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PLANT AREA: Matla Power Station

TITLE: Scope of Work for supply and delivery of scale and corrosion prevention chemicals for Matla Power Station Ash water systems, Auxiliary Cooling water systems and Main Cooling Water systems on an as and when required basis for a period of 5 years

REF: MEP - 051318	Reference Rev No:1	MULTIDISCIPLINARY: No	Plant Level: All

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GENERAL

- Data books, reviews, reports and diagrams/drawings shall be submitted to Engineering after the completion of the work Engineering to forward the data books to Quality Department (Document Control)

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- Data books, reviews, reports and diagrams/drawings shall be submitted to Engineering after the completion of the work Engineering to forward the data books to Quality Department (Document Control)
- All QCP's to be submitted to Engineering and Quality for approval prior to outage/project or maintenance work commencement

	SCOPE OF WORK DESCRIPTION / ACTIVITY	PROCEDURE, SPECIFICATION, ENG. REQUIREMENTS / DOCUMENTATION	HOLD POINTS, WITNESS, REPORTS	RESPONSIBLE PARTY
1.1	Safety	• All work is to be done in accordance with Matla plant procedures and safety regulations (GGR 0992) • Matla power station induction must be done before any work commences • Permit to work must be in place before any work commences • Worker's register must be completed and daily risk assessment conducted before any work commences	Eskom to witness	Contractor
1 2	Environmental Management	• All activities listed in the National Environmental Act 107 of 1998, EIA Regulations as amended, must have environmental **AUTHORISATION** before commencement of work • The contractor shall comply with all applicable legal and other requirements • The polluter pays principle will be applied • The contractor manager shall ensure compliance with Eskom Matla Environmental procedures to ensure the prevention of pollution (refer OMOP 4090 and 4402) • The last payment will be processed based on the status of the last housekeeping check sheet (Annexure C· OMOP 4402) of designated area. • EMS file based on ISO14001 will be required.	Eskom to witness	Contractor

1 3	Quality Management	• The contractor/executioner of work will be responsible for drawing up all QCP documentation and this must be approved by engineering and authorised by the Quality Department before commencing with the work. • Contractors/executioner to adhere to QM 58 and OMOP4497 requirements • Number of NCR issued can affect your next tendering process • The QCP shall be signed progressively by the Engineer/Supervisor, Eskom QC Inspector, Contractor QC Inspector and/or AIA. • No procuring of outage items without the approval of scopes by quality • All outage scopes creep and scopes addition should be approved by quality • No contractor should be in the possession of scopes for execution without the scopes approved by quality • The contractor is subjected to quality auditing at any point in time during execution of scope	Hold point	Contractor
1 4	Inputs from other departments			
1 5	Commissioning reference			

	SCOPE OF WORK DESCRIPTION / ACTIVITY	PROCEDURE, SPECIFICATION, ENG. REQUIREMENTS / DOCUMENTATION	HOLD POINTS, WITNESS, REPORTS	RESPONSIBLE PARTY
1	**SYSTEMS DESCRIPTION**			
1.1	**SYSTEM INFORMATION**			
1.1.1	**ASH WATER SYSTEMS** **REQUIREMENT: SCALE INHIBITOR** Scale inhibitors are used in the prevention of $CaCO_3$ scale are the polymeric inorganic phosphates This class of compounds includes the salts of pyrophosphates, tri-polyphosphates and hexametaphosphate At dosage levels of 1,0 mg kg-1 these products inhibit the crystallisation of CaCO3 crystallites by suppressing both nucleation and crystal growth The number of pumps and estimated system flow rates where dosing should occur on the suction side of the pumps are as follow Final Cut 2 X 700m³/hr (1016 4ml/month) SWR 2 X 2000m³/hr (2904 4ml/month) 3 X 1000m³/hr (2178ml/month) AWR 2 X 720m³/hr(500 ml/month) **Note:** Dosing rates must be based on this volume			

	The dosing infrastructure available for the specified systems are as follow Final Cut 1 x Dosing Tank 3000 Litres 2 x Dosing Pumps SWR 1 x Dosing Tank 3000 Litres 5 x Dosing Pumps AWR 1 x Dosing Tank 2500 Litres 4 x Dosing Pumps **Note:** All dosing and other monitoring equipment are to be supplied on loan and maintained by the supplier for the duration of the contract if needed The Ash water quality is provided in Appendix A			
1.1.2	**AUXILIARY COOLING WATER SYSTEMS** **CLOSED SYSTEMS INFORMATION: DEMIN WATER COOLING** **REQUIREMENT: BIOCIDE AND CORROSION INHIBITOR** Closed recirculating systems should have very little water loss and continuously recirculates the same water The heat absorbed from the heat transfer equipment is dissipated to			

	another heat sink Because there are no evaporative losses and provided that the system is operated correctly, make-up water is minimal and the mineral content remains essentially constant However, corrosion by-products can easily accumulate and foul heat transfer equipment Biocides not compatible with closed systems Dodecylguanidine hydrochloride contributes 3 mg kg^{-1} to 7 $mg.kg^{-1}$ chlorine at typical application rates of 25 mg kg^{-1} to 50 mg kg^{-1} Carbamates can attack copper alloys and precipitate iron Carbamates are more applicable to open recirculating cooling water systems Quaternary ammonium salts (Quats) contribute to the chloride concentration of the system. No specific contribution can be listed as a result of the extent of formulations available Chlorine cannot be applied to close cooling water system (with demineralised water makeup) as result of the chloride contamination Chlorine, however, remains a good biocide for open evaporative systems provided the system pH is within the most effective range for chlorine But safety issues have limited its use Corrosion control requires knowledge of the metallurgy of the system, an understanding of the susceptibility of the metals to corrode under the operating conditions encountered, and an understanding of the limitations of the specific corrosion inhibitors applied Principal economic advantages for the use of corrosion inhibitors in cooling water stem from two sources, namely, a they reduce the frequency of maintenance and inspection shut-downs, and			

b they permit more extensive use of iron and carbon or low alloy steels

The systems volumes are as follow

Systems	Volume (m^3) approx. volumes	Number of Units
Auxiliary Cooling	30	6
Chiller Plant	1	6
Aircon Chiller - Head tank	10	1
Compressor (Slurry Plant)	1	1

1.1.3

OPEN SYSTEMS INFORMATION: POTABLE WATER COOLING

REQUIREMENT: BIOCIDE AND SCALE INHIBITOR

Open recirculating cooling system continuously re-uses the water that passes through the heat transfer equipment Evaporative cooling to the atmosphere expels the unwanted heat transferred to the cooling water. Open recirculating cooling systems are oxygen saturated and may contain a high level of dissolved solids These factors can significantly affect the build-up of deposits and deterioration of the heat transfer equipment. The Auxiliary Cooling water specifications are included in Appendix B

1.1.4	**MAIN COOLING WATER SYSTEMS** **REQUIREMENT: CRYSTAL MODIFIER** Organic polymers have also been found to have effective calcium carbonate scale prevention properties These include polycarboxylytes, such as polyacrylates, polymethacrylates, polymaleates, and their copolymers Dose rates are in the order of 2,0 mg kg^{-1} to 4,0 mg kg^{-1} The polymers adsorb on to the $CaCO_3$ crystal structure, limiting the growth of $CaCO_3$ and ultimately limiting scale formation These polymers are more frequently considered dispersants They retard $CaCO_3$ scale by maintaining small particles of distorted crystalline material in suspension South system volume = 47 ML North system volume = 47 ML Blowdown volume = 4 ML/D per system (at MCR) Average raw water make-up = 60 ML/D per system (at MCR) CoC (based on K) = 16 Cooling water Temperature range 0 – 45 °C The cooling water is circulated at a maximum flowrate of 14.36 m^3/s (South CW system) or 13 m^3/s (North CW system), through the condensers and back to the cooling towers The flowrate is dependent on the number of CW pumps running (max 6 pumps per system), which is dependent on the number of operating units on-load The system has the following materials of construction			

	Deformed H T reinforced concrete (Class A, B & C), Carbon steel, Mild steel, Cast iron, Titanium condenser tubes, Brass condenser tubes, Polygrid splash on South Cooling Towers and flat asbestos-cement sheets on North System Other chemicals dosed in system Lime (Calcium hydroxide), Flocculent & Coagulant The chemical constituents of all dosing chemicals will be communicated during contract phase The Main Cooling Water specifications are included in Appendix C			
2 2.1 2.2	**DETAILED REQUIREMENTS** Supply and delivery of chemicals to scale/corrosion prevention chemicals for all the 3 mentioned systems The contractor is to supply and maintain their own dosing system on site (Pumps, tanks, pipelines, etc) where needed Supply and delivery of the best suited biocide for the Auxiliary Cooling Water Systems Biocides to be used as little as possible in the system Caution must be taken against excessive foaming at the air extraction zones An anti-foam chemical should be available and dosed in order to prevent excessive foaming	Biocide efficacy test of dosing for the biocides should be provided, an acceptable kill rate will be 99 99% of total planktonic bacteria within the system, after optimal time for the biocide used The minimum efficacy is 99 99% kill at the optimal kill time for the biocide These results must be reported to the PS regularly. Bacterial counts to be constant / decreasing – (to be done on a monthly basis) Visual inspections algae growth to be		

		minimized – (to be done on a two weekly basis and a report generated) Legionella counts 10^1 - 10^2 / Litre – (to be done quarterly)		
2.3	The supplier should recommend and install appropriate online monitoring systems, where applicable, for the monitoring of scale formation (main cooling water system and open auxiliary cooling water system), corrosion rate (closed auxiliary cooling water system) and monitoring of sessile bacteria proliferation and biofilm formation (open and closed auxiliary cooling water systems) The online monitoring systems will provide valuable feedback on the effectiveness of the suppliers proposed treatment regimes			
2.4	Water sample from the station should be taken on all the mentioned systems and laboratory tests should be conducted to establish which chemical (based on the active ingredient) is most suitable for Matla Power Station system water type/chemistry and a feedback report must be generated and included in the enquiry document. The chemicals must be effective to improve and / or keep system in stable condition complying with the applicable Eskom Standard's specification values as per the Appendix's	The tender documents must contain an analysis of the existing chemistry conditions of the systems with a predictive dosing model which will demonstrate the best suited chemical and optimal dosing rate in order to prevent scale formation/prevent corrosion and prevent microbiological fouling on the mentioned systems The result must indicate the proposed chemical/s together with the active ingredient and the concentration of the active ingredient The recommended dosing rate, concentration to be dosed and the treatment price as Rand per Mega Litre (R/ML) of ash water treated Additionally, a method in which the dosage will be monitored and controlled should be outlined as well as a method by which residual chemical in the system can be determined		

2.5	The supplier should submit a report outlining the optimal treatment regime for all the mentioned systems to meet the specified scaling limits, corrosion prevention limits and bio-control limits	The proposed chemicals should not cause any damage or blockages in any parts of the water systems and should be compatible with the chemicals already dosed in these systems The supplier will ensure that the chemicals supplied do not affect the materials of construction for any of the mentioned systems		
2.6	The supplier service must compile a monthly report on the effectiveness of the proposed dosing regimes Changes to the dosing regimes should be implemented during seasonal changes or in any event where the water quality of a system has changed. The supplier should sample the water from the different systems on a frequent basis to determine if there are any changes to the water quality	The monthly reports should include the following • Quantity of chemicals used • Concentration dosed (ppm) • R/ML for the month • Performance Results • Comments on deviations if any		
2.7	The supplier should provide a detailed 16 points Material Safety Data Sheet (MSDS) with a South African contact number for each chemical to be used The MSDS must state the main active ingredient and the concentration thereof	All chemical deliveries to Matla must be accompanied by a Certificate of Analysis (COA) for each chemical together with a 16 point MDSD/PDS for each chemical		
2.8	All chemical containers shall have an identifying label that includes as a minimum the substance name, shelf life or expiry date, appropriate hazard warnings and identification of manufacturer or distributor			
2.9	Chemicals to be delivered in Original Equipment Manufacturer (OEM) containers, no repackaging allowed			

2.10	All storage tanks of chemicals must be labelled with the name, use and safety information of the chemical. Contact names must be available in the event of a chemical spill			
2.11	The supplier must conduct periodic site visits to ensure that the specified chemicals are being dosed optimally and the desired treatment outcome is achieved. The supplier is expected to give technical backup on the products and their correct application			
2.12	The supplier must carry out plant inspections during outage opportunities and compile a report with the effectiveness of chemicals being dosed as well as suggestions/ recommendations			
2.13	Lead time delivery of chemicals must be within reasonable time period (three days maximum)			
2.14	The supplier should mention all previous work conducted with similar SOW requirements and plant equipment as per Matla Power Station			
2.15	A company and / or supplier's audit to be done quarterly on all installations and / or dosing systems covering all aspects of safety and operational procedural compliance and a report of all findings to be submitted to Matla Power Station			
2.16	The Contractor must provide training / awareness to Matla Power Station's personnel if needed			

BILL OF MATERIAL

	Full description Material/Spares/Equipment	Specifications of Material/Spares/Equipment	Stock No	Part Number	Required Quantity
1	1 x scale inhibitor chemical for the mentioned Ash Water Systems				As per supplier specifications
2	1 x corrosion inhibitor chemical for the mentioned Closed Demin Water Auxiliary Cooling Water Systems				As per supplier specifications
3	1 x scale inhibitor chemical for the mentioned Open Potable Water Auxiliary Cooling Water Systems				As per supplier specifications
4	1 x Biocide chemical for the mentioned Closed Demin Water Auxiliary Cooling Water Systems				As per supplier specifications
5	1 x Biocide chemical for the mentioned Open Potable Water Auxiliary Cooling Water Systems				As per supplier specifications
6	1 x anti-foam chemical to prevent foaming in the Auxiliary Cooling Water Systems after biocide dosing				As per supplier specifications
7	1 x crystal modifier chemical for the mentioned Main Cooling Water Systems				As per supplier specifications
8	All required dosing equipment (tanks, pumps, piping, valves, monitoring equipment)				As per supplier specifications
9	Online monitoring systems, where applicable				As per supplier specifications

APPENDIX A: ASH WATER SYSTEMS

Ash water quality based on 5 years 95th percentile data.

Final cut Chemical Paramenter	Value	Unit
Aluminium (Al)	0.092	ppm
Ammonium (NH4) as N	0 047	ppm
Antimony (Sb)	<0.005	ppm
Arsenic (As)	<1	ppb
Barium (Ba)	0.079	ppb
Beryllium (Be)	<0.005	ppm
Boron (B)	2.182	ppm
Cadmium (Cd)	<0.005	ppm
CaH	1005.2	ppm
Calcium (Ca)	359	ppm
Chloride (Cl)	209.3	ppm
Chromium (Cr)	0.020	ppm
Cobalt (Co)	<0.005	ppm
Copper (Cu)	<0.005	ppm
Cyanide (CN)	<0.025	ppm
E.coli	36	CFU/100 ml
Electric conductivity (EC) @ 25 degrees C	3199.0	uS/cm
EMA	2465.5	ppm
Faecal coliform	39	CFU/100 ml
Fluoride (F)	0.596	ppm
Hexavalent chromium (Cr6+)	0.008	ppm
Iron (Fe)	0.044	ppm

Lead (Pb)	<0.01	ppm
Magnesium (Mg)	49 1	ppm
M-alkalinity	233.4	ppm
Manganese (Mn)	0.169	ppm
Mercury (Hg)	<1	ppb
MgH	673.5	ppm
Molebdenum (Mo)	0.154	ppm
Nickel (Ni)	<0.005	ppm
Nitrate (NO3) as N	0.242	ppm
Orthophosphate (PO4) as P	<0.005	ppm
P-alkalinity	6.8	ppm
pH @ 25 degrees C	8.8	
Phosphorus (P)	<0.005	ppm
Potassium (K)	71.0	ppm
Selenium (Se)	<2	ppb
Silica (SiO2)	15.3	ppm
Silicon (Si)	3.450	ppm
Sodium (Na)	346.2	ppm
Strontium (Sr)	7.210	ppm
Sulphate (SO4)	2209 8	ppm
Total Chromium (Cr)	0.019	ppm
Total coliform	45	CFU/100 ml
Total Dissolved solids @ 180 degrees C	1462.0	ppm
Total Hardness	1541.5	ppm
Turbidity	3.6	NTU
Vanadium (V)	0.073	ppm
Zinc	<0.005	ppm

APPENDIX B: AUXILIARY COOLING WATER SYSTEMS

Cooling water specification for closed systems with demineralised water make-up as per Eskom Chemistry Standard for Auxiliary Cooling Water 240-106192541 Revision 1

Parameter	Units	Limit or range
Turbidity	NTU	<1
pH		In accordance with correct chemical additives concentration
Conductivity	$\mu S.cm^{-1}$	In accordance with correct chemical additives concentration
Inhibitor(s)*	$mg\ kg^{-1}$	In accordance with vendor and or Eskom recommendation
Copper	$\mu g.kg^{-1}$	< 50
Iron	$\mu g.kg^{-1}$	< 200
Oil	$mg\ kg^{-1}$	< 5
System water losses	% loss	< 2 % per week
Total hardness as $CaCO_3$	$mg\ kg^{-1}$	< 5
Dissolved oxygen	$mg\ kg^{-1}$	In accordance with inhibitor requirements

Planktonic bacteriological counts for closed systems with demineralised water make-up as per Eskom Chemistry Standard for Auxiliary Cooling Water 240-106192541 Revision 1

Parameter	Units	Limit or range
Total aerobic bacteria	CFUs/ml	<10 000
Total anaerobic bacteria	CFUs/ml	<1000
H_2S producers	CFUs/ml	<10

Cooling water specification for open systems with potable water make-up as per Eskom Chemistry Standard for Auxiliary Cooling Water 240-106192541 Revision 1

Turbidity	NTU	< 15
pH		8.3 to 8.9
Conductivity	µS cm^{-1}	< 3500
Corrosion inhibitors	mg kg^{-1}	In accordance with vendor and or Eskom *recommendations*
Sodium	mg kg^{-1}	< 500
Potassium	mg kg^{-1}	< 500
Oil	mg kg^{-1}	< 5 / Negotiable
Water losses	% loss	In accordance with evaporation and blow down requirements
M Alkalinity	mg kg^{-1}	60 to 150
Total hardness as $CaCO_3$	mg kg^{-1}	< 500
Calcium carbonate precipitation potential Using Stasolt 4	mg kg^{-1}	< 30 With scale control program < 5 Without scale control program
Copper	mg kg^{-1}	< 500
Iron	mg kg^{-1}	< 500
Chlorides	mg kg^{-1}	< 400
Sulphates	mg kg^{-1}	Poor quality concrete – Stations <1000 mg kg-1 if Na+ < 250 mg kg-1 <750 mg kg-1 if Na+ > 250 mg kg-1 High quality concrete – Stations < 1500 mg kg^{-1} if Na+ < 500 mg kg^{-1} < 1000 mg kg^{-1} if Na+ >500 mg kg^{-1} Note Mg^{2+} to be <160 mg kg^{-1} as $CaCO_3$
Magnesium	Mg (as $CaCO_3$) x SiO_2	Mg (as $CaCO_3$) x SiO_2 < 25 000
Silica	as SiO_2	< 150 mg kg^{-1} as SiO_2 While also taking cognisance of Mg x SiO_2 limitation

The target/specification of the scaling rate is $0.01 mg/dm^2/day$.

Bacteriological counts for open evaporative systems with potable and raw water makeup as per Eskom Chemistry Standard for Auxiliary Cooling Water 240-106192541 Revision 1

Parameter	Units	Limit or range
Total aerobic bacteria	CFUs per ml	< 10 000
Total anaerobic bacteria	CFUs per ml	< 1000
H_2S producers	CFUs per ml	< 10
Legionella	CFU per litre	<100

APPENDIX C: MAIN COOLING WATER SYSTEM

Raw water quality (95th percentile data from Jan 2018 – Feb 2021)

Parameter	Unit	Value
Turbidity	NTU	46
pH		8 6
Conductivity	uS/cm	326
M-alkalinity	mg/kg $CaCO_3$	98
Calcium hardness	mg/kg $CaCO_3$	54
Magnesium hardness	mg/kg $CaCO_3$	59
Total hardness	mg/kg $CaCO_3$	113
Sodium, Na	mg/kg	22
Potassium, K	mg/kg	8
Reactive Silica, SiO_2	mg/kg	15

Chloride, Cl	mg/kg	14
Sulphate, SO_4	mg/kg	47
EMA		60
Organic Acid, OA		13
Langelier Index, LI		0 4
Total Organic Carbon (TOC)	mg/kg	9

Cooling Water quality (95th percentile data from Jan 2018 – Feb 2021)

Parameter	Unit	Value	South CW	North CW
CW Turb	NTU	<100	74	71
CW pH		8 1 - 8 6	8 76	8 81
CW K25	uS/cm	<4000	3340	3430
CW P-alk	mg/kg	<7 5	16	20
CW M-alk	mg/kg	120 - 160	190	191
CW CaH	mg/kg	200 - 500	517	453
CW MgH	mg/kg		335	441
CW TH	mg/kg		750	759
CW Na	mg/kg	<500	489	499
CW K	mg/kg		126	138
CW Cl	mg/kg	<400	370	380
CW SiO2	mg/kg	<150	48	39
CW SO4	mg/kg	<1000	1143	1162
CW Mg*SiO2		<25 000	11769	10336
CW CCPP		10 - 45	64	61

Cooling water specification as per Eskom Chemistry and Microbiology Standard for Cooling Water 240-55864767 Revision 4

Parameter	Unit	Spec	Target
pH @ 25°C		8 1 – 8.6	8.1 – 8 5
Conductivity	µS/cm	< 4000	2800 – 3000
Turbidity	NTU	< 100	< 50
P-alkalinity	mg/kg $CaCO_3$	< 7 5	< 5
M-alkalinity (with crystal modifier)	mg/kg $CaCO_3$	120 – 160	120 – 160 *
Calcium hardness	mg/kg $CaCO_3$	200 – 500	200 – 400
Permanent hardness	mg/kg as $CaCO_3$	< 400	
PO_4^{3-}	mg/kg as P	< 0 5	< 0 5
NO^{3-}	mg/kg as N	1	< 1
SO_4^{2-}	mg/kg $CaCO_3$	< 1000 if Na^+ > 250 < 750 if Na^+ < 250	< 1000 < 750
Cl	mg/kg	< 400	< 400
Sodium	mg/kg as Na	< 500	
Reactive Silica	Mg/kg as SiO_2	< 150	
Mg X SiO_2	mg/kg	< 25000	< 23000
OA	mg/kg	< 20	
COD	mg/kg	< 200	
Ammonia	mg/kg as NH_4	< 40	
Scaling Potential Calcium Carbonate precipitation potential (CCPP) at 38°C	mg/kg as CaCO3 with a crystal modifier	10 - 45	<40

* WITH THE USE OF A CRYSTAL MODIFIER

SCOPE COMPILATION REFERENCES				
SOURCE & Ref No.	Yes	No	N/A	Comments
Previous outage service reports				
Return to service data packages				
Maintenance Strategy with Rev number				
SAP defects (attach list as appendix)				
GHRMS (STEP) reports (Generation Heat Rate Management System)				
Online Condition Monitoring				
Pre-outage performance test results				
Post outage performance test results				
GPSS/ Plant Performance data on UCLF incurred				
OMS / IIRMS recommendations (Audits Reports)				
Risk controls (IRM system)				
Previous audits and reviews (e.g. ERAP)				
Engineering Change Requests (Projects)				
LOPP strategy reports				
URS				
Philosophy (Outage)				
Condition Monitoring Report				

VA/PHD Viewer trends				
Corrective Actions				
CARAB reports				
Statutory Requirements				
Grid code requirements				
Waivers and Exemptions				
Calibration requirements				
Previous Outage SOW variations				
Post Mortems Actions from previous outages				
Pre–Outage plant walks				
Risk based inspection (RBI) report				
Simulation, TOIs, OON, SI				

COMMENTS

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