IMPROVING ENERGY EFFICIENCY IN COOLING TOWER DESIGN
Environmental Impacts of Buildings

> 39% of total energy use*

> 70% of electricity consumption*

> HVAC accounts for 40-60% of the energy used in US commercial & residential buildings**

* source Gulf news June 2005 and Statistics provided by USGBC’s LEED for Product Manufacturers presentation, ©2005

**Statistics provided by US Department of Energy: Buildings info and components
How Can We Improve the Energy Efficiency?

- Utilize water cooled chiller design
- Optimize the chiller performance
- Minimize the chiller operation
- Optimize the cooling tower efficiency
  - ASHRAE 90.1
  - ASHRAE 189.1
  - Proper tower selection
  - Proper tower operation
Step 1: Utilize Water Cooled Systems
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Water vs. Air Cooled Systems

> Lower condensing temperatures

> 1.5 to 3 times greater COP than air cooled

> 30 to 50% potential energy savings

> By far the largest opportunity to reduce energy usage

Marley®
AN SPX BRAND
Step 1: Utilize Water Cooled Systems

When Are Air Cooled Systems Appropriate?

> Below 300 tons
  • California Title 24 allows 100% air cooled systems under 300 tons
  • Payback favors dry cooled below ~200 to 300 tons
  • Various ASHRAE studies
  • However, water cooled systems still more efficient

> Limited water availability
  • Water usage is frequently over-estimated
Step 1: Utilize Water Cooled Systems

Water Usage Curves

Information provided from UPDATE Sizing and Selection Software from SPX Cooling Technologies
Water Saving Strategies

> Hybrid wet/dry cooling tower
  • NCWD
  • Utilizes sensible and latent cooling

> Increase cycles of concentration

> Make-up water alternatives
No Water?

> Must use a dry system
Step 2:
Optimize Chiller Condenser Temperature and Range
Optimize Chiller Performance

> 2 vs. 3 GPM per ton

> Design cold water temperatures as low as possible
  - Efficiency improves 1 to 3% for every 1°
Optimize Chiller Performance

> 7° F approach temps are typical (=3,89° C)

> 5° F is feasible and reasonably common (=2,78° C)
  • Lower chiller operating cost

> Approach temp is proportional to capacity
  • Example: Reducing the approach temp from 7° F to 5° F equates to 29% increase in required tower capacity
Step 3: Optimize Cooling Tower Efficiency

> Meet the minimum base case 90.1 for the entire building

- CTI certified 38.2 GPM/hp for axial fan open cooling towers (=11.6 m³/h/kW)
- CTI certified 20 GPM/hp for centrifugal fan open cooling towers (=6.1 m³/h/kW)
ASHRAE Standard 90.1 (2010)

- Looking to achieve 30% energy savings over previous version
- Part of ASHRAE’s goal to achieve market-viable net-zero energy buildings by 2030
- Efficiencies defined for Evaporative Fluid Coolers
- Centrifugal fans will have same requirements as axial fans
Axial vs. Centrifugal Fans

> Axial fans are two times more efficient than centrifugal

> Centrifugal-forced draft towers still viable:
  - Indoors
  - Ducting
  - Replacements
Step 3: Optimize Cooling Tower Efficiency

Increase 90.1 Efficiency Requirement

> Increase 90.1 efficiency requirement
  - Double the minimum efficiency from 38.2 to 76.4
  - Does not always increase the tower cost

> UPDATE sizing & selection software
  - http://qtcapps.ct.spx.com

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Step 4: Operate Cooling Towers Efficiently
Energy Efficient Operation

> Using Variable Frequency Drives
  • Method of control
  • Example: 10 cell cooling tower (100hp/cell) 1000 hp total at 50% heat load
    • Operating with 5 cells on full speed = 500 hp
    • Controlling 10 cells together (ramping all fans up and down together by VFD) = 125 hp to meet the same duty.
Energy Efficient Operation

> Using Variable Frequency Drives cont.

> Crossflow towers are ideal varying flow rates throughout the year
  • Readily handles multiple flow rates through the use of basin dams
Step 5: Responsible Cooling
Proper Water Management

> Develop and implement a water management plan for the cooling tower

> Improve water efficiency by installing and/or maintaining a conductivity meter and automatic controls to adjust bleed rate and maintain proper concentration
Proper Water Management

> Have a measured program in place that verifies make-up water quantities used from non-potable sources

> Acoustics – reduce sound levels
  • Attenuation, Low Noise and Ultra-Low Noise Fans
Questions?