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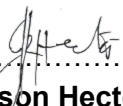
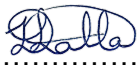
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## **CONTENTS**

	<b>Page</b>
<b>1. INTRODUCTION .....</b>	<b>3</b>
<b>2. SUPPORTING CLAUSES .....</b>	<b>3</b>
2.1 SCOPE .....	3
2.1.1 Purpose .....	3
2.1.2 Applicability .....	3
2.2 NORMATIVE/INFORMATIVE REFERENCES .....	4
2.2.1 Normative .....	4
2.2.2 Informative .....	4
2.3 DEFINITIONS .....	4
2.3.1 Disclosure Classification .....	5
ABBREVIATIONS .....	5
2.4 ROLES AND RESPONSIBILITIES .....	5
2.5 PROCESS FOR MONITORING .....	6
2.5.1 Cooling water .....	6
2.5.2 Hot and cold water systems .....	6
2.6 RELATED/SUPPORTING DOCUMENTS .....	6
<b>3. LEGIONELLA STANDARD .....</b>	<b>6</b>
3.1 SAMPLING PROCEDURE .....	6
3.2 ANALYSIS .....	6
3.4 WORKING IN LEGIONELLA CONTAMINATED AREAS .....	8
<b>4. AUTHORISATION .....</b>	<b>10</b>
<b>5. REVISIONS .....</b>	<b>11</b>
<b>6. DEVELOPMENT TEAM .....</b>	<b>11</b>
<b>7. ACKNOWLEDGEMENTS .....</b>	<b>11</b>

## **TABLES**

Table 1: Risk Categories for various Legionella counts in cooling water .....	7
Table 2: Legionella Limits in Potable Water Systems .....	8
Table 3: Summary of Actions to be taken for Different Parameters and Systems .....	9

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## **1. INTRODUCTION**

Legionella and Legionnaires disease were first noted in the summer of 1976, when an outbreak of an acute respiratory disease occurred amongst delegates at an American Legion Conference. Legionella were identified as the causative agents, after they were detected in the water of an ornamental spray fountain at the conference venue. Since then, research has determined that the bacteria are found naturally in water and soil.

The conditions prevalent in Eskom's cooling water systems and air conditioning systems are highly favourable for Legionella contamination i.e. temperatures between 20 and 50°C, potential stagnant or low flow areas and raw water inflow supplying nutrients. Additionally, the existence of biofilms in the cooling water systems offers the Legionella protection from adverse conditions and water treatment chemicals. The growth of Legionella is also enhanced by low concentrations of iron, zinc and potassium.

Although the Legionella are quite prolific in the cooling water system, they only become problematic if aspirated (breathed) into the lungs. For this to occur the water has to be in fine droplets as is the case in spray cooling or humidifying.

Only 1-5% of people who have been in contact with Legionella, contract the disease. The infection includes symptoms similar to pneumonia and is therefore often misdiagnosed. The susceptibility of persons is increased if:

- The person is over 50 years old,
- The person is male,
- The person smokes, drinks or uses drugs,
- The person is immunocompromised.

It is thus essential that Eskom Management be aware of the risk and know how to control and treat the problem.

## **2. SUPPORTING CLAUSES**

### **2.1 SCOPE**

Eskom power plants (cooling water systems) provide a conducive environment for the formation, growth and infectious mode of Legionella. The Eskom Legionella Management Standard specifies the allowable counts, in different water systems; risk assessments required; monitoring areas and time intervals between sampling; relevant personal protective equipment to be used and signage required around the possible risk areas.

#### **2.1.1 Purpose**

The Eskom Legionella Management Standard is aimed at assisting all relevant parties with the minimum control and management requirements of Legionella, in order to comply with SANS 893 and to minimise the risk of contracting Legionnaires disease.

#### **2.1.2 Applicability**

This standard is applicable to all Eskom sites, which have open evaporative cooling water systems, auxiliary cooling water systems and air conditioning systems. This document shall apply throughout Eskom Holdings Limited Divisions.

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## 2.2 NORMATIVE/INFORMATIVE REFERENCES

Parties using this document shall apply the most recent edition of the documents listed in the following paragraphs.

### 2.2.1 Normative

- SANS 893-1 (2013) Legionnaires' disease, Part 1: Risk Management
- SANS 893-2 (2013) Legionnaires' disease, Part 2: The control of *Legionella* in water systems.

### 2.2.2 Informative

- Reynolds K (2001). Effect of raw water quality and environmental factors on the concentrations of Legionella in Eskom. Eskom Research Report, RES/RR/01/15074.
- Coubrough P (2003). Guidelines for Legionella levels in water: A code of practice. WRC Report, TT 174/02, Apr 03.
- ISO 11731: 2 (2009). Detection and enumeration of *Legionella* in water. Edition 1.

## 2.3 DEFINITIONS

Definition	Explanation
Aerosol	Suspension in a gaseous medium of solid particles or solid and liquid particles that has negligible falling velocity.
Algae	Small, usually aquatic, plant which requires light to grow, often found on exposed areas of cooling towers.
Air-conditioning	Form of air treatment whereby temperature, humidity and air cleanliness are all controlled within limits determined by the requirements of the air-conditioned enclosure.
Bacteria	Microscopic, unicellular organism.
Biocide	Substance which kills microorganisms.
Biofilm	Community of bacteria and other microorganisms that is embedded in a protective layer with entrained debris, attached to a surface.
Open evaporative cooling water system	Section of plant involved with the handling and transportation of water used to reduce temperatures on power plants or in air-conditioning systems.
Cycles of concentration	Is the number of times cooling water is passed in the system before the limiting parameter is reached (blow down).
Drift	Circulating water lost from the tower as liquid droplets entrained in the exhaust air stream.
Fouling	Organic growth or other deposits on heat transfer surfaces causing loss in efficiency.
<i>Legionella</i>	Rod shaped, non-acid fast, non-spore-forming, motile bacteria, pathogenic Gram-negative bacterium, including species that cause legionellosis.  <b>NOTE 1</b> The genus <i>Legionella</i> belongs to the family <i>Legionellaceae</i> which has over 40 species. Most species are not responsible for

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	causing disease. These are ubiquitous in the environment and found in a wide spectrum of natural and artificial collections of water.  NOTE 2 The growth of <i>Legionella</i> is promoted by increased water temperature (> 20 °C and < 50 °C), stagnation and presence of nutrients.
Legionnaires Disease	Pneumonia-like disease caused by <i>Legionella</i> bacteria.
Legionellosis	Generic term for illnesses caused by <i>Legionella</i> bacteria.
Microorganism	Organism of microscopic size that includes bacteria, fungi, protozoa and viruses.
Planktonic	Free floating microorganisms in an aquatic system.
Raw water	Water which is added to a cooling water system to compensate for wastage (e.g. via system leaks), evaporative loss and bleed.
Risk assessment	Overall process of risk identification, risk analysis and risk evaluation.
Sessile	Aquatic microorganisms adhering to a surface normally as part of a biofilm.
Sludge	General term for soft mud-like deposits found in the sump or the base of a cooling system.
Slime	Mucus-like exudate which covers a surface produced by some microorganisms.
Windage	Physical loss of water from a cooling tower caused by draught of air or wind around the base of the cooling tower as a result of cross winds as opposed to drift.
Dead-leg	A length of water system pipework leading to a fitting through which water only passes infrequently when there is draw off from the fitting, providing the potential for stagnation.

### 2.3.1 Disclosure Classification

**Controlled disclosure:** controlled disclosure to external parties (either enforced by law, or discretionary).

### ABBREVIATIONS

Abbreviation	Description
CFUs	Colony forming units.
CW	Cooling water.

### 2.4 ROLES AND RESPONSIBILITIES

The Chemical Services Manager shall be responsible for ensuring that the requirements of this document are complied with.

The SCOT is responsible for the periodic review of this document.

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## **2.5 PROCESS FOR MONITORING**

### **2.5.1 Cooling water**

- A detailed risk assessment of each plant will be conducted by an external to Eskom assessor, certified to evaluate the risk of Legionnaire's infection to personnel. Microbiologists can assist with the recommendations of the external assessors.
- A comprehensive, formalised, recorded chemical dosing regimen must be instituted. There must be documented proof of continued improvement in the water quality management.
- Cooling water samples will be submitted to a ISO17025 accredited laboratory on a quarterly basis and must be analysed according to the ISO 11731 method (for normal counts).

### **2.5.2 Hot and cold water systems**

- A detailed risk assessment of each plant will be conducted, by an external assessor, to evaluate the risk of infection to personnel.
- Water from the hot and cold potable water systems does not have to be routinely monitored if the water is supplied by the municipality.
- Dead legs, as specified in SANS 893 standard should be flushed regularly (monthly) and any dead ends limited.

Safety showers/eye wash basins must be flushed for approximately one minute on a monthly basis because the water in the system is normally stagnant.

## **2.6 RELATED/SUPPORTING DOCUMENTS**

## **3. LEGIONELLA STANDARD**

### **3.1 SAMPLING PROCEDURE**

1. Samples should be taken in sterile 1 litre containers.
2. Remove the cap of the sterile 1 litre container (take care not to touch the inside of the neck of the bottle nor inside the cap).
3. Take a sample by filling the container but ensure a headspace of approximately 20mm (do not rinse the container).
4. Screw the cap on well and ensure the bottle does not leak.
5. Label the container with a waterproof marker. Include site of sample, date, analysis required, sampler's name, note weather conditions if extreme.
6. Cool the sample for transportation, if possible (DO NOT FREEZE). Otherwise maintain the sample at the temperature of the system that it was taken from.
7. Submit to an accredited laboratory for analysis within 24 hours of sampling.

### **3.2 ANALYSIS**

Samples must be analysed according to the ISO 11731 methodology by a SANAS accredited laboratory. Cooling water must be analysed with the method for higher counts while potable water is analysed by the method for expected low counts.

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## **2.3 RISK MANAGEMENT**

Cooling water counts are arranged in low to high-risk categories as shown in Table 1.

**Table 1: Risk Categories for various Legionella counts in cooling water**

Counts (CFU/L)	Guidelines
1 — 10 000	No additional action is necessary. Keep on with normal control activities (acceptable).
10000—100000	Shows evidence of poor control. Investigate your dosing system (poor)
>100 000	Take urgent action to reduce levels of contamination (very poor)
Although industrial cooling systems limits are set out as above, the aim should be to achieve less than a 100cfu/L. This should be the ultimate goal.	

Standard practice in the management of Legionella outbreaks includes the initial draining and thorough cleaning of the system. This may be applicable in Eskom's smaller auxiliary cooling units and air conditioning units but can definitely not be used in the case of the main cooling water system.

In this case it is suggested that the chemical dosing treatment (biocide/dispersant) regime be investigated and relevant corrections made to minimise the risk.

It is essential that post clean up monitoring be conducted to ensure the efficacy of the clean. This is relevant regardless of the size of the system or clean up regime. The regularity of this monitoring should be in-line with the possible risk to personnel. The more likely the interaction between personnel and Legionella, the more regular the follow up monitoring.

The allowable counts in potable waters are shown in Table 2.

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**Table 2: Legionella Limits in Potable Water Systems**

General systems		Susceptible populations	
<b>Legionella bacteria (cfu/L)</b>	<b>Action required</b>	<b>Legionella bacteria (cfu/L)</b>	<b>Action required</b>
<u>Less than 100</u>	System under control	Less than 100	System under control
More than 100 but less than 1 000	<p>Either:</p> <p>a) If only one or two samples are positive, system shall be re-sampled. If a similar count is found again, a review of the control measures and risk assessment shall be carried out to identify any remedial actions.</p> <p>b) If the majority of samples are positive, the system may be colonised, albeit at a low level, with <i>Legionella</i>. Disinfection of the system shall be considered but an immediate review of control measures and risk assessment shall be carried out to identify any other remedial action required.</p>	More than 100	The system shall be re-sampled and an immediate review of the control measures and risk assessment shall be carried out to identify any remedial actions, including possible disinfection of the system.
More than 1 000	The system shall be re-sampled and an immediate review of the control measures and risk assessment shall be carried out to identify any remedial actions, including possible disinfection of the system.	More than 1000	System out of control. Isolation and immediate action must be taken within 24 hours after the results have been reported.
All microbiological limits will be in accordance with SANS 241-1			

### 3.4 WORKING IN LEGIONELLA CONTAMINATED AREAS

If personnel have to enter any part of the plant which may contain Legionella it is imperative that either a P3 filter in half face mask or a 3M Aura Particulate Respirator 9332+ be worn over both the nose and mouth.

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Due to the fact that Legionella is often found in biofilms, the fact that the system has been drained does not minimise the risk. In fact, it may increase, as the humidity within the system will allow the water present to be present in droplet form.

In the case of condenser inspections, once the system has been drained, high pressure water jets are often used to clean the condenser face and tubes. This practice also forms water droplets and thus requires respiratory filters.

## **2.5 LEGIONELLA IN BIOFILMS**

Recent research on Legionella has highlighted its protected growth within biofilms. It is thus more prudent to monitor biofilm samples than water samples. For this to occur either a coupon must be placed in the CW and a biofilm allowed to form, or a biofilm monitoring device must be installed. These samples should be taken at the same time as the water samples and the extent of biofilm development evaluated.

**Table 3: Summary of Actions to be taken for Different Parameters and Systems**

<b>Parameter</b>	<b>Main CW System (CWS)</b>	<b>Auxiliary CW</b>	<b>Biofilms</b>
<b>History</b>	Low risk counts	Low to high-risk counts	Not conducted
<b>Sample</b>	One Litre water	One Litre water	1 coupon/stud
<b>Regularity</b>	3 monthly	3 monthly	3 monthly
<b>Reaction to high risks</b>	-Investigate water treatment regime -Resample -Continue to monitor until clear.	-Drain the system and remove waste. -Clean with water chemicals. -Resample -Continue to monitor until clear.	As main CWS

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#### 4. AUTHORISATION

This document has been seen and accepted by:

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## **5. REVISIONS**

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## **6. DEVELOPMENT TEAM**

The following people were involved in the development of this document:

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## **7. ACKNOWLEDGEMENTS**

- CW Care Group

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