BACKGROUND INFORMATION DOCUMENT

APPLICATIONS FOR POSTPONEMENT OF, AND EXEMPTION FROM, THE MINIMUM EMISSIONS STANDARDS FOR ESKOM'S COAL AND LIQUID FUEL-FIRED POWER STATIONS

BID

In 2004 the National Environmental Management: Air Quality Act (NEM:AQA) (Act No 39 of 2004) was promulgated heralding a new approach to air quality management in South Africa.

Following the promulgation of the Act, national ambient (ground-level) air quality standards were published in December 2009. The ambient standards were followed by the publication of Minimum Emission Standards (MES) in April 2010.

The MES have two broad requirements, which are limits for 'existing plants', (which come into effect in 1 April 2015), and more stringent 'new plant' limits, which must be complied with by 1 April 2020. For Eskom, these emission standards apply to all the company's coal- and liquid fuel-fired power stations. Due to resource and capacity constraints, Eskom will not be able to comply with all the emission standards at all its power stations and must therefore seek postponements and in some circumstances, exemptions from the emissions standards where the standards cannot be met.

The purpose of this Background Information Document (BID) is to present an overview of Eskom's reasoning for the postponement and exemption applications and to invite your participation in that process. The BID contains a description of the Minimum Emissions Standards and what they entail, why Eskom will not be able to fully comply with the standards when they come into effect, what Eskom will be doing to reduce emissions, the process that will be used in support of Eskom's application and how you can participate.

What are emission standards?

In managing air quality, the authorities must ensure that the air breathed by people does not contain more than a certain quantity of pollution in every unit of air that is inhaled. That quantity of pollution per unit of air is expressed as the weight of the pollutant (typically in micrograms) per cubic meter of air, or $\mu g/m^3$. Expressed in this manner, air pollution is referred to as a *concentration*. Authorities then use defined standards (typically sourced from the World Health Organisation (WHO)) to define the concentrations below which human health will not be adversely affected. These standards are called 'ambient air quality standards' and apply to the air to which

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people (and the environment) are exposed (in contact with or breathed). Ambient air quality standards were published in South Africa in December 2009 (**Annexure 1**).

In order to manage ambient air quality, the authorities must obviously control the pollution that is emitted into the atmosphere (atmospheric emissions). To do so, maximum allowable emissions are typically prescribed and in South Africa these have been translated into law as Minimum Emission Standards (MES). The MES are also expressed as concentrations but because the concentrations are greater where they are emitted (before they are diffused through the atmosphere), the standards are expressed in mg/m^3. These concepts are illustrated schematically in **Figure 1**.

comply with the 'new plant' standards. In terms of the legislation Eskom will need to ensure that the power stations do not emit more than the values shown in **Table 1**.

Table 1: Summary listing of the MES that will apply for the three primary emissions from Eskom's coal- and liquid fuel-fired power stations (in mg/m^3).

MES	PM	SO_2	NO_x
2015	100	3500	1100
2020	50	500	750

What will Eskom need to do to comply with the MES?

Eskom will need to modify its existing power stations to comply with the MES with different technologies being used for the different pollutants. The technology options are detailed below for each of the three primary pollutants.

PM emissions

Most Eskom coal-fired Power Stations are already fitted with electrostatic precipitators (ESPs) that remove fly ash (including PM) from the emissions. The newer power stations in the fleet may be able to achieve the MES by having the ESPs optimised, but for the other power stations new fabric filter plants (FFPs) would need to be installed. The FFPs have generally higher removal efficiencies than the ESPs, as they provide a physical (fabric) barrier to the fly ash.

Nitrogen oxides (NO_x)

In order to reduce NO_x emissions to meet the MES, several interventions will be required. The first of these will be installing low NO_x burners in the power stations that do not yet have them and secondly, optimising the performance of low NO_x burners where these are already installed. In some cases the low NO_x burners will also need to be supplemented with over-fire air. In essence these technologies either reduce flame temperature or provide less oxygen, both of which limit the formation of NO_x.

Sulphur dioxide (SO_2)

Eskom's existing operational power stations have no direct form of SO_2 control so emissions are a function of the sulphur content of the coal. Flue gas desulphurisation (FGD) is the only technology that can be used for SO_2 control given the size of Eskom's power stations and the MES. FGD is based on passing combustion emissions through alkaline water. There are two types of FGD, namely wet and semi-dry with the former having higher capital but lower running cost implications and the latter having relatively lower capital but higher running cost implications.

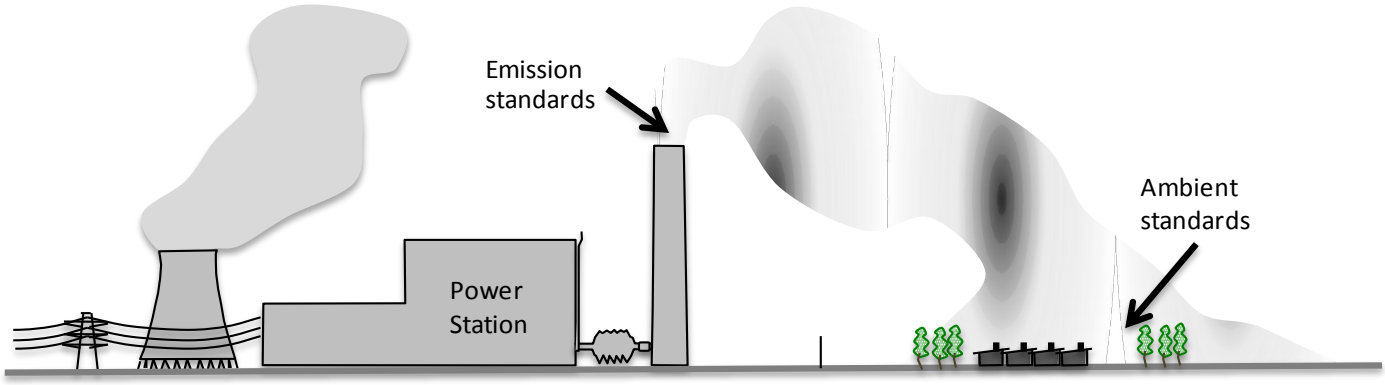

Figure 1: Schematic illustration of the difference between emission and ambient standards.

Box 1: Difference between µg and mg

Grams are a measure of mass (defined as the quantity of matter in an object). The kilogram (kg) is the best-known unit of measure of mass where there are then 1000 grams (g) in a kg. Similarly there are a 1000 milligrams (mg) in a g and 1000 micrograms (µg) in a mg.

The MES have two commencement timelines. The first of these is in April 2015 by which time all industrial operations that emit atmospheric pollution must be able to comply with a series of 'existing plant' emission limits. For Eskom's power stations the key pollutants are particulate matter (PM, mainly ash), sulphur dioxide (SO_2) and nitrogen oxides (NO_x). The second timeline is April 2020 by which time all Eskom's power stations will have to

So what is the problem then?

Power station emissions do not harm human health

Previous modeling studies and air quality monitoring shows that in most cases, power station emissions contribute very little to ambient pollution levels, or there is compliance with ambient air quality limits, especially in areas where people live. An exemption or postponement of the Minimum Emission Standards will thus not result in harm to human health.

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This will be re-assessed in the Atmospheric Impact Report.

Water availability

South Africa is a water scarce country and coal-fired power stations require significant amounts of water where 'wet' cooling is used. The country simply does not have enough water to allow further wet cooled stations and so the two newest power stations (Medupi and Kusile) will be dry cooled. FGD is an effective form of SO_2 control but it requires significant quantities of water. In rough terms a wet cooled power station uses about 15 times the water required for dry cooling which is why the Department of Water Affairs has prescribed that all new power stations in South Africa are to be dry-cooled.

FGD retrofits on all power stations would mean an additional 70 million cubic metres of water per annum, in water use, which increases Eskom's total water consumption by about 20%. Given that most of South Africa's currently available water (yield) has already been allocated, there is little additional supply and even if the water was available it is questionable whether FGD would be the best use of a very scarce resource.

Phasing the retrofits

To meet the MES Eskom will need to install additional emissions control equipment at their various power stations. This is less of a problem for the 2015 MES because most of the power stations (although not all) will be able to comply with the 2015 MES. The problem becomes more acute for the 2020 MES where all of the power stations will need to have new emissions control equipment installed (or retrofitted) to meet the required limits. In order to retrofit Eskom needs to 'switch off' units at their power stations. Switching off units means reducing the overall electricity supply and if there is inadequate spare capacity in the system, switching off units means the possible interruption of electricity supply to certain areas and 'load shedding'. To provide some perspective, a retrofit requires that a unit be offline for some 150 days. In order to meet the MES by 2020, at least 2 units a year per power station (not before 2017) will need to be retrofitted resulting in approximately 14% of the coal fired fleet being offline, between 2017 and 2019.

The cost

Preliminary calculations indicate that the capital costs for full compliance with the MES are some R210 billion with significant increases also in operating costs. These costs will impact significantly on the electricity tariff, and the affordability of the tariff increase by the consumer is questionable.

Box 2: What is meant by a 'unit'?

Most of South Africa's power stations are modular in nature and made up of a series of individual electricity generating units. The larger power stations are typically made up of 6 generating units with each unit generating 600 MW of electricity and the whole power station then generating 3600 MW (6 x 600 MW). These power stations are colloquially referred to as 'six-packs'. When maintenance is done, it is possible to take individual units off line rather than having to shut down the whole power station.

Figure 2: Map showing the geographical locations of the various power stations referred to in this document, notably Tables 2 and 3.

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Variability of emissions

Emissions from coal-fired power stations vary over time because the ash content, sulphur content and combustion properties of the coal vary. As a result, average emissions need to be 30 to 40% lower than the emission limit in order to ensure compliance with the emission limit under all normal operating conditions. There are several cases in which average emissions comply with the Minimum Emission Standard, but worst case emissions do not, and in such cases postponements or exemptions need to be applied for.

In summary Eskom's actions in respect of postponement or exemption are where:

1. Eskom will be able to comply with the MES but not within the required time periods. In these circumstances Eskom will be applying for *postponement* of the MES.

2. Water (and possibly reagent) cannot be sourced for FGD then there is no other way of materially controlling SO_2 emissions so that they will comply with the MES. In these circumstances, Eskom will apply for *exemption* from the MES.

3. For some of the older power stations, which will be decommissioned, it does not make economic sense to retrofit where the retrofit will only operate for a few years before the power station is shut down. In these circumstances Eskom will apply for *exemption* from the MES.

The various postponements and exemptions are summarised per power station in the section that follows.

Which power stations are affected and how?

In **Table 2,** the projected compliance with the 2015 and 2020 MES is summarised for each of the coal and liquid-fuel-fired power stations in the Eskom fleet. It can be seen from the table that there will be a relatively high degree of compliance with the 2015 MES but that compliance with the 2020 MES will be far more challenging. As a function of the degree to which compliance can be assured, Eskom's proposed postponement and exemption applications are summarised in **Table 3**.

Table 2: Summary listing of projected compliance of Eskom's coal- and gas-fired power stations with the 2015 and 2020 MES. Note that WC=will comply, MNC=might not comply and WNC=will not comply. The locations of the power stations can be seen in Figure 2.

Power station	Pollutant					
	2015 Compliance			2020 Compliance		
	PM	NO_x	SO_2	PM	NO_x	SO_2
Kusile	WC	WC	WC	WC	WC	WC
Medupi	WC	WC	MNC	WC	WC	WNC
Majuba	WC	WNC	WC	WC	WNC	WNC
Matimba	WC	WC	MNC	WNC	WC	WNC
Kendal	WC	WC	WC	WNC	WC	WNC
Lethabo	MNC	WC	WC	WNC	WNC	WNC
Duvha U1-3	WC	WC	WC	WC	WNC	WNC
Duvha U4-6	WC	WC	WC	WNC	WNC	WNC
Matla	WNC	WNC	WC	WNC	WNC	WNC
Tutuka	WNC	MNC	WC	WNC	WNC	WNC
Kriel	WNC	WNC	WC	WNC	WNC	WNC
Arnot	WC	WC	WC	WC	WNC	WNC
Hendrina	WC	WNC	WC	WC	WNC	WNC
Camden	WC	WNC	MNC	WNC	WNC	WNC
Grootvlei	WNC	MNC	MNC	WNC	WNC	WNC
Komati	WC	WNC	WC	WNC	WNC	WNC
Ankerlig - all units	WC	WC	WC	WC	WC	WC
Gourikwa - all units	WC	WC	WC	WC	WC	WC
Port Rex - all units	WC	WC	WC	WC	WNC	WC
Acacia - all units	WC	WC	WC	WC	WNC	WC

How will Eskom motivate for a postponement or an exemption?

The specific legal requirements that govern postponement and exemption applications are listed in **Annexure 2**. In response to those legal requirements Eskom will need to provide details on the constraints that prevent the MES from being met within the required time period or at all (as described above). In addition the NEM:AQA requires that an Atmospheric Impact Report (AIR) must be prepared in support of a postponement or exemption application. Eskom will commission independent air quality specialists to prepare AIRs for each of the applications.

What will be in the AIRs?

For the authorities to decide on postponement or exemption applications in respect of the MES, they must understand the ambient air quality implications of the request to postpone or even exempt certain emissions from complying with the MES. As such the AIRs will provide an assessment of how ambient air quality is likely to be affected by Eskom's proposed delays in meeting the MES

Box 3: Wet-cooling versus dry-cooling

The 'power' in a power station is derived by converting water in liquid phase to steam. As the water turns to steam it expands rapidly and that provides the power to rotate turbines, which then generate electricity. That steam then has to be returned to liquid phase and this means that power stations must have large cooling facilities. The older generation power stations use water in large cooling towers to effect that cooling (wet cooling) but the new power stations use banks of fans that cool with air (dry cooling). With dry cooling significant quantities of water are saved but there is an efficiency cost in that electricity has to be used to drive the fans.

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Table 3: Summary listing of the postponements and exemptions for which Eskom plans to apply. '15 and '20 refer to the 2015 and 2020 MES, respectively. The locations of the power stations are shown in Figure 2.

Power station	PM	NO_x	SO_2
Kusile			
Medupi			Postpone '15 &'20
Majuba		Exempt '15 & ' 20	Exempt '20
Matimba	Postpone '20		Exempt '15 & ' 20
Kendal	Postpone '20		Exempt '20
Lethabo	Postpone '20	Exempt '20	Exempt '20
Duvha U1-3		Exempt '20	Exempt '20
Duvha U4-6	Postpone '20	Exempt '20	Exempt '20
Matla	Postpone '15 &'20	Exempt '15 & '20	Exempt '20
Tutuka	Postpone '15 &'20	Exempt '15 & '20	Exempt '20
Kriel	Postpone '15 &'20	Exempt '15 & '20	Exempt '20
Arnot		Exempt '15 & '20	Exempt '20
Hendrina		Exempt '15 & '20	Exempt '20
Camden	Exempt '20	Postpone '15, Exempt '20	Exempt '20
Grootvlei	Postpone '15	Exempt '20	Exempt '20
Komati	Exempt '20	Exempt '15 & '20	Exempt '20
Ankerlig - all units			
Gourikwa - all units			
Port Rex - all units		Exempt '20	
Acacia - all units		Exempt '20	

(postponement) or an inability to meet the MES at all (exemption). Atmospheric dispersion modelling will be used to predict ambient air quality and this will be assessed in combination with reviews of ambient air quality monitoring data to ascertain how emissions from the various power stations influence ambient air quality.

A key component of the assessment will be ascertaining how compliance with the ambient air quality standards will be affected by the delayed implementation of the MES or not meeting the MES at all. If either results in the ambient air quality standards being exceeded then that will have significant implications for decision-making. Where there is a risk of the AAQS being exceeded it will be necessary to determine under what circumstances the AAQS will be exceeded and the length of time for which the standard will be exceeded. It is very important to note that a key assumption underpinning the preparation of the AIRs is that the AAQS are adequately protective of human health and the environment. It is not intended to conduct detailed health or environmental risk assessments in the AIRs, only to ascertain how the AAQS will be affected by the proposed delay in meeting the MES or not meeting the MES at all.

Box 4: What is atmospheric dispersion modelling?

Emissions into the atmosphere are diffused and transported (or dispersed) as a function of various atmospheric processes such as turbulence and wind velocity. Atmospheric dispersion modelling simulates those atmospheric processes in order to predict the ambient concentrations of the emission in question. There are various modelling approaches but the one that will be used for the AIRs is a so-called 'puff' model. Puff models take a 'puff' of pollution and then disperse that puff through the atmosphere as a function of the state of the atmosphere when the puff is emitted.

The air quality consultants are also required to submit a modelling plan to the authorities, which must be consistent with the modelling guidelines issued by the Department of Environmental Affairs. The modelling plan is also available for review where stakeholders have such an interest. It should be noted that the dispersion modelling will only include emissions from the individual Eskom Power Stations and not emissions from other sources. Background ambient air quality concentrations (viz. the ambient concentrations that occur as a result of all possible sources) will be determined, however, so that the Eskom emissions are not considered in isolation of other emissions.

What about stakeholder involvement?

Stakeholder consultation is a key component of the postponement and exemption application process. Two rounds of consultation are being planned as part of the process. The first round of consultation will see the contents of this BID being presented in various public engagements and opportunity created for comments and questions to be raised on the proposed approach to preparing the applications.

The second round of consultation will see the applications themselves together with the AIRs being made available for stakeholder review and comment. That second round will also see a series of public engagements at the same venues used for the first round of consultation. It is important to note that stakeholders can comment on individual applications (viz per power station) or across the board as they see fit.

Public meetings will be held in the following centres:

- Lephalale;
- eMalahleni;
- Standerton;
- Vanderbijl Park;
- East London; and,
- Johannesburg.

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3.1 National Ambient Air Quality Standards for Sulphur Dioxide (SO_2)

Averaging Period	Concentration	Frequency of Exceedence	Compliance Date
10 minutes	500 µg/m^3 (191 ppb)	526	Immediate
1 hour	350 µg/m^3 (134 ppb)	88	Immediate
24 hours	125 µg/m^3 (48 ppb)	4	Immediate
1 year	50 µg/m^3 (19 ppb)	0	Immediate
The reference method for the analysis of sulphur dioxide shall be ISO 6767			

3.2 National Ambient Air Quality Standards for Nitrogen Dioxide (NO_2)

Averaging Period	Concentration	Frequency of Exceedence	Compliance Date
1 hour	200 µg/m^3 (106 ppb)	88	Immediate
1 year	40 µg/m^3 (21 ppb)	0	Immediate
The reference method for the analysis of nitrogen dioxide shall be ISO 7996			

3.3 National Ambient Air Quality Standards for Particulate Matter (PM10)

Averaging Period	Concentration	Frequency of Exceedence	Compliance Date
24 hours	120 µg/m^3	4	Immediate – 31 Dec 2014
24 hours	75 µg/m^3	4	1 January 2015
1 year	50 µg/m^3	0	Immediate – 31 Dec 2014
1 year	40 µg/m^3	0	1 January 2015
The reference method for the determination of the particulate matter fraction of suspended particulate matter shall be EN 12341			

3.4 National Ambient Air Quality Standards for Ozone (O_3)

Averaging Period	Concentration	Frequency of Exceedence	Compliance Date
8 hours (running)	120 µg/m^3 (61 ppb)	11	Immediate
The reference method for the analysis of ozone shall be UV photometric method as described in SANS 13964			

3.5 National Ambient Air Quality Standards for Benzene (C_6H_6)

Averaging Period	Concentration	Frequency of Exceedence	Compliance Date
1 year	10 µg/m^3 (3.2 ppb)	0	Immediate – 31 Dec 2014
1 years	5 µg/m^3 (1.6 ppb)	0	1 January 2015
The reference methods for the sampling and analysis of benzene shall either be EPA compendium method TO-14 A or method TO-17			

3.6 National Ambient Air Quality Standards for Lead (Pb)

Averaging Period	Concentration	Frequency of Exceedence	Compliance Date
1 year	0.5 µg/m^3	0	Immediate
The reference method for the analysis of lead shall be ISO 9855			

3.7 National Ambient Air Quality Standards for Carbon Monoxide (CO)

Averaging Period	Concentration	Frequency of Exceedence	Compliance Date
1 hour	30 mg/m^3 (26 ppm)	88	Immediate
8 hour (calculated on 1 hourly averages)	10 mg/m^3 (8.7 ppm)	11	Immediate
The reference method for analysis of Carbon Monoxide shall be ISO 4224			

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ANNEXURE 1

National Environmental Management: Air Quality Act, 2004 (Act No. 39 of 2004)

National Ambient Air Quality Standards

1.0 Definitions

"averaging period" means a period over which an average value is determined.

"compliance date" means the date in which compliance with the standard is required.

"frequency of exceedances" means a frequency (number/time) related to a limit value representing the tolerated exceedence of that limit value at a specific monitoring location, i.e. if exceedances of limit value are within the tolerances, then there is still compliance with the standard. This exceedances is applicable to a calendar year.

"limit value" means a level fixed on the basis of scientific knowledge, with the aim of reducing harmful effects on human health (or the environment (or both)), to be attained within a given compliance period and not to be exceeded once attained.

2.0 General

2.1 Reference Conditions

Concentration shall be expressed at a standardized temperature of 25°C and a pressure of 101,3 kPa.

2.2 Reference Methods

Where test methods are specified, any other method which can be demonstrated to give equivalent results may be used. Documentary proof of equivalence in the form of test results from a SANAS accredited laboratory or a peer-reviewed report shall be provided. The obligation to provide sufficient proof shall lie with the proponent.

2.3 Ambient air quality measurement requirements

Assessment of all ambient pollutant concentrations shall be conducted in terms of section 5.2.1.3 of the National Framework for Air Quality Management in the Republic of South Africa.

ANNEXURE 2:

Specific Legal Provisions for Postponement and Exemption Applications

Postponement of the Minimum Emission Standards will be applied for in terms of section 6 of the Listed Activities and Associated Minimum Emission Standards identified in terms of section 21 of the National Environmental Management: Air Quality Act, 2004 (Act No. 39 of 2004):

(1) As contemplated in Section 5.4.3.5 of the 2007 National Framework for Air Quality Management in South Africa (2007) … an application may be made to the National Air Quality Officer for the postponement of the compliance timeframes in Section 5 for an existing plant.

(2) The application contemplated in 6(1) must include –

(a) An Atmospheric Impact Report in terms of Section 30 of the Act, compiled by a person registered as a professional engineer or as a professional natural scientist in the appropriate category;

(b) A detailed justification and reasons for the application; and

(c) A certified copy of the announcement of the intention to seek postponement in, at least, one newspaper distributed in the area affected by the specific plant.

(3) The National Air Quality Officer, with the concurrence of the Licensing Authority as contemplated in section 36 of the Act, may grant a postponement of the compliance timeframes in (5) for an existing plant, not exceeding 5 years.

Exemption from complying with the Minimum Emission Standards will be applied for in terms of section 59 of NEM:AQA:

(1) (a) Any person or organ of state may, in writing, apply for exemption from the application of a provision of this Act to the Minister.

(b) No exemption from a provision of section 9, 22 or 25 may be granted in terms of paragraph (a).

(2) An application in terms of subsection (1) must be accompanied by reasons.

(3) (a) The Minister may require an applicant applying for exemption to take appropriate steps to bring the application to the attention of relevant organs of state, interested persons and the public.

(b) The steps contemplated in paragraph (a) must include the publication of a notice in at least two newspapers circulating nationally -

(i) giving reasons for the application; and

(ii) containing such other particulars concerning the application as the Minister may require.

(4) The Minister may -

(a) from time to time review any exemption granted in terms of this section; and

(b) on good grounds withdraw any exemption.

(5) The Minister may on such conditions and limitations determined by the Minister delegate any of the powers contained in this section to -

(a) the MEC responsible for air quality in a province; or

(b) a metropolitan or district municipality.

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