Name of Activity: High Performance Computing Water Reduction and Energy Efficient Cooling

Category: Comprehensive Energy and/or Fleet Management

PSO:

Description:

Sandia's Center 9300 built the Red Sky super computer in response to the nation's critical need for High Performance Computing (HPC). The project involved the decommissioning of the Thunderbird HPC system and the deployment of the Red Sky HPC system. Energy efficiency was of top concern when designing and implementing the system. The result is a computer that will provide 7 times the computational power of the system it replaces while using approximately 200 fewer tons of cooling, over 5 million fewer gallons of water per year and over 30 percent less power consumption.

Were costs avoided during this project? Yes

Was waste generation avoided during this project? Yes.

Is the activity being nominated for an E-star award? Yes

Nomination POC

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Team/Project/Facility Information

List of who directly participated in the activity:

Jeff Ogden

Eric Engguist

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Cathy Houf

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Ryan Braithwaite

Joe Mervini

Adam Supinger

Chris Beggio

Ken Lord

James Toledo

Matt Bohnsack

Jon Stearley

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Aron Warren

Don Rudish

Alan Pomplun

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John Zepper

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Description:

Sandia's Center 9300 built the Red Sky super computer in response to the nation's critical need for High Performance Computing (HPC). The project involved the decommissioning and replacement of the Thunderbird HPC system and the deployment of the Red Sky HPC system.

One of the goals of Red Sky was to have an HPC system that performed faster than its predecessor Thunderbird.

Red Sky has made the Top 500 list as the 10th fastest computer in the world. Red Sky achieved a peak performance of more than 500 teraflops (or 500 trillion mathematical operations per second), and an impressive 433.5 teraflops against the Linpack benchmark commonly used for ranking supercomputing speed.

In addition to raw horsepower, a goal was set for the Labs' newest supercomputer to be designed to maximize its eco-efficiency by using cutting edge technological innovations.

The system, for example, uses a newly designed power distributing system that significantly reduces power leakage and a unique cooling system that is more than 95 percent efficient in cooling the system's multitude of computer racks.

This was a unique collaborative effort between the Compute System Design and Implementation Team and the Corporate Computing Facilities Infrastructure Team. Previous to this build, the Compute System Design and Implementation Team purchased systems based solely on the compute cycle technical requirements and later the Corporate Computing Facilities Infrastructure Team was brought in to "make-it-work" in the designated location.

For this effort, the Corporate Computing Facilities Infrastructure Team was instrumental in the vendor selection process and teaming with Oracle/Sun. They examined not only what power and cooling would be required to manage the system but the efficiency of all components of the system. The selected system resulted in an extremely efficient HPC system. The amazing impacts of this effort are as follows:

- First HPC build where procurement specs defined energy efficiency as a requirement

- 15 percent less power … 1/6th power per flop compared to predecessor
- Technology advances in modern processor chips combine more processing capability into the same space and reduce the power required to run each processor (In aggregate, this is part of the benefit of Moore's Law of increasing density on semiconductor chips)
- 40 percent less water use resulting in over 5 million gallons saved annually
- Less water lost to evaporation in cooling cycle, and much less energy required to cool water entering the computer facility
- 10x better cooling efficiency (from 70 percent to 97 percent).
- Significant reduction in electricity used to cool off the computer systems; the ability to use high-efficiency cooling actually permits using slightly warmer water to exchange the heat from the system, also saving on electricity
- 4x denser footprint (less physical space equals reduced operating costs); high-density American Power Corporation modular Power Distribution Unit (PDU)
- Improved rack-based cooling system utilizing the Sun Glacier door**,** the 1st rack mounted refrigerant-based passive cooling system on the market. The Glacier door cools the components removing 90% of the heat load
- Red Sky has a carbon footprint of 203 Tonnes of carbon dioxide equivalents or CO2E and Footprint (global hectares or gha) of 46 compared to its predecessor which with a carbon footprint of 912 Tonnes CO2E and Footprint (gha) of 205

This effort has successfully set the stage for other HPC system efforts at Sandia,throughout the DOE complex and the world.

Note:

Was waste generation avoided during this project? Yes.

Sandia's Red Sky HPC installation team participated in a diversion effort to keep packaging foam #4 LDPE (low density polyethylene) from being disposed in the solid waste. Thirty cubic yards of foam material was diverted, weighing between 200 and 300 pounds. And, concurrently recycled all packaging material used in the transport of the Red Sky system components where feasible.

Were costs avoided during this project?

We did some in-house system integration/design work and the IB Torus network design was also done in-house and utilized some of the infiniband concepts from Thunderbird. These would have all been design costs incurred.