Eskom	Instructions	Hendrina Power Station

Delivery of Coagulant and Flocculant Chemicals for a Period of 5 Years at Hendrina Power Station

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Title: **Scope of Work for the Supply and**

CONTENTS

1. Introduction

Chemicals are used at Hendrina Power Station for a wide range of reasons including but not limited to treating of water throughout the energy generation process. The availability of such chemicals is important in energy generation. It uses demineralized water to produce steam which turns the turbine and produce power. The demineralized water produced needs to undergo through pre-treatment process to remove turbidity and TOC to prolong life span of the resin installed in the Cation, Anion and Mixed bed vessels and consequently prevent fouling, erosion, scaling and the corrosion of the turbine and boiler plant.

Hendrina Power Station is a fossil fired power generating utility producing a generated capacity of 2000 MW. Each unit consist of condenser (heat exchanger), for steam cooling and condensing to condensate water that return to boiler feed water for steam generation again, the process is a continuous cycle.

The cooling system is supplemented with concentrated cooling water (CCW) from the open cycle evaporative cooling Tower system. The condenser uses cold-cooling water (FROM COLD DUCT) to cool down and condensate the steam, and the hot-cooling (FROM HOT DUCT) water will then be pumped to the cooling tower for heat loss and cool down to ambient temperature, and return to the condenser, this process is a continuous cycle. This operation causes a concentration of salts within the cooling water system. This salinity in conjunction with high hydroxyl alkalinity (high pH) renders this water highly scale forming (mainly calcium carbonate) sometimes called Precipitation fouling. Of which under hot temperature condition the calcium carbonate precipitates in all plant heat exchangers and scaled up the heat exchangers tubes, thus reducing the effectiveness of heat exchanging and this promotes plant equipment under performance resulting in plant load losses.

The other cooling water regime, program required is the Flocculation process, whereby all suspend matter is being bind together chemically to aid in settling and being removed out of the system by means of b/downs (Turbidity is being measured and controlled). Turbidity in cooling water is usually a function of the presence of silt, clay, sand, pulverized fuel ash, coal dust, precipitated salts, and algae. The source of these suspended particles is the make-up water(s), internal micro-biological growth or dust particles scrubbed from the air being supplied to the tower.

Suspended matter causes fouling of pipework, heat exchanger surfaces, cooling water packings and drift eliminators. Fouling of heat exchange surfaces results in inefficient heat transfer and increased microbiologically induced corrosion (generally anaerobic)

Siliceous suspended matter can also give rise to erosion / corrosion of pump internals, volutes, heat exchanger tubing and pipework. The most abrasive particles are sand and grit.

Suspended materials can also co-precipitate with calcium carbonate and calcium sulphate.

The limit for turbidity has been specified as < 100 FTUs. Generally, the turbidity should be controlled. During flood conditions the turbidity of raw water supplies can rise dramatically over a period of a few days. During these periods, stations may well depend on their reservoirs to supply water until the turbidity subsides.

2. Supporting Clauses

2.1 Scope

This document describes the technical requirements for the supply, delivery of Water Treatment Plant and cooling water system chemicals, and Pre-treatment optimization for a period of 5 years at Hendrina Power Station.

The scope covers the supply, delivery of bulk chemicals for water treatment plant (coagulant and flocculant) and chemicals for cooling water system process for the flocculation control in cooling water system. The supplier must make sure that the chemicals must not run out on site and the plants must have enough chemical stored for back up or emergency use.

This document covers the supply and delivery of the following treatment chemicals:

- Supply, deliver, install, commission, and maintain dosing equipment suitable for Water treatment plant, raw water Pre-treatment optimization and cooling water systems chemical process. Supply and monitor the **coagulant and flocculant chemicals for raw water treatment system and flocculant chemicals for cooling water system**.

Purpose

The purpose of the document is to provide guidance and specify the requirement for the sourcing of the chemicals for Hendrina Power Station.

2.1.1 Applicability

This document is applicable to Hendrina Power Station.

2.2 Normative and Informative References

2.2.1 Normative

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

[1] 240-150393224 Pre-treatment criteria guideline (WTP raw water treatment) [2]

240-92139372 Guideline for Managing of bulk chemical deliveries.

[3] 240-55864764 Potable water standard

[4] 240-88257914 Chemistry Guideline for Demineralised Water Production Using Ion Exchange Resins

[5] 240-53113712 Demin Water Production using Ion Exchange Resins Chemistry Standard

2.2.2 Informative

[1] 240-150642762, Generation Plant Safety Regulations [2]

ISO 9001 Quality Management Systems.

[3] Handling of hazardous substances

[4] Occupational Health & Safety Act

[5] SANS 241-1:2015

[6] SANS 50881- Chemical used for treatment of water intended for human consumption – aluminium chloride hydroxide (monomeric) and aluminium chloride hydroxide sulphate (monomeric)

[7] SANS 51409 - Chemical used for treatment of water intended for human consumption – Polyamines.

2.3 Definitions

Definition	Description
System	An integrated set of constituent pieces that are combined in an operational or support environment to accomplish a defined objective. These pieces include people, hardware, software, firmware, information, procedures, facilities, services and other support facets

2.3.1 Classification

Controlled Disclosure: Controlled Disclosure to external parties (either enforced by law, or discretionary).

2.4 Abbreviations

Abbreviation	Description
HPS	Hendrina Power Station
QCP/QIP	Quality Control Plan / Quality Inspection Plan
PS	Power Station
SOW	Scope of Work
ISO	International Standards Organisation
QCP	Quality Control Plan
OHSA	Occupational Health and Safety Act
BMH	Bulk Materials Handling
L	Litres
Kg	Kilograms
WTP	Water Treatment Plant
NSF	National Sanitation Foundation – An accredited, independent thirdparty certification body that test and certify products to verify they meet the public health and safety standard

2.5 Roles and Responsibilities

System Engineer – Responsible for defining the technical specifications and scope to be executed by the contractor, as well as ensuring that sound engineering practice is followed, and quality work is delivered.

Contract Manager – Responsible for the procurement document(s) required to establish a contract with the contractor deemed capable of executing the scope.

Contractor – Responsible for providing all the services required for the execution of the full scope of work.

2.6 Process for Monitoring

2.7 Related/Supporting Documents

3. Scope of Work

3.1. Detail work description for water treatment plant, raw water pre-treatment optimization chemicals (coagulant and flocculant).

Supply and monitor the coagulant and flocculant treatment process. Technical performance of the chemical treatment must maintain the Total organic carbon (TOC) percentage removal of greater than 40% and Turbidity (NTU) of <2 across the clarifiers. Both chemicals must be dosed separately. Both chemicals must not have negative impact on the demineralized plant resins and the flocculation chemical for water cooling system.

Table 1: **Raw water chemistry for water treatment data**

Parameter	Concentrations
pH	7.5 to 8.7
TOC	3.7 to 7 ppm
Conductivity	184 to 200 µS/cm
Turbidity	10 to 20NTU

Dosing Regime:

- Both chemicals Coagulant and Flocculant dosing to be continuous.
- Provide Certificate of analysis and Material Safety Data Sheets (MSDS) with every delivery
- Add a clearly visible MSDS label in front of the tanks.
- Ensure continuity of treatment from start of contract up to end date as decided by Hendrina
- Be available 24hrs/day for any technical back-up assistance on emergencies that might be needed. Perform Jar Test monthly, as monitoring control for the effectiveness of the clarification turbidity and TOC removal
- Should a spillage occur during off loading, such a spillage shall be cleaned by the Contractor before end of business the same day.
  Ensure an uninterrupted supply of chemicals to meet the 100% availability of treatment. No down time due to chemical supply.

Ensure the use of Accredited and Recognised laboratory, for measurements and reporting is utilised at your disposal.

- The chemical qualities of the cooling water, both physical and chemical.
- Performance criteria/program to control clarification turbidity removal under limits
- Conduct a base line study within the first week of contract award inspecting relevant dosing system points for current and existing condition.
- A full report of all chemical's performance must be submitted to Hendrina section Supervisor.
- Recommend and identify the most effective dosing regimen to achieve best maximum performance.
- Supply proper and suitable offloading facility/equipment for bulk chemical transfer.
- Provide training to the Hendrina staff on how to operate and do fault finding on the dosing plant.
- Preform and conduct onsite test and plant adjust the chemical dosing accordingly. (e.g., Clarification jar test etc.)
- Supply all safety equipment applicable to the process and where necessary/not available.
- Always comply with safety standards around the dosing stations.

NOTE: The chemical shall comply with the NSF, And it shall be registered in the database (NSF database)

3.2 The Contractor shall supply flocculant for the Cooling Water clarification process. The Contractor shall optimise the dosing of the flocculant for each side of the CW system (CWN and CWS) and the lime at the South Sedimentation plant.

Table 2: Quality of the Cooling Water (Chemistry Specification)

Parameter	**Limit or Range**
Turbidity	< 100 NTU
Clarifier turbidity	<15 NTU
Conductivity	< 4000 uS/cm
pH	8.1 - 8.6 at 25 º C
P Alkalinity	< 7.5 mg/kg as CaCO3
M Alkalinity	80 - 120 mg/kg as CaCO3 without a crystal modifier **120 to 160 mg/kg as CaCO3 with a crystal modifier**

Calcium	200 - 500 mg/kg as CaCO3
Magnesium	Mg (as CaCO3) x SiO2 <25 000
Silica	<150 mg/kg as SiO2
Permanent hardness only when Tot hard > M Alk	< 400 mg/kg as CaCO3
Calcium carbonate precipitation potential at 38degC	> 10 but < 30 mg/kg as CaCO3
Sulphate (note Na limit)	< 1000 mg/kg if Na+ < 250mg/kg
Sulphate (note Na limit)	< 750 mg/kg if Na+ > 250mg/kg
Phosphate	< 0.5 mg/kg as PO4
OA and COD or TOC	As low as economically possible through application of suitable flocculants
Chloride	< 400 mg/kg as Cl
Nitrate and Nitrite	Not specified
Sodium	< 500 mg/kg
Potassium	Not specified
Copper, Zinc, and Iron	Not specified
Ammonia	< 40 mg/kg as NH_4

Note: Lime softening treatment (South) and Sulphuric Acid (North) is applied for the cooling water chemistry control. The proposed treatment program SHALL not impede this chemistry limits. (as in Table 2)

The scope includes the following:

1. Perform flocculant selection tests (Jar tests) and provide detailed report with recommendations for the treatment program for acceptance by the Employer. The proposed treatment programme shall take into consideration optimal dosing of both the flocculant and the lime for turbidity and alkalinity control.
2. Execute jar tests, as per the ASTM standard procedure, on each delivery interval and optimise the dosing of the lime and flocculant for CWS and flocculant for CWN.
3. Adjust poly (flocculant) dosing to give the determined concentration considering the CCW flows. Conduct pot drop tests to confirm that the dosing pump is discharging the correct amount of chemical as per dosing rate that has been set.

4. The dosing program shall achieve and maintain performance as specified in CW chemistry standard for the clarifier outlet and the main CW system as specified in table 5 below.
5. The dosing chemical should be in the liquid form and should not cause any damage or blockages in any parts of the Cooling Water and distribution systems.
6. The product must be adaptable to seasonal changes, effective to improve the system stability and comply with the target values as stipulated according to the Cooling Water specifications captured in Table below.
7. The chemical name together with the active ingredients and concentrations must be specified.
8. A detailed 16-point Safety Data Sheet (SDS) shall be provided upon delivery. Contact details to be used in the event of an emergency (include a telephone number) must be provided.
9. The supplier must provide a Certificate of Analysis (COA) that includes but is not limited to colour, pH and specific gravity.
10. All drums and tanks of chemicals must be labelled as a minimum with the chemical name, shelf life or expiry date, the appropriate hazard warnings, and identification of respective manufacturer.
11. Chemical to be delivered in Original Equipment Manufacturer (OEM) containers and no repackaging allowed.
12. The supplier must provide a technical knowledge transfer to the site technicians and chemist on the management and control of the treatment regime.

Table 3 Cooling water clarifier specifications to be achieved.

Parameter	Units	Spec	Target
Outlet pH		9.5 - 10.2	9.5 - 10.2
Sludge	%	<15	<8
Turbidity	NTU	<15	<10
Turbidity Removal	%	>85	>98
Clarifier Outlet Alkalinity	PPM	2P=M	2P=M

4. Chemical specifications

The table below is the list of the chemicals to be supplied and their specifications as well as the estimated quantities for the duration of the contract.

Material No.	Short Description	Long Description	Quantity
0209529	CHEMICAL: CHLOROHYDRATE COAGULANT; LIQUID (RAW WATER)	CHEMICAL: TYPE: ALUMINIUM CHLOROHYDRATE (ACH) COAGULANT; FORM: LIQUID; CONTAINER CAPACITY: 10 T; CONTAINER: TANK BULK; CHEMICAL SHOULD NOT ADD CHLORIDES AND SULPHATES; BLENDS ARE NOT ACCEPTED; CHEMICAL IS EFFICIENT; PH3-4.5; ALUMINIUM PCT/MM; 12-13PCT; SPECIFIC GRAVITY 25DEG: 1.4; VISCOSITY: 10-50CPS; FOR USE ON WATER TREATMENT PLANT	700 000L
0157272	CHEMICAL: POLYAMIDE; FLOCCULANT/LIQUID (RAW WATER)	CHEMICAL: TYPE: POLYAMIDE; FORM: FLOCCULANT/LIQUID; CONTAINER CAPACITY: 5 T; CONTAINER: TANK BULK; COLOR: YELLOW TO CLEAR; PH: 5-7; SPECIFIC GRAVITY: 1.037-1.052; VISCOSITY: 200-600CP; CHEMICAL SHOULD NOT ADD CLORIDES AND SULPHATES; BLENDS ARE NOT ACCEPTED; FOR USE ON WATER TREATMENT PLANT	30 000L
0210434	FLOCCULANT CHEMICAL: LIQD (COOLING WATER SYSTEM)	CHEMICAL: TYPE: POLYFLOC CATIONIC POLYELECTROLYTE: FORM; LIQUID; CONTAINER; TANK BULK; FOR COOLING WATER SYSTEM TREATMENT	550 000L

4.1 Effective Date

This document will be effective from the date that the contract is authorised.

5. Requirements

5.1 Handling and Transportation

5.1.1 Employer's requirements for the service of supply and deliver water treatment plant, raw water pre-treatment chemicals (coagulant and flocculant)

- Supply and delivery of the Water treatment Chemicals Flocculant and Coagulant dosing.
- Chemical treatment to maintain the Total organic carbon (TOC) percentage removal of greater than 40%
- Raw water- Clarifier outlet Turbidity (NTU) of <2 across the clarifiers and CW <15NTU across the clarifiers
- Both chemicals must be dosed separately (split dosing)
- Perform Jar Test monthly, as monitoring control for the effectiveness of the clarification
- Provide Certificate of analysis and Material Safety Data Sheets (MSDS) with every delivery
- Technical back-up assistance on emergencies as and when required.
- Blended chemicals shall **not** be accepted.
- The Pre-treatment chemicals shall comply to NSF.
- The *Contractor* takes into consideration the cooling water quality and makes provision in his/her selection of chemicals for any species that may cause interference in the action of the proposed chemical treatment programme and remains responsible for the performance to the specifications specified in this document.
- The treatment chemicals offered must be proven to be effective to improve and keep the system stable and the conditions complying with the relevant Eskom Standard limit values.
- The treatment chemicals must be adaptable to system changes e.g., variation in water quality and temperature and seasonal (winter/summer)
- The cooling water chemistry must be compliant with the Eskom Standard with the limits as indicated in the table above.

5.2 Handling and Transportation

The contractor is expected to practice safe handling techniques during the onloading, offloading, and throughout the transportation of the chemicals, if necessary. The Employer's representative will not accept any damaged items upon delivery.

Should the delivered chemicals be found to be defective or out of spec, the contractor remains responsible for the handling and transportation in the replacement process of the item(s). No cost reimbursement for defective products or transportation

5.3 Other requirements

- Ensure continuity of chemical treatment from day one of contract start date to contract end date or as decided by Hendrina Power Station.
- No down time due to chemical supply shall be accepted.
- Supply standard operating procedure for the dosing plant.
- Supply all safety equipment applicable to the process and where necessary/not available.
- Always comply with safety standards around the dosing stations, (e.g., with people and the environment. Zero spillages shall be maintained, should a spillage occur, such a spillage shall be cleaned by the Contractor before end of business)
- Be available 24hrs/day for any technical back-up assistance that might be required.
- Ensure the use of Accredited laboratory, for measurements and reporting.

5.4 Safety Requirements

The Contractor is to comply with the latest revision of the Eskom Generation Plant Safety Regulations, site specific procedures, and stipulations of the OHS Act.

5.5 Documentation to be Submitted by the Contractor

The following documents must be submitted with every delivery:

- Material data sheet as per OHSA requirements.
- Certificate of analysis.
- Weigh bridge certificate confirming the quantity delivered (Payment will be based on the results from the Eskom weighbridge unless not available).
- The delivered chemical should be labelled with the name and chemical spec as per the MSDS.

5.6 Quality Assurance Requirements

The Contractor is to be responsible to record and archive all off-site, factory tests and on-site tests.