ESKOM

APPLICATION FOR POSTPONEMENT OF THE MINIMUM EMISSIONS STANDARDS COMPLIANCE TIMEFRAMES FOR THE DUVHA 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
ESP	Electrostatic Precipitator
FGD	Flue gas desulphurisation
GNR	Government Notice No.
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

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 Duvha Power Station (hereafter referred to as "Duvha"), which lies to the south east of Emalahleni in the Nkangala District of the Mpumalanga Province. The last of Duvha's generating units was commissioned in 1984. Duvha is a wet-cooled coal-fired power station in Eskom's fleet.

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 on 22 November 2013 ("GNR 893") which was promulgated in terms of Section 21 of the NEMAQA. GNR 893 provides for transitional arrangements in respect of the requirement for existing plants to meet the MES and provides that less stringent limits must be achieved by existing plants by 1 April 2015, and the more stringent 'new plant' limits must be achieved by existing plants by 1 April 2020. Duvha (U1-3) already achieves the 50 mg/Nm^3 PM_{10} emission limit (MES for 'new plant'). Duvha (U4-6) do not currently comply too the 'existing plant' MES for PM_{10} emissions, however compliance with the 'new plant' MES will be achieved through Fabric Filter Plant (FFP) retrofits by 2024. Duvha also already achieves the 1100 mg/Nm^3 Nitrogen oxides (NO_x) limit (MES for 'existing plant'), and the 3500 mg/Nm^3 SO_2 MES for 'existing plant.' However, due to water resource, financial and electricity supply capacity constraints (presented in more detail in this document and supporting Annexures), Eskom's Duvha Power Station will not be able to comply with either the 'new plant' MES for SO_2 nor will it be able to comply with the 'new plant' MES for NO_x (Table 1).

Table 1: Minimum Emission Standards for Category 1: Combustion Installations, sub-category 1,1: Solid Fuel Combustion Installations, for which Eskom is applying for postponement for the Duvha Power Station.

Description:	Solid fuels combustion installations used primarily for steam raising or electricity generation.		
Application:	All installations with design capacity equal to or greater than 50 MW heat input per unit, based on the lower calorific value of the fuel used		
Substance or mixture of substances		**Plant status**	**mg/Nm^3 under normal conditions of 10% 0_2, 273 Kelvin and 101,3 kPa.**
Common name	**Chemical symbol**		
Particulate Matter*	N/A	New	50
		Existing	100
Sulphur dioxide	SO_2	New	500
Nitrogen oxides	NOx	New	750

** Only relevant to Duvha Units 4-6*

The purpose of this document is to present an application for postponement from specific MES compliance timeframes for Duvha (Table 1). The document has been structured to present firstly Eskom's atmospheric emissions reduction plan, then to propose requested emission limits to which Duvha could be held and which could then be included in the Atmospheric Emission Licence (AEL). The legal basis for applying for postponement is then presented, including the requirements that must be met in making such an Application. Finally, the reasons for the Application for postponement 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) to comply fully with the MES by the 2015 and 2020 timeframes stipulated. This is elaborated on in the sections below. As a result, Eskom prefers to adopt a phased and prioritised approach to compliance with the MES. 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 achieve the SO_2 new plant limit immediately once commissioned, and flue gas desulphurisation will be retrofitted at Medupi 6 years after each unit is commissioned, so that the new plant SO_2 limit will also be achieved at Medupi over time.

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

- Particulate Matter emission reduction: Fabric Filter Plant (FFP) retrofits at Grootvlei Units 2-4; Tutuka, Kriel, Matla and Duvha Units 4-6;
- NO_x emission reduction: Low NO_x burner (LNB) retrofits at Matla, Majuba, Tutuka; and,
- SO_2 emission reduction: Flue gas desulphurisation (FGD) retrofit at Medupi.

The planned retrofit schedule is depicted in Figure 1. The decommissioning dates for a 50-year and a 60-year power station life are shaded grey. Currently the Integrated Resource Plan is based on a 50-year life for all power stations, but there is a possibility that the life of some of the power stations could be extended to 60 years. 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, 3 of the 6 units at Duvha, Matla, Kriel, Tutuka, Komati, and 3 of the 6 units at Grootvlei. 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, 3 units at Duvha, 3 units at Grootvlei, Medupi, Kusile;
- Boilers with low NOx design at Kendal and Matimba;
- Low NO_x Burners (LNBs) at Medupi, Kusile, Ankerlig, Gourikwa; and,
- Flue gas desulphurisation (FGD) at Kusile.

The proposed retrofits will reduce emissions of relative PM by 67% between now and 2027; relative NO_x by 25% between 2019 and 2025 and relative SO_2 by 30% between 2021 and 2027 (assuming that Medupi and Kusile are fully operational, as they will be once all these retrofits have been realised, and that power station decommissioning starts according to the 50-year life plan; Figure 2 to Figure 4).

		Years															Decommissioning dates	
	Retrofits	**15/16**	**16/17**	**17/18**	**18/19**	**19/20**	**20/21**	**21/22**	**22/23**	**23/24**	**24/25**	**25/26**	**26/27**	**27/28**	**28/29**	**29/30**	**50-year life**	**60-year life**
Medupi	FGD																2064-	2074-
Majuba	LNB																2046-2051	2056-2061
Kendal	None																2038-2043	2048-2053
Matimba	None																2037-2041	2047-2051
Lethabo	None																2035-2040	2045-2050
Tutuka	FFP																2035-2040	2045-2050
	LNB																	
Duvha	FFP (U4-6)																2030-2034	2040-2044
Matla	FFP															D	2029-2033	2039-2043
	LNB															D		
Kriel	FFP												D	D	D	D	2026-2029	2036-2039
Arnot	None							D	D	D	D	D	D	D	D	D	2021-2029	2031-2035
Hendrina	None						D	D	D	D	D	D	D				2020-2026	2030-2036
Camden	None							D	D	D							2020-2023	
Grootvlei	FFP (U2-4)											D	D	D	D		2025-2028	
Komati	None										D	D	D	D	D		2024-2028	

Flue gas desulphurisation (FGD) retrofit
Low NO_x Burner (LNB) retrofits
Fabric Filter Plant (FFP) retrofits
Decommissioning dates: 50 year life and current plan for RTS

Figure 1: Planned emission abatement retrofits and power station decommissioning dates to illustrate Eskom's overall atmospheric emissions reduction plan.

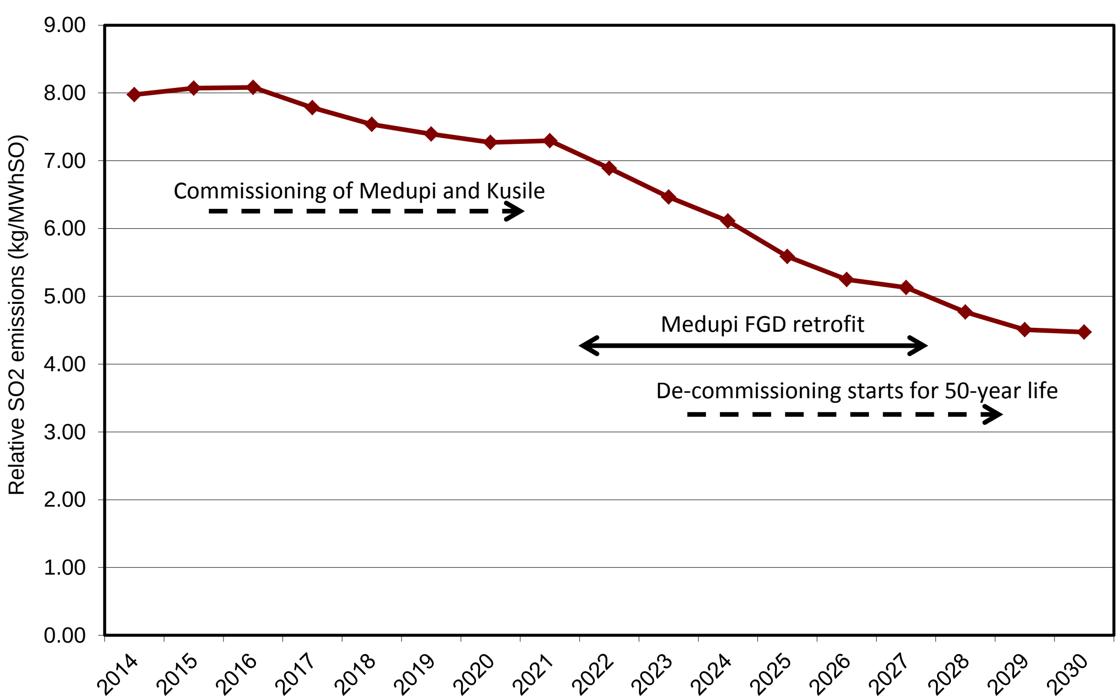

Figure 2: Planned reduction in relative SO_2 emissions

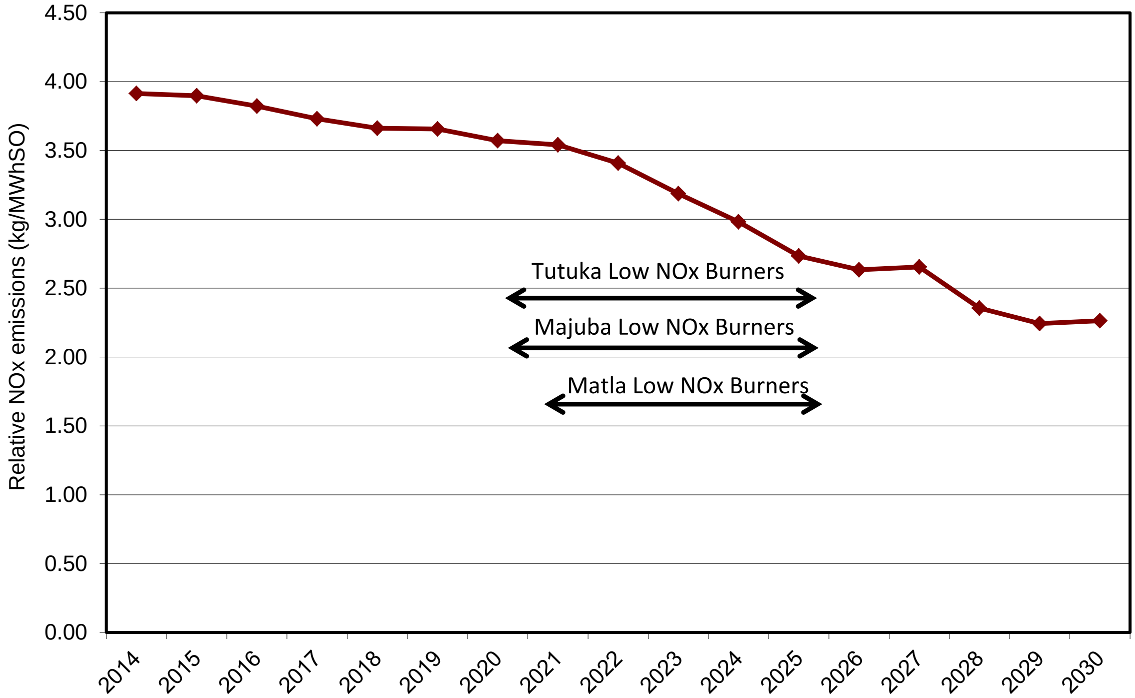

Figure 3: Planned reduction in relative NO_x emissions

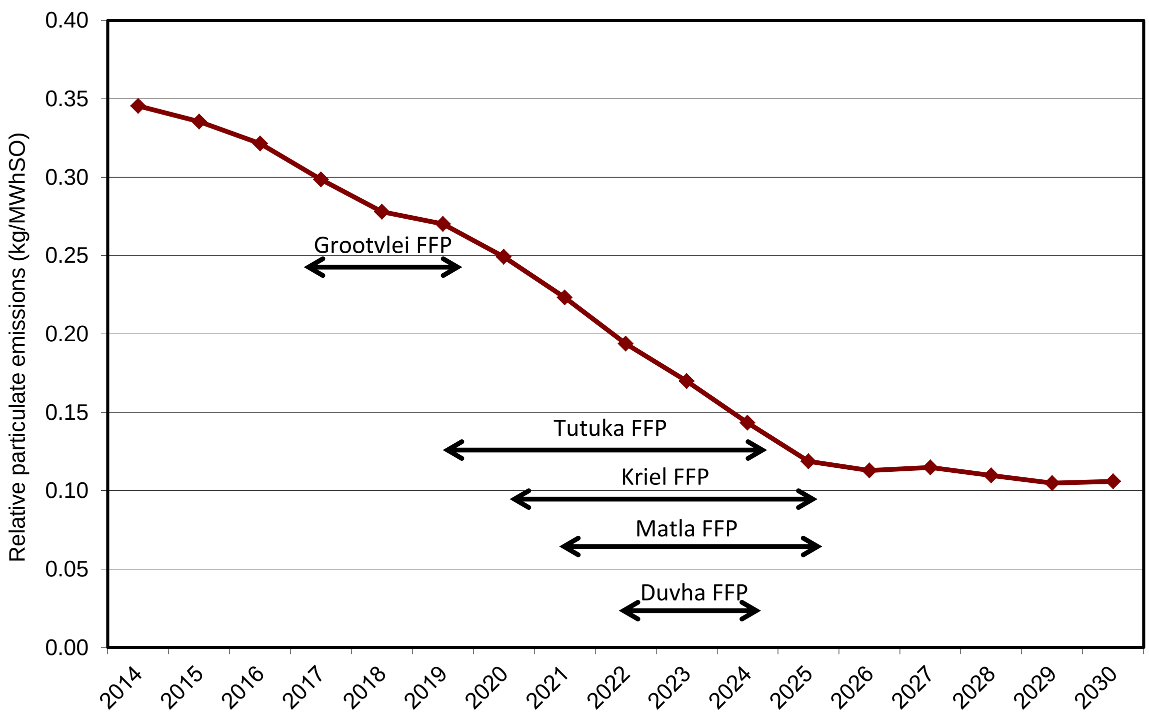

Figure 4: Planned reduction in relative Particulate Matter emissions

Table 2: Eskom's compliance with the MES before and after the implementation of their emissions reduction plan. C means 'compliant', N means 'non-compliant' and the blocks with a thick border show where compliance is achieved after the retrofitting.

	BEFORE RETROFITTING						AFTER RETROFITTING					
	Particulate Matter		Sulphur dioxide		Oxides of nitrogen		Particulate Matter		Sulphur dioxide		Oxides of nitrogen	
	2015	2020	2015	2020	2015	2020	2015	2020	2015	2020	2015	2020
Kusile	C	C	C	C	C	C	C	C	C	C	C	C
Medupi	C	C	N	N	C	C	C	C	C	C	C	C
Majuba	C	C	C	N	N	N	C	C	C	N	C	C
Kendal	C	N	C	N	C	C	C	N	C	N	C	C
Matimba	C	N	N	N	C	C	C	N	N	N	C	C
Lethabo	C	N	C	N	C	N	C	N	C	N	C	N
Tutuka	N	N	C	N	N	N	C	C	C	N	C	C
Duvha (1-3)	C	C	C	N	C	N	C	C	C	N	C	N
Duvha (4-6)	N	N	C	N	C	N	C	C	C	N	C	N
Matla	N	N	C	N	N	N	C	C	C	N	C	C
Kriel	N	N	C	N	N	N	C	C	C	N	N	N
Arnot	C	C	C	N	N	N	C	C	C	N	N	N
Hendrina	C	C	N	N	N	N	C	C	N	N	N	N
Camden	C	N	N	N	N	N	C	N	N	N	N	N
Grootvlei	N	N	N	N	N	N	C	C	N	N	N	N
Komati	C	N	C	N	N	N	C	N	C	N	N	N
Ankerlig	C	C	C	C	C	C	C	C	C	C	C	C
Gourikwa	C	C	C	C	C	C	C	C	C	C	C	C
Acacia	C	C	C	C	C	N	C	C	C	C	C	N
Port Rex	C	C	C	C	C	N	C	C	C	C	C	N

3 REQUESTED INTERIM EMISSION LIMITS

The current limits listed in Table 3 are as in Duvha's Atmospheric Emissions Licence (AEL) 17/4/AEL/MP312/11/07. The alternative emission limits that are requested for Duvha during normal operating conditions, are:

Table 3: Current and requested interim limits for Duvha.

	Current Limit (from AEL)		Requested Emission Limits*	
	Limit value	**Averaging period**	**Limit value**	**Averaging period**
Particulate Matter	Unit 1-3: 100 Unit 4-6: 200	Daily	**Present to 1 April 2015:** Unit 1-3: 100 mg/Nm^3 ; Unit 4-6: 200 mg/Nm^3 **1 April 20154 to 1 April 2024:** Unit 1-3: 50 mg/Nm^3 ; Unit 4-6: 200 mg/Nm^3 **1 April 2024 onwards:** Unit 1-3: 50 mg/Nm^3 ; Unit 4-6: 50 mg/Nm^3	Daily
Sulphur dioxide	4000	Monthly	2600	Daily
Nitrogen oxides	1700	Monthly	1100	Daily

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

The requested SO_2 and NO_x emission limits were derived from gaseous spot measurements that were conducted at Eskom's power stations in 2011. In order to account for the variability that occurs in emission levels as a result of varying coal qualities and changing operating conditions, the requested SO_2 limit was calculated by adding 40% to the measured SO_2 concentration, and the requested NO_x limit was calculated by adding 30% to the measured NO_x concentration. The spot measurements were collected when the power station units were running at full load. Particulate emissions are currently monitored continuously at all units on all power stations, and so there is more certainty as to what limit can be complied with. The requested PM limit is usually at least 40% higher, but can be up to three times higher, than average PM emissions, due to fluctuations in the operation of the abatement technology and the operating conditions of the power stations.

It is requested that the proposed alternative limits only apply during normal working conditions, and not during start-up or shut-down periods. In addition, it is requested that the particulate emission limit does not apply for 10% of the days in the year, managed cumulatively on a station basis, to allow for on-line maintenance. Many of Eskom's power stations are at or beyond their mid-life, and so require a lot of maintenance. Often emission levels are higher when maintenance is conducted or due to process variability. Given the constrained electricity system, it is usually not possible to take the units on outage to perform the required maintenance. Moreover, if the proposed alternative emissions limits are made to apply for 100% of the time, too much redundancy has to be built into the power station which is simply not cost-effective or practicable.

Typical conditions which may result in particulate emissions being higher include:

- Coal quality variability, for example if a seam with poor quality coal is mined, or if a poor quality batch of input coal is received
- Dust handling plant breakdowns. The coal received by many power stations is getting progressively worse, so the burden of the ash to be removed by the dust handling plant is getting higher, resulting in the dust handling plant being over-loaded. In addition, insufficient opportunity for outages means that the

dust handling plants cannot be properly maintained, so the plants lose the redundancy and margins that they were originally designed for.

- Bag filter maintenance: on-load repair of leaking bags, or routine bag replacements. Load losses are taken during on-load rebags, but there is dust in the ducts as a result of the rebag, and so emissions are higher for a day or two after the rebag.
- Premature fabric filter bag failures as a result of full hoppers, due to the dust handling plant problems described above.
- Electrostatic precipitators can be damaged because of high hopper levels as a result of the dust handling plant problems explained above. An outage is required to repair the electrostatic precipitators.
- SO_3 plant trips. A problem on the common plant (the sulphur storage and transfer system) affects 3-6 units at a power station, while a problem on the unitised SO_3 skid only affects one unit. Potential problems on the common plant include no supply of sulphur (due to a refinery or transport strike); a problem with the auxiliary steam supply resulting in the sulphur solidifying; and leaks on the sulphur storage tanks or the sulphur distribution system. Problems experienced on the SO_3 skid include problems with sulphur control and leaks; process air is blocked or dirty or the compressor is not working; converter catalyst blockages result in reduced efficiency of the SO_3 plant; or lance blockages result in sulphur distribution problems in the duct.
- Low back-end temperatures, as can occur in winter when ambient temperatures are low, or there is reduced load, result in the back-end going into acid dew point, and so SO3 injection is stopped to prevent acidic condensation. This results in elevated emissions.
- SO_3 plant scheduled maintenance and refurbishment.
- SO_3 plant electrical breakdowns of heaters, motors and switchgear.
- A unit running at low load on oil support due to a draught group failure, coal supply problems, tube leaks, mill plant problems or dust handling plant problems. Oil support firing is used when the load drops too low or there is poor coal quality, to support combustion and prevent explosions (this is a legal requirement). The SO_3 plant usually trips at low load because the temperature drops too low.
- Tube leaks result in increased moisture in the flue gas, which make the ash sticky and difficult to remove.

4 LEGAL BASIS FOR DECISION-MAKING

4.1 Overview

Eskom had initially planned to apply for exemption from the ‘new plant’ MES for SO_2 and NO_x for Duvha, since Eskom does not intend to retrofit additional SO_2 and NO_x abatement technology to Duvha. With regards to the PM emissions, Eskom has initially planned to apply for exemption from the ‘existing plant’ MES for PM_{10} for Duvha’s Units 4-6, as the planned FFP retrofits will only achieve compliance with the ‘new plant’ MES for PM_{10} by 2024. During the stakeholder engagement process, stakeholders questioned why Eskom was applying for exemption and not for postponement, on the basis that postponement appears to be, legally, the clearer option. After due consideration and further engagement with the authorities, Eskom has decided to in fact pursue that route and will only be applying for postponement. It must be recognised though that the decision to only apply for postponement is based on the understanding that multiple postponements will indeed be possible.

4.2 Regulatory requirements

In terms of Section 14(1) of the NEMAQA, the Minister of Water and Environmental Affairs ("Minister") must designate an officer in the Department of Environmental Affairs (DEA) as the National Air Quality Officer. In this regard, Dr Thulie Mdluli 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 (11)(a) – (c) of GNR 893 of 22 November 2013 (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 NEMA Environmental Impact Assessment (EIA) Regulations.

In respect of these requirements we have attached –

1. As Annexure C, a copy of the AIR prepared in respect of Duvha. The AIR provides, *inter alia*, an assessment of how ambient air quality is likely to be affected by Duvha's requested emission limits by utilising, *inter alia*, atmospheric dispersion modelling;
2. Detailed justifications and reasons for the Application (see Section 3.2 below); and,
3. A comprehensive report on the public participation process followed, and associated documentation (Annexure D).

As provided for in Section 46 of the NEMAQA Eskom will also submit a request for variation of the AEL to the Licencing Authority, which in the case of Duvha is the Mpumalanga Department of Economic Development, Environment and Tourism (MDEDET).

5 REASONS FOR APPLYING FOR POSTPONEMENT

As mentioned above, the Application must be accompanied by reasons. Such reasons are set out below and include the fact that emissions from Duvha should not result in non-compliance with National Ambient Air Quality Standards (NAAQS) (the requested emission limit for SO_2 will contribute to the continued non-compliance with ambient SO_2 standards at the Witbank monitoring stations, although Duvha is believed to only contribute 15% to the measured concentrations), 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.

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 Duvha Power Station, and then to Annexure B in which the technology options available to Eskom for compliance with the MES are detailed.

5.1 Water availability

Both wet and semi-dry FGD are critically dependant on the availability of large quantities of water being available at the power stations where FGD is deployed. The reader is referred to Annexure F, which is an independently prepared summary of the availability of water in the various catchments and sub-catchments in which the coal-fired powers stations operate. The reader is reminded that the water demands of FGD increase the water required by a wet-cooled power station like Duvha by some 120% (around 39 million m^3/annum without FGD, to more than 46 million cubic metres per annum with wet FGD). The Duvha Power Station is a wet-cooled power station, which means that it already uses some 3 times the quantity of water that it does of coal. The effect of FGD will exacerbate this water consumption. There is currently no additional water available to operate FGD at Eskom's power stations. Additional water will only become available when the second phase of the Lesotho Highlands project has been completed, which is currently scheduled for 2021. 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. More than 98% of South Africa's available water has already been allocated.

5.2 Environmental implications of FGD

FGD is not without negative environmental consequences:

- Up to almost 510 000 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 900 000 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).
- Duvha is expected to produce an additional approximately 220 000 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 Duvha 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%.

5.3 Impact on ambient air quality

Eskom established an ambient air quality monitoring station at Komati in 2006, 17 km southeast of the Duvha Power Station, measuring, amongst others, ambient SO_2, NO_2 and PM_{10} concentrations and meteorological parameters. The DEA established ambient air quality monitoring stations in Middleburg and Witbank. Ambient data for the three year period 2010, 2011 and 2012 at the Komati, Middleburg and Witbank monitoring stations provides some indication of ambient air quality in the area and of the sources that influence air quality at the site. The impact of Duvha's emissions on ambient air quality has been comprehensively assessed in the accompanying independently compiled Atmospheric Impact Report.

5.3.1 Sulphur dioxide

An analysis of ambient SO_2 concentrations measured at the Komati monitoring station situated 17 km south-east of Duvha indicates compliance with the hourly, daily and annual average NAAQS for SO_2, but SO_2 concentrations are elevated above background levels. In similar vein compliance with the SO_2 NAAQS is also evident at the Middelburg monitoring station 25 km north-east of Duvha, with relatively lower concentrations than at the Komati monitoring station. The picture is somewhat different for the Witbank monitoring station where generally higher SO_2 concentrations prevail and non-compliance with the 1 hour, daily and annual average NAAQS for SO_2 is evident in the monitoring record. Importantly, the average diurnal variation shows that highest SO_2 concentrations are experienced during the early morning and evening, suggesting that surface sources are the most important source of SO_2 in Witbank. Non-compliance with the ten-minute averaging periods is almost certain for Witbank and possible at Komati and Middelburg. As such, the requested emission limits for Duvha power station will see continued non-compliance with the NAAQS at the Witbank monitoring station (although modelling suggests that Duvha contributes no more than 15% to the measured concentrations), but compliance at the Komati and Middelburg monitoring stations.

5.3.2 Particulate Matter (PM_{10})

Ambient PM measured at Komati monitoring station indicates non-compliance with both the daily and annual NAAQS (with the annual average in 2010 being more than double the limit value). The same pattern of non-compliance with the NAAQS for both daily and annual averages is seen for Middleburg and Witbank. No material change is likely in ambient PM_{10} concentrations as the power station is seen to contribute only marginally to the measured concentrations at all three monitoring sites, bearing in mind that the bulk of the contribution to PM_{10} concentrations arises from low level sources, especially domestic fuel use.

5.3.3 Nitrogen oxides (NO_x)

Ambient NO_x measured at Komati, Middleburg and the Witbank monitoring stations indicates full compliance with the hourly and annual NO_2 NAAQS. There will be no change to the ambient NO_2 concentrations but no change is necessary as there is currently full compliance with the NO_2 NAAQS.

5.3.4 Cumulative assessment of requested emission limits in the Northern Highveld

According to the model predictions, SO_2, NO_x and PM_{10} emissions from current operations at the Northern Highveld power stations (combined – for Kendal, Duvha, Matla, Kriel, Arnot, Hendrina and Komati) do not result in non-compliance with the NAAQS.

Modelling results confirm that Eskom's requested PM emission limits cumulatively fall well below the NAAQS limit values for both the annual average and 99th percentile 24-hour concentrations. A similar picture is presented for the cumulative NO_2 emissions which also comply with the NAAQS limit values and maximum permissible exceedences per annum. While cumulatively the annual average SO_2 concentration falls within the NAAQS limit value, the 99th percentile 24-hour and 1-hour concentrations do not, and significantly exceed the permissible number of exceedences per annum. This finding, however, must be seen in the light that the predicted concentrations are probably an exaggeration of what actually happens in practice because when the SO_2 emission sources are combined, the model error brought about by modelling the maximum emissions rates at the power stations individually, is exaggerated further still because the chances of all the sources operating at the requested emissions limits for an entire year is highly improbable if not impossible.

5.4 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.

5.4.1 Direct financial costs

Eskom estimates that the CAPEX cost of full compliance with the MES at all Eskom's power stations is approximately R200 billion in 2013 real terms (excluding financing costs), and that annual OPEX costs are at least R6 billion per annum (Table 4). 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 between R75 billion and R300 billion, assuming that wet FGD is implemented on Medupi, Majuba, Matimba, Kendal and Tutuka, and that semi-dry FGD is implemented on all the other power stations. 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 R20 and R64 billion. For the tariff impact calculation an amount of R40 billion is used.

Full compliance with the MES for PM_{10} at Duvha would require a FFP retrofit and dust handling plant upgrade (at units 4-6) (CAPEX of over R2.5 billion). This is planned for and compliance will be achieved by 2024. Full compliance with the MES for SO_2 and NO_x would require a flue gas desulphurisation retrofit (well in excess of R10 billion) and a Low NOx Burner retrofit (around R2 billion), however these are not planned for Duvha.

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 2013 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 Overfire 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, Duvha and Grootvlei 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.

The reader is also referred to Annexure E in which an independent assessment has been conducted of the costs proposed by Eskom to ensure that these costs have not been exaggerated.

5.4.2 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 8 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 current Multi Year Price Determination 3 (MYPD3) electricity tariff agreement (valid from 2013 to 2018).

5.4.3 Cost benefit analysis

The basis of the assessments of the impact of Duvha's 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 a publication entitled The External Cost of Coal-Fired Power Generation: The case of Kusile prepared for Greenpeace, a case is made for the direct financial costs that will be invoked by the Kusile Power Station (Eskom's second new build power station after Medupi). Damage costs have been determined in a general sense as a function of studies conducted elsewhere which have been extrapolated to the South African circumstance. It is not the intention here to critique that study, but it must be noted that the study is based on a power station that will be fully compliant with the MES. In other words compliance with the MES, according to the Greenpeace study, will still imply a damage cost.

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. The 2004 FRIDGE study included detailed cost-benefit assessments of various interventions for reducing the air quality burden in poor communities. For reducing emissions from coal-fired boilers, a benefit/cost ratio of 0.8 was determined indicating that costs exceed benefits by 20%.

For SO_2 emissions reductions specifically, the financial net present value (NPV)[1] of the measure was estimated at negative R15.445 billion while the economic NPV was estimated as negative R12.769 billion with a benefit/cost ratio of zero. It must be noted though this calculation excluded impacts on building maintenance, acid rain and associated impact on crops, forests and soil fertility. The study also included the assumption that there was no market for the gypsum that is produced by FGD. Critically importantly, the FRIDGE study highlighted that positive

[1] All costs are equated to the current value of money.

interventions lie in the household sector, where such interventions offer relatively cheap measures that deliver substantial health benefits.

Considering that there is compliance with ambient NO_2 standards in all non-urban places on the Highveld and everywhere in the vicinity of power stations, and considering that SO_2 emissions from Duvha do not result in non-compliance with ambient SO_2 standards, the benefit of retrofitting FGD and low NO_x burners at Duvha, and spending several hundred million rand per annum operating the FGD is questionable.

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.

5.4.4 Summary

The implications of Eskom's prioritised plan for emission reduction are summarised in Table 4 together with how these implications will change if full compliance with the MES were to be achieved.

Table 4: Implications of Eskom's prioritised plan for emission reduction, compared with the implications of full compliance with Minimum Emission Standards

Implications	Full compliance with MES	Eskom's emission reduction plan
Water consumption increase	20% (67 million m^3/annum)*	2% (8 million m^3/annum)
CAPEX cost (2013 overnight costs, excluding interest and interest during construction)	Approx R200 billion**	R44 billion**
Annual OPEX costs (2013 costs)	Approx R6 billion**	R900 million**
Tariff increase	8-10 % average over 15 years	2.6 % average over 15 years
Auxiliary power consumption increase	2 255 GWh/year*	180 GWh/year
CO_2 emission increase (direct emissions from the FGD process only)	1-4 million tons/annum	400 000 tons/annum
Increase in coal consumption due to low NO_x burner retrofits	970 000 tons/annum	550 000 tons/annum
Waste (FGD by-product) production	9.5 million tons/annum*	1.7 million tons/annum

**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*
***Costs are 2012 real (overnight) costs, excluding financing costs*

6 PUBLIC PARTICIPATION

The requirement that the public participation process for an application for postponement from the Minimum Emission Standards follow the process specified in the NEMA Environmental Impact Regulations was only published on 22 November 2013 in GNR 893. Nevertheless, Eskom has always been of the view that stakeholder consultation is a key component of the Application, as such a detailed public participation process as stipulated within the NEMA EIA Regulations was followed as a guideline from the beginning of the process. 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 already completed a pre-feasibility study, and identified that the following offsets are likely to be most favourably received by households and other stakeholders:

- Retrofits of thermal insulation in houses;
- Install ceilings in houses;
- Replace existing coal/wood burning stoves with more efficient, low emission stoves;
- Supply Liquid Petroleum Gas (LPG) stoves and heaters and an LPG subsidy; and,
- Increase the free basic electricity subsidy.

Eskom will make the results of this pre-feasibility study available to the authorities and public on request.

Eskom plans to embark on a pilot study in the winter of 2014 (subject to the approval of the required funding), where these interventions will be implemented in a few households to test their effectiveness in improving air quality. Eskom is unfortunately not in a position to commit to offset projects where success is not yet assured, but is willing to commit to a plan of action, and to engage with relevant authorities and other stakeholders in this regard. Eskom feels that an offset programme would be most effectively developed by a partnership between government, communities, Eskom and other stakeholders.

8 CONCLUDING COMMENTS

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. There will be compliance with the new plant Particulate MES, but only after the fabric filter plant retrofit has been completed on Units 4-6, by 2024. Eskom contends that compliance with the ‘new plant’ SO_2 and NO_x MES at Duvha is not warranted since emissions from Duvha do not result in non-compliance with ambient SO_2 and NO_2 standards in the vicinity of Duvha (there is non-compliance with the SO_2 NAAQS at the Witbank monitoring station, but mainly due to surface sources of SO_2. Duvha only contributes up to 15% of total ambient SO_2 levels). 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.