Eskom

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Date: 26 April 2024
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Dear Dr Gwaze,

MARCH 2024 MONTHLY PROGRESS REPORT ON THE POSTPONEMENT OF MINIMUM EMISSION STANDARD CONDITIONS FOR KUSILE POWER STATION: REF: LSA223027

ESKOM WAS ISSUED A MINIMUM EMISSION STANDARDS (MES) POSTPONEMENT IN RESPECT OF KUSILE'S SO_2 LEVELS BY THE DFFE ON 5 JUNE 2023. THE VARIED ATMOSPHERIC EMISSION LICENCE (AEL) WAS ISSUED BY THE NKANGALA DISTRICT MUNICIPALITY ON 13 JUNE 2023. BOTH THE MES APPROVAL AND THE AEL ALLOW ESKOM TO OPERATE THE TEMPORARY STACKS WITHOUT FGD. THE APPROVALS ARE ISSUED SUBJECT TO SEVERAL CONDITIONS, INCLUDING THAT ESKOM IMPLEMENT MEASURES TO MINIMISE THE IMPACT ON HUMAN HEALTH.

This letter provides an update on key issues, including specific reporting requirements identified by the authorities in the various approvals for the Kusile temporary stacks project. Monitoring and mitigation is being implemented as far as practical in line with the programme in the Kusile Power Station Temporary Stack Monitoring Framework approved by the authorities on 18 September 2023.

As an initial point, I would like to confirm that no exceedances of the stack or ambient trigger level conditions were recorded during March 2024.

1. **Progress of repairs of permanent stacks for the duration of the operation of the temporary stacks.**
   I. The target date for the recovery of the West stack remains 31 December 2024.
   II. Unit 1 and Unit 3 slurry cleaning completed.

III. Alimak operation is not possible during windy conditions and wind direction can result in flue gas contamination at the top of the stack from units 1 or 3 preventing safe access to the stack.
IV. Flue cleaning has been suspended and will commence once 55m level platform and K1 lobster are secured to 90m level platform since lobster 3 moved while cleaning causing 55m level to be unstable.
V. The Permanent Stack recovery progress report is attached (**Annexures A1 and A2**).

2. Temporary Stack Emission Monitoring

Continuous Emission Monitoring (CEMS):

I. Unit 1, 2 and 3 CEMS are installed and commissioned.
II. The retrofitting of Unit 1 and 3 reports from Sep until Dec 2023 had been completed and reports are in the process of been resubmitted to the authority/ies and published on Eskom portal.
III. Unit 2 PM spot checks was done on the 23 February 2024 and report received on 06 March 2024 **(Annexure B).**
IV. Unit 2 correlation test is planned to be completed by 02 – 05 May 2024, delay for the test was due to load restriction caused by challenges on milling plant. The Unit was off on 17 March – 03 April 2024 for boiler tube leak repair.
V. Unit 2 emission reports will be retrofitted upon finalization of correlation test and implementation of correlation curves.

Stack Performance:

I. The Kusile Monthly Emission report for March 2024, which includes emission data for Units 1,2, 3 and 4 is attached **(Annexure C)**.
II. Upon retrofitting the emission reports after correlation curves had been implemented, the station noted exceedances of particulate emission (PM) daily averages on Unit 1 and 3 during the period of October, November, and December 2023. The investigation was undertaken to determine the causes of the exceedances. The investigation also identified the measures and recommendations to be put in place to prevent similar re-occurrences in the future. The detailed investigation report is attached (Annexure E).
III. Based on the available data information, all Kusile units operated in compliance with the AEL emission limits for PM, NOx or SO_2 during March 2024.
IV. Fall out dust (fugitive dust) reports are submitted to the licensing authority on or before 30th of every month as per Atmospheric Emission License condition.

3. Health Screening for the increased SO_2 emission and associated health impacts

I. Communication system is developed to enable communication with the health ambassadors in the various receptor areas. An Excel spreadsheet of ambassadors with names, contact details and areas they represent is readily available.
II. An SMS system had been developed. The contact details of ambassadors have been loaded on the SMS system and they are grouped according to receptor areas.
III. A toll-free line is in the final stage of establishment for community members who would like to call in with concerns (for heath related information)
IV. Engagement with specific businesses in the area is taking and will continue and progress reported in the proceeding months.

V. The surrounding business are planned to be visited for engagement and awareness (feedback will be shared in the proceeding months).

4. Occupational Health and Hygiene status

4.1. Continuous SO_2 Perimeter Monitoring:

I. Weekly monitoring of the plant's perimeter for SO_2 surges were conducted throughout March 2024.
II. SO_2 levels along the perimeter remained below detection levels, meeting the statutory requirement of 0.5 ppm OEL-STEL/C.

4.2. Continuous Personal Exposure Sampling:

I. BOP & FGD Controllers and an FGD Senior Plant Operator underwent personal exposure sampling for SO_2 during March 2024.
II. Their exposure levels were consistently below detection levels and compliant with the statutory requirement of 0.5 ppm OEL-STEL/C.

Table: Personal Exposure Sulphur Dioxide Concentration for March 2024

Month	Number of samples	Areas Sampled	Designation	Concentration (ppm)	Status	Comment(s)
March 2024	1	FGD	Controller	< 0,5	Complaint	Concentrations below OEL.
March 2024	1	FGD	Senior Plant Operator	< 0,5	Complaint	Concentrations below OEL.
March 2024	1	BOP	Controller	< 0,5	Complaint	Concentrations below OEL.

4.3. Conclusion:

Our continuous SO2 perimeter monitoring, and personal exposure sampling generally indicated compliance with regulatory limits with no ongoing issues. We will continue to monitor and investigate any anomalies to ensure the safety and well-being of both our workers and the surrounding community.

5. Stakeholder Engagement Plan and Status

Stakeholders	Method of engagement	Involvement	Status
Employees	• Awareness sessions Leadership briefings (GM's address) Employee engagements	• Once a month • Every Friday Monthly	Completed
Local Municipalities • Emalahleni • Victor Khanye • Bronkhorstspruit	Face-to-face meeting	Once a quarter	May/June 2024
Media • Emalahleni FM • Witbank News	• Advert • Print	When required	Eskom media desk to publish

6. Ambient Air Quality Monitoring

I. To better assess compliance with national ambient air quality standards, identify potential sources of pollution, protect public health and the environment and establish a baseline for future mitigation measures Eskom has installed additional ambient air quality monitoring stations at Balmoral and Wilge. The existing air quality monitoring stations (Kendal, Phola and Chicken Farm) will complement the additional monitoring sites to reduce uncertainties and improve the understanding of air quality issues in the area.

II. The Balmoral and Wilge monitoring stations are equipped to monitor ambient concentrations of sulphur dioxide (SO_2) continuously. In addition, meteorological parameters of wind velocity, wind direction and ambient temperature, humidity, ambient pressure and rainfall, amongst others, are also recorded.

III. The following parameters, nitrogen dioxide (NO2), ozone (O3) and fine particulate matter of particulate size <10µm and particulate size <2.5µm in diameter (PM10 and PM2.5) will be monitored from 01 April 2024.

IV. The data for this reporting period (01 – 31 March 2024) were analysed for ambient SO2 as monitored at Balmoral, Chicken Farm, Phola and Wilge air quality monitoring stations. The Particulate Matter and NO2 data were further analysed for Chicken Farm and Phola.

V. Full dynamic calibration audits are carried out on the gas analysers (SO_2, NO_2 and O_3 analysers) quarterly and particulate matter analysers are calibrated every six months. All calibration results and certificates are filed in the laboratory for assessment purposes. Inter-laboratory calibrations are routinely carried out with other accredited laboratories, to enhance quality control.

VI. There were no exceedances of the ambient SO2 limits recorded for all the monitoring stations during the monitoring period under review. There were fourteen (14) exceedances of the PM2.5 daily limit of 40 µg/m3 recorded at the Chicken Farm monitoring station.

VII. There were no events that triggered the notification of stakeholders in terms of the agreed AEGL recorded in March 2024.

Table 1 Highest SO_2 concentrations recorded (in ppb)

Monitoring Stations	10-min average	Date	Hourly average	Date	Daily average	Date
Balmoral	ND		ND		ND	
Chicken Farm	103.6	31/03/2024 09:10	70.9	13/03/2024 15:00	18.9	26/03/2024
Phola	116.1	12/03/2024 10:20	106.0	12/03/2024 12:00	22.6	26/03/2024
Wilge	80.8	1303/2024 11:50	65.2	13/03/2024 15:00	18.4	26/03/2024

VIII. Good representative percentage data was recovered for all the parameters monitored during the monitoring period under review at the monitoring stations with the exceptions of few parameters at Phola, Chicken Farm and Balmoral respectively. The pollutant and meteorological data for Balmoral were low due to power interruptions in the area. The data for PM2.5 and PM10 were not recorded at the Phola monitoring station due to faulty instruments. The data for PM10 was not recorded at Chicken Farm monitoring station due to faulty instrument. The data for SO2 was not recorded at the Balmoral monitoring station due to faulty instrument and power interruptions at site.

IX. The raw monitoring data, downloaded at 1-minute averages, is available in real-time to the DFFE-managed South African Air Quality Information System (SAAQIS) since the 14th of December 2023 for all Eskom air quality monitoring sites.

X. The detailed February 2024 Kusile ambient monitoring report is attached (**Annexure D).**

7. Poultry Health Monitoring

I. A service provider had been appointed for Kendal Poultry monitoring per the condition of environmental authorisation (record of decision) and the MES approval. Execution of the monitoring is on hold due to the outbreak of Avian Influenza.

II. Eskom Kusile representatives met with Kendal Poultry representative on the 19 March 2024, they indicated that they are concluding testing with State veterinary and will update Eskom once all process had been finalized to commence with monitoring.

8. Animal Health Monitoring

I. Eskom has reached an agreement with Topigs and GHB farms regarding animal/pig health monitoring on 13 March 2024.

II. Monitoring has commenced and the results with be shared in the upcoming progress reporting updates.

9. Emergency preparedness and response

I. There has been no incidence of exceedance that required emergency response from Kusile Power Station, however the Emergency Response Team (ERT) remain on high alert.

II. The ERT is in regular communication with Emalahleni Local Municipality Emergency Services as per the Mutual Aid Agreement.

III. Emalahleni Local Municipality Emergency Services representatives in Disaster Management, Fire and Emergency Services, and Environment were added in Kusile Power Station Distribution List for regular updates.

IV. All other Service Level Agreement (SLA's) with relevant stakeholder (Kendal Power Station) remain in force for duration of the temporal stack.

In conclusion, I believe the above illustrates that Eskom is committed to complying with the conditions of the approvals granted with respect to the Kusile temporary stacks. Eskom is implementing measures to ensure that it understands its impact and can limit its operations' environmental and health impact. Further, where full implementation of the conditions is not yet completed, Eskom is working with relevant stakeholders with focus to ensure the remaining issues are resolved as soon as possible.

I hope the above is in order. Please contact our team if you require any further information.

Yours sincerely

Christopher Nani
ACTING GENERAL MANAGER
KUSILE POWER STATION

DATE: 29/4/2024

MONTHLY PROGRESS REPORTS ON THE POSTPONEMENT OF MINIMUM EMISSION STANDARD CONDITIONS FOR KUSILE POWER STATION: REF: LSA223027

List of annexures

Annexure A1 and A2: Kusile West Chimney Recovery Project – March 2024
Annexure B: Kusile Power Station Unit 2 PM Spot checks report – March 2024
Annexure C: Kusile Monthly Emission Report – March 2024
Annexure D: Kusile Ambient Air Quality Report – March 2024
Annexure E: Detail investigation report of PM exceedances

Eskom

Dr P. Gwaze
National Air Quality Officer
Department of Forestry, Fisheries and Environment
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Date: 09 April 2024

Enquiries: S Mahlangu
Tel: 013 699 7097

Monthly Progress Report for Kusile Power Station West Stack Recovery April 2024:

#	Head Frame for Flue Cleaning	Status	Start Date	End Date
1.	Installation	100%	10 Jan 2024	9 March 2024
	Secure Lobster Bends			
2	Secure Lobster bend K2-3	100%	12 Feb 2024	11 March 2024
	Cleaning Lobster bend 3	100%	11 March 2024	14 March 2024
	Cleaning Lobster bend 2	100%	13 March 2024	16 March 2024
	Secure 55 Platform to 90 ML			
	Secure the 3 main beams to 90ML X 6 brackets, 6 chain blocks slings	100%	23 March 2024	10 April 2024
	Secure Lobster Bend K1			
	Secure the Lobster 1 to 90ML X 6 brackets, 6 chain blocks 6 lifting lugs and slings.	60%	3 April 2024	16 April 2024
	Vertical Flue Cleaning unit 3			
	Clean vertical flue unit 3	0%	17 April 2024	29 May 2024
	Clean vertical flue unit 2	0%	30 May 2024	11 July 2024
	Clean vertical flue unit 1	0%	12 July 2024	16 August 2024

NOTES:

West Stack:

- The target date for the recovery of the West stack remains the 31 December 2024.

Risks:

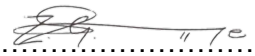
- Alimak operation is not possible during windy conditions and wind direction can result in flue gas contamination at the top of the stack from units 1 or 3 preventing safe access to the stack.

Re-sequencing of the Schedule:

- Flue cleaning has been suspended and will commence once 55m level platform and K1 lobster are secured to 90m level platform since lobster 3 moved while cleaning causing 55m level to be unstable**.**

Trust, you find the above in order.

Kind Regards,



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sanas Testing Laboratory T1026

SICK Automation Southern Africa (PTY) Ltd
Attention: Mr Austin Mzimela
P.O. Box 430
Florida Hills
1748
Gauteng

Date	Your Reference	Our Reference	Enquiries
06 March 2024	Order No. PO80596	Q2024 02 02KNM RMNR027(0)	MN Radebe Cell: 076 547 8394 e-mail: Mxolisi@inthuu.co.za

REPORT – 2024/03/05/RMNR027(0)
PARTICULATE MATTER MEASUREMENTS ON UNIT 2 FLUE AT KUSILE POWER STATION.

Herewith the report for the particulate matter measurements which was conducted on Unit 2 flue at Kusile Power Station. The measurements were conducted on the 23rd of February 2024.

The report is only applicable for PM measurements.

We thank you for the opportunity to be of service and trust that your requirements have been interpreted correctly. If you have any queries, please contact us at the above numbers, we will gladly assist.

Yours faithfully
Inthuu Measurements CC

R Nare

A Vorster

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Stack tester **AV Makama**	Prepared by: ..... (Signature) **MN Radebe** **(Project Leader)**	Issued by: ..... (Signature) **R Nare** **(Technical Signatory)**	Accepted by: ..... (Signature) **A Mzimela** **(Project Manager)**

REPORT

CUSTOMER	:	SICK AUTOMATION SOUTHERN AFRICA (PTY) LTD
OPERATING COMPANY	:	KUSILE POWER STATION
LOCATION	:	MPUMALANGA
TYPE OF MEASUREMENT	:	PARTICULATE MATTER
TITLE	:	PARTICULATE MATTER MEASUREMENTS ON UNIT 2 FLUE AT KUSILE POWER STATION.
PROJECT No.	:	Q2024 02 02KNM
ORDER No	:	PO80596
REPORT No.	:	2024/03/05/RMNR027(0)
REPORT DATE	:	06 MARCH 2024

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Summary:

Customer	:	Kusile Power Station
Plant		Unit 2 – Temporary Stack
Operating Times	:	24 hours
Emission Source	:	Power Generation - Fossil Fuel Boilers
Listed Activity	:	Subcategory 1.1: Solid Fuel Combustion Installations
Measured Components	:	Particulate Matter
Date of Measurement	:	23rd of February 2024
Emission Source No.	:	Unit 2 Flue
Name and Address of Measurement Service Provider		***Inthuu Measurements CC*** ***2/410 Seventh Road*** ***Bredell A.H*** ***Kempton Park*** ***1619***

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Measurement Summary

The summary table below gives statistics for the valid PM and velocity measurements.

Measured Component	Unit of Measurements	Min	Max	Ave
Particulate Matter	[mg/Nm^3 (d)] @ 10% O_2	44,4	64,8	52,9
Particulate Matter	mg/Am^3 (w)	26,1	38,0	31,0
Particulate Matter	mg/Am^3 (d)	28,1	40,9	33,3

GLOSSARY

Some of the following abbreviations were used in the text, figures and tables:

PM	Particulate Matter
AMS	Automated Measurement System
SRM	Standard Reference Method
CEM	Continuous Emission Monitor
PJFF	Pulse Jet Fabric Filter plant
BMCR	Boiler Maximum Continuous Rating
°C	Degrees Celsius
Pa (g)	Gauge pressure in Pascal
kPa (abs)	Absolute pressure in kilo Pascal
% v/v	Percentage on a Volume-by-Volume basis
Am^3	**Actual** Cubic Metres
Nm^3	**Normal** Cubic Metres
$Am^3(w)$	**Actual** Cubic Metres on a wet basis
$Nm^3(w)$	**Normal** Cubic Metres on a wet basis
$Am^3(d)$	**Actual** Cubic Metres on a dry basis
$Nm^3(d)$	**Normal** Cubic Metres on a dry basis
g/s	Grams per second
mg/s	Milligrams per second
dP	Differential pressure
AO	Analogue Output
AEL	Atmospheric Emission Limit
SL	Scattered Light

- **'Actual'** refers to the measured temperature and pressure conditions of the gases in the duct.
- **'Normal' or 'Standard'** refers to the actual conditions being normalised to 0 °C and 101,325 kPa.

1 MEASUREMENT OBJECTIVE

Kusile Power Station has installed an Automated Measuring Systems (AMS) for the monitoring of particulate matter emissions in compliance with the National Environmental Management: Air Quality Act, 2004 (Act No. 39 of 2004).

Inthuu Measurements CC was contracted by Sick Automation, to perform particulate matter measurements on the temporary stack of Unit 2. The customer requested that a backfitting curve is provided from the three PM tests that were conducted until full PM correlation is conducted.

The measurements will provide results to be used by the station to determine a temporary linear regression allowing the reporting of emissions from an Automated Measurement System (AMS). Constants are derived from the gravimetric measurements by a Standard Reference Method (SRM) and the corresponding AMS signal.

Measurements were conducted on the 23rd of February 2024.

2 PLANT DESCRIPTION AND MATERIALS HANDLED

Kusile Power Station currently operates five coal-fired power generation units (Units 1, 2, 3, 4 and 5). Units 6 is still under construction. Each unit consists of a steam driven turbine and a boiler supplying steam. The boilers are specially designed to burn low grade coal, which contains high percentages of ash and sulphur.

The units are equipped with both particulate matter and gaseous abatement technologies. Kusile uses Pulse Jet Fabric Filter Plants (PJFFPs) to remove particulates from the boiler waste gases. Units 4, 5 and 6 are equipped with a Flue-Gas Desulfurization (FGD) plant to reduce Sulphur dioxide emissions (SO2) from the flue gases. Units 1, 2 and 3 are currently equipped with temporary stacks as their FGD plants are currently under maintenance. In addition to gaseous emission abatement, the boiler is also equipped with low NOx burners and over-fire Air to reduce Nitrogen monoxide and Nitrogen dioxide emissions.

Currently, no further emission abatement technology is implemented at Kusile Power Station.

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3 DESCRIPTION OF MEASUREMENT SITE

Measurements were conducted on Unit 2 Temporary Stack.

The stack consists of a steel outer windshield. The height of the stack is approximately 116m and it has 12 platforms, with Platform 12 being the last one.

The gaseous and the particulate AMSs are positioned at the sixth platform and measurements also took place on the sixth platform. Both the sampling ports and the monitors are positioned at a height above the floor such that neither the ports nor the alignment of the instruments are influenced by the expansion and contraction of the flue when the boiler is switched on or off.

Unit 2 has four purpose-built ports. A maximum of two ports are accessible for measurements because the other two ports are used for monitors probes. Ports used to conduct measurements are positioned at 90 degrees to each other and only a radius of each port was sampled.

4 MEASUREMENT AND ANALYTICAL METHODS AND APPARATUS

Compound	Method	Comment
Velocity	Based on USEPA Method 2 - Velocity - Pitot tube	Std-type Pitot.
Particulate Matter	Based on ISO 9096: 2003 Stationary source emissions - Manual Determination of mass concentration of particulate matter.	
Low Mass Concentrations	Based on BS EN 13284-1: 2002 Stationary source emissions — Determination of low range mass concentration of dust — Part 1: Manual gravimetric method	Based on ISO 9096 with additional requirements on the filter preparation and procedures before and after the tests.
Combustion Gases		
Oxygen (O_2)	Based on USEPA Method 3A - Determination of Oxygen and Carbon Dioxide Concentrations in Emissions from Stationary Sources (Instrumental Analyser Procedure)	Electrochemical cell measuring principle
Moisture (H_2O)	Based on USEPA Method 4- Determination of moisture content in stack gases	
Correlation Function	VDI 2066, Part 4	Giving the 75% Tolerance and 95% Confidence bands.
Report Format	BS EN 15259:2007 - Air quality. Measurement of stationary source emissions. Measurement strategy, measurement planning, reporting and design of measurement sites	

5 PLANT OPERATING CONDITION DURING THE MEASUREMENTS

The operation of the plant was set up by Kusile Power Station and tested by Inthuu Measurements personnel. Normal operating conditions were maintained for the duration of the survey.

The station provided an achievable maximum load of 580MW during the measurements.

5.1 WASTE GAS CLEANING

Kusile Power Station employs Pulse Jet Fabric Filter Plants (PJFFPs) for gas cleaning in terms of particulate matter. Unit 4, 5 & 6 are equipped with Flue-Gas Desulfurization (FGD) plant to remove Sulphur dioxide (SO_2) from the flue gases. In addition to gaseous emission abatement, the boiler is equipped with of low NOx burners and over-fire Air to reduce Nitrogen monoxide and Nitrogen dioxide emissions.

The coal which was burnt during the test period was the normal supply.

Additional operating data is tabulated in the Appendices.

6 PRESENTATION OF MEASUREMENT RESULTS AND DISCUSSION

Plant parameters were provided for the duration of each test and the data is tabulated in **Appendix A**.

The PM correlation function is provided in **Appendix B.**

Appendix C shows the checklist of nozzles used during the measurements. Measurements quality control plan records are attached in **Appendix D**.

Inthuu Measurements ensures that equipment used for the measurements are calibrated and comply with the quality standard before commencing with the measurements. Reference equipment is calibrated by SANAS accredited laboratories. **Appendix E** shows the calibration information for the equipment used for the measurements.

The monitor calibration certificate is attached in **Appendix F** once received to show that the monitor was calibrated before the measurements.

6.1 EVALUATION OF THE OPERATING CONDITIONS DURING THE MEASUREMENTS

Table 6.1.1: Boiler Load, Total Air Flow and Gas Volume Flow

`Test No.:	Boiler Load	Standard deviation of Boiler load	Total Air Flow	Standard deviation of Total Air flow	Measured Gas flow	Measured Gas flow	Measured Gas flow
	MW	MW	kg/s	kg/s	[Nm^3/s (d)] at 10% O_2	Am^3/s (w)	Am^3/s (d)
1	579,4	1,0	682,5	2,3	738,27	1265,52	1180,69
2	579,4	0,6	683,9	2,0	748,54	1276,86	1187,23
3	579,7	0,6	677,8	3,2	758,44	1290,46	1199,55

Table 6.1.1 shows the boiler load, total air flow and gas flow rate at various load.

6.2 EVALUATION OF MEASUREMENT RESULTS

Table 6.2.1: Face Velocity and Nozzle Diameter

`Test No.:	Boiler Load	Average face velocity	Nozzle diameter
	MW	cm/s	mm
1	579,4	4,9	4,0
2	579,4	4,9	4,0
3	579,7	4,9	4,0

Table 6.2.1 shows the average face velocity for the three conducted tests. The average face velocity for all the three tests was 4,9 cm/s.

The Eskom Standard states that the minimum filtration face velocity should be in accordance with the filter manufacturer's recommendation. Before a test is conducted, a nozzle is selected to comply with the average face velocity as per the manufacturer's filter pressure drop requirement. The nozzle size selection is based on the average velocity in the stack which is determined prior to the measurements being conducted. Nozzle size of 4,0 mm was used for all the tests.

Table 6.2.2: Measured Dust Concentration, Isokineticity and Monitor Output

`Test No.:	Boiler Load	Measured Dust Concentration	Measured Dust Concentration	Measured Dust Concentration	Dust Emissions	% Isok
	MW	mg/Nm^3 (d) at 10% O_2	mg/Am^3 (w)	mg/Am^3 (d)	Raw Scattered Light	%
1	579,4	49,4	28,8	30,9	0,8	99
2	579,4	64,8	38,0	40,9	1,2	100
3	579,7	44,4	26,1	28,1	1,0	101

Table 6.2.2 shows the measured dust concentration, isokineticity by Inthuu and analogue output signals from the monitor.

Three tests were conducted, and they were all used to generate a Backfitting curve. Backfitting curve is valid for a period of 3 months and full PM correlation must be conducted after this period.

Table 6.2.2 shows that monitor output for dust emissions was reading low values than anticipated. These values are ideally not a true reflection of the plant conditions hence they do not correspond to the measured dust concentration and boiler load. It is advised that the monitor be check and calibrated so that the measurements may be repeated.

The percentage isokineticity was between 99% and 101% for all tests. This complies with the Eskom Monitoring and Reporting Standard requirement of isokineticity ranging between 95% and 105%.

The particulate emission function yields the emission in [mg/Nm^3 (d) at 10% O_2] corrected for temperature, pressure, moisture, and oxygen. Alternative curves are provided in mg/Am^3 (w) and mg/Am^3 (d)

6.3 SUMMARY OF RESULTS

a) **Particulate Concentrations**

Three tests were conducted, and all tests were used to generate a Backfitting curve. The emission concentrations for the selected tests ranged between 44,4 and 64,8mg/Nm^3(d) at 10% O_2, 26,1 and 38,0mg/Am^3(w), 28,2 and 40,9mg/Am^3(d)

I. Measurement results: Scattered light parameters on DCS "As Found" **[mg/Nm^3 (d) at 10% O_2]**

E, y = 53,1887SL - 0,01

II. Measurement results: Scattered light parameters on DCS "As Found" **mg/Am^3 (w)**

E, y = 31,1696SL – 0,01

III. Measurement results: Scattered light parameters on DCS "As Found" **mg/Am^3 (d)**

E, y = 33,5005SL – 0,02

6.4 Detailed Results of Particulate Matter Measurements

Customer		SICK Automation		
Unit No.		Unit 2		
Location		Temporary Stack		
Test No.		1	2	3
Stack tester:		AVM	AVM	AVM
Date	dd-mm-yy	2024/02/23	2024/02/23	2024/02/23
Start Time	HH:mm:ss	10:10:00	11:46:00	13:17:00
End Time	HH:mm:ss	11:23:00	12:56:00	14:28:00
Sampling time	Minutes	64	64	64
Boiler load	MW	579	579	580
Comprehensive Summary				
Duct dimensions:				
Duct Inside diameter	m	7,000	7,000	7,000
Duct area	m^2	38,48	38,48	38,48
Sampling plane:				
Number of Traverses	-	2	2	2
Number of points per traverse	-	4	4	4
Sampling time per point	Minutes	8	8	8
Ambient temperature	°C	27,5	30,3	33,9
Equipment data:				
Pitot tube format		L-Type	L-Type	L-Type
Nozzle diameter	mm	4,0	4,0	4,0
Consumables data:				
Thimbles used		SCV16	SCV17	SCV18
Measured data:				
Gas Temperature	°C	139,3	139,4	141,4
Barometric pressure	kPa	85,2	85,2	85,0
Duct pressure	Pa (g)	-273,3	-336,6	-359,1
Duct pressure	kPa (abs)	84,9	84,8	84,6
Moisture Mass	g	47,0	50,0	51,0
Moisture	%v/v	6,7	7,0	7,0
Oxygen	%	8,6	8,5	8,4
Velocity	m/s	32,9	33,2	33,5
Gas Volume Flow (QactWet)	Am^3/s	1265,5	1276,9	1290,5
Gas Volume Flow (QactDry)	Am^3/s	1180,7	1187,2	1199,5
Gas Volume Flow (Qnw)	Nm^3/s	702,6	707,8	710,4
Gas Volume Flow (Qnd)	Nm^3/s	655,5	658,1	660,3
Gas Volume Flow (Qnd 10 %O_2)	Nm^3/s	738,3	748,5	758,4
Gas flow rate	kg/s	904,2	902,2	905,6
Gas density in duct	kg/m^3	0,7	0,7	0,7
Sampled gas temperature (to)	°C	27,8	30,3	34,4
Dust mass	mg	45,3	60,8	42,7
Gas Volume Sampled (Vact)	Am^3 (w)	1,5728	1,6002	1,6373
Gas Volume Sampled (Vnw)	Nm^3 (w)	0,8733	0,8870	0,9013
Gas Volume Sampled (Vad)	Am^3 (d)	1,4675	1,4879	1,5220
Gas Volume Sampled (Vnd)	Nm^3 (d)	0,8148	0,8248	0,8378
Sampling rate per traverse	Am^3/h (d)	0,6879	0,6975	0,7134
Dust Concentration	mg/Am^3 (w)	28,8	38,0	26,1
Dust Concentration	mg/Nm^3 (w)	51,9	68,5	47,4
Dust Concentration	mg/Am^3 (d)	30,9	40,9	28,1
Dust Concentration	mg/Nm^3 (d)	55,6	73,7	51,0
Correction factor (10% O_2)		0,9	0,9	0,9
Dust Concentration Normalised to 10% O_2	mg/Nm^3 (d) @ 10% O_2	49,4	64,8	44,4
Dust Outlet Dust Flowrate	mg/s	36435,4	48509,9	33676,0
Moisture Concentration	g/Nm^3 (d)	57,7	60,6	60,9
Average Face velocity	cm/s	4,9	4,9	4,9
Isokineticity	%	99	100	101
Average O/M Signal	SL	0,8	1,2	1,0

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APPENDIX A

Plant Parameters

A.1: Plant Parameters Averages

A.2: Plant Parameters Standard Deviation

A.1: Plant Parameters Averages

Description	Units	Test 1	Test 2	Test 3
SO_2	mg/Nm^3	1745,0	1775,3	1815,9
NO	mg/Nm^3	308,0	318,8	320,7
NO_2	mg/Nm^3	0,3	0,2	-0,1
Nox	mg/Nm^3	471,7	488,2	490,4
NO_2	mg/Nm^3	0,3	0,2	-0,1
Nox	mg/Nm^3	471,7	488,2	490,4
TEMP	0C	142,0	142,9	144,2
stack O2	Vol %	6,6	6,5	6,4
O2	Vol %	6,6	6,5	6,4
Velocity	m/s	31,2	22,3	41,7
Load MW	MW	579,4	579,4	579,7
steam flow	Kg/s	471,6	472,2	474,3
air flow	Kg/s	682,5	683,9	677,8
LH O_2	%	6,1	6,0	5,9
RH O_2	%	5,9	5,8	5,7
LH Air heater temp	0C	142,4	142,6	143,8
RH Air heater temp	0C	126,9	128,8	129,6
Mill 10	RPM	6,9	7,0	6,9
Mill 20	RPM	7,2	7,3	7,2
Mill 30	RPM	6,6	6,7	6,6
Mill 40	RPM	0,0	0,0	0,0
Mill 50	RPM	0,0	0,0	0,0
LH FFP DP	kPa	1,6	1,6	1,6
RH FFP DP	kPa	1,4	1,3	1,3
Monitor Output	SL	0,8	1,2	1,0

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A.2: Plant Parameter Standard Deviations

Description	Units	Test 1	Test 2	Test 3
SO_2	mg/Nm^3	27,7	29,4	44,4
NO	mg/Nm^3	4,1	4,2	4,9
NO_2	mg/Nm^3	0,2	0,2	0,1
Nox	mg/Nm^3	6,6	6,1	7,5
NO_2	mg/Nm^3	0,2	0,2	0,1
Nox	mg/Nm^3	6,6	6,1	7,5
TEMP	0C	0,5	0,4	0,2
stack O2	Vol %	0,1	0,1	0,1
O2	Vol %	0,1	0,1	0,1
Velocity	m/s	8,9	16,6	1,3
Load MW	MW	1,0	0,6	0,6
steam flow	Kg/s	1,7	0,7	1,1
air flow	Kg/s	2,3	2,0	3,2
LH O_2	%	0,1	0,1	0,1
RH O_2	%	0,1	0,1	0,1
LH Air heater temp	0C	1,4	0,1	0,7
RH Air heater temp	0C	0,4	0,6	0,2
Mill 10	RPM	0,0	0,0	0,0
Mill 20	RPM	0,1	0,1	0,1
Mill 30	RPM	0,0	0,0	0,0
Mill 40	RPM	0,0	0,0	0,0
Mill 50	RPM	0,0	0,0	0,0
LH FFP DP	kPa	0,0	0,0	0,0
RH FFP DP	kPa	0,0	0,0	0,0
Monitor Output	SL	0,1	0,1	0,1

APPENDIX B

Particulate Matter Correlation Curves

Figure 1.1: "As Found" Backfitting Particulate Matter Curve [mg/Nm^3(d) @ 10% O_2]
Figure 1.2: "As Found" Backfitting Particulate Matter Curve [mg/Am^3(w)]
Figure 1.3: "As Found" Backfitting Particulate Matter Curve [mg/Am^3(d)]

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KUSILE POWER STATION

Particulate Emission Monitor Correlation Certificate

Plant: Unit 2
Location of monitor: Temporary stack
Monitor information:
Make of Monitor: TBA
Model: TBA
Serial Numbers:
Optical head: TBA
Reflector : TBA

Limits of validity:
Lower limit: 44 mg/Nm3 (d) [as an hourly average]
Upper limit: 65 mg/Nm3 (d) [as an hourly average]

Dates:
Calibration date: To Be Advised
Measurements dates: 23 February 2024

Linear function:

Correlation coefficient(R) = 0,99

E = 53,1887SL - 0,01

where: E = Emission [mg/Nm^3(d)@ 10% O_2]
SL = Scattered Light [SL]

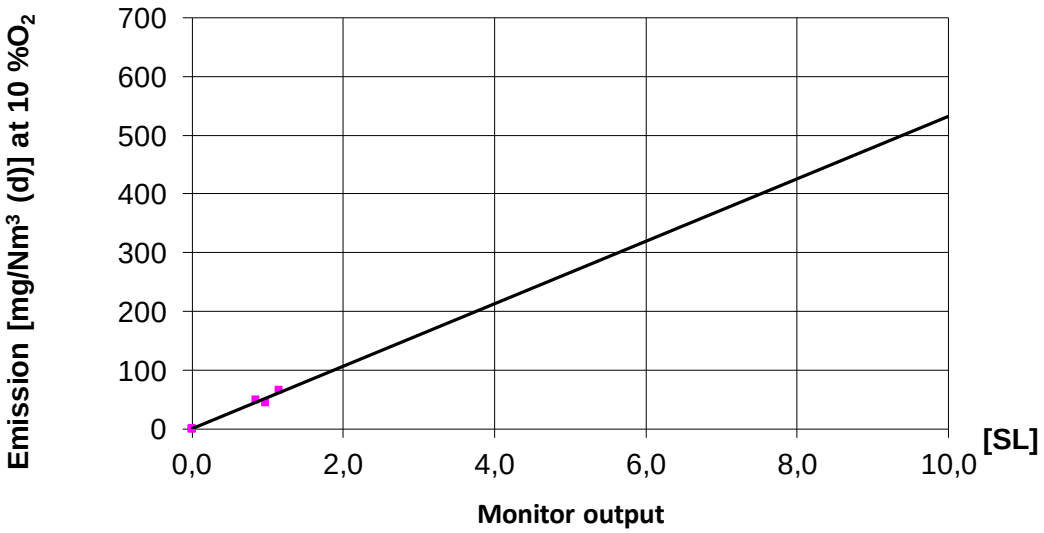

FIGURE 1.1

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KUSILE POWER STATION

Particulate Emission Monitor Correlation Certificate

Plant: Unit 2
Location of monitor: Temporary stack
Monitor information:
Make of Monitor: TBA
Model: TBA
Serial Numbers:
Optical head: TBA
Reflector : TBA

Limits of validity:
Lower limit: 26 mg/Am3 (w) [as an hourly average]
Upper limit: 38 mg/Am3 (w) [as an hourly average]

Dates:
Calibration date: To Be Advised
Correlation dates: 23 February 2024

Linear function:

Correlation coefficient(R) = 0,99

E = 31,1696SL - 0,01

where: E = Emission [mg/Am^3(w)]
SL = Scattered Light [SL]

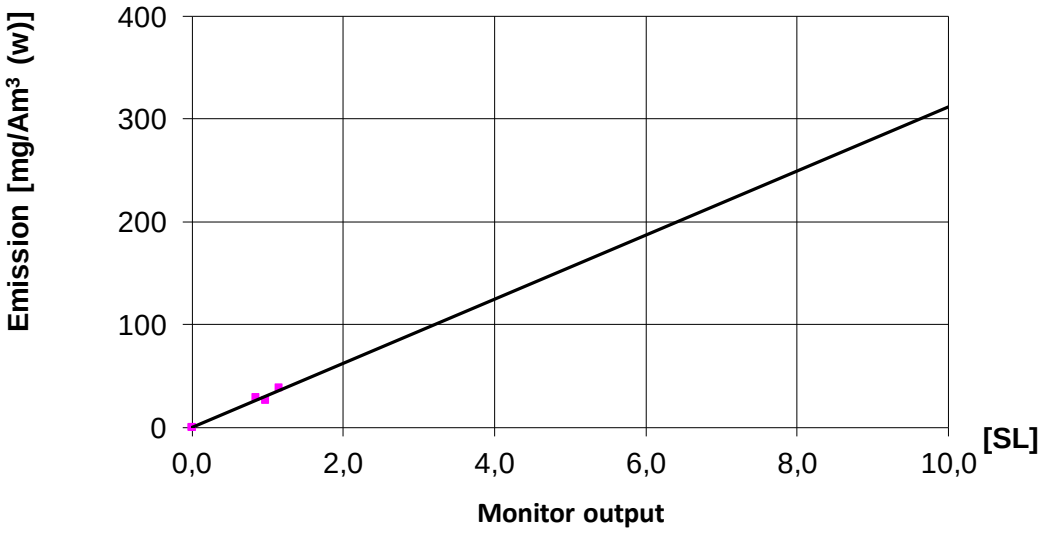

FIGURE 1.2

Prepared by: Inthuu Measurements

KUSILE POWER STATION

Particulate Emission Monitor Correlation Certificate

Plant: Unit 2
Location of monitor: Temporary stack
Monitor information:
Make of Monitor: TBA
Model: TBA
Serial Numbers:
Optical head: TBA
Reflector : TBA

Limits of validity:
Lower limit: 28 mg/Am3 (d) [as an hourly average]
Upper limit: 41 mg/Am3 (d) [as an hourly average]

Dates:
Calibration date: To Be Advised
Correlation dates: 23 February 2024

Linear function:

Correlation coefficient(R) = 0,99

E = 33,5005SL - 0,02
where: E = Emission [mg/Am^3(d)]
SL = Scattered Light [SL]

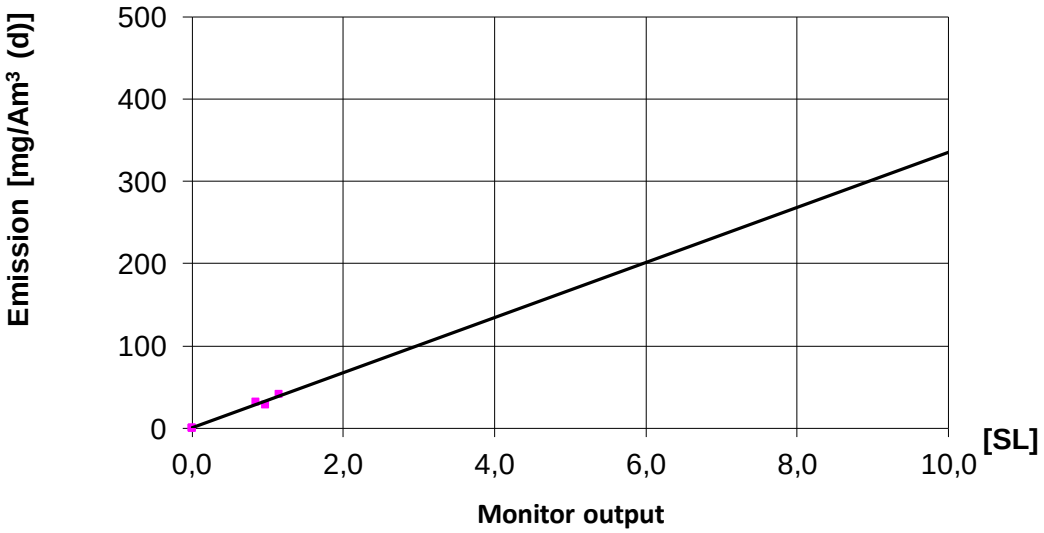

FIGURE 1.3

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Appendix C

Nozzle Checklist

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Doc. No:	INT-QMS-TS 02
Rev. No:	1
Effective date:	2023/01/30
Page:	1 of 1
Compiled by:	R Nare
Authorized by:	A Riekert
Approved by:	C Scheepers

Customer	: Kusile Unit 2
Technician	: AV Makama
Measurements Type	: P.M
Vernier SN	:

Nozzle Verification

Date	Nozzle No	Diameter A	Diameter B	Diameter C	Diameter D	Pass / Fail
2024/02/23	4.0 mm	4.0 mm	4.0 mm	4.0 mm	4.0 mm	Pass
2024/02/23	4.0 mm	4.0 mm	4.0 mm	4.0 mm	4.0 mm	Pass
2024/02/23	4.0 mm	4.0 mm	4.0 mm	4.0 mm	4.0 mm	Pass
2024/02/23	4.0 mm	4.0 mm	4.0 mm	4.0 mm	4.0 mm	Pass

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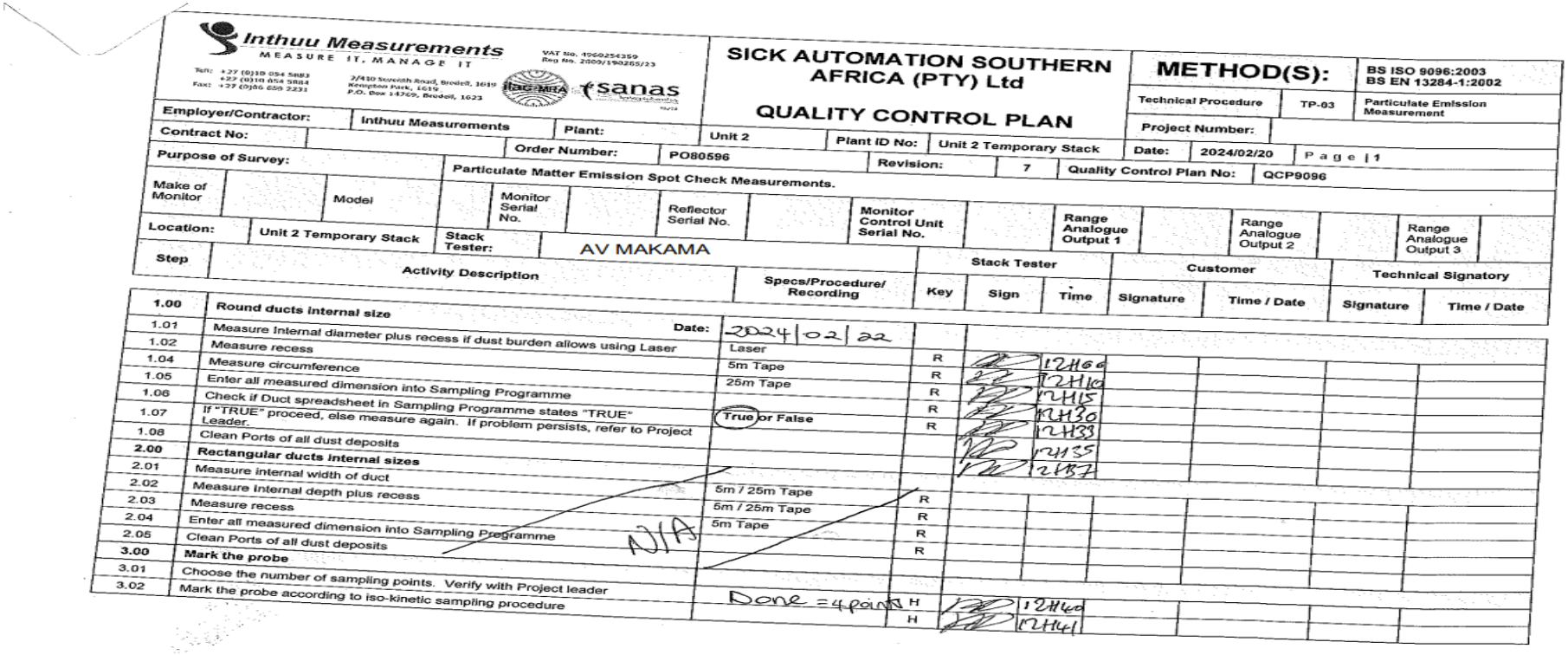
Appendix D

Measurements Quality Control Plan



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SICK AUTOMATION SOUTHERN AFRICA (PTY) Ltd

QUALITY CONTROL PLAN

METHOD(S): BS ISO 9096:2003 / BS EN 13284-1:2002

Employer/Contractor:	Inthuu Measurements	Plant:	Unit 2	Plant ID No:	Unit 2 Temporary Stack	Technical Procedure	TP-03	Particulate Emission Measurement					
Contract No:		Order Number:	PO80596	Revision:	7	Project Number:		Date:	2024/02/20	Page | 1			
Purpose of Survey:	Particulate Matter Emission Spot Check Measurements.					Quality Control Plan No:	QCP9096						
Make of Monitor		Model		Monitor Serial No.		Reflector Serial No.		Monitor Control Unit Serial No.		Range Analogue Output 1		Range Analogue Output 2		Range Analogue Output 3	
Location:	Unit 2 Temporary Stack	Stack Tester:	AV MAKAMA										

Step	Activity Description	Specs/Procedure/ Recording	Key	Stack Tester Sign	Stack Tester Time	Customer Signature	Customer Time / Date	Technical Signatory Signature	Technical Signatory Time / Date
1.00	**Round ducts internal size** Date:	2024/02/22							
1.01	Measure Internal diameter plus recess if dust burden allows using Laser	Laser	R		12H66				
1.02	Measure recess	5m Tape	R		12H10				
1.04	Measure circumference	25m Tape	R		12H15				
1.05	Enter all measured dimension into Sampling Programme		R		12H30				
1.06	Check if Duct spreadsheet in Sampling Programme states "TRUE"	(True) or False	R		12H39				
1.07	If "TRUE" proceed, else measure again. If problem persists, refer to Project Leader.				12H35				
1.08	Clean Ports of all dust deposits				12H37				
2.00	**Rectangular ducts internal sizes**								
2.01	Measure internal width of duct	5m / 25m Tape	R						
2.02	Measure Internal depth plus recess	5m / 25m Tape	R						
2.03	Measure recess	5m Tape	R						
2.04	Enter all measured dimension into Sampling Programme		R						
2.05	Clean Ports of all dust deposits								
3.00	**Mark the probe**								
3.01	Choose the number of sampling points. Verify with Project leader	Done = 4 points	H		12H40				
3.02	Mark the probe according to iso-kinetic sampling procedure		H		12H41				

N/A

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Location:	Unit 2 Temporary Stack		Stack Tester			Customer		Technical Signatory	
Step	Activity Description	Specs/Procedure/ Recording	Key	Sign	Time	Signature	Time / Date	Signature	Time / Date
4.00	**Sampling equipment set up**	Done	S		14:10				
4.01	Level sampling equipment	Console 4: 53256659	R		14:20				
4.02	Iso-k Box Serial Number.	2010/01/SP4/02	R		14:21				
4.03	Probe serial number.	2010/01/TC4/02	R		14:28				
4.04	Thermocouple serial number.				14:30				
4.05	Pitot serial number	Console 1			14:32				
4.06	Silica gel scale serial number	Done	S		13:40				
4.07	Attach vacuum pump	Done	S		13:48				
4.08	Attach water trap and silica gel containers	Done	S		13:56				
4.09	Attach impulse lines to sampling equipment	Done	S		14:02				
4.10	Attach impulse lines and sampling line to probe								
5.00	**Leak check on impulse lines**	**Drop in Pa:** 0 kPa	R		15:23				
5.01	Perform leak check on static impulse line & record drop in 15 seconds		H						
5.02	If drop < 200 Pa in 15 seconds then proceed, else fix leak	**Drop in Pa:** 0 kPa	R		15:22				
5.03	Perform leak check on Total impulse line & record drop in 15 seconds		H						
5.04	If drop < 200 Pa in 15 seconds then proceed, else fix leak	**Drop in Pa:** 0 kPa	R		15:20				
5.05	Perform leak check on O_2 impulse line & record drop in 15 seconds		H						
5.06	If drop < 200 Pa in 15 seconds then proceed, else fix leak								
6.00	**Perform vacuum check on sampling line**	**Advance:** 0.0006 m^3	R		10h22				
6.01	Perform vacuum check on sampling line & record advance in 60 seconds		H						
6.02	If advance < 0.0005 m^3 in 60 seconds then proceed, else fix leak								

Notes:

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Location:	Unit 2 Temporary Stack							Stack Tester			Customer		Technical Signatory	
Step	Activity Description						Specs/Procedure/ Recording	Key	Sign	Time	Signature	Time / Date	Signature	Time / Date
7.00	Day No.: 1					Date:	2024/02/23							
7.01	Record the LAR or PTW No.							H		8H00				
7.02	All workers signed Worker's register							R		8H01				
7.03	Record Boiler load and operating condition						580 MW	R		9H20				
7.04	Iso-k Box Serial No.						Carlo 4	R		9H00				
7.05	Probe Serial No.						20/01/1584/02	R		9H01				
7.06	Thermocouple Serial No.						20/01/1584/02			9H00				
7.07	O_2 Analyser Serial No.						V23 OLF 39078			9H00				
7.08	Determine nozzle size for the test						Done	R		9H01				
7.09	Inspect Ports of dust deposits						Done			9H02				
7.10	Fit correct nozzle Enter diameter in Excel If "Fail" use another nozzle	Test No	Nozzle No	Diameter A	Diameter B	Diameter C	Diameter D	Pass / Fail	S					
		1	4.0mm	4.0mm	4.0mm	4.0mm	4.0mm	pass			10H08			
		2	4.0mm	4.0mm	4.0mm	4.0mm	4.0mm	pass			11H36			
		3	4.0mm	4.0mm	4.0mm	4.0mm	4.0mm	pass			13H08			
		4												
		Filter F/B	4.0mm	4.0mm	4.0mm	4.0mm	4.0mm	pass			14H36			
7.11	Run F/B (Insert to deepest point and remove probe – all traverses)								S					
8.11	Fit filter & record number	Test No	Filter	Traverse	Filter	Traverse	Filter	Traverse	S					
		1	SCV-16	A	SCV-16	B	SC				9H20			
		2	SCV-17	A	SCV-17	B					11H35			
		3	SCV-18	A	SCV-18	B					13H09			
		4												
		Filter F/B	SCV-19	A	SCV-19	B					14H37			
		Rinse F/B No.	SCV-19		SCV-19						14H40			
8.12	Weigh water trap and Silica gel	Test No.	Initial mass			Final mass			S					
		1	1455.0g	1455.0g		1502.0g	1502.0g				9H20			
		2	1455.0g	1562.0g		1612.0g	1612.0g				11H40			
		3	1534.0g	1534.0g		1585.0g	1585.0g				13H10			
		4												

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Location:	Unit 2 Temporary Stack											
					Stack Tester			Customer		Technical Signatory		
Step	Activity Description	Specs/Procedure/ Recording			Key	Sign	Time	Signature	Time / Date	Signature	Time / Date	
8.13	Perform leak check on static impulse line & record drop in 15 seconds If drop < 200 Pa in 15 seconds then proceed, else fix leak	Test No	Pressure drop	Pass / Fail	S							
		1	0 kPa	pass			9H21					
		2	0 kPa	pass			11H41					
		3	0 kPa	pass			13H12					
		4										
8.14	Perform leak check on total impulse line & record drop in 15 seconds If drop < 200 Pa in 15 seconds then proceed, else fix leak	Test No	Pressure drop	Pass / Fail	S							
		1	0 kPA	pass			9H22					
		2	0 kPA	pass			11H42					
		3	0 kPA	pass			13H13					
		4										
8.15	Perform leak check on O_2 impulse line & record drop in 15 seconds If drop < 200 Pa in 15 seconds then proceed, else fix leak	Test No	Pressure drop	Pass / Fail	S							
		1	0 kPA	pass			9H23					
		2	0 kPA	pass			11H43					
		3	0 kPA	pass			13H15					
		4										
8.16	Perform vacuum check on sampling line & record advance in 60 seconds (Filter fitted) If advance < 0.0005 m3 in 60 seconds then proceed, else fix leak	Test No	Advance before test	Pass / Fail	Advance after test	Pass / Fail	S						
		1	0,0005	pass	0,0005	pass			9H40				
		2	0,0005	pass	0,0005	pass			11H44				
		3	0,0005	pass	0,0005	pass			13H16				
		4											

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Location:	Unit 2 Temporary Stack				Stack Tester			Customer		Technical Signatory	
Step	Activity Description		Specs/Procedure/ Recording		Key	Sign	Time	Signature	Time / Date	Signature	Time / Date
8.17	Test Start Time	Test No	Start Time		S						
		1	10H09				10H09				
		2	11H45				11H45				
		3	13H16				13H16				
		4									
8.18	Contact control room at the end of last test to inform of completion of survey Confirm return to normal operation	Time:	15H30		R		15H30				
8.19	Rinse nozzle and sampling liner up to the filter. Record condition of nozzle	Test No	Record your assessment of nozzle, level of deposit etc.		S						
		1	Nozzle Still round				11H30				
		2	Nozzle Still round				12H04				
		3	Nozzle Still round				14H34				
		4									
8.20	Record Isokineticity	Test No	Isokineticity [%]	Pass / Fail	S						
		1	99.1% T-1	pass			11H32				
		2	99.9% T-2	pass			12H59				
		3	101.2% T-3	pass			14H28				
		4									
Notes											

Inthuu Measurements
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Kempton Park, 1619
P.O. Box 14769, Bredell, 1623

ilac-MRA
sanas Testing Laboratory T1026

Location:	Unit 2 Temporary Stack		Stack Tester			Customer		Technical Signatory	
Step	Activity Description	Specs/Procedure/ Recording	Key	Sign	Time	Signature	Time / Date	Signature	Time / Date
9.00	Site De-establishment Date:	2024/02/23							
9.01	Is the area clear of any equipment?	Yes	S		15H40				
9.02	Is the area clear of any tripping hazards?	Yes	S		15H41				
9.03	Is the area clear of any domestic waste?	Yes	S		15H43				
9.04	Sign off LAR/PTW	Yes	R, W		15H49				
9.05	Document review	Done	R		15:24				

ADDITIONAL INFORMATION ON ABBREVIATIONS USED

TOI:	Temporary Operating Instruction	P-WCL:	Pre-Work Check List
PSR:	Plant Safety Regulations	CM:	Contracts Manager
LAR/PTW:	Local Access Register/ Permit to Work	QC:	Quality Control
RP:	Responsible Person	QCP:	Quality Control Plan
AS:	Authorised Supervisor	AO:	Analogue Output

PREPARED BY: GN Djetkeu DATE: 20th February 2024	Intervention Legend:	Project Leader			Customer			Technical Signatory		
		Name	Sign	Date	Name	Sign	Date	Name	Sign	Date
	S – Surveillance (casual checks) W – Witness (stand by checks) H – Holding (move only on approval) R – Review (read and accept)	Mxolisi		05/03/24						

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Appendix E

Equipment Calibration Records

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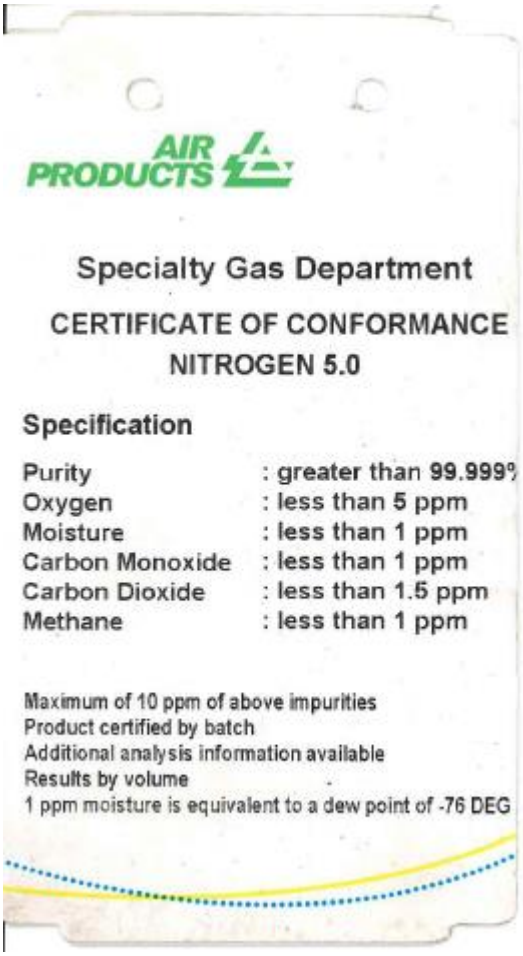

AIR PRODUCTS

Specialty Gas Department

CERTIFICATE OF CONFORMANCE
NITROGEN 5.0

Specification

Purity	: greater than 99.999%
Oxygen	: less than 5 ppm
Moisture	: less than 1 ppm
Carbon Monoxide	: less than 1 ppm
Carbon Dioxide	: less than 1.5 ppm
Methane	: less than 1 ppm

Maximum of 10 ppm of above impurities
Product certified by batch
Additional analysis information available
Results by volume
1 ppm moisture is equivalent to a dew point of -76 DEG

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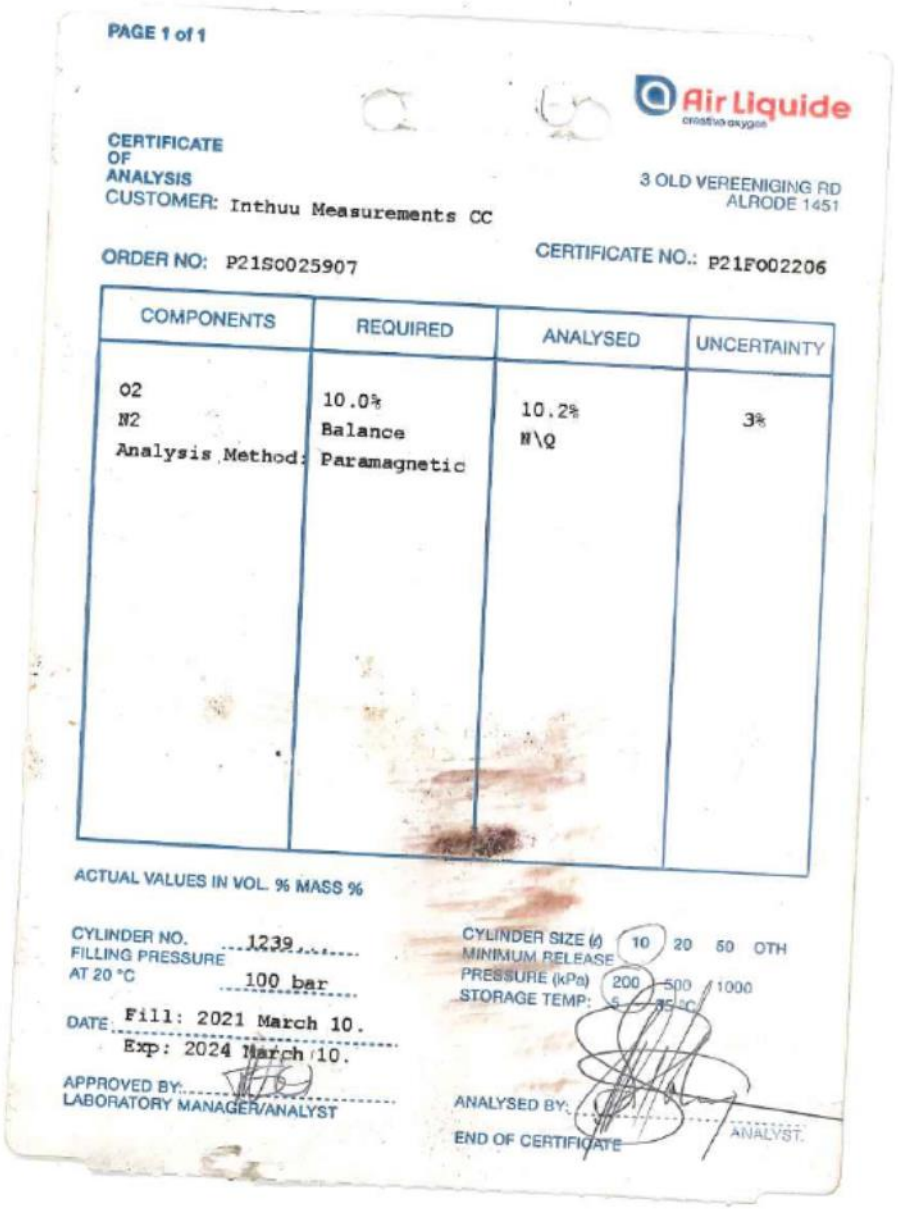

PAGE 1 of 1

Air Liquide
creating the oxygen

CERTIFICATE OF ANALYSIS

3 OLD VEREENIGING RD
ALRODE 1451

CUSTOMER: Inthuu Measurements CC

ORDER NO: P21S0025907

CERTIFICATE NO.: P21F002206

COMPONENTS	REQUIRED	ANALYSED	UNCERTAINTY
O2	10.0%	10.2%	3%
N2	Balance	N\Q	
Analysis Method:	Paramagnetic		

ACTUAL VALUES IN VOL. % MASS %

CYLINDER NO. 1239

FILLING PRESSURE AT 20 °C 100 bar

DATE: Fill: 2021 March 10.
Exp: 2024 March 10.

APPROVED BY:
LABORATORY MANAGER/ANALYST

CYLINDER SIZE (ℓ) 10 20 50 OTH

MINIMUM RELEASE PRESSURE (kPa) 200 500 1000

STORAGE TEMP: 5 35 °C

ANALYSED BY:
ANALYST

END OF CERTIFICATE

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CSIR
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Council for Scientific and Industrial Research
Defence and Security Cluster
Aeronautic Systems Impact Area
Air Speed Calibration Wind Tunnel
Building 13
Meiring Naude Road
Brummeria
0184

P O Box 395
Pretoria 0001
South Africa
Tel +27 12 841 2064
Fax +27 12 349 1156
www.csir.co.za

CERTIFICATE

OF

CALIBRATION

Calibration of	:	Pitot Tube
Manufacturer	:	Inthuu Measurements
Model Number	:	S Type
Serial Number	:	2021/06/PTST15/01
Calibrated for	:	Inthuu Measurements 2/410 Seventh Road Bredell Kempton Park 1619
Date of Calibration	:	13 January 2023

Calibrated by: Ismael Mashaba Wind Tunnel Operator +27 12 841 2064	**Checked by:** Peter Skinner CWT Facility Technical Expert +27 12 841 4839	**Authorised by:** Sarah Dikgale Technical Signatory +27 12 841 4733
Date of Issue : 19 January 2023		Certificate Number: 2257/2023

Inthuu Measurements
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CALIBRATION OF A PITOT TUBE
Serial No. 2021/06/PTST15/01

This calibration certificate documents the traceability to National Standards, which realises the physical units of measurement according to the international system of units.

Standards and Equipment used:

Description	Manufacturer	Model	Serial Number	Cal Certificate
Wind Tunnel	CSIR	Subsonic	DPSS ASC CWT	2017-005
Thermometer	Gold Brand	LIG	CSIR 92-93	308-33694
Water Manometer	Essen & Delft	11316	2648	M00074906
Barometer	Wilh Lambrecht KG Gotting en	610/470138	2606	M00077886
Digital Voltmeter	Agilent	34410A	MY53011342	115479-1
Hygrometer	Vaisala	HMW70Y	V1320030	HM\GC-4172

1. PROCEDURE AND SETTINGS

The instrument was calibrated in the calibration tunnel over one or more of the available ranges as required.

(i) The relevant calibration procedure is 6636-CWTQM-00027.
(ii) The results are given in the table on page 3.
(iii) The calibration equation is given on the graph on page 4.

2. ATMOSPHERIC CONDITIONS

The calibration was performed in Pretoria at the following atmospheric conditions:

(i) Atmospheric pressure : 869.3 mbar
(ii) Atmospheric Temperature : 21.0 °C

3. RESULTS

(i) The results given in this certificate were correct at the time of calibration and relate to UUT identified on this certificate.
(ii) The calibration is valid between 6.88 m/s to 34.4 m/s.
(iii) The reported uncertainties of measurement are based on a standard uncertainty multiplied by a coverage factor of k=2, which, unless specifically stated otherwise, provides a level of confidence of approximately 95 %. The uncertainty on page 3 includes the curve fit uncertainty for the calibrated instrument.
(iv) The relationship between airspeed and dynamic pressure is:

$$P_d = \frac{1}{2}\rho V^2 \qquad V = \sqrt{\frac{2P_d}{\rho}}$$

Where Pd is dynamic pressure in Pa, is air density in kg/m3 at the measurement point and V is airspeed in m/s.

(v) Dynamic pressure on the Pitot tube was measured with a calibrated water manometer.
(vi) In service dynamic pressure must be measured with a calibrated pressure transducer with an uncertainty in pressure measurement of less than 4.5 Pa.
(vii) To obtain measurements within the calibration accuracy, the calibration equation with the calibration coefficient of **0.85** given on the graph, must be used.
(viii) The user is obliged to have the object re-calibrated at appropriate intervals.
(ix) The instrument is suitable for calibration.

Calibrated by:	Checked by:	Authorised by:
Ismael Mashaba Wind Tunnel Operator +27 12 841 2064	Peter Skinner CWT Facility Technical Expert +27 12 841 4839	Sarah Dikgale Technical Signatory +27 12 841 4733
Date of Issue : 19 January 2023		Certificate Number: 2257/2023

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CALIBRATION OF A PITOT TUBE
Serial No. 2021/06/PTST15/01

No.	Indicated Airspeed (m/s)	True Airspeed (m/s)	Uncertainty (m/s)
1	8.9	6.9	0.8
2	11.6	9.3	0.7
3	17.7	14.2	0.7
4	23.5	19.2	0.7
5	29.2	24.2	0.8
6	35.1	29.3	1.0
7	41.1	34.4	1.1
8	35.1	29.3	0.9
9	29.2	24.2	0.8
10	23.4	19.2	0.7
11	17.6	14.2	0.7
12	11.6	9.3	0.7
13	8.6	6.9	0.9

Calibrated by:	Checked by:	Authorised by:
Ismael Mashaba Wind Tunnel Operator +27 12 841 2064	Peter Skinner CWT Facility Technical Expert +27 12 841 4839	Sarah Dikgale Technical Signatory +27 12 841 4733
Date of Issue : 19 January 2023		Certificate Number: 2257/2023

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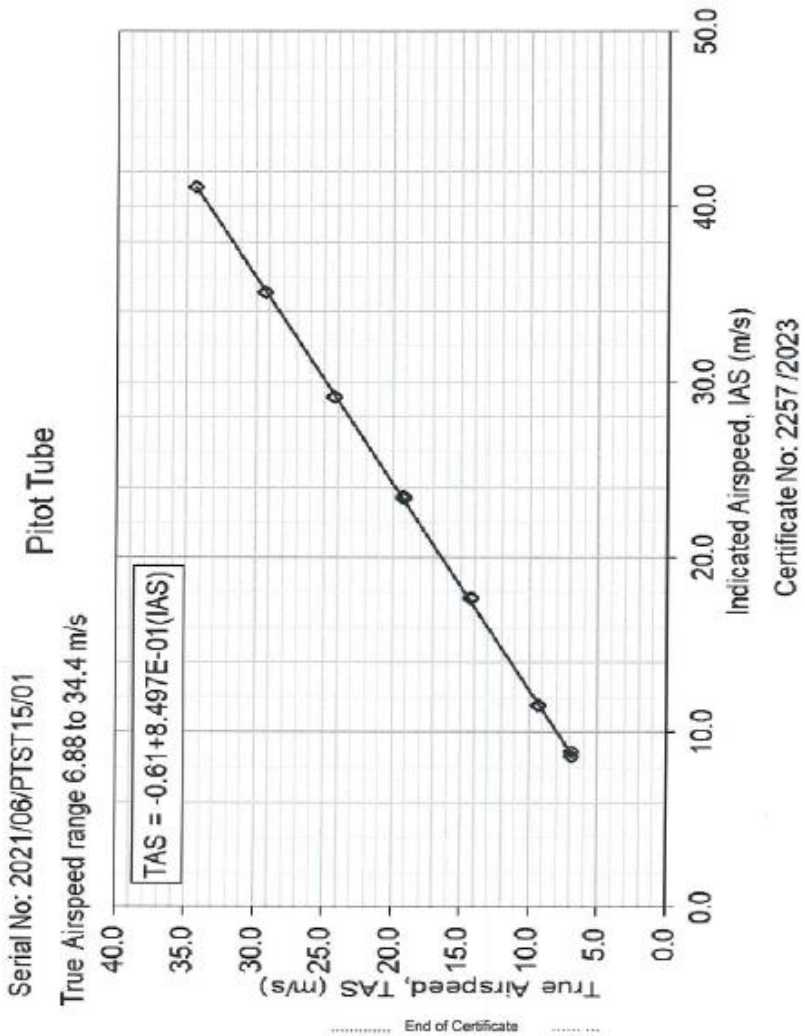

End of Certificate

Calibrated by:
Ismael Mashaba
Wind Tunnel Operator
+27 12 841 4733

Checked by:
Peter Skinner
CWT Facility Technical Expert
+27 12 841 4839

Authorised by:
Sarah Dikgale
Technical Signatory
+27 12 841 4733

Date of Issue: 19 January 2023

Certificate Number: 2257/2023

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CSIR

DAS TOTAL QUALITY MANAGEMENT SYSTEM
AERONAUTICS SYSTEMS
CWT INSTRUMENT ACCEPTANCE FORM

OUR REF:		DATE:	30 Jan 2023
FROM:		FAX NO:	
		TEL NO:	
E-MAIL		CELL NO:	
SUBJECT:			
PAGES:	1of 1		

Company: Eskom Koeberg Nuclear Power Station

Contact Person: Pumela Mangesi

Item Description	Make & Model	Serial Number
L-TYPE Pitot-tube	S Steel	2013/01/PTL 201/04

Condition of instrument: Good Condition

Accessories: ______

Test Requirements: ______

Delivery Method:

Delivered by: AV Matamba **Signature:** [signature]

Accepted by: Linda **Signature:** [signature]

6636-CWTQM-00018
Rev: 2

January 2020

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Web: www.unimet.co.za

MEASUREMENTS PERFORMED IN
SANAS ACCREDITED CALIBRATION LABORATORY No 205

PRESSURE METROLOGY

CERTIFICATE OF CALIBRATION

Date of issue : 31/08/2023

Certificate No : 2308P11648-3

Technical Signatory

A Mathieson.

The results of all measurements are traceable to the national measuring standards.

The values in this certificate are correct at the time of calibration. The results relate only to the measurement component of the instrument supplied. The results exclude the influence of any auxillary equipment that may be attached to the instrument. Subsequently the accuracy will depend on such factors as the care executed in the handling and use of the device, and the frequency of use. Recalibration should be performed after a period so chosen to ensure that the instrument's accuracy remains within the desired limits.

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CERTIFICATE OF CALIBRATION

Certificate Number	:	2308P11648-3
Calibration of a	:	Barometer
Manufacturer & Type	:	Greisinger GPB2300
Serial Number	:	1404
Calibrated for	:	Inthuu Measurements, Kempton Park.
Contact Details	:	Alne Vorster, Tel: 010 054 5883.
Procedure Number	:	53-128
Date of Calibration	:	28/08/2023
Date of Issue	:	31/08/2023
Laboratory Environment	:	19.6 °C
Reference Standards	:	205-S-01 Ruska, PPG 6200 S/N 39478

Reference Pressure mbar	Indication mbar		Correction mbar	
	Rising	Falling	Rising	Falling
800	804	804	-4	-4
850	856	856	-6	-6
900	905	905	-5	-5
950	955	955	-5	-5
1000	1005	1005	-5	-5
1050	1055	1055	-5	-5
1150	1153	1153	-3	-3

The uncertainty of measurement is ± 2 mbar.
The reported uncertainty is based on a standard uncertainty multiplied by a coverage factor of k=2, which unless specifically stated otherwise, provides a confidence level of 95%, in accordance with the Guide to the Expression of Uncertainty in Measurement, first edition, 1993.

Comments : None.

Calibrated by : D Wedderspoon *** End of Certificate *** Technical Signatory

Inthuu Measurements
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MEASUREMENTS PERFORMED IN
SANAS ACCREDITED CALIBRATION LABORATORY No 205

PRESSURE METROLOGY

CERTIFICATE OF CALIBRATION

Date of issue : 31/08/2023

Certificate No : 2308P1648-4

Technical Signatory

A Mathieson.

The results of all measurements are traceable to the national measuring standards.

The values in this certificate are correct at the time of calibration. The results relate only to the measurement component of the instrument supplied. The results exclude the influence of any auxillary equipment that may be attached to the instrument. Subsequently the accuracy will depend on such factors as the care executed in the handling and use of the device, and the frequency of use. Recalibration should be performed after a period so chosen to ensure that the instrument's accuracy remains within the desired limits.

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CERTIFICATE OF CALIBRATION

Certificate Number	:	2308P1648-4
Calibration of a	:	Manometer
Manufacturer & Type	:	HK Instruments MM-5K
Serial Number	:	2022/03/MM-K5/05
Calibrated for	:	Inthuu Measurements, Kempton Park.
Contact Details	:	Alne Vorster, Tel: 010 054 5883.
Procedure Number	:	53-129
Date of Calibration	:	30/08/2023
Date of Issue	:	31/08/2023
Laboratory Environment	:	19.5 °C
Reference Standards	:	205-S-01 Ruska, PPG 6200 S/N 39478

Reference Pressure kPa	Indication kPa Rising	Indication kPa Falling	Correction kPa Rising	Correction kPa Falling
0	0.00	0.00	0.00	0.00
1	0.95	0.95	0.05	0.05
2	1.90	1.90	0.10	0.10
3	2.87	2.87	0.13	0.13
4	3.83	3.83	0.17	0.17
5	4.80	4.80	0.20	0.20

The uncertainty of measurement is ± 0.02 kPa.
The reported uncertainty is based on a standard uncertainty multiplied by a coverage factor of k=2, which unless specifically stated otherwise, provides a confidence level of 95%, in accordance with the Guide to the Expression of Uncertainty in Measurement, first edition, 1993.

Comments : The manometer scale/tube was calibrated in a vertical position. In the vertical position the manometer is designed to have a scale factor of 1. The specific gravity of the manometer fluid, as supplied by the customer, is 0.826.

Calibrated by : D Wedderspoon *** End of Certificate *** Technical Signatory

Inthuu Measurements
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MEASUREMENTS PERFORMED IN
SANAS ACCREDITED CALIBRATION LABORATORY No 205

PRESSURE METROLOGY

CERTIFICATE OF CALIBRATION

Date of issue : 31/08/2023

Certificate No : 2308P11648-5

Technical Signatory

A Mathieson.

The results of all measurements are traceable to the national measuring standards.

The values in this certificate are correct at the time of calibration. The results relate only to the measurement component of the instrument supplied. The results exclude the influence of any auxillary equipment that may be attached to the instrument. Subsequently the accuracy will depend on such factors as the care executed in the handling and use of the device, and the frequency of use. Recalibration should be performed after a period so chosen to ensure that the instrument's accuracy remains within the desired limits.

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1406

CERTIFICATE OF CALIBRATION

Certificate Number	:	2308P11648-5
Calibration of a	:	Manometer.
Manufacturer & Type	:	Airflow, Incline Manometer.
Serial Number	:	BOX5
Calibrated for	:	Inthuu Measurements, Kempton Park.
Contact Details	:	Alne Vorster, Tel: 010 054 5883.
Procedure Number	:	53-129
Date of Calibration	:	31/08/2023
Date of Issue	:	31/08/2023
Laboratory Environment	:	20.5 °C
Reference Standards	:	205-S-01 Ruska, PPG 6200 S/N 39478

SCALE FACTOR SET TO 0.2

Reference Pressure	Indication (kPa)	Calculated (kPa)	Correction (kPa)
0	Rising	Rising	Rising
0.000	0.000	0.000	0.000
0.450	2.185	0.436	0.014
0.450	2.180	0.435	0.015
0.450	2.165	0.432	0.018
0.450	2.170	0.433	0.017
0.450	2.180	0.435	0.015
0.450	2.165	0.432	0.018
0.450	2.175	0.434	0.016
0.450	2.165	0.432	0.018
0.450	2.165	0.432	0.018
0.450	2.165	0.432	0.018

The uncertainty of measurement is ± 0.025 kPa
The reported uncertainty is based on a standard uncertainty multiplied by a coverage factor of k=2, which unless specifically stated otherwise, provides a confidence level of 95%, in accordance with the Guide to the Expression of Uncertainty in Measurement, first edition, 1993.

Comments : The manometer was calibrated after ensuring that the top of the instrument plate was level, and the face of the plate was vertical.
The indicated pressure was multiplied by the scale factor of 0.2 and the specific gravity of the manometer fluid, as supplied by the customer, is 0.826.

Calibrated by : D Wedderspoon *** End of Certificate *** Technical Signatory

Inthuu Measurements
MEASURE IT, MANAGE IT

VAT No. 4960254359
Reg No. 2009/190265/23

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P O Box 145295 • Bracken Gardens • 1452
Tel: 011 626 3808 • Cell: 072 244 1371 • Fax: 086 610 4196
Web: www.unimet.co.za

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205
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MEASUREMENTS PERFORMED IN
SANAS ACCREDITED CALIBRATION LABORATORY No 205

PRESSURE METROLOGY

CERTIFICATE OF CALIBRATION

Date of issue : 31/08/2023

Certificate No : 2308P11648-6

Technical Signatory

A Mathieson.

The results of all measurements are traceable to the national measuring standards.

The values in this certificate are correct at the time of calibration. The results relate only to the measurement component of the instrument supplied. The results exclude the influence of any auxillary equipment that may be attached to the instrument. Subsequently the accuracy will depend on such factors as the care executed in the handling and use of the device, and the frequency of use. Recalibration should be performed after a period so chosen to ensure that the instrument's accuracy remains within the desired limits.

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Inthuu Measurements
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CERTIFICATE OF CALIBRATION

Certificate Number	:	2308P11648-6	
Calibration of a	:	Pressure Gauge	
Manufacturer & Type	:	Wika 63mm	
Serial Number	:	88	
Calibrated for	:	Inthuu Measurements, Kempton Park.	
Contact Details	:	Alne Vorster, Tel: 010 054 5883.	
Procedure Number	:	53-126	
Date of Calibration	:	30/08/2023	
Date of Issue	:	31/08/2023	
Laboratory Environment	:	19.5 °C	
Reference Standards	:	205-S-01 Ruska, PPG 6200	S/N 39478

Reference Pressure kPa	Indication kPa		Correction kPa	
	Rising	Falling	Rising	Falling
0	0.0	0.0	0.0	0.0
-10	-9.8	-9.9	-0.2	-0.1
-20	-19.3	-19.5	-0.7	-0.5
-30	-29.7	-29.9	-0.3	-0.1
-40	-38.9	-38.9	-1.1	-1.1

The uncertainty of measurement is ± 0.2 kPa.
The reported uncertainty is based on a standard uncertainty multiplied by a coverage factor of k=2, which unless specifically stated otherwise, provides a confidence level of 95%, in accordance with the Guide to the Expression of Uncertainty in Measurement, first edition, 1993.

Comments : None.

Calibrated by : D Wedderspoon *** End of Certificate *** Technical Signatory

Inthuu Measurements
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Web: www.unimet.co.za

MEASUREMENTS PERFORMED IN
SANAS ACCREDITED CALIBRATION LABORATORY No 306

TEMPERATURE METROLOGY

CERTIFICATE OF CALIBRATION

Date of issue : 31/08/2023

Certificate No : 2308T11648-1

Technical Signatory

A Mathieson.

The results of all measurements are traceable to the national measuring standards.

The values in this certificate are correct at the time of calibration. The results relate only to the measurement component of the instrument supplied. The results exclude the influence of any auxillary equipment that may be attached to the instrument. Subsequently the accuracy will depend on such factors as the care executed in the handling and use of the device, and the frequency of use. Recalibration should be performed after a period so chosen to ensure that the instrument's accuracy remains within the desired limits.

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Web: www.unimet.co.za

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CERTIFICATE OF CALIBRATION

Certificate Number	:	2308T11648-1
Calibration of a	:	Digital Temperature Indicator & Probe
Manufacturer & Type	:	GRC, FY400 & Unknown Type K.
Serial Number	:	11
Calibrated for	:	Inthuu Measurements, Bredell, Kempton Park.
Contact Details	:	Alne Vorster, Tel: 010 054 5883.
Procedure Number	:	53-167
Date of Calibration	:	31/08/2023
Date of Issue	:	31/08/2023
Laboratory Environment	:	21.1 °C
Reference Standards	:	306-S-04 Fluke, 9144 Block Calibrator S/N B 26027

Reference Temperature °C	Indicated Reading °C	Correction °C
50	48	2
100	99	1
150	150	0
200	201	-1
250	251	-1
300	301	-1
350	351	-1
400	401	-1

The uncertainty of measurement is ± 2 °C
The reported uncertainty is based on a standard uncertainty multiplied by a coverage factor of k=2, which unless specifically stated otherwise, provides a confidence level of 95%, in accordance with the Guide to the Expression of Uncertainty in Measurement, first edition, 1993.

Comments : The thermocouple was immersed to a constant depth of 150 mm.

Calibrated by : D Wedderspoon

Technical Signatory

Inthuu Measurements
MEASURE IT, MANAGE IT

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Reg No. 2009/190265/23

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MEASUREMENTS PERFORMED IN
SANAS ACCREDITED CALIBRATION LABORATORY No 306

TEMPERATURE METROLOGY

CERTIFICATE OF CALIBRATION

Date of issue : 31/08/2023

Certificate No : 2308T11648-2

Technical Signatory

A Mathieson.

The results of all measurements are traceable to the national measuring standards.

The values in this certificate are correct at the time of calibration. The results relate only to the measurement component of the instrument supplied. The results exclude the influence of any auxillary equipment that may be attached to the instrument. Subsequently the accuracy will depend on such factors as the care executed in the handling and use of the device, and the frequency of use. Recalibration should be performed after a period so chosen to ensure that the instrument's accuracy remains within the desired limits.

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Inthuu Measurements
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Web: www.unimet.co.za

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CERTIFICATE OF CALIBRATION

Certificate Number	:	2308T11648-2
Calibration of a	:	Digital Temperature Indicator & Probe
Manufacturer & Type	:	GRC, FY400 & Unknown Type K.
Serial Number	:	12
Calibrated for	:	Inthuu Measurements, Bredell, Kempton Park.
Contact Details	:	Alne Vorster, Tel: 010 054 5883.
Procedure Number	:	53-167
Date of Calibration	:	31/08/2023
Date of Issue	:	31/08/2023
Laboratory Environment	:	21.1 °C
Reference Standards	:	306-S-04 Fluke, 9144 Block Calibrator S/N B 26027

Reference Temperature °C	Indicated Reading °C	Correction °C
50	49	1
100	99	1
150	150	0
200	200	0
250	250	0
300	300	0
350	350	0
400	400	0

The uncertainty of measurement is ± 2 °C
The reported uncertainty is based on a standard uncertainty multiplied by a coverage factor of k=2, which unless specifically stated otherwise, provides a confidence level of 95%, in accordance with the Guide to the Expression of Uncertainty in Measurement, first edition, 1993.

Comments : The thermocouple was immersed to a constant depth of 150 mm.

Calibrated by : D Wedderspoon

Technical Signatory

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Appendix F

Monitor Calibration Certificate

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P.O. Box 14769, Bredell, 1623

TYPE:
FWE200DH

SICK

SICK Engineering GmbH
Bergener Ring 27
D-01458 Ottendorf-Okrilla
Germany

Ident-Nr.: **9214515 ZSV7**

EU declaration of conformity en
The undersigned, representing the following manufacturer herewith declares that the product is in conformity with the provisions of the following EU directive(s) (including all applicable amendments), and that the respective standards and/or technical specifications have been used as a basis for this (download: www.sick.com).

You can obtain the EU declaration of conformity with the standards used at: www.sick.com

Date: 2017-12-14

ppa. Klaus Haider
Senior Vice President
(GBC Analyzers)

i.V. Dr. Niels Syassen
Vice President R&D
(GBC Analyzers)

EU-Konformitätserklärung de
Der Unterzeichner, der den nachstehenden Hersteller vertritt, erklärt hiermit, dass das Produkt in Übereinstimmung mit den Bestimmungen der nachstehenden EU-Richtlinie(n) (einschließlich aller zutreffenden Änderungen) ist, und dass die entsprechenden Normen und/oder technischen Spezifikationen zugrunde gelegt sind (Download: www.sick.com).

ЕС декларация за съответствие bg
Подписалият, който представя долуспоменатия производител, обявява, че продуктът съответства на разпоредбите на долуизброените директиви на ЕС (включително на всички действащи изменения) и че са базира на съответните норми и/или технически спецификации за приложение (Изтегляне: www.sick.com).

Prohlášení o shodě EU cs
Níže podepsaný, zastupující následujícího výrobce, tímto prohlašuje, že výrobek je v souladu s ustanoveními následující(ch) směrnice (směrnic) EU (včetně všech platných změn) a že podkladem byly odpovídající normy a/nebo technické specifikace. (Ke stažení: www.sick.com).

EU-overensstemmelseserklæring da
Undertegnede, der repræsenterer følgende producent, erklærer hermed, at produktet er i overensstemmelse med bestemmelserne i følgende EU-direktiv(er) (inklusive alle gældende ændringer), og at alle tilsvarende standarder og/eller tekniske specifikationer er blevet anvendt (download: www.sick.com).

ΕΕ-Δήλωση συμμόρφωσης el
Ο Υπογράφων, εκπροσωπών τον ακόλουθο κατασκευαστή, δηλώνει με το παρόν έγγραφο ότι το προϊόν συμμορφώνεται με τους όρους της(των) ακόλουθης(-ων) Οδηγίας(-ών) της ΕΕ (συμπεριλαμβανομένων όλων των εφαρμοζόμενων τροποποιήσεων) και ότι έχουν ληφθεί υπόψη τα αντίστοιχα πρότυπα ή/και οι τεχνικές προδιαγραφές (Λήψη: www.sick.com).

Declaración de conformidad de la UE es
El abajo firmante, en representación del fabricante indicado a continuación, declara que el producto es conforme con las disposiciones de la(s) siguiente(s) directiva(s) de la UE (incluyendo todas las modificaciones aplicables) y que las respectivas normas y/o especificaciones técnicas han sido utilizadas como base. (Download: www.sick.com).

EL vastavusdeklaratsioon et
Allakirjutanu, kes esindab järgmist tootjat, kinnitab käesolevaga, et antud toode vastab järgneva(te) EL-i direktiivi(de) sätetele (kaasa arvatud kõikidele asjakohastele muudatustele) ja et on rakendatud vastavaid nõudeid ja/või tehnilisi kirjeldusi. (Allalaadimine: www.sick.com).

EU-vaatimustenmukaisuusvakuutus fi
Allekirjoittanut, joka edustaa alla mainittua valmistajaa, vakuuttaa täten, että tuote on seuraavan (-ien) EU-direktiivin (-ien) vaatimusten mukainen (mukaan lukien kaikki sovellettavat muutokset) ja että sen perustana ovat vastaavat standardit ja tekniset erittelyt (Latausosoite: www.sick.com).

Déclaration de conformité UE fr
Le soussigné, représentant le constructeur ci-après, déclare par la présente que le produit est conforme aux exigences de la (des) directive(s) de l'UE suivantes (y compris tous les amendements applicables) et que les normes et/ou spécifications techniques correspondantes ont servi de base (téléchargement: www.sick.com).

Izjava o sukladnosti EU hr
Potpisnik, koji zastupa proizvođača navedenog u nastavku, ovime izjavljuje da je proizvod usklađen s odredbama dolje navedenih direktiva EU-a (uključujući sve nastale izmjene) i da je u skladu s odgovarajućim normama i/ili tehničkim specifikacijama (preuzimanje: www.sick.com).

EU megfelelőségi nyilatkozat hu
Alulírott, az alábbi gyártó képviseletében ezennel kijelenti, hogy a termék megfelel az alábbi EU-irányelv(ek) követelményeinek (beleértve azok minden vonatkozó módosítását) és kijelenti, hogy a megfelelő szabványokat és/vagy műszaki előírásokat vette alapul. (Letöltés: www.sick.com).

ESB-samræmisyfirlýsing is
Undirritaður, fyrir hönd framleiðandans sem nefndur er hér að neðan, lýsir því hér með yfir að varan er í samræmi við ákvæði eftirtalinna ESB-tilskipana (að meðtöldum öllum breytingum sem við eiga) og að þessu til grundvallar samræmist varan viðeigandi stöðlum og/eða tækniforskriftum (niðurhal: www.sick.com).

Dichiarazione di conformità UE it
Il sottoscritto, in qualità di rappresentante del costruttore sotto indicato, dichiara con la presente che il prodotto è conforme alle disposizioni della(e) seguente(i) direttiva(e) UE (comprese tutte le modifiche applicabili) e che si basa sulle rispettive norme e/o specifiche tecniche (scaricabili dal sito web: www.sick.com).

ES atitikties deklaracija lt
Pasirašiusysis, atstovaujantis šiam gamint ojui deklaruoja, kad gaminys atitinka šios (ių) ES direktyvos (ų) reikalavimus (įskaitant visus taikytinus keitinius) ir kad buvo remtasi antrajame puslapyje nurodytais standartais ir (arba) techninėmis specifikacijomis (atsisiųsti: www.sick.com).

ES atbilstības deklarācija lv
Apakšā parakstījusies persona, kas pārstāv zemāk minēto ražotāju, ar šo deklarē, ka izstrādājums atbilst zemāk minētajai (-ām) ES direktīvai (-ām) (ieskaitot visus atbilstošos grozījumus) un ka izstrādājuma izgatavošanā par pamatu ņemti attiecīgie standarti un/vai tehniskās specifikācijas (lejupielāde: www.sick.com).

EU-verklaring van overeenstemming nl
Ondergetekende, vertegenwoordiger van de volgende fabrikant, verklaart hiermee dat het product voldoet aan de bepalingen van de volgende EU-richtlijn(en) (inclusief alle van toepassing zijnde wijzigingen) en dat de overeenkomstige normen en/of technische specificaties als grondslag werden gebruikt (Download: www.sick.com).

EU-samsvarserklæring no
Undertegnede, som representerer nedennevnte produsent, erklærer herved at produktet er i samsvar med bestemmelsene i følgende EU-direktiv(er) (inkludert alle relevante endringer) og at relevante normer og/eller tekniske spesifikasjoner er blitt anvendt (Nedlasting: www.sick.com).

Deklaracja zgodności UE pl
Niżej podpisany, reprezentujący wymienionego poniżej producenta oświadcza niniejszym, że wyrób jest zgodny z postanowieniami podanej/podanych poniżej dyrektyw/y UE (wraz z odnośnymi poprawkami) oraz, że za podstawę wzięto odpowiednie normy i/lub specyfikacje techniczne (download: www.sick.com).

Declaração UE de conformidade pt
O abaixo assinado, que representa o seguinte fabricante, declara deste modo que o produto está em conformidade com as disposições da(s) seguinte(s) directiva(s) UE (incluindo todas as alterações aplicáveis) e que foram usadas como base as respectivas normas e/ou especificações técnicas. (Download: www.sick.com).

Declarație de conformitate UE ro
Semnatarul, în calitate de reprezentant al producătorului numit mai jos, declară prin prezenta că produsul este în conformitate cu prevederile directivelor UE enumerate mai jos (inclusiv cu toate modificările aferente) și se întemeiază pe normele și/sau specificațiile tehnice corespunzătoare (download: www.sick.com).

EÚ vyhlásenie o zhode sk
Dolu podpísaný zástupca výrobcu týmto vyhlasuje, že výrobok je v súlade s ustanoveniami nasledujúcej (nasledujúcich) smernice (smerníc) EÚ (vrátane všetkých platných zmien) a že ako základ boli použité príslušné normy a/alebo technické špecifikácie (Download: www.sick.com).

Izjava EU o skladnosti sl
Podpisani predstavnik spodaj navedenega proizvajalca izjavljam, da je proizvod v skladu z določbami spodaj navedenih direktiv EU (vključno z vsemi ustreznimi spremembami) in da so osnova ustrezni standardi in/ali tehnične specifikacije (prenos: www.sick.com).

EU-försäkran om överensstämmelse sv
Undertecknad, som representerar nedanstående tillverkare, försäkrar härmed att produkten överensstämmer med bestämmelserna i följande EU-direktiv (inklusive samtliga tillämpliga tillägg till dessa) och baseras på relevanta standarder och/eller tekniska specifikationer (nedladdning: www.sick.com).

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used directives and standards

Pos	Pos.text	Short.desc.	Document-No.	Issued	SICK-Id-No.	Pos-Exchg.
0100	OJEU L 96	LV DIRECTIVE 2014/35/EU	RL 2014/35/EU	2014-02-26	8606192	
0110	OJEU L 96	EMC DIRECTIVE 2014/30/EU	RL 2014/30/EU	2014-02-26	8606191	
0130	OJEU L 174	ROHS DIRECTIVE 2011/65/EU	RL 2011/65/EU	2011-06-08	8606079	
1000	LVD	SAFETY REQUIREMENTS ELECTRICAL EQUIPMENT	EN 61010-1	2010-10-01	8606036	
1040	LVD	ENCLOSURES PROTECTION DEGREES (IP-CODE)	EN 60529	1991-10-01	8605520	
1050	LVD	ENCLOSURES PROTECTION DEGREES(IPCODE)/A1	EN 60529/A1	2000-02-01	8605590	
1060	LVD	ENCLOSURES PROTECTION DEGREES(IPCODE)/A2	EN 60529/A2	2013-10-01	8606169	
2010	EMC	EMC,IMMUNITY FOR INDUSTRIAL ENVIRONMENTS	EN 61000-6-2	2005-08-01	8605737	
2040	EMC	ELECTRICAL EQUIPMENT FOR MEASUREMENT	EN 61326-1	2013-01-01	8606121	
2150	EMC	EMC, LIMITS F.HARMONIC CURRENT EMISSIONS	EN 61000-3-2	2006-04-01	8605810	
3000	ROHS	TECHNICAL DOCUM. HAZARDOUS SUBSTANCES	EN 50581	2012-09-01	8606209	

as of 2017-12-19 EU declaration of conformity 9214515

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Ergänzende Informationen zu den EMV-Produktfamilienstandards EN 61326-1 und EN 61326-2-x

Diese Normen enthalten Definitionen von Grenzwerten und Prüfpegeln für mehrere Umgebungen.

Bezüglich der Störaussendung sind Anforderungen für die Umgebungsbereiche
- Industrie (Klasse A) und
- Haushalts-/Gewerbebereich (Klasse B) enthalten.

Bezüglich der Störfestigkeit sind Anforderungen für die Umgebungsbereiche
- Beherrschte elektromagnetische Umgebung (niedrigste Anforderungen),
- Allgemeine Umgebung und
- Industrielle Umgebung (höchste Anforderungen) enthalten.

Die in dieser Konformitätserklärung aufgeführten Geräte entsprechen den Anforderungen folgender Umgebungen:

Störaussendung:	**Klasse A**
Störfestigkeit:	**Industrielle Umgebung**

Sie sind somit für den Einsatz in industrieller Umgebung vorgesehen. Bei Verwendung im Wohn- und Gewerbebereichen können zusätzliche Maßnahmen für die Begrenzung der Störaussendung erforderlich sein.

Additional informations with respect to the EMC product family standards EN 61326-1 and EN 61326-2-x

These standards contain definitions for emission limits and immunity requirements for multiple environments.

In respect of emissions, the standards contain limits for the environments
- industrial (class A) and
- residential / commercial (class B).

In respect of immunity, the standards contain requirements for the environments
- electromagnetic protected (lowest requirements)
- general
- industrial (hardest requirements)

The devices listed in this declaration of conformity are conformal to the requirements of the environments below.

Emissions:	**Class A**
Immunity:	**Industrial environment**

Their intended usage is limited to industrial environments. When used in residential or commercial environments, additional measures may be required to limit the electromagnetic emissions.

Tell: +27 (0)10 054 5883
+27 (0)10 054 5884
Fax: +27 (0)86 659 2231

2/410 Seventh Road, Bredell, 1619
Kempton Park, 1619
P.O. Box 14769, Bredell, 1623

SICK

Ergänzende Informationen zu den EMV-Produktfamilienstandards EN 61326-1 und EN 61326-2-x

Diese Normen enthalten Definitionen von Grenzwerten und Prüfpegeln für mehrere Umgebungen.

Bezüglich der Störaussendung sind Anforderungen für die Umgebungsbereiche
- Industrie (Klasse A) und
- Haushalts-/Gewerbebereich (Klasse B) enthalten.

Bezüglich der Störfestigkeit sind Anforderungen für die Umgebungsbereiche
- Beherrschte elektromagnetische Umgebung (niedrigste Anforderungen),
- Allgemeine Umgebung und
- Industrielle Umgebung (höchste Anforderungen) enthalten.

Die in dieser Konformitätserklärung aufgeführten Geräte entsprechen den Anforderungen folgender Umgebungen:

Störaussendung:	**Klasse B**
Störfestigkeit:	**Industrielle Umgebung**

Sie sind somit für den Einsatz in allen spezifizierten Umgebungen geeignet.

Additional informations with respect to the EMC product family standards EN 61326-1 and EN 61326-2-x

These standards contain definitions for emission limits and immunity requirements for multiple environments.

In respect of emissions, the standards contain limits for the environments
- industrial (class A) and
- residential / commercial (class B).

In respect of immunity, the standards contain requirements for the environments
- electromagnetic protected (lowest requirements)
- general
- industrial (hardest requirements)

The devices listed in this declaration of conformity are conformal to the requirements of the environments below.

Emissions:	**Class B**
Immunity:	**Industrial environment**

They are therefore adequate for usage in all specified environments..

Inthuu Measurements
MEASURE IT, MANAGE IT

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Reg No. 2009/190265/23

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Fax: +27 (0)86 659 2231

2/410 Seventh Road, Bredell, 1619
Kempton Park, 1619
P.O. Box 14769, Bredell, 1623

SICK

List of devices (count: 16)

SICK-ID-No.	Device-type
1066190	FWE200DH-NNJ
1068441	FWE200DH-NNE
1068461	FWE200DH-BNJ
1069590	FWE200DH-NNP
1069591	FWE200DH-BNE
1069592	FWE200DH-BNP
1069593	FWE200DH-NHJ
1069594	FWE200DH-NHE
1069595	FWE200DH-NHP
1069596	FWE200DH-BHJ
1069597	FWE200DH-BHE
1069598	FWE200DH-BHP
1080211	FWE200DH-NNJS
1082849	FWE200DH-NNT
1084553	FWE200DH-NND
1092874	FWE200DH-NNE

as of 2017-12-19
EU declaration of conformity 9214515

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P.O. Box 14769, Bredell, 1623

7 REVISIONS

Revision No.	Date	Description
0	2024/03/06	Original report document

8 DISTRIBUTION LIST

A Mzimela	Sick Automation
R Nare	Inthuu Measurements CC
A Vorster	Inthuu Measurements CC

Eskom

Ms Nompumelelo Simelane
Nkangala District Municipality
PO Box 437
Middleburg
1050

Date:

April 2024

Enquiries: Lesiba Kgobe
Tel: +27 13 699 7817

Ref: *Kusile Power Station AEL (17/4/AEL/MP311/12/01)*

Dear Ms. Simelane

KUSILE POWER STATION'S MONTHLY EMISSIONS REPORT FOR MARCH 2024

This serves as the monthly report required in terms of Section 7.6 in Kusile Power Station's Atmospheric Emission License: 17/4/AEL/MP311/12/01. The emissions are for the month of March 2024.

Hoping the above will meet your satisfaction.

Yours sincerely

Christopher Nani
ACTING GENERAL MANAGER
DATE: 24/04/2024

Generation Division – Coal New Build Unit
Management Department (Kusile Power Station)
R545 Kendal/Balmoral Road, Haartebeesfontein Farm, Witbank
Postnet Suite 283 Private Bag X 7297 Witbank 1035 SA
Tel+27 13 693 4320 Fax +27 86 768 3030 www.eskom.co.za

1. KUSILE POWER STATION MONTHLY EMISSIONS REPORT: Atmospheric Emission License 17/4/AEL/MP311/12/01

2. Raw Materials and Products

Raw Materials and Products	**Raw Material Type**	**Units**	**Max Permitted Consumption Rate**	**Consumption Rate Mar-2024**
	Coal	Tons	*1 818 083*	*718 414*
	Fuel Oil	Tons	*5 533*	*1827.585*
	Limestone	Tons	*72 917*	*12181*
Production Rates	**Product / By-Product Name**	**Units**	**Max Production Capacity Permitted**	**Indicative Production Rate Mar-2024**
	Energy	GWh	*3 214.080*	*1 346.976*
	Ash	Tons	*663 583*	*227 665.501*
	Gypsum	Tons	*129 250*	*6 821.360*
	RE PM	kg/MWh	*not specified*	*0.092*
	RE SOx	kg/MWh	*not specified*	*5.289*

3. Energy source characteristics

Fuel Characteristic	Units	Stipulated Range	Monthly Average Content
Coal Sulphur	%	*1.3*	*0.800*
Ash in Coal	%	*38*	*31.690*
Fuel Oil Sulphur	%	*3.5*	*2.690*
Ash in FO	%	*0.1*	*0.030*

4. Emissions Limits (mg/Nm³)

Associated Unit/Stack	PM	SO_2	NOx
North	*50*	*3500*	*750*
South	*50*	*1000*	*750*

5. Abatement Technology (%)

Associated Unit/Stack	Technology Type	Efficiency Mar-2024	Utilisation Mar - 2024	Technology Type	Efficiency Mar-2024	Utilisation Mar- 2024
Unit 1	*FFP*	*99.921%*	*100%*	*FGD*	*Out of service*	*Out of service*
Unit 2	*FFP*	*99.989%*	*100%*	*FGD*	*Out of service*	*Out of service*
Unit 3	*FFP*	*99.898%*	*100%*	*FGD*	*Out of service*	*Out of service*
Unit 4	*FFP*	*99.987%*	*100%*	*FGD*	*99.939%*	*100%*

Note: Both the FFP and FGD does not have bypass mode operation, hence plant 100% Utilised.

6. Monitoring reliability (%)

Associated Unit/Stack	PM	SO_2	NO
Unit 1	*100.0*	*100.0*	*100.0*
Unit 2	*100.0*	*100.0*	*100.0*
Unit 3	*100.0*	*100.0*	*100.0*
Unit 4	*31.7*	*99.2*	*98.4*

Unit 4 monitor reliability was below the 80% reliability due to faulty analyser, and the analyser has since been replaced.

7. Emissions Performance

Table 7.1: Monthly tonnages for the month of March - 2024

Associated Unit/Stack	PM	SO_2	NO_x
Unit 1	50.6	3 111	977
Unit 2	2.9	827	223
Unit 3	63.1	3 028	805
Unit 4	6.7	158	658
SUM	123.4	7 124	2 662

Table 7.2: Operating days in compliance to PM AEL Limit - March 2024

Associated Unit/Stack	Normal	Grace	Section 30	Contravention	Total Exceedance	Average PM (mg/Nm³)
Unit 1	30	0	0	0	0	24.6
Unit 2	16	0	0	0	0	4.8
Unit 3	30	1	0	0	1	31.8
Unit 4	25	0	0	0	0	4.4
SUM	**101**	**1**	**0**	**0**	**1**	

Table 7.3: Operating days in compliance to SO_2 AEL Limit - March 2024

Associated Unit/Stack	Normal	Grace	Section 30	Contravention	Total Exceedance	Average SO_2 (mg/Nm³)
Unit 1	31	0	0	0	0	1 404.9
Unit 2	17	0	0	0	0	1 302.1
Unit 3	31	0	0	0	0	1 523.5
Unit 4	26	0	0	0	0	94.5
SUM	**105**	**0**	**0**	**0**	**0**	

Table 7.4: Operating days in compliance to NOx AEL Limit – March 2024

Associated Unit/Stack	Normal	Grace	Section 30	Contravention	Total Exceedance	Average NOx (mg/Nm³)
Unit 1	31	0	0	0	0	439.5
Unit 2	17	0	0	0	0	351.6
Unit 3	31	0	0	0	0	405.0
Unit 4	26	0	0	0	0	394.1
SUM	**105**	**0**	**0**	**0**	**0**	

Table 7.5: Legend Description

Condition	Colour	Description
Normal		Emissions below Emission Limit Value (ELV)
Grace		Emissions above the ELV during grace period
Section 30		Emissions above ELV during a NEMA S30 incident
Contravention		Emissions above ELV but outside grace or S30 incident conditions

Figure 1: Kusile Unit 1 PM Emissions - March 2024

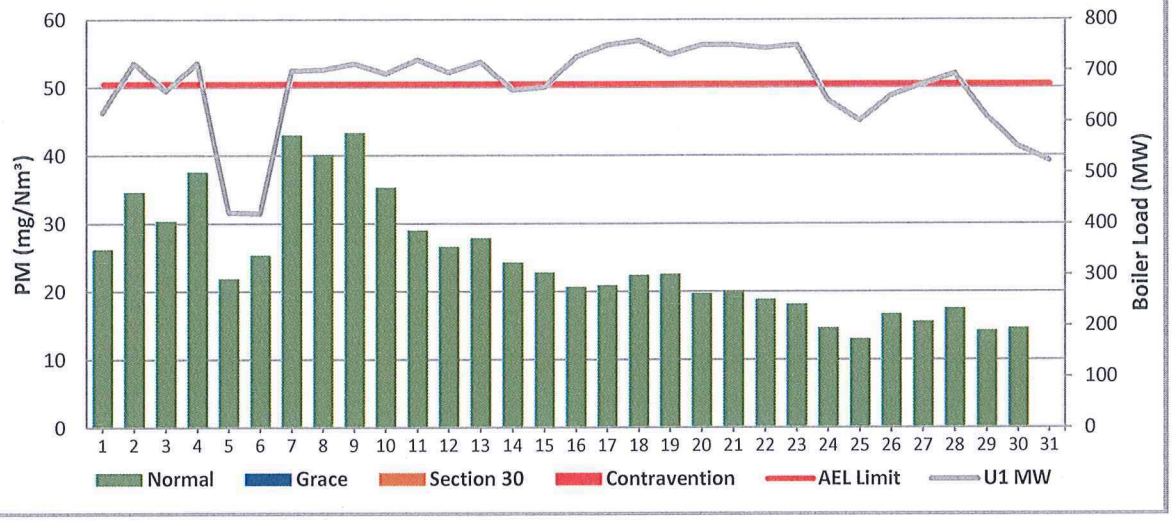
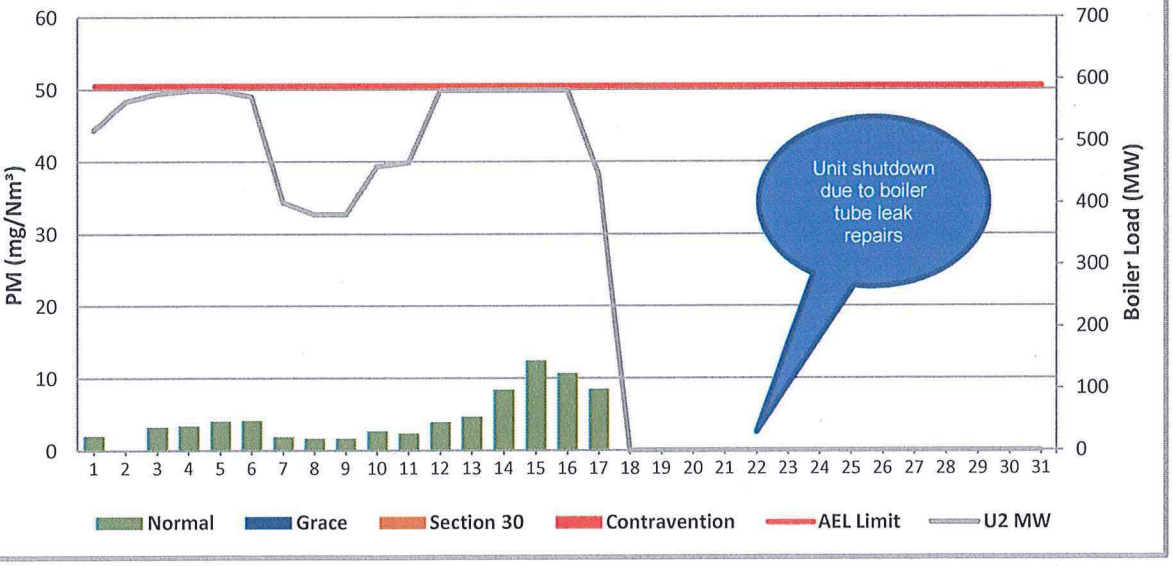
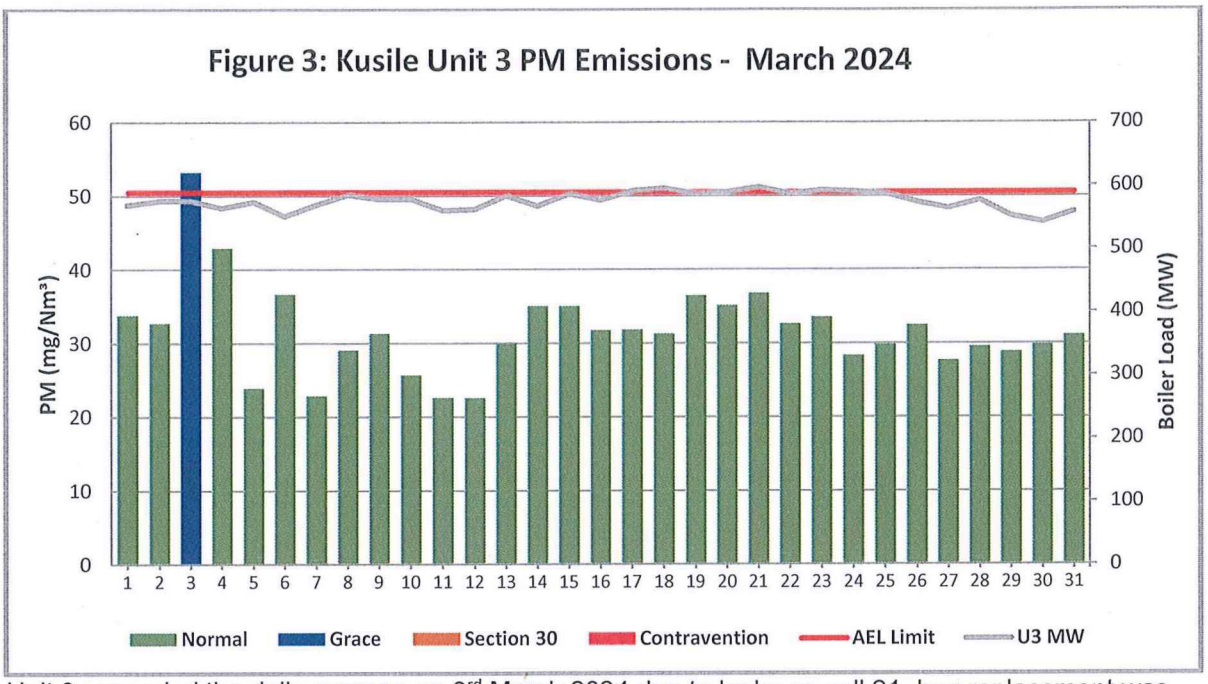
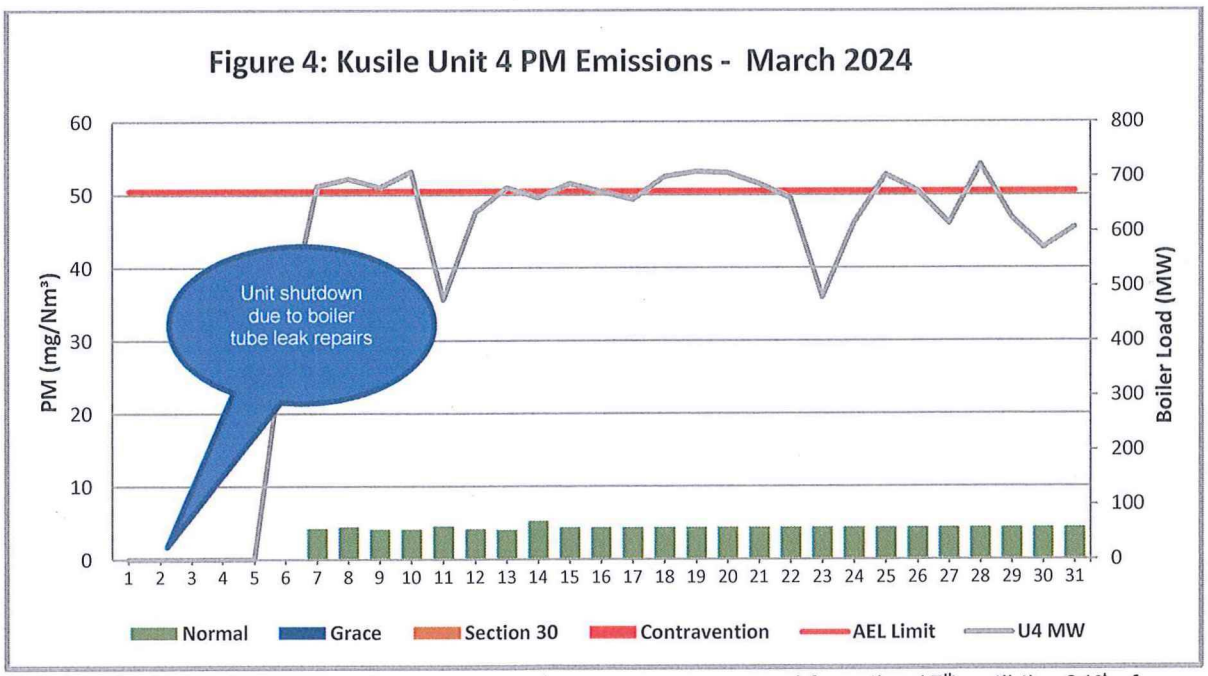


Figure 2: Kusile Unit 2 PM Emissions - March 2024





Unit 3 exceeded the daily average on 3rd March 2024 due to leaks on cell 21, bag replacement was done to manage the dust concentration.



Due to a faulty analyser a monthly dust emission average was used from the 15th until the 31st of March 2024.

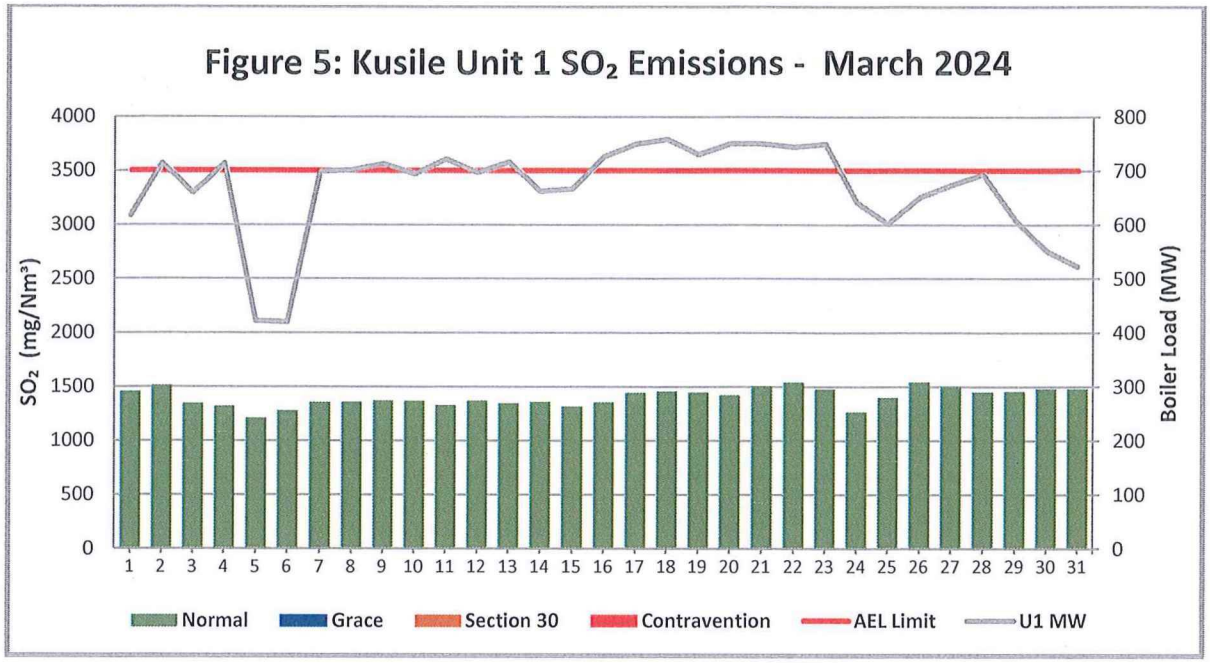


Figure 5: Kusile Unit 1 SO2 Emissions - March 2024
SO2 (mg/Nm³)
Boiler Load (MW)
4000
3500
3000
2500
2000
1500
1000
500
0
800
700
600
500
400
300
200
100
0
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31
Normal
Grace
Section 30
Contravention
AEL Limit
U1 MW

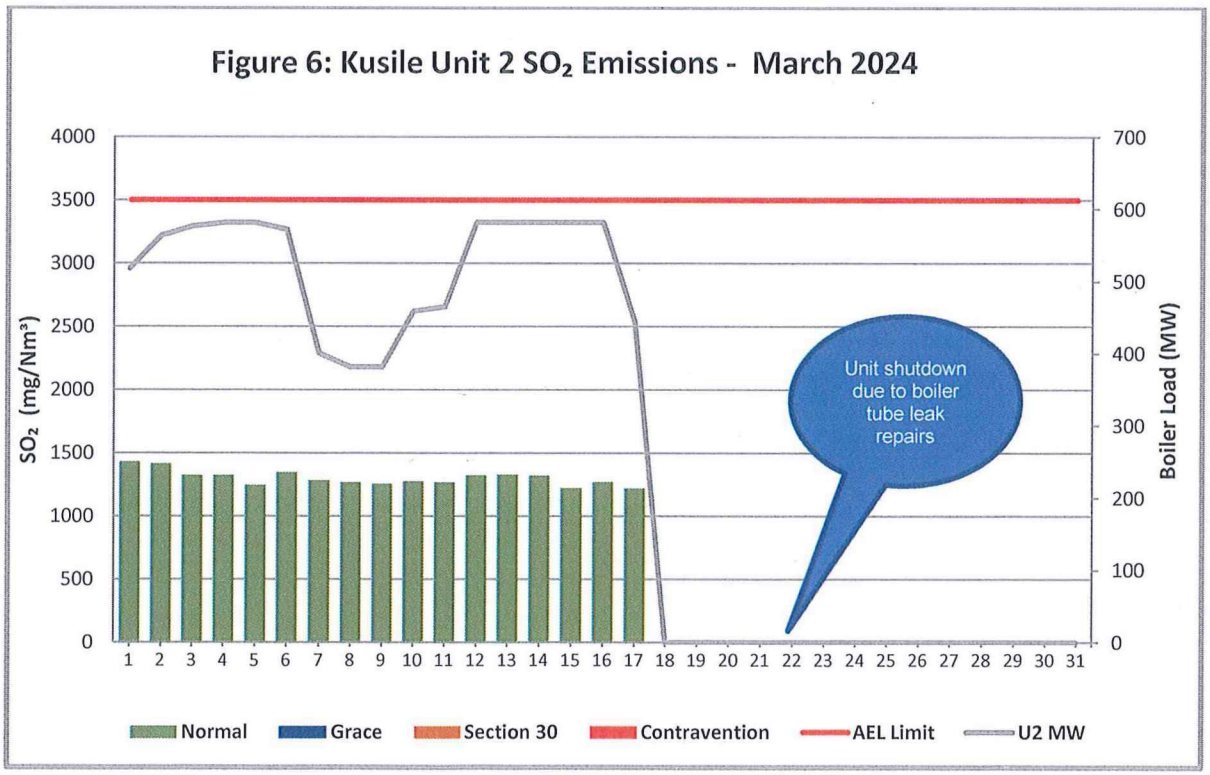


Figure 6: Kusile Unit 2 SO2 Emissions - March 2024
SO2 (mg/Nm³)
Boiler Load (MW)
4000
3500
3000
2500
2000
1500
1000
500
0
700
600
500
400
300
200
100
0
Unit shutdown due to boiler tube leak repairs
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31
Normal
Grace
Section 30
Contravention
AEL Limit
U2 MW

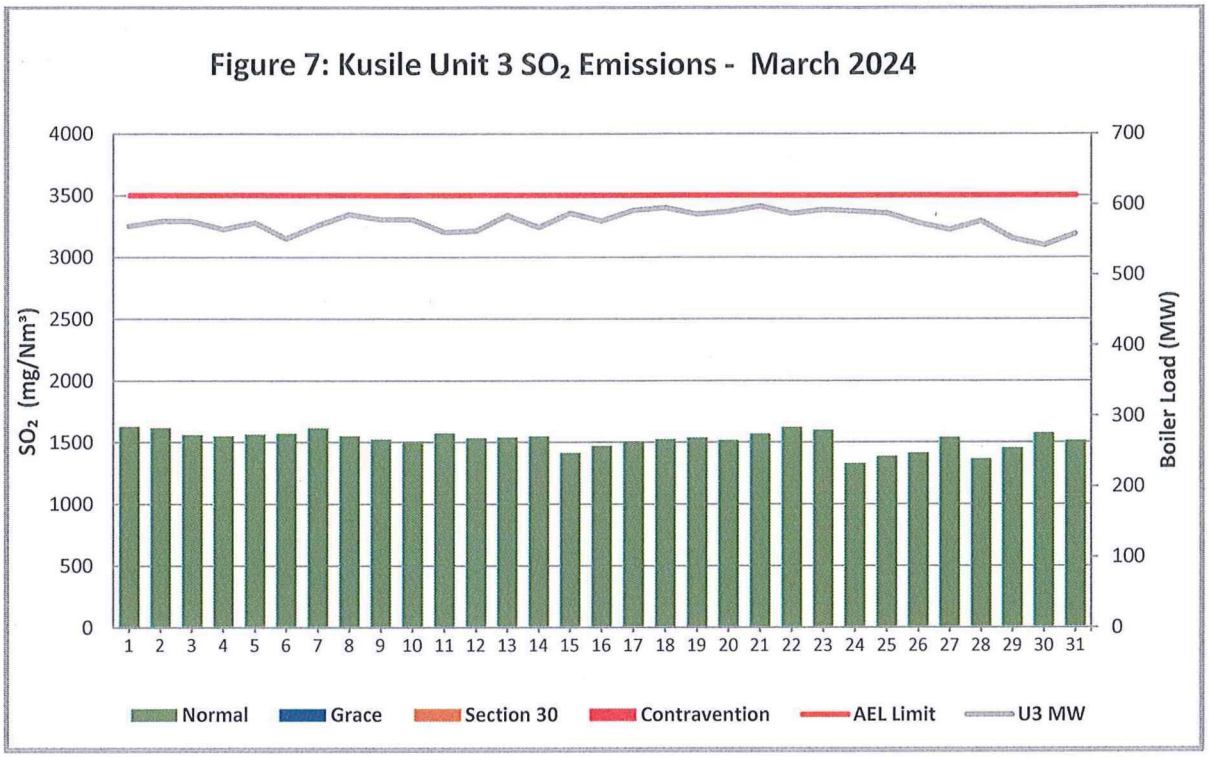


Figure 7: Kusile Unit 3 SO2 Emissions - March 2024
SO2 (mg/Nm³)
Boiler Load (MW)
4000
3500
3000
2500
2000
1500
1000
500
0
700
600
500
400
300
200
100
0
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31
Normal
Grace
Section 30
Contravention
AEL Limit
U3 MW

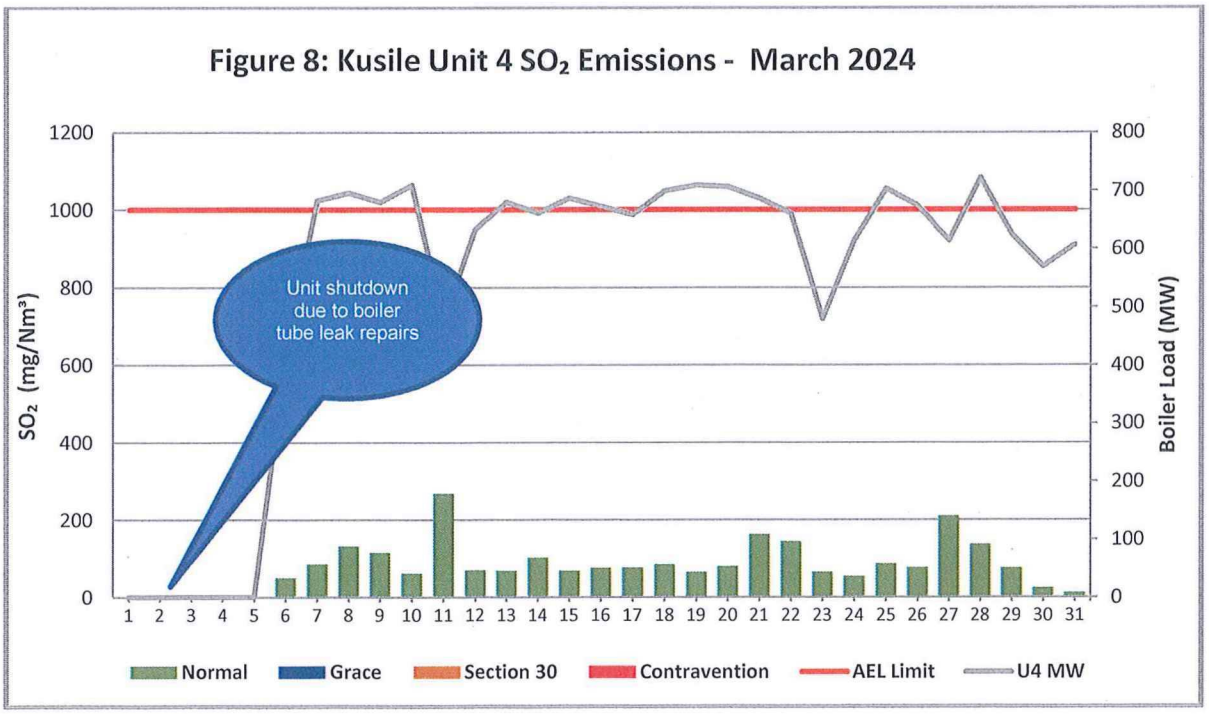


Figure 8: Kusile Unit 4 SO2 Emissions - March 2024
SO2 (mg/Nm³)
Boiler Load (MW)
1200
1000
800
600
400
200
0
800
700
600
500
400
300
200
100
0
Unit shutdown due to boiler tube leak repairs
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31
Normal
Grace
Section 30
Contravention
AEL Limit
U4 MW

Figure 9: Kusile Unit 1 NOx Emissions - March 2024

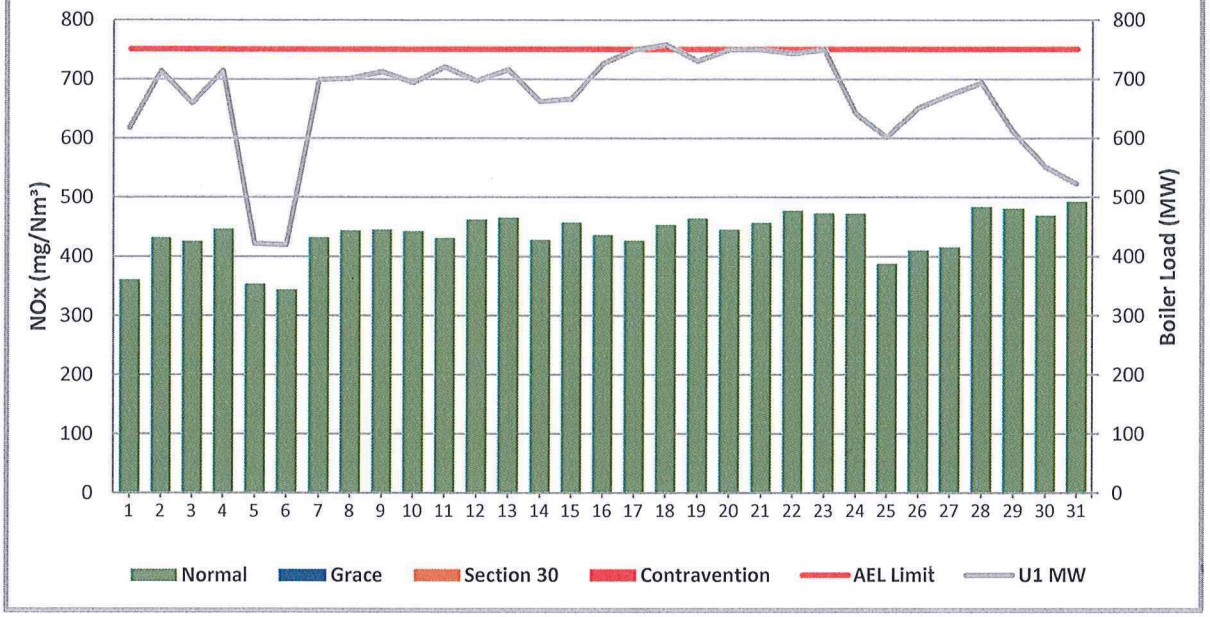


Figure 10: Kusile Unit 2 NOx Emissions - March 2024

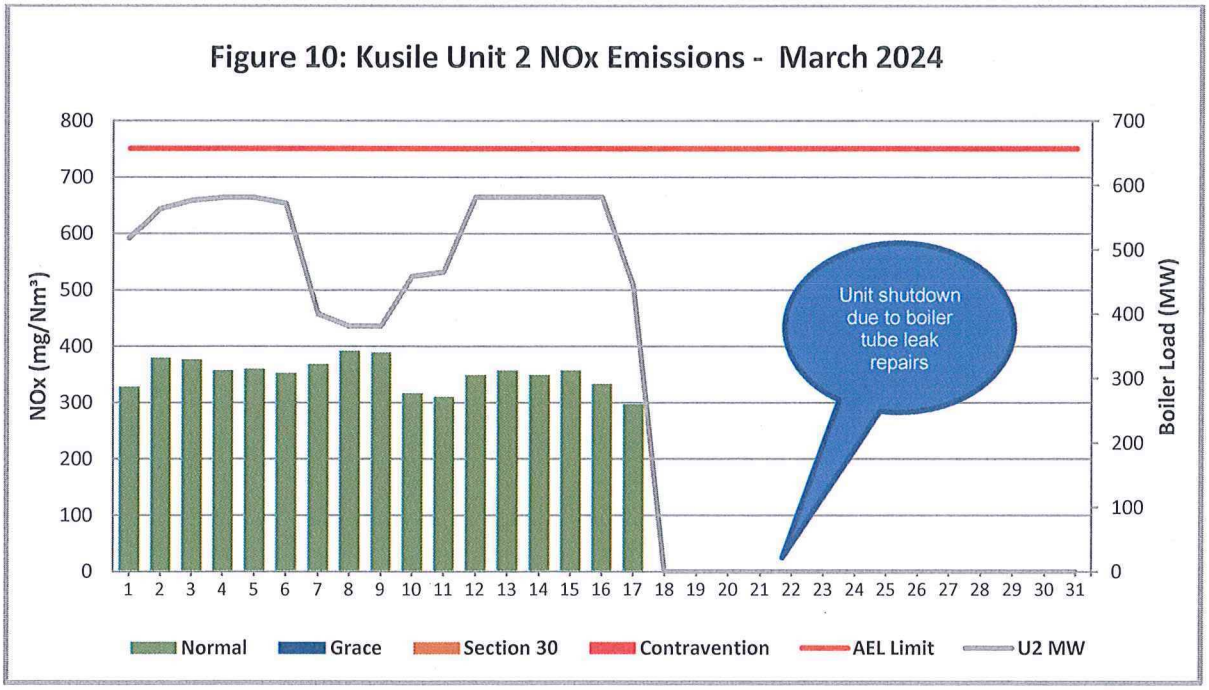


Figure 11: Kusile Unit 3 NOx Emissions - March 2024

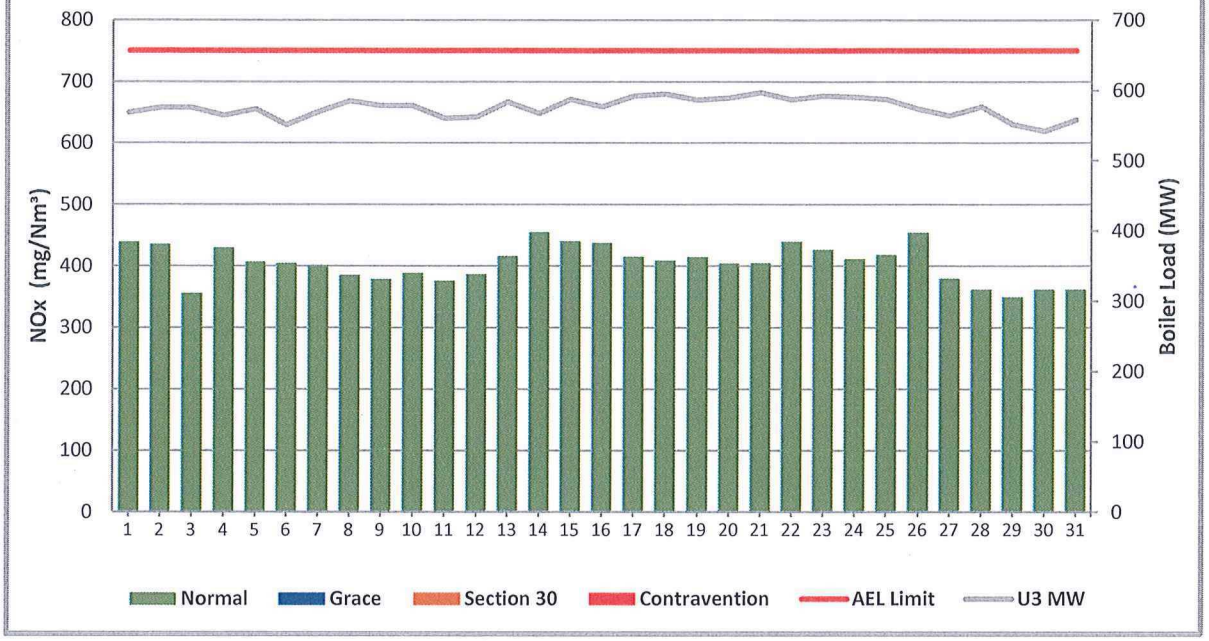
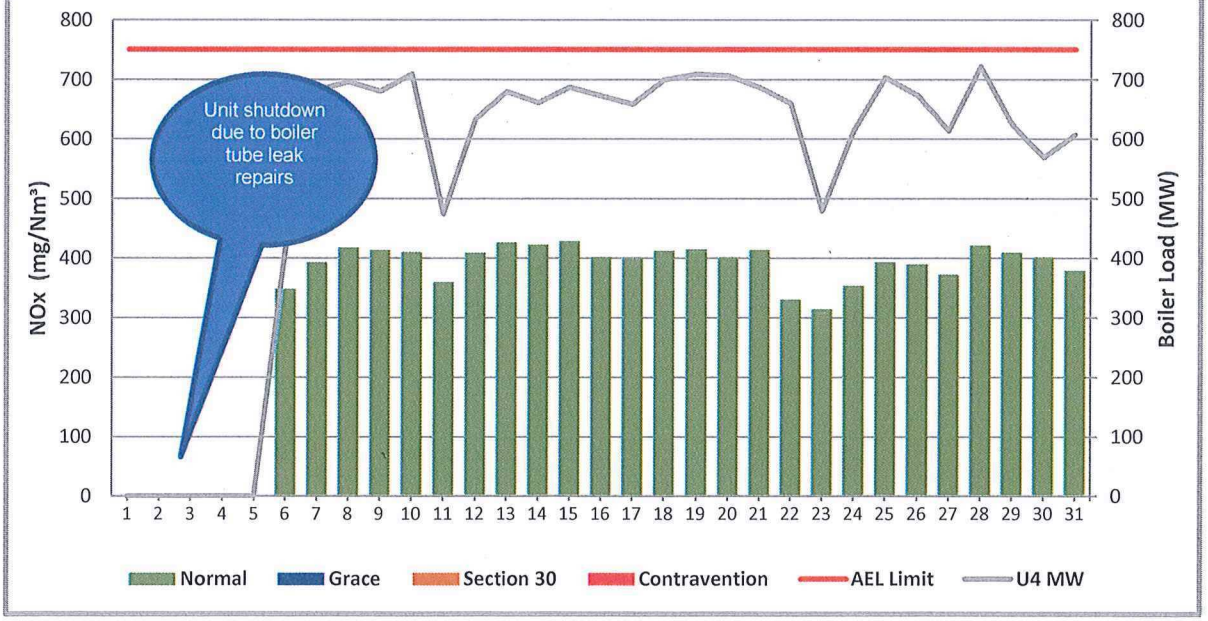


Figure 12: Kusile Unit 4 NOx Emissions - March 2024



8. Correlation and Parallel test

Unit 1, 3 and 4 are operated with valid correlation and parallel curves. Unit 2 is operated with unity curves; the emissions will be retrofitted upon completion of the test and implementation of the curves. The emission reports for Unit 2 will be resubmitted.

9. Shut down and Light up information

Unit No. 1	*Event 1*		*Event 2*		*Event 3*	
Breaker Open (BO)	5:15 pm	2024/03/02	10:40 am	2024/03/25	8:45 pm	2024/03/30
Draught Group (DG) Shut Down (SD)	5:20 pm	2024/03/02	10:40 am	2024/03/25	8:50 pm	2024/03/30
BO to DG SD (duration)	00:00:05	DD:HH:MM	00:00:00	DD:HH:MM	30:20:50	DD:HH:MM
Fires in time	5:45 pm	2024/03/02	11:25 am	2024/03/25	9:45 pm	2024/03/30
Synch. to Grid (or BC)	10:15 pm	2024/03/02	4:15 pm	2024/03/25	2:10 am	2024/03/31
Fires in to BC (duration)	00:04:30	DD:HH:MM	00:04:50	DD:HH:MM	00:04:25	DD:HH:MM
Emissions below limit from BC (end date)	not > limit	not > limit	not > limit	not > limit	not > limit	not > limit
Emissions below limit from BC (duration)	n/a	DD:HH:MM	n/a	DD:HH:MM	n/a	DD:HH:MM

Unit No. 2	*Event 1*		*Event 2*	
Breaker Open (BO)	10:40 pm	2024/03/01	9:25 pm	2024/03/17
Draught Group (DG) Shut Down (SD)	10:40 pm	2024/03/01	10:00 pm	2024/03/18
BO to DG SD (duration)	00:00:00	DD:HH:MM	01:00:35	DD:HH:MM
Fires in time	11:20 pm	2024/03/01		
Synch. to Grid (or BC)	4:25 am	2024/03/02		
Fires in to BC (duration)	00:05:05	DD:HH:MM		DD:HH:MM
Emissions below limit from BC (end date)	not > limit	not > limit		
Emissions below limit from BC (duration)	n/a	DD:HH:MM		DD:HH:MM

Unit No. 4	*Event 1*		*Event 2*	
Breaker Open (BO)	BO previously	BO previously	7:10 am	2024/03/23
Draught Group (DG) Shut Down (SD)	n/a	n/a	DG did not trip or SD	DG did not trip or SD
BO to DG SD (duration)	n/a	DD:HH:MM	n/a	DD:HH:MM
Fires in time	10:25 pm	2024/03/05	3:15 pm	2024/03/23
Synch. to Grid (or BC)	6:20 pm	2024/03/06	6:00 pm	2024/03/23
Fires in to BC (duration)	00:19:55	DD:HH:MM	00:02:45	DD:HH:MM
Emissions below limit from BC (end date)	not > limit	not > limit	not > limit	not > limit
Emissions below limit from BC (duration)	n/a	DD:HH:MM	n/a	DD:HH:MM

10. Complaints

No complaints reported for the month of March 2024

Date and time complaint was received	Complaint received	Source code name	Root cause analysis	Calculation of impact/emissions associated with incidents and dispersion modelling of pollutants where applicable.	Measures implemented or to be implemented to prevent recurrence	Date by which measures will be implemented
No complaints reported for the month of March 2024						

Kusile Ambient Air Quality Monitoring

March 2024

1. INTRODUCTION

At the request of Environmental Management, Research, Testing and Development Department (RT&D) air quality team initiated an additional ambient air quality monitoring site at Balmoral and Wilge, in the vicinity of Kusile power station. The objective is to assess compliance with national ambient air quality standards, identify potential sources of pollution, protect public health and the environment and establish a baseline for future mitigation measures to enable Eskom to operate temporary stacks at the Kusile power stations at emission levels above the levels authorised in the station's Atmospheric Emission Licence (AEL). The existing air quality monitoring stations (Phola and Chicken Farm) will complement the additional monitoring stations to reduce uncertainties, as each monitoring station has an objective linked to a power station of interest. The Ogies monitoring station will be commissioned in April 2024.

Kendal air quality monitoring data does not form part of the analysis for this reporting since the Kendal monitoring site is solely used for research purposes to assess the worst-case scenario of emissions from the Kendal power station. The monitoring station is located about 2 km from the Kendal power station in the prevailing wind direction. Data recorded at the station reflects the impact of Kendal power station downwind of the station and other sources.

The Balmoral and Wilge monitoring stations are currently equipped to continuously monitor ambient concentrations of sulphur dioxide (SO_2). In addition, meteorological parameters of wind velocity, wind direction and ambient temperature, humidity, ambient pressure and rainfall, amongst others are also recorded.

The following parameters, nitrogen dioxide (NO_2), ozone (O_3) and fine particulate matter of particulate size <10µm and particulate size <2.5µm in diameter (PM_{10} and $PM_{2.5}$) will be monitored from 01 April 2024.

The data for this reporting period (01 – 31 March 2024) were analysed for ambient SO_2 as monitored at Balmoral, Chicken Farm, Phola and Wilge air quality monitoring stations. The Particulate Matter and NO_2 data were further analysed for Chicken Farm and Phola.

This report focuses on the results of the ambient air quality monitoring stations; results from stack monitoring, fugitive dust and animal health are addressed in our reports produced for the station.

2. DATA ACQUISITION AND QUALITY CONTROL

Each monitoring station is visited every two weeks by trained technicians for routine service. Zero and span checks are carried out on each analyser during routine services and any discrepancies are logged and used during data verification at Eskom RT&D Sustainability Department.

Full dynamic calibration audits are carried out on the gas analysers (SO_2, NO_2 and O_3 analysers) quarterly and particulate matter analysers are calibrated every six months. All calibration results and certificates are filed in the laboratory for assessment purposes. Inter-laboratory calibrations are routinely carried out with other accredited laboratories ,to enhance quality control.

Data at the monitoring stations are logged directly using dedicated CR-1000 Campbell Scientific data loggers. Permanent data records of all calculated 10-minutes mean values of all parameters monitored, together with minimum and maximum values, are stored on the

logging device. These are derived from 10-second scans and are also logged and saved in 1-minute intervals. The raw 1-minute average data is also transferred live to the South African Ambient Air Quality Information System (SAAQIS) server since the 14th of December 2023. Recorded data are downloaded remotely from the site through communicators that are connected to the Eskom network and transferred onto a central computer for verification and validation.

3. MONITORING STATION LOCATIONS

Figure 1 below indicates the locations of the air quality monitoring stations in relation to the Kusile power station. The new monitoring stations, Balmoral and Wilge, are denoted by green icons and the pre-existing monitoring stations, Chicken Farm and Phola, by yellow icons.

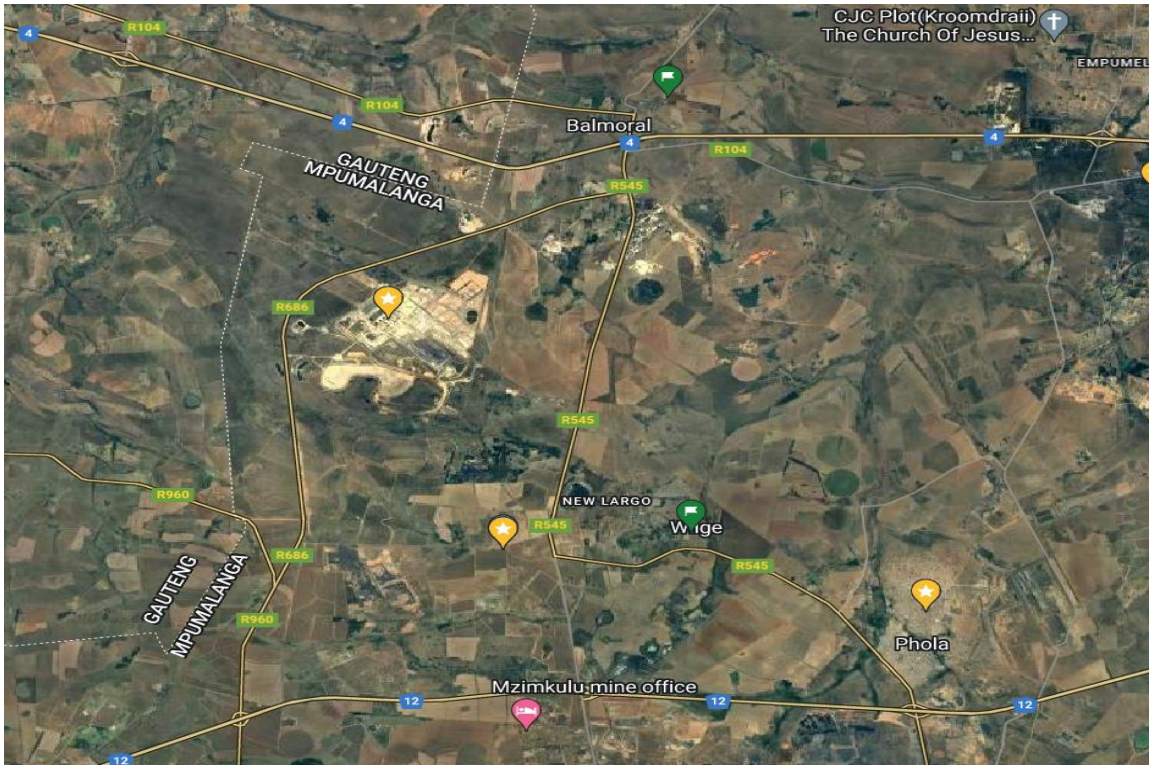


Figure 1: Air Quality Monitoring stations in relation to Kusile power station

4. MONITORING RESULTS AND DISCUSSIONS

The data is statistically analysed to assess the diurnal and monthly variations of the air pollutants, as well as to evaluate it against the current national ambient air quality standards for SO_2, NO_2, O_3, $PM_{2.5}$ and PM_{10}.

4.1. DATA RECOVERY

The SANAS guideline figure of 90% data availability per parameter monitored is used as a standard for representative data capture. This describes the required completeness of data set for the reporting of averages and is based on standard arithmetic calculations. The completeness calculations for data sets exclude zero and span data and times where service and/or maintenance is being conducted on the instruments in question. Station availability is reported as a measure of the percentage of time that electrical power was available to the monitoring station.

Table 1: Percentage data recovery per parameter monitored in March 2024

Stations name	SO_2	NO_2	O_3	$PM_{2.5}$	PM_{10}	WSP	WDR	Station Availability
Balmoral (BL)	0.1					54.2	54.2	47.4
Chicken Farm (CF)	99.1	64	99.6	100	0	100	100	100
Phola (PO)	99.3	98.8	99.3	0	0	100	100	99.6
Wilge (WL)	91.8					100	100	92.2

Good representative percentage data was recovered for all the parameters monitored during the monitoring period under review at the monitoring stations with the exceptions of few parameters at Phola, Chicken Farm and Balmoral respectively. The pollutant and meteorological data for Balmoral were low due to power interruptions in the area. The data for $PM_{2.5}$ and PM_{10} were not recorded at the Phola monitoring station due to faulty instruments. The data for PM_{10} was not recorded at Chicken Farm monitoring station due to faulty instrument. The data for SO_2 was not recorded at the Balmoral monitoring station due to faulty instrument and power interruptions at site.

4.2. METEOROLOGICAL OBSERVATIONS

The distributions of wind direction and wind speed for daytime and night-time hours for the reporting period are summarised on polar diagrams. The centre of the wind rose depicts the position of the air quality monitoring site. The positions of the spokes in the polar diagram represent directions from which the wind was blowing. The length of the segment indicates the percentage of the time the wind blew from that direction and the speed in the various categories are denoted by colours and width.

4.2.1. BALMORAL AIR QUALITY MONITORING STATION

The wind at Balmoral monitoring station was coming from the north-eaterly to easterly directions during the day and from the south-easterly to south-south-easterly directions during the night time. The monitoring station is north-east of Kusile power station.

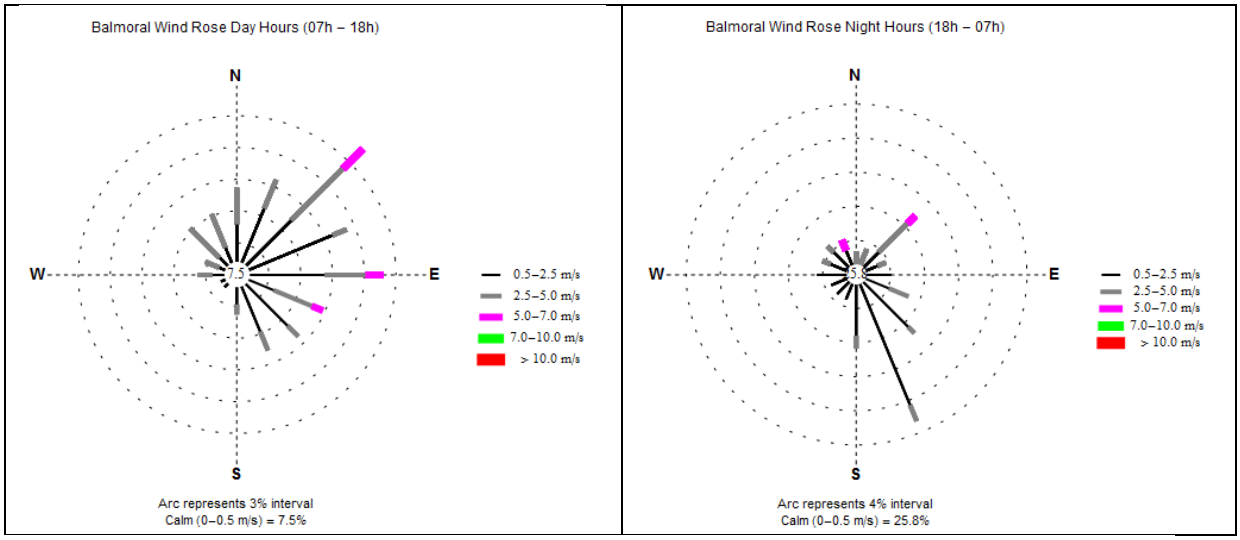


Figure 2: Wind profiles at Balmoral monitoring station

4.2.2. CHICKEN FARM AIR QUALITY MONITORING STATION

The dominant wind directions at Chicken Farm monitoring station during the day were north-west, north-north-west, north and east. During the night, the dominant wind directions were north-east, east and east-south-east. The monitoring station is south of Kusile power station.

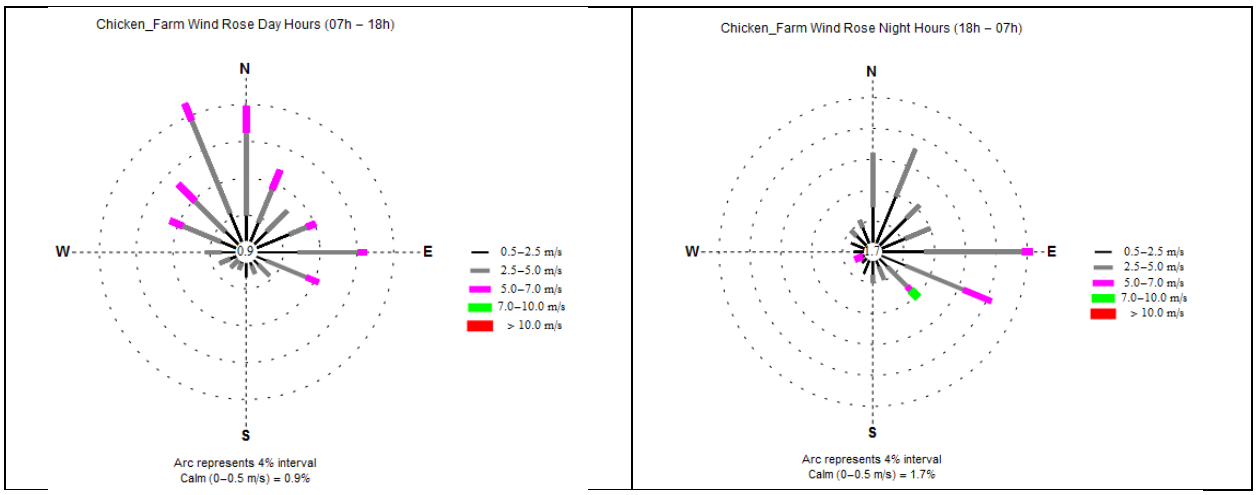


Figure 3: Wind profiles at Chicken Farm monitoring station

4.2.3. PHOLA AIR QUALITY MONITORING STATION

The dominant wind directions at Phola monitoring station during the day were west-north-west and north-west. During the night, the dominant wind directions were east-north-east, east and east-south-east. The monitoring station is south-east of Kusile power station.

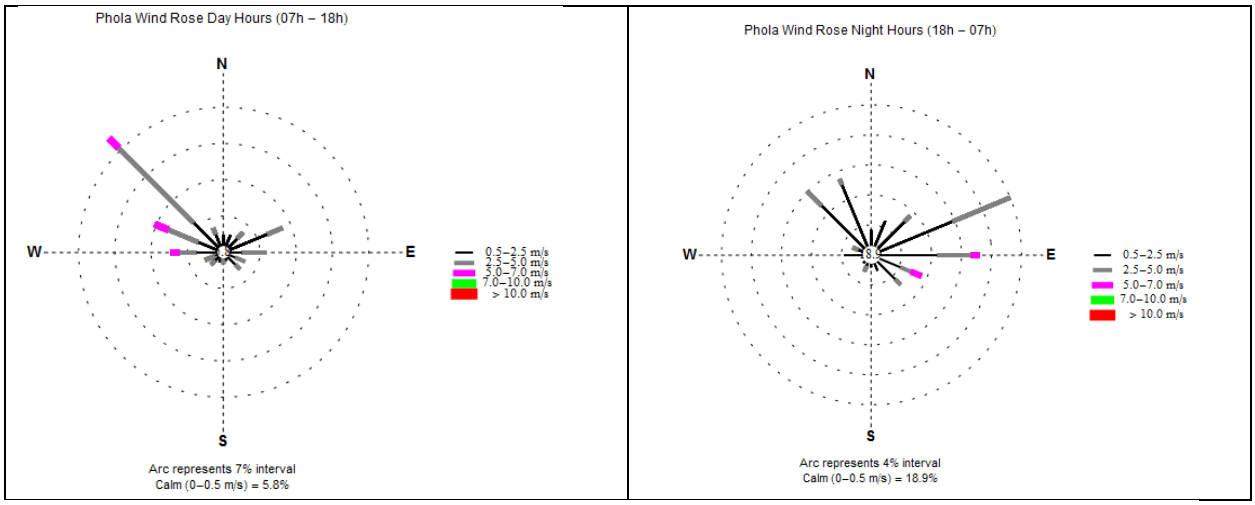


Figure 4: Wind profiles at Phola monitoring station.

4.2.4. WILGE AIR QUALITY MONITORING STATION

The wind at Wilge monitoring station was coming from the north, north-north-east, north-east to north-north-west directions during the day. The dominant wind sectors during the night are north-east, south-south-east to south-east. The monitoring station is south-east of Kusile power station.

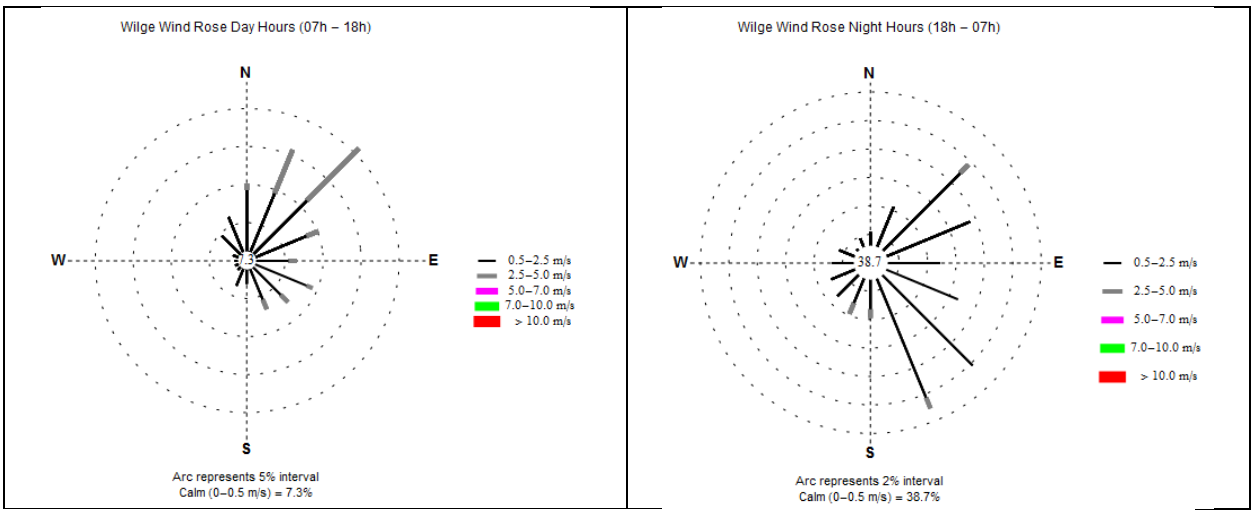


Figure 5: Wind profiles at Wilge monitoring station.

4.3. EXCEEDANCES OF THE NATIONAL AMBIENT AIR QUALITY LIMITS

Table 2: National Ambient Air Quality Standards

Pollutant	Unit	Period	Limit	Number of annual exceedances allowed	Source
Carbon Monoxide	Ppm	1hr	26.	88.	DFFE
Carbon Monoxide	Ppm	8hr	8.7	11.	DFFE
(PM_{10}) by Beta gauge	µg/m^3	24hr	75.	4.	DFFE
(PM_{10}) by Beta gauge	µg/m^3	1year	40.	0.	DFFE
($PM_{2.5}$) by Beta gauge	µg/m^3	24hr	40	4	DFFE
($PM_{2.5}$) by Beta gauge	µg/m^3	1year	20	0	DFFE
Nitrogen dioxide	Ppb	1year	21.	0.	DFFE
Nitrogen dioxide	Ppb	1hr	106.	88.	DFFE
Ozone	Ppb	8hr	61.	11.	DFFE
Sulphur dioxide	Ppb	1hr	134.	88.	DFFE
Sulphur dioxide	Ppb	10min	191.	526.	DFFE
Sulphur dioxide	Ppb	24hr	48.	4.	DFFE
Sulphur dioxide	Ppb	1year	19.	0.	DFFE

The National Department of Forestry, Fisheries and the Environment (DFFE) has set the South African Ambient Air Quality Standards for the criteria pollutants as illustrated in Table 2.

Table 3: Highest SO_2 concentration recorded (in ppb).

Monitoring Stations	10-min average	Date	Hourly average	Date	Daily average	Date
Balmoral	ND		ND		ND	
Chicken Farm	103.6	31/03/2024 09:10	70.9	13/03/2024 15:00	18.9	26/03/2024
Phola	116.1	12/03/2024 10:20	106.0	12/03/2024 12:00	22.6	26/03/2024
Wilge	80.8	1303/2024 11:50	65.2	13/03/2024 15:00	18.4	26/03/2024

There were no exceedances of the ambient SO_2 limits recorded for all the monitoring stations during the monitoring period under review. The highest SO_2 concentrations recorded at the monitoring stations are indicated in Table 3 and figures 6 to 8 below.

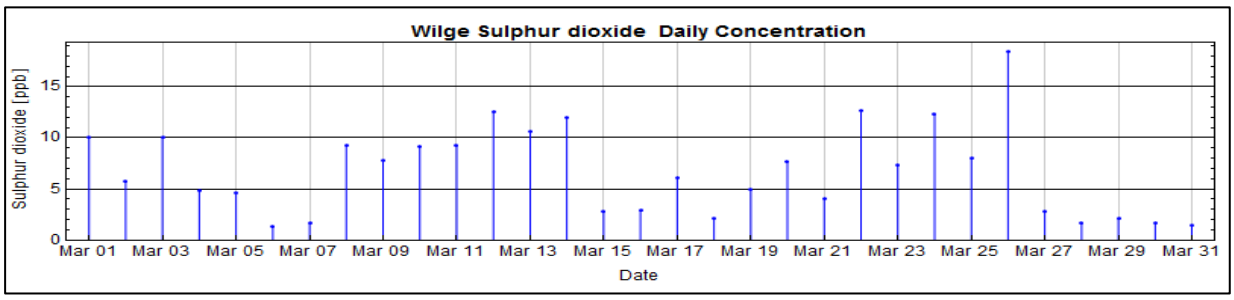


Figure 6: Time series graph for the SO_2 daily mean concentrations at Wilge AQM station

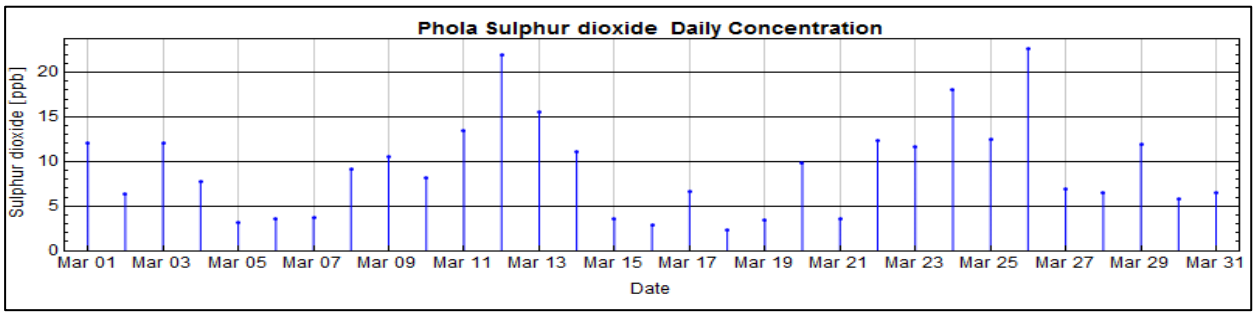


Figure 7: Time series graph for the SO_2 daily mean concentrations at Phola AQM station

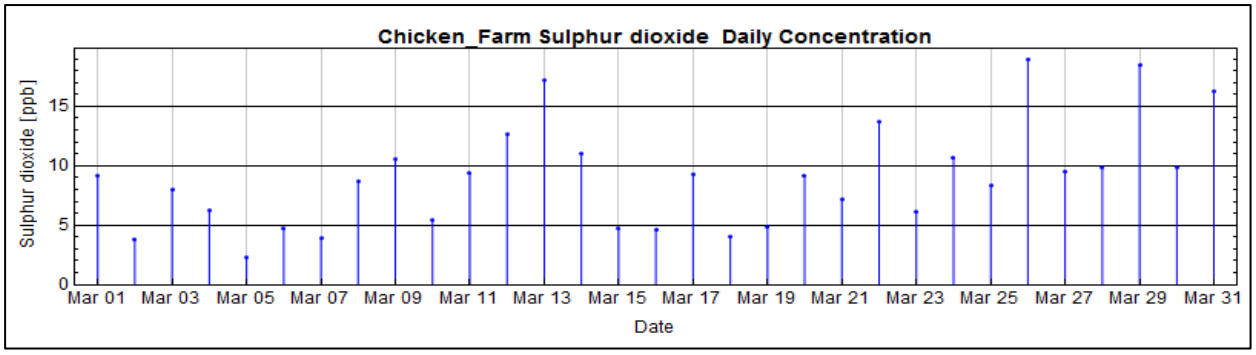


Figure 8: Time series graph for the SO_2 daily mean concentrations at Chicken Farm AQM station

There were no exceedances of the NO_2 hourly limit of 106 ppb recorded at the monitoring stations during the March 2024 monitoring period. There were fourteen (14) exceedances of the $PM_{2.5}$ daily limit of 40 µg/m^3 recorded at the Chicken Farm monitoring station. See Figure 10 below.

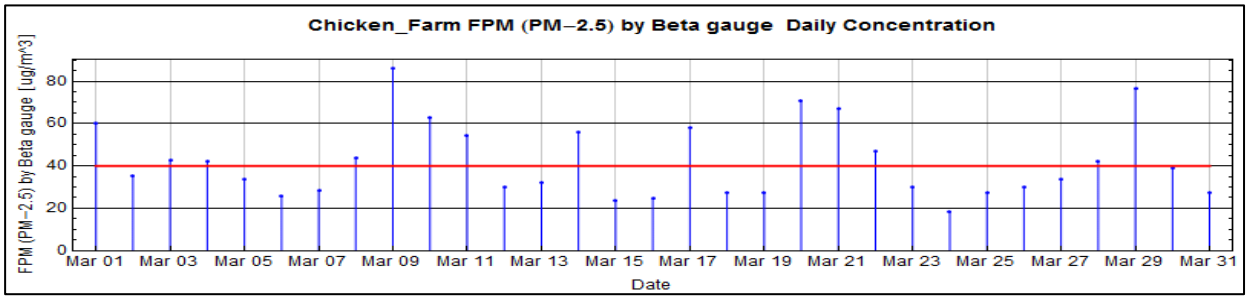


Figure 9: Time series graph for the $PM_{2.5}$ daily mean concentrations at Chicken Farm AQM station

Table 4: Exceedances above national ambient air quality limits for Chicken Farm air quality monitoring station

$PM_{2.5}$ Daily Exceedances (Chicken Farm)					
Pollutant	**Limit**	**Year**	**Month**	**Day**	**Conc. (µg/m^3)**
$PM_{2.5}$	40	2024	March	01	60.3
$PM_{2.5}$	40	2024	March	03	42.5
$PM_{2.5}$	40	2024	March	04	42.2
$PM_{2.5}$	40	2024	March	08	43.7
$PM_{2.5}$	40	2024	March	09	85.9
$PM_{2.5}$	40	2024	March	10	62.7
$PM_{2.5}$	40	2024	March	11	54.6
$PM_{2.5}$	40	2024	March	14	55.7
$PM_{2.5}$	40	2024	March	17	58.1
$PM_{2.5}$	40	2024	March	20	71.0
$PM_{2.5}$	40	2024	March	21	67.3
$PM_{2.5}$	40	2024	March	22	46.8
$PM_{2.5}$	40	2024	March	28	42.3
$PM_{2.5}$	40	2024	March	29	76.8

Table 5: Exceedances of the NAAQ Limits per pollutant- March 2024

Averaging Period	**Balmoral**	**Chicken Farm**	**Phola**	**Wilge**
SO_2 10-min	0	0	0	0
SO_2 Hourly	0	0	0	0
SO_2 Daily	0	0	0	0
NO_2 Hourly		0	0	
O_3 8-hourly		227	11	
$PM_{2.5}$ Daily		14	ND	
PM_{10} Daily		ND	ND	

A summary of all exceedances per pollutant for March 2024 is shown in Table 5.

SO_2 trigger levels or emergency response levels will be based on the United States Acute Exposure Guideline Levels for Hazardous Substances. (AEGL) as amended for South African circumstances. Levels confirmed with the authorities are as follows.

a. AEGL 1 – the cautionary notification level (non-disabling level) - is based on the South African NAAQS limit – for SO_2 this will be 191 ppb over 10-minute for exposure more than 4 hours.

b. AEGL 2 – the warning notification level (disabling level for those with asthma) – is aligned to the US AEGL approach – for SO_2 will be 744 ppb over a 10-minute for exposure up to 8 hours.

c. AEGL – the lethality level – for SO_2, this will be 29 771 ppb over a 10-minute period.

There were no events that triggered the notification of stakeholders in terms of the agreed AEGL recorded in March 2024.

Table 6: Number of exceedances recorded from November 2023 to March 2024

SITES	CF	PO	BL	WL	Allowed No. of Exceedances
PM_{10} (Daily)	0	0	ND	ND	**4**
$PM_{2.5}$ (Daily)	23	1	ND	ND	**4**
NO_2 (hourly)	0	0	ND	ND	**88**
SO_2 (Hourly	0	0	0	0	**88**
SO_2 (Daily)	0	0	0	0	**4**
O_3 (8h moving)	115	67	ND	ND	**11**
SO_2 (10 minute)	0	0	0	1	**526**

Chicken Farm air quality monitoring is in non-compliance with national ambient air quality limits of $PM_{2.5}$ daily limit of 40 µg/m³. The sources that have an impact on Chicken farm are Eva high Steel and Vanadium in the north-east, Phola Township in the east-south-east, Klipspruit Colliery in the south east and Kusile Power station in the north to north-west sectors.

5. DFFE AND SAAQIS REPORTING

The raw monitoring data, downloaded at 1-minute averages is available in real-time to the DFFE-managed South African Air Quality Information System (SAAQIS) since the 14th of December 2023 for all Eskom air quality monitoring stations.

6. CONCLUSIONS

There were no exceedances of the ambient SO_2 limits recorded for all the monitoring stations during the monitoring period under review. There were fourteen (14) exceedances of the $PM_{2.5}$ daily limit of 40 µg/m^3 recorded at the Chicken Farm monitoring station.

There were no events that triggered the notification of stakeholders in terms of the agreed AEGL recorded in March 2024.

Incident Investigation Report

Kusile Power Station Unit 1 and 3 Particulate Matter (PM) daily average exceedances in October, November, and December 2023.

1. IDENTIFYING INFORMATION:

a. **Type of incident:** Particulate Matter emission limit exceedances

b. **Business Unit affected:** Kusile Power Station

c. **Location of the incident**: Unit 1 and 3

d. **Date of the incidents**:

Unit 1	**October 2023:** • 20-28/10/2023 **November 2023:** • 5-7/11/2023 • 11-15/11/2023 • 22-25/11/2023
Unit 3	**November 2023** • 02-25/11/2023 • 29-30/11/2023 **December 2023** • 01-20/12/2023

e. **Contact details of the person reporting the incident:** Lesiba Kgobe – 013 699 7917

2. DESCRIPTION OF INCIDENT:

Upon retrofitting the emission reports, Kusile Power Station noted exceedances of Particulate Matter emission daily averages limits on Unit 1 and 3 in October, November and December 2023.

3. LEGISLATION APPLICABLE TO THE INCIDENT

National Environmental Management Air Quality Act

Kusile Power Station Atmospheric Emission License Ref no 17/4/AEL/MP311/12/01

4. SUPPORTING EVIDENCE:

Kusile Power Station emission reports for October, November and December 2023.

5. INVESTIGATION FINDINGS:

i. Only indicative values were available resulting in the station unable to activate the high dust emission response procedure, due to lack of correlated data.

ii. The first 1000-1200 operational hours are associated with high emissions. The material fibres for the installed bag set are 100% PPS and did not assist with the reduction of PM that is provided by the PI or P84 fibre.

iii. PM concentration is affected by cleaning system parameters and exposure to high differential pressure (DP).

iv. Online cell inspection was ongoing based on cell dust flow meters trends. This was effective in reducing dust from damaged bags but ineffective in reducing high dust concentrations associated with bleed through.

6. INVESTIGATION COMMITTEE MEMBERS:

- System Engineer – Nontobeko Moyo
- System Engineer – Nthabiseng Tsosane
- Process Engineer – Hanneke Heymans
- Senior Advisor Environmental- Cylia Malebana
- Senior Advisor Environmental – Maqhawe Nkambule
- Environmental Officer – Nhlonipho Nkosi
- Performance and Testing Technician – Kenneth Mkhonto

1. Executive Summary

Upon retrofitting the emission reports, Kusile Power Station noted exceedances of Particulate Matter emission daily averages limit on Unit 1 and 3 in October, November and December 2023.

2. Sequence of Events

- Unit 3, Unit 1, and Unit 2 returned to service on the 29 September, 16 October, and 28 November 2023 respectively.
- The Continuous Emissions Monitoring Systems (CEMS) for unit 1, 2 and 3 were installed and commissioned by 29 Setember 2023.
- The PM and Gaseous (SO2 and NOx) emissions were being reported using the unity curves upon the returned to service of the units until correlation tests were completed.
- Correlations tests for Unit 3 and 1 were completed successfully by November 2023 Unit 3 and December 2023 Unit 1 and the finalized reports were received by January 2024.
- Implementation of the correlations curves on Unit 1 and 3 Distributed Control System (DCS) and Emission Reporting Tool (ERT) were completed and the process of retrofitting emission reports commenced.

3. Incidents details

Emission Monitoring: A new DCS screen was configured for the temporary stack where only indicative values were available for operator to monitor the emissions limits pending correlation testing. Figure 1 below shows a snapshot of the DCS for Unit 2 showing the temporary stack Continuous Emission Monitoring System (CEMS) screen. This is what was available to the operator for the period during which correlations were not implemented. The correlation curves were implemented on the 15 January 2024 for Unit 1 and 3 following the completion of the tests. Unit 2 correlation test is still pending due to load restriction.

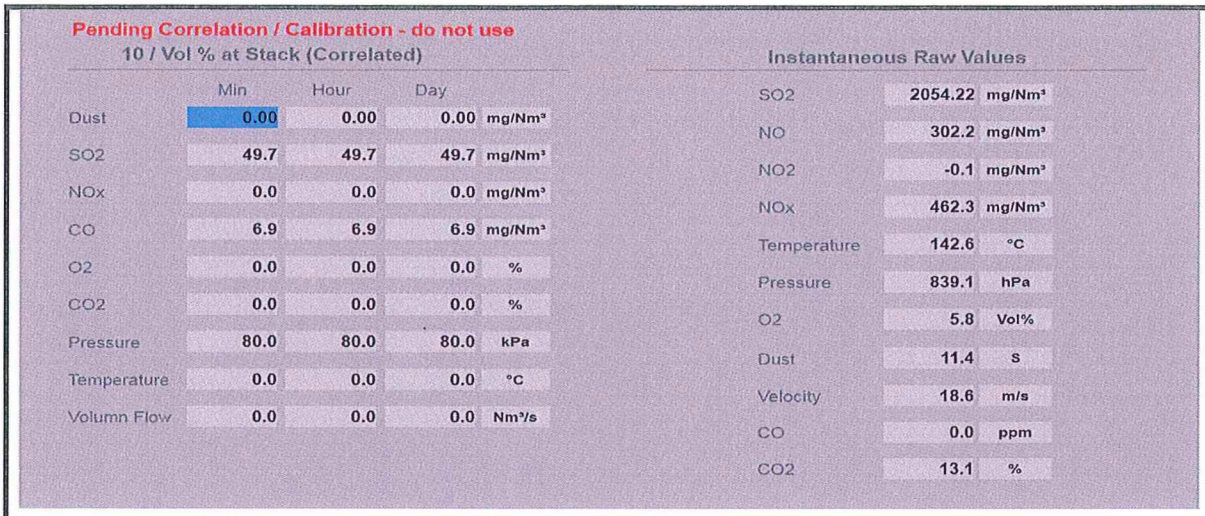


Figure 1: Temporary stack DCS interface (Current Unit 2 state with indicative values available for monitoring

Ash Bleed-Through: Filtration theory defines the filter fabric as a support medium, on which a primary ash cake is to form. This primary cake is responsible for increasing filtration efficacy. On the primary layer, the secondary ash cake is formed which is to be removed by the installed cleaning system for conveying via the Dust Handling Plant (DHP). During pulse cleaning, the cleaning pulse abruptly pushes the bag outward allowing for the secondary ash cake to dislodge, however, it also temporarily stretched the bag fabric, opening the pores and allowing for the passing of the smaller ash particle. For this reason, there is ash bleed-through, or increased emission associated with the pulse cleaning. The cleaning system parameters are set such that the secondary ash cake removal is achieved with the least possible cleaning pressure and frequency settings. This is to allows for the extension of the filter bag life. More importantly, the settings allow for improved Pulse Jet Fabric Filter plant (PJFFP) PM removal efficiency as it allows for primary ash cake to be established at an early stage of operation through minimising the ash bleed-through. For the case of returning Kusile Unit 1 and 3 to service, the system differential pressure (DP) at which the cleaning system pulse cleaning is initiated was changed from 1.3kPa to 1.5kPa to delay the cleaning sequence starting point. This was to account for the bag set being new and prone to ash bleed-through and to allow for the formation of the ash cake. The settings would be optimised to the system DP at a later stage of operation as required.

System Differential Pressure: There were instances where there was a decrease in pressure supplied to the system for pulse cleaning, this would lead to elevated operating differential pressures from the system. The system would then automatically adjust the cleaning pressure and frequency to reduce the

DP, however, this has a negative effect on the outlet PM concentration. In addition to this, any increase in operating DP is associated with the Induced Draught (ID) Fan vanes position increasing to overcome the DP and maintain stable furnace pressure. This vital control further exacerbates the PM concentration challenge as it pulls harder against any ash leaks existing in the plant.

Filter Material: For any bag set, it is envisaged that there are emissions associated with early bag life, however, the set installed in unit 1 and 3 had fibre composition of 100% PPS and did not include the PI/P84 final layer. This final layer is included in the updated Kusile PPS bag specification and is a trilobal fibre that allows for increased surface area and reduces these emissions associated with pulse cleaning at early bag life.

PJFF Plant PM Management: The PJFF plant is the abatement technology installed for the removal of PM to concentrations below 50mg/Nm^3. The system has known design defects concerning the distribution of flow through the plant. This makes sections of the plant structure and certain position of the filter bag installation prone to erosion damage. The damaged bags act as point of ash leakage and has a negative effect on the outlet dust concentration measured from the plant. Several engineering changes have been implemented that have improves the flow distribution challenge in the plant such as:

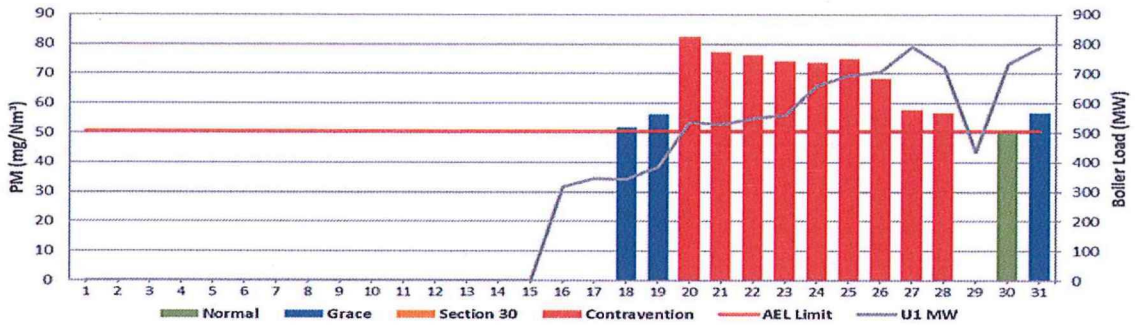
- Installation of deflector plates on the individual cell inlets
- Installation of diffusion plate on the inlet to reduce the volumetric flow towards the bags
- Installation of dummy bags in high wear areas
- Installation of erosion protection tiles and angle irons for ducting and supports

These have assisted with the erosion challenge however frequent bag failure remains a problem requiring intervention for PM management. The PJFF plant is fitted with individual cell dust flow monitors that provides a relative dust flow concentration measured as a percentage. The dust flow meters are trended on a weekly basis and PJFF cell prioritisation for cell access communicated to the maintenance team. Cell inspections for bag replacements are then conducted by the maintenance department. For the period where the PM concentration measurements were not available on the CEMS, these activities were ongoing based on information from the cell dust flow monitors.

3. Trends from the operation of the PJFFP and daily PM concentration

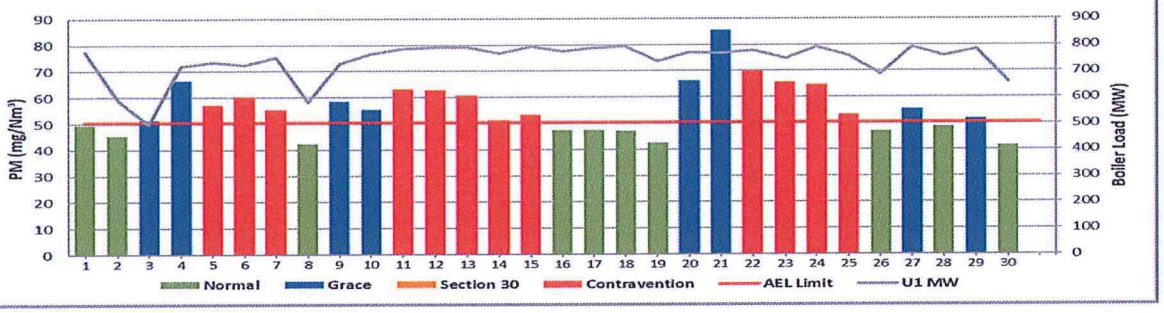
Unit 1 – October 2023

Figure 1: Kusile Unit 1 PM Emissions - October 2023



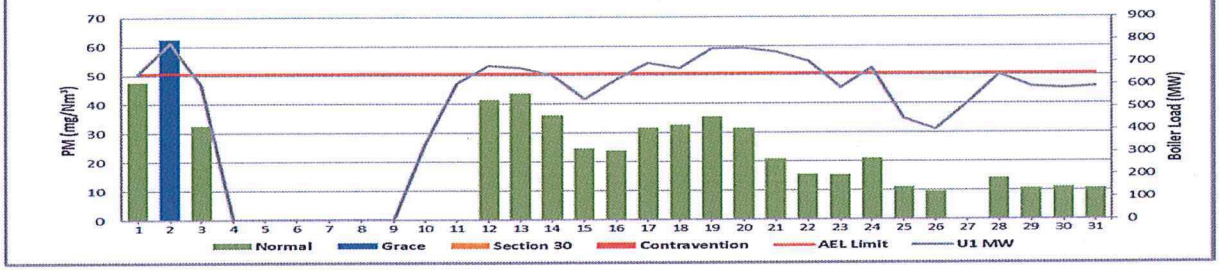
Unit 1 – November 2023

Figure 1: Kusile Unit 1 PM Emissions - November 2023

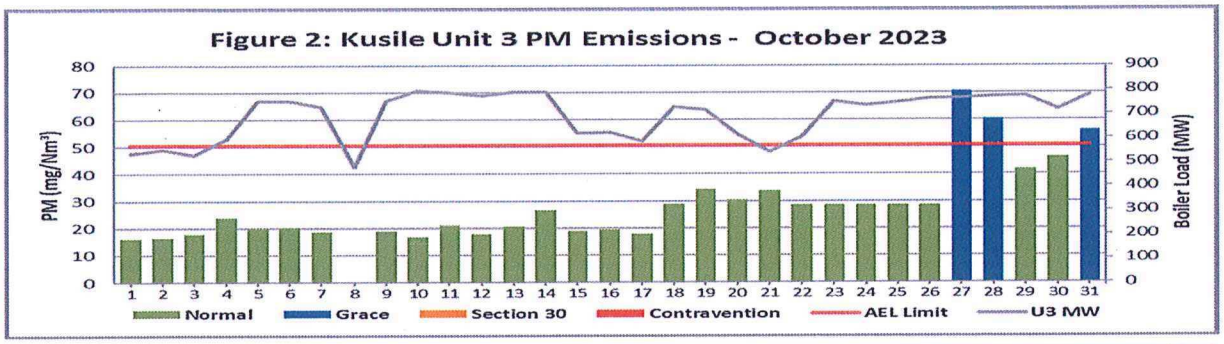


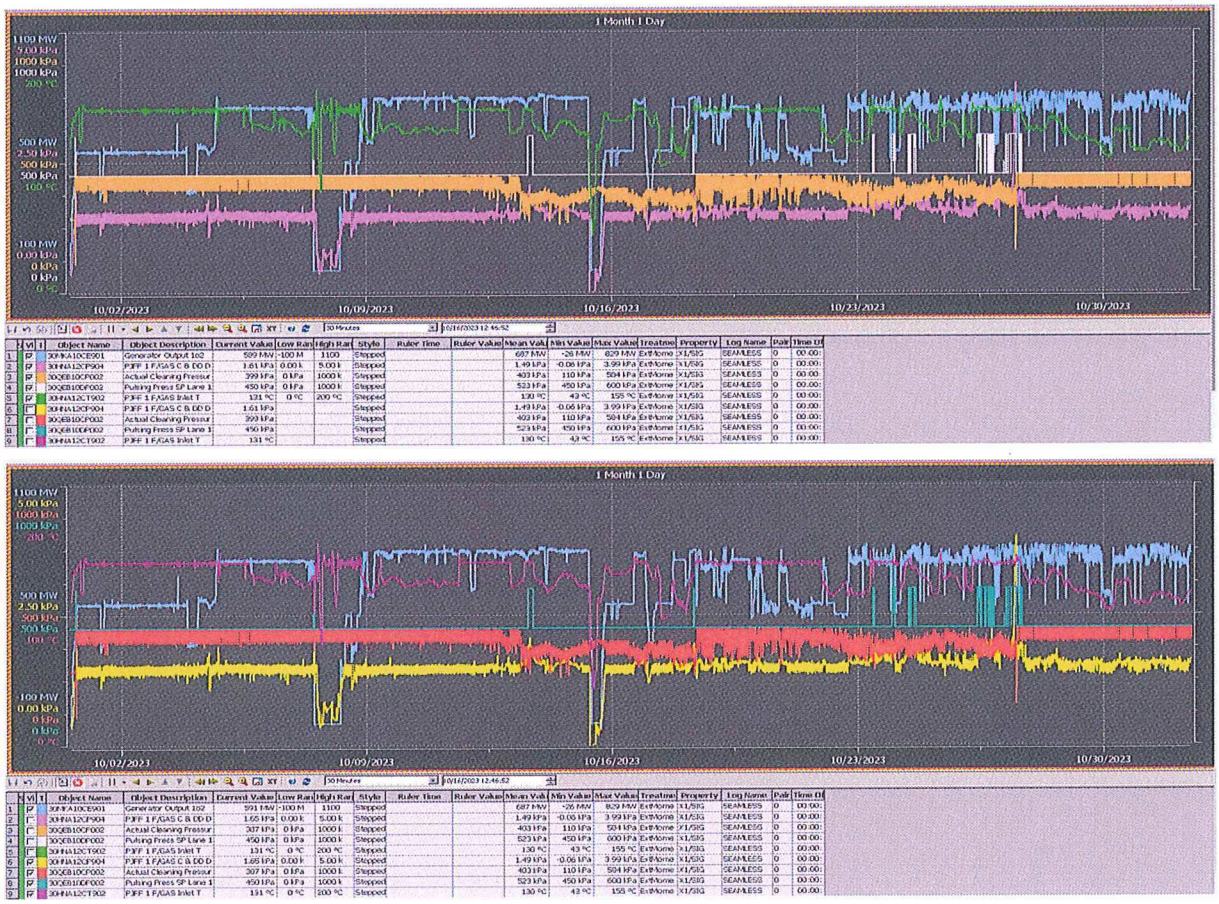
Unit 1 – December 2023

Figure 1: Kusile Unit 1 PM Emissions - December 2023



Unit 3 – Oct 2024

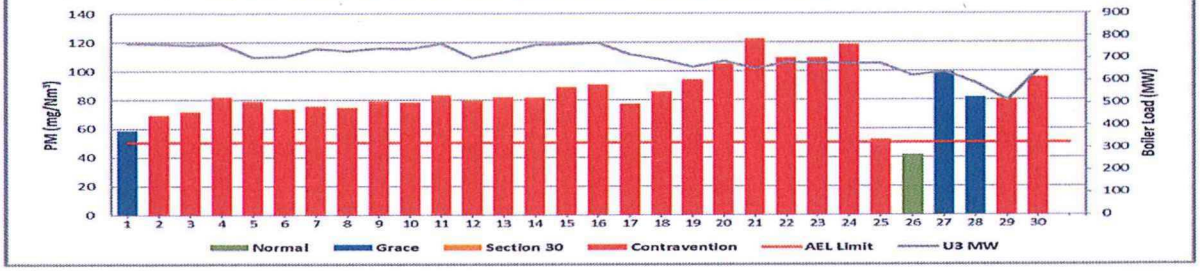


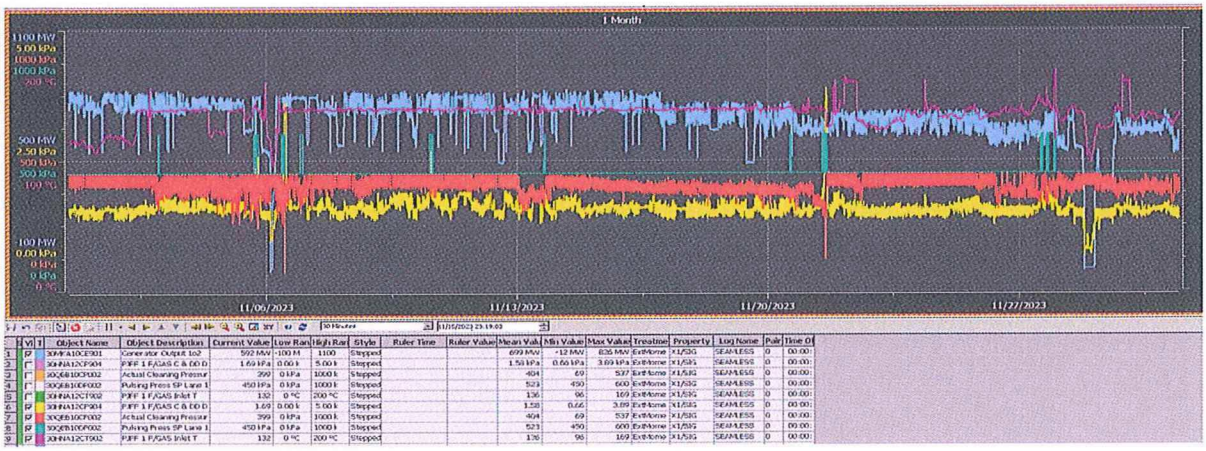


Controlled Disclosure

Unit 3 – Nov 2023

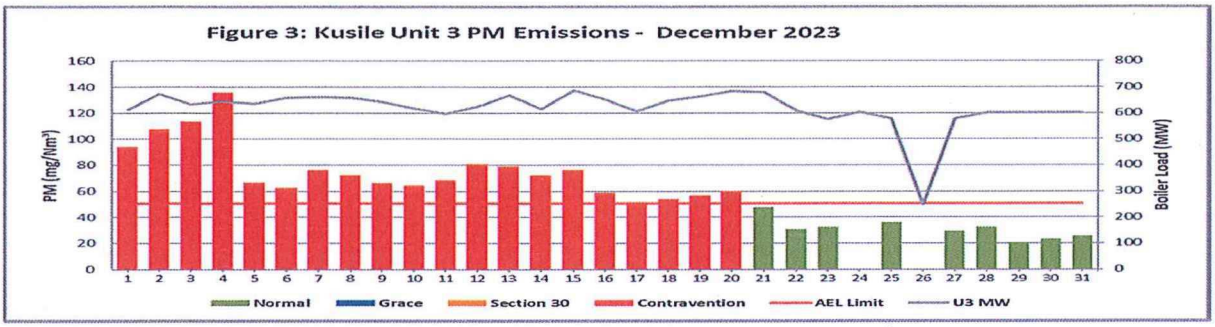
Figure 3: Kusile Unit 3 PM Emissions - November 2023





Unit 3 – December 2023

Figure 3: Kusile Unit 3 PM Emissions - December 2023



4. Investigation Findings

- Only indicative values were available resulting in the station unable to activate the high dust emission response procedure, due to lack of correlated data.
- The first 1000-1200 operational hours are associated with high emissions. The material fibres for the installed bag set are 100% PPS and did not assist with the reduction of PM that is provided by the PI or P84 fibre.
- PM concentration is affected by cleaning system parameters and exposure to high DP.
- Online cell inspection was ongoing based on cell dust flow meters trends. This was effective in reducing dust from damaged bags but ineffective in reducing high dust concentrations associated with bleed through.

5. Incident analysis

Root cause

- Use of PPS bags that are without PI or P84 fibre final layer.

Direct cause

- High dust emissions from PJFFP

Contributory causes

- Operating of Unit 1 and 3 with unity curves

6. Corrective and preventative action recommendations

No	Action	Responsibility	Target Date
5.1	Spot checks are to be done on units during the next CEMS installation while awaiting correlations for implementation of a preliminary curve. This will allow for the operator to have values to monitor and action while awaiting test.	Performance Testing Engineering Manager	Upon return to service of Units – if required
5.2	Cleaning system setting DP used to start the pulse cleaning will be increased to 1.5kPa from 1.3kPa for a new bag set. In addition to	Boiler Maintenance Manager	Upon installation of new bags

	this, the maximum pulse cleaning pressure setting will be limited to 500kPa instead of 600kPa to prevent disturbance of the primary ash cake		
5.3	The specification for the PPS will be used at Kusile going forward will include the PI or P84 fibre final layer.	PJFFP System Engineer	Completed
5.4	Online bag replacements will continue as required by the system for PM concentration management.	Boiler Maintenance Technician	As and when required

7. LESSON LEARNT

- The use of correct specification for procuring the PJFFP bags.
- Spots checks to be done while awaiting plant conditions to allow for full correlation test specifically for Units coming from long term outage.

Compiled by:	Supported by:	Approved by:
Lesiba Kgobe **Environmental Management Manager** Date: 24/04/2024	Grace Olukune **Engineering Group Manager** Date: 24/4/2024	Christopher Nani **Acting General Manager** Date: 24/04/2024