

Title: LP Turbine Blade Root Shot Peening System - Technical Specification

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1. BACKGROUND AND OBJECTIVE

Turbo Gen Services (TGS), a business unit with Eskom Rotek Industries (ERI), focuses on the maintenance engineering of the Turbine Island as well as the refurbishment of turbine equipment and generators during Eskom maintenance outages; either on-site, or in the Rosherville-based workshops.

Low Pressure Steam turbines fitted with fir tree blade roots are subjected to cyclic stresses possibly resulting in fatigue failure.

To alleviate the possibility crack formation on the blade roots of the turbine rotor, shot peening is a method that is applied by the OEM's. ERI intends procuring the required equipment to carry out this task.

This document outlines TGS's requirements for a Shot Peening System.

The picture below indicates the blade root profile to be shot peened.



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2. DELIVERABLES

2.1 Machine

- 2.1.1 The supply, installation and commissioning of a Shot Peening System that has capability to:
- 2.1.2 Perform Shot Peening on the Turbine Rotor Blade roots as per URS
- 2.1.3 The system shall be installed at the ERI Rosherville Works. The supplier shall indicate the services required for the function optimally in term of electricity, compressed air, water or any other service.
- 2.1.4 The shot peening nozzle must follow the profile of the blade root (circular arc).
- 2.1.5 The supplier shall design and install a jig fixing the nozzle to the rotor disc for automated shot peening and path following. The motion of the nozzle will repeated and reversed.
- 2.1.6 All vessels shall comply to relevant local codes and standards. Vessels may be designed according to international codes, provided they are classified according to local standards and comply to local regulations.
- 2.1.7 All electrical components shall be listed, approved or registered with a recognised testing laboratory to ensure that the components meet suitable standards that will prevent catastrophic failure.
- 2.1.8 Any non-standard tools required for the maintenance of the Shot Peening System shall be provided on delivery. These tools shall be accompanied by a complete maintenance manual including but not limited too: design verification/validation, approved drawings and material specifications/data sheets.
- 2.1.9 The system shall consist of, but not limited to, the following high-level components:
 - a) Air Blast components including a compressor, air tank, valves, gauges, pressure relief valves, connecting pipe work and flanges, control unit.
 - b) Media Storage Pot
 - c) Nozzles and hoses.
 - d) Air Filtration
 - e) Media recovery and sorting.
 - f) Mounting jig with means to sweep the nozzle head, either stepper motors or pneumatic, supplier can specify.

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2.2 Robotic Arm with Rotating Lancing Head

- 2.2.1 The shot peening operation may be performed by a rotating lancing head that is fixed to a robotic arm.
- 2.2.2 The robotic arm must be supplied with its own control system.
- 2.2.3 The robotic arm must have its own base that may be adjusted to ensure the arm movement is repeatable with minimal deviation.
- 2.2.4 The arm must be capable of motion in at least 3 axes.
- 2.2.5 The robotic arm shall be supplied with coverings that will prevent any unwanted ingress of dust, moisture or shot peen media.
- 2.2.6 The material for the lancing head must be such that it ensures longevity based on the intended use.

2.3 Training

- 2.3.1 Operator training for ERI Employees. Training to be conducted at Rosherville. Operators shall be trained in the appropriate handling, loading, lifting, transportation, operating and maintenance procedures. These operators shall be certified to use the machine by the supplier before the training is considered complete.
- 2.3.2 Repairs and service training for ERI Employees. Training to be conducted at Rosherville

2.4 Documentation

- 2.4.1 Operating and Maintenance Manual
- 2.4.2 Quality Control/Inspection and Test Plan
- 2.4.3 Procedure Specifications for each test performed in accordance with the Quality Control Plan
- 2.4.4 Certificates of all tests performed in accordance with the Quality Control Plan
- 2.4.5 Installation and commissioning plan
- 2.4.6 Maintenance Manual
- 2.4.7 Critical spare parts list and or repair kit
- 2.4.8 All relevant machine documentation including but not limited to: Declaration of conformity, Data sheets including material specification/data sheets, inspection and acceptance logs, wiring diagrams
- 2.4.9 Certificates of all tests performed in accordance with a Quality Control Plan
- 2.4.10 Training manual
- 2.4.11 Suppliers of all components/systems shall provide proof of adherence to ISO 9001:2015 or latest equivalent standard.

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3. FUNCTIONAL REQUIREMENTS

3.1 Operating Requirements

- 3.1.1 The Shot Peening system is required to shot peen the fir tree blade roots of LP Turbine discs.
- 3.1.2 The shot peening media to be used will be according to S110 (Ø 0.2794mm) cast steel peening shot.
- 3.1.3 The flow rate shall be adjustable to suit the required conditions.
- 3.1.4 The supply pressure shall be adjustable to suit the required conditions.

3.2 Design

- 3.2.1 The design of the Shot Peening System and any associated components and accessories shall adhere to recognised applicable industry standards, this shall include electrical design, ingress protection, vessel design, etc.
- 3.2.2 All panels on the machine shall require specialised tooling to open in order to prevent unauthorised access to the machine.
- 3.2.3 The machine design shall be robust to withstand frequent transport and movement. It shall also be able to withstand site conditions that include temperature up to 50°C, and Dusty conditions.
- 3.2.4 Fragile components like the control panel, switchgear etc must be equipped with protection that can be easily put in place during transport and storage.
- 3.2.5 All connections, such as electrical and air must be robust and durable for frequent connection and disconnection in a site environment. The connections must be of a quick coupling nature to reduce set-up and packing time. It must also be equipped with FME and mechanical protection when disconnected.
- 3.2.6 Further the design will be such that no electrical shock is possible when the machine is switched on in any configuration.

3.3 Capacity and Dimensions

- 3.3.1 Maximum Machine Height: Supplier to advise.
- 3.3.2 Maximum weight: Supplier to advise.

3.4 Electrical Requirements

- 3.4.1 Electrical Supply Available on Sites:
- 3.4.2 Voltage: 380V Three Phase AC
- 3.4.3 Current: Max 150A
- 3.4.4 Frequency: 50 Hz

3.5 User Interface Requirements

- 3.5.1 The machine shall be supplied with a remote pendant with lead to enable operation at work area - 15m cable.
- 3.5.2 The machine and pendant shall have the following user interfaces:

3.6 Machine

- 3.6.1 Operator control switch (on/off switch to start and stop machine).

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3.6.2 Emergency stop button.

3.6.3 Local / remote switch (switching between front panel and remote pendant control)

3.6.4 Fault indicators

3.7 Remote Pendant

3.7.1 Heat on/off switch

3.7.2 Emergency stop

3.7.3 MIN 15m heat resistant cable and mechanical protection of cable

3.7.4 The remote control unit must not be permanently secured to the machine but rather be available as a plug in unit as required.

3.8 Safety

3.8.1 The Shot Peening System shall, as a minimum, include the following safety features:

- g) Overcurrent and short circuit Protection
- a) Proof shall be furnished that the system complies with the essential requirements of relevant health, safety and environmental protection legislation.
- b) Supplier to provide list of risks/hazards associated with machine operation as well as recommended mitigations.

3.9 Quality

The suppliers of all components/systems quality management system shall provide proof of adherence to ISO 9001:2015 or latest t standard.

3.9.1 Almen Strip Testing Equipment

Almen Strip testing equipment shall be included in the scope of supply as well as sufficient test strips for periodic testing to verify the shot peening parameters.

4. GENERAL REQUIREMENTS

All equipment and materials must be heavy duty, suitable for unattended continuous operation, ensuring a high degree of reliability and safe operation.

All moving parts of equipment must be adequately guarded. Access to lubrication points must be provided without the removal of components.

All tools required for the regular servicing of the equipment must be included.

The Supplier must guarantee the supply of all items and works supplied to be suitable for the process and operating requirements stated in this specification and specified standards.

The latest proven technology is to be incorporated in all designs in order to ensure high availability, efficiency and reliability.

All components requiring regular servicing, replacement or inspection must be readily accessible and easily replaceable by a small service team. All normal maintenance

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work on the equipment must be readily accomplishable by a small service team without the use of special tools within an eight-hour service period.

4.1 Documentation

The following documents shall be provided on quotation:

4.1.1 Technical Description of Induction System:

- a) Overall dimensions
- b) Power consumption
- c) Electrical mains requirements
- d) Weight

4.1.2 The following documents shall be provided on delivery (prior to commissioning):

- a) General arrangement drawings showing all leading dimensions and installation details
- b) Wiring diagrams
- c) Operating and maintenance instructions or manuals
- d) Installation and commissioning procedures
- e) Software user manuals if applicable.
- f) Declaration of conformity
- g) Data sheets
- h) Inspection and acceptance logs
- i) Training manuals
- j) Equipment list
- k) Spares List

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4.2 Material

- 4.2.1 All materials must be suitable for their purpose and must be in accordance with the relevant specifications. All material shall be completely free from all surface and internal imperfections, such as flaws, cracks and blow holes.
- 4.2.2 All material certificates are to be provided upon delivery.
- 4.2.3 All equipment must be adequately protected against corrosion.

4.3 Commissioning and Handover

- 4.3.1 Any tools required for the maintenance of the induction heating machine shall be provided on delivery. The tools shall be accompanied by a complete maintenance manual including but not limited to: design verification/validation, approved drawings and material specifications/data sheets
- 4.3.2 Operator theoretical and practical training for twelve (12) off ERI Employees. Training to be conducted at Rosherville. Operators shall be trained in the appropriate handling, loading, lifting, transportation, operating and maintenance procedures during handover and prior to commissioning on site. These operators shall be certified to use the machine by the supplier before the training is considered complete.
- 4.3.3 Repairs and service theoretical and practical training for ERI Employees. Training to be conducted at Rosherville. These operators shall be certified to use the machine by the supplier before the training is considered complete.
- 4.3.4 Service level agreement for 12 months after receipt of machines for maintenance and repairs including training.
- 4.3.5 Critical spares and repair kit to be supplied on handover.

5. COMPONENT INFORMATION AND GEOMETRY

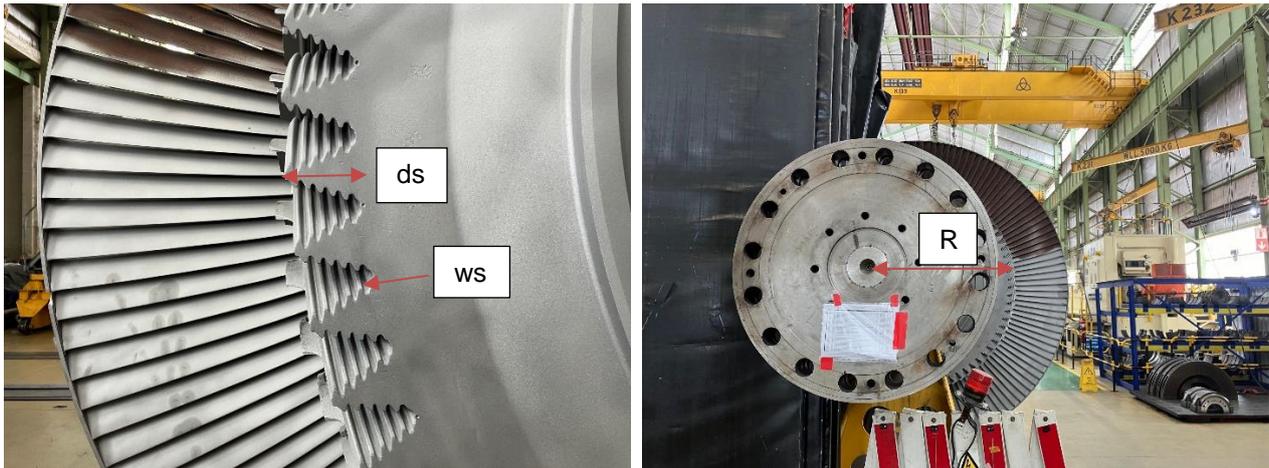
The pictures below show an example of the rotor disk blade roots to be shot peened.



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Some of the key dimensions are as follows:

Serration Outer Radius	1650mm (R)
Disk Width	250mm (W)
Serration C/L Radius	187mm (r)
Serration C/L Radius Offset	12.2mm (d)
Serration Depth	75mm (ds)
Minimum Serration Width	9.5mm (ws)

6. INVENTORY LIST

The following is a probable list of items the shot peening system may consist off. The supplier will issue the final list of parts on order placement.

Shot Peening parts

1. Shot peening guns
2. Shot peening nozzles
4. Wear plates
5. Pressure regulators
6. Shot peeners valves – Air inlet valves, abrasive metering valves, shut-off valves, media mixing valves, deadman valves, and pop-up valves
7. Shot peening cabinet windows
8. Shot peening cabinet grating
9. Shot peening hose
10. Shot peening room floor grating
11. Deadman controls, handles, and valves
12. Foot pedals
13. Dust collectors filters
14. Breathing air filters
15. Media separator screen and parts

Shot peening accessories and ancillary equipment

1. Air Blowguns
2. Shot peening hose back pressure tester

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3. Shot peening nozzle wear gage
4. Shot peening water additives - Passivates, Rust Inhibitors, and Antimicrobial agents
5. Dust suppressants
6. Industrial vacuums
7. Masking caps and shields
8. Material handling equipment
9. Media separators reclaimers and recyclers
10. Moisture traps, water separators, air dryers
11. Shot peening masking tapes, films, and materials

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