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Dear Gunnar,

Thank you for the opportunity to comment on the document entitled "Process Optimization Guidance Document for Reducing Mercury Emissions from Coal Combustion in Power Plants (hereafter "POG")". **This document provides a good starting point to look for the various options to reduce mercury emission from thermal power plants across the globe, but as specified in the comments below, important revisions are required to improve upon the current draft. It should also be noted, as the POG authors have previously acknowledged, the document is not a Best Available Techniques/Best Environmental Practices (BAT/BEP) evaluation for this sector, since it was not designed or written for this purpose.**

The following are the consolidated comments of members of the Zero Mercury Working Group (ZMWG), on that draft document. In this cover letter we covered important comments on the respective section and sub-sections of the document, but for further details please see also the attached comments in the text of the POG.

Overarching comments-

1. The report needs to emphasize **mercury-dedicated technologies** as the first step instead of considering them (as it does now) as a supplement to the "co-benefit" technologies of wet FGDs and SCRs for SO_2 and NOx controls. This is because the penetration of SO_2 and NOx controls is slow or close to non-existent for existing fleet of coal-fired plants outside the U.S and the EU. On the other hand, dedicated mercury control technologies (activated carbon injection, mercury oxidation technologies, etc.) are available, cheap, and capable of lowering mercury emissions by 90 percent and higher.

2. A serious effort to control mercury emissions from coal combustion must evaluate the feasibility of **mercury-specific measures as the first step** instead of considering it as the "last step" as envisioned in the UNEP/Paragraph 29 study. This is because even in the U.S., where overall air pollution control is more advanced, we still have in the year 2010, only 32 percent of the boilers with wet FGDs for SO_2 control and even

a fewer number of units with SCR for NOx control (though almost 100 percent of the EGUs have PM control with cold- or hot-side ESPs or fabric filters). What this means is that it would take a very long time (to perhaps, 2030?) to get Hg control from 'co-control" units. Additionally, the pre-treatment technologies (coal washing, etc.) are only marginally beneficial in removing Hg. If the goal of the UNEP is to obtain a certain and yet high (90 to 95 %) level of mercury control in a reasonable amount of time (say, 2015 to 2020) at a reasonable cost, mercury controls such as activated carbon injection (ACI) are a proven and cost effective technology for coal fired power plants in the US."

3. For the " Decision Tree" approach outlined in the UNEP report (page 57), should be reconfigured by incorporating dedicated Hg technologies for those cases when "co-benefits" of SOx and/or NOx controls are currently not available or would take a long time (say, not till 2030 ?) before they actually become available. The goal of this approach is to get dedicated mercury controls in place by the time frame of 2015-2020. We need to emphasize that mercury is cumulative neurotoxin whereas SOx and NOx are not, and therefore mercury control should not wait for other 'co benefit" controls to be applied first.

4. The material presented in the chapters on mercury control strategies should be better integrated into the "Decision Tree". Including information on coal properties and mercury removal efficiencies will greatly enhance the usefulness of the "Decision Tree" tool. The preceding chapters present a wealth of data on the degree to which coal properties influence the mercury removal capacity of different control strategies. The decision tree should be expanded to include this information to enable a decision maker to follow a path best suited to the specific characteristics of the coal in their area. Similarly, the "Decision Tree", as presented in the POG, does not give information on the mercury removal rates achievable along the various pathways. This data is essential to ensure that "optimal" mercury control is being achieved; particularly because ACI technologies have consistently demonstrated 90% removal efficiency

5. Previously, with comments on the draft Para 29 study methodology, the ZMWG submitted the recently completed July 2010 NESCAUM report *"Technologies for Control and Measurement of Mercury Emissions from Coal-Fired Power Plants in the United States: A 2010 Status Report."* The focus of this report is on ACI technology as well as on technologies to promote oxidation of elemental mercury to oxidized mercury in the flue gas for subsequent removal in a wet or dry scrubber (if there is one already in place). If the coal-fired boilers only have a PM control devices (and, most of the coal-fired EGUs do), then ACI may be an optimum control technology that can be installed now and at a reasonable cost that is also capable of high level of Hg emission reductions (90 percent and higher).

<u>Specific comments by section:</u>

1. Abstract

About Multipollutant control technologies- A listing of the other toxins present in coal needs inclusion.

2. Inroduction-

- Decision Tree- Hopefully, it is based on and tested against how utilities in the past have made ACTUAL decisions on what tech to choose for Hg control. Have they? We have the impression that it is NOT the way utilities make their Hg control selection decisions. In any case, it would be good if we note if this approach has been ACTUALLY tested against actual decision making. It is important to know that to what extent has the actual decision been affected by the required Hg emission reduction and those in place for other pollutants?

- Achieving reduction in GHG emissions- Coal fired boilers cannot do much regarding energy efficiency improvements. **Unless plants are upgraded to ultra supercritical combustion, energy efficiency improvements have limited potential for reducing CO2. However, if CCS is introduced into the consideration, the link between CO2 and Hg removal breaks down. CCS has a large efficiency penalty, and the reduction of CO2 in this way will increase emissions of Hg by around 20%, depending upon the CC technology used.**
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3. Objective and Scope

- Examples of coal usage-Countries like Japan, Australia, Canada they all have coal EGUs.
- **technical sequence of options-** Dedicated controls should not be looked at AFTER the co benefits. Co benefits may never occur or may occur too late (as in the US) because of all kinds of regulatory and policy delays in the control of traditional pollutants (scrubbers, SCR etc.). Hg on the other hand is neurotoxin and ACI can reduce Hg emissions NOW and one does not have wait 10 to 20 to 30 years for co benefits to arrive 9and they still might not arrive for existing power plants. It will take even longer in China or India for co benefits to appear, if they appear at all. That is why, ACI is being applied NOW in the US (see GAO report and NESCAUM July 2010 report). And, it is rather cheap (see our NESCAUM report). It may be that the sequencing reflects that used in EU's BREF process, for example, where, the usual technical sequence of options (based on primary before secondary, and multi-pollutant before single pollutant) aims to give the most environmentally and cost effective way of achieving a given standard. However, the costs of co-benefit depend upon whether the technologies are required for the abatement of other pollutants, and where they are not so required, dedicated controls become much more cost effective and are achievable. The text must reflect different situations in other countries, and the above concerns should therefore be clarified in the text.

- Optimum mercury control strategy- This implies a strategy that achieves the highest level of mercury control. The decision tree should include mercury removal rate information so that “optimal” mercury control can be selected.
- Co-benefit-In addition to above comment, if co benefits never happen or happen too late, then ACI should be evaluated as FIRST strategy as it is now being done in the US in many states (Massachusetts, New Jersey, Illinois, New York, Connecticut, etc., see GAO 2009 report)

4. Mercury Emissions from Coal Combustion

- References missing at many places

5. Mercury Emission Control Strategies

- **Improvement of the efficiency** also provides for reduction of all emitted pollutants including greenhouse gases (GHGs)- Please be careful about efficiency increase can do for GHG reductions. Not much, because there are severe limits to how much thermodynamic efficiency can actually be increased. May be 1 to 2 percent points.
- Hg specific controls would need to be looked at as FIRST option instead of a last option.
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- **Co-benefit removal-** The general discussion on speciation must consider the differences between coal types like bituminous, sub-bituminous and lignite
  - **Discussion about coal characteristics focussed upon US coal-types only- Section must include coal from other countries**
  - **Adding halogens to the flue gas has been shown to reduce mercury, but the resulting flue gas composition has not been widely studied. In EU halogenated dioxins and furans were produced and this should also be addressed in the document.**
- **Dedicated Mercury Removal Technologies-** Not too much sure about co-benefits in real world. They think, Co benefits are not going to happen or happen at a very slow rate. Hg, on the other hand, could be controlled NOW with dedicated methods and rather cheaply.

6. Improvement of Plant Efficiency

  - "Improvement of plant efficiency may involve a number of measures designed to conserve fuel (coal) and, as a result, to reduce the amount of mercury emissions per unit of electricity generated" - While this is true, overall emissions will increase since more mercury per ton of coal will be emitted. Caution must be exercised here to ensure that the right numbers are used to generate the benefits of mercury reductions from increased efficiency given that increased consumption may occur as a result. (Increased efficiency = lower cost = increased consumption).
  - Clarity needed regarding improvement in boiler efficiency

7. Coal Preparation-

  - **Coal Blending/Switching-**

In the document…………As can be seen, coal blending has the potential of increasing the mercury capture by about 80%…………. **It should say “to 80**

percent and not by 80 percent" see Figure. Or, say: increasing … by 60 percent (from 50 to 80 percent)" or Perhaps we should say 'by up to 80%'

In the document………..The unblended subbituminous coal would have achieved between 0-40% oxidized mercury (ICAC, 2009)………. it is necessary to state whether the 0-40% oxidized mercury was achieved with or without SCR.

- In the document………Thus, coal blending of coal with characteristics similar to those of PRB and bituminous coal above may potentially be a cost effective approach for increasing mercury oxidation for plants firing low S (and low Cl, high Ca) coal. The effect may be more pronounced in plants equipped with SCR systems………… The above text occurs in a section on coal blending/switching, which is one particular way of reducing mercury emissions. However, it arbitrarily and partially introduces another i.e. the co-benefit effect of SCR. In doing so, it not only distracts from the impact of coal blending/switching, but does so in a partial way by only introducing the co-benefit effect of one of several technologies providing co-benefit. Indeed, SCR only provides the indirect co-benefit of increasing the oxidation of elemental mercury, rather than directly removing it, so SCR has no co-benefit effect independent of other technologies. It would therefore be more logical to restrict this section to the effect of coal blending/switching, with the added impact of SCR being more properly addressed in the separate section(s) on co-benefit.

- Fig. 9- The Fig should NOT say Delta across catalyst. That is what Y axis is already showing. NO? May be, it does not need to say ANYTHING. "Delta" causes confusion!
- **In the document……**Coal selection and blending has the potential to reduce mercury emissions by over 80%**………….too certain to say?**
- **In the document………**Another form of coal blending may be co-firing of biomass and/or waste materials with coal. The practice is increasing in several countries, especially in the European Union, as biomass and waste materials are considered as carbon-neutral……

There is a large amount of material in the literature about a serious lack of "carbon neutrality" of bio fuels because of "indirect land use effect" and the type/location of the wood and the practices used in forest management, etc.

- **In the document…..**One review suggests that the majority of plants cofiring biomass with coal achieve mercury emissions which are similar to or lower than those achieved with firing coal alone but that co-firing MSW or sewage sludge could lead to increased emissions of mercury………. **Greater clarification is needed regarding the basis of the "similar to or lower mercury emissions": whether its mass of emission or a rate of emissions? Its quite relevant as biomass has a significantly lower calorific value than coal, and therefore more biomass has to be burned to achieve the same output.**

- **Coal additives-**

……The amount of mercury capture generally increases as the amount of halogens in coal and UBC increase…… **What you say about UBC is true, but why refer to UBC here when the focus is coal additives such as bromine?**

- **In the document……**An order of magnitude more of chlorine-based additive was needed to achieve the same level of baseline elemental mercury reduction………… **What is SEA2 in the Figure 10? Please explain.**
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- **Improvement in Mercury capture through Particulate Matter Control-**
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- **In the document……**The range of measured mercury removals, especially for the ESP, may be an indicator of the potential for improvement due to increased efficiency of a PM collector or due to modification of flue gas and fly ash properties that promote formation of PM-bound mercury……… **Need to be written more clearly. It is not DUE to the increased efficiency of a PM collector. What needs to be said is that there is potential for improvement IF the efficiency of the PM control COULD be improved.**

- Please provide references, range etc.

- **9. Co-benefit Mercury Removal by So_2 and NO_x Controls**
- Table 5- FF, Reasons for Qualitative mercury capture needs to checked

- **Co-benefit of SO2-**
- **In the document…… Operation of a wet FGD requires that a PM control dev**
- **ice be installed………..**
- **mostly PM control device is installed.**

10. Dedicated Mercury Control-

- **Sorbent Injection Upstream of PM Control-**
- Please explain "arc" rates.

11. Multipollutant Control

E-Beam-

- In the document………. The technology is at an early commercialization stage with a number………..**how many?**
- In the document…..A concept has been proposed for the fertilizer production companies to provide the ammonia needed to the power plant and receive the "upgraded" solid nitrogen granular fertilizer. Finally, improved design of electron beam accelerators to allow for the reduction of their size and to provide for increased long-term reliability would greatly enhance market acceptance of the process…….**Please say what happens to mercury? I did not see any data here. Would**

you speculate? Since Kim is quoted above that Hg can be removed at 98% efficiency.

Enviroscrub/Pahlman-

In the document……According to the supplier, different types of reactors are suitable including fluidized bed, baghouse, transport……. "**Transport"? Is that the name of a type of a reactor??**

Electro-catalytic Oxidation-

In the document…..It should be pointed out that these results were achieved with 337 ppm NO_X in the inlet of the ECO system, approximately 40% higher than a similar installation with low-NO_X burners………**Please explain!**

In the document……. As a result, one would typically use an ECO system in combination with low NO_X burners or other devices to minimize NO_X into the ECO reactor……….

PEESP-

In the document………As a result, one would typically use an ECO system in combination with low NO_X burners or other devices to minimize NO_X into the ECO reactor……. **please say something about relative effectiveness of WET ESPs versus FF. Are wet ESPS now just as good as FFs? For PM control? For Hg control??**

12. Decision Tree-

- The tree only optimizes for SO2, NOx and Hg, there needs to be further consideration about the additional HAPs and toxic elements present in coal ash, as well as the GHG issues related to the emissions. While I can appreciate that this would make for a voluminous effort, it should not be ignored in the decision tree implemented by the decision-makers involved with the individual EGUs. A CAUTIONARY NOTE ABOUT THIS MUST BE CONSISTENTLY PLACED THROUGHOUT THE DOCUMENT…
- In the document……..Therefore, for design purposes, it is important to understand the amount of Hg^0 escaping the existing air pollution equipment configuration in order to be able to properly size the ACI system………. **Or to OPTIMIZE the existing air pollution control equipment**
- In the document……..Since currently the majority of power plants in the world do not have CCS installed, the selection for NO_X control is the first decision point in the Decision Tree**……. Please be precise regarding "majority" ? It is not the majority. HARDLY ANY coal fired EGU today has CCS**
- In the document….However, a number of countries may not currently have NO_X emission regulations that would be stringent enough to consider installation of SCR …… **And, also that do have stringent controls for NOx such as US, they rate of penetration of SCR into the existing fleet is rather slow, driven by slow "cap and trade" approaches. Same true for SO2.**

13. Post-control Issues-

- Toxics will be of concern
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14. Examples of Control Costs-

- In the document………One of the approaches that may be used when comparing costs in different countries is the so-called purchasing power parity (PPP) approach, which utilizes the long-term equilibrium exchange rate of currencies in two countries to equalize their purchasing power………… **The incremental O and M costs of ACI are NOT high. Compared to the costs for SO2 and NOx, they are rather very low**

15. Summary-

In the text……… **limited appearance of ACI in table 8**

For more information please contact:

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