Sample Specification for Procurement of Operation and Maintenance Services for Fresh Water Cooling Towers

It is the basic responsibility of owners of fresh water cooling towers to properly operate and maintain their cooling towers and, for this purpose, they should arrange regular inspections, timely maintenance and periodic testing of water quality of their cooling towers in accordance with the Code of Practice for Water-cooled Air Conditioning Systems and guidelines on Good Operation and Maintenance Practice of Fresh Water Cooling Towers for Air-conditioning Systems issued by the Electrical and Mechanical Services Department (EMSD).

2. The following sample tender specification for operation and maintenance of fresh water cooling towers serves to assist owners of towers and management agencies ("users") in procuring cooling tower operation and maintenance services. It is intended to provide typical specification of requirements for common operation and maintenance services with regard to the above Code of Practice and guidelines for reference by users. Users may consider using relevant parts of the requirements contained in this sample specification for their own procurement documents for operation and maintenance of their cooling towers.

3. The sample specification is not meant to suit the needs of all users, and therefore should not be indiscriminately copied. Users should carefully consider their own circumstances and needs, in order to maintain the cooling towers in safe operational and hygienic conditions by meeting requirements in the CoP (WACS) including control of bacterial quality, and avoid nuisance to the public contravening the Public Health and Municipal Services Ordinance. Users may modify the sample specification as appropriate to suit their own installations, taking into account of the configuration and conditions of their cooling towers, specific requirements on the quality and level of operation and maintenance services, and availability of technical support services to the users etc.

4. For cooling towers which have joined the Fresh Water Cooling Towers Scheme ("FWCT Scheme") administered by the EMSD, the owners are reminded of their obligations to comply with the Scheme requirements, including proper operation and maintenance, upkeep of monthly operational and water quality records by Form CT3, annual audit and submission of an audit report to the EMSD. For cooling towers not yet joined the FWCT Scheme, their owners are highly recommended to make application to the EMSD to do so. Please visit the follow website on more details of the FWCT Scheme: http://www.emsd.gov.hk/emsd/eng/pee/psfwct.shtml

Electrical and Mechanical Services Department
October 2012

Particular Specification for Operation and Maintenance of Fresh Water Cooling Tower Installation

1. GENERAL REQUIREMENTS

1.1 General

The Contractor shall inspect, serve, repair, operate and maintain the cooling tower installation(s) to meet the functional requirements. The Contractor shall properly operate and maintain the cooling tower installation(s) in a good and uncontaminated condition and minimize nuisance to surrounding area and public. The operation and maintenance requirements in this Specification generally follow the Code of Practice for Water-cooled Air Conditioning Systems and guidelines on Good Operation and Maintenance Practice of Fresh Water Cooling Towers for Air-conditioning Systems published by the Electrical and Mechanical Services Department. Unless specified otherwise, "cooling tower" in this Specification will denote "fresh water cooling tower" for brevity.

1.2 Cooling Tower Installation

The cooling tower operation and maintenance works shall comprise supply of materials and labour necessary for carrying out the following works to the cooling tower installations as listed in the Annex 1 Equipment Schedule and those subsequently added:

(a) Water treatment of the cooling tower installation(s);

(b) Preventive and planned routine maintenance of the cooling tower installation(s);

(c) Cooling water quality monitoring, water sampling and bacterial tests;

(d) Remedial actions for water sampling results at or above control thresholds;

(e) Corrective maintenance and repair of the cooling tower installation(s).

1.3 Site Visits before Submitting Tender

Before completing and submitting tenders, the tenderers are advised to visit the cooling tower installation sites to appreciate and familiarize the extent of work.

1.4 Maintenance Log Book

The Contractor shall maintain a maintenance log book at each installation. The log book shall be provided by the Employer [see a sample sheet of log book at Annex 2] and kept at appropriate places on site by the Contractor. Every attendance and detail of work done to the installation(s) shall be entered into the log book by the Contractor so as to form a maintenance record, and/or to certify the Contractor's attendance visits as required by this Contract.

1.5 Stock of Spare Parts

The Contractor shall keep adequate stocks of chemicals, spare parts, equipment and other components which are necessary to maintain the clean and satisfactory operating and water quality conditions of the installation(s) at all the times.

1.6 Taking over of Existing Installation(s)

The maintenance of the installation(s) is currently carried out under a maintenance contractor. With effect from the commencement date of the Contract, the Contractor shall take over the above responsibility and shall carry out the Works for those existing cooling tower installation(s) in accordance with the requirements of this Particular Specification.

1.7 Handover of Installations to the Employer prior to the Termination or Expiry of the Contract

One month prior to the termination or expiry of the Contract, the Contractor shall arrange a

schedule handover to the Employer for all Installations of the Contract. The Contractor shall ensure that the Installations are in good working order, clean and satisfactory operation condition at the time of handover.

2. EXTENT OF WORKS

2.1 Operation and Preventive Maintenance

2.1.1 General Requirement

The Contractor shall carry out operation and preventive maintenance for all parts of the cooling tower installation(s) in accordance with the requirements set out in this Section 2.1.

The Contractor shall carry out all necessary preventive maintenance for any part of the cooling tower installation(s) with a view to ensuring that the equipment and accessories are operated in clean, safe, reliable, efficient and effective conditions.

The costs of operation and preventive maintenance for the installations and all the associated equipment, devices and accessories, etc. shall be included in the unit rates for entered by the Contractor in the Schedule of Rates.

The Contractor may be required to carry out preventive maintenance works outside normal working hours (including Sundays and public holidays) without any cost implication.

In addition, the Contractor shall repair or replace at no additional cost to the Employer any part/component/equipment of an installation, which is proved to be defective by reason of the Contractor's negligence, inadequate servicing and maintenance, poor performance and workmanship, use of incorrect materials or materials of inferior quality.

2.1.2 Water Treatment

The Contractor shall operate and maintain water treatment facilities according to the manufacturer's recommendation.

The Contractor shall refill all chemicals, the cost of which shall be included in the unit rate for that entered in the Schedule of Rates.

Water treatment work should be carried out under the direction of competent technical personnel. Chemicals should be handled with care by personnel wearing appropriate protective clothing, including goggles, gloves, face-shield and chemical-proof apron to prevent contact with the agents. Personnel involved in water treatment work should be trained in safety procedures, including proper use and maintenance of protective equipment, thorough hand washing and drying after work.

2.1.3 Periodic Running of Standby Unit(s) and Temporary Shut-down

The cooling tower system shall be kept in regular use whenever possible. When the system is used intermittently or installed as a standby unit, the Contractor shall run the standby unit including water treatment facilities at least one hour per week.

If the system is intended to be put out of use for more than a week, the Contractor shall either:

(a) keep it full of treated water which shall be checked (for biocide levels and water quality) and circulated once a week; or

(b) fully drain off the system water and dry the system by mechanical fan, and then cover and shut off the inlet and outlet pipes leading to the cooling tower(s) to prevent water from entering the system.

In either case, the cooling tower(s) temporarily shut-down shall be isolated from the water supply mains to avoid back contamination. Drain valve shall be opened at all times to prevent

accumulation of water in the tower basin in rainy days. The Contractor shall carry out full re-commissioning including cleaning and disinfection before the system is brought into service again.

2.1.4 Routine Inspection and Preventive Maintenance

The Contractor shall regularly inspect and properly maintain the cooling tower installation(s) in accordance with the frequencies and requirements set out in this Section. Inspection and maintenance shall cover cooling towers and their associated mechanical equipment, water treatment facilities and water tanks.

2.1.4.1 Weekly routines

The Contractor shall:

(i) Check cooling water for clarity, odour, surface debris, algae and temperature.

(ii) Check water level of basin and the foaming condition of the cooling tower.

(iii) Check bleed-off valves, strainers, drains and float valves for proper operation.

(iv) Check operation condition of water treatment dosing equipment, and check water treatment chemicals or materials for adequacy and safety.

(v) Check operation conditions of the cooling tower fan and drive, water treatment dosing facilities, and water pumps.

(vi) Drain stagnant water in dead-legs if any by manual purging for at least 15 minutes each.

(vii) Run all standby condensing water-side equipment at least one hour.

(viii) Check quantity of chemicals and refill if necessary.

(ix) Check any water leakage from make-up tank and bleed-off tank.

(x) Check float valves and level sensors of make-up tank and bleed-off tank.

2.1.4.2 Monthly routines

The Contractor shall:

(i) General

- Check cooling water for clarity, odour, surface debris, algae and temperature and ensure that the cooling water be properly dosed with biocides or alike by chemical treatment devices (or disinfected by physical treatment devices if adopted instead) to prevent microbial growth.

- Check internal surface condition of cooling towers for scale, rust, sludge, and biofilm accumulation, in particular the water basin. The Contractor shall remove them by scrubbing and cleaning.

- Check sprays and distribution deck for proper water distribution.

- Check for proper operation of bleed-off valves and other valves of the installation.

(ii) Water Basin

- Check basin sides and corners of cooling towers for any leakage or overflow.

- Inspect suction screen and clean away any accumulated debris.

- Assure float valves and make-up water controls operating freely and maintain proper water level.

(iii) Tower Framework

- Inspect the tower framework visually for any deterioration and test its members for soft spots with a screw driver or other pointed tool.

- Check and clean all air inlet corrugated GRP louvers.

- Grease vibration isolation springs.

- Remove corrosion and rust and carry out touch-up painting.

- Inspect the general condition and check tightness of framework bolts for safe use.

(iv) Fills and Drift Eliminators

- Check condition/ cleanliness of fills and drift eliminators, and remove any accumulated dirt.

- Check that fills are intact and in place with no sagging or gaps in packs.

(v) Make-up and Bleed-off Water Tanks

- Check tank sides and corners for any leakage or overflow.

- Assure float valves and water level controls operating freely and maintain proper water level.

- Inspect the support framework of the tanks visually for any deterioration.

- Inspect suction and discharge of bleed-off water tank and clean away any accumulated debris.

2.1.4.3 Quarterly routines

The Contractor shall:

(i) Adjust and lubricate fans, pumps and motors bearings.

(ii) Adjust and lubricate all moving parts of valves.

(iii) Clean the water distribution pipework including nozzles.

2.1.4.4 Half yearly routines

The Contractor shall:

(i) Clean, desludge and disinfect water basin and internal surfaces of cooling towers as follow:

(a) circulate first biodispersant in the system;

(b) circulate chlorinated water of 5 ppm for 4 hours and then drain;

(c) manually clean and desludge internal surfaces;

(d) refill and recirculate chlorinated water for 6 hours and then drain.

Dechlorinate the water in (b) and (d) by a neutralizer (e.g. sodium thiosulphate) before draining.

(ii) Fully clean fills and drift eliminators.

(iii) Remove and clean end caps in each header.

(iv) Clean and disinfect make-up and bleed-off water tanks, following similar procedures in Water Supplies Department's guide to cleansing of fresh water storage tanks [see Annex 5].

(v) Wash accessible areas of the towers and fill pack.

2.1.5 Monitoring of Water Quality

The Contractor shall arrange regular water sampling and testing of cooling water to monitor water treatment effectiveness, including bacterial tests which shall be conducted by laboratories accredited by the Hong Kong Laboratory Accreditation Scheme (HOKLAS). The bacterial testing of cooling water shall include the following:

(a) Monthly testing of heterotrophic colony count (HCC)

(b) Quarterly testing of Legionella bacteria count (LBC)

[Note for information and necessary adjustment for LBC testing (not to be included in the specification): Monthly testing of LBC should be conducted for cooling tower installations at medical and health facilities such as hospitals, general clinics, specialist clinics; community support facilities for the elderly, such as residential elderly homes, social centre for the elderly; establishments providing health care and services for the sick and infirm.]

The Contractor shall collect water samples from a water sampling point, if available in the cooling tower system, which should be located away from the chemical dosing point, water inlet and bleed-off position. Sampling tap and hose, if provided, shall be run with cooling water for at least 30 seconds prior to sampling. If such a sampling point is not available, water samples may be collected from the cooling tower basin or the location where cooling water falls from the fill into the basin.

The Contractor shall carry out investigation, review water treatment programme and take corresponding remedial actions according to Section 2.1.7 when cooling water sampling result(s) is/are at/above the respective control thresholds below:

	Lower control threshold (cfu/mL)	Upper control threshold (cfu/mL)
Legionella bacteria count (LBC)	10	1,000
Heterotrophic colony count (HCC)	100,000	5,000,000

[Note (not to be included in the specification): The following clause should be added for cooling towers which have joined the FWCT Scheme. For cooling towers not yet joined the Scheme, owners are also encouraged to adopt the following requirement as far as practicable]

The Contractor shall also sample, measure, test and record the operation and water quality parameters as listed in the Form CT3 issued by the EMSD for the FWCT Scheme [see a sample form at Annex 4] on a monthly basis. The Contractor shall complete the Form and submit to the Employer for record.

2.1.6 Cooling Tower Inspection and Water Sampling by Government Authorities

The Contractor shall provide assistance (such as access to the cooling tower installation(s), shutdown of the installation(s), opening of covers and locks and etc.) to Government Authorities (e.g. Electrical and Mechanical Services Department, Department of Health) when required by them for inspection and water sampling of the cooling towers.

2.1.7 Remedial Actions for Cooling Water Sampling Results at or above Bacterial Control Thresholds

When cooling water sampling results are found at or above the respective lower or upper bacterial control thresholds as stipulated in Section 2.1.5, no matter that the water sampling is conducted by the Contractor, Government Authorities or third party employed by the Employer, the Contractor shall carry out remedial actions in accordance with the requirements set out in this Section.

2.1.7.1 On-line Disinfection

The Contactor shall carry out on-line disinfection when:

(a) LBC is detected to be ≥ 10 cfu/mL and < 1,000 cfu/mL; or

(b) HCC is detected to be ≥100,000 cfu/mL and < 5,000,000 cfu/mL.

The Contactor shall carry out on-line disinfection for the cooling tower system according to the following procedures:

(i) Add biodispersant and circulate through the cooling tower system prior to on-line disinfection (dosage as recommended by the Cooling Tower Specialist Contractor).

(ii) Dose a biocide of different chemical composition, or similar composition at a higher concentration, to the cooling tower system in addition to that of the regular water treatment programme.

(iii) Circulate the biocide through the cooling tower system for the time specified by the biocide manufacturer.

(iv) Return the system to normal operation.

(v) Re-test cooling water samples to ascertain the water bacterial quality has resumed normal (i.e. below the lower control thresholds).

2.1.7.2 Emergency Decontamination

The Contactor shall carry out emergency decontamination when:

(a) LBC is detected to be 1,000 cfu/mL or more; or

(b) HCC is detected to be 5,000,000 cfu/mL or more; or

(c) on-line disinfection, as well as, cleaning and disinfection are not effective in controlling Legionella and heterotrophic colony count in cooling tower water.

The Contactor shall carry out emergency decontamination for the cooling tower system according to the following procedures:

(i) Prohibit entering the vicinity of the cooling tower(s).

(ii) Circulate biodispersant throughout the system before disinfection (dosage as recommended by the cooling tower system services providers).

(iii) Add sodium hypochlorite to the system water to obtain a measured concentration of 50mg/L (ppm) of free chlorine at pH 7.0-7.6.

(iv) Circulate the system water with the fans off for a period of at least 6 hours.

(v) Maintain the free chlorine level at an absolute minimum of 20 mg/L (ppm) at all times.

(vi) After 6 hours, de-chlorinate and drain the system.

(vii) Clean thoroughly the basin, fill, drift eliminator, fan and water distribution system.

(viii) Refill with fresh water and add sodium hypochlorite.

(ix) Recirculate without using the fan, at 20mg/L (ppm) of free available chlorine for 6 hours.

(x) De-chlorinate and drain the system.

(xi) Refill, recirculate and take water samples for testing.

(xii) Re-commission system when Legionella and HCC levels are detected below the lower control thresholds as stipulated in Section 2.1.5.

2.1.8 Operation and Maintenance Records

The Contractor shall keep proper records of system operation, routine inspection, water sampling results and maintenance work by using the sample log sheet in Annex 2. The operation and maintenance records shall be made readily available for inspection and reproduction when required by authorized public officers.

2.2 Corrective Maintenance and Repair Services

The Contractor shall carry out corrective maintenance and repair work for any part of the cooling tower installation(s) in accordance with the following requirements:.

(i) The Contractor shall, at any time during the Contract Period attend fault calls and carry out all necessary repair works for any part of the cooling tower installation(s).

(ii) The Contractor shall provide all necessary consumables and minor parts at his own cost. Such consumables and minor parts shall include, but not be limited to: "O" rings, gaskets, seals, bolts, nuts, washers, pins, locks, bearings, belts, valves, actuators, dampers, pipe/tube fittings, thermostats, switches, isolators, fuses, buttons, indicators, control/protective relays, meters, contactors, current transformers, etc.

(iii) The cost for the corrective maintenance is deemed to be included in the unit rate entered in the Schedule of Rates.

(iv) For replacement of major parts other than those specified in item (ii) above, the Contractor shall obtain prior acceptance of the Employer. The Contractor shall submit a quotation to the Employer for consideration.

(v) The Contractor shall submit the Employer full justifications to support that the replacement of the parts is due to genuine operational need and not due to any negligence or default of the Contractor in execution of the works.

(vi) All provision of parts shall include a guarantee period of 1 year for their normal operation except damage by vandalism or other causes beyond the Contractor's control. If necessary, the Contractor shall obtain similar back-to-back guarantee from relevant manufacturers or suppliers of the subject parts provided by the Contractor.

(vii) The Employer reserves the right to provide consumables and parts not included in item (ii) above for the execution of works by the Contractor.

3. SUPPLY AND INSTALLATION OF WATER TREATMENT FACILITIES
(Optional for a cooling tower installation without proper water treatment facilities)

The Contractor shall design, supply, install, test and commission a complete set of automatically controlled water treatment system to the cooling tower installation completed with chemical dosing pumps, chemical storage tanks, sensors, control devices, control wiring, associated pipe

works and electrical works.

The automatic water treatment system shall include, but not limited to, the following:

(i) The system shall continuously or intermittently treat the cooling water with chemicals to control corrosion, scaling and microbial growth.

(ii) Water treatment chemicals shall be added by automatic dosing devices which may either be of metered dosing type or proportional dosing type to suit the application.

(iii) Water treatment chemicals shall include one inhibitor to control corrosion and scaling, and two different biocides to control microbial growth.

(iv) The two different biocides shall be injected alternatively at periodic intervals to avoid microorganisms to develop resistance against the biocides.

The Contractor shall provide a guarantee period of 1 year for its normal operation except vandalism or other damage to the subject parts beyond the Contractor's control. If necessary, the Contractor shall obtain similar back-to-back guarantee from manufacturers or suppliers of the subject parts provided by the Contractor.

4. SCHEDULE OF RATES

The tenderer shall complete and submit the following Schedule of Rates together with the tender. The unit rates shall cover both the cooling tower installation(s) and all associated equipment, instruments, devices, accessories, fittings, and supports etc.

A. Operation and Maintenance

Item	Description	Unit Rate in HK$ per month	Quantity	Total in HK$
1.	Routine operation and maintenance for cooling tower installation and associated equipment according to the Specification (per month): Breakdown of item 1 (for reference only) (a) Preventive maintenance and inspection (b) Corrective maintenance and repair services (c) Water sampling and bacterial tests (d) Water treatment chemicals and other consumables	_____ per month _____ _____ _____ _____	_____ months (to be input by the Employer)	_____

B. Provision of Water Treatment Facilities
(Optional item – see Section 3 of the Specification)

2.	Supply and installation of water treatment facilities according to the Specification (per installation):	_____	1 installation	_____

Annex 1

EQUIPMENT SCHEDULE - EXISTING COOLING TOWERS INSTALLATION

(To be provided by the Employer as appropriate)

A. Cooling Tower

Item	**Technical Information**	**Cooling Tower No. 1**	**Cooling Tower No. __**
1.	Cooling tower ID/ref. no. (if any)		
2.	Physical location (e.g. roof/ podium / indoor)		
3.	Year of installation (if known)		
4.	Brand / Make (if known)		
5.	Type of cooling tower (i.e. Induced draft counter flow/ Induced draft cross flow/ Forced draft counter flow/ Forced draft cross flow/ etc.)		
6.	Casing material (i.e. Stainless steel/ Fiberglass/ etc.)		
7.	Overall dimension (L x W x H) (mm) or (Dia x H) (mm)		
8.	No. of cell(s) (No.)		
9.	No. of fan(s) (No.)		
10.	Circulating water flow rate (liter/sec)		
11.	Air flow rate (liter/sec)		

B. Water Treatment Facility (if available)

Item	**Technical Information**	**Water treatment facility No. 1**	**Water treatment facility No. __**
1.	Type of water treatment facility (i.e. Chemical water treatment/ Filtration system/ Ozone disinfection system/ etc.)		
2.	Brand / Make of water treatment facility (if known)		

Annex 2

Operation and Maintenance Records for Cooling Tower System

For the period: _____

A. System Description

Record	Details
Building Name & Building Address	
Cooling tower type	
Number of cooling tower in system	
Heat rejection capacities of the cooling towers	
Building owner's name / contact details*	
Cooling tower owner's name and contact details*	
Cooling tower system operation team details*	
Water treatment services provider's name and contact details*	
Water sampling / laboratory contractor's name and contact details*	

* To include company name, contact person's business and after hours telephone numbers

B. *Weekly / Monthly Records for the month ( ) of year ( )*

	Procedures	**Date of Action**				
		Week 1	Week 2	Week 3	Week 4	Monthly
1.	Check cleanliness, organic fouling and physical debris					
2.	Inspect for slime and algal growth					
3.	Inspect for deterioration of materials, damage to components, blockages and corrosion					
4.	Inspect for correct operation of fans, motors and pumps					
5.	Inspect water leaks from seams					
6.	Inspect misshaped exterior or collapsed internal supports					
7.	Inspect supporting framework					
8.	Inspect fill and drift eliminator					
9.	Check condition and operation of ball valve					
10.	Check fan thermostat (if equipped)					
11.	Check sprays and distribution deck					
12.	Check bleed-off rate					
13.	Refill chemicals (if necessary)					

C. ***Quarterly / 6-monthly / Yearly Records for the year ( )***

	Procedures	**Date of Action**			
		Quarter 1	Quarter 2	Quarter 3	Quarter 4
1.	Lubricate fan and pump bearings / gearbox				
2.	Drain basin and clean distribution deck, fill and drift eliminator				
3.	Check security of all bolts and fittings				
4.	Clean fan blades				
5.	Clean all components as required				

D. ***Monthly Water Sample Bacterial Test Records for the year ( )***

Bacteria Test		**Testing Laboratory**	**Date of Test**	**Test Results (cfu/mL)**	**Action**
Heterotrophic colony count	Month 1				
	Month 2				
	Month 3				
	Month 4				
	Month 5				
	Month 6				
	Month 7				
	Month 8				
	Month 9				
	Month 10				
	Month 11				
	Month 12				
Legionella bacteria count	Month 1				
	Month 2				
	Month 3				
	Month 4				
	Month 5				
	Month 6				
	Month 7				
	Month 8				
	Month 9				
	Month 10				
	Month 11				
	Month 12				

Note: The Contractor may modify or develop their own operation and maintenance records format to suit the particular configuration and needs of the cooling tower installation. The record format shall be submitted to the Employer for approval before use.

Annex 3

RECOMMENDED SPARE PARTS LIST
(to be input by the Employer)

Item	Description	Quantity
1. 2. 3.		

Annex 4

(For cooling towers which have joined the Fresh Water Cooling Towers Scheme)

EMSD EE CT3 (11/2010)

Fresh Water Cooling Tower Scheme for Air Conditioning Systems
Summary of Operational Information for Cooling Tower Installation
(Records kept by Owners of Cooling Towers)

Date: _____

Operational information for the month of_____in Year_____
Cooling tower installation(s) at : _____

1. Operational information and water sampling results of the above month are summarized in page 2 of this Form.
2. This is also to record that
   (a) The cooling tower shell is in good*/fair*/bad* condition.
   (b) The supporting framework of the cooling tower shell is in good*/fair*/bad* condition.
   (c) The maintenance carried out for each cooling tower of the installation has been recorded according to the requirements of the Scheme document.

   (*Remark: If the cooling tower shell and / or the supporting framework for the cooling tower is/are in bad condition, please use a separate sheet to describe details and planned action if any*):

Signature of Owner or his Representative: _____ Date: _____

Full Name of Owner or his Representative:	Company Chop:
Company:	
Tel No.: Fax No.:	
Correspondence Address:	

* delete as appropriate

<u>Operational Information</u> (for Month: _____ Year: _____):

Cooling Tower Registration No.: PS- _____

Owner's cooling tower ref. no. _____

Daily operation time: _____ to _____

Power : Energy consumption for all water-side equipment of the AC system _____ kWh

Make-up fresh water : Total water consumption in the month _____ m^3

Effluent discharge : Total discharge volume in the month _____ m^3

Cooling water sampling results (Monthly unless otherwise stated - see Notes 1 to 4)**:**

Water sampling date:			Water Temperature		ºC
Total Dissolved Solids (TDS)		mg/L	Calcium Hardness		mg/L
Conductivity		µS/cm	Total Alkalinity		mg/L
Suspended Solids (SS)		mg/L	pH		
Residual biocide concentration (1)		mg/L	Residual biocide concentration (2)		mg/L
Residual inhibitor concentration (1)		mg/L	Residual inhibitor concentration (2)		mg/L
Heterotrophic Colony Count (HCC)		cfu/mL	Legionella pneumophila Sg1		cfu/mL
Legionella pneumophila Sg2-14		cfu/mL	Legionella Other species		cfu/mL

Bleed-off water sampling results (Quarterly - see Note 5)**:**

Water sampling date:			Water Temperature		ºC
5-Day Biochemical Oxygen Demand (BOD_5)		mg/L	*Chemical Oxygen Demand (COD)		mg/L
Suspended Solids (SS)		mg/L	Dissolved Oxygen (DO)		mg/L
Residual biocide concentration (1)		mg/L	Residual biocide concentration (2)		mg/L
Residual inhibitor concentration (1)		mg/L	Residual inhibitor concentration (2)		mg/L
Ammoniacal N		mg/L	Threshold Odour No.		T.O.N.
Colour		H.U.	Turbidity		N.T.U.
Synthetic Detergents		mg/L	E. Coli / 100 mL		count

Note 1: HCC to be tested every month and Legionella to be tested every three months unless otherwise required for validation of the effectiveness of water treatment.
Note 2: HCC and Legionella should be tested to APHA 9215B:1998 and AS3896 respectively or equivalent.
Note 3: Copies of the laboratory test reports on Legionella and HCC should be accompanied with this form.
Note 4: Cooling water samples should be tested every month unless otherwise required.
Note 5: Bleed-off water samples should be tested every three months unless otherwise required.

* delete as appropriate

Annex 5

Cleansing of Make-up and Bleed-off Water Tanks
(Reference: Water Supplies Department's Guide to Cleansing of Fresh Water Storage Tanks)

Steps for cleansing of water tanks:

(a) close the inlet and outlet valves of the water tank;

(b) empty the water tank through the washout pipe;

(c) thoroughly scrub and cleanse the water tank and the inlet/out pipes with fresh water;

(d) drain away the water through the washout pipe;

(e) scrub the water tank thoroughly with a solution of chloride of lime or bleaching powder containing not less than 50 parts per million of chlorine solution . (For chloride of lime or bleaching powder contains 33% of available chlorine in weight, a 50 parts per million chlorine solution can be prepared by mixing 15 grams of chloride of lime or bleaching powder in 100 litres of water.);

(f) rinse the water tank thoroughly with fresh water;

(g) drain away the water through the washout pipe;

(h) open the inlet valve to refill the water tank with water;

(i) open the outlet valve, and the water tank is ready for use.

Annex 6

GUIDANCE NOTES FOR OCCUPATIONAL SAFETY AND HEALTH

1. Sufficient personal protective equipment shall be provided to the personnel responsible to carry out inspection and maintenance work of a cooling tower system. Recommended list of personal protective equipment required related to different job nature is shown in Table 1.

2. Training in safe work procedure, including the use and maintenance of protective equipment shall be provided to the personnel carrying out cooling tower system commissioning.

3. Water treatment may involve the application of relatively aggressive and toxic chemicals in an environment, which is difficult to control. Safety of plant and personnel is the major concern. All personnel involved must be fully conversant with the safe handling of the products, which form part of the water treatment regime. Water treatment chemicals shall be handled with care according to the manufacturer's instructions.

4. Material safety data sheet (MSDS) and relevant recognized data sheet for the chemicals used in water treatment process shall be provided by water treatment services providers and included in the operation and maintenance manual. MSDS and relevant warning / safety label shall be provided on the surface of water treatment chemical bucket. The MSDS and labels shall be properly protected against water and chemical damage.

5. Workers shall practice with a high standard of personal hygiene. Adequate washing facilities shall be provided and made easily accessible.

6. Water treatment programme for a cooling tower system shall be established by a competent service provider and complied with the requirements specified in this Specification.

7. Eye wash bottles or washing basin with fresh water tap shall be provided adjacent to water treatment chemicals tanks or any appropriate location for emergency use. However, the water contained in the eye wash bottle shall be replaced periodically.

8. Water treatment chemical shall be stored at an appropriate location to facilitate chemical handling. Mechanical / natural ventilation shall be provided to the room entirely / partially used for water treatment chemical storage.

9. Electrical fittings and luminaries serving water treatment chemical storage area shall be weather-proof and corrosion resistant type.

10. Warning signs shall be erected to alert for operation and maintenance personnel of the potential hazard caused by cooling tower; and to restrict the unauthorised access to cooling towers.

11. Workers exposed to hazardous substances and engaged in processes of cleaning and disinfection and water treatment shall undergo regular health surveillance with a medical practitioner. In the event that the worker develops respiratory, cutaneous and other symptoms when exposed to hazardous chemicals, immediate medical attention shall be sought.

Table 1: Recommended List of Personal Protective Equipment

Job	Potential Hazard	Respirator and Clothing
Testing and commissioning	Aerosol	Half face piece, capable of filtering smaller than 5μm particulates, ordinary work clothing
Inspection	Aerosol	Half face piece, capable of filtering smaller than 5μm particulates, ordinary work clothing
Water Sampling	Aerosol	Half face piece, capable of filtering smaller than 5μm particulates, ordinary work clothing
High pressure spraying	Aerosol	Respirator as above, waterproof overalls, gloves, boots, goggles or face shield
Chemical treatment with sodium hypo-chlorite solution in ventilated space	Spray mist and very low concentration chlorine	Half face piece, acid gas and particulate respirator, goggles or face shield, overalls, gloves, and boots
As above, confined space	Unknown chlorine concentration, high mist, possible lack of oxygen	To comply with the requirement under The Factories and Industrial Undertakings (Confined Spaces) Regulation