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OBJECTION TO ORICA AUSTRALIA'S APPLICATION TO EXPORT THE POPS WASTE, HEXACHLOROBENZENE TO FRANCE FOR INCINERATION

National Toxics Network (NTN) is a NGO (non-government organisation) network working for pollution reduction, protection of environmental health and environmental justice. NTN is the Australian focal point for the International POPs Elimination Network (IPEN) and strives to achieve the full implementation of the *Stockholm Convention on Persistent Organic Pollutants* (POPs) 2001 and other relevant international and regional chemical treaties. We are committed to a toxics free future. NTN has a particular focus on the assessment and management of new POPs, the management of hazardous waste, protecting children's environmenta health and the combined impact of chemicals and climate. Our senior advisor is a member of the UN Expert Group on Climate Change and Chemicals and a coauthor of the report 'Climate Change and POPs; Predicting the Impact'.

As Australia's peak NGO dealing with toxics and pollution issues, NTN has maintained a keen interest in the HCB controversy over many years and has been represented on a number of bodies dealing directly and indirectly with HCB waste including the:

- National Advisory Body on Scheduled Waste (NAB)
- HCB Management Plan Panel
- Stockholm Convention Reference Group
- Hazwaste Act Policy Reference Group
- Dioxin Consultative Group
- NGO Observer to the POPs Review Committee
- NTN Observer on Hazwaste Technical Advisory Group
- NTN Observer on the Botany Community Participation and Review Committee

Executive Summary

This objection to the application by Orica Australia to export HCB waste to France is supported by the Doctors for the Environment Australia, Friends of the Earth (FOE), Nature Conservation Council, Greenpeace Australia, International POPs Elimination Network (IPEN), Basel Action Network (BAN) the Global Alliance for Incineration Alternatives (GAIA) as well as the national French NGO, MDRGF / Movement for Rights and Respect for Future Generations.

The Australian chemical manufacturer Orica has announced its plans to export its stockpile of highly toxic Hexachlorobenzene (HCB) waste to an incinerator in France; the Tredi Seche Global Solutions incinerator in Salaise-sur-Sanne, just south of Lyon.

The National Toxics Network and supporting organisations oppose this attempt to dump the responsibility for Australia's most toxic waste on another country

Australia is a developed country and should deal with its own POPs (persistent organic pollutants) waste as it has in the past. Australia has the technical expertise and suitable technologies capable of destroying HCB are commercially available. It is possible and feasible to site destruction facilities in Australia.

Australia urgently needs a hazardous waste destruction facility that can address the bourgeoning amounts of current POPs waste as well as future POPs waste. Newly listed POPs are present in large quantities in Australian building and electronic wastes and these require environmentally sound destruction.

Australia also has an obligation to destroy its wastes within national borders, under Basel Convention Article 4 to *"take the appropriate measures to (b) Ensure the availability of adequate disposal facilities for the environmentally sound management of hazardous wastes and other wastes."*

Transport of such a large amount of toxic POPs waste across the globe is in itself hazardous. While this current permit is only for 132 tonnes, there is approximately another 10,000 tonnes that would need to be shipped and transported for incineration. This current proposal with the Tredi Seche Global Solutions incinerator will not accept all the HCB waste and large quantities of HCB waste will remain in Australia and need to be destroyed.

The *Stockholm Convention on Persistent Organic Pollutants* 2001 warns that the incineration of hazardous POPs waste creates more toxic POPs byproducts in the incinerator dust, flyash, liquid scrubber waste and air emissions. These dioxin contaminated waste residues will need disposal and management into perpetuity.

This is the third attempt by Orica to ship the toxic waste overseas for burning. Previous attempts to export the waste to Germany and then Denmark were rejected after public outrage and community demonstrations. The German and Danish governments concluded that Australia has a legal responsibility to manage its own waste and is financially and technically capable of doing so.

The exports were rejected and Australia's reputation as a leader in environmentally management was seriously impacted.

In 2006, Orica was quoted in the media as saying, "where there is opposition we will not go" (Environmental Manager, No 547, 11 July 2006). There is growing opposition in France, both locally and nationally and increasing international concerns.

The proposal by Orica to export its highly toxic HCB waste to France for incineration is unacceptable and should be rejected. Suitable destruction technologies that can achieve far better environmental outcome than incineration are available and can be established in Australia, thus avoiding all the risks associated with long range transport of the toxic waste. Australia has an international obligation to manage and destroy its own waste.

1. The Proposal

Tredi Seche Global Solutions incinerator in Salaise-sur-Sanne

The proposed location for burning the Orica HCB waste is the Tredi Seche Global Solutions incinerator in Salaise-sur-Sanne, just south of Lyon. TREDI, is a branch of the Group Séché Environnement, a French waste company handling household and industrial waste. In 2002, the company acquired TREDI, which owned two facilities, Saint-Vulbas concerned with the destruction of industrial gases and decontamination of contaminated electrical equipment and the Salaise facility which focused on the rehabilitation of electrical transformers.

The Global Solutions incinerator in Salaise-sur-Sanne consists of 3 combustion lines for the thermal treatment of waste:

- Salaise 1 and 2 are based on rotary kiln systems for hazardous waste
- Salaise 3 is based on a grate combustion system for burning hospital, industrial and household waste.

The incinerator facility is not without adverse events. On July 15, 2009, an accident at the Trédi plant resulted in the release of 'a whitish cloud containing chlorine.' Four people were affected and an emergency system was put in place by the prefecture including cuts to routes and activities. The report stated that the smoke was not toxic but provided no analytical results. [1]

We are unable to ascertain what management and disposal option are available for the incinerator residues and byproducts such as flyash and wastewater.

1.1 The Community Response

The current proposal by Orica to ship highly toxic HCB to France for incineration follows closely from the complete failure of the waste holders to convince either the German authorities in 2006/7 or the Danish government in 2008-9 to accept Australia's HCB waste for incineration.

This application to export to France has already resulted in opposition by the French NGO,

[1] http://www.risques.tv/video.php?id_DTvideo=65

VIVRE, based near the proposed incinerator[2] and is also opposed by the national French NGO, MDRGF (Movement for Rights and Respect for Future Generations). It is evident that despite the absence of public consultation by Orica with these organisations in France, and the extremely short notice, there is strong opposition to the import of Australian waste within the French community. The one organisation cited as in support of the import has previously undertaken environmental consultancy for the Group Séché Environnement, and does not reflect the position of French NGOs. International concern has now been expressed by the global organisation, IPEN,[3] representing over 700 organisations concerned with POPs elimination, as well as the Basel Action Network whose expertise is in the transport and management of hazardous waste[4] and the Global Alliance for Incinerator Alternatives.

2. Australia Obligations

Australia has a moral and legal obligation to deal with its own waste and should not shift its responsibilities for hazardous waste management off-shore.

2.1 International Obligations

Orica's current proposal to export its HCB waste contravenes the obligations and principles of environmentally sound management of hazardous waste as developed by the UN Secretariat of the *Basel Convention on the Control of Transboundary Movements of Hazardous Wastes & their Disposal* (1989).

Basel Convention Article 4 requires Australia to *"take the appropriate measures to (b) Ensure the availability of adequate disposal facilities, for the environmentally sound management of hazardous wastes and other wastes."*

Basel Convention principles include:

f) the self-sufficiency principle - management and disposal of waste in the country where it was created.

g) the proximity principle - the disposal of hazardous waste as close as possible to their point of generation.

h) the least trans-boundary movement principle – trans-boundary movements of hazardous waste reduced to a minimum.

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[2] http://www.vivreicienvironnement.org
[3] http://www.ipen.org
[4] http://www.ban.org

2.2 National Obligations

In 1996 the Australian National Advisory Body (NAB) on Scheduled Waste released the National Management Plan for Hexachlorobenzene (HCB) to oversee the destruction of the HCB waste stockpile. The plan recommended that the waste should be destroyed as "close to the source as possible" in the light of the risk in transporting such a large stockpile of POPs waste and Australia's proven ability to destroy hazardous waste in an environmentally sound manner. The HCB Management Plan was endorsed by the Federal Australian Government and NSW State Government.

3. Options For Home Grown Non Incineration Technology

Orica's key argument for exporting the waste is that technology is not available in Australia, yet successful destruction trials of HCB have been undertaken in Australia.

3.1 Available Technology in Australia

Australian waste treatment companies have already demonstrated that the capability to treat POPs waste such as HCB to a high level of Destruction Efficiency (DE) without incineration. The Eco Logic Gas Phase Chemical Reduction (GPCR) process in Kwinana destroyed Australia's major stockpiles of POPs. This technology was exported following requests from other countries to clean up POPs stockpiles, having exhausted supplies of POPs for treatment in Western Australia.

3.2 Gas Phase Chemical Reduction Technology

The report, "Non-Combustion Technologies for POP Destruction: Review and Evaluation", prepared by the UNIDO agency, the International Centre for Science and High Technology (ICS) in March 2007 is supportive of the use of the GPCR technology for commercial destruction of POP wastes.

Trevor Bridle, former manager of the Ecologic GPCR facility confirmed that in Australia:

"The GPCR process was demonstrated, at commercial scale, using the Ecologic facility in Kwinana in 1999, as being suitable for the safe destruction of drummed HCB waste from Orica. The commercial trials showed that the organic compounds in the HCB waste were destroyed with greater than 99.99999% efficiency."

In April 1999, a commercial trial was executed on HCB waste from Orica. The waste treated was a dry crystalline material, containing primarily HCB (84 %). The waste was stored in polypropylene bags, which were in turn packed into polypropylene-lined drums. The drums were loaded into the SBV for processing. The quantity of waste in each drum ranged from 117 to 254 kg. The test program involved three separate test runs of 3, 9 and 27 drums, processing 514, 1,584 and 4,610 kg of waste, respectively. Only 2% of the input mass was present following treatment. This material was tested and found to be silicon and carbon residue. The HCB was destroyed in the reactor with a DE >99.9999% for all tests.

GPCR technology holders approached Orica in 2008 to offer to establish a new and further improved Gas Phase Reduction (GPR) facility to destroy the HCB. Orica however dismissed this option stating that they would not consider using a technology that was not currently operating commercially on HCB wastes. As HCB is a POPs banned under the Stockholm Convention and Orica is the only major source of HCB wastes in Australia, it is not surprising that without support from Orica there is no facility in Australia currently operating commercially on HCB wastes. If Orica were to agree to allow the GPRC technology to treat the HCB waste then activities to establish the facility would begin as soon as Australian government approvals are issued. Orica's intransigence on this issue is the primary barrier to treating the HCB waste in Australia.

3.3 Benefits of non incineration technology

In 2014, a similar technology (e.g., GPR) is available and there are companies interested and willing to work with Orica to establish such facilities in Australia. This form of HCB destruction provides a safe clean alternative to incineration with a significant reduction in CO_2 emissions or greenhouse gases associated with a comparable incinerator. Importantly, no ash is produced. Non-incineration technologies like GPCR have a high degree of public and regulatory acceptance based on the concept of a "closed loop" system.

For further informtion on the Advantages of non incineration technologies see Annex 2

3.4 Other Destruction Technologies in Australia

Australia has operated two destruction technologies, one of which is currently capable of treating the HCB waste in Australia (ie BCD), demonstrating its technical capacity to destroy the hcb stockpile within its own national borders. The technologies used were;

- Base Catalyst Dechlorination (BCD)- Queensland
- Plasma Arc destruction (Plascon) – Queensland

Orica has been aware that this technology is available in Australia and has been used successfully to treat POPs wastes.

3.5 Why has Orica rejected these technologies?

The reason that Orica has chosen to overlook these technologies is not clear but is likely to be based on their commercial considerations. While the cost of export and destruction of the wastes in France has not been revealed some general costs for the alternative technologies are available.

- BCD (Spolana): 1400-1700 US $/t for organochlorines with a Chlorine content of 50% (150 tonnes/month)
- BCD (Australia) $AU250-$1000 p/tonne

The prices are indicative only and may be subject to significant variation on a contractual basis.

For more information on the use of BCD to treat POPs waste in Spolana see Annex 1.

Orica's narrow approach has again failed to consider alternative non-combustion technologies or upgrading of existing local technology to standards that are effectively treating HCB waste in Europe to high DE levels. Despite claims by Orica that the BCD technology cannot accept the diversity of waste types in the HCB stockpile, it is evident from the case study of Spolana (Annex 1) that this is not the case.

By utilising a combination of non incineration techniques, the HCB waste stockpile could and should be destroyed within Australia.

3.6 Australia's Need for POPs Destruction Capacity

In the coming decades, the Australian government and community will be faced with ever-growing stockpiles of newly listed POP chemicals requiring environmentally sound destruction. The recent listing of a POPs chemical used in building products; hexabromocyclododecane (HBCDD) means considerable quantities of POPs contaminated building products will enter the waste stream with ongoing house renovations and demolitions. Australia is already faced with massive quantities of electronic waste contaminated with the POPs listed brominated flame retardants.

4.0 Transport Dangers

There are risks and danger associated with transport of hazardous waste over long distances, particularly with regard to the marine environment where the consequences of spills and cargo loss may lead to irreversible, long-term environmental harm.

The Commonwealth Government have an obligation to thoroughly investigate and exhaust all Australian options for treatment of the HCB waste before setting in train a range of high level risks for the environment and human health by shipping the waste to France.

The most significant transport related risks include:

- risk of spills, accident or loss of containers at sea with potentially long-term irreversible pollution damage to marine ecosystems due to the long persistence and toxicity of HCB in the environment;
- risk of spills and or other incidents at transit and destination ports with potentially long-term irreversible damage to inshore aquatic ecosystems; and
- security risks such as piracy, terrorism or hijack.

5. The Case Against Incineration

Incineration is often referred to as a 'diffuser mechanism for POPs' rather than a destruction mechanism. The diffusion then takes place via releases to air (gas and particulate emmisions), land (fly ash) and via liquid waste from the dioxin wet scrubbers.

5.1 *Stockholm Convention on Persistent Organic Pollutants* 2001

The *Stockholm Convention on Persistent Organic Pollutants* 2001 lists incineration of hazardous waste as having the potential for comparatively high formation and release of dioxins and furans to the environment.[5] The convention states that polychlorinated dibenzo-p-dioxins and dibenzofurans, hexachlorobenzene and polychlorinated biphenyls are unintentionally formed and released from thermal processes involving organic matter and chlorine as a result of incomplete combustion or chemical reactions. The higher the chlorine content of the waste materials burned, the greater the quantity of dioxins formed.

Dioxins and furans are among the most toxic of all compounds and by incinerating Orica's HCB these will be formed and are either released to air, or remain in the ash byproducts or liquid waste from the dioxin wet scrubbers. As serious POPs, dioxins and furans have the potential to pollute the local and global environment.

5.2 High Temperature Incineration does not destroy HCBs, it creates new toxins

The incineration of HCB at high temperatures does not ensure its destruction. HCB is noted for its high levels of stability even at temperatures beyond 1000^{o}C as well as its tendency to generate reactions which give rise to a range of other persistent and toxic chemicals. Mejdoub et al (1998)[6] cite a number of studies in which toxic chemicals are generated as a result of high temperature incineration, finding that HCB plays an important role (as a precursor or as an intermediate) in formation of chlorinated dibenzodioxins and dibenzofurans.

Destruction facilities for the Orica HCB stockpile must, at a minimum, be able to demonstrate that they can maintain dioxin air emissions within the 0.1 ng/ m^3_N WHO- TEQ regulatory limit using the continuous Arnesa system. However, even if the French incinerator is able to constantly meet this regulatory limit, it does not resolve the problem of dioxins and other byproducts in scrubber wastes and ash. Improved scrubber efficiency in recent decades has increased the concentrations of unwanted byproducts such as dioxin and furans in the incinerator residues. Even the best run incinerators are plagued by *de novo* synthesis of dioxins (that is the formation and reformation of dioxins in flue gases as they leave the stack) which escapes monitoring devices.

For more on the incineration byproducts and dioxin monitoring see Annex 3

In short, incineration of HCBs does not ensure destruction and almost certainly leads to the generation of many harmful compounds that can escape to atmosphere and other environmental media. It is clear that incineration is a poor method by which to attempt to destroy HCB waste when better alternatives are available.

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[5] *Stockholm Convention on Persistent Organic Pollutants* 2001 Annex C UNINTENTIONAL PRODUCTION Part II: Source categories. Polychlorinated dibenzo-p-dioxins and dibenzofurans, hexachlorobenzene and polychlorinated biphenyls are unintentionally formed and released from thermal processes involving organic matter and chlorine as a result of incomplete combustion or chemical reactions. The following industrial source categories have the potential for comparatively high formation and release of these chemicals to the environment: (a) Waste incinerators, including co-incinerators of municipal, hazardous or medical waste or of sewage sludge;

[6] N. El Mejdoub, A. Souizi, L. Delfosse., (1998) Experimental and numerical study of the thermal destruction of hexachlorobenzene. *Journal of Analytical and Applied Pyrolysis*, 47 (1998) 77-94

5.3 Destruction Efficiencies (DE) versus Destruction and Removal Efficiencies (DRE)

Compared to non-combustion technologies, incinerators have poor Destruction Efficiencies (DE) and are commonly measured against Destruction and Removal Efficiencies (DRE). The primary reason is that incinerators have become better at removing pollutants from the stack gases by various scrubbers. The pollutants have not been destroyed merely transferred to another media such as fly ash, filter cake, scrubber liquors or bottom ash. In evaluating the Orica export application, regulators need to assess whether the waste will be sent to a facility that produces the highest available Destruction Efficiencies or whether a better outcome can be achieved in Australia without the risks of transport halfway around the globe.

5.4 Fate of Contaminated Incinerator Ash - Disposal of Incineration Byproducts

While the community pressure to reduce airborne dioxin emissions from waste incinerators led to better efficiency and performance of dioxin scrubber technology, particularly through the use of activated carbon beds and sprays, this has resulted in increased dioxin contamination in filters, scrubber matrices such as the electrostatic precipitator (ESP's) dusts, baghouse dusts and filter cake, liquid wastes (from wet scrubbers), adsorption onto activated carbon and of course fly ash and to a lesser extent bottom ash.

Karolina Sulova of the Czech Republic Environment Ministry rejected German imported waste for incineration stating:

"The remnants after the incineration always make up about one-third of the original quantity. They have hazardous qualities and must be stored at an appropriate dump,"

Studies as far back as the 1980's confirmed that the generation of ash by hazardous waste incinerators is reported to range from 9 to 29% of the weight of wastes burned.[7] For example in 2008, it was reported that the Danish Kommunikemi incinerator dumped around 40,000 tonne of ash per annum in landfill while also exporting around 1,000 tonnes per annum of toxic flyash to Langoya in Norway.

A 2005 report by IPEN[8] focusing on the unregulated and partially regulated use of incinerator ash in Europe provided average composition of fly ash and bottom ash from Dutch waste incinerators. These ash byproducts were contaminated with high concentrations of heavy metals, POPs and PICs (products of incomplete combustion). Scrubber waters also contain elevated pollutants that are extracted through wet scrubber systems designed to capture contaminants in the flue gas train.

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[7] Trenholm, A., Gorman, P. & Junclaus, G. Performance Evaluation of Full-Scale Hazardous Waste Incinerators, Vol. 1: Executive Summary. USEPA, EPA-600/2-84-181a, November 1984.

[8] Petrlik, M.S.J. and Ryder, R., (2005) *After Incineration – The Toxic Ash Problem.* The International POP's Elimination Network "Keep the Promise, Eliminate POPs!" Campaign and Dioxin, PCBs and Waste Working Group of the International POPs Elimination Network (IPEN) Report

Conclusion

The proposal by Orica to export its highly toxic HCB waste to France for incineration is unacceptable and should be rejected. Suitable destruction technologies are available for setup in Australia. These have the potential to destroy the HCB waste in a way that achieves a far better environmental outcome than incineration. Treatment in Australia also avoids most of the risks associated with transport of the waste across the globe. NTN therefore requests that the Federal Minister for the Environment considers this controversial proposal carefully, and fully examines the options and advantages of domestic treatment. We believe any reasonable assessment of this HCB export proposal must lead to its rejection and strongly urge the Minister to reject this proposal outright.

ANNEX 1

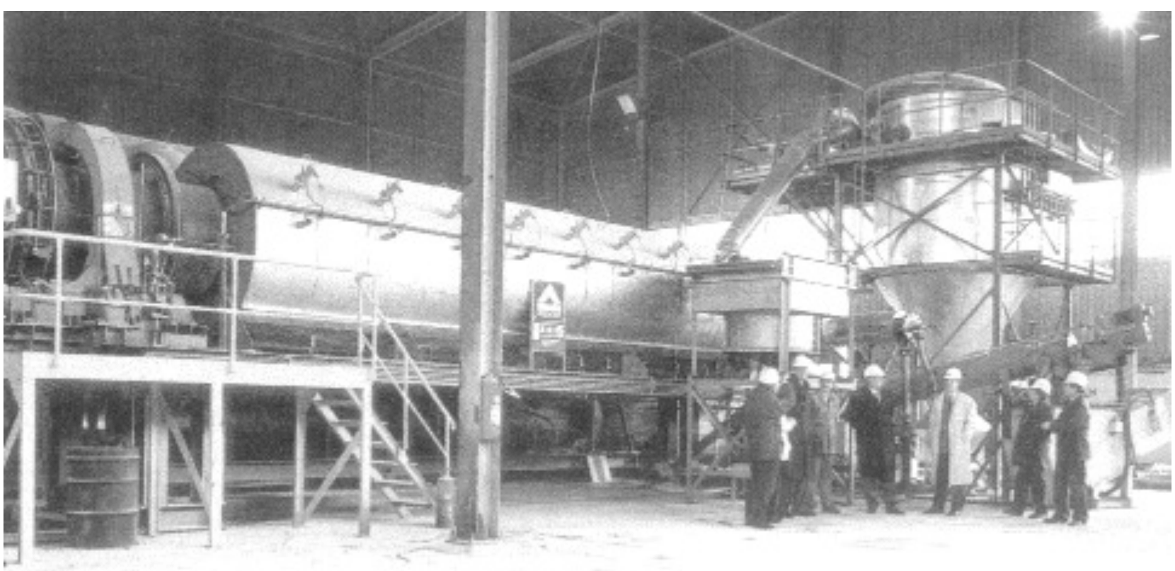
The Spolana Experience – BCD technology and Indirect Thermal Desorption

Within the massive Spolana chemical complex flanking the Elbe River at Neratovice, 30km north of Prague, is a 17 hectare plant once used to make Agent Orange and other herbicides, as well as pesticides. Spolana produced dioxin contaminated chlorinated compounds including the so-called Seveso dioxin, a by-product of herbicide production, during a three-year period during the 1960s. When production was abandoned, the buildings were sealed, and scant attention was paid to the hazard until August 2002, when severe flooding raised concerns that the contaminants could be washed into the river and cause widespread hazards to health.

The Czech government put up US$90 million to decontaminate the plant, using technology from a British company, TCSR, working in partnership with French contractor Suez Environment.

Part of the challenge was to process the toxins on site, without disrupting output from the neighbouring PVC plant, which employs 1,000 people. An Indirect Thermal Desorption (ITD) unit was built on site. This technology separates organic pollutants from soil and other materials in a rotating drum without direct contact with the heat source.

Using patented technology from TCSR, a Base Catalysed Decomposition plant was also assembled for the first time in Europe to break down chlorinated hydrocarbons chemically. Its end products: salt, water and carbon. A shell building was built over the contaminated areas, allowing a negative pressure as workers in special suits and breathing apparatus remove contaminated soil, materials, and ultimately the plant itself, for treatment in the processing facility. The aim of the work, which will take another two years to complete, is to process an estimated 35,000 tonnes of contaminated soil and materials and leave a site fit for re-use.



The Thermal Desorption Unit (TDU) at Spolana.

The thermal desorption unit heats contaminated materials to 500-600 C stripping in absence of oxygen and POPs are collected in filter and condensation system. The BCD unit (see below) then treats this concentrate.

The BCD Unit at Spolana

The tables below demonstrate the high Destruction Efficiencies achieved by the BCD unit for HCB, lindane and dioxin at Spolana.

Destruction capability of HCB & Lindane

Material	Inlet mg/kg		Outlet Oil Matrix mg/kg	
	HCB	Lindane	HCB	Lindane
Chemical waste	29,000	1,500	< 1.0	< 1.0
Chemical waste	200,000	900	< 2.0	< 2.0
Chemical waste	550,000	1,000	< 2.0	< 2.0
Chemical waste	270,000	1,000	< 2.0	< 2.0
Chemical waste	160,000	1,000	< 2.0	< 2.0
Dust	7,607	7	< 2.0	< 2.0
Chemical waste	1,598	19,000	< 2.0	< 2.0
Concentr Aqueous	630	< 2.0	< 2.0	< 2.0
Concentr Organic	11,000	< 2.0	< 2.0	< 2.0

Dioxin destruction rates

Material	Inlet ng/kg I-TEQ	Outlet Oil Matrix ng/kg I-TEQ
Chemical waste	209,000	0 (Reported value)
Chemical waste	200,000	4.3
Chemical waste	11,000	0.23
Chemical waste	47,000	0
Chemical waste	35,000	0
Dust	1,620,000	0.52
Chemical waste	78,000	0
Concent Aqueous	96,000	0
Concent Organic	876,000	0

The tables below indicate the stripping capacity of the Indirect Thermal Desorption Unit at Spolana, a necessary first step in removing and concentrating the POPs from heterogeneous waste matrices such as soil, rubble and concrete.

Treatment of Solid Matrices in Upstream Desorber -HCB & Lindane Removal

Material	Inlet mg/kg		Outlet mg/kg	
	HCB	Lindane	HCB	Lindane
Soil	2,643	1.34	< 1.0	< 1.0
Brick& Concrete	49,000	11	< 1.0	< 1.0
Concrete	5,100	18	< 1.0	< 1.0
Plaster	270	< 1.0	< 1.0	< 1.0

Treatment of Solid Matrices in Upstream Desorber - Dioxin Removal

Material	Inlet ng/kg I-TEQ	Outlet ng/kg I-TEQ
Soil	46,500	2.9
Brick& Concrete	2,420,000	6.3
Concrete	4,780,000	66.0
Plaster	3,800	5.6

The Spolana experience is but one of a number of emerging projects for POPs destruction that are seeking to avoid the use of high temperature incinerators due to their poor destruction efficiencies. The United Nations Development Programme (through the Global Environment Facility) is also encouraging non-incinerator alternatives for POPs destruction. The Slovakia project is another example of the growing range of non-incineration technologies being commercialized internationally.

In the words of UNIDO, the *"Slovakia Project will build on the significant level of Civil Society involvement that has begun during project preparation and also on the Australian experience where public policy is to avoid the use of incinerators for the destruction of hazardous wastes and* *to involve Civil Society in the approval and the operational oversight of selected destruction technologies. As a result of the Australian experience, groups within Australian Civil Society that had vigorously opposed incineration and/or land burial of PTS-containing wastes participated in the decisions to utilize these newer technologies, participated in reviews of these technologies, and generally accepted them. The Australian experience resulted in a remarkable level of Civil Society agreement (Government, industry, international, national and community-based NGOs) on the successful deployment of a Non-combustion approach to the destruction of Australia's PCB containing equipment and wastes, and can be viewed as a model "barriers reduction" effort. Early indications from this Programme and Project show similar promise for achieving strong Civil Society support for the activities that will be undertaken in the participating countries."*[9]

[9] United Nations Development Programme, Global Environment Facility, Government of Slovakia Project Document, 21 November 2005 ' Non-combustion Demonstration project in Slovakia', Executing Agency: United Nations Industrial Development Organization (UNIDO)

ANNEX 2
Principles and Advantages of non incineration technologies

Principles of Gas Phase Chemical Reduction

Gas Phase Chemical Reduction (GPCR) is a proven, non-incineration technology for the destruction of hazardous organic chemicals and has been successfully applied to pesticides, dioxins, PCBs, CFCs, and chemical warfare agents. The process involves the heating of organic compounds in a hydrogen atmosphere at temperatures of 850°C to 900°C. Chlorinated hydrocarbons, such as polychlorinated biphenyls (PCBs) are chemically reduced to methane or natural gas and hydrogen chloride (HCl). The HCl is further reduced to sodium chloride (NaCl) in the scrubber. The technology is suitable for organic wastes in all matrices including soil, sediment, sludge, high-strength oils, watery wastes, and bulk solids such as electrical equipment, equipment casings, drums, etc. Many of the outputs from waste treatment are recyclable. The product gas output that consists mainly of methane can be used as fuel for ancillary system components.

Advantages of GPCR

The GPCR technology has considerable advantages as a waste treatment for the HCB:

1. The technology does not involve combustion in the destruction process. The Process uses hydrogen and high temperature to chemically reduce rather than oxidize the organic waste compounds. The absence of oxygen in the destruction process precludes the formation of dioxins or furans, which require oxygen for their formation.

2. The technology operates in essentially a closed system. All process effluent streams are contained and analyzed to ensure that no hazardous compounds are released into the environment. If any of the process effluent streams exceed the allowable discharge criteria then the waste streams can be reprocessed prior to release.

3. The technology achieves total destruction efficiencies (DEs), for POPs and other substances of concern that approach 100%. Extensive testing of the technology has demonstrated destruction efficiencies that exceed 99.9999% (six nines) for all POPs wastes tested. The destruction efficiency calculation includes all effluent streams as opposed to the DRE, which only include gaseous emissions.

4. The technology is commercially available for technology transfer. The GPCR technology has been used commercially for PCB destruction and cleaning of transformers and electrical capacitors in Kwinana, Western Australia, and in St. Catharines, Ontario, Canada.

5. The technology is demonstrable and inherently safe. The GPCR technology has over ten years of safe operation with no cases of death, or life threatening injuries.

GPCR provides a safe clean alternative to incineration with approximately a 90% reduction in CO_2 emissions or greenhouse gases associated with a comparable incinerator. Importantly, no ash is produced. GPCR has a high degree of public and regulatory acceptance based on the concept of a “closed loop” system.

BCD technology

Base Catalyst Dechlorination (or Decomposition) is a process where organochlorines are reacted with an alkaline polyethylene glycol, forming a glycol ether and/or a hydroxylated compound, which requires further treatment, and a salt. In order to feed the BCD reactor the HCB material must first be dissolved in mineral oil and is then fed to the reactor through a manifold of the appropriate temperature to maintain the HCB waste in a liquid form. Significant improvements have been made with the technology (such as in Spolana) to improve the recovery of oil used in the process above 90%.[10]

In the past BCD technology has been trialed in Australia on HCB waste and found to have acceptably high DE. Orica has claimed that this technology is only capable of treating the high concentration wastes in liquid forms. The Orica waste stockpile also contains large amounts of contaminated soil, rubble, packaging, concrete and personal protective equipment. Orica contends that the BCD technology does not have the capacity to accept these other materials through the feed manifolds to the reactors.

Indirect Thermal Desorption

However, an intermediate technology known as Indirect Thermal Desorption Units (ITDU) provides a solution to this problem. One of the best examples of how these technologies (ITDU and BCD) can combine is found in the Spolana site in Czechoslavakia. The Spolana chemical manufacturing complex is one of the most polluted in the world (more on this below) with high concentrations of dioxin, HCB, pesticides and other POPs in soil, demolition rubble, concentrates and other forms.

High temperature incineration was ruled out at the Spolana site as it was considered a diffuser mechanism that did not necessarily destroy the POPs but transferred them to ash and other residues of the incinerator which ultimately ended up in the environment. The same logic ought to apply to any consideration of incineration of HCB in either Germany or Denmark.

A combination of two technologies, Base Catalyst Dechlorination (BCD) and Indirect Thermal Desorption Units (ITDU) overcame the issue of difficult feedstocks. The ITDU uses a rotating kiln to heat the contaminated rubble, soil or other materials to a temperature (usually 500-600^{o} C) in the absence of oxygen to strip the POPs from the other wastes where they are then collected in a filter and condensed. The resulting concentrate of POPs are then removed and fed into the BCD plant (as in Spolan**a)**

[10] Vijgen, J., International HCH and Pesticides Association. *Presentation on Non-Incineration Technologies for POP’s Destruction. 2006*

ANNEX 3 Incineration and Its Byproducts – Monitoring for Dioxins

Sampling in European nations is usually conducted periodically (quarterly or annually) using the EN 1948 dioxin sampling method. This involves capture of a sample over a 6 hour period usually conducted while the incinerator is carefully operated in a steady state.

In 1993, concerns over lack of correlation between elevated PCDD/PCDF soil concentrations and stack emission concentrations around a waste incinerator in Belgium led to a broader study of the accuracy of the EN 1948 point sampling method and whether it produced representative results of long-term operating emissions. The study compared the results of PCDD/PCDF sampling using the EN 1948 method and the 'Arnesa' air monitoring system which was used for continuous sampling periods of 15 days. The results indicated that the standard measurement underestimated dioxin emissions by a factor of 30 to 50.[11]

The sampling of incinerator flue gases for PCDD/PCDF analysis is almost universally conducted during steady state operation at optimum temperatures for dioxin suppression. It has been known for some time that incinerator plants produce higher levels of dioxin and dioxin-like emissions during upset conditions and during start-up phases[12].

Temperature fluctuations during start-up and operation can also lead to 'scrubber bypass' situations unless prohibited by statutory mechanisms. If gas temperatures in the incinerator are too high baghouse fabric filters can be damaged causing elevated emissions. In some facilities the flue gases are switched to bypass mode to prevent baghouse fabric damage until normal temperatures can be reached. In this case untreated or partially treated flue gasses are released to atmosphere with high concentrations of contaminants. Conversely, low temperatures can cause collation or clogging of lime injection mechanisms increasing emission concentrations.

A 2006 paper[13] examining PCDD/PCDF emissions for a Japanese incinerator during both start up and steady state operations concluded that the incinerator clearly met the 0.1 ng/ Nm^3 WHO-TEQ regulatory limit while operating in steady state conditions but exceeded the regulatory limit 19 fold at the stack exit during start up conditions. Of particular interest is the comparison between boiler and stack exit concentrations. The average concentration of the dioxins at startup (RUN1-RUN5) was 18 ng WHO-TEQ/m^3_N at the boiler outlet, and 1.9 ng WHO-TEQ/m^3_N at the stack.

This study also provides an indication of the transfer of PCDD/PCDF to scrubber waste matrices through measurement at both the boiler and flue gas exits. PCDD/PCDF's are reduced by around 90% by the time the combustion waste gas leaves the boiler and exits the incinerator via the scrubbing devices and stack during the start-up phase. This dioxin is almost largely adsorbed onto fly ash and captured in the scrubbing systems. Some PCDD/PCDF escapes in a volatile state, some adsorbed onto particulate and yet more can be formed by post-scrubber *de novo* synthesis all of which escapes to atmosphere.

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[11] De Fre R., and Wevers M., 1998 Underestimation in dioxin emission inventories. *Organohalogen Compounds* Vol 36 1998

[12] Takasuga et al., 2004. Formation of Polychlorinated Naphthalenes, Dibenzo-*p*- Dioxins, Dibenzofurans, Biphenyls, and Organochlorine Pesticides in Thermal Processes and Their Occurrence in Ambient Air. *Archives Environ. Contam. Toxicol.* Vol 46 : 419-431

[13] Hajime Tejima, Masahide Nishigaki, Yasuyuki Fujita, Akihiro Matsumoto, Nobuo Takeda and Masaki Takaoka *2007 NAME OF PAPER Chemosphere,* Vol 66, Issue 6 *:1123-1130*

Table 1
PIC Contaminants identified in Bottom Ash from Hazardous Waste Incinerators [14]

Parameter	Concentration (ppb)
Acetone	20,000
Benzene	42
2-Butanone	2,000
Chlorobenzene	27
Chloroform	46
1,2-Dichloropropane	32
Diethyl phthalate	120,000
2,4-Dimethylphenol	23,000
Dimethyl phthalate	55,000
Ethylbenzene	380
Methanol	410,000
Methylene chloride	38,000
4-methyl-2-pentanone	2,300
Naphthalene	24,000
2-Nitroaniline	180,000
Nitrobenzene	29,000
Phenol	40,000
Styrene	320
Tetrachloroethylene	1,200,000
Toluene	2,500
1,1,1-Trichloroethane	12
Trichloroethylene	120
Xylenes	1,900
TOTAL	2,308,679

Heavy metals in hazardous waste incinerator ash have been a widely studied problem for many years and are the focus of regulatory measures that control the final distribution and fate of incinerator ash. Standard assessments of bottom ash for metal contamination consist of weak leachate tests (such as the ASLP) using distilled water to simulate leaching conditions in a landfill environment or the more aggressive Toxicity Characteristic Leaching Procedure (TCLP) using dilute hydrochloric acid. The focus on leachability of metal to the exclusion of other contaminant represents a serious data gap when assessing the environmental fate of incinerator ash that is reintroduced into the environment for 'beneficial purposes' such as construction materials, masonry additives and road-base.

While research during the 1980s and 1990s clearly demonstrated that heavy metals and POPs such as dioxins and furans were contaminating fly ash and bottom ash from municipal, hazardous and medical waste incinerators, since then researchers have discovered a much broader range of contaminants in the Air Pollution Control (APC) residues such as dust and scrubber water.

[14] Boegel, J. Assessment of Residues from Incineration of RCRA Wastes. In: Land Disposal, Remedial Action, Incineration, and Treatment of Hazardous Waste, Proceedings of the Thirteenth Annual Research Symposium, USEPA Hazardous Waste Engineering Laboratory, Cincinnati, July 1987, EPA1600/9-87/015.

Scrubber waters also contain elevated pollutants that are extracted through wet scrubber systems designed to capture contaminants in the flue gas train. The following table identifies some of the more hazardous pollutants reported in scrubber water from a US hazardous waste incinerator. It should be noted that phthalates feature prominently and continue to be investigated or their potent endocrine disruption capabilities

Table 2
Pollutants Found In Scrubber Effluents from Hazardous Waste Incinerators

Pollutant	Scrubber Wastewater (micrograms per litre)	
Acetone	32	(1)
Methylene Chloride	<5	(1)
Naphthalene	<20	(1)
Benzoic acid	260	(2)
Bis (2-ethylhexyl)phthalate	32	(2)
Chloroform	4,100	(2)
Chloromethane	2,500	(2)
1,2-Dichloroethane	32,000	(2)
Diethyl phthalate	30	(2)
Di-n-butyl phthalate	22	(2)
Phenol	100	(2)
Tetrachloroethane	5,200	(2)
Toluene	5,000	(2)
1,1,1-Trichloroethane	6,800	(2)
Trichloroethene	14,000	(2)
Total xylenes	1,200	(2)
Dioxins and furans (total)	43	(3)