

# Minimizing Legionella's Risk

## A Discussion in Question and Answer Format

### What is Legionella?

Legionella refers to a group of bacteria commonly found in aquatic environments. The most important member of this group is Legionella pneumophila, which is most commonly associated with the disease legionellosis.

### What is Legionellosis and how is it transmitted to humans?

Legionellosis refers to infections caused by Legionella type bacteria in humans. In the U.S., two primary forms of legionellosis are recognized:

- Legionnaires' Disease
- Pontiac Fever

Legionellosis is transmitted to people by inhaling Legionella organisms that are suspended in droplets of water from aerosol-producing devices. These include showers in the home, as well as cooling towers, evaporative condensers and condensate drip pans. Studies indicate that aerosols from cooling towers usually drift no further than 600 to 900 feet (200 to 300 meters). If however, the air inlet ducts of nearby air conditioning systems draw in aerosols from contaminated cooling tower, the air distribution system within the building itself can potentially transmit the disease. New evidence suggests that aspiration is another way of contracting Legionella.

### What is Legionnaires' Disease (LD)?

LD is a severe type of pneumonia caused by Legionella pneumophila. Legionnaires' Disease received public attention when it affected persons attending an American Legion Convention at the Bellevue-Stratford Hotel in Philadelphia, Pennsyl-

vania in 1976. The bacteria causing this outbreak was subsequently named Legionella pneumophila. Further investigation revealed that this disease was not new. The examination of stored tissue specimens revealed that various species in the genus Legionella were responsible for cases of pneumonia as far back as 1947. While this is a potentially fatal illness, most cases can be treated successfully with antibiotics. Symptoms include high fever, dry cough, difficulty breathing and diarrhea. The disease rarely occurs in healthy people, but tends to afflict older people, infants and patients with preexisting conditions.

### What is Pontiac Fever?

Pontiac fever is a flu-like, less severe, upper respiratory illness also caused by Legionella organisms. It is a self-limiting illness in which fever, headache and muscle pain are prominent symptoms; pleurisy has been observed, but not pneumonia. The illness generally resolves itself within 6 days without antibiotic therapy.

### What are the typical sources of Legionella bacteria?

Legionnaires' Disease Bacteria (LDB) are widely found in water and are present in most drinking water supplies. Legionella requires moisture for survival. Potable hot water systems (water heaters in the home) at temperatures below 140°F (60°C), cooling towers and the various components of air-conditioning systems are considered to be amplifiers of the bacteria. The organism survives typical chlorine disinfection treatment for potable water and consequently appears in finished domestic and industrial water distribution systems. Table 1 is a summary of legionellosis outbreaks and sources.<sup>1</sup>



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Table 1: Legionella outbreak and source<sup>a</sup>

Outbreak Location	Epidemic Source
Hospital	Potable water system
Hospital	Respiratory therapy device
Spa <sup>b</sup>	Whirlpool
Bank Trust building <sup>b</sup>	Cooling tower
Prison	Cooling Tower
Tourist lodges	Potable water system
Hotel for the elderly	Evaporative condenser
Hospital	Shower heads
Hospital	Respiratory therapy device
Grocery store	Mist machine above produce

<sup>a</sup> These outbreaks occurred in the United States during the time period of 1984-1989.

<sup>b</sup> These were Pontiac Fever outbreaks.

## Can Legionella bacteria grow in cooling towers and cause Legionnaires' Disease?

Yes, cooling tower systems have the potential to support the growth of Legionella bacteria, allowing the bacteria to reach high levels. The temperature, pH, organic and inorganic conditions in these systems provide a good environment for Legionella growth. Legionella are spread in aerosol droplets in the exiting air of cooling towers and may be inhaled by humans in the immediate vicinity of the tower.

These bacteria may then cause Legionnaires' disease or Pontiac Fever. Legionella are introduced into cooling towers mostly in makeup water. They normally do not grow in the cooling water, even though they may increase in number in the water as a result of evaporation, i.e. cycles of concentrations. Legionella are now known to grow primarily within protozoa,<sup>2,3</sup> which are found primarily in biofouled areas. These areas are characterized by microbial slime, sludge sediments and stagnant water found in dead-end areas. Consequently, a number of outbreaks of legionellosis in cooling water systems have been associated with biofouled systems. Minimizing the potential for a cooling water system to become a source of the disease requires an effective, properly supervised and serviced water treatment program. This must be combined with operating and maintenance procedures that minimize the occurrence of slime, algae, and scale, in accordance with your consultant/supplier recommendations.<sup>4,5</sup>

## Are cooling towers the primary source of Legionella outbreaks?

While a connection between cooling towers and Legionellosis has been highly publicized, it is important to remember cooling systems are not the only Legionella reservoirs. Some researchers believe the role of cooling towers in outbreaks has been overstated. Do not ignore other potentially bio-contaminated, aerosol producing, tepid water systems (such as parts washers or pelletizer bath water systems) when evaluating possible sources of health risk.

## What safety precautions does GE recommend when working around cooling systems?

GE Water & Process Technologies is committed to product stewardship, which includes supplying product and safety information that can assist those working around cooling towers/wet-type heat rejection systems. GE recommends precautionary procedures similar to those published by ASHRAE and OSHA.<sup>4,6</sup> Examples of these procedures are:

During any cleaning, maintenance or decontamination procedure that produces aerosols (such as the application of high pressure steam, water or air), a half mask air-purifying respirator equipped with P100 cartridges shall be used. Additionally, workers should wear rubber gloves, goggles, coveralls and boots to protect the skin and eyes from injury by the chemicals being used for decontamination.

To further minimize exposure when inspecting a tower that is generating aerosols, or if it is suspected that contamination exists, a half-mask air-purifying respirator equipped with P100 cartridges should be used. A note of caution: Before using a respirator a person needs to: 1) receive medical clearance that ensures he/she is physically fit to wear a respirator, 2) get fit tested, and 3) be trained in the use of a respirator. Please contact your company industrial hygienist or health and safety professional for advice on use of all safety equipment and procedures.

## What is the position of U.S. regulatory agencies concerning treatment for LDB?

Laboratory studies submitted to the U.S. Centers for Disease Control and Prevention (CDC) showed that a number of oxidizing and non-oxidizing biocides are effective in destroying *Legionella pneumophila*. However, application of U.S. EPA registered microbiocides at recommended dosages may not ensure eradication of *Legionella* in bulk waters and on cooling system surfaces. While the U.S. EPA and CDC do not endorse any specific chemical treatment, GE concurs with CDC's position that, "It might be prudent to encourage regular treatment with chemicals that have been tested and shown to be effective in preventing slime, corrosion or scale, algae or high populations of bacteria."

## Is testing for Legionella bacteria recommended on a routine basis?

The concentration (CFU/ml) of *Legionella* required to cause illness has not been conclusively established. Nevertheless, many cooling tower owners/operators desire to periodically monitor the circulating water for the LDB population. The value of routine *Legionella* testing in preventing epidemics of Legionellosis has not been shown though periodic testing (e.g., quarterly) can be helpful for demonstrating responsible care. In some countries outside the U.S., testing for *Legionella* bacteria is mandated by government regulation. Please note, even where testing is required, there are no current government regulations concerning permissible numbers of these bacteria in water systems. Some U.S. *Legionella* researchers have suggested guidelines on numbers of *Legionella* and actions to be taken.<sup>7,8</sup> The guidelines in Tables 2 and

taken.<sup>7,8</sup> The guidelines in Tables 2 and 3 are from: Reducing Risks Associated with *Legionella* Bacteria in Building Water Systems, by B.G. Shelton, G.K. Morris and G.W. Borman, in "Legionella, Current Status and Emerging Perspectives," ASM Press, 1993. In Europe and elsewhere, program review or system remediation may be triggered by levels of *Legionella* considerably lower than in the tables from Shelton and Morris.

Whenever *Legionella* is considered, ensure that a system for interpreting the significance of *Legionella* test results and a clear action response plan are in place prior to submitting samples for *Legionella* testing.

## Are there any microbiocides known to be effective against Legionella bacteria?

Yes. A number of laboratory studies have indicated that the active ingredients in many GE products kill *Legionella* bacteria. Among these ingredients are: isothiazolin, 2,2 dibromo-3-nitrilopropionamide, glutaraldehyde, bromonitropropanediol, methylenebisthiocyanate, and chlorine/bromine-based oxidizing biocides. Also, specific laboratory data have been developed for some GE microbiocides in-house (GE UK Laboratory) and by an independent laboratory. The test results have established that these products effectively reduce *Legionella* at normal concentrations in a laboratory test protocol. Actual effectiveness of these products in the field may vary depending upon specific system conditions.

Table 2: Suggested Remedial Action Criteria for Legionella

Legionellae/mL	Remedial Action <sup>a</sup> if detected in:		
	Cooling Towers and Evaporator Condensers	Potable Water	Humidifier / Fogger
Detectable, but <1	1	2	3
1 to 9	2	3	4
10 to 99	3	4	5
100 to 999	4	5	5
≥1,000	5	5	5

<sup>a</sup>Suggested remedial action, see Table 3.

Table 3: Remedial Actions

Hazard Level	Actions
1	Review routine maintenance program recommended by the manufacturer of the equipment to ensure that the recommended program is being followed. The presence of barely detectable numbers of legionellae represents a low level of concern.
2	Implement Action 1. Conduct the follow up analysis after a few weeks for evidence of further Legionella amplification. This level of legionellae represents little concern, but the number of organisms detected indicates that the system is a potential amplifier for legionellae.
3	Implement Action 2. Conduct review of premises for direct and indirect bioaerosol contact with occupants and health risk status of people who may come in contact with the bioaerosols. Depending on the results of the review of the premises, action related to cleaning and/or biocide treatment of the equipment may be indicated. This level of legionellae represents a low but increased level of concentration.
4	Implement Action 3. Cleaning and/or biocide treatment of the equipment is indicated. This level of legionellae represents a moderately high level of concern, since it is approaching levels that may cause outbreaks. It is uncommon for samples to contain numbers of legionellae that fall in this category.
5	Immediate cleaning and/or biocide treatment of the equipment is definitely indicated. Conduct post-treatment analysis to ensure effectiveness of the corrective action. The level of legionellae represents a high level of concern since it poses the potential for causing an outbreak. It is very uncommon for samples to contain numbers of legionellae that fall in this category.

Hazard Levels 4 and 5: see Control of Legionella in cooling Towers, Summary Guidelines, Wisconsin division of Health<sup>4</sup>  
 For more information, you may wish to contact your State Health Agency or the CDC Respiratory Disease Branch at (404) 639-2211.

What methods are used for the detection and isolation of Legionella bacteria?

The CDC considers bacteria culturing the only reliable method for detecting live (viable) Legionella in water. It is essential that a minimum of 100 mL of water be collected in sterile bottle, placed in an insulated container, and transported to the laboratory within 24 hours.

Other methods include: Direct Fluorescent Antibody (DFA) staining, serologic studies based on Indirect Fluorescent Antibody (IFA), and Urinary Antigen testing. Polymerase Chain Reaction (PCR) gene problem testing has been applied to Legionella but a commercial test kit is not available. Such methods can be powerful screening and identification tools and results can be obtained in 2 to 4.5 hours. Unfortunately, these methods cannot differentiate live (viable) from dead (nonviable) cells. Note: At the present time in the U.S., there is no officially accepted standard method for the detection of Legionella bacteria, though an International Standard (ISO11731) has been published.<sup>9</sup>

### Can water treatment companies state that their products control the growth of Legionella Bacteria?

No. Since the U.S. EPA disallows all Legionella control claims on labels or other literature, it is unlawful for companies to make such claims. However, U.S. EPA will allow technical bulletins that describe the results of laboratory tests about Legionella bacteria, as long as direct effects on human health are not implied.

### What is the GE standard recommendation to minimize the probability for Legionnaires' Disease?

For detailed information see GE's Chemical Water Treatment Recommendations. This document is based on the Cooling Technology Institute's "Guideline: Best Practices for Control of Legionella."<sup>5</sup>

GE recommends a complete water treatment program to maintain a clean system, including the use

of microbiocides along with a planned preventative maintenance program to minimize corrosion, scale deposits and system fouling.

## Can the risk of Legionnaires' Disease be minimized?

Based on the information, which has been reported by various agencies, we certainly believe so. Effective management of water treatment along with system design, location, operations and maintenance are key to minimizing the risk of Legionnaires' Disease.

GE offers a complete cooling tower management program.

## Is additional information on Legionella available?

Yes, additional information is available. The U.S. Department of Labor, Occupational Safety and Health Administration (OSHA) has developed Chapter 7, Legionnaires' Disease, in the Technical Manual, Section II. It can be accessed through the Internet at [www.osha.org](http://www.osha.org).

The Cooling Technology Institute's (CTI) Guideline: "Best Practices for Control of Legionella" can be accessed at [www.cti.org](http://www.cti.org) or by request at 281-583-4087. The American Society of Heating, Refrigeration, and Air Conditioning Engineers (ASHRAE) has issued a guideline, "Minimizing the Risk of Legionellosis Associated with Building Water Systems." For additional information, call 404-636-8400 or access through the web at [www.ashrae.org](http://www.ashrae.org). The GE document, GE Chemical Water Treatment Recommendations for Reduction of Risks Associated with Legionella in Open Recirculating Cooling Water Systems is available from your GE sales representative or by request at [custhelp@ge.com](mailto:custhelp@ge.com).

## References

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6. U.S. Department of Labor, Occupational Safety and Health Administration (OSHA). Technical Field Manual, Section II, Chapter 7. Legionnaires' Disease. May, 1996. OSHA Instruction TED 1.15 CH-1.
7. Shelton, B.G., Morris, G.K. and G.W. Gorman. 1993. Reducing Risks Associated with Legionella Bacteria in Building Water Systems in "Legionella, Current Status and Emerging Perspectives." eds. J.M. Barbaree, R.F. Breiman and A.P. Dufour. ASM:PP 279-281.
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9. International Standard ISO11731 Water quality-Detection and enumeration of Legionella, Int'l. Org. for Standardization, Geneva, Switzerland (1998)

## General References

Approved Code of Practice & Guidance: Legionnaires' Disease – The Control of Legionella Bacteria in Water Systems, UK Health & Safety Commission, HMSO books, London, UK (2000).

Australian/New Zealand Standard 3666 Air-handling and water systems of buildings-Microbial control Part 3: Performance-based maintenance of cooling water systems, Standards Australia International Ltd. Sydney, NSW, Australia (2000).

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"Preliminary Studies on Environmental Decontamination of Legionella pneumophila," 1979. MMWR (Morbidity Weekly Report): 28:286-287.

U.S. Department of Energy. 1984. "Legionnaires' Disease: Guidelines for minimizing the risks." Office of the Deputy Assistant Secretary for Environment, Safety and Health. Washington, D.C.

## Legionella Testing Laboratories

While GE does not perform Legionella testing "in-house", the company understands the desire of cooling tower owners/operators to conduct periodic tests for LDB. GE provides a list of testing laboratories without endorsing one laboratory over another. For sampling procedures, customers should contact the testing laboratory of their choice.

Customers requesting that GE Water & Process Technologies to handle their Legionella sampling and testing needs, a process utilizing an outside testing lab has been developed to provide this service. Contact your GE service representative for details.

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