ESKOM

APPLICATION FOR ALTERNATIVE LIMITS AND POSTPONEMENT OF THE MINIMUM EMISSIONS STANDARDS COMPLIANCE TIMEFRAMES FOR THE MAJUBA POWER STATION

DATE: November 2018

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

LIST OF ACRONYMS

AIR	Atmospheric Impact Report
AEL	Atmospheric Emission License
AQMP	Air Quality Management Plan
DEA	Department of Environmental Affairs
DOE	Department of Energy
EIA	Environmental Impact Assessment
ESP	Electrostatic Precipitator
FGC	Flue gas conditioning
FGD	Flue gas desulphurisation
GNR	Government Notice No.
HFPS	High Frequency Power Supply
IRP	Integrated Resource 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

LIST OF ANNEXURES

Annexure A Atmospheric Impact Report – Lethabo
Annexure B Summary Atmospheric Impact Report
Annexure C Health impact focussed cost benefit analysis
Annexure D Public Participation report

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 lying in coal-fired power stations. One such power station is the Majuba Power Station (hereafter referred to as "Majuba"), which lies to the south-east of Standerton in the Gert Sibande District of the Mpumalanga Province. The station is located within the Highveld Priority Area (HPA) in terms of the NEMAQA.

In terms of the Integrated Resource Plan, stations will 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 Majuba's generating units was commissioned in 2001, the power station is planned to be decommissioned between 2046 and 2051.

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 893 22 November 2013 as amended in GNR 1207 on 31 October 2018 ("GNR 1207") which was promulgated in terms of Section 21 of the NEMAQA. 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, not 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.

Majuba already achieves the 50 mg/Nm^3 PM emission limit for 'new plant'. It also complies with the 3500 mg/Nm^3 'existing plant' limit for Sulphur dioxide (SO_2). Eskom's Majuba Power Station will, however, not be able to comply with either the 'new plant' MES for SO_2, nor will it be able to comply with the 'existing plant' or the 'new plant' MES for Nitrogen dioxide. Majuba will be retrofitting technology which will enable compliance with the 'new plant' NO_x standard by April 2026. However, due to water resource, financial and electricity supply capacity constraints (presented in more detail in this document and supporting Annexures), Majuba Power Station will not be able to comply with the 'new plant' MES limits for SO_2 As such, Eskom with this Application is applying in terms of GNR 1207 for an alternative limit for NO_x until the retrofit is complete and is requesting a postponement and alternative emission limits for SO_2. The alternate limits are achievable but less stringent than the new plant standards.

The purpose of this document is to present an application for postponement from specific MES compliance timeframes and propose alternative limits for Majuba 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 it's influence on Eskom's emissions. Based on this the proposed emission limits to which Majuba could be held and which could then be included in the Atmospheric Emission Licence (AEL) are proposed. The legal basis for applying for postponement 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, postponement and/or alternative limits are presented.

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 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 limit 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 a pilot studies which will confirm the appropriate technology for Matimba and Kendal

Currently the Integrated Resource Plan is based on a 50-year life for all power stations however the actual shut down and decommissioning dates of power stations are determined based on economic, supply and demand side criteria. In 2017/18 11 units at Eskom's most costly and oldest plants namely Grootvlei, Hendrina and Komati were shut down for reserve storage. Based on the current electricity demand these three power stations will be shut down and later decommissioned by 2025. Further, Arnot, Camden, and Kriel will be decommissioned by 2030. The shutting down of these power plants will reduce the cumulative pollution in the three airsheds, some reduction has already materialised due to the 11 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, and 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 will also result in a substantial decrease in Eskom's emissions over time, for example it is projected that compared to a 2020 baseline that 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 have 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

Majuba Power Station, which lies to the south-east of Standerton in the Gert Sibande District of the Mpumalanga Province has an installed capacity of 3795MW.

The current limits listed in Table 3 are as in Majuba's AEL (ref: Dr PKI Seme/Eskom H SOC Ltd/MPS/0014/2014/F02). The alternative emission limits that are requested for Majuba during normal operating conditions are:

Table 1: Current and Requested Emission Limits for Majuba

<table>
<tr><th rowspan="2"></th><th colspan="3">Current Limit
(from AEL)</th><th colspan="3">Requested Emission Limits*</th></tr>
<tr><th>Limit value</th><th>Averaging period</th><th>Date to be achieved by</th><th>Limit value</th><th>Averaging period</th><th>Date to be achieved by</th></tr>
<tr><td>Particulate Matter</td><td>100</td><td>Daily</td><td>1 April 2015</td><td>50</td><td>Daily</td><td>1 April 2020</td></tr>
<tr><td rowspan="2">Sulphur Dioxide</td><td rowspan="2">3500</td><td rowspan="2">Daily</td><td rowspan="2">1 April 2015</td><td>3500</td><td>Daily</td><td>1 April 2020</td></tr>
<tr><td>3000</td><td>Daily</td><td>1 April 2025</td></tr>
<tr><td rowspan="2">Nitrogen Oxides</td><td rowspan="2">1500</td><td rowspan="2">Daily</td><td rowspan="2">1 April 2015-31 March 2020</td><td>1400</td><td>Monthly</td><td>1 April 2020</td></tr>
<tr><td>750</td><td>Daily</td><td>1 April 2026 until decommissioning</td></tr>
</table>

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

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

In summary the postponement for Majuba requested is:

1. Postponement of the SO_2 new plant MES and an alternative limit of 3000 mg/Nm^3 from 2025 onwards
2. An alternative limit of 1400 mg/Nm^3 monthly for NO_x until 2026 (completion of low NO_x retrofit) and compliance to the new plant standard from there onwards.

No postponement for the PM standards is requested.

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 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 afore mentioned Act.

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. While Eskom and the independent consultants appointed to complete the AIR will make 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 postponement application. The variation request is prepared based on the assumption that the requested MES postponement is granted by the NAQO. If the NAQO decision is substantially different from the requested postponement, Eskom reserves its right to amend its variation request.

5 REASONS FOR APPLYING FOR POSTPONEMENT

As mentioned above, the Application for postponement must be accompanied by reasons. Such reasons are set out below and include the fact that emissions from Majuba will not result in non-compliance with National Ambient Air Quality Standards (NAAQS), project delays and 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 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 prevents compliance) but rather all in combination. Before presenting these various reasons, the reader is referred to Annexure A, in which various information is presented on the Majuba Power Station.

5.1 Remaining Power Station Life

Majuba is currently scheduled to be decommissioned between 2046 and 2051, according to the Integrated Resource Plan which plans for a 50 year life for Eskom coal fired power stations.

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 operation of FGD would only commence from 2032, while this provides sufficient time given Majuba's planned life other considerations such as ambient air quality and financial constraint indicate that it is not financially viable to retrofit Majuba with FGD.

5.2 Water Availability

Water is an extremely limited resource in South Africa and it is argued that the implementation of FGD at Majuba is not an appropriate decision for a water scarce country. Majuba Power Station being a half wet-cooled and half dry cooled power station, means that it uses large quantities of water albeit less than a wet cooled power station.

Both wet and semi-dry FGD are critically dependant on large quantities of water being available at the power stations where FGD is deployed. Recent investigations undertaken for Medupi indicate that the implementation of FGD will increase its water requirement to up to 9 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). Retrofitting Majuba will require an additional 9 Mm^3/annum.

The water demands of FGD are thus significant across the power stations and will increase Eskom's water demand by some 58.7 million m^3/annum – a 20% increase in the combined water consumption of Eskom's power stations[1].

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 now being 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 Oct. 2025 when it will get reviewed). Some of Eskom's older power stations are

[1] **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 flee, excluding the stations to be decommissioned by 2030. The October amendment of the MES for SO_2 new plant to 1000 mg/Nm^3 will required a revision of technology choices. .*

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 whom 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, it is 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 98% of South Africa's available water has already been allocated.

5.3 Environmental Implications of FGD

FGD is not without negative environmental consequences:

- Up to almost 622 000 tons of sorbent (limestone) per annum is required to operate the FGD. 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 1 000 000 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 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).
- Majuba is expected to produce an additional approximately 374 000 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 Majuba 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%.[2]

5.4 Impact on Ambient Air Quality

The impact of Majuba's emissions on ambient air quality has been comprehensively assessed in the accompanying independently compiled Atmospheric Impact Report (Annexure A). An analysis of ambient air quality data from the Majuba ambient air quality monitoring station indicates general compliance for all pollutants for all averaging periods. For actual emissions of SO_2 and NO_X at Majuba Power Station the predicted annual average secondary particulate concentration is low and significantly less than the national ambient $PM_{2.5}$ standard of 20 µg/m^3. Diurnal hourly averages exhibit pronounced morning and late afternoon peaks for PM_{10}, $PM_{2.5}$ and NO_2, with an approximate midday peak of SO_2 indicating the important contribution of ground level sources such as domestic fuel use to the peak values measured.

[2] CO_2 volumes to be confirmed

5.4.1 Sulphur Dioxide

An analysis of ambient SO_2 concentrations measured at the Majuba monitoring station (situated of Majuba Power Station), indicates compliance with the hourly, daily and annual average NAAQS for SO_2. The data integrity at this monitoring station is of concern specifically for 2015 but in 2016 & 17 the data recovery was above 70%. Dispersion modelling reveals that predicted SO_2 concentrations resulting from current emissions from Majuba Power Station are significantly below and in compliance with the NAAQS.

5.4.2 Particulate Matter (PM)

Ambient PM measured at Majuba monitoring station indicates compliance with hourly, daily and annual NAAQS. Current and future PM emissions from the power stations contribute only marginally to the measured ambient concentrations.

5.4.3 Nitrogen dioxide

Ambient NO_2 measurements at all monitoring stations are in compliance with the NAAQS.
For actual NO_X emissions at Majuba Power Station the predicted annual average NO_2 concentration is significantly less than the national ambient NO_2 NAAQS.

5.4.4 The Highveld Priority Area

Eskom is aware that Majuba is situated within the Highveld Priority Area and is, as such making a substantial financial investment into reducing emissions from Majuba's operations, through the installation of low NOx burners.

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 Kendal 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. These financial costs must be considered in context of Eskom's current financial position which limits Eskom's ability to raise funding for new projects requiring significant CAPEX and increased maintenance costs. This financial position is expected to prevail for several years. Indeed raising the funding for Medupi FGD has proved to be difficult and is still in the process of being finalised.

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 2018 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 Majuba would require a FGD retrofit, which is the only way of consistently achieving the new plant SO_2 emission limit, in excess of R17.3 billion and a LNB retrofit estimated to be around R2.4 billion.

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 Multi Year Price Determination 3

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 5 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, failing which Eskom's financial health will further deteriorate and the ability to raise funding for these projects would be limited. The original assumptions however, are still at risk. If the price increase of 15% per annum is not approved by NERSA, Eskom would need to further prioritise its operations 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 Majuba's emissions on human health and the environment is a comparison of the measured and predicted air quality concentrations with the NAAQS. The monitored and modelled scenarios reflect compliance with NAAQS and levels well below the standards. 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.

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 CBA was not completed prior to setting standards. Eskom commissioned a CBA to support the decision making process for this application (Annexure C).

The aim of the CBA study was to determine the health costs associated with current emissions, health benefits associated with compliance to the new Minimum Emission Standards, and the direct and indirect costs of compliance. The baseline scenario to determine the cost to health assumed no new abatement technologies would be installed, resulting in relative emissions being constant for each power plant.

The model estimated the increased exposure as a result of Eskom's emissions from the 13 power stations in 2018 would result in an additional 320 cases of premature mortality (assuming no new abatement technology implemented). This increased exposure is estimated to result in an additional 320 cases premature mortality attributed to air pollution from the 13 power stations in 2018. To translate these health outcomes (cases of mortality) to a health cost, a Value of a Statistical Life of R53 million was attributed to each mortality, resulting in a R17.6 billion baseline health cost in 2018.

The outcomes of the analysis is that scenario 2, Eskom's proposed reduction plan and scenario 4, Eskom's proposed reduction plan plus decommissioning of Komati, Grootvlei and Hendrina had the best cost to benefit ratios with costs 1.8 and 1.3 times higher than the benefits. The full compliance option which would have most power stations retrofitted had the worst cost benefit ratio of costs 5.3 times higher than the benefits. The

Eskom reduction plan with the addition of Kendal and Matimba FGD reflected costs 2.2 times higher than benefits.

In respect of SO_2 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 SO_2'. 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 SO_2 control are untenable and that the cost benefit ratio does not support FGD as the best option to reduce the impact on health. Majuba power station is sited outside of the more polluted airshed and as can be seen by monitored and modelled data there is full compliance with NAAQS.

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

5.6 Project Delays

The process to implement projects such as the emission retrofit projects is complex and there is a continual risk of delays affecting planned project completion dates. Notwithstanding implementing controls to reduce project delays such as high level project oversight and attempts to fast track commercial processes the Majuba low NOx projects have been subject to approximately a 12 month delay which has contributed in the need to request the proposed extended postponement for the last two units

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 Majuba meetings took place in Amersfoort With regards to the AEL variation request to be submitted, 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 an approved 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 a 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 earlier in 2019. The large scale rollout of offset intervention is planned for 2019 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. 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.

The Eskom Emission Reduction Plan will lead to a reduction in total emissions from several power stations specifically particulate emissions. Further several power stations will be decommissioned by 2030 reducing the total load of all emissions in each of the three air sheds applicable to this year's application.

The impact of Majuba's emissions on ambient air quality has been comprehensively assessed. Monitored and data from the Majuba ambient air quality monitoring station indicates general compliance for all pollutants for all averaging periods, the predicted annual average secondary particulate concentration is low and significantly less than the national ambient $PM_{2.5}$ standard. Given this limited impact of Majuba on ambient air quality together with 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 not deemed beneficial to retrofit Majuba with FGD.

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 and there is a requirement to submit applications by 31 March 2019, Eskom will comply with this 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 SO_2 emission limit and any other aspects of significance.

Eskom believes given the motivation presented above in terms of it's complete emission reduction plan and it's implications and the specific detail in respect of Majuba that the application for the requested alternate limits are appropriate and in line with the relevant regulatory and policy requirements and as such the Application should be approved by the NAQO.