BACKGROUND TO THE PCB PROBLEM AND HIGHLIGHTS OF THE REPORT OF THE TASK FORCE ON PCBS

Background

Within the past ten years polychlorinated biphenyls (PCBs) have been identified throughout the global environment. They have been found in water, air, soil and sediment. They tend to accumulate in the fatty tissues of animals, and may cause a variety of adverse effects in different species.

Recent experiments have shown that PCBs are toxic at much lower levels than previously indicated, and that they cause liver cancer and decreased fertility in rats and monkeys. In Japan, PCBs are known to have caused a variety of skin disorders in a large group of people who ate rice oil contaminated with PCBs.

Ranch mink fed fish from the Great Lakes have suffered severe reproductive disruption causing financial loss to fur breeders. In colonies of Herring Gulls on the Great Lakes severe reproductive failures have been related to PCBs in food chains. Reproductive failures in Lake Trout in the Muskoka Lakes and in Striped Bass in the St. John River have been associated with high PCB content in the fish eggs.

Nature and Use of PCBs

PCBs are a family of chemically similar organochlorine compounds; commercial grades have been distinguished according to the proportion of chlorine they contain and in North America are commonly referred to by the trade name Aroclor. They have been widely used for over 40 years in many applications including heat transfer fluid, hydraulics, printing inks, copying paper, paints and other plasticizer purposes. However, the major use of PCBs in Canada has always been as insulating oil and dielectric fluid in electrical transformers and capacitors. One of the most important useful attributes of PCBs is their great chemical stability. Associated with this stability is their fire-resistance and their persistence once they enter the environment. These properties are enhanced in those PCBs containing greater proportions of chlorine.

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In 1973, Canada supported the OECD (Organization for Economic Cooperation and Development) decision urging Member countries to control the manufacture of, and trade in, PCBs and to permit their use only as dielectric fluid in transformers and capacitors, heat transfer fluid and hydraulic fluid in mining equipment.

Actions Taken to Reduce Losses of PCBs

There is no known manufacture of PCBs in Canada. Historically, the Canadian market has been supplied almost exclusively through Monsanto Canada Limited by imports from Monsanto Company in the U.S.A. When evidence of undesirable ecological effects of PCBs began to accumulate, Monsanto Company made changes to their PCB product line to reduce the environmental persistence of waste capacitor and transformer fluids and phased out sales of PCBs to persons other than electrical equipment manufacturers. These changes began in 1970 and by the middle of 1973 stocks of PCBs in the hands of manufacturers other than those in the electrical equipment industry are believed to have been largely exhausted. However, stocks of products that contain PCBs are not yet exhausted.

Electric utilities and electrical equipment manufacturers in Canada have revised their codes of practice to reduce the release of PCBs into the environment as wastes in processing or in disposal of unserviceable equipment.

In view of the occupational hazard, as recommended by National Health and Welfare, Consumer and Corporate Affairs in early 1976 banned the PCB - containing microscope immersion oils under the Hazardous Products Act.

Task Force on PCBs

In August 1975, in anticipation of the passage of the Environmental Contaminants Act (proclaimed April 1, 1976), a task force on PCBs was appointed by the Joint DOE/NH&W Committee on Environmental Contaminants:

- to investigate and document the PCB problem in Canada
- to make recommendations concerning

- the information that should be sought under the mandatory disclosure provisions of the Environmental Contaminants Act and
- the information that should be provided through further government research and
- the efficacy of the OECD's decision as the basis for Canadian controls and
- other desirable controls on PCBs.

The task force examined the information on the amounts of PCBs imported, used, recycled, exported and disposed of, including the amounts used in various commercial and domestic products and the amounts used in various commercial activities. One of the greatest problems in assessing the PCB problem has been the collection of this information on use of PCB in the economy. There are good data concerning the importation of PCBs in bulk for Canadian manufacturing use. Almost no other data are available on the movement of PCBs in commerce. Some quantitative information is available from monitoring the amounts or concentrations entering the environment in the recent past.

The task force examined the information on levels of PCBs in various ecosystems in Canada in order to determine the source and mode of entry of PCBs into various sectors of the environment.

Distribution of PCB in Canadian Ecosystems

Despite the problems of collecting satisfactory information it is clear that the most serious identified problem of contamination by PCB is in the Great Lakes and associated regions. This is most clearly seen in the Herring Gull data where the residue levels are generally ten times higher than the levels found on the Atlantic coast.

That PCBs are present at higher concentrations in specific regions is confirmed as well by the fish data. Higher residues are found in species from the Great Lakes and St. Lawrence River. (However, levels

of PCBs in most important commercial species are generally less than the 2 ppm established by the Health Protection Branch, NH&W.) Levels of PCB in fish from the Atlantic coast are somewhat higher than in those from the Pacific coast. The level in the Arctic Char from Hudson Bay indicated that this environment has a higher contamination than more northerly arctic locations. Residue levels in Polar Bear from the eastern Arctic, particularly around Hudson Bay, were higher than levels in those from the western Arctic.

The Lake Trout data from Lake Minto (Ungava, northern Quebec) confirm that PCBs are present in remote arctic freshwater ecosystems; atmospheric transport is the most probable route of contamination. Probably the same route is responsible for the contamination of small lakes in the Prairies and of the Ontario terrestrial ecosystem. This airborne PCB is of uncertain origin; it is probably the result of ineffective incineration of waste PCB and waste containing PCB.

The information from the analysis of fatty tissue of humans indicates higher PCB levels in Ontario and Quebec and lower levels in the Prairie Provinces. Residue levels in human fatty tissue, viewed as an integrator of human exposure levels from all routes, indicate that higher PCB exposure is associated with the more industrial parts of the nation. The very wide ranges reported in the Ontario surveys for the years 1971-72 and 1973-74 suggest a rather wide range of exposure.

Source of PCB to the Environment

Despite the shortcomings of the data base, it is possible to make some generalisations concerning routes into the environment. Of the wastewater treatment plant effluents sampled, nearly every plant effluent around the Great Lakes contained PCB in at least trace concentration of 5-10 parts per trillion. A few locations, such as Toronto, Hamilton, Windsor and Saginaw, account for much of the measured discharge via this route. Control of PCB from industrial plants to these municipal wastewater treatment plants could probably reduce much of the continuing municipal

discharges. The information on industrial discharges directly into the environment is fragmentary, but indicates that industrial sources do exist. Much the same conclusion can be made about landfill leachate resulting from solid waste disposal, though generally the volume of discharge would be much smaller than waste discharges from sewage treatment or industrial plants.

Sewage sludge disposal on agricultural land is another route for PCB entry into the environment. It appears that repeated applications of the sludge will result in a buildup of PCB residue in the soil. There is an indication that some plants will take up PCB from contaminated soil.

Very little work has been undertaken on monitoring PCBs in the emissions from incinerator stacks, and in rain, snow or air. From the very scant data, it would appear that the atmospheric route is far more important than has previously been thought. A crude estimate of PCB entering Lake Erie in rain is 500-1000 kg/yr; for comparison, the PCB entering Lakes Erie and Ontario from municipal wastewater treatment plants in Ontario is estimated to be 250 kg/yr. The phenomenon of vaporisation of PCB from water surfaces, particularly the Great Lakes, does not appear to have been researched.

Approximately 59 kg/yr and 2.5 kg/yr of PCB enter Lakes Huron and Superior from tributaries sampled. Much larger quantities of PCB enter these Lakes from American tributaries.

Other Observations

The task force considered other relevant observations concerning trends of PCB levels in the environment, types of PCB in samples, the composition of commercial mixtures and toxicological implication of PCB residues in organisms. Consideration was also given to the presence of other chemical species of particular toxicological importance, either contained in commercial PCB (e.g. chlorodibenzofurans) or derived from

commercial PCB (e.g. metabolites). It also considered the relative consumption by industry of the lower and higher chlorinated PCBs and their estimated losses to the environment.

The crude estimates of losses taken together with the evidence that exists of the presence or absence of PCB with 4 chlorine atoms per molecule (tetrachlorobiphenyl) in birds and fish indicate that tetrachlorobiphenyl and other lower chlorinated biphenyls (LCPBs) are degraded more rapidly than are higher chlorinated biphenyls (HCBPs). Because Monsanto's sales curtailment must have exerted already a great effect on losses of tetrachlorobiphenyl and other LCBPs into the environment, and because this material is more rapidly degraded than HCBP, any reduction in Canadian discharges of LCBP to the Great Lakes ecosystem that would result from new restrictions on use in electrical equipment in Canada would be only of secondary importance, when viewed against the vastly greater consumption of LCBPs in the U.S. Great Lakes region.

Conversely Canadian actions to reduce losses of HCBP to the Great Lakes ecosystem could have a large long-term effect in view of the estimated relative quantities of HCBP used in Canada and the U.S.A. within the Great Lakes region.

It is clear that Canadian control efforts alone will be insufficient to reduce environmental levels of PCBs in the Great Lakes to tolerable values. Effective action will also be necessary in the U.S. portions of the Great Lakes Basin. This was the subject of discussion at the recent ministerial meeting between Mr. Marchand, Minister of the Environment, and Mr. Train, Administrator, U.S. Environmental Protection Agency, and led to a bilateral pledge of cooperation.

Rationale for regulatory options

In developing the first regulations under the Environmental Contaminants Act which deal with the control of PCB, the Department of the Environment and the Department of National Health and Welfare are setting a precedent. The Task Force utilized the following systematic approach in developing a regulatory proposal.

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The nature of the problem was identified as the inherent

toxicity and the exposure of organisms to PCBs. The toxicity cannot be reduced; thus controls can only be formulated to reduce exposures.

The following three ways of reducing exposures can be used.

i) restricting the purposes for which PCBs may be used;

ii) restricting losses into the environment from permitted uses;

iii) restricting the proportion of environmentally persistent PCBs in material lost into the environment.

The possible ways in which practical regulations could be formulated and beneficial results from each of these possible regulatory restrictions were examined in detail.

In addition, the federal and provincial laws concerning pollution control were reviewed. The Federal Fisheries Act, Clean Air Act and Environmental Contaminants Act all have aspects which are relevant to the control of PCBs. The provincial governments have their own individual sets of laws, which parallel the federal legislation in many ways.

Selected Regulatory Strategy

The severity of the problems posed by the presence of PCBs in the environment left the task force in no doubt that formal controls are necessary in order to ameliorate the situation. The inter-relationships between use, entry into the environment, persistence, biological effects, and chemical composition of the various chlorinated biphenyls are very complex. For this reason the task force recommendations were based on a consideration of its report as a whole, and of a strategy that is expected to prove both efficacious and practicable in its application.

The Task Force recommended that all uses of those PCBs that are highly persistent in the environment be phased out. It is not practically feasible to prohibit, with immediate effect, the import or use of all persistent PCBs. It is unlikely that alternative fluids

could be made available on a commercial scale for all purposes by a predictable date. It was necessary, therefore, to recommend the adoption of a stepwise procedure for instituting controls. The order in which the steps should be taken is dependent upon factors such as practicability, rapidity of environmental response, and the scale of the danger that will be eliminated.

A major difficulty in devising adequate but not unnecessarily disruptive controls is the dependence of electric power distribution systems on equipment designed to use only PCB-based fluids. The availability of these fluids for several decades has resulted in a very great degree of dependence on the performance and reliability of equipment that contains them. This makes it particularly necessary for the environment protection authorities to be satisfied that the restrictions they introduce do indeed answer to the apprehended environmental and health hazards.

Of the three ways of reducing exposures to PCB identified earlier, the reduction to the greatest extent practicable of identified sources of entry of PCB into water and atmosphere is likely to be the most efficacious measure. In this regard, the only acceptable current method of disposal of surplus or waste PCB is incineration under controlled conditions.

The second most effective tactic for causing relatively rapid decreases in loss of PCB into the environment is the elimination of the few remaining uses of PCB that can be classified as non-electrical and open-system. This is more restrictive than the control measure recommended to member countries by the OECD Council decision. The long-term objectives would be to eliminate all uses of environmentally persistent PCBs, but elimination of various dielectric uses requires long lead times for development of alternative fluids.

The third way of reducing exposures to PCB is the lowering of the proportion of persistent PCB species in commercially available dielectric oils. However, any major change in the specifications of the available dielectric fluids also requires a long lead time for field testing of reliability.

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Major Recommendations for Control of PCBs

1. Initial regulations should restrict use of PCBs in new goods to

dielectric insulating oils. Appropriate regulations could be brought in quickly under the Environmental Contaminants Act after the necessary consultations with the provinces.

2. All uses of those PCBs that are highly persistent in the environment should be phased out. This will require discussion with industry, provinces and with U.S. government authorities because of the impact on the electrical industry.

3. Regulations should prohibit the release of PCB into the environment, the addition of PCB to any aqueous effluent or gaseous emission, the disposal of industrial wastes containing PCB in landfill operations, and the disposal of PCB into combustion devices that operate under inadequate conditions. This will require further government investigation and data-gathering to identify the major sources, and it will require negotiation with the provinces to determine the special control measures and the appropriate legislative power, i.e. the Fisheries Act, the Clean Air Act, the Environmental Contaminants Act, or the variety of appropriate provincial laws.

There are a number of other recommendations for the development of specific controls and for government programs and information-gathering. In particular, persons engaged in commercial activities involving PCBs should be required under the Act to notify the government. Furthermore, an inspection program should be carried out to identify disposal systems and any source likely to be a significant contributor of PCBs to the environment.