Health and Safety Executive	Operational Circular
Field Operations Directorate	OC 255/9
Review Date	3/09/2008
OG Status	Fully Open
Author Unit	FOD OHEU

See OC 255/11

To
AFQ Inspectors (Bands 0-4)
RSG/SSG Specialist Inspectors (Mech, Occ Hyg) (Bands 0-3)
RSG/SSG Medical and Occupational Health Inspectors
CHID Inspectors (Bands 0-3)
Railway Inspectors (Bands 0-3)
Workplace Contact Officers (Band 5)

LEGIONELLOSIS: ROUTINE INSPECTION OF WATER SYSTEMS INCORPORATING COOLING TOWERS AND EVAPORATIVE CONDENSERS

This OC provides guidance for routine inspection and enforcement at premises where there is a risk from legionellosis from water systems incorporating cooling towers and evaporative condensers. For guidance during outbreak investigations see **OC 255/12** Control of legionella: Investigation of outbreaks (and single cases) of legionellosis from water systems incorporating cooling towers and evaporative condensers.

BACKGROUND

1 *Legionella* is the genus of bacteria, which gives rise to the risk of infection from diseases, collectively known as legionellosis. These consist of both pneumonias and non-pneumonic illnesses. The species *Legionella pneumophila* presents the most serious hazard, which is mainly, but not solely, responsible for causing legionnaires' disease. This is a pneumonia which has serious effects and is fatal in 10-12% of cases. *Legionella* is widespread in both natural water sources and artificial water systems. It proliferates where temperatures are favourable (20-45^{0}C), nutrients are available and water is stagnant. Infection can then occur by the inhalation of aerosols or particles generated from the source.

2 Cooling systems which incorporate cooling towers and evaporative condensers pose particular problems in relation to the management of the risk from *Legionella*. This is because their mode of operation can create ideal conditions for microbial growth and deliberately requires the creation of sprays and aerosols, which can be dispersed over a wide area if not controlled properly. Those at risk of exposure, therefore, not only include those who work in the premises where they are installed, but also others in the vicinity including members of the public. Employees involved in cleaning or maintenance may be at increased risk.

3 The principles for carrying out inspections are essentially the same for all water systems where there is a potential risk of legionellosis. However, due to the relative complexity of the control measures required for cooling towers and evaporative condensers, and the fact that many operate as an integral part of an industrial process, inspectors need to consider matters in more detail. This circular gives guidance to assist this.

LEGISLATION

4 Duties under the Health and Safety at Work etc Act 1974 (HSW Act) extend to risks from *Legionella* arising from work activities. In addition, harmful micro-organisms are subject to the Control of Substances Hazardous to Health Regulations (COSHH), and accordingly, the requirements to carry out an assessment, and to prevent, or adequately control exposure will apply to risks of legionellosis. An assessment needs to take into account all persons likely to be exposed including the public. The Management of Health and Safety at Work Regulations 1992 are also relevant with respect to management arrangements.

5 The Approved Code of Practice (ACoP) (L8 Rev) *The prevention or control of legionellosis (including legionnaires' disease)* (file 255) provides a basic framework for controlling exposure to the organism, giving advice on the requirements of HSW Act and COSHH. It places responsibility on employers and others to:

1) identify and assess risks of legionellosis;

2) avoid the use of systems that give rise to a reasonably foreseeable risk of legionellosis or, where this is not reasonably practicable, prepare a written scheme for minimising the risk from exposure;

3) implement and manage the scheme of precautions including the appointment of a person, or persons, to take managerial responsibility and to provide supervision; and

4) keep appropriate records.

The ACoP also gives advice on the management, selection, training and competence of personnel, and sets out the responsibilities of manufacturers, importers, suppliers and installers of products and services. Further technical detail is given in HSE guidance booklet HS(G)70: *The control of legionellosis including legionnaires' disease* (file 255) (currently being revised).

Notification of Cooling Towers and Evaporative Condensers Regulations 1992

6 There is also a duty under The Notification of Cooling Towers and Evaporative Condensers Regulations 1992 (NCTEC Regulations) for occupiers to notify the local authority (LA) in writing of details of 'notifiable devices'. These comprise cooling towers and evaporative condensers, except where they contain no water that is exposed to air and/or their water or electricity supply is not connected. The requirement is to notify the LA, although the Regulations are enforced by the relevant enforcing authority for the premises with the notifiable device.

7 The main purpose of such requirements is to assist in investigating outbreaks. There is no obligation for LAs to maintain a register, although in many cases they will do so and it is expected that, whatever the form in which the information is collated, it will be made readily available to HSE inspectors.

8 It has not been the practice for HSE to systematically keep its own record of these installations, only to obtain the information when it has been required. However, some FOD regions are now doing this in order to support a more proactive inspection role, using workplace contact officers (WCOs) to obtain regular updated lists from LAs. WCOs can also enquire of their presence during routine workplace contacts, which will help identify installations that have not been notified. There is no formally agreed method of storing this information on FOCUS, nor is there likely to be, but some FOD field offices have adopted

their own arrangements. If a decision is made to maintain a permanent record, FOD and CHID offices should attempt to ensure that their efforts are coordinated according to their respective geographical areas of responsibility.

Temporary, hired cooling towers

9 Hired cooling towers can be temporarily installed on site. Inspectors should be aware that not only do the users of these have the same legal obligations as for permanent installations, but that suppliers also have responsibilities (see Engineering NIGM 3/A/1997/6 *The temporary use of hired cooling towers*).

TRAINING AND HEALTH AND SAFETY

10 Before proceeding with inspection for all types of installations, inspectors must read and be familiar with FOD Health and Safety Policy Supplement No 30 *Legionellosis* (this document is also an integral part of the CHID Health and Safety Policy). This requires that inspectors receive formal training before undertaking any close physical examination of a cooling tower or evaporative condenser. This training is also important to assist inspectors in identifying key issues for inspection.

INSPECTION PROCEDURE

11 The following procedure can be carried out fully by all inspectors who have received the necessary training. Those who have not, should restrict themselves to examining the paperwork only and then refer a physical examination to one who has. Where reference is made to consulting specialist advice, at the first level, this should be the Regional/Scottish Specialist Group (RSG/SSG) occupational hygiene specialist inspectors. RSG/SSG mechanical engineering specialist inspectors may also be able to assist if aspects of the mechanical operation of an installation need to be examined. If deep knowledge of the topic is required then the matter should be referred, via the RSG/SSG to the Directorate of Science and Technology, Dangerous Pathogens Section (DST E6).

12 Inspectors should first check to see if an installation has been notified under the NCTEC Regulations. Once this has been done, the overall objective of a routine inspection is to ensure compliance with the COSHH Regulations and the ACoP. This proceeds in 2 stages:

1) the examination of the assessment under COSHH; and

2) a close physical examination.

Assessment

13 The COSHH assessment should address the risks from the system and how they are controlled. It should include details of management responsibilities; a schematic of the system; details of precautions taken including cleaning and disinfection and water treatment programmes; records of operation, monitoring and remedial work. The ACoP should be consulted for further detail of requirements. If water treatment or any other task is performed by a contractor then the assessment should address the respective responsibilities of the occupier and the contractor. Poor or no paperwork may give an indication of problems, but even if all is in order at this stage, it should not be assumed that the system is definitely safe.

14 It is important that the assessment considers the system as a whole and not just the

cooling tower or evaporative condenser. This should include all associated pipe work, pumps, heat exchangers etc. Deadlegs and parts of the system used intermittently, eg test loops in engineering factories, injection moulding machines, can create a particular problem with microbial growth going unnoticed. Once brought back on-line they can cause heavy contamination, sometimes overloading the water treatment regime altogether. Examination of the system schematic and procedures to avoid stagnation are important in this respect.

15 Many assessments place much emphasis on the water treatment programme. While this is a vital element in controlling the risk, inspectors should ensure that other matters are appropriately addressed, particularly the management of the system, the cleaning and disinfection programme (required at least twice yearly (see HS(G)70)) and the presence of 'drift eliminators'.

16 The paperwork often contains details of chemical and microbial monitoring. Chemical parameters indicate the degree to which scale and corrosion are controlled and biocide concentrations, while measurements of total microbiological activity (dipslides or total viable counts (TVCs)) are used to indicate the overall effectiveness of water treatment programmes. Dipslide and TVC results, by themselves, should not be taken as an indication of the degree of risk from the system, but the **trend** of counts can be informative (NB isolated sample results will be of little use) when taken into consideration as one factor in assessing the condition of the system, along with other aspects of compliance with the ACoP. A simple guide is given below on how to interpret these. Changes in trends may be of particular significance, but it should be noted that these could also represent problems with the sampling regime.

Range of results	Interpretation
10^4 cfu/ml or less	System under control
>10^4 and up to 10^5 cfu/ml	System may be out of control; Programme operation should be reviewed
>10^5 cfu/ml	Corrective action should be implemented

17 Where results of *Legionella* monitoring are also encountered, it is unlikely that these will exist separately from TVC or dipslide measurements and inspectors should, therefore, not attempt any further interpretation based on these. If they do exist in isolation and/or interpretation is thought necessary for other reasons, then specialist advice should be consulted, particularly as *Legionella* sampling and analysis is fraught with problems. The indication of the presence of *Legionella* alone should not be regarded as a cause for alarm.

18 If, at the stage of examining the paperwork, there is evidence of a serious risk of infection to those in the vicinity of the installation, strong consideration should be given to issuing a prohibition notice (PN) in order to have it switched off completely and remedial action taken. This course of action would be justified in a situation where there is no or an inadequate assessment, combined with a complete absence of both water treatment and cleaning/disinfection programmes. It may also be justified in other circumstances and inspectors will need to make careful judgements here, if necessary, consulting specialist advice. If, in these circumstances, the occupier agrees to switching off the installation to allow a close physical inspection to proceed, then this should be carried out prior to issuing a PN in order that all possible evidence can be taken into account, but if this agreement is not forthcoming then a PN can be issued based on the assessment of paperwork alone.

Physical examination

19 To carry out a complete inspection of a system, a close physical examination will almost always be necessary. This should be limited to observing the main elements of the installation, essentially the packing, the pond and the drift eliminator.

Forced/induced draught installations

20 Cooling towers (see appendix) work on the basic principle of transferring heat from circulating water to an air stream. This is achieved by maximising the surface area of the water by spraying it onto a 'packing' or 'fill' material. From here the water will fall into a 'pond' or 'reservoir'. A fan is used to increase the velocity of the air stream, blowing or pulling across the packing. In so doing, it further breaks up the water droplets to cause an aerosol. A drift eliminator is the principal means of engineering control to reduce escape of this aerosol to the general atmosphere. With an evaporative condenser, the water runs across a heat exchanger coil carrying a coolant instead of the packing. Otherwise it is essentially the same.

21 Before proceeding with a close physical inspection, the fan should always be turned off (see Health and Safety Policy Supplement No 30). The inspection should generally only take about 15 minutes although complex systems will require longer. However, before approaching the installation a small interval should be allowed for the system to equilibrate. Fifteen minutes should suffice for smaller installations, but up to 30 minutes should be allowed for larger ones (in case of doubt, wait for the longer period). In other circumstances, as indicated below, the pump may also need to be turned off. However, inspectors should be aware that the installation may be designed to give continuous cooling to a process and switching off the pump may give rise to critical overheating which could be both hazardous and damaging to the process or product.

Cross-flow towers

22 In cross-flow towers the air stream moves horizontally across the packing (see appendix) and only the fan needs to be turned off. If sub-standard conditions are indicated during the inspection of paperwork or by other evidence, then the pump should be shutdown as well.

Counter-flow towers

23 In counter-flow towers the air stream moves vertically upwards against the water-flow through the packing and it will be difficult to observe the packing (see appendix) without getting wet. In these circumstances it will be necessary to switch the pump off as well.

24 Switching off the fan should not cause a problem, but if the occupier is uncooperative or where shutting down of the pump is required, but not possible, a revisit should be considered at another time. This may have to be during a period of downtime, although this is less favoured as conditions may not be typical. There are 3 possibilities for this:

1) installations may only operate during the working day and can be visited out of hours;

2) there may be a 'cooling season' (late spring to autumn) outside of which a visit can be made; or

3) a visit can be made during a regular maintenance shutdown.

25 If, as in para 18, a PN is issued, a close physical inspection can proceed, but it should be noted that the purpose of the PN is not to enable this to take place, but to prevent the risk to all in the first place.

26 If, for whatever reason, the installation or any part of it cannot be switched off, and a visit is not possible at another time, and a PN is not justified, a close physical inspection should not be attempted **under any circumstances** and specialist advice should be sought. It may be possible, however, to make some observations from a distance, including the presence of wet patches on neighbouring buildings which may indicate uncontrolled drift.

27 In situations where there exist several or banks of cooling towers, then arrangements can be made to switch to another while one is being inspected, although attention will need to be paid to their relative proximity and the potential exposure to aerosol, which might consequently arise. Alternatively, visiting during a period of downtime (of all towers) may be the best option here.

Access

28 If there are problems with gaining access either to the installation itself or any part which needs to be inspected, a request should be made to have this improved. The use of enforcement powers should be considered if this is not met. If access is difficult for inspection then it will also be so for the purposes of examination and maintenance by the occupier which may indicate that this is not carried out regularly. Access or cover plates may be removed to look at the packing or drift eliminator, but otherwise no attempt should be made to dismantle any part of the installation.

Packing

29 This should be observed to see if it is free from biofilm, slime and scale. This will give an indication to the general cleanliness and maintenance of the system. Then, it should be checked to see if water is flowing evenly through it. In the case of a counter-flow tower (where the pump needs to be turned off before the packing can be observed) dry areas may indicate where it is blocked.

Pond

30 Observations should be made for nutrients which favour microbial growth, including *Legionella*. There are 4 potential sources:

1) algal growth;

2) scale arising from dissolved salts within the water;

3) detritus from the outside atmosphere, eg leaves, dead insects; or

4) rust.

Small amounts of these substances will often be found, but significant contamination should be present to justify taking action.

Drift eliminators

31 In spite of its name, the function of a drift eliminator is to 'reduce' rather than actually 'eliminate' aerosol drift. As such, its principle of operation is to physically interrupt the air stream by 'turning' it, causing aerosol to impact on its surfaces, resulting in its removal before reaching the outside environment. To perform this, it has to be fitted between the pack and the outlet to the open atmosphere.

32 HS(G)70 specifies a requirement for high-efficiency drift eliminators. Although it is known that some types are more effective than others, there is no industry standard and more research is needed to define the key design factors. However, those with a wave profile, which are commonly in use, **can** be regarded as being high efficiency, while those comprising either one or more sets of angled slats, placed one after the other (usually made of wood), **cannot**. Those referred to as '4-pass' drift eliminators are often regarded as being of high efficiency. Although this might be the case, there is no accepted definition of what constitutes a 'pass' and consequently, one with a quoted specification of 4 or even more 'passes' may not be adequate. By the same token those which are '3-pass' or less may be effective, depending on their design. Beyond these basic guidelines, specialist advice should be sought if there are thought to be problems with the effectiveness of drift eliminators. The revised HS(G)70 may give further guidance in future.

33 During an inspection, inspectors should check to see that a drift eliminator exists, that it is a high-efficiency type and that it is fitted properly with no gaps. If it is possible to view from underneath or behind it, a simple test to judge its effectiveness is to see if daylight shows through it. If it does, it is not effective. This may be due to bad design, damage or improper fitting. A check should also be made for the presence of biofilm and its general physical condition. If there are problems with access to the eliminator a request should be made to have this improved (see para 28).

34 Where the design of the tower does not allow for the fitting of high-efficiency drift eliminators, the highest standards in all other areas of control and monitoring should be in place.

Natural draught installations

35 These operate by natural air movements and do not have a fan. They should first be observed from a distance. If problems are not suspected, a closer approach can then be made with caution. Otherwise a shutdown of the pump should be requested before this is attempted. As above, if the request is not met then the other options should be considered (see para 24).

36 It can be expected that most will not be equipped with drift eliminators, although some may be fitted with sets of angled slats, placed successively one after the other. Due to the absence of a fan, the amount of aerosol will be less than for forced/induced installations and their use as a control measure will consequently be less critical. It will not, therefore, be appropriate for inspectors to insist on their use, but it should be stressed that in order to control *Legionella,* increased reliance will need to be placed on the water treatment and cleaning and disinfection programmes, and that there should be stricter microbiological monitoring. The inspection of these aspects of the assessment is all the more important because of this.

37 Many natural draught installations are made of wood. Inspectors should seek specialist advice on the suitability of this before considering any action here.

Specialist assistance

38 The need for specialist assistance (see para 11) will depend on the inspector's own experience but in general it should be sought if advice is needed when it is not possible to have the required part of the installation switched off for a close physical inspection; when it is thought necessary to investigate the technical aspects in any more detail than given in this OC and HS(G)70; or when observations during maintenance or cleaning need to be made. DST E6 are better placed to advise on generic design and construction issues, but RSG/SSG should be kept informed of concerns.

Sampling

39 The unreliability of isolated microbiological measurements is such that they can never be taken as a useful indicator of the risk from a system. As stated above, the aim of the inspection is to assess compliance with COSHH and the ACoP and sampling either for microbial growth in general or the *Legionella* bacteria in particular are **not** necessary to further this and should **not** be attempted by inspectors.

40 As stated in para 16, inspectors will come across details of sampling regimes in records of water treatment programmes and should consider the trends shown here in conjunction with all other factors in assessing the risk from the system.

41 Information from other public bodies (LA Environmental Health Departments, Public Health Laboratory Service) may be received alerting HSE to high microbial counts or the presence of *Legionella* at particular premises. Inspectors should not feel pressurised to carry out precipitate action in these circumstances and if a visit is judged necessary, it should be carried out according to the above inspection procedure. Where the interpretation of such results is thought necessary, specialist support should be consulted.

Other risks

42 In addition to the risk from *Legionella*, other hazards may be present during monitoring and maintenance of water systems. It should be noted that water treatment chemicals are often highly toxic. Great care needs to be taken to ensure that users and other occupants of a building are not affected, that chemicals do not enter drinking water and are not discharged into storm water drains without the permission of the relevant water authority. Similarly, chlorination of water, whether directly, or by the use of sodium hypochlorite solution poses a risk.

WATER TREATMENT COMPANIES

43 Many occupiers contract out activities in relation to the maintenance and control of risks from these systems to specialist water treatment companies (WTCs). The extent of these varies, but it usually involves at least water treatment and cleaning/disinfection programmes. However, many occupiers may be under the impression that these companies carry out a complete management programme and that no further action is required of themselves. Managerial responsibility for the installation(s) cannot be contracted out and ultimately lies with the occupier.

44 Inspectors should ensure that both occupiers and WTCs are fully aware of how their respective contractual responsibilities discharge their duties with respect to the ACoP; that WTCs demonstrate competency in the tasks which they perform; that where WTCs claim to carry out a complete COSHH assessment, this addresses all aspects of the risk not just those concerned with water treatment. Action should be considered where these requirements are not met.

ACTION BY INSPECTORS

45 It is both FOD and CHID policy that water systems incorporating cooling towers and evaporative condensers should be inspected routinely as part of preventative inspection programmes. Inspectors should therefore proceed accordingly, but only carrying out close physical inspections where training has been received.

46 Records of notifiable devices should be consulted in order to identify when they might be encountered on premises (see para 8), but not all will have been notified and knowledge of processes should guide inspectors to enquire of their presence. This is particularly important in industries with processes involving significant amounts of heat, eg foundries, plastics, chemical manufacturing and processing.

ENFORCEMENT GUIDELINES

47 Because of widespread public concern about legionnaires' disease, inspectors should be able to demonstrate that their powers have been properly exercised. The NCTEC Regulations, HSW Act, and in particular COSHH, may all be used for HSE enforcement. Both notices and prosecutions should be considered, if the precautionary measures are manifestly below the standard outlined in the ACoP. Depending on circumstances the following actions may be appropriate:

1) Failure to notify under the NCTEC Regulations - improvement notice (IN).

2) No or inadequate assessment under COSHH - IN.

3) Serious risk of infection arising from the absence of or an inadequate assessment along with no water treatment programme and no evidence of cleaning and disinfection procedures - PN and/or prosecution.

4) Failure to provide safe access - IN.

5) Excessive organic contamination and/or presence of excessive scale in the pond - IN to require immediate shock dosing, followed up by thorough cleaning and disinfection **or** immediate cleaning and disinfection.

6) Absence of, or clearly defective, drift eliminator - IN.

7) A clearly identified risk from the presence of organic contamination **and** absence of, or clearly defective, drift eliminator - PN and/or prosecution.

48 Even if occupiers comply with notices issued according to the above guidelines, over a longer term, cumulative evidence may emerge of consistent failure to manage the system. Consideration of prosecution should then be given even if infringements at any one particular time are not the most serious.

49 A more stringent level of enforcement may be necessary in outbreak situations (see **OC 255/12**).

Water treatment companies

50 Enforcement action should also be considered against water treatment companies where they are either clearly lacking in competence, negligent or have issued misleading

documentation which indicates that a system is properly controlled under COSHH, when it manifestly is not.

CANCELLATION OF INSTRUCTIONS

51 OC 255/5 - **cancel** and **destroy**.

3 September 1998

(220/FOD/1017/1998)

Disc No: J:\Editors\CA1\ocfiles\255_9.sam

ASI headings

Air conditioning: assessment: condensers: cooling towers: diseases: infection: inspection (s): legionellosis: legionnaires' disease: Notification of Cooling Towers and Evaporative Condensers Regulations 1992: water: water cooling.

APPENDIX
(paras 20, 22 and 23)

TYPES OF COOLING TOWERS