

Integrated Chiller System Reduce Building Operation and Maintenance Costs in Cold Climates

N. Sheets and M. Liu

Electric driven water-cooled chiller systems consume 0.7 kilowatts per ton of cooling produced, while electric driven air-cooled chiller systems require 1.2 kilowatts. The water-cooled chiller system offers a sizable energy advantage, yet approximately 60% of chiller systems use an air-cooled chiller. Differences between the systems' initial cost and operational concerns explain the variance in these statistics. A majority of HVAC systems are constrained by a budget set forth by the building's owner. The lower initial cost of the air-cooled chiller system becomes an attractive quality in these situations and weighs heavily on the final chiller decision. System designers are also often willing to sacrifice the extra energy consumption in order to simplify the system operation. Air-cooled chiller systems can provide cooling under almost any ambient conditions without any operational problems, while water-cooled chiller systems become difficult to operate and control in cold weather due to cooling tower freezing.

HVAC systems are required to operate under a wide range of conditions and climates. Varying seasonal climate conditions can have a significant effect on the operation and maintenance of a water-cooled chiller system. This is often the case for buildings located in climates characterized by extreme seasonal temperatures with periodic warm periods during traditional non-cooling seasons. For example, Omaha, Nebraska's typical winter is extremely cold with an ASHRAE winter design temperature of -7°F , but it is not uncommon to have outside temperatures in excess of 70°F during the same time span. The unpredictable variance of outside weather conditions can cause winter cooling loads within a building; therefore, the cooling tower must be available year-round. Several additional design considerations for cooling tower operation exist for continual tower availability in these types of climates.

When a cooling tower is idle during periods of cold weather, the basin water must be protected from freezing to prevent pipes from bursting and to keep the tower available. If the cooling tower were required to operate under freezing conditions, ice formation may

occur on tower components. The possibility of ice formation requires additional maintenance and regular visual inspection to prevent excessive ice formation, which can cause capacity control issues, temporary shutdown periods to de-ice, or damage to cooling tower components to the extent of replacement. Currently, there are several methods to prevent tower contents from freezing and enable tower operation under all ambient conditions.

Choosing the optimal cooling tower design/operation strategy is a major concern for building operators who rely solely on water-cooled chiller systems to provide yearly building cooling. The current cooling tower system designs require a new design solution, and there are case studies available that compare a new design's performance to a common industry design practice.