouling species on the vessel or movable structure are already present in that area. However, biofouling acquired from distant locations may contain invasive aquatic species that pose a biosecurity risk. To aid in assessing the risk, three origin categories are defined:

- **Regional biofouling:** biofouling acquired in the same location where in-water cleaning is proposed. 'Regional' is as specified by the relevant state or territory government in Australia and local government in New Zealand. This category may be defined on the basis of biogeography, such as the distribution of (or specific pest management programs for) an invasive aquatic species or the location of high-value environments. Such delineation is the responsibility and prerogative of the state or territory government or local government in conjunction with other governments or agencies, as appropriate.
- **Domestic biofouling:** biofouling acquired from outside the region where in-water cleaning is proposed, but within the respective country's waters. Examples of this would be in-water cleaning of a vessel or movable structure in Sydney (New South Wales) whose biofouling may have been acquired in Fremantle (Western Australia); or cleaning of a vessel in Nelson, South Island, whose biofouling may have been acquired from Auckland, North Island.
- **International biofouling:** biofouling acquired from outside the waters of the country where in-water cleaning is proposed.

Log books that detail the voyage history (geographic locations visited and dates of each visit) of a vessel since its last cleaning or full anti-fouling coating renewal should be kept on board. Similar details should be maintained for movable structures, as appropriate. This provides the relevant authority with information on possible origins of the biofouling on the vessel or movable structure when in-water cleaning is proposed.

Biofouling type

These guidelines divide biofouling into two categories: microfouling and macrofouling (see Appendix 5 for images of examples of both types). Each represents biofouling assemblages of differing diversity, age and abundance.

- **Microfouling** refers to a layer of microscopic organisms including bacteria and diatoms and the slimy substances they produce. It is often referred to as a 'slime layer' and can be easily removed by gently passing a finger over the surface.
- **Macrofouling** refers to large, distinct multicellular organisms visible to the human eye, such as barnacles, tubeworms, mussels, fronds of algae and other large attached or mobile organisms.

Macrofouling growths represent a greater biosecurity risk as they may contain a diverse range of organisms, and are more difficult to effectively remove and contain. The type of biofouling on a vessel or movable structure can be determined by inspection (either by divers or remotely-operated cameras). Documentation of an inspection, such as an entry in a Biofouling Record Book, may be adequate evidence of the type of biofouling on a vessel or movable structure.

B. Guidance on in-water cleaning

This section describes situations where in-water cleaning may be appropriate and the conditions that may apply. This section should be used together with the decision-support tool in Appendix 1.

General guidance

1. If used regularly, in-water cleaning is an effective measure to limit development of biofouling. Regular (i.e. 6–12 monthly) in-water cleaning is recommended for all submerged surfaces, particularly propellers and other niche areas on vessels and movable structures.
2. In-water cleaning to routinely remove mature and extensive macrofouling as a substitute for earlier and/or better maintenance practices is not recommended.
3. In-water cleaning is only acceptable where contaminant discharges from the cleaning activity meet any standards or requirements set by the relevant authority.
4. In-water cleaning of vessels or movable structures should ideally be carried out before departing to new destinations, not after arriving at those destinations.
5. In-water cleaning should only be carried out on anti-fouling coatings that are suitable for in-water cleaning. Information on the suitability and ability of a coating to withstand in-water cleaning without damage and effects on service life, and on appropriate cleaning methods, should be obtained from the coating manufacturer.

6. In-water cleaning should not be performed on vessels or movable structures that have reached or exceeded their planned in-service period. When the anti-fouling coating has reached the end of its service life the vessel or movable structure should be removed from the water and a new anti-fouling coating applied.
7. In-water cleaning or treatment of biofouling should only be carried out using technology that does not harm the underlying coating or result in excessive release of contaminants. The capabilities of new technologies should be verified independently. Information on the suitability of particular cleaning or treatment methods can be obtained from coating manufacturers.
8. When in-water cleaning involves removal of macrofouling of domestic or international origin, methods to ensure minimal release of biological material into the water should be used. In-water cleaning technologies should aim to, at least, capture debris greater than 50 micrometres (μm) in diameter, which will minimise release of viable adult, juvenile and larval stages of macrofouling organisms. Any cleaning debris collected must be disposed of on land and in compliance with the waste disposal requirements of the relevant authority.
9. If suspected invasive or non-indigenous aquatic species are encountered during in-water cleaning or other vessel maintenance activities, the relevant authority should immediately be notified and the cleaning or maintenance activity ceased.

Recommendations for decision making on in-water cleaning

- Microfouling, regardless of origin, may be removed without the need for full containment of biofouling waste, provided the cleaning method is consistent with the coating manufacturer's recommendations. Where microfouling is removed using a gentle, non-abrasive cleaning technique, the contamination risk is likely to be acceptable.
- Macrofouling of regional origin (as defined by the relevant authority) may be removed without the need for full containment of biofouling waste provided the cleaning method is consistent with the coating manufacturer's recommendations and the contaminant discharges meet any local standards or requirements.
- Macrofouling of domestic origin may be removed without the need for full containment of biofouling waste following risk assessment by the relevant authority. If the relevant authority determines containment of biofouling waste is required, the guidance provided in point 8 (above) should be used. In either case, the cleaning method must be consistent with the coating manufacturer's recommendations and contaminant discharges must meet any local standards or requirements.
- Macrofouling derived from international locations should only be removed using cleaning methods that minimise release of all organisms, or parts of organisms, and anti-fouling coating debris, using the guidance described in point 8 (above). The cleaning method must be consistent with the coating manufacturer's recommendations and contaminant discharges must meet any local standards or requirements.

Appendix 1 provides a decision support tool to aid decision making on in-water cleaning based on these recommendations.

Exceptions to these recommendations

- The recommendations on in-water cleaning may not apply in locations where biosecurity controls have been implemented for invasive aquatic species management purposes.
- A need for in-water cleaning may arise during an emergency, to address an operational, health and safety or biosecurity hazard. Identification and handling of such situations is the responsibility of the relevant authority.
- Situations not covered by the decision support tool are solely at the discretion of the relevant authority.

Appendix 1: Decision support tool for in-water cleaning

This tool for in-water cleaning is designed to help relevant authorities make decisions about in-water cleaning practices in their jurisdictions. It will also help owners or operators of vessels and other movable structures determine the types of information and documentation that relevant authorities may require of them to make decisions on in-water cleaning. Relevant authorities may require additional information for their risk-assessment and decision-making processes.

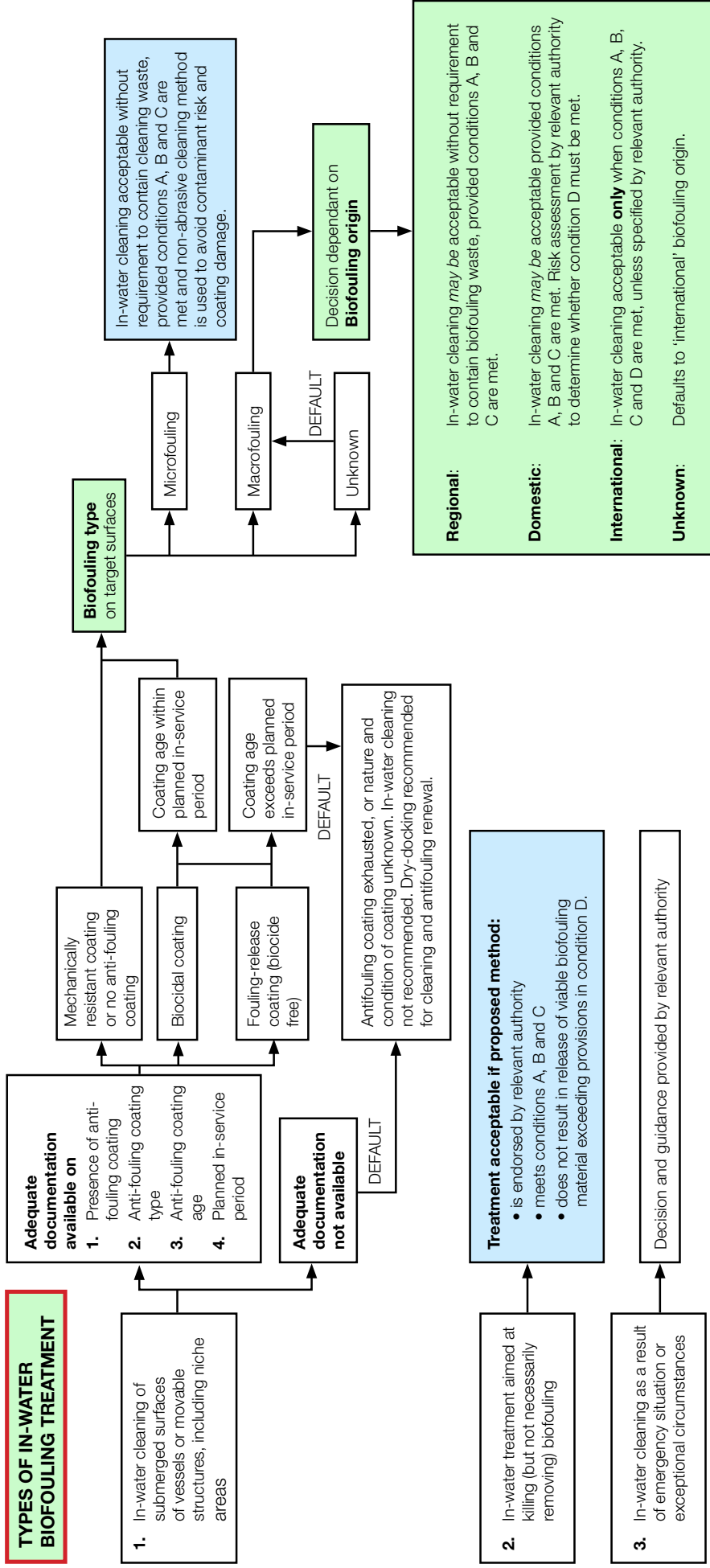
When information and/or documentation required for making decisions on in-water cleaning is not available, the following default assumptions apply:

- If the type of a coating (e.g. biocidal; biocide-free) cannot be reliably determined, then it should be assumed that the coating contains biocides.
- If the age of a coating cannot be reliably determined, then it should be assumed that the coating has reached the end of its service life.
- Where the type of biofouling on a vessel or structure is unknown, it should be assumed that macrofouling is present.
- If the origin of the biofouling on a vessel or movable structure is unknown, then it should be assumed that it is of international origin. If the biofouling is likely to be from more than one origin category (e.g. regional and international) then decisions on in-water cleaning should be based on the furthest likely origin (i.e. international).

The decision support tool should be used in conjunction with the main text of the *Anti-fouling and in-water cleaning guidelines*.

Decision-Support Tool for in-water cleaning

This tool is designed to assist relevant authorities with making decisions about in-water cleaning practices in their jurisdictions. The tool is part of, and must be used in conjunction with, the main text of the *Anti-fouling and in-water cleaning guidelines*. The terms used in this tool are defined in the guidelines.



Conditions for removal and/or treatment of biofouling:

- A:** Anti-fouling coating is suitable for cleaning/treatment.
- B:** Cleaning/treatment method does not damage coating surface.
- C:** Discharges meet local standards or requirements.
- D:** Cleaning/treatment method ensures that release of biological material into the water column is minimised through the capture and containment of biofouling waste. Cleaning method should aim to, at least, capture debris greater than 50 µm in diameter which will minimise the release of viable adult, juvenile and larval stages of macrofouling.

Appendix 2: Types of anti-fouling coatings

Biocidal coatings are coatings that release chemicals such as copper compounds or other pesticides that aim to deter biofouling organisms. There are four general types of biocidal coatings:

- **Soluble matrix** controlled depletion polymer or ablative anti-fouling coatings contain a binder that is slightly soluble in seawater. Hydration causes the coating surface to slowly dissolve, releasing the freely associated biocide.
- **Insoluble matrix**, contact leaching, long-life or diffusion anti-fouling coatings use an insoluble binder that contains a high concentration of biocide released from the coating through a diffusion process.
- **Self-polishing copolymer** anti-fouling coatings release biocides as a result of hydrolysis causing the coating to 'erode' when a vessel is moving.
- **Metallic** anti-fouling coatings use copper or copper nickel alloy as either metal sheathing or metal particles mixed into a coating.

Biocide-free coatings do not depend on chemicals for their anti-fouling properties, instead relying on their physical nature. They are split into two subcategories:

- **Fouling release coatings** rely on non-stick, low surface energy compounds, such as silicone or fluoropolymers, to impair the adhesive attachment of biofouling.
- **Mechanically resistant coatings** (epoxy, ceramic/epoxy and epoxy/glass) are tough, highly durable coatings without specific anti-fouling properties. They allow biofouling organisms to accumulate and are designed to withstand regular in-water cleaning (including abrasive methods).

Appendix 3: In-water cleaning technology

The most commonly available in-water cleaning technologies are brushing/scraping, use of soft cleaning tools, and water or air jet systems. These methods vary in their effectiveness in removing and containing biofouling organisms, and in their suitability for use on different anti-fouling coating types.

- **Brush systems**—Brushes are a widely used method for in-water hull cleaning because of their ability to remove surface deposits and low levels of biofouling from biocidal coatings. They can have a rejuvenating effect on the performance of some coating types. Existing brush systems are not able to remove all biofouling from a surface or contain all of the removed material. Use of abrasive brushes can also result in exacerbated release of biocidal coating material. Use of brushes on fouling-release coatings can damage the coating surface and is not recommended unless the brushes are sufficiently soft and will not harm the integrity of the coating. Advice should be sought from the coating manufacturer or supplier before using any brush system on an anti-fouling coating.
- **Soft tools**—Fouling release coatings prevent firm attachment of biofouling organisms. Soft cleaning tools, such as cloths, squeegees and wiping tools can be used to remove microfouling and macrofouling effectively from surfaces coated in fouling release coatings without harming the integrity of the coating. These coatings are delicate and scratching of the surface should be avoided. If cloths are used for cleaning, it is necessary to ensure no shell fragments or other hard objects are trapped beneath the cloths that could scratch and damage the coatings.
- **Water jet and air jet (blast) systems**—Water and air jet cleaning systems are versatile tools because their operating pressure (and jet pattern) can be varied according to coating type and biofouling extent. The effects of water jet technology on biocidal coatings are not fully understood. At the time of writing, available water jet systems are not able to contain all removed biofouling or coating material. Water pressures that do not harm the integrity of the anti-fouling coating should be used.

Other technologies:

- **Technologies that kill, but not necessarily remove biofouling**—Several types of biofouling treatment are available that kill biofouling organisms but do not actively remove them from a surface. These include heat (in the form of steam or heated water) or enveloping technologies (wrapping of a vessel or movable structure in plastic sheets or canvas sleeves to suffocate biofouling). These are generally developing technologies and their effectiveness and effects on anti-fouling coatings have not been evaluated.
- **Developing technologies**—A number of technologies that collect biofouling and coating material are under development but were not commercially available in either Australia or New Zealand at the time these guidelines were developed. Any novel technology should aspire to achieve the standards set out in Part 2 Section B of these guidelines.

Appendix 4: Biofouling Management Plan and Biofouling Record Book template

This template was prepared by the International Maritime Organization.

A. Format and content of Biofouling Management Plan

Introduction

This section should contain a brief introduction for the ship's crew, explaining the need for biofouling management, and the importance of accurate record keeping. The plan should state that it is to be available for viewing on request by a port state authority and should be written in the working language of the crew.

Ship particulars

At least the following details should be included:

- Ship's name
- Flag
- Port of registry
- Gross tonnage
- Registration number (i.e. IMO number and/or other registration numbers, if applicable)
- Regulation length
- Beam
- Ship type (as classified by Lloyd's Register)
- International call sign and Maritime Mobile Service Identity (MMSI).

Index

A table of contents should be included.

Purpose

The purpose of the plan is to outline measures for control and management of ships' biofouling in accordance with the *2011 Guidelines for the control and management of ships' biofouling to minimize the transfer of invasive aquatic species*. It provides operational guidance for planning and actions needed for ships' biofouling management.

Description of anti-fouling systems

The plan should describe the anti-fouling systems in place for different parts of the ship, including:

- type(s) of anti-fouling coating systems applied
- details of where anti-fouling systems are and are not applied or installed
- manufacturer and product names of all coatings or products used in the anti-fouling coating systems
- anti-fouling system specifications (including dry film thickness for coatings, dosing and frequency for Marine Growth Prevention System (MGPS)) together with the expected effective life, operating conditions required for coatings to be effective, cleaning requirements and any other specifications relevant for paint performance.

Previous reports on the performance of the ship's anti-fouling systems should be included, if applicable, and the anti-fouling system certificate or statement of compliance or other documentation should also be referenced, as appropriate.

Description of operating profile

The plan should describe the ship's operating profile that has determined the performance specifications of the ship's anti-fouling systems and operational practices, including:

- typical operating speeds
- periods underway at sea compared with periods berthed, anchored or moored
- typical operating areas or trading routes
- planned duration between dry-dockings/slippings.

Description of areas on the ship susceptible to biofouling

The plan should identify the hull areas, niche areas and seawater cooling systems on the ship that are particularly susceptible to biofouling and describe the management actions required for each area. It should describe the actions to be taken if the ship is operating outside the desired operating profile, or if excessive unexpected biofouling is observed, and any other actions that can be taken to minimise accumulation of biofouling on the ship.

A diagram of the ship should be included in the plan to identify the location of those areas of the ship that are particularly susceptible to biofouling (including access points in the internal seawater cooling systems). If necessary these should show both side and bottom views of the ship.

Operation and maintenance of the anti-fouling system

This section should contain a detailed description of the operation and maintenance of the anti-fouling system(s) used, including schedule(s) of activities and step-by-step operational procedures.

Timing of operational and maintenance activities

This section should stipulate the schedule of planned inspections, repairs, maintenance and renewal of the anti-fouling systems.

In-water cleaning and maintenance procedures

This section should set out planned maintenance procedures (other than for on-board treatment processes) that need to be completed between dry-docking events to minimise biofouling. This should include routine cleaning or other treatments. Details should be provided on the treatment/cleaning to be conducted, specification of any equipment required, details of the areas to which each specific treatment/cleaning is to be applied, step-by-step operational procedures where relevant and any other details relevant to the processes (such as chemicals required for treatment and any discharge standards).

Operation of onboard treatment processes

This section should provide specific advice about MGPS fitted, internal seawater cooling systems covered by the system and any not covered, and the associated maintenance and inspection schedule and procedures. This would include information such as when each MGPS is run, for how long and any cleaning/maintenance requirements of the system once use is finished. This section should also include advice for ship operators on procedures for biofouling management if the MGPS is temporarily out of operation.

Safety procedures for the ship and the crew

Details of specific operational or safety restrictions, including those associated with the management system that affects the ship and/or the crew. Details of specific safety procedures to be followed during ship inspections.

Disposal of biological waste

This section should contain procedures for disposal of biological waste generated by treatment or cleaning processes when the cleaning is conducted by, or under the direct supervision of, the ship owner, master or crew.

Recording requirements

This section should contain details of the types of documentation to be kept to verify the operations and treatments to be recorded in the Biofouling Record Book, as outlined below.

Crew training and familiarisation

This section should contain information on provision of crew training and familiarisation.

B. Format and content of the Biofouling Record Book

Period From: To:

Name of ship

Registration number*

Gross tonnage

Flag

* Registration number = IMO number and /or other registration numbers.

The ship is provided with a Biofouling Management Plan Y/N

A diagram of the ship indicating underwater hull form (showing both side and bottom views of the ship, if necessary) and recognised biofouling niches.

1 Introduction

The guidelines recommend that a Biofouling Record Book be maintained for each ship, in which should be recorded the details of all inspections and biofouling management measures undertaken on the ship.

2 Entries in the Biofouling Record Book

The following information should be recorded in the Biofouling Record Book:

2.1 After each dry-docking:

- a. Date and location that the ship was dry-docked.
- b. Date that ship was re-floated.
- c. Any hull cleaning that was performed while dry-docked, including areas cleaned, method used for cleaning and the location of dry-dock support blocks.
- d. Any anti-fouling coating system, including patch repairs, that was applied while dry-docked. Detail the type of anti-fouling coating system, the area and locations to which it was applied, the coating thickness achieved and any surface preparation work undertaken (e.g. complete removal of underlying anti-fouling coating system or application of new anti-fouling coating system over the top of existing anti-fouling coating system).
- e. Name, position and signature of the person in charge of the activity for the ship.

2.2 When the hull area, fittings, niches and voids below the waterline have been inspected by divers:

- a. Date and location of ship when dive surveyed and reason for survey.
- b. Area or side of the ship surveyed.
- c. General observations with regard to biofouling (i.e. extent of biofouling and predominant biofouling types, e.g. mussels, barnacles, tubeworms, algae and/or slime).
- d. The action taken, if any, to remove or otherwise treat biofouling.
- e. Any supporting evidence of the actions taken (e.g. report from the classification society or contractor, photographs and receipts).
- f. Name, position, signature of the person in charge of the activity.

- 2.3 When the hull area, fittings, niches and voids below the waterline have been cleaned by divers:
- a. Date and location of ship when cleaning/treatment occurred.
 - b. Hull areas, fittings, niches and voids cleaned/treated.
 - c. Methods of cleaning or treatment used.
 - d. General observations about the biofouling (i.e. extent of biofouling and predominant biofouling types; e.g. mussels, barnacles, tubeworms, algae and/or slime).
 - e. Any supporting evidence of the actions taken (e.g. report from the classification society or contractor, photographs and receipts).
 - f. Records of permits required to undertake in-water cleaning, if applicable.
 - g. Name, position and signature of the person in charge of the activity.
- 2.4 When the internal seawater cooling systems have been inspected and cleaned or treated:
- a. Date and location of ship when inspection and/or cleaning occurred.
 - b. General observations about biofouling of internal seawater cooling systems (i.e. extent of biofouling and predominant biofouling types; e.g. mussels, barnacles, tubeworms, algae and/or slime).
 - c. Any cleaning or treatment undertaken.
 - d. Methods of cleaning or treatment used.
 - e. Any supporting evidence of the actions taken (e.g. report from the classification society or contractor, photographs and receipts).
 - f. Name, position and signature of the person in charge of the activity.
- 2.5 For ships with a MGPS fitted:
- a. Records of operation and maintenance (such as regularly monitoring the electrical and mechanical functions of the systems).
 - b. Any instances when the system was not operating in accordance with the biofouling management plan.
- 2.6 Periods of time when the ship was laid up/inactive for an extended period:
- a. Date and location where ship was laid up.
 - b. Date when ship returned to normal operations.
 - c. Maintenance action taken before and after the period laid up.
 - d. Precautions taken to prevent biofouling accumulation (e.g. sea chests blanked off).
- 2.7 Periods of time when ship operating outside its normal operating profile:
- a. Duration and dates when ship not operating in accordance with its normal operating profile.
 - b. Reason for departure from normal operating profile (e.g. unexpected maintenance required).
- 2.8 Details of official inspection or review of ship biofouling risk (for ships arriving internationally, if applicable):
- a. Date and location of ship when inspection or review occurred.
 - b. Port state authority conducting the inspection/review and details of procedures followed or protocol adhered to and inspector/s involved.
 - c. Result of inspection/review.
 - d. Name, position, signature of the person in charge of the activity for the ship.

2.9 Any additional observations and general remarks:

- a. Since the ship was last cleaned, has the ship spent periods of time in locations that may significantly affect biofouling accumulation (e.g. fresh water, high latitude—Arctic and Antarctic—or tropical ports)?

Record of Biofouling Management Actions

SAMPLE BIOFOULING RECORD BOOK PAGE

Name of Ship:

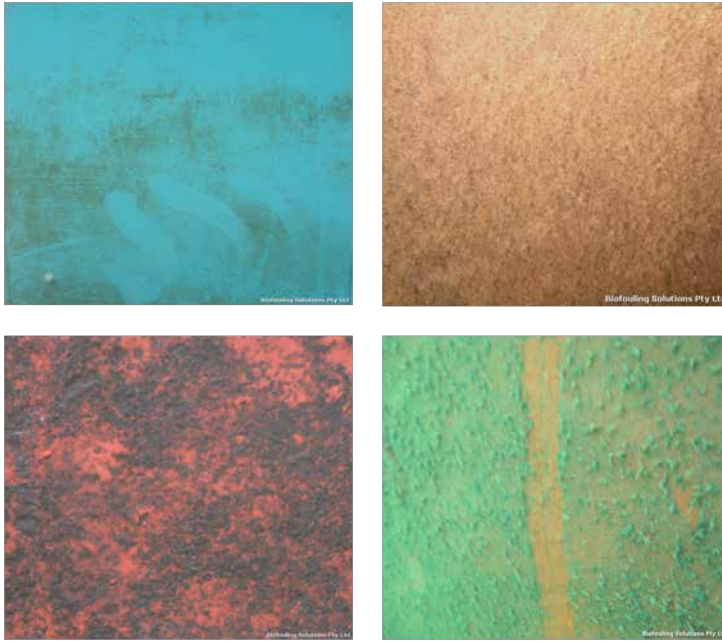
Registration number:

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

Signature of master

Appendix 5: Microfouling and macrofouling images

Microfouling: a layer of microscopic organisms including bacteria and diatoms and the slimy substances they produce. Often referred to as a 'slime layer', microfouling can usually be removed by gently passing a finger over the surface.



Macrofouling: large, distinct multicellular organisms visible to the human eye, such as barnacles, tubeworms, mussels, fronds of algae and other large attached or mobile organisms.

