Comments on the

# Draft Notification on Air Emission Standards for Coal-Based Thermal Power Plants by the Government of India, Ministry of Environment, Forests, and Climate Change

prepared by

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[1] Resume provided in Attachment A.

The Indian Ministry of Environment, Forests, and Climate Change (MoEFCC) has published a draft notification for air and water emission standards for coal-based thermal power plants under the Environment Protection Act, 1986.[2] The comments below are provided only for the air quality portions of the draft notification.

We urge the MoEFCC to carefully consider these comments, provide clarifications as needed and revise/strengthen the respective standards in the final notification.

At the outset, we commend the MoEFCC for proposing draft standards for emissions from coal-fired power plants. We recognize that, at present, other than some particulate matter ("PM") standards (350 $mg/m^3$ for units smaller than 210 MW and commissioned prior to 1982; and 150 $mg/m^3$ for others[3]) there are no national level standards in India for coal-fired thermal power plants for $NO_x$, $SO_2$, and mercury.[4] Thus, the proposed standards are definitely an improvement – provided compliance with the standards can be demonstrated in actual practice at all of the 454 coal/lignite based thermal units above 25 MW capacity in India, per most recent information available.[5]

That being said, we believe that the draft standards should be strengthened in a number of ways. The following discussion of ways that the draft standards should be strengthened is organized as follows. First, we provide some general comments on the proposed draft notification standards. Second, we provide comparisons of the proposed standards to similar standards applicable in certain other jurisdictions, namely the European Union, China, and the United States. The

[2] A copy of the draft notification standards is provided at the very end of these comments in Attachment E for ease of reference.

[3] Cropper, M., et. al., Resources for the Future (RFF) Paper, The Health Effects of Coal Electricity Generation in India, RFF DP 12-25, June 2012, Table 3. We are also aware that there may be local PM standards that are more stringent – such as by the Andhra Pradesh Pollution Control Board and the Delhi Pollution Control Committee.

[4] It should be noted that all references to cubic meters or $m^3$ in this report are implicitly to be read as standard or normal $m^3$, i.e., $Nm^3$ whether so stated or not. It should also be noted that in air pollution practice, standard or normal conditions do not always mean the same everywhere. For example, in the EU (and presumably also in India) these conditions are 0 Celcius and 1 atmospheric pressure. In the US, standard conditions can be 68 F or 70 F or something else, although pressure is always at 1 atmosphere at mean sea level.

[5] Highlights, Performance Review of Thermal Power Stations 2011-12, Central Electricity Authority, available at http://www.cea.nic.in/reports/yearly/thermal_perfm_review_rep/1112/highlights.pdf. This was the most recent listing we could find on the Central Electricity Authority website (last accessed June 7, 2015).

comparisons for the EU and China are provided only for the post-2017 levels (i.e., the most stringent) of the Indian standards. Lastly, we provide actual emissions performance data from 2014 from various US coal-fired power plant units, demonstrating that numerous units in the US are currently achieving even the most-stringent post-2017 proposed Indian standards. Collectively, therefore, we believe that the MoEFCC should consider making several adjustments to the proposed standards and to related aspects, such as compliance monitoring, in order to make sure that the goal of reduced air emissions from coal-fired thermal power plants is actually realized as intended.

## A. General Comments

At the outset, we note that all of the proposed standards are in the form of concentrations (i.e., milligrams of pollutant emissions per cubic meter of stack gas flow). While other jurisdictions such as the EU and China, for example, also have power plant standards in the form of concentrations, we respectfully believe that such standards are insufficient and ineffective because such concentrations of pollutants at the stack are only half the story – the other half being the flow rate of the stack gases. Together, the concentration and flow rate provide the quantifiable mass rate of emissions from a source.

Air emission impacts from any air pollution source are caused by the mass (or more accurately, the mass rate – i.e., mass per unit time) of pollutant emissions. Of course, simply having the mass rate makes it difficult to compare sources of different sizes. All other aspects remaining the same, the "bigger" the source, the greater its mass emission rate of pollutants. There is therefore the need to normalize the mass rate with an activity parameter denoting the function of the source. For coal-fired power plants, candidates for the activity parameter include coal use rate (i.e., tonnes per unit time) or heat input into the boiler as a result of fuel combustion (i.e., mega Joules per unit of time). Other activity parameters can include the gross or net generation of a unit (in MWh). Collectively, the pollutant mass rate and the activity rate can be used to create a normalized form of the emissions metric – such as milligrams of pollutant emissions per mega Joule of heat input or grams of pollutant emissions per MWh gross generation. These normalized metrics directly provide pollutant mass emission rates when the corresponding activity parameter (i.e., heat input or gross generation) is known.

Use of normalized metrics provides at least three advantages over a concentration-based limit. First, since the activity parameters included in the normalized metrics are readily tracked, it becomes easier to accurately and meaningfully assess the impact of pollutant emissions from a source into an air shed. A second and significant advantage of the normalized metric is that it makes the comparison of pollutant emissions from different sources easier. Thus, sources that are better performing can be distinguished from others that are more average or poorly performing sources. A third advantage is the lack of need to address several of the shortcomings of concentration-based standards that will be discussed subsequently.

Of the different types of mass-normalized metrics discussed above, we prefer the so-called "output"-based form using gross MW generation as the normalizing activity parameter, as opposed to the "input"-based form using heat input or coal feed as the activity parameter. Output-based forms incorporate the thermal-to-electric generation efficiency at a unit into the metric – which is desirable. Going further, normalizing by net generation also includes losses or efficiencies in parasitic loads at a unit. Regardless of the advantages and disadvantages between these various normalized metrics, we urge the MoEFCC to fundamentally rethink the proposed concentration-based form of the standards and repropose or finalize them in mass-normalized form. Later we provide comparisons of the proposed standards with US standards which are in mass-normalized forms.

Second, regardless of whether the standards are proposed in concentration-based or mass-normalized forms, a numerical value of the standard should have an associated averaging time. In other words, while emissions from a power plant stack can be continuous as long as the unit is operating, these emissions (both concentrations, as well as flow rates and therefore mass rates) will vary with time. Without specifying an averaging time, it would be difficult to consistently compare emissions over time, and short term spikes in emissions may not be observed or prevented. If the measurement method is a typical stack test, the averaging time period is the duration of the stack test, which may last 2-3 hours. Clearly, measuring variable emissions over such a short period of time provides no information on the other, longer time periods with no measurements. Also, sources can relatively easily (more so for concentration-based standards) adjust operating parameters to "pass" a stack test while emitting vastly different pollutant rates at other times. Thus, compliance with the standard is not meaningfully assured. We note that the concentration-based EU standards and the mass-normalized US standards that will be used as comparisons include averaging over 30-days. Such averaging time is – sometimes expressed as a 30-day rolling average, and at other times as 30-boiler operating days in the US,[6] or as monthly in the EU[7]).

Third, we note that the type of PM is not specified in the standard – i.e., whether it is the filterable component of the PM emitted from a boiler (and after the exhaust flue gases leave the PM control device, such as an electrostatic precipitator ("ESP")) or whether it also includes the so-called condensable fraction of PM as well. The condensable fraction (mainly composed of sulfuric acid mist as well as various organic compounds) can form when the exhaust gases continue to cool after leaving the ESP – thus, they are formed and emitted after the control device. We also note that the draft notification does not differentiate between different sizes of PM – i.e., it does not contain separate proposed standards for the $PM_{10}$ and $PM_{2.5}$ size fractions. In particular, as the MoEFCC is well aware, adverse health concerns are significant from the emissions of the finer or smaller PM size fractions. We will assume that the draft standard refers to just the filterable portion of total suspended particulates.

Fourth, we realize that including an averaging time such as 30-days, which is essential as discussed above, requires continuous measurements of pollutant concentrations, flow rates, coal feed rate, boiler heat input or gross generation and the like. Therefore, we believe that continuous measurements of activity parameters, such as coal feed rate, boiler heat input, or generation, should be readily available at any power plant unit; we note that continuous emissions monitors ("CEMS") for several of the proposed pollutants (i.e., $NO_x$, $SO_2$, filterable PM, and mercury), as well as flow, are readily available. The $NO_x$, $SO_2$, and flow CEMS have been in use at US power plants for at least 20+ years[8] and are also required for larger EU power

[6] See, for example, the NSPS regulations for the US, provided in Attachment B, at 60.43Da(c) and (g) for $SO_2$ and 60.44Da(a)(1) for $NO_x$.

[7] See, for example, the regulations on industrial emissions for the EU, Directive 2010/75/EU of the European Parliament and of the Council, 24 November 2010, provided in Attachment C, at Annex V, Part 4, 1(a), which state that "no validated monthly average value exceeds the relevant emission limit values set out in Parts 1 and 2."

[8] While $NO_x$, $SO_2$, and flow CEMS at US coal fired power plants were in use prior to the mid-1990s, almost every single coal-fired power plant unit in the US was required to have these three CEMS when the implementing regulations under Title IV of the US Clean Air Act of 1990 went into effect in the mid-1990s – i.e., roughly 20 years ago.

plants.[9] Many vendors make such instruments. Mercury CEMS have been in use for roughly the last 5-7 years at many US power plants. CEMS are also available for filterable particulate matter and have been in use at US coal fired plants (as well as other sources such as cement kilns, etc.) for the last 5+ years. We are aware that the Indian Central Pollution Control Board has recently proposed various types of continuous measurements for sources, including power plants, mainly dealing with effluent water parameters.[10] We urge the MoEFCC and the Central Pollution Control Board to include continuous measurement CEMS for exhaust gas flow rate, $NO_x$, $SO_2$, filterable PM, and mercury as well.

Fifth, we note that even as proposed, the concentration-based standards lack specificity because they do not mention any stack gas conditions which greatly affect measured concentrations. First, they do not mention whether the comparisons are to be made on a "wet" (i.e., including water vapor) or "dry" basis. More importantly, they neglect to mention any excess air or excess oxygen concentration corrections. Typically, concentration measurements are corrected to 3 or 6 percent oxygen, reflecting typical unit operations with some level of excess air. Leaving out an oxygen correction makes the concentration standard meaningless. All that a source would need to do to meet any given standard, on a test day, would be to simply dilute the stack gas flow by running the unit with more excess air for the duration of the test, for example. Again, we reiterate that the mass-normalized forms of the standard do not require any such oxygen corrections since the overall mass rate of emissions does not change while concentrations and flows change over time.

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[9] The EU regulations, Directive 2010/75/EU of the European Parliament and of the Council, 24 November 2010, at Annex V, Part 3, (1) state that "[t]he concentrations of $SO_2$, $NO_x$, and dust in waste gases from each combustion plant with a total rated thermal input of 100 MW or more shall be measured continuously."

[10] See Guidelines for Real-time Effluent Quality Monitoring System, Guidelines for Online continuous monitoring system for Effluents, Central Pollution Control Board, Parivesh Bhawan, East Arjun Nagar, Delhi – 110 032, July 11, 2014, available at http://cpcb.nic.in/FinalGuidelinse.pdf. ("Central Pollution Control Board vide its letter No. B-29016/04/06PCI-1/5401 dated 05.02.2014 issued directions under section 18(1)b of the Water and Air Acts to the State Pollution Control Boards and Pollution Control Committees for directing the 17 categories of highly polluting industries such as Pulp & Paper, Distillery, Sugar, Tanneries, Power Plants, Cement, Oil Refineries, Fertilizer, Chloral Alkali Plants, Dye & Dye Intermediate Units, Pesticides and Pharma Sector, Common Effluent Treatment Plants (CETP) and STPs, Common Bio Medical Waste and Common Hazardous Waste Incinerators for installation of online effluent quality and common emission monitoring systems to help track the discharges of pollutants from these units."(emphasis added)).

Sixth, and lastly, we question the need to have different standards by unit size for $SO_2$, the omission of the $SO_2$ standard for the smaller (<500 MW) units for the 2004-2006 date range, and the omission or lack of a mercury standard for the smaller (<500 MW) units for the pre-2003 units. There is no basis to believe that such smaller units cannot control their $SO_2$ and mercury emissions as effectively as larger units.

We reiterate that the MoEFCC should address these fundamental issues prior to finalization of the notification.

**B. Comparisons of the Numerical Levels of the Proposed Standards to those of Other Jurisdictions**

Table A (all of the Tables are provided following the text) shows the proposed MoEFCC standards, the EU and China concentration-based standards, and the mass-normalized US New Source Performance Standards (NSPS) for coal power plant units – for $SO_2$, $NO_x$, and filterable PM. We show the comparisons to the US standards for various time periods. For the EU and China standards, we provide the comparison of the most stringent post-2017 MoEFCC standard to the appropriate EU/China standard. Copies of the relevant standards from the US, EU, and China are provided as Attachments B, C, and D, respectively, for ease of reference. We note that only portions of the EU and China standards are provided in Table A. Standards that pertain to special areas in China, for example, are not shown. The EU standards (and the US NSPS standards) also contain percent reduction options for $SO_2$ (as compared to the $SO_2$ equivalent content entering the boiler via the sulfur in the coal). These are not shown in Table A and are not discussed further since the MoEFCC draft notification does not contain equivalent percent reduction standards for $SO_2$.

Before discussing how the proposed MoEFCC standards compare to those in China, the EU, and the US, and to actual emissions performance in the US, we note a handful of issues with the proposed limits. First, the proposed MoEFCC standards do not include any standards for any of the pollutants for the 2007-2016 time period. We are not sure if this is a deliberate omission – in which case the MoEFCC should provide some explanation or basis; or, if it is a typographical error in the draft notification – i.e., whether the period ending 2004-2006 should be 2004-2016 instead. The MoEFCC should clarify.

Second, in the Table A comparisons, we note that the EU standards include correction to 6% oxygen.[11]

Third, to make the comparisons with the US NSPS standards meaningful in Table A, we have converted the US standards to equivalent concentration standards. Generally, this required making an assumption with regards to typical unit efficiency (we have assumed 38%) and a separate assumption regarding the so-called fuel factor or F-factor. This parameter relates exhaust gas flow to heat input for a given fuel. It depends on many additional factors including the composition of the coal (such as its carbon, nitrogen, oxygen, sulfur, oxygen, and moisture contents), its heating value and also the exhaust gas conditions (such as temperature and assumed excess oxygen concentration). Pressure is also a variable but we have assumed 1 atmosphere pressure in our analysis. The assumed F-factor can make a dramatic difference in calculating concentrations from mass-normalized standard values.

Various tabulations of F-factors for different types of coal are provided in the literature. We discuss a few of them below. A generic value of 350 $m^3$/GJ is suggested by the World Bank, corrected to 6% excess oxygen.[12] The US EPA recommends the following dry (Fd) and wet (Fw) F-factors for the main coal types.[13]

[11] See Directive 2010/75/EU of the European Parliament and of the Council, 24 November 2010, Article 30, Emission Limit Values and also Annex V (Parts 1 and 2 for Limits) which states that "[a]ll emission limit values shall be calculated at a temperature of 273.15 K, a pressure of 101.3 kPa and after correction for the water vapour content of the waste gases and at a standardised $O_2$ content of 6 % for solid fuels, 3 % for combustion plants, other than gas turbines and gas engines using liquid and gaseous fuels and 15 % for gas turbines and gas engines."

[12] Thermal Power: Guidelines for New Plants, Pollution Prevention and Abatement Handbook, World Bank Group, effective July 1998, Annex C, available at http://www.ifc.org/wps/wcm/connect/3ca3ef004885553eb614f66a6515bb18/thermnew_PPAH.pdf?MOD=AJPERES

[13] Table reproduced from page 14 of EPA Method 19 - Determination of Sulfur Dioxide Removal Efficiency and Particulate Matter, Sulfur Dioxide, and Nitrogen Oxide Emission Rates, available at http://www.epa.gov/ttnemc01/promgate/m-19.pdf

**Table 19–2—F Factors for Various Fuels**[1]

| Fuel Type | $F_d$ | | $F_w$ | | $F_c$ | |
|---|---|---|---|---|---|---|
| | dscm/J | dscf/$10^6$Btu | wscm/J | wscf/$10^6$Btu | scm/J | scf/$10^6$Btu |
| Coal: | | | | | | |
| Anthracite[2] | $2.71\times10^{-7}$ | 10,100 | $2.83\times10^{-7}$ | 10,540 | $0.530\times10^{-7}$ | 1,970 |
| Bituminus[2] | $2.63\times10^{-7}$ | 9,780 | $2.86\times10^{-7}$ | 10,640 | $0.484\times10^{-7}$ | 1,800 |
| Lignite | $2.65\times10^{-7}$ | 9,860 | $3.21\times10^{-7}$ | 11,950 | $0.513\times10^{-7}$ | 1,910 |

At the EU, a relevant guidance standard states as follows: "For solid fuels, the fixed factor is acceptable for commercially traded hard coal and biomass with a moisture content below 25% by mass. At the reference oxygen concentration for solid fuels (6 vol%), this equates to a Fuel Factor of 0.359 $m^3$/MJ or 359 $m^3$/GJ (c.f. 360 $m^3$/GJ recommended by the European Environment Agency)."[14] Thus, this is in the World Bank range of 350 $m^3$/GJ. The document also notes that the factor at 0% oxygen (i.e., under stoichiometric conditions) is around 0.256 $m^3$/MJ or 256 $m^3$/GJ – a dramatic difference from the 359 $m^3$/GJ at 6% oxygen corrected.

In view of these significant differences, we did not rely on these generic F-factor values available in the literature. Rather, as shown in Table B, we calculated the F-factors (both wet and dry, under 0%, 4% and 6% oxygen corrections) for typical Indian coals as shown in Table B. The coal data (average conditions for each coalfield) were taken from a recent UNEP report.[15] We used the average (across all coalfields) F-factor (at 6% oxygen corrected) of 393 $m^3$/GJ.

As Table A shows, the most-stringent of the proposed standards (i.e., post-2017) compare well with the EU and China standards but are weaker than converted US NSPS standards, except for $SO_2$. With regards to the US, the national NSPS standards are periodically updated; however, individual new units, modified units, and units whose emissions endanger public health or

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[14] Graham, D., et. al., Validated methods for flue gas flow rate calculation with reference to EN 12952-15, VGB Powertech, January 31, 2012, at 8, available at https://www.vgb.org/vgbmultimedia/rp338_flue_gas.pdf

[15] UNEP Assessment of the Mercury Content in Coal fed to Power Plants and study of Mercury Emissions from the Sector in India, prepared by Central Institute of Mining & Fuel Research (CIMFR) (Council of Scientific & Industrial Research), Department of Science & Technology, Dhanbad, India, (February 2014), available at http://www.unep.org/chemicalsandwaste/Portals/9/Mercury/REPORT%20FINAL%2019%20March%202014.pdf

environmental values such as visibility are subject to more stringent case-by-case Best Available Control Technology (BACT) or Best Available Retrofit Technology (BART) limits. For example, Table A shows that the most-stringent NSPS standard is around 0.11 lb/MMBtu for $SO_2$ and around 0.075 lb/MMBtu for $NO_x$. However, BACT/BART limit determinations in the last 5 years or so have been around 0.08 lb/MMBtu or lower for $SO_2$ and around 0.05 lb/MMBtu or lower for $NO_x$.

While the proposed $NO_x$ and PM standards are undoubtedly an improvement over current conditions, the available evidence demonstrates that the standards (and, in particular, the proposed PM standard) should be further reduced. Almost all Indian coal-fired power plants already have particulate controls in the form of ESPs.[16] A properly designed, maintained, and well run ESP should be able to meet a lower PM standard of 10 mg/m$^3$ instead of the proposed 30 mg/m$^3$. This would make the Indian standard comparable to the best US and EU standards.

Finally, with regards to the proposed mercury standards, Table A provides comparisons to the US Maximum Achievable Control Technology (MACT) standards. The forms of the US MACT standards shown in Table A are in units of lb/GWh. The most lenient of the US MACT standards shown in Table A are for low ranked (i.e., lignite) coal, at 4.0E-02 or 0.04 lb/GWh. Using the conversion from mass-based to concentration based units and assuming the same F-factor of 393 m$^3$/GJ, this standard corresponds to 0.0048 mg/m$^3$. Clearly, even this most lenient of the US MACT standards is significantly more stringent than the MoEFCC draft standard of 0.03 mg/m$^3$.

We have reviewed available data for the mercury content in various coals used in Indian power plants. An example listing is provided in the UNEP report previously cited.[17] Table 8 from this

[16] *Id.* at 23. ("Almost all the coal/ lignite based power plants in India are equipped with electrostatic precipitators with typical operational efficiencies of particulate capture of more than 99.0 per cent.

The following power plants have installed additional air pollution control devices (APCDs):
o Koradi TPS of Maharastra have installed fabric filters along with electrostatic precipitator;
o Trombay Power Plant and Dhanu Power Plants have installed wet flue gas desulphurization; and
o A few pulverized coal fired power plants have employed ammonia conditioning and $SO_3$ dosing to enhance efficiency of ESP." )

[17] *Id.* at Table 8.

report provides the mercury content in grams/tonne (equivalent to parts per million (ppm) by weight). The mercury levels in coal are comparable to that in many US coals. In the next section, we will show that even with these comparable mercury inlet levels many US plants are achieving much lower mercury levels in the exhaust gases. In fact, available data indicates that even in several Indian power plants, much lower mercury emissions levels have been achieved. The UNEP report previously cited provides at least three such examples, which are assumed to be accurate. The Talcher STPP/NTPC power plant achieved a mercury level of 14.84 $ug/m^3$ or 0.01484 $mg/m^3$ as compared with the 0.03 $mg/m^3$ proposed standard. The inlet level of mercury for this plant was in the range of 0.205 to 0.303 ppm in the coal, which is one of the highest mercury content coals of all those listed in the UNEP report. Next, the Korba power plant achieved a mercury level of 11.50 $ug/m^3$ or 0.0115 $mg/m^3$ (again, significantly lower than the proposed standard of 0.03 $mg/m^3$), with an inlet level of mercury in coal listed at 0.176 ppm. Lastly, the Budge Budge power plant achieved a mercury level of just 4.24 $ug/m^3$ or 0.00424 $mg/m^3$, significantly lower than the proposed standard. The inlet mercury level for this plant was noted as ranging from 0.05 to 0.183 ppm.[18]

**C. Levels of Actual Emissions Being Achieved by Various US Coal-Fired Units.**

Using the conversion of mass-normalized levels to concentrations discussed in the prior sections, we have determined that the most-stringent proposed post-2017 MoEFCC standards for $SO_2$ and $NO_x$ (100 $mg/m^3$) correspond roughly to 0.087 pounds per million Btu (lb/MMBtu), as shown in Table A. The PM standard of 30 $mg/m^3$ corresponds to roughly 0.025 lb/MMBtu.

Thus, we compare actual performance data for various US coal power plant units (most of which were built prior to 2003) with these levels. This comparison suggests that not only the post-2017 but also the pre-2017 standards should be made more stringent.

The data from Tables C, D, E, and F are available at www.epa.gov/ampd. Table C shows the $SO_2$ comparisons using monthly (i.e., 30-day average) data from 2014. The fuels used are either coal, waste coal or petroleum coke. We have excluded data for plants that did not run at least 100 hours in a given month. Further, we have restricted the table to plants with $SO_2$ rates higher

[18] *Id.* at Table 9 for the mercury test levels, and at Table 8 for the inlet coal mercury levels for the plants cited.

than 0.01 lb/MMBtu. This excludes units where significant amounts of a clean fuel such as natural gas may have been used. Nevertheless, Table C shows that there are over 1500 unit-months of data just from 2014 where units have achieved lower emissions rates than the most-stringent proposed MoEFCC post-2017 standard for $SO_2$.

Table D shows similar comparisons for $NO_x$. Again, we have used monthly average data and excluded data for units that did not run at least for 100 hours in a given month. We have then further restricted the data set to units with $NO_x$ emissions starting at 0.01 lb/MMBtu, thereby excluding units where significant quantities of natural gas may have been used. Nevertheless, Table D shows that there were over 1700 unit-months of data just from 2014 where units have achieved lower emissions rates than the most-stringent proposed MoEFCC post-2017 standard for $NO_x$.

Table E shows data for filterable PM collected by the EPA for the MACT rulemaking process in the 2009-2010 time frame. Data for over 500 units tested at or below 0.025 lb/MMBtu, the level roughly corresponding to the most-stringent post-2017 proposed MoEFCC standard of 30 mg/$m^3$ are shown.

Finally, Table F shows mercury test data collected by the EPA as part of the MACT rulemaking process in the 2009-2010 time frame. There are relatively few lignite units in the US and these data are not shown. Thus, data shown are for bituminous and sub-bituminous coals. Indian coals are closer to US bituminous coals, as far as sulfur and ash content are concerned. Using the conversion discussed above, the draft MoEFCC standard of 0.03 mg/$m^3$ corresponds to a mass-based level of approximately 0.25 lb/GWh. This corresponds to a heat-input based level of approximately 23 lb/trillion Btu (TBtu). As we see in Table F, almost 400 US units have tested at levels below the draft standard proposed by the MoEFCC.

The point of showing the data in Tables C through F from actual US unit performance is to demonstrate that existing coal fired power units, many built prior to 2003, using existing air pollution control technologies, are capable today of operating with significantly lower mass emission rates than even the most stringent of the (equivalent) limits included in the draft standards proposed by the MoEFCC. Standards proposed at appropriate levels can help drive such emissions lower.  This is especially important in the Indian context, given that a significant amount of the country's electricity production derives from coal combustion in thermal power plants and that ambient levels of air pollution are worsening in many parts of the country.

In summary, we hope that the MoEFCC will seriously consider the comments provided.  We recommend that the MoEFCC adopt mass-based standards, in either an output-based format or even an input-based format.  We suggest that the proposal adopt the following input mass-based (or equivalent output mass-based) standards, regardless of unit size:

| | **PM (filterable)** | **$SO_2$** | **$NO_x$** | **Mercury** |
|---|---|---|---|---|
| **New Units** | 6.5 mg/MJ (approx. 0.015 lb/MMBtu) | 35 mg/MJ (approx. 0.08 lb/MMBtu) | 26 mg/MJ (approx. 0.06 lb/MMBtu) | 0.43 mg/GJ (approx. 1.0 lb/TBtu) |
| **Existing Units** | 13 mg/MJ (approx. 0.03 lb/MMBtu) | 52 mg/MJ (approx. 0.12 lb/MMBtu) | 43 mg/MJ (approx. 0.10 lb/MMBtu) | 0.43 mg/GJ (approx. 1.0 lb/TBtu) |

Compliance with each of these limits should be demonstrated on a 30-day rolling average basis using CEMS for each pollutant.   Compliance for new units should be required upon commissioning, while for existing units compliance should be required over a reasonable time period of around 5 years, which can be extended to allow for longer times for smaller units (except those in critical areas).

Adopting and enforcing standards at these suggested levels will go a long way in transforming India into a leader in air pollution control from thermal power plants and will lead to significant benefits in public health and restoration of environmental values.