High-performance composite ships to be built by UC San Diego-led consortium with help of ARPA grant

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HIGH-PERFORMANCE COMPOSITE SHIPS TO BE BUILT

BY UC SAN DIEGO-LED CONSORTIUM WITH HELP OF ARPA GRANT

A research and industrial consortium led by structural engineers at the University of California, San Diego has been selected to receive a grant of up to $3 million from the Advanced Research Projects Agency (ARPA) to design and construct a new generation of ships and ship components based on light-weight composite materials.

The two-year grant will be matched with $4.75 million from the nine-member consortium, bringing total funding for the project to $7.75 million.

By the end of the two-year grant, the consortium is expected to design, build and test critical hull sections for two high- performance passenger ships ranging from 65-feet to 100-feet in length.

The consortium also is expected to design and build components for large cargo ships, including huge vehicle ramps capable of supporting tanks and other armored vehicles, hatch covers able to tolerate up to 2 million pounds each, and a five- story deck house.

"This project is on a fast spring-board for the creation of tens of thousands of jobs in the United States," said Robert Asaro, professor of structural engineering at UC San Diego, and principal investigator of the ship project.

"There's far reaching and long-range research and development, to be sure," he added. "But there is also a very near-term payoff in terms of jobs and international product sales."

U.S. Rep. Randy "Duke" Cunningham (R-San Diego), who supported the proposal, added: "The key to revitilizing our commercial shipbuilding industy is our technological edge. The research planned at UCSD and its partners may identify promising technologies that can make our maritime industry a player on the world scene."

According to federal estimates, the expected worldwide market over the next decade for ship construction is $300 billion to $400 billion. Most of this market focuses on large ships including tankers, containerships, cruise ships, and smaller vessels such as ferries, work boats and coastal patrol boats.

However, the U.S. accounts for only one percent of this business.

"With advanced composite materials, the U.S. is offered a superb technical and economic competitive edge to capture a greater share of the major ship building market," said Asaro.

During the past year, UC San Diego researchers have been researching the use of advanced composite materials for bridges and other infrastructure under a federally sponsored Technology Reinvestment Project. As part of the project, UC San Diego structural engineers at the Charles Lee Powell Structures Laboratories and a consortium of industrial partners are designing and building a fan-shaped highway bridge in San Diego that would connect the east and west campuses of UC San Diego.

"We're using very similar technologies and similar classes of materials for the ship project," said Asaro. "There are strong parallels in design approaches and in the kinds of loads that have to be supported, although in ships you get much higher loading situations."

Currently, most large ships are built from either aluminum or steel. The use of advanced composite materials--including kevlar, epoxy, plastics, fiber and glass--offer several advantages: they're light-weight, corrosion-resistant, durable, and can be tailored for strength, flexibility and shape.

As envisioned, the project will involve the design and construction of two classes of sleek passenger ships.

One variety, called surface effects ships (SES), is designed with a catamaran hull and thin-edged pontoons that run the length of the ship, each with a cavity of air inside them. The ship thereby glides on a cushion of air with only the pontoon blades touching the sea surface. By the end of the two-year grant period, Asaro says the consortium will design and construct a 100-foot hull for an SES ferry capable of transporting 149 passengers at 60 knots. Eventually, this class of ship could grow upward to 300 feet using the same materials, construction and technology.

A second class of ship, called a small water area twin hull (SWATH) also begins with a catamaran hull. However, this ship rides on submerged pontoons attached to the hull by thin, stilt- like struts. The design sharply reduces the ill effects of heavy seas on ships by minimizing contact with the ocean's choppy surface. Asaro said the consortium will design and build a 65- foot hull for a SWATH vessel within two years.

"Constructing SWATH boats is highly labor intensive with aluminum, requiring an enormous amount of cutting and joining," said Asaro. "With composite manufacturing and the use of molds, we feel we can get the cost down by more than 30 percent, maybe 50 percent, assuming you are building more than one.

"Further we can reduce construction time by a factor of 2. If you tell someone you can deliver a boat in half the time, it means a lot."

Even before the ship hulls are ready, the consortium will have designed and built large ship components for naval cargo vessels.

These include large stern ramps that may measure as tall as 80 feet, and as wide as 50 feet. Currently, these structures are made from heavy-weight steel. Asaro said if these ramps were built from composites, its weight would be cut in half and last more than twice as long.

"Corrosion is a big problem with these things," he said. "There are lots of operational reasons to want to go toward composites for these."

Aside from ramps, a variety of other ship components are slated for composites including hatch covers, helicopter landing pads, observational platforms and decking.

"With large ship structures, we feel this represents an opportunity to make a major improvement in the product," said Asaro. "We can greatly improve performance, life cycle and maintenance. The tooling is cheap, it reduces labor costs and it's lighter in weight meaning you have more space for cargo."

Throughout the project, the consortium will be working with a variety of national and international certification agencies to make sure the new materials meet fire safety standards.

Aside from UC San Diego, other members of the ship consortium include: Designers & Planners, Inc., based in Arlington, Va.; Tran-Science Corp., of La Jolla; Swath Ocean Systems, San Diego; NASSCO, San Diego; Harley Boats, Inc., Bartol, Fla.; TPI, Inc., Warren, Rhode Island; Structural

Composite Inc., Texas; Seemann Composites of Gulfport, Miss.; and Gionnotti Marine Services, Ventura, Calif.

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