1. Facilities Data

1.A. Chilled Water Source: The existing buildings are currently fed from independent cooling system. The systems are a mixture of air cooled chilled water and direct expansion. There are no existing central chiller plants serving the campus.

2. Chilled Water Requirements

2.A. The site has approximately 55-60 existing structures located throughout with a variety of uses from storage sheds, green houses, operations and maintenance, laboratories, educational, administration and residential.

2.B. The structures are spread out over most of the site with buildings arranged in small clusters and some isolated by themselves. Many of the smaller buildings and structures are not air conditioned. In addition, many of the buildings are separated by large distances with small load requirements which would make implementing a central energy plant to serve the entire campus not very cost effective.

2.C. There is a portion of the site which has a denser building arrangement with higher load spaces located east of the railroad at the end of the canal which may present an opportunity for the use of a central plant. There is planned growth and new construction for this area.

3. Future Chilled Water

3.A. New Chiller Plant: In concert with the new construction, an expandable central energy plant should be constructed in the area outlined as a likely location in the general area west of the canal. With the density of the buildings in this area and the current and future cooling demand, a central chilled water energy plant will be more cost effective and efficient.
3.B. Site Chilled Water Piping Distribution: At the time the central chilled water plant is designed, the anticipated maximum chiller plant capacity should be determined by the design professional. The site piping distribution should be sized to accommodate the total anticipated system flow when the plant is at maximum capacity. The site pipe routing shall take into consideration the current and future building locations and shall be routed in a way to facilitate connection of existing systems into the new central loop.

4. Cost:

4.A. Energy costs are another critical topic to be included in an energy and economic analysis. The utility company for this site is Florida Power and Light who has extensive rebate programs available. In addition, they have special rate structures for customers who implement thermal storage systems and can greatly reduce operating costs by shifting energy consumption and demand charges associated with chiller operation to off-peak periods. High efficiency water cooled chillers have rebates available up $17 per ton. Thermal storage systems have the potential to achieve rebates high enough to pay for themselves.

Location of the plant will be a critical decision. It would be recommended to locate the central plant near the center of the buildings it serves. This will reduce piping main sizes on the site distribution as well as minimize pumping energy required. A central location for this site would be somewhere near the end of the canal.

4.B. Recent project history has shown that a typical water cooled chiller plant structure and equipment runs approximately $3000 per ton. At an estimated 500 tons for the initial plant it would result in a building cost of $1.5M.

Site piping distribution costs change rapidly. With a plant centrally located near the end of the canal would result in an estimated site piping cost of $500K.

Total estimated cost of implementing a central chiller plant sized to accommodate the proposed buildings would be approximately $2M.

5. Site Investigation

Survey Data:

Johnson Education Center HB35

This building is served by an existing air cooled chilled water system. The interior of the building is currently under design for a complete interior mechanical system upgrade including replacement of all of the existing air handling units. The existing air cooled chiller has been replaced in recent years and can have as much as 5 years of useful life remaining. Air cooled chillers located directly on the coast such as this site can have the life drastically reduced due to overall corrosion and rapid deterioration of the condenser coils rendering the equipment significantly less efficient. This building would be a prime candidate for connection to a central plant since the existing systems are already chilled water. Incorporating this building into a central plant would only require a connection of the central plant chilled water piping and disabling of the bypass in the existing 3-way valves.
Link Engineering Building HB18

This building is served by an existing chilled water plant. The plant consists of a 130 ton water cooled and a 80 ton air cooled chiller. The air cooled chiller is relatively new with approximately 7 years left of useful life. The water cooled chiller is older and is due for major repair and has 5-10 years of service life left. This building is a prime candidate to be connected to a central plant as the existing systems are chilled water. In addition to the chilled water system, there is a large 40 ton air cooled packaged outdoor air unit on the roof providing make-up air to the lab spaces. Conversion of the chilled water portion of this building into a central plant will be a relatively simple task requiring only a connection to the central plant piping and disabling of the existing 3-way valves and a complete interior renovation would not be necessary. The outdoor air unit would require replacement with a chilled water unit.

There is a host of abandoned mechanical equipment in and around the Utility Building HB29 which houses the chiller equipment for HB18. All of the equipment that has been abandoned and not being used should be removed and disposed of.

Biomedical Marine Research East HB16

This building is served by direct expansion split systems. One 20 ton and one 3 ton unit currently are installed. The 20 ton unit has approximately 4 years of useful service life and the 3 ton unit is at the end of its anticipated useful life. Conversion of this building to be served from a central plant would require a replacement of the direct expansion air handling units with new chilled water units as well as extension of chilled water from the main plant to this building.

Education Annex East/West HB27, HB28, HB29

These three buildings are served by nine small DX split systems. Most of them have been replaced within the last four years and would be estimated to have approximately four years of useful service life. Conversion of this building to be served by a central chilled water plant would require a replacement of the DX air handling units with new chilled water air handlers.

Library HB43

The library building is serviced by eleven small DX split systems ranging from 2-2.5 tons dating back to 1999. All of the outdoor units are past their anticipated useful service life and show signs of corrosion on both the housing and condenser coils. The units should be replaced. Conversion of this building to be served by a central chilled water plant would require a replacement of the DX air handling units with new chilled water air handlers. This building is scheduled for demolition in Phase 2.

Analysis

A detailed computer analysis was performed modeling the buildings outlined as potential candidates for a central plant. The analysis will includes both energy and economics and provide multiple alternatives for comparison. The chiller plant has many options with varying up-front costs and operational / energy costs.
Geothermal systems were not considered in this analysis as the costs associated with the drilling of wells for a proposed plant of this size is not economically feasible.

Alternatives considered include:

a. Alternative 1: This system was modeled using the equipment and systems that are currently installed for the various buildings. It is a mixture of air cooled and water cooled chiller systems as well as direct expansion.

b. Alternative 2: This system was modeled as water cooled chillers with standard cooling towers. These systems are the most common type of system utilizing water cooled chillers with optimized cooling towers for heat rejection. FP&L offers a cost per installed tonnage rebate for this type of system.

c. Alternative 3: Partial thermal storage systems. A partial thermal storage system uses approximately 50% of the chiller capacity and supplements the rest with 50% stored ice capacity. These systems building ice during off-peak overnight hours. During peak hours, the chillers run to satisfy the building load. When the chillers are at full load and the building load exceeds their capacity, the ice is melted and blended to make up the capacity difference. These type of systems effectively cost the same as 100% chilled water so there is no significant up-front cost. Operationally, it shifts 50% of the consumption for refrigeration energy to off-peak hours and cuts the demand in half year round. These systems require the chillers to make ice overnight and building cooling after hours would be limited. FP&L offers rebates for the implementation of this type of system rated at the amount of tonnage shifted to off-peak hours.

d. Alternative 4: A full thermal storage system was used. The operational schedules of the site and buildings connected to the central system will have to be reviewed for feasibility. Thermal storage systems utilize off-peak hours to build ice. During peak hours, the chillers are disabled and the ice is melted for use in building cooling. This shifts the entire refrigeration energy load to off-peak hours as well as the demand. Any thermal storage system would have to be reviewed with the operational schedule of the campus to determine feasibility. These systems require the chillers to make ice overnight and building cooling after hours would be limited. FP&L offers rebates for the implementation of this type of system rated at the amount of tonnage shifted to off-peak hours.

Refer to the Energy Cost Budget / PRM Summary and Trace 700 Economic Summary for analysis output data.

Although the installed costs associated with the central plant are significantly higher than the systems based on the existing equipment, the cost of operation is reduced greatly. The analysis includes future equipment repairs and replacements. In a coastal application such as this, the useful service life of an air cooled piece of equipment is reduced by as much as 50%. A life of 8-10 years was used for the typical service life of an air cooled piece of equipment which would require 2 to 3 replacements over the life of the study versus 1 for the water cooled system. In addition, estimated rebates were included in the analysis: Alternative 2 had a $10,000 rebate. Alternative 3 had a $50,000 rebate and for Alternative 4,
the added cost for the full thermal storage system was offset by the rebate so no additional up front cost was included.

A review of the output data from the analysis indicates a payback ranging from 11-14 years for any of the three water cooled central plant options with an annual energy cost savings ranging from $50-60K. Any of the three water cooled options are viable as long as the operational schedule permits. The Owner’s operational schedule for the various buildings must be reviewed closely to determine whether or not a thermal storage system could be applied since the chiller plant changes over to make ice during evening hours. It is possible to provide some cooling to the site while making ice, however the amount can not be significant.