Interim Guidance on Non-Liquid PCB Disposal Methods to Be Used as Alternatives to a 40 CFR 761.75 Chemical Waste Landfill (CWL)

(Developed in Conjunction with the Memorandum on Application of Anti-Dilution Provisions to Superfund Sites)

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OTS personnel will be available to provide consultation on this guidance. To be consistent with the current process for fielding PCB disposal questions, please direct any inquiries to the Hazardous Site Control Division of OERR. OERR will then coordinate with OTS.

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I. Introduction

A Chemical Waste Landfill (CWL) is one of several options for the disposal of non-liquid PCBs. Because the CWL regulations in 40 CFR 761.75 allow the Regional Administrator (RA) to grant waivers from some or all of the regulatory requirements, OTS is providing guidance on what kinds of considerations should be included in decisions regarding the use of these waivers. The goal of this guidance is to allow the flexibility which may be needed under site-specific conditions while at the same time ensuring adequate protection of human health and the environment from the disposal and/or treatment of PCB-contaminated non-liquids. This goal can best be met through evaluating a combination of site-specific risk factors and disposal treatment factors.

Toward this goal, the guidelines are presented in three sections. As a reference point, the first section (Item II) lists the risk factors that should be considered in making any disposal/treatment decisions. The second section (Item III) examines how the current CWL requirements relate to these risk factors. The third section (Item IV) examines alternatives to the current CWL requirements, including both destructive and non-destructive approaches. These alternatives are also examined relative to the risk factors.

For the purpose of this guidance, non-liquid PCBs are defined as those materials not passing through the filter in the Paint Filter Liquids Test, Method 9095, in "Test Methods for Evaluating Solid Wastes" (SW-846). Sludges will generally be dewatered prior to treatment with the supernatent being handled consistent with the regulations for liquid PCBs. The effectiveness of a sludge dewatering process should be demonstrated using the Paint Filter Test.

II. Risk Factors for Evaluating a PCB Disposal/Treatment Option

In general, PCBs tend to sorb to solid materials, especially organic solid materials, in preference to partitioning into water or partitioning into air. However, when faced with the more limited option of partitioning into air or into water, PCBs (on net) prefer to partition into air because of vapor pressure/water solubility considerations. Therefore, when sorbed PCBs are exposed to a water/air interface, the water will in effect (and on net) cause some portion of the sorbed PCBs to desorb and volatilize into the air.

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Organic liquids can partition PCBs out of the solid materials, dissolve PCBs, facilitate drawing PCBs into an aqueous solution, and transport the PCBs into the water column. Therefore, in the absence of organic liquids and known geologic and hydrologic anomalies, the major (though not the only) potential exposure concerns from disposing non-liquid PCBs arise from vaporization of PCBs from solid materials (inhalation); dispersion of fine particulates containing PCBs (inhalation and dermal); and direct contact with the PCB solids (dermal). Appropriate controls before, during, and after disposal (such as avoiding coincident disposal of organic liquids, avoiding generation/dispersal of dust, and providing proper containment from all directions, including elimination/capture of runoff) can mitigate release of PCBs to the exposure pathways of concern.

A. Evaluation of risk factors shall include

1. consideration of nearby and distant occupational and non-occupational populations; the magnitude of the distance would depend on the potential environmental transport of toxic materials as determined by a model such as the Industrial Source Complex Long Term (ISCLT) model;

2. all toxic materials released before, during, and after treatment or containment;

3. data that are most applicable or descriptive of the disposal site i[illegible]f;

4. appropriate chem[illegible]cal analysis methods for [illegible]e material containing PCBs; appropriate incl[illegible]es satisfactory elimination of interferences [illegible]d having appropriate sensitivity and selectivity; and

5. when site-specific data are not appropriate and sufficient, the most appropriate models (e.g., ISCLT, SESOIL) should use reasonable worst case estimates for factors such as release to the environment, environmental degradation, and environmental transport.

B. For occupational exposures (before, during, and after disposal) that pose a potentially unacceptable risk, it may be possible to attain an acceptable risk by requiring workers to wear protective clothing. Workplace monitoring may also be required to verify workplace exposure levels.

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III. Risk-Based Objectives of the 40 CFR 761.75 Chemical Waste Landfill (CWL) Requirements

The requirements for a CWL, found in 40 CFR 761.75, address the risk factors by providing containment and isolation as well as measures for ensuring that the containment and isolation continue for the lifetime of the CWL. A summary of these requirements is as follows.

1. Limits on surrounding and underlying soil permeability;

2. Synthetic liner integrity - composition, thickness, and underlying support;

3. Limits on hydrologic conditions and restrictions from siting near surface water;

4. Protection against floods and other high surface water conditions;

5. Construction restricted to areas of low topographic relief;

6. Monitoring systems - surface and ground, before, during, and after landfilling;

7. Leachate collection - several options;

8. Operating practices/procedures -

    a. prevent damage, segregate from disposed organic solvents,

    b. prepare an operations plan and solidify/stabilize liquid PCBs,

    c. prohibit the disposal of ignitable wastes,

    d. require recordkeeping; and

9. Supporting facilities -

    a. restrict access to landfill,

    b. provide adequate roads for handling transportation vehicles, safely, and

    c. prevent safety problems and hazardous conditions from spills and wind.

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IV. Characteristics of Alternatives to a 40 CFR 761.75 Landfill

A. General

1. Any single disposal method for PCBs can do one of two things: (a) eliminate the possibility of environmental release by destroying the PCBs or (b) decrease the probability of environmental release by containing the PCBs. Monitoring is needed to ensure the long-term effectiveness of containment. Chemical analysis is needed to ensure the demonstrated effectiveness of destruction methods. Obviously, any combination of destruction and containment may be used together as long as the result from the combination is adequate protection of health and the environment.

2. The effectiveness of any destruction/removal technique must be verified by a demonstration for the Regional Administrator (RA). At a minimum, the demonstration should include at least three consecutive tests, as is the standard requirement in the "Guidance Manual for Writers of PCB Disposal Permits for Alternate Technologies" (October 1, 1988) for approval of TSCA alternate PCB destruction methods, treating

   a. the maximum PCB concentration expected to be treated at the site;

   b. material representative of the PCB contaminated matrices found on site and from which the PCBs are to be removed/destroyed;

   c. throughput quantities similar to those expected during actual treatment on-site during full scale disposal operations; and

   These tests should be conducted under environmental conditions/controls similar to those that would be required at the treatment site.

3. The effectiveness of the destruction/removal of PCBs should be determined by collecting representative samples of the treated material and analyzing those samples for the presence of PCBs and any other chemicals of concern. Chemicals of concern would include

   a. products of the incomplete destruction of PCBs, such as polychlorinated dibenzofurans and polychlorinated dibenzo-p-dioxins;

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b. other chlorinated organic materials, such as chlorinated benzenes, chlorinated ethylenes, or freons;

c. caustic inorganic materials such as sodium hydroxide and hydrogen chloride; and

d. any other hazardous or toxic constituents at regulated levels, levels resulting in an unreasonable risk to health or the environment, or levels which might be incompatible with synthetic liners.

4. Agency quality assurance and quality control guidelines should be followed.

B. Destructive Alternatives

1. The risk-based effectiveness of any destructive alternative should be measured by (a) the amount of destruction needed based on site-specific considerations and (b) the demonstrated ability of the alternative to provide that level of destruction.

2. Depending on the site-specific risk characteristics, containment and monitoring requirements may still be necessary following destruction. Access to the disposal site may have to be restricted to avoid inhalation and dermal exposure. Structures may have to be constructed to eliminate migration to surface and ground waters.

3. Under TSCA, there is no preference for or consideration of an innovative destruction process whose effectiveness has not been demonstrated on the same scale and on the same kind of material as will occur during treatment. Better projections of cost and destruction efficiency are made from fully and appropriately demonstrated technologies. There is a considerable cost in both time and resources to scale up, demonstrate the operational reliability , and subsequently confirm the disposal effectiveness of a new technology which has only been verified on laboratory scale or pilot demonstrations.

In the event that appropriate full scale testing is not available or possible prior to selection of a disposal option, treatability studies can be used to provide information on the destruction potential of an unproven PCB destruction technology. When evaluating the cost of an unproven technology,

consideration should be given to potential time delays, cost increase, and decreases in disposal efficiency resulting from scale up. The impact of these factors can be so substantial that existing demonstrated technologies which, upon initial consideration, have significantly higher costs, may upon closer analysis be more comparable in cost to less expensive technologies, demonstrated at a small scale, after including the learning curve and other development costs for these "less expensive" technologies. For all unproven technologies, full scale pilot operations and shakedown should be performed prior to commencement of full treatment operations.

4. If destructive processes are to be used with no further treatment or containment, these destructive processes must not generate or leave behind unsafe levels of other toxic constituents or any residual materials which would facilitate PCB transport in the environment.

   Destructive processes that generate or leave behind unsafe levels of other toxic constituents and/or any residual materials which would facilitate PCB transport in the environment must be followed by further treatment or containment to mitigate the exposure and risk from the toxic constituents and other residual materials.

5. Some kinds of destructive processes have shown greater promise than others. Greater promise is a relative term and performance may be very significantly affected by the amount of material to be treated, the PCB concentration in the material, and the presence of other chemical s in the soil, the ambient temperature, and soil characteristics.

6. Table 1 lists the kinds of alternative (NOT a PCB Incinerator, High Efficiency Boiler, or Chemical Waste Landfill) destructive and non-destructive PCB disposal methods which have been used and have been proposed to be used in the disposal of non-liquid PCBs.

7. For those methods identified in Table 1, Table 2 provides information as to the relative differences in these methods with respect to estimated cost for the disposal, proven effectiveness, generation of other toxic constituents as by-products of the disposal, etc.

C. Non-Destructive Alternatives

1. The risk-based effectiveness of any non-destructive alternative should be measured by (a) the amount of containment needed based on site-specific considerations and (b) the demonstrated ability of the alternative to provide that degree of containment.

2. Since the long-term effectiveness of most non-destructive containment is not known, or at best limited, non-destructive alternatives must also have requirements to monitor/detect the migration of PCBs out of the treated material and/or (less preferably the migration of PCBs into ground or surface water. The monitoring should continue semiannually even after treatment has been completed and the site no longer active. However, the frequency of monitoring may be reduced if it can be demonstrated that there is no potential for migration to water supply wells or surface water.

3. Treatability studies and field demonstrations are strongly recommended where organics are solidified or stabilized.

4. Additional containment, treatment and/or stabilization may be necessary when non-liquid PCBs are in the presence of other organic (or inorganic. materials which might directly facilitate the mobility or transport of PCBs or reduce the attenuation capacity or the underlying geology. An example would be the requirement of a synthetic liner under this kind of solidified/stabilized material.

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TABLE 1

List of Alternate Technologies
That Have Been Considered at Superfund Sites

Group 1. Thermal Destruction:

A. Infrared Thermal Treatment
B. Circulating Bed Combustor

Group 2. Physical Separation:

A. Thermal Treatment

(1) Rotary Thermal Desorber
(2) Fluidized Bed

B. Solvent Extraction

(1) Soil Washing (TEA)
(2) Liquified Gas
(propane and/or butane)

Group 3. Solidification/Stabilization

A. Chemical Fixation

(1) Plus Encapsulation
(2) In-Situ Inorganic Polymer
(3) Silicates

B. Vitrification

(1) In-Situ

C. Plus Chemical Dechlorination

Group 4. Biological

(A) Digester
(B) In-Situ

Group 5. Chemical Dechlorination

More detail on these treatment technologies is found in the Appendix

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TABLE 2. Current Comparative Ranking of Technologies for Treatment of Non-Liquid PCBs

Ranking: 1 - Best, 5 - Worst

Technologies	Tested, Proven, Results Available	Relative Disposal Cost	Potential for Release	Presence & Effect of Other Chemicals	Formation of By-Products	Amount of Material Disposed	Mobility in Matrix	Accessibility
1A	1	5	1	2	2	2	3[a]	2
1B	1	3	1	2	1	2	3[a]	2
2A(1)	2	3	2	2	2	4	3[a]	2
2A(2)	2	4	2	2	2	3	3[a]	2
2B(1)	3	3	3[b]	3	1	3	3[a]	3
2B(2)	3	3	2	2	1	3	3[a]	3
3A(1)	2	2	4[c]	2	1	2	4[c]	3
3A(2)	2	1	4[c]	2	1	2	4[c]	3
3A(3)	2	2	4[c]	2	1	2	4[c]	3
3B(1)	2	2	1	1	2	3	1	3
3C	4	1	2	2	3	3	3[a]	3
4(A)	3	2	1	2	2	2	3[a]	3
4(B)	3	1	4	2	2	2	3[a]	3
5	2	3	2	2	2	2	3[a]	3

[a] Heavy metals
[b] Trace amounts of the solvent, triethylamine, may remain
[c] Volatile and semi-volatile organics (PCBs)

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Appendix

Summary of Alternate Technologies for Use on Superfund Sites

Group 1. Thermal Destruction:

A. Infrared Thermal Treatment

Shirco, O.H. Material and Haztech (Westinghouse) have all demonstrated TSCA disposal requirements and obtained TSCA PCB operating permits. Heavy metals are not disposed of, but O.H. Material has demonstrated that chemical changes occur during treatment so that the ash has passed the heavy metal-EP Toxicity Test. Process is sensitive and care must be taken to use the correct type of liquid fuel and to maintain the infrared elements so that residual PCBs do not show up in the ash.

B. Circulating Bed Combustor (CBC)

Ogden Environmental Services has demonstrated that the CBC meets TSCA disposal requirements and has obtained a TSCA operating permit. PCB residuals have not been detected in the ash.

Group 2. Physical Separation:

A. Thermal Treatment

(1) Rotary Thermal Desorber

Chemical Waste Management has completed an R&D project under a TSCA R&D permit. Results have been mixed. PCBs are removed from soil to levels of about 10 ppm.

(2) Fluidized Bed

American Toxic Disposal, Inc. (ATD) has treated PCB-contaminated sediment in Waukegan Harbor under a Region V R&D approval, with mixed results. ATD has applied for a nationwide permit with Headquarters but has not followed through.

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B. Solvent Extraction

(1) Soil Washing (TEA)

Resources Conservation Company used the BEST (BEST is the name of a company) technology of washing soil with triethylamine (TEA) solvent at the General Refining Superfund site in Garden City, Georgia. The process will be tested under the SITE Program.

Biotrol, Inc. uses attrition scrubbing to separate the highly contaminated particulates from coarser particles. The resulting contaminated water/particulate mixture is treated by a another treatment method. The process was used for 2 years to clean up a wood treatment site in Minnesota. Data are not yet available.

(2) Liquified Gas
propane and/or butane)

CF Systems Corp. tested the soil washing technology under the SITE Program. PCBs were removed to 8 ppm levels.

Group 3. Solidification/Stabilization

A. Chemical Fixation

(1) Plus Encapsulation

Hazcon, Inc. tested the process under the SITE Program, using Chloranan as a plastic encapsulant for organics. TCLP results indicated heavy metals were stabilized. Organics in the TCLP tests were below 1 ppm, but TCLP results for untreated soil were at the same levels. Cost: $90 - $120 per ton.

(2) In-Situ Inorganic Polymer

International Waste Technologies/Geo-con, Inc. demonstrated under the SITE Program their in-situ process using proprietary chemicals. PCBs, although apparently immobilized, were not detected in TCLP tests on treated <u>and</u> untreated soils. Results could not be confirmed for other organics as well. Data for heavy metals are not available. Cost: $110 - $194 per ton.

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(3) Silicates

Chemfix Technologies, Inc. uses soluble silicates and silicate setting agents to solidify/stabilize contaminated soils. TCLP results from SITE Program studies indicate copper and lead were immobilized. Although PCBs were present in the soil, PCB results were not offered.

B. Vitrification

(1) In-Situ

Geosafe Corp. has applied for a TSCA permit and is scheduled to demonstrate the process during the fall of 1990. Tested at a Superfund site in Region X, with low level PCBs, results using TCLP were negative for both PCBs and heavy metals.

C. Plus Chemical Dechlorination

A company (Qual Tech?) is currently performing R&D tests under a Region VI approval combining solidification and stabilization with chemical dechlorination. The technology looks promising because the cost should be on the order of $100 to $200 per ton, similar to solidification/stabilization processes.

Group 4. Biological

(1) Digester

Biotrol, Inc. was mention above.

Mo-Tech, Inc. uses solid/liquid contact digestion to treat biodegradable waste. The process will be evaluated under the SITE Program.

General Electric has applied for a TSCA R&D approval to study treatment of PCB contaminated soil/sediment using a bioreactor. Approval is imminent.

(2) In-Situ

Pacific Power is performing bioremediation studies under a TSCA R&D approval on PCB contaminated soil in Richland, Utah. White rot fungus, an indigenous species, is used as the treatment microorganism. The SITE Program is sponsoring a demonstration of the process at the Goose Farm Superfund site in Plumstead, New Jersey.

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Group 5. Chemical Dechlorination

Galson, Inc. has completed a TSCA R&D project using the KPEG process to clean soil contaminated with PCBs. Results were mixed, with treated soils in the 5 ppm - 10 ppm PCBs levels.

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