Comments on the series of Applications for Suspension of the Minimum Emissions Standards (MES) Compliance Timeframes for Various Eskom Coal-Fired Power Plants

By

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In a series of applications dated roughly November 2018, Eskom has requested that its many coal-fired power plants be excused from meeting applicable MES in the required timeframes.

As justification for not meeting the timeframes for the MES, Eskom provides several reasons which I discuss below.

A. Remaining Power Station Life

This reason is supported by Eskom by stating that some of the plants in question (such as Arnot) are likely to be decommissioned in the not-too-distant future (implying therefore that adding capital investment to such plants as would be required with installing necessary air pollution controls such as flue gas desulfurization (FGD) for Sulphur dioxide (SO_2) control; or Selective Catalytic Reduction (SCR) for nitrogen oxides (NO_x) control; or fabric filters (FF) for control of particulate matter (PM). This justification is not tenable because in no case does Eskom make a legally binding commitment to the supposed decommissioning date. Therefore, the stated decommissioning years cannot and should not be relied upon. As such, it is likely that Eskom will simply continue to operating the plants in question, making this particular reason for compliance delay, moot.

B. Water Availability

This reason is provided to exclude the installation of wet or dry FGD, both of which do require water (which can be substantially treated and recycled, which Eskom does not discuss). The reality, however, is that the great benefit to using wet or dry FGD is the substantial reduction in

SO2 emissions – i.e., reductions of 98% or 99% from the very large SO2 emissions from local high-sulfur coals – which simply cannot be obtained by any other means. SO2 is a significant air pollutant, directly and via conversion to PM2.5 or fine particulate matter. Thus, for all plants which do not have immediate actual decommissioning dates, either wet or dry FGD should be installed by Eskom. I comment on the cost of FGD later in the report.

For the plants which are likely to be decommissioned in the near future – i.e., within the next 5 years or less, Eskom should consider SO2 removal technologies such as dry sorbent injection (DSI) which can remove SO2 from the exhaust gas stream using no water at all. Using reagents such as trona, lime, or sodium bicarbonate, in dry powder form, DSI can remove as much as 50% SO2, which would go a long way (but not all the way) towards achieving compliance with the MES. I suggest this option so that, for these plants, which will not have long remaining lives – DSI will nonetheless provide some SO2 reductions as opposed to having the units at these plants simply emit high levels of SO2 uncontrolled. Further, the capital costs of DSI are substantially lower (less than 10%) of the capital cost of wet FGD and DSI can be installed in less than 12 months, including design. While DSI does require the use of the aforementioned reagents and thereby incurring operating costs, the benefits due to substantial SO2 (and also acid gas such as hydrochloric and hydrofluoric acid) reductions in a very short time frame – is an attractive option that Eskom should consider. To reiterate, this technology can apply to plants/units that have upcoming decommissioning dates in the next few years so that in the interim while they are still in operation, substantial SO2 reductions can be realized.

C. Additional Adverse Environmental Impacts of FGD

Eskom tries to make the case that the use of additional limestone and the generation of gypsum as well as incremental increases in CO2 emissions means that FGD is not appropriate. Of course, this is disingenuous. FGD is used worldwide as the top SO2 removal technology because of its high degree of SO2 removal from coal-fired power plant exhausts, even given the adverse impacts pointed out by Eskom. Eskom’s reasoning in this case is merely self-serving.

D. Capital Costs

Eskom notes that complying with the MES in a timely manner means that it will incur substantial costs. The MES delay applications state:

> "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:
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> - SO2 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.
> - NOx emission reduction by the most appropriate technology is estimated to cost between R10 and R40 billion for all power stations. This includes Low NOx 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."[1]

The costs noted by Eskom, with no technical support or background information, are not realistic in the least.

First, the problem with Eskom's presentation of costs above is that it provides no technical backup or support for the fleet-wide costs for SO2 (via FGD); NOx (using low-NOx burners; burner optimization, etc.); and PM (using FF retrofits, where needed) noted above. Therefore, it is difficult to simply accept them. And, as noted above, non-FGD options such as DSI can be implemented at a fraction of the capital cost of FGD – and Eskom simply did not consider the capabilities and/or costs of DSI.

[1] Arnot Application, Section 5.5.1

Second, and more substantially, Eskom's costs appear to be substantially inflated. As comparison, I will consider air pollution control costs for coal-fired power plants being incurred in India. As background, Indian coal units which intend to remain operating have recently committed to installing various air pollution controls (such as FGD for SO2 control, low NOx burners with or without over-fire air and SCR for NOx control, and upgraded ESPs for PM – as needed to meet standards promulgated in 2015) – all within the next three to four years.

A recent report[2] summarizes the costs for various air pollution controls in India. I reproduce the key table below.

Table 18: Cost of PCT

PCT	Capital cost (Million INR/MW)	O&M cost (INR/MW/annum)	Reagent cost (INR/kWh)
WFGD	5	0.6	0.02- 0.15
SWFGD	3	0.6	0
Dry FGD (SDA and CDS)	3.5	0.6	0.02-0.16
LI	1.5	0.6	0.02-0.15
LI+ washed coal	1.5	0.6	0.02-0.16
SCR	3	0.05	0.01-0.07
SNCR	2	0.01	0.01-0.04
LNB	0.5	0	0
LNB+OFA	0.8	0	0
ESP	0.5	0.05	0
ESP + washed coal	1	0.1	0.08

Using the cost figures above, which are from 2018, I have calculated the costs of installing low NOx burners (which would be able to meet the NOx standards) and either wet or dry FGD (as Eskom itself has determined) at the various Eskom plants. For NOx, I considered the costs of installing low NOx burners at each unit at each of the following Eskom plants: Acacia, Ankerlig, Arnot, Camden, Duvha, Gourikwa, Grootvlei, Hendrina, Kendal, Komati, Kriel, Kusile, Lethabo, Majuba, Matimba, Matla, Medupi, Port Rex, and Tutuka. Collectively, my estimate shows that the cost of low NOx burners for all of these plants should be around 4.6 billion Rand, using a current exchange rate between Indian Rupees and the Rand. Contrast this with the cost estimate provided by Eskom (quoted earlier) which ranged from 10-40 billion Rand. I note that even this inflated estimate considered the use of low NOx burners for some of the plants and burner

[2] Benefit and Cost Analysis of Emission Standards for Coal-Based Thermal Power Plants in India, CSTEP, July 2018.

optimization (which would cost even less) for other plants. I believe that Eskom's costs for NOx control via low NOx burners are inflated by a factor of 2 to 8 at least.

For FGD, I considered the following plants with their corresponding decommissioning dates in parentheses (which are more than 5 years into the future): Matla (2031), Duvha (2034), Tutuka (2037), Lethabo (2040), Matimba (2041), Kendal (2043), Majuba (2049), and Medupi (2050). I assumed that all of the units at the Duvha, Lethabo, and Matla plants would install dry FGD while units at the other plants would install wet FGD – again, consistent with Eskom's assumptions. Using plant and unit sizes specified in Eskom's reports, and using the Indian cost data, and using a current currency conversion, I estimate that the total FGD costs for these plants would be just less than 30 billion Rand. Again, this is a far smaller capital cost estimate than Eskom's 140-170 billion Rand. Eskom's estimate is off by a factor of 4 to almost 6. Of course, when one is proposing to retrofit these large numbers of air pollution controls, vendors and suppliers will also provide additional discounts and preferential commercial terms. I am not included these aspects, which would make my estimated costs even lower – and Eskom's estimates, even higher by comparison.

I did not separately calculate the costs for fabric filter retrofits, mainly because there is less recent data available from India to make this comparison. But, the range of 15-40 billion Rand provided by Eskom for this upgrade appears vastly inflated as well.

In summary, from a cost standpoint, there is simply no doubt that Eskom's estimated for FGD and low NOx burners at is various plants is vastly overstated. It is also likely that Eskom's costs for fabric filter upgrades is similarly inflated.

E. Schedule for Installation of Air Pollution Controls

While not directly addressed on a plant-by-plant basis in Eskom's many applications to delay compliance with the MES, I note the following with regards to the schedule for compliance with specific air pollution controls:

(i) Retrofits for existing particulate controls such as electrostatic precipitations (ESPs) and/or fabric filters (FF) can generally be accomplished in less than 12-18 months at the most, including engineering design, procurement, and installation. In fact, timelines can be substantially shorter depending on the scope of the retrofit.

(ii) Installation of New ESPs or FF, if needed. Although this should be not be an issue with any of the Eskom plants since they all have some form of PM control, even if new ESPs or FF are required, the typical timeline for installation of such controls is less than 36 months.

(iii) Low NOx Burner (LNB) Retrofit for NOx Control. A wide variety of global suppliers make a wide range of LNB for all types of coal-fired boilers (tangential fired, wall fired, cell burners, etc.). Typical time to specify, manufacture, install is less than 12 months.

(iv) Selective No-catalytic Reduction (SNCR) for NOx Control. Although Eskom does not include this option for NOx control, it is worth considering at particular plants where low NOx burners may not adequately or consistently provide the necessary NOx levels. In this option, a reducing agent such as ammonia is injected directly into the furnace chamber at a location where the gas temperature is typically around 850 – 1150 C. Ammonia reacts with NOx reducing the latter to nitrogen. Efficiencies of NOx reduction can be as high as 50-75% depending on the NOx concentration from the burner region, the degree of mixing of the ammonia and the exhaust gas stream, the temperature of the mixing zone, as well as boiler/plant characteristics such as load-cycling, etc. In any case, this option should be considered by Eskom for NOx reduction in conjunction with LNB/burner optimization because it can result in substantially lower outlet NOx emissions at very economic conditions. Installation timeframes for proper SNCR are typically 18 months or less, including specification of the system, design of the ammonia injectors, and installation of the injectors, ammonia tank, etc.

(v) Selective Catalytic Reduction (SCR) for NOx Control. This is the top NOx control technology for coal-fired boilers and has been in use world-wide since 1985 or thereabouts. Eskom has not considered this option at all. While capital costs for this technology are higher than SNCR discussed above, NOx reduction of 90% or greater can be obtained. As such this option should be included by Eskom, especially for units that will not be decommissioned for the next 10 years or longer. Typical timeframes to design, procure, and install such systems is around 36 months.

(vi) DSI for SO2 Control. As noted, this very option for SO2 removal has minimal capital costs and can be installed well within 12-18 months.

(vii) FGD for SO2 Control. FGD (especially wet FGD) is considered the top technology for SO2 control because it can provide greater than 99% reduction in SO2 emissions. Dry FGD can provide reduction in the 90% or greater range. While capital costs for FGD can be higher than DSI, these high reduction percentages cannot be achieved by DSI. Typical installation time for FGD, based on recent Indian installations are in the 36-40 month range. For example, a recent FGD installation in India was completed in 38-40 months.[3] As noted earlier, India is in the midst of installing FGD on a substantial portion of its existing coal-fired fleet between now and 2021.

[3] This was for retrofitting a FGD system at the Vindhyachal STPP-V Unit 13. Vindhyachal is operated by the NTPC. Written correspondence from The Central Public Information Officer, NTPC Limited, NTPC Bhawan, to Shri Harshit Sharma (February 6, 2018), available at https://cl.ly/3h37380y2P1m/FGD%20retrofit%20(NTPC).pdf