Presentation Overview

- Primary Hull Structure
  - Minehunters
  - Special Forces & Boats
- Superstructure
- Foils and Appendages
  - Surface Ships
  - Submarines
- Components

Primary Structure

OSPREY Class Minehunter

Length:	57.2 meters (187 feet, 10 inches)
Beam:	11.0 meters (35 feet, 11 inches)
Draft:	2.9 meters (9 feet, 4 inches)
Displacement:	895 metric tons
Propulsion:	two 800 hp amagnetic diesel engines with variable fluid drives turning two cycloidal propellers
Accommodations:	5 officers; 4 CPO; 42 enlisted

Construction Particulars

All glass reinforcement for primary structure is E glass. Spun woven roving of 1400 grams per square meter is used for the hull, transverse bulkheads, and decks. The spun woven roving is a fabric with the weft direction reinforcement consisting of rovings that have been "tufted." This treatment, which gives the fabric a fuzzy appearance, improves the interlaminar shear strength over traditional woven rovings. The superstructure is constructed of a "Rovimat" material consisting of a chopped strand mat stitched to a woven roving. Stitching of the two fabrics was chosen to improve performance with the semi-automated resin impregnator (which is used during the lamination process). The total weight of the Rovimat is 1200 grams per square meter (400 g/m^2 mat + 800 g/m^2 woven roving).

The resin is a high grade toughened isophthalic marine polyester resin. It is specially formulated for toughness under shock loads and to meet the necessary fabrication requirements. The resin does not have brittle fracture characteristics of normal polyester resins, which gives it excellent performance under underwater explosive loads. Combined with spun woven roving, the laminate provides superior shock and impact resistance. The resin formulation has been optimized for improved producibility. Significant is the long gel time (up to four hours) with low exotherm and a long extended delay time to produce a primary bond. [1-32]

Primary Structure

Special Forces 11- Meter RIB

In-Service Photos of the U.S. Navy Special Warfare's 11-Meter RIB Built by U.S. Marine

Primary Structure

Boats

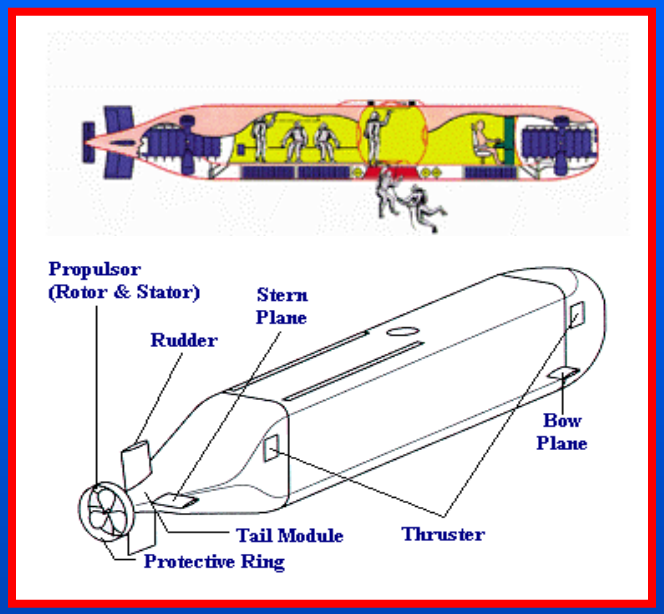
At sea Aboard ***USS Blue Ridge*** (LCC 19) Sailors Practice Deployment of Ship's Small Boats

Members of Inshore Boat Unit Seventeen (IBU 17) Patrol the Waters of Apra Harbor, Guam

Primary Structure

Swimmer Delivery Vehicles

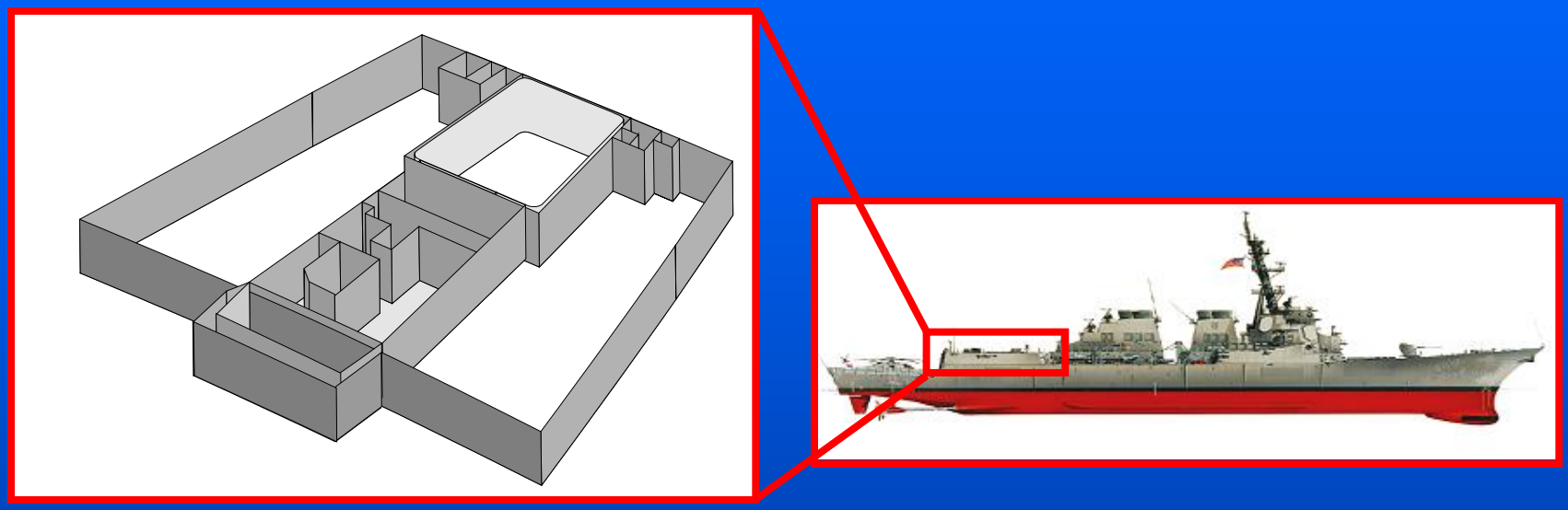
Special Forces Divers Work with a Swimmer Delivery Vehicle



Schematic of Northrop Grumman's 65-foot Advanced SEAL Delivery System

Superstructure

Helicopter Hanger for DDG 51 Flt IIA



Composite Helicopter Hanger for DDG 51 Flight IIA Destroyer Built
at Northrop Grumman Ship Systems' Gulfport Facility
Scheduled to be Installed on DDG 100

Superstructure

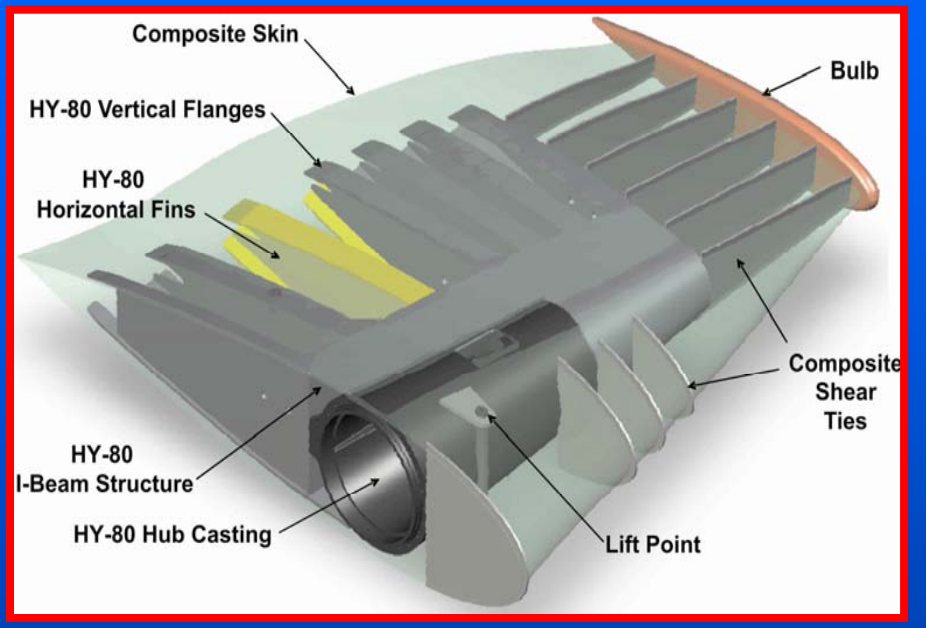
DDG 51 Forward Director Room

Forward Director Room Built by Northrop Grumman's El Segundo Facility as Technology Demonstrator for DDG 51 under ManTech Funding

Foils & Appendages

Surface Ships

Composite MCM Rudder Built by Structural Composites Shown During Shock Trials



A Composite Twisted Rudder under Development

Foils & Appendages

Submarines

Advanced Composite Sail Envisioned for Virginia Class Submarines (top left) and 1/4-Scale Prototype Built by Seemann Composites (bottom left)

Composite Submarine Bow Dome Produced by Goodrich Composites

Components

Boat Davits

Priority	High
Opportunity	Potential to reduce maintenance and increase personnel safety
Technical Issues	Functional design, safety factors, interface with metal hardware
Previous Work	Advanced Lightweight Engineering in the Netherlands has developed a composite davit for Davit International in Germany
Return on Investment	Medium

Conventional Boat Davits
on ***USNS Comfort***

Components

Bulkheads, Nonstructural

Priority	Medium
Opportunity	Opportunity to reduce cost and weight while improving fire resistance
Technical Issues	Fire, cost, supportability
Previous Work	Currently use Nomex/phenolic sandwich
Return on Investment	Medium

Webcore Hybrid Fabric-Web/Strut-Web Core with Pre-Attached Fabric Proposed for Navy SBIR Door Project

Components

Bulwarks

Priority Low

Opportunity Potential to reduce weight and maintenance

Technical Issues Not suitable for retrofit

Previous Work LPD 17 design calls for composite bulwarks

Return on Investment Low

Bulwark Structure on LPD-17 under Construction and ***USS INGRAHAM*** (FFG 61)

Components

Cable Passage Tubes

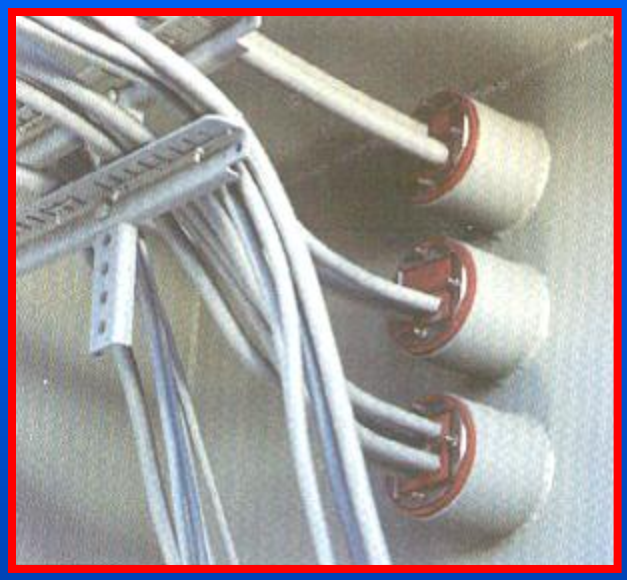
Priority Medium

Opportunity Reduced maintenance and ease of handling

Technical Issues Fire and watertight certification

Previous Work

Return on Investment Medium



Bulkhead Example of Nelson Firestop Multi-Plug Tested to US Navy Standards (DoD-Std-2003)

Components

Cable Hangers

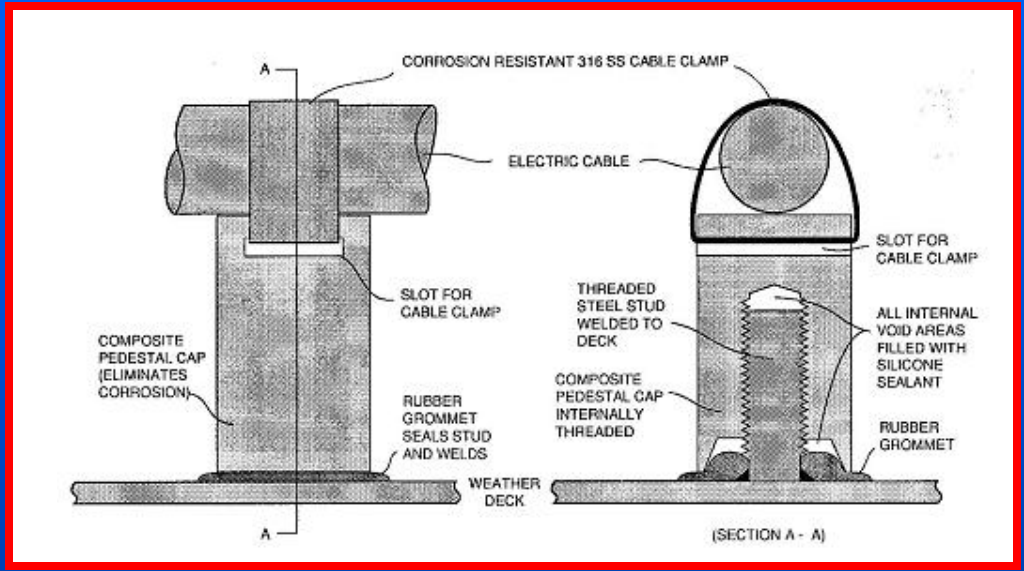
Priority Medium

Opportunity Potential to reduce weight and maintenance

Technical Issues Fire

Previous Work

Return on Investment Medium



Single Cable Composite Pedestal Cable Hanger
[Dennis Conroy & Larry Murphy, NSWCCD Code 823]

Components

CHT Systems

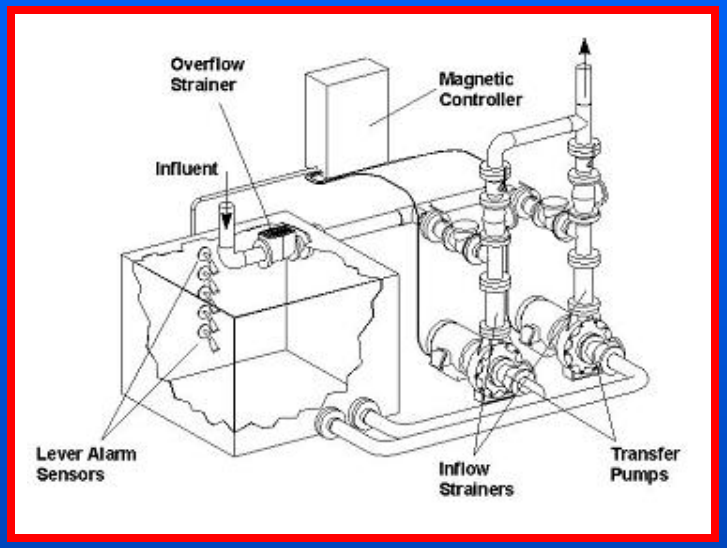
Priority High

Opportunity Eliminate severe corrosion and make maintenance easier

Technical Issues Fire; integrate with existing system elements

Previous Work Navy has fielded prototype composite systems. The U.S. Navy is now specifying GRP (fiberglass) piping and ladders for use inside the CHT tank, as this material holds up extremely well in the sewage environment.

Return on Investment Medium



U.S. Navy Type III Marine Sanitation Device [US Navy Shipboard Environmental Information Clearinghouse]

Components

Condensate Drains

Priority Medium

Opportunity Reduce corrosion and related maintenance

Technical Issues Fire

Previous Work

Return on Investment High

Intake Fan Room/Plenum Drain on ***USS INCHON*** (MCS12), Dec 2000. [Capital Investment for Labor Machinery Space Ventilation Program, Norm Clayton & John Miller, NSWCCD Codes 624 & 9213]

Components

Counter Measure Washdown Piping

Priority	High
Opportunity	Aluminum tubing subject to corrosion and fouling
Technical Issues	Demonstrate survivability of composite system
Previous Work	Fleet currently planning on replacing with CuNi system
Return on Investment	High

Images of Topside Counter Measure Washdown [Photograph by Robert Benson (above) and Cathy A. Brenneman (below)]

Components

Deck Grating

Priority	High
Opportunity	Eliminate corrosion and related maintenance and safety issues
Technical Issues	Fire and strength
Previous Work	ERM-7 has fielded composite grating on 4 ships; numerous unauthorized replacements in the fleet. NAVSEA Drwg 803-6983499, GRP Deck Grating specifies MODAR resin – parts expected to be in supply system late FY 03
Return on Investment	High

Composite Deck Grating on FFG-58 ***USS Samuel B. Roberts***

Components

Door Hinges

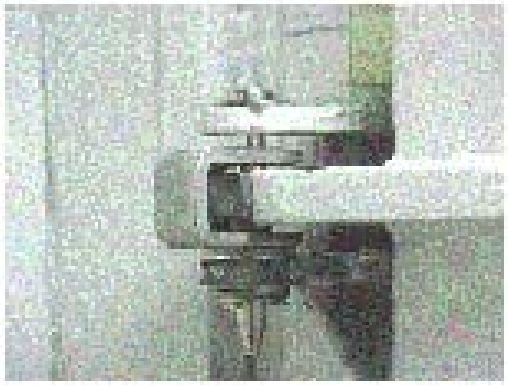
Priority High

Opportunity Eliminate severe corrosion; make maintenance and operation easier

Technical Issues Fire, operability and strength

Previous Work Ken Brayton, NAVSEA 05P7 has led SBIR & other efforts to develop composite closures & mechanisms

Return on Investment High



Watertight Door Showing Wear Due to Hinge Misalignment (above) and Corrosion (below)

Components

Doors

Priority	High
Opportunity	Corrosion, weight, stealth & ease of operation
Technical Issues	Fire & strength
Previous Work	Prototypes have been developed by Ingalls and Webcore
Return on Investment	High

E-Glass/Vinyl Ester-Paneled Door Built by Ingalls used in ManTech Topside Project

Components

Electrical Enclosures

Priority High

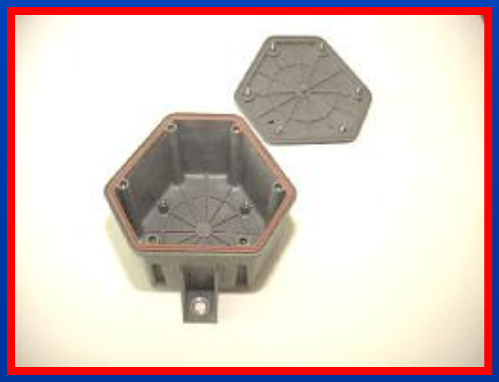
Opportunity Reduce corrosion and related maintenance

Technical Issues Fire and impact resistance

Previous Work ERM-7 is in the process of certifying ULTEM 2300 electrical enclosures

Return on Investment High

Typical Corrosion-Related Failure (above) and ULTEM 2300 Box Molded by Glenair (below)



Components

Fairings

Priority High

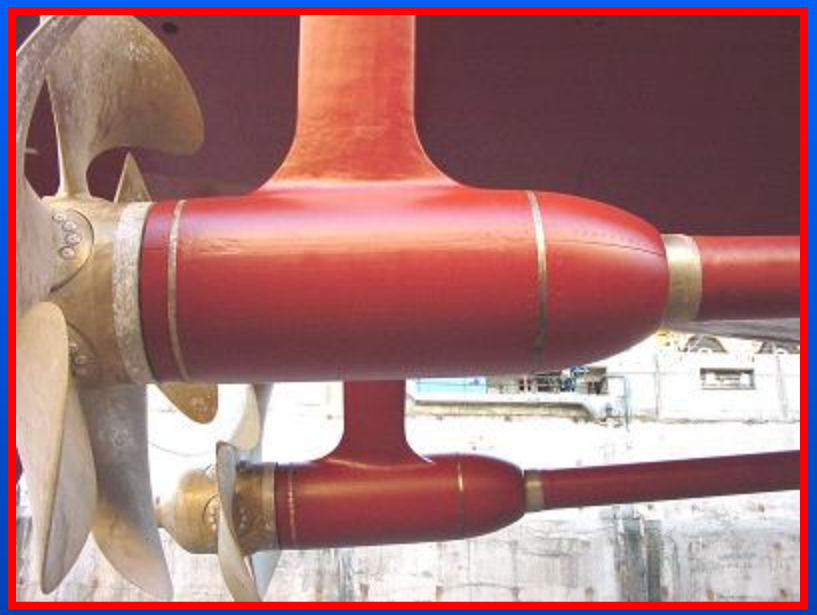
Opportunity Metal rope guards difficult to replace underwater

Technical Issues Fastener interface

Previous Work Composite propulsion shaft rope guards installed on Aircraft Carriers showing:

- Less than ½ the cost and weight of original Cu-Ni
- Bolt-on vs. weld-on
- Easy waterborne removal/install gives full access to stave bearings & zincs

Return on Investment High



Installed Composite Fairwaters (NAVSEA 05M3)

Components

Fans & Blowers

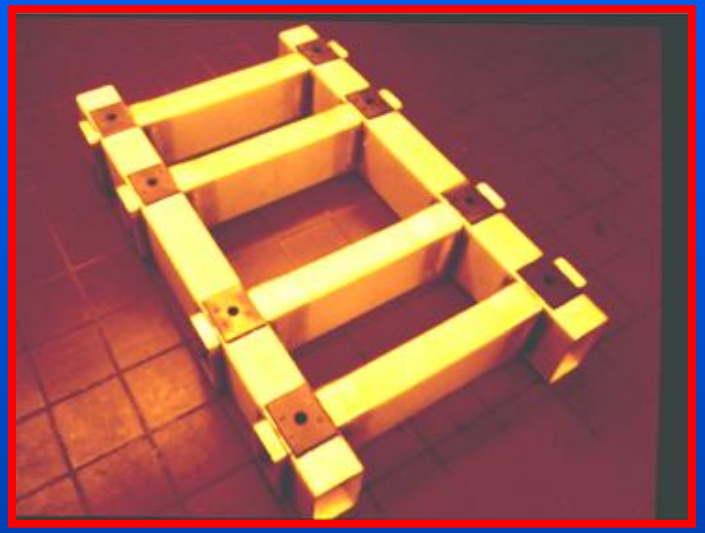
Priority	High
Opportunity	Reduced corrosion, easier to maintain & quieter
Technical Issues	Fire, operability and strength
Previous Work	NAVSEA PMS 400D32 is pursuing composite fans via SBIR & ManTech programs
Return on Investment	High

Typical Axial Fan

Components

Foundations

Priority	High
Opportunity	Severe corrosion on saltwater pump foundations is major maintenance issue and contributes to machinery vibration; potential to make machinery "quieter"
Technical Issues	Fire and shock
Previous Work	Brunswick Defense built a filament-wound foundation that was tested at NSWCCD
Return on Investment	Medium



Filament Wound Machinery Foundation by Brunswick Defense

Components

Funnels & Deck Drains

Priority Medium

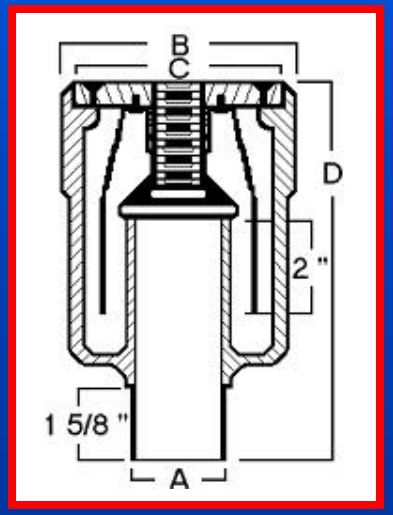
Opportunity Potential to reduce weight and maintenance

Technical Issues Interface to metal structure

Previous Work ERM-7 has awarded SPARTA a contract to build prototype Type D deck drains. Type A is scheduled for development in FY 04.

Return on Investment High

Typical Navy Funnels
[Dolsey Ltd., Norfolk, VA]

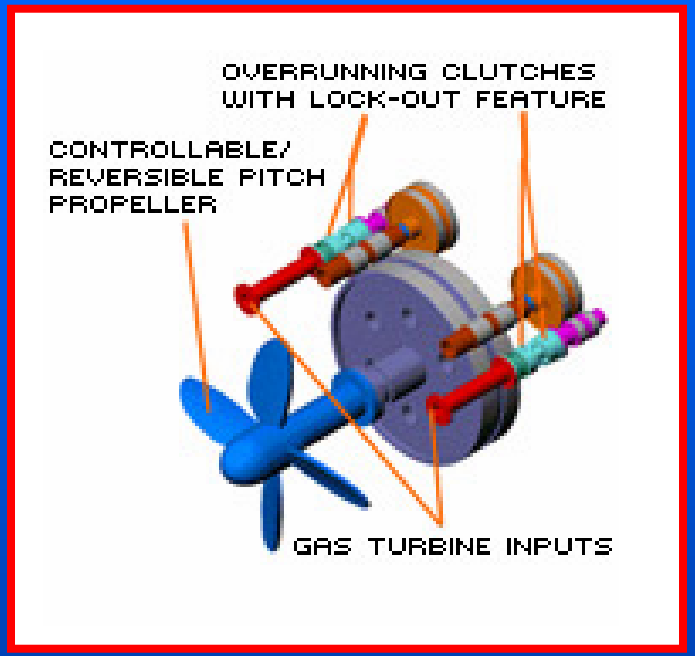


Type “A” Deck Drain

Components

Gear Cases

Priority	Low
Opportunity	Reduce weight and make machinery quieter
Technical Issues	Strength, creep and high temperature performance
Previous Work	Some "high end" work done by DTRC, Annapolis
Return on Investment	Low



Example of Reduction Gear Arrangement for DDG 51 Class Where Each of the Ship's Two Propellers is Driven GE Multiple-Input Reduction Gear Powered by Two GE Gas Turbines

Components

Handrails

Priority	Medium
Opportunity	Reduce maintenance and electronic interference
Technical Issues	Cost and UV resistance
Previous Work	Some isolated topside use
Return on Investment	Medium

A Sailor uses a Pneumatic Sander to Prepare Metal Handrail for Painting Preservation

Components

Hatches

Priority	High
Opportunity	Reduced weight improves ease of operation; reduce maintenance; and improve stealth
Technical Issues	Hardware operability and fire resistance
Previous Work	Ingalls' door with composite panel; Webcore SBIR project: UCSD cargo door
Return on Investment	High

Scuttle Hatch Locking Device (above) and Lifting Assist Mechanism (below) [Ken Brayton, 05P7]

Components

Heat Exchangers

Priority Medium

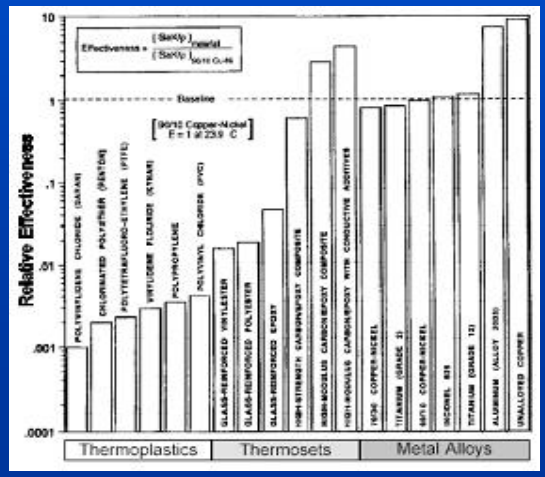
Opportunity Reduce corrosion and fouling

Technical Issues Increase thermoconductivity at reasonable cost

Previous Work NSWC, Annapolis developed carbon epoxy laminates with conductive additives that performed better than Cu-Ni

Return on Investment Medium

Example of Fouled Heat Exchanger Head Inlet (above) [ERM, Fred Tsao, 05L] and Relative Effectiveness of Composites (below) [Joseph Korczynski, NSWCCD]



Components

Helicopter Hanger Doors

Priority High

Opportunity Reduced corrosion maintenance and machinery maintenance from less weight

Technical Issues Strength and fire resistance

Previous Work Seemann Composites and BIW have developed a composite helicopter door for DDG 51 Flt IIA. A composite helicopter hanger is scheduled to be installed on DDG-100.

Return on Investment Medium

Composite Helicopter Hanger First Article Door (above) and Operational Test Jig (below) [Seemann Composites]

Components

Helicopter Net Frames

Priority	High
Opportunity	Reduce corrosion and weight
Technical Issues	Certification
Previous Work	Frames changed from flame sprayed steel to CRES on DDG 79 and later; safety net component hardware modified to CRES material
Return on Investment	High

Helicopter Net Frames
on the ***USS Thach*** (FFG-43)

Components

Insulation

Priority Medium

Opportunity Reduce weight and maintenance.

Technical Issues Cost

Previous Work Polyimide foam certified as fire-safe insulation. The replacement of fiberglass with polyimide foam hullboards on USN CG 47 Class cruisers produced a weight reduction of approximately 50 tons.

Return on Investment Medium

Inspec Foams' Thermal Hullboard for MIL-I-742 Type Applications with Glass Cloth Laminated to SOLIMIDE® Thermal Insulation Foam Weighing 0.15 lbs/ft^2 at 1" Thickness [Inspec]

Components

Ladders

Priority	High
Opportunity	Corrosion elimination and enhanced safety
Technical Issues	Cost and functionality
Previous Work	Some isolated topside use of composites
Return on Investment	High

Composite Ladder Located Topside on FFG-58, the ***USS Samuel B. Roberts***

Components

Life Rails & Lines

Priority	High
Opportunity	Reduce maintenance and electronic interference
Technical Issues	Cost and UV resistance
Previous Work	Some isolated topside use
Return on Investment	Medium

Life Rails & Lines Located Topside on FFG-58, the ***USS Samuel B. Roberts*** and the ***USS Gary*** (FFG-51)

Components

Louvers

Priority	High
Opportunity	Reduce maintenance and improve stealth
Technical Issues	Cost, certification and durability
Previous Work	Composite louvers developed for the DDG 51 class destroyers
Return on Investment	High

Radar Absorbing Composite Louver
Developed for the
DDG 51 Class Destroyers

Components

Mast Stays & Lines

Priority	Medium
Opportunity	Reduce weight, electronic interference and maintenance
Technical Issues	End fittings and overall cost
Previous Work	Used on recreational sailboats
Return on Investment	High

Mast Arrangement on ***USS Elrod*** (FFG 55) Showing Stays and Lines

Components

Masts

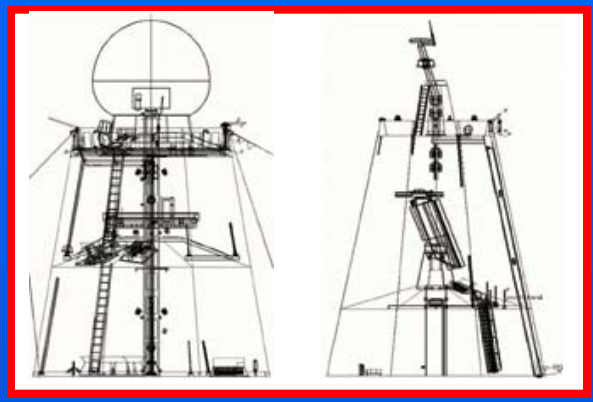
Priority Medium

Opportunity Improve equipment supportability

Technical Issues Cost

Previous Work AEM/S on ***USS Radford*** and LPD-17

Return on Investment Low



Advanced Enclosed Mast System for LPD 17 Class Ships

Components

Motor Housings

Priority Low

Opportunity Improve equipment supportability

Technical Issues Shock qualification

Previous Work

Return on Investment Low

Examples of Typical Electric Motor Housings

Components

Pipe Hangers

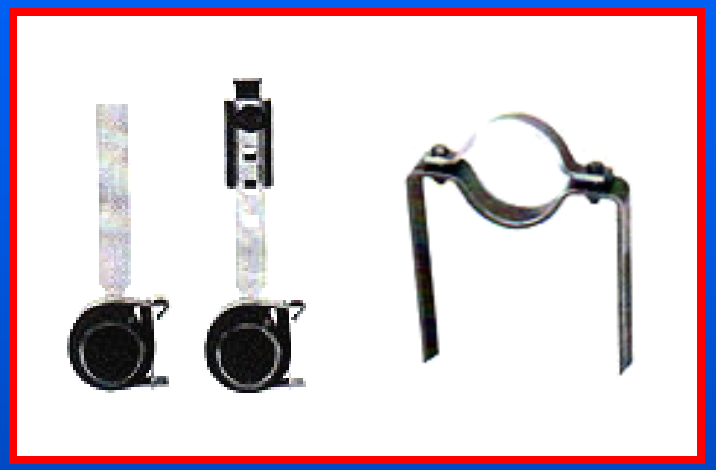
Priority High

Opportunity Eliminate corrosion and reduce pipe vibration

Technical Issues Cost and fire

Previous Work All hangers in weather, passageways to weather, in the mast, uptakes and dirty side of CPS fan rooms have been changed to CRES 316L material on DDG 77 and later

Return on Investment High



Navy Type 1 and Type 2 Hangers
[Dolsey Ltd., Norfolk, VA]

Components

Piping

Priority	High
Opportunity	Eliminate corrosion related maintenance: reduce weight & vibration
Technical Issues	Cost and fire
Previous Work	Numerous offshore installations and Navy prototypes waiting congressional plus-up
Return on Investment	High

Ameron's Bondstrand® 2000USN MIL-P-24608 Pipe Assembly Weighs 3.6 pounds Compared to 6.8 pounds for CuNi

FIBERBOND® Pipe Shown to Withstand 2000ºF Fires [EDO Specialty Plastics]

Components

Plenums

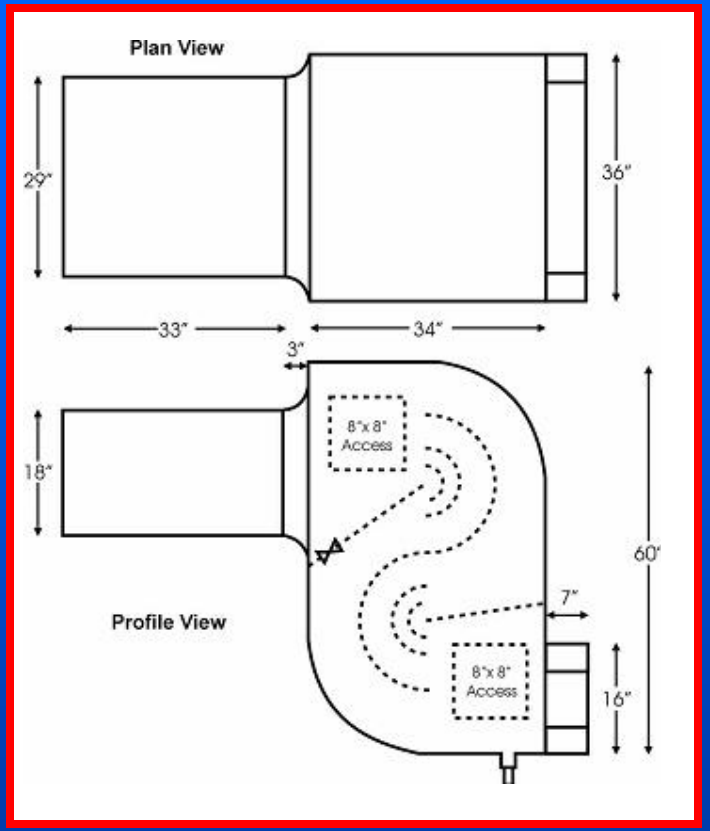
Priority High

Opportunity Eliminate severe corrosion and associated maintenance

Technical Issues Cost and fire

Previous Work Plastic turning vanes have been fielded on a limited basis

Return on Investment High



Proposed FFG Composite Plenum for 1180 CFM Nat Supply Aux Mchry Rm # 3, Helo Hgr #2, 1-278-2-Q

Components

Propellers

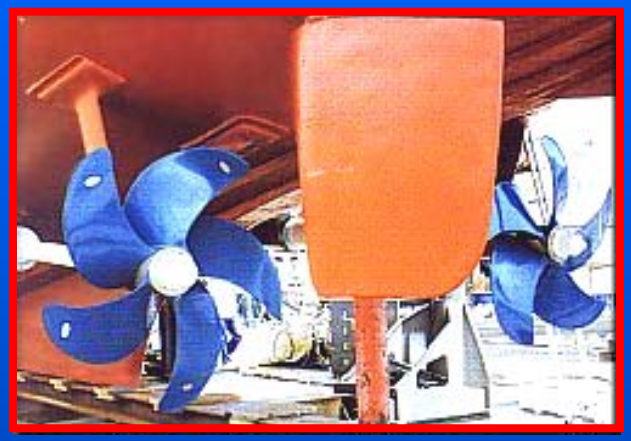
Priority Low

Opportunity Potential to make propellers quieter

Technical Issues Strength and cost

Previous Work Existing systems for large yachts and R&D work on underwater propulsors

Return on Investment Low

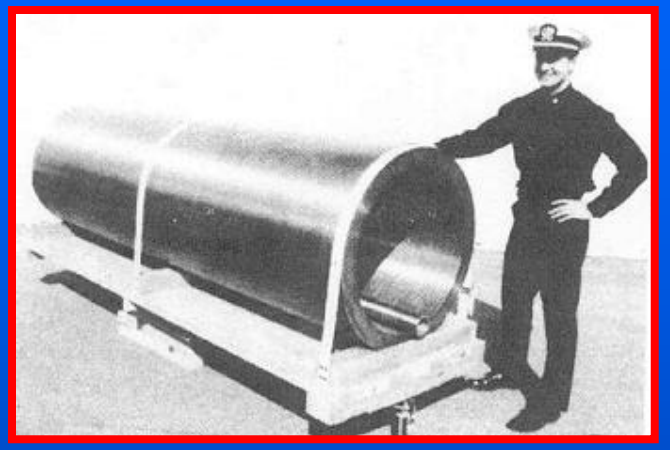


The Contur® Propeller with Exchangeable Composite Blades Offered by AIR Fertigung-Technologie GmbH, Germany

Components

Propulsion Shafting

Priority	Medium
Opportunity	Reduce vibration, weight and corrosion maintenance
Technical Issues	Interface to metal couplings and cost
Previous Work	Commercially available for high speed craft, NSWC Annapolis prototype work on AOE & subs
Return on Investment	Medium



33 inch Diameter Filament Wound Section of Propulsion Shafting Developed by DTRC, Annapolis for Testing to Meet AOE-Class Performance Requirements [George Wilhelmi]

Components

Pump Internals

Priority High

Opportunity Increase mean time between failure and reduce time to repair

Technical Issues Standardization of U.S. Navy pump population

Previous Work ERM-7 has fielded composite pump internals on 19 ships

Return on Investment High

Navy Shock-Qualified Composite Pump Internals Built by Flowserve

Components

Pumps

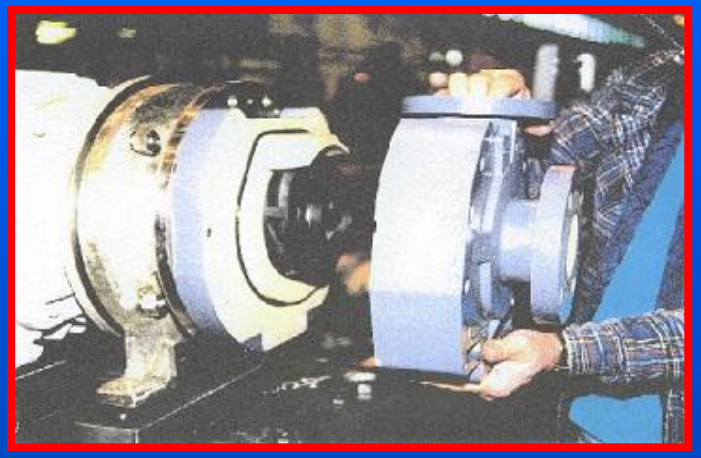
Priority High

Opportunity Reduce corrosion, much quicker to repair and quieter

Technical Issues Cost and standardization of U.S. Navy pump population

Previous Work ERM-7 has funded production of 1 size pump, ManTech effort pending

Return on Investment High



Navy Shock-Qualified Composite Pump Built by Flowserve and Installed as Part of the Navy's SMARTSHIP Program

Components

Retractable Bitts & Chocks

Priority Medium

Opportunity Corrosion related maintenance and safety – corroded bitts difficult to retract

Technical Issues Certification

Previous Work The following modifications have been made to retractable bitts on DDG 79:

- Modified surface preparation requirements
- Improved Bar Rust coating system
- Revised PMS MRC to require more frequent maintenance
- Drain lines installed in bitt chambers Bar Rust coating on DDG 79 Bitts

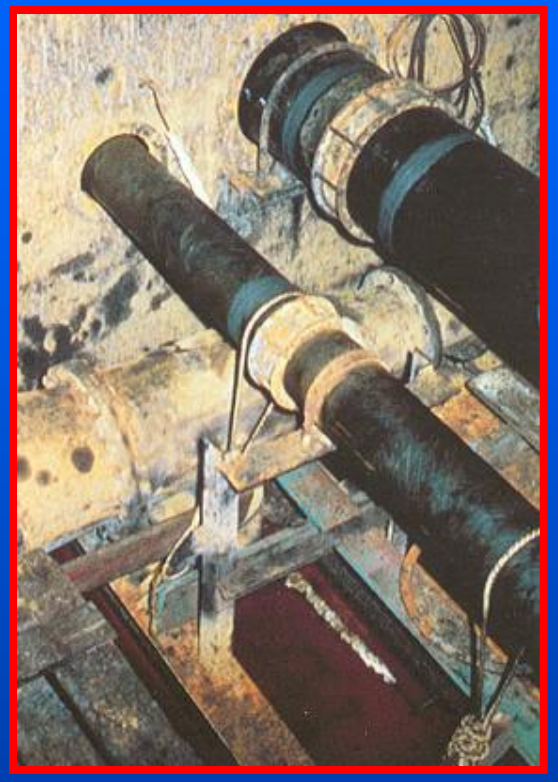
Return on Investment Medium

Typical Retractable Bitt Showing Corrosion from Mooring Line Wear and Standing Water

Components

Saltwater Piping

Priority	High
Opportunity	Potential to reduce corrosion, fouling and vibration problems
Technical Issues	Fire & certification
Previous Work	Many offshore installations and proposed U.S. Navy use pending congressional plus-up
Return on Investment	High



Composite Pipe Installed in Severe Saltwater Ship Environment (Ameron®)

Components

Seachest Strainers

Priority High

Opportunity Reduce corrosion and integrate antifouling agent

Technical Issues Integrate effective, environmentally-friendly antifouling

Previous Work PMS 400F funding pilot program

Return on Investment High

Fouled Seachest Strainer (top) Cutout (middle) and Prototype Composite Strainer (bottom)

Components

Shafting Overwraps

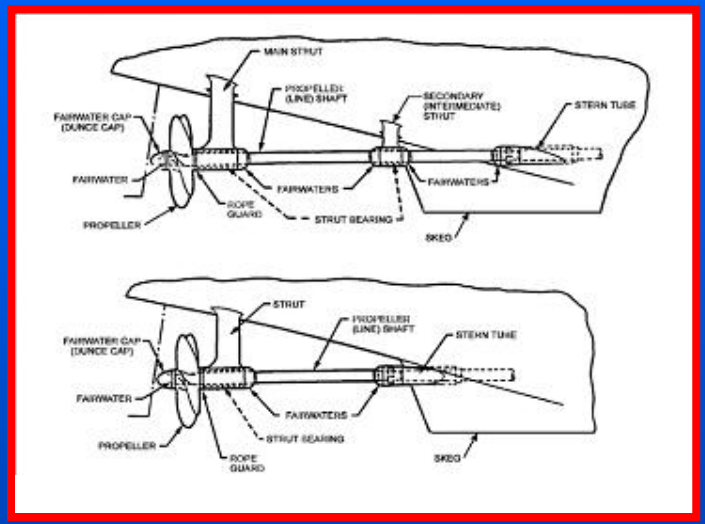
Priority High

Opportunity Current manual method labor intensive and not durable. All shafting exposed to seawater must be coated to prevent corrosion, which can lead to fatigue failure. Glass Reinforced Plastic (GRP) (in accordance with MIL-STD-2199) consists of four alternately wrapped layers of fiberglass cloth and Phillyclad 1775/620 resin.

Technical Issues Environmentally-compliant process; bond to steel; durability

Previous Work NNS currently funded as ManTech project

Return on Investment High



Main Propulsion Shafting General Arrangement [SupSalv]

Components

Stacks

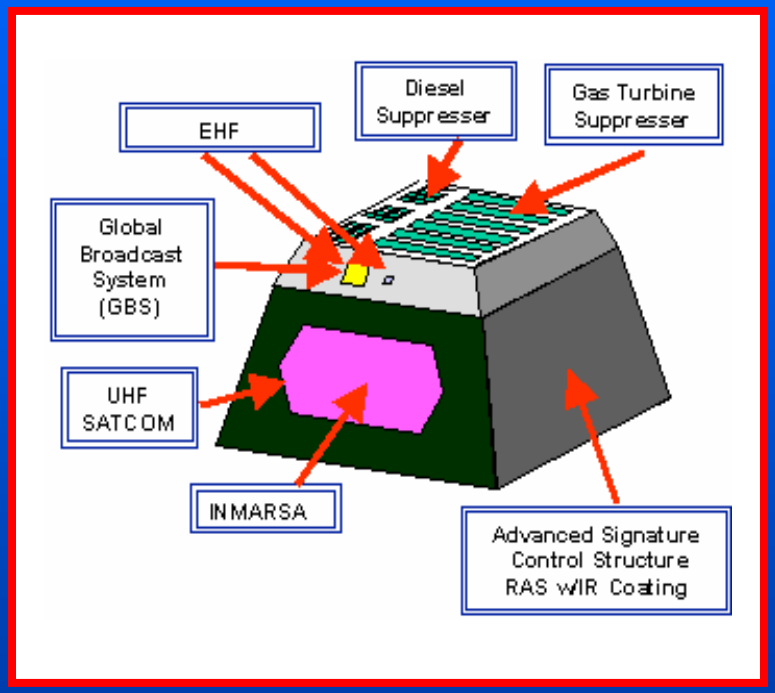
Priority Low

Opportunity Potential to reduce topside weight and integrate sensors

Technical Issues Cost precludes retrofit

Previous Work Ingalls completed Low Observable Stack project

Return on Investment Low



Low Observable Multifunction Stack Concept [ONR]

Components

Stair Treads

Priority Medium

Opportunity Corrosion elimination and enhanced safety

Technical Issues Fire

Previous Work Some unauthorized installations

Return on Investment Medium

Topside Example of Stair Treads on the ***USS Samuel B. Roberts*** Showing Wear of Painted Finish

Components

Stanchions

Priority Medium

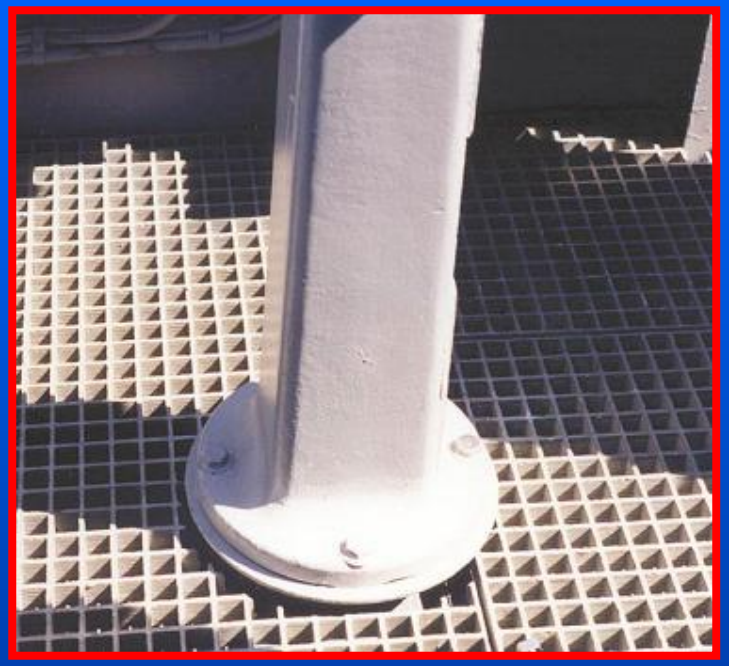
Opportunity Reduce corrosion and weight

Technical Issues Cost & functionality

Previous Work Some topside applications utilized products with insufficient strength and UV protection.

Improved polyurethane/E-glass composite stanchions are currently installed on a carrier for evaluation. These stanchions can bend 90° and spring back to original shape.

Return on Investment Medium



Topside Example of Stanchion on the ***USS Samuel B. Roberts*** Showing Surrounding Deck Grating

Components

Stowage Lockers

Priority	High
Opportunity	Reduce corrosion, weight & condensation
Technical Issues	Fire
Previous Work	Some commercially available products
Return on Investment	Medium

Damage Controlman Checks Fit of a Self Contained Breathing Apparatus (SCBA) from a Damage Repair Locker

Components

Tanks

Priority	High
Opportunity	Reduce corrosion especially with saltwater & sewage systems - Tank and Void preservation has been reported by the Type Commanders as their single largest maintenance burden.
Technical Issues	Fire and certification
Previous Work	Some prototype sewage treatment systems on carriers
Return on Investment	High

Current Tank Coatings after 36 Months
[ERM, Beau Brinckerhoff, 05M]

Components

Tank Vents

Priority High

Opportunity Reduce corrosion maintenance and weight

Technical Issues Fire and certification

Previous Work

Return on Investment High

Tank Vent System on the ***USNS Comfort***

Topside Example of Corroded Tank Vent on the ***USS Samuel B. Roberts***

Components

Topside Personnel Protection

Priority High

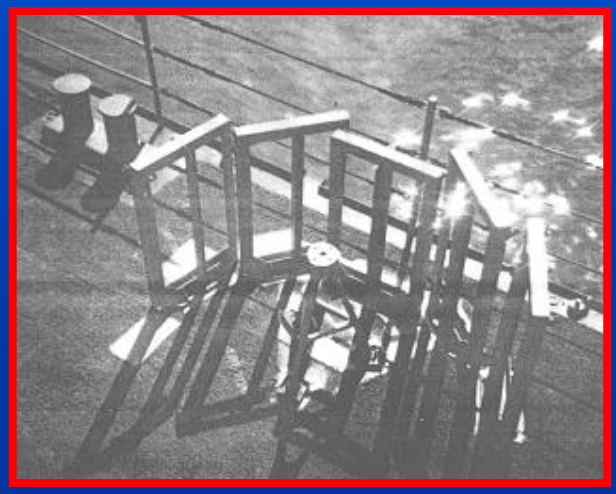
Opportunity FFG role for homeland security may increase vulnerability of topside personnel

Technical Issues Cost, stowability & performance

Previous Work Kevlar®-reinforced systems have been fielded on a limited basis, including ***USS Radford*** (DD-968) under MAC ALT 384 for up to forty ships supporting Desert Storm

Return on Investment High

Machine Gun Installation on the ***USS Elrod*** (FFG 55) and Armor Frames [MAC ALT 384]



Components

Topside Superstructure

Priority	Medium
Opportunity	Potential for in-situ repair of chronic aluminum deckhouse corrosion areas
Technical Issues	Fire and bond to aluminum
Previous Work	Numerous prototype systems developed including MARITECH, Helo Hanger and ManTech projects
Return on Investment	Low

MARITECH Composite Superstructure Project Built by Structural Composites and Ingalls using Adhesive Technology

Components

Valves

Priority	High
Opportunity	Potential to extend service life, and significantly reduce maintenance and adverse mission impacts of corrosion-prone metal components by using composite materials. Potential to eliminate hydroblast cleaning of CHT system valves
Technical Issues	Shock qualification and fire
Previous Work	Composite valves have passed shock test (NAVSEA drwg 803-6983491) and installed on 6 ships. The Capital Investment for Labor program plans on a major carrier CHT system installation.
Return on Investment	High

Composite Ball-Valve Family Developed by NSWCCD

Components

Vent Screens

Priority High

Opportunity Eliminate corrosion related maintenance and improve operability

Technical Issues Fire

Previous Work ERM-7 has fielded composite vent screens on 13 ships. NAVSEA drwg 803-6983500, Vent Screen, GRP Installation and Details will lead to MODAR screens in the supply system by the end of FY 03.

Return on Investment High

Example of Vent Screen Fielded by ERM-7

Components

Ventilation Ducting

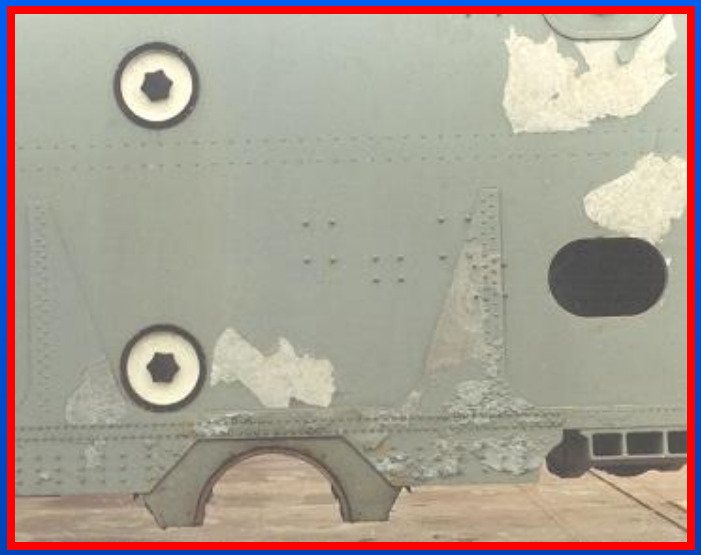
Priority	High
Opportunity	Eliminate corrosion related maintenance; improve ship air quality and improve ship availability
Technical Issues	Cost
Previous Work	NSWCCD and ManTech have fielded prototype systems
Return on Investment	High

Prototype Composite Ventilation Duct System Built by Boeing and Structural Composites Installed on the ***USS Samuel B. Roberts***, FFG-58

Components

Weapon System Enclosures

Priority	High
Opportunity	Eliminate corrosion related maintenance and improve operability
Technical Issues	Certification
Previous Work	ASROC housings were unsuccessfully built with aluminum-honeycomb core composite
Return on Investment	High



Example of Severely Corroded ASROC Housing That Utilized Aluminum Honeycomb