
	<b>Duvha Power Station</b> <b>Cooling Water Treatment</b> <b>Program</b> <b>Scope of Work</b> Water Treatment Plant	Doc. no.
		Rev. 1
		Pages

**Compiled by:**



**C Mngqibisa**

Senior Chemist

**Supported**

*A.G. Groenewald*

**A Groenewald**

WTP Section Chemist

**Supported**



**T Masethe**

System Engineer

**Approved by:**

*N.P Thabethe*

**N Thabethe**

Chemical Services Manager

Provide a comprehensive cooling water chemical treatment program for Duvha Power Station. **The duration of the program is projected to run for sixty (60) months**

The cooling water treatment should address the following.

- **Corrosion Inhibition:** Reduce the corrosion rates for both general corrosion and pitting corrosion. This treatment should also manage corrosion product deposits, minimising problems and enhancing equipment life.
- **Deposit control:** Reduce mineral salt precipitation and other contaminations. This treatment should minimise the development of hard scale and fouling by suspended solids
- **Fouling control:** A comprehensive programme to minimise slime and suspended solid dispersions. The treatment should include:
  - (1) A non-chromate liquid product based with orthophosphate (stabilized phosphate) and zinc as corrosion inhibitor.
  - (2) An organic phosphate and polymeric dispersant for deposit and biofilm control
  - (3) A copper corrosion Inhibitor - azoles based
- **Microbiological:** Reduction of microbiological counts (Legionella, Algae, and Biofilm formers) to within Eskom and national limits for industrial cooling towers. This will require suitable biocide/bio dispersant dosing regimen with a secondary biocide addition on a regular basis

#### Bacteriological Quality (planktonic)

<u>Parameter</u>	<u>Target</u>	<u>Limits</u>	<u>Frequency</u>
Total aerobic bacteria	<u>&lt;10<sup>5</sup> CFU/ml</u>	<u>&lt;10<sup>5</sup> CFU/ml</u>	<u>Monthly</u>
Total anaerobic bacteria	<u>&lt;10<sup>4</sup> CFU/ml</u>	<u>&lt;10<sup>5</sup> CFU/ml</u>	<u>Monthly</u>
Legionella	<u>&lt;100 CFU/L</u>	<u>&lt;10 000 CFU/L</u>	<u>Bimonthly</u>
H2S producers	<u>&lt;50 CFUs/ml</u>	<u>&lt;50 CFUs/ml</u>	<u>Monthly</u>
Chlorophyll	<u>&lt;25 µg/kg</u>	<u>&lt;25 µg/kg</u>	<u>When there is algal bloom</u>

#### Bacteriological Quality (sessile)

<u>Parameter</u>	<u>Target</u>	<u>Limits</u>	<u>Frequency</u>
Total aerobic bacteria	<u>&lt;10<sup>6</sup> CFU/ml</u>	<u>&lt;10<sup>5</sup> CFU/ml</u>	Quarterly
Total anaerobic bacteria	<u>&lt;10<sup>5</sup> CFU/ml</u>	<u>&lt;10<sup>5</sup> CFU/ml</u>	Quarterly
H2S producers	<u>&lt;50 CFUs/ml</u>	<u>&lt;50 CFUs/ml</u>	Quarterly

It is highly recommended that the program dosing must include alternating biocides and a continuous dispersant. Dosing biocides to be conducted in a minimum of every 3 days.

The program must complement cold lime softening treatment mainly and sulphuric acid for bicarbonate neutralization treatment when lime plant is not available

The supplier is to submit, a full report of the microbiological tests which indicates why the suggested microbiological program will be successful. The report will include the kill tests and other recommendations based on the tests.

.

The program must also include the following: -

- Management, operation and monitoring of chemical dosing. (The dosing system - On line biofilm monitoring and treatment for chemicals shall be supplied by the supplier at the south and north cooling water centre well and have satellite dosing equipment at the strategic unit points as per mutual agreement with the system engineering (example: boiler feed water pump condenser)
- On-line chemical monitoring and recording of the data by the safest means.
- Monitoring the efficacy of the treatment on the cooling water system whenever possible by conducting unit condenser inspection and compile a report when there is an outage.
- Inspection of cooling water towers at determined frequency whereby colour photos shall be used as reference point in the treatment effectiveness (algae growths, bio films)
- Weekly reports of the online data to the contract manager.
- Submission of monthly reports to the Eskom project manager entailing analytical results, effectiveness of the program and chemical dosing concentrations and recommendations from the supplier. The Legionella results will always be submitted as a certificate from accredited laboratory
- The treatment program should be designed to operate at approximately 20 cycles of concentration in the cooling water. Any deviations will be discussed, and a mutually agreeable outcome determined.

### **Dosing and Monitoring:**

The chemical stability of the water shall be monitored with Calcium Carbonate Precipitating Potential index

The following monitoring report should be submitted by the service provider:

- (1) Monthly report on chemical consumption, water analysis including blow-down water volumes
- (2) Monthly report on corrosion rate, scaling rate
- (3) Microbiological count ((total sessile and planktonic Bacteria, legionella and SRB's)
- (4) Cooling tower's pillars visuals
- (5) Operation system details

### **Guarantee**

Any unit (out of five) may go for planned/forced shutdown at any point in time, during that period; service provider shall control/stop the dosing of chemicals accordingly. The cost of chemicals for this period will be managed on actual use basis. The above shall be coordinated with Eskom project manager and engineer in charge.

The service provider shall clearly indicate the dosing rate of chemicals. If the contractor is in position to reduce the dose rate the balance quantity of chemicals as supplied/contracted shall be retained by Duvha P.S.

## **Cooling water system material of construction**

The water touched base material of construction is composed of the following:

- Concrete
- Stainless steel
- Mild steel
- Admiralty Brass
- Copper nickel
- Titanium

**Chemicals supplied must not affect the materials of construction within the CW system**

## **Guarantee**

The contractor should guarantee the following parameters.....

(On 30 days exposure)

- (1) Cumulative corrosion rate on MS : < 3.0mpy
- (2) Cumulative corrosion rate on SS : < 0.1mpy
- (3) Cumulative corrosion rate on Admiralty Brass : < 0.3mpy
- (4) Condenser Cleanliness factor of greater than 83%
- (5) Total Planktonic Bacterial Count(TBC) : <1.0 X 10<sup>5</sup> colonies/ml
- (6) Total sessile bacteria count : <1.0 x 10<sup>6</sup> colonies/ml
- (7) Sulphate Reducing Bacteria(SRB) : <50 colonies/ml
- (8) Cumulative Scaling Rate : < 15mg/dm<sup>2</sup>/year
- (9) Deterioration of heat transfer co-efficient shall not be more than 5% of the design value.
- (10) Selected heat exchangers and pipe lines shall be subjected to physical inspection on monthly basis if possible. During inspection, indications of scale, fouling and corrosion over and above the initial condition shall not be present.

The above performance of chemical treatment programme shall be monitored by using a corrosion test coupon rack, scale deposit monitor and bio-fouling monitor or similar on-line monitor. (Sessile samples are collected from on-line monitors, either Robbins Devices or Biological On-line Micro Monitors (BOMMs)

### Cooling water system details:

The system details for the cooling water system are shown below. If any further details are required the contractor may request the information from the contract manager.

	Parameter	Details
(1)	Station Capacity	5 X 600MW units
(2)	Cooling Tower make	Hamon Sobelco (with LTA construction-civil subcontractor)
(3)	Cooling Tower type	Evaporative Cooling
(4)	Handling Capacity	45 000 M <sup>3</sup> /hr per unit
(5)	Inlet Hot Water Temperature	53 <sup>0</sup> C
(6)	Outlet Cold Water Temperature	22.5 <sup>0</sup> C
(7)	Wet Bulb Temperature	11.05 <sup>0</sup> C
(8)	Dry Bulb Temperature	15.45 <sup>0</sup> C RH 61.4%
(9)	Cooling Range	16.94 <sup>0</sup> C
(10)	Cooling Approach	N/A
(11)	Metallurgy of condenser tubes	Admiralty brass,CuNi-90/10
(12)	Metallurgy of other condenser system	Water box and others made of S.S.and M.S.

Hyperbolic natural draught Cooling Towers-, .....

Parameters	Towers 1-3	Towers 4-6
Height	133.7 M	147 M
Pond diameter	99.7 M	113.5 M
Over all dimensions	51.4 M	56.5 M
Diameter at top	55.25 M	60.85 M
Minimum shell thickness	180 mm	180 mm
Nominal flow rate/CT	45000 m <sup>3</sup> /hr	48800 m <sup>3</sup> /hr
Temperature In	39.44 <sup>0</sup> C	34.70 <sup>0</sup> C

Temperature Out	22.50°C	19.10°C
Evaporation at duty point	1270m <sup>3</sup> /hr	1270m <sup>3</sup> /hr
Nominal heat rejection	886 MW	886 MW
Maximum guaranteed Heat rejection	1275 MW	1275 MW

The following residual levels of inhibitors/chemicals are to be maintained in the system. Suitable site analysis must be adopted and the requisite instruments, laboratory requisites and (reagents/chemicals) and personnel and are to be maintained at the site:

Sl.No.	Parameters	Range
(1)	pH	7.5 to 8.5
(2)	Residual Zinc as Zn	Minimum 1.0 ppm
(3)	Residual Orthophosphate as PO <sub>4</sub>	Minimum 6.0 ppm
(4)	Residual Organophosphate as PO <sub>4</sub>	Minimum 3.0 ppm
(5)	Residual Total Phosphate as PO <sub>4</sub>	Minimum 9.0 ppm
(6)	Residual Azole	Minimum 1.0 ppm
(7)	Biocide residual (chlorine dioxide/ isothiazalone)	As per dosing regime.

#### **Requirements and responsibilities of the service provider:**

- The supplier is to provide dosing equipment and monitoring systems ensuring that they are 100% available and reliable.
- Equipment failures must be rectified by the supplier within 24 hours of being notified of the problem.
- The supplier must conduct a minimum of weekly plant visits to ensure tank levels and dosing equipment is fully functional.
- During the contract period the service supplier shall deploy their operating personnel to operate and monitor the complete system. Operating personnel should be trained for trouble free operation of the treatment programme.
- The contracted supplier should also have a site technician in charge of day-to-day activities and liaising with the Eskom representative

- In addition, the service provider must have a technical expert from product manufacture to advise the client representative as and when required to ensure the proper operation of the programme to meet the specified guarantees.
- The supplier must install or utilise on-line equipment for monitoring of sessile bacteria proliferation and biofilm formation. This equipment must be readily inspectable.
- The supplier must be able to supply a bio dispersant which should be dosed continuously with the supply of dosing pumps and other equipment
- **The supplier must provide a potable platform for cooling water chemical storage which have a deep tray underneath to contain any spillage**
- All generated analytical results to be used for the monthly report must be carried at an accredited laboratory
- Monthly reports must be submitted to the project manager by the fifth working day of the month
- The contractor shall submit a Test Certificate of each lot of chemicals supplied. The contractor should also provide the analytical procedure to verify the parameters of test certificates.
- The supplier will ensure that the chemicals supplied do not affect the materials of construction within the CW system (e.g. concrete, rebarring, heat exchanger tube metals (eg. titanium, brass), stainless steel or mild steel).
- Transportation of chemicals, its loading, unloading, storage and handling at site will be the responsibility of the service provider
- During the contract period the service supplier shall deploy their operating personnel to operate and monitor the complete system. Operating personnel should be trained for trouble free operation of the treatment programme.
- The contracted supplier should also have a site technician in charge of day-to-day activities and liaising with the Eskom representative.
- An inspection report to be submitted to Duvha Contract Manager for acceptance and approval before chemical adjustment are conducted.

### **Liquidated damages / Trial Period**

Initially the programme will run with chemical dosing as the initial quoted dose rate. After one month the corrosion and biofilm coupons will be tested and corrosion rate will be evaluated. In the case of failure, in any parameter, the dose rate will be modified for a further month. At the end of the second month the parameters will again be evaluated and if successful the programme will continue and will be deemed successful.

In the case that the programme for the second month failed, the service provider will be afforded four months, to modify the programme. If at the end of six month from the initial start date of the contract and the program has been evaluated and found to be unacceptable, the contract will be terminated on account of unsuccessful completion.

A final report of the trial shall be submitted to the Duvha contract manager for acceptance and approval. This must include pictures of the site condition before and after.

### **Support and application knowledge**

The contractor must ensure that Duvha personnel are keep to date with latest technologies and innovative procedures and with the best and latest technologies so that the station can align with the power industry and be globally bench marked

This will include the following:

- Training for Duvha personnel
- Update on national and global conferences
- Direct link to technical consultants around the globe to assist in problem solving
- Access to a global library on all industrial cooling water matters (various processes and effluent challenges)
- Sharing in global best practices in the power industry and latest developments
- 

### **Constraints on how the Contractor Provides Works**

- **Time constraints or delays in terms of plant availability can be expected, due to operating production requirements. These delays will be communicated to the contractor by the contract manager or employers representative.**
- **Work will be performed in a dusty and noisy environment, on high platforms, confined spaces and in open environment.**

### **Services and Equipment**

- **Free electricity and water will be supplied by Eskom Holdings Limited. The Employer will provide 220V and 380V existing socket points for use by the Contractor.**

#### **1. Management of work done by Task Order**

The *Service Manager* issues a Task Order to the *Contractor* which specifies clearly the work to be provided, additional specifications and procedures and any other constraints the *Contractor* complies with in providing the Works. The Task Order is issued before the *Contractor* Provides the Work.

The *Service Manager* issues Task Orders to the *Contractor* in a timely manner that allows the *Contractor* to properly plan the work within the time periods stated on the *Task Order*.

The *Service Manager* issues to the *Contractor* any information relative to the *Employer's* need and circumstance surrounding forecast future work required from the *Contractor*. This information allows the *Contractor* to provide staff in a cost effective and efficient manner.

#### **2. Health and safety, the environment and quality assurance**

##### **1.1 Health and safety risk management**

The *Contractor* shall comply with the health and safety requirements contained in Annexure B (SAS0012 rev 6) to this Service Information.



## 1.2 Plant Safety Regulations

- a) *The Employer* shall, on request from the *Contractor*, isolate required plant from all sources of danger as described in the Plant Safety Regulations.
- b) *The Employer* shall, on request, make available a copy of the latest revision of the Plant Safety Regulations available to the *Contractor*.
- c) The Contractor shall conform to all the rules and regulations applicable to Plant Safety and shall complete the Worker's Register prior to working on the plant.
- d) The *Contractor* shall have as a minimum at least two people authorised as a Responsible Person in terms of the Eskom Plant Safety Regulations to take out permits to work on the CW system within six months from the *contract start date*.

## 1.3 Environmental constraints and management

The *Contractor* shall comply with the environmental criteria and constraints stated in Annexure B (SAS0012 rev 6) to this service information.

## 1.4 Security arrangements

- 1.4.1 The *Contractor* applies for temporary access permits (Contractor's permit) at the security gate. The *Contractor* personnel shall be required to be in possession of a Contractor's permit at all times. Access permits for vehicles will be issued only for permanent site crew.
- 1.4.2 All *Contractor* personnel shall be issued with a temporary access permit (Contractor's Permit) which will contain the following information:
  - Name
  - ID number
  - Company
  - Validity date