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

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Signed: 

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

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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.

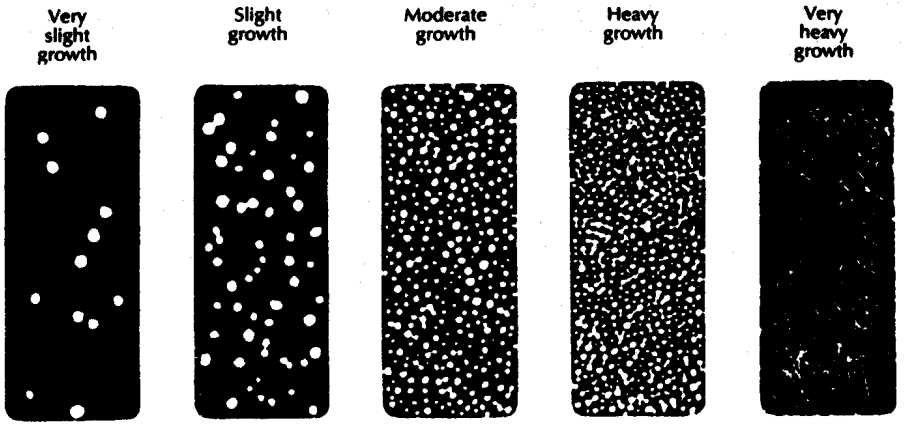
3. Incubation:

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

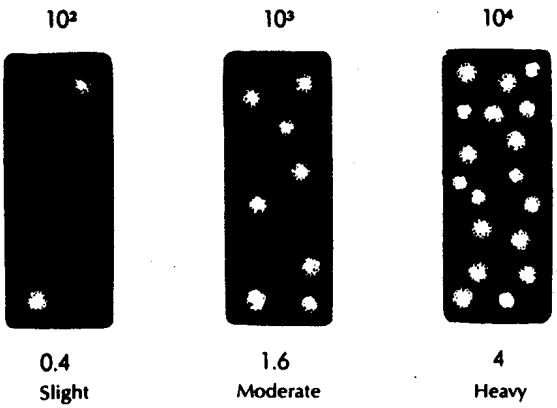
Compare results to charts provided to estimate level of contamination. Note that very high levels may lead to a confluent growth and could be recorded as a nil result. Compare to an unused slide when reading results.

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):	