ANTIFOULING PERFORMANCE STANDARDS FOR THE MARITIME INDUSTRY

DEVELOPMENT OF A FRAMEWORK FOR THE ASSESSMENT, APPROVAL AND RELEVANCE OF EFFECTIVE PRODUCTS

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in association with

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A consultancy for the

Natural Heritage Trust

Natural Heritage Trust

Helping Communities Helping Australia

An Australian Government Initiative

ACRONYMS

ACA	Australasian Corrosion Association
ASIC	Australian Seafood Industry Council
AMSA	Australian Maritime Safety Authority
APAS	Australian Paint Approval Scheme
APMF	Australian Paint Manufacturers Federation
APVMA	Australian Pesticides and Veterinary Medicines Authority (APAS).
ASTM	American Society for Testing and Materials
ATC	Australian Transport Council
AYF	Australian Yachting Federation
CDP	Controlled depletion polymer
DEH	Australian Government Department of the Environment and Heritage
DNV	Det Norske Veritas
DSTO	Defence Science and Technology Organisation
FSU	Floating storage units
FSPO	Floating production, storage and offloading (vessels)
GF-AAS	Graphite furnace atomic absorption spectrophotometry
HLG	High Level Officials Group
IACS	International Association of Classification Societies
IAS	International Antifouling System
IGA	Inter-Governmental Agreement
IMO	International Maritime Organisation
ISO	International Standards Organisation
MSV	Marine Safety Victoria
MEPC	Marine Environment Protection Committee
NATA	National Association of Testing Laboratories
NIMPCG	National Introduced Marine Pests Coordination Group
NMSC	National Marine Safety Committee

NIMPCG	National Introduced Marine Pests Coordination Group
NRMMC	Natural Resource Management Ministerial Council
NSCV	National Standard for Commercial Vessels
OCS	Offshore Constitutional Settlement
PCCP	Painting Contractors Certification Program
POEO	Protection of the Environment Operations (Act, Victoria)
RAIA	Royal Australian Institute of Architects
SCAA	Surface Coatings Association of Australia
SEPP	State Environment Protection Policy (Victoria)
SPC	Self-polishing copolymer
SOLAS	International Convention for the Safety of Life at Sea
SSCP	US Society for Protective Coatings
TBT	Tributyltin
TCMTB	Thiocyanomethylthio-benzothiazole
USL	Uniform Shipping Laws
VOC	Volatile Organic Content

ANTIFOULING PERFORMANCE STANDARDS FOR THE MARITIME INDUSTRY: DEVELOPMENT OF A FRAMEWORK FOR ASSESSMENT, APPROVAL AND RELEVANCE OF EFFECTIVE PRODUCTS

EXECUTIVE SUMMARY

The aim of this consultancy, on Antifouling Performance Standards for the Maritime Industry, is to assist the Australian Government Department of the Environment and Heritage (DEH) in meeting its responsibilities to contribute to the improved prevention of introduced marine pest incursions nationally. The consultancy is funded by the National Heritage Trust.

Biofouling of vessels, marine equipment, and structures is recognised as an important vector for introduced marine pests and the Report of the National Taskforce on the Prevention and Management of Marine Pest Incursions (1999) recommended that the hull fouling issue be given similar priority to ballast water. Following acceptance of this report, the National Introduced Marine Pests Coordination Group (NIMPCG) was established to implement the reforms identified in the report. The Biofouling Working Group of NIMPCG identified antifouling paint standards as a key management tool for minimising the risk of hull fouling species translocation, and considered that in the short term there should be a focus on the development of biofouling standards and codes of practice for the various boating and shipping sectors.

This consultancy report represents the first step in this process: the development of antifouling performance standards within a framework for the assessment, approval and relevance of effective antifouling products for use by the various recreational and commercial sectors. The consultancy followed the steps proposed by DEH for the consultancy:

(i) To assess the capability of existing Australian organisations, authorities or schemes to administer or support such a framework
(ii) To determine the applicability of international approval schemes
(iii) To determine the existence and relevance of any Australian or international performance standards
(iv) To liaise with Australian paint manufacturers and suppliers and other relevant parties on a functional and achievable scheme for the approval of product performance
(v) To develop recommendations for performance criteria for antifouling products of different types and for specific classes of watercraft and operating profiles.

This report proposes a four component framework for ensuring that vessels moving between coastal water zones have applied and maintained effective antifouling prevention systems on their underwater hulls:

(i) *Monitoring of compliance*: The establishment of a survey regime to survey and inspect compliance with antifouling performance regulations (proper product selection, application and maintenance) for various classes of vessel. For the regulation of SOLAS class vessels, international co-operation should be sought through the IMO. For domestic, non-SOLAS commercial vessels and domestic recreational craft, uniform regulation, codes of conduct and guidelines should be developed by the States and the Northern Territory. Surveyors employed by State and NT Marine Safety Authorities could then be empowered and trained to monitor

regulatory compliance on behalf of the relevant State and NT environmental authorities.

(ii) *Certification of application*: The availability or development of a system to certify that appropriate antifouling products are used and that the quality of application of an antifouling coating system will meet system performance standards or, where this is impractical such as for the small DIY owner, there are appropriate limitations on endorsement. In appraising current industry practices there was a strong view, particularly among the manufacturers and suppliers of antifouling paints, that deficiencies in the application of these paints was the principal reason antifouling paints failed to achieve their potential service life. Upgrading industry standards by the defining good industry practice and auditing applicators against those standards was seen as an important

(iii) *Antifouling product and system approval*: The availability or development of a system to verify or approve the efficacy or performance of antifouling products and systems for various vessel operating profiles or applications against relevant specifications, to publicly disseminate information on "approved" products, and to ensure ongoing quality assurance of paint production. With the Federal Government's Australian Pesticides and Veterinary Medicines Authority (APVMA) currently certifying antifouling paints and its Australian Paint Approval Scheme (APAS) already setting performance standards for a broad range of commercial paints and quality assuring their manufacture. Australia is well placed to develop an integrated system of approving these products.

(iv) *Antifouling product standards and system specification*: Antifouling performance standards need to apply to all types of underwater hull treatments, which therefore encompasses both biocidal (ablative and non ablative) and non-toxic coating systems. They also need to be relevant to all classes of vessel that pose a risk of translocating marine species as hull fouling, including recreational craft, commercial water craft, shipping and mobile infrastructure. Standards must also consider coating systems, not just single products, as antifouling life is a function of system characteristics and proper application.

No national system of specifications or standards for antifouling paints currently exists in Australia, and there is only one national test method. Overseas standards have varying relevance and applicability, with additional limitations being the lack of facilities in Australia for testing ablative coatings and the lack of any standards specifically relevant to non-toxic fouling release coating systems. A need therefore exists for the development of antifouling standards and specifications applicable to assessing and validating the performance and efficacy of different types of antifouling and suitability to different classes of vessels. Formation of a technical working group, with representatives from industry and relevant authorities and agencies, is considered the most effective means of achieving this.

RECOMMENDATIONS

Compliance Monitoring and Survey

Recommendation 1: SOLAS vessels (Section 4.1)
Australia should seek international co-operation by making a submission to IMO for an international instrument that addresses the management and control of ship's hull fouling and the consequential transfer of marine organisms.

Recommendation 2: Non-SOLAS vessels (Section 4.1)
State and Northern Territory Governments should manage translocation of marine pests by hull fouling on all non-SOLAS commercial vessels through uniform regulation, codes of conduct and guidelines.

Recommendation 3: Recreational vessels (Section 4.1)
State and Northern Territory Governments should manage translocation of marine pests by hull fouling on all domestic recreational craft through uniform regulation, codes of conduct and guidelines.

Certification of Paint Application

Recommendation 4 - A licensing scheme should be established to monitor and control the commercial application of antifouling paint in Australia. (Section 4.2.1).

Recommendation 5 - DEH should explore the development of an antifouling paint applicator licensing scheme with the Australian Government Analytical Laboratories, who operate the Painting Contractors Certification Program. (Section 4.2.1).

Recommendation 6 - State Government Marine Safety Surveyors should be suitably trained and empowered to inspect the operations of antifouling paint applicators accredited under a PCCP scheme, on behalf of the relevant environmental authorities, in terms of best industry practice, as defined under the licensing scheme proposed in Recommendation 5.

Recommendation 7- For DIY applicators, purchase invoices or evidence of third party oversight could provide evidence of satisfactory antifouling paint application, but such evidence should be deemed valid for a period of no more than 12 months (Section 4.2.2).

Recommendation 8- A wide, but targeted, education program should be developed for recreational boat owners to demonstrate the environmental imperative for any antifouling certification scheme and its implementation (Section 4.2.2).

Product Registration

Recommendation 9- The Registration (Approval) of antifouling paints should be developed by the agreement of the APVMA and APAS. It is proposed that the APVMA would remain the conduit for manufacturers seeking approval of antifouling paints and would continue to dictate all toxic and environmental standards. In the longer term, APAS would establish durability and efficacy standards for antifouling paints to meet the diverse requirements of ship owners and operators. These specifications would need to include demands on the paint manufacturers and suppliers for third party ISO 9003 quality assurance of paint manufacture and distribution. (Section 4.3)

Product and System Approval

Recommendation 10- An Australian approval system for antifouling paint efficacy and performance should be developed based on standards and specifications relevant to the intended application. (Section 4.4.1)

Recommendation 11- Approval of antifouling paint systems should be to a classification system, which considers product type (ablative/non-ablative, biocidal/non-biocidal), class (substrate suitability), grade (vessel speed/activity) and application (docking cycle). (Section 4.4.2)

Recommendation 12- Approval of antifouling systems developed to overseas specifications should be deemed acceptable for relevant applications in Australia, conditional on the system components being registered by the APVMA. (Section 4.4.3)

Recommendation 13- Appropriate test methods and facilities need to be developed for validating efficacy and performance of ablative and non-toxic coatings in the Australian marine environment. (Section 4.4.3)

Recommendation 14- A review of the availability and capability of existing companies and organisations to perform antifouling efficacy and performance testing in Australia is needed as a base for a national antifouling qualification system, as is a review of the utility and relevance of overseas data. (Section 4.4.4)

Recommendation 15- A "National Antifouling Standards and Specifications Working Group", comprising representatives of the paint industry and other relevant organisations, authorities and interest groups, be established to develop appropriate performance criteria, specifications and qualification standards and test methods to provide surety of antifouling efficacy and performance in the Australian marine environment. (Section 4.4.6)

1 INTRODUCTION

1.1 The Consultancy

The Australian Government Department of the Environment and Heritage (DEH), in the Invitation to Tender, identified the purpose of the consultancy as to assist it in meeting its portfolio responsibilities, including:

- Implementation of recommendations from the Report of the National Taskforce on the Prevention and Management of Marine Pest Incursions (1999); and
- Natural Heritage Trust Objectives.

Biofouling of vessels, marine equipment, and structures is recognised as an important vector for introduced pests. In government policy the importance of biofouling has been recognised in the Report of the National Taskforce on the Prevention and Management of Marine Pest Incursions (1999), which was supported by all State Governments. The report noted (p. 54)

> "The importance of hull fouling as a vector for introduction and translocation of introduced marine pests is becoming increasingly recognised. However, efforts to date on introduction and translocation have largely concentrated on ballast water. The Taskforce considers that greater effort needs to be directed towards management of hull
>
> > The Taskforce recommends that the hull fouling issue be given similar priority to that of ballast water………(Recommendation 4.13)"

The report also stated that the importance of hull fouling as a vector for introduced marine pests is given added impetus by the Commonwealth Government's commitment to phase out the use of tributyltin-based antifoulants. That commitment is now being implemented following Australia's acceptance of the International Convention on the Control of Harmful Anti-Fouling Systems on Ships, 2001.

Following acceptance of the Report of the National Taskforce by all State Governments, the National Introduced Marine Pests Coordination Group (NIMPCG) was established to implement the reforms identified in the Report. The Biofouling Working Group of NIMPCG identified antifouling paint standards as a key management tool for minimising the risk of hull fouling species translocation and considered that in the short term, there should be a focus on the development of biofouling standards and codes of practice for the various boating and shipping sectors.

The first step in this process was considered to be the development of antifouling performance standards through the establishment of a framework for the assessment, approval and relevance of effective products for use by the various recreational and commercial sectors. The consultancy would draft such a framework through the following steps:

i. Assess the capability of existing Australian organisations, authorities or schemes to administer or support such a framework (e.g. APVMA, Australian Paint Approval Scheme (APAS, Standards Australia)
ii. Determine the applicability of international approval schemes (e.g. Lloyd's Register)
iii. Determine the existence and relevance of any Australian or international antifouling performance standards

iv. Liaison with Australian paint manufacturers and suppliers and other relevant parties on a functional and achievable scheme for the approval of product performance

v. Develop recommendations for performance criteria for antifouling products of different types and for specific classes of watercraft and operating profiles. Such performance criteria would take into account the impact of Australia's climatic variations on fouling organism loads and performance requirements.

Thompson Clarke Shipping was successful in tendering for this consultancy and this report presents the results and recommendations.

1.2 The Risk of Vessel Fouling as a Marine Pest Vector

Australian inshore waters are subject to the risk of invasion by marine pests from two sources: introduction of species directly from overseas, and translocation from established populations elsewhere in Australia. Hull fouling has been identified as a significant vector and considered to pose a risk as high, or even higher than ballast water in a 2001 AMOG consultancy[1]. This assertion was based on evidence that:

- *Most cargo vessels, including those with well-maintained antifouling systems, continue to carry fouling organisms in unprotected niches such as around rudders and propellers, on intake grates and in sea-chests, and on docking support strips*
- *The antifouling effectiveness of a coating diminishes between dockings, and hull surfaces can be significantly fouled towards the end of their inter-docking cycle, or if coatings fail prematurely*
- *Recreational yachts and other vessels stationary for extended periods of time foul relatively rapidly*
- *Not only attached organisms, but also epibenthic species………., can be carried on hulls associated with fouling growth*
- *A single, fertile, fouling organism has the potential to release many thousands of [reproductive propagules] with the capacity to found new populations……..*
- *With the exception of holoplanktonic organisms………and neritic fishes, most of the marine species introduced to, or spread through Australian inshore waters could have been translocated as, or associated with, hull fouling*

The AMOG consultancy [2] identified the vessels to pose the greatest risk in the introduction and translocation of hull fouling as:

- *Platforms, barges, pontoons, and derelict and laid-up vessels, which have been moored for extended periods of time*
- *Recreational and small craft which spend significant periods at moorings or in marinas and which also do not, or cannot use high performance antifouling coatings*
- *Poorly maintained merchant vessels*
- *Vessels nearing the end of their docking cycles; and*
- *Vessels with long docking cycles which do not undertake in-water cleaning of unprotected or poorly protected areas, such as propellers, and around rudders and seawater intake grates between dockings*

A number of actions, directed at improving hull maintenance and antifouling practices, were proposed to minimise the risk of organism translocation as hull fouling, including[3]:

- *A collaborative program with marine paint companies and ship owners to enhance antifouling practices to minimise development of macrofouling……..by ensuring, perhaps by a warranty scheme, that paint*

[1] AMOG Consulting (2001) Hull Fouling as a Vector for the Translocation of Marine Organisms. Phase 1 Study – Hull Fouling Research. AFFA Ballast Water Research Series Report No. 14

[2] ibid. p. iii

[3] ibid, p. iv

systems are appropriate for the operating conditions of the vessel and that the system will remain effective through to the next planned docking

- *Promotion of the use of modern technology antifouling paints which can increase and provide extended antifouling protection*
- *Scrutiny of high risk vessels and other floating facilities before allowing their entry or detention in, and movement from or between Australian ports*
- *Inspection of international yachts and other pleasure craft at their first port of call to ensure they are free of exotic organisms*
- *Promotion of good maintenance and antifouling practices to small boat owners, including actions to ensure boats do not continue to operate, or move outside their home port when the predicted life of the paint scheme has been exceeded or the antifouling has lost its effectiveness*

The Biofouling Working Group of NIMPCG developed an options paper on management options for vessel biofouling[4]. This paper identified four principal systems for management, all of which would require the development of vessel-appropriate antifouling standards. The four systems were:

System 1 - adequate antifouling for port entry
System 2 - adequate antifouling for vessel registration
System 3 - adherence to an antifouling code of practice
System 4 - adequate antifouling as a condition of an operating licence or permit

System 1 was considered relevant to international merchant, commercial fishing, naval, and recreational vessels, and to domestic commercial and naval vessels; System 2 to domestic commercial fishing, tourist boats, dive boats, ferries, and moored recreational vessels; System 3 to recreational trailerable vessels; and System 4 to mobile infrastructure and aquaculture equipment.

A NIMPCG Biofouling Workshop in September 2001 considered the Working Group paper and concluded that:

- The short term strategy should focus on the development of biofouling standards and codes of practice for the various sectors
- Further discussions were requires to prioritise legislative/regulatory requirements and longer term administrative arrangements for the maintenance of biofouling standards

The investigation and proposals for the development and implementation of a system of antifouling performance standards in this report are a step towards achieving NIMPCG's objectives.

1.3 Report Structure

This report examines four components considered necessary in for a system to ensure vessels moving between coastal water bodies have applied and maintained effective antifouling prevention systems on their underwater hulls:

i. *Monitoring of compliance*: the existence or requirements of a third party system to survey and oversee compliance with antifouling performance regulations (proper product selection, application and maintenance) for various classes of vessel;

[4] NIMPCG Biofouling Working Group, National System for the Prevention and Management of Marine Pest Incursions: Biofouling, August 2002

ii. *Certification of application*: the availability or development of a system to certify that appropriate antifouling products are used and that the quality of application of an antifouling coating system will meet system performance standards or, where this is impractical such as for the small DIY owner, there are some limitations on endorsement;

iii. *Antifouling product and system approval*: the availability or development of a system to verify or approve the efficacy or performance of antifouling products and systems for various vessel operating profiles or applications against relevant specifications, to publicly disseminate information on "approved" products, and to ensure ongoing quality assurance of paint production;

iv. *Antifouling product standards and system specification*: the availability of, or requirement for, antifouling performance standards or specifications for validating antifouling product and system efficacy and endurance.

The results of our investigation into the availability or need for new systems to underpin such a framework are presented in four major parts:

1. *Review* of requirements and existing systems relevant to this framework;
2. *Consultation* with relevant organisations and individuals
3. *Synthesis* of the review and consultation process:
4. *Recommendations* for development of an appropriate framework,

In considering the application and impact of the proposals, it should be emphasised that the primary application would be to vessels entering Australian waters, or moving between coastal regions. Recreational, commercial and harbour craft which operate solely within a defined water body would not require the same scrutiny as cruising, coastal or international craft.

2 REVIEW

2.1 Antifouling Paint Types and Markets

Paint coatings and other surface treatments used to prevent or inhibit the settlement and growth of marine organisms on underwater surfaces can be broadly categorised according to their mode and mechanism of action. An understanding of these different antifouling types is considered necessary to the development of an antifouling regulatory or certification system. The most widely used approach is to create a surface, which continually releases biocide at the substrate-water interface. In recent years non-biocidal coatings, known as fouling release or minimally adhesive coatings, have also been developed. These have surface characteristics which reduce the strength of adhesion of attaching organisms, thus enabling them to be easily removed or to be sloughed by the movement of water over the surface or by the movement of a vessel through the water.

2.1.1 Biocidal coatings

2.1.1.1 Antifouling biocides

Few biocides have the necessary combination of characteristics to make them safe yet effective antifouling agents. Mercury, arsenic and their compounds, and also now the organotins, are examples of effective antifouling agents that have been deemed unacceptable due to adverse environmental or human health risks. The number of “acceptable” antifouling agents is now a rather short list. The list of compounds approved by the APVMA for use in antifouling paints in Australia comprises: metallic copper, cuprous oxide, cuprous thiocyanate, chlorothalonil, diuron, dichloro-octyl isothiazolin, thiram, zinc oxide, zinc pyrithione and zineb. A number of other biocides are used in overseas formulations including irgarol (not approved for use in Australia), copper pyrithione (yet to be submitted for registration in Australia), dichlofluanid, TCMS pyridine and thiocyanomethylthio-benzothiazole (TCMTB). Generally the organic biocides are only used as booster biocides to improve the active spectrum of copper compounds.

2.1.1.2 Soluble matrix paints

Free-association antifouling paints are paints in which the biocide is mixed through the paint matrix/binder/resin. To be effective, the biocide must be continuously released at the paint surface at a rate necessary to generate a toxic concentration within the surface boundary layer. In soluble matrix paints the paint binder is sparingly soluble and slowly dissolves to allow biocide to be released. Traditionally these paints were based on the natural product wood rosin. Limitations in the dissolution process prevented these paints from remaining effective for periods beyond 18 months to 2 years.

2.1.1.3 Contact leaching paints

Contact leaching paint, also known as hard racing or long life paints, are also free-association types but have an insoluble matrix. Continuous biocide release if generated by the high biocide concentration ensuring that biocide particles contact each other through the paint film. As surface biocide is released, microchannels are created which permit release of biocide from deeper in the coating. Biocide release rates decrease exponentially with time and effective life is again limited to periods rarely exceeding 18 months.

2.1.1.4 Ablative paints

Ablative paints are essentially soluble matrix paints with improved mechanisms of solubility that enable effectiveness for periods up to 36 months. Controlled depletion polymer (CDP) technology is one example of this paint type. The key difference between ablative paints and true self-polishing paints is that the ablative mechanism is still hydration and dissolution, not hydrolysis.

2.1.1.5 Self-polishing copolymer paints

Organotin copolymer paints, based on tributyltin methacrylate, were the first true self-polishing copolymer (SPC) antifouling coatings. These differ to all previous types in that the copolymer acts as both the paint matrix and biocide. When immersed in seawater, the bond between the organotin moiety and the acrylate is cleaved by hydrolysis, allowing the organotin biocide to be released into the water. The residual polymer backbone then becomes water-soluble and dissolves, exposing a fresh layer of active surface. This chemical process not only generates a continuous and predictable release of biocide, but the paint surface actually smoothes in service which improves ship performance. With correct application, organotin SPC coating systems could provide antifouling effectiveness for 5 or more years.

Tin-free self-polishing coatings are now available based on copper, zinc and silyl acrylate. Unlike the organotins SPC's, these copolymers do not generate sufficient biocide to be effective, so cuprous oxide and booster biocides are incorporated in the formulations. However, effective antifouling performance in excess of 5 years can be achieved.

The polishing rate of SPC coatings can be varied to maximise effectiveness on vessels with different operating speeds and activity. For example, softer (fast polishing) systems are applied to slow, or low activity vessels, while harder (slow polishing) systems are used on fast, or high activity vessels.

Biocide-free self-polishing copolymer coatings have also been formulated in which a non-toxic compound is substituted for the copolymer bound biocide. The objective of these is to create an active, polishing surface that would be too unstable for fouling to remain attached.

2.1.1.6 Copper, copper alloys and copper resins

Metallic copper releases copper ions when immersed in seawater at a rate that can inhibit the attachment of fouling and copper sheathing of timber sailing ships was one of the first effective antifouling treatments. Although copper sheet is no longer used for reasons of durability, metallic copper is still used for its antifouling properties in copper nickel alloys (70/30 and 90/10), incorporated as copper flake into epoxy resins, or mixed into paint formulations.

2.1.2 Non-toxic coatings

2.1.2.1 Fouling release coatings

Fouling release coatings do not contain active antifouling biocide but depend for their effect on surface characteristics, which reduce the strength of adhesion of fouling. Fouling release, or removal, is achieved by either the movement of the vessel through the water or by physical cleaning. Although some do inhibit settlement, fouling attachment frequently occurs on stationary or low activity vessels. PTFE (Teflon®)-based systems were the first fouling release coatings developed, but silicone-based systems have since been found to perform more effectively.

2.1.2.2 Deterrent surfaces

Surfaces which deter fouling settlement by chemical, or physical means have been proposed as environmentally acceptable alternatives to biocidal coatings. Studies on antifouling mechanisms in marine organisms suggest that some secondary metabolites act as fouling deterrents rather than biocides and antifouling treatments based on these "natural" products are under development.

Fibre flock coatings have been promoted as effective alternatives to biocidal systems, with the movement of vertically oriented fibres claimed to deter the settlement of spores and larvae. Various electrical solutions have also been proposed, including electro-conductive coatings

2.1.3 Antifouling markets

2.1.3.1 Recreational craft

Recreational craft encompasses both motorised and sailing craft with varying speeds, usage patterns and voyage profiles. Many non-trailerable vessels would be expected to spend considerable time at moorings. It is presumed that antifouling products would generally be acquired through retail outlets and application commonly undertaken by amateurs. Docking and repainting frequency is likely to be at 12 to 24 month intervals, although the antifouling effectiveness may be exceeded before maintenance is performed.

2.1.3.2 Commercial watercraft

Commercial fishing vessels, ferries, dive boats, tugs and harbour craft can be classified as commercial watercraft. Many such vessels would have high activity, although in seasonal industries, such as tourism or fishing, vessels may be laid up for significant periods during the year. For most, antifouling application would be expected to be undertaken professionally in commercial ship or boat yards. Required antifouling life could extend up to 36 months and fouling ahead of projected dockings would have an economic impact on operations through either increased fuel costs or unscheduled docking costs. Barges may represent a special case because of long periods of inactivity and lower maintenance demands.

2.1.3.3 Shipping

The cost of docking and repainting increases with the size of the ship, as do the economic costs of fouling on ship operation. Dockings and out of water maintenance would occur in commercial facilities, and painting is frequently under the technical supervision of the antifouling paint supplier. Organotin SPC coatings provided effective antifouling performance over the 5 years between dockings mandated under SOLAS and there has been a strong desire by ship owners for tin-free antifouling paints to match this performance. However, not all ships follow 5 year docking cycles, with many docking at 36, 30 or 24 month intervals.

Speed and activity of ships also vary, with some in almost constant operation, while others have extended periods in harbour. Some naval ships, for example, spend considerable time in port.

2.1.3.4 Aluminium hulls

Aluminium hulled vessels represent a special segment of the antifouling market because paint containing cuprous oxide cannot be used on these vessels due to its corrosive influence on the hull material. Aluminium is used as hull material in two significant vessel sectors: small craft and high speed catamarans. The alternative to cuprous oxide is the less corrosive cuprous thiocyanate, but this does not have the same long term performance.

2.1.3.5 Mobile infrastructure

Mobile infrastructure, such as dredges, drilling rigs etc., represent a special vessel sector which spend long periods idle or with low activity, and possible subsequent relocation into disparate geographic region. Maintenance dockings are likely to be infrequent as dockings would be costly and fouling unlikely to have an economic impact on operation.

2.1.4 Limitations of application

It needs to be noted that antifouling life is not simply a function of product formulation and its quality control, batch to batch, but also of system application. Antifouling life is a function of the biocide package, the biocide reservoir within the paint, and the rate of release. For example, the effective life of a self-polishing copolymer system is influenced by the effectiveness of surface preparation prior to painting and is also proportional to the final dry film thickness of the coating system, the polishing rate of the paint, and the speed and activity of the vessel. For maximum effectiveness on all vessels, the paint selection and application specification needs to be prepared with knowledge of the projected docking cycle and the speed and activity of the vessel.

2.2 The Division of Vessel Survey Responsibilities in Australia

The safety regulation of vessels that trade domestically or internationally is primarily the responsibility of Flag States. They have to ensure that vessels are constructed and operated in accordance with national standards. These standards are primarily upheld and enforced by Flag States through national legislation that authorises the appointment of marine surveyors to verify compliance by survey and inspection. For vessels that trade internationally, a secondary layer of enforcement has been established through the Port State Control inspection regime created by the IMO.

In Australia, the vast majority of safety standards arise from the adoption and implementation of international Conventions. Safety Equipment, Safety Radio, Safety Construction and Loadline are good examples. The major Convention that regulates environmental matters is the International Convention for the Prevention of Pollution by Ships 1973 as amended 1978, which is often referred to as “MARPOL 73/78”. This Convention seeks to prevent pollution of the seas from oil, noxious substances, sewage, garbage and gas emissions. Another major environmental Convention will soon emerge in the form of the International Convention for the Control and Management of Ships' Ballast Water and Sediments. All of these Conventions require Flag States and Port States to monitor compliance through survey and inspection. It is the function of national (Flag States) or State marine safety agencies to carry out these tasks as it would be for any future IMO instrument that addresses translocation of marine pests through hull fouling.

In most countries, survey and inspection of international and domestic vessels is administered through a single marine safety authority. Federal agencies, in turn, contract out the survey and inspections to approved classification societies. However, under our Federal system of government, the responsibility for administering marine safety has been split between State and Federal agencies.

It is beyond the scope of this project to analyse legislation in detail, but for comparative purposes, occasional reference will be made to Victorian legislation when State survey arrangements are compared with the Commonwealth structure

2.2.1 Offshore Constitutional Settlement 1979

The division of responsibility between Commonwealth and State Governments for the survey and inspection of commercial vessels was the subject of disagreement as to the scope of each Government's respective jurisdiction. That disagreement was resolved through the Offshore Constitutional Settlement of 1979 ("the OCS") which allocated the constitutional responsibilities of the Commonwealth and the States and Northern Territory in waters over which Australia asserted sovereign authority. The OCS included an agreement on shipping and navigation whereby certain Commonwealth jurisdiction was surrendered to the States.

As far as the survey and certification of trading ships is concerned, the agreement gave the States jurisdiction over all vessels trading intrastate, whereas the Commonwealth retained jurisdiction for all vessels trading interstate or overseas. The *Navigation Act* 1912 (Cth) ("the Act") and State/Territory marine safety legislation reflect that agreement as can be seen from the relevant provisions set out below.

2.2.2 Navigation Act 1912 (Cth)

The complications that arise from having survey responsibilities shared between State and Commonwealth can quickly be seen from the application provisions in the relevant statutes. Section 2(1) of the Act provides that:

> "Except in so far as the application of this section is expressly excluded by a provision of this Act, this Act does not apply in relation to:
> (a) a trading ship proceeding on a voyage other than an overseas voyage or an inter-State voyage;
> (b) an Australian fishing vessel proceeding on a voyage other than an overseas voyage;
> (c) an inland waterways vessel; or
> (d) a pleasure craft;
>
> or in relation to its owner, master or crew."
>
> A "trading ship" is defined in s.6 (1) as being:
>
> "a ship that is used for…….or in connection with, any business or commercial activity and includes a ship for:
> (a) the carriage of passengers or cargo for hire or reward; or
> (b) the provision of services to ships or shipping, whether for reward or otherwise;

> but does not include a Commonwealth ship, a fishing vessel, an off-shore industry mobile unit, an off-shore industry vessel to which this Act applies, an inland waterways vessel or a pleasure craft."

Whilst Section 2(1) reflects the terms of the OCS, there are provisions that allow for a flexible approach to surveying between the Commonwealth and States. For example, in Section.8 AA there is a proviso to the application of the *Navigation Act* to trading ships whereby owners of vessels that are trading intrastate may apply to AMSA for a declaration that their vessel(s) be subject to the Act. This has particular application for vessels over 500 GT. Also, under Section 423B, vessels may obtain an exemption from provisions of the Act when engaged on interstate or overseas voyages.

2.2.3 States / Territory Legislation

The equivalent application provision under Victorian law is set out in Section 6(3) of the *Marine Act* 1988 (Vic):

> "...this Act applies to and in relation to -
>
> (a) a trading vessel proceeding on an intra-state voyage; and
>
> (b) an Australian fishing vessel, a hire and drive vessel, or a recreational vessel, proceeding on-
>
> (i) an intra-state voyage; or
> (ii) that part of an inter-state voyage which began in Victoria where the vessel is not within the jurisdiction of another State or a Territory of the Commonwealth; and
>
> (c) a vessel connected with Victoria that is an Australian fishing vessel, a hire and drive vessel, or a recreational vessel, proceeding on an inter-state voyage which began in Victoria; and
>
> (d) an Australian fishing vessel proceeding on an inter-state voyage, a hire and drive vessel, or a recreational vessel, where the vessel is within State waters; and
>
> (e) any other vessel within State waters… "

Notwithstanding the administrative complexities, the Commonwealth and State legislative frameworks combine to ensure that commercial vessels, both domestic and international, are subject to survey even though survey standards among the States are not consistent.

2.2.4 Inter-Governmental Agreement 1997

The need for consistent marine safety and survey standards has been of concern to Commonwealth and State Governments for some years. The Australian Transport Council thus endorsed goals and guiding principles for national marine safety regulation and operational arrangements, in the 1997 draft National Marine Safety Strategy. In November 1997 the Commonwealth, States and Northern Territory entered into an agreement to establish a National Marine Safety Regulatory Regime to improve marine safety and the efficiency of marine safety administration through the development of uniform legislation throughout Australia ("the IGA").

The parties agreed, retrospectively, to the establishment of the National Marine Safety Committee (" NMSC ") to give effect to the objectives including the requirement to:

> *"develop draft model legislation and appropriate marine safety standards and arrangements which provide for consistent regulatory and legislative marine safety practices in all jurisdictions, including developing standards for safe vessel operation, design, maintenance and construction, consistent with international obligations, national verification and certification processes and mutual recognition principles and processes."* [5]

Whilst the IGA is principally concerned with vessels that are under State survey, i.e. vessels other than those to which the *Navigation Act* applies,[6] NMSC will review the application of the Act to Australian and foreign vessels engaged on certain coastal voyages as part of its role to develop a National Marine Safety Strategy.[7]

2.3 Vessel Classes

2.3.1 SOLAS

2.3.1.1 Introduction and history

The *Safety Of Life At Sea Convention*, known as "SOLAS" or the "Safety Convention" is generally regarded as the most important of all international treaties that are concerned with the safety of merchant shipping. It regulates the construction of vessels and a wide range of safety and operational issues including stability, fire protection, radio equipment, carriage of dangerous goods and the survey of hull, machinery and equipment for cargo and passenger ships. The first version was adopted in 1914, in response to the sinking of the RMS " Titanic", subsequent versions were adopted in 1929, 1948 and 1960.

The 1960 Convention incorporated widespread changes to the 1948 Convention that reflected technical developments in the shipping industry. A further Convention was adopted in 1974, which incorporated not only the amendments agreed up until that date but also a new amendment procedure designed to ensure that changes could be made within a specified period of time. As a result the 1974 Convention has been updated and amended on numerous occasions. The Convention in force today is sometimes referred to as SOLAS 1974, as amended.

2.3.1.2 Application

Unless expressly provided otherwise, SOLAS applies only to ships engaged on an 'international voyage' which is defined as 'a voyage from a country to which the present Convention applies to a port outside such country, or conversely.' SOLAS class vessels, generally, are subject to Commonwealth survey.

Chapter 1 -Regulation 3 provides that the regulations, unless expressly provided otherwise, do not apply to:

- Ships of war and troopships.
- Cargo ships of less than 500 gross tons.
- Ships not propelled by mechanical means.

[5] IGA para. 10 (iii)
[6] IGA Recital D
[7] IGA para. 10 (ix)

- Wooden ships of primitive build.
- Pleasure yachts not engaged in trade.
- Fishing vessels.

A 'cargo ship' is any ship, which is not a passenger ship – a passenger ship being one that carries more than 12 passengers.[8]

The SOLAS Convention requires a Flag State to ensure that ships registered under its flag comply with the standards prescribed in the Convention and that certificates are issued attesting to such compliance. Since 1998, in addition to regulations prescribed by the Convention, ships are to be designed, constructed and maintained in compliance with the structural, mechanical and electrical requirements of a classification society that is recognised by the marine safety authority of the relevant Flag State or in accordance with national standards which provide an equivalent level of safety.[9] In Australia, the SOLAS Convention is given effect through Part IV of the Act.[10]

2.3.2 USL Code and National Standard for Commercial Vessels

The Uniform Shipping Laws Code ("USL Code") provides standards for the design, construction, crewing and operation of domestic commercial vessels in Australia. These standards apply to vessels under State survey. The Code was completed in 1979 in response to the need for a common national safety standard for commercial vessels. It was also intended to minimise problems that would otherwise occur in the implementation of the agreement on shipping and navigation under the OCS.

Domestic commercial vessels are regulated by the marine safety agencies in each of the states and in the Northern Territory. Each jurisdiction has legislation that calls up the USL Code and then applies the provisions to trading, fishing and hire and drive vessels. Unfortunately, the USL Code is not applied throughout the States and Northern Territory in a consistent manner. The outcome of the IGA referred to above is the production by the NMSC of the National Standard for Commercial Vessels (" NSCV ") as the principal technical standard for commercial vessels. It is being designed to overcome existing administrative differences and thus provide common national standards that will gradually replace the USL Code. As a word of caution to the States, the NMSC's Industry Advisory Committee have expressed the view that the NSCV will not work unless it is implemented uniformly.[11]

In Victoria, the survey and certification regime for commercial vessels is administered by Marine Safety Victoria. The Director of this organization is responsible for carrying out various statutory functions including developing appropriate standards for the construction, crewing, equipment and operation of vessels and taking steps to ensure that those standards are maintained.[12]

2.3.3 Recreational

Recreational vessels are not generally subject to the SOLAS Convention or the terms of the Act. The domestic nature of recreational vessels means that they are subject to much less regulation than vessels that trade commercially, particularly those that carry passengers or trade

[8] SOLAS Part A, Regulation 2
[9] SOLAS Part A-1, Regulation 3-1
[10] The full convention is set out in Schedule 1 of the Act
[11] "Safety Lines" (Newsletter of the NMSC) Issue 11, January 2003
[12] The particular powers of the Director are set out in Schedule 4 of the *Marine Act* 1988

internationally. Thus, whilst these vessels are subject to State or Northern Territory regulation, they are not generally vessels that are in survey. In Victoria, whilst all vessels must be registered, there are exceptions to this for commercial vessels under survey or vessels that do not have an engine.[13] It follows that sailing vessels without auxiliary engines do not even have to be registered.

There have been calls for a national strategy to be implemented to ensure that an appropriate Authority develops a policy and administers regulations for all marine craft that are subject to biofouling, including recreational vessels [14] In many respects this is a desirable approach to a national problem. However, the regulation of domestic recreational craft, like domestic commercial vessels, largely falls within State and Territory jurisdiction. It therefore seems practical to develop uniform legislation among the States and Northern Territory.

The substantial number of recreational craft compared to commercial vessels does have implications for any survey and inspection regime that may be required to underpin any antifouling regulations for this class of craft. The limited surveying resources of the States and the Northern Territory may necessitate the development of a risk-based approach to surveying and inspecting antifouling on recreational craft.

2.3.4 Marine Infrastructure

The offshore petroleum industry in Australia is regulated by Part VB of the Act and the *Petroleum (Submerged Lands) Act* 1967 ("PSLA").[15] Both pieces of legislation are designed to ensure the protection of life and property and the preservation of the environment and this is achieved through the adoption of international Conventions.

The regulation of offshore infrastructure is complex and presents various operational difficulties. For example, when floating production storage and offloading vessels ("FPSO") are operating as vessels they are subject to the Act and when they are connected to the riser they are subject to the PSLA. Furthermore there has been some suggestion that the application of the Act over foreign flagged vessels operating offshore and not trading to any Australian port is uncertain. Whilst PSLA regulations generally take precedence over those issued pursuant to the Act,[16] there is significant industry concern over possible inconsistencies between the two Acts as can be seen from the recent review of the Navigation Act by the Department of Transport and Regional Services.[17]

Fortunately, for the purposes of this study, surveying issues with respect to offshore structures are not a major issue because FPSOs, Floating Storage Units ("FSU") and fixed rigs are not generally coated with anti-fouling. The static nature of their operations means that anti-corrosion coatings are applied instead and these are coal tar epoxy or pure epoxy coatings that do not generally contain active antifouling compounds.

[13] Section 8(1) *Marine Act* 1988 (Vic) makes it an offence to operate a vessel that is not registered. However, Regulation 406(1) exempts trading, fishing and hire and drive vessels and vessels that do not have an engine capable of being used for propulsion

[14] AH Taylor and G Rigby "*The Identification and Management of Vessel Biofouling Areas as Pathways for the Introduction of Unwanted Aquatic Organisms.*" Report prepared for the Department of Agriculture Fisheries and Forestry Australia as part of the Research Advisory Group Ballast Water Research Programme, August 2002 p149.

[15] Regulations governing Offshore Industry Mobile Units are contained in *Marine Orders* Part 47 and regulations governing Floating Offshore Facilities are contained in *Marine Orders* Part 60

[16] Section 283K *Navigation Act* 1912

[17] See pp 128-134 available at http://www.dotars.gov.au/transinfra/pdf/navactfinatlreport.PDF

2.3.5 Emerging Commonwealth and State Regulation

The current regulatory framework governing the survey of commercial and recreational vessels is likely to be reviewed, in part at least, at Commonwealth and State level. This expectation arises from recommendations made by the High Level Officials Group (HLG), established by the Natural Resource Management Ministerial Council (NRMMC) to advise on the most appropriate administrative and legislative arrangements for a National System for the Prevention and Management of Marine Pest Incursions. The recommendations to the NRMMC and the Australian Transport Council included the following preventative measures:-

> *The Australian Government will manage the risks of introduction of marine pests through internationally sourced ballast water from commercial shipping, throughout its voyage in Australian waters, and by bio-fouling on the hulls and equipment for all vessels entering Australian waters from overseas;*
>
> *The States and the Northern Territory will manage the risks of translocating marine pests for all vessels travelling between Australian ports through agreed model legislation for domestically sourced ballast water, or agreed codes of conduct, protocols and guidelines for other matters;*
>
> *The Australian Government will establish a Single National Shipping Interface to deliver consistent, agreed advice on management requirements for both international and coastal commercial shipping through a seamless single point of contact for all shipping operators.*

Whilst there is likely to be support from regulatory authorities for a national approach to this problem, it is to be hoped that support will also be given to calls for an IMO Convention to regulate the control of hull fouling on SOLAS class vessels.[18] The desirability of an international approach to regulating this class of vessel can be shown by considering the practical operational issues that will have to be taken into account.

Insisting that a ship move from in or near port waters to reasonably adjacent deep water for in-water cleaning is seen as neither advisable nor always feasible. Persistent ocean swells along much of Australia's southern coastline can create conditions where hull cleaning is too dangerous for divers. Low water temperatures and strong currents provide further difficulties at some ports. This means that vessels may have to steam to calmer tropical waters for in-water cleaning or to an overseas drydock. Cleaning in itself is also not always a solution. Severe hull fouling is often a consequence of the antifouling paint either having exceeded its effective life or being inappropriate to the vessel's requirements. In these circumstances fouling would rapidly re-establish unless the antifouling coating system is renewed.

As far as the cost of cleaning is concerned, docking is obviously very costly, but even in-water cleaning is going to be expensive because significant time will be involved, particularly for large capesize bulkcarriers with over 20,000 square metres of hull plating below the waterline. The cost of this exercise would be prohibitive in the context of the freight (revenue) that can be earned on any single voyage ex Australia. Ongoing costs may also be incurred if in-water cleaning reduces SPC film thickness to the extent that an unscheduled drydocking eventually becomes necessary.

Australian flagged coastal bulk carriers and tankers may experience similar difficulties to vessels trading internationally where delays in warm water ports often leads to the rapid growth of unacceptable hull fouling. However, smaller domestic commercial craft are generally easier to monitor. Furthermore, slipping, say, a fishing vessel to remove locally acquired hull fouling prior

[18] AH Taylor and G Rigby Loc Cit.

to sailing inter-State is a much more manageable proposition. The same principle also applies to recreational craft.

Australia is most unlikely to unilaterally introduce hull fouling regulations that would govern port entry for international trading vessels. To do so would incur the risk that a significant number of ship operators would avoid trading to Australia. This might arise simply due to legitimate concerns by ship operators that TBT free hull coatings are not sufficiently reliable to ensure an order for hull cleaning would not be incurred, particularly by ships that have been trading to tropical ports. Any reduction in the number of ships willing to trade to Australia could cause significant upward pressure on freight rates to the disadvantage of exporters in general and the mining and primary export sectors in particular.

2.4 Existing Antifouling Regulation, Certification & Standardisation

2.4.1 International

2.4.1.1 International Convention on the Control of Harmful Antifouling Systems on Ships

The first foray by the IMO into antifouling regulation was the call to ban or limit the use of paints containing organotin; this was contained in the 1990 Resolution of the IMO's Marine Environment Protection Committee. The resolution recommended that Governments adopt measures to eliminate the use of antifouling paint containing TBT on non-aluminium hulled vessels of less than 25 metres in length and eliminate the use of antifouling paints with a leaching rate of more than 4 micrograms of TBT per day. However, the consequential hull fouling issues that are arising as a direct consequence of banning TBT are being addressed only now through the development of increasingly more effective alternatives to TBT based paints and efforts through NIMPCG and some States to generally improve antifouling and vessel maintenance practices.

The International Maritime Organisation adopted the International Convention on the Control of Harmful Antifouling Systems on Ships ("the Convention") on 5th October 2001. The Convention binds Parties to implementing a ban on the application or re-application of organotin compounds that act as biocides in anti-fouling systems as from 1 January 2003.[19] Furthermore, as from 1 January 2008, TBT will no longer be permitted on hulls unless they are coated to prevent TBT leaching from the non-compliant anti-fouling systems.[20]

The Convention applies to ships entitled to fly the flag of a Party which has ratified the Convention or which operates under authority of the Party and to ships that enter a port, shipyard or offshore terminal of a Party. The widespread application of the Convention raises various issues as far as surveying is concerned and the IMO has made provision for survey arrangements to vary depending upon the type of vessel or structure. The survey provisions for most commercial vessels are set out in Annex 4 and apply to ships of 400 gross tonnage and above engaged in international voyages, excluding fixed and floating platforms, FSU and FPSO vessels. These units will be subject to alternative arrangements to be determined by the Administration. Ships of 24 metres or more in length but less than 400 gross tons engaged in international voyages will have to carry a Declaration on Anti-fouling Systems signed by the owner or authorised agent.

[19] Annex 1
[20] Ibid

The survey and certification regime is designed to ensure that there is an appropriate initial survey prior to the vessel entering service or before the International Antifouling System ("IAS") certificate is issued for the first time, and when the anti-fouling system is changed or replaced. These surveys will be endorsed on the IAS certificate, which will be issued by each party's marine administration.

As far as foreign flag vessels are concerned, IAS certificates will be inspected by parties to the Convention as part of the Port State Control regime. Vessels that are found to be in violation of the Convention may be detained, dismissed or excluded from all ports in the inspecting party's jurisdiction.[21] In the case of domestic vessels, enforcement of the Convention is to be maintained by parties through the imposition of appropriate sanctions.[22]

The convention comes into force twelve months after the date on which not less than 25 States, the combined merchant fleets of which constitute not less than 25% of the gross tonnage of the world's merchant fleet.[23] As of June 2004, there are only eight nations that have ratified the convention.[24] However, that does not prevent flag States from implementing the terms of the Convention in their domestic law prior to the Convention coming into force. It is this fact which provides the main driver to compliance in the immediate future. Owners of international trading vessels that are on 5 year drydock cycles and who have impending docking(s) scheduled for 2003 onwards, cannot afford to ignore this issue or the apparent inevitability that the Convention will be in force generally prior to their next drydocking.

Australia signed the Convention on 19 August 2002. The Government proposes to ratify in accordance with Art 17 of the Convention and it is expected Australia with ratify the Convention before it enters force internationally.[25] However, to abide with the spirit of the convention, the Australian Pesticides and Veterinary Medicines Authority ("APVMA") has deregistered all antifouling products containing organotins as active biocides, effectively banning the sale and application of organotin antifouling systems in Australia.

Most State Governments prohibit the use of TBT paints on vessels less than 25 metres in length and limit the leaching rates for TBT where it is used on vessels over 25 metres in length.[26]

2.4.1.2 Classification Societies

Classification Societies were first established in 1760 when the Registers Society was founded at Lloyd's to provide merchants and underwriters with information on the condition of vessels. The role of the ship classification societies has, of course, steadily evolved and a contemporary definition of the work carried out by these organisations that has been drafted by the International Association of Classification Societies as follows:

> *Ship Classification, as a minimum, is to be regarded as the development and worldwide implementation of published Rules and/or Regulations, which will provide for:*
>
> 1. *the structural strength of (and where necessary the watertight integrity of) all essential parts of the hull and its appendages,*

---

[21] Article 11
[22] Article 12
[23] Article 18
[24] http://www.imo.org/includes/blastDataOnly.asp/data_id%3D7358/status.xls
[25] National Interest Analysis tabled in House of Representatives http://www.aph.gov.au/house/committee/jsct/march2003/treaties/Antifouling-NIA.pdf including the reasons advanced for Australia to ratify the Convention at p.3
[26] For an informative summary see brochure prepared by Fremantle Ports "*Management of TBT Antifoulants in Western Australia*" available at www.fremantleports.com.au.

2. *the safety and reliability of the propulsion and steering systems, and those other features and auxiliary systems which have been built into the ship in order to establish and maintain basic conditions on board, thereby enabling the ship to operate in its intended service.*

The achievement of these goals is conditional upon continued compliance with the Rules and/or Regulations and proper care and conduct on the part of the Owner and Operator. (see IACS' 'Guide to Managing Maintenance')

Notes:-

(a) A ship built in accordance with a Member Society's Rules and/or Regulations, or in accordance with requirements equivalent thereto, and fulfilling the applicable stability requirements will be assigned a class in the Register Book of the Society. For ships in service, each Member Society maintains the provisions of class by way of periodical visits by its Surveyors to the ship as defined in its Rules and/or Regulations in order to ascertain that the ship currently complies with those Rules and/or Regulations. Should significant defects become apparent or damages be sustained between the relevant visits by the Surveyors, the Owner and Operator are required to inform the Society concerned without delay. Similarly any modification which would affect Class must receive prior approval by the Society.

(b) A ship is said to be in Class when the Rules and/or Regulations which pertain to it have, in the opinion of the Society concerned, been complied with.

Individual Societies to explain by an additional note as to how they deal with items, either statutory or class, beyond the basic definition.[27]

Classification societies have not traditionally been concerned with coatings apart from a recent move to specifying requirements for ballast tanks to minimise corrosion. However, with the advent of the Antifouling Convention, the societies are making arrangements to assist owners of vessels under their survey to comply with the convention because the leading classification societies act for many flag States in implementing IMO Conventions.

The Marine Environment Protection Committee ("MEPC") of the IMO has issued guidelines for surveys and certification of anti-fouling systems on ships. The guidelines recognise that flag States will conduct surveys of ships in accordance with the guidelines and issue a Statement of Compliance to that effect. These ships may then be issued with an IAS certificate upon entry into force of the Convention. The MEPC recognise that the Convention raises a major new survey item and they have therefore recommended that the guidelines be reviewed on a regular basis.

Statement of Compliance certification is already being widely sought by ship owners. As an example of class society response to this need, Det Norske Veritas offer services to issue such documentation upon first docking. As can be seen from their web site, the issue of DNV documentation will usually be based on a review of the relevant documents from paint manufacturer, ship owner and yard including declaration, material safety data sheet, active ingredients and CAS number. Survey requirements obviously vary and sampling will not be necessary where the anti-fouling system is of a type that is approved by DNV or where it is on the DNV verified list of TBT free products.[28]

[27] http://www.iacs.org.uk
[28] See generally http://www.dnv.com

2.4.2 National

There is currently no national system of specifications for antifouling paints and only one national test method in Australia, although there are a number of avenues of through which such specifications and related test methods of could be developed.

2.4.2.1 The Australian Pesticides and Veterinary Medicines Authority (APVMA)

The APVMA, formerly the NRA, is the national registration authority for agricultural and veterinary chemicals. It operates the national system that evaluates, registers and regulates all agricultural and veterinary chemicals, including antifouling paints. Before an antifouling paint can enter the Australian market, it must go through the APVMA's rigorous assessment process to ensure that it meets their standards of safety and effectiveness.

The APVMA is a partnership between the Commonwealth and the States/Territories and was established as a Commonwealth Statutory Authority, with responsibility for the evaluation, registration and review of agricultural and veterinary chemicals, and their control up to the point of retail sale.

Any changes to a paint that is already on the market must also be referred to the APVMA. Under the National Registration Scheme, companies must supply the APVMA with extensive data about the product. These are independently evaluated to ensure that the product is safe for people, animals and the environment and that it won't pose any unacceptable risk to trade with other nations. If the product meets the APVMA's standards it may be registered for use in Australia. The APVMA also reviews products that have been on the market for many years to ensure that they meet contemporary standards. It manages a national compliance program to ensure that products supplied in Australia continue to meet the conditions of registration.

The APVMA has a specification for antifouling paints which must meet both toxicity and effectiveness requirements. While the APVMA has access to considerable expertise on the toxicity and likely environmental impact of chemical constituents likely to be present in antifouling paints, its expertise on assessing the effectiveness of the paints to resist fouling is rather limited.

The APVMA database, which is updated nightly, contains details of all antifouling paints that are registered for use in Australia. The data includes the product name, registering company, active constituents and product category. A list of over 50 products approved as of September 2003 is shown in Appendix A

2.4.2.2 Standards Australia

Standards Australia is the national standards writing body. It has developed an extensive range of paint specifications and test methods for paint and two guideline standards for painting, through Committee CH/3 and its range of sub-committees. The paint industry plays a crucial role in this work, largely through the Australian Paint Manufacturers Federation[29] and through the representation of other focus groups, notably the Australasian Corrosion Association, Royal Institute of Architects, the Surface Coatings Association of Australia, applicators, raw material suppliers and independent building material suppliers and consumer groups.

[29] www.apmf.asn.au

In respect of antifouling paints, AS1580 Method 481.5 "Coatings-Durability resistance to fouling-Marine underwater paint systems" is the only Standards Australia document specifically related to antifouling paint. However, there is a comprehensive range of other AS1580 test methods which can be invoked to monitor other parameters of such paints, e.g. drying time, application properties, viscosity and film thickness. Standards Australia also has a range of specifications for surface preparation and coating inspection, viz. the AS 1627 "Metal finishing - Preparation and pretreatment of surfaces" and AS 3894 "Site testing of protective coatings" series respectively. It also issues guidelines for the application of protective coatings for steel viz. AS/NZS 2312 "Guide to the protection of structural steel against atmospheric corrosion by the use of protective coatings", which could be used in supporting the education and accreditation of the applicators of paints on shipping.

2.4.2.3 Australian Paint Approval Scheme

The Australian Paint Approval Scheme[30] is a Commonwealth Government scheme for the certification of paint and the accreditation of paint manufacturers.

The APAS is tailored to meet the needs of users and specifiers of paint. It sets paint standards and approves and quality assures paints and related surface coatings. It was originally established to meet the needs of public sector organisations involved in specifying and using paint, however in recent years it has been open to the private sector. Users of the scheme can select from a range of some 230 paint types included in over 150 specifications, ranging from common house paints and anticorrosive and industrial coatings to very specialised products. APAS specifications are usually set at as high a quality as the Technical Committee consider is reasonably achievable. It relies on the expertise of specialists within the public sector, with feedback from the paint industry, in developing specifications. Not only does government want paints to last as long as practicable but the Australian climate is particularly severe on paints compared with climates where paint is sold in greatest volume.

Responsibility for APAS has changed many times; from the Department of Supply, the Department of Manufacturing Industry, the Department of Defence, the Department of Science and the Department of Housing and Construction. Today it is within the ambit of the Australian Government Analytical Laboratories.

Through its "List of Approved Products" and on-going product audit, the scheme provides assurance that paints supplied to Government projects comply with established performance standards in terms of appearance and durability and are manufactured to best industry practice.

In recent years the APAS focus has widened to take a more proactive stance on occupational health, safety and environmental performance of paints. Notably, over the last decade it has progressively withdrawn approval from paints containing lead, chromates and coal tar and has established limits for volatile organic compounds, initially for high volume usage decorative products.

The APAS is directed by a Management Committee, which draws user representatives from each State, and the Commonwealth, notably from the Defence forces. Technical matters such as specification development, product formulation and auditing of manufacturers are delegated to a Technical Committee, which draws on the expertise of paint specialists within government.

Product approval is a two-stage process:

[30] www.apas.gov.au

(i) The APAS "Recognises" satisfactory manufacturing units, which identifies them as having both the technical competence to develop and manufacture quality products and a system which safeguards on-going product quality. This involves APAS auditors confirming that the manufacturer's expertise, facilities and systems are adequate.

(ii) Once "Recognised" the manufacturer can apply for "Product Approval" (or certification) on the basis of compliance with any of the APAS specifications. Approval is granted on the basis of the evidence, subject to the concurrence of the APAS's technical experts.

The names of "Approved Products" are circulated to government paint users and specifiers, and manufacturers are at liberty to market their APAS status both by identification on cans and in general promotions. Indeed manufacturers are encouraged to supply APAS approved products to the general market and to indicate on the container by means of the APAS logo and specification number, that the product has been manufactured to comply with APAS requirements.

The APAS is by no means unique as a paint certification scheme. Singapore and Canada also have schemes. The Singapore scheme is operated by the Singapore Institute of Standards and Industrial Research. It covers 50 certified products covering 9 different paint types. Of the overseas schemes the Canadian General Standards Board scheme is the largest, with some 290 products certified.

Further details on the scope and operation of APAS, in the context of standards and quality control within the paint industry is presented in an overview paper[31]
While the APAS is primarily a scheme of approving paints and uses many Standards Australia test methods and specifications to underpin the scheme, it is a specification writing body in its own right. At present it has no antifouling paint specifications in use. Most APAS specifications are underpinned by Standards Australia specifications, which in turn invoke Standards Australia test methods.

Details of the APAS procedures for the specification and approval of paints is provided in their "Document 192" on the APAS web site[32].

2.4.2.4 Painting Contractors Certification Program (PCCP)

The performance of an antifouling system depends both on the efficacy of the antifouling product and the manner and quality of application.

The Painting Contractors Certification Program (PCCP)[33] is the only industry specific scheme in Australia remotely appropriate for objectively ensuring that a particular applicator of anti-fouling paints has the skills and commitment to apply them satisfactorily. This Commonwealth Government scheme certifies painting contractors in the heavy duty protective coating industry who are proven to have the necessary skills, training, resources, experience and quality assurance. The scheme mirrors a similar scheme developed by the US Society for Protective Coatings (SSPC)[34].

[31] DJ Bartlett *"Paint Standards and Certification in Australia - A Public Sector Viewpoint,"* Int. Corrosion Conf. Melb. 1996
[32] www.apas.gov.au
[33] www.apas.gov.au
[34] www.sspc.org

The PCCP will only accredit contractors who are competent enough to carry out the work; adhere to a quality management system; have a history of satisfied customers; are sufficiently reliable; and have a reputation for completing a job to the customer's satisfaction.

The PCCP's current certification is available to contractors under both Shop and Field Application and covers five classes of work.

The classes are:

Class 1: Shop application - open yard.
Class 2: Shop application - enclosed blast cleaning paint application.
Class 3: Field application - atmospheric exposure service.
Class 4: Field application - immersion service.
Class 5: Removal of hazardous coatings.

Currently only one contractor involved with ship painting is currently PCCP certified. This suggests that a major attitudinal change would be needed in the ship painting industry or the PCCP would need to develop a more workable, less stringent scheme for the ship painting industry.

Details of the scheme and the current accreditation requirements are provided on the PCCP website.[35]

2.4.3 Antifouling Standards and Specifications

In the following sections, brief summaries are provided of current national and international standards and specifications for antifouling materials. A brief summary is also provided of activities known to be underway overseas to up-date or draft new antifouling performance standards.

2.4.3.1 Australian Standards (Standards Australia)

Australian AS 1580.481.5-1993
Paints and related materials – Methods of Test
Method 481.5: Coatings – Durability and resistance to fouling – Marine underwater paint systems[36]

This standard sets out a procedure for assessing the performance of marine underwater paint systems exposed, under static conditions, to a marine environment. The method provides for the determination of protection of the substrate from deterioration and corrosion with or without cathodic protection, and durability and resistance to fouling of paint systems applied to these substrates.

The method is to apply the paint systems to be tested to prescribed test panels, which are then affixed to a test rack and immersed from a test raft. The paint systems are examined periodically for permanent settlement of fouling organisms and for film integrity.

35

36 Standards Australia, 1993. Third edition

Requirements for the test raft, its location and compliance, control and test panels, and the test procedure are detailed within the standard.

The compliance of a test site is measured against documented monitoring of fouling characteristics, to ensure consistent settlement and diversity and temperature, chlorinity and pH. Water temperature ranges are specified for tropical and temperate test sites.

2.4.3.2 American Standards (ASTM – American Society for Testing and Materials)[37]

ASTM Designation: D 3623 – 78a (Re-approved 1998)
Standard Test Method for Testing Antifouling Panels in Shallow Submergence

This test method covers a procedure for testing antifouling compositions in shallow marine environments and a standard antifouling panel of known performance to serve as a control in antifouling studies.

The method is designed as a screening test in evaluating antifouling coating systems. Results of the standard system in a specific marine environment are included to assist in interpreting results. Antifouling systems providing positive comparisons with the standard system should be considered acceptable for use in protecting underwater marine structures.

Requirements for the preparation and exposure of test panels, the formulation of the standard system, rating of fouling and physical condition of the coating and calculation of fouling resistance and physical condition of the test systems are detailed within the standard.

ASTM Designation: D 4938 – 89 (Reapproved 2002)
Test Method for Erosion Testing of Antifouling Paints Using High Velocity Water Standard

This test method covers the determination of erosion rates for marine antifouling paint systems immersed in flowing natural seawater.

Under this method, steel panels coated with the antifouling paint system under evaluation are positioned in a high velocity water channel and coating thickness measurements taken at specified time intervals. The test method is intended to measure the erosion rates of ablative antifouling paint systems exposed to flowing water at velocities designed to subject the paint system to shear stresses experienced in service. Measurement of erosion rates are considered necessary to help in the assessment of ablative antifouling paint film thicknesses required for fouling control between scheduled dry-dockings of ships, in the selection of materials, in producing quality assurance, and in understanding the performance mechanism. The test data is intended to serve as a guide for predicting the service life of ablative antifouling paints in order to calculate the necessary paint thickness to fit specified deployment cycles.

ASTM Designation: D 4939 – 89 (Reapproved 2003)
Standard Test Method for Subjecting Marine Antifouling Coating to Biofouling and Fluid Shear Forces in Natural Seawater

This test method covers the determination of antifouling performance and reduction of thickness of marine antifouling coatings by erosion or ablation under specified conditions of hydrodynamic

[37] American Society for Testing and Materials, West Conshohocken, PA, USA

shear stress in seawater alternated with static exposure in seawater. The antifouling coatings to be tested and a control coating are applied to steel panels and exposed in natural seawater at a site where the fouling rate is high. Test panels are attached to a rotating drum and dynamic exposure consists of subjecting the test panels to shear stress by rotating the drum underwater at a specified revolution rate. The exposure consists of static and dynamic cycles of typically 30 days each. Film thickness measurements are taken at intervals during exposure.

ASTM Designation: D 5108 – 90 (Reapproved 2002)
Standard Test Method for Organotin Release Rates of Antifouling Coating Systems in Sea Water.

This test method covers the laboratory determination of the rate at which organotin expressed as tributyltin (TBT) is released from an antifouling coating in synthetic sea water using graphite furnace atomic absorption spectrophotometry (GF-AAS) or other analytical methodology. The candidate paint system is applied to cylindrical test specimens and, at specified intervals, each specimen is placed in a container of seawater and rotated for 1 h. The rate of tributyltin release from the paint is determined by measuring tributyltin concentrations in the seawater.

The method is designed to provide a laboratory procedure to measure changes in the release rates of solvent soluble tin during immersion under specified conditions, and to provide reliable comparisons of the release rate characteristics of different antifouling formulations. The method serves as only a guide for organotin release rates in service, which can vary over the life of the coating, with environmental conditions, and with vessel activity.

ASTM Designation: D 5479 – 94 (Reapproved 2000)
Standard Practice for Testing Biofouling Resistance of Marine Coatings Partially Immersed

This practice covers a procedure to test biofouling resistant coating systems or antifouling systems, or both, when subjected to in-situ partial immersion exposure. The method is designed as a screening test to evaluate the performance of applied coating systems and other materials designed to resist biofouling settlement. Panels are mounted on a rack on a floating raft so that the panels are partially out of the water. Fully immersed panels are exposed simultaneously and a concurrent fouling census performed using non-toxic panels to ensure heavy fouling accretion.

ASTM Designation: D 5618 – 94 (Re-approved 2000)
Standard Test Method for Measurement of Barnacle Adhesion Strength in Shear

This test method covers the measurement of barnacle adhesion in shear to surfaces exposed in a marine environment. The method is designed as a screening test in the evaluation of coating systems and other material designed to resist biofouling attachment. Surfaces with known barnacle adhesion strengths included to serve as controls. Test surfaces are immersed in the marine environment in accord with Method D 3623. When barnacles are observed to have settled, the strength of adhesion is measured using a hand-held device to measure the force needed to detach barnacles from the surface.

ASTM Designation: D 6642 – 99
Standard Test Method for Copper Release Rates of Antifouling Coating Systems in Seawater

This test method covers the laboratory determination of the rate at which copper is released from an antifouling coating in synthetic seawater using graphite furnace atomic absorption spectrophotometry (GF-AAS). The candidate paint system is applied to cylindrical test specimens and placed in a tank of synthetic seawater. Then, at specified intervals, specimens are rotated in a container of seawater and the rate of copper release determined by measuring copper concentrations in the measuring container. The method is designed to provide a laboratory procedure to measure changes in the release rates under specified environmental conditions. Such quantitative measurement helps in selection of materials, in providing quality control, and in understanding the performance mechanism.

ASTM Designation: D 6632 – 01
Standard Test Method for Total Copper in Antifouling Paints

This test method is for the analytical determination of copper in liquid samples of antifouling coatings, and outlines in detail equipment, reagents, and necessary steps to satisfactorily determine the concentration of copper in paint. The significance of the method is to allow the accurate determination of copper content as a means of verifying composition.

2.4.3.3 International Standards (ISO – International Standards Organization)[38]

International Standard ISO 15181-1
Paints and Varnishes – Determination of Release Rate of Biocides from Antifouling Paints – Part 1: General Method for Extraction of Biocides

This standard specifies a general method for extracting biocides from paint films of antifouling paints into a specified artificial seawater under specified conditions. It is used in conjunction with ISO 15181-2 to determine the amount of copper biocides in the extract and to allow the calculation of the release rate of the biocide form the paint film. The procedure is similar to that in ASTM D 6442.

International Standard ISO 15181-2
Paints and Varnishes – Determination of Release Rate of Biocides from Antifouling Paints – Part 2: Determination of Copper-ion Concentration in the Extract and Calculation of the Release Rate

This standard specifies the apparatus and analysis technique for determining copper (based) biocides in artificial seawater which have been extracted from antifouling paints in accordance with ISO 15181-1. The method measures the copper-ion concentration and gives the final calculation for the release rate of the copper. Release rates are compared against a well-documented reference standard as a means of establishing that test conditions are within normal operating parameters.

[38] International Organization for Standardization, Geneva, Switzerland

2.4.3.4 Specifications

Australian Paint Approval Scheme (APAS) Specification 0159
Marine Underwater Coating Systems

There is no currently approved APAS Specification for antifouling paintings. A working draft exists for a new specification (0159) for a paint system for use on the underwater hulls of ships comprising an anticorrosive or barrier coating and an antifouling coating in black, white and two other suitable colours. Requirements specified in the draft, intended to meet Royal Australian Navy needs, include:

- The effectiveness of the antifouling system shall not be impaired by being dried out for up to a maximum of 6 weeks
- The system shall erode under normal service conditions to maintain a relatively smooth surface
- The system shall be suitable for immersion in seawater after the final coat has air dried for 16 hours
- The active ingredient/s of the antifouling topcoat shall not be tributyltin (TBT) based.

Tests for product approval and field durability test procedures are yet to be specified.

U.S. Military Specification MIL-PRF-24647C (24 September 2001)
Performance Specification
Paint System, Anticorrosive and Antifouling, Ship Hull

This specification, included as Appendix B, which is approved for use by all Departments and Agencies of the U.S. Department of Defence, covers a variety of high grade paint systems for application to ships hulls to prevent marine biofouling and corrosion. The specification covers two types, seven classes, four grades and six applications of antifouling systems as follows:

Type I –	Paint systems having topcoats of ablative antifouling paints
Type II –	Paint systems having topcoats of nonablative antifouling systems

The type I antifouling topcoat paints are intended to polish (erode or ablate) under water flow conditions to provide a biofouling free, smooth hull for fuel efficiency. Type II antifouling topcoat paints are intended to provide biofouling control without eroding.

Class 1A -	Paint systems having copper based toxics in the antifouling topcoats; for use on metal substrates except aluminum alloys.
Class 1B -	Paint systems having mixed-toxics (one or more of which shall be a copper compound) in the antifouling topcoats; for use on metal substrates, except aluminum alloys.
Class 1C -	Paint systems having antifouling topcoats that are toxic-free; for use on all metal substrates, including aluminum.
Class 2 -	Paint systems for use on aluminum.
Class 3A -	Paint systems having antifouling topcoats containing only copper-based toxics for use on rubber.
Class 3B -	Paint systems having antifouling topcoats containing mixed-toxics (one or more of which shall be a copper compound) for use on rubber.
Class 3C -	Paint systems having antifouling topcoats that are toxic-free for use on rubber.

Grade A -	Volatile organic content (VOC) of the antifouling topcoats will be a maximum of 3.4 pounds per gallon [lb/gal; 400 grams per liter (g/L)]. VOC of all other individual paints in the paint system will be in accordance with the requirements of Grade B.
Grade B -	VOC of each individual paint of the paint system will be a maximum of 2.8 lb/gal (340 g/L).
Grade C -	VOC of each individual paint of the paint system will be a maximum of 2.3 lb/gal (275 g/L).
Grade D -	VOC of each individual paint of the paint system will be a maximum of 0 lb/gal (0 g/L).

Application 1 -	Paint systems having red color antifouling for underwater hull, with a service life of five years
Application 2 -	Paint systems having black color antifouling for waterline (boottop) of hull, with a service life of five years
Application 3 -	Paint systems having gray color antifouling for underwater hull, with a service life of five years (Application 3 for classes 1C, 2 and 3C only)
Application 4 -	Paint systems having red color antifouling for underwater hull, with a service life of seven years
Application 5 -	Paint systems having black color antifouling for waterline (boottop) of hull, with a service life of seven years
Application 6 -	Paint systems having gray color antifouling for underwater hull, with a service life of seven years (Application 3 for classes 1C, 2 and 3C only)

A paint system under this specification consists of the following individual paints:

- Anticorrosive paint (primer), when required, intended for direct application to the substrate being painted
- Anticorrosive topcoat (s) intended for application over a primer
- Tie coat (s), if required, intended for application to an anticorrosive paint and overcoated with antifouling paint
- Antifouling topcoat (s)

Minimum service life is specified as without failure due to loss of adhesion, blistering, flaking, depletion by excessive ablation or loss of anti-fouling capability (except minor sliming and biofouling from the boottop to the light load line).

Performance and efficacy requirements for qualification can include reporting of erosion or ablation rates (Type I only) and testing against ASTM (D 4939, D4938, D3623) and specific MIL-PRF-24647 test methods. The latter include tests for resistance to tropical biofouling organism attachment, erosion, shallow submergence, and ship tests.

Qualification standards are quite rigorous and defined in detail under the specification. For example, resistance to tropical organism attachment requires panel testing in Florida or Hawaii, with six test panels of each system tested for biofouling resistance over two years of erosion tests (12 cycles, each 2-4 month static exposure followed by flow channel testing and 24 months shallow submergence. Ship tests are to be conducted on ship (s) operating in high biofouling tropical or subtropical areas such as the Caribbean, Mediterranean or Western Pacific, and the coatings must not be underwater scrubbed or otherwise maintained. The period for commercial ship patch tests and whole ship applications is five years, Government ship patch tests two years (minimum), Government full ship tests one year (minimum), and paints in service on Navy ships are monitored for five or seven years to verify service life.

The efficacy standard for antifouling topcoats in ship tests is that they have no biofouling of any kind, omitting non-adherent slime, on at least 95 percent of the areas painted and is free of film failure, such as peeling, flaking, and erosion through to the anticorrosive, and acceptable ratings for checking, cracking and blistering.

Qualification of non-toxic fouling release coatings (Classes 1C or 3C) have special requirements which include cycles of static and flow channel testing in which at least 60% of fouling attached during static immersion shall be released by a 20 knot velocity in channel flow testing. 80% of the total panel surface is to be free of hard fouling after testing at 20 knots and 85% after testing at 30 knots.

2.4.3.5 Efficacy Guidelines

APVMA Antifouling Efficacy Data Guidelines, January 2001
Guidelines for Submitting Antifouling Efficacy Data[39]

These instructions describe the general requirements and the format used for submitting efficacy data in support of the registration of a new antifouling chemical product. Products that require registration include antifouling coatings or paints that contain controlled-release biocides, as do biologically derived biocides including biological chemicals, plant and animal extracts, microbial products and biological control agents. Products developed as physical deterrents to fouling do not require registration. This includes products such as silicone coatings, fibreflock surface and “non-stick” surfaces.

For registration, comprehensive efficacy date is requested showing results of laboratory, simulated field-scale and field scale trials which prove that the new antifouling product, when used according to the label directions, is effective for the purposes claimed. Efficacy studies should include calculated data on leaching or release rates of the active chemical from the coating, and information to indicate the period of protection expected. Data from overseas countries may be used to support an application but, in most cases, data produced under Australian conditions are required. If submitted, the relevance of overseas data to Australian conditions must be established, including a consideration of such factors as salinity, water temperature and type of fouling organisms present, relevant to Australian climactic zones, marine conditions and species.

In designing efficacy studies to meet APVMA requirements, the guidelines direct that consideration be given to the following:

- The antifouling characteristics of the products are biocide release rate, erosion/polishing rates, physical durability and biological activity
- Representative sites must be used; for example on vessels following normal trading patterns or in accelerated laboratory tests closely modeling typical exposures and environmental extremes
- Current application technology/best practice should be used
- Studies should be carried out over at least one year, with longer trials necessary to demonstrate performance under varying or atypical weather conditions, or to provide evidence of product efficacy and durability over the time period claimed on the label
- Valid study designs should be uses, with appropriate statistical analyses
- Studies should include controls.

[39] www.apvma.gov.au/guidelines/antifouling

In identifying appropriate methods and study designs, reference is made to ISO 15181-1 & 2, AS 1580.481.5, ASTM D 3623, 4939, and 6442

[U.K.] Guidelines on the Efficacy Data Requirements for Approval of Non-Agricultural Pesticide Products: Antifouling Products[40]

In the United Kingdom, the Registration Authority (HSE) is obliged to look at the efficacy of non-agricultural pesticide products submitted for approval. This document gives guidance on the nature and extent of efficacy data required to gain a commercial approval of a pesticide containing active ingredient/biocide(s) for use as an antifouling product against fouling organisms on vessels, floating/submerged structures and apparatus or equipment used in aquaculture, and also for the continuing approval of current products containing existing active ingredients following review.

The data requirement is for the demonstration of the innate activity of the active ingredient/biocide as a potential antifouling biocide, and that the formulation of the biocide into representative coating(s) will result in a product that demonstrates effective antifouling capability. However, it is specifically stated that the effective life of a coating will not be considered in an assessment nor will any information be used as the basis for a product guarantee scheme.

Product performance claims are needed to support the application, including recommended dry-docking intervals and the anticipated or recommended use(s) for the product; e.g. marine, freshwater, deep sea, low activity, use on yachts, aquaculture, etc. The document recognises that the individual specifications of an antifouling product for a vessel's particular operating condition s will vary considerably, but the general effectiveness of a product under typical fouling conditions will need to be generated. It is noted that the maximum period of service life of an antifouling product is dependent on factors including the vessel trading pattern, and thickness and type of antifouling coating applied.

Types of data considered relevant to an application are form laboratory test, including in vitro toxicity screening tests, simulated filed tests (e.g. raft tests), and field tests (e.g. vessel patch tests). The purpose of laboratory tests is to demonstrate the inherent biological properties of an active ingredient as an "anti-weed, anti-animal etc." agent; simulated field tests to demonstrate the antifouling capability of a test formulation under static conditions; and field tests to demonstrate antifouling capability under in-use service conditions.

Only general guidance on efficacy data collection of antifouling products is given. With respect to simulated field tests, raft testing is cited as the only internationally recognised method of evaluating products. Two test protocols are cited (CEPE Antifouling Working Group, 1993; ASTM D 3623) but it is stressed that use of these protocols is not mandatory.

Field tests/in service monitoring permits antifouling products to be tested under similar operating conditions and stresses encountered as when the antifouling product is in service. Examples of tests given include panel tests where coated panels are attached to a vessel for a short period of time, and patch tests where vessels are painted with a test coating as a strip or patch on the side of the hull. The guidance document acknowledges that data generation from field trials requires many years to carry out.

[40] Biocides and Pesticides Assessment Unit, Health & Safety Executive, Bootle, Merseyside, UK. January 2002

The guidance on field tests concludes with the comment that there are no current national or international standards which cover field evaluation of antifouling products. This was not seen to be a deterrence form submitting data generated form company protocols for panel tests or in-service data.

2.4.3.6 Overseas Development of New Standards, Efficacy Criteria and Specifications

ASTM Subcommittee D01.45: Marine Coatings (US)[41]

ASTM has acknowledged that antifouling coating technology is in a state of transition, with new, environmentally friendly, coating formulations and concepts being continually introduced. The chair of the ASTM Subcommittee on marine coatings has reported that this subcommittee is in the process of developing standards for determination of biocide release rates, introducing revised methods for the field evaluation of coatings for the control of biofouling accumulation, and creating new methods for the determination of biocide in liquid paint.

Efficacy Criteria for Biocide-Free Antifouling Products (Germany)

The German Federal Environmental Agency commissioned the marine research institute LimnoMar to outline basic criteria intended to assess the efficacy as well as the risks posed to the environment and human health by biocide-free antifouling products. These criteria are been applied in the creation and development of an eco label (Blue Angel) for biocide-free antifouling products in Germany.

An overview of efficacy requirements in other countries noted that in no country do registration requirements apply to biocide-free antifouling paints.

The potential application of existing antifouling paint testing standards (as listed in Section 3.4.8.2) to different type of biocide-free antifouling systems is considered under this process, but performance, assessment criteria or standards have not yet been discussed.

LimnoMar is hosting an international workshop in Germany in late 2003 to discuss these issues.

NATO Specification for Antifouling Paint Systems for Naval Vessels

A NATO Working Group is currently working on developing specifications or STANAGs (Standard Agreements) for antifouling paint systems that can be applied by the various NATO navies. It is understood that U.S. Military Specification MIL-PRF-24647C is being used as the model for this specification.

[41] ASTM Standardization News, www.astm.org/SNEWS/APRIL_2001/antif_apr01.html

3 CONSULTATION WITH INDUSTRY AND AGENCIES

3.1 Antifouling Paint Manufacturers

Data on the industry and its view on the potential for a cohesive framework for the assessment, approval and control of antifouling paints for the various commercial and recreational sectors was obtained in several ways:

- Direct phone or personal contact was made with key staff in each organization. This was a particularly effective means of information gathering, largely because of the consortium's close rapport with the industry and an established network with key people. Several meetings were also held with key industry people.

- A questionnaire (Appendix C) focused to provide formalised feedback on the industry's views was sent to all current suppliers of antifouling paints to the Australian market place, as listed in the APVMA directory[42]. Of the ten current suppliers of antifouling paint suppliers only one minor supplier did not respond to the questionnaire.

- Manufacturer manuals, data sheets and web sites and association/institute publications were accessed.

- Discussions were held with the Australian Paint Manufacturers Federation's (APMF), and reference made to their relevant literature, notably the annual report. The questionnaire to manufacturers was also back copied to the APMF, who wrote to the industry encouraging their support.

In overview, the Australian paint industry is both well developed and highly quality assurance focused. It is also very cohesive. This has largely been achieved because of the strong support of international affiliations of most of the major players and the efforts of key national organisations, notably with the Australian Paint Manufacturers Federation (APMF), Standards Australia, the Australian Paint Approvals Scheme (APAS), the Surface Coatings Association of Australia (SCAA) and related technically focused associations.

The APMF is proactive as a lobby group to government, developing and promoting modification of legislation at State and Commonwealth levels, notably in labeling of containers and on occupational health and safety and environmental issues. The Surface Coatings Association of Australia provides a technical forum to industry via monthly technical meetings in each State, an annual national conference and through training programs.[43]

To summarise, there are four major manufacturers and suppliers of antifouling paints into the Australian marketplace, namely Akzo Nobel (Australia) Pty Ltd, Jotun (Australia) Pty Ltd, Wattyl (Australia) Pty Ltd, Hempel Marine Paints Pty Ltd, and several suppliers of much smaller quantities, namely Resene Paints Pty Ltd, Tasmanian Paints Pty Ltd, Corrosion Control Management (Australia) Pty Ltd, Asian Paints (Qld) Pty Ltd and Supalux Paints Co. Pty Ltd. A tenth company, Ameron Australia Pty Ltd is listed on the APVMA web-site, but no response was received from that company. Rextel Pty Ltd (agent for US Paint Corp) and Shipway Spescoat Pty Ltd, also have products listed by the APVMA, but could not be contacted.

[42] www.apvma.gov.au/PubcrisWebApp/ProductList
[43] www.ascn.asn.au

In terms of the specification, approval and application of antifouling paints, of the nine manufacturers and suppliers who responded to the questionnaire, the following generalised comments are relevant:

- Where comments were tendered, the manufacturers or distributors of antifouling paints said that the market place was the most effective controller of product quality and that defective products were quickly eliminated from the marketplace due to the experiences of disenchanted ship owners.

- Four manufacturers/suppliers were critical of the time taken by the APVMA to register products submitted and, of these, three queried why legitimate overseas approved formulations should not be recognised in Australia. One manufacturer indicated that that the cost of registration was a serious impediment to registration of products by small paint manufacturers and inhibited them from improving formulations.

- Of the five respondents who made suggestions for improving the system of approving or certifying antifouling paint formulations, three proposed that it should be conducted by APAS, while one suggested that the APVMA should limit it role to consideration of toxicity matters. One respondent proposed Standards Australia as the specification authority and another suggested ISO specifications as a longer term goal.

- Several manufacturers/suppliers proposed that greater emphasis needed to be given to upgrading standards for application of antifouling paints. Indeed, general discussions with the manufacturers suggested that this was one of the weak links in the process, particularly in ensuring that the paint is applied to a clean surface and at an adequate thickness.

- There was no agreement, or indeed much guidance or support, for a uniform regime of test procedures and specifications for antifouling paint. Rather, each manufacturer has evolved their own in-house procedures, which they claim are meaningful to their specific product lines.

- The market share of the Australian antifouling paint by the various suppliers is not directly available. Rather, for the purposes of this study, the market share has been estimated on the basis of the somewhat optimistic responses in the supplier's questionnaires and the consortium's knowledge.

Manufacturer	Local	Overseas
Akzo Nobel	45	50
Jotun (inc. CCM)	15	30
Wattyl	20	5
Hempel	15	15
Tasmanian Paints	< 0.1	-
Supalux	-	(Note 1)
Resene	5	-
Asian Paints	-	-

Note 1: Principal has some 30% of international market.

3.2 Classification Societies

We sought comment from the International Association of Classification Societies in London and also from the major classification societies that carry out statutory work such as SOLAS, MARPOL and Loadline Convention surveys for AMSA, namely: ABS Pacific, Bureau Veritas, Det Norske Veritas, Germanischer Lloyd, Lloyd's Register of Shipping and Nippon Kaiji Kyokai,

We sought the societies and IACS' comment generally as to issues arising in the development of antifouling performance standards. In particular we indicated our need to establish:

(a) The current requirements and rules of Classification societies in respect of exterior hull coatings for anti-fouling paints

(b) Policies and rationale for the setting of such rules.

(c) Instructions to surveyors re hull painting systems

We also invited general comment on the following matters:-

1) The extent to which classification societies will monitor the condition and efficacy of AFS coatings at normal vessel surveys, having particular regard to the life of the AFS, polishing rates and consistency, biocide release rates and fouling release (from non-toxic paint coatings).

2) Will (your) classification society perform any role in the application of AFS, as part of the survey functions?

3) Issues arising from the systems for managing namely:
   (a) Antifouling standards as a condition of port entry, particularly administration of antifoulant standards

   (b) Antifouling encouraged by a code of practice

   (c) Antifouling as a permit condition

We received two answers from the societies. The first was from Det Norske Veritas who responded, materially, as follows:-

> *The requirements we have for coating is limited mostly to ballast tanks and we have no requirements for exterior hull coatings except no then for the anti-fouling systems (AFS). Enclosed please find a guideline and a Type Approval program we have for this service.*
>
> *As you will see, what we do is limited very much only to the forbidden Tributyltinoxide (TBT) polymer. For the Type Approval program this is quite contrary to all other Type Approval programs DNV have and we might some time in the future change this to include the efficiency of the AFS. But since very little standardised test methods are available, this is very difficult.*
>
> *We are, however, engaged in research regarding the efficiency of anti-fouling paints. In one project ECOPAINT, which is a EU founded joint industry project, we are doing some tests on antifouling. You can find some information about this project on www.ecopaint.net . We have started to develop two test methods. One is our own development, a spinning disk where we are testing the polishing rate of self polishing anti-fouling in natural sea water. The other is an ASTM method, ASTM D 4939, where we are exposing anti-fouling on a drum on a raft in natural sea water. The drum has run and still periods*

> *imitating a ships moving in sea and stopping in harbour. For this last test, we could be interested in some contacts to do the same tests in tropical waters.*
>
> *Another project we are participating in, 16 Norwegian vessels has been applied TBT-free anti-fouling paint from 6 paint producers. The painting is applied on large test fields on the side of the vessels. Here the fouling on the different test fields will be recorded. The results from this project will not be published before the end of 2005.*
>
> *Regarding the questions you have on page 3 of your letter, the DNV surveyor will not evaluate the conditions and the efficiency of the AFS. The surveyor will only follow the regulations set up by IMO as you will find in our guidelines.*

Lloyd's Register also replied as follows:-

> *I understand that the requirements stem from the IMO and therefore technically do not fall under the jurisdiction of classification. Our involvement in the process is, however, significant since we act for a large number of Flag States in the implementation of the IMO regulations and it is to be anticipated that the inspection of AFS's will be no exception.*
>
> *The Convention will enter force 12 months after ratification by at least 25 states representing at least 25% of the world fleet. From a scan of the IMO website this morning 3 countries, representing 2.12% are shown as signatories. However, individual countries or regions may implement national or regional legislations similar to the IMO Convention before the*
> *Convention comes into force and this is likely to be the principal driver to compliance in the early stages. A Record of Compliance is issued to ship owners before the Convention comes into force and LR can issue this to clients upon request and satisfactory inspection.*
>
> *The IMO has produced draft guidelines for surveys and these are attached for your information.*
> *We are developing our own guidelines for surveyors based upon the IMO requirements but these are generally considered company confidential and it is unlikely that we would be able to provide you with a copy when finalised.*
>
> *At present surveys are conducted based upon the requirements of the convention. We are building a database of recognised anti fouling coatings (copy attached for reference) which is available to the public through our web site. (Access CDLive home page and follow links through "approvals lists"). Criteria for inclusion is detailed in the introductory section. Where the existing or proposed coating is not recognised laboratory tests would be required.*

It is understandable that the Classification Societies are focussed on IMO and Flag State compliance issues. Inevitably, there is no equivalent attention being paid to hull fouling and the consequential environmental issues. Fortunately, DNV and perhaps other Societies, appear to be engaged in testing the efficiency of antifouling coatings. Their membership will doubtless be appraised of the results. Whilst the use of increasingly efficient antifoulings has a strong economic incentive behind it (to minimise fuel consumption that otherwise increases when ships are operated with fouled hulls) it will have a correspondingly beneficial environmental impact. Reducing the volume of hull fouling also means reducing the translocation risks that are attendant thereon.

3.3 State Agencies

3.3.1 Environmental Protection Authorities

General comment was sought from the EPA's of Queensland, NSW and Victoria with respect to issues that they thought should be considered in the development of antifouling performance standards for products used across all boating and shipping sectors. We included a specific request for them to consider the following:-

1. The use of anti-fouling standards as the primary management tool for domestic vessels both commercial and recreational.

2. The impact of State environmental policies on the development of antifouling standards.

3. Issues arising from the systems for managing biofouling that were examined in the article, namely:
   (a) Antifouling standards as a condition of port entry, particularly administration of antifoulant standards
   (b) Antifouling standards as a condition of boat registration
   (c) Antifouling encouraged by a code of practice
   (d) Antifouling as a permit condition

All three EPA's kindly provided responses. The Victorian EPA provided a particularly comprehensive response, which is reproduced below; it appears to succinctly identify the major operational and administrative issues of concern. Of particular note is the preference for a national approach to this problem if antifouling standards are to be used as a condition for port entry. The need for consultation is widely recognised.

3.3.2 Response from Victorian EPA

EPA Victoria have indicated an interest in participating in further discussions regarding the recommended antifouling paint performance criteria, the operational requirements for vessels and the administrative implementation of these requirements. They responded materially as follows:-

> *Victoria's statutory water protection policy, the State environment protection policy (SEPP) -Waters of Victoria, requires that actions be put in place to minimise the environmental risk of introduction and spread of marine pests via hull fouling. The development of antifouling performance standards as a mechanism to minimise the introduction of species via hull fouling will help to deliver on SEPP requirements.*
>
> *Avoiding the negative environmental impacts of antifouling paints needs to be central to the development of antifouling performance criteria. Although antifouling paints are used to minimise the introduction of marine species, consideration should also be given to minimising the impacts of antifouling paints on non-target organisms. Any new product(s) should go through an ecological risk assessment for effects on non-target biota. Performance criteria for antifouling paints should focus on minimising fouling by using the lowest possible level of chemical antifoulants. As well, research to support the development of antifouling performance criteria needs to consider the interaction between antifoulants and the hull surface properties as well as the biology of the pest.*

It seems practical to develop antifouling standards based on vessel types and their various operational requirements. It is likely that different administrative systems, potentially administered by a number of different organisations, will be required to implement the different systems.

The implications of the proposed mechanisms need to be further investigated, particularly in terms of the way antifouling performance criteria and antifouling standards are developed and reviewed. EPA Victoria looks forward to participating in further discussions on the development of antifouling paint performance criteria, setting the standards and administering the different systems, including EPA's potential role in these systems.

The following comments relate to each of the systems for managing biofouling that were examined in the report:

(a) *Antifouling standards as a condition of port entry, particularly administration of antifoulant standards;*

Further discussion is needed on the most appropriate mechanism (and organisation) to set and administer antifouling standards. Antifouling standards as a condition of port entry will be most practically implemented through a single national system for both international and domestic vessels. The most efficient way to achieve this needs further exploration (e.g. data requirements and most efficient use of this data).

(b) *Antifouling standards as a condition of boat registration;*

As for (a) above. Once the administrative mechanism is determined, the most appropriate approach to accreditation and inspection needs to be determined.

(c) *Antifouling encouraged by a code of practice; and*

This approach seems appropriate for this category of vessels. Where the risk of fouling is low, it is important to avoid the use of antifouling paints. A pamphlet distributed to boat owners with their registration papers will be an efficient way of distributing the relevant information.

(d) *Antifouling as a permit condition.*

As well as developing a permit condition, it is unclear whether all of the infrastructure in this category, are in practice, cleaned before and after use in a specified area. Therefore, guidance material may be needed to support this requirement (or maybe a standard permit condition developed to outline cleaning requirements).

3.3.3 Response from EPA NSW

The NSW Environment Protection Authority (EPA) are also keen to discuss the environmental aspects of antifouling and they responded materially as follows:-

The national regulatory body, the Australian Pesticides & Veterinary Medicines Authority (APVMA) assesses and registers agricultural and veterinary products. Most antifouling agents including organotin products (for example tributyltin, TBT) and their alternatives would be classified as pesticides, and therefore would need to be registered by the APVMA. Efficacy, environmental, health *and occupational health and safety issues would be considered during the APVMA assessment. APVMA has guidance on chemical, biological and physical deterrents to fouling in Antifouling Efficacy Data Guidelines (http://www.apvma.gov.au/guidelines/antifouling.shtml).*

All aspects of a chemical's lifespan must be considered in the initial registration process. This includes adequate mechanisms for waste disposal in the form of paint chips, excess unused paint and wastes generated during the maintenance cleaning of vessels. The EPA has produced several publications concerning marinas. Hard copies of these will be forwarded to you under separate covering documentation.

With regard to your question concerning State environmental policies, the EPA would be concerned to prevent pollution of water offences under section 120 of the Protection of the Environment Operations (POEO) Act 1997, and any breaches of the Pesticides Act 1999. Offences including willful or negligent misuse of pesticides causing injury to persons, damage to property, harm to non-target animals or plants, use of unregistered pesticides or use of pesticides contrary to an approved label would all be liable for prosecution by the EPA under the Pesticides Act 1999.

Activities listed in Schedule 1 to the POEO Act require a licence from the EPA. These 'scheduled activities' include the following:
'Marinas and boat repair facilities comprising:
Pontoons, jetties, piers or other structures (whether water-based or land-based) designed or utilised to provide moorings or dry storage for 80 or more vessels (excluding rowing boats, dinghies, or other small craft), or
Works such as slipways, hoists or facilities for the repair and maintenance of vessels (excluding rowing boats, dinghies, or other small craft) at which 5 or more vessels or any vessels 25 metres or longer is handled or capable of being handled at any one time'.

3.3.4 Marine Safety Victoria

We briefly discussed the practical operational issues associated with surveying and inspection of domestic craft with the General Manager Commercial Shipping, Marine Safety Victoria (" MSV "). The following comments are relevant:-

- Antifouling practice and certification for SOLAS vessels will presumably be regulated in accordance with the terms of the Convention, thus it is assumed the focus of this study is on non-SOLAS vessels.

- Because the survey and inspection regime in Victoria is concerned with the safety of commercial vessels, there is no provision in the *Marine Act* for the general survey and inspection of pleasure craft and no provision expressly authorising the inspection of antifouling paint on any vessel.

- Whilst vessels under Victorian survey must be slipped every two years, this obviously does not apply to vessels such as privately owned and operated pleasure craft that are not in State survey. Other States don't necessarily require mandatory slipping every two years for commercial vessels; some require slipping only on an 'as needed' basis.

- Hull fouling is essentially an environmental issue that falls outside MSV's obligations under the *Marine Act* and is of primary concern to the Environment Protection Authority. Nevertheless, MSV recognise that it is the only administrative authority in Victoria with a team of qualified marine surveyors and therefore MSV would be pleased to assist and work with the EPA in addressing hull fouling issues.

- The risks from hull fouling that are of concern to the EPA are well recognised even though in the small ship sector there are probably less than 100 pleasure vessels arriving in Victoria from inter-State each year. The problem is also impacted by Victorian fishing vessels that operate inter-State and then return to Victoria and inter-State fishing vessels fishing in Victorian waters.

- As far as permits for port entry is concerned, there may be merit in considering a risk-based approach such as that developed by the Victorian EPA for ballast water management.

- MSV would be pleased to further discuss this issue with Environment Australia, EPA Victoria and others as may be necessary.

3.4 Australian Yachting Federation

The Competition Manager, Australian Yachting Federation ("AYF") considers the development of antifouling performance standards requires a widespread consultation programme with the recreational boating community and other user groups. This is likely to require a significant amount of time and certainly more than was available for the preparation of this report. The AYF have kindly offered to facilitate a consultation programme with their membership through their website.[44]

3.5 Australian Seafood Industry

We sought comment from the Australian Seafood Industry Council, but at the time of preparing this report no reply had yet been received. Nevertheless, it is recognised that adequate consultation will be necessary with ASIC in developing any antifouling regulatory framework.

3.6 The Australian Pesticides and Veterinary Medicines Authority

In order to determine the APVMA's current and developing strategy and attitude to the assessment and certification of antifouling paints, and as part of the consortium's review, the matter was discussed with the APVMA. The APVMA advised that, because of the diversity of products dealt with by the APVMA, it was very difficult to be fully conversant with all of technologies. He indicated that he would welcome discussing how the APAS might be able to play a role in certification of the durability performance of antifouling paints and in their on-going quality assurance.

[44] www.yachting.org.au

3.7 Australian Paint Approval Scheme

As part of the consortium's review of options for approval and specification of antifouling paints, the potential for developing antifouling paint specifications and approving complying products under the APAS umbrella, was discussed with the Secretary and Executive Officer of the scheme.

The following key outcomes are pertinent:

(i) APAS would be prepared to publish an appropriate range antifouling specifications, if they were developed under Environment Australia's mandate and, provided they could be formatted to the APAS style and with the other normal provisos of APAS Approval.

(ii) Is likely that such specifications could be ratified by APAS within three months of any specifications being provided to the organisation, assuming that the paint industry saw no impediments to their publication.

(iii) APAS would be likely to insist that matters of toxicity and environmental impact remain entirely the role of the APVMA, and would underpin such decisions made by the APVMA in any APAS product approvals.

(iv) An impediment in the current APAS process, in the consortium's view, which APAS considers could be overcome, is the lack of any quality assurance demands placed by APAS on imported products under the "Category 2 Approval" and the impracticality of imported products achieving "Category 1 Approval".

Under the current scheme "Category 1 Approval" places three demands on the paint manufacturers:

- Their manufacturing facility must be ISO 9000 certified
- Their quality control laboratory must be National Association of Testing Laboratories (NATA) accredited.
- Their manufacturing facility must be audited by APAS at regular intervals.

Probably because of the cost impediments of APAS inspection, no paints of overseas manufacture currently enjoys full “Category 1 Approval”.

At the other extreme, “Category 2 Approval” only requires that the submitted sample complies with the specification test requirements and there is no demand for ongoing quality assurance. This category is essentially reserved for specialised products that are not manufactured locally.

In the consortium's view “Category 2 Approval” would not be adequate for antifouling paint approval as:

Against this background, APAS thought it likely that the consortium's concerns could be accommodated by the APAS by specifically requiring ISO 9000 certification for all approved antifouling paints.

3.8 Painting Contractors Certification Program

There are considerable impediments to the ship painting industry in being underpinned by a full third party quality assurance system of the PCCP type in the foreseeable future. Specifically, while some applicators of antifouling paints may well be able to achieve the quality control and technical standards demanded by the existing PCCP process, most could probably not. Moreover, the cost of PCCP accreditation is not insignificant and it is a highly likely that most applicators in the shipping industry would perceive such costs as prohibitive.

Against this background, discussions were held with the Manager PCCP, to explore whether the PCCP process could be adapted to accommodate these limitations. In particular, and in concert with PCCP, a less demanding accreditation in both technical and quality control terms and much cheaper, was as a possible model for further consideration.

In developing a scheme of accreditation of applicators of antifouling paints under the PCCP umbrella, it is necessary to be aware of the stake holders in the current scheme and the composition of the management board, in terms of how they may react to the development of an essentially parallel scheme.
The current PCCP board consists of representatives of the following organisations:

Australian Paint Approval Scheme
Australian Institute of Steel Construction
Australasian Corrosion Association
Blast Cleaners and Coaters Association
Australian Institute of Petroleum
Australian Paint Manufacturers Federation
Geopave
Master Painters Association
Surface Coatings Association of Australia
Transport South Australian
Water Services Association
Water Services Association of Australia

3.9 Australian Anitfouling Paint Testing Facilities

The National Association of Testing Authorities, Australia ("NATA") advised that there were currently no NATA approved rafts or other marine immersion facilities for the testing of marine underwater paint systems in Australia. The reason given was that there was no current APAS specification requiring this testing, thus obviating any need for maintenance of the facilities.

Two independent companies conduct environmental testing for paint manufacturers: the Allunga Exposure Laboratory, in Townsville, and Pacific Environmental Testing Services in "The Junction", NSW. Neither have an antifouling paint test raft, although PETS have the capability to perform marine immersion exposures at Taylors Beach, Port Stephens.

Of the marine paint companies, only Akzo Nobel and Wattyl have antifouling test rafts in Australia, both in southern Queensland. Akzo Nobel also has a raft in Auckland, New Zealand, as do Resene Paints (operated by Altex Coatings, NZ). Other companies undertake raft testing elsewhere in the world, but not in our immediate region.

The Defence Science and Technology Organisation (DSTO) have antifouling paint test rafts at Williamstown, Port Phillip Bay, and in Trinity Inlet, Queensland. These rafts are used to evaluate antifouling paints and other fouling control coatings with potential for application on RAN ships and submarines. Neither facility is NATA registered. DSTO also operates a "rotary simulator" to assess the performance, particularly polishing rates, of antifouling coatings under dynamic flow conditions that simulate exposure on ship hulls. This facility is also located at Williamstown.

No flow channels or sea immersed rotating drums of the types described in ASTM Methods D4938 or D4939 exist in Australia.[45]

[45] Refer Section 2.4.3.2.

4 SYNTHESIS

4.1 Antifouling Regulation and Survey

Commonwealth legislation in respect of antifouling paints is going to be shaped, initially at least, by the *International Convention on the Control of Harmful Antifouling Systems on Ships.* This Convention has been developed by the IMO as the international standard for regulating SOLAS vessels. Australian flag vessels under Commonwealth survey will have to adhere to that standard once it has been ratified and implemented by the Commonwealth, as will foreign flag vessels visiting Australian ports.

The Convention does not address hull fouling or the translocation of marine pests and, thus far, nor does any other Convention. Representations have been made to the Commonwealth to attempt to correct this state of affairs by making a submission to the IMO for either an Annex to the TBT Convention or a separate Convention. Any IMO Convention could then be implemented by the Commonwealth.

The six Classification Societies that carry out survey work for AMSA are safety orientated organisations that are substantially driven by IMO Conventions through IACS. This is where minimum standards for international shipping are developed. These standards may then be varied by Flag States at their discretion. Whilst organizations such as DNV are engaged in researching operational effectiveness of different hull coatings, implementation of coating standards is likely to be driven primarily by IMO Conventions or, to a lesser extent, by legislative measures implemented by Flag States.

That Classification Societies are now taking responsibility for survey and certification of antifouling systems as a consequence of the IMO AFS Convention is significant, as it is no longer such a big step for them to adopt such a role in certifying antifouling systems at least from a technical perspective if not on the basis of performance.

We have briefly examined some aspects of the current Victorian survey regime. These survey provisions are directed to the setting of safety standards and inspection of commercial vessels. There are no specific provisions for inspecting antifouling on these vessels and no provision for the general inspection of recreational craft for antifouling or anything else.

Marine Safety Victoria are willing to discuss how their marine surveyors can best assist the EPA in carrying out antifouling inspections. There is ample provision in the *Environment Protection Act* 1970 (Vic) for the Authority to require the owner or operator of a vessel to make it available for inspection or test by an authorised officer to ensure the vessel complies with the EP Act.[46] It is apparent that officers from Marine Safety Victoria could be authorized by the EPA to carry out vessel compliance inspections on their behalf if the Victorian legislature were to regulate hull fouling and antifouling under this Act. As discussed in Section 4.2 below, there would be considerable merit in extending this authorisation to monitoring the applicators of antifouling paints for any shortcomings in the surface preparation and painting of vessels.

EPA Victoria have expressed the view that further discussion is needed on the most appropriate mechanism and organization to set and administer antifouling standards. This is undoubtedly necessary. They also suggest that if antifouling standards are adopted as a condition of port entry, then such an arrangement can most practically be implemented through a national system

[46] Section 55A(1)

for international and domestic vessels. EPA Victoria considers the same approach needs to be adopted for considering the imposition of antifouling standards as a condition of boat registration.

The recommendations of the High Level Officials Group ("HLG"), which was established by the Natural Resource Management Ministerial Council ("NRMMC") to advise on the most appropriate governance, funding and legislative arrangements for a comprehensive National System for the Prevention and Management of Marine Pest Incursions recommended, inter alia, the following preventative measures to the Natural Resource Management Ministerial Council and the Australian Transport Council:-

> *The Australian Government will manage the risks of introduction of marine pests through internationally sourced ballast water from commercial shipping, throughout its voyage in Australian waters, and by bio-fouling on the hulls and equipment for all vessels entering Australian waters from overseas;*
>
> *The States and the Northern Territory will manage the risks of translocating marine pests for all vessels travelling between Australian ports through agreed model legislation for domestically sourced ballast water, or agreed codes of conduct, protocols and guidelines for other matters;*
>
> *The Australian Government will establish a Single National Shipping Interface to deliver consistent, agreed advice on management requirements for both international and coastal commercial shipping through a seamless single point of contact for all shipping operators.*

We must await the outcome of ATC's review of the HLG recommendations.

A single national approach represents a desirable operational solution but jurisdictional complexities have to be taken into account. The HLG recommendations implicitly recognise OCS jurisdictional considerations and only argue for a single national entity to ensure the distribution of consistent advice to international and domestic commercial shipping. Their focus on developing common regulation, protocols, codes of conduct and guidelines among the States and the Northern Territory represents a constructive and pragmatic approach to managing hull fouling risks associated with non-SOLAS vessels and recreational craft. If, as is to be hoped, ATC ultimately accept that a common national approach is necessary to manage this issue, then draft uniform regulation, codes of conduct and guidelines can be prepared by the National Marine Safety Committee for the non-SOLAS and recreational sectors.

Recommendation 1: *SOLAS vessels*
Australia should seek international co-operation by making a submission to IMO for an international instrument that addresses the management and control of ship's hull fouling and the consequential transfer of marine organisms.

Recommendation 2: *Non-SOLAS vessels*
State and Northern Territory Governments should manage translocation of marine pests by hull fouling on all non-SOLAS commercial vessels through uniform regulation, codes of conduct and guidelines.

Recommendation 3: *Recreational vessels*
State and Northern Territory Governments should manage translocation of marine pests by hull fouling on all domestic recreational craft through uniform regulation, codes of conduct and guidelines.

4.2 Certification of Paint Application

Effective and reliable performance of antifouling systems over extended periods is largely dependent on the quality of coating application. The quality assurance of ship paint application and the accreditation of paint application facilities for shipping are difficult problems to address for two reasons:

- The commercial ship painting industry ranges from well-controlled sophisticated facilities down to have small operators, sometimes of doubtful credentials and with little appreciation of third party accountability.

- A significant to proportion of the paint applied to ships and boats is carried out by the "Do it yourself" (DIY) applicator. In such instances, third party oversight would be impracticable.

Against this background, it will be necessary to adopt at least two strategies.

(i) For ships and boats painted by commercial applicators, the applicator will need to be able to establish that they have an effective quality management system, the necessary technical competence and a track record of success.

(ii) For ships and boats that are painted by DIY applicators, the accepted service life of the certified antifouling paint will need to be restricted to a period of not greater than 12 months.

4.2.1 Commercial Antifouling Paint Application

In determining the effectiveness of a commercial paint applicator, the PCCP is the only industry specific accreditation scheme in Australia. As mentioned in Section 2.4.5, currently only one contractor involved with ship painting is currently PCCP certified, which suggests that a major attitudinal change would be needed in the industry or the PCCP would need to develop a more workable, less stringent scheme for the ship painting industry.

Experience in developing the PCCP in Australia (and the equivalent body in the USA) has shown that that the principle impediment to attracting small to medium-sized painting applicators into accreditation schemes is the cost. This includes both the direct charges by the PCCP, typically $1000 - $2,000 per annum, and the indirect costs of training personnel and setting up and maintaining quality assurance procedures. In addition, there is probably widespread mistrust of any independent scrutiny.

After discussion of the issues with Mr. G. Eccleston, Manager of the PCCP and consideration by this consortium, the following process is seen as a realistic and pragmatic way forward.

(i) Develop guidelines that establish it minimum standards for applicators of antifouling paints.

(ii) Develop an appropriate questionnaire, aimed at seeking responses from applicators, to establish their expertise, quality systems and track record, in order to enable comparison with the acceptance guidelines. (A working group consisting of specialists in product accreditation and representatives of the industry could draft both the guidelines and the questionnaire.) A generalised idea of how the questionnaire might be formatted is example by the current PCCP questionnaire in Appendix D. It is important to note that the consortium envisages that the questionnaire would be considerably shorter and more narrowly focused questioning than the current PCCP questionnaire. This is in recognition that most of these applicators are unlikely to have a simpler and less sophisticated operation than most generalist coating applicators currently under the PCCP umbrella.

Along with the questionnaire, it would be necessary to prepare guidance notes to assist commercial applicators to recognise what is needed to achieve the accepted minimum requirements.

(iii) It is envisaged that the PCCP Secretariat would administer the scheme. Specifically, applicators would apply for, and complete, the questionnaire. The PCCP would then check compliance of the completed questionnaire against the program guidelines. Where the company complied with requirements, a PCCP license would then be issued.

In addition, it would be the responsibility of the applicator to immediately advise the PCCP Manager of any changes to their operations and to resubmit the questionnaire annually, as a quality control measure. It is anticipated that the annual direct cost for each application facility would be perhaps $100 - $200.

Because this scheme would be far less demanding of applicators than the existing PCCP procedures, it would be necessary to make a clear distinction, in terms of nomenclature.

(iv) Because of the time it is likely to take to familiarise paint applicators with the principles and operation of the licensing scheme and then to bring their premises up to the quality standards required, compliance could not be made mandatory for a considerable time after introduction of the scheme. It is anticipated that this would take about two years.

This scheme could be strengthened over the years, as applicators became more conversant with third party quality control oversight and as the industry became generally more sophisticated.

To promulgate this proposal, it is recommended that representatives of NIMPCG should meet with the Manager of the PCCP and other representatives of the Australian Government Analytical Laboratories as appropriate, preferably with key members of this consortium, to explore the most cost-effective and timely way to develop the scheme.

As detailed in Section 3.8, the current PCCP is directed by a Management Board drawn from a diverse range of organisations, each having their own specific agendas. In particular, some members of the Board might argue that a less demanding, cheaper scheme the accreditation for ship painters might weaken the existing scheme. However, we would argue that ship painters do not intrude into the existing PCCP market and, provided the ship painting scheme can be clearly differentiated from the existing scheme, there should be no confusion. Moreover, it would be impractical to expect the ship painting industry to upgrade to the current PCCP level in the foreseeable future and a less demanding scheme for this industry would provide a reasonable and realistic level of scrutiny.

In the final analysis, some technical oversight of ship painting is in the national interest and needs to proceed, irrespective of the commercial interests of related industries. Notwithstanding, possible opposition to such an accreditation scheme by the stakeholders of the existing PCCP scheme needs to be acknowledged in progressing this proposal.

Recommendation 4 - *A licensing scheme should be established to monitor and control of the commercial application of that antifouling paint on all vessels within the Australia.*

Recommendation 5 - *Environment Australia explore the development of an antifouling paint applicator licensing scheme as proposed in this report with the Australian Government Analytical Laboratories, who operate the Painting Contractors Certification Program. In developing this scheme, it is important that the likely agendas of the stakeholders in the existing PCCP scheme are recognised.*

As discussed above, the development of acceptance standards for commercial applicators of antifouling paints and establishment of a system of desk top auditing each applicator in terms of facilities, equipment, expertise and track record, are important elements in the quality assurance of paint application. However, to be control the industry effectively, some field monitoring is highly desirable. The States already have Marine Safety Surveyors in the field (refer Section 4.1), who may be able to provide at least some oversight of antifouling paint application, against the standards proposed in Section 4.2.1 (i) above, provided they were suitably trained. Where deficiencies in application procedures and standards were identified by these surveyors, they would be in a position to gather evidence for prosecution.

Recommendation 6 - *State Government Marine Safety Surveyors should be suitably trained and empowered to inspect the operations of antifouling paint applicators accredited under a PCCP scheme, on behalf of the relevant environmental authorities, in terms of best industry practice, as defined under the licensing scheme proposed in Recommendation 5.*

DIY Paint Application

Because of the large number of vessels painted under the DIY market and the similarly large number of locations where they are painted, it would be impractical to monitor the effectiveness of any fouling paint application in this market. Moreover, because most DIY applicators are likely to lack the expertise of the commercial applicator, the performance of the applied antifouling paint system is likely to be highly variable. Because of this variability, it is recommended that the active life of all antifouling paints applied in the DIY market be limited to 12 months. This restriction not only recognises the likely variations in paint application quality, but would also serve to encourage the some DIY applicators to seek out commercial applicator, enhancing the overall standard of application across the industry.

D I Y applicators would need to be able to establish that their vessels have been painted with an antifouling paint. This could be variously demonstrated by:

- Retaining invoices of the antifouling paint purchased, showing the date, brand, type and volume of paint.

- A written statement from the owner's boat club representative, confirming the club's oversight of the repainting.

In introducing such a scheme, and indeed making any changes in National procedures involving the public, there is often significant resistance considerable confusion. A wide, but targeted, education program, demonstrating the environmental imperative for such a scheme and the details of how it is to be implemented will be required.

Recommendation 7 - *For DIY applicators, purchase invoices or evidence of third party oversight could provide evidence of antifouling paint application, but such evidence should be deemed valid for a period of no more than 12 months*

Recommendation 8 - *A wide, but targeted, education program should be developed for recreational boat owners to demonstrate the environmental imperative for any antifouling certification scheme and its implementation*

4.3 Paint Registration (or "Approval")

In Registration (or "Approval") of antifouling paints, both the APVMA and APAS have important roles to play and both need to be involved in the process.

Both organisations have well-developed systems for establishing that paints meet specification requirements and for disseminating the names of certified (approved) products. Both publish their list their certified products. The APVMA detail the acceptable paints on their website, while the APAS publish a "List of Approved Products". Both organisations also allow manufacturers to show compliance of their paints on data sheets and labels. It is likely that in any fully developed scheme in which both organisations were involved, the certified or 'approved' products could be promoted by both of them, to maximise public exposure.

As discussed previously, the APVMA's primary role is to appraise the toxic and environmental impact of all ingredients of an antifouling paint (and any other products), supplied to the Australian market and where, deemed acceptable, register that product. Its role in ensuring that antifouling paints are effective is a secondary one, which has developed in the absence of any other regulatory organisation.

The APAS's role is to set performance standards for paint and to ensure that these standards are maintained from batch to batch, variously by their independent oversight or by other third party quality assurance. They have no role, or experience, in appraisal of the toxicity or environmental impact of paint. Because, until recent years, their role has been restricted to servicing the public sector, and because to date the Navy has independently appraised antifouling paints, APAS has not developed any antifouling paint specifications nor "approved" any products. (Although one antifouling paint specification is in the process of being drafted.)

By the APVMA and APAS working in concert, it is the consortium's view that the expertise of both organisations could be used effectively harnessed for maximum benefit.

While it is critical that these two organisations be given that the opportunity to explore how best they might interface, the following guidelines are suggested:

- The APVMA would remain the conduit for manufacturers seeking approval of antifouling paints.

- The APVMA would continue to dictate all toxic and environmental standards for antifouling paints and would appraise all products in terms of these requirements.

- The APVMA would invoke APAS requirements on the durability and efficacy standards for antifouling paints, once appropriate APAS specifications had been developed. Until that time the existing APVMA efficacy standards would apply.

- The APAS would develop antifouling paint specifications to meet the diverse requirements of ship owners and operators. These specifications would need to include both efficacy requirements and demands on the paint manufacturers and suppliers for third party ISO 9003 quality assurance of paint manufacture and distribution. They would also identify that APAS reserved the right to audit the paint for quality and to investigate any product complaints.

- Both the APVMA and APAS would continue to list Certified (Approved) products as they currently do and allow manufacturers to promote those products on cans, data sheets and other promotional literature.

In order to finally resolve how the APVMA and APAS might best interface, it is recommended that the two Commonwealth Government organisations confer directly, using the recommendations detailed above as a basis for their discussions. In any event, it is crucial that both organisations recognise the national imperative of establishing a process that only approves non polluting, effective, antifouling paints to the Australian marketplace.

Recommendation 9 - *The Registration (Approval) of antifouling paints should be developed by the agreement of the APVMA and APAS. It is proposed that the APVMA would remain the conduit for manufacturers seeking approval of antifouling paints and would continue to dictate all toxic and environmental standards. In the longer term, APAS would establish durability and efficacy standards for antifouling paints to meet the diverse requirements of ship owners and operators. These specifications would need to include demands on the paint manufacturers and suppliers for third party ISO 9003 quality assurance of paint manufacture and distribution.*

4.4 Performance Standards and Specifications

Maintenance of an effective antifouling coating system is seen as primary means of minimising the risk of introduction and translocation of exotic and potential marine pest species. The benefits of regular and conscientious hull maintenance are also likely to flow on to allow promotion of best practice in controlling the development of fouling growth in hull niches, such as seawater intakes, and on unpainted surfaces, such as propeller shafts, rudder posts and propellers. Maintenance of an effective antifouling system involves three aspects: antifouling product efficacy, correct application to achieve required antifouling life, and renewal within the effective life of the paint. The framework proposed to provide authorities with some surety of antifouling efficacy on the hull of a vessel is a combination of antifouling performance standards and evidence or certification of application.

4.4.1 Efficacy Standards

The underlying requirement for a certification or other regulatory system is to provide surety of antifouling efficacy through product and system standards and specifications. In the following discussion, antifouling effectiveness is taken to mean prevention of attachment, growth and/or persistence of all macroalgal and animal growth. The term persistence is used in relation to non-toxic foul release coatings, which do not necessarily kill or otherwise deter the settlement and attachment of spores and larvae of fouling organisms, but enable the sloughing or dislodging of attached growth when the vessel is underway.

The base standard would be the minimum time an off-the-shelf antifouling product would provide antifouling effectiveness when applied, as in a DIY application, as a single coat system. Higher standards can be achieved by providing assurance of antifouling dry film thickness, applying multiple coats of antifouling, using high performance paints, and/or ensuring paint characteristics match the operating profile of the vessel.

In Section 4.2.2, it was proposed that for ships and boats that are painted by DIY applicators, the accepted service life of the certified antifouling paint will need to be restricted to a period of not greater than 12 months. For this, an assurance is required that any antifouling product available for retail sale will generally provide at least 12 months antifouling effectiveness in the environment a vessel is berthed, moored or operated. Proof or demonstration of at least 12 months antifouling effectiveness, possibly under specified conditions, could be considered a minimum performance standard for APVMA antifouling product registration.

Longer periods of antifouling effectiveness, up to and exceeding 5 years, can be achieved, but it is considered that surety and certification of such performance requires professional coating selection and application or at least third party oversight of the antifouling application. An approval system for antifouling paint performance, based on efficacy standards and system specifications, would assist applicators and overseers in certifying application and predicted antifouling system performance. For such a system, suitable test and qualification procedures need to be applied or, if none exist, developed.

Recommendation 10 - *An Australian approval system for antifouling paint efficacy and performance should be developed, based on standards and specifications relevant to the intended application.*

4.4.2 Antifouling Classifications

Two broad categories of antifouling coating are recognised: biocidal and non-biocidal. Within the former, coatings can be further categorised as ablative/polishing or non-ablative/non-polishing.

Antifouling system performance criteria could be required to meet the following criteria or combination of criteria:
Effective life: 12/24/36/60 months
Vessel activity: Static/Low/High
Vessel speed: Low (<10 knots), Moderate (10-20 kn), High (>20 kn)
Hull material: Composite/Wood/Steel/Aluminium/Rubber
Fouling environment: Low/High

The system used within the US MIL Specification provides an example of how products and systems can be categorised to meet necessary performance specifications for the required matrix of product types and operational criteria.

Based on the MIL-Spec approach, as classification scheme could be developed as follows. Types of biocides are not included in this classification as regulation of these is considered to remain the responsibility of the APVMA, and all biocides would have to be registered by that authority.

Product Type:
I ablative topcoats (biocidal)
II non-ablative topcoats (biocidal)
III non-ablative topcoats (non-biocidal)
Product Class:
suitable for use on composite materials
suitable for use on wood
suitable for use on metal, except for aluminium
suitable for use on metal, including aluminium
suitable for use on rubber
Product Grade:
- A for moored and static vessels and structures
- B for low activity vessels
- C for high activity vessels
- D for low speed watercraft (< 10 knots)
- E for moderate speed craft (10-20 knots)
- F for high speed craft (>25 knots)

System Application:
- a 12 month docking cycle
- b 24 month docking cycle

c 36 month docking cycle
d 60 month docking cycle

Qualification of paint systems would be to one of more of the above classifications; for example, a paint system could be qualified as Type I, Classes 1,2,3 & 5, Grades B & D, Application c, when applied following the manufacturer's technical specifications.

Recommendation 11 - *Qualification of antifouling paint systems should be to a classification system which considers product type (ablative/non-ablative, biocidal/non-biocidal), class (substrate suitability), grade (vessel speed/activity) and application (docking cycle).*

4.4.3 Available and/or Relevant Standards and Specifications

If possible, it is considered that Australia should not require duplication of efficacy or performance qualification undertaken overseas, if the standards achieved match those required to be met on vessels entering or operating in Australian waters. For example, qualification against the US MIL, or the forthcoming NATO STANAG specifications should be accepted as suitable evidence of performance. MIL-PRF-24647C is the only detailed performance specification identified in the course of this study (Section 3.4.8.4). Evidence that products are qualified under this specification should be accepted as appropriate evidence of this specified performance standard. NATO STANAG qualified products should equally be acceptable.

However, the MIL specification only encompasses high performance, long life coatings and other classes of antifouling are required within the Australian maritime sector. Lower cost paints, with lower performance expectations, are a major component of the Australian market. For these products, less rigorous performance standards are needed, but qualification against appropriate performance standards is still necessary to enable certification of efficacy over a planned docking cycle.

The only relevant Australian standard is AS 1580.481.5, the test method for assessing durability and resistance to fouling of underwater marine coatings by static immersion testing (Section 2.4.3.1). Static raft testing is relevant to performance testing of non-ablative/non-polishing systems but on its own is not suitable for evaluation of either ablative/polishing systems or biocide-free fouling release coatings.

Overseas standards are also limited in their usefulness in determining efficacy of modern antifouling coatings. ASTM D3623 is similar to AS 1580 481.5 in prescribing a method for determining fouling resistance under static conditions. ASTM D5479 is also a static test but for coatings partially immersed.

The major characteristics of biocidal antifouling paint systems that determine its performance are the efficacy of the biocide or biocide package, the biocide release rate, and the paint ablation or polishing rate and the consistency of these over time. Exposure to fouling pressure by static immersion indicates whether the biocide/biocide package efficacy and release rate are effective at that point in time; static immersion does not however allow or test for ablation or self-polishing action of a coating which is designed to maintain and renew antifouling action on moving vessels.

Two ASTM methods, D4938 and D4939, are relevant to assessing the performance of ablative or self-polishing coatings. D4938 enable the measurement of coating erosion rates in a high velocity water channel, but with no concurrent assessment of antifouling performance. D4939 attempts to more closely represent conditions on a vessel hull by exposing test coatings to alternating cycles of hydrodynamic shear, to assess ablation rate, and static immersion, to assess antifouling performance.

No facilities exist for the conduct of testing to either ASTM D4938 or D4939 exist in Australia. DSTO does operate a rotary simulator for dynamic flow testing of underwater coatings, including measurement of polishing rates, but the method and equipment is not equivalent to that specified by the ASTM.

ASTM D4939 could also be applicable to biocide free coatings as it simulates cycles of fouling attachment and flow to remove attached fouling. ASTM D5618 was developed to assess fouling adhesion strength to non-toxic coatings, but has limitations in that adhesion strengths are too low to measure on the better fouling release coatings, and barnacle settlement can be too low for valid statistical measurement.

The intent of test methods for determining biocide release rates (ASTM D5108, ASTM D6642, ISO 15181) is the measurement of biocide release in a laboratory environment as a means of determining the relative release rates of products for the purposes of reducing biocide input and harmful effects to non-target species. The values generated are not accurate indicators of actual release on vessel hulls, nor provide a meaningful assessment of long term paint efficacy.

No standard protocols have been approved for patch testing of antifouling paints on ship hulls.

The APVMA “Antifouling Efficacy Data Guidelines” provide guidance on the type and quality of experimental and field data necessary to support efficacy claims, but this Authority stops short of providing detailed and rigorous performance specifications. This is consistent with their major role in determining that a biocide will be effective for the purposes claimed, i.e. preventing fouling growth.

There is also a fundamental gap in the regulatory processes governing antifouling coatings and technologies in Australia in that there is no requirement for proof of efficacy of non-biocidal systems or regulation of sale of these systems. This is of concern in addressing hull fouling risks, as such coatings are prone to fouling attachment which would not detach from ineffective systems.

Recommendation 12 - *Qualification of antifouling systems to overseas specifications should be deemed acceptable for relevant applications in Australia, conditional on the system components being registered by the APVMA.*

Recommendation 13 - *Appropriate test methods and facilities need to be developed for validating efficacy and performance of ablative and non-toxic coatings in the Australian marine environment.*

4.4.4 Antifouling Test Facilities

Fouling intensity is widely considered to be most severe in tropical harbour waters as a consequence of the warmer waters prolonging fouling settlement seasons and enhancing growth rates. Fouling severity can however be as or more severe in temperate Australian waters, particularly through the summer months. It is therefore not considered essential that antifouling testing be conducted in a tropical environment, particularly if test panels are immersed at a time that ensures that the known fouling season occurs during the latter part of the test qualification period. If, for example, a paint is to be tested for static antifouling performance over 12 months, immersing test panels in autumn will result in the paint being exposed to high fouling pressures at the end of the exposure period, and thus demonstrating antifouling efficacy at this time.

Nevertheless, as discussed in Section 3.9, few facilities exist for the panel testing of antifouling coatings in Australia.

As previously acknowledged by the APVMA in their "Antifouling Efficacy Data Guidelines", data produced under Australian conditions is important in establishing antifouling efficacy in Australian waters. However, the limited restricted range of appropriate test facilities creates an impediment to gaining relevant data for the implementation of national performance standards, specifications and qualification procedures. A need therefore exists to determine:

- the present availability and capacity of antifouling test facilities
- the capability of existing organisations (e.g. Scientific Standards Laboratory, Allunga Exposure Laboratory) and paint companies to utilise, expand or establish appropriate test facilities
- the utility and relevance of overseas data, both from in-house paint company testing and independent assessments

Recommendation 14 - *A review of the availability and capability of existing companies and organisations to perform antifouling efficacy and performance testing in Australia is needed as a base for a national antifouling qualification system, as is a review of the utility and relevance of overseas data.*

4.4.5 Performance/Efficacy Specifications

4.4.5.1 Biocidal systems (Product Types I and II)

The minimum standard for biocidal systems, which could be a condition of APVMA product registration, could be by static testing to AS1580 Method 481.5 or equivalent. The qualification standard would be no persistent fouling (as defined in the method) after 12 months in tropical and/or temperate conditions. For type I coatings, some consideration must however be given to ablation or polishing rates, particularly with regard to grades C and F coatings, to ensure that systems would not polish through within the 12 month period

For Type II coatings, and applications b and higher, longer and relevant periods of static testing to AS1580 or equivalent, could be required, or evidence from ship trials. Some attention does need to be given to avoid unnecessarily protracting the approval process. However it is unlikely that Type II coatings could meet greater that application b requirements. For this type of coating, applications greater than application a would required system technical specification and application (e.g. no of coats, DFT).

Type I coatings for applications b and higher would require a combination of static and dynamic testing, either by cycling dynamic and static conditions, and/or quantification of ablation/polishing rates at nominal speeds. System technical specification would again be required. Well documented ship trials could be used to supplement this information.

4.4.5.2 Non-biocidal systems (Product Type II)

The relatively recent development of non-toxic fouling release coatings has exposed gaps in the standard regulatory and testing methods for antifouling coatings. The most appropriate method of test would be to expose the system to fouling and then determine the ease and completeness of removal, either by an experimental method, or by exposing the surfaces to flowing seawater. The performance standard would be demonstrable foul release characteristics.

The MIL-Spec follows this approach by specifying cycles of shallow water immersion followed by exposure and observation of fouled panels in a water channel. The rotating drum method would also seem suitable for assessing fouling release performance.

Some non-biocidal systems, for example fibreflock coatings, have been claimed to resist or deter fouling attachment. To evaluate these claims, static testing to AS1580 or equivalent would be appropriate, with the performance standard being no fouling after requisite time.

4.4.6 National Antifouling Standards and Specifications Working Group

Development of appropriate performance criteria, specifications and qualification standards, the means to acquire the necessary efficacy data, and the facilities or methods required for data acquisition would be best pursued in close consultation with the paint industry and other relevant organisations, authorities and interest groups. The formation of a "National Antifouling Standards and Specifications Working Group" is suggested as means of best achieving these aims within the shortest possible timeframe.

Within the questionnaire submitted to industry as part of this consultancy, the question was asked:
"Would your company be willing to participate, or be represented, on a technical working group to develop national antifouling standards and/or specifications?"

Five of the nine companies responding to the consortium's questionnaire replied positively to this question. Significantly these five included the major international paint companies Akzo Nobel, Hempel, Jotun and Wattyl (Sigma).

Recommendation 15 - *A "National Antifouling Standards and Specifications Working Group", comprising representatives of the paint industry and other relevant organisations, authorities and interest groups, be established to develop appropriate performance criteria, specifications and qualification standards, and test methods to provide surety of antifouling efficacy and performance in the Australian marine environment.*