



### NRDC COMMENTS ON DRAFT BAT/BEP GUIDANCE DOCUMENT

The Natural Resources Defense Council (NRDC) hereby submits comments on the Draft Guidance on Best Available Techniques and Best Environmental Practices (BAT/BEP) for Controlling and Where Feasible, Reducing Mercury Emissions to the Atmosphere, as set out in Article 8 of the Minamata Convention on Mercury.

In the table below, please find NRDC’s comments for the following documents (listed in the order as they appear):

1. Guidance document on BAT/BEP- intro
2. Guidance on Best Available Techniques and Best Environmental Practices to Control Mercury Emissions from Coal-fired Power Plants and Coal-fired Industrial Boilers
3. BAT-BEP Guidance- NonFerrous
4. Draft guidance on cement clinker production facilities
5. Draft guidance on waste incineration facilities

Suggested new text is shown in **bold** and suggested deletions in ~~strikeout~~.

Document Title	Page Number	Section/ Subsection	Comment
<b>Guidance document on BAT/BEP- Intro</b>	3	1.7.1	<p><u>Revise text, adding bolded text or deleting strikeout text, as follows:</u></p> <p>Step 4: "...from these, select the control technique options which are the most effective to control and where feasible reduce emissions of mercury and to achieve a high general level of protection of <b>human health and</b> the environment as a whole."</p> <p>Step 5: "...determine which of these options can be implemented under economically and technically viable conditions taking into consideration costs and benefits and that they are</p>

			<p>accessible to the operator of the facility as determined by the Party concerned. <b>Note the options selected can often differ for new and existing facilities, since more stringent controls are often technically and economically viable at new facilities.</b> The need for good maintenance and good operational control of the techniques to maintain achieved performance over time should be taken into account.”</p>
	7	1.8	<p>Comment: There is general misuse of monitoring terms that will become extremely confusing for readers, especially in an international context.</p> <p>The text incorrectly uses the term CEM or CEMS to describe analyzer systems that are not used for stack monitoring (such as process monitoring within the process) and therefore does not include sorbent trap methods that are used for CEMS in the United States as CEMs. Instead, the term Continuous Emission Monitoring Systems or CEMS should refer to any system used at the stack (not within the process at a place that is not measuring emissions, such as upstream of an air pollution control device) regardless of the analysis method used, and thus refers to both analyzer as well as other methods (such as sorbent traps, where allowed as a CEMS method) used as stack compliance monitoring methods.</p> <p>Accordingly, analyzers used upstream of the air pollution control device for testing should not be referred to as CEMS even if they use much of the same equipment as used in an analyzer, but sorbent trap systems can be used as CEMS downstream of the device, and they frequently are in the United States.</p> <p>Also, “Continuous” in the acronym “CEMS” refers to the fact that emission samples are continuously sampled or monitored. It has nothing to do with the averaging time of the analysis method, which leads to our comments about misuse of other terms. In the United States, both analyzer methods and sorbent traps are used as CEMS, even though averaging times for the measurement may be a few minutes (in the case of the analyzer) or a few days (in the case of the sorbent trap).</p> <p>Thus, no individual sample stream is monitored continuously in an SCEM, but is monitored “semi-continuously” – say, every 15 minutes. So, semi-continuous in the context of an SCEM means that there are periods of time between sample periods where sample gas is not being collected for analysis. In some cases there are measurement methods that do not lend themselves to continuous sampling of even a single stack, and these may be regarded as SCEMs if they take a sample, stop, analyse it, and then start sampling and analyzing again. But, in the case of the Hg analyzer methods being discussed and the use of sorbent traps, they can and are being used in the United States as CEMS and not as SCEMS. Therefore, this</p>

			<p>acronym is not being used correctly in the text.</p> <p>For example, the text describes analyzer methods that accumulate a sample over a few minutes that are used in CEMS systems in the United States (such as cold vapour atomic fluorescence) as semi-continuous (See Section 6.1 of the coal draft). This is incorrect. These systems, in particular the Tekran Hg analyzer that is common in many CEMS in the US that uses two gold traps, continuously draws a sample of flue gas and uses more than one trap to ensure that continuous monitoring is possible. The cycle time of the traps is only 150 seconds, or 2 ½ minutes.<sup>1</sup> The text makes a similar mistake regarding sorbent traps.</p> <p>In the cement section sorbent traps are identified as semi-continuous although they are in fact an approved method for CEMS in the United States. This is very confusing in part because these methods that are widely used in CEMS in the United States are identified by the author as semi-continuous emission monitors or SCEMs</p> <p>In fact, the use of SCEM in the text appears to suggest that any monitoring device that provides a time-averaged measurement is “semi-continuous”. However, <i>all analysers</i> and methods used in emissions monitoring – NOx, SO2, mercury, etc. – use some form of time averaging in their measurement or signal processing.<sup>2</sup> Even if this is more narrowly defined as only those systems that accumulate a sample before analysing it, that would still include many systems that continuously draw the gas for measuring and are regarded as CEMS. Therefore, the manner in which the author appears to be applying the term “semi-continuous” there may be no “continuous” forms of emissions monitoring and therefore no such thing as a CEMS.</p> <p>We recommend that the SCEM acronym and all reference to “semi-continuous” should be removed throughout the draft. This term SCEM is very confusing as used in light of the fact that methods that the author described as SCEMS are recognized as CEMS by US EPA. We reiterate and provide text revisions regarding these terms in the relevant portions of the other monitoring portions of the guidance as well.</p>
	8	1.8.1	<p>“The selection of a measurement or monitoring approach should begin with consideration of the intended outcomes. Short term measurements may be needed to provide quick feedback for process optimization, <del>and</del> <del>or</del> long term monitoring may be desirable for <b>more accurate emissions data</b> and emissions inventory reporting. Continuous emissions monitoring may be</p>

<sup>1</sup> [http://www.tekran.com/files/Newsletters/Tekran\\_NL01.pdf](http://www.tekran.com/files/Newsletters/Tekran_NL01.pdf)

<sup>2</sup> Time averaging of continuous flow analyzers is necessary to address detector noise. Therefore, measurements cannot be continuously provided even for these analyzers.

			needed to control the process if mercury emissions are highly variable, for example due to rapidly changing mercury contents in the feed materials, <b>or to improve compliance with applicable standards.</b> ”
	12	1.8.2.1.1	“In this method a sample is withdrawn from the flue gas stream isokinetically through probe/filter system, maintained at 120 °C (250°F) or the flue gas temperature (whichever is greater), followed by a series of impingers in an ice bath.”
<b>Guidance on Best Available Techniques and Best Environmental Practices to Control Mercury Emissions from Coal-fired Power Plants and Coal-fired Industrial Boilers</b>	5	1	“ <del>While not</del> <b>Even when not</b> designed <b>specifically</b> for mercury capture, these APCSs are capable of capturing some of the mercury output from combustion with the direct effect of reducing the release of mercury to the atmosphere (so-called mercury co-benefit of APCS).”
	6	2. Title	“Processes Used In <del>The</del> Coal-Fired Power Plants And Coal-Fired Industrial Boilers, Including Consideration Of Input Materials And Behaviour Of Mercury In The Process”
	6	2.1	“In some countries lignite and subbituminous coal are termed “brown coal”, <b>while</b> bituminous and anthracite coal are termed “hard coal”.”
	8	2.2	“ <b>The form of the mercury in the flue gas is important because the form determines whether or not it can be captured and, if so, how.</b> Mercury emissions from coal-fired boilers can be classified into three main forms: gaseous elemental mercury (Hg <sup>0</sup> ), gaseous oxidized mercury (Hg <sup>2+</sup> ), and particulate-bound mercury (Hgp) which may be elemental or oxidized mercury.”
	9	2.2	“ <b>Elemental gaseous mercury is a gaseous form of mercury that cannot be captured unless first transformed into oxidized or particulate mercury. Particulate mercury and oxidized mercury can be removed with pollution control devices.</b> The relative amounts of these three main forms of mercury in the flue gases are the so-called mercury speciation. Mercury bromination/chlorination is assumed to be the dominant mercury chemical transformation mechanism affecting the speciation of mercury. Other potential mechanisms involve mercury interactions with ash particle surfaces where reactive chemical species, catalysts, and active

		<p>sorption sites are available to convert elemental to oxidized mercury as well as elemental and oxidized mercury to particulate-bound mercury (Galbreath and Zygarlicke, 2000). Gas phase oxidation occurs primarily via <del>chlorine</del> <b>halogen</b> species originally present in the coal as the gases cool down through the air preheater and air pollution control devices. The extent of gas phase mercury oxidation is highly dependent upon the coal rank, concentration of <b>halogens (such as chlorine or bromine)</b> <del>chlorine</del> present in the coal, and the operating conditions of the boiler (e.g., air-to-fuel ratio and temperature). For example, a study of mercury speciation measurements from fourteen different coal combustion systems reported from 30 to 95 per cent oxidized mercury upstream of the air pollution control devices (Prestbo and Bloom, 1995). A literature survey reveals that mercury oxidation falls primarily in the range of 45 to 80 per cent, with the oxidized form of mercury mostly being mercury chloride (Senior et al., 2004).</p> <ul style="list-style-type: none"> <li>• Different combustion or firing methods of coal are used in power plants and industrial boilers. These methods include:</li> <li>• Suspension firing of pulverized coal (PC firing)</li> <li>• Stoker firing (i.e., firing on a slowly moving or fixed grate)</li> <li>• Fluidized bed firing (in either a bubbling type or a circulating fluidized bed)</li> <li>• <b>Cyclone firing of crushed coal</b></li> </ul> <p>Most large steam generation at power plants is produced through the <b>PC and cyclone firing methods</b>. In a PC boiler, finely grounded coal is pulverized to a fine powder and blown directly to individual burners where it is mixed with pre-heated combustion air and combusted in a flame. The heat energy from the combustion process is used to produce steam which drives a turbine-generator set to produce electricity. Field tests indicate that the speciation profile varies a lot among the tested PC boilers (Wang et al., 2010). <b>In cyclone firing crushed (but not pulverized) coal is burned in a swirling combustion chamber at high temperatures, making a liquid slag out of most of the mineral matter in the coal. The hot gases then enter the furnace where they radiate heat to the furnace walls and convect heat to generated steam, which drives a turbine generator set to produce electricity. Cyclone boilers generate less fly ash per unit coal burned than PC boilers because most of the mineral matter in a cyclone boiler becomes a liquid slag that is collected from the bottom of the cyclonic combustion chamber. Cyclone boilers, however, tend to be high NOx emitters due to the high combustion temperature.</b></p> <p>Stoker firing is still in use in some parts of the world, mostly in smaller boilers. In stoker firing, heated air passes upward through apertures in the grate. Dampers are positioned in under-grate zones in order to achieve proper biasing of airflow. Over-fire combustion (air added above the grate) adds turbulence to gases coming from the grate and supplies the required air for the</p>
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			portion of fuel that burns in suspension. In general, stokers produce less particulate matters per unit of fuel fired, and coarser particulate matters compared with PC firing, because combustion takes place in a quiescent fuel bed without significant ash carryover into the exhaust gases.”
	10	3.1	<p>“Coal washing generates waste slurry. There is potential soil or groundwater contamination if coal washing slurry is not safely managed.”</p> <p>Comment regarding above text: Since this is a crucial aspect of coal washing, it needs to be expanded upon. At least briefly discuss some methods to safely manage the waste.</p>
	10	3.2	“ Depending <b>upon</b> the configuration of pollution control equipment, varying amounts of mercury removal could be accomplished.”
	11	3.2	<p>“The overview of the magnitude of co-benefit mercury removal for different configurations of existing APCSSs are shown in <b>Error! Reference source not found.</b> (Srivastava et al., 2006; EIPPCB, 2013). It should be noted that the co-benefit removal as shown in <b>Error! Reference source not found.</b> will vary depending on coal properties and operational parameters of the APCSSs.”</p> <p>Comment regarding above text: Consider adding relevant portion of Table 1 of 2015 ES+T article by Zhang et al following Table 2 below. We provide a copy of this article with our comments.</p>
	11	Table 2, Row 3	“Good capture of oxidized mercury. <b>Catalytic oxidation on filter cake enhances oxidation and capture.</b> ”
	12	3.2	“Therefore, co-benefit techniques, which can control air pollutants emission and moreover remove mercury, <b>can be</b> quite effective as a comprehensive air pollution control.”
	12	3.2	“...as well as high level mercury removal efficiency, <b>which in this case as</b> <del>averagely averages</del> 74.4 per cent, which results in 1.2 µg/m <sup>3</sup> of mercury concentration in the flue gas <b>for this application.</b> ”
	12	3.2	“Furthermore, the combination of SCR, Low Low Temperature ESP (LLT-ESP), and wet FGD, can achieve quite high level mercury removal efficiency <del>as averagely averaging</del> 86.5 per cent <b>in this case</b> , which results in 0.88 µg/m <sup>3</sup> of mercury concentration in the flue gas for this specific case.”
	12	3.2	<p>“The mercury concentrations in Figure 5 show wide ranges because these include older <del>and/or smaller</del> units which provide the higher concentration.”</p> <p>Comment regarding above text: We are not sure that age or size has much to do with it. The range of emission rates probably has more to do with the coal characteristics and operating conditions than anything else. What does size have to do with mercury emission rate?</p>

	13	3.2	<p>Comment: Figures 4 and 5 and associated discussion. What is the difference between an ESP and a LLT-ESP? This needs to be explained here although it is described much later in the document. When we see SCR+ESP+FGD in Figures 4 and 5, are these cold-side ESPs (our guess is that most are)? If that is the case, it is important to explain here how the LLT-ESP's are different from what most people understand to be cold-side ESPs. This is discussed somewhat later in the document (section 3.2.1.4). But some description is needed here to let the reader know what an LLT-ESP is. It is also a good time to introduce the importance of temperature, as that is what drives mercury to go to the oxidized form as the equilibrium state changes – and oxidized mercury is more easily captured.</p> <p>Furthermore, regarding these figures, the dry FGD is always followed rather than preceded by either an ESP or a fabric filter. So, the capture mechanism is very different than the case where you have a wet FGD preceded by an ESP. In fact, it would be more correct to label these as SCR+dry FGD+ESP, or SCR+dry FGD+FF, depending upon whether a fabric filter or ESP is the final particulate control device.</p> <p>Also, as noted above, we are not sure that age or size of the unit has as much to do with the range of emission rates and capture efficiencies shown on these figures as the coal characteristics and the operating conditions of the units. For example coal halogen levels, carbon levels in the fly ash, gas temperatures, and pH of the wet scrubber likely have much more impact on the capture efficiency than the age or size of the unit.</p>
	13	3.2.1.1	<p>“The effectiveness of an ESP depends largely on the electrical resistivity of the particles being collected <b>and the treatment time, which is determined by the size of the ESP (and is related to the specific collection area, or SCA, a measure of the collection area versus the gas volume being treated).</b>”</p>
	14	3.2.1.1	<p>“<b>An ESPh is generally much less effective than an ESPc at removing mercury because mercury tends to oxidize as temperature drops, making it more susceptible to adsorption onto fly ash and capture with the lower temperature ESPc.</b> This is particularly important for units burning low-sulfur coal, resulting in fly ash with higher electrical resistivity.”</p>
	14	3.2.1.1	<p>“For example, while the average reported mercury removal for an ESP operating on a bituminous coal was about 30 per cent, the range of measured removals varied from 0 to about 60 per cent (US EPA, 2001).”</p> <p>Comment regarding above text: Hot or cold side ESP? Likely cold side since removal with ESPh would likely be much less.</p>
	14	3.2.1.1	<p>“It is important to understand the PM collection performance of a device since this in turn</p>

			affects the device's capability to reduce mercury emissions. <b>Sulfur content of the coal as well as level of unburned carbon in the fly ash will also impact the degree of mercury capture by the ESPc.</b> "
	14	3.2.1.1	"ESPs <del>generally</del> remove only Hg <sub>p</sub> in the process of collecting PM."
	15	3.2.1.1	"Low temperatures in the control device system (less than 150 °C) also enhance mercury control and LLT-ESP has been practiced in Japan to achieve higher removal efficiency of dust and mercury (CRIEPI and FEPC, 2012). <b>SO<sub>3</sub> from coal sulfur or from flue gas conditioning will also suppress the mercury capture in an ESPc because the SO<sub>3</sub> competes with mercury for capture on the carbon.</b> "
	15	3.2.1.2	"In addition to longer contact time, better contact is provided in a FF (gas penetrates through the filter cake) than in an ESP (gas passes over the surface of the cake). <b>The result is that gaseous elemental mercury is more likely to be oxidized and transformed into a form that can be captured when a FF is used.</b> "
	18	3.2.2.1	<del>"The operation of a wet FGD requires that a PM control device be installed upstream of the wet FGD scrubber (Srivastava and Jozewicz, 2001)."</del>  Comment regarding above text: This is incorrect. Although most wet scrubbers are preceded by an ESP or other PM control device, there are combination wet particulate scrubbers that also are wet FGD. Since this doesn't really add to the discussion anyway, it should be removed.
	18	3.2.2.2	<del>"Some issues that limit the use of spray dryers with high sulfur coals include the ability of the existing PM control device (most often a FF) to handle the increased loading and achieve the required efficiency."</del>  Comment regarding above text: This is incorrect. The PM control device is not the limiting factor. For an SDA the limiting factor is the concentration of lime in the slurry. For circulating dry scrubbers, there is no limitation because water and lime are added separately. CDS scrubbers can be used on high sulphur coal. In any event, it has no bearing and should be deleted.
	18	3.2.2.2	"Scrubbing of halogen species in the spray dryer absorber may make oxidation and subsequent capture of mercury (mostly in the form of elemental mercury for these coals) in the downstream FF less effective. Sometimes, higher mercury capture is accomplished by FF alone for low rank coal than mercury capture by SDA-FF (Srivastava et al., 2006)."  Comment regarding above text: Another incorrect statement. The concentration of the lime in the slurry limits the SO <sub>2</sub> removal of an SDA. It has nothing to do with the FF. For example, Circulating Dry Scrubbers (CDS) can achieve high removal efficiencies on high sulphur coal

			because the water and lime are added separately rather than together as a slurry.
	18	3.2.2.2	<p><i>“Cross media effects for SO<sub>2</sub> control devices (non-mercury related)</i> The operation of FGD system generally increases energy consumption, typically up to 5 per cent.”</p> <p>Comment regarding above text: This isn’t really “cross media” related. It is an energy impact of a scrubber. We’re not sure what it is doing here since it is not specifically related to mercury removal. Also, 5% seems a bit high.</p>
	19	3.2.3	<p>“Under certain conditions, SCR catalysts have been shown to change mercury speciation by promoting the oxidation of elemental mercury to oxidized mercury, particularly for high <del>ehlorine</del> <b>halogen</b> coal.”</p> <p>Comment regarding above text: Some would argue that bromine is what is really important, much more so than chlorine. So, better to say high halogen.</p>
	19	3.2.3	<p>“Instead, by increasing the amount of oxidized mercury upstream of the wet FGD, the SCR improves mercury capture in the wet FGD systems, resulting in the enhanced removal of mercury (Chu, 2004; Favale et al., 2013). <b>Also, oxidized mercury is more likely to be adsorbed onto fly ash, which will improve capture by the ESPc.</b>”</p>
	19	3.2.3	<p>“...the parameter that shows the most promise for the optimization of mercury removal is the <del>ehlorine</del> <b>halogen</b> content of the coal.”</p>
	19	3.2.3	<p>“ As discussed in the coal blending section below, <b>in the United States</b> oxidation of elemental mercury to oxidized mercury is greater for bituminous coals (<b>which in the United States tend to be higher in halogen content</b>) than for subbituminous coals (<b>which in the United States tend to be lower in halogen content</b>).”</p> <p>Comment regarding above text: This has less to do with coal rank than with halogen content. It just so happens that in the US higher rank coals tend to be higher in halogen than subbituminous coals. It is unclear is that is broadly the case in other countries.</p>
	19	3.2.3	<p>“The extent of mercury oxidation and capture by increasing the fraction of bituminous coal in a subbituminous/bituminous coal blend, may be augmented by an SCR. A field study at a large utility plant firing a 60 per cent subbituminous and 40 per cent bituminous blend at two identical boilers (one with SCR and the other without SCR) demonstrated an increase in the oxidized mercury fraction from 63 per cent without SCR to 97 per cent with SCR. Generally, in systems with SCRs, mercury oxidation across the SCR increases with an increasing percentage of bituminous coal in a subbituminous/bituminous coal blend. For example, for the 65/35 subbituminous/bituminous coal blend, the amount of increase was 49 percentage points</p>

			<p>(from 13 to 62 per cent). However, the increase was only 14 percentage points (from 6 to 20 per cent) for the 79/21 blend (Serre et al., 2008).</p> <p>The unblended subbituminous coal in a unit without SCR would have achieved between 0 and 40 per cent oxidized mercury (ICAC, 2010). In another field study, tests conducted in three bituminous coal-fired plants showed mercury oxidation across the SCR of up to over 90 per cent. The resultant mercury removal in downstream wet scrubbers was 84 to 92 per cent with SCR operation compared to 43 to 51 per cent without SCR operation. However, plants firing subbituminous coals showed little change in mercury speciation across the SCR reactors (Laudal, 2002).”</p> <p>Comment regarding above text: Again, this is not so much an issue of coal rank, but of halogen content. If a boiler had subbituminous coal with adequate halogen, there would be no need to blend with another coal or add bromine.</p>
	20	3.3.1	<p>“Typically, high sulfur bituminous coals are blended with low sulfur subbituminous coals to lower SO<sub>2</sub> emissions. As an undesired side effect of this SO<sub>2</sub> emission control strategy, mercury speciation may be altered reducing the amount of oxidized mercury and increasing the amount of elemental mercury, thus compromising mercury capture in a downstream FGD system. However, blending of coals may also be used to increase the amount of oxidized mercury in flue gas. In addition to mercury content, certain coal characteristics such as chlorine and bromine content or alkalinity content are important for mercury removal and should be known.”</p> <p>Comment regarding above text: Again, this is a very US centric discussion that may not apply elsewhere depending upon fuel chemistry in other places. Better to put it in the context of high halogen versus low halogen coals rather than high sulphur versus low sulphur or bituminous versus subbituminous.</p> <p>The discussion about bituminous versus subbituminous or lignite and coal blending is misleading because it is based on US experience that may be different elsewhere. This has less to do with coal rank than with halogen content. It just so happens that in the US higher rank coals tend to be higher in halogen than subbituminous coals. If a boiler had subbituminous coal with adequate halogen, there would be no need to blend with another coal or add bromine.</p> <p>Also, the text should mention that increased oxidation will also improve removal by the PM control device.</p>
	20	Table 3	<p>Comment regarding table: Mercury contents, in fact, will vary widely across coals and even</p>

			for the same coal, as stated in Section 6 of the text and as we note below. Better to give ranges applicable globally, since it is unclear if these values are typical of coals outside of the USA.
	20	3.3.1	<p>“It should be noted from <b>Error! Reference source not found.</b> that even though mercury content is the same at 0.1 ppm for both types of coals...”</p> <p>Comment regarding above text: Mercury content also varies widely, as noted above.</p>
	24	3.4.1	<p>“A specially designed FF <b>and air preheater</b>, Compact Hybrid Particulate Collector (COHPAC) located downstream of ACI, was used for removing the injected carbon.”</p>
	25	3.4.1	<p>“In some cases low mercury removal by untreated activated carbon is the result of a combination of lower levels of chlorine in subbituminous coal and the neutralization of halogen species by high levels of sodium and calcium in the subbituminous coal fly ash.”</p> <p>Comment regarding above text: Is subbituminous coal lower in halogens everywhere? Be clear that this is the US experience and that coals from other parts of the world may have different chemistries.</p>
	25	3.4.2	<p>“ 2) in general, can be operated at lower injection rates, which leads to fewer plant impacts and a lower carbon content in the captured fly ash”</p> <p>Comment regarding above text: Not sure if this is the case if halogen levels are already high.</p>
	25	3.4.2	<p>“3) results in better performance <b>with low halogen</b> coals.”</p> <p>Comment regarding above text: Subbituminous and lignite was the case in the US. Not sure if it is the case elsewhere.</p>
	27	3.4.3	<p>“The ACI increases the quantities to landfill.”</p> <p>Comment regarding above text: By roughly how much? Usually, the amount of carbon is very small compared to fly ash collected in PM control device. It would be good to make this point here.</p>
	27	3.4.3	<p>“There is potential of secondary mercury release from thermal treatment of fly ash and electrostatic separation of carbon from fly ash.”</p> <p>Comment regarding above text: Do you mean in the ESP or is this some sort of after treatment? Please be clear.</p>
	27	3.5	Revise section heading to read as follows: “Cost <b>and Benefits</b> of Mercury Control Technologies”

			<p>Comment regarding above text: We note that the definition of “available” and thus the definition of BAT under the Convention includes consideration of both the costs and benefits of mercury control options, but there is no discussion in this text of the benefits of stricter mercury controls on coal combustion facilities. We are aware of benefits studies from both US EPA (See e.g., <a href="http://www.epa.gov/ttn/ecas/regdata/RIAs/matsriafinal.pdf">http://www.epa.gov/ttn/ecas/regdata/RIAs/matsriafinal.pdf</a>; <a href="http://www.epa.gov/oaqps001/combustion/docs/boilerreconfinalria121220.pdf">http://www.epa.gov/oaqps001/combustion/docs/boilerreconfinalria121220.pdf</a>) and others which could be discussed here, as well as studies documenting the benefits of decreasing mercury exposure generally (See e.g. <a href="http://www.ehjournal.net/content/12/1/3">http://www.ehjournal.net/content/12/1/3</a>). This section should be revised to include a benefits section comparable to the cost discussion, for both legal and policy reasons.</p>
	27	3.5	<p>“Defining the cost of mercury removal accomplished as a co-benefit is complex because cost apportionment needs to be considered between mercury control cost and the cost of controlling other pollutants such as <b>PM</b>, <b>SO<sub>2</sub></b> or <b>NO<sub>x</sub></b> (Sloss, 2008).”</p>
	27	3.5	<p>“Usually mercury reduction through co-benefit effects (the installation of technologies such as FGD and SCR which also reduce mercury emissions) can be regarded as minimal or even ‘free’ <b>because high capital cost technologies like SCR and FGD are generally added for the purpose of NO<sub>x</sub> or SO<sub>2</sub> control, respectively, and would not be added solely for mercury control because lower cost alternatives are available for mercury control.</b> Alternatively, mercury control may be accomplished by dedicated technology such as ACI <b>at a much lower cost providing that there is an existing PM control device.</b>”</p>
	27	3.5.1	<p>“Therefore, the BAT chosen for mercury capture can be different in different countries. It should be pointed out that when considering nationwide or even region-wide deployment of BAT, a range of costs should be considered for any given BAT rather than an exact figure.”</p> <p>Comment regarding above text: This text is misleading because “therefore” and the second sentence suggests BAT selection is a function only of cost. Again, the benefits side of BAT must be considered as well, for both legal and policy reasons.</p>
	28	Table 4	Comment regarding table: 2015 dollars?
	28	Table 6	Comment regarding table: What year CNY?
	28	Table 9	Comment regarding table: Please indicate if these are US costs and the year basis of the cost.
	32	5	<p>“General principles for the choice of BAT for the point source categories listed in Annex D are described in the introductory chapter of this guidance. Here we focus on the choice of mercury controls in the coal combustion sector.</p> <p><b>The use of BAT to control, and where feasible to reduce emissions, is required for new sources as defined in para 2(c) of Article 8 and is one of several measures which a Party may use for existing sources as defined in para 2(e) of Article 8. This guidance is intended</b></p>

			<p>to support Parties in selecting and implementing BAT.</p> <p>The final determination by the Parties of what constitutes BAT for atmospheric emissions of mercury from coal-fired power plants and industrial boilers needs to consider various technologies and techniques described in this guidance document. The Parties under Article 8 may use emission limit values (ELVs) for both new and existing sources that are consistent with the application of BATs. To be certain that the application of the BAT selected by the parties results in expected reductions in emissions of mercury, Article 8 notes that ELVs can be either in the form of limits on mercury concentrations or a limit on mass of mercury or a limit on emission rate of mercury or mercury compounds, expressed as “total mercury” emitted from the affected source. Well-defined ELVs (with necessary monitoring and reporting of mercury emissions already described in this report) associated with the selected BAT, will facilitate assurance that the application of BAT will result in the expected mercury reductions.”</p>
	32	5.1.5	<p>Insert text in new section:</p> <p><b>“Section 5.1.5 Summary of Emissions Levels Associated with BAT/BEP</b></p> <p>As noted in section 5.1.3, control measures for mercury removal involves the use of conventional post combustion APCs for SO<sub>2</sub>, NO<sub>x</sub>, and PM can result in substantial reductions in mercury emissions as a “co-benefit”. The combination of SCR, ESP and wet FGD, which is an efficient technique already in common use in some countries, can achieve levels of 0.0012 mg Hg/Nm<sup>3</sup> of mercury concentration in the flue gas. Further, dedicated mercury control, including ACI technology, has shown even more effective removal. The operations of ACI technology in the United States show that mercury concentration in flue gas after ACI and fabric filters are lower than 0.001 mg Hg/Nm<sup>3</sup>. Thus, as indicated above, the performance level associated with best available techniques and best environmental practices in installations with dedicated technology for control of mercury emissions to air (such as ACI) is below 0.001 mg Hg/Nm<sup>3</sup> and is 0.0012 mg Hg/Nm<sup>3</sup> for plants with conventional post-combustion APCs.</p> <p>It is reasonable for Parties to require more stringent BAT, such as the level of control (or ELVs) associated with ACI technology, at new facilities. New facilities have the benefit of being able to design the most up to date technology into the plant, while existing sources must work within the limitations of the existing equipment, such as conventional pollution controls. For an existing plant, for example, there may not be adequate space available to retrofit BAT without relocating existing equipment at a very large expenditure.</p>

Regulations in the United States provide an example of more stringent requirements for new facilities versus existing facilities. As shown in the table, for the Mercury and Air Toxic Standards for electric utility boilers, US EPA requires much more stringent emission standards for new facilities than for existing facilities. Therefore, it is reasonable that BAT/BEP as required for new facilities should be substantially more stringent than the requirements for existing facilities. Also shown are two tables comparing emission limits for new (or reconstructed) industrial boilers with emission limits for existing industrial boilers. [ENVIRONMENTAL PROTECTION AGENCY 40 CFR Part 63 [EPA-HQ-OAR-2002-0058; FRL-9676-8]]”

TABLE 3—EMISSION LIMITATIONS FOR COAL-FIRED AND SOLID OIL-DERIVED FUEL-FIRED EGUS

Subcategory	Filterable particulate matter	Hydrogen chloride	Mercury
Existing—Unit not low rank virgin coal .....	3.0E-2 lb/MMBtu. (3.0E-1 lb/MWh)	2.0E-3 lb/MMBtu. (2.0E-2 lb/MWh)	1.2E0 lb/TBtu. (1.3E-2 lb/GWh).
Existing—Unit designed low rank virgin coal .....	3.0E-2 lb/MMBtu. (3.0E-1 lb/MWh)	2.0E-3 lb/MMBtu. (2.0E-2 lb/MWh)	1.1E-1 lb/TBtu. (1.2E-1 lb/GWh). 4.0E0 lb/TBtu <sup>a</sup> . (4.0E-2 lb/GWh <sup>a</sup> ).
Existing—IGCC .....	4.0E-2 lb/MMBtu. (4.0E-1 lb/MWh)	5.0E-4 lb/MMBtu. (5.0E-3 lb/MWh)	2.5E0 lb/TBtu. (3.0E-2 lb/GWh).
Existing—Solid oil-derived .....	8.0E-3 lb/MMBtu. (9.0E-2 lb/MWh)	5.0E-3 lb/MMBtu. (8.0E-2 lb/MWh)	2.0E-1 lb/TBtu. (2.0E-3 lb/GWh).
New—Unit not low rank virgin coal .....	7.0E-3 lb/MWh	4.0E-4 lb/MWh	2.0E-4 lb/GWh.
New—Unit designed for low rank virgin coal .....	7.0E-3 lb/MWh	4.0E-4 lb/MWh	4.0E-2 lb/GWh.
New—IGCC .....	7.0E-2 lb/MWh <sup>b</sup>	2.0E-3 lb/MWh <sup>d</sup>	3.0E-3 lb/GWh <sup>e</sup> .
New—Solid oil-derived .....	9.0E-2 lb/MWh <sup>c</sup>	2.0E-2 lb/MWh	2.0E-3 lb/GWh.

**Note:** lb/MMBtu = pounds pollutant per million British thermal units fuel input.  
 lb/TBtu = pounds pollutant per trillion British thermal units fuel input.  
 lb/MWh = pounds pollutant per megawatt-hour electric output (gross).  
 lb/GWh = pounds pollutant per gigawatt-hour electric output (gross).  
<sup>a</sup> Beyond-the-floor limit as discussed elsewhere.  
<sup>b</sup> Duct burners on syngas; based on permit levels in comments received.

**TABLE 3—EMISSION LIMITS FOR BOILERS AND PROCESS HEATERS**  
 [lb/MMBtu heat input basis unless noted; alternative output based limits are not shown in the summary table below]

Subcategory	Filterable PM (or total selected metals) (lb per MMBtu of heat input) <sup>a</sup>	HCl (lb per MMBtu of heat input) <sup>a</sup>	Mercury (lb per MMBtu of heat input) <sup>a</sup>	CO (ppm @3% oxygen) <sup>a</sup>	Alternate CO CEMS limit, (ppm @3% oxygen) <sup>b</sup>
Existing—Coal Stoker .....	0.040 (5.3E-05) ...	0.022	5.7E-06	160	340
Existing—Coal Fluidized Bed .....	0.040 (5.3E-05) ...	0.022	5.7E-06	130	230
Existing—Coal Fluidized Bed with FB heat exchanger .....	0.040 (5.3E-05) ...	0.022	5.7E-06	140	150
Existing—Coal-Burning Pulverized Coal .....	0.040 (5.3E-05) ...	0.022	5.7E-06	130	320
Existing—Biomass Wet Stoker/Sloped Grate/Other .....	0.037 (2.4E-04) ...	0.022	5.7E-06	1,500	720
Existing—Biomass Kiln-Dried Stoker/Sloped Grate/Other .....	0.32 (4.0E-03) .....	0.022	5.7E-06	460	ND
Existing—Biomass Fluidized Bed .....	0.11 (1.2E-03) .....	0.022	5.7E-06	470	310
Existing—Biomass Suspension Burner .....	0.051 (6.5E-03) ...	0.022	5.7E-06	2,400	° 2,000
Existing—Biomass Dutch Ovens/Pile Burners .....	0.28 (2.0E-03) .....	0.022	5.7E-06	770	° 520
Existing—Biomass Fuel Cells .....	0.020 (5.8E-03) ...	0.022	5.7E-06	1,100	ND
Existing—Biomass Hybrid Suspension Grate .....	0.44(4.5E-04) .....	0.022	5.7E-06	2,800	900
Existing—Heavy Liquid .....	0.062 (2.0E-04) ...	0.0011	2.0E-06	130	ND
Existing—Light Liquid .....	0.0079 (6.2E-05) .....	0.0011	2.0E-06	130	ND
Existing—non-Continental Liquid .....	0.27 (8.6E-04) .....	0.0011	2.0E-06	130	ND
Existing—Gas 2 (Other Process Gases) .....	0.0067 (2.1E-04) .....	0.0017	7.9E-06	130	ND
New—Coal Stoker .....	0.0011 (2.3E-05) .....	0.022	8.0E-07	130	340
New—Coal Fluidized Bed .....	0.0011 (2.3E-05) .....	0.022	8.0E-07	130	230
New—Coal Fluidized Bed with FB Heat Exchanger .....	0.0011 (2.3E-05) .....	0.022	8.0E-07	140	150
New—Coal-Burning Pulverized Coal .....	0.0011 (2.3E-05) .....	0.022	8.0E-07	130	320
New—Biomass Wet Stoker/Sloped Grate/Other .....	0.030 (2.6E-05) ...	0.022	8.0E-07	620	390
New—Biomass Kiln-Dried Stoker/Sloped Grate/Other .....	0.030 (4.0E-03) ...	0.022	8.0E-07	460	ND
New—Biomass Fluidized Bed .....	0.0098 (8.3E-05) .....	0.022	8.0E-07	230	310

Comment on proposed text: This summary text is needed to expressly the link the guidance provided in the previous sections to the identification of BAT for this source sector. See Section 5 of the cement draft for comparable language on emission levels or levels of control “associated with BAT”. The ‘new’ versus ‘existing’ facility distinction is required by Paragraph 8(a) of Article 8 of the Convention where there are potential differences between BAT identification for the two categories of facilities, as the US EPA regulations demonstrate.

	36	6	“This section is limited to specific aspects of mercury emission monitoring for coal-fired power plants and industrial boilers. <b>Among other forms of mercury emission monitoring and measurement, Continuous Emission Monitoring Systems (CEMS) for mercury are discussed. Mercury CEMS take a continuous sample of the stack or chimney exhaust gas after any pollution controls and provide a measure of mercury emissions from that stack or chimney.</b> ”
	36	6.1	Revise section heading as follows: “Continuous Emissions Monitoring Using Hg Analyzers”
	36	6.1	“ <b>Continuous Emission Monitoring Systems (CEMS) may use Hg analyzers and these are used at hundreds of US electric utility systems for continuous monitoring of gaseous mercury emissions.</b> Mercury monitoring using <del>CEM instruments</del> mercury analyzers is

			effective for coal combustion flue gas streams (Sarunac, 2007). <del>For emission compliance purposes,</del> The analyzer methods that are most widely used only measure elemental mercury. Therefore the mercury CEMS systems must include a converter that converts oxidized mercury to elemental mercury. The most common approach is thermal conversion. The CEMS includes a complete sampling, sample conditioning and conversion, zero air supply (for the dilution proble) and calibration system as well as a data acquisition system.”
	36	6.1	<p><del>CEM instruments are located in the</del> <b>The CEMS system samples the gases at the stack and measure a low particulate concentration gas stream. The remaining particulate matter in the gas stream is filtered out of the sample. Hg CEMS analyzer systems are used on a wide range of facilities, including facilities with wet FGD systems, dry FGD systems, and systems with only PM control. Some facilities use inertial filters, but CEMS sampling systems equipped with a fixed filter having a regular cleaning cycle are increasingly popular in the United States due to their smaller size and simplicity.”</b></p> <p>Comment regarding above text: Analyzers that are NOT at the stack are not CEMS, they are process analyzers. Misuse of the acronym CEMS is fairly common in the US, but it will be very confusing in an international document if this acronym gets misused.</p>
	36	6.1	<p><b>“ Because particulate matter is filtered out, Hg analyzer CEMS only measure the gaseous components of mercury emissions, which are what is regulated in the United States. Because the averaging period for these analyzer systems is brief (typically a few minutes or less) these analyzers provide real-time or near real-time data and the CEMS may therefore be used for process control and performance testing as well as stack monitoring. While the CEMS analyzer systems are commonly used for stack emissions monitoring after the pollution control devices, in some cases, especially for testing purposes, For mercury control purposes, CEMs analyzers are sometimes have also been used to sample the particulate-laden gas stream before a particulate control device to help assess the capture of mercury across that particulate control device. A commonly used filter probe technology for this purpose is the inertial filter. It uses a technique of sample gas acceleration and relies on the inertial forces of the particulate and a sintered filter to separate the gas and particulates.”</b></p>
	36	6.1	<p><del>CEM monitoring of sample gas saturated with water by a wet scrubber is commonly practiced although it requires special considerations. A special fixed filter probe is used to avoid blockage from condensation of water and typically employs a frequent filter media cleaning cycle using compressed air. Heated sample lines are used with careful regulation of sample gas temperature to avoid condensation of water and the resulting absorption of oxidized mercury into this water....</del> A CEMS analyzer provides the coal combustion operator with real time or</p>

			<p><b>near real-time mercury analysis data, which is what makes them useful for process control. Experience has shown that mercury emissions can be highly variable, depending upon coal characteristics, and plant operating characteristics. The advantage of having real-time monitoring is that the facility owner can identify situations where mercury emissions increase and take corrective action to mitigate mercury emissions. Which can</b></p> <p><del>These may be used in the form of a feedback loop with the sorbent injection or coal additive feed equipment or it could be in the form of direct operational changes that</del> <b>reduce those high mercury emitting situations in the future.</b> This feature allows tight control over the mercury emission concentration despite changes of mercury concentration in the fuel... The CEMS analyzer systems also provides the advantages of sensitivity to low concentrations of mercury, down to <b>below 0.5 ug/m<sup>3</sup></b>, speciated mercury measurements, and high repeatability of results when calibrated with a dynamic mercury spiking methodology. <b>These mercury CEMS analyzers offer the ability to perform complete system integrity checks with both elemental and oxidized Hg...</b></p> <p><del>Semi-continuous emission monitors (SCEM), which are often labeled as CEM, are commonly used to overcome interference from other gases in the sample stream. These instruments provide mercury concentration averages over a short sample periods, which are typically less than 5 minutes. The short sample period averages provide adequate data in almost all situations.</del> <b>While CEMS analyzers provide the advantage of real-time data, they have the disadvantage of having the highest initial cost and they require capable instrument technicians.”</b></p> <p>Comment regarding above text: Industry does not recognize the acronym SCEM. Better to put this in the context of the averaging time for the measurement as has been done earlier in this section. Additional text is provided to further explain the benefits of using analyzer systems, and improve the accuracy of the text.</p>
	36	6.2	Revise section heading as follows: <b>“Continuous Emission Monitoring with Sorbent Trap Systems and Periodic Monitoring with Sorbent Trap Systems”</b>
	36	6.2	<b>“ Sorbent traps for mercury monitoring in coal combustion gas streams have been shown to provide accurate and replicable data, even at very low mercury emission concentrations (Sarunac, 2007). It is possible to monitor using one set of traps over a sampling period lasting several days or several hours in coal combustion plants, depending upon the size of the trap used and the sampling rate.”</b>
	36	6.2	<b>“ In the US, these advantages have resulted in many coal combustion facilities performing their own monitoring using sorbent traps using these systems as part of a Continuous Emission Monitoring System and also for short-term testing. It is possible to monitor using one set of traps over a sampling period lasting several days in coal combustion plants.”</b>

	36	6.2	<p>Add text at end as follows: <b>“Through regular replacement of sorbent traps so that emissions are continuously monitored, sorbent traps can provide continuous mercury emissions measurements in a mercury CEMS. While generally less expensive in initial cost than analyzer CEMS and simpler to set up, the disadvantages compared to analyzer CEMS for continuous monitoring are that: 1) they do not provide real-time or near-real-time data, and cannot be used for process control; 2) there is a risk of lost data if a sample from a period of several days does not meet quality assurance needs; 3) when used as a mercury CEMS there is a substantial amount of consumable materials that must be purchased over time as well as labor and laboratory services.</b></p> <p><b>In principle, sorbent trap measurements measure total mercury of all mercury species because the mercury in the inlet wool is included in the analysis. Some suppliers offer traps intended to measure speciated mercury measurements; however, there is limited data on the use of these.</b></p> <p><b>Because sorbent traps can be quickly set up for testing, sorbent trap methods are the most commonly used method for performing short-term testing, such as Relative Accuracy Test Audits (RATAs) of mercury CEMS. Sorbent trap mercury measurements will also include mercury that may be included in the particle matter that passes through the air pollution controls as well as the gaseous mercury emissions. This can contribute to differences between the measurements of Hg CEMS analyzers, which only measure gaseous mercury, and sorbent trap measurements.”</b></p>
	36	6.3	<p><b>“ The Prior to the availability of CEMS instruments and sorbent traps, the use of impinger methods for mercury monitoring in coal combustion plants <del>has historically been</del> was once the prominent method.”</b></p>
	37	6.3	<p><b>“The impinger methods use multiple impingers in series to allow some QC evaluation. Impinger methods have several disadvantages: 1) they only give an indication of mercury emission at one time and thus are not suitable for continuous measurement of mercury emissions; 2) they require very labor-intensive sampling and laboratory efforts. For these reasons impinger methods are generally not used in commercial settings, but for research purposes only.”</b></p>
	37	6.4	<p><b>“It is expected that there is a significant variation in the mercury content of the coal, so frequent coal analysis is required for an accurate mercury input value.”</b></p> <p>Comment regarding above text: Correct, which is why we previously provided our comments about the potentially misleading data on coal mercury concentrations in Table 3.</p>

	37	6.5	<p>“Predictive emission monitoring is a good screening tool for coal combustion plants but due to the wide mercury content variation of coal, it is not an accurate means of monitoring mercury air emissions.”</p> <p>Comment regarding above text: Same as immediately above.</p>
	37	6.5	<p>“The predictive monitoring systems are useful for estimating the mercury air emissions in preparation for sorbent trap <b>or other</b> monitoring activities.”</p>
	37	6.6	<p>“This is due to the mercury content variation in coal and the wide variation in mercury capture within a coal combustion plant’s emission control equipment.”</p> <p>Comment regarding above text: See previous comments regarding Table 3.</p>
<b>BAT-BEP Guidance- NonFerrous</b>	4	1	<p>“Mercury exists as <del>an</del> element in nearly all metallurgical raw materials and hence thermal processing and other smelting operations have the potential to release mercury to the atmosphere.”</p> <p>Comment regarding above text: Is up to 200 ppm really “trace”?</p>
	4	1	<p>“Secondary metals smelting produces negligible amounts of mercury emissions, because these are metals recycling processes that use scrap metal and drosses as feed.”</p> <p>Comment regarding above text: This statement is incorrect. Electric Arc Furnaces (secondary steel mills) are one of the most significant sources of Hg emissions in the USA and other developed world countries, due to the Hg switches historically used in automobiles and appliances sent to steel mills as scrap feed. This paragraph should be deleted or carefully rewritten.</p>
	5	2	<p>“Techniques to reduce mercury emissions from smelting and roasting in the non-ferrous sector may also result in the production of mercury-containing materials. An example is calomel (mercury(I) chloride), produced in the Boliden-Norzink process (see Section <b>Error! Reference source not found.</b>). This guidance does not address the management of these materials but <b>under Articles 3 and 10 of the Convention the storage and trade of calomel, other mercury compounds, and mercury derived from these compounds are regulated. Moreover, under Article 11 of the Convention their disposal must be performed in they should be stored or disposed of</b> an environmentally sound manner as waste.”</p> <p>Comment regarding above text: This text is both incomplete and incorrect as currently worded.</p>
	17	3	<p>“A cross-cutting section on multi-pollutant control technologies that provide a co-benefit for mercury emissions capture is <del>also</del> presented <b>separately.</b>”</p>

	31	5.1 Table 4, Columns 4 and 5, Row 3	<p>“Unsure if this technique is currently in use; Not widely used, Mercury containing material disposal as hazardous waste”</p> <p>Comment regarding above text: On the basis of these findings, we question why this technology appears here since it would not qualify as BAT if not “available”.</p>
	34	5.1.1	<p>“Such technology may not be necessary where a combination of gas cleaning equipment with sulfuric acid plants is operated and sufficiently controls mercury as well as sulfur emissions...</p> <p><b>Regardless of the method chosen, all of the technologies are capable of mercury reduction in excess of 90% in the flue gas, including the co-benefit gas cleaning/sulfuric acid plant combination. These options are globally available and pose no extraordinary technology or operational challenges. Therefore, BAT options chosen by Parties should achieve comparable levels of performance, particularly for new or large facilities.”</b></p> <p>Comment regarding above text: This summary paragraph is needed to provide clarity regarding the level of performance found by the expert group to be BAT.</p>
	37	5.2.5	<p>Revise text in bullets to read as follows:</p> <p>“</p> <ul style="list-style-type: none"> <li>• <b>Safe management and transport of mercury wastes resulting from air pollution controls (e.g., liquid elemental mercury recovered from the retorts or mercury(I) chloride produced from the Boliden-Norzink process)</b></li> <li>• <b>Trade in mercury and mercury compounds in compliance with Article 3 of the Convention.”</b></li> </ul> <p>Comment regarding above text: Revisions are needed to be consistent with the Convention</p>
	40	6.3	<p>“Considerations for Determining BEP Monitoring”</p> <p>Comment regarding above text: A summary paragraph is required here indicating which options would typically be considered BEP, and which would not be considered BEP, absent extraordinary circumstances.</p>
<b>Draft guidance on cement clinker production facilities</b>	5	2.2.2	<p>“Vertical shaft kilns are not described here as they show low energy efficiency and poor environmental performance.”</p> <p>Comment regarding above text: To the extent these kilns are still used in some countries, the guidance should specify these kilns cannot be considered BAT because of these characteristics. Otherwise, the failure to include any discussion of these plants provides no guidance as to their</p>

			acceptability.
	5	2.3.1	<p>“However, it should be noted that mercury contents can be <b>vary</b> significantly <del>higher than</del> <b>from what is</b> presented in Table 1.”</p> <p>Comment regarding above text: Hg content could potentially be lower as well as higher</p>
	6	2.3.2	<p>Comment regarding Section 2.3.2: We think this section does a nice job of describing the concentrating effect in the kiln. However, something that needs to be discussed is the potential for very sudden, high mercury releases from Portland cement kilns during a transient, especially, for example, when the in-line raw mill is taken out of service for periodic maintenance. This can cause a sudden spike in mercury emissions of over an order of magnitude as that highly concentrated mercury can be suddenly released. This is why in the US many Portland Cement kiln operators are electing to use Hg analyzer CEMS rather than sorbent trap CEMS, because the real-time information is so important. This figure from Scheiber, R.J., and Kellet, C.D., (2009) Compilation of Mercury Emissions Data, PCA R&amp;D Serial No. 3091, Portland Cement Association, Skokie, IL demonstrates how much the mercury emissions change when the raw mill is turned off for periodic maintenance. As a result of the high emissions with the raw mill off, the importance of controlling mercury emissions during raw mill off conditions becomes critical.</p> <p><sup>1</sup> <a href="http://www.slideshare.net/jportercline/8-b-81-mercury-abatement-in-the-us-cement-industry-v2">http://www.slideshare.net/jportercline/8-b-81-mercury-abatement-in-the-us-cement-industry-v2</a>, slide 22</p>

			<p style="text-align: center;"><b>Mercury Emissions Raw Mill Off + Raw Mill On</b></p> <p style="text-align: center;">Schreiber &amp; Kellett 2009</p>
	6	2.3.2	“This is logical as mercury does not end up in the clinker, the only way mercury can leave the system is its emission with the waste gas <b>or kiln dust (if it is discarded).</b> ”
	8	3.1	Revise Section Title as follows: “Primary measures to control mercury emissions”
	15	3.2.3	“-mercury-sorbent contact time”  Comment regarding above text: If the sorbent is well mixed into the gas stream, the mass transfer is fast. The biggest issue is really dispersion in the gas stream.
	15	3.2.3	“Furthermore, filter bag type and filter air-to-cloth ratio also affect the amount of mercury that can be adsorbed <b>by potentially limiting the sorbent injection rate. Therefore, the polishing baghouse must be adequately sized.</b> ”
	16	3.2.3	“In the U.S., the total capital costs to install sorbent injection with a polishing baghouse at a new 1.2 million short ton per year kiln were calculated at \$3.2 million (2005 USD).”  Comment regarding above text: Please check accuracy of this statement.

	18	3.3.2	<p>“NH<sub>3</sub>”</p> <p>Comment regarding above text: formatted (subscript 3)</p>
	18	3.3.2	<p>“On the other hand, Low Dust systems don’t have problems with the high dust load (<b>much higher than the dust loading of a coal-fired plant</b>) before filter and thus allow much longer operation time of the catalyst. <del>Furthermore, they are installed at lower temperature (smaller volume flow) allowing smaller number of catalyst layers.</del>”</p>
	18	3.3.2	<p>“This oxidized mercury <del>can then better be removed from the gas stream in a subsequent</del> <b>is more likely to be removed in downstream air pollution control devices, such as the dust filter or wet scrubber.</b>”</p>
	18	3.3.2	<p>“That means that it works in combination with High-Dust-SCR, but not with Tail-End-(Low Dust-) SCR <b>unless the low dust SCR is followed by a scrubber.</b>”</p>
	19	3.3.2	<p>“Quantification of the mercury oxidizing effect <b>in Portland cement kiln applications</b> requires further investigation.”</p>
	19	3.3.2	<p>“The mercury oxidizing side effect can be achieved only in cement plants <del>which are equipped with the High Dust SCR technique where the dust filter or a scrubber are downstream of</del> <b>the SCR.</b>”</p> <p>Comment regarding above text: It is possible that a low dust SCR could be followed by a scrubber.</p>
	19	3.3.2	<p>“The use of catalysts increases the operational costs due to higher energy consumption due to pressure drop and cleaning air for the catalyst.”</p>
	21	5	<p>Revise text to place second paragraph after the third paragraph because the finding in paragraph 2 is based upon the data in the third paragraph.</p>
	21	5	<p>“Reported mercury emissions shows that the majority of cement plants worldwide have mercury emissions below 0.03 mg/Nm<sup>3</sup>. In the report Mercury in the Cement Industry (Renzoni et al., 2010) it was found that many values are under 0.001 mg mercury/Nm<sup>3</sup> (under the detection limit) and very few values are higher than 0.05 mg mercury/Nm<sup>3</sup>.”</p> <p>Comment regarding above text: A distinction should be made here for new versus existing facilities, as required by Paragraph 8(a) of Article 8 of the Convention. It is common for new facilities to be subject to more stringent emission limits than existing facilities. The reason is because new facilities have the benefit of being able to design the most up to date technology into the plant, while existing sources must work within the limitations of the existing equipment. For an existing plant, for example, there may not be adequate space available to retrofit BAT without relocating existing equipment at a very large expenditure.</p>

Regulations in the United States provide an example of more stringent requirements for new facilities versus existing facilities. As shown in the tables on the following page, for the Portland Cement National Emission Standards for Hazardous Air Pollutants, US EPA requires much more stringent emission standards for new facilities than for existing facilities.

TABLE 1—EXISTING AND NEW SOURCE STANDARDS

Pollutant	Existing source standard	New source standard
Mercury .....	55 lb/MM tons clinker .....	21 lb/MM tons clinker.
THC .....	24 ppmvd .....	24 ppmvd.
PM .....	0.07 lb/ton <sup>a</sup> clinker (3-run test average) .....	0.02 lb/ton <sup>b</sup> clinker (3-run test average)
HCl .....	3 ppmvd .....	3 ppmvd.
Organic HAP (alternative to Total Hydrocarbons) .....	12 ppmvd .....	12 ppmvd.

<sup>a</sup> Also applies to NSPS modified sources.

<sup>b</sup> Also applies to NSPS new and reconstructed sources.

Therefore, it is reasonable that BAT/BEP as required for new facilities should be substantially more stringent than the requirements for existing facilities.

	22	5.2	“There are a number of secondary measures that should be considered <b>and utilized as needed.</b> ”
	23	6.1	“(X µg/Nm <sup>3</sup> at Y per cent of O <sub>2</sub> , dry basis)”
	23	6.1	<p>“The objective of an <b>anticipated</b> emissions reporting scheme <b>under the Convention</b> has an important impact on the type of monitoring chosen for a certain installation. <del>Therefore testing</del> <b>BEP compliance will require testing</b> and monitoring <del>comprise the material balance method (based on input sampling and analyses) and/or</del> <b>based on</b> emission measurements (output) at the stack, <b>absent extraordinary circumstances.</b>”</p> <p>Comment regarding above text: Text revisions are required both for clarity and to remove materials balance (by itself) from consideration as BEP absent extraordinary circumstances. See below for further comment on this issue.</p>
	23	6.2	<p>“- for the material balance approach - the untreated raw materials and fuels, dust collected and removed from the system;”</p> <p>See Comment below.</p>
	24	6.4.1	“System mercury mass balance may offer a better estimate of emissions than spot stack measurements. Variability of mercury levels in fuels and in input materials and representativeness of samples will influence the results of a spot sample.”

			<p>Comment regarding above text: This is not an either/ or situation. Mass balance may be helpful in conjunction with spot sampling. Mass balances by itself should not be BEP given the challenges in doing it accurately.</p> <p>An actual measurement of air emissions, and especially a continuous measurement of emissions, is much preferred to a mass balance. For a mass balance to provide a good indication of air emissions, all of the mercury inputs (fuel, raw materials, etc.) and solid and liquid outputs (fly ash, scrubber by-products, kiln dust, etc.) must be continually sampled and tested so that variations are captured in the sample data. Due to the high variability of mercury emissions and also the variability of mercury in the input streams (raw materials, etc.), obtaining adequate samples is often impractical. Regarding Portland cement kilns, there is very high variability of mercury emissions that results from process changes, and especially whether the in-line raw mill is operating or not, makes continuous emission monitoring very important. This high variability has motivated many facilities to use Hg analyzer-based CEMS rather than sorbent traps because of the importance of real-time (or, in fact, near real-time) data.</p> <p>As an example of the importance of continuous emissions monitoring, in its requirements for monitoring of Hg emissions from these sources, continuous monitoring is required by US EPA except where the total annual emissions are under a threshold level. As a result, the vast majority of Portland cement kilns in the United States are required to monitor mercury emissions on a continuous basis.</p>
	25	6.4.2	<p>“Disadvantages: low accuracy at low emission levels; method may not be usable to demonstrate compliance with emissions limits depending on how emission limits are set.”</p> <p>Comment regarding above text: Is this method accurate enough when emission levels are set consistent with BAT as stated on p. 21? If not, this method should not be considered BEP for this reason and the comments above.</p>
	25	6.4.2	<p>“In a few developed countries (Germany, U.S.) regulations are changing requirements from spot stack sampling to continuous sampling and analysis (<b>analyzer or sorbent trap CEMS or Sorbent Trap System</b>) in order to provide for a better characterization of emissions.”</p> <p>Comment regarding above text: CEMS can be analyzer based or sorbent trap based. Therefore, sorbent traps are not distinct from CEMS.</p>
	25	6.4.3	Entire section deleted.

			<p>Comment: This concept of “semi continuous” will be very confusing. What makes a CEMS continuous is the sampling or monitoring, not the data. Nearly all CEMS for all pollutants entail some degree of averaging time that will vary based upon the particular method of analysis used. Semi-continuous is misused in this section. SCEMS refers to when a single analyzer time shares between different emissions sampling points. See comments on introduction for a more elaborate discussion of this point.</p>
	26	6.4.4	<p>Comment: In the US Sorbent Traps are allowed for CEMS. See also comments on introduction text regarding description of monitoring techniques.</p>
Convention BAT BEP Guidance Waste Incineration	1	Summary	<p>“Best available techniques for waste incineration include appropriate selection of site; waste input and control; techniques for combustion, flue gas, solid residue and effluent treatment. For small medical waste incinerators, application of best available techniques is often difficult, given the high costs associated with building, operating, maintaining and monitoring such facilities. <b>Accordingly, Parties should maximize the use of non-incineration alternatives when applying BAT BEP to small incinerators.</b>”</p> <p>Comment regarding above text: Need to provide guidance about what Parties should do when faced with applying BAT BEP to small waste incinerators. Repeat this idea in Section 3.7 where non-incineration alternatives are identified.</p>
	32	5.1	<p>“With a suitable combination of primary and secondary measures associated with best available techniques, mercury emission levels not higher than 10 µg/m<sup>3</sup> (at 11 per cent O<sub>2</sub>) have been reported (Daschner et al., 2011). It is further noted that under normal operating conditions emissions lower than this level can be achieved with a well-designed waste incineration plant. There are many waste incinerator plants worldwide that are designed and operated according to most of the parameters defining best available techniques and that meet the associated emission levels. “</p> <p>Comment regarding above text: A distinction should be made here for new versus existing facilities, as required by Paragraph 8(a) of Article 8 of the Convention. It is common for new facilities to achieve better performance and be subject to more stringent emission limits than existing facilities. The reason is because new facilities have the benefit of being able to design the most up to date technology into the plant, while existing sources must work within the limitations of the existing equipment. For an existing plant, for example, there may not be adequate space available to retrofit BAT without relocating existing equipment at a very large expenditure.</p> <p>Regulations in the United States provide an example of more stringent requirements for new</p>

			facilities versus existing facilities. See e.g., US EPA’s emission standards for new and existing medical waste incinerators at 74 Fed. Reg. 51371-2 (October 6, 2009)(Tables 1 and 2), available at <a href="http://www.gpo.gov/fdsys/pkg/FR-2009-10-06/pdf/E9-22928.pdf">http://www.gpo.gov/fdsys/pkg/FR-2009-10-06/pdf/E9-22928.pdf</a> .
	32	5.1	“There are also non-incineration techniques as described in the Basel Convention ESM technical guidance for mercury waste and <i>emerging technology options</i> (see section <b>Error! Reference source not found.</b> of the present document) that may represent feasible and environmentally sound alternatives to incineration. <b>Parties should pursue non-incineration alternatives where the cost of compliance with BAT is challenging, such as applying BAT to small medical waste incinerators.</b> ”
	38	5.5.1	<p>“The mean annual emission value is about 2.5 µg/Nm<sup>3</sup> (yearly average based on daily averages), similar for all combination of control techniques installed. More than 90 per cent of the installations emit less than 10 µg/m<sup>3</sup>. All applied combinations of techniques are appropriate for mercury reduction as proven by the small ranges of the annual emission values reported for each combination.”</p> <p>Comment regarding above text: As indicated above, observations should be made here differentiating new versus existing facilities regarding emission levels achieved, as required by Paragraph 8(a) of Article 8. Can new facilities typically meet 2.5 or lower, and thus should this be considered an appropriate BAT level of control for new (large) facilities?</p>