Eskom	**Outage Scope of Work (SOW)**	**Engineering**

Title:	**Tubular Air Heaters**	Document Identifier:	*
Type:	**Opportunity/GO/IR Maintenance**	Alternative Reference Number:	
Planned Start Date:		Area of Applicability:	**Kendal Power Station**
Duration:	28 Days to 75 Days	Functional Area:	**Engineering & Outages**
Submission Interval:	T – 1	Revision:	**00**
Outage ID:	**N/A**	Total Pages:	**17**
		Next Review Date:	**N/A**
		Disclosure Classification:	**Controlled Disclosure**

Compiled By:	**Approved By:**	**Authorised by:**	**Accepted by:**
J Eganza	**T Rasivhetshele**	**M Mabizela**	**Z Maleka**
Senior Engineer	**Boiler Engineering Manager(Acting)**	**Engineering Manager(Acting)**	**Outage Manager**
Date:	**Date:**	**Date:**	**Date:**

Content

1. Scope Compilation References

SCOPE COMPILATION REFERENCES				
SOURCE & Ref No.	**Yes**	**No**	**N/A**	**Comments**
Previous outage service reports	X			Condition Monitoring report
Return to service data packages	X			Leakage Reports
Maintenance Strategy with Rev number				
SAP defects (attach list as appendix)				
GHRMS (STEP) reports (Generation Heat Rate Management System)				
Online Condition Monitoring	X			DCS and Leakage Reports
Pre-outage performance test results	X			
Post outage performance test results	X			
GPSS/ Plant Performance data on UCLF incurred	X			
OMS / IIRMS recommendations (Audits Reports)	X			
Risk controls (IRM system)				
Previous audits and reviews (e.g. ERAP)				
Engineering Change Requests (Projects)				
LOPP strategy reports	X			
URS	X			
Philosophy (Outage)		X		
Condition Monitoring Report	X			
VA/PHD Viewer trends				
Corrective Actions				
CARAB reports				
Statutory Requirements				
Grid code requirements				
Waivers and Exemptions				
Calibration requirements				
Previous Outage SOW variations				
Post Mortems Actions from previous outages				
Pre–Outage plant walks				
Risk based inspection (RBI) report				
Simulation, TOIs, OON, SI				

SUBSYSTEM	**Y / N**	**Page №**

2. Goal

This outage prepares the unit to achieve the following performance targets with respect to the plant system this scope of work covers:

1. No load losses on The TAH
2. UCLF of 0 %
3. UAGS of zero (0 %)

2.1 Definitions/abbreviations

IN	1 - 2 weeks	INSPECTION For inspection purposes only to determine scope of work or obtain history; i.e. fans, boiler, ducting, air heaters and precipitators/FFP
ST	As required	SHORT TERM PLANNED REPAIRS Any planned work required outside of the normal outage philosophy Planned and requested 28 days in advance Readiness indicator and ORC Risk Report to be submitted with the request

3. Objectives

The objective of this scope of work is to inspect the Tubular Air heaters for erosion damage and repair defects to make the Tubular Air heaters perform to specification. Where planned to replace the Tubes.

4. Detailed Work Description

The table below shows the detailed work description to be covered during the following maintenance periods.

1. Opportunity Outage
2. Interim Outage
3. General Outage
4. Tube Replacement

4.1 Opportunity Outage

Subsystem	Component	Major Scope	Activity Scope of work	
TAH	General	Inspect	• Inspect the general condition of the TAH for damage and erosion. • Identify the missing ferrules and tube damage to prepare for the scope.	•
TAH	Top Bank Tube Plate and Tubes	Inspect	• Inspect the Top bank Tube plate for erosion and damage and smooth operation. • Apply Epoxy composite on the whole surface of the tube plate • Remove damaged Ferrules and install where possible • Blank Tubes that are damaged and eroded	•
TAH	Bottom Bank Top Tube Plate	Inspect	• Inspect the Top bank Tube plate for erosion and damage and smooth operation. • Apply Epoxy composite on the whole surface of the tube plate	•

			• Remove damaged Ferrules and install where possible • Blank Tubes that are damaged and eroded	
TAH	Casing	Inspect	• Inspect the casing internally and externally for erosion. • Repair any holes in the casing with window patchs	•
TAH	Expansion Joints	Inspect	• Inspect the expansion joints for holes and damage. • Repair any anomalies	•
TAH	Stay rods	Inspect	• Visually inspect the stay rods for erosion and damage. • Repair all the Stay support Rods that are damaged	•
TAH	TAH	Pressure Test	• Pressure test the TAH after repair and pressure test after the repair to confirm repair.	•

4.2 General Overhaul and Interim Outage

Plant	Component	Major scope	Scope of work(reviewed)	Est	Outage type	Price each	Total
Primary air heater	All	Preparation for safe work	Ensure unit shutdown cools the Primary air heaters sufficiently for safe access.		IR/ GO		
			Open PAH doors (gas and air side all doors) on 13m/l, 28m/l, and 44m/l as soon as boiler cooling is stopped.	14	IR/ GO		
			Build scaffold on 0m/l for floor access to enable tube replacement.		IR/ GO		
			Build scaffold on 13m/l to enable roof repairs and plugging of tubes.		IR/ GO		
			Build scaffold on 13m/l to enable access to PA fan discharge / PAH air inlet door.		IR/ GO		
			Remove ash inside both Primary Air Heaters at 44m/l, 28m/l and 13m/l		IR/ GO		
			Fabricate blanks and install them on different tubes as per a need	6000	IR/ GO		
			Perform repairs on tube plates that show visible damage		IR/ GO		

			Perform high pressure washing on both Primary Air Heaters to remove scaling on both top and bottom banks	2	IR/ GO		
			Remove ash inside both Primary Air Heaters at 16m/l		IR/ GO		
			Build scaffold on 28m/l to enable roof repairs and plugging of tubes.		IR/ GO		
			Open expansion joint covers, clean expansion joints, do repairs on expansion joints and weld back expansion joint covers for both 44m/l expansion joints of both PAHs	16	IR/ GO		
			Open expansion joint covers, clean expansion joints, do repairs on expansion joints and weld back expansion joint covers for both 13m/l expansion joints of both PAHs	8	IR/ GO		
			Cut, prepare and perform seal welding using window patches on worn areas on walls and roofs of both PAHs.	100	IR/ GO		

	Tubes	Mapping tube repairs	Use the tube map given by Eng to mark the tubes blanked after repairs, no more than 20 blocked tubes per air heater (total for the two banks) will be allowed, although less will be preferred as all blocked tubes will be replaced.	2	IR/ GO		
		Leak testing on top bank And Tube repairs on top bank	After tubes are clean, run the corresponding PA fan and inspect the primary air heaters from all the gas-side dead spaces, i.e. 28m/l and 44m/l and 13m/l. Audibly, visually and with the aid of a feather duster, any leaks should be identified and marked.	2	IR/ GO		
			All permanently blanked tubes must be un blanked and marked for further testing.	5000	IR/ GO		

			On any tubes swinging from side to side (i.e. loose at the tube plate), the tube must be re-expanded in the tube plate and new ferrules inserted. If no repair can be done, they are to be blanked. As these tubes are the most likely to cause consequential damage, they need to be treated as critical. Ensure that both ends of the tube are blanked off.	5000	IR/ GO		
			All the ferrules must be removed and new ferrules must be inserted on all the top banks tubes	20 000	IR/ GO		

			Depending on the depth of the hole, tubes are to be repaired as follows: Tubes with holes less than 150 mm from either end, can be repaired by inserting 250mm long ferrules over the holes. Damage within 600 mm from either end, can be repaired with special extra-long ferrules (750 mm long). Mark all tubes with damage deeper than 600 mm to show blanking on the top and bottom. When ferrules are inserted, they are to be sealed using epoxy.	16 000	IR/ GO		
			Put epoxy around the standard 250mm long ferrules and then insert the ferrules over the holes in all the tubes where damage is within 150mm from the end.	20 000	IR/ GO		
			Put epoxy around the 750mm long ferrules and then insert the ferrules over the holes in all tubes where damage is within 600mm from the end. If these ferrules are stuck too far out of the tube, and cover the holes, the end can be cut off.	5000	IR/ GO		

			On all tubes damaged deeper than 600 mm or blocked, do tube replacement.		IR/ GO		
			On all tubes that are swinging from side to side (i.e. loose at the tube plate), the tube must be re-expanded in the tube plate and new ferrules inserted. If no repair can be done, they are to be replaced. As these tubes are the most likely to cause consequential damage, they need to be treated as critical.	3000	IR/ GO		
			It is likely that dropped tubes have sustained damage, all dropped tubes should be jacked up and reinstated, or if this proves impossible, they are to be replaced. All jacked tubes that had been replaced must be expanded	2000	IR/ GO		

			After tube repairs are complete, repeat testing and repairs until all damaged tubes are all repaired by running the corresponding PA fan and inspecting the primary air heaters from all the dead spaces, i.e. 28m/l and 44m/l. Audibly, visually and with the aid of a feather duster, any leaks that were not yet repaired should be identified, marked and repaired. If leakage is found, the repair and testing must continue until no pressure is felt at the door and no internal leaks can be found.	2000	IR/ GO		
			Do the pressure test and make sure that all the leakages are sealed off for **zero** leakage (use feather duster),then call the Engineer for final inspections	4	IR/ GO		
		Leak testing on bottom bank/Tube repairs/ replacement on bottom bank	After tubes are clean, run the corresponding PA fan and inspect the primary air heaters from all the gas-side dead spaces, i.e. 28m/l and 44m/l and 13m/l. Audibly, visually and with the aid of a feather duster, any leaks should be identified and marked.	4	IR/ GO		

			All permanently blanked tubes must be un blanked and marked for further testing.	3000	IR/ GO		
			On any tubes swinging from side to side (i.e. loose at the tube plate), the tube must be re-expanded in the tube plate and new ferrules inserted. If no repair can be done, they are to be blanked. As these tubes are the most likely to cause consequential damage, they need to be treated as critical	6000	IR/ GO		
			All the ferrules must be removed and new ferrules must be inserted on all the bottom banks tubes	10400	IR/ GO		
			Depending on the depth of the hole, tubes are to be repaired as follows: Tubes with holes less than 150 mm from either end, can be repaired by inserting 250mm long ferrules over the holes. Damage within 600 mm from either end, can be repaired with special extra-long ferrules (750 mm long). Mark all tubes with damage deeper than 600 mm to show blanking on the top and bottom.	12000	IR/ GO		

			Put epoxy around the standard 250mm long ferrules and then insert the ferrules in the holes in all the tubes where damage is within 150mm from the end.	12000	IR/ GO		
			Put epoxy around the 750mm long ferrules and then insert the ferrules in the holes in all tubes where damage is within 600mm from the end. If these ferrules are stuck too far out of the tube, and cover the holes, the end can be cut off.	3000	IR/ GO		
			On all tubes damaged deeper than 600 mm or blocked, do tube replacement.	4000	IR/ GO		
			On all tubes that are swinging from side to side (i.e. loose at the tube plate), the tube must be re-expanded in the tube plate and new ferrules inserted. If no repair can be done, they are to be replaced. As these tubes are the most likely to cause consequential damage, they need to be treated as critical.	3000	IR/ GO		

			It is likely that dropped tubes have sustained damage, all dropped tubes should be jacked up and reinstated, or if this proves impossible, they are to be replaced. All jacked up tubes must be expanded.	3000	IR/ GO		
			All tubes on the cold end of the air heater, next to the primary air fan discharge must visually be checked from the air space. Damaged tubes will be repaired by cutting out the bottom, chamfering the end and replacing it with pre-manufactured inserts, made of mild steel as per drawing supplied by engineering. The depth to be cut into the bank will depend on the depth that all tubes are at full thickness and not corroded anymore, this will be inspection based, after which a set depth will be specified. Inserts is only possible where side access is available. Blocked tubes in between these tubes will need full tube replacement.	6000	IR/ GO		

			After tube repairs are complete, repeat testing and repairs until all damaged tubes are all repaired, by running the corresponding PA fan and inspecting the primary air heaters from all the dead spaces, i.e. 28m/l and 44m/l and 13m/l. Audibly, visually and with the aid of a feather duster, any leaks that were not yet repaired should be identified, marked and repaired. If leakage is found, the repair and testing must continue until no pressure is felt at the door and no internal leaks can be found.		IR/ GO		
			Do the pressure test and make sure that all the leakages are sealed off for **zero** leakage (use feather duster),then call the Engineer for final inspections	4	IR/ GO		
	Tube protection ferrules	Ferrule replacement	All ferrules must be replaced on 44m/l, 28m/l and 13m/l and silicon should be put around them before being inserted. Ensure that ferrules are installed in the top of every tube at 28 m/l and 44m/l. By default 250mm ferrules will be used, unless damage requires longer ferrules.		IR/ GO		

	Gas side walls, floor and casing	Cleaning	Clean all floor/ wall/ roof surfaces on 44m/l, 28 m/l and 13 m/l, include vacuuming as needed.	2	IR/ GO		
			Inspect cleaning - No visible ash is to remain.	2	IR/ GO		
		Inspection and repairs	Gas side at 44m/l, 28m/l and 13m/l: Walls, roof, floor and dividing plates and stays must be visually inspected for wear and cracks and repaired where damaged. Ensure the top corners of the 28m/l casing are also checked, as leaks are very likely there.	2	IR/ GO		
	Air side walls, floor and casing	Inspection and repairs	All areas of air-side ducting adjacent to the tube banks: Walls, turning vanes, floor, roof and stays must be visually inspected for wear and cracks and repaired where damaged. Visually check whether any water from washing has leaked into the air-side or if any tubes are visibly misaligned, and repair damage identified by this. Also remove all ash build-up on the floor. Access is available from doors at the 13m/l, 28 m/l and 39m/l.	2	IR/ GO		

			Remove ash inside both Primary Air Heaters at 44m/l, 28m/l and 13m/l		IR/ GO		
	Expansion joints	Inspection and repairs	All the expansion joints on 44m/l and 13 m/l must be inspected and repaired/replaced if needed. Inspect and change the insulation material around expansion joints if needed. Inspect and change the pins when needed.	6	IR/ GO		
			Close PAH doors (gas and air side all doors) on 13m/l, 28m/l, 44m/l as soon as the PAH scope is completed and all the debris and scaffolds had been removed.	14	IR/ GO		

Manufacturing of blanks, cutting of plates for patches and expansion joints

Operation	**Operation**	**Quantity**	**Price per plate**	**Total price**
Cutting of plates for blanking	6mm Mild Steel plates, 70mm x 70mm	4000		
Cutting of plates for wall and roof patches	6mm Mild Steel plates, 1m x 1m	100		
Cutting of plates	3mm Mild steel plates, 1m x 1m	500		
Removal of expansion joint cover plates, straights and corners	3mm Mild steel plates, 30m	8		
Replacement of expansion joint cover plates, straights and corners	3mm Mild steel plates, 30m	8		
Rolling of expansion joint covers	3mm Mild Steel plates	30		
Cutting of expansion joint covers	3mm Mild Steel plates, 2m x 600mm	100		

4.3 Scope Variations

N/A

4.4 Financial Performance

N/A

4.5 Time Management

N/A

4.6 Skills required

N/A

4.7 Tools and equipment requirements

N/A

4.8 Preservation requirements

N/A

4.9 Transportation Requirements

N/A

5. Summary of the Scope

NB: The SOW will be registered at Documentation Center at T-6, once the SOW has been frozen.

Provide summary of scope here.

5.1 General Arrangement & Location Drawings

№	DRAWING NUMBER	TITLE
1		

6. Applicable Corporate/Generation/International Guidelines and Standards

Insert text here.

№	REFERENCE NUMBER	DOCUMENT TITLE
1		

7. General Considerations

ACTIVITIES	SPECIFICATIONS
PRE-REQUISITES / PRE-CONDITIONS	
SAFETY **Specified safety requirements for the specific system**	
ENVIRONMENT **Specified pollution control requirements, specified waste management requirements, specified energy efficiency requirements.**	

QUALITY **All Outage QCP's to be done as per Kendal Control and Approval of QCP Process. (*1017482)**	
RISK ASSESSMENT **A risk report with a complete list of risks, risk rating and mitigating actions for the specific plant system.**	
Refer to XXX Bow tie risk assessment.	

8. Bills of Material

(SOW variation will be issued only if refurbishment or replacement components exceed budget. Otherwise cutting instruction will be used to communicate which components must be replaced or refurbished)

SUBSYSTEM							
№	**REPLACE/ REFURBISH**	**COMPONENT DESCRIPTION**	**COMPONENT / MATERIAL SPECIFICATION**	**OPERATING PARAMETERS**	**PART / NUMBER**	**STOCK NUMBER**	**DESIGN QUANTITY**
1.							
2.							
3.							
4.							

9. Acceptance

This document has been seen and accepted by:

Name	Designation
Tendani Rasivhetshele	Boiler Engineering Manager (Acting)
Thengi Molotsi	System Engineer
Itumeleng Mogale	Outage Controller
Zanele Maleka	Outage manager

10. Revisions

Note: Start with the latest Revision History in the first row and go backwards.

Date	Rev.	Compiler	Remarks
May 2021	00	J Eganza	Original

11. Development Team

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

- Tendani Rasivhetshele – Senior Boiler Engineer.
- Thengi Molotsi – System Engineer.

12. Acknowledgements

- Tendani Rasivhetshele – Boiler Engineering Manager(Acting)
- Malibongwe Mabizela – Engineering Manager (Acting)