Sao tome energy storage for load shifting

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A project to deploy a 1.5-MW commercial-scale ocean thermal energy conversion (OTEC) platform in the African island nation of São Tomé and Príncipe by 2025 has gained a key design certification. The crucial milestone directly addresses technical risks that have hampered OTEC, a long-pursued baseload offshore renewable technology.

“History is an important teacher, and we are committed to learning from it,” said Global OTEC Founder and CEO Dan Grech. “Failure of previous OTEC projects highlights where we should exercise caution, so third-party technical due diligence from the earliest stage is important for our success,” he said.

Global OTEC’s flagship project is the “Dominque,” a floating 1.5-MW OTEC platform set to be installed in São Tomé and Príncipe in 2025 (Figure 1). The company says the platform “will be the first commercial-scale OTEC system.”

That’s significant because OTEC is a technology that was proposed as far back as 1881 by French physicist Jacques Arsened’Arsonval for converting solar radiation absorbed into the ocean to electrical power. OTEC has been proven to provide continuous power as well as fresh drinking water and cold water for refrigeration. But while more than a dozen prototypes have been tested intermittently since the first experimental 22-kW low-pressure turbine was deployed in 1930, no commercial-scale plants exist.

Existing prototypes have typically conformed to three basic configurations depending on their location: on land, relatively a short distance from the coast; mounted on the edge of a continental shelf; or on a floating platform or ship, where deep cold water can be accessed directly underneath the hull.

More recent notable projects include Makai Ocean Engineering’s land-based 105-kW OTEC plant at a research center in Hawaii, and a 20-kW OTEC floating pilot plant spearheaded by the Korean Research Institute of Ships and Ocean Engineering (KRISO) that began operating in 2012. KRISO is now developing a 1-MW OTEC demonstration in the small Pacific Island of Kiribati based on a trial operation of a system tested in South Korea’s East Sea (near Pohang, Figure 2).

The Korean Research Institute of Ships and Ocean Engineering (KRISO) plans to relocate its 1-MW K-OTEC 1000 barge OTEC power cycle equipment, tested near Pohang, South Korea, to Kiribati Island. Courtesy: KRISO

“The 1-MW OTEC demonstration was designed for 24-degree-C seawater temperature difference and has successfully carried out in a trial operation (output of 338 kW under operating condition of 18.7-degree-C temperature difference) in Korea,” Dr. Hyeon-Ju Kim, a KRISO principal researcher, told OES in a

July 2022–published interview. “If the demonstration of the 1-MW OTEC plant near the equator is successfully carried out in the future, competent professionals can draw a positive outlook on the scale of 10-, 100-, and 400-MW OTEC plants gradually.”

OTEC development is also making headway in Japan, where in 2016, a 100-kW OTEC demonstration on Kume Island, Okinawa Prefecture, was connected to the grid. OTEC power generator Xenesys, which runs and maintains the project for Okinawa Prefecture (Kumejima Town), alongside project partners Japanese transportation firm Mitsui O.S.K. Lines (MOL) and Saga University, confirmed the demonstration (Figure 3) is still operating.

Global OTEC acknowledged, however, that launching its first commercial project, the Dominique, will require trailblazing a deployment pathway that directly addresses risks that have long hampered OTEC. The most prominent one relates to cold water riser pipes (see sidebar above, “What Is a Riser Pipe?”), which furnish OTEC installations with the significant amount of cold water they require.

Global OTEC says it chose a floating barge design because onshore OTEC plants “require several multi-kilometer pipes fixed to the seabed” to facilitate the acquisition and safe discharge of water. Water pipes, it noted, “represent one of the largest cost centers of an OTEC plant.” Onshore OTEC, which effectively centralizes power production, also limits the regions where the process can be economical, and it presents a single point of failure in the event of a natural disaster.

Along with thoroughly vetting its risks related to OTEC riser pipes—through third-party technical reviews—the company says it has pursued a rigorously detailed design phase for the cold-water pipe “in collaboration with suppliers and scientists on the cutting-edge of subsea riser pipe designs.” To further curb risks, it will deploy its first commercial systems “in a market where much smaller distances between warm surface seawater and cold deep water are present,” it said.

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