Comments of the

World Shipping Council

Submitted to the

California State Lands Commission

In the matter of

Proposed Amendments to Article 4.8 Biofouling Management Regulations for Vessels Operating in California State Marine Waters

November 21, 2011
The World Shipping Council files these comments in response to the Notice of Proposed Regulatory Action published on September 16, 2011 (the “Notice”). The Notice proposes to amend Article 4.8 of Title 2, Division 3, Chapter 1 of the California Code of Regulations (CCR). The new title of Article 4.8 would be Biofouling Management Regulations for Vessels Operating in California Waters.

The World Shipping Council (WSC or the Council) is a non-profit trade association that represents the liner shipping industry, primarily operators of containerships, vehicle carriers, and roll-on/roll-off vessels. Together, the Council’s members carry approximately 90% of the world’s containerized trade. Vessels operated by Council members make frequent calls in California ports, and the Council’s members would be directly and substantially affected by the proposed rules.1 The Council appreciates the opportunity to comment on the proposed rules. These comments are supplemented by the statements of two experienced shipping company supervisors with extensive experience in hull husbandry. See Statement of Brian G. Constable, Vice President and Chief Operating Officer for APL Maritime; and Statement of Nils Larsson, Senior Superintendent for Wallenius Marine. Also attached is the Statement of John A. Lewis, Principal Marine Consultant, ES Link Services Pty Ltd. Mr. Lewis is an internationally recognized expert in fouling-mediated invasions and hull husbandry. These three statements are referenced throughout our comments, but readers are strongly encouraged to read the complete statements.

The Council appreciates the challenge of protecting California waters from the transfer of aquatic species as well as the difficulties of drafting regulations absent sufficient analysis of what current antifouling technologies can achieve on various vessel types and over what time periods. The fact is, however, that the proposed regulations are unrealistic and operationally infeasible, and they conflict with the statutory authority on which they are based.

Simply put, the proposed rules are not achievable using state-of-the-art marine coatings and recognized hull husbandry practices. This creates an untenable situation for ocean carriers. Continuing to call California ports under the regulations as proposed would place our member companies in a position in which simply entering a California port would likely place the vessel in violation of California law. We believe that this untenable situation can be avoided through a fundamental change in the proposed approach that would serve California’s interest in protecting state waters while also supporting California’s current position as the primary gateway for numerous international imports and exports serving the North American economy.

1 A full description of the Council and a list of its members are available at www.worldshipping.org.
Our comments attempt to detail the fundamental problems presented with the proposed ranking system put forward in the rule, demonstrate why compliance is not feasible using state-of-the-art technologies and practices, and describe how we believe these problems could be avoided through a mandatory, ship-specific management approach that requires the use of appropriate coatings and recognized hull husbandry practices while allowing sufficient flexibility in recognition of the diverse operating conditions and limits that are found in marine operations. In our judgment, there are four critical problems with the proposed rule that require attention in order to design a program that will be both effective and practical.

First, contrary to its statutory mandate, the Commission has not addressed what products, processes, and practices constitute “best available technology economically achievable” (“BATEA” or “BAT”) in the context of minimizing hull fouling. There is nothing in the record that constitutes a scientifically credible analysis of what hull conditions can realistically be maintained using the best products and practices available.

Second, as a direct result of the failure to conduct the required BAT analysis, the Commission has proposed very strict hull cleanliness standards that are unachievable in the real world. The Council believes that even the cleanest vessels would routinely fail the standards as proposed, setting up a regulatory regime that has the potential to generate large fines, but little environmental protection.

Third, because the proposed rule sets standards that will not be met by even the highest standards of hull husbandry, the six-month schedule for hull inspections effectively translates into a requirement to clean at a minimum every six months. In addition to not resulting in compliance, there is a substantial concern that such frequent cleaning would cause hull coatings to deteriorate prematurely, thus resulting in an increased overall level of fouling of vessels during the periods between out-of-water maintenance. In short, the regulations as proposed are likely to be self-defeating.

Fourth, the proposed rules conflict with the approach taken by the International Maritime Organization in its recently adopted biofouling management guidelines. In addition to adopting a one-size-fits-all performance standard approach that was rejected by the IMO, the proposed rules effectively require in-water cleaning before entering California waters. This may increase the risk of invasion in those geographic locations that have not already restricted in-water cleaning. California’s prescriptive approach, which focuses on only one of the many jurisdictions that a vessel will visit, removes the flexibility that operators need in order to minimize fouling throughout the full geographic range of their operations.

We address each of these concerns further below.
1. The Proposed Hull Condition Standards Are Not Based on the Best Available Technology Economically Achievable.

The Notice proposes regulations that adopt “percentage cover” limits on macrofouling. Non-niche portions of the submerged hull could not exceed Rank 1, meaning that there could be no macrofouling present excepting algal fronds along the boot top. Niche areas could not exceed Rank 2, which means that no more than 5% of such an area could be covered with macrofouling. Statements by Commission staff made in the technical advisory group (TAG) meetings indicate that staff believe that most well-maintained vessels would meet these standards, but there is insufficient information in the docket to support those statements. Indeed, there is no indication that the Commission has compiled the necessary information to determine what hull conditions can be reasonably maintained on different ships using best available technologies.

Section 71204.6 of the California Public Resources Code, which instructs the Commission to adopt hull fouling regulations, provides in relevant part that:

“The commission shall consider vessel design and voyage duration in developing the regulations. The regulations shall be based on the best available technology economically achievable and shall be designed to protect the waters of the state.”

The Code does not define “best available technology economically achievable,” but the term is a well-known one from the federal Clean Water Act. For the purposes of implementing its delegated National Pollutant Discharge Elimination System (NPDES) program, California adopts the U.S. Environmental Protection Agency standards. See 23 CCR 2235.2. Section 304(b)(2)(B) of the Clean Water Act, 33 U.S.C. § 1314(b)(2)(B), requires that the agency applying a BAT standard consider the following factors:

“Factors relating to the assessment of best available technology shall take into account the age of equipment and facilities involved, the process employed, the engineering aspects of the application of various types of control techniques, process changes, the cost of achieving such effluent reduction, non-water quality environmental impact (including energy requirements), and such other factors as the Administrator deems appropriate.”

EPA’s regulations at 40 C.F.R. § 125.3(d)(3) list the same factors.

No single factor is dispositive, and the agency has discretion to put different weight on the various factors. Notwithstanding that flexibility, if an agency is going to promulgate a rule based on BAT, it must first conduct a credible review of what the available technology can do. Here, at the most basic level, there is no discussion in the docket about what coatings and active systems are available, their suitability for different types of vessels or voyages, their effectiveness, their commercial availability, their durability, or their cost. Equally important, there is little recognition of the degree and frequency of limited macrofouling that does occur on vessels that utilize the best coatings and systems. The
The question of what constitutes best available technology is not even acknowledged. Because the Commission did not undertake that statutorily required and necessary first step, there is no scientific or factual information in the docket that supports a finding that application of the “best available technology economically achievable” would result in a hull that meets the Rank 1 standard after any substantial time in the water or that a Rank 2 condition is achievable for all niche areas. It is logically impossible to justify a performance standard on the basis of BATEA when there has been no evaluation of what technologies can achieve what results.

The Notice seeks to gloss over the inconvenient fact that the docket contains neither a technology analysis nor a risk analysis by stating that:

“This ranking scale is a modified version of a well-known, well-vetted, peer-reviewed scale that has been used widely for research, inspection, and general assessment purposes on a wide variety of vessel types since its introduction in 2005 (Floerl et al. 2005, Floerl et al. 2010, Hopkins and Forrest 2010, Floerl personal communication 2011). The proposed scale is also based on organism percent cover, a metric currently used by many in-water maintenance contractors hired by shipping companies to complete underwater hull husbandry and inspection.” Initial Statement of Reasons (ISOR) at 13.

Although the ranking scale has been used to assess whether surface observers and divers consistently rank vessels to a pre-determined scale, the scale was not developed to identify conditions that can be achieved by a given technology over some defined time period. There is no evidence that the ranking system is derived from an analysis that associates a given level of risk of invasion with the specific rankings contained in the scale. As such, the proposed ranking system does nothing to save the proposed rule from the lack of BATEA analysis or alternatives analysis. By the Commission’s own terms, the 0-5 ranking system is merely descriptive of the percentage fouling cover on an examined portion of a hull. The ranking system does not and cannot by itself say anything about the technologies, practices, and operational profile that a vessel would likely have to employ in order to meet a particular rank standard. The ranking scale is a shorthand narrative description of the relative number of organisms on a hull – nothing less and nothing more. The assignment of ranks 1 and 2 as the maximum permissible coverage for non-niche and niche areas, respectively, is completely arbitrary, and is unsupported by anything in the papers cited in support of the use of the scale. There is nothing inherently wrong with the scale, but its use must be confined to its intended purpose – description of a physical condition.

John Lewis discusses the rank system in some detail at pages 2-3 of his statement. The reader is invited to read that full discussion, but we quote the following passage in summary:

“The New Zealand LOF ranking system is not appropriate for adoption as a performance/compliance standard for merchant shipping for several reasons:

- It is an arbitrary ranking system developed to enable quantitative modelling of qualitative measures of biofouling extent and abundance;
- Assignment of ranks has been demonstrated to have high levels of error;
• The ranking system was designed for yacht hull surfaces, and does not address the complexity of niche areas, nor the localised presence of minor biofouling prevalent on the vast hull surfaces on merchant ships;
• LOF rankings do not correlate well with measured biofouling metrics, particularly on merchant vessels; and
• Percentage cover values attributed to LOF rankings do not address the significant differences between localised and scattered biofouling (see Courtaulds Coatings 1993) and the significance of this with respect to antifouling performance, failure and biosecurity risk. In essence, scattered biofouling across a hull represents a failure of the antifouling coating system through either depletion, a coating system unsuitable to vessel operating profile, or vessel inactivity- each warranting system renewal or regeneration. Localised biofouling represents operational damage and niche failures normal to in-service operation.

It should be noted that the LOF ranking system has not been adopted, nor is it being considered as a performance standard in New Zealand or Australia.” John Lewis Statement at 3.

In summary on the issue of the statutory requirement that the regulations be based on the best available technology economically achievable, the Council acknowledges that, because of the tremendous variability in vessel types, trading routes, vessel speeds, hull coatings, husbandry practices, etc., a BAT analysis for hull fouling is not a simple undertaking. The fact that the question is difficult or requires substantial data to answer does not, however, relieve the Commission from following the requirements that the legislature wrote into the statute. To the contrary, it is precisely because the task is complicated that a thorough and rigorous scientific evaluation is necessary. As these comments discuss in more detail below, failure to complete the basic research necessary before issuing a draft rule has resulted in a draft rule that is unrealistic, contrary to its authorizing statute, and likely to have unintended negative consequences in terms of potential invasions. The Commission needs to re-examine its rulemaking process, this time with the purpose of doing the necessary technical and scientific analysis that needs to precede the drafting of regulations that have significant and wide-ranging implications that reach well beyond California or the United States.²

² The Commission’s failure to perform the required BATEA analysis is underscored by the “alternatives analysis” provided in the Initial Statement of Reasons. There, after each section, precisely the same statement appears:

“The Commission Staff has determined that there are no alternatives considered which would be more effective in carrying out the purpose of the proposed regulations or would be as effective and less burdensome to affected private parties.”

Merely to repeat the statutory instruction that an alternatives analysis be conducted is not the same as doing that analysis. The alternatives analysis in this case is, or should be, closely linked to the BATEA analysis, because both seek to obtain the best environmental result with a reasonable burden. Neither required analysis was conducted with respect to the proposed rule.
2. **The Rank 1 and Rank 2 Standards Are Unrealistic.**

   As discussed in the section above, the docket contains no scientific analysis to conclude that the Rank 1 and Rank 2 performance standards are consistent with the best available technology economically achievable or with prevention of the introduction of invasive species. The lack of scientific rigor is not merely a technical or legal failing, however. The failing is substantive and fundamental, because all indications are that the proposed standards cannot be met consistently over time by even the best maintained vessels in the fleet.

   a. **Experience demonstrates that even vessels having low risk profiles and using the best hull husbandry practices are likely to violate the proposed rank standards.**

   The liner vessels operated by WSC members typically have hulls that are among the cleanest in the global oceangoing fleet. That is the case for several reasons, including relatively high speeds, short dwell times in port, and a strong economic incentive to keep hulls clean in order to save fuel. Despite the fact that these vessels are among the cleanest in the world, the Council believes that these vessels would in many cases fail the proposed hull condition standards. Such failures would not occur for lack of diligent hull husbandry, but rather because the standards are not reasonably attainable.

   i. **Non-niche areas**

   With respect to the non-niche areas of the submerged hull, the Rank 1 standard would be violated if even a single barnacle were attached to the main hull. Common sense dictates that having a hull with absolutely no macrofouling would be exceedingly rare in the real-world marine environment except within a very short period after out-of-water maintenance and application of a new anti-fouling coating. In large part because all coatings will be subject to a certain degree of mechanical damage during their in-service periods, the reality is that no coating, no matter how advanced or well maintained, can maintain a condition where there is no macrofouling at all over the entire life of the coating.

   In this instance, common sense is supported by the experience of shipping lines and researchers. Even leaving aside rare and widely dispersed organisms on flat hull surfaces, there are areas on the main hull that are not included in the proposed rule’s list of niche areas subject to LoF Rank 2 that commonly collect some level of macrofouling. One such area is the bulbous bow, which tends to sustain coating damage from the anchor chain and thus to foul. The area is relatively small, but this fouling would render the vessel in violation of the proposed standards. Other areas on the sides of the hull where the coating has been physically damaged by docks, fenders, tugs, and/or in-water cleaning operations will also typically support macrofouling. These situations are discussed in more depth in the three attached expert statements. See Larsson Statement at 1-2, and attachments; Constable Statement at 2-3; Lewis Statement at 4-5. The conclusions stated there are all consistent: hulls in commercial operation will sustain coating damage that results in some macrofouling. A couple of excerpts present the gist of the matter, starting with Nils Larsson’s statement:
“As can be seen on attachments 1 and 2, which are taken directly before and after hull cleaning, there is a limited amount, but still some, macro fouling even after cleaning. As the proposed requirements state no macro-fouling on the hull, we would not comply even seconds after having the hull cleaned.

Additionally, scratches from anchor chain (attachment 3) or from touching the quay side or other hard objects (attachment 4) may damage the anti fouling system and those areas will show macro fouling within a very short period of time. The anti-fouling on the bulbous bow is especially vulnerable to damages.” Larsson Statement at 1.

Brian Constable’s statement describes the same dilemma:

“The performance standards in the proposed regulations are unlikely to be met by even the cleanest vessels in any fleet, and the actions that would have to be taken in order to attempt to meet those standards will increase fouling over the life of a coating rather than decrease it. In addition to the factors discussed above, the more routine problems that cause fouling of the hull are highlighted below:

1) All vessels incur mechanical damage whilst in service. Quite often this is incurred when leaving the dry dock.
2) The most significant culprit in causing mechanical damage to the hull is the fendering systems (or lack of) at the respective terminals in the world. This is again beyond the control of an Owner/Operator unless it is at a terminal owned or operated by that company.
3) Anchor chain damage. Although it is never intended to anchor a line haul vessel, this does occur as stated above. This results in damage in the bulbous bow area and vertical sides up forward. This leads to significant localized growth until the vessel is next dry-docked.” Constable Statement at 2.

The rationale in the ISOR for selecting LoF Rank 1 as the performance standard for non-niche areas does nothing to allay the concern that the standard cannot be met consistently. The ISOR states conclusions about both level of risk of invasion and the current level of cleanliness of hulls:

“Between July 2003 and June 2005, the States of California, Oregon, and Washington received a combined total of 29,282 vessel arrivals and the average wetted surface of each of these vessels was 9070.4 square meters (Davidson et al. 2007), slightly more than two American football fields side by side (8918.7 square meters). The vessel surfaces addressed by this provision represent the vast majority of the wetted surface of a vessel (excludes niche areas). Therefore, biofouling covering even five percent, essentially LoF Rank 2 (two) could result in a very large number of organisms. This is an unacceptable amount of biofouling and would represent an extremely high risk of NIS introduction.

This provision is therefore necessary to define an acceptable level of cleanliness that the vessel’s wetted surfaces, excluding the niche areas specified in 2 CCR § 2298.3(b)(1), would need to be
maintained or cleaned to. Most vessels operating in California and elsewhere are already regularly maintained to a Rank 1 (one) for economic reasons (i.e., because of the increase in hydrodynamic drag and the decrease in fuel efficiency tied to greater biofouling accumulation). Therefore, the proposed regulation codifies the current level of cleanliness maintained by a large portion of the fleet and is necessary to require the remaining vessel owners and operators who don’t already manage their biofouling to do so.” (ISOR at 17.)

The first paragraph of the quoted language states a conclusion with respect to the risk associated with LoF Rank 2, and deems that risk unacceptable. No basis for that risk assessment is provided, and none appears in the materials in the docket. The second paragraph concludes that the bulk of the fleet already complies with LoF Rank 1 (zero macrofouling) for non-niche portions of the hull. Again, however, there is no support cited for the conclusion. In fact, experience in the liner industry is that the best maintained ships do not routinely meet the proposed standards. This conclusion should not be surprising, because the proposed standards prohibit even the modest levels of fouling that are identified in some of the more recent studies cited in the proposed rulemaking.

The Council is aware of one single paper in the docket from which the Commission might have drawn a conclusion that LoF Rank 1 is attainable. That paper is Davidson et al. 2009, *The role of containerships as transfer mechanisms of marine biofouling species*. That study involved opportunistic sampling of 22 containerships calling the Port of Oakland. The study’s findings included very low (but in many cases not zero) incidences of macrofouling on observed flat-bottom transects for the majority of the vessels sampled. That is good news, but the study does not purport to conclude that no macrofouling existed on the non-niche portions of the hulls observed. It is merely a description of the condition of the discrete areas sampled on a small number of vessels. One third of the samples did find biofouling on the observed flat-bottom transects, which means that those vessels would not meet LoF Rank 1. Moreover, it is a widely recognized fact that macrofouling on the flat bottom of a vessel is very low due to the lack of sunlight and other factors. Concluding that a sample of vessels exhibited little, if any macrofouling on their flat-bottoms, has little significance as an indicator of overall hull fouling as this area constitutes one of the least demanding surfaces when compared with other areas of the hull. Macrofouling on the flat-sides and other wetted surfaces of the hull is more prevalent for a variety of reasons that are not addressed in the ISOR. Indeed, the assertion that the current proposal will serve to “codify the current level of cleanliness maintained by a large portion of the fleet” is simply untrue and inconsistent with the limitations that are widely recognized in the industry. This is not due to the fact that numerous vessels are highly fouled, but rather because the proposed standards do not allow for even modest levels of fouling that are known to exist on even the cleanest vessels operating in the world’s fleet.

The point here is that, to the extent that the Commission is placing significant weight on the Port of Oakland study (which shows the least fouling of any of the papers included in the docket) to support the Rank 1 standard, the study cannot bear that weight. It is one thing to say that one has looked at limited sections of the hulls of a small sample of vessels and in many cases did not find macrofouling. It is quite another to say – as the Commission appears to do here – that this limited examination is sufficient to justify a standard that mandates that no vessel may ever have even a single
macrofouling organism attached to the hull (excluding niche areas and algal fronds) when it arrives in California. As discussed in the attached statements of Messrs. Constable, Larsson, and Lewis, there are a substantial number of observed instances in which recently dry-docked and recently cleaned vessels do display some macrofouling on non-niche parts of their hulls despite the use of properly applied, high quality coatings.

Setting a zero-tolerance rule for hull areas that the plain evidence shows will have some modest amount of macrofouling does little to inform management decisions by vessel operators. As the research papers in the docket observe over and over, there are a tremendous number of variables – and no small amount of chance – that affect the level of fouling on any given vessel. If a vessel is as likely to fail the standard as to meet it given a particular course of conduct, the regulation simply imposes the threat of penalties without in any way guiding or encouraging improvements in management practices.

ii. **Niche areas**

With respect to niche fouling, the LoF Rank 2 standard is similarly unrealistic. As the Commission has noted in the docket, the commercial objectives for keeping niche areas clear of fouling do not align as closely with invasion prevention objectives as is the case with non-niche portions of the submerged hull. In the case of sea chests, for example, currently available systems have been designed with the primary objective of maintaining a free flow of water into and out of pipes that penetrate the hull. As such, those systems are not optimized for keeping clean those niche areas that do not directly affect water flow. In short, given the small percentage of allowable coverage under the Rank 2 standard for niche areas, there is no information in the docket that demonstrates that such a standard is “achievable” as stated in the ISOR at page 16. Indeed, the discussion in the ISOR highlights the problem.

The ISOR provides the following explanation of why Rank 2 (as opposed to Rank 1 or Rank 3) was chosen as the performance standard for niche areas:

“MFD staff, in consultation with the TAG, believes that setting the performance standard for these specific niche areas at LoF Rank 2 (two) is more achievable [than Rank 1] because even properly managed niche areas may be difficult to maintain to a level completely devoid of macrofouling. The proposed standard is also superior to one requiring a LoF Rank 3 (three) as the latter would allow up to and including fifteen percent of biological cover and would therefore not provide an acceptable level of protection for California waters. Additionally, a performance standard utilizing a LoF Rank 3 (three) will not represent an improvement over the status quo for many vessels. (ISOR at 15-16)

The first sentence of the quoted passage acknowledges that niche areas are more difficult to keep clean than flat areas of the hull, and cites that as a reason for choosing a performance standard at Rank 2 rather than Rank 1. What the discussion never addresses, however, is whether Rank 2, while “more achievable” than Rank 1, is itself in fact achievable using the best available technology economically achievable. The final quoted sentence states that many vessels are at Rank 3 today: “Rank
3 (three) will not represent an improvement over the status quo for many vessels,” but provides no support for that conclusion. The discussion leaves several key questions unanswered. Why does the Commission believe that Rank 3 represents the status quo? If Rank 3 is the status quo, on what basis does the Commission believe that Rank 2 is “achievable,” presumably with available technology? These questions, which are central to the statutory mandate, are not addressed. Instead, performance standards are assigned arbitrarily, and the availability of technology to meet those standards is assumed. That may be an expedient pathway for the Commission, but it is not what the law requires. Nor is that approach likely to yield the desired environmental results, because it is based entirely on unsubstantiated assumptions that, as discussed further below, are factually inaccurate.

The Commission’s willingness in the ISOR to make categorical statements about what is achievable with respect to niche area fouling prevention is even more difficult to understand in light of the uncertainty that the Commission expressed in its 2011 Biennial Report on the California Marine Invasive Species Program, dated January 2011 and included as a technical reference in the Notice. There, staff identified the issue of available technologies to combat fouling in niche areas as being one of substantial uncertainty:

“Certain technologies have been developed to address fouling accumulation within some of these niche areas, but third party evaluations of the efficacy of these technologies have been limited. The Commission should support the development of new technologies to address and prevent fouling within vessel sea chests and other niche areas, as well as independent assessments of these technologies to determine their usefulness as a tool to manage fouling on vessels operating within California.” 2011 Biennial Report at 114.

The docket does not identify any means by which the lack of information about the efficacy of prevention technologies for niche areas that existed in January of this year has been overcome prior to the issuance of the proposed rule. The obvious conclusion is that no more is known now than was known earlier this year about what constitutes best available technology to prevent fouling in niche areas. Moreover, the Commission’s suggestion in January that new technologies be developed indicates that currently available technologies are not adequate to limit niche fouling to an acceptable level. In light of those facts, setting a precise numeric standard for niche fouling is simply arbitrary, a result that the law does not allow.

Sea chests, rudder assemblies, stern and bow thrusters, and numerous other specialized underwater structures found on a ship’s hull are known to present unique and significant challenges to maintaining these surfaces free of macrofouling. Challenges should not be barriers to improving current hull husbandry practices, but any rules put in place to deal with these structures needs to be fully cognizant of the relevant limitations of high performance marine coatings and active antifouling systems. Each of the three attached statements addresses the issue of niches areas – sea chests in particular.

In his statement, Brian Constable of APL Maritime states:
“Sea Chests: These do get attacked by algae and barnacles, both internally and externally. These areas cannot be cleaned except in drydock, and improvements in anti-fouling performance for sea-chests will require new technologies and systems beyond those available today.” Constable Statement at 3.

Nils Larsson makes a similar point:

“For sea chests, which for security reasons are closed by welding and leave us very little chance to clean them between drydockings, the proposed standards are unreasonable. Even though sea chests are properly coated and protected by anodes the macro fouling will be far beyond 5% after a five year period. The requirement to have max 5% macro fouling in the sea chests is, with the technologies that we are aware of, unrealistic if we are to maintain the same level of security. If we disregard the security risk and would actually start cleaning the sea chests we would introduce a safety risk as diving close to the sea water inlet poses a great risk if the inlet is not properly shut off.” Larsson Statement at 2.

John Lewis discusses the niche area problem in great detail at pages 6-9 of his statement, and the reader is encouraged to consult those pages for a useful technical discussion. Because of the length of that discussion, we quote here only its conclusion:

“In summary, although it is recognized that biofouling in sea chests can pose a potential biosecurity risk, knowledge and advice of effective methods to maintain or achieve compliance with the proposed regulations is wanting. To my knowledge there has been no assessment of best available technology that could achieve or approach the required standards for sea chests by CSLC or other body.” Lewis Statement at 9.

If wide-spread conditions of non-compliance could be easily rectified through the application of best available technology and hull husbandry practices, then the proposed standards would arguably serve their intended purpose. Unfortunately, that is not the case. Instead, the proposed standards would result in wide-spread non-compliance by the very carriers that are already using best available technology and hull husbandry practices. A fundamental change in the proposed rules is necessary to achieve the intended objectives and to avoid penalizing those ocean carriers who are already applying state-of-the-art technology.

3. The Combination of Unrealistically Strict Performance Standards and The Requirement to Perform Frequent Underwater Inspections May Lead to Unintended Consequences.

Proposed subsections 2298.3(b)(1) and (2) set the performance standards for non-niche and niche portions of the hull. Subsection (b)(3) requires vessel operators to maintain proof that the hull has been inspected: (1) no more than six months prior to arrival in California for vessels over a year out of drydock, and (2) no more than 12 months prior to arriving in California for vessels delivered new or
leaving drydock within 12 months of arrival in California. The stated purpose of the required inspections is “to ensure compliance with Subparts (1) and (2) of this section upon arrival to a California port or place.” For vessels deployed in regularly scheduled services, such as the services offered by members of the Council, the requirement translates into a requirement for an inspection every six months after the first twelve month period following initial delivery or last drydocking.

Inasmuch as the purpose of the inspection requirement is to “ensure compliance” with the performance standards, the result of the inspection requirement is that a vessel finding a non-compliant condition will be required to clean in order to attempt to come into compliance. It is at that decision point that the Commission’s incorrect and unsubstantiated assumptions about the condition of most vessels may lead to unintended consequences. Although the ISOR does not discuss what expectation the Commission has as to how often vessels may need to clean in order to meet the performance standards, the January 2011 Biennial Report provides some insight into the Commission’s starting assumptions about frequency of cleaning:

“In-water cleaning is an option many vessel owners and operators utilize to remove fouling organisms during the time between dry dock cleanings (i.e. inter-dry dock period) if fouling levels become elevated and noticeable drag is experienced. In-water cleaning can include cleaning of many underwater areas on a vessel, or it can simply involve the cleaning of the propeller (i.e. propeller polishing). Overall, 19.1% of the fleet has conducted some sort of in-water cleaning since delivery or dry dock, and about half of those have conducted propeller polishing only. Considering that nearly 84% of the fleet has been dry docked or delivered within the past three years, it is not surprising that only 9.2% of the fleet has undergone in-water cleaning to the hull and other submerged surfaces recently. Although there were many more individual tankers and containerships reporting in-water cleaning, the only vessel class that had more than 15% of their fleet undergoing this type of treatment were the passenger vessels (24.5%; Figure VI.27).” (Biennial Report at 78.)

When one combines these relatively low reported cleaning frequencies with the Commission’s statements that the majority of the fleet calling California is already in compliance with the proposed Rank 1 non-niche performance standard, the logical conclusion would be that the adoption of the rules would not result in greatly increased in-water cleaning, and thus that coating damage from increased cleaning should not be a problem under the proposed rules. The problem is that the underlying assumption that vessels will typically comply without having to undergo frequent in-water cleaning is plainly incorrect, as discussed in detail above. As also discussed above, the disconnect between the data in the docket and the Commission’s assumptions about typical hull conditions arises from extrapolating from relatively few instances of macrofouling being observed on small test patches of a small sample of vessels to a much broader conclusion that most hulls have absolutely no macrofouling outside of niche areas. The data do not support such a conclusion, and real-world experience directly contradicts that conclusion.

The dilemma is this. If the majority of commercial hulls are quite clean, but not 100% free of macrofouling, then diligent inspections on the schedule required by the proposed rule are likely to lead
to a substantial increase in the frequency of in-water cleanings in comparison to the frequencies described in the Biennial Report. In addition to substantial cost implications, including substantial extra fuel burned to return to schedule, repeated and frequent cleanings would likely result in degradation of many hull coatings. No matter how carefully done, in-water hull cleaning reduces the coating thickness of selected coatings and can present a significant likelihood of damage to many marine coatings as underwater cleaning is often undertaken in conditions that are imperfect. In-water cleaning can result in detachment of coatings in some cases, and can cause micro-scratchs that provide surfaces that are more susceptible to organism attachment. For these reasons, neither the public nor the industry would be well-served by the creation of standards that effectively require repeated and frequent cleanings that will serve to degrade the very coatings that vessels depend upon to prevent fouling.

Here again, the experiences of operators who manage cleaning operations are instructive. Brian Constable’s statement discusses the issue at pages 3-5. We provide on representative excerpt below:

“The consequence of the fact that cleaning causes some level of coating damage is not that we do not clean – we do – but we must make decisions about when and how to clean in the context of the performance of our coatings over the entire five year period between dry-docking. It is not economically sensible or operationally feasible to create a situation in which we clean so often that we create a situation of increasingly poor coating performance with each cleaning, leading in turn to more cleaning and even worse performance. This sort of “vicious cycle” must be avoided by weighing the overall long-term performance of the coating instead of managing based on the condition of the hull at any one arbitrary point in time.” Constable Statement at 4; see also Larsson Statement at 2.

John Lewis discusses the issue of cleaning both from the perspective of damage caused to hull coatings and also from the perspective of the impact that improperly timed or managed cleaning can have on the spread of invasive species. That discussion is at pages 5-6 of Mr. Lewis’ statement.

Enforcement of the rule as proposed appears quite likely to produce the cycle described in all three of the attached statements, in which too-frequent cleaning incrementally and cumulatively reduces coating effectiveness to the point that there is more total organism growth than if the hull had never been cleaned. That would leave vessel operators with a very unattractive choice. On the one hand, in an attempt to avoid violation of the rules, they could clean frequently in an attempt to meet the zero-tolerance standard when they call in California. Doing so, however, would degrade the overall effectiveness of their hull coatings over the life of the coating, thus increasing fouling, fuel use, air emissions, and potential transport of invasives to ports in jurisdictions other than California. On the other hand, operators could risk penalties from California while adhering to an operationally oriented inspection and cleaning regime that maximizes the continuous performance (not just the performance in California) of the antifouling system through-out its useful life. That approach would reduce overall fouling, reduce release of cleaned material (coating residue and organisms) into coastal waters, maximize fuel efficiency, and maximize coating life. In short, the combination of overly strict performance standards and mandatory inspections is likely to trigger excessive cleaning and to drive
operators away from the “best available technology” and instead toward an arbitrary and ineffective hull husbandry program. That would be counterproductive for all concerned, and it would turn both of the statutory mandates – to employ best available technology and to protect the waters of the state – on their heads.

4. **International Consistency and Discussion of the Way Forward.**

Underwater hull husbandry for the control of macrofouling is a complicated matter. The variables that can affect the choice of coatings, the need for and frequency of cleaning, and the effects of cleaning on long-term coating performance are numerous and interdependent. The Council’s central critique of the proposed rule is that it seeks to address an inherently diverse set of conditions that are literally unique to each vessel by setting a rigid numerical standard and management approach to all vessels. The problems with that approach are multiplied by the fact that the Commission has proposed management standards which, according to all available analysis, cannot consistently be met even by those vessels that have the cleanest hulls in the global fleet. That fact, coupled with the fact that the Commission has failed to address what qualifies as “best available technology economically achievable” or the performance that can be expected of such technology, means that the proposed rule fails both as a matter of environmental policy and as a matter of law.

Because many vessels calling California trade internationally, calling ports all over the world, the most sensible solutions for hull fouling will be those adopted through the International Maritime Organization (IMO). As the Commission is aware, the IMO recently adopted guidelines that are based on each vessel having a tailored biofouling management plan coupled with recordkeeping requirements designed both to insure compliance with the plan and to generate information on what management approaches work best. Throughout the materials supporting the proposed rules, the Commission makes reference to its efforts to conform the proposed rules to the IMO guidelines. The sentiment is commendable and appropriate; unfortunately, the proposed rule takes a rigid performance standard approach that is directly counter to the practical and flexible management plan approach adopted by the IMO.

California’s proposed approach is not merely inconsistent with the IMO guidelines in terms of its conceptual approach, however. By focusing on the hull condition only when the vessel is in California waters, the proposed regulations effectively transfer the problem to other jurisdictions. Because the proposed regulations require compliance with the hull cleanliness standards “upon arrival to a California port or place,” any required hull cleaning must by definition be completed at a prior port call in another jurisdiction. California is, in essence, telling other jurisdictions that they must accept a biological risk that California itself will not accept.

In addition to the fact that the proposed regulations would prohibit cleaning of macrofouling in California waters by prohibiting a vessel with macrofouling on non-niche areas from even entering California waters, California’s section 401 certification to the U.S. EPA’s Vessel General Permit (Additional Condition number 6, page 4) expressly prohibits such cleaning:
“6. Propeller cleaning is allowed until January 1, 2012, after which, propeller cleaning is allowed as specified in regulations adopted by SLC. All other in-water hull cleaning is prohibited unless conducted using the best available technologies economically feasible, as determined by both SLC and the State Water Board. This prohibition includes underwater ship husbandry discharges (Discharge #25).”

Unless the Commission intends to issue regulations establishing the “best available technologies economically feasible” for hull cleaning before any fouling regulations go into effect, the VGP requirements above make clear that the proposed regulations would require vessel operators, in order to comply with California’s regulations, to take actions in other jurisdictions that California does not intend to allow in its own waters.

If California’s approach were adopted by numerous jurisdictions around the world, especially if combined with the sort of numerical standards proposed by California, it would create a situation in which vessels would not be able to comply with the regulations of any jurisdiction unless they were to perform vessel cleaning in the open ocean, which is obviously unsafe and impractical. This is not a theoretical concern, because as the Commission has acknowledged, jurisdictions are increasingly placing restrictions on hull cleaning, either because of water quality concerns, safety issues, or because of invasive species concerns, or all three. Those restrictions are described also in each of the three statements attached to these comments.

As these sorts of restrictions and requirements increase, so too will the need for international consistency. The World Shipping Council urges California to recognize that reality now, and to conform its approach to the recently adopted IMO guidelines. More specifically, given the diversity of the fleet, and given that the necessary work has not been done to support a numeric standard consistent with the BATEA approach mandated by the statute, the Council urges the Commission to rework its proposed rule in the following ways:

1. Delete proposed section 2298.3.
2. Focus efforts on the management plan and reporting requirements as set forth in proposed sections 2298.4 and 2298.5, with amendments to ensure consistency with the IMO guidelines.

These adjustments will eliminate the most inequitable and self-defeating aspects of the rule, increase international consistency, generate substantial data that can be used to evaluate the effectiveness of different management approaches under varying conditions, and provide vessel operators with a mechanism for improving management practices in a way that does not simply transfer California’s problems to other jurisdictions. All of these results are consistent with the language and the intent of the underlying statute and with good environmental stewardship and best hull husbandry practices.

The Council appreciates the opportunity to provide these comments for the Commission’s consideration. We stand ready to work with the Commission to improve the proposed rule so that it
meets both the letter and the spirit of the governing statute, and so that it fits better with the realities of vessels engaged in international trade.
Proposed Amendments to Article 4.8 Biofouling Management Regulations for Vessels Operating in California State Marine Waters

Technical Issues in the Practical Application and Achievement of the Proposed Regulations and their Benefit in Protecting California State Marine Waters from Invasions by Harmful Marine Species

John A Lewis,
Principal Marine Consultant,
ES Link Services Pty Ltd
Castlemaine, Vic. AUSTRALIA

Introduction

The World Shipping Council, the Pacific Merchant Shipping Association, and the Cruise Lines International Association have sought my expert scientific and technical opinion on the proposed amendments to Article 4.8 Regulations governing the management of biofouling on vessels operating in California waters.

My opinions and concerns with the effectiveness of the proposed regulations, as detailed below, are drawn from my experience in antifouling and biofouling and invasive marine species prevention and management gained through:

- A 30 year scientific career in the Australian Defence Science and Technology Organisation which focussed on biofouling management and environmental compliance for the Royal Australian Navy, including studies to find effective, environmentally-acceptable alternatives to organotin-based antifouling coatings, effective methods for the prevention of biofouling in shipboard seawater piping systems, and measures to minimise the risk of invasive marine species translocation as biofouling on RAN vessels;
- Collaborative studies with both the RAN and the Australian Shipowners Association to trial the performance of tin-free antifouling coatings on Defence and commercial vessels respectively, and similarly to assess the biofouling and risk posed by such biofouling for the translocation of invasive aquatic species on vessels;
- Over more than 10 years, consultation and support to the Australian Government in the development of measures and policies to minimise the risks posed by biofouling for the translocation of invasive aquatic species on vessels;
- Professional consultation and support to the Australian and New Zealand Governments in proposing, pursuing, and effectively achieving adoption of Guidelines for the control and management of ships’ biofouling to minimise the transfer of invasive aquatic species at the International Maritime Organisation (IMO); and
• Professional consultation and specialist advice to the Australian and New Zealand Governments in their recent review and revision on their Code of Practice for Antifouling and In-water Hull Cleaning and Maintenance.

In summary, my concerns on the proposed regulations are that:

1. The proposed Performance Standards and application of these standards to the world’s commercial trading ship fleet are impractical and unachievable, in both determination of compliance and availability of technologies to maintain compliance;
2. The best available technology proposed for the achievement and maintenance of compliance for vessels that are found to breach the proposed regulations is in-water cleaning which, apart from its impracticality for operational trading ships, is acknowledged to potentially increase risks of invasive aquatic species incursion and translocation using current practices; and
3. Compliance with the proposed performance standards for niche areas, and particularly sea chests, doesn’t recognise the inadequacy of existing biofouling measures for these areas, nor does the proposal seek to assess the efficacy of current technologies or identify available technologies that could enable compliance with the proposed standards.

The above issues have previously been considered in detail by the Australian Government in the development of biofouling management guidelines for commercial trading vessels operating in Australian waters, and in the further promotion of similar guidelines to the international shipping community through the IMO. The key biofouling management approaches adopted have been:

1. Not all individual vessels pose equal risk for the translocation of invasive marine species, and increased risk is associated with low activity, extended residency vessels and inactive vessels;
2. Proactive measures to minimise the risk of biofouling colonisation of a vessel have greater long term potential and practicality for minimising the risk of invasive marine species translocation on commercial trading ships than reactive regimes based on biofouling standards, inspection, and enforcement;
3. In-water cleaning should not be applied as routine measure to manage the risks posed by biofouling in invasive species transfer and, when applied, a risk assessment is necessary to balance the risks of chemical and biological contamination from cleaning against the risks of not cleaning, and to ensure that technologies are available and applied to minimise chemical and biological risks should cleaning proceed.

**Proposed Performance Standards for Biofouling Management**

The proposed performance standards are based on a system developed to rank the abundance of fouling assemblages on the hulls of international yachts arriving in New Zealand on an ordinal scale (Floerl et al. 2005). That rank system was not developed for the purpose of setting numeric performance standards, and it is not appropriate for that purpose. The intent of this ranking was a simple method to estimate the abundance of fouling assemblages on yachts arriving in New Zealand, which could then be used in models to identify useful predictors of biofouling risk based on
characteristics of maintenance and travel history. Ranks were assigned to correlate to, and quantify for modelling purposes, the qualitative descriptors: no visible fouling, slime fouling only, light fouling, considerable fouling, extensive fouling, and very heavy fouling.

Application of the ranking was to the hull only, and allocated by personnel from the surface after a brief visual inspection of submerged areas around the bow, waterline, and stern/rudder. Accuracy of the assigned rankings was determined by comparison with still images taken underwater with a remote-operated video camera. Variability between rankings and actual biofouling cover was high, with inaccurate assignment of rankings for close to 10% of vessels at Rank 1, >25% of vessels at Rank 2, >50% of vessels at Rank 4, and >60% of vessels at Rank 5.

The same Level of Fouling (LOF) ranking system, by personnel at the surface, was subsequently applied in a study on barges and their tugs operating on New Zealand – Australia routes (Hopkins & Forrest 2010). In addition to assessing the correlation between rankings and quantitative measurements of biofouling, diver-assigned rankings were compared to surface assigned rankings. This study found that, there was a significant statistical relationship between rankings and quantitative measures of biofouling present overall, but no post-hoc analysis of differences between rankings is reported. The illustrated results show high variability in accuracy within ranks.

The ranking system has been further assessed in an extensive survey of biosecurity risks associated with biofouling on international vessels arriving in New Zealand, encompassing merchant, passenger and fishing vessels, and yachts and launches. This study concluded that surface LOF scores were weakly or poorly correlated with most metrics of fouling on all vessel types.

The New Zealand LOF ranking system is not appropriate for adoption as a performance/compliance standard for merchant shipping for several reasons:

- It is an arbitrary ranking system developed to enable quantitative modelling of qualitative measures of biofouling extent and abundance;
- Assignment of ranks has been demonstrated to have high levels of error;
- The ranking system was designed for yacht hull surfaces, and does not address the complexity of niche areas, nor the localised presence of minor biofouling prevalent on the vast hull surfaces on merchant ships;
- LOF rankings do not correlate well with measured biofouling metrics, particularly on merchant vessels; and
- Percentage cover values attributed to LOF rankings do not address the significant differences between localised and scattered biofouling (see Courtaulds Coatings 1993) and the significance of this with respect to antifouling performance, failure and biosecurity risk. In essence, scattered biofouling across a hull represents a failure of the antifouling coating system through either depletion, a coating system unsuitable to vessel operating profile, or vessel inactivity- each warranting system renewal or regeneration. Localised biofouling represents operational damage and niche failures normal to in-service operation.

It should be noted that the LOF ranking system has not been adopted, nor is it being considered as a performance standard in New Zealand or Australia.
Proposed Application of the LOF Ranking System in the Proposed Regulations

The proposed regulations cite, but do not apply, the range of LOF rankings. Only Rank 1, “microfouling only”, and Rank 2, “light biofouling”, are applied. The associated proposed regulations are to:

1. Maintain or clean the vessel so that upon arrival, the following niches are at or below Rank 2...
2. Maintain or clean the vessel so that upon arrival, the wetted portions of the vessel, except those niche areas described...are at or below Rank 1... Filamentous or turf algae at the waterline, including one meter above and one meter below the waterline, shall be excluded from this Level of Fouling Rank...

Points of concern with the practicality of this application are:

- By definition in the proposed regulations, “Macrofouling means large, distinct multicellular organisms visible to the human eye such as barnacles, tubeworms or fronds of algae”. This does not distinguish between alive and dead organisms. Biofouling species are often killed by conditions en route, but shells and skeletons persist which can be difficult to discern from living organisms.
- The acceptance of filamentous or turf algae near the waterline acknowledges that not all macrofouling constitutes a biosecurity risk. Just as the common macroalgae that grow at the waterline are already spread widely around the globe in ports, harbours, embayments and other coastal waters, and therefore no longer considered a biosecurity risk, so too are many of the common invertebrate biofouling organisms across barnacles, tubeworms, hydroids and bryozoans. Biofouling biosecurity risk relates less so to the presence or absence per se of macrofouling, but to the extent and richness of biofouling development which generally relates to antifouling system selection, application and performance, residency times in potential source and recipient ports, vessel activity, and appropriateness of hull husbandry practices.
- The application of only two LOF Ranks raises the question as to why the LOF ranking system was adopted as the basis for the regulations, particularly noting its shortcomings. A less generic and more considered, appropriate, and practical measure of biofouling presence and absence and the associated biosecurity risk of this biofouling would seem preferable, which could be adopted as “clean to” standard for extended residency vessels. As noted below, cleaning standards for vessels in regular operation, as proposed in the regulations, are likely to be counter-productive.
- From practical experience, few merchant vessels in regular service, and with typical dry docking intervals of 36 or 60 months, would meet the proposed regulations due to the common occurrence of small numbers of macrofouling species on localised areas of damage and inactive paint across hull surfaces, and macrofouling covering greater than 5% of surface in niches, particularly sea chests. There are also niches prone to localised biofouling that are not specified as niches in the proposed regulations, notably cathodic protection anodes, which would add to the difficulty of achieving and maintaining compliance.
Although the risk of macrofouling recruitment to an unprotected or ineffectively protected wetted surfaces increases with increasing residency time, common vessel biofouling species, such as *Hydroides* tubeworms and amphibalaniid barnacles often settle through mass spawning and settlement events within ports. During such an event, even a short turn around in a port can lead to localised fouling by these species in niches on a merchant ship hull such as areas of paint damage or failure.

**Biosecurity Risks associated with In-water Cleaning**

Unmanaged in-water cleaning can enhance biosecurity risks in two ways: by facilitating the release of propagules or viable fragments during the cleaning process, and damaging antifouling coatings to increase the risk of biofouling colonisation of the hull.

Apart from the chemical contamination risks associated with the in-water cleaning of biocidal antifouling coatings, in-water cleaning can increase biosecurity risks. For these reasons the practice has been effectively banned in Australia and New Zealand since 1997 and is increasingly banned or restricted elsewhere. Against this backdrop, the proposed regulations seem regressive and even environmentally damaging in promoting in-water cleaning in foreign waters as the key means of compliance.

A recent review of biosecurity and contaminant risks associated with in-water cleaning for the Australian Government (NIWA 2010) included the following conclusions:

- None of the brush-based or water jet systems reviewed are demonstrably able to remove 100 per cent of biofouling from targeted surfaces or to contain 100 per cent of the removed material;
- In-water cleaning should be permissible only on vessel surfaces that are coated in non-biocidal antifouling coatings or no coating at all, and where the biofouling is restricted to a slime layer;
- In-water cleaning of surfaces containing secondary and tertiary biofouling should be permissible only if the biofouling is of local origin;
- In-water cleaning should be permissible only if the cleaning method does not damage the antifouling coating; and
- In-water cleaning of hull or niche area surfaces coated in biocidal antifouling coatings should not be permissible because commercially available in-water cleaning technologies are currently not able to capture and contain all biological and paint waste released by the cleaning process.

Against this backdrop, and recognising a need for in-water cleaning in some circumstances such as to improve hull and fuel efficiency or prevent the development of reproductively mature communities of high risk biofouling species, the Australian and New Zealand Governments have undertaken a detailed review and revision of the in-water cleaning ban. The outcome, now under consideration by the two governments, is controlled in-water cleaning using a risk based approach that considers the biofouling type, biofouling origin, cleaning method, coating type and debris containment. A further
study by the New Zealand Government is presently examining the relative environmental risks of cleaning vs. not cleaning under different scenarios.

One of the reasons underlying the biosecurity risks of uncontrolled in-water cleaning is the initiation of mass spawning events. It is known that some biofouling species, ascidians and *Hydroides* tubeworms for example, are stimulated to spawn by damage and by sensing the presence of conspecific propagules in the water. The in-water cleaning of one vessel therefore not only increases its own risk of re-fouling, but increases the risk of fouling of other vessels in the vicinity.

Biofouling on merchant ships in global service is the consequence of progressive accrual of individuals and species from the diversity of ports visited. However, the in-water cleaning required within the proposed regulations to enable compliance would be undertaken in a single location, and most likely in a state with no regulatory controls or risk assessment on the method, capture and containment of dislodged biofouling. This not only exposes the waters of that state to establishment of exotic marine species including potentially invasive species, but increases the risks to other states of invasion from that established invasive marine species hot spot for vessel colonisation and translocation.

In-water cleaning can also compromise antifouling effectiveness and increase biofouling risks by:

- Abrading surface paint layers of ablative and SPC antifouling coatings with the effect of reducing system thickness and consequently system life, thus compromising the antifouling specification intended to meet planned dry-docking intervals;
- Scratching the surface of silicone foul release coatings which compromises surface integrity and facilitates macrofouling attachment
- Increasing the area of damaged paint around localised paint failures, which increase the areas of unprotected surface subject to re-fouling. Also, propagule pressure dictates that the more frequently a surface is exposed to re-fouling, the greater the risk of biofouling by potentially invasive marine species

**Best Available Technology for Biofouling Management in Niche Areas**

The Australian Guidelines for biofouling guidelines for commercial vessels (Australian Government 2009), which formed the basis of the IMO biofouling management guidelines (IMO 2011), were drawn from recommendations in the Australian Shipowners Association study of marine pest risks associated with biofouling of commercial vessels (ASA 2007). The study confirmed that niche areas could be more vulnerable to biofouling than hull areas, identified possible reasons for this, and made recommendations on improved antifouling practices that could reduce incidence. Many of the recommendations were drawn from a previous comprehensive report to the Australian Government on management of vessel biofouling areas (Taylor & Rigby 2004). These practices were, however, largely untested, as the biofouling in niche areas had largely been unaddressed as it rarely compromised ship performance and hull efficiency. Proactive encouragement of guideline adoption was seen as the most productive way to test and gain feedback on the measures, which could then be promoted as best available practice to minimise the risk of invasive species translocation. The
study recognised that in-water cleaning may be required in circumstance when system failure occurred, but cautioned that this should be implemented under a controlled approach to minimise the biosecurity risk associated with such cleaning.

The proposed regulations specify that wetted portions of the hull and niche areas be “maintained or cleaned” to meet the relevant standards. No consideration is apparent on the best available technologies to achieve compliance through maintenance, beyond the generic “out of water” maintenance, with the implied solution being uncontrolled in-water cleaning with no attention to the invasive marine species and other environmental risks posed by this practice. The initial statement of reasons includes the generic statement that “basic hull husbandry practices and targeted use of appropriate anti-fouling systems can be utilized to maintain these niche areas at an acceptable level of biofouling, as defined by this provision”, but no evidence is provided as to what these practices are and assessment by CLSC of their proven effectiveness.

Sea chests, in particular, have been recognised as accumulating biofouling that can facilitate the translocation of invasive marine species (e.g. Lewis 2002, Coutts et al. 2003, ASA 2007, Coutts & Dodgshun 2007). The proposed regulations require that sea chests are at or below Rank 2, small patches of macrofouling covering no more than 5% of the internal sea chest surfaces. Compliance with this regulation is not practical and most likely not achievable on in-service merchant ships because:

- The variable pattern of water flow through a sea chest which can include low flow refuge areas in corners and high velocity areas around seawater take offs compromises effective antifouling coating performance;
- Complexity of design that includes square corners, angular protrusions and discharge lines compromises good surface preparation, coating application and durability, and enables biofouling attachment to paint defects that further accelerates paint degradation;
- Diver access to sea chests on in-service ships, whether to inspect for compliance or to attempt remedial action, is often not physically possible and, even if so, could represent a significant OH&S hazard;
- There are no proven antifouling technologies to maintain sea chests free of biofouling.

I am not aware of any detailed study to determine the best available technologies to prevent, or even minimize, biofouling growth in sea chests. The Australian and IMO biofouling management guidelines recommend the use of marine growth prevention systems (MGPS) that chemically dose water in the sea chest to minimise biofouling, but these systems are not, as posited by CLSC in a TAG meeting, “dedicated systems to prevent biofouling in that area”. There are numerous issues and uncertainties in the use, benefits and relative performance of MGPSs in sea chests, including:

- MGPS systems are designed to keep inboard seawater pipework free of biofouling, not sea chests
- The relative effectiveness of the three primary MGPS types (anodic copper, electrochlorination, chemical dosing) has not been evaluated in commercial ship piping systems to my knowledge, and definitely not in sea chests. Reports on performance in sea chest are largely anecdotal.
MGPS systems are commonly fitted to sea strainers inboard of the sea chests, and redesign is needed to fit them to sea chests;

Biocide release concentrations are set to provide preventative concentrations within the pipework at operating flow rates, not to generate toxic concentrations within sea chests of generally large, and often variable volume;

The required dosage from MGPSs to prevent biofouling is not well established nor clearly understood, particularly for anodic copper systems. For example, studies undertaken to determine why an anodic copper MGPS was ineffective in preventing biofouling in seawater systems on Australian submarines found that a 10-fold increase in copper concentration above the manufacturer’s recommendation was needed to prevent biofouling growth (Lewis & Smith 1991);

Where dosing is into sea chests, effective biofouling control is necessary when vessels are in port, as this is when colonisation occurs. Observed reductions in sea chest biofouling associated with MGPS use may be provided in sea chests by systems that continue to operate at normal operating concentrations despite reduced seawater flow through, for example in engine services systems, due to the generation of high biocide concentrations within the sea chests. My personal observation is that highest biofouling occurs in sea chests and seawater piping systems that continue normal operation in port, such as auxiliary seawater systems. However this has not been studied; and

environmental concerns on the discharge of both copper and residual chlorine from treated seawater cooling systems.

Acknowledging that biofouling levels in sea chests on in-service merchant ships are unlikely to meet the proposed performance standard, there are equally issues and uncertainties associated with the removal or treatment of this biofouling to achieve compliance, including:

- the risks of organism release through the action of opening a sea chest;
- the previously mentioned difficulties and hazards associated with diver access;
- the difficulty in removal of biofouling in a confined, limited access and low visibility environment, and assurance that the performance has been achieved; and
- the absence of any proven, environmentally safe, methods to kill or otherwise remove biofouling within a sea chest by chemical, heat or other treatment, noting that residual shells and skeletons would still be in breach of the standard.

On the last point, in 2003 the sea chests and sea water piping systems of an Australian warship became clogged with mussels while operating in the Arabian Gulf and these mussels were thought to be Arabian mussels of high risk to Australia. Sea water piping systems were acid-cleaned on route back to Australia, but sea chests could not be treated. On arrival back in Australia specially constructed blanking plates were fitted to all sea chests and the contained seawater treated with a chemical considered to be the most effective for this specific purpose. This was totally ineffective and blanking plates were left in place until the ship entered a scheduled dry docking a week later. The mussels were subsequently identified as Australian mussels that had infested the ship before it departed for the Gulf.
In summary, although it is recognised that biofouling in sea chests can pose a potential biosecurity risk, knowledge and advice on effective methods to maintain or achieve compliance with the proposed regulations is wanting. To my knowledge there has been no assessment of best available technologies that could achieve or approach the required standards for sea chests by CLSC or other body.

**Application of the Proposed Regulations to Extended Residency Vessels**

It is well known that not all individual vessels present the same biosecurity risk from biofouling. Risk relates to quality of maintenance and operational profile, including vessel speed, activity and length of residency. CLSC has acknowledged that much of the merchant fleet is well maintained and likely to pose low non-indigenous species risk. The high biosecurity risk posed by extended residency vessels is also acknowledged within the proposed regulations, but the treatment does not seem commensurate with the risks when compared to the rigorous and potentially unachievable standards applied to active trading vessels. Defining “extended residency” as exceeding 90 days seems exceedingly generous and posing high risk against knowledge of the biomass, complexity and diversity of biofouling observed to develop on unprotected surfaces in shorter times, particularly in high fouling areas. State regulations in Australia are in place to address such a risk, particularly for non-trading vessels such as dredgers and other construction vessels that have extended residency periods when operating both overseas and in Australia. Extended residency overseas heightens the risk of colonisation by exotic organisms, and extended residency in Australia heightens the risk of release and establishment. Merchant vessels in lay-up pose similar risks of infection, but lower risks of inoculation if they re-enter regular service with short port turn-around times. However, they do constitute a risk that should be addressed (Floerl & Coutts 2009).

The proposed regulations do seem relevant and practical for extended residency vessels of any type. Many of the biosecurity concerns and risks of in-water cleaning are lessened by a “clean before you go” policy, which allows for the removal of biofouling in the location where it most likely colonised the vessel. Almost by definition, such an approach would not apply to vessels in regular service because the place of colonisation would not be known. For such application, a performance “clean to” standard also has validity, which could be to a “slime only” standard for hull surfaces (but with no waterline allowance) and “light fouling” equivalent for niche areas. However, depending on their design, cleaning of sea chests may remain problematic, and research is needed into alternative methods for containment and effective sterilisation to enable the identification and application of best available technologies. Measures directed at extended residency vessels are likely to appreciably increase the protection of Californian State waters from invasive and other non-indigenous marine species.

**Alternatives to the Proposed Regulatory Action to Minimize Biosecurity Risks Associated with Biofouling on Merchant Vessels**

Although in-service merchant vessels are acknowledged to pose a lesser biosecurity risk, the principles of propagule pressure in invasions, which considers the interaction between the size of a
single incursion event with the frequency of events, warrants measures to minimise biofouling across this sector. This has been the basis for development of biofouling management guidelines in both Australia and through the IMO. As previously discussed, these guidelines were developed in the understanding that knowledge on best available technologies, and the proven effectiveness of many of the proposed measures was wanting.

The IMO Guidelines are currently voluntary, but moves in the future may be to a mandatory regime. Should CSLC wish, or be required to continue with regulatory measures to require biofouling management measures on in-service merchant vessels, a prudent approach could be to require vessels to develop and implement a biofouling management plan. This would have global benefit in encouraging and promoting the trial and application of biofouling reduction measures, which could then be used to inform a review and determination of best available technologies for both hull surfaces and niche areas. When this assessment of best available technologies is completed, it will then be possible to better evaluate further possible regulatory actions.

References


