3,000 FEET UNDER THE SEA

Choosing the proper materials to help move water long distances is important in any piping system application. When the project requirements get more specific – like pumping ashore 38-degree seawater from a 3,000-foot depth for use by aquaculture and energy-generating tenants in Hawaii – that decision carries even more importance.

Engineers at the Natural Energy Laboratory of Hawaii Authority (NELHA), near Keahole Point on the western-most point of the Big Island of Hawaii, needed to do just that. NELHA operates the Hawaii Ocean Science and Technology Park that provides the resources, support, and facilities for many innovative ocean-related businesses. Engineers from NELHA's consultant, Makai Ocean Engineering, Inc., chose about 10,000 feet of HDPE pipe in 55-inch and 63-inch diameters.

"It works," said Tom Daniel, one of the project scientists with NELHA, when describing the reasons for choosing HDPE. "The flexibility and strength have proven to be ideal. The buoyancy and flexibility of HDPE allow cost-effective deployments."

Since the world's tropical oceans are a huge collector of heat energy, NELHA engineers can take advantage of a process that uses that energy for various scientific and practical endeavors. That process is called Ocean Thermal Energy Conversion (OTEC). NELHA has hosted a series of OTEC experiments since its founding in 1974.

OTEC utilizes the difference in temperature between warm surface seawater and cold deep seawater to produce energy. The cold deep seawater can also be used to air-condition buildings, desalinate water, grow lobsters and fish, produce algae and shellfish, grow cold-climate fruit and vegetables and much more. To do that, NELHA must get the cold water from deep in the ocean to the surface.

The Municipal & Industrial Division of the Plastics Pipe Institute (PPI) is focused on opening and broadening market opportunities for polyethylene pipe for water distribution. The NELHA project at Keahole Point was a perfect fit to advance the vision and mission of both organizations.

"These are the kinds of unique applications that you'll be seeing more of in the future," said Rich Gottwald, executive director of PPI. "The list of applications for HDPE keeps growing."

PPI manufacturing member KWH Pipe of Mississauga, Ontario produced the pipe for the project from March through May of 2001. The pipe was ultimately carried by barge to the project site and installed in October of 2001. Ease of installation was another main reason HDPE pipe was chosen.

"The pipe is filled with air, which supports it and its anchors during towing to the site where it is flooded for sinking," Daniel said. "The intrinsic buoyancy of the HDPE pipe allows cost-effective designs using buoyant catenaries or pendant-weighted buoyant sections to avoid rough areas on the bottom of the ocean."

The 9000-foot long cold water pipeline was successfully deployed Oct. 11 and 12, 2001 by the Contractor, Healy Tibbitts Builders, Inc. of Honolulu. The pipeline was delivered in two shipments arriving the previous June and July.

The pipe was fused into nine sections, each approximately 1,000 feet in length on shore at Kawaihae Harbor on the northwest corner of the Big Island. In a 3-day assembly and deployment operation, the flanged sections were joined into one 9,000-foot long pipe segment, towed 27 miles to the site and deployed using a controlled submergence process.

A separate warm water intake structure was also installed near the 80-foot-deep end of one shore crossing tunnel, and spool pieces connect that structure and the offshore HDPE pipe to the two tunnels constructed earlier. The tunnels extend about 500 ft onshore to the pump station which is now under construction. The system is expected to begin pumping ashore deep cold (39°F) and surface (76°F - 81°F) seawater by the end of July 2002.

Daniel says OTEC has tremendous potential for large-scale energy generation in the future.

“If ways can be found to deploy and operate large pumps at 3,000-foot depth, HDPE might again prove to be the ideal pipe material for the very large diameter pipes required for that application, too,” Daniel said.

In the meantime, there is growing interest in smaller diameter suction pipelines for bringing ashore deep seawater for aquaculture and cooling applications, like the one at Keahole Point. The only existing example outside of NELHA is Cornell University's Lake Source Cooling Project which cools the University campus by pumping cold water from 250 feet deep in Cayuga Lake through a 2-mile long 63-inch HDPE pipeline, also designed by Makai Ocean Engineering.

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