Process Water Efficiency

HEALTHCARE - TOP 5 GREEN BUILDING STRATEGIES

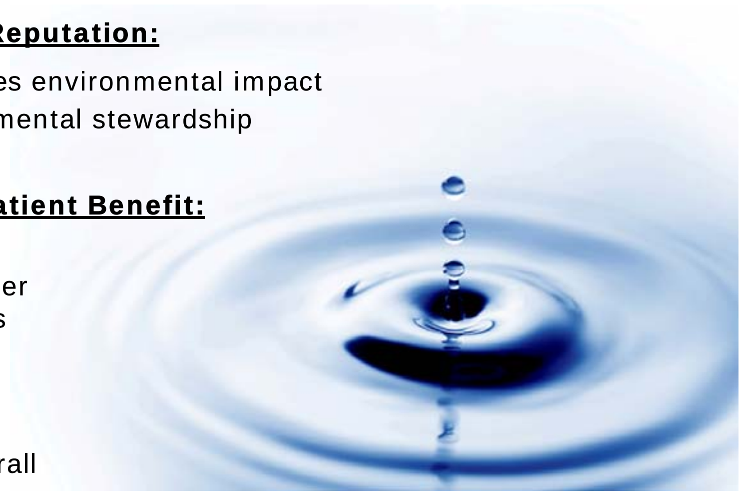
EPA Publication 909-F-07-001

What? Water is an increasingly visible and expensive resource. Process water - used to operate building systems including boilers/chillers, cooling towers, and sterilizers – comprises about 75% of hospital water use. Reducing water use can lower operational costs and should be part of an integrative design process for construction.

Why?

Enhanced Community Reputation:

- Water efficiency reduces environmental impact
- Demonstrates environmental stewardship



Environmental / Staff / Patient Benefit:

- Lower environmental impact on drinking water sources and waterways receiving wastewater

Cost Competitive:

- Improves facility's overall operational efficiency
- Process water technologies are readily available and well tested with documented savings

How?

- Reuse cooling tower water and boiler blowdown
- Recover and reuse condensate
- Increase efficiency or replace water-cooled equipment

Case Studies

- Emory University
- Univ. of Florida

Green Guide for Health Care (GGHC) Criteria: *Construction: Water Efficiency and Operations: Water Conservation* www.gghc.org

This is one of 5 ***Building Healthy Hospitals*** case studies developed by EPA's Pacific Southwest Regional Office, with Resource Conservation Challenge and Pollution Prevention funds.

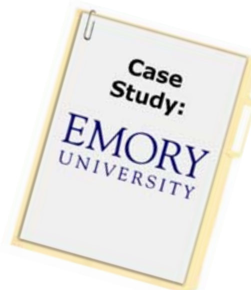
www.epa.gov/region09/waste/p2/projects/hospart.html

Indoor Air · Sustainable Flooring · Process Water Efficiency · Lighting Efficiency · Energy Efficiency

CASE STUDY: CONDENSATE WATER RECOVERY

Applicability:	New construction or major renovation projects; condensate water recovery can be done at any healthcare facility not connected to a central cooling plant
Environmental Impact:	Reduced use of cooling tower make-up water saved 900,000 gallons of water per year.
Other Benefits:	Long term operating efficiency.

Background



Normal operation of air handling units produces condensate water from cooling coils that typically drains to municipal sewer systems. Condensate is characteristically clean water that can be captured and reused for other non-potable water applications.

Performance

The total water use at Emory's Winship Cancer Institute is estimated to be 80 percent less than a comparable facility through the use low flow fixtures and process water efficiency improvements. This water use efficiency is in large part the result of Emory's conservation efforts in high water use areas, including process water associated with HVAC systems. The Winship Cancer Institute recovers condensate water from the air handling units of its cooling system, for use as make-up water in the cooling towers. This reduces water needed for the cooling towers by approximately 900,000 gallons per year. Features of the system include:

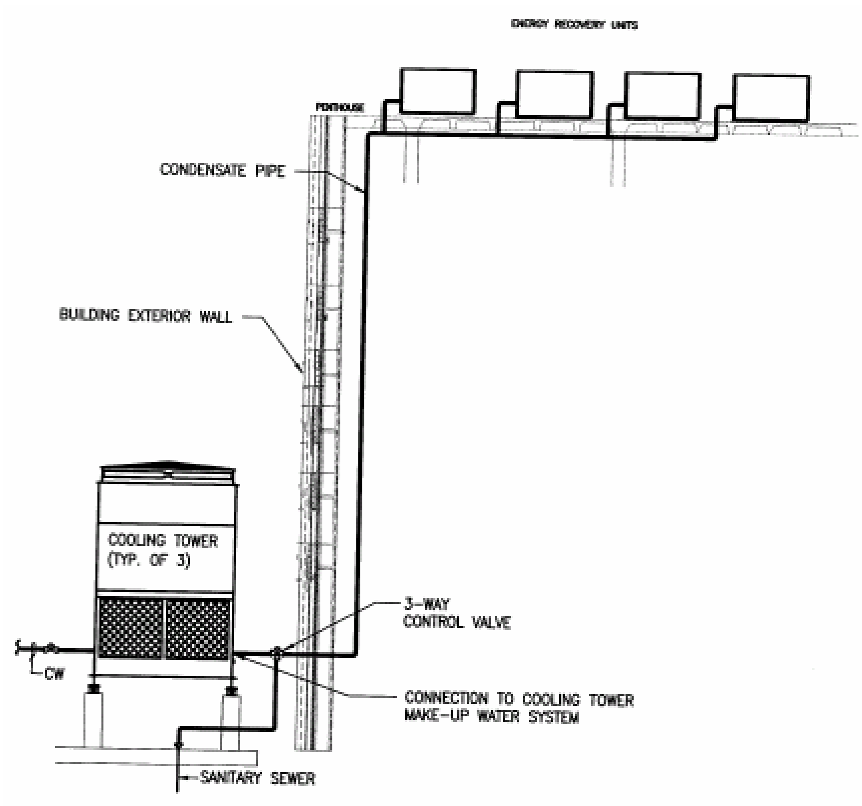
- Condensate recovery works by gravity flow; A drain line runs from each air handling unit to a central connection point in the penthouse, and from there a single line runs to the cooling towers.
- Collected condensate water enters the cooling towers at temperatures between 50 and 60 °F.
- A 3-way valve in the line feeding make-up water to the cooling towers allows the system to draw from reclaimed condensate or domestic water. The cooling towers have a level control to determine the amount of condensate needed in the towers, controlling the 3-way valve accordingly.

- Normally, the cooling towers need more make-up water than can be recovered from the condensate, in which case the system uses supplemental domestic water.

- When occasionally there is some excess condensate, it drains to the municipal sewer; without the recovery system, all condensate would be sent to the sewer. Each air handling unit has a two way valve in the condensate line to allow for the system maintenance.

- All condensate pans in air handling units throughout Emory's campus are treated to control algae growth to keep drain lines from clogging and pans from overflowing. The condensate pans at the Winship Cancer Institute are treated the same way as every other air handling unit and no extra maintenance costs are incurred.

WINSHIP CANCER INSTITUTE CONDENSATE RECOVERY SYSTEM



Cost

Installing a condensate recovery system requires additional engineering design and added plumbing costs to pipe condensate from the point of recovery to the cooling towers. Because of the gravity fed design and relatively close proximity between the air handling units and the cooling towers, Emory realized a payback on this project of less than 1 year (see cost/benefit analysis). This payback period depends on the cost of raw water (from a municipal source) and the cost of piping (largely dependent on the distance) required to collect and return condensate to the system.

COST/BENEFIT ANALYSIS – WINSHIP CANCER CONDENSATE RECOVERY

	Condensate Recovery System	Comments
Initial Cost	$45,000	Costs include piping system from air handling units to cooling towers and associated hardware.
Water Savings	900,000 gallons	Nearly all condensate recovered is reused in make-up water; in rare instances, excess condensate is discharged to the municipal sewer system.
Cost Savings	$48,600	2005: $5.40 per 1,000 gallons of water 2006 and beyond: Significantly higher – water costs may rise 40 percent or more annually for several years.
Simple Payback	Approx. 5 years	Payback is estimated at 9.25 years based on 2005 water costs and is longer than Emory would normally require for capital projects, but water costs are expected to rise sharply in the greater Atlanta area. As a result, Emory expects cost savings from water conservation to exceed the costs of the condensate recovery system in approximately 5 years.

Case Study *Vitals*

The following summarize success criteria for implementing this project at other healthcare facilities:

- Consider the condensate recovery potential as well as the amount of make-up water needed when evaluating the effectiveness of a condensate recovery system. Ideally, 75 percent or more of the recovered condensate should be used.
- Though Emory installed a condensate recovery system at a building with an independent cooling system, the same strategy could be implemented at a central cooling plant. For example, Emory has implemented a similar system at one of the three central cooling plants serving the campus. Condensate water from one of the buildings served by the plant is collected and pumped back to the plant using the

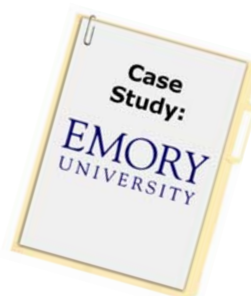
same route followed by the chilled water lines. The need for a pump and the longer distance to the plant increase the equipment cost; however, this system collects and reuses approximately 3,000,000 gallons of water per year, resulting in a similar payback to the system at Winship Cancer Institute.

CASE STUDY: INTEGRATED WALK-IN REFRIGERATION SYSTEM

Applicability:	New construction or major renovation projects; can be applied to cool walk-in refrigeration coolers or freezers in kitchens or laboratories.
Environmental Impact:	Reduced use of domestic water needed to cool walk-in refrigerator compressors by 11,826,000 gallons per year.
Other Benefits:	Long term operating efficiency.

Background

Healthcare facilities often have large, walk-in refrigerated areas for laboratory use or food storage. These areas can be chilled using a variety of technologies, but are often served by an independent compressor that cools the area using chilled air or water. Compressors chilled by water typically draw from domestic water sources and discharge to municipal sewer systems.



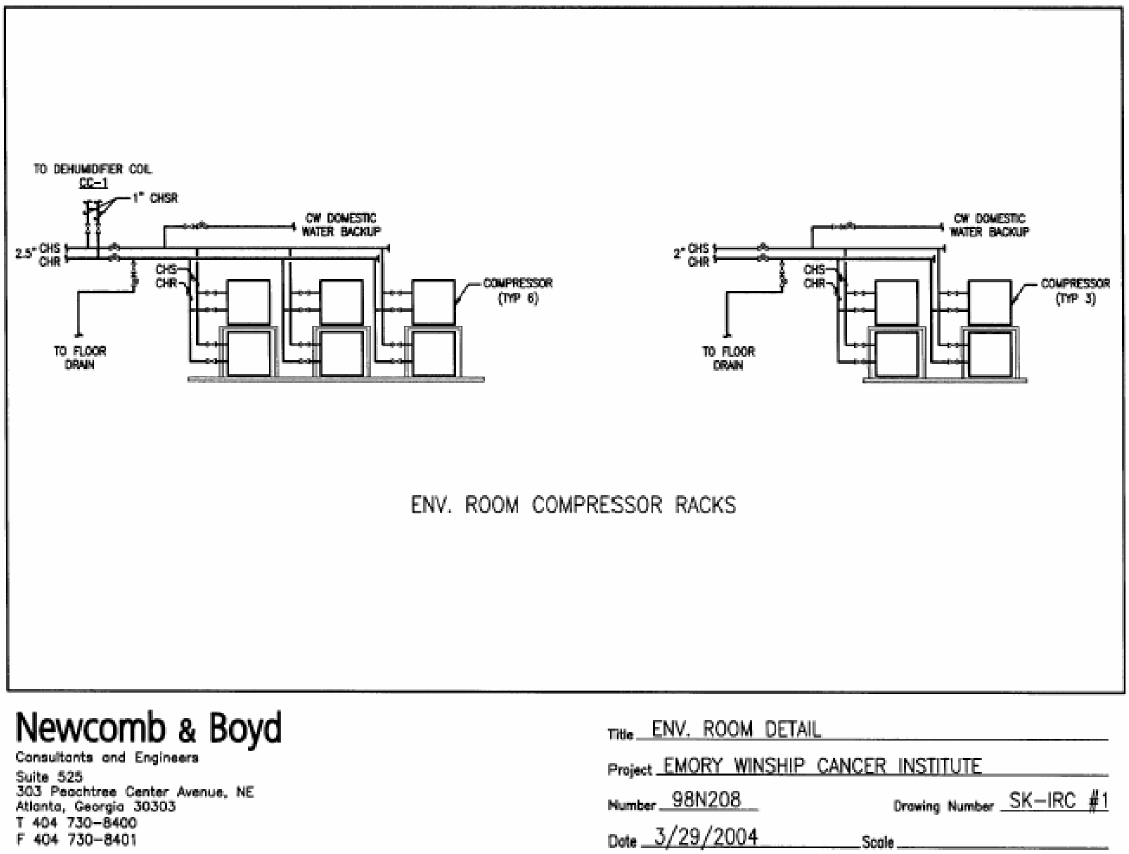
Each of the three laboratories at the Winship Cancer Institute is equipped with three 70 to 100 square foot walk-in refrigerators used to store reagents and research materials, chilled to 39° F.

Performance

Emory has integrated the cooling system used to cool the walk-in refrigerators with the chilled water loop that also serves the air handling units. Rather than using domestic water to cool the compressors used to chill these rooms, Emory has routed already chilled water from the building's air handling units through the compressors, then returning the water to the chillers. This innovation was made easier because the compressors used to chill the walk-in refrigerators were located in the penthouse in close proximity to the air handling units. The water lines connecting the air handling units and compressors are equipped with a temperature sensor; if the temperature in these lines should increase above 60° Fahrenheit, domestic water is used to cool the compressors until the supply water from the chillers drops back below 60° F.

Because it relies on already chilled water generated from air conditioning systems, the efficiency of this strategy is directly linked to the frequency of operation of the building's air conditioning system. Georgia's warm, humid climate requires significant use of air conditioning systems; therefore, the chillers are used for most of the year. However, the air conditioning system is typically unused seasonally between December and February during which time the walk-in refrigerators are cooled using domestic water.

WALK-IN REFRIGERATOR – CHILLER SCHEMATIC



Cost

Integrating the compressors used to cool the walk-in refrigerators with the air handling unit chilled water loop requires additional engineering design and added plumbing costs to connect the two typically separate systems. Depending on the amount of piping required to make this modification the payback period can range from 1 to 7 years.

WALK-IN REFRIGERATION SYSTEM COST/BENEFIT ANALYSIS		
	Integrated Walk-In Refrigeration System	**Comments**
Initial Cost	$40,000	Total costs to modify all 9 units.
Water Savings	11,826,000 gallons	Avoided domestic water use.
Cost Savings ($)	$63,840	Emory pays $5.40 per 1,000 gallons of water.
Payback	0.63 years (7.5 months)	Cost savings from water conservation exceeded the costs of the integrated walk-in refrigeration system in the first year.
Notes: The viability and favorable payback of this project relies heavily on two factors that may or may not exist at other facilities; namely: 1. Relatively low initial cost because of the close proximity of the compressors used to chill the refrigerators and the air handling units for the HVAC system. 2. The high use of the HVAC system necessitated in humid and hot southeastern U.S. climates.		

Case Study *Vitals*

The following summarize success criteria for implementing this project at other healthcare facilities:

- The proximity of the walk-in refrigerator compressors and air handling units helped minimize the cost of integrating these systems.
- This type of system can be applied to cool any walk-in refrigerators, not just those in laboratories.

The system used at Winship Cancer Institute is appropriate for other facilities in warm weather climates. Alternatively, cooler climate facilities could consider implementing a similar strategy using a heat exchanger.

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