Science and Technology Facilities Council

CONTROL OF LEGIONELLA

Safety Code No 38

Rev. 1.11, Issued February 2023

Contents

Revisions

1.0	Initial Issue	September 2010
1.1	Update training providers	September 2011
1.2	Minor update to 4.1.1	December 2011
1.3	Addition of Appendix 8	October 2012
1.4	Document Retention Policy Added	August 2014
1.5	Legislation references updated, Water Safety Group (ToR) Added, ISIS Cooling Towers and Evaporative Condensers (R11 and R80) Water Safety Plan Added	April 2016
1.6	Revision to Hydrop guidance documents for cooling towers and separately all other legionella hazards	June 2017
1.7	Rationalisation of appendices 1, 2 & 8	October 2018
1.8	Added Appendix for DL Closed loop systems	July 2019
1.9	Updated Appendix for ISIS cooling towers	February 2020
1.10	Update to training Appendix	August 2022
1.11	Updated Appendix 2 added	February 2023

CONTROL OF LEGIONELLA

1. PURPOSE

Legionella are a range of bacteria widespread in natural fresh water which can if they proliferate cause Legionnaires' disease or Legionellosis - potentially fatal forms of pneumonia. In the UK there are between 200 and 300 cases per year of which approximately 30 are fatal.

While the ecology of Legionella in water systems is not fully understood, in the laboratory, it will grow optimally in stagnant nutrient rich water in the temperature range 20°C to 45°C (37°C body temperature) and pH 6.5-7.5. Water contaminated by Legionella only presents a risk when it is dispersed in air in the form of an aerosol (very fine water droplets / spray) such as that from a shower. Legionnaires' disease can therefore be contracted where there are opportunities to inhale infected water droplets.

Legionnaires' disease is a statutorily reportable disease.

There is no health and safety legislation specific to the management of Legionella, rather it is addressed through general duties defined under the:

- Health and Safety at Work etc. Act 1974, Sections 2, 3 and 4;
- Management of Health and Safety at Work Regulations 1999, particularly Regulations 2, 3, 4 and 6;
- Control of Substances Hazardous to Health Regulations (COSHH) 2002, particularly Regulations 6, 7, 8, 9 and 12, where the definition of hazardous substances includes harmful micro-organisms;
- Notification of Cooling Towers and Evaporative Condenser Regulations, 1992;
- Public Health (Infectious Diseases) Regulations 1988;
- The Water Supply (Water fittings) Regulations 1999;
- The Water Supply (Water Quality) Regulations 2010; and
- Food Safety Act 1990.

An HSC Approved Code of Practice (ACOP) 'Legionnaires Disease - The control of Legionella bacteria in water systems', L8, offers specific guidance for managing the risk from Legionella bacteria.

The present code establishes STFC standards and arrangements for the management and control of Legionella risks at STFC premises minimising, avoiding or preventing infection.

2. SCOPE

The present code applies to the design, operation and maintenance of all water systems where there is the potential for Legionella to grow and become dispersed as a respirable aerosol, whether owned or managed by the STFC or brought onto STFC sites by facility users, tenants; contractors or other visitors.

The sources include, but are not limited to, the following domestic or non-domestic systems:

- Cooling Towers;
- Hot Water Calorifiers (primary heating coil, electric immersion heater or otherwise);
- Cooling systems for scientific equipment;
- Fixed and mobile air conditioning, dehumidification or ventilation systems, and humidifiers;
- Water Storage Tanks;
- Domestic or emergency showers or eye wash stations;
- Water features or fountains, including drinking fountains;
- Sprinkler Systems, hose reels;
- Car Washers;
- Machine tools coolant systems;
- Fire-fighting systems for example sprinkler systems, hose and reels
- Machine Tool Coolant Systems e.g. lathes etc; and
- Hot and Cold Water systems, domestic and industrial.

3. DEFINITIONS

3.1 Cooling Tower

Apparatus through which warm water is discharged against an air stream, in doing so part of the water is evaporated to saturate the air, and this cools the water. The cooler water is usually pumped to a heat exchanger to be reheated and recycled through the tower.

3.2 Dead Leg

Pipes leading to a fitting through which water only passes when there is draw-off from the fitting.

3.3 Dip Slide

A testing device for the microbial content of liquids. It consists of a plastic carrier bearing a sterile culture medium which can be dipped in the liquid to be sampled. It is then incubated to allow microbial growth. The resulting microbial colonies and number are estimated by reference to a chart.

3.4 Drift Eliminator

More correctly referred to as drift reducers or minimisers this equipment contains a complex system of baffles designed to remove water droplets from cooling tower air passing through it.

3.5 Evaporative Condenser

A heat exchanger in which refrigerant is condensed by a combination of air movement and water sprays over its surface.

3.6 Legionella Responsible Persons

Persons who have been formally appointed, in accordance with the HSE Approved Code of Practice, to assume managerial responsibility for implementation of the Legionella precautions and the responsibilities detailed in this SHE code.

3.7 Sentinel Tap

For a hot water services this is the first and last taps on a re-circulating system. For cold water systems (or non-re-circulating hot water systems) they are the nearest and furthest taps from the storage tank. The choice of sentinel taps may also include other taps which are considered to represent a particular risk.

3.8 Water Safety Group (WSG) / Steering Group

This is a multidisciplinary group formed to undertake the commissioning, development, implementation and review of the water safety plan. The aim of the Water Safety Group is to ensure the safety of all water used by residents, staff and visitors, to minimise the risk of infection associated with water, including legionella.

4. RESPONSIBILITIES

4.1 Head of Estates shall:

4.1.1 ensure that one or more suitably trained and experienced Legionella Responsible Persons (LRPs), and deputies, are appointed and provided with the resources to manage Legionella hazards within defined areas of responsibility, as appropriate discussing their appointment with other Directors where such hazards exist, see Appendix 6. The names of such appointments should be recorded in the SHE Directory, which will generate appointments in writing.

4.1.2 ensure Site Water Safety Groups are established to review of Legionella management at each STFC site, see Appendix 9.

4.2 Legionella Responsible Persons shall:

4.2.1 ensure that effective arrangements are implemented for the assessment and management of the Legionella risks within their area of responsibility, see Appendices 1,2,3 and 4.

4.2.2 as appropriate, ensure one or more suitably qualified and experienced persons or Legionella management contractors are appointed for water systems treatment and maintenance to undertake the duties detailed in this code on their behalf . Where contractors are employed they shall be registered with the Legionella Control Association. The competence and performance of those undertaking these activities should be reviewed

regularly and documented.

4.2.3 ensure that a documented register of all water systems, including cooling towers and evaporative condensers, is established, maintained and regularly reviewed, see Appendix 5.

4.2.4 ensure that all existing or new cooling towers or evaporative condensers are registered with the local environmental health authority in writing detailing the type and location of the facility. A copy of their notification should be retained. Where cooling towers or evaporative condensers are made redundant, decommissioned or demolished, inform the local environmental health authority in writing retaining a copy of the notification.

4.2.5 ensure that documented risk assessments are conducted for systems detailed in the water systems register within their area of responsibility. Risk assessments should determine whether potential for harm or exposure is reasonably foreseeable and as appropriate detailing the control measures necessary to prevent or minimise the risk from Legionella exposure, see Appendix 1, 2, 3 and 4.

Legionella Risk Assessments should be reviewed every 2 years, or whenever significant changes or modifications to water systems occur or in the light of the results of Legionella monitoring programmes.

4.2.6 ensure that documented “Written Schemes”, based on risk assessments are created to outline the controls for preventing, reducing, controlling and monitoring Legionella hazards. The scheme should describe the correct operation of the water system and persons responsible for carrying out actions, see Appendix 1, 2, 3 and 4, including:

- An accurate schematic diagram of the system, updated whenever there is a significant change;
- System commissioning, shutdown and re-commissioning procedures and precautions;
- System checks and frequencies to determine the effectiveness of Legionella controls and warning of system malfunction;
- Maintenance requirements and frequencies; and
- Remedial actions to be taken in the event of system malfunction or Legionella outbreak.

4.2.7 ensure that all records relating to the management of Legionella are retained for at least 5 years, including but not limited to test results, inspection records, maintenance records, contractor training records etc., see Appendix 5.

4.2.8 ensure that the design of new water systems, or equipment containing water, considers the hazards arising from Legionella in order that the risks are eliminated or minimised.

4.2.9 as appropriate supervise the contracts for water system treatment and maintenance of cooling towers, and hot and cold water systems.

4.2.10 immediately report any instances of increased risk (e.g. high bacterial or other pathogen counts) or Legionella outbreak to the SHE Group, see STFC SHE code 5 Reporting and Investigation of SHE Incidents.

4.2.11 ensure that Site Water Safety Groups are established and operated as per ToR. See Appendix 9.

4.3 Water Safety Group/Steering Groups

4.3.1 See Appendix 9 for DL and RAL Terms of Reference.

4.4 Managers, including those responsible for the design, construction or operation of water-containing systems shall

4.4.1 inform and seek the advice of the LRP in respect of: work on or modifications to existing water equipment/systems or their design; or any new water equipment/systems and their design and installation, that may pose the risk of Legionella incubation, see Appendices 1, 2, 3 and 4.

4.3.2 ensure that all staff, users, contractors or other visitors working in areas, or undertaking activities, where Legionella hazards could exist or could be introduced into existing water systems are made aware of potential hazards and controls detailed in the relevant Risk Assessments and Written Schemes. It is likely also that there are other hazards present where Legionella controls are employed, for example: scalding; COSHH; and environmental disposal hazards.

See SHE Code 15 Contractor Management, and SHE Code 19 Work on buildings premises, services and infrastructure.

STFC staff working in such areas should be trained, see Appendix 6, and evidence of training and competence sought from contractors.

4.3.3 report all incidents or near misses related to the management and control of Legionella, see STFC SHE code 5 Reporting and Investigation of SHE Incidents. Report all actual or suspected cases of Legionnaires disease in staff or others working on STFC sites immediately to the STFC SHE Group and Occupational Health teams.

4.5 SHE Group shall:

4.4.1 Report all instances of Legionnaires disease to local environmental health authorities, and the HSE under the Reporting of Injuries, Diseases and Dangerous Occurrences Regulations (RIDDOR), 2013. See Appendix 7.

4.4.2 ensure that an audit of the implementation of this SHE code is undertaken, as appropriate by the appointed Legionella management contractor, at least every 3 years, see STFC SHE Code 30 SHE Auditing and Inspection. This shall be in addition to any local audit/inspection programmes undertaken against relevant guidelines and approved codes of practice more frequently.

5 References

i. The Water Regulations Advisory Scheme's (WRAS) 'Water Regulations Guide', and any other requirements of the local water undertaker.
ii. The Water Supply (Water fittings) Regulations 1999.
iii. The Water Supply (Water Quality) Regulations 2000.
iv. HSE Legionnaires' disease The control of legionella bacteria in water systems. Approved Code of Practice and guidance on regulations: L8 (Fourth edition) Published 2013
v. HSE Legionnaires' disease: Technical guidance Part1: The control of legionella bacteria in evaporative cooling systems: HSG274 Part 1 Published 2013
vi. HSE Legionnaires' disease Part 2: The control of legionella bacteria in hot and cold water systems: HSG274 Part 2 Published 2014
vii. HSE Legionnaires' disease: Technical guidance Part 3: The control of legionella bacteria in other risk systems: HSG274 Part 3 Published 2013
viii. BS 1710 – 1984 - Specification for identification of pipeline services.
ix. BS 8558:2015 provides complimentary guidance to BS EN 806 . It is a guide to the design, installation, testing, operation and maintenance of services supplying water for domestic use within buildings and their curtilages.
x. BS EN 806-5:2012 Specification for installations inside buildings conveying water for human consumption - Operation and maintenance.
xi. BS EN 806-1:2000 Specifications for installations inside buildings conveying water for human consumption -General.
xii. BS EN 806-2:2005 Specifications for installations inside buildings conveying water for human consumption – Design.
xiii. BS EN 806-3:2006 Specifications for installations inside buildings conveying water for human consumption - Pipe sizing. Simplified method.
xiv. BS EN 806-4:2010 Specifications for installations inside buildings conveying water for human consumption – Installation.
xv. BS 8551-2015 Provision and management of temporary water supplies and distribution networks
xvi. BSI PD 855468-2015 Guide to the flushing and disinfection of services supplying water
xvii. BS 8558-2015 Guide to the design, installation, testing and maintenance of services
xviii. BS EN ISO 5667-1 2006 Water Quality - Sampling
xix. BS 8554 2015 - Code of practice for the sampling and monitoring of hot and cold water services in buildings
xx. BS7592:2008 – Sampling for Legionella bacteria in water systems – Code of practice.
xxi. BS 8580:2010 – Water Quality – Risk assessments for Legionella Control – Code of Practice.
xxii. PWTAG CodeofPractice1.13v5_000

Appendices

APPENDIX 1. STFC LEGIONELLA MANAGEMENT GUIDELINES

Science & Technology Facilities Council

LEGIONELLA MANAGEMENT GUIDELINES

HYDROP E.C.S.

PREPARED BY
Samuel Rollins BSc (Hons)

Wrens Court, 55 Lower Queen Street, Sutton Coldfield, West Midlands, B72 1RT
Tel: 0121 354 2030 Fax: 0121 354 8030
info@hydrop.com www.hydrop.com

CONTENTS

REVISIONS

Initial Issue	30/9/2010
Update training providers	06/09/2011
Revision	13/07/2012
Update legislation references. Procedures and protocols for cooling towers removed and relocated to a dedicated document within Safety Code 38 Appendix 8 for ISIS cooling towers and evaporative condensors (R11 and R80)	04/04/2016
Revision and Update	15/05/2017

1 PROCEDURES AND PROTOCOLS

1.1 AIM

As part of STFC's commitment to provide a fully compliant service, it is necessary that all regular tests and checks set out in this document shall be carried out even if they cause minor disruption to services, and that comprehensive records will be maintained.

1.2 PRIMARY METHOD OF BACTERIAL CONTROL – COOLING TOWERS (Reference - ISIS Cooling Towers and Evaporative Condensers (R11 and R80) Water Safety Plan in Appendix 8)

1.3 PRIMARY METHOD OF BACTERIAL CONTROL – DOMESTIC WATER SYSTEMS

STFC employs 'Temperature Control' as the primary method of biological control, to manage and control the risk of bacterial proliferation. This is achieved by maintaining the following temperatures:

1. Cold water at temperatures of < 20°C
2. Cold Water Services (CWS) Distribution at <20°C
3. Stored hot water at ≥60°C
4. Hot Water Services (HWS) Flow at ≥60°C
5. HWS Distribution at all outlets at ≥50°C
6. HWS Return at ≥50°C

In order to ensure maximum efficiency of the control measures employed, it is important to keep all systems clean and well used at all times and at the correct temperatures.

During specific circumstances, such as when the primary method of bacterial control is shown by the various Pre-Planned Maintenance (PPM) Programme Monitoring Tasks to be failing, the water quality shall be maintained by the use of shot-dosing of a suitable disinfecting agent (disinfection), the levels of which must be maintained within the recommended limits for achieving disinfection as specified within the current edition of BS8558: 2015 and L8 (Fourth Edition) – The Control of Legionella bacteria in water systems..

STFC's management team and their advisors will continue to consider new developments and improvements in the field of Legionellosis Management & Control, in order to ensure that the control of the prevailing risk of Legionellosis posed by the systems on the various sites is constantly reviewed and improved and always maintained at the maximum level.

1.4 PRIMARY METHOD OF BACTERIAL CONTROL – OTHER LEGIONELLA RISK SYSTEMS

All managers must identify all systems which contain water where there is a risk from Legionella. It must be ensured that a risk assessment is undertaken for all such systems, with controls in accordance with the HSE guidance document L8 (Fourth Edition).

The following are examples of systems which should be included, together with suggested controls:

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1. Sprinklers and hose reel systems: Consider regular draining and replenishing of the water, particularly if connected to the mains water system; when testing, ensure aerosol generation is minimised.

2. Water Softeners: Clean and disinfect resin and brine tanks as directed by manufacturer.

3. Lathe and machine tool coolant systems: Clean and disinfect storage and distribution of coolant system as directed by manufacturer.

4. Emergency showers and eyewash: Flush through and purge to drain six-monthly or as directed by manufacture. Check operation of thermostat to ensure water is not heated above 20˚C.

5. Vehicle Washers: These are usually operated at less than 20˚C and may re-cycle water. The filtration and cleaning systems should be checked regularly, cleaning and disinfection should be undertaken in according to manufacturer's instructions.

6. Vehicle screen wash systems: should have recommended concentration of Screen Wash fluid added.

1.5 PRIMARY methods for 'Safe' Hot water - scalding control

Scalding control shall be provided primarily by warning signage similar to that depicted below:

Where the risk of scalding is assessed to be higher than normal, the risk shall be controlled by 'Hot Temperature Management', achieved by delivering water at the point of use at ≤41°C by the use of thermostatic mixing valves (TMV) and/or thermostatic mixing taps (TMT).

Where installed, all TMVs / TMTs shall be maintained appropriately and at outlets fitted with TMVs, the temperature shall be measured and maintained at:

1. 41°C for showers
2. 41°C for basins
3. 38°C for bidets
4. 44°C for baths

2 SYSTEM/PLANT DESIGN, INSTALLATION AND MAINTENANCE

2.1 GENERAL DESIGN AND INSTALLATION CONSIDERATIONS – COOLING SYSTEMS

Cooling systems should be designed and constructed so as to aid safe operation, cleaning and disinfection (see BS 4485:Part 3: 1988 and BS 4485:Part 4: 1996). In particular, the following points must be considered:

1. Cooling systems should be designed and constructed so as to minimise the release of drift and to aid safe operation and regular cleaning and disinfection. In particular:

2.1.1 COMMISSIONING, OPERATION AND MAINTENANCE

1. Cooling systems should be operated and maintained carefully and correctly. The installer should provide operating instructions giving adequate information on the safe operation of the system.

2. Systems should be properly commissioned before use to ensure that they operate correctly and within the design parameters. This will apply both to new installations and to existing installations which have been substantially altered.

3. A number of outbreaks have been associated with the start up of new cooling systems or following a period out of use. It is essential that precautions are taken to control the risk during commissioning and start up as well as during normal operation of the system. Commissioning and start up procedures should include detailed precautions necessary to control risk.

4. Cooling systems and towers should be kept in regular use where possible. Where a system is used intermittently or it may be needed at short notice, one option is to ensure that it is run once each week. It should at the same time be dosed with water treatment chemicals and water quality should be monitored. The whole system should be run for long enough to thoroughly distribute treated water. If a system is out of use for a week or longer the water should be treated with biocide immediately on reuse and if out of use for a month or longer it should be drained, cleaned and disinfected immediately before reuse. This applies both to normal operation and commissioning periods.

2.1.2. CLEANING AND DISINFECTION

1. Cooling systems need to be cleaned and disinfected at appropriate intervals in order to present conditions which permit legionella to multiply, and to allow water treatment programmes to work more effectively.

2. Cleaning and disinfection should be carried out:

   a. immediately before the system is taken into use remove contamination which may have occurred during construction;
   b. if the system, or part of it, has been out of use for a significant period
   c. if the system or part of it has been extensively altered, entered for maintenance or otherwise disturbed in a manner which may lead to contamination; and
   d. at regular intervals which depend on the system and premises involved, or as indicated by the results of routine monitoring.

4. Industrial cooling systems should also be cleaned in early spring and early autumn except where this is not practicable for operational reasons. Industrial cooling systems vary greatly in size and in their operating conditions. In some

environments it may be necessary to clean the system more frequently, especially if it becomes contaminated by organic materials such as dust or oil from the process. Cleaning frequency in these circumstances will be determined by inspection and monitoring of water quality.

5. Because of their size or the nature of the process, some industrial cooling systems cannot be cleaned so frequently. Where it is not reasonably practicable to stop the process in order to clean the cooling system, other measures such as on-line cleaning should be considered and those measures which are reasonably practicable should be applied and monitored with particular rigour.

6. Cooling systems are sometimes cleaned by water jetting. This process can create a considerable spray which may contain organic debris and possibly legionella from deposits in the system so that while it has the advantage of cleaning surfaces thoroughly, the process may itself present a risk. Water jetting should therefore only be used when there is no reasonable alternative and care should be taken to protect both the operators and those in the vicinity. Loose materials and sludge should be removed as far as before water jetting starts, operators should wear suitable respiratory protective equipment and windows and ventilation inlets should be closed or the building should be unoccupied. Water jetting should not be carried out while there are unprotected people and passers-by in the vicinity.

7. Hard scale is often difficult to remove by normal cleaning methods and while small quantities of scale will have little adverse affect, large quantities will make effective cleaning difficult and may shelter organic material or micro-organisms. Scale should be removed as far as possible and if, following cleaning, large quantities remain it may be necessary to use chemical descaling methods. Since these employ mild acids, care needs to be taken in their use. If scaling occurs rapidly, this may indicate that the operation of the system and the water treatment regime need review.

8. Where surfaces need to be recoated following cleaning and disinfection, the coating material should be suitable and not encourage or harbour bacterial growth.

2.1.3 FREE RESIDUAL CHLORINE

1. Chlorine is highly reactive and will combine rapidly with organic material in the cooling system. The level of available chlorine will therefore rapidly decline if the system is heavily contaminated. Chlorine may also attack, and be absorbed by, wooden components in the tower. It is also released as water cascades over the tower. It is therefore essential to add enough chlorine to overcome these losses and to maintain the required concentration.

2. The efficacy of chlorine as a biocide or disinfectant is also affected by the alkalinity of the water. As pH rises its efficacy is reduced. When using chlorine it is therefore necessary to monitor free residual chlorine levels throughout disinfection in order to ensure they are of the required concentration, and the pH of the water to ensure that its efficacy is not impaired. The disinfecting effect is greatest at pH values at or below the neutral pH value of 7. At pH values at or above 8 its disinfecting effect is greatly reduced. This is discussed in greater detail in the Department of Health's Report of the Expert Advisory Committee on Biocides.

2.1.4 WATER TREATMENT OF COOLING SYSTEMS

1. Water treatment is required to prevent corrosion and the build up of materials and organic growth in the system. Traditionally this was to maintain its efficiency. However, the risk of legionnaires' disease from cooling systems

means that the control of legionella is now a particularly important consideration.

2. To control legionella, the water treatment regime should prevent or adequately reduce the amounts of:

   a. scale and corrosion products which might otherwise protect legionella in the system;
   b. sediments which might prevent water treatment processes from working effectively;
   c. bacteria and other organisms.

3. This is usually achieved by the use of an appropriate combination of dispersants and scale and corrosion inhibition as well as a biocidal treatment.

4. The relationship between legionella and other materials and organisms in water is complex and not fully understood. Selection of an appropriate water treatment regime is complicated by the potential effect of different chemicals on each other, on the materials of the system and by the risk to anyone who may be exposed to them. It will therefore be necessary to seek advice from a consultant or a reputable water treatment company.

5. Water treatment will not be effective unless the system is clean. If there are deposits or other contaminants in the water system these may prevent the water treatment programme from working effectively. In particular, biocides will react with and be used up by organic materials. It is therefore important to ensure that the water system is clean and there is an effective system for monitoring water quality.

2.1.5 METHODS OF WATER TREATMENT

1. Biocidal treatment is an essential part of the water treatment regime. This may involve chlorination of water or the addition of other biocides on a regular basis and/or physical methods of treatment in order to kill or control organisms including legionella. Effective biocide treatment will also help to prevent the build up of biofilm (slimes) on surfaces in the system which might shelter legionella and allow it to multiply unhindered.

2. Regular chlorination of 1 to 2 mg/l is normally advocated for the control of legionella although concentrations of 0.5 to 1.0 mg/l may be effective in large cooling systems. Higher concentrations may sometimes be needed if water quality deteriorates but since chlorination above 2 mg/l can increase corrosion in the system, regular dosing at higher concentrations is not advocated. Chlorine is normally added as sodium or calcium hypochlorite in liquid form or as a complex chlorine releasing agent in tablet form. It has the advantage that free residual chlorine levels in the water can readily be measured but it cannot always be used because it is not compatible with some water treatment chemicals such as certain corrosion inhibitors. Chlorine is rapidly lost and its effectiveness is reduced at pH values above 8, i.e. if the water is alkaline. The use of chlorine as a biocide should not be confused with its use as a disinfectant.

3. Other biocides may be effective against legionella if added in sufficient concentrations for sufficient time. These include oxidising biocides such as bromine or iodine releasing compounds, stabilised chlorine dioxide and non oxidising biocides which are generally complex organic chemicals. It is common practice to add two biocides on an alternating basis in order to avoid biocide resistance within the microbiological population and because few biocides are broadly active on all organisms.

4. Biocides are often supplied as proprietary mixtures. If a proprietary biocide is used the supplier should be asked to provide test data to substantiate any claims about the effectiveness of the biocide in field trials, and to confirm the necessary concentrations and contact times.

5. A variety of alternative methods of water treatment are now becoming available. One approach relies upon the electrolytic dissolution of metals such as silver and copper into the water, thereby generating biocidal ions in solution. Another is the introduction of ozone, producing oxidising biocide in the water. Physical methods such as pasteurisation (heating to a temperature at which legionella will not survive) and irradiation by ultraviolet light are also available, although ultraviolet irradiation can only be effective if the water is clear, so it will usually be necessary to install filters in conjunction with ultraviolet systems.

6. Each of the techniques described above have the potential advantage that they may replace the use of chemical biocides, but they should be capable of achieving at least the equivalent biocidal effects to those of the traditional methods (e.g. chlorination).

7. All methods of biocidal water treatment should be regarded as part of the overall water treatment regime, not as a complete alternative, since they need to be used in conjunction with inhibitors and dispersants. The suppliers of water treatment chemicals and systems should be asked to provide evidence of their ability to control legionella in the proposed application and to advise on all additional measures necessary to ensure adequate control of water quality, in particular any necessary preparatory work such as cleaning and disinfection. The supplier should be asked to provide information, where suitable techniques exist, on the monitoring of performance of water treatments.

8. Water quality may also be improved by filtration. It is common practice to incorporate strainers in a cooling system to remove larger suspended particles but these will not remove smaller particles. Filters are also available to remove much of the finer suspended matter. These play a valuable role in keeping cooling systems clean and may enhance the water treatment regime.

2.1.6 SETTING UP CHEMICAL WATER TREATMENT REGIMES

1. When setting up a water treatment regime it will first be necessary to ensure that the system is clean and to determine its operating conditions and the volume and quality of the water to be treated. The quantities of biocide and other treatment chemicals to be dosed into the system should be calculated initially from the volume of water in the system, and any likely losses during use. The quality of 'make-up' water supplied to the system is also important. If potable water from the mains is used, then this will normally be of high quality but if water is taken from boreholes, ponds, rivers or from other non-potable sources it may be significantly contaminated by organic materials and organisms including legionella. Water supplied through holding tanks and softeners may also be contaminated by legionella. The water treatment regime should cater for the added burden from such t sources and in some cases the make-up water may need to be treated before use.

2. There are a number of techniques available for the introduction of biocides to a water system. Wherever possible, biocides should be automatically dosed. While manual dosing can be effective it relies on the operator conscientiously adding chemicals in the required order time and frequency and to the right part of the system. Failure to do so has contributed to past outbreaks.

3. Where cooling systems are to be chlorinated, this may be done continuously. Otherwise they should be treated at least once per day with chlorine levels being sustained for long enough to control organic growth.

4. Where proprietary biocides are used they are generally added on a 'shot' basis. The biocide will be added in sufficient quantity to maintain the required concentration for the required time, typically a matter of hours, as biocides gradually break down or dissipate. The frequency of dosing will depend on the system; biocides need to be added at least every week and often more frequently.

2.1.6 DISSOLVED SOLIDS

1. Cooling water contains dissolved solids which increase in concentration as water is lost from the system by evaporation. To maintain these at an acceptable level, water is discharged from the system, either at a continuous low rate or periodically at a greater rate, and replaced by fresh water. This may be done automatically by monitoring water conductivity and when this reaches a predetermined level a valve operates to discharge cooling water which is then replaced by clean make-up water. Care is needed to ensure that water is not discharged during or immediately after the dosing of water treatment chemicals since this may result in dilution of biocide concentration in the water to below the optimum effective level.

2.1.7 MONITORING AND ROUTINE CHECKING

1. If precautions are to remain effective the condition and performance of the cooling system will need to be monitored and water quality routinely tested to ensure that the water treatment regime continues to control water quality. This should involve:

    a. checking the performance of the system and its component parts, as recommended by the designer or installer of the system;
    b. inspecting the cooling tower and accessible parts of the system for damage and signs of contamination;
    c. testing water quality to ensure that the treatment regime continues to control to the required standard.

2. Cooling systems should routinely be inspected and their performance monitored. The frequency will depend on the system; for well maintained systems in premises where there are no high risk factors, where the system is operating correctly and where water treatment is automatically dosed and the dosing equipment incorporates malfunction alarms, a weekly check together with a monthly test of water quality may suffice. For other systems, this will need to be carried out more frequently.

3. Testing of water quality is an essential part of the treatment regime and should include testing of both the re-circulating water and make-up water supplied to the system. Testing may be carried out by a water treatment company or consultant or by the operator, provided they have been trained to do so and are properly supervised. A series of tests should be carried out of the chemical and microbiological condition of the water. The results of testing should be interpreted by a suitable experienced and competent person and any remedial measures be carried out promptly.

4. Where the system is treated by chlorination it is important that free residual chlorine and pH should be measured. Where non-oxidising biocides or physical methods are used for controlling microbiological activity, techniques are becoming available to measure biocide levels in cooling water. It is still necessary to measure the microbiological activity itself.

5. The most convenient way to measure microbiological activity is to use 'dip slides'. These are plastic slides with a coating of agar - a medium on which

micro-organisms will grow. The dip slide is dipped into the cooling water, then placed in a small container and allowed to incubate in a warm place for 48 hours.

6. The incubation period and temperature should be the same each time the test is performed in relation to a particular water system. Unless this is done it becomes difficult to interpret the results from dip slide tests performed over a period of time, as different organisms grow within different temperature ranges. Bacteria will grow to form colonies on the agar and by comparing these with a comparison chart the level of contamination of the water can be gauged. Alternative techniques are available for laboratory measurement of microbiological activity and new techniques are being developed for testing on site.

7. The use of dip slides and similar techniques has limitations. They do not specifically indicate the presence or proliferation of legionella but are generally to indicate trends in microbiological quality. If the cooling system is cleaned and disinfected and the water treatment regime is properly set up from the start then dip slides can be used to show whether it continues to be effective or whether remedial action, either by modification of the treatment regime or cleaning and disinfection of the system, needs to be taken. The timing of dip slides and other microbiological sampling is important, results attained must be considered in the light of the state of the system, e.g. when biocide was last added and the system cleaned.

8. Tests may need to be carried out more frequently when there are changes in the condition or performance of the system, and especially if the regular inspection shows the water to be cloudy or contaminated following cleaning and disinfection. Cleaning of the system releases organic material and unless this material is completely removed and the system effectively disinfected, it may lead to an increased rather than a reduced microbiological activity.

9. If, on inspection, the water is found to be cloudy visibly contaminated this may indicate poor microbiological control. The visible condition of the water is not necessarily a good indicator of its microbiological condition since contaminants will not necessarily be organic and, conversely, relatively clear water may be unacceptably contaminated. However, it will indicate the further investigation is warranted.

2.2 GENERAL DESIGN AND INSTALLATION CONSIDERATIONS – DOMESTIC WATER SYSTEMS

Systems which utilise or contain water and can affect the water supply, the atmosphere and the user shall be monitored regularly and be subjected to the following regime:

1. All designs must be carried out and presented in accordance with all relevant and current Guidelines, European and British Standards and “best-practices.

2. The systems shall be carefully designed to eliminate or minimise aerosol production and excessive water retention. They must also be designed to be readily drained and cleaned.

3. No materials used in construction shall include those that are known to harbour or provide nutrient for bacteria. Any materials that come into contact with the water in a hot or cold water installation shall comply with the requirements of the Water Supply (Water Fittings) Regulations 1999. The list of products and materials that have been assessed for compliance with the Water Supply (Water Fittings) Regulations 1999 requirements are listed in the current edition of Water Fittings and Materials Directory that is updated every six months. Further

information on the selection of materials can be found in BS8558:2015 and BS6920:2014.

4. All TMVs/TMTs installed must be installed and maintained/serviced in accordance with all relevant and current Guidelines, European and British Standards and "best-practices" as far as reasonably practicable. Any TMVs which shall remain but are not accessible, shall be made accessible for maintenance at the earliest opportunity.

5. It is STFC's policy that no flexible hoses shall be fitted to any new buildings or refurbishments commissioned by or on behalf of STFC. Some flexible hoses are unsuitable for use with domestic potable water, because they support extensive microbial growth, give the water a very strong, unpleasant, taste and odour or release toxic substances into it. Hose materials may encourage the growth of *Legionella* bacteria. It is, therefore, STFC's policy that in new buildings or refurbishments commissioned by or on behalf of STFC, flexible hoses shall be avoided where possible. Any flexible hoses fitted shall be WRAS approved. Enquiries regarding specific types of flexible hose shall be directed to the manufacturer/supplier.

6. All systems shall be maintained in a clean and sound condition and must be easily and safely accessible.

7. All systems/outlets shall be frequently used, or suitably flushed to simulate the necessary usage frequency, in order to avoid stagnant water which will increase the potential of bacterial growth and proliferation.

8. All plant and distribution pipe-work (where accessible) shall be clearly labelled.

2.3 COLD WATER STORAGE TANKS

1. Cold water storage tanks shall be constructed from non-deleterious materials which must be WRAS approved.

2. Cold water storage tanks shall be designed and installed in accordance with the current Water Supply (Water Fittings) Regulations 1999) and installed in appropriate and suitable locations to allow easy and safe access to facilitate inspection and maintenance.

3. Sectional Cold Water Storage tanks shall be designed with external assembly flanges and self-draining profiles, since this arrangement facilitates easy cleaning of internal surfaces.

4. Externally located Cold water storage tanks shall be suitably protected from environmental conditions, particularly the local high ambient temperatures for all new buildings and, where practicable, for existing installations.

5. Cold water storage tanks shall be protected from the ingress of light, insects and birds.

6. Cold water storage tanks shall be sized and arranged so as to minimise retention time of stored water (24hrs maximum), and therefore to increase the rate of stored water exchange.

7. Cold water storage tanks shall be subjected to a periodic "need" test which requires the user/estates maintenance team to question the presence of each unit and consider its removal if the services it supplies can be, equally well, supplied by converting the systems to domestic Mains fed only.

8. When water temperatures are found to be persistently outside the recommended parameters, each unit shall be subjected to a "drop-test" designed to ascertain the capacity and demand requirements of each system, in order to ensure that excessive volumes of water are not unnecessarily stored. Eliminating storage within a system would also allow the negation of the necessary PPM Programme tasks and their replacement with much less onerous, more infrequent and less costly tasks to be carried out.

9. All associated pipework and valves shall be adequately insulated and clearly labelled to identify their purpose.

10. Delayed-action ball valves shall be fitted (where practicable) in order to help avoid stagnation of water.

11. In new buildings where Cold water storage tanks are linked "in parallel", the feed to each tank shall be fitted with a water meter in order to allow for confirmation of equal and uniform usage from all tanks in the configuration.

12. Various arrangements of pumping systems are indicated in BS8558:2015. Where booster pumps are to be installed, a break cistern will be required between the mains supply pipe and the pumps. This is required in order to comply with the Water Supply (Water Fittings) Regulations 1999 with regard to prevention of backflow. Control of the pump(s) should be fully automatic in operation and controlled by pressure sensors. Where two or more pumps are installed, the design flow should be achieved with one pump stationary (or out of service). Automatic control should be provided to cyclically and sequentially control all pumps to ensure that each is regularly brought into service. If this is not possible, documented procedures shall be in place to ensure equal usage is achieved.

13. Cold water storage tanks shall be maintained in good condition, clean from excessive corrosion, sludge deposition, scale deposition.

14. Stored water shall be maintained at a temperature of <20°C (or no more than 2°C greater than the inlet supply temperature to the building).

15. Where indicated and when it is deemed necessary and practicable, Cold Water Storage Tanks shall be upgraded, refurbished, modified or replaced so that they may comply with current Water Supply (Water Fittings) Regulations 1999. Following these works, each tank shall be cleaned and disinfected in accordance with BS8558:2015 and L8 (Fourth Edition) prior to it being allowed back into service.

16. Cold Water Storage Tanks shall be subjected to periodic monitoring to include:

    1. Temperature monitoring.
    2. General physical inspections.

17. Cold Water Storage Tanks shall be subjected to a clean and disinfection, when the results of the monitoring indicate the need.

2.4 HOT WATER CALORIFIERS

1. Calorifiers shall be installed in appropriate and suitable locations to allow easy and safe access to facilitate inspection and maintenance.

2. Where more than one Calorifier or heating device is used, they shall be connected in parallel, taking care to ensure that the flow can be balanced so that the water temperature from all the Calorifiers exceeds 60°C at all times.

3. The combined storage capacity and heater output must be sufficient to ensure that the outflow temperature, at continuous design flow (at least 20 minutes) from calorifiers or other heaters, shall not be less than 60°C. This applies to both circulating and non-circulating hot water systems.

4. The positioning of the control and high limit thermostats, cold feed and return water connections must ensure that these temperatures are achieved.

5. Means shall be taken to prevent warm water entering the cold-feed. A check valve shall be provided in the cold feed, as close to the calorifier as practicable, to prevent such circulation. However, the installation of such a check valve shall not be carried out in systems that use the cold feed for expansion. In these cases, U-bend or S-bend shall be installed in the cold-feed, sufficient distance from the connection to the calorifier, so that water which is warm is not displaced (on heating up) beyond the bend and the vertical pipe rise.

6. Where practicable, all pressurisation/expansion vessels shall be of the flow-through type. Where pressurisation vessels are of the single entry type they must be fitted with appropriate flow-through valves or drain valves to facilitate flushing of the unit.

7. The practice of terminating the air vent over the Water Storage Tank shall be discouraged. The vent shall be arranged to discharge over a separate tun-dish arrangement, with visible Type A air gap, sited at a level that takes account of the hydrostatic head of the system. The calorifier or water heater shall be provided with a suitable safety valve of appropriate size and vacuum release arrangement.

8. Where water quality indicates the need, cathodic protection from galvanic action by means of sacrificial anodes shall be provided.

9. Calorifiers shall be fitted with a de-stratification pump, where necessary, in order to avoid temperature stratification of the stored water. Some semi-storage/high-efficiency Calorifiers are supplied with an integral pump that circulates water in the Calorifier. De-stratification pumps shall not be fitted to this type of units.

10. A single circulating pump shall normally be installed on the return. If, for reasons of reliability, two pumps are installed in parallel they shall be arranged to have individual non-return and service valves and be controlled such that each one is brought into operation twice a day.

11. When Calorifiers are isolated from the system (for whatever reason), the associated distribution system shall be subjected to DAILY flushing. However, this is only necessary when the Calorifier isolated is the sole supply of Hot Water Services (HWS) to that distribution system. Where more than one Calorifier supplies the distribution services, the isolated calorifier shall be drained down and remain drained whilst off line.

12. A suitably sized drain shall be connected to the base of each calorifier (where practicable).

13. Calorifiers shall be maintained at the following temperature profiles at all times:

    a. "Stored" and "Flow" at ≥60.0°C
    b. "Return" at ≥50°C - "Return" temperatures must be measured from each "Return" leg
    c. "Distribution" at ≥50°C
    d. "Drain" at ≥50°C

14. Ideally, the Calorifiers should be allowed to operate continuously ensuring that the heat source is available constantly. Where the Primary Heating Source is not set by a timer, the heating source shall be left 'on' at all times.

15. Where a building is to remain un-occupied, the calorifier shall be emptied and pasteurised before being allowed back 'on-line'.

16. Calorifiers shall be subjected to regular manual check for "Flow" and "Return" temperature. Manual temperature checks must also be carried out where the units are fitted with Building Management Systems (BMS).

17. Calorifiers shall be subjected to regular inspections for Water Quality, Calorifier physical condition, Temperature and Bacterial activity.

18. Calorifiers shall be subjected to a regular blow-down and flush via the drain point. There is no reason to open calorifier hatches (where fitted) for routine internal inspections unless drain water condition indicates the need for internal cleaning of the vessel when access would be obtained via the hatch.

19. Cleaning, flushing and pasteurisation shall be carried out in the event of major modifications or after a period out of service, before a Calorifier is returned to service. Pasteurisation shall also be carried out when the stored water temperature falls below 45.0°C for more than 1 hour before the Calorifier is returned to service.

20. Return and shunt pumps shall be overhauled on an annual basis (where this is a stated requirement) or shall be serviced and maintained to manufactures specifications.

21. Cistern-type water heaters shall be maintained such that the cold tank part of the heater is kept clean and at the correct temperature, and the hot tank part maintained at a temperature of >60.0°C allowing for distribution temperatures of >50.0°C. A screened vent and an insect/rodent overflow screen shall be fitted to the tank part of the units.

22. Instant water heaters (<5litres), including combination boilers, usually store small water volumes, and because of this they do not usually need to be operated within the temperature profile and limits prescribed for larger systems (≥60°C for the 'flow' and (≥50°C for the 'return' and 'outlet') which are necessary for thermal disinfection. These units can, therefore, be operated at "safe" temperatures of ≤41.0°C although they should be switched-on at all times to ensure and encourage adequate use. Infrequent use of these units (less than Daily) would increase the potential of bacterial growth and proliferation (as would be the case in all infrequently used areas throughout the system – both hot and cold), although particularly in this case because of the low temperatures where operated.

2.5 HOT WATER AND COLD WATER DISTRIBUTION SYSTEMS

1. The design and installation of the hot and cold water distribution system shall comply with the Water Supply (Water Fittings) Regulations 1999 and BS8558:2015.

2. The design of the pipework shall ensure that there is no possibility of a cross-connection between installations conveying potable water and an installation containing non-potable water or water supplied from a private source (untreated). There shall be no possibility of backflow towards the source of supply from any tank, cistern or appliance, whether by back siphonage or otherwise.

3. All cold distribution pipework, mains and tank down feeds shall be located, as far as is practicable, to minimise heat gains from their environment. Pipework shall not be routed through hot ducts or run adjacent to heat sources, such as radiators.

4. All pipework shall be insulated, except for any exposed final connections to facilities, and shall be arranged to eliminate or minimise dead-legs.

5. As far as possible, the objective shall be to design the cold water systems to ensure that the inlet, outlet and surface water temperatures of cold water storage tanks are not greater than 2˚C above that measured at the main water meter. Also, at cold water draw-off points, a temperature of not greater than 2˚C above the temperature measured in the source Cold water storage tanks shall be reached within one minute.

6. Stagnation shall be avoided. Hot and cold water services shall be sized to provide sufficient flow at draw-off points. The aim shall be to promote turnover of water by means of; the design of the distribution circuitry, adequate usage and avoidance of "disused" areas.

7. Where practicable; separate drinking water systems shall be provided directly from the mains without storage, with stored cold water (down service) being used solely for supplies to WCs, wash hand basins, etc. The supply shall not be softened. Additionally, it shall be established that the usage is sufficient to avoid deterioration in water quality, for example, that the inlet water temperature does not exceed 20°C and that the outlet does not remain unused.

8. The water supply to vending and ice making equipment shall be taken from a potable supply up stream of a regularly used outlet with the minimum of intervening pipe run i.e. less than 3 metres. The supply shall not be softened to less than 70ppm Total Hardness. Additionally, it shall be established that the usage is sufficient to avoid deterioration in water quality, for example, that the inlet water temperature does not exceed 20°C and that the outlet does not remain unused.

9. The equipment shall be positioned so that the warm air exhaust does not impinge directly on taps or hoses supplying cold water.

10. The domestic hot water system shall not be used for heating purposes. This includes all radiators, towel rails etc, whatever the pipework configuration.

11. Central "common blending" systems shall not be used, since the length of distribution pipework containing water in the temperature range that supports bacterial growth and proliferation would far exceed the maximum permissible lengths mentioned above.

12. Water temperatures at all outlets, both Cold Water Services (CWS) and HWS, shall be measured at least once annually (where practicable) and a representative number ("direct" fed Sentinel taps) shall be measured at regular intervals. Temperatures shall be measured after two minutes for the CWS and one minute for the HWS at full flow and be maintained at <20°C and >50°C respectively.

13. Temperature monitoring shall be supported with regular microbiological sampling when considered necessary.

14. Designated drinking water systems and outlets water temperatures shall be measured on a Monthly basis. Temperatures must be aimed to be maintained within 2°C from incoming mains water temperature. Where the water source is from a bore hole or where the temperatures recorded persistently fall outside

the recommended temperature limits, the monitoring must be supported with microbiological analysis for the presence of *E.coli* and presumptive coliforms.

15. Where infrequently used facilities are deemed to be no longer required, they should be notified to the Estates Department for removal.

16. Where a building or sections of the system remain unused for long periods of time, steps shall be taken as follows:

    a. Flush all water facilities (including toilet and urinal cisterns) thoroughly on a Weekly basis whilst the building is not in use.

    b. If the facilities within a building are to remain unused for a prolonged period (more than one month), then the system shall be drained down, where practicable, (including all vessels) and cleaned and disinfected (any calorifiers are to be pasteurised) prior to being allowed back 'on-line'.

       Note: The "Area Closure and Opening Process and Dead-leg Flushing pro-forma must be completed. Where this is not practicable, all associated facilities shall be flushed on a WEEKLY basis.

    c. Consideration shall be given to isolating the unused sections from the system and possibly removing pipe-work and fixtures completely to avoid "dead-legs".

17. Where a Fire hose-reel is supplied by the Domestic Mains and the line supplying the hose-reels is quite exclusive, distinct and separate from the line supplying domestic facilities, the fire line shall be fitted with a suitable Reduced Pressure Zone (RPZ) valve. Where the fire and domestic supplies share the same line, each hose-reel spur shall be fitted with a double check valve. It is important, however, to ensure that the valves are fitted as close to the domestic line as possible in order to ensure that the dead-leg up-to the valves is kept as small as possible.

18. Where the installation of RPZ or double check valves is not practicable, each unit shall be subjected to a Weekly flushing regime in order to minimise stagnation and the potential for increased bacterial proliferation.

19. Regular checking of the hose-reels, for operational integrity, shall be maintained. This task, however, shall be carried out with due care and attention – ensuring that the creation of aerosols is as low as practicable.

20. The water in a self-contained eyewash station must be refilled, disposed, and maintained in accordance with manufacturer's instructions. Emergency showers shall also be flushed Weekly to clean the line and verify proper operation.

2.6 SHOWERS BATHS AND THERMOSTATIC MIXING VALVES/TAPS (TMV/TMT)

1. All showers heads shall be maintained in a good and clean condition and free from excessive scale and dirt deposition.

2. At outlets fitted with TMVs/TMTs, the temperature shall be measured and maintained at:

   - 41°C for showers
   - 41°C for basins
   - 38°C for bidets
   - 44°C for baths

3. All TMVs/TMTs shall be subjected to regular temperature monitoring. The temperature monitoring shall be supported with regular microbiological sampling where considered necessary.

4. All shower-heads shall be inspected on a regular basis and de-scaled, cleaned and disinfected/replaced. The disinfection process shall include all associated hoses.

5. The pipe-work length from the TMV to the outlet shall be restricted to a maximum of two metres.

6. All TMVs/TMTs shall be fitted with strainers, isolation valves and non-return valves.

7. All TMVs shall be accessible (as far as reasonably practicable).

8. All TMVs shall be inspected and subjected to a fail-safe test on a regular basis (carried out as described in the manufacturer's instructions).

9. Central "common blending" shower-block systems shall not be used and all pipe-work length from the TMV to the shower-head shall be restricted to a maximum of two metres.

10. Where "common blending" shower-block systems are already in place, each system shall be fitted with a solenoid valve (at the furthest point from the mixer valve), programmed to automatically purge water for a three minute period each day.

2.7 EXPANSION/PRESSURISATION VESSELS

1. All new and replacement expansion/pressurisation vessels fitted shall be of the "flow-through" type.

2. Expansion vessels shall be located on the cold feed rather than on the hot water side of the system. The length of pipework between the expansion vessel and cold feed shall be as short as practicable, e.g. less than 1 metre.

3. All existing expansion vessels, where not being replaced, shall be of the flow-through type. Where pressurisation vessels are of the single entry type they must be fitted with appropriate flow-through valves or drain valves to facilitate flushing of the unit.

2.8 GREYWATER SYSTEMS

1. Greywater systems shall comply with BS 8525-1:2010 - Greywater systems – Part 1: Code of practice and BS 8525-2:2011 - Greywater systems –Part 2: Domestic greywater treatment equipment – Requirements and test methods.

2.9 TEMPORARY WATER SUPPLIES

1. STFC, or others on its behalf, when providing and managing temporary water supplies, shall comply with their duties under the Health and Safety at Work etc. Act a and BS 8551:2015 - Provision and management of temporary water supplies (not including provisions for statutory emergencies).

2. This provides clear practical guidance on how to install temporary supplies, whether by connection to the mains or tanker-fed, and how the distribution system should be disinfected and tested to ensure that the water is wholesome. It also considers the safe storage of bottled water, though not the maintenance of the dispensers.

2.10 LATHES, CUTTING TOOLS, ETC

1. All lathes and cutting tools shall be maintained in a good and clean condition and free from excessive corrosion and dirt deposition.

2. All lathes and cutting tools shall be flushed or emptied on a daily basis or used without coolant.

3. All lathes and cutting tools shall be subjected to a Monthly cleaning and disinfection.

4. All lathes and cutting tools shall not use untreated water or untreated grey water and water shall not be dispersed using sprays.

2.11 IRRIGATION SYSTEMS

1. All irrigation systems must be maintained in the same manner as domestic cold water systems, i.e.:

    - The source must be of suitable quality (fire-fighting systems must not be used to supply irrigation systems).
    - Temperatures of the source and distribution systems to be maintained <20°C. Temperatures must be measured periodically.
    - Where large bodies of water are used to supply irrigation systems, they must be periodically monitored for bacteriological contamination particularly during the warmer months when the level of bacterial contamination maybe high.
    - When the level of bacterial contamination is persistently high where the use of biocide to control bacterial growth is impracticable, put system out-of-use or use alternative water source.
    - When possible, treat large storage tanks/reservoirs with a suitable biocide when temperatures persist above 20°C or when system is shown to be significantly contaminated with bacterial growth.
    - Maintain the level of aerosols generated as low as practicable. When this unavoidable, ensure that the irrigation is not carried out when the area irrigated is populated.

2.12 ORNAMENTAL FOUNTAINS AND WATER FEATURES

1. Regular maintenance including biocidal treatment will greatly reduce the risk of Legionella growth. Ornamental features that by design or application are more of a risk, require close attention. The most commonly used biocides in small ornamental features are ionized copper, halogens (chlorine and bromine), hydrogen peroxide and polyquat. For larger features there are many other options including ozone, peracetic acid, and chlorine dioxide. For more details on biocides, refer to the addendum to this document,

2. In applications where the manufacturer does not allow chlorine, other less reactive products such as hydrogen peroxide or polyquat, should be used (check with manufacturer). Both ozone and UV, properly applied are very effective at killing all bacteria, viruses and algae. UV provides no residual disinfectant; it will only kill the bacteria that flow across it. UV will greatly reduce organic loading and result in much lower use of chlorine. UV may add some heat to the water. Ozone will provide an effective residual disinfectant. When using ozone indoors, insure the product is properly applied and the generator is installed to minimize risk of ozone leakage indoors. Even small amounts of ozone in the air can be harmful to lungs

3. When not in use for three or more days, features should be drained and cleaned or fed with a high chlorine level (5ppm) prior to operation as stagnant water will

impact Legionella and biofilm growth. For ornamental features that are left stagnant, the best thing to do is drain them completely during those periods. Some manufacturers recommend changing feature water if it becomes cloudy or has an odour. If water becomes cloudy or has an odour, there are significant amounts of bacteria in the water and excellent conditions for biofilm growth. Ornamental features in public settings should never be operated with cloudy or smelly water.

4. For ornamental features in public settings, STFC is responsible to insure the unit is never used for public bathing. Features with other organic loading, such as wildlife, should take appropriate measures to control Legionella as well as other pathogens.

Indoor Ornamental Water Features			
Parameter	Large (> 200 gal)	Medium (less than 100 gallons)	Small (less than 5 gallons)
Filtration	Constant Filtration	Drain & clean monthly	Drain & clean weekly
Bacteria Control	Automatic control & feed of biocide. Maintain at least 0.5ppm free chlorine (or equivalent) continuously	Manual or automatic biocide feed to maintain at least 0.5ppm free chlorine (or equivalent) 6 hours a day.	Manual dosing once a day of liquid chlorine to develop 3 – 5 ppm free chlorine (or equivalent) for 1 hour.
Algae Control	Feed chlorine or algaecide as required to insure no algae or slime		
Slime Control	Spray slimy areas with a weak bleach solution and rinse		
6-Monthly	Open & inspect filter	Open & inspect filter	Open & inspect filter
Annual	Drain, clean & inspect	Drain, clean & inspect	Drain, clean & inspect

Outdoor Ornamental Water Features			
Parameter	Large (> 200 gal)	Medium (less than 100 gallons)	Small (less than 5 gallons)
Filtration	Constant Filtration	Drain & clean monthly	Drain & clean weekly
Bacteria Control	Automatic control & feed of biocide. Maintain at least 0.5ppm free chlorine (or equivalent) continuously	Manual or automatic biocide feed to maintain at least 0.5ppm free chlorine (or equivalent) 6 hours a day.	Manual dosing once a day of liquid chlorine to develop 3 – 5 ppm free chlorine (or equivalent) for 1 hour.
Algae Control	Algaecide and biocide should control slime	Feed chlorine or algaecide as required to insure no algae or slime	
Slime Control	Algaecide and biocide should control slime	Spray slimy areas with a weak bleach solution and rinse	
6-Monthly	Open & inspect filter	Open & inspect filter	Open & inspect filter
Annual	Drain, clean & inspect	Drain, clean & inspect	Drain, clean & inspect

5. Each unit is considered to be at a significantly higher risk if:

- Water temperature exceeds 25°C. Temperature should be measured at the hottest area in the system and at the time of day when the water temperature is hottest.
- The unit is routinely stagnant.
- There is additional organic loading of the unit.
- The unit has submerged lighting.

2.13 HUMIDIFIED FOOD CABINETS

1. All humidified food cabinets must be properly maintained and kept in a hygienic condition.

2. All humidifier reservoirs must be emptied after each use.

3. All humidifier reservoirs must be disinfected (using a suitable disinfectant or as directed by manufactures instructions), immediately prior to each use. The disinfectant used must be removed from the system, by adequately flushing the humidifier reservoirs prior to being put into use.

2.14 WATER SOFTENERS

1. All water softeners must be properly maintained and kept in a hygienic condition.

2. All water softeners must be properly and suitably cleaned and disinfected by a suitably qualified contractor on a regular basis.

3. All salt tanks must be regularly checked and maintained topped-up with salt solution.

2.17 PORTABLE AIR CONDITIONING UNITS

1. STFC do not recommend the use of Portable "wet" evaporative cooling point-of-use units. These units are considered to pose a significant Risk of Legionellosis because of their mode of operation, which includes the wetting of medium and the production of aerosols, which, if not maintained correctly, can increase the potential of bacterial growth and proliferation. The Estates Team shall immediately isolate and remove any such units and advise the infection control team of the service receiver.

2.16 PORTABLE HUMIDIFIERS

1. Portable humidifiers shall not be used without the written permission of the LRP who would need to ascertain suitability of use following an adequate risk assessment.

2. All portable humidifiers shall have their reservoir (where applicable), filled using only sterile water.

3. All portable humidifiers shall have their reservoir (where applicable), emptied on a daily basis.

4. All humidified incubators shall be cleaned and disinfected, after each use, using appropriated disinfectant solutions as recommended by the manufacturer.

3 RISK ASSESSMENTS

3.1 SCOPE

Suitable and sufficient Legionella risk assessments shall be carried out in accordance to BS 8580:2010 – Water Quality – Risk assessments for Legionella Control – Code of Practice on all the buildings currently owned or occupied (under a full maintenance lease or otherwise) by STFC.

These will be reviewed at least every two years in order to identify and assess the risk of Legionellosis and water quality issues from work activities and water sources on the premises and organise any necessary precautionary measures. and when there are significant changes to statutory standards, operational requirements, significant changes to a building's domestic water and process systems.

BS 8580:2010 – Water Quality – Risk assessments for Legionella Control – Code of Practice recommends that the risk assessment should be carried out by independent bodies and shall not take the form of a quotation for any remedial works required. The risk assessment shall not only concentrate on the physical condition of the associated plant and equipment, the *"hardware",* but must also assess the risk posed by the management and execution of the controls systems, *"software",* in place.

Systems which are susceptible to colonisation by Legionella, and which incorporate means for creating and disseminating water droplets, will be identified, and the risk they present will be assessed. Risks will be assessed not just for the routine operation of the system, but also in unusual circumstances such as; breakdown, abnormal operation, design, installation and commissioning. Action plans and work procedures shall be developed and implemented to reduce the risk to a minimum.

The objective of the risk assessment is to institute management procedures to ensure that compliance is continuing and not notional.

The primary purpose of the assessment is to demonstrate that management has identified all the relevant factors, has instituted corrective or preventive action, and is monitoring that the plans are implemented and effective.

A further purpose of the assessment is to enable a valid decision to be made about:

i. the risk to health, i.e. whether the potential for harm to health from exposure is reasonably foreseeable unless adequate precautionary measures are taken;
ii. what control measures are to be implemented to the minimise the risk from exposure to Legionella.

The Risk Assessments must include identification and evaluation of potential sources of risk and:

i. the particular means by which exposure to Legionella is to be prevented; or
ii. if prevention is not reasonably practicable, the particular means by which the risk from exposure to Legionella is to be minimised.

The Risk Assessments, Action Logs, Written Schemes and implementation of precautionary measures, shall be carried out by Company or Contractor personnel who have had and can demonstrate suitable and appropriate training or shall be commissioned from a suitably qualified and experienced third party.

Where additional resources and guidance are required this will be by the appointment of one or more experts from outside STFC with clear, written responsibilities and lines of communication.

Where the assessment demonstrates that there is no reasonably foreseeable risk or that risks are insignificant and unlikely to increase, no further assessment or measures are necessary. However, should the situation change, the assessment shall be reviewed and any necessary changes implemented.

The assessment shall be reviewed at least every two years or whenever there is reason to believe that the original assessment may no longer be valid or in accordance with the schedule detailed above. This may be because of:

i. changes to the plant or water or its use;
ii. changes to the use of the building in which it is installed;
iii. the availability of new information about risks or control measures;
iv. the results of checks indicating that the control measures are no longer effective.

A written Action Plan will be devised based on the results of the Risk Assessments. This must clearly identify who has overall accountability for the premises, and who is responsible for devising and carrying out the procedures.

Inadequate management, lack of training and poor communication have all been identified as contributory factors in outbreaks of Legionnaires' disease. It is therefore important that those people involved in assessing risk and applying precautions are competent, trained and aware of their responsibilities.

All recommendations made in the risk assessment, must be made with the specific requirements of STFC and must take into consideration manpower and budgeting considerations.

The risk assessment must take into consideration the following:

i. The potential of bacterial contamination of the all areas of the system including plant and equipment.
ii. The potential of bacterial amplification.
iii. The potential of bacterial transmission.
iv. The potential of exposure to the bacteria.
v. The susceptibility of the user.

In addition, the risk assessment should include risk analysis on the following areas of the domestic and process water systems:

3.2 EVAPORATIVE COOLING SYSTEMS (COOLING TOWERS)

1. Location and physical condition of Cooling Towers and associated distribution pipe-work.
2. Design, configuration and accessibility of Cooling Towers and associated distribution pipe-work.
3. Type and condition of drift eliminators.
4. Type and condition of pack.
5. Status and condition of all associated stand-by equipment such as pumps etc.
6. Levels of corrosion, sludge deposition, scale and biological activity.
7. Status and efficacy of Water Treatment regimes.
8. Status and efficacy of Biological Control Treatment regimes.

3.3 COLD WATER SERVICES - STORAGE

1. Physical condition and hygiene standard of all associated Water Storage Tanks.
2. Design and configuration of all associated Water Storage Tanks.
3. Capacity requirements and available storage capacities of all associated Water Storage Tanks.
4. Temperature profiles of all associated Water Storage Tanks.
5. Biological activities of all associated Water Storage Tanks.

6. Water Supply Regulations parameter compliance of all associated Water Storage Tanks, including location and accessibility.

3.4 COLD WATER SERVICES - DISTRIBUTION

1. Physical condition of all associated distribution pipe-work (where reasonable accessible).
2. Design and configuration of all associated distribution pipe-work.
3. Temperature profiles of all associated distribution services and outlets.
4. Biological activities of all associated distribution services.
5. Presence of dead-legs and areas of low-flow within all the associated distribution services.
6. Presence of flexible hoses, aerators, strainers, non-touch taps.
7. Presence of vending machines and water dispensers.
8. Usage considerations of all associated distribution services.

3.5 HOT WATER SERVICES - HOT WATER GENERATION AND STORAGE

1. Physical condition of all associated Hot Water Generating Units.
2. Design and configuration of all associated Hot Water Generating Units
3. Temperature profiles of all associated Hot Water Generating Units, to include; flow, return and drain temperatures.
4. Capacity requirements and available storage capacities of all associated Hot Water Generating Units.
5. Presence of temperature stratification within associated Water Storage Calorifiers.
6. Biological activities of all associated distribution services.

3.6 HOT WATER SERVICES - DISTRIBUTION

1. Physical condition of all associated distribution pipe-work.
2. Design, configuration and accessibility of all associated distribution pipe-work.
3. Temperature profiles of all associated distribution services and outlets.
4. Biological activities of all associated distribution services.
5. Presence of dead-legs and areas of low-flow within all the associated distribution services.
6. Usage considerations of all associated distribution services.
7. Presence of space-heating within all associated distribution pipe-work.
8. Condition, temperature profiles and operation status of all showerheads within all associated distribution services.
9. Condition, temperature profiles, accessibility and operation status of all TMVs/TMTs within all associated distribution services.
10. Presence of flexible hoses, aerators, strainers, non-touch taps.
11. Presence of undesired lengths of blended water pipe-work within all associated distribution services.

3.7 'WET' AIR CONDITIONING

1. Physical condition of all associated Air Handling Units.
2. Design, configuration and accessibility of all associated Air Handling Units.
3. Method of humidification and operation status of all humidifiers within all associated Air Handling Units.
4. Condition, design and configuration of drip-trays within all associated Air Handling Units.
5. Condition, design and configuration of glass traps/U-bends within all associated Air Handling Units.
6. Physical condition and hygiene standards of duct-work of all associated Air Handling Units.

3.8 OTHER SYSTEMS

1. Type of unit.
2. Potential to cause an aerosol.
3. Potential of aerosol being inhaled.
4. Physical condition units and associated plant.
5. Location, design, configuration and accessibility of all units.
6. Water Treatment Programmes in place and their efficacy (if applicable).
7. Maintenance Programme and Hygiene Standards employed.

3.9 MANAGEMENT, MAINTENANCE, MONITORING AND RECORD KEEPING

1. Presence of and adequacy of all implemented Monitoring and Maintenance Programmes in place by all relevant departments.
2. Presence of and adequacy of all implemented Record Keeping Programmes in place.
3. Presence of and adequacy of all implemented Auditing Programmes in place.

3.10 SCHEMATIC DIAGRAMS AND PHOTOGRAPHIC REPRESENTATION

1. Schematic diagrams shall be produced for each system surveyed and will include schematic representation of all major distributions and associated plant installation/configuration. The schematic diagrams will be based on a non-intrusive basis and will be based on pipe-work/plant accessibility.
2. Electronic photographs shall be included in the report to illustrate the status and condition of the system surveyed and to highlight particular problems identified during the survey process.

3.11 PREPARATION OF REMEDIAL WORKS "PRIORITY CHARTS"

1. From all data and information gathered during the Site Survey, a listing of Risk of Legionellosis Priority shall be produced for the Site surveyed and a detailed Remedial Works Priority Listing shall then be produced in order to allow for the correct scheduling of all proposed works.

3.12 PREPARATION OF SITE SPECIFIC "PRE-PLANNED MAINTENANCE" (PPM) PROGRAMMES)

1. A detailed and sufficient Pre-Planned Maintenance Programme document shall be produced for each Site surveyed. The Programme shall include; the type of works, the frequency of works and all relevant works specifications.

3.13 INTERIM REPORTS

1. For all buildings/areas assessed to be of Moderate Risk or higher, the Risk Assessor Consultant shall issue an "Interim Problem Notification Form" indicating any necessary immediate corrective and remedial actions that need to be carried out. In addition, the "Interim Problem Notification Form" shall indicate the Short/Medium-term and Long-term corrective and remedial actions that need to be carried out.

3.14 CONSULTANCY MEMORANDA

1. Any additional instructions and advice from the Risk Assessment Consultant shall be in the form of a "Consultancy Memorandum", which shall clearly indicate the nature of any faults/problems discussed and the resulting Risk of Legionellosis caused. In addition, any corrective action or remedial works required, shall be clearly stated and listed and prioritised in terms of urgency.

4 PREPARATION OF ACTION PLAN

On completion of the Risk Assessment, the LPR shall consider each Risk Assessment Report and shall ensure the design, arrangement, implementation and management of all necessary Remedial Works required to allow the systems to comply with the current and relevant guidelines and legislation, and to ensure minimisation or control of the prevailing risk.

The preparation of the Action Plan shall include:

1. Development of schemes for risk minimisation and control in order of priority giving consideration to cost, risk and difficulty.
2. Listing of all identified faults in priority order of non-compliance and potential risk.
3. Preparation of a management programme for the minimisation of risks so that an action plan identifying resources and timescales is drawn up.
4. Management of the programme to identify compliance failures for remedial action.
5. Review of the programme of the Action Plan, at least, 6-Monthly intervals. All changes to the water systems and functional content shall be recorded and evaluated.

5 MAINTENANCE AND CARE OF WATER SYSTEMS EQUIPMENT

The plant and equipment used in STFC's buildings which have water in the system and can affect the water supply or the atmosphere shall be monitored regularly and be subjected to the following regime:

i. The systems shall be carefully designed so as to minimise aerosols and the material used in construction would not harbour or provide nutrient for bacteria. They shall be designed to be readily drained and cleaned.
ii. The systems shall be maintained in a clean and sound condition and must be easily and safely accessible.
iii. All plant and distribution pipe-work (where accessible) shall be clearly labelled.
iv. The water quality shall be maintained by ensuring the systems are kept in a good condition by regular cleaning and disinfecting by a regular dosage of water treatment.
v. Careful monitoring of the precautions.
vi. Records must be kept of the maintenance performed and the results obtained.

5.1 RISK MANAGEMENT PROCESSES AND PROCEDURES

In order to ensure that the devised Risk Management Programme is effective in minimising or controlling the risk of Legionellosis, STFC (or others on its behalf) shall undertake a number of risk management processes including the periodic inspection and monitoring of plant, systems and equipment. These processes shall include:

i. Non PPM Programme Control Processes which shall be used when and 'As Required' – See Section 6 of this document - NON PPM PROGRAMME CONTROL PROCESSES.

ii. PPM Programme scheduled tasks to be carried out systematically – See Section 7 of this document - PRE-PLANNED MAINTENANCE PROGRAMME - TASK FREQUENCIES

5.2 CALIBRATION

Temperature measurement equipment and water sampling equipment used by site staff, or by contractors carrying out monitoring works on behalf of STFC, shall be calibrated on an annual basis and the certification of calibration appropriately provided and held by the MM. Calibration service providers shall be accredited via UKAS calibration and accredited to ISO 17025. Records of calibration will be compiled and held on file to enable reference to be made as and when required.

6 NON PPM PROGRAMME CONTROL PROCESSES

6.1 DEAD LEGS/AREAS OF LOW-FLOW USAGE EVALUATION AND FLUSHING

Science & Technology Facilities Council	Legionellosis Management And Control PPM Programme		
Process Nº:	1	Advice Note:	P-LEG 01
Task:	Dead Legs/Areas of Low-Flow Usage Evaluation & Flushing		
Frequency:	WEEKLY		

Systems or individual outlets that are not frequently used allow the development of stagnant water conditions, which increase the potential of bacterial growth and proliferation, including the Legionella. In order to remove any stagnation that may have developed or to stop stagnation from occurring in the first place, it is important to introduce a "flushing" programme where necessary. Local Staff shall have the responsibility to ensure that this requirement is implemented and systematically audited to ensure adequate and correct implementation.

The flushing programme shall be designed so that it allows for the whole dead-leg to be removed. This is achieved by ensuring that the flushing is carried out at the specified system or outlet and for an appropriate length of time. The length of time of purging water from the system is important because it is vital to ensure that all the stagnant water has been expelled from the pipe-work and at least until "circulating" or "fresh" water is drawn from the outlet (water at temperatures exhibited throughout the rest of the system).

The flushing programme shall follow the procedure outlined below:

1. Carry out the “Usage Evaluation” process in order to identify areas/outlets which are not used at least weekly so that they can be flushed.
2. Ensure that the system/outlet can be flushed safely and in a tidy manner into an appropriate drain if not plumbed for drainage.
3. Ensure that the purging of water from outlets does not create an unnecessary amount of aerosol at least no more than would be created when outlet is operated normally.
4. Ensure that "splash-back" is minimised, where practicable, by placing a sponge or another material capable of absorbing some of the force of the water against the surface of the appliance.
5. Purge the hot and the cold or the mixed water in turn for a minimum of 2 minutes or for a period of time necessary to draw water from the outlet at temperatures exhibited throughout the rest of the system.
6. If a system or an area consisting of multiple outlets requires flushing, it is important to begin with the nearest outlet to the main distribution pipe-work, working progressively away from the main distribution pipe-work.
7. Where showers need to be flushed, it is important to ensure that, where practicable, the shower-head is removed in order to reduce the potential of aerosol production. Where the head is fixed, exposure to the aerosol produced must be minimised. One method that can be employed in this situation is the use of a transparent plastic bag, fixed around the shower- head, with one corner pierced to allow partial discharge of water.
8. Consider whether the system/outlet can be removed negating further flushing.
9. Report the process via STFC’s Log-book system.

6.2 NOTIFICATION OF CLOSURE OF SECTION/AREA PROCESS SPECIFICATION AND PRO-FORMA:

Science & Technology Facilities Council	Legionellosis Management And Control PPM Programme		
Process Nº:	2	Advice Note:	P-LEG 02
Task:	NOTIFICATION OF CLOSURE OF SECTION/AREA "Section/Area" refers to; a part of a block/building, a room within a block, a section of a building etc.		

When major changes to the domestic water are planned in this area as part of system modifications, alterations and/or refurbishments, the PM and GM shall ensure that the site installation and commissioning procedures are addressed. These shall include all relevant sections as described in BS8558:2015.

During the temporary closure of areas, where no major modifications, alterations and/or refurbishments are planned, a procedure for flushing hot and cold water systems shall be instituted. This shall include for opening all taps and WC cisterns etc for a period of 2 minutes weekly. Alternatively when this is impractical, the system can be disconnected and the procedure recommended for new installations may be carried out immediately prior to reoccupation. All area closures and planned re-opening dates if known shall be notified to the LPR.

Note: It is the responsibility of the LPR to ensure that actions are taken and a completed copy of this form is sent to the Building Manager and a copy retained within the site Log-book.

This section to be completed by the Building Manager or Capital Projects Manager

Section proposed closure:				
Is all of the Section proposed for closure?	Yes		No	
If No, specify:				
Date for proposed closure:				
Period of proposed closure:				
Reason for proposed closure:				
Are major modifications, alterations and/or refurbishments planned?	Yes		No	
If Yes, Project Manager/SO:				
Will the use of the Section change following re-opening:	Yes		No	
If Yes, specify:				
Project Manager/occupier:				
Date:		Signature:		

This section to be completed by the LPR

Form received by:				
Date:				
Does this Section need to be included in a "Flushing" Programme?	Yes		No	
If Yes, has Section been included in "Flushing" Programme?	Yes		No	
If Yes, start date:				
Person/Organisation responsible for flushing:				
Signature of Person/Organisation representative:				

Name: ……

Signed: ..... Date: .....

6.3 HAND-OVER PROTOCOL FOR NEW BUILD AND REFURBISHMENTS AND PERMIT TO OPEN SECTION/AREA PROCESS SPECIFICATION AND PRO-FORMA:

Science & Technology Facilities Council	Legionellosis Management And Control PPM Programme		
Process Nº:	3	Advice Note:	P-LEG 03
Task:	HAND-OVER PROTOCOL FOR NEW BUILD AND REFURBISHMENTS AND PERMIT TO OPEN SECTION/AREA		
Section/Area:			

10 DAYS PRIOR TO SECTION/AREA RE-OPENING

i. Where applicable, the commissioning data in accordance with BS8558:2015 must be received from installer and a copy provided to the Capital Projects Manager and LPR.
ii. Shower heads shall be cleaned and disinfected (Capital Project Manager responsibility to demonstrate to LPR).
iii. TMVs/TMTs shall be cleaned and disinfected (Capital Project Manager responsibility to demonstrate to LPR).
iv. System must be cleaned and disinfected in accordance with BS 8558:2015. If occupation of all areas is not within 24 hours from the disinfection process, all outlets, including WC, urinals and other appliances (including provision points for appliances) must be flushed for at least two minutes on a daily basis full until occupation (Capital Project Manager responsibility to demonstrate to LPR).
v. Disinfection certificates and flushing records must be received from installer and a copy provided to the Capital Projects Manager and LPR).
vi. Water temperatures to be recorded 3 times equally spaced over 24 hours (Project Manager/SO responsibility to demonstrate to MM). After 1 minute of running hot water the minimum temperature to be reached shall be minimum 50°C.
vii. Failure to achieve 50°C return temperature shall be reported to the Capital Projects Manager (Capital Project Manager responsibility to demonstrate to LPR).
viii. Cold water temperature recorded shall be <20°C (Capital Project Manager responsibility to demonstrate to LPR).
ix. Failure to achieve 50°C return temperature shall be reported to the Capital Projects Manager (Capital Project Manager responsibility to demonstrate to LPR).
x. Water samples shall have been taken for microbiological analysis (*Legionella spp* and TVCC). Samples **must not** be taken within 48hrs from the last disinfection process. **Note:** Acceptable results of these (at least "presumptive" for *Legionella sp.*) must be received before opening the Section/area
xi. Failure to achieve acceptable results must be reported to the Capital Projects Manager (Capital Project Manager responsibility to demonstrate to LPR) and discussed with STFC's external Legionella Consultants.

AT HAND-OVER

No.	Description	Yes	No	N/A
1.	Is the Section/Area complete?			
2.	Is the domestic water installation complete?			
3.	Is HEVAC installation complete?			
4.	Have all the commissioning data in accordance with BS8558:2015 been received?			
5.	Have all material and fittings WRAS certificates been received?			
6.	Has the installation been surveyed and Risk Assessed?			
7.	If Yes, have any faults/short-falls been identified?			
8.	If Yes, have all these faults been rectified?			
9.	Has the system been disinfected in accordance with BS8558:2015			
10.	If Yes, When? Date:			
11.	If Yes, have the disinfection certificates been received?			
12.	Have bacteriological samples been taken following disinfection?			
13.	If Yes, any positive results obtained? If Yes, please provide sample results.			
14.	Has the system been flushed Daily since disinfection?			
16.	If Yes, have flushing records been received?			
17.	Are there any flexible hoses fitted?			
18.	Is the installation of flexible hoses acceptable?			

This section to be completed by the LPR

I confirm that all required actions have been undertaken and Section/Area is permitted to open:

Proposed date of Hand-over: ……..

Proposed date of occupation: ……..…

Full or Phased occupation: ……..

If *Phased* occupation, have appropriate control measures been implemented to avoid water stagnation in the non-occupied areas? [Yes/No]

Name: ……

Signed: ..... Date: .....

6.4 NEW PIPEWORK AND ASSOCIATED COMPONENTS PRE AND POST INSTALLATION CLEANING AND DISINFECTION PROCESS SPECIFICATION AND PRO-FORMA:

Science & Technology Facilities Council	Legionellosis Management And Control PPM Programme		
Process Nº:	4	Advice Note:	P-LEG 04
Task:	NEW PIPEWORK AND ASSOCIATED COMPONENTS PRE AND POST INSTALLATION CLEANING AND DISINFECTION PROCESS		
If the Maintenance Staff or appointed contractor cannot, at any stage, comply with any part of this Specification, then an alternative Specification shall be agreed which, both; meets the requirements of current legislation and the needs of the Site.			

6.4.1 SMALL SECTIONS - NEW PIPEWORK (LESS THAN 2 METRES) AND ASSOCIATED COMPONENTS PRE-INSTALLATION CLEANING AND DISINFECTION

i. Thoroughly clean all new pipework to be installed.
ii. Using a suitable vessel, safely prepare a disinfectant solution of sodium hypochlorite of 100mg/l (ppm) free chlorine.
iii. Safely immerse all cleaned pipework and associated components in the disinfectant solution and leave to soak for a minimum of 30 minutes.
iv. Remove pipework and associated components from disinfectant solution and rinse with fresh clean water for a minute and allow them to drip dry in a clean, cool dry place and install within 12 hours of disinfection.

6.4.2 MEDIUM SECTIONS - NEW PIPEWORK (MORE THAN 2 METRES) AND ASSOCIATED COMPONENTS POST-INSTALLATION CLEANING AND DISINFECTION

NOTE: All components must be cleaned and disinfected as described above, prior to installation.

i. Ensure than new pipework is isolated from existing pipework with isolation valves and fitted with injection points at either end. Isolation valves must be locked-off until such time that the microbiological results indicate that the system is safe to use.
ii. Using a suitable vessel, safely prepare a disinfectant solution of sodium hypochlorite of 50mg/l (ppm) free chlorine.
iii. Using a suitable pump, inject disinfectant solution in the new pipework and allow to circulate for at least 1 hour. Measure level of free chlorine after 1 hour and ensure that it is at least 30 mg/l (ppm). If disinfectant level is below 30 mg/l (ppm) after 1 hour, repeat this step.
iv. Thoroughly flush the new pipework with clean mains water until tests indicate that the residual level of free chlorine is no greater than 0.5 mg/l (ppm), or that present in the mains water supply.
v. Using a suitable sterile containers, collect water samples and submit for biological analysis. The analysis shall measure the presence of contamination by general bacteria (TVCC). **NOTE: Samples to be collected no earlier than 48 hours following disinfection.**

6.4.3 LARGE SECTIONS - NEW PIPEWORK (LARGE SECTIONS OF PIPEWORK AND NEW COMPLETE INSTALLATIONS) AND ASSOCIATED COMPONENTS POST-INSTALLATION CLEANING AND DISINFECTION

NOTE: All components must be cleaned and disinfected as described above, prior to installation.

i. If CWS storage vessels are associated with the system, they shall be cleaned and disinfected before the new pipework is disinfected.
ii. Any water treatment equipment shall be disconnected from the system. The pH of the water shall be measured and must be between 5.5 and 9.0 before chlorinating solution is introduced. If pH is found to be below 5.5 the system shall be drained, flushed and refilled with fresh water.
ii. Treated water must then be used to charge the distribution system. If a storage vessel is associated with the system, the disinfectant solution must be prepared in and supplied by this vessel. If a storage vessel is not associated with the system, a portable vessel must be used to deliver the disinfectant solution as described above.
iii. Sampling points representative of the system must be tested to ensure 50 mg/l (ppm) free chlorine throughout the system to start disinfection. The whole system must be allowed to stand charged for a minimum period of 1 hour, a representative number of samples must be taken from the distribution system and tested to ensure levels have been maintained above 30 mg/l (ppm) free chlorine. All test and sampling points must be identified and the results of each test recorded.
iv. The system shall be thoroughly flushed out with clean mains water until tests indicate that the residual level of free chlorine is no greater than 0.5 mg/l (ppm), or that present in the mains water supply.
v. Using a suitable sterile containers, collect water samples and submit for biological analysis. The analysis should measure the presence of contamination by general bacteria (Total Viable Colony Count – TVCC).
vi. **NOTE 1: Samples to be collected <u>no earlier than 48 hours</u> following disinfection.**

6.4.4 NEUTRALISATION:

Disinfectant solutions of more than 3000 litres must be neutralised before disposal with sodium bisulphite (SB) or sodium thiosulphate (ST) at the rate of 350 gm SB/m^3 or 525 gm ST/m^3 of disinfectant solution.

NOTE: Ensure that for installations of large section of pipework and new complete installations the 'HAND-OVER PROTOCOL FOR NEW BUILD AND REFURBISHMENTS' and 'PERMIT TO OPEN SECTION/AREA' protocols are completed before putting system into use. These records and associated certificates must be issued with 'hand-over documentation' and maintained in the 'Site Log Book System'.

6.5 "PERMIT TO RELEASE FOR USE" SMALL SIZED PIPEWORK INSTALLATION PROJECTS PRO-FORMA:

Science & Technology Facilities Council	Legionellosis Management And Control PPM Programme		
Process Nº:	5	Advice Note:	P-LEG 05
Task:	"PERMIT TO RELEASE FOR USE" SMALL SIZED PIPEWORK INSTALLATION PROJECTS		
If the Maintenance Staff or appointed contractor cannot, at any stage, comply with any part of this Specification, then an alternative Specification shall be agreed which, both; meets the requirements of current legislation and the needs of the Site.			

This section to be completed by the LPR

Brief description of works undertaken

Has the work been completed?	Yes		No		When	
Pipework and fittings disinfected?	Yes		No		When	

Have all necessary works been carried out?	Yes	No	N/A	Comments
TMV/TMTs commissioned correctly & set at correct temp?				
Strainers/aerators been cleaned and disinfected?				
Shower heads/hoses been cleaned and disinfected?				
Are all direct-supplied outlet CWS temps within specification?				
Are all direct-supplied outlet HWS temps within specification?				
Are all blended outlet temps within specification?				

Has biological analysis been carried out? Yes [ ] No [ ]

If Yes; what were the results	HWS		CWS							
Location and asset	Pre	Post	Pre	Post	TVCC	*E. coli*	*Legionella sp.*	*Pseudomonas aeruginosa*	*Pseudomonas sp.*	Sample Result

Date for release for use?	

All actions have been undertaken and installation ready for use:

Legionella Responsible Person:

Signed: ..... Date: .....

6.6 Estates Certificates

Certificate of Calorifier/Tank clean and Disinfection

Site:_____ Building:_____
Location:_____ Work Order No._____
Asset No._____

Owner's System Designation			
Cold Service Disinfected	Yes/No	Hot Service Disinfected	Yes/No
Tanks Cleaned/Disinfected			
Calorifiers Cleaned/Disinfected			
Pre-Chlorination Checklist			
Task	Performed	Informative Comments	
Warning Signs Placed	Occupants Informed	All Outlets Signed	
Yes/No	Yes/No	Yes/No	
Calorifier/Tank/ Chlorination			
Water pH	Disinfection Agent	Volume Used	
Initial Disinfection Agent Level	Contact Time	End Disinfection Agent Level	
Pipework/Outlet Chlorination			
Task	Performed	Informative Comments	
All Outlets Tested	Yes/No		
Inaccessible Outlets	Yes/No		
Outlets >50 ppm	Yes/No		
Nearest Cold Tap ppm			
Furthest Cold Tap ppm			
Nearest Hot Tap ppm			
Furthest Hot Tap ppm			
Last Outlet Time			
Contact Time			
Pipework/Outlet Flushing			
Task	Performed	Informative Comments	
First Outlet Time	Yes/No		
All Outlets Flushed	Yes/No		
Inaccessible Outlets	Yes/No		
Nearest Cold Tap ppm			
Furthest Cold Tap ppm			
Nearest Hot Tap ppm			
Furthest Hot Tap ppm			
Sampling			
Task	Performed	Informative Comments	
Samples Taken	Yes/No		
Sampling Points			
Re-instatement			

All Warning Signs Removed	System Brought Back Online	Occupants Informed
Yes/No	Yes/No	Yes/No
Additional Comments		

Signed:_____ Date:_____

Certificate of Calorifier Pasteurisation

Site:_____ Building:_____

Location:_____ Work Order No._____

Asset No._____

Tasks	Comments	Signature
System drain flush carried out:		
Inlet valve closed:		
Outlet valve closed:		
Circulation pumps off:		
Shunt pump on:		
Are there any leaks:	(Y/N)	
Type of heating provided:		
Time of beginning of process:		
Pasteurising temperature achieved:		
Time pasteurising temperature kept:		
Time of end of process:		
Water analysis carried out:	(Y/N)	
Analysis results:		
Date of last disinfection:		
Any refurbishment, improvements carried out during this disinfection:		
Additional Comments		

Signed:_____ Date:_____

7 PRE-PLANNED MAINTENANCE PROGRAMME

In order to ensure that the devised Risk Management Programme is effective in minimising or controlling the risk of Legionellosis, STFC (or others on its behalf) will undertake a number of periodic inspection and monitoring tasks.

For the specific task frequencies employed, please refer to the PPM Programme Schedule below:

Science & Technology Facilities Council		Legionellosis Management And Control PPM Programme	
Item Monitored		Task	Frequency
HOT AND COLD WATER DISTRIBUTION *The Sentinel taps must be representative of the system monitored and must be fed "directly" from the system and always monitored prior to blending devices.		Temperature Monitoring	MONTHLY DIRECT-FED SENTINEL OUTLETS
		General inspections of water outlets	MONTHLY CARRIED OUT DURING TEMP MONITORING
		Cleaning and disinfection	AS REQUIRED
KNOWN DEAD LEGS AND AREAS OUT-OF-USE		Flushing of Dead Legs	WEEKLY LOCATIONS DETERMINED LOCALLY
INFREQUENTLY USED OUTLETS		Flushing of Infrequently used outlets following 'Usage Evaluation'	WEEKLY LOCATIONS DETERMINED LOCALLY
WATER BIOLOGICAL ANALYSIS	Routine sampling	*Legionella and* TVCC (*E. coli* and coliforms as required)	AS REQUIRED DEPENDING ON SITE SCHEDULE
	By exception and Ad-hoc sampling and during suspected cases and/or outbreaks	*Legionella spp. , Pseudomonas aeruginosa & spp.* & TVCC (*E. coli* and coliforms as required)	WHEN HWS AND CWS OUTLET TEMPERATURES AND/OR ON-LINE DISINFECTANT ARE PERSISTENTLY OUTSIDE THE RECOMMENDED TEMPERATURE LIMITS PRE & POST FLUSH SAMPLES
			FOLLOW-UP FROM PREVIOUS BIOLOGICAL ANALYSIS "FAILURES" PRE & POST FLUSH SAMPLES
			AS PART OF AREA OPENING PROCEDURES PRE & POST FLUSH SAMPLES
POINT-OF-USE FILTER INSTALLATION AND REPLACEMENT		Installation/Replacement	WHERE REQUIRED
Cold water storage tanks *Including all Domestic and Process Tanks		Temperature Monitoring	MONTHLY AND BMS IF FITTED
		General Inspections	6 MONTHLY
		Required capacity determination	WHEN TEMPERATURES ARE PERSISTENTLY OUTSIDE RECOMMENDED TEMPERATURE LIMITS
		Clean and Disinfection	AS REQUIRED
		Pressurisation Vessel Flushing (Where no flow-through units fitted)	WEEKLY
Fire Fighting Equipment *When Fire Fighting Equipment are off the Domestic water supplies unrestricted.		Fire hose reels flushing	WEEKLY
Calorifiers to include: Calorifiers include: Storage vessels, buffer vessels, direct gas-fired, plate heat-exchanges etc. Where multiple calorifiers are linked, the monitoring must include the flow and return of EACH unit and not just common flow & return.		Temperature Monitoring — Manual	WEEKLY AND BMS IF FITTED
		Temperature Monitoring — Manual	MONTHLY
		General visual inspections and Drain Sludge Flushing	QUARTERLY
		Pasteurisation/Disinfection	AS REQUIRED
		Expansion Vessel Flushing (Where no flow-through units fitted)	WEEKLY

Item Monitored (Continued…)	Task		Frequency
Cistern Type Water Heaters	Temperature Monitoring		MONTHLY
	Inspection of cold tank section		6-MONTHLY
	Cleaning & Disinfection		AS REQUIRED
Low Volume Water Heaters Water heaters of >5 litres storage capacity, including Combi boilers	Temperature Monitoring from unit nearest outlet		MONTHLY
	General visual inspections		6-MONTHLY
Instant Water Heaters Water heaters of <5 litres storage capacity	Temperature Monitoring from unit nearest outlet		6 MONTHLY
	General visual inspections		6-MONTHLY
Shower Heads	Temperature Monitoring		MONTHLY
	General Inspections		QUARTERLY
	Shower Head Clean and Disinfection		QUARTERLY
	Shower Flushing		WEEKLY
TMVs/TMTs (Including Shower Mixers)	Temperature Monitoring	Baths/Showers	MONTHLY
	Clean and Disinfection and/or Servicing	Baths/Showers	6 MONTHLY
		Basins/Sinks	AS REQUIRED
Air Conditioning/Handling	Inspection and cleaning of traps		MONTHLY
	AHU drip-trays and batteries clean and disinfection		6 - MONTHLY
Ice Making Machines	General Inspections		QUARTERLY
	Clean and Disinfection		MONTHLY
	Service		6 - MONTHLY
Irrigation systems	General Inspections		MONTHLY
	Dead-leg/Infrequently used areas flushing		WEEKLY
	Biological Monitoring		TVCC MONTHLY (SUMMER MONTHS)
Humidified Food Cabinets	General Inspections		QUARTERLY
	Clean and Disinfection		DAILY
Water Softeners	General Inspections and softened water Yes/No test		MONTHLY
	Salt level check		WEEKLY
	Clean/Disinfection		6 – MONTHLY
Ornamental Fountains/Water Features	Residual disinfectant Measurement		DAILY
	Temperature Monitoring/ pH and Alkalinity		DAILY
	Visual inspection		WEEKLY
	Filter inspections		MONTHLY
	Filter changes		QUARTERLY
	Pump cleaning		QUARTERLY
	Filter media changes		ANNUALLY
	Cleaning and disinfection		QUARTERLY
	Biological Monitoring	TVCC	MONTHLY
		Legionella sp.	QUARTERLY

"As-Required" is determined by the results of each visit and is dependent on various measured parameters such as; physical condition, biological activity (if applicable), temperature, usage frequency etc. and decided by STFC or its representative All necessary procedures must be pre-agreed prior to commencement.

8 METHOD OF OPERATION OF THE PPM PROGRAMME

8.1 ADVICE NOTE: LEG 01
Microbiological Sampling Protocol

Science & Technology Facilities Council	Legionellosis Management And Control PPM Programme
Legionellosis Management And Control PPM Programme	
Task No:	LEG 01
Task:	Microbiological Sampling Protocol
Frequency:	AS SPECIFIED IN SECTION 12 PRE-PLANNED MAINTENANCE PROGRAMME - TASK FREQUENCIES
If the Maintenance Staff or appointed contractor cannot, at any stage, comply with any part of this Specification, then an alternative Specification shall be agreed which, both; meets the requirements of current legislation and the needs of the Site.	

8.1.1 MICROBIOLOGICAL SAMPLING METHODOLOGY

Microbiological samples shall be collected from representative locations of each system, including plant and equipment, and submitted for analysis in accordance with the protocol below. Microbiological samples shall be collected as specified in Section 7 and under the following circumstances:

1. Re-sampling following positive biological results.
2. Where domestic water systems are treated with on-going on-line disinfectants.
3. When the PPM Programme indicates failure of control parameters.
4. When HWS and CWS outlet temperatures are PERSISTENTLY outside the recommended temperature limits.
5. As part of BUILDING/Area OPENING procedures.
6. Re-sampling following positive biological results.
7. During a suspected outbreak.
8. During an outbreak (as instructed by the outbreak investigating officer).

Microbiological samples can be analysed for the following organisms:

1. *E. coli*
2. Coliforms
3. TVCC
4. *Legionella spp.*
5. *Pseudomonas aeruginosa*

Routine (initial) microbiological samples shall include:

1. Dip-slides
2. *E. coli*
3. Coliforms
4. TVCC
5. Legionella samples shall only be collected following initial sample failures.

8.1.2 HEALTH AND SAFETY CONSIDERATIONS

Sampling of water may occur in a wide variety of locations. Each location and reason for sampling has its own risks associated with it, and it is important to make an assessment of these risks and put appropriate control measures in place before commencing any sampling. Examples of risks include:

1. Wet floors that present a slip hazard when sampling from kitchen areas, toilet/rest rooms, cooling towers etc.
2. Working at height when ladders/steps are required to reach water sampling points.
3. Manual handling risk when carrying large amounts of sampling equipment around.
4. Working in confined spaces when sampling from difficult-to-reach parts of water systems.
5. *Legionella* infection risk if sampling from water sources that create aerosols, such as cooling towers and showers.

Appropriate precautions shall be taken to minimise aerosol production, as described in BS 7592:2008 (British Standards Institution, 2008) and BS8554:2015. For example, running taps gently to reduce splashing; using a sterile plastic bag with one corner cut off to enclose the shower head and to funnel the water into a sampling container; sampling cooling towers from sampling points on the return service of the cooling water to the tower, rather than the tower itself.

In addition, some specific safety notes have been included in the sections below:

The following is a list of equipment that may be needed for sampling. The list is not intended to be exhaustive and not all items may be required for all types of sampling.

1. Sterile food-grade plastic bags.
2. Laboratory supplied sterile sample bottles.
3. Labels.
4. Permanent waterproof marker pens and biros.
5. Laboratory request forms for water samples.
6. Nitrile (plastic) gloves.
7. Alcohol medical wipes.
8. Plastic shoe coverings.
9. Cool boxes with separators and 10% by volume of frozen ice-packs (ice packs shall not be used for *Legionella* samples)
10. Digital camera.
11. Digital voice recorder.
12. Calibrated thermometer.
13. Calibrated stop-watch
14. Calibrated disinfectant residual measuring device (may be colorimetric or electronic type).

8.1.3 SAMPLE BOTTLES REQUIRED FOR THE COLLECTION OF WATER FOR DIFFERENT MICROBIOLOGICAL ANALYSES

Test Required	Sample Bottles
Coliforms, *Escherichia coli, Pseudomonas aeruginosa*, Aerobic Colony Counts, environmental mycobacteria	1 x sterile bottle (supplied by the contracted laboratory) containing an appropriate neutraliser to neutralise any residual disinfectant in the water. *(The most commonly used neutraliser, which is appropriate for chlorinated or brominated water systems and those using ozone or hydrogen peroxide, is sodium thiosulphate. For mains water and hydrotherapy pools, 18 mg/L sodium thiosulphate shall be added. For systems dosed via copper silver ionisation EDTA shall be used as the required neutralising agent).*
Legionella and other pathogenic bacteria such as *Salmonella*, *Campylobacter* and *E. coli* O157, where required	1 x sterile bottle (supplied by the contracted laboratory) containing an appropriate neutraliser to neutralise any residual disinfectant in the water. *(as above)*

8.1.4 MICROBIOLOGICAL SAMPLING COLLECTION & SUBMISSION FOR ANALYSIS PROTOCOL

Microbiological Sampling must be carried out in accordance with "BS 7592:2008 - Sampling for Legionella bacteria in water systems – Code of practice","Examining food, water and environmental samples from healthcare environments Microbiological Guidelines - December 2010" and "BS8554:2015 – Code of Practice for the Sampling and Monitoring of hot and cold water Services in Buildings".

The prime objective is to obtain a sample which is representative as far as possible of the water to be examined. To achieve this, certain precautions are necessary which are common to all sampling procedures for the bacteriological examination of water:

1. A suitably UKAS (or equal) accredited laboratory must be used for all samples collected for bacteriological analysis.
2. All staff undertaking bacteriological sampling must be suitably and adequately trained in the process of sample collection.
3. Good personal hygiene procedures, including thorough washing of hands using soap, must be adopted by the operative prior to the commencement of the exercise.
4. Sterile bacteriological sampling bottles must be used containing sodium thiosulphate to neutralise any chlorine in the water to be sampled.
5. Care shall be taken to avoid accidental contamination of the sample during collection and subsequent handling. Avoid splashing. Ensure the sample bottle does not touch the tap. Do not touch the water as it flows into the bottle or the inside of the cap or bottle. Replace the lid.
6. When sampling for *E. coli*, coliforms and TVCC, the outlet (tap/shower) must be disinfected inside (up the spout) and outside with a 1% solution of chlorine, and left for 2 minutes then flushed for 2 minutes, before the sample is collected. This is to ensure that there is no contamination of the water introduced from the outlet.
7. It is good practice to establish the water temperature at the time of sampling. Hot water should reach 50˚C within 1 minute at outlets, whilst cold water should be 20˚C or below after running the water for two minutes (Health and Safety Commission, 2000). A calibrated stopwatch and calibrated probe thermometer must be used to measure the temperature of the water to ensure conformity with these guidelines. This information shall be recorded along with the identity of the site and whether or not the outlet was intended to be hot or cold.
8. The changes which occur in the bacteriological content of water between the time of sampling and examination shall be reduced to a minimum by ensuring that the sample is not exposed to light, is kept cool in an insulated container (cool-box) and is transported to the laboratory as quickly as possible.
9. The sample shall be examined as soon as possible after collection, preferably within six hours but no more than eighteen hours (PHLS 1952, 1953 b).

Every sample bottle must be clearly identifiable, and the following information shall be supplied with the sample:

1. Agency requesting the examination
2. Sampled by
3. Reference number
4. Date and time of sampling
5. Reason for sampling
6. Supply
7. Type of water
8. Location of sampling point
9. Disinfectant residual (to be measured when sampling is carried out following disinfection)
10. Pre or Post Flush sample
11. Usage frequency

12. Temperature of HWS and CWS (HWS and CWS temperature to the TMV must be measured when sample collected from a blended outlet)

8.1.5 Sample bottles

1. Sterile bottles, of appropriate volume, shall be provided by the laboratory performing the examination and should be used exclusively for bacteriological purposes.
2. All sample bottles provided by the laboratory performing the examination shall contain adequate neutralising agent necessary to neutralise residual chlorine or chloramines.

8.1.6 Order of collection of Samples

1. When a number of samples for different purposes are to be taken from the same sampling point, certain precautions are necessary. The sample for bacteriological examination of *Legionella spp.* shall be collected first unless special investigations are necessary, as, for example, to determine the cause of taste, odours or the concentration of metals in the first flush. For chlorine estimation, a bottle which does not contain thiosulphate shall be used and where possible, this test for chlorine shall be done immediately on site (to be measured when sampling is carried out following disinfection).
2. To avoid contamination, samples for bacteriological examination shall be kept strictly separate from all others. Boxes for the transport of samples shall be made of materials that can be disinfected regularly. They shall not be used for carrying anything other than samples of water for bacteriological examination.

8.1.7 Opening and filling of Sample Bottles

1. Keep the sample bottle unopened until the moment it is required for filling.
2. Never rinse out a bottle before taking a sample.
3. Loosen the string or rubber band holding the cover in position; hold the bottle by the base in one hand and remove the stopper and cover together with the other hand.
4. Retain the stopper and cover in the hand whilst the bottle is filled, and replace them immediately.
5. Finally secure the cover.

8.1.8 Sampling from Cooling Water – Water Samples for laboratory analysis

1. Good personal hygiene procedures, including thorough washing of hands using soap, must be adopted by the operative prior to the commencement of this exercise.
2. Samples shall be taken from cooling systems at sample point locations situated on the return service to the cooling water to the tower, and as near as possible to any heat source rather than by removing an inspection hatch and collecting samples from within the tower itself. It is important to collect samples at locations that correspond (at the time sampled) to the highest risk – the highest numbers of Legionella occur in circulating water just after the pumps have been switched on. Thus, if possible, samples shall be collected shortly after pumps have initially been switched on. If sediment accumulation is excessive, it might be advisable to sample the sediment.
3. Supply water - Samples shall be taken of the supply water. Water can be collected either from the float valve at the inlet to the cooling tower pond or from the header cistern. If a water-softening system is incorporated into the system, samples of softened water and water that has not been softened shall be collected.
4. Cooling circuit with cooling towers - NOTE Legionella will grow in the warmest part of these systems, which is usually located in the region of the refrigerator condenser or other similar heat exchange equipment. Ideally, a sample point shall be fitted on the return service to the cooling tower, located near to the heat

source, for example, just after the refrigerator condenser. If no such sample point is available, then a sample shall be collected from the cooling tower pond at a point furthest removed from the fresh water inlet valve (a tap might be provided at an appropriate point on the side of the pond furthest removed from the fresh water inlet). Samples shall not be taken from the drain valve as part of a routine monitoring programme, as any sample collected might not be representative of the circulating water.

5. Samples shall be collected, if possible, when the biocide is at its lowest concentration and there is a maximum potential number of legionella present, for example:
   a. when re-circulating pumps have just been started;
   b. at the time after which any biocidal activity has ceased, and immediately prior to the next biocide addition;
   c. at the period of time just before any dilution of the water takes place either by automatic or manual operation.
6. Evaporative condensers - In evaporative condensers, water is circulated from the pond to the top of the tower and returned via a spray system over the heat exchanging system within the tower; in these cases, samples shall only be collected (while the re-circulating pump is running) from the pond at the point furthest removed from the cold water inlet or a dedicated sample point. The dedicated sample point shall be disinfected before sampling.

NOTE 1: - Condensers using softened makeup waters will often have a buffer cistern as part of the circuit. Samples shall not be taken during makeup.

NOTE 2: - Water samples shall be stored between 2 and 8°C. They shall be submitted to the laboratory to ensure that they can be examined promptly, ideally the same day, but always within 24 hours of collection.

8.1.9 Sampling from Cooling Water – Dip-slides

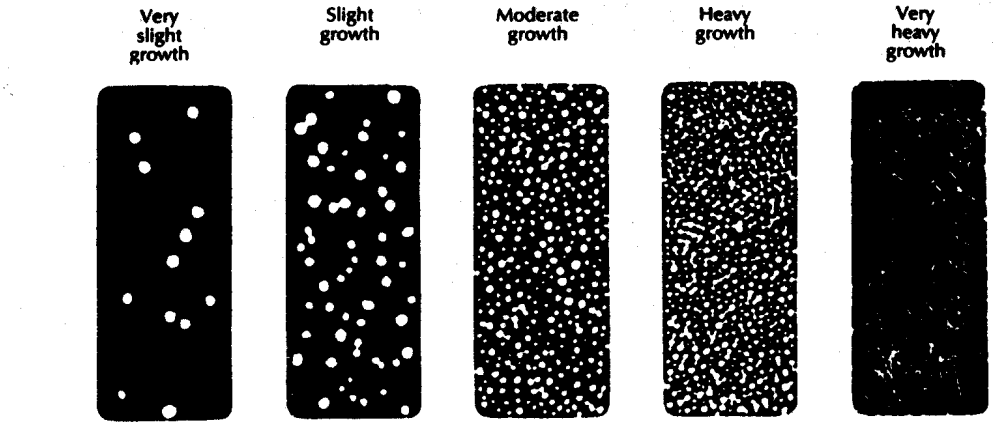
1. Storage:
   - The slides should be kept cool but not refrigerated. They will remain suitable for use as long as there is no visible contamination and the agar surfaces remain smooth and adherent to the slide. Check before use that there is no growth on the slides.

2. Inoculation (Fluids):
   - Remove the dip-slide tongue from its bottle, holding it by the cap to avoid touching the culture medium.
   - Immerse it in the fluid to be tested for about ten seconds, or expose the slide to a spray or running fluid so that the agar surfaces are covered.
   - Remove the slide from the fluid and allow it to drain for a few seconds.
   - Replace the dip-slide into its bottle and tighten the cap.

3. Incubation:
   - Inoculated dip-slides should be incubated at 30°C. It is important to begin incubation as soon as possible, and to continue incubation for several days to guard against false negative results.
   - Incubation time is 1-2 days for bacteria. The optimum temperature for most yeasts and moulds is 27°C to 30°C. Incubation time 2-7 days.
   - If the incubation temperature is considerably different from the operating temperature, microbial growth may be slow and it is advisable to continue incubation for further periods to detect the presence of organisms.

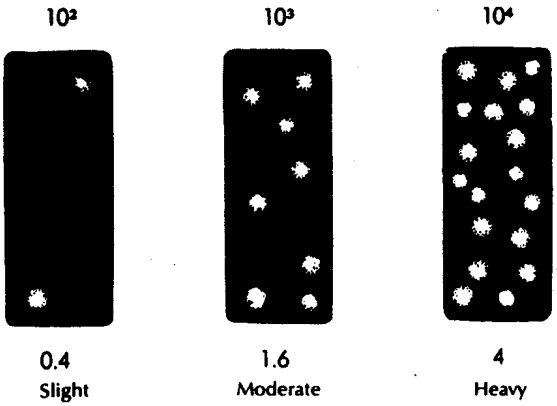
4. Interpretation of Results
   - Compare results to charts provided to estimate level of contamination. Note that very high levels may lead to a confluent growth and could be recorded as a nil result. Compare to an unused slide when reading results.

Comparison Chart Bacteria/Yeasts



Fluids CFU/ml	10^3	10^4	10^5	10^6	10^7
Surfaces CFU/cm²	2.5	12	40	100	250

Comparison Chart Moulds



Disposal Instructions

Infected slides should be autoclaved, incinerated or soaked in disinfectant before disposal.

8.1.10 Sampling from Taps

1. Good personal hygiene procedures, including thorough washing of hands using soap, must be adopted by the operative prior to the commencement of this exercise.
2. Taps chosen for sampling shall be clean, free of all attachments and in good repair. Remove all external fitting such as anti-splash devices or hoses where fitted.

3. Any alteration of the tap setting during sampling shall be avoided as it may have an adverse effect.
4. A “pre-flush” sample (first draw-off) and a “post-flush” sample (after flushing for at least 2 minutes) must be collected from taps.
5. When collecting a “post-flush” sample; the outlet must be disinfected inside (up the spout) and outside with a 1% solution of chlorine, and left for 2 minutes then flushed for 2 minutes, before the sample is collected. This is to ensure that there is no contamination of the water introduced from the outlet.
6. Fill the bottle from a gentle stream. Avoid splashing. Ensure the sample bottle does not touch the tap. Do not touch the water as it flows into the bottle or the inside of the cap or bottle. Replace the lid.
7. Occasionally, when a tap is turned on, water may leak slightly between the spindle and the gland. This is liable to run down the outside of the tap and, by gaining access to the sample, cause contamination. Under such conditions, no sample for bacteriological examination shall be taken until the leak has been remedied.

8.1.11 Sampling from Showers

1. Good personal hygiene procedures, including thorough washing of hands using soap, must be adopted by the operative prior to the commencement of this exercise.
2. A “pre-flush” sample (first draw-off) and a “post-flush” sample (after flushing for at least 2 minutes) must be collected from showers. The “pre-flush” sample must be collected with the shower head in place. The “post-flush” outlets must be collected with the shower head and hose (where practicable) removed.
3. Create a funnel using a clean food grade bag with a corner cut off clean pair of scissors wiped with alcohol based anti-bacterial medical wipes immediately prior to use. Place the showerhead into the bag, seal the open end and put the cut corner into the sample bottle.
4. If the shower is fed from a hot water system turn the temperature up to maximum. For instant heated showers turn the shower onto the lowest temperature where the heater is used.
5. Turn the shower on to a gentle flow and fill the bacteriological bottle(s) without rinsing, leaving a small air gap. Avoid splashing. Ensure that the sample bottle does not touch the showerhead. Replace the lid.

8.1.12 Sampling from Tanks

1. Remove tank lid, avoiding tipping any dirt into the tank.
2. Good personal hygiene procedures, including thorough washing of hands using soap, must be adopted by the operative prior to the commencement of the sampling. Alternatively, a fresh pair of disposable gloves must also be worn by the operative after the lid has been removed.
3. Sampling from tanks must be carried out as far from the inlet as possible.
4. Collect a sample using sterile bottle(s), suitable for collecting samples for bacteriological analysis required by immersing the bottle under the surface of the water, without rinsing, leaving a small air gap. Avoid splashing.
5. Ensure that the sample bottle does not touch the tank or other structures prior to sample collection.
6. Do not touch the water as it flows into the bottle or the inside of the cap or bottle.
7. Ensure that the sample bottle does not touch the tank or other structures following sample collection.

8.1.13 Sampling from Calorifiers

1. Good personal hygiene procedures, including thorough washing of hands using soap, must be adopted by the operative prior to the commencement of this exercise.

2. Sampling from calorifiers must be carried from the drain and both; a "pre-flush" sample (first draw-off) and a "post-flush" sample (after flushing for at least 2 minutes) must be collected.
3. Collect a sample using sterile bottle(s), suitable for collecting samples for bacteriological analysis, without rinsing, leaving a small air gap. Avoid splashing.
4. Ensure that the sample bottle does not touch the calorifier or other structures.
5. Do not touch the water as it flows into the bottle or the inside of the cap or bottle.

8.1.14 Additional Measures to be followed when collecting Samples for Bacteriological Examination of *Legionella spp.*

The sampling method for *Legionella* shall be in accordance with ISO 11731:1998 and BS 7592:2008 - Sampling for Legionella bacteria in water systems – Code of practice. A UKAS (or equal) accredited laboratory that takes part in the Health Protection Agency's water external quality assessment (EQA) scheme for the isolation of *Legionella* from water should test samples (visit http://www.hpaweqa.org.uk for further information). The laboratory shall also apply a minimum theoretical mathematical detection limit of <20 *Legionella* bacteria/litre sample.

All staff undertaking bacteriological sampling must be suitably and adequately trained in the process of sample collection and be aware of the risks of *Legionellosis*. Staff who are likely to be more susceptible to *Legionellosis* **shall not** undertake sampling. It is the responsibility of the operative's manager (this shall apply equally to COMPANY employees as well as to Contractor staff), to assess their risk of Legionellosis before being assigned the task of sample collection.

1. Sterile bottles, of 1 litre volume, suitable for collecting samples for bacteriological examination of *Legionella spp.* shall be provided by the laboratory performing the examination.
4. Collection of samples from taps:
a. Follow item **Section Sampling from Taps.**
5. Collection of samples from Showers:
a. Follow item **Section Sampling from Showers.**
6. Collection of samples from Tanks:
    a. In addition to item **Section Sampling from Tanks**, follow the instructions below:
    b. Collect a **further** sample using sterile bottle(s), of 1 litre volume, suitable for collecting samples for bacteriological examination of *Legionella sp* by immersing the bottle under the surface of the water, without rinsing, leaving a small air gap. Avoid splashing.
7. Collection of samples from Calorifiers:
    a. In addition to item **Section Sampling from Calorifiers**, follow the instructions below:
    b. Collect a **further** sample using sterile bottle(s), of 1 litre volume, suitable for collecting samples for bacteriological examination of *Legionella spp.*, without rinsing, leaving a small air gap. Avoid splashing.

Following sampling, all water samples for *Legionella spp.* analysis shall be stored at an ambient temperature (approximately 20˚C), in the dark, and returned to the laboratory as soon as possible, preferably the same day but at the latest so that processing can begin within 24 hours of taking the sample. Transporting and/or storing the sample at temperatures below 6 ˚C might reduce subsequent recovery of legionella since the bacteria might be induced into a non-culturable state.

8.1.15 Handling and shipping of samples

Samples shall be packaged and shipped to the laboratory for analysis as soon as possible. Generally, the shorter the time between sample collection/processing and sample analysis, the more reliable the analytical results will be.

Before shipping samples to the laboratory:

1. Check that sample bottles are labelled correctly.
2. Pack samples carefully in the shipping container to prevent bottle damage, shipping container leakage, and sample degradation.
3. Check that the bottle caps are securely fastened.

8.1.16 Labelling of sample bottles

Protocols for labelling, documenting, and packaging samples established by the receiving laboratory must be followed. Obtain authorisation from the laboratory before shipping samples for analysis. Each sample bottle must be correctly labelled with the site/building identification, exact location of sample collection, date, time, and sample designation.

12.1.15 Packaging of samples

When packaging samples for shipment to the laboratory, remember that all bottles must be protected from damage (especially glass bottles) and (or) leaking. The laboratory usually will return with the cooler reusable packing materials such as mesh bags, foam sleeves, and bubble wrap. Plastic bags and cardboard boxes will not be returned. Do not use foam peanuts or vermiculite.

When packaging samples:

1. Make sure bottle labels are waterproof and that information is legible.
2. Tighten all bottle caps to prevent leakage.
3. Use adequate packing material to prevent bottle damage.
4. When shipping multiple sets of samples in the same container, label each set of sample bottles with a different letter of the alphabet (A, B, C) so that bottles of each sample set will have the same letter.
    - Place all bottles from a sample set into a separate bag (such as plastic or mesh) or bind with a rubber band to keep them together.

8.1.17 Shipping of samples

Whenever possible, deliver samples to the laboratory on the day of collection. Check laboratory hours of operation—keep in mind that the laboratory might not receive samples on Saturdays, Sundays, or holidays. The integrity of chilled samples sent late on a Thursday or on a Friday could be compromised if not received by the laboratory in time to be unpacked and refrigerated. If the time taken to deliver the samples exceed the maximum recommended submission time, the samples must be discarded and the collection process repeated. If the temperatures of the cool box during delivery fall outside the recommended limits, the samples must be discarded and the collection process repeated.

8.1.18 Biological analysis process auditing

The Legionella Consultant shall carry an audit on the following:

1. Training records of each field operative to ensure adequate training level.
2. Visually check and confirm the correct collection of each type of sample.
3. Calibration certificate status of all instruments used in the process.
4. Inspect and confirm suitable condition of cool boxes.
5. Visually check and confirm the correct packaging of collected samples.
6. Visually check and confirm the correct monitoring of the submission time and cool box temperature of the sample.
7. Check and confirm that the laboratory has no issues with samples received.

8.2 ADVICE NOTE: LEG 02
Distribution and Outlet Temperature Monitoring

Science & Technology Facilities Council	Legionellosis Management And Control PPM Programme
Task No:	LEG 02
Task:	**Distribution and Outlet Temperature Monitoring**
Frequency:	AS SPECIFIED IN SECTION 7 PRE-PLANNED MAINTENANCE PROGRAMME - TASK FREQUENCIES
If the Maintenance Staff or appointed contractor cannot, at any stage, comply with any part of this Specification, then an alternative Specification shall be agreed which, both; meets the requirements of current legislation and the needs of the Site.	

8.2.1 General

i. Water temperatures at all outlets, both CWS and HWS, shall be measured at least once annually and a representative number ("direct" fed Sentinel outlets) shall be measured at regular intervals. Temperatures shall be measured after one minute at full flow.

ii, Designated drinking water systems and outlets water temperatures shall be measured at regular intervals. Temperatures must be aimed to be maintained within +/- 2°C from incoming mains water temperature. Where the water source is from a bore hole or where the temperatures recorded fall outside the recommended temperature limits, the monitoring must be supported with microbiological analysis for the presence of *E.coli* and presumptive coliforms.

8.2.2 CWS

i. The outlet temperature measured after allowing the water to run for 2 minutes shall not exceed 20°C. Where the temperature exceeds 20°C, the cold water temperature at the point of supply shall be measured. When the supply temperature is between 18°C and 20°C, the measured outlet temperature, after running the tap for 2 minutes, shall be less than 2°C higher than that at the point of supply.

ii. Any tap which fails this test must be considered as a potential risk and the whole cold water system shall be investigated. If the point of supply temperature exceeds 20°C, the water Company shall be alerted.

iii. On each monitoring visit, the temperature of the mains water source must be measured, including any cold water storage water tank when the CWS temperature at the selected outlets tested is measured and found to exceed 20°C.

8.2.3 HWS

i. The outlet temperature measured after allowing the water to run for 1 minute shall exceed 50°C. Where the temperature fails to reach the required temperature, the source shall be measured and adjusted as necessary, and the LPR informed as appropriate.

ii. On each monitoring visit, the temperature of the source supply (Calorifier etc.) must be measured. This must include the "flow" and "return" temperatures of each Unit in the system.

8.2.4 Blended Outlets

The INITIAL and MAXIMUM outlet temperature measured shall NOT exceed:

At outlets fitted with TMVs, the temperature shall be measured and maintained at:

a. 41°C for showers
b. 41°C[1] for washbasins
c. 38°C for bidets
d. 44°C for baths

[1]For washbasins, washing under running water is assumed.

8.3 ADVICE NOTE: LEG 03
Distribution Services Disinfection

Science & Technology Facilities Council	Legionellosis Management And Control PPM Programme
Task No:	LEG 03
Task:	**Distribution Services Disinfection**
Frequency:	AS SPECIFIED IN SECTION 7 PRE-PLANNED MAINTENANCE PROGRAMME - TASK FREQUENCIES
If the Maintenance Staff or appointed contractor cannot, at any stage, comply with any part of this Specification, then an alternative Specification shall be agreed which, both; meets the requirements of current legislation and the needs of the Site.	

Note: It is not usually practicable to carry out whole-system hyper-chlorination due to the unlikely event that the system would be emptied to allow for this process to be carried out. When whole-system disinfection is required and hyper-chlorination is not practicable, an on-line disinfection using an appropriate disinfectant agent shall be carried out.

When disinfecting distribution systems in buildings, it is important to ensure that all persons in the building are notified that the distribution system is being disinfected and that the water must not be used. Outlets shall be taped and signs placed on each outlet advising of this.

NOTE: STFC will only allow chlorine dioxide as the disinfection agent. Where alternative disinfection agents are intended for use, a written proposal outlining the reasons why an alternative disinfection agent is proposed for use, the proposed disinfection agent, Control Of Substances Hazardous to Health (COSHH) sheets, risk assessment and methodology. Alternative disinfection agents shall not be used without prior written consent from the LPR.

8.3.1 Disinfection of the System using Chlorine dioxide (ClO_2):

i. If CWS storage vessels are associated with the system, they shall be cleaned and disinfected by following ADVICE NOTE: LEG 08 before the distribution system is disinfected.
ii. Any water treatment equipment shall be disconnected from the system.
iii. Treated water must then be used to charge the distribution system. If a storage vessel is associated with the system, the disinfectant solution must be prepared in and supplied by this vessel. If a storage vessel is not associated with the system, a portable vessel must be used to prepare within and supply from the disinfectant solution.
iv. Sampling points representative of the system must be tested using a chlorine dioxide test kit to ensure 50 ppm (**ClO_2**) throughout the system to start disinfection. The whole system must be allowed to stand charged for a minimum period of 1 hour, a representative number of samples must be taken from the distribution system and tested using chlorine dioxide test kit to ensure levels have been maintained above 30 ppm (**ClO_2**). All test and sampling points must be identified and the results of each test recorded.
v. The system shall be thoroughly flushed out with clean mains water until tests indicate that the residual chlorine dioxide concentration is no greater than 0.1ppm (**ClO_2**).
vi. Using a suitable sterile container, collect a water sample and submit for biological analysis. The analysis should measure the presence of contamination by general bacteria (Total Viable Colony Count – TVCC). **NOTE: Samples to be collected no earlier than 48 hours following disinfection.**

8.3.2 Neutralisation:

Normally, chlorine dioxide solutions do not require neutralisation prior to disposal to foul sewer. However, if local conditions require it, 50 ppm disinfectant solutions can be neutralised before disposal with sodium bisulphite (SB) or sodium thiosulphate (ST) at the rate of 350 gm SB/m^3 or 525 gm ST/m^3 of disinfectant solution.

8.4 ADVICE NOTE: LEG 04
Water Storage Tank – 24hr Drop-test

Science & Technology Facilities Council	Legionellosis Management And Control PPM Programme
Task No:	LEG 04
Task:	**Water Storage Tank – 24hr Drop-test**
Frequency:	AS SPECIFIED IN SECTION 7 PRE-PLANNED MAINTENANCE PROGRAMME - TASK FREQUENCIES
If the Maintenance Staff or appointed contractor cannot, at any stage, comply with any part of this Specification, then an alternative Specification shall be agreed which, both; meets the requirements of current legislation and the needs of the Site.	

Cold water storage tanks shall be sized and arranged so as to minimise retention time of stored water (12 hrs maximum), and therefore to increase the rate of stored water exchange.

Cold water storage tanks shall be subjected to a periodic "need" test which requires the user to question the presence of each unit and consider its removal if the services it supplies can be, equally well, supplied by converting the systems to domestic Mains fed only.

Each unit shall be subjected to an annual "drop-test" designed to ascertain the capacity and demand requirements of each system, in order to ensure that excessive volumes of water are not unnecessarily stored:

i. When the tank is full and no water is entering via the inlet, measure the height of the water level in the tank - (A); from the bottom of the tank to the level of water.
ii. During the identified period of maximum demand, isolate the supply to the tank and immediately mark the level of water within the tank using a non-deleterious marker.
iii. After one hour, re-mark the level of water within the tank using a non-deleterious marker and measure the "height" of water used in the one hour – (B).
iii. Divide the height of the water level in the tank - (A) by the "height" of water used in the one hour – (B) to calculate the total capacity of water in hours.

Note: When tanks are linked, the process above must be carried out for the " combined" volume.

8.5 ADVICE NOTE: LEG 05
Water Storage Tank – Temperature Monitoring

Science & Technology Facilities Council	Legionellosis Management And Control PPM Programme
Task No:	LEG 05
Task:	**Water Storage Tank – Temperature Monitoring**
Frequency:	AS SPECIFIED IN SECTION 7 PRE-PLANNED MAINTENANCE PROGRAMME - TASK FREQUENCIES
If the Maintenance Staff or appointed contractor cannot, at any stage, comply with any part of this Specification, then an alternative Specification shall be agreed which, both; meets the requirements of current legislation and the needs of the Site.	

Using a calibrated thermometer, measure and report the following:

i. Ambient (external temperature)
ii. Tank room temperature
iii. Stored water temperature (Temperature of the tanked water shall be monitored via the drain point if practicable)
iv. Supply temperature

Note: Remember to measure and record temperature reading from as far away from the ball cock as possible. Care must be taken not to contaminate the stored water by the use of unclean temperature probes.

8.6 ADVICE NOTE: LEG 06
Water Storage Tank – Visual General Inspection

Science & Technology Facilities Council	Legionellosis Management And Control PPM Programme
Task No:	LEG 06
Task:	**Water Storage Tank – Visual General Inspection**
Frequency:	AS SPECIFIED IN SECTION 7 PRE-PLANNED MAINTENANCE PROGRAMME - TASK FREQUENCIES
If the Maintenance Staff or appointed contractor cannot, at any stage, comply with any part of this Specification, then an alternative Specification shall be agreed which, both; meets the requirements of current legislation and the needs of the Site.	

i. Using a calibrated thermometer, measure and report the following:
Ambient (external temperature); Tank room temperature; Stored water temperature (Temperature of the tanked water shall be monitored via the drain point if practicable); Supply temperature
ii. Visually inspect tank room for bird and/or rodent infestation and state amount:
iii. If insulation allows for inspection of the external condition of the tank walls, inspect for corrosion pitting and leaks
iv. Visually inspect internal walls of tank for signs of scale deposition, corrosion and slime deposits
v. Visually inspect tank and associated valves/pipework for leaks
vi. Visually inspect bottom of tank for sludge deposition and state amount
vii. Visually inspect internal walls of tank for corrosion and state amount
viii. Visually inspect for signs of stagnation such as water surface dirt, oil films, insects, smell, low input
ix. Visually inspect water surface for; dirt, oil films, insects and state amount
x. Visually inspect for slimy deposits on the internal walls of tank and state the colour of substance and state amount
xi. Visually inspect for algae growth indicated by either green or red plant like growth on water surface
xii. Visually inspect the insulation for signs of wear and tear and areas where the insulation has been removed
xiii. Visually inspect that the lid is correctly fitted and that any bolts are securely tightened
xiv. Visually inspect that all insect/rodent screens fitted are clear from debris so that water can flow easily.
xv. Visually inspect that the ball valve opens and closes correctly.
xvi. Visually inspect all pipework for signs of corrosion and leaks, and check the condition of insulation fitted
xvii. Visually inspect all valves for correct operation, signs of corrosion and leaks.
xviii. Visually inspect all booster pumps fitted for correct operation.
xix. Indicate the date that the tank was last cleaned and disinfected and indicate whether it was disinfected as routine or due to adverse conditions.

8.7 ADVICE NOTE: LEG 07
Water Storage Tank – Cleaning and Disinfection

Science & Technology Facilities Council	Legionellosis Management And Control PPM Programme
Task No:	LEG 07
Task:	**Water Storage Tank – Cleaning and Disinfection**
Frequency:	AS SPECIFIED IN SECTION 7 PRE-PLANNED MAINTENANCE PROGRAMME - TASK FREQUENCIES
If the Maintenance Staff or appointed contractor cannot, at any stage, comply with any part of this Specification, then an alternative Specification shall be agreed which, both; meets the requirements of current legislation and the needs of the Site.	

8.7.1 Tank Cleaning

i. The pH of the water shall be measured and must be between 5.5 and 9.0 before chlorinating solution is introduced. If the pH is found to be below 5.5 the system shall be drained, flushed and refilled with fresh water.
ii. The tank(s) shall be filled with fresh water and chlorinating agent to give a minimum free chlorine concentration of 50ppm (50mg/l), and when full, allowed to stand for 1 hour.
iii. After 1 hour, measure free chlorine level, if free chlorine level is below 30ppm, repeat step ii.
iv. The tank(s) shall be drained and then thoroughly flushed out with clean mains water until tests indicate that the residual chlorine concentration is no greater than 0.5ppm (0.5mg/l), or that present in the mains water supply.
v. Where the volume exceeds 5000 litres, the disinfected water must be neutralised, using sodium thiosulphate, before disposal. The neutralised waste MUST NOT be drained through the system.
vi. Fix ball valve in close position.
vii. Isolate Tank from system. Outlets must be sealed from inside tank.
viii. Empty the Tank via drain-point or by using a submersible or barrel type pump, in the absence of a drain-point or if draining from drain-point is impracticable.
ix. Clean Tank and remove all deposits of scale, corrosion and sludge deposition using a combination of hand scraping and brushing together with application of chemicals to dissolve or soften the scale (where necessary). Vacuum out all loose debris and deposits.
x. When using high-pressure jet washers to clean the internal surfaces of the Tank, suitable PPE must be used, including a positive pressure respirator. In this circumstance, the escape of aerosols must be restricted or minimised.
xi. Where oil and grease contaminants on the tank surface are implicated, they shall be removed using suitable de-greasants. Where necessary (and practicable) the tank can be steam cleaned to remove grease contaminants.
xii. Where “significant” or “highly-significant” levels of biological contamination is reported, the Tank shall be disinfected (using the disinfection method below), before the cleaning process is commenced.

8.7.2 Tank Disinfection Using Sodium hypochlorite

i. The pH of the water shall be measured and must be between 5.5 and 9.0 before chlorinating solution is introduced. If pH is found to be below 5.5 the system shall be drained, flushed and refilled with fresh water.
ii. The tank(s) shall be filled with fresh water and chlorinating agent to give a minimum free chlorine concentration of 50ppm (50mg/l), and when full, allow to stand for 1 hour.
iii. After 1 hour, measure free chlorine level, if free chlorine level is below 30ppm, repeat step ii.

iv. The tank(s) shall be drained and then thoroughly flushed out with clean mains water until tests indicate that the residual chlorine concentration is no greater than 0.5ppm (0.5mg/l), or that present in the mains water supply.

v. Where the volume exceeds 5000 litres, the disinfected water must be neutralised, using sodium thiosulphate, before disposal. The neutralised waste MUST NOT be drained through the system.

vi. The tank is to be refilled with fresh water via the inlet ball valve(s).

vii. Using a suitable sterile container, collect a water sample and submit for biological analysis. The analysis should measure the presence of contamination by general bacteria (Total Viable Colony Count – TVCC). Samples to be collected no earlier than 48 hours following disinfection.

8.7.3 Tank Disinfection Using Chlorine dioxide (ClO_2) – Soaking Method

i. Once the activated solution is in the system and adequately mixed, check that a reserve of at least 50mg/L as ClO_2 is given. Add more activated solution if necessary.

ii. Draw chlorinating agent from all outlets and ensure the presence of at least 50ppm ClO2. After 1 hour, check ClO_2 level, if below 30ppm, repeat steps ii. If level is >30ppm ClO_2, after one hour flush system with fresh water and put to drain.

iii. The tank(s) and system shall be thoroughly flushed out with clean mains water until tests indicate that the residual ClO_2 concentration is no greater than 0.5ppm (0.5mg/l), or that present in the mains water supply.

iv. After the one hour soak period, the system can be drained and flushed out and provided the system volume is less than $2m^3$ and the residual less than 20mg/L as ClO_2 can be discharged to sewer without deactivation. For larger volumes/higher residuals then this should be deactivated using Sodium Thiosulphate solution.

v. The area of the storage vessel above the water line (overflow, lid, ball valve etc) shall be manually cleaned and then disinfected by spraying with 500 ppm ClO_2 solution using garden type pressure sprayer ensuring surfaces remain wet for 10 minutes

vi. If the water volume is less than $2m^3$ and the residual ClO_2 content is less than 20 mg/L as ClO_2 then it is probably acceptable to discharge the water to sewer without further deactivation.

vii. The tank is to be refilled with fresh water via the inlet ball valve(s).

viii. Using a suitable sterile container, collect a water sample and submit for biological analysis. The analysis should measure the presence of contamination by general bacteria (Total Viable Colony Count – TVCC). Samples to be collected no earlier than 48 hours following disinfection.

8.7.4 Tank Disinfection Using Chlorine dioxide – Spray Method

i Spray all surfaces of the tank using a knapsack or garden pressure sprayer or fogger, with ready prepared 500ppm ClO_2 solution, ensuring that all surfaces remain wet with disinfectant for at least 10 minutes. Note the requirements for personal protective equipment when spraying of fogging chlorine dioxide solutions.

ii. When the spray disinfection is complete and the solution has been in contact with all surfaces for at least 10 minutes, thoroughly rinse all sprayed surfaces with clean water and remove any residues with pump/wet vac or flush through to drain.

iv. Refill with fresh water and put back into service. Check residual of chlorine dioxide is below 1ppm as ClO_2.

v. Using a suitable sterile container, collect a water sample and submit for biological analysis. The analysis shall measure the presence of contamination by general bacteria (Total Viable Colony Count – TVCC). Samples to be collected no earlier than 48 hours following disinfection.

8.8 ADVICE NOTE: LEG 08
Pressurisation Vessel Flushing

Science & Technology Facilities Council	Legionellosis Management And Control PPM Programme
Task No:	LEG 08
Task:	**Pressurisation Vessel Flushing**
Frequency:	AS SPECIFIED IN SECTION 7 PRE-PLANNED MAINTENANCE PROGRAMME - TASK FREQUENCIES
If the Maintenance Staff or appointed contractor cannot, at any stage, comply with any part of this Specification, then an alternative Specification shall be agreed which, both; meets the requirements of current legislation and the needs of the Site.	

Doubts have been expressed about the desirability of using single entry pressurisation vessels on cold water systems. The use of single entry pressurisation vessels effectively forms a vertical dead-leg through which there is no flow of water and concern has been expressed about the possibility of bacterial growth within the vessel. It is considered preferable therefore, that a pressurisation vessel with both inlet and outlet connections be installed, wherever practicable, so that the water content of the vessel is constantly changed. This will also allow for compliance with BS 6144 and BS 6920.

Where pressurisation vessels are of the single entry type they must be fitted with appropriate drain valves to facilitate flushing of the unit on at least Weekly basis.

All vessels shall be flushed at least weekly for long enough to ensure adequate replacement of its contents.

Care must be taken to avoid damage to the diaphragm.

8.9 ADVICE NOTE: LEG 09
Storage Calorifiers –Temperature Monitoring

Science & Technology Facilities Council	Legionellosis Management And Control PPM Programme
Task No:	LEG 09
Task:	**Storage Calorifiers –Temperature Monitoring**
Frequency:	AS SPECIFIED IN SECTION 7 PRE-PLANNED MAINTENANCE PROGRAMME - TASK FREQUENCIES
If the Maintenance Staff or appointed contractor cannot, at any stage, comply with any part of this Specification, then an alternative Specification shall be agreed which, both; meets the requirements of current legislation and the needs of the Site.	

i. Measure and record the INDIVIDUAL "Set" temperature setting of the thermostat (if fitted and calibrated). Temperature to exceed 60°C.

ii. Measure and record the INDIVIDUAL "Flow" temperature using a contact thermometer or fitted gauge. Temperature to be taken from "Flow" pipework as close to the Calorifier as possible. Temperature to exceed 60°C.

iii. Measure and record the "Return" temperature using a contact thermometer or fitted gauge. Temperature to be taken from "Return" pipework as close to the Calorifier as possible. Temperature to exceed 50°C.

iv. Isolate Cold Feed and open drain point and measure and record temperature. Temperature to exceed 60°C.

v. The temperature measurements shall be carried out at different times during the day in order to allow indicative temperature monitoring of the vessel during a typical daily usage profile.

Note: If contact probe is to be used for temperature monitoring through copper pipework, the appropriate temperature adjustment must be made to the recorded temperature before reporting temperature on the Log-sheet (see table below)

Water temperature	Temperature errors °C (to be added to or subtracted from measured value as indicated)							
	Surface							
	Cu*		ABS		UPVC		Galv	
	1 Min	2 Min	1 Min	2 Min	1 Min	2 Min	1 Min	2 Min
10°C	-2	-2	-7	-6	-7	-6	-2	-2
20°C	-1	-1	-2	-2	-2	-2	-1	-1
30°C	0	0	+7	+6	+7	+6	0	0
40°C	+1	0	+10	+8	+9	+7	+1	+1
50°C	+2	+1	+14	+12	+13	+12	+2	+1
60°C	+2	+2	+39	+17	+39	+17	+3	+3
Water temperature	Pipewrap							
	Cu*		ABS		UPVC		Galv	
	1 Min	2 Min	1 Min	2 Min	1 Min	2 Min	1 Min	2 Min
10°C	-6	-4	-7	-6	-7	-6	-6	-4
20°C	-3	-2	-3	-2	-3	-2	-3	-2
30°C	+2	+1	+3	+2	+3	+2	+2	+1
40°C	+6	+4	+8	+6	+8	+6	+5	+3
50°C	+10	+8	+14	+10	+14	+10	+8	+5
60°C	+15	+10	+20	+15	+20	+15	+12	+8

1 Min = *Measurement after one minute contact time*
2 Min = *Measurement after two minutes contact time*
Cu = *Copper table x, BS 2871: Part 1*
ABS = *Class E plastic*
UPVC = *Class E plastic, BS 3505*
Galv = *Heavy galvanised steel, BS 1387*
* = *Can be used (approximately) for Stainless Steel (BS 4127 Part 2)*
= *Large errors. Only use if intrusive measurement cannot be used.*

Note: Ambient air temperature adjacent to pipework 22°C. Corrections for aged pipework with internal scale deposits may be appropriate.

Source: BSRIA laboratory tests.

8.10 ADVICE NOTE: LEG 10
Storage Calorifiers –Visual General Inspection including drain flushing

Science & Technology Facilities Council	Legionellosis Management And Control PPM Programme
Task No:	LEG 10
Task:	**Storage Calorifiers –Visual General Inspection including drain flushing**
Frequency:	AS SPECIFIED IN SECTION 7 PRE-PLANNED MAINTENANCE PROGRAMME - TASK FREQUENCIES
If the Maintenance Staff or appointed contractor cannot, at any stage, comply with any part of this Specification, then an alternative Specification shall be agreed which, both; meets the requirements of current legislation and the needs of the Site.	

i. Ensure operational status of Calorifier by checking the status of the associated isolation valves
ii. If the Calorifier is OFF, indicate the date it came Off-line
iii. Confirm status of Inlet Valve
iv. Confirm status of Outlet Valve
v. Confirm the operational status of the circulation pump(s)
vi. Confirm the operational status of the shunt pump(s)
vii. Visually inspect Calorifier and associated valves for leaks
viii. Visually inspect all pipework for signs of corrosion and leaks, and visually inspect the condition of insulation fitted. Visually inspect all valves for correct operation, signs of corrosion and leaks
ix. Visually inspect all pumps fitted for correct operation and leaks
x. Measure and record the temperature setting of the thermostat (if fitted)
xi. Measure and record the “flow“ temperature using a contact thermometer or fitted gauge. Temperature to be taken from “flow” pipework as close to the Calorifier as possible.
xii. Measure and record the “return“ temperature using a contact thermometer or fitted gauge. Temperature to be taken from “return” pipework as close to the Calorifier as possible
xiii. Isolate CW feed and open drain point into a bucket and collect approximately the 1st litre of water discharged. Measure and record the condition, viscosity and colour of this water.
xiv. Check for colour, viscosity and sludge deposition amount. Measure and record the temperature of the water
xv. Using a contact thermometer, measure and record the temperature of the calorifier at; the top, middle and bottom. If there is more than 5°C difference between the top temperature and the bottom temperature then the calorifier is suffering from temperature stratification. If a contact thermometer cannot be used, then measure and record the difference in the “flow” temperature and the “drain” temperature.
xvi. Visually inspect the insulation for signs of wear and tear and areas where the insulation has been removed
xvii. Visually inspect that any gauges fitted are operating correctly. Compare against calibrated instruments.
xviii. Open the CW feed valve and then open the drain point allowing enough water to flow through so that any water discoloration is removed.

8.11 ADVICE NOTE: LEG 11
Storage Calorifiers – Pasteurisation

Science & Technology Facilities Council	Legionellosis Management And Control PPM Programme
Task No:	LEG 11
Task:	**Storage Calorifiers – Pasteurisation**
Frequency:	AS SPECIFIED IN SECTION 7 PRE-PLANNED MAINTENANCE PROGRAMME - TASK FREQUENCIES
If the Maintenance Staff or appointed contractor cannot, at any stage, comply with any part of this Specification, then an alternative Specification shall be agreed which, both; meets the requirements of current legislation and the needs of the Site.	

i. Purge Calorifier via drain point and refill.
ii. Isolate all valves on the incoming and outlet sides.
iii. Ensure that the pressure release "blow" valve is capable of withstanding temperatures of up to 80°C.
iv. Bring Calorifier to 70°C (if practicable) and allow to stand at this temperature for at least 1 hour. Where this is not possible an alternative means of disinfection shall be used.
v. Ensure that no water is drawn from the Calorifier whilst pasteurisation in progress.
vi. Allow Calorifier to reach its normal operating temperature, ≥60°C, and return to service.
vii. Using a suitable sterile container, collect a water sample and submit for biological analysis. The analysis should measure the presence of contamination by general bacteria (Total Viable Colony Count – TVCC). Samples to be collected no earlier than 48 hours following pasteurisation.

8.12 ADVICE NOTE: LEG 12
Expansion Vessel Flushing

Science & Technology Facilities Council	Legionellosis Management And Control PPM Programme
Task No:	LEG 12
Task:	**Expansion Vessel Flushing**
Frequency:	AS SPECIFIED IN SECTION 7 PRE-PLANNED MAINTENANCE PROGRAMME - TASK FREQUENCIES
If the Maintenance Staff or appointed contractor cannot, at any stage, comply with any part of this Specification, then an alternative Specification shall be agreed which, both; meets the requirements of current legislation and the needs of the Site.	

Doubts have been expressed about the desirability of using single entry expansion vessels on hot water systems. The use of single entry expansion vessels effectively forms a vertical dead-leg through which there is no flow of water and concern has been expressed about the possibility of bacterial growth within the vessel. It is considered preferable therefore, that an expansion vessel with both inlet and outlet connections should be installed, wherever practicable, so that the water content of the vessel is constantly changed. This will also allow for compliance with BS 6144 and BS 6920.

Where expansion vessels are of the single entry type they must be fitted with appropriate drain valves to facilitate flushing of the unit on at least Weekly basis.

All vessels shall be flushed at least weekly for long enough to ensure adequate replacement of its contents.

Care must be taken to avoid damage to the diaphragm.

8.13 ADVICE NOTE: LEG 13
Cistern Type Water Heaters – Temperature Monitoring

Science & Technology Facilities Council	Legionellosis Management And Control PPM Programme
Task No:	LEG 13
Task:	**Cistern Type Water Heaters – Temperature Monitoring**
Frequency:	AS SPECIFIED IN SECTION 7 PRE-PLANNED MAINTENANCE PROGRAMME - TASK FREQUENCIES
If the Maintenance Staff or appointed contractor cannot, at any stage, comply with any part of this Specification, then an alternative Specification shall be agreed which, both; meets the requirements of current legislation and the needs of the Site.	

i. Measure and record the "Set" temperature setting of the thermostat (if fitted and calibrated). Temperature to be at least 60°C.
ii. Measure and record the temperature of the furthest outlet supplied by the unit. Temperature to be at least 50°C within 1 min.
iii. The temperature measurements shall be carried out at different times during the day in order to allow indicative temperature monitoring of the vessel during a typical daily usage profile.

Note: If contact probe is to be used for temperature monitoring through copper pipework, the appropriate temperature adjustment must be made to the recorded temperature before reporting temperature on the Log-sheet (see table below)

Water temperature	Temperature errors °C (to be added to or subtracted from measured value as indicated)							
	Surface							
	Cu*		ABS		UPVC		Galv	
	1 Min	2 Min	1 Min	2 Min	1 Min	2 Min	1 Min	2 Min
10°C	-2	-2	-7	-6	-7	-6	-2	-2
20°C	-1	-1	-2	-2	-2	-2	-1	-1
30°C	0	0	+7	+6	+7	+6	0	0
40°C	+1	0	+10	+8	+9	+7	+1	+1
50°C	+2	+1	+14	+12	+13	+12	+2	+1
60°C	+2	+2	+39	+17	+39	+17	+3	+3
Water temperature	Pipewrap							
	Cu*		ABS		UPVC		Galv	
	1 Min	2 Min	1 Min	2 Min	1 Min	2 Min	1 Min	2 Min
10°C	-6	-4	-7	-6	-7	-6	-6	-4
20°C	-3	-2	-3	-2	-3	-2	-3	-2
30°C	+2	+1	+3	+2	+3	+2	+2	+1
40°C	+6	+4	+8	+6	+8	+6	+5	+3
50°C	+10	+8	+14	+10	+14	+10	+8	+5
60°C	+15	+10	+20	+15	+20	+15	+12	+8

1 Min = *Measurement after one minute contact time*
2 Min = *Measurement after two minutes contact time*
Cu = *Copper table x, BS 2871: Part 1*
ABS = *Class E plastic*
UPVC = *Class E plastic, BS 3505*
Galv = *Heavy galvanised steel, BS 1387*
* = *Can be used (approximately) for Stainless Steel (BS 4127 Part 2)*
= *Large errors. Only use if intrusive measurement cannot be used.*

Note: Ambient air temperature adjacent to pipework 22°C. Corrections for aged pipework with internal scale deposits may be appropriate.

Source: BSRIA laboratory tests.

8.14 ADVICE NOTE: LEG 14
Cistern Type Water Heaters – Inspection of Tank Section

Science & Technology Facilities Council	Legionellosis Management And Control PPM Programme
Task No:	LEG 14
Task:	**Cistern Type Water Heaters – Inspection of Tank Section**
Frequency:	AS SPECIFIED IN SECTION 7 PRE-PLANNED MAINTENANCE PROGRAMME - TASK FREQUENCIES
If the Maintenance Staff or appointed contractor cannot, at any stage, comply with any part of this Specification, then an alternative Specification shall be agreed which, both; meets the requirements of current legislation and the needs of the Site.	

i. If casing allows for inspection of the external condition of the unit walls, inspect for corrosion pitting and leaks
ii. Visually inspect tank and associated valves/pipework for leaks
iii. Visually inspect bottom of tank for sludge deposition and state amount
iv. Visually inspect internal walls of tank for corrosion and state amount:
v. Visually inspect water surface for; dirt, oil films, insects and state amount
vi. Visually inspect for slimy deposits on the internal walls of tank and state the colour of substance and state amount
vii. Visually inspect for algae growth indicated by either green or red plant like growth on water surface
viii. Visually inspect the insulation for signs of wear and tear
ix. Visually inspect that the lid is correctly fitted
x. Visually inspect that all insect/rodent screens fitted are clear from debris so that water can flow easily.
xi. Visually inspect that the ball valve opens and closes correctly
xii. Visually inspect all pipework for signs of corrosion and leaks, and check the condition of insulation fitted.
xiii. Indicate the date that the tank was last cleaned and disinfected and indicate whether it was disinfected as routine or due to adverse conditions.

8.15 ADVICE NOTE: LEG 15
Cistern Type Water Heaters – Clean and Disinfection

Science & Technology Facilities Council	Legionellosis Management And Control PPM Programme
Task No:	LEG 15
Task:	**Cistern Type Water Heaters – Clean and Disinfection**
Frequency:	AS SPECIFIED IN SECTION 7 PRE-PLANNED MAINTENANCE PROGRAMME - TASK FREQUENCIES
If the Maintenance Staff or appointed contractor cannot, at any stage, comply with any part of this Specification, then an alternative Specification shall be agreed which, both; meets the requirements of current legislation and the needs of the Site.	

i. Clean Tank and remove all deposits of scale, corrosion and sludge deposition using a combination of hand scraping and brushing together with application of chemicals to dissolve or soften the scale (where necessary). Vacuum out all loose debris and deposits.
ii. The tank section of the unit shall be filled with fresh water and chlorine dioxide to give a minimum chlorine dioxide concentration of 50ppm (50mg/l).
iii. Draw chlorinating agent from all outlets supplied by the unit and ensure the presence of at least 50ppm free chlorine at each outlet. After 1 hour, chlorine dioxide level, if chlorine dioxide level is below 30ppm, repeat steps ii & iii. If level is >30ppm free chlorine, after one hour flush system with fresh water and drain.
iv. Refill cistern with fresh water via inlet valve.
vi. Using a suitable sterile container, collect a water sample and submit for biological analysis. The analysis should measure the presence of contamination by general bacteria (Total Viable Colony Count – TVCC). Samples to be collected no earlier than 48 hours following disinfection.

8.16 ADVICE NOTE: LEG 16
Low Volume Water Heater >15 litres– Temperature Monitoring

Science & Technology Facilities Council	Legionellosis Management And Control PPM Programme
Task No:	LEG 16
Task:	**Low Volume Water Heater >15 litres– Temperature Monitoring**
Frequency:	AS SPECIFIED IN SECTION 7 PRE-PLANNED MAINTENANCE PROGRAMME - TASK FREQUENCIES
If the Maintenance Staff or appointed contractor cannot, at any stage, comply with any part of this Specification, then an alternative Specification shall be agreed which, both; meets the requirements of current legislation and the needs of the Site.	

i. Measure and record the "Set" temperature setting of the thermostat (if fitted and calibrated). Temperature to be at least 60°C
ii. Measure and record the temperature of the furthest outlet supplied by the unit. Temperature to be at least 50°C within 1 min
iii. The temperature measurements shall be carried out at different times during the day in order to allow indicative temperature monitoring of the vessel during a typical daily usage profile

Note: If contact probe is to be used for temperature monitoring through copper pipework, the appropriate temperature adjustment must be made to the recorded temperature before reporting temperature on the Log-sheet (see table below)

Water temperature	Temperature errors °C (to be added to or subtracted from measured value as indicated)							
	Surface							
	Cu*		ABS		UPVC		Galv	
	1 Min	2 Min	1 Min	2 Min	1 Min	2 Min	1 Min	2 Min
10°C	-2	-2	-7	-6	-7	-6	-2	-2
20°C	-1	-1	-2	-2	-2	-2	-1	-1
30°C	0	0	+7	+6	+7	+6	0	0
40°C	+1	0	+10	+8	+9	+7	+1	+1
50°C	+2	+1	+14	+12	+13	+12	+2	+1
60°C	+2	+2	+39	+17	+39	+17	+3	+3
Water temperature	Pipewrap							
	Cu*		ABS		UPVC		Galv	
	1 Min	2 Min	1 Min	2 Min	1 Min	2 Min	1 Min	2 Min
10°C	-6	-4	-7	-6	-7	-6	-6	-4
20°C	-3	-2	-3	-2	-3	-2	-3	-2
30°C	+2	+1	+3	+2	+3	+2	+2	+1
40°C	+6	+4	+8	+6	+8	+6	+5	+3
50°C	+10	+8	+14	+10	+14	+10	+8	+5
60°C	+15	+10	+20	+15	+20	+15	+12	+8

1 Min = *Measurement after one minute contact time*
2 Min = *Measurement after two minutes contact time*
Cu = *Copper table x, BS 2871: Part 1*
ABS = *Class E plastic*
UPVC = *Class E plastic, BS 3505*
Galv = *Heavy galvanised steel, BS 1387*
* = *Can be used (approximately) for Stainless Steel (BS 4127 Part 2)*
= *Large errors. Only use if intrusive measurement cannot be used.*

Note: Ambient air temperature adjacent to pipework 22°C. Corrections for aged pipework with internal scale deposits may be appropriate.

Source: BSRIA laboratory tests.

8.17 ADVICE NOTE: LEG 17
Combination Boiler – Temperature Monitoring

Science & Technology Facilities Council	Legionellosis Management And Control PPM Programme
Task No:	LEG 17
Task:	**Combination Boiler – Temperature Monitoring**
Frequency:	AS SPECIFIED IN SECTION 7 PRE-PLANNED MAINTENANCE PROGRAMME - TASK FREQUENCIES
If the Maintenance Staff or appointed contractor cannot, at any stage, comply with any part of this Specification, then an alternative Specification shall be agreed which, both; meets the requirements of current legislation and the needs of the Site.	

i. Measure and record the "Set" temperature setting of the thermostat (if fitted and calibrated). Temperature to be at least 60°C

ii. Measure and record the temperature of the furthest outlet supplied by the unit. Temperature to be at least 50°C within 1 min

iii. The temperature measurements shall be carried out at different times during the day in order to allow indicative temperature monitoring of the vessel during a typical daily usage profile

Note: If contact probe is to be used for temperature monitoring through copper pipework, the appropriate temperature adjustment must be made to the recorded temperature before reporting temperature on the Log-sheet (see table below)

Water temperature	Temperature errors °C (to be added to or subtracted from measured value as indicated)							
	Surface							
	Cu*		ABS		UPVC		Galv	
	1 Min	2 Min	1 Min	2 Min	1 Min	2 Min	1 Min	2 Min
10°C	-2	-2	-7	-6	-7	-6	-2	-2
20°C	-1	-1	-2	-2	-2	-2	-1	-1
30°C	0	0	+7	+6	+7	+6	0	0
40°C	+1	0	+10	+8	+9	+7	+1	+1
50°C	+2	+1	+14	+12	+13	+12	+2	+1
60°C	+2	+2	+39	+17	+39	+17	+3	+3
Water temperature	Pipewrap							
	Cu*		ABS		UPVC		Galv	
	1 Min	2 Min	1 Min	2 Min	1 Min	2 Min	1 Min	2 Min
10°C	-6	-4	-7	-6	-7	-6	-6	-4
20°C	-3	-2	-3	-2	-3	-2	-3	-2
30°C	+2	+1	+3	+2	+3	+2	+2	+1
40°C	+6	+4	+8	+6	+8	+6	+5	+3
50°C	+10	+8	+14	+10	+14	+10	+8	+5
60°C	+15	+10	+20	+15	+20	+15	+12	+8

1 Min = *Measurement after one minute contact time*
2 Min = *Measurement after two minutes contact time*
Cu = *Copper table x, BS 2871: Part 1*
ABS = *Class E plastic*
UPVC = *Class E plastic, BS 3505*
Galv = *Heavy galvanised steel, BS 1387*
* = *Can be used (approximately) for Stainless Steel (BS 4127 Part 2)*
= *Large errors. Only use if intrusive measurement cannot be used.*

Note: Ambient air temperature adjacent to pipework 22°C. Corrections for aged pipework with internal scale deposits may be appropriate.

Source: BSRIA laboratory tests.

8.18 ADVICE NOTE: LEG 18

Instant Water Heater <15 litres– Temperature Monitoring – Temperature Monitoring

Science & Technology Facilities Council	Legionellosis Management And Control PPM Programme
Task No:	LEG 18
Task:	**Instant Water Heater <15 litres– Temperature Monitoring – Temperature Monitoring**
Frequency:	AS SPECIFIED IN SECTION 7 PRE-PLANNED MAINTENANCE PROGRAMME - TASK FREQUENCIES
If the Maintenance Staff or appointed contractor cannot, at any stage, comply with any part of this Specification, then an alternative Specification shall be agreed which, both; meets the requirements of current legislation and the needs of the Site.	

Units of this type, because of the limited stored water volume, do not usually need to be operated within the temperature profile and limits prescribed for larger systems (≥60°C for the 'flow' and ≥50°C for the 'return' and 'outlet') which are necessary for thermal disinfection. It maybe possible to operate these units at "safe" temperatures of ≤41.0°C although they must be switched-on at all times to ensure and encourage adequate use. However, infrequent use of these units (less than daily) would increase the potential of bacterial growth and proliferation (as would be the case in all infrequently used areas throughout the system – both hot and cold), although particularly in this case because of the low temperatures operated

8.19 ADVICE NOTE: LEG 19
TMV/TMT – Temperature Monitoring

Science & Technology Facilities Council	Legionellosis Management And Control PPM Programme
Task No:	LEG 19
Task:	**TMV/TMT – Temperature Monitoring**
Frequency:	AS SPECIFIED IN SECTION 7 PRE-PLANNED MAINTENANCE PROGRAMME - TASK FREQUENCIES
If the Maintenance Staff or appointed contractor cannot, at any stage, comply with any part of this Specification, then an alternative Specification shall be agreed which, both; meets the requirements of current legislation and the needs of the Site.	

8.19.1 Showers, Baths and Bidets

i. Measure and record the "Initial" and "Final" outlet temperature, of each shower and bath fitted with a TMV/TMT. The measurements shall be carried out immediately and after allowing the water to run for 1 minute at full-flow respectively. The "Initial" and "Final" outlet temperature measured shall not to exceed:

a. 41°C for showers
b. 41°C for basin
c. 44°C for baths
d. 37°C for bidets

Where these temperatures are exceeded, the TMV/TMT shall be adjusted in order to allow the unit to operate within the recommended temperature limits described above

8.19.2 Sinks and basins and other non full body immersion outlets

i. Measure and record the "Initial" and "Final" outlet temperature, of the HOT water outlet of each sink, basin and other non-full body immersion outlets fitted with a TMV/TMT. The measurements shall be carried out immediately and after allowing the water to run for 1 minute at full-flow respectively. The "Initial" and "Final" outlet temperature measured shall not exceed 41°C.
ii. Where these temperatures are exceeded, the TMV/TMT shall be adjusted in order to allow the unit to operate within the recommended temperature limits described above.
iii. Using an electronic and calibrated thermometer with a suitable contact probe, measure and record the temperature of the HWS supply pipe ONLY of each TMV/TMT. The temperature of the HWS shall not be less than 50°C. The measurements shall be carried out following task 2. (i).
iv. Measure and record the COLD water outlets of each sink, basin and other non-full body immersion outlets fitted with a TMV/TMT. The measurements shall be carried out immediately and after allowing the water to run for 2 minutes at full-flow respectively. The outlet temperature measured shall not exceed 20°C

8.20 ADVICE NOTE: LEG 20
TMV/TMT – General Condition Inspections & servicing

Science & Technology Facilities Council	Legionellosis Management And Control PPM Programme
Task No:	LEG 20
Task:	**TMV/TMT – General Condition Inspections & servicing**
Frequency:	AS SPECIFIED IN SECTION 7 PRE-PLANNED MAINTENANCE PROGRAMME - TASK FREQUENCIES
If the Maintenance Staff or appointed contractor cannot, at any stage, comply with any part of this Specification, then an alternative Specification shall be agreed which, both; meets the requirements of current legislation and the needs of the Site.	

i. Inlet check valves (if fitted): Measure inlet pipework surface temperature for indication of cross-flow. A more effective test can be considered if appropriate, utilising drain points positioned between isolating and check-valves
ii. Temperature measurements: a) locked; b) adjustable/pre-set maximum, Operate flow controls and measure blended temperature. Measure maximum and minimum blended temperature. For thermostat and pressure-balanced mixers, blend temperature shall stabilise quickly and remain within +2°C of set value. For manual mixers, refer to commissioning data
iii. Thermal shut-down (TMV/TMT only): Operate mixer at blended temperature, then isolate cold supply. Valve must shut down in accordance with the manufacturer's data
iv. Temperature control: Operate mixer at blended temperature, then open other local cold outlets off common supply. Measure shift in blend temperature with reference data compiled at the commissioning stage
v. Strainers: Isolate and visually inspect and clean as necessary.
vi. Flow control(s): Operate fully and check for effective closure. If time delay is incorporated, measure length of flow cycle
vii. Automatic drain valve (if fitted): Check effective operation.
viii. Mixing valve: a) temperature control; b) flow control(s); c) inlet check valves. Where specified by manufactures guidance and/or site conditions and inspection confirms the requirement, carry out visual inspection of internal serviceable mechanisms. Clean or renew components as necessary. Lubricate as indicated in manufacturer's data. Refer to manufacturer's data for recommended procedures and cleaning agents/lubricants. For products of (serviceable) cartridge construction, fit and commission exchange units if required
viii. Service displaced units in workshop as part of rolling planned maintenance procedure
ix. Supply pipe-work: Visually inspect for damage leaks, etc. and rectify
x. For all new installations, record the supply pressures to allow the appointed person to compare these pressures and temperatures to confirm agreement with commissioning data
x. Controls: Operate inlet valves and check individual flow rates of hot and cold water supplies. If valve is stripped down and reassembled all parts shall be greased as recommended in the manufacturer's maintenance instructions
xi. Thermostat: Check mixed water outlet setting. Ensure thermometer bulb is immersed in flowing water if measurement taken at shower head
xii. Temperature limiter: Measure mixed water outlet temperature at limit safety stop. Limiter setting 41°C
xiii. Inlet check valves (where fitted): Check operation. Non-return valves may have been removed if operating with balanced pressure supplies).

8.21 ADVICE NOTE: LEG 21
TMV/TMT – Clean, De-scale and Disinfection

Science & Technology Facilities Council	Legionellosis Management And Control PPM Programme
Task No:	LEG 21
Task:	**TMV/TMT – Clean, De-scale and Disinfection**
Frequency:	AS SPECIFIED IN SECTION 7 PRE-PLANNED MAINTENANCE PROGRAMME - TASK FREQUENCIES
If the Maintenance Staff or appointed contractor cannot, at any stage, comply with any part of this Specification, then an alternative Specification shall be agreed which, both; meets the requirements of current legislation and the needs of the Site.	

When site conditions are found to result in scale build-up within a valve, the valve should be de-scaled and disinfected as per this specification to a frequency determined by site tests and inspections.

i. Each TMV/TMT shall be removed from its location and replaced with a new or previously serviced TMV. The removed TMV/TMT shall be taken to a suitably equipped work-shop for service.
ii. At the work-shop, each TMV/TMT shall be dismantled and physically cleaned from all scale deposits and scale deposition (using a suitable de-scaling solution where necessary).
iii. All components shall be disinfected (this applies to all cleaned and new components). All components shall be flushed with clean water and immersed in a Sodium hypochlorite disinfectant solution (100 ppm) for 20 minutes minimum.
iv. Remove components from disinfectant solution and rinse with clean water to remove presence of chlorine.
v. Reassemble, refit and test operation of valve, including fail-safe test.
vi. Rinse in clean water, allow to drip-dry and store in a cool and dry place.

8.22 ADVICE NOTE: LEG 22
Shower – Temperature Monitoring

Science & Technology Facilities Council	Legionellosis Management And Control PPM Programme
Task No:	LEG 22
Task:	**Shower – Temperature Monitoring**
Frequency:	AS SPECIFIED IN SECTION 7 PRE-PLANNED MAINTENANCE PROGRAMME - TASK FREQUENCIES
If the Maintenance Staff or appointed contractor cannot, at any stage, comply with any part of this Specification, then an alternative Specification shall be agreed which, both; meets the requirements of current legislation and the needs of the Site.	

i. Measure and record the "Initial" and "Final" outlet temperature, of each shower fitted with a TMV. The measurements shall be carried out immediately and after allowing the water to run for 1 minute at full-flow respectively. The "Initial" and "Final" outlet temperature measured shall not to exceed 41°C

ii. Where this temperature is exceeded, the TMV shall be adjusted in order to allow the unit to operate within the recommended temperature limits described above

iii. Using an electronic and calibrated thermometer with a suitable contact probe, measure and record the temperature of the HWS and CWS supply pipes of each TMV. The temperature of the CWS shall not exceed 20°C and the temperature of the HWS shall not be less than 50°C. The measurements shall be carried out following task 1. (i).

8.23 ADVICE NOTE: LEG 23
Shower – Head Replacement / Clean and Disinfection

Science & Technology Facilities Council	Legionellosis Management And Control PPM Programme
Task No:	LEG 23
Task:	**Shower – Head Replacement / Clean and Disinfection**
Frequency:	AS SPECIFIED IN SECTION 7 PRE-PLANNED MAINTENANCE PROGRAMME - TASK FREQUENCIES
If the Maintenance Staff or appointed contractor cannot, at any stage, comply with any part of this Specification, then an alternative Specification shall be agreed which, both; meets the requirements of current legislation and the needs of the Site.	

8.23.1 Shower Head Replacement

i. Examine shower head for signs of dirt, scale and slime deposition
ii. If any of the above is considered to be significant, replace existing shower head with new, packaged shower head and dispose of the old shower head in an appropriate manner

8.23.2 Shower Head Clean and Disinfection

i. Each shower-head shall be removed from its location and replaced with a new or previously serviced shower-head. The removed unit shall be taken to a suitably equipped work-shop for service.
ii. At the work-shop, each shower-head shall be dismantled and physically cleaned from all scale deposits and scale deposition (using a suitable descaling solution where necessary).
iii. Rinse in clean water.
iv. All components shall be disinfected (this applies to all cleaned and new components). All components shall be flushed with clean water and immersed in a Sodium hypochlorite disinfectant solution (100 ppm) for 20 minutes minimum
v. Remove components from disinfectant solution and rinse with clean water to remove presence of chlorine
vi. Rinse in clean water, allow to drip-dry and store in a cool and dry place

9 ENGINEERING CONTINGENCY MEASURES

9.1 HIGHER THAN RECOMMENDED CWS TEMPERATURES

Results Interpretation and Specific Action Required: The information below is meant to indicate some possible causes and suitable remedial action and shall not be considered exhaustive. Each failure must be considered in detail and the causes suitably addressed.

Result	Possible cause	Remedial Action
Mains >20°C	1. High ambient temperatures	• Consider on-line disinfectant to negate temperature control as primary bacterial control method. • Increase water through-put by strategic flushing to reduce water retention time. • When temperature exceeds 20°C persistently; carry out biological sampling (as described in Section 8 and LEG 01) to ascertain effect of increased CWS temperatures.
Tank temperature >2°C than Mains temperature	1. Tank over capacity	• Reduce stored water capacity to reduce water retention time. • Increase water through-put by strategic flushing to reduce water retention time. • Carry out biological sampling (as described in Section 8 and LEG 01) to ascertain effect of increased CWS temperatures.
	2. Lack of adequate tank insulation	• Install or improve tank insulation.
	3. High tank room temperatures	• Increase tank room ventilation.
Outlet temperatures greater than mains/tank temperatures	1. Areas of "low-flow" or dead-legs in the system and lack of adequate use causing stagnation	• Increase water through-put by strategic flushing to reduce water retention time.
	2. Lack of adequate insulation	• Install or improve tank insulation.
	3. Heating pipes in close proximity to CWS pipes	• Increase insulation • Consider relocation of CWS/heating pipes if practicable. • Consider on-line disinfectant to negate temperature control as primary bacterial control method.

NOTE: Ensure that all temperature measuring instruments including: thermometers; gauges and BMS Temperature monitoring points are adequately calibrated.

9.2 LOWER THAN RECOMMENDED HWS TEMPERATURES

Results Interpretation and Specific Action Required: The information below is meant to indicate some possible causes and suitable remedial action and should not be considered exhaustive. Each failure must be considered in detail and the causes suitably addressed.

Result	Possible cause	Remedial Action
Stored and/or Flow temperatures <60°C	1. Low "Set" temperatures for hot water generation of <60°C	• Increase temperature to ≥60°C. • If temperature <50°C, carry-out pasteurisation of vessel. • Carry out biological sampling (as described in Section 8 and LEG 01) to ascertain effect of decreased HWS temperatures.
	2. Thermostat failure	• Replace thermostat. • Carry-out pasteurisation of vessel before use. • Carry out biological sampling (as described in Section 8 and LEG 01) to ascertain effect of decreased HWS temperatures.
	3. Primary heating supply isolated	• Employ heating supply. • Carry-out pasteurisation of vessel before use. • Carry out biological sampling (as described in Section 8 and LEG 01) to ascertain effect of decreased HWS temperatures.
	4. Primary heating failure	• Repair primary heating supply. • Carry-out pasteurisation of vessel before use. • Carry out biological sampling (as described in Section 8 and LEG 01) to ascertain effect of decreased HWS temperatures.
	5. Generation units under-rating/under capacity	• Consider capacity vs demand and replace unit with more suitably sized vessel. • Carry-out pasteurisation of replacement vessel prior to being put into service.
	6. Temperature taken with contact probe	• Obtain 'direct' temperature, using calibrated thermometer, from ideally located sampling point and reconsider results.
	7. Gauges and/or BMS temperature monitoring points not calibrated	• Calibrate all gauges and/or BMS monitoring points and reconsider results.
Return temperature <50°C when Flow temperature >60°C	1. Distribution system short circuiting	• Carry out investigation of distribution pipe-work to locate possible short-circuit.
	2. Circulation pump under rated	• Upgrade circulation pump to a suitable rating. • Carry out biological sampling (as described in Section 8 and LEG 01) to ascertain effect of decreased HWS temperatures.
	3. Circulation pump faulty	• Replace/repair circulation pump.
	4. Temperature measurement taken down stream of cold supply	• Re-measure temperature from location upstream of cold supply.

	5. Temperature taken with contact probe	• Obtain 'direct' temperature, using calibrated thermometer, from ideally located sampling point and reconsider results.
	6. Gauges and/or BMS temperature monitoring points not calibrated	• Calibrate all gauges and/or BMS monitoring points and reconsider results.
Distribution temperatures <50°C when Flow temperature >60°C	1. Excessive heat loss.	• Inspect HWS and CWS insulation and upgrade where practicable. • Carry out biological sampling (as described in Section 8 and LEG 01) to ascertain effect of decreased HWS temperatures.
	2. "non-returned" pipe spurs	• Inspect the length of non-returned spurs and rectify by relocating HWS Return to within 300mm of point of delivery if practicable.
	3. Areas of "low-flow" or dead-legs in the system	• Increase water through-put by strategic flushing to reduce water retention time. • Carry out biological sampling (as described in Section 8 and LEG 01) to ascertain effect of decreased HWS temperatures.
	4. Presence of space-heating apparatus on the HWS system	• Investigate the presence of heat loss due the presence of space heating (towel rails, linen cupboard heaters, etc.) and remove from the system. • Carry out biological sampling (as described in Section 8 and LEG 01) to ascertain effect of decreased HWS temperatures.
	5. Failure of Trace Heating system or Trace Heating system not extending to extremities of the system.	• Inspect the Trace heating system and repair/replace if necessary or extend system to allow for temperature maintenance to system spurs. • Carry out biological sampling (as described in Section 8 and LEG 01) to ascertain effect of decreased HWS temperatures.

9.3 BIOLOGICAL RESULT INTERPRETATIONS AND APPROPRIATE ACTIONS – DOMESTIC WATER SYSTEMS

9.3.1 PRE-FLUSH ANALYSIS RESULTS IN THE ABSENCE OF POST-FLUSH ANALYSIS CONTAMINATION

<table>
<tr><td colspan="2">Sample Taken</td><td rowspan="2">Result Interpretation</td><td rowspan="2">Action Required
<u>(Initial Sample)</u>
(To be carried out by incumbent Water Hygiene Contractor with the assistance of the Legionella Consultant)</td><td colspan="4" rowspan="2">Action Required
<u>(Re-Sample)</u>
(To be carried out by incumbent Water Hygiene Contractor with the assistance of the Legionella Consultant)</td></tr>
<tr><td>Pre-Flush</td><td>Post-Flush</td></tr>
<tr><td>Negative</td><td>Negative</td><td>No contamination detected in sample</td><td>No Action Required</td><td colspan="4">Not Applicable</td></tr>
<tr><td>Insignificant</td><td>Negative</td><td>Contamination probably localised only</td><td>Flush outlet thoroughly</td><td colspan="4">Review Management & Control Programme to ensure adequate and correct implementation</td></tr>
<tr><td rowspan="2">Significant</td><td rowspan="2">Negative</td><td rowspan="2">Contamination probably localised only</td><td rowspan="2">Chemically clean outlet. Flush outlet thoroughly and re-sample</td><td>Negative</td><td>Insignificant</td><td>Significant</td><td>Highly Significant</td></tr>
<tr><td rowspan="2">No Further Action Required</td><td rowspan="2">Review Management & Control Programme to ensure adequate and correct implementation</td><td colspan="2" rowspan="2">Take outlet out of use immediately. Chemically clean, disinfect and replace outlet. Flush outlet thoroughly and re-sample.

Investigate local installation and fittings and search for dead-legs, non WRAS approved materials.

Repeat Process.</td></tr>
<tr><td>Highly Significant</td><td>Negative</td><td>Contamination probably localised only</td><td>Take outlet out of use immediately. Chemically clean/replace outlet. Flush outlet thoroughly and re-sample</td></tr>
</table>

9.3.2 POST-FLUSH ANALYSIS RESULTS IN THE ABSENCE OF PRE-FLUSH ANALYSIS CONTAMINATION

<table>
<tr><td colspan="2">Sample Taken</td><td rowspan="2">Result Interpretation</td><td rowspan="2">Action Required
<u>(Initial Sample)</u>
(To be carried out by incumbent Water Hygiene Contractor with the assistance of the Legionella Consultant)</td><td colspan="4" rowspan="2">Action Required
<u>(Re-Sample)</u>
(To be carried out by incumbent Water Hygiene Contractor with the assistance of the Legionella Consultant)</td></tr>
<tr><td>Pre-Flush</td><td>Post-Flush</td></tr>
<tr><td>Negative</td><td>Negative</td><td>No contamination detected in sample</td><td>No Action Required</td><td colspan="4">Not Applicable</td></tr>
<tr><td>Negative</td><td>Insignificant</td><td>Contamination probably systemic</td><td>Flush outlet and system thoroughly.</td><td colspan="4">Review Management & Control Programme to ensure adequate and correct implementation</td></tr>
<tr><td rowspan="2">Negative</td><td rowspan="2">Significant</td><td rowspan="2">Contamination probably systemic</td><td rowspan="2">Flush outlet and system thoroughly and re-sample.</td><td>Negative</td><td>Insignificant</td><td>Significant</td><td>Highly Significant</td></tr>
<tr><td rowspan="2">No Further Action Required</td><td rowspan="2">Review Management & Control Programme to ensure adequate and correct implementation</td><td rowspan="2">Take system out of use immediately. Instigate system disinfection and re-sample
(not earlier than 48hrs following disinfection).

Investigate local installation and distribution system and fittings and search for dead-legs, non WRAS approved materials.

Repeat Process.</td></tr>
<tr><td>Negative</td><td>Highly Significant</td><td>Contamination probably systemic</td><td>Take system out of use immediately. Instigate system decontamination and re-sample.</td></tr>
</table>

9.3.3 POST-FLUSH ANALYSIS RESULTS IN THE PRESENCE OF PRE-FLUSH ANALYSIS CONTAMINATION

<table>
<tr><th colspan="2">Sample Taken</th><th rowspan="2">Result Interpretation</th><th rowspan="2">Action Required
<u>(Initial Sample)</u>
(To be carried out by incumbent Water Hygiene Contractor with the assistance of the Legionella Consultant)</th><th colspan="4" rowspan="2">Action Required
<u>(Re-Sample)</u>
(To be carried out by incumbent Water Hygiene Contractor with the assistance of the Legionella Consultant)</th></tr>
<tr><th>Pre-Flush</th><th>Post-Flush</th></tr>
<tr><td rowspan="4">ANY SAMPLE RESULT</td><td>Negative</td><td>No contamination detected in sample</td><td>No Action Required</td><td colspan="4">Review Management & Control Programme to ensure adequate and correct implementation</td></tr>
<tr><td>Insignificant</td><td>Contamination probably systemic with likely localised contamination</td><td>Flush outlet thoroughly.</td><td colspan="4">Not Applicable</td></tr>
<tr><td>Significant</td><td>Contamination probably systemic with likely localised contamination</td><td rowspan="2">Flush outlet and system thoroughly and re-sample.</td><td>Negative</td><td>Insignificant</td><td>Significant</td><td>Highly Significant</td></tr>
<tr><td>Highly Significant</td><td>Contamination probably systemic with likely localised contamination</td><td>No Further Action Required</td><td>Review Management & Control Programme to ensure adequate and correct implementation</td><td colspan="2" rowspan="2">Take system out of use immediately. Chemically clean, disinfect and replace outlet. Instigate system disinfection and re-sample (not earlier than 48hrs following disinfection).

Investigate local installation and distribution system and fittings and search for dead-legs, non WRAS approved materials.

Repeat Process.</td></tr>
<tr><td colspan="2">Take system out of use immediately. Chemically clean outlet. Instigate system decontamination and re-sample.</td><td colspan="2">Take system out of use immediately. Chemically clean outlet. Instigate system decontamination and re-sample.</td></tr>
</table>

9.4 BIOLOGICAL ANALYSIS RESULTS INTERPRETATION KEY – DOMESTIC WATER SYSTEMS

Analysis Sample	Reported Results	Result Interpretation
Aerobic count TVCC (22°C or 37°C)	None Detected	Negative
	$>10^1$cfu/ml - $<10^3$cfu/ml	Insignificant
	$>10^3$cfu/ml - $<10^4$cfu/ml	Significant
	$>10^4$ cfu/ml	Highly Significant
Legionella spp.	None Detected	Negative
	$<10^2$cfu/l	Insignificant
	$>10^2$cfu/l - $<10^4$cfu/l	Significant
	$>10^4$ cfu/l	Highly Significant
Coliforms *and E. coli*	None Detected	Negative
	<1cfu/100ml	Negative
	>1cfu/100ml	Highly Significant

10 RECORD KEEPING – DATA COLLECTION AND MANAGEMENT

The LRP shall ensure that appropriate records are kept, including details of:

1. The person or persons responsible for conducting the risk assessments, managing, and implementing the associated written scheme(s) and the training records of such personnel.

2. The significant findings of the risk assessment.

3. The written scheme and details of its implementation. This should include:
   - The physical treatment programme - for example, the use of temperature control for hot and cold water systems;
   - The chemical treatment programme, including a description of the manufacturer's data on effectiveness, the concentrations and contact time required;
   - Health and safety information for storage, handling, use and disposal of chemicals;
   - System control parameters (together with allowable tolerances); physical, chemical and biological parameters, together with measurement methods and sampling locations, test frequencies and procedures for maintaining consistency;
   - Remedial measures to be taken if the control limits are exceeded, including lines of communication; and
   - Cleaning and disinfection procedures.

4. The results of any monitoring, inspection, test or check carried out, and their dates. This should include details of the state of operation of the system, i.e. in use/not in use. This should include the checks detailed in Section 12.

5. Details of remedial work and precautionary measures that have been carried out, including sufficient detail to show that they were carried out correctly and the dates on which they were carried out.

6. A log detailing all visits by relevant contractors, consultants and other personnel.

7. Cleaning and disinfection procedures and associated reports and certificates.

8. Results of the chemical analysis of the water.

9. Information on other hazards, eg treatment chemicals.

10. Local environmental health authority cooling tower notifications.

APPENDIX 2. ISIS COOLING TOWERS AND EVAPORATIVE CONDENSERS (R11 AND R80) WATER SAFETY PLAN

Science and Technology Facilities Council

Legionella Management Guidelines for the ISIS Cooling Towers and Evaporative Condensers (R11 and R80) and Adiabatic Coolers

This Water Safety Plan was formally approved by The ISIS Legionella Review Committee:

Date: February 6th 2023

Name: John Thomason

Signed: 

Version: 3.3
Date of Issue: February 2023
Date of Review: August 2023

HYDROP E.C.S.

PREPARED BY: Helen Jones BSc(Hons) PgC

Wrens Court, 55 Lower Queen Street, Sutton Coldfield, West Midlands, B72 1RT
Tel: 0121 354 2030 Fax: 0121 354 8030
info@hydrop.com www.hydrop.com

CONTENTS

16. NOTIFICATIONS

i. DISTRIBUTION AND VERSION CONTROL

This Water Safety Plan - Procedural Document has a controlled circulation and should not be copied without the permission of the ISIS Legionella Review Committee Chair.

Version No.	Type of Change	Date	Description of Change
V1		June 2015	Initial document
V2	Update	November 2018	Update following audit HYR30899
V3	Addition	August 2019	Addition of Adiabatic Coolers and update of sampling following re-instatement
V3.1	Addition	January 2020	Addition of 13.1 (High Microbiological Results, Legionella) and 16. Adverse Water Sample results notification
V3.2	No Changes	August 2022	Reviewed – 11 August 2022 - No Changes
V3.3	Addition	Feb 2023	Addition of 13.2 Legionella escalation following positive resamples and highly significant results

1. APPLICATION AND SCOPE

1.1 Extent of Application

This Water Safety Plan (WSP) shall apply to Science and Technology Facilities Council (STFC) only. It is the responsibility of the Duty Holder of STFC to ensure that the requirements of this WSP are notified to and complied with by all other parties.

This WSP shall be read in conjunction with STFC Control of Legionella, Safety Code 38 (SHE Code). The WSP applies to the R80 Evaporative Condensers and the R11 Cooling Towers and the Adiabatic Coolers., herein known as 'the Cooling Systems.'

1.2 Scope

The scope of this WSP shall be limited to:

i. 5 x R80 Evaporative Condensers
ii. 1 x R11 Cooling Tower (consisting of 3 cells)
iii. 4 x Adiabatic Coolers

2. AIM

It is the responsibility of any person operating the Cooling Systems within STFC, in whatsoever capacity to comply with the requirements of this document.

This document provides the guidance, instruction, specification and infrastructure for the implementation of STFC's Management & Control programme for the management and control of the ISIS Cooling Towers,Evaporative Condensers and Adiabtic Coolers.

It is expected that this WSP will be complied with by all necessary parties within STFC, all appointed contractors and any sub contractors who are carrying out works on the Cooling systems, in whatsoever capacity, with or without contractual agreements.

Management procedures shall seek to ensure that compliance with this WSP is continuing and not notional.

As part of STFC's commitment to providing a fully compliant service, it is necessary that all regular tests and checks set out in this document are carried out even if they cause minor disruption to STFC's services, and that comprehensive records are maintained.

3. PRECAUTIONS

The risk of Legionnaires' disease from cooling systems can be controlled by:

a. careful attention to the design and construction of the cooling tower and cooling system to ensure that the release of aerosol is minimised, the materials used in their construction do not harbour or provide nutrients for bacteria and they can readily be completely drained and cleaned;
b. positioning towers away from ventilation inlets and populated areas if possible;
c. maintaining the system in a clean and sound condition;
d. controlling water quality;
e. carefully monitoring precautions

Some of these elements, especially those relating to the position, design and construction of cooling systems will be difficult to apply to existing installations. These should be considered when the cooling systems are replaced or new systems installed. Where an existing installation does not meet the standards recommended below, greater care will be needed in applying and monitoring those precautions which are reasonably practicable. However, four elements are essential to the safe operation of all cooling systems - the use of effective drift eliminators, regular cleaning and disinfection, water treatment and monitoring of maintenance and water treatment practices. Note that Legionella will proliferate not just in the cooling tower, but throughout the water cooling system, so precautions apply to the whole system.

3.12 Local Authority Registration:

Under the Notification of Cooling Towers and Evaporative Condensers Regulations 1992 all premises with cooling towers and evaporative condensers must be registered with the local authority.

The Towers have been re-registered to the Vale of White Horse District Council and is for 3 Cooling Towers (R11) and 5 Evaporative Condensers (R80) and names Paul Masterson, Ancillary Plant Leader as the Responsible Person for the Cooling Systems. The registration is on file and can be viewed on-line.

There is no requirement to register the adiabatic coolers with the Local Authority.

4. SYSTEM/PLANT DESIGN, INSTALLATION AND MAINTENANCE

Cooling systems should be designed and constructed so as to control the release of drift, to aid safe operation, cleaning and disinfection (see BS 4485:Part 3: 1988 and BS 4485:Part 4: 1996). In particular, the following points must be considered:

1. Drift eliminators, usually made of plastic or metal, shall be installed in the towers. In spite of the name, the function of a drift eliminator is to 'reduce' rather than actually 'eliminate' aerosol drift. Although some types are more effective than others, there is no industry standard. However, they shall be well fitted and selected on the basis of their ability to reduce the release of small water droplets - there shall be no visible drift released from the tower.

2. The area above the cooling tower pond shall be as well enclosed as possible to reduce the effects of wind. Wind movements around the tower may cause spray to escape through the sides, especially if it is poorly enclosed. This is particularly significant when the tower runs with its fan off. It will also be necessary to screen the tower or its pond to prevent the entry of birds, vermin, leaves or other debris or contaminants and to reduce solar heat gain.

3. The water distribution system within the cooling systems shall be designed to create as little aerosol (i.e. small water droplets) as possible. The water circuitry shall be as simple as is practicable, with the avoidance of dead legs and 'difficult to drain' loops and bends. Easily understood and accurate schematics of the various water circuits shall be available, with any dead legs or dead ends highlighted and redundant pipe work removed. The absence of water circulation means that any microbial population can be left undisturbed for long periods, allowing growth and multiplication. Any subsequent disruption of the dead leg/dead end could lead to a rapid colonisation of the water system.

4. Those parts of the cooling systems which become wet shall be accessible for cleaning; packs should be readily removable and easily dismantled. The wetted areas of the tower shall, where possible, be shaded from direct sunlight to discourage the growth of algae. The pond should have a sloping bottom with a drain connection at the lowest point which is large enough to carry away water and slurry quickly and easily. A suitably sized drain-down valve should be located at the lowest point of the system so that it can be conveniently and completely drained, including all pipe work and items of equipment. It may be necessary to fit supplementary drain valves to the bottom of individual items of equipment.

5. The cooling systems shall be constructed of materials which can be readily disinfected and which do not support microbial growth. Preserved (see BS5589:1989) timber may be used for the manufacture of cooling towers and packs but it needs to be impervious and easy to clean and disinfect.

6. Inclusion of a water meter in the tower supply pipeline both for the measurement of make-up rates and for the proportional dosage of treatment chemicals is recommended.

7. A full water treatment programme shall be integrated into the system design, with provision made for sample, injection, bleed and drain points and for the incorporation of dosing and bleed equipment; ideally this shall be automated.

8. Cooling systems should be positioned as far away as possible from air-conditioning and ventilation inlets, opening windows and occupied areas, taking note of the prevailing wind direction and the wind distribution over neighbouring buildings. This should also be considered when replacing old cooling systems as it may be possible to reposition them to a more suitable location.

9. Specific information on the water treatment programme in use should be included. Where automatic dosing equipment is used, there should be a means of confirming that treatment is being applied. Irrespective of the dosing method, both the quantity and frequency of chemical application should be recorded. Such records should be expanded to include the results of system monitoring and show any action required and confirmation that this has been carried out.

10. Manuals should include details of the normal control parameters, limits, with corrective actions, for out-of-specification situations, or where plant operating conditions or make-up water quality has changed; and cleaning and disinfection procedures.

11. Automatic controls should be employed, either for chemical addition or to allow system bleed-off, they should be checked over their full operating ranges. In the specific case of conductivity controlled bleed-off, regular calibration of the conductivity cell should be carried out.

12. Standby equipment, such as towers and recirculation pumps, should operate on a rota basis e.g. daily on/off or otherwise isolated and held dry.

13. When a biocide is added to a water system, all standby equipment or pipe work should be brought into circulation so that the biocide is distributed throughout the entire system.

4.1 Cooling Systems Position

Cooling towers should be positioned as far away as possible from air conditioning and ventilation inlets, opening windows and occupied areas, taking note of the prevailing wind direction and the wind distribution over neighbouring buildings (air may be drawn back into the lee of a building by wind eddies).

4.2 Commissioning, Operation and Maintenance

Cooling systems should be operated and maintained carefully and correctly. The installer should provide operating instructions giving adequate information on the safe operation of the system.

The Cooling systems should be properly commissioned before use to ensure that they operate correctly and within the design parameters. This will apply both to new installations and to existing installations which have been substantially altered.

A number of outbreaks have been associated with the start up of new cooling systems or following a period out of use. It is essential that precautions are taken to control the risk during commissioning and start up as well as during normal operation of the system. Commissioning and start up procedures should include detailed precautions necessary to control risk.

The Cooling systems should be kept in regular use where possible. Where a system is used intermittently or it may be needed at short notice, one option is to ensure that it is run once each week. It should at the same time be dosed with water treatment chemicals and water quality should be monitored. The whole system should be run for long enough to thoroughly distribute treated water.

If a system is out of use for a week or longer the water should be treated with biocide immediately on reuse and if out of use for a month or longer it should be drained, cleaned

and disinfected immediately before reuse. This applies both to normal operation and commissioning periods.

The usage of the adiabatic cooler will be seasonal April to September and so the cold feed to the unit during the winter month will be drained down.

5. MICROBIOLOGICAL CONTROL METHODS

Management of the cooling systems to reduce the risk of microbial growth such as *Legionella sp.* is vital to health and safety. It requires on-going maintenance and surveillance of control measures employed.

5.1 Water Treatment

Water treatment is required to prevent corrosion and the build up of materials and organic growth in the system. Traditionally this was to maintain its efficiency. However, the risk of legionnaires' disease from cooling systems means that the control of Legionella is now a particularly important consideration.

To control Legionella, the water treatment regime should prevent or adequately reduce the amounts of:

a. scale and corrosion products which might otherwise protect Legionella in the system;
b. sediments which might prevent water treatment processes from working effectively;
c. bacteria and other organisms.

This is usually achieved by the use of an appropriate combination of dispersants and scale and corrosion inhibition as well as a biocidal treatment.

The relationship between Legionella and other materials and organisms in water is complex and not fully understood. Selection of an appropriate water treatment regime is complicated by the potential effect of different chemicals on each other, on the materials of the system and by the risk to anyone who may be exposed to them. It will therefore be necessary to seek advice from a consultant or a reputable water treatment company.

Water treatment will not be effective unless the system is clean. If there are deposits or other contaminants in the water system these may prevent the water treatment programme from working effectively. In particular, biocides will react with and be used up by organic materials. It is therefore important to ensure that the water system is clean and there is an effective system for monitoring water quality.

A complete Water Treatment Programme based on the physical and operating parameters for the cooling system and a thorough analysis of the make-up water shall be established. The components of the Water Treatment Programme shall be environmentally acceptable and comply with any local discharge requirements.

The Water Treatment Programmes employed will have sufficient range of adjustment to cope with any potential variations in make-up water supply quality. This enables control to be maintained. Failure to take account of variations in quality may lead to the rapid development of uncontrolled microbiological conditions within the cooling system.

The Water Treatment Programme will be regularly monitored by a combination of STFC personnel and external contractors.

The composition of the make-up and cooling water should be routinely monitored to ensure the continued effectiveness of the Water Treatment Programme. The frequency and extent shall depend on the operating characteristics of the system and may change from time-to-time.

The monitoring programme shall include the routine sampling and testing for the presence of bacteria, via a dip slide and Legionella bacteria.

5.2 R80 Evaporative Condensers:

For the R80 Evaporative Condensers; STFC employs Water Treatment via a 'Dolphin System' as the primary method of biological control, to manage and control the risk of bacterial proliferation within the cooling water. This system means that chemicals are not needed to be dosed into the sump of the towers.

Chemical parameters are checked on a daily/weekly/monthly basis and microbiological samples for dip slide are taken on a weekly basis and Legionella are taken on a quarterly basis. The sample locations are described in the R80 Cooling Tower Legionella Sampling Schedule present in the log book.

5.3 R11 Cooling Tower:

For the R11 Cooling Tower; STFC employs "Water Treatment with automatic Chemical Dosing" as the primary method of biological control, to manage and control the risk of bacterial proliferation within the cooling water. Chemicals will be automatically dosed into the sump of the towers via a pumped loop system consisting of:

a. Scale/Corrosion Inhibitor
b. Oxidising Biocide
c. Non Oxidising Biocide

Chemical parameters are checked on a daily/weekly/monthly basis and microbiological samples for Legionella are taken on a quarterly basis. Chemical parameters are checked on a daily/weekly/monthly basis and microbiological samples for dip slide are taken on a weekly basis and Legionella are taken on a quarterly basis. The sample locations are described in the R11 Cooling Tower Legionella Sampling Schedule present in the log book.

5.4 Water Softeners:

The Water Softeners are subject to a full service annually with disinfection and then a maintenance service visit on a 6 monthly basis. The media is changed on an as-required basis depending on the results of the hardness checks and maintenance visits. The hardness is checked on a monthly basis by the contractor carrying out the cooling water checks.

5.5 Break Tanks:

Both the R80 and R11 towers are fed from break tanks. R80 is located in the R80 building and R11 in cell 1 of the tower. Both tanks are subject to a 6 monthly inspection and disinfection is carried out on an as-required basis depending on the results of the inspections.

5.6 Adiabatic Coolers:

The supply to each of the adiabatic coolers has a UV lamp to reduce potential of contamination. Whilst in use the water supply to the adiabatic coolers from R55 will be checked for hardness on a weekly basis; Legionella samples will be collected from each of the coolers on a monthly basis and dipslides collected on a weekly basis.

6. CLEANING AND DISINFECTION

Cooling systems need to be cleaned and disinfected at appropriate intervals in order to present conditions which permit Legionella to multiply, and to allow water treatment programmes to work more effectively.

In addition to this regular disinfection, the cooling systems shall be cleaned and disinfected:

a. before being put back into service:

b. after any prolonged shutdown of a month or longer (a risk assessment may indicate the need for cleaning and disinfection after a period of less than one month, especially in summer and for health care premises where shutdown is for more than five days);
c. if the tower or any part of the cooling system has been mechanically altered;
d. if the cleanliness of the tower or system is in any doubt; and
e. if microbiological monitoring indicates that there is a problem.

The cleaning and disinfection arrangements for the cooling systems are particularly important and should be planned for a period when the facility can most easily be shutdown e.g. over a weekend. The following are typical stages in a cleaning and disinfection regime:

1. Pre-disinfection with chlorine;
2. Rinsing and subsequent flush with thiosulphate;
3. Clean all areas;
4. Remove packing where possible;
5. Where water jetting is carried out isolate as far as possible;
6. Provision and use of suitable PPE including RPE;
7. De-scaling may require chemical treatment; and
8. Drain, then disinfect and de-chlorinate prior to refilling and re-starting water treatment.

Chlorine is highly reactive and will combine rapidly with organic material in the cooling system. The level of available chlorine will therefore rapidly decline if the system is heavily contaminated. Chlorine may also attack, and be absorbed by, wooden components in the tower. It is also released as water cascades over the tower. It is therefore essential to add enough chlorine to overcome these losses and to maintain the required concentration.

The efficacy of chlorine as a biocide or disinfectant is also affected by the alkalinity of the water. As pH rises its efficacy is reduced. When using chlorine it is therefore necessary to monitor free residual chlorine levels throughout disinfection in order to ensure they are of the required concentration, and the pH of the water to ensure that its efficacy is not impaired. The disinfecting effect is greatest at pH values at or below the neutral pH value of 7. At pH values at or above 8 its disinfecting effect is greatly reduced. This is discussed in greater detail in the Department of Health's Report of the Expert Advisory Committee on Biocides.

A safe system of work must be devised to ensure that all staff engaged on the work and any other persons are not exposed to contaminated water. Additional safety hazards such as confined spaces and use of hazardous equipment must also be addressed within the risk assessment and safe system of work. The LRP should determine whether the task should be controlled using a 'Permit to Work' or 'Work Authorisation' procedure.

6.1 R80 Evaporative Condensers:

For the R80 Towers; Disinfection, cleaning and manual desludging of the towers shall be undertaken at least every 6 months, whether the systems are operational or not, but more frequent cleaning may be necessary depending on local environmental conditions such as dirty atmospheres and the conclusions reached in the risk assessment. The R80 towers will be cleaned and disinfected using Sodium Hypochlorite to a concentration of 5ppm free chlorine and will be maintained for at least 5 hours, the system will then be neutralised with Sodium Thiosulphate.

6.2 R11 Cooling Tower:

For the R11 Towers; Disinfection, cleaning and manual desludging of the cells shall be undertaken on a 3 monthly rolling programme, but more frequent cleaning may be necessary depending on local environmental conditions such as dirty atmospheres and the conclusions reached in the risk assessment. Each cell will be cleaned and disinfected using Sodium Hypochlorite to a concentration of 5ppm free chlorine and will be maintained for at least 5 hours, the system will then be neutralised with Sodium Thiosulphate. The cleaning and disinfection of the cells will be carried out in 3 stages;

1. Cell Shutdown

2. Cleaning and inspection
3. Restarting

The disinfection will be carried out at stages 1 and stages 3 and recorded on the Cooling Tower Maintenance Cleaning / Chlorination certificate.

6.3 Adiabatic Coolers

The adiabatic coolers shall be disinfected on commissioning, start up and shut down in accordance with Advice Note LEG07. This involves the disinfection of the softened supply line and the spray nozzles. Each line will be disinfected to 50ppm of free Chlorine for an hour and recorded on the R55 Adiabatic Cooler supply Chlorination Certificate.

7. RISK ASSESSMENTS

Legionellosis management and control risk assessments are a **statutory requirement** under current guidelines and legislation; they should be carried out as part of the total *"Management Systems Controls"* package for STFC and should not be carried out *"just to comply".*

A suitable and sufficient Legionella risk assessment compliant with ISO/IEC 17020:2012, BS8580-1:2019, ACoP (L8), 4th Edition and HSG274 Part 1 shall be carried out by STFC's externally appointed specialist independent advisor, In order to identify and assess the risk of Legionellosis and water quality issues from the cooling systems. The assessment shall be reviewed and/or updated when there are significant changes to statutory standards, operational requirements and when there are significant changes to the water systems.

Where the assessment demonstrates that there is no reasonably foreseeable risk or that risks are insufficient and unlikely to increase, no further assessment or measures are necessary. However, should the situation change, the assessment should be reviewed and any necessary changes implemented.

The assessment will be reviewed at least every 2 years or sooner if there is reason to believe that the original assessment may no longer be valid or in accordance with the schedule detailed above. This may be because of:

i. changes to the water or its use;
ii. changes to the use of the building or part of the building in which it is installed;
iii. the availability of information about risks or control measures;
iv. changes to Key Personnel, contractors or service providers;
v. the results of checks indicating that the control measures are no longer effective;
vi. Any new construction works or system modifications.

BS 8580:2019 – Water Quality – Risk assessments for Legionella Control – Code of Practice recommends that the risk assessment should be carried out by independent bodies and shall not take the form of a quotation for any remedial works required. The risk assessment shall not only concentrate on the physical condition of the associated plant and equipment, the *"hardware",* but must also assess the risk posed by the management and execution of the controls systems, *"software",* in place.

7.1 Post-risk assessment requirements

The Risk assessments will be issued to the Responsible Person for the Cooling Systems and a written Action Plan will be devised based on the results of the Risk Assessments. This must clearly identify who is responsible for devising and carrying out the procedures.

The preparation of the Action Plan shall include:

1. Development of schemes for risk minimisation and control in order of priority giving consideration to cost, risk and difficulty.
2. Listing of all identified faults in priority order of non-compliance and potential risk.
3. Preparation of a management programme for the minimisation of risks so that an action plan identifying resources and timescales is drawn up.

4. Management of the programme to identify compliance failures for remedial action.
5. Review of the programme of the Action Plan, at least, 6-Monthly intervals. All changes to the water systems and functional content shall be recorded and evaluated.

8. RECORD KEEPING

To ensure that precautions continue to be carried out and that adequate information is available for checking what is done in practice, a record should be kept and maintained for **at least five years** showing the information specified in the ACOP.

Precautionary measures and treatments, monitoring results and remedial work should be logged and signed or initialled by the person who has carried out the work. Sufficient information should be recorded to show what measures have been taken and how they have been monitored.

The detailed information required in the log will depend on the type and complexity of the system or water service to which it applies.

The purpose of a Log-Book system is to improve the efficiency and effectiveness of installation and maintenance, and also to provide a record of various tasks and observations so that the plant history can be reviewed at any time by the maintenance staff. It will prove essential to the maintenance engineer in the operation of a planned plant maintenance scheme, and, if properly followed, will prevent unacceptable conditions developing as a result of ineffective maintenance.

The Log-Book will:

1. Identify the installation requiring attention and how it operates.
2. Record results of the initial commissioning (if available) and any re-commissioning so that observations made during maintenance checks can be compared.
3. Define the maintenance task or observation required and the frequency.
4. Provide for the recording of maintenance observations and results and for comments to be made in respect of any defect seen during the inspection. This facility should exist for each item of plant individually and for overall system observations.
5. Provide preliminary guidance on fault diagnosis and checking to assist with immediate on-site correction or adjustment.
6. Provide for, and make reference to, any separate observation sheet required to record extensive or abnormal observations which cannot be noted on the routine inspection sheets.
7. Facilitate cataloguing and cross-referencing to other Log-Books for plant/installations on the same Site (for example, the refrigeration plant, the chilled water installation, the air conditioning plant and the heat source).
8. Provide dates and results of inspections, tests and all associated works and procedures.
9. Provide dates for next scheduled inspection, test and associated works visits.

These entries should bear the signature of the person carrying out the task and should be suitably and safely retained and made available for inspection for **at least five years** from completion.

Details of operational and functional tasks must be drawn up for the site by the Responsible Person for Cooling Systems. These, together with the completion of Log-Books, will enable a proper historical record to be compiled of all works carried out and observations made.

9. MONITORING AND ROUTINE CHECKING

If precautions are to remain effective the condition and performance of the cooling system will need to be monitored and water quality routinely tested to ensure that the water treatment regime continues to control water quality. This should involve:

a. checking the performance of the system and its component parts, as recommended by the designer or installer of the system;
b. inspecting the cooling systems and accessible parts of the system for damage and signs of contamination;
c. testing water quality to ensure that the treatment regime continues to control to the required standard.

The Cooling systems should routinely be inspected and their performance monitored. The frequency will depend on the system; for well maintained systems in premises where there are no high risk factors, where the system is operating correctly and where water treatment is automatically dosed and the dosing equipment incorporates malfunction alarms, a weekly check together with a monthly test of water quality will suffice.

Testing of water quality is an essential part of the treatment regime and will include testing of both the recirculating water and make-up water supplied to the system for both systems.

The daily/weekly testing will be carried out by site engineers, whilst the monthly testing will be carried out by a water treatment company or consultant, provided they have been trained to do so and are properly supervised. A series of tests will be carried out of the chemical and microbiological condition of the water. The results of testing will be interpreted by a suitable experienced and competent person and any remedial measures be carried out promptly.

Where the system is treated by chlorination it is important that free residual chlorine and pH should be measured. Where non-oxidising biocides or physical methods are used for controlling microbiological activity, techniques are becoming available to measure biocide levels in cooling water. It is still necessary to measure the microbiological activity itself.

The most convenient way to measure microbiological activity is to use 'dip slides'. These are plastic slides with a coating of agar - a medium on which micro-organisms will grow. The dip slide is dipped into the cooling water, then placed in a small container and allowed to incubate in an incubator at 30°C for 48 hours.

The incubation period and temperature should be the same each time the test is performed in relation to a particular water system. Unless this is done it becomes difficult to interpret the results from dip slide tests performed over a period of time, as different organisms grow within different temperature ranges. Bacteria will grow to form colonies on the agar and by comparing these with a comparison chart the level of contamination of the water can be gauged. The use of dipslides and similar techniques has limitations. They do not specifically indicate the presence or proliferation of Legionella but are generally to indicate trends in microbiological quality. If the cooling system is cleaned and disinfected and the water treatment regime is properly set up from the start then dip slides can be used to show whether it continues to be effective or whether remedial action, either by modification of the treatment regime or cleaning and disinfection of the system, needs to be taken. The timing of dip slides and other microbiological sampling is important, results attained must be considered in the light of the state of the system, e.g. when biocide was last added and the system cleaned.

Tests may need to be carried out more frequently when there are changes in the condition or performance of the system, and especially if the regular inspection shows the water to be cloudy or contaminated following cleaning and disinfection. Cleaning of the system releases organic material and unless this material is completely removed and the system effectively disinfected, it may lead to an increased rather than a reduced microbiological activity.

If, on inspection, the water is found to be cloudy visibly contaminated this may indicate poor microbiological control. The visible condition of the water is not necessarily a good indicator of its microbiological condition since contaminants will not necessarily be organic and, conversely, relatively clear water may be unacceptably contaminated. However, it will indicate the further investigation is warranted.

All monitoring and routine checks must be carried out by competent persons. The training requirements for competent persons are described in the 'SHE Code' SC38.

10. PRE-PLANNED MAINTENANCE PROGRAMME (PPM) TASKS

In order to ensure that the devised Risk Management Programme is effective in minimising or controlling the risk of Legionella and other water borne pathogens, STFC (or others on its behalf) will undertake a number of periodic inspection, maintenance and monitoring tasks.

The actual frequency of the tasks adopted, should depend on the process and the condition of the incoming mains water.

10.1 Cooling Towers:

The R80 towers are controlled by the Dolphin System. Weekly checks are carried out by site engineers and consist of:

a. Tower operational status
b. Water Meter Reading
c. Dipslide
d. pH
e. Conductivity by both webmaster and manual
f. Hardness
g. Calcium Balance
h. Chloride

The R11 have the standard chemical control by automatic dosing of both scale/corrosion inhibitors and biocides. Daily and weekly checks are carried out by the site engineers and consist of:

a. Conductivity
b. pH
c. Hardness
d. Calcium Balance
e. Chlorine
f. Bromine
g. Phosphonate
h. Inhibitor
i. Phosphate
j. Dipslide

The biocide, R11b sodium hypochlorite with dispersant, has continual dosing monitored by chlorine analysers and added as and when by the on line records, the set point is 0.75ppm plus/minus 0.1ppm.

On a weekly basis the pH and Conductivity probes are to be calibrated using the sites standards that must be checked to ensure that they remain in date. A record of calibration is to be maintained.

The thermometer in the incubator is to be replaced on an annual basis with a calibrated probe and a record of certification held.

The pumps are serviced as required following vibration analysis and shot pulse which is monitored by Omnitrend on a constant basis every 6 weeks as a snap shot and they will be serviced if required.

The cooling system sensors have a schedule of replacement and they will be replaced on a yearly basis.

The monthly checks carried out by the Water Treatment consist of:

TABLE 1 - PLANNED MAINTENANCE PROGRAMME - TASK FREQUENCIES TO BE CARRIED OUT:

ITEM MONITORED	TASK	TASK FREQUENCY	CARRIED OUT BY
R80 Cooling Systems	pH	MONTHLY	CONTRACTOR
	Conductivity	MONTHLY	CONTRACTOR
	Chloride	MONTHLY	CONTRACTOR
	Hardness	MONTHLY	CONTRACTOR
	Calcium Balance	MONTHLY	CONTRACTOR
	Calcium Hardness	MONTHLY	CONTRACTOR
	Soluble Iron	MONTHLY	CONTRACTOR
	Concentration Factor	MONTHLY	CONTRACTOR
	Suspended Solids	MONTHLY	CONTRACTOR
	Alkalinity	MONTHLY	CONTRACTOR
	Clean and Disinfection	6 MONTHLY	SITE
	Legionella Samples	QUARTERLY	CONTRACTOR

CONTINUED/…			
ITEM MONITORED	**TASK**	**TASK FREQUENCY**	**CARRIED OUT BY**
R11 Cooling Systems	**Hardness (Calcium, Magnesium and Total)**	MONTHLY	CONTRACTOR
	Chlorine, Bromine and Phosphonate	MONTHLY	CONTRACTOR
	pH	MONTHLY	CONTRACTOR
	Conductivity	MONTHLY	CONTRACTOR
	Chloride	MONTHLY	CONTRACTOR
	Inhibitors	MONTHLY	CONTRACTOR
	Calcium Balance	MONTHLY	CONTRACTOR
	Soluble Iron	MONTHLY	CONTRACTOR
	Concentration Factor	MONTHLY	CONTRACTOR
	Alkalinity	MONTHLY	CONTRACTOR
	Clean and Disinfection	6 MONTHLY	SITE
	Legionella Samples	QUARTERLY	CONTRACTOR

Legionella samples shall be collected on a quarterly basis by the Water treatment provider and sent to a UKAS accredited laboratory for analysis within 24 hours of sampling and in accordance with Advice Note LEG01. If the cooling towers are shut down for a period of more than 1 month the sampling for Legionella will be undertaken within 2 weeks of returning the tower to service.

10.1.0 Shot Dosing requirements

Shot dosing for R11 is not required as the biocide, R11b, is dosed depending on the chlorine analyser records. However, 25litres is dosed before chlorination for R11.

R80 utilise the same chemical, R11b, and will be dosed at a rate of 150ml. This is dosed into the port into the side of the sump of each of the towers if the dipslides are above the recommended limits.

10.2 Adiabatic Coolers:

The 4 Adiabatic Coolers are monitored by the site engineers with the following checks:

1. Weekly softened supply line hardness check
2. Weekly dip slides

The water treatment provider will also collect Legionella samples from each unit on a monthly basis.

The feed line is flushed on a weekly basis, 200 litres of water is flushed from each of the units to ensure that the 600 litre capacity line is flushed through.

11. TASK SPECIFICATION LISTINGS

ADVICE NOTE: LEG 01
Microbiological Sampling Protocol

Science & Technology Facilities Council	Legionellosis Management And Control PPM Programme
Legionellosis Management And Control PPM Programme	
Task No:	LEG 01
Task:	Microbiological Sampling Protocol
Frequency:	AS SPECIFIED IN SECTION 10 PPM - TASK FREQUENCIES
If the Maintenance Staff or appointed contractor cannot, at any stage, comply with any part of this Specification, then an alternative Specification shall be agreed which, both; meets the requirements of current legislation and the needs of the Site.	

MICROBIOLOGICAL SAMPLING METHODOLOGY

Microbiological samples shall be collected from representative locations of each system which are described in the log book, including plant and equipment, and submitted for analysis in accordance with the protocol below. Microbiological samples shall be collected as specified in Section 7 and under the following circumstances:

1. When the Cooling Tower PPM/Water Treatment Programme indicates failure of control parameters.
2. As part of Cooling Tower re-instatement.
3. Re-sampling following positive biological results.
4. When the PPM Programme indicates failure of control parameters.
5. As part of reinstatement procedures.
6. Re-sampling following positive biological results.
7. During a suspected outbreak or outbreak (as instructed by the outbreak investigating officer).

Microbiological samples will be analysed for the following organisms:

1. *Legionella spp*.

Routine (initial) microbiological samples shall include:

1. Dip-slides
2. *L*egionella samples

HEALTH AND SAFETY CONSIDERATIONS

Sampling of water may occur in a wide variety of locations. Each location and reason for sampling has its own risks associated with it, and it is important to make an assessment of these risks and put appropriate control measures in place before commencing any sampling.

Examples of risks include:

1. Wet floors that present a slip hazard when sampling from cooling towers etc.
2. Working at height when ladders/steps are required to reach water sampling points.
3. Manual handling risk when carrying large amounts of sampling equipment around.
4. Working in confined spaces when sampling from difficult-to-reach parts of water systems.
5. *Legionella* infection risk if sampling from water sources that create aerosols, such as cooling towers.

The following is a list of equipment that may be needed for sampling. The list is not intended to be exhaustive and not all items may be required for all types of sampling.

1. Laboratory supplied sterile sample bottles.
2. Labels.
3. Permanent waterproof marker pens and biros.
4. Laboratory request forms for water samples.
5. Nitrile (plastic) gloves.
6. Alcohol medical wipes.
7. Plastic shoe coverings.
8. Cool boxes with separators and 10% by volume of frozen ice-packs (ice packs shall not be used for *Legionella* samples).
9. Digital camera.
10. Digital voice recorder.
11. Calibrated thermometer.
12. Calibrated stop-watch
13. Calibrated disinfectant residual measuring device (may be colorimetric or electronic type).

SAMPLE BOTTLES REQUIRED FOR THE COLLECTION OF WATER FOR DIFFERENT MICROBIOLOGICAL ANALYSES

Test Required	Sample Bottles
Legionella (and other pathogenic bacteria such as *Salmonella*, *Campylobacter* and *E. coli* O157, where required	1 x sterile bottle (supplied by the contracted laboratory) containing an appropriate neutraliser to neutralise any residual disinfectant in the water. *(as above)*

MICROBIOLOGICAL SAMPLING COLLECTION & SUBMISSION FOR ANALYSIS PROTOCOL

Microbiological Sampling must be carried out in accordance with "BS 7592:2008 - Sampling for Legionella bacteria in water systems – Code of practice" and "Examining food, water and environmental samples from healthcare environments Microbiological Guidelines - December 2010".

The prime objective is to obtain a sample which is representative as far as possible of the water to be examined. To achieve this, certain precautions are necessary which are common to all sampling procedures for the bacteriological examination of water:

1. A suitably UKAS (or equal) accredited laboratory must be used for all samples collected for bacteriological analysis.
2. All staff undertaking bacteriological sampling must be suitably and adequately trained in the process of sample collection.
3. Good personal hygiene procedures, including thorough washing of hands using soap, must be adopted by the operative prior to the commencement of the exercise.
4. Sterile bacteriological sampling bottles must be used containing sodium thiosulphate to neutralise any chlorine in the water to be sampled.
5. Scrupulous care shall be taken to avoid accidental contamination of the sample during collection and subsequent handling. Avoid splashing. Ensure the sample bottle does not touch the tap. Do not touch the water as it flows into the bottle or the inside of the cap or bottle. Replace the lid.
8. The changes which occur in the bacteriological content of water between the time of sampling and examination shall be reduced to a minimum by ensuring that the sample is not exposed to light, is kept cool in an insulated container (cool-box) and is transported to the laboratory as quickly as possible.
9. The sample shall be examined as soon as possible after collection, preferably within six hours but no more than eighteen hours (PHLS 1952, 1953 b).

Every sample bottle must be clearly identifiable, and the following information shall be supplied with the sample:

1. Agency requesting the examination
2. Sampled by
3. Reference number
4. Date and time of sampling
5. Reason for sampling
6. Supply
7. Type of water
8. Location of sampling point
9. Disinfectant residual (to be measured when sampling is carried out following disinfection)
10. Pre or Post Flush sample

Sample bottles

1. Sterile bottles, of appropriate volume, shall be provided by the laboratory performing the examination and should be used exclusively for bacteriological purposes.
2. All sample bottles provided by the laboratory performing the examination shall contain adequate neutralising agent necessary to neutralise residual chlorine or chloramines.

Opening and filling of Sample Bottles

1. Keep the sample bottle unopened until the moment it is required for filling.
2. Never rinse out a bottle before taking a sample.
3. Loosen the string or rubber band holding the cover in position; hold the bottle by the base in one hand and remove the stopper and cover together with the other hand.
4. Retain the stopper and cover in the hand whilst the bottle is filled, and replace them immediately.
5. Finally secure the cover.

Sampling from Cooling Water – Water Samples for laboratory analysis

1. Good personal hygiene procedures, including thorough washing of hands using soap, must be adopted by the operative prior to the commencement of this exercise.
2. Samples shall be taken from cooling systems at sample point locations situated on the return service to the cooling water to the tower, and as near as possible to any heat source rather than by removing an inspection hatch and collecting samples from within the tower itself. It is important to collect samples at locations that correspond (at the time sampled) to the highest risk – the highest numbers of Legionella occur in circulating water just after the pumps have been switched on. Thus, if possible, samples shall be collected shortly after pumps have initially been switched on. If sediment accumulation is excessive, it might be advisable to sample the sediment.
3. Supply water - Samples shall be taken of the supply water. Water can be collected either from the float valve at the inlet to the cooling tower pond or from the header cistern. If a water-softening system is incorporated into the system, samples of softened water and water that has not been softened shall be collected.
4. Cooling circuit with cooling towers - NOTE Legionella will grow in the warmest part of these systems, which is usually located in the region of the refrigerator condenser or other similar heat exchange equipment. Ideally, a sample point shall be fitted on the return service to the cooling tower, located near to the heat source, for example, just after the refrigerator condenser. If no such sample point is available, then a sample shall be collected from the cooling tower pond at a point furthest removed from the fresh water inlet valve (a tap might be provided at an appropriate point on the side of the pond furthest removed from the fresh water inlet). Samples shall not be taken from the drain valve as part of a routine monitoring programme, as any sample collected might not be representative of the circulating water.
5. Samples shall be collected, if possible, when the biocide is at its lowest concentration and there is a maximum potential number of Legionella present, for example:
   a. when recirculating pumps have just been started;

b. at the time after which any biocidal activity has ceased, and immediately prior to the next biocide addition;
c. at the period of time just before any dilution of the water takes place either by automatic or manual operation.

6. Evaporative condensers - In evaporative condensers, water is circulated from the pond to the top to the tower and returned via a spray system over the heat exchanging system within the tower; in these cases, samples shall only be collected (while the recirculating pump is running) from the pond at the point furthest removed from the cold water inlet or a dedicated sample point. The dedicated sample point shall be disinfected before sampling.

NOTE 1: - Condensers using softened makeup waters will often have a buffer cistern as part of the circuit. Samples shall not be taken during makeup.

Sampling from Cooling Water – Dip-slides

1. Storage:

The slides should be kept cool but not refrigerated. They will remain suitable for use as long as there is no visible contamination and the agar surfaces remain smooth and adherent to the slide. Check before use that there is no growth on the slides.

2. Inoculation (Fluids):

Remove the dip-slide tongue from its bottle, holding it by the cap to avoid touching the culture medium.
Immerse it in the fluid to be tested for about ten seconds, or expose the slide to a spray or running fluid so that the agar surfaces are covered.
Remove the slide from the fluid and allow it to drain for a few seconds.
Replace the dip-slide into its bottle and tighten the cap.

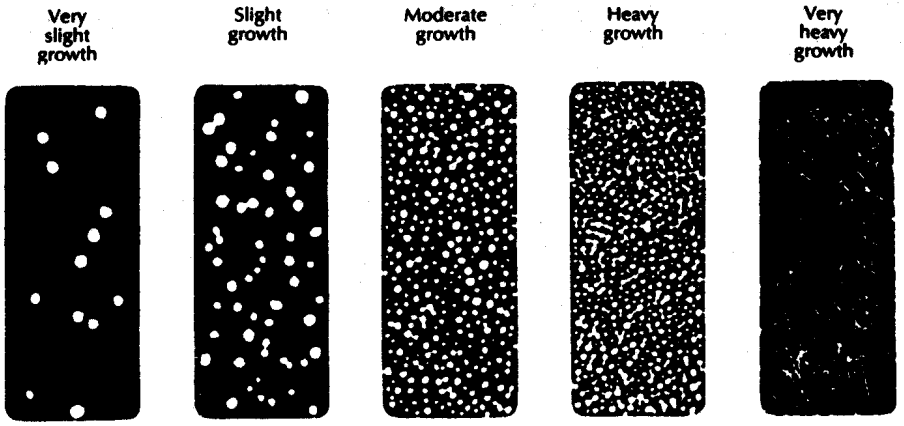
3. Incubation:

Inoculated dip-slides should be incubated at 30^{0}C. It is important to begin incubation as soon as possible, and to continue incubation for several days to guard against false negative results.
Incubation time is 1-2 days for bacteria. The optimum temperature for most yeasts and moulds is 27^{0}C to 30^{0}C. Incubation time 2-7 days.
If the incubation temperature is considerably different from the operating temperature, microbial growth may be slow and it is advisable to continue incubation for further periods to detect the presence of organisms.

4. Interpretation of Results

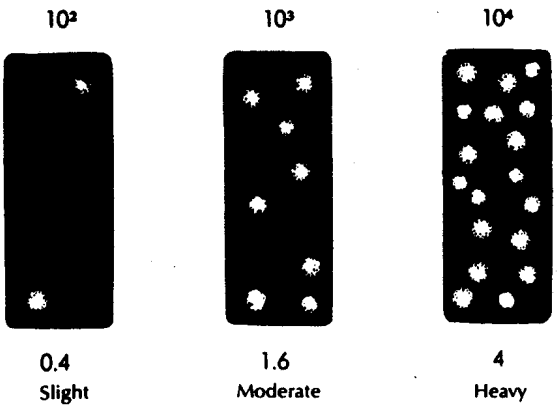
Compare results to charts provided to estimate level of contamination. Note that very high levels may lead to a confluent growth and could be recorded as a nil result. Compare to an unused slide when reading results.

Comparison Chart Bacteria/Yeasts



Fluids CFU/ml	10^3	10^4	10^5	10^6	10^7
Surfaces CFU/cm²	2.5	12	40	100	250

Comparison Chart Moulds



Disposal Instructions

Infected slides should be autoclaved, incinerated or soaked in disinfectant before disposal.

Additional Measures to be followed when collecting Samples for Bacteriological Examination of *Legionella spp.*

The sampling method for *Legionella* shall be in accordance with ISO 11731:1998 and BS 7592:2008 - Sampling for Legionella bacteria in water systems – Code of practice. A UKAS (or equal) accredited laboratory that takes part in the Health Protection Agency's water external quality assessment (EQA) scheme for the isolation of *Legionella* from water should test samples (visit http://www.hpaweqa.org.uk for further information). The laboratory shall also apply a minimum theoretical mathematical detection limit of <100 *Legionella* bacteria/litre sample.

All staff undertaking bacteriological sampling must be suitably and adequately trained in the process of sample collection and be aware of the risks of *Legionellosis*. Staff who are likely to be more susceptible to *Legionellosis* **shall not** undertake sampling. It is the responsibility of the operative's manager (this shall apply equally to COMPANY employees as well as to Contractor staff), to assess their risk of Legionellosis before being assigned the task of sample collection.

Sterile bottles, of 1 litre volume, suitable for collecting samples for bacteriological examination of *Legionella spp.* shall be provided by the laboratory performing the examination.

Following sampling, all water samples for *Legionella spp*. analysis shall be stored at an ambient temperature (approximately 20°C), in the dark, and returned to the laboratory as soon as possible, preferably the same day but at the latest so that processing can begin within 24 hours of taking the sample. Transporting and/or storing the sample at temperatures below 6 °C might reduce subsequent recovery of Legionella since the bacteria might be induced into a non-culturable state.

Handling and shipping of samples

Samples shall be packaged and shipped to the laboratory for analysis as soon as possible. Generally, the shorter the time between sample collection/processing and sample analysis, the more reliable the analytical results will be.

Before shipping samples to the laboratory:

1. Check that sample bottles are labelled correctly.
2. Pack samples carefully in the shipping container to prevent bottle damage, shipping container leakage, and sample degradation.
3. Check that the bottle caps are securely fastened.

Labelling of sample bottles

Protocols for labelling, documenting, and packaging samples established by the receiving laboratory must be followed. Obtain authorisation from the laboratory before shipping samples for analysis. Each sample bottle must be correctly labelled with the site/building identification, exact location of sample collection, date, time, and sample designation.

Packaging of samples

When packaging samples for shipment to the laboratory, remember that all bottles must be protected from damage (especially glass bottles) and (or) leaking. The laboratory usually will return with the cooler reusable packing materials such as mesh bags, foam sleeves, and bubble wrap. Plastic bags and cardboard boxes will not be returned. Do not use foam peanuts or vermiculite.

When packaging samples:

1. Make sure bottle labels are waterproof and that information is legible.
2. Tighten all bottle caps to prevent leakage.
3. Use adequate packing material to prevent bottle damage.

4. When shipping multiple sets of samples in the same container, label each set of sample bottles with a different letter of the alphabet (A, B, C) so that bottles of each sample set will have the same letter.

Place all bottles from a sample set into a separate bag (such as plastic or mesh) or bind with a rubber band to keep them together.

Shipping of samples

Whenever possible, deliver samples to the laboratory on the day of collection. Check laboratory hours of operation—keep in mind that the laboratory might not receive samples on Saturdays, Sundays, or holidays. The integrity of chilled samples sent late on a Thursday or on a Friday could be compromised if not received by the laboratory in time to be unpacked and refrigerated. If the time taken to deliver the samples exceed the maximum recommended submission time, the samples must be discarded and the collection process repeated. If the temperatures of the cool box during delivery fall outside the recommended limits, the samples must be discarded and the collection process repeated.

Biological analysis process auditing

The Legionella Consultant shall carry an audit on the following:

1. Training records of each field operative to ensure adequate training level.
2. Visually check and confirm the correct collection of each type of sample.
3. Calibration certificate status of all instruments used in the process.
4. Inspect and confirm suitable condition of cool boxes.
5. Visually check and confirm the correct packaging of collected samples.
6. Visually check and confirm the correct monitoring of the submission time and cool box temperature of the sample.
7. Check and confirm that the laboratory has no issues with samples received.

ADVICE NOTE: LEG 02
Cooling Tower Chemical Water Treatment General Requirements

Science & Technology Facilities Council	Legionellosis Management And Control PPM Programme
Legionellosis Management And Control PPM Programme	
Task No:	LEG 02
Task:	**Cooling Tower Chemical Water Treatment General Requirements**
Frequency:	AS SPECIFIED IN SECTION 10 PPM - TASK FREQUENCIES
If the Maintenance Staff or appointed contractor cannot, at any stage, comply with any part of this Specification, then an alternative Specification shall be agreed which, both; meets the requirements of current legislation and the needs of the Site.	

This applies to the R11 Cooling Systems only:

It is necessary to add chemicals and biocides to evaporative cooling systems in order to avoid the presence of scale and corrosion. It is also necessary to use some form of biocidal treatment to restrict the growth of bacteria and algae in the systems.

This is really only good housekeeping, but it must be remembered that bacteria, and Legionella in particular, thrive in dirty systems.

The following are required:

i. A scale inhibitor (unless external softening is in use)
ii. A corrosion inhibitor
iii. Two alternating non-oxidising biocides OR
iv. A single oxidising biocide.

The chemicals shall be added automatically, and shall be used in direct proportion to the cooling tower make up.

In addition, there shall be a blow down, designed to control the system concentration. This can be manual, but really ideally to be automatic and linked to the system Total Dissolved Solids if it is to be effective. Over-concentration leads to deposition and contamination.

This applies to the entire site Cooling Systems only.

MSDS sheets for these products, the production of which are a requirement of the Control of Substances Hazardous to Health Act shall also be maintained in the cooling tower log book.

The use of the chemicals shall be such that the minimum quantity is used whilst complying with the Water Treatment Specification.

ADVICE NOTE: LEG 03
Cooling Tower Chemical Water Treatment Monitoring

Science & Technology Facilities Council	Legionellosis Management And Control PPM Programme
Legionellosis Management And Control PPM Programme	
Task No:	LEG 03
Task:	**Cooling Tower Chemical Water Treatment Monitoring**
Frequency:	AS SPECIFIED IN SECTION 10 PPM - TASK FREQUENCIES
If the Maintenance Staff or appointed contractor cannot, at any stage, comply with any part of this Specification, then an alternative Specification shall be agreed which, both; meets the requirements of current legislation and the needs of the Site.	

A specialist from the Water Treatment Contractor is required by contract to attend site and shall carry out the analysis as described in section 10:

In addition, ensure that:

i. Record if Towers are in use.
ii. Initiate any necessary adjustments to the programme in the light of these findings.
iii. Check operation of the system automatic dosing equipment and adjust, maintain as required.
iv. Carry out corrosion monitoring as necessary.
v. Ensure that there is sufficient chemical stock for at least one MONTH.
vi. Complete individual System Log Sheets. Date, sign and print name. Ensure that any action required of them is carefully explained to site staff.

Please note that the details which follow are intended to be the minimum requirements that STFC will accept.

Parameter	**Range**
pH	7.5 - 9.0
Suspended Solids	Slight
Conductivity / TDS	To suit Conc. Factor
Total Alkalinity	600 ppm max
Chloride	200 ppm max.
Concentration Factor	3 - 6 cycles
Other Chemical Parameters	To generally agree with above

ADVICE NOTE: LEG 04
Cooling Tower Condition Monitoring

Science & Technology Facilities Council	Legionellosis Management And Control PPM Programme
Legionellosis Management And Control PPM Programme	
Task No:	LEG 04
Task:	**Cooling Tower Condition Monitoring**
Frequency:	AS SPECIFIED IN SECTION 10 PPM - TASK FREQUENCIES
If the Maintenance Staff or appointed contractor cannot, at any stage, comply with any part of this Specification, then an alternative Specification shall be agreed which, both; meets the requirements of current legislation and the needs of the Site.	

TASK		FREQUENCY
FAN GUARD	Remove fan guard, clean, where rusted rub down rust points, prime and paint with protective paint. Where replaced, wipe nuts, washers and bolts with grease and tighten.	6 - MONTHLY
FAN UNIT	Check all fan motors and drive bearings and lubricate as necessary. Wipe clean shaft and lightly grease.	MONTHLY
	Adjust any belts and tension as required (replace if frayed or showing signs of wear).	MONTHLY
	Where glove boxes are installed on drives check oil level weekly, change oil every 6 months.	MONTHLY/ 6-MONTHLY
	Check tightness and adjust thrust bearings and locking collars as necessary.	3-MONTHLY
	Check all nuts, washers and bolts and replace where necessary.	3-MONTHLY
	Check operation and tightness of all bolts and replace where rusted.	3-MONTHLY
	Check operation and tightness of all bolts and lightly wipe protective grease.	3-MONTHLY
	Check and wipe impeller, if necessary clean and paint rusted parts.	3-MONTHLY
	Check and clean fan scroll; if necessary clean and paint any rusted parts. On completion run, test and carry out the operation check shown in log sheet and record results.	3-MONTHLY
ELIMINATORS	Remove eliminators after having first noted their positioning and which side should be uppermost.	6-MONTHLY
	Wipe/brush blades with a descalant and hose down as necessary to remove any matter. Where algae or slime is present, use 5% sodium hypochlorite. When hosing down, care should be taken not to create aerosols.	6-MONTHLY
	Any tools or equipment used to clean the eliminators must be suitable for the materials used in their construction to ensure no damage is caused.	6-MONTHLY
	Should inspection reveal signs of deposits, scale or other fouling then the application of approved chemicals, with appropriate precautions, is indicated. Advice should be sought on this cleaning process. Fouled eliminators do not necessarily indicate a defective water treatment programme since they are not exposed to the water circulation path and are subject to different conditions.	6-MONTHLY
	Similarly clean the eliminator mounting frame and inspect for signs of corrosion. Clean and make good as necessary. Replace the eliminator sections taking care to ensure they are the correct way up, properly aligned and sealed so as to ensure their effectiveness.	6-MONTHLY

TASK (CONTINUED…)		FREQUENCY
SPRAYS OR TROUGHS (AS APPLICABLE)	Remove spray nozzles and clean orifice and cone using chemicals where necessary. Do not rely on visual inspection to assess the need to clean as fouling of this item is unlikely to be clearly visible. It is essential to maintain an effective spray, otherwise the capacity of the unit will be impaired and scaling of the pack might occur.	6-MONTHLY
	Spray nozzles are usually inserted using grommets. Where a grommet is covered with the material may be one that supports micro-biological growth and it should be replaced with a Water Research centre listed alternative.	6-MONTHLY
	Clean spray pipe-work header and suspension brackets and Inspect for corrosion. Repair and make good as necessary.	6-MONTHLY
	Where troughs are used as the water distribution system they must be cleaned to remove debris or dirt that has collected within them. Removal of the trough hosing and wiping will usually suffice. Care must be taken to ensure that the debris and dirt are not washed into the tower.	6-MONTHLY
	Clean the support grid and inspect for signs of rusting; if rusted clean and make good.	6-MONTHLY
	Replace the trough sections ensuring correct levelling and alignment.	6-MONTHLY
	Check for even water flow and distribution over the pack.	6-MONTHLY
COOLING TOWER PACK AND INTERNAL MAINTENANCE	Remove pack section after having paid particular attention to their positioning and which side should be uppermost (this may not be necessary where the pack is symmetrical).	6-MONTHLY
	Clean pack to remove any fouling. The cleaning method must be appropriate to the design and the material used. Plastic batten packs can often be wiped, brushed -or scraped with a non-metallic scraper. Corrugated interlaced plastic packs may require cleaning by hose, chemical application or purpose made brushes. In some cases it might be more cost effective simply to dispose of the pack and replace it. Alternatively and depending on cost, a spare pack(s) should be substituted so that the dirty pack(s) can be thoroughly cleaned in readiness for future use.	6-MONTHLY
	Should fouling be present it is essential to establish the reasons. Fouling could imply that the water treatment and control is suspect and the water treatment specialist should be called immediately to the site.	6-MONTHLY
	Similarly, clean the internal casing of the tower and the pack support grid. Inspect closely for signs of rust and where applicable clean and make good.	6-MONTHLY
	Replace the pack making sure the sections are installed the correct way up, properly aligned and sealed as to ensure their effectiveness.	6-MONTHLY
LOUVRES AND SCREENS	Brush off any dust, dirt and debris which may have collected on the louvres blades or screen and wash-down. Inspect for signs of rusting and when dry, clean, prepare and make good as necessary.	6-MONTHLY
POND	Drain the pond and clean out all the sediment or debris. Washing, light brushing with 5% sodium hypochlorite solution and wiping, paying particular attention to the water line will usually suffice. Sediment should be flushed away via the drain pipe into the foul water drainage system. Clean the overflow outlet opening and hose through.	6-MONTHLY
	Scrub clean and hose off the strainer screen and hose away all sediment and debris which may have collected around the outflow pipe orifice.	6-MONTHLY
	Hose through all drain lines and sampling points to waste. The operator is again reminded to avoid causing aerosols.	6-MONTHLY
	When cleaning, inspect the pan thoroughly for rust or solid deposits. Chemically remove all solid deposits and when dry clean any rust spots and make good as necessary. Where plastic ponds are installed the surface should be inspected for integrity.	6-MONTHLY
	Three monthly cleaning of the pan is essential as the sediment is often corrosive and can lead to premature failure of the plant.	6-MONTHLY

TASK (CONTINUED…)		FREQUENCY
BALL VALVE	Check the operating level of the pond and adjust the ball valve as necessary. Clean ball valve with 5 per cent sodium hypochlorite solution.	6-MONTHLY
	Change the ball valve washer every 6 months since its effectiveness is not easily established under operating conditions.	6-MONTHLY
	Examine ball valve float at least annually for leaks and signs of erosion and pitting.	12-MONTHLY
IMMERSION HEATER AND TRACE HEATING	Operational checks will establish whether or not the immersion heater or trace heating tapes have failed. If so they should be replaced.	6-MONTHLY
	Check the integrity of electrical installation and the thermal systems' weather proofing and make good as necessary.	6-MONTHLY

ADVICE NOTE: LEG 05
Cooling Tower Cleaning and Disinfection General Guidance

Science & Technology Facilities Council	Legionellosis Management And Control PPM Programme
Legionellosis Management And Control PPM Programme	
Task No:	LEG 05
Task:	**Cooling Tower Cleaning and Disinfection General Guidance**
Frequency:	AS SPECIFIED IN SECTION 10 PPM - TASK FREQUENCIES
If the Maintenance Staff or appointed contractor cannot, at any stage, comply with any part of this Specification, then an alternative Specification shall be agreed which, both; meets the requirements of current legislation and the needs of the Site.	

It must be the aim of STCF to comply with the recommendations of HSE document L8, which stipulates that all industrial cooling towers shall be cleaned and disinfected twice each year or as dictated by testing procedures.

In practice, this means that all the tower systems shall be shut for cleaning and disinfection twice each year ***WHERE THIS IS POSSIBLE.***

However, if at any time there is a problem in shutting down cooling towers (and their associated plant) for any length of time an on line disinfection can be carried out.

ADVICE NOTE: LEG 06

Cooling Tower Cleaning and Disinfection - For Cooling Towers that can be closed down more than one working day – Shut Down

Science & Technology Facilities Council	Legionellosis Management And Control PPM Programme
Legionellosis Management And Control PPM Programme	
Task No:	LEG 06
Task:	**Cooling Tower Cleaning and Disinfection - For Cooling Towers that can be closed down more than one working day – Shut Down**
Frequency:	AS SPECIFIED IN SECTION 10 PPM - TASK FREQUENCIES
If the Maintenance Staff or appointed contractor cannot, at any stage, comply with any part of this Specification, then an alternative Specification shall be agreed which, both; meets the requirements of current legislation and the needs of the Site.	

It is the aim of STFC is to comply with the recommendations of HSE document L8, which stipulates that all industrial cooling towers shall be cleaned and disinfected twice each year or as dictated by testing procedures.

The cooling tower and associated distribution pipe-work including associated equipment (where practicable) shall be cleaned and disinfected at shut-down and re-instatement and as required.

A minimum of one weeks' notice shall be given to any interested party with regard to tower emptying and discharge of chemicals.

Pre-cleaning Disinfection Procedure:

Work Supervisor must liaise with site contact to ensure:

i. Fans are isolated
ii. All valves on the water circuit are open to allow unrestricted flow to all parts of the tower water circuit
iii. The tower drains are closed
iv. All circulation pumps are running
v. The dosage and bleed systems are isolated
vi. Any necessary scaffolding has been erected
vii. Packs and drift eliminators are removed
viii. Necessary pressure washing "tents" have been suitably erected
ix. All gangway entrances will be "tiger taped" and warning notices will be displayed

Suitable bio dispersant shall be added to achieve a Free Chlorine reserve of 5ppm. The system volume shall be calculated by multiplying the length, width and depth of the cooling tower sump then multiplying that figure by 1.05 to allow for the connecting pipe work the system will be dosed with 0.4ltrs Sodium Hypochlorite to $1M^3$ system water.

The free chlorine and pH will be monitored at 60 minute intervals. Level of pH is usually >7 - <9. If there is any change to the pH during the disinfection process, the process shall cease and the pH considered.

The free chlorine level will be maintained for a period of 5 hours minimum.

Once disinfection is complete, the free chlorine in the system will be neutralised using Sodium Thiosulphate dosed at 100g to 1M^3 system water and the system drained and refilled with clean water.

Tower Cleaning Procedure

All walkways, handrails and any noticeable slip hazards will be cleaned before any work commences.

Prior to removal of drift eliminators and pack for the R11 Towers is not possible, therefore the eliminators will be removed as far as possible to access the pack and an endoscope used to assess the integrity and cleanliness of the pack.

The hatches on sides of tower, where appropriate, shall be removed to gain access to the base, cleaned, inspected and replaced correctly.

The sump of the tower shall then be drained using an external pump and thoroughly cleaned and washed.

The tower shall be washed down on the outside and any surrounding area cleaned up before the tower is reassembled in reverse order. The tower shall then be refilled.

Post-cleaning Disinfection Procedure

Suitable bio dispersant shall be added to achieve a Free Chlorine reserve of 5ppm. The system volume shall be calculated by multiplying the length, width and depth of the cooling tower sump then multiplying that figure by 1.05 to allow for the connecting pipe work the system will be dosed with 0.4ltrs Sodium Hypochlorite to 1M^3 system water.

The free chlorine and pH will be monitored at 60 minute intervals. Level of pH is usually >7 - <9. If there is any change to the pH during the disinfection process, the process shall cease and the pH considered.

The free chlorine level shall be maintained for a period of 5 hours minimum.

Once disinfection is complete, the free chlorine in the system shall be neutralised using Sodium Thiosulphate dosed at 100g to 1M^3 system water and the system drained and refilled with clean water.

Temporary pressure washing “Tents”, Signs, barriers and warning notices shall be removed.

ADVICE NOTE: LEG 07
Adiabatic Coolers Cleaning and Disinfection

Science & Technology Facilities Council	Legionellosis Management And Control PPM Programme
Legionellosis Management And Control PPM Programme	
Task No:	LEG 07
Task:	**Adiabatic Cooler Cleaning and Disinfection**
Frequency:	AS SPECIFIED IN SECTION 10 PPM - TASK FREQUENCIES
If the Maintenance Staff or appointed contractor cannot, at any stage, comply with any part of this Specification, then an alternative Specification shall be agreed which, both; meets the requirements of current legislation and the needs of the Site.	

The cooling systems including associated equipment (where practicable) shall be cleaned and disinfected at shut-down and re-instatement and as required.

A minimum of one weeks' notice shall be given to any interested party with regard to tower emptying and discharge of chemicals.

Procedure:

- Fill IBC with 1000 litres soft water and connect pump
- Add 500ml of Chlorine
- Start pump to circulate IBC, check pH and add Chlorine to achieve >50ppm Free Chlorine
- Wait 15 minutes, recheck Chlorine levels and top up if required
- Connect pump discharge to supply pipe and fill line
- Fill line to each cooler using sample valve to bleed air into 25 litre barrel
- Remove all spray nozzles and fill 20 litre container with >50ppm Free Chlorine
- Insert nozzles into container
- Record the Free Chlorine level and pH every 15 minutes for 1 hour
- If Free Chlorine drops <35ppm Free Chlorine top up and restart time
- After 1 hour of Free Chlorine @>50ppm stop pump and open drain valves on coolers
- Return all sample water back to IBC
- Rinse nozzles in clean water and re-attach
- Disconnect pump discharge and connect to IBC and add dechlor
- Circulate IBC and wait until Free Chlorine is <0.5ppm
- Drain IBC and remove all hoses and pumps
- Open softened water supply and purge using sample valve at each cooler
- Check hardness at coolers is between 20-50ppm

Complete the disinfection certificate

12. ON-GOING MONITORING AND AUDIT

The ISIS Legionella Review shall, collectively, be responsible for ensuring that all processes are audited for the Management & Control of Legionella in accordance with this Water Safety Plan.

Audits shall be carried out by an external provider on a quarterly basis.

13. CONTINGENCY MEASURES

High TDS	1. Increased Risk of: a. Scale b. Corrosion c. Bio-fouling d. General deposition	1. Check bleed 2. Check chemical dosing 3. Check make-up 4. Refer to Water Treatment Company if situation continues
Low TDS	1. Waste of chemicals and water 2. Increased risk of: a. Corrosion b. Bio-fouling	1. Check bleed 2. Dose chemicals to restore specified levels
High chemical reserves	1. Waste of chemicals 2. Potential for deposits 3. Mutual inhibition of chemical activities 4. Increased risk of: a. Corrosion	1. Check concentration factor 2. Check dosage equipment 3. Reduce chemical dosage if appropriate
Low chemical reserves	1. Increased risk of: a. Scale b. Corrosion c. Bio-fouling	1. Check bleed 2. Check dosage equipment 3. Check chemical drums 4. Increase chemical dosage if appropriate
Negative hardness balance	1. Increased risk of: a. Scale deposition b. Nutrient presence	1. Check concentration factor 2. Check chemical reserves 3. Check dosage equipment 4. Contact Water Treatment Company if situation continues
High dip-slide count	1. Risk of bacterial contamination (may include Legionella)	1. Check levels of biocide 2. Re-dose biocide if appropriate 3. Retest dip-slide count 4. Contact Water Treatment Company if situation continues
Presence of slime and algae	1. Increased risk of: a. Bacterial contamination (may include Legionella) b. Blockage of equipment	1. Check levels of biocide 2. Re-dose biocide if appropriate 3. Clean tower to remove deposits 4. Contact Water Treatment Company if situation continues
Presence of scale and sludge	1. Increased risk of: a. Nutrients b. Bacterial contamination (may include Legionella) c. Blockage of equipment d. Erosion e. Poor heat transfer	1. Check concentration factor 2. Check chemical dosage 3. Carry out dip-slide sample 4. Clean tower to remove deposits 5. Contact Water Treatment Company if situation continues

13.1 HIGH MICROBIOLOGICAL RESULTS (LEGIONELLA):

All contingency responses must be suitably and sufficiently notified by completing the site defect log and completing the 'Adverse Water Sample Results Notification', found in Section 16. Notifications.

Water microbiological water analysis sample results interpretation:

Analysis Sample	Reported Results	Result Interpretation
Legionella sp.	None Detected	Negative - Pass
	<100cfu/l	Insignificant - Pass
	>100cfu/l - <1,000cfu/l	Significant - Fail
	>1,000cfu/l	Highly Significant - Fail

The absence of legionella does not indicate the absence of risk. Sporadic Legionella positive results are not uncommon (even with low TVCs) and, provided the TVCs and biocide control are good, are not normally a major cause for concern. However, repeated Legionella positives or positives plus poor biocide control and/or poor TVCs are and should be investigated.

Legionella cfu/litre	Comments and action required
Not detected or up to 100	'Not detected' does not mean 'not present' or that there is no risk. Focus on maintaining control measures, particularly keeping the general aerobic count less than 1 x 104 cfu/ml
>100 and up to 1000	Low-level legionella count detected. This may be a sporadic result or could indicate a persistent problem. Reassess the control programme and the general aerobic count. Ensure the water treatment system is operating correctly. Adjust the biocide dosage if the general aerobic count does not indicate good control (less than 1 x 104 cfu/ml). Resample to verify the initial result and then again to check that remedial actions are effective
>1000 or persistent low-level results	Immediate action required. Resample and as a precautionary measure shot dose the water system with an appropriate biocide or increase the level of continuous dosage of biocide. Reassess the entire control programme and take any corrective actions.

	Resample the system to verify the count and to determine the effectiveness of the corrective action, resample again within 48 hours. If the high legionella counts persist, review the risk assessment to identify further remedial actions

13.2 LEGIONELLA RE-SAMPLE ESCALATION

Where a sample has indicated that it is positive for legionella, whether insignificant or significant the Responsible person and/or deputy shall carry out the required remediation and re-sample the tower or system. If the re-sample returns a not detected or an insignificant result the Responsible person can continue with the relevant contingency steps, however, if the result at any time shows a highly significant count, or the resample shows two consistent counts then the escalation should be through SHE SC05 - Incident reporting and investigation.

14. THE COURSE OF ACTION IF AN OUTBREAK OF LEGIONNAIRES' DISEASE IS CONFIRMED OR SUSPECTED

STFC will usually be informed of a suspected outbreak of Legionnaires Disease by a member of the STFC Infection Prevention and Control Committee or Health and Safety Executive. If an outbreak is suspected, then this Committee, in collaboration with the Outbreak Control Team, will normally work in association with the Public Health England and the local Medical Officer for Environmental Health to search for the source of the causative organism and identify any failing in control measures. This search is a specialist task which involves epidemiological studies and taking water samples for analysis.

The Health and Safety Executive may be involved in the investigation of outbreaks under the Health and Safety at Work Act 1974. Local authority environmental health officers may also be involved.

It is essential that the cooling systems are not drained or disinfected before samples have been taken. The Engineers role is an important one - guiding specialists to the various water systems within the building, and, in particular, to the points from which samples can be taken. Easy access to these sampling points is essential.

An investigation would concentrate upon all potential sources of Legionella infection including:

i. the domestic hot and cold water system distribution;
ii. showers or spray washing equipment;
iii. drainage systems and taps;
iv. whirlpool baths, therapy pools and birthing pools
v. humidifiers in ventilation systems;
vi. cooling coils in air conditioning systems;
vii. fountains and sprinklers;
viii. medical equipment using a water source.

To assist in such investigations STFC maintenance team of engineers will need to be able to provide details of all associated equipment, its location, technical data, the operating, maintenance and spares information on all the above installations. They must assist by advising the investigating team as to the extent of servicing on the site and locating taps and sample points.

Off-site information will also be required such as whether there has been any local excavation or earth moving works; alterations to water supply systems or drainage systems or any other factors that may have a bearing on the site.

15. MAJOR OUTBREAK PLAN

An outbreak is defined as two or more cases where the onset of illness is closely linked in time (weeks rather than months) and where there is epidemiological evidence of a common source of infection, with or without microbiological evidence. An incident/outbreak control team should always be convened to investigate outbreaks. It is the responsibility of the Proper Officer to declare an outbreak. In England and Wales the Proper Officer, appointed by the local authority, is usually a Consultant in Communicable Diseases Control (CCDC). If there are suspected cases of the disease, medical practitioners must notify the Proper Officer in the relevant local authority.

Legionnaires' disease is notifiable under the Health Protection (Notification) Regulations 2010. Under these Regulations, human diagnostic laboratories must notify Public Health England (PHE) of microbiologically confirmed cases of legionnaires' disease.

16. NOTIFICATIONS

16.1 Management Process No. 1: Adverse Water Sample Results Notification:

HYDROP	Science & Technology Facilities Council	NO. 1	**Adverse Water Sample Results Notification**

To be completed by Responsible Person (Water) – Cooling Systems					
Date:		Completed by:			
Date of Sample		Date of results:		Site	
Cooling Tower:					
Organism:		Result:		Pre-flush	
				Post-flush	

Interpreted Level of Contamination			
TVCC (✓)	Legionella (✓)	E. coli (✓)	Coliforms (✓)

Proposed Remedial Works Required:	
Additional Remedial Works Required by Authorising Engineer (Water):	

APPENDIX 3. CLOSED LOOP WATER SYSTEMS

HYDRACLEAN LIMITED

VINCI FACILITIES

Science & Technology Facilities Council

Closed Loop Water Systems

Legionella Risk and Control

Risk and Control of Legionella in closed loop water systems

Growth of Legionella bacteria

Legionella bacteria can proliferate in water systems with conditions that favour the bacteria. These conditions can exist within LTHW and Chilled water systems. These conditions are summarised below for each type of system.

LTHW:

These systems are typically used for space heating via AHU's, FCU's or radiators

Legionella bacteria can enter these systems through make up water either on initial filling or replenishing water lost through leaks or maintenance works.

When in normal use the temperatures are generally in excess of 50^0C and so Legionella bacteria will be killed off making these systems low risk, however if the systems have been left off line or had areas without circulation and the systems untreated then it is possible that Legionella bacteria could be present and proliferate. If work is undertaken on these systems when pressurised then small localised quantities of Legionella bacteria could be released into the atmosphere creating a possible small localised risk.

In normal use systems should be treated with inhibitors and biocides to prevent corrosion and bacterial growth

If there are any planned maintenance works then the system should have the pressure released by removing some water through a drain valve being careful not to release aerosols.

If "bleeding" systems through air valves then a cloth should be used over the air release to prevent aerosol production or P3 filter masks worn by the operatives.

If the systems are to be worked on while pressurised and this work may entail the release of aerosols then the systems should be tested for Legionella bacteria and if required P3 filters issued to operatives and the work area restricted. However if the system is operating at 60C or greater then it is reasonable to assume that the risk is controlled.

Chilled

These systems are typically used for cooling buildings via AHU's and FCU's or equipment and processes.

Legionella bacteria can enter these systems through make up water either on initial filling or replenishing water lost through leaks or maintenance works.

When in normal use the temperatures are generally in the range where Legionella bacteria can proliferate. If work is undertaken on these systems when pressurised then small localised quantities of Legionella bacteria could be released into the atmosphere creating a possible small localised risk.

In normal use systems should be treated with inhibitors and biocides to prevent corrosion and bacterial growth

If there are any planned maintenance works then the system should have the pressure released by removing some water through a drain valve being careful not to release aerosols.

If "bleeding" systems through air valves then a cloth should be used over the air release to prevent aerosol production or P3 filter masks worn by the operatives.

If the systems are to be worked on while pressurised and this work may entail the release of aerosols then the systems should be tested for Legionella bacteria and if required P3 filters issued to operatives and the work area restricted.

Dissemination of Legionella Bacteria:

Legionella bacteria can only cause illness in humans if high enough numbers of the bacteria can be disseminated in an aerosol spray and be breathed in by susceptible people.

Closed loop water systems as the name suggest do not, in normal operation allow the water outside the system to cause any risk from Legionella bacteria making these systems inherently low risk systems.

Control measures should therefore concentrate on circumstances where aerosols could be generated and therefore any risk controlled.

Recommended control measures for Close loop water systems

Table 1.0

Activity	Risk LTHW	Risk Chilled	Control Measure
Planned maintenance work allowing water to be released	If system is operating below 50 C then possible risk or aerosol production	Possible risk of aerosol production	Remove pressure from the system by bleeding water off from drain valve before works
Planned maintenance works allowing water to be released when system under pressure	Aerosol production	Aerosol production	LTHW if system has been operating at >60 C in the last week then no action. LTHW and Chilled: Test system for Legionella bacteria before works and if required treat or wear P3 mask and control works area during any aerosol production.
Bleeding the system	Aerosol production	Aerosol production	Use cloth to prevent aerosol production or wear P3 mask
Emergency works	Aerosol production	Aerosol production	If possible de-pressurise system. Limit aerosol production and if aerosols may be produced restrict work area.
Normal Operation	No aerosol but possible bacterial growth depending on temperature and use	No aerosol but possible bacterial growth	Consider treating systems with inhibitors and biocides

APPENDIX 4. OTHER LEGIONELLA RISK SYSTEMS

All managers must identify all systems which contain water where there is a risk from Legionella. It must be ensured that a risk assessment is undertaken for all such systems, with controls in accordance with the HSE guidance document L8 (Fourth Edition).

The following are examples of systems which should be included, together with suggested controls:

- Sprinklers and hose reel systems: Consider regular draining and replenishing of the water, particularly if connected to the mains water system; when testing, ensure aerosol generation is minimised.

- Water Softeners: Clean and disinfect resin and brine tanks as directed by manufacturer.

- Lathe and machine tool coolant systems: Clean and disinfect storage and distribution of coolant system as directed by manufacturer.

- Emergency showers and eyewash: Flush through and purge to drain six-monthly or as directed by manufacture. Check operation of thermostat to ensure water is not heated above 20°C.

- Vehicle Washers: These are usually operated at less than 20°C and may re-cycle water. The filtration and cleaning systems should be checked regularly, cleaning and disinfection should be undertaken in according to manufacturer's instructions.

- Vehicle screen wash systems: should have recommended concentration of Screen Wash fluid added.

- Air scrubbers

- Ice Machines

APPENDIX 5. RECORD KEEPING AND WATER SYSTEM REGISTERS

The LRP shall ensure that appropriate records are kept, including details of:

a) The person or persons responsible for conducting the risk assessments, managing, and implementing the associated written scheme(s) and the training records of such personnel.

b) The significant findings of the risk assessment.

c) The written scheme and details of its implementation. This should include:
- The physical treatment programme - for example, the use of temperature control for hot and cold water systems;
- The chemical treatment programme, including a description of the manufacturer's data on effectiveness, the concentrations and contact time required;
- Health and safety information for storage, handling, use and disposal of chemicals;
- System control parameters (together with allowable tolerances); physical, chemical and biological parameters, together with measurement methods and sampling locations, test frequencies and procedures for maintaining consistency;
- Remedial measures to be taken if the control limits are exceeded, including lines of communication; and
- Cleaning and disinfection procedures.

d) The results of any monitoring, inspection, test or check carried out, and their dates. This should include details of the state of operation of the system, i.e. in use/not in use. This should include the checks detailed in Appendices 1-4.

e) Details of remedial work and precautionary measures that have been carried out, including sufficient detail to show that they were carried out correctly and the dates on which they were carried out.

f) A log detailing all visits by relevant contractors, consultants and other personnel.

g) Cleaning and disinfection procedures and associated reports and certificates.

h) Results of the chemical analysis of the water.

i) Information on other hazards, eg treatment chemicals.

j) Local environmental health authority cooling tower notifications.

APPENDIX 6. TRAINING

Role	Initial Training	Refresher	Frequency	Comments
Legionella Responsible Person (LRP) or Deputy	Legionellosis: Role of Responsible Person, 2 day - e.g. Develop Training - WS1 Plus Legionella: Hot and Cold Water Systems, 2 day - e.g. Develop Training - WS2 Or Legionella Cooling Towers & Equipment, 1 day - e.g. Develop Training - WS3 Dependent on water systems managed, and optionally Water Systems Hazard Identification & Risk Assessment, 3 day - e.g. Develop Training - WS8	Ditto	3 yearly or when legislation changes	
Courses Available from:	Develop Training Ltd., HYDROP E.C,S,			
Staff and others working in areas where Legionella hazards exist	Short Legionella Awareness on-line training course	As required, and while awaiting initial attendance at tutored 1 day course		
	Legionella Awareness, 1 day course - e.g.Develop Training - WS11	Ditto	3 yearly or when legislation changes	
Courses Available from:	Develop Training Ltd., HYDROP E.C.S.			

APPENDIX 7. EMERGENCY ACTION IN THE EVENT OF AN OUTBREAK

A suspected Legionella outbreak is likely to be identified by the health authority who will communicate with all relevant local industrial premises, in order to attempt to identify the source of the bacteria. Where a STFC premises is approached in this way, the following action must be taken:

1) Co-operate fully with the investigating authorities providing them with assess to sampling points etc. in order that they can take water samples.

2) Provide access to all relevant records, in particular to plans of cooling towers and hot and cold water services and records of inspections, cleaning and disinfection regimes.

3) Shut down any systems capable of generating aerosols, which have been implicated in an outbreak.

4) Undertake emergency disinfection of systems suspected of harbouring Legionella bacteria. This should only be carried out as directed by the Local Environmental Health Departments.

5) Where relevant, investigate the health status of staff or other persons who could have been affected.

Further detailed requirements can be found in the HSE Guidance document L8 (Fourth Edition).

APPENDIX 8. AUDIT CHECKLIST

General Programme management

Ref.	Question	Comments
1. Programme management		
1.1	Is there a responsible person agreed for every water system nominated in writing?	
1.2	Is there an appointed deputy?	
1.3	Are the duties of all persons involved clearly defined and communicated?	
1.4	Are all persons involved adequately trained?	
1.5	Are the responsibilities of the occupier and contractor(s) clearly defined?	
1.6	Has it been ensured that the contractors are adequately trained and competent?	
1.7	Have the other relevant health and safety issues - COSHH assessments for chemicals, safe access etc. been addressed?	

Cooling Towers

1.	**Physical Condition and design**	
1.1	Are the drift eliminators suitable, in good condition and effective?	
1.2	Is the system water in good condition?	
1.3	Is the sump free from sediment?	
1.4	Are all visible surfaces free from slime or algae?	
1.5	Are all visible surfaces free from scale deposits?	
1.6	Are all visible surfaces free from corrosion?	
1.7	Is the water flow even across the whole of the tower fill?	
1.8	Have all the dead legs or poor flow areas been eliminated?	
1.9	Has all redundant plant been isolated from the system?	
1.10	Are all pipe runs as short and direct as possible?	
1.11	Is the tower constructed of impervious materials?	
1.12	If constructed of wood, is this in good condition?	
2.	**Risk Assessment (General)**	
2.1	Has the existence of the cooling tower/evaporative condenser been notified to the local authority?	
2.2	Is there a written risk assessment for the system?	
2.3	Does it contain an up to date schematic plan of the system?	
2.4	Does it contain details of the precautions to be taken?	
2.5	Does it contain instructions for the operation of the system?	
2.6	Does the assessment conclude that the risk?	

2.7	Does the assessment consider the tower's physical condition?	
2.8	Does it consider the tower's positioning?	
2.9	Does it consider the population density near the premises?	
2.10	Does it consider any 'at risk' groups of persons?	
2.11	Has elimination or replacement with a lower risk system been properly considered?	
3.	**Schematic Diagram**	
3.1	Does it show all system control valves?	
3.2	Does it show standby plant (spare pumps etc)?	
3.3	Does it show any associated storage tanks?	
3.4	Does it show system bleed valve?	
3.5	Does it show chemical dosing pumps and injection points?	
3.6	Does it show system drain valve?	
3.7	Does it show the origin of the water supply?	
4.	**Cleaning and Disinfection**	
4.1	Is there a written cleaning and disinfection procedure?	
4.2	Is it carried out at least every six months?	
4.3	Does it specify chlorine level at start of pre-clean chlorination?	
4.4	Does it specify contact/circulation time?	
4.5	Does it specify chlorine level at end of pre-clean chlorination?	
4.6	Does it give the method for cleaning all accessible parts?	
4.7	Does it specify chlorine levels at start of post-clean chlorination?	
4.8	Does it specify contact/circulation time?	
4.9	Does it specify chlorine level at end of post-clean chlorination?	
4.10	Is the removal of the tower fill/pack for cleaning and disinfection specified in the assessment?	
4.11	Are they removed for cleaning and disinfection in practice?	
4.12	Are there suitable health and safety procedures for carrying out cleaning and disinfection?	
5.	**Ongoing Water Treatment**	
5.1	Is a water treatment programme in place?	
5.2	Does it use chemicals to control scale?	
5.3	Does it use chemicals to control corrosion?	
5.4	Does it use chemicals to control bacterial and algae (biocides)?	
5.5	Are alternating biocides used?	
5.6	Are the chemicals automatically dosed?	
5.7	Is there an automatic bleed to control dissolved solids?	
6.	**Ongoing Safe Operation**	
6.1	Are there procedures for circulation of all parts once per week?	
6.2	Is there a shutdown of the installation at least once per year? How long does it last?	

6.3	Are there procedures for start up after shutdowns?	
6.4	Instructions for draining during long shutdowns?	
6.5	Instructions regarding valve settings for normal operation?	
6.6	Procedures for switching duty/standby pumps.	
7.	**Monitoring and Record Keeping**	
7.1	Daily check to ensure conformance with operating procedures?	
7.2	Daily visual check made on the cleanliness of the system water?	
7.3	Chemical water quality checks carried out at least monthly?	
7.4	System physical condition checks carried out at least weekly?	
7.5	Dip slide tests taken at least weekly?	
7.6	Are Legionella tests carried out every quarter?	
7.7	Records of all tests undertaken maintained?	
7.8	Recommendations for remedial action recorded?	
7.9	Completion of remedial action recorded?	

Hot and Cold Water Services

Ref.	Question	Comments
1.	**Physical Condition and Design**	
1.1	Is the cold water storage tank adequately lagged?	
1.2	Is the cold water storage tank adequately covered, insect screened and reasonably clean?	
1.3	Is the hot water storage tank/calorifier adequately lagged?	
1.4	Are there any materials that do not comply with the water fittings regulations?	
1.5	Does the Cold Water tank hold more than can be used in 24 hours?	
1.6	Is the stored cold water temperature above 20^{o}C?	
1.7	Is the stored hot water temperature below 60^{o}C?	
1.8	Is the cold water temperature at the furthest draw-off point above 20^{o}C?	
1.9	Is the hot water temperature at the furthest draw-off point below 50^{o}C?	
1.10	Are there any dead ends?	
1.11	Are there any little used outlets (for example outhouses etc.)?	
1.12	Are showers fed from storage tanks (as opposed to electric)?	
1.13	Are there systems other than showers that can generate aerosols?	
2.	**Risk assessment**	
2.1	Is there a written risk assessment for the system?	
2.2	Does it contain an up to date schematic plan of the system?	
2.3	Does it contain details of the precautions to be taken?	
2.4	Does it contain instructions for the operation of the system?	
2.5	Does the assessment conclude that there is a significant risk?	
2.6	Does the assessment consider the physical condition of tanks, calorifiers and pipework?	

Ref.	Question	Comments
2.7	Has elimination or replacement with a lower risk system been properly considered?	
3.	**Inspection and Maintenance**	
3.1	Are the temperatures of hot water calorifiers regularly monitored?	
3.2	Are Cold water tank temperatures regularly monitored?	
3.3	Are tap outlet temperatures regularly monitored?	
3.4	Is the physical condition of Calorifiers and Water tanks regularly checked, cleaned and disinfected as necessary?	
3.5	Are Shower heads regularly de-scaled?	
3.6	Are little used outlets flushed through regularly?	

APPENDIX 9. STFC SITE WATER SAFETY GROUP TERMS OF REFERENCE (TOR)

The Site Water Safety Group aims to minimise the risk of illness associated with water born hazards (including legionella) for all site residents: staff; tenants; contractors; and visitors. While the scope and focus of this group is domestic water systems it includes any system in which Legionella hazards may arise for example lathe cutting fluids, cooling systems etc.

Site Water Safety Groups are multidisciplinary teams formed to undertake the commissioning, development, implementation and review of the site's water safety plan.

It provides a forum to support Legionella Responsible Persons undertake their responsibilities under SHE Code 38 'Control of Legionella' in which people with a shared interest and understanding of the site's water hazards meet to take collective ownership for ensuring it identifies microbiological hazards, assesses risks, identifies and monitors control measures and develops incident response protocols.

The Site Water Safety Group will review, and as appropriate take action to ensure, the site's compliance with STFC SHE Code 38 'Control of Legionella' and associated legislation and codes of practice.

Responsibilities:

- Ensure the Legionella Risk Assessments for all entries in the site register of water systems, domestic water systems and other sources of Legionella, are reviewed two yearly or more frequently following significant change to these systems or external good practice;
- Identify responsibility areas through demarcation of equipment assets, Identify new water, or other liquid born, hazards introduced to the site ensuring they are listed in the site register of water systems and as appropriate risk assessments and written schemes are developed for them;
- Review reported water system/Legionella incidents ensuring root cause and remedial actions arising from them are suitable and sufficient to minimise the potential for recurrence, and these actions carried out in a timely manner;
- Provide advice and guidance in the event of a Legionellosis outbreak, as appropriate assisting site emergency controllers/site management in managing the incident;
- Review the findings of specialist water systems/Legionella audits ensuring their recommendations are acted upon and agreed actions are carried out in a timely manner; and
- Provide quarterly reports on the status of water safety management and to the site Health and Safety Committee (through SHE Group reports), and present annually a review of site water safety management to the site Health and Safety Committee.

Membership:

- Representative from site CSD Estates team;
- The site Legionella Responsible Person(s);
- Representatives from any STFC Department whose activities/operations/equipment may affect site domestic water systems;
- Representatives from any STFC Department whose activities/operations/equipment may be a source of Legionella hazards independent of site domestic water systems;

- Representative from STFC SHE Group;
- Representative from the site's Facilities Management contractors for Hard and/or Soft Services;
- Representative from site water treatment contractor(s); and
- Representative from the site's Legionella Management Contractors.

Meeting administration:

- Quarterly; and
- Chaired by site LRP (or a senior member of CSD Estates).

Reports to:

- Site Health and Safety Committee.

APPENDIX 10. DOCUMENT RETENTION POLICY

Records established	Minimum retention period	Responsible record keeper	location of records	Comments/ Justification
Water Systems Register	Current + 5 years	Estates Teams	Local Record Systems	
Audits	Current + 5 Years	Estates Teams	Local Record Systems	
Appointments:				
Legionella Responsible Person	Most Recent	Director	SHE Directory	Appointment Letter