Eskom	Scope of Work	Tutuka Power Station Chemical Services

Title: **Scope of Work- 24-hour Operation and monitoring of Sewage Treatment Plant (Thuthukani and Tutuka) at Tutuka Power Station**

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Content

1. Introduction

Tutuka Power Station manages two wastewater treatment works mainly Thuthukani and Tutuka Sewage Treatment works. Tutuka waste treatment works receives raw sewage from different areas of the power station and enters the Plant at the inlet work through screw-type strainer. Thuthukani waste treatment works is designed to treat only the wastewater from the nearest area Thuthukani towns, the RDP and the hostel. Thuthukani and Tutuka wastewater treatment works are operated 24/7 a week with an operator, an assistant operator, Safety officer and shift supervisor for each plant in the plant.

Tutuka water use licence governs the management of the Tutuka power station sewage treatment works. The Sewage treatment works are required to comply with the final water quality as well as the minimum monitoring requirements as in the Tutuka water use license.

2. Supporting Clauses

2.1 Purpose

This document provides details scope of work for the wastewater treatment works (Tutuka and Thuthukani) sewage treatment plant. This document includes Tutuka water use licence and guidelines that should be adhered to.

2.2 Applicability

This document shall apply to Tutuka Power Station only.

2.3 Effective date

The effective date will be from the authorisation date.

2.4 Normative/Informative References

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

2.4.1. Normative

[1] ISO 9001 Quality Management Systems

[2] Tutuka Water use license

[3] Sewage Treatment Plant Operating Guideline

[4] ISO 9001: Quality Management Systems

2.4.2. Informative

[1] ISO 14001 Environment Management Systems

[2] National Environmental Management Act (Act 107 of 1998)

[3] 240-62196227: Life Saving Rules

[4] ISO 19458, Water Quality – Sampling for Microbiological Analysis

[5] THE NATIONAL WATER ACT, 1998 (ACT NO. 36 OF 1998) (THE ACT). Published under Government Notice 665 in Government Gazette 36820, dated 6 September 2013.

[6] WATER SERVICES ACT, 1997 Regulations Relating to compulsory national standards for PROCESS CONTROLLERS and WATER SERVICES WORKS

2.5 Definitions

Definition	Description
Activated Sludge	A biological treatment process in which sewage is aerated with a biologically active sludge causing microorganisms to remove pollutants from the sewage.
Algae	Relatively large organisms generally coloured blue-green or green by the presence of chlorophyll. Algae require sunlight for growth.
Denitrification	Is an anoxic process to convert Nitrate to Nitrogen Gas
Escherichia coli (E. coli)	Is a gram-negative, facultative anaerobic, rod-shaped, coliform bacterium. It is found in large numbers in the gastrointestinal tract and faeces of humans and warm-blooded animals. Its presence is considered indicative of fresh faecal contamination, and it is used as an indicator organism for the presence of less easily detected pathogenic bacteria (similar to faecal coliform - typically used in assessment of drinking water).
Faecal coliform	Is a rod-shaped gram-negative non-spore forming bacterium, which can ferment lactose with the production of acid and gas when incubated at 35-37oC.They are found in the bodily waste of all warm blooded humans and animals. Most species are not capable of survival outside the body for a long period of time. Their presence in water indicates contamination by human sewage or animal droppings.
Limit	The values representing either an operating range or an absolute “end of the line” condition.
Mixed Liquor	Mixed liquor is a mixture of raw or settled wastewater and activated sludge contained in an aeration basin in the activated sludge process.
Nitrification	Nitrification is the process of transforming organic nitrogen in wastewater to Nitrate.
Primary Treatment	It is gravity sedimentation where the majority of settable solids are removed from crude sewage flowing through it.
Process Controller	In the context of this document a Process Controller is the person who executes those functions that include both the elements of control and operations at wastewater treatment plant / sewage plant. It may in certain cases also be the Chemical Services Manager.
Scale	Scale is a dense coating of predominantly inorganic material formed from the precipitation of water-soluble constituents.
Secondary Treatment	It is the treatment stage where the pollutants (settable, colloidal, and dissolved) are removed biologically by the action of microorganisms.
Sewage	The waste material or dirty water from the community.

2.5.1. Client/Employer

Tutuka Power Station

2.5.2. Principal *Contractor*

An *Employer* appointed by the client to operate and monitor Tutuka power Station waste water treatment plants

2.6 Abbreviations

Abbreviation	Explanation
STP	Sewage Treatment Plant
SVI	Sludge Volume Index
TDS	Total Dissolved Solids
TOC	Total Organic Carbon
TSS	Total Suspended Solids
WAS	Waste Activated Sludge
WUL	Water Use Licence
WWTP	Wastewater Treatment Plant
WWTW	Wastewater Treatment Works

2.7 Roles and Responsibilities

2.7.1. Tutuka Chemical Services

a) Compiles the scope of work.
b) Coordinates execution of the scope on site
c) Reviews technical submission provided by the contractor.
d) Contracts Manager for the wastewater treatment works (Thuthukani and Tutuka Sewage plants)

2.8. Process for Monitoring

The *Contractor* will compile monthly reports which will ensure the works are executed within quality standards.

2.9. Related/Supporting Documents

N/A

3. Wastewater Treatment Works design

3.1 Description of the works

Tutuka Wastewater Treatment Plant receives wastewater from all different areas of the power station waste activities enters the Plant at the inlet work through screw-type strainer. Thuthukani wastewater treatment works receives wastewater from Thuthukani township, RDP and the hostel.

- **Balancing Pond (Pre-aeration)**

The raw sewage is fed to a balancing pond, and then pumped into the aeration basin at a controlled rate.

Pre-aeration and flow balancing takes place in the Balancing Pond. Pre-aeration equipment comprises two submerged Turbine-type aerators, free standing on the bottom of the pond, which provide sufficient oxygenation to reduce the estimated BOD (Biochemical oxygen demand) load by approximately 30% and to maintain solids in suspension.

The pre-aerators are manually controlled from a control panel, situated next to the balancing pond. The hydraulic retention time of the balancing pond at peak flow is approximately 2 hours.

- **Transfer pump Station**

The transfer pumps are used to transfer pre-aerated sewage from the Balancing Ponds to the Aeration Tank. The pumps operate one duty/one standby on HAND/OFF/AUTO control in the local control panel. Float level switches will be pre-set to allow the duty pump to run between low and high settings. 2 x 380 V submersible pump, and a pumping rate of 34 l/sec.

- **Screening**

A manually raked screen angled at 45^{o} is installed in the inlet chamber to the aeration tank. The pumped sewage from the Transfer Pump Station is discharged just ahead of the screen.

Collected solid matter on the screen must be raked up on to the drainage tray, where drainage water is returned to the inlet channel. The screen must be raked at least once per shift.

Dewatered screenings should be removed for disposal by burying or burning and dried screenings should not be allowed to blow around the site area.

- **Aeration Pond**

The two vertical surface turbine aerators provide the means to aerate the sewage and keep the contents of the aeration tank completely mixed at all times. The strong turbulence allows close contact of the raw sewage and the purifying bacteria.

The requirements in terms of O_2 are of three kinds, i.e., the oxygen necessary for the destruction of the BOD and the oxygen necessary for the life of the bacterial mass contained in the tank, and for oxidation of ammonia.

Actually, these requirements are theoretical, for it is necessary to take into consideration all the corrective factors in the transfer of the oxygen to the ambient medium. This result in an increase in the quantity of oxygen which must be supplied.

Dissolved oxygen level should be maintained at between 1, 0 and 2,0mg/l for optimum operation of the aeration system. This is normally done by making use of the aeration timing controls to match peak inflow periods.

The average hydraulic retention time at average dry weather flow is approximately14 hours. The solids retention time at a mixed liquor suspended solids, concentration of 4000 mg/l is approx. 19 hours. The contents of the aeration tank are referred to as ‘mixed liquor’

The aerators may be controlled manually or automatically by means of a 24-hour timer switch situated in the main control panel. The auto timer can be set for aerators to run independent of each other for any required period to within a half hour.

The running periods for the aerators can be set on auto timer control to coincide with peak flow periods. The aerator immersion is set at +50 mm which is established by the difference between water level and the top of the aerator cone. This aeration immersion can be varied by raising or lowering the level of the outlet which is fitted with slotted fixing holes, thus providing a further means of controlling oxygen input.

Following a lengthy period of aeration in the aeration basin the activated sludge liquor overflows into the settling tank/clarifier via an inlet pipe up the centre column of the clarifier.

- **Settlement Tank (Clarifier)**

Mixed liquor from the aeration tank passes over the control weir and into the clarifier through the centre column and out through inlet ports to the main settlement area of the tank. Settled sludge is scraped to the centre concentrating hopper in the floor of the tank by means of rotating scraper and

is displaced through a pipe to the return sludge sump. The sludge discharge rate is variable by means of a series of discharge pipe rings fitted to the outlet end of the vertical sludge pipe. The rings which are self-locating will vary the height of the sludge pipe and will therefore vary the sludge draw off rate. The sludge discharge rate should be approximately 100% of the plant average dry weather flow rate (22l/sec.)

Sludge from the sludge sump is returned to the aeration pond by means of a submersible pump where it is used to maintain the necessary concentration. Excess sludge must be extracted at regular intervals approximately once a week during operation.

Surface floating matter is removed by the scum skimmer sweeping the scum to a scum outlet box, from where it is discharged to the return sludge sump by the automatic operation of a plug type valve operated by a striker bar on the rotating bridge every revolution of the tank.

Clear water overflows the serrated weir plate into the outside launder and is discharged through a short pipe to the chlorine contact tank. A baffle plate prevents surface matter overflow. Weir and baffle plates must be kept clean by regular scrubbing and washing.

From the chlorination tank, the clarified water flows to the maturation pond for final polishing and storage prior to discharge from the treatment plant.

- **Sludge Return**

Sludge and scum collected in the sludge sump is returned to the inlet end of the aeration tank by means of two solids handling submersible pumps, operating one duty and one on standby. Three mercury float level switches will be pre-set to allow the duty pump to run between low- and high-level settings.

The standby pump will only start if the duty pump fails, or if the high-level switch is made. Pump change over should be done fixed duty periods to balance wear & tear on the pumps.

The discharge valves on both sludge return pumps must stay in the open position, so that pump changeover is affected only by switching pump duty from Pump 1 to Pump 2, or vice versa.

Two pumps will only be run simultaneously under emergency conditions as the plant is designed to cope with the delivery rate of one pump.

Should a pump clog with solid matter, quick clean out facilities by way of quick opening hand holes in the pump body are provided.

The pumps are self-priming and will only require hand priming should the pump be taken out of service for any reason and the pump body drained.

Each pump is fitted with non-return valve and gate valve, discharging the sludge through a manifold into the return sludge pipeline and from there back to the aeration tank.

Ideal operating range is between 35% and 45% sludge in the aeration tank. The mixed liquor suspended solids (MLSS) should be maintained at between 3 500 mg/l and 4 500 mg/l, corresponding to a sludge volume of 350 to 450 ml/l. should the sludge concentration be higher, recirculation to the aeration tank must be stopped and the sludge pumped to the drying beds.

This is done by:

a) Opening the valve to the selected sludge drying bed.
b) Opening the valve on the delivery pipeline to the sludge drying beds.
c) Closing the valve on the return sludge pipeline to the aeration tank.

When the drying bed has sufficient sludge discharge to it, the valve operation is reversed to allow normal sludge to return back to the aeration tank.

- **Sludge Drying Beds.**

Six sludge frying beds are available for dewatering waste sludge as necessary. Sludge is discharged to the selected drying bed by opening the inlet valve and allowing sludge to flow on to the drying bed to a depth of ±150 mm.

Care should be taken to ensure that the concrete slab is in position to prevent wash away of sand media.

Water will drain through the sand and stone bed and gravitate back to the sludge sump.

The sludge held on the surface of the sand bed will dry out to a cake over a period of days, depending on weather conditions. The dried sludge layer is then removed by hand for disposal, ensuring that only a minimal amount of sand is removed with the sludge. After removal of the dried sludge the sand bed must be levelled ready for re use. After an extended period of use it may be necessary to top up the sludge drying bed with sand

3.2 **Employer's requirements for the service**

The scope of work covered in this contract is the operation, monitoring, and management of the sewage plants (Thuthukani and Tutuka) at Tutuka Power Station. The contractor shall provide, operators that are classified as per 3630 regulation (Class III), split supervisory for each plant (Process controllers class V), basic laboratory analysis (chlorine, Dissolved oxygen, Nitrates, Phosphates, Ph, ammonia, COD , Jar test ,Sludge volume index and plant optimisation. The contractor must provide with monitoring equipment's and ensure that they are calibrated, verified, and maintained and per manufactures instruction. The contractor must perform routine plant checks and reporting of defects. Operation personnel of the plant must be in accordance with regulation 3630. The contractor must provide a Chemical Technician with a National diploma in Analytical Chemistry, Chemical Engineering, and water care with a minimum of 2 years' relevant experience.

3.2 Scope of work for Thuthukani and Tutuka sewage plants

The term of this contract shall be for 60 months' subject to periodic assessment and interventions to be done by employers as specified below. The service provider must provide the following:

1. Operation, analysis, and optimisation of currently installed sewage treatment plant to meet all Tutuka water use license compliance for water discharge.
2. Contractor to ensure that we and troubleshoot the sewage treatment plants to ensure we achieve 90% in analytical and microbiological parameters as per Tutuka water use licence and improvement of current operational practises.
3. Provide technical support and advice to employer on modifications or investigations concerning the sewage plants.
4. The contractor shall provide all PPE for all employees required for the operational of the sewage plants (Wastewater treatment plants)
5. The contractor shall provide transport (LDV) for transportation of operational equipment's, chemicals that necessary to perform the operation.
6. Keep the register for every person visiting the plant.
7. Record the readings from the meters: Inflow and Outflow
8. Clean the area of the Macerator and empty the debris bin in hazardous bin.
1. Clean the Grit channel.
2. Keep the area underneath the sensor of the inflow meter always free of debris.
3. Always be alert that the Blowers are on and are in working order.

4. Always be alert that the Aerators are working and complete their check sheet accordingly.
5. Always be alert that Poly Aluminium chloride is dosed when Aerators are on load.
6. Check that the pumps from the Aeration Tank are working.
7. Check the rate of Poly aluminium chloride dosing (Jar test) and adjust accordingly to optimise the plant.
8. Check the Poly Aluminium chloride if it contains the chemical, refill when it is low.
9. Check the Clarifier surface; clean the foam with water from the hose pipe.
10. Clean the Clarifier weir with Granular HTH using hard broom.
11. Ensure the Clarifier Bridge is rotating.
12. Note the cleanliness of the water from the clarifier and if there is carry over.
13. Ensure that there is always Chlorine chips in the dispenser and dispenser is closed.
14. Check the water supply to the Chlorine chips is open and the flow is not interrupted.
15. Check the flow of sludge in the sludge pit.
16. Note the rate of flow and the thickness of the sludge in the sludge pit.
17. Note that the sub miscible pumps in the pit are working.
18. Check the sludge in the beds if it is dry.
19. Remove and clear drying beds that contain dry sludge and record it.
20. Drain sludge from Aeration tank when SVI is 400g/l.
21. Operate the draining valves together with the RAS valves during draining of sludge.
22. Take the samples according to the planned times label them clearly.
23. Keep the plant clean at all times.
24. Report anything unusual that is happening and note the time it happened.

3.3 Plant Deliveries

1. Submission of monthly report to the employer's system engineer and must include the following.
2. Optimisation plan for both plants
3. List of defects for both plants on weekly basis to track progress.
4. Weekly update on plant progress
5. Adherence to green drop programmes
6. The contactor must employ a class **V** inspector to review the monthly report before they are submitted to the employer.

7. All monthly reports must be submitted to the employer not later than 5 days after each month end.

3.4 Obligation of the contractor

1. The plants (both Tutuka and Thuthukani sewage treatment) are class C and shall be operated in accordance with Tutuka Power Station Water Use License conditions, the operating manuals, all the related plant procedures, and Regulation 3630 requirements.
2. The process controllers shall be classified in accordance with Regulation 3630 and green drop guidelines.
3. The number, duties, training, qualifications, and compulsory medical examination of the persons employed at the sewage plants shall be in accordance with the requirements of the plant's registration certificate issued in accordance with Regulation 3630.
4. The chemical stock shall be maintained at the minimum of 50% at which it must be reported to the contract supervisor.
5. The contractor shall provide transportation to transport all required chemicals, operational equipment's that are necessary to fulfil the operational duties (LDV)

3.4 Plant inspections

The following plant inspections should be carried out at twice per shift, to ensure continuous and safe operation of plant.

Note: Plant condition should be logged, and all abnormalities and defects must be reported.

1. Inlet screens free of obstructions
2. Balancing pond level
3. Transfer pumps status
4. Aeration pond level
5. Aeration pond outlet screen free of obstructions
6. Clarifier condition
7. Clarifier bridge operational
8. Sludge returns pump status.
9. Chlorination status
10. Pond level (Maturation Pond)
11. Chemicals levels

3.5 Staff

1. The plant shall be monitored 24 hours a day and seven days a week.
2. Every staff member must sign the attendance register that would be kept at the Sewage treatment plant.
3. Submit daily completed check sheets compiled by the employer.
4. The number, training, qualifications of all staff members employed at the sewage treatment works shall be in accordance with regulation 2834.
5. The contractor must employ a Chemical technician with a National diploma in Chemistry/ Chemical engineering or Water care with a minimum of 2-year relevant experience
6. Contractor shall employ a safety officer to be responsible for both sewage plants.
7. Class C (Thuthukani sewage treatment plant) type plant, number of operators to be present is as follows:

a. Site supervisors for each plant day shift only (1) Class V
b. Process controller/operator per shift (4) – Class III
c. operator/ process controller per shift (4) – Class II

8. Class C (Tutuka sewage treatment plant) type plant, number of operators to be present is as
9. follows:

d. Site supervisors for each plant day shift only (1) Class V
e. Process controller/operator per shift (4) – Class III
f. operator/ process controller per shift (4) – Class II

10. Persons employed at the treatment works shall be registered as per Regulation 3630 and Eskom must be provided with proof.
11. Employees shall be dedicated to the treatment works plant operation and plant optimisation.

3.6 All operator's/process controllers shall be trained in' Green drop programme, wastewater treatment, Hazardous chemicals substances and a copy of their certificate must be Description of the works.

3.7 Quality Control and Assurance

a) Quality assurance requirements as per QM-58 Supplier Contract Quality Requirements Specification
b) The contractor must supply equipment's for plant monitoring as follows:
   1. Chlorine (Cl_2) analysers (**for both plants)** for both free and total Chlorine in Parts per million, and provide necessary reagents to perform the analysis
   2. Portable Dissolved oxygen analyser ppb level **(**for **both plants)**
   3. Bench top pH (Hydrogen ion) and conductivity analyser **(for both plants)**
   4. Phosphates (PPM) **for both plants**
   5. Nitrates (PPM) **for both plants**
   6. Nitrites (PPM) **for both plants**
   7. COD (PPM) for **both plants**
   8. Ammonia (PPM) for **both plants**

c) The contractor must ensure calibration, verification, reliability and maintenance of the equipment's for monitoring supplied for both plants.
d) The samples must be collected by *Contractor* for onsite laboratory analysis and Outsourcing. These samples must be analysed by both *Employer* and *Contractor* for quality assurance and control. Both reports will be discussed during the monthly meetings.
e) The contractor must employ an ISO 17025 accredited laboratory for all required analysis and provide proof of the accreditation.
f) The contractor must do plant optimisation to ensure compliance to the Tutuka water use licence water quality requirements.
g) The contractor must employ the competent laboratory that will supply results within and turnaround time of **5 days** for each set of analysed samples.
h) The contractor must perform and comply to all required analysis as per Tutuka water use license.
i) The Chemical Technician employed by the contractor must monitor analyse generated results e.g. (Chlorine, Turbidity, Sludge volume index, Dissolved oxygen and perform plant optimisation.
j) The Chemical Technician employed by the contractor must review all check sheets.
k) The Chemical Technician employed by the contractor must perform chemical dosing verifications for all chemicals dosed and adjust accordingly.
l) The contractor must conform to Quality Management System-ISO 9001:2015 requirements.

4. Acceptance

This document has been seen and accepted by:

Name	Designation
Michael Mukwevho	Chemical Services Manager
Nthabiseng Ntoampe	Snr Chemist

5. Revisions

Date	Rev.	Compiler	Remarks
January 2023	0	N Nxumalo	New document created
November 2023	1	N Nxumalo	Updated new regulation and process controller classifications

6. Development Team

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

- N Nxumalo

7. Acknowledgements

N/A