BLUE WATERS

SUSTAINED PETASCALE COMPUTING

October 8, 2015

National Petascale Computing Facility

Chilled Water Pump Control

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NCSA

NSF

GREAT LAKES CONSORTIUM FOR PETASCALE COMPUTATION

CRAY

BLUE WATERS

- 288 CRAY CABINETS
- 26,864 COMPUTE NODES
- >49,000 AMD CPUS
- 405,248 CPU CORES
- 4,224 NVIDIA KEPLER GPUS
- 1.5 PETABYTES RAM
- 13.34 PETAFLOPS
- 72 XDP COOLING UNITS
- >95% LIQUID COOLING
- PEAK >3,500 TONS

NPCF

- LEED GOLD CERTIFIED

Basic System Description

- Separate chilled water loops for building climate controls and chilled water for computing systems
- Separate control of Blue Waters from BAS
- Examples of gpm at 43 F and 50 F, effect of temp change on flow rate.
  - For 43 F water, gpm = 2,700
  - For 50 F water, gpm = 5,400

Basic System Description

- The facility has 4 chilled water pumps serving the HPC equipment, pump capacity is 2,325 gpm each
- Total CHW pump capacity is 9,300 gpm
- Historical pump operation would be on-off usage and flow increments were one pump's capacity
- Flow adjustment historically with 3-way valves
- Default operation to avoid disruption of HPC system cooling would leave all 4 pumps running simultaneously regardless of load

Chilled Water Pumps Energy Case Study

- Problem: Running 4 pumps at all times is inefficient and expensive. It also results in low return water temperature when load is low.
- Due to fluctuations in the heat load of Blue Waters and other computing equipment, the amount of chilled water needed varies.

- Primary cooling system concerns are differential pressure, flow rate of chilled water, and return temperature.

- Running 4 pumps (each with a 100 Hp motor) continuously costs $429.70 daily when electricity costs $0.06/kWh.
- Fixed flow rate and varying load don’t match

- Solution: Install variable frequency drives and utilize the VFDs to control the chilled water pumps based on system differential pressure and flow data.
- The controls system varies the speed of each pump and the number of pumps operating to provide the required differential pressure and flow rate.
- The total cost of this project was about $51,000, including VFDs, wiring, and controls integration.

- Running only the pumps needed (about 56% long-term average of total pump capacity) costs $240.63 daily when electricity costs $0.06/kWh.
- Result: Electricity cost savings of $189.07 daily and monthly (30 days) savings of $5,671.99.
- Simple payback: $51,000/$5,671.99 yields return of investment in less than 9 months.

QUESTIONS

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