Review of Dioxin Emissions in Hong Kong
Summary of Findings

The following is a summary of findings made by Professor Christoffer Rappe of the Umeå University, Sweden, in his Paper submitted to the Environmental Protection Department for the study entitled *Review of Dioxin Emissions in Hong Kong*. Under this assignment, Professor Rappe was given a copy of the Assessment Report prepared by the Consultants and other relevant information for an independent review. He was required to present his views with particular reference to the health impacts of dioxin emission from those significant sources identified by the Consultants.

In the first part of his Paper, Professor Rappe summarized a number of sources known to release dioxins (as PCDD/Fs) into the environment. They include primary sources and secondary sources. Primary sources are divided into four categories, namely chemical processes such as bleaching of pulp with chlorine gas, combustion processes such as incineration, photochemical reactions under atmospheric conditions, and some biological processes.

The formation of PCDD/Fs during incineration of waste has been discussed for more than 20 years. The emissions from an incinerator are flue gas, fly ash and slag. Up to now most studies have been on flue gas and some on fly ash and slag. The levels of PCDD/Fs in fly ash and slag were quite high in the 1970s and 1980s, but with the technology used today these have been reduced dramatically. The origin of PCDD/Fs is not completely understood, but they appear to result from a serious of complex thermal reactions occurring during periods of poor combustion or during the cooling period.

In 1986, Sweden introduced an emission limit of 0.1 nanogramme I-TEQ per cubic meter (of PCDD/Fs in fuel gas) for municipal solid waste (MSW) incinerators, which today becomes an operating guideline in most European Union countries. Incinerators fulfilling this strict guideline can now be found in Sweden, Germany, Austria, The Netherlands, Spain, Japan and Hong Kong.

Professor Rappe further highlighted several studies which indicate that PCDD/Fs may be emitted from open burning of household wastes, landfill fires, house heating and some other wood/coal burning ovens. Despite this, based on experience with several advanced countries, the dominating sources of PCDD/Fs appear to be from the industries. In Sweden in the mid 90s, the major source is the metal production/treatment processes. In the Netherlands, MSW incineration was found to be the major source in 1992, but in year 2000 they consider the use of pentachlorophenol as the major source of environmental contamination. In the United Kingdom, MSW incineration was the dominate source, contributing an average of 70% of the emission from industrial sources.

In the second part of the Paper, Professor Rappe gave his comments on the situation in Hong Kong, as summarized below -

(a) Professor Rappe agreed with the Consultants' recommendation of a pilot sampling program to verify the established inventory which has been based on the United Kingdom's emission factors, and see the importance of long range aerial transport.

(b) The ambient PCDD/F levels in Hong Kong are similar to those found in most other countries. The higher values in winter as demonstrated in the two monitoring stations (Tsuen Wan and Central/Western) should not be due to emissions from the Chemical Waste Treatment Centre (CWTC).

(c) Professor Rappe thought that the carbon monoxide (CO) value in the flue gas of the CWTC incinerator could be a very good indicator for potential plant instabilities that might lead to increased PCDD/F level.

(d) It is now generally accepted that food can account for more than 98 percent of the total uptake from the environment. Among the other exposure routes, inhalation can contribute up to 2 percent of the total uptake of PCDD/Fs. The total dietary intake estimated for Hong Kong people (105 picogramme I-TEQ per day) is similar to data from other countries. Based on the Consultants' calculation, Professor Rappe agreed that the CWTC could only contribute up to 0.1-0.4 percent of the existing ambient PCDD/F concentrations, and hence should not have any adverse effect on the health of the exposed population.

(e) Professor Rappe recommended that dioxin-like polychlorinated biphenyls, which have been included in the recent review by World Health Organization (WHO), should be studied in Hong Kong for the food intake as well as for emissions from CWTC.

(f) Professor Rappe highlighted several studies related to occupational exposure to PCDD/F levels of workers in MSW incinerators in Sweden and Germany, and all reported that no significant change to the blood PCDD/F levels had been found as versus other people.

(g) Professor Rappe has worked with the International Agency for Research on Cancer (IARC), a WHO agency, in the evaluation of carcinogenic risks of PCDD/Fs. Given the available scientific evidences, only one PCDD/F congener (out of 210), namely 2,3,7,8-TCDD, is classified as carcinogenic to humans. However, it is worth noting the following paragraph in the IARC's evaluation: *"In view of the results mentioned above, it should be noted that the present background levels of 2,3,7,8-TCDD in human populations (2-3 nanogramme per kilogram) are 100 to 1,000 times lower than those observed in this rat carcinogenicity study. Evaluation of the relationship between the magnitude of the exposure in experimental systems and the magnitude of the response (i.e. dose-response relationships) do not permit conclusions to be drawn on the human health risks from background exposures to 2,3,7,8-TCDD."*

(h) Professor Rappe thought that it should be all right for the CWTC to co-incinerate clinical wastes. Moreover, the operational parameters for the CWTC incineration

systems are all within acceptable ranges, and with the provided pollution control devices such configuration has been proven to meet the 0.1 nanogramme I-TEQ per cubic metre. He agreed with the Consultants' finding that it was very unlikely that the released quantities of PCDD/Fs from the CWTC could be detrimental to human health. The PCDD/F data on ash also show that the situation at CWTC is quite good.

(i) Professor Rappe agreed that the limit of 0.1 nanogramme I-TEQ per cubic metre should also be used for the planned incineration of MSW, sewage sludge and animal carcass.

(j) Professor Rappe opined that the introduction of a 2 nanogramme I-TEQ per cubic metre as a trigger for initiation of remedial action, as proposed by the Consultants, was a good idea.

(k) Professor Rappe recommended that Hong Kong should monitor for PCDD/Fs and dioxin-like PCB levels, as with the WHO guideline, in meat and meat products, milk and dairy products, fish and vegetables, and from such measurements an estimate for the dietary intake for local people can then be made.

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