NATURAL RESOURCES DEFENSE COUNCIL

NRDC SUBMISSION OF INFORMATION RELEVANT TO THE IDENTIFICATION OF INDIVIDUAL STOCKS OF MERCURY OR MERCURY COMPOUNDS EXCEEDING 50 MT, AND SOURCES OF MERCURY SUPPLY GENERATING STOCKS EXCEEDING 10 MT

Article 3, Paragraph 5 (a) of the Minamata Convention on Mercury reads in pertinent part:

> "Each Party shall endeavor to identify individual stocks of mercury or mercury compounds exceeding 50 metric tons, as well as sources of mercury supply generating stocks exceeding 10 metric tons per year, that are located within its territory"

Under Paragraph 12 of Article 3, the Conference of the Parties (COP) is required to develop further guidance regarding this Convention obligation.

I. Definitions

A. Mercury

Mercury is defined under the Convention as elemental mercury, CAS number 7439-97-6.[1] For the purposes of Article 3, mercury also includes mixtures of mercury with other substances, including alloys of mercury, with a concentration of at least 95% by weight.[2] This inclusion of mixtures is intended to discourage the mixing of mercury with other substances for the purpose of avoiding Convention obligations.[3]

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[1] Article 2(d).

[2] Article 3.1(a).

[3] The mixtures definition can also be found in the EU mercury export ban regulation, 1102/2008, available at http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32008R1102&from=EN. The inclusion of alloys clarifies both solid and liquid mixtures are included within this definition.

Mercury supply primarily comes from five sources: a) primary mercury mining,[4] b) by-product mercury from mining other metals and natural gas production,[5] c) decommissioning chlor-alkali facilities; d) recovery of mercury from wastes, depleted catalysts and used products that contain mercury; and e) government or private mercury stocks. Facilities engaged in the production, recovery, trade and use of mercury from these supply sources may have relevant stocks to be identified, as discussed further below.

B. Mercury compounds

Article 3 of the Convention specifies six mercury compounds included within Article 3 and the associated stocks identification provision.[6] Each of these six substances included within the Article 3 mercury compounds definition is discussed immediately below.

1. Mercury (I) chloride (calomel)

Mercury (I) chloride, CAS number 10112-91-1, can be produced in large quantities as a byproduct of non-ferrous metals processing (i.e., sulfide ore roasting during industrial gold processing, lead/zinc smelting). The roasting and smelting of sulfide ores generates sulfide dioxide, which can be captured and converted to sulfuric acid. Mercury emitted to the stack gases can also be captured by air pollution control equipment designed for this purpose, utilizing mercury (II) chloride in the scrubber which reacts with the mercury in the gases to produce mercury (I) chloride or calomel.[7] This mercury compound is internationally traded for the purpose of recovering mercury,[8] and is included within the European Union (EU) mercury export ban.[9] It is also used as a specialty chemical in electrochemical applications, such as in batteries.[10]

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[4] The extraction and production of mercury from naturally occurring ores where the principal material sought is mercury, as defined in Article 2.

[5] Metal extraction and production activities where the principal material sought is not mercury. Gold, zinc, lead, copper and silver production are examples where mercury can be produced as a byproduct, because trace mercury is also present in the mined ore body.

[6] Article 3.1(b).

[7] US EPA, Report to Congress: Potential Export of Mercury Compounds from the United States for Conversion to Elemental Mercury, October 2009, pp. 17, 18, 22, available at http://www.epa.gov/hg/pdfs/mercury-rpt-to-congress.pdf (hereafter "EPA Report to Congress").

[8] EPA Report to Congress, pp. 50, 58.

[9] EC Regulation 1102/2008, Article 1. See also http://ec.europa.eu/environment/chemicals/mercury/pdf/hg_flows_safe_storage.pdf, pp. 30-31.

[10] EPA Report to Congress, Table 3-12.

2. Mercury (II) oxide

Mercury (II) oxide, CAS Number 21908-53-2, is produced from the direct oxidation of elemental mercury, and is an intermediate compound produced during the recovery of mercury from calomel and mercury (II) sulfate.[11] It is also chemically manufactured, and was used historically to produce mercury oxide batteries (covered by the battery phase-out provisions of Annex A of the Convention). Since mercury oxide can yield elementary mercury through simple roasting and condensing the vapor, a process that is widely accessible, this compound was identified as a possible means of trading and recovering commercial quantities of mercury,[12] and is included within the EU mercury export ban.[13]

3. Mercury (II) sulfate

Mercury (II) sulfate, CAS Number 7783-35-9, is also produced during sulfide ore roasting, and can produce recoverable mercury through simple roasting and condensing the vapor. Accordingly, the compound was identified as a possible means of trading and recovering commercial quantities of mercury.[14]

4. Mercury (II) nitrate

Mercury (II) nitrate, CAS Number 10045-94-0, is produced from reacting elemental mercury with nitric acid, and has laboratory use applications.[15] The recovery of mercury from this compound can be achieved through widely available roasting and condensing the vapor, and thus was identified as a possible means of trading and recovering commercial quantities of mercury.[16]

5. Cinnabar

Cinnabar is the naturally occurring mercury sulphide ore used to produce elemental mercury, typically by roasting in air and condensing the vapor. It is most commonly red in appearance, was historically used in cosmetics, and still used in some traditional applications as a paint pigment.[17] It is included within the EU mercury export ban.[18]

6. Mercury sulphide

Mercury sulphide, CAS Number 1344-48-5, can be produced during gold processing using cyanide leaching. The mercury in the ore will form soluble mercury cyanide

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[11] EPA Report to Congress, p. 58.
[12] EPA Report to Congress, pp. 51, 58.
[13] EC Regulation 1102/2008, Article 1.
[14] EPA Report to Congress, pp. 17, 51, 58.
[15] EPA Report to Congress, Table 3-12.
[16] EPA Report to Congress, pp. 51, 58.
[17] See http://geology.com/minerals/cinnabar.shtml.
[18] EC Regulation 1102/2008, Article 1.

compounds which can then be converted into insoluble compounds through the addition of calcium sulfide or sodium sulfide to the leachate. The resulting insoluble mercury compounds, like mercury sulphide, can then be precipitated out before carbon sorption of the gold.[19] Mercury sulfide is internationally traded for the purpose of mercury recovery.[20]

C. "Individual" Stocks

There is no definition in the Convention of "individual" stocks, therefore Parties may look to the context of the obligation within the Convention when interpreting this Convention requirement. The provision is found within Article 3 entitled "Mercury Supply Sources and Trade", and thus may be viewed as a mechanism for identifying the significant sources of global mercury supply, and for facilitating the Parties' tracking of these supplies and the effectiveness of the Convention in reducing the global mercury supply over time.[21]

In this context, a Party may implement the obligation so that all relevant large stocks of mercury and the specified compounds are eligible for identification, noting that Parties are under an obligation to "endeavor" to identify these sources. Accordingly, all stocks of mercury and mercury compounds under the control of a given individual or entity may be considered one "individual" stock for quantification purposes, since control over the mercury or mercury compounds (and their ultimate fate) is the important consideration under Article 3.[22] Moreover, since the mercury compounds were chosen because they can or do produce recoverable mercury, the weight of the mercury and all mercury compounds under the control of an entity can be aggregated for this purpose.[23]

For mercury supply generating stocks, the applicable quantity threshold is "exceeding 10 metric tons per year", thus the total quantity of mercury and mercury compounds produced annually must be evaluated, not the quantity stored at a particular time. Accordingly, it does not matter whether the mercury or relevant compounds are sold or transferred offsite immediately after production.

On the other hand, the obligation to identify individual stocks "exceeding 50 metric tons" is intended to capture large stocks of mercury and relevant compounds in storage at any particular time. Accordingly, the threshold applies to the largest quantity under the control of an entity at any particular time within the calendar year.

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[19] EPA Report to Congress, p. 18.

[20] EPA Report to Congress, p. 50.

[21] Toward this objective, governments may wish to create a registry of companies (and their associated facilities) storing or producing large stocks of mercury or mercury compounds, and periodically update the registry to reflect current domestic circumstances.

[22] Parties are therefore encouraged to consider whether companies may have established multiple entities for the purpose of circumventing reporting requirements under the Convention or applicable domestic law.

[23] In determining the weight of the mercury compounds, Parties should consider the weight of the compound(s), not just the mercury in the compounds, since Article 3.5(a) refers to the weight of the compounds themselves.

II. Potential Types of Facilities That May Possess or Produce Covered Stocks[24]

Mercury or mercury compounds (as defined above) may be stored or produced by the following types of facilities:

- Government agencies (i.e., agencies managing strategic minerals, agencies managing abandoned industrial facilities, military agencies)
- Mercury or mercury compound traders (i.e., companies exporting or importing elemental or commodity grade mercury, or mercury compounds)
- Primary mercury mining facilities[25]
- Non-ferrous metal mining or processing facilities[26]
- Natural gas and oil production facilities[27]
- Mercury cell chlor-alkali facilities (these facilities typically produce chlorine and caustic soda from brine using mercury to conduct an electric current for an electro-chemical reaction)[28]
- Mercury product manufacturers, including but not limited to manufacturers of mercury-added measuring devices and mercury oxide batteries[29]
- Mercury waste treatment, catalyst recycling,[30] or product recycling facilities (i.e., facilities with mercury retorts)

[24] Both active and closed facilities of the types identified may require evaluation, considering that some sites have been abandoned with significant quantities of mercury or mercury compounds remaining at the site. Closed or historic sites may be identified through a records search of relevant facility types, experts/stakeholder outreach, and industry reporting.

[25] The Convention defines "primary mercury mining" as mining in which the principal material sought is mercury. See Article 2(i). See footnote 4.

[26] As noted above, mercury and mercury compounds can be produced from the processing (i.e., roasting) of non-ferrous metals, such as industrial gold, lead, and zinc.

[27] In some parts of the world, significant concentrations of mercury are present in oil and gas deposits. Mercury can be generated as a byproduct of waste treatment/management at these operations. See e.g., http://www.unep.org/chemicalsandwaste/Portals/9/Mercury/Waste%20management/4-5_Rasio%20Sani%20INDONESIA%20country%20report.pdf.

[28] Under Article 5 and Annex B of the Convention, the use of mercury in chlor-alkali production must be phased out by 2025. A recent survey of existing plants (2013 update) found 8,413 MT of elemental mercury onsite at these facilities, not including mercury wastes, etc. See http://www.unep.org/chemicalsandwaste/Mercury/PrioritiesforAction/ChloralkaliSector/Reports/tabid/4495/language/en-US/Default.aspx. The reuse of this mercury is restricted under Article 3.5(b) of the Convention.

[29] Examples of measuring devices where manufacturers may be using large quantities of mercury include producers of fever thermometers and sphygmomanometers (blood pressure cuffs). See http://www.unep.org/chemicalsandwaste/Portals/9/Mercury/socio-economic%20analysis%20onmercury%20thermometer%20and%20sphygmomanometer%20transition%20in%20China-FINAL.pdf. Mercury oxide batteries are batteries containing 30-40% mercury, and particularly relevant in this context because mercury (II) oxide is one of the covered mercury compounds.

[30] For example, the catalyst used to produce vinyl chloride monomer (the precursor to PVC) through the calcium carbide process is activated carbon impregnated with mercury chloride ($HgCl_2$). It has been estimated that to produce 1 MT of PVC through the calcium carbide process, 1-2 kg of Hg-impregnated catalyst is consumed. See e.g., Mercury Transformation and Distribution Across a Polyvinyl Chloride (PVC) Production Line in China, Wen Ren,

- Facilities recovering mercury from mine tailings[31]
- Mercury compound and catalyst producers[32]
- Disposal sites where elemental mercury or mercury compounds can be retrieved for use in commerce
- Large interim storage facilities not otherwise specified

III. Methods for Determining Quantities of Mercury or Mercury Compound Stocks

The most direct means of identifying the facilities with relevant stocks of mercury or mercury compounds is to require reporting of mercury/mercury compound production, imports, and/or storage. Under such a reporting scheme, Parties may obtain information needed to comply with Article 3.5(b), and information which may be useful in reporting on other aspects of Convention compliance.

Parties may also utilize site-specific information obtained through facility inspections to estimate the size of stocks, either in conjunction with a reporting requirement or as an independent information gathering mechanism. Inspection-related information gathering tools include:

- Visual inspection
- Records assessment (revenue, sales, quantities, etc.)
- Process design capacity (i.e., design capacity of retort, roaster)
- In the case of cinnabar, area (or estimated quantity) of unprocessed ore

Visual inspections can reveal the size of stocks by counting or estimating the number of relevant containers, and then multiplying the number by the quantity of mercury/mercury compounds per container (for example, one mercury “flask” = 34.5 kg of mercury, while other containers are designed to hold one metric ton of mercury). In the case of cinnabar ore, a similar estimation can be performed based on the area of unprocessed ore at the facility, or the change in quantity of unprocessed ore at a facility over a period of time.

Lei Duan, Zhenwu Zhu, Wen Du, Zhongyi An, Lingjun Xu, Chi Zhang, Yuqun Zhuo, and Changhe Chen, *Environ. Sci. Technol.* 2014, 48, 2321–2327.

[31] See e.g., http://www3.cec.org/islandora/en/item/11208-assessment-primary-and-secondary-mercury-supplies-in-mexico.

[32] Producers of mercury compounds used in polyurethane manufacturing, and mercury catalysts used in vinyl chloride monomer production, may be particularly important in this regard. See Annex B, Part II. In 2007, an estimated 20-35 MT of mercury was used to produce mercury catalysts for polyurethane production in the EU. See http://ec.europa.eu/environment/chemicals/mercury/pdf/study_summary2008.pdf, p. 10.

A records assessment can indicate how much mercury is produced, handled, or sold by the facility during a given period of time. Information on the process design of relevant facility components can indicate how much mercury/mercury compounds can be produced or used by a facility during a given period of time.

IV. Chlor-Alkali Facilities

Ascertaining the amount of mercury at chlor-alkali facilities using the mercury cell process is important for multiple reasons. These facilities may possess relevant mercury stocks requiring identification under Article 3.5(a) of the Convention. In addition, this information will be useful in determining how this mercury should be managed in accordance with the restrictions on re-use at the time of decommissioning, in accordance with Article 3.5(b) of the Convention. Finally, the information will be useful in complying with Articles 10 and 11 of the Convention related to interim storage and waste management.

In determining the amount of mercury at these facilities, it is important that all locations where mercury may be stored, used, or accumulated be considered. The most obvious locations include the mercury storehouse, where mercury awaiting use and/or mercury removed from shut-down cells may be located, and the mercury in the cells themselves.[33]

However, significant quantities of mercury may also accumulate in equipment other than cells, such as piping and storage tanks, sewers, traps, and mercury sumps.[34] A 0.5 mm mercury layer in a 20 meter diameter tank represents more than 2 MT of mercury.[35] Some of this mercury can be recovered during plant operations; other accumulations may be recovered during plant stoppages or at decommissioning.

The decontamination of buildings and equipment, and other associated decommissioning/remediation activities at a closed mercury cell chlor-alkali facility may be the source of additional quantities of mercury. Mercury can be trapped in non-accessible areas of the plant such as cell components, maintenance areas, mercury retorting areas, the wastewater treatment system, areas where significant spills may

[33] Radioactive tracer techniques are available to measure the quantity of the mercury in the cells. See http://www.chem.unep.ch/mercury/Sector-Specific-Information/Docs/ANALYTICAL%2010%20%20Edition%202.pdf. Cruder estimates can be made based upon production capacity.

[34] Euro Chlor, Guidelines for Making a Mercury Balance in a Chlorine Plant, March 2010, pp. 12-13, available at http://www.unep.org/chemicalsandwaste/Portals/9/Mercury/Documents/chloralkali/Updates%20from%20Eurochlor/ENV%20PROT%2012%20Edition%205.pdf (hereafter "Euro Chlor Mercury Balance Guideline").

[35] Euro Chlor Mercury Balance Guideline, p. 7.

have occurred, including beneath the plant where mercury has been known to leak through the floor beneath the cells.[36] Special attention should be paid to sewers and buried piping.[37] Solid mercury compounds and dissolved mercury may be present in other areas of the plant, and some of these materials/wastes can produce recoverable mercury after treatment.[38]

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[36] Euro Chlor, Guideline for Decommissioning of Mercury Chlor-Alkali Plants, September 2009, p. 12, available at http://www.unep.org/chemicalsandwaste/Portals/9/Mercury/Documents/chloralkali/Updates%20from%20Eurochlor/Env%20Prot%203%20Edition%205.pdf, (hereafter "Euro Chlor Decommissioning Guideline").

[37] Euro Chlor, Management of Mercury Contaminated Sites, November 2009, p. 8, available at http://www.unep.org/chemicalsandwaste/Portals/9/Mercury/Documents/chloralkali/Updates%20from%20Eurochlor/ENV%20PROT%2015%20Edition%202.pdf.

[38] Euro Chlor Decommissioning Guideline, pp. 12-19.