US Army Corps of Engineers®

BUILDING WATER SYSTEMS QUALITY

ENVIRONMENTAL QUALITY: MINIMIZING THE RISK OF LEGIONELLOSIS ASSOCIATED WITH BUILDING WATER SYSTEMS ON ARMY INSTALLATIONS

ENGINEER MANUAL

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Environmental Quality
MINIMIZING THE RISK OF LEGIONELLOSIS ASSOCIATED WITH BUILDING WATER SYSTEMS ON ARMY INSTALLATIONS

1. Purpose. The purpose of this report is to disseminate information and guidance to Army installations to help minimize Legionella contamination in building water systems. This document generally focuses on the maintenance aspects of building water systems with respect to Legionellosis. Though some design guidance can be gained from this document, it is recommended that the applicable UFC is referenced. The building water systems in this report include:

a. Potable and Emergency Water Systems

b. Heated Spas

c. Architectural Fountains and Waterfall Systems

d. Cooling Towers Including Fluid Coolers (Closed-Circuit cooling Towers) and Evaporative Condensers

e. Direct Evaporative Air Coolers, Misters (Atomizers), Air Washers, and Humidifiers

f. Indirect Evaporative Coolers

2. Applicability. This Manual applies all Department of the Army Directorate of Public Works (DPW)

3. Distribution Statement. Approved for public release; distribution is unlimited

4. References.

a. Legionella 2003 An Update and Statement by the Association of Water Technologies (AWT) – June 2003
http://www.syntec.com/wp-content/uploads/2014/09/Legionella-2003-Update.pdf

b. ASHRAE Guideline 12-2000 – Minimizing the Risk of Legionellosis with Building Water Systems http://www.montcopa.org/DocumentCenter/View/1036

c. Cooling Technology Institute – Legionellosis, Guideline: Best Practices for Control of Legionella (July 2008) http://www.cti.org/downloads/WTP-148.pdf

d. Note: numerous other sources are referenced within these reference documents if more information is desired. Also, this report summarizes and often quotes verbatim the information found in the References.

5. History and Disease Information: In light of the recent Legionellosis outbreak in the South Bronx area of New York City (which began in mid to late July of 2015), the HQ US Army Corps of Engineers believes that it is prudent in the field to examine the maintenance procedures in all building water systems on Army installations.

a. The disease is commonly known as Legionnaires' disease (LD) and was realized and named after an outbreak of pneumonia-like illness in Philadelphia in July 1976. Two-thirds of the patients required hospitalization, of which 34 died. Although this type of bacteria had been in existence and causing disease for many years before that, this large-scale tragic event caused significant research to be performed to fully understand the origin and transmission of what is now called Legionella.

b. Legionella are warm water organisms (parasitic bacteria) that are found primarily in surface waters of lakes, ponds, rivers and streams. Because Legionella are protected by being inside of host organisms, typical potable water supply disinfection methods do not eradicate the bacteria. Therefore, Legionella can be found in many potable and non-potable water systems of buildings. The potential for Legionella to cause disease dramatically increases where conditions for growth (amplification) exist and actions/activities cause the bacteria to be inhaled (aspirated). Because the optimum temperature range for Legionella growth in potable water is 86°F to 104°F (30°C to 40°C), water heater temperature settings in this range should certainly be avoided. Temperatures of 122°F (50°C) for 2 hours or 140°F (60°C) for 2 minutes results in 90-percent destruction of Legionella bacteria. A temperature of approximately 158°F (70°C) results in instantaneous 100-percent destruction of the bacteria; though this is definitely not a code requirement due to potential scalding in potable water applications - this temperature could be suitable for temporary flushing of systems where a Legionellosis outbreak has occurred.

c. This is an environmental disease with the causative agent (Legionella) transmitted from an environmental source (water or soil) to a host. It is not transmitted from person to person – thus, it is not a communicable disease. Legionella pneumophila (Lp) is the species responsible for 90% of legionellosis cases. The disease is a potentially fatal, multi-system respiratory illness with an average mortality rate of 15-20%. Fortunately, it is selective in attack and infects only 2-5% of those appropriately exposed to the bacteria.

6. Host Susceptibility, Disease Symptoms, and Potential Sources: The greatest host susceptibility to Legionella is found in the elderly and those with suppressed or compromised immune or respiratory systems. This includes: heavy smokers, alcoholics, HIV patients, cancer, bone marrow or organ-transplant patients, and others with lung or respiratory diseases. Underlying disease and advanced age also contribute to a significantly higher risk of mortality with Legionnaires' disease (LD). The most common risk factor found in LD patients is heavy

cigarette smoking, along with chronic lung disease. Bone marrow and organ transplants represent the most intense risk factor, since the medicines used to protect new organ transplants also compromise the body's immune defenses against infection. Patients taking corticosteroid medicines are also at risk.

a. LD Symptoms may include:

(1) High Fever, Chills, Headache, Muscle Pain (Flu-like symptoms)

(2) Dry Cough and Difficulty in Breathing

(3) Diarrhea and/or Vomiting

(4) Confusion and Delirium

b. LD Incubation period is 2-10 days. This is the time it takes, after exposure, before symptoms of the illness appear. For several days, the patient may have flu-like symptoms and feel tired and weak.

c. Evaporative cooling systems were initially implicated as the source of Legionella in nosocomial Legionellosis outbreaks. And early on, these systems and cooling towers in general became the "official source and reservoir" of Legionnaires' disease. This was unfortunate and proved problematic to cooling tower owners, manufacturers and to the water treatment industry as a whole, for they were subsequently expected to be the ones responsible to "take care of" Legionella. Eventually, epidemiological investigations showed that potable water systems can be a significant source of Legionella. While the larger, headline-grabbing, LD outbreaks are usually associated with cooling towers, information from the United Kingdom (U.K.), Health and Safety Executive, shows that the vast majority of LD cases are sporadic and from sources other than cooling towers. As well, the Centers for Disease Control and Prevention indicate the vast majority of LD cases go unreported and undetected. In studies conducted by Hodgson and Casey in 1998, several thousand samples collected from a variety of sources showed the following colonization frequencies (colonization is the formation of compact population groups of the same type of microorganism).

d. Legionella Colonization Frequencies: (Hodgson & Casey study, 1998)

(1) Cooling Towers 6.26%

(2) Potable Water Distribution Systems 7.01%

(3) Hot Water Heaters 12.03%

e. This means that, based on the samples in this study, water heaters and potable water distribution systems were more likely to show colonization of Legionella than cooling towers.

These percentages represent the colonization frequencies in the samples collected from these system types, and not the percentage of Legionnaires' disease outbreaks detected from these system types.

f. While water treatment specialists more typically deal with the non-potable water systems that they chemically treat, i.e., cooling towers, evaporative condensers and other heat-transfer associated water systems, they should also be knowledgeable concerning Legionella in domestic plumbing systems.

g. The mere presence of Legionella does NOT in and of itself, results in disease. It is only when Legionella are able to 1) amplify (increase in population density), 2) present certain virulent factors and 3) gain transmission into the lungs of susceptible human hosts that they can cause LD infections. Legionella must have certain strain-specific virulence factors to cause disease. They must also be present in sufficient quantity to cause infection.

7. Prioritization. It is the DPW's responsibility to create a plan to minimize the risk of Legionella on their post, and this report is simply a guideline of best practices to begin the implementation of such a plan.

a. It is not the intent of this report to place unrealistic demands on the Department of Public Work's (DPW's) engineering, maintenance, and environmental personnel, but to disseminate best practices to help minimize the risk of Legionnaires' disease (LD) on Army installations. Many of these recommendations should already be part of good maintenance practices in the daily operations and maintenance performed on the installation. Implementing some of these recommendations may involve coordinated efforts with DPW Engineering, DPW Maintenance, DPW Environmental, the Safety Office, the Occupational Health Office, Contractors, and the like. It is fully expected as this effort moves forward that there may be a cost associated with increased engineering, repair, maintenance, inspection, testing etc. Legitimate requests for additional personnel, modifications to existing maintenance contracts, and other associated requirements associated with this task should be requested through the proper channels.
To maximize outcomes with minimal staff the DPW is to perform a risk assessment of all building water systems on his installation and focus implementation efforts on those building water systems with the greatest risk of potential LD outbreaks. A common sense approach should be used to prioritize implementation of best practices. The following are some suggested building priorities.

b. Hospitals/Health Clinics/Medical Facilities/Child Development Centers and other buildings that may have patients with compromised immune systems, thus making them higher risk candidates to contract LD. Note only a very small percentage of Legionella cases are documented to occur in children as the middle age and elderly seem to be more prone to contract the disease - https://www.healthychildren.org/English/health-issues/conditions/chest-lungs/Pages/Legionnaires-Disease.aspx .

c. Barracks/Dormitories/Lodging Facilities and similar buildings that generally have high concentrations of showers and domestic hot water usage and storage. These buildings sometimes remain unoccupied for several months at a time allowing for large volumes of stagnant water to

set and pose a greater risk of the Legionella bacteria to propagate. During these unoccupied times sometimes boilers and domestic hot water heaters are down for annual maintenance, allowing temperatures in large domestic water storage tanks to reach temperatures suitable for amplification of Legionellae growth.

d. Gymnasiums/Fitness Centers/Whirlpools/Spas and similar buildings that have either a larger domestic hot water load with multiple showers or that have bodies of water heated to temperatures suitable for the growth of Legionella.

e. All Buildings with water-source cooling systems such as cooling towers, fluid coolers, and evaporative condensers with potential for stagnation, scale, sediment, biofilms, and algal, providing a food source for amoebae/protozoa populations promoting Legionellae reproduction. Legionella concentrations are amplified with poor cooling tower maintenance and can be inhaled or aspirated into the lungs from an aerosol mist.

f. All Buildings with direct evaporative air coolers, misters (atomizers), air washers, and humidifiers. Most of this equipment, when used and maintained properly, do not promote Legionellae growth, but have that potential when the equipment is improperly installed/maintained or from periods of non-use when water is allowed to remain stagnant.

g. The remainder of this report will address transmission of Legionnaire's Disease (LD) and then general recommended guidelines to minimize the risk in various types of potable and non-potable building water systems. Each Army installation is different and unique; therefore modifications to the guidelines are inevitable based on what works best at each site.

Typical Large Cooling Tower Serving a Hospital

8. Transmission of Legionnaire's Disease. Most data on the transmission of the disease are from investigations of disease outbreaks. This data suggests that in most instances, transmission to humans occurs when water containing the organism is aerosolized in respirable droplets (1-5 micrometers in diameter) and inhaled by a susceptible host. Prior to the disease a number of events must occur, some of which can be influenced by good engineering and maintenance practices. The events are survival in nature (beyond the scope of engineering and maintaining building systems), amplification, dissemination, and transmission. The last three can all be influenced by design and maintenance practices.

a. The most effective means of controlling Legionellosis is preventing the transmission at as many points as possible in the disease chain. If one preventive measure fails, others will be in place as back-up mechanisms.

b. According to ASHRAE Guideline 12 (section 3.3) a variety of aerosol producing devices have been associated with outbreaks of the disease to include cooling towers, evaporative condensers, showers, whirlpool spas, humidifiers, decorative fountains, and grocery store produce misters. A number of outbreaks associated with cooling towers and evaporative condensers have occurred after the devices have been restarted after a period of inactivity. Furthermore this guideline states that shower heads and tap faucets can produce aerosols containing legionellae in droplets of respirable size, along with respiratory therapy equipment filled or rinsed with contaminated potable water in hospitals.

9. Potable and Emergency Water Systems. Potable Water Systems: This starts at the point where the water enters the building and stops at the point where the water exits the piping at shower heads, faucets, etc.

a. Disinfection and water treatment of public (municipal) and installation (on post) water systems. At their point of distribution is not addressed in this report, but see Reference a: Legionella 2003 An Update and Statement by the Association of Water Technologies (AWT) – June 2003 (pages 11 – 16) for more information on this.

Open Showers at an Air Force Base

b. Recommendations for Potable Water Systems:

(1) Reduce deadlegs (stagnant lines and stubs) in the system. On renovation projects remove deadlegs that are created as the result of the removal of existing plumbing fixtures.

(2) Where feasible store domestic hot water at a minimum temperature of 140°F and deliver through the distribution and recirculation return loops at a minimum temperature of 124°F. Thermostatic mixing valves or anti-scald valves will have to be in place to prevent scalding. Note the IPC does not allow domestic hot water distribution above 140°F.

(3) Where practical in other smaller applications such as family housing etc., store domestic hot water at temperatures of 120°F or above. Ensure thermostatic mixing valves or anti-scald valves are in place where required.

(4) Where feasible clean and inspect hot water tanks regularly – recommend annually. This applies to those tanks that have inspection hatches or other means that allow inspection of the tank interior.

(5) Continually run hot water circulation pumps – avoid recycling to mixing valves only. Hot water recirculation pumps should not be part of an energy conservation measure (ECM).

(6) Store and distribute the cold domestic water at or below 68°F – if not possible, then consider monitoring for *Legionella* and using a disinfection system if *Legionella* are not under control.

(7) Flush the entire system annually and after periods of non-use – i.e. a barracks is used all summer and fall, but is unoccupied during the winter months – the system should be completely flushed before occupancy is continued in the spring.

(8) Occasionally flush out infrequently used peripheral type fixtures. These could accumulate sediment and legionellae growth appears to be heaviest at the solid-liquid interface with the development of slime deposits (see Reference b, Para 4.1.4). This is recommended after periods of non-use and could involve a change in standard operating procedures (i.e. turning on infrequently used showers and sinks in hospitals for a few minutes three or four times a week).

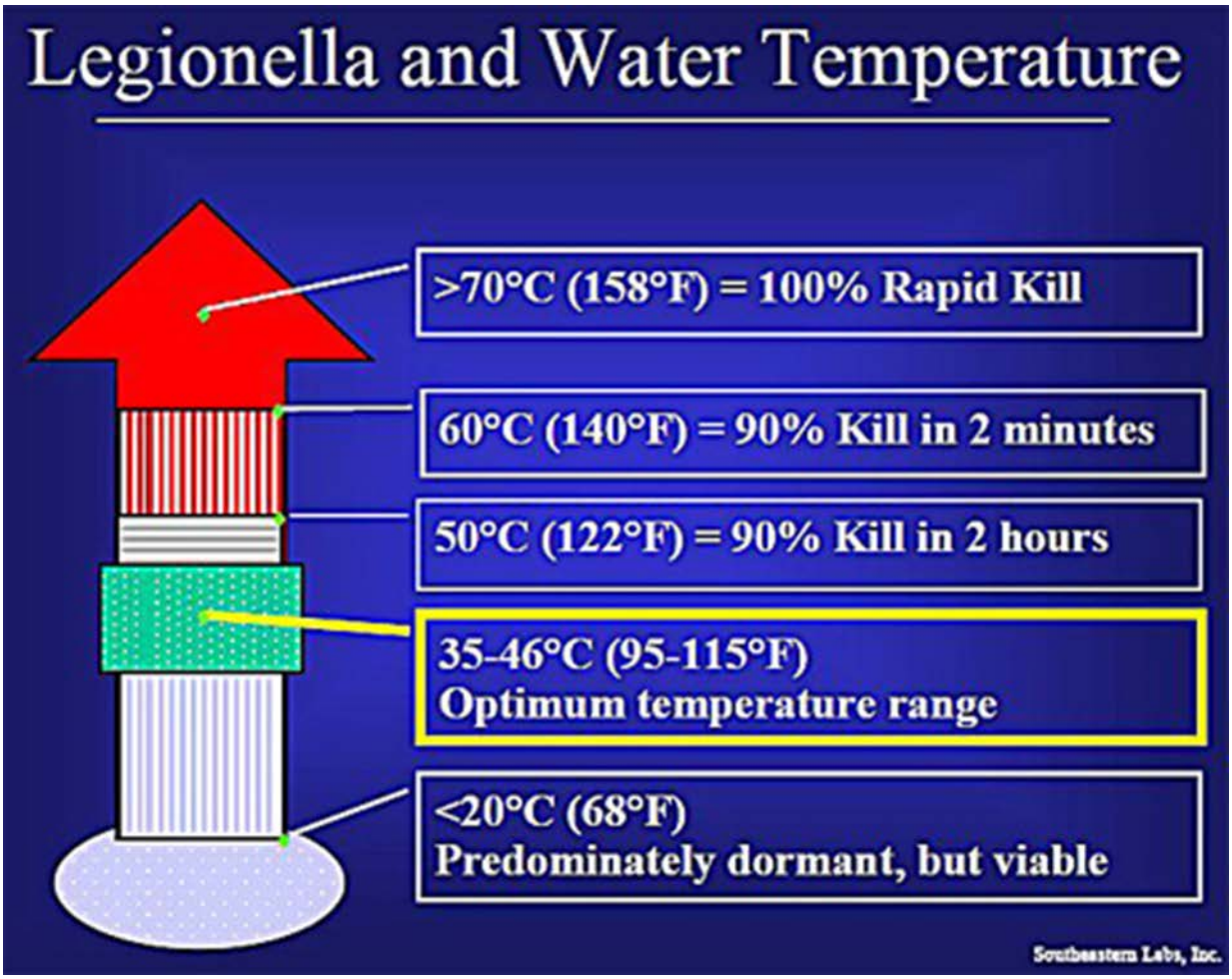
(9) Where decontamination of hot water systems is required (typically due to the implication of Legionellosis or the actual outbreak of Legionellosis) the hot water temperature should be temporarily raised and maintained at a minimum temperature of 160°F and progressively flushing each outlet around the system. This is thermal shock treatment. The recommended time for the flushing is 30 minutes, and multiple 30 minute flushes will most likely be necessary based on the capacity of the water heater and the number of outlets that can be flushed simultaneously. Appropriate safety measures should be followed to prevent scalding. For systems where thermal shock treatment is not possible, shock chlorination may provide an alternative (see Reference b, Para 4.1.6 for recommended chlorine level).

(10) The mixing valve(s) shall be installed as close to the fixture(s) as possible to reduce the amount of stored tempered water in the distribution piping.

(11) For additional design measures that should be considered on high risk facilities (with patients with compromised immune systems) such as hospitals and Veterans Affairs (VA) buildings, reference the VA Plumbing Design Manual at the link below:

http://www.cfm.va.gov/til/dManual/dmPlbg.pdf

c. See the figure on the next page for water temperatures and how the Legionella bacteria respond to various temperatures. Above 113°F Legionella is killed with time. The optimum amplification range of the bacteria is between 86°F and 104°F. The source for this information can be found in Reference a, page 12.



Legionella and Water Temperatures

d. Recommendations for Emergency Water Systems. Under this category are safety showers, eye wash stations, and fire sprinkler systems. All three of these systems are generally plumbed to the potable water system and normally have little or no flow resulting in stagnant conditions.

Additionally, according to Reference b, section 4.2.1, Legionellae bacteria have been discovered in these systems and when these devices are used, aerosolization is expected, but there have been no documented cases of Legionellosis resulting from exposure.

(1) Safety showers and eye wash stations should be flushed at least once a month.

(2) Fire sprinkler systems operate only during a more immediate emergency and the only recommendation is that appropriate precautions are taken when checking the operation of these systems. These precautions include wearing a face mask or respirator when testing occurs to avoid breathing aerosol mists/droplets generated. These systems are generally rarely used and can be a risk when tested.

10. Heated Spas. Heated spas are small baths or pools used for relaxation, hygienic, or therapeutic purposes. Common features include water temperatures 90°F to 104°F and the constant agitation/recirculation of water through high velocity jets and/or the injection of air. Included under this category are whirlpool spas, hot tubs, whirlpools, and whirlpool baths. Due to the temperatures, the production of aerosol mists, and nutrients resulting from a small volume of water per occupant, these systems are favorable to the growth of Legionellae. Legionellae have been isolated from as many as 33% of the spas sampled, but only in those spas where the disinfectant (chlorine or bromine) levels were not adequately maintained. Several multiple-case outbreaks of Legionellosis have been traced to spas and hot tubs. No cases of Legionellosis have been traced to whirlpool baths.

Recommendations for Heated Spas (Reference Section 5.6 in Reference b)

a. Clearly post and enforce the maximum number of occupants (10 ft2 of surface area per bather). Using this formula an 8 ft diameter circular spa would have a maximum bather load of five at one time.

b. Clearly post warnings on the increased health risk related to use by individuals who are have compromised immune systems or have chronic lung disease.

c. Hygienic maintenance of spa filters is more difficult than swimming pool filters due to the higher concentration of bathers. According to Reference b, Section 5.6.1.3, health codes consistently accept the following recommended flow rates:

(1) High rate sand filters- 5-10 gal/min per ft2 of filter media

(2) Diatomaceous earth filters – 1.5 gal/min per ft2 of filter media

(3) Cartridge filters – 0.375 gal/min per ft2 of filter media

d. The American National Standards Institute and National Spa and Pool Institute (ANSI/NSPI) have established chemical standards on pool disinfection. See the recommended levels below for chlorine, bromine, and pH levels.

	Minimum	**Ideal Values**	**Maximum**
Free chlorine (mg/L)	3.0	4.0 – 5.0	10.0
Combined chlorine (chloramines) (mg/L)	None	None	0.2
Bromine	4.0	4.0 – 6.0	10.0
pH	7.2	7.4 – 7.6	7.8

e. The ideal values should be considered minimum values for control of Legionella because of the resistance of Legionella to halogens. These parameters should be measured daily depending on the frequency of spa use. Several alternative nonhalogen methods of water treatment are available and may be successful in controlling Legionella, but sufficient data is not available at this time on these methods.

f. Routine maintenance recommendations by ANSI/NSPI are as follows:

(1) Take the spa at the end of each day carry out superhalogenation (shock disinfection) using 10 mg/L or 10 times the combined chlorine level, whichever is greater, for one to four hours.

(2) Spa water should be replaced at least once a week.

(3) Daily spa water changes may be required during periods of continuous conditions of high use.

(4) When the water is changed the spa should be thoroughly cleaned in order to remove buildup of microbial biofilm.

g. Training and record keeping is recommended for all maintenance personnel on all aspects of the safe operation of whirlpool spas. It should be emphasized that spas are not the same as swimming pools so maintenance for safe operation is different. Records should include water chemistry measurements, back flushing of filters, water changes, and spa cleaning.

11. Architectural Fountains and Waterfall Systems. In these systems water is either sprayed in the air or cascades over a steep media and then returns to a man-made pool. This section does not cover fountains in natural bodies of water or natural waterfalls.

Indoor Wall Fountains

Recommendations for Fountains and Waterfall Systems: Outdoor fountains and pools in hotter climates and indoor fountains and pools near sources of heat may be susceptible of becoming amplifiers of Legionella. According to Reference b, Section 6.5, several multiple-case outbreaks of Legionellosis have been associated with decorative fountains in public buildings, particularly hotels.

a. Drains or sumps should be situated at the lowest level of the pool with no other low points that are not served by drains or sumps.

b. Provision for maintenance should be made where access to pump(s) and filter(s) are provided.

c. Stagnant areas and areas that are difficult to clean should be avoided.

d. Regular cleaning is recommended (no guidance on the frequency is available).

e . Use of filters should be considered, but systems with a small volume of water may be drained and refilled with fresh water every few weeks in lieu of filtering.

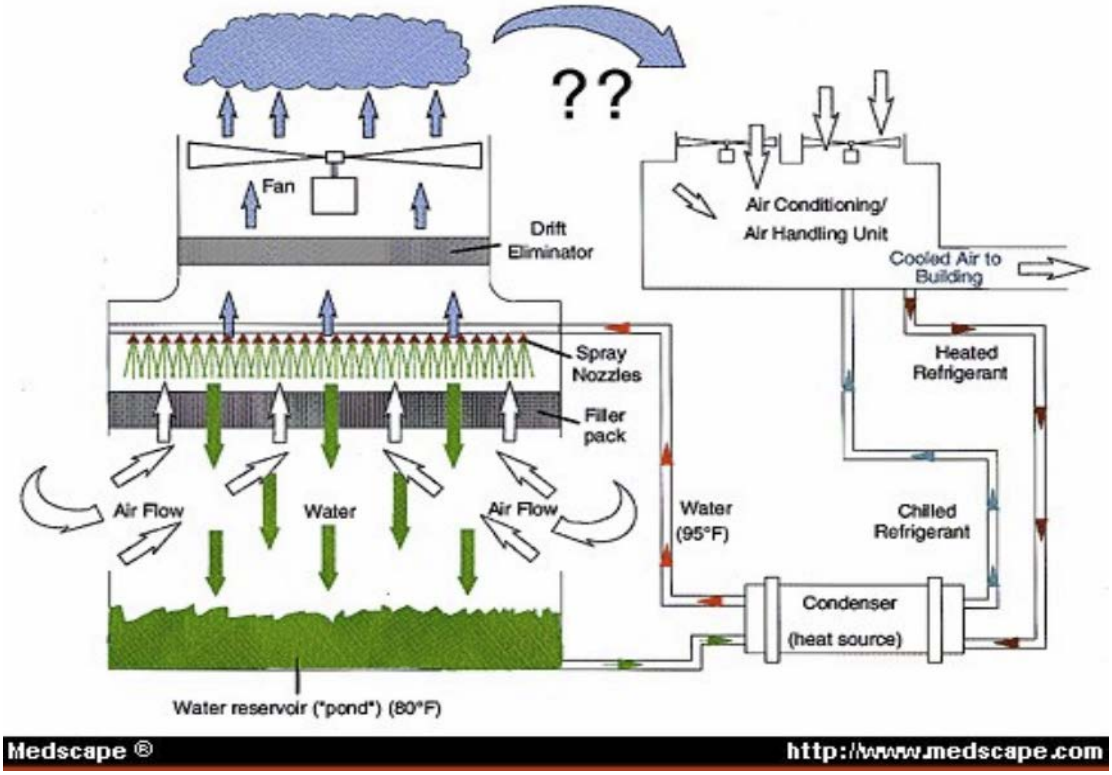
f. Microbial fouling control is important and treatment with a biocide may be recommended in some situations. The biocide must be registered with the EPA for use in decorative fountains.

12. Cooling Towers, Fluid Coolers, and Evaporative Condensers. Please refer to Reference c: Cooling Technology Institute – Legionellosis, Guideline: Best Practices for Control of Legionella (July 2008); and Reference 2: ASHRAE Guideline 12, Section 7; for additional information.

a. Cooling Towers. Defined as an evaporative heat transfer device in which atmospheric air cools warm water, with direct contact between the water and the air, by evaporating part of the water. Air movement through the tower is usually achieved by fans, although some larger cooling towers use natural draft circulation of air.

b. Fluid Coolers (Closed Circuit Cooling Towers) and Evaporative Condensers. These are evaporative heat transfer devices similar to cooling towers with the major difference being that the process fluid does not directly contact the atmospheric air. The process fluid (most often water or a water/glycol mix) is contained inside a coil assembly.

c. Recommendations for Cooling Towers, Fluid Coolers, and Evaporative Condensers. Some of these recommendations are related to design of new equipment and some of them are related to the maintenance of existing cooling towers/fluid coolers/Evaporative condensers. The reference to cooling tower or tower is generic and refers to both open circuit and closed circuit equipment as applicable. The majority of the recommendations that follow are quoted directly from the Association of Water Technologies in their 2003 Legionella Statement as referenced in Reference a.



Typical Cooling Tower Showing Potential for Legionella Transmissions

d. Tower Design/Replacement/Repair Recommendations:

(1) Tower location should consider prevailing winds and proximities with respect to people populations (particularly at-risk populations), building air intakes and surrounding units.

(2) Tower location should consider prevailing winds and proximities which could introduce bacterial nutrient sources into the tower (kitchen exhausts, industrial processes, etc.).

(3) Tower location should consider the location of building intake outside air vents and maximize the distance from these intakes. No guidance on acceptable minimal distances could be found, but the distance should be sufficient where cooling tower drift or splash-out is not fed into the building air supply systems.

(4) Shield or cover cold-water basins, distribution decking, and other wet surfaces from sunlight to prevent algae growth in biofilms.

(5) Materials of construction should be smooth and non-porous.

6) Water distribution piping should: a) be as simple as possible – avoiding deadlegs, stagnant lines and loops that are difficult to drain, b) promote effective flow through the entire system – utilizing equalization lines when necessary.

(7) Towers should be easily accessible for inspection, sampling, cleaning and disinfecting.

(8) The system should be designed to be completely drained or pumped out.

(9) Provisions should be made to effectively dose, monitor and control a water treatment program, including:

(a) inhibitor and biocide/s chemical injection

(b) water sampling

(c) corrosion coupon sampling

(c) effective bleed and control points

(10) High efficiency drift eliminators should be used and maintained. Effective drift eliminator air seals should be provided covering all open areas beyond the eliminators themselves. Small gaps should be avoided as they allow elevated local velocities and can lead to droplet formation and leakage.

(11) Tower designs should avoid using elevated exit air velocities at the drift eliminators, designing the plenum to maintain airflow within acceptable ranges throughout. Distribution components are to minimize the creation of very small droplets which are more likely to escape through the drift eliminators.

(12) Fill selection should be based on expected water quality and treatment, to iminimize fouling and poor water distribution.

(13) When suspended solids in the cooling tower water are excessive, side stream filtration should be considered for reduction of these solids.

(14) Filtered water, treated with trace (or greater) halogen residual, should be used as tower make-up.

(15) Multiple-cell tower basins should be designed such that each cell and basin can be isolated, while the other cells remain in operation.

(16) The tower system's total operating volume should be known for proper chemical dosing, particularly that of biocide and dispersant treatments.

e. Tower Operations and Maintenance Recommendations.

(1) Clean tower and disinfect before start-up, especially new system start-up, and after any long shutdown period (greater than 2 to 4 weeks).

(2) Treat water for control of corrosion, scale, fouling and microorganisms.

(3) Where a cooling tower is out of use, it should be drained and kept dry.

(4) Establish a maintenance plan and log all activities, including the chemical treatment program's dosages, services and results.

(5) Maintain all drift (mist) eliminators in efficient and proper operating condition as well as the operations of fans that affect drift productions.

(6) If deadlegs in the piping system exist and cannot be removed, blow them down regularly – particularly after biocide treatments and cleanings.

(7) Exercise all valves in the system periodically by opening and closing them fully.

(8) Damaged, deteriorated, or missing tower louvers, nozzles, valves, and fill should be repaired/replaced.

(9) Clean the basin when slime, algae, or dirt are visible.

(10) Blow down direct free cooling (chilled water) risers weekly.

(11) Thoroughly flush and clean the entire system at least once (preferably twice) a year and include an oxidizing disinfection before and after each cleaning.

Existing Cooling Tower on Roof of Building

13. Water Tower Treatment Recommendations. Water treatment is dependent of the properties of the water at the installation and the type of cooling tower equipment used in the application. Therefore these recommendations are not a one size fits all solution. Each installation DPW should consider the recommendations and apply/modify them as works best for the installation and application.

a. A number of products have been developed and promoted as being successful in controlling Legionella in cooling systems, such as electronic water treatment, material coatings, and bio-static components. Though these technologies may have some benefit, these approaches are not yet sufficient to discuss in this report. Therefore these recommendations are for more conventional water treatment practices as summarized directly from Reference c: Cooling Technology Institute – Legionellosis, Guideline: Best Practices for Control of Legionella (July 2008), pages 6 and 7.

b. Routine Treatment (Continuous Application of Halogens):

(1) For relatively clean systems with clean potable makeup, feed a source of halogen (chlorine or bromine) continuous and maintain a free residual. Continuous free residuals of 0.5 to 1.0 ppm (as Cl_2) in the cooling tower hot return water have been recommended by some agencies.

(2) Stabilized halogen products should be added according to label instructions, and sufficient to maintain a measurable halogen residual.

(3) A biodispersant/biodetergent may aid in the penetration and removal of biofilm and may increase the effectiveness of the biocide.

(4) Continuous halogen programs may require periodic use of non-oxidizing biocides.

c. Routine Treatment (Intermittent Use of Halogens) – When Continuous Halogenation is Not Possible:

(1) For relatively clean systems with clean potable makeup, establish a free halogen residual of 1.0 up to 2.0 ppm (as Cl_2) and hold this residual for not less than 1 hour each day.

(2) Stabilized halogen products should be added according to label instructions, and sufficient to maintain a measurable halogen residual. This level should be held for at least 1 hour each day.

(3) Bulk water and sessile counts and microscopic examination of deposit samples will be required to ensure that concentrations and duration of halogen residuals are adequate.

(4) biodispersant may aid in the penetration and removal of biofilm and may increase the effectiveness of the biocide.

(5) Discharge of system water directly to surface water may require de-halogenation.

(6) Nonoxidizing biocides are recommended.

c. Periodic On-Line Disinfection – Hyperhalogenation**:** Hyperhalogenation is the maintenance of 5 ppm free halogen residual for at least 6 hours. This periodic disinfection may be necessary for systems:

(1) That have process leaks

(2) That have heavy biofouling

(3) That use reclaimed wastewater as makeup

(4) That have been stagnant for a long time

(5) When the total aerobic bacteria counts regularly exceed 100,000 CFU/mL. CFU = colony forming units

(6) When *Legionella* test results show greater than 100 CFU/mL

Note: In cases where high Legionella counts exist (>1000 CFU/mL), where Legionnaires Disease is known or expected to be associated with the tower, or when very high microbial counts exist (>100,000 CFU/mL) within 24 hours of a periodic disinfection; an “Emergency

Disinfection Procedure" is recommended. See Reference c: Cooling Technology Institute – Legionellosis, Guideline: Best Practices for Control of Legionella (July 2008), page 7 for a summary of this recommended procedure.

14. Other Devices That May Require Consideration. Direct evaporative air coolers, misters (atomizers), air washers, humidifiers, indirect evaporative coolers, and metalworking systems do not have as much data to directly link them to Legionellosis, but some recommendations can be found in Reference b: ASHRAE Guideline 12-2000, Sections 8, 9, and 10 (pages 10-13).

Typical Evaporative Coolers

15. Testing and Remediation. Due to the nature of Legionellosis (the bacteria is naturally occurring in the environment) and the fact that sporadic (single cases**)** can have a number of potential sources in which the infected individual visited or resided (both on and off the Army Post), a single sporadic case of Legionellosis does not trigger a full scale environmental assessment of a suspected facility unless there is recent, prior history of Legionellosis linked to the facility. But even in sporadic cases, testing and remediation can still be performed as a precautionary measure in a suspected facility.

a. An environmental health assessment should be initiated within 24 hours of notification of information of two or more suspected Legionellosis cases to a common place within an appropriate time period. Coordination and receipt of appropriate sample collection materials may take a day or two, but initial steps to gather information and coordinate efforts can begin in the interim period. The objective of the environmental health assessment is to determine the most likely source of an outbreak of Legionellosis and to prevent Legionellosis from occurring by lowing a facility's risk factor for Legionella propagation and growth.

b. It is important to understand that reported cases of Legionellosis may not be confirmed for 3-6 weeks after onset of illness. This will factor into the types of samples collected and assessment methods. It is also important conduct such investigations in a strictly confidential manner, as with many other infectious diseases, in order to minimize unwarranted alarm and adverse economic impact. But those in the chain of command should still be notified immediately upon suspected Legionellosis cases to help leverage additional resources for quick identification, testing, and remediation.

c. See the links below from the Florida Department of Health, OSHA, and Legionella.org for some common testing and remediation procedures of different scenarios and different system types. Also see the references of this pamphlet for additional remediation recommendations.

http://www.floridahealth.gov/diseases-and-conditions/legionnaires-disease/_documents/GSI%20Legionella%20Update%20Final2.pdf
https://www.osha.gov/dts/osta/otm/legionnaires/sampling.html
https://www.osha.gov/dts/osta/otm/otm_iii/otm_iii_7.html
http://legionella.org/guidelines/

16. New Construction. All new and on-going construction should follow the same design and construction practices summarized in this report to minimize the risk of Legionellosis. Where applicable, each RFP and/or SOW for new buildings and renovation projects should require the contractor to conduct training on maintenance and operations procedures to minimize the risk of Legionellosis. This training should be documented as part of the submitted O&M manuals with a recorded video for the DPW maintenance staff.

17. Conclusion. In the short term, it is the responsibility of each DPW to take all necessary steps to minimize the potential of Legionella outbreaks on their installation. In the longer term, UFC and UFGS guidance will be updated with Tri-service input to require the most effective Legionella mitigating technologies for future renovation and MILCON projects.

FOR THE COMMANDER:

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