

	Scope of Work	Kusile Power Station
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1. Introduction

The inspection of the LP last stage blades and rotor steeples/serrations of Medupi and Kusile LP turbines are conducted in accordance with the original equipment manufacturer's recommendations. The inspection entails full surface non-destructive testing (NDT) on the blade aerofoil, the blade root and rotor last stage steeples. Both the blade root NDT and rotor steeples require the blades to be removed (blade-out), inspected and reinstalled at the workshop. This is to be carried out every 50 000 equivalent operating hours (EOHs).

An alternative to blade-out inspection (for access to the root) is in-situ phased array ultrasonic testing (PAUT) of the blade root. To reduce the risk of long outage durations and likelihood of outage slips related to the blade-out inspections of the LP last stage (also referred to as L-0) blade roots, the PAUT option is a preferred and recommended method.

There is currently no developed and qualified PAUT procedure to inspect these blade roots. It is crucial that a project is started to ensure that the procedure is developed and qualified to facilitate the inspection of the blade roots without the blades being removed from the rotor.

This document encompasses the Scope of Work (SoW) for the project to develop a LSB PAUT procedure for the Medupi and Kusile LPT's.

2. Supporting Clauses

2.1 Scope

2.1.1 Purpose

This document is aimed at detailing the scope of work required for the development and qualification of the Medupi and Kusile LP turbine last stage blades phased array ultrasonic testing or any other suitable inspection technique that could satisfy the requirements of this scope, the Non-Destructive Testing Inspection Qualification Standard [4], the flaw specification [2] and the inspection objectives [5].

The document is further aimed at the procurement of fourteen (14) test or dummy blades roots to be used during open and blind trials required as detailed in this scope of work.

2.1.2 Applicability

This document shall be applicable to Medupi and Kusile power stations.

2.1.3 Effective date

This document shall be effective from the date that it is authorised.

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2.2 Normative/Informative References

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

2.2.1 Normative

- [1] ISO 9001 Quality Management Systems
- [2] 474-12938 Medupi and Kusile LP Stage 6 (L-0) Flaw Specification Report.
- [3] 240-87660096 Non-Destructive Testing Inspection Qualification Standard
- [4] 240-83539994 Standard for Non-Destructive Testing (NDT) on Eskom Plant
- [5] 474-13092 Medupi and Kusile LP Stage 6 (L-0) Inspection Objectives

2.2.2 Informative

- [1] 474-12938 Medupi and Kusile LP Stage 6 (L-0) Flaw Specification Report

2.3 Definitions

Not applicable

2.4 Abbreviations

Abbreviation	Explanation
3D	Three dimensional
CAD	Computer aided design
EDM	Electric discharge machining
EOH	Equivalent Operating Hours
NDT	Non-Destructive Testing
LP(T)	Low Pressure (Turbine)
LSB	Last Stage Blade
PAUT	Phased Array Ultrasonic Testing

2.5 Roles and Responsibilities

As per the Standard for Non-Destructive Testing Inspection Qualification 240-87660096.

2.6 Process for Monitoring

N/A

2.7 Related/Supporting Documents

Refer to section 2.2.

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3. Scope of work

Medupi and Kusile Power Station low-pressure turbines (LPT) have two double flow sections, which are made up of six stages per flow. There are 53 last stage blades fitted to each side of the LPT with a hub diameter of 1420 mm and casing diameter of 2996 mm. The LPT LSB's are manufactured from St11NiE material. The exhaust area per flow is 5.5 m² with an exhaust temperature of ~40 °C. The last stage LP blades (L033K) have a curved axial entry fir tree root design with a total of 3 serrations (hooks) which for the purpose of this report are numbered from the highest radial position 1 (also referred to as the top serration or 1st serration), to the lowest radial position, 3 (also referred to as the bottom serration or 3rd serration). The blade features an integral snubber with the aerofoil having a highly twisted design. The mean blade length is 766 mm, with a mean snubber height of 592 mm and blade mass of ~17.8 kg. For more information, refer to [5] 474-13092 Medupi and Kusile LP Stage 6 (L-0) Inspection Objectives

3.1 Works information

The first part of this scope is for the manufacturing and supply by the Contractor the fourteen (14) test or dummy blades roots. The blades shall be manufactured using the material St11NiE or equivalent and will be in accordance with the 3D CAD drawings to be provided by the Employer.

The second part is for the successful Contractor (but different to the blades supply Contractor) to participate and/or undertake some activities required for the development and qualification of the in-situ phased array ultrasonic testing of last stage blades of the Kusile and Medupi low pressure turbine rotors.

The Contractor may propose other techniques other than the PAUT. The Contractor shall illustrate and validate any Technique in line with the Eskom NDT qualification standard.

The development and qualification process shall be in accordance with Eskom Standard for Non-Destructive Testing Inspection Qualification 240-87660096.

The following shall be provided to the Contractor by Eskom:

- a) The input data that includes the description of the blades, material of the blades and the operational history of the units where the blades are installed.
- b) Flaw specification report
- c) Inspection objectives
- d) 3D CAD drawings of the blade roots and the rotor steeples
- e) 14 Test or dummy blades consisting of the blades root and 100mm aerofoil above the root.
- f) The rotor for fitting of blades during blind trials

3.2 Expected deliverables from the Contractor.

3.2.1 Technical Justification

The technical justification shall comprise qualitative and quantitative analysis and data that validates the selection of the nondestructive testing technique of the system being offered. It shall comprehensively discuss, provide evidence and the adequacy of how the Employer's inspection objective will be met.

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During the technical justification (or later during the qualification process) it may be found that the inspection objectives are not obtainable. The Contractor may at that time recommend alternative inspection objections based on the results. The Employer reserves the right to amend/alter the inspection objectives, if required.

The essential variables of the NDT system shall be identified and categorized as fixed and variable parameters.

The Contractor should use simulation software (e.g., CIVA or other simulation tools) to simulate the inspection, determine the worse-case flaws and for optimizing the inspection.

The technical justification shall also detail the selection of the NDT equipment and its justification with regard to the Employer's inspection objective.

The inspection procedure shall be developed to facilitate the detection and sizing of the defects in accordance and within the parameters set in the inspection objectives.

3.2.2 Open trials

The Contractor shall insert EDM notches on the test blades/specimens to be provided by the Employer. The flaws shall be in line with the Contractor's technical justification and agreed with Eskom.

The Contractor shall supply all the hardware, software, tooling, rigs/scanners, probes, and any other equipment required for inspections.

The Contractor shall conduct open trials on test blades in order to practically demonstrate that the offered NDT system is capable of fulfilling the requirements of the inspection objective and that it validates and support the data presented in the technical justification.

The open trials will be performed by the Contractor at the Employer's facilities/workshop at the date/s agreed to between the two parties (the Employer and the Contractor).

The Contractor shall train the Employer's NDT Technician in line with the procedure and equip them with the know-how of using the equipment to be used during inspections.

3.2.3 Blind trials

Upon submission and acceptance of the technical justification and open trials results by the Contractor, the Employer will arrange the blind trials. The Employer shall be responsible for all activities related to the blind trials.

The Employer shall provide the test blade roots with flaws unknown to the Contractor for the purpose of the blind trials. The test blades will be fitted by the Employer into the rotor steeples to simulate the real conditions for blind trials.

Suitably qualified Contractor NDT Technicians shall be available for the blind trials to be conducted and evaluated by the Employer at the Employer's premises on the dates to be agreed on by both parties.

The Employer's NDT Technicians (ERI) shall form part of the Contractor's blind trial for assessment.

The blind trial results shall be used by the Employer as the ultimate performance assessment of the Contractor's NDT system capability and meeting the requirements of the inspection objectives. The

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Employer shall not accept under performance in blind trials and shall declare the Contractor as competent or not competent based on the blind trial results.

3.2.4 Qualification

When the Contractor's NDT system (NDT procedure, personnel/operator, and equipment) is declared successful by the Employer's qualification body, the system shall remain unchanged. Modification or substitution of the equipment, personnel or procedure shall render the system invalid and re-qualification shall be necessary.

The Employer's Level 3 NDT specialist together with the inspection qualification authority shall evaluate, accept, or reject the techniques and qualification processes if it does not meet the Employer's requirements.

Upon qualification, the certification of the personnel shall be issued by external national qualification authority. The validity of the certification shall be in accordance with the national qualification authority rules.

3.2.5 General Requirements

The Contractor shall provide records of similar works done in connection with qualification and implementation of PAUT on any other blade roots or similar plant. This shall include references.

The Contractor shall provide a program indicating the duration of each activity.

The Contractor shall provide a price list for the works.

4. Acceptance

This document has been seen and accepted by:

Name	Designation
	Senior Engineer - NDT
	Corporate Specialist – Structural Integrity
	Corporate Specialist - Turbines
	Senior Consultant - Turbines
	Middle Manager - NDT
	Senior Technologist - NDT

5. Revisions

Date	Rev.	Compiler	Remarks
March 2024	1		First Issue

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6. Development Team

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

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7. Acknowledgements

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