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April 8, 2008

Mark Smith – US Energy Services Company

RE: LVCC CHW plant upgrade – NON0804

Dear Greg:

tekWorx has completed its on-site review of the subject project, and we have updated the conclusions and recommendations as noted herein. We also respectfully request that since there is no written specification that the information herein is not shared with anyone outside your firm without tekWorx' prior approval.

1. **Summary of Existing Plant Configuration and Operation**
   - **a.** Single central plant serving 6 outlying buildings.
   - **b.** Mechanical cooling is produced by three x 1,200 ton York centrifugal chillers.
   - **c.** Constant speed primary / variable speed secondary pumps, each set headered.
   - **d.** Three variable cooling towers with headered constant speed condenser pumps.
   - **e.** Chilled water system differential temperature: 10°F design / 5 - 7°F typical
   - **f.** Chillers reportedly must sometimes be sequenced ON for flow rather cooling.
2. **Additional information and assumptions**
   - **a.** The mechanical equipment is in generally good condition.
   - **b.** The pumps are properly sized, distribution pump impellers are not trimmed.
   - **c.** The quantity and type of instrumentation is adequate for a typical PS system, and all instrumentation is reasonably accurate.
   - **d.** All heat exchanger valves are two-way.
   - **e.** There are no bypass lines or pumps in the buildings.
3. **Conclusions**

   The plant is generally in good condition: equipment seems to be well maintained, premises are clean, instruments seem to be working properly, and the control strategy is adequate for the primary secondary design. Further, the local control contractor (TAC) seems competent and cooperative as well.

   The major energy related issue is low system ΔT, which is caused by two conditions:

   - The ΔT across the transfer stations is too low. In our opinion, this is clearly the result of using two-way butterfly valves to control the heat exchanger supply water temperature to the customer. These valves cannot effectively limit the amount of water necessary to produce the desired temperature. Consequently, excess chilled water is flowing through the transfer station and it is thus returning to the plant at a lower than design temperature.
   - The low loop return temperature is compounded by a fundamental shortcoming of the traditional primary secondary design: chilled water not used by the load will always flow through the bypass and blend with warm water returning from the load. Thus the return water temperature which is already too low is reduced even further.

The low system ΔT condition leads to excess energy consumption in two ways:

- There is more water flowing than necessary so pump energy is being wasted. Increasing the system ΔT will reduce the flow in direct proportion, and it will reduce the pump energy in proportion to the cube of the flow reduction.
- The PS system model provides constant flow through the chillers, so low ΔT reduces the tonnage the chiller can produce in direct proportion. Thus, the lead chiller is not able to fully load before the lag chiller set (chiller, primary pump, condenser pump and cooling tower) must be activated to help meet a load that could otherwise be met without it. Increasing the system ΔT will consequently reduce the amount of time that lag chiller sets are operating unnecessarily.

4. Recommendations

Our recommended solution involves combination of both mechanical and control changes. The mechanical changes will allow the plant to operate in a full variable flow mode during most load conditions to gain energy savings while maintaining the existing primary secondary operation where appropriate. These mechanical changes must be then accompanied by adjustments in the control strategy and architecture in order to properly determine the appropriate mode, maintain proper equipment operation and get the full energy benefit. These changes are summarized below.

a. Mechanical and Piping Changes:

- Install a two-position control valve in the CHW bypass line.
- Replace the heat exchanger butterfly valves with hi-performance rotary valves.

b. Control System and Instrumentation Changes

- Install DP transmitters between the CHWS and CHWR headers in the plant and across the evaporator barrel of each chiller.
- Install tekWorx CEO (Control and Energy Optimization) System and integrate with the existing BAS the attached drawing.

c. Adaptive Algorithms

- Determination variable flow or primary secondary mode of operation.
- Chiller sequencing to assure maximum chiller loading.
- Balancing the cooling towers and chillers for optimum CDW temperature
- Control of all CHW pumps to maximize their overall efficiency.
- Adjustment of system DP setpoint based on HEX valve position.

5. tekWorx Scope and Pricing

a. tekWorx CEO system and the related services are based on the following scope:

- Pre-project analysis including the work to prepare this proposal.
- Control panel with CPU, I/O terminal blocks and communication gateway.
- Control sequence design based on adaptive control as noted above.
- Programming to implement adaptive algorithms as noted above.
- Communications programming for data exchange with BAS.
- On-site commissioning and training – up to three visits of up to five days each.

b. The estimated price for materials and services listed above is $129,000.

6. **Items and Services expressly not provided**
   - **a.** Labor or materials for mounting any field devices.
   - **b.** Labor or materials for mounting or wiring the tekWorx panel and instruments.
   - **c.** Programming of any system or device not provided by tekWorx.
   - **d.** Payment or performance bonds.
7. **Service and Maintenance**
   - **a.** Remote monitoring service: $750 per month, or $8,000 for a one year contract.
   - **b.** The on-site post warranty service rate is $1,000 per day plus travel expense.
   - **c.** On-site service response is subject to up to 5 days notice.
8. **Summary of Estimated Financial Considerations**
   - **a. Estimated Savings**
     - Estimated annual cooling production: ~ 6,700,000 ton-hours
     - Estimated average kW/ton reduction: ~ 0.15 kW/ton
     - Annual savings based on $0.109/kW-h: ~ $111,000
   - **b. Estimated Project Cost**
     - tekWorx CEO and related services: $129,000
     - Remote monitoring service (one year): $8,000
     - Mount and wire tekWorx CEO panel: $5,000*
     - Furnish and install DP transmitters (total of 4): $8,000*
     - Furnish and install CHW bypass valve: $16,000*
     - Furnish and install HEX valves (total of 4): $28,000*
     - Re-program existing BAS: $20,000*

       * NOT provided by tekWorx; estimates must be obtained from local contractors.

We look forward to discussing this project further at your earliest convenience.

Best regards,

tekWorx, LLC