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Intelligent Demand Prediction and Operation Optimization for Cost-effective Campus Cooling

Abstract

The goal of this project is to reduce the cost of chilled water production while optimizing the operation of chillers using different energy sources. The project objective is to develop a quantitative model that optimizes the efficiency of chilled water production on the basis of energy cost and demand prediction. The model endeavors to calculate the cost and efficiency of producing chilled water from different sources such as the steam turbine and the electric motor driven chillers at UNL. The model uses energy conversion efficiency estimates to calculate the production cost difference between different technologies. The model will also determine the time periods for which different energy sources are used, for instance, when the steam turbine chillers need to be operated to reduce the high electricity demand-charge due to the peak time electricity use. The model will also use historical city campus chilled water demand and weather data to develop a statistical chilled water demand prediction. This model would be used to optimize chilled water production by allowing the forecasting of chilled water production for a short term (48-hour) period based upon ambient weather forecasts and mid-term (monthly) strategic plans. The two aspects of this model (demand prediction and chiller optimization) are intended to produce the maximum energy efficiency at the least cost for the production of chilled water. The case study and verification will be conducted at UNL's central chilled water plant. The project is conducted by a multi-disciplinary collaboration between UNL Facility Management, Lincoln Electric System (LES), and faculty from the Construction Management and the Industrial and Management Systems Engineering departments.