Legionnaires' disease

On 27 April 1988, two people - one with suspected food poisoning, the other with suspected pneumonia - were admitted to the same Essex hospital. Two days later, tests had confirmed that both people had legionnaires' disease and doctors noticed that both had been working in Broadcasting House in London. This chance observation led to an immediate alert of the public health authorities and to searches for the source of infection and for potential victims.

Eventually, 58 people were confirmed as suffering from legionnaires' disease; 18 worked for or at the BBC and the rest were members of the public who had happened to pass by or who lived close to Broadcasting House. Three people died.

The source of the infection was a cooling tower which had stood idle for 2-3 months in the autumn of 1987. As we shall see, such a situation is a potential recipe for disaster.

Legionella bacteria

In July 1976, 182 delegates to an American Legion convention in Philadelphia were struck down with a mysterious acute respiratory illness. The search began for what was, six months later, found to be the bacterial species Legionella pneumophila. Twenty-nine people died in this outbreak.

The Legionella organism is a particularly small bacterium (bacteria are single-celled organisms that multiply by dividing into two) which doesn't grow in conventional laboratory growth media - which is why it took so long to find it.

Outside the lab, Legionella thrives in any warm, non-sterile water, particularly if the water contains sludge, iron, algae and amoebae. The bacterium is found everywhere in nature - in rivers, lakes, ponds and streams, and in wet soil. It is probably found in low concentrations in all open water systems, including those of building services such as hot and cold water systems (CIBSE 1987). Legionella has probably been around for hundreds of years but has been isolated only recently because the new environments that support its growth have the potential to cause outbreaks (two or more cases) of disease rather than sporadic (single) cases. Typical disease-causing environments are air-conditioned buildings with poorly maintained or sited cooling towers. As John Rimington, Director General of the Health and Safety Executive, has said:

'Legionnaires' disease is an illness which we have managed to create for ourselves. In designing and constructing systems to control our environment, we have created conditions which can be ideal for the propagation of Legionella. Those systems must be properly monitored and maintained. That is the key to controlling this disease.' (Health and Safety Executive 1989)

However, Legionella is a threat to human health only under certain circumstances - when conditions are such that the bacteria multiply to reach high numbers and become airborne in highly contaminated droplets (see Sources of infection below).
By 1988, at least 23 different Legionella species had been identified, with 12 different serogroups (a serogroup causes a particular immunological response in infected people) (Winn 1988). The organism responsible for causing legionnaires’ disease is Legionella pneumophila serogroup 1 sub-type Pontiac. The species name pneumophila indicates the bacterium’s fondness for the human lung. Outbreaks of acute respiratory disease from as far back as 1959 are now known to have been caused by Legionella pneumophila.

Legionella infections

Legionellosis is the collective term used for clinical conditions caused by bacteria from the Legionellaceae family. The species Legionella pneumophila can cause two distinct clinical syndromes: full-blown legionnaires’ disease and Pontiac fever. Legionnaires’ disease is quite separate from sick building syndrome or humidifier fever. Between 100 and 200 cases of the disease are reported each year. It is a type of pneumonia, with symptoms that come on abruptly 2-10 days after exposure (but more usually 3-6 days) in a susceptible person. Only about 1 per cent of those exposed go on to develop legionnaires’ disease. Susceptible people include the elderly; those who are already ill from respiratory or heart disease; people on renal dialysis and with kidney disease; those taking immunosuppressant drugs (such as anti-cancer agents); diabetics; alcoholics; and smokers. Men are more vulnerable than women: only three out of ten sufferers are women. Most cases have been in people aged between 40 and 70 years.

Legionnaires’ disease is thought to account for 2-10 per cent of all cases of pneumonia in Europe (Badenoch Report 1987). From the figures on the annual number of deaths from pneumonia, between 1,000 and 5,000 deaths from legionnaires’ disease would be expected in the UK each year. In fact, only 161 legionnaires’ disease deaths were reported between 1979 and 1986, suggesting that a very large number are not diagnosed or reported as such (Occupational Health Review 1988).

The symptoms of legionnaires’ disease are high fever, chills, headache and muscle pains, followed by a dry cough and breathing difficulty. As Table 2 shows, about a third of sufferers also develop diarrhoea or vomiting, and nearly a half become confused or delirious. The disease is fatal in up to about 18 per cent of cases, which is a mortality rate similar to that seen for other types of pneumonia. Antibiotics are usually an effective treatment. However, it is important that the correct diagnosis is made so that an antibiotic to which Legionella pneumophila is sensitive can be used. Complete recovery from legionnaires’ disease takes several months, even for people previously in good health. It is not yet known whether people who have had legionnaires’ disease are then immune to re-infection.

Pontiac fever, named after an unsolved outbreak of acute respiratory disease affecting 144 people in a health department in Pontiac, Michigan, USA, in 1968, differs from legionnaires’ disease in that symptoms of pneumonia are not involved (see Table 2) and the disease is not fatal. The incubation period averages 36 hours, and 95 per cent of those exposed develop the disease. It has been suggested that Pontiac fever is an allergic reaction (Rowbotham 1980).
Table 2: Symptoms of legionnaires' disease and Pontiac fever

<table>
<thead>
<tr>
<th>Symptom</th>
<th>Percentage of patients</th>
</tr>
</thead>
<tbody>
<tr>
<td>Legionnaires' Disease</td>
<td>Pontiac fever</td>
</tr>
<tr>
<td>Cough</td>
<td>75</td>
</tr>
<tr>
<td>New sputum production</td>
<td>45</td>
</tr>
<tr>
<td>Coughing blood (haemoptysis)</td>
<td>21</td>
</tr>
<tr>
<td>Breathing difficulty (dyspnoea)</td>
<td>50</td>
</tr>
<tr>
<td>Muscle pains (myalgias)</td>
<td>38</td>
</tr>
<tr>
<td>Upper respiratory tract symptoms (nose, throat)</td>
<td>13</td>
</tr>
<tr>
<td>Headache</td>
<td>32</td>
</tr>
<tr>
<td>Confusion</td>
<td>45</td>
</tr>
<tr>
<td>Nausea or vomiting</td>
<td>30</td>
</tr>
<tr>
<td>Diarrhoea</td>
<td>33</td>
</tr>
<tr>
<td>Abdominal pain</td>
<td>8</td>
</tr>
<tr>
<td>Fever</td>
<td>-</td>
</tr>
<tr>
<td>Fever above 39C</td>
<td>70</td>
</tr>
<tr>
<td>Slowed heart rate</td>
<td>40</td>
</tr>
</tbody>
</table>


The mortality rate in the BBC outbreak was low: only 5 per cent of those who contracted the disease died. This may have been because of the relatively good health of the population exposed, unlike in the world’s worst outbreak, probably also from a contaminated cooling tower, at Stafford General Hospital in April 1985, when 30 people died - a mortality rate of about 30 per cent.

Sources of infection

Most cases of legionnaires’ disease are not associated with outbreaks (two or more cases from a single source): 75 per cent of reported cases in the UK are sporadic, i.e. single cases (Badenoch Report 1987). The source of infection is often not identified although most sporadic cases are associated with hot water systems (Employment Committee 1986).
Legionellae enter hot and cold water systems, cooling water systems or process water systems in industry through contamination of exposed water or through the mains water supply. It has often been stated that more than 90 per cent of known outbreaks of legionnaires’ disease arising from cooling towers are associated with nearby building works. The suggestion is that the dust neutralises the biocides in the cooling water or helps to sustain the droplets released into the environment.

A survey carried out by the Public Health Laboratory Service in the aftermath of the Stafford General Hospital outbreak showed that 70 per cent of water systems in hospitals and 75 per cent of systems in business premises were contaminated (Bartlett et al 1985). However, very low numbers of Legionella in a water system are unlikely to cause problems. Disease occurs when conditions favour the growth and multiplication of bacteria so that high concentrations are reached. Stagnant water favours growth; contamination (and outbreaks of disease) occurs when new water systems are brought into operation or when systems are started up after a period of shut-down, since under these circumstances water may have been lying around in the system for weeks or even months. Stagnant water zones such as dead-legs where dirt, sludge, rust or scale can accumulate may also shelter bacteria.

In addition, the materials used in the systems may affect the organism’s ability to multiply: some pipes, washers, grommets, sealants and jointings are more likely than others to support surface growth.

The temperature of the water is a very important factor. Temperatures of about 37 degrees centigrade (37 °C is normal human body temperature) are best for growth of Legionella. Growth rates decrease at lower temperatures and cease altogether below 20 °C. Above 37 °C the rate of multiplication also decreases, until at 46 °C it is zero. At higher temperatures the bacteria are eventually killed off, more quickly as the temperature rises.

**Aerosols**

Water cooling towers, certain kinds of humidifier, air-conditioning systems, showers, spray taps, and other water systems produce small droplets in the course of their normal operation (see Table 3). The main mechanisms by which aerosols are created are water streams breaking up or striking a surface, or bubbles bursting at a water surface. Air movement can spread these aerosols hundreds of metres from their source: in the BBC outbreak, one victim lived 500 metres from the contaminated cooling tower.

Inhaling tiny droplets of contaminated water is the only proven way of catching legionnaires’ disease: it is not contagious and cannot be passed from person to person. The organism is not thought to be harmful if swallowed, although guinea pigs who were fed large doses of contaminated water developed pneumonia and died (Winn 1988).

Danger arises when contaminated water becomes aerosolised and the droplets evaporate before they reach the ground, so creating particles that are so small they can be inhaled into the lowest part of the lungs - the alveoli, where exchange of gases takes place.

The factors that determine whether or not a person who has inhaled contaminated aerosol will go on to develop disease include the susceptibility of the individual, the
number of bacteria that have been inhaled, and the length of exposure time. For instance, exposure to a contaminated shower-head may be brief, whereas exposure in a building where the ventilation system is taking in contaminated air from a nearby rooftop cooling tower may be continuous.

Table 3: Possible sources of Legionella bacteria

- Air-conditioning equipment (cooling water systems, humidifiers, cooling coils, condensers)
- Air washers
- Cold water systems
- Condensers (e.g. evaporative, steam turbine)
- Fire sprinklers
- Hot water systems
- Humidifiers (atomising, spray, portable)
- Jacuzzis Nebulisers and humidifiers (for medical use)
- Showers
- Spray taps/mixer taps
- Swimming pools
- Ventilation bags (for medical use)
- Water-based coolants (lathes, diamond wheels and other rotating machines generate aerosols)
- Wet cooling towers
- Whirlpool baths/spas

Wet cooling towers

In both the BBC and the Stafford General Hospital outbreaks, cooling towers were believed to be the source of infection. It is surprising that more outbreaks of legionnaires’ diseases haven’t occurred, particularly in connection with the air-conditioning water cooling towers of office blocks or public buildings. The maintenance of many cooling towers on London office blocks is atrocious, according to evidence given to the inquiry into the Stafford outbreak (Badenoch Report 1987).

How cooling towers work

There are several types of cooling tower, but they all work on the same principle. Cooling towers are designed to remove unwanted heat from air-conditioning plant (see Figure OO) or from process cooling in industry. Before the ducted air is circulated through the building it is cooled by the cooling coil through which water chilled by a refrigeration unit is circulated. Heat from the refrigeration cycle is removed at the condenser, which may be cooled by air or, more commonly, by water circulating through the cooling tower.

The cooling water is drawn from the pond at the base of the tower and pumped through the refrigerant condenser where it gains heat. It is then pumped to the top of the tower and sprayed on to a filler pack before draining back into the pond. Air is blown or drawn through the filler pack and gains moisture and heat in the process of cooling the water by evaporation. The purpose of the filler pack is to increase the rate of evaporation, and hence cooling, by providing a large area of wetted surface.
Design of cooling towers

Cooling towers need to be designed in such a way that growth of Legionella is minimised:

- The tower must be sited so that air from the discharge does not enter open windows or air-conditioning or ventilation intakes. Prevailing wind directions should be taken into account. High efficiency eliminators are essential to minimise the amount of water carried out in the airstream leaving the tower.
- Construction materials should be non-porous with a smooth surface for easy cleaning. All non-metallic components such as seals, ‘O’-rings, washers, etc. should be of a type known not to support bacterial growth, as listed in the Water Fittings and Materials Directory (Water Research Centre 1990). Filler packs should not be made from organic materials such as wood or cardboard which are more likely to support microbial growth. The filler pack must be cleanable. The water circuit should be as simple as possible, avoiding dead-legs and awkward loops that may be difficult to drain. The system should be able to be dismantled easily for inspection and cleaning. The water distribution system should be designed to minimise aerosol generation. Sump design should promote the removal of sludge from the system. The entire system must be able to be drained. Air-breaks and traps must be provided for all drains. The pond should be shielded from direct sunlight to minimise microbial growth.

Further technical details on cooling tower design can be found in Guidance Note EH48, which is being updated, from the Health and Safety Executive (HSE 1987); in the Code of Practice published by the DHSS and the Welsh Office (1989); and in Technical Memoranda TM13 from the Chartered Institution of Building Services Engineers (CIBSE 1987).

Water treatment

However well designed a cooling tower is, it still poses a threat unless the quality of the water in the system is good. Before the BBC outbreak, arrangements for treating the water and maintaining the cooling towers at Broadcasting House had broken down completely. There was no written statement on water treatment policy, no schedule listing necessary maintenance procedures, record-keeping was inadequate, and no one person was clearly responsible for ensuring that procedures were carried out.

For every cooling tower, a water treatment programme must be designed for that system, both to maintain the efficiency of the system and to prevent the growth of micro-organisms including Legionella. It should include:

- a bleed or blow-down to prevent build-up of impurities in the re-circulating water
- scale and corrosion control biocidal treatment chemicals to control sludge build-up
- a filtration system or strainer system to prevent the accumulation of sludge

Prevention of the build-up of scale is important since biocides cannot penetrate under scale where legionellae may be harbouring. The cooling tower water must be kept free from organic debris since this ‘uses up’ the biocide and prevents it from combining with its intended target, the Legionella bacterium.
Use of biocides

While the Badenoch Committee was carrying out its inquiry into the outbreak of legionnaires’ disease at Stafford General Hospital it recommended that another committee be set up to review the use of biocides to control the growth of Legionella (Committee of Inquiry 1986). The Expert Advisory Committee on Biocides reported in 1989 (Department of Health 1989). It found that hardly any proper research had been carried out into the use and effectiveness of biocides in cooling towers, and was unable to recommend any one biocide over the others. However, it considered that most biocides on the market would be effective provided that the water system was already ‘clean’, that the biocides could reach all parts of the system, and that they could remain there for a sufficient time. The committee made the following points:

There is little evidence to support any particular dosing system: as long as cooling towers are kept in good condition, intermittent dosing with biocides is adequate. Continuous dosing may be needed for towers in a poor condition.

There is no such thing as a ‘safe’ level of Legionella in a cooling water system, and there is little point in routine testing for the organism. In any case, however rigorous the maintenance procedures are, there will always be some legionellae in cooling water systems; bacterial counts are often inaccurate; and there is a delay in getting back the results. (The London Hazards Centre recommends that samples of water, sludges and, perhaps, air should be taken if there is any doubt, and before and after any major clean-up. Of course, tests must be done if the tower is thought to be associated with human infection.)

Towers that are used all year round should be cleaned and disinfected twice a year. When chlorine is used as the biocide after twice yearly cleaning, a free chlorine level of 5-15 milligrams per litre (or parts per million) should be maintained for five hours before the tower is brought back into use.

As yet, there is no firm evidence that legionellae readily develop resistance to biocides. The Committee recommends that different biocides be used to prevent resistant strains from being selected. (The London Hazards Centre advises, however, that use of more complex biocides should be avoided because of increased toxic risk to engineers and building occupants.)

Cleaning and disinfecting

The Code of Practice published by the DHSS and the Welsh Office (1988) is the most comprehensive document available in the UK for those whose job it is to keep buildings free from Legionella bacteria. For cooling towers, it recommends that cleaning and disinfecting of the entire system is needed at the following times:

- when the system is first brought into use after installation; before start-up, mid-way through, and at the end of short ‘cooling seasons’. After final cleaning, towers should be left ‘dry’ during the winter months; twice yearly for systems that are operated all year round. The water quality should be carefully monitored; after a shut-down period of five days or more; if the system or part
of it has been altered or otherwise disturbed; when the ‘cleanliness’ of the system is in doubt.

Workers cleaning towers must have protective clothing and respirators to protect them from both bacteria and chlorine (or other biocides). Water lances should not be used since they create aerosols.

The best way to disinfect by chlorination is to add a solution of sodium hypochlorite rather than slow-releasing tablets (DHSS 1989). Chlorine is one of the most deadly gases in existence, and sodium hypochlorite is a dangerous chemical: undiluted solutions are caustic, causing burns to the eyes and skin, and poisonous. It - and any other chemicals used for cleaning purposes - comes under the Control of Substances Hazardous to Health (COSHH) Regulations (1988) which came fully into force on 1 January 1990.

**COSHH Regulations**

Under the COSHH Regulations an employer has to assess all work that is liable to expose any worker to hazardous solids, liquids, dusts, fumes, vapours, gases or micro-organisms. Assessment means evaluating the risk and taking appropriate action to prevent people from being exposed.

The COSHH Regulations also apply to workplaces where there is a risk of legionellosis, since they cover micro-organisms that create a hazard to the health of any person (Health and Safety Commission 1989). COSHH leaflets can be obtained free from Health and Safety Executive Area Offices. The revised HSE Guidance Note EH48 on legionnaires’ disease will give practical guidance on assessments under the COSHH Regulations and the sort of action that will be necessary. Most trade unions have produced guidance on COSHH for their members.

Chlorinated water is hazardous to aquatic life when discharged directly into water courses. In the USA, biocides are classed as pesticides and their use is more strictly controlled than in the UK. Similar regulations apply in other countries, e.g. Holland and Canada. In the UK, biocides are less regulated but a licence to discharge chlorinated water is needed under Section 34 of the Control of Pollution Act 1974. The licence application includes information on the nature and flow-rate of the discharge: bleed water should be discharged at a steady rate to the sewer to dilute the chlorine.

**Replacement of wet cooling towers**

There are large numbers of wet cooling towers in the UK that are about 20 years old, and the estimated useful life of a tower is about 10-20 years (Employment Committee 1989). The contaminated tower at the BBC, for example, was installed in 1972.

The policy within the NHS is now to use equipment such as air-cooled condensers when a wet cooling tower needs replacing, so that wet towers will be phased out. At the very least, older towers, which are more likely to harbour legionellae, should have wooden components replaced with plastic ones. The aim nationwide must be to replace all wet towers with air-cooled systems as soon as possible.
Air-conditioning equipment

Wet cooling towers are often implicated in outbreaks of legionnaires’ disease, but other parts of the air-conditioning system may also provide ideal conditions for growth and dispersal of legionellae, i.e. water temperature of 20-45°C; the presence of sludge, scale, rust, algae and organic particles which provide food for the bacteria; and the production of small droplets or aerosols that can travel along the ductwork into rooms where people are working.

No one air-conditioning system is the same as another, but you should be able to work out where potentially hazardous sites and components lie in your system. Several of these components can be seen in Figure 00.

Air inlets

Air inlets are potential sources of entry of contaminated droplets from the drift of cooling towers and evaporative condensers sited on nearby roof-tops. Sometimes, air inlets are placed right next to cooling towers on the roof. The outbreak in Pontiac, which gave rise to the illness known as Pontiac fever, is believed to have arisen from contaminated exhaust from an evaporative condenser being drawn into the air-conditioning system (Department of Health 1989).

Humidifiers

Humidifiers can become heavily contaminated unless they are kept scrupulously clean. Atomising and spray-type humidifiers spray water into the ductwork (or directly into the workplace in some industrial applications).

Spray humidifiers use recycled water: spray water is collected and returned to a tank from which water is reused. The tank provides ideal conditions for the growth of a range of micro-organisms and the spray mechanism could easily contaminate the air as it passes through the system.

Steam injection is the preferred method of humidification since it doesn’t involve recycling water and the high temperature reached is probably biocidal. Steam injection humidifiers should be used to replace the spray type wherever possible. Care must be taken to ensure that the source of the steam does not contain toxic amines, which are often added to the main plant boiler steam as anti-corrosion agents (Binnie 1988). A second best is to use water direct from the mains supply, with no re-circulation.

All types of humidifier should be cleaned regularly, at least every 2-3 months, with a final rinse with a mild disinfectant. However, biocides and chemical water treatments to prevent the build-up of sludge and scale and to stop corrosion should not be used since these chemicals would then be discharged into the building.

Portable humidifiers have been responsible for cases of legionnaires’ disease. They work by producing an aerosol via a high speed pump placed above a basin of water, and so create ideal conditions for Legionella growth. The Chartered Institution of Building Services Engineers (1987) recommends that such units be kept very clean, with daily
washing and draining of the unit. Distilled water should be used in sensitive areas such as hospitals.

**Air cooling mechanisms**

The cooling coil is maintained at a low temperature by the refrigeration unit, which produces chilled water to circulate round the hollow coils placed in the air flow. The water in the warm air is condensed onto the cooling coil, and the drops collect in a drip tray. Condensed water is initially below 20°C but will be warmed as it stands in the condensate tray, so providing a source of infection. Water droplets may sometimes be picked up by the air flow in the duct as it 'scours' the stagnant water surface. Contamination may arise directly from micro-organisms drawn through the air inlet or indirectly from the drain if there is no air-break between condensate discharge and drain (Health and Safety Executive 1987).

Another cooling mechanism is the use of air washers, which spray water into the airflow and collect it again by means of eliminator places. The recycled water is a source of infection, as described above for spray humidifiers, and inevitably the eliminators fail to collect all the water.

**Ductwork**

Water can enter ductwork from various sources, such as leaking equipment and pipes, and can stagnate at room temperature. Again, the air flow may scour the water surface, so spreading contaminated droplets.

**Hot and cold water services**

In April 1989, 30 people at a nursing home for the elderly in Surrey were struck down by legionnaires' disease. The bacteria were isolated from the water system. Four people died - luckily no more than 13 per cent of this vulnerable population. In fact, hot water systems are the source of most outbreaks of legionnaires' disease in the UK.

The 'domestic' water systems of most hotels and hospitals are probably positive for Legionella, and occasionally systems in these and other large buildings give rise to outbreaks or to sporadic cases of infection (Department of Health 1989). Showers and taps with spray heads are most commonly implicated in dissemination of contaminated water droplets (Health and Safety Executive 1987).

Mains water is normally free from significant levels of bacteria since it has been chlorinated. However, a potential hazard arises when it becomes tepid after standing for a long period. Legionella may colonise water storage tanks, calorifiers, pipework, filters and certain fittings and materials. Systems should be designed and maintained with the following points in mind:

- **Cold water storage tanks** should hold only a day's supply and should be sited in well-ventilated spaces, out of direct sunlight. Tanks should be fitted with tight lids or covers, and lagged to maintain a low temperature. The drain should be at the lowest level. Regular inspection and annual clearing of tanks should be carried out. Sludge, scale and debris should be removed and rust pitting cleaned.
Overflows should be protected by fine mesh screens. When two or more tanks are installed to serve the same system, they should be arranged in series so that water flows through them all and is not drawn just from one. Cold water piping should avoid hot zones and should be lagged, if possible, to maintain a temperature of less than 20 °C. Where hot and cold water have to be mixed, this should be done as close to the point of delivery as possible. Hot water should be stored at a temperature of at least 60 °C, and the temperature at taps and other draw-off points should be at least 46 °C. Signs should be put up to warn people of the dangers of scalding from hot taps. The design of water systems should be as simple as possible, with no stagnant water zones (dead-legs) where dirt, sludge, rust or scale can accumulate. Blind ends that have resulted from modification of the system should be removed wherever possible. Water fittings with the highest usage should be located at the end of a dead-end spur to ensure the best water throughput in the spur. Shower-head supply pipes should be self-draining. Non-metallic parts such as sealants, washers and jointings should be of a type known not to support bacterial growth. The Water Fittings and Materials Directory, published by the Water Research Centre (1990), lists fittings and materials that are acceptable under bye-laws for connection to the mains water supply, and which are neither toxic nor provide nutrients for micro-organisms. Calorifiers (vessels in which water is heated to a thermostatically controlled temperature) should have re-circulation pumps fitted if they have a zone of lukewarm water at the bottom, beneath the heating elements. They must also be readily accessible for draining (at the lowest point), dismantling and cleaning, which should be carried out at least every year and more often in hard water areas. Periodic discharge of water from the calorifier should minimise the build-up of sediment. Water service systems should be disinfected after installation or refurbishment.

The main measures to prevent the growth of Legionella in water systems are cleanliness, maintenance of cool conditions for cold water and of hot temperatures for hot water services, and regular use of water to prevent it from remaining static. Further guidance on the design and maintenance of water systems can be found in Technical Memoranda 13 (CIBSE 1987), Guidance Note EH48 (Health and Safety Executive 1987) which is currently being updated, and the code of practice Control of Legionellae in Health Care Premises (DHSS and the Welsh Office 1989).

**Other equipment**

Legionella can grow in other equipment and fittings, for instance in the water that stands in fire sprinklers (the initial water-fill should be treated with chlorine). Jacuzzis (whirlpool spas) use warm water which is constantly recirculated through high velocity jets, or air is injected to agitate the water. This agitation creates an aerosol above the surface of the water. Both fire sprinklers and jacuzzis have been associated with legionnaires’ disease, so careful cleaning and maintenance is essential.

Bacteria can grow in shower-heads where the fitting is made from a material that can be used as a nutrient source. When the shower is turned on, a spray of contaminated droplets is created. All shower fittings, whether used regularly or not, should be run for
5 minutes each week, passing hot water for the first 2 minutes. Other possible sources of Legionella are given in Table 3.

Responsibility and record-keeping

Detailed records are needed for all water systems or other plant or equipment that might give rise to legionnaires’ disease, to include the following points:

- the layout of the system, including parts that are temporarily out of use what constitutes correct and safe operation, as determined during design and commissioning procedures for maintenance, monitoring, cleaning and disinfection and their frequency; details of work done and when safety precautions for carrying out this work the name of the person(s) responsible for all aspects of control

Some useful checklists and examples of records can be found in Technical Memoranda 13 (CIBSE 1987) and the Code of Practice from the DHSS and Welsh Office (1989).

Training

Training is needed for service engineers in the maintenance of water systems and in the use of biocides. The Expert Advisory Committee of Biocides was concerned that no acknowledged qualifications or training existed for such workers. The training given to outside maintenance contractors and water treatment suppliers should be checked.

What to do in an outbreak

It is important that procedures are developed for dealing with an outbreak, suspected outbreak or discovery of high levels of contamination with Legionella before it occurs, so that panic doesn’t reign. The following checklist outlines the actions that might form the basis of a contingency plan:

- Inform the relevant public authorities immediately. In England and Wales, this is the Health and Safety Executive and the local authority Medical Officer for Health. In Scotland, the Community Medicine Specialist (Communicable Diseases and Environmental Health Group) or the Designated Medical Officer should be contacted. Develop procedures to seal off infected areas and close buildings where Legionella has been or may be found. Shut down all possibly contaminated systems while the source of infection is being identified. Inform the workforce. Make arrangements for medical tests for people who may have been exposed.

The law and legionellosis

In January 1989, the BBC was fined £3,600 for criminal negligence in the outbreak at Broadcasting House in London which cost three people their lives. In May 1989, British Aerospace was fined £4,000 for an outbreak at its factory in Bolton which affected 30 people. Both of these cases were heard in magistrates’ courts and both organisations were charged under Section 2(1) of the Health and Safety at Work Act 1974 with failing to ensure the safety of their employees and under Section 3(1) for failing to protect the safety of people not in their employment.
Another section of the Act that is relevant to legionnaires’ disease is Section 4, which requires that premises and plant or substances are safe and without risk to health. The Control of Substances Hazardous to Health (COSHH) Regulations 1988 are also applicable (see p.00). For more information on the law and health and safety in the workplace, see Appendix 5.

Changes in legislation

Following the various committees of inquiry and anger about the outbreaks of legionnaires’ disease in the 1980s, particularly those at the BBC and Stafford General Hospital, the Health and Safety Commission reached the conclusion that clearer and more comprehensive legislation is needed to control the disease. At the end of 1989, the Commission published a consultative document which suggests that either a set of Regulations or an Approved Code of Practice should be drawn up. Regulations will be needed if it is decided to ban or modify all wet cooling towers. However, a code approved under Section 16 of the Health and Safety at Work Act seems a more likely prospect: failure to comply with its provisions could be used in court as proof that the law had been broken.

Such a code would probably outline measures to be taken to assess foreseeable risks of legionellosis from plant and equipment and indicate action to prevent or control such risks. These actions are already needed under the COSHH Regulations (see p.00), and the code would include detailed guidance on the control of legionnaires’ disease.

Registration or licensing of cooling towers

In Scotland, where legionellosis is a notifiable disease, all wet cooling towers and whirlpool spas (jacuzzis) are supposed to be registered, although this is not a statutory requirement. The Health and Safety Commission’s consultative document considers whether registration should be extended to the rest of the UK, but the case for doing so is not argued very strongly: ‘...those who are most likely to ignore any requirement to register are likely also to be those who have inadequate or non-existing preventive and maintenance regimes’ (Health and Safety Commission 1989).

Other possible options for control proposed by the Commission include the licensing of wet cooling towers or of other potential sources of infection, or banning the installation of new towers with phase-out of existing ones. None of these options seems likely to be instituted.

Punishing the offenders

So far, cases against employers who have caused outbreaks of legionnaires’ disease have been heard only in magistrates’ courts, where the maximum fine is £2,000 for each offence. The Health and Safety Executive has been strongly criticised, particularly by trades unions whose members have developed legionnaires’ disease, for not taking such cases to the Crown Court, which could impose up to 2 years’ imprisonment and unlimited fines. One trade union officer at the BBC said: ‘Clearly three people being killed is not sufficient to go to the Crown Court for action these days’ (Labour Research 1989).
It is not only trade unionists who are concerned about the apparent laxity with which prosecutions have been brought. In March 1989, the House of Commons Employment Committee published a report Legionnaires’ Disease at the BBC, in which it criticised the Health and Safety Executive for ignoring its advice to apply for Crown Court trial:

'We regard the penalties imposed by the Magistrates’ Court as totally inadequate to reflect the seriousness of the offences and of their consequences in a case where negligence had caused three deaths and much suffering, where the infection could (as we were told) have spread so much more widely, and where it resulted from the inexcusable and admitted criminal acts of the BBC. The maximum permitted penalties should have been imposed.'

The Employment Committee believed that the Health and Safety Executive should also have prosecuted the individuals responsible, and perhaps the main board or other individual directors who had responsibility for safety matters. It further recommended that legionnaires’ disease and Pontiac fever be made notifiable diseases (legionellosis is already notifiable in Scotland), that more inspectors be employed by the Health and Safety Executive and local authorities to carry out inspections of wet cooling towers, and that regulations be introduced to control legionnaires’ disease.

Checklist for Legionnaires’ disease

Each workplace should have:

- a written scheme for preventing or controlling the risk of legionellosis, to include:
  - details of the source(s) of risk and results of assessments precautions to be implemented the name of the person(s) responsible for overseeing and implementing precautions, with clear lines of responsibility laid down an outline of the procedures to be taken to carry out the precautions monitoring of the procedures
  - detailed inspection and maintenance schedules detailed records training programmes a policy on the replacement of wet cooling towers a written plan of actions to be taken in the event of an outbreak, suspected outbreak or heavy contamination a system for reviewing the above

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