5.1 Cooling Systems

Applicability

This BMP is intended for industrial water users that use circulated water to convey heat generated from industrial equipment and mechanical devices such as heat exchangers, condensers, process machinery, tools, air conditioning systems, appliances, vacuum pumps, x-ray or similar medical and dental equipment, welding machines, icemakers, and aircompressors. This BMP is not targeted to larger, once-through cooling systems on bodies of water such as lakes and bays that use and may recirculate water from within the same or adjacent water bodies or large once-through cooling systems that typically consume water by forced evaporation only.

Description

Cooling involves the removal of process energy in the form of heat. This BMP centers on the practices for optimizing the water-use efficiency of cooling systems other than large-scale evaporative cooling towers or large systems that typically consume water through forced evaporation (*See* Cooling Towers BMP). Water-cooling systems using single-pass water in a variety of industrial applications can use large amounts of water.

The single most significant opportunity for water reduction comes from eliminating or limiting the use of single-pass cooling systems. The use of single-pass cooling systems is prohibited by ordinance or legislation in numerous municipalities and states. Options for replacement of single-pass water cooling include the use of air cooling, the use of non-aqueous fluids and the use of recirculating and recycling water systems. If single-pass cooling cannot be eliminated, then opportunities should be explored for reuse of the cooling water for other on-site purposes.

Implementation

After identification of water-cooled equipment, implementation should consist of the following actions:

1) Performance of a water efficiency evaluation on each water-cooled system or process to identify areas or opportunities for reduction of water use. Information gathered should include types of equipment and processes, estimated or measured water use, water quality requirements, heat load and identification of opportunities to optimize the removal of heat within the process.
2) Replacement or upgrades of water-cooled systems with equipment that uses closed loop recirculating equipment.
3) Replacement or upgrades of water-cooled systems with equipment using alternative cooling modes such as air-cooling or non-aqueous systems.

4) Elimination of single-pass water cooling in facilities which have small evaporative coolers, sometimes known as “swamp coolers.” Swamp coolers are only effective in areas of low relative humidity and need recirculating systems in order to operate efficiently. Operating efficiency of recirculating evaporative coolers should be optimized by regular replacement of pads and maintenance of equipment.
5) When practical, installation of individual meters on all water-cooled systems and daily monitoring of use.
6) An evaluation of and use, if possible, of alternative sources of cooling water such as condensate, saline water, reclaimed water, harvested rainwater, graywater, or water used in other onsite processes.
7) Evaluation of opportunities for reuse of the cooling water for other processes on site.
8) Operation of the water-cooled processes and equipment in an efficient manner at all times and keeping equipment in optimal operating condition. This includes maximization of external air-cooling opportunities and optimization of heat exchange equipment.
9) Use of solenoid valves or other methods for shutting down of systems when not in use.

Schedule

The industrial water user should identify and complete an efficiency evaluation of water-cooled systems in a timely manner. Evaluations of very large or complex systems should be completed within six (6) months of beginning this BMP.

1) The industrial water user should eliminate or upgrade all single-pass cooling systems within a normal budget cycle to implement the BMP in order to achieve the maximum water efficiency benefit in a reasonable time frame.
2) If determined to be necessary for very large or complex facilities, the schedule can be extended. BMPs should be initiated in the second year and continued until the targeted efficiency is reached.

Scope

To accomplish this BMP, the industrial water user should do the following:

1) Industrial water users with one facility, or several facilities with the same or very similar industrial processes, should perform an efficiency evaluation and perform upgrades or replacements as outlined in Section D.
2) For industrial water users with multiple facility sites or multiple industrial processes, a progressive implementation schedule should be followed,

implementing the BMP in successive facilities until all facilities have been evaluated and conservation measures implemented.

3) Cost-effectiveness considerations may result in partial implementation of this BMP at one or several of a large number of facilities.

Documentation

To track this BMP, the industrial water user gathers and maintains the following documentation and can utilize industry accepted practices:

1) List of water-cooled devices or systems and description of the process the cooling is used for, type of cooling process, water use stream, and heat load;
2) System requirements for cooling including temperature, volume, heat load and duration of flows (hours/day);
3) Where meters exist, the daily water use records for each system as appropriate for make-up water, discharge, and flow through the system;
4) Written details and records of all facility replacements, modifications, and upgrades of cooling systems made to meet the requirements of this BMP; and
5) Details of alternate water sources or water reuse opportunities considered.

Determination of Water Savings

Based on historical records, manufacturers' performance data, or observations and measurements, calculated water savings due to implemented changes in operating procedures or equipment replacements and upgrades can be estimated. For example, it is estimated that retrofitting of single-pass cooling equipment such as x-rays to recirculating water systems can cut water use by 90 percent (*See* Section I. References for Additional Information, 4).

Cost-Effectiveness Considerations

The industrial water user should determine the cost effectiveness to implement each identified replacement or equipment upgrade to its cooling systems operations, utilizing its own criteria for making capital improvement decisions. A cost effectiveness analysis under this BMP should consider capital equipment costs, changes in staff and labor costs, additional costs or savings in energy use, costs for waste disposal, and potential savings in wastewater treatment costs. Many operating procedures and controls that improve the water use efficiency should be implemented simply as a matter of good practice.

References for Additional Information

1) *Process Cooling & Equipment*, monthly magazine published by BNP Media focuses specifically on cooling equipment, materials and supplies used during the manufacturing process. http//www.process-cooling.com

2) *Commercial and Institutional End Use of Water*, published by AWWA Research Foundation and American Water Works Association, 2000 (ISBN 1-58321-035-0).
3) *Handbook of Water Use and Conservation*, Amy Vickers, Waterplow Press, May 2001.
4) *Water Efficiency Guide for Business Managers and Facility Engineers*, State of California Department of Water Resources, October 1994.
5) *Waste Not, Want Not: The Potential for Urban Water Conservation in California (Appendix D),* Pacific Institute, November 2003. http://www.pacinst.org/reports/urban_usage/waste_not_want_not_full_report.pdf