



INNOVATIONS FOR LIVING®

CASE STUDY

XStrand® Reinforcements Strengthen Pipe for Ocean Thermal Energy Conversion Project

High-performance glass fibers reinforce pipe moving large volumes of water while withstanding salt and currents in demonstration project

OTEC Process

- Uses temperature difference between surface and deep water to drive a Rankine cycle with low-boiling-point fluid

Large-Diameter Pipe

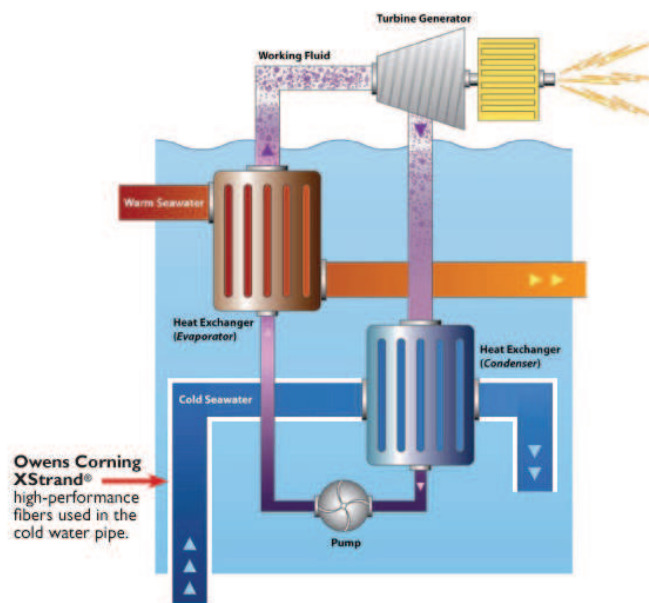
- Filament winding used to produce pipe on a floating platform

Reinforcement

- XStrand® high-performance reinforcements
- Single-end roving

Principal Market

- Renewable energy



The U.S. Department of Energy (DOE) recently awarded a cooperative agreement contract to Lockheed Martin to demonstrate a pipe fabrication approach using modern composite technology and manufacturing methods at both prototype and pilot plant scales. Lockheed Martin has contracted with Owens Corning to provide XStrand® high-strength glass fiber reinforcements for use in the large-diameter cold-water pipe that will be required to reach ocean depths of thousands of feet.

Ocean Thermal Energy Conversion (OTEC) generates electricity by exploiting the temperature difference between warm surface water and deep cold water. The temperature difference is used to drive a Rankine cycle operating with a low-boiling-point fluid. Warm surface water passes through a heat exchanger, vaporizing the fluid, which drives a turbine generator, producing electricity. The process is free of global warming emissions and does not require any external fuel source.

Dennis Cooper, OTEC program manager for Lockheed Martin, said OTEC holds the promise of providing clean, base-load electricity to energy markets that today rely almost exclusively on fossil fuels. "It's conceivable, for example," explained Cooper, "that OTEC could enable Hawaii achieve energy independence within a generation. Our independent research and development work to date has shown OTEC to be technically feasible. The next step is to demonstrate it on a commercial scale and the DOE contract will help accelerate our progress toward that goal."

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Since the ocean's temperature difference is relatively small, large volumes of sea water must be moved to generate commercial levels of power. The fabrication and installation of large-diameter cold-water piping represents one of the largest technical challenges to the successful installation and operation of an offshore OTEC system.

To support the project's early development work, Owens Corning performed fatigue and corrosion testing at its Science and Technology Center in Granville, Ohio, as well as provided quantities of XStrand® high-performance reinforcements and small composite components for aggressive performance testing. The company also worked closely with Lockheed Martin engineers to develop three special fabric designs for the project.

"This is another exciting application of composite technology in renewable energy," said Marcio Sandri, Americas vice president and managing director for the Owens Corning Composite Solutions Business. "Composite materials already enable cost-effective fabrication of blades for wind turbines. With high-strength glass fiber reinforcements enabling the continuous production of tough, corrosion-resistant large-diameter pipe at sea directly from a floating platform, OTEC can become another viable method for obtaining energy from renewable sources."

Under terms of the \$1.2 million DOE cooperative agreement, Lockheed Martin will demonstrate a cold-water-pipe fabrication approach using modern fiberglass technology and innovative composite manufacturing methods. Fabrication work will be performed at Lockheed Martin's Advanced Technology Center in Sunnyvale, Calif. West Virginia University's Constructed Facilities Center is also supporting the project.

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For more about how Lockheed Martin is addressing energy and climate challenges, visit:
www.lockheedmartin.com/capabilities/energy/

For more about XStrand® high-performance glass fiber reinforcements from OCV™ Reinforcements, visit:
<http://www.ocvreinforcements.com/page/hp.asp>



OCV Reinforcements

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