PDMT Panel Presentations – July 21, 2005

TITLE: Current Large Composite Structures

PRESENTER: Albert W. Horsmon, Jr., SP North America

ABSTRACT: The presentation will cover current composite technologies, materials and processes used in the manufacture of large high performance marine structures. Material selection runs the gamut from fiber types (E-glass, aramid, carbon), to weave, through sandwich core selection. Then processing options (hand applied, infusion, pre-preg) are added to the mix to show the extra levels of complication involved in designing and building large composite structures. Weights and cost comparisons for a large motoryacht built of similar materials but with different processes will be covered.

The results are often stunning: 40 knot "plastic" corvettes, towering trideck motoryachts, 30m electronics masts, even 120m diameter wind turbines, are current large composite structures.

TITLE: Seaborne Composite Coalition (SCC): Advancing Intermodal Mobility

PRESENTER: Jason Updegraph, Naval Surface Warfare Center Carderock Division (representing the Office of the Secretary of Defense (OSD) Office of Force Transformation)

ABSTRACT: The Office of Force Transformation, in partnership with other government agencies, has formed a *Seaborne Composite Coalition (SCC)* to advance the national competitive advantage of the *United States* in large-scale composite vessel construction. The intent is to catalyze ongoing efforts within numerous innovative commercial and defense sectors that use composite construction techniques in maritime vessels.

The overall objective of the coalition is to create a means to solve one of the most significant and complex issues of our time – namely the understanding of networked demands and logistical interdependencies of an information driven world. Large-scale, lightweight composite vessels are well suited to help provide solutions for some of these issues.

Our direct expectation for operationally relevant, high-speed, short-sea shipping is to create a new source of national competitive advantage using large-scale, lightweight composite vessels and to develop new competencies for the design and production of modular, lightweight, high-speed vessels.

TITLE: Production Technology Transfer and Demonstration for Large Composite Naval Vessels

PRESENTER: Bret Smith, Goodrich (presentation co-authored by Glenn Eliassen, Umoe-Mandal)

ABSTRACT: The potential benefits of composite materials used in naval vessels as primary structural has been recognized for quite some time. With sufficient funds and adequate time a preeminent composite solution could be demonstrated. However, recent Navy budgets have placed increased expectations on immediate affordable solutions. A rapidly changing threat has required new thinking in available countermeasures. Without a change in philosophy of how composites should be used and can be deployed as a part of the US Navy's solution, composites will be used scarcely. The Littoral Combat Ship (LCS) competition provided a scenario to investigate this philosophical change in how composite materials and technologies could be used in the USN. Three separate LCS designs, two metallic and one composite, were proposed. The composite design was not selected to move beyond the preliminary design phase. Nevertheless, Umoe-Mandal (UM) and Goodrich (GR) performed noteworthy work to develop and demonstrate relevant USN composite shipbuilding capabilities.

UM has delivered nine Mine Countermeasure Vessels (MCMVs) of the Oksøy class to the Royal Norwegian Navy from 1994-97, and a pre-series vessel of the Skjold-class Fast Patrol Boat (FPB) in 1999. Currently the production of the five Skjold-class series vessels is well underway at the yard in Norway, due for delivery in the period 2006-09. In addition the yard has built a Whitbread-around-the-world contender, a civilian rescue vessel, and high performance composite parts like centrifugal (lifting) fans, gun shields and towed bodies for mine sweeping purposes. GR has designed analyzed, manufactured, installed and serviced large composite structures for the US Navy for 40 years. These products include Sonar domes, structural fairings acoustic treatments and radar absorbing components for submarines, surface ships and special operation force vehicles.

General composite materials and processes used by GR and UM were very similar. Combined experience helped identify the most appropriate materials. Material candidates were selected and validated through testing. A merging of the two companies composite experiences coupled with input from other team members helped to established the baseline approach to design, fabricate and outfit a large all-composite Surface-Effect-Ship. UM's proven production and assembly methods were leveraged to set forth the production plan. Some concern for executing this approach in production was expressed, since this approach ultimately would need to be adopted by the shipyard. To address this concern a Risk Mitigation Demonstration Article (RMDA) was proposed and executed. Shipyard employees with no prior composite material experience were selected, trained and then built the RMDA and critical elements that included representative ship production requirements and features, such as flat panel production, sealing, bonding, joining, assembly, machining and installation of thermal protection systems.

TITLE: Composite Material Superstructures on Steel Naval Vessels

PRESENTERS: Glenn Eliassen & Jon Vonli, Umoe Mandal

ABSTRACT: Fibre Reinforced Plastic (FRP) has been used successfully as the structural material in larger naval ships for years, in particular in Scandinavia, with the Norwegian Oksoy class MCMV and Skjold class LCS, and the Swedish Visby class corvette. Another application anticipated for some years now are FRP superstructures for steel naval vessels. This would offer several advantages like reduced weight,

lowered centre of gravity, reduced maintenance cost, reduced signatures and the possibility to integrate sensors in the structural material. However, as always, advantages are accompanied by challenges, initially identified as obtaining an acceptable vulnerability to weapon loads, especially blast incidents, subsequent fires, and achieving sufficient electromagnetic shielding between compartments.

A multinational $ 12M R&D program has been executed to address these challenges, with major European research establishments, shipyards and designers as participating parties. The program was funded by the Ministries of Defence in Norway, Denmark, France, Italy, the Netherlands and the UK and was successfully completed in February 2004. The main project objective was to strengthen the technological basis for large-scale application of FRP composite materials to naval vessels and structures, so that such vessels can be designed with confidence on the basis of modelling and failure prediction.

Umoe Mandal, being a key participant, will give a presentation of the work done in this R&D program. The program background and motivation will be described, along with the established program structure, a description of the work tasks (in design, analysis, production and testing), and the project results.

TITLE: Structural Applications of Composites in the U. S. Navy

PRESENTER: Dr. Erik Rasmussen, Structures and Composites Division Head, Naval Surface Warfare Center, Carderock Division

ABSTRACT: Composite materials are gaining increasing consideration for U.S. Navy ship applications. The need to reduce acquisition and life cycle cost, reduce manning, reduce signatures, and increase the level engineering integration in future ships makes composite materials attractive alternatives for these platforms. In considering the needs of the Navy’s future ships, certain challenges emerge regardless of the specific platform under consideration. These challenges include materials and manufacturing cost, validated design practices, managing fire smoke and toxicity risks, long term environmental performance, and readiness of the shipbuilding infrastructure.

This presentation highlights the requirements that guide the use of composite materials for ship applications, how composite materials have been used on Navy platforms to date, current research activities, and the role composite materials may play in future ship design. Truly integrating composite materials into the ship design process will allow the U.S. Navy and its shipbuilding partners the ability to utilize the benefits that these materials can provide.

TITLE: Navy Composites Manufacturing Technology Center – A Brief Review of ManTech Projects

PRESENTER: Ivan Snell, Composites Manufacturing Technology Center

ABSTRACT: The Composites Manufacturing Technology Center (CMTC) is the Navy's Center of Excellence for composites manufacturing technology. The CMTC is operated by the South Carolina Research Authority (SCRA) under a Cooperative Agreement with the Office of Naval Research and is one of the Navy's nine Centers of Excellence that

serve as technology resources to ONR under the Navy ManTech Program. The CMTC develops improved manufacturing processes and facilitates technology transfer for the resolution of composite materials manufacturing and repair issues that are identified and prioritized by the Navy's Program Executive Offices (PEO's), other DOD services and industry. The developed technologies have application to modern DOD aircraft, surface ships, submarines, land vehicles, and associated weapons and missiles.

The technology resource for the CMTC is The Composites Consortium which is chaired by SCRA. TCC is an industry-focused, balanced team of prime contractors for weapons systems, composites industry suppliers, universities, and institutes. The CMTC draws upon the strong in-depth knowledge, experience and the collective expertise of the consortium membership in the resolution of composite materials manufacturing and repair problems.

This presentation will consist of a brief overview of ongoing ManTech composite projects, with an emphasis on technologies specifically applicable to the implementation of composite materials on surface ships and submarines. Mention will be made of ongoing projects for aircraft and missile applications to highlight recent developments and the level of sophistication of the current state of art of manufacturing technology for composite materials.

TITLE: High Performance Composite Ship Structures

PRESENTER: Jerry Fanucci, KaZaK Composites

ABSTRACT: KaZaK Composites will discuss several of its currently active Navy SBIR programs related to high performance composite Ship Structures, including work related to 1) Pultrusion of very large carbon and glass skinned, balsa core sandwich panels with integral joints for DD(X)-like superstructure, 2) Impact resistant composite hull bottom structure for LCUs, 3) Proprietary core material meeting UL-1709 and optimized for pultrusion processing, 4) Pultruded composite joiner panel system, 5) Lightweight composite hatch system, 6) Stanchions and dunnage for T-AKE and other cargo ships, and 7) Composite submarine Universal Modular Mast guide trunk.

TITLE: Fire Resistant Composites

PRESENTER: Richard N. Blackington (consultant), Creative Pultrusions, Inc. (CPI)

ABSTRACT: Composites are becoming a material of interest in the next generation of Naval Surface Combatants. Requirements for stealth, reduced weight and maintenance are forcing the shift from traditional metals to composites. However, the fire performance of current composites poses a safety risk aboard ships. Creative Pultrusions, Inc. (CPI) has, with in-house funds, responded to this safety initiative with the development of a fire resistant polyurethane system that has exceeded the requirements of the International Maritime Organization (IMO) Part 5 as well as exceeding the smoke standards of E662. The independent test results of these efforts will be presented to the Panel. Included in the brief will be the results of structural testing of panels pultruded under the auspices of an SBIR project involving both Materials Sciences Corporation and CPI.

TITLE: Composite Watertight Doors

PRESENTER: Rob Banerjee, WebCore Technologies, Inc.

ABSTRACT: WebCore, in collaboration with Mafo-Holtkamp, has developed a lightweight composite watertight door for Navy ships. The door features Mafo-Holtkamp's proprietary operating mechanism and steel frame and a composite panel made with WebCore's patented TYCOR® material and fire-resistant phenolic resin. The composite door is significantly lighter than the baseline Mafo-Holtkamp stainless steel door. The composite door has passed hydrostatic tests as well as durability and flammability tests. A prototype composite door is scheduled for shipboard installation and sea trial later this year. WebCore will also present their recent work on topside structures and other shipboard applications of composites.

TITLE: Composite Hull Acoustics Review

PRESENTER: Ray Fischer, Noise Control Engineering, Inc.

ABSTRACT: The acoustical characteristics and signature of a ship are of the same level of importance as its stability, strength, speed or maneuverability – particularly for navy combatants. The vessel's underwater radiated signature, noise levels of manned compartments, and sonar self-noise are significant design and production issues. For conventional metal hulls there are well-developed noise prediction routines for ship compartments that can be used in the design stage for the prediction and for the optimal selection of noise treatment. However the same is not true for composite hulls. This talk will explore some of the differences between the acoustic properties of composite and metal panels and what needs to be understood in order to develop accurate prediction algorithms for composite hulls.
