ESKOM

APPLICATION FOR SUSPENSION FROM THE MINIMUM EMISSIONS STANDARDS AND ALTERNATIVE EMISSION LIMIT REQUEST FOR THE KOMATI POWER STATION

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LIST OF ACRONYMS

AIR	Atmospheric Impact Report
AEL	Atmospheric Emission License
APPA	Atmospheric Pollution Prevention Act, 1965 (Act No. 45 of 1965)
AQMP	Air Quality Management Plan
DEA	Department of Environmental Affairs
DOE	Department of Energy
EIA	Environmental Impact Assessment
ERP	Emission Reduction Plan
ESP	Electrostatic Precipitator
FGC	Flue Gas Conditioning
FGD	Flue Gas desulphurisation
GNR	Government Notice No.
HFPS	High Frequency Power Supply
IRP	Integrated Recourse Plan
IRR	Issues and Response Report
LNB	Low NO_x Burner
LPG	Liquid Petroleum Gas
NAAQS	National Ambient Air Quality Standards
NAQO	National Air Quality Officer
NEMAQA	National Environment Management: Air Quality Act, 2004 (Act No. 39 of 2004)
NEMA	National Environmental Management Act, 1998 (Act No. 107 of 1998)
NERSA	National Electricity Regulator of South Africa
NO	Nitrogen oxide
NO_2	Nitrogen dioxide
NO_X	Oxides of nitrogen ($NO_X = NO + NO_2$)
PM	Particulate Matter
PM_{10}	Particulate Matter with a diameter of less than 10 µm
$PM_{2.5}$	Particulate Matter with a diameter of less than 2.5 µm
RTS	Return to Service
SO_2	Sulphur dioxide
TSP	Total Suspended Particulates
µm	1 µm = 10^{-6} m
WHO	World Health Organisation

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1 INTRODUCTION

Eskom, as South Africa's public electricity utility, generates, transmits and distributes electricity throughout South Africa. The utility also supplies electricity to neighbouring countries including Namibia, Botswana, Zambia, Zimbabwe and Mozambique. Eskom's principal generation technology is pulverised coal with approximately 90% of its current generating capacity is from in coal-fired power stations. One of the 15 coal-fired power station is the Komati Power Station (hereafter referred to as "Komati"), situated within 3 km of both R35 linking Middleburg and Bethal and the R542 between Witbank and Hendrina, in the Nkangala District of the Mpumalanga Province.

In terms of the Integrated Resource Plan and Eskom Consistent Data Set coal stations will generally be decommissioned at 50 years. The exact date of decommissioning is determined by current and future demand, the performance of other electricity generating plants and the cost of generation. The last of Komati's generating units was commissioned in 1966, after which the power station was mothballed in the late 1980's. Due to the increase in electricity demand, this power station commenced its return to service in 2008, and the last unit went into commercial operation in 2013. It is intended to decommission the station between 2024 and 2029 and the station is being shut down between 2018 and 2023.

In terms of the National Environmental Management: Air Quality Act, 2004 (Act No. 39 of 2004) (NEMAQA), all of Eskom's coal and liquid fuel-fired power stations are required to meet the Minimum Emission Standards (MES) contained in GNR 1207 on 31 October 2018 ("GNR 1207") which was promulgated in terms of Section 21 of the NEMAQA[1]. GNR 1207 provides for transitional arrangements in respect of: a once off postponement with the compliance of minimum emissions for new plant for five years from the date of issue, no once off postponement will be valid beyond 31 March 2025; a once off suspension for plants being decommissioned by 31 March 2030; the National Air Quality Officer may grant an alternate emission limit or emission load if certain conditions are met. The application for any of these requests must be submitted by 31 March 2019.

Komati already achieves the 100 mg/Nm^3 Particulate Matter (PM) and 3500 mg/Nm^3 Sulphur dioxide (SO_2) emission limits (MES for 'existing plant'). However, Eskom's Komati Power Station does not comply with the Nitrogen oxide (NO_X) 1100 mg/Nm^3 emission limit. Similarly the station is unable to comply with the 'new plant' MES limits for NOx (750 mg/Nm^3), PM (50 mg/Nm^3) and SO_2 (1000 mg/Nm^3). As such Eskom is requesting a once-off suspension with new plant MES and alternative limits of 100 mg/ Nm^3 for PM 1100 mg/ Nm^3 for NO_x and 2600 mg/Nm^3 for SO_2 until station decommissioning in 20292029.

The purpose of this document is to present an application for the suspension from specific MES compliance timeframes and propose an alternative limit for Komati as required in terms of GNR 1207. The document has been structured to present an overview of Eskom's emission reduction plan including the current shut down of units for reserve storage, the decommissioning plan and its influence on Eskom's emissions. Based on this the proposed alternative emission limits to which Komati could be held and which could then be included in the Atmospheric Emission Licence (AEL) are proposed. The legal basis for the suspension of compliance and alternative limits is then presented, including the requirements that must be met in making such an application. Finally, the reasons for the application for suspension and alternative limits are presented.

[1] GNR 893 amended the "original: MES regulations GNR 893 which were promulgated on 22 November 2013 in terms of Section 21 of the NEMAQA

2 ESKOM'S EMISSION REDUCTION PLAN

Eskom considers that it is not practically feasible or beneficial for South Africa (when considering the full implications of compliance, planned decommissioning and health impacts) to comply fully with 'new plant' MES by stipulated timeframes. As a result, Eskom proposes to adopt a phased and prioritised approach to compliance with the MES. The highest emitting stations will be retrofitted first. Reduction of Particulate Matter (PM) emissions has been prioritised, as PM is considered to be the ambient pollutant of greatest concern in South Africa. In addition, Eskom proposes to reduce NO_x emissions at the three highest emitting stations. Kusile Power Station will be commissioned with abatement technology to achieve the new plant standards. Medupi is commissioned with abatement technology which can meet PM and NOx new plant standards and will be retrofitted with flue gas desulphurisation so that the new plant SO_2 limit will also be achieved at Medupi over time. There are six coal fired power stations which will be decommissioned before 2030, an additional two by 2035 and the remaining existing plants (excluding Majuba, Medupi and Kusile) by 2043.

Emission reduction interventions to achieve compliance with the new plant emission limits are planned for the following stations:

- Particulate Matter emission reduction: Tutuka, Kriel, Matla and Duvha Units 4-6, Matimba, Kendal and Lethabo;
- NO_x emission reduction: at Matla, Majuba, Tutuka, Camden; and
- SO_2 emission reduction: at Medupi and pilot studies which will confirm the appropriate technology for Matimba and Kendal.

Currently the draft Integrated Resource Plan 2018 is based on a general 50-year life for all coal fired power stations however the actual shut down and decommissioning dates of power stations are determined based on economic, technical and environmental criteria. For consistency in the Eskom postponement applications the decommissioning dates as defined in the in the Eskom Consistent Data set (Eskom 36-623 rev 3) for planning have been used. In 2017/18 eleven (11) units at Eskom's most costly and oldest plants namely Grootvlei, Hendrina and Komati were shut down for reserve storage. In 2017/18 eleven (11) units at Eskom's most costly and oldest plants have been shut down. The remaining units at these three power stations, namely Grootvlei, Hendrina and Komati will be shut down by 2023. The shutting down of these power plants will reduce the cumulative pollution in the three airsheds, some reduction has already materialised due to the 10 units which are shut down for reserve storage in 2017/18. The emissions load will continuously decrease ensuring that health impacts from Eskom's power stations will not increase.

The retrofits listed above are over and above the emission abatement technology which is already installed at Eskom's power stations, which is:

- Electrostatic Precipitators (ESPs) at Matimba, Kendal, Lethabo, Matla, Kriel, Tutuka, Komati and 3 of 6 units at Duvha. In addition SO_3 injection plants have also been installed at those stations with ESPs, except Tutuka, to improve the efficacy of the same;
- Fabric Filter Plants (FFPs) at Majuba, Arnot, Hendrina, Camden, Grootvlei, Medupi, Kusile, and 3 units at Duvha;
- Boilers with Low NO_x design at Kendal and Matimba;
- Low NO_x Burners (LNBs) at Medupi, Kusile, Ankerlig, Gourikwa and on some units at Camden; and
- Flue gas desulphurisation (FGD) at Kusile.

Eskom applied and was granted postponements between 2014 and 2015. Since then Eskom has updated its emission reduction plan to include the enhancement of existing particulate matter abatement technology currently installed at Kendal, Matimba and Lethabo Power Stations.

Implementing the emission reduction plan and installing more efficient emission control technology will reduce Eskom's emissions. The decommissioning of the older stations and an increased use of the newer less emitting Medupi and Kusile power stations will also result in a substantial decrease in Eskom's emissions over time. For example, it is projected that compared to a 2020 baseline by 2035 Eskom's relative PM emissions will reduce by 58%, SO_2 by 66% and NO_x by 46%.

Eskom's proposed atmospheric emission reduction plan is estimated to cost R 67 billion over the next 10 years. The cost has been included in the latest Multi Year Price Determination tariff application.

The retrofit schedule and projected emission reduction above clearly illustrates Eskom has been and remains committed to implementing emission reduction technologies to improve air quality in South Africa. Though there are delays in the implementation of the retrofit plan Eskom remains committed to ensuring these planned technology installations are completed.

A detailed discussion on Eskom's emission reduction plan is provided in the Eskom Summary Document.

3 REQUESTED POSTPONEMENT EMISSION LIMITS

The current limits listed in Table 1 are as in Komati's AEL (ref: NDM/AEL/MP313/12/12). The proposed emission limits that are requested for Komati during normal operating conditions are:

Table 1: Current and requested emission limits for Komati

	Current Limit (from AEL)			Requested Emission Limits***		
	Limit value	**Averaging period**	**Date to be achieved by**	**Limit value**	**Averaging period**	**Date to be achieved by**
Particulate Matter	100	Daily	1 April 2015	100	Daily	1 April 2020 until decommissioning
	50		1 April 2020			
Sulphur dioxide	3500	Daily	1 April 2015	2600	Daily	1 April 2020 until decommissioning
	2600		1 April 2020			
	500		1 April 2025			
Nitrogen oxides	1300	Daily	1 April 2015	1100	Daily	1 April 2020 until decommissioning
	750		1 April 2020			

****The requested interim emission limits above are in mg/Nm^3 at 273 K, 101.3 kPa, dry and 10% O_2.*

In summary the once off suspension and alternative emission limit requested for Komati is: (i) Suspension of compliance from the new plant MES PM standard (50 mg/Nm^3), NO_x standard (750 mg/Nm^3) and SO_2 standard (1000 mg/Nm^3) until station decommissioning in 2029. During this period daily limits of 100 mg/Nm^3 for PM and 2600 mg/Nm^3 will be achieved until decommissioning in 2029; and (ii) An alternative emission limit between 1 April 2020 until decommissioning in 2029 of 1100 mg/Nm^3 for $NO_{X.}$

Based on the remaining life of the Komati power station, the techno-economics and cost benefits assessment any additional measures other than what was committed to above and the emission limits requested are not financially viable.

It is requested that the proposed alternative emission limits only apply during normal working conditions, and not during start-up or shut-down, upset conditions and maintenance periods.

4 LEGAL BASIS FOR DECISION-MAKING

4.1 Regulatory Requirements

In terms of Section 14(1) of the NEMAQA, the Minister of Environmental Affairs ("Minister") must designate an officer in the Department of Environmental Affairs (DEA) as the National Air Quality Officer. In this regard, Dr Thuli Khumalo has been designated by the Minister as the current National Air Quality Officer. Section 14(4)(b) of the NEMAQA provides that the National Air Quality Officer may delegate a power or assign a duty to an official in the service of his/her administration. It is our understanding that no such delegation has been made for the area of jurisdiction in which the power station is located. Accordingly, Eskom submits this Application to the National Air Quality Officer (NAQO).

In terms of Paragraph (12)(a) – (c) of GNR 893 of 22 November 2013 (the Regulations), the postponement application must include:

In terms of Paragraph (12)(a) – (c) of GNR 1207 of 31 October 2018 (the Regulations), the postponement application must include:

1. An air pollution impact assessment compiled in accordance with the regulations prescribing the format of an Atmospheric Impact Report (AIR) (as contemplated in Section 30 of the NEMAQA), by a person registered as a professional engineer or as a professional natural scientist in the appropriate category;
2. A detailed justification and reasons for the application; and
3. A concluded public participation process undertaken as specified in the National Environmental Management Act and the Environmental Impact Assessment (EIA) Regulations made under section 24(5) of the aforementioned Act.

In respect of these requirements we have attached –

1. As Annexure A, a copy of the AIR prepared in respect of Komati. The AIR provides, *inter alia*, an assessment of how ambient air quality is likely to be affected by Komati's requested emission limits by utilising, *inter alia*, atmospheric dispersion modelling;
2. Detailed justifications and reasons for the Application (see Section 5 below); and,
3. A comprehensive report on the public participation process followed, and associated documentation (Annexure D).

4.2 Changes in Regulatory Framework

In October 2018 the 2017 National Framework for Air Quality Management in the Republic of South Africa and the Amendment to Listed Activities and Associated Minimum Emission Standards Identified in terms of Section 21 of NEMAQA were published. Eskom and the independent consultants appointed to complete the AIR have made every effort to provide complete information, Eskom reserves the right to supplement the information if it deems appropriate or if requested to do so by the NAQO.

4.3 The Need to Amend Variation Requests

In terms of timing, Eskom is required to submit an AEL variation request parallel to the MES once off suspension and request for an alternative emission limit application. The variation request is prepared based on the assumption that the requested application is granted by the NAQO. If the NAQO decision is substantially different from that requested in the application, Eskom reserves its right to amend its variation request.

5 REASONS FOR APPLYING FOR POSTPONEMENT

As mentioned above, the application for suspension and a request for alternate emission limits must be accompanied by reasons. Such reasons are set out below and include the fact that Komati has a short remaining life; emissions from Komati will not result in substantial additional non-compliance with National Ambient Air Quality Standards (NAAQS); together with a suite of undesired environmental consequences of compliance with the MES including associated water demands, transport impacts and increases in waste and carbon dioxide (CO_2) production. These undesired consequences together with the financial costs of compliance (such as an increase in the electricity tariff) must be weighed up against the benefits that will accrue as a result of compliance with the MES. It is Eskom's view that the benefit of compliance does not justify the non-financial and financial costs of compliance (see section 5.5 below for the details of the cost-benefit analysis completed).

None of these reasons should be seen as exclusive (i.e. it is not one reason alone that indicates full compliance to the MES is not appropriate) but rather all in combination. As set out in the Constitution of the Republic of South Africa, there is the need to recognise the interrelationship between the environment and development. There is a need to protect the environment, while simultaneously recognising the need for social and economic development. There is the need therefore to maintain the balance in the attainment of sustainable development.

5.1 Remaining Power Station Life

Komati is currently scheduled to be decommissioned between 2024 and 2029 and will be shut down by 2023, according to the Eskom Consistent Data Set which plans for a 50 year life for Eskom coal fired power stations generally.

Based on Eskom's experience at Medupi it is estimated that the time required for FGD development and construction would be 12 years (project development 4 years, commercial process 2 years and construction 6 years – one unit per year). Given these project timelines construction of FGD would be taking place simultaneously with the decommissioning of the station (assuming all other issues discussed below could be addressed) – an illogical arrangement. It is thus considered not financially viable to retrofit Komati with FGD given its current operating life.

5.2 Water Availability

Water is an extremely limited resource in South Africa and it is argued that the implementation of FGD at Komati is not an appropriate decision for a water scarce country.

Recent investigations undertaken for Medupi indicate that the implementation of FGD will increase its water requirement to up to 8 Mm^3/annum. Wet FGD approximately triples the water consumption of a dry-cooled power station; semi-dry FGD more than doubles the water consumption of a dry-cooled power station (a wet cooled power station uses more than 10 times the amount of water of an equivalent dry-cooled power station. Typically 0.12 l/kWh for dry cooled to 2 l/kWh for wet cooled). Typically 0.12 l/kWh for dry cooled to 2 l/kWh for wet cooled). The water demands of FGD increase the water required by a wet-cooled power station like Komati by some 7% (around 42 million m^3/annum without FGD, to more than 45 million cubic metres per annum with wet FGD). The Komati Power Station being a wet-cooled power station already uses large quantities of water.

The water demands of FGD are thus significant across the power stations and will increase Eskom's water demand by some 59 million m^3/annum – a 20% increase in the combined water consumption of Eskom's power stations[2].

The total water demands in the Integrated Vaal River Catchments presently exceed the water availability in the catchment until Phase 2A of the Lesotho Highlands Water Project (LHWP) is implemented. The projected completion date of Phase 2A of the LHWP is now beyond 2026. The water supply deficit is expected to grow with the growing urban demand in the greater Gauteng area. It is unlikely that DWS will license new major demands in this system until then. Thus far all efforts by DWS to reduce demand in the Vaal River system have been delayed or ineffective. Rand Water for example are requesting an increase in its water license volume to cater for the additional demand and DWS have refused thus far as there is no water available in the Vaal System.

Eskom has a combined water licence of 360 million m^3/annum from the Vaal River Eastern Subsystem to generate electricity (licensed to October 2025 when it will get reviewed). Some of Eskom's older power stations are expected to be decommissioned within the next 5 to 10 years but that does not significantly contribute to reducing the shortages in the Vaal River System as the declining demand for Eskom's water use is already taken into account in the annual operating analysis. Eskom will not be able to re-allocate its water allocation to FGD as a relinquishing of our licenced volume goes back to DWS to determine who would be the best user for the water being made available.

Beyond 2026 when LHWP 2 comes into operation it is possible that water is available for retrofits to the current fleet supplied from the Vaal System.

The argument is also not just one of having water available in the catchment, but also one of determining whether FGD is a judicious use of what is an extremely scarce resource in South Africa in the face of multiple competing demands for that same resource. Especially since more than 95% of South Africa's available water has already been allocated.

5.3 Environmental Implications of FGD

Assuming FGD was required for Komati which is as said impractical FGD is not without negative environmental consequences:

- Up to 124 000 tons of sorbent (limestone) per annum would be required to operate the FGD at Komati. The main source of sorbent is the Northern Cape, so the sorbent would need to be transported over hundreds of kilometres, preferably by rail or otherwise by road. The transport of the sorbent would result in environmental impacts, notably greenhouse gas emissions, and fugitive dust emissions. An increase in truck traffic would also result in an increase in driver mortalities, as has been observed in association with coal transport in Mpumalanga.
- Up to 225 000 tons of gypsum will be produced per annum as a by-product of the FGD process. If a high quality limestone is used, a high quality gypsum can be produced by wet FGD, and this could be

[2] **Assuming that wet FGD is installed on the 5 newest stations excluding Kusile, and semi-dry FGD is installed on the rest of the coal-fired fleet, but excluding FGD on stations which will close by 2030. The October amendment of the MES for SO_2 new plant to 1000 mg/Nm^3 will require a revision of technology choices.*

taken up by the market for e.g. wallboard production. Lower grade gypsum can also be used for agricultural purposes. However, if there is not sufficient demand from the market, the gypsum will need to be disposed of in which case it would need to be managed carefully to ensure that there are no impacts on groundwater or air quality (from fugitive dust emissions).

- Komati is expected to produce an additional approximately 40 000 tons of CO_2 per annum, as the wet FGD process directly produces CO_2 as a by-product through the reaction:
  $SO_2 + CaCO_3 \rightarrow CaSO_4 + CO_2$. In addition, the electricity output of Komati would be reduced by around 1% due to the additional auxiliary power requirements of the FGD, and correspondingly the relative CO_2 emissions would increase by 1%.[3]

5.4 Komati Impact on Ambient Air Quality

Eskom established an ambient air quality monitoring station at Komati in 2006, measuring, amongst others, ambient SO_2, NO_2 and PM_{10} concentrations and meteorological parameters. The impact of Komati's emissions on ambient air quality has been comprehensively assessed in the accompanying independently compiled Atmospheric Impact Report. It can be seen from the measured ambient air quality measurements from the Komati monitoring stations (Komati, Witbank, Kriel Village and Elandsfontein) that both SO_2 and NO_2 comply with the NAAQS for the various averaging periods, but PM is seen not to comply. Ambient daily PM concentrations indicate sustained high loading and non-compliance with the PM NAAQS. Analysis of diurnal data shows that the Komati Power Station does not contribute significantly to ambient PM and that the exceedances derive from ground level emissions such as domestic fuel use.

5.4.1 Sulphur Dioxide (SO_2)

10-minute average SO_2 concentrations indicate that Kriel Village has generally a higher SO_2 loading than the other two stations but all stations are seen to comply with the NAAQS. Data recovery is seen to be generally poor at Elandsfontein, marginally better at Komati and best at Kriel Village. Daily average for SO_2 concentrations shows non-compliance with the NAAQS. This is evident from monitoring data collected from Komati (2016), Kriel (2015) and Witbank (2015 and 2016) monitoring stations. Such non-compliance with the daily standard is indicative of sustained high loading of SO_2 in those areas. In terms of the annual average SO_2 concentrations, the Komati monitoring station has non-compliance with the standard for 2015. Although there is compliance with the standard at Witbank monitoring station, the average 2015 value was 49.5$\mu g/m^3$, which can be read as non-compliance with the standard in that year again reflecting sustained, elevated concentrations of SO_2 in the areas of the monitoring stations.

5.4.2 Particulate Matter (PM)

Daily average particulate matter **(PM_{10})** concentrations measured indicates that there is wholesale non-compliance with the NAAQS for all monitoring stations. Some 144, 117 and 65 days were seen to exceed the limit value (4 allowed) for 2017, 2015 and 2016 respectively at Komati, 112 and 87 days at Witbank for 2015 and 2016 respectively. The very high PM_{10} loading at the various stations creates a very high risk of adverse health effects amongst the people exposed to the same.

Daily average particulate matter ($PM_{2.5}$) concentrations indicate that there is wholesale non-compliance for all the monitoring stations where at Komati for example the limit value was exceeded on no less than 89 days (where < 4 is allowed) in 2017. Similarly Witbank was seen to exceed the limit value for 85 days in 2015 and 55 days in 2016 and 2017 respectively. Annual average $PM_{2.5}$ concentrations indicate that there is non-compliance with the NAAQS for all years for all the monitoring stations, indicating sustained elevated concentrations of $PM_{2.5}$ in these areas. For Komati in 2015 non-compliance is also likely and for 2016 the

[3] To be confirmed

average is 19.6 μg/m^3 compared to the limit value of 20 μg/m^3 which is to all intents and purposes a non-compliance. The concentrations imply very high sustained concentrations of $PM_{2.5}$ with very high risk of adverse health effects.

5.4.3 Nitrogen Oxides (NO_x)

Hourly average nitrogen dioxide (NO_2) concentrations measured indicates that more than 90% of the concentrations are below 75μg/m^3 for the four monitoring stations (Komati, Kriel, Witbank and Elandsfontein) and full compliance with the NAAQS is implied. In terms of annual average concentrations for NO2, there is full compliance with NAAQS for all monitoring stations.

5.4.4 The Highveld Priority Area

Eskom is aware that Komati is situated within the Highveld Priority Area and as such made substantial financial investment into reducing emissions from Komati's operations, through the upgrade of emissions reduction technologies on each of the station's units.

5.4.5 Cumulative Assessment of Requested Emission Limits in the Northern Highveld

In addition to the individual AIR completed for each power station, an air quality report, considering the cumulative impact of the Eskom stations including Komati over the HPA was completed (Annexure B). The analysis included three scenarios; which considered (1) the actual emissions, (2) emissions if the MES was complied with and (3) emissions if six power stations are decommissioned by 2030. The general conclusions of the analysis indicate that the quality of air will be in compliance with NO_2 National Air Quality Standards (NAAQS), but noncompliance with the daily and annual SO_2 standards in several areas across the Highveld. Daily and annual average PM_{10} and $PM_{2.5}$ concentrations could be in noncompliance and for extended periods of time. The effect of the above is that PM ambient levels currently result in increased health risk for a large part of the Highveld.

Dispersion modelling results based on individual and combined power station emissions, excluding all other sources; indicate a negligible contribution to PM pollution. In addition the diurnal pattern in PM concentrations based on monitored ambient data clearly indicate a morning and early evening peaks, typical of low level source contributions. However, a combination of SO_2 and NO_x emissions from all the Highveld power stations is predicted to form a significant component of the $PM_{2.5}$ load especially over Emalahleni area, which is in noncompliance with PM standards, is a cause for concern.

In addition, the combined SO_2 emissions from all Eskom power stations are predicted to contribute a significant amount to the pollution in and around the Emalahleni and Middelburg areas and even extending south towards Komati Power Station. However analysis indicates that the non-compliance is not only due to Eskom Power Stations but a function of a multitude of sources in the Highveld.

The dispersion modeling and ambient air quality monitoring data indicate that the elevated pollution levels in the Highveld require a holistic approach, addressing all identified and potential sources. Therefore, a single approach, targeted at only eliminating Eskom power station emissions will not result in acceptable ambient air quality levels that are not harmful to human health and the environment.

5.5 Cost Implications of Compliance with the MES

The financial implications of compliance to the MES, most especially the financial implications of compelling existing plants to comply with 'new plant' standards is presented below.

5.5.1 Direct Financial Costs

Eskom estimates that the CAPEX cost of full compliance with the MES at all Eskom's power stations is greater than R187 billion in 2019 real terms (excluding financing costs), and that annual OPEX costs are at least R5 billion per annum. This includes the costs for emission control for the entire existing fleet and flue gas desulphurisation at Medupi. Medupi's other emission abatement costs and all emission abatement costs for Kusile have been excluded from these totals because they have already been incorporated into the Medupi and Kusile projects. These costs are considered to be accurate to a factor of two.

The breakdown of the CAPEX costs is as follows:

- SO_2 emission reduction by FGD is estimated to cost R 140 – 175 billion. The estimated cost assumes R 15 - 26 billion per power station dependent on installed capacity and wet or dry FGD technology. It is taken that wet FGD is implemented on Medupi, Majuba, Matimba, Kendal, and Tutuka, (power stations being decommissioned after 2035) and that semi-dry FGD is implemented on Duvha, Lethabo and Matla (stations decommissioned between 2030 and 2035). For the tariff impact calculation an amount of R150 billion is used.
- NO_x emission reduction by the most appropriate technology is estimated to cost between R10 and R40 billion for all power stations. This includes Low NO_x Burner retrofits at stations which need them, and burner optimisations at others. For the tariff impact calculation an amount of R20 billion is used.
- Particulate Matter emission reduction by FFP retrofits is estimated to cost between R15 and R40 billion. For the tariff impact calculation an amount of R40 billion is used.

Full compliance with the MES at Lethabo would require a FGD retrofit, which is the only way of consistently achieving the new plant SO_2 emission limit, an cost of between R 15 – 20 billion and a LNB retrofit estimated to be around R2 billion, as well as FFP retrofit and dust handling plant upgrade (CAPEX of over R5 billion).

The CAPEX cost estimates were derived as follows:

- FGD: Costs for existing stations are based on a study done by EON Engineering for all Eskom's power stations in 2006, adding on provisions for balance of plant considerations and owner's development costs, and inflated to 2018 costs. Costs are considered to be accurate to a factor of 2. Costs for Medupi are according to the Concept Design Report, and are considered to be accurate to within 20%.
- Low NO_x Burners and/or Overfired Air: Costs are based on International Energy Agency (2006) costs, escalated for inflation, rate of exchange and Owner Development Costs. Costs are considered to be accurate to a factor of 2.
- FFPs: Costs are based on actual tender prices for an enquiry for FFP retrofits at Matla and Duvha in 2011/12. Costs are considered to be accurate to 40% for Tutuka, Matla and Duvha and to approximately a factor of 2 for other power stations.

The OPEX costs are only for flue gas desulphurisation, and are also based on costs in the EON Engineering report for the existing fleet, and on costs in the Medupi Concept Report for Medupi. Again, the OPEX costs do not include OPEX for Kusile. The main cost items are the sorbent (limestone), water, gypsum disposal, auxiliary power and maintenance costs. For the tariff impact calculation an amount of R6.3bn per annum is used.

The certainty with which Eskom presents costs depends on the stage of the project. Before concept release approval, costs are based on averages of published international data and benchmarks for similar technologies, and so are considered to be accurate to a factor of two. Once the conceptual designs have been done, costs are generally accurate to within 50%. Once the detailed designs are completed, costs are considered to be accurate to within 20%. Once the contracts have been placed, costs are considered to be accurate to within 10%. There is only complete certainty about the costs once the contract has been completed.

5.5.2 Electricity Tariff Implications

The electricity tariff is the mechanism through which the cost of producing electricity is recovered from the consumers thereof. The cost of compliance with the MES would be part of the inherent cost of production of electricity in future. Eskom has estimated that full compliance with the MES by 2020 would require the electricity tariff to be on average between 7 and 10% higher than what it would be in the absence of the emission abatement retrofits, over a 20-year period. The different between the base tariff and the tariff including the costs of MES compliance would be slightly higher (than the mentioned average) in the earlier years and slightly lower than the mentioned average in the later years. The implications for the tariff are of course dependent on when the emission abatement retrofits are installed, and what assumptions are used for interest and inflation rates and future base electricity tariffs.

This tariff calculation is based on the following assumptions:

- The CAPEX and OPEX costs are the mid-point amounts as provided above.
- The CAPEX costs are incurred in 2020, and fully implemented over a period of up to six years (with a shorter period resulting in the higher %, in the range mentioned above).
- The average remaining power station life is 20 years, thus the CAPEX costs for the retrofits are depreciated over a 20-year period.
- The inflation rate is 6%.
- Nominal pre-tax cost of capital is 14%.
- Cost-reflective electricity tariffs are reached within five years after the Multi Year Pricing Determination 4 (MYPD4) electricity tariff agreement (from 2018-20).

The electricity tariff is applied for by Eskom, but decided on by the National Electricity Regulator of South Africa (NERSA). Eskom has included the CAPEX required to cover the proposed emission reduction plan with an estimated cost of R 67 billion over the next 10 years, it is covered in the MYPD4 application (for costs over the next 3 years). If there is a requirement for additional retrofits based on the DEA response to this application, these costs would need to be provided for through the tariff (i.e. opex recovered annually, capex recovered over the operational life of the assets), failing which Eskom's financial health will further deteriorate and the ability to raise funding for these projects would be limited. The original assumptions are still at risk. The price increase of 15% per annum was not approved by NERSA and Eskom will need to further prioritise its operations including assessing the Emission Reduction Plan and seek further support to its balance sheet. In addition, Eskom has not reached a level where it is recovering its efficient and prudent costs (even at the end of the MYPD 4 period if the 15% increase is approved).

5.5.3 Cost Benefit Analysis

The basis of the assessments of the impact of power stations emissions on human health and the environment is a comparison of the measured and predicted air quality concentrations with the NAAQS. Stakeholders have argued correctly that the NAAQS cannot be interpreted to imply no health risk at all but the counter argument is that the NAAQS express a 'permissible' level of risk. To manage air quality to a point that it is completely free of risk is to invoke such significant financial and non-financial costs that those costs will in themselves result in severe potential economic and social consequences. In these terms it is necessary to present here some perspectives on the cost-benefit of full MES compliance.

In the 2017 National Air Quality Framework for Air Quality Management provision is made for suspensions and alternative emission limits due to the potential economic implications of emission standards on existing plant. The provision is provided because a sector specific Cost Benefit Analysis (CBA) was not completed prior to setting standards. Eskom commissioned a health impact focussed CBA to support the decision making process for this application. The aim of the CBA was to determine the health costs associated with current emissions, health benefits associated with compliance to the new MES, and the direct and indirect costs of compliance under the scenarios tested. The CBA followed the approach recommended by the World Health Organisation (WHO) and it used input (exposure response functions) provided by the South African Medical Research Council (SAMRC).

Health benefits associated with each scenario were calculated against the baseline that assumed no new abatement technologies would be installed, and all plants would continue to emit air pollution at their current rates until decommissioning. Scenario costs were calculated using Eskom's estimates of abatement technology capital and operational spending requirements.

Scenarios were then compared in a cost-benefit analysis with a cost:benefit ratio, in terms of which a number greater than 1 indicates that the costs outweigh the benefits, and a number less than 1 indicates that the benefits outweigh the costs. The CBA ratios need to be interpreted with care. They are meant only to provide a perspective on and inform the decision-making process underlying the scenarios. It is further to be noted that the cost benefit ratios were assessed using different discount rates (8.4%, 1% and -1%) and the order of the scenarios as measured by cost benefit ratio remained the same for all discount rates.

Table 2: Cost and benefits NPV estimates for each scenario and cost:benefit range

	FC (S1)		**ERP (S2)**		**ERP+FGD (S3)**		**ERP+ED (S4)**	
Million Rands	*lower*	*upper*	*lower*	*Upper*	*lower*	*upper*	*lower*	*upper*
NPV of Costs	-43 369	-65 053	-16 923	-25 385	-21 205	-31 808	-16 923	-25 385
NPV of benefits	2 403	21 625	1 962	17 661	2 252	20 264	3 374	30 367
NPV of Benefits minus Costs	-40 966	-43 428	-14 961	-7 724	-18 954	-11 544	-13 549	4 982
Cost:Benefit Ratio *(range)*	18.0	3.0	8.6	1.4	9.4	1.6	5.0	0.8
Cost:Benefit Ratio *(central)*	4.5		2.2		2.4		1.3	

The modelling shows the early decommissioning of the coal-fired power stations assessed in S4 ERP+ED (implementation of the ERP and early decommissioning of Grootvlei, Hendrina and Komati), would have a significantly larger beneficial effect on health costs than abatement technologies alone. This plays a large role in positioning Scenario 4 as the most beneficial scenario, both in terms of largest health cost benefits, lowest cost of abatement, as well as relative cost:benefit ratio.

While S1 FC (full compliance to the MES) would eventually have the second most absolute benefits (after S4 ERP+ED), the uncertainty of the effectiveness of actual emission reduction (even if Eskom complies with the MES ambient concentrations will remain high due the significance of other sources) as well as the long implementation timeframe mean that NPV of benefits values are reduced.

Implementation of the Eskom Emission Reduction Plan (S2 – ERP) is shown to be more beneficial from a cost benefit perspective than implementation of the ERP with the addition of FGD at Kendal (S3) and full compliance to the MES (S1).

In addition it should be noted that increased implementation of the PM reduction technology will inflate the cost of electricity, making it more unaffordable to poor communities who are typically exposed to elevated PM10 concentrations thereby curtailing access to one of the most potentially effective means of mitigating the current health risk.

In respect of SO2 emissions the cost-benefit is more difficult to qualify. Although the risk of non-compliance with the NAAQS is generally low, stakeholders have presented that it is 'unacceptable to allow the continued emissions of large quantities of SO2'. In principle this comment is accepted but again the argument is one of weighing up both the financial and non-financial costs of reducing those emissions. The argument has already been made that the water use implications of SO2 control are untenable and that the cost benefit ratio does not support FGD as the best option to reduce the impact on health.

No argument is presented anywhere in these applications that reducing atmospheric emissions is not required. The argument is simply one of ensuring that emissions reductions are carefully planned and phased so that the associated cost-benefit is positive. A key consideration is that half of the existing Eskom power stations will be shut down and decommissioned in the next 10 – 15 years significantly reducing the emissions. The planned offset project which will reduce low level emissions in communities in the vicinity of Eskom power station has not been studied long enough to conclusively provide cost benefit. However initial assessment indicates a significant reduction in exposure to indoor air pollution. In cases where solid fuel stoves are removed and replaced with LPG equipment (and in the absence of regression), the particulate matter emissions are avoided completely. Focussing on coal only and taking the annualised coal use of 1206kg per household (control group mean, 2016) – the resulting PM emissions that can be avoided are 14.48kg of PM2.5 per year per household and 15.57kg of PM10 per year per household.

5.6 Project Delays

Emission retrofit of the type being planned require years of planning, which precede a lengthy installation process, as well as substantial capital funding and power station down-time. The planning process involves Eskom internal processes that allow for technology concept and -design approval after which significant funds need to be allocated to the project. Being a state owned entity, government approval for projects of such a nature is also required which lead to the additional project development time-lines. Contracts to commence the project are only put in place once carefully regulated commercial processes have been completed.

Over and above the aforementioned milestones, the actual commencement of the installation of the abatement technology at a unit needs to be carefully scheduled to fit into a six-month unit outage time, which is usually planned alternatingly for each unit (i.e. one unit per year) as part of an official longer term outage schedule. Once a unit is taken down for maintenance, it is not operational, and thus does not contribute power to the grid. Unit down-time needs to take into account fleet generation capacity and can only take place, if Eskom is sure the country's energy demands can be met. Once the pollutant specific abatement technology has been installed, it takes months for the relevant technology to function optimally (optimisation period), as test-runs and assessments take place to ensure the equipment functions to its design capacity (in this case for NOx and PM to meet 'new plant' emission standards). The optimisation period for FFPs is typically 9 months and the optimisation period for LNBs can typically take up to a year, emphasising that abatement technology installation completion does not automatically signify immediate full compliance but an immediate reduction in emissions is realised.

6 PUBLIC PARTICIPATION

The requirement that the public participation process for an application for postponement from the MES follow the process specified in the NEMA Environmental Impact Assessment (EIA) Regulations. Eskom supports and aligns its public participation process with the requirements as stipulated within the NEMA EIA Regulations. The public participation process followed for this postponement application has increased the number of public meetings to include communities in the vicinity of the power stations, in the case of Komati meetings were held in Kwazamokuhle and Hendrina. With regards to this once off suspension and alternative emission limits application, the public participation process undertaken meets the requirements of Section 46 of NEMAQA. For details pertaining to the public participation process, the reader is referred to Annexure D of this Application.

7 EMISSION OFFSETS

Eskom is willing to implement emission offsets in areas where power stations impact significantly on ambient air quality, and where there is non-compliance with ambient air quality standards as a condition of granted postponement. Eskom is of the view that in many cases household emission offsets are a more effective way of reducing human exposure to harmful levels of air pollution, than is retrofitting power stations with emission abatement technology. Emission retrofits at power stations also increase the cost of electricity, which may make electricity unaffordable for more people, resulting in an increase in the domestic use of fuels and deterioration in air quality in low income areas.

Eskom has undertaken several feasibility and pilot studies (2011 – 2018) in KwaZamokuhle, a township near Hendrina Power Station to identify and test potential offset interventions. Based on the results of the studies conducted to date, it was concluded that ambient air quality in the affected communities could be improved by replacing household's coal stoves with a hybrid gas electricity stoves and a LPG heater together with retrofitting the houses with a ceiling to insulate the houses.

The recommended Air Quality Offset intervention for the lead implementation (in KwaZamokuhle and Ezamokuhle) entails the following (Figure 1);

- Provision of a basic plus retrofit which consists of;
    - Insulation entailing installation of a SPF ceiling system and draft proofing
    - Electrical rewiring and issuance of Certificate of Competence (CoC).
- Stove swap which entails
    - Provision of electricity based energy source with LPG backup. This will include a hybrid electric gas stove, LPG heater plus 2x9 kg LPG cylinders and Compact fluorescent lamp (CFL) for energy efficiency lighting.
    - Removal and disposal of the coal stove

Figure 1: Household Intervention for Lead Implementation Sites (KwaZamokuhle and Ezamokuhle)

The lead implementation in KwaZamokuhle and Ezamokuhle is planned to commence in 2019. The large scale rollout of offset intervention is planned for 2020 to 2025 (including offset interventions for Kriel Power Station).

8 CONCLUSIONS

Eskom is committed to ensuring that it manages and operates its coal-fired power stations in such a manner that risks to the environment and human health are minimised and socio-economic benefits are maximised. The Eskom Emission Reduction Plan will lead to a reduction in total emissions from several power stations specifically particulate emissions. Further several power stations (including Komati) will be shutdown and decommissioned by 2030 reducing the total load of all emissions in each of the three air sheds applicable to these applications.

As set out in the Constitution of the Republic of South Africa, there is the need to recognise the interrelationship between the environment and development. There is a need to protect the environment, while simultaneously recognising the need for social and economic development. There is the need therefore to maintain the balance in the attainment of sustainable development.

Eskom contends that compliance with the MES at Komati is not warranted since Komati only has a short remaining life – decommissioning is scheduled to start between 2024 and 2029. The requested alternative emission limit for NO_x for Komati Power Station are highly unlikely to result in non-compliance with the NAAQS. Compliance with the MES for SO_2 will result in additional environmental impacts in terms of water demand, increases in CO_2 emissions and waste production, and significant financial costs. The financial costs of compliance with the MES will translate into an increase in the electricity tariff. If air quality is to be improved in surrounding residential areas then interventions should be geared towards limiting low-level (surface) emission sources of especially PM.

The long lead time of 12 years required to design, procure and construct a flue gas desulphurisation plant and Eskom's financial position which limits funding options, it is requested that this is considered in the decision making process. The Air Quality offset programme initiated by Eskom will continue to be implemented, based on current information Eskom believes this programme will reduce direct exposure to harmful indoor pollution and improve the quality of life.

Given that a revised National Framework for Air Quality Management and the Amendment of Listed Activities and Emission Standards were only published in October 2018 and there is a requirement to submit applications by 31 March 2019. Eskom has complied with this requirement but reserves the right to submit additional information including additional modelling scenarios which assess the closure of power stations, a high level assessment of technologies which could meet the new 1000mg/Nm^3 SO2 emission limit and any other aspects of significance.

Eskom believes given the motivation presented above in terms of its complete emission reduction plan and its implications and the specific detail in respect of Komati that the application for a once off suspension and the requested alternative emission limits are appropriate and in line with the relevant Constitutional, regulatory and policy requirements and as such the application should be approved by the NAQA.