Advanced adsorption chiller uses nanomaterial to be up 50 percent more efficient

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PNNL has been awarded $2.8 million to adapt its nanomaterial-using adsorption chiller system for field military bases on the front lines of battle. By using up to 50 percent less diesel than the air-chilling technologies currently used by the military, the system could save soldiers lives by reducing attacks on troops who transport fuel in supply convoys. Credit: PNNL

A new, energy-efficient air chilling system could keep troops on the front lines cool while using about half as much diesel as current systems. The system's decreased fuel consumption could also save lives by reducing attacks on American soldiers who deliver fuel to field operations.

The Department of Energy's Pacific Northwest National Laboratory will

receive up to $2.8 million over three years to develop the system, the Department of Defense, Navy and DOE's Advanced Research Projects Agency-Energy, also known as ARPA-E, announced Wednesday. PNNL's project was among five awarded a total of $8.5 million to improve the efficiency of battlefield heating and air conditioning systems by 20 to 50 percent.

"PNNL is looking forward to adapting its ongoing research into advanced, energy-efficient cooling technologies and apply it toward important military needs," said PNNL Laboratory Fellow and project leader Pete McGrail. "Our team has a strong emotional connection to the success of this project, as it could help prevent American soldiers from being injured or killed while moving fuel in dangerous supply convoys around the battlefield."

PNNL is partnering with Oregon State University and Power Partners, Inc. of Athens, Ga. on the project.

PNNL's system will be a next-generation adsorption chiller that is specially designed to be smaller, lighter, more efficient and operate under the extreme temperatures experienced at bases on the frontlines, also called forward operations. The chiller will use a novel nanomaterial called a metal organic framework, or MOF. MOFs are crystal-like compounds made of metal clusters connected to organic molecules, or linkers. Together, the clusters and linkers assemble into porous 3D structures. PNNL developed a MOF that can hold up to three times more water than the silica gel used in today's adsorption chillers. This helps make PNNL's test adsorption chiller system much smaller and lighter. This project will build on advances in adsorption cooling technology PNNL has already made under ARPA-E's Building Energy Efficiency Through Innovative Thermodevices, or BEET-IT, program.

Further improvements for this project will include breakthroughs in

microchannel heat exchanger technology and improvements in the MOF's thermal properties. Both advances will help reduce the size and weight of the chiller further and squeeze out more cooling efficiency.

"This will be the most advanced adsorption cooling system ever developed, and these advances are needed to meet very demanding military requirements," McGrail said.

PNNL's military system will run off of waste heat coming from a diesel generator. This could reduce the diesel fuel use needed to cool field military installations by up to 50 percent. The planned 3-kilowatt unit will weigh about 180 pounds and take up about 8 cubic feet.

This isn't the first time the two systems have received support. PNNL began developing its MOF adsorption chiller for commercial buildings in 2010, when PNNL received ARPA-E funding for the BEET-IT, program. PNNL also received ARPA-E funding in 2011 to adapt the adsorption chiller to heat and cool electric vehicles with minimal impact on driving distance.

Provided by Pacific Northwest National Laboratory