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Ad Hoc Open-ended Working Group on Mercury
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Nairobi, Kenya
6–10 October 2008
Item 3 of the provisional agenda*

Review and assessment of options for enhanced voluntary measures and new or existing international legal instruments

Report on the major mercury-containing products and processes, their substitutes and experience in switching to mercury-free products and processes

Note by the secretariat

1. The Governing Council of the United Nations Environment Programme, in its decision 24/3 IV on chemicals management, established an ad hoc open-ended working group of Governments, regional economic integration organizations and stakeholder representatives to review and assess options for enhanced voluntary measures and new or existing international legal instruments for addressing the global challenges presented by mercury.

2. At its first meeting, the Ad Hoc Open-ended Working Group on Mercury requested the secretariat to undertake intersessional work in a number of areas in preparation for its second meeting.

3. The secretariat requested information from Governments, intergovernmental organizations and non-governmental organizations. Information submitted has been made available on the website of the mercury programme (http://www.chem.unep.ch/mercury) and has been used in the preparation of the assessment. The work on mercury-containing products and processes and the consideration of effective substitutes has also built, as far as possible, on work undertaken for other forums that is directly relevant to this undertaking. In addition, detailed follow-up on the extent of use of mercury-containing products and processes was carried out with a number of countries.

4. The report provides information on mercury-containing products and processes that have effective substitutes, including information on the relative quantities of mercury used, and on experience in switching to non-mercury processes or products.

5. The report comprises an executive summary and a detailed discussion. For ease of reference, the executive summary has been reproduced in the annex to the present note. The full report, including both the executive summary and the detailed discussion, will be presented as an addendum to the present note under the symbol UNEP(DTIE)/Hg/OEWG.2/7/Add.1. Both the executive summary and the full report are being circulated as submitted and have not been formally edited.

* UNEP(DTIE)/Hg/OEWG.2/1.

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Suggested actions

6. The Ad Hoc Open-ended Working Group on Mercury may wish to draw upon the information contained in the report in considering options for the control of mercury, in particular the experiences of switching to alternatives and substituting alternative processes.

Annex

Global Report on Mercury Use in Products and Processes, Level of Substitution, Technology Change-over, and Available Substitutes

Prepared for:
United Nations Environment Programme

Executive Summary

At its twenty-fourth session in February 2007, the Governing Council of the United Nations Environment Programme (UNEP) adopted decision 24/3 IV, recognising that further long-term international action was required to reduce the risks posed by mercury to human health and the environment. The Council established an ad hoc open-ended working group (OEWG) of Governments, regional economic integration organizations and stakeholder representatives to review and assess measures to address the global issue of mercury. The first meeting was held from November 12 to 16, 2007 in Bangkok, Thailand and agreed on a program of inter-sessional work to be undertaken by the secretariat in order to further discussions at the Working Group's second meeting to be held from October 6 to 10, 2008.

This report provides information on use and relative quantities of mercury in major mercury containing products and processes, the level of substitution of such products and processes, and experiences with technology changeover and alternatives, including mercury use and substitution at the country level in geographic regions throughout the world.

In an effort to effectively collect mercury data, UNEP circulated a request for information to countries. This request included estimated mercury demand, level of substitution, and experience with non-mercury alternatives for six product categories (measuring and control devices, batteries, dental use, electrical and electronic devices, lamps/lighting, and other uses) and three process categories (vinyl chloride monomer production, chlor-alkali production, and small scale/artisanal gold mining). The level of substitution for products and processes was grouped into three categories as indicated below.

Table ES1: Level of Substitution Categories

Level of Substitution	Description
2	Substitutes available in market and commonly used
1	Substitutes available in market but minimally used
0	No available substitutes in the market

Responses were received from thirty-three countries. Information presented for each of the products and processes includes:

- For mercury containing products and processes: Description of product/process, purpose of mercury in the product/process, quantity of mercury used per unit of product/process, representative manufacturers and processors, retail pricing, and estimated annual demand for mercury at the country level.

- For mercury-free alternatives: Description of product/process, representative manufacturers/processors, retail pricing, advantages and disadvantages of these substitutes

as compared to mercury containing products/processes, level of mercury substitution, and experience with alternatives.

In addition, a summary is provided for each product and process, including the key findings for demand and substitution. This section also describes whether transition success to the non-mercury alternative was achieved. Transition success is considered demonstrated if the following two conditions are met:

1) Greater than 50% of respondents indicate that substitutes are available and commonly used, and no negative experiences with the alternatives were reported..
2) Two or more respondents had an annual demand of zero tons of mercury or have implemented a product/process ban that will lead to zero tons of mercury in 2009.

The use of mercury in products/processes and its substitution was then categorized based on transition results from a global perspective. This categorization included the following three groupings:

- Transition Success Demonstrated: This grouping includes products and processes where alternative technologies are available and transition success has been demonstrated in some responding countries. Products and processes in this grouping would be considered most readily substitutable on a global basis.

- Alternatives Available – Challenges Identified: This grouping includes products and processes where alternative technologies are available, but there are economic, technical, social, and/or institutional challenges identified that remain before the alternatives can be fully implemented on a global basis. Products and processes in this grouping would require an intermediate or longer transition time depending upon the magnitude of the challenges identified.

- Site Specific Feasibility: This grouping includes products and processes where economic, technical, social, and/or institutional factors that impact the feasibility of implementing the non-mercury alternatives vary significantly from site to site.

Transition Success Demonstrated

Based upon the responses provided, several products and processes have alternative technologies available, and have demonstrated transition success to these non-mercury alternatives. These products and processes are listed below:

- *Thermometers*: Several alternative technologies such as liquid, dial, and digital were identified. Fifty-three percent of the respondents indicated that these alternatives are available in the market and commonly used without any negative experiences reported. Further, five countries reported zero demand for mercury containing thermometers. However, four countries reporting a level of substitution of "1" indicated that the costs were higher for the non-mercury alternatives.

- *Sphygmomanometers:* Two major alternative technologies, aneroid and electronic, were identified. Sixty-nine percent of the respondents indicated that these alternatives are

available in the market and commonly used without any negative experiences reported. Three countries reported zero demand for mercury containing sphygmomanometers.

- *Thermostats:* Two major alternative technologies, mechanical and electronic, were identified. Eighty-two percent of the respondents indicated that these alternatives are available in the market and commonly used without any negative experiences reported. Five countries reported zero demand for mercury containing thermostats.

- *Batteries (non-miniature):* Paste-type zinc-manganese cylinder batteries, paperboard type zinc-manganese cylinder batteries, alkaline zinc-manganese cylinder batteries, and mercuric oxide batteries have commercially available alternatives such as alkaline manganese. Seventy-six percent of the respondents indicated that these alternatives are available in the market and commonly used without any negative experiences reported. Six countries reported zero demand for mercury containing non-miniature batteries.

- *Switches and relays*: Numerous alternative technologies were identified for the various types of mercury containing switches and relays. Seventy percent of the respondents indicated that these alternatives are available in the market and commonly used without any negative experiences reported. Further, four countries reported zero demand for mercury containing switches and relays.

- *High Intensity Discharge (HID) Automobile Lamps:* Automobile manufacturers use mercury-containing high-intensity discharge (HID) headlamps for use on some high-end luxury or performance automobiles but mercury-free halogen lamps are currently used for the majority of automobiles. Headlamp design and type is determined by the automobile manufacturer and typically cannot be changed by the consumer. HID headlamps cost more than halogen headlamps but they provide certain benefits including improved nighttime visibility, smaller size, longer life, and better efficiency. Automobile manufacturers that want performance benefits similar to HID headlamps now have the option to select from two recently developed mercury-free headlamp technologies: HID headlamps that use zinc iodide as a substitute for mercury, and LED headlamps.

- *Chlor-alkali Production*: Many countries around the world with mercury cell chlor-alkali plants have significantly reduced mercury consumption by closing mercury cell chlor-alkali facilities, reducing their mercury release through improved operations, or have successfully converted from the mercury cell process to the membrane cell process. In addition, there is industry commitment to close or convert mercury chlor-alkali facilities in Europe and India. Although conversion from a mercury cell process to membrane cell process is technically feasible, the conversion costs vary from site to site. Significant factors that affect conversion costs include the need for increased capacity, energy costs, and maintenance costs associated with the age of the mercury cell facility. The benefits reported from completing a conversion of mercury cells to membrane cells include reduced energy consumption, reduced need for maintenance, and elimination of mercury management issues. Approximately 89% of RFI responses for chlor-alkali production were rated at a substitution level of “2”, and there were no negative responses provided for the transition to the non-mercury alternatives. Also, ten countries reported estimated mercury demand of zero.

Alternatives Available – Challenges Identified

The following products and processes have alternative technologies available, but there are economic, technical, social, and/or institutional challenges identified that remain. These challenges must be addressed before the alternatives can be fully implemented on a global basis.

- *Silver oxide, zinc air, alkaline and mercuric oxide miniature batteries*: Mercury free miniature batteries are available as alternatives to these mercury containing products. However, these alternatives have limited availability, and are not available to meet the demands of many miniature battery applications. Despite this, product bans at the state level in the United States for all uses of these products go into effect by 2011, allowing enough time for manufacturers to develop mercury free miniature batteries for most applications.

- Dental amalgam: Mercury-free alternatives to dental amalgam include composite and glass ionomer materials. The alternatives can be matched to the tooth color and are widely used where aesthetics are important. They also have the advantage of not requiring special handling of waste generated during cavity filling. The alternatives cost more, take longer to place, and often have lower resistance to fracture and wear. Three countries (Denmark, Norway and Sweden) determined that the alternatives were adequate replacements for amalgam and, in 2008, imposed bans on dental amalgam. Eight countries, representing fifty percent of the responses received relating to this mercury use, indicated that substitutes are available and commonly used in those countries. Despite the fact that transition success has been demonstrated in some countries, the higher cost of the alternatives is a challenge that is preventing the further transition away from dental amalgam. Four countries commented on the higher cost of alternatives.

- *Liquid Crystal Display (LCD) backlight units*: LCD displays with mercury-free light-emitting diode (LED) backlights are currently available in both laptop computers and televisions. The LED backlight technology has certain performance advantages over the widely-used cold-cathode fluorescent backlights, including longer life, higher contrast ratio, and the potential for decreased power consumption. LED backlight technology is still evolving, has a higher cost, and a successful transition may require the redesign of the products that use LCD displays.

- *Linear and compact fluorescent lamps*: LED lamps are currently available as alternatives to both linear and compact fluorescent lamps but these LED lamps are suitable only for limited types of applications due to lower light output and high cost. LED lamps have the potential to become a feasible alternative to fluorescent lamps due to their long life and energy-efficiency but further technological advancements are required for this potential to be realized.

- *HID lamps (non-automobile)*: Mercury-free alternatives to HID lamps are not currently available, with a few exceptions. However, several mercury-free lamp technologies were identified that are potential alternatives to mercury-containing HID lamps, including: LED lamps, metal halide lamps using zinc iodide as a substitute for mercury, and mercury-free high-pressure sodium lamps.

- *Artisanal and small-scale gold mining:* Mercury-free alternatives to the amalgam gold mining process are available and currently in use. However, a successful transition away from mercury use is likely to require: large-scale training and education efforts; initiatives

to overcome cultural, logistical and economic barriers; and a reduction in the supply of low-priced mercury.

Site Specific Feasibility

The following process was determined to require a site-specific analysis before the economic feasibility of implementing a non-mercury process could be assessed:

- *Vinyl chloride monomer (VCM) production*: VCM manufacturers in nearly every country, with the exception of China and Russia, have converted to the mercury-free ethylene-based process because of lower energy requirements and lower raw material costs. In China, the production of VCM with mercury using the acetylene-based process continues to be economically favorable due to factors including inexpensive coal and limited availability of ethylene for the ethylene-based process. The use of mercury for VCM production is expected to increase as China expands its VCM production with additional facilities using the acetylene-based process.

Limitations on the information provided were considered in this analysis. Many responses contained data gaps for certain categories of products and processes. Further, the estimated mercury demand responses provided often contained data from various years, with some responses providing data as far back as 2001. Therefore, it was not possible to use these responses as a basis to extrapolate aggregate mercury demand estimates on a regional or a global basis.