Questionnaire to the project

"Requirements for facilities and acceptance criteria for the disposal of metallic mercury"

We would be very grateful if you could send back the questionnaire until
6 July 2009 to Sonja.Bauer@bipro.de.

Name: Elena Lymberidi-Settimo

Institution: European Environmental Bureau / Zero Mercury Working Group

Telephone number: + 32 228913 01

e-mail: elena.lymberidi@eeb.org

Function: Project Co-ordinator Zero Mercury Campaign

☒ Please find attached the filled in questionnaire

☐ I would be interested to further discuss this topic by a telephone call, possible dates when I am available:

……

☐ No interest in further discussions

Questions

1. Do you know recent or ongoing research / scientific activities related to disposal options of metallic mercury waste? *If available, please indicate contact persons, documents or links.*	1. **EU funded project on : Managing mercury** The third 2006 LIFE-Environment preparatory project is MERSADE - "Design, construction and validation of a prototype installation for a safe deposit of surplus mercury from European industry" (LIFE06 PREP/E/000003). The European Commission adopted a mercury strategy in January 2005 with the aim of effectively phasing out this highly toxic substance. The strategy states that surplus mercury should be safely stored or disposed of, and it is this aspect that the project will contribute to. The project will both construct a pilot model for safe storage of mercury and test the effectiveness of disposal in bricks. The beneficiary is Minas de Almaden y Arrayanes SA (Mayasa), a Spanish company which runs a wide range of mercury-related installations across Europe. The beneficiary will work in partnership with Spain's Castilla La Mancha University, and the Spanish National Centre of Metallurgical Research. Spain is Europe's major mercury-producing country. The beneficiary's website is at http://www.mayasa.es Or you could contact the LIFE unit at European Commission, DG Environment – Santiago Urquijo <santiago.urquijo-zamora@ec.europa.eu>; 2. **Permanent storage of long-lived hazardous waste in underground deep bedrock depositories.** Summary of key findings regarding mercury waste from the Swedish inquiry into permanent storage of long-lived hazardous waste in underground deep bedrock depositories 2008-04-10, SOU 2008:19 http://www.regeringen.se/sb/d/108/a/98458 3. **Gesellschaft für Anlagen und Reaktorsicherheit (GRS) mbH,** Dr. Sven Hagemann, (Sven.Hagemann@grs.de) should also be contacted as they have great experience with waste disposal and storage issues and especially salt-mines. (www.grs.de) 4. **US** Department of Energy, plans to prepare a study, called an environmental impact statement, to decide which site or combination of sites should be used to store mercury. A draft study is expected to be issued this fall. http://www.thenewstribune.com/news/northwest/story/799020.html . DOE has set up a website at www.mercurystorageeis.com See also Other reports from the US (attached) • https://www.dnsc.dla.mil/eis/documents/FinalFS/Process_FS.pdf • Mercury Contamination – Amalgamate (contract with NFS and ADA), September 1999 • Sulfur Polymer Stabilization/Solidification (SPSS) Treatment of Mixed-Waste Mercury Recovered from Environmental Restoration Activities at BNL, January 2001 • PRELIMINARY ANALYSIS OF ALTERNATIVES FOR THE LONG TERM MANAGEMENT OF EXCESS MERCURY, August 2002 • Record of Decision for the Final Mercury Management Environmental Impact Statement; Notice, April 2004

		• Advances in encapsulation technologies for the management of mercury-contaminated hazardous wastes, September 2004 • Economic and Environmental Analysis of Technologies to Treat Mercury and Dispose in a Waste Containment Facility, April 2005 5. The European Environmental Bureau organised a **conference on** "***EU Mercury surplus management and mercury-use restrictions in measuring and control equipment***" on 19 June 2006, in Brussels**.** All presentations as well as the Conference report and the participants list are available at http://www.zeromercury.org/EU_developments/060619-BXL-conference.html **Other publications (attached)** • Mercury in waste in the European Union: sources, disposal methods and risks, February 2004
2.	Do you know recent or ongoing research / scientific work related to pre-treatment techniques for metallic mercury waste? *If available, please indicate contact persons, documents or links.*	1. SAKAB and DELA Gmbh are researching and developing a environmentally sustainable solidification process for metallic mercury.(www.sakab.se) , (www.delagmbh.de), please contact Susanne Kummel, [Susanne.Kummel@sakab.se], relevant to this see also **Mercury immobilization** – a requirement for permanent disposal of mercury waste in Sweden, Margareta Svensson, 2006 http://www.sakab.se/upload/dokument/pdf/Laddningsbara%20filer/Forskning%20&%20utveckling/Mercury_immobilization.pdf 2. Further to that, there are several technical scale processes to solidify mercury already on the market. See Documentation below Encapsulation/ solidification of liquid Hg - http://www.albuw.ait.ac.th/Group_R/Mercury/report-3/pdf_link/Encapsulation1.pdf - http://www.pubs.bnl.gov/documents/22164.pdf - http://www.bnl.gov/bnlweb/pubaf/pr/2001/bnlpr053101.htm - http://www.p2pays.org/ref/26/25256.pdf - Technologies for Immobilizing High Mercury Subcategory Wastes http://www.epa.gov/epaoswer/hazwaste/ldr/mercury/imoblzn2.pdf Some recent US patents: - Christelle Riviere-Huc, Vincent Huc, Emilie Bosse (2008) Method for stabilisation of metallic mercury using sulphur. USPTO Application #: 20080019900 http://www.freshpatents.com/Method-for-stabilisation-of-metallic-mercury-using-sulphur-dt20080124ptan20080019900.php (French company!) - Robin M. Stewart, John E. Litz, Thomas Broderick (2002) Method and apparatus for stabilizing liquid elemental mercury. http://www.patentstorm.us/patents/6403044-fulltext.html An earlier approach - Oji, L. (1998) Mercury disposal via sulphur reactions. J. Env. Eng. 124 (10), 945-952

		Evaluation of the suitability of pre-treatment techniques for metallic mercury waste should include the following considerations; -during the process, are details provided of releases of all forms of mercury & mercury compounds by all routes, as well as releases of other chemicals used in the process -efficiency of the stabilisation process – what % of mercury is stabilised? -after stabilisation, do any possibilities remain for releases of mercury (in any form, by any route) from the material – both in the short term and long term. -what understanding is there as to whether any materials that, if mixed with the solidified mercury, could increase any releases of mercury from the material ie could co-disposal with other wastes alter the stability -under what conditions is the final material stable (and how is the stability defined; levels of releases/timescale for stability, etc. - If data are provided for 'zero' releases in the form of "less than x amount/time", are the limits acceptable -what testing has been carried out to support the above claims -what existing cases can they be cited as workable examples (and for these, what amounts were stabilized & stored, over what time scales, under what conditions eg any co-disposal) -is the process designed to ONLY produce materials for final terminal storage (i.e not designed to enable recovery of the mercury at any stage) – can the process be compared with other processes; use of energy & chemicals/ properties of the stabilized materials
3.	What is the current legal framework related to the disposal and /or treatment of metallic mercury in your country?	Representing EU NGOs we would consider as background legislation the EU Landfill directive, http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CELEX:31999L0031:EN:NOT, as well as COUNCIL DECISION of 19 December 2002 establishing criteria and procedures for the acceptance of waste at landfills pursuant to Article 16 of and Annex II to Directive 1999/31/EC (2003/33/EC). Some relevant information may also be contained in the Best Available Technique Reference Document (BREF) on the chlor-alkali industry, under the IPPC directive - ftp://ftp.jrc.es/pub/eippcb/doc/cak_bref_1201.pdf , as well as other BREFs - http://eippcb.jrc.es/reference/ e.g. on Emissions from Storage, Non-Ferrous Metals Industries, Management of Tailings and Waste-Rock in Mining Activities, Waste Treatments Industries etc. The European Parliament (March 2006) [1]has called for legally binding measures to safely store excess mercury in secure sites, continuously monitored and located where active intervention can take place immediately if necessary. It also underlined the importance of the polluter-pays principle as far as storage of surplus mercury is concerned. Also the Basel convention (http://www.basel.int/) related work could be considered for information although we would actually expect them to follow the outcomes of this present study; Control of Transboundary Movements of Hazardous Wastes and

[1] http://www.europarl.europa.eu/sides/getDoc.do;jsessionid=C764B97AE2975C6454E428F8F0699FE7.node2?language=EN&pubRef=-//EP//TEXT+TA+P6-TA-2006-0078+0+DOC+XML+V0//EN

		their Disposal. http://www.basel.int/techmatters/index.html; • Draft Technical Guidelines on the ESM of Mercury Waste. Draft of 30 April 2009. Comments invited from Parties and others by 30 September 2009 • Draft Technical Guidelines on the ESM of Mercury Waste. COP9 Draft (10 April 2008). Comments received from Parties and Others
4.	What are the current ways of treatment of metallic mercury and disposal of metallic mercury within your country?	Not specified yet at EU level; only relevance the EU Export ban and storage regulation - http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CELEX:32008R1102:EN:NOT, and the EU landfill directive as relevant.
5.	Are there any national preferences as regards the options stated in Regulation (EC) N°1102/2008 (salt mines, deep underground hard rock formations) in which way metallic mercury should permanently be disposed of? *If yes, please indicate reasons for the preferences.*	Metallic mercury in liquid form should not be disposed off underground until special safety concerns have been taken into account. During the discussions BEFORE the adoption of the EU Mercury Export ban and storage regulation- the following has been part of our position - http://www.zeromercury.org/EU_developments/070424NGOS_COuncil_WPE_Hg_Export_ban.pdf **Temporary storage of decommissioned mercury from the chlor-alkali industry must start as soon as possible, in continuously-monitored secure sites located where immediate intervention can take place if necessary.** – Disposal of liquid wastes is prohibited from the EU Landfill Directive, due to the risks the nature of these waste entail. Disposal for liquid metallic mercury in salt mines raises serious concerns with respect to the environmental safety over the very-long term.[2] – The European Commission is currently co-financing MAYASA to implement the LIFE preparatory project MERSADE, with the objectives to value the facilities available at the current storage area, design a prototype for storage of metallic mercury and a monitoring plan for 50 years and study a line for transforming liquid metal mercury into a more stable species. The project started in late 2006[3]. – In the US investigation on safe disposal of mercury has been going on for years.[4] A study has concluded that the safest way is to store mercury in above-ground facilities where continuous monitoring will take place, amongst other defined safety conditions[5]. Temporary timeframe is set in 40 years for the time being.[6]

[2] EEB Conference report " EU mercury surplus management and Mercury-use restrictions in measuring and control equipment", October 2006, p.23
[3] http://www.mayasa.es/ing/mersade.asp
[4] USEPA (1997) – Mercury Study, Report to Congress. EPA-452/R-97-003. US Environmental Protection Agency, Washington DC, USA; 199
[5] US EPA Preliminary Analysis of Alternatives for the Long Term Management of Excess Mercury, August 2002, http://www.epa.gov/ORD/NRMRL/pubs/600r03048/600R03048.pdf
[6] Record of Decision for the Final Mercury Management Environmental Impact Statement; Notice
http://a257.g.akamaitech.net/7/257/2422/14mar20010800/edocket.access.gpo.gov/2004/pdf/04-9726.pdf

		– Research to develop a technology for the chemical stabilization of metallic and oxidized mercury is still ongoing in Sweden, but no commercial solution is available yet[7]. – Until safe disposal techniques are developed and fully evaluated metallic mercury shall be stored temporarily in such a way that it can be retrieved (but only to allow storage in a more suitable manner, with retrieval for reuse being strictly prohibited). – A framework of minimum conditions for storage should be established ensuring continuous monitoring, minimum safety standards, regular and transparent reporting, advance planning and projections, assurance of delivery, and penalties for failure. – The responsibility for safe final disposal should remain with the Member States and the chlor-alkali industry as appropriate. – The European Parliament (March 2006) has called for legally binding measures to safely store excess mercury in secure sites, continuously monitored and located where active intervention can take place immediately if necessary. It also underlined the importance of the polluter-pays principle as far as storage of surplus mercury is concerned.
6.	Do you have appropriate storage possibilities in your country?	At EU level, different possibilities are discussed.
7.	Do you have specific experiences related to the underground storage of hazardous waste?	1. Old salt mines in Germany which are used as hazardous waste disposal have experience on this – we have also visited the Herfa-Neurode mine, K&S – contact person – Alexander Baart, Tel +49 (0)561 93012025, Fax +49 (0)561 93011714, K+S Entsorgung GmbH, Bertha-von-Suttner-Str. 7, 34131 Kassel, www.ks-entsorgung.com 2. However, there are recent examples of other mines that are or have been used for underground waste disposal (under a different legal regime) that have partially collapsed or are in danger of collapsing: - Teutschenthal (a so-called Backfill Mine or Disposal Mine) used for storing hazardous waste since 1995 has partially collapsed in 1996 (after similar incidents in 1916 and 1940): Official documentation by the mining company: http://www.grube-teutschenthal.de/versatz.htm, http://www.grube-teutschenthal.de/historie.htm - Morsleben: The underground repository for low level nuclear started operation in 1981 as the one and only disposal facility for low level nuclear waste in the former German Democratic Republic. Morsleben have been re-licensed for waste disposal only in 1991(after the re-unification) but went out of operation in 1998 because of danger of partially collapsing. Partly collapsed in 2001. o Coverage in the Newspaper WELT: http://www.welt.de/print-welt/article460884/Atommuell-

[7] http://www.sakab.se/upload/dokument/pdf/Laddningsbara%20filer/Forskning%20&%20utveckling/Mercury_immobilization.pdf

	Endlager_Morsleben_droht_der_Einsturz.html Newspaper (Die Welt): “Nuclear waste dump site Morsleben is threatened to collapse” (2001). o Documentation by Greenpeace Germany: http://www.greenpeace.de/fileadmin/gpd/user_upload/themen/atomkraft/morsleben.pdf A Greenpeace factsheet about Morsleben (5 pages / 2003) Morsleben can also be visited, see http://www.bfs.de/en/transport/endlager/morsleben.html/besuch_eram.html - Asse II: Went in operation as a potash mine 1906. Two “sister” mines Asse I and Asse III flooded in 1906 and 1923. Started operation as a “research disposal facility” for nuclear waste in 1967. Out of operation since 1978 because of missing license, Water intrusion since 1988, in danger of collapsing. - Documentation by Greenpeace Germany: http://www.greenpeace.de/fileadmin/gpd/user_upload/themen/atomkraft/asseii.pdf - See also article on Asse II accident and concerns from Der Spiegel (attached) 3. Salt mines or other underground facilities could flood, and then there is possibility of corrosion of flasks etc. Example: Asse mine. Water intrusion since 1988. Reason: Too extensive mining. Distance between overlying rock formations and the mined potash layers was too small. The creeping of the salt lead to the opening of new water-leading paths. Institut für Gebirgsmechanik (2007) Gebirgsmechanische Zustandsanalyse des Tragsystems der Schachtanlage Asse II. http://www.helmholtz-muenchen.de/fileadmin/ASSE/PDF/News/Kurzbericht-Zustandsanalyse-V-4.pdf 4. Generally a recovery of waste is very expensive and dangerous, because - The containers and bags holding the waste are generally constructed for transport purposes not for withholding large pressures and mechanical/ chemical stress for a long time. Example: It is being debated whether the waste containers in the Asse mine should be recovered. Problem: They might be already corroded or damaged and therefore handling poses a great direct risk for the personal – a risk that may even be greater than the much lower risk to the population du to later pollution of groundwater. - In salt mines, all open space is filled with crushed salt once the maximum amount of waste has been brought to a specific cavity. After that the rock salt continues creeping onto the crushed salt and waste until it is a compact mass. After the completion of this process recovery means digging and mining – quite a cumbersome activity. Moreover, the already backfilled areas of the mine contribute to the overall stability. Digging the waste out would further destabilize the whole system o Presentation by Michael Sailer, Öko-Institut (2007): possible safety problems due to recovery activities http://www.oeko.de/files/aktuelles/application/pdf/sailerasseendppt.pdf o Dettmann (2007): additional cost of recovery of nuclear waste from the Asse mine: about 470 Mio EUR. http://www.asse2.de/vortraege/vortrag-dettmann.pdf

		5. Also relevant to underground storage – experiences from the underground storage of the nuclear waste should be taken into consideration – see presentation from Mr. Mike Heith, Sheffield Hallam University Health, environmental and safety questions related to the underground storage/disposal of mercury over time
8.	Which type of containment should be used for the storage (permanent or temporary)?	Container suitability is largely related to the form of mercury being stored. The long term storage of metallic mercury is associated with many problematic areas, such as amalgamation with the container; Stabilisation as a sulphur or selenium compound or similar reduces many of the problems associated with storage of metallic mercury Some options which many need to be looked further are: - Stainless steel flasks, (these usually contain 18% per weight Cr, and 8% per weight Ni. Considering the limited amounts of Cr and Ni globally, it might be that future generations may be tempted to pick up the flasks (legally or illegally) with related exposure to mercury. We have witnessed how the Soviet Union collapsed and then because the origin of both Hg and radioactive iron scrap from the military equipments. So to avoid emissions it might be best to pack it in less valuable containers. In addition, stainless steel containers, probably need iron containers inside to reduce the risk of corrosion, since Hg will corrode(amalgamate) the Cr and Ni. - Iron flasks (iron without any alloy metals), since iron does not form an amalgam/alloy with mercury, and does no break (like plastic material). Unfortunately iron may corrode quite fast in saline solutions. But: Flasks may be constructed with a coating or a second shell that protects the iron from corroding even when in contact with saline waters. Otherwise, it would be better to have dry conditions to avoid corrosion. - Glass and Teflon could also be an option as Hg containers, since they are 'impermeable' to Hg, contrary to other plastics than Teflon – but then other issues as strength, pressure resistance, fragility may need to be checked.
9.	Do you see a pre-treatment of metallic mercury (e.g. solidification) as essential before a safe storage?	Yes. The pre-treatment of metallic mercury wastes, using the most suitable method to prevent long-term future releases of mercury by any route, is the only way that can enable adequate storage conditions to be employed. Failure to do so renders any storage option sub-optimal. Liquid mercury is not an acceptable form for storage because it may react with the environment and pose danger for the environment or human health in the future. Metallic mercury easily vaporises or may leak out of corroded/damaged storage containers. Thus, metallic mercury must be stabilized in order to obtain safe storage conditions. SAKAB and DELA Gmbh are currently developing a solidification technology for the stabilisation of metallic mercury.
10.	Do you have any experiences and/or	Stabilization should be considered by conversion to ionic sulphur or selenium compounds, taking into account issue of

	preferences related to pre-treatment technologies of metallic mercury? *If yes, please indicate relevant contact persons, documents or links.*	toxicity (selenium vs sulphur), stability of the final compound etc. It seems that the safest is stabilization with sulphur to HgS (cinnabar) since this is the most common Hg compound in nature with proved stability. Selenium appears to be poisonous. However, whatever way is proposed it should be environment friendly, avoid emissions, etc and overall environmental impact should be addressed.
11.	Which aspects are most important for you related to the revision of the annexes I, II and III of Directive 1999/31/EC on landfill of waste? *e.g. any specific suggestions on what would especially need to be revised, any additional options*	All annexes should be revised considering the particular risks arising from the nature and long –term properties of the metallic mercury, especially considering the possibility to store temporary or permanently mercury in liquid form (also as per Art. 4 of the 1102/2008 Regulation. Special attention may need to be paid in relation to monitoring while the facility is open but also at the long term after a facility is shut, in case liquid mercury was to be put underground one way or the other. Following the annexes revision, the Decision 2003/33 may also need to be revised accordingly to reflect above concerns. Also conditions for above ground storage should be analysed in detail – this would be beneficial for the EU but also at global level, given the ongoing work under UNEP and considering the availability of different types of facilities in different regions.
12.	Which further items related to the disposal of metallic mercury would be of special interest for you?	-