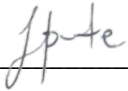
	<p style="text-align: center;">SCOPE OF WORK (SOW)</p>	<p style="text-align: center;">TURBO GEN SERVICES (TGS)</p>
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1. OBJECTIVES

Scaling / Sludge build-up of pipes and tubes has been a major problem across Eskom Power Stations, particularly with the relatively poor cooling water quality, poor flows and carryover of sludge/debris to supplied components. High pressure water jetting and Acid cleaning has been identified as a means of removing scales / sludge from the internal surfaces of tubes.

This document is drafted to select & place a contract with external service providers who can perform High Pressure Cleaning and Acid cleaning of oil pipes and tubes.

2. GENERAL REQUIREMENTS - HPWJ

2.1 HIGH PRESSURE WATER JETTING (HPWJ) REQUIREMENTS FOR CONDENSER AND HEAT EXCHANGER TUBING INCLUDING OIL PIPES

2.1.2 ACCEPTANCE CRITERIA

The internal surfaces of all tubes shall be cleaned by means of High Pressure Water Jetting (HPWJ). The acceptance criteria is that all scale shall be removed from the internal surfaces of the tubes, i.e. the entire internal tube surface of all the tubes shall be completely cleaned to a uniform metallic colour with no traces of corrosion product or other scales and deposits. This shall be validated by means of high resolution endoscope inspection and / or destructive analysis of “cleaned tube” where applicable. Non achievement of the aforementioned acceptance criteria shall be considered as non-performance with respect to the contract.

2.1.2 MINIMUM EQUIPMENT REQUIREMENTS

For tubes with an internal diameter of 20.5 mm up to 25 mm, the minimum nozzle flow rate shall be 50 litre/min at 1 000 bar working pressure. For tubes with an internal diameter between 15 and 20.5 mm the minimum nozzle flow rate shall be 33 litre/min at 1 000 bar working pressure.

Rotating tube cleaning nozzles with multiple radial water jets or polishing nozzles shall be used. The cleaning nozzles shall be obtained from a recognised HPWJ equipment supplier including technical datasheets, providing technical information for a range of nozzle sizes, shall be available for all the types of nozzles used on site. The maximum pressure rating of the nozzle shall be 1 035 bar or 15 000 psi.

A technical data sheet shall be provided for the HPWJ pumps. The HPWJ pump shall maintain a minimum continuous working pressure of 1 000 bar at a flow rate of 50 litre/minute. This requirement assumes one pump will supply one cleaning nozzle. If a single pump is to supply more than one nozzle simultaneously, the pump shall maintain a minimum continuous working pressure of 1 000 bar and a minimum volume flow of 50 (litre/min) per each of the cleaning nozzles attached simultaneously to the pump.

The nozzles shall travel the full length of all the tubes.

The HPWJ flexible hose from the foot valve to the tube cleaning nozzle shall have a minimum internal diameter of 6 mm for tubes with an internal diameter between 15 and 20.5 mm. For tubes with an internal diameter of more than 20.5 mm, the HPWJ flexible hose from the foot valve to the tube cleaning nozzle shall have a minimum internal diameter of 7 mm. The maximum hose length is the condenser tube length

plus an additional 7 m. If the tube length is more than 12 meters, the tubes shall be cleaned from both ends to avoid excessive long hoses. The foot valve shall be positioned in the waterbox. The minimum number of hoses available on site for the main and BFPT condensers are 4 and 2 respectively.

The flexible hose from the pump outlet to the foot valve shall have a minimum internal diameter of 10 mm.

The Contractor shall make provision for a reasonable set/number of spare equipment and tooling, particularly, nozzles, hoses, couplings, all wear and tear parts such as seals etc. These spares shall be available on site. In the event of HPWJ Pump breakdown then repair or suitable replacement shall be affected within 2 hours. The latter shall only apply to eventualities involving unexpected major breakdown of HPWJ Pumps.

Under no circumstances will the tube sheet coating or tube ends be damaged by the HPWJ cleaning. The Contractor shall establish a system or method to ensure impinging water jets from the nozzle are not directly focused towards the tube sheet or onto the outside diameter of the exposed tube ends. Prior to any HPWJ cleaning activities and inspection shall be performed by the Contractor supervisor and the Engineer to record the existing condition of the tube sheet and tube ends. This activity shall be included in the QCP as a hold point. Any damage to coating will be for contractor's expense to repair; Eskom's coating standard [3] shall be applied for any coating repairs.

The Contractor shall make provision of adequate number of hand held pneumatic powered feeders.

The Contractor's selection of all lances, nozzles, sleeves and hosing shall be suitable for the tubing diameters as defined by site.

The endoscope used for inspection of the tubes after HPWJ shall have a minimum length of 20 m and a camera with minimum specifications.

2.1.3 COMMISSIONING TESTS AND OPTIMIZATION

Before any work is performed the Contractor shall demonstrate the following to the Engineer:

Provide all required certificates (equipment pressure tests, pressure gauge calibration, personnel training).

The Engineer shall verify that the equipment on site complies in all respects to the technical data sheets provided with the tender as well as that the number of pumps, hoses, foot valves, cleaning nozzles, etc. on site corresponds in all respects to the information provided in the tender returnables.

The Contractor shall demonstrate to the Engineer that the HPWJ pump, hose and nozzle combination can supply a volume flow rate of 50litre/min by means of a container and stopwatch method for a pump outlet pressure of 1000 bar.

The Contractor shall demonstrate that the lance safety device (with a hand held pneumatic powered feeder) prevents the lance from withdrawing from the tube during HPWJ and hence is safe for operators.

Before starting with the production cleaning activity the contractor in consultation with the engineer shall establish an acceptable nozzle resident/dwell time (cleaning a minimum of 10 tubes) demonstrating the capability of meeting the acceptance criteria. During cleanliness sampling inspections, it may be found that cleaning with the pre-

established nozzle resident/dwell time is ineffective (scale not being entirely removed). In such an event the nozzle resident/dwell time may be further increased by virtue of a 10 tube cleaning test. This shall only be performed in consultation with the engineer, and actual high definition endoscope inspections of ‘cleaned tube sections’

If available, the Engineer shall provide the contractor with a short piece, typically 1m, of new condenser tube of the same material of construction as that in the condenser or heat exchanger. The Contractor shall demonstrate to the Engineer that the working pressure and cleaning nozzle combination does not damage the tube internal surface.

2.1.4 ADDITIONAL REQUIREMENTS

The Contractor shall supply suitable Endoscope/Fiberscope equipment to facilitate post cleaning inspection. The fibre scope shall have a reach length of at least 6 m with a digital display that includes image capture and/or recording capabilities.

The Contractor shall supply and install suitable protection or covers on the main cooling water inlet duct to eliminate any of the debris removed from the condenser tube falling down the CW inlet duct.

The Contractor shall compile a final method statement, safety work procedure and Quality Control Plan (QCP) and submit these to the Engineer for approval before cleaning may commence. The Engineer shall have the opportunity to add witness or hold points on the QCP.

All tubes which are blocked or obstructed and which cannot be unblocked by HPWJ shall be marked on the tubesheet drawing.

The Contractor shall maintain a daily logbook where the number of tubes cleaned, working pressures, etc. are logged.

As stated above the minimum acceptance criteria is that all scale shall be removed from the internal surface of the tubes, i.e. the entire internal tube surface of all the tubes shall be completely clean with no traces of corrosion product or other scales and deposits on the tube inner surfaces.

The Contractor shall clean the waterboxes and drain pipes connected to waterboxes after cleaning the tubes. All foreign materials and debris shall be removed from the waterboxes by the contractor.

3. GENERAL REQUIREMENTS – ACID CLEANING

Introduction:

This section defines the scope of work for acid cleaning of system fluid pipes and tubes to remove scale, rust, corrosion products, and other deposits that hinder flow efficiency and heat transfer. The contractor is responsible for the chemical cleaning operation. He must ensure that the work is carried out by an authorised or competent person, that only legal equipment is used, that all workers are familiar with Risk Assessments, Safety Precautions and Hazards, as well as the isolations and that all tasks are carried out according to the relevant procedure.

Objective:

To perform effective acid cleaning of the internal surfaces of oil pipes and tubes to restore optimal flow capacity and ensure integrity without damaging the metal surface.

Scope:

The work includes but is not limited to:

- Preparation and inspection of pipes and tubes before cleaning.
- Selection and handling of appropriate acid cleaning chemicals.
- Controlled acid circulation and cleaning operations.
- Neutralization, flushing, and post-cleaning inspections.
- Disposal of spent chemicals and cleaning wastes as per environmental regulations.

Work Description:

Pre-Cleaning Activities

- Inspect pipes/tubes for integrity and ensure all fittings and joints are secure.
- Conduct baseline thickness and corrosion assessments.
- Isolate sections of piping system if necessary.
- Drain and flush the system to remove loose debris and fluids.

Acid Cleaning Procedure:

- Prepare acid solution (typically HCl or a proprietary acid blend) at specified concentration.
- Circulate acid solution through the pipes/tubes for a predetermined duration.
- Monitor temperature, flow rate, and acid concentration continuously.
- Conduct intermediate inspections to evaluate cleaning progress.
- Add corrosion inhibitors if required to protect metal surfaces.

Post-Cleaning Activities:

- Circulate neutralizing agents to stop acid action.
- Flush the system thoroughly with water to remove all residues.
- Conduct visual inspection and non-destructive testing (NDT) such as ultrasonic thickness measurement.
- Collect and analyze water/effluent samples for environmental compliance.

Safety and Environmental Controls:

- Ensure all personnel follow PPE requirements and safety protocols.
- Use acid-resistant equipment and containment to prevent spills.
- Manage waste chemicals according to hazardous waste regulations.
- Provide emergency procedures for acid exposure incidents.

Deliverables:

- Pre- and post-cleaning inspection reports.
- Chemical usage and disposal documentation.
- Thickness measurement and NDT results.
- Coating or painting
- Final acceptance certificate confirming cleaning efficacy.

Schedule:

- Detailed timeline with mobilization, cleaning, and demobilization phases.

Additional Requirements:

- Each Eskom site to share a complete list of blanks, temporary connections and looping requirements, and a site-specific procedure indicating the specific routing of the solvent circulation, indicating any bypass requirements.

Operational requirements:

- Potable or raw water supply capable of delivering 150 – 200 cubic metres per hour.
- A 380 V power supply at a 200 A loading, to be connected to the contractor's circulating pump switchboard.
- A suitable drainage system. The station drains system is the most suitable.
- A portable boiler or auxiliary steam supply to raise the water temperature to 50 – 70 °C.

First aid:

Eye contact, causing severe irritation, watering and painful burning.

First Aid Treatment:

- Immediately wash eyes with plenty of running water for at least 20 minutes including underneath eyelids. Promptly obtain medical assistance.

Skin contact, causing extremely painful burning and irritation.

First Aid Treatment:

- Immediately strip off contaminated clothing and drench affected area in running water for at least 20 minutes. Promptly obtain medical assistance.

Gassing, causing coughing, and extreme irritation of nose and throat.

First Aid Treatment:

- Remove patient from exposed area into fresh air.
- Keep warm.
- Apply CPR as required.
- Provide oxygen support as required.
- Treat as stretcher case.
- Promptly obtain medical assistance.

Chemical cleaning procedure

- Fill the system with potable or raw water.
- Ensure that all instrumentation impulse lines are isolated.
- Start the contractor's circulating pumps.
- Check the system for leaks, and repair as required.
- Heat the solution using a portable boiler.
- Switch off the boiler once the required temperature (Degrease: 45 – 55 °C, Acid injection: 60 - 70°C, Passivation: 40 – 50 °C) has been attained at the contractor's mixing tank.
- Inject the degrease chemicals until the following concentrations are achieved:
 - 0.05 % Sodium Hydroxide
 - 0.05 % Tri Sodium Phosphate
 - 0.005 % detergent
- Circulate the solution for a minimum of 2 hours.
- Drain the solution into the relevant drainage system.
- Refill the system and flush to waste until the electrical conductivity indicates that all the chemicals have been flushed out (ca. 1000 µS/cm)

- Inject sufficient acid to attain a concentration of 5.0 – 6.0 %, together with the required amount of inhibitor. Consideration may be given to the addition of 0.5 – 1.0 % Ammonia BiFluoride once the acid concentration has stabilised.
- Circulate the solution using the contractor's pump until stable ferrous iron readings are obtained for at least 90 minutes.
- Drain the system whilst neutralising with hydrated lime, and inject a trace citric acid solution during the flushing step.
- Refill with a trace citric acid solution.
- Flush the system with potable or raw water until the chloride concentration is less than 100 ppm.
- Fill the system with demin water, heat to 40°C and inject tri sodium phosphate (TSP) until a concentration of 0.05 % is achieved.
- Circulate the solution and, if required, inject additional TSP to achieve a pH of 9.0.
- Circulate the solution for 2 – 3 hours.
- Drain the system as quickly as possible and apply a flow of dry compressed air for 2 – 4 hours.
- Inspect the large bore piping and all available header inspection points.
- Refill the system with lubricating oil, and initiate the bypass flush within 96 hours of the completion of the neutralisation stage.

Alternative procedures:

- Dependant on the metallurgy of the system, a passivation stage may be added after draining the system.
- Fill the system with demin water, heat to 60°C and inject hydrazine (N₂H₄) until a concentration of 100 ppm is achieved and add 0.01% Toly Triazole to protect any yellow metal components.
- Circulate the system for 2 – 3 hours.
- Continue steps after draining the system and refilling the system with lubricating oil
- Consideration may be given to alternative passivation procedures, but only after thorough consultation with the necessary discipline specialists. 5.3 refers.

Bypass flush:

- Reinstate the oil plant to enable the commencement of bypass flushing.
- Commence the bypass flush within seven days of the completion of the chemical clean.
- Continue flushing until the oil reaches an ISO specification of 20/17 or better .

4. SCOPE OF WORK (SOW)

The generic SOW includes but not limited to the following:

- Condenser tubes
- Oil pipes
- Generator coolers
- Main oil coolers
- Seal oil coolers
- Lube oil cooler
- Control oil system and coolers

- Stator water piping and coolers
- Exciter coolers
- Plate heat exchangers
- Lubrication oil supply and returns line, including associate system drainage lines (baffle drains, tundish drains, etc)
- Seal oil supply and returns lines, including associate system drainage lines (baffle drains, tundish drains, etc)
- Lubrication and seal oil pump suction lines (AOP, AC –lube and seal oil, DC – lube and seal oil)
- Main Oil Tank cleaning including drain lines (example Coalescer suction line)
- Vacuum truck for disposal of any fluids used during the cleaning process as an when it is required.

5. SAFETY REQUIREMENTS

High Pressure Water Jetting:

The safety of the Contractor personnel is of extreme importance. **The following are the minimum safety requirements that the HPWJ operators shall comply to:**

- Operators shall wear CE (European Economic Area Conformity Marking) certified water jetting suits, and face shields rated for the working pressure stated in section 3.4.
- All foot and leg protection equipment to be appropriately rated for the working pressure stated in section 3.4.
- The Contractor shall work in accordance with a safety procedure/instruction aligned to industry recognised HPWJ practices and standards to protect personnel using HPWJ equipment.
- HPWJ operators shall be trained and certified by an independent industry recognised HPWJ authority. No operator will be allowed to use HPWJ lances on site without the required certification.
- All HPWJ hoses and associated equipment and tooling, i.e. nozzles, fittings, foot valve, used on site shall have valid pressure test certificates. The test pressure shall be a minimum of 1 400 bar.
- All hose end connections to be fitted with the appropriate “hose checks” to prevent injury by restraining the hose in the event of an end fitting failure.
- The HPWJ pump discharge shall be fitted with a calibrated pressure gauge and safety relief valve or rupture diaphragm.
- Any manholes which are open for ventilation purposes shall be properly barricaded by the Contractor to eliminate unauthorised human entry while cleaning is in progress.
- Barriers and Warning notices must be in place before any work commences
- Specific requirements related to Eskom’s “Life Saving Rules” that would be applicable to this activity.

Acid Cleaning:

Safety Precautions

These steps to be carried out by the Contractor and Eskom Safety Officer.

- The importance of the safety of all personnel involved in chemical cleaning cannot be over-emphasised.

- Every possible precaution must be taken to minimise the risks of the inadvertent contact of personnel with the cleaning solvents

The following are mandatory minimum requirements that must be followed on any chemical cleaning:

- A safety shower close to the chemical pump station.
- A shark net barricade to restrict entry to the pump station and concentrated chemical storage area and a hazard tape barrier around the entire area dedicated to the clean;
- Suitable personal protective clothing (Hard hat / Ear plugs / Safety boots / Protective goggles / Full chemical wet suits / Full face plastic visors / Safety gloves / Elbow length rubber gloves / Rubber boots / Dust masks / Respirators with appropriate cartridges);
- Warning signs at appropriate locations.
- First-aid or medical staff present during solvent injections.
- Annexure A presents the first aid information for various chemicals used in the chemical cleaning of condensers.
- Handling and storage of acids
- All chemicals used in chemical cleaning should be accompanied by the appropriate data description and hazard sheets, which are obtainable from the chemical supplier.
- Strong acids and alkalis must be handled with great care, and the correct lifting and handling equipment must always be used when off-loading, moving, and storing the chemicals.
- Hazardous chemicals should ideally be delivered to site on wooden pallets, shrink-wrapped and clearly identified.
- Once off-loaded, usually by use of a fork-lift truck, they should be deposited in an allocated area close to the chemical cleaning contractor's equipment, and stored behind a fenced screen or orange hazard netting, which is only accessible from within the chemical cleaning area, which is also demarcated by the standard red and white hazard tape.
- Any subsequent handling and dispensing of the chemicals by the chemical cleaning contractor's staff should be done with all the necessary safety apparel and equipment necessary to handle spillages or accidental spraying during injection of the chemicals into the system being chemically cleaned.

Handling of waste

- All effluents, which are generated as a result of chemical cleaning activities, are to be routed to the dam as per Eskom guideline. (Site specific)
- If the effluents cannot be absorbed within the power station system, the other alternative is to remove the neutralised waste from the site by use of road tankers and disposed of at a registered waste disposal site.

Handling acid spillage

- The best practice is to not allow acid spillages to occur.
- Should any acid spillage occur, this can be immediately neutralised using hydrated lime and then hosed away using a fire-hose or similar.
- All spillage clean-ups must be done to the applicable Environmental Management Requirements and not violated.

6. SHEQ REQUIREMENTS

All service providers are expected to comply with, but not limited to the following:

- Compliance with the Occupational Health and Safety Act 85 of 1993 is compulsory.
- Adherence to Quality Management System Policies, Procedures and related requirements of ISO 9001.
- Adherence to Occupational Health and Safety Policies, Procedures and related requirements of the OHSAS 18001.
- Adherence to environmental aspects, related impacts and legal requirements associated with work activities in accordance with ISO 14001.
- Adherence to Life Saving Rules.
- Compliance with the Eskom Plant Safety Regulations.
- Only authorised documents and processes are to be used in the execution of duties.
- Continuously seek methods for improvements from a process, quality and safety perspective.
- Obey all instructions.
- Familiarize with:
 - The applicable work instructions and procedures in place.
 - Safe working conditions and procedures.
 - All legal and contractual requirements.
 - Discipline and integrity.

- Compliance to all ERI Work Instructions, processes, procedures, and standards
- Adherence to ERI's disciplinary code or practice.
- Set example to co-workers and others.
- Participate in Risk Assessments.
- Responsible for own safety.
- Responsible for Personal Protective Equipment issued.
- Execute duties promptly and safely.
- Safeguard tools and safety equipment issued.
- Keep good relationship with all personnel.
- Compile a HIRA for each and every activity that needs to be performed.
- Ensure the activities are carried out following a Works Instructions and Procedure.
- Adhere to clean condition policy where required.
- All activities to be carried out as per the documented processes and comply with the requirements of ISO and OHSAS certification

- Service provider to comply to Eskom PPE (Personal Protective Equipment) Policy with regards to issuing of PPE to resources
- Proper use of PPE to be followed
- Ensure that tools and equipment are stored correctly in a safe place.

7. KEY PERFORMANCE INDICATORS

Objective	Key Performance Indicator	Measure	Unit of Measure	Source of Evidence
Safety Sustainability	LTI Free days	LTI Free days	Days	To be provided by supplier
Turnaround Time	Available within 24 hours	Number of queries responded to	Nr	To be provided by supplier
Due Date Performance	Due Date Performance	Average contracted outage days	Days	To be provided by supplier
Reduce the Number of Rework Incidents	No of Rework Incidents	Number of Rework Incidents	Nr	To be provided by supplier
Reduce the Rework Duration	Rework Duration (Days additional to planned outage duration)	Number of Days Rework Duration Impacts Outage Due Date	Days	To be provided by supplier
No of Legal & Environmental Contraventions	No of Legal & Environmental Contraventions	Number of contraventions	Nr	To be provided by supplier
Zero Fatalities Excl 3rd party at fault	Zero Fatalities Excl 3rd party at fault	Number of fatalities	Nr	To be provided by supplier