MANUFACTURE, SUPPLY, DELIVERY & COMMISIONING OF THE AUTOMATED UT SCANNER FOR CRR OF GENERATOR ROTORS

Document Identifier:	
Alternative Reference Number:	Not Applicable
Area of Applicability:	Eskom Rotek Industries SOC Ltd
Functional Area:	Turbo Gen Services
Revision:	4
Total Pages:	9
Next Review Date:	
Disclosure Classification:	Controlled Disclosure

Compiled by	Supported by	Functional responsibility
Tumelo Machaha	Steven Dube	Mr. Owen Makhubele
NDT Mechanical design draughtsman	NDT – Level 2 Technician	NDT HOD (Works)
Date: 14/06/2023	Date: 14/06/2023	Date: 14/06/2023

1. PURPOSE:

The purpose of this SOW is to provide the specifications and objectives of the NDT Automated Scanner for the Coil Returning Ring (CRR) inspection on Generator rotors, which needs to be procured for the NDT Department. The scanner should perform non-destructive testing (NDT) inspections to identify defects, cracks, or anomalies in the CRRs, ensuring their structural integrity and safe operation.

2. SUPPLY, DELIVERY, INSTALLATION & COMMISSIONING:

The supply, delivery, installation, and commissioning of the NDT automated generator retaining ring scanner involves the procurement of the scanner system from a supplier. The supplier is responsible for supplying the scanner, delivering it to the designated location, and overseeing the installation and commissioning process. This includes setting up the scanner, ensuring its proper functioning, and conducting necessary tests to validate its performance.

DETAIL SCOPE OF WORK & TECHNICAL SPECIFICATIONS

The scope of work for the NDT generator retaining ring automated scanner includes the following detailed specifications:

1. AUTOMATED SCANNER DESIGN

1.1 SCANNER SIZE AND CONFIGURATION:

- Modular Design: The automated scanner system should be designed as a modular system, allowing it to accommodate a range of sizes and configurations of Generator Retaining Rings (CRRs) used in different generator models and fleets.
- Diameter Range: The scanner should be capable of fitting CRRs with diameters ranging from 400mm to 2000mm.
- Axial Length Range: The scanner should be adjustable to fit CRRs with axial lengths between 300mm and 1000mm.

1.2 MODULARITY AND FLEXIBILITY:

- Adjustable Configuration: The scanner system should be designed with adjustable components, such as probe holders and supports, to accommodate different CRR diameters and widths within the specified ranges.
- Easy Setup and Adjustment: The modular design should provide ease of setup and adjustment, allowing operators to quickly configure the scanner to fit specific CRR dimensions. The mechanical setup should be performed by no more than two personnel.
- Quick Changeover: The scanner should facilitate quick changeover between different CRR sizes and configurations, minimising downtime during inspections. It should be designed for ease of use, allowing operators to quickly become familiar with the system and operate it efficiently.
- The scanner should have the least possible number of parts to facilitate the sign in process in the high-risk areas of Gen-Services (to limit the possibilities of component contamination on site and Rosherville workshop)

1.3 HEIGHT ADJUSTMENT MECHANISM:

- Out-of-situ scanning: The scanner should also be capable of scanning components when they are not in their operational position. This means that the scanner should have the flexibility to scan components that have been removed from the system or are accessible outside of their normal location.

1.4 CIRCUMFERENTIAL AND AXIAL SCANNING:

- Circumferential and Axial Scanning: The automated scanner should be capable of performing circumferential and axial scanning of the CRR surface, ensuring complete coverage.
- Adjustable Scanning Parameters: The scanner should use easily available off the shelf NDT Ultrasonic software for both mechanical and Ultrasonic parameters.
- The scanner needs to complete two CRR inspections with dimensions of (1000mm width and 2000mm diameter) within one shift (maximum 12 hours)

2. PROBE CONFIGURATION AND PROBE HOLDERS DESIGN

2.1 INTERCHANGEABLE PROBES:

- Compatibility: The automated scanner should support interchangeable probes suitable for the chosen Non-Destructive Testing (NDT) techniques, specifically: Ultrasonic Testing (UT), Ultrasonic Testing Phase Array (PA),Time of flight diffraction (TOFD) and Alternating Current Field Measurement (ACFM).
    - NOTE: If all techniques could be incorporated in one, this would be much more desirable.

2.2 PROBE HOLDERS:

- Rotation and Swivelling: The probe holders should allow rotation around their axis and swivelling in two opposite directions, minimum 45 degrees in two directions.
- Secure Locking: The holders should provide a secure locking mechanism to maintain the desired probe position during scanning, preventing unintended movement or misalignment.
- Tilt Capability: The probe head should have the ability to tilt at least 60 degrees in addition to swivelling. This allows for inspection of the chamfer areas of the CRR's

2.3 PROBE LOAD AND COUPLANT CONSIDERATIONS:

- Load Threshold: The scanner should be designed in such a way that the load applied on the probes does not result in scraping off of the couplant gel used while scanning.
- Couplant supply needs to be designed to apply a CRACK approved couplant medium.

3. NDT TECHNIQUES

The scanner should support multiple NDT techniques.

- Ultrasonic Testing (UT),
- Phased Array (PAUT) with Total Method Focusing (TMF) and / or Full Matrix Capture (FMC)
- Time of flight diffraction (TOFD)
- Alternating Current Field Measurement (ACFM)

3.1 SUMMARY TECHNIQUES DETAILED

3.1.1 Ultrasonic Testing (UT):

- UT is a widely used NDT technique that utilises high-frequency sound waves to inspect materials for internal flaws. In the context of the scanner, UT involves the use of ultrasonic transducers that emit and receive ultrasonic waves. These waves propagate through the CRRs and interact with any defects present, producing echoes that are analysed to determine the location, size, and characteristics of the flaws.

3.1.2 Phased Array (PA) with Total Method Focusing (TMF) and / or Full Matrix capture (FMC)

- Phased Array is an advanced ultrasonic testing technique that uses a specialised probe with multiple small ultrasonic elements. These elements can be individually controlled to emit ultrasonic waves at different angles and focal points. TMF is a sophisticated algorithm that optimises the beamforming process, allowing for improved focusing of the ultrasonic energy and enhanced defect detection capabilities. TMF enables the creation of high-resolution images that provide detailed information about the internal structure.
- FMC is a data acquisition technique commonly used in conjunction with Phased Array. It involves capturing a complete set of data by firing ultrasonic beams at multiple locations and recording the resulting echo signals. FMC captures the complete matrix of time-domain signals from all possible transmit-receive combinations of ultrasonic elements in the phased array probe. This data-rich approach enables advanced post-processing and beamforming algorithms, facilitating the creation of high-quality images and accurate defect characterisation.

3.1.3 Alternating Current Field Measurement (ACFM):

- ACFM is an electromagnetic NDT technique used to detect and size surface-breaking cracks. It relies on the interaction between an alternating current and the magnetic field created around the crack. A specialized ACFM probe generates an alternating current that induces a magnetic field in the vicinity of the crack. The probe then measures the changes in the magnetic field caused by the presence of the crack, allowing for the detection and characterization of surface defects.

NB: By supporting these NDT techniques, the scanner can provide a comprehensive inspection of the CRRs, ensuring the detection and characterisation of various types of defects, cracks, and anomalies. The combination of UT, PA with TMF, FMC, and ACFM offers a powerful set of tools to assess the structural integrity and safety of the CRRs used in generators.

4. DATA ACQUISITION SYSTEMS:

- The scanner should integrate with standard off the shelf data acquisition systems capable of capturing and recording NDT data during the scanning process. It should support real-time data visualisation and offline data analysis. The system should provide data resolution of at least (1mm X 1mm axial vs circumferential).

5. INSPECTION PARAMETERS:

- The scanner should allow built-in customisation of inspection parameters for both mechanical and Ultrasonic functions.

6. INSPECTION REPORTING:

- The scanner should generate comprehensive inspection reports that include information such as CRR identification, scanning parameters, detected defects, defect dimensions, and their locations. The reports should be customisable, printable, and exportable in standard file formats. The system should allow for storage and retrieval of inspection data for future reference and trend analysis.

7. SAFETY FEATURES:

- The scanner should incorporate safety features to protect operators and prevent damage to the CRRs. This may include emergency stop buttons, interlocks, protective enclosures, and visual or audible alarms. The system should adhere to relevant safety standards and regulations to ensure a safe working environment.

8. SYSTEM COMPATIBILITY AND INTEGRATION:

- The scanner should be compatible with existing NDT analysis software.

9. WARRANTY:

- The Generator Retaining Ring automated scanner will be provided with a warranty period to ensure the system's performance and reliability. During this warranty period, the supplier will be responsible for addressing any defects or malfunctions that may occur with the scanner. The warranty will cover the latest software updates, repair or replacement of faulty components or the entire system, depending on the nature and severity of the issue.

- Additionally, maintenance and support services will be included during the warranty period. The supplier will provide regular maintenance checks to ensure the scanner's optimal functioning and identify any potential issues. If any problems arise, the supplier will promptly address them to minimize downtime and ensure continuous operation of the scanner.
- The warranty and maintenance services aim to provide Rotek NDT with peace of mind and assurance that the Generator Retaining Ring UT automated scanner will operate reliably and effectively throughout the specified warranty period.

SCOPE OF WORK: DEMONSTRATION SERVICE

As part of the demonstration service for the NDT Ultrasonic testing generator retaining ring automated scanner, the supplier is expected to perform the following steps:

1. **SETUP AND CONFIGURATION:**

    - The supplier should ensure that the scanner is correctly set up and configured according to the specified requirements. This involves installing the necessary software, connecting the scanner to the data acquisition systems, and verifying the communication between the scanner and external devices.

2. **CALIBRATION AND VERIFICATION:**

    - The supplier should calibrate the scanner and verify its accuracy and performance using appropriate calibration standards and procedures. This includes checking the alignment, accuracy of scanning parameters, and functionality of the interchangeable probes.
    - The scanner should have a calibration lab within the boundaries of South Africa.

3. **DEMONSTRATION OF NDT TECHNIQUES:**

    - The supplier should demonstrate the NDT techniques supported by the scanner, such as Ultrasonic Testing (UT), Phased Array (PAUT) in addition Total Method Focusing (TMF) and / or Full Matrix Capture (FMC) and alternating current field measurement (ACFM). The demonstration should showcase the scanner's capability to detect defects, cracks, and anomalies in the CRRs using these techniques.

4. REAL-TIME DISPLAY:

- The demonstration will include a real-time display of the scanning process on a monitor or screen, allowing participants to observe the movement of the scanner, position of the transducers, and the acquired ultrasonic and Eddy current data.

5. SCANNING PROCEDURES:

- The supplier should explain and demonstrate the scanning procedures using the scanner. This includes demonstrating the motorised scanning mechanism, adjusting scanning parameters, and demonstrating both transverse and longitudinal scanning modes.
- The purchase of the scanner shall include a qualification process that shall be used to qualify the inspection at a later date for Rotek NDT clients' purpose.

6. TRAINING AND DOCUMENTATION:

- The supplier of the Generator Retaining Ring UT automated scanner shall provide comprehensive training to the users, including scanner operation, maintenance, troubleshooting, and safety procedures. In addition, detailed documentation, including user manuals, technical specifications, and software guides, should be provided.

7. DATA ACQUISITION AND ANALYSIS:

- The supplier should demonstrate the scanner's data acquisition capabilities by performing real-time data visualisation, waveform analysis, image processing. The supplier should demonstrate the quality of the data obtained minimum resolution of (1mm X 1mm) and explain the software tools available for data analysis and reporting.

8. CUSTOMISATION AND REPORTING:

- The supplier should demonstrate the scanner's ability to customise inspection parameters (frequency, gain, threshold levels, filtering options) based on the specific requirements of the CRRs being inspected.

9. HEALTH AND SAFETY

Health and safety considerations for the NDT UT generator retaining ring automated scanner should include the following:

9.1. OPERATOR SAFETY:

- The scanner should incorporate safety features to protect operators during the scanning process. This may include emergency stop buttons, interlocks, protective enclosures, and visual or audible alarms. The system should adhere to relevant safety standards and regulations to ensure a safe working environment.

9.2. CRR PROTECTION:

- The scanner should be designed to prevent damage to the CRRs during the inspection process. Care should be taken to avoid any excessive pressure, vibrations, or impacts that could potentially compromise the structural integrity of the CRRs.

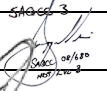
9.3. ENVIRONMENTAL SAFETY:

- The scanner should meet environmental safety standards and regulations to ensure that its operation does not pose any risks to the surrounding environment. This may include adherence to noise level limits, emission standards, and proper waste disposal practices.

9.4 PERSONAL PROTECTIVE CLOTHING:

- Operators using the NDT UT generator retaining ring automated scanner should be provided with appropriate personal protective clothing.

10. DOCUMENT SUPPORTED BY:

NAME	POSITION	SIGNATURE	DATE
Tumelo Machaha	NDT Mechanical Design Draughtman		14/06/2023
Steven Dube	NDT Level 2 Technician		14/06/2023
Dean Van Wyk	NDT Level 2 Technician		14/06/2023
Devonne Appollis	NDT Level 2 Technician		14/06/2023
Cavin Govender	NDT Asset Controller		14/06/2023
Owen Makhubele	NDT Services Manager		14/06/2023