BKV GROUP

Technical Memorandum

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Project	Tennessee State University Campus Master Plan
Subject	4. Future Campus Requirements 4.5 Utility Infrastructure Requirements 4.5.4 Steam and Chilled Water
From	I.C. Thomasson Associates, Inc.
To	Tennessee State University

The objective of this work is to discuss capacity of the electrical distribution system and suggestions for improvement.

1. STEAM

Table 4.5.1 shows how the new buildings are expected to add to the campus steam load.

The table looks first at near term projects, which consists of a major library addition of approximately 75,000 square feet. This is calculated to add 3,000 pph of steam load. Even without taking diversity into account, this is still within the capacity of the existing equipment in the central plant as well as that of the distribution system.

Assuming all the proposed new buildings come on line and the indicated buildings are demolished, adding a net of approximately 1,054,000 square feet of conditioned space, this adds another 31,328 pph of diversified steam load to the system for a total of 92,434, just beyond the limiting capacity of the DA. In addition this load would be well beyond the capacity of the plant if the largest working boiler were to be out of service on a peak day. The distribution system, on the other hand, has ample capacity in the main line as well as each branch for all the proposed new load.

Thus, there is capacity for the addition of a number of buildings on the TSU campus. The distribution system is ample in all directions so that there are no restrictions on where those buildings can be added. Before the last third of the proposed buildings could be added, a renovation of the boiler house to replace or enlarge the DA would be necessary. Furthermore, if the university determines that it requires back-up capacity, an additional boiler of at least 48,000 pph capacity would be needed. This could be provided by renovating the existing coal fired boiler or by installing another gas fired package boiler.

As discussed in Section 3, the coal-fired boiler renovation has been estimated to have a probable cost of approximately $1,650,000. According to TSU personnel the permit for the facility has been kept current.

There is a potential for new EPA MACT (Maximum Available Control Technology) regulations that could require the installation of additional air pollution control equipment. These regulations are currently under development, and the local Air Pollution Control

Department is reviewing proposed standards so that it can develop appropriate local guidelines. This information will most likely not be available in the immediate future

2. CHILLED WATER

As discussed in Section 3, the total chiller capacity of 3,750 tons appears to be adequate for the existing campus cooling load, but the chilled water pumps are not always able to distribute enough water to serve the buildings because of lower than expected DT on the chilled water. Some pump capacity can be recaptured by changes made at building air handlers and in building operation schemes. It is recommended that TSU proceed with planned DT improvements in the central plant an initiate a study of the building systems to identify equipment that can be modified to utilize the chilled water more effectively. Even with building improvements, however, there is clearly very little capacity left for new buildings at the existing chiller plant. Therefore, changes are definitely required before additional load can be put on the system.

Table 4.5.2 shows how the chilled water load is expected to increase as new buildings are added to the system. The diversified load could be expected to grow to over 5,000 tons if all buildings are constructed as proposed.

The 75,000 square foot library is expected to add approximately 250 tons of load to the system. At the expected temperature rise of 10 degrees, this would bring the total system flow to almost 11,000 gpm. This is well beyond the capacity of the two distribution pumps and the distribution header. Adding all the new buildings pushes the system beyond the limits of the chillers as well as the pumps. There are several possible solutions:

- Install additional chillers and pumps in the existing chiller plant
- Install new chillers and pumps in a satellite plant
- Install new chillers in each individual building.

There is limited room available for new chillers around the existing plant. If the requested improvements to the boiler plant are implemented, that could further limit space.

The relative merits of these options also depend partly on issues regarding the chilled water distribution system. The 18" chilled water header leaving the plant is already beyond its ideal capacity. Figure 4.5.2 shows the location of new buildings in relation to the existing chilled water lines. Most of the buildings are well located to be tied into an existing branch of the distribution system by way of the existing downshafts and manholes. The distribution system was designed with an 18" trunk line that runs the length of campus without any reduction in size. This is ideal for installing a second chiller plant on the opposite end of the system from the existing plant. This chiller plant should have two chillers sized at 1000 tons each. This chiller plant could be stand-alone or it could be housed in proposed Building a20 or a21. Based on similar sized chiller plants on other college campuses, the anticipated probable cost of installing a second chiller plant would be on the order of $4,000,000.

Installing chillers in each new building is the simplest short-term solution, but the central plant advantages of load diversity, economy of scale, and centralized maintenance would be lost. In addition, each building would be saddled with the aesthetic and acoustic burden of a cooling tower. A compromise might be to install one large chiller on each branch that feeds into the system and partially unloads that part of the distribution system. For example, the library could serve as a mini-plant for branch 4 if a 500 ton chiller were installed there.

No expansion is currently planned at the Avon Williams campus. Therefore, there are no capacity issues to address there.