



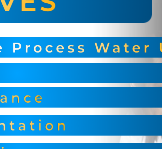
Beyond
SMART CITIES

OPTIMIZE PROCESS WATER USE - CREDIT
TRAINING PROGRAM
FOR GREEN BUILDING AND SUSTAINABILITY SPECIALIST

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*** CWES ***



LEARNING OBJECTIVES

- Intent of Optimize Process Water Use
- Behind the intent
- Step by Step Guidance
- Required Documentation
- Terms and Definitions

WE- CR(2) - DESIGN

INTENT

To conserve low cost potable water resources used for mechanical processes while controlling, corrosion and scale in the condenser water system.

POTENTIAL TECHNOLOGIES & STRATEGIES

To significantly reduce makeup water inputs, it is important to achieve target cycles of concentration (see Further Explanation, Cycles of Concentration). Cooling tower or evaporative condenser water efficiency is measured in the number of recirculation cycles before water must be removed by blowdown

OPTIMIZE PROCESS WATER USE

REQUIREMENTS

Whether the project uses 100% potable or 100% nonpotable water for c cooling, the first step is to obtain a chemical analysis. - Engage a water treatment professional to perform the analysis. If a potable water analysis has already been completed, it must be no more than five years old. At a minimum, the analysis must measure the concentration parameters identified in the credit requirements. Highlight each parameter in the documentation. - Describe the analysis. The narrative must identify the source of the makeup water and the process for analysis

IMPLEMENTATION

REQUIRED DOCUMENTATION

Documentation	1 point	2 points
Potable water analysis results	X	X
Potable water analysis narrative	X	X
Cycles of concentration calculations	X	X
Evaporative water calculations		X
Water treatment calculations		X
Nonpotable water analysis (if using 100% nonpotable water)		X

BEHIND THE INTENT

Refrigeration systems remove heat, usually from air, to cool interior building spaces. This heat is expelled into either the atmosphere or another medium. A cooling tower or evaporative condenser removes heat in part by evaporating water; as the water absorbs heat, it changes from a liquid to a vapor. As the water evaporates, however, dissolved solids become more concentrated in the remaining water and eventually begin to deposit scale on cooling tower or evaporative condenser elements, making such systems less efficient. To prevent buildup of deposits, cooling tower and evaporative condenser systems remove a portion of the water through a process called blowdown. Makeup water is then added to replace evaporative losses and blowdown volume. Cooling towers can therefore account for large portions of a building's total water use.

To significantly reduce makeup water inputs, it is important to achieve target cycles of concentration (see Further Explanation, Cycles of Concentration). Cooling tower or evaporative condenser water efficiency is measured in the number of recirculation cycles before water must be removed by blowdown. ➡

Increasing the number of cycles can save thousands of gallons of potable water during a building's peak cooling periods. Chemically analyzing makeup water allows for calculation of optimal cycles. Cycles can also be increased by treating water to remove or sequester dissolved solids rather than relying only on blowdown and input of fresh makeup water.

BEHIND THE INTENT +

Evaporative cooling is the most energy efficient method to reject heat from a process (1 lb. of water removes almost 1,000 BTU's (970 BTU/lb.) with the added benefit of reducing greenhouse gas emissions. Cooling towers and evaporative condensers utilize evaporative cooling to operate with maximum energy efficiency; to preserve this energy savings, it is important to conserve the water these system use, especially in water stressed regions. In some climate zones, heat rejection system designs can help to decrease the water intensity of the building cooling process using a combination of wet, dry, or adiabatic cooling. In some cases, 100% dry operation is possible.

BEHIND THE INTENT +

For wet cooling systems, this credit addresses water conservation strategies while still saving energy. This strategy includes maximizing cycles of concentration in cooling towers and evaporative condensers and make-up water reduction strategies including the use of reclaimed water and hybrid cooling.

The use of alternative recycled water to meet process water demands can further reduce building potable water use.

Updates to this credit recognize regional variations in the quality of local water supply and recognize additional strategies for reducing potable water use for diverse project types.

Core and Shell projects can now earn up to 3 points under WE credit Optimize Process Water Use. One point was re-allocated from WE credit Indoor Water Use Reduction to this credit, to better align WE points available with the typical scope of work of Core and Shell projects and to reward incremental process water savings.



STEP-BY-STEP GUIDANCE

Only projects served by cooling towers or evaporative condensers are eligible for this credit.

STEP 1. OBTAIN WATER ANALYSIS

Whether the project uses 100% potable or 100% nonpotable water for cooling, the first step is to obtain a chemical analysis.

- Engage a water treatment professional to perform the analysis. If a potable water analysis has already been completed, it must be no more than five years old.
- At a minimum, the analysis must measure the concentration parameters identified in the credit requirements. Highlight each parameter in the documentation.
- Describe the analysis. The narrative must identify the source of the makeup water and the process for analysis.

STEP 2. CALCULATE CYCLES OF CONCENTRATION

Determine how many times the cooling tower or evaporative condenser water can circulate through the system without causing performance or operational concerns by using Equation 1. Based on the maximum concentrations indicated in the credit requirements:

Equation 1. Factor water-use reduction

$$\text{Cycles of concentration} = \frac{\text{Acceptable maximum concentrations in condenser water}}{\text{Potable water concentrations in makeup water}}$$

STEP 3. IDENTIFY LIMITING FACTOR

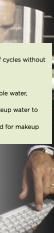
Identify which concentration parameter has the fewest calculated cycles before it exceeds the maximum concentration. The parameter's number of cycles, the limiting factor, will determine the maximum number of cycles for the cooling tower or evaporative condenser.

STEP 4. SET COOLING TOWER OR EVAPORATIVE CONDENSER CYCLES

Adjust the cooling tower or evaporative condenser settings for the maximum number of cycles without exceeding concentration levels or affecting condenser operation.

STEP 5. INCREASE SYSTEM PERFORMANCE

- Increase the number of cycles by treating the water or, if the project is using 100% potable water, supplementing it with water from a nonpotable source.
- Evaluate whether greater potable water efficiency could be achieved by treating makeup water to reduce or sequester some of the dissolved solids.
- Nonpotable water derived from the site can offset a portion of the potable water used for makeup (see Further Explanation, Selecting Nonpotable Sources).



REQUIREMENTS

Option 1. Cooling Tower and Evaporative Condenser Cycles of Concentration (1-2 points except CS, 1-3 points CS)

For cooling towers and evaporative condensers, conduct a one-time potable water analysis, measuring at least the five control parameters listed in Table 1.

Table 1. Maximum concentrations for parameters in condenser water

Parameter	Maximum level
Ca (as CaCO ₃)	600 ppm
Total alkalinity	500 ppm
SiO ₂	150 ppm
Cl ⁻	300 ppm
Conductivity	3300 µS/cm

ppm = parts per million

µS/cm = micro siemens per centimeter



REQUIREMENTS +



- ✓ Calculate the maximum number of cooling tower cycles by dividing the maximum allowed concentration level of each parameter by the actual concentration level of each parameter found in the potable makeup water analysis. Limit cooling tower cycles to avoid exceeding maximum values for any of these parameters.
- ✓ The materials of construction for the water system that come in contact with the cooling tower water shall be of the type that can operate and be maintained within the limits established in Table 1.

REQUIREMENTS +



✓ Table 2. Points for cooling tower cycles

Cooling tower cycles	Points (all except CS)	Points (CS)
Maximum number of cycles achieved without exceeding any maximum concentration levels or affecting operation of condenser water system	1	1
Meet the maximum calculated number of cycles to earn 1 point, and increase the number of cycles by a minimum of 20% by increasing the level of treatment and/or maintenance in condenser or make-up water systems	2	2
OR		
Meet the maximum calculated number of cycles to earn 1 point and use a minimum 20% recycled nonpotable water		
Meet the maximum calculated number of cycles to earn 1 point, and increase the number of cycles by a minimum of 30% by increasing the level of treatment and/or maintenance in condenser or make-up water systems	3	3
OR		
Meet the maximum calculated number of cycles to earn 1 point and use a minimum 30% recycled nonpotable water		

- ✓ Minimum percentage recycled non-potable water used in cooling tower makeup should be based on water use during the month with the highest demand for make-up water.
- ✓ Projects may consider using water reclaimed from another process as a source of makeup water for evaporative cooling equipment as long as the resultant circulating water chemistry conforms to the parameters established in Table 1.
- ✓ Projects whose cooling is provided by district cooling systems are eligible to achieve Option 1 if the district cooling system complies with the above requirements.

REQUIREMENTS +



Option 2. Optimize Water Use for Cooling (1-2 points except CS, 1-3 points CS)

To be eligible for Option 2, the baseline system designated for the building using ASHRAE 90.1-2016 Appendix G Table G3.1.1 must include a cooling tower (systems 7, 8, 11, 12, and 13)

Achieve increasing levels of cooling tower water efficiency beyond a water-cooled chiller system with axial variable-speed fan cooling towers having a maximum drift of 0.002% of recirculated water volume and three cooling tower cycles. Points are awarded according to Table 3.

REQUIREMENTS +

Table 3. Points for reducing annual water use compared to Water-Cooled Chiller System

Percentage Reduction	Points (BD+C)	Points (CS)
25%	1	1
50%	2	2
100%	-	3

Demonstrate that the project is using minimum 20% recycled alternative water to meet process water demand for 1 point, or using minimum 30% recycled alternative water to meet process water demand for 2 points. Ensure that recycled alternative water is of sufficient quality for its intended end use.
Minimum percentage of recycled alternative water used should be based on water use during the month with the highest water demand.
Process water uses eligible for achievement of Option 3 must represent at least 10% of total building regulated water use and may not include water used for cooling. Eligible subsystems may include:

REQUIREMENTS +

- Boilers
- Humidification systems
- Other subsystems using process water

Projects served by district systems are eligible to achieve Option 3 if the district system complies with minimum thresholds for recycled alternative water use.

Core and Shell projects:
Demonstrate that the project is using minimum 20% recycled alternative water to meet process water demand for 1 point, using minimum 30% recycled alternative water to meet process water demand for 2 points, or using minimum 40% recycled alternative water to meet process water demand for 3 points. Ensure that recycled alternative water is of sufficient quality for its intended end use.

REQUIRED DOCUMENTATION

Documentation	Option 1	Option 2	Option 3
	1 point	2 points	
Potable water analysis results	x	x	
Potable water analysis narrative	x	x	
Cycles of concentration calculations	x	x	
Recycled nonpotable water calculations		x	
Water treatment calculations		x	
Nonpotable water analysis (if using 100% nonpotable water)		x	
Documentation showing that project Baseline system is designated as systems 7, 8, 11, 12, or 13 under ASHRAE 90.1-2016 Appendix G Table G3.1.3			x
Calculations demonstrating percent reduction in cooling tower water usage for systems where the proposed design uses the latent heat of evaporative cooling of water			x
Site or mechanical systems plan, energy model or other showing project design			x
Water subsystem monthly demand calculations			x
Recycled alternative water source quantity calculations and plumbing drawings/schematics of the alternative water system. For municipally supplied alternative water, provide documentation that the municipality has agreed to supply the volume of recycled alternative water claimed by the project.			x
Manufacturer information for water subsystem			x

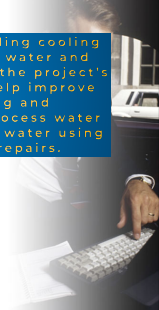
REFERENCED STANDARDS

✓ASHRAE Standard 90.1-2016



CONNECTION TO ONGOING PERFORMANCE

LEED O+M WE credit Water Performance : Designing building cooling systems and other water subsystems to minimize potable water and reuse alternative water sources can significantly reduce the project's water footprint over the building life cycle, which may help improve a project's water performance score. Additionally, treating and maintaining the quality of makeup water used to meet process water demands can preserve the performance and efficiency of water using subsystems, reducing the frequency of replacement and repairs.



TERMS AND DEFINITIONS

✓External meter a device installed on the outside of a water pipe to record the volume of water passing through it. Also known as a clamp-on meter.

✓Reclaimed water wastewater that has been treated and purified for reuse

✓Wet meter a device installed inside a water pipe to record the volume of passing water

