



# Recent Focus of US Navy Underwater Hull Coating Systems Programs

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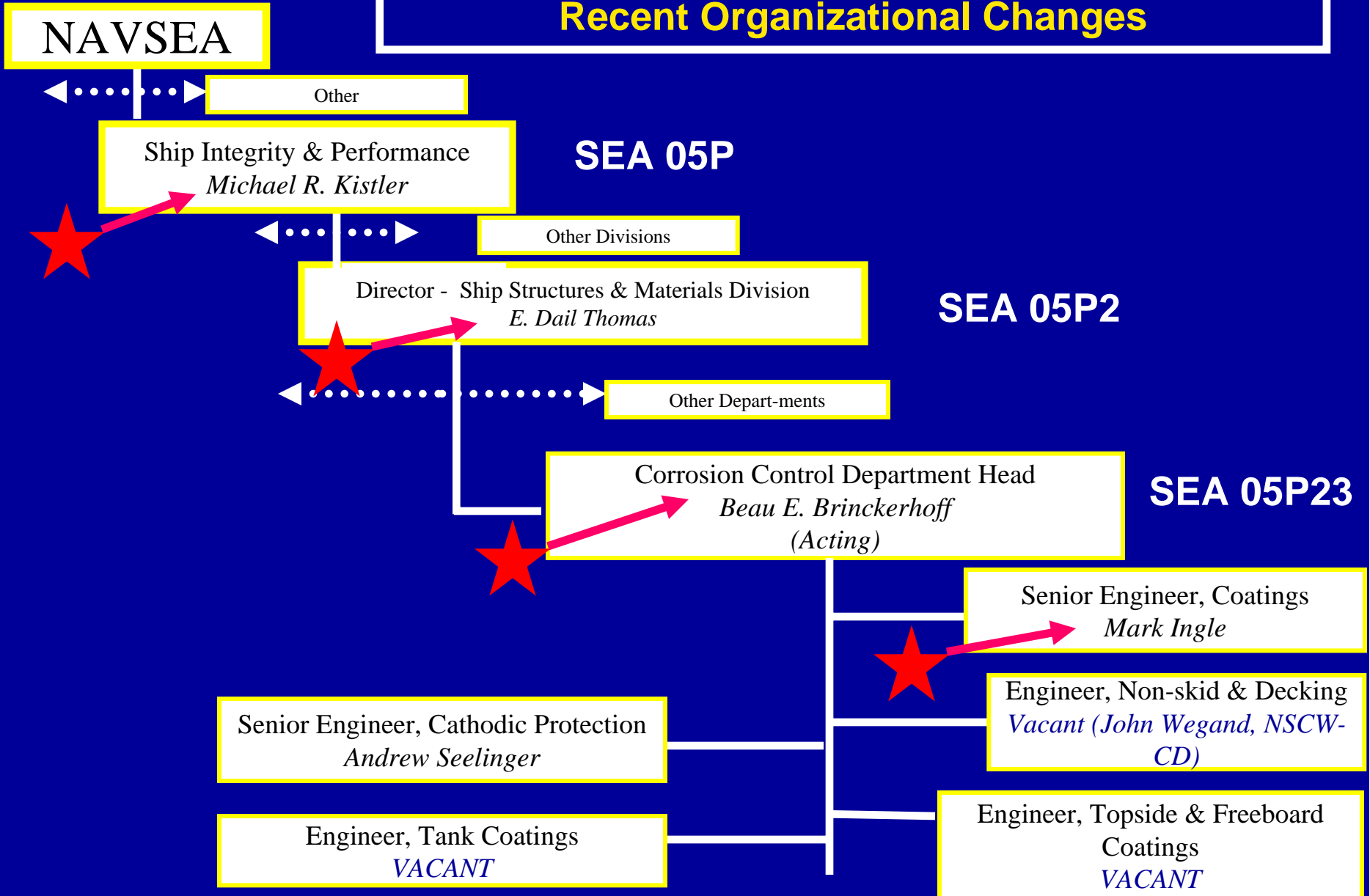
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The 14<sup>th</sup> International Congress on Marine  
Corrosion and Biofouling  
July 27-31, 2008  
Kobe, Japan



# Naval Sea Systems Command (NAVSEA) Recent Organizational Changes



Pre-decisional



# NAVSEA 05P23 TECHNICAL AUTHORITY AREAS

- SEA 05P23 is US Navy Technical Authority for Paints, Coatings, and Corrosion Control
  - NAVSEA specifies, qualifies, and manages coatings throughout the life-cycle
  - NAVSEA does not conduct basic research or formulate paints

**Superstructure &  
Catwalks  
(Enamel, Silicone  
Alkyd)**

MIL-PRF-24635  
MIL-PRF-24763  
MIL-DTL-24631

**Interior  
Bulkheads &  
Decks  
(Chlorinated  
Alkyd)**

MIL-PRF-24596  
MIL-PRF-46081  
MIL-DTL-24607

**Tanks &  
Voids  
(Epoxy)**

MIL-PRF-23236  
MIL-DTL-24441



**Flightdeck &  
Topside Decks  
(Non-Skid)**

MIL-PRF-24667

**Bilge/Wet  
Spaces  
(Epoxy)**

MIL-DTL-24441

**Underwater Hull  
(Antifouling)**

MIL-PRF-24647

**Topside Camouflage &  
Freeboard  
(Enamel, Silicone Alkyd)**

MIL-PRF-24635  
MIL-PRF-24763

**Machinery Space/Passageway  
(Enamel, Silicone Alkyd)**

MIL-DTL-1115  
MIL-DTL-15090  
MIL-DTL-700

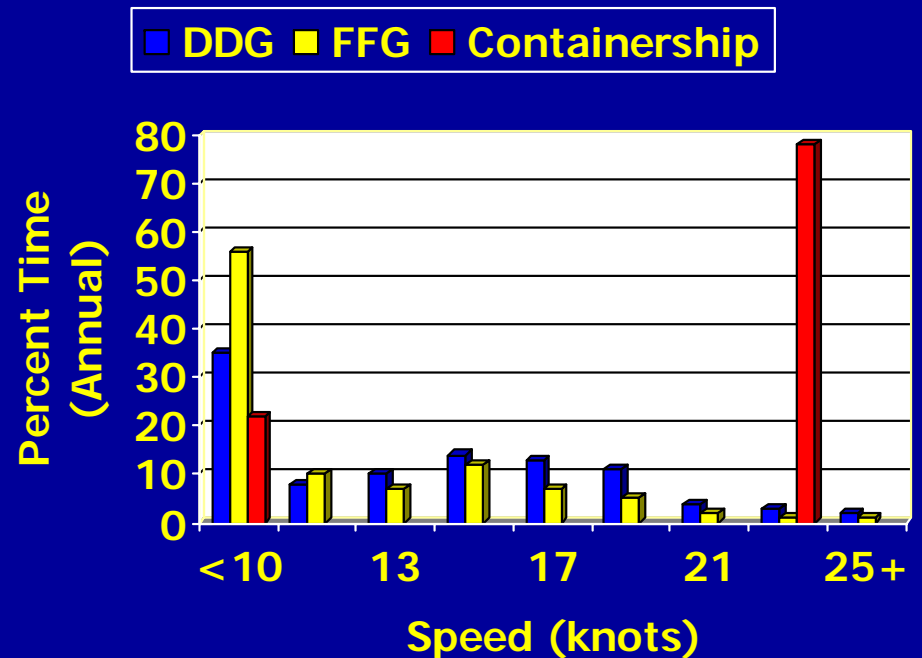


# Objectives

- Outline investment drivers for hull coating technology at NAVSEA
- Review coating qualification & transition to US Navy Fleet
- Update progress on NAVSEA's antifouling (AF) hull coatings program
- Highlight future US Navy ship developments that demand long-life, high performance hull coating systems

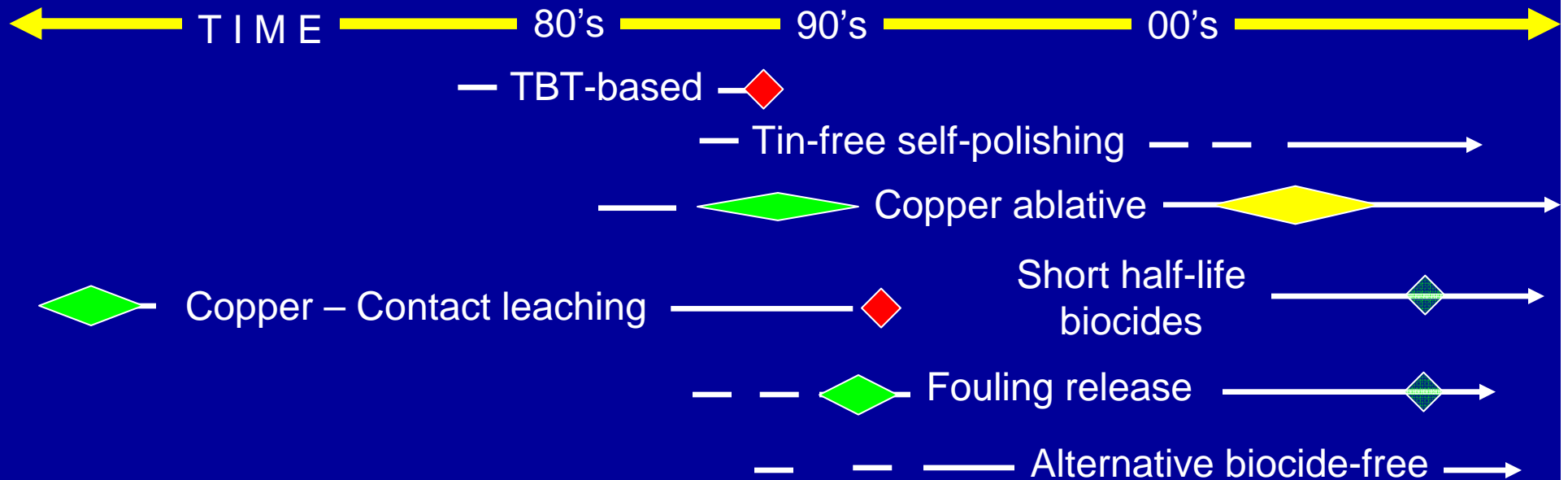
# US Navy - Unique Operational Profile




- “Can”, but don’t, go fast
- Lengthy pierside intervals
  - 50% at sea, 50% pierside
- Long drydocking intervals
  - 5-7 years
  - 10-12 years





# US Navy - Unique Hull Coatings Timeline



-  Added coating to Qualified Products List
-  Ended use of coating
-  Extend drydock intervals



# Investment Drivers: Unique Operational Demands

- Evolution of mission focus - toward littoral
- Unique hull designs
- Pressure to reduce fuel consumption
- Extended drydocking intervals
- Identifying optimal coating systems is further complicated by:
  - Unique operational profile
  - Investment priorities
    - US Navy
    - Industry
  - Market demands
  - Limited formulation design space, especially with respect to US environmental regulations
    - Volatile organic content (VOC)
    - Biocide and product registration



# Investment Drivers:

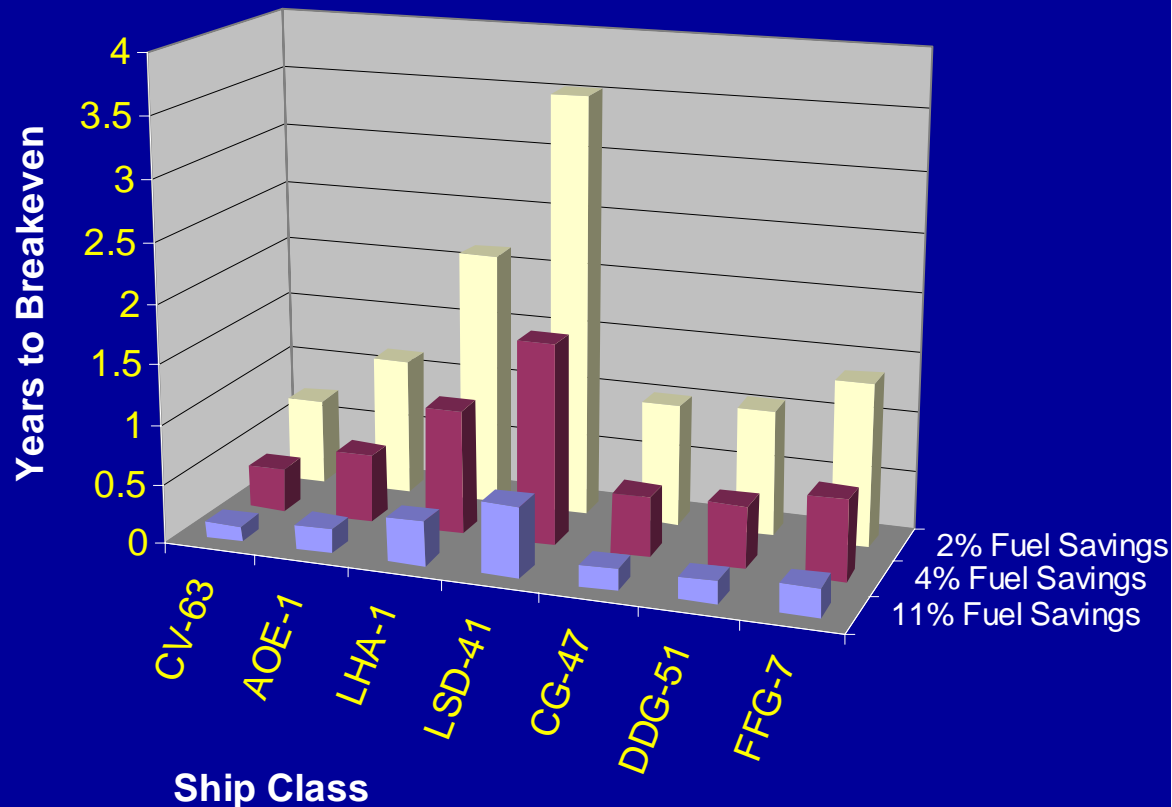
## Environmental Regulations – Cu, TBT, Water

- USA:
    - San Diego violates Federal Water Quality Standards
      - February 2005 - San Diego Regional Water Quality Control Board issued an order requiring the port to put in place a 20-year plan to phase out copper-bearing hull paint in the Shelter Island Yacht Basin (limited to private yachts)
    - Puget Sound Naval Shipyard - pressure to eliminate copper discharge from drydocks
    - Uniform National Discharge Standards (UNDS) – Will set numerical limits on copper emissions from hull coating leachate. Proposed rule likely in 2008.
- The allowable copper emissions are likely to be reduced in US waters.
  - All current Navy qualified coatings may be at compliance risk.
  - NAVSEA will require re-qualification of reformulated coatings.



# Investment Drivers: Pressure to Reduce Fuel Consumption

## Foul Release Cost Benefit Analysis



- 300+ ship US Navy
- Annual fuel budget
  - Approaching 1 Billion USD
  - Fuel costs increased by at least 140 %
  - \$1.47/gal in 2005 to more than \$3.50/gal in 2008
- Room for improvement
  - Increase fouling-free time of operation
    - Hull coatings
    - Hull husbandry practices

**Challenge to NAVSEA: Develop data to support cost benefit analysis.**

# Navy Focus: Minimize Adverse Environmental Impact From Hull Coatings

## • Past

- No full implementation of TBT-based coatings
  - Experimental basis only
- Cancelled specification for hard resin/rosin, high copper formulations (“Formula 121”)

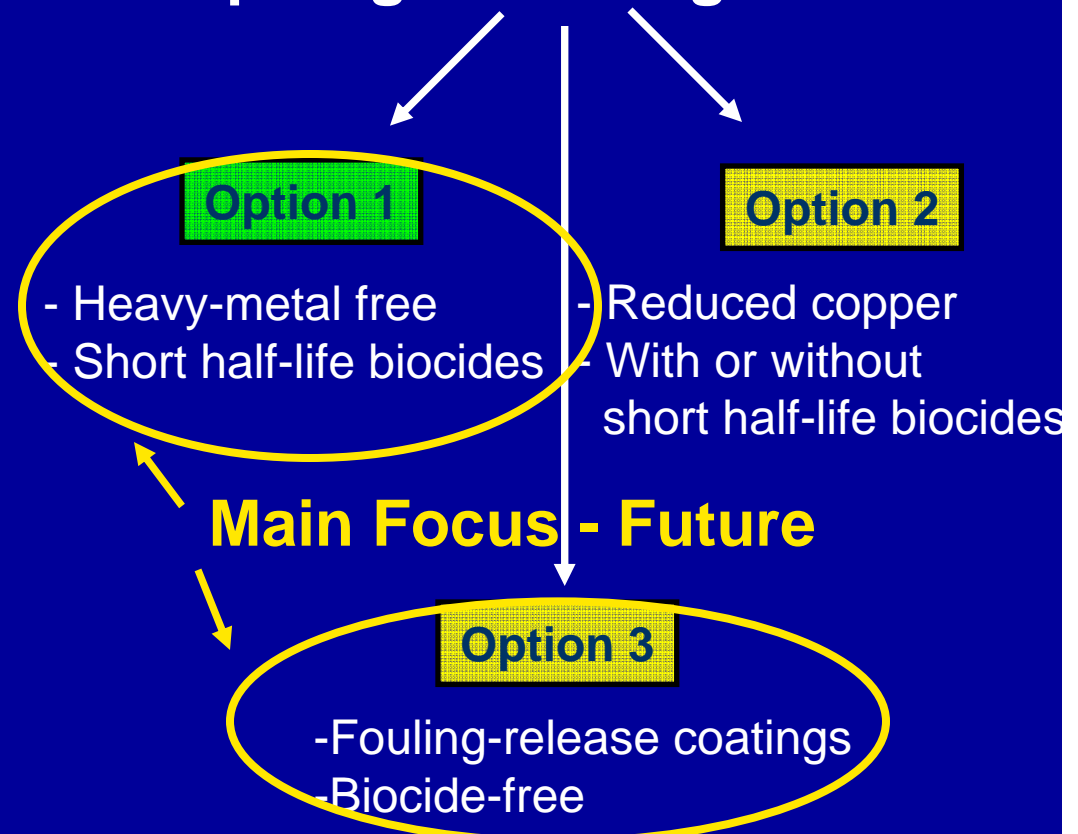
## • Present

- Fouling release coating on qualified products list
- Low copper or copper-free coatings
  - Arranged environmental use permits (EUPs) for patch and hull testing of emerging coatings
  - Closely monitoring EPA registrations – new biocides
- Developing contain, capture, & treat in-water hull cleaning technology

## • Future –

- Industrial waste minimization
- Paint warranties

### 3-pronged coatings focus:





# Qualification Process

- Performance specification - MIL-PRF-24647D
- Determine the coating Type, Class, Grade and Application
  - Type – such as biocide-based or biocide-free
  - Class – such as type of substrate
  - Grade – VOC
  - Application – expected service life & vessel type
- Start with technical authority at NAVSEA 05P23
  - Pre-requisites
  - Performance testing
    - Fouling control
    - Physical property
    - Performance under cathodic protection
    - Repair
    - ... more ...
    - Ship hull testing



# NAVSEA AF Program – Current Focus

## Copper-Free, Biocide-based Coating

**Coating:** Copper-free applied over universal primer to aluminum hull of US Coast Guard 47-foot motor lifeboat operating in San Juan, Puerto Rico

**Test System Applied:** Jan. 9 - 22, 2005

**Inspected:** Aug. 2005 light algae growth.  
April 2006 cleaning needed, cleaned  
Dec. 2006 pulled for zinc replacement;  
cleaned well.



Good performance: USCG wants more of this coating.



Pressure wash, algae easily removed, polishing apparent



Some hard fouling on welds, not a speed problem

**US Navy will add this coating to Qualified Products List (QPL) as a 3-year service life, copper free coating.**

**Before end of 2008**



# NAVSEA AF Program - Current Focus

## Traditional Foul-release Coatings

- Historical Navy experience with silicone elastomers (US Navy QPL product)
  - Panel tests – test sites and bilge keel panels
  - Hull tests
    - MCM (mine sweepers)
    - USS *Scott* (DDG – 995)
    - USS *Independence* (LCS-2) (New - littoral combat ship)
  - Patch tests
    - USS *Abraham Lincoln* (CVN-72)
    - USS *Moosbrugger* (DD-980)
    - USS *David R. Ray* (DD-971)
    - USS *John Paul Jones* (DDG-53)
    - USS *Spruance* (DD-963)
    - USS *Paul F. Foster* (DD-964)
  - USCG small boats (cooperative effort with NAVSEA)
- Second silicone elastomeric material pending addition to QPL







# NAVSEA AF Program – Current Focus

## Advanced, Foul-release Coatings

- New advanced FR technology
  - Commercial product introduced to US Navy & commercial fleets - May 2007
    - Fluorinated polymer + silicone resin
    - Ampiphilic surface - mixed hydrophobic and hydrophilic areas
    - Inhibits organism settlement and adhesion
    - Smoother than conventional FR
- Commercial tanker & container ship owners report ships with speeds > 10 knots can achieve
  - 4-11% fuel savings
  - coating is smoother and stays clean at lower speeds
- Military Sealift Command reporting good performance



**US Navy Planned Work:**

**Demonstration installation of new technology on DDG in 2009**

**NAVSEA challenge: Quantify fuel savings on Navy ships**



# Performance Requirements – US Navy Hull Coatings

## Performance Specification: MIL-PRF-24647D

Cu RELEASE: < 10  $\mu\text{g}/\text{cm}^2/\text{day}$   
OR 50% OF current copper  
ablatives

OR, NO Copper  
- **ASTM-D-6442 METHOD,**  
**90-DAY PERIOD**

WITHSTAND 35-knot FLOW

VOC < 400 g/l

- **CAN USE OXOL**

SUPPORT 12-year DOCKING  
WITHOUT CLEANING

- **CAN ACCEPT CLEANINGS**  
**ANALOGOUS TO CURRENT**  
**COATINGS**

COATING THAT  
MEETS NAVSEA  
NEEDS

APPLICABLE USING  
STANDARD EQUIPMENT

- **CAN USE HIGH-SOLIDS**  
**PUMPS**

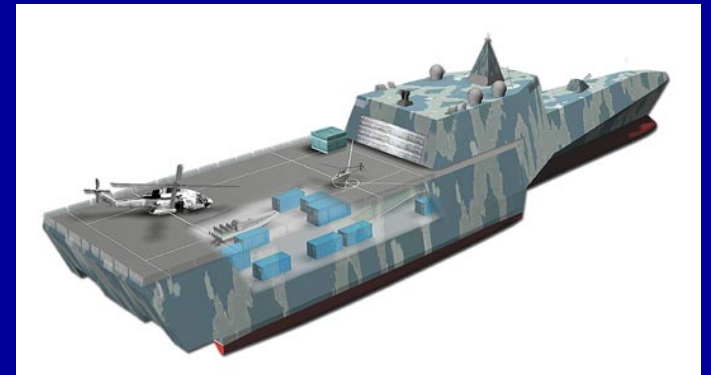
- **CANNOT HAVE NUMEROUS**  
**EXTRA COATS OR DRY TIME**

Meets US Environmental Protection  
Agency (EPA) REGISTRATION  
REQUIREMENTS

[www.nstcenter.com](http://www.nstcenter.com) – for more information on the US Navy's AF Hull  
Coatings Program, strategies, plans, status

# Future Needs – US Navy Ship Developments

- New US Navy ships will challenge existing current antifouling coatings
  - Some are smaller & faster craft
    - 120 m or 370 feet
    - High speeds
  - Aluminum hulls
  - Smaller crews
  - Require less maintenance
- Special hull coating needs for these ships
- US Navy is not like commercial







# Summary

- Provided updates on the US Navy's hull coatings program as a function of
  - Increasing operational demands
  - On-going regulatory developments
- Underscored the US Navy's underwater hull coating qualification process and requirements
- Emphasized challenges in identifying materials for the Navy's unique operational profile
- Outlined the current focus of the US Navy's hull coatings program
  - EPA registered, copper-free products
  - Foul-release coatings
  - Reduced copper coatings – still considered
- Described the future US Navy hull coatings needs for
  - High speed vessels
  - Aluminum hulls
  - Alternative hull materials – may be flexible



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