1. INTRODUCTION

The Port of San Diego (Port) and the Institute for Research and Technical Assistance (IRTA) were recently awarded an EPA Pollution Prevention Grant to identify alternatives to copper hull paint. The goal of this project is to identify viable alternatives to copper-based hull paint and work collectively to encourage the transition to these paints.

The project is comprised of ten tasks and will occur for a two year period between January 2008 and June 2010. The primary tasks include testing alternative coatings on panels and on boat hulls. Panel testing will be conducted during the summer of 2008, while boat hull testing will occur the following summer (2009). The development of a paint testing protocol is necessary for both the panel testing and boat hull testing to document the project's procedures, ensure consistency and to ensure that the end results can be reproduced.

This panel testing protocol will be based on ASTM D3623-78a standard method for testing antifouling paints in shallow submergence and includes information on materials and methods used for applying coatings, maintenance and cleaning procedures, as well as a detailed description of the assessment measures and analyses used. This protocol will also identify how the selection criteria that will be used to determine which paints will be applied to boat hulls in the following phase of this study.

2. MATERIALS AND METHODS

2.1. Panel Preparation

This project will test hull paint coatings on fiberglass panels. The Project Team decided to use fiberglass panels because most of the pleasure craft in the San Diego region have fiberglass hulls. All of the panels that will be tested in the project will be 12 inches by 12 inches. Hull coatings are routinely applied by boat yards and the team wanted to represent the field application as closely as possible. The team has decided that the fiberglass panels will be prepared and coated in a uniform manner and that no pre-painted panels will be used.

Several of the boat yards in the area have volunteered to apply the baseline and alternative coatings to the panels. The panels will be prepared in local San Diego Bay boat yards. One-half inch diameter holes will be drilled in the panels three-fourths inch from the sides of each corner so they can be attached to PVC frames (Section 2.4). A gel coat will be applied; the panels will be sanded and cleaned to remove any contaminants. Once all of the panels have been prepped in this manner, both sides of the panels will be painted with the appropriate coating, following the methods described in section 2.3 of this protocol.

2.2. Test Coating Categories

The Project Team will test alternative non-copper coatings in the panel testing. The team decided to distinguish the coatings based upon the presence/absence of an active antifouling ingredient to better understand the differences in the coatings that contain biocides and the coatings that do not contain biocides. These coatings were classified into three categories including:

- Zinc Coatings
- Non-Zinc Organic Biocide Coatings
- Non-Biocide Coatings

The zinc coatings generally contain various zinc compounds like zinc oxide or zinc pyrithione. The industry has been developing low zinc content coatings and most of the coatings in this category have fairly low zinc content. Non-zinc biocide coatings often contain an organic biocide like Econea. The non-biocide coatings are generally foul release coatings which means they rely on a smooth surface to prevent or reduce fouling.

Table 1 shows the coatings that will be tested on panels. The table shows the coating supplier, and the alternative coatings classified by the categories above, and the coatings to be used as reference control coatings. As indicated, the reference control coatings contain copper. There are a total of 50 alternative coatings. Twenty-eight of the coatings contain no biocide. Seventeen of the coatings contain zinc and five of the coatings contain a non-zinc biocide.

Coatings containing biocides must be registered before they can be used. Suppliers with such coatings must submit data to EPA and secure registration before the coating can be used. After the coating is registered by EPA, the coatings must be registered by the California Department of Pesticide Regulation (DPR). Table 2 summarizes the registration status of each of the coatings. The two copper coatings have been used for many years and are registered by EPA and the state. Many of the coatings that will be tested in the project contain no biocides and do not require registration. This is indicated in the table by NA or not applicable. The other coatings may contain biocides of various types and some of the suppliers have started the registration process; in other cases, the suppliers have not yet begun the registration process.

In order to test the biocide containing coatings, the Project Team must apply to DPR for a Pesticide Research Authorization to test the unregistered coatings. The Project Team submitted the request on April 15, 2008 and expects to receive authorization for the testing shortly.

2.3. Test Coating Application

The details of the application procedure vary greatly for the test coatings. The boat yards will assist the team in applying each coating in the manner specified by the supplier or manufacturer. In all cases, the suppliers have been invited to be present when their coatings are applied. Most suppliers have expressed an interest in attending. During the application process, the project team will record initial coating information on the coating tracking forms. This information will include the color of the undercoat and the test coating to enable detection of physical alterations or blemishes to the coating surfaces over the project period.

Table 3 presents general information on the application procedures for the alternative coatings. The first two columns show the supplier and the name of the coating respectively. For each coating, the third column specifies an application method. Some of the coatings will be sprayed. Spraying provides a smoother surface. It can be important to have a smooth surface to prevent or reduce attachment, particularly in the case of the foul release non-biocide coatings. The fourth column indicates whether undercoats need to be applied. In several cases, suppliers specify primers or tie coats which must be used under the test coating top coat. The fifth column indicates whether thinner is required. Generally, thinner is not used when coatings are rolled on. Thinners may be used when coatings are sprayed depending on the temperature and humidity during the application. The sixth column shows the cure time for the coating before it can be placed in the water.

2.4. Site Location

Once the panels have been painted and cured, they will be placed in the water for static immersion testing. It is important to conduct the immersion testing during the summer because it is the time of the year where the highest fouling will occur. All of the panels will be placed in the water starting the week of June 2 and will remain in the water through the week of October 6, 2008. The Project Team may reconsider and extend the period past the October date if it seems warranted. This will not impact the assessment or analyses used to evaluate these paints for this study however.

All of the panels will be placed in boat slips within the SIYB so that the side of the panel to be examined will be facing south. This is important so the panels will not experience variations in exposure levels of sunlight, water temperature and circulation.

Some workgroup members have expressed concern about cross contamination. They have a concern that the copper or zinc coatings which are designed to leach their metals may influence other panels in the same vicinity that may be foul release coatings. This could influence the results of the performance evaluation. Although coating suppliers who routinely conduct panel testing have indicated that cross contamination should not be a problem, the Project Team will take measures to place panels containing different types of coatings in separate boat slips.

PVC frames for holding the coatings will be constructed. A picture of the types of frames that will be used is shown in Figure 1. Each PVC frame will hold three panels. Each panel will be attached to the PVC frame with nylon tie wraps on either side. The PVC frames will then be attached to floating docks and submerged, with the top of each panel 12 inches under the surface of the water. This will account for tidal variation and leave the panels submerged at a constant depth. PVC poles attached to the PVC frame will connect the frame to the floating dock.

Figure 1. View of Panels and PVC Frame (Photo: Swain, FIT)

Prior to immersion, each panel will be assigned a code name or number corresponding to the panel itself, the coating applied to the panel, the cleaning method (described in Section 2.5 below), and the date. The code name will be clearly marked for each panel for ease of identification in the field and in photographs.

2.5. Cleaning

A key element of this project is to identify the effort needed to clean the test coatings. This will enable the project team to compare the effectiveness of alternative coatings (in terms of cleaning and cleaning costs) to commonly used copper paints. To accomplish this, the project team intends to investigate the effect of different cleaning regimes during this study. Each test coating will be comprised of a set of three panels which will evaluate two cleaning regimes as well as a non-cleaned panel. One panel is intended to mimic standard hull cleaning practices[1], and will be cleaned using a pre-determined frequency and method. It will be cleaned every three weeks with a soft cloth or a diaper. Another panel will be cleaned according to the paint supplier specifications. This regime is included to evaluate whether the suppliers recommended cleaning efforts are effective in removing the typical fouling growth expected during local summertime conditions. The cleaning methods and frequencies used on this panel will vary, as the team will be following suppliers' recommendations. A final panel will not be cleaned for the entire four month period it is submerged. This panel will only be cleaned at the completion of the test period (October) to determine whether infrequent cleaning is able to remove a large build up of fouling growth. Cleaning of this final panel will utilize a soft cloth or

[1] Standard hull cleaning practices incorporate Best Management Practices using less-abrasive cleaning methods and typical diver cleaning frequencies found to be commonly used during the summer months in southern California.

diaper and, if necessary, a green pad. The project team will document the specific mechanism(s) used.

The panels will be cleaned while they are in the water to mimic the cleaning process that pleasure craft undergo. Prior to cleaning the panels, the project team will receive training on proper cleaning procedures and assessment techniques to ensure consistency in reporting results. The Project Team will perform all of the cleaning during this study.

2.6. Quality Assurance/Quality Control

There will be three mechanisms incorporated into this project to ensure quality results are derived from the panel testing. The use of reference coatings, negative controls, and a cleaning control will aid the interpretation of results upon completion of the panel immersion testing. These QA/QC controls are discussed within this section.

1. **Reference Coatings** Reference coatings will be used during this project to provide a means of comparing the effectiveness of test coatings to hull paints commonly used by the local boating community. Standard copper-based antifouling coatings will be selected as reference coatings and evaluated in the same manner as the test coatings. In visits to the area boat yards, the Project Tteam asked about the commonly used copper coatings. Based on these conversations, the team has identified two copper antifouling coatings for reference coatings. The first, called Super KL and made by International Paint, is a high copper content coating containing between 50% and 75% copper. The second coating, called AF-33 and made by Sea Hawk, is a low copper content coating containing about 33% copper.

   Both the high and low copper content references will use the same set up procedure as used for the test coatings. A PVC frame holding a set of three panels will be constructed for each reference coating. The reference coatings will be applied with a roller. This application method is consistent with that used currently by boatyards for all copper paints. A brush is often also used for detail, and as such, will be similarly used in this project. The reference coatings will be applied according to supplier specifications and the suppliers will be present to oversee the operation.

2. **Negative Controls** Negative controls will consist of both blank panels with no coating applied and non-painted gel coated panels. The blank panels will allow the Project Team to characterize the fouling community within the test site. These panels will be important when assessing whether the test coatings are actually preventing the attachment of particular types of fouling growth, or whether the type of biofouling organisms are not observed on a panel because they are simply not present in the environment during the study period. Because there is no antifouling coating applied, the blank panels should show heavy fouling in comparison to the reference coatings. The blank panels will be placed in various locations to see if differences in the biofouling community and/or

growth rates within the entire test site boundary are occurring. No cleaning will occur on the blank panels during the entire test period.

There will also be panels with only gel coat applied. These panels will act as a negative control by evaluating whether the proposed cleaning methods on their own can adequately control fouling in the absence of a hull coating. It is proposed that the gel coat-only panels be cleaned following the approach described above in section 2.5, with the following exception. Similar to the test coatings, the gel coat-only panels will be housed in a PVC frame holding a set of three panels. One panel will not be cleaned, while a second panel will be cleaned with a diaper or soft cloth every three weeks. Because there are no supplier instructions for cleaning, the project team made the decision to clean the final panel with a green scotch brite pad on a six week frequency. Both of the negative controls will undergo the same assessment and evaluation as all other coated panels.

3. **Cleaning Controls** For each coating tested, one of the three panels will not be cleaned during the entire four month test period. This panel will serve as a cleaning control and will be used to evaluate how effective the coating is on its own and how different cleaning regimes may influence the performance of the test coating. Cleaning of this final panel will occur at the end of the four month test period and will utilize a soft cloth or diaper and, if necessary, a green pad. The project team will document the specific mechanism(s) used during the final cleaning of this panel.

3. PANEL TESTING ASSESSMENT MEASURES

This section will describe how the Project Team intends to evaluate the panels utilized in the Project and assess the relative antifouling performance and cleaning effort needed for each coating. The type and degree of fouling on panels, as well as the effectiveness of the specified cleaning regime (method and frequency) will be examined regularly throughout the four-month period (June through October). Visual and numeric assessments will be used to identify the degree and type of biofouling, coating surface condition, and the appropriateness of each cleaning method and/or frequency for each type of test paint. The methodology described in this section presents guidance for quantitative analysis and consistent evaluation of the performance of test coatings. Using this information, the Project Team will be able to estimate the relative effectiveness of the test coatings against fouling and assess the cleaning efforts required.

The Project Team will inspect the panels weekly to note, document and photograph the biofouling growth. During weeks when cleaning is required, the panels will be cleaned in the manner described in Section 2.5 of this document, and the cleaning assessment discussed below in Section 3.2 will also be conducted.

As discussed earlier, each set of panels of a particular test coating within a PVC frame will be assessed. The first step of every inspection will be to note the presence of silt on the panel. When silt is observed, the panel will be gently agitated in the water to remove the loose or unattached materials that may cover fouling organisms. This will reduce interference in observing attached organisms on the panels. The panels will be retrieved from the water one frame at a time. The test panels will not be allowed to dry during the inspection period and the length of time the panels are out of the water will be minimized; only allowing time for photographs and data documentation. The inspection form to be used throughout the project is presented in Table 4. The date of immersion, time and date of inspection, as well weather and other general environmental conditions will be recorded. The Project Team will also minimize contact with the panel surface during this time, taking care to handle the panel set by the frame.

3.1 Fouling Assessment

The field evaluation of the amount and type of biofouling present during the study will follow the procedures outlined in ASTM standards 3623-78a and 6990-05. The types of fouling organisms can generally be classified into one of the following three categories:

1. **Soft fouling:** Includes slime, algae and grasses. The term slime refers to a range of components such as absorbed organic and inorganic chemicals, trapped silt and detritus, diatoms, initial algal germination, and low form algae. Soft fouling usually has minimum effect on coating systems and performance of craft.
2. **Hard fouling:** Refers to calcareous structures, such as barnacles, serpulid tube worms (locally referred to as coral), and calcareous deposits. This fouling form may be detrimental to performance of coating systems.
3. **Composite fouling:** Occurs in the advanced stages of fouling, and contains both hard and soft fouling organisms. Mature barnacles and tube worms are present, along with hyroids with calcareous cellular structure such as anenomes. Slime, grass, soft shell-less animal forms such as hydroids, tunicates, and other soft fouling organisms may also be present. Composite fouling is extremely detrimental to a boat’s performance, coating, and machinery systems.

During each inspection, biofouling will be recorded in tabular form and with digital imagery. Biofouling attachment occurring within ½ inch of the edges of test panels will not be included in the assessment. Photographs of the panels throughout the project will be taken, as these have been shown to be useful method from which to compare the performance of test surfaces. A size scale and color reference indicator will be placed in each photograph to assist in assessing organism size and panel condition.

The fouling assessment of the type and density of fouling for each panel will focus on primary biofouling settlement. This term refers to the biofouling attached directly to the surface of the coated panel. Primary foulers will be recorded and used in the antifouling performance rating. Organisms that attach to other organisms, or secondary fouling, will be noted but not included in the calculation of the antifouling performance rating. It will also be noted if a fouling organism is found to be growing into the paint film. Immature or unidentifiable foulers will be recorded as “incipient fouling” while macrofouling organisms will be documented under their appropriate group.

The Fouling Resistance (FR) of the coatings will be evaluated through ASTM method 3623-78a. This methodology reflects the non-fouled area, and occurs as follows. During inspections, the percent cover, number of individuals, and size range will be recorded for barnacles, mussels, and tubeworms. The percent cover of bryozoans, hydroids, tunicates, and sponges will also be recorded. The type of algae present and the percent cover of each type will also be assessed. Those test surfaces free of fouling except for the presence of algal spores and other biological slimes will be given an FR rating of 100. If there are no macrofouling organisms, but the panel is partially covered by adherent slime, an FR rating of 99 will be given. If incipient fouling is present, the FR rating will be reduced to 95. If mature forms of fouling are present, an FR rating will be obtained by subtracting from 95 the sum of the number of individuals present and the percent surface covered by colonial forms.

Numeric ratings will be correlated to each visual assessment of fouling conditions. Table 5 describes the fouling performance rating criteria based on fouling resistance ratings and the types of organisms typically associated with that level of fouling resistance. The fouling performance ratings range from 1-5, with 1 being little to no fouling and 5 being indicative of intense fouling. The fouling performance rating will be completed once prior to cleaning (pre-cleaning assessment) and then again after cleaning (post-cleaning assessment) for those panels on which cleaning is scheduled.

Table 5 Fouling Performance Rating

Rating	**FR rating**	**Description of Fouling Typically Observed**
1	100 to 95	A clean foul-free surface; or soft fouling present - with algal spores and other biological slimes present; light silting; paint still visible beneath fouling
2	94 to 80	Soft and/or hard fouling present; Slime as dark green patches with yellow or brown colored areas; moderate silting; painted surface may be obscured by fouling
3	79 to 60	Soft and hard fouling present; grass filaments up to 3 inches in length; or flat network of filaments, green, yellow or brown in color; or soft non-calcareous fouling such as tunicates or sea squirts projecting up to ¼ in height; Calcareous fouling up less than ¼ inch in diameter or height may be present (i.e., tubeworms)
4	59 to 40	Soft and hard fouling present; combination of tubeworms and barnacles less than ¼ inch in diameter or height.
5	< 40	Composite Fouling present; combination of tubeworms and barnacles, may be greater than ¼ inch in height and dense; barnacles growing on top of another; lengthy, soft algae; soft sedentary animals without calcareous covering growing over various forms of hard fouling

3.2 Cleaning Assessment

Once the fouling assessment has been completed, coatings requiring cleaning during that week will be cleaned using the procedures discussed in Section 2.5. Pre-cleaning fouling information recorded during the fouling assessment (Section 3.1) will be considered the starting point from which to compare cleaning efforts. During cleaning, a cleaning assessment will be used to correlate the relative cleaning effort required to remove the fouling growth from the panels. If the specified cleaning regime is not able to thoroughly remove the fouling growth, even with a vigorous cleaning effort, the information will be documented as such for that panel. A post-cleaning fouling performance rating will also be recorded to provide a means for comparison to the pre-cleaning rating. Cleaning efforts for each panel will follow the specified cleaning regimes (method and frequency) for each panel. In addition to the photos taken as part of the fouling assessment, photographs will also be taken after cleaning to provide verification of how well the cleaning method is working. Similar to the fouling ratings, cleaning efforts will be rated numerically to determine the effort needed to clean each panel. Table 6 describes the factors utilized in the cleaning assessment rating which result in a rating scale ranging from 1-5. If a panel is unable to be cleaned completely (ie adequate removal of all of the fouling growth), the cleaning assessment will be given a 5 rating.

Table 6 Cleaning Assessment Rating

	Cleaning Effort
1	Light pressure: very easy to remove growth with one wipe
2	Light to medium pressure: still easy to remove growth but may require two or more passes in some areas to remove growth
3	Firm effort: firm scrubbing and continuous passes required to remove fouling growth
4	Hard effort: With very hard physical effort, growth presented a challenge to remove but could be removed using specified cleaning mechanism.
5	Using specified cleaning mechanism and hard effort, growth was unable to be removed.

The evaluation of each test panel for physical defects is based on ASTM D 6990-05. During the post-cleaning inspection of each panel, the presence of wearing, blistering, cracking, chipping, flaking and damage will be noted. The color of the undercoat and the test coating will also be compared to what was recorded during the application process (Section 2.3) to enable detection of physical alterations or blemishes to the coating surfaces over the project period. Overall physical deterioration will be reported as percent surface area affected by surface defects, which is estimated based on the visible area of the coating. The assessment criteria for the coating condition is identified in Table 7.

Table 7 Post-Cleaning Coating Condition

Rating	Coating Condition
1	New, slick finish, still shiny if appropriate to type of coating
2	Shine is gone or surface is lightly etched on all of coating, no physical blemishes or defects
3	Some blemishes or defects in coating less than 20% of panel
4	Some blemishes or defects in coating on 20%-50% of panel
5	Blemishes or defects on over 50% of panel

4. DATA ANALYSIS

The goal of the panel testing is to identify coatings that are 1) effective in repelling or preventing fouling growth, or 2) relatively easy to clean. Test coatings meeting either, or both of these criteria will be eligible to continue on to the next phase of the project. Additionally, test coatings continuing into the next phase of the project must also prove to be effective relative to the QC standards. The Project Team will be able to objectively evaluate the test coatings and take into account the variability due to different types of antifouling properties (i.e., biocide versus non-biocide, ablative versus fouling release) through the project's assessment measures. The Project Team will consider the data generated from the fouling and cleaning assessments in the following manner.

Effectiveness in repelling or preventing fouling growth

By analyzing the type and density (% surface area) of biofouling growth on the test coatings and the negative controls, the Project Team will be able to determine the coatings that appear effective in preventing or repelling growth. Effective coatings will show a lower percentage of growth both in terms of biofouling type and density than the negative controls.

Panels identified as having a pre-cleaning Fouling Performance rating of 1 or 2 for the entire test panel set (including the no-clean panel) throughout the duration of the project will automatically be included in the next phase. Coatings achieving these ratings indicate only a minor amount of growth is adhering to the panel and as such hull deterioration and/or performance is not being jeopardized.

Test coatings having a rating of 3 or higher on the no-clean panel, yet are able to regularly maintain a 1 or 2 pre-cleaning fouling rating on either of the cleaning regime panels will also automatically be moved through to the next phase of this study. These panels indicate that the frequency of cleaning is keeping biofouling growth at an acceptable level. It is speculated this is representative of the scenario that will be observed for many of the nonbiocide test coatings.

Test coatings that regularly receive a pre-cleaning Fouling Performance rating of 3 or higher on either of the cleaning regime panels indicate that the coating is continuing to accumulate large amounts of fouling growth. These panels will be further assessed on the ease of cleaning to determine whether they will pass on to the next phase of testing.

Relative ease in cleaning efforts

The Cleaning Assessment rating and post cleaning coating conditions are intended to provide an indication of the level of effort needed to clean the coating. It is important to understand this, as an important element for any successful hull coating is the cost required to maintain it. The specified cleaning regime should be able to regularly provide cleaning ratings of 1 - 3 to be considered effective. This means that the method and frequency are appropriate to assume that cleaning can be accomplished in a timely manner and without considerable effort. Ideally, the specified cleaning regime should be able to return the panel to the optimal 1 or 2 fouling performance condition described in Section 3.1 above, with a minimal to moderate cleaning effort. An important distinction to make is whether the coating condition is only observed immediately after cleaning, or if the panel remains relatively free of fouling until the next scheduled cleaning.

Test coatings comparing to, or performing better than the reference coatings will automatically be moved in to the next phase. This means that the test coating must regularly receive Fouling Performance ratings (pre- and post-cleaning) identical to, or better than the reference coatings. Additionally, the cleaning assessment ratings, particularly for the standard hull cleaning practices panel must perform at, or better than the reference coating's standard hull cleaning practices panel. This indicates that the coating is performing in the same manner as the common practice today, and as such, consumers will not have to make many efforts in terms of maintenance efforts and/or costs.

As stated in Section 3.1, those test coatings given a pre-cleaning Fouling Performance ratings from 3-5 may also move on to the next phase of testing, provided they meet qualifying cleaning criteria. Panels with a 3 or higher pre-cleaning fouling rating that, can achieve a 1 or 2 post-cleaning fouling rating AND have a cleaning rating ranging from 1-3 will be considered for inclusion in the boat hull phase. This situation indicates that the cleaning method appears effective although the frequency may need to be increased to reduce the level of fouling occurring between cleanings. As such, alterations to the cleaning frequency for the boat hull phase may be considered by the Project Team.

Panels receiving Cleaning Assessment ratings of 4 indicate that, while the specified cleaning method may remove growth, the identified frequency is not effective at controlling the level of fouling. Panels regularly receiving cleaning assessments of 4, may enable the coating to be included in the next phase, provided that the coating condition ratings do not exceed a level 2. If the coating is moved in to the next phase, the cleaning frequency will be increased and noted as such. This determination will be at the project team's discretion.

Panels receiving Cleaning Assessment ratings of 5 indicates that the specified cleaning method and stated frequency are not effective at controlling fouling. In these cases, it would be assumed that either the frequency of cleaning would have to be increased or more abrasive cleaning methods would be required; each having its own negative impacts (increased cost to boater, environmental impacts, or impacts to the boat hull). Panels regularly receiving a 5 on the cleaning assessments will not move on to the next phase.

Using the process established above, the Project Team should also be able to provide a rank to those paints moving through to the next phase. While this ranking will not play a major role in identifying the list of paints for boat hull testing, it will be critical to the overall outcome of the study, as the higher performing coatings (ie those that can reduce fouling growth without impacting the environment and are easy to clean) will be the ones recommended as preferred alternatives.

"Safer Alternatives to Copper Antifouling Paints" Project

Table 1 Proposed List of Test Coatings

Contact Information			Test Coatings		
Company	Contact	Copper	Zinc	Non-Zinc Organic Biocide	Non-Biocide
Blue Water Marine	Jack Hickey		Blue Water Shelter Island (ZnO and ZnP)	Experimental Metal Free (E)	
				Experimental Metal Free Plus (E)	
Creative Coatings Corp.	Marlan Hoffman				Photo Finish
Ecological Coatings, LLC	Nick Patenaude				EC-4300
					EC-4900
E-Paint Co.	Kimberly Goodwin		ePaint Eco (ZnP)	E Paint SN-1	EP-21 Release Coating
			EP-2000 (ZnP)		SUNWAVE
			Ecominder		
Fuji Hunt	Phillip Hampton				Smart Surfaces Duplex
Harbor Engineering Services	Jack Hickey		B49 (ZnO and ZnP and E)		
			B69 (ZnO and E)		
			EAF077 (ZnP and E)		
			EAF088 (ZnP and E)		
Innovative Marine	Al Hamilton				Hempasil XA 112
International Paint	Rusty Rutherford	Super KL	Pacifica (ZnO and ZnP)	Trilux Copper Free	Intersleek 900
			Pacifica Plus (ZnO and ZnP)		VC Performance Epoxy
Jones Marketing Services / Hyperseal	Loch Jones		Hyper Zinc Marine		Hyperglass
KISS Polymers, LLC	Keith Kent				KISS Ultra Concentrated Gel
					MegaGuard Ultra LiquiCote
Microphase	Brad Leinhart				Phase Coat Bare Bottom
New Nautical Coatings, Inc.	Erik Norrie		Mission Bay (ZnO and ZnP)	Seahawk Smart Solution (E)	
Oceanic Surfaces International, LLC	Mark Sammons				ECO-5

"Safer Alternatives to Copper Antifouling Paints" Project

Table 1 Proposed List of Test Coatings

Contact Information			Test Coatings		
Company	Contact	Copper	Zinc	Non-Zinc Organic Biocide	Non-Biocide
Petit Paint (Kop-Coat Specialty Coatings)	John Ludgate		Vivid Free (ZnO and ZnP)		Klear n'Klean
			Vivid SPC (ZnO and ZnP and E)		
			Hydrocoat ECO (ZnP and E)		
PPG	Jim McCarthy		Coating X (ZnP)		Sigmaglide 890
Ram Protective Coatings	Bill Kraus				Ceram-Kote 99M
Seacoat Technology, LLC	John Bowlin				Sea-Speed GC V4
Sea Hawk	Barth Hudiburgh	AF-33			Propspeed
Seashell Technology	David Schultz				SeashellST5000
					SeashellST5100
Sherwin Williams	Tom Vahle		Seaguard HMF (ZnO and ZnP)		
Sound Specialty Coatings Corp.	Nancy Pierson				AQUAPLY M
					AQUAPOLY mbc
Specialty Products, Inc.	Doug Kleweno				PTU-200
					Polyshield HT
Water Tight, LLC	Bill Rashick				Water Tight
Xurex Nano-Coating	Graeme Marsh				ProGlide
					HabraCoat

ZnCr = Zinc Chromate; ZnO = Zinc Oxide; ZnP = Zinc Pyrithione; E = Econea

Table 2 Test Coatings Registration Status

Company	Test Coatings	Registration Status With EPA	Registration Status With California
Blue Water Marine	Blue Water Shelter Island (ZnO and ZnP)	not registered	not registered
	Experimental Metal Free (E)	not registered	not registered
	Experimental Metal Free Plus (E)	not registered	not registered
Creative Coatings Corp.	Photo Finish	NA	NA
Ecological Coatings, LLC	EC-4300	NA	NA
	EC-4900	NA	NA
E-Paint Co.	ePaint Eco (ZnP)	not registered	not registered
	EP-2000 (ZnP)	registered	registered
	Ecominder	registered	registered
	E Paint SN-1	registered	registered
	EP-21 Release Coating	NA	NA
	SUNWAVE	NA	NA
Fuji Hunt	Smart Surfaces Duplex	NA	NA
Harbor Engineering Services	B49 (ZnO and ZnP and E)	not registered	not registered
	B69 (ZnO and E)	not registered	not registered
	EAF077 (ZnP and E)	not registered	not registered
	EAF088 (ZnP and E)	not registered	not registered
Innovative Marine	Hempasil XA-112	NA	NA

Table 2 Test Coatings Registration Status

Company	Test Coatings	Registration Status With EPA	Registration Status With California
International Paint	Pacifica (ZnO and ZnP)	registered	registered
	Pacifica Plus (ZnO and ZnP)	not registered	not registered
	Trilux Copper Free	not registered	not registered
	Intersleek 900	NA	NA
	VC Performance Epoxy	NA	NA
Jones Marketing Services / Hyperseal	Hyper Zinc Marine	not registered	not registered
	Hyperglass	NA	NA
KISS Polymers, LLC	KISS Ultra Concentrated Gel	NA	NA
	MegaGuard Ultra LiquiCote	NA	NA
Microphase	Phase Coat Bare Bottom	NA	NA
New Nautical Coatings, Inc.	Mission Bay (ZnO and ZnP)	registered	registered
	Seahawk Smart Solution (E)	submitted	not registered
Oceanic Surfaces International, LLC	ECO-5	NA	NA
Petit Paint (Kop-Coat Specialty Coatings)	Vivid Free (ZnO and ZnP)	registered	registered
	Vivid SPC (ZnO and ZnP and E)	not registered	not registered
	Hydrocoat ECO (ZnP and E)	not registered	not registered
	Klear n'Klean	not registered	not registered
PPG	Coating X (ZnP)	not registered	not registered
	Sigmaglide 890	NA	NA
Ram Protective Coatings	Ceram-Kote 99M	NA	NA

Table 2   Test Coatings Registration Status

Company	Test Coatings	Registration Status With EPA	Registration Status With California
Seacoat Technology, LLC	Sea-Speed GC V4	NA	NA
Sea Hawk	Propspeed	NA	NA
Seashell Technology	SeashellST5000	NA	NA
	SeashellST5100	NA	NA
Sherwin Williams	Seaguard HMF (ZnO and ZnP)	EPA registration imminent	not registered
Sound Specialty Coatings Corp.	AQUAPLY M	NA	NA
	AQUAPOLY mbc	NA	NA
Specialty Products, Inc.	PTU- 200	NA	NA
	Polyshield HT	NA	NA
Water Tight, LLC	Water Tight	NA	NA
Xurex Nano-Coating	ProGlide	NA	NA
	HabraCoat	NA	NA

ZnCr = Zinc Chromate; ZnO = Zinc Oxide; ZnP = Zinc Pyrithione; E = Econea

NA = Not Applicable

Table 3 Test Coatings Application Procedures

Company	Test Coatings	Application Method	Undercoats	Thinner	Water Cure Time
Blue Water Marine	Blue Water Shelter Island (ZnO and ZnP)	roll	none	no	16 hours
	Experimental Metal Free (E)	roll	none	no	16 hours
	Experimental Metal Free Plus (E)	roll	none	no	16 hours
Creative Coatings Corp.	Photo Finish	roll	none	no	
Ecological Coatings, LLC	EC-4300	roll	none	no	5 days
	EC-4900	roll	none	no	5 days
E-Paint Co.	ePaint Eco (ZnP)	roll	none	no	24 hours
	EP-2000 (ZnP)	roll	none	no	24 hours
	Ecominder	roll	none	no	24 hours
	E Paint SN-1	roll	none	no	24 hours
	EP-21 Release Coating	roll	none	no	24 hours
	SUNWAVE	roll	none	no	24 hours
Fuji Hunt	Smart Surfaces Duplex	spray	three	yes	24 - 48 hours
Harbor Engineering Services	B49 (ZnO and ZnP and E)	roll	none	no	8 - 48 hours
	B69 (ZnO and E)	roll	none	no	8 - 48 hours
	EAF077 (ZnP and E)	roll	none	no	8 - 48 hours
	EAF088 (ZnP and E)	roll	none	no	8 - 48 hours
Innovative Marine	Hempasil XA-112	spray	one	no	24 hours

Table 3 Test Coatings Application Procedures

Company	Test Coatings	Application Method	Undercoats	Thinner	Water Cure Time
International Paint	Pacifica (ZnO and ZnP)	roll	none	no	24 hours
	Pacifica Plus (ZnO and ZnP)	roll	none	no	24 hours
	Trilux Copper Free	roll	none	no	24 hours
	Intersleek 900	roll	two	no	24 hours
	VC Performance Epoxy	roll	none	no	24 hours
Jones Marketing Services / Hyperseal	Hyper Zinc Marine	roll	none	no	24 hours
	Hyperglass	roll	none	no	24 hours
KISS Polymers, LLC	KISS Ultra Concentrated Gel	cloth	none	no	none
	MegaGuard Ultra LiquiCote	cloth	none	no	none
Microphase	Phase Coat Bare Bottom	roll	one	no	24 hours
New Nautical Coatings, Inc.	Mission Bay (ZnO and ZnP)	roll	none	no	24 hours
	Seahawk Smart Solution (E)	roll	none	no	24 hours
Oceanic Surfaces International, LLC	ECO-5	spray or roll	none	no	6 hours
Petit Paint (Kop-Coat Specialty Coatings)	Vivid Free (ZnO and ZnP)	roll	none	no	48 hours
	Vivid SPC (ZnO and ZnP and E)	roll	none	no	48 hours
	Hydrocoat ECO (ZnP and E)	roll	none	no	48 hours
	Klear n'Klean	roll (foam)	one	no	48 hours
PPG	Coating X (ZnP)	roll	none	no	24 hours
	Sigmaglide 890	roll primer / spray topcoat	one	no	4 hours

Table 3   Test Coatings Application Procedures

Company	Test Coatings	Application Method	Undercoats	Thinner	Water Cure Time
Ram Protective Coatings	Ceram-Kote 99M	spray	none	no	24 hours
Seacoat Technology, LLC	Sea-Speed GC V4	roll	none	no	24 hours
Sea Hawk	Propspeed	roll	none	no	24 hours
Seashell Technology	SeashellST5000	spray	none	no	48 hours
	SeashellST5100	spray	none	no	48 hours
Sherwin Williams	Seaguard HMF (ZnO and ZnP)	spray	none	no	24 hours
Sound Specialty Coatings Corp.	AQUAPLY M	roll	none	no	24 hours
	AQUAPOLY mbc	roll	none	no	48 - 72 hours
Specialty Products, Inc.	PTU- 200	spray (will bring)	none	no	24 hours
	Polyshield HT	spray (will bring)	none	no	24 hours
Water Tight, LLC	Water Tight	one way brush	none	no	24 hours
Xurex Nano-Coating	ProGlide	spray	none (prep material)	no	48 hours
	HabraCoat	spray	none (prep material)	no	48 hours
ZnCr = Zinc Chromate; ZnO = Zinc Oxide; ZnP = Zinc Pyrithione; E = Econea					