TECHNICAL FEATURE

Risk Management For Legionellosis

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ANSI/ASHRAE Standard 188, *Legionellosis: Risk Management for Building Water Systems,* was published in June. This long-awaited document establishes minimum legionellosis risk management requirements for building water systems. The standard establishes particular requirements for design engineers when they are involved in new buildings, renovations, additions or modifications to existing buildings.

The design engineer first needs to evaluate which requirements of the standard apply to their project. This evaluation determines if the project contains any of the following building risk factors:

- Multiple housing units with one or more centralized hot water systems;
- Contains more than 10 stories (including levels below grade);
- Health-care facility with patient stays over 24 hours;
- Facilities that house or treat immune-compromised, at-risk occupants such as those being treated for burns, organ transplant, chemotherapy, chronic lung disease, diabetes; and
- Facilities designated for housing occupants over age 65.

If any of these factors are present, then the design engineer needs to comply with Section 8 requirements in the standard with regard to potable water, both for hot and cold water systems.

The evaluation also determines if the project contains one or more of the following system components:

- Cooling towers or evaporative condensers;
- Whirlpools, spas, ornamental fountains;
- Humidifiers, air washers, atomizers, misters; and
- Other nonpotable water systems or devices that have the potential to release water aerosols, such as ice machines.

If any of these system components are present, then the engineer needs to comply with the relevant portions of Section 8 of the standard for those system components in addition to any potable water system requirements necessary as a result of building risk factors in the list above. Section 8 is discussed later in this article.

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Standard 188 applies also to the construction and operation phases of a project, as well as to operation and maintenance of existing buildings.

Background on the Standard

The term "legionellosis" refers to two illnesses, each contracted from exposure to *Legionella* bacteria. The more severe form, when pneumonia results, is called Legionnaires' disease (LD). An estimate by the U.S. Centers for Disease Control is 8,000 to 18,000 cases of LD per year in the United States, with more than 10% of those cases becoming fatal. It is important that requirements be in place to manage risk of exposure to these bacteria from building water systems, where a significant percentage of the exposures occur. A less-severe illness known as Pontiac Fever, which has flu-like symptoms, can also be caused by *Legionella*.

The risk of disease or illness from exposure to *Legionella* bacteria is not as simple as the bacteria being present in a water system. Other factors that contribute to the risk are environmental conditions that promote the growth and amplification of the bacteria in the system, a means of transmitting this bacteria (via water aerosols generated by the system), and the ultimate exposure of susceptible persons to the colonized water that is inhaled or aspirated by the host providing a pathway to the lungs. The bacteria are not transmitted person-to-person, or from normal ingestion of water. Susceptible persons at high risk for legionellosis include, among others, the elderly, dialysis patients, persons who smoke, and persons with medical conditions that weaken the immune system.

The development of the standard spanned over a 10 year period, beginning in 2005, and published June 26, 2015. *Figure 1* shows a timeline of the development of Standard 188-2015. In the course of that time, a balanced committee of experts produced five public review drafts, responding to comments and improving the document at each step. With the final version, a consensus process standard for legionellosis risk management of building water systems was produced. The document is written in code language, so that it can be adopted as desired by government bodies (see "NYC Responds to Outbreak" sidebar). ASHRAE standards are otherwise voluntary.

What's in the Standard?

Standard 188 is intended for use by owners and managers of human-occupied buildings, and those involved in the design, construction, installation, commissioning, operation, maintenance and service of centralized building water systems and components.

The standard specifies minimum legionellosis risk management requirements for human-occupied buildings, not including residential, and their associated potable and nonpotable water systems.

Specific compliance pathways are defined in the standard for the following groups: building designers, building owners, and health-care facilities.

NYC Responds to Outbreak

In August, investigators discovered that a cooling tower at the Opera House Hotel in New York City was the source of a nearly monthlong outbreak of Legionnaires' disease that caused 12 deaths and more than 120 cases of infection due to *Legionellosis*.

During the search for the source, 14 other cooling towers were found to be infected at other building sites. No city records were kept that indicated which buildings have cooling towers.

In response to the outbreak, the New York City Council adopted legislation that requires adherence to part of ANSI/ASHRAE Standard 188-2015, *Legionellosis: Risk Management for Building Water Systems.*

New York City is considered the first major U.S. city to regulate cooling towers. The legislation addresses registration and inspection of cooling towers. It requires owners to create and file a plan to maintain equipment to comply with Sections 5, 6 and 7.2 of the standard.

Section 5 deals with building surveying, Section 6 with general requirements, while Section 7.2 lists common tasks and steps for items such as new system start-up and seasonal shutdowns, general system maintenance, water treatment, disinfection plans, etc.

Michael Patton, a member of the committee who wrote the standard, testified before the Council on behalf of ASHRAE. While Patton encouraged full adoption of the standard, he said it was helpful that at least those sections were included.

"Those sections by themselves are very good," Patton testified, "but it doesn't really address the whole idea of informing building owners, managers, property managers how to put a plan for a whole building into place and what it should contain."

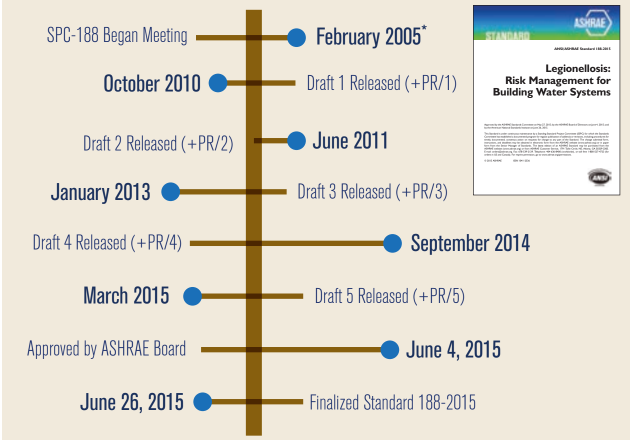
Sources: ASHRAE, NBCNewYork.com

The compliance pathways direct each user group to a building survey (and frequency of repeated surveys), and to appropriate general and building water system-specific requirements in the standard. The building survey evaluates the presence of certain potential aerosol generators and certain risk factors that relate to legionellosis. The results of the survey determine the compliance pathway that must be followed for that group and that particular building.

General requirements include establishment by building owners of a program team of one or more individuals and (in turn) a water management program for which they are responsible to comply with the standard. The water management program must meet specific and detailed requirements for what legionellosis control strategies must accomplish and how they are to be documented—but not what specific strategies are to be used or applied. *Table 1* describes the elements of the process.

Please refer to the standard for specifics, but note that buildings that meet the criteria as to risk factors related to legionellosis are required to develop a plan that includes potable water in addition to any of the listed potential aerosol generators that are present. If none of the risk factors are present, then the plan must include only the potential aerosol generators that are present.

FIGURE 1 Standard 188-2015 development.



*First meeting was as GPC-12 (Guideline), later became SPC-188
PR = Public reviews (required by the ANSI/ASHRAE standards process)

TABLE 1 Elements of a water management program.

PROGRAM TEAM	Identify persons responsible for program development and implementation.
DESCRIBE WATER SYSTEMS/FLOW DIAGRAMS	Describe the potable and nonpotable water systems within the building and on the building site and develop water system schematics.
ANALYSIS OF BUILDING WATER SYSTEMS	Evaluate where hazardous conditions may occur in the water systems and determine where control measures can be applied.
CONTROL MEASURES	Determine locations where control measures must be applied and maintained in order to stay within established control limits.
MONITORING/CORRECTIVE ACTIONS	Establish procedures for monitoring whether control measures are operating within established limits and, if not, take corrective actions.
CORRECTIVE ACTIONS/CONFIRMATION	Establish procedures to confirm that: • The program is being implemented as designed (verification). • The program effectively controls the hazardous conditions throughout the building water systems (validation).
DOCUMENTATION	Establish documentation and communication procedures for all activities of the program.

In addition to the general requirements for development of the water management program, specific preventive measure requirements for the following building water systems are required as indicated above:

- **Potable water systems (when risk factors were found in the survey).** Requirements include system start-up and shutdown, system maintenance, water treatments, and contingency response plans.
- **Open and closed circuit cooling towers and evaporative condensers.** Requirements include equipment siting, new system startup, system maintenance, water treatment, shutdown and start-up, disinfection, location of makeup valves, and contingency response plans.
- **Whirlpool spas.** Requirements include bather-related requirements, filter operation and maintenance, water quality, disinfection and monitoring, microbiology, microbiological testing (when contamination is discovered), contingency response plan and operating manuals.
- **Ornamental fountains and other water features.** Requirements include equipment siting, operation, maintenance, water treatment, and contingency response plans.
- **Aerosol-generating misters, atomizers, air washers, and humidifiers.** Requirements include equipment siting, new system start-up, system maintenance, water

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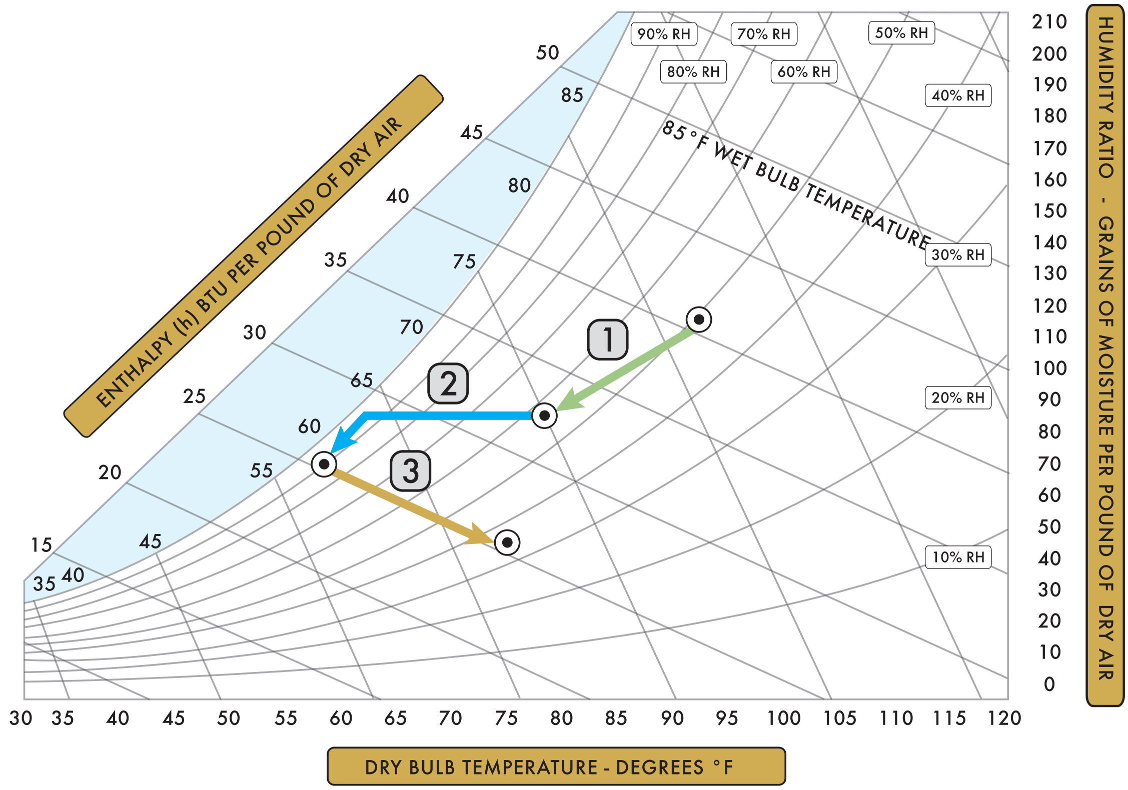

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treatment, system shutdown and start-up, disinfection and contingency response plans.

Requirements are included in Section 8 of the standard for designing building water systems for new construction, renovations, refurbishment, replacement, or repurposing of a facility. Examples of system elements to be considered during the design process include:

- Providing proper access to expansion tanks, water hammer arrestors, water storage tanks, pump, water heaters and other equipment and components containing water.
- Maintaining proper system water temperatures and the use of system versus point-of-service tempering valves.
- Providing proper insulation to control the heat loss or heat gain in water piping and system components.
- Provide proper protection to prevent cross connections between potable and nonpotable water systems.
- Design piping systems to avoid no-flow and low-flow conditions.
- Locate building outdoor intakes such that they do not take in the discharge of cooling towers or evaporative condensers.
- Locate water system valving such that all systems can be properly balanced.

The design engineer shall also prepare construction and as-built documents that indicate:

- An overview of the system and its intended mode of operation.
- A diagram of water systems including pipe routing sizes, flow rates, valving, design temperatures, temperature monitoring points, fill provisions, blowdown provisions, makeup provisions, sampling points and drain provisions.
- Locations of all equipment associated with the water systems including equipment sizes, capacity and specifications.
- Applicable water system control schematics and components.
- Specifications for all water system components such as piping, insulation, valves, pumps, equipment including all installation and start-up requirements.


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The design engineer also provides instructions for the proper balancing and commissioning of all building water systems including the procedures for flushing and disinfection.

A normative annex with requirements for health-care facilities is a part of the Standard. Normative Annex A includes requirements for health-care facilities that meet certain criteria as to facility accreditation and staff who are certified as infection preventionists or with a minimum of a graduate degree in epidemiology. The annex is written using terminology consistent with that used in the health-care industry. The intent of the annex is to be equal to or more stringent than the base document. Health-care facilities that do not meet the criteria to use the annex must follow the base document. Please refer to the standard for details.

Standard 188 consists of normative sections followed by normative and informative annexes. The normative sections and normative annex specify the requirements for compliance. Building water systems can vary significantly in their design, and in the potential for transmission of *Legionella*, as well as the presence of susceptible individuals. Scientific evidence is not available or is inconclusive regarding some aspects of *Legionella* control. The informative annexes and references provide suggestions, recommendations and references for guidance to develop water management plans for specific buildings.

Next Steps

The standard is now published and converted to continuous maintenance status by ASHRAE. The strong positive response to the document has been encouraging, and ASHRAE looks forward to ongoing improvement of the document using the continuous maintenance process.

ANSI/ASHRAE Standard 188-2015, *Legionellosis: Risk Management for Building Water Systems,* is available from the ASHRAE Bookstore (http://tinyurl.com/legionellosis), or it can be read for free online via this page, *www.ashrae.org/standards,* under the Preview ASHRAE Standards section near the bottom left. ■

The Real Story Part I: VRF Technology Vs. Geothermal Heat Pump Systems

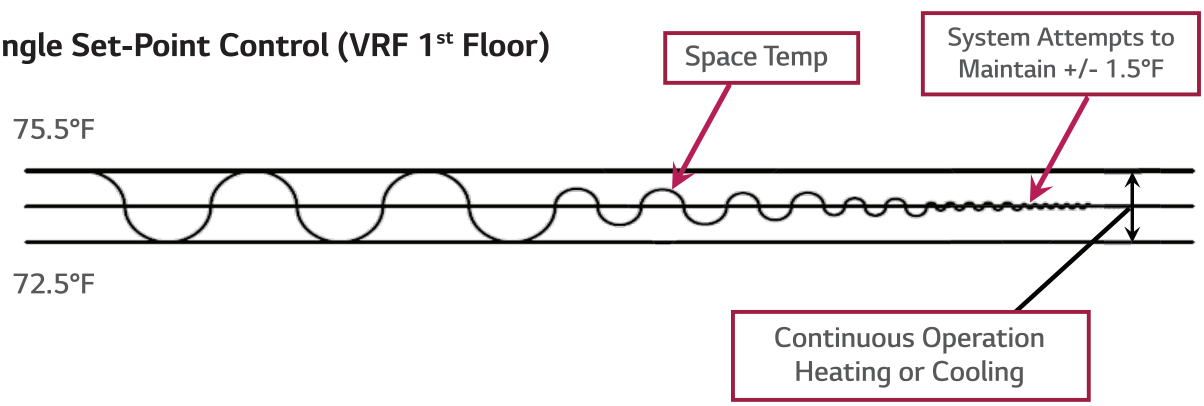
Selecting the right HVAC system is about more than just energy usage. A recent study of the ASHRAE headquarters in Atlanta, Georgia, has highlighted several important lessons about the proper application of VRF systems. LG's VRF technology, Multi V™ IV, can offer many solutions.

The study, conducted and released by a geothermal heat pump manufacturer, concentrated specifically on measured energy usage differences between two vastly different systems: geothermal water source heat pumps versus air-cooled VRF. But this was not a fair comparison. As many HVAC design engineers can attest, installation and total life-cycle cost play a huge role in determining which system to use.

The 1st and 2nd floors at ASHRAE are very different in size and utilization, and therefore the cooling and heating loads are different. The volume of outside air to the 1st floor VRF is 23% more than the 2nd Floor Geothermal Heat Pump (GHP) system. The 1st Floor VRF area is 20% greater with more occupants and seeing more use than the 2nd Floor GHP. In addition, lighting and plug loads for the 1st Floor VRF are greater than the 2nd Floor GHP.

Even the control methods of these two systems are quite different. The 1st Floor VRF uses a single set-point control to maintain within +/- 1.5°F of set-point while the 2nd Floor GHP uses a dual set-point with 6°F dead-band. This results in greater run hours for 1st Floor VRF and greater energy usage than the 2nd Floor GHP. LG's VRF systems offer two set-point control that can offer greater energy savings than the system used at ASHRAE headquarters.

Single Set-Point Control (VRF 1st Floor)



Use of the data does not imply ASHRAE has endorsed, recommended, or certified any equipment or service used at ASHRAE International Headquarters.

With minimal maintenance requirements, compressors located remotely and integrated controls, the LG Multi V IV system is easy to maintain and has a lower life-cycle cost than any conventional system on the market today.

VRF vs. GHP	Initial investment per square foot 38% less than GHP
Operating Cost	33% less than GHP
Life-cycle Cost	36% less than GHP

*Based on an analysis of the ASHRAE HQ building by LG Electronics USA, Inc.

LG's group control solutions allow multiple indoor units in open office areas to be controlled by one thermostat, eliminating the problem of some indoor units in cooling mode competing with other indoor units in heating mode as seen at ASHRAE headquarters.

LG Multi V products are engineered to simplify your HVAC system installation by removing the need for cooling towers, boilers, water pumps and ground loops, resulting in less installation cost and time compared to Geothermal Heat Pump systems. With minimal maintenance requirements, compressors located remotely and integrated controls, the LG Multi V IV air source system is easy to maintain and has a lower life-cycle cost than any conventional system on the market today.

For those who still prefer a water-source product, LG offers Multi V Water IV, a flexible Variable Refrigerant Flow (VRF) water-source HVAC system with variable water flow controls. LG systems can accommodate up to 64 thermal zones with technology that allows the user to pipe farther, conditioning the building with fewer systems. These innovative systems eliminate the need for additional units and provide designers with uncompromised engineering flexibility.

With smaller space requirements and reduced piping needs compared to typical chilled-water or water-source heat pump systems, LG Multi V Water IV VRF systems lower the overall construction, material and energy costs, while also allowing more leasable space for the owner.

Dual Set-Point Control (2nd Floor GHP)