Clemson Local Data Centers Site Study Statement of Work

Background:

As part of its strategic plan, ClemsonElevate, Clemson has a goal of doubling research expenditures by 2035. Clemson expects a growth of High-Performance Computing (HPC) resources to be integral to this goal, but other areas of research computing are also expected to grow, such as:

- General computing resources
- National and Regional NSF grant projects\testbeds
- HPC hosting
- Artificial Intelligence and Machine Learning

Clemson's data center (ITC) was built in 1987 on 9.3 acres of Clemson owned land located in Anderson, SC. The building has 27,714 net assignable square feet. Current HPC floor space is roughly 5,100 square feet. Current Enterprise floor space is roughly 9,100 square feet.

ITC has 5MW aggregate power service from Duke Power but lacks distribution infrastructure to maximize the utilization of those incoming power feeds. ITC has 500 Tons of chilled water for AC and liquid cooling capacity. A tertiary loop provides 280 Tons of liquid cooling capacity to designated areas in the research computing space by leveraging existing chiller capacity. Rear door heat exchangers are currently employed to capture heat on the rear of some racks.

Total building load in ITC exceeds 1.5 MW at present, but has been as high as 2.3MW. Palmetto has an estimated peak approaching 1MW of power for compute resources. Cloud Lab has an estimated peak of more than 300kW of power. CPUs are expected to meet and exceed 500 Watts per socket, and more that 1kW per accelerator, driving per system power requirements to increase. This presents challenges providing required power distribution per rack.

Clemson estimates that continued growth in research expenditures, specifically HPC, will put pressure on power distribution capabilities, resulting in, at some point, demand for HPC resources to exceed supply of power distribution capabilities. [1]

ITC does not have a designated life cycle replacement plan for equipment both within and outside of the research computing arena.

Study Details:

Clemson is requesting a study on ITC and another data center, Poole (located on campus), to:

> (1) validate current power capacity, generation, and distribution, cooling, configuration, etc. opportunities and challenges; and

[1] The study should include charts and graphs to indicate the growth of power generation, power distribution, and research expenditures generated by HPC over time as a function of any proposed upgrades.

(2) assess the impacts of the doubling of HPC capacity in support of Clemson Elevate on existing infrastructure; and

(3) develop a lifecycle replacement plan for these two data centers, factoring in proposed impacts from growth in HPC.

- There are "two sides" to ITC. One side is focused on research computing and HPC and the other side is used for enterprise applications. The study should factor in both sides.

- The study should evaluate current power capacity, generation, and distribution, cooling, etc. opportunities and challenges at ITC and Poole locations overall. And then "zoom into" the growth in HPC, highlighting power, utility, configuration, etc. challenges and opportunities.

- Study should include reviewing the existing and providing best-practice recommendations on Layer 1 distribution (cabling) throughout ITC and Poole with a focus on fiber and copper cable management systems.

- To accommodate potential growth in HPC activity and therefore infrastructure needs, initial discussions suggest the study should consider the entire square footage of raised floor currently at ITC (~19,000 sqft.).

- The study should factor in opportunities using the terrain around ITC. A new capital project to expand the interior footprint of ITC (i.e. the creation of a large capital project) is not part of the existing strategy and should not be a primary element of any recommendation.

- Assume Duke Power continues to be Clemson's primary utility partner and expansion projects need to be compatible with their expectations and deployment guidelines.

- In addition to cost estimates, study should be accommodated by critical path timelines for each recommendation with highlighting interdependencies across recommendations.

- Study should include an analysis of the expected growth of (and/or changes related to) vendor solutions in the HPC space over the next 8-10 years.

- Study should include benchmarking against the HPC facilities and capabilities of peer higher education institutions, incl. benchmarking against local/regional datacenter providers for the enterprise side of our datacenter to help guide those enhancement proposals.

- Study should include an investigation of *what* should be included in continual LCR funding in the HPC space, and what should be "premium" or otherwise funded resources. Clemson can provide insight into current practice and thoughts on this point.

In addition to developing lifecycle replacement plans for the two sites, the study should investigate lifecycle replacement options for continuing to provide HPC resources (with required growth, taking into consideration the costs of deploying new or replacement technologies). This LCR plan should include how the plan is to be updated, including how the plan is to be governed and managed.

- LCR plan should include an overall LCR for ITC and Poole, including annual costs (one-time and recurring) and equipment to be purchased over the next 10 years.
- LCR plan should include infrastructure, networking, etc. components to ensure a comprehensive plan for those two sites.
- Clemson is open to considering traditional LCR models or creative/non-standard LCR models (e.g., equipment leasing). An early project discussion on options is expected.
- All LCR proposals should include plans and timelines for retiring and replacing any equipment in scope of the LCR proposal.
- Current hardware resources have been added to the HPC cluster annually, resulting in a highly heterogenous cluster. Guidance should include strategies to build more homogeneous resources.

Study Deliverables

- Executive summary of study outputs, summarizing key findings and opportunities
- Detailed information and analyses on challenges and opportunities for ITC and Poole.
- Summarized, practical, and costed options to enable ITC infrastructure to be improved and/or reconfigured to maximize power capacity and align with the goals expressed above.
    - Includes proposed floor plans and estimated costs for each option.
- Comprehensive and detailed LCR Plan for ITC and Poole for 10 years, including costs, appropriate sequencing, and impacted asset inventories, etc.
    - Including the amount of funding needed to get any deferred LCR "back on track."
- Comments, insights, and recommendations for items referenced in the details above.

Responder Requirements:

- The responders conducting the study will have restricted, escorted access to the physical space for the study as appropriate. They will also have resources assigned from Clemson to assist in gathering data and efficiently completing the study.
- Responders should have extensive experience with higher education data center designs and expansion projects, with special focus on the needs of HPC deployments.
- Responders should also have extensive knowledge of the Uptime Institute's Datacenter Classification process and the requirements for all tiers of certification. Experience with assisting datacenters reach specific levels of certification a plus.
- Responders should have a BICSI Data Center Design Consultant (DCDC) certification and optionally validated experience with ISO/IEC 22237.