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Working Group on Strategies and Review

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Item 3 of the provisional agenda

REVIEW OF THE 1998 PROTOCOL ON HEAVY METALS*

Further technical input for reviewing the 1998 Protocol on Heavy Metals

Report of the Chair of the Task Force on Heavy Metals
prepared in consultation with the secretariat

1. This report describes the results of the third meeting of the Task Force on Heavy Metals, held in Ottawa on 9–12 May 2006. It reflects the technical work done at an editorial meeting held in Dessau (Germany) on 8–10 February 2005. It includes summaries of the technical elements of a sufficiency and effectiveness review of the 1998 Protocol on Heavy Metals, in accordance with article 10 of the Protocol; proposals for potential emission limit values for mercury from existing chlor-alkali plants and from mercury-containing emissions from medical waste incineration (annex V of the Protocol, paras. 19 and 23(c)); and elements for taking into account the extent to which a satisfactory basis exists for the application of an effects-based

* This document was submitted on the above date because of processing delays.

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approach. Presentations made during the Task Force meeting are available at http://www.unece.org/env/tfhm/meetings.htm.

2. Expert from the following Parties to the Convention attended the meeting of the Task Force: Austria, Canada, Finland, France, Germany, Italy, the Netherlands, Norway, Spain, Sweden and the United States. Also present were representatives from the French-German Institute for Environmental Research, the International Council of Mining and Metals, the Lead Development Association International, the International Cadmium Association, Eurochlor, the International Cooperative Programme (ICP) on Modelling and Mapping, the Coordinating Centre for Effects, the Meteorological Synthesizing Centre – East of EMEP (MSC-E) and the European Commission. A member of the secretariat was present.

3. Mr. D. Jost (Germany) chaired the meeting, which was hosted by Canada and Germany.

I. OBJECTIVES AND INTRODUCTORY REMARKS

4. Ms. C. Heathwood (Canada) welcomed participants, noting the importance of the sufficiency and effectiveness review of the 1998 Protocol on Heavy Metals as a key to assessing whether the Protocol had made progress in achieving its aims.

5. The Chair opened the meeting, noting that volunteer experts had prepared background documents on chapters for the sufficiency and effectiveness review, as agreed at the Task Force's second meeting in Geneva (EB.AIR/WG.5/2005/2/annex III). The background documents, summarized below, are available in full on the website of the Task Force www.unece.org/env/wgs/docs37th%20session.html.

6. Ms. B. Wachs of the secretariat presented the background and mandate of the Task Force, noting that the Executive Body had asked it to complete its sufficiency and effectiveness review by December 2006, if possible.

7. Mr. H. Gregor, Chair of the Working Group on Effects, presented an overview of recent activities of the International Cooperative Programmes (ICPs) related to heavy metals.

II. PROGRESS MADE BY THE TASK FORCE ON THE SUFFICIENCY AND EFFECTIVENESS REVIEW OF THE 1998 PROTOCOL ON HEAVY METALS

8. In accordance with the workplan of the Convention and article 10 of the Protocol, the Task Force has prepared draft chapters of technical elements to assist the Working Group on

Strategies and Review in preparing for a review of the sufficiency and effectiveness of the 1998 Protocol on Heavy Metals. At the request of the Chair, these chapters are summarized below.

A. Best available scientific information on the effects of deposition of heavy metals from long-range atmospheric transport

9. This chapter describes atmospheric transport, ambient concentrations and depositions of heavy metals; observed and modelled concentrations and temporal trends of heavy metals in environmental media and biota; and comparisons, as appropriate, with effects indicators of significance. It provides an assessment of effects on ecosystems and human health from the deposition of heavy metals from long-range atmospheric transport with a focus on cadmium, lead and mercury.

10. Heavy metals are a natural component of the earth's crust and cycle through the environment in varying concentrations as a result of natural processes. In the post-industrial age, however, human activities have unlocked previously sequestered heavy metals from stable matrices and released them into the atmosphere, where to some extent they are transported across national boundaries. This has resulted in an enrichment of heavy metals in environments that are far from emission sources. While atmospheric deposition contributes to this enrichment, and to potentially harmful effects on the environment, other sources and site-dependent chemical and physical factors are also important for ecosystem accumulation.

11. ***Mercury.*** Of the three metals that are the focus of this review, mercury displays the greatest potential for long-range atmospheric transport. Mercury is emitted primarily in the gaseous elemental state (Hg (0)) and various compounds of ionic mercury (Hg (II)). The Hg (II) compounds tend to deposit closer to emissions sources, but elemental mercury can remain in the atmosphere for as long as two years and is easily transported over long distances. Concentrations of atmospheric mercury at remote locations in the UNECE region are fairly consistent (about 1.5 ng/m^3). Long-term data sets are scarce, however; data from stations located around the North Atlantic suggest that levels reached a peak in the 1980s, decreased by more than 50% by the late 1990s, and then stabilized. These findings are generally reflected in sediment, bog and glacier cores. Within Europe, EMEP modelling suggests, in general a twofold decrease in deposition between 1990 and 2003 as a result of reduced emissions, and that up to 50% of anthropogenic mercury deposition is derived from transboundary European sources, whereas between 25% and 60% may be derived from intercontinental sources. North American models suggest an even greater contribution from intercontinental sources to some regions of North America.

12. Recent results from the ICP on Integrated Monitoring (ICP-IM) suggest that remote forest catchments of Northern and Central Europe continue to accumulate deposited mercury.

Studies in Scandinavia found that mercury concentrations were associated with microbial effects in surface soils. However, mercury concentrations in terrestrial wildlife (that are not part of the aquatic food chain) are generally low and do not present a risk to wildlife or humans who consume them.

13. In the majority of lakes and rivers in North America and Scandinavia, methylmercury (a particularly hazardous form that biomagnifies up food chains) remains elevated in predatory fish. These levels may cause adverse neurobehavioural effects in fish-eating birds, mammals and humans consuming notable amounts of these fish. Generally, there is little evidence in remote locations that fish mercury concentrations have decreased over the past 10 to 15 years.

14. Mercury concentrations are also elevated at the top of marine food chains. Scientific evidence indicates that current levels of mercury in marine mammals are significantly elevated over pre-industrial levels. As in freshwater ecosystems, however, levels over the past 10 to 15 years appear relatively unchanged. The highest levels of mercury (mostly in the form of methylmercury) are found in long-living predatory fish and marine mammals. The more highly contaminated marine mammals can exceed thresholds for effects.

15. The primary source of human methylmercury exposure is from the consumption of fish, particularly larger and older predatory freshwater and marine species. It is recognized, however, that fish is an important, beneficial food for many populations and that moderate consumption of a variety of fish (following established consumption guidelines) is not likely to result in exposures of concern. Guidelines consider factors such as species, fish size and water body as well as the age and gender of human consumers. For example, guidelines are generally more restrictive for women of childbearing age because of potential adverse effects to foetuses. Nonetheless, people who consume high amounts of contaminated fish or marine mammals may be highly exposed to methylmercury, and therefore may be at risk.

16. Human exposure to elevated levels of mercury, especially in the form of methylmercury, can cause adverse effects, such as neurodevelopmental effects in newborns and young children. Among the general population, most estimated levels of dietary intake are not high enough to exceed guidelines set by national health agencies and the World Health Organization. However, some people in various populations that consume certain fish and/or marine mammals may have exposures that exceed the intake guidelines. For example, studies have shown that blood mercury concentrations regularly exceeded US and Canadian guidelines among women of childbearing age in Arctic populations that consume marine mammals. Also, a 2005 report by the US Centers for Disease Control and Prevention indicates that about 6% of women (ages 16–49) in the general US population have blood mercury levels higher than the levels corresponding to the US Environmental Protection Agency’s Reference Dose.

17. ***Cadmium.*** Cadmium is emitted to the atmosphere primarily in the particulate phase. While the majority of larger-diameter particles are deposited relatively close to the source, the finer particles have the potential for long-range transport. Deposition of cadmium resulting from long-range atmospheric transport has been reported in remote areas. Evidence suggests that deposition rates in remote areas peaked at several times pre-industrial rates during the 1960s and 1970s and have since decreased to levels only slightly higher than pre-industrial ones. These results are consistent with results of EMEP modelling and monitoring in Europe, which suggest, in general, a twofold decrease in atmospheric concentrations and deposition between 1990 and 2003. EMEP modelling suggests that 10%–80% of deposition in European countries is derived from emissions in other European countries.

18. Recent results from ICP-IM suggest that remote forest catchments of Northern and Central Europe continue to accumulate deposited cadmium. In general, soil cadmium concentrations in remote regions do not exceed thresholds for adverse effects on microbiota or vegetation. Vegetation, which accumulates cadmium from a number of sources, including atmospheric deposition, is the primary source of cadmium exposure for terrestrial herbivores that tend to accumulate cadmium in their liver and kidneys. Available information indicates that levels of cadmium in terrestrial wildlife are generally low and do not exceed thresholds of effects.

19. Cadmium is relatively mobile in freshwater ecosystems and can be accumulated by freshwater biota. However, unlike mercury, cadmium does not biomagnify in freshwater ecosystems. While lakes in Northern Europe were found to contain elevated concentrations of cadmium as a result of long-range atmospheric transport, the levels that were reported do not exceed the estimated thresholds for toxic effects. Overall there appears to be a low risk of adverse effects due to environmental exposure to cadmium through freshwater ecosystems. However, under conditions of very soft water, there may be some risk because the estimated thresholds may not be sufficiently protective for these water conditions.

20. In marine ecosystems cadmium can achieve relatively high levels in some marine mammals. The contribution of anthropogenic cadmium to marine ecosystems, however, is thought to be relatively small. The vast majority of cadmium circulating in the world’s oceans arises from natural sources and processes.

21. Food is the greatest source of human cadmium exposure, accounting for about 99% of cadmium intake in non-smokers, on average. Cereals, potatoes and leafy vegetables represent the greatest source of dietary cadmium; however, consumption of organ meats and shellfish can also represent a significant dietary source. Cadmium-containing fertilizers, natural soil content and atmospheric deposition all contribute to levels in food crops. In general, levels of dietary intake

of cadmium are below applicable consumption guidelines for the prevention of kidney damage, and there does not appear to be any risk of adverse effects to the general population as a result of long-range atmospheric transport. However, the safety margin for human health effects due to current exposures is considered to be small. Thus, further accumulation of cadmium in agricultural lands could result in exposures of concern.

22. ***Lead.*** Lead is emitted to the atmosphere primarily in the particulate phase. While the majority of larger-diameter particles are deposited relatively close to the source, the finer particles have the potential for long-range transport. Organic forms of lead, such as tetraethyl and tetramethyl lead, are significantly more volatile than inorganic forms of lead and are more amenable to atmospheric transport. Evidence suggests that atmospheric deposition rates of lead in remote regions peaked during the 1970s and early 1980s at levels up to 200 times higher than historic background. Deposition rates appear to have decreased rapidly since the early 1980s. This is consistent with results of EMEP monitoring and modelling in Europe, which suggest a general two- to threefold decrease in atmospheric concentrations and deposition between 1990 and 2003. EMEP modelling suggests that transboundary transport within Europe can account for 10%–90% of deposition in European countries. In North America, lead air concentrations decreased considerably in the 1980s and early 1990s and continued to decline through the mid- and late 1990s, although at a slower rate. Results from Arctic monitoring indicate that lead concentrations in air have generally decreased since the 1980s, though recent average levels are relatively stable.

23. Recent results from ICP-IM indicate that atmospherically deposited lead is accumulated in forested catchments of Northern and Central Europe. Concentrations of lead measured in some forest humus layers and reported by the ICP on Forests (ICP-Forests) may exceed thresholds for effects in soil organisms. However, these ICP-Forests sites are not necessarily in remote locations. Lead does not appear to reach concentrations of toxicological significance in terrestrial wildlife as a result of deposition from long-range atmospheric transport.

24. Concentrations of lead in freshwater ecosystems influenced by long-range atmospheric transport are relatively low and are not considered to represent a toxicological threat to aquatic organisms. However, lead poisoning from ingestion of lead shot, or sinkers, is a serious threat to aquatic wildlife. Available information indicates that lead from atmospheric deposition does not represent an ecological risk to marine ecosystems.

25. The general population can be exposed to atmospherically deposited lead primarily through the diet, mainly cereals and leafy vegetables, but this likely does not contribute substantially to exceedences of exposure guidelines. Children are also exposed to lead through the ingestion of lead-containing dust and other particles (e.g. deteriorating paint chips, residential

soil). In a 1999–2002 survey of children in the United States, 1.6% exceeded the current blood guideline established by the Centers for Disease Control and Prevention (CDC) for the prevention of neurodevelopmental effects (10 ug/dL), but these elevated levels are probably not attributable to long-range transport.

26. Among aboriginal populations in Northern Canada and Greenland, the use of lead shot to harvest wildlife is thought to be the dominant source of dietary lead. In a survey of Inuit women, up to 12% of women exceeded the CDC blood guideline. The source of lead exposure does not appear to be related to deposition of lead from long-range atmospheric transport.

27. ***Other metals.*** The main group of other metals that were considered are those for which some Parties have collected and voluntarily reported emissions data, including arsenic (As), chromium (Cr), copper (Cu), nickel (Ni), selenium (Se) and zinc (Zn). Other metals, though not reported on by Parties, for which new information on long-range transportation exists include platinum group metals (platinum (Pt)), palladium (Pd), and rhodium (Rh)) and antimony (Sb). Evidence suggests that all of the aforementioned metals have the potential for long-range atmospheric transport and are to some extent anthropogenically enriched in remote environments. It should be noted, however, that nickel and chromium display a lower potential for long-range atmospheric transport than do the other metals. Atmospheric concentrations and deposition of most metals appear to be stable or decreasing in remote environments, with the exception of platinum, palladium, rhodium and antimony, which have shown increases in recent years. Studies from ICP-IM suggest that copper and zinc are accumulating in forested catchments of Northern and Central Europe. Presently, available information indicates that none of these “other” metals achieves high enough concentrations as a result of long-range atmospheric transport and deposition to cause adverse effects on wildlife or human health.

B. Results of modelling and mapping of critical loads of lead, cadmium and mercury and their exceedances in the EMEP domain

28. This chapter provides the results of applying an approach for calculating critical loads and exceedances in Europe according to scientifically reviewed methodologies described in the Convention’s *Manual on Methods and Criteria for Modelling and Mapping Critical Loads and Levels and Air Pollution Effects, Risks and Trends* (hereafter, “the *Mapping Manual*”). The Task Force agreed to include these results in the sufficiency and effectiveness review of the Protocol.

29. While critical loads are an indicator of the sensitivity of receptor areas to metal inputs, the risk of effects is defined by the exceedances (i.e. cases where modelled inputs are greater than the critical loads).

30. The critical load of a metal is defined, according to the methodology in the *Mapping Manual*, as the highest total metal input rate below which harmful effects on human health and ecosystems will not occur in an infinite time perspective, according to present knowledge. The underlying effects criteria (critical limits) are based on indicators for human health and ecotoxicological effects in terrestrial and freshwater ecosystems.

31. Critical loads of heavy metals were computed using the *Mapping Manual*'s methodology for 18 European Parties under the Convention. In addition, critical loads for forest ecosystems in the whole of Europe can be computed and mapped using the Coordination Centre for Effects (CCE) background database. The critical loads were compared to preliminary computations of ecosystem-specific depositions that were computed by MSC-E for the three heavy metals using estimated and reported emissions for 1990 and 2000. Results, including critical load maps as well as preliminary exceedance maps, are summarized in EB.AIR/WG.1/2005/10/Add.1.

32. The risk of adverse effects caused by heavy metal deposition is calculated for each ecosystem individually and expressed as a statistic of exceedance in each EMEP grid cell. When atmospheric deposition was used as the only metal input, the risks of effects of lead were more widespread than those of cadmium. For mercury, as well, exceedances were widespread in countries that submitted data. For lead and mercury, the risk to terrestrial ecosystems was in general higher than the risk to human health. In addition, a widely distributed risk was identified with respect to mercury effects in surface waters, where high exceedances occurred with respect to the mercury concentration in precipitation.

33. Uncertainties have been addressed in the process of identifying critical limits. Following current scientific knowledge, critical limits have been recommended and published in the *Mapping Manual* for use in the EMEP domain. The uncertainty in the comparison of the critical loads exceedances of emission reduction alternatives is dominated by the uncertainty regarding the emission data used to model deposition. Bearing these uncertainties in mind, the overall assessment indicates that atmospheric deposition of cadmium in 2000 did not cause widespread exceedances; the exceedance of lead deposition has decreased since 1990 but was still widespread in 2000; and the exceedances for mercury remained elevated and widespread without much change between 1990 and 2000 in most of the eight countries that provided data on mercury. Exceedances would be higher for cadmium and lead if inputs from fertilizers were also taken into account.

34. The critical loads approach considers the potential for long-term effects. In interpreting critical loads exceedances, it should be noted that there are a number of reasons metal inputs may accumulate in ecosystems for some time before effects are detected. However, by definition,

harmful effects will in the long run be avoided if depositions are reduced to critical loads and maintained at this threshold.

C. Developments in best available techniques (BAT) and emission limit values (ELVs)

35. This chapter describes relevant changes between the current state of development in best available techniques (BAT) and on the emission limit values (ELVs) set forth in the Protocol, as described in its annexes III and V respectively.

36. Techniques have evolved since the signing of the Protocol for all source categories. In some cases, the BAT set out in annex III have been further developed and continue to be recognized as BAT. For example, annex III refers to PARCOM decision 90/3, which considers as a preferred option the use of membrane technology for new chlor-alkali plants and recommends the phasing out of existing mercury cell plants by 2010. This approach continues to be supported in more recent documents such as the European BAT Reference (BREF) document on the chlor-alkali industry.

37. In other sectors, new BAT have been identified. Additionally, emerging techniques with the potential of further reducing heavy metals emissions were identified for most sectors.

38. For most source categories, annex III identifies numerical values for reduction efficiencies and emission concentrations that can be achieved by applying BAT. In most cases, developments in BAT for these sources have resulted in improvements in reduction efficiencies and lower emission concentrations.

39. There may be processes not specifically covered in the annexes that are relevant sources of particulate matter and heavy metals emissions. For example, a review of the scientific literature suggests that the combustion of biomass and peat, rotary furnaces in iron foundries and secondary aluminum production may merit further technical investigation.

40. The ELVs for particulate matter set out in annex V are in many cases within the range of current national ELVs. There are some cases where current ELVs are more stringent than those identified in annex V. For example, ELVs for new installations may be lower than those in annex V, as in the case of combustion installations.

41. For most source categories, annex V includes ELVs for particulate matter, but not specifically for cadmium, lead and mercury. For most categories, ELVs for cadmium, lead and mercury have been identified and applied by some Parties.

D. Assessment of technological developments and improved product control and product management measures

42. This chapter discusses how measures and technological developments have improved relative to the measures given in annexes VI and VII to the Protocol. Annex VI contains binding product control measures, and annex VII contains guidance to Parties on a range of possible product management measures.

43. Air emissions of heavy metals may occur at several steps of a product’s life cycle: during production of the metal, during manufacturing of products, during their use, from landfills, from incineration of waste and sewage sludge, from cremation and when products are recycled. The potential for air emissions varies among products and the specific metals used.

44. A variety of measures have been introduced to address the management of products containing heavy metals that have the potential to contribute to air emissions and long-range transboundary air pollution. In general, in Europe, regulatory measures are mainly used, including market restrictions and waste management controls, while in North America both regulatory and non-regulatory measures tend to be used, including targets and timelines for reducing or minimizing waste, improved collection and recycling and other product stewardship measures.

45. Mercury has been the subject of particular attention within the UNECE area, including, for example, in EU directives and in the European Union’s Mercury Strategy, in Canada-Wide Standards and in a wide range of regulatory and non-regulatory measures taken within the United States. These have resulted in significant reductions in mercury emissions.

46. Information on the consumption of mercury is limited. The most recent available data indicate that consumption has decreased since the mid-1990s. When mercury consumption reductions across product groups are compared, the most notable reductions have been achieved for batteries relative to other products assessed in this review. Significant reductions have been achieved for batteries, while for other products the reductions have not been as great. A very rough estimate suggests that more than 325 tonnes of mercury are still consumed each year in electrical components (>75 tonnes), measuring devices (>60 tonnes), fluorescent lamps (>40 tonnes), dental amalgam (>120 tonnes) and batteries (>30 tonnes) in the European Union and North America. The relation between the consumed amount of mercury and air emissions is dependent on factors such as the efficiency of collection of products and the sorting of mercury-containing products before incineration. This kind of information is limited, and it is therefore difficult to draw any general conclusions on the efficiency of such measures.

47. All Parties to the Protocol have phased out the marketing of leaded petrol for use in on-road vehicles. Almost all Parties have introduced prohibitions with a lead content limit for petrol of 0.005 g/l, which is lower than the limit set in the Protocol. Research has shown that most types of engines can use unleaded fuels. Work is ongoing to find and evaluate alternatives for remaining applications (e.g. for racing cars and certain aircraft).

48. Almost all Parties to the Protocol have implemented prohibitions on the content of mercury in batteries that are more stringent than the requirements in the Protocol, and have also introduced limits on the content of mercury in button cells, whose market is expected to continue to grow in the coming years. The current content of mercury in button cells is declining and several models of mercury-free alternatives are available. It has been difficult to collect batteries, especially those that are incorporated into articles.

49. In general, most Parties to the Protocol have introduced measures to address the mercury-containing products highlighted in annex VII. Most Parties have implemented a variety of measures, both regulatory and non-regulatory, to manage the emissions that can arise from products containing mercury, such as electrical components, measuring devices (mainly in the health care sector), fluorescent lamps and dental amalgam. These measures include market prohibitions, limits on mercury content, hazardous waste management and efforts to improve end-of-life management. A considerable amount of effort has gone into regulating mercury-containing pesticides and mercury in paint.

50. Technological developments are ongoing to address the mercury content in products as well as to improve their end-of-life management. Mercury-free alternatives are available for almost all uses. However, there are as yet no mercury-free alternatives on the market to replace mercury-containing fluorescent lamps. Typically, measures introduced set limits for mercury content in various types of lamps or focus on efforts to improve end-of-life management. In some countries, relative to other products, dental amalgam has been subject to fewer efforts to address emissions. Measures taken by some Parties aim mainly to reduce discharges of mercury to sewer systems. Generally, the use of dental amalgam has decreased somewhat, and in some European countries it has been almost totally phased out.

51. Many Parties limits the mercury contents of sewage sludge used in agricultural applications. These limits do not address the direct emission of mercury from soil to air or indirect emissions when sewage sludge is incinerated, a practice common in many countries. Such direct and indirect emissions may be significant.

52. There was a divergence of opinion in the Task Force about whether or not to include in the sufficiency and effectiveness review products not specifically mentioned in the Protocol that

had a potential for indirect air emissions of heavy metals. Some experts felt that only products with demonstrated direct links to air emissions should be included in the review, given that the Protocol concerned long-range transport of heavy metals as air pollution, rather than heavy metals in general. These experts believed that indirect emissions arising from stages in the life cycle other than product use are covered by the technical annexes that outline BAT and ELVs. Other experts were of the opinion that BAT can also refer to the use of less hazardous substances and the sorting out of waste-containing heavy metals before incineration in accordance with the technical annexes. The view of these experts was that total emissions from products may contribute significantly to total anthropogenic air emissions of heavy metals and that, in line with annex VII, paragraph 2, management measures undertaken for products other that those specifically mentioned in paragraph 3 should be included in the review.

53. Due to the divergence in opinion, two annexes are presented in the background report, one of which describes measures relating to a series of products with potential for indirect emissions and the other describing an alternative approach proposed by one expert to outline measures to address indirect emissions. As no consensus was reached in favour of either annex, the Task Force has requested further guidance on this matter from the Working Group on Strategies and Review.

E. Changing economic conditions

54. With respect to the requirement in article 10 to review changing economic conditions, there is no provision in the Protocol granting an exemption to Parties to their obligations under the Protocol.

F. Overview of heavy metals emissions

55. Parties annually report emissions on cadmium, lead and mercury to the secretariat. In addition, many Parties voluntarily report emissions of six other metals: arsenic (As), chromium (Cr), copper (Cu), nickel (Ni), selenium (Se) and zinc (Zn).

56. In 2005 and previous years, data on emissions of lead, cadmium and mercury between 1990 and 2003 were reported as follows: 39 (80%) of 49 Parties reported lead emissions; 36 Parties (73%) reported cadmium and 37 Parties (76%) reported mercury. This represents a considerable increase in the number of Parties reporting compared to previous years. Parties reported data on other metals as follows: 30 Parties (61%) reported data on arsenic and zinc; 31 Parties (63%) reported chromium and copper; 29 Parties (59%) reported nickel and 24 Parties (49%) reported selenium.

57. For the EMEP region, the changes in cadmium, lead and mercury emissions for the period 1990–2003 were estimated on the basis of the total emissions of 24 countries[1] that reported national emissions for each of the metals for both 1990 and 2003. As figure 1 shows, the total emissions from these 24 countries between 1990 and 2003 decreased by at least 50% for all three metals. Emissions of lead decreased in all the countries, with the amount varying from about 31% (Latvia) to 99% (Monaco) and averaging about 92%. The lowest reduction of cadmium is in Slovenia (4%), the highest in the Republic of Moldova (96%). Two countries (Spain and Cyprus) reported an increase in cadmium emissions. Cadmium emissions decreased overall by about 51%. The reductions of mercury emissions varied from about 17% (Slovenia) to 92% (Republic of Moldova). While four countries (Belarus, Cyprus, Lithuania and Spain) reported increases in mercury emissions, overall, the decrease in total reported mercury emissions was 57% for all 24 countries.

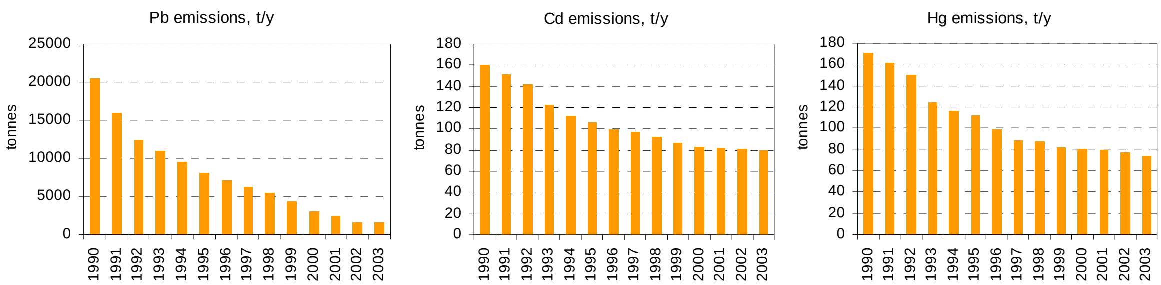

Figure 1. Reported emissions of lead, cadmium and mercury in the EMEP region (24 countries)

58. Concerning Parties outside the geographic scope of EMEP, Canada reported data on cadmium, lead and mercury for each year from 1990 through 2003 (figure 2). The United States reported emissions of cadmium, lead and mercury for 1990, 1996, 1999 and 2002. In Canada emissions of lead, cadmium and mercury decreased between 1990 and 2003 by about 70%, 66% and 75% respectively. In the United States, mercury emissions decreased from about 200 tonnes in 1990 to 102 tonnes in 2002 (a reduction of approximately 49%), while lead emissions decreased from roughly 3,000 tonnes in 1990 to 1,570 tonnes in 2002 (a 48% reduction). With regard to cadmium emissions in the United States, there is currently too much uncertainty to quantify reductions.

[1] Austria, Belarus, Belgium, Bulgaria, Cyprus, the Czech Republic, Denmark, Estonia, Finland, France, Hungary, Italy, Latvia, Lithuania, Monaco, the Netherlands, Norway, the Republic of Moldova, Slovakia, Slovenia, Spain, Sweden, Switzerland and the United Kingdom.

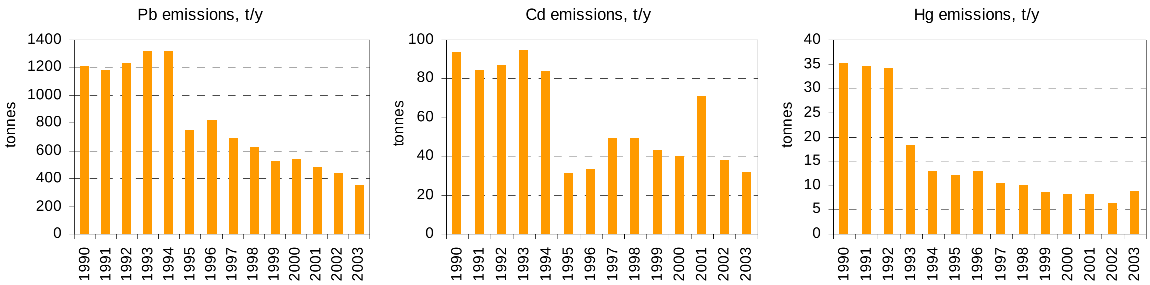

Figure 2. Reported emissions of lead, cadmium and mercury in Canada

59. Changes in arsenic, chromium, copper, nickel and zinc emissions in the EMEP region for the period 1990–2003 were estimated on the basis of the emissions of 17 countries.[2] Changes in selenium emissions for1990–2003 were assessed on the basis of the emissions of 13 countries.[3] Total reported emissions of other metals in these countries decreased between 1990 and 2003. Chromium ranks first (emission decreased by about 70%), followed by arsenic (64%), nickel (54%), zinc (31%) and copper (24%). Emissions of selenium decreased by only 7%.

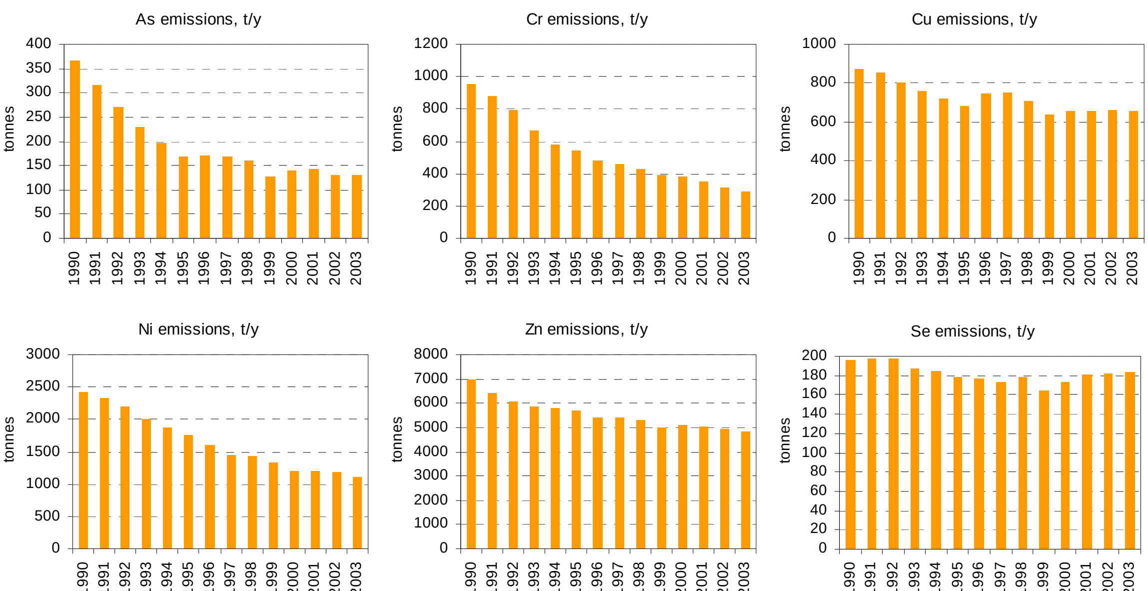

Figure 3. Reported emissions of arsenic, chromium, copper, nickel, zinc (17 countries) and selenium (13 countries) in the EMEP region

[2] Belarus, Belgium, Cyprus, Denmark, Estonia, Finland, France, Hungary, Italy, Latvia, Lithuania, the Netherlands, the Republic of Moldova, Slovakia, Spain, Sweden and the United Kingdom.

[3] Belgium, Denmark, Estonia, France, Hungary, Italy, Latvia, the Netherlands, the Republic of Moldova, Slovakia, Spain, Sweden and the United Kingdom.

60. Officially reported emissions of heavy metals continue to have significant uncertainties. The Task Force noted that officially reported data on heavy metals emissions were still missing from some countries, and it recognized the merit of further improvement in the overall quality of emission data. Expert estimates of emissions are used in modelling exercises when officially submitted data are not available or are not of sufficiently high quality.

III. EMISSION LIMIT VALUES

61. Annex V to the Protocol states that limit values for existing chlor-alkali plants (para. 19) and for mercury-containing emissions from medical waste incineration (para. 23(c)) shall be evaluated no later than two years after the entry into force of the Protocol. The Task Force reviewed the technical developments of ELVs for both source categories as summarized below.

62. The reported emissions for the best-performing chlor-alkali installations in the European Union, Switzerland and Norway range between 0.2 and 0.5 g Hg/Mg Cl_2 capacity. On average, the emissions are currently about 1 g Hg/ Mg Cl_2 (range 0.18 – 2.3 g Hg/Mg Cl_2 for the year 2005). For medical waste incineration the reported emissions for the best-performing installations in the European Union range from 0.001 to 0.02 mg/Nm3 (daily average). Most current ELVs range from 0.02 to 0.05 mg/Nm3 (daily average); for example, Canada-wide standards for mercury emissions from medical waste incineration range from 0.02 to 0.04 mg/Nm^3.

63. The Executive Body, at its twenty-third session, agreed that the evaluations of ELVs for both source categories had been fulfilled and requested the Task Force to develop proposals for ELVs for both source categories. The Task Force was not able to reach a consensus on a proposal. However, most members of the Task Force supported the following statements:

(a) Based on data from the European Union, it is expected that most plants in the European Union will be able to reach an ELV of 0.75 g Hg/Mg Cl_2 as a yearly average by 2012. By applying currently available best techniques and practices, existing chlor-alkali plants can minimize their emissions.

(b) Based on information from the European Union and Canada, for medical waste incineration treated independently or together with municipal waste an ELV of 0.05 mg/Nm^3 is achievable.

64. However, two experts (including one from industry) could not agree with the statements related to ELVs in paragraph 63, partly because they believed that significant uncertainties remained concerning the feasibility and practicality of implementing these specific ELVs. These

experts noted that some regulatory schemes used different metrics to set limits for emissions from chlor-alkali facilities. One expert expressed the view that the Task Force had not yet sufficiently considered and reported information to the Working Group related to the costs of implementing measures to achieve the indicated values in paragraph 63, the expected reduction in emissions, and the associated human health or environmental benefits. In addition, there may be other approaches to achieving equivalent emission reductions without relying on a specific ELV. For example, in the United States, substantial emission reductions have been achieved using a combination of other approaches for both source categories.

65. It would be beneficial to undertake further technical review and consider other relevant factors (such as emissions, costs and feasibility), including information from countries outside the European Union, before drawing conclusions about specific ELVs.

IV. PROGRESS REPORT ON THE ASSESSMENT OF THE EXTENT TO WHICH A SATISFACTORY BASIS EXISTS FOR AN EFFECTS-BASED APPROACH

66. Article 10, paragraph 3(b)(iii) of the Protocol requires that a review of the Protocol take into account the extent to which a satisfactory basis exists for the application of an effects-based approach. Moreover, the workplan of the Convention requests the Task Force to continue the technical work necessary to assess the extent to which a satisfactory basis exists for the application of an effects-based approach, review information and prepare a progress report on the basis for such an approach.

67. The Task Force was presented with summary information on the risks of the effects of air pollution to human health and the environment evaluated on the basis of the critical loads approach used in the EMEP region. Other risk assessment approaches, including the weight of evidence approach, were mentioned without further analysis.

68. In the context of EMEP, an integrated effects-based approach enables the assessment of emission reductions at least cost, subject to environmental targets. A critical load approach was used in support of the 1994 Oslo Protocol and the 1999 Gothenburg Protocol.

69. Scientific knowledge on critical loads has been developed over the past 16 years, starting with international workshops and projects in the late 1980s. The modelling and mapping of critical loads has involved various ICPs and various European scientific forums. The development of European modelling methodologies and databases was conducted by the ICP on the Modelling and Mapping of Critical Levels and Loads and Air Pollution Effects, Risks and Trends (ICP Modelling and Mapping), including its Coordination Centre for Effects (CCE).

70. In 1998, the Netherlands Ministry of Housing, Spatial Planning and the Environment published two manuals presenting guidelines for calculation methods, critical limits and input data for the calculation of critical loads of heavy metals for terrestrial and aquatic ecosystems. Since the publication of these manuals, a number of additional reviews and updates have been prepared by an expert panel on heavy metals of the ICP Modelling and Mapping. CCE has issued calls for data from national focal centres to produce European maps.

71. Critical loads of cadmium, lead and mercury were computed by 18 European Parties in 2005 using both human and ecosystem health as endpoints. Results were adopted by the twenty-second meeting of the Task Force on Modelling and Mapping (Bled, 6–7 April 2006). For countries where national data are not available, information on biogeochemical data can be used to compute critical loads of heavy metals. This database has also been applied in support of effects-based protocols under the Convention.

72. The critical loads methodology applied in the EMEP region regarding heavy metals is comparable to that used in support of the Gothenburg Protocol. The Working Group on Effects, at its twenty-third and twenty-fourth sessions, stated that the effects-based approach for heavy metals was sound and recommended the use of such data for work under the Convention. The Executive Body at its twenty-third session confirmed that the new 2005 European critical loads data and maps could be used for work under the Convention (ECE/EB.AIR/87, item 19(g)).

73. European critical load maps were compared to computations of ecosystem-specific depositions for 1990 and 2000 of cadmium, lead and mercury modelled by MSC-E. The use of officially reported emission data resulted in modelled depositions that were lower than the values of monitored deposition data. A recent review of the EMEP models for heavy metals and persistent organic pollutants (POPs) concluded that the official national heavy metals emission data were likely to be too low. The uncertainty of exceedance calculations was mainly due to the quality of national emission data.

74. Emissions, depositions, critical loads and exceedances could be used to support decisions related to reducing heavy metals emissions. However, economic and technological information is also required for an assessment of the potential to reduce emissions of heavy metals.

75. Information on technology, economics and exceedances has been used in an optimized approach in support of the 1999 Gothenburg Protocol. This required an integrated assessment model approach that included cost curves of abatement measures. Currently, there is no integrated assessment model to optimize heavy metal emission reductions. The use of critical loads, depositions and exceedances can be envisaged for analyses of emission scenarios in the EMEP region, including the application of BAT.

76. The Task Force took note of the information outlined above and agreed that further work could be done to explore other effects-based approaches if required.

V. FURTHER WORK OF THE TASK FORCE

77. The Task Force agreed on its draft workplan for 2007. Current priority settings could be summarized as follows:

(a) Complete, if necessary, the technical work to assess the extent to which a satisfactory basis exists for the application of an effects-based approach;

(b) Prepare a technical study of source categories not specifically covered in annexes II and III of the Protocol which may be sources of cadmium, lead and/or mercury emissions;

(c) Carry out other work as proposed by the Working Group on Strategies and Review.

78. The Task Force requested further guidance from the Working Group on Strategies and Review on additional work on products and product groups.

79. The fourth meeting of the Task Force is expected to be held in 2007 (date and venue to be announced).