



# NREL + SANDIA + JOHNSON CONTROLS

NREL and Sandia National Laboratories have partnered with Johnson Controls to deploy the company's BlueStream Hybrid Cooling System (HCS) at ESIF's high-performance computing (HPC) data center to reduce water consumption seen in evaporative cooling towers. As part of the BlueStream HCS, a thermosyphon cooler—an advanced, low pressure drop, dry cooler that uses refrigerant in a passive cycle to dissipate heat—was placed upstream of the HPC data center cooling towers to create a hybrid cooling system. Intelligent controls within the Johnson Controls' system coordinate the operation for optimum water and operating cost efficiency—using wet cooling when it's hot and efficiently modulating towards dry cooling when it's not. The unique design and controls of the thermosyphon cooler allow it to safely cool the primary cooling loop water and prevent freeze-ups even during subfreezing ambient temperature conditions.

## R&D STRATEGY

Johnson Controls modeled the installation of a thermosyphon upstream of the ESIF's evaporative cooling towers and found that the system would cut the annual water use for cooling by 56% without any negative impacts on the HPC data center's efficiency. Based on these positive results, a thermosyphon was installed on the ESIF roof and started operating in August 2016. The system is being monitored for one year to compare the actual results with the modeled results. Sandia National Laboratories is participating in the project for possible applications at their site.

## IMPACT

The use of thermosyphon coolers in evaporative cooling systems can yield significant water savings. Such issues will gain increasing prominence as the world moves towards exascale computers, which will have 1,000 times the performance capability of today's supercomputers. The expected high energy consumption of an exascale computer will require focusing on both energy-smart and water-smart cooling solutions.



Johnson Controls thermosyphon with hail guards and cooling towers on top of the ESIF. Photo by Dennis Schroeder, NREL 41999

## Partner with NREL at the ESIF

User facility access to the ESIF is awarded through the review and approval of user proposals, depending on the scientific merit, suitability of the user facilities, and the appropriateness of the work to DOE objectives, and includes a signed user agreement for the facility.

For more information, please visit:

[www.nrel.gov/esif/work-with-us.html](http://www.nrel.gov/esif/work-with-us.html)

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The Energy Systems Integration Facility (ESIF) at the National Renewable Energy Laboratory (NREL) provides the R&D capabilities needed for private industry, academia, government, and public entities to collaborate on utility-scale solutions for integrating renewable energy and other efficiency technologies into our energy systems.

To learn more about the ESIF, visit: [www.nrel.gov/esif](http://www.nrel.gov/esif).

**National Renewable Energy Laboratory**

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