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Legislative Council Panel on Environmental Affairs

Effect of Dioxins and Removal of Dioxin-contaminated Soil at Penny's Bay

The Administration briefed Members on the Environmental Impact Assessment (EIA) study for the decommissioning of Cheoy Lee Shipyard (CLS) at Penny's Bay at a special meeting of the Panel on 12 March 2002. This paper provides supplementary information to address the concerns raised by Members at the meeting.

Thermal Desorption vs Alternative Treatment Methods for Dioxin-contaminated Soil

2. We have conducted a thorough comparative analysis of all feasible technologies known to us, or combination of these technologies, for the treatment of dioxin-contaminated soil during the EIA study. These technologies include in-situ capping, direct incineration, thermal desorption, chemical de-chlorination (see paragraph 8 below) and various other technologies that have been used in the United States and Australia as well as those available locally including the existing facilities at the Chemical Waste Treatment Centre (CWTC) in Tsing Yi. The EIA report recommended treating the dioxin-contaminated soil by thermal desorption followed by incineration of the treatment residue at CWTC ("the recommended method").

3. The question has been raised as to whether in-situ capping should be used instead of the recommended method. While in-situ capping may minimize direct human exposure to the contaminants, it does not reduce or remove the toxicity and mobility of the contaminants. A potential environmental risk will remain on site limiting future productive uses of the land. As a responsible Government, we should resolve the problem and not leave it to future generations.

4. Some have asked if direct incineration of the dioxin-contaminated soil should be pursued instead of the recommended method. Direct incineration is an effective method to remove organic pollutants including dioxins. In the CLS case, direct incineration could be carried out at CWTC or a purpose-built incinerator. However, the setting up of a purpose-built incinerator and the process of direct incineration is very costly and time-consuming. Paragraphs 5 and 6 below explain in greater detail the option of direct incineration at CWTC.

5. We have explored the option of direct incineration at CWTC. Although effective in treating dioxin-contaminated material, CWTC has a number of constraints. First of all, it is not designed for treatment of solid waste in bulk quantities. Without any modification to the existing facilities, it would take about 90 years to incinerate all 30,000 m^3 of dioxin-contaminated soil at CWTC. If minor modifications were made to the kiln to increase the daily capacity of treating solid waste, the total treatment time could be shortened to about 18 years. In both scenarios, long-term storage of the contaminated soil at another site would be required, which is undesirable.

6. Even with major modifications, it will still take about 3.5 years for CWTC to incinerate just the contaminated soil, leaving all other chemical wastes requiring incineration untreated. Due to the intense energy required, the cost of direct incineration will be about 30% higher than that of the recommended method which is as effective as direct incineration in achieving the target level of performance. The recommended method would also reduce the quantity of contaminants that needs to be transported and incinerated at CWTC (600 m^3 of oily residue generated from the thermal desorption process instead of 30,000 m^3 of contaminated soil), thereby lowering the overall treatment cost and minimizing any secondary environmental impacts.

7. Bio-degradation has also been suggested as an alternative. It is a possible treatment method for organic pollutants but it is not suitable for treating dioxins because of the low biodegradation rate. There is no record of successful field application in treating large quantity of dioxin-contaminated soil. A number of emerging technologies have also been considered in the EIA report e.g. solvent extraction, vitrification, etc. However, these are not considered mature technologies proven for implementation on a scale similar to the CLS case. Compared with other alternatives, the recommended method of thermal desorption followed by incineration of the treatment residue at CWTC has the advantages of proven large scale experience, high efficiency of contaminant destruction, less secondary environmental impacts and cost-effectiveness.

Incineration at CWTC vs Chemical De-chlorination for Treatment of Thermal Desorption Residue

8. The 600 m^3 of oily residue generated from the thermal desorption process over a period of one to two years will require further treatment, either by incineration or chemical de-chlorination The EIA report recommended incineration at CWTC as against chemical de-chlorination as the destruction efficiency of chemical de-chlorination is lower than that of incineration. The chemical de-chlorination process would itself generate five times more by-product oily residue requiring further treatment. This would result in double-handling and potentially more secondary environmental impacts. Currently, there is no chemical de-chlorination plant in Hong Kong. Procurement of such a plant (about $30 million) from overseas will be required. Unlike incineration, dechlorination is highly dependent on the characteristics of the feed waste material and a treatability test is therefore required to determine the design parameters for the plant. Conducting the treatability test would however require the setting up and operation of a thermal desorption plant in the first place to produce sufficiently large quantities of residue as test samples. Considering the cost and timing implications of that process and the fact that CWTC could handle incineration of the residue, setting up a chemical dechlorination plant and conducting the treatability test were considered neither necessary nor practicable. On the other hand, incineration is a well-proven process and incineration of the residue at CWTC will comply with the specified emission standards.

Overseas Experience in Thermal Desorption

9. The recommended method of thermal desorption is an internationally accepted technology for removing dioxins and other organic contaminants from the soil. It has been successfully used at a number of sites in Australia and the United States. In Australia, thermal desorption was used for the Sydney Olympic site clean up. In the United States, there are more than 150 full-scale thermal desorption projects (Troxler et al, 1992 quoted by American Academy of Environmental Engineers). A list of some published thermal desorption projects in the last 15 years is at Annex A.

On- site vs Off -site Treatment

10. The main advantage of on-site treatment at CLS is that it reduces the risk of exposing the contaminants during transportation to To Kau Wan (TKW) and CWTC. In terms of cost, the difference between on-site and off-site treatment is the saving in transportation cost which is about $5 million.

11. With on-site treatment, however, the CLS site could only be released for construction of the main road access to the theme park after completion of all decontamination works and decommissioning of the treatment facilities. If all the contaminated soil is to be treated on-site, the opening of the theme park could be delayed by about 3 years in the worst-case scenario. In the best-case scenario, the delay will still be more than 2 years.

12. Transporting the dioxin-contaminated soil to TKW for storage and further treatment will enable the infrastructure works at CLS to proceed concurrently. By adopting this off-site treatment arrangement, we do not anticipate delay of the opening of the theme park by the decontamination works. Furthermore, the TKW site is about 3 km away from the theme park and shielded by natural topography. The thermal desorption process at TKW will comply with all environmental legislation and requirements. There would be no effect on the activities at the theme park, even if the treatment facilities at TKW were to continue operating beyond the opening of the theme park.

Transportation Risk

13. The dioxin-contaminated soil and the oily residue generated from the thermal desorption process are classified as chemical wastes and their handling is subject to control under the Waste Disposal Ordinance (WDO). Waste collection licences will be required from the Environmental Protection Department (EPD) for collection and transportation of these chemical wastes.

14. The dioxin-contaminated soil will be transported from CLS to TKW via a dedicated non-public haul road by top-sealable roll-off trucks under speed limit control and the escort of two other vehicles (one in the front and one at the back). Transportation of the 30,000 m^3 of dioxin-contaminated soil will last about 6 months. On average, there will be about 30 truck trips each day. Each truck trip will carry about 6 m^3 of soil. The health risk in relation to inhalation of dioxin in case of transportation accident is estimated at around 3×10^{-18}. This magnitude is extremely low when compared with the acceptable health risk range

of $1x10^{-4}$ - $1x10^{-6}$.

15. The transportation of the oily residue generated from the thermal desorption process from TKW to CWTC will have similar low inherent risks given the non-volatile, insoluble and low inflammability nature of the contaminants and the adoption of similar safety measures such as speed limit and escort. The 600 m^3 of oily residue generated during the treatment period (one to two years) will be collected and transported to CWTC by batches in sealed drums at around 2 to 3 trips of per week. Each trip will carry about 2 m^3 of the residue. The health risk in relation to inhalation of dioxin in case of transportation accident is estimated to be about 4×10^{-14}.

Contingency Plans

16. We will require the contractor to put in place a contingency plan setting out clear procedures for responding to emergency situations e.g. transportation accidents leading to spillage of the dioxin-contaminated soil and treatment residue or non-compliance of emission standards at the thermal desorption plant at TKW. A site emergency response centre (ERC) will be established to manage the effective implementation of the contingency plan. All emergency events will be immediately reported to the ERC. The duty emergency response coordinator will notify relevant parties and authorities and arrange to carry out immediate remedial measures.

17. Although the estimated risks of spillage during transportation of the contaminated soil and treatment residue are very low, we will require the contractor to provide adequate standby site staff and equipment to deal with any transportation accident. To facilitate quick response to any spillage, arrangements will be made with the Fire Services Department and Hong Kong Police Force in the relevant geographic areas to provide the necessary assistance. They will assist in securing the site/location, thereby reducing the possibility of exposure by the public. Once the immediate emergency situation has been brought under control, the removal and disposal of spilled material would be carried out in a manner acceptable to EPD.

18. Notwithstanding the low inherent risk of the operation of thermal desorption plant (air-sealed operation, inert environment inside the plant, no fuel storage on site), the TKW plant will be equipped with stringent air emission controls including continuous emission monitoring system and backup carbon filter to ensure consistent compliance with the emission standards. In addition,

the plant will be fully automated and its operation controlled by computers. The feed cutoff system will be automatically activated in the event of non-complaince with emission standards.

Capability of CWTC in Handling Dioxin-contaminated Material

19. CWTC has adequate spare capacity to handle the oily residue generated from the thermal desorption process at TKW, which is only about 5 m^3 per week. Under the CWTC contract managed by EPD, the incinerator is required to meet a minimum destructive and removal efficiency (DRE) of 99.9999% for polychlorinated biphenyls, dioxins and furans, polychlorophenols and polychlorobenzenes. There is regular monitoring of dioxin emissions from CWTC both from the stack and ashes. Last year, the average dioxin concentration is 0.008 ng I-TEQ/m^3 in the flue gas, 0.006 parts per billion (ppb) in the bottom ash and 0.021 ppb in the fly ash, which are all well below the most stringent international emission standards of 0.1 ng I-TEQ/m^3 and USEPA's recommended clean-up level of 1 ppb for soil of residential exposures.

20. The methodology for analyzing, sampling and determining the DRE of CWTC incinerator is in accordance with the USEPA publication SW-846 entitled "Test Method for Evaluation of Solid Waste, Physical/Chemical Methods". The performance test is typically carried out on 3 consecutive days and a total of about 10 tonnes of test compound (nitrochlorobenzene) are incinerated. Results from the previous performance tests on DRE are given below:

Date	Test Compound	DRE
Apr 93	Trichlorobenzene	>99.99993
May 94	Trichloroethylene	>99.99990
June 95	m-nitrochlorobenzene[1]	>99.99996
June 96	m-nitrochlorobenzene	>99.99996
Jan 98[2]	m-nitrochlorobenzene	>99.99995

[1] After the commissioning of the CWTC, it was agreed that local waste streams should be used for the annual incinerator DRE test. In August 1994, a local waste stream containing over 40% of nitrochlorobenzene (NCB) became available. Since its characteristics are quite similar to PCB and trichlorobenzene, NCB was used as the test compound for subsequent DRE tests.

[2] For 1997, the scheduled test was deferred till January 1998 due to replacement work on the waste heat boiler.

Nov 98	m-nitrochlorobenzene	>99.99994
Jan 00[3]	m-nitrochlorobenzene	>99.99995
Dec 00	m-nitrochlorobenzene	>99.99994
Sep 01	m-nitrochlorobenzene	>99.99993

Exclusion of Decommissioning of CLS from Theme Park EIA Study

21. The decommissioning of CLS involves two designated projects under the Environmental Impact Assessment Ordinance (EIAO), one for the waste disposal facility under item G4, Part I of Schedule 2 and the other for the decommissioning of the shipyard under item 17, Part II of Schedule 2. After the site of shipyard has been cleared, the land will be used for the construction of sections of roads, railway, parts of a water recreation centre and a drainage channel forming part of the overall development of the Penny's Bay area.

22. The theme park is classified as a separate designated project under a different Item O8 of Part 1 of Schedule 2 of the EIAO. The theme park itself is not constructed on the shipyard site. It is legally proper for the EIA study for the "theme park" designated project not to include the decommissioning of CLS. When the Advisory Council on the Environment (ACE) endorsed the EIA report for the theme park and associated infrastructure two years ago, one of the conditions of the endorsement was that no work should commence at the CLS site until a separate EIA study for the decommissioning of CLS had been completed and an environmental permit issued. The EIA report for the decommissioning of CLS was endorsed by ACE with conditions at its meeting on 26 March 2002.

Liability for Land Contamination

23. At present, the Government is considering the possible legal avenues which may be pursued in relation to the contamination at the site. In order not to prejudice Government's position, it is not appropriate to comment further on the liability issue.

[3] The scheduled test for late 1999 was deferred till January 2000 due to a change in the maintenance programme.

Liability of Government in case of Delay in Theme Park Opening

24. Government is bound by the provisions of the agreement with The Walt Disney Company and Hongkong International Theme Parks Limited not to make any comment on or disclosure of the same.

Need for Legislation on Land Contamination

25. A number of existing legislation could be used to deal with land contamination. The WDO, which is one of a number of environmental laws, sets out a framework for the management and prevention of waste by way of imposing licensing and other statutory requirements. The WDO imposes criminal liability for failure to comply with the statutory requirements.

26. Proper waste disposal practices help to prevent land contamination. Some improper waste disposal activities which may contribute or lead to land contamination can be the subject of prosecution. For example, the offence of using or permitting to be used any land or premises for the disposal of waste without a licence carries a fine of HK$200,000 and imprisonment for 6 months for the first offence; for a second or subsequent offence, a fine of HK$500,000 and imprisonment for 6 months; and if the offence is continuing offence, a fine of HK$10,000 for each day that the offence has continued. The offence of failing to comply with any direction given by the Director of Environmental Protection regarding the disposal of waste carries a fine of HK$100,000 for the first offence; for a second or subsequent offence, a fine of HK$200,000 and imprisonment for 6 months; and if the offence is a continuing offence, a fine of HK$10,000 for each day that the offence has continued.

27. The EIAO is another example of legislation which contains provisions to address land contamination issues. The designated projects listed in Part II of Schedule 2 to the EIAO involve land uses which have the potential to cause land contamination (e.g. an oil refinery, a petro-chemical works, a bulk chemical storage facility, a ship building or repairing facility of a certain size). A project proponent is required to follow the statutory environmental impact assessment process before an environmental permit may be issued for decommissioning these designated projects.

28. At present Government is considering the possible legal avenues which may be pursued in relation to the contamination at the CLS site. In order

not to prejudice Government's position, it is inappropriate to make any further comment on whether there is need for specific legislation on land contamination.

Archaeological Rescue Works

29. We are consulting the Antiquities Advisory Board on the archaeological rescue works at CLS and its views will be adopted in the implementation of the rescue works.

Civil Engineering Department
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Annex A

Location of Some Thermal Desorption Projects in the US

(Remediation Technology Cost Compendium – Year 2000)

Site	Application Year	Location
Waldick Aerospace Devices Superfund Site	1993	New Jersey
Re-Solve, Inc. Superfund Site	1994	Massachusetts
Port Moller Radio Relay Station	1995	Alaska
Wide Beach Development Superfund site	1990	New York
Outboard Marine Corporation Superfund Site	1992	Illinois
Reich Farm Superfund Site	1995	New Jersey
Rocky Flats Environmental Technology Site	1996	Colorado
McKin Company Superfund Site	1986	Maine
Samey Farm Superfund Site	1997	New York
Sand Creek Industrial Superfund Site, OU 5	1995	Colorado
Naval Air Station Cecil Field	1995	Florida
Letterkenny Army Depot	1994	Pennsylvania
Metaltec	1995	New Jersey
Adington Blending & Packaging Superfund Site	1996	Tennessee
TH Agriculture & Nuhition Company Superfund site	1993	Georgia
FCX Washington Superfund Site	1995	North Carolina
Longborn Army Ammunition Plant, Burning Ground No. 3	1997	Texas
Alameda Naval Air Station, Interim Soil Removal	1993	California
Fort Lewis Solvent Refined Coal Pilot Plant	1996	Washington
Fort Campell POL Site	1994	Kentucky
Dane County Regional Airport, Troaz Field	1994	Wisconsin