Japanese tsunami's effects will change how, where future nuclear power plants are built

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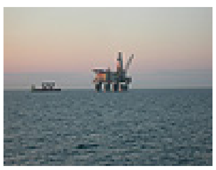

Seismically isolated platform in the North Pacific demonstrates how power plants can be built to withstand extreme conditions, says Constantinou of UB.

The design of next-generation nuclear power plants and other critical energy facilities will undoubtedly be influenced by the Japanese tsunami and its devastating effects on Japan's nuclear reactors, says Michael C. Constantinou, PhD, professor of civil, structural and environmental engineering at the University at Buffalo.

"If a nuclear reactor is built at a site where a 30-foot tsunami wave is possible, if it comes, it is going to have a significant effect, there is no way to control for that," says Constantinou, a structural engineer, and researcher with UB's MCEER (Multidisciplinary Center for Earthquake Engineering Research.) He works on seismic protective systems that deflect and dissipate seismic energy and protect structures during earthquakes.

"The only way to prevent the situation is to build the plant further inland, to seismically isolate it and, perhaps, to elevate it," he says.

According to Constantinou, it is possible to seismically isolate an entire facility on a concrete platform.

"This is possible technologically, but much more complex," he says.

Constantinou is familiar with this technique, having consulted with UB colleague Andrew Whittaker on the design of seismically isolated offshore oil and gas drilling platforms in the North Pacific near Russia's Sakhalin islands, several hundred miles north of the epicenter of the March 11th Japanese earthquake.

"These platforms sit on concrete bases on the ocean floor with legs that are about 80 meters tall, and the structure on top of the platform is another 20 stories high; the entire structure weighs some 30,000 tons," he explains.

"Conditions there are extreme," he continues. "It is a multi-hazard environment, where one hazard can worsen the effects of another. The platforms are designed to withstand, without failure or significant effect, major earthquakes, ice forces on platform legs where giant slabs of ice two meters thick can form, temperatures as low as -40, blasts and very large waves, on the order of 10 meters above the ocean's surface, which only may occur once every 10,000 years, and waves in combination with ice slabs," he says. "They are very difficult structures to design."

The offshore platforms, about 100 meters by 100 meters in plan dimensions, sit on four friction pendulum bearings, each of which has the capacity to safely carry 13,000 tons. The friction pendulum bearings allow structures to respond to strong earthquakes by swinging gently from side to side, like a pendulum, minimizing the risk of damage to the structure and the people who work inside it.

Constantinou says that the bearings, made of steel ductile to very low temperatures and which have a large displacement capacity and a capacity to carry such large loads, are the only ones suitable for the extreme conditions encountered in the North Pacific.

"It wouldn't be possible to use elastomeric -- rubber -- bearings, which are very frequently used in Japanese buildings," Constantinou explains. "At those very low temperatures, the rubber bearings become brittle and can shatter like glass. Also, these loads and displacement demands are too large for elastomeric bearings."

UB faculty often travel to countries and regions devastated by earthquakes, as part of international efforts to improve seismic design of buildings and infrastructure. Disaster mitigation, response to extreme events and multi-hazard engineering are research strengths of the university identified in the UB 2020 strategic plan.

Provided by University at Buffalo