Prevention of Legionnaires' Disease
預防退伍軍人病症

Code of Practice
工作守則

(2007 Edition)
（二零零七年版）

(English Version)

Prevention of Legionnaires' Disease Committee, Hong Kong
香港預防退伍軍人病症委員會

Government of Hong Kong Special Administrative Region
香港特別行政區政府

Preface

The development of a healthy environment for our community necessitates actions to improve the physical and socio-economic environment affecting health, helping one another to evolve their maximum potential. With the impact of globalization, new patterns of consumption and communication, environmental degradation, urbanization and changes in the pattern of diseases and in the social determinants of health, there is a need for us to take a fresh look on the concept of health, and to adopt new approaches and strategies to improve health.

Despite the relatively low incidence of reported cases of Legionnaires' Disease in Hong Kong when compared with overseas countries, effective protection of the community from this disease is vital. The establishment of Prevention of Legionnaires' Disease Committee can surely provide an effective platform for medical and engineering professionals to join hands for offering expert advices to formulate strategies for preventing Legionnaires' Disease.

The Code of Practice for Prevention of Legionnaires' Disease was first published in 1994 and subsequently revised in 2000. Taking into account the experience and the evolving knowledge of other countries and the feedbacks received from the users in recent years, this revised edition has been specially added the general precautions in association with spas and the handling of garden soils. From which, broader practical guidelines for proper design, operation, maintenance and handling of related facilities or materials to avoid the spread of Legionella bacteria can be provided. I am confident that this revised code of practice can surely safeguard our environment and enhance the quality of our lives.

I would like to express my sincere gratitude to all members of the Committee, all members of Technical Sub-committee and the colleagues of Electrical and Mechanical Services Department for the efforts provided in preparing and revising this Code.

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Chairman
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Content

1. Background

1.1 Legionnaires' Disease (LD) was first recognised in July 1976 when an outbreak occurred among delegates attending an American Legion Convention in Philadelphia in which more than two hundred cases were reported and 34 people died. After medical investigations, it was identified that the responsible bacterium of the disease was previously unknown, and was subsequently given the name *Legionella pneumophila.*

1.2 Since the identification of Legionellae, cases ranging from sporadic infection to outbreak were subsequently reported in USA, Canada, UK, Australia, Singapore, etc. Based on past records, LD is more active in the said countries than in Hong Kong.

2. Medical Aspects

2.1 LD typically manifests as severe pneumonia, with patients presenting symptoms of malaise, muscle pains, cough, breathlessness, headache and fever, often culminating in respiratory failure. The disease has an incubation period of 2 to 10 days.

2.2 The bacteria that cause LD are small coccobacilli measuring up to 0.5μm by 1-3μm, with occasional longer forms of 10-15μm or more, within the genus Legionellae. Over 42 species of Legionellae have been identified and the *Legionella pneumophila* serogroup 1 is most commonly responsible for LD outbreaks.

2.3 Legionellae survive and multiply in natural fresh water, including lakes, rivers, streams, ponds, mud and soil, as well as man-made water systems. The optimum temperature for proliferation of the bacteria is around 20ºC to 45ºC, and particularly in the range of 35ºC to 43ºC. The proliferation ceases above 46°C and below 20°C, while the survival time decreases to a few minutes at above 60ºC. At 70ºC the organism is killed virtually instantaneously.

2.4 The organism appears to be insensitive to pH but requires as nutrition the presence of simple organic life (such as algae and microorganism in sludge, scale, biofilm, etc.), inorganic substances (such as nitrogen based substances, small concentration of iron, zinc, etc. in fresh water piping systems), and organic substances (such as certain types of rubber) for survival. Nevertheless the bacteria can hardly survive in salt water and domestic water supplies which are well chlorinated.

2.5 Transmission of the bacteria to the human bodies is mainly by inhalation of airborne droplets (i.e. aerosols) or particles in fine mist containing the bacteria into the lungs where they are deposited. According to the previous reported cases, the sources of the aerosols causing an outbreak were mainly traced to water systems in buildings including evaporative cooling towers and humidifiers of air-conditioning systems, hot and cold water services, whirlpool spas, industrial heating and cooling processes, etc. Normal range of operation temperature of these systems is conducive to the growth of Legionellae.

2.6 The correlation between the proliferation temperature of the bacteria and the operating temperature of commonly found water systems is shown in Figure 1.

2.7 There is no evidence that LD is transmitted by person to person contact.

2.8 The following types of people are more susceptible to LD:-

(a) patients who have low resistance to infection, especially those with respiratory disease, or on renal dialysis or immuno-suppressant drugs;

(b) smokers;

(c) people of increasing age, particularly over 50 years old;

(d) males (3 times more susceptive than females);

(e) drinkers.

2.9 To summarise, the infection of LD is due to a combination of the following factors as shown in Figure 2 :-

(a) aerosol containing Legionellae;

(b) inhalation of the aerosol; and

(c) susceptible person.

3. The Hong Kong Situation

3.1 Following the outbreak of LD in 1985 at Stafford District Hospital, UK, the Prevention of Legionnaires' Disease Committee was set up in Hong Kong. The Committee is chaired by the Electrical and Mechanical Services Department, and it comprises members from the Department of Health, the then Works Bureau, The University of Hong Kong, The Chinese University of Hong Kong, the Architectural Services Department and the Water Supplies Department.

3.2 Initially, the terms of reference of the Committee were confined to areas of immediate concern, especially on the preventive measures against LD in government hospitals. Starting from 1987 the recommendations of the Committee were gradually implemented in government hospitals. A set of the recommendations was also sent to all subvented hospitals and private hospitals in July, 1989. In January, 1990, a technical guideline was issued to the project design teams and operation and maintenance teams of Government buildings to ensure that they are aware of the issue and will adopt proper attitude and appropriate measures in handling the relevant design, operation and maintenance of engineering plants/equipment.

3.3 To further promote the awareness of the public on the disease, the Committee published the pamphlet "Understanding Legionnaires' Disease" and this Code of Practice so as to present guidelines to the public on prevention of LD and to allay unnecessary alarm and fear

caused by the overwhelming publicity of the issue. Furthermore, Subcommittees were established to assist in the publicity launch and to advise the Committee on technical matters, such as preparation of publicity materials, drawing up investigation procedures and plans to handle an outbreak, collection and analysis of technical information, etc. In order to strengthen the representation, the Committee was re-organised in 2002 and chaired by a public health expert with members representing government bureau and departments concerned and experts nominated from the medical faculty of universities and the engineering profession. The organisational relationship, the membership of the Committee and the terms of reference are shown in Figures 3A and 3B.

3.4 In March 1994, LD has been listed as a notifiable disease under the Quarantine and Prevention of Disease Ordinance (Cap. 141). Medical practitioners are required by law to notify the Department of Health when they have reasons to suspect the existence of a case of the disease in accordance with 'FORM 2' of the said Ordinance, a copy of which is reproduced in Annex 1.

3.5 There were 62 reported cases of LD between 1994 and the end of 3rd quarter of 2007. All were sporadic cases with no evidence of clustering. Table 1 shows a summary of the cases.

Table 1: Summary of Notified Cases of Legionnaires' Disease 1994 – 2007

Year	No. of Cases	Year	No. of Cases
1994	3	2001	3
1995	1	2002	4
1996	2	2003	3
1997	2	2004	3
1998	1	2005	11
1999	1	2006	16
2000	2	2007*	10

* up to 31 October 2007

3.6 LD was added into the list of notifiable occupational disease under the Occupational Safety & Health Ordinance (Cap. 509) in June 1999. Medical practitioners are required to notify the Commissioner of Labour of any cases of LD if the patient's occupation involves repair, maintenance or service of either cooling system that uses fresh water, hot water service system, or other water using apparatus. A copy of the notification form is attached in Annex 2. Moreover, it is also prescribed for compensation under the Employees' Compensation Ordinance (Cap. 282).

4. Guidelines on Design, Operation and Maintenance of Water Using Apparatus

Water using apparatus shall mean an apparatus or equipment utilizing or consuming water in its normal operation.

Under all circumstances, the first option to be considered is to avoid, where reasonably practicable, the use of equipment which can create a spray of contaminated water. Where the use of such equipment cannot be avoided, the risk should be prevented or controlled by measures to reduce exposure to contaminated water droplets and to prevent conditions which allow the proliferation of Legionellae in water.

4.1 Water Safety Plan for Water Using Apparatus

4.1.1 Developing a Water Safety Plan (WSP) for water using apparatus is the preferred approach to manage specific health risks of exposure to Legionellae.

4.1.2 Owners or operators of water using apparatus should develop the specific WSPs for their systems. Major benefits of developing and implementing WSP are the systematic and detailed assessment and prioritization of hazards (biological, chemical or physical agents, or water conditions, with the potential to cause adverse health effects), and the operational barriers and control measures.

4.1.3 The steps involved in developing a WSP are shown in Figure 10. WSP should consist of the following key components:

(a) System assessment – determination of whether the water quality at the point of potential exposure or use meets the health-based target, based on a risk assessment for the population likely to be exposed.

(b) Monitoring – identification and monitoring of control measures used to ensure water quality (e.g. biocide, temperature, pH).

(c) Management and communication – to document the results of system assessment and monitoring, and describe actions to be taken during normal operation and after incidents, including documentation and communication (e.g. a plan for remedial actions after adverse monitoring results, such as low residual biocide levels, and listing those to be informed of an event). The actions should be taken as soon as practicable.

4.1.4 The WSP should be prepared in conjunction with the relevant parties (e.g. building facility managers, system operation and maintenance staff, water treatment service providers, etc.). The WSP should be reviewed on a regular basis to reflect changes and ongoing improvements in the system, the available evidence base and the surrounding environment. Finally the WSP should be amended if control is not maintained.

4.1.5 The relevant details of the WSP can be referred to “Legionella and the prevention of legionellosis” published by World Health Organization in 2007 (Item [1] in the References (Paragraph 9 of this Code)).

4.2 Cooling Towers

Cooling towers are commonly used as heat rejection equipment for air conditioning and industrial cooling processes. The operation temperature of the coolant water is optimal to the growth of Legionellae (Figure 1) and the generation of aerosol during the cooling process in the cooling tower easily leads to the dispersion of aerosol to the surroundings. Improperly designed, operated and maintained cooling towers have been one of the main causative agents causing LD. The longitudinal view of a typical cooling tower and a typical cooling tower system are shown in Figure 4A and 4B respectively.

4.2.1 Design Precautions

(a) The cooling tower shall be sited sufficiently far away from fresh air intakes of a building or an air conditioning system, operable windows, outlets of air exhaust system, and public thoroughfare. Minimum separation distances are given in the latest edition of Code of Practice for Water-cooled Air Conditioning Systems – Part 1: Design, Installation and Commissioning of Cooling Towers.

(b) The cooling tower system shall be provided with water treatment facilities, physical and/or chemical, to prevent the installation from corrosion and scale deposition and to suppress the growth of micro-organisms in cooling water.

(c) The cooling tower shall be equipped with effective drift eliminator, which shall also be extended across the air stream without any bypass. The permissible drift emission is given in the latest edition of Code of Practice for Water-cooled Air Conditioning Systems – Part 1: Design, Installation and Commissioning of Cooling Towers.

(d) The fill and drift eliminator shall be easily removable for cleaning or replacement and the materials shall have adequate strength to withstand cleaning by water jet.

(e) The surfaces of all cooling tower construction materials shall be non-porous and easy-to-clean.

(f) The water pipework of the cooling tower shall be designed to avoid dead legs. If the existence of dead legs cannot be avoided, mitigation measures, such as manual/automatic drain valve for periodic drain-off, shall be provided.

(g) Louvres, where appropriate, shall be provided to prevent water from spilling out and to obstruct direct sunlight from entering the cooling water basin.

(h) The water basin shall be smooth, without dirt trapping pattern, accessible, cleanable, and provided with drains of adequate size at the lowest point and at screeners.

(i) The cooling tower shall be provided with easy access to all internal surfaces for inspection and removal of components. Ladder, handrail, platform and toe board shall also be provided to facilitate cleaning, maintenance and inspection.

(j) A water tap shall be fitted at the pipework for the collection of water samples for testing the water quality. The location of the water tap shall be at a representative sampling point, preferably where the warm cooling water enters the cooling tower, and not adjacent to the make-up water inlet or the chemical dosing point(s).

4.2.2 Operation and Maintenance Precautions

4.2.2.1 Water Treatment

(a) A comprehensive water treatment programme shall be adopted to continuously or intermittently filter and treat the water with corrosion inhibitors, surfactants, and anti-fouling chemicals, or other proven physical methods. The water treatment programme shall aim at controlling the fouling of the cooling tower system due to silt, scale and microbial growth in order to maintain efficient heat transfer at metal surfaces, ensure free flow of water throughout the system, and control the proliferation of bacteria.

(b) The selection of water treatment systems (physical or chemical) for eliminating and controlling general biological growth shall be based on the following criteria:-

(i) The water treatment system or the water treatment chemicals shall preferably be proprietary products manufactured by a manufacturer to an international or national standard, and have proven record when used or dosed in accordance with the manufacturer's recommendations in respect of frequency, dose strength, preparation, etc.

(ii) The water treatment system or the water treatment chemicals shall be chemically and physically compatible with the cooling water.

(iii) The water treatment chemicals shall be compatible and non-corrosive to piping materials.

(iv) The water treatment chemicals shall be safe and easy to use.

(v) The water treatment chemicals and their end-products shall be environmentally friendly and have no mammalian toxicity. They shall be chemically and biologically degradable. They shall not cause any hazards or adverse impacts on the environment through drainage and meet all relevant requirements

and regulations of the Environmental Protection Department.

(vi) The water treatment chemicals shall be compatible with each other, and shall remain effective under a wide range of temperature changes, varying flow velocities, pH, conductivity, total dissolved solids and suspended matters commonly found in water circuit of a cooling tower system. The chemicals shall be capable of penetrating foam, sludge, slime and scale.

(c) Water treatment chemicals should be added to turbulent zones within the water system to assist in rapid dilution and mixing. Also, if there are possible interactions between the treatment chemicals used, separate dosing points should be used to ensure dilution of one potentially reactive chemical prior to adding a second chemical.

(d) The method of dosing shall either be:

(i) Automatic continuous drip feed or metered dosing with dosing rate and concentration control. This dosing method is highly recommended.

(ii) Manual slug dosing on regular basis (e.g. daily, twice-weekly, weekly, biweekly, etc.)

(iii) Automatic metered dosing controlled by timers or make-up water flowmeter, etc.

(e) The following water treatment strategies may also be considered:

(i) To use two chemicals, each of which shall comply with the criteria aforementioned, alternatively at periodic intervals.

(ii) To use a combination of two compatible chemicals to provide better control against a range of micro-organisms.

(iii) To carry out occasional slug dosing or intermittent shock dosing with a high level of chlorine.

(f) The water treatment work should be carried out under the direction of suitably qualified and experienced persons. 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 these agents. Personnel involved in the work procedures should be trained in safety procedures, including the use and maintenance of protective equipment. They should wash and thoroughly dry hands before eating, drinking and smoking.

4.2.2.2 Bleed-off

(a) Water in the cooling tower circuit evaporates during normal cooling tower operation, leaving the dissolved substances behind in the water circuit and thus increasing the total dissolved solids (TDS) in the cooling water. This increase in TDS will lead to metal corrosion, chemical sedimentation, as well as growth of those bacteria which depend on the dissolved solids as nutrients.

(b) To overcome these problems, some amount of cooling water should be bled off and replaced with make-up water, thus limiting the concentration of the total dissolved solids.

(c) Bleed-off can be achieved by continuously draining to waste with the flow rate controlled by a water conductivity meter, which is highly recommended, or by intermittent discharge. Intermittent discharge can be executed by a manually operated drain valve.

(d) In order to conserve water, the cycle of concentration in designing bleed-off system shall not be less than 6.

4.2.2.3 Routine Cleaning and Disinfection

(a) Cooling towers shall be cleaned, desludged and disinfected regularly. The frequency of cleaning should be based on tower cleanliness and the particular site environment. As a guide, the frequency of cleaning should be half-yearly. Less frequent cleaning intervals, but not exceeding yearly, is acceptable if the relevant performance is good. If not, more frequent cleaning may be required.

(b) Cleaning, desludging and disinfection should also be carried out if the cooling tower has been:-

(i) contaminated during construction, or by dusts, inorganic or organic matters.

(ii) shut down for a prolonged time, say more than 4 months.

(iii) mechanically altered or disrupted in a manner which may lead to contamination.

(iv) infected or may have been infected by an adjacent cooling tower which has been confirmed as a source of LD case or outbreak.

(c) Cleaning, desludging and disinfection shall be carried out as follows:-

(i) To chlorinate the water and circulate for four hours, maintaining a minimum level of free residual chlorine at 5 ppm through the entire cooling tower water circuit.

(ii) To drain the entire water circuit and the make-up tank.

(iii) To manually clean the tower, sump, fill, eliminator, make-up tank and the water circuit system. Accessible areas of the towers and the fill pack shall be adequately washed. Cleaning methods which create excessive spray such as high pressure water jetting shall be avoided as far as possible. Staff involved in water jetting shall be adequately trained, wear suitable respiratory protective equipment such as a cartridge respirator containing a particulate filter of appropriate efficiency. They should wash and thoroughly dry hands before eating, drinking and smoking.

(iv) To refill with water, rechlorinate and recirculate for at least six hours, maintaining a minimum level of free residual chlorine at 5 ppm.

(v) To drain and flush the system.

(vi) To refill with water and dose with the appropriate start-up level of treatment chemicals.

(vii) To re-commission the system.

4.2.2.4 Important Points for Collecting Water Samples for Bacterial Tests

(a) Water samples shall be collected from the water sampling point of the cooling tower system and 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.

(b) When a sampling point is not available, water shall be collected from the cooling tower basin, or from where water falls from the fill into the basin.

4.3 Design, Operation and Maintenance Precautions of Other Components in Air-conditioning Systems

4.3.1 Condensate Drain Trays of Air Handling Unit / Fan Coil Unit (AHU / FCU)

Design, operation and maintenance precautions shall include the following:-

(a) Drain valves shall be provided at the lowest points of the drain pipework to facilitate flushing.

(b) Adequate sloping at AHU / FCU condensate collection pan shall be provided and the drain pipe shall be connected at the lowest position of the drip tray to avoid accumulation of water (Figure 5).

(c) Condensate drain trays for AHU/FCU shall be properly connected to the building drainage pipework.

(d) An air break and a U-trap shall also be provided at the condensate drain pipework before it is connected to the building drainage pipework to prevent backflow of drain from other AHU/FCU (Figure 6).

(e) Drain trays shall be regularly inspected, cleaned and disinfected.

(f) Horizontal drain pipes shall be regularly inspected for possible clogging.

4.3.2 Air Duct and Air Filters

Design, operation and maintenance precautions shall include the following:-

(a) Appropriate air duct cleaning points/assess panels shall be provided to facilitate inspection and cleaning.

(b) Air duct servicing access points or panels shall be provided at air duct at intervals of around 3 metres between centres in accessible positions. Access points or panels shall also be provided at positions such as around duct bends, tees, branches, duct heaters/reheaters, air mixing boxes, variable air volume (VAV) boxes, duct humidifiers, in-line booster fans, dampers, silencers, etc. to facilitate cleaning and inspection.

(c) Air duct servicing access panels shall preferably be of size not less than 250 mm x 250 mm. They shall not cause dripping or condensation at their surfaces even at the worst condition under the prevailing weather in Hong Kong. In this connection, adequate thermal insulation shall be provided between the cooling air flowing in the air duct and the metalwork of the servicing access panels against the hot and humid surrounding air around the access panels. In particular all metalwork forming a bridge through the insulation from the hot surrounding air to the cooled metal parts shall be avoided or properly insulated and complete with an overall vapour barrier.

(d) Air filters in air conditioning system shall be regularly inspected, cleaned or replaced to minimize the collection of dust and micro-organisms, so as to ensure good indoor air quality and to prevent the spread of bacteria causing infectious diseases.

4.3.3 Humidifiers

Design, operation and maintenance precautions shall include the following:-

(a) Steam humidifier shall be the first choice to be used for humidification.

(b) Water spray type humidifier and humidifier that operates on the principle of evaporation of cold water will generate fine mists and would become an infectious source of LD if water contains Legionellae. Such humidifiers shall be avoided in new installations, and shall be replaced if used in existing installations.

(c) Recirculating water spray humidifiers shall preferably be equipped with sidestream ultraviolet radiation for recirculating water.

(d) Recirculating water spray humidifiers shall be cleaned frequently. The water reservoir shall be drained each day and the system shall be disinfected at least once every six months. If the humidifier is shut down for over a month, it shall be disinfected before being brought into use again.

4.3.4 Air Washers

Design, operation and maintenance precautions shall include the following:-

(a) Because of utilizing high pressure nozzles for producing small water droplets for air cleaning, the air washer shall be designed and operated below or above the temperature range suitable for proliferation of Legionellae.

(b) Dead end piping and any area in the water distribution system where water may become stagnant shall be avoided.

(c) Water filters and air filters for the system shall be regularly cleaned or replaced.

(d) Appropriate disinfectant device, such as photochemical ozone generator or ultraviolet radiation device, shall be used to control microbiological growth in water.

(e) The complete air washer system shall be cleaned not less than once a month.

4.4 Centralized Hot Water Systems

Centralized hot water systems usually operate at 35ºC to 50ºC. These temperatures are ideal for the growth of Legionellae.

4.4.1 Design Precautions

(a) The hot water storage device of the system (e.g. direct or indirect heated calorifier, storage vessel, etc.) shall be designed to operate at 60ºC to effectively kill the bacteria and the water tap outlet temperature shall be around 50ºC in all areas except for the supply to paediatric, geriatric and

psychiatric wards of hospitals where the provisions as laid down in (e) below should be observed instead.

(b) The water supply system and the size of the hot water storage device shall be so designed that the water within the device shall have reached 60°C for at least 5 minutes prior to being discharged to the distribution system under normal loading conditions.

(c) Drain outlets shall be provided at the lowest points of hot water storage devices for flushing away settled sludge. The system shall be easy to drain and clean.

(d) In order to overcome the problem of stratification and stagnation of water in hot water storage tanks and pipework, circulation pumps shall be provided where necessary (Figure 7).

(e) In paediatric, geriatric and psychiatric wards of hospitals, the hot water supply temperature at outlets shall not exceed 43ºC to prevent accidental scalding. Thermostatic mixing valves which mix hot and cold water automatically to provide water at a preset temperature shall be used (Figure 8). Typically such thermostatic mixing valves shall comply with the following :-

(i) The mixed water at the outlet of the tap shall be within +2ºC of the preset outlet temperature while the hot water supply temperature changes from 50ºC to 65ºC.

(ii) The outlet temperature, if adjustable, shall be resettable only with the aid of tools or else the mechanism for adjusting the temperature shall be concealed and inaccessible to the patients.

(iii) The valve shall be fail-safe such that in case the cold water supply fails, the valve shall automatically shut off the water supply within 4 seconds once the outlet water temperature is 10ºC above the preset temperature.

(iv) The valve shall be of durable design and be able to react quickly to hot and cold water temperature changes, as well as fluctuations in supply water pressure and back pressure from the final hot water outlets.

(v) The valve shall be installed as near to the tap outlets as possible and the manufacturer's recommendations regarding the maximum number of tap outlets to be supplied by each thermostatic valve shall be strictly followed.

(f) Dead legs and stagnant corners in the hot water pipework shall be avoided. The number and length of spur-fed hot water tap outlets shall be minimized.

(g) All piping systems and associated hot water storage devices shall be flushed clean upon commissioning prior to bringing them into operation.

(h) The use of natural rubber, porous and organic matters (e.g. leathers) as parts of the pipework (e.g. as materials for washers) shall be avoided since these materials provide nutrients and a favourable environment for the growth of micro-organisms. Materials such as neoprene and suitable synthetic materials which do not support microbial growth shall be used instead.

(i) Hot water storage devices shall be well insulated to prevent loss of heat down to a temperature at which Legionellae may survive.

(j) Short circuiting of the cold make-up water through the hot water storage devices should not be possible and the system shall be designed to ensure that water is adequately heated and disinfected prior to leaving the storage devices.

(k) Tap diffusers shall not be installed in high risk areas, such as hospitals. Mixing valves shall be as close to the shower outlet as possible, and shower fittings shall be detachable so that they can be routinely cleaned and disinfected.

4.4.2 Operation and Maintenance Precautions

(a) Hot water storage devices shall be operated at 60ºC and the tap outlet temperature shall be maintained around 50ºC in all areas except those specified in 4.4.1 (a) above.

(b) Water holding tanks shall be regularly cleaned and drained to avoid contamination, sludge, slime, algae, fungi, rust, scale, dust, dirt and other foreign materials. The frequency of cleaning shall depend on the accumulation rate of sediments, which is primarily dependent on the quality of the inlet water. Under normal circumstances, the cleaning frequency shall be at least once per year.

(c) The following modifications/improvements shall be carried out as necessary:-

(i) To remove redundant pipework that may lead to stagnant water.

(ii) To retrofit existing hot water storage devices so as to provide drains at the lowest point of the devices.

(iii) To provide secondary pumped circulation where necessary to reduce temperature stratification within the hot water storage devices (Figure 7).

(d) Hot water outlets which are infrequently used or are connected to stagnant water supply pipework shall be flushed at full flow for a minimum period of one minute at least on a monthly basis. Any spurs, dead ends or stagnant points in the pipework shall also be purged regularly.

(e) When thermostatic mixing valves are used, the following maintenance practices are recommended: -

(i) To check the outlet water temperature with a thermometer monthly or at least quarterly to detect any shift in the outlet temperature from the required setting.

(ii) To carry out comprehensive maintenance involving inspection, dismantling for cleaning, replacing faulty parts and other parts as recommended by the manufacturer yearly. In areas with poor water quality, more regular servicing may be required;

(iii) To perform fail-safe test on each valve after comprehensive servicing by shutting down the cold water supply to the valve. Water flow from the valve shall cease in accordance with 4.4.1 (e)(iii).

4.5 Cold Water Supply Systems

Legionellae can also exist in the cold water supply systems when there are increased temperatures, appropriate nutrients and stagnated water in the systems.

4.5.1 Design Precautions

The following preventive measures on the design of cold water supply systems shall also be observed for prevention of LD:-

(a) Potable water storage tanks shall be fitted with a tight-fitting lid, and an appropriately sized drain valve and associated pipework to facilitate flushing, cleaning and decontamination. Overflow pipes and air vents shall be fitted with a mesh to exclude vermin, dusts and other extraneous materials.

(b) Potable water storage tanks shall be installed at a shady location and insulated, if necessary, to ensure that the bulk of water stored does not rise to temperatures where Legionellae will proliferate. Sufficient space, access, cleaning and drainage facilities shall be available to permit easy inspection and maintenance.

(c) Materials for jointing, valves and taps shall not support the growth of Legionellae. Natural rubber, porous and organic plumbing washers (e.g. leather) will provide nutrients and a

favoured environment for the growth of Legionellae. All washers shall therefore be of neoprene or other suitable synthetic materials which do not support microbial growth.

(d) The number and length of spurs of the piping shall be minimized.

(e) On commissioning, the potable water system shall be cleaned to remove rust, sludge and sediment.

4.5.2 Operation and Maintenance Precautions

The following preventive measures on the operation and maintenance of potable water supply systems shall also be observed for prevention of LD:-

(a) Any water holding tanks shall be drained and cleaned regularly to avoid contamination, sludge, slime, algae, fungi, rust, scale, dust, dirt and other foreign materials. The tanks shall be regularly inspected, thoroughly cleaned and scrubbed with a solution of chloride of lime or bleaching powder containing not less than fifty parts of chlorine in one million parts of water (50 ppm).

(b) The frequency of cleaning shall be on a quarterly basis, or more frequency depending on the level of corrosion, sludge and sediment experienced.

(c) Any corroded covers of cold water storage tanks shall be replaced to remove possible nutrients for microbial growth.

(d) Any spur, dead-ends or stagnant point in the pipework shall be purged regularly.

4.6 Architectural Fountains

In man-made water fountains (including indoor decorative fountains and those installed in the indoor environment, such as shopping centres for visual excitement), water is either sprayed in the air to form different features or splashed on the rocks to form cascades and returns to the man-made pool. A system that is operated intermittently may have greater chance to be detected with Legionellae in the water.

4.6.1 Design Precautions

(a) Pipe runs shall be as short as practicable to avoid dead legs and stagnant water in the pipework.

(b) Drain valves shall be provided and situated at the lowest levels of the basin and the piping to facilitate flushing, cleaning and disinfection.

(c) Filters or strainers shall be installed to remove sediments, dirt and debris in water.

(d) A water treatment system, such as physical methods, dosing of biocides and other chemicals, shall be provided to control the microbial growth, scale formation and corrosion in the system, as well as to disinfect the circulating water.

(e) Adequate access for pipework, pumps and filters shall be provided for maintenance.

4.6.2 Operation and Maintenance Precautions

(a) The installation shall be regularly and visually inspected for general cleanliness.

(b) The installation, including filters and strainers, shall be regularly cleaned or replaced to reduce the accumulation of dirt, organic matter and other debris.

(c) A small volume of pool water shall be drained regularly and replenished with fresh water.

(d) The water treatment programme to control microbial fouling shall be regularly reviewed for monitoring its effectiveness.

4.7 Spa Pools (Whirlpools)

Spa pools (whirlpools) utilize warm water at approximately 35ºC to 40ºC, mixing with air and flowing through water jets to produce turbulence and create aerosols. The aerosol produced is likely to be inhaled by the spa users. A schematic diagram of a typical spa system is shown in Figure 9.

4.7.1 Design Precautions

(a) The use of flexible corrugated plastic pipes shall be avoided because the surface area in the valleys between the ridges of the corrugations is difficult to clean.

(b) The selected piping material shall not support microbial growth.

(c) The pipework shall be designed to minimise the length of pipe runs, the surface area and the number of pipe fittings.

(d) Provision shall be made in the design to facilitate ease of access to all pipework for maintenance, draining, cleaning and disinfection.

(e) The system shall be designed to have water continuously circulated, filtered, chemically and/or physically treated and heated.

(f) Chemicals added to the spa pool water as a solution shall normally be added by dosing pumps, which can be adjusted to vary the volume of the chemicals dosed per stroke and the number of strokes per hour.

4.7.2 Operation and Maintenance Precautions

(a) The spa pool water shall be continuously recirculated, filtered and disinfected, and with good pH control to minimize the proliferation of micro-organisms.

(b) When chlorinating disinfectants are used, a free chlorine residual of 3 to 5 ppm shall be maintained in the pool water. Other biocides of effective concentration can also be used.

(c) The spa pool system shall be checked daily before opening the spa pool, periodically throughout the day and at the end of the day after closing the spa pool for water clarity, condition of water filters, condition of automatic chemical dosing equipment, pool equipment cleanliness, residual disinfectant concentration, etc.

(d) Monthly, quarterly and annual programmes for checking and cleaning all equipment of the spa pool shall be drawn.

(e) The spa pool system shall be drained and cleaned, normally once a week. Excessive use of pools can lead to accumulation of soluble matter in the water. Any body fats deposited on the sides of the pool shall also be removed. The system shall be refilled with clean water at intervals.

(f) If the spa pool is equipped with jets, they shall be removed, inspected and cleaned at least once a month.

4.8 Design, Operation and Maintenance Precautions of Other Water-using Apparatus

4.8.1 Dental equipment, misting devices for fruit and vegetable display cabinets in retail outlets, swimming pools, vehicle washers, emergency showers and eye wash sprays and respiratory therapy equipment are known water-using apparatus that have been suspected or confirmed in association with LD.

4.8.2 The pipework of the apparatus listed in 4.8.1 shall be cleaned and disinfected regularly. The water in use shall be treated chemically or physically to control bacterial growth, scale formation and to remove silt, dirt, sludge, etc.

4.8.3 Sterile water shall be used to operate the respiratory devices and also be used for rinsing and cleaning these devices.

5. Collection of Water Samples from Water Using Apparatus for Testing Legionella, Heterotrophic Colony Count (HCC), and Other Water Quality Parameters

5.1 Regular collection of water samples from water using apparatus for testing Legionella, HCC and other water quality parameters (such as total dissolved solids, suspended solids, conductivity, pH, total alkalinity, calcium hardness, inhibitors concentration, biocide concentration and residual chlorine) are important to monitor and validate the effectiveness

of the water treatment programme in order to prevent the proliferation of Legionella in the system.

5.2 The frequency of collection of water samples from cooling towers for testing Legionella, HCC, other water quality parameters, the testing methods, the target ranges, and the associated actions required when their testing results were found falling outside the predetermined target ranges should be referred to the Code of Practice for Water-cooled Air Conditioning Systems, Part 2 – Operation and Maintenance of Cooling Towers ([4] in References – Paragraph 9 of this Code).

5.3 The collection of water samples from water using apparatus, other than cooling towers, for testing Legionella, HCC and other water quality parameters should also be carried out regularly according to the WSP already developed. To monitor all control measures, to validate effectiveness of the WSP, and to implement the required actions when the testing results outside the target ranges are important to prevent the proliferation of Legionella in the system.

5.4 The testing methods or procedures for Legionella and HCC shall comply with internationally recognised standards, such as:

Legionella	**Heterotrophic Colony Count**
AS/NZS 3896:1998 BS 6068.4.12:1998 ISO 11731: 1998	AS 4276.3.1:1995 BS 6068-4.5 BS EN ISO 6222:1999 APHA 9215B:1998

5.5 The methods for collecting water samples and preservation and handling of water samples for testing Legionella and HCC shall comply with relevant internationally recognised standards, such as AS 2031:2001, BS 7592:1992, BS EN ISO 5667-3:2003, or BS 6068-6.3:2003.

5.6 The laboratory which carries out the above tests shall be accredited by the Hong Kong Laboratory Accreditation Scheme (HOKLAS) or any equivalent accreditation authority.

6. Control Measures during Outbreak of Legionnaires' Disease

The authority concerned may impose more stringent control measures to all water-using apparatus being suspected to be the potential sources during the outbreak of LD.

7. Design, Operation and Maintenance Records

7.1 A formal design, operation and maintenance record for the system with accurate and adequate information shall be kept and be made available for inspections if demanded by Government appointed officials.

7.2 The record shall include, but not limited to:-

(a) the name, contact phone and address of the person and/or company who is responsible for design, operation and maintenance of the system.

(b) a description of the system such as location, make, model, capacity and year of manufacture/installation as well as details on the correct and safe operation.

(c) a schematic layout plan of the plant or system.

(d) a programme for routine water treatment, cleaning, desludging and disinfection of the system.

(e) details of maintenance such as :-

(i) date and result of visual inspection;

(ii) date of cleaning, desludging and disinfection;

(iii) date of water treatment with details on the treatment carried out;

(iv) maintenance work and date executed;

(v) method of bleed-off and details of the automatic bleed-off controls, if any.

(f) Each activity listed in (i) to (v) shall be authenticated by the signature of the person who has carried out the task.

7.3 Record books shall be kept for at least 24 calendar months. The name, contact phone and address of the person or company who is holding the record book shall be indicated by a durable label attached to or painted on the system.

8. Handling Garden Soils, Composts and Potting Mixes

8.1 Garden soils, composts and potting mixes can be harmful to human health if people handling them do not take precautions. Soil surveys in Australia and Japan found that the soil samples were positive for *Legionellae*. Infections with one species, *Legionella longbeachae*, have been associated with gardening and use of potting soil in Australia, Japan and United states.

8.2 The likely routes of transmission of *L. longbeachae* are from contaminated hands to mouth and by breathing in aerosol and dust from contaminated materials. However, there is no known effective way of preventing proliferation and multiplication of *L. longbeachae* in garden soils, composts and potting mixes.

8.3 To help prevent infection, the following precautions shall be taken when handling such materials.

(a) Read the warning on bagged garden soils, composts and potting mixes.

(b) Wear gloves and a face mask.

(c) Carefully dampen contents in the bag before opening it fully.

(d) Avoid breathing garden soils, composts and potting mix dust.

(e) Wash hands immediately after using garden soils, composts and potting mixes.

(f) Dispose of gloves and face mask carefully.

9. References

[1] Legionella and the Prevention of Legionellosis, World Health Organisation (WHO), 2007

[2] Occupational Safety & Health Administration (OSHA) Technical Manual, Chapter 7, Department of Labour, USA

[3] Guidelines for the Control of Legionnaires' Disease, Department of Human Services, Victoria, Australia, 1999.

[4] Code of Practice for Water-cooled Air Conditioning Systems – Part 1 to Part 3, Electrical and Mechanical Services Department, Hong Kong Special Administrative Region, China, 2006

[5] Code of Practice for the Control of Legionnaires' Disease, New South Wales Department of Health, Australia, 2004.

[6] Code of Practice for the Control of Legionella Bacteria in Cooling Towers, Institute of Environmental Epidemiology, Ministry of Environment, Singapore, 2001.

[7] Approved Code of Practice and Guidance – The Control of Legionella Bacteria in Water Systems, Health and Safety Executive, UK, 2004.

[8] TM13:2002 Minimising the Risk of Legionnaires' Disease, CIBSE, UK, 2002

[9] ASHRAE Guideline 12-2000 Minimizing the Risk of Legionellosis Associated with Building Water System, American Society of Heating, Refrigeration and Air Conditioning Engineers, USA, 2000

[10] Government of South Australia. Enjoy gardening without the risk of *Legionella*. http://www.dh.sa.gov.au/pehs/PDF-files/enjoy-gardening.pdf

Annex 1 附件一

FORM 2
QUARANTINE AND PREVENTION OF DISEASE ORDINANCE
(Cap. 141)

Notification of Infectious Diseases other than Tuberculosis

Particulars of Infected Person

Name in English:	Name in Chinese:	Age/Sex:	I.D. Card/Passport No.:
Address:			Telephone Number:
Place of Work/ School Attended:			Telephone Number:
Hospital(s) attended:			Hospital/A&E Number:

Disease ["✓"] below Suspected/Confirmed on _____ / _____ / _____

☐	Acute Poliomyelitis	☐	Japanese Encephalitis	☐	Rubella
☐	Amoebic Dysentery	☐	Legionnaires' Disease	☐	Scarlet Fever
☐	Bacillary Dysentery	☐	Leprosy	☐	Severe Acute Respiratory Syndrome
☐	Chickenpox	☐	Malaria		
☐	Cholera	☐	Measles	☐	*Streptococcus suis* Infection
☐	Community-associated methicillin-resistant *Staphylococcus aureus* infection	☐	Meningococcal Infections	☐	Tetanus
		☐	Mumps	☐	Typhoid Fever
☐	Dengue Fever	☐	Paratyphoid Fever	☐	Typhus
☐	Diphtheria	☐	Plague	☐	Viral Hepatitis
☐	Food Poisoning	☐	Rabies	☐	Whooping Cough
☐	Influenza A(H5), Influenza A(H7) or Influenza A(H9)	☐	Relapsing Fever	☐	Yellow Fever

Notified under the Prevention of the Spread of Infectious Diseases Regulations by

Dr. ……..… on …… / …… / ……
(Full Name in BLOCK Letters) (Date)

Telephone Number: …… ……..……..……..
(Signature)

Remarks:

DH 1(s)(Rev. Jan 2007)

Annex 2 附件二

OCCUPATIONAL SAFETY AND HEALTH ORDINANCE
NOTIFICATION OF OCCPATIONAL DISEASES

To : Commissioner for Labour

PARTICULARS OF PATIENT

Name: _____ HKID/Passport no.: _____

Male/Female* Date of birth: ___ /___ /____ Occupation: _____

Home address: _____

_____

Telephone no. (Home) _____ (Office) _____ (Pager/Mobile) _____

Name and address of employer: _____

_____ Telephone no. (Employer) _____

Workplace address (if different from employer's address): _____

_____

For Internal use:

Code: _____

Code: _____

Code: _____

Code: _____

NOTIFIABLE OCCUPATIONAL DISEASES *(Please put a tick in* □)

□1	Radiation Illness	□18	Lead Poisoning	□35	Chrome Ulceration
□2	Heat Cataract	□19	Manganese Poisoning	□36	Urinary Tract Cancer
□3	Compressed Air Illness	□20	Phosphorus Poisoning	□37	Peripheral Polyneuropathy
□4	Cramp of Hand or Forearm	□21	Arsenic Poisoning	□38	Localised Papillomatous or Keratotic New Skin Growth
□5	Beat Hand	□22	Mercury Poisoning	□39	Occupational Vitiligo
□6	Beat Knee	□23	Carbon Bisulphide Poisoning	□40	Occupational Dermatitis
□7	Beat Elbow	□24	Benzene Poisoning	□41	Chemical Induced Upper Respiratory Tract Inflammation
□8	Tenosynovitis of Hand or Forearm	□25	Poisoning by Nitro-, Amino-, or Chloro- Derivatives of Benzene	□42	Nasal or Paranasal Sinus Cancer
□9	Anthrax	□26	Dinitrophenol Poisoning	□43	Byssinosis
□10	Glanders	□27	Poisoning by Halogen Derivatives of Hydrocarbons	□44	Occupational Asthma
□11	Leptospirosis	□28	Diethylene Dioxide Poisoning	□45	Silicosis
□12	Extrinsic Allergic Alveolitis	□29	Chlorinated Naphthalene Poisoning	□46	Asbestos-Related Diseases
□13	Brucellosis	□30	Poisoning by Oxides of Nitrogen	□47	Occupational Deafness
□14	Tuberculosis in health care workers	□31	Beryllium Poisoning	□48	Carpal Tunnel Syndrome
□15	Parenterally Contracted Viral Hepatitis in health care workers	□32	Cadmium Poisoning	□49	Legionnaires' Disease
□16	Streptococcus suis Infection	□33	Dystrophy of the Cornea	□50	Severe Acute Respiratory Syndrome
□17	Avian Chlamydiosis	□34	Skin Cancer	□51	Avian Influenza A

Diagnosis: Confirm/Suspect* Date of onset of illness: _____ / _____ / _____

Follow-up of patient: Treated/Referred to hospital/Others(specify)*: _____

Other relevant information: _____

Name of notifying medical practitioner: _____

Address of notifying medical practitioner: _____

_____

Telephone no. of notifying medical practitioner: _____

Fax no. of notifying medical practitioner: _____

Date: _____ Signature: _____

**Delete whichever is inapplicable*

Please return this form by fax (no. 25812049) or by mail to Occupational Health Service, Labour Department, 15/F Harbour Building, 38 Pier Road, Central, Hong Kong.
For details of Notifiable Occupational Diseases and their related occupations, please refer to Schedule 2 of the Occupational Safety & Health Ordinance and to the Labour Department publication "Guidance Notes on the Diagnosis of Notifiable Occupational Diseases". Enquiry telephone no. : 2852 4041.

LD483 (Rev. 8.2.2005)

FIGURE 1 圖一

Relationship between Proliferation of Legionella and Temperature of Water Systems when in Use and when Other Bacterial Growth Factors are Present

退伍軍人病菌的滋生與在運作中的供水系統的溫度及其他有助細菌滋生的因素的相互關係

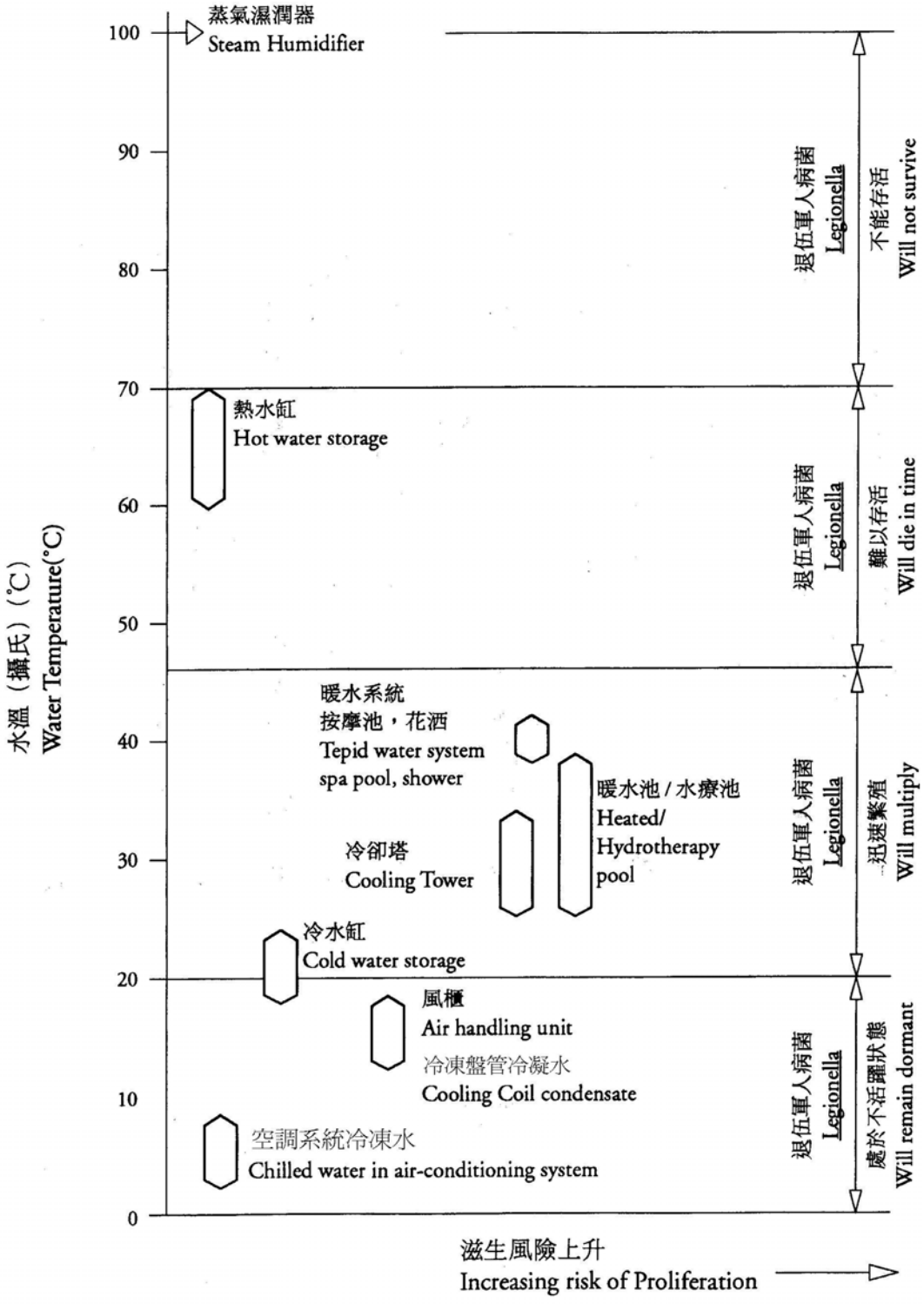


FIGURE 2 圖二

Transmission of Legionnaires' Disease
退伍軍人病症的傳播

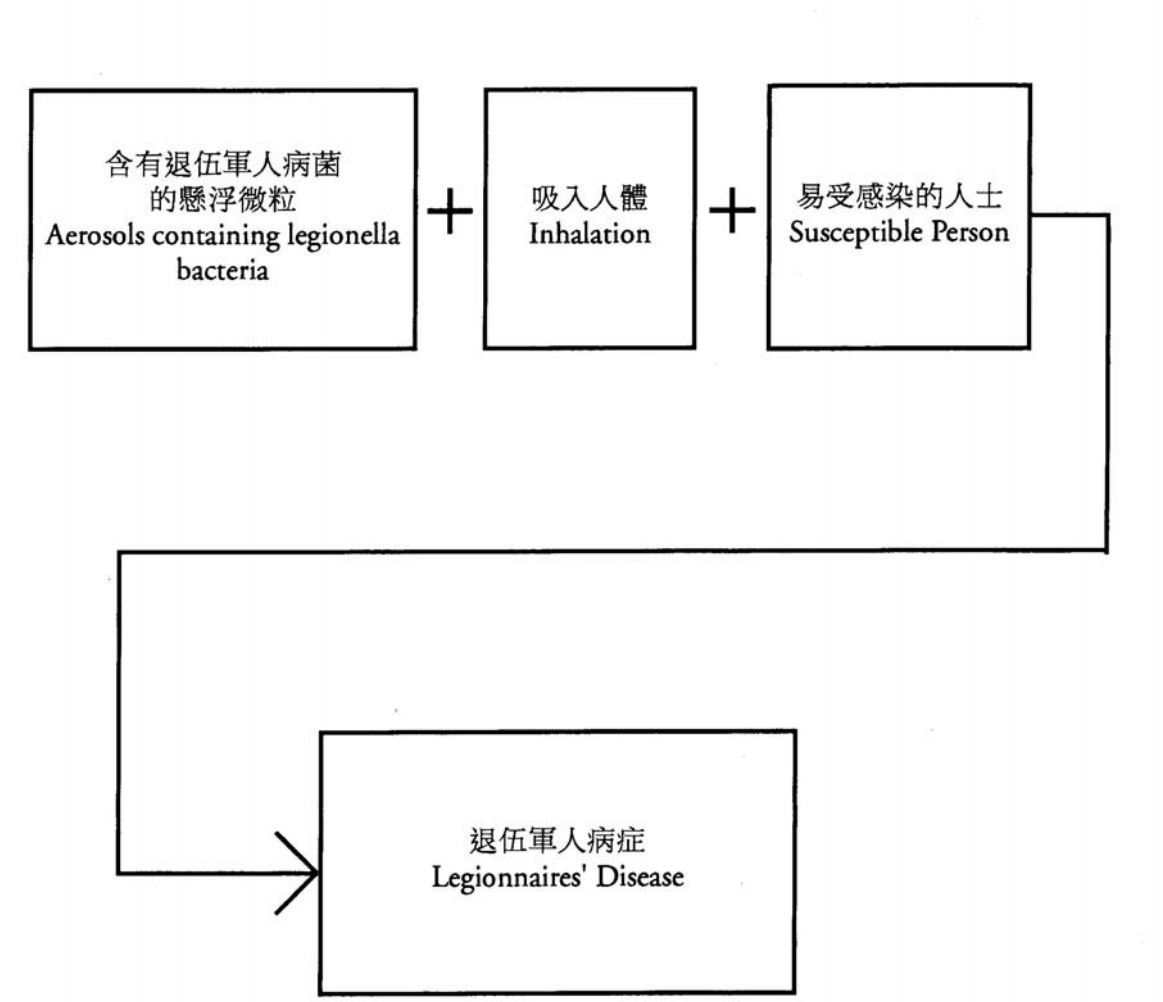
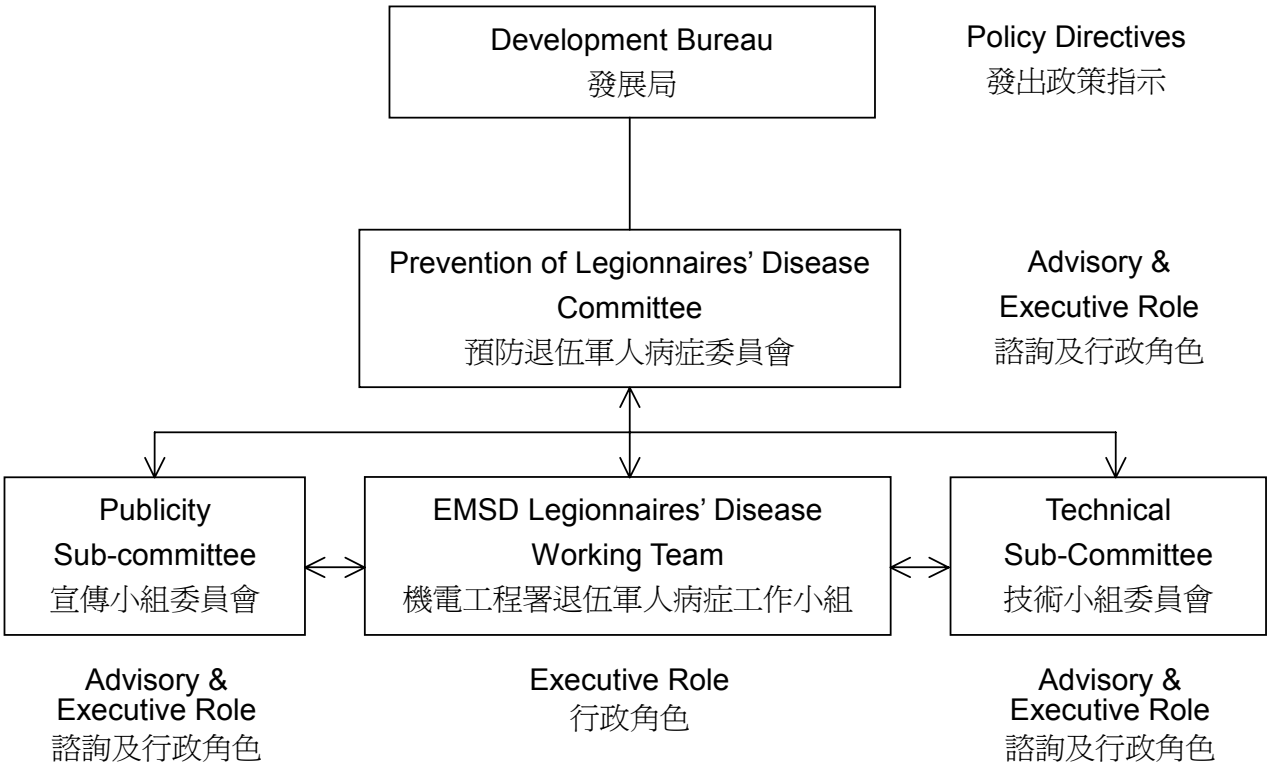


FIGURE 3A 圖三甲

Organisation of The Prevention of Legionnaires' Disease Committee
預防退伍軍人病症委員會組織圖



Publicity Sub-committee 宣傳小組委員會

Members 委員
1. EMSD 機電工程署
2. DH 衞生署
3. ISD 政府新聞處

Members Attending on as-and-when Required Basis
委員有需要情況下出席
1. Members of Medical Profession 醫學界委員
2. Members of Engineering Profession 工程界委員

Technical Sub-Committee 技術小組委員會

Members 委員
1. EMSD 機電工程署
2. DH 衞生署
3. ArchSD 建築署

Members Attending on as-and-when Required Basis
委員有需要情況下出席
1. BD 屋宇署
2. FEHD 食物環境衞生署
3. LD 勞工署
4. WSD 水務署
5. Members of Medical Profession 醫學界委員
6. Members of Engineering Profession 工程界委員

Note 註：

ArchSD	建築署	Architectural Services Department
BD	屋宇署	Buildings Department
DH	衞生署	Department of Health
EMSD	機電工程署	Electrical and Mechanical Services Department
FEHD	食物環境衞生署	Food and Environmental Hygiene Department
ISD	政府新聞處	Information Services Department
LD	勞工署	Labour Department
WSD	水務署	Water Supplies Department

FIGURE 3B 圖三乙

Composition of Prevention of Legionnaires' Disease Committee and Terms of Reference
預防退伍軍人病症委員會委員名單及職權範圍

Composition of Prevention of Legionnaires' Disease Committee
預防退伍軍人病症委員會委員名單

	Up to 14 November 2007 **至2007年11月14日止**	**From 15 November 2007** **自2007年11月15日起**
Chairman : 主席：	Prof. LEE Shiu-hung 李紹鴻教授	Prof. GRIFFITHS Sian 葛菲雪教授
Vice-chairman : 副主席：	An Assistant Director of Electrical & Mechanical Services Department 機電工程署助理署長一名	An Assistant Director of Electrical & Mechanical Services Department 機電工程署助理署長一名
Members : 委員：	Ir. CHAN Ka-lung 陳家龍工程師 Ir. CHIU Siu-wah, Tony 趙小華工程師 Prof. IP Pik-yiu, Margaret 葉碧瑤教授 Dr. TSANG Ngai-chong, Dominic 曾艾壯醫生 A representative of the Secretary for Development 發展局局長的代表一名 A representative of the Director of Architectural Services 建築署署長的代表一名 Two representatives of the Director of Health 衛生署署長的代表兩名 A representative of the Director of Water Supplies 水務署署長的代表一名	Ir. CHAN Ka-lung 陳家龍工程師 Ir. CHUI Chi-hung, Eric 崔志雄工程師 Prof. HUI Mamie 許明媚教授 Dr. TSANG Ngai-chong, Dominic 曾艾壯醫生 A representative of the Secretary for Development 發展局局長的代表一名 A representative of the Director of Architectural Services 建築署署長的代表一名 A representative of the Director of Buildings 屋宇署署長的代表一名 Two representatives of the Director of Health 衛生署署長的代表兩名 A representative of the Director of Water Supplies 水務署署長的代表一名
Secretary : 秘書：	A Senior Professional of Electrical & Mechanical Services Department 機電工程署的高級專業人員一名	A Senior Professional of Electrical & Mechanical Services Department 機電工程署的高級專業人員一名

Terms of Reference 職權範圍

To advise the Government from the public health, microbiology and engineering services perspectives on:-

(a) the minimization of the risk of Legionnaires' Disease; and

(b) the promotion of good practices to the building owners and associated practitioners to prevent the outbreak of Legionnaires' Disease.

從公眾健康、微生物學及工程服務的角度，就以下事宜向政府提供意見：

(甲) 減低退伍軍人病症的風險；以及

(乙) 向建築物擁有人及有關從業員推廣良好作業方法，以防出現退伍軍人病症。

FIGURE 4A 圖四甲

Longitudinal Section of a Typical Cooling Tower
典型冷卻塔縱切面圖

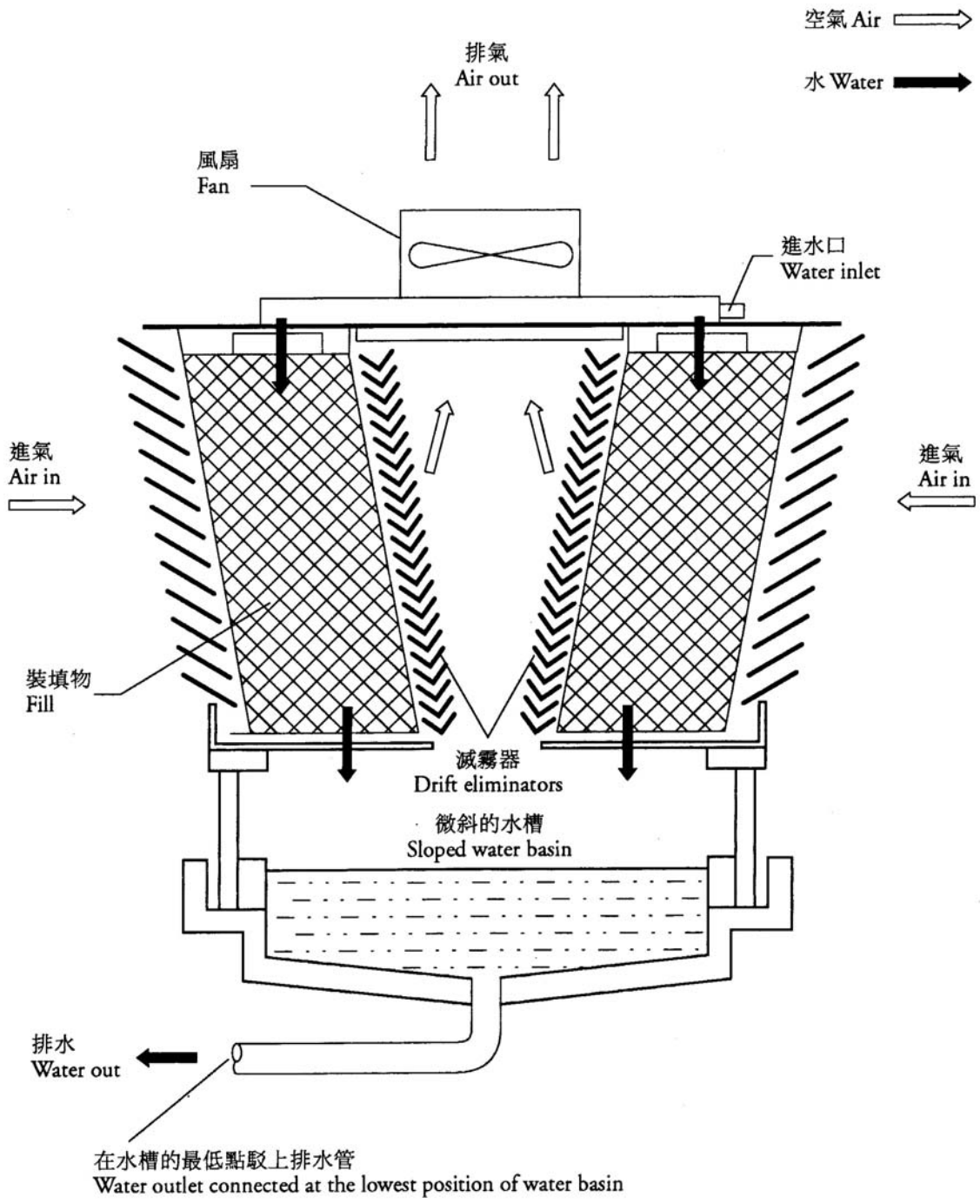


FIGURE 4B 圖四乙

Schematic Diagram of a Cooling Tower System
冷卻塔系統示意圖

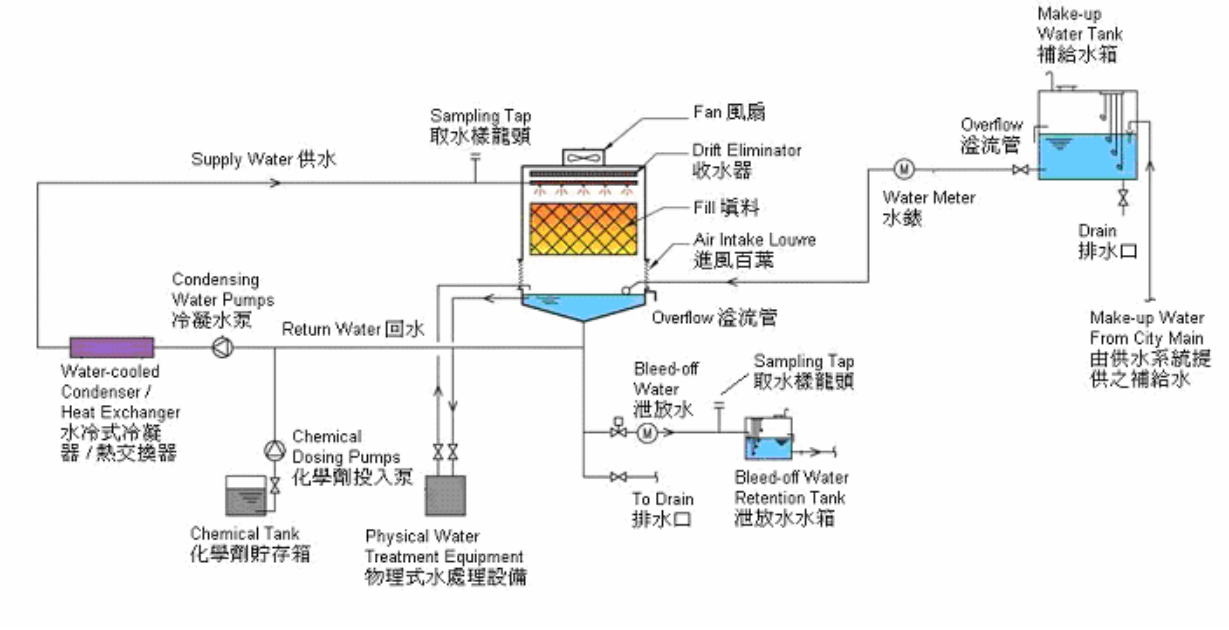


FIGURE 5 圖五

Air Handling Unit / Fan Coil Unit (AHU / FCU) Drain Tray
風櫃 / 盤管式風機排水盤

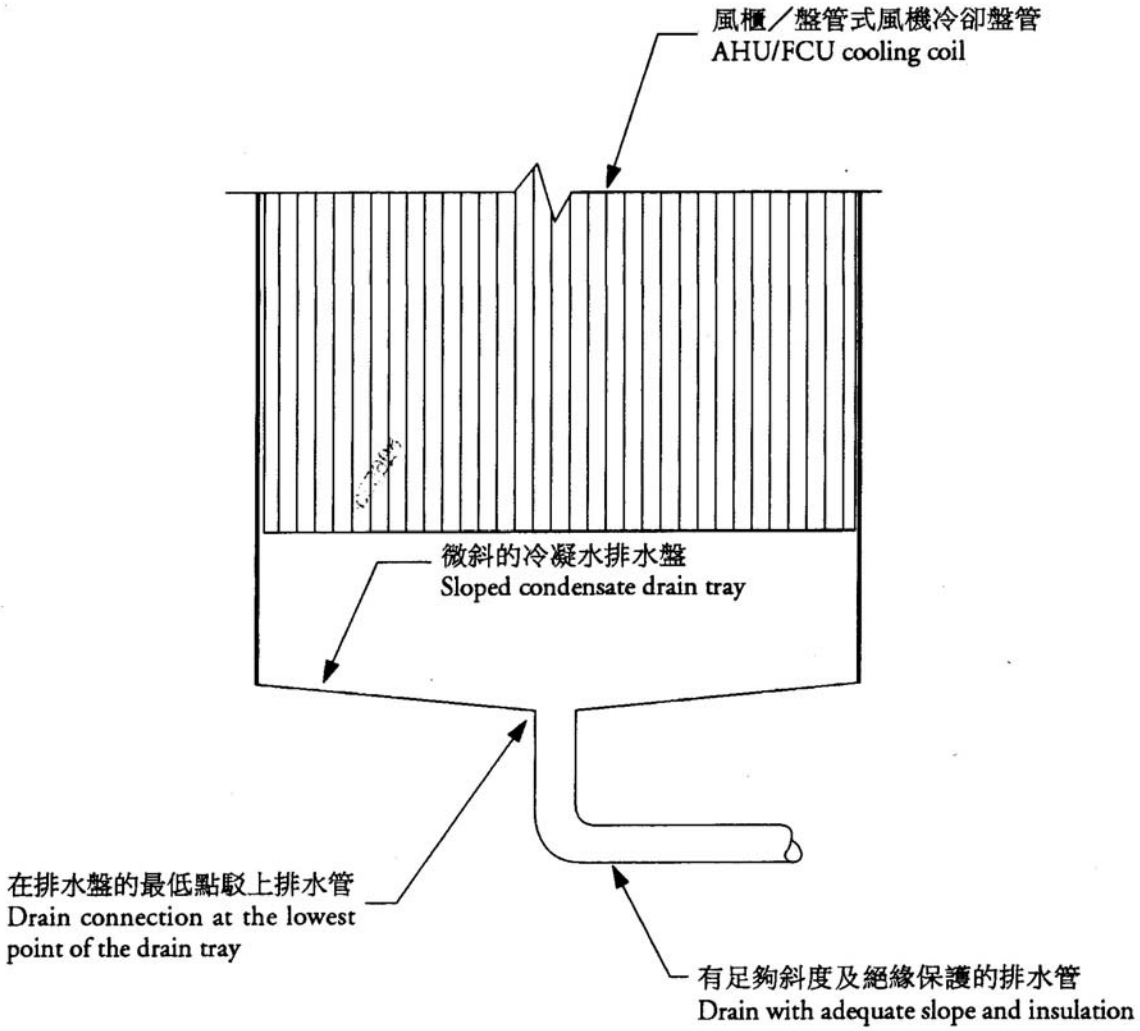
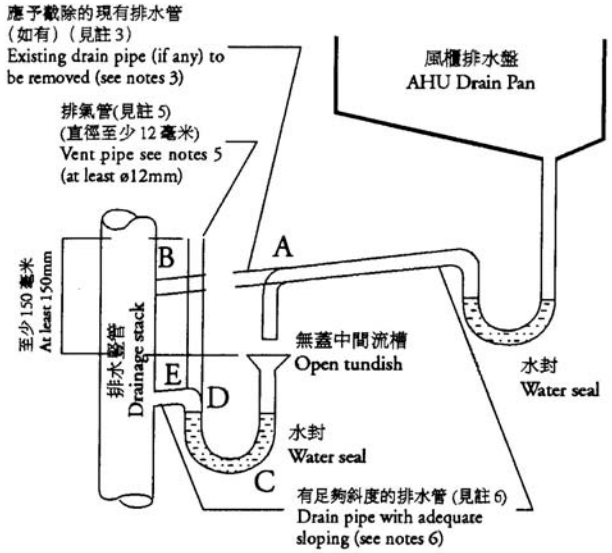


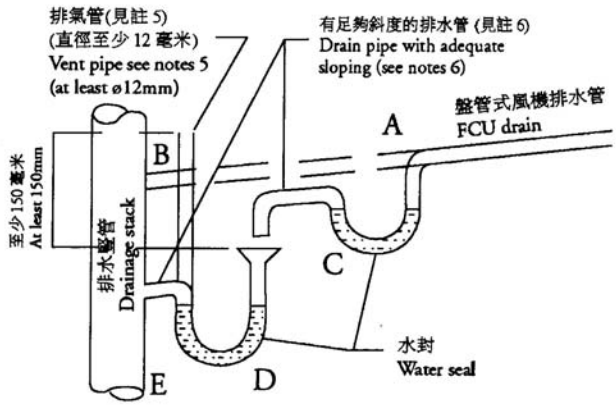
FIGURE 6 圖六

Air Break and U-trap (Water Seal) at AHU/FCU Condensate Drain Pipework

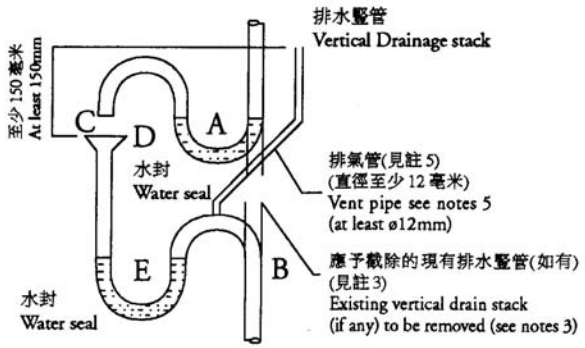
風櫃 / 盤管式風機冷凝水排水系統的氣隔及U型聚水器（水封）



i) 風櫃排水管接駁方式 AHU drain connection



ii) 盤管式風機排水管接駁方式 FCU drain connection



iii)排水豎管的其他設計方法 Alternative design at vertical drain stack

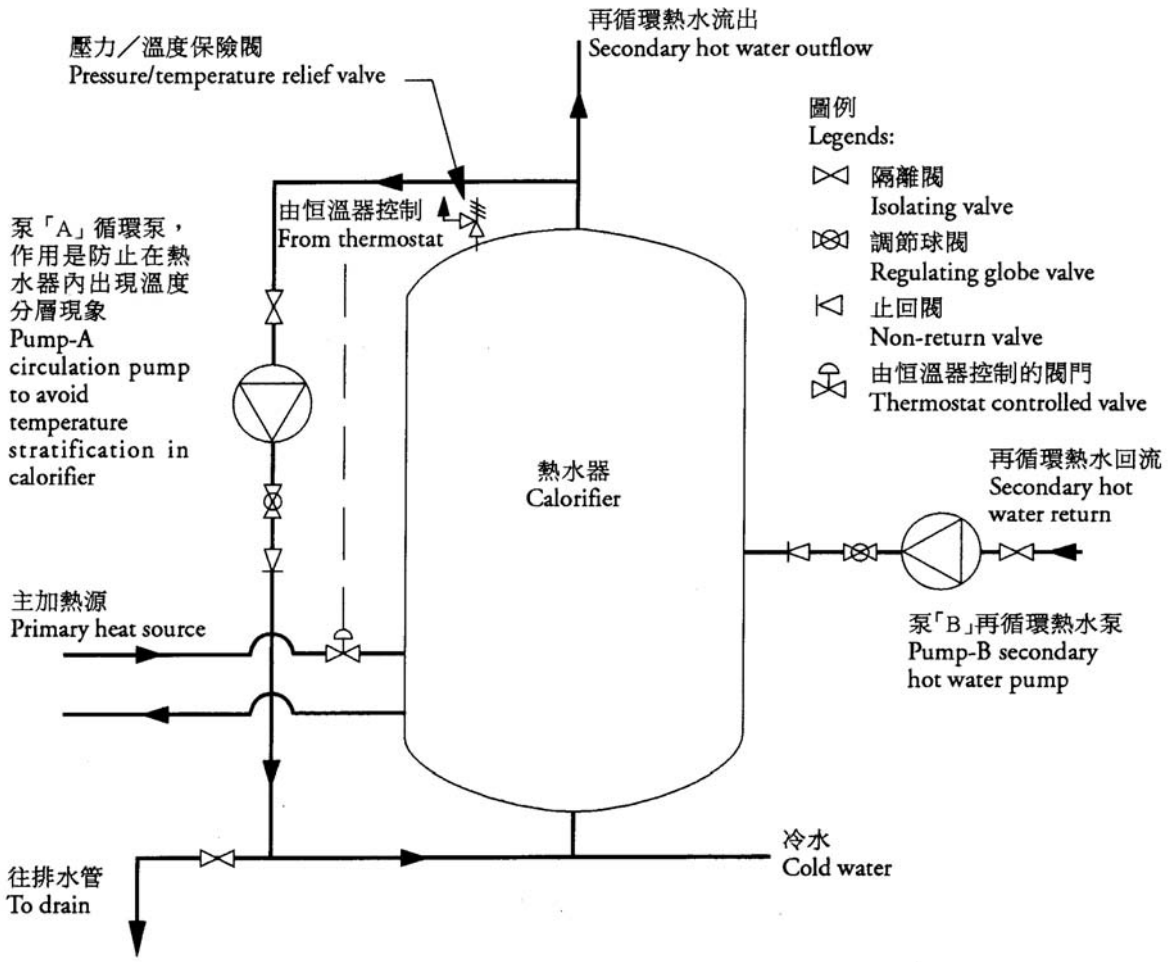
註 Notes:

1. 應視乎實地情況，採用 i)、 ii)或 iii)的方法設計存水彎。
   Depend on the site condition, the design of the water seal should be of type i), ii), or iii).
2. 排水管及無蓋中間流槽應有絕緣保護。
   Drain pipes & open tundish should be insulated.
3. 如現已設有排水管，則該管的 A 至 B 段應予截除。所有受破壞的絕緣應予修妥。
   The existing drain pipe (if any) from A to B shall be removed. All damaged insulation should be made good.
4. 水封應有足夠的深度，以抵受排水管最大驟增壓力。
   Water seal shall be of sufficient depth to withstand maximum surge in drain pipe pressure.
5. 應視乎需要按繪圖所示加裝排氣管。
   The additional vent pipe shown in the drawings should be required as and when necessary.
6. 建議排水管的斜度最少應為1:5，管道的大小應與現有的排水管配合。
   Recommended drain pipe sloping is at least 1 in 5; pipe size should match that of existing drain.

FIGURE 7 圖七

Pumped Circulation in Calorifier to Reduce or Eliminate Temperature Stratification

在熱水器內施行泵壓循環以減低或消除溫度分層現象



註 Note:

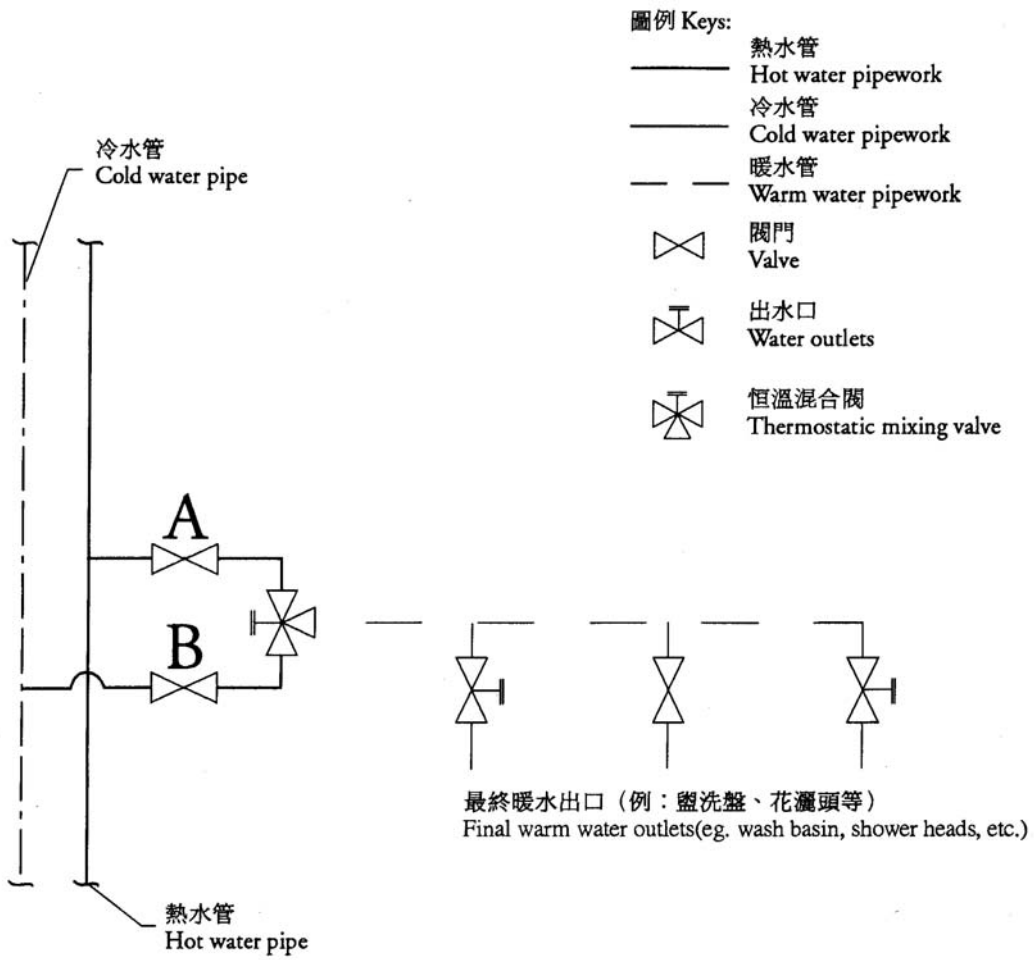
1. 低壓、高流量的循環泵「A」的流量，應按實際情況決定。作為一項指引，可將熱水系統最高峰每小時需求除以該系統內操作中熱水器總數，作為初步設定的流量。
   The flowrate of the low head, high flowrate circulation pump-A should be determined on site. As a guideline, the flowrate could first be set at the calculated peak hourly demand of the hot water system divided by the total no. of operating calorifiers in the system.

2. 循環泵「A」可以用時間掣控制，亦可持續不斷地操作。在設定泵操作的總運轉時間及頻率時，須顧及要減低或消除熱水器內溫差現象。
   The circulation pump-A may be timer controlled or continuously operated. The total run time and frequency of operation shall be so selected to reduce or eliminate the temperature gradient within the calorifier.

3. 除非已知道熱水供應系統提供了讓退伍軍人病菌滋生的適合環境，否則無須採取減低或消除熱水器內溫度分層現象的措施。
   It was not considered necessary to take any action to reduce or eliminate temperature stratification in calorifiers unless it was recognised that the hot water supply system could provide an environment suitable for the proliferation of legionella.

FIGURE 8 圖八

Thermostatic Mixing Valve
恒溫混合閥



註 Notes:

1. 在正常情況下閥門A及閥門B應該開啟。但是在對恒溫混合閥進行例行故障保險測試時，應把閥門B關閉。
   Valve A and B shall be turned on normally. Valve B should be shut off for routine fail-safe test of the thermostatic mixing valve.
2. 每個恒溫混合閥最多可供應的最終暖水出口數目，應依循製造商的建議。
   Maximum no. of final warm water outlets to be supplied by each thermostatic mixing valve shall follow the recommendation of the manufacturer.
3. 恒溫混合閥的安裝位置，應盡量靠近最終暖水出口。
   Thermostatic mixing valve should be installed as near to the final warm water outlets as possible.

FIGURE 9 圖九

Schematic Diagram of a Typical Spa System
典型溫泉系統示意圖

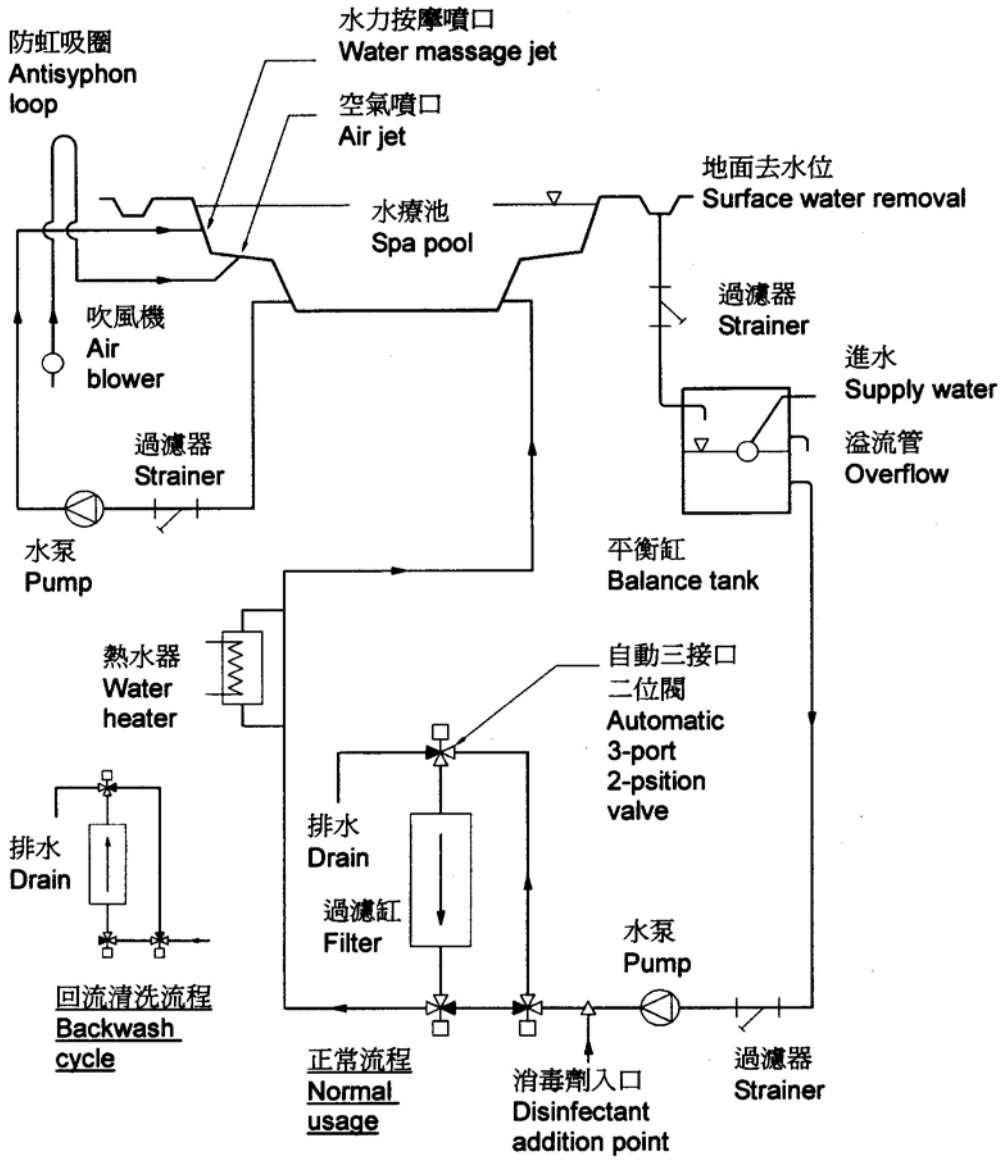
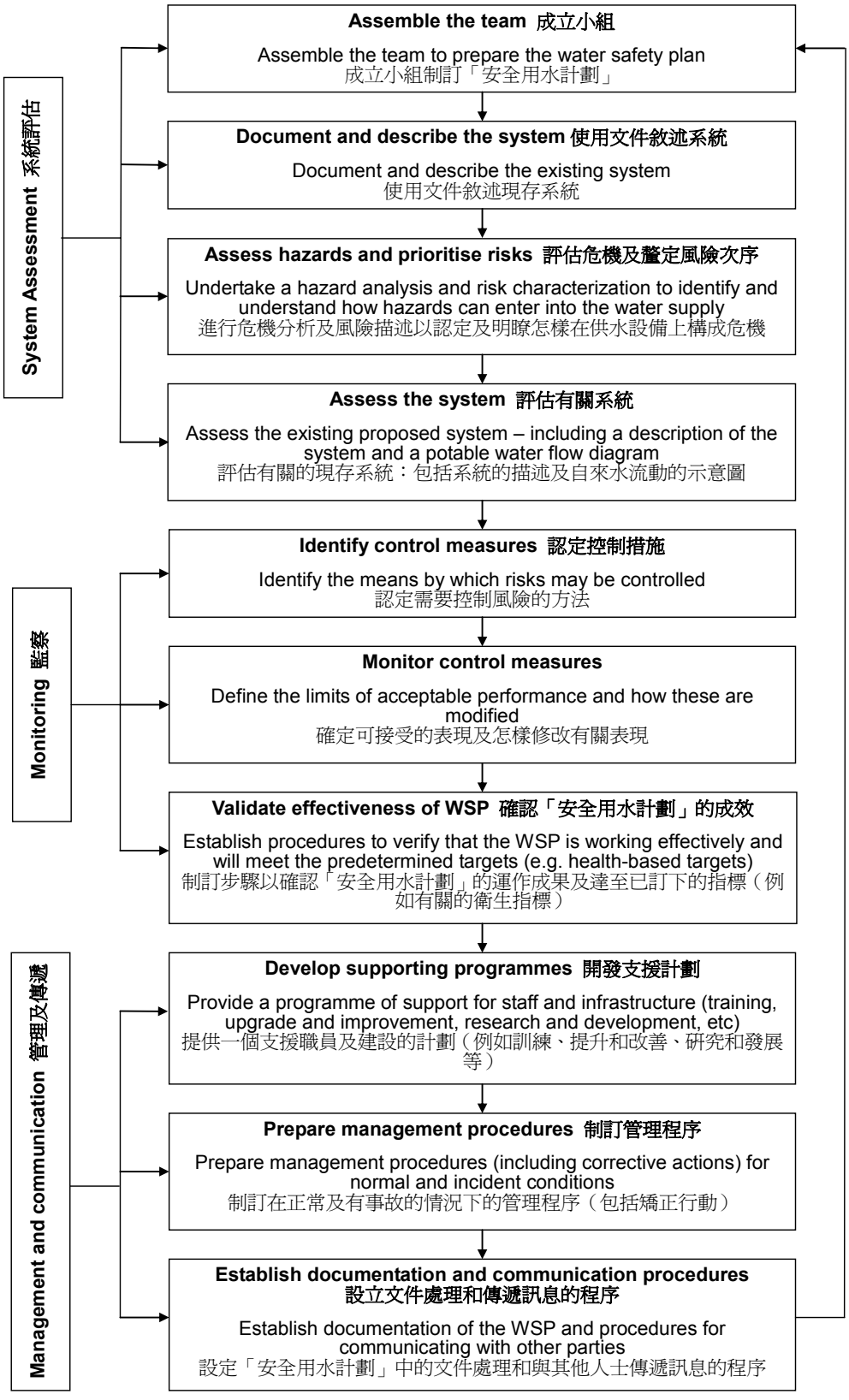


FIGURE 10 圖十

Overview of the Key Steps in Developing a Water Safety Plan
制訂安全用水計劃重要步驟的概略



Source: Adapted from Legionella and the prevention of legionellosis published by WHO in 2007
來源：根據世界衛生組織在2007年出版的Legionella and the Prevention of Legionellosis制訂

Code of Practice for Prevention of Legionnaires' Disease
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