Eskom	Scope of Work	Kusile Power Station

Title: **Kusile Power Station Unit 1-6 Pressure Parts Tube SOLO 5-year contract Scope Of Work**

Document Identifier: **KUS-20250547**

Alternative Reference Number: **N/A**

Area of Applicability: **Kusile Power Station**

Functional Area: **Outage Management**

Revision: **1**

Total Pages: **12**

Next Review Date: **30 May 2030**

Disclosure Classification: **Controlled Disclosure**

Compiled by	Supported by	Functional Responsibility	Authorized by
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Date: 27/05/2025	Date: 2025/06/04	Date: 2025/06/11	Date: 2025-06-12.

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1. Introduction

Kusile Power Station Management has taken a decision to outsource Boiler pressure part Tube-SOLO (Tube - Steam Oxide Life Optimization) Scope to a suitably qualified, experienced and well-established Contractor. This document describes the detail of the applicable areas in the boiler, scope of work, standards, quality, requirements, specifications, terms & conditions as well as the criteria to qualify for the tender.

2. Supporting Clauses

2.1 Scope

2.1.1 Purpose

The purpose of this document is to define the specified scope of work activity requirements for Kusile Power Station. The station is expected to perform at 85% EAF, 10% PCLF and 5% UCLF, and the specified Tube-SOLO outage activities and management strategy efforts must support this requirement. It is therefore imperative that the successful and suitably qualified Contractor aligns his/her organisation fully to these specified scope activities and processes laid down in this document.

The SOW deliverables are as follows:

a. Conduct quality check on the sandblasted areas (including confirming fire-side sandblasting)
b. Conduct Tube-SOLO in accordance with the Eskom Tube-SOLO SOW.
c. Daily inspections feedback
d. Submit Tube-SOLO inspections raw results (in **excel spreadsheet**) to the plant Tube-SOLO custodian and Engineering.
e. Submit finalised Tube-SOLO inspection report in **pdf** to the plant Tube-SOLO custodian and Engineering.

2.1.2 Applicability

This document shall apply throughout Eskom Kusile Power Station Unit 1-6 that are on commercially operational. The document serves as a reference for both the contractor and Eskom to ensure alignment with the project objectives, scope and deliverables.

2.1.3 Effective date

Document is effective upon authorization.

2.2 Normative/Informative References

2.2.1 Normative

[1] ISO 9001 Quality Management Systems

[2] OHSACT Occupational Health and Safety Act, 85 of 1993

[3] 240-83539994: Standard for Non-Destructive Testing (NDT) on Eskom Plant

[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] 240-84418020: Tube-SOLO Sandblasting procedure

[7] ASME 5 – Non-destructive Examination

[8] ECNDT 2006 - Mo.2.8.3 Article: Ultrasonic Thickness Measurement of Internal Oxide Scale in Steam Boiler Tubes

[9] BS EN 15317: Non-destructive testing - Ultrasonic testing - Characterization and verification of ultrasonic thickness measuring equipment

2.3 Definitions

Definition	Description
Contractor	Service provider contracted for supplying specific service to Eskom, Kusile Power Station.
Employer	Eskom, Kusile Power Station
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
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.
Residual life	That part of the life of a component remaining before expected failure due to creep damage, wall loss or crack mechanisms.

Plant	Any structure, machinery, apparatus or equipment which does not fall within the scope of the operating regulations for high voltage systems, and excludes, mobile, portable lifting equipment, domestic circuits' appliances and tools.

2.4 Abbreviations

Abbreviation	Description
OEM	Original Equipment Manufacturer
PCLF	Planned Capability Loss Factor
QCP	Quality Control Plan
SOW	Scope of Work
EAF	Energy availability factor
UCLF	Unplanned Capability Loss Factor
QA	Quality assurance
QC	Quality Control
NDT	Non Destructive Testing
PCM	Process Control Manual
OD	Outside Diameter
WT	Wall Thickness
LTOC	Long Term Overheating Creep
Tube-SOLO	Tube Steam Oxide Life Optimization
UT	Ultrasonic testing
RT&D	Eskom Research Testing and Development

2.5 Roles and Responsibilities

Employer is required to:

a. Provide the contractor with access to the plant for site measurements and assessment.
b. Facilitate safety inductions and necessary permits to work.
c. Ensure availability of Eskom technical personnel for consultation and clarification during project execution.
d. Provide the contractor with Tube-SOLO outage scope of work.
e. Updates the contractor with any changes in the program and/or schedule.

The contractor is required to:

a. Conduct sandblasting quality checks with Eskom Tube-SOLO custodian prior to conducting Tube-SOLO. This should include confirming fire-side sandblasting.

b. Conduct Tube-SOLO measurements.
c. Provide daily inspections feedback to the Employer.
d. Provide Tube-SOLO measurements raw data
e. Provide Tube-SOLO measurements results in **excel spreadsheet**.
f. Provide Tube-SOLO measurement report in **pdf format**.

2.6 Process Monitoring

This SOW will be monitored and updated by engineering and maintenance if and when required.

2.7 Related/supporting documents

N/A

3. SCOPE OF WORK

Creep remains to be one of the leading failure mechanisms in Eskom power plants. Tube-SOLO (Tube-Steam Oxide Life Optimization) is a technology that is used to carry out creep damage analysis on boiler tubes operating in creep regime. It comprises of two methods, (i)Non-Destructive testing and (ii)Metallurgical laboratory analysis. Both methods estimate the remaining life on the tube based on the oxide buildup.

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

Tube-SOLO shall be conducted on the following boiler locations where Ferritic steel is installed:
(a) Superheater 1.2
(b) Superheater 2
(c) Superheater 3
(d) Reheater 1
(e) Reheater 2

Ultrasonic testing (UT) thickness gauge should be used on the boiler tubes to measure the oxide layer. Based on the results obtained from the Ultrasonic test, samples will be cut for laboratory analysis.

3.1 Superheater

Table 1: Material specifications, design and operating conditions of superheater outlet.

Parameters	SH1.2 outlet	SH 2 outlet	SH3 outlet
Design code	EN12952		
Operating hours	47297		
Material	7CrMoVTIB10-10	VM12-SHC	TP347HFG-X10CrMoNVb-9-1
Outer Diameter(mm)	44.50	38	42.2
Wall Thickness(mm)	7.10	6.3	6.3-8
Design Temperature (ºC)	535.9	575.6	599
Operating Temperature (ºC)	485.9	530.6	564
Design Pressure (MPa)	29.38	28.65	28.65
Design Pressure (MPa)	27.48	26.75	26.75

Table 2: Tube-SOLO inspection area.

Circuit	Description	Element	Tube
SH1.2	Superheater 1.2 Area 1 Bundle 4 LHS	1-21 *Note: Every second element*	1-10
SH1.2	Superheater 1.2 Area 6 Bundle 4 RHS	1-21 *Note: Every second element*	1-10
SH1.2	Superheater 1.2 Area 4 Bundle 4 RHS	1-21 *Note: Every second element*	1-10
SH1.2	Superheater 1.2 Area 5 Bundle 3 RHS	1-21 *Note: Every second element*	1-10
SH1.2	Superheater 1.2 Area 3 Bundle 4 LHS	1-21 *Note: Every second element*	1-10
SH1.2	Superheater 1.2 Area 2 Bundle 3 LHS	1-21 *Note: Every second element*	1-10
SH2	Superheater 2 Area 1 Bundle 4	1-191 *Note: Every second element*	1-5
SH2	Superheater 2 Area 3 Bundle 4	1-191 *Note: Every second element*	1-5

SH2	Superheater 2 Area 5 Bundle 3	1-191 *Note: Every second element*	1-5

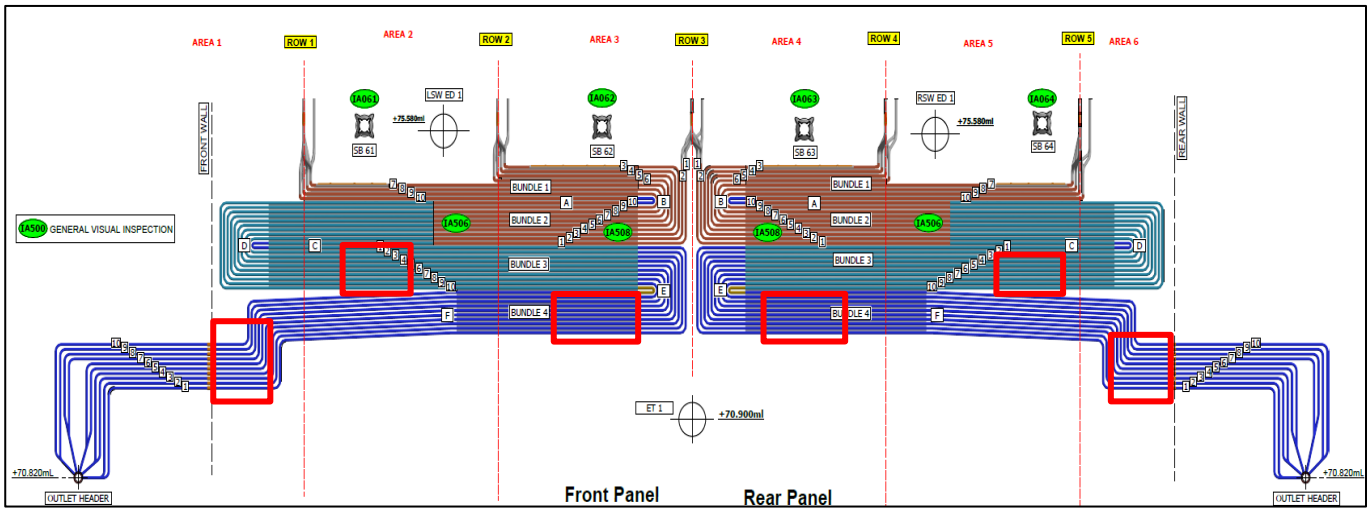

Figure 1: Schematic drawing of SH1.2 Screen Area 1 Bundle 4 LHS and RHS Tube 1 (leading tube) showing where Tube-SOLO inspections should be conducted.

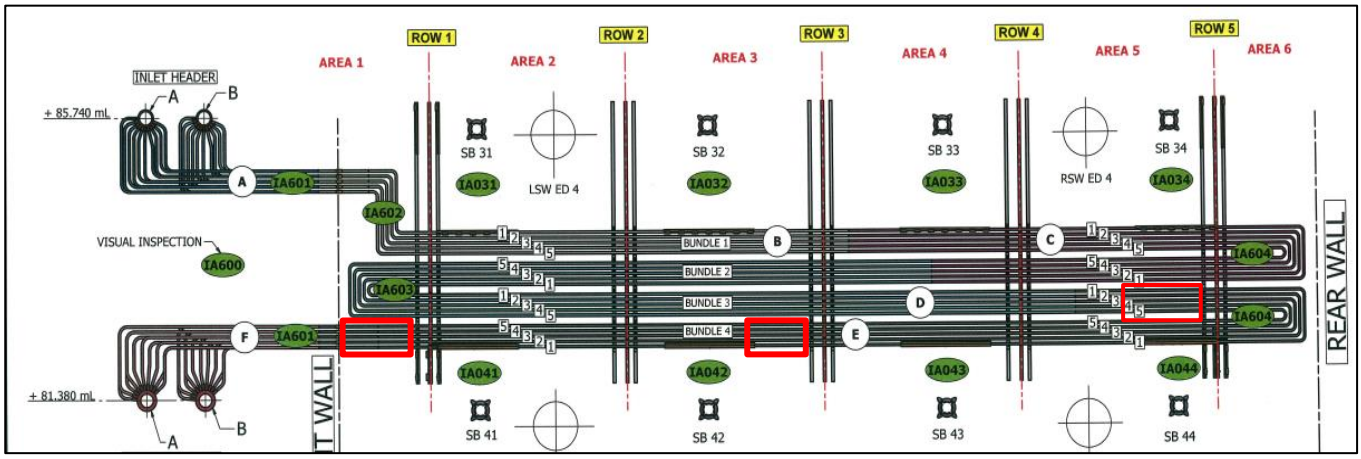

Figure 2: Schematic drawing of SH2 Area 1 Bundle 4 Tube 1(leading tube) showing where Tube-SOLO inspections should be conducted.

3.2 Reheater

Table 3: Material specifications, design and operating conditions of reheater outlet.

Parameters	**RH1 Outlet Area 3**	**RH1 Outlet Area 5**	**RH2 Outlet**
Design code	EN12952		
Operating hours	47297		
Material	13CrMo4-5	10CrMo9-10	TP347HFG-X10CrMoVNb9-1
Outer Diameter(mm)	48.3	48.3	57
Wall Thickness(mm)	4	4.5	3.6
Design Temperature (ºC)	507.9	531.5	607
Operating Temperature (ºC)	472.9	496.5	572
Design Pressure (MPa)	6.85	6.85	6.71
Design Pressure (MPa)	5.5	5.5	5.36

Table 4: RH1 Tube-SOLO inspection SOW.

Circuit	**Description**	**Element**	**Tube**
RH1	Reheater 1 Area 3 Bundle 4 - adjacent to the material grade transition (13CrMo4-5 to 10CrMo9-10)	1-191 *Note: Every second element*	1-13
RH1	Reheater 1 Area 6 Bundle 4	1-191 *Note: Every second element*	1-13
RH1	Reheater 1 Area 3 Bundle 2	1-191 *Note: Every second element*	1-13
RH2	Reheater 2 Area 6 Bundle 1(transition *TP347HFG to X10CrMoVNb9-1)	1-96 *Note: Every second element*	1-9

* TP347HFG (Austenitic steel) is installed on RH2 elements, thus Tube-SOLO is not conducted in this area. However, due to the premature Long Term Overheating Creep (LTOC) failure that occurred on RH2, Tube-SOLO will be done on the transition material(X10CrMoVNb9-1) to assess the creep in the area.

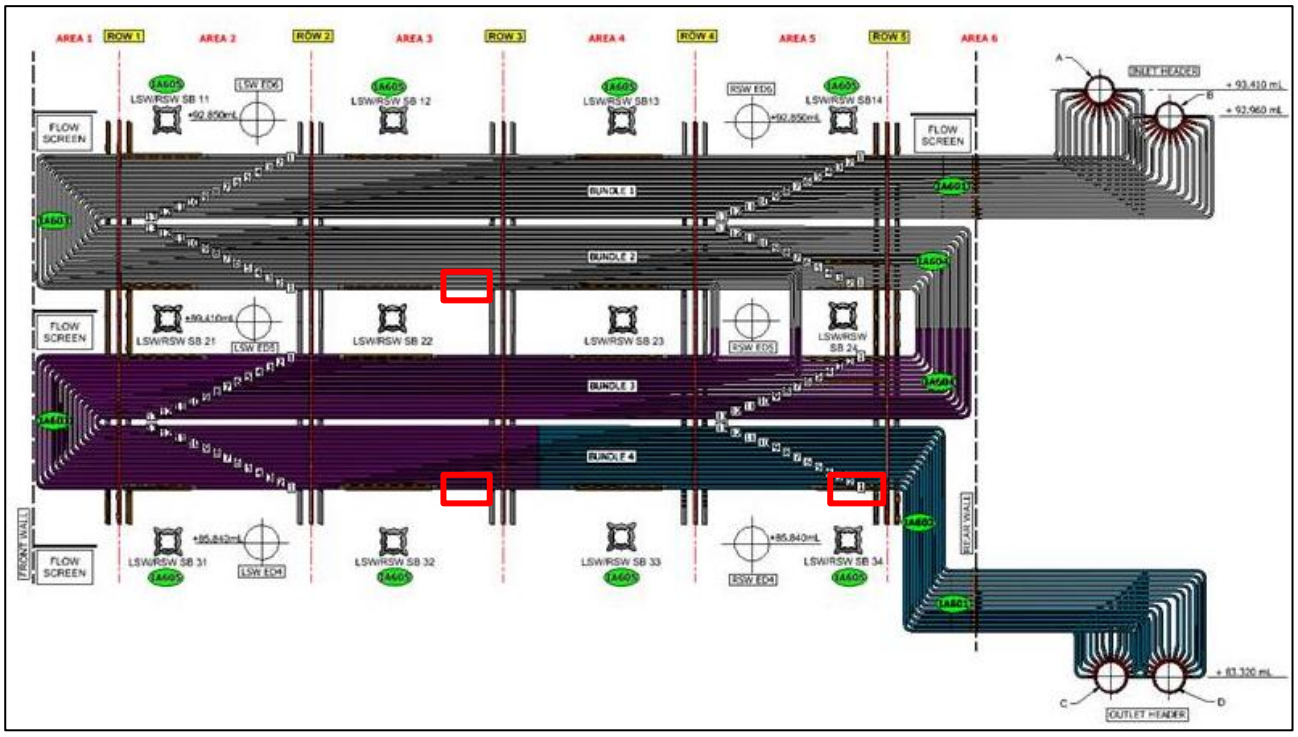

Figure 3: Schematic drawing of RH1 showing where Tube-SOLO inspected should be conducted.

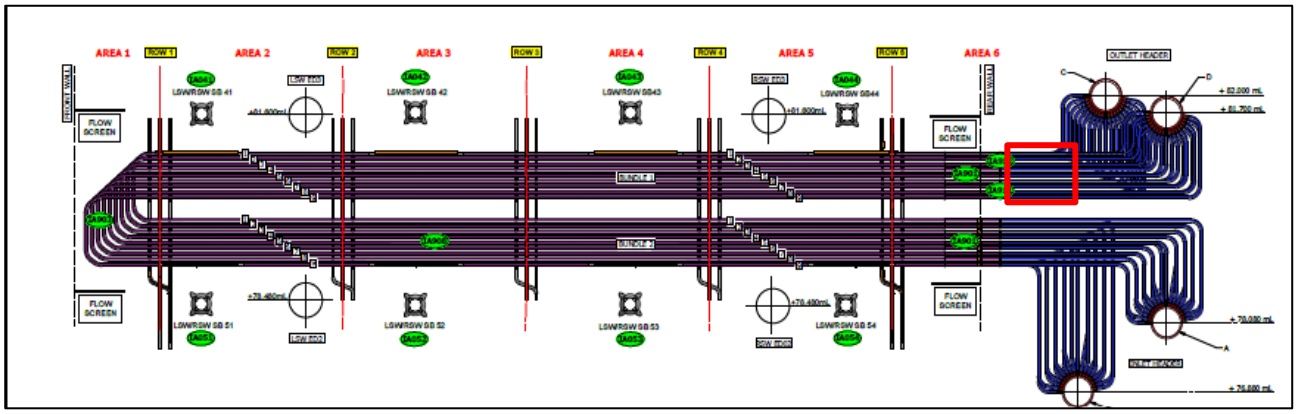

Figure 4: Schematic drawing of RH2 showing where Tube-SOLO inspected should be conducted.

4. Acceptance

This document has been seen and accepted by:

Name	Designation
George Mthimkhulu	Senior Boiler Engineer
Siyakudumisa Mtsweni	Engineering Manager
Grace Olukune	Engineering Group Manager

5. Revisions

Date	Rev.	Compiler	Remarks
May 2025	1	Karabo Khosana	1st issue for TubeSOLO SOW

6. Development Team

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

- Karabo Khosana

7. Acknowledgements

N/A