Agreement between California Energy Commission and DOE- Lawrence Berkeley National Laboratory

Title: Data Center Economizer Cooling with Tower Water
Amount: $200,000.00
Term: 24 months
PIER Contact: Richard Sapudar
RD&D Committee: 12/3/2009

Funding

FY	Program	Area	Initiative	Budget	This Project	Remaining Balance	
08	Electric	IAW	Energy Efficiency	$3,326,731	$200,000	$0	0%

For the 2008 fiscal year, the total Electric budget is $62.5 million. Within the Electric program, the IAW program area budget is $5.5 million and, from this amount, $3.3 million was allocated to the Energy Efficiency budget initiative. If approved, the remaining initiative balance will be $0.00.

Recommendation

Approve this agreement with DOE- Lawrence Berkeley National Laboratory for $200,000.00, with $50,000 in match funding. Staff recommends placing this item on the discussion agenda of the Commission Business Meeting.

The Problem

There is an expectation that air used to cool computing equipment in data centers be cooled within the American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE) recommended range with an upper limit of 80.6°F. Typically a range of 70°F -75°F is used during design requiring cooling coil chilled water to be at least 48°F wet-bulb. This range tends to "over-cool" the data center requiring more energy than necessary. Taking advantage of the higher recommended ASHRAE temperature will enable partial or full cooling to be provided with higher temperature cooling tower water alone. American Power Conversion (APC), a division of Schneider Electric Company, is a leading supplier of data center power and cooling equipment. They have designed a secondary air to water cooling coil which is in series with the normally designed chilled water coils mounted in the computer room air handlers. This secondary coil can effectively use cooling tower water to provide partial or full data center cooling at the higher ASHRAE range. The effectiveness and reliability of this technology must be demonstrated and independently verified before market acceptance of the technology can occur.

Proposed Research

Lawrence Berkeley National Laboratory (LBNL) will partner with APC to demonstrate the technology at one of LBNL's data centers. LBNL and APC will develop a measurement and verification plan of the thermal performance and energy savings using this technology while providing reliable and controlled cooling for the computing equipment, keeping it within its temperature tolerances. This project aims to

show how use of tower water cooling can eliminate many hours per year of chiller operation and speed adoption of this energy efficiency strategy. It is estimated that reduced chiller operation can lower data center electricity consumption by 15%, with a potential total savings of approximately 854 million kWh saving data center operators $102 million in electricity cost each year.

Research Justification and Goals

This project "[will develop, and help bring to market] increased energy efficiency in buildings, appliances, lighting, and other applications beyond applicable standards, and that benefit electric utility customers" (Public Resources Code 25620.1.(b)(2)), (Chapter 512, Statues of 2006)); and supports California's goal to focus on identifying and implementing cost-effective retrofits in the water system that increase efficiency and provide both energy and peak savings per the Integrated Energy Policy Report 2005 by:

- Demonstrating the energy savings that can be obtained using cooling tower water to cool IT equipment using higher temperature water than traditional chilled water systems.

These proposed awards also support the general goal of SB 1250 (Perata, Chapter 512, Statutes of 2006), which states, in part, "the Public Interest Research, Development, and Demonstration Program is to develop, and help bring to market, energy technologies that provide increased environmental benefits, greater system reliability, and lower system cost, and that provide tangible benefits to electric utility customers."

Background

The proposal was submitted through competitive solicitation, Emerging Technology Demonstrations Grants Program (ETDG) Opportunity Notice 08-006. This opportunity notice was structured to solicit proposals under four categories 1) Data Center, 2) Energy Storage, 3)Industrial Energy Efficiency and 4) Water and Wastewater. This proposal was ranked 1 out of 7 proposals received through the solicitation under the data center category.

This project focuses on a cooling strategy that has potential for large HVAC savings in California's mild climates. The concept is to design in-row cooling systems that can provide the necessary cooling without operating compressor based cooling (chillers). American Power Conversion (APC), a Schneider Electric Company, is a leading supplier of data center power and cooling equipment. For this project, APC has developed and shop tested an in-row cooling product that can operate with higher temperature cooling water such as could be produced by use of a cooling tower rather than operating a chiller.

There is an expectation that air used to cool IT equipment should be cooled within the ASHRAE recommended ranges – having a maximum upper inlet temperature of 80.6°F. More typically a range of 70°F to 75°F is used. The highest coolant temperature practical for achieving the desired air temperature is constrained given typical cooling coil effectiveness. It is unlikely that water warmer than 60°F could be used by most coils while still achieving an air supply temperature in the 70°F to 75°F range.

Another and perhaps preferred approach would be use of an integrated water-side economizer where the plate frame heat exchanger is replaced with an additional air to water cooling coil in series with the normal chilled water coils mounted in the air-handling units. The additional coil in front of the chilled water coil, from an airflow perspective, would be directly cooled by tower water. Well designed data centers can provide return air from the IT equipment to the cooling equipment as high as 105°F or

greater. At this return air temperature, some level of incremental economizer cooling could be provided any time the tower water temperature can be cooled a few degrees below 105°F. This implies wet-bulb temperature could be as high as 93° while still providing some degree of economizer cooling. This value allows partial economizer operation in all climates throughout the year. Additionally full cooling could be supported with wet-bulb temperatures as high as 53°F.

APC has developed a prototype in-row cooler that employs this concept using an additional coil that will utilize tower cooled water rather than relying on use of a chiller. This project is to demonstrate the use of this product in an LBNL data center with measurement and verification of the performance, reliability and economics of the technology.