Value of Measurement and Power Provider Communications in High Performance Computing

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HPC - Value of Metrics and Communications

• HPC - What is being measured?
• Operational Questions
• Data from Disparate sources
• Operational Challenge
• Power Provider Perspective
• Communications between HPC Center and Power Provider

Measurement and Communications
# Measure to Manage

## Measurements

### Power
- Quality
- Load
- UPS Batteries
  - Float Voltage
  - Temperature

### Mechanical
- Chillers
  - Set points
  - Efficiencies
- CRAC
  - Humidity
  - Temperature
- Liquid Cooling
  - Water quality
  - Flow
  - Pressure

### IT
- Network
- Device Performance
- Server
- Job scheduling

## Operational Questions

- How are these measurements monitored?
- What is impact of job scheduling on power demand variations?
- What is impact of scheduled maintenance?
- What provisions are made to communicate variations to power provider?
- Impact on performance

## Outcome

- Power forecasts based on real data
- Improved efficiency
- Predictability
- Reliability
- Provider relationship
Operational Challenge

From Anna Maria’s Intro:

- Recent installed HPC systems have raised concerns with some utilities
- Requires modeling power consumption and quality of large HPC computational block loads
- Requires the need to address operational cost increases with larger load
- Requires the ability to know what to monitor
  - Continually log events of HPC workload to include scheduled maintenance, unscheduled power interruptions, power glitches, etc. to gain broader knowledge
Communications With Power Provider

- HPC facilities are using increasing amounts of power
- Top 25 HPC sites use between <1 and 20+ MW
- Scheduled maintenance can result in 5 MW load swings to the grid in a short period of time
- Other sources and patterns of power variation need to be better understood
- HPC centers are just beginning to engage in demand dialog with their power providers
- For larger HPC Centers, there is value in regular communications with providers
Western Area Power Administration (WAPA) markets and transmits hydroelectric power from 57 powerplants operated by the **Bureau of Reclamation**, the **U.S. Army Corps of Engineers**.

WAPA’s Sierra Nevada Region manages transmission facilities in California:
- 50% of SN’s load is located in the Sacramento Municipal Utility District’s balancing authority area.
- 50% is located in the California Independent System Operator (CAL ISO) balancing authority area.

WAPA must operate the balancing authorities in accordance with **NERC standards**, including:
- Operating Reserves
- Automatic Generation Control
- Frequency Response
- Power Balancing Control Performance
- Emergency Operations
- Capacity Emergencies
- Verification of Power Capability
- Voltage and Reactive Capacity

Failure to operate in accordance with guidelines can cause grid instability, fines.

WAPA needs to understand the dynamic load characteristics of its large power users

WAPA adjusts dam gate flow and spill based on power forecasts.
WAPA-LLNL Relationship

- WAPA supplies power to LLNL, LBL and SLAC
- Power forecasting at LLNL and elsewhere can be challenging - 5 MW swings
- LLNL HPC Maintenance occurs every Wednesday. Neither depth nor duration of power dip is sufficiently predictable. Not enough cycles.
- LLNL is capturing additional data on load profile during maintenance and other times
- WAPA requirements
  - Want demand variation to be <5%
  - Want forecast 2 days in advance; 5 days in advance for holidays.
- WAPA has 90 minute window in which to do power forecast
- Data at WAPA’s planning desk is 6 hours old.
- WAPA needs data by 10AM Monday for Wednesday (LLNL maint day) forecast.
- Opportunity to explore secure link between LLNL and WAPA to eliminate time lag
Power Provider - WAPA View of LLNL Load

March 2013:

Demand Dips
Power Provider - WAPA View of LLNL Load

June 2013:

Demand Swings
Value of Communications

• With near real time connection, WAPA will have better information with which to prepare power forecast
• Known power variations (heavy loads, scheduled maintenance, vacation days) can be built into WAPA forecasts.
• Improved forecasts and communications can help avoid unexpected peaking or sell-off effects for WAPA.
Summary

- Have a plan for sensors and measurements - fill in gaps
- Track power usage and patterns for different operational situations
- Build model for power forecasting
- Adjust model with cycles and experience
- Improve Communications with Power Provider
Questions?

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