Facility and Utility Planning Impacts, Demand Response Forecasting and Additional External Data Center Issues

DOE HPC Operations Review

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Breakout participants

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Processes (scope of activity)

- <u>What needs to be done?</u>
- Understand limitations of the existing facilities and utilities
- Understand what is missing from the overall utility planning process
  - Power utilities reasonably understood – Energy savings a big driver
  - Water utilities newer to the process with liquid cooling solutions – Water conservation could become the next limiting factor
  - Network utilities is typically managed as a business system and should be treated as a utility to meet the future demands of HPC
    - Dark Fiber

Processes (scope of activity), cont.

- <u>What begins first: timeline for activities?</u>
- Laboratories need to address future computational requirements and how they impact existing institutional facilities and utilities
- Plan at the institutional level and provide input to site wide master plans
  - Ensure facility and utility upgrades are coordinated with the broader needs of the Laboratories.
- Rolling annual update of a 5 year master plan

Processes (scope of activity), cont.

- <u>What is the role of early prototype systems?</u>
- N/A

Processes (scope of activity), cont.

- <u>What is the role of utility companies?</u>
- Some sites are beginning to experience that utility companies are now interested in large HPC block loads
  - What is their concern? Load swings, demand response, load shedding, power management, power capping, power limiting
- Consensus is that utilities should be more concerned about the impacts of HPC swings
- The existing modeling tools utilized by utilities are antiquated to address the problem or even realize that there is a potential concern

Processes (scope of activity), cont.

- <u>What are the roles of research and design and engineering?</u>
- Definitely a role with R&D and Engineering
  - Eat our own dog food
- Beginning to develop research areas of grid analysis
- UPS studies and dips - SMART energy storage analysis underway to offset utility dependence
- Papers are being developed in area of HPC-utility integration
  - Infant stages of what should be addressed in power utility forecasting
- Laboratories need to continue to prioritize research funding toward HPC utility operation improvements

Processes (scope of activity), cont.

- <u>What resiliency activities are executed (for example, redundancy)</u>
- Utility redundancy is already part of current best management practices and should be continued
  - Power feeders, transformers, cooling towers, chillers, etc.

Organization and management

- <u>What is the structure of the integration and preparation teams?</u>
- All laboratories have embedded facility operations expertise within HPC operations
- Some laboratories have hybrid teams comprised of internal and external expertise
  - Consultants on demand
    - —Risk is delayed responses
    - —Higher costs

Organization and management, cont.

- <u>What are the necessary skills for the activity team?</u>

Facility Engineers	Facility Technicians	Operators
BIM – 3D Modelers	Control System Integrators	Facility Knowledgeable Computer Scientists

Experiences and lessons learned

- <u>What were the good and bad experiences and lessons learned?</u>
- Good
  - X-ray utility electrical equipment prior to being placed in service to locate equipment deficiencies and prohibit failures
  - Utilize load banks as part of commissioning and maintenance
- Bad
  - Inconsistent water quality specifications from computer vendor

Experiences and lessons learned, cont.

- <u>What were the most productive activities?</u>
- Commissioning of system activities for baseline operating conditions
  - Utilize data for future maintenance activities
- Deploying dedicated building automation systems to provide dedicated control for HPC operations
- Involving facility personnel input earlier in procurements to avoid unforeseen conditions during machine deployment
  - This is happening with CORAL and Trinity

Experiences and lessons learned, cont.

- <u>What were the resiliency experiences?</u>
- Geographical preference for utility separations
- Multiple utility sources
- Robust designs

Experiences and lessons learned, cont.

- <u>What was the highest risk? Was it a surprise or expected?</u>
- Unconventional water temperatures specified by computer vendors creating additional process loops
  - It was a surprise
  - Required rework of utility water systems to accommodate this special requirement

Most significant observation

- <u>Provide a summary statement for the most significant observation</u>
- All sites have similar issues but they are not present at each site at the same time. Some issues will surface sooner at some sites and later at other sites. All solutions will not be the same but lessons learned can be greatly shared and leveraged between the sites.

Effort estimate

- How big of an effort was this?
- Very costly
- Difficult to forecast
- Effort based on level of impact to the utility and facility infrastructure required to meet the demands of the computational load
- All sites have annual utility and facility infrastructure improvement projects to stay ahead of the curve
- Requires larger interface with campus improvements