K-State project aims to make sodium-cooled nuclear reactors safe, efficient

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Proposals to reduce America's heavy dependence on foreign oil are helping to renew interest in nuclear energy. And at Kansas State University, the goal is to help make that energy source as safe as possible.

The K-State department of mechanical and nuclear engineering has received a three-year, approximately $550,000 grant from the U.S. Department of Energy's Nuclear Energy Research Initiative for the project "Experimental Development and Demonstration of Ultrasonic Measurement Diagnostics for Sodium Fast Reactor Thermohydraulics." Principal investigator Akira Tokuhiro, associate professor, along with Bruce Babin, assistant professor, Terry Beck, professor, and Mohammad Hosni, professor and department head, will look at technology issues in sodium-cooled fast reactors.

In reactor design, creating the reactor core and then the cooling system are the most important aspects, Tokuhiro said.

"Liquid sodium works well for this task," he said of the cooling system. Sodium conducts heat better than water, which is the current coolant of choice. In addition, sodium's boiling point is higher than water's.

"Reactors produce a lot of heat and you want a coolant that has a high boiling point," Tokuhiro said.

Although sodium makes an excellent coolant for reactors, it is

chemically reactive and optically opaque, which has implications for operations, maintenance and inspections. Using sodium, rather than water, as a coolant was the subject of much research in the '60s, '70s and '80s. However, waning support for nuclear energy in the post-Three-Mile Island and Chernobyl years led research and development to basically cease by the early '90s, Tokuhiro said.

The concept is well-known, but Tokuhiro and co-investigators plan to undertake research on how to actually make a sodium-cooled reactor work and work safely and economically.

For example, reactor operators must be able to measure and monitor certain things in a reactor to make sure the coolant is working, such as the velocity, pressure and temperature of the coolant. Since scientists can't see through liquid sodium and it chemically reacts with oxygen, there are only a few ways to measure the velocity of liquid sodium in motion.

"Ultrasonic is practically the best way and our project will further develop the technology in this area," Tokuhiro said. "Also, since the speed of sound or acoustic waves change in sodium with temperature, if you can detect the change in this speed, you can back calculate the temperature of sodium -- in principle.

"These thermohydraulic measurements need to be well tested in order to assess their applicability in a sodium-cooled fast reactor," he said. "This research will maintain and extend the U.S. nuclear sodium fast reactor knowledge base, as well as educate the next generation of professionals familiar with the sodium fast reactor."

Source: Kansas State University