Ice Storage – How and Why....

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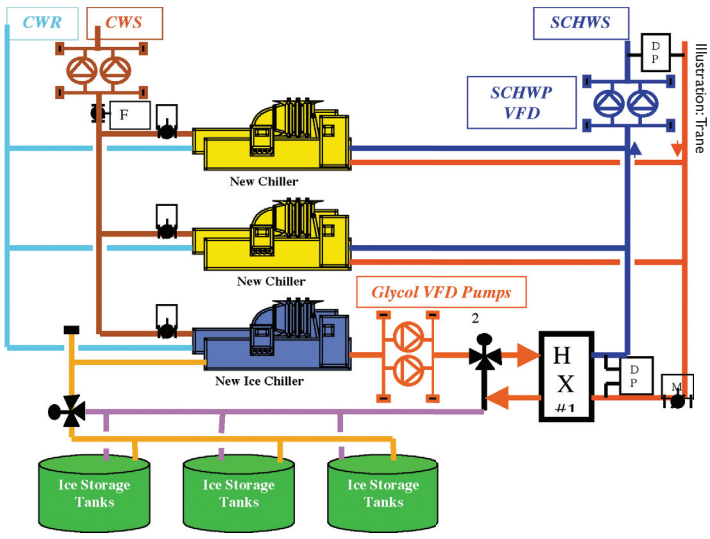
Ice storage installations are on the rise in the New York Metro area. Large financially-driven institutions in the New York City, Long Island and Westchester County areas are leading the way. Attractive economics, environmental benefits, and added facility reliability are turning thermal storage into a compelling design option. Although there are other kinds of storage systems, such as chilled water, ice storage technology makes the most sense because of the typical space limitations in commercial buildings.

Richard Haley of the Trane Company, notes "the integrated design of chillers and ice storage has a tremendous amount of benefit for overall system flexibility. Customers are catching on to the concept and it's evident in the projects which we are executing. In the last couple years, we have installed half a dozen major ice storage systems."

An ice storage system uses a chiller to make ice during off-peak night time hours when energy is cheaper and then melts the ice for peak period cooling needs, effectively shifting the electric load and avoiding higher price energy and demand charges during the day. The operation of an ice storage system is comprised of two normal modes: the ice charging mode and ice melt/burn mode.

During the ice charging mode, there is typically a designated ice-making chiller that is run for the purpose of producing low temperature glycol to freeze the water inside an ice storage tank. The glycol loop, consisting of the ice storage tanks, heat exchangers and pumps are isolated from the main building chilled water loop (see flow diagram above). The ice charging mode continues until the ice is fully frozen, usually about 8 to 10 hours and is done during the utility's off-peak period. Ice melt commences as the building load increases and the temperature differential between the chilled water supply and the chilled water return increases.

SAMPLE FLOW DIAGRAM WITH TRANE CHILLERS AND CALMAC ICE STORAGE TANKS



Thermal Energy Storage Tanks

Notes:
CWS = Condenser Water Supply
CWR = Condenser Water Return
SCHWS = Secondary Chilled Water Supply
SCHWR = Secondary Chilled Water Return

Economics

The economic benefits of ice storage are largely derived from shifting expensive on-peak electric demand/consumption to the cheaper off-peak electric rates. Avoided demand charges in Long Island Power Authority (LIPA) and ConEd territories range from $20 to $35/kW in the summer months and the spread between on-peak and off-peak energy is usually 2.5 to 3 cents.

Additional savings are delivered from extended free cooling periods and the efficient delivery of low flow/low temp systems that reduce pump and fan power demand and consumption. Typical building operation dictates that free cooling benefits typically can be secured up to an outdoor temperature of 50 degrees Fahrenheit. Beyond that point, the transition back between free cooling and mechanical cooling is risky. The potential for having an entire chiller plant shut-down during normal business hours is unacceptable. Ice storage acts as a buffer in that scenario, allowing operators to become more comfortable with the operation of free cooling during questionable outdoor air temperature levels. Buildings can expect to add up to half of a month of free cooling on either end of the summer.

With low flow/low temp, the benefits of delivering lower temperature chilled water to reduce the demand and consumption of pumps and fans are well documented. However, using ice storage to produce low temperature chilled water and avoiding chiller efficiency penalties is not. Delivering 40°F chilled water, as opposed to 44°F can add another 0.1kW/ton of electric demand to a chiller. Using ice to drive down the temperature eliminates that chiller efficiency penalty. Over the past few years, simple paybacks for ice storage installations in the New York metro area have ranged from 3 to 5 years.

According to Walter Smith, Senior Vice President for Reckson Associates Realty Corp that has put several ice storage facilities in its buildings, "Reckson's goal is to own one of the highest quality office portfolios in the tri-state area. Creating that portfolio is dependent on putting in high quality infrastructure that meets the financial needs of both our tenants and shareholders. Strong financial management is integral to our success."

Environment

The most basic function of ice storage is to shift on-peak electric load to off-peak. Realizing that on-peak generation in the New York Independent System Operator's ("NYISO") territory is considerably "dirtier" than off-peak generation, there are considerable environmental benefits derived from the reduction of air polluting emissions (NOx, SOx, and CO_2). A typical central plant renovation, incorporating ice storage, provides environmental benefits equivalent to planting hundreds of thousands of acres of trees or removing a couple hundred cars from the road.

Ice storage delivers more than one type of "green" benefit. William Beck, Managing Director of Global Engineering and Critical Systems for Credit Suisse, said, "Credit Suisse is a financial institution that is committed to the environment. Ice storage made perfect sense for us. It's good for business and good for the environment."

Reliability

Batteries are to electricity as ice storage is to chilled water. Similar to the way batteries act as a back-up for electricity, ice acts as a back-up for chilled water. Ice storage can reduce the risk of the transition between free cooling and mechanical cooling and carry you through a temporary chiller shut-down, whether it is during a free cooling operation or other operational quirk which temporarily shuts down central plant chillers.

Sites with data center or trading floor operations, typically strive to reach a certain N+ level of reliability, or in some cases 2N. At one of Morgan Stanley's mission critical facilities, they are approaching a 2N level of reliability on their HVAC operations via the utilization of ice storage. Daniel Pugliese, Operations Manager, for Hines who manages the Morgan Stanley building has stated "one of our performance based goals is to operate 24-7, 365 days a year. Ice storage combined with the piping configuration that our team developed, not only helps us to meet those goals, but allows us to exceed those goals by providing an added level of reliability in an economically attractive fashion."

Most mission critical facilities provide their massive cooling needs with Computer Room Air Conditioning ("CRAC") units. These units typically incorporate a free cooling mode where the compressors shut-down and the cool medium in the coils provide the air conditioning needs. The units operate in the same manner whether they are fed from a dry cooler system or a second feed that comes from the central plant/ice storage loop.

Ice storage is providing less expensive cooling, more reliability and decreased impact on the environment. Smart financial managers are driving the marketplace towards ice.

Eugene Garcia is president of ECM Energy Management Services. Mr. Garcia possesses more than 15 years of energy, engineering and finance related experience. He has provided operational and strategic planning to meet the needs of internal business requirements as well as those of external customers. His technical experience includes the design, procurement, and production of energy and its related systems. His market knowledge is derived from both domestic and international experiences related to the deregulation and privatization trends surrounding the energy industry.

Todd Coulard, manager of the Energy Services Group ("ESG") of Trane New York/New Jersey, has over 15 years experience in the design and implementation of energy efficiency projects. He is currently responsible for the development and construction of large-scale comprehensive energy efficiency projects for Trane. His group is involved in the project estimating, budgeting, savings calculations, and providing hands-on supervision and technical support to subcontractors. ESG assesses client properties and evaluates site specific energy efficiency and capital improvement measures, with an emphasis on economic viability for clients. Mr. Coulard's group develops Energy Performance program proposals including financial analysis, financing options and statistical analysis of client energy consumption profiles. Prior to joining Trane, Mr. Coulard was Director of Facilities for the Durst Organization. He was involved in the commissioning of Four Times Square, the development of the 1155 Thermal Storage Project and implementation of energy efficiency measures throughout the Durst portfolio.