Veris Application Note

Optimizing Chiller Plant Performance

⚠ DANGER ⚠

HAZARD OF ELECTRIC SHOCK, EXPLOSION, OR ARC FLASH

- Follow safe electrical work practices. See NFPA 70E in the USA, or applicable local codes.
- This equipment must only be installed and serviced by qualified electrical personnel.
- Read, understand and follow the instructions before installing this product.
- Turn off all power supplying equipment before working on or inside the equipment.
- Use a properly rated voltage sensing device to confirm power is off.
  DO NOT DEPEND ON THIS PRODUCT FOR VOLTAGE INDICATION
- Only install this product on insulated conductors.

Failure to follow these instructions will result in death or serious injury.

The information provided herein is intended to supplement the knowledge required of an electrician trained in high voltage installations. There is no intent to foresee all possible variables in individual situations, nor to provide all training needed to perform these tasks. The installer is ultimately responsible to assure that a particular installation will be and remain safe and operable under the specific conditions encountered.

Introduction

In most commercial facilities, the chiller plant represents a significant percentage of the total building electrical consumption, so maximizing the efficiency of the chiller plant is a crucial part of managing the facility's mechanical system. Most building operators are unable to achieve maximum system efficiency because of insufficient assessment data. Several key factors make chiller optimization difficult:

- Accurate chiller system assessments must account for both the chiller operation and the impact on the cooling tower, condenser water pumps and chilled water pumps.
- Very few buildings have accurate system curve data to aid in optimizing performance. The chiller manufacturers provide data on the chillers, the pump manufacturers provide data on the pumps and the tower manufacturers provide data on the towers, but there is rarely actual performance data which reflects the interaction of all components.
- To accurately assess the effects of changes made to plant operation, the total kW for all of the components must be measured and summed. This is typically expensive and often requires shutdown and rewiring of the chiller plant.

Although these factors represent a significant challenge to the building owner, the use of installed automation systems and metering technology provides an opportunity for payback of all installation costs within a year or less for most building owners. Measurement of a few simple variables combined with state-of-the-art power sensing products permits the building owner to implement a successful program of chiller optimization in a relatively short time. Ongoing monitoring using graphics-based interfaces allows the operator to precisely determine the impact of changes in a timely and efficient manner.

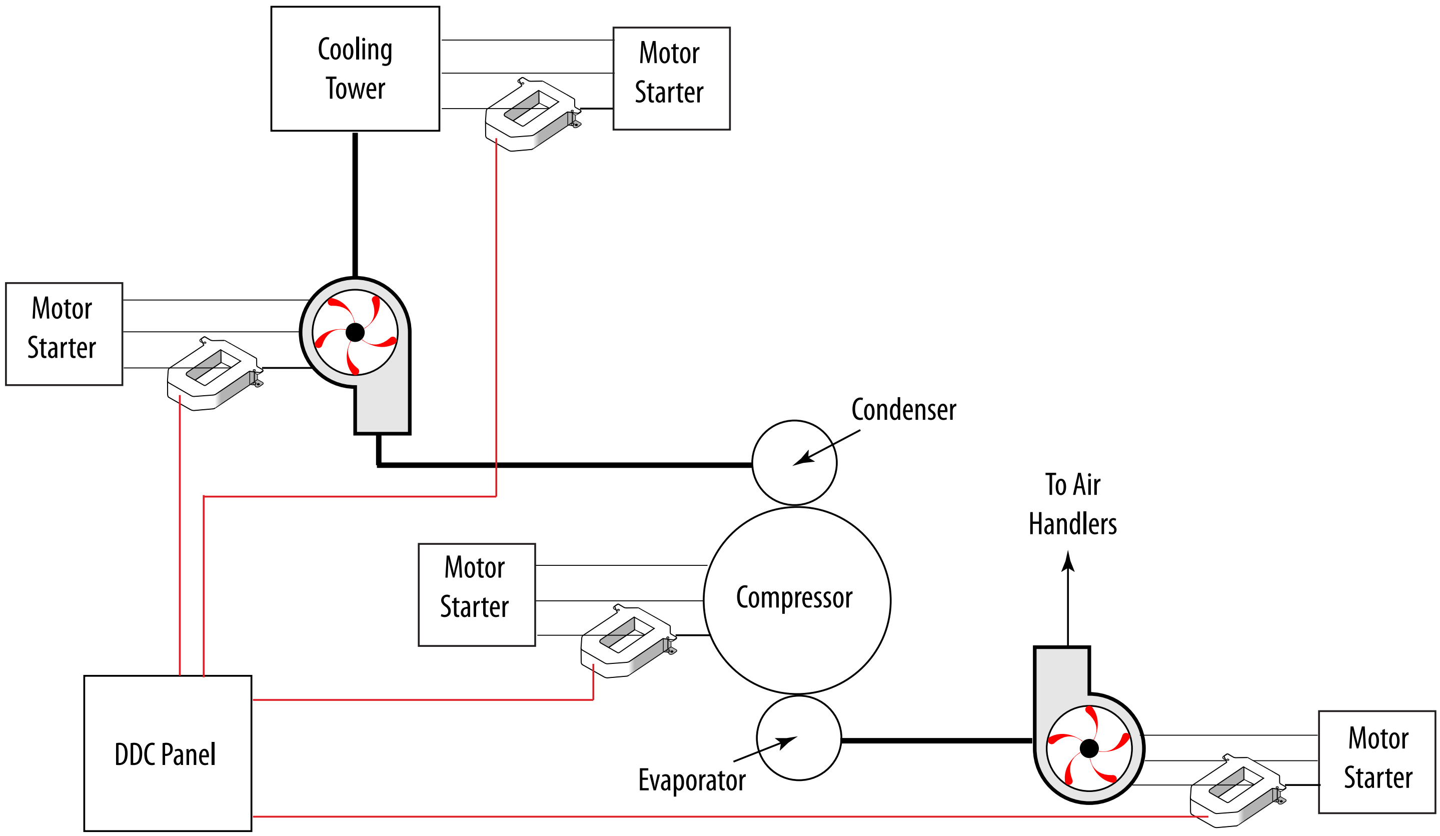
Successful implementation requires several elements:

1. Automated control system with analog inputs;
2. Graphical user interface for plotting multiple variables;
3. Entering and leaving condenser water temp (ECWT & LCWT) sensor(s) to measure the water temperature entering and leaving the condenser;
4. Entering and leaving chilled water temp (EChWT & LChWT) sensor(s) to measure the entering and leaving chilled water temperatures at the evaporator;
5. Chilled water flow (in GPM) to calculate the tons of cooling;
6. Power meters for the chiller, pump(s) and tower electrical supply leads.

Single Phase Power Sensor Theory of Operation

Mechanical loads such as chillers, pumps, and cooling towers are balanced loads, which means that the power drawn by each of the three phases is considered to be equal. This provides an excellent opportunity for lowering installation costs by measuring the power on a single phase of the load and using software to determine the total power load. The sensor uses a split-core, high-accuracy current sensor combined with an integral voltage sensor and the associated circuitry to produce an analog output (4-20 mA) proportional to the power (kW) being sensed. This approach is superior to calculated methods using current sensors, since the kW transducer captures power factor and voltage, providing a much higher level of accuracy than calculated values.

Typical Installation



The total kW for the system is calculated by summing the kW values measured at each section of the chiller plant:

$kW_{total} = kW_{chiller} + kW_{pumps} + kW_{tower}$

Using this data to measure power, the building operator can adjust the temperature differential on the condenser and chilled water loops while measuring the kW consumed by the entire chiller plant (chiller, pumps, and towers). By measuring the volume of water (GPM) flowing in the system and the DT of the chilled water supply, the user can calculate the efficiency of the system:

$Efficiency = kW / Ton$

$Efficiency = kW_{total} / [(GPM * DT)/24]$