IFCS **Intergovernmental Forum on Chemical Safety**

FRAMEWORK

for the

MANAGEMENT OF

PCBs

Prepared by Professor Ian D. Rae, Chairman, IFCS PCB Strategy Group,
as a contribution to the work of the Group

INTERGOVERNMENTAL FORUM ON CHEMICAL SAFETY

A unique, over-arching mechanism to develop and promote international strategies and partnerships among national governments, intergovernmental and non-governmental organizations.

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FRAMEWORK

MANAGEMENT OF PCBs

1. Prologue

In 1996 the Intergovernmental Forum on Chemical Safety (IFCS), at the request of the UNEP Governing Council(GC)[1], developed recommendations and information on international action on twelve persistent organic pollutants *(i.e.*, PCBs, dioxins, furans, aldrin, dieldrin, DDT, endrin, chlordane, hexachlorobenzene, mirex, oxaphene and heptachlor). The IFCS, through an international multistakeholder process, assessed realistic response strategies, policies and mechanisms for reducing and/or eliminating emissions, discharges and losses of POPs, and produced a report containing information and recommendations on international action. IFCS recommended that UNEP GC and World Health Assembly (WHA) initiate immediate international action to protect human health and the environment through measures which will reduce and/or eliminate the emissions and discharges of the 12 specified POPs and, where appropriate, eliminate production and subsequently the remaining use of those POPs that are intentionally produced.

The UNEP GC[2] and WHA[3] endorsed the conclusions and recommendations of the IFCS on POPs. In its decision UNEP GC,

- requested UNEP to convene an intergovernmental negotiating committee (INC) to prepare, preferably by 2000, a global legally binding instrument for implementing international action on POPs.
- urged governments to initiate action on the IFCS recommendations and to provide technical assistance, capacity building and funding to enable developing countries and countries with economies in transition to take appropriate action on POPs.
- requested UNEP to initiate a number of immediate actions on POPs.

Following strong interest in obsolete chemicals at Forum II (1997), the third Intersessional Group meeting (ISG3, December 1998) included the topic on its agenda. While several aspects of the problem of obsolete chemicals and pesticides are being addressed through a number of international efforts, the issues and problems are much farther reaching than the sum total of the

[1]Decision 18/32

[2]Decision 19/13C

[3]Resolution 50/13

ongoing efforts. ISG3 aimed at bringing an overall focus to dealing with the range of issues taking into consideration ongoing work.

ISG3 agreed to consider polychlorinated biphenyls (PCBs) as first priority in the area of obsolete industrial chemicals. Participants acknowledged that there was PCB management guidance available under the Basel convention, and a comprehensive set of UNEP-developed guidance would soon be produced, including information on PCB substitutes. It was also noted that UNEP Chemicals and the Basel secretariat were working jointly on PCB management training. However, with the notable exception of a few pilot projects, there appeared to be little underway to ensure that developing countries and countries with economies in transition had the necessary infrastructures or resources for proper PCB management.

In order to assist countries in taking action on PCBs, the ISG3 endorsed a strategy for involving stakeholders at the global, regional, sub-regional and national level in the development and implementation of action plans for disposal of PCBs. The IFCS approach is to facilitate the involvement of IFCS participants at all levels in activities organized by UNEP to assist in the development and implementation of PCB action plans.

The range of activities that could be considered in action plans includes:

1. Inventory Development:

    - identification of PCBs and PCB-containing equipment;
    - management of in-use PCBs;
    - identification of PCB-contaminated sites.

2. Collection and Storage of Materials for Destruction:

    - management measures for storage and transportation;
    - national implications and policies;
    - international implications (Basel).

3. Alternatives to PCBs.

4. Economic Aspects and Funding:

    - costs of measures;
    - sources of funds;
    - responsibility for actions/clean-up, etc.

5. Destruction:

    - renovation of contaminated oils and equipment;
    - cleanup of contaminated sites;
    - incineration and other methods of destruction;

- factors to be considered in the above.

The above areas correspond to the guidelines provided by UNEP Chemicals, and close cooperation is maintained between UNEP and IFCS.

Early in 1999, the IFCS set up a PCB Strategy Group which would carry forward the strategy outlined above. One of the main tasks of the Strategy Group is to maintain coordination between IFCS partners and others who are undertaking work with PCBs.

Membership of the IFCS Strategy Group	
Professor Ian D. Rae (Chair) University of Melbourne Australia	Mr Jack Weinberg Environmental Health Fund Chicago, USA
Mrs Oluronke Soyombo Federal Environment Protection Agency Nigeria	Mr John Scowcroft Euroelectric Brussels, Belgium
Mr John H. Smith Environmental Protection Agency USA	

The IFCS seeks to assist the work of UNEP Chemicals, insofar as it relates to PCBs, by producing this framework for the preparation of national management or action plans for PCBs. Although actions have been taken in some countries to deal with PCB-containing wastes, to develop inventories and to plan for the removal from service of PCB-containing equipment, there exist very few comprehensive management plans. The present document has been prepared by Professor Ian Rae, Chairman of the IFCS PCB Strategy Group, in consultation with the members. The Framework should assist countries in developing effective management plans.

STARTING THE MANAGEMENT PROCESS

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IDENTIFY STAKEHOLDERS

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PROVIDE INFORMATION

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INVITE PARTICIPATION

2. Initial steps

2.1 Identify all stakeholder groups

It is important that all potential stakeholders be involved in the planning process. There are several reasons for this, but among them are the needs for distribution of information, provision of infrastructure and international contacts, responsibility for management and possibly financing of any actions, and for maintaining broad societal views and support for action. Stakeholders will come from different sectors of a country's population, and are likely to include:

- ***government***, usually represented by officials but sometimes including elected political figures and their advisors. As well as providing infrastructure and organisational capacity, it is this group of stakeholders which has the power to legislate or regulate, and also to maintain international obligations under various conventions. Government involvement should be considered broadly, since as well as departments concerned specifically with the environment, there should be representation from those concerned with industry and transport, health, agriculture, and possibly labour departments, as appropriate in particular countries.

- ***industry***, because most PCBs are likely to be held in the electrical power industry. In some countries this industry is nationalised, in others privately owned, but in either case the relevant government agency or private corporation(s) should be included. Industries of this type are likely to have international connections and be able to draw on information in this way, just as governments will. Other industries which might merit representation are those concerned with waste management or building demolition/ refurbishment, and industry organisations representing electricians who might encounter PCBs in the course of their work.

- ***public***, the public interest is often represented by environment groups. The involvement of these groups in consultative planning processes is becoming more common. Representation will obviously vary widely from country to country, and while the main role of such groups is to represent the public interest they are sometimes able to contribute technical advice and often able to draw on international networks to provide information. There may be opposition from government and/or industry representatives to the involvement of environment groups, but experience in a number of countries has shown that they have much to contribute by way of alternative scenarios (often not as strongly based in economic considerations) and by bringing global perspectives to the work of a national group. It is better to hear these alternative views during the planning process than to have them raised at a later stage. Public fora are also a good way to bring forward a range of views for consideration by the planning group.

2.2 Provide background information

Background information on production and industrial uses of PCBs, and the threats they present to human health and the environment, is available internationally. For example, the toxicological profile for these substances is being updated by the US Department of Health and Human Services, Agency for Toxic Substances and Disease Registry[4]. Information drawn from these sources should be distributed to stakeholders so that a common information base exists. It would be useful if information could also be provided on how a range of different countries have dealt with PCBs. A useful package would also include the recent UNEP Chemicals publications on PCBs including those on inventories[5] and PCB destruction methods[6].

2.3 Invite participation in the planning stage

While it may be expensive to bring stakeholders together for discussion, especially in large countries, and electronic communication may not be readily accessible in some countries, all stakeholders should be invited to participate. Regional meetings within countries can be useful, and meetings involving several countries facing similar situations may lead to the sharing of information. Any meeting or distribution network should include representatives of each of the three groups described above, and participants should receive agenda material before the meeting and, following the meeting, written reports on proceedings.

Although material is often available in a range of languages, key material may not be available in local languages and so an important first step may be the preparation of summary documents in these languages. The usefulness of these documents will be enhanced if coverage can be obtained in local newspapers and magazines, and especially if briefings for journalists and interested members of the public can be provided.

3. Developing the Management Plan

A management plan will need to be prepared for PCBs. Sometimes this will take the form of guidelines, or be set out in legislation or regulations. In the following sections information is provided about the matters which need to be addressed in the management of PCBs. Development of the plan is not necessarily a sequential process, but early decisions will be

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[4] US Department of Health and Human Services, Agency for Toxic Substances and Disease Registry, 1600 Clifton Road NE, E-29, Atlanta, Georgia 30333, USA. Draft for consultation released December 1998.

[5] Guidelines for the Identification of PCBs and Materials Containing PCBs, First Issue, August 1999, Prepared by UNEP Chemicals. Available in English, Spanish and French. Copies may be obtained from UNEP Chemicals, 11-13 chemin des Anemones, CH-1219 Chatelaine, Geneva, Switzerland; fax +41 22 797 34 60, email: chemicals@unep.ch or on the UNEP website at: http://www.chem.unep.ch/pops.

[6] Inventory of Worldwide PCB Destruction Capacity, First Issue, December 1998, Prepared by UNEP Chemicals in co-operation with the Secretariat of the Basel Convention (SBC). Available in English, Spanish and French. Copies may be obtained from UNEP Chemicals, 11-13 chemin des Anemones, CH-1219 Chatelaine, Geneva, Switzerland; fax +41 22 797 34 60, email: chemicals@unep.ch or on the UNEP website at: http://www.chem.unep.ch/pops/.

necessary about the inventory and about such things as storage, handling and transport. This will, of course, be a living document which changes as more is learned about PCB holdings. Many other aspects of the management plan could be developed in parallel by expert groups.

ASPECTS OF PCB MANAGEMENT

- ✓ **the PCB inventory**
- ✓ **establishment of thresholds**
- ✓ **requirements for treatment of PCBs**
- ✓ **analyses and monitoring**
- ✓ **education and training**
- ✓ **storage, handling and transport**
- ✓ **timelines**
- ✓ **PCB contaminated sites**
- ✓ **removing and replacing PCBs**

3.1 Preparation of a PCB inventory

An inventory will need to be prepared so that scale and variety of PCB holdings can be known at least with reasonable certainty. In some countries, governments will have the necessary legislative and regulatory power to oblige holders of PCBs to provide information for the construction of a national inventory, but in other cases this power will be lacking and alternative ways will need to be found to gather information. Obviously, drafting new legislation or regulations is one action that government officials can take, but the backing of senior political figures will be needed before this intention could be translated into legal instruments. Consciousness raising, by means of documentation, publicity through print and electronic media or conferences and workshops, and even personal intervention, may be needed to bring the issue of PCBs to ministerial and public attention.

The involvement of industrial stakeholders (including government instrumentalities, where appropriate) will be required, whether regulations exist or not. In some cases, an industry or industry association will be prepared to provide on a voluntary basis information about aggregate PCB holdings in cases where specific holders are not identified. Attention should be given not only to fixed facilities such as those owned by major power generators and distributors, and by other users who possess transformers and capacitors, but also to non-networked generators such as mining companies operating in regions where there is a need to generate their own power.

The PCB inventory can be constructed in stages, and it will have to be accepted that initial

entries might include some uncertainty. Refinement of the inventory will probably require chemical analyses of transformer and capacitor fluids, and so some costs will be involved and time may need to be allowed for performance of this work. Attention can also be given to electrical equipment being imported, to ensure that PCB holdings are not increasing during a time when efforts are being made to reduce them.

Because of concerns raised over PCBs in the 1970s and 1980s, the PCBs in many items of electrical equipment were drained off and the equipment refilled with clean mineral (paraffin) oil. However, the draining procedures were inadequate for complete removal and the result has been the generation of large quantities of dilute solutions of PCBs in oil. The inventory, as it develops, should include details such as this and not just totals of PCBs. The inventory should also list PCBs in storage pending destruction, and as the destruction of PCBs progresses it should also include information about the quantities destroyed.

Guidelines for construction of an inventory were published by UNEP Chemicals in August 1999[5].

3.2 Thresholds

In deciding on management strategies for PCBs, thresholds need to be established for quantities and concentrations of PCB-containing material. For example, a single ballast capacitor from an old fluorescent light fitting, containing approximately 100g of PCBs, might not attract the attention of regulators, but a building containing hundreds of such light fittings might contain large quantities of PCBs. Such PCBs may be best left in place until the building is refurbished, unless of course there has been leakage of the liquid PCBs into the environment.

Similarly, concentration levels for PCBs in oil can be established as triggers for action. At very low concentrations the solvent mineral oil (paraffin) itself will represent a greater threat to the environment than the small amount of PCBs in solution. Some jurisdictions prescribe a level (often 50 mg/kg) below which combustion of PCB/paraffin mixtures in relatively unsophisticated furnaces is permitted. At higher concentrations the material must be treated chemically or burned in specially-constructed high temperature incinerators with treatment of combustion products which minimise release of organo-chlorines (especially polychlorinated dibenzo -dioxins and -furans).

3.3 Export or treatment in country?

Destruction of PCBs is generally not undertaken in developing countries. Many developing countries and emerging economies have, in total, quantities of PCBs which would not be large enough to justify the establishment of a local destruction facility. More often, a quantity of PCB would be removed from equipment and consolidated for treatment or destruction, followed by export to a developed country, where it may be destroyed. This is permitted under the terms of the Basel Convention on Transboundary Movement of Hazardous Waste. In the few cases where this has occurred, the necessary funding has been provided by a donor country or organisation. In preparing the ground for such a transfer, the developing country needs to

prepare an accurate inventory. It is sometimes suggested that organisations or countries from which PCB-containing equipment had been supplied to developing countries might exercise product stewardship by taking responsibility for repatriation (and destruction) of PCBs, but no such examples are known and there are no immediate prospects of such a programme being put in place.

Various methods have been adopted in different countries for destruction of PCBs and mineral oil contaminated with PCBs. There might be opportunities to bring smaller-scale destruction facilities for the PCBs to consolidation points in developing countries, and to operate them there for relatively short periods to destroy the accumulated wastes before moving to a new location, possibly in another country. The Fluidex (S.D. Myers) alkoxide-type treatment and the Base Catalysed Dechlorination (BCD) process are both suitable for dilute PCB-in-oil solutions, are relocatable, and are relatively low in capital cost. However, given the excess capacity of destruction facilities which exists in Western Europe it seems likely that most PCB wastes will be exported from developing countries for destruction elsewhere.

UNEP has produced a survey of non-incineration PCB destruction methods[7] available in English, Spanish and French.

3.4. PCB Analysis and Monitoring

The PCB Management Plan should make provision for uniformity of analyses and monitoring regimes, so that useful comparisons may be made over time and between different sites and facilities. PCB analyses may be performed by well-equipped modern laboratories, but do not require the extreme sophistication of dioxin/furan analyses. Thus, most developing countries - or at least groups of countries in sub-regions - should have access to this service. Financial allocations will need to be arranged, and monitoring programmes devised, to make the best use of available funds. Industries - the electricity industry, for example, or an oil refinery or aluminium smelter - would be likely to have the necessary laboratory facilities. The document *Guidelines for the Identification of PCBs and Materials Containing PCBs*[5] published by UNEP Chemicals is available in English, Spanish and French.

PCB analyses will be important where uncertainty exists about the identity of fluids in electrical equipment or the residual concentration of PCBs in paraffin in retrofilled equipment. Spills and leakages are likely to have taken place where PCB-containing equipment was used or dismantled, and so soils and construction material in the immediate vicinity should be checked for contamination. Results obtained in a number of jurisdictions suggest other places where monitoring might begin. Food samples should be analysed, especially seafood from inshore regions because of the potential for bioaccumulation and biomagnification in those species. Landfill leachates might be other targets of attention, especially where dumping of PCB-containing equipment was known or suspected to have taken place.

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[7] Survey of Currently Available Non Incineration PCB Destruction Technologies. Available in English, Spanish and French. Copies may be obtained from UNEP Chemicals, 11-13 chemin des Anemones, CH-1219 Chatelaine, Geneva, Switzerland; fax +41 22 797 34 60, email: chemicals@unep.ch or on the UNEP website at: http://www.chem.unep.ch/pops/.

3.5 Education and Training

Education in its broadest sense needs to be part of the PCB management process. In the very first stages, government officials will need to gain the support of ministers and other political leaders, and this may involve bringing to their attention the dangers posed by PCBs to human health and the environment, and the concerns which have been raised world-wide. The presentation for signing in 2001 of an international treaty on Persistent Organic Pollutants (POPs, which includes PCBs) should be publicised. The activities of some environment NGOs may be viewed as part of this "education" programme.

Another early step to be taken is the education and training of workers who may come into contact with PCBs, notably those in the electricity industry, and also of those government officials who will be responsible for implementing regulations and compiling inventories.

Education of the broader public is more difficult, and arguably less necessary. It also needs to be approached with some caution, lest the effort required to bring to public attention the existence of possible problems causes the risks to be over-stated. Provision of information through the technical education and training system is a useful way to proceed, and more detailed information can be included on government web sites, where it will reach what are often the most concerned sectors of the community.

3.6 PCB-Contaminated Sites

Management of PCBs does not only involve the PCB liquids themselves and equipment which contains them or may have contained them, since other materials may also have been contaminated with PCBs. Leakages from electrical equipment, both in-service and in storage, and at facilities where PCBs are handled and destroyed, can give rise to comparatively large quantities of soil and concrete contaminated with PCB. These can pose the same risks to human health and the environment as the PCBs themselves and they therefore need to be handled in the same way after they are removed from the contaminated sites. Some simple destruction technologies, such as indirect thermal desorption after admixture with lime (the process used to clean up the Sydney Olympics site), are available for contaminated soils and relatively small-scale facilities of this type could be established.

3.7 Removing PCBs from Equipment

Once it has been confirmed that equipment contains PCBs, planning for removal of the toxic material needs to begin. As with analyses and monitoring, uniform procedures need to be arranged to ensure that such work is carried out under appropriate conditions by trained staff. Draining the equipment will remove most of the PCBs, but much is retained in the interstices, in porous materials of construction, and on internal surfaces of the equipment, so simply retrofilling the drained items produces dilute solutions of PCBs in the new dielectric fluid. Conventionally, the replacement was mineral oil but new alternatives are becoming available. Repeated draining and flushing with mineral oil, possibly separated by brief periods of service,

will eventually lower PCB content to acceptable levels - often taken as 2 mg/kg - at the expense of generating large volumes of contaminated oil during the sequence.

Technology is available for cleansing transformer mineral oil of its PCB content by circulating the contaminated oil through a reactor while the transformer continues to operate. There are also available systems of solvent-washing of equipment which has been removed from service.

Standards for acceptable levels of residual PCB concentration and for surface contamination of obsolete equipment need to be established, and several international guidelines are available.

3.8 Replacements for PCBs

The most common replacement for PCBs is mineral oil (paraffin), but this represents a return to the practice of the pre-PCB era. Flammability was a major reason for the replacement of mineral oil dielectric fluids by PCB and many equipment-holders will be concerned about increased fire risk attending the replacement of chlorinated materials by mineral oil. The response at some facilities has been to blanket the dielectric fluid with inert gases to reduce the risks of fire when electrical equipment overheats. The use of alternative organo-chlorine materials and of some new formulations has also been suggested (see box).

USE OF ALTERNATIVE ORGANO-CHLORINE MATERIALS AND SOME NEW FORMULATIONS

Some organo-chlorine alternatives of low flammability - trichloroethylene, tetrachloroethylene, and trichlorobenzene - have been suggested as replacements for PCBs, but all have substantially lower boiling points than PCBs. This may not be a serious disadvantage, since the last-named has already found some use as a component (together with PCB) of one member of the Arachlor range. The most recently developed dielectric fluids are based on natural vegetable oils, but while these may have appropriately high flash points, they are - when compared to mineral oils - more easily oxidised and polymerised, and more easily attacked by microorganisms. Silicone oils are good replacements for PCBs, but are much more expensive.

3.9 Storage, Handling and Transport

Once PCBs are removed from equipment, or when the PCB-containing equipment is itself removed from service, the PCB should be treated like other hazardous material, and similar regulations should apply to it. These should cover (i) handling by trained operators, (ii) transport only by licensed carriers, (iii) storage in secure premises away from sensitive areas (such as wetlands and food preparation sites) and under conditions (impervious floor, bunding to contain spills) which prevent off-site migration.

3.10 Timelines

Timelines for removing PCBs from equipment should be established, keeping in mind that their may be a gap between removal to storage and consignment for destruction. Other factors to be considered are time taken to compile inventories, time to make budget provision for costs, the service lifetimes of equipment of various types, and the need to remove PCBs first from situations where they are most likely to result in exposure to people and the environment should they escape containment. These situations include proximity to wetlands and coastal areas, and near food-growing or food-preparation areas.

4. Concluding remarks

This framework document sets out the important matters which need to be considered when drawing up a national management plan or action plan for PCBs, and also provides some suggestions for the planning process. The situation will be different in every country, as regards the state of inventory development, quantities of PCBs held and the situations where they will be found, capacity to destroy PCBs in the country, and the existence of sufficient expertise and financial support to ensure the identification and eventual destruction of PCBs.

While IFCS plays a coordinating, catalyticand supporting role, the major players responsible for providing technical assistance to governments and implementing programmes are the United Nations agencies:

UNEP Chemicals 11-13 chemin des Anémones CH-1219 Châtelaine, Geneva, Switzerland fax +41 22 797 34 60 email: chemicals@unep.ch website: http://www.chem.unep.ch/pops/	**Secretariat of the Basel Convention** 11-13 chemin des Anémones CH-1219 Châtelaine, Geneva Switzerland fax +41 22 797 34 54 website: http://www.basel.int/
UNDP website: http://www.undp.org/	

This framework for development of a PCB management plan or strategy has been prepared by Professor Ian D. Rae (Australia, Chair of the IFCS PCB Strategy Group), as a contribution to the work of the Group.

This document contains the views of the author and has not been reviewed by the Intergovernmental Forum on Chemical Safety. It does not necessarily represent the views or policy of the Intergovernmental Forum on Chemical Safety.

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