	<b>Standard</b>	<b>Technology</b>
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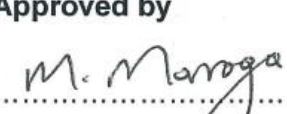
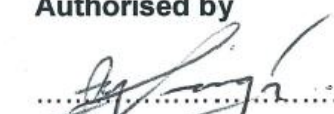

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## **1. INTRODUCTION**

Tube-SOLO (Tube - Steam Oxide Life Optimization) is a technology that is used to carry out creep damage analysis on high and low alloy boiler tubes. Creep remains one of the leading boiler tube failure (BTF) mechanisms in Eskom. The technology involves the combination of Non-Destructive Testing (NDT) and metallurgical analysis to examine the condition of boiler tubes by estimating the remaining tube life.

Tube-SOLO consists of two processes.

- a) Non-Destructive Testing using a thickness gauge.
- b) Boiler tube creep management strategy.

Tube-SOLO is performed using advanced ultrasonic testing (UT) thickness gauges that have many powerful measurement features. The gauges are able to measure precisely the thickness of multilayer materials with a single transducer. The measured layers (i.e. remaining wall and internal oxide scale) are used with unit operating data to estimate the remaining creep-rupture life of a tube. The metallurgical data acquired from sampling is then used to verify the Tube-SOLO data and the replacement programs are generated based on consolidated results.

The intention of this document is to specify requirements for implementing and managing Tube-SOLO effectively on Eskom plants.

## **2. SUPPORTING CLAUSES**

### **2.1 SCOPE**

The scope applies to steam boiler tubes operating in the creep regime ( $>450^{\circ}\text{C}$ ), where Long-term Overheating Creep (LTOC) BTFs may occur.

#### **2.1.1 Purpose**

The purpose of this document is to provide standardised technical and functional requirements to effectively implement and manage Tube-SOLO inspections on Eskom boiler plants.

#### **2.1.2 Applicability**

This document shall apply to all Eskom's coal-fired boiler plant heat exchanger tubing operating in the creep regime, mainly:-

- a) Superheaters; and
- b) Reheaters

### **2.2 NORMATIVE/INFORMATIVE REFERENCES**

Parties using this document shall apply the most recent edition of the documents listed below.

#### **2.2.1 Normative**

- [1] ISO 9001 Quality Management Systems.
- [2] 240-136432227: Eskom Tube-SOLO Work Instruction.
- [3] 240-83539994: Standard for Non-Destructive Testing (NDT) on Eskom Plant.

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- [4] 240-80180993: Standard for Boiler Tube Creep Management in Eskom Plant.
- [5] 240-87660096 Non Destructive Testing Inspection Qualification Standard

### 2.2.2 Informative

- [6] ASME 5 – Non-destructive Examination.
- [7] EPRI Fourth Edition Boiler Condition Assessment Guideline.
- [8] 240-84418020: Tube-SOLO Sandblasting procedure.
- [9] ECNDT 2006 - Mo.2.8.3 Article: Ultrasonic Thickness Measurement of Internal Oxide Scale in Steam Boiler Tubes.
- [10] BS EN 15317: Non-destructive testing - Ultrasonic testing - Characterization and verification of ultrasonic thickness measuring equipment.
- [11] Impact of oxidation on creep life of superheaters and reheaters, Published in OMMI, 2009, Volume 6, Issue 1, April.
- [12] SSPC-SP 5 - NACE No.1 Surface Preparation Standard for White Metal Blast Cleaning

### 2.3 DEFINITIONS

Definition	Description
Creep	The tendency of a solid material to move slowly or deform permanently under the influence of mechanical stresses. Creep is more severe in materials that are subjected to high temperatures for long periods, and generally increases as they near their melting point.
High Alloy	CrMoV all alloys containing >5% Cr but < 12.5% Cr
Low alloy	CMoV steel, all alloys containing < 5% Cr, < 2% Ni, < 3% Mo
Residual life	That part of the life of a component remaining before expected failure due to creep damage, wall loss or crack mechanisms.
Site Metallurgist	An Eskom appointed Metallurgical Engineer/Technologist/Advisor that is responsible for advising a Power Station with regard to remaining life analysis of high temperature / high pressure components
UT Level 1, Level 2 and Level 3	The person authorised by the NDT Service Provider who is competent in accordance with the requirements of standard 240-83539994.
RT&D Tube-SOLO Technician	An Eskom RT&D appointed NDT Engineer/Technician/Advisor that is responsible for implementing and managing Tube-SOLO Inspections on site.
Competency Certificate	Written Eskom confirmation that NDT personnel are satisfactorily competent to perform Tube-SOLO on Eskom plant without the need for direct supervision by the RT&D Tube-SOLO Technician. Approval shall be as per 240-83539994.
Competency Assessment	A performance demonstration by the operator to assess whether they are competent to perform Tube –SOLO operations on Eskom Plant
Verification samples	Tube samples that have been removed as a result of the inspection to verify inspection data.

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### 2.3.1 Disclosure Classification

**Controlled disclosure:** controlled disclosure to external parties (either enforced by law, or discretionary).

## 2.4 ABBREVIATIONS

Abbreviation	Description
BTF	Boiler Tube Failure
ECNDT	European conference on Non-Destructive Testing
EPEI	Eskom Production Engineering Integration
EPRI	Electric Power Research Institute
GO	General Overhaul
ISO	International Organization for Standardization
LTOC	Long-term Overheating Creep
NDT	Non-Destructive Testing
NPA	Non Destructive Testing Personnel Approval
QC	Quality Control
Rep	Representative
RT&D	Eskom Research Testing and Development
SSPC	Steel Structures Painting Council (The Society for Protective Coatings)
Tube-SOLO	Tube Steam Oxide Life Optimization
UT	Ultrasonic Testing

## 2.5 ROLES AND RESPONSIBILITIES

### 2.5.1 Eskom System or Boiler Engineer

- Shall consult with all stakeholders to ensure that the final scope of work is both relevant and executable before it is approved.
- Shall ensure that the verification samples (see section 3.1.6) are included in the scope of work.
- Shall issue the approved scope of work to the outage coordinator or project coordinator for execution and distribution to the Tube-SOLO Team (see 3.5.1) before the outage starts.
- Shall provide a list of replaced tubes at the end of the outage to consolidate the results and reports before final issue to the RT&D Tube-SOLO Technician. The list Shall focus on the areas specified in the Tube-SOLO scope of work.

### 2.5.2 Eskom Tube-SOLO Outage Coordinator or Project Coordinator

- Generally appointed by the outage manager.
- Shall distribute the approved scope of work to the Tube-SOLO Team (see section 3.5.1) before the outage starts.
- Shall ensure that the NDT Service Provider who shall be issued with the contract has a Tube-SOLO competency certificate from Eskom RT&D before performing Tube-SOLO work on Eskom plant.

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- d) Shall provide the following Tube-SOLO details during planned and unplanned outages to the Tube-SOLO Team.
  - I. Scaffolding program.
  - II. Sandblasting program.
  - III. Planned inspection window.
  - IV. Replacement program in areas where Tube-SOLO inspections are planned.
- e) Shall manage all activities relating to implementing Tube-SOLO on Eskom plant, including:-
  - I. Appointing a competent person to mark areas to be inspected.
  - II. Providing sandblasting feedback to the Tube-SOLO Team.
  - III. Ensuring that the verification samples that have been scoped or requested by the boiler engineer and/or site metallurgist have been removed, labelled, sandblasted and transported to Eskom RT&D.
  - IV. Ensuring that the training tube samples (see 3.1.7) that have been requested by the NDT Service Provider or RT&D Tube-SOLO Technician have been secured for collection.
- f) Shall ensure that the NDT Service Provider and sandblasting contractor have fulfilled their roles and responsibilities specified in this document before they leave site or before payments are made. All relevant stakeholders must be consulted for feedback.
- g) Shall be responsible for setting up the following meetings (team specified in section 3.5.1.).
  - I. Implementation & clarification meeting before the start of the outage.
  - II. Post-mortem and close out meeting at the end of the outage.
  - III. Issuing NDT report of activities conducted on site in accordance with Eskom Standard 240-83539994

### **2.5.3 RT&D Tube-SOLO Technician**

- a) Shall manage all of the inspection requirements relating to the implementation of Tube-SOLO on Eskom plants.
- b) Shall provide Tube-SOLO training to new NDT Service Providers who have not been trained in this technique. Thereafter the training is the responsibility of the NDT service provider, who shall apply for competency certification of personnel applying this method on Eskom plant.
- c) Shall facilitate blind trials for the competency assessment of operators who meet the requirements in section 3.3.1.
- d) Shall maintain a list of Tube-SOLO competent NDT Service Providers and UT technicians on hyperwave.
- e) Shall assist with the implementation of the Tube-SOLO activities on Eskom plant as and when required.
- f) Shall approve the following during an outage:-
  - a. Sandblasting quality.
  - b. Results and reports
- g) Shall distribute the approved results and reports to all stakeholders or may authorize the NDT service provider to do so.
- h) Shall ensure that the NDT Service Providers approved to implement Tube-SOLO comply with the Eskom Tube-SOLO work instruction (240-136432227) and the provisions of this standard.
- i) Shall supply NDT Service Providers approved for the first time with ten calibration samples (see section 3.1.5).

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### **2.5.4 RT&D NDT Level 3**

- a) Shall issue the certificate of competence for both Service Provider and technicians in accordance with Eskom Standard for Non-Destructive Testing (NDT) on Eskom Plant 240-83539994.
- b) Shall ensure that RT&D Tube-SOLO Technicians involved in Tube-SOLO have the required NDT training and certification (UT Level I).

### **2.5.5 NDT Service Provider**

- a) Shall be responsible for ensuring that all NDT personnel meet all of the requirements of the Eskom Standard 240-83539994 and have a competency certification issued by Eskom RT&D NDT Level 3..
  - Where sub-contracted labour is used the employer is responsible for ensuring that all the NDT personnel of the sub-contractor meets all of the provisions specified in this standard and Eskom Standard and have a competency certification issued by Eskom RT&D NDT Level 3.
- b) Shall not authorise an employee to undertake duties beyond that for which the individual is certified or approved by Eskom to do.
- c) Shall ensure work is undertaken in accordance with relevant and authorised procedures for performing Tube-SOLO on Eskom plant.
- d) Shall be responsible for ensuring compliance with safety requirements relating to implementing Tube-SOLO on Eskom plant.
- e) Shall ensure that all the provisions of this standard relating to their company are implemented.
- f) Shall be liable for all non-conformances raised against their company.

### **2.5.6 UT Level 1 Operator**

- a) Shall perform Tube-SOLO in accordance with the Eskom Tube-SOLO work instruction (an Eskom inspection procedure).
- b) Shall report all Tube-SOLO related activity issues to their supervisor, including:-
  - a. Sandblasting quality challenges (i.e. inability to receive correct UT signals or insufficient scanning area)
  - b. Scaffolding challenges.
  - c. Access challenges (e.g. confined spaces, work environment conditions etc.)
- c) Shall have a competency certification issued by Eskom RT&D NDT Level 3.
- d) Shall not be appointed as the supervisor for Tube-SOLO activities on Eskom plant.

### **2.5.7 UT Level 2 Operator**

- a) Shall be appointed as the supervisor.
- b) Shall have a competency certification issued by Eskom RT&D NDT Level 3
- c) Shall manage the implementation of Tube-SOLO inspection on site.
- d) Shall ensure that the approved UT Level I operators implement the Eskom Tube-SOLO work instruction during an outage.
- e) May be authorised by the RT&D Tube-SOLO Technician to approve sandblasting quality depending on experience acquired. Minimum experience required:
  - 1) Should have implemented three Tube-SOLO scopes of work on the same boiler.
  - 2) Should have knowledge of the reheaters and superheaters circuits specified in the scope of work (this includes: headers; inlet and outlet legs, intermitted legs, etc.).

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- f) Shall report all challenges relating to the implementation of Tube-SOLO activities to the Tube-SOLO Team (see 3.5.1).
- g) Shall audit all the outputs before issuing them to the RT&D Tube-SOLO Technician for approval.

### **2.5.8 UT Level 3 Operator**

- a) Shall be responsible for requesting Tube-SOLO approvals and renewals.
- b) Shall have a competency certification issued by Eskom RT&D NDT Level 3
- c) Shall be responsible for ensuring that the NDT personnel on site are authorised and approved for the inspection.
- d) Shall ensure that their UT operators can apply the Eskom Tube-SOLO work instruction.
- e) Shall implement all of the provisions relating to the NDT Level III that are specified in the Eskom Standard for Non-Destructive Testing (NDT) on Eskom Plant 240-83539994.
- f) Shall be responsible for managing the training of NDT personnel for Tube-SOLO (see section 3.3).
- g) Shall conduct site audits to ensure that the approved NDT operators implement the Eskom Tube-SOLO work instruction and provisions of this standard.

### **2.5.9 NDT Service Provider's Project Coordinator**

- a) Shall coordinate and facilitate the project.
- b) Shall assist the supervisor with compiling the results and reports.
- c) May not audit or authorise the results and reports relating to Tube-SOLO.
- d) May distribute the audited outputs for approval to the RT&D Tube-SOLO Technician.
- e) Shall be responsible for requesting training samples (see section 3.1.7) from the Eskom Tube-SOLO Outage Coordinator or Project Leader.

### **2.5.10 Sandblasting Contractor**

- f) Shall implement the scope of work.
- g) Shall prepare the surface as specified by the Eskom Tube-SOLO work instruction (240-136432227).
- h) Shall issue the sandblasting quality report to the Tube-SOLO Team.

## **2.6 PROCESS FOR MONITORING**

- The responsibility to comply with the requirements of this document lies with the Tube-SOLO NDT Technician and Eskom Level III.
- The control and monitoring of Tube-SOLO activities performed on Eskom plant shall be in accordance with the requirements of this standard.
- Periodic audits on approved NDT Service Providers shall be conducted against the requirements of this document by the Tube-SOLO NDT Technician.

## **2.7 RELATED/SUPPORTING DOCUMENTS**

- [13] 240-84418036: Tube-SOLO NDT Inspection procedure.
- [14] 240-84418020: Tube-SOLO Sandblasting procedure.
- [15] 240-80180993: Standard for Boiler Tube Creep Management in Eskom Plant.

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### **3. TECHNICAL REQUIREMENTS**

#### **3.1 EQUIPMENT REQUIREMENTS**

##### **3.1.1 Ultrasonic thickness gauge minimum specification**

- Single element transducer default setup.
- Digital display and A-scan presentation (waveform display).
- Thickness, velocity, and time-of-flight measurements capability.
- Able to precisely measure multilayer materials (i.e. the gauge must be able to displays the different multi-layer thickness in millimetres).
- Shall be portable, single operator.
- Measurement mode:
  - Single element transducer - Mode 2: Time interval between the delay line echo and the first back-wall echo. Due to delay laws.
- High resolution software option of 0.001 mm or 0.0001" with single or dual element transducer.
- Standard resolution of 0.01 mm or 0.001" for all transducers.
- Minimum Display: LCD or VGA display with indoor and outdoor light settings.
- Data logger: Able to save a minimum of 10,000 waveforms with thickness measurements.
- Able to transfer data to a computer using an interface program.
- Meet the requirements of EN15317 or approved equivalent.

##### **NB:**

All ultrasonic equipment suitable for Tube-SOLO must meet or exceed the performance of the Eskom's Tube-SOLO ultrasonic NDT work instruction (240-136432227). New equipment that may be compatible with the above specification must undergo a qualification process as required by the Eskom Non Destructive Testing Inspection Qualification Standard (240-87660096).

##### **3.1.2 Transducer specification**

- a) Must have a small foot print (i.e. smallest surface area contact).
- b) Probe tip diameter: 6mm to 8mm
- c) Delay lines (wedge) tip diameter: 6mm to 8mm
- d) Frequency range: 20MHz to 30MHz
- e) Single or dual element contact transducer.
- f) Wall thickness range: 1.0mm to 12mm.
- g) Oxide thickness range: 0.20mm to 1.25mm.

##### **3.1.3 Couplant requirements**

- Thick and sticky semi-fluids (non-dripping)
- Density close to 1400 kg.m<sup>-3</sup> at room temperature.

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- The couplant must not harm the component to be inspected or represent a health hazard to the operator and must meet the Eskom standard for chemical restriction and control.
- The coupling medium shall be chosen to suit the surface conditions and the profile of the surface to ensure adequate coupling.

#### **3.1.4 Calibration step wedge design (wall thickness)**

- This shall be manufactured using material that shall be tested.
- Typical material being tested on Eskom boiler plant:
  - DIN St35.8 (ASME/ASTM SA-192)
  - DIN 15Mo3 (ASME/ASTM SA-209 T1)
  - DIN 13CrMo44 (ASME/ASTM SA-213 T11 or BS3059 620)
  - DIN 10CrMo9-10 (ASME/ASTM SA-213 T22 or BS3059 622)
  - DIN X20CrMoV12-1
- Thickness sizes: 2mm, 4mm, 6mm, 8mm, 10mm, 12mm

#### **3.1.5 Calibration tube samples (oxide thickness)**

- Eskom RT&D shall provide new Tube-SOLO NDT service providers with only six calibrating samples.
- Typical material being tested on Eskom boiler plant:
  - DIN St35.8 (ASME/ASTM SA-192)
  - DIN 15Mo3 (ASME/ASTM SA-209 T1)
  - DIN 13CrMo44 (ASME/ASTM SA-213 T11 or BS3059 620)
  - DIN 10CrMo9-10 (ASME/ASTM SA-213 T22 or BS3059 622)
  - DIN X20CrMoV12-1
- The samples shall cover the minimum, middle and maximum readings.
  - Wall thickness range: 3.00mm and 12.00mm.
  - Oxide thickness range: 0.20mm and 0.80mm.
  - Outside diameter (OD) range: 30mm and 70mm.
    - Note: The OD of the tubes that shall be supplied to the NDT service providers shall not have any influence on the readings measured because of the probe's small footprint.
  - A maximum of four readings shall be measured around the circumference of the tube samples (i.e. at 0°, 90°, 180 and 270°).
- The oxide and wall thickness readings shall be labeled on the external surface of each sample.
- The samples shall be catalogued and labelled clearly.
- The samples shall be referenced on the reports.
- The tube sample height shall not exceed 100mm for handling purposes.

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### **3.1.6 Verification tube samples**

- These are tubes removed to validate data (NDT) and calibrate inspection results (metallurgist).
- The tubes should be selected based on recent inspection results.
- The tube length should not exceed 500mm.
- The quantity or size shall be specified by the site metallurgist and/or system or boiler engineer.
- The relevant station shall transport the tube samples to the RT&D Tube-SOLO Technician.

### **3.1.7 Training samples**

- Eskom power station shall provide tube samples to be used for training. Stakeholders who are interested must communicate with outage in accessing tubes of interest.
  - The tubes shall not be sandblasted. Sandblasting is the responsibility of the stakeholder.
- The tubes removed should only be from the superheaters and reheaters that are in the scope of work or tubes that have internal oxide scale.
- The quantity shall depend on available material removed from Eskom plant as a result of planned maintenance programs.
- The collection of the samples from site is the responsibility of the stakeholder.

## **3.2 SITE INSPECTION REQUIREMENTS**

### **A. Personnel minimum requirements:-**

- Two UT Level 1
- One UT Level 2
- One UT Level 3
- One project coordinator

The NDT service provider may supply Eskom with more personnel to reduce the inspection duration.

### **B. Maximum average scanning pattern for the following stations:**

- a) Duvha, Grootvlei, Hendrina, Kriel, Majuba, Matimba and Tutuka
  - 2.80 minutes per tube (4 scans taken).
- b) Arnot, Camden, Kendal, Komati, Lethabo, Matla
  - 2 minutes per tube (4 scans taken).

This includes the movement between elements and tubes.

### **C. Estimated duration:-**

The equation below provides a guideline in estimating the inspection duration:-

Estimated duration (days) = (total number of tubes to be inspected × max average scanning pattern) / 60 minutes / hours per shift / total number of full equipment available.

The estimated inspection duration does not include the following:

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- Safety requirements
- Delays
- Rigging
- Data analysis (see section 3.5.2)

**D. Site provisions:**

- All areas must be cleaned to SA3 surface finish or as prescribed in the Eskom Tube-SOLO work Instruction.
- Sufficient lighting, i.e. ~1300 lumens (or 1300 lux) per square meter spread across the area to be inspected (100Watts = 1300 lumens).
- Safe scaffolding.
- Permit to work.

### **3.3 TUBE-SOLO COMPETENCY CERTIFICATION CRITERIA**

- The Tube-SOLO training shall only be offered to NDT service providers as and when required.
- Retraining shall only be offered to NDT Level 3's, provided:
  - They are new in the company.
  - They have not applied Tube-SOLO in past two years.
- No competency certificates shall be offered if the training prerequisites are not met.
- Eskom can at any time suspend or revoke the competency certificate provided the following can be proven:
  - The NDT Service Provider has failed to comply with or implement the requirements of the certification.
  - The NDT Service Provider has deviated from implementing the Eskom Tube-SOLO work instruction 240-136432227.

#### **3.3.1 Training prerequisites:**

- a. Minimum personnel requirements:
  - i. Two UT Level 1 operators.
  - ii. One UT Level 2 operator.
    - Preferably also certified on one advanced NDT method: PAUT, TOFT, GUL etc.
  - iii. One UT Level 3 operator.
- b. Minimum equipment requirements:
  - i. Two qualified thickness gauges.
  - ii. Two qualified transducers.
  - iii. Four step wedges.
  - iv. One approved couplant.
- c. NDT service provider's Level 3 shall submit a formal request for competency certification to Eskom RT&D.

#### **3.3.2 Training criteria**

The training at RT&D shall be offered as and when required to all NDT Service Providers who have contracts with Eskom to implement Tube-SOLO.

Training shall cover the following areas:-

1. Theory and background (2 hours per team).
2. Eskom work instruction (procedure) and calibration (3 hours per team).

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3. Open trails (3 hours per team).
4. Blind trials (3 hours per technician).

### **3.3.3 Competency certification criteria**

- a) Technicians shall be examined on the following:
  1. Equipment operation.
  2. Calibration criteria.
  3. 240-136432227: Eskom Tube-SOLO Work Instruction.
  4. Blind trials samples.
- b) There shall be three classifications of technicians to be considered when processing the certification:
  1. NDT operator who can work independently. This is the operator who has passed the examination specified in a) above and have successfully implemented Tube-SOLO independently on site during the limited competency certification.
  2. NDT operator who cannot work independently. This is the operator who has passed the examination specified in a) above but has failed to implement Tube-SOLO independently on site during the limited approval.
  3. NDT operator that cannot apply Tube-SOLO. An operator who has failed the examination specified in a) above.

### **3.3.4 Competency certification types**

#### **3.3.4.1 Limited Competency Certification**

- A. This certificate shall be issued to NDT Service Providers who shall be working under close supervision by the RT&D Tube-SOLO Technician.
- B. The following NDT Service Providers shall be eligible for this certificate:
  - i. New NDT service providers who have never applied Tube-SOLO on Eskom plant.
  - ii. NDT Service Providers who have not implemented a minimum of two inspection scopes over the past two years.
  - iii. NDT Service Providers whose full competency certification has been revoked because they did not meet the full certification conditions or requirements.

NB: NDT Service Providers who wish to add more UT operators can do so at any time after the competency certificate has been issued provided they can submit proof of training and have completed a successful blind trial at RT&D.

#### **3.3.4.2 Full Competency Certification**

- a) This certificate shall be issued to NDT service provider who shall be working under no or minimum supervision from the RT&D Tube-SOLO Technician.
- b) The following NDT Service Providers shall be eligible for the certificate:-
  - 1) NDT Service Providers who have shown acceptable performance on a minimum of two inspection scopes on Eskom plant under supervision. If more than two inspection scopes have been implemented, ALL these shall be acceptable for the certificate to be granted.
  - 2) NDT Service Providers who have successfully applied a minimum of two inspection scopes during the full certification.

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- 3) NDT Service Providers who have implemented successfully one inspection scope during the previous full competency certificate but have implemented successfully a minimum of 4 scopes within the past 2 years.

NB: NDT Service Providers who wish to add more UT operators can do so at any time after the full competency certificate has been issued provided they can submit proof of training and complete a successful blind trial at RT&D.

### **3.3.5 Competency certification**

The letter shall include the following information:

- a. Company details
- b. Approval type (full or limited).
- c. Conditions and restrictions for the issued certificate.
- d. Certification expiry date which shall be aligned with the approval to perform NDT on Eskom plant.
- e. Details of the approved operators with conditions.
- f. Authorisation signatures.

### **3.3.6 Renewal process**

- a. Approvals shall be renewed yearly as required by the Eskom standard 240-83539994.
- b. The NDT service provider's Level 3 shall formally request for the renewal from the Eskom RT&D Tube-SOLO Rep and NDT Level 3.
- c. The renewal of the full competency certification without blind trials shall only be granted to NDT service providers with acceptable performance on all site inspections scopes.
- d. Additional conditions for the renewal of the limited competency certification are specified in section 3.3.4.

## **3.4 KEY COMPETENCY REQUIREMENTS**

### **3.4.1 NDT Service Provider:**

- Able to operate advanced UT equipment (A-scan waveform).
- Project management skills. Managing NDT project for a minimum of 3 years.
- Data capturing.
- Computer literacy (Microsoft Office and pdf). Proof of training may be requested (e.g. certificate).
- Report writing skills.

### **3.4.2 RT&D Tube-SOLO Technician**

- Candidate must have completed, as a minimum, UT Level 1 certification.
  - If not certified the candidate must complete a certification on UT Level 1 within 2 years.
  - Furthermore, he/she must complete a UT Level 2 within 4 years.
- Minimum qualification: Diploma in any engineering field.
- An understanding or appreciation of oxidation behavior of power plant steels. Informal training shall be scheduled with senior metallurgist.
- 1 year minimum experience gained under senior supervision on Tube-SOLO application.

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- Knowledgeable of Eskom boiler components (e.g. reheater, superheater etc.)
- Able to read boiler drawings.
- Computer literacy.
- Report writing skills.

### **3.5 TUBE-SOLO OUTPUTS**

#### **3.5.1 Communication channels**

Communication relating to Tube-SOLO shall be done through the Eskom formal medium of communication.

Tube-SOLO Team:

- RT&D Tube-SOLO Technician.
- RT&D site metallurgist.
- Eskom boiler engineer or system engineer.
- Eskom outage coordinator or project coordinator.
- NDT service provider project coordinator and supervisor.
- Sandblasting contractor's supervisor.

#### **3.5.2 Inspection outputs**

1. Eskom Outage coordinator/project leader:

- Ensure that the following contracts are in place:
  - Competent NDT service provider for TUBE-SOLO.
  - Grit blasting.
- Contract for the sandblasting service provider.
- Tube-SOLO outage program.
- Tube-SOLO scope of work.

2. Sandblasting contractor:

- Daily progress reports
- Approved quality report (after sandblasting has been completed)

3. NDT service provider:

- Sandblasting quality feedback (including confirming fire-side sandblasting)
- Daily inspections feedback
- Inspections raw data.
- Inspection results (excel spreadsheet).
- Inspection Reports (Microsoft word or pdf)

4. RT&D Tube-SOLO Technician:

- Sandblasting quality checks:
- Review and approve the following outputs:-
  - Inspection raw data
  - Inspection results
  - Inspection reports

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- Final results shall be issued within one month of the completion of the inspection.
- Signed reports shall be issued within two months of the completion of the inspection.

If there is more than one outage at the same power station, it is recommended that different output deadlines should be set by the Tube-SOLO Team specified in 3.5.1.

#### 4. AUTHORISATION

This document has been seen and accepted by:

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#### 5. REVISIONS

Date	Rev.	Compiler	Remarks
March 2019	0	V Ralefeta	To implement and manage TUBE-SOLO NDT competencies
March 2019	0.1	V Ralefeta	Final Draft after Review Process
March 2019	1	V Ralefeta	Final Document for Authorisation and Publication

#### 6. DEVELOPMENT TEAM

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

- Andrew Downes
- Grant Meredith
- Michael Mkhize

#### 7. ACKNOWLEDGEMENTS

- Tebogo Moipolai
- Dheshan Naran
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- Michael Mkhize

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