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Project Summary

Preliminary Operations Plan and Guidelines for the At-Sea Incineration of Liquid PCB Wastes

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This document is a preliminary operations plan and guidelines report for the disposal of polychlorinated biphenyl (PCB) wastes by at-sea incineration. The effort on this study was divided into two subtasks. In Subtask A, an inventory of government-owned PCB wastes suitable for at-sea incineration was developed. Approximately 1.3 million gallons of government-owned liquid PCB wastes were identified in Subtask A, 425,000 gallons of which were considered immediately available for disposal by at-sea incineration. In Subtask B, operating plans and a schedule for an EPA-coordinated project to dispose of these wastes were developed. The operations plan addresses both land-based and at-sea operations. Land-based operations include waste collection and preparation, transportation to a processing facility, processing of wastes and containers, interim storage of bulk liquids, transportation to a ship loading site on the Gulf of Mexico, and ship loading. Incineration site selection, permit requirements, incineration procedures, and cargo tank decontamination are addressed for at-sea operations. The preliminary schedule for the disposal project shows a duration of 10 months from decision to proceed with the project to completion of disposal operations.

This Project Summary was developed by EPA's Industrial Environmental Research Laboratory, Research Triangle Park, NC, to announce key findings of the research project that is fully documented in a separate report of the same title (see Project Report ordering information at back).

Introduction

The problem of disposing of wastes containing polychlorinated biphenyls (PCBs) is not unique to the private sector. Various Federal, state, and local government organizations have accumulated these wastes in the course of operations and must dispose of these wastes in accordance with applicable regulations. Alternatives for the disposal of PCB wastes include land-based thermal or non-thermal treatment and at-sea incineration.

The feasibility of disposing of government-owned PCBs by at-sea incineration was investigated. Government-owned stocks of PCB wastes have been inventoried and a conceptual plan developed for disposal of these wastes onboard the chemical waste incinerator ship M/T Vulcanus. This project summary highlights the results of the PCB inventory and operations plan.

Summary and Conclusions

An inventory of government-owned PCB wastes suitable for at-sea incineration was developed. The first step in compiling the inventory of PCB wastes was to define the list of government organizations to be contacted. This list consisted originally of four organizations, defined by EPA, from whom the Agency had received requests for disposal assistance. After initial contacts with these organizations, it was determined that the quantity of wastes was less than the minimum amount necessary to make at-sea incineration economically feasible. Therefore, the list of contacts was expanded at EPA's request to include other government and private industry sources. In all cases, Regional EPA offices were contacted for assistance in locating government-owned stocks of PCB wastes.

Government-owned PCB wastes in the inventory were grouped as available and potentially available. Available stocks included those wastes which were (1) liquids incinerable on the Vulcanus; (2) currently stored and ready for transport and disposal; and (3) owned by an organization which expressed a positive interest in participating in an EPA-coordinated test burn, and which was willing to pay all disposal costs.* The type, quantity, and location of approximately 1.3 million gallons of PCBs under government ownership were identified. Of this total, only about 425,000 gallons were considered immediately available for at-sea incineration.

Potentially available stocks included wastes which were identified in the inventory but which did not meet all of the three above criteria. About 843,000 gallons of PCB wastes were identified as potentially available. They consisted primarily of PCB fluids in transformers, lubricating systems, and hydraulic systems which did not meet criterion 2. About 17% of the potentially available PCBs were not considered available because criterion 3 was not met. A cursory survey of several industrial sources indicated that an additional 836,000 gallons of PCB fluids were also available from those sources.

Figure 1 shows the volume percentage of available government-owned PCBs located in each state. Tennessee, with 51%, has the largest volume. Most of the available PCBs (about 85%) are located in the four states of Tennessee, Texas, Ohio, and Alabama. About 64% of the available PCB stocks are located in the states of Ohio, Tennessee, and Kentucky.

For the purposes of the inventory, available government-owned liquid PCB

*Criterion 3 was slightly modified for the final inventory from an original criterion that a positive interest was expressed and only transportation costs would be paid by the waste owner. The change was made to ensure that stocks could be considered available, even if EPA could not reimburse each organization for the costs of waste processing and incineration. Such reimbursement had been assumed when compilation of the inventory began

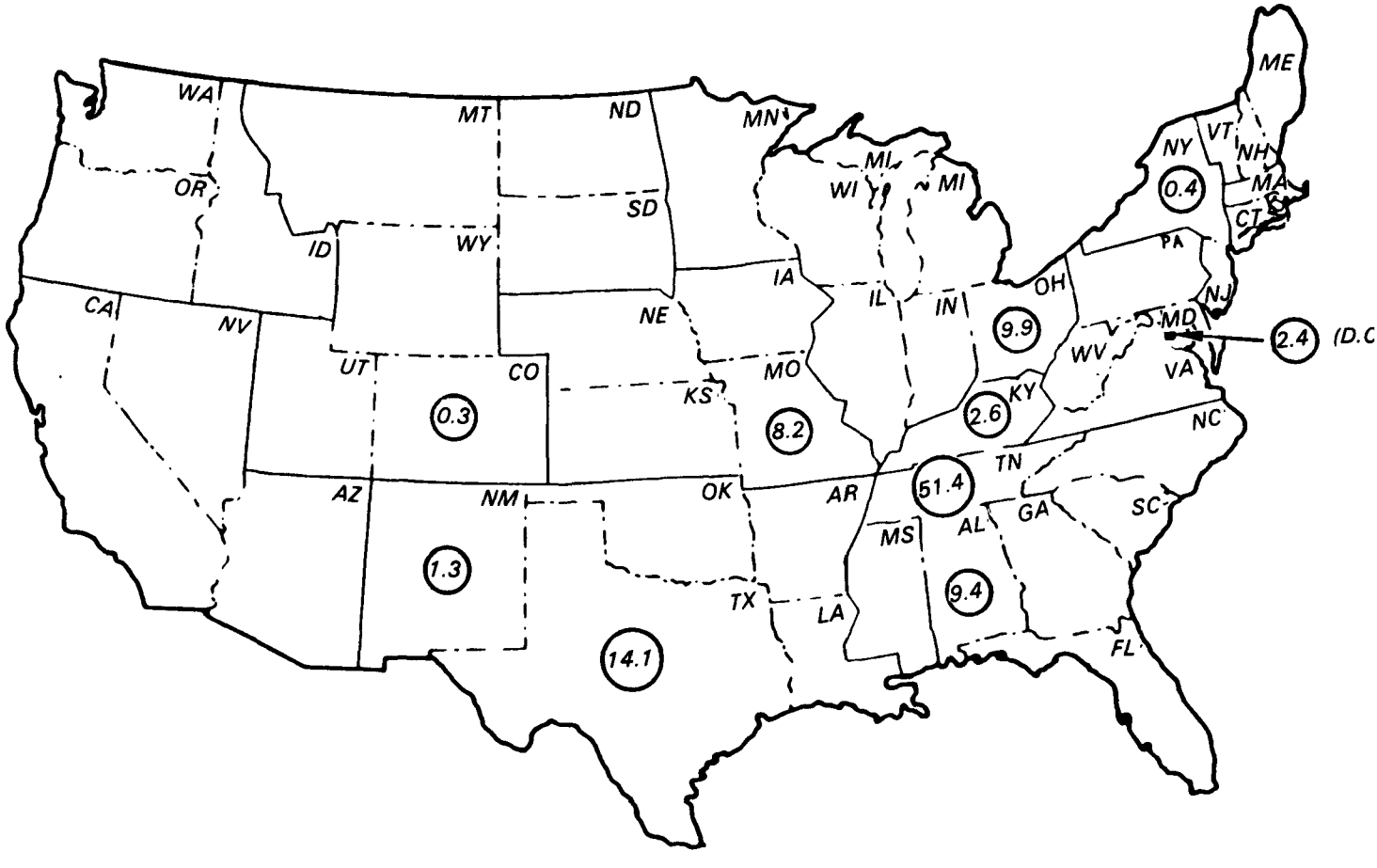

Figure 1. Percentage of available PCB wastes located in each state.

waste stocks were divided into two categories:

- Category A wastes consist of organic liquids with PCB content of 500 ppm or greater.
- Category B wastes consist of organic liquids with PCB content less than 500 ppm.

Table 1 summarizes information on ownership, volume, PCB content, and location of available PCB wastes. Based on the data in Table 1, an average PCB content for stocks in each category (A and B) was calculated. This average, calculated as the volume-weighted sum of concentrations in Table 1, represents an estimate of what the concentration of Category A and Category B wastes would be if each were blended separately. The average PCB content of Category A wastes is 39% and of Category B wastes 70 ppm. The overall average PCB content of all waste (i.e., the PCB concentration if all wastes were blended together) is 24%.

Approximately 121,000 gallons, or 30% of the available PCBs, are stored in 55-gallon metal drums. The remaining 70% are stored in bulk. Truck transport is applicable to all available PCB stocks, and rail transport is applicable to over 70% of all stocks (by volume). Appendix A of the full report contains more detailed information on all aspects of the PCB inventory.

Technical effort under the PCB disposal project will consist of the following tasks:

- Collection and preparation of waste stocks prior to transport.
- Transportation of wastes to a land-based processing facility.
- Processing at the land-based facility (including dedrumming, blending, and container disposal).
- Transportation of blended wastes to the ship loading site and ship loading.
- Incineration at sea.

Safety procedures to protect workers and the public from exposure to PCBs will be observed. These procedures will be consistent with applicable regulations and accepted practices for protection of human health and the environment. Safety precautions will be implemented when handling PCBs including use of protective equipment, maintenance of clean and contaminated areas, and monitoring. Standards and guidelines for worker exposure to PCBs will be observed. Finally, contingency plans will be in effect which will define steps taken to prepare for and prevent emergency situations and to deal with these situations should they arise.

Wastes will first be collected and prepared for transportation by the waste owners. Currently all of the available PCBs are stored in bulk or 55-gallon metal drums. Owners will be responsible for ensuring that wastes are properly packaged, marked, and shipped in accordance with Department of Transportation (DOT) regulations (49 CFR 171-179) and provisions of EPA's Toxic Substances Control Act (TSCA) regulations (40 CFR 761). The DOT hazard class is the key to determining the proper shipping name and packaging requirements for PCB wastes. The hazard class for PCBs (40 CFR 172.101) is Other Regulated Materials-E (ORM-E) and the proper shipping name is polychlorinated biphenyls (RQ-10/4.54). Specific packaging requirements for ORM-E are indicated in 40 CFR 173.510. Marking requirements for PCBs are defined by TSCA regulations in 40 CFR 761.20 and 40 CFR 761.44. Preparation procedures include obtaining analytical data on the waste sufficient to provide information on PCB content, diluent

Table 1. *Government-Owned PCBs Available for At-Sea Incineration*

Government Organization	*Volume, Gallons*	*PCB Category*[a]	*PCB Concentration*[b]	*Location*
1	*8,500*	*A*	*(70%)*	*Washington, DC, area*
1	*1,500*	*B*	*(50 ppm)*	*Washington, DC, area*
2	*20,000*	*A*	*(70%)*	*Alabama*
2	*1,500*	*A*	*(70%)*	*New York*
3	*20,000*	*A*	*(70%)*	*Alabama*
4	*42,300*	*A*	*(70%)*	*Ohio*
4	*11,200*	*A*	*(70%)*	*Kentucky*
4	*12,000*	*A*	*(70%)*	*Tennessee*
4	*20,000*	*A*	*2500 ppm*	*Tennessee*
4	*6,000*	*A*	*1000 ppm*	*Tennessee*
4	*8,000*	*A*	*700 ppm*	*Tennessee*
4	*10,600*	*A*	*(500 ppm)*	*Tennessee*
4	*160,000*	*B*	*70 ppm*	*Tennessee*
4	*2,000*	*B*	*(50 ppm)*	*Tennessee*
5	*35,000*	*A*	*40%*	*Missouri*
5	*5,500*	*A*	*(70%)*	*New Mexico*
5	*1,200*	*A*	*(70%)*	*Colorado*
6	*3,800*	*A*	*35%*	*Texas*
6	*56,200*	*A*	*500 ppm*	*Texas*

[a] *PCB categories are: A = ≥ 500 ppm PCB (organic); B = < 500 PCB (organic). These categories are based on the regulatory 500 ppm/50 ppm cutoffs and combustion considerations.*

[b] *Concentrations in parentheses are TRW estimates based on the following: transformer fluid - 70% PCB; capacitor fluid - 100% PCB; rinsate - 50 ppm PCB. Otherwise concentrations are based on data obtained from waste owners. Proportions of transformer fluid, capacitor fluid, and rinsate are TRW estimates, unless data were available from owners. Rinsate volume is assumed to be 15% of the total volume, if present. Equal amounts of transformer and capacitor fluid are assumed, if both are present.*

and/or rinse solvent, heating value, and other information (e.g., sludge content) needed to determine whether special handling, processing, or safety procedures are needed prior to incineration. Shipping containers will be inspected before, during, and after loading for transport.

The waste owner will select the transportation mode (rail or truck) he deems most suitable and which is acceptable to the disposal contractor. Shipping papers must accompany each PCB waste shipment. The format should be as described in DOT regulations (40 CFR 172.200-204). Alternatively, a manifest system may be employed as described in EPA's Resource Conservation and Recovery Act (RCRA) regulations (40 CFR 263, Subpart B). State and local regulations may also apply to transportation of PCBs, and may be more stringent than Federal regulations. Regulatory aspects of waste shipments should be coordinated through EPA Regional Offices and the responsible state or local regulatory authorities. Firm commitments for transport of PCB wastes should be obtained by waste owners. These commitments should include method of transport, schedules, shipping papers or manifests, routes, destinations, liability, and authority transfer requirements. Written instructions (contingency plans) should be provided in case of spillage, fire, or need for in-transit transfer from one vehicle to another, consistent with applicable DOT and EPA regulations (40 CFR 177 and 40 CFR 761, respectively) and provisions of the National or Regional Contingency Plans.

Wastes will be transported to a land-based facility for processing prior to incineration. The land-based processing facility was assumed to be located near a port on the Gulf of Mexico, because this location is close to available PCB stocks and an EPA-designated at-sea incineration site. Federal regulations under RCRA require the owner/operator of a facility handling hazardous wastes which supports an at-sea incineration vessel to obtain a permit. The land-based processing facility should either (a) have RCRA interim status (i.e., comply with the filing requirements of 40 CFR 122.22 and meet the applicable standards set forth in 40 CFR 265), or (b) have a RCRA permit and meet the applicable standards set forth in 40 CFR 264, or (c) have interim status or a final permit under an authorized state RCRA hazardous waste program. The facility should be designed to prevent emissions of hazardous materials, contain spills, leaks, and other accidents, and minimize harm to personnel in the event of accidents. It must be capable of (a) analyzing incoming wastes to determine processing requirements, (b) processing wastes and drums (e.g., solids removal and emptying, rinsing, and disposing of drums), (c) blending wastes to obtain a suitable mixture for burning in the shipboard incinerator, and (d) temporarily storing wastes prior to ship loading. TSCA regulations (40 CFR 761) dictate rinsing requirements (triple rinse with a suitable solvent, equivalent to about 85% removal of PCB residuals), storage requirements (approved containers), and drum disposal requirements (Annex II chemical waste landfills or approved incinerators). Blended wastes must be able to support combustion without auxiliary fuel. In general, this requirement will be met if the wastes contain less than 30-40 percent chlorine and have a net heating value of at least 6300 Btu per pound.

Blended PCB wastes will be transported to the incinerator ship by pipeline, rail, or truck. Pipeline transport is the preferred method, but is only applicable if an existing pipeline can be used or if the processing facility is located near the ship loading dock. Transportation by rail and truck is subject to the DOT and EPA regulations noted above for waste shipments to the land-based processing facility. Ship loading operations encompass two distinct areas of responsibility: land-based and shipboard. Land-based responsibilities include, for example, operating the waste pumping system, connecting the pumping system to the PCB transportation vehicle, pipeline, or dockside tank, and visual monitoring for leaks from pumps and piping connections. Shipboard responsibilities include connecting the loading hose to the loading manifold, operating valves to load various tanks, gauging the tanks, and monitoring for shipboard leakage. At the end of the loading operation, all equipment which has come into contact with PCBs must be decontaminated by rinsing as per Annex IV of the TSCA PCB Regulations, 40 CFR 761.43.

At-sea incineration operations are subject to a number of Federal and international regulations. EPA regulations (40 CFR 220-229) under the Marine Protection, Research, and Sanctuaries Act (MPRSA) and Intergovernmental Maritime Consultative Organization (IMCO) regulations and guidelines under the London Dumping Convention apply to at-sea incineration of PCBs. Some provisions of RCRA regulations also apply. MPRSA regulations require that the material to be burned must be adequately described in the ocean dumping permit and that the precise times and locations of incineration must be specified. Technical requirements are not detailed in MPRSA regulations, but are established on a case-by-case basis. IMCO regulations do specify technical requirements such as operating conditions and monitoring requirements. These regulations specify a minimum flame temperature of 1250°C,* combustion and destruction efficiencies in excess of 99.9 percent, automatic waste shut-off devices, and monitoring of CO and CO_2 in the stack gas. Additional IMCO requirements forbid black smoke or flame extension above the exit plane of the stack, require prompt reply to radio calls during incineration, and prescribe certain recordkeeping requirements. Incineration under terms of a research permit** also requires monitoring of total organic chlorine and total hydrocarbons in the stack gas. A RCRA permit application need not be filed by the owner/operator of the incineration vessel because such a person is deemed to have a RCRA permit by rule if he has a valid ocean dumping permit, complies with the terms of that permit, and complies with certain RCRA manifest, recordkeeping, and reporting requirements under 40 CFR 264.

Shipboard monitoring, sampling, and analysis of combustion product gases must be performed to comply with the terms of the ocean dumping permit. Existing equipment on the Vulcanus may be used for monitoring flame temperature (by using a correlation based on furnace wall temperature measured by thermocouple) and CO_2 and CO in the stack gas (by continuous monitors). Additional monitors for oxygen and total hydrocarbons could be easily installed, if required. Onboard analysis for total organic chlorine and PCB in the stack gas can be accomplished by sampling with a benzene impinger train equipped with water-cooled probe and analysis of samples obtained from this train by onboard gas

*Unless adequate destruction at a lower temperature is substantiated by test results.

**EPA policy has been to grant research permits for the first burn of a particular waste, and special permits for subsequent burns

chromatograph. An electron capture detector could be used for PCB determinations (in both waste feed and stack gas) and a Hall electroconductivity detector could be adapted for determining total organic chlorine. Onboard analysis of samples of ambient (personnel breathing zone) air for PCB should be performed in accordance with a written health and safety plan. Other samples, such as wipe samples of ship surfaces and drinking water supplies, should be taken for possible analysis if PCB contamination is indicated by ambient air samples. Land-based analysis using gas chromatography/mass spectrometry (GC/MS) techniques should be used to confirm onboard PCB determinations. Limited analyses for chlorinated dioxins and dibenzofurans using GC/MS should be considered, because these extremely toxic compounds may be formed from combustion of PCB wastes containing chlorobenzenes.

Serial rinsing of the ship's tanks using successively lower concentration PCB wastes is the recommended procedure for cargo tank decontamination. That is, after the tankful of high concentration PCB liquids has been incinerated, the tank should be filled again with lower concentration PCB liquids which are then incinerated. This procedure should provide sufficient removal of residual PCBs. Full decontamination using a triple rinse or equivalent procedure is unnecessary because PCB residues remaining in the tanks will be greatly diluted by subsequent waste cargoes and destroyed during ensuing burns. Normally, the tanks on the Vulcanus are not cleaned between burns of different wastes, because no humans are exposed to waste residues inside the empty tanks. However, if entry into the cargo tanks is required after PCBs are burned, a more rigorous tank decontamination procedure should be employed. The decontamination procedure employed should be tailored to the specific situation using the most applicable equipment and procedures. Acceptable levels of PCBs in tank residuals should also be determined based on the situation. Because TSCA regulations have set the lower limit concentration for regulating PCBs at 50 ppm, verification of residual PCB levels in the ship's tanks of less than 50 ppm should be required.* However, health and safety considerations may require a more stringent criterion.

*A recent court decision on the 50 ppm limit (described in the May 20, 1981, Federal Register) may affect this criterion.

A preliminary schedule for a project to dispose of government-owned PCB wastes is presented in Figure 2. Several assumptions were made in constructing the project schedule. These assumptions involve estimating durations and assuming certain logical relationships between tasks. The major logical assumptions were:

- EPA would coordinate collection and transportation of PCB wastes to a central land-based processing facility, requiring contracts with individual waste owners.
- The ship owner would also operate the land-based processing facility, so that a single contract could be awarded for land-based and at-sea operations.
- An incinerator ship would be certified, in U.S. waters, and available to incinerate PCBs when required.
- No permits other than an at-sea dumping permit would be required.**
- A designated at-sea incineration site would be available for the project.

**An ocean dumping permit for incineration of PCBs onboard the M/T Vulcanus in the Gulf Ocean Incineration Site was recently awarded.

Because monitoring activities on land and at sea were not anticipated to be critical schedule items, they were not included in the preliminary schedule. Planning and performance of these tasks are, however, essential from a project standpoint.

Two key milestones are important in performance of this project, in light of the preliminary schedule for incineration. The first is the expiration of the designation of the Gulf Ocean Incineration Site. Designation of this site expired on September 15, 1981. Because this at-sea incineration site has been identified as the site for at-sea incineration of PCBs, redesignation of this site will be required. The second important milestone is the expiration of the seaworthiness certificate of the Vulcanus (September 1982). No incineration can take place on the Vulcanus after this date unless the ship's certification is extended temporarily or the ship is recertified.

Based on the current assumptions for project logic and duration, it is possible for EPA to coordinate an at-sea incineration project for disposal of government-owned PCBs on the Vulcanus under the existing ocean dumping permit before the ship's certificate expires. To do this, a decision to proceed with

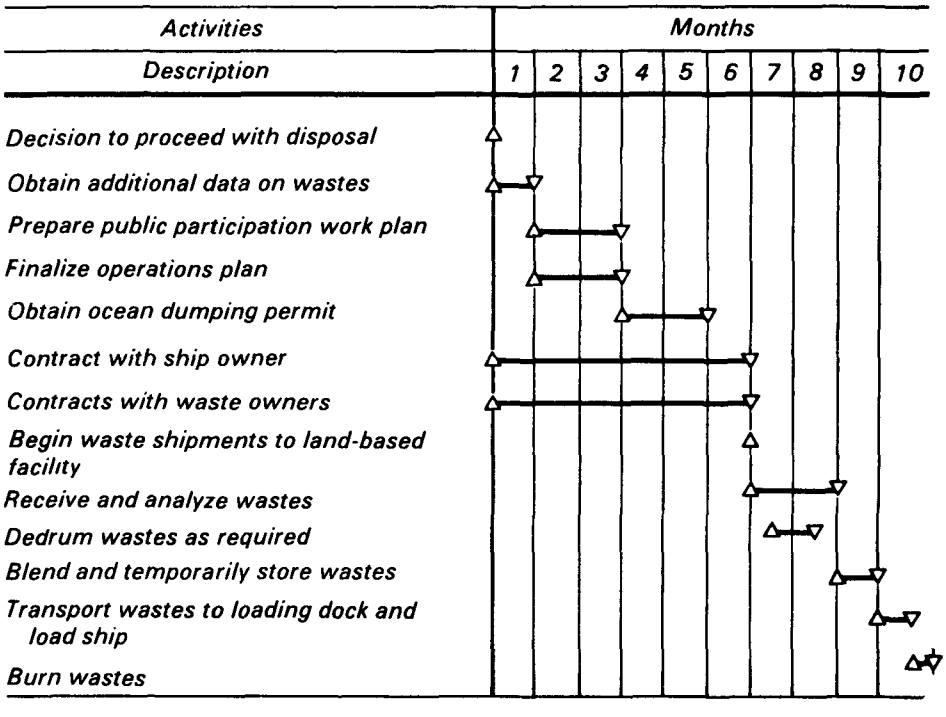

Figure 2. Project schedule.

disposal had to be made by December 1980. An alternative scenario which might further compress the project schedule would be for individual waste owners to contract directly with the ship owner for disposal services. In either case, the need for obtaining an ocean dumping permit (activity 4-6 in Figure 2) would be negated, because a permit already exists. Otherwise, government-owned PCB wastes could not be incinerated at sea until (a) another at-sea incineration vessel becomes available, and (b) another ocean dumping permit is applied for and approved. This alternative would delay substantially the disposal project. This would result in additional costs being incurred by a number of government organizations for storing PCB wastes. Such a delay might force many of these organizations to abandon at-sea incineration for other disposal methods as a means of destroying their liquid PCB wastes.

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The complete report, entitled "Preliminary Operations Plan and Guidelines for the At-Sea Incineration of Liquid PCB Wastes," (Order No. PB 83-181 834; Cost: $13.00, subject to change) will be available only from:
National Technical Information Service
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