



NREL Energy Performance Testing of Asetek's RackCDU System on a Single Rack of Twin Blade Servers

**Cooperative Research and
Development Final Report**

CRADA Number: CRD-13-518

NREL Technical Contact: David Sickinger

**NREL is a national laboratory of the U.S. Department of Energy
Office of Energy Efficiency & Renewable Energy
Operated by the Alliance for Sustainable Energy, LLC**

This report is available at no cost from the National Renewable Energy
Laboratory (NREL) at www.nrel.gov/publications.

CRADA Report
NREL/TP-2C00-72296
August 2018

Contract No. DE-AC36-08GO28308

NOTICE

This work was authored by the National Renewable Energy Laboratory, operated by Alliance for Sustainable Energy, LLC, for the U.S. Department of Energy (DOE) under Contract No. DE-AC36-08GO28308. Funding provided by the U.S. Department of Energy Office of Science (SC), Advanced Scientific Computing Research (ASCR). The views expressed in the article do not necessarily represent the views of the DOE or the U.S. Government. This report is available at no cost from the National Renewable Energy Laboratory (NREL) at www.nrel.gov/publications.

This report is available at no cost from the National Renewable Energy Laboratory (NREL) at www.nrel.gov/publications.

U.S. Department of Energy (DOE) reports produced after 1991 and a growing number of pre-1991 documents are available free via www.OSTI.gov.

Cover Photos by Dennis Schroeder: (left to right) NREL 26173, NREL 18302, NREL 19758, NREL 29642, NREL 19795.

NREL prints on paper that contains recycled content.

Cooperative Research and Development Final Report

In accordance with Requirements set forth in the terms of the CRADA agreement, this document is the final CRADA report, including a list of Subject Inventions, to be forwarded to the DOE Office of Science and Technical Information as part of the commitment to the public to demonstrate results of federally funded research.

Parties to the Agreement: Asetek Services, Inc.

CRADA number: CRD-13-518

CRADA Title: NREL Energy Performance Testing of Asetek's RackCDU System on a Single Rack of Twin Blade Servers

Joint Work Statement Funding Table showing DOE commitment:

Estimated Costs	NREL Shared Resources a/k/a Government In-Kind
Year 1	\$20,000.00
Year 2	\$5,000.00
Year 3	\$5,000.00
TOTALS	\$30,000.00

Abstract of CRADA Work:

The project will entail Asetek retrofitting 1 – 2 compute racks of servers at the National Renewable Energy Laboratory (NREL) to test and validate RackCDU's cooling performance and long-term reliability. The project will also entail measuring and reporting energy savings under a real workload by comparing total power input to the system vs. total heat removed by liquid and air. Direct measurements will be made to compare and contrast energy consumption and performance both before and after RackCDU installation. The scope of this project is strictly demonstration and feedback on the system. No development work will be performed under this CRADA.

Summary of Research Results:

In this study, we reported on the first tests of Asetek's RackCDU direct-to-chip liquid cooling system for servers at NREL's ESIF data center. The system was simple to install on the existing servers and integrated directly into the data center's existing hydronics system. The focus of this study was to explore the total cooling energy savings and potential for waste-heat recovery of this warm-water liquid cooling system. RackCDU captured up to 64% of server heat into the liquid stream at an outlet temperature of 89 degrees F, and 48% at outlet temperatures approaching 100 degrees F. This system was designed to capture heat from the CPUs only, indicating a potential for increased heat capture if memory cooling was included. Reduced

temperatures inside the servers caused all fans to reduce power to the lowest possible BIOS setting, indicating further energy savings potential if additional fan control is included. Preliminary studies manually reducing fan speed (and even removing fans) validated this potential savings but could not be optimized for these working servers. A report was produced after the Asetek direct-to-chip liquid cooling system had been in operation for 16 months (system commissioned June 10, 2013). This Asetek cooling system remained in operation until May 23, 2018 when servers were finally decommissioned.

- **Citation:** D. Sickinger, O. Van Geet, C. Ravenscroft. 2014. *Energy Performance Testing of Asetek's RackCDU System at NREL's High Performance Computing Data Center*. NREL/TP-2C00-62905. <https://www.nrel.gov/docs/fy15osti/62905.pdf>.

Subject Inventions Listing:

None

ROI #:

None

Report Date:

18 June 2018

Responsible Technical Contact at Alliance/NREL:

David Sickinger

Name and Email Address of POC at Company:

Steve Empedocles, sem@asetek.com

DOE Program Office:

USDOE Office of Energy Efficiency and Renewable Energy (EERE)

This document contains NO confidential, protectable, or proprietary information.